A PROPOSAL SUBMITTED TO:
City of Columbia

HYDROLOGIC MONITORING OF MCBAINE BOTTOMS, INCLUDING EAGLE BLUFFS CONSERVATION AREA, 2024-2026

U.S. Geological Survey
Central Midwest Water Science Center

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CENTRAL MIDWEST WATER SCIENCE CENTER

Background/Introduction

The City of Columbia, Missouri, with a population of approximately 126,254 people (U.S. Census Bureau, 2020), uses the Missouri River alluvial aquifer in the McBaine Bottoms area, the low-lying alluvial land along the eastern side of the Missouri River in the vicinity of McBain, Mo (fig. 1), for its municipal water supply (City of Columbia, 2022). In the early 1990s, the City constructed wastewater-treatment wetland units to receive blended primary and secondary treated effluent from the wastewater treatment facility (Smith and Richards, 2008). Prior to the waste-water treatment wetland units receiving any treated effluent, monitoring wells were drilled during 1991-1993 by the City and USGS throughout the alluvial aquifer in McBaine Bottoms to collect groundwater samples and analyze for water quality (Richards, 1995, 1999). Then, beginning in 1994, the Missouri Department of Conservation (MDC) began using a combination of treated effluent from the treatment wetland units and pumped Missouri River water as the water source for the managed wetland in Eagle Bluffs Conservation Area (Eagle Bluffs). The DNC began full wetland management in late 1995.

Over the past 31 years, the USGS has continued to collect water-quality samples, both groundwater and surface water sites, and record groundwater-level data throughout the Missouri River alluvial aquifer near McBaine Bottoms and Eagle Bluffs. The overarching objective of this on-going data collection is to track groundwater quality changes and infer groundwater flow, spatially and vertically through the aquifer, relative to the practice of discharging treated effluent, seasonal flooding of the Eagle Bluffs, and operation of the City wetland treatment units near the City's municipal well field.

Several comprehensive analyses of pre- and post-effluent water-quality data over time have indicated changes in the groundwater chemistry beneath Eagle Bluffs and near the treatment wetland units (Richards 1995, 1999, 2003; Smith and Richards 2006, 2008). Smith and Richards (2008) analysis concluded twenty-two monitoring wells throughout the study area have been affected by treated effluent, based on post-effluent chloride concentrations being higher han the typical less than about 40 milligrams per liter (mg/L) observed in pre-effluent groundwater and surface samples. Recent water-quality data (2018-2022) had two groundwater samples that exceeded Secondary Maximum Contamination Levels (EPA, 2023b) of 250 mg/L with chloride concentration results of 257 and 252 mg/L, from MW 116C and MW 01-2B respectively.

Wastewater indicator and pharmaceutical compounds, indicative of treated effluent, were also detected in recent groundwater-quality samples (2018-2022). Water samples were analyzed for

a total of 187 wastewater indicator and pharmaceutical compounds. Of those 187 total compounds, 54 compounds were detected over the course of the last five years. The following analytes were detected in groundwater samples: Carbamazepine, Carisoprodol, Gabapentin, Lidocaine, Meprobamate, N,N-diethyl-meta-toluamide DEET, and Warfarin. The detection of wastewater indicators, pharmaceutical compounds, and altered groundwater chemistry away from wetland treatment unit 1 (unit 1) and Eagle Bluffs flooded acreage indicates the migration and mixing of treated effluent with groundwater flowing through the alluvial aquifer.

In addition to altered water chemistry, water-level measurements collected over years and, at times, seasonally illustrate the potential for groundwater migration from locations near unit 1 and Eagle Bluffs treated-effluent discharge areas toward the City municipal well field (Smith and Richards, 2008). A consistent feature of water-level measurements in the area is a "groundwater high" beneath Eagle Bluffs and unit 1. This persistent groundwater high, coupled with a cone of depression to the north in McBaine Bottoms, beneath the municipal well field, creates a hydraulic gradient with the potential for lateral migration of effluent-enriched groundwater from Eagle Bluffs and unit 1 toward the municipal well field.

Problem

The combination of effluent-enriched groundwater, indicated by water-quality data, and water-level data indicating groundwater mounds beneath Eagle Bluffs and unit 1, creates the potential for introduction of effluent-enriched groundwater into the municipal water supply of the City. To ensure awareness of water quality changes and provide City planners with information for water resource management decisions, a present-day evaluation of groundwater quality and potential groundwater flow is needed. As of 2023, the most recent comprehensive investigation of available data was completed in 2008, which presented understanding of groundwater quality data (1997-2007) and water-level data (2004-2007). A modern investigation of groundwater quality trends, both spatial and temporal, and groundwater flow is prudent to reflect the addition of the 377 water-quality samples collected between 2008 and 2023, and potential changes in factors, both natural and anthropogenetic, that may affect groundwater movement in the alluvial aquifer over the last 14 years.

Similarly, the current (2023) sampling site strategy has was established about 2014. In 2009, the groundwater sampling sites had been reduced from 15 to 9 sites along potential groundwater flow paths between unit 1 and the "groundwater high" beneath Eagle Bluffs toward the municipal well field. This geographically restricted dataset limits analysis and interpretation of water quality throughout the Missouri River alluvial aquifer near McBaine Bottoms. The addition of several sampling sites beyond the interpreted groundwater flow paths between unit 1 and the "groundwater high" beneath Eagle Bluffs toward the municipal well field will allow more rigorous comparison of effluent effects on water quality and increased confidence of interpreted groundwater flow paths.

Also, since about 2014, mass water-level measurements have occurred only once per year every other alternating year. This frequency and depending on time of year may not adequately reflect the impact of the seasonal flooding in Eagle Bluffs or present day (2023) operational management of the municipal well field. Detailed, groundwater level maps at seasonal times

related anticipated likely changes in groundwater recharge and/or municipal well pumping are required for improved confidence in interpretation of groundwater flow paths. Increasing the frequency of mass water-level measurements to twice a year over the next three year is needed to improve present understanding of groundwater movement.

