

ARS000002

**Authorization to Discharge Under the National
Pollutant Discharge Elimination System and the
Arkansas Water and Air Pollution Control Act**

2018 Annual Report

2019-04-01

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1.0 Introduction

The City of Little Rock (City) and the Arkansas Department of Transportation (ARDOT) are co-permittees under the National Pollutant Discharge Elimination

System (NPDES) permit ARS000002 (Permit) in accordance with the Arkansas Water and Air Pollution Control Act and the Clean Water Act. The purpose of the Permit is to outline the activities required for ARDOT and the City of Little Rock to lawfully discharge waters from within the territorial boundaries of the City via the municipal separate storm sewer system (MS4) into the Arkansas River and its tributaries. Compliance with the terms of the permit is assured by the adoption of storm water quality management plans (SWQMP) which provide guidance on best practices to mitigate the pollution of waterways to the maximum extent practicable (MEP). The Permit became effective 2012-04-01 and is currently administratively effective at the time of this report.

Each section of this report follows the reporting requirements as identified in section 6.9 of the Permit. For clarity, the requirements as given in the permit are shown in quotes, followed by a description of compliance activity associated with the requirement. Where separate reporting by the co-permittees is required, subsections for each permittee are provided.

Requirement:

Annual Report - Each co-permittee shall contribute to the preparation of an annual system-wide report to be submitted by April 1 of each year between the effective date of the permit and the date of expiration. The report shall be in the form as outlined in the SWQMP and shall include the following separate sections, with an overview for the entire MS4 and subsections for the co-permittees where applicable. Preparation and submittal of a system-wide annual report shall be conducted by the co-permittees. The report shall indicate if the co-permittees have failed to provide required information on the portions of the MS4 for which they are responsible. The co-permittees shall be responsible for timely submittal of the system-wide report. Each co-permittee shall be responsible for content of the report relating to the portions of the MS4 for which it is responsible, and for failure to provide information for the system-wide annual report. Each co-permittee shall sign and certify their portion of the annual report.

2.0 Executive Summary

The City and ARDOT have provided policies and ordinances to ensure compliance with the City of Little Rock NPDES permit. The City provides quarterly reports of water quality within various tributaries of the Arkansas River, and these reports do not appear to indicate a trend toward either improvement or deterioration of water quality. ARDOT and the City provide enforcement of policies, inspections, maintenance, monitoring and public education to promote the health of the MS4. These activities include hundreds of miles of storm sewer maintenance, thousands of miles of street maintenance, dozens of public outreach

activities and partnerships with volunteers and non-profit organizations. In 2018, these programs cost approximately \$25 million in direct and administrative expenses. Both ARDOT and the City operate under a SWQMP which has provided effective controls for maintaining the quality of surface waters within Little Rock.

3.0 Municipal Separate Storm Sewer Report

3.1 Changes to Stormwater Quality Management Program

Requirement:

Proposed changes to the stormwater quality management programs that are established as permit conditions, including an update on areas added to the MS4 due to annexation or other legal means

The City of Little Rock and ARDOT propose no changes to the SWQMP for 2018. Approximately 0 acres of land was annexed into the City of Little Rock during 2018. A map of annexations to Little Rock is given in Appendix B.

3.2 Revisions to Assessments and Fiscal Analysis

Requirement:

Revisions, if necessary, to the assessments of controls and the fiscal analysis reported in the permit application under 40 CFR 122.26 (d)(2)(v) and 40 CFR 122.26 (d)(2)(vi)

The City of Little Rock and ARDOT propose no revisions to the assessments of controls and fiscal analysis of the permit application.

3.3 Discharge Monitoring Report Summary

Requirement:

A summary of the data, including monitoring data that is accumulated throughout the reporting year

Discharge sampling shows a high level of variability between sampling locations and between sampling periods. City staff has not determined any consistent correlation between sampling locations and measured parameters.

Figure 1 presents all reported measurements represented as a percentage of recommended limits for aquatic life as given in the EPA's Regulation No. 2: Regulation Establishing Water Quality Standards for Surface Waters of the State of

Arkansas. Recommended limits for nitrogen and phosphorous are have been derived from the EPA's ecoregional criteria for Region IX: Southeastern Temperate Forested Plains and Hills. Where specific guidance has is not provided (including hardness, flow, total suspended solids and biological oxygen demand), these factors are represented as a percentage of 95th percentile of all measurements taken from the area since the beginning of the discharge monitoring program.

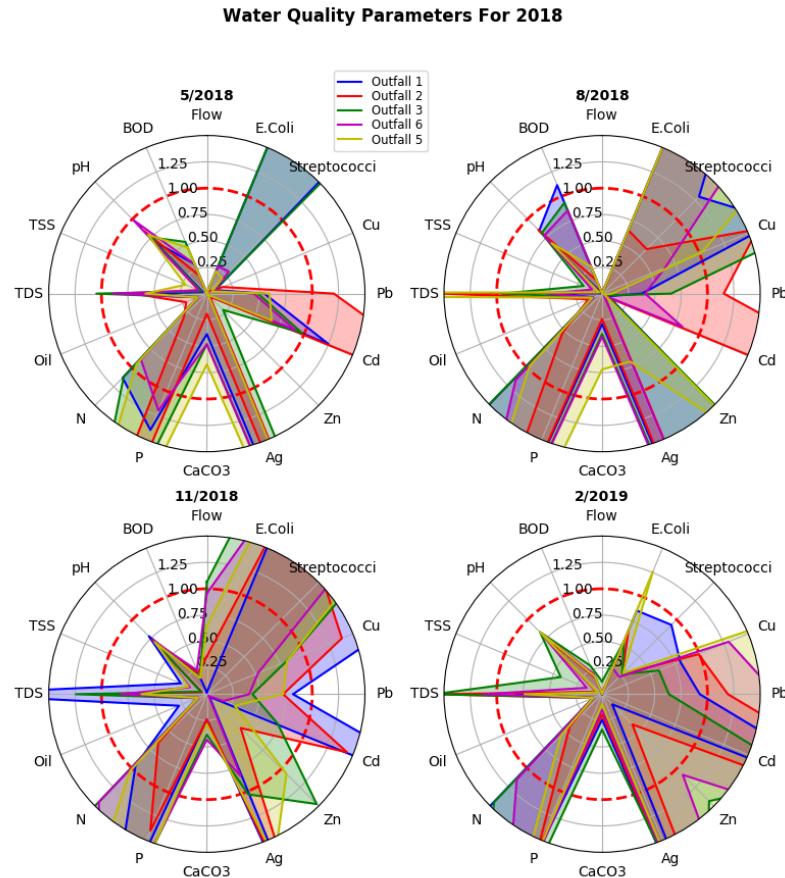


Figure 1: Normalized measurements of water quality parameters

Additional tables and charts of discharge monitoring are provided in Appendix C.

3.4 MS4 Budget Summary

Requirement:

Estimated annual expenditures and projected budget for the year following each annual report.

ARDOT costs to implement with SWMP part of the general operating budget are anticipated to be approximately \$900,000 for the upcoming permit year. ARDOT has 3 crews with a total of 58 personnel dedicated to working in the Little Rock metropolitan area that have an annual salary of approximately \$1,948,000. These crews can be supported by other crews that are assigned as needed throughout District Six.

City maintenance of the MS4 is paid for by the City Street Fund and is tasked to the 215 employees of the Public Works. In 2018 \$8.6 million was budgeted for the maintenance expenses of streets and storm drains, which is expected to become \$8.4 million in 2019. Administrative expenses of the Public Works, which includes overhead costs necessary for administration of the NPDES permit, were \$4 million in 2018 to \$4.9 million in 2019. The City also invests in its storm drainage infrastructure through capital improvement projects financed by sales tax. These improvements are financed in 3-year cycles, with 2018 falling into the 2015-2018 cycle. \$2.8 million is spent on each of the seven wards for a total estimated expense of \$19.9 million of capital improvements, which include municipal drainage improvements. The City is also the beneficiary of a water quality grant from the Arkansas Natural Resources Commission and the Environmental Protection Agency for the construction of low impact development improvements on Main Street from Markham to Capitol Avenue. \$1.4 million is expected to be spent in 2019.

Operations and maintenance costs of the MS4 are met by the City Street Fund. These expenses are summarized in the table below.

Public Works Street Fund Operating Expenses

Activity	2018	2019
Administration	984491	1997357
Operations Administration	3093825	2906002
Street and Drainage Maintenance	7579120	7388095
Storm Drain Maintenance	993872	1045613
Work Pool	162984	151998
Resource Control and Scheduling	423782	381072
Control Devices	940121	925953
Signals	1155223	1171683
Parking Meters	110603	111634
Civil Engineering	1808901	1804462
Traffic Engineering	3414186	3413682
Parking Enforcement	302248	301607
Total	20969356	21599158

Table 1: Operating expenses directly and indirectly related to MS4 maintenance

3.5 Enforcement, Inspection and Education

Requirement:

A summary describing the number and nature of enforcement actions, inspections, and public education programs;

3.5.1 ARDOT Enforcement, Inspection and Education

ARDOT conducts inspections of its construction projects and maintenance facilities in accordance with existing regulations and ARDOT policy. Two stormwater related articles were published in the Department's Arkansas Highways magazine in the May/June Magazine of 2018. The articles published in the Arkansas Highways Magazine are featured on the Stormwater section of the website for easier access. This publication is provided to all Department personnel and the public statewide. Several hundred stormwater education brochures were distributed during environmental education events as well as Arkansas Environmental Education Association events, the Arkansas State Fair, DrainSmArt and other community related activities throughout the year. The Department has added several stormwater-related educational brochures in English and Spanish on its website. The Department has also made stormwater educational material available at six public libraries in the Little Rock area.

In 2018, no warning letters were sent to contractors on any ARDOT construction projects in Little Rock for failure of timely BMP replacement or repair.

3.5.2 Little Rock Enforcement, Inspection and Education

Enforcement

The City Public Works is authorized by ordinance to enforce City codes pertaining to stormwater management plans and flood prevention. Through the performance of periodic inspections and complaints, the Public Works took 41 enforcement actions in 2018. The majority of enforcement activity is the issuance of notices of violations by Public Works inspectors for grading permit violations. A summary is given in the table below.

Storm Water Ordinance Enforcement Actions

Category	Actions Taken
Grading Permit Violations	4

Category	Actions Taken
Unlawful Discharge	5
Sanitary Sewer Overflows	1
Obstruction to MS4	4
Total	41

Table 2: Summary of notices and citations issued by the City of Little Rock for storm water code violations

Inspections

The City Public Works inspects both private and public construction projects for compliance with NPDES requirements. Publicly funded construction projects are inspected at or near a daily basis while private construction projects under Public Works issued permits are inspected periodically as well as following requests, complaints or prior to issuance of certificates of occupancy.

Education

The City Public Works serves as a repository of information for the Public for topics of water quality and the MS4. Brochures, graphic material and staff are made available to the public Monday through Friday during normal business hours. Supplemental information is provided on the City website. Public outreach pertaining to water quality is disseminated frequently by the City Sustainability Commission and their partner organizations. The City Mayor has made sustainability a priority for the City Public Works department and the public-private partnerships they have facilitated have taken the lead in public education.

Sustainability Commission The Mayor's Sustainability Commission was established in 2008 to advise the City on sustainable practices. Since that time, the Commission has worked with various groups in the City to develop new environmentally green policies that have positively impacted city government and the residents of Little Rock.

LRTV Little Rock TV (LRTV) is a municipal government access channel where the City of Little Rock is able to broadcast public service information as well as televised events to the general public. LRTV has in its program rotation several advertisements related to public education about water quality. The rotation is similar to a slideshow with billboards cycling at 15 to 20 second intervals. The storm water education billboards run inside of loops 15 to 60 minutes long run 23-24 times per day. The total runtime of these billboards in 2018 would be 36-148 minutes. Examples of the water quality billboards are given in appendix *FIXME*. Also, as of February 2019, LRTV has included in its programming a

short educational video from University of Arkansas Research and Extension (UAEX) entitled *If It Rains It Drains!*



Figure 2: Educational video developed by UAEX to promote water quality education shown on LRTV.

Public Outreach Events The City sustainability officer and sustainability educator hosted or were featured speakers at approximately outreach events in 2018. Some of these include public speaking events at the following locations:

Public Education and Outreach Events

Date	Group	Location	Attendees
3/6/2018	Mills	MRF	60 High school students Landfill Scholars Program

Date	Group	Location	Attendees
3/7/2018	Clinton	MRF	4 School and grad- So Landfill- cial ate En students ter- prise Class
3/13/2018	Davidson	classroom	32 Ele presents student men- tary kinder- garten class
3/22/2018	Mr	MRF	60 House and students Spring Landfill Break Program
4/2/2018	Boy Scout Troop	Holy Souls	10 kids from 6th grade to seniors in high school
5/14/2018	Pinto	Oyster	~30 adults View- Bar adults“ Stiff Station N.A.
7/24/2018	Mark Church	Projectmack Village	Church Mis- in groups sion Cam- of 10- Projectmack 12 Village12 kids

Date	Group	Location	Attendees
7/31/2018	Mark Church	4	Mis- in groups sion Cam- of Projectmack 10- Village12 kids
8/9/2018	Woodlind	10	Heightfa- seniors Se- cil- nior ity Living by CARTI, 10- 11:15
10/3/2018	PA	~20	Academy people“ Green lunch Team time
11/1/2018	PlumbBk/Cle	20	Neigh- Fu- people“ bor- neral hood Home Association 6:30 p.m.
11/9/2018	Athor	5	Ohio School St. off stu- Mississippis, 2 teachers
11/5/2018	PA	400	Academy students en- 12:30 tire school
11/30/2018	MRF	45	High and stu- school land- dents, Env fill two Stud- tour teachers ies group

Date	Group	Location	Attendees
11/30/2018	Sus- tain- abil- ity Commission	landfill	8
12/2/2018	Uni- ver- sal- ist Church	Rustar Reservd	11 adults
12/10/2018	Elec- tric Coop	AR	25
		Elec- tric Coop	em- ploy- ees
		off I-30	at ice cream social
1/11/2019	An- thony School &	school, about 10:30- 35 11:15 kids in	
		1:30- 3:00	three dif- fer- ent grade lev- els (3rd, 4th, 5th)
1/15/2019	An- thony School	5th	20
		grade class School	students
1/17/2019	An- thony School	6th	20
		grade class School	students

Date	Group	Location	Attendees
1/24/2019	Qu2nd	60	
	Group Pres	attendees	
	Church		
1/29/2019	Orkefest	3	
	Elementary	classes	
	of		
	20		
	students		
2/12/2019	7th	20	
	An-	grade students	
	thony	class	
	School		
2/19/2019	Oyster	25	
	Club	Bar	attendees
2/20/2019	8th	15	
	An-	grade students	
	thony	class	
	School		
2/21/2019	Green	10	
	An-	Team	students
	thony		
	School		

Table 7: Public speaking presentations given by the City of Little Rock's recycling and sustainability educator.

Topics included recycling, sustainability, water quality and other topics outlined in the commission's Roadmap To 2020. Aside from speaking, the sustainability officers also provide promotional content for social media and the City Government Access Channel (LRTV).

The City of Little Rock Public Works also participated in the 2018-05-10 Forests to Faucets Festival at Lake Willastein hosted by Central Arkansas Water (CAW). The event was attended by 185 5th graders who spent the day learning about the importance of water and its many uses. The Public Works provided a display and educational presentation about the City of Little Rock MS4, its relationship to the environment and how it is maintained.



Figure 3: Public Works staff demonstrates a small model storm sewer system to 5th grade students.

Private Partners Non-government organizations assist the City with meeting its water quality goals directly through cleanups, such as Friends of Fourche Creek (FoFC) and the Keep Little Rock Beautiful (KLRB), as well as promotional and educational activity. FoFC regularly communicates with the public about floatables and other risks to waterways through Facebook and television and radio interviews. With a small grant from the City of Little Rock Public Works, Audubon Arkansas has produced a children's coloring book with educational material about the importance of our waterways which has been distributed to the following locations:

- Audubon Arkansas – Field trip visitors and Afterschool Programs
- Arkansas State Fair
- Area Elementary Schools
- Centre at University Park
- Central Arkansas Water
- LR Wastewater Reclamation Authority

Audubon Arkansas is also a partner with the local Drain Smart program, where local artists promote awareness of the MS4 with painted murals on curb inlets with high visibility to the public. In 2018 12 murals were commissioned, and another 6 locations are proposed for 2019.

3.6 Changes to Water Quality

Requirement:

Identification of water quality improvements or degradation

The City and ARDOT have not identified any changes to water quality in 2018.

3.7 Pollution Prevention measures

The City of Little Rock is supported by the Pulaski County Regional Recycling & Waste Reduction District (RRWRD) which facilitates recycling, reuse and the responsible disposal of materials which impact water quality.

Residents are provided with a 65-gallon bin for curbside collection of papers, plastics, glass and metals for recycling. Bins can be requested online or by phone through the City's 3-1-1 non-emergency service request system. RRWRD also coordinates the operation of Green Stations, which dispose of automotive fluid and fluorescent lighting. The Green Station in Little Rock is located at 10001 Kanis Road which is collocated with the electronic waste recycling drop off.

Approximately \$34,170.48 is spent annually to support the Pulaski County RRWRD. Public promotion of these measures is included within annual expenses of both the Sustainability Summit and the Wetlands Maintenance and Sustainability Summit which totaled \$64,000 in 2018. Public service announcements are given on LRTV and are included in the annual operating expenses of \$300,000 for the LRTV program.

3.7.1 Motor Vehicle Fluids

Requirement:

The co-permittees shall ensure the establishment or availability of a program to collect used motor vehicle fluids for recycle or proper disposal. The program will identify locations where used vehicle fluids may be taken for recycling or disposal in accordance with state requirements. The City of Little Rock will publicize materials which can be recycled or disposed, times available to the public for using the facilities, and locations. The annual report shall include the amount of materials collected (weight or volume), the amount of money used for advertising, the method of advertising used to inform the public, and the overall cost of the program.

3.7.1.1 ARDOT Motor Vehicle Fluids

ARDOT implemented a program to recycle automotive oil as well as oil from its equipment before March 1, 1997. During the 2018, 1,035 gallons of oil and gas products as well as 12,259 gallons of antifreeze were recycled from equipment used by crews working in Little Rock.

3.7.1.2 Little Rock Motor Vehicle Fluids

The City of Little Rock operates and services a substantial fleet of vehicles ranging from police cars to sweepers. The Fleet Services department maintains contracts with waste disposal professionals to manage the large volume of motor vehicle fluids necessary to operate and maintain the City's motor pool.

In an effort to reduce emissions, some of the City of Little Rock's motorpool run on compressed natural gas (CNG). A fueling and service station for these vehicles is located at 501 Ferry Street. Motor vehicle waste from this facility is summarized below:

Recycled Automotive Waste from CNG Facility

Material	Quantity	Measure
Oil filters	500	ea
Used oil	7.5	gal
Used cleaning agents	28	gal

Table 13: Recycled materials from the compressed natural gas fueling facility located at 501 Ferry Street in downtown Little Rock.

The Fleet Services department is located adjacent to Public Works operations and services the majority of the vehicles in the City motor pool. The greatest volume of motor vehicle fluids comes from this facility and is summarized below:

Recycled Automotive Waste from Little Rock Fleet Services Facility

Material	Quantity	Measure
Oil filters	2000	ea
Used oil	1020	gal
Used cleaning agents	520	gal
Antifreeze	427	gal

Table 15: Recycled materials from the municipal fleet services facility located at 3314 J E Davis.

