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MAJOR GOALS: The main goals of this project were adding water quality sites to the Illinois portion of the NGWMN and establishing new water quality data services from the ISWS database to the NGWMN Portal.

PROJECT SUMMARY: The Illinois State Water Survey (ISWS) added 12 new water quality surveillance sites at existing water level network sites. The ISWS established water quality data services for water level network sites and worked to resolve legacy issues with the existing water quality database for network wells, including capturing required metadata fields not previously part of the database. Data services were established in the latter half of the project.

Support of Data Services and Addition of Water Quality Sites to Illinois NGWMN

**Devin Mannix, Greg Rogers, Vlad Iordache
Illinois State Water Survey**

**Final Report
January 30, 2026**

Overview of work

The Illinois State Water Survey (ISWS) is the principal state scientific agency charged with understanding the groundwater, surface water, and climate systems of Illinois. Under state statute the ISWS is the primary repository for water data in the state. The ISWS has been an integral data provider to the NGWMN since the inception of the program, with NGWMN network sites providing water levels for the Glacial Sand and Gravel aquifer (N100GLCIAL) and the Cambrian-Ordovician aquifer (S300CAMORD). A smaller set of wells monitor the Silurian-Devonian aquifers (N400SLRDVN) and the Pennsylvanian aquifer (N300PNSLVN).

As the state's repository for water data, the Illinois State Water Survey also houses data for water quality data statewide with records going back to the mid-1800s in the ISWS Groundwater Quality Database (GWQDB). With no existing water quality sites established in Illinois' NGWMN network, we identified water quality sites meeting minimum data requirements, modified the NGWMN registry accordingly, and established data services for water quality network wells. There were several structural issues with the groundwater quality database that needed resolved to establish water quality data services, as this database has focused on archival using an internal database schema that needed mapped to national standards and NGWMN program requirements.

Summary of Work

Objective 2a

As historical water quality sampling at the ISWS has predominantly been in the form of synoptic studies and other special investigations at a frequency below the recommended one-five years, we focused on establishing a core water quality network that will support reoccurring sampling on a schedule of a minimum every two to five years as part of regular water level monitoring within NGWMN. We established 12 new water quality Surveillance sites

within the NGWMN. Water quality surveillance sites were chosen following guidelines in the NGWMN Framework document (Subcommittee on Ground Water, 2013), along with availability of existing water quality data, local research and monitoring needs, and their vulnerability to contamination. Priority for site selection was given to existing network wells that also satisfied minimum data requirements for water quality data and have potential for sustained support from either internal research initiatives or local project support.

Table 1 lists new water quality Surveillance sites. All new water quality sites are within the Sand and gravel aquifers (glaciated regions) National Aquifer and are part of regionally relevant aquifer systems, the first seven sites part of the Mahomet Aquifer in central Illinois, and the last five within the St. Charles Bedrock Valley system in the western Chicago suburbs. These locations were chosen for their strong local support to sustain ongoing monitoring and regionally and nationally relevant water quality research, with the Chicago region continuing to manage winter deicer impacts on aquifers (Cullen & Hadley, 2024; Kelly et al., 2016), and central Illinois having sporadic geogenic arsenic concerns (Holm et al., 2004) in addition to being part of the expansive agricultural region subject to nitrate contamination in shallow aquifers. As Illinois is a heavily anthropogenically modified landscape, Water Quality Network wells in Illinois are often classified as Suspected Changes or Documented Changes, often due to either nitrate from agriculture sources or chloride from winter deicer application. Several monitoring locations are nested and the more confined aquifers are generally closer to expected Background conditions, with monitoring wells in natural areas having more subtle anthropogenic influences.

Table 1. List of new ISWS water quality sites added to the NGWMN.

