



Assembly and visualization of groundwater-quality monitoring data, Upper Big Blue Natural Resources District, east-central Nebraska

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NRD Conference 3/5/2024

Background

USGS Nebraska Water Science Center, in cooperation with Upper Big Blue (UBB) Natural Resources District (NRD), developed a set of tools to allow UBB to assess their groundwater quality monitoring program

- To better understand disparate *nitrate* concentrations
 - Siting of septic fields
 - Well construction information
- To assess whether the groundwater monitoring network was adequate characterizing the resource within the NRD
- To review whether the replacement wells were acceptable alternatives the original wells

Approach

- **Organize and combine water-quality data sets from different sources**
- **Assemble and curate important metadata**
- **Present data in a geospatial and graphical interface**

Approach

- **Retrieve up-to-date water-quality results**
 - *UBB's internal water quality databases*
 - *Water Quality Portal (USGS samples)*
 - *Nebraska Dept of Environment and Energy (NDEE) Clearinghouse, for other samples in NRD*
- **Combine WQ data with well construction information**
 - *Nebraska Department of Natural Resources (NEDNR) well registration database for well info*
- **Build web tool to visualize well and water-quality results in graphs and maps**

Retrieve the water quality data results

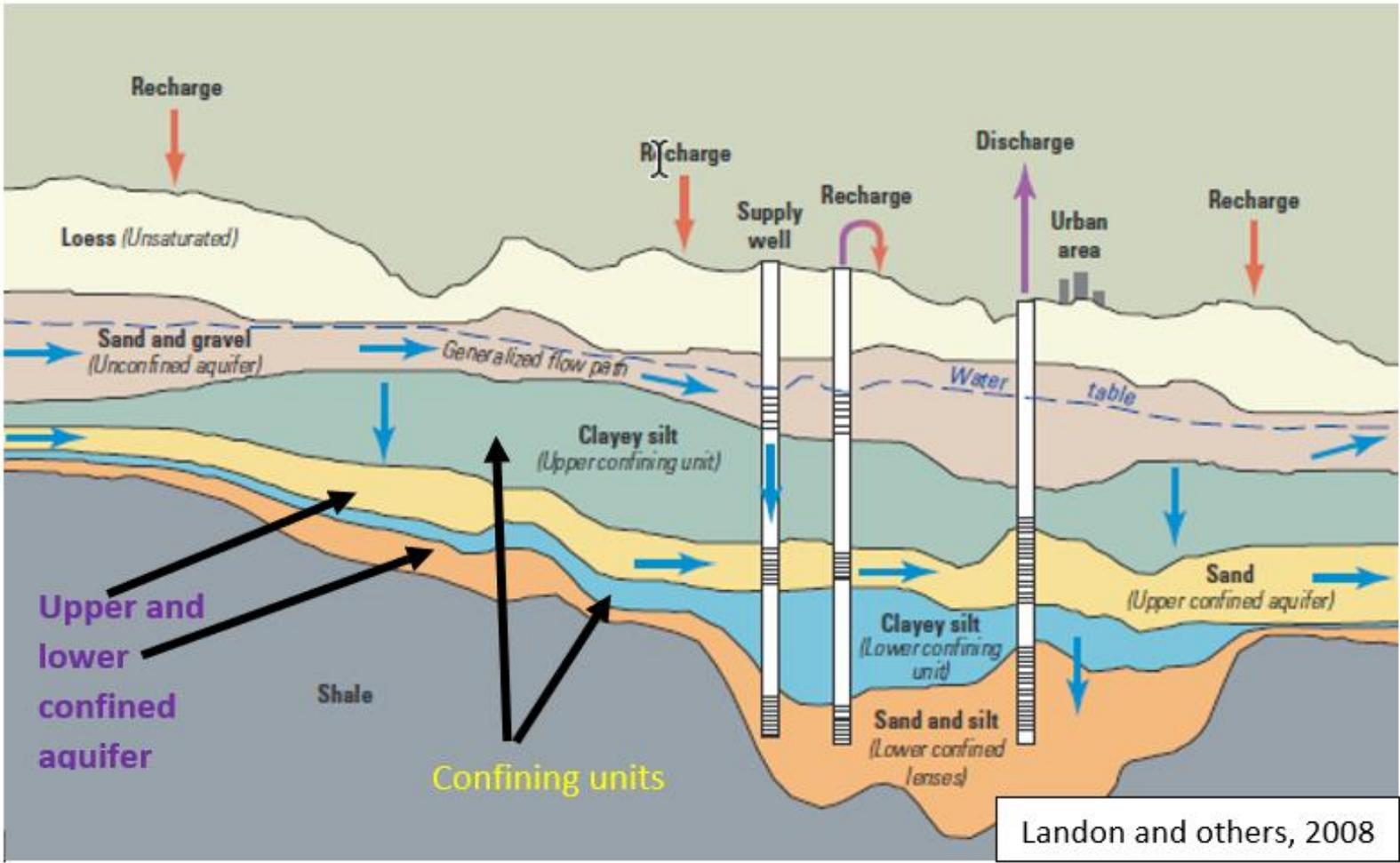
Sources

- **Upper Big Blue NRD**
 - Local database files (Access, Beehive)
- **Water Quality Portal**
 - Cooperative service sponsored by the USGS, EPA, and the National Water Quality Monitoring Council (NWQMC).
 - Integrates publicly available water quality data from the USGS National Water Information System (NWIS) the EPA Water Quality Exchange (WQX) Data Warehouse, and the USDA ARS Sustaining The Earth's Watersheds - Agricultural Research Database System (STEWARDS).
 - <https://www.waterqualitydata.us/>
- **Nebraska Groundwater Quality Clearinghouse**
 - <https://clearinghouse.nebraska.gov/>

Populate "well pedigree"

Steel
Manhole Cover

Unconfined
aquifer



Landon and others, 2008

Drill Depth



(Material Type)

Documentation

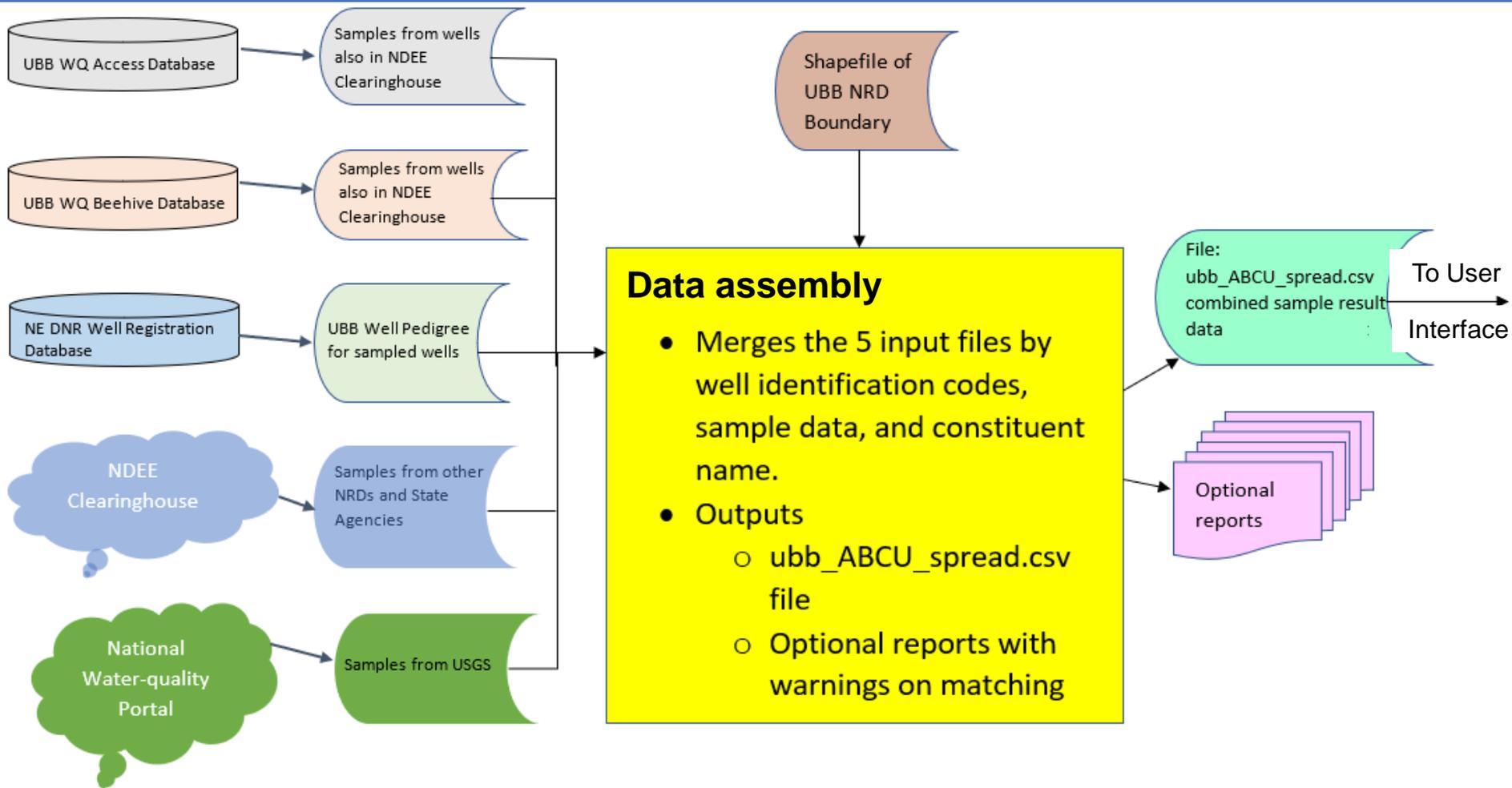
USGS Data Release

- **Snapshot of the water quality data**
 - **UBB databases**
 - **Nitrate only**
 - **Limited to wells and results in CH**
 - **Well pedigree**
 - **Well construction information**
 - **Water-bearing units**
- **Other associated metadata**

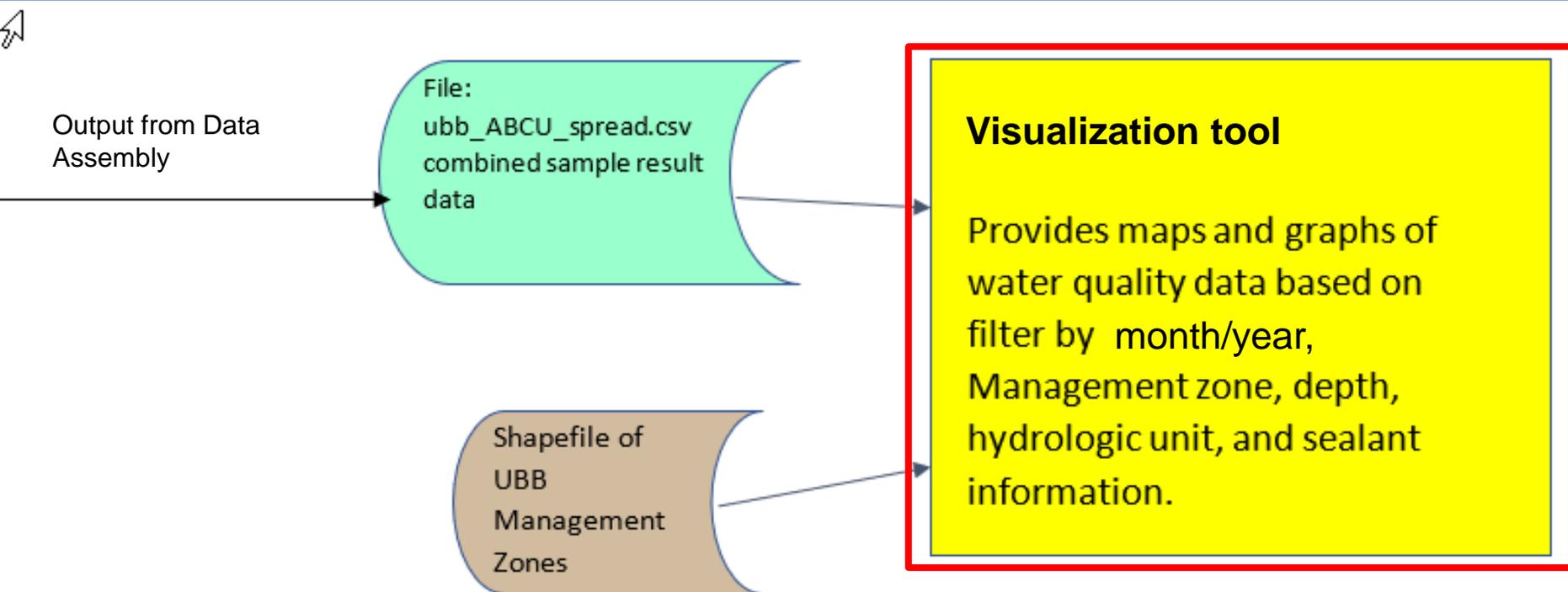
Other data not included in Data Release

- **Clearinghouse (retrieved from web)**
- **Water Quality Portal data (retrieved from web)**

Create the combined water-quality and well information file for UBB



Provide a tool to visualize water-quality results in graphs and maps



Visualization tool

Nitrate as N concentrations, Upper Big Blue (UBB) Natural Resources District (NRD), east-central Nebraska.

Data were retrieved from the UBB NRD database, the National Water Quality Monitoring Council's Water Quality Portal (WQP), and the Nebraska Department of Environment and Energy's Groundwater Quality Clearinghouse Database.

Filter sites

Sample collection agency
UBBNRD only

Time period of sampling dates
Mar-45 Apr-23

Well construction

- Screen seal
- Aquifer seal
- Concrete casing
- Surface seal only
- Unknown construction

Sealed near surface

- Yes
- No
- Information not available

Additional seal

- Yes
- No
- Information not available

Groundwater Management Zone

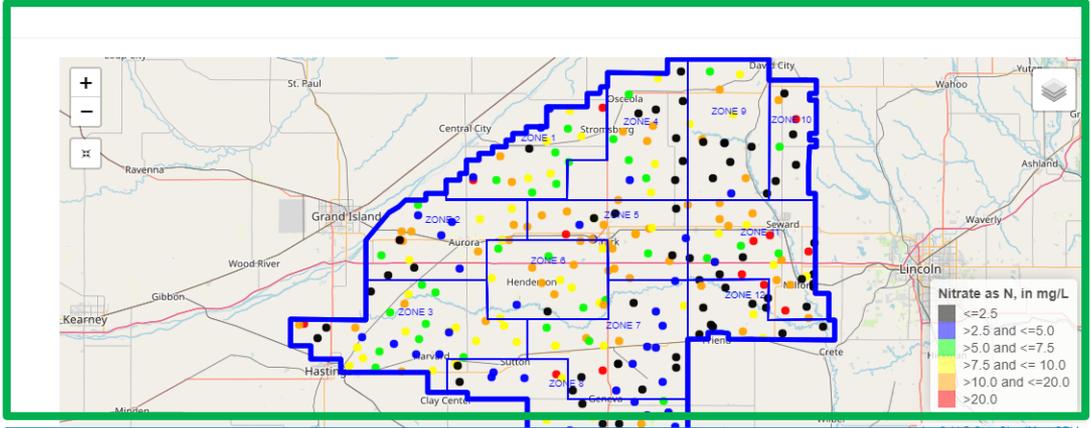
- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10
- 11
- 12

Depth category

- 0-49
- 50-99
- 100-199
- 200-299
- >300

Water-bearing Zone

- DA
- CF A
- CF B
- UF A
- UF B
- UF M
- Unknown water-bearing zone



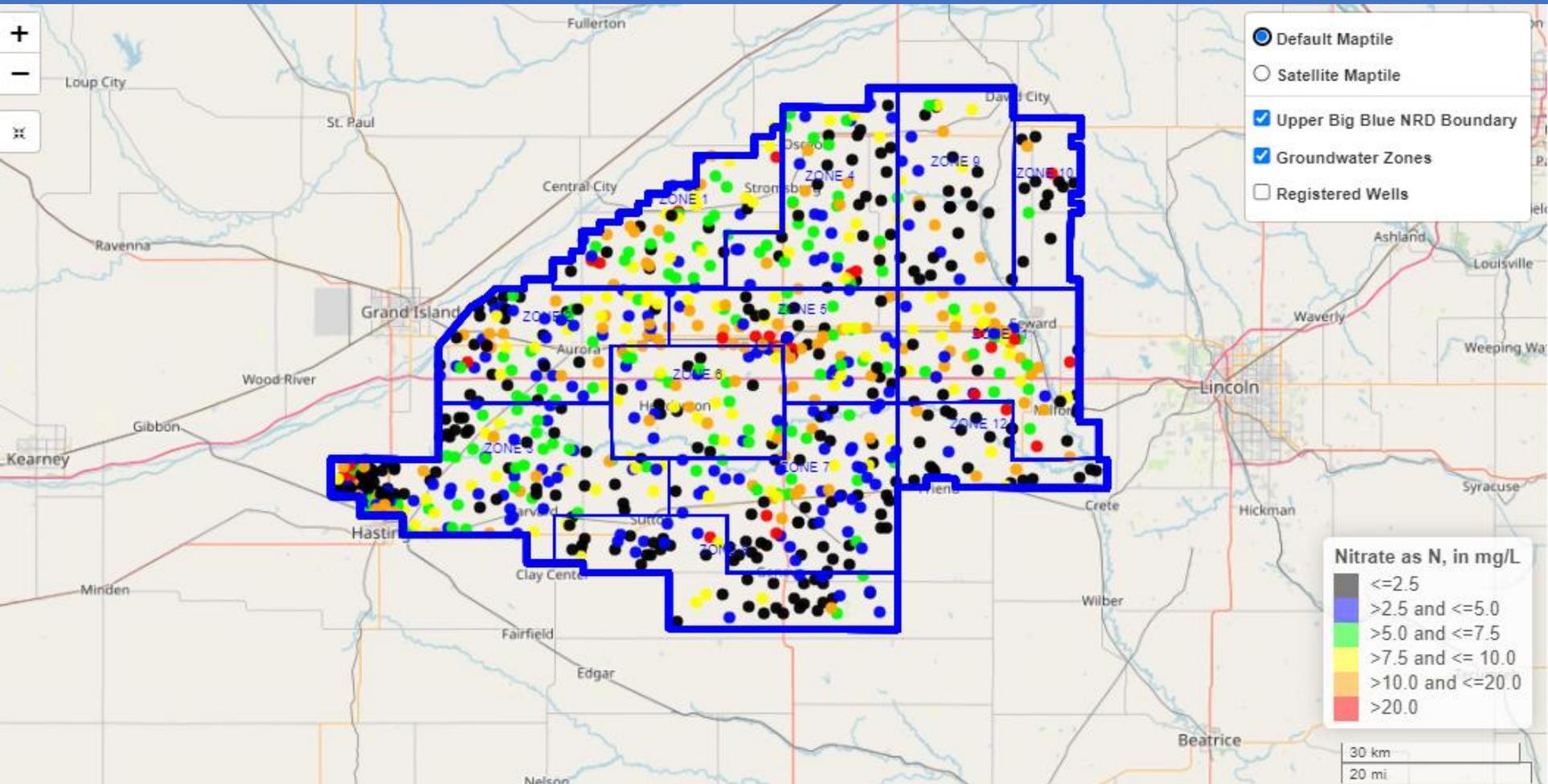
Site plot | Site table | Wells near site | Find wells by search | Zone boxplot | Depth boxplot | Sealed near surface boxplot

