Public Services

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VERN M. REDIFER, P.E., Director

January 10, 2014

Charles McKinney
Department of Ecology, Central Region Office
15 W. Yakima Ave. Suite 200
Yakima, WA 98902-3452

Re: **Lower Yakima Valley GWMA - 2013 Fourth-Quarter Report (IAA No. C1200235)**

Dear Charlie:

Enclosed please find one (1) copy of Yakima County's fourth-quarter report as required under Attachment A, Statement of Work, Agreement No. C 1200235 between the State of Washington Department of Ecology and Yakima County.

This report addresses deliverables 1.1 and 2.2 as required under the agreement.

Deliverable 2.1, invoices, to be sent under separate cover.

If you have any questions, please let me know.

Thank you.

Lisa H. Freund, Administrative Manager
Yakima County Public Services

enclosure

IAA No. C 1200235 – 4th Quarter 2013 Report
Lower Yakima Valley GWMA
January 10, 2014

TASK 1 - ADMINISTRATIVE FUNCTIONS
DELIVERABLES

1.1 Meeting Records

For each meeting of the GWAC, submit a copy of the agenda, minutes, attendance and public meeting notice at the end of each quarter.

Attachment (A) includes the GWAC meeting records of October 17, November 21 (draft) and December 19, 2013 (draft); the Irrigated Ag Working Group summaries of October 3, October 24, and November 21, 2013; the Residential, Commercial, Industrial, and Municipal (RCIM) Working Group summaries of October 31 and November 21, 2013; the Data Collection Working Group summary of November 7, 2013; and the Education and Public Outreach (EPO) Working Group summaries of October 2, November 6 and December 4, 2013.

Meeting of Working Group Chairs – (Charlie McKinney, Kirk Cook, Jim Trull)

Three conference calls were held in the fourth quarter.

TASK 2 - PROGRAM FUNCTIONS
DELIVERABLES

2.2 Status Report

Submit written quarterly status reports summarizing GWAC plans, activities and work products, and describing any interlocal agreements or other contracts by the end of each quarter.

Work Plans and Products

The GWAC reviewed, discussed, and was asked to provide input on the following documents in the fourth quarter:

- Nutrient Loading Assessment
- Regulatory Review Draft Framework
- Draft Deep Soil Sampling Plan
- Draft Best Management Practices (BMP) Database Summary
- GWMA Goals and Objectives

At its October meeting, the GWAC was provided a Nutrient Loading Assessment presentation, which offered three methods to quantify nutrient loading within the Lower Yakima Valley GWMA. The group also reviewed and discussed the Draft Deep Soil Sampling Plan, which would provide a snapshot of where the GWAC should be focusing its efforts. The plan has a preliminary budget of $217,000. The GWAC was also charged with reviewing and providing feedback on the draft Best Management Practices (BMP) database. These documents will provide the basis of the Introduction and Background elements of the GWMA Work Plan. In addition, the GWAC was asked to review and finalize the GWMA Goals and Objectives. Note: as of this writing, edits have not been finalized.

The Nutrient Loading Assessment, Draft Deep Soil Sampling Plan, and Draft Best Management Practices (BMP) Database Summary are included as Attachment (B)

Deep Soil Sampling and Confidentiality

The Deep Soil Sampling Plan was not finalized in the fourth quarter in part because of unresolved confidentiality issues. Landowners are interested in participating in deep soil sampling; however, they are not willing to risk their family livelihood if high levels are discovered and they are subsequently sued for polluting. Numerous discussions took place at GWAC meetings, separate working group meetings and in a meeting with a Yakima County Prosecuting Attorney and the Sunnyside-Roza Joint Board of Control's attorney in an effort to find a solution that would protect landowners. As of this writing, a solution has not been reached. The proposed deep soil sampling has been postponed until after the next growing season (Fall 2014) so the confidentiality issue can be addressed.

GWAC Self-Assessment Survey

At the suggestion of the meeting facilitator, the GWAC participated in a year-end self-assessment survey to evaluate its work to date. The results were shared at the December GWAC meeting and are included as Attachment (C)

Education and Public Outreach (EPO)

The EPO prepared standardized GWAC Talking Point slides for members' use at community presentations and meetings. The GWAC approved the slides at its December meeting. The EPO was also asked to provide feedback on the GWAC Self-Assessment Survey, and to create a year-end report and news release announcing the GWAC's accomplishments to date. (Note: this quarterly report and its predecessors serve as the accomplishments report. A news release guiding readers to the reports will be published in January 2014).

The High Risk Well Assessment survey outreach campaign was launched in December with a targeted 600-piece mailing, letters to area newspaper editors from Chairman Rand Elliott, news releases and Public Service Announcements (PSAs). Chairman Elliott also announced the survey and sought support at the Community Advisory Board Meeting of the Proyecto Bienestar on December 11, 2013. All materials were prepared and released in English and Spanish.

As of December 31, Yakima Health District surveyors had completed 21 sampling surveys. An additional 23 surveys had been attempted. 50 additional households had called the Health District Help Desk requesting to be surveyed. The contract with the Health District calls for a minimum of 225 completed surveys. To meet this goal, the contract was extended to March 31, 2014.

The standardized talking points, letter to households, letters to newspaper editors and distribution list, news releases, outreach budget, radio schedule and contract amendment are included as Attachment (D)

Working Group Activities:

Livestock/CAFO (Charlie McKinney, Chair)

The Work Group held no face-to-face meetings during the quarter. The group concentrated on the following activities:

- Reviewed and provided feedback on the Regulatory Review Draft Framework provided by HDR Consultants
- Reviewed the BMP Database Summary from HDR
- Reviewed, discussed and commented on the GWMA Goals and Objectives
- Reviewed, discussed and commented on the Deep Soil Sampling project being proposed and led by the Irrigated Agriculture Work Group

The Chair participated in three Work Group Chair Conference Calls to coordinate work and issues with the other GWMA Work Groups.

Irrigated Ag (Jim Trull, Chair)

The Irrigated Agriculture working group met three times during the 4th quarter: October 3, October 24, and November 21, 2013. During the first October meeting, the Chair pointed out that the GWAC advised the working groups to review and report on the GWMA Goals and Objectives document. For the most part, the group decided to leave it alone as there were just a few stylistic issues with the document, and that the goals and objectives of the GWMA are considered to be dynamic and subject to change as data and observations are collected over time. The group moved on to reviewing the newest version of the draft Deep Soil Sampling Plan. At this point, the document has undergone several revisions from different working groups and GWAC members, which left two issues of concern for the group to discuss: grower protection and potential property damages. The group expressed concern regarding confidentiality of grower information to protect them from lawsuits, and cited this as a critical piece of the plan to create productive grower participation, and to maintain trust between growers and the involved entities. The group spent time on the topic of property damage and how the South Yakima Conservation District (SYCD), growers, GWAC, and sampling consultants will follow a liability plan. Discussion followed regarding who will be responsible for particular property damages, such as damage to subterranean pipes, which may occur during the sampling process if particular precautions are ignored or mistakes are made.

During the second October meeting, Pony Ellingson with PgG began the meeting with the draft sample allocation method (Task 3) that has been under development for several months. Pony began by explaining the 3D matrix that will be used to facilitate the selection of sample allocation efforts. The goals of the sample allocation method are to categorize each candidate field to be tested by the average NRCS leaching potential, crop type and irrigation type, and by weighting the sample distribution based on acres in each category, as well as making sure all crops are proportionately represented by risk, and to eliminate any sampling bias. After discussing the draft sample allocation method, the group reviewed the draft BMP summary which was tasked to the group by Mike Murray of HDR during the October GWAC meeting. After much deliberation regarding the specific goals and objectives associated with this task, the group tabled further discussion because of the lack of meeting time left and the uncertainty of the group's role in this task. The draft sample allocation method (Task 3), entitled Calculations to Allocate Soil Samples in 2014 - Revision 1 is included as Attachment (E)

During the November meeting, discussion began with a comment made regarding Best Management Practices (BMPs). Very few BMPs are stand alone, many are used in part or seasonally, and linked to additional BMP(s). In addition, BMPs are site and time specific. A BMP that works for one field might be detrimental to another field, and vice versa. Some fields can change their practices and adopt newly identified BMPs, while other fields can't. An agronomist in attendance described what was called the rule of the 4 R's: applying the Right nutrient, at the Right rate, during the Right time, and the Right place. In this member's opinion, if you stray from the 4 R's, you are no longer following science, but policy instead. A dialogue regarding the prioritization of BMPs ensued, which led to the majority of the group expressing that this would not be effective. Each field is operated under different conditions such as crop type, soil type, nutrient conditions, which supports the argument that a BMP with a #1 priority might work great for one field, but could greatly diminish the productivity of another, even within the LYV GWMA boundaries. The group generally felt that the deep soil sampling plan will be best used to identify problematic areas, and to assess nutrient levels over time.

Regarding contacting landowners for deep soil sampling participation, the group Chair reported that in the opinion of the Roza-Sunnyside Joint Board of Control's lawyer, there is still an issue with participant confidentiality in the deep soil sampling plan. It is important to procure the protection from lawsuits as soon as possible, as it directly impacts grower participation recruitment and soil sampling efforts. Jim reported that the Roza-Sunnyside Joint Board of Control can facilitate a newsletter to reach local growers asking for participation, but the data confidentiality issue must be resolved before this outreach is conducted. Jim, backed by the group, feels that grower protection is a very high priority and a keystone to the success of the LYV GWMA project.

Residential, Commercial, Industrial, and Municipal (RCIM) (Robert Farrell, Chair)

The RCIM working group met twice in the 4th quarter: October 31 and November 21, 2013. During the October meeting, the group discussed RCIM's future involvement within the GWMA, and how much effort should be put in to other sources other than Irrigated Agriculture and Livestock/CAFO. Steve Swope referenced an EPA report that identified only 3 percent of nitrate in the valley coming from these other sources. The group decided that it will remain in existence for the time being to review and comment on the Nutrient Loading Assessment, and provide quality control to the GWAC. Next, the group reviewed the Draft Initial BMP Database presented by Mike Murray with HDR during October's GWAC meeting. The group generally agreed that each of the objectives and management targets presented in Sections 3-6 were applicable to the LYV GWMA. The comment was raised during discussion that public education and outreach would be the best means to elicit cooperation, rather than enacting additional regulations. Finally, the group discussed the creation of a checklist that would be presented to the GWAC or the Data Collection working group. The group members would research and provide their findings during the next working group meeting. A short discussion was held regarding Kirk Cook's Nutrient Loading Assessment presentation. The group recommends the higher level of assessment that was proposed by Mr. Cook.

During the November meeting, the group reported their findings regarding the Nutrient Loading Assessment checklist. During individual research, multiple members found difficulty finding additional nutrient sources that weren't already identified in recent GWMA studies around the country. The group decided that it would be most efficient to adopt identified nutrient sources as they apply to the LYV GWMA as necessary. The group Chair reported that a recent

conversation held with Sanjay Barik (not present during this meeting) indicated Sanjay's advocacy on using the SPAtially Referenced Regression on Watershed (SPARROW) model's inputs still stood. The SPARROW model is specific to the Yakima Basin, and it is expected to provide pertinent data regarding the RCIM's scope. Steve Swope with PgG downloaded the data and believes that the sources are complete.

Data Collection, Characterization and Monitoring (Kirk Cook, Chair)
The Data Collection working group held one formal meeting on November 7, 2013. During this meeting, Steve and Pony from PgG introduced the Draft Potential Groundwater Monitoring Stations document prepared by PgG. The consultants stated that an important aspect of the project is to monitor nitrate concentrations in particular wells over time, and that the document outlines how to select the most beneficial and reliable groundwater monitoring wells. PgG asked that the group review and provide comment no later than two weeks. Next, Kirk reviewed the Nutrient Loading Assessment, recapping the three different methods to quantify nutrient loading within the LYV GWMA. The three approaches mainly differ in respect to the amount of effort that is put into them, and the amount of data collection that would need to occur. The group generally felt that the more GWMA-specific data that is collected, the more accurate the assessment would be. A short discussion was held on the USGS proposal to combine two currently available models to track nutrient loading and transport within the LYV GWMA. These models include a vadose zone model and a particle tracking groundwater model, which would identify sources of nitrate pollution, flow paths, and travel times. Although the combined model would be more comprehensive in its approach, it could take a few years to get them running, which may not satisfy the interim goals of the GWMA, and could be very expensive. Confidentiality was raised as an issue during this meeting; however, it was tabled since this subject is being investigated by the Irrigated Agriculture Chair. The Draft Potential Groundwater Monitoring Stations document is included as Attachment (F)

Regulatory Framework (Tom Eaton, Chair)
The Regulatory Framework Committee had one meeting via teleconference. They developed a draft purpose statement and will prepare a workplan for the group once they agree on a purpose statement.

Education and Public Outreach (Lisa Freund, Chair)
The EPO met on October 2, November 6 and December 4, 2013. At the October meeting, the group discussed the dwindling participation and ways to increase participation and membership. Ignacio Marquez volunteered to contact the members regarding their ongoing participation, and to solicit new membership from community groups. The group also reaffirmed the GWAC goals, objectives, and budget as requested by the GWAC. The Public Questionnaire survey results were reviewed and discussed (300 households solicited; 136 completed surveys) and outreach opportunities for the upcoming High Risk Well Assessment Survey were discussed.

At the November meeting, Ignacio Marquez reported that he had solicited area agencies to participate in the EPO. Of those contacted, ESD/WorkSource expressed interest. ESD staff Rhonda Marquez and Robert Villanueva attended the meeting and offered to provide outreach materials at their Sunnyside WorkSource office. The group also reviewed and submitted feedback on the draft GWAC Self-Assessment Framework survey as requested by GWAC Facilitator Penny Mabie. The group completed its draft GWAC Talking Points Slides for the GWAC's review at its November meeting. The intent of the slides is to create a starting point for presentations that can be used by GWAC members and working groups. The first presentation

for the slides to be used is on December 11, 2013, when Chairman Rand Elliott addresses the Community Advisory Board (CAB) of El Proyecto Bienestar. The group agreed that the Chairman should seek the CAB's support of the High Risk Well Assessment survey.

High Risk Well Assessment Survey Outreach Campaign

At the December meeting, the group created and finalized an outreach campaign and budget to solicit participation in the High Risk Well Assessment Survey. The group agreed to launch the campaign immediately. The following bilingual outreach took place the week of December 11, 2013:

1. 600-direct mail pieces (English/Spanish) were sent to households in the GWMA, inviting their participation in the survey.
2. Chairman Rand Elliott announced the survey and sought support at the Proyecto Bienestar meeting on December 11, 2013.
3. English/Spanish Letters to area newspaper editors from Chair Rand Elliott were submitted to the *Yakima Herald Republic, El Sol, Review/Independent, Sunnyside Daily Sun News, the Grandview Herald/and Prosser Record Bulletin.*
4. News releases (English/Spanish) were sent to area media.
5. Chairman Rand Elliott offered to mention the survey on KIT Radio's afternoon show on Dec. 23.

The group agreed to January action items for the campaign:

1. Schedule and participate in KDNA's public affairs program
2. Draft and launch PSAs (paid and public service) English/Spanish radio ads
3. Finalize and distribute English/Spanish church bulletin notice
4. Mail English/Spanish postcard reminder to the 600 households - TBD

GWMA Website

All Public Questionnaire results and materials were posted to the web in English and Spanish for public viewing, as was the High Risk Well Assessment survey information. All outreach materials directed readers to the GWMA website. The GWMA calendar continued to be updated in real-time to provide a "go-to" location that lists both the upcoming working group meetings and monthly GWAC meetings. The website may be viewed at: http://yakimacounty.us/GWMA/

Contracts and Interlocal Agreements:

The contract with the Yakima Health District to conduct the High Risk Well Assessment surveys was extended to March 31, 2014. The contract amendment is included with Attachment (D).

Attachment A

GWAC Meeting Records of October 17, November 21 (draft) and December 19, 2013 (draft)

- ***Irrigated AG Working Group Meeting Summaries – October 3 October 24 and November 21, 2013***

- ***Residential, Commercial, Industrial and Municipal (RCIM) Working Group Meeting Summaries – October 31, November 21, 2013***

- ***Data Collection, Characterization and Monitoring Working Group Meeting Summary – November 7, 2013***

- ***Education and Public Outreach (EPO) Working Group Meeting Summaries – October 2, November 6 and December 4, 2013***

Lower Yakima Valley GWAC Meetings
Attendance

GWAC Meetings							
PRIMARY (ALTERNATE)	17-Oct-2013	21-Nov-2013	19-Dec-2013				
Elliott, Rand	attended	absent	attended				
(Redifer, Vern)	attended	attended	attended				
Sanchey, Elizabeth	absent	attended	absent				
(Ring, Tom)	absent	attended	attended				
George, Steve	attended	attended	attended				
(Waddington, Justin)	absent	absent	absent				
Sheehan, Jason	attended	attended	attended				
(DeGroot, Dan)	attended	attended	attended				
Turner, Stuart	attended	attended	attended				
(Durfey Chelsea)	absent	attended	attended				
Reddout, Helen	attended	attended	attended				
(Hannigan, Wendell)	absent	absent	absent				
- ALT/Alt Rep: Fendell, Larry	attended	attended	absent				
Mendoza, Jean	absent	attended	attended				
(Anderson, Eric)	attended	absent	absent				
Whitefoot, Jan	absent	absent	absent				
(Dyjak, Jim)	attended	attended	attended				
Crowe, Laurie	attended	attended	absent				
(Newhouse, Jim)	absent	absent	absent				
Farrell, Robert	attended	attended	absent				
(Van Wingerden, John)	attended	absent	absent				
Cook, Kirk	attended	attended	absent				
(Prest, Ginny)	absent	attended	absent				
Cervantes, Andy	attended	attended	absent				
(Stern, Ginny)	attended	attended	attended				
McKinney, Charlie	attended	attended	attended				
(Tebb, Tom)	absent	absent	attended				
Eaton, Tom	absent	attended	absent				
(Jennings, Marie)	absent	absent	attended				
Kelly, Gordon	absent	attended	attended				
Desta, Dr. Kefy	absent	absent	absent				

Lower Yakima Valley GWAC Meetings
Attendance

GWAC Meetings							
PRIMARY (ALTERNATE)	**17-Oct-2013**	**21-Nov-2013**	**19-Dec-2013**				
(Peters, Dr. Troy)	attended	attended	attended				
Frans, Lonna	absent	absent	absent				
(Bachmann, Matt)~~(Barbash, Jack)~~	attended	attended	attended				
Trull, Jim	attended	attended	attended				
(Cowin, Ron)	absent	absent	absent				
Guerra, Lino	attended	attended	absent				
(Perez, Rick)	absent	absent	absent				
Simpson, Doug	attended	attended	attended				
Rogers, Kathleen	attended	attended	attended				
(Rogers, Bud)	attended	attended	attended				
Newhouse, Patricia	attended	attended	attended				
(Wedam, Sue)	attended	absent	attended				

Daily Sun News

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Affidavit of Publication

STATE OF WASHINGTON
COUNTY OF YAKIMA SS

Timothy J. Graff, being first duly sworn on oath deposes and says that he is the Publisher of the DAILY SUN NEWS, a daily newspaper.

That said newspaper is a legal newspaper and it is now and has been for more than six months prior to the date of publications hereinafter referred to, published in the English language continually as a daily newspaper in the city of Sunnyside, YAKIMA County, Washington, nd it is now and during all of said time printed in an office maintained at the afforesaid place of publication of said newspaper, and that the said Daily Sun News was on the 4th Day of April, 1969 approved as a legal newspaper by the Superior Court of said Yakima County.

That the annexed is a true copy of a LEGAL PUBLICATION -
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Subscribed and sworn to before me 10/25/13

Notary Public in and for
the State of Washington
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NORA HERNANDEZ
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08-20-2015
STATE OF WASHINGTON

Yakima County
Notice of Public Meeting Lower Yakima Valley Groundwater Advisory Committee

Notice is hereby given that Yakima County is holding a public meeting of the Lower Yakima Valley Groundwater Advisory Committee on Thursday, October 17, 2013 at 5:00 p.m. at Radio KDNA Conference Rooms 1 & 2, 121 Sunnyside Ave. in Granger, WA pursuant to Chapter 173-100-080 WAC Ground Water Management Areas and Programs.

For additional information to learn more about the Lower Yakima Valley Groundwater Management Area, the Groundwater Advisory Committee, and its goals and objectives, please see the Lower Yakima Valley Groundwater Management Area on the County webpage at: http://www.yakimacounty.us/gwma/

For more information about the meeting, please contact Lisa Freund, Yakima County Public Services Administrative Manager at 574-2300.

Dated this Wednesday, October 9, 2013

PUBLISH: DAILY SUN NEWS
October 10, 2013

YAKIMA HERALD-REPUBLIC

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Yakima County

Notice of Public Meeting
Lower Yakima Valley Groundwater Advisory Committee

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Dated this **Wednesday, October 9, 2013**

(370481) October 10, 2013

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STATE OF WASHINGTON,)
)
COUNTY OF YAKIMA)

Debbie Martin, being first duly sworn on oath deposes and says that she/he is the Accounting clerk of Yakima Herald-Republic, Inc., a daily newspaper. Said newspaper is a legal newspaper approved by the Superior Court of the State of Washington for Yakima County under an order made and entered on the 13th day of February, 1968, and it is now and has been for more than six months prior to the date of publication hereinafter referred to, published in the English language continually as a daily newspaper in Yakima, Yakima County, Washington. Said newspaper is now and has been during all of said time printed in an office maintained at the aforesaid place of publication of said newspaper.

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Yakima County Notice of Public Meeti

it was published in regular issues (and not in supplement form) of said newspaper once each day and for a period of 1 times, the first insertion being on 10/10/2013 and the last insertion being on 10/10/2013

Yakima Herald-Republic 10/10/13
YakimaHerald.com 10/10/13

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Debbie Martin

Accounting Clerk

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Sworn to before me this 10th day of, October 2013

Lisa M. Dripps

Notary Public in and for the
State of Washington,
residing at Yakima

Yakima County

Notice of Public Meeting
Lower Yakima Valley Groundwater Advisory Committee

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For more information about the meeting, please contact Lisa Freund, Yakima County Public Services Administrative Manager at 574-2300.
Dated this **Wednesday, October 9, 2013**

(370481) October 10, 2013

Meeting Time and Location

Thursday, October 17, 2013, 5:00 – 8:00 p.m.

Radio KDNA in Granger
121 Sunnyside Ave
Conference rooms 1 & 2
Granger, Washington

Purpose of the Meeting:

- Hear from Heritage University students on their public questionnaire experience
- Review Nutrient Budget scope of work and budget and determine next steps
- Review Deep Soil Testing proposal and determine next steps
- Learn about BMP database
- Hear from Working Groups

Agenda

Time	Topic	Purpose	Lead
5:00 – 5:10 p.m.	Welcome & Meeting Overview	Introduction, meeting overview, confirm agenda	Penny Mabie, facilitator
5:10 – 5:15 p.m.	Committee Business	• Approve August 15 and September 19 meeting summaries	Penny Mabie
5:15 – 5:35 p.m.	Heritage University Public Questionnaire Report	• Hear about the students' experience in administering the survey • Hear a recap of the survey results	Heritage University students
5:35 – 6:05 p.m.	Nutrient budget	• Hear about proposed scope and budget for nutrient budget and nutrient loading study • Determine next steps	Kirk Cook
6:05 – 6:50 p.m.	Deep Soil Testing Proposal	• Hear from Irrigated Agriculture and CAFO/Livestock Working Group on proposal for Deep Soil Testing scope • Determine next steps	Jim Trull
6:50 – 7:00 p.m.	BREAK		
7:00 – 7:30 p.m.	Best Management Practices Database	• Understand the BMP database • Discuss process for BMP technical effectiveness evaluation • Identify input needed from GWAC	Mike Murray, HDR
7:30 – 7:45 p.m.	Working Group Report Out	• Hear from working groups	Penny Mabie Working group leads

		• Provide feedback; plan for future discussions	
7:45 – 7:55 p.m.	Public Comment	Opportunity for members of the public to make comments to the committee	
7:55 – 8:00 p.m.	Next Steps	• Review action items, next steps, and next meeting topics	Penny Mabie
8:00 p.m.	Adjourn		

Next Meeting: November 21, 2013

Committee Members

Stuart Turner, agronomist, Chelsea Durfey (alternate)	Turner and Co.
Helen Reddout, Wendell Hannigan (alternate)	Community Association for Restoration of the Environment
Kathleen Rogers, Bud Rogers (alternate)	Lower Valley Community Representative Position 1
Patricia Newhouse, Sue Wedam (alternate)	Lower Valley Community Representative Position 2
Doug Simpson	Irrigated Crop Producer
Jean Mendoza, Eric Anderson (alternate)	Friends of Toppenish Creek
Jan Whitefoot, Jim Dyjak (alternate)	Concerned Citizens of the Yakama Reservation
Steve George, Justin Waddington (alternate)	Yakima County Farm Bureau
Jason Sheehan, Dan DeGroot (alternate)	Yakima Dairy Federation
Jim Trull, Ron Cowin (alternate)	Sunnyside-Roza Joint Board of Control
Laurie Crowe, Jim Newhouse (alternate)	South Yakima Conservation District
Robert Farrell, John Van Wingerden (alternate)	Port of Sunnyside
Rand Elliott, Vern Redifer (alternate)	Yakima County Commission
Gordon Kelly	Yakima County Health District
Kefyalew Desta, Dr. Troy Peters (alternate)	WSU Irrigated Agriculture Research and Extension Center
Tom Eaton, Marie Jennings (alternate)	U.S. Environmental Protection Agency
Elizabeth Sanchey, Tom Ring (alternate)	Yakama Nation
Lonna Frans, Matt Bachmann (alternate)	U.S. Geological Survey

Kirk Cook, Virginia "Ginny" Prest (alternate)	Washington Department of Agriculture
Andy Cervantes, Ginny Stern (alternate)	Washington Department of Health
Charlie McKinney, Tom Tebb (alternate)	Washington Department of Ecology
Lino Guerra, Rick Perez (alternate)	Hispanic Community Representative

Committee Ground Rules:

- Come to committee meetings prepared
- Treat one another with civility
- Respect each other's perspectives
- Listen actively
- Participate actively
- Honor time frames
- Silence electronic devices during meetings
- Speak from interests, not positions.

2013 Meeting Dates:

March 21	July 18	November 21
April 18	August 15	December 19
May 16	September 19	
June 20	October 17	

LOWER YAKIMA VALLEY GROUNDWATER MANAGEMENT AREA ADVISORY COMMITTEE (GWAC)

MEETING SUMMARY

Thursday, October 17, 2013

Radio KDNA
121 Sunnyside Ave, Granger, WA 98932

I. Call to Order

Roll Call: The meeting was called to order at 5:02 pm by Penny Mabie, Facilitator.

Member	Seat	Present	Absent
Stuart Turner	Agronomist, Turner and Co.	✓	
Chelsey Durfey	Agronomist, Turner and Co. (alternate)		✓
Helen Reddout	Community Association for Restoration of the Environment	✓	
Wendell Hannigan	Community Association for Restoration of the Environment (alternate)		✓
Kathleen Rogers	Lower Valley Community Representative Position 1	✓	
Bud Rogers	Lower Valley Community Representative Position 1 (alternate)	✓	
Patricia Newhouse	Lower Valley Community Representative Position 2	✓	
Sue Wedam	Lower Valley Community Representative Position 2 (alternate)	✓	
Doug Simpson	Irrigated Crop Producer	✓	
Jean Mendoza	Friends of Toppenish Creek		✓
Eric Anderson	Friends of Toppenish Creek (alternate)	✓	
Jan Whitefoot	Concerned Citizens of the Yakama Reservation		✓
Jim Dyjak	Concerned Citizens of the Yakama Reservation (alternate)	✓	
Steve George	Yakima County Farm Bureau	✓	
Justin Waddington	Yakima County Farm Bureau (alternate)		✓
Jason Sheehan	Yakima Dairy Federation	✓	
Dan DeGroot	Yakima Dairy Federation (alternate)	✓	

Jim Trull	Roza-Sunnyside Joint Board of Control	✓	
Ron Cowin	Roza-Sunnyside Joint Board of Control (alternate)		✓
Laurie Crowe	South Yakima Conservation District	✓	
Jim Newhouse	South Yakima Conservation District (alternate)		✓
Robert Farrell	Port of Sunnyside	✓	
John Van Wingerden	Port of Sunnyside (alternate)	✓	
Rand Elliott	Yakima County Board of Commissioners	✓	
Vern Redifer	Yakima County Board of Commissioners (alternate)	✓	
Gordon Kelly	Yakima County Health District		✓
Dr. Kefy Desta	WSU Irrigated Agriculture Research and Extension Center		✓
Dr. Troy Peters	WSU Irrigated Agriculture Research and Extension Center (alternate)	✓	
Tom Eaton	U.S. EPA		✓
Marie Jennings	U.S. EPA (alternate)		✓
Elizabeth Sanchey	Yakama Nation		✓
Tom Ring	Yakama Nation (alternate)		✓
Lonna Frans	U.S. Geological Survey		✓
Matt Bachmann	U.S. Geologic Survey (alternate)	✓	
Kirk Cook	WA Department of Agriculture	✓	
Virginia "Ginny" Prest	WA Department of Agriculture (alternate)		✓
Andy Cervantes	WA Department of Health	✓	
Ginny Stern	WA Department of Health (alternate)	✓ (by phone)	
Charlie McKinney	WA Department of Ecology	✓	
Tom Tebb	WA Department of Ecology (alternate)		✓
Lino Guerra	Hispanic Community Representative	✓	
Rick Perez	Hispanic Community Representative (alternate)		✓

II. Welcome & Meeting Overview

Moment of silence.

Introductions.

Reminders:

- Please make sure you sign in.

- Please speak up and use the microphone so everyone can hear.

III. Committee Business:

August 15, 2013 meeting summary approved by committee with no changes.

September 19, 2013 meeting summary approved by committee with no changes.

Laurie Crowe with South Yakima Conservation District advised that they have put together a fifty page booklet on the History of Yakima's Agricultural Industry that may be useful to the Groundwater Advisory Committee. Twenty-five copies were distributed to the members for their review and comment. Committee members were asked to provide any comments directly to Laurie, and to consider whether the GWAC wants to post this document on the GWMA website for informational purposes.

IV. Heritage University Public Questionnaire Report: (Presented by: Jessica Black, Professor of Environmental Science and Francisco Ramirez, student.)

The members were provided with a map of the survey areas. The red dots on the map indicate areas targeted for surveys. Francisco was the field monitor for the survey and he reported to the GWAC how the surveys were administered. Students went out in pairs with one bilingual student in each pair. Francisco tried to assign the students to areas they were familiar with. His area was Sunnyside as he had gone to school there. A list of addresses was provided by the County. They then Google mapped the addresses. They found it helpful to print out the parcels of the houses and use their GPS on their phones. Parcels were organized by travel, as well as time. Francisco found that the hours between 4:00 p.m. and 7:00 p.m. worked best for contacting households. In some cases the students went out a second or third time to make contact.

Issues:

- A lot of homes were found to be vacant
- Some homes had locked gates
- Dogs were the main issue

Out of 300 homes in the survey sample, the students were able to complete 136 surveys. All 300 homes received an English/Spanish postcard notification in advance of the survey. Houses where no one was home received an English/Spanish flyer about the students' visit and a request to contact the County. The 136 homes that were surveyed received an English/Spanish packet of information about the GWAC, private wells and nitrate in groundwater. Others declined the survey stating they already had their water tested or they had simply taken care of the matter.

The purpose of the survey was to gauge what people knew about nitrates, their drinking water and the GWMA GWAC. The data from the survey revealed that most people had knowledge of nitrates and the dangers. It also revealed that the GWAC needs to work on getting their name and purpose out to the public, as only 42 percent of the respondents had heard of the committee. Results are posted on the website: http://www.yakimacounty.us/gwma/education_public_outreach.php.

A committee member asked if the map could be made more specific and could indicate the targeted areas as well as the locations of actual surveys. Jessica advised that Heritage University is uncomfortable with addresses being made public as this put Heritage University in a comprising position due to privacy concerns.

V. Nutrient Budget: (Kirk Cook presented)

The budget has not been developed yet. The Data Working Group is trying to get a handle on what is being applied to the surface. It is known what crops, soil and types of irrigation are used. However, with regards to fertilizers, while application guidelines could be used to draw assumptions; that would not take into account what is really happening in the field. Kirk noted the need to start with basic information, e.g., what is the assessed nutrient that will move down-level into the soil? If there is a nutrient assessment, it needs to include discrete areas where other types of crops are. It also would need to know what is going into the ground, the impact, rate, quantity of nutrients, crop location, etc.

Kirk noted the following questions that need to be asked:

- Where did application take place?
- How much is being applied (nitrate)? There is a lot of manure spraying, but there is also synthetic spraying.
- When is it being applied?
- What form is the nutrient (manure, green manure, etc.)?
- What is the irrigation application (applied or rainfall)?

There is also a need for confidentiality. In order to get growers to participate, Kirk noted they would need to be assured of confidentiality. The GWAC needs help from the growers in order to learn what they do over the year.

Kirk described three levels of potential approaches to developing the nutrient budget:

- Basic level – survey crop types, nutrient application, schedules, irrigation practices in three representative areas
- Medium level – basic level plus compare with DSS, five representative areas, soil type assessment
- High Level – basic and medium plus vadose zone monitoring and additional DSS

The committee needs to decide which model to use. Kirk asked GWAC members to send their thoughts and ideas to him. The work group will make a presentation at the November meeting with additional information about the USGS modeling approach that was discussed in September, as well as have a draft scope of work for developing the nutrient budget ready for the committee's review. If the GWAC does not want to go with the USGS modeling approach, Kirk noted the work group suggests that the committee at least go with the medium level model.

Several members of the committee advised that there are a lot of studies out there already, and they should be used, so as to ensure work is not "redone."

VI. Deep Soil Testing Proposal: (Jim Trull presented)

The GWAC was provided with a "Draft Deep Soil Sampling Plan for the Lower Yakima Valley Groundwater Management Area." Deep soil sampling would provide a snap shot view of where the GWAC should be focusing its efforts. The hope is that it would lead to an educational program. The work group started out using the Columbia-Basin GWMA's deep soil sampling plan as a template for their plan. Jim described some of the changes that were included to adopt the Columbia-Basin plan to the Lower Yakima Valley area. For instance, the current draft plan would start out with sampling one hundred farms the first year and fifty farms the second year. Another change is the farmers would not have to pay for the sampling. The funding for sampling would be provided through the South Yakima Conservation District. There is worry that the GWAC would not get farmer participation without guaranteeing confidentiality. (The committee was told that the Yakima County prosecuting attorney has advised that participants can be protected from public disclosure requests. The other level of confidentiality this is needed is to have protection from the need to disclose specific sampling results and locations in court, as well.)

The preliminary budget for deep soil sampling is $217,000.00

Next Steps:

- Sign an agreement with South Yakima Conservation District.
- Sampling matrix (grouping crops together)
- Work group meeting next week

VII. Best Management Practices Database: (Mike Murray, HDR presented)

The committee was provided with a "Draft Initial Best Management Practices Database Summary". Mike explained that the purpose of the BMP database is to identify and assess current available technologies and management approaches. He noted the need to develop an approach for organizing BMPs in order to create a useful database. The committee needs to discuss the proposed framework.

Mike described a proposed hierarchal approach that could serve as an outline for the BMP database:

- Identify potential nitrogen sources (e.g., irrigated cropland)
- Develop list of key management objectives (e.g., design and operate irrigation system to decrease soil water percolation beneath root zone)
- Develop list of management targets per objective (e.g., improve irrigation scheduling)
- Develop list of best management practices per target (e.g., use weather base irrigation scheduling)

There are six potential proposed nitrogen source categories in the proposed approach:

- Irrigated cropland (includes solid and liquid manure cropland application)
- Livestock operations (storage and handling of manure)
- Turfgrass and Other urban landscaping
- Municipal and industrial land application of wastewater (including storage and handling)
- Sewer leakage
- Septic systems

Management objectives would be to reduce nitrates by:

- Design and operating irrigation systems
- Manage crop plants
- Manage N fertilizer and manure
- Improve storage and handling

The committee was asked to review the source tables in the draft BMP database technical memo, focusing on the objectives and management targets, and provide feedback to the County within the next two weeks. The County will compile and forward all comments to Mike Murray.

VIII. Working Group reports:

Education and Outreach: (Orange document)
The group is receiving invitations from groups such as El Projecto Bienestar (Project Well-being) to hear about the GWAC. A GWAC presentation is scheduled for Project Well-being's Community Advisory Board on December 2nd. Chair Rand Elliott is unavailable on this date and the GWAC needs to approve a recommended replacement to speak at the meeting. The committee approved Rand's alternate, Vern Redifer, as recommended by the EPO. The EPO will provide a proposed Power Point presentation for the approval of the committee at the next meeting. This presentation will be what Vern will provide to the Board.

A committee member requested that the EPO consider sending a second GWAC member with Vern to the presentation (preferably Jean Mendoza or Patricia Newhouse).

One outcome of the survey done by Heritage is that 45 homes are interested in having their well tested.

The next survey scheduled is the "High Risk Well Assessment survey". Yakima Health District has been contracted to conduct up to 320 surveys. They will conduct a test run of the 45 homes from the Public Questionnaire survey that expressed interest in a well test before contacting additional households. Andy Cervantes from the state Department of Health has trained the Health District employees who will be administering the survey.

Irrigated Agriculture:
Nothing new to report.

CAFO/Livestock:
The work group did not meet. They are working on setting a meeting date. They did have some email discussions on the issue of bio-solids. Ecology has a staff person who is willing to come and talk to the work group about bio-solids. It was suggested this would be a good topic for the Residential, Commercial, Industrial and Municipal working group. (It was brought to the attention of the committee that Chelsea Durfey, Stuart Turner's alternate, is highly involved and informed on bio-solids and can be a great resource for the GWAC.)

Regulatory:
The work group took the list of regulations that HDR developed and has started discussion with regulators about how they implement the regulations, whether it's by inspection, testing, etc.

Residential, Commercial, Industrial and Municipal:
The work group meeting is scheduled for the last Thursday of October. A representative from the Department of Ecology suggested that there is a model producing nutrient loading data that is current through 2011that could be useful. The work group also discussed the nitrogen cycle.

Data Collection:
The group did not formally meet. They did get a hydro-geologist from the Department of Ecology and Department of Health to discuss the USGS model. They plan to make presentation to the GWAC at the November meeting.

IX. Public Comment:

No comments.

X. Next Steps:

- Penny noted it is time for the GWAC to conduct an evaluation of their work to date. She will develop a draft self-assessment survey and ask EPO work group members to review the draft. Then the survey will be provided to all GWAC members to complete. Results will be provided at December's meeting.

Action items:

- Review History of Agriculture in Yakima.
- Penny will send out copies of slides from tonight's presentations and have them posted on the website.
- Review nutrient budget and proposed options; send comments to Kirk.
- The committee will hear more on deep soil sampling next month
- Work groups need to review the BMP database framework within the next two weeks and provide comments.

Topics for November meeting:

- Goals and objectives of working groups – it is time to finalize them.
- Decision on whether or not to use the History of Yakima Agriculture booklet.
- USGS modeling proposal
- Nutrient budget
- EPO's Power Point presentation draft
- Deep soil sampling scope of work

Due to a full agenda for November, Dr. Stevens' basic nitrate presentation request will be delayed to a future meeting.

XI. 2013 Meeting Calendar:

- November 21
- December 19

Meeting calendar will be reassessed at the end of the year.

The meeting was adjourned at 7:26 pm.

Meeting summary approved by the GWAC on November 21, 2013.

Daily Sun News

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That said newspaper is a legal newspaper and it is now and has been for more than six months prior to the date of publications hereinafter referred to, published in the English language continually as a daily newspaper in the city of Sunnyside, YAKIMA County, Washington, nd it is now and during all of said time printed in an office maintained at the afforesaid place of publication of said newspaper, and that the said Daily Sun News was on the 4th Day of April, 1969 approved as a legal newspaper by the Superior Court of said Yakima County.

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the State of Washington
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State of Washington
DORRIS T KRESSE
My Appointment Expires Apr 21, 2014

YAKIMA COUNTY
NOTICE OF PUBLIC MEETING
Lower Yakima Valley Groundwater Advisory Committee

NOTICE IS HEREBY GIVEN that Yakima County is holding a public meeting of the Lower Yakima Valley Groundwater Advisory Committee on Thursday, November 21, 2013 at 5:00 PM at Radio KDNA Conference Rooms 1 & 2, 121 Sunnyside Ave. in Granger WA pursuant to Chapter 173-100-080 WAC Ground Water Management Areas and Programs.

For Additional Information

To learn more about the Lower Yakima Valley Groundwater Management Area, the Groundwater Advisory Committee, and its goals and objectives, please see the Lower Yakima Valley Groundwater Management Area on the County webpage at: http://www.yakimacounty.us/gwma/

For more information about the meeting, please contact Lisa Freund, Yakima County Public Services Administrative Manager at 574-2300.

Dated this Wednesday, November 13, 2013

PUBLISH: DAILY SUN NEWS
November 14, 2013

YAKIMA HERALD-REPUBLIC

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Yakima County

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Dated this **Wednesday, November 13, 2013**

(381250) November 14, 2013

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STATE OF WASHINGTON,)
)
COUNTY OF YAKIMA)

Debbie Martin, being first duly sworn on oath deposes and says that she/he is the Accounting clerk of Yakima Herald-Republic, Inc., a daily newspaper. Said newspaper is a legal newspaper approved by the Superior Court of the State of Washington for Yakima County under an order made and entered on the 13th day of February, 1968, and it is now and has been for more than six months prior to the date of publication hereinafter referred to, published in the English language continually as a daily newspaper in Yakima, Yakima County, Washington. Said newspaper is now and has been during all of said time printed in an office maintained at the aforesaid place of publication of said newspaper.

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and the such newspaper was regularly distributed to its subscribers during all of the said period. That the full amount of the fee charged for the foregoing publication is the sum of $67.70

Debbie Martin

Accounting Clerk

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Sworn to before me this 14th day of, November 2013

Lisa M. Dripps

Notary Public in and for the
State of Washington,
residing at Yakima

Yakima County

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Dated this **Wednesday, November 13, 2013**

(381250) November 14, 2013

LOWER YAKIMA VALLEY

GROUNDWATER ADVISORY COMMITTEE

Groundwater Management Area (GWMA):
The purpose of the GWMA is to reduce nitrate contamination concentrations in groundwater below state drinking water standards

Meeting Time and Location

Thursday, November 21, 2013, 5:00 – 7:30 p.m.

Radio KDNA in Granger
121 Sunnyside Ave
Conference rooms 1 & 2
Granger, Washington

Purpose of the Meeting:

- Finalize GWMA program goals and objectives
- Determine next steps for Nutrient Budget and Loading Study
- Consider options for assembling and modeling data, including USGS modeling proposal
- Review Deep Soil Sampling proposal and determine next steps
- Review and approve general GWAC talking points
- Hear from Working Groups

Agenda

Time	Topic	Purpose	Lead
5:00 – 5:10 p.m.	Welcome & Meeting Overview	Introduction, meeting overview, confirm agenda	Penny Mabie, facilitator
5:10 – 5:15 p.m.	Committee Business	• Approve October 17 meeting summaries • Committee self evaluation survey • Facilitation contract	Penny Mabie Vern Redifer
5:15 – 5:30 p.m.	Outstanding Committee Decisions	• Finalize GWMA Program goals and objectives • Consider including Agricultural History of Yakima in GWAC materials	Penny Mabie
5:40 – 6:15 p.m.	Nutrient Budget and Data Modeling Options	• Hear update on nutrient budget and nutrient loading study • Hear about and discuss options for data modeling, including USGS data modeling proposal • Determine next steps	Kirk Cook
6:15 – 6:35 p.m.	Deep Soil Sampling Proposal	• Hear update on Deep Soil Sampling Proposal • Determine next steps	Jim Trull
6:35 – 6:50 p.m.	Standardized Talking Points	• Discuss and approve standardized talking points regarding the GWMA and the work of the GWAC	Lisa Freund

6:50 – 7:15 p.m.	Working Group Report Out	• Hear from working groups • Provide feedback; plan for future discussions	Penny Mabie Working group leads
7:15 – 7:25 p.m.	Public Comment	Opportunity for members of the public to make comments to the committee	
7:25 – 7:30 p.m.	Next Steps	• Review action items, next steps, and next meeting topics	Penny Mabie
7:30 p.m.	Adjourn		

Next Meeting: December 19, 2013

Committee Members

Stuart Turner, agronomist, Chelsea Durfey (alternate)	Turner and Co.
Helen Reddout, Wendell Hannigan (alternate)	Community Association for Restoration of the Environment
Kathleen Rogers, Bud Rogers (alternate)	Lower Valley Community Representative Position 1
Patricia Newhouse, Sue Wedam (alternate)	Lower Valley Community Representative Position 2
Doug Simpson	Irrigated Crop Producer
Jean Mendoza, Eric Anderson (alternate)	Friends of Toppenish Creek
Jan Whitefoot, Jim Dyjak (alternate)	Concerned Citizens of the Yakama Reservation
Steve George, Justin Waddington (alternate)	Yakima County Farm Bureau
Jason Sheehan, Dan DeGroot (alternate)	Yakima Dairy Federation
Jim Trull, Ron Cowin (alternate)	Sunnyside-Roza Joint Board of Control
Laurie Crowe, Jim Newhouse (alternate)	South Yakima Conservation District
Robert Farrell, John Van Wingerden (alternate)	Port of Sunnyside
Rand Elliott, Vern Redifer (alternate)	Yakima County Commission
Gordon Kelly	Yakima County Health District
Kefyalew Desta, Dr. Troy Peters (alternate)	WSU Irrigated Agriculture Research and Extension Center
Tom Eaton, Marie Jennings (alternate)	U.S. Environmental Protection Agency
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Charlie McKinney, Tom Tebb (alternate)	Washington Department of Ecology
Lino Guerra, Rick Perez (alternate)	Hispanic Community Representative

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LOWER YAKIMA VALLEY GROUNDWATER MANAGEMENT AREA ADVISORY COMMITTEE (GWAC)

MEETING SUMMARY

Thursday, November 21, 2013

Radio KDNA
121 Sunnyside Ave, Granger WA 98932

I. Call to Order:

Roll Call: The meeting was called to order at 5:05 p.m. by Penny Mabie, Facilitator.

Member	Seat	Present	Absent
Stuart Turner	Agronomist, Turner and Co.	✓	
Chelsey Durfey	Agronomist, Turner and Co. (alternate)	✓	
Helen Reddout	Community Association for Restoration of the Environment	✓	
Wendell Hannigan	Community Association for Restoration of the Environment (alternate)		✓
Jan Whitefoot	Concerned Citizens of the Yakama Reservation		✓
Jim Dyjak	Concerned Citizens of the Yakama Reservation (alternate)	✓	
Jean Mendoza	Friends of Toppenish Creek	✓	
Eric Anderson	Friends of Toppenish Creek (alternate)		✓
Larry Fendell	Friends of Toppenish Creek (Stand in)		✓
Lino Guerra	Hispanic Community Representative	✓	
Rick Perez	Hispanic Community Representative (alternate)		✓
Robert Farrell	Port of Sunnyside	✓	
John Van Wingerden	Port of Sunnyside (alternate)		✓
Jim Trull	Roza-Sunnyside Joint Board of Control	✓	
Ron Cowin	Roza-Sunnyside Joint Board of Control (alternate)		✓
Laurie Crowe	South Yakima Conservation District	✓	
Jim Newhouse	South Yakima Conservation District (alternate)		✓
Tom Eaton	U.S. EPA	✓	
Marie Jennings	U.S. EPA (alternate)		✓

Lonna Frans	USGS Washington Water Science Center		✓
Matt Bachmann	USGS Washington Water Science Center (alternate)	✓	
Kirk Cook	WA Department of Agriculture	✓	
Ginny Prest	WA Department of Agriculture (alternate)	✓	
Charlie McKinney	WA Department of Ecology	✓	
Tom Tebb	WA Department of Ecology (alternate)		✓
Andy Cervantes	WA Department of Health	✓	
Ginny Stern	WA Department of Health (alternate)	✓	
Dr. Kefy Desta	WSU Irrigated Agriculture Research and Extension Center		✓
Dr. Troy Peters	WSU Irrigated Agriculture Research and Extension Center (alternate)	✓	
Elizabeth Sanchey	Yakama Nation	✓	
Tom Ring	Yakama Nation (alternate)	✓	
Rand Elliott	Yakima County Board of Commissioners		✓
Vern Redifer	Yakima County Board of Commissioners (alternate)	✓	
Steve George	Yakima County Farm Bureau	✓	
Justin Waddington	Yakima County Farm Bureau (alternate)		✓
Gordon Kelly	Yakima County Health District	✓	
Jason Sheehan	Yakima Dairy Federation	✓	
Dan DeGroot	Yakima Dairy Federation (alternate)	✓	
Kathleen Rogers	Lower Valley Community Representative Position 1	✓	
Bud Rogers	Lower Valley Community Representative Position 1 (alternate)	✓	
Patricia Newhouse	Lower Valley Community Representative Position 2	✓	
Sue Wedam	Lower Valley Community Representative Position 2 (alternate)		✓
Doug Simpson	Irrigated Crop Producer	✓	

II. Welcome and Meeting Overview

Introductions

Moment of Silence

III. Committee Business:

October 17, 2013 Meeting Summary was approved with no changes.

December meeting date is confirmed for Thursday, December 19, 2013.

GWMA Groundwater Advisory Committee (GWAC) Self Assessment Survey
Penny Mabie explained that she would be sending an email to all group members with a link to an online survey. The GWMA Groundwater Advisory Committee (GWAC) Self Assessment is a tool that will calculate how well the group is doing. The two-page survey involves rating the statements with 1 = Strongly Disagree; 2 = Don't Feel Strongly or 5 = Strongly Agree. At the end of this survey is a field for comments. Those taking the survey do not have to submit their name. There is a two week deadline for this to be completed. Due date is December 6, 2013.

Facilitation Contract Renewal – Vern Redifer
Vern Redifer reminded the group that as it's the end of the year, the committee needs to decide whether or not to continue the contract with Penny Mabie of EnviroIssues. A discussion followed and the end consensus was to continue the contract for 2014 as the group is making good progress, the budget is healthy and the group likes Penny facilitating the meetings. A request was made for receiving the meeting materials in a more timely fashion. Penny noted that often materials await working group meeting review, which affects the schedule, but agreed to send out as much as she could earlier.

IV. Outstanding Committee Decisions

Finalize GWMA Program Goals and Objectives – Penny Mabie
Penny stated as she has not received any comments on the working product that it is ready for now. She noted the caveat "For Now" as the group is still in a very early stage (gathering information) so they can consider these as guiding goals but it will remain a working document – it's not locked down. It's reflective as to where the committee is at this point.

Discussion followed regarding the timeline for finalizing the GWMA program, as goal dates were removed from the current draft of the goals and objectives. The optimistic goal stated to Ecology was five years as there was a need for a timeline to demonstrate some progress. Penny asked if the committee wants to have a timeline in the document. Concerns were voiced in regard to putting timeframes in without knowing what all is involved in collecting the information to make the goal. It was suggested that deadlines, targets and a schedule are needed to keep the GWAC on task. The workgroups are doing the majority of the work and it would be beneficial for them to have a deadline. Vern reminded all that if they review the formation of this group and the RCW, the task of this group is to develop a program to achieve a way of reducing nitrates. Timeframes should be associated with the tasks, instead of the objectives. Once the program is developed, the GWAC wi will pass on this program to other agencies, users, etc. He reminded the committee that Yakima County has not

yet signed a contract with Ecology to free up the $1.6m. When the County does sign a contract, there will be dates for a completed program. Ecology will decide on the program due date. Decision makers in Olympia have lots of expectations that this group will deliver. The goals and objectives discussion was tabled until December. It was suggested that Matt Bachmann and Jean Mendoza get together and utilizing the last draft, write up proposed language associated with timelines and the group can review their proposal at the next meeting.

A request was made that the County issue a press release at the end of the year so that the public will know what the GWAC has accomplished. Vern explained that the workplan that we submitted to Ecology has a list where we agreed we would give the public information. He pointed out that the quarterly reports that we produce for Ecology are on the County's website for the public to access. The County will use those quarterly reports and develop an end-of-year report to distribute to the media.

Consider Including Agricultural History of Yakima in GWAC Materials – Penny
The GWAC decided the report provided to them for review should be posted on the GWMA website, but with a "draft" stamp on it. A committee member suggested the document does need to expand information on irrigation and canals but that can be added later; others agreed.

V. Nutrient Budget and Data Modeling Options – Kirk Cook

Kirk Cook opened by stating that a tremendous amount of work was put into the comparisons of methods to analyze nitrogen loading to groundwater for the Lower Yakima Valley Groundwater Management Area and thanked all who contributed. He explained the GWAC needs to decide on an option of either looking at what's occurring at the top of the water table or after the nitrate has gone into the water. Kirk said that the Yakima Valley has pretty good fluctuation in the water table which affects the vadose zone and that it moves during each season.

He then examined the three proposals presented: 1) USGS Proposal; 2) USGS Yakima GW Model coupled with N Balance and 3) Hybrid Approach. Kirk recommended the USGS Model with N Loading ($150k) as it is technically solid, addresses GWMA's goal and USGS will match half the cost.

Discussion followed with some suggesting that modeling is not needed; rather all that is needed is to make changes on the ground instead of working on answering questions for which we already know the answers. The group will consider a no modeling option. Penny observed that it might be useful to the GWAC to have a better sense of the context of the modeling conversations – how they relate to the GWMA program, the purposes for the various technical work, etc. Many GWAC members agreed. She will work with Kirk, Vern, Troy Peters, Charlie McKinney and Matt to frame this in a context so there can be a

better conversation next month. Vern pointed out that there is a need to create a plan/program as we do have a deadline with money to spend.