The Solid Waste services department is located outside of the City of Little Rock; however, their operations serve residents within the city. Their facility services the fleet of trucks which transport waste from homes to the municipal landfill. Motor vehicle waste from this facility is summarized below.

Recycled Automotive Waste from the Municipal Landfill

Material	Quantity	Measure
Oil filters	2050	ea
Used oil	1354	gal
Used cleaning agents	117	gal

Table 14: Recycled materials from the municipal landfill facility located at 10803 Ironton Cutoff immediately outside of Little Rock.

In Little Rock, 7,644 gallons of oil, antifreeze and gasoline were collected by the RRWRD Green Station in 2018. Recycling of motor vehicle fluids is promoted at the sustainability summit and other speaking events by the City sustainability officer as well as on social media and LRTV; however, itemized costs of advertising for motor vehicle fluid recycling are not collected.

3.7.2 Household Hazardous Waste

Requirement:

The City of Little Rock shall ensure the establishment or availability of a program to collect household hazardous waste materials for recycle, reuse, or proper disposal. The amount of materials collected (weight or volume), the amount of money used for advertising, the method of advertising used to inform the public, and the overall cost of the program will be included in the annual report. Recycling of household hazardous waste is promoted at speaking events by the City sustainability officer as well as by content on social media and LRTV. The City does not collect itemized advertising costs for household hazardous waste recycling. The household hazardous waste collected in 2018 by the Little Rock Green Station is shown in table the table below.

Recycled Household Hazardous Waste

Item	Quantity
Fluorescent Lights	8,823 lights
U-Shaped and Incandescent	8 Bulbs
Herbicides	1 55gal drum
Pesticides	1 55gal drum

Table 3: Summary of waste items collected by Little Rock Green Stations

3.8 Structural Controls

Requirement:

Structural Controls: Each co-permittee shall operate and maintain any stormwater structural controls over which it has jurisdiction, in a manner so as to reduce the discharge of pollutants to the MEP.

3.8.1 ARDOT Drainage Maintenance Report

Requirement:

Arkansas State Highway and Transportation Department will inspect the drainage system for which it is responsible at least once/month. The inspections should include a schedule of maintenance for correcting deficiencies in the system.

ARDOT spent \$35,907.98 to purchase materials to construct or repair catch basins, junction boxes, and ditch paving, and to purchase replacement drainage culverts. ARDOT spent a total of \$284,355.37 for materials and installation and associated ditch cleaning of minor drainage structures. ARDOT spent \$19,511.89 to machine clean and reshape existing ditches, remove and properly dispose of 1,313.5 cubic yards of excess material. ARDOT spent \$2,103.10 to purchase riprap, matting, geotextiles, sod, seed, and fertilizer to repair and prevent ditch and slope erosion. The total cost of purchase and installation was \$20,900.89.

3.8.2 Little Rock Drainage Maintenance Report

Requirement:

The City of Little Rock will inspect 20 percent of the drainage system each year. The drainage system consists of curb and guttering, piping, and open ditches in the City of Little Rock right-of-way and public easements. Areas with recurring drainage problems shall be inspected more frequently. The City of Little Rock will also maintain and clean the ponds along Coleman Creek and within War Memorial Park. These ponds should be inspected twice per year.

Operations

The City of Little Rock Public Works Operations provides preventative and complaint-driven maintenance for the MS4. Annual inspections for inadequate drainage are conducted for each of the seven wards as well as periodic inspections of streets and drainage by the street foremen. The 3-1-1 service provides residence

with the ability to create and document requests for service and also acts as a scheduling tool for maintenance activity. Over !!TODO!! requests for service were made in 2018 for repairs and maintenance to the MS4.

3-1-1 Maintenance Requests for City of Little Rock MS4

Type of Request	Number of Requests
Ditch Maintenance	1645
Inlet and catch basin cleaning	873
Inlet and catch basin repair	87

Table 4: Service requests taken online and by phone through the Little Rock 3-1-1 system

The requests for maintenance in the 3-1-1 service only partially address the scope of the maintenance activity provided by the Public Works Operations staff. A complete list of the maintenance operations performed by the Public Works and associated costs is given in the table below.

Public Works Operations MS4 Maintenance Summary

Activity	Quantity	Units	Cost
Catch basin repair	102	Ea	\$126,765
Catch basin cleaning	918	Ea	\$118,158
Storm Sewer Repair	922	LF	\$187,661
Emergency Storm Sewer Cleaning	30	LF	\$823.47
Ditch maintenance, hand cleaning	614412	LF	\$666,259
Ditch maintenance, Excavation	20220	LF	\$124,398
Ditch maintenance, Channel construction	3160	LF	\$39,972
Ditch maintenance, Litter removal	694377	LF	\$98,960
Ditch maintenance, Mowing	529	acres	\$54,243
Ditch maintenance, Stabilization (rip-rap)	426	sq-yd	\$33,383
Street sweeping, Miles swept	21775	curb-mi	\$649,388
Street sweeping, Litter removed	1829	cyd	\$25,174
Ditch spraying, minor and major	10.5	acres	\$3,136.89
Unclassified maintenance activity	16916	man-hr	\$325,546

Table 5: Unit quantities and costs associated directly with the maintenance of the MS4

Parks and Recreation

Additionally, many of the open channels and waterways of the MS4 are within municipal parks. The 49 employees of the Parks and Recreation department provide intensive maintenance, including litter removal and mowing, of the 4,200 acres of developed park land and also monitor and maintain the 1,900 acres of undeveloped parks with the City of Little Rock.

The City Parks and Recreation department provides weekly as well as post-event maintenance of War Memorial Park, which includes the ponds along Coleman Creek. Parks and Recreation has removed sediments and organic matter from the floor of the pond once in 2004 and again in 2009 to preserve fish habitat. The discharge from these ponds is also naturally filtered by the bioswale located downstream of a splash pad within the park. At MacArthur Park, the City Parks and Recreation department has performed monthly sampling of the pond with the assistance of the Arkansas Health Department to measure the efficacy of their campaign to reduce public feeding of geese. The data is not sufficient to demonstrate change of the water quality within the pond; however, continued monitoring is planned for the following year. A summary of results is shown below.

E Coli Sampling at MacArthur Park

Date	Quantity	Units
2018-09-21	461.1	#/100ml
2018-11-09	PRESENT	-
2018-12-14	PRESENT	-

Table 12: The measurements taken at MacArthur Park Pond are not equivalent to the assays taken at the prescribed outfalls. ‘Present’ indicates that e.coli have been identified by the density of colony-forming-units has not been determined.

Maintenance of the MS4 in public areas is supplemented by volunteer efforts, such as those by the FoFC and KLRB commission. The FoFC conducts over 20 cleanups a year that removes waste such as floatables, tires and even refrigerators from the Fourche Creek Bayou.

3.9 Areas of New Development

Requirement:

Areas of New Development: Each co-permittee shall utilize a comprehensive master planning process to develop, implement, and enforce controls which will reduce, to the MEP, the discharge of pollutants from areas of new development and significant redevelopment after

construction is completed. The City of Little Rock will require permanent controls, as required by the Little Rock Code of Ordinances, to be implemented at newly developed areas to control the increased volume of water that will be discharged.

The City of Little Rock shall notify construction sites disturbing (clearing, grading, or other construction activities) 1 or more acres within their MS4 boundary of the requirement to contact the Arkansas Department of Environmental Quality (ADEQ), Water Division, about the stormwater regulations and as how to obtain coverage under NPDES Construction Stormwater General Permit (ARR150000) and to develop a Stormwater Pollution Prevention Plan (SWPPP) and to install and maintain erosion and sediment control for the site prior to the start of construction. The City of Little Rock shall also notify sites that are over 5 acres or more within their MS4 boundary of the requirements that they must submit a Notice of Intent (NOI), permit fee and SWPPP to the Arkansas Department of Environmental Quality to obtain coverage under NPDES Construction Stormwater General Permit prior to the start of construction

3.9.1 ARDOT New Development Summary

The following projects were under contract in Little Rock at various times during 2018:

- BB0618 – I-430/Rodney Parham Road Interchange Improvements (LR)
- CA0608 – Baptist Hospital – University Avenue (Widening) (LR)

Quantities and associated costs of erosion control materials are listed in the table below.

Controls for ARDOT 2017 Projects

Item	Quantity	Units	Paid Cost
Concrete Ditch Paving	747.59	Square Yards	\$51,292.09
Drop Inlet Silt Fence	404.7	Linear Feet	\$3,642.30
Dumped Rip Rap	264.79	Cubic Yards	\$17,974.10
Filter Sock	360	Linear Feet	\$2,772.00
Mulch Cover	10.14	Acres	\$8,334.18
Rock Ditch Checks	5.93	Cubic Yards	\$444.75
Sand Bag Ditch Checks	844	Bag	\$7,933.50
Seeding	3.61	Acres	\$4,641.30
Silt Fence	9,391.00	Linear Feet	\$26,187.37
Solid Sodding	1,245.04	Square Yards	\$4,774.69
Temporary Seeding	6.24	Acres	\$3,425.76
Wattle	300	Linear Feet	\$2,910.00

Item	Quantity	Units	Paid Cost
Total			\$134,332.04

Table 6: Payable quantities of erosion controls used in ARDOT highway construction jobs

3.9.2 Little Rock New Development Summary

Chapter 29 of City code requires that all construction, subdivision approvals and remodeling activities have a stormwater management and drainage plan approved by the Public Works with the exceptions of residential single family or duplex structures, commercial or industrial structures on lots less than one acre or additions of less than 500 square feet to existing commercial or industrial structures. Permitted stormwater management and drainage plans must conform to the City SWQMP and City Storm Water Management and Drainage Manual.

Review of stormwater management and drainage plans for new construction projects is the responsibility of the City Public Works and includes the evaluation of construction plans for compliance of erosion control, detention and storm sewer design. All construction projects on lots larger than one acre are instructed to contact ADEQ to obtain the necessary permitting. In 2018 Public Works reviewed 117 new construction permits.

3.10 Roadways

Requirement:

Roadways: Each co-permittee shall operate and maintain public streets, roads, and highways for which they are responsible in a manner so as to reduce, to the Maximum Extent Practicable (MEP), the discharge of pollutants. The Arkansas State Highway and Transportation Department will sweep all State Highway routes within the City of Little Rock on which curbs and barrier walls are provided once per month. The City of Little Rock will sweep the Central Business District three times a week, one hundred fifty (150) miles of arterial street on which curbs and barrier walls are provided once per week, and the balance of the arterial streets on a monthly basis. Each co-permittee will keep records which will include the number of sweeper units used, amount of debris collected (weight or volume), and problem areas which contribute the highest volume of debris. The annual report shall contain the above information.

3.10.1 ARDOT Roadway Maintenance

ARDOT reports the following actions to meet this requirement:

- Spent \$972.77 to purchase material to pickup litter by ARDOT personnel; total cost to pickup litter by ARDOT Personnel and contract; 5,861.5 cubic yards of litter picked up and disposed of by ARDOT personnel and contract; \$0 to purchase materials to pickup litter by jail inmate program.
- ARDOT in cooperation with the Arkansas Beautiful Commission promotes an Anti-Litter Program to encourage people not to litter and to cite those people who do litter. This program includes training for law enforcement personnel, advertising anti-littering laws, enforcement awards, prisoner litter pick, and a violator reporting system.
- Adopt-A-Highway Litter Pickup: \$550.58 total cost to provide bags, pick up filled bags and dispose of Adopt-A-Highway litter; The Adopt-A-Highway groups did not report the amount of litter they collected. There are currently Adopt-A-Highway groups in Little Rock who have adopted 25 miles of highway.
- Street Sweeping: ARDOT spent \$217,619.60 total cost to operate 2 vacuum sweepers in Little Rock which picked up 1,233.5 cubic yards of debris during the year.
- The Department conducts herbicide applications with 51 certified applicators under Arkansas State Plant Board regulations as well as the requirements of the NPDES Pesticide Permit. Fertilizers are applied at the minimum rate necessary according to the guidelines contained in the Department's Standard Specifications manual.

ARDOT also reports the following ‘problem areas’ for roadway maintenance for 2018

- I-430 river crossing - limited shoulder space and high traffic
- I-30 south terminal - limited shoulder space and high traffic
- South terminal interchange - limited shoulder space and high traffic
- I-630/I-30 interchange - limited shoulder space and high traffic
- Hwy 10 - leaves and lawn debris in gutters and high traffic

3.10.2 Little Rock Roadway Maintenance

The City of Little Rock services public streets through cleaning, debris removal and repair. Streets are maintained by City employees with assistance provided by volunteers organized by community members, local non-profits and City staff.

- The City of Little Rock supports the Adopt-A-Street program which currently has 212 groups who have adopted 158.25 miles of streets. These volunteer groups do not report quantities of litter removed.
- The City Wide Cleanup, an effort by the Keep Little Rock Beautiful organization is an annual drive to remove litter from the City. In March 2018 821 volunteers collected 60 bags of recyclables and 31 tons of waste.

The event covered 418 city blocks, 65 of parks and 3.55 miles of waterways, resulting in the removal of 458 tires from Fourche Creek.

- The Public Works operates nine sweepers which swept 21,780 curb-miles and collected 1,830 cubic yards of litter in 2018 at an estimated cost of \$674,600.

3.11 Flood Control Projects

Requirement:

Flood Control Projects: Each co-permittee shall ensure any flood control project it undertakes assesses, and minimizes to the MEP, the impacts on water quality of receiving waters. All flood control projects will be reviewed by the City of Little Rock. The annual report shall contain a summary of any flood control projects that were reviewed during the reporting period.

3.11.1 ARDOT Flood Control

ARDOT reports no flood control projects for 2018.

3.11.2 Little Rock Flood Control

The City of Little Rock reports no flood control projects for 2018. !!TODO!!

3.12 Spill Prevention and Response

Requirement:

Spill Prevention and Response: Each co-permittee shall implement a program to prevent, contain, and respond to spills that may discharge into the MS4. The co-permittees will have supervisory personnel trained for methods of containing spills. The Arkansas Department of Environmental Quality is to be notified immediately after a spill occurs. The criteria for containing and controlling a spill shall be addressed in the Stormwater Quality Management Program. The annual report shall include a summary of any spills and their appropriate responses that occurred within the reporting period.

3.12.1 ARDOT Spill Response Summary

ARDOT reports any spills to ADEQ and it participates in the “Keep Arkansas Beautiful” Program. It provides annual training for maintenance personnel in the identification and reporting of illicit discharges into the Department right-of-way.

ARDOT has an Oil Spill Prevention and Response Plan that is carried in ARDOT tanker vehicles and tanker vehicle operators are trained in that plan. The Environmental Division provides annual training in Spill Prevention Control and Countermeasures to maintenance personnel in the District and assists District personnel in the maintenance of Pollution Prevention Manuals at each maintenance facility.

Members of the Department’s NPDES Section provided annual training, including illicit discharge detection and reporting for District 6 maintenance personnel on February 13, 2019. A make-up training class will be provided on April 24, 2019. The PowerPoint slides used in the training will be posted on the Maintenance Local Area Network for later review by district personnel and a roster of personnel trained will be maintained.

3.12.2 Little Rock Spill Response Summary

The City of Little Rock identifies spills by public reporting through 3-1-1 as well as by observations made by City personnel. Spill reports are investigated by the City Public Works, and upon identification of an unlawful discharge into the MS4, ADEQ is provided notification within 24 hours. Following the initial notification, the City conducts enforcement actions and investigation necessary to mitigate the spill. A formal written response is provided to ADEQ Water Quality division within 5 working days of the initial notification. Records of notices of violation and relevant documentation are maintained at the City Public Works. A summary of spill responses is given in the table below.

Unlawful Discharge Summary

Date	Location	Violation	Result
4/23/2018	Rushmore Avenue	Sediment controls stalled, sediment removed	in-

Date	Location	Violation	Result
4/25/2018	800 Cleaning	Notice Shady chemicals	
	Creek Drive	sued, BMPs amended	
4/25/2018	1 Sanita	Service Cum- Sewag ber- dine land Street	repaired
4/27/2018	00 Food Waste	Bass waste, re- Pro grease moved, Parkway con- tain- ment provided	
5/7/2018	500 Cleaning	Notice Chenal chemicals	
	Parkway	sued, BMPs amended	
8/20/2018	00 Sedime	Gbntrols Cantrell Road	in- stalled, sed- i- ment removed
9/11/2018	00 Sedime	Pending W 98th Street	trial
10/8/2018	per Constr	ation Lane washout	washout cleaned and washout installed

Date	Location	Violation	Result
10/10/2018	Food Fi- nan- cial Cen- tre Parkway	New waste, ser- grease vice line installed	
11/15/2018	Sedime W 32nd St	Fill re- moved from MS4	

Table 8: Summary of stormwater ordinances for unlawful discharges during the permit year

3.13 Construction Site Runoff

Requirement:

Construction Site Runoff: Each co-permittee shall implement a program to reduce, to the MEP, the discharge of pollutants from construction sites

The annual report will include the number of permits issued, the total permitted acres of disturbed soil, and management practices which were used to achieve compliance with the 5 tons/ per acre per year soil loss tolerance. In addition, AHTD will continue to develop and make available standard details, specifications, and/or manuals identifying acceptable Best Management Practices that must be used on AHTD projects at construction sites which have more than one acre of disturbed soil, and the City of Little Rock will continue to develop and make available standard details, specifications, and/or manuals identifying acceptable Best Management Practices that must be used at construction sites in accordance with the requirements of Chapter 29 of the Little Rock Code of Ordinance.

3.13.1 ARDOT Construction Runoff Reduction

Requirement:

SWMP Reporting Requirement:

The Department of Transportation will report annually any revisions to the Standard Specifications for Highway Construction that incorporate new BMPs for construction site runoff and erosion control.

Program Activities:

The ArDOT Standard Specifications were revised and took effect in April 2014. Wattles, Triangular Silt Dikes, and Filter Socks are included in the new Standard Specifications as approved BMPs and are being used on ArDOT construction jobs. Also, the hydraulically applied erosion control products (HECPs) are being used on ArDOT construction jobs and their effectiveness evaluated on those projects. A Special Provision for Removing and Replacing Topsoil will be incorporated on jobs as project location and size permits.

The Erosion and Sediment Control Design and Construction Manual was updated in December of 2016. ArDOT incorporates erosion control measures into all construction contracts and obtains all necessary permits for work within the Department rights-of-way. Contractors are required to obtain all necessary permits including ADEQ general storm water permits for any work beyond the rights-of-way such as; borrow pits, stockpile locations, and waste areas. The update includes the newly revised Construction General Permit (ARR150000), Short Term Activity Authorization (STAA) guidance, and updated Best Management Practices. In addition, a Special Provision requiring contractors of ArDOT jobs disturbing an acre or more soil to be certified by the Center for Training Transportation Professionals Training (CTTP) has been implemented for all jobs let after October 1, 2018.

SWMP Reporting Requirement:

The Department of Transportation will report annually the course description and dates of construction site runoff training classes conducted for its personnel within the geographical area covered by the Permit.

