



60 Ways to Leave Your Groundwater ... Cleaner

A Long Term Groundwater Improvement Project In Oregon's Willamette Valley

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What is a GWMA?

A Groundwater Management Area is a tool used by the Oregon Department of Environmental Quality to address a large scale groundwater contamination when the contaminants originate from non-point sources.



GWMA Process (in general)

- (1) Document contamination
- (2) Declare a Groundwater Management Area (GWMA)
- (3) Appoint an Advisory Committee
- (4) Form an Action Plan
- (5) Implement the Action Plan
- (6) Rescind the GWMA declaration

Nitrate refers to nitrate-N

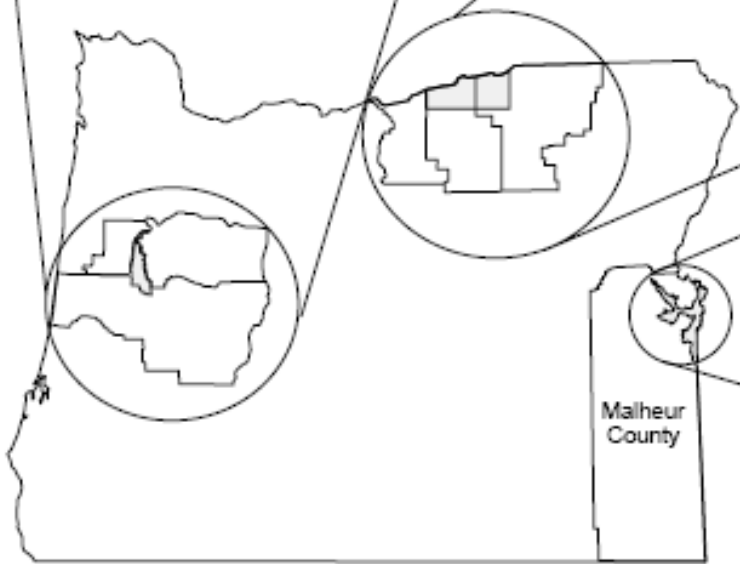
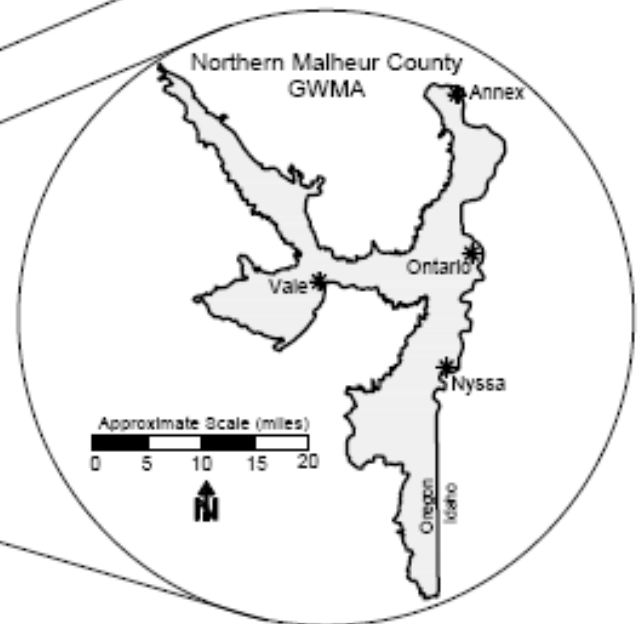
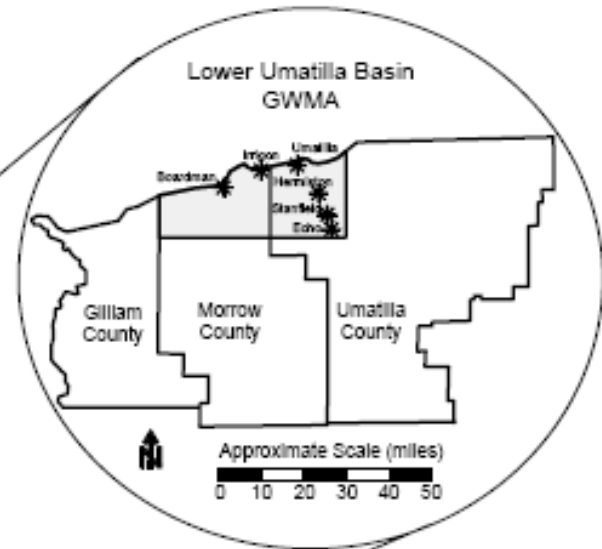
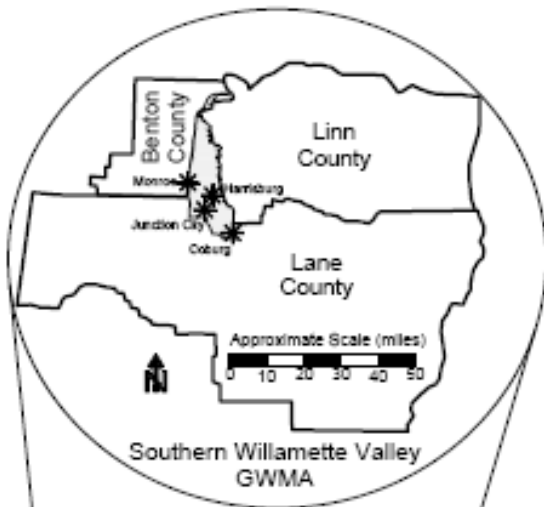
mg/L \simeq ppm