VI. Deep Soil Sampling – Jim Trull

Jim noted that participation and cooperation by the landowners is absolutely necessary to make the GWMA effective and functional. The sticking point in finalizing the deep soil sampling plan is the issue of confidentiality. Landowners would like to know if they have high nitrate levels but they are not willing to risk their family and livelihood if high levels are discovered and they are subsequently sued for polluting. Yakima County's prosecuting attorney has reviewed all of the state's statutes and says that information provided through Farm Plans is not discoverable under the Freedom of Information Act. Landowners countered that they could be sued for something else and once in the court system, there could be a disclosure request that would show if their land did have issues with nitrates.

It was decided that Laurie Crow,, Jim, Vern, a Yakima County Prosecuting Attorney and the Sunnyside-Roza Joint Board of Control's attorney would meet and discuss the confidentiality issue.

VII. Standardized Talking Points – Lisa Freund

Lisa presented the 14 talking points slides for the group's review and approval. EPO's charge is the public education component and the group created some very simple, basic slides and a slide template for the working groups and the GWAC to use as a foundation for public presentations. The 14 slides explain what the GWMA is, why it was formed, what the group is doing and how the public can participate. Feedback from the committee suggested that more work needs to be done. Concerns were voiced about the use of "enforcement strategies"; they would like to see more emphasis on identifying the problems, as the GWMA mission is to help producers improve practices. Stuart and Charlie agreed to send Lisa their proposed edits. Penny suggested that Jason and Stuart work together to draft their edits and then send them to Lisa.

VIII. Working Group Report Outs

As the meeting was exceeding its timeframe, Penny suggested the committee skip the working group report outs unless the working groups had urgent items to address. There were no urgent items.

IX. Public Comment:

Chelsea Durfey suggested that the group waits until the GWMA Groundwater Advisory Committee (GWAC) Self Assessment Survey results come in before renewing Penny's contract. Vern noted that the committee had already decided to move forward with the contract. He queried the committee if they wanted to reconsider their decision; they did not.

Kathleen Rogers asked what is being done to provide alternate water sources for the people out there with contaminated wells. Vern answered that the

County was successful in a Department of Health request in securing $150,000 for a drinking water program. This is not part of the GWMA funding. This program has not begun yet, but the people that were provided with a reverse osmosis system have been surveyed and the County is hoping that a group could be created with all the agencies together to get some matching money.

Pony Ellington pointed out that the group needs hard groundwater data so the consultant team is developing concrete recommendations for sampling, drilling of shallow water wells and a budget discussion.

X. Next Steps:

- Penny, Vern, Matt, Kirk and Dr. Troy Peters will discuss how to frame the Data Modeling concept in context with the work of other working groups.
- Edit Standardized Talking Points.
- Pursue confidentiality issue.
- Further consider modeling options.

XI. Next Meeting:

- Review edits to Goals and Objectives.
- Identify modeling option.
- Approve edited Standardized Talking Points.

XII. 2013 Meeting Calendar

- December 19

Meeting calendar will be reassessed at the end of the year.

The meeting was adjourned at 7:48 pm.

Meeting summary approved by the Lower Yakima Valley Groundwater Advisory Committee on_____

YAKIMA HERALD-REPUBLIC

INVOICE

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Contact: LISA FREUND
Address: 128 NORTH 2ND STREET ROOM 408
YAKIMA, WA 98901
Telephone: (509) 574-2343 Fax:
Account Rep: Simon Sizer- Legals - 398
Phone #: (509) 577-7740
Email: ssizer@yakimaherald.com

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Yakima County

Notice of Public Meeting Lower Yakima Valley Groundwater Advisory Committee

NOTICE IS HEREBY GIVEN that Yakima County is holding a public meeting of the Lower Yakima Valley Groundwater Advisory Committee on **Thursday, December 19, 2013 at 5:00 PM at Radio KDNA Conference Rooms 1 & 2, 121 Sunnyside Ave. in Granger WA** pursuant to Chapter 173-100-080 WAC Ground Water Management Areas and Programs.

For Additional Information To learn more about the Lower Yakima Valley Groundwater Management Area, the Groundwater Advisory Committee, and its goals and objectives, please see the Lower Yakima Valley Groundwater Management Area on the County webpage at: http://www.yakimacounty.us/gwma/

For more information about the meeting, please contact Lisa Freund, Yakima County Public Services Administrative Manager at 574-2300.
Dated this **Wednesday, December 11, 2013**

(389270) December 12, 2013

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YAKIMA HERALD-REPUBLIC

Affidavit of Publication

STATE OF WASHINGTON,)
)
COUNTY OF YAKIMA)

Debbie Martin, being first duly sworn on oath deposes and says that she/he is the Accounting clerk of Yakima Herald-Republic, Inc., a daily newspaper. Said newspaper is a legal newspaper approved by the Superior Court of the State of Washington for Yakima County under an order made and entered on the 13th day of February, 1968, and it is now and has been for more than six months prior to the date of publication hereinafter referred to, published in the English language continually as a daily newspaper in Yakima, Yakima County, Washington. Said newspaper is now and has been during all of said time printed in an office maintained at the aforesaid place of publication of said newspaper.

That the annexed is a true copy of a:
Yakima County Notice of Public Meeti

it was published in regular issues (and not in supplement form) of said newspaper once each day and for a period of 1 times, the first insertion being on 12/12/2013 and the last insertion being on 12/12/2013

Yakima Herald-Republic 12/12/13
YakimaHerald.com 12/12/13

and the such newspaper was regularly distributed to its subscribers during all of the said period. That the full amount of the fee charged for the foregoing publication is the sum of $67.70

Debbie Martin

Accounting Clerk

LISA M DRIPPS NOTARY PUBLIC STATE OF WASHINGTON My Comm. Expires 04/05/2017

Sworn to before me this 12th day of, December 2013

Lisa M. Dripps

Notary Public in and for the
State of Washington,
residing at Yakima

Yakima County

Notice of Public Meeting
Lower Yakima Valley
Groundwater Advisory
Committee

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For more information about the meeting, please contact Lisa Freund, Yakima County Public Services Administrative Manager at 574-2300.
Dated this **Wednesday, December 11, 2013**

(389270) December 12, 2013

Affidavit of Publication

STATE OF WASHINGTON
COUNTY OF YAKIMA SS

Timothy J. Graff, being first duly sworn on oath deposes and says that he is the Publisher of the DAILY SUN NEWS, a daily newspaper.

That said newspaper is a legal newspaper and it is now and has been for more than six months prior to the date of publications hereinafter referred to, published in the English language continually as a daily newspaper in the city of Sunnyside, YAKIMA County, Washington, and it is now and during all of said time printed in an office maintained at the afforesaid place of publication of said newspaper, and that the said Daily Sun News was on the 4th Day of April, 1969 approved as a legal newspaper by the Superior Court of said Yakima County.

That the annexed is a true copy of a LEGAL PUBLICATION -
Yakima County Public Services
December 19, 2013 Mtg.
published in regular issues (and not in supplemental forms) of said newspaper once each week for a period of 1 consecutive issue(s) commencing 12/12/13 and ending on 12/12/13, both dates inclusive, and that such newspaper was regularly distributed to its subscribers during all of said period. That the full amount of the fee charged for the foregoing publication is the sum of $ 35.00, amount has been paid in full, at the rate of $7.00 per column inch per insertion.

Subscribed and sworn to before me 12/12/13

Notary Public in and for
the State of Washington
030110-00000

Notary Public
State of Washington
DONNIS T KRESSE
My Appointment Expires Apr 21, 2014

Yakima County
Notice of Public Meeting
Lower Yakima Valley Groundwater
Advisory Committee

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For Additional Information
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For more information about the meeting, please contact Lisa Freund, Yakima County Public Services Administrative Manager at 574-2300.
Dated this Wednesday, December 11, 2013
PUBLISH: DAILY SUN NEWS
December 12, 2013

LOWER YAKIMA VALLEY

GROUNDWATER ADVISORY COMMITTEE

Groundwater Management Area (GWMA):
The purpose of the GWMA is to reduce nitrate contamination concentrations in groundwater below state drinking water standards

Meeting Time and Location

Thursday, December 19, 2013, 5:00 – 7:00 p.m.

Radio KDNA in Granger
121 Sunnyside Ave
Conference rooms 1 & 2
Granger, Washington

Purpose of the Meeting:

- Review and adopt revised Goals and Objectives.
- Approve edited Standardized Talking Points.
- Hear update on issues associated with Deep Soil Sampling proposal
- Discuss GWAC workplan and technical and working group efforts underway
- Review GWAC self evaluation results and discuss follow-up
- Hear from Working Groups

Agenda

Time	Topic	Purpose	Lead
5:00 – 5:10 p.m.	Welcome & Meeting Overview	Introduction, meeting overview, confirm agenda	Penny Mabie, facilitator
5:10 – 5:30 p.m.	Committee Business	• Approve November 21 meeting summaries • Discuss committee self evaluation survey results • Discuss and decide on 2014 GWAC meeting schedule	Penny Mabie
5:30 – 5:45 p.m.	Outstanding Committee Decisions	• Review proposed changes and finalize provisional GWMA Program goals and objectives • Review and finalize revised Standardized Talking Points	Penny Mabie
5:45 – 6:25 p.m.	GWMA Workplan, technical and working group work	• Review GWMA workplan and set context for working group efforts such as deep soil sampling, nitrogen budget, groundwater monitoring and modeling • Hear update on deep soil sampling issues • Discuss ongoing work and needed committee decisions	Kirk Cook Charlie McKinney Vern Redifer Jim Trull
6:25 – 6:30 p.m.	BREAK		

6:30 – 6:45 p.m.	Working Group Report Out	• Hear from working groups • Provide feedback; plan for future discussions	Penny Mabie Working group leads
6:45 – 6:55 p.m.	Public Comment	Opportunity for members of the public to make comments to the committee	
6:55 – 7:00 p.m.	Next Steps	• Review action items, next steps, and next meeting topics	Penny Mabie
7:00 p.m.	Adjourn		

Next Meeting: *tbd*

Committee Members

Stuart Turner, agronomist, Chelsea Durfey (alternate)	Turner and Co.
Helen Reddout, Wendell Hannigan (alternate)	Community Association for Restoration of the Environment
Kathleen Rogers, Bud Rogers (alternate)	Lower Valley Community Representative Position 1
Patricia Newhouse, Sue Wedam (alternate)	Lower Valley Community Representative Position 2
Doug Simpson	Irrigated Crop Producer
Jean Mendoza, Eric Anderson (alternate)	Friends of Toppenish Creek
Jan Whitefoot, Jim Dyjak (alternate)	Concerned Citizens of the Yakama Reservation
Steve George, Justin Waddington (alternate)	Yakima County Farm Bureau
Jason Sheehan, Dan DeGroot (alternate)	Yakima Dairy Federation
Jim Trull, Ron Cowin (alternate)	Sunnyside-Roza Joint Board of Control
Laurie Crowe, Jim Newhouse (alternate)	South Yakima Conservation District
Robert Farrell, John Van Wingerden (alternate)	Port of Sunnyside
Rand Elliott, Vern Redifer (alternate)	Yakima County Commission
Gordon Kelly	Yakima County Health District
Kefyalew Desta, Dr. Troy Peters (alternate)	WSU Irrigated Agriculture Research and Extension Center
Tom Eaton, Marie Jennings (alternate)	U.S. Environmental Protection Agency
Elizabeth Sanchey, Tom Ring (alternate)	Yakama Nation

Lonna Frans, Matt Bachmann (alternate)	U.S. Geological Survey
Kirk Cook, Virginia "Ginny" Prest (alternate)	Washington Department of Agriculture
Andy Cervantes, Ginny Stern (alternate)	Washington Department of Health
Charlie McKinney, Tom Tebb (alternate)	Washington Department of Ecology
Lino Guerra, Rick Perez (alternate)	Hispanic Community Representative

Committee Ground Rules:

- Come to committee meetings prepared
- Treat one another with civility
- Respect each other's perspectives
- Listen actively
- Participate actively
- Honor time frames
- Silence electronic devices during meetings
- Speak from interests, not positions.

***Proposed* 2014 Meeting Dates:**

January 16	May 15	September 18
February 20	June 19	October 16
March 20	July 17	November 20
April 17	August 21	December 19

LOWER YAKIMA VALLEY GROUNDWATER MANAGEMENT AREA ADVISORY COMMITTEE (GWAC)

MEETING SUMMARY

Thursday, December 19, 2013

Radio KDNA
121 Sunnyside Ave, Granger WA 98932

I. Call to Order:

Roll Call: The meeting was called to order at 5:04 p.m. by Penny Mabie, Facilitator.

Member	Seat	Present	Absent
Stuart Turner	Agronomist, Turner and Co.	✓	
Chelsey Durfey	Agronomist, Turner and Co. (alternate)	✓	
Helen Reddout	Community Association for Restoration of the Environment	✓	
Wendell Hannigan	Community Association for Restoration of the Environment (alternate)		✓
Jan Whitefoot	Concerned Citizens of the Yakama Reservation		✓
Jim Dyjak	Concerned Citizens of the Yakama Reservation (alternate)	✓	
Jean Mendoza	Friends of Toppenish Creek	✓	
Eric Anderson	Friends of Toppenish Creek (alternate)		✓
Larry Fendell	Friends of Toppenish Creek (Stand in)		✓
Lino Guerra	Hispanic Community Representative		✓
Rick Perez	Hispanic Community Representative (alternate)		✓
Robert Farrell	Port of Sunnyside		✓
John Van Wingerden	Port of Sunnyside (alternate)		✓
Jim Trull	Roza-Sunnyside Joint Board of Control	✓	
Ron Cowin	Roza-Sunnyside Joint Board of Control (alternate)		✓
Laurie Crowe	South Yakima Conservation District		✓
Jim Newhouse	South Yakima Conservation District (alternate)		✓
Tom Eaton	U.S. EPA		✓
Marie Jennings	U.S. EPA (alternate)	✓	

Lonna Frans	USGS Washington Water Science Center		✓
Matt Bachmann	USGS Washington Water Science Center (alternate)	✓	
Kirk Cook	WA Department of Agriculture		✓
Ginny Prest	WA Department of Agriculture (alternate)		✓
Charlie McKinney	WA Department of Ecology	✓	
Tom Tebb	WA Department of Ecology (alternate)	✓	
Andy Cervantes	WA Department of Health		✓
Ginny Stern	WA Department of Health (alternate)	✓	
Dr. Kefy Desta	WSU Irrigated Agriculture Research and Extension Center		✓
Dr. Troy Peters	WSU Irrigated Agriculture Research and Extension Center (alternate)	✓	
Elizabeth Sanchey	Yakama Nation		✓
Tom Ring	Yakama Nation (alternate)	✓	
Rand Elliott	Yakima County Board of Commissioners	✓	
Vern Redifer	Yakima County Board of Commissioners (alternate)	✓	
Steve George	Yakima County Farm Bureau	✓	
Justin Waddington	Yakima County Farm Bureau (alternate)		✓
Gordon Kelly	Yakima County Health District	✓	
Jason Sheehan	Yakima Dairy Federation	✓	
Dan DeGroot	Yakima Dairy Federation (alternate)	✓	
Kathleen Rogers	Lower Valley Community Representative Position 1	✓	
Bud Rogers	Lower Valley Community Representative Position 1 (alternate)	✓	
Patricia Newhouse	Lower Valley Community Representative Position 2	✓	
Sue Wedam	Lower Valley Community Representative Position 2 (alternate)	✓	
Doug Simpson	Irrigated Crop Producer	✓	

II. Welcome and Meeting Overview

Moment of Silence

III. Committee Business:

November 2013 Meeting Summary will be up for approval in January 2014.

January meeting date is confirmed for Thursday, January 16th, 2014.

Committee Self-Evaluation Survey Results

Penny Mabie explained that as some members of the committee didn't receive the survey until today she would just take a moment to go over it.

The Self Assessment Survey is a tool that will calculate how well the group is doing. It can be used as an opportunity to reflect, what work we want to do, what we can do if we want to change the way we talk together.

Discussion followed with comments on questions 6 and 10 mostly concerned about trust. Penny noted that there are some polarized opinions and the philosophies are varied but as a group, we are not enemies. She pointed out that the group is here to engage and contribute. If the way we're doing that is no longer working then let's figure out another way.

Some members were concerned after November's meeting coming to a stalemate, that after so many months can GWAC go any further. Penny agreed that it was a very legitimate concern. She suggested that we put all of our differences aside and that one of the ground rules is to speak from interest not position. When we get to the interest/values level then we can build a bit of the trust to talk about the values and interests together. Penny says she can make sure that we're talking about interests and have people make a more definitive statement so that more common ground could be found.

Penny recommended that the group does the evaluations one time per year and asked if anyone had any suggestions, to please send them her way.

2014 GWAC Meeting Schedule

The group agreed that the third Thursday of each month was good. It was suggested that GWAC skip the December meeting as it's a very hard time to meet and to get a meeting facility with holiday parties having booked already. Sunnyside location is always a consideration however there is no telephone or internet.

Penny reminded the group that everyone has an alternate. When it's time for public input, it is only for the public. If the alternate has something to say, they need to communicate it to the member for discussion with the group but cannot comment as public.

She had a second reminder that for formal discussions with the media, the spokesperson for the group is Rand or his alternate, Vern. Discussion followed a comment on Lisa Freund speaking to the media. Penny said the distinction is when the spokesperson, for instance, wants to speak up as farm bureau member then there's no conflict with the GWMA committee's work.

Confidentiality was again brought up. Jim, Vern and three attorneys met for a very productive meeting. We need to slow down a bit and it was agreed to postpone deep soil sampling until fall so that the confidentiality issue is spelled out so that everyone clearly understands it. There is still a lot of work that needs to go into this but Vern is very optimistic that they've found a way that is legal, simple, gets us everything we need and will not put any farmers at risk.

A brief discussion followed about a bill that could be written that states the data gathered for this program may not be released to any other entity as it is only for GWMA. Jim stated that we were getting ahead of ourselves and that it was speculative at this time and we should just put it on the table for future time.

Penny questioned why delay the testing. The reason given was that if the testing needs to take place in February/early March, there were too many details to work out before with the most difficult being the confidentiality issue.

Penny tasked the working groups to lay out what can be done ahead of the soil sampling to present in January. Then in February, the working groups could identify what work needs to be done and move on to implementation.

Vern added that at the last legislative session with Senator Honeyford, he acquired $1.6m for GWMA and $150k for drinking water. The drinking water is separate from GWMA so we want to wait until we get the well testing results back so that we can help as many people as we can. It's in the works, not today, but coming right on the heels of the water sampling.

IV. Outstanding Committee Decisions

Proposed Changes and Finalize Provisional GWMA Program Goals and Objectives

Penny reminded the group that the Goals and Objectives are a living document so it's hard to set in stone. Some in the group want deadlines, there's some concern about the most current document, no language about the date (a concrete number). It was suggested to put the date within five years, 2017 would be more concrete.

It was also stated that it was ambitious of the group to say that we're going to reduce loads as we haven't finished measuring yet. Agreed that we got behind on the timeline and it was suggested that we start with the completion and analysis as the baseline point and compare to that. Rand said to bring the drinking water to drinking water standards with working on the nutrient – we have control. Vern agreed that we need a measurable goal/objective. He said the goal will not be finished until the Lower Valley water meets State drinking water standards and once that happens, we can set objectives. We will not be successful until we can drink the water.

Penny proposed that we retain this as our goal and objective and reflect that they are provisional and then set the goals based on this. The goal is high, lofty

and challenging – to build a strategic success we need to figure it out prior. In five years there are some things that we want the people to know – from the health side we want folks to know what to do and by then producers would know what works. Penny stated that we need to do Specific, Measurable, Achievable, Relevant and Timely (SMART).

Review and Finalize Revised Standardized Talking Points – Penny and Lisa
Lisa made the requested changes on the slides. The first on Page 10, enforcement was replaced with accountability. And on Page 11, enforcement was eliminated altogether. These were the only concerns voiced at prior meeting. All agreed that the changes were good and appropriate.

Suggestion was made to change the word "Purpose" on the first and last slide to "Goal". The consensus agreement was to make talking points final.

V. GWMA Workplan, Technical and Working Groups – Kirk Cook, Charlie McKinney, Vern Redifer, Jim Trull

Review GWMA Workplan and Set Context for Working Groups
Penny presented a slideshow depicting the working groups and the elements of the GWMA program implementation, developing workplan, 2013-2014 program development and then 2015 program implementation. She suggested that the group think about the elements of the GWMA that drives the workplan. Penny said she spoke to HDR (technical consultants) and they provided a slide that represents the model that she feels is how we get to the GWMA program. If we develop acceptable data, develop a neutral problem statement (education, evaluation, communication, facilitating consensus) then that should be the GWMA Program. We need to develop the elements of the GWMA: Introduction, background and problem statement to develop acceptable data, goals and objects, outreach and education which will sum up our strategies, implementations and evaluation. We need to match up the elements of the program. Then we move to strategies and come up with BMP solution consensus and then Implementation and evaluation.

VI. Working Group Report Outs

Irrigated Agriculture:
Already reported.

CAFO/Livestock:
Did not meet. Have meeting scheduled for January 2nd but will send out email to reschedule.

Residential, Commercial, Industrial and Municipal:
Did not meet. Meeting was scheduled for day after Christmas, but has been canceled.

Education and Outreach:
Lisa Freund announced that the High Risk Well Assessment survey is launched. There were the news releases in addition to the 600 piece mailing. The Health District is conducting the surveys. They have done almost 30 so far. Phase I; Rand was talking to the El Projecto Bienestar (Project Well-being) advisory board and he put in a plug about the survey and hopefully we'll hear about it on TV next week. Next month, there will be English/Spanish radio ads on Spanish stations that will be targeting the Lower Valley. Our goal is to get a minimum of 250 surveys completed by the end of March. You have the opportunity to spread the word, invitation to participate, etc.

Regulatory:
Did not meet as chair is out of town.

Vern requested that the next time the chairs get together, to please invite him as he has some ideas to share. Seems we're confusing everyone – especially the consultants. We need to figure out some protocols as to how we interact as we've contracted with them.

VII. Public Comment:

None

VIII. Next Steps:

- Penny will send out a reminder that the working groups are expected to come back in February with their task lists for 2014.
- EPO will make the requested change to the talking points.

IX. Next Meeting:

- Matt Bachmann's proposal – Kirk Cook will speak to Troy Peters about a no modeling option.
- Review action items and next steps.
- Discuss 2014 Task list.
- November summary at January 2014 meeting.

X. 2014 Meeting Calendar

- January 16, 2014.

The meeting was adjourned at 6:56 pm.

Meeting summary approved by the Lower Yakima Valley Groundwater Advisory Committee on_____

Irrigated Ag Working Group

Charge from Groundwater Management Area Advisory Committee

Working Group Members

Dr. Kefy Desta (WSU), Dr. Troy Peters (WSU) Elizabeth Sanchey (Yakama Nation), Jean Mendoza (Friends of Toppenish Creek), Jim Trull (Roza-Sunnyside Joint Board of Control), John Van Wingerden (Port of Sunnyside), Lonna Frans (U.S. Geological Survey), Ralph Fisher (EPA), Ron Cowin (SVID), Stuart Turner (Turner & Co.), Thomas Tebb (Department of Ecology), Ginny Prest (Dept of Ag), Laurie Crowe (South Yakima Conservation District), Scott Stephen (Citizen), Mike Shuttleworth (Citizen), Chelsea Durfey (Citizen), Lino Guerra (Citizen), Doug Simpson (Farmer)

Meetings/Calls Dates

Conference Call: 3:00 PM – 3:55 PM Thursday, October 3, 2013

Call: (509) 574-2353, PIN 2353#

Participants

Dave Fraser, Don Jameson, Frank Lyall, Ginny Prest, Jim Trull, Don Gatchalian (Yakima County staff support), Troy Ross-Havens (Yakima County staff support)

Key Discussion Points

During the beginning of the meeting, the Chair pointed out that the GWAC advised the working groups to review and report on the GWMA Goals and Objectives document. For the most part, the group decided to leave it alone as there were just a few stylistic issues with the document, and that the goals and objectives of the GWMA are thought to be dynamic and subject to change as data and observations are collected through time. The group moved on to reviewing the newest version of the draft Deep Soil Sampling Plan. At this point, the document has undergone several revisions from different working groups and GWAC members, which left only a few issues of concern for the group to discuss; grower protection and potential property damages. The group expressed concern regarding confidentiality of grower information to protect them from lawsuits, and cited this as a critical piece of the plan to create productive grower participation, and to maintain trust between growers and the involved entities. Public disclosure laws cited in RCW 89.08.560 and RCW 42.56.270 will aid in protecting growers, and assist the GWMA with language to clearly show how the growers will be protected from lawsuits and grower specific information leaks before grower participation documents are signed. It was also suggested that field data be shown by matrix attributes (crop type, irrigation type, soil type, soil leaching index, etc.), instead of spatially (latitude, longitude, parcel number) to prevent data displays from being made that show where samples were taken in the GWMA and associated nutrient concentrations, further protecting grower confidentiality.

The group spent time on the topic of property damage and how the SYCD, growers, GWAC, and sampling consultants will follow a liability plan. Discussion followed regarding who will be responsible for particular property damages, such as damage to subterranean pipes, which may occur during the sampling process if particular precautions are ignored or mistakes are made. The meeting was adjourned after looking through the Deep Soil Sampling Plan draft cost estimate. The members felt that the draft cost estimate shows how the decision of sampling down to 6-feet instead of 10-feet will give them a lot more, "bang for their buck." It was mentioned that PGG has been working closely with the SYCD to develop the cost estimate, and that the cost estimate should be fairly accurate. An agreement is suggested between the GWAC and SYCD to deem the cost estimate appropriate.

Resources Requested

None at this time.

Recommendations for GWAC

None at this time.

Irrigated Ag Working Group

Charge from Groundwater Management Area Advisory Committee

Working Group Members

Dr. Kefy Desta (WSU), Dr. Troy Peters (WSU) Elizabeth Sanchey (Yakama Nation), Jean Mendoza (Friends of Toppenish Creek), Jim Trull (Roza-Sunnyside Joint Board of Control), John Van Wingerden (Port of Sunnyside), Lonna Frans (U.S. Geological Survey), Ralph Fisher (EPA), Ron Cowin (SVID), Stuart Turner (Turner & Co.), Thomas Tebb (Department of Ecology), Ginny Prest (Dept of Ag), Laurie Crowe (South Yakima Conservation District), Scott Stephen (Citizen), Mike Shuttleworth (Citizen), Chelsea Durfey (Citizen), Lino Guerra (Citizen), Doug Simpson (Farmer)

Meetings/Calls Dates

South Yakima Conservation District office – 200 Cheyne Road – Zillah, WA 98953

1:30 PM – 3:00 PM Thursday, October 24, 2013

Call: (509) 574-2353, PIN 2353#

Participants

Dave Fraser, Don Jameson, Frank Lyall, Ginny Prest, Jim Trull, Laurie Crowe, Jean Mendoza, Rosalio Brambila, Scott Stephen, Pony Ellingson, Chelsea Durfey*, Ginny Prest*, Troy Ross-Havens (Yakima County staff support)

*participated via telephone

Key Discussion Points

Pony Ellingson with Pacific Groundwater Group began the meeting with the draft sample allocation method (Task 3) that has been in development for a few months now. Pony began by explaining the 3D matrix that will be used to facilitate the selection of sample allocation efforts. This matrix will include model inputs such as crop type, irrigation type, nitrate leaching potential and crop acreage. The goal of the sample allocation method is to categorize each candidate field to be tested by the average NRCS leaching potential, crop type and irrigation type, and by weighting the sample distribution based on acres in each category.

The group reviewed methods for grouping crop types into categories for the allocation method, methods for the grouping of irrigation types, NRCS leaching potential categorization and weighting for heterogeneous soils within the LYV GWMA. General consensus was reached by the group that rooting depths published by the NRCS in 1997 will be used to categorize crop type within the 3D matrix. These rooting depth categories include less than 2.5 feet, 2.5 up to 4 feet, and more than 4 feet. The IAWG reviewed the Irrigation type efficiency data published by the NRCS part 652 that categorizes irrigation methods and condensed them into three types of

general methods (drips, sprinklers, and surface application) that will be used to categorize irrigation types within the 3D matrix. The group will need further discussion and possibly preliminary modeling efforts to determine whether 3 or 4 leaching potential values will be used from the NRCS Web Soil Survey tool. A lively discussion occurred focused on the difficulty in quantifying the amount of water that an individual farmer applies to a field. It was noted that in the LYV GWMA, often there is more than one field per irrigation delivery, and more than one irrigation delivery per field. Water is sometimes applied to a crop by more than one method and for more than one purpose.

After discussing the draft sample allocation method, the group moved on to reviewing the draft BMP summary which was tasked to the group by Mike Murray of HDR during the October GWAC meeting. After much deliberation regarding the specific goals and objectives associated with this task, the group tabled further discussion, which generally was driven by the lack of time left in the meeting and the uncertainty of the group's role in this task.

The next Irrigated Ag Working Group meeting will be held on November 21st, at a particular time before the 5:00PM GWAC Meeting that has yet to be determined.

Resources Requested

None at this time.

Recommendations for GWAC

None at this time.

Irrigated Ag Working Group

Charge from Groundwater Management Area Advisory Committee

None at this time

Working Group Members

Dr. Kefy Desta (WSU), Dr. Troy Peters (WSU), Elizabeth Sanchey (Yakama Nation), Jean Mendoza (Friends of Toppenish Creek), Jim Trull (Roza-Sunnyside Joint Board of Control), John Van Wingerden (Port of Sunnyside), Lonna Frans (U.S. Geological Survey), Ralph Fisher (EPA), Ron Cowin (SVID), Stuart Turner (Turner & Co.), Thomas Tebb (Department of Ecology), Ginny Prest (Dept of Ag), Laurie Crowe (South Yakima Conservation District), Dave Fraser (Simplot Agronomist), Scott Stephen (Citizen), Don Jameson (Citizen), Mike Shuttleworth (Citizen), Chelsea Durfey (Citizen), Lino Guerra (Citizen), Doug Simpson (Farmer)

Meetings/Calls Dates

Where: KDNA Granger Conference Room – 121 Sunnyside Avenue, Granger, Washington

When: 2:30 PM – 4:00 PM Thursday, November 21, 2013

Call: (509) 574-2353 - PIN# 2353

Participants

Jim Trull (Chair), Dave Fraser, Don Jameson, Bob Stevens, Stuart Turner, Laurie Crowe, Jean Mendoza, Scott Stephen, Pony Ellingson, Chelsea Durfey, Ginny Prest, Troy Peters, Troy Ross-Havens (Yakima County staff support)

Key Discussion Points

Agenda

1. Review Meeting Notes of October 24th Meeting

No comments were raised with the October 24th meeting notes.

2. Final Review of Irrigated Ag Best Management Practices

The group's discussion started out with a comment made regarding BMPs. Very few BMPs are stand alone, many are used in part or seasonally, and linked to additional BMP(s). In addition, BMPs are site and time specific. A BMP that works for one field might be detrimental to another field, and vice versa. Some fields can change their practices and adopt newly identified BMPs, while other fields can't. An agronomist

present in the group described what was called the rule of the 4 R's: applying the Right nutrient, at the Right rate, during the Right time, and the Right place. In this member's opinion, if you stray from the 4 R's, you are no longer following science, but policy instead.

A dialogue regarding the prioritization of BMPs ensued, which led to the majority of the group expressing that this would not be effective. Each field is operated under different conditions such as crop type, soil type, nutrient conditions, which supports the argument that a BMP with a #1 priority might work great for one field, but could greatly diminish the productivity of another, even within the LYV GWMA boundaries. One member would like to see an effort to reduce or eliminate rill and furrow irrigation, as it mobilizes soluble nitrates.

The comment was made that without proper nutrient and irrigation management, adopting the listed BMPs will not reduce nitrate leaching to groundwater alone. After irrigation and nutrient management have been optimized, the BMPs may provide added benefit. In addition, growers need to start with the basics; soil testing, nutrient requirements, and proposes incentive funds for proper irrigation management which would lead to better yields, reduced water consumption, and reduced nutrient application.

One member added that they were afraid that once the BMP list is publicized, growers might find themselves being heckled by the public on why they are not implementing any or all of the BMPs. These accusations would likely be made without thorough understanding of the intricacies and differences among the wide array of crop conditions present in the LYV GWMA, as each field presents its own challenges.

A concern with wording in some of the BMPs would be misleading if published as is. One particular BMP suggests zero excess nitrates. This is short of reality. Although it is possible to reduce the nitrate loading to groundwater, zero excess is an unrealistic goal. It is important to note that the occasional flushing of salts with water from soils is necessary to maximize total crop nutrient extraction. Also, the term "fertilizer" needs to be explored as it may not be defined to include all nutrient sources such as soil amendments.

The group feels that the deep soil sampling plan will be best used to identify problematic areas, and to assess nutrient levels over time. One member would like to see the matching of cropping systems with cultural patterns and deep soil sampling data, and then reward growers with improved operational practices.

ACTION: Jim will compile all current comments on the BMP database and submit to the consultant.

3. Soil Sample Allocations

Pony reviewed the Soil Sample Allocation technical memorandum with the group. He explained the categorical criteria and matrix data needed for each crop and how a particular crop would be grouped and analyzed through the plan. He explained that the goal of the sample allocation plan is to make sure all crops are proportionately represented by risk, and to eliminate any sampling bias. Originally, the plan called for grouping crop type by rooting depth as one of the grouping categories. The group thought it might be more functional if crops are grouped by crop type instead of rooting depth, which generally correlate strongly.

Pony stated that he will add a crop type block to the sample allocation plan, and perform an additional iteration to see if the crops group into the correlating rooting zone depth as expected. Pony recommended that the group start thinking about how the LYV GWMA soil sampling funds will be best spent.

4. Contact with Landowners Requesting Participants

The group Chair reported that in the opinion of the Roza-Sunnyside Joint Board of Control's lawyer, there is still an issue with participant confidentiality in the deep soil sampling plan. The Chair has contacted County representatives and has not received any direction or response regarding protecting growers from lawsuits during or following data collection from their agricultural lands. It is important to procure the protection from lawsuits as soon as possible, as it directly impacts grower participation recruitment and soil sampling efforts. Relating to data confidentiality, a few group members feel reluctant to permit the USGS to analyze grower data. They expressed concern that once the USGS acquires the data, it would be publicized shortly thereafter.

Jim reported that the Roza-Sunnyside Joint Board of Control can facilitate a newsletter to reach local growers asking for participation, but the data confidentiality issue must be resolved before this outreach is conducted. Jim, backed by the group, feels that grower protection is of very high priority and a keystone to the success of the LYV GWMA project.

Resources Requested

None at this time

Recommendations for GWAC

None at this time

Deliverables/Products Status

None at this time

Residential, Commercial, Industrial, Municipal Working Group

Charge from Groundwater Management Area Advisory Committee

None at this time

Working Group Members

Robert Farrell – Chair (Port of Sunnyside), Dr. Kefy Desta (WSU), Elizabeth Sanchey (Yakama Nation), Gordon Kelly (Yakima Health District), Jan Whitefoot (Concerned Citizens of Yakama Reservation), Jim Dyjak (Citizen), John Van Wingerden (Port of Sunnyside), Stuart Turner (Turner & Co), Tom Ring (Yakama Nation), Donald Gatchalian (Yakima County), Troy Ross-Havens (Yakima County staff support)

Meetings/Calls Dates

Meeting:	Thursday, October 31, 2013 10:00 AM – 12:00 PM
Location:	KDNA Granger 121 Sunnyside Avenue Granger, Washington
Conference Call:	(509)574-2353, PIN# 2353 (for those unable to attend in person)

Participants

Robert Farrell (Chair), Gordon Kelly, John Van Wingerden, Kathleen Rogers, Steve Swope (Pacific Groundwater Group), and Troy Ross-Havens (County support staff)

Key Discussion Points

Agenda:

1. RCIM contribution to GWAC

The group began by discussing RCIM's future involvement within the GWAC, and how much effort should be put forth regarding "all other sources" not including irrigated agriculture or livestock/CAFO. Steve referenced an EPA report that identified nearly 2/3 of nitrate in the valley

associated with Dairy, approximately 1/3 associated with crops, and only 3% associated with all other sources, which led to the question, "how much effort and resources should be put into this catch-all group termed RCIM in the LYV GWMA?" Are resources better spent in areas that have previously been found to have more nitrates associated with them? Is it worthy to consider disbanding the RCIM Working Group and reassigning its members to Irrigated Ag or Livestock/CAFO? It was suggested that the group should remain in existence to provide quality assurance and quality control. The Data Working Group is currently developing a nitrate loading budget plan that includes RCIM-type categories such as sewer lines, biosolids, septic tanks, etc. The RCIM group will assist in assuring all sources have been identified as well as providing comment and suggestion on data collection protocol, as well as providing an initial checklist to be included in the budget.

2. RCIM role and existence

Discussion content of agenda items 1 and 2 were very similar. The group decided, with support from Steve Swope, that they will remain in existence for the time being to review and comment on the Nitrate Loading Budget being developed by the Data Collection Working Group. RCIM will provide technical support and quality control to the GWAC. Following the above activity, the group's existence would then be brought to the GWAC for further direction.

3. Review and comment: Draft Initial BMP Database presented by Mike Murray (HDR) during October's GWAC meeting

The RCIM group generally agreed that each of the objectives and management targets presented in Sections 3-6 were applicable to the LYV GWMA. Comment was raised during discussion associated with Sources 3 and 6, that public education and outreach would be best suited for cooperation, rather than enacting additional regulations.

The group discussed the creation of a checklist that would be presented to the GWAC as a rough draft in December. The members will perform individual research, then summarize and compile their findings in the November working group meeting. It was suggested that reports previously conducted throughout the country will be utilized to collect ideas and determine if they are applicable to the LYV GWAC.

4. Review and comment: Nitrate Loading Assessment Talk given by Kirk Cook during October's GWAC meeting

A short discussion was held regarding Kirk Cook's Nitrate Loading Assessment presentation. The group recommends the higher level of assessment that was proposed by Kirk.

5. Schedule next RCIM Working Group meeting

The next RCIM Working Group meeting will be held at KDNA Granger on November 21 at 1:30PM – 2:30PM.

Resources Requested

None at this time

Recommendations for GWAC

High level of modeling for the Nitrate Loading Assessment

Deliverables/Products Status

None at this time

Proposed Next Steps

- Provide the Data Collection Working Group a checklist of "all other sources" that encompasses the scope of the RCIM Working Group.
- Review and comment on the Nitrate Loading Budget as necessary.

Residential, Commercial, Industrial, Municipal Working Group

Charge from Groundwater Management Area Advisory Committee

None at this time

Working Group Members

Robert Farrell – Chair (Port of Sunnyside), Dr. Kefy Desta (WSU), Elizabeth Sanchey (Yakama Nation), Gordon Kelly (Yakima Health District), Jan Whitefoot (Concerned Citizens of Yakama Reservation), Jim Dyjak (Citizen), John Van Wingerden (Port of Sunnyside), Stuart Turner (Turner & Co), Tom Ring (Yakama Nation), Kathleen Rogers (Citizen), Sanjay Barik (Ecology), Donald Gatchalian (Yakima County)

Meetings/Calls Dates

Where: KDNA Granger Conference Room – 121 Sunnyside Avenue, Granger, Washington

When: 1:30 PM – 2:00 PM Thursday, November 21, 2013

Call: (509) 574-2353 - PIN# 2353

Participants

Robert Farrell (Chair), Gordon Kelly, *Kathleen Rogers, and Troy Ross-Havens (Yakima County support staff)

* Participated by telephone

Key Discussion Points

Agenda:

1 Collaborate notes/research/ideas regarding the Nitrate Source Checklist to be delivered to the Data Collection and Monitoring Working Group for development of the Nutrient Loading Assessment

Last meeting, the group decided that the members would conduct individual research and implement their current knowledge and understanding regarding nitrate source contributors

that could be present in the LYV GWMA for inputs into the Nutrient Loading Assessment that the Data Collection and Monitoring Working Group would assemble. The group members discussed their findings regarding research associated with the Nutrient Source Checklist, and found that there wasn't much else out there in addition to what has been reported in other GWMA's around the country. Based on the outcome of recent GWMA reports that nutrient sources other than irrigated cropland and livestock/CAFO operations are relatively insignificant, the group decided that the most efficient way to approach this checklist would be to adopt previously documented sources from other GWMAs as they apply to the LYV GWMA.

2 Discuss SPARROW model inputs as necessary

The group Chair reported that a recent conversation held with Sanjay Barik (not present during this particular meeting) indicated Sanjay's advocacy on using the SPAtially Referenced Regression on Watershed (SPARROW) model's inputs still stood. The SPARROW model is specific to the Yakima Basin, and it is expected to provide pertinent data regarding the RCIM's scope. Steve Swope with PgG downloaded the data and believes that the sources are complete.

3 Other items that may be requested

There was a short discussion on biosolids, and how they have been land applied in Yakima County for many years. It is understood that biosolids are highly regulated and permitted in Yakima County through the Department of Ecology.

Resources Requested

None at this time

Recommendations for GWAC

None at this time

Deliverables/Products Status

None at this time

Proposed Next Steps

None at this time

Data Collection, Characterization, Monitoring Working Group

Charge from Groundwater Management Area Advisory Committee

Working Group Members

Kirk Cook - Chair (Dept of Ag), Andres Cervantes (Dept of Health), Dr. Kefy Desta (WSU), Jan Whitefoot (CCYR), Jim Trull (SVID), Kevin Lindsey (GSI - Consultant), Laurie Crowe (South Yakima Conservation District), Lonna Frans (USGS), Matt Bachmann (USGS), Lorraine Edmond (Citizen), Mark Nielson (Benton County Conservation District), Steve Swope (PGG - Consultant), Stuart Turner (Turner & Co.), Thomas Tebb (Dept of Ecology)

Meetings/Calls Dates

Conference Call: 1:00 PM – 3:00 PM, Thursday, November 7, 2013

Call Number: 509.574.2353 PIN# 2353

Participants

Kirk Cook, Matt Bachmann, Ginny Stern, Steve Swope, Pony Ellingson, Melanie Redding, Kevin Lindsey, Frank Lyle, Jean Mendoza, Don Gatchalian (Yakima County staff support), and Troy Ross-Havens (Yakima County staff support)

Key Discussion Points

Agenda:

- Steve and Pony's Introduction of the Draft Potential Groundwater Monitoring Stations document prepared by PgG

Steve and Pony from Pacific Groundwater Group (PgG) gave a big picture overview of the LYV GWMA process and how it concerns data collection and the Potential Groundwater Monitoring Stations draft document completed by PgG for HDR and the LYV GWMA. The report is based on all available nitrate analyses from the late 70's to more recent findings. Pony mentioned that the data came from two different sources; one source was a compilation of USDA, USGS, EPA, and DOH data; while the other was data regarding monitoring well locations and owners on file with Yakima County. An important aspect of the project is to monitor Nitrate concentrations in particular wells over time, this document is to outline how to select the most beneficial and reliable groundwater monitoring wells. The Potential Well Locations draft document is requested to be reviewed and commented on no later than two weeks from today's conference call.

- Nutrient Loading Study
    1. Presentation of three basic approaches followed by group discussion
    2. Review of feedback from GWAC on the merit of such a study
    3. Timelines to begin such a study
    4. Interface with Deep Soil Study

Kirk stated that following his most recent presentation of this study to the GWAC, he has received comment back ranging from support for a table top model (lowest effort) to an extensive groundwater similar to the approach presented by Matt Bachmann during the September GWAC meeting (highest effort).

Kirk reviewed each study type to the group explaining that the lowest effort would involve looking up and using published documents and numbers associated with the current nutrient pathways evident in the LYV GWMA to develop the Nutrient Loading Study. This approach would not be relatively GWMA specific as it would not collect site-specific data within the GWMA, and would be more of a generalization. A medium effort approach would involve talking to local residents to determine what the constituents are actually applying to the ground in regards to nutrients and how over application, under application, or "ideal" application is contributing to groundwater quality. This approach goes a step further in eliminating the assumption that residents are following the recommended application rates, and gearing data collection towards GWMA. A high effort approach would be a model/study that is more comprehensive in the manner that it might include Vadose zone modeling as well as the involvement of a groundwater particle tracking basis, and a further attempt to understand what is happening in the root zone, beyond the root zone, in the Vadose zone and, ultimately, groundwater impacts associated with these practices.

General concern with the lack of integrity in the lowest effort approach was shared amongst the participants. Participants felt that this approach was not showing what is actually occurring in the LYV GWMA, and does a poor job characterizing the area completely. This approach does not completely collect data to make a scientifically informed decision on whether LYV residents are contributing or not contributing to groundwater contaminant concentrations. It was mentioned that the Data Working Group was tasked by the GWAC to identify existing sources of groundwater contributions, and that this approach did not satisfy that objective. One participant objected, expressing that some residents will contribute more nitrogen than average, and some will contribute less than average; during years yielding better than average productivity, residents might apply more nitrogen than years yielding less than average productivity, which will ultimately force the nitrogen budget to "break even".

The majority of the participants expressed favor for the medium or high effort level study, which would allow for a more thorough data collection protocol to more accurately

characterize what practices are either negatively or positively impacting groundwater quality. A few caveats accompany these approaches, as sensitivity in timeline and allocated funds exist.

- USGS Proposal and Alternatives
    1. Discussion of pros and cons to USGS proposal
    2. Alternatives to integrated Vadose/GW model
    3. How do current efforts or studies impact comprehensive model
    4. Outline presentation to GWAC on the 21st

A short discussion was held on this topic. The USGS proposal includes a very robust data set, which the group agreed that the larger data set; the better, and that the quality and relativity of the data is very significant. Group members generally agreed that a more comprehensive approach to modeling nutrient transport in the LYV GWMA, however, it is apparent that the proposed approach by USGS could take some time to merge the vadose zone model and the LYV groundwater model, and may not satisfy the interim goals of the GWMA. The group raised question about where the funds allocated for the GWAC would be best spent. A USGS representative reminded the group that the USGS can provide approximately 35% of the funds required to develop and implement the proposed model, and that if the GWAC doesn't act soon, those funds could no longer be available. Although the group agreed that a scientifically sound approach needs to be adopted to base future decisions on, the group was somewhat divided in the USGS proposal, as some supported it while others advised to proceed with caution if this approach was adopted. Kirk stepped forward to compose a proposal for both benefits and cost to present to the GWAC on November 21st. Kirk requested the participants to provide any considerations to be included in the proposal.

Resources Requested

None at this time

Recommendations for GWAC

None at this time

Deliverables/Products Status

None at this time

Proposed Next Steps

- Compose benefit and cost proposal to present to GWAC during the November 21st GWAC meeting for deliberation on further action.

Education and Public Outreach Working Group

Charge from Groundwater Management Area Advisory Committee

Working Group Members

Andres Cervantes (GWAC-DOH), Jean Mendoza (GWAC-Friends of Toppenish Creek), Tom Tebb (GWAC-Ecology), Elizabeth Torres (Citizen), Gretchen Stewart (EPA), Nieves Negrete (Citizen), Patricia Newhouse (GWAC-Citizen Rep Position #2), Tom Eaton (GWAC-EPA), Dean Effler (Citizen), Joye Redfield-Wilder (Ecology), Wendell Hannigan (GWAC-Alternate), Stuart Turner (GWAC-Turner & Co)

Meetings/Calls Dates

Meeting: Wednesday, October 2, 2013 1:30 PM - 3:30 PM

Participants

Andres Cervantes, Joye Redfield-Wilder, Patricia Newhouse, Ignacio Marquez (AGR), Lisa Freund (EPO Chair -Yakima County) and Karri Espinoza (Yakima County staff)

Key Discussion Points

Ignacio Marquez, Community Liaison for the Department of Agriculture, was introduced. He attended the September GWAC meeting and has an interest in participating in EPO.

EPO Working Group Check In/Reaching Decisions: EPO working group participation and involvement was discussed. Most of the work has been completed by a few members. There is also an issue of members not completing agreed-to assignments. How can we boost participation and get work done?

ACTION: Ignacio volunteered to contact all working group members to check their availability and willingness to serve, be active in the group and assign back-ups. Lisa will provide him with a contact list.

Status Report:

1. **GWAC Goals and Objectives: Recommendation to GWAC** – A review of EPO's goals and objectives and EPO portion of the GWAC budget was reviewed and discussed.

   ACTION: The group unanimously agreed on the EPO's original goals, objectives and portion of the GWAC budget. The group also agreed to the overall GWAC budget, as presented at the August GWAC meeting. Lisa will provide the GWAC committee a final approval from the EPO on its portion of the budget. She will also obtain an Accounting report of expenses to-date by category to present to the group at the next meeting.

2. **Completed Work/ Report Back :**

   a. *"Connect with Your Government "Radio Program* – Andy reported that the radio program went well and all points were spoken about. It was aired on KNDA and LUZ radio stations.
   b. *Heritage Public Questionnaire Results* – Lisa presented the group with a report of the survey results. 300 households were solicited and 136 surveys completed.

3. **3rd Quarter Member Assignments/Status** :

   a. *Heritage Student Evaluation Form*- This assignment was not completed. The window of opportunity has passed for an accurate evaluation to be performed. The group agreed to drop the evaluation.
   b. *GWAC Program Master Slides* – no action has been taken on this assignment.

   ACTION: Andy and Joye agreed to take on this project and prepare a generic presentation, in consultation with Gretchen Stewart & Dean Effler.

   c. *Budget for radio PSAs* - no action has been taken on this assignment.

   ACTION: Ignacio and Patricia agreed to research radio costs.

4. **New Mom Brochure:** The brochure has been completed, but has not yet been approved by the GWAC. Given the length of time since the brochure was approved by the EPO, it will be brought back for their review before forwarding to the GWAC.

   ACTION: Lisa will ask Dean to distribute the brochure to the group again for review. Subject to EPO approval, the brochure will be brought back to the GWAC for final approval.

5. **Website Links:** Was not discussed.

6. **4th Quarter Outreach Opportunities**: Rand Elliott is not available to attend the Community Advisory Board (CAB) for El Proyecto Bienestar on December 2. 2013. The group recommended Vern Redifer to present on the GWAC's behalf.

   ACTION: Lisa will give Vern a heads-up and present the recommendation to the GWAC at the next meeting on October 17, 2013

Proposed Next Steps

1. Contact the members of the EPO working group regarding their ability and willingness to be involved. Assigned to: Ignacio. Due date: before November EPO meeting.

2. Present EPO Budget approval to GWAC at the October 17, 2013 meeting, Assigned to: Lisa.

3. Obtain report of an accounting break down of EPO expense to-date. Assigned to: Lisa. Due date: November 6 EPO meeting.

4. Contact Radio KNDA regarding costs of PSA's. Assigned to: Ignacio and Patricia. Due date: November EPO meeting.

5. Prepare a generic Power Point presentation to be distributed to all working groups for customization to fit their presentation needs. Assigned to: Andy and Joye, in consultation with Gretchen Stewart & Dean Effler. Due date: present at November EPO meeting.

6. Distribution of the "New Mom Brochure" to the EPO group. Assigned to: Dean and Lisa. Due date: present at November EPO meeting.

7. Recommendation that Vern represent/present the GWAC at the Community Advisory Board (CAB) for El Proyecto Bienestar on December 2, 2013. Assigned to: Lisa.

Next meeting Wednesday, November 6, at 1:30 PM, Yakima County Courthouse Room 419 (phone: 509-574-2353 [PIN 2353#])

Education and Public Outreach Working Group

Charge from Groundwater Management Area Advisory Committee

None at this time.

Working Group Members

Andres Cervantes (GWAC-DOH), Jean Mendoza (GWAC-Friends of Toppenish Creek), Tom Tebb (GWAC-Ecology), Elizabeth Torres (Citizen), Gretchen Stewart (EPA), Nieves Negrete (Citizen), Patricia Newhouse (GWAC-Citizen Rep Position #2), Tom Eaton (GWAC-EPA), Dean Effler (Citizen), Joye Redfield-Wilder (Ecology), Wendell Hannigan (GWAC-Alternate), Stuart Turner (GWAC-Turner & Co)

Meetings/Calls Dates

Meeting: Wednesday, November 6, 2013 1:30 PM - 3:30 PM

Participants

Andres Cervantes (GWAC-DOH), Joye Redfield-Wilder (Ecology), Ignacio Marquez (AGR), Lisa Freund (EPO Chair -Yakima County) Karri Espinoza (Yakima County staff), Jean Mendoza (GWAC-Friends of Toppenish Creek), Robert Villanueva (ESD/Work Source), Rhonda Marquez (ESD/Work Source); Gretchen Stewart (EPA) – via phone

Key Discussion Points

Introductions: Robert Villanueva and Rhonda Marquez from ESD/Work Source were introduced.

EPO Member Check-In: Ignacio Marquez contacted the EPO committee members he could reach by phone. The members he was able to reach were fine with the regularly scheduled meeting date and time; however, their attendance has been low because of other priorities. (One contact noted that nitrate is not a "hot" local topic). He made additional community contacts to see if anyone would like to serve on the EPO group. Robert Villanueva (ESD/Work Source) and Rhonda Marquez (ESD/Work Source) were among those he contacted. They both have contacts with migrant services in the community. He contacted Phil Rigdon at the Yakama Nation regarding potential EPO membership from the Tribe. Phil said he'd look into GWMA and get back to him. Ignacio also has an e-mail in to the Yakima Valley Farmworkers Clinic (YVFWC) to see if someone from the medical field would be willing to serve on the committee. He has contacted Michele Besso at Evergreen Legal Services; she said she would ask if anyone from that agency is interested in participating on the EPO.

ACTION: Ignacio will follow up with the Yakama Nation and YVFWC and report on results prior to the December 4 EPO meeting.

ACTION: Andy will approach Gordon Kelly (YHD) about getting a YHD medical representative to join the EPO group. If he needs reinforcement he may ask Vern or Rand to go with him. He will report on results at the December 4 EPO meeting.