Finally, many potential groundwater contaminants, such as PFAS, are of increasing concern. The EPA has proposed MCL for six PFAS (EPA, 2023a). Legislation has been received by Congress to require the Administrator of the EPA to designate PFAS as hazardous substances (Congress, 2020). Since research into any potential negative impacts of these contaminates is relatively recent and on-going, the establishment of a dataset composed of McBaine Bottoms analyses of groundwater samples for PFAS is needed to understand if PFAS are present, in what concentrations, and to confirm laboratory results, as regulatory guidance continues to evolve.

Objectives and Scope

The objective of this project proposal is to improve understanding of groundwater movement and groundwater quality in the Missouri River alluvial aquifer near McBaine Bottoms, including Eagle Bluffs, through modern scientific investigation of available groundwater quality and groundwater level data. In addition, routine groundwater level and water quality will continue to be collected, with two additional groundwater monitoring wells, sampling for PFAS, and increased frequency for groundwater level measurements.

A. Complete an evaluation of trends in existing groundwater quality data and water-level data from 2008 through 2022 to enhance understanding of historic spatial and temporal trends.
B. Improve understanding of groundwater movement throughout the Missouri River alluvial aquifer near McBaine Bottoms and Eagle Bluffs.
C. Improve understanding of groundwater quality, including collection and analysis for PFAS.

Approach

To accomplish the project objectives, general work tasks will include:

A. Interpretive product: Comprehensive evaluation of existing groundwater quality data and water-level data from 2008 through 2022.
B. Bi-annual water-level measurement data collection throughout the available monitoring well network (fig. 1).
C. Continue bi-annual discrete water-quality sampling as established since 2014 (table 1, Timeline) with the addition of sample collection and analysis for PFAS and two additional groundwater sample locations.

Task A: Peer-reviewed, interpretive product focused on evaluation of groundwater quality data and water-level data from 2008-2022.

1. Compile, organize, and analyze available water quality and water-level data.
2. Compile additional available key datasets that may impact water quality and groundwater movement; including but not limited to hydrogeologic framework, alluvial aquifer hydraulic properties, municipal supply well field operation data,

Eagle Bluffs operational data, Missouri River water-level, precipitation data, and land use.
3. Analyze water-quality data spatial and temporal trends, per USGS statistical methodologies (Helsel and others, 2020), with integration of natural and anthropogenic factors.
4. Analyze water-level data spatial and temporal trends, with integration of natural and anthropogenic factors.
5. Integration and interpretation of water quality and water-level trends.
6. Publish the results through a peer-reviewed, interpretive product.

Task B: Bi-annual water-level measurement data collection throughout the available monitoring well network (fig. 1).

1. Bi-annually collection water-level measurement, monitoring well integrity, and field condition data throughout the monitoring well network.
2. Documentation and publication of data will be made available through the National Water Information System (https://waterdata.usgs.gov/nwis).

Task C: Bi-annual discrete water-quality sampling per established schedules, including quality assurance sampling, additional groundwater sampling sites (USGS 7 and USGS 9D), and the addition of collection and analysis for PFAS.

1. Groundwater levels will be measured and documented.
2. All discrete water samples will be analyzed for field properties and chemical constituents. Major ions and nutrients will be sampled and analyzed twice per year. PFAS will be sampled and analyzed once per year. Pesticides will be sampled and analyzed every two years (beginning 2024) in alternation with sampling and analysis of Wastewater indicators and Pharmaceuticals. Specific constituents for each constituent group schedule are listed in appendix A.
3. For quality assurance, one sample of an equipment blank and one sample of a source solution blank will be analyzed prior to fieldwork sample collection. Also, one field blank and one field replicate will be submitted per year.
4. Documentation and publication of data will be made available through the National Water Information System (https://waterdata.usgs.gov/nwis) or other appropriate publication.

Quality Assurance Plan

USGS Fundamental Science Practices (FSP) will be followed to provide unbiased, objective, and impartial scientific information. Quality assurance (QA) measures, as described in the FSP and CMWSC Quality Assurance Plan, will be followed to ensure the completeness of the information communicated during the study. The QA objectives for the collection and communication of information will withstand scientific scrutiny, ensure that data are obtained by methods appropriate for its intended used, and ensure that data are representative and of known completeness and comparability.

Data used in the analysis and interpretation process will be derived from reliable host sources, including the USGS National Water Information System. The data gathered will be quality assured by the project chief. Policies and procedures for archiving data and project information

are also provided in the Central Midwest Water Science Center data management plans. The material will be drafted and peer reviewed in accordance with USGS Scientific and Publication standards. The project and project budget will be reviewed by USGS management on a quarterly basis to ensure project timelines are met.

In addition to Standard USGS Quality Assurance (QA) - Quality Control (QC) methodology described in the National Field Manual for the collection of Water-Quality Data (USGS, 2018), quality control samples for PFAS analysis will be collected and processed. Blank samples will include an equipment and source solution blank, a field blank, and a field replicate each year. Equipment blanks are used to evaluate the equipment as a source of contamination and source solution blanks evaluate the blank water as a source of contamination. A field blank evaluates the cleaning processes in the field and a field replicate will be collected each year to determine variability.

Deliverables

1. Annual groundwater sample results and water-level data will be quality assured and entered into the USGS National Water Information System (https://waterdata.usgs.gov/nwis), which is a publicly accessible permanent repository for all USGS hydrologic and water-quality data.
2. USGS interpretive report describing and documenting trends of groundwater quality data and groundwater level data through end of 2022.
3. USGS SIM and Data Release of groundwater level maps for groundwater level data collected from 2024 to 2026.
4. Annual briefing of study progress provided to City of Columbia personnel.