Program Activities:

Beginning in February 2010, the Department instituted an erosion and sediment control training and certification course through the University of Arkansas Center for Training Transportation Professionals (CTTP) to train and certify construction and maintenance personnel. The CTTP training is also open to Department contractors. Additionally, annual NPDES Stormwater training was developed and provided by personnel from the Department's Environmental Division. In-person training for Maintenance and Construction personnel was conducted on February 13, 2019 and Make-up training will be on April 24, 2019. The PowerPoint slides used in the trainings will be posted on the Maintenance Local Area Network (LAN); and Construction training is provided on the Construction LAN. Training rosters are maintained for all employees who attended or completed annual maintenance or construction training.

SWMP Reporting Requirement:

The Department of Transportation will report annually the job numbers, job locations, and dates of site visits.

Program Activities:

Members of the Department's Environmental Division visited the following area jobs during the Permit year. Job 061102 was visited since there were few active jobs within the city of Little Rock; however the job is within the highly urbanized area.

ARDOT Construction Site Visits

Date	Location	Job Number
3/14/2018	Hwy. 67 Interchange (Cabot)	61102
6/24/2018	Hwy. 67 Interchange (Cabot)	61102
7/18/2018	Baptist Hospital-University Ave.	CA0608
11/28/2018	Baptist Hospital-University Ave.	CA0608
11/28/2018	I-430 Rodney Parham Rd. Intchng. Imprvts. (S)	BB0618

Table 9: Dates of inspections by location

3.13.2 Little Rock Construction Runoff Reduction

The City's program for reducing construction site runoff is a combination of monitoring and administrative controls which are written in the SWQMP and codified in Chapter 29 of the City of Little Rock Code of Ordinances. Construction and land alteration activities are subject to permitting by the City, and as a condition of these permits, construction activities must provide plans for erosion control, drainage and NPDES compliance where applicable. Significant land alteration activities are unlawful without a grading permit, except where allowed by Chapter 29 of City code.

In addition to submitting plans for City approval, construction activity is subject to inspection by City staff. Inspections are conducted periodically as well as prior to issuance of certificates of occupancy and any construction or land alteration activity which does not provide adequate erosion controls is subject to stop work orders and other penalties.

In 2018, the City of Little Rock Public Works permitted 117 construction projects, which disturbed a total area of 543 acres. The result of these land alteration activities is predicted to cumulatively reduce soil loss by 4900 tons/acre/year. A list of all permitted projects is provided in appendix H.

3.14 Changes to Roles and Responsibility

Requirement:

An update on Roles and Responsibility if applicable.
ARDOT and the City of Little Rock report no changes to roles and responsibility.

3.15 Monitoring and Reporting

3.15.1 Representative Monitoring

Requirement:

Representative Monitoring: Monitoring shall be conducted on representative outfalls, internal sampling stations, and/or in-stream monitoring locations to characterize the quality of stormwater discharges from the Municipal Separate Storm Sewer System.

The locations of sampled outfalls are given by the Permit and are believed to be representative of water quality within the MS4. Grab samples of storm water are collected only by qualified personnel and analyzed by ADEQ accredited labs. Quarterly reports are reviewed by City staff authorized in accordance with the Permit.

3.15.2 Storm Event Data

Requirement:

Storm Event Data: Quantitative data shall be collected to estimate pollutant loadings and event mean concentrations for each parameter sampled. Records shall be maintained of all analytical results, the date and duration of the storm event sampled; rainfall measurements or estimates of the storm event which generated the sampled runoff; the duration between storm events sampled and the end of the previous measurable storm event; and an estimate of the total volume of the discharge sampled.

All discharge samples were collected during rain events which exceeded 0.1in of precipitation. The measured precipitation in the table below is an average of six ground weather stations within the limits of the City of Little Rock. The time between acquiring samples and the most recent rain event vary from one to six days. Approximately eight liters of water is required for the battery of laboratory tests performed. In total, approximately 160 liters of runoff was sampled during 2018. The City holds records of all reported samples.

Storm Event Data

Sample Locati	Date	du-tion (hrs)	Rainfa-in (in)	Most Recent	Volume (gal)
Event					
		du-	Days		
		ra-	Since		
Sample Locati	Date	du-tion (hrs)	Rainfa-in (in)	Most Recent	Volume (gal)
1	4/25/2018	0.57	4	14400	
2	4/25/2018	0.57	4	12342	
3	4/25/2018	0.57	4	6163	
5	4/25/2018	0.57	4	3744	
6	4/25/2018	0.57	4	8640	
1	6/8/2018	0.13	7	2880	
2	6/8/2018	0.13	7	7200	
3	6/8/2018	0.13	7	3600	
5	7/18/2018	1.25	1	144	
6	8/9/2018	1.4	4	6384	
1	10/15/2018	1.64	2	5166720	
2	10/15/2018	1.64	2	4636800	
3	10/15/2018	1.64	2	4636800	
5	10/15/2018	1.64	2	3137760	
6	10/15/2018	1.64	2	1738080	
1	2/7/2019	0.78	11	586080	
2	2/7/2019	0.78	11	40320	
3	2/7/2019	0.78	11	1520	
5	2/7/2019	0.78	11	14400	
6	2/7/2019	0.78	11	21600	

Table 10: Precipitation summaries and discharge estimates for each sampled outfall

3.15.3 Sampling

Requirement:

Grab Samples: Grab Samples shall be taken during the first two hours of discharge.

Representative Storm Events: Samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable storm event. Throughout 2018, the City has a contractual agreement with Environmental Services Company, Inc. for the collection, analysis and reporting of storm water samples. Samples are collected quarterly during rain events from five outfall locations as specified in NPDES permit ARS000002.

Outfall Sampling Locations

Identifier	Latitude	Longitude
Outfall 001:	34 44' 30"	92 20' 30"
Outfall 002:	34 43' 30"	92 21' 30"
Outfall 003:	34 45' 15"	92 26' 00"
Outfall 005:	34 44' 00"	92 14' 30"
Outfall 006:	34 42' 00"	92 15' 36"

Table 11: Coordinates for outfalls identified for quarterly water quality sampling
Reporting is provided electronically through the Environmental Protection Agency's NETDMR service. Electronic reports are certified by an authorized representative of the City.

3.15.4 Seasonal Loadings and Event Mean Concentrations

Requirement:

Seasonal Loadings and Event Mean Concentrations: Data shall be maintained to provide estimates for each major outfall of seasonal pollutant loadings and event mean concentrations for a representative storm event for the parameters which the co-permittees must monitor. This information may be estimated from the monitoring results and shall take into consideration land uses and drainage areas for the outfall.

A seasonal trend analysis is given in appendix F.

3.16 Changes to Legal Authority

Requirement:

An update on Legal Authority if applicable.

ARDOT and the City of Little Rock report no changes to legal authority.

3.17 Changes to SWQMP Resources

Requirement:

An update on SWQMP Resources if applicable.

ARDOT and the City of Little Rock report no changes to SWQMP resources.

3.18 Changes to SWQMP Review

Requirement:

Program Modification: The approved SWQMP shall not be modified by the co-permittees without the prior approval of the Director, unless in accordance with the items below: - Portions of the SWQMP not specifically required by 6.2 may be modified upon written notification to the permitting authority. - Modifications adding (but not subtracting or replacing) components, controls, or requirements to the approved SWQMP may be made by the co-permittees at any time upon written notification to the permitting authority. - Modifications made under this paragraph shall not become enforceable permit conditions until such time as the modifications are formally approved. - Modification requests and notifications shall be signed and shall include a certification that the co-permittees were given an opportunity to comment on proposed changes.

The co-permittees must review and revise the City of Little Rock and Arkansas State Highway and Transportation Department SWQMP to ensure compliance with the requirement to reduce the discharge of pollutants to the Maximum Extent Practicable (MEP) as contained in Section 402(p)(3)(B)(iii) of the Clean Water Act. Specifically, the co-permittees must review and revise the SWQMP sections regarding construction site runoff and public education. The co-permittees shall conduct a review of the current SWQMP and shall revise the SWQMP to include additional BMPs regarding public education and construction site runoff particularly, these revisions will include notification of ADEQ's NPDES permitting program to construction sites, institute an employee education program, increase public education, increase the frequency of construction site inspections, and notify ADEQ Enforcement Section of construction sites that do not have erosion controls installed. The co-permittees shall submit to ADEQ their suggested revisions to the SWQMP within eleven (11) months following the effective date of the permit. ARDOT and the City of Little Rock do not propose any changes to the SWQMP at this time.

4.0 Conclusions

ARDOT has expended a significant amount of money and personnel resources on such things as personnel training, litter collection, maintenance and repair of the drainage system, and other activities detailed in Section 2.1. While there is no way to measure the impact of these measures on the quality of surface water within the MS4 area, the Department believes the controls implemented are effective. The City of Little Rock values the quality of water within its territorial boundaries for the welfare of its residents and the local environment. Through the application of administrative and engineering controls, the resources and

manpower spent on maintenance and upkeep of the MS4, and the training of personnel and promotion of public awareness, the City has managed to protect the quality of its waters. Continued application of existing policies and ordinances is expected to maintain the water quality within Little Rock.

5.0 Certifications

I certify that the above Annual Report is true and correct to the best of my knowledge.

Mark Headley, P.E. District 6 Engineer Arkansas Dept. of Transportation

6.0 Appendices

Appendix A: City of Little Rock and ARDOT District VI NPDES Permit

NPDES Permit

Appendix B: 1997 NPDES Report

1997 report

Appendix C: Annexations

Recent Annexations in the City of Little Rock

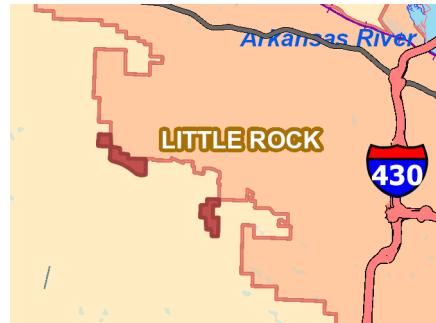


Figure 1: Recent Annexations in the City of Little Rock

Lands incorporated into the City of Little Rock within the report year A total of 284 acres was annexed in 2018.

Appendix H: Educational and Outreach Material

Storm Water II



Figure 2: Storm Water II

Example promotional and educational material used by the City of Little Rock to promote water quality.

Stormwater Management

Example promotional and educational material used by the City of Little Rock to promote water quality.

Storm Water IV

Example promotional and educational material used by the City of Little Rock to promote water quality.

Storm Water III

Example promotional and educational material used by the City of Little Rock to promote water quality.

Storm Water I

Example promotional and educational material used by the City of Little Rock to promote water quality.

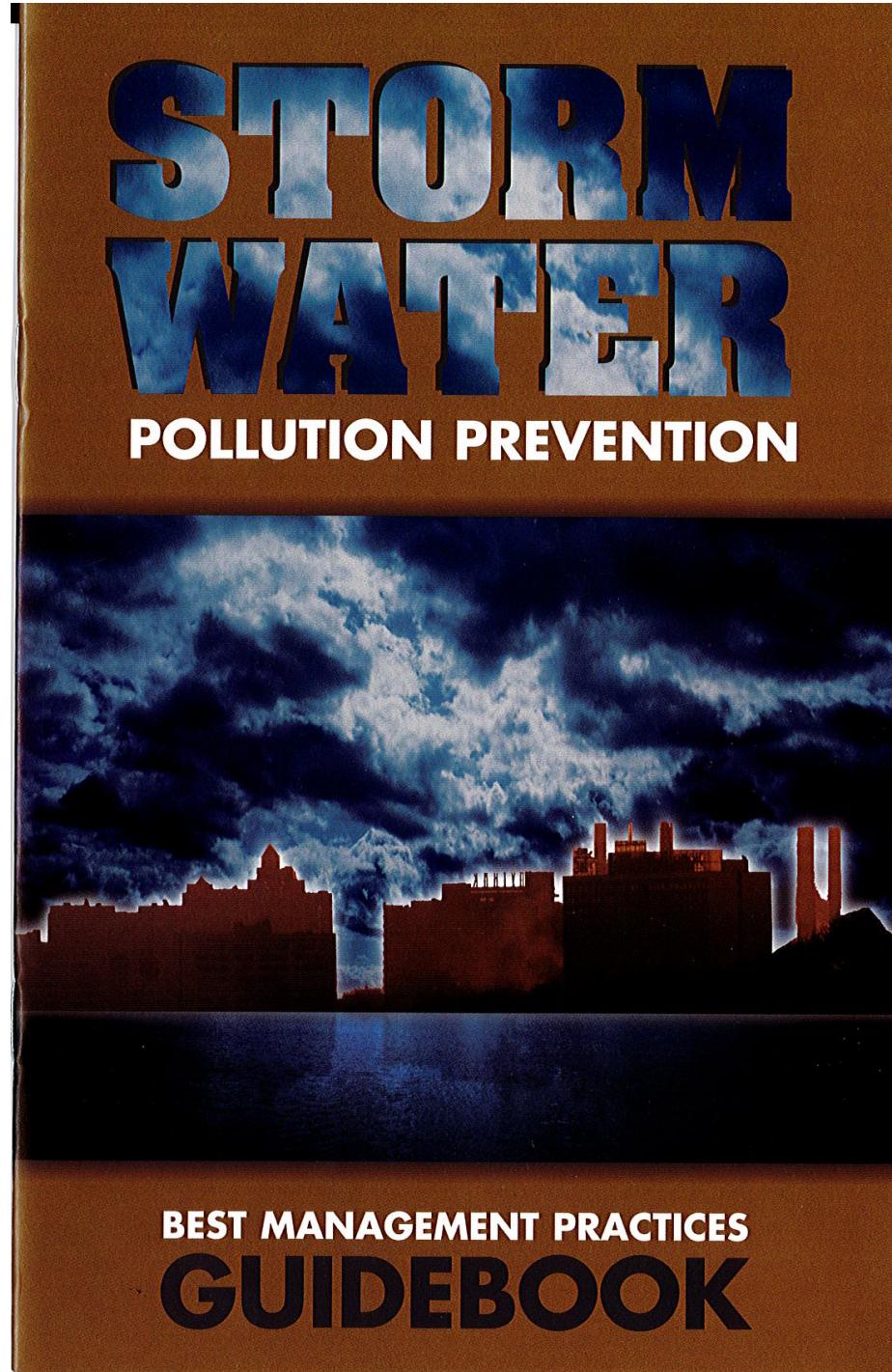


Figure 3: Stormwater Management



Figure 4: Storm Water IV

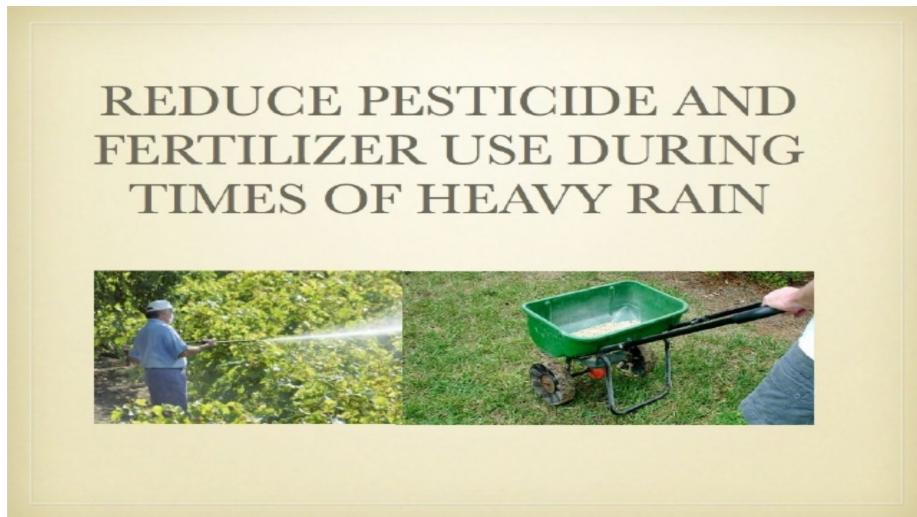


Figure 5: Storm Water III



Figure 6: Storm Water I

Coloring Book

Example promotional and educational material used by the City of Little Rock to promote water quality.

Drainsmart

Example promotional and educational material used by the City of Little Rock to promote water quality.

Sammy and Wayne

Example promotional and educational material used by the City of Little Rock to promote water quality.

Forests to Faucets

Example promotional and educational material used by the City of Little Rock to promote water quality.

Appendix F: Monitoring Summary

City of Little Rock Water Quality Parameters for 2018

Radar chart showing all parameters measured during 2018 normalized to available EPA water quality recommendations for the area. Where specific guidance is absent, measurements are normalized to the 95th percentile of all previous measures