Nitrate Standards

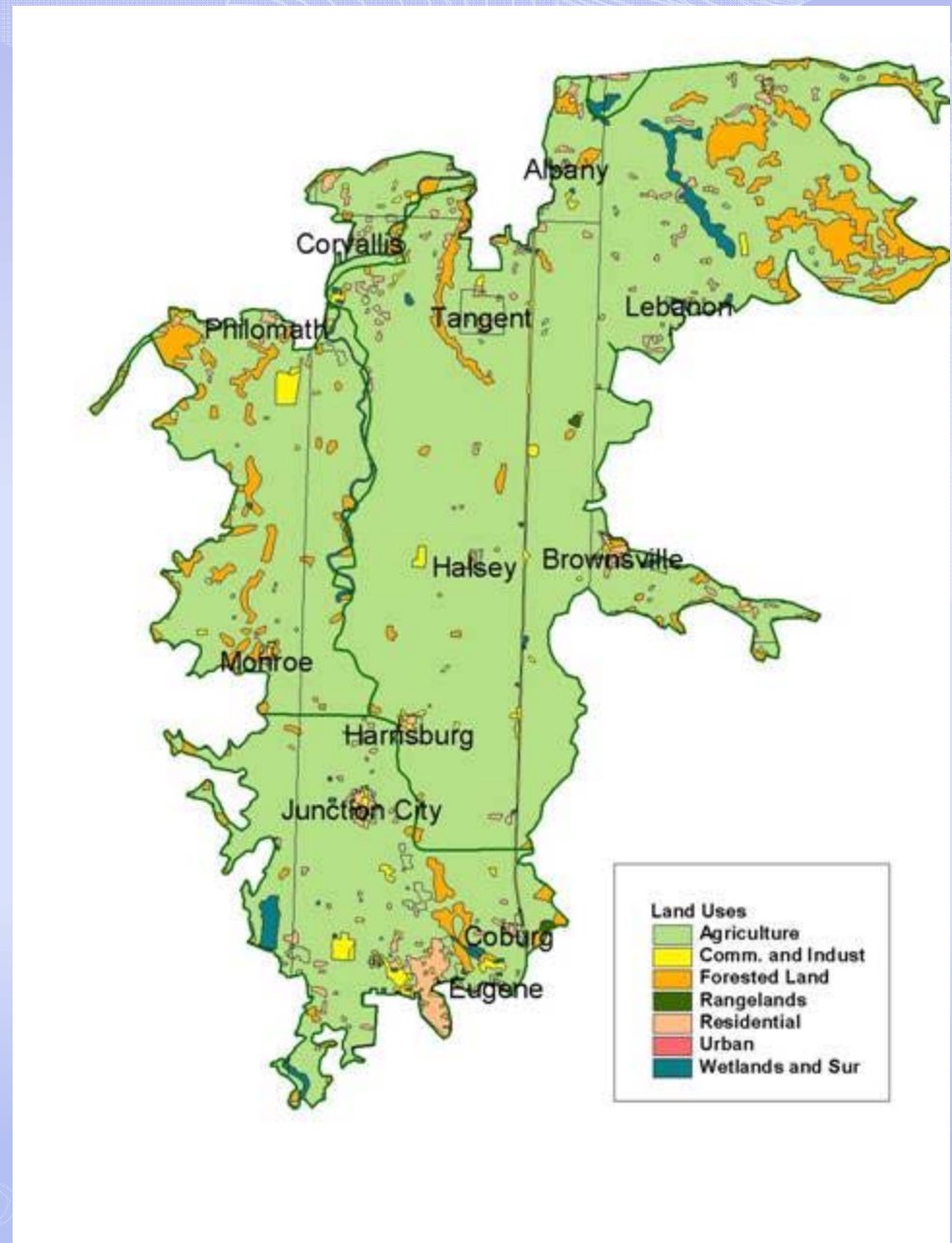
- The public drinking water standard is 10 mg/L
- “Action Level” for Oregon GWMA declaration is 7 mg/L



Location of Oregon's Groundwater Management Areas

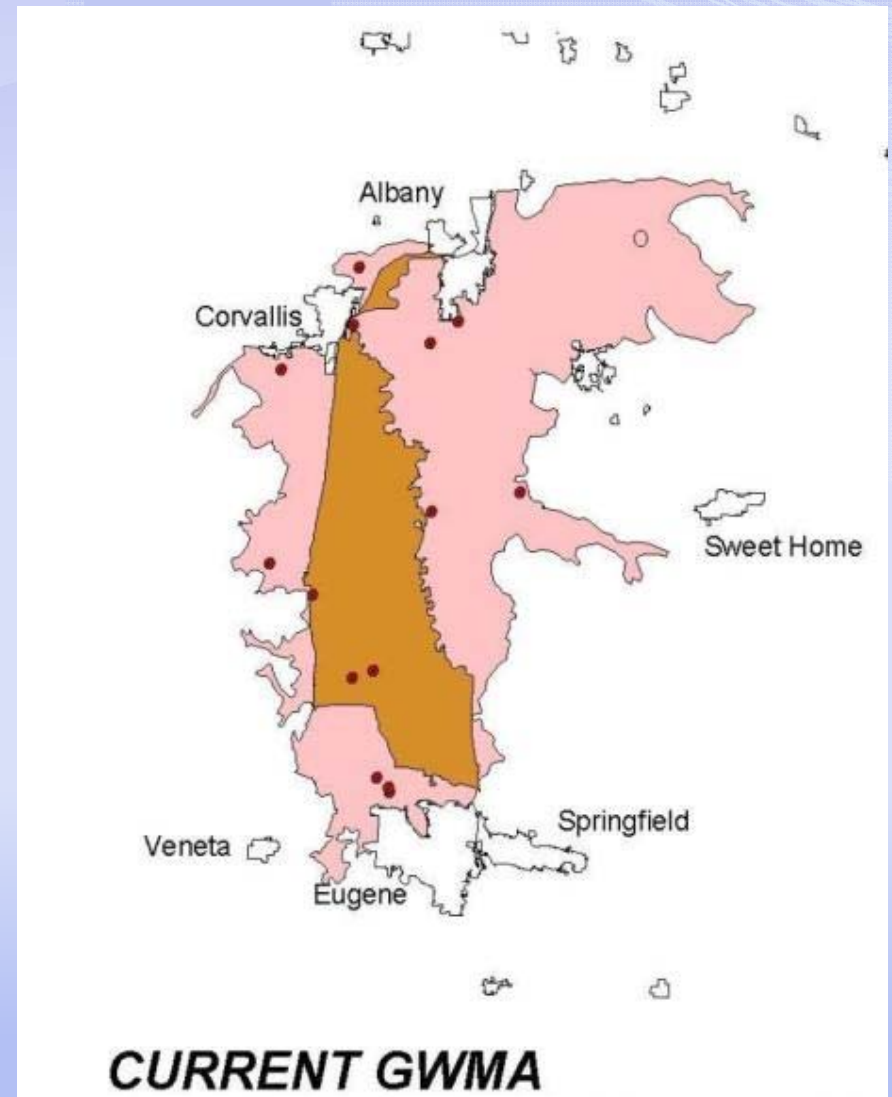


In the SWV
GWMA, the
Land Use is
Predominately
Agriculture



The GWMA boundaries were also designed to

- Be recognizable to the general public, so they would know if they are “in”
- Capture most of the high nitrate values seen in the earlier studies



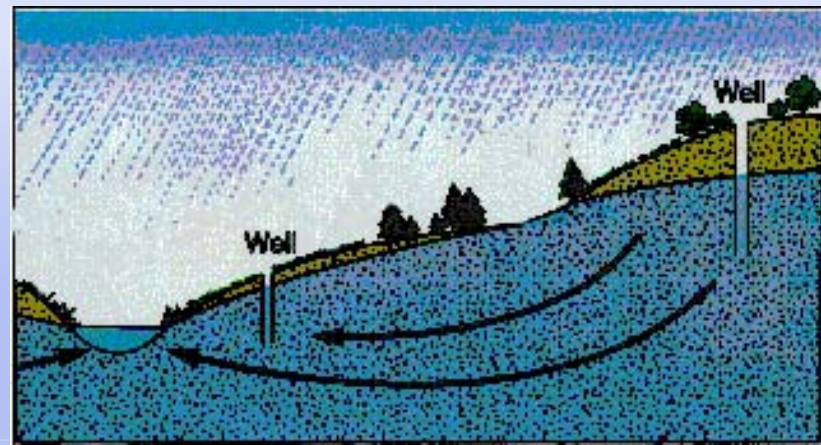
Where Are We Now?