Additional seal boxplot | Construction period boxplot | Concrete construction boxplot | Well construction boxplot | Parameter comparison plot

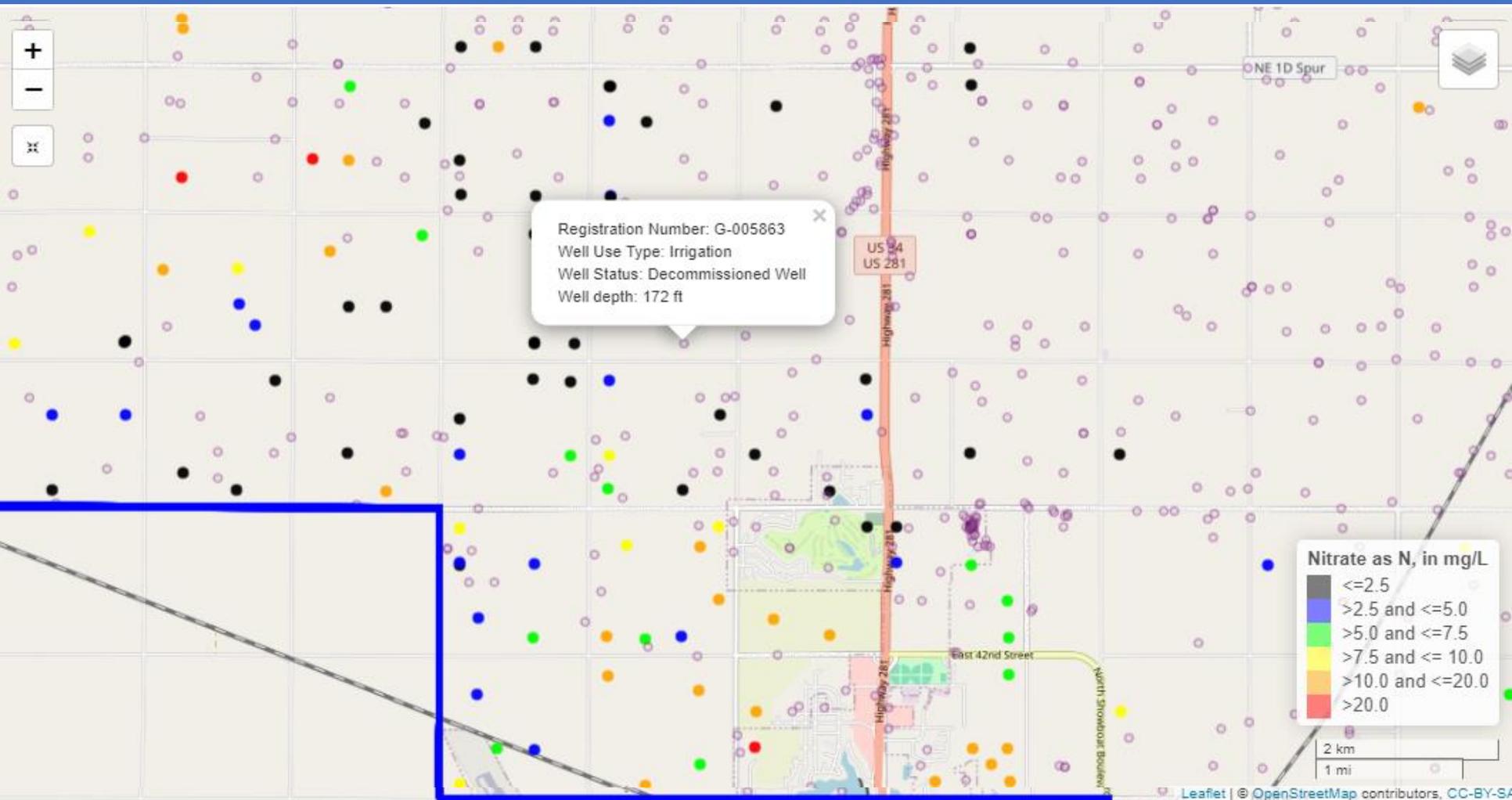
Boxplot explanation

Download the plot

Map panel



Map panel



Filters

Nitrate as N concentrations, Upper Big Blue (UBB) Natural Resources District (NRD), east-central Nebraska.

Data were retrieved from the UBB NRD database, the National Water Quality Monitoring Council's Water Quality Portal (WQP), and the Nebraska Department of Environment and Energy's Groundwater Quality Clearinghouse Database.

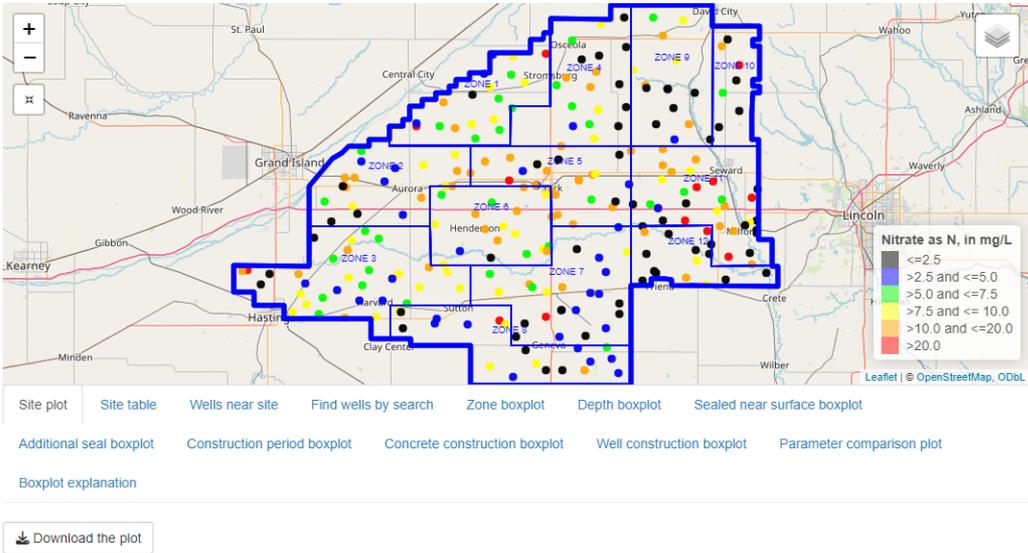
Filter sites

Sample collection agency
UBBNRD only

Time period of sampling dates
Mar-45 Apr-23

Well construction	Sealed near surface	Additional seal
<input checked="" type="checkbox"/> Screen seal	<input checked="" type="checkbox"/> Yes	<input checked="" type="checkbox"/> Yes
<input checked="" type="checkbox"/> Aquifer seal	<input checked="" type="checkbox"/> No	<input checked="" type="checkbox"/> No
<input checked="" type="checkbox"/> Concrete casing	<input checked="" type="checkbox"/> Information not available	<input checked="" type="checkbox"/> Information not available
<input checked="" type="checkbox"/> Surface seal only		
<input checked="" type="checkbox"/> Unknown construction		

Groundwater Management Zone	Depth category	Water-bearing Zone
<input checked="" type="checkbox"/> 1	<input checked="" type="checkbox"/> 0-49	<input checked="" type="checkbox"/> DA
<input checked="" type="checkbox"/> 2	<input checked="" type="checkbox"/> 50-99	<input checked="" type="checkbox"/> CF A
<input checked="" type="checkbox"/> 3	<input checked="" type="checkbox"/> 100-199	<input checked="" type="checkbox"/> CF B
<input checked="" type="checkbox"/> 4	<input checked="" type="checkbox"/> 200-299	<input checked="" type="checkbox"/> UF A
<input checked="" type="checkbox"/> 5	<input checked="" type="checkbox"/> >300	<input checked="" type="checkbox"/> UF B
<input checked="" type="checkbox"/> 6		<input checked="" type="checkbox"/> UF M
<input checked="" type="checkbox"/> 7		<input checked="" type="checkbox"/> Unknown water-bearing zone
<input checked="" type="checkbox"/> 8		
<input checked="" type="checkbox"/> 9		
<input checked="" type="checkbox"/> 10		
<input checked="" type="checkbox"/> 11		
<input checked="" type="checkbox"/> 12		



Filter sites

Sample collection agency

All agencies

Time period of sampling dates



Well construction

- Screen seal
- Aquifer seal
- Concrete casing
- Surface seal only
- Unknown construction

Deselect All

Sealed near surface

- Yes
- No
- Information not available

Deselect All

Additional seal

- Yes
- No
- Information not available

Deselect All

Groundwater Management Zone

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10
- 11
- 12

Deselect All

Depth category

- 0-49 ft
- 50-99 ft
- 100-199 ft
- 200-299 ft
- >300 ft

Deselect All

Water-bearing Zone

- Dakota aquifer or Greenhorn Formation
- High Plains aquifer, lower confined
- High Plains aquifer, lower unconfined
- High Plains aquifer, upper and lower unconfined
- High Plains aquifer, upper confined
- High Plains aquifer, upper unconfined
- Unknown water-bearing zone

Deselect All

Filter by sampling agency

Nitrate as N concentrations, Upper Big Blue (UBB) Natural Resources District (NRD), east-central Nebraska.

Data were retrieved from the UBB NRD database, the National Water Quality Monitoring Council's Water Quality Portal (WQP), and the Nebraska Department of Environment and Energy's Groundwater Quality Clearinghouse Database.

Filter sites

Sample collection agency

- UBBNRD only
- All agencies
- UBBNRD only
- All except UBBNRD

Well construction

- Screen seal
- Aquifer seal
- Concrete casing
- Surface seal only
- Unknown construction

Sealed near surface

- Yes
- No
- Information not available

Groundwater Management Zone

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10
- 11
- 12

Depth category

- 0-49
- 50-99
- 100-199
- 200-299
- >300

Additional filters:

- DA
- CF A
- CF B
- UF A
- UF B
- UF M
- Unknown water-bearing zone

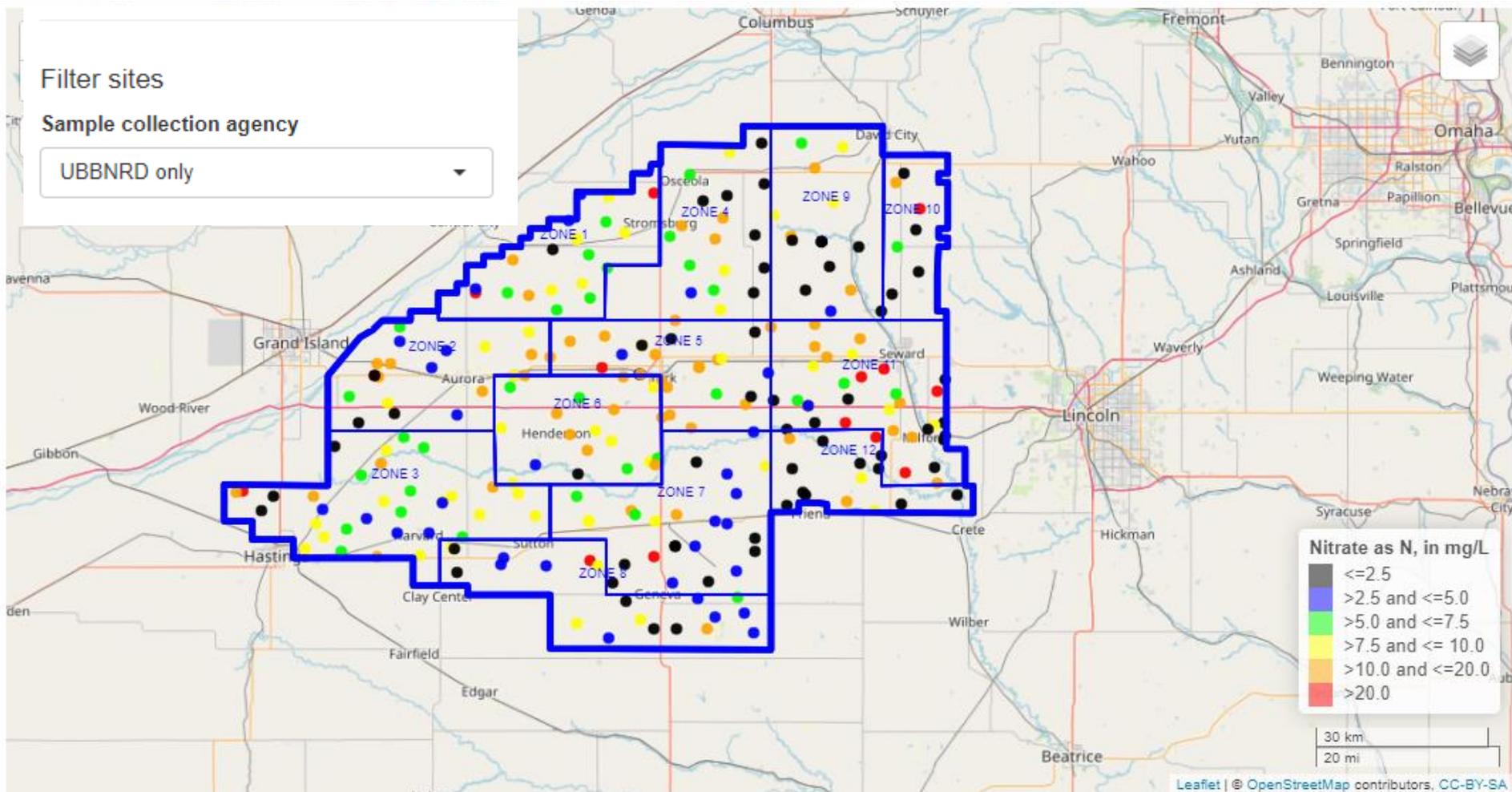
Map Legend: Nitrate as N, in mg/L

- <=2.5
- >2.5 and <=5.0
- >5.0 and <=7.5
- >7.5 and <=10.0
- >10.0 and <=20.0
- >20.0

Navigation:

- Site plot
- Site table
- Wells near site
- Find wells by search
- Zone boxplot
- Depth boxplot
- Sealed near surface boxplot
- Additional seal boxplot
- Construction period boxplot
- Concrete construction boxplot
- Well construction boxplot
- Parameter comparison plot
- Boxplot explanation
- Download the plot

Filter by sampling agency



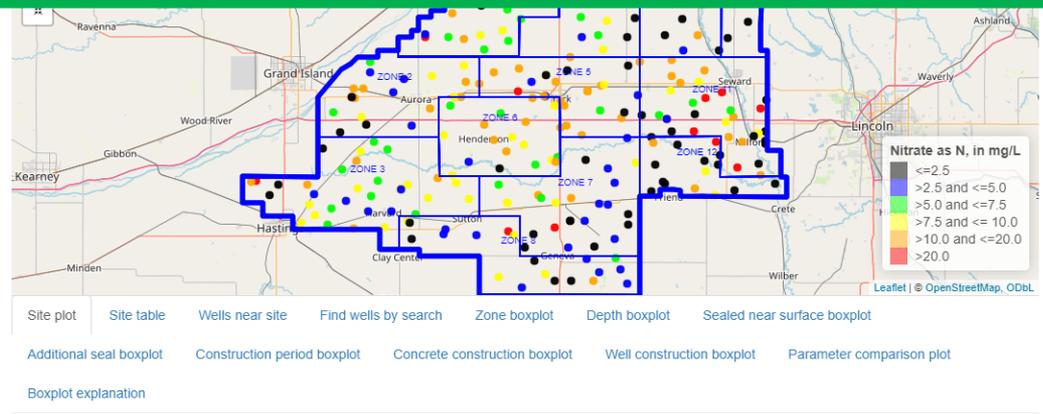
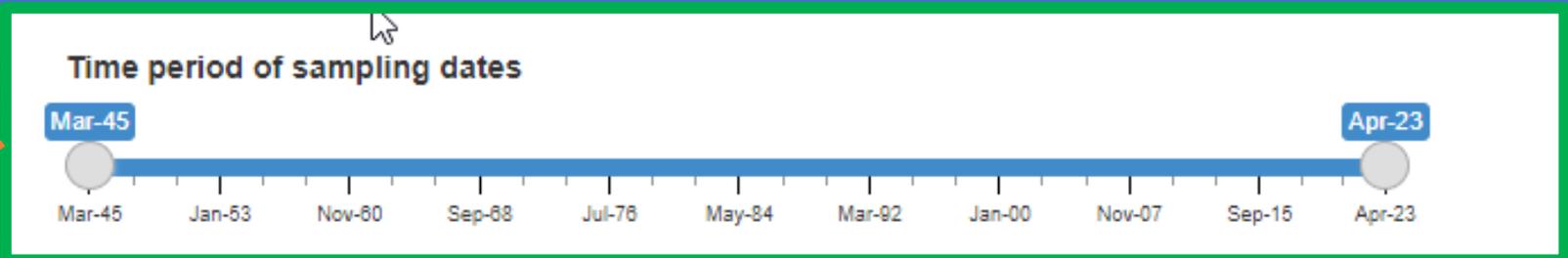
Filter by date of sample

Nitrate as N concentration
Data were retrieved from the UBB NRD data

Filter sites
Sample collection agency
UBBNRD only

Time period of sampling dates
Mar-45 Apr-23

- Well construction**
 - Screen seal
 - Aquifer seal
 - Concrete casing
 - Surface seal only
 - Unknown construction
- Sealed near surface**
 - Yes
 - No
 - Information not available
- Additional seal**
 - Yes
 - No
 - Information not available
- Groundwater Management Zone**
 - 1
 - 2
 - 3
 - 4
 - 5
 - 6
 - 7
 - 8
 - 9
 - 10
 - 11
 - 12
- Depth category**
 - 0-49
 - 50-99
 - 100-199
 - 200-299
 - >300
- Water-bearing Zone**
 - DA
 - CFA
 - CFB
 - UFA
 - UFB
 - UFM
 - Unknown water-bearing zone