Timeline and Budget

	FY[1] 2024				FY 2025				FY 2026			
Activity	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
Groundwater sampling: Inorganics and Nutrients		X		X		X		X		X		X
Groundwater sampling: PFAS				X				X				X
Groundwater sampling: Wastewater Indicator and Pharmaceuticals								X				
Groundwater sampling: Pesticides				X								X
Mass Water Level measurement		X		X		X		X		X		X
Peer-reviewed, interpretive product: data analysis	X	X	X	X	X	X						
Peer-reviewed, interpretive product: publication							X	X	X	X	X	X
Bi-annual, water-level data: review and publication											X	X

Funding	FY[1] 2024	FY 2025	FY 2026	Total
City of Columbia	$131,700	$144,700	$153,200	$429,600
USGS match[2]	$56,500	$62,100	$65,700	$184,300
Total	$188,200	$206,800	$218,900	$613,900

[1]FY = Federal fiscal year, October 1 – September 30.

[2]USGS Match funds are estimated, actual USGS contribution will depend on the availability of funding

Personnel

Hydrologist GS-11- Project manager and report lead
Hydrologist GS-12 - Assist GS-11 and GS-7 in project, provide guidance on USGS policy and Fundamental Science Practices
Hydrologist GS-7 – Fieldwork support groundwater sampling and water level measurements

Figures

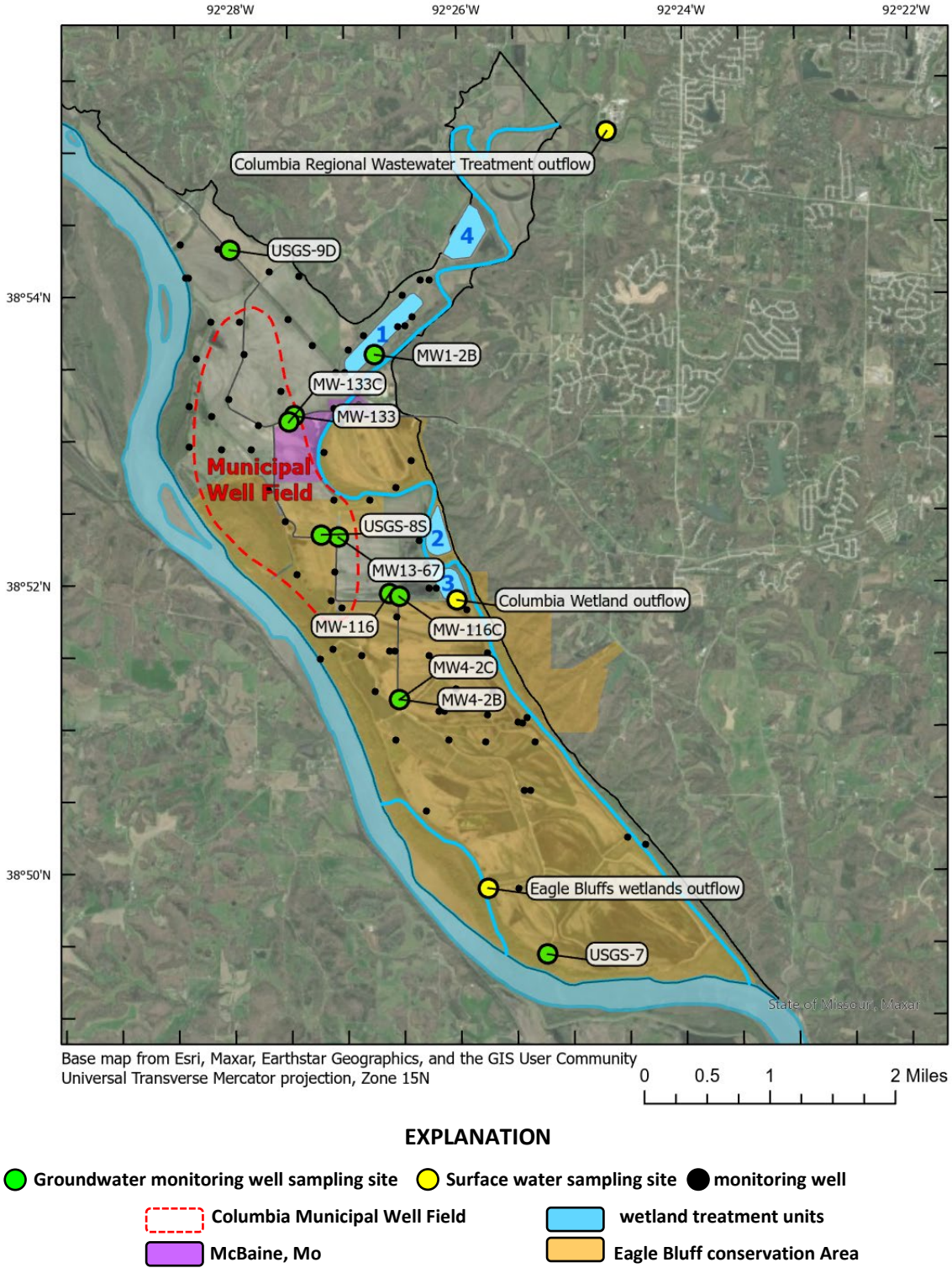

Figure 1. Location of water-quality sampling sites in McBaine Bottoms and Eagle Bluffs Conservation Area.

Tables

USGS SITE ID	SITE NAME
385335092264302	COLUMBIA MW 01-2B
385112092263102	COLUMBIA MW 04-2B
385112092263103	COLUMBIA MW 04-2C
385219092270401	COLUMBIA MW 13-67
385220092270701	COLUMBIA USGS 08S
385156092263202	EAGLE BLUFFS MW-116C
385156092263201	EAGLE BLUFFS MW-116
385310092272601	EAGLE BLUFFS MW-133
385307092272901	EAGLE BLUFFS MW-133C
385419092280000	COLUMBIA USGS 09D
384926092251000	COLUMBIA USGS 07
385153092260101	COLUMBIA WETLAND OUTFLOW
384953092254501	EAGLE BLUFFS WETLAND OUTFLOW
385509092243901	COLUMBIA REGIONAL WASTEWATER TREATMENT OUTFLOW

