Western Ambient Groundwater Monitoring Program

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Outline

- Objective of monitoring
- ND ambient monitoring
- Aquifer and well selection
- Analytical program
- Expected timeline
- Program progress
- Preliminary results

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Western Ambient Groundwater Monitoring Program Objective

- The goal of the Western Ambient Groundwater Monitoring Program is to provide an assessment of the quality of North Dakota's groundwater resources with regard to potential oil field contamination

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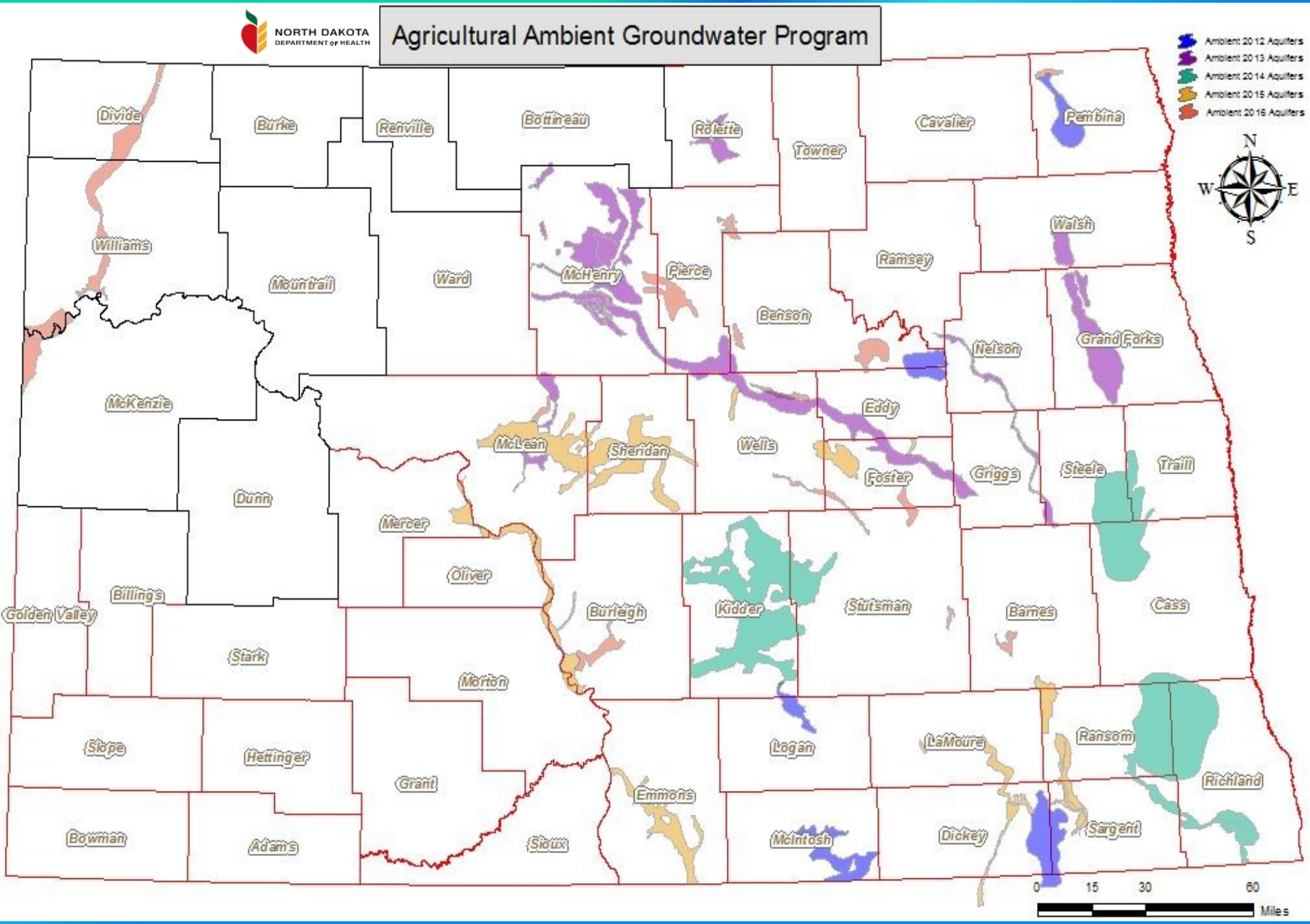
Agricultural Ambient Groundwater Program