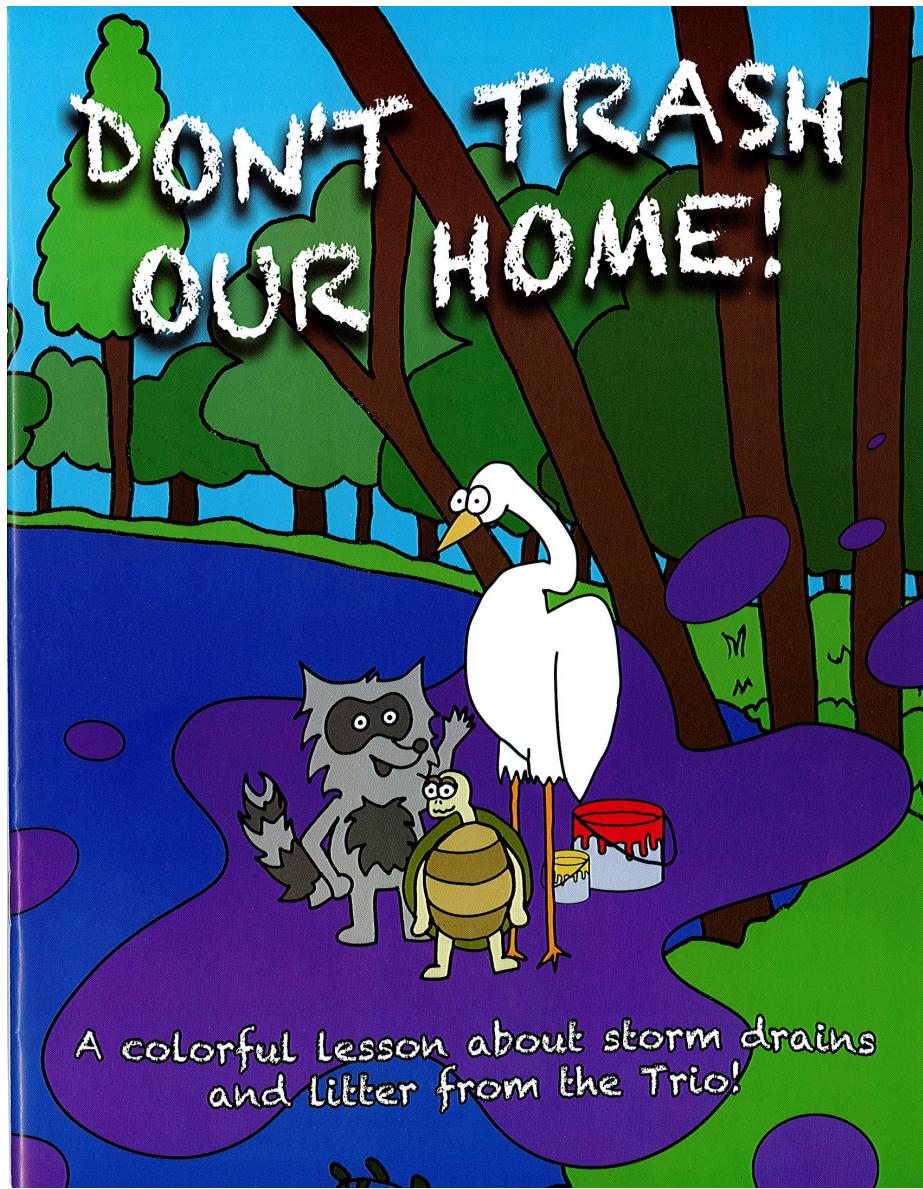


Figure 7: Coloring Book



Figure 8: Drainsmart



Figure 9: Sammy and Wayne



Figure 10: Forests to Faucets

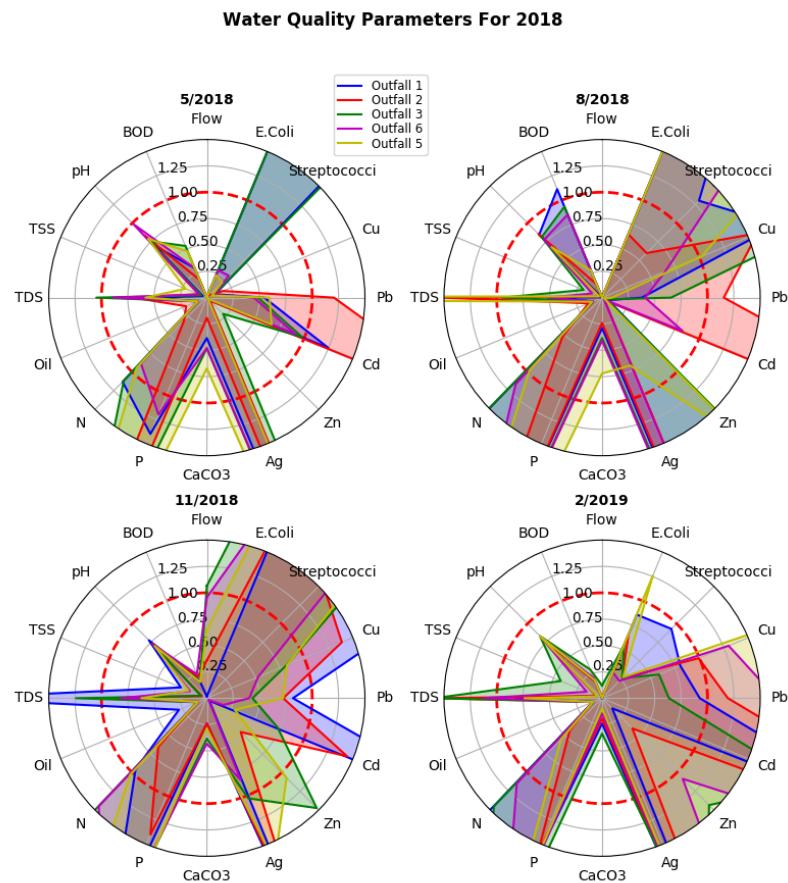


Figure 11: City of Little Rock Water Quality Parameters for 2018

City of Little Rock Water Quality Parameters for 2017

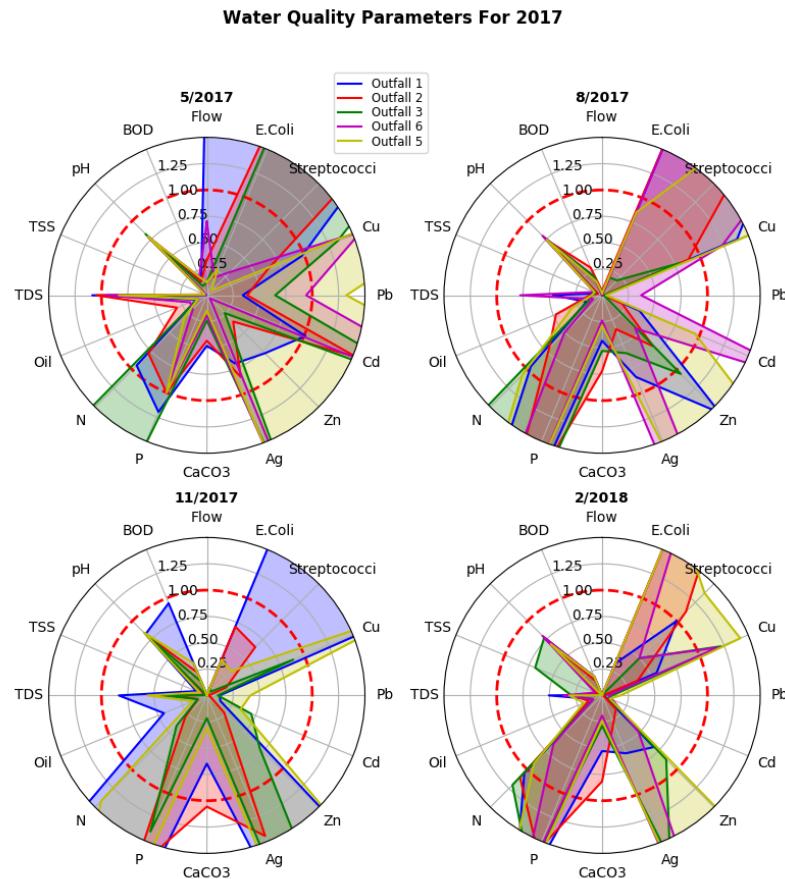


Figure 12: City of Little Rock Water Quality Parameters for 2017

Radar chart showing all parameters measured during 2017 normalized to available EPA water quality recommendations for the area. Where specific guidance is absent, measurements are normalized to the 95th percentile of all previous measures

City of Little Rock Water Quality Parameters for 2016

Radar chart showing all parameters measured during 2016 normalized to available EPA water quality recommendations for the area. Where specific guidance is absent, measurements are normalized to the 95th percentile of all previous measures

City of Little Rock Water Quality Parameters for 2014

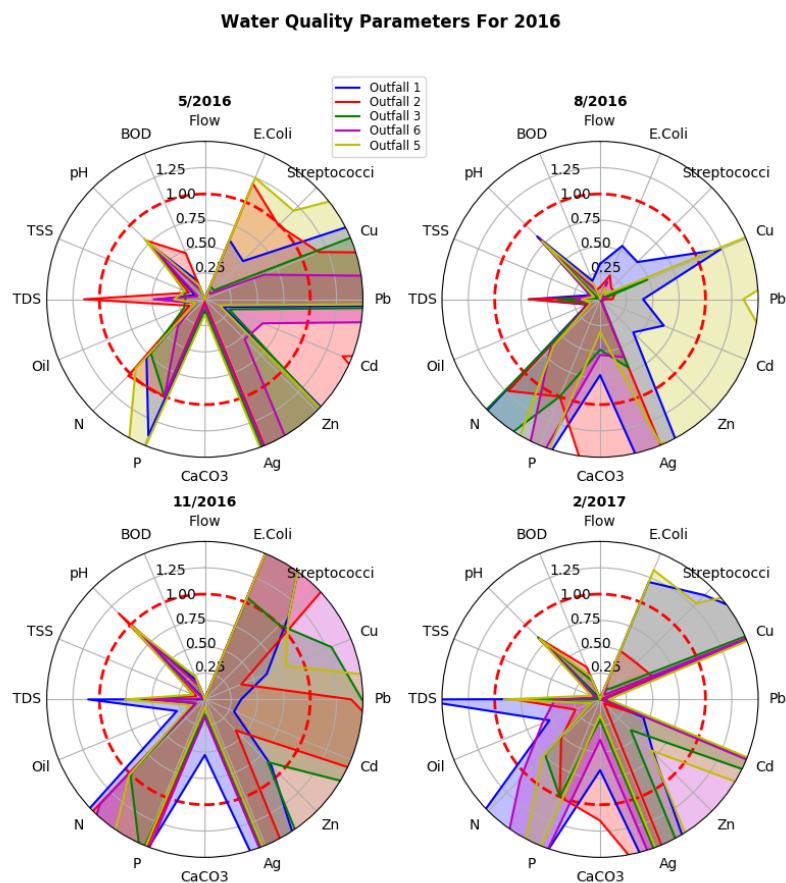


Figure 13: City of Little Rock Water Quality Parameters for 2016

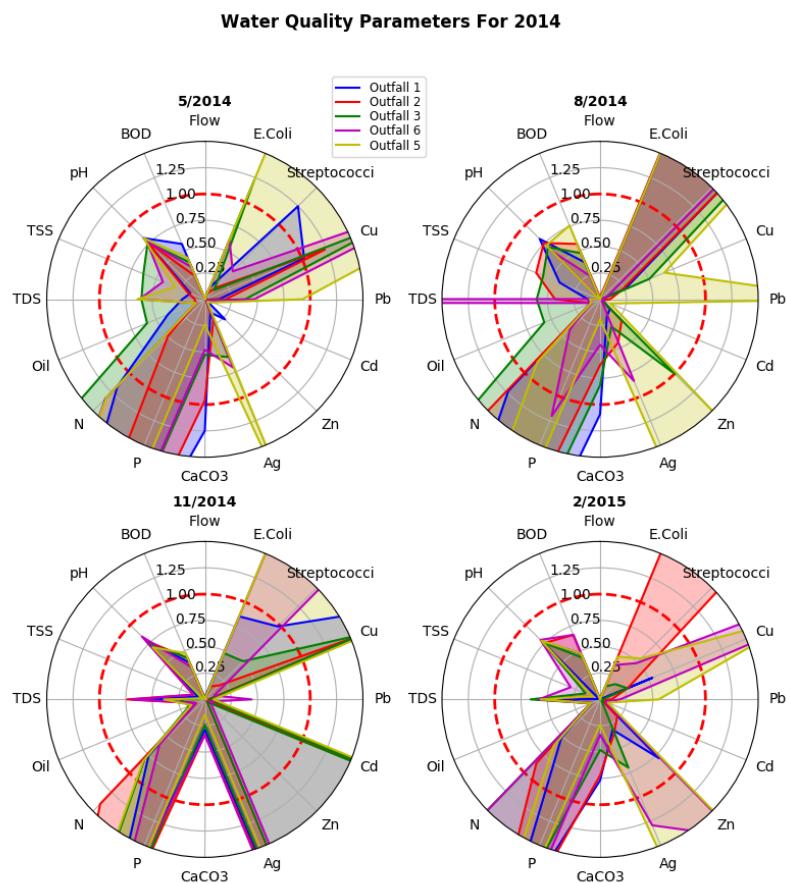


Figure 14: City of Little Rock Water Quality Parameters for 2014

Radar chart showing all parameters measured during 2014 normalized to available EPA water quality recommendations for the area. Where specific guidance is absent, measurements are normalized to the 95th percentile of all previous measures

City of Little Rock Water Quality Parameters for 2015

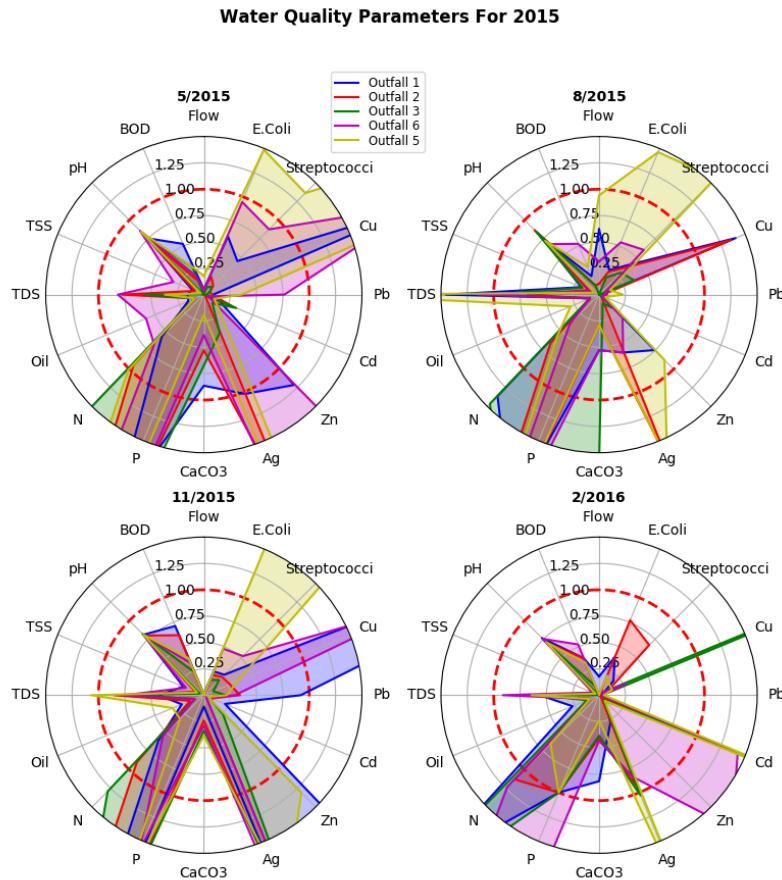


Figure 15: City of Little Rock Water Quality Parameters for 2015

Radar chart showing all parameters measured during 2015 normalized to available EPA water quality recommendations for the area. Where specific guidance is absent, measurements are normalized to the 95th percentile of all previous measures

Appendix D: Regional Analysis

City of Little Rock Water Quality Parameters for Ag by Region

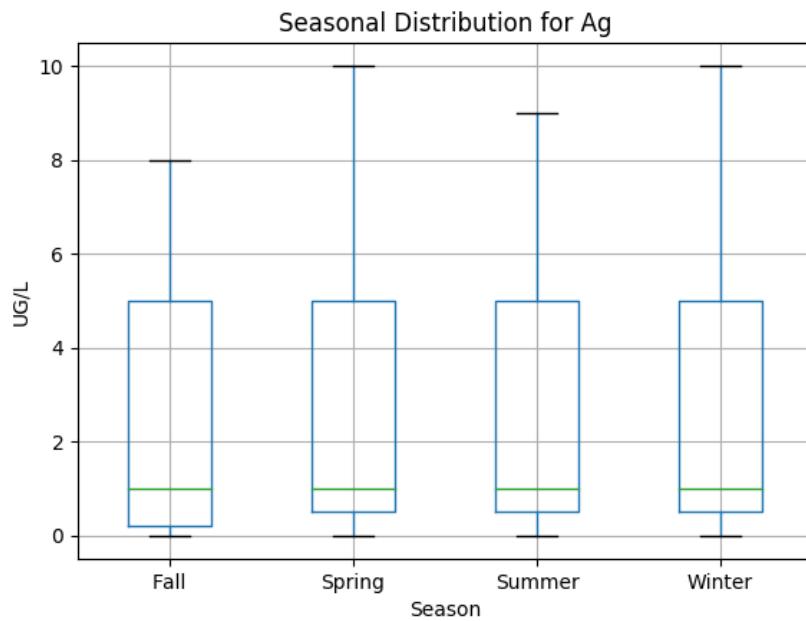


Figure 16: City of Little Rock Water Quality Parameters for Ag by Region

Distributions of measurements for Ag from all recorded measurements grouped by location.

City of Little Rock Water Quality Parameters for Ag by Region

Distributions of measurements for Ag from all recorded measurements grouped by location.

City of Little Rock Water Quality Parameters for Ag by Region

Distributions of measurements for Ag from all recorded measurements grouped by location.

City of Little Rock Water Quality Parameters for Ag by Region

Distributions of measurements for Ag from all recorded measurements grouped by location.