Table 1. Sampling sites

References

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APPENDIX A

Nutrients (USGS Schedule 800)			
Analyte	**CAS Number**	**Reporting Level**	**Unit**
nitrogen, ammonia + organic nitrogen (total)	17778-88-0	0.14	mg/L
Nitrogen, ammonia as N	7664-41-7	0.04	mg/L
nitrogen, nitrite (dissolved)	14797-65-0	0.002	mg/L
nitrogen, nitrite + nitrate (dissolved)		0.08	mg/L
phosphorus, phosphate, ortho	14265-44-2	0.008	mg/L
Phosphorus (total)	7723-14-0	0.04	mg/L
Major Ions (USGS Schedule 546)			
Analyte	**CAS Number**	**Reporting Level**	**Unit**
Acid Neutralizing CapaCity (ANC), laboratory	471-34-1	8	mg/L
Calcium	7440-70-2	0.04	mg/L
Chloride	16887-00-6	0.1	mg/L
Fluoride	16984-48-8	0.02	mg/L
ICP SETUP			unsp
Magnesium	7439-95-4	0.02	mg/L
pH, laboratory		0.1	pH
Potassium	7440-09-7	0.6	mg/L
Sodium	7440-23-5	0.8	mg/L
Sp. Conductance Lab		5	uS/cm
Sulfate	14808-79-8	0.04	mg/L
Wastewater organics (USGS Schedule 4433)			
Analyte	**CAS Number**	**Reporting Level**	**Unit**
1,4-Dichlorobenzene	106-46-7	0.08	ug/L
1-Methylnaphthalene	90-12-0	0.04	ug/L
2,2',4,4'-Tetrabromodiphenyl ether	5436-43-1	0.04	ug/L
2,6-Dimethylnaphthalene	581-42-0	0.04	ug/L
2-Methylnaphthalene	91-57-6	0.04	ug/L
3,4-Dichlorophenyl isocyanate	102-36-3	0.32	ug/L
3-beta-Coprostanol	360-68-9	7.4	ug/L
3-Methyl-1H-indole (skatol)	83-34-1	0.2	ug/L
3-tert-Butyl-4-hydroxyanisole (BHA)	121-00-6	0.16	ug/L
4-Cumylphenol	599-64-4	0.04	ug/L
4-n-Octylphenol	1806-26-4	0.02	ug/L
4-nonylphenol monoethoxylate - total (NP1EO)	68412-54-4	1.6	ug/L
4-Octylphenol diethoxylate (OP2EO)	2315-61-9	0.2	ug/L
4-Octylphenol monoethoxylate (OP1EO)	2315-67-5	0.6	ug/L
4-tert-Octylphenol	140-66-9	1.2	ug/L
5-Methyl-1H-benzotriazole	136-85-6	1.4	ug/L
Acetophenone	98-86-2	0.4	ug/L

Acetyl-hexamethyl-tetrahydro-naphthalene (AHTN)	21145-77-7	0.04	ug/L
Anthracene	120-12-7	0.02	ug/L
Anthraquinone	84-65-1	0.04	ug/L
Atrazine	1912-24-9	0.16	ug/L
Benzo[a]pyrene	50-32-8	0.02	ug/L
Benzophenone	119-61-9	0.08	ug/L
beta-Sitosterol	83-46-5	4.8	ug/L
beta-Stigmastanol	19466-47-8	3.4	ug/L
Bis-(2-ethylhexyl) phthalate (DEHP)	117-81-7	14	ug/L
Bisphenol A	80-05-7	0.04	ug/L
Bisphenol A d-14			pct
Bromacil	314-40-9	0.16	ug/L
Bromoform	75-25-2	0.16	ug/L
Caffeine	58-08-2	0.08	ug/L
Caffeine-d9	72238-85-8		pct
Camphor	76-22-2	0.08	ug/L
Carbaryl	63-25-2	0.06	ug/L
Carbazole	86-74-8	0.02	ug/L
Chlorpyrifos	2921-88-2	0.12	ug/L
Cholesterol	57-88-5	7.6	ug/L
Cotinine	486-56-6	0.2	ug/L
Decafluorobiphenyl (surrogate)	434-90-2		pct
Diazinon	333-41-5	0.32	ug/L
Dichlorvos	62-73-7	0.18	ug/L
Diethoxynonylphenols- total (NP2EO)	20427-84-3	1.6	ug/L
Diethyl phthalate	84-66-2	0.4	ug/L
d-Limonene	5989-27-5	1.8	ug/L
Fluoranthene	206-44-0	0.02	ug/L
Fluoranthene-d10 (surrogate)	93951-69-0		pct
Hexahydrohexamethyl cyclopentabenzopyran (HHCB)	1222-05-5	0.04	ug/L
Indole	120-72-9	0.04	ug/L
Isoborneol	124-76-5	0.09	ug/L
Isophorone	78-59-1	0.05	ug/L
Isopropylbenzene (Cumene)	98-82-8	0.04	ug/L
Isoquinoline	119-65-3	0.8	ug/L
Menthol	89-78-1	0.32	ug/L
Metalaxyl	57837-19-1	0.16	ug/L
Methyl salicylate	119-36-8	0.08	ug/L
Metolachlor	51218-45-2	0.04	ug/L
N,N-diethyl-meta-toluamide (DEET)	134-62-3	0.04	ug/L
Naphthalene	91-20-3	0.02	ug/L