- Implemented in 1992 to monitor impacts to groundwater aquifers resulting from agricultural practices
- Sampling conducted in 50 of North Dakota's most vulnerable glacial drift aquifers
- Approximately 1100 wells are sampled on a 5 year rotation
- Samples analyzed for general water chemistry, pesticides/herbicides, trace metals, and nitrates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Agricultural Ambient Groundwater Program
Ambient 2012 Aquifers
Ambient 2013 Aquifers
Ambient 2014 Aquifers
Ambient 2015 Aquifers
Ambient 2016 Aquifers
N
W
E
S
Divide
Burke
Renville
Bottineau
Rolette
Towner
Cavalier
Pembina
Williams
Mountrail
Ward
McHenry
Pierce
Ramsey
Walsh
Benson
Nelson
Grand Forks
McKenzie
McLean
Sheridan
Wells
Eddy
Foster
Griggs
Steele
Traill
Dunn
Mercer
Oliver
Billings
Golden Valley
Burleigh
Kidder
Stutsman
Barnes
Cass
Stark
Morton
Slope
Hettinger
Grant
Logan
LaMoure
Ransom
Richland
Bowman
Adams
Sioux
Emmons
McIntosh
Dickey
Sargent
0
15
30
60
Miles

Western Ambient Groundwater Monitoring Program

- Initial study area in Northwest North Dakota
- Selected due to increase in oil activity in the Bakken formation

- Study area includes 8 counties:
  - Mountrail
  - Williams
  - McKenzie
  - Dunn
  - Divide
  - Burke
  - Renville
  - Bottineau

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- 33 named surficial aquifers exist in the project area
- Permitted water use was evaluated as basis for potential risk determination
- Aquifer water use ranked
  - High ≥ 1,000 acre feet year
  - Medium 200 -999 acre feet per year
  - Low < 200 acre feet per year
- Water usage data combined with vulnerability ranking from previous studies to determine sampling priority for aquifers
- Determine number of observation wells only

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- 536 potential wells were identified
- Potential well determination based on 5 prioritization criteria:
  1) 2-inch well diameter
  2) Screened interval priority– wells less than 200 feet
  3) Background water chemistry available or newly installed well
  4) Not located on Reservation lands
  5) Only one well per section (unless multiple oil wells in section)

Prioritization Criteria for Well Selection

1) Using only 2-inch diameter wells, potential wells went from 536 → 274.
2) Of those, 241 wells had screened intervals of <200 feet
3) Background water chemistries were available for 218 wells
4) Ft. Berthold and Three Affiliated Tribes have began a sampling plan on reservation lands. Omitting the wells from the area brings potential wells to 212
5) Finally applied the "only one well per section" criterion →153 potential wells remaining

- After evaluating all well criteria, wells in 13 aquifers were eliminated from consideration
- After full evaluation, 153 wells in 20 aquifers were selected for sampling

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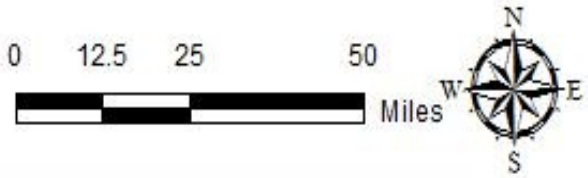