2) **GWAC Feedback:** Lisa reported that the GWMA Committee approved the EPO's recommendation for Vern Redifer to serve as Rand Elliott's back-up GWAC spokesperson at its October 17 meeting.

A GWAC member requested that Vern take a GWAC partner with him to the El Proyecto Bienestar meeting on December 2, 2013. Patricia Newhouse was suggested and she has agreed to present with him.

Andy Cervantes shared the mapping concept he would like to provide the GWAC in response to its ongoing questions about where the Heritage Students surveyed and who participated.

ACTION: Vern Redifer and Patricia Newhouse will give a GWMA/GWAC presentation to the El Proyecto Bienestar on Monday, December 2, 2013.

ACTION: Andy and Lisa will create a map overlay that illustrates where the Heritage students surveyed by quadrant, who participated in the survey, who declined to participate, who could not be contacted, and who wanted a more in-depth well survey. The map will also illustrate where the nitrate "hotspots" and data gaps exist. The map will be provided to the GWAC prior to its meeting on November 21, 2013.

3) GWMA Program Master Slides:

Andy presented printed copies of the power point slides he created for the Proyecto Bienestar presentation. There was a discussion of creating a GWMA template of about 5-6 slides that all working groups could use as a starting point for their own presentations.

ACTION: Jean will put together some slides of the GWMA historical information and send to the group.

Andy will save his slides in PDF form and send to the EPO for its review before forwarding to the GWAC for its review and approval. Members will provide e-mail feedback to him by Wednesday, November 13, 2013 if they want their input considered by the GWAC.

Andy will forward the final slides to Lisa by Friday, November 15 so the GWAC has time to review them prior to its November meeting.

ACTION: Robert and Rhonda will talk to Work Source to see if it would be feasible to have a continual running GWMA/Nitrate slide show running on waiting room TV's, and/or post a wall map of nitrate hotspots, provide Nitrate Handouts, and possibly having someone come in and give a short presentation to client groups during their mandatory meetings. They will report back on their findings on or before the December 4 EPO meeting.

4) **Radio Advertising/PSA Report Back:** Ignacio contacted KDNA & Town Square Media. They provided him with quotes for radio advertisement which he presented to the group. KDNA offered time for call-ins with questions also.

ACTION: Ignacio will contact other Hispanic media outlets (La Familia, Addelente (sp?) for advertising quotes and report back on or before the December 4 EPO meeting.

5) **New Mom Brochure:** This subject was tabled for the December 4, 2103 meeting or until Dean Effler can be present at a meeting.

6) **GWAC Self-Assessment Framework_vo:** Each member present was given the self assessment and asked to fill it out and submit it to Lisa Freund. Lisa noted that the document had been e-mailed to the EPO membership, with comments due back by Friday, November 8.

ACTION: Lisa will compile the EPO's comments and return them to GWAC facilitator Penny Mabie by Friday, November 8.

Recommendations for the GWAC

Review and approve the GWMA/GWAC "talking points" slide presentation.

Proposed Next Steps

Media Blitz for the High Risk Well Assessment Survey

Radio PSAs

PowerPoint slide show, map, brochures to be available at Work Source and other locations

DECEMBER 4 AGENDA ITEMS:

1. PSAs for the High Risk Well Assessment Survey
2. Report Back-Proyecto Bienestar presentation
3. New Mother Brochure – Jean Mendoza
4. Translating GWAC meeting summaries – Jean Mendoza

5. Healthcare provider survey – Jean Mendoza
6. EPO Expenditures– Lisa Freund

Next meeting Wednesday, December 4, at 1:30 PM, Yakima County Courthouse Room 419 (phone: 509-574-2353 [PIN# 2353#])

Education and Public Outreach Working Group

Charge from Groundwater Management Area Advisory Committee

None at this time.

Working Group Members

Andres Cervantes (GWAC-DOH), Jean Mendoza (GWAC-Friends of Toppenish Creek), Tom Tebb (GWAC-Ecology), Elizabeth Torres (Citizen), Gretchen Stewart (EPA), Nieves Negrete (Citizen), Patricia Newhouse (GWAC-Citizen Rep Position #2), Tom Eaton (GWAC-EPA), Dean Effler (Citizen), Joye Redfield-Wilder (Ecology), Wendell Hannigan (GWAC-Alternate), Stuart Turner (GWAC-Turner & Co)

Meetings/Calls Dates

Meeting: Wednesday, December 4, 2013 1:30 PM – 4:00 PM

Participants

Andres Cervantes (GWAC-DOH), Joye Redfield-Wilder (Ecology), Lisa Freund (EPO Chair -Yakima County), Karri Espinoza (Yakima County staff), Jean Mendoza (GWAC-Friends of Toppenish Creek), Patricia Newhouse (GWAC-Citizen Rep Position #2), *Ignacio Marquez (AGR), *Elizabeth Torres (Citizen), *Nieves Negrete (Citizen)

*via phone

Key Discussion Points

Welcome & Meeting Overview: Lisa Freund welcomed the group and presented an overview of the meeting agenda.

A discussion of EPO's involvement in the Irrigated Ag outreach to the producers and growers took place. Several Irrigated Ag members had discussed the possibility of EPO conducting a survey and providing outreach and education to the producers and growers. As the Irrigated Ag had to not made a formal request, it was remanded back to that group for further discussion and clarification via Jean Mendoza.

> **ACTION:** Joye Redfield-Wilder will inquire through Ecology whether the fruit grower community was invited to sit on the GWAC. Jean will clarify Irrigated Ag's "ask" of the EPO.

YHD Medical Rep on EPO: Andy spoke with Gordon Kelly at the Yakima Health District about YHD providing a medical representative to join the EPO group. Gordon doesn't feel this is possible at this time due to short staffing.

ACTION: No further action to find an additional representative from the medical field will be taken at this time. If advice is needed in the medical/health arena Andy will run it through Gordon Kelly.

WorkSource: No report at this time.

GWAC Talking Points Feedback: The EPO group reviewed the GWAC recommended changes to the general slide power-point presentation. The GWAC's specific recommendation was to remove references to "enforcement" activities. Changes to slide #10 have not yet been forwarded by the GWAC member who made the request; however, the EPO group suggested changing the word "enforcement" on the slide to "accountability." Changes to slide #11 were agreed to by the group. For easier reading, it was suggested that the orange font color be changed to a brighter color on all slides.

ACTION: Lisa will present the recommendations to the GWAC at its December 19th meeting for its approval.

Report Back On Radio Advertising: Ignacio Marquez reported that he got a quote from Adelante Media Group. He is also waiting for a quote from La Familia. He followed up with the Yakama Nation regarding a representative for the EPO group, he is waiting to hear back from Elizabeth Sanchey.

ACTION: Ignacio Marquez will forward the Adelante Media Group quote to the EPO group. Lisa Freund will check into what Yakima County is currently doing regarding advertisement to see if the EPO could piggy-back with the County to get a better rate. Joye Redfield-Wilder will check to see which English radio stations Ecology is currently doing business with.

Outreach for High Risk Well Assessment Survey: YHD has starting contacting the 45 households from the Public Questionnaire survey who expressed interest in a well assessment survey. Some households have agreed to participate; however, they have had some declines due to fear of consequences if they participate. One household started the survey and terminated it due to a question that was perceived as invasive (income question). The group discussed options for better educating the public on the pros of having this free testing of their wells.

ACTION: The group calendared the following action plan for outreach to the community.

Immediately:

- Develop and seek approval for the outreach campaign marketing Budget (Lisa F/Joye)
- Announce the survey and seek support at the Proyecto Bienestar meeting on December 11, 2013 (Lisa will make request of Chair Rand Elliott)

- Draft and finalize a Letter to Newspapers for Chair Rand Elliott's signature - by December 11. (Joye/Lisa F.)
- Edit and finalize the direct mail letter to the 600 households who will be invited to participate in the survey-by Dec 11 (Lisa will send draft letter to Joye Redfield-Wilder for edits)
- Draft, finalize and send out news release for area media-by Dec 16 (Lisa F.)
- Identify available spots on KDNA's January calendar for the one-hour public affairs program. Report back with available dates-by Dec 11 (Elizabeth Torres)
- Schedule KDNA public affairs date
- Draft PSAs- by Dec 11 (Joye)
- Draft church bulletin notice –by Dec 16 (assigned to Joye?)
- Outreach to churches (Patricia)
- Schedule KIT radio program – Bastinelli - *(Done. Rand is scheduled on Mike Bastinelli's program on December 23. He will discuss the survey (lf)*
- Resend radio ad quotes to the group (Ignacio)
- Launch PSA radio campaign-last week of December (Ignacio/Lisa)
- Participate in KDNA's public affairs program –Jan TBD. (Andy Cervantes)
- Mail postcard reminder to the 600 households -TBD

Week of December 9th: Due: PSA radio spots and pricing identification, proposed marketing budget, draft letter to newspapers, letter to 600 households, draft news release, and PSA text.

- Joye Redfield-Wilder will translate the key points in the letter into radio spots and church fliers

- Note: ALL EPO members are tasked with reviewing materials and returning comments by Monday, December 9 at 5:00 PM.

Week of December 16th: - Due: church fliers, PSA language and advertising budget to GWAC

- Distribute news release announcing survey.

Spanish Language Translation of GWAC meetings: Not addressed at this meeting due to the time-sensitive discussion of the risk assessment outreach campaign. Jean requested it be placed at the top of the January agenda.

New Mom Brochure: Not addressed at this meeting due to lack of time (see above).

Healthcare Provider Survey: Not addressed at this meeting. Lisa noted that Jean's concerns with the Yakima Health District have been remanded back to the GWAC, via Facilitator Penny Mabie. The EPO is not the appropriate body to address her concerns.

Website links and 4th quarter outreach opportunities: Not addressed at this meeting.

The meeting was adjourned at 4:00 PM.

Next meeting Wednesday, January 8, 2014 at 1:30 PM, Yakima County Courthouse Room 419 (phone: 509-574-2353 [PIN# 2353#])

Attachment B

- **Nutrient Loading Assessment for the Lower Yakima Valley GWMA**
- **Draft Deep Soil Sampling Plan – GWAC Review Version 1**
- **Draft Initial Best Management Practices Database Summary**

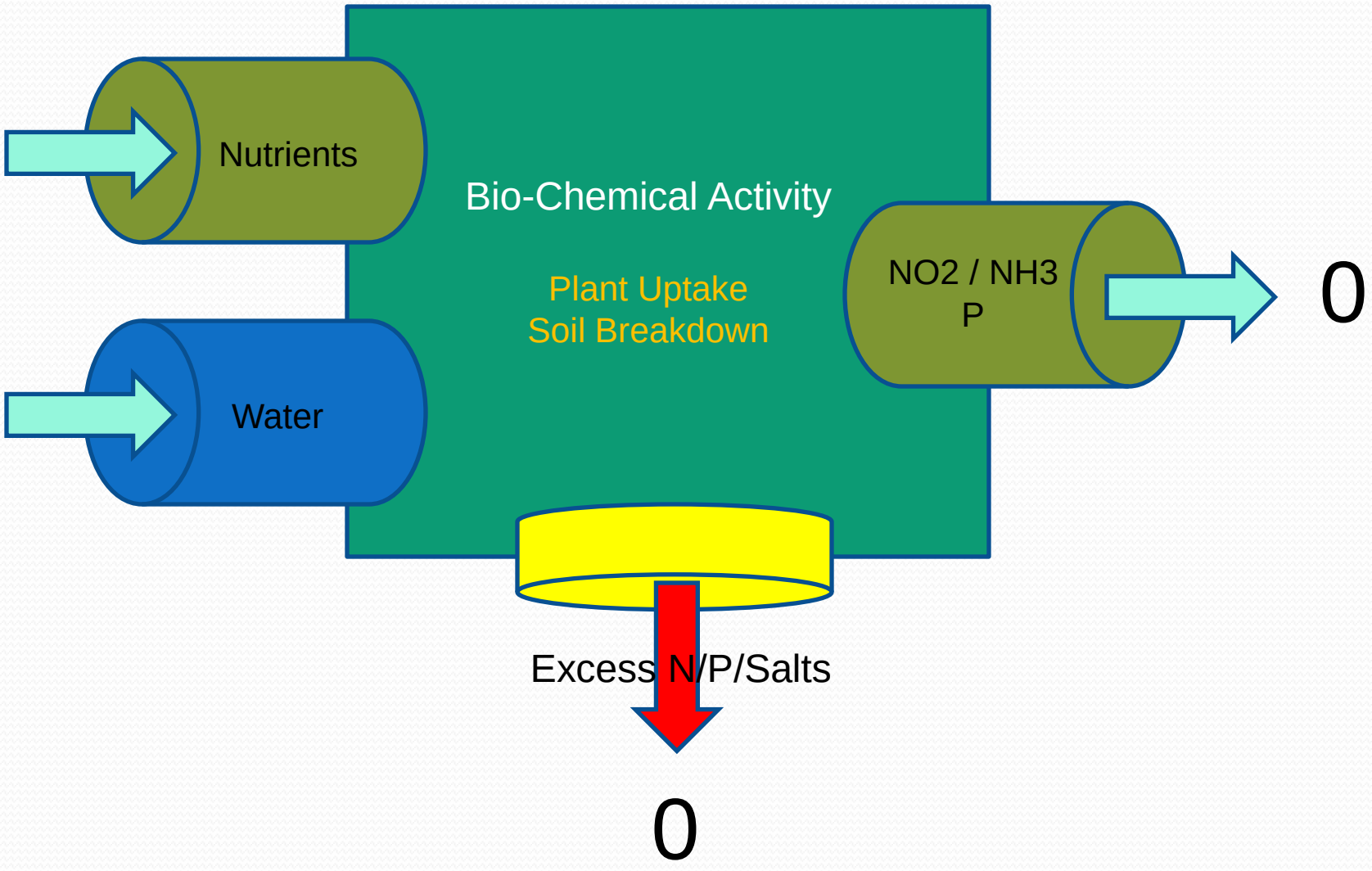
Nutrient Loading Assessment for the Lower Yakima Valley Groundwater Management Area

Concept Presentation
October 17, 2013

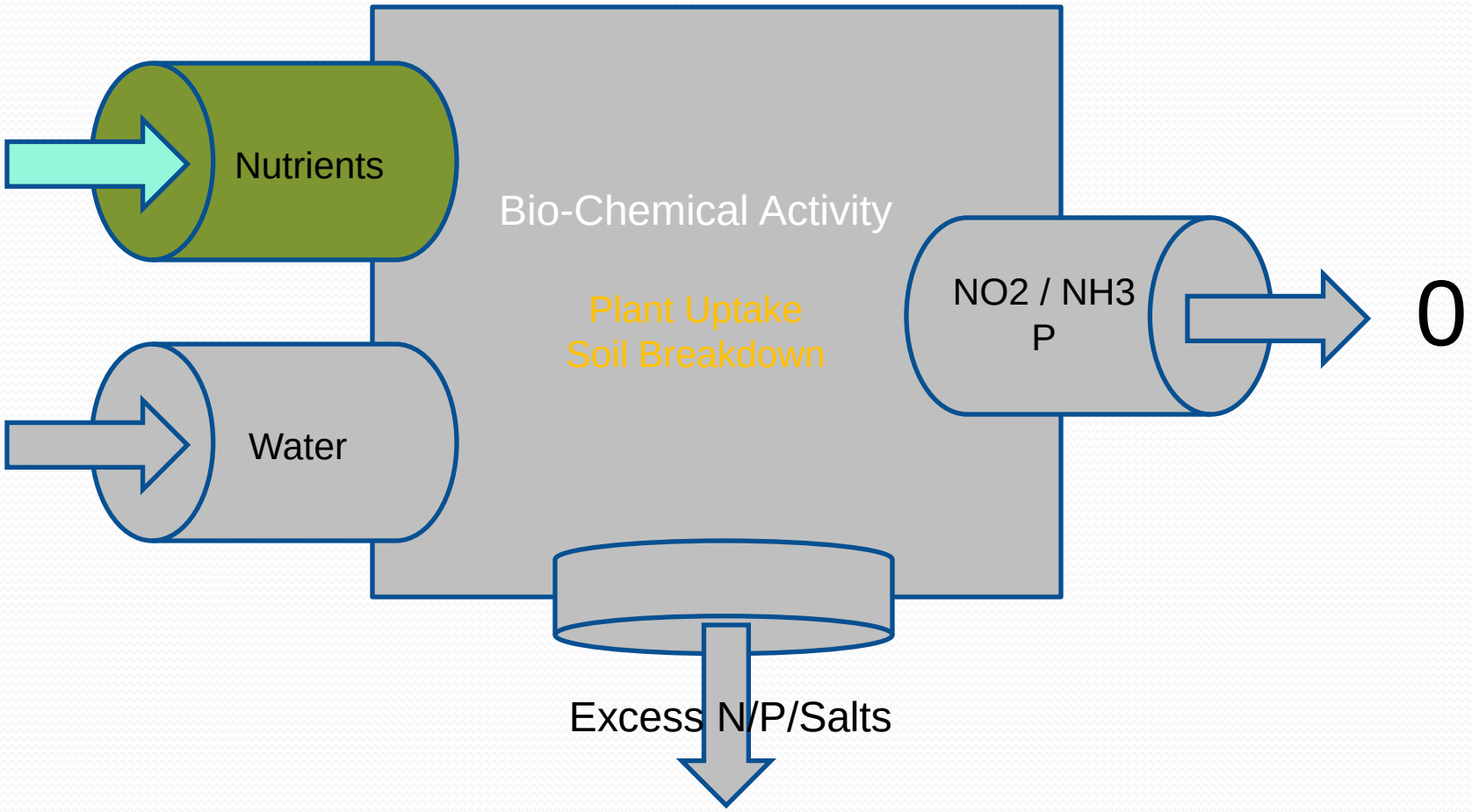
GWMA Advisory Board

Washington State Department of Agriculture
WSDA
100 YEARS

Basic Nutrient Loading Assessment



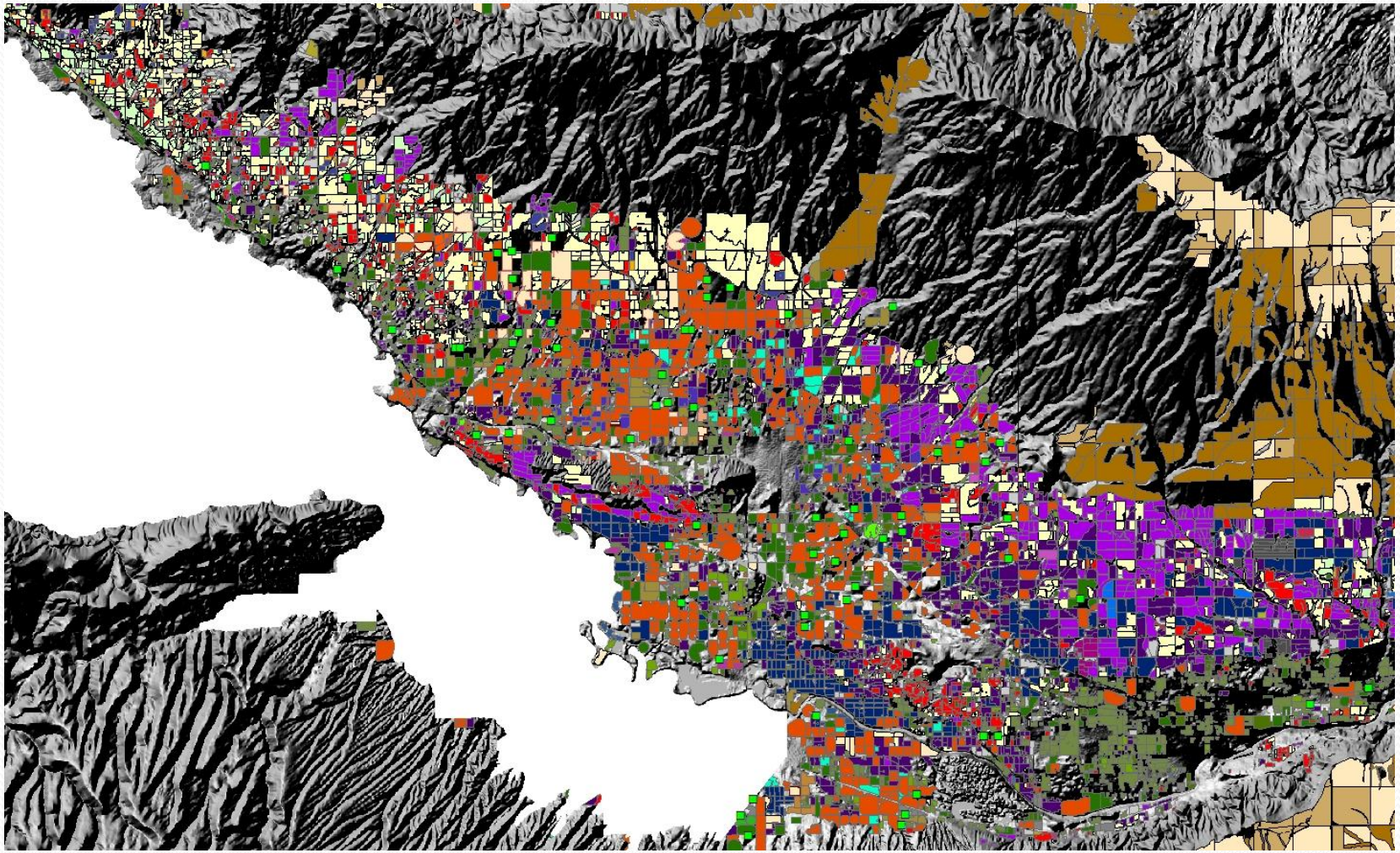
Basic Nutrient Loading Assessment



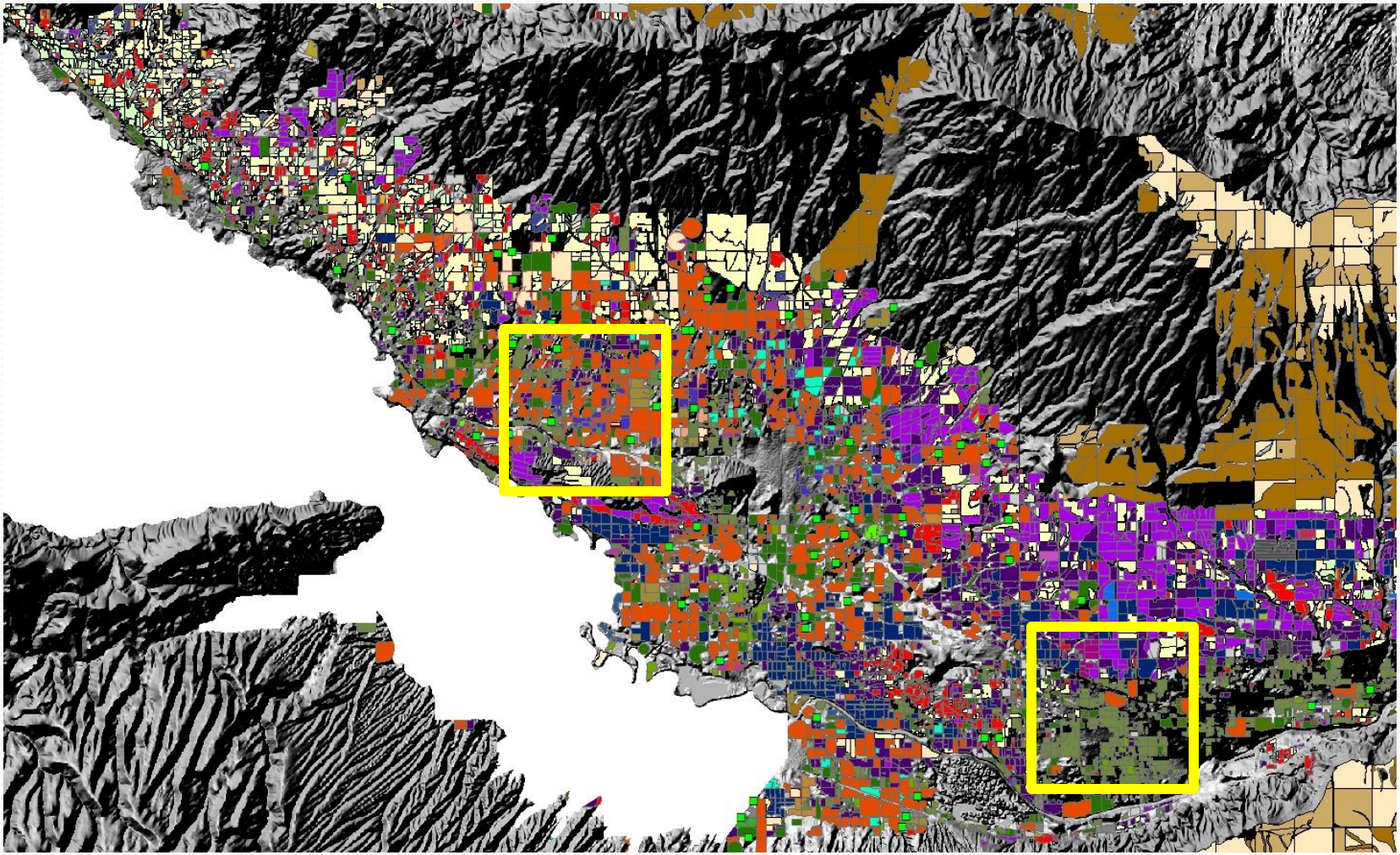
Basic Nutrient Loading Assessment

1) Where is application taking place ?
2) How much is being applied ?
3) When is it being applied
4) What form is the nutrient in ? (manure, comm., green manure)
5) What is the rate of uptake?
6) **What is the rate of loss, (soil, surface water, air)**

Basic Nutrient Loading Assessment



Basic Nutrient Loading Assessment



Basic Nutrient Loading Assessment

1) Where is application taking place ?

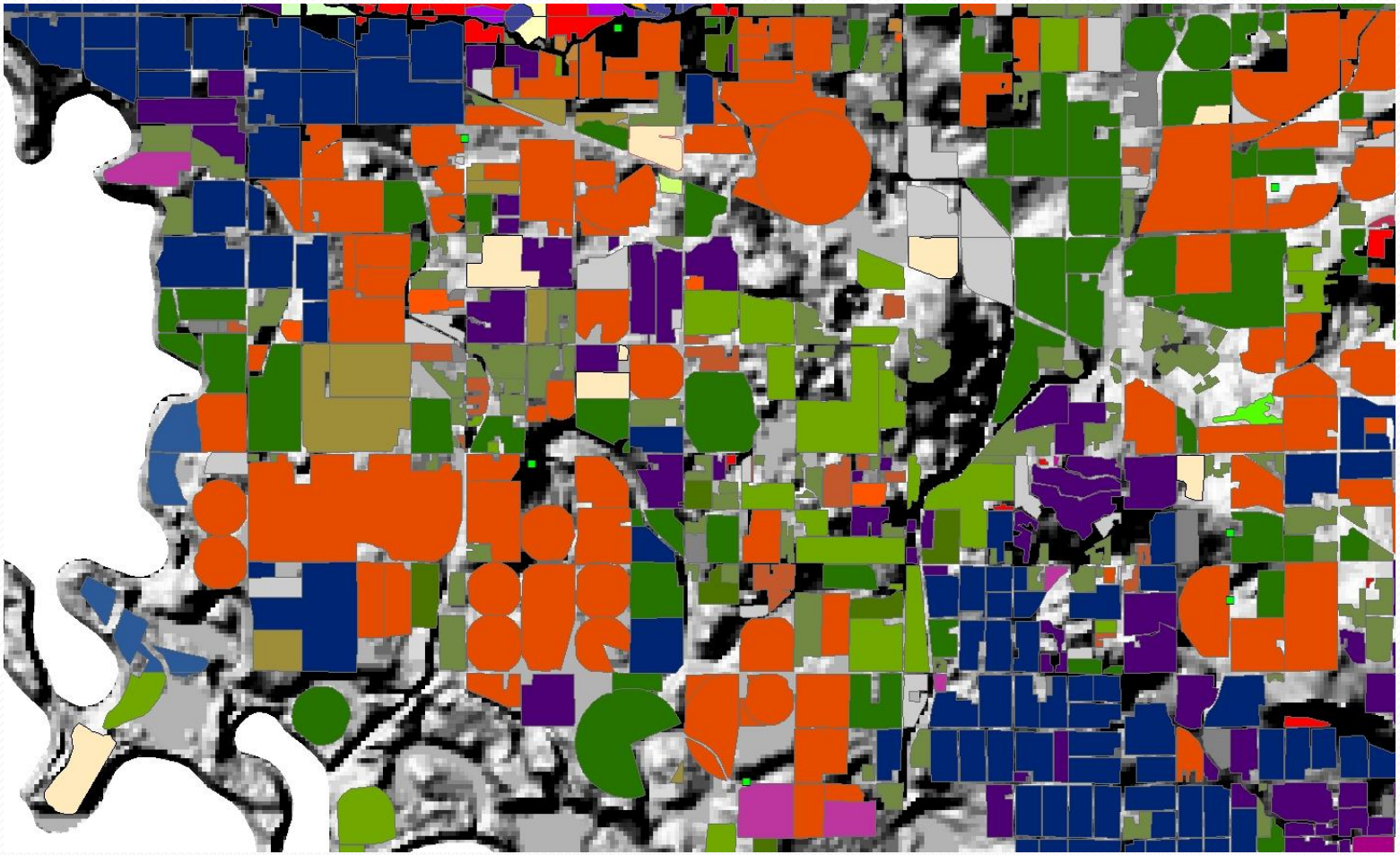
2) How much is being applied ?

3) When is it being applied

4) What form is the nutrient in ? (manure, comm., green manure)

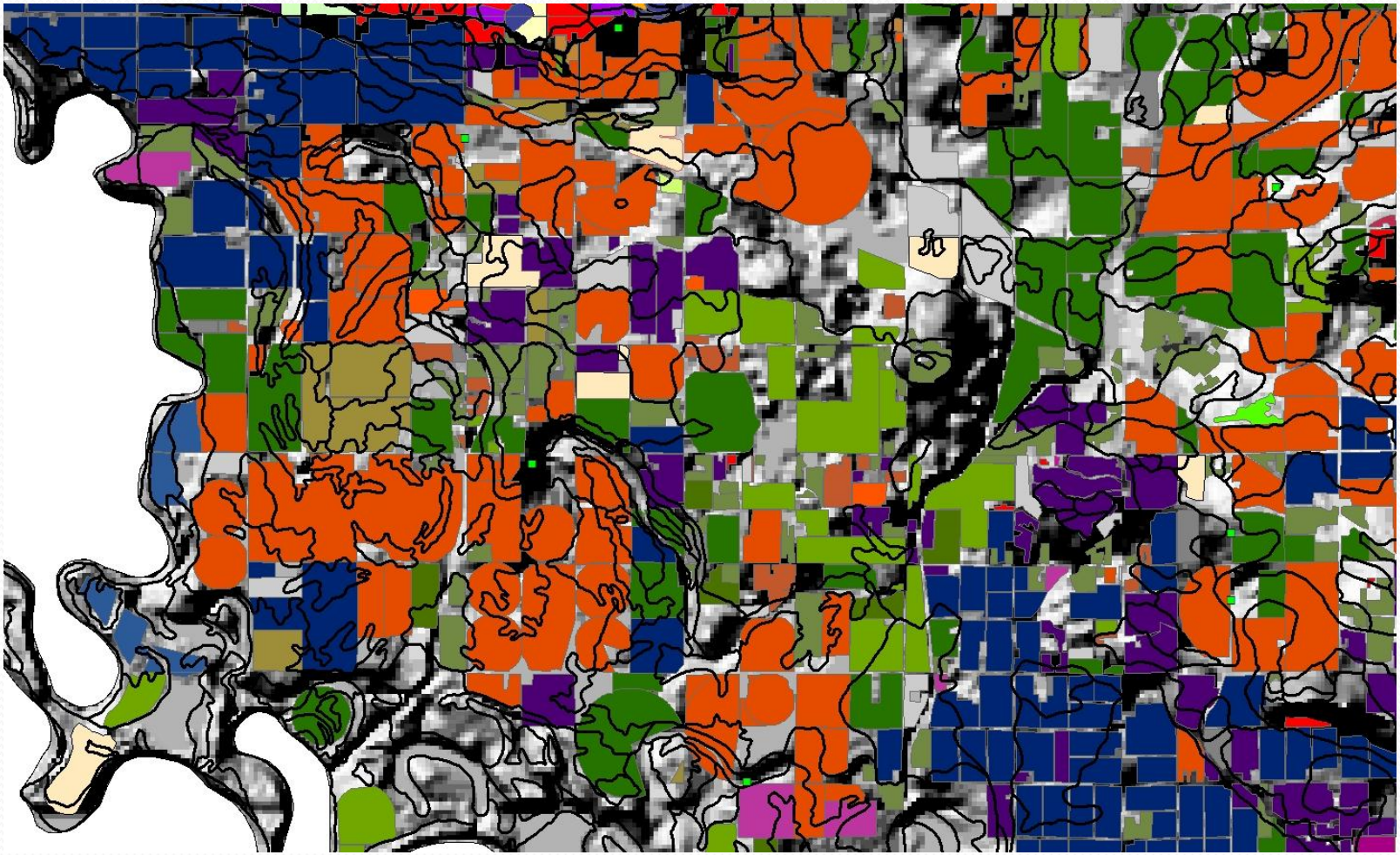
5) Data collected in representative areas – extrapolated over area of concern

Basic Nutrient Loading Assessment

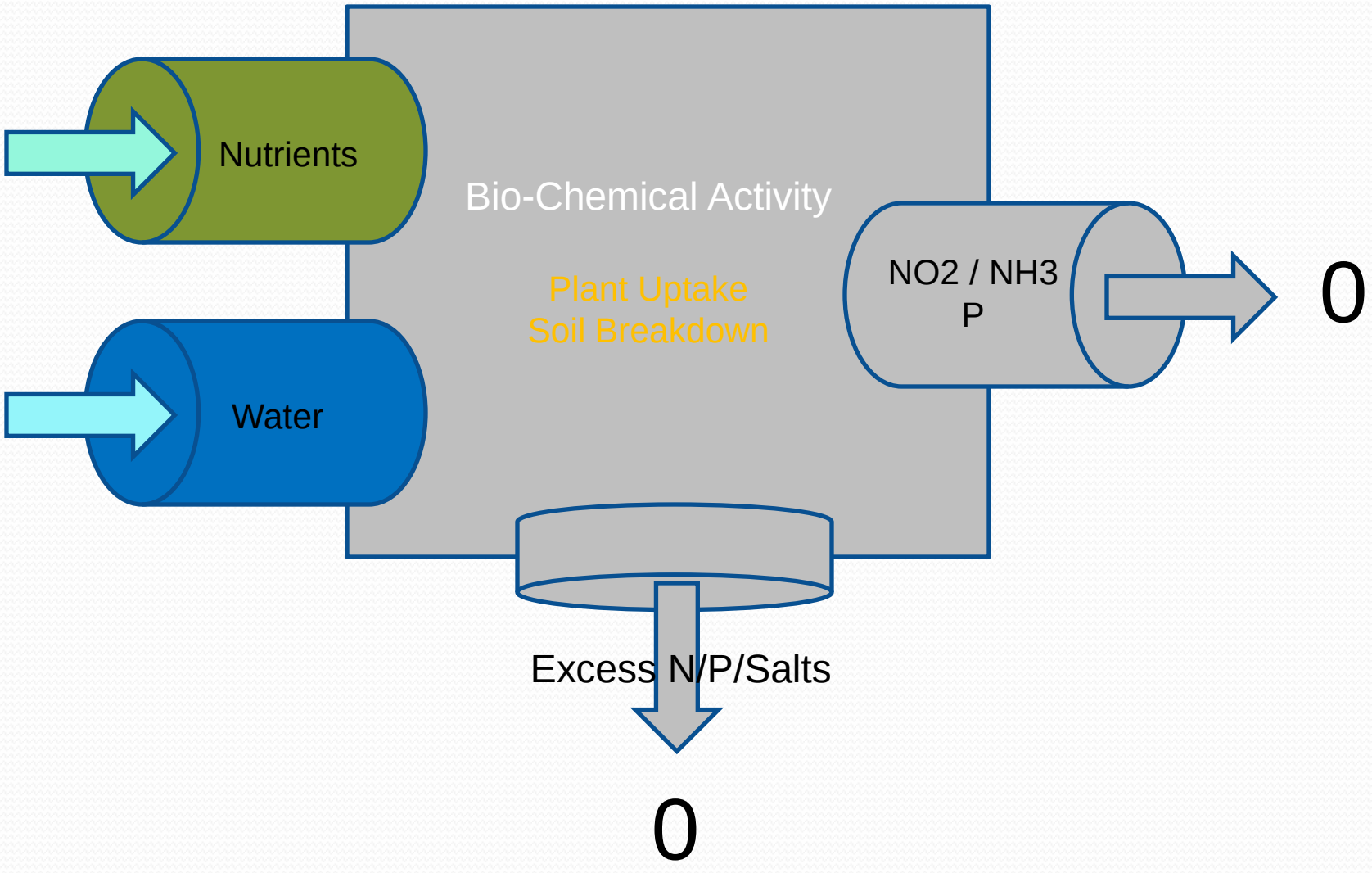


Basic Nutrient Loading Assessment

Crop Location & Soils



Basic Nutrient Loading Assessment



Basic Nutrient Loading Assessment

Irrigation / Soils

1) What is irrigation application (applied and rainfall) ?

2) Method of Irrigation ?

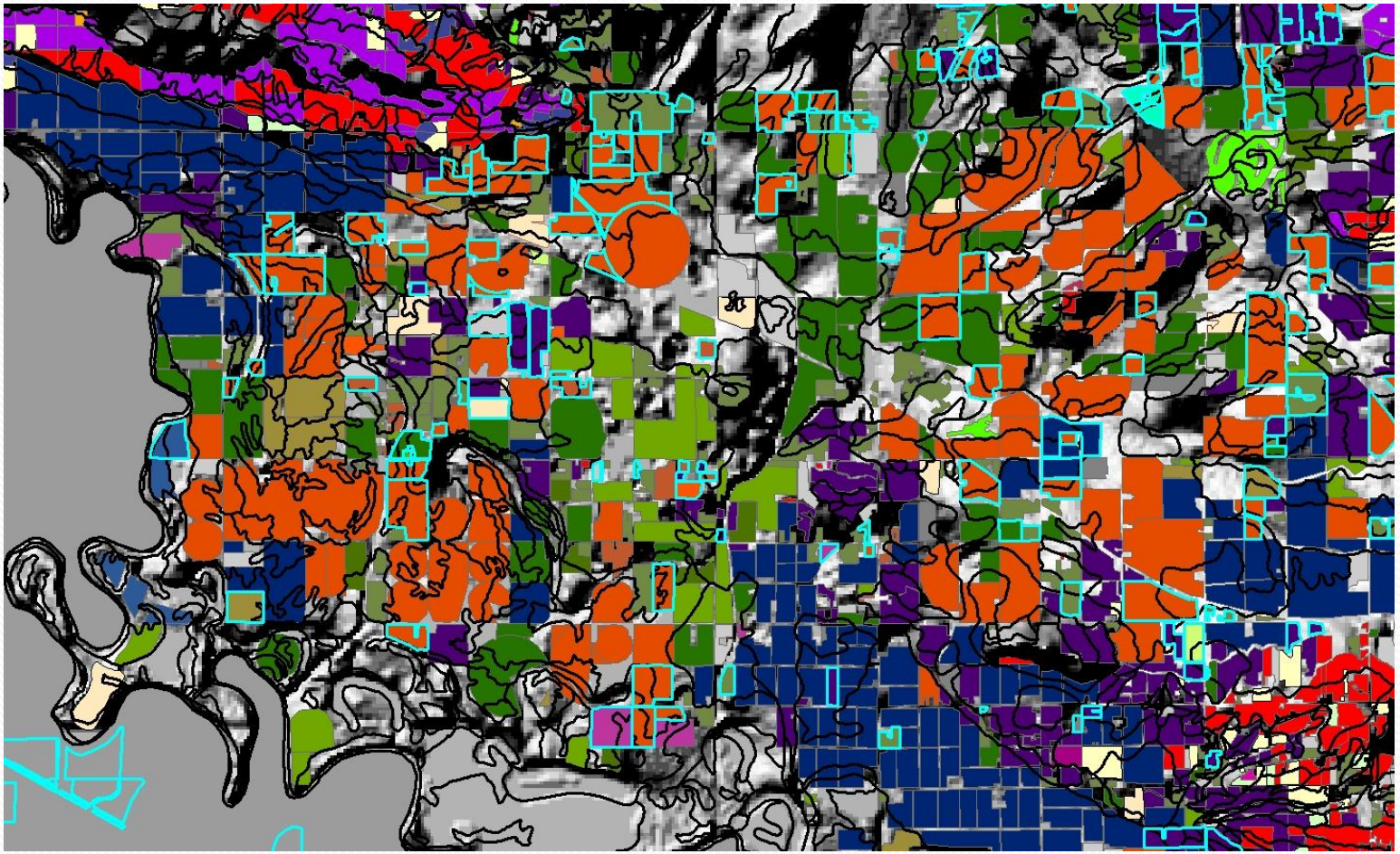
3) What are soil type(s) ?

4) What is irrigation recommendation (for crop)?

5) What is total (+ / -) to the crop system?

Basic Nutrient Loading Assessment

Crop Location / Soils / Irrigation



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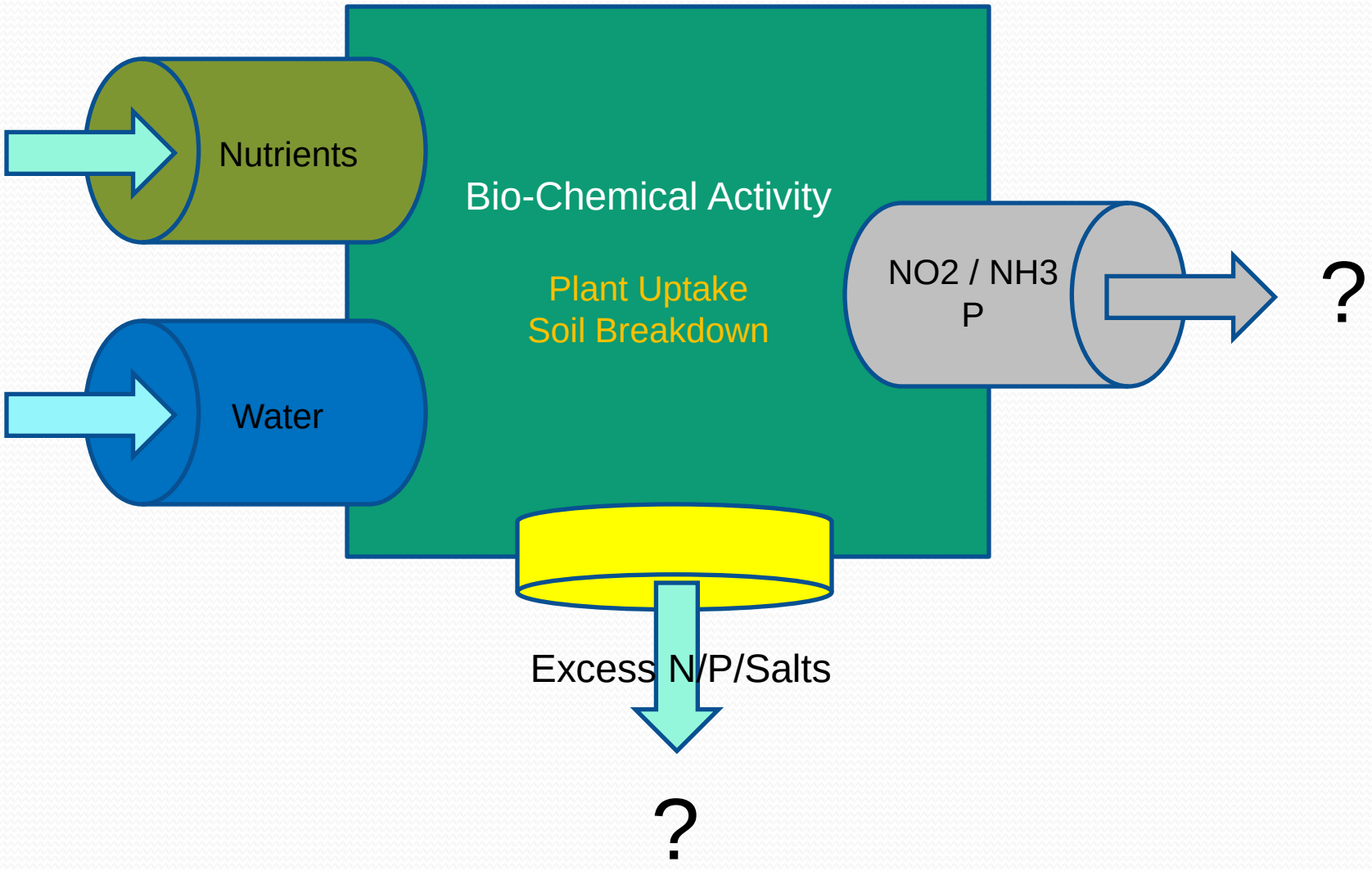
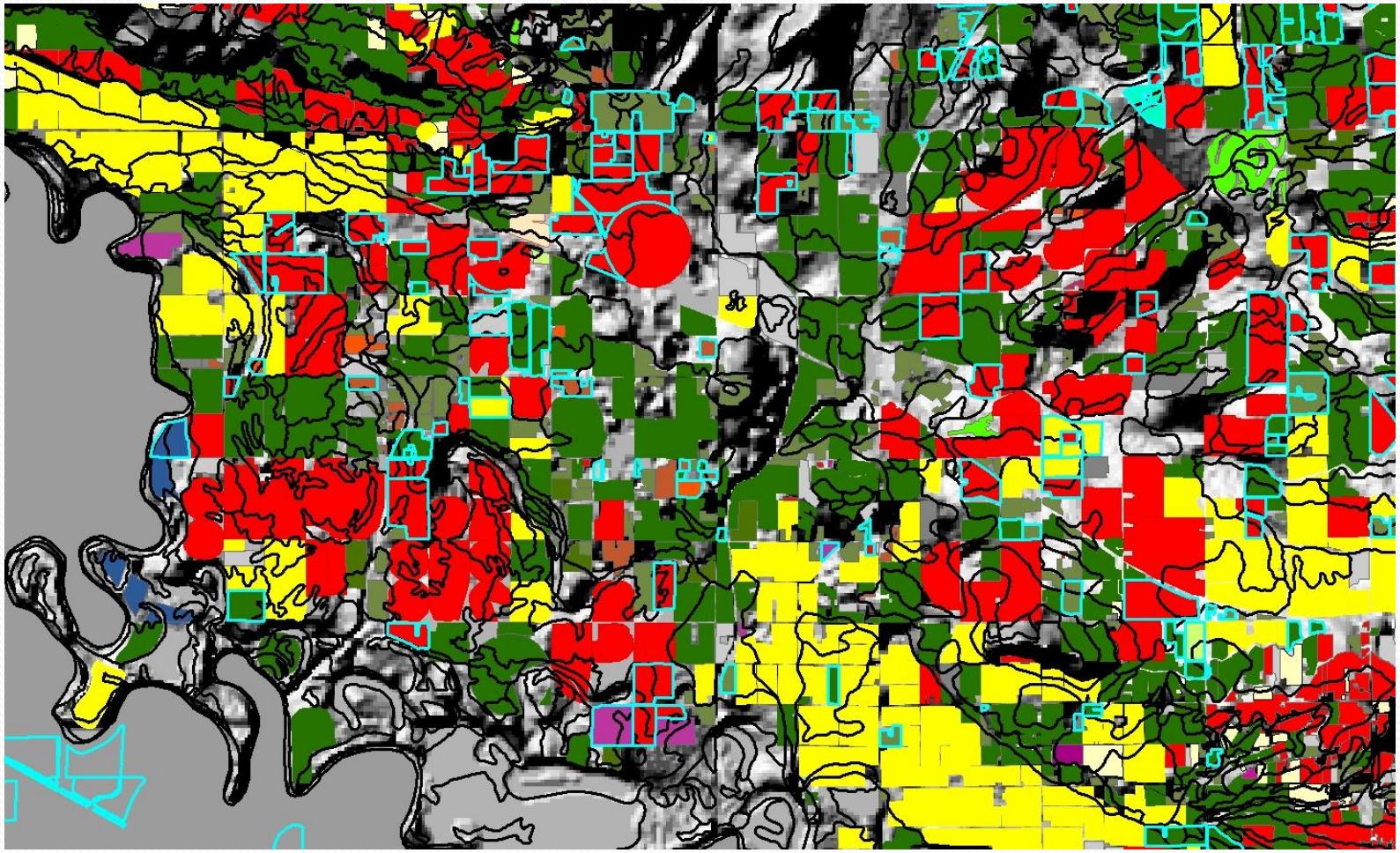


Basic Nutrient Loading Assessment

Relative Nutrient Load



Basic Nutrient Loading Assessment

Nutrient Load Assessment:

Will provide technically based accounting (est.) of all nutrient inputs

Will provide crop specific nutrient loading data

Will allow for loading estimates by agricultural activity

Will provide technically based assessment of loading to groundwater

Will provide measure as to whether we are overloading or under-loading crops and where that maybe occurring

Will provide additional basis for BMP selection

Will not provide for estimate related to groundwater concentrations in the future

Basic Nutrient Loading Assessment

Time:	3 – 4 months for basic data collection and analysis	
	2 – months to develop report to GWMA	
Cost:	Basic Level	$ 40 – 50 K
	Medium Level	$ 60 – 65 K
	High Level	$ 65 – 100 K
Basic:	Survey of crop types, nutrient application schedules, irrigation practices, three representative areas	
Medium:	(Basic), compare with DSS, five representative areas, soil type assessment	
High:	(Basic) (Medium), vadose zone monitoring, additional DSS	

DRAFT DEEP SOIL SAMPLING PLAN
LOWER YAKIMA VALLEY
GROUNDWATER MANAGEMENT AREA

October 3, 2013

DRAFT DEEP SOIL SAMPLING PLAN
LOWER YAKIMA VALLEY
GROUNDWATER MANAGEMENT AREA

Prepared for:

Lower Yakima Valley GWMA
Yakima County, Administrator

Prepared by:

Irrigated Agriculture Working Group

October 3, 2013
Deep Soil Sampling Plan-GWAC review version 1.docx

TABLE OF CONTENTS

FIGURES

ATTACHMENTS

1.0 INTRODUCTION

The GWMA project is a multi-agency, citizen-based, coordinated effort to reduce groundwater nitrate concentrations in the Lower Yakima Valley (LYV) to below Washington State drinking water standard. This project will identify activities contributing to nitrate groundwater contamination based on scientific data and evaluation.

Nitrate is added to soil by natural processes and human activities. Human activities include growing crops, and managing animal waste, human waste, and waste waters. Nitrate within the plant root zone may be utilized by the plants and if managed properly, leaching to groundwater can be minimized.

Nitrate in soil results primarily from land use at that location over time. Measuring deep soil nitrate may therefore help identify activities that contribute to nitrate groundwater contamination. Looking at nitrate concentrations in soil samples can provide relatively quick feedback on the effectiveness of changes to management practices designed to reduce groundwater contamination.

Initial deep soil sampling should be conducted for the purposes of:

1) Providing baseline data regarding the nitrogen content (nitrate, ammonium, and organic matter) of soils underlying a variety of soil, crop, and irrigation systems that represent a cross-section of agricultural activities.

2) Provide an initial assessment of current management practices in place today and in the past.

3) Provide information regarding availability of soil nitrogen to crops.

4) Provide the foundation for a technically based education program.

5) Provide information about project design, practical realities, time requirements and costs that can be used in developing subsequent project scopes.

This deep soil sampling may not be sufficient to address future technical questions that may arise during the course of data collection and assessment conducted by current and future consultants tasked by the LYV GWMA Executive Committee (GWAC).

This program will be conducted by South Yakima Conservation District (SYCD) and is summarized below.

1. Grower participation will be solicited by general mailings and outreach by SYCD and other participants of the GWAC.

2. To guide field selection, SYCD will use existing data, and work with the Irrigated Ag Workgroup, to identify risk of nitrate leaching posed by various soil/cropping/irrigation systems.

    a. SYCD will utilize the NRCS N-leaching-potential web tool to evaluate each field prior to final selection.

b. SYCD will select individual fields that will promote sampling across broad spectrum of field cropping systems, irrigation systems, and soil types in the Lower Yakima Valley.

c. SYCD will record pertinent management information including cropping systems, nitrogen sources and amounts, historical yields, irrigation type and amounts and application methods.

3. Soil sampling and analysis will begin in early 2014. Soil samples will be collected:

   a. After crop harvest but prior to nitrogen applications where possible. Recent crop, nutrient, and irrigation actions will be recorded.

   b. At 1-foot increments from 0 to a depth not exceeding 6 feet, or to the depth of refusal as basalt, gravel or caliche that define the limits of a shallower potential root zone.

   c. The top 0-1 foot sample will be analyzed for nitrate, ammonium and organic matter content. Samples at other depths will be analyzed for nitrate only.

4. Sampling and analysis will be performed by qualified firms contracted to SYCD. Funding to SYCD will be from the LYV GWMA budget.

5. The GWAC will retain technical data for analysis. Personal data (grower names, addresses, sample locations, etc) will be retained by the SYCD.

Deep soil sampling will be conducted initially for two years to collect baseline information. Deep soil sampling may be repeated in future years to allow analysis of the effects of changing management practices. The timing and budget of future sampling will be coordinated with the pace of change in nitrogen application and irrigation water management practices, as determined by the GWAC.

2.0 DEEP SOIL SAMPLING PROGRAM

2.1 PROJECT ADMINISTRATION

The program will be administered by SYCD under the direction of the GWAC and this plan. Attachment A contains contact information for key project personnel.