Site plot | Site table | Wells near site | Find wells by search | Zone boxplot | Depth boxplot | Sealed near surface boxplot

Additional seal boxplot | Construction period boxplot | Concrete construction boxplot | Well construction boxplot | Parameter comparison plot

Boxplot explanation

Download the plot

Filter by date of sample

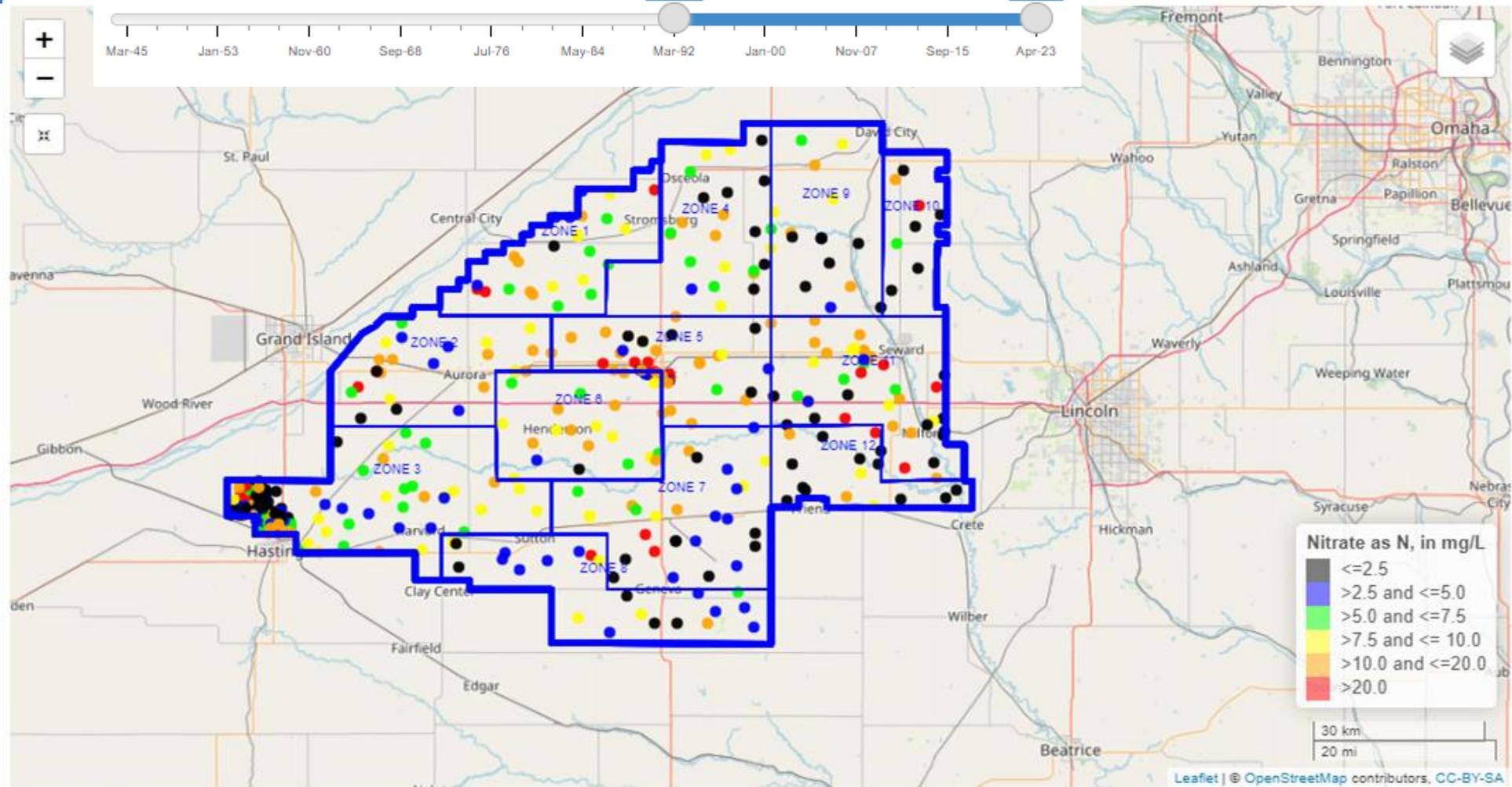
Time period of sampling dates

Mar-45

Mar-92

Apr-23

Mar-45 Jan-53 Nov-60 Sep-68 Jul-76 May-84 Mar-92 Jan-00 Nov-07 Sep-15 Apr-23



Filter by construction info

Nitrate as N concentrations, Upper Big Blue (UBB) Natural Resources District (NRD), east-central Nebraska.

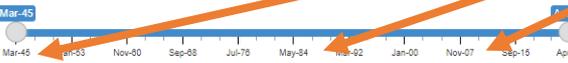
Data were retrieved from the UBB NRD database, the National Water Quality Monitoring Council's [Water Quality Portal \(WQP\)](#), and the Nebraska Department of Environment and Energy's [Groundwater Quality Clearinghouse Database](#).

Filter sites

Sample collection agency

UBBNRD only

Time period of sampling dates



- Well construction**
 - Screen seal
 - Aquifer seal
 - Concrete casing
 - Surface seal only
 - Unknown construction
- Sealed near surface**
 - Yes
 - No
 - Information not available
- Additional seal**
 - Yes
 - No
 - Information not available

- Groundwater Management Zone**
 - 1
 - 2
 - 3
 - 4
 - 5
 - 6
 - 7
 - 8
 - 9
 - 10
 - 11
 - 12
- Depth category**
 - 0-49
 - 50-99
 - 100-199
 - 200-299
 - >300
- Water-bearing Zone**
 - DA
 - CF A
 - CF B
 - UF A
 - UF B
 - UF M
 - Unknown water-bearing zone

Well construction

- Screen seal
- Aquifer seal
- Concrete casing
- Surface seal only
- Unknown construction

Sealed near surface

- Yes
- No
- Information not available

Additional seal

- Yes
- No
- Information not available

Map showing well locations with a blue box highlighting a specific area.

Site plot | Site table | Wells near site | Find wells by search | Zone boxplot | Depth boxplot | Sealed near surface boxplot

Additional seal boxplot | Construction period boxplot | Concrete construction boxplot | Well construction boxplot | Parameter comparison plot

Boxplot explanation

Download the plot

Filter by zones

Nitrate as N concentrations, Upper Big Blue (UBB) Natural Resources District (NRD), east-central Nebraska

Data were retrieved from the UBB NRD database, the National Water Quality Monitoring Council

Filter sites

Sample collection agency

UBBNRD only

Time period of sampling dates

Mar-45 to Apr-2

Well construction

- Screen seal
- Aquifer seal
- Concrete casing
- Surface seal only
- Unknown construction

Sealed near surface

- Yes
- No
- Information not available

Additional seal

- Yes
- No
- Information not available

Groundwater Management Zone

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10
- 11
- 12

Depth category

- 0-49
- 50-99
- 100-199
- 200-299
- >300

Water-bearing Zone

- DA
- CF A
- CF B
- UF A
- UF B
- UF M
- Unknown water-bearing zone

Groundwater Management Zone

- 1 **Phase 1**
- 2 **Phase 1**
- 3 **Phase 1**
- 4 **Phase 2**
- 5 **Phase 3**
- 6 **Phase 3**
- 7 **Phase 2**
- 8 **Phase 2**
- 9 **Phase 2**
- 10 **Phase 2**
- 11 **Phase 3**
- 12 **Phase 2**

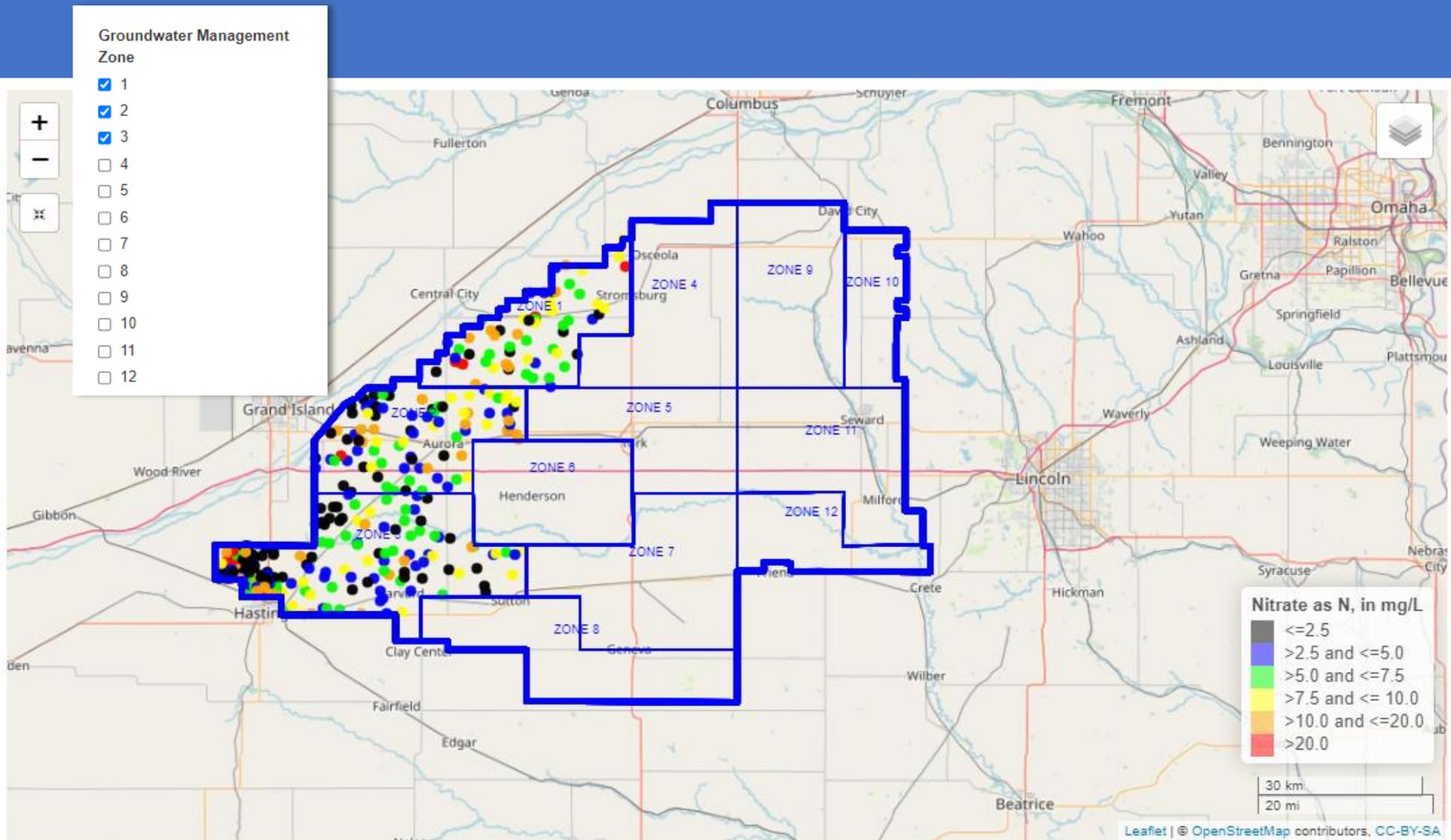
Depth category, in feet

- 0-49
- 50-99
- 100-199
- 200-299
- >300

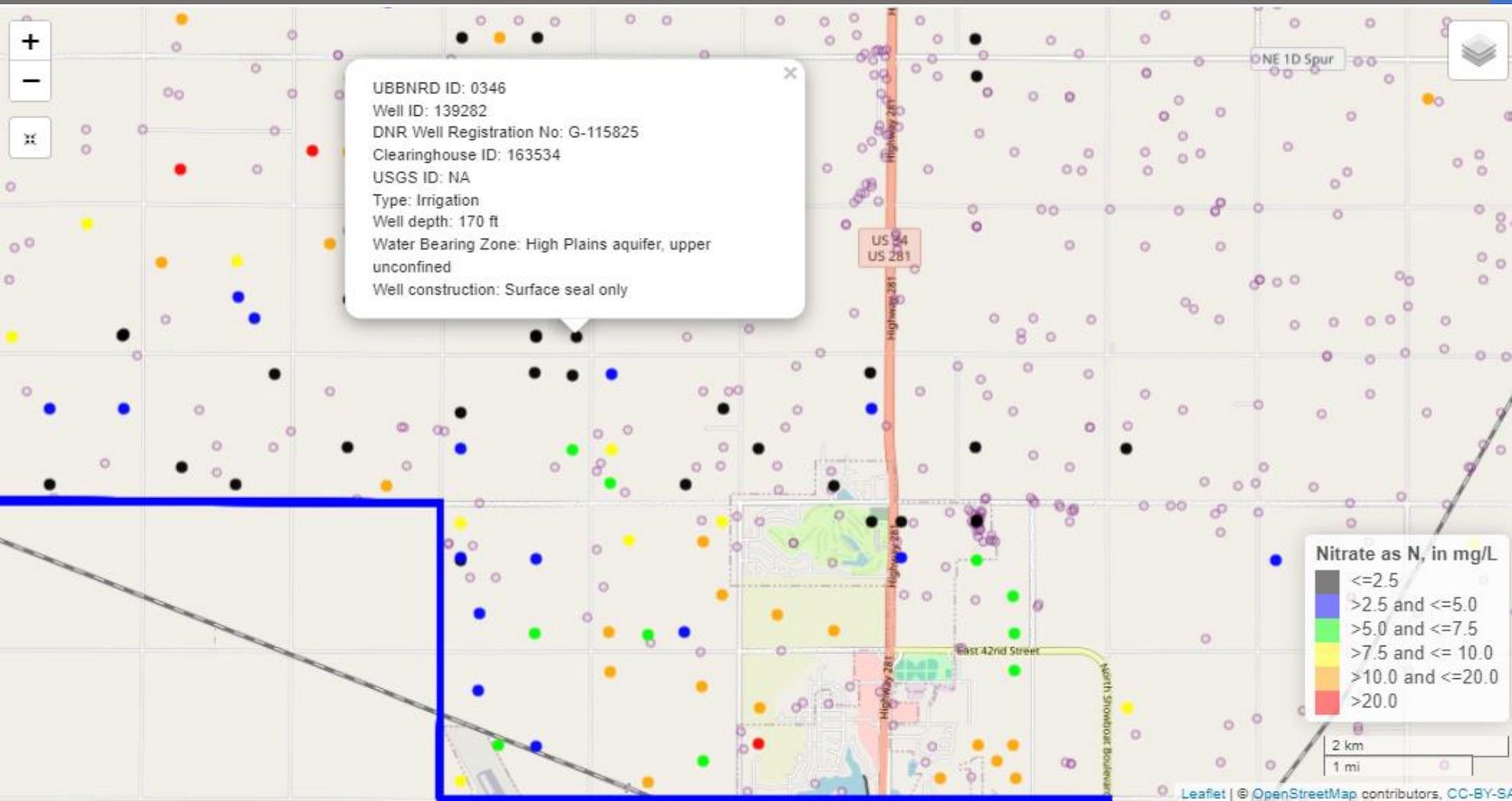
Water-bearing Zone

- DA *Dakota & other aquifers*
- CF A *HPA, upper confined*
- CF B *HPA, lower confined*
- UF A *HPA, upper unconfined*
- UF B *HPA, lower unconfined*
- UF M *HPA, lower unconfined*
- Unknown water-bearing zone

Filter by zones



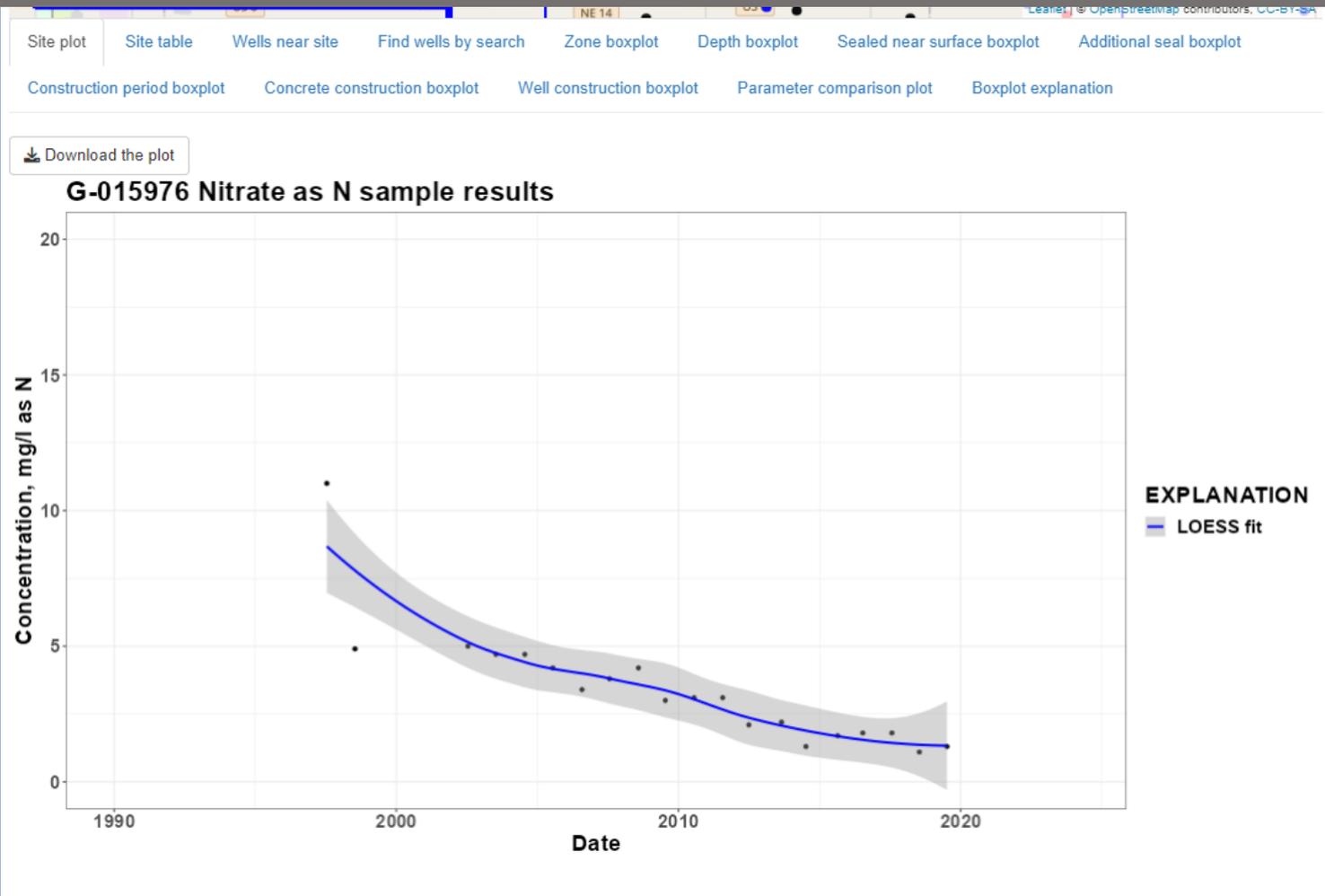
To better understand nitrate concentrations- Individual wells