City of Little Rock Water Quality Parameters for Ag by Region

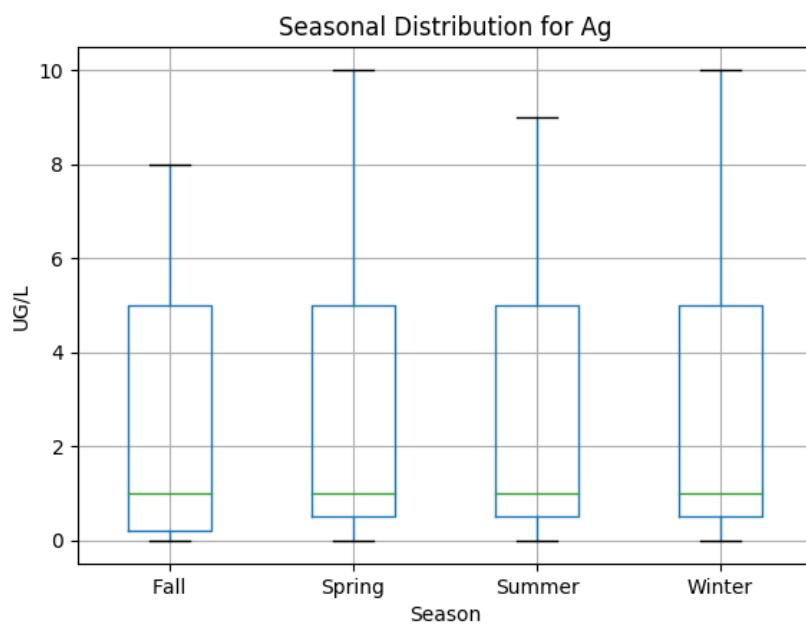


Figure 17: City of Little Rock Water Quality Parameters for Ag by Region

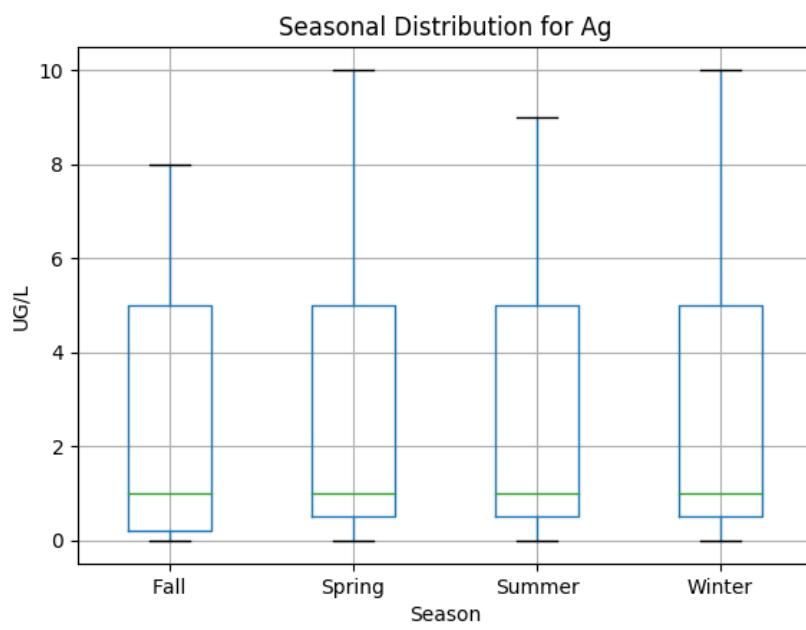


Figure 18: City of Little Rock Water Quality Parameters for Ag by Region

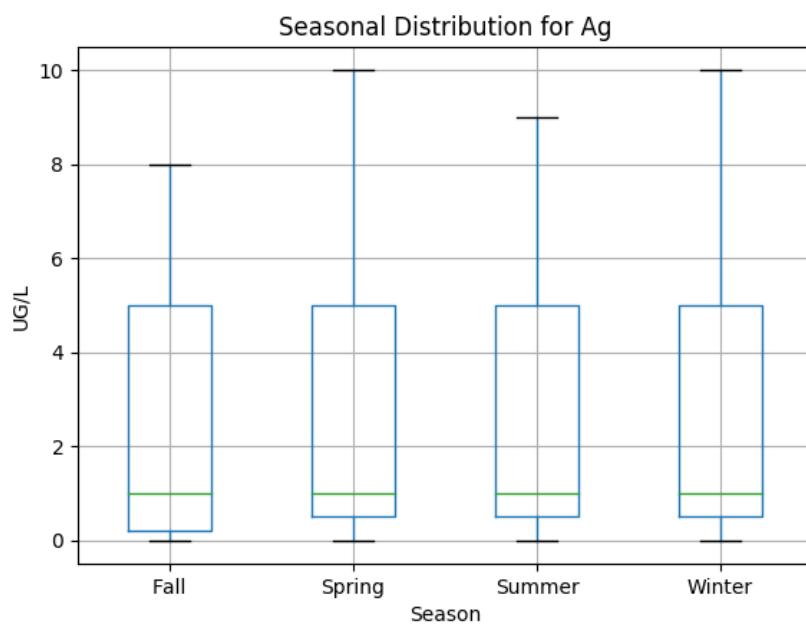


Figure 19: City of Little Rock Water Quality Parameters for Ag by Region

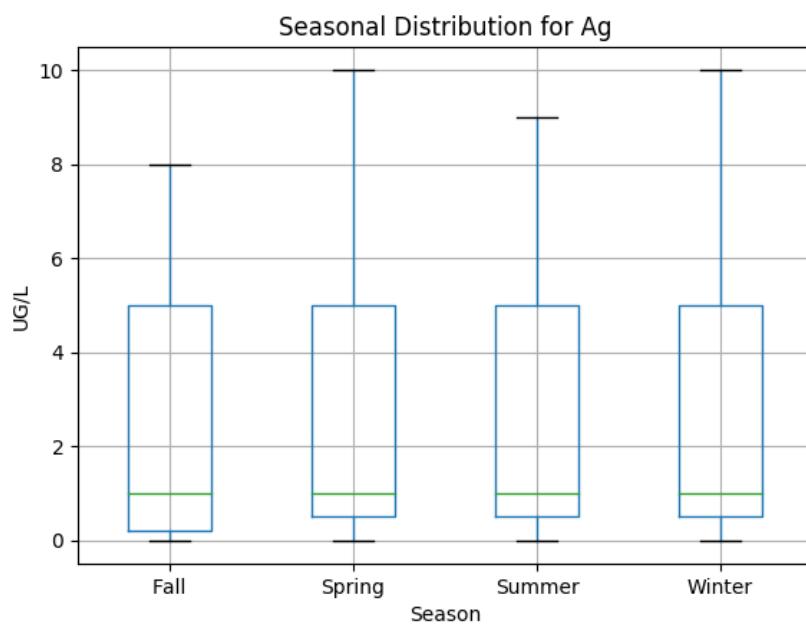


Figure 20: City of Little Rock Water Quality Parameters for Ag by Region

Distributions of measurements for Ag from all recorded measurements grouped by location.

City of Little Rock Water Quality Parameters for Ag by Region

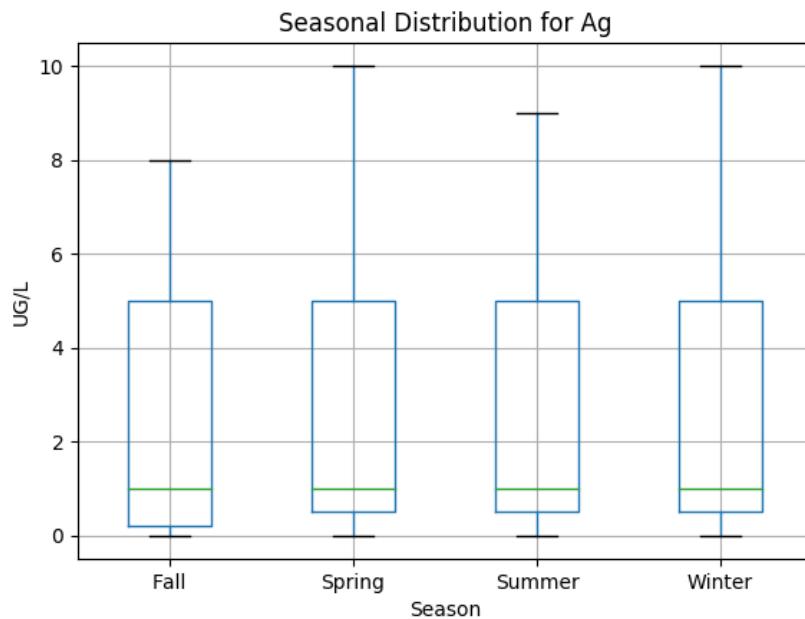


Figure 21: City of Little Rock Water Quality Parameters for Ag by Region

Distributions of measurements for Ag from all recorded measurements grouped by location.

City of Little Rock Water Quality Parameters for Ag by Region

Distributions of measurements for Ag from all recorded measurements grouped by location.

City of Little Rock Water Quality Parameters for Ag by Region

Distributions of measurements for Ag from all recorded measurements grouped by location.

City of Little Rock Water Quality Parameters for Ag by Region

Distributions of measurements for Ag from all recorded measurements grouped by location.

City of Little Rock Water Quality Parameters for Ag by Region

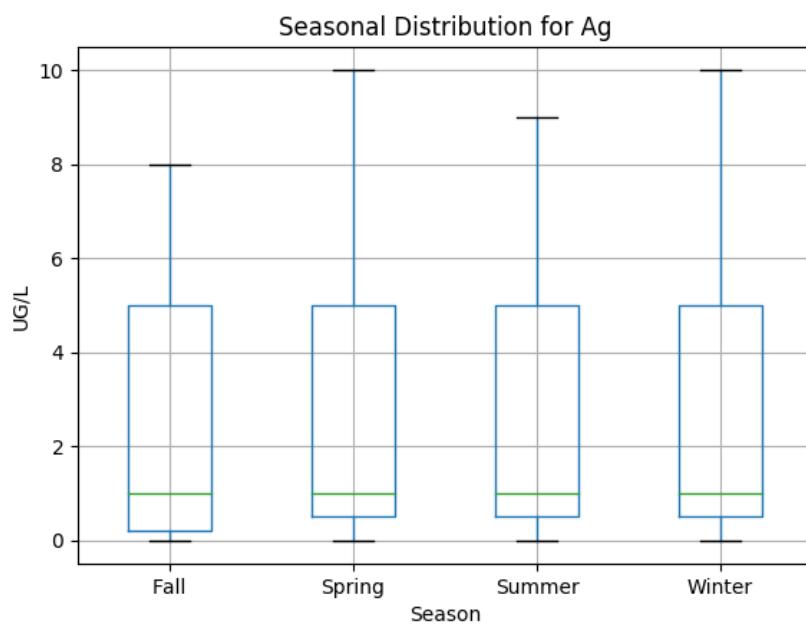


Figure 22: City of Little Rock Water Quality Parameters for Ag by Region

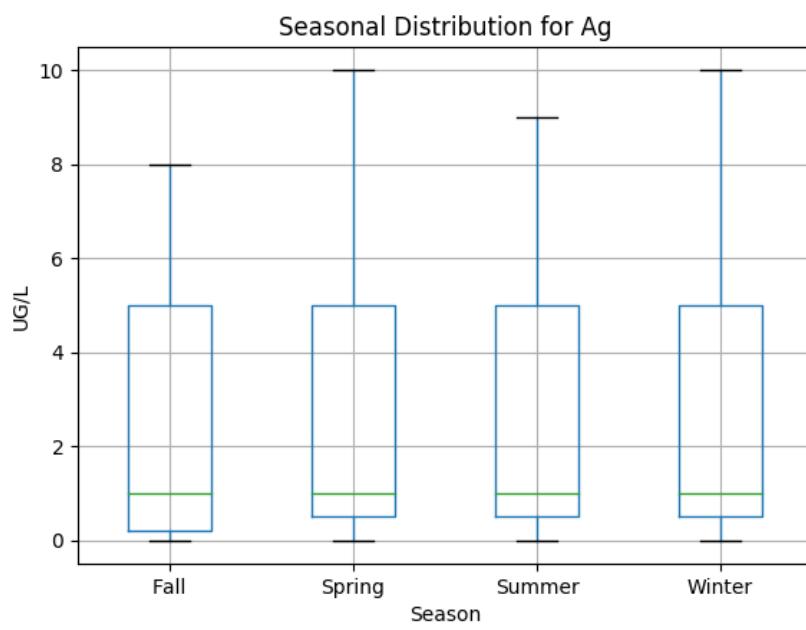


Figure 23: City of Little Rock Water Quality Parameters for Ag by Region

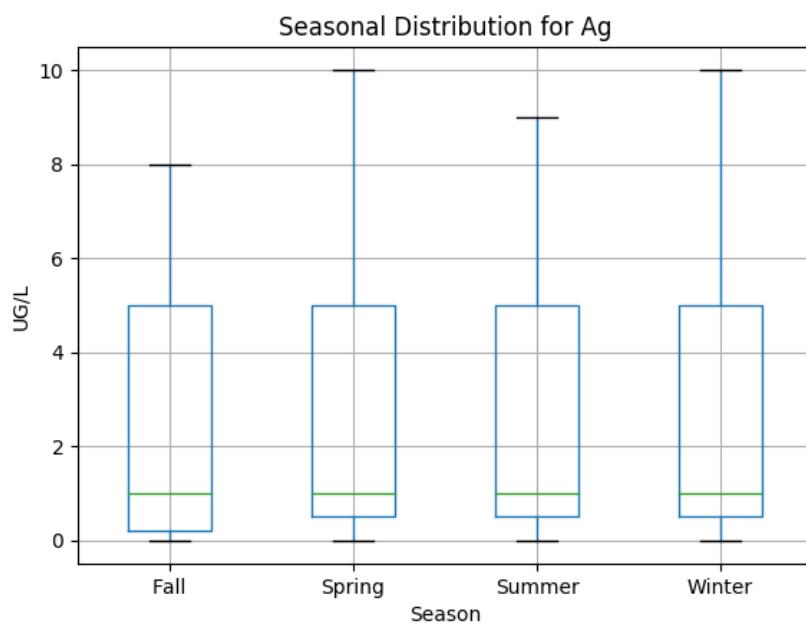


Figure 24: City of Little Rock Water Quality Parameters for Ag by Region

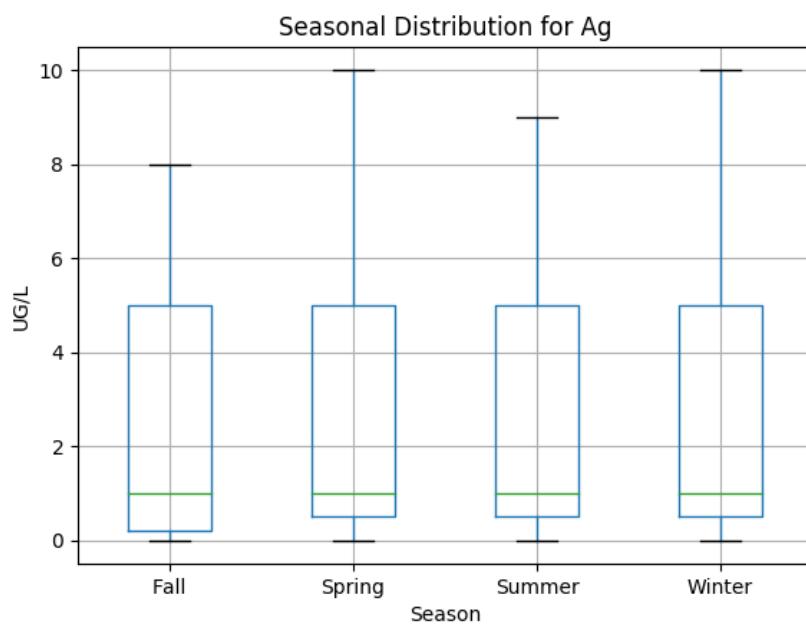


Figure 25: City of Little Rock Water Quality Parameters for Ag by Region

Distributions of measurements for Ag from all recorded measurements grouped by location.

City of Little Rock Water Quality Parameters for Ag by Region

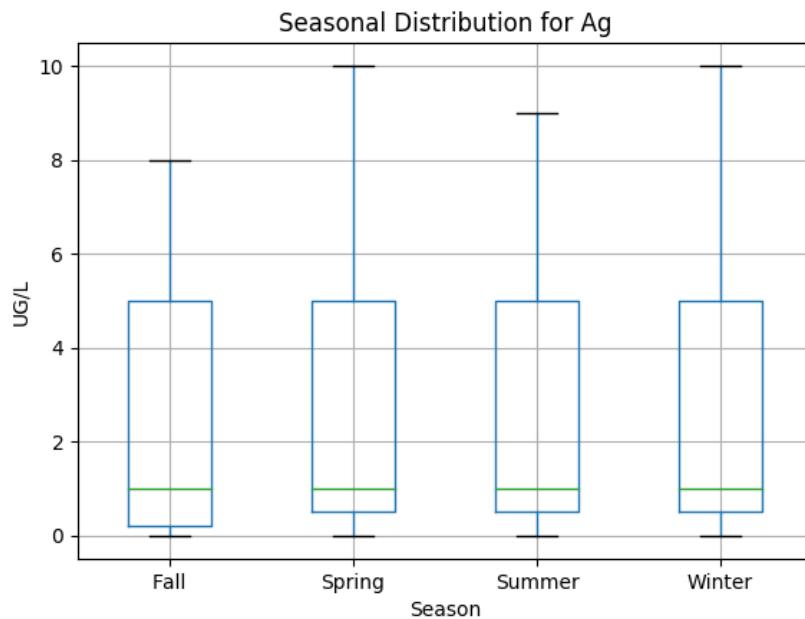


Figure 26: City of Little Rock Water Quality Parameters for Ag by Region

Distributions of measurements for Ag from all recorded measurements grouped by location.

City of Little Rock Water Quality Parameters for Ag by Region

Distributions of measurements for Ag from all recorded measurements grouped by location.

City of Little Rock Water Quality Parameters for Ag by Region

Distributions of measurements for Ag from all recorded measurements grouped by location.

City of Little Rock Water Quality Parameters for Ag by Region

Distributions of measurements for Ag from all recorded measurements grouped by location.

City of Little Rock Water Quality Parameters for Ag by Region

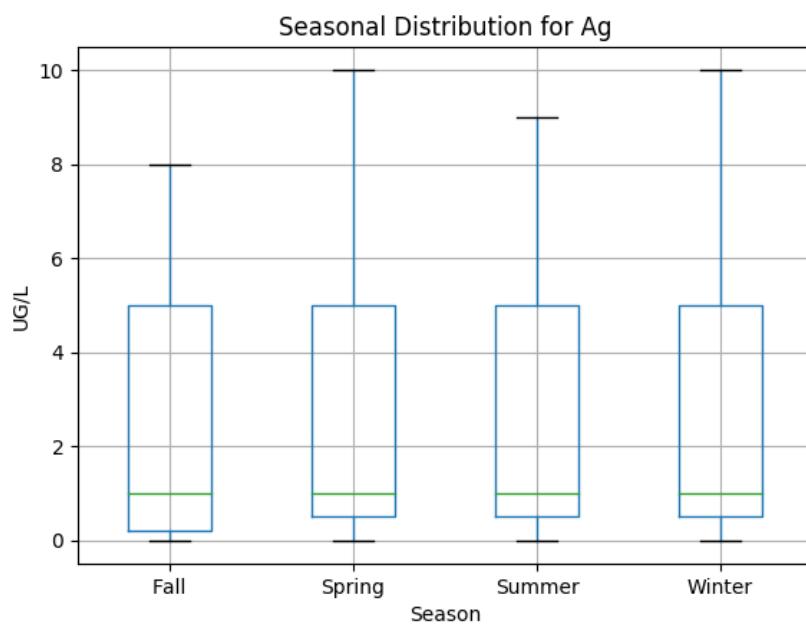


Figure 27: City of Little Rock Water Quality Parameters for Ag by Region

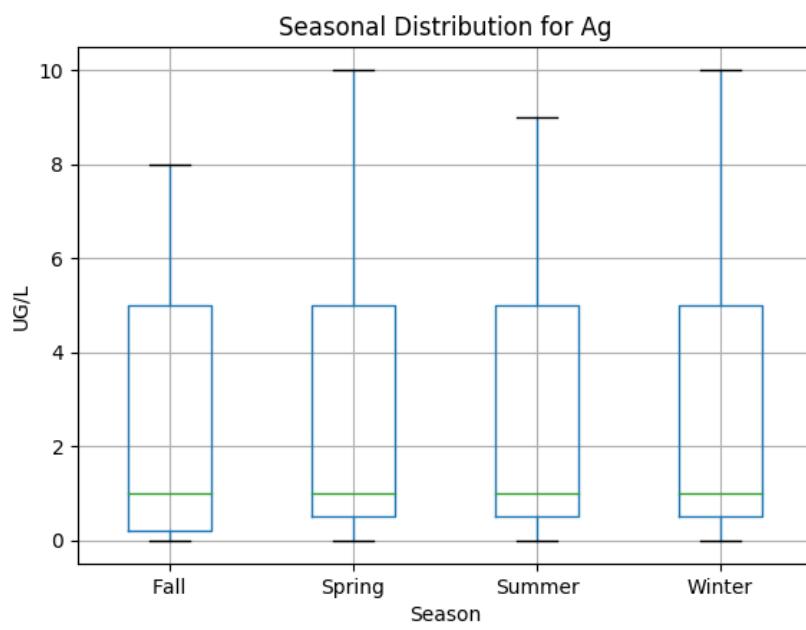


Figure 28: City of Little Rock Water Quality Parameters for Ag by Region

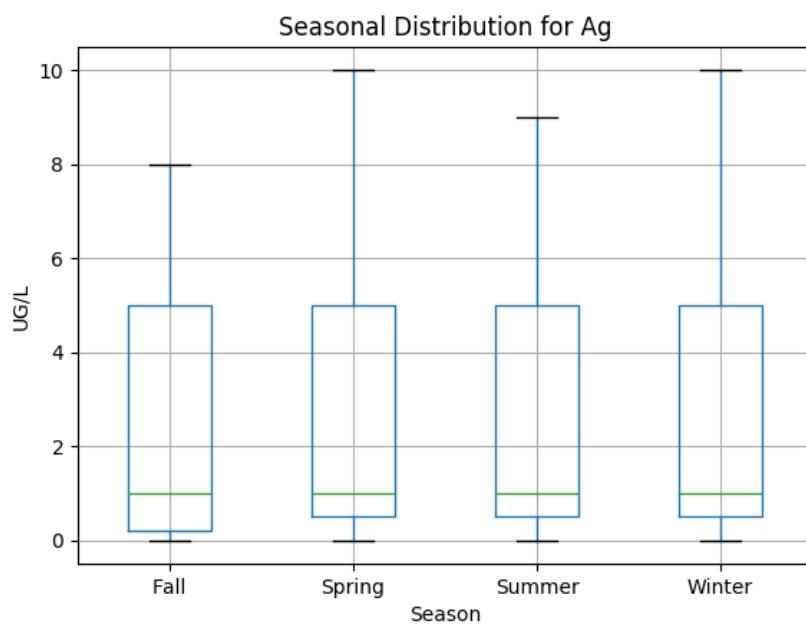


Figure 29: City of Little Rock Water Quality Parameters for Ag by Region

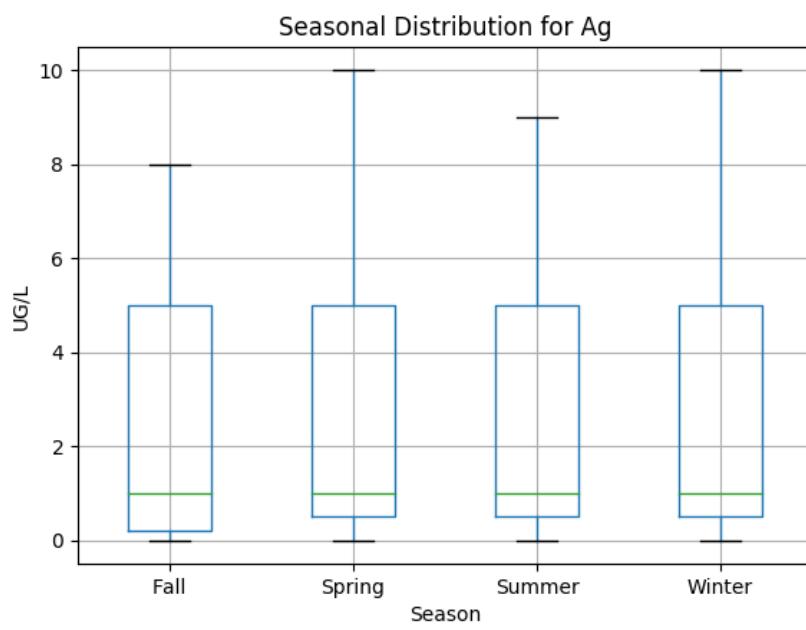


Figure 30: City of Little Rock Water Quality Parameters for Ag by Region

Distributions of measurements for Ag from all recorded measurements grouped by location.