SYCD will perform the following tasks:

- Recruit growers for the sampling program with assistance from the GWAC.
- Screen proposed fields against budget and technical criteria, as described below in Section 2.2.
- Approve or deny fields proposed for sampling based on screening criteria.
- Assign a unique field number for approved fields.
- Obtain agreements from cooperating growers (Attachment B).

- Contract with firms to collect and analyze soil samples.
- Maintain records of sampling and analysis results.
- Record sampling data, analytical results, and quality assurance/quality control (QA/QC) results in a computer database (database design provided by GWMA).
- Report to the GWAC.

2.2 SELECTION OF SAMPLING SITES

Sampling sites will be proposed by growers and approved or denied by SYCD using the methods described below. The goal in field selection will be to involve as many growers and field conditions as possible for the established budget.

2.2.1 GIS Mapping of Fields

To the extent possible using existing data available in a GIS format, the GWMA project will generate a set of GIS coverages that provide field boundary, nitrate leaching potential (NRCS web tool approach), crop, and irrigation method for each irrigated field or pasture within the GWMA. Dry-land agriculture fields and pastures will not be included or sampled. The categories of fields defined by similar leaching potential, crop, and irrigation conditions will be ranked by acreage within the GWMA. The number of fields to be sampled within each category will be determined by the GWMA with the categories representing the most acreage receiving the highest allocation. Categories representing small acreage within the GWMA may not be sampled at all. SYCD may also set aside a portion of the sampling budget for categories representing high risk of nitrate leaching to groundwater, regardless of acreage. Attachment C provides further description of this process and examples of the number of fields that would be sampled assuming various numbers of categories and sampling targets.

A summary of the number of fields to be sampled within each field category will be available to SYCD in preparation for approving or denying fields. This work should be completed in 2015.

2.2.2 Outreach to Growers

Grower participation will be solicited by general mailings and outreach by SYCD and others participating in the GWAC. Growers will be encouraged to propose fields for sampling by contacting SYCD. In preparation for sampling starting in February 2014, outreach should occur in January 2014 or sooner.

2.2.3 Screening of Proposed Fields

SYCD will use the following criteria to approve or deny proposed fields:

1. A cooperating grower must acknowledge agreement with this plan by signing the Grower Agreement Form (Attachment B).
2. Fields will be approved for sampling until target allocations for each field category are reached. In addition, SYCD will utilize the NRCS nitrate leaching potential tool (a risk assessment tool in the NRCS WebSoil Data Mart) to evaluate each field prior to final selection.

3. Available approved budget for soil sampling throughout the GWMA for that season must not be exceeded.

2.2.4 Sites Identified by Other GWAC Work Groups

Sites other than irrigated agricultural fields may be sampled using the methods of this plan. Such sites may be proposed by the RCIM (residential-commercial-industrial-municipal) or Livestock-CAFO work groups. For application to sites other than agricultural fields, the method should be reviewed and modified if necessary to conform to site conditions. For instance:

- The number of boreholes and the radius within which boreholes are drilled may need to be reduced if a site with a small footprint is investigated.
- The depth of sampling should be coordinated around land cover, and water and waste management specific to the site.
- Analytes should be reviewed.

If the RCIM and Livestock-CAFO work groups propose sites for sampling, they will produce addenda to this plan indicating the sampling sites and necessary modifications to methods. Sites should be proposed prior to SYCD contracting for the work.

2.3 SAMPLING REQUIREMENTS

2.3.1 Expected Variability

The LYV GWAC understands that it would be cost prohibitive to characterize each field to a level of detail necessary to identify all the variability within a field or to accurately quantify field-level leaching estimates. Sampling sites will therefore be selected to measure effects of management practices for the predominant field conditions. The GWAC will evaluate the deep soil sampling program to determine whether the sample requirements and evaluation criteria should be modified during future sampling events.

Generic Variability: Generic conditions exist which create variability in all fields. Examples include field border effects, cultivation patterns, and position relative to an irrigation system. Figures 1 through 12 provide sampling schemes to be used for common field conditions that will be encountered by the program[1]. These figures provide minimum setback distances to avoid field border and cultivation effects. They also suggest sampling locations and transect directions relative to irrigation systems so that known differences in irrigation uniformity can be avoided or incorporated appropriately.

Field Specific Variability: Factors that cause field specific variability include soil type, topography, and management practices. Selecting a sample site with relatively uniform conditions will be the responsibility of the grower. While resources are available to aid the grower, most growers have intimate knowledge of their fields and are best suited to select the locations of average field conditions.

[1] Figures 3 and 4 apply to dryland sites which are not currently proposed for sampling. These figures are included for possible future reference.

2.3.2 Definitions

Based on the discussion above and for use in this document, the following definitions have been developed.

Sampling Setbacks: Those areas of the field that are automatically determined to be not representative of the average field condition and therefore inappropriate for sampling (Figures 1 – 12). Examples include field borders, first span of a center pivot, and known lap areas.

Sampling Zone: The field area available for sampling after the setbacks described in Figures 1 - 12 are taken into account.

Sampling Site: A sixty-foot diameter circle within the Sampling Zone where samples will be collected from four boreholes. The same sampling site will be used year-to-year if possible.

Borehole: A borehole where discrete soil samples are collected to contribute to the composite samples. Boreholes may be advanced by any method capable of collecting discrete samples over 1-ft intervals – mechanized sampling devices are recommended.

Discrete Sample: A soil sample from a borehole, prior to compositing.

Composited One-foot Sample: The soil sample that will be analyzed to represent concentrations in a given one-foot depth increment within a sampling site. This soil will come from a composite mixture of discrete samples from the same depth from all four boreholes.

2.3.3 Sampling Method Requirements

Samplers and laboratories will be contracted by SYCD to perform the field and laboratory work. SYCD will establish terms of the contract including minimum qualifications. The contracts will reference this plan as the basis for sampling and analysis requirements.

Samples will be collected within a 60 foot diameter sampling site identified by the grower in conjunction with the sampler. The latitude and longitude at the center of the sampling site will be measured with a global positioning system device (GPS) provided by the sampler. The sampler will provide the coordinates to the grower for future reference. Latitude and longitude coordinates will be based on the datum WGS84 and recorded in decimal degrees. A minimum of four boreholes are required. A mechanized sampling tool (eg: Giddings, AMS, GeoProbe) is recommended that can collect soil from discrete one-foot increments to a depth of 6 feet below ground. The pattern and location of the boreholes within the sample site will be conducted per the guidelines found in Figures 1 - 12. Attachment D is a Soil Sample Field Form to be filled out by the sampler during field work. Portions of the sampling tools that contact soil must be cleaned between sample runs to minimize cross contamination of samples.

The soil from each borehole will be collected at one foot increments and placed temporarily in clean plastic buckets at the field site until composite mixing occurs. Each discrete soil sample will be described by the sampler in terms of consistency, moisture content, color, grain size, and other observations such as odor. The sampler will record soil descriptions on Boring Logs (Attachment F). The Boring Logs and Soil Sample Field Forms will be returned to the SYCD by the sampler.

Boreholes will be advanced to a maximum depth of 6 feet or until refusal, whichever is shallower. If boreholes terminate at different depths, composite samples will be created by compositing available discrete samples (which may number less than four). During boring and soil collection, care should be taken to avoid mixing the soil from discrete one-foot depth increments with soils from shallower or deeper depths.

After all boreholes have been dug and the soil from each individual depth increment has been placed in the plastic buckets, the soil will be mixed thoroughly in the bucket to form a composite one-foot sample. After compositing, a portion of soil in each quadrant of the bucket will be transferred to a lab-prepared sample container. Tools used to mix and transfer samples must be clean to minimize cross contamination of samples.

2.3.4 Safety and Liability

Because of the proposed sample depths, samplers should use mechanized sampling equipment, which is inherently dangerous. In addition to physical hazards of the equipment itself, there is the potential to intersect power and other utility lines that may lie above or beneath a sampling site.

The sampler must call the utility notification center (information at http://www.callbeforeyoudig.org) and allow sufficient time for response prior to field work. The grower must identify and note the existence of grower's private utilities during orientation with SYCD and flag/stake those underground utilities in the field that are within the agreed sample site.

Responsibility for personnel safety will reside with the sampling company.

The GWMA project will assume no liability for damage to property of the cooperating grower. SYCD will carry liability insurance and name GWMA as an additional insured. Property damage caused by negligence on the part of the sampler will be repaired by the sampler. The grower will sign a statement releasing SYCD from liability for damages resulting from the sampling program.

2.3.5 Sampling Schedule

Each sampling site will be sampled for baseline purposes once, unless additional soil sampling is requested based on review of data by GWMA workgroups.

When possible, samples will be collected after crop harvest but prior to any nitrogen amendments. Recent crop, nutrient, and irrigation actions will be recorded by SYCD.

2.3.6 Handling and Custody

A Soil Sample Field Form (Attachment D) will be filled-out by the sampler for each site. The unique field number will be assigned by the SYCD and the unique sample identification will consist of a sample date and a combined number consisting of the field number and depth in feet (eg: "695-01"). Grower personal information should not be included on the Soil Sample Field Form, Boring Logs, or sample container labels.

The information shown on the example sample label below must be placed on each sample container. Laboratory-supplied labels with equivalent information content are acceptable.

EXAMPLE LABEL		
Sample Date: *08/29/2013*	Sample Time: *13:10*	Sampler: *KNJ*
Sample Number (Field No. and depth): *695-01*		
Analyses Requested: *Nitrate-N, Ammonium-N, OM*		

Soil samples will be delivered by contracted samplers to contracted commercial laboratories. For delivery to the lab, samples shall be placed in a cooler with reusable ice substitutes or with ice. If ice is used, sample containers must be placed inside a waterproof bag to prevent contact with melting ice. At no time shall the sampler store samples for more than 48 hours. Samplers may dry samples using methods acceptable to the laboratories and consistent with analytical methods. If the laboratory cannot analyze the sample within 48 hours of sample collection the laboratory must preserve the samples by methods acceptable for the analytical method and standard practice.

The sampler and lab must complete a Chain of Custody form for each batch of samples delivered. The COC must contain the Date, Time, Sampler Name, Field number, and Sample Depth for each sample submitted. The sampler relinquishing the samples and the laboratory receiving the samples must sign the COC. The "owner" and "client" information on the COC shall be the SYCD, not the grower.

2.4 ANALYTICAL METHODS

The following analytes are required for this program.

- nitrate-nitrogen
- ammonium-nitrogen
- organic matter

The sample from the upper one-foot will be analyzed for all three analytes. Other samples will be analyzed solely for nitrate-nitrogen. The following subsections specify the laboratory analysis methods.

SYCD will contract with one or more laboratories to perform the work. Only laboratories that participate in the North American Laboratory Proficiency Testing Program (NAPT) and NAPT's Proficiency Assessment Program (PAP) for the methods listed in this plan will be eligible.

The laboratory shall be instructed to report nitrate concentrations in parts per million (ppm) or milligrams per kilogram (mg/kg) and as pounds per acre (lbs/acre) for each one-foot layer. All reporting values shall be on a dry weight basis. Laboratories shall report assumptions used in conversion from ppm (mg/Kg) to lbs/acre.

The analytical lab report (including QA/QC results) will be submitted to SYCD within three weeks from the date of the analysis. The lab report must indicate the date and time of the analysis for each sample.

2.4.1 Nitrate-Nitrogen

Either of the two analytical methods below are acceptable for measuring nitrate-nitrogen.

Method: Cadmium Reduction

Reporting limit: 1 mg/Kg or lower

Method Reference: Cadmium Reduction Method, S-3.10, Western States Laboratory Proficiency Testing Program: Soil and Plant Analytical Methods, 3rd Edition, 2005, From: Plant, Soil, and Water Reference Methods for the Western Region. 1994, R.G: Gavlak, D.A. Horneck, and R.O. Miller, WREP 125.

Method: Automated Cadmium Reduction (with extraction step added for application to soil samples)

Reporting Limit: 1 mg/Kg or lower

Method Reference: 4500-NO3. F, 1987. Annual Book of ASTM Standards, Vol. 11.01. American Soc. Testing & Materials, Philadelphia, Pa.

2.4.2 Ammonium-Nitrogen

Method: KCL Extraction / Exchangeable ammonium

Reporting Limit: 1 mg/Kg or lower

Method Reference: KCL Extraction / Exchangeable ammonium Method; S-3.50; Western States Laboratory Proficiency Testing Program: Soil and Plant Analytical Methods, 3rd Edition, 2005, From: Plant, Soil, and Water Reference Methods for the Western Region. 1994, R.G: Gavlak, D.A. Horneck, and R.O. Miller, WREP 125.

2.4.3 Organic Matter

Method: Walkley-Black Titration

Reporting Limit: 0.1 percent

Method Reference: Walkley-Black ; S-9.10; Western States Laboratory Proficiency Testing Program: Soil and Plant Analytical Methods, 3rd Edition, 2005, From: Plant, Soil, and Water Reference Methods for the Western Region. 1994, R.G: Gavlak, D.A. Horneck, and R.O. Miller, WREP 125.

2.5 QUALITY CONTROL AND DATA QUALITY OBJECTIVES

Adherence to this plan will maintain quality control for the project. Quality assurance samples shall be analyzed and the results reported to SYCD. The SYCD contract with samplers and laboratories will allow for the GWMA project to discuss results with the samplers and laboratories to determine the cause of problems and arrange for changes in procedure to achieve the data quality objectives.

Laboratories shall perform laboratory blank measurements, calibration measurements, method detection limit determinations, duplicate analyses and performance evaluation samples according to standard laboratory and method-specific procedures. In addition, SYCD will submit performance evaluation samples to the labs. Quality assurance data must be reported with each analytical report submitted to SYCD.

2.5.1 Quality Control Requirements

2.5.1.1 Instrument and Equipment Testing, Inspection, Calibration, and Maintenance

The participating laboratories will follow their standard operating procedures for maintenance and calibration of instruments or systems used for this project. The frequency of calibration will also be consistent with their standard operating procedures.

2.5.1.2 Inspection/Acceptance of Supplies and Consumables

Soil sampling tools shall be supplied by the participating samplers and they will assure the tools are clean and in proper operating condition. Laboratories will inspect and accept supplies per their standard operating procedures. Samplers will obtain sampling containers from the participating laboratories. Samplers shall only accept new (not used) sample containers that are clean.

2.5.1.3 Data to Support Repeat Sampling

To promote consistency and avoid confusion where sites are sampled repeatedly, the Soil Sample Field Form previously filled-out for a sampling site/year shall be retained by SYCD for sampling in subsequent years. In addition, SYCD shall retain, as part of the Farm Plan, prior forms and the latitude and longitude of sampling sites so that the same sites can be revisited. Samplers shall fill out new Soil Sample Field Forms while referencing prior Forms. Sample-related data (eg: field number, site location) shall be exactly the same between forms where appropriate. Where differences are necessary (location change, prior error, irrigation system change, crop change, etc), samplers shall clearly indicate a change in condition on the new Soil Sample Field Form.

2.5.1.4 Specialized training

Labs and sampling firms are responsible for providing personnel who are qualified to perform the work.

2.5.2 Quality Control Samples and Data Quality Objectives

Requirements to assess accuracy, representativeness, comparability and completeness are summarized below. Data Quality Objectives (DQOs) have been established to help the GWMA project meet its overall objectives. Project DQOs may be revised by GWAC approval in the future.

2.5.2.1 Accuracy

Accuracy is a measure of confidence that describes how close a measurement is to its "true" value. In this program, accuracy will be measured by analysis of performance evaluation (PE) samples provided by a third party and by evaluation of internal lab control samples where such samples are standard to the lab practice.

PE samples (soil with known nitrate concentration) will be obtained by SYCD and submitted blind to prospective laboratories prior to contracting with SYCD. These samples will be obtained from a source used by the North American Laboratory Proficiency Testing program. Two concentrations of PE samples will be used and will represent medium (10-15 mg/kg) and high (>50 mg/kg) soil nitrate values. In addition, SYCD will provide each contracted laboratory blind samples from the medium

and high PE samples at least twice during the project time period each year. The RPD between the known value and the reported value from each laboratory will be calculated. A RPD of 20% will be acceptable for this project. If the Relative Percent Difference (RPD) for individual laboratories regularly falls outside this range, the GMWA project will take corrective action which may include denying the laboratory further participation in the GWMA program.

2.5.2.2 Representativeness

Representativeness is the degree to which data from the project accurately represent a particular characteristic of the environmental matrix which is being tested. Representativeness of samples is ensured by adherence to the field sampling protocols and standard laboratory protocols. The design of the sampling scheme and number of samples should provide a representativeness of the soil matrix being sampled.

2.5.2.3 Comparability

Comparability is the degree to which data can be compared directly to similar studies. Using standardized sampling, analytical methods and units of reporting with comparable sensitivity helps ensure comparability. The GWMA project is using sampling and analysis methods that are currently being employed by the agricultural industry for nutrient management decisions. The Columbia Basin Deep Soil Sampling Program was conducted using similar procedures.

2.5.2.4 Completeness

Completeness is the percentage of valid results obtained compared to the total number of samples taken for a parameter. A complete or valid result will include full completion of the Sampling Form, Boring Logs, and a laboratory analysis report. Percent completeness may be calculated using the following formula. A DQO of 80% is established for this parameter.

$$\%\ Completeness = \frac{\#\ of\ valid\ results}{\#\ of\ samples\ taken} \text{X } 100$$

2.6 INFORMATION MANAGEMENT

2.6.1 Soil Sampling

Documentation of field and laboratory work for each soil sampling site will consist of submittal of the following documents to SYCD:

- A completed Soil Sample Field Form
- Completed Boring Logs
- A completed Chain of Custody Form
- A copy of the analytical results, including QA/QC results

Forms shall be submitted to the SYCD who will retain the minimum records necessary for technical analysis of the data, documentation to facilitate repeat sampling, and possible audit of financial data.

2.6.2 Data Report to Cooperating Grower

SYCD will provide the cooperating grower copies of the documents listed in section 2.6.1 above (for their field).

2.6.3 Computerization of Technical Information

SYCD will enter sample and analytical data into a computer database. The GWMA project will provide the SYCD the database entry form. Computerized data will include technical data necessary for interpretation of the results by the GWMA project. Such data will include sample ID; sampling date; nitrate, ammonium, and OM concentrations; and depth; field information including nitrogen sources and amounts, historical yields, and irrigation amounts. The sampling and analytical data will be linked to the soil type, nitrate leaching potential (per NRCS), irrigation type, crop, and other data provided by the grower and recorded by SYCD. SYCD will provide the GWMA the computer database within 90 days of the close of the sampling season (eg: by mid August assuming a mid-May end of sampling season).

2.6.4 Protection of Personal Information

To encourage full participation, SYCD will not release personal information (name, address, phone, field and sample locations) obtained from growers and will retain for its internal records only that data necessary to facilitate repeat sampling of sites and possible audit of financial records. Such information will be part of the Farm Plan exempted from Public Disclosure Laws pursuant to RCW 42.56.270.

3.0 TARGETED SAMPLING

Analysis of initial Deep Soil Sampling data collected in early 2014 will likely reveal uneven coverage of geographic areas, soil types, crop types, irrigation types, and nitrogen sources. Uneven coverage is expected and may be acceptable; however, extreme bias or uneven coverage could jeopardize fulfillment of GWMA project goals. The GWMA project will analyze distribution of the 2014 data across the field conditions, and identify possible unacceptable bias or gaps in coverage. If unacceptable bias or gaps are present, the GWMA project will reach-out to growers in uncovered areas and request participation in the deep soil sampling program. Outreach should occur in winter of 2014-15, and sampling to fill data gaps will occur in early 2015.

Targeted sampling may also include sampling of the following sites not accessible through the 2014 program. Note these locations may involve locations that are not irrigated agricultural fields, and would be identified through work of appropriate GWMA subcommittees (eg: livestock-CAFO or residential-commercial-industrial-municipal).

- control sites without intentional nitrogen application
- industrial and commercial sites managing nitrogen fertilizers or wastes
- point sources of possible nitrogen contamination
- private fields in close proximity to wells

FIGURES

Figure 1. Sampling scheme for center pivot irrigation system.

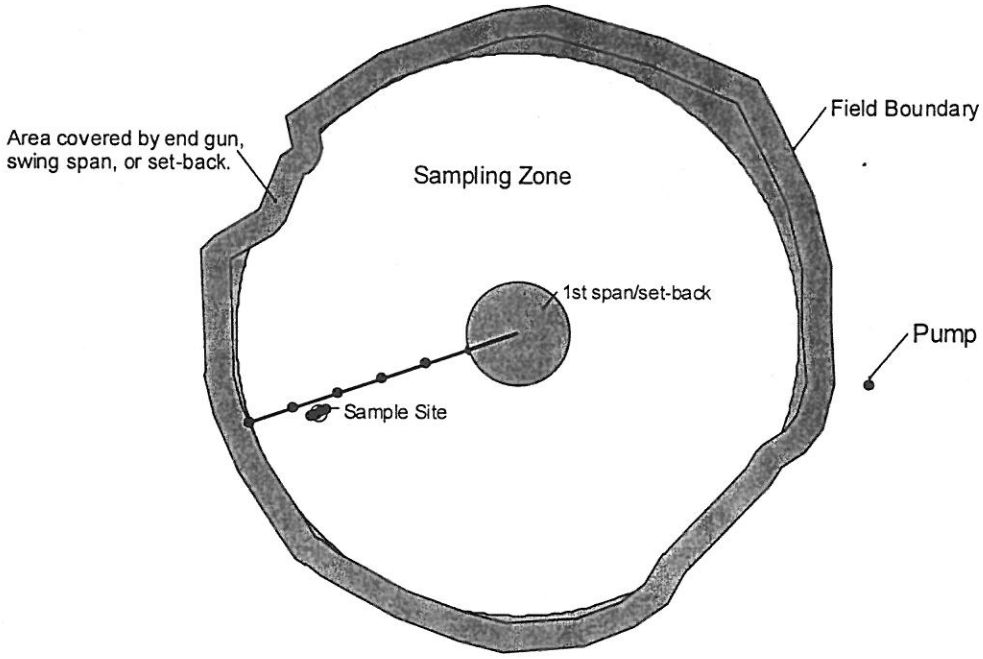


Figure 2. Sample site detail for center pivot irrigation.

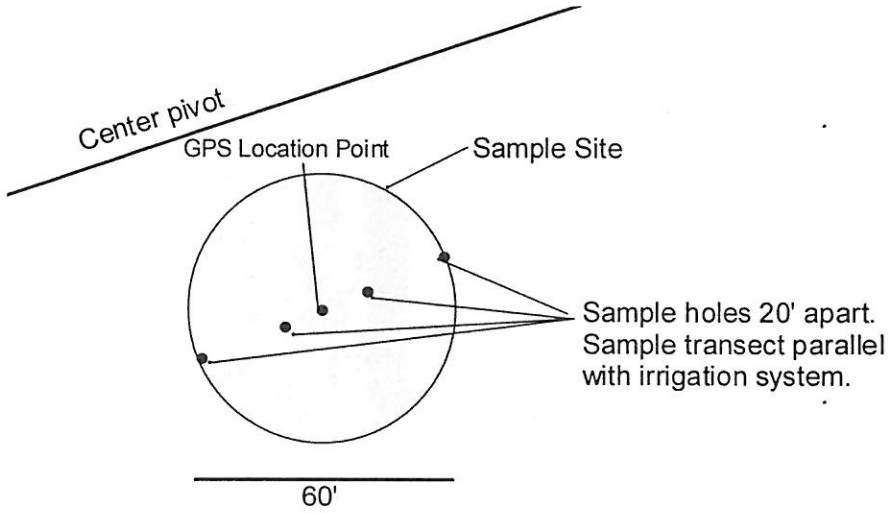


Figure 3. Sampling scheme for dryland fields.

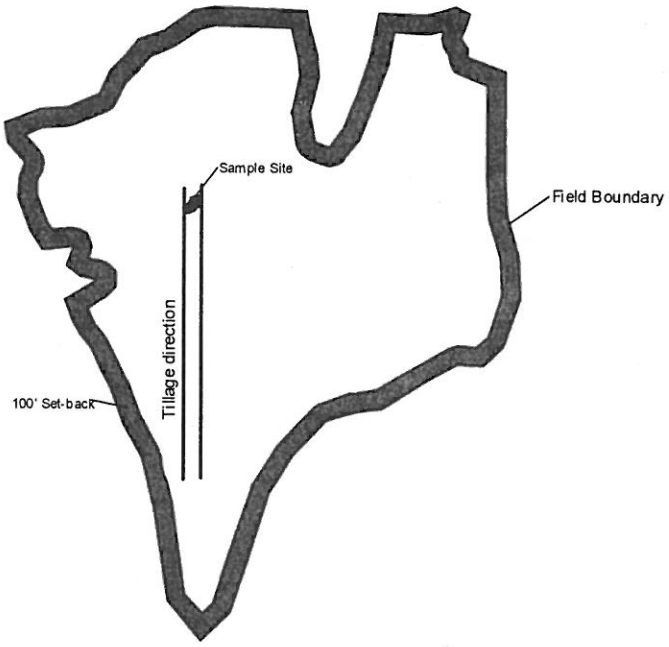


Figure 4. Sample site detail for dryland fields.

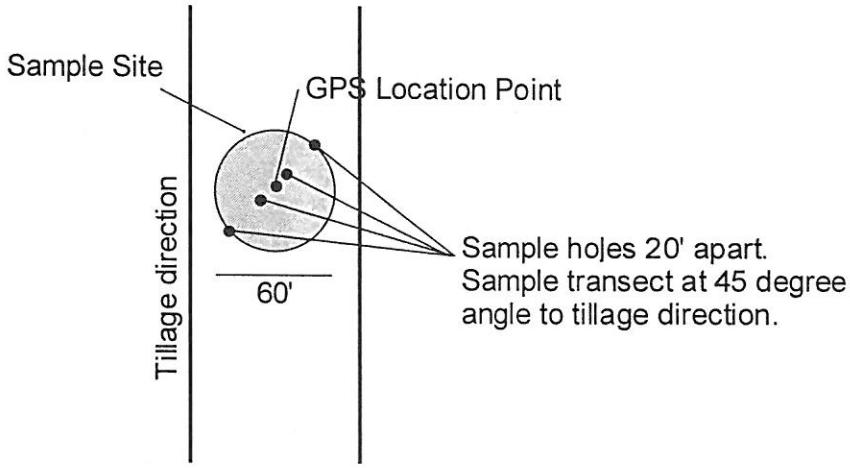


Figure 5. Sampling scheme for handline, wheelline, or solid set (row crop) irrigation systems.

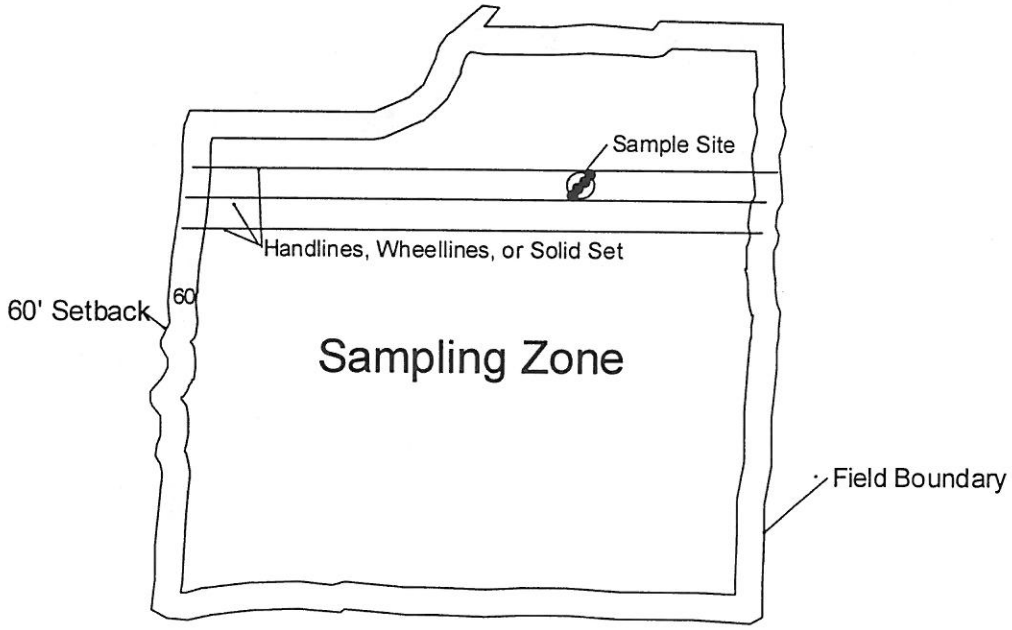


Figure 6. Sample site setail for handline, wheelline, or solid set (row crop) irrigation systems.

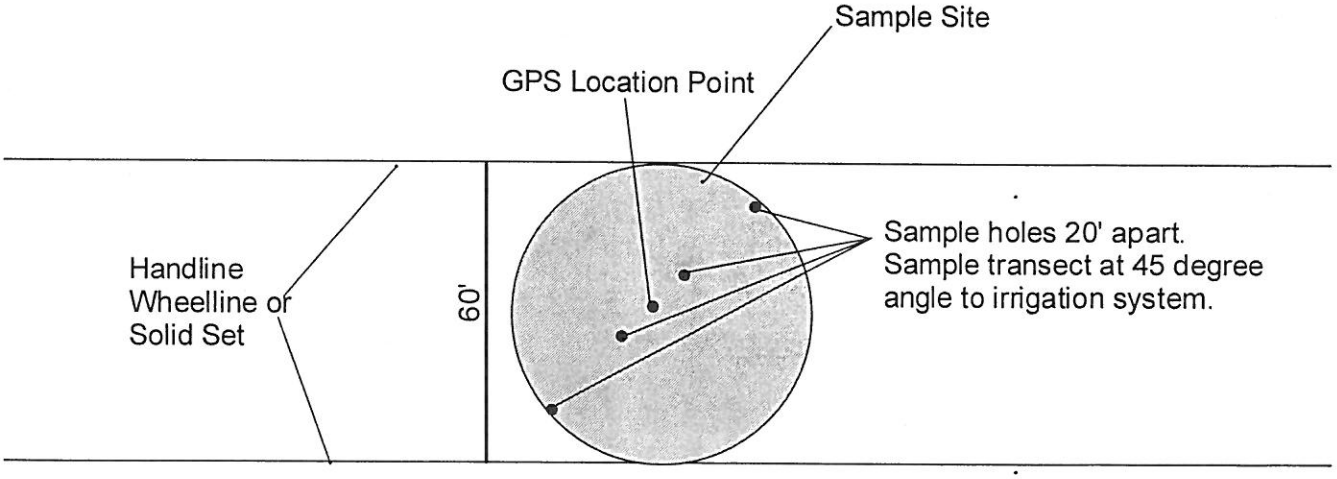


Figure 7. Sampling scheme for rill irrigation systems.

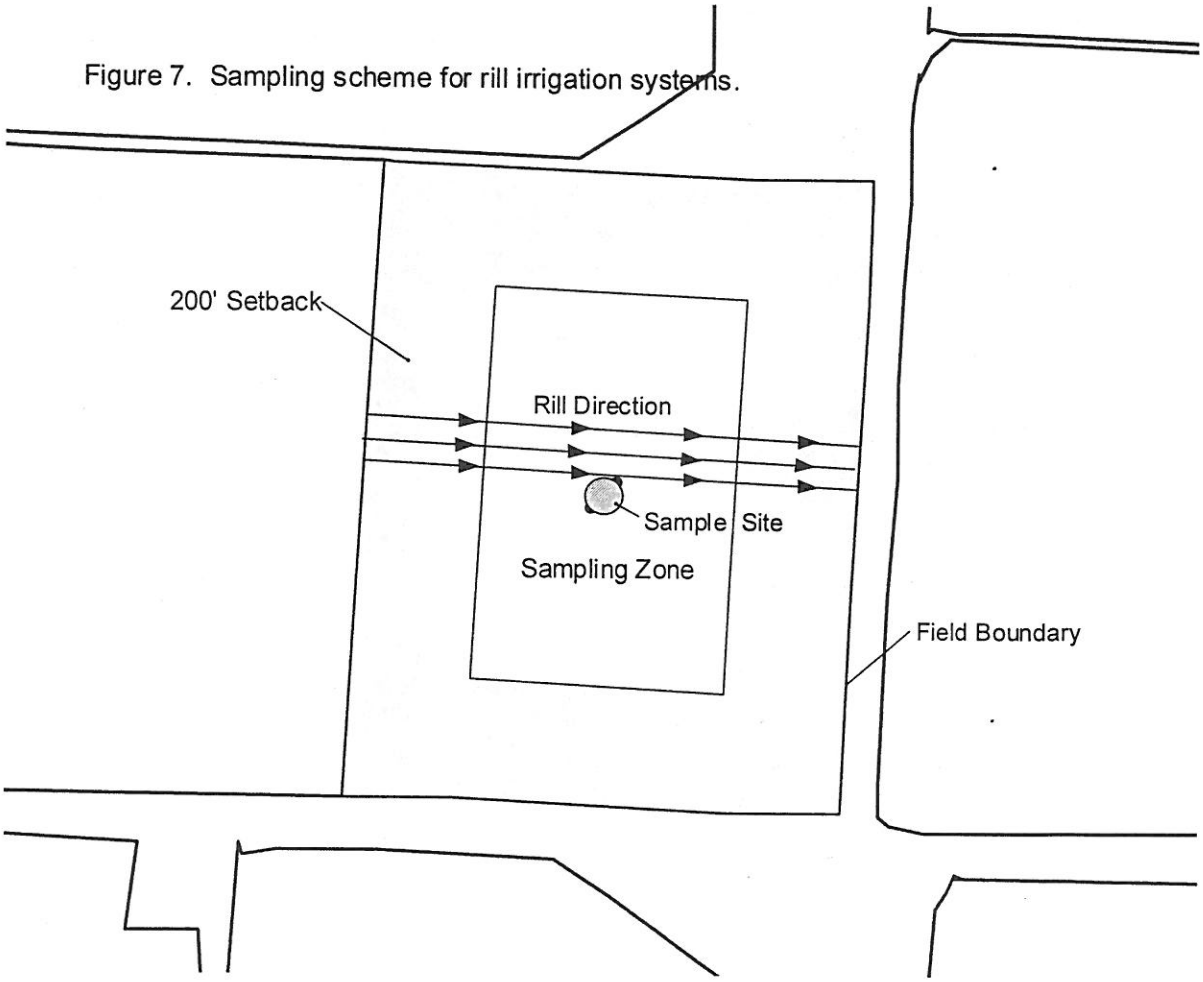


Figure 8. Sample site detail for rill irrigation systems.

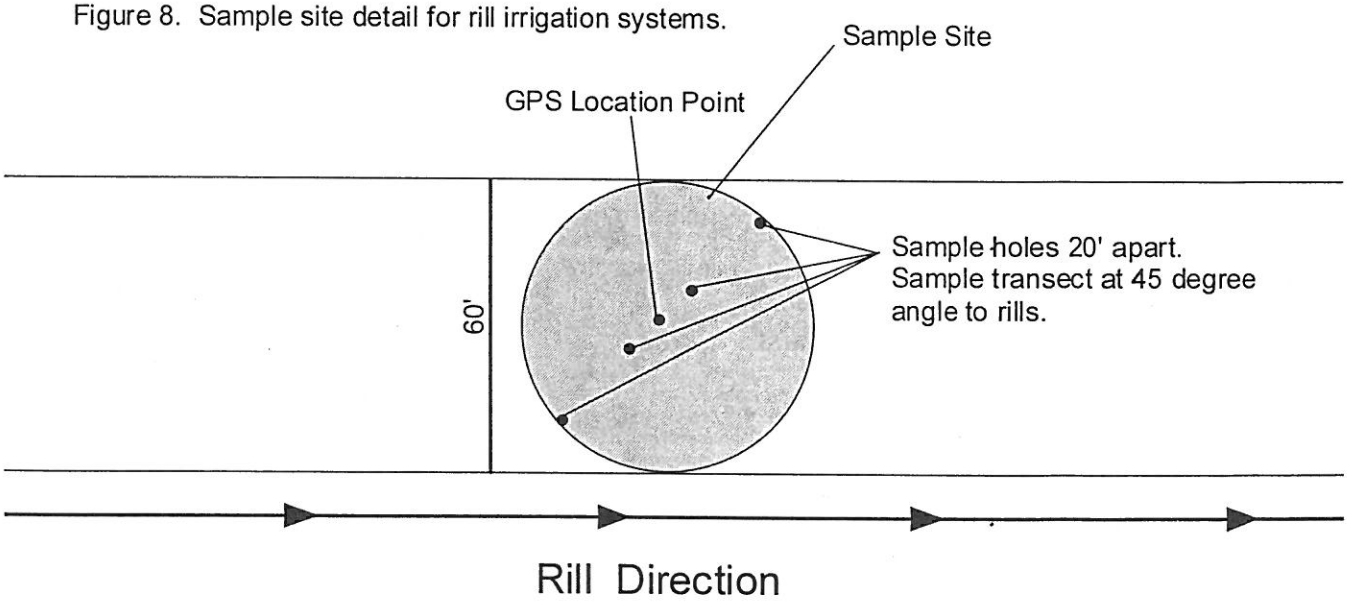


Figure 9. Sampling scheme for solid set or micro-spray (orchards & vineyards) irrigation systems.

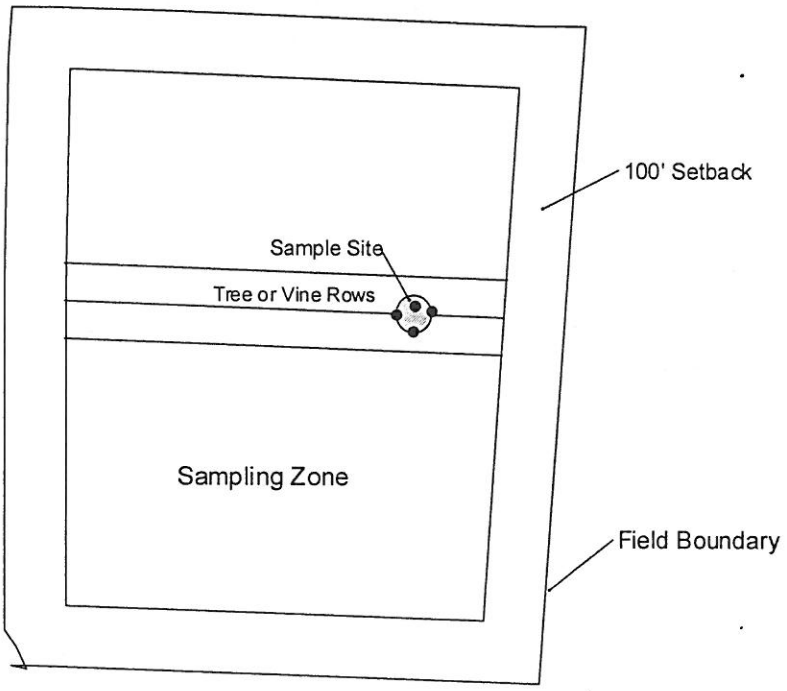


Figure 10. Sample site detail for orchard and vineyards wtih solid-set or drip irrigation systems.

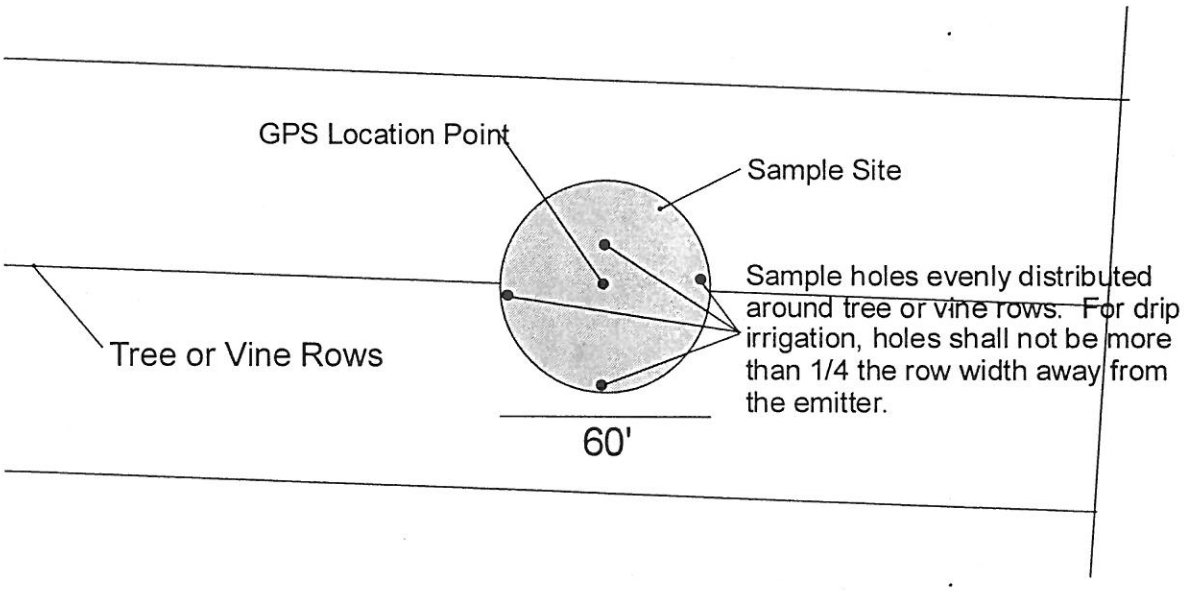


Figure 11. Sampling scheme for linear move irrigation systems.

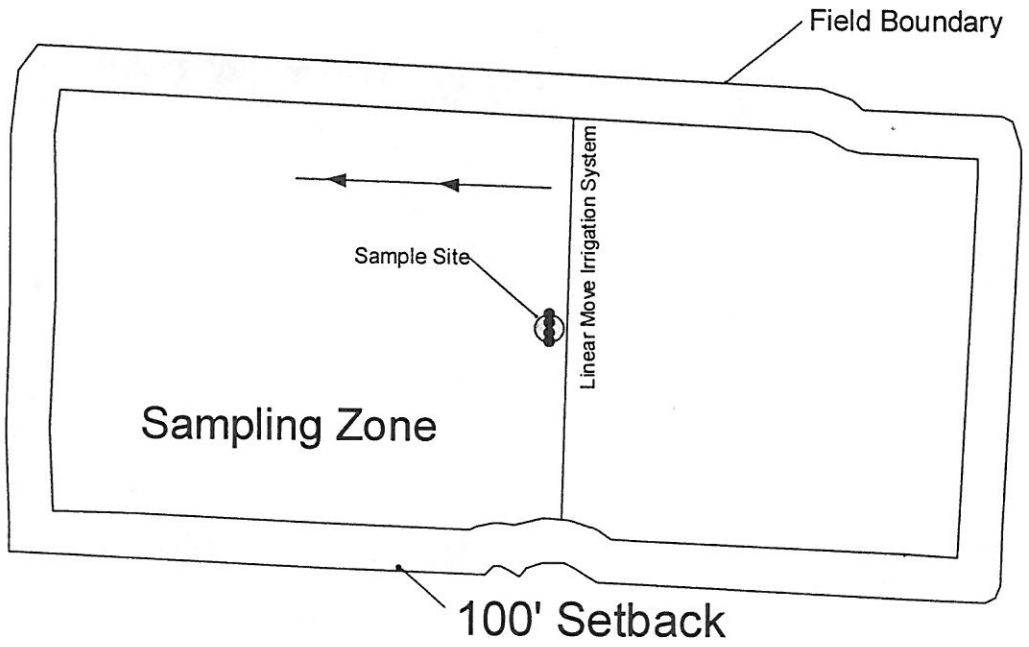
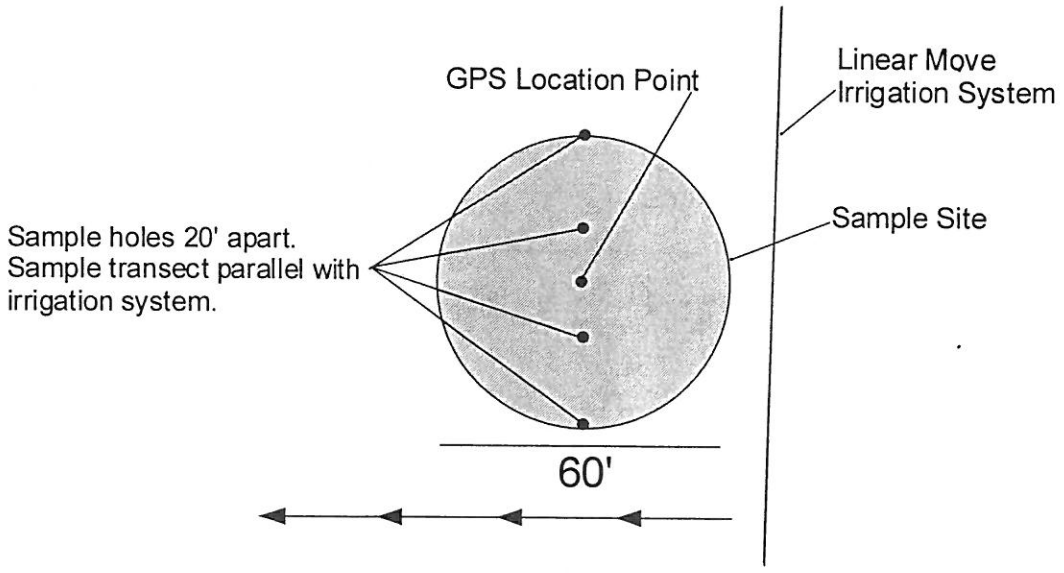


Figure 12. Sample site detail for linear move irrigation systems.



ATTACHMENT A
KEY PERSONNEL

Attachment A - Key Personnel

Lower Yakima Valley Groundwater Management Area

Deep Soil Sampling Program Role	**Person**
GWMA Project Deep Soil Sampling Project Manager	
GWMA Project Deep Soil Sampling Assistant Project Manager	
SYCD Project Administrator	
GWAC Chair	
Irrigated Agriculture Committee Chair	
Livestock-CAFO Committee Chair	
Data Committee Chair	

ATTACHMENT B
GROWER AGREEMENT FORM

Attachment B - Grower Agreement Form

Lower Yakima Valley Groundwater Management Area

I hereby certify I have read and accept the Deep Soil Sampling Plan, including communication, data sharing, field work, liability, and information management elements. I will arrange sampler access to the sampling site.

Printed Name:

Grower's Signature:

Date:

Company Name:

ATTACHMENT C
PROPOSED PROCESS TO ALLOCATE SOIL SAMPLES IN SPRING 2014

PACIFIC groundwater GROUP

Technical Memorandum

To: Don Gatchalian and Jim Trull

From: Pony Ellingson, PGG

Re: Proposed process to allocate soil samples in Spring 2014

Date: September 16, 2013

This memo presents an approach for obtaining soil samples that reflect existing agricultural practices in Spring 2014 in the Lower Yakima Valley Groundwater Management Area. The process was developed by PGG working with Laurie Crowe and Ralph Fisher in response to comments received on the committee review draft of the Deep Soil Sampling Plan of September 2, 2013. This process could become part of the Deep Soil Sampling Plan. The process uses the following factors to allocate samples (data on these factors are available in GIS format prior to sampling):

- Natural Resource Conservation Service's Nitrate Leaching Potential (Web Tool)
- Crop Type or Group
- Irrigation type

The text below assumes numbers of field-type categories, and numbers of fields sampled within each category; however, those numbers are examples only and are designed to yield about 100 fields sampled, which presumes a budget limitation. Input to the process could be changed to yield more or fewer fields based on GWAC input. Attachment A provides examples where various inputs are used, with the result that a range of fields are sampled. The text below follows example "D" in Attachment A.

Process

1. Determine the average NRCS N leaching potential for each field. WSDA will provide field boundaries in GIS coverage. The NRCS web tool will provide coverage of N leaching potential for NRCS soil map units. GIS analysis will calculate weighted average N leaching potential within each field. Values would be broken into low, moderate, and high soil risk classes. Note that the NRCS process uses four classes but the GWMA project would divide the range of numeric values (they range from 0 to 1) into three (not four) classes. The advantage of fewer classes is to reduce the ultimate number of field categories, as explained further below.

2. Group crop types and map data at field level. Define four crop groups for the GWMA project (eg: all trees; row crops; all grasses; etc). Groups may be defined by ranges of recommended N application, application timing, crop residuals, root depth, or

deep soil N results from other projects (eg: Columbia basin, California). WSDA will provide field-level data. GIS polygons should be field boundaries.

3. Group irrigation types and map at field level. Use WSDA coverage of irrigation at the field level to define three groups of irrigation types based on similar irrigation efficiency, uniformity, or other measure of deep percolation potential (eg: drip; sprinkler; flood). GIS polygons should be field boundaries.

4. Categorize each field in the GWMA using three parameters: NRCS N leaching potential, crop type or group, irrigation type. Most recent data on crop and irrigation type would be used as available from WSDA; however, during outreach and advertisement of the soil sampling program, GWMA project would indicate a preference for fields that have had consistent land use for at least 3 years.

5. Add up acreage of fields within each category and rank them from low acreage to high acreage.

6. Considering the available budget, establish a target for the number of fields to be sampled in each category. Categories with the largest acreage shall have the highest targets; however, the targets will be capped (eg: max 6 fields sampled) to allow adequate coverage of smaller categories under a budget limitation. A minimum target for any one category may also be warranted to yield a distribution of N data for each category (eg: 3 fields sampled). Define a minimum acreage threshold below which a category would have a target of zero fields sampled (eg: smallest two-fifths of the categories). Especially high risk categories may warrant sampling even if the category does not meet the acreage threshold.

Attachment A:

Analysis of how input to the allocation process influences number of fields sampled. Text above uses hypothetical "D "below. See Table for numbers.

A. 4 NRCS N values x 6 crop groups x 4 irrigation types = 96 categories. Assume that the categories are divided into quintiles by acreage:
    a. First and second quintiles fall below acreage threshold for sampling
    b. Third quintile has a target of 3 fields sampled per category
    c. Fourth quintile has a target of 5 fields sampled per category
    d. Fifth quintile has a target of 8 fields sampled per category

    Number of fields to be sampled = (96*.20*3)+(96+.20*5)+(96*.20*8) = 307 fields.

B. 4 NRCS N values x 6 crop groups x 4 irrigation types = 96 categories. Assume that the categories are divided into quintiles:
    a. First and second quintiles fall below acreage threshold for sampling
    b. Third quintile has a target of 2 fields sampled per category
    c. Fourth quintile has a target of 4 fields sampled per category
    d. Fifth quintile has a target of 6 fields sampled per category

    Number of fields to be sampled = (96*.20*2)+(96+.20*4)+(96*.20*6) = 230 fields.

C. 3 NRCS N values (use numerical values to define low, moderate, high) x 5 crop groups x 3 irrigation types = 45 categories. Assume that the categories are divided into quintiles:
    a. First and second quintiles fall below acreage threshold for sampling
    b. Third quintile has a target of 2 fields sampled per category
    c. Fourth quintile has a target of 4 fields sampled per category
    d. Fifth quintile has a target of 6 fields sampled per category

    Number of fields to be sampled = (45*.20*2)+(45+.20*4)+(45*.20*6) = 108 fields.

D. 3 NRCS N values (use numerical values to define low, moderate, high) x 4 crop groups x 3 irrigation types = 36 categories. Assume that the categories are divided into quintiles by acreage:
    a. First and second quintiles fall below acreage threshold for sampling
    b. Third quintile has a target of 3 fields sampled per category
    c. Fourth quintile has a target of 4 fields sampled per category
    d. Fifth quintile has a target of 6 fields sampled per category

Number of fields to be sampled = (36*.20*3)+(36+.20*4)+(36*.20*6) = 94 fields.

E. 3 NRCS N values (use numerical values to define low, moderate, high) x 4 crop groups x 3 irrigation types = 36 categories. Assume that the categories are divided into quintiles by acreage, that 100 fields are sampled, and each category gets an equal target:
    a. All categories have a target of 100/36 = about 3 fields sampled per category.

CALCULATION OF NUMBERS OF FIELDS SAMPLED DEPENDING ON DESIGN OF ALLOCATION PROCESS

	hypothetical sample allocation				
	A	B	C	D	E
number of NRCS N Leach Potential values	4	4	3	3	3
number of crop types	6	6	5	4	4
number of irrigation types	4	4	3	3	3
number of categories:	96	96	45	36	36
number of fields sampled for first quintile	0	0	0	0	3
number of fields sampled for second quintile	0	0	0	0	3
number of fields sampled for third quintile	3	2	2	3	3
number of fields sampled for fourth quintile	5	4	4	4	3
number of fields sampled for fifth quintile	8	6	6	6	3
total number of fields sampled	307	230	108	94	100

ATTACHMENT D
SOIL SAMPLE FIELD FORM

Soil Sample Field Form

Return this form, filled out, to South Yakima Conservation District
PO Box 1766 (or 200 Chenye Rd), Zillah, WA 98953
Fax: (509) 829-9027

Field Number provided by Conservation District: _____

Sample Collection Date: _____ Sampled by: _____

Check Box for irrigation method			
surface		big gun	
drip		other	
micro		moisture monitoring device	
handline			
wheeline			
pivot- circle			
Linear move			

Fill in Crop	
2013	
2012	
2011	

Fill in Land Cover

Fill in recent crop, water, nutrient actions

Check depths sampled in each borehole, and samples submitted to lab:

Depth in ft	Borehole 1	Borehole 2	Borehole 3	Borehole 4	Composite Submitted
0-1					
1-2					
2-3					
3-4					
4-5					
5-6					
6-7					
7-8					

Sampling location in field:
Draw field, sampling site, irrigation system, borders and other features.
Provide GPS coordinates to owner.