NGWMN Site #	Registry status	Name	Principal Aquifer	Local Aquifer	Measurement Frequency	Measurement Category	Well Depth (ft)
P444911	Existing	VERM 08-01A	Sand and Gravel	Mahomet	Two to Five Years	Surveillance	244
P444912	Existing	VERM 08-01B	Sand and Gravel	Glasford	Two to Five Years	Surveillance	105
P444917	Existing	CHAM-09-03A	Sand and Gravel	Mahomet	Two to Five Years	Surveillance	308
P452901	Existing	PIAT-09-01A	Sand and Gravel	Mahomet	Two to Five Years	Surveillance	321
P452902	Existing	PIAT-09-01B	Sand and Gravel	Glasford	Two to Five Years	Surveillance	136
P495463	Existing	CHAM-12-02A	Sand and Gravel	Mahomet	Two to Five Years	Surveillance	245
P496467	Existing	CHAM 12-02C	Sand and Gravel	Glasford	Two to Five Years	Surveillance	91
P498308	Existing	SUGR-18-01	Sand and Gravel	St Charles Bedrock Valley	Two to Five Years	Surveillance	80
P498309	Existing	SUGR-18-02	Sand and Gravel	St Charles Bedrock Valley	Two to Five Years	Surveillance	185
P498310	Existing	SUGR-18-03	Sand and Gravel	St Charles Bedrock Valley	Two to Five Years	Surveillance	122
P498311	Existing	GENV-18-01	Sand and Gravel	St Charles Bedrock Valley	Two to Five Years	Surveillance	135
P498312	Existing	GENV-18-02	Sand and Gravel	St Charles Bedrock Valley	Two to Five Years	Surveillance	119

Lastly, we maintained the well registry and performed database maintenance to ensure continued delivery of all existing water level network sites and net water quality network sites. Data was backed up daily and services were updated as needed to maintain continuity with any database revisions.

Though there were plans to establish 2-3 trend wells with continuous specific conductance probes, these were not completed prior to the final report. One of the planned sites failed to produce sufficient quantities of water during a pump test and was flagged as being a poor candidate for continuous monitoring. At the remaining prospective sites, we are working to secure financial support for equipment, ongoing monitoring, and site visits. Additionally, we have recently identified temperature data being collected and stored in a separate database at a number of existing trend wells as part of the sensor suites in the wells. We are in the process of QA/QCing these data and investigating the potential for deploying these as water quality trend sites.

Objective 2b

Following the Framework document (Subcommittee on Ground Water, 2013) and the NGWMN Tip Sheet on Standard Elements for Water Quality Data Web Services, new and modified database fields were added to the groundwater quality database to meet minimum data standards for project data. New fields were added for Sample Fraction, Analytical Method, and Analytical Method System which were previously missing from the ISWS Groundwater Quality Database and we are working with the Health and Environmental Applications Laboratory to include these outputs as part of sample reporting for subsequent analyses. In cases where this metadata is not readily available we are working through records to update the relevant services manually.

We also modified the ISWS database schema to consistently capture unique well identifiers for project data, necessary for serving water quality data services for specific sites. Previously, water quality database schema focused on capturing sporadically populated site information, with much of the database infrastructure designed around capturing partially known well metadata with a focus on mailed samples for private well data, often without known well provenance. Database upload procedures did not consistently populate or check for unique well identifiers upon data submission leading to missing data in historical samples. The recent updates as part of this work rectified missing site ids and implemented capture of unique well identifiers for uploaded project data, which was one of the major limitations for establishing site-based water quality data services. Additionally, the analytical results field was modified to cast results as numeric and parse out string-based inputs in a separate comment field, most commonly related to inconsistent non-detect reporting. We are working with our respective laboratories to ensure non-detect metadata is reported in a consistent format going forward.

Table 2. List of Analytes found within A National Framework for Ground-Water Monitoring in the United States (2013).

Sampling Goal	Monitoring well type	Lists	Determinants
Quality	Trend	Standard list ¹	Ground-water level Temperature pH Specific or electrical conductance
	*Note the sets of wells used to obtain water-quality samples for water <i>quality</i> monitoring may not be the same sets as those used for <i>quantity</i> monitoring.		
	Surveillance	Extended plus standard list (total or dissolved, depending on needs or questions being addressed)	Sodium Calcium Magnesium Potassium Chloride Sulfate Alkalinity Nitrate + nitrite as nitrogen Ammonia Orthophosphate Dissolved oxygen Total dissolved solids Oxygen reduction potential Iron Manganese Other analytes with Federal Drinking-Water Standards
	Trend or surveillance	Supplemental (Optional)	Trace metals Synthetic organics Emerging Contaminants Selected Isotopes Others
	Special studies	Unique to monitoring project (e.g., special studies)	Variable; depending on specific questions to be addressed

¹If desired, trend wells can also be sampled for extended list.