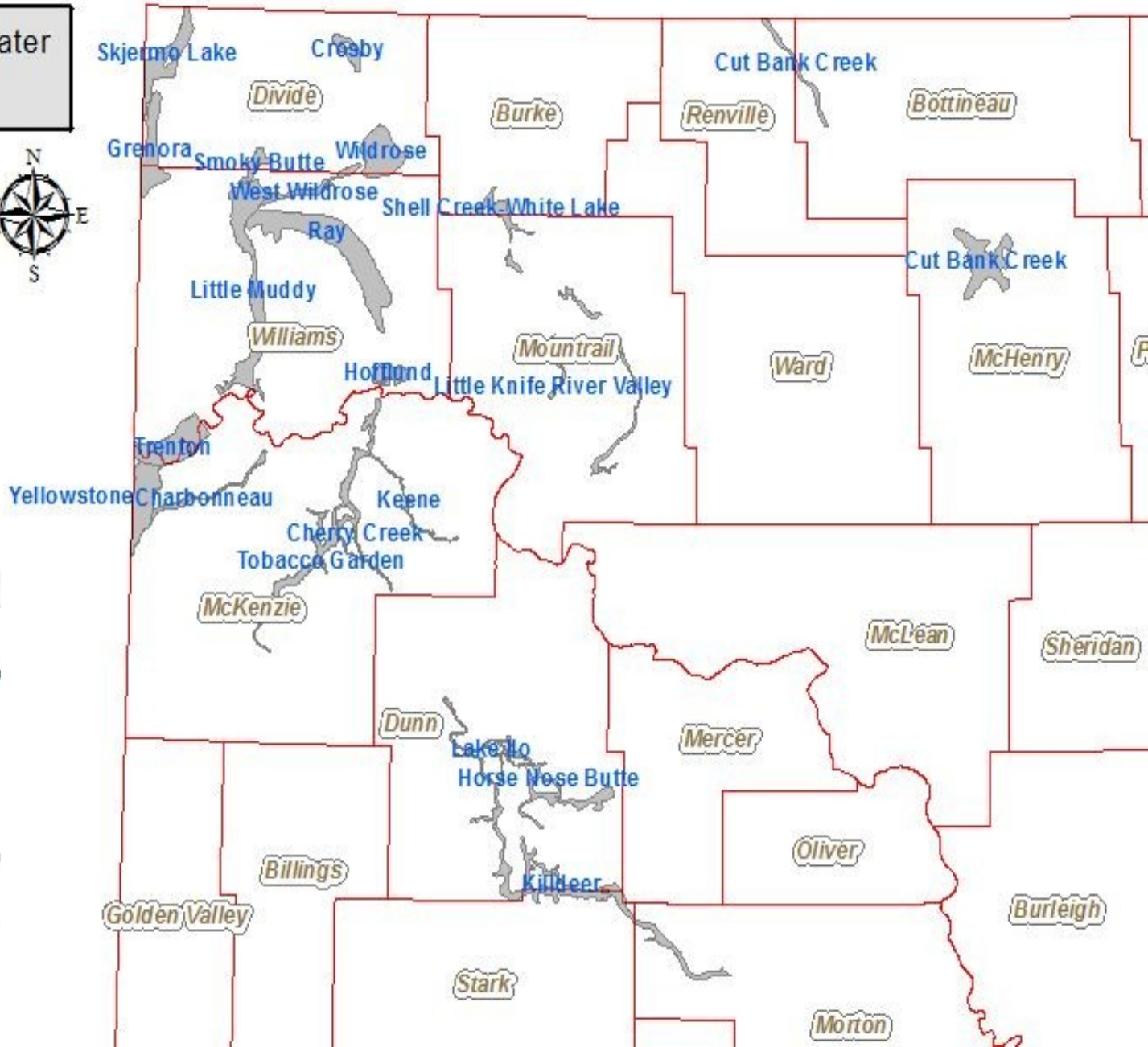

Analytical Program

- Group 194
  - General Chemistry
  - Bromide
  - Trace Metals and Strontium
  - VOC and SVOC
  - TPH (GRO and DRO)

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Proposed sampling schedule

Aquifer	# of Wells	Tenative 1st Rotation	Tenative 2nd Rotation
Hofflund	14	Fall 2013	Fall 2016
Killdeer/Lake Ilo	14	Fall 2013	Fall 2016
Little Muddy	43	Spring-Fall 2014	Spring-Fall 2017
Charbonneau	4	Fall 2014	Fall 2017
Ray	7	Fall 2014	Fall 2017
Shell Creek-White Lake	21	Spring 2015	Spring 2018
Trenton	7	Spring 2015	Spring 2018
Tobacco Garden	2	Fall 2015	Fall 2018
Skjermo Lake	6	Fall 2015	Fall 2018
Yellowstone	2	Fall 2015	Fall 2018
Cherry Creek	3	Fall 2015	Fall 2018
West Wildrose	4	Fall 2015	Fall 2018
Grenora	9	Fall 2015	Fall 2018
Little Knife River Valley	2	Fall 2015	Fall 2018
Keene	1	Spring 2016	Fall 2019
Wildrose	1	Spring 2016	Fall 2019
Horse Nose Butte	1	Spring 2016	Fall 2019
Smokey Butte	7	Spring 2016	Fall 2019
Crosby	2	Spring 2016	Fall 2019
Cut Bank Creek (Mohall)	3	Spring 2016	Fall 2019
Total: 20 Aquifers	**153 Wells**	**3-year rotation**	

Program Progress

- Sampling commenced in late September 2013
- 20 wells were sampled between September and November
  - Killdeer aquifer – 9 wells
  - Lake Ilo aquifer – 5 wells
  - Hofflund aquifer – 6 wells
- Sampling season ended due to
  - Weather
  - Contamination detected in field blank samples

Preliminary Results

- General chemistry and metals results obtained, not yet evaluated
- Bromide not analyzed due to laboratory issues
- No contaminants detected in VOC, SVOC, and GRO analyses
- Low levels of DRO detected (40 to 117 µg/L) – not believed to be indicative of contamination from oil field activities
  - Appear to be "non-petroleum" organics
  - Further evaluation to be conducted

Thank You

Questions or Comments?

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