North

ATTACHMENT E
BORING LOG

Soil Boring Log

LOWER YAKIMA VALLEY GROUNDWATER ADVISORY COMMITTEE

Return this form, filled out, to South Yakima Conservation District
PO Box 1766 (or 200 Chenye Rd), Zillah, WA 98953
Fax: (509) 829-9027

Field Number provided by Conservation District: _____

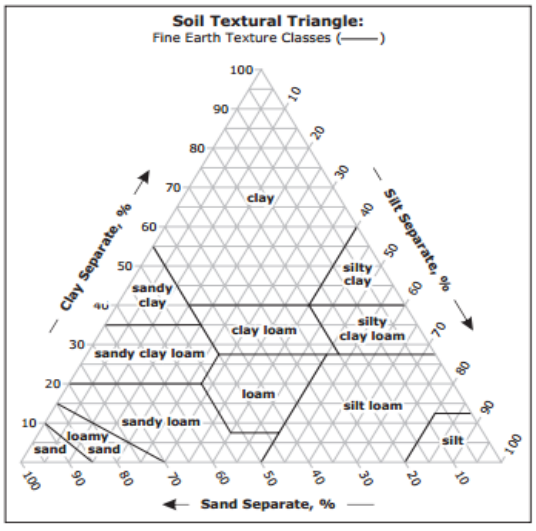
Boring Number: _____

Boring Date: _____ Boring Logged by: _____

Boring and Sampling Device (example: AMS 9100 Ag Probe with 1-inch tube sampler) _____

Describe each soil sample.

Depth in ft	Munsel color	Consistence	Moisture	Texture	Other
0-1					
1-2					
2-3					
3-4					
4-5					
5-6					
6-7					
7-8					



TEXTURE MODIFIERS - Conventions for using "Rock Fragment Texture Modifiers" and for using textural adjectives that convey the "% volume" ranges for **Rock Fragments - Size and Quantity**.

Fragment Content % by Volume	Rock Fragment Modifier Usage
< 15	No texture adjective is used (noun only; e.g., *loam*).
15 to < 35	Use adjective for appropriate size; e.g., gravelly.
35 to < 60	Use "**very**" with the appropriate size adjective; e.g., *very gravelly*.
60 to < 90	Use "**extremely**" with the appropriate size adjective; e.g., *extremely gravelly*.

Moisture options:
D=dry
M=moist
Dp=damp
W=wet

Consistance options:
L=loose, S=soft, SH=slightly hard, HA=hard, EH=extremely hard, FR=friable, FI=firm; VFI=very firm; C=cemented.
See Field Book for Describing and Sampling Soils, NRCS, August 2011.

Draft Initial Best Management Practices Database Summary

To: Don Gatchalian (Yakima County)

From: Mike Murray (HDR)
David Kuhns (HDR)
Jay Decker (HDR)

Date: August 30, 2013

Subject: Scope 1, Task 3 – Initial BMP Database Summary

Purpose

The Lower Yakima Valley Groundwater Advisory Committee (GWAC), through Yakima County Public Services, selected HDR Engineering, Inc. (HDR) and Pacific Groundwater Group (PGG) to assist in accomplishing two scopes of work. The first scope (lead by HDR) is a study to identify applicable local, state, and federal regulatory requirements that control and manage nitrates in groundwater, identify Best Management Practices (BMPs), and evaluate the effectiveness of these BMPs. The second scope (lead by PGG) focuses on completing the initial site assessment activities begun by the GWAC and other agencies.

The purpose of the BMP database review (Scope 1, Task 3) is to begin identifying and assessing currently available technologies and management approaches for minimizing nitrate leaching to groundwater from potential sources.

Six potential nitrogen sources are identified for the Lower Yakima Valley Groundwater Management Area (GWMA):

- Irrigated cropland (includes solid and liquid manure cropland application)
- Livestock operations (storage and handling of manure)
- Turfgrass and Other Urban Landscaping
- Municipal and industrial land application of wastewater (including storage and handling)
- Sewer leakage
- Septic systems

The GWAC is evaluating source contribution to nitrate loading to groundwater.HDR proposes a hierarchal classification approach to develop a BMP database:

1. For each potential nitrogen source listed above, develop management objectives for reducing nitrate leaching to groundwater.
2. For each management objective, development management targets relating to general actions for reducing nitrate leaching to groundwater.
3. For each management target, list specific BMPs with associated references.

This hierarchal approach, illustrated in Figure 1, serves as the outline for a BMP database.

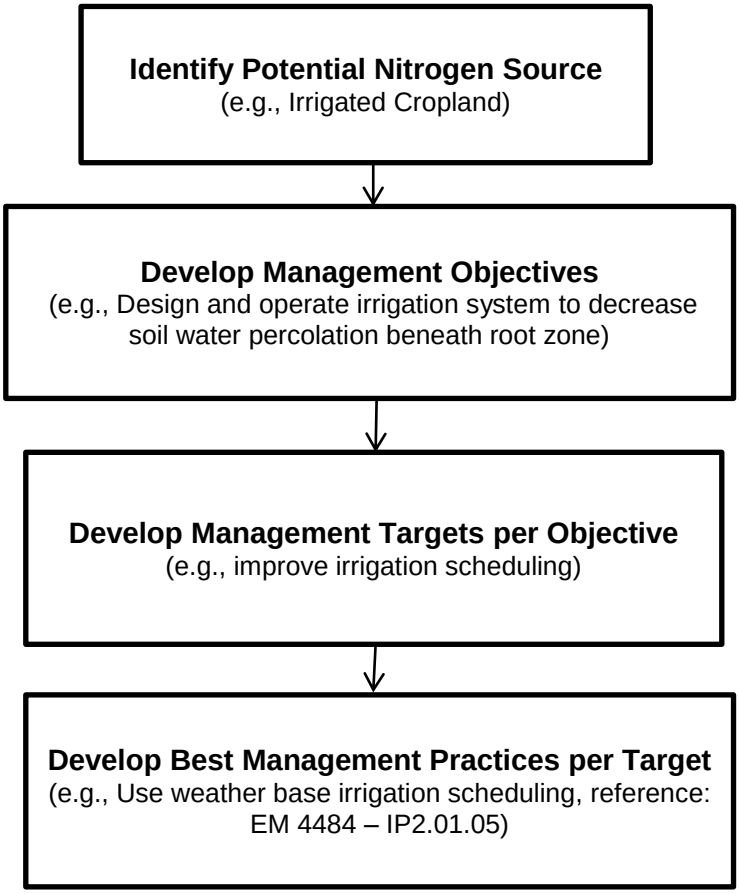


Figure 1. BMP Database Hierarchal Outline

HDR requests that GWAC review the attached tables developed for each potential source, which include management objectives, management targets, and BMPs. Each table also includes BMP references. Following the tables are full reference citations. In addition, HDR has placed each referenced BMP into a PDF file to allow GWAC easy access once the database is fully developed (not yet available).

For each potential nitrogen source, managing nitrate leaching to groundwater may require implementation of multiple BMPs. This hierarchal approach provides for a selection of BMPs that meets a specified management target and management objective. The goal is to select a suite of BMPs that meet specific land users' needs and constraints.

This document serves as a description of the initial BMP database summary. Additional BMPs will be added, and some removed, as the project develops. The next step in the process is to evaluate BMPs for implementation in the GWMA and to assess BMP effectiveness.

Attachments

Attached are six sets of tables, where each table lists the following:

- Source – land activity that potentially contributes nitrate to groundwater
- Objective (OB) – list of objectives for reducing nitrate leaching to groundwater for the source
- Management Target (MT) – general action(s) required to meet the objective
- Best Management Practice (BMP) – specific method, process, or activity that helps meet the management target and the objective for the source.
- Reference –information source for the BMP

Following the six tables is the listing of BMP references with information on author, title, and publication source.

Source 1. Irrigated Cropland (includes solid and manure cropland application)

Which irrigated cropland activities potentially contribute to nitrate (N) leaching to groundwater?

- Irrigation practices
- Crop practices
- N source management (type, quantity, and timing)
- Others (e.g., spills, stockpiling, etc.)

Objectives for Reducing Nitrate Leaching to Groundwater from Irrigated Cropland[1]

1. Design and operate irrigation system to decrease soil water percolation beneath root zone.
2. Manage crop plants to maximize nitrogen use efficiency (NUE)[2].
3. Manage N fertilizer and manure (liquid and solid) to increase crop NUE.
4. Improve storage and handling of fertilizer and manures to decrease off-target discharges.

[1] Information from *Nitrogen Source Reduction to Protect Groundwater Technical Report 3, 2012*. California State Water Resources Control Board was used to aid in the development of BMPs for cropland.

[2] Nitrogen use efficiency (NUE) - percent N applied to cropland (from all sources) that is recovered by the crop and therefore is not lost to the atmosphere (denitrification) or to surface water or groundwater.

Best Management Practices for Irrigated Cropland

OB = objective; MT = management target; BMP = best management practice

Irrigated Cropland Objectives for Reducing Nitrate Loading to Groundwater	Management Target	Best Management Practices	References
OB 1.1 Design and operate irrigation system to decrease soil water percolation beneath root zone	MT 1.1.1 Perform irrigation system evaluation and monitoring	BMP 1.1.1.1 Conduct irrigation system performance evaluation	EM 4885 – IP 2.01.03; PNW 293; EM4828
		BMP 1.1.1.2 Install and use flow meters or other measuring devices to track water volume applied to each field at each irrigation	EM 4885 – IP 2.01.01
		BMP 1.1.1.3 Conduct pump performance tests	EM 4885 – IP 2.01.02
	MT 1.1.2 Improve irrigation scheduling	BMP 1.1.2.1 Use weather based irrigation scheduling	EM 4885 – IP 2.01.05, 2.01.06
		BMP 1.1.2.2 Use plant-based irrigation scheduling	EM 4885 – IP 2.01.05, 2.01.06; EM4821; EB1513
		BMP 1.1.2.3 Measure soil moisture content to guide irrigation timing and amount	EM 4885 – IP 2.01.05, 2.01.06; PNW0475
		BMP 1.1.2.4 Avoid heavy pre-plant or fallow irrigations	
	MT 1.1.3 Improve surface gravity system design and operation	BMP 1.1.3.1 Convert to surge irrigation	EM 4885 – IP 2.02.03; EM4826
		BMP 1.1.3.2 Use high flow rates initially, then cut back to finish off the irrigation	EM 4885 – IP 2.02.10; EM4828
		BMP 1.1.3.3 Reduce irrigation run distances and decrease set times	EM 4885 – IP 2.02.04; EM4828
		BMP 1.1.3.4 Increase flow uniformity among furrows (e.g., compaction furrows)	EM 4885 – IP 2.02.02
		BMP 1.1.3.5 Grade fields as uniformly as possible	EM 4885 – IP 2.02.05, 2.02.05
		BMP 1.1.3.6 Where high uniformity and efficiency are not possible, convert to drip, center pivot, or linear move systems	EM 4885 – IP 2.01.08
	MT 1.1.4 Improve sprinkler system design and operation	BMP 1.1.4.1 Monitor flow and pressure variations throughout system	EM 4885 – IP 2.03.02
		BMP 1.1.4.2 Repair leaks and malfunctioning sprinklers, follow manufacturer recommended replacement intervals	EM 4885 – IP 1.00.05, 2.03.03
		BMP 1.1.4.3 Operate sprinklers during the least windy periods	EM 4885 – IP 2.03.05
		BMP 1.1.4.4 Reduce distance between lateral lines or alternate lateral line location over successive irrigations	EM 4885 – IP 2.03.04, 2.03.06
		BMP 1.1.4.5 When pressure variation is excessive, use flow control or pressure regulating nozzles	EM 4885 – IP 2.03.02
	MT 1.1.5 Improve micro-irrigation system design and operation	BMP 1.1.5.1 Use appropriate lateral hose length to improve uniformity	EM 4885 – IP 2.04.02
		BMP 1.1.5.2 Check for clogging potential and prevent or correct clogging	EM 4885 – IP 2.04.03
	MT 1.1.6 Make other irrigation infrastructure improvements	BMP 1.1.6.1 Installation of subsurface drains	EM 4885 – IP 5.01.01
		BMP 1.1.6.2 Backflow prevention	EM 4885 – IP 6.00.03, EB1722
OB 1.2 Manage crop plants to maximize NUE	MT 1.2.1 Modify crop rotation	BMP 1.2.1.1 Grow cover crops	EM 4885 – IP 5.01.01
		BMP 1.2.1.2 Include deep-rooted or “nitrogen scavenger” crop species in annual crop rotations	PNW513
		BMP 1.2.1.3 Grow more crops per year (double cropping)	Bul 869
		BMP 1.2.1.4 Include perennial crop rotation	PNW513
	MT 1.2.2 Monitor crops	BMP 1.2.2.1 Monitor crop performance for each field including yield, nitrogen content, estimate of nitrogen removed from field versus remaining in field	NRCS Part 651. Ch. 13, Appendix 13B
OB 1.3 Manage N fertilizer and manure to increase crop NUE	MT 1.3.1. Improve rate, timing, and placement of N fertilizers	BMP 1.3.1.1 Adjust nitrogen fertilization rates based on soil nitrate testing	EM 4885 – IP 3.02.01
		BMP 1.3.1.2 Adjust timing of nitrogen fertilization based on plant tissue analysis	EM 4885 – IP 3.02.03
		BMP 1.3.1.3 Apply nitrogen fertilizer in small multiple doses rather than single large dose	EM 4885 – IP 3.02.05
		BMP 1.3.1.4 Measure nitrate content of irrigation water and adjust fertilizer accordingly	EM 4885 – IP 3.02.02
		BMP 1.3.1.5 Use low rates of foliar nitrogen instead of higher rates applied to soil	

Irrigated Cropland Objectives for Reducing Nitrate Loading to Groundwater	Management Target	Best Management Practices	References
OB 1.3 Manage N fertilizer and manure to increase crop NUE	MT 1.3.1. Improve rate, timing, and placement of N fertilizers	BMP 1.3.1.6 Vary nitrogen application rates within large fields according to expected needs (precision agriculture)	Peters and Davenport
		BMP 1.3.1.7 When fertilizing in surface gravity systems, use delayed injection procedures	
		BMP 1.3.1.8 Develop a nitrogen budget that includes crop nitrogen harvest removal, supply of nitrogen from soil, and other inputs	CSU-XCM-173
		BMP 1.3.1.9 Use controlled release fertilizers, nitrification inhibitors, and urease inhibitors	EM 4885 – IP 3.02.06
		BMP 1.3.1.10 Assess the risk of contamination of ground and surface water due to fertilizer leaching or runoff	EM 4885 – IP 3.01.01
		BMP 1.3.1.11 Maintain records of all soil, tissue, and water tests, cropping rotations, yields, and applications (dates, material, method, results)	CSU-XCM-173
		BMP 1.3.1.12 Develop realistic yield goals	EM 4885 – IP 3.02.07
	MT 1.3.2. Improve rate, timing, and placement of animal manure applications	BMP 1.3.2.1 Apply moderate rates of manure and compost, and use materials with high nitrogen content (inorganic fertilizer) to meet the peak nitrogen demand	
		BMP 1.3.2.2 Incorporate solid manure immediately to decrease ammonia volatilization loss	EM 4885 – IP 3.03.05
		BMP 1.3.2.3 When applying liquid manure in surface gravity irrigation systems, use the delayed injection procedure to improve application uniformity	
		BMP 1.3.2.4 Use quick test methods to monitor dairy lagoon water nitrogen content immediately before and during application, and adjust application rate accordingly	
		BMP 1.3.2.5 Develop a nitrogen budget that includes crop nitrogen harvest removal, supply of nitrogen from manure, and other inputs	CSU-XCM-173; USU 2010
		BMP 1.3.2.6 Calibrate solid manure and compost spreaders	EM 4885 – IP 3.03.01; NRCS Part 651. Ch. 13, Appendix 13A
		BMP 1.3.2.7 Ensure uniformity of application with manure	EM 4885 – IP 3.03.07
		BMP 1.3.2.8 Do not apply manure to frozen ground, especially sloping fields	EM 4885 – IP 3.03.08
		BMP 1.3.2.9 Test manure or other waste materials for nutrient content	EM 4885 – IP 3.02.04; NRCS Part 651. Ch. 13, Appendix 13B
		BMP 1.3.2.10 Use synchronized rate nutrient application of lagoon water to reduce or eliminate the need for fertilizer	NDESC 2005 (II)
	MT 1.3.3. Use fertilizer guides to determine and apply appropriate fertilizer amounted.	BMP 1.3.3.1 Follow recommendations of Fertilizer Guide: Home Vegetable Gardens, Irrigated Central Washington	FG0052
		BMP 1.3.3.2 Follow recommendations of Fertilizer Guide: Irrigated Alfalfa Central Washington	FG0003
		BMP 1.3.3.3 Follow recommendations of Fertilizer Guide: Irrigated Asparagus	FG0012
		BMP 1.3.3.4 Follow recommendations of Fertilizer Guide: Irrigated Field Beans for Central Washington	FG0005
		BMP 1.3.3.5 Follow recommendations of Fertilizer Guide: Irrigated Field Corn for Grain or Silage	FG0006
		BMP 1.3.3.6 Follow recommendations of Fertilizer Guide: Irrigated Hops for Central Washington	FG0011
		BMP 1.3.3.7 Follow recommendations of Fertilizer Guide: Irrigated Mint Central Washington	FG0008
		BMP 1.3.3.8 Follow recommendations of Fertilizer Guide: Irrigated Peas for Central Washington	FG0033
		BMP 1.3.3.9 Follow recommendations of Fertilizer Guide: Irrigated Small Grains, Central Washington	FG0009
		BMP 1.3.3.10 Follow recommendations of Fertilizer Guide: Irrigated Sudangrass Pasture or Silage	FG0036
		BMP 1.3.3.11 Follow recommendations of Fertilizer Guide: Irrigated Vineyards for Entire State	FG0013
		BMP 1.3.3.12 Follow recommendations of Fertilizer Guide: Ornamentals, Entire State Except Central Irrigated Washington	FG0049
		BMP 1.3.3.13 Follow recommendations of Fertilizer Guide: Vegetable and Flower Gardens, Except Irrigated Central Washington	FG0050
		BMP 1.3.3.14 Follow recommendations of Fertilizer Guide: Improved Pasture, Hay, Eastern Washington	FG0037
		BMP 1.3.3.15 Follow recommendations of Fertilizer Guide: Grass Seed for Eastern Washington	FG0038

Irrigated Cropland Objectives for Reducing Nitrate Loading to Groundwater	Management Target	Best Management Practices	References
OB 1.3 Manage N fertilizer and manure to increase crop NUE	MT 1.3.3. Use fertilizer guides to determine and apply appropriate fertilizer amounted.	BMP 1.3.3.16 Follow recommendations of Fertilizer Guide: Barley for Eastern Washington	FG0029
		BMP 1.3.3.17 Follow recommendations of Fertilizer Guide: Soil Samples/Orchards	FG0028C
		BMP 1.3.3.18 Follow recommendations of Fertilizer Guide: Instructions for Tree Fruit Leaf Nutrient Analysis	FG0028E
		BMP 1.3.3.19 Follow recommendations of Fertilizer Guide: Peas and Lentils for Eastern Washington	FG0025
		BMP 1.3.3.20 Follow recommendations of Fertilizer Guide: Lawns, Playfields and Other Turf, East and Central Washington	FG0024
OB 1.4 Improve storage and handling of fertilizer and manures to decrease off-target discharges	MT 1.4.1 Avoid fertilizer material and manure spills during transport, storage, and application	BMP 1.3.4.1 Do not overfill trailers or tanks. Cap or cover loads.	EM 4885 – IP 4.01.06
		BMP 1.3.4.2 When transferring fertilizer, take care not to allow materials to accumulate on the soil	
		BMP 1.3.4.3 Maintain all fertilizer storage facilities and protect them from the weather	
		BMP 1.3.4.4 Clean up fertilizer spills promptly	
		BMP 1.3.4.5 Shut off fertilizer applicators during turns and use check valves	
		BMP 1.3.4.6 Maintain proper calibration of fertilizer application equipment	EM 4885 – IP 3.03.01
		BMP 1.3.4.7 Create a buffer around wellheads from fertilizer and manure storage, handling, and application	EM 4885 – IP 6.00.02
		BMP 1.3.4.8 Distribute rinse water from fertilizer application equipment throughout field	
		BMP 1.3.4.9 Avoid manure spills/discharges during transport, storage, and application	
		BMP 1.3.4.10 Prevent back siphonage/flow of chemicals or nutrients down a well after injection	EM 4885 – IP 6.00.03, EB1722
		BMP 1.3.4.11 Identify and properly seal all abandoned and improperly constructed wells	EM 4885 – IP 6.00.04

Source 2. Livestock Operations (storage and handling of solid and liquid manure)

2.1 Background

A basic description of dairy and other livestock operations is presented below in order to develop management objectives, targets, and practices. The application of manure (both solid and liquid) to cropland is covered under "Source 1. Irrigated Cropland."

2.2 Dairy Waste Management Systems

Dairies operate either as a freestall operation, as a drylot operation, or as a combination of both.

Freestall. In a freestall dairy operation, adult cows are housed in covered freestalls and have access to exercise yards (open areas with no roofs), often referred to as corrals or open lots. Freestalls are buildings with long rows of individual stalls. They are bordered on the front side by a feed bunk and on the back side by a concrete-paved flush and travel lane (often referred to as flush-lane or flush-alley), used for both manure collection and as access pathway for the animals to their stalls. The stalls themselves are unpaved and generally bedded with dry manure solids or other dry materials that are periodically refreshed to keep the freestalls clean and comfortable for the cows. Feed is distributed into feed bunks along the front of the freestalls. Typically, milking cows are walked to a centrally-located milking barn (milking center) two to three times a day. The entire complex of freestall, flush-lane, and feed bunk is roof-covered to protect from sun and rain.

Animal manure (from liquid and solid excretions) accumulates primarily in the flush-lane that passes behind an individual animal's bedded freestall. The flush-lane is often comprised of a slatted floor, where animal hooves work the manure through the slats into the lane (also referred to as an alley) below, and the manure is collected by flushing or scraping the lane. Flush-lanes are flushed with recycled water from the liquid manure storage lagoon two to five times daily. Flush water is collected, passes through a mechanical solid separation system, and the liquid portion (with suspended solids) is stored in a manure storage lagoon for treatment. Some dairies may use a mechanical scraper under the slatted floor as an alternative to flushing or a combination of the two systems.

A number of different collection and solid separation systems are available. Systems differ in their effectiveness at separating coarse solids and fine solids from the liquid fraction. Separated solids (solid manure) are generally stored in stockpiles or windrows for drying and storage. Dried, separated solids are reused for bedding in freestalls and corrals, as soil amendment in crop fields, or hauled off-property as soil amendment.

Liquid manure is stored in manure storage lagoons ("lagoons") and recycled for flushing. Liquid manure is ultimately blended with irrigation water and used as fertilizer in crop fields associated with the dairy.

Drylot. Drylots (corrals) are earthen-surface exercise yards without flooring or plant cover, and usually without any roofing. Drylot dairies generally lack flush-lanes for the collection of manure, except in the milking barn area and its associated travel lanes. Animal excrement collects in the corral area and is regularly scraped. Scraped solids are dried, sometimes composted to various degrees, and then reused as bedding in the freestalls and corrals, used as soil amendment in fields, or sold off-dairy as soil amendment.

Dairies also collect surface runoff from animal housing areas. Stormwater runoff from roof tops is often collected separately and diverted to stormwater drains. Any runoff that has come in contact with animal waste must be collected in the liquid manure storage pond or lagoon.

2.3 Beef Cattle Waste Management Systems

Beef cattle feedlots function similarly to dairy drylots or uncovered animal holding areas, although the animal stocking rate may be higher for beef cattle. Beef cattle can be confined on unpaved, partially-paved, or totally paved lots. Large feedlot operations (confined animal feeding operations [CAFOs]) are similar to dairies in that any runoff that has come in contact with animal waste must be collected and managed.

2.4 Sources of Nitrogen from Live Stock Operations

What are potential source areas for nitrate in livestock operations?

- Manure generated in uncovered animal holding areas (corrals and drylot areas)
- Manure generated in freestall and milking barn operations
- Liquid manure storage lagoons
- Solid manure storage area
- Feed stock (primarily forage)
- Liquid and solid manure applied to crop fields (addressed under “Source 1. Irrigated Cropland”)
- Human waste discharged to septic leach fields (addressed under “Source 6. Septic Systems”)

Objectives for Reducing Nitrate Leaching to Groundwater from Livestock Operations (land application of liquid and solid manure is covered under “Source 1. Irrigated Cropland)”:

1. Manage solid and liquid manure in uncovered animal holding areas (e.g., corrals an drylots) to minimize the direct and indirect leaching of nitrate to groundwater.
2. Manage manure in freestall and milking barn operations (and other enclosed structures holding livestock), to maximize capture of solid and liquid waste, while minimizing water usage.
3. Design and operate liquid manure storage lagoons, settling basins, and holding ponds to minimize the leaching of nitrate to groundwater.
4. Design and operate solid manure storage areas to minimize leaching of nitrate to groundwater.
5. Manage livestock herds to minimize leaching of nitrate to groundwater.

Best Management Practices for Livestock Operations

OB = objective; MT = management target; BMP = best management practice

Livestock Operation Objectives for Reducing Nitrate Loading to Groundwater	Management Target	Best Management Practices	References
OB 2.1. Manage manure and liquid waste in uncovered animal holding areas (e.g. corrals and drylots) to minimize the direct and indirect leaching of nitrate to groundwater	MT 2.1.1. Perform livestock site assessment (new or established facility). Applicable to all objectives under livestock operations.	BMP 2.1.1.1 Conduct a livestock site characteristics evaluation (checklist) (meant to be an aid in planning and design, improvements, and operation and maintenance of a livestock facility)	USU – 2010 (dairy); NRCS Part 651 Ch. 8 and Ch. 10, Table 10-4; EB1746-W7; EB1746-F8
	MT 2.1.2. Improve surface management of uncovered animal holding area	BMP 2.1.2.1 Collect manure from uncovered holding areas as frequently as possible to achieve optimum animal health, comply with regulations, and to reduce exposure of manure to precipitation and runoff prior to treatment	USU – 2010; EB1746-F7
		BMP 2.1.2.2 Maintain a firm, dry surface with loose manure layer less than 1 inch deep and 25 to 35 percent pen moisture content	USU - 2010
		BMP 2.2.2.3 Clean corrals and drylots to provide a smooth surface with 3 to 5 percent slope and maintain the integrity of the hardpan below the holding area surface	USU – 2010; NRCS Part 651, Ch. 9, 651.96b(2)
		BMP 2.2.2.4 Collect runoff from holding areas	USU – 2010; NRCS Part 651, Ch. 10, 651.1001(b); EB1746-F8
		BMP 2.2.2.5 Divert clean stormwater runoff away from uncovered animal holding areas	USU – 2010; NRCS Part 651 Ch. 10 651.1001(a),(b); EB1746-F8
		BMP 2.2.2.6 Remove all manure from abandoned uncovered animal holding areas	NRCS Part 651, Ch. 9, 651.96(b)
		BMP 2.2.2.7 Create a buffer around wellheads from manure storage and handling areas	EM 4885 – IP 6.00.02; EB1746-F7
		BMP 2.2.2.8 Identify and properly seal all abandoned and improperly constructed wells (applicable for all source BMPs)	EM 4885 – IP 6.00.04
OB 2.2 Manage animal waste in freestall and milking barn operations to minimize indirect leaching of nitrate to groundwater	MT 2.2.1 Improve exterior building water management	BMP 2.2.1.1 Divert roof runoff from entering uncovered animal holding areas and from entering wastewater system	NRCS Part 651, Ch. 10, 651.1001(a)
	MT 2.2.2 Optimize water use for freestall and milking center manure management	BMP 2.2.2.1 Scrape (manual or automated) alleys, open areas, and/or gutters system to conserve flush water	NRCS Part 651 Ch. 10, 651.1002(a)(1)
		BMP 2.2.2.2 Meet NRCS design criteria for flush-lane (alleys) and gutters	NRCA Part 651 Ch. 10, 651.1002(a)(2)
OB 2.3 Design and operate liquid manure storage lagoons, settling basins, and holding ponds to minimize the leaching of nitrate to groundwater	MT 2.3.1 Improve solids separation from manure liquid stream in dairy operations to reduce solids loading into lagoons	BMP 2.3.1.1 Use settling basin (see MT 2.3.3 for basin design and management considerations)	USU – 2010; NRCS Part 651 Ch. 10, 651.1005(a)(2)
		BMP 2.3.1.2 Use mechanical methods	USU – 2010; NRCS Part 651 Ch. 10, 651.1005(a)(2)
		BMP 2.3.1.3 Use weeping wall basins	NDESC 2005
	MT 2.3.2 Improve lagoon nitrogen treatment design and operations	BMP 2.3.2.1 Conduct lagoon treatment performance and adequacy assessment	USU – 2010; NRCS Code 359; NRCS Part 651 Ch. 10, 651.1005 (a)(b)
		BMP 2.3.2.2 Use mechanical aeration for aerobic lagoon treatment	USU -2010; NRCS Part 651 Ch. 10, 651.1005(b)(3)
		BMP 2.3.2.3 Use anaerobic digestion	NRCS Code 359; NDESC 2005; NRCS Part 651 Ch. 10, 651.1005(b)(2)
		BMP 2.3.2.4 Use Oxidation Ditch	NRCS Part 651 Ch. 10, 651.1005(b)(5)
	MT 2.3.3 Improve lagoon, settling basin, and holding pond design and management	BMP 3.3.3.1 Evaluate criteria for siting, investigation, and design of liquid manure storage facilities (both new and for existing facilities)	NRCS Part 651 Ch. 10, Table 10-4
		BMP 2.3.3.2 Use impermeable or low permeable liner (synthetic or clay) material (see NRCS Part 651 Ch. 10, Table 10-4 to assess liner criteria)	NRCS Code 359; NRCS Part 651 Ch. 10, 651.1004(b)
		BMP 2.3.3.3 Ensure lagoons, basins, and holding ponds have capacity to handle stormwater runoff (e.g. 25-year, 24-hour storm event) in addition to normal wastewater	NRCS Code 359; NRCS Part 651 Ch. 10, 651.1004
		BMP 2.3.3.4 Inspect storage structures, pumps and piping, toe and foundation drains, tanks, and treatment	NRCS Part 651, Ch. 13, 651.1302

Livestock Operation Objectives for Reducing Nitrate Loading to Groundwater	Management Target	Best Management Practices	References
		equipment regularly. Use a checklist and keep records of inspections	

Livestock Operation Objectives for Reducing Nitrate Loading to Groundwater	Management Target	Best Management Practices	References
OB 2.3 Design and operate liquid manure storage lagoons, settling basins, and holding ponds to minimize the leaching of nitrate to groundwater	MT 2.3.3 Improve lagoon, settling basin, and holding pond design and management	BMP 2.3.3.5 Keep cows away from storage structure banks	
		BMP 2.3.3.6 Maintain at least 2 feet of freeboard in storage structures at all times and consider an additional structure(s) for diverting runoff and to allow for cleaning of solids from structures	NRCS Part 651, Ch. 13, 651.1302
		BMP 2.3.3.7 Use aboveground waste storage tank for storing liquid manure	NRCS Part 651 Ch. 10, 651.1004(b)
OB 2.4 Design and operate solid manure storage areas to minimize leaching of nitrate to groundwater.	MT 2.4.1. Improve surface management in manure solids holding areas	BMP 2.4.1.1 Assess manure stockpile location and relocate if necessary	NRCS Part 651 Ch. 8
		BMP 2.4.1.2 Control and collect runoff from stockpile areas	NRCS Part 651 Ch. 10, 651.1004(a); EB1746-F8
		BMP 2.4.1.3 Divert clean stormwater runoff away from stockpile areas	NRCS Part 651 Ch. 10, 651.1004(a);EB1746-F8
		BMP 2.4.1.4 Use grassed filter strips below stockpiles	USU-2010
		BMP 2.4.1.5 Measure nitrate in soils down gradient of manure stockpiles to assess nitrate buildup in soils	USU-2010
	MT 2.4.2 Improve manure storage facility design	BMP 2.4.2.1 Properly size solid manure storage areas to account for number and size of animals and number of days in storage	NRCS 313; NRCS Part 651, Ch. 10, 651.1004(a)
		BMP 2.4.2.2 Use roof solid manure storage	NRCS Part 651, Ch. 10, 651.1004(a)
	MT 2.4.3. Improve manure treatment	BMP 2.4.3.1 Use manure composting	NCRS Part 651, Ch. 10, 651.1005(b)(6)
OB 2.5 Manage livestock herd to minimize leaching of nitrate to groundwater	MT 2.5.1 Adjust feed formulation to reduce nitrogen excretion without reducing animal performance	BMP 2.5.1.1 Adjust feeding method to reduce crude protein levels by supplementing with amino acids to reduce N excretion	USU – 2010; NDESC 2005
	MT 2.5.2 Base herd size on land base requirements for manure	BMP 2.5.2.1 Calculate herd size for fixed acreage based on manure management	USU -2010; NRCS Part 651, Ch. 4, 651.0403
	MT 2.5.3 Find alternative outlets for manure land application based on land base requirements for set herd size	BMP 2.5.3.1 Calculate cropland needs for fixed herd size based on manure management	USU -2010; NRCS Part 651, Ch. 4, 651.0403
	MT 2.5.4 Improve livestock pasture management	BMP 2.5.4.1 Manage livestock in pastures based on stocking rates and manage pasture so cattle graze evenly over field	NRCS Part 651, Ch. 9, 651.96; WSU-CE 1992

Source 3. Turfgrass and Other Urban Landscaping

Urban landscaping refers to areas within the Lower Yakima Valley that have turfgrass (e.g., residential lawns, golf courses, parks, athletic fields, school grounds) and non-turfgrass landscaped areas (e.g., ornamental plants). Turfgrass in the valley usually requires nitrogen fertilizer and irrigation. Thus, there is a potential for over application, resulting in nitrate leaching to groundwater.

What controls nitrate leaching to groundwater from turfgrass and other urban landscaping?

- Irrigation practices
- Fertilizer nitrogen management (type, quantity, and timing)
- Vegetation selection and management

Objectives for reducing nitrate Leaching to groundwater from turfgrass and other urban landscaping

1. Design and operate irrigation system to decrease soil water percolation beneath root zone.
2. Make effective use of fertilizer and fertilizer alternatives to maximize plant nitrogen uptake.
3. Select turfgrass and landscape plants that efficiency use nitrate and water.

Best Management Practices for Urban Landscaping

OB = objective; MT = management target; BMP = best management practice

Urban Landscaping Objectives for Reducing Nitrate Loading to Groundwater	Management Target	Best Management Practices	References
OB 3.1 Design and operate landscape irrigation system to decrease soil water percolation beneath root zone	MT3.1.1 Improve irrigation scheduling	BMP 3.1.1.1 Use soil moisture content and soil type to guide irrigation timing and amount	SPU Lawn Care for the PNW; EB 0482;
		BMP 3.1.1.2 Use "weather-smart" irrigation controller to determine frequency and amount of turfgrass and landscaping irrigation	ET Manager™ RainBird (example only: http://www.rainbird.com/landscape/products/controllers/ETmanager.htm)
	MT3.1.2 Improve irrigation system design	BMP 3.1.2.1 Design turfgrass sprinkler system to provide even application of water and design sprinkler sets based on water demand (e.g., have separate set for turfgrass areas in shade versus fully exposed areas, as timing of sets would be different)	EB 0482
		BMP 3.1.2.2 Use drip irrigation for landscape scrubs and individual plants	Peters (WSU)
OB 3.2 Make effective use of fertilizer and fertilizer alternatives to maximize plant uptake	MT 3.2.1. Improve rate, timing, and placement of nitrogen fertilizer and fertilizer alternatives	BMP 3.2.1.1 Conduct soil testing of lawn (ask about through local WSU Extension) to determine nutrient requirements and deficiencies	PNW646, EB1971E
		BMP 3.2.1.2 Use slow release fertilizers such as urea formaldehyde (UF), sulfur coated urea (SCU), or isobutylidine diurea (IBDU) to allow lawns to absorb nutrients more efficiently	EB0482
		BMP 3.2.1.3 Apply fertilizer in multiple applications throughout year instead of a single application with a larger application occurring in September	EB0482
		BMP 3.2.1.4 Apply fertilizer to landscape trees and shrubs at agronomic rates and at recommended times of the year	EB1034
		BMP 3.2.1.5 Make and use compost or buy compost as an alternative to using commercial synthetic fertilizers	EB1971E
		BMP 3.2.1.6 Apply plant or lawn fertilizers only when plants show a need – not for the sole purpose of following a schedule	Ecology #0004048
		BMP 3.2.1.7 Apply just enough nitrogen to lawns to promote dense turf and prevent yellowing to yield a healthier lawn	SPU Lawn Care for the PNW
		BMP 3.2.1.8 Set realistic expectations for lawn and plant appearance, and for the benefits of using fertilizer	SPU Lawn Care for the PNW
		BMP 3.2.1.9 Do not apply fertilizer when heavy rains are predicted that could wash away fertilizer	Ecology #0004048
		BMP 3.2.1.10 Follow directions on fertilizer label when applying	EB0482
		BMP 3.2.1.11 Use cover crops in gardens in the winter to fix nitrogen and till into garden during the spring for use as green manure	EB1971E
		BMP 3.2.1.12 Use a mulching lawn mower to lower the required amount of fertilizer needed to apply to lawn	
OB 3.3 Select Turfgrass and landscape plants that efficiency use nitrate and water	MT 3.3.1 Select plant types that are specific for Lower Yakima Valley	BMP 3.3.1.1 Use drought tolerant cool-season turfgrasses designed for eastern Washington.	EP0482
		BMP 3.3.1.2 Use xeriscaping for landscaping to reduce water and fertilizer demand.	WSU –http://public.wsu.edu/~lohr/wcl/

Source 4. Municipal and Industrial Land Application of Wastewater (including storage and handling)

The land application of industrial and municipal wastewater to cropland is allowed through a State Waste Discharge Permit as required by Chapter 90.48 Revised Code of Washington (RCW) and Chapter 173-216 Washington Administrative Code (WAC). Design criteria for the permitted facilities includes the application of wastewater at agronomic rates and also the requirement to meet the Water Quality Standards for Ground Waters of the State of Washington (Chapter 173-200 WAC).

What controls nitrate leaching to groundwater at a wastewater land application site?

- Irrigation practice
- Crop practice
- N source management (type, quantity, and timing)
- Wastewater storage facilities

Objectives for Reducing Nitrate Leaching to Groundwater from Municipal and Industrial Wastewater Land Application Sites

1. Design and operate irrigation system to decrease soil water percolation beneath root zone.
2. Manage crop plants to maximize NUE[1].
3. Manage wastewater and other sources of N to increase crop NUE.
4. Improve handling, storage, and overall management of wastewater to minimize leaching of nitrate to groundwater.

[1] Nitrogen use efficiency (NUE) - percent N applied to cropland (from all sources) that is recovered by the crop and therefore is not lost to the atmosphere (denitrification) or to surface water or groundwater.

Best Management Practices for Municipal and Industrial Land Treatment and Application of Wastewater (including storage and handling)

OB = objective; MT = management target; BMP = best management practice

Municipal and Industrial Land Treatment and Application of Wastewater Objectives for Reducing Nitrate Loading to Groundwater	Management Target	Best Management Practices	References
OB 4.1 Design and operate irrigation system to decrease soil water percolation beneath root zone	MT 4.1.1. Follow MT 1.1.1 through MT 1.1.6 for Source 1. Irrigated Cropland	BMPs 1.1.1.1 through BMP 1.1.6.2 for Source 1. Irrigated Cropland	See references for Source 1. Irrigated Cropland
OB 4.2 Manage crop plants to maximize NUE	MT 4.2.1. Follow MT 1.2.1 and MT 1.2.2 for Source 1. Irrigated Cropland	BMPs 1.2.1.1 through BMP 1.2.2.1 for Source 1. Irrigated Cropland	See references for Source 1. Irrigated Cropland
OB 4.3 Manage wastewater and other sources of N to increase crop NUE	MT 4.3.1. Improve rate, timing, and placement of wastewater effluent and other nitrogen source applications	BMP 4.3.1.1. Conduct a monitoring program to record facility operation and management practices, monitor effluent variations, monitor treatment effectiveness, evaluate soil and crop treatment effectiveness, and to determine compliance with water quality standards	Ecology #93-36
		BMP 4.3.1.2. Estimate the agronomic rate for a crop and include all sources of nitrogen available during the growing season.	Ecology #04-10-081; PNW 513
		BMP 4.3.1.3. Adjust treatment/application rate based on soil nitrate testing	EM 4885 – IP 3.02.01
		BMP 4.3.2.4. Adjust treatment/application timing based on plant tissue analysis	EM 4885 – IP 3.02.03
		BMP 4.3.1.5. Measure nitrate content of effluent and adjust treatment/application accordingly	EM 4885 – IP 3.02.02
		BMP 4.3.1.6. Cease operation of facility during heavy or prolonged rainfall to prevent ground saturation and runoff	Ecology #04-10-081
		BMP 4.3.1.7. Avoid application of effluent to frozen ground	Ecology #04-10-081
		BMP 4.3.1.8. Follow seasonal application by only applying effluent during the growing season	Ecology #04-10-081
OB 4.4 Improve handling, storage, and overall management of wastewater to minimize leaching of nitrate to groundwater	MT 4.4.1. Site land treatment/application facilities using criteria protective of surface water and groundwater	BMP 4.4.1.1. Provide buffers and setback from any wells near application site	DOH Design Criteria for Municipal WW Land Treatment Systems, Ecology #97-23
		BMP 4.4.1.2. Site facility so applied effluent does not pond or flow into any streams, rivers, lakes, or other water bodies	DOH Design Criteria for Municipal WW Land Treatment Systems, Ecology #97-23
		BMP 4.4.1.3. Provide an appropriate buffer between the facility and any surface water drainage systems	Ecology #93-36, Ecology #97-23
	MT 4.4.2 Follow operational requirements for wastewater land application	BMP 4.4.2.1. Create a farm management plan which addresses irrigation, cropping, harvesting, worker access, and equipment methods	DOH Design Criteria for Municipal WW Land Treatment Systems
		BMP 4.4.2.2. Refrain from allowing livestock to graze in application area to prevent excess nutrient loading and soil compaction	Ecology #93-36
	MT 4.4.3. Construct and operate wastewater storage facilities to prevent groundwater contamination	BMP 4.4.3.1. Design storage facilities to be able to adequately store the volume of wastewater during time frames when land treatment/application is not possible (such as during the winter or non-growing seasons). Include a hydraulic balance analysis considering precipitation, evapotranspiration, and estimated influent volumes.	Ecology #98-37
		BMP 4.4,3.2 Locate and construct storage facilities in a manner where wastes do not overflow or leach into groundwater	Ecology #98-37
		BMP 4.4.3.3. Equip storage facilities with a free-board gauge so that it can be determined when it is necessary to empty or stop filling impoundment to prevent overflow	Ecology #98-37
		BMP 4.4.3.4. Conduct seepage evaluation of storage facilities	Ecology #98-37

Source 5. Sewer Leakage

What controls sewer water leaching from sewers systems?

- Exfiltration of wastewater from damaged, outdated, and/or poorly fitted pipes and collection system components (e.g., manholes).

Objectives for Reducing Wastewater Leaching to Groundwater from Leaking Sewers

- Maintain municipal sewers in a good working order to prevent seepage of sewer water to groundwater.

Best Management Practices for Sewer Leakage

OB = objective; MT = management target; BMP = best management practice

Sewer Leakage Objectives for Reducing Wastewater Loading to Groundwater[1]	Management Target	Best Management Practices	References
OB 5.1 Maintain municipal sewers in a good working order to prevent seepage of sewer water to groundwater	MT 5.1.1. Perform routine inspections to locate sewer leaks and problem areas	BMP 5.1.1.1 Create a maintenance and inspection plan of sewers with a priority focused on older systems (concrete pipes and vitrified clay pipes are considered most problematic)	EPA 832-F-99-031
		BMP 5.1.1.2 Use dye testing to verify illicit connections and determine connectivity between sewer and other systems	Ecology #98-37
		BMP 5.1.1.3 Use smoke testing to locate illicit connections, pipe defects, and other problems in sanitary sewer	Ecology #98-37
		BMP 5.1.1.4 Perform closed circuit television (CCTV) or camera inspection to locate problems in sanitary sewer	EPA 832-F-99-031
		BMP 5.1.1.5 Perform lamping type inspection to locate problems in sanitary sewer near sewer access points	EPA 832-F-99-031
		BMP 5.1.1.6 Use air pressure testing to determine if sewer sections are compromised	Ecology #98-37
	MT 5.1.2. Rehabilitate outdated or inadequate sewer lines	BMP 5.1.2.1. Replacement of compromised sanitary sewer line with new pipe	EPA 832-F-99-031
		BMP 5.1.2.2. Sealing of leaking joints in sanitary sewer line	EPA 832-F-99-031
		BMP 5.1.2.3. Slip line leaking pipe for rehabilitation of sanitary sewer line	Ecology #98-37
		BMP 5.1.2.4. Use cured-in-place-pipe (CIPP) technology for pipe rehabilitation of sanitary sewer line	Ecology #98-37
		BMP 5.1.2.5. Use fold-and-form technology for pipe rehabilitation of sanitary sewer line	Ecology #98-37
		BMP 5.1.2.6. Perform manhole rehabilitation for manholes identified as a location of potential exfiltration	Ecology #98-37

[1] For sewer water, nitrate is expected to be present at low or non-detectable levels. However, once sewer water enters groundwater, the wastewater undergoes mineralization and nitrification resulting in the formation of nitrate.

Source 6. Septic Systems

The following agencies are responsible for regulating on-site domestic (human-derived) wastewater treatment systems in the Lower Yakima Groundwater Management Area:

- Yakima Health District – Authority and approval over individual and small (up to 3,499 gallons/day) on-site sewage systems.
- Washington State Department of Health (WDOH) – Authority and approval over on-site sewage systems designed to handle domestic strength sewage at design flows from 3,500 to 100,000 gallons/day (may include mechanical treatment). Staff also reviews and approves all septic tanks, pump chambers, and other tanks used as part of small and large systems in Washington State.

Objectives for Reducing Nitrate Leaching to Groundwater from On-Site Domestic Waste Treatment Systems

1. Operate, maintain, and repair on-site treatment system to meet performance requirements.
2. Reduce nitrogen loading to soil drainfields.

Best Management Practices for Septic Systems

OB = objective; MT = management target; BMP = best management practice

Reducing Nitrate Leaching to Groundwater from On-Site Domestic Waste Treatment Systems	Management Target	Best Management Practices	References
OB 6.1 Operate, maintain, and repair on-site treatment system to meet performance requirements	MT 6.1.1. Routinely conduct inspections and maintenance on septic system	BMP 6.1.1.1 Have a qualified professional conduct an annual inspection of the septic tank to assess sludge and scum levels, baffles and tees, and drainfield and downslope area	EB1671; WAC 46-272A-0270
		BMP 6.1.1.2 Pump out septic tank when needed	EB1671; WAC 46-272A-0270
		BMP 6.1.1.3. Practice good housekeeping by reducing water use, avoiding flushing of toxic chemicals and hard to digest waste, and protecting the system from physical damage	EB1671; WAC 46-272A-0270
	MT 6.1.2. Repair septic system failures	BMP 6.1.2.1. Repair or replace the on-site septic system with conforming system or component or a system meeting regulatory requirements	WAC 246-272A-0280
OB 6.2 Reduce nitrogen loading to soil drainfields	MT 6.2.1. Improve on-site treatment of nitrogen	BMP 6.2.1.1. Install and operate an on-site nitrogen reduction system to reduce nitrogen concentration entering drainfield	DOH 337-024; WAC 246-272C
	MT 6.2.2. Use alternatives to on-site septic system	BMP 6.2.2.1. Connect to available public wastewater treatment system sewer line and eliminate on-site septic system	
		BMP 6.2.2.2. Compost Toilets	DOH 337-024
		BM P 6.6.2.3 Design, install, and use greywater system for subsurface irrigation	DOH 337-063

Attachment A

Best Management Practice (BMP) References

Source 1. Irrigated Cropland BMP References

EM4885
BUL 869
NRCS Part 651
CSU-XCM-173
NDESC 2005 (II)
FG0052
FG0003
FG0012
FG0005
FG0006
FG0011
FG0008
FG0033
FG0009
FG0036
FG0013
FG0049
FG0050
FG0037
FG0038
FG0029
FG0028C
FG0028E
FG0025
FG0024
EB1722
EB1513
PNW513
Peters and Davenport
EM4821
PNW0475
PNW293
EM4826
EM4828

Source 2. Livestock Operation BMP References

USU – 2010
NRCS Part 651
EM4885
NDESC 2005
NRCS Code 359
NRCS Code 313
EB0820 (WSU-CE 1992)
EB1746-W7

EB1746-F7
EB1746-W8
EB1746-F8

Source 3. Urban Landscaping BMP References

SPU Lawn Care for the PNW
EB0482
ET ManagerTM RainBird
PNW646
EB1971E
EB1034
Ecology #0004048
WSU –http://public.wsu.edu/~lohr/wcl/
Peters

Source 4. Municipal and Industrial Land Treatment and Application of Wastewater BMP References

Ecology #93-36
Ecology #04-10-081
EM 4885
DOH Design Criteria for Municipal WW Land Treatment Systems
Ecology #97-23
Ecology #98-37

Source 5. Sewage Leakage BMP References

Ecology #98-37
EPA 832-F-99-031

Source 6. Septic System BMP References

EB1671
WAC 46-272A (DOH Publication #333-117)
DOH #337-024
WAC 246-272C (DOH Publication #337-065)
DOH #337-063

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CSU-XCM-173	Waskom M, R. (1994). *Best Management Practices for Irrigation Management (Publication XCM-173).* Fort Collins: Colorado State University Cooperative Extension.

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DOH #337-063	Washington State Department of Health. (2012). *Guidance for Performance, Application, Design, and Operation & Maintenance: Tier Two and Three Greywater Subsurface Irrigation Systems Chapter 246-274 WAC (DOH Publication #337-063).* Olympia: Department of Health.
DOH Design Criteria for Municipal WW Land Treatment Systems	Washington State Department of Health. (1994). *Design Criteria for Municipal Wastewater Land Treatment Systems for Public Health Protection.* Olympia: Department of Health.
EB0482	Stahnke, G. K., Brauen, S. E., Byther, R. S., Antonelli, A. L., & Chastagner, G. (2005). *Home Lawns (Publication EB0482).* Pullman: Washington State University Extension.
EB0820	Brauen, S. (1992). *Pasture Management for Small Landowners in Western Washington (Publication EB0820).* Pullman: Washington State University Cooperative Extension.
EB1034	Maleike, R., & Pinyuh, G. (1996). *Fertilizing Landscape Trees and Shrubs (Publication EB1034).* Pullman: Washington State University Cooperative Extension.
EB1513	James, L.G, J.M. Erpenbeck, D.L. Bassett, and J.E. Middleton. *Irrigation Requirements for Washington. Estimates and Methodology* (Publication EB1513). Pullman: Washington State University Extension.
EB1671	Washington State University Cooperative Extension. (2002). *Properly Managing Your Septic Tank System (Publication EB1671).* Pullman: Washington State University Cooperative Extension.
EB1722	Stevens, R. G., Sullivan, D. M., & Cogger, C. G. (1993). *How Fertilizers and Plant Nutrients Affect Groundwater Quality (Publication EB1722).* Pullman: Washington State University Cooperative Extension.
EB1746-F7	Washington State University Cooperative Extension. (1993). *Assessing the Risk of Groundwater Contamination by Improving Animal Manure Storage Fact Sheet 7 (EB1746-F7).* Pullman: Washington State University.
EB1746-W7	Washington State University Cooperative Extension. (1993). *Assessing the Risk of Groundwater Contamination from Animal Manure Storage Worksheet 7 (EB1746-W7).* Pullman: Washington State University.
EB1746-F8	Washington State University Cooperative Extension. (1993). *Assessing the Risk of Groundwater Contamination from Improving Animal Lot Management Fact Sheet 8(EB1746-F8).* Pullman: Washington State University.
EB1746-W8	Washington State University Cooperative Extension. (1993). *Assessing the Risk of Groundwater Contamination from Animal Lot Management Worksheet 8 (EB1746-W8).* Pullman: Washington State University.
EB1971E	Cogger, C. (2005). *Home Gardener's Guide to Soils and Fertilizers (Publication EB1971E).* Pullman: Washington State University Extension.
Ecology #93-36	Washington State Department of Ecology. (1993). *Guidelines for Preparation of Engineering Reports for Industrial Wastewater Land Application Systems (Publication #93-36).* Olympia: Department of Ecology.
Ecology #97-23	Washington State Department of Ecology. (1997). *Water Reclamation and Reuse Standards (Publication #97-23).* Olympia: Department of Ecology.
Ecology #98-37	Washington State Department of Ecology. (2008). *Criteria for Sewage Works Design (Publication #98-37 WQ).* Olympia: Department of Ecology.