- ◆ **GWMA declared in 2004**
- ◆ **A committee was appointed**
- ◆ **An Action Plan was finalized Dec 2006**
- ◆ **Outreach and implementation continues**



SWV Groundwater Resource

- ◆ Shallow (20-40 ft.)
- ◆ Unconfined
- ◆ In some areas, the shallow groundwater overlies a larger and deeper regional aquifer







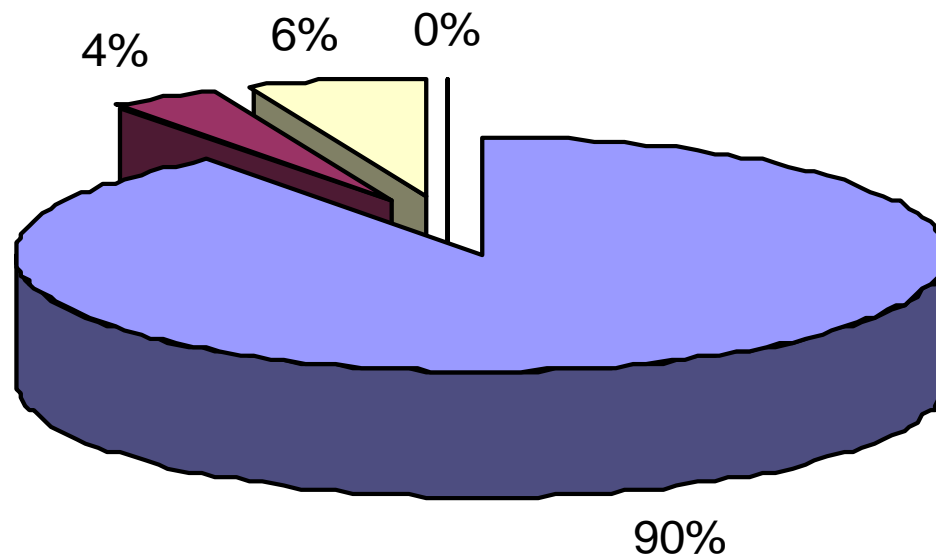
Nearly all of the GWMA Residents Rely on Groundwater



Four Sources of Nitrate Analyzed by the Nitrogen Budget

Percentage Nitrogen Contribution by Source

	Crops	1,704 annual tons
	Septic Systems	74 annual tons
	CAFOs	109 annual tons
	Large Wastewater Systems	



Residential Focus

- ◆ **Approximately 21,000 people living in the GWMA and nearly all of the GWMA residents rely on groundwater for their drinking water supply.**
- ◆ **Many rural landowners still use hand-dug or driven wells.**
- ◆ **Septic Systems—68% of the septic systems in the GWMA do not have a septic system record.**
- ◆ **Home and garden fertilizer use**

Education and Outreach

- Free nitrate well water testing
- Rural Living Basics Classes
- Festivals—Daffodil Festival
- Kids Day for Conservation
- Curriculum



Agricultural Focus

- ◆ ~197 square miles (93 % of the area) Includes grains, hay and forage, seed crops, row crops, vegetables, fruits, and various specialty seed crops. Known as the “grass seed capitol of the world.”
- ◆ Eight permitted Confined Animal Feeding Operations (CAFOs)
- ◆ Small acreage agricultural landowners.