Individual wells



Individual wells



Individual wells



- Site plot
- Site table
- Wells near site
- Find wells by search
- Zone boxplot
- Depth boxplot
- Sealed near surface boxplot
- Additional seal boxplot
- Construction period boxplot
- Concrete construction boxplot
- Well construction boxplot
- Parameter comparison plot
- Boxplot explanation



Download the data

Sample data for selected site

Show 10 entries

Search:

Date	Time	TimeZone	UBBNRD.ID	WellReg_No	WellID	USGSsiteID	Clearinghouse.ID	Results_Nitrate.as.N	Units_Nitrate.as.N	LT_Nitrate.as.N	RL_Nitrate.as.N	RL_units_Nitrate.as.N	USGSPCo
3509	2016-08-16		0346	G-115825	139282		163534	0	mg/l as N	<	0.2	mg/l as N	
3606	2017-07-05		0346	G-115825	139282		163534	0	mg/l as N	<	0.2	mg/l as N	
3888	2018-08-02		0346	G-115825	139282		163534	0	mg/l as N	<	0.2	mg/l as N	

Showing 1 to 3 of 3 entries

Previous 1 Next

Individual wells



- Site plot
- Site table
- Wells near site
- Find wells by search
- Zone boxplot
- Depth boxplot
- Sealed near surface boxplot
- Additional seal boxplot
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- Concrete construction boxplot
- Well construction boxplot
- Parameter comparison plot
- Boxplot explanation

Registration information for wells within 2,000 meters of selected well

Show entries Search:

field_1	WellID	Registrati	Status	WellUseDes	distance	Section	Township	Range	RangeDirec	TotalDepth	Completion	Decommissi	Replacemen	Latitude	Longitude	Top_of
1	13860	139282	G-115825	Active Registered Well	Irrigation	12.46	15	8	10	West	170	2002-04-24T00:00:00		40.656801	-98.422133	
2	4902	28835	G-022466	Decommissioned Well	Irrigation	275.28	22	8	10	West	167	1963-08-26T00:00:00	2012-10-25T00:00:00	40.65441667	-98.42336111	
3	17408	217422	G-022466	Active Registered Well	Irrigation	277.04	22	8	10	West	161	2012-06-08T00:00:00		40.654425	-98.42345	1
4	19237	250605	G-014291	Active Registered Well	Irrigation	283.04	15	8	10	West	171	2018-05-01T00:00:00		40.65551667	-98.42519444	2
5	3538	19737	G-014291	Decommissioned Well	Irrigation	291.81	15	8	10	West	172	1967-05-03T00:00:00	2018-06-05T00:00:00	40.65541667	-98.42523889	1
6	11156	78738	G-070576	Active Registered Well	Irrigation	306.38	23	8	10	West	149	1987-04-28T00:00:00		40.6548608	-98.4196261	

Individual wells

Find wells by search

Site plot Site table Wells near site Find wells by search Zone boxplot Depth boxplot Sealed near surface boxplot Additional seal boxplot
Construction period boxplot Concrete construction boxplot Well construction boxplot Parameter comparison plot Boxplot explanation

Use the search box to find wells in unfiltered water-quality sample data table. [Click row to zoom map to well.](#)

Show entries

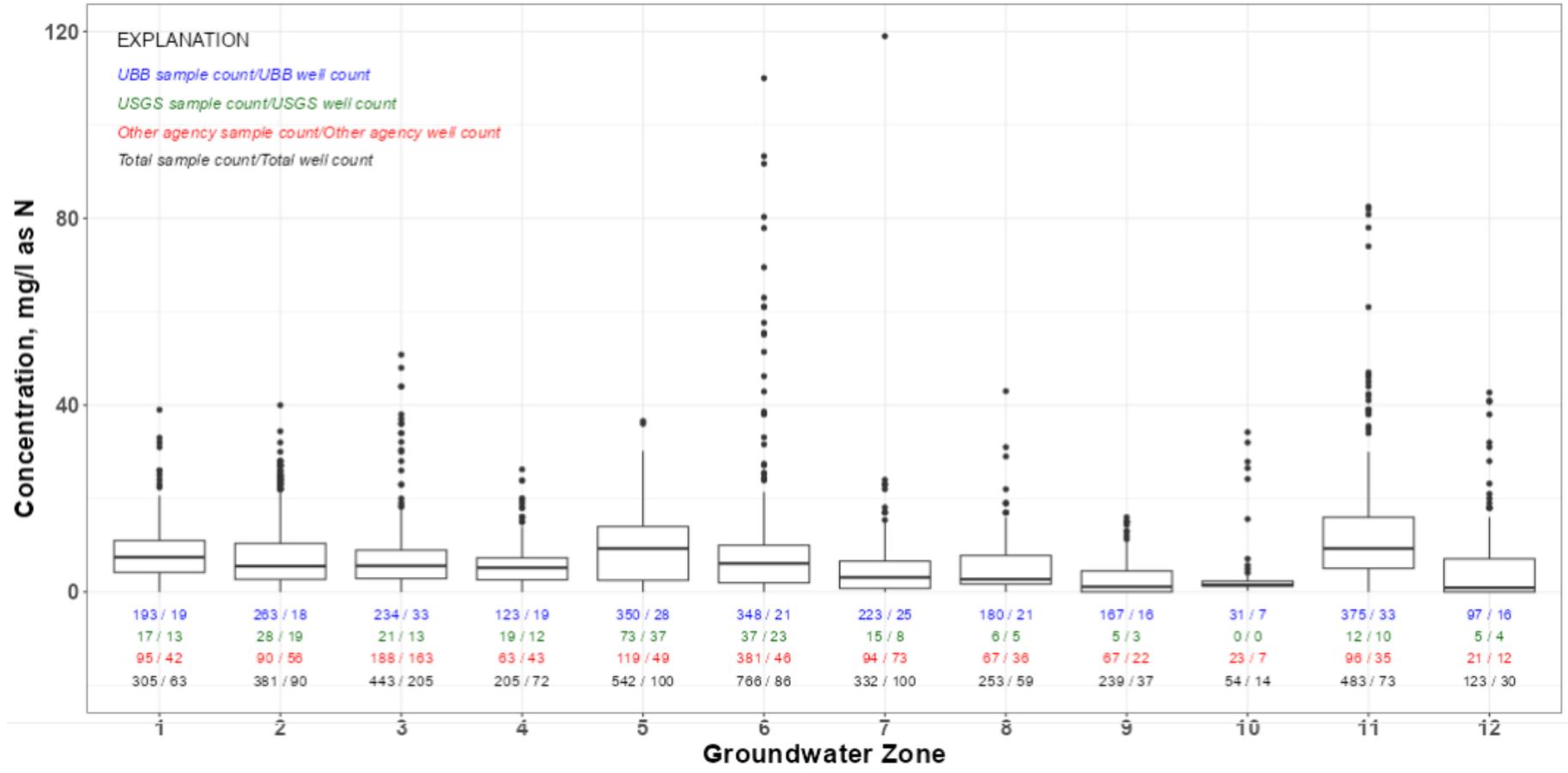
Search:

WellLabel	UBBNRD.ID	WellReg_No	WellID	USGSsiteID	Clearinghouse.ID	LatDD	LongDD	WellDepth_ft	YearDrilled
G-011088		G-011088	16053		46645	40.83777661	-98.21362552	195	
G-024167		G-024167	30642		47267	40.71108772	-98.01386778	124	
G-051687	1108	G-051687	59225	405551097110801	87029	40.930803	-97.1856	95	
G-051687	1108	G-051687	59225	405551097110801	87029	40.930803	-97.1856	95	
G-051687	1108	G-051687	59225	405551097110801	87029	40.930803	-97.1856	95	
G-051687	1108	G-051687	59225	405551097110801	87029	40.930803	-97.1856	95	
G-051687	1108	G-051687	59225	405551097110801	87029	40.930803	-97.1856	95	
G-051687	1108	G-051687	59225	405551097110801	87029	40.930803	-97.1856	95	
G-051687	1108	G-051687	59225	405551097110801	87029	40.930803	-97.1856	95	

Assessing the groundwater monitoring network- Well category comparisons

- Site plot
- Site table
- Wells near site
- Find wells by search
- Zone boxplot**
- Depth boxplot
- Sealed near surface boxplot
- Additional seal boxplot
- Construction period boxplot
- Concrete construction boxplot
- Well construction boxplot
- Parameter comparison plot
- Boxplot explanation

Nitrate as N levels by Groundwater Zone (1945-03-29 to 2023-04-20)

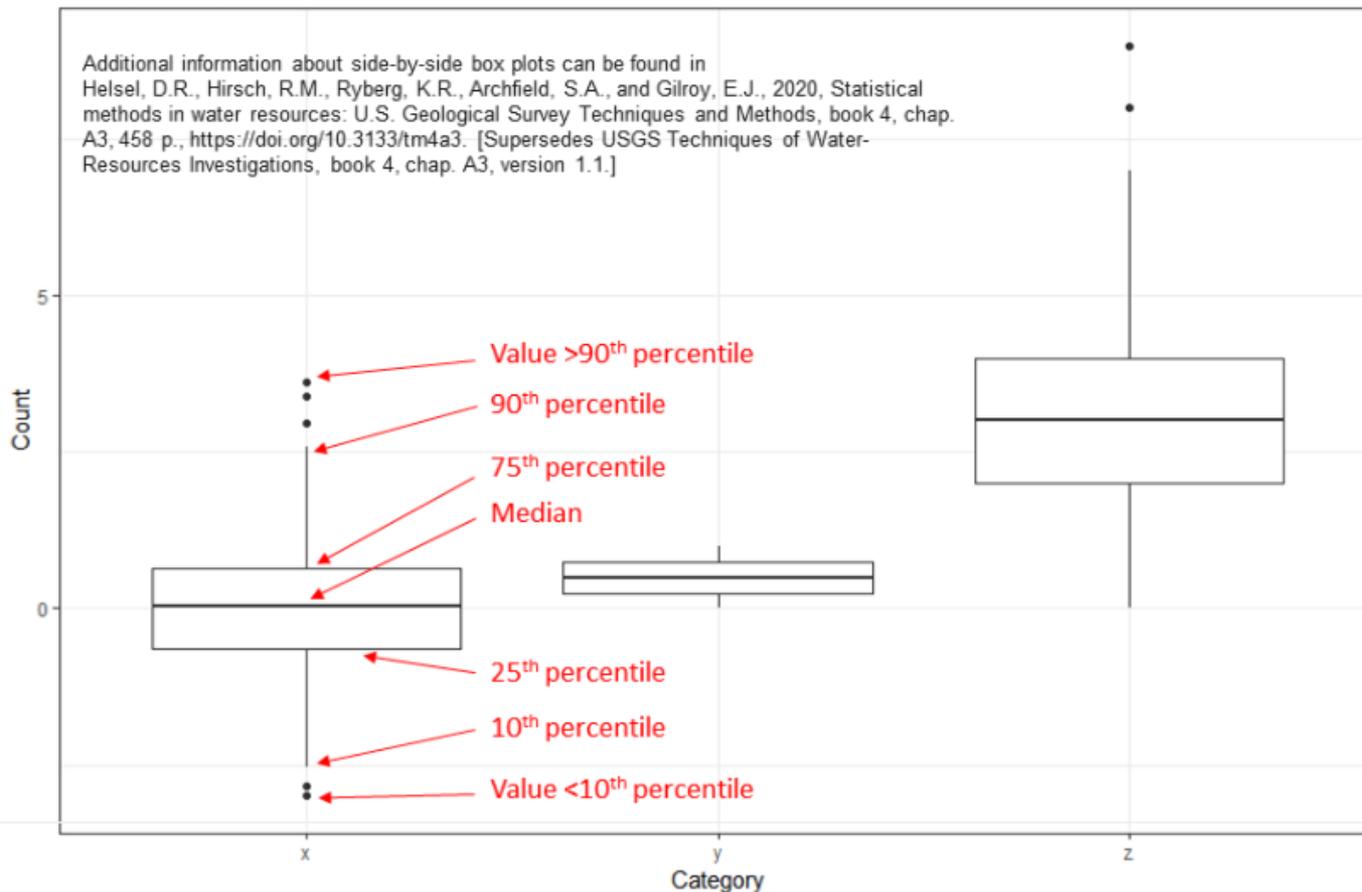


Well category comparisons

- Site plot
- Site table
- Wells near site
- Find wells by search
- Zone boxplot
- Depth boxplot
- Sealed near surface boxplot
- Additional seal boxplot
- Construction period boxplot
- Concrete construction boxplot
- Well construction boxplot
- Parameter comparison plot
- Boxplot explanation**

Example boxplot

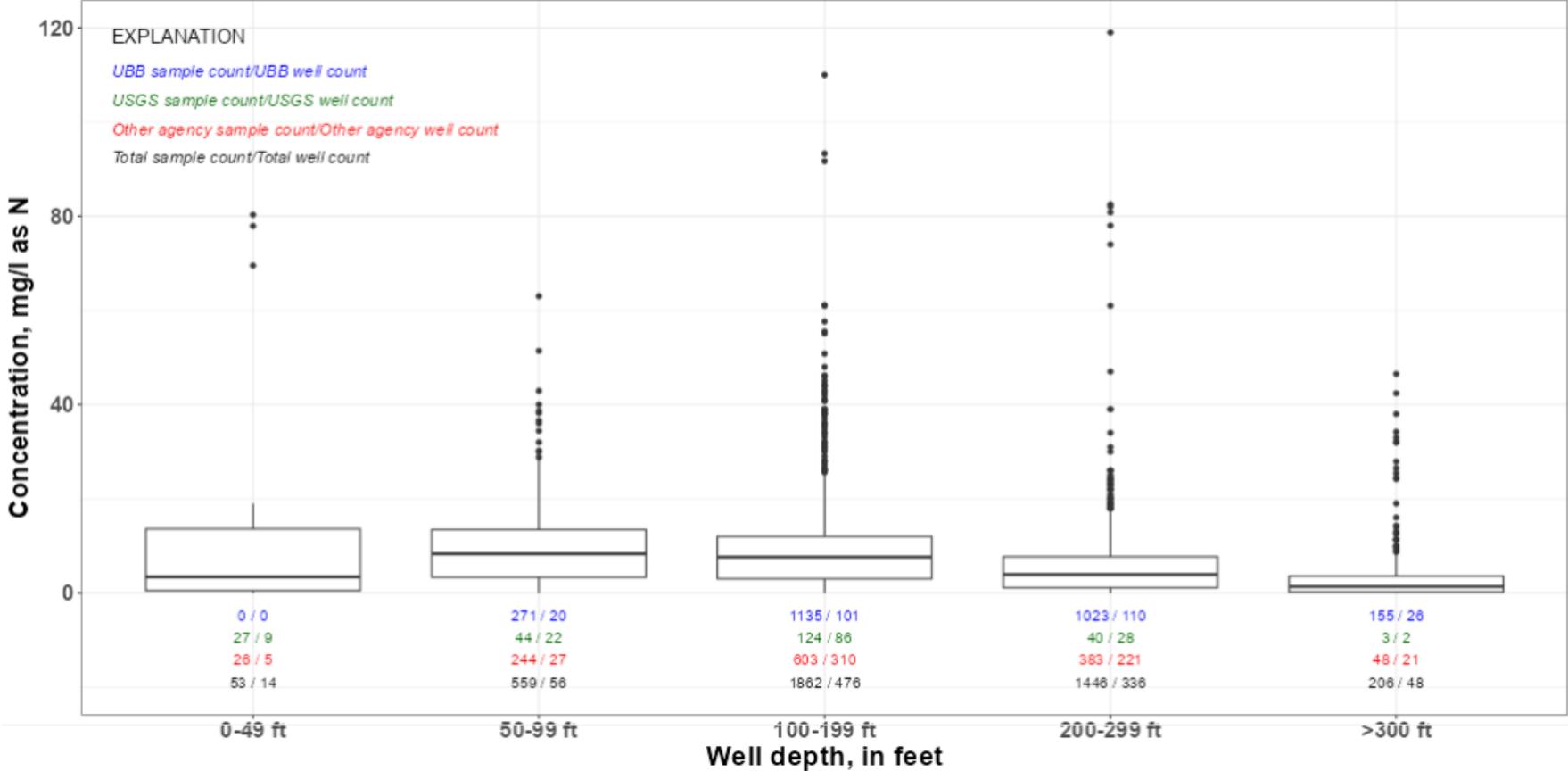
Additional information about side-by-side box plots can be found in Helsel, D.R., Hirsch, R.M., Ryberg, K.R., Archfield, S.A., and Gilroy, E.J., 2020, Statistical methods in water resources: U.S. Geological Survey Techniques and Methods, book 4, chap. A3, 458 p., <https://doi.org/10.3133/tm4a3>. [Supersedes USGS Techniques of Water-Resources Investigations, book 4, chap. A3, version 1.1.]