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Ecology #04-10-081	Washington State Department of Ecology. (2004). *Guidance on Land Treatment of Nutrients in Wastewater, with Emphasis on Nitrogen (Publication #04-10-081).* Olympia: Department of Ecology.
EM4821	Ley, T. W. (2003). *Visual Crop Moisture Stress Symptoms (Publication EM4821).* Pullman: Washington State University Cooperative Extension.
EM4828	Ley, T. W., & Leib, B. (2003). *Surface Irrigation Systems (Publication EM4828).* Pullman: Washington State University Cooperative Extension.
EM4885	Canessa, P., & Hermanson, R. (1995). *Irrigation Management Practices to Protect Ground Water and Surface Water Quality State of Washington (Publication EM 4885).* Pullman: Washington State University Cooperative Extention.
EPA 832-F-99-031	United States Environmental Protection Agency. (1999). *Collection Systems O&M Fact Sheet: Sewer Cleaning and Inspection (Publication EPA 832-F-99-031).* Washington D.C.: Environmental Protection Agency.
ET ManagerTM RainBird	Rain Bird. (2013, August 28). *ET Manager*. Retrieved from Rain Bird: Sprinkler Systems, Commercial Irrigation, Residential Irrigation, Lawn Sprinklers, Drip Irrigation, Golf Course Irrigation and Agricultural Irrigation: http://www.rainbird.com/landscape/products/controllers/ETmanager.htm
FG0003	Washington State University Cooperative Extension. (1980). *Fertilizer Guide: Irrigated Alfalfa Central Washington (FG0003).* Pullman: Washington State University.
FG0005	Washington State University Cooperative Extension. (1980). *Fertilizer Guide: Irrigated Field Beans for Central Washington (FG0005).* Pullman: Washington State University.
FG0006	Washington State University Cooperative Extension. (1979). *Fertilizer Guide: Irrigated Field Corn for Grain or Silage (FG0006).* Pullman: Washington State University.
FG0008	Washington State University Cooperative Extension. (1980). *Fertilizer Guide: Irrigated Mint Central Washington (FG0008).* Pullman: Washington State University.
FG0009	Washington State University Cooperative Extension. (1977). *Fertilizer Guide: Irrigated Small Grains, Central Washington (FG0009).* Pullman: Washington State University.
FG0011	Washington State University Cooperative Extension. (1977). *Fertilizer Guide: Irrigated Hops for Central Washington (FG0011).* Pullman: Washington State University.
FG0012	Washington State University Cooperative Extension. (1982). *Fertilizer Guide: Irrigated Asparagus (FG0012).* Pullman: Washington State University.
FG0013	Washington State University Cooperative Extension. (1983). *Fertilizer Guide: Irrigated Vineyards for Entire State (FG0013).* Pullman: Washington State University.
FG0024	Washington State University Cooperative Extension. (1982). *Fertilizer Guide: Lawns, Playfields and Other Turf, East and Central Washington (FG0024).* Pullman: Washington State University.
FG0025	Washington State University Cooperative Extension. (1980). *Fertilizer Guide: Peas and Lentils for Eastern Washington (FG0025).* Pullman: Washington State University.

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FG0033	Washington State University Cooperative Extension. (1977). *Fertilizer Guide: Irrigated Peas for Central Washington (FG0033).* Pullman: Washington State University.
FG0036	Washington State University Cooperative Extension. (1978). *Fertilizer Guide: Irrigated Sudangrass Pasture or Silage (FG0036).* Pullman: Washington State University.
FG0037	Washington State University Cooperative Extension. (1980). *Fertilizer Guide: Improved Pasture, Hay, Eastern Washington (FG0037).* Pullman: Washington State University.
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FG0049	Washington State University Cooperative Extension. (1983). *Fertilizer Guide: Ornamentals, Entire State Except Central Irrigated Washington (FG0049).* Pullman: Washington State University.
FG0050	Washington State University Cooperative Extension. (1982). *Fertilizer Guide: Vegetable and Flower Gardens, Except Irrigated Central Washington (FG0050).* Pullman: Washington State University.
FG0052	Washington State University Cooperative Extension. (1982). *Fertilizer Guide: Home Vegetable Gardens, Irrigated Central Washington (FG0052).* Pullman: Washington State University.
NDESC 2005	National Dairy Environmental Stewardship Council. (2005). *Cost-effective and Environmentally Beneficial Dairy Manure Management Practices.* San Francisco: Sustainable Conservation.
NRCS Code 313	Natural Resources Conservation Service. (2007). *Conservation Practice Standard: Waste Storage Facility (Code 313).* Washington D.C.: NRCS.
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PNW646	Collins, D., Miles, C., Cogger, C., & Koenig, R. (2013). *Soil Fertility in Organic Systems: A Guide for Gardeners and Small Acreage Farmers (Publication PNW646).* Pullman: Washington State University Extension.
SPU Lawn Care for the PNW	McDonald, D. (1999). *Ecologically Sound Lawn Care for the Pacific Northwest.* Seattle: Seattle Public Utilities.
USU - 2010	Davis, J. G., Koenig, R. T., & Flynn, R. P. (2010). *Manure Best Management Practices: A Practical Guide for Dairies in Colorado, Utah and New Mexico.* Logan, Utah: Utah State University Cooperative Extension.
WAC 46-272A	Washington State Department of Health. (2007). *Rules and Regulations of the State Board of Health: On-site Sewage Systems Chapter 246-272A WAC (Publication #333-117).* Olympia: Department of Health.
WAC 246-272C	Washington State Department of Health. (2012). *Rules and Regulations of the State Board of Health: On-site Sewage System Tanks Regulations Chapter 246-272C WAC (Publication #337-065).* Olympia: Department of Health.
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Attachment C

- GWAC Self-Assessment Survey

1. Meetings are well organized and begin and end on time.

Answer Options	Strongly disagree	Somewhat disagree	Don't feel strongly	Somewhat agree	Strongly agree	Rating Average	Response Count
	1	1	1	3	12	4.33	18
						answered question	18
						skipped question	0

2. GWAC members have opportunity to express themselves on issues under discussion

Answer Options	Strongly disagree	Somewhat disagree	Don't feel strongly	Somewhat agree	Strongly agree	Rating Average	Response Count
	0	3	1	3	11	4.22	18
						answered question	18
						skipped question	0

3. The "rules of engagement" under which the GWAC does its work are clear

Answer Options	Strongly disagree	Somewhat disagree	Don't feel strongly	Somewhat agree	Strongly agree	Rating Average	Response Count
	0	4	2	6	6	3.78	18
						answered question	18
						skipped question	0

4. The facilitation support for the GWAC is appropriate

Answer Options	Strongly disagree	Somewhat disagree	Don't feel strongly	Somewhat agree	Strongly agree	Rating Average	Response Count
	1	1	2	5	9	4.11	18
						answered question	18
						skipped question	0

5. The facilitator makes sure everyone has an equal opportunity to participate

Answer Options	Strongly disagree	Somewhat disagree	Don't feel strongly	Somewhat agree	Strongly agree	Rating Average	Response Count
	1	1	1	3	11	4.29	17
						answered question	17
						skipped question	1

6. In general, participating in the GWAC is a valuable use of my time

Answer Options	Strongly disagree	Somewhat disagree	Don't feel strongly	Somwhat agree	Strongly agree	Rating Average	Response Count
	1	6	1	5	5	3.39	18
						answered question	18
						skipped question	0

7. The GWAC has been effective in communicating to the community how to be involved in the development of the GWMA program

Answer Options	Strongly disagree	Somewhat disagree	Don't feel strongly	Somewhat agree	Strongly agree	Rating Average	Response Count
	2	5	6	5	0	2.78	18
						answered question	18
						skipped question	0

8. The GWAC has been effective in communicating to the community how to be involved in the advisory committee

Answer Options	Strongly disagree	Somewhat disagree	Don't feel strongly	Somewhat agree	Strongly agree	Rating Average	Response Count
	2	4	6	6	0	2.89	18
						answered question	18
						skipped question	0

9. • There is improved ability for members to talk with each other since the beginning of the GWAC

Answer Options	Strongly disagree	Somewhat disagree	Don't feel strongly	Somewhat agree	Strongly agree	Rating Average	Response Count
	2	2	3	9	2	3.39	18
						answered question	18
						skipped question	0

10. Trust is present between GWAC members

Answer Options	Strongly disagree	Somewhat disagree	Don't feel strongly	Somewhat agree	Strongly agree	Rating Average	Response Count
	11	2	5	0	0	1.67	18
						answered question	18
						skipped question	0

11. Member's contributions are being fully considered

Answer Options	Strongly disagree	Somewhat disagree	Don't feel strongly	Somewhat agree	Strongly agree	Rating Average	Response Count
	1	6	2	8	1	3.11	18
						answered question	18
						skipped question	0

12. I am comfortable contributing ideas to the group

Answer Options	Strongly disagree	Somewhat disagree	Don't feel strongly	Somewhat agree	Strongly agree	Rating Average	Response Count
	1	4	1	9	3	3.50	18
						answered question	18
						skipped question	0

13. I am getting to know other GWAC participants more as people and less as advocates for an interest

Answer Options	Strongly disagree	Somewhat disagree	Don't feel strongly	Somewhat agree	Strongly agree	Rating Average	Response Count
	2	7	2	7	0	2.78	18
						answered question	18
						skipped question	0

14. The group works well together and is following through with the stated group agreements

Answer Options	Strongly disagree	Somewhat disagree	Don't feel strongly	Somewhat agree	Strongly disgree	Rating Average	Response Count
	7	2	1	8	0	2.56	18
						answered question	18
						skipped question	0

15. The GWAC has made progress towards its goals since it began meeting

Answer Options	Strongly disagree	Somewhat disagree	Don't feel strongly	Somewhat agree	Strongly agree	Rating Average	Response Count
	4	4	2	4	4	3.00	18
						answered question	18
						skipped question	0

16. I can point to progress in the group's work to reduce groundwater contamination

Answer Options	Strongly disagree	Somewhat agree	Don't feel strongly	Somewhat agree	Strongly agree	Rating Average	Response Count
	7	3	0	6	1	2.47	17
						answered question	17
						skipped question	1

17. I am learning more regarding the problems with groundwater contamination in the Lower Yakima Valley

Answer Options	Strongly disagree	Somewhat disagree	Don't feel strongly	Somewhat agree	Strongly agree	Rating Average	Response Count
	1	5	1	6	5	3.50	18
						answered question	18
						skipped question	0

18. There is a greater understanding of the problems being addressed In the community

Answer Options	Strongly disagree	Somewhat disagree	Don't feel strongly	Somewhat agree	Strongly agree	Rating Average	Response Count
	2	4	5	6	1	3.00	18
						answered question	18
						skipped question	0

19. The GWAC's working groups are making progress towards their objectives

Answer Options	Srongly disagree	Somewhat disagree	Don't feel strongly	Somewhat agree	Strongly agree	Rating Average	Response Count
	1	3	1	11	2	3.56	18
						answered question	18
						skipped question	0

20. Discussion and dialog among GWAC participants has increased my knowledge about the issues

Answer Options	Strongly disagree	Somewhat disagree	Don't feel strongly	Somewhat agree	Strongly agree	Rating Average	Response Count
	0	5	1	6	6	3.72	18
						answered question	18
						skipped question	0

21. The GWAC meetings are contributing to my knowledge of potential overlaps, trade-offs and conflicts that are involved in developing the GWMA program

Answer Options	Strongly disagree	Somewhat disagree	Don't feel strongly	Somewhat agree	Strongly agree	Rating Average	Response Count
	1	1	2	7	7	4.00	18
						answered question	18
						skipped question	0

22. I come to meetings adequately prepared (have read materials ahead of time)

Answer Options	Strongly disagree	Somewhat disagree	Don't feel strongly	Somewhat agree	Strongly agree	Rating Average	Response Count
	0	2	1	9	6	4.06	18
						answered question	18
						skipped question	0

23. I am communicating the work of the GWAC with my constituents and bringing their thoughts and concerns to the GWAC for consideration

Answer Options	Strongly disagree	Somewhat disagree	Don't feel strongly	Somewhat agree	Strongly agree	Rating Average	Response Count
	0	1	1	10	6	4.17	18
						answered question	18
						skipped question	0

24. I have followed through on tasks and assignments in order to help move the process forward

Answer Options	Strongly disagree	Somewhat disagree	Don't feel strongly	Somewhat agree	Strongly agree	Rating Average	Response Count
	1	0	0	10	7	4.22	18
						answered question	18
						skipped question	0

25. I am participating fully in at least one working group

Answer Options	Strongly disagree	Somewhat disagree	Don't feel strongly	Somewhat agree	Strongly agree	Rating Average	Response Count
	2	0	1	2	13	4.33	18
						answered question	18
						skipped question	0

26. Is there anything you would like to add?

Answer Options	Response Count
	10
answered question	10
skipped question	8

Number		Response Text Categories
1		It takes patience and willing to work with others and other points of view.
2		At our last meeting we had an honest discussion of some things that had been left unsaid for a long time. While it was good to get things on the table, it frankly left me with the feeling that we had no hope of accomplishing our goal.
3		I have only just joined a working group as I'm fairly new to the group.
4		My comments: 3. The "rules of engagement" under which the GWAC does its work are clear - At times the rules of engagement are so restrictive that we don't discuss anything substantive 11. Member's contributions are being fully considered - I worry that some people with bureaucratic power are sabotaging the process. Members of the EPO group spent a great deal of time developing a survey of health care providers - the physicians and assistants who interact directly with people regarding their health. The Yakima Health District was given the task of conducting this survey. They did not send it to the targeted individuals. They sent it to office managers, laboratories, pharmacies, dentists and even medical supply companies like Keeler's Medical supply. 13. I am getting to know other GWAC participants more as people and less as advocates for an interest - I talked with one of my constituents this week. He observed that government, most specifically the EPA, wants everyone to be friends, sit around the campfire and sing "Kum Bay Ya". He added that we already have lots of friends. Our purpose in coming to the meetings is to protect our friends from pollution, not replace them. 16. "Somewhat agree" is offered twice and there is no option for "somewhat disagree" 19. The GWAC's working groups are making progress towards their objectives - In many cases there are no measureable objectives. 23. I am communicating the work of the GWAC with my constituents and bringing their thoughts and concerns to the GWAC for consideration - One of the major concerns for my constituents - the adverse health and economic effects of groundwater pollution was very firmly taken off the table at the beginning of the discussions. I would like to share information with the Spanish speaking community. There have been major road blocks. The chairman "forgot" about a meeting with a group of Hispanic leaders last year. The EPO group has still not discussed translation of minutes into Spanish. Thank you for hearing my worries. Jean Mendoza
5		We have GWAC members who are RUDE and continually interrupt others when they speak to push THEIR groups view point.This needs to stop.
6		Although nitrate contamination has probably not been reduced yet as a result of the GWMA, the plan is on track. If it stays on track, nitrate reduction will eventually occur. We need to all take ownership in finding a way for producers to participate in field data collection. Otherwise, it will be very difficult for the GWMA process to stay on track and fulfill its mission.
7		Still people speaking from positions rather than at the table to improve ground water quality

8		I have more at stake with Nitrates in the ground water than anyone else at the GWAC meetings. I have 3500 animals that drink from the ground water, 35 employee families that drink the ground water and my family drinks the ground water. It is VERY dissappointing to me that there is a strong undercurrent of prosecution, littigation and laying blame for the situation coming from this group. i thought coming in that the citizens in the GWMA would pull together to help identify ways to correct this issue ovewr a period of years. Perhaps it is because so many members do not even live in the actual GWMA area, and are only interested in promoting their own agenda. I think that removing two or three members would greatly improve the function of the committee and would go a long way to improvfing the trust of the GWAC among producers, the people who will need to make the change for change. Why are we not listening to the experience of the other GWMA'swe have heard from? Because the interest is not to move forward as quickly as possible to improve the ground water but to prosecute and litigate the people they want to lay the blame on. My land will NEVER be used for testing because I have an idea what went on on this land proior to my purchasing it. I beleive that I have improved the land dramtically but am now afrqaid to try to verify that because of the threats if it is not as good as I want or that some of the issues have now moved further down. A neighbor told me they had a child die from nitrate issues in the 1980's, over 10 years prior to my purchasing the land. Am I to be responsible for that? I also think that Penny was fairly effective in the first several meetings but has lost some of her effectiveness. I was put off last meeting when Helen came into the room that Penny coddled her but when Leno walked in seeral minutes later that Penny completely ignored him. Why do different memberws receive diffenet treatment? Why do meetings last so long? If the talk is ficused on the issues then we can acheive everything that we should in 2 hours. There is no need to go beyond that time as people will only misuse this time. I believe it is important to discuss the lack of trust producers, who will be the most affected by the GWMA,and perhaps ask some members to resign to gain the trust so that we can move forward. Tom's response that if producers don't go along he will prosecute them is one of the reasons for the distrust in the first place. If the desire of the GWAC is to improve ground water quality as soon as possible, and certain members are preventing that then they should step asside for the good of the citizens of the GWMA. I enjoy many people who attend. It is good to get to know them better. I want this to succeed. We mostly have the right people to make a successful effort. after 18months, lets get the right people in the right seats, the people who don't desire success, or only success of their agenda,off of the bus and let's get this thing moving forward meaningfully. Sincerely, Dan DeGroot
9		Operating bylaw is not being followed ie - members need to participate and attend. If not they are to be removed. Some members are not participating in the consensus model. They are taking independent actions outside the GWAC process. Members lack trust, credibility and are more interested to using the GWAC as a podium to put forth an agenda.
10		The lawsuits against some of the growers are poisoning the group.

Attachment D

- Standardized GWAC Talking Points
- High Risk Well Assessment Bilingual Outreach Materials
  - Invitation to Households
  - Chairman Rand Elliott's Letter to Newspaper Editors and Distribution List
  - News Releases
  - Outreach Budget and Radio Schedule
- Yakima Health District Contract Amendment

GWMA Mission

Groundwater Management Area (GWMA):

The goal of the Lower Yakima Valley GWMA is to reduce nitrate contamination concentrations in groundwater below state drinking water standards.

LOWER YAKIMA VALLEY GROUNDWATER ADVISORY COMMITTEE

Groundwater Management Area (GWMA)

Background

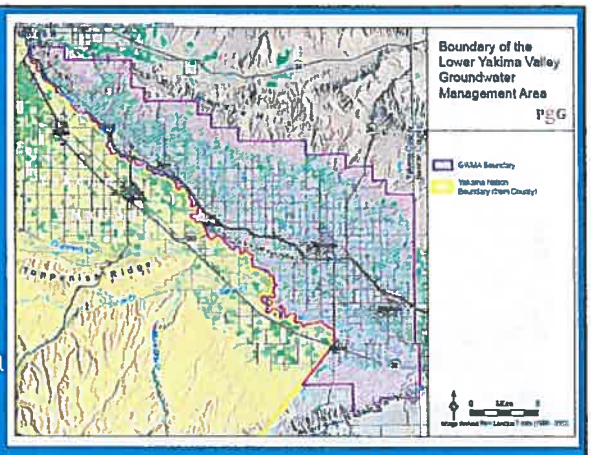
- In 2011, the Lower Yakima Valley Groundwater Management Area (GWMA) was formed to address nitrate contamination in groundwater.
- The GWMA is a response to the elevated nitrate levels found in the Lower Yakima Valley which exceed the state standard of 10.0 mg/L.
- Private drinking water wells with nitrate levels higher than the state standard, pose a greater health risk to those individuals susceptible to elevated nitrate in their drinking water.

LOWER YAKIMA VALLEY GROUNDWATER ADVISORY COMMITTEE

Groundwater Management Area (GWMA)

GWMA Boundaries

The GWMA boundaries extend west from Union Gap east to County Line Road, minus the Yakama Nation.



The GWMA encompasses 175172.66 acres or 273.7 square miles.

http://www.yakimacounty.us/gwma/documents/GWMA_Boundary.pdf

LOWER YAKIMA VALLEY GROUNDWATER ADVISORY COMMITTEE

Groundwater Management Area (GWMA)

What the GWMA Intends to Do:

Yakima County requested Dept of Ecology to recognize the GWMA and provide assistance for helping reduce the nitrate level in the groundwater. Objectives include:

- Data Collection, Monitoring and Analysis.
- Public Education and Outreach.
- Problem Identification.
- Potential Measures or Practices for Reducing Groundwater Contamination.

LOWER YAKIMA VALLEY GROUNDWATER ADVISORY COMMITTEE

Groundwater Management Area (GWMA)

GWMA GroundWater Advisory Committee

- The Lower Yakima Valley Groundwater Management Area Committee (GWAC) is responsible for developing the (GWMA) plan.
- The GWAC is a multi-agency and citizen-based group with 22 primary members and alternates.
  - To learn about their progress or to attend a meeting, please visit:
    http://www.yakimacounty.us/gwma/meetings.php

LOWER YAKIMA VALLEY GROUNDWATER ADVISORY COMMITTEE

Groundwater Management Area (GWMA)

GWMA GroundWater Advisory Committee Membership

Commissioner Rand Elliott,
Yakima County Board of Commissioners

Vern Redifer, P.E. (alternate),
Yakima County Public Services

Lower Yakima Valley GWAC Members and Alternates

http://www.yakimacounty.us/gwma/members.php

LOWER YAKIMA VALLEY GROUNDWATER ADVISORY COMMITTEE

Groundwater Management Area (GWMA)

GWMA Working Groups:

http://yakimacounty.us/GWMA/

Livestock / CAFO
Chair: Charlie McKinney

Irrigated Agriculture
Chair: Jim Trull

Residential, Commercial, Industrial, Municipal
Chair: Robert Farrell

Data Collection, Characterization, Monitoring
Chair: Kirk Cook

Regulatory Framework
Chair: Tom Eaton

Education & Public Outreach
Chair: Lisa Freund

Funding
Chair: Pending

LOWER YAKIMA VALLEY GROUNDWATER ADVISORY COMMITTEE

Groundwater Management Area (GWMA)

GWAC Work Groups

Work groups were convened to provide focused information and plans for the objectives identified in the request.

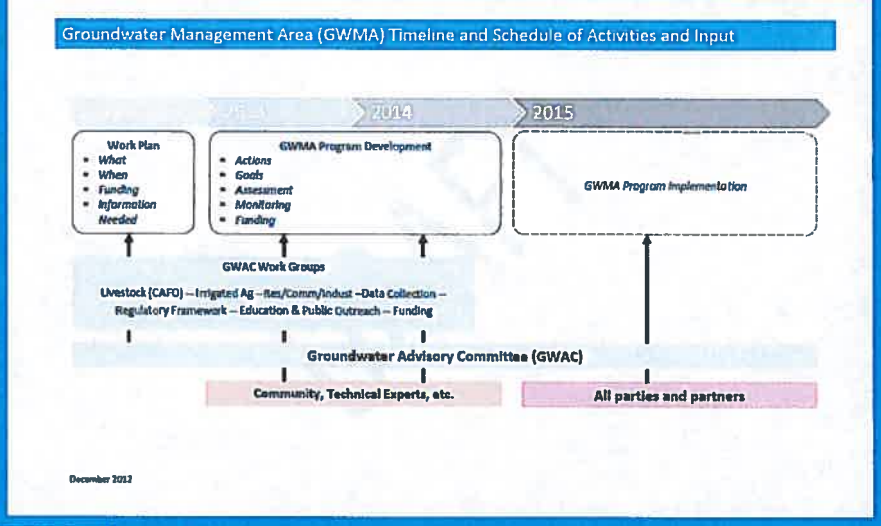
The GWMA website offers reference material and guides users to agency partners who have additional information.

The work group meetings are posted on the website and are open to the public just like the committee meetings.

LOWER YAKIMA VALLEY GROUNDWATER ADVISORY COMMITTEE

Groundwater Management Area (GWMA)

GWMA Timeline



LOWER YAKIMA VALLEY GROUNDWATER ADVISORY COMMITTEE

Groundwater Management Area (GWMA)

Citizen-Based Pollution Prevention

Pollution prevention will be a guiding principle for all work.

A coordinated effort to address groundwater contamination in the Yakima Basin.

Seeks credibility with the general public, the farming community, stakeholders, and special interest groups.

Multiple approaches including education, technical assistance and accountability strategies.

LOWER YAKIMA VALLEY GROUNDWATER ADVISORY COMMITTEE

Groundwater Management Area (GWMA)

How To Get It Done?

Identify the primary sources of nitrate contamination using scientific data.

Identify or develop practices that will minimize nitrate contamination of groundwater

Develop a plan that recommends strategies for implementing improved practices

Provide appropriate education and outreach on health risks and how to prevent exposure.

LOWER YAKIMA VALLEY GROUNDWATER ADVISORY COMMITTEE

Groundwater Management Area (GWMA)

How To Get It Done?

Citizen surveys.

Multi-language media outreach.

Health community education, awareness and participation.

Partnerships with Agricultural businesses and employers, farming community, special interest groups, medical organizations, and other interested stakeholders.

LOWER YAKIMA VALLEY GROUNDWATER ADVISORY COMMITTEE

Groundwater Management Area (GWMA)

How Can You Help?

Encourage participation in GWAC-sponsored well testing and surveys.

- Free well water sampling to Lower Valley residents is now underway.
- The sampling and survey take about 30 minutes.
- Results will be available in March 2014.
- To participate, contact the Yakima Health District Help Desk at 509.249.6508.

LOWER YAKIMA VALLEY GROUNDWATER ADVISORY COMMITTEE

Groundwater Management Area (GWMA)

Summary

The goal of the LYV GWMA is the reduction of nitrate levels in the groundwater to below state standards.

Previous studies conducted by EPA and others, have shown a significant problem with elevated nitrate in the shallow aquifer.

Nitrate is an Acute contaminant which can affect those residents at higher risk from nitrate rather quickly, and from a single exposure.

The biggest threat is to the private wells, that are shallow, poorly constructed, poorly located, and rarely tested.

Surveys within the LYV with residents may continue as a tool for providing outreach to residents.

LOWER YAKIMA VALLEY GROUNDWATER ADVISORY COMMITTEE

Groundwater Management Area (GWMA)

Contact

Who do I report suspected nitrate contamination to?

Yakima County Health District Communicable Disease Report Line: 509-249-6521

For information about water quality, treatment, options, call the Environmental Health help desk at 509-249-6508

On the Yakama Nation

Indian Health Services Environmental Health

Shawn Blackshear 509-865-1776

Shawn.blackshear@ihs.gov

For more information on the Lower Yakima Valley Groundwater Management Area or the Groundwater Advisory Committee, please visit: http://www.yakimacounty.us/gwma/

Thank you for your interest.

LOWER YAKIMA VALLEY GROUNDWATER ADVISORY COMMITTEE

Groundwater Management Area (GWMA)

LOWER YAKIMA VALLEY

GROUNDWATER ADVISORY COMMITTEE

Groundwater Management Area (GWMA):
The purpose of the GWMA is to reduce nitrate contamination concentrations in groundwater below state drinking water standards

December 13, 2013

Dear Resident:

The Lower Yakima Valley Groundwater Advisory Committee (GWAC) in partnership with the Yakima Health District is offering *free* nitrate and coliform tests for private and shared wells. This is a part of an ongoing effort to help residents in the Lower Yakima Valley learn more about the water quality and impact to public health of the area's drinking water.

We are writing to encourage you to participate in a short survey that should only take about 30 minutes. The survey is a quick look at conditions surrounding your well that may impact water quality and the health of your family. The samples will show if the water quality may also be a concern to your family's health. The short survey and samples will be completed by an environmental health specialist from the Yakima Health District.

The testing is paid for by state funds made available to Yakima County to address areas where there may be high levels of nitrate in drinking water. The survey will help us understand the conditions that exist around the wells and how to best help the residents. It is not our intention to collect personal data for any other use or purpose.

All information collected will be made available to you and will help you make informed decisions about your drinking water and your family's health.

To learn more about the program and to set up an appointment to participate, please call the Yakima Health District Help Desk at 509-249-6508. Surveys will be conducted in the months of January through March.

The Lower Yakima Valley GWAC is a multiagency and citizen-based group coordinating efforts to reduce nitrate contamination in drinking water in the Lower Yakima Valley. To learn more about the GWAC, please visit: http://www.yakimacounty.us/gwma/.

We look forward to working with you.

Sincerely,

J. Rand Elliott, Yakima County Commissioner
Chairman
The Lower Yakima Valley Groundwater Management Area Advisory Committee

LOWER YAKIMA VALLEY

GROUNDWATER ADVISORY COMMITTEE

Groundwater Management Area (GWMA):
The purpose of the GWMA is to reduce nitrate contamination concentrations in groundwater below state drinking water standards

13 de diciembre, 2013

Estimado residente:

El Comité Asesor del Área de Manejo de Agua Subterránea del Valle Bajo de Yakima (GWAC) en asociación con el Distrito de Salud de Yakima está ofreciendo pruebas *gratis* de nitrato y bacterias coliformes para los pozos privados y compartidos. Como parte de un esfuerzo continuo para ayudar a los residentes en el Valle Bajo de Yakima a informarse más sobre la calidad y el impacto que tiene el agua para beber del área en la salud pública.

Lo animamos a que participe en una encuesta corta que sólo debe tomar aproximadamente 30 minutos. La encuesta es un vistazo rápido a las condiciones que rodean su pozo y que pueden afectar la calidad del agua y su salud y la de su familia. Las muestras mostrarán si la calidad del agua pudiera ser también una preocupación para la salud de su familia. La encuesta corta y las muestras serán tomadas por un especialista en salud ambiental del Distrito de Salud de Yakima.

Las pruebas son pagadas con fondos disponibles del estado para el Condado de Yakima para tratar áreas donde pueda haber niveles altos de nitrato en el agua para beber. La encuesta nos ayudará a entender las condiciones que existen alrededor de los pozos y la manera de apoyar mejor a los residentes. No es nuestra intención recolectar datos personales para ningún otro uso o propósito.

Toda la información recolectada estará disponible para usted y le ayudará a tomar decisiones informadas acerca de su agua para beber y la salud de su familia.

Para más información sobre el programa y para hacer una cita para participar, por favor llame a la línea de ayuda del Distrito de Salud de Yakima al 509-249-6508. Se realizarán las encuestas en los meses de enero a marzo.

El comité GWAC del Valle Bajo de Yakima es un grupo formado por varias agencias y ciudadanos que coordinan los esfuerzos para reducir la contaminación por nitrato en el agua para beber en el Valle bajo de Yakima. Para más información acerca de GWAC, visite: http://www.yakimacounty.us/gwma/.

Esperamos poder trabajar con usted.

Atentamente,

J. Rand Elliott, Presidente de Comisionados del Condado de Yakima
Comité Asesor del Área de Manejo de Agua Subterránea del Valle Bajo de Yakima

NAME	TITLE	COMPANY	ADDRESS	CITY	ST	ZIP	EMAIL
Richard Burger	Editor	Grandview Herald/Prosser Record Bulletin	107 Divison St.	Grandview	WA	98930	richard.burger@recordbulletin.com
Eric Peterson	Editor	Review-Independent	PO Box 2052	Toppenish	WA	98948	epeterson@yvpub.com
Bob Crider	Editor	Yakima Herald-Republic	PO Box 9668	Yakima	WA	98907	bcrider@yakimahearld.com
Bob Story	Editor	Sunnyside Daily Sun News	PO Box 878	Sunnyside	WA	98944	bstory@eaglenewspaper.com

LOWER YAKIMA VALLEY

GROUNDWATER ADVISORY COMMITTEE

Groundwater Management Area (GWMA):
The purpose of the GWMA is to reduce nitrate contamination concentrations in groundwater below state drinking water standards

December 12, 2013

Bob Story, Editor
Sunnyside Daily Sun News
PO Box 878
Sunnyside, WA 98944

To the Editor:

As the chairman of the Lower Yakima Valley Groundwater Advisory Committee (GWAC), I wanted to let your readers know about an important opportunity to have their wells tested for free as a part of our effort to assist citizens and learn more about the health of the drinking water in the Lower Yakima Valley.

The committee, which includes residents and interested groups from the Lower Yakima Valley, has been making progress to find solutions related to nitrate and bacterial contamination found in some of the drinking water wells in the Lower Yakima Valley.

Not all water supplies in the area have been impacted. Public water systems in the area maintain safe and reliable drinking water supplies. However many of the homes in the Lower Yakima Valley are served by private or shared wells, and there is enough data to suggest that many of these wells are at risk from surface contaminants.

I want to encourage all residents to participate in the sampling program. It will only take about 30 minutes. The information gathered in the Lower Yakima Valley for the committee will only be used to evaluate the typical water quality in the groundwater. The survey will help us understand the conditions that exist around the wells and how to best help the residents. It is not our intention to collect personal data for any other use or purpose.

Residents who participate will receive copies of their sample results. This is so they can make an informed decision about their drinking water and their family's health.

Affected residents will be receiving a letter in the mail. To learn more about the program and to set up an appointment to participate, please call the Yakima Health District Help Desk at 509-249-6508. Appointments can be scheduled right now with results expected in March.

To learn more about the GWAC, please visit: http://www.yakimacounty.us/gwma/.

Sincerely,

J. Rand Elliott, Yakima County Commissioner
Chairman
The Lower Yakima Valley Groundwater Management Area Advisory Committee

LOWER YAKIMA VALLEY

GROUNDWATER ADVISORY COMMITTEE

Groundwater Management Area (GWMA):
The purpose of the GWMA is to reduce nitrate contamination concentrations in groundwater below state drinking water standards

12 de diciembre, 2013

Al Editor:

Como presidente del Comité Asesor del Área de Manejo de Agua Subterránea del Valle Bajo de Yakima (GWAC), quiero informar a sus lectores acerca de una importante oportunidad para que sus pozos sean evaluados gratis como parte de nuestros esfuerzos de apoyo a la ciudadanía y para enterarnos acerca de lo saludable que es el agua para beber en el Valle Bajo de Yakima.

El comité, el cual incluye residentes y grupos interesados del Valle Bajo de Yakima, ha estado progresando en encontrar soluciones relacionadas con la contaminación por bacteria y nitrato encontrada en algunos de los pozos de agua para beber en el Valle Bajo de Yakima.

No todos los suministros de agua en el área han sido afectados. Los sistemas de agua pública en el área mantienen suministros de agua para beber segura y confiable. Sin embargo, hay muchos datos que indican que los pozos privados o compartidos de hogares del Valle Bajo de Yakima están en riesgo de exponerse a contaminantes superficiales.

Quiero animar a todos los residentes para que participen en el programa de pruebas. Sólo tomará aproximadamente 30 minutos. La información que reúna el comité en el Valle Bajo de Yakima únicamente se usará para evaluar la calidad típica del agua subterránea. La encuesta nos ayudará a entender las condiciones que existen alrededor de los pozos y la manera de apoyar mejor a los residentes. No es nuestra intención recolectar datos personales para ningún otro uso o propósito.

Los residentes que participen recibirán copias de los resultados de sus muestras de agua. Esto es para que puedan tomar una decisión informada acerca del agua para beber y la salud de su familia.

Los residentes afectados recibirán una carta por correo. Para más información sobre el programa y para hacer una cita para participar, por favor llame a la línea de ayuda del Distrito de Salud de Yakima al 509-249-6508. Las citas se pueden programar desde ahora y esperamos ya tener los resultados en marzo.

Para más información acerca de GWAC, visite: http://www.yakimacounty.us/gwma/.

Atentamente,

J. Rand Elliott, Presidente de Comisionados del Condado de Yakima
Comité Asesor del Área de Manejo de Agua Subterránea del Valle Bajo de Yakima

LOWER YAKIMA VALLEY

GROUNDWATER ADVISORY COMMITTEE

Groundwater Management Area (GWMA):
The purpose of the GWMA is to reduce nitrate contamination concentrations in groundwater below state drinking water standards

Lower Valley Groundwater Citizens Group
Offering Free Private Well Testing

FOR IMMEDIATE RELEASE: MONDAY, DECEMBER 16, 2013

CONTACT: Lisa Freund, Yakima County Public Services Administrative Manager
Office: 509-574-2300
Cell: 509-961-0470

Yakima – The Lower Yakima Valley Groundwater Advisory Committee (GWAC) in partnership with the Yakima Health District is offering free nitrate and coliform tests to private and shared wells as part of an ongoing effort to help residents in the Lower Yakima Valley learn more about the water quality and impact to public health of the area's drinking water.

To participate, households must be served by a private or shared well within the Lower Yakima Valley Groundwater Management Area (GWMA) and be willing to take part in a well assessment survey. An environmental health specialist from the Yakima Health District will complete both the well assessment survey and take the samples from the wells. The visit will take about 30 minutes at most, and all of the information, including well water test results, will be made available to the households.

The information collected will help the GWAC understand the conditions that exist around the wells and how to best help the residents. The survey is not intended to collect personal data for any other purpose.

To learn more about the program and to set up an appointment to participate, please call the Yakima Health District Help Desk at 509-249-6508. Appointments can be scheduled right now. Any concerns about water quality, sample results or the site survey will be explained to the participants, with sample results expected to be completed by March.

To learn more about the GWAC, please visit:
http://www.yakimacounty.us/gwma/.

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Public Services

128 North Second Street · Fourth Floor Courthouse · Yakima, Washington 98901
(509) 574-2300 · 1-800-572-7354 · FAX (509) 574-2301 · www.co.yakima.wa.us
VERN M. REDIFER, P.E., Director

El Comité Asesor Ciudadano de Agua Subterránea del Valle Bajo de Yakima
Está ofreciendo pruebas gratis a pozos privados

PARA OUBLICACIÓN INMEDIATA: LUNES 16 DE DICIEMBRE, 2013

CONTACTO: Lisa Freund, Yakima County Public Services Administrative Manager
Oficina: 509-574-2300
Celular: 509-961-0470

Yakima – Comité Asesor del Área de Manejo de Agua Subterránea del Valle Bajo de Yakima (GWAC) en asociación con el Distrito de Salud de Yakima está ofreciendo pruebas *gratis* de nitrato y bacteria coliforme a pozos privados y de uso compartidos como parte de un esfuerzo continuo para ayudar a los residentes en el Valle Bajo de Yakima a informarse más sobre la calidad y el impacto que tiene el agua para beber del área en la salud pública.

Para participar, las viviendas deben usar agua de un pozo privado o compartido dentro del Área de Manejo de Agua Subterránea del Valle bajo de Yakima (GWMA) y estar dispuesto a tomar parte en una encuesta de evaluación del pozo. Un especialista en salud ambiental del Distrito de Salud de Yakima hará la encuesta de evaluación del pozo y tomará las muestras de los pozos. La visita tomará aproximadamente 30 minutos y toda la información, incluyendo los resultados de las pruebas del agua de los pozos, estará disponible para usted.

La información recolectada ayudará a GWAC a entender las condiciones que existen alrededor de los pozos y la manera de ayudar mejor a los residentes. La encuesta no tiene la intención de recolectar datos personales para ningún otro propósito.

Para más información sobre el programa y para hacer una cita para participar, por favor llame a la línea de ayuda del Distrito de Salud de Yakima al 509-249-6508. Desde ahora usted puede llamar para hacer una cita. A los participantes se les responderá cualquier duda o preocupación que tengan acerca de la calidad del agua, de los resultados de las muestras o de la encuesta. Esperamos tener los resultados en marzo.

Para más información acerca de GWAC, visite el sitio:
http://www.yakimacounty.us/gwma/.

###

GWAC High Risk Well Assessment Sampling
Outreach Budget
Dec. 2013 - March 2014

Outreach	Distribution Date(s)	Expenses	Sub Total	Total
Direct mail #1 600 invitations to Participate	Dec. 13, 2013			**$676**
		Printing 600 letters & Envelopes	$350	
		Labels	$50	
		Postage ($.46 X 600)	$276	
Direct mail #2 Reminder card	Jan. 17, 2014			**$466**
		Printing 600 cards	$140	
		Labels	$50	
		Postage ($.46 X 600)	$276	
Flyers (1000)	Jan-March 2014			**$150**
		Printing	$150	
Translation	Dec 2013 - March 2014			**$350**
		Spanish language, all outreach materials ($50.00/page)	$350	
Radio Advertising	Dec. 28-Jan. 25 (includes weekend)			**$5000**
		See next page, Ad program	$5000	
Balance for contingencies of $7,000 budget				**$358**
		Printing	$358	

GRAND TOTAL **$7000**

ATTACHMENT

GWAC High Risk Well Assessment Sampling
Radio Advertising Program
Dec. 2013-Feb. 2014

Radio station	Run dates	price/spot	Paid spot/free spot	Sub Total	Total
KZTA-Spanish	Dec. 28-Jan. 25 (includes weekend)	$15/spot	60/(TBD)	$900.00	
KIT-English	Dec. 28-Jan. 25		88 spots (22/week)	$1,032.00	
The Bull	Jan. 4-Feb 1		88 spots (22/week)	$872.00	
KDNA – Spanish	Dec. 30-Jan. 27		88 spots 1 Public Affairs slot	$1,000.00	
La Familia	Jan. 4 – Feb. 1		60 spots or?? Per budget	$900.00	
					4,704.00
Balance for contingencies of $5,000 budget					**296.00**
					$5000

AMENDMENT # 1
AGREEMENT BETWEEN YAKIMA HEALTH DISTRICT AND YAKIMA COUNTY PUBLIC SERVICES DEPARTMENT

THIS AMENDMENT is made to the agreement dated June 25, 2013 between the County of Yakima, Washington (hereinafter called the "County") whose address is Yakima County Courthouse, 128 N. 2nd St., fourth floor, Yakima, WA 98901 and the Yakima Health District (hereinafter referred to as the "Health District") 1210 Ahtanum Ridge Dr., Yakima, WA 98903.

It is mutually agreed that the above referenced Agreement shall be revised to extend the term of this Agreement to March 31, 2014. All other provisions remain unchanged.

IN WITNESS THEREOF, the County and the Health District have executed this amendment as of the date and year last written below.

DONE this 25th day of November 2013

YAKIMA HEALTH DISTRICT

Andre Fresco, MSEPH
Administrator, Yakima Health District

Attest: Tiera L. Girard
Clerk of the Board

Approved as to form:
Deputy Prosecuting Attorney

BOARD OF YAKIMA COUNTY COMMISSIONERS

Michael D. Leita, Chairman

Kevin J. Bouchey, Commissioner

Excused
J. Rand Elliott, Commissioner
Constituting the Board of County Commissioners for Yakima County, Washington

BOCC608-2013
December 3, 2013

Attachment E

- **Calculations to Allocate Soil Samples in 2014 – Revision 1**

PACIFIC groundwater GROUP

Technical Memorandum

To: Laurie Crowe and Jim Trull

From: Pony Ellingson, PGG

Copy: Don Gatchilian, Yakima County; and Mike Murray, HDR

Re: Calculations to Allocate Soil Samples in 2014 – Revision 1

Date: November 25, 2013

This memo provides for review a basis for allocating soil samples for the Lower Yakima Valley Groundwater Management Area Deep Soil Sampling Plan (DSSP) in 2014. The method used to allocate samples was described in an attachment to the DSSP and discussed at our Irrigated Agriculture Working Group meeting of October 24, 2013; however, slight modifications have been made in response to data and further consideration. Two changes were made for this revision: 1) a table was added listing the acreages for crop types according to WSDA, and 2) primary crops have been listed in Tables 4 and 5 along with the rooting depth group, as requested. No changes were made to calculations. The method used to generate the information in this memo consists of the following steps:

1. Calculate the average NRCS N leaching potential (NLP) for each field in the GWMA including the EPA order area. WSDA field polygons were intersected with NRCS soil mapping units (and related NLPs) in GIS to perform this step.
2. Determine a crop group for each field using three groups based on rooting depth (RD): RD > 4, 2.5 < RD < 4, and RD < 2.5. Table 1 shows how crops were grouped by rooting depth and Table 2 presents WSDA crop data in decreasing order of acreage in the GWMA.
3. Determine an irrigation group for each field using WSDA irrigation type and the following groups: drip, sprinker, surface. Table 3 shows how the more numerous WSDA irrigation types were further categorized into three GWMA irrigation groups. There is some uncertainty when reducing to the GWMA's three groups since WSDA has some single fields with more than one irrigation type (eg: "drip and rill" becomes the GWMA "drip").
4. Categorize each field in the GWMA using the three parameters above: average NRCS N leaching potential, crop group, irrigation group.
5. Add up acreage of fields within each category and rank them from high acreage to low acreage. The acreage for crop and irrigation categories defined by WSDA "unknowns" were deleted at this stage.
6. Allocate the number of fields to be sampled in each category considering budget and the category acreage. We provide an example that allocates one field for each 1% of the total acreage in the GWMA – for a total of 100 fields targeted for sam-

pling. You could easily modify this method by allocating 0.5 or 1.5 fields per each 1% of the total acreage in the GWMA, which would result in 50 or 150 fields sampled, respectively. The DSSP describes a slightly different method of allocation which could also be considered.

Two options were generated by altering the ranges of NLP used to define categories. Option 1 (Table 4) has three equal NLP ranges (0-0.33, 0.34-0.66, 0.67-1.0). Option 2 (Table 5) weights the higher NLPs (high leaching risk) greater by increasing the range over which fields with high NLP values are grouped (0-0.25, 0.26-0.5, 0.51-1.0).

Table 6 compares the options, which don't differ greatly even though option 2 is intended to cause categories with higher NLP values to have greater acreage, and thus be sampled more. The top 10 categories in options 1 and 2 comprise 96 % and 94 % of the GWMA acreage, respectively (Table 6). Of the top 10 categories, 4 and 5 categories in options 1 and 2 (respectively) are in the maximum NLP range (indicating that option's 2 emphasis on high NLPs worked to a small degree). In neither option does a category with a minimum NLP value make the top 10. The top 10 categories are 90% duplicated between the options (for this comparison we classed the NLP values as high, medium, or low).

If one field is sampled for each 1% of the GWMA acreage, the number of fields sampled for each category is equal to the "Percent of Acreage" column on Tables 3 and 4. This approach results in a sampling of 100 fields total, regardless of the method of creating categories. A preliminary cost estimate for sampling 100 fields was submitted previously.

Table 1. GWMA Crop Groups Based on Rooting Depth
Lower Yakima Valley GWMA

GWMA_Grp_Crop	WSDA CropType	WSDA Description
Unknown/NA	Developed	Ag land taken out of production. This may be either vacant with the potential for development, or has already been developed.
Unknown/NA	Unknown	Not been surveyed & confirmed yet; or not able to determine crop.
Unknown/NA	Fallow	Fallow is agricultural land not in current production. This may be unplanted, bare, crop-free, unsown, uncultivated, or idle ground.
<2.5 feet	Onion	Includes bulb onions and chalets.
<2.5 feet	Mint	Includes spearmint, peppermint, and native mint.
<2.5 feet	Cucumber	
<2.5 feet	Market Crops	Includes a variety of mixed fresh market crops such as onion, sweet corn, radish, pepper, etc. These are pimarily truck farms, and many sell produce at local farm outlets.
<2.5 feet	Nursery, Orchard/Vineyard	
<2.5 feet	Pepper	
<2.5 feet	Carrot Seed	
<2.5 feet	Nursery, Ornamental	
<2.5 feet	Driving Range	Golf Course Driving Range - recreation.
<2.5 feet	Golf Course	
<2.5 feet	Nursery, Greenhouse	
<2.5 feet	Iris	Field grown.
2.5 to 4 feet	CRP/Conservation	Conservation Reserve Program is a voluntary subsidy program of the USDA. Planted to conservation grasses or wildlife feed. CRP/CREP in this database is unverified as that determination is made by FSA.
2.5 to 4 feet	Corn, Sweet	Sweet corn is often double-cropped after green peas, especially in center pivot operations. Consider this when analyizing data.
2.5 to 4 feet	Watermelon	
2.5 to 4 feet	Wildlife Feed	Grown for wildlife only, usually it's corn or barley for migratory birds.
2.5 to 4 feet	Squash	
2.5 to 4 feet	Timothy	Hay
2.5 to 4 feet	Tomato	
2.5 to 4 feet	Sorghum	Usually grown for silage.
2.5 to 4 feet	Grass Hay	Includes mixtures of various grasses, and includes hay or silage uses. This field may also be grazed, which is a common practice.
2.5 to 4 feet	Corn Seed	Sweet or field corn seed.
2.5 to 4 feet	Pasture	Grazed. All pastures are mapped in Western WA and primarily irrigated pastures are mapped in Eastern WA. Pastures are mid-high quality grazing lands. Rangeland or scabland is not included.
2.5 to 4 feet	Pumpkin	
2.5 to 4 feet	Wheat Fallow	Part of the wheat system, in which the land is idle for a year to collect moisture to grow a crop and break disease cycles. Includes summer fallow and chem fallow.
2.5 to 4 feet	Triticale	Grown as cereal grain or for triticale hay or silage. This is a hybrid cross between wheat ("triticum") and rye ("secale").
2.5 to 4 feet	Rye	Grown as cereal grain or for rye hay/silage.
2.5 to 4 feet	Oat	Grown as cereal grain or for oat hay.
2.5 to 4 feet	Corn, Field	Grain corn or silage corn.
2.5 to 4 feet	Sudangrass	Grown for silage or hay.
2.5 to 4 feet	Wheat	Grown as cereal grain or for wheat hay. Wheat is mapped as a wheat system. In dryland areas of the state, a wheat/fallow rotation is used primarily for moisture reasons.
2.5 to 4 feet	Barley	Grown as cereal grain or for barley hay.
2.5 to 4 feet	Christmas Tree	Includes all types of christmas trees, noble, douglas fir, scotch pine, frazier fir, grand fir, etc
2.5 to 4 feet	Barley Hay	Usually beardless barley
2.5 to 4 feet	Grape, Juice	Juice grapes include Concord and Niagara varieties.
2.5 to 4 feet	Grape, Wine	
2.5 to 4 feet	Green Manure	Usually grass, wheat, barley or rye grown to add organic matter to soil, weed suppression, or to prevent soil erosion.
>4 feet	Alfalfa/Grass Hay	Alfalfa and grass hay mixtures.
>4 feet	Rhubarb	
>4 feet	Hops	
>4 feet	Cherry	Sweet and tart cherries are not differentiated.
>4 feet	Orchard, Unknown	
>4 feet	Walnut	
>4 feet	Blueberry	
>4 feet	Plum	Includes plums and plumcots.
>4 feet	Nectarine/Peach	Nectarine and Peach are not differentiated, thus mapped as one.
>4 feet	Apricot	
>4 feet	Apple	
>4 feet	Asparagus	
>4 feet	Pear	
>4 feet	Alfalfa Hay	Hay
>4 feet	Poplar	Hybrid variety grown for paper or pallet wood.
>4 feet	Caneberry	Includes raspberry, marionberry, and blackberry. The majority of WA caneberry acreage is red raspberry.