City of Little Rock Water Quality Parameters for Ag by Region

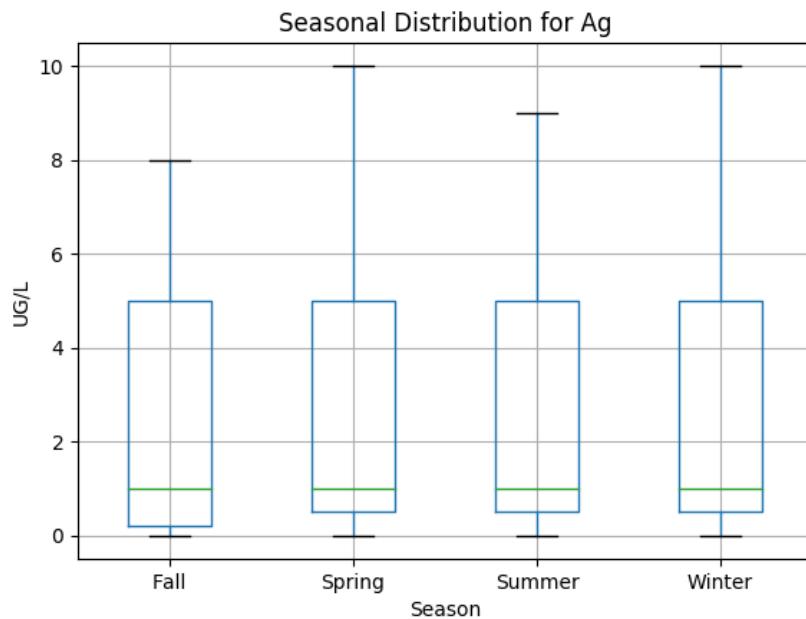


Figure 31: City of Little Rock Water Quality Parameters for Ag by Region

Distributions of measurements for Ag from all recorded measurements grouped by location.

City of Little Rock Water Quality Parameters for Ag by Region

Distributions of measurements for Ag from all recorded measurements grouped by location.

City of Little Rock Water Quality Parameters for Ag by Region

Distributions of measurements for Ag from all recorded measurements grouped by location.

City of Little Rock Water Quality Parameters for Ag by Region

Distributions of measurements for Ag from all recorded measurements grouped by location.

City of Little Rock Water Quality Parameters for Ag by Region

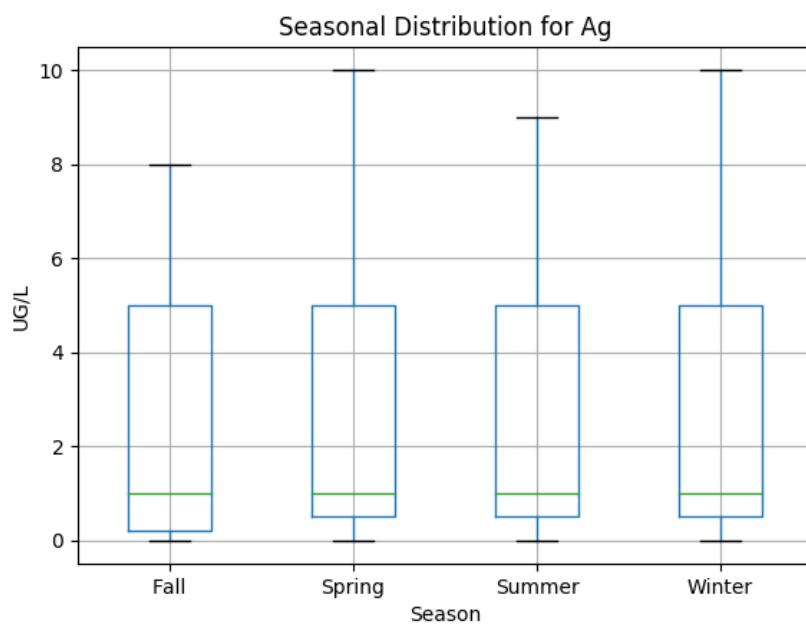


Figure 32: City of Little Rock Water Quality Parameters for Ag by Region

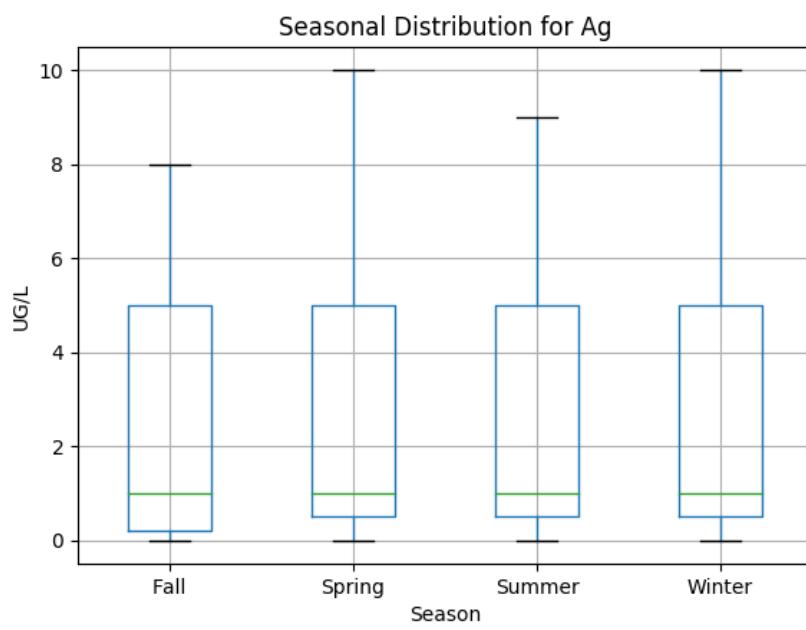


Figure 33: City of Little Rock Water Quality Parameters for Ag by Region

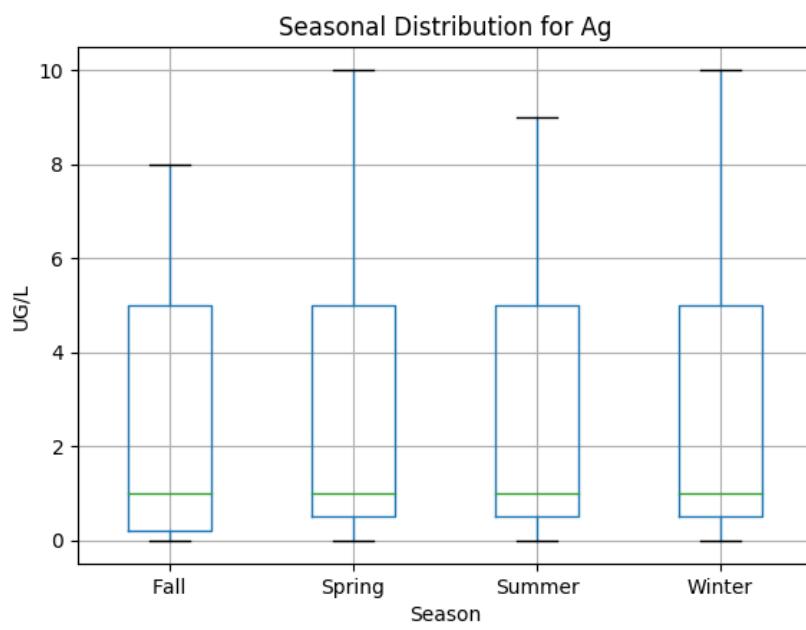


Figure 34: City of Little Rock Water Quality Parameters for Ag by Region

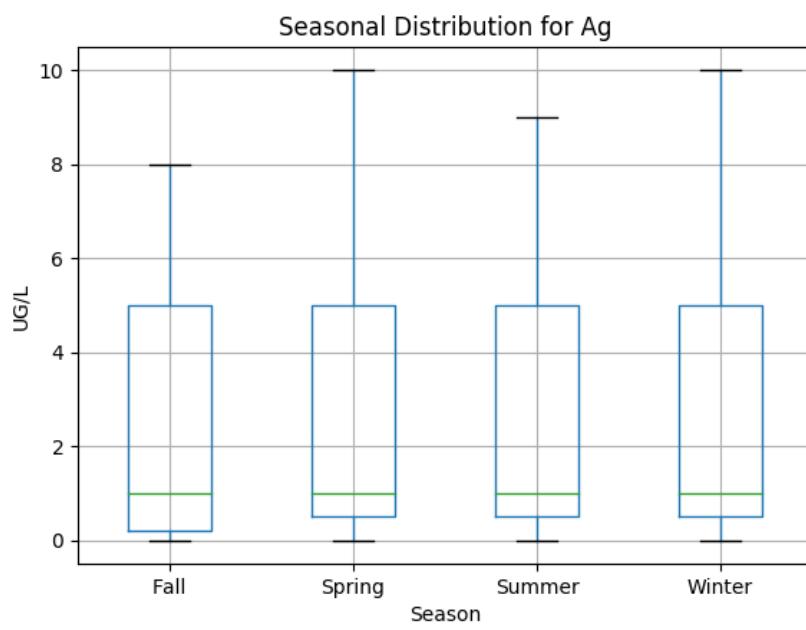


Figure 35: City of Little Rock Water Quality Parameters for Ag by Region

Distributions of measurements for Ag from all recorded measurements grouped by location.

City of Little Rock Water Quality Parameters for Ag by Region

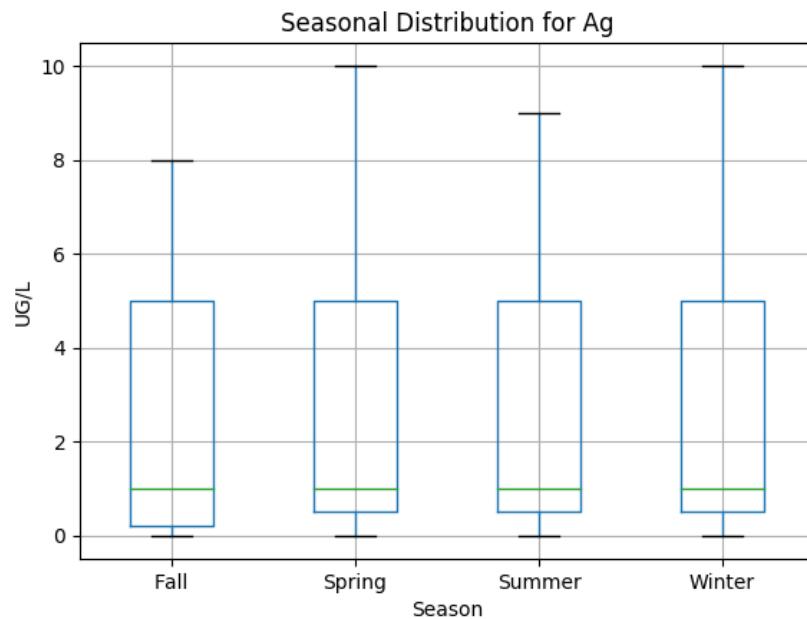


Figure 36: City of Little Rock Water Quality Parameters for Ag by Region

Distributions of measurements for Ag from all recorded measurements grouped by location.

City of Little Rock Water Quality Parameters for Ag by Region

Distributions of measurements for Ag from all recorded measurements grouped by location.

City of Little Rock Water Quality Parameters for Ag by Region

Distributions of measurements for Ag from all recorded measurements grouped by location.

City of Little Rock Water Quality Parameters for Ag by Region

Distributions of measurements for Ag from all recorded measurements grouped by location.

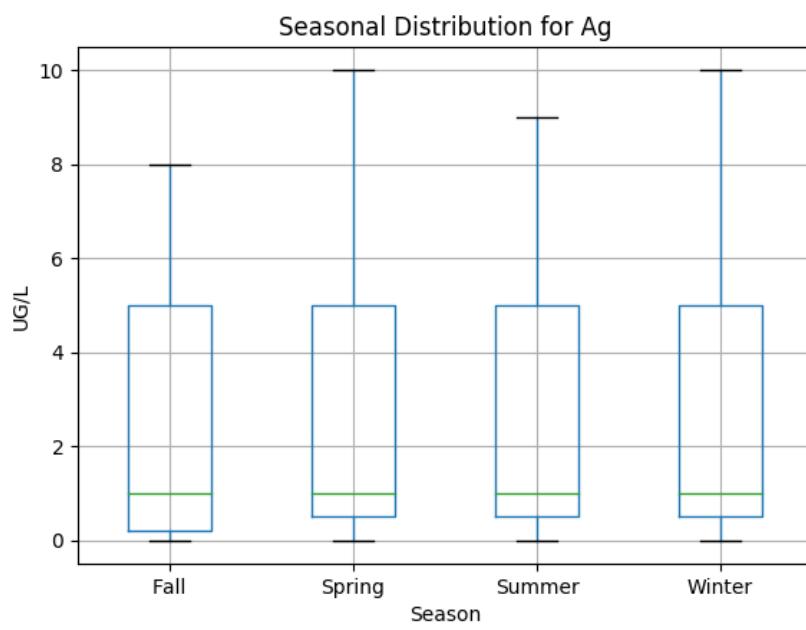


Figure 37: City of Little Rock Water Quality Parameters for Ag by Region

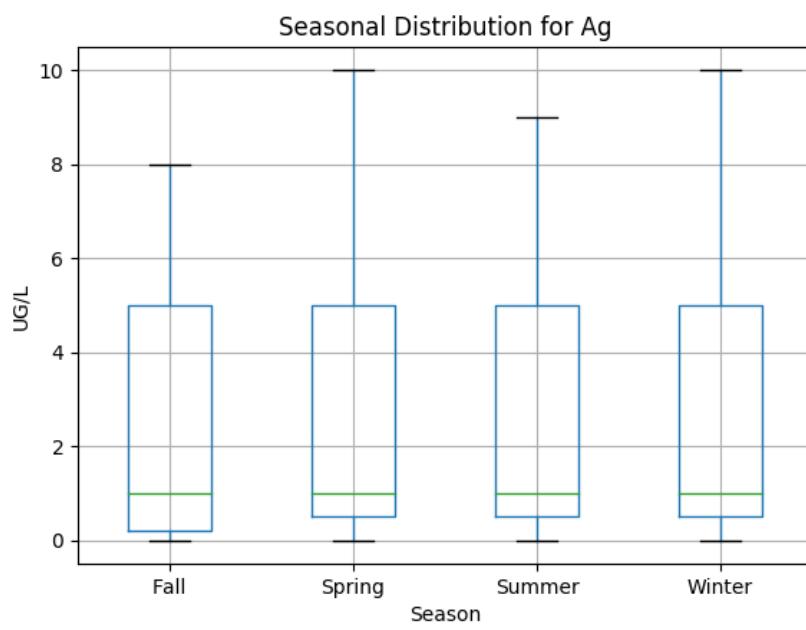


Figure 38: City of Little Rock Water Quality Parameters for Ag by Region

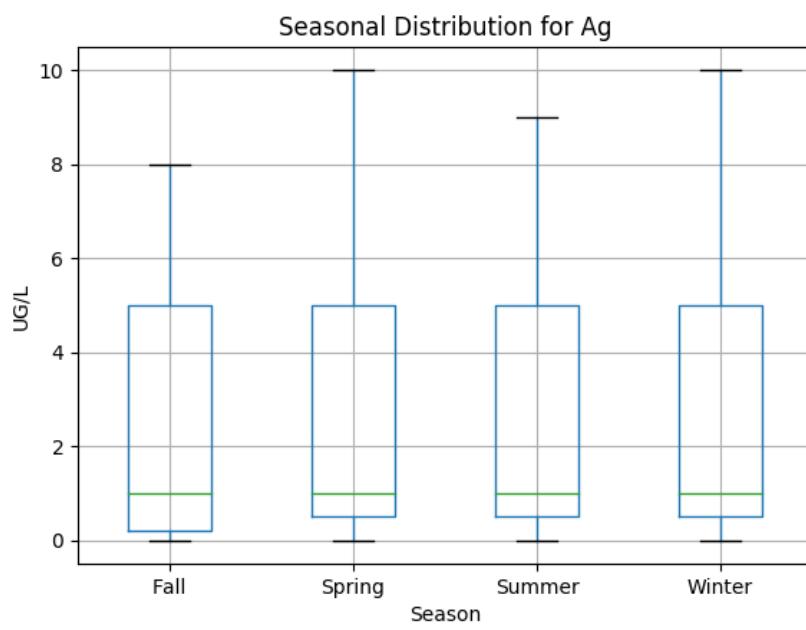


Figure 39: City of Little Rock Water Quality Parameters for Ag by Region

Appendix E: Seasonal Analysis

City of Little Rock Water Quality Parameters for Hg by season

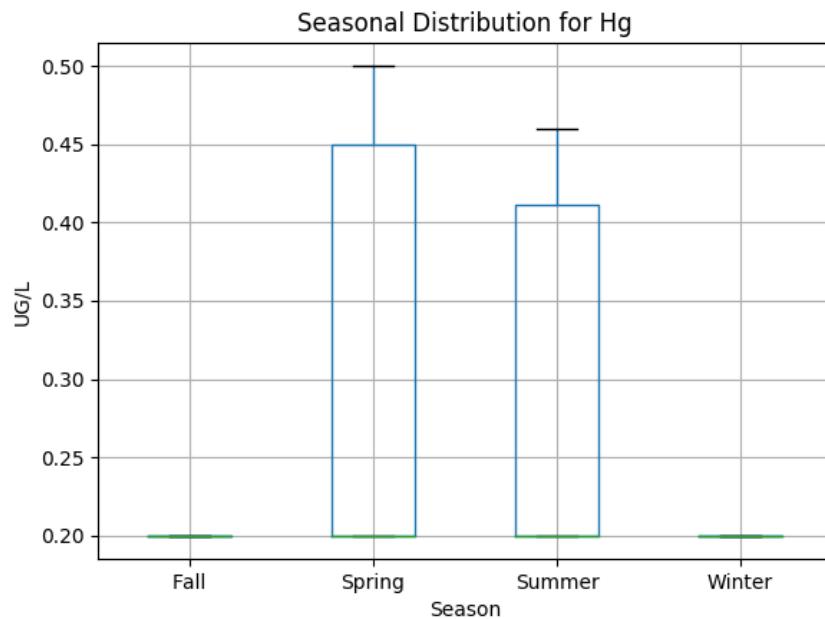


Figure 40: City of Little Rock Water Quality Parameters for Hg by season

Distributions of measurements for Hg from all recorded measurements grouped by season.