Well category comparisons

- Site plot
- Site table
- Wells near site
- Find wells by search
- Zone boxplot
- Depth boxplot**
- Sealed near surface boxplot
- Additional seal boxplot
- Construction period boxplot
- Concrete construction boxplot
- Well construction boxplot
- Parameter comparison plot
- Boxplot explanation

Nitrate as N levels by well depth (1945-03-29 to 2023-04-20)



Additional water quality parameters

[Site plot](#) [Site table](#) [Wells near site](#) [Find wells by search](#) [Zone boxplot](#) [Depth boxplot](#) [Sealed near surface boxplot](#) [Additional seal boxplot](#)

[Construction period boxplot](#) [Concrete construction boxplot](#) [Well construction boxplot](#) **Parameter comparison plot** [Boxplot explanation](#)

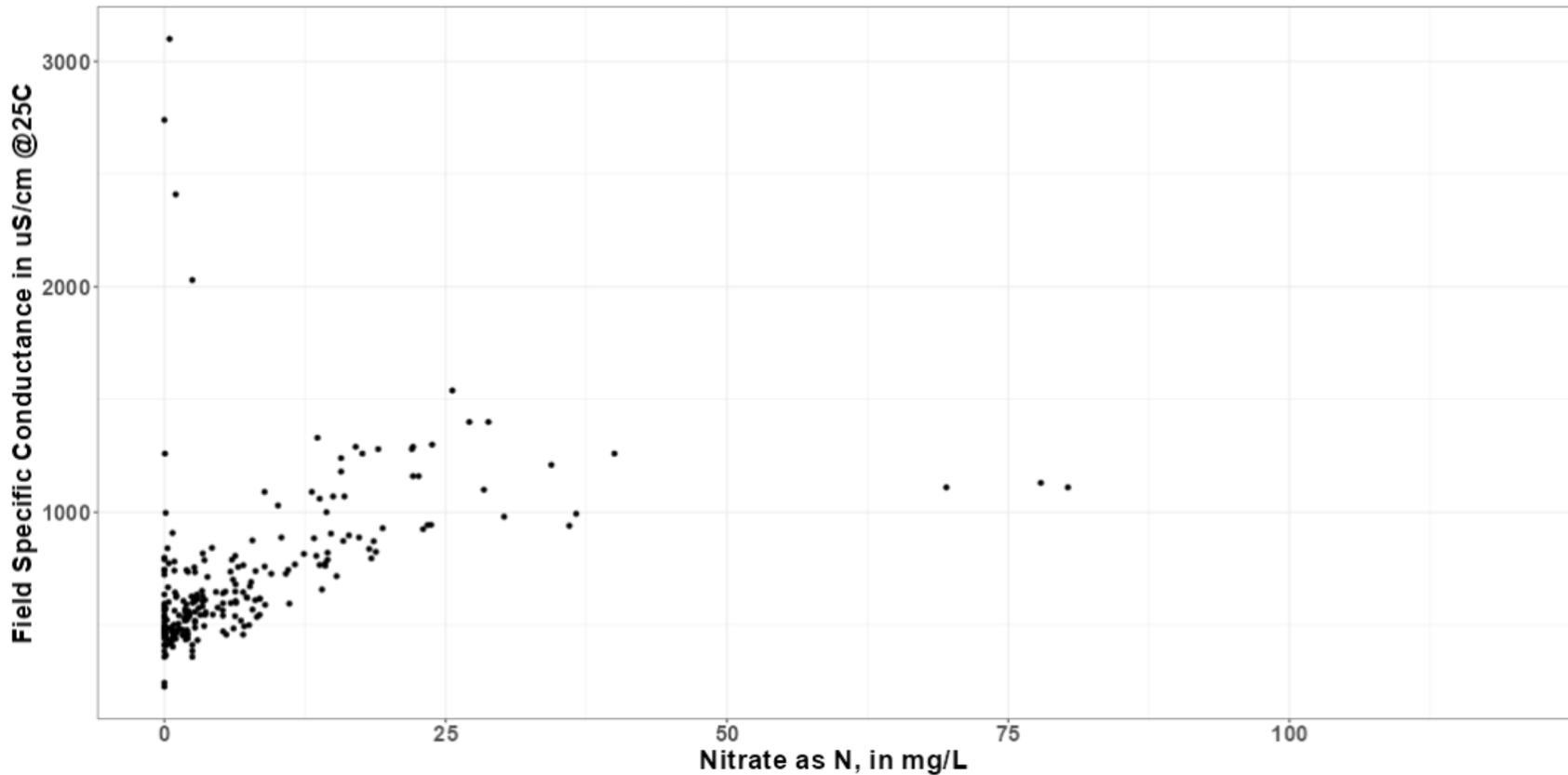
Parameter:

Field Specific Conductance

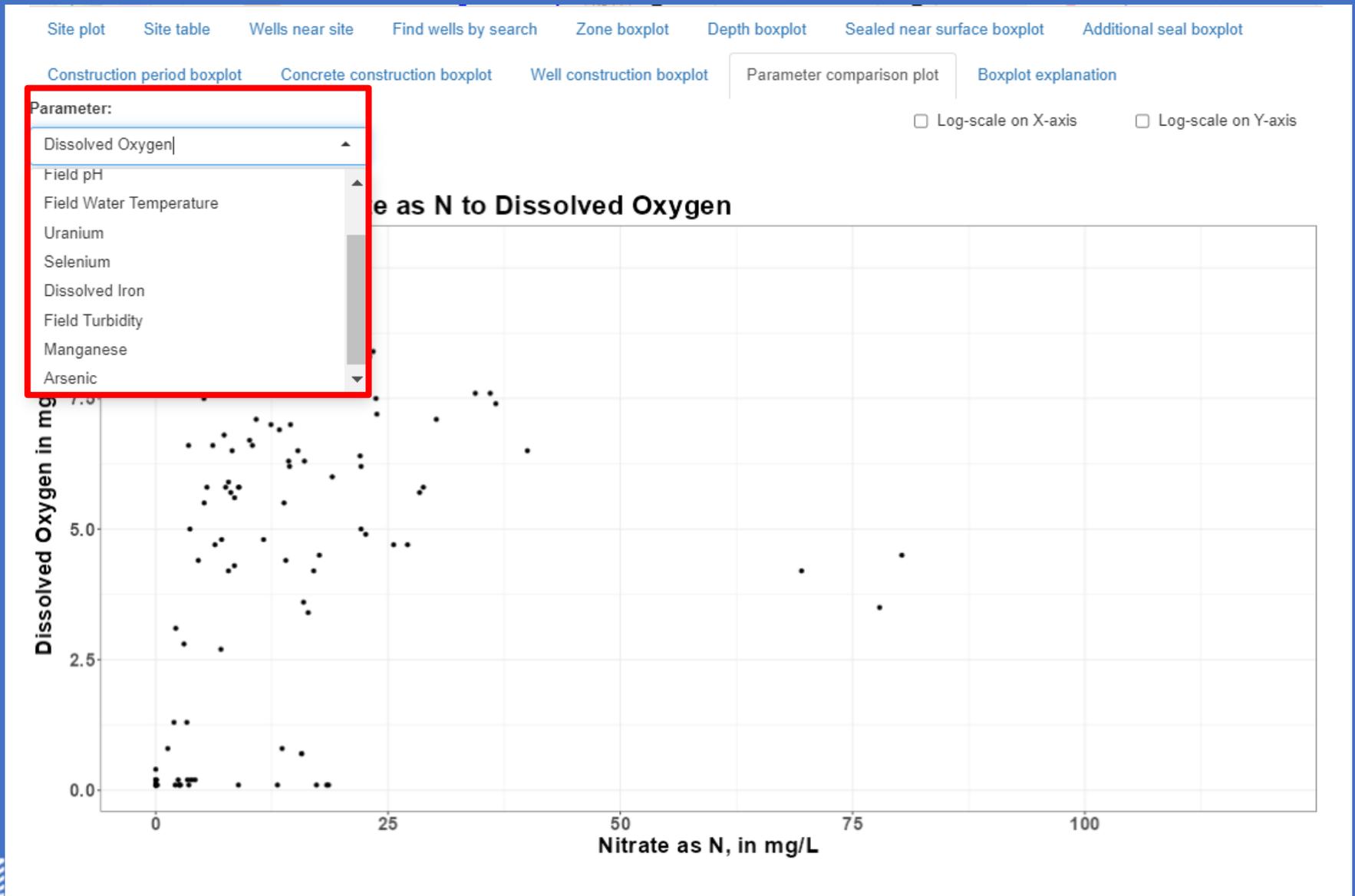
Log-scale on X-axis

Log-scale on Y-axis

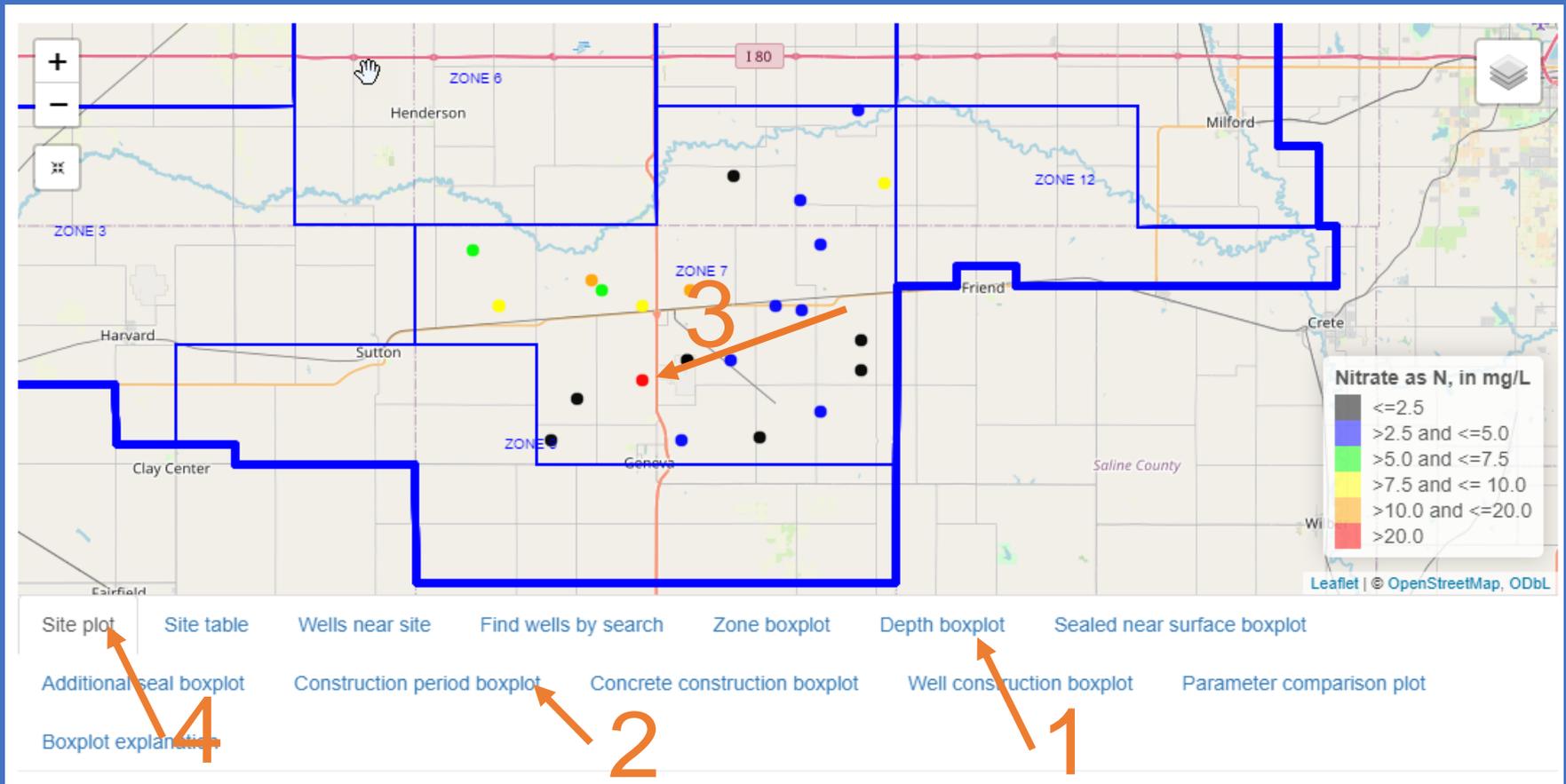
Comparison of Nitrate as N to Field Specific Conductance



Additional water quality parameters



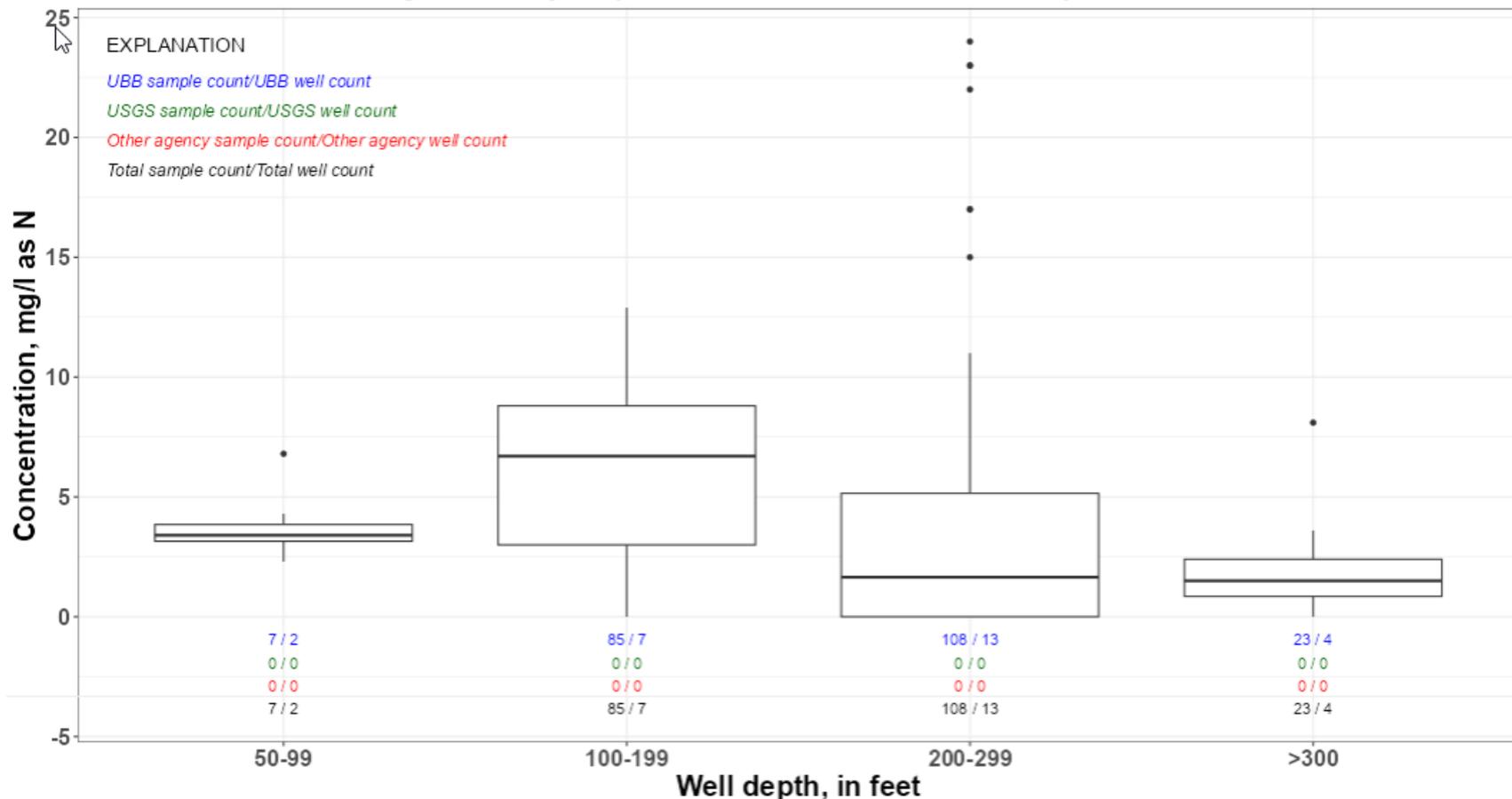
Exercise—Look at Zone 7, a Phase 2 Groundwater Management Zone



Exercise—Zone 7, step 1: nitrate by depth, in feet

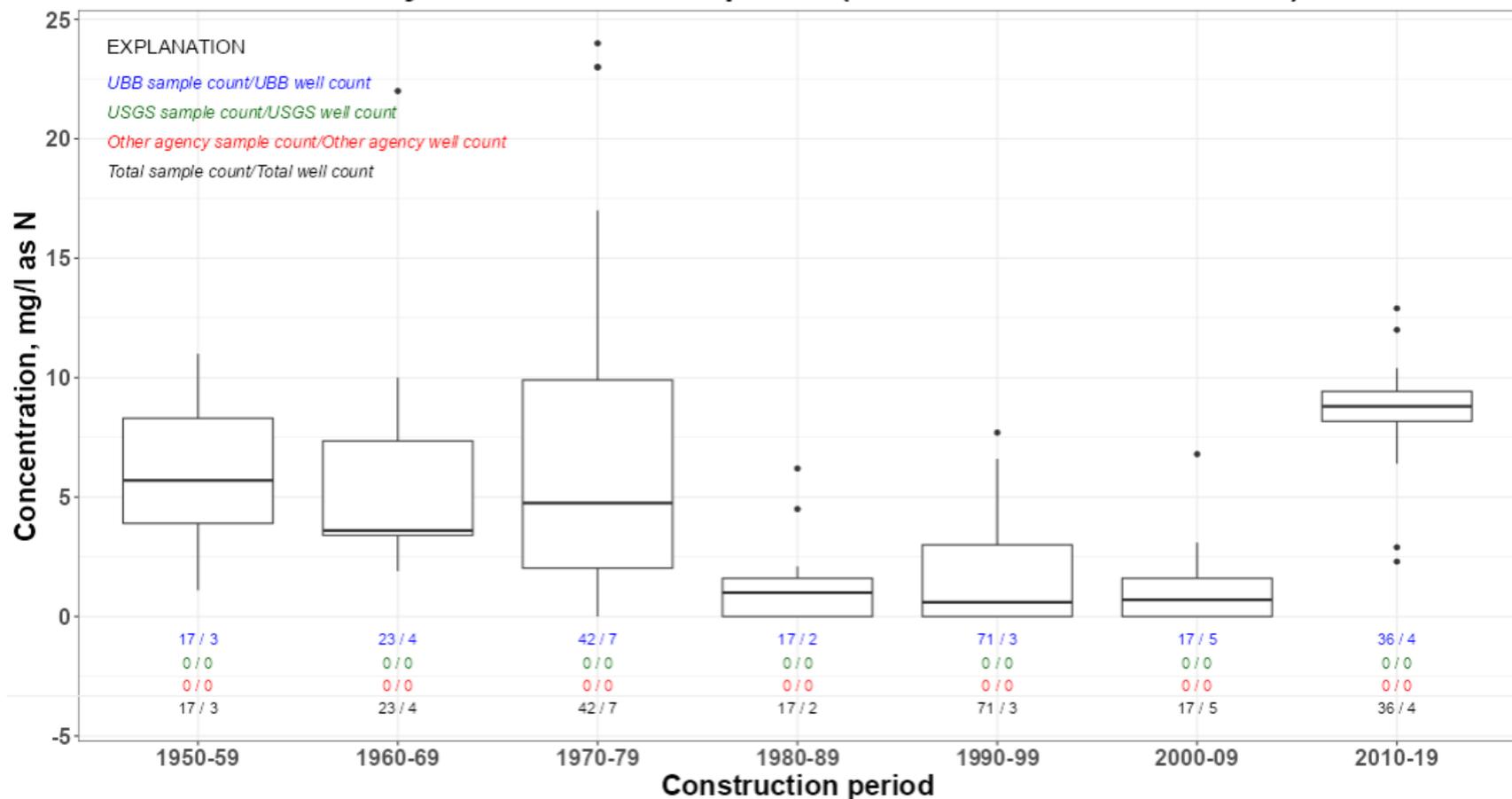
Boxplot explanation

Nitrate as N levels by well depth (1945-03-29 to 2023-04-20)