Table 2. GWMA Crop Types by Acreage
Lower Yakima Valley GWMA

CropType	Total Records (fields)	Total Acres
Corn, Field	727	21,084
Apple	984	18,327
Grape, Juice	690	11,657
Alfalfa Hay	359	7,715
Cherry	740	6,927
Hops	271	6,344
Pasture	716	5,971
Grape, Wine	352	5,497
Pear	408	4,016
CRP/Conservation	17	3,881
Fallow	500	3,721
Wheat	89	3,187
Wheat Fallow	13	1,908
Mint	86	1,657
Grass Hay	116	1,285
Sudangrass	50	1,276
Triticale	26	1,215
Alfalfa/Grass Hay	87	1,057
Asparagus	66	1,035
Nectarine/Peach	106	978
Developed	117	729
Nursery, Ornamental	22	352
Apricot	54	339
Barley	12	242
Market Crops	39	225
Corn, Sweet	26	203
Squash	13	174
Plum	40	171
Golf Course	9	148
Onion	7	147
Wildlife Feed	9	145
Timothy	3	141
Pumpkin	7	128
Pepper	5	120
Rye	6	104
Corn Seed	2	101
Unknown	2	78
Oat	7	62
Barley Hay	1	56
Green Manure	7	50
Nursery, Orchard/Vineyard	12	46
Cucumber	4	43
Sorghum	1	40
Blueberry	5	28
Orchard, Unknown	2	27
Caneberry	4	19
Iris	3	17
Poplar	3	14
Tomato	3	14
Nursery, Greenhouse	2	7
Walnut	2	7
Carrot Seed	1	6
Christmas Tree	1	4
Driving Range	1	4
Watermelon	1	3
Rhubarb	1	3
	6837	112,735

Table 3. GWMA Irrigation Groups Based on WSDA Irrigation Types
Lower Yakima Valley GWMA

GWMA_Group	WSDA Irrigation_Type	WSDA Description
Drip	Drip/Rill	Combination of types
Drip	Drip	Drip lines, low volume
Drip	Drip/Sprinkler	Combination of types
None/Unk	Unknown	Unknown type - but is irrigated somehow
None/Unk	None	No irrigation visible or known to exist
Sprinkler	Wheel Line	Lateral move sprinklers - includes large overhead
Sprinkler	Big Gun/Sprinkler	Combination of types
Sprinkler	Sprinkler	Various sprinkler types - hand line, solid set etc
Sprinkler	Big Gun/Center Pivot	Combination of types
Sprinkler	Big Gun/Wheel Line	Combination of types
Sprinkler	Center Pivot	Center pivot operation, also inlcudes lateral move
Sprinkler	Sprinkler/Wheel Line	Combination of types
Sprinkler	Center Pivot/Rill	Combination of types
Sprinkler	Center Pivot/Sprinkler	Combination of types
Sprinkler	Center Pivot/Sprinkler/Wheel Line	Combination of types
Sprinkler	Center Pivot/Wheel Line	Combination of types
Sprinkler	Big Gun	Large single nozzle with large water volume
Sprinkler	Micro Sprinkler	Micro emitter sprinklers - low volume
Surface	Rill/Wheel Line	Combination of types
Surface	Rill/Sprinkler	Combination of types
Surface	Flood	Field is flooded without furrows, free flowing
Surface	Rill	Ditch or furrow irrigated, includes gated pipe

Table 4. Field Categories Ranked by Total Acreage for Option 1 (3 equal NLP ranges)
Lower Yakima Valley GWMA

Parameter 1	Parameter 2	Parameter 3					
NLP Class	GWMA_Grp_ Irrigation	GWMA_Grp_ Crop	Primary Crops[1]	Number of Fields	SUM_of_ Acres	Percent of Acreage	Cummulative percent of acreage
0.34-0.66	Sprinkler	2.5 to 4 feet	corn, grapes, pasture, wheat, grass hay, sudangrass, triticale	1114	21,715	24	24
0.34-0.66	Sprinkler	>4 feet	tree fruit, alfalfa, hops, asparagus	1747	21,693	24	48
0.67-1.0	Sprinkler	>4 feet	tree fruit, alfalfa, hops, asparagus	740	12,576	14	62
0.34-0.66	Surface	2.5 to 4 feet	corn, grapes, pasture, wheat, grass hay, sudangrass, triticale	619	10,605	12	74
0.67-1.0	Sprinkler	2.5 to 4 feet	corn, grapes, pasture, wheat, grass hay, sudangrass, triticale	357	5904	7	81
0.34-0.66	Drip	>4 feet	tree fruit, alfalfa, hops, asparagus	210	4428	5	86
0.34-0.66	Drip	2.5 to 4 feet	corn, grapes, pasture, wheat, grass hay, sudangrass, triticale	173	3086	3	89
0.34-0.66	None/Unk	2.5 to 4 feet	corn, grapes, pasture, wheat, grass hay, sudangrass, triticale	40		0	89
0.67-1.0	Surface	2.5 to 4 feet	corn, grapes, pasture, wheat, grass hay, sudangrass, triticale	119	2283	3	92
0.67-1.0	Drip	2.5 to 4 feet	corn, grapes, pasture, wheat, grass hay, sudangrass, triticale	146	2118	2	94
0.34-0.66	Surface	>4 feet	tree fruit, alfalfa, hops, asparagus	109	1384	2	96
0.67-1.0	Drip	>4 feet	tree fruit, alfalfa, hops, asparagus	57	1190	1	97
0.34-0.66	None/Unk	Unknown/NA		183		0	97
0.67-1.0	None/Unk	Unknown/NA		101		0	97
0.34-0.66	Sprinkler	Unknown/NA		178		0	97
0.34-0.66	Surface	<2.5 feet	fallow, mint	51	723	1	98
0.34-0.66	Sprinkler	<2.5 feet	fallow, mint	52	667	1	99
0.67-1.0	Sprinkler	Unknown/NA		77		0.0	99
0.67-1.0	None/Unk	2.5 to 4 feet	corn, grapes, pasture, wheat, grass hay, sudangrass, triticale	16		0.0	99
0.34-0.66	Drip	<2.5 feet	fallow, mint	14	314	0.4	99
0-0.33	Sprinkler	2.5 to 4 feet	corn, grapes, pasture, wheat, grass hay, sudangrass, triticale	14	287	0.3	99
0.67-1.0	Surface	>4 feet	tree fruit, alfalfa, hops, asparagus	16	181	0.2	99
0.34-0.66	Surface	Unknown/NA		15		0.0	99
0.67-1.0	Surface	<2.5 feet	fallow, mint	14	130	0.1	100
0.34-0.66	None/Unk	>4 feet	tree fruit, alfalfa, hops, asparagus	12		0.0	100
0.67-1.0	Drip	<2.5 feet	fallow, mint	5	100	0.1	100
0.67-1.0	Sprinkler	<2.5 feet	fallow, mint	14	97	0.1	100
0-0.33	Sprinkler	>4 feet	tree fruit, alfalfa, hops, asparagus	4	87	0.1	100
0-0.33	None/Unk	2.5 to 4 feet	corn, grapes, pasture, wheat, grass hay, sudangrass, triticale	2		0.0	100
0-0.33	Surface	2.5 to 4 feet	corn, grapes, pasture, wheat, grass hay, sudangrass, triticale	2	31	0.0	100
0.67-1.0	Drip	Unknown/NA		1		0.0	100
0.67-1.0	Surface	Unknown/NA		3		0.0	100
0.67-1.0	None/Unk	<2.5 feet	fallow, mint	1		0.0	100
0-0.33	Sprinkler	<2.5 feet	fallow, mint	2	5	0.0	100
0.34-0.66	Drip	Unknown/NA		2		0.0	100
0.67-1.0	None/Unk	>4 feet	tree fruit, alfalfa, hops, asparagus	3		0.0	100
0-0.33	None/Unk	Unknown/NA		1		0.0	100
0-0.33	drip	2.5 to 4 feet	corn, grapes, pasture, wheat, grass hay, sudangrass, triticale	1	2	0.0	100
					89,603		

1. In order of decreasing acreage in GWMA. See Table 1 for a complete list of WSDA crop types included in this root depth range

Table 5. Field Categories Ranked by Total Acreage for Option 2 (3 NLP ranges: 0-0.25, 0.26-0.5, 0.51-1.0)
Lower Yakima Valley GWMA

Parameter 1	Parameter 2	Parameter 3					
NLP Class	GWMA_Grp_ Irrigation	GWMA_Grp_ Crop	Primary Crops[1]	Number of Fields	SUM_of_ Acres	Percent of Acreage	Cummulative percent of acreage
0.51-1.0	Sprinkler	>4 feet	tree fruit, alfalfa, hops, asparagus	1032	18,097	20	20
0.25-0.5	Sprinkler	>4 feet	tree fruit, alfalfa, hops, asparagus	1456	16,203	18	38
0.25-0.5	Sprinkler	2.5 to 4 feet	corn, grapes, pasture, wheat, grass hay, sudangrass, triticale	899	15,321	17	55
0.51-1.0	Sprinkler	2.5 to 4 feet	corn, grapes, pasture, wheat, grass hay, sudangrass, triticale	575	12,356	14	69
0.25-0.5	Surface	2.5 to 4 feet	corn, grapes, pasture, wheat, grass hay, sudangrass, triticale	479	8057	9	78
0.51-1.0	Surface	2.5 to 4 feet	corn, grapes, pasture, wheat, grass hay, sudangrass, triticale	261	4861	5	84
0.25-0.5	Drip	>4 feet	tree fruit, alfalfa, hops, asparagus	176	3592	4	88
0.51-1.0	Drip	2.5 to 4 feet	corn, grapes, pasture, wheat, grass hay, sudangrass, triticale	190	3058	3	91
0.25-0.5	None/Unk	2.5 to 4 feet	corn, grapes, pasture, wheat, grass hay, sudangrass, triticale	31		0	91
0.25-0.5	Drip	2.5 to 4 feet	corn, grapes, pasture, wheat, grass hay, sudangrass, triticale	129	2145	2	93
0.51-1.0	Drip	>4 feet	tree fruit, alfalfa, hops, asparagus	91	2026	2	96
0.51-1.0	None/Unk	Unknown/NA		128		0	96
0.25-0.5	Surface	>4 feet	tree fruit, alfalfa, hops, asparagus	90	1045	1	97
0.51-1.0	None/Unk	2.5 to 4 feet	corn, grapes, pasture, wheat, grass hay, sudangrass, triticale	25		0	97
0.25-0.5	None/Unk	Unknown/NA		156		0	97
0.25-0.5	Sprinkler	Unknown/NA		151		0	97
0.51-1.0	Sprinkler	Unknown/NA		104		0	97
0.25-0.5	Surface	<2.5 feet	fallow, mint	51	723	1	98
0.51-1.0	Surface	>4 feet	tree fruit, alfalfa, hops, asparagus	35	520	1	98
0.25-0.5	Sprinkler	<2.5 feet	fallow, mint	41	485	1	99
0.51-1.0	Sprinkler	<2.5 feet	fallow, mint	25	279	0.3	99
0.51-1.0	Drip	<2.5 feet	fallow, mint	10	248	0.3	99
<= 0.25	Sprinkler	2.5 to 4 feet	corn, grapes, pasture, wheat, grass hay, sudangrass, triticale	11	229	0.3	100
0.25-0.5	Drip	<2.5 feet	fallow, mint	9	166	0.2	100
0.51-1.0	Surface	<2.5 feet	fallow, mint	14	130	0.1	100
0.25-0.5	None/Unk	>4 feet	tree fruit, alfalfa, hops, asparagus	12		0.0	100
0.51-1.0	Surface	Unknown/NA		9		0.0	100
0.25-0.5	Surface	Unknown/NA		9		0.0	100
<= 0.25	None/Unk	2.5 to 4 feet	corn, grapes, pasture, wheat, grass hay, sudangrass, triticale	2		0.0	100
<= 0.25	Sprinkler	>4 feet	tree fruit, alfalfa, hops, asparagus	3	57	0.1	100
0.51-1.0	Drip	Unknown/NA		1		0.0	100
0.51-1.0	None/Unk	<2.5 feet	fallow, mint	1		0.0	100
<= 0.25	Sprinkler	<2.5 feet	fallow, mint	2	5	0.0	100
0.25-0.5	Drip	Unknown/NA		2		0.0	100
0.51-1.0	None/Unk	>4 feet	tree fruit, alfalfa, hops, asparagus	3		0.0	100
<= 0.25	None/Unk	Unknown/NA		1		0.0	100
<= 0.25	Drip	2.5 to 4 feet	corn, grapes, pasture, wheat, grass hay, sudangrass, triticale	1	2	0.0	100
					89,603		

1. In order of decreasing acreage in GWMA. See Table 1 for a complete list of WSDA crop types included in this root depth range

Table 6. Comparison of Options 1 and 2
Lower Yakima Valley GWMA

Option	1					2				
Strategy	Three equal NLP classes (0-0.33, 0.34-0.66, 0.67-1.0)					Three NLP classes (0-0.25,0.26-0.5,0.51-1.0) Emphasize higher NLP				
	WSDA "unknowns" excluded					WSDA "unknowns" excluded				
Category Rank	NRCS Nitrate Leaching Potential	Irrigation Group	Crop Rooting Depth	Acreage	Cummulative Percent Acreage	NRCS Nitrate Leaching Potential	Irrigation Group	Crop Rooting Depth	Acreage	Cummulative Percent Acreage
1	0.34-0.66	Sprinkler	2.5 to 4 feet	21,715	24	0.51-1.0	Sprinkler	>4 feet	18,097	20
2	0.34-0.66	Sprinkler	>4 feet	21,693	48	0.25-0.5	Sprinkler	>4 feet	16,203	37
3	0.67-1.0	Sprinkler	>4 feet	12,576	62	0.25-0.5	Sprinkler	2.5 to 4 feet	15,321	54
4	0.34-0.66	Surface	2.5 to 4 feet	10,605	74	0.51-1.0	Sprinkler	2.5 to 4 feet	12,356	68
5	0.67-1.0	Sprinkler	2.5 to 4 feet	5,904	81	0.25-0.5	Surface	2.5 to 4 feet	8,057	76
6	0.34-0.66	Drip	>4 feet	4,428	86	0.51-1.0	Surface	2.5 to 4 feet	4,861	82
7	0.34-0.66	Drip	2.5 to 4 feet	3,086	89	0.25-0.5	Drip	>4 feet	3,592	86
8	0.67-1.0	Surface	2.5 to 4 feet	2,283	92	0.51-1.0	Drip	2.5 to 4 feet	3,058	89
9	0.67-1.0	Drip	2.5 to 4 feet	2,118	94	0.25-0.5	Drip	2.5 to 4 feet	2,145	91
10	0.34-0.66	Surface	>4 feet	1,384	96	0.51-1.0	Drip	>4 feet	2,026	94
Fraction of top 10 categories with maximum NLP:	4 of 10					5 of 10				
Fraction of top 10 categories with minimum NLP	0 of 10					0 of 10				
Percent Duplication of categories in top 5	100%									
Percent duplication of categories in top 10	90%									

Attachment F

- **Draft Potential Groundwater Monitoring Stations – December 3, 2013**

PACIFIC groundwater GROUP

POTENTIAL GROUNDWATER MONITORING STATIONS
YAKIMA GROUNDWATER MANAGEMENT AREA

DECEMBER 3, 2013

POTENTIAL GROUNDWATER MONITORING STATIONS
YAKIMA GROUNDWATER MANAGEMENT AREA

Prepared for:

HDR Inc., Yakima County, and
Lower Yakima Valley Groundwater Advisory Committee

Prepared by:

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December 3, 2013
JE1302

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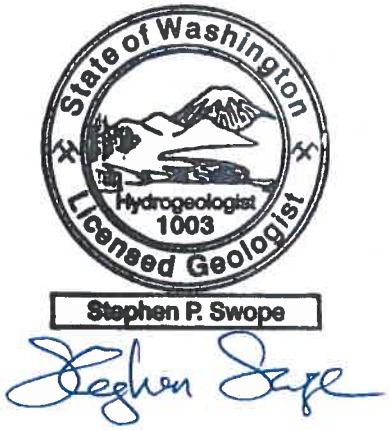
SIGNATURE

This report, and Pacific Groundwater Group's work contributing to this report, were reviewed by the undersigned and approved for release.



Stephen Swope
Principal Hydrogeologist
Washington State Hydrogeologist No. 1003

1.0 EXECUTIVE SUMMARY

The purpose of this report is to present analysis of water quality trends, evaluation of spatial data gaps, and selection of monitoring stations for long term groundwater monitoring.

Nitrate data were provided to Pacific Groundwater Group (PGG) by Yakima County, who compiled data from the United States Geologic Survey (USGS), Yakima Health District, Valley Institute for Research and Education (VIRE), and Yakima County's own nitrate survey database. Additional data from the United States Environmental Protection Agency (EPA) were added by PGG but data from the area covered by the consent order between EPA and several dairies were not included. Data were imported into a consistently formatted water quality database to be submitted as an electronic deliverable to Yakima County. The WQ database contains nitrate results from 2,532 samples.

The WQ database includes geographic locations and a unique well ID for all nitrate samples, although the geographic locations are often approximate. Most nitrate samples also contain address locations.

Well depths are available for 63 percent of the samples and range from 1.17 feet in alluvium to 2,715 feet below ground surface in basalt. Half of the well depths are shallower than 136 feet. Nitrate concentrations are at or below the natural background level of 0.3 mg/L in 14.3 percent of samples. Nitrate concentrations exceed the GWMA-adopted water quality goal of 10 mg/L in 12.9 percent of samples. PGG evaluated the database, including use of statistics, to identify the number and distribution of monitoring stations, and the numbers of samples that are necessary to meet several of the GWMA monitoring objectives listed below:

- Fill spatial data gaps
- Monitor hot spots
- Track increasing concentration trends
- Measure basin-wide average concentration
- Monitor common water supply aquifers
- Measure effects of current and future practices
- Address health risks

Yakima County will visit the wells recommended by PGG through this evaluation, and verify conditions at the prospective monitoring stations. These visits will be combined with the Education and Outreach Committee's High Risk Well Assessment Survey. Wells that meet accessibility and construction criteria will be used as monitoring stations to meet each objective. Final design of the sampling programs to meet these objectives will be contained in a future deliverable scheduled for February 2014. The following paragraphs summarize analysis and recommendations for each objective:

Spatial Data Gaps: The largest five areas without nitrate data were identified as spatial data gaps. The areas range from 4.7 to 12.9 square miles. Existing wells were identified in those areas for field verification with the goal of identifying a single well in each area to serve as a monitoring station.

Hot Spots: PGG identified 71 "hot spots" with maximum nitrate concentrations in excess of 20 mg/L. Assuming an acceptance rate of 15 percent (owner acceptance, good physical conditions, etc.) to be verified by field visits, we expect to monitor approximately 15 percent of these hot spots (10 monitoring stations).

Increasing Trends: Of the 46 wells with at least 10 samples that have been collected over time, seven had a statistically significant increasing trend in nitrate concentrations, and nine had a statistically significant decreasing trend. The sample locations with increasing trends warrant monitoring because they are likely most to sensitive to land use changes, and may also pose a health risk if the increase is rapid enough. PGG thus recommends field verification and monitoring of the seven wells with increasing trend. All these wells are public water supply wells that are sampled for nitrate to meet WDOH requirements. As part of final evaluation of these stations, the GWMA will consider the frequency of monitoring conducted to meet WDOH requirements, frequency of monitoring necessary to meet GWMA objectives, and whether special QA/QC requirements imposed by the GWMA project dictate that the GWMA project collect its own samples.

Basin-Wide Average: PGG used the simple random approach to identify the number of monitoring stations that need to be sampled to measure the basin-wide-average at a level of confidence that supports use of the data for GWMA purposes. Those purposes include comparison of a current average to past and future averages, and comparison of averages to the GWMA-adopted water quality goal of 10 mg/L nitrate. The largest number of samples is required for a comparison of averages collected at different times. On the order of 1,000 samples appear to be necessary to confidently identify differences in basin-wide averages over time. That number of samples could be generated by a range of strategies; including sampling each of 170 to 250 stations four to six times over a year. PGG has provided Yakima County a list of wells to be field evaluated for use as future monitoring stations. Owner acceptance and physical conditions, to be confirmed through field verification, may limit the number of stations available to address this objective.

Common Water Supply Aquifers: The random sample set developed for the basin-wide average will likely include representative samples from common water supply aquifers. In addition, public water supply wells (sampled for WDOH) will be concentrated in these zones. Thus no separate set of wells was developed to address this objective. The ability of the basin-wide data set and WDOH water supply wells to monitor common water supply aquifers will be verified after the monitoring stations are selected.

Measure Effects of Current and Future Practices: Wells in the existing database are typically designed to supply drinking water not to reflect the effects of current or future nitrogen management practices. Many years or even decades of monitoring will be required to confidently distinguish changes in groundwater nitrate concentrations using existing wells. Thus quickly measuring the effects of current and future practices should not rely solely on wells in the existing database. Nitrate concentrations in specially designed water table monitoring wells (shallow wells) will currently reflect the effects of existing BMPs, and will respond much more quickly to future changes. Thus such wells are recommended to help meet this objective.

Specially designed shallow wells are recommended where BMPs are known to be changing. The number of wells and locations should be specified in a work plan

generated at a time coordinated with changes to nitrogen management changes. To allow the wells to reflect recent historic practices as well as future practices, the wells should be installed as soon as appropriate locations can be identified. We therefore recommend allocation of budget to this work, and laying the groundwork for implementation.

Health Risks: Drinking water wells causing human health risks will be identified by Yakima County under a separate GWMA task. Based on that work, an unknown number of monitoring stations will be added to the monitoring network.

2.0 PURPOSE

The Lower Yakima Valley Groundwater Advisory Committee (GWAC), through Yakima County Public Services, selected HDR Engineering (HDR) and Pacific Groundwater Group (PGG) to perform two Scopes of Work under HDR contract #CON0082545. The first scope (led by HDR) is a study to identify applicable local, state, and federal regulatory requirements that control and manage nitrates in groundwater, identify Best Management Practices (BMPs), and evaluate the effectiveness of these BMPs. The second scope (led by PGG) focuses on development of a monitoring plan to evaluate changes in nitrate concentrations in groundwater.

This report describes methods used to select potential monitoring stations to be visited and inspected by Yakima Health District (YHD). The purpose of these YHD site visits is to complete the High Risk Well Assessment Survey and to verify the accessibility and suitability of the locations for long term monitoring (Field Verification).

In order to prepare a list of potential monitoring stations, PGG used the groundwater quality database developed for the Lower Yakima Valley Groundwater Management Area (GWMA) to characterize existing data, hereafter referred to as the WQ database (Section 3.2). Nitrate concentration trends are described in Section 5.0. In Section 6, PGG identifies existing wells for proposed for YHD field verification and future nitrate monitoring using well selection criteria listed in HDR contract #CON0082545. These wells are provided to the GWAC in an electronic database that is not reproduced as a table in this report. Specific tasks under the HDR contract covered in this report include:

- Task 1b (partial): Select potential monitoring stations for field verification; develop draft Field Verification Work Plan
- Task 2a: Water quality trend analysis
- Task 2b: Evaluate data gaps and provide recommendations on new sampling stations

This work was performed, and this report prepared, in accordance with hydrogeologic practices generally accepted at this time in this area. The resulting report is for the exclusive use of the Lower Yakima Valley Groundwater Advisory Committee, Yakima County, and HDR, for specific application to the Lower Yakima Valley.

3.0 DATA SOURCES

The following subsections describe three databases referenced in this report. The databases are linked through common data fields.

3.1 NITRATE WATER QUALITY DATABASE

A database was developed as part of this study to gather all groundwater nitrate data that had been collected to date. Sources of nitrate data provided by Yakima County (County) included the United States Geologic Survey (USGS), Yakima Health District (YHD), the Valley Institute for Research and Education (VIRE), and Yakima County's own nitrate survey database. Additional nitrate data from the United States Environmental Protection Agency (EPA) were added by PGG, but data from the area covered by the consent order between EPA and several dairies were not included. All data were imported into a consistently formatted water quality database.

3.2 WELL LOCATION DATABASE

A database of 7,790 domestic and public well locations and ownership information was developed as part of this study. This Well Location Database is used to propose potential monitoring stations (Section 6). Well location and ownership information for 7,695 domestic wells was provided by Yakima County, and was generated as part of the County's Nitrate Treatment Pilot Program. Well location and ownership information for 95 public water system wells were collected and added by PGG. PGG also supplemented the database with well depths from well logs where available.

3.3 INFORMATIONAL PUBLIC QUESTIONNAIRE, SURVEY #2

The Education and Public Outreach Working Group under the direction of the LYV GWAC created a 19-question survey to find out what residents served by private wells know about:

- Their drinking water and their opinion of its safety,
- Nitrate in groundwater, and
- The GWAC meetings.

The survey, conducted by Heritage University students during August and September of 2013, targeted eight areas and 300 households in the LYV GWMA (Lisa Freund, Yakima County, personal communication, 2013). The areas chosen were known to either have high nitrate in groundwater or were in areas where little data on nitrate levels exist.

Of the 300 households, 136 households responded to the survey, and 45 respondents (15 percent) agreed to be part of the more in-depth survey that includes water quality sampling for nitrate. These results will help determine where a second, more in-depth study of private wells in the Lower Yakima Valley should occur and the response percentages that could be expected from future surveys. The follow-up survey, which will

include visits to proposed monitoring stations as described in section 5, is scheduled to take place later this year.

4.0 NITRATE CONCENTRATIONS IN THE LYV GWMA

The following table presents summary statistics for nitrate concentrations in the LYV GWMA, with non-detect values included at a value of half the detection limit. All nitrate concentrations in this report are milligrams nitrogen per liter (mg/L). A map showing monitoring well locations and sample locations is presented in Figure 1. Sample collection dates range from October 16, 1978 to March 5, 2013, although 85 percent of the samples were collected since 2000.

Statistic	Value
n(samples)	2,532
non-detect	375 (14.8%)
n(locations)	678
Minimum	0.03
Maximum	98.1
Mean	5.815
Median	4.7
Variance	51.78
Standard Deviation	7.196

Well depths are available for 428 of 678 locations (63 percent). Well depths range from 1.17[1] feet in alluvium to 2,715 feet below ground surface in basalt. Half of the well depths are shallower than 136 feet. Figure 2 indicates the distribution of well depths follows an approximately lognormal distribution.

Quality Assurance and Quality Control (QA/QC) data were not available for any of the data included in the WQ database, and 25 samples were excluded due to incomplete nitrate concentration values. The Groundwater Monitoring Quality Assurance/Quality Control Plan (PGG, 2013) indicates that data without associated QA/QC information not included in long-term monitoring data. However, the WQ data may be used for long-term monitoring point selection. The following sections characterize the nitrate data available for long-term monitoring point selection:

Data Distribution - The nitrate data with or without non-detect values do not follow a normal, lognormal, or gamma distribution and are therefore treated as non-parametric.

Comparison to Natural Background - According to the Ecology Preliminary Assessment (2010), "Concentrations above 0.3 mg/L indicate some process is leading to increased nitrogen in groundwater beyond what would be observed in a pristine watershed." A total of 363 of 2532 (14.3 percent) nitrate concentrations were detected or non-detect at or below the natural background level of 0.3 mg/L. Well locations where

[1] This well depth comes from the USGS NWIS database, and is listed as a well, not a spring, completed in alluvium. The information in the USGS NWIS database is generally considered to be of good quality.

the maximum value was at or below 0.3 mg/L are shown on Figure 3. Most of these wells cluster towards the edges of the GWMA.

Comparison to Ground Water Quality Criterion - The Washington State Groundwater Quality Criterion (GWQC) for nitrate is 10 mg/L. A total of 327 of 2,532 (12.9 percent) nitrate concentrations were detected above the GWQC of 10 mg/L.

Variability with Depth – Maximum nitrate concentration data are plotted in Figure 4 by three depth intervals: 0 to 100 feet, 100 to 200 feet, and greater than 200 feet. Geologic analysis to divide the dataset by aquifer was not performed. Where well depths are known, the three depth intervals generally divide the dataset into three equally-sized groups. Figure 4 shows that the wells where the maximum nitrate concentrations were at or below 0.3 mg/L tend to be completed at depths greater than 200 feet, with a cluster of wells with depths of 0 to 100 feet between Mabton and Sunnyside.

A boxplot of maximum nitrate concentration for each well location by well completion depth interval is presented in Figure 5. The boxplot shows that the mean and median nitrate concentration values generally decrease with depth up to 1,000 feet[2].

Depth Interval (feet below ground surface)	Number of Wells (n)	Mean[1]	Median[1]	Standard Deviation[1]
0 to 100	123	9.38	5.32	11.56
100 to 200	119	8.15	5.11	8.27
200 to 500	79	6.10	4.73	5.84
500 to 1000	19	3.88	1.30	4.39
Greater than 1000	22	3.92	1.50	6.16

[1] nitrate mg/L

Of the 22 sampled wells that are deeper than 1,000 feet, eight have maximum concentrations below 0.3 mg/L, 10 have maximum concentrations between 0.3 and 10 mg/L, and four have maximum concentrations above the GWQC of 10 mg/L.

5.0 NITRATE CONCENTRATION TRENDS

Concentration trends were evaluated on the entire nitrate data set over time, and for individual wells where time series data are available.

5.1 TREND FOR COMBINED DATASET

We evaluated the apparent long-term nitrate trend in the combined dataset by grouping maximum nitrate results per well location from the WQ database into five year periods (e.g. 1980 to 1984, 1985 to 1989), and making comparison between the groups. A list of statistics for each five year period is presented below. The median and number of high nitrate concentration values have increased over time; however, a bias toward an

[2] Possible outliers were not identified or removed prior to calculating these statistics.

increasing trend could be as a result of more recent sampling programs targeting shallower wells that are more subject to nitrate contamination; whereas older data tends to be from deeper water supply wells that were routinely sampled to meet WDOH drinking water monitoring requirements. Evaluations using data from individual wells, discussed in the following subjection, are not subject to this bias and should be favored as a measure of trend in the GWMA.

Date Range of Well Samples	Number of Wells (n)	Mean Nitrate[1]	Median Nitrate[1]	Standard Deviation[1]
1975 to 1979	4	1.45	1.10	1.66
1980 to 1984	51	3.48	1.70	4.10
1985 to 1989	40	3.33	1.80	3.63
1990 to 1994	76	3.52	2.60	3.89
1995 to 1999	69	4.06	3.90	3.29
2000 to 2004	295	6.36	4.00	8.56
2005 to 2009	90	4.74	4.44	3.60
2010 to 2014	323	13.51	11.50	11.17

[1] nitrate mg/L

5.2 MANN-KENDALL TREND TEST FOR INDIVIDUAL WELLS

Forty-six wells had more than 10 samples over time and were therefore evaluated for individual trends (Figures 6 through 15). All sample locations were public water system wells with data from the WDOH Sentry database. Quality Assurance and Quality Control (QA/QC) information was not available for the WDOH dataset, but cursory inspection suggests there are QA/QC issues with these data. For example, on Figure 10, Station 2897016 shows anomalously high variability in nitrate concentrations between samples.

The wells for which time-series data are available tend to be deeper than average, with a median depth of 342 feet compared to 136 feet for all wells. Therefore, although free of the type of bias that may be present in the grouped data discussed in Section 5.1, they may not reflect trends in shallower wells.

PGG identified wells with statistically significant trends using the Mann-Kendall trend test (Table 1). The Mann-Kendall test is a nonparametric trend test which uses ranks instead of concentration values. The Mann-Kendall trend test results for wells with upward trends are presented below. Statistical significance can be affected by outlier values; outliers were not identified or removed as part of this analysis.

Results show 16 statistically significant trends, 7 upward and 9 downward. Locations where statistically significant upward trends occur are listed below and are shown in Figure 17. An upward trend is indicated by a positive tau and a significant trend is indicated by a p of less than 0.05. Wells with upward trends are widely spread through the GWMA, although 3 wells cluster near Grandview. The similarity in number of upward and downward trends suggests an absence of strong uniform trend throughout the GWMA.

Well ID	number of samples (n)	Std dev	p	tau	Up/ Down	Location
2897001	32	3.63	7.0E-03	0.34	Up	Grandview
2897010	139	4.67	1.1E-06	0.28	Up	Grandview
2897011	29	1.24	2.8E-02	0.29	Up	Grandview
6494002	21	1.62	3.4E-03	0.47	Up	Outlook Elem School
6591901	37	3.37	2.7E-02	0.26	Up	Panorama Place Water Assn
8540005	12	0.98	1.9E-02	0.53	Up	City of Sunnyside
AB70001	10	4.34	1.2E-02	0.64	Up	Wineglass Cellars

std dev = standard deviation; p = statistical significance; Tau = test statistic; Trend considered significant for p<=5.0E-02 (0.05)

6.0 IDENTIFICATION OF POTENTIAL SAMPLING STATIONS

PGG developed a list of potential monitoring stations (provided to Yakima County electronically as a database) using well selection criteria listed in HDR contract #CON0082545. PGG used two databases, the nitrate WQ database and the Well Location database described above to select stations using the criteria listed below and further described in Subsections 6.1 through 6.7:

1. Spatial data gaps – Investigating spatial data gaps will identify whether additional hot spots exist. Monitoring stations are proposed for the largest 5 areas where no existing nitrate information is available. Spatial data gaps were selected by measuring the distance between all known nitrate concentrations.

2. Hot spots - Monitoring well stations are proposed at or near wells with maximum nitrate concentrations equal or greater than 20 mg/L (or twice the GWCL of 10 mg/L) to achieve the objective of monitoring groundwater quality and change over time.

3. Increasing concentration trends – Monitoring well stations are proposed at or near wells with statistically significant increasing nitrate trends. These wells will likely be among the first to show changes in nitrate concentration.

4. Basin-wide monitoring - Monitoring well stations are proposed using a simple random selection process with sample size large enough to achieve a confident comparison of baseline average to future average nitrate concentration.

5. Common water supply aquifers - Monitoring well stations proposed for the basin-wide monitoring will likely include representative samples in common water supply aquifers. This will be verified by comparing the depth profile of the basin-wide monitoring locations to the depth profile of all wells.

6. Measure Effects of Current and Future Practices (Best Management Practice (BMP) effectiveness) - Monitoring is recommended in water table (shallow) wells constructed specifically for this purpose. Specifics should be proposed in a subsequent work product.

7. Health risks- Drinking water wells causing human health risks will be identified by Yakima County under a separate GWMA task.

Several of the subsections below refer to "field verification." Yakima County will evaluate numerous possible wells identified by PGG for possible future use as a GWMA monitoring station. Those wells that are made accessible by owners and are physically accessible to field staff will be used for future monitoring. We anticipate additional well depth information will be gathered during field verification. A single well may be used to meet more than one objective.

This report identifies numbers of wells targeted for sampling but does not propose specific sampling strategies to meet the objectives. Sampling strategy will be provided in the Monitoring Plan that will be submitted to the GWAC as a subsequent task.

6.1 SPATIAL DATA GAPS

PGG identified the 5 largest areas within the GWMA without nitrate data, but where wells are available for monitoring. Using ArcGIS software, we mapped the distance from every point in the LYV to existing wells with nitrate sample data or the GWMA boundary, whichever was closer; then used the minimum distance map to find the five largest areas (Figure 16). The areas range from 4.7 to 12.9 square miles.

Only the five largest areas were selected because there appeared to be a break in size between the next smallest data gap area. Due to the low response rate and incomplete well depth information, well depth was not accounted for in the spatial data gaps analysis.

Within the five areas there are 215 possible monitoring wells. Based on a response rate of 15 percent (as achieved by the YHD Health Survey), there should be a sufficient number of wells to select one monitoring well for each spatial data gap. For the purpose of the upcoming survey, wells were ranked for each of the 5 areas based on proximity to the centroid of the spatial data gaps. And for each of the 5 areas, 10 wells were provided to the LYV GWAC for field surveying.

6.2 HOT SPOTS

PGG identified 71 wells with maximum nitrate concentrations equal or greater than 20 mg/L, a concentration twice the GWCL of 10 mg/L (chosen to define a "hot spot"). See Figure 4 for nitrate concentrations by well depth and Figure 17 for a summary of well locations where maximum nitrate is greater than 20 mg/L.

Those wells that are made accessible by owners and are physically accessible to field staff will be used for future monitoring. Assuming an acceptance rate of 15 percent, approximately 10 of these wells may be available as future monitoring stations.

6.3 INCREASING CONCENTRATION TRENDS

PGG identified 7 wells with upward trends using the Mann-Kendall trend test as described in Section 5. Despite some irregularities in the data for some of these 7 wells, all 7 wells will be retained as future monitoring stations if they remain available.

As noted above, none of the existing data include QA/QC data, however, the Groundwater Monitoring Quality Assurance/Quality Control Plan (PGG, 2013) allowed for continued use of WDOH data. WDOH requires that Group A and B public water supply systems sample for nitrate, regardless of sampling performed to meet the GWMA objectives. Thus the GWMA may continue to rely on data gathered within the WDOH program.

Many years to decades may be necessary to confidently detect changes in nitrate concentration in wells typical of the existing database, and additional supply wells added through field verification. The long time frames are caused by slow groundwater flow rates and variability which obscures actual change (signal to noise). For these and other reasons, monitoring for BMP effectiveness should not rely solely on water supply wells. Monitoring of specially designed and sited water table monitoring wells (shallow wells) is recommended to determine levels and trends in nitrate concentrations. They will respond much more quickly to local land use change than deeper and more variable wells in the WQ database and Well Location database.

6.4 BASIN-WIDE MONITORING

PGG used the simple random approach to identify the number of monitoring stations that would need to be sampled to measure the basin-wide-average at a level of confidence that supports use of the data for future GWMA purposes. Those purposes include comparison of a current average to past and future averages, and comparison of averages to the GWMA-adopted water quality goal of 10 mg/L nitrate. The largest number of samples are required for a comparison of averages collected at different times. To meet that objective, PGG estimates on the order of 1,000 samples would be required. That number of samples could be generated by a range of strategies – including sampling each of 170 to 250 stations four to six times over a year. Owner acceptance and physical conditions, to be confirmed through field verification, may limit the number of stations available to address this objective.

Target well locations for field verification were identified using a simple random sampling plan. Simple random sampling means that each of the 7,790 well locations has an equal chance of being one of the selected measurements a future monitoring station. This method is used for estimating means, medians, and trends when the population does not in general contain major trends, cycles, or patterns, which appears to be a valid assumption in this case. With this sampling method, a large number of samples are necessary to confidently identify changes in the basin-wide average nitrate concentration between baseline and data sets collected after land use change.

The simple random method assumes that the sampling frame, which is our master list of well locations in the Well Location database, is a complete list for the GWMA or is representative of the entire population of wells in the GWMA. If the sampling frame is

grossly incomplete or biased, a random sample of wells from the Well Location database may be biased relative to the entire population of wells.

Only 15 percent of well owners agreed to have their wells sampled when approached by YHD (Section 3.1). A high nonresponse rate may result in a biased well monitoring network if the nonrespondent wells differ systematically from the respondent wells. For example, if private well owners are highly nonresponsive, but public water system well owners are responsive, the resultant monitoring network could be biased as to location, depth, or nitrate concentration. Since the response rate is expected to be low, the final monitoring well network will be compared to the simple random sample target well list to evaluate for bias in well owner type, well depth, or well location.

6.5 COMMON WATER SUPPLY AQUIFERS

The simple random sampling plan as described above will also be used to identify stations to monitor common water supply aquifers. The random sample will likely include a representative sample of well depths, and a representative sample of common water supply aquifers. This assumption will be verified after the final monitoring stations are selected.

6.6 MEASURE EFFECTS OF CURRENT AND FUTURE PRACTICES (BMP EFFECTIVENESS)

Wells in the existing database are typically designed to supply drinking water not to reflect the effects of current or future nitrogen management practices. Many years or even decades of monitoring will be required to confidently distinguish changes in groundwater nitrate concentrations using existing wells. Thus quickly measuring the effects of current and future practices should not rely solely on wells in the existing database. Nitrate concentrations in specially designed water table monitoring wells (shallow wells) will currently reflect the effects of existing BMPs, and will respond much more quickly to future changes. Thus such wells are recommended to help meet this objective.

Specially designed shallow wells are recommended where BMPs are known to be changing[3]. The number of wells and locations should be specified in a work plan generated at a time coordinated with changes to nitrogen management changes. To allow the wells to reflect recent historic practices as well as future practices, the wells should be installed as soon as appropriate locations can be identified.

6.7 HEALTH RISKS

Areas of elevated human health risk will be identified using results of the Education and Outreach Committee's High Risk Well Assessment Survey. Factors such as presence of a seal, number of affected population served, nitrate concentration will be used to evaluate

[3] In future phases of this project, changes to BMPs will be made to reduce the release of nitrate to groundwater. The shallow water table below locations where these changes are made will likely show the most rapid changes in nitrate concentration.

human health risk. This evaluation will be performed in association with the WDOH. The number of wells monitored will depend on the number of responses to the survey.

7.0 REFERENCES

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Table 1. Mann-Kendall Trend Test Results

Well ID	n	Standard Deviation	p, Statistical Significance	Tau	Significant Trend? (Up/Down)
4965001	158	3.757434616	2.36E-15	-0.44383	Down
4965004	78	1.89009415	5.65E-07	-0.4372	Down
628702	55	4.538235117	2.37E-06	-0.43898	Down
9980003	17	0.922267825	0.001970103	-0.56298	Down
AA43202	56	3.188313314	0.014880689	-0.22617	Down
2897008	17	2.190488295	0.018875547	-0.42647	Down
415701	18	0.953212148	0.025326289	-0.39344	Down
2897016	102	5.180332219	0.042952381	-0.13641	Down
1624202	17	3.084524942	0.043545581	-0.36765	Down
2897010	139	4.66576742	1.09E-06	0.280523	Up
6494002	21	1.621034502	0.003399434	0.466667	Up
2897001	32	3.630838346	0.007041277	0.339095	Up
AB70001	10	4.343853896	0.012266059	0.644444	Up
8540005	12	0.97557287	0.019440878	0.534367	Up
6591901	37	3.371602995	0.027055988	0.255639	Up
2897011	29	1.242397174	0.0281302	0.291359	Up
8540008	19	1.206685083	0.057831056	0.327433	
3035001	10	2.545829705	0.063697524	0.50128	
9980001	28	1.436279871	0.065804727	-0.25067	
4965002	21	3.665686709	0.074193016	0.288475	
2241801	12	1.617658943	0.080057926	0.413167	
8512101	17	0.673063125	0.083351925	0.317345	
2897017	12	9.085462372	0.086471118	0.393939	
6618501	14	0.994219833	0.188887477	-0.27473	
4965003	95	3.14459843	0.197246656	0.090287	
3430101	16	0.825814497	0.206981122	0.24268	
8540009	21	1.239719054	0.213335901	0.218521	
359401	11	0.421730202	0.241476879	-0.29359	
1624201	20	3.620006397	0.269223869	0.185682	
2897007	110	3.727389015	0.29422757	-0.06812	
6990001	23	1.6916734	0.340254098	0.148011	
2897012	13	1.680576061	0.360121638	-0.20513	
9191301	46	4.239114351	0.399168849	0.087337	
2897014	22	0.09500057	0.472785711	-0.1341	
2897003	30	0.664776257	0.475308478	-0.09447	
2959701	18	0.562694556	0.517352164	0.140028	
628701	23	1.12963739	0.52119571	0.102968	
AA48401	13	3.627026754	0.624854445	-0.11613	
8540006	23	0.305602496	0.631960332	-0.08802	
2897013	80	2.64923693	0.644453287	-0.03751	
2897002	34	2.18098009	0.667067051	-0.05372	
8540007	25	1.154570627	0.766732275	-0.05238	
430201	15	1.544543391	0.804336071	-0.05742	
477601	16	5.74453969	1	-0.00837	
2900001	21	0	1	1	
9980002	17	0.764660632	1	0.015401	

stdev = standard deviation

p = statistical significance

Tau = test statistic

Trend considered significant for p<=0.05

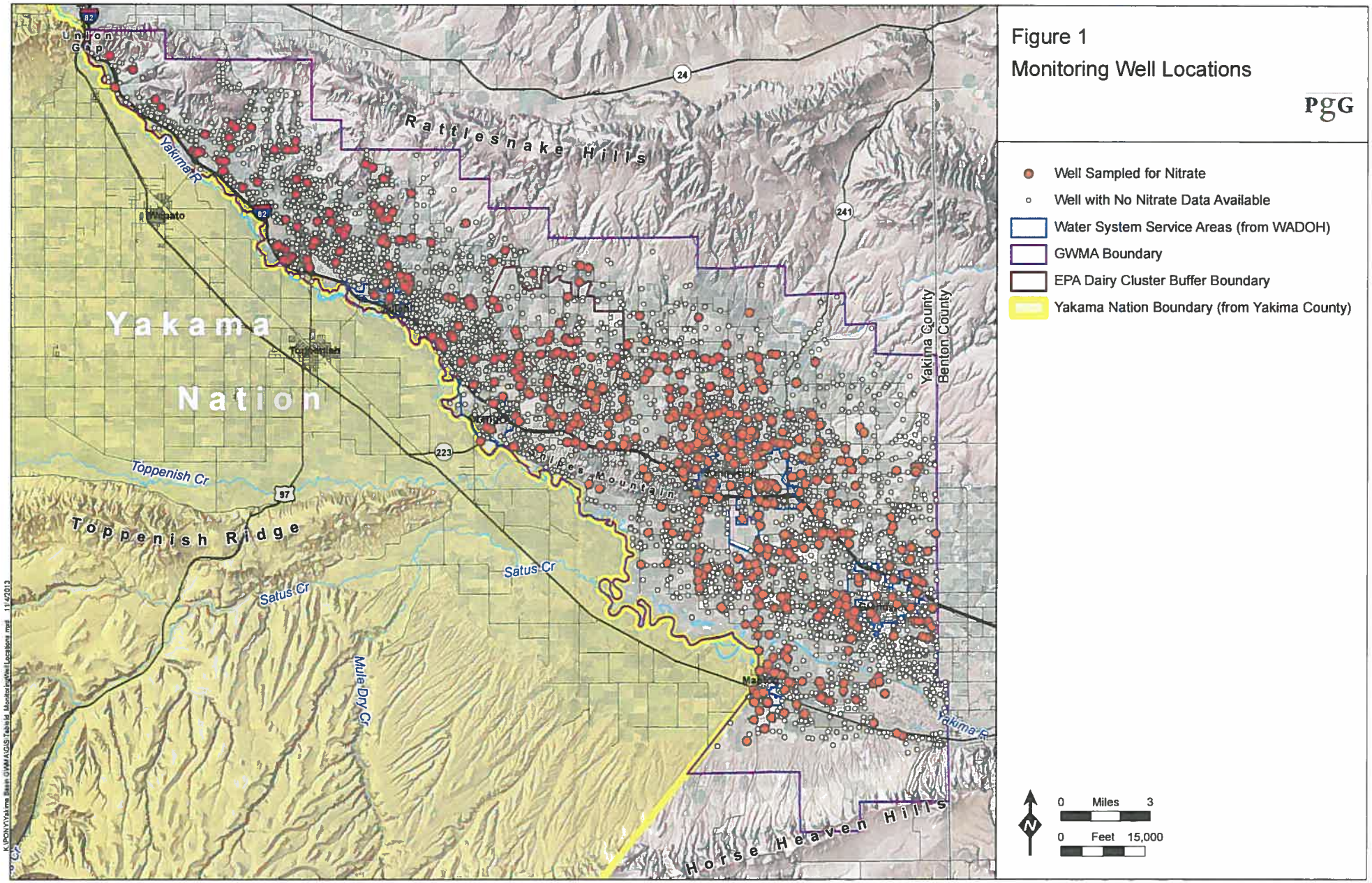
Figure 1
Monitoring Well Locations
PGG
Well Sampled for Nitrate
Well with No Nitrate Data Available
Water System Service Areas (from WADOH)
GWMA Boundary
EPA Dairy Cluster Buffer Boundary
Yakama Nation Boundary (from Yakima County)
Yakama Nation
Rattlesnake Hills
Toppenish Ridge
Horse Heaven Hills
Yakima County
Benton County
Yakima R.
Toppenish Cr
Satus Cr
Satus Cr
Mule Dry Cr
Union Gap
Wapato
Toppenish
Mabton
Mule Mountain
82
24
241
223
97
0 Miles 3
0 Feet 15,000
N

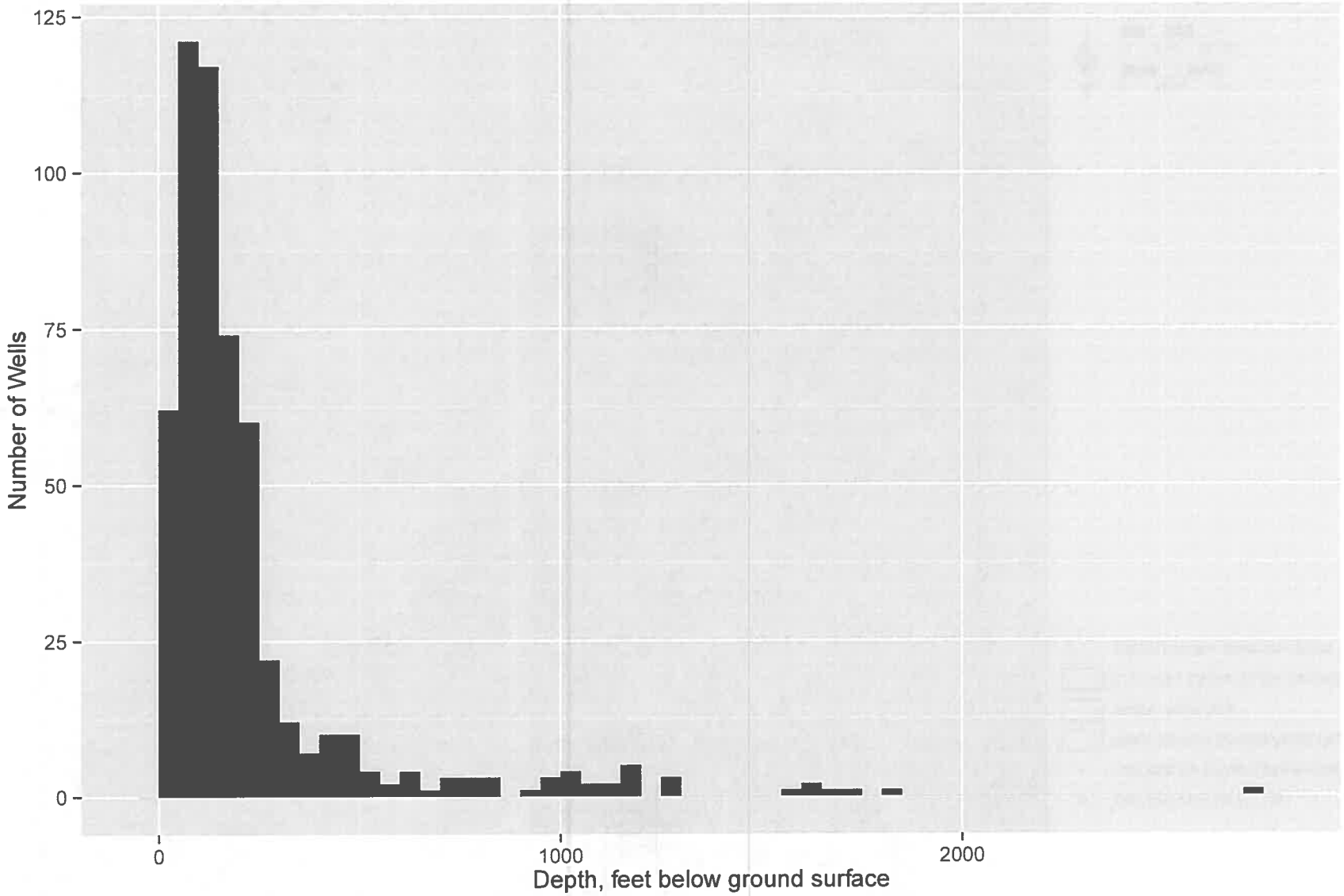

Figure 2. Well Depth Histogram

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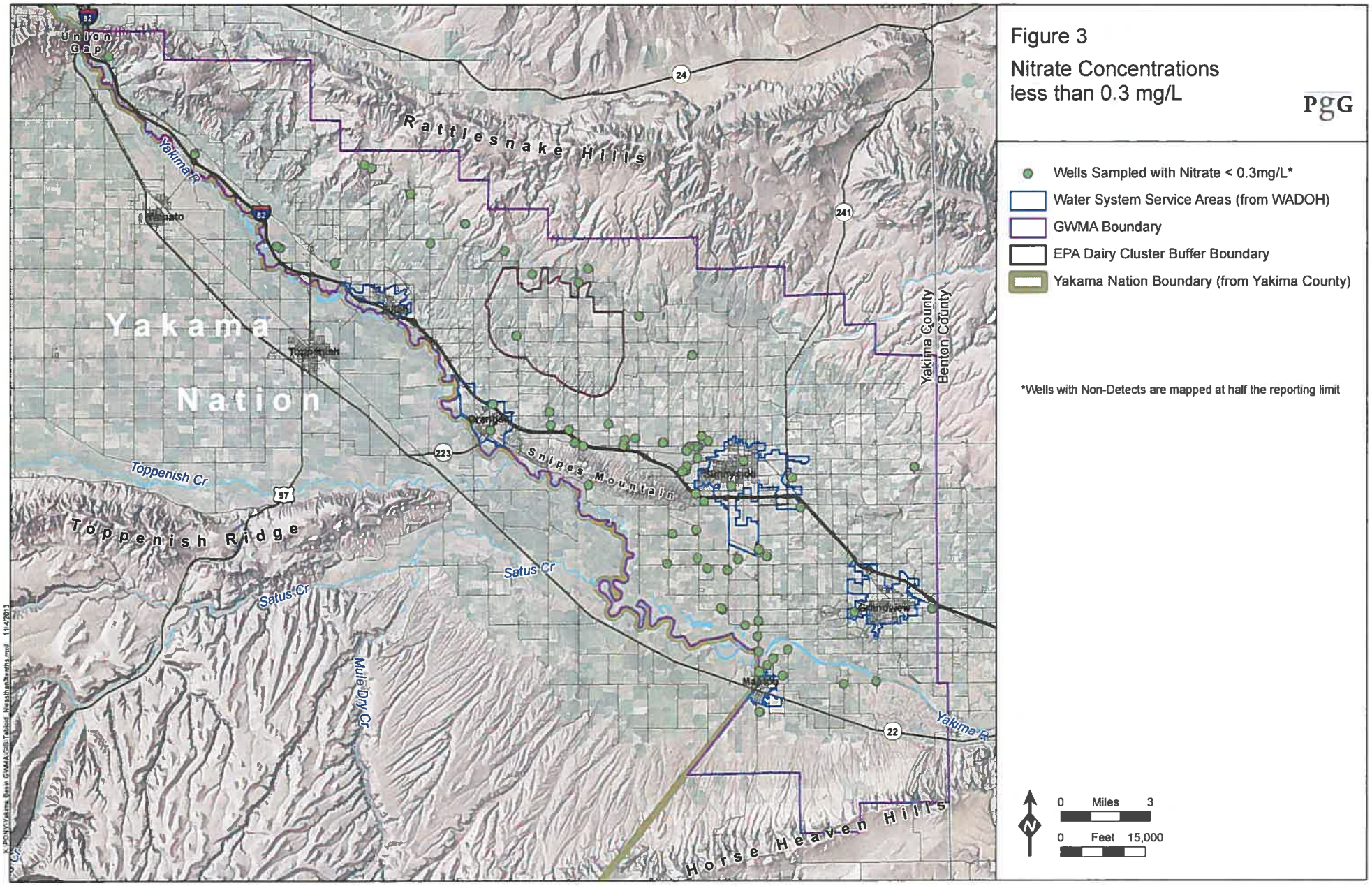
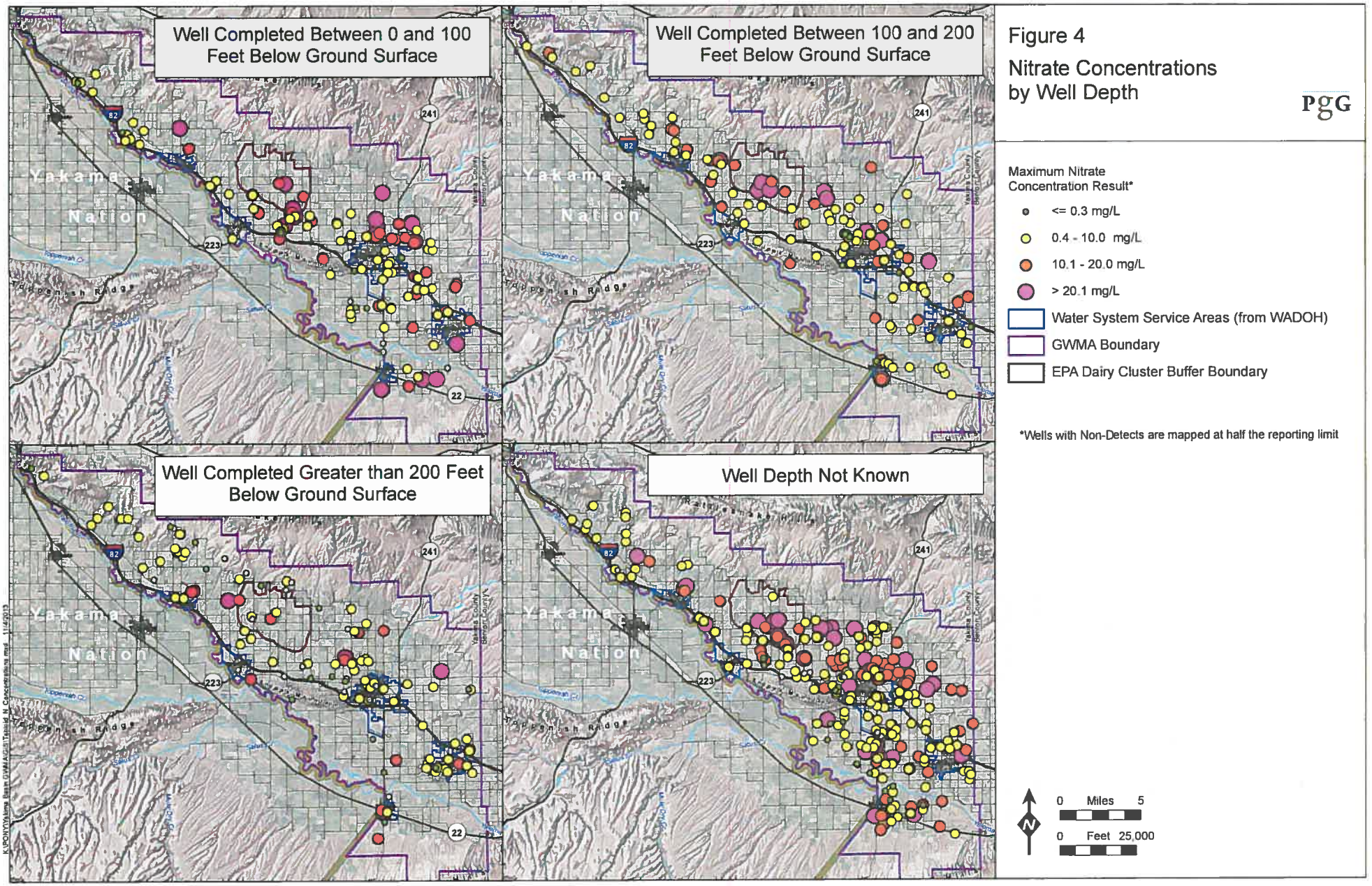
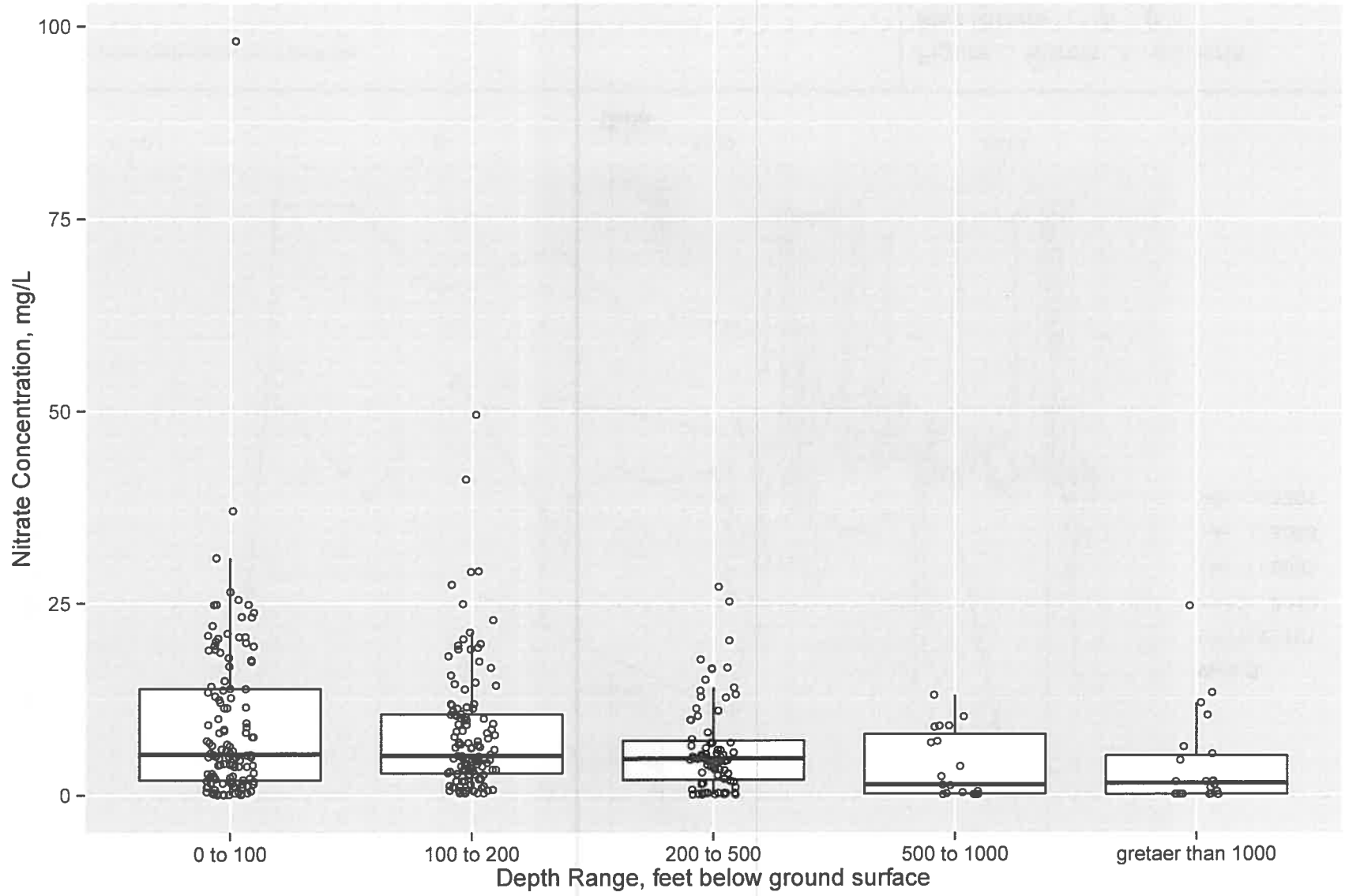