para-Nonylphenol total	84852-15-3	1.6	ug/L
p-Cresol	106-44-5	0.4	ug/L
Pentachlorophenol	87-86-5	1.6	ug/L
Phenanthrene	85-01-8	0.02	ug/L
Phenol	108-95-2	0.16	ug/L
Prometon	1610-18-0	0.16	ug/L
Pyrene	129-00-0	0.02	ug/L
Sample Volume			mL
Tetrachloroethylene	127-18-4	0.16	ug/L
Tri(2-butoxyethyl) phosphate	78-51-3	2	ug/L
Tri(2-chloroethyl) phosphate	115-96-8	0.16	ug/L
Tributyl phosphate	126-73-8	0.24	ug/L
Triclosan	3380-34-5	0.32	ug/L
Triethyl citrate (ethyl citrate)	77-93-0	0.12	ug/L
Triphenyl phosphate	115-86-6	0.08	ug/L
Tris(dichloroisopropyl) phosphate	13674-87-8	0.32	ug/L
Pharmaceuticals (USGS Schedule 2440)			
Analyte	**CAS Number**	**Reporting Level**	**Unit**
1,7-Dimethylxanthine	611-59-6	88	ng/L
10-Hydroxy-amitriptyline	64520-05-4	8.3	ng/L
Abacavir	136470-78-5	2	ng/L
Acetaminophen	103-90-2	84	ng/L
Acetaminophen-d3			pct
Acyclovir	59277-89-3	22	ng/L
Albuterol	18559-94-9	6.7	ng/L
Albuterol-d9			pct
Alprazolam	28981-97-7	21	ng/L
Amitriptyline	50-48-6	37	ng/L
Amitriptyline-d3, sur			pct
Amphetamine	300-62-9	4.4	ng/L
Amphetamine-d6			pct
Antipyrine	60-80-0	50	ng/L
Atenolol	29122-68-7	13	ng/L
Atrazine	1912-24-9	20	ng/L
Benztropine	86-13-5	44	ng/L
Betamethasone	378-44-9	114	ng/L
Bupropion	34911-55-2	18	ng/L
Caffeine	58-08-2	91	ng/L
Caffeine-(trimethyl-13C3)			pct
Carbamazepine	298-46-4	11	ng/L
Carisoprodol	78-44-4	20	ng/L

Carisoprodol-d7, sur	1218911-16-0		pct
Chlorpheniramine	132-22-9	54	ng/L
Cimetidine	51481-61-9	140	ng/L
Citalopram	59729-33-8	6.6	ng/L
Clonidine	4205-90-7	61	ng/L
Codeine	76-57-3	32	ng/L
Codeine-d6	371151-94-9		pct
Cotinine	486-56-6	6.4	ng/L
Cotinine-d3			pct
Dehydronifedipine	67035-22-7	20	ng/L
Desmethyldiltiazem-d4, sur			pct
Desvenlafaxine	93413-62-8	84	ng/L
Dextromethorphan	125-71-3	8.2	ng/L
Diazepam	439-14-5	4	ng/L
Diazepam-d5	65854-76-4		pct
Diltiazem	42399-41-7	10	ng/L
Diltiazem-d3			pct
Diphenhydramine	147-24-0	48	ng/L
Diphenhydramine-d3			pct
Duloxetine	116539-59-4	37	ng/L
Erythromycin	114-07-8	80	ng/L
Erythromycin-13C,d3, sur	959119-26-7		pct
Ezetimibe	163222-33-1	205	ng/L
Ezetimibe-d4, sur	1093659-90-5		pct
Fadrozole	102676-47-1	13	ng/L
Famotidine	76824-35-6	34	ng/L
Fenofibrate	49562-28-9	6.4	ng/L
Fenofibrate-d6, sur	1092484-56-4		pct
Fexofenadine	83799-24-0	44	ng/L
Fexofenadine-d10, sur	1215900-18-7		pct
Fluconazole	86386-73-4	30	ng/L
Fluoxetine	54910-89-3	26	ng/L
Fluoxetine-d6			pct
Fluticasone propionate	80474-14-2	30	ng/L
Fluvoxamine	54739-18-3	80	ng/L
Fluvoxamine-d4, sur			pct
Gabapentin	60142-96-3	160	ng/L
Glipizide	29094-61-9	80	ng/L
Glyburide	10238-21-8	4	ng/L
Guanylurea	141-83-3	140	ng/L
Hexamethylenetetramine	100-97-0	55	ng/L

Hydrocodone	125-29-1	40	ng/L
Hydrocodone-d3			pct
Hydrocortisone	50-23-7	147	ng/L
Hydrocortisone-13C3,sur			pct
Hydroxyzine	68-88-2	7.4	ng/L
Iminostilbene	256-96-2	145	ng/L
Ketoconazole	65277-42-1	113	ng/L
Ketoconazole-d4, sur			pct
Lamivudine	134678-17-4	16	ng/L
Lidocaine	137-58-6	4	ng/L
Loperamide	53179-11-6	80	ng/L
Loperamide-d6, sur			pct
Loratadine	79794-75-5	7	ng/L
Loratadine-d4, sur			pct
Lorazepam	846-49-1	202	ng/L
Lorazepam-d4, sur	84344-15-0		pct
Meprobamate	57-53-4	12	ng/L
Metaxalone	1665-48-1	16	ng/L
Metformin	657-24-9	13	ng/L
Metformin-d6, IS/sur			pct
Methadone	76-99-3	7.6	ng/L
Methadone-d9			pct
Methocarbamol	532-03-6	11	ng/L
Methotrexate	59-05-2	52	ng/L
Methyl-1H-benzotriazole	29385-43-1	80	ng/L
Metoprolol	51384-51-1	10	ng/L
Morphine	57-27-2	80	ng/L
Nadolol	42200-33-9	20	ng/L
N-Desmethyldiltiazem		70	ng/L
Nevirapine	129618-40-2	46	ng/L
Nicotine	54-11-5	58	ng/L
Nizatidine	76963-41-2	80	ng/L
Nordiazepam	1088-11-5	20	ng/L
Norethindrone	68-22-4	20	ng/L
Norfluoxetine	56161-73-0	80	ng/L
Norfluoxetine-d6			pct
Norsertraline	87857-41-8	80	ng/L
Norverapamil	67018-85-3	8.6	ng/L
Omeprazole + Esomprazole		16	ng/L
Oseltamivir	196618-13-0	15	ng/L
Oxazepam	604-75-1	226	ng/L