City of Little Rock Water Quality Parameters for Zn by season

Distributions of measurements for Zn from all recorded measurements grouped by season.

City of Little Rock Water Quality Parameters for N by season

Distributions of measurements for N from all recorded measurements grouped by season.

City of Little Rock Water Quality Parameters for BOD by season

Distributions of measurements for BOD from all recorded measurements grouped by season.

City of Little Rock Water Quality Parameters for Ni by season

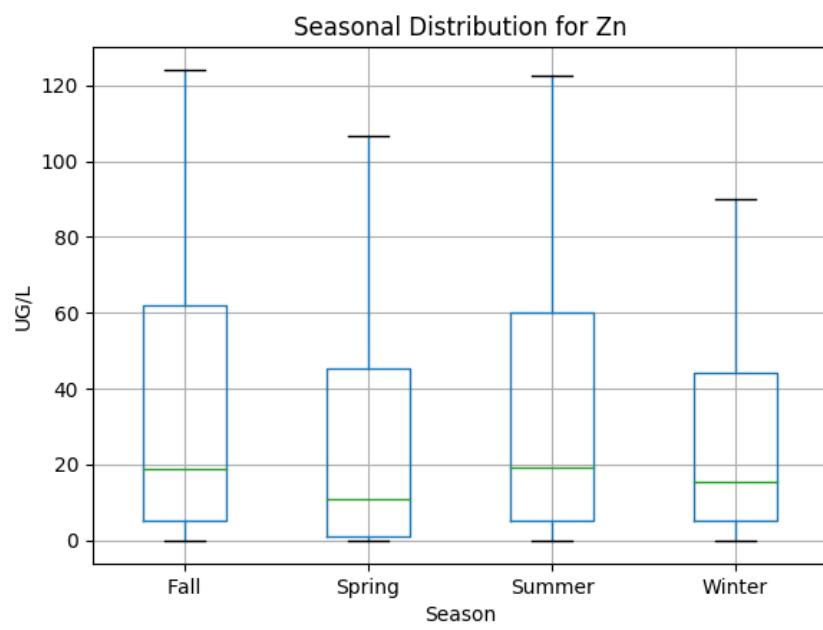


Figure 41: City of Little Rock Water Quality Parameters for Zn by season

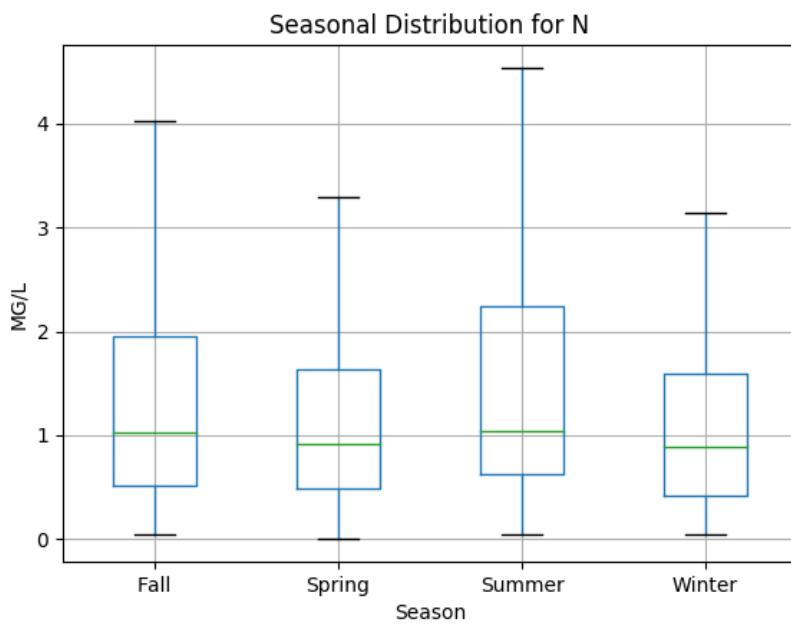


Figure 42: City of Little Rock Water Quality Parameters for N by season

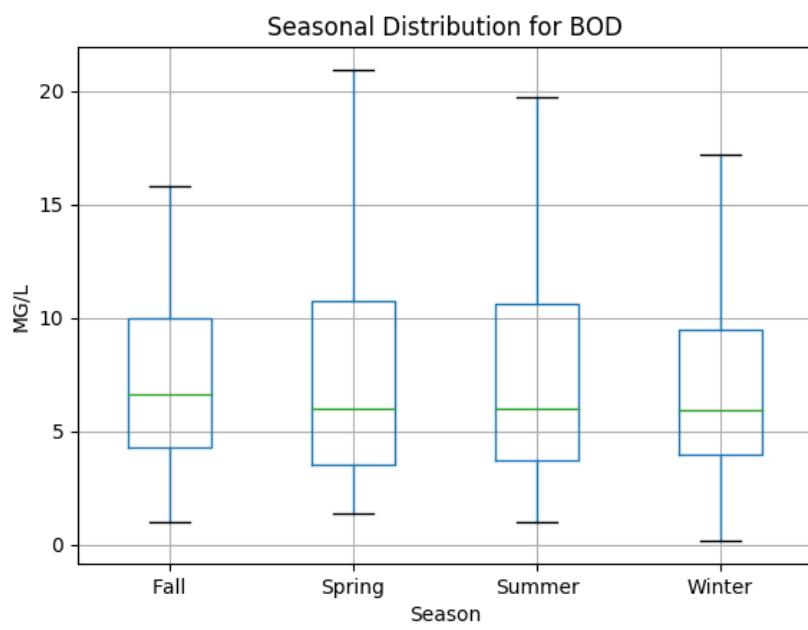


Figure 43: City of Little Rock Water Quality Parameters for BOD by season

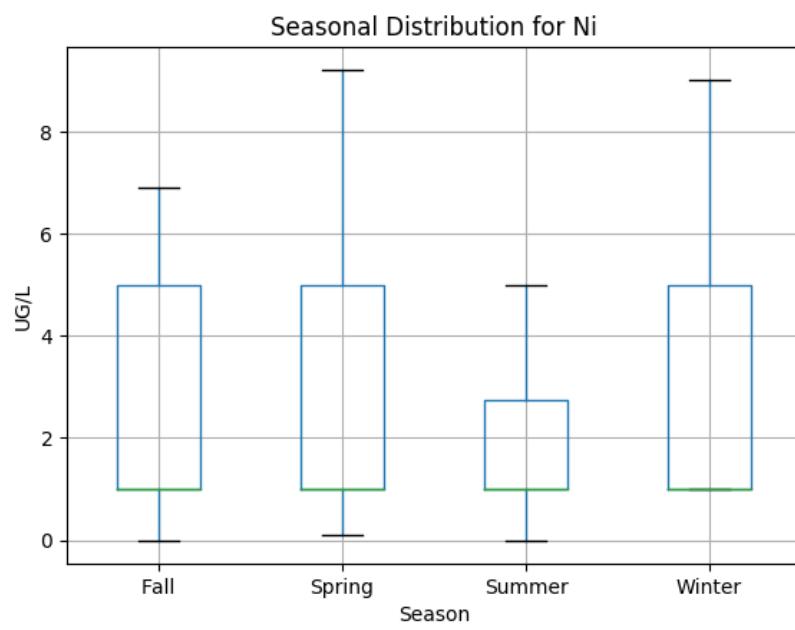


Figure 44: City of Little Rock Water Quality Parameters for Ni by season

Distributions of measurements for Ni from all recorded measurements grouped by season.

City of Little Rock Water Quality Parameters for TSS by season

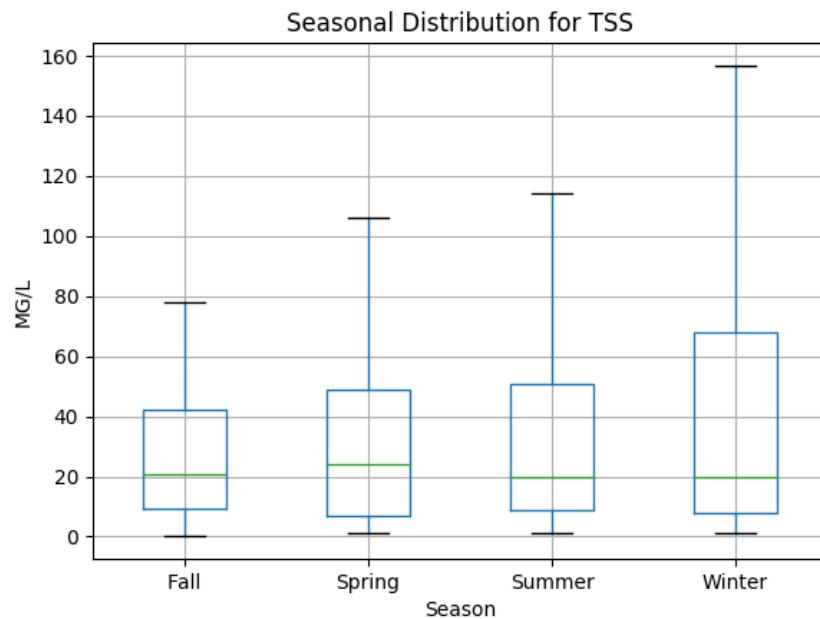


Figure 45: City of Little Rock Water Quality Parameters for TSS by season

Distributions of measurements for TSS from all recorded measurements grouped by season.

City of Little Rock Water Quality Parameters for Pb by season

Distributions of measurements for Pb from all recorded measurements grouped by season.

City of Little Rock Water Quality Parameters for P by season

Distributions of measurements for P from all recorded measurements grouped by season.

City of Little Rock Water Quality Parameters for Streptococci by season

Distributions of measurements for Streptococci from all recorded measurements grouped by season.

City of Little Rock Water Quality Parameters for Cyanide by season

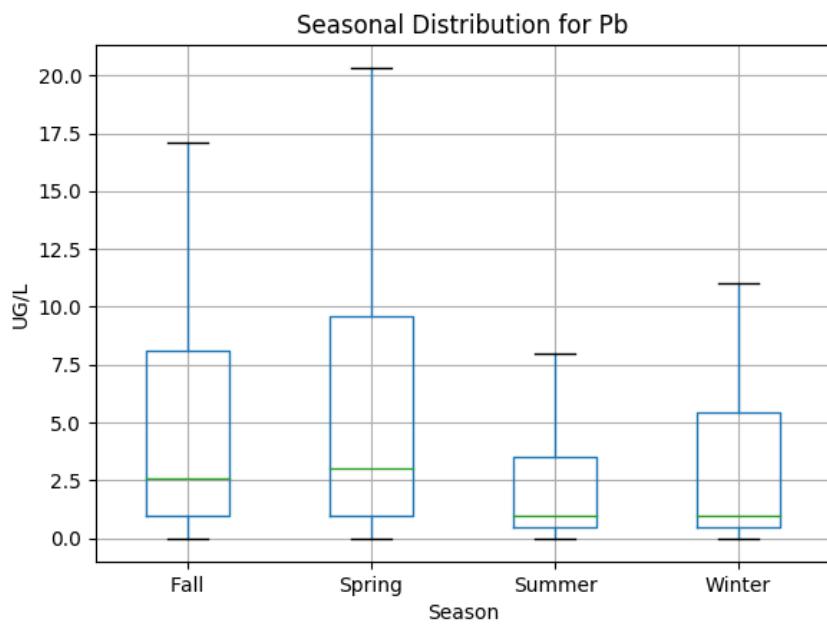


Figure 46: City of Little Rock Water Quality Parameters for Pb by season

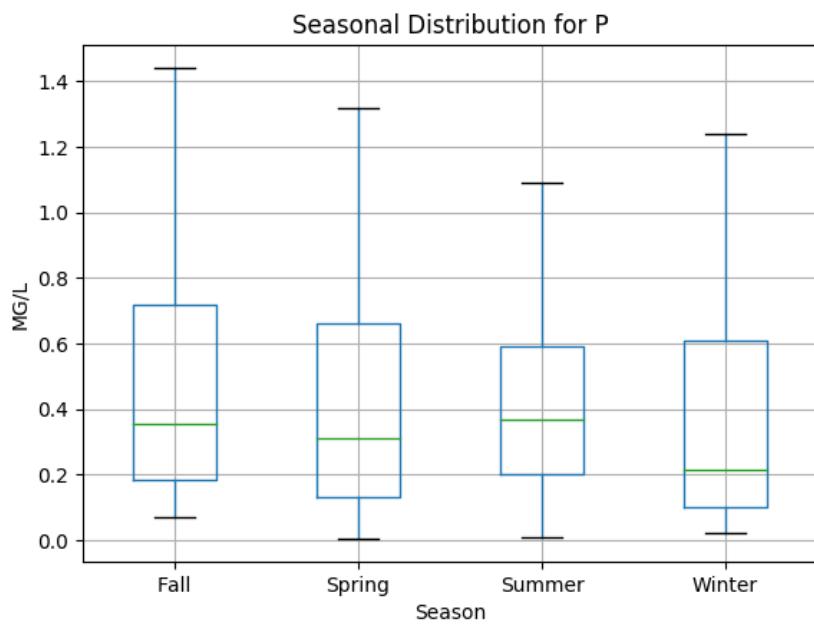


Figure 47: City of Little Rock Water Quality Parameters for P by season

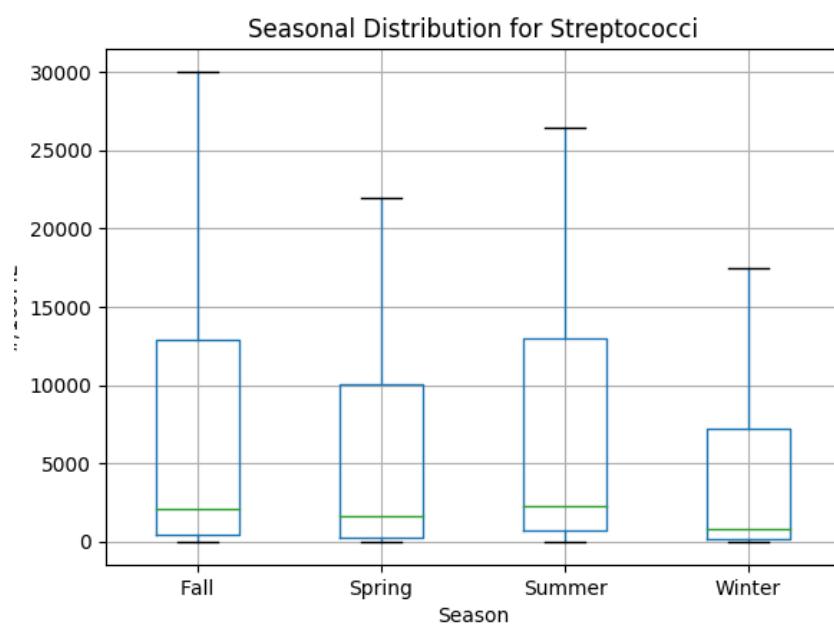


Figure 48: City of Little Rock Water Quality Parameters for Streptococci by season

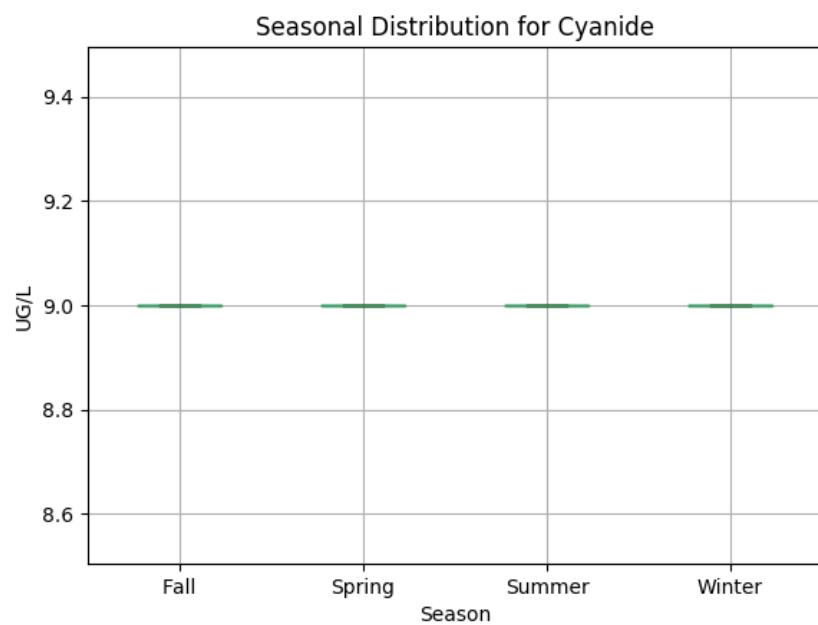


Figure 49: City of Little Rock Water Quality Parameters for Cyanide by season

Distributions of measurements for Cyanide from all recorded measurements grouped by season.

City of Little Rock Water Quality Parameters for TDS by season

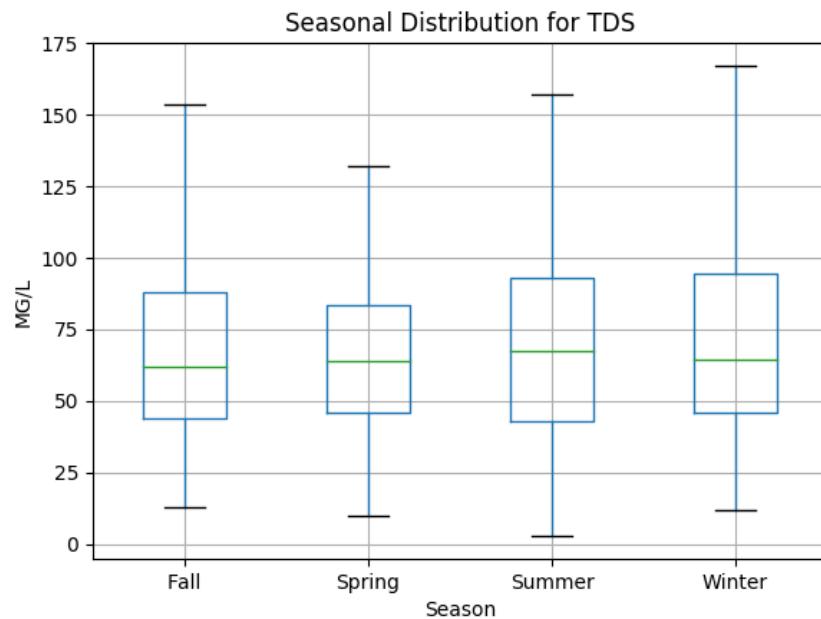


Figure 50: City of Little Rock Water Quality Parameters for TDS by season

Distributions of measurements for TDS from all recorded measurements grouped by season.