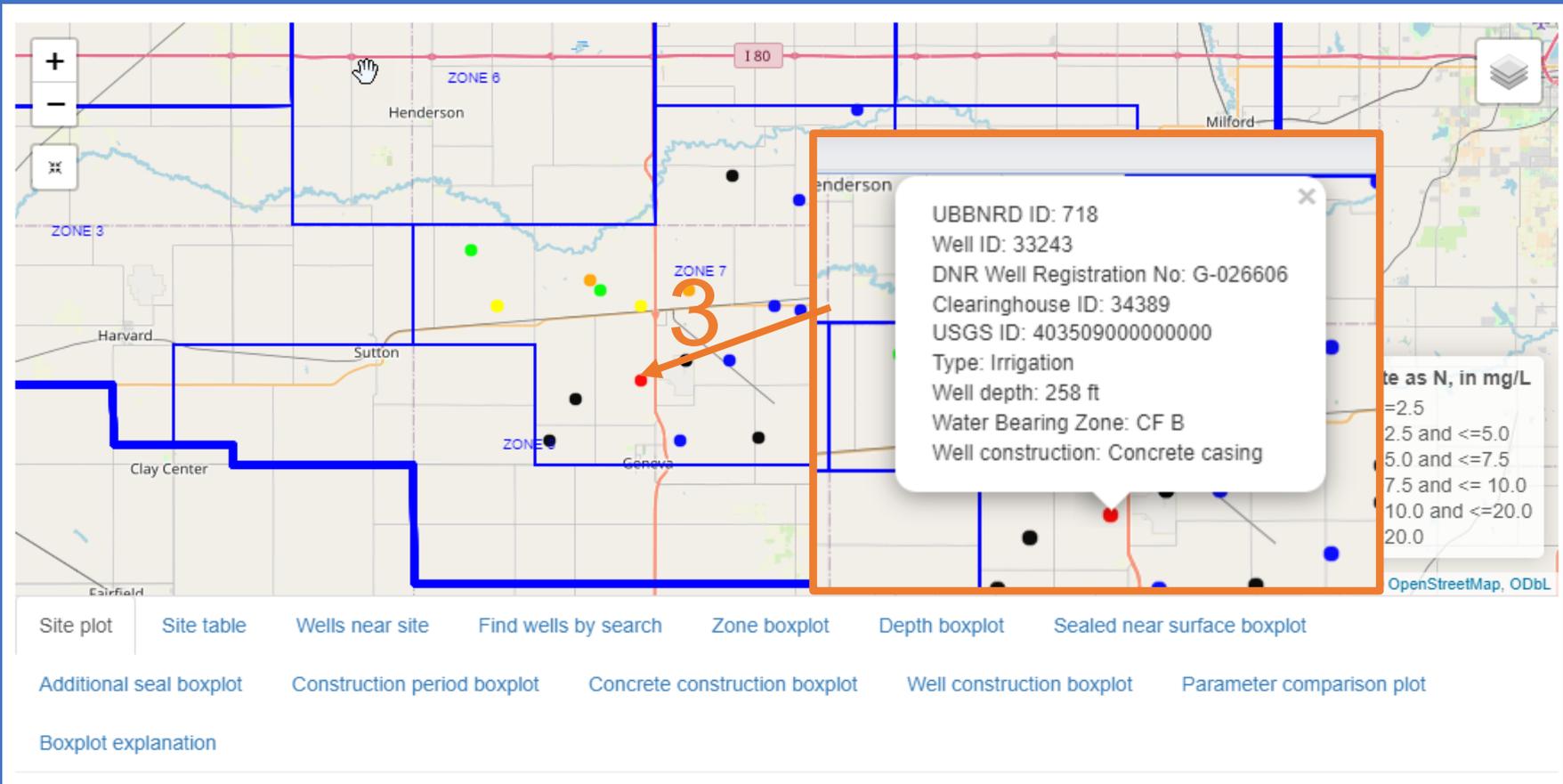


Exercise—Zone 7, step 2: nitrate by construction period

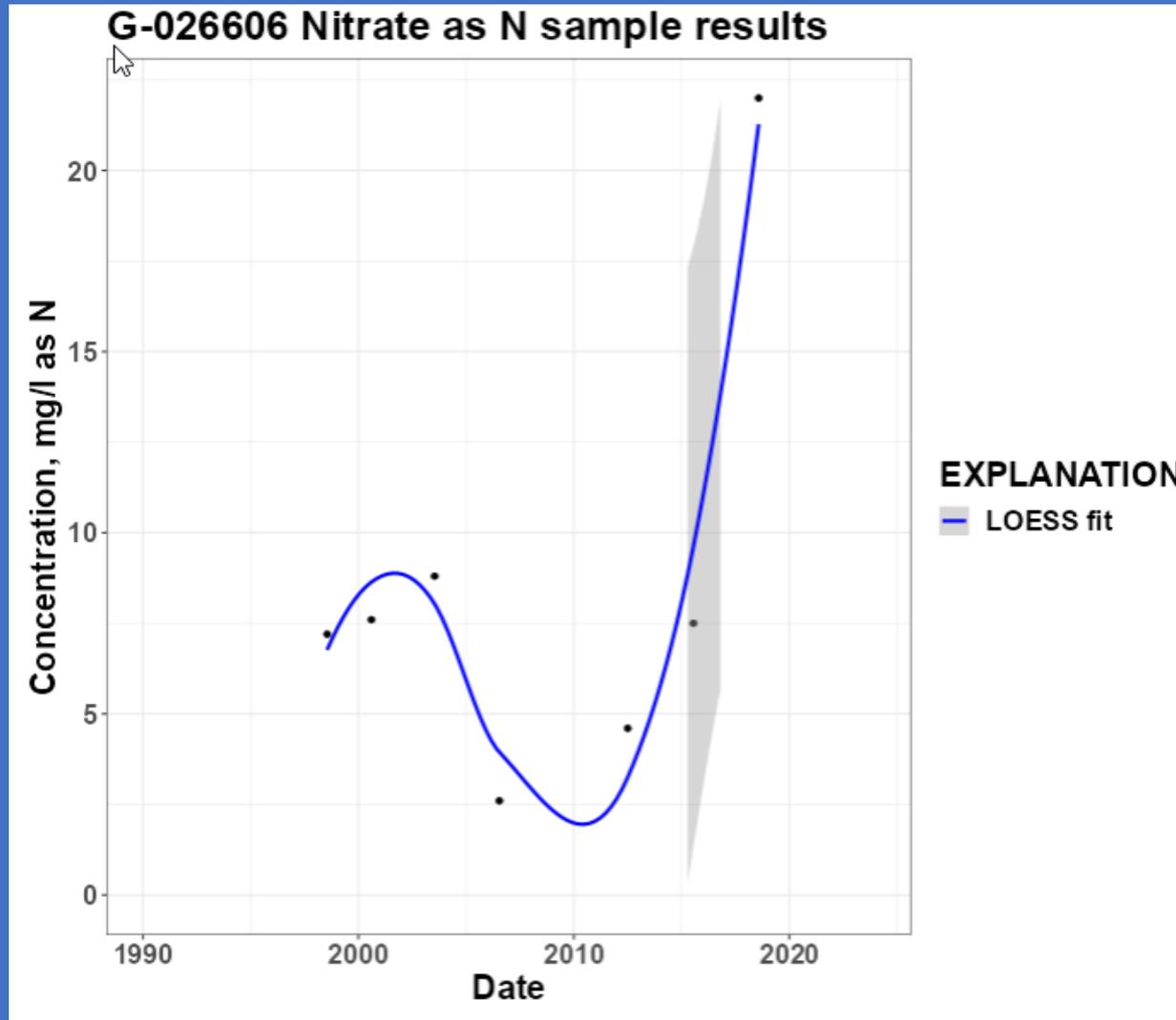
Nitrate as N levels by well construction period (1945-03-29 to 2023-04-20)



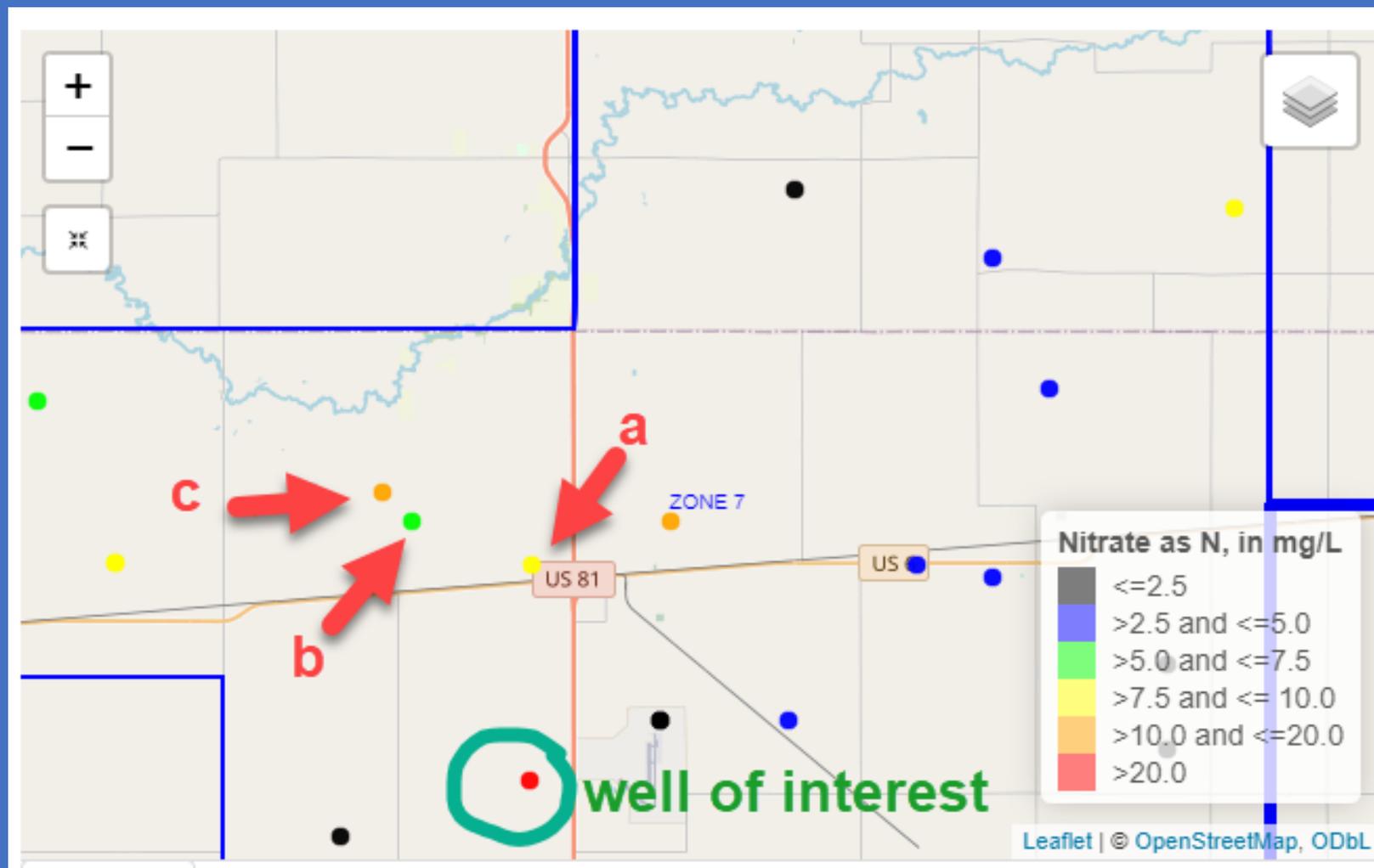
Exercise—Zone 7, step 3: well info



Exercise—Look at Zone 7, step 4: nitrate in well with trend line

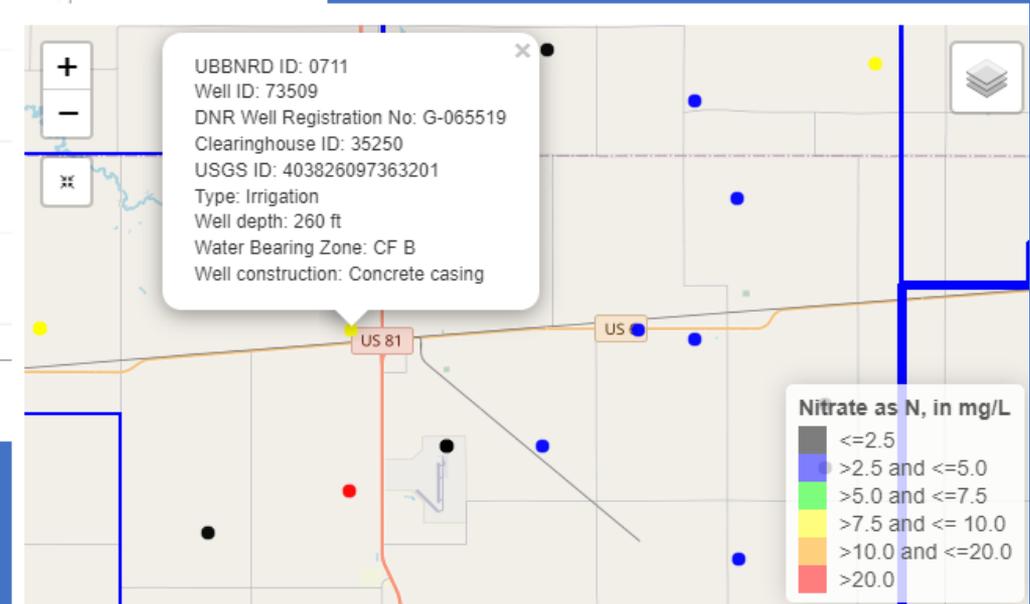
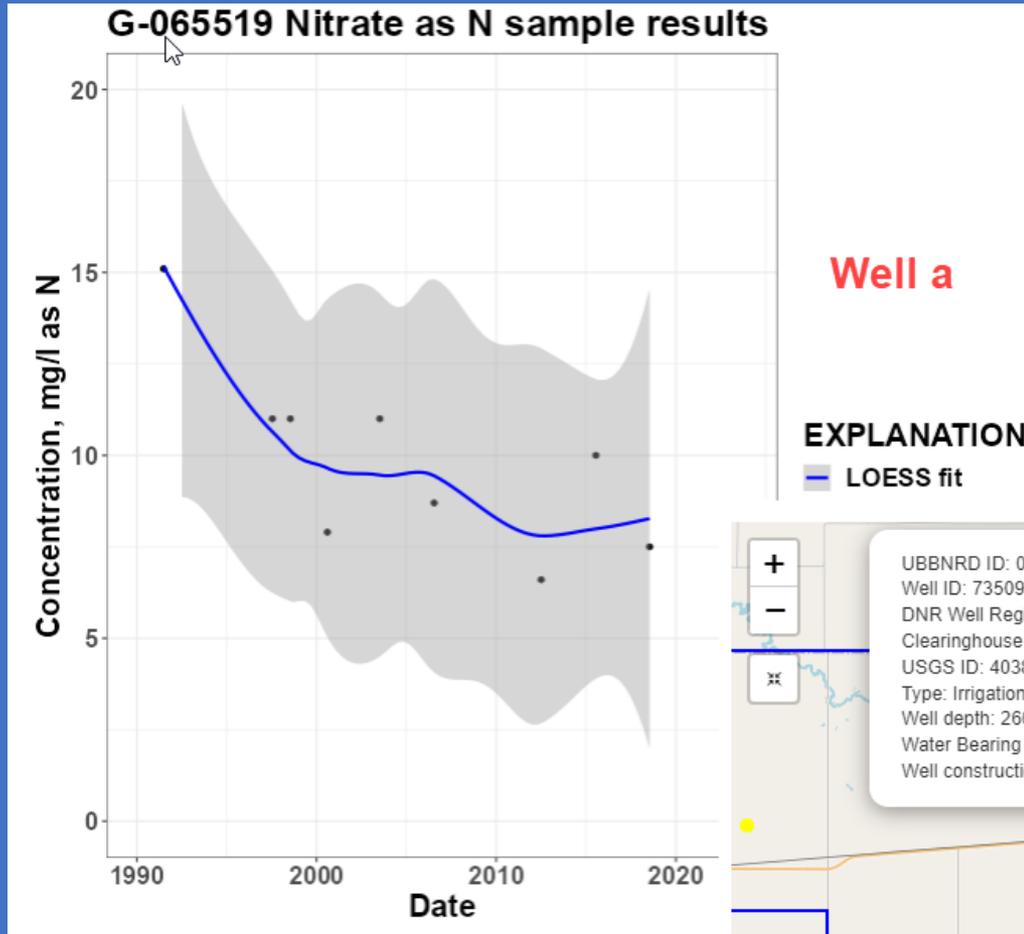