Figure 3
Nitrate Concentrations
less than 0.3 mg/L
PgG
Wells Sampled with Nitrate < 0.3mg/L*
Water System Service Areas (from WADOH)
GWMA Boundary
EPA Dairy Cluster Buffer Boundary
Yakama Nation Boundary (from Yakima County)
*Wells with Non-Detects are mapped at half the reporting limit
Union Gap
Yakima R
Rattlesnake Hills
Yakama Nation
Toppenish Cr
Toppenish Ridge
Satus Cr
Satus Cr
Mule Dry Cr
Snipes Mountain
Horse Heaven Hills
Yakima County
Benton County
0 Miles 3
0 Feet 15,000


Well Completed Between 0 and 100 Feet Below Ground Surface
Well Completed Between 100 and 200 Feet Below Ground Surface
Well Completed Greater than 200 Feet Below Ground Surface
Well Depth Not Known
Yakama Nation
Toppenish Ridge
82
241
223
22
Figure 4
Nitrate Concentrations by Well Depth
PgG
Maximum Nitrate Concentration Result*
<= 0.3 mg/L
0.4 - 10.0 mg/L
10.1 - 20.0 mg/L
> 20.1 mg/L
Water System Service Areas (from WADOH)
GWMA Boundary
EPA Dairy Cluster Buffer Boundary
*Wells with Non-Detects are mapped at half the reporting limit
N
0 Miles 5
0 Feet 25,000



Non-detect values plotted at half the Method Reporting Limit value
black open circles represent actual data points, shifted in position to avoid directly overplotting other points
Maximum value selected for each well location

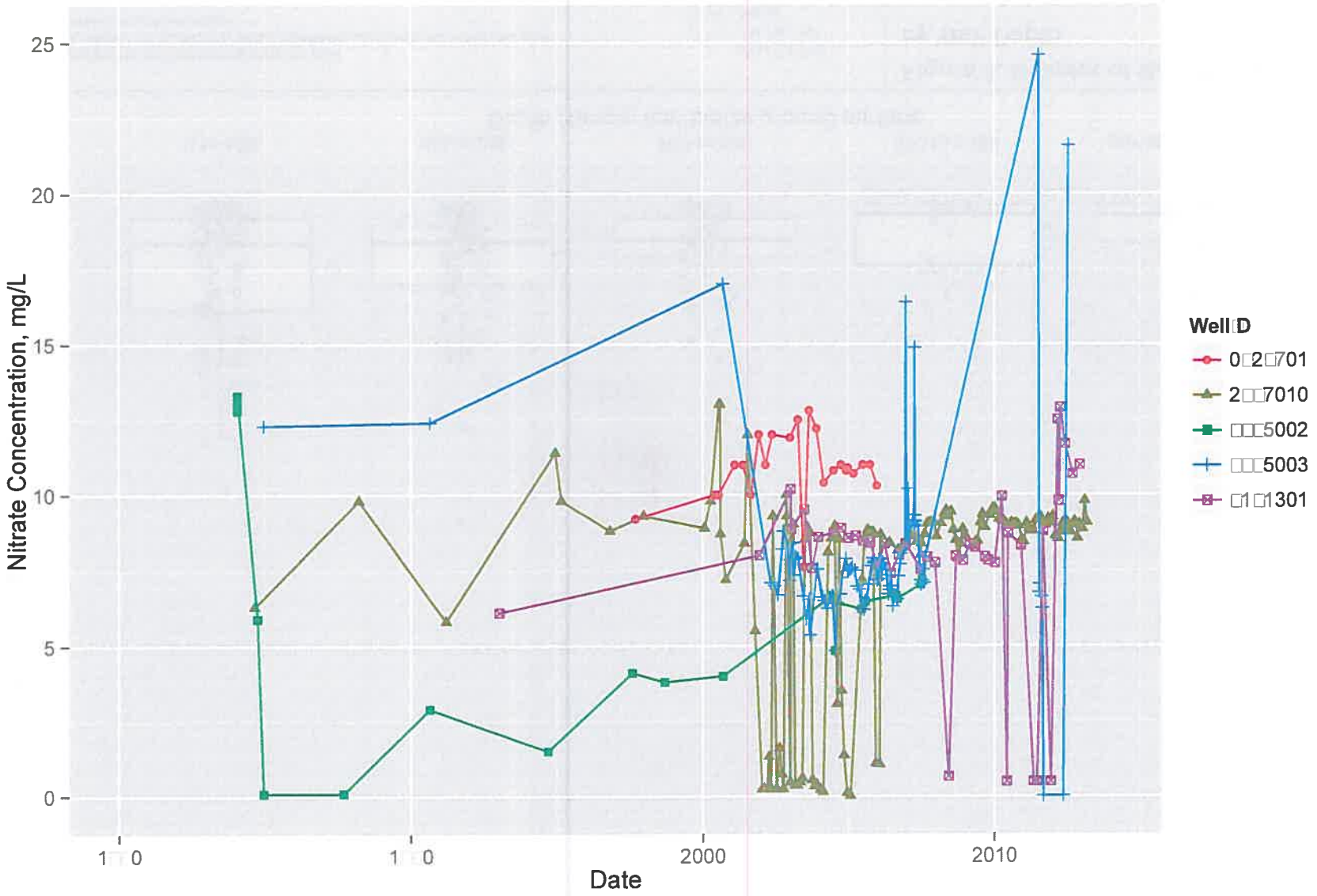
Prepared 12/03/2013

- Max (<1.5*IQR)
- 75th Percentile
- Median
- 25th Percentile
- Min (<1.5*IQR)

IQR = Interquartile Range

Figure 5. Boxplot of Max Nitrate by Well Depth

PgG



Non-detect values plotted at half the Method Reporting Limit value

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Figure □. Nitrate □i□ e□ □erie□
Max Nitrate □□□.5 □ g□□

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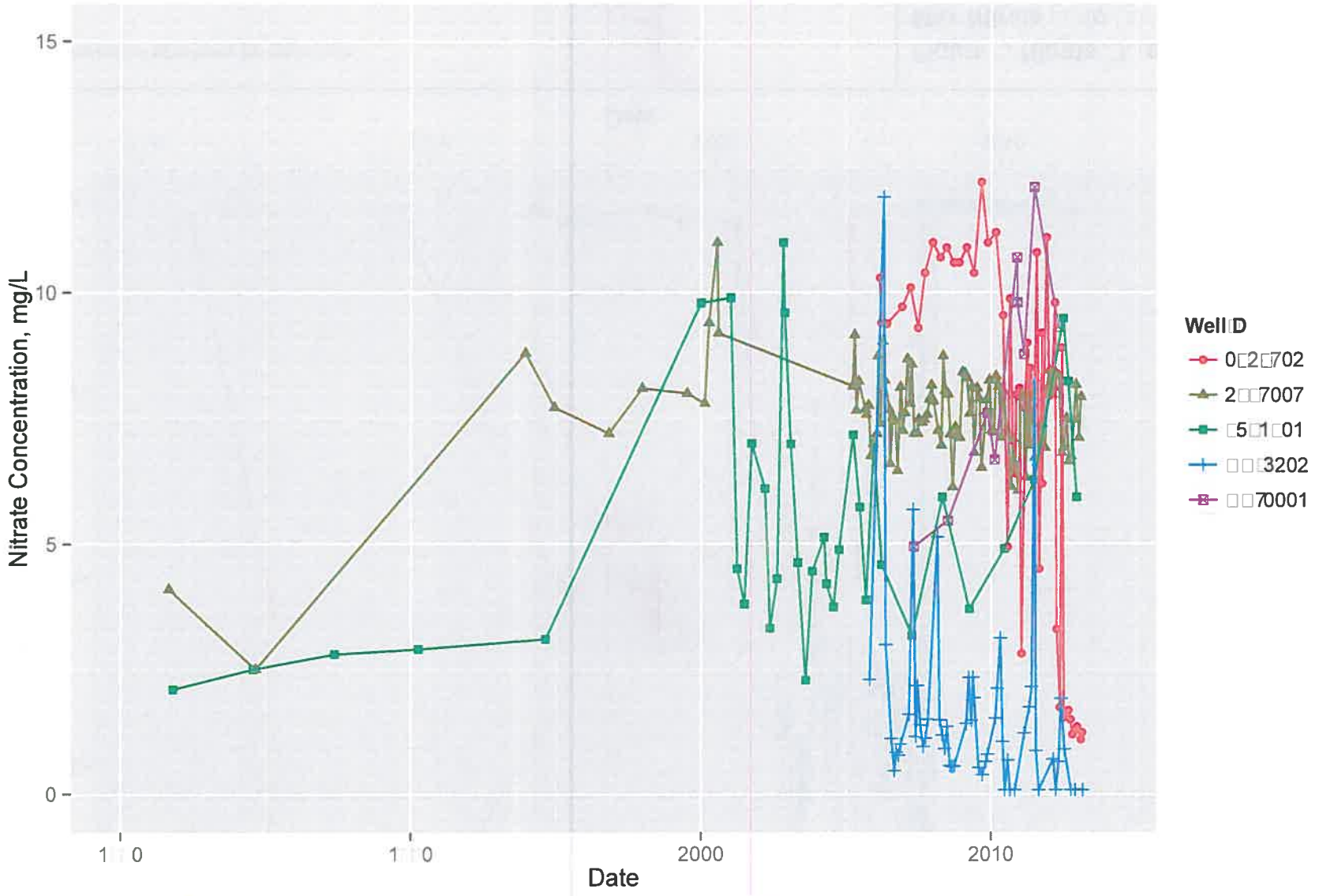

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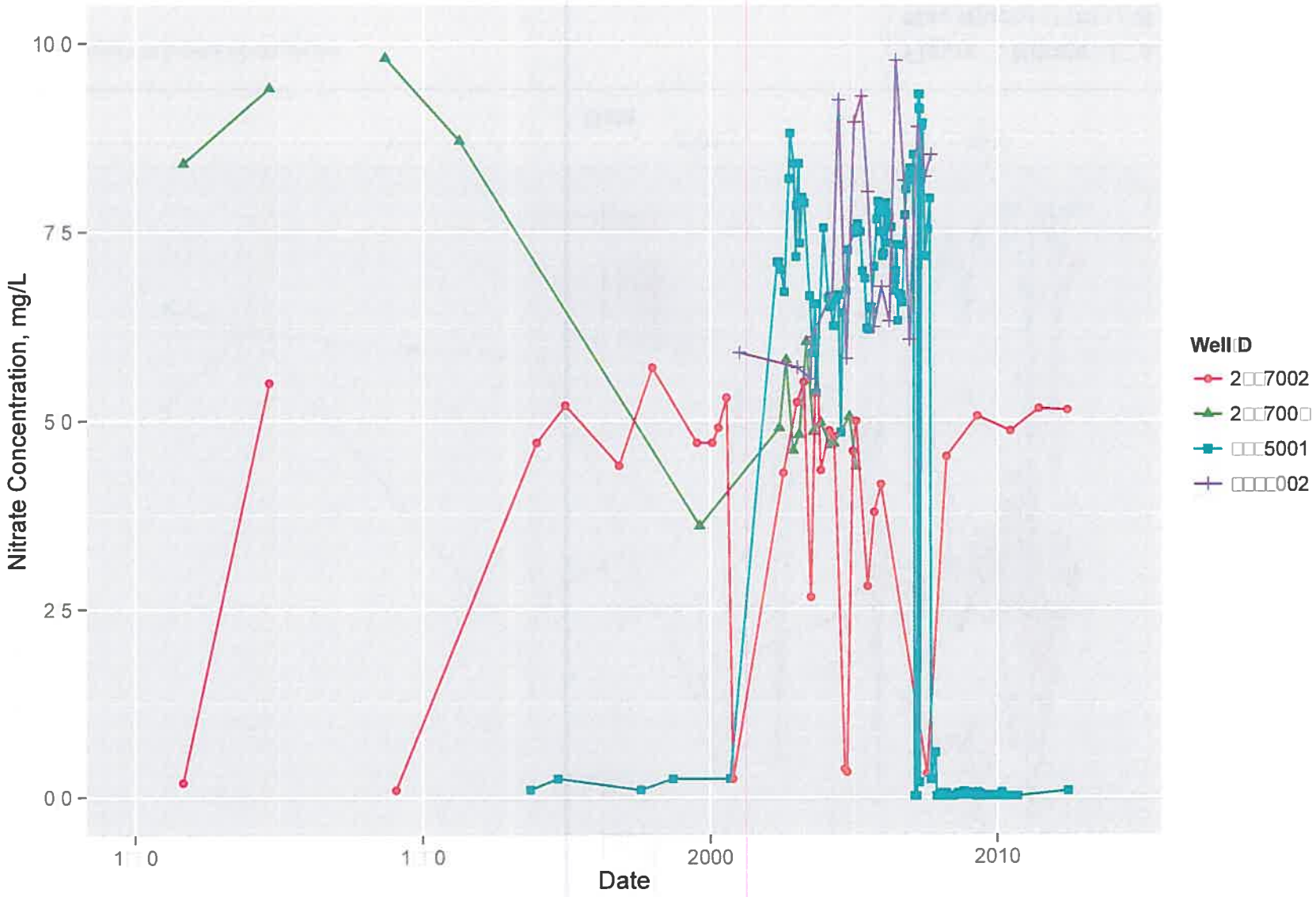
Figure . Nitrate i e erie
Max Nitrate to .5 g

PgG



Non-detect values plotted at half the Method Reporting Limit value

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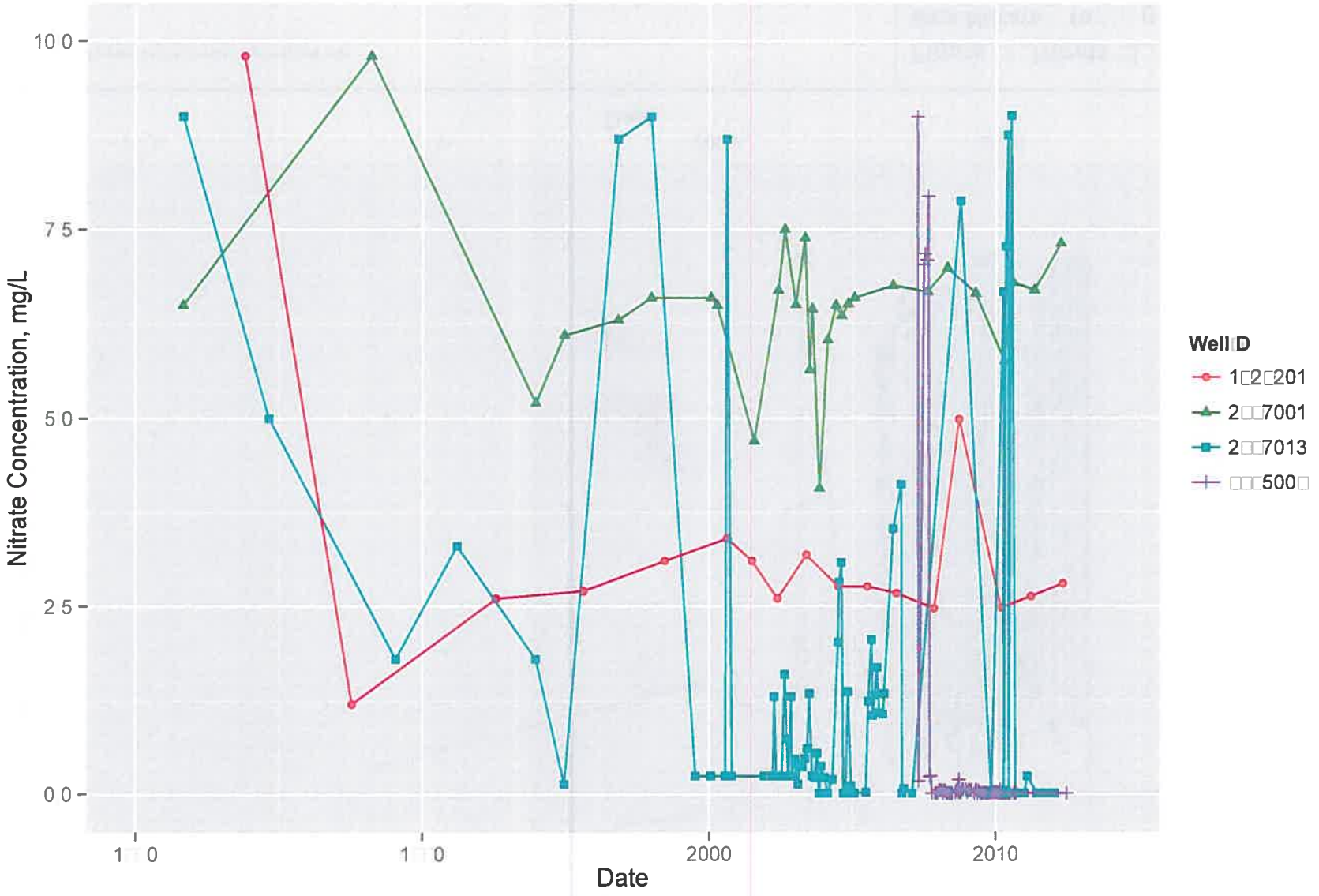
Max Nitrate to g

PgG



Non-detect values plotted at half the Method Reporting Limit value

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Figure □. Nitrate □i□ e□ □erie□
Max Nitrate □ to □□ □ g□□

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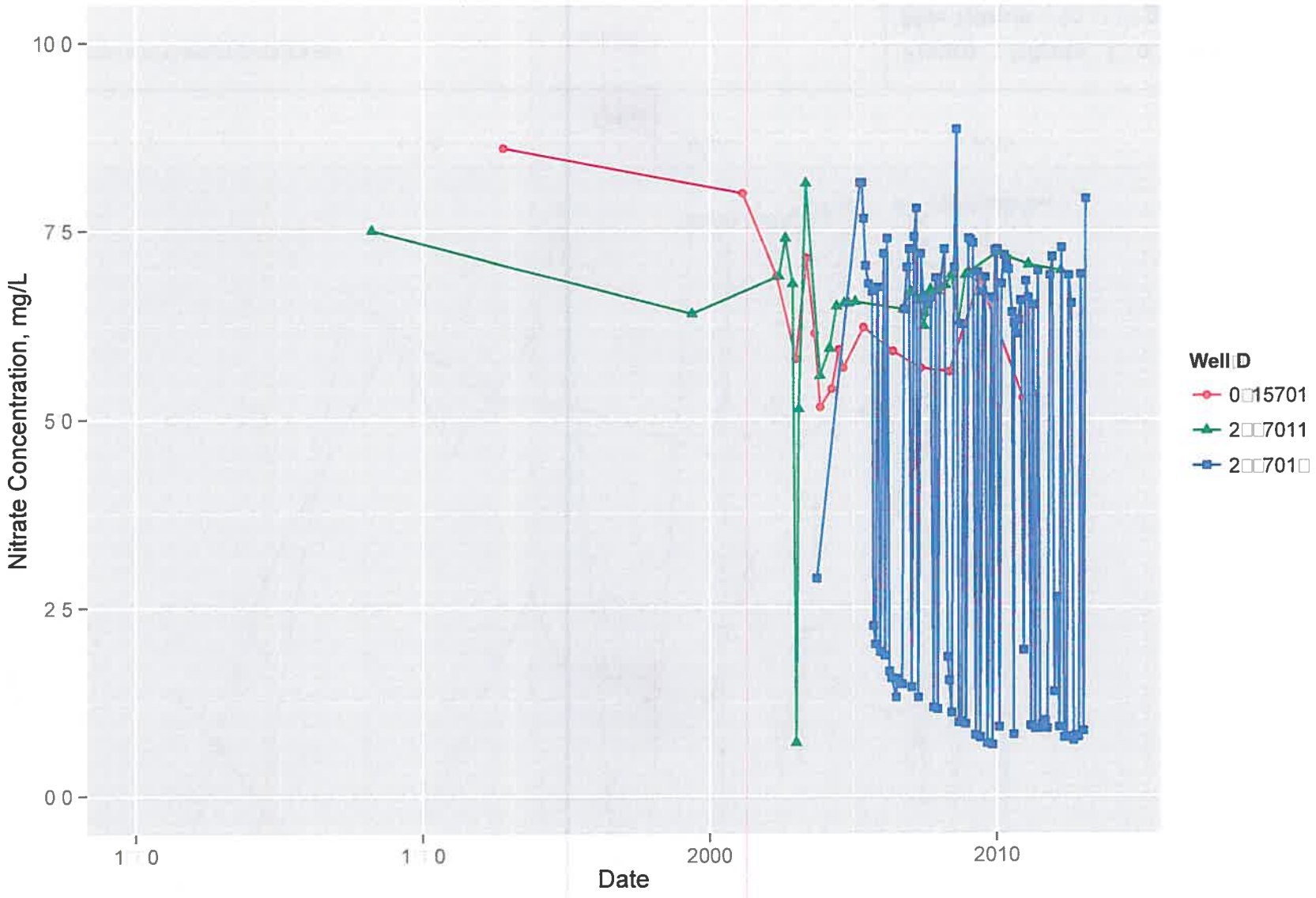

Non-detect values plotted at half the Method Reporting Limit value

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Max Nitrate to g

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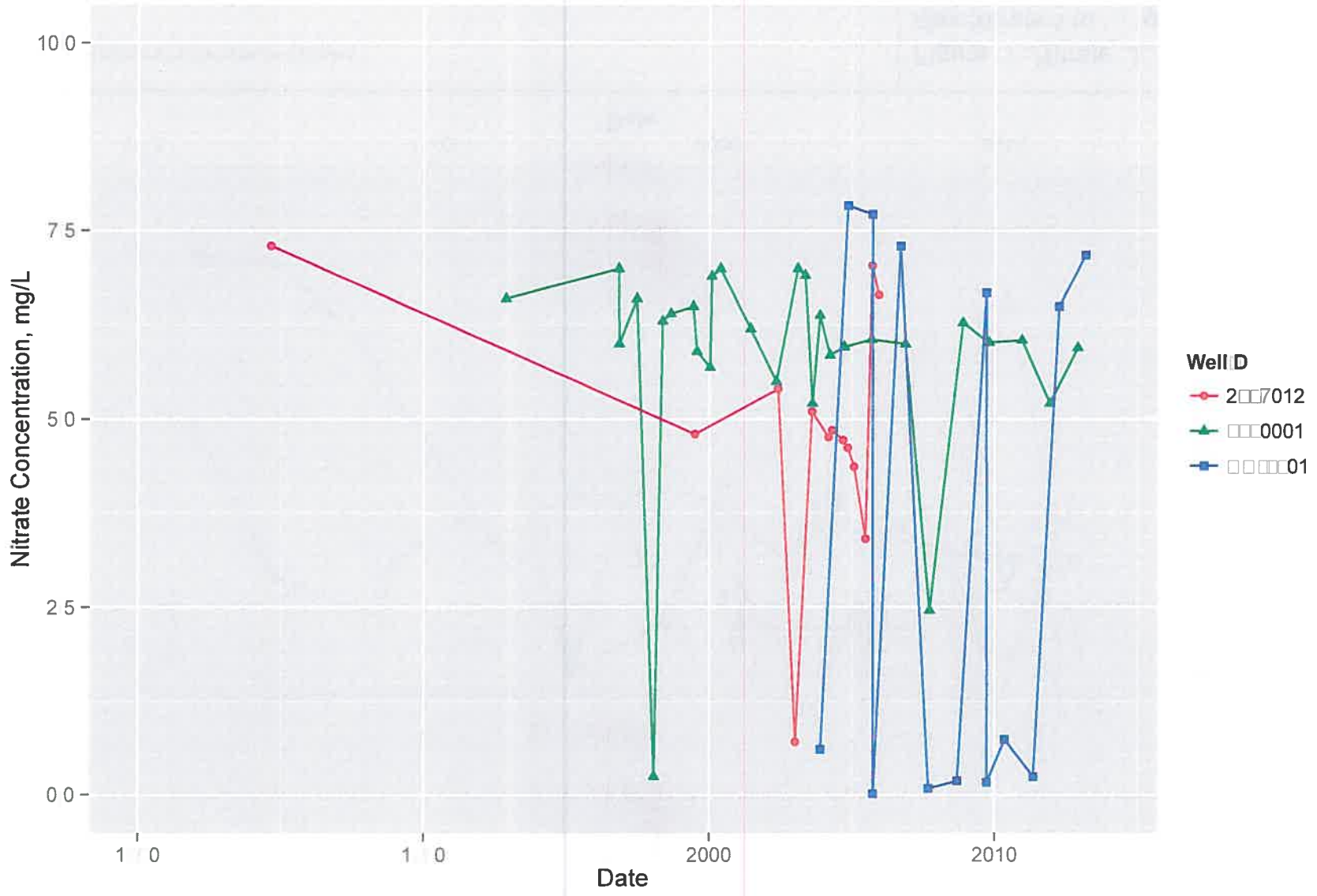

Non-detect values plotted at half the Method Reporting Limit value

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Figure . Nitrate i e erie
Max Nitrate to g

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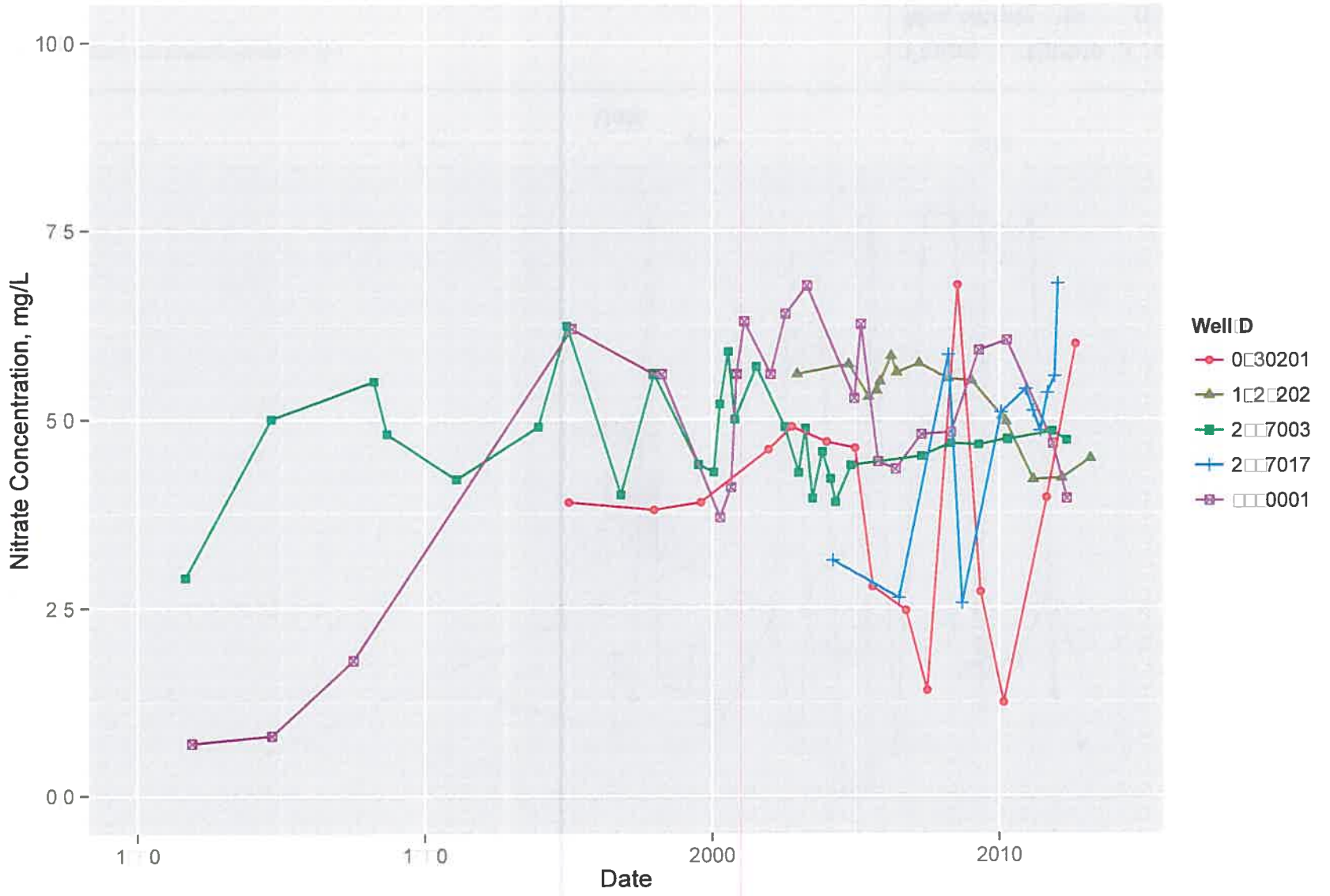

Non-detect values plotted at half the Method Reporting Limit value

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Figure . Nitrate i e erie
Max Nitrate 5 to g

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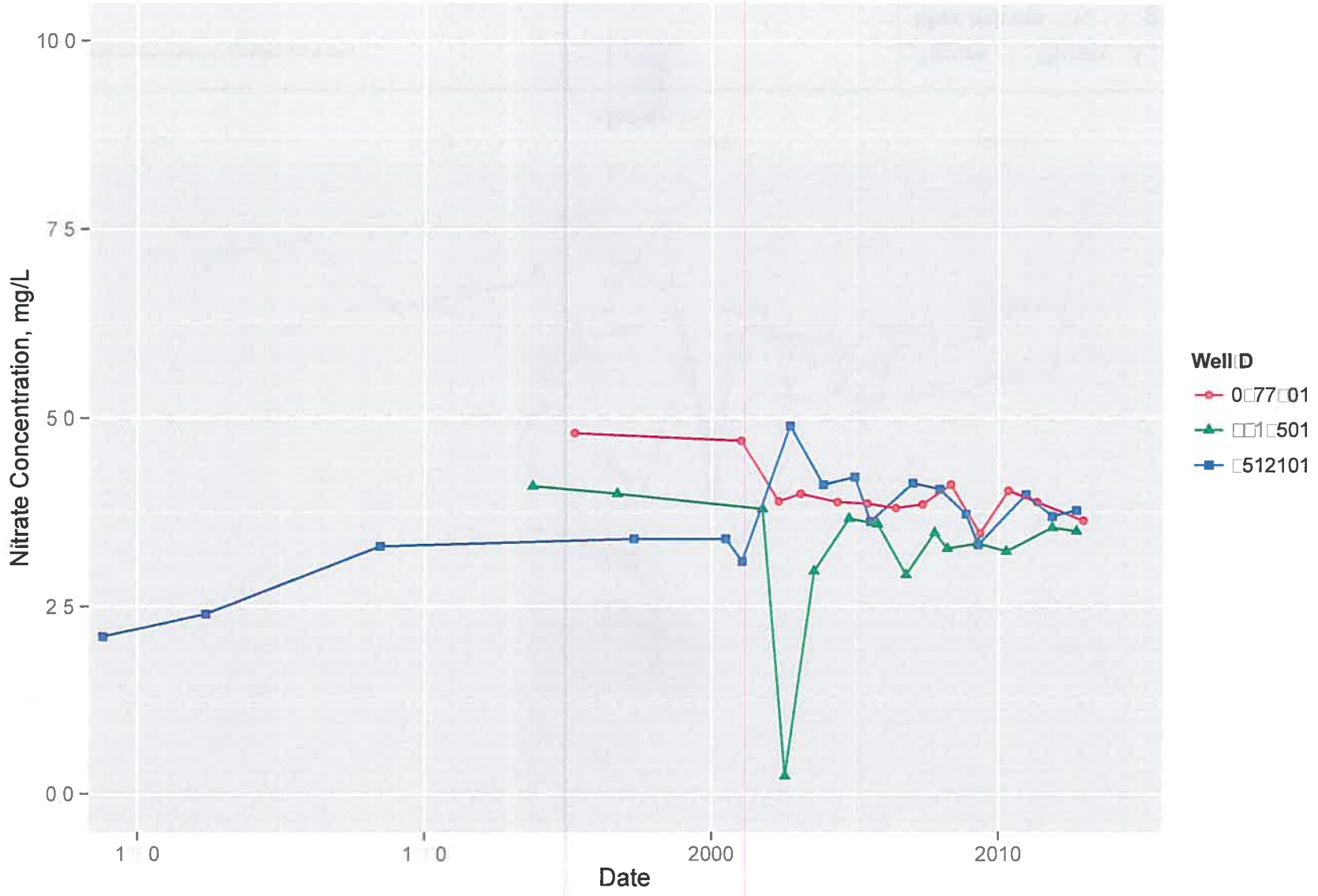

Non-detect values plotted at half the Method Reporting Limit value

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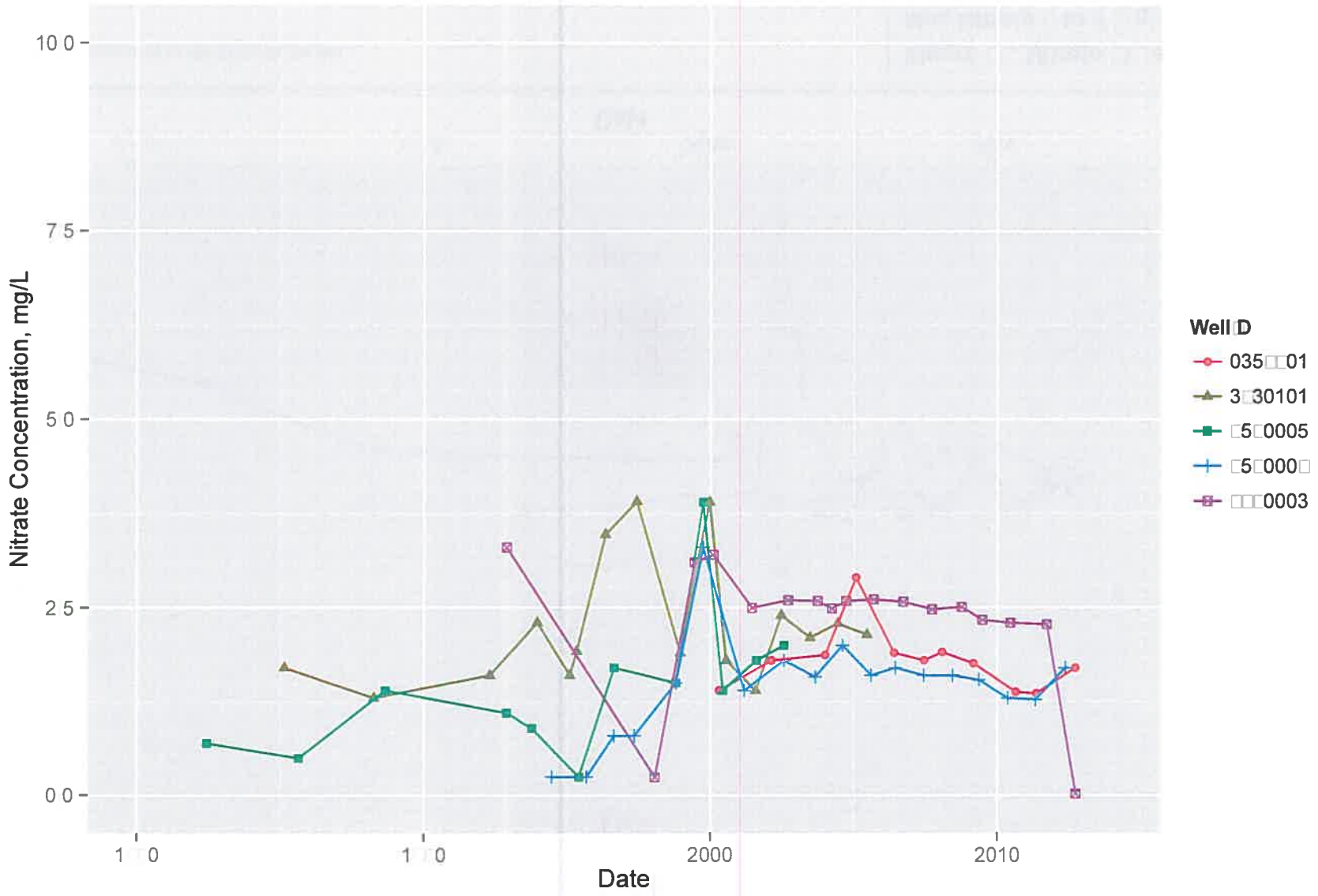

Non-detect values plotted at half the Method Reporting Limit value

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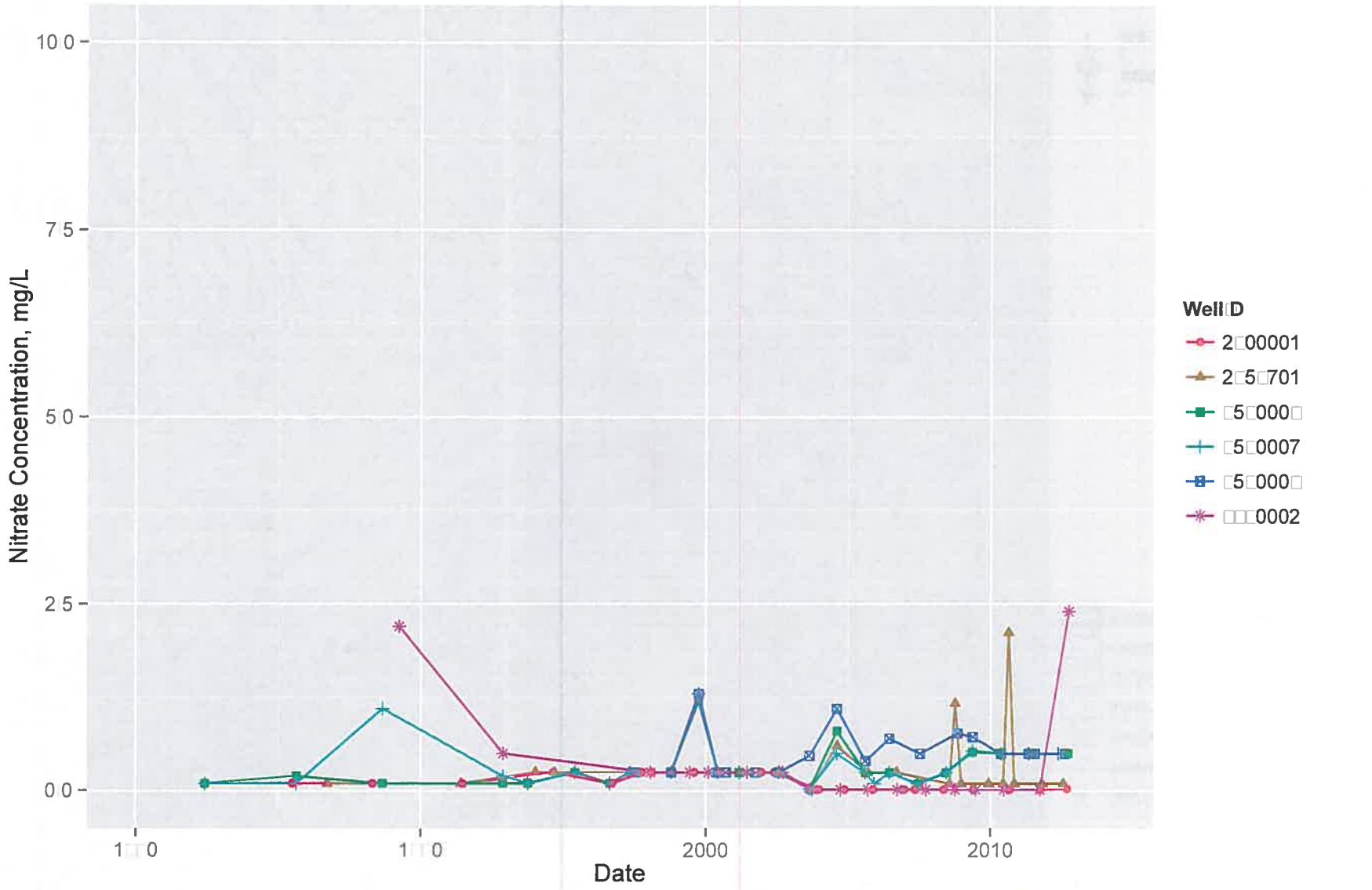
Figure . Nitrate i e erie
Max Nitrate to g

PgG



Non-detect values plotted at half the Method Reporting Limit value

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Figure 5. Nitrate i e erie
Max Nitrate g

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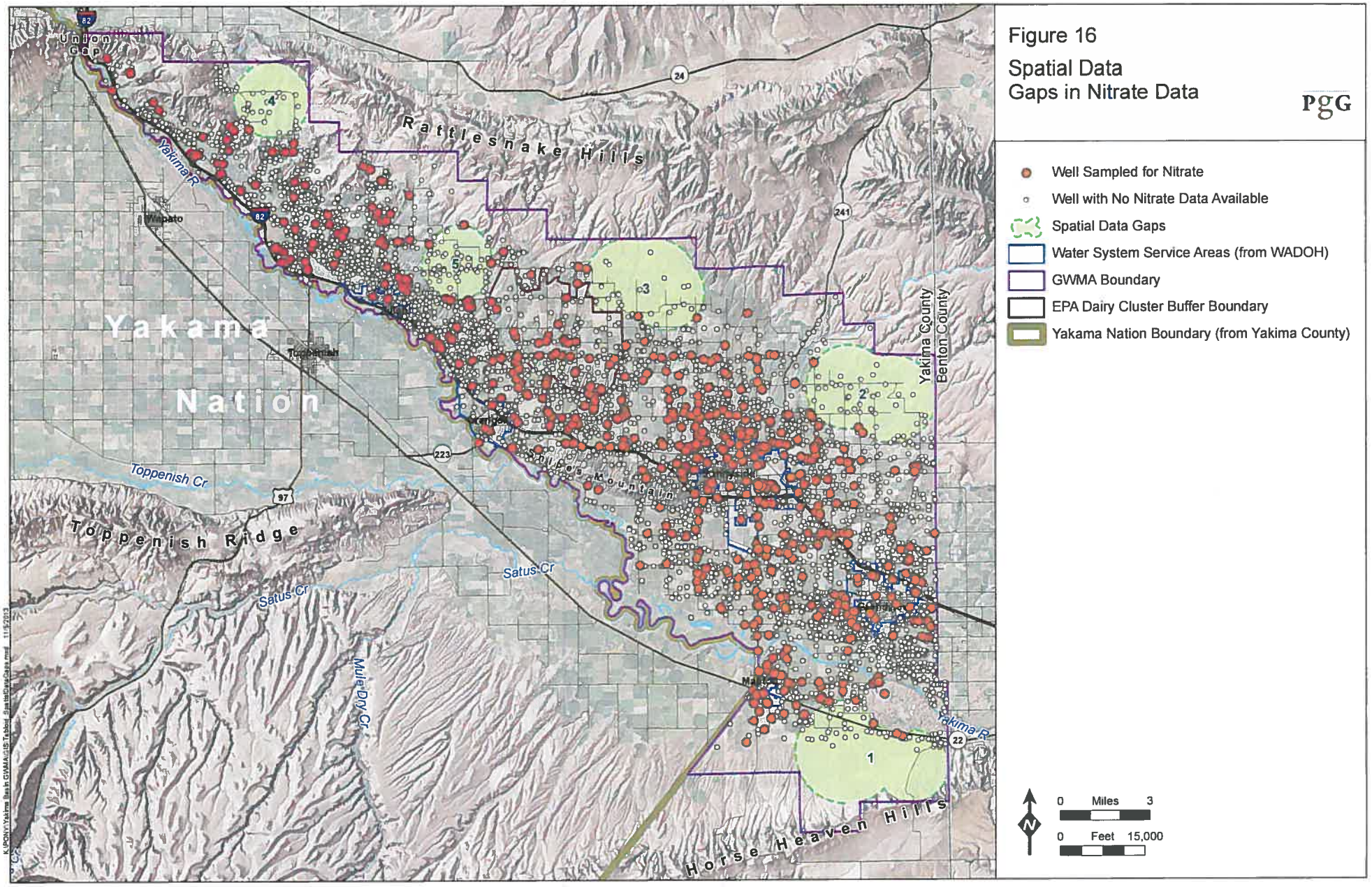
Figure 16
Spatial Data
Gaps in Nitrate Data
PgG
Well Sampled for Nitrate
Well with No Nitrate Data Available
Spatial Data Gaps
Water System Service Areas (from WADOH)
GWMA Boundary
EPA Dairy Cluster Buffer Boundary
Yakama Nation Boundary (from Yakima County)
Yakama Nation
Rattlesnake Hills
Toppenish Ridge
Horse Heaven Hills
Yakima R
Toppenish Cr
Satus Cr
Mule Dry Cr
Yakima County
Benton County
Wapato
Union Gap
0 Miles 3
0 Feet 15,000
N

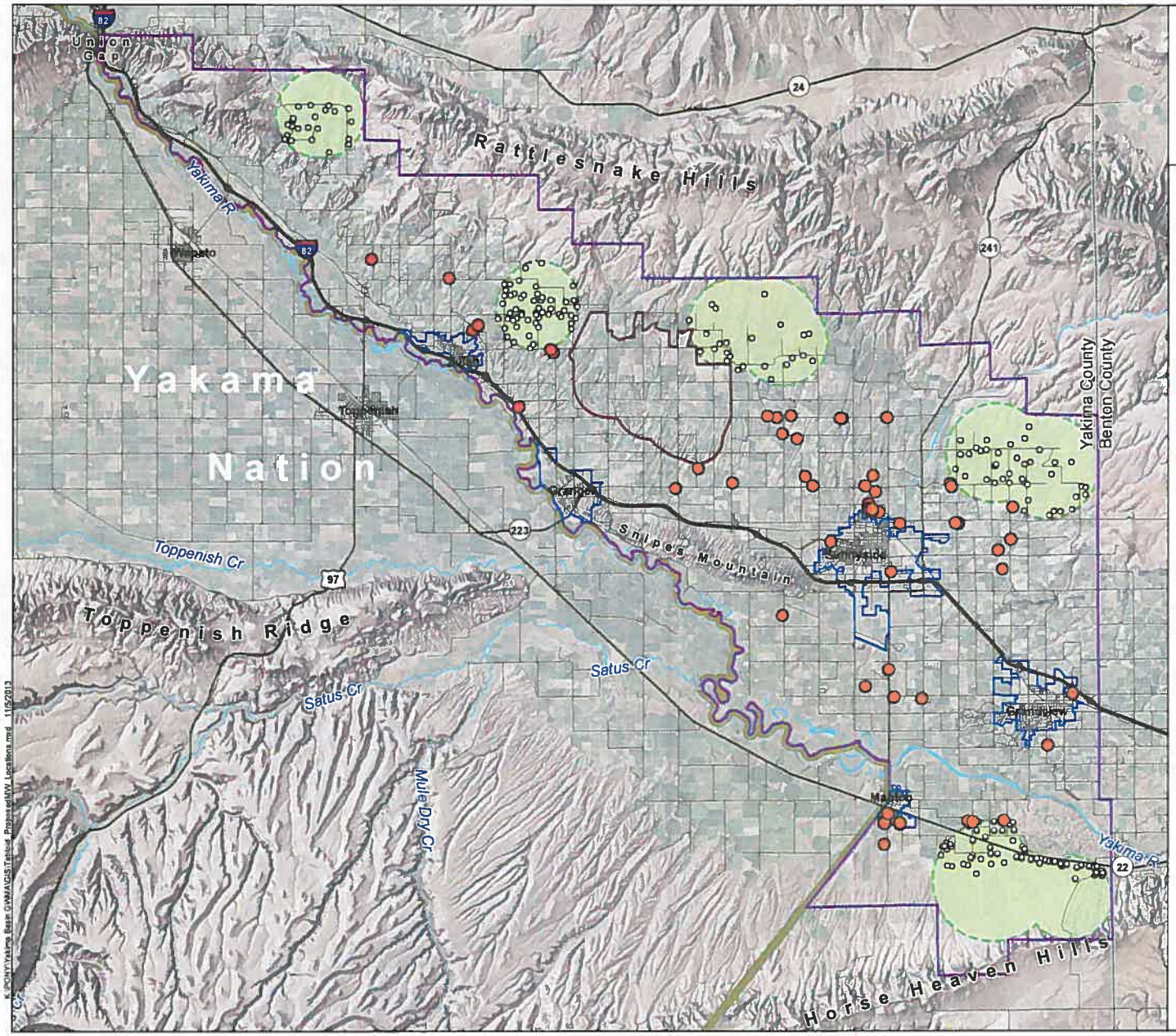

Figure 17

Proposed Monitoring Locations for Spatial Data Gaps, Trends and Hot Spots

PgG

Proposed Monitoring Locations

- Wells Located in Spatial Data Gaps
- Wells with Maximum Nitrate Concentration >20.0 mg/L (Hotspots)
- Spatial Data Gaps
- Water System Service Areas (from WADOH)
- GWMA Boundary
- EPA Dairy Cluster Buffer Boundary
- Yakama Nation Boundary (from Yakima County)

N

0 Miles 3

0 Feet 15,000

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