Oxazepam-d5, sur	65854-78-6		pct
Oxycodone	76-42-6	25	ng/L
Oxycodone-d3			pct
Paroxetine	61869-08-7	72	ng/L
Penciclovir	39809-25-1	80	ng/L
Pentoxifylline	5/6/6493	9.4	ng/L
Phenazopyridine	94-78-0	13	ng/L
Phendimetrazine	634-03-7	20	ng/L
Phenytoin	57-41-0	188	ng/L
Piperonyl butoxide	51-03-6	60	ng/L
Prednisolone	50-24-8	150	ng/L
Prednisone	53-03-2	105	ng/L
Promethazine	60-87-7	114	ng/L
Promethazine-d6, sur			pct
Propoxyphene	469-62-5	28	ng/L
Propoxyphene-d11, sur			pct
Propranolol	525-66-6	26	ng/L
Pseudoephedrine + Ephedrine		6	ng/L
Pseudoephedrine-d3			pct
Quinine	130-95-0	80	ng/L
Ractopamine	97825-25-7	20	ng/L
Raloxifene	84449-90-1	80	ng/L
Raloxifene-d10, sur			pct
Ranitidine	66357-35-5	192	ng/L
Ranitidine-d6, sur			pct
Sertraline	79617-96-2	16	ng/L
Sitagliptin	486460-32-6	97	ng/L
Sulfadimethoxine	122-11-2	14	ng/L
Sulfamethizole	144-82-1	104	ng/L
Sulfamethoxazole	723-46-6	20	ng/L
Sulfamethoxazole-(phenyl-13C6)			pct
Tamoxifen	10540-29-1	270	ng/L
Tamoxifen-d5, sur	157698-32-3		pct
Temazepam	846-50-4	18	ng/L
Temazepam-d5			pct
Theophylline	58-55-9	80	ng/L
Thiabendazole	148-79-8	4	ng/L
Thiabendazole-d4			pct
Tiotropium	186691-13-4	50	ng/L
Tiotropium-d3, sur			pct
Tramadol	27203-92-5	7.4	ng/L

Triamterene	396-01-0	5.2	ng/L
Trimethoprim	738-70-5	20	ng/L
Trimethoprim-d9			pct
Valacyclovir	124832-26-4	163	ng/L
Venlafaxine	93413-69-5	5.2	ng/L
Verapamil	52-53-9	140	ng/L
Verapamil-d6, sur			pct
Warfarin	81-81-2	6	ng/L
Pesticides (USGS Schedule 2437)			
Analyte	**CAS Number**	**Reporting Level**	**Unit**
1H-1,2,4-Triazole	288-88-0	22	ng/L
2-(1-Hydroxyethyl)-6-methylaniline (HEMA)	196611-19-5	160	ng/L
2,4-D	94-75-7	62	ng/L
2,4-D-d3, sur	202480-67-9		pct
2-[(2-Ethyl-6-methylphenyl)amino]-1-propanol	61520-53-4	5	ng/L
2-Aminobenzimidazole	934-32-7	9	ng/L
2-Amino-N-isopropylbenzamide	30391-89-0	4	ng/L
2-Chloro-2',6'-diethylacetanilide	6967-29-9	5	ng/L
2-Chloro-N-(2-ethyl-6-methylphenyl)acetamide	32428-71-0	5	ng/L
2-Hydroxy-4-isopropylamino-6-amino-s-triazine OIAT	19988-24-0	4	ng/L
2-Hydroxy-6-ethylamino-4-amino-s-triazine (OEAT)	7313-54-4	100	ng/L
2-Hydroxyatrazine (OIET)	2163-68-0	8	ng/L
3,4-Dichlorophenylurea	2/8/2327	108	ng/L
3-Hydroxycarbofuran	16655-82-6	16	ng/L
3-Phenoxybenzoic acid	3739-38-6	61	ng/L
3-Phenoxybenzoic acid-13C6, sur	na		pct
4-(Hydroxymethyl)pendimethalin	56750-76-6	114	ng/L
4-Chlorobenzylmethyl sulfoxide	24176-68-9	3.2	ng/L
4-Hydroxychlorothalonil	28343-61-5	42	ng/L
4-Hydroxyhexazinone A	72576-13-7	3	ng/L
Acephate	30560-19-1	10	ng/L
Acetochlor	34256-82-1	10	ng/L
Acetochlor OA	194992-44-4	65	ng/L
Acetochlor SA	187022-11-3	320	ng/L
Acetochlor SAA	618113-86-3	176	ng/L
Acetochlor-d11, sur	1189897-44-6		pct
Alachlor	15972-60-8	27	ng/L
Alachlor OA	171262-17-2	60	ng/L
Alachlor SA	142363-53-9	840	ng/L
Alachlor-d13, sur	1015856-63-9		pct
Aldicarb	116-06-3	8	ng/L

Aldicarb sulfone	1646-88-4	20	ng/L
Aldicarb sulfoxide	1646-87-3	2.2	ng/L
Ametryn	834-12-8	2.6	ng/L
Asulam	3337-71-1	24	ng/L
Atrazine	1912-24-9	6.8	ng/L
Azinphos-methyl	86-50-0	8	ng/L
Azinphos-methyl oxon	961-22-8	15	ng/L
Azoxystrobin	131860-33-8	3	ng/L
Bentazon	25057-89-0	9	ng/L
Bifenthrin	82657-04-3	19	ng/L
Bromacil	314-40-9	5.6	ng/L
Bromoxynil	1689-84-5	60	ng/L
Butachlor SA, sur	187022-12-4		pct
Butralin	33629-47-9	5	ng/L
Butylate	2008-41-5	10	ng/L
Carbaryl	63-25-2	5.6	ng/L
Carbaryl-d7, sur	362049-56-7		pct
Carbendazim	10605-21-7	10	ng/L
Carbendazim-d4, sur	291765-95-2		pct
Carbofuran	1563-66-2	5	ng/L
Carbofuran-d3, sur	1007459-98-4		pct
Chlorimuron-ethyl	90982-32-4	8.8	ng/L
Chlorpyrifos	2921-88-2	3	ng/L
Chlorpyrifos oxon		4.4	ng/L
Chlorsulfuron	64902-72-3	50	ng/L
cis-Cyhalothric acid	68127-59-3	105	ng/L
cis-Permethrin	61949-76-6	4.2	ng/L
cis-Permethrin-13C6, sur	na		pct
Cyanazine	21725-46-2	50	ng/L
DCPA monoacid (Chlorthal-monomethyl)	887-54-7	700	ng/L
Dechlorofipronil		3.8	ng/L
Dechlorometolachlor	126605-22-9	2	ng/L
Deethylatrazine (CIAT)	6190-65-4	11	ng/L
Deethylatrazine-d6, sur	na		pct
Deiodo flubendiamide	1016160-78-3	10	ng/L
Deisopropylatrazine (CEAT)	1007-28-9	20	ng/L
Demethyl fluometuron	3032-40-4	3.6	ng/L
Demethyl hexazinone B	56611-54-2	3	ng/L
Demethyl norflurazon	23576-24-1	4	ng/L
Desamino metribuzin (Metribuzin DA)	35045-02-4	9	ng/L
Desamino-diketo metribuzin	52236-30-3	200	ng/L