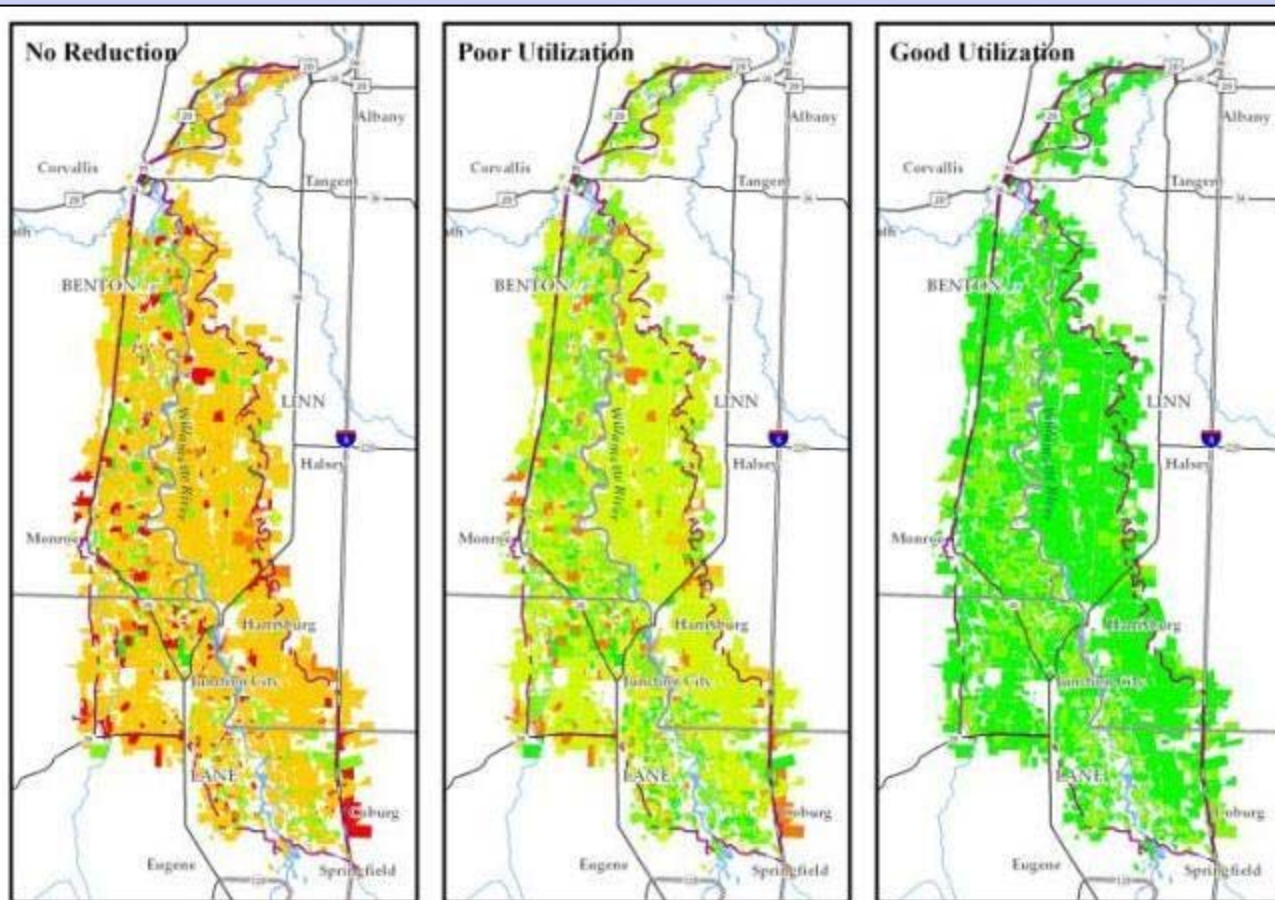


Uptake ratios take into account conditions and management practices

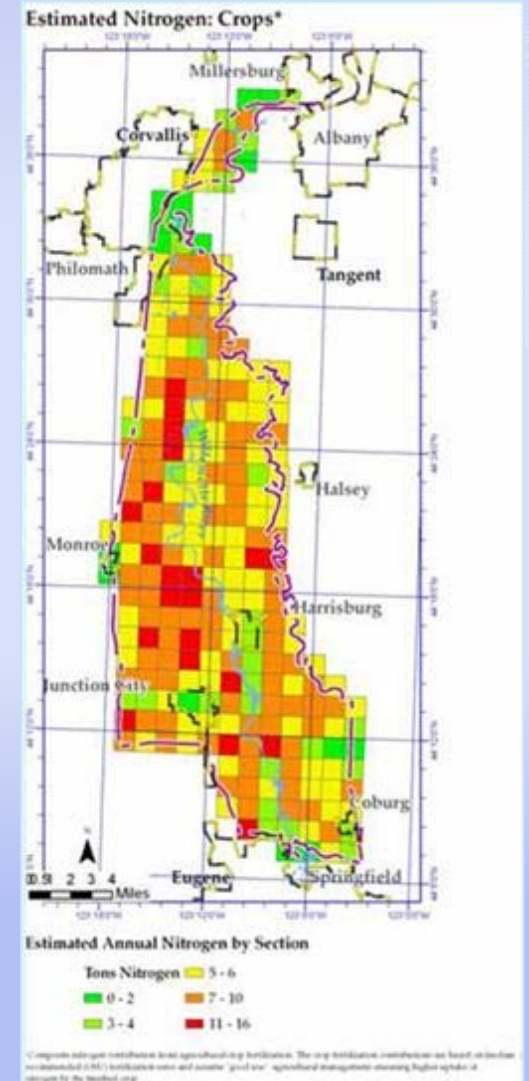
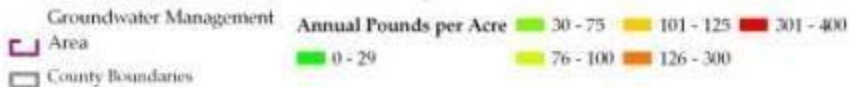


Field Classification	Percent of Crop Lands	Poor Utilization (low) Uptake Ratio	Good Utilization (high) Uptake Ratio
Alfalfa	.29%	15%	60%
Beans/peas	.19%	10%	60%
Berries & vineyards	1.29%	30%	70%
Christmas trees	.34%	50%	80%
Clover	1.13%	15%	60%
Corn	.13%	30%	65%
Double cropping	.10%	30%	70%
Grains	4.26%	10%	80%
Grass seed rotation	56.60%	40%	85%
Hayfield	6.59%	40%	85%
Irrigated annual rotation	12.55%	50%	50%
Irrigated perennial	3.18%	60%	90%
Mint	2.52%	40%	65%
Orchard	.96%	60%	90%
Pasture	3.93%	40%	85%
Sugar beet seed	.69%	50%	70%
Turfgrass	.90%	40%	85%

Nitrogen Potentially Lost Per Acre Depending on Utilization (conditions and management practices)



Median Application Rate (No Use Reduction), Poor Utilization, & Good Utilization
Estimated Crop Contribution



Monitoring Groundwater Quality



Long Term Measuring Overall Water Quality

- DW = 14 domestic wells, generally deeper, used on a regular basis.
- GW = 25 groundwater monitoring wells, generally shallower, purged only when sampled



Long Term Measuring Overall Groundwater Quality

- What is being measured
- pH
- Specific Conductance
- Temperature
- Dissolved Oxygen
- Nitrate
- Sulfate (every other event)



Long Term Measuring Overall Groundwater Quality

**Sampling occurs every
3 months (quarterly)**

**22 Quarterly events completed,
next one is due end of May 2012**





GW-12

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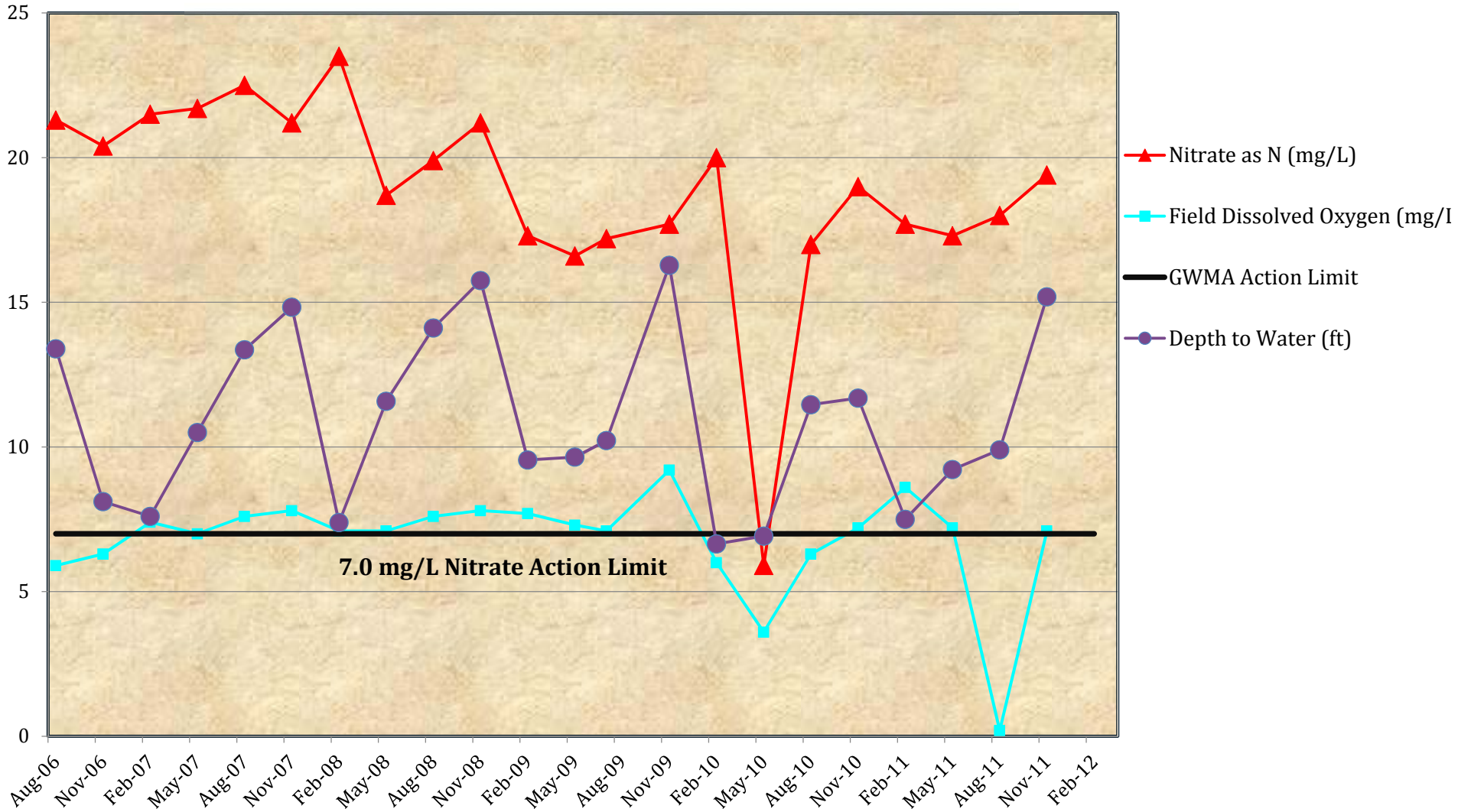
1009 ft