Exercise—UBB nitrate results in three nearby wells

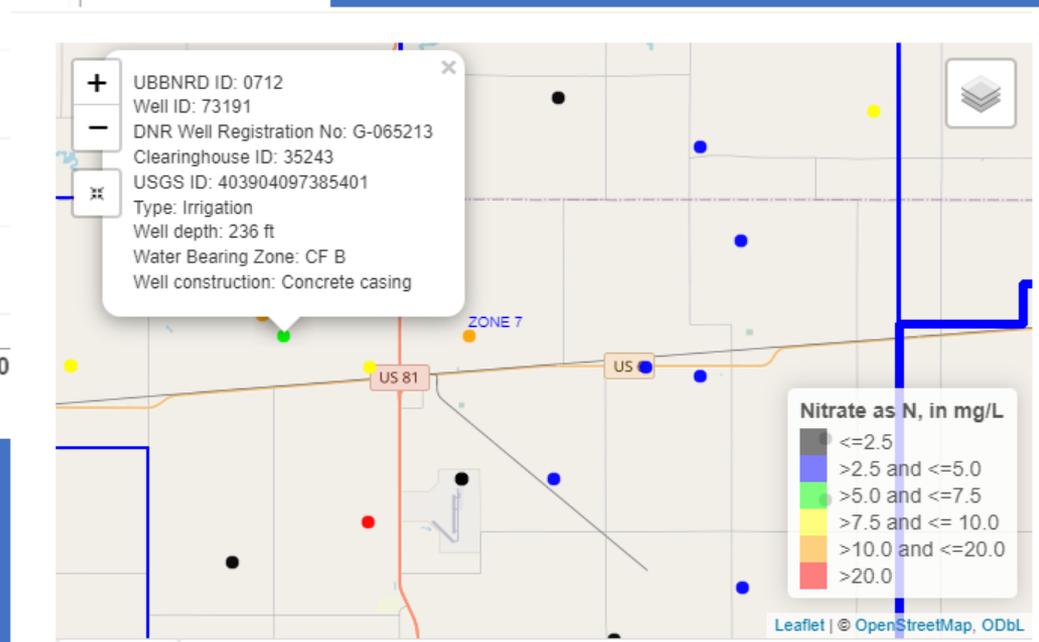
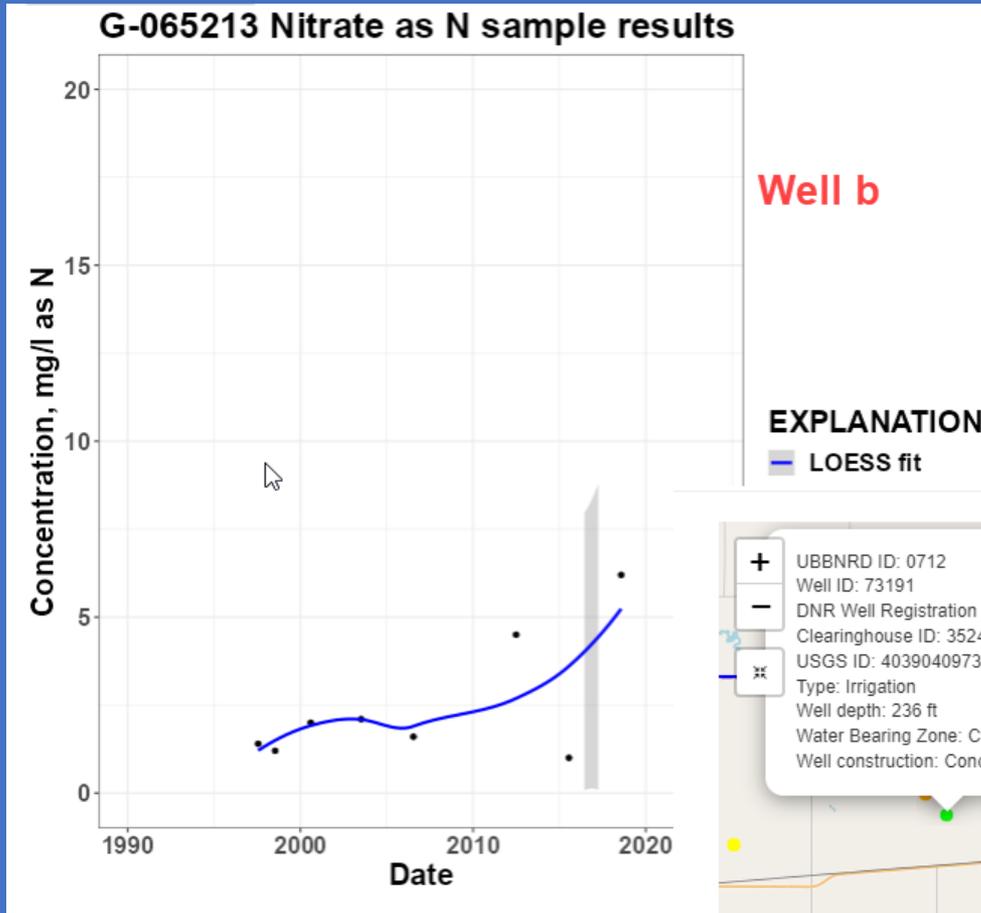


Leaflet | © OpenStreetMap, ODbL

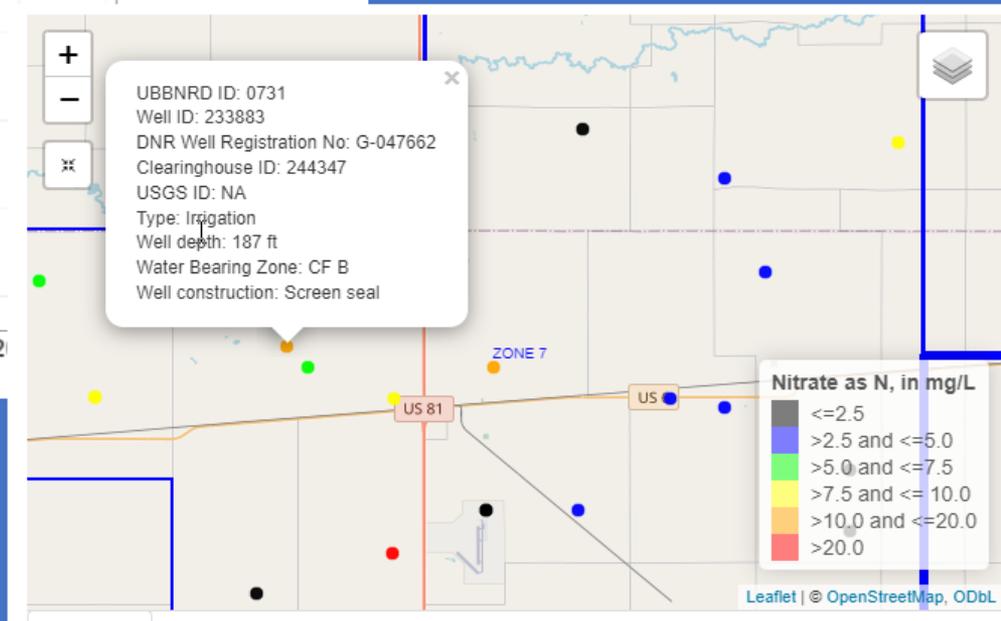
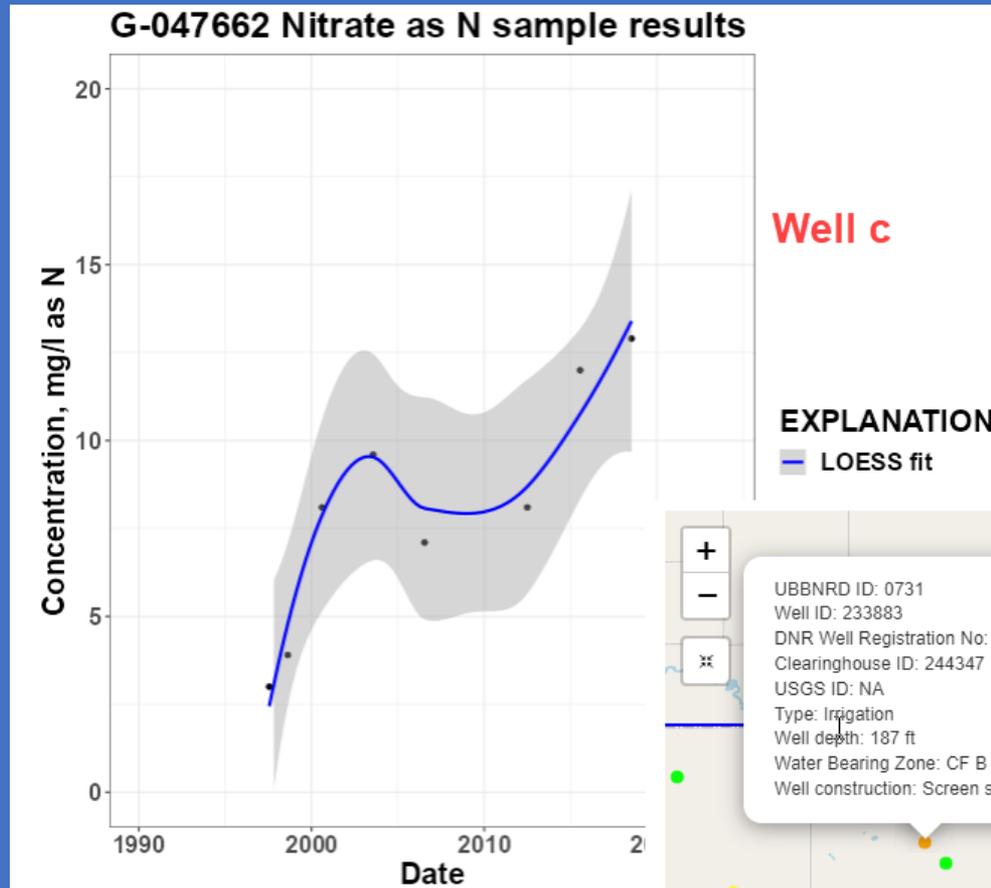
Exercise—Look at UBB nitrate results in well a



Exercise—Look at UBB nitrate results in well b



Exercise—Look at UBB nitrate results in well c



Other analysis: Network coverage

Qualitatively assessed monitoring well

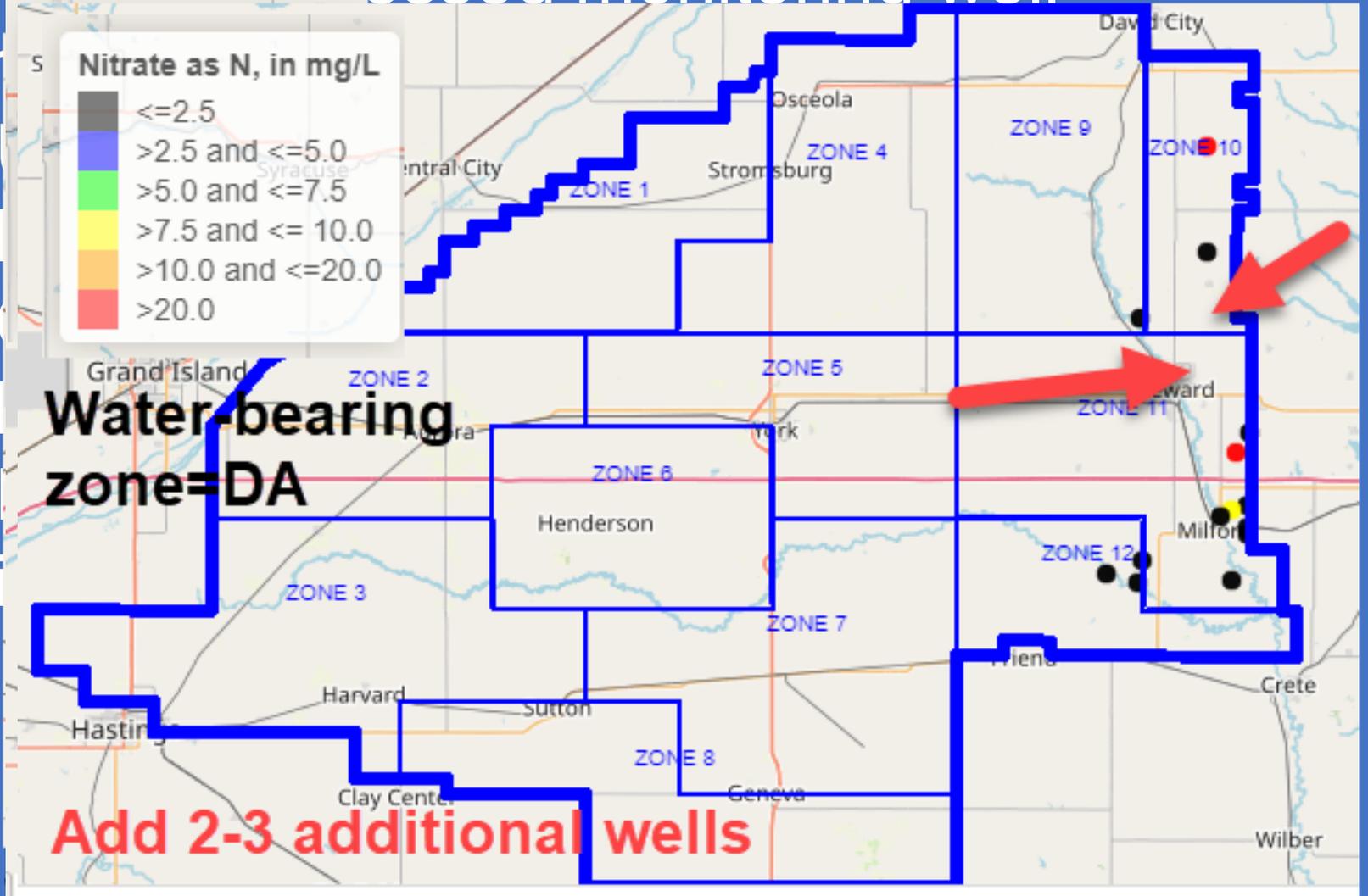
coverage

•

•

•

Possible



ZONE 10 - C1A & C1B - C1A, C1B, and C1C

Replacement wells

Original/ Replacement	Well Registration	Legal	Screened interval
Original-1	G-073010	T07N02W30CCDD	180-200
Replacement-1	G-055332	T07N02W03D	200-300
Original-2	G-009893	T07N04W13CCAB	154-214
Replacement-2	G-009893	T07N04W13C	160-220
Original-3	G-054536	T07N01W11BBDD	247-351
Replacement-3	G-054536	T07N01W11B	205-285
Original-4	G-023552	T08N04E4CC	40-100
Replacement-4	G-141964	T08N04E4C	60-132

Data gaps & takeaways

- **NEDNR well registration database is an excellent resource for most wells, but for many older wells there may be more information in scanned notes within the database**
 - **Time and resources for this study were limited to the assembly of construction information for UBB sampled wells**
- **Collection of additional WQ parameters (dissolved oxygen, iron, nitrogen isotopes) may be helpful in interpreting nitrate levels**
- **Initial exploration of data revealed to clear “smoking guns” related to well construction and nitrate levels, but still actively being researched**

Current status

- ✓ **Assembled existing water quality data from dispersed data repositories**
- ✓ **Combined water quality data with well construction information that can provide insight into transport mechanisms**
- ✓ **Created a customized geospatial and graphical tool to more readily explore groundwater quality in the Upper Big Blue NRD**

Public release

March 2024

Data Release

sciencebase.gov

McGuire, V.L., Strauch, K.R., Dietsch, B.J., Rahman, F.I., and Wilkins, E.E., 2023, Dataset of Sampled Well Characteristics and Groundwater-Quality Results, Upper Big Blue Natural Resources District, east-central Nebraska: U.S. Geological Survey, <https://doi.org/10.5066/P988E3DY>.