Desulfinylfipronil	205650-65-3	3.8	ng/L
Desulfinylfipronil amide	1115248-09-3	10	ng/L
Diazinon	333-41-5	6.4	ng/L
Diazinon-d10 (diethyl-d10), sur	100155-47-3		pct
Diazoxon		4	ng/L
Dicamba	1918-00-9	800	ng/L
Dichlorvos	na	52	ng/L
Dicrotophos	141-66-2	4	ng/L
Didealkylatrazine (CAAT)	3397-62-4	24	ng/L
Didemethyl hexazinone F (Hexazinone TP F)	56611-55-3	10	ng/L
Diflubenzuron	35367-38-5	6	ng/L
Diflubenzuron-d4 (4-chlorophenyl-d4), sur	1219795-45-5		pct
Diflufenzopyr	109293-97-2	72	ng/L
Diketonitrile-isoxaflutole	143701-75-1	10	ng/L
Dimethachlor SA, sur	na		pct
Dimethenamid	87674-68-8	3	ng/L
Dimethenamid OA	380412-59-9	85	ng/L
Dimethenamid SA	205939-58-8	79	ng/L
Dimethoate	60-51-5	4.6	ng/L
Disulfoton	298-04-4	11	ng/L
Disulfoton oxon	126-75-0	2	ng/L
Disulfoton oxon sulfone	2496-91-5	6	ng/L
Disulfoton oxon sulfoxide	2496-92-6	6	ng/L
Disulfoton sulfone	6/5/2497	9	ng/L
Disulfoton sulfoxide	7/6/2497	4	ng/L
Diuron	330-54-1	5	ng/L
Diuron-d6, sur	na		pct
Diuron-d6, sur			pct
EPTC	759-94-4	206	ng/L
EPTC R248722	65109-69-5	4	ng/L
Ethoprop	13194-48-4	5	ng/L
Etoxazole	153233-91-1	4.2	ng/L
Fenamiphos	22224-92-6	4.6	ng/L
Fenamiphos sulfone	31972-44-8	5	ng/L
Fenamiphos sulfoxide	31972-43-7	5	ng/L
Fenbutatin oxide	13356-08-6	500	ng/L
Fentin	668-34-8	30	ng/L
Fipronil	120068-37-3	4	ng/L
Fipronil amide	205650-69-7	9.2	ng/L
Fipronil sulfide	120067-83-6	4.2	ng/L
Fipronil sulfonate	209248-72-6	44	ng/L

Fipronil sulfone	120068-36-2	5.6	ng/L
Flubendiamide	272451-65-7	4.4	ng/L
Flumetsulam	98967-40-9	38	ng/L
Fluometuron	2164-17-2	10	ng/L
Fonofos	944-22-9	11	ng/L
Halosulfuron-methyl	100784-20-1	12	ng/L
Hexazinone	51235-04-2	3.6	ng/L
Hexazinone TP C	72585-88-7	2	ng/L
Hexazinone TP D	30243-77-7	294	ng/L
Hexazinone TP E	72576-14-8	76	ng/L
Hexazinone TP G		22	ng/L
Hexazinone-d6 (N,N-dimethyl-d6), sur	1219804-22-4		pct
Hydroxy didemethyl fluometuron		50	ng/L
Hydroxy monodemethyl fluometuron		12	ng/L
Hydroxyacetochlor	60090-47-3	20	ng/L
Hydroxyalachlor	56681-55-1	6	ng/L
Hydroxydiazinon	29820-16-4	11	ng/L
Hydroxymetolachlor	131068-72-9	2.4	ng/L
Hydroxyphthalazinone		28	ng/L
Hydroxysimazine	11/3/2599	120	ng/L
Imazamox	114311-32-9	30	ng/L
Imazaquin	81335-37-7	10	ng/L
Imazethapyr	81335-77-5	8	ng/L
Imidacloprid	138261-41-3	16	ng/L
Indoxacarb	173584-44-6	5.2	ng/L
Isoxaflutole	141112-29-0	18	ng/L
Isoxaflutole Acid RPA 203328	142994-06-7	9.2	ng/L
Kresoxim-methyl	143390-89-0	5	ng/L
Lactofen	77501-63-4	10	ng/L
Linuron	330-55-2	5.6	ng/L
Linuron-d6 (dimethyl-d6), sur	1219804-76-8		pct
Linuron-d6 (dimethyl-d6), sur	1219804-76-8		pct
Malaoxon	1634-78-2	54	ng/L
Malathion	121-75-5	5.4	ng/L
Malathion-d10 (diethyl-d10), sur	347841-48-9		pct
MCPA	94-74-6	95	ng/L
Metalaxyl	57837-19-1	6	ng/L
Metconazole	125116-23-6	5	ng/L
Methamidophos	10265-92-6	10	ng/L
Methidathion	950-37-8	8.4	ng/L
Methomyl	16752-77-5	3	ng/L