Date: 7/8/2010

44° 22' 20.25" N 123° 10' 33.93" W elev 289 ft

Eye a

GW-12 Crook Road



7/8/2011
19°

N

GW-20

DW-17

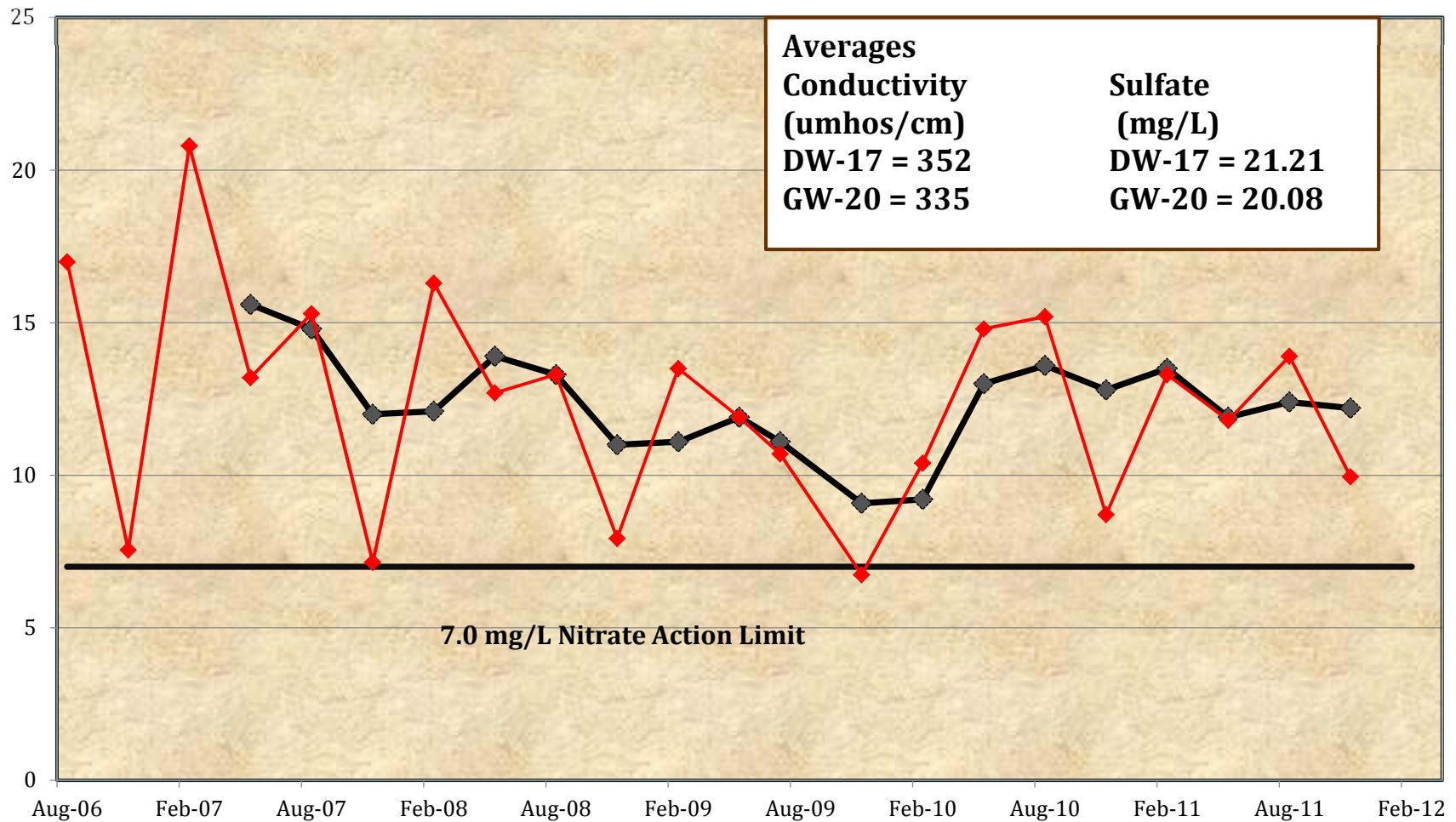
Hubbard Rd

1391 ft

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GW-20 and DW-17 Nitrate-N Values in mg/L



— GWMA Action Limit

◆ DW-17 Nitrate as N (mg/L)

◆ GW-20 Nitrate as N (mg/L)

Groundwater or *Surface Water*?

- Over the years, there seems to be some water results from select wells that indicate we are seeing more surface-water influence than groundwater influence.
- Wells GW-17 and sometimes GW-5 are good examples of this phenomena

Willamette River Historic Channels, North of Corvallis, Oregon



L I D A R

Revealing Oregon's Dynamic Landscape

The Willamette River and its former channels near Corvallis, Oregon. For thousands of years, the Willamette River has meandered across the valley floor. This 3D enhanced image was created using a combination of lidar-derived elevation data and aerial orthophotography.
2010 Oregon Department of Geology and Mineral Industries Lidar imagery and graphic design by Daniel Coe