We mapped ISWS-specific custom storet codes for analytes to the recommended format provided in the Water Quality Data Elements spreadsheet and other supporting tipsheets. Generally, most recommended analytes part of either the Standard or Extended list of analytes (Table 2) have direct equivalents in the standard ISWS groundwater quality samples (Table 3), with the exception of nitrate + nitrite as nitrogen, which was present in historical samples but is rare in our current laboratory analyses, and water level, which is not currently captured as part of water quality data entry, but is available through water level network services if taken during sampling. There is also an extensive list of supplemental analytes that are typically, but not always, included in water quality samples, notably trace metals and occasionally selected isotopes. Some of these analytes have drinking water standards (i.e. arsenic) and are therefore part of the “Extended” list of analytes per the Guidance document, but are included in trace metal analysis by the laboratory as part of other Supplemental analytes.

Table 3. Current list of ISWS groundwater analytes and their corresponding NGWMN standard names with their respective analyte list. Detection limited is reported here as the most frequently reported value in recent samples, as historically this value has not been included in laboratory reports except when below the detection limit. We will be working with respective laboratories to ensure reporting for future samples.

ISWS Storet	ISWS Name	ISWS Description	Units	Method Speciation	NGWMN Analyte	NGWMN Analyte List
00010	Temp (C)	Water temperature (C)	deg C		Temperature	Standard
00090	Ox-Red Pot	Oxidation-reduction potential (millivolts)	mV		Oxidation reduction potential (ORP)	Extended
00094	Cond (fld)	Specific conductance, field (μ mhos/cm @ 25C)	mmhos/cm		Specific Conductance	Standard
00300	DO	Oxygen, dissolved (mg/L)	mg/l		Dissolved oxygen (DO)	Extended
00400	pH (field)	pH (standard units) field			pH	Standard
00403	pH (lab)	pH (standard units) lab			pH	Standard
00410	Alkalinity	Alkalinity, titration to pH 4.5, lab (mg/L as CaCO ₃)	mg/l	as CaCO ₃	Alkalinity	Extended
00608	NH ₃ -N, d	Ammonia-nitrogen, dissolved (mg/L as N)	mg/l	as N	Ammonia	Extended
00915	Ca, d	Calcium, dissolved (mg/L as Ca)	mg/l		Calcium	Extended
00925	Mg, d	Magnesium, dissolved (mg/L as Mg)	mg/l		Magnesium	Extended
00930	Na, d	Sodium, dissolved (mg/L as Na)	mg/l		Sodium	Extended
00935	K, d	Potassium, dissolved (mg/L as K)	mg/l		Potassium	Extended
00941	Cl, d	Chloride, dissolved (mg/L as Cl)	mg/l		Chloride	Extended
01046	Fe, d	Iron, dissolved (μ g/L as Fe)	ug/l		Iron	Extended
70300	TDS	Residue, total filterable @180C (mg/L)	mg/l		Total dissolved solids	Extended
01056	Mn, d	Manganese, dissolved (μ g/L as Mn)	ug/l		Manganese	Extended
00441	S, d	Sulfur, dissolved (mg/L as S)	mg/l	as S	Sulfur	Supplemental
00618	NO ₃ -N, d	Nitrate-nitrogen, dissolved (mg/L as N)	mg/l	as N	Nitrate	Supplemental