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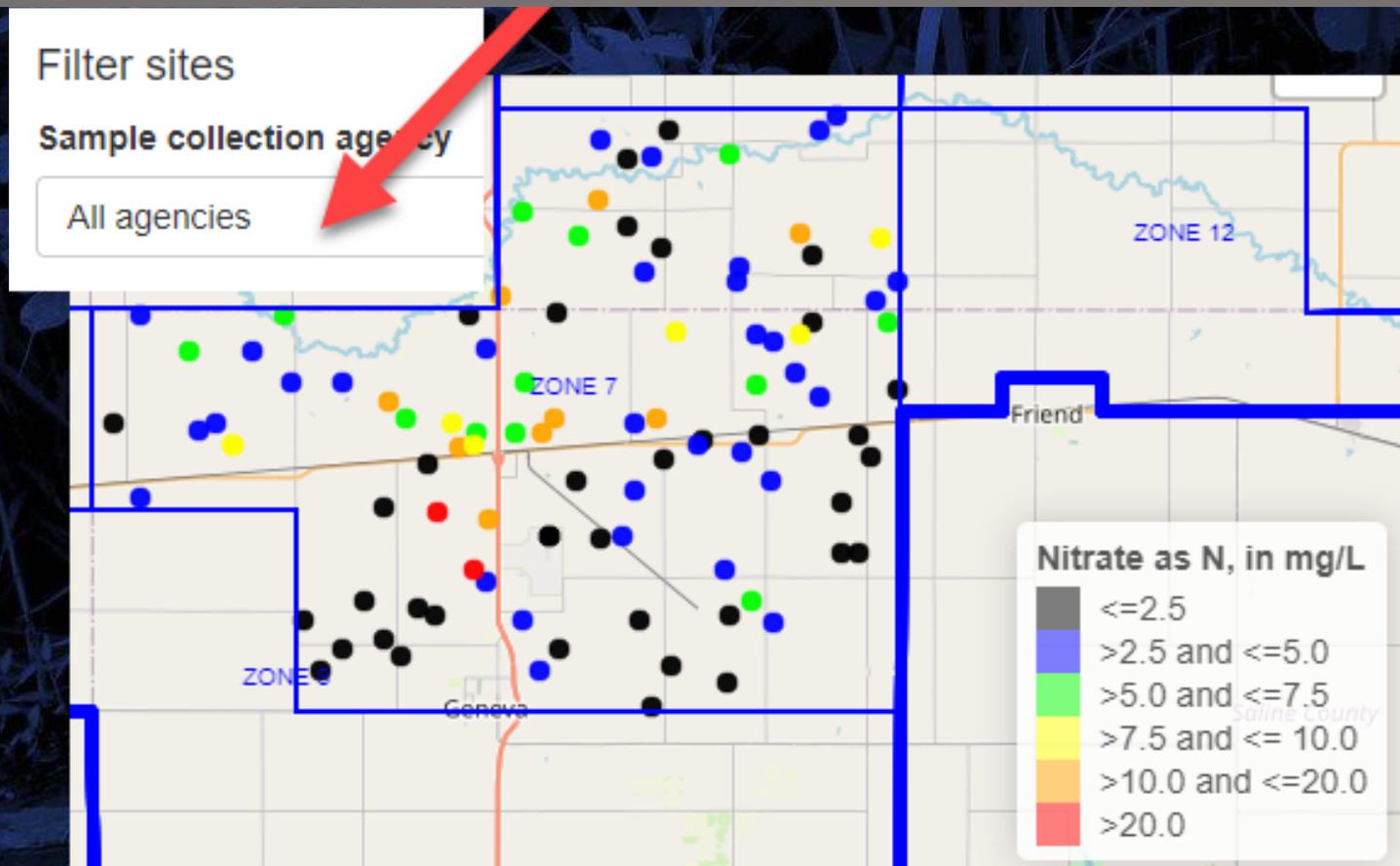
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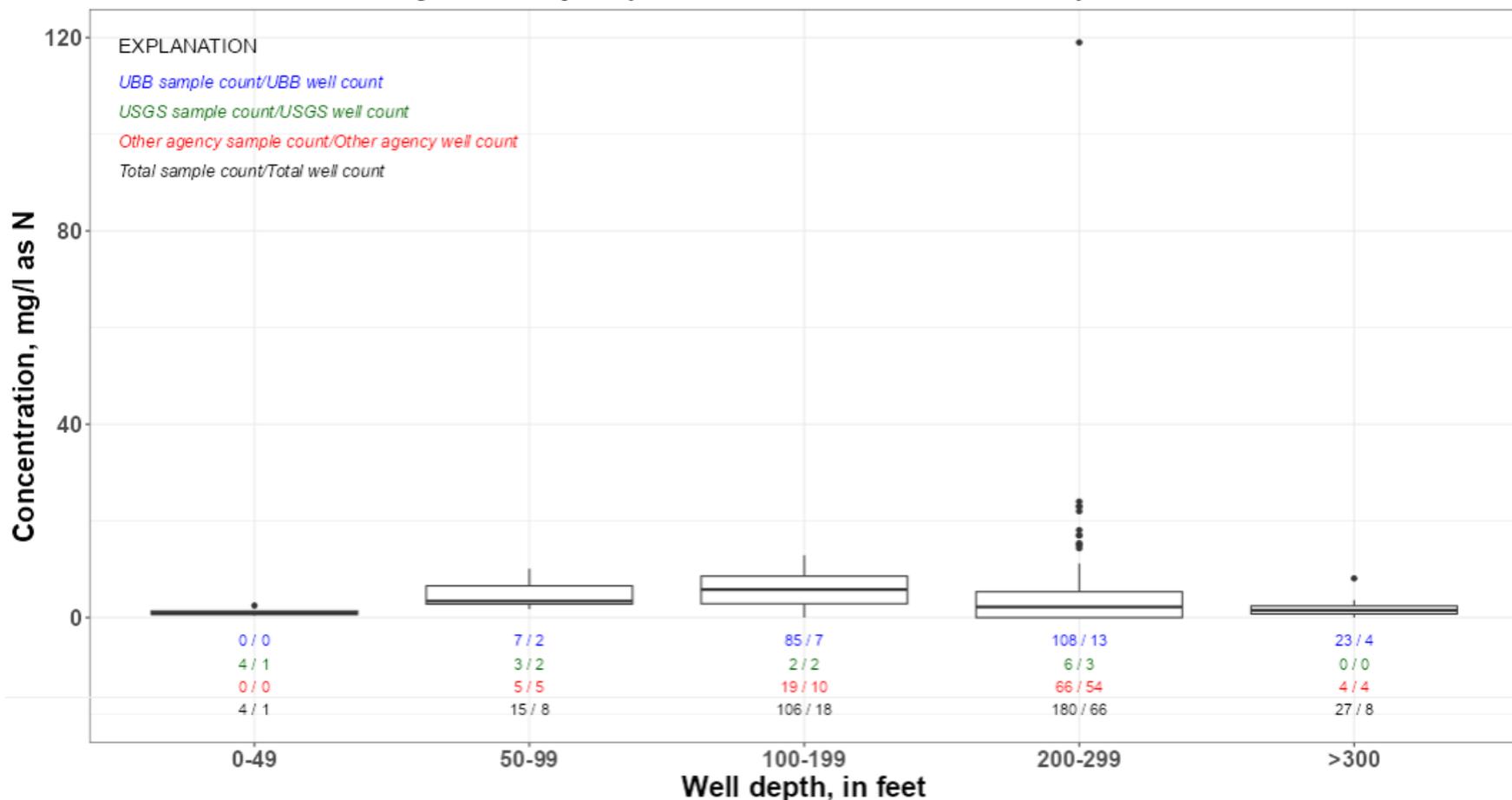
USGS Nebraska Water Science Center
5231 South 19th St.
Lincoln, NE 68512-1271
(402) 328-4100
<https://www.usgs.gov/centers/ne-water>

Exercise 2—Look at Zone 7, Display 5a: Results from others since March 1945



Exercise 2—Look at Zone 7, Display 5b: All results, by depth

Nitrate as N levels by well depth (1945-03-29 to 2023-04-20)



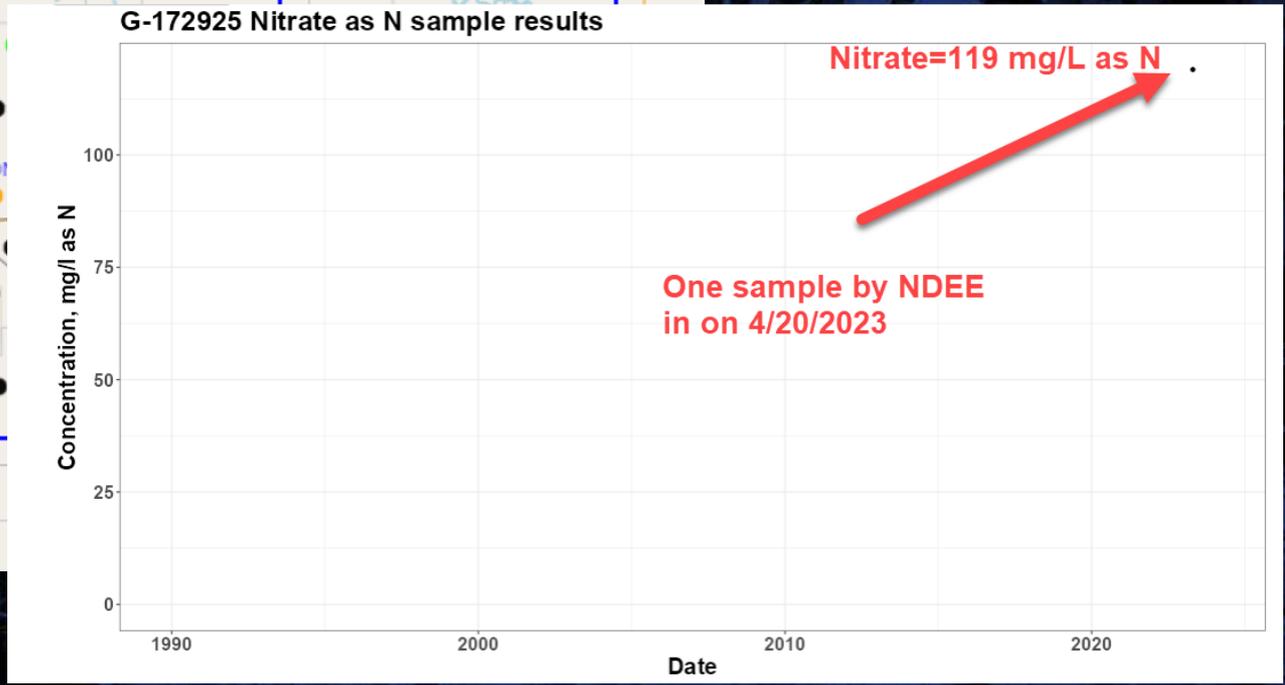
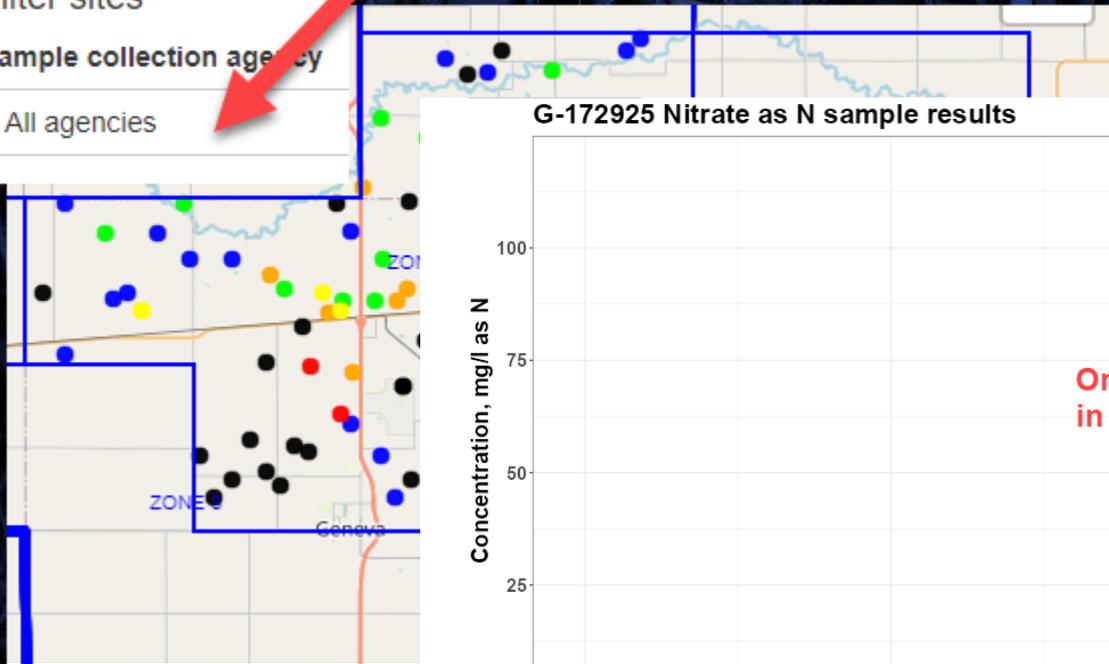
Exercise 2—Look at Zone 7, Display 5c: All results, one well

The screenshot shows a web application interface for viewing well data. On the left, a 'Filter sites' menu is open, showing 'Sample collection agency' with 'All agencies' selected. A red arrow points from the title to this menu. The main area is a map of 'ZONE 7' with various colored dots representing wells. A red arrow points from the title to a specific well on the map. A popup window on the right displays the following information:

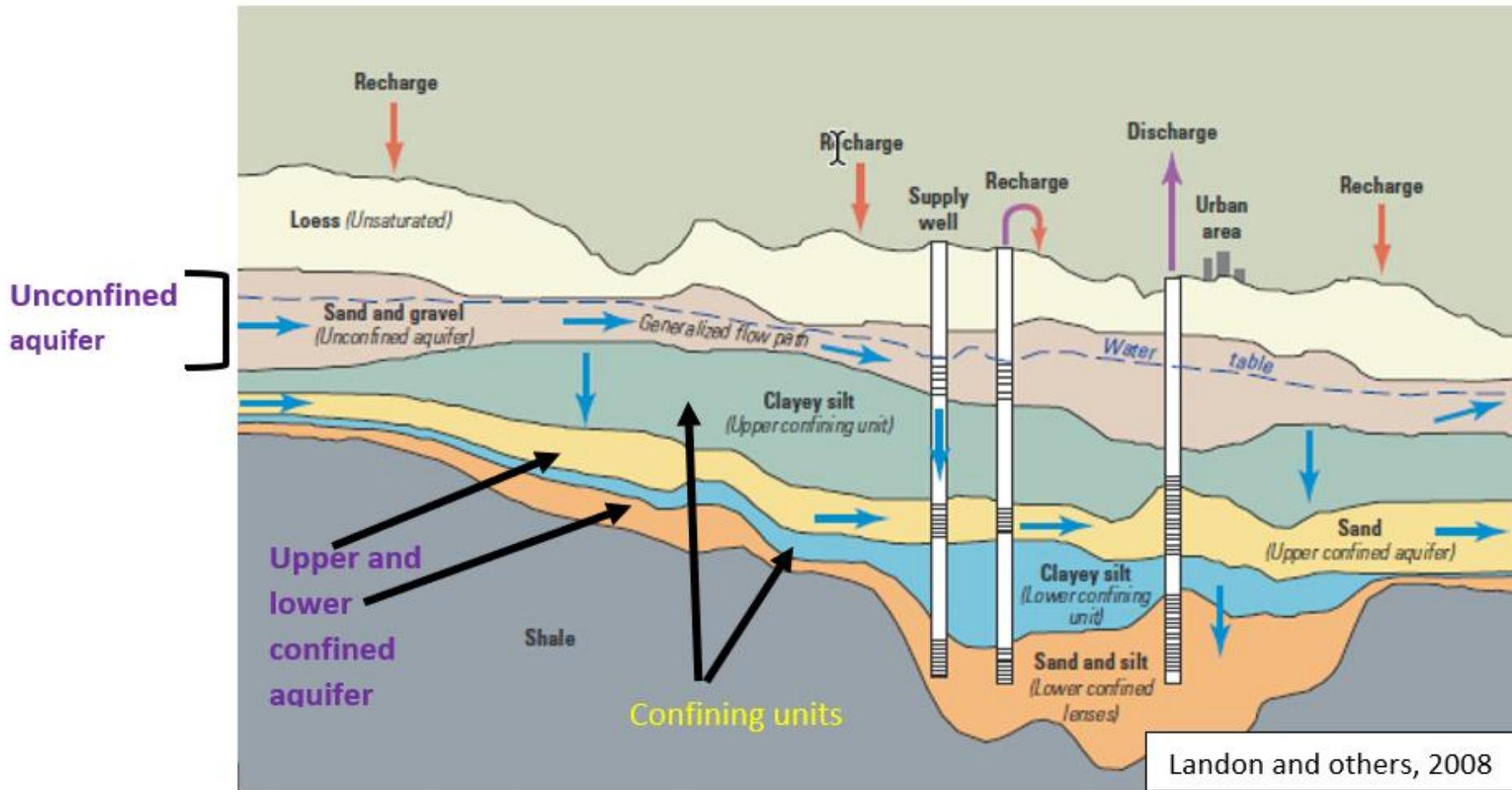
- UBBNRD ID: NA
- Well ID: 233493
- DNR Well Registration No: G-172925
- Clearinghouse ID: 373616
- USGS ID: NA
- Type: Domestic
- Well depth: 230 ft
- Water Bearing Zone: Unknown water-bearing zone
- Well construction: Unknown construction

Exercise 2—Look at Zone 7, Display 5d: Results in one well

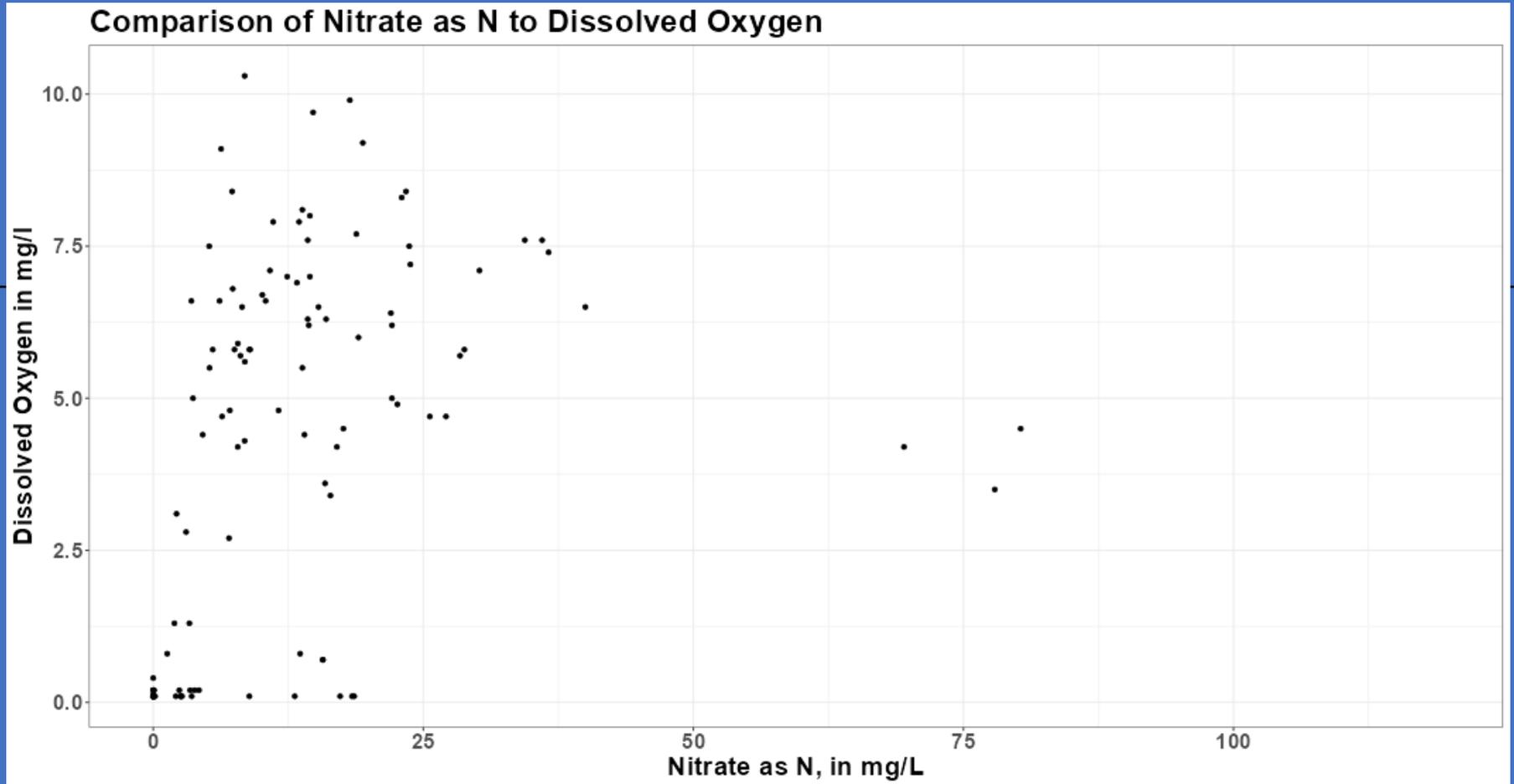
Filter sites
Sample collection agency
All agencies



Aquifer schematic, York area



Parameter graph—Nitrate versus dissolved oxygen



Monitoring well network, management zones and phases, UBB NRD, 2022

EXPLANATION

ForMap_sta

- Active (273 wells)
- ★ Inactive (92 wells)

Management zone and phase

- Phase 1
- Phase 2
- Phase 3
- Urban areas