8/18/2011
199 201



GW 5

Larson Ln

1172 ft

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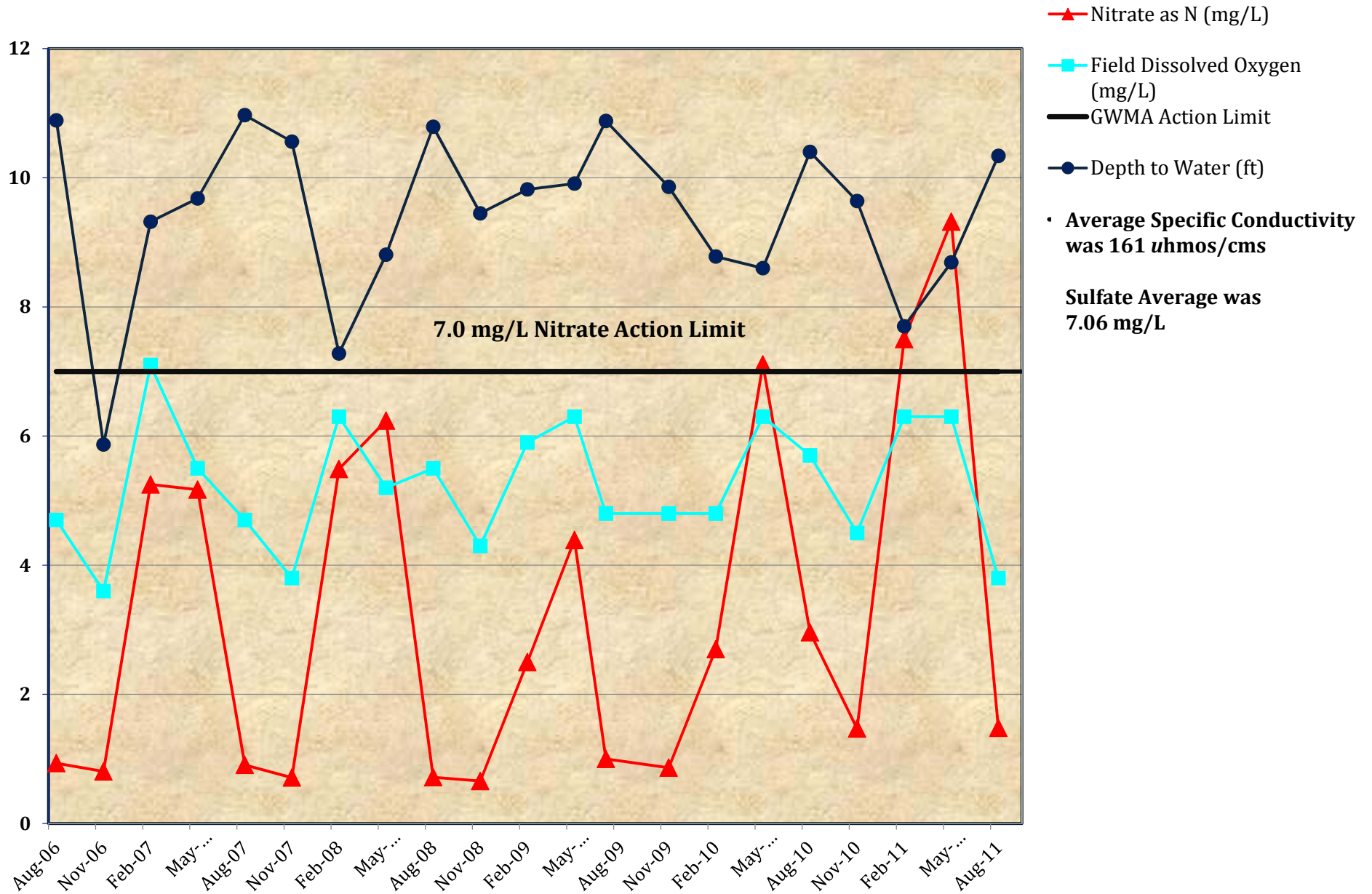
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Imagery Date: 8/18/2011 199

44°11'39.08" N 123°09'29.22" W elev 338 ft

Eye alt 5410 ft

GW-5 Hayes and Zumwalt



GW-5

Groundwater or Surface Water?

- ◆ All high nitrate-N values in Feb or May
- ◆ All nitrate-N values <1.5 mg/L in Aug or Nov
- ◆ Lowest conductivity in Aug and Nov
- ◆ Watertable lowest in Aug and Nov

If this well is river water influenced – one might think the nitrate would be lowest when the river stage is the highest (Feb) & the DTW is the lowest (Feb and May)