ISWS Storet	ISWS Name	ISWS Description	Units	Method Speciation	NGWMN Analyte	NGWMN Analyte List
00666	P, d	Phosphorus, dissolved (mg/L as P)	mg/l	as P	Orthophosphate	Supplemental
00946	SO4, d	Sulfate, dissolved (mg/L as SO4)	mg/l	as SO4	Sulfate	Supplemental
00950	F, d	Fluoride, dissolved (mg/L as F)	mg/l		Fluoride	Supplemental
01000	As, d	Arsenic, dissolved (µg/L as As)	ug/l		Arsenic	Supplemental
01005	Ba, d	Barium, dissolved (µg/L as Ba)	ug/l		Barium	Supplemental
01010	Be, d	Beryllium, dissolved (µg/L as Be)	ug/l		Beryllium	Supplemental
01020	B, d	Boron, dissolved (µg/L as B)	ug/l		Boron	Supplemental
01025	Cd, d	Cadmium, dissolved (µg/L as Cd)	ug/l		Cadmium	Supplemental
01030	Cr, d	Chromium, dissolved (µg/L as Cr)	ug/l		Chromium	Supplemental
01035	Co, d	Cobalt, dissolved (µg/L as Co)	ug/l		Cobalt	Supplemental
01040	Cu, d	Copper, dissolved (µg/L as Cu)	ug/l		Copper	Supplemental
01049	Pb, d	Lead, dissolved (µg/L as Pb)	ug/l		Lead	Supplemental
01057	Tl, d	Thallium, dissolved (µg/L as Tl)	ug/l		Thallium	Supplemental
01060	Mo, d	Molybdenum, dissolved (µg/L as Mo)	ug/l		Molybdenum	Supplemental
01065	Ni, d	Nickel, dissolved (µg/L as Ni)	ug/l		Nickel	Supplemental
01080	Sr, d	Strontium, dissolved (µg/L as Sr)	ug/l		Strontium	Supplemental
01085	V, d	Vanadium, dissolved (µg/L as V)	ug/l		Vanadium	Supplemental
01090	Zn, d	Zinc, dissolved (µg/L as Zn)	ug/l		Zinc	Supplemental
01095	Sb, d	Antimony, dissolved (µg/L as Sb)	ug/l		Antimony	Supplemental
01100	Sn, d	Tin, dissolved (µg/L as Sn)	ug/l		Tin	Supplemental
01106	Al, d	Aluminum, dissolved (µg/L as Al)	ug/l		Aluminum	Supplemental
01130	Li, d	Lithium, dissolved (µg/L as Li)	ug/l		Lithium	Supplemental
01140	Si, d	Silicon, dissolved (µg/L as Si)	ug/l		Silicon	Supplemental
01145	Se, d	Selenium, dissolved (µg/L as Se)	ug/l		Selenium	Supplemental
01150	Ti, d	Titanium, dissolved (µg/L as Ti)	ug/l		Titanium	Supplemental
07018	Tritium	Tritium in water	T.U.		Tritium	Supplemental
50790	d18O_H2O	Delta Oxygen08 of water (per mil (‰))	per mil		Oxygen Delta 18	Supplemental

ISWS Storet	ISWS Name	ISWS Description	Units	Method Speciation	NGWMN Analyte	NGWMN Analyte List
50791	dD_H2O	Delta Deuterium of water (per mil (‰))	per mil		Deuterium	Supplemental
71850	NO3, t	Nitrogen, nitrate, total (mg/L as NO3)	mg/l	as NO3	Nitrogen	Supplemental
71870	Br, d	Bromide, dissolved (µg/L as Br)	ug/l		Bromide	Supplemental
71874	CH4	Methane (mg/L as CH4)	mg/l	as CH4	Methane	Supplemental
71875	H2S	Hydrogen sulfide (mg/L as H2S)	mg/l	as H2S	Hydrogen sulfide	Supplemental
81280	NPOC,d	Nonpurgeable organic carbon, dissolved (mg/L) (NVOC,d)	mg/l		Organic carbon	Supplemental
82081	d13C_DIC, d	Delta Carbon03 of Dissolved Inorganic Carbon, dissolved (per mil (‰))	per mil		Carbon, isotope of mass 13	Supplemental
82085	d18O_SO4, d	Delta Oxygen08 of Sulfate, dissolved (per mil (‰))	per mil		Oxygen 18/oxygen 16 ratio in sulfate	Supplemental
82086	d34S_SO4, d	Delta Sulfur-34 of Sulfate, dissolved (per mil (‰))	per mil		Sulfur-34/Sulfur-32 ratio	Supplemental

Water quality data services were built in SOAP based XML web services with the assistance of the organization's software developer casting ISWS formatted data structure into the desired NGWMN formatted standards. Service description and operations within can be found at [NGWMNService Web Service](#).

Conclusion

With a legacy database containing data back to the late 1800s, the ISWS had an expansive but inconsistent history of water quality monitoring assembled from a combination of various data providers ranging from individual municipalities to state agencies, special studies, and selected monitoring investigations often related to individual research efforts as an extension of our role as the state repository for water-related data. With this work we established a core network of water quality surveillance sites at ISWS operated monitoring wells in Illinois covering glaciated sand and gravel aquifers with known water quality challenges relevant to regional and national water quality research. We also established the first groundwater quality data services in ISWS history.