Methomyl oxime	13749-94-5	8000	ng/L
Methoxyfenozide	161050-58-4	2.2	ng/L
Methyl paraoxon	950-35-6	19	ng/L
Metolachlor	51218-45-2	3.2	ng/L
Metolachlor hydroxy morpholinone	61520-54-5	10	ng/L
Metolachlor OA	152019-73-3	149	ng/L
Metolachlor SA	171118-09-5	68	ng/L
Metolachlor-d6, sur	1219803-97-0		pct
Metribuzin	21087-64-9	20	ng/L
Metribuzin DK	56507-37-0	236	ng/L
Molinate	2212-67-1	28	ng/L
Myclobutanil	88671-89-0	7	ng/L
N-(3,4-Dichlorophenyl)-N-methylurea (DCPMU)	3567-62-2	5	ng/L
Naled	300-76-5	56	ng/L
Nicosulfuron	111991-09-4	12	ng/L
Nicosulfuron-d6 (dimethoxy-d6), sur	1189419-41-7		pct
Norflurazon	27314-13-2	3.4	ng/L
Novaluron	116714-46-6	50	ng/L
O-Ethyl O-methyl S-propyl phosphorothioate	76960-87-7	5	ng/L
Omethoate	1113-02-6	2	ng/L
Orthosulfamuron	213464-77-8	6	ng/L
Oryzalin	19044-88-3	12	ng/L
Oxamyl	23135-22-0	2	ng/L
Oxamyl oxime	30558-43-1	5	ng/L
Oxyfluorfen	42874-03-3	500	ng/L
Paraoxon	311-45-5	3.4	ng/L
Pendimethalin	40487-42-1	10	ng/L
Phorate	298-02-2	11	ng/L
Phorate oxon	2600-69-3	55	ng/L
Phorate oxon sulfone	6/9/2588	20	ng/L
Phorate oxon sulfoxide	5/8/2588	7	ng/L
Phorate sulfone	4/7/2588	36	ng/L
Phorate sulfoxide	3/6/2588	4.6	ng/L
Phthalazinone	90004-07-2	15	ng/L
Piperonyl butoxide	51-03-6	25	ng/L
Profenofos	41198-08-7	3	ng/L
Prometon	1610-18-0	4	ng/L
Prometryn	7287-19-6	4.2	ng/L
Pronamide (Propyzamide)	23950-58-5	2.4	ng/L
Propanil	709-98-8	12	ng/L
Propargite	2312-35-8	2	ng/L

Propazine	139-40-2	3.2	ng/L
Propiconazole	60207-90-1	6	ng/L
Propoxur	114-26-1	3.2	ng/L
Prosulfuron	94125-34-5	10	ng/L
Pyraclostrobin	175013-18-0	2.4	ng/L
Pyridaben	96489-71-3	2.4	ng/L
Pyrimidinol (2-Isopropyl-6-methyl-4-pyrimidinol)	2814-20-2	8	ng/L
Pyriproxyfen	95737-68-1	3	ng/L
Sample Volume for Schedule 2437			mL
sec-Acetochlor OA	152019-74-4	55	ng/L
Siduron	1982-49-6	5	ng/L
Simazine	122-34-9	7.2	ng/L
Sulfentrazone	122836-35-5	18	ng/L
Sulfometuron-methyl	74222-97-2	4	ng/L
Sulfosulfuron	141776-32-1	11	ng/L
Tebuconazole	107534-96-3	15	ng/L
Tebuconazole-d6, sur	na		pct
Tebufenozide	112410-23-8	2	ng/L
Tebupirimfos	96182-53-5	2	ng/L
Tebupirimfos oxon		2	ng/L
Tebuthiuron	34014-18-1	3	ng/L
Tebuthiuron TP 104	59962-53-7	5.6	ng/L
Tebuthiuron TP 108	39222-73-6	10	ng/L
Tebuthiuron TP 109 (OH)	139888-73-6	38	ng/L
Tebuthurion TP 109	59962-54-8	11	ng/L
Terbacil	5902-51-2	21	ng/L
Terbufos	13071-79-9	6.8	ng/L
Terbufos oxon	56070-14-5	4	ng/L
Terbufos oxon sulfone	56070-15-6	11	ng/L
Terbufos oxon sulfoxide	56165-57-2	4	ng/L
Terbufos sulfone	56070-16-7	32	ng/L
Terbufos sulfoxide	10548-10-4	3	ng/L
Terbuthylazine	5915-41-3	3.6	ng/L
Tetraconazole	112281-77-3	7	ng/L
Thiobencarb	28249-77-6	4.2	ng/L
Thiobencarb-d10 (diethyl-d10), sur	1219804-12-2		pct
trans-Permethrin	61949-77-7	3.8	ng/L
Triallate		12	ng/L
Tribuphos	78-48-8	2	ng/L
Triclopyr	55335-06-3	88	ng/L
Trifloxystrobin	141517-21-7	2.8	ng/L

PFAS (USGS Lab Code 9660)			
11Cl-PF3OUDS	-	16.4	ng/L
4:2FTS	-	17.5	ng/L
6:2FTS	-	52.4	ng/L
8:2FTS	-	19.1	ng/L
9Cl-PF3ONS	-	18.8	ng/L
ADONA	-	2	ng/L
FBSA	-	101	ng/L
FHx-SA	-	38.9	ng/L
FOSA	-	15.6	ng/L
GenX	-	17.7	ng/L
N-EtFOSAA	-	12.2	ng/L
N-EtFOSA-M	-	162	ng/L
N-MeFOSAA	-	15.4	ng/L
N-MeFOSA-M	-	123	ng/L
PFBA	-	16.2	ng/L
PFBS	375-73-5	20	ng/L
PFBS	-	10.1	ng/L
PFDA	-	20.6	ng/L
PFDoA	-	17.8	ng/L
PFDS	-	10.5	ng/L
PFHpA	-	43.1	ng/L
PFHpS	-	18.5	ng/L
PFHxA	-	39.8	ng/L
PFHxS Branched	-	22.8	ng/L
PFHxS Linear	-	11.4	ng/L
PFNA	-	7.8	ng/L
PFNS	-	16.1	ng/L
PFOA	-	5.2	ng/L
PFOS Branched	-	19.8	ng/L
PFOS Linear	-	14.3	ng/L
PFPeA	-	12.8	ng/L
PFPeS	-	12.5	ng/L
PFTeDA	-	24.7	ng/L
PFTrDA	-	15.6	ng/L
PFUnDA	-	16.2	ng/L