7/8/2

Fawver Ln

Goracke Rd

GW-18

GW-17

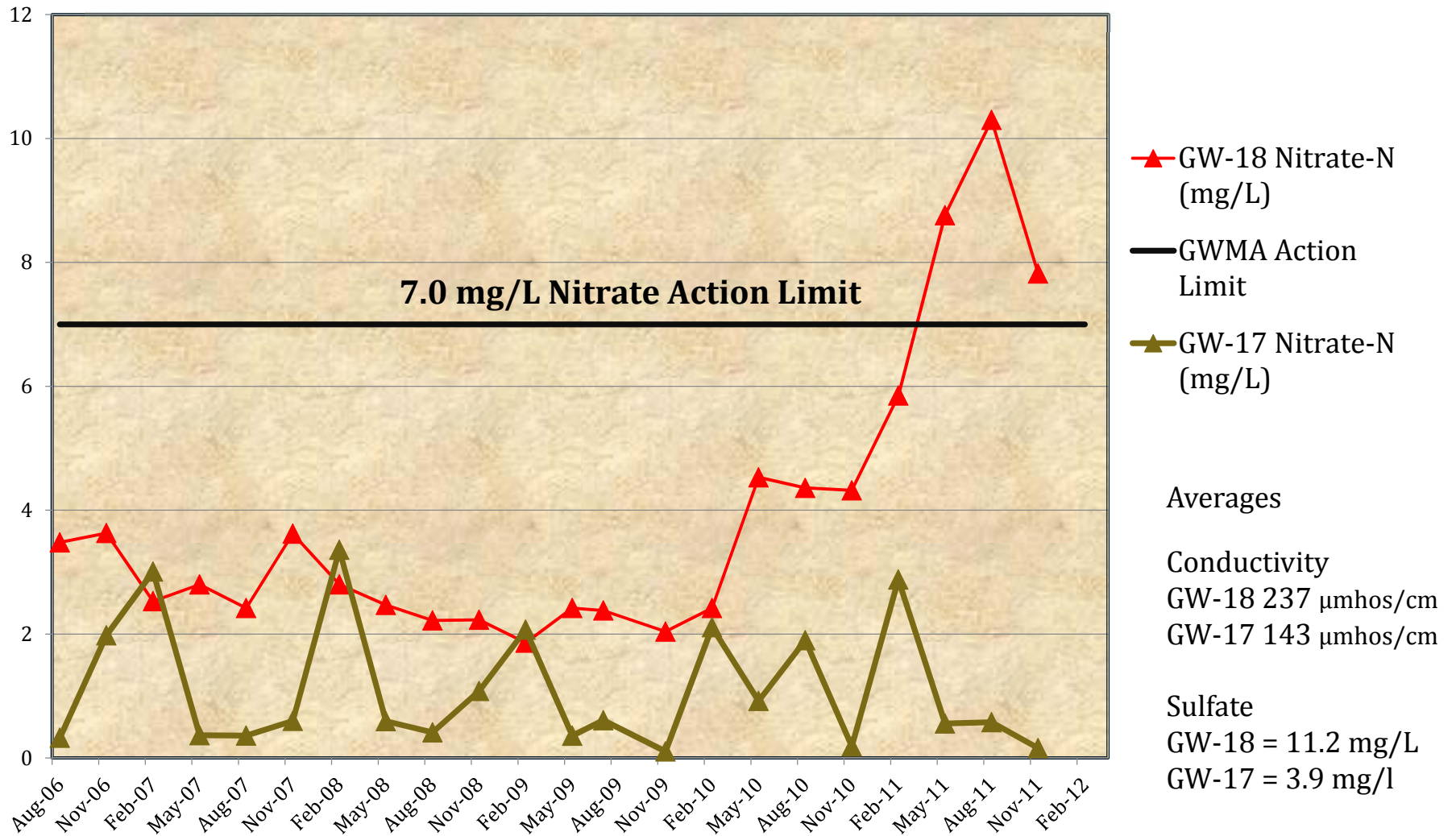
Noraton Rd

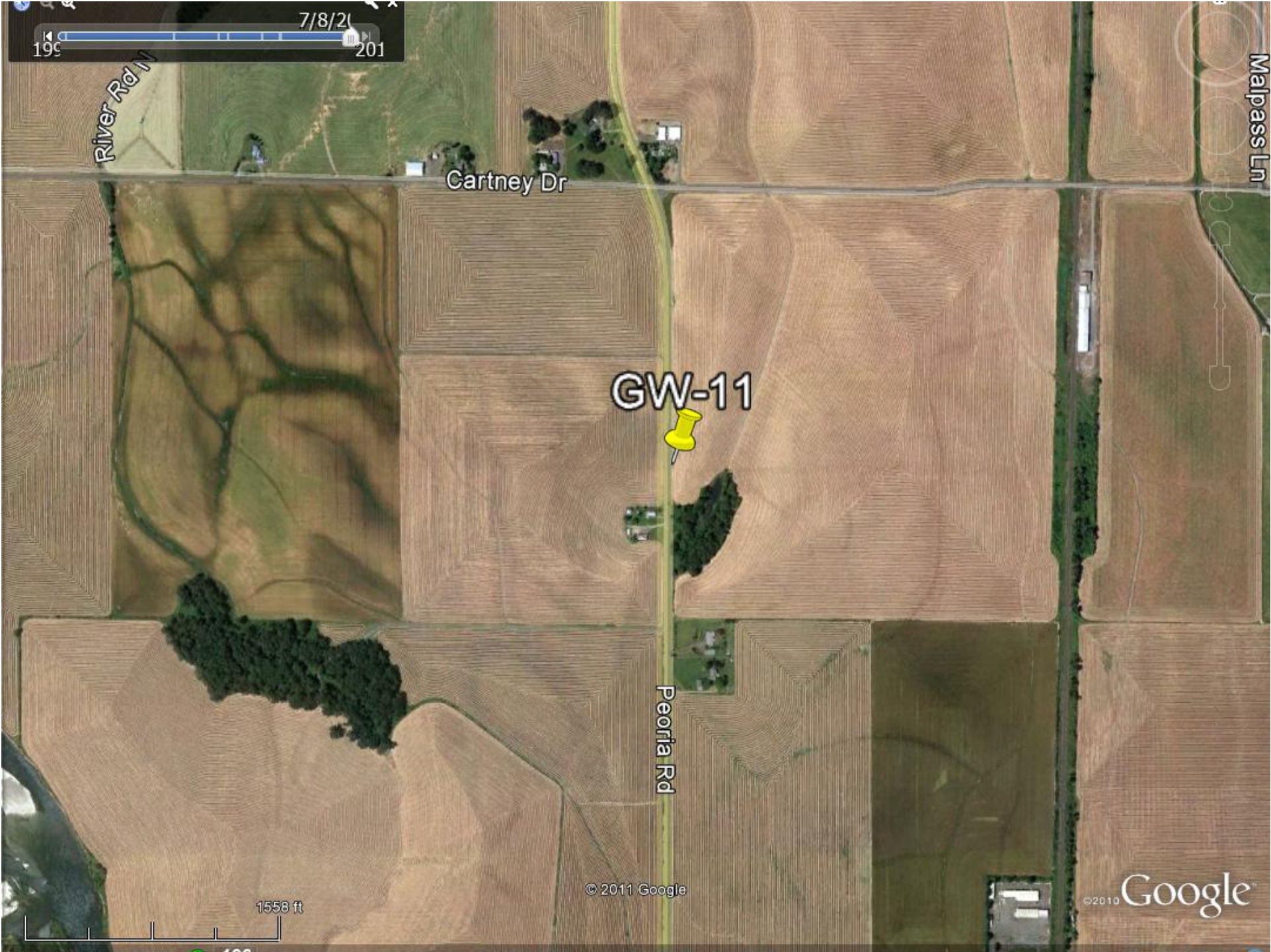
1336 ft

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GW-18 & GW-17 on Goracke





GW-11

River Rd

Cartney Dr

Peoria Rd

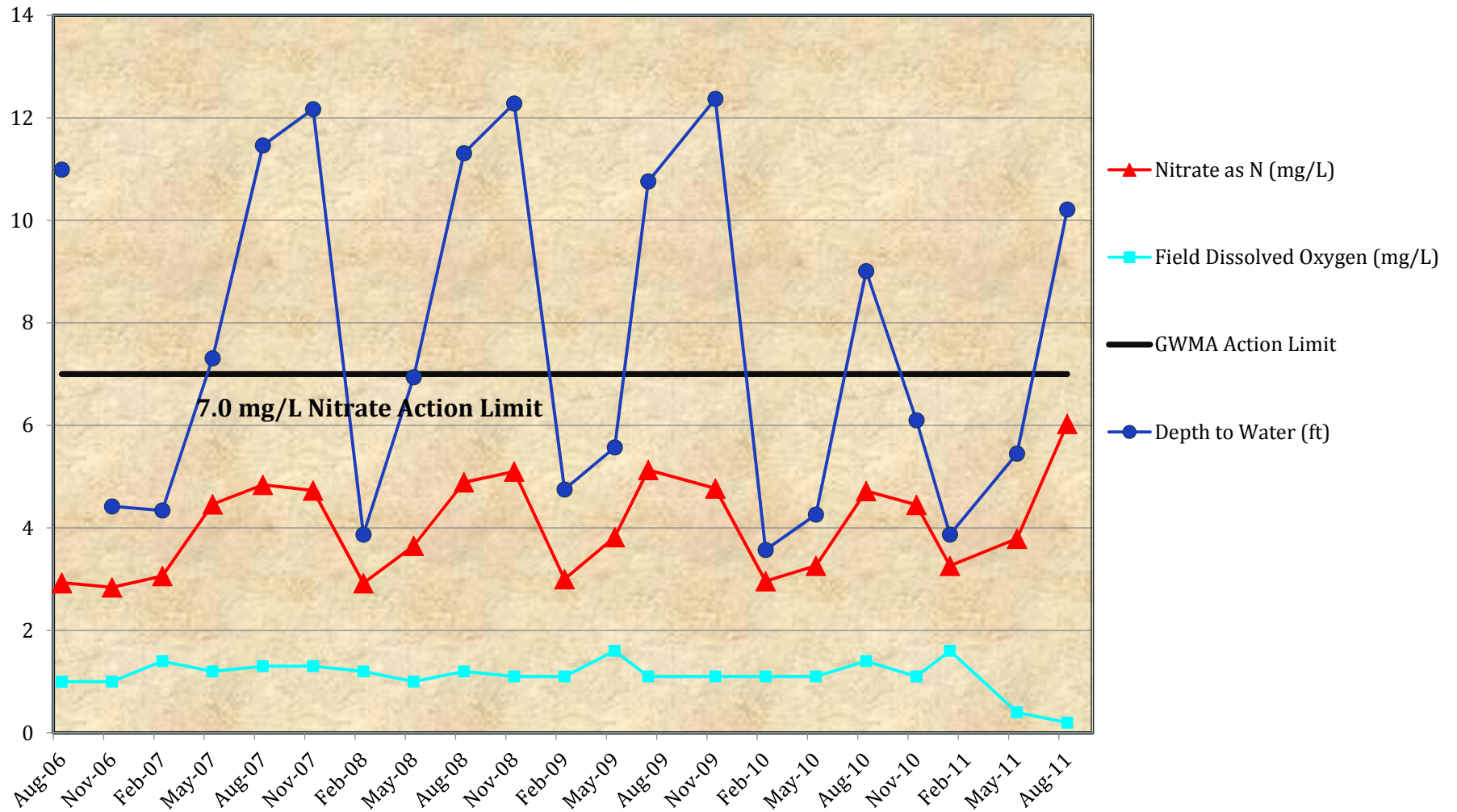
Malpass Ln

1558 ft

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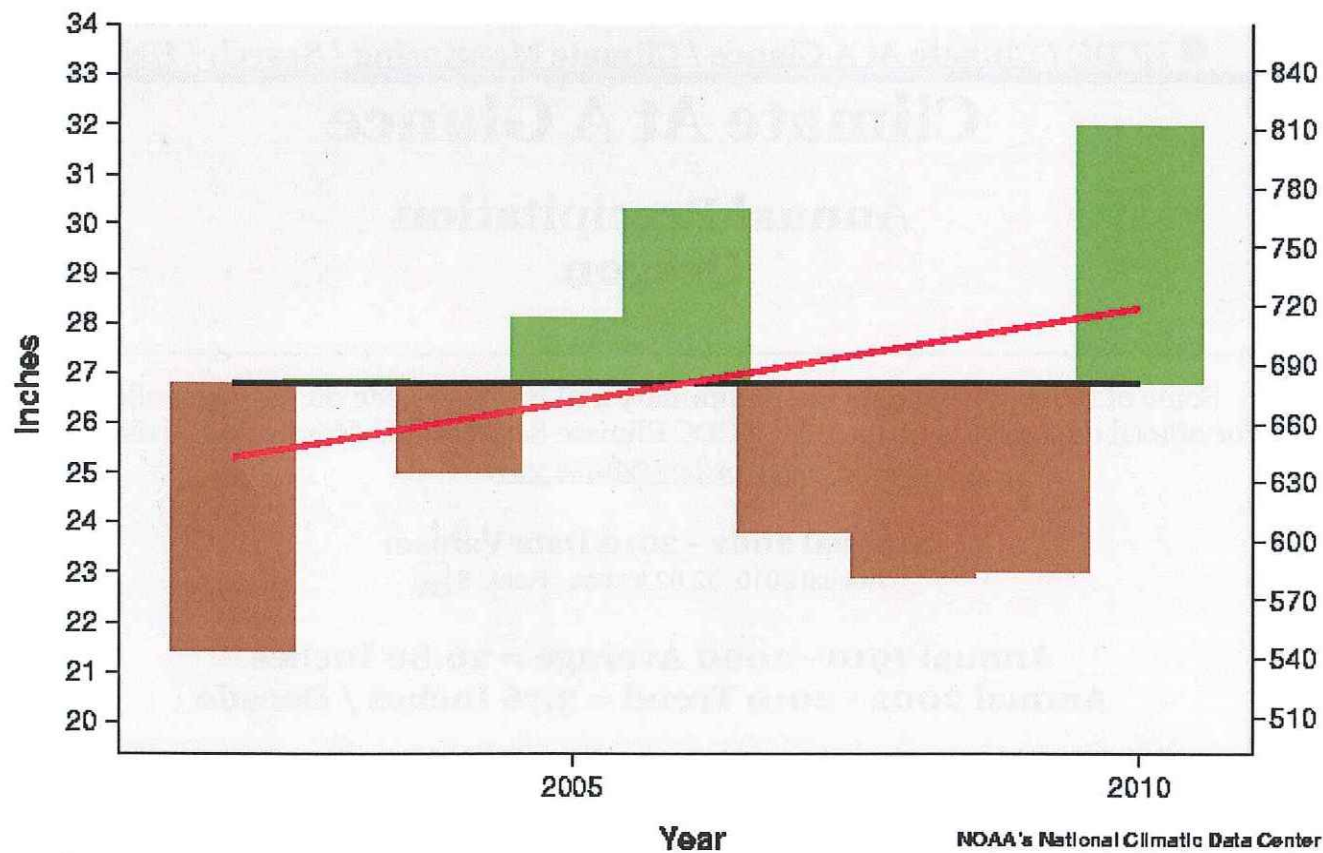
GW-11 Peoria Road



Overall Trend Comparisons

Well	Nitrate-N Increase 2011 vs Increase 2010	Nitrate-N Decrease 2011 vs Decrease 2010	Nitrate-N Steady 2011 vs Steady 2010
Domestic Wells	4 (2011) 1-2 (2010)	2 (2011) 7 (2010)	8 (2011) 5-6(2010)
Monitoring Wells	11 (2011) 7 (2010)	4 (2011) 7 (2010)	8 (2011) 9 (2010)

- Above Average Precipitation
- Below Average Precipitation
- Average Precipitation
- Trend



Agricultural Changes – Active Management

- ◆ **Dropped irrigation nozzles – less water needed to irrigate the same crop thus less potential for over-irrigation**
- ◆ **Veris Mapping and adoption of precision agriculture practices**
- ◆ **Updated fertilizer guidances and practices**
- ◆ **Anaerobic digesters**
- ◆ **Awareness and money**

These changes equal less nitrogen input and loss



What else is happening in the GWMA?

- ❑ On-going discussions with USGS to help better define the legacy vs. current impacts
- ❑ Possible grant opportunity for installing lysimeters, building a database, and using this to help validate the NTT
- ❑ Fellowship – Intern thanks to EPA – review all data – help design a lysimeter project



To help resolve some of the mysteries, we are including some additional parameters for selected wells

Chloride

Boron

Bromide

Iron

Manganese

Stable O & H

<http://gwma.oregonstate.edu/>