While our statewide coverage for Principal Aquifers and Major Aquifers is increasingly comprehensive for water level network sites, the water quality network is notably missing coverage in the Cambrian Ordovician Aquifer and the Silurian-Devonian Aquifer. These will likely be a topic of consideration for future expansion of water quality monitoring. The Cambrian Ordovician Aquifer System will be a challenging National Aquifer to include in the water quality network in Illinois given the prohibitive depths to water in Northeast Illinois, which precluded it from our initial project scope. For the Cambrian Ordovician, leveraging other data sources such as the ambient groundwater sampling done by the Illinois Environmental Protection Agency or individual public supplies may be more viable for Extended and Supplemental Analytes, with Standard Analytes best suited to continuous monitoring via sensor probes. We look forward to continued improvement of both the water quality and water level networks and increasing the national utility of the NGWMN program.

A map of all new water quality network wells is shown below.

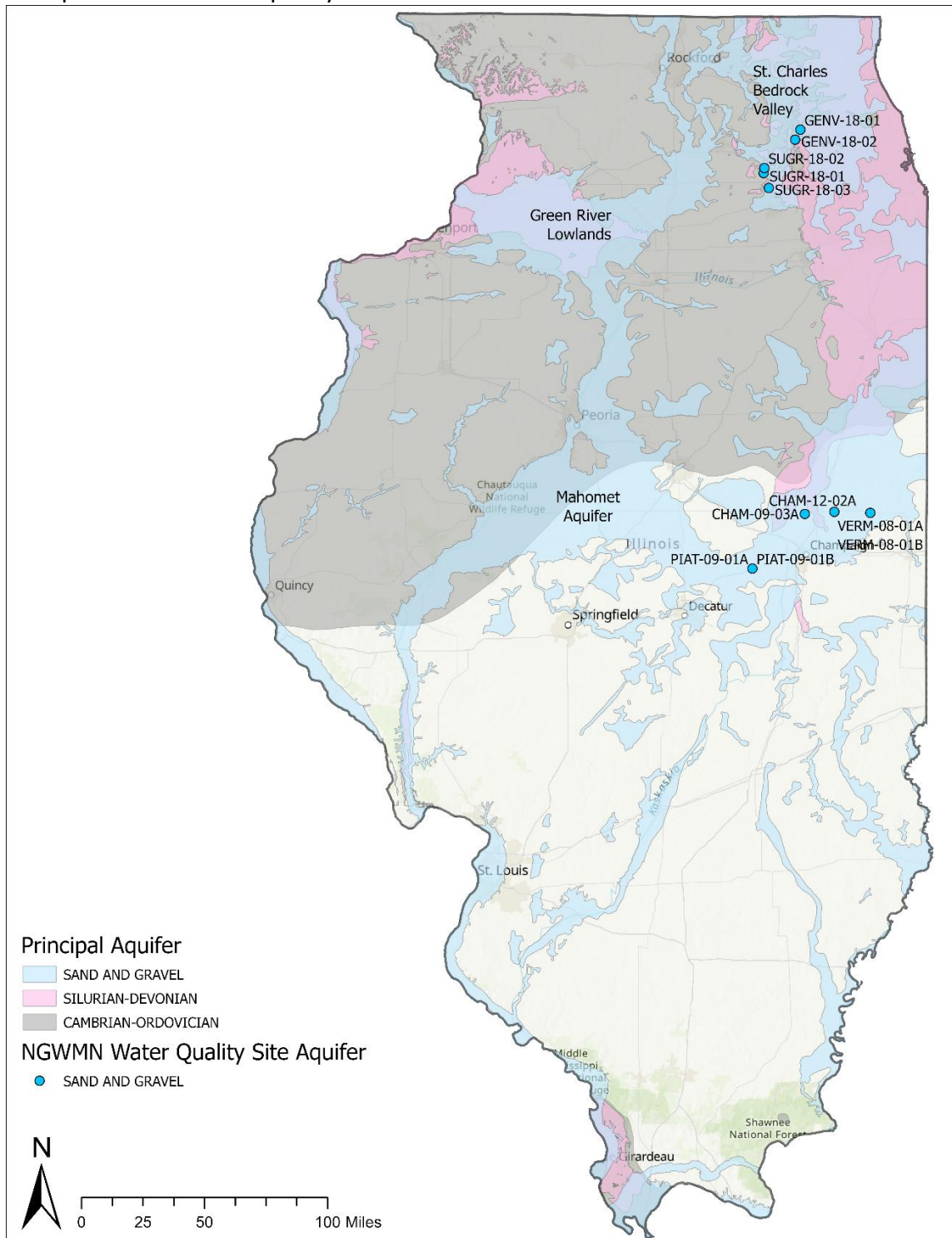


Figure 1. Map of current ISWS active water quality monitoring wells.

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