City of Little Rock Water Quality Parameters for Oil by season

Distributions of measurements for Oil from all recorded measurements grouped by season.

City of Little Rock Water Quality Parameters for Cr by season

Distributions of measurements for Cr from all recorded measurements grouped by season.

City of Little Rock Water Quality Parameters for Se by season

Distributions of measurements for Se from all recorded measurements grouped by season.

City of Little Rock Water Quality Parameters for Cd by season

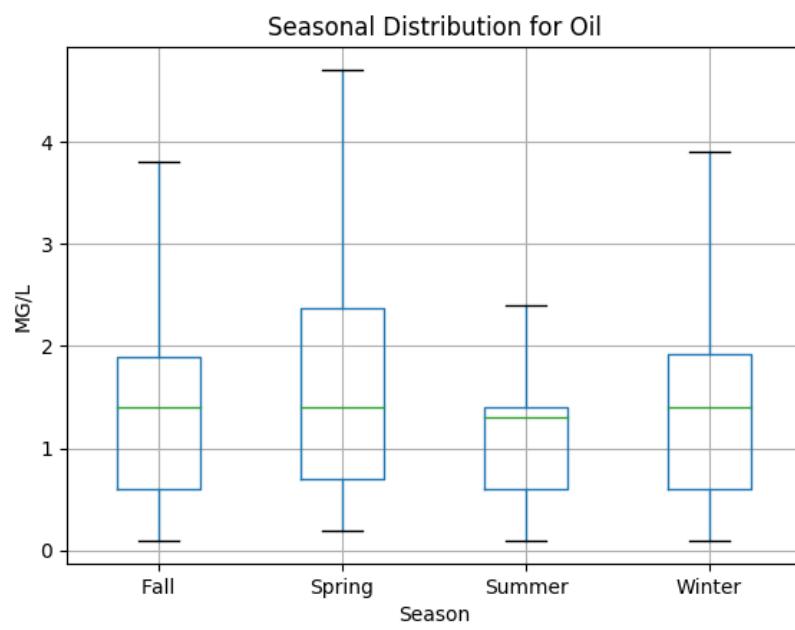


Figure 51: City of Little Rock Water Quality Parameters for Oil by season

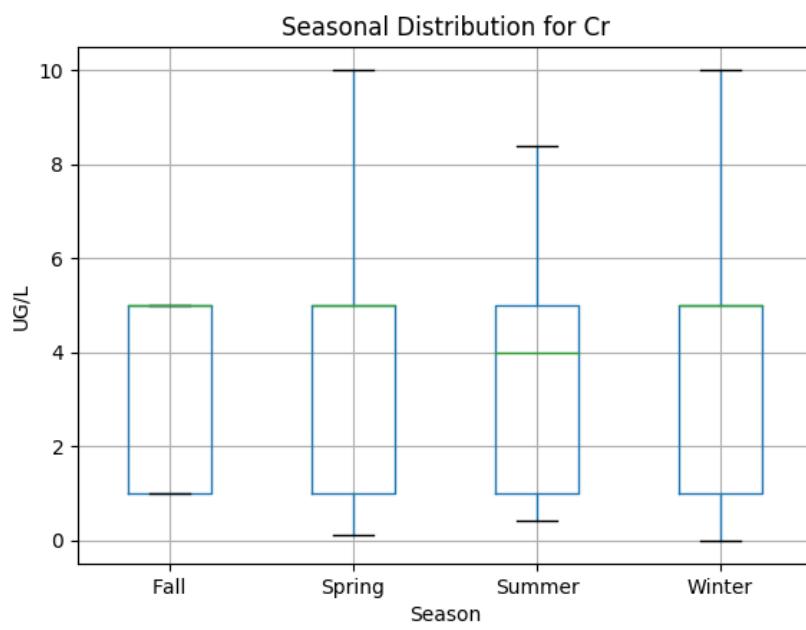


Figure 52: City of Little Rock Water Quality Parameters for Cr by season

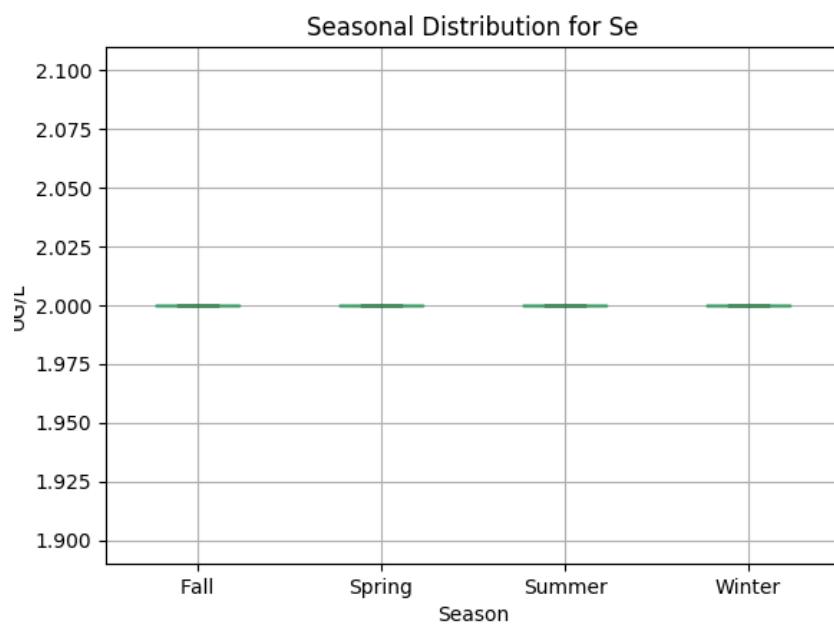


Figure 53: City of Little Rock Water Quality Parameters for Se by season

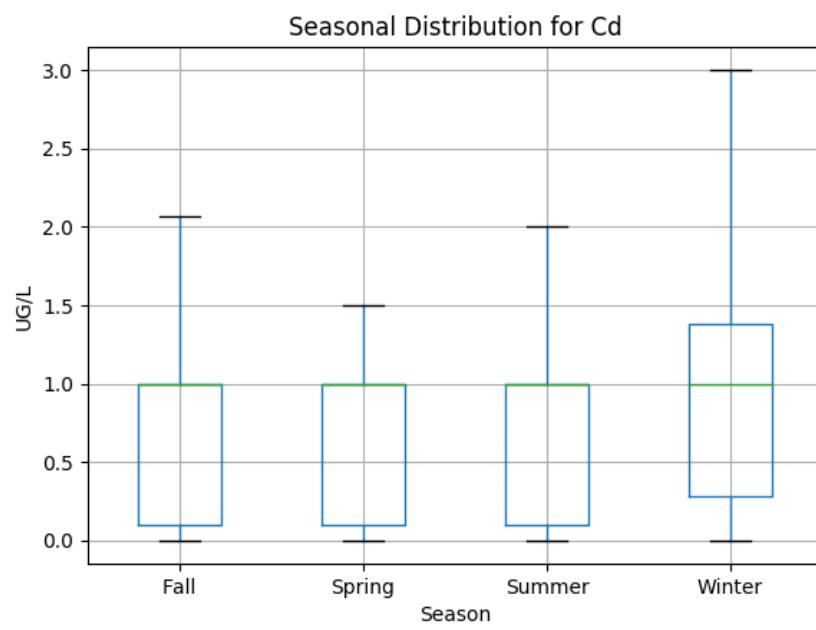


Figure 54: City of Little Rock Water Quality Parameters for Cd by season

Distributions of measurements for Cd from all recorded measurements grouped by season.

City of Little Rock Water Quality Parameters for E.Coli by season

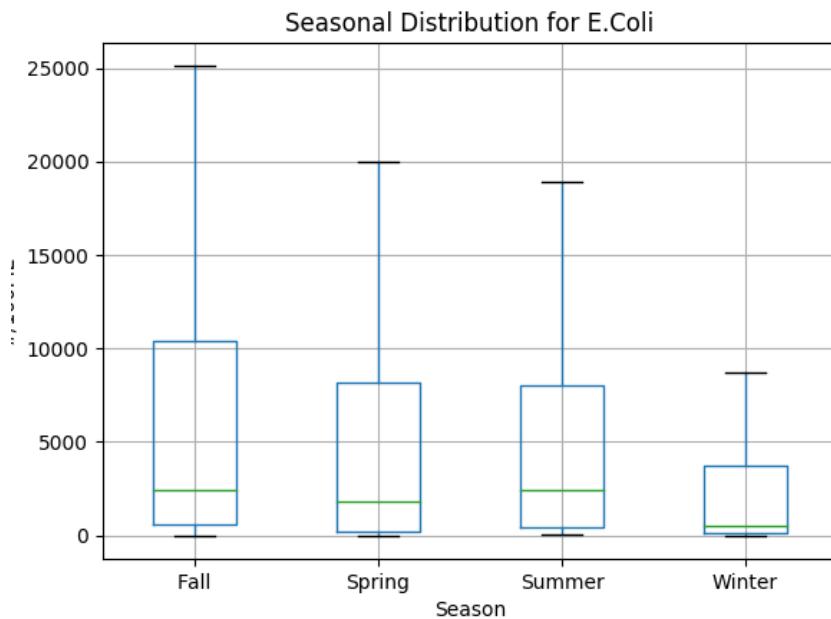


Figure 55: City of Little Rock Water Quality Parameters for E.Coli by season

Distributions of measurements for E.Coli from all recorded measurements grouped by season.

City of Little Rock Water Quality Parameters for N, Kjeldahl by season

Distributions of measurements for N, Kjeldahl from all recorded measurements grouped by season.

City of Little Rock Water Quality Parameters for BOD, C by season

Distributions of measurements for BOD, C from all recorded measurements grouped by season.

City of Little Rock Water Quality Parameters for CaCO₃ by season

Distributions of measurements for CaCO₃ from all recorded measurements grouped by season.

City of Little Rock Water Quality Parameters for Flow by season

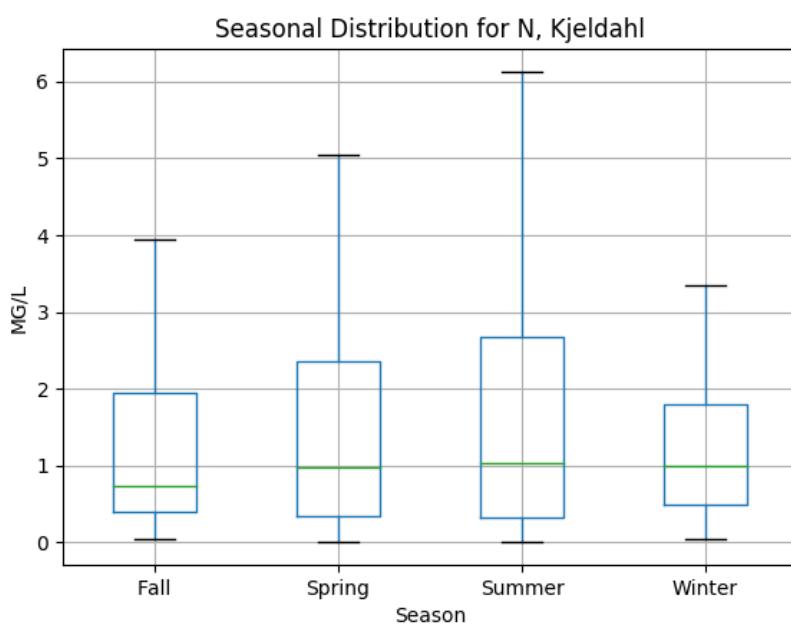


Figure 56: City of Little Rock Water Quality Parameters for N, Kjeldahl by season

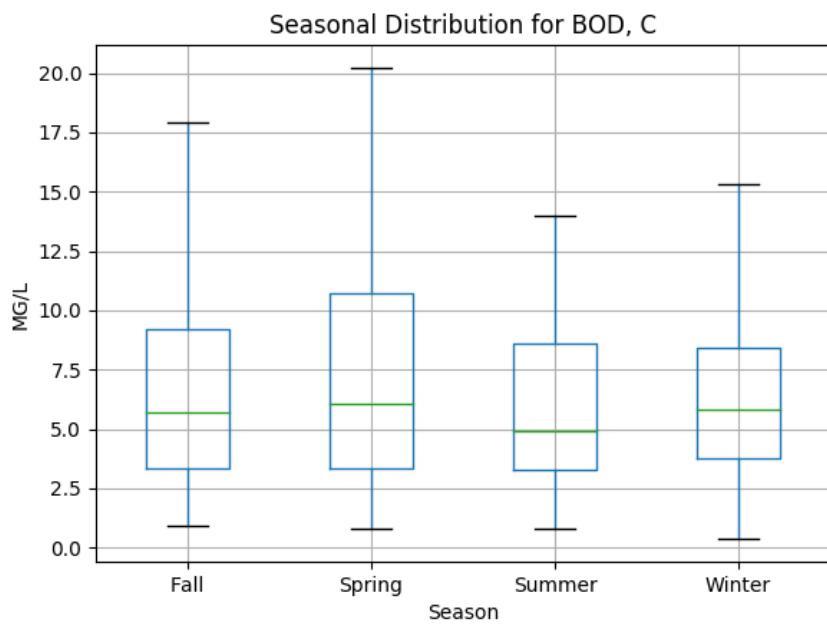


Figure 57: City of Little Rock Water Quality Parameters for BOD, C by season

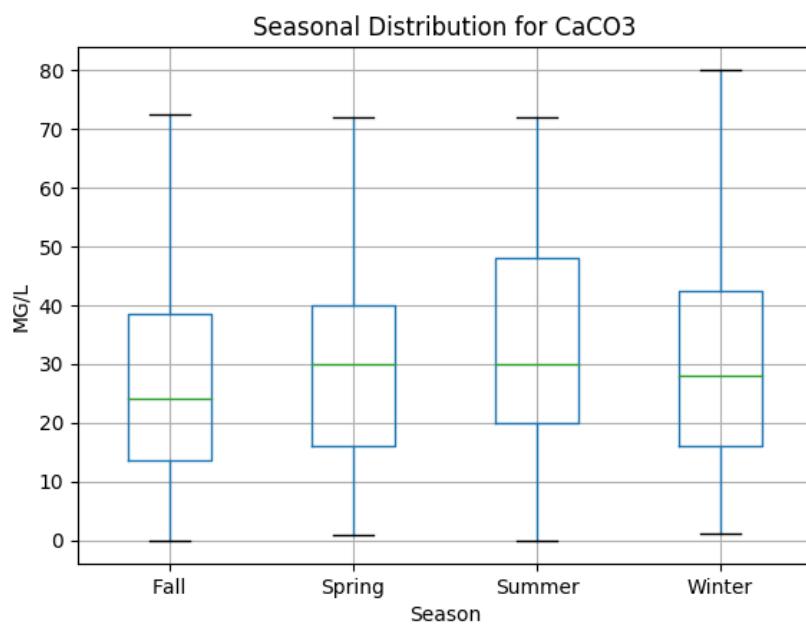


Figure 58: City of Little Rock Water Quality Parameters for CaCO₃ by season

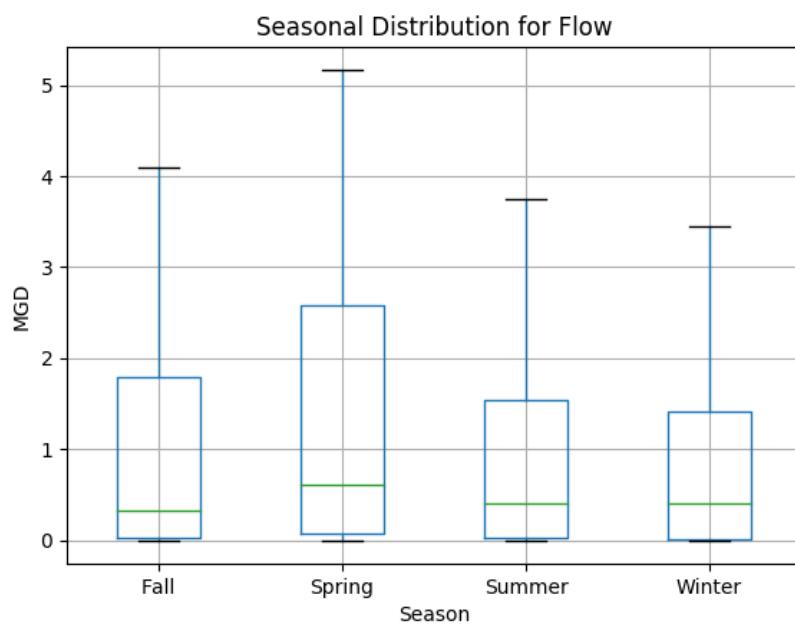


Figure 59: City of Little Rock Water Quality Parameters for Flow by season

Distributions of measurements for Flow from all recorded measurements grouped by season.

City of Little Rock Water Quality Parameters for Be by season

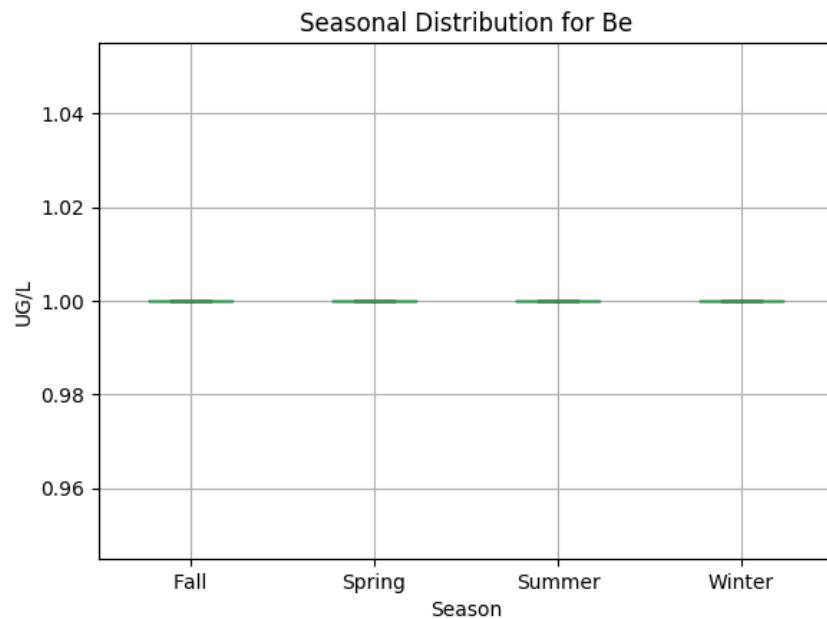


Figure 60: City of Little Rock Water Quality Parameters for Be by season

Distributions of measurements for Be from all recorded measurements grouped by season.

City of Little Rock Water Quality Parameters for pH by season

Distributions of measurements for pH from all recorded measurements grouped by season.

City of Little Rock Water Quality Parameters for Cu by season

Distributions of measurements for Cu from all recorded measurements grouped by season.

City of Little Rock Water Quality Parameters for Ag by season

Distributions of measurements for Ag from all recorded measurements grouped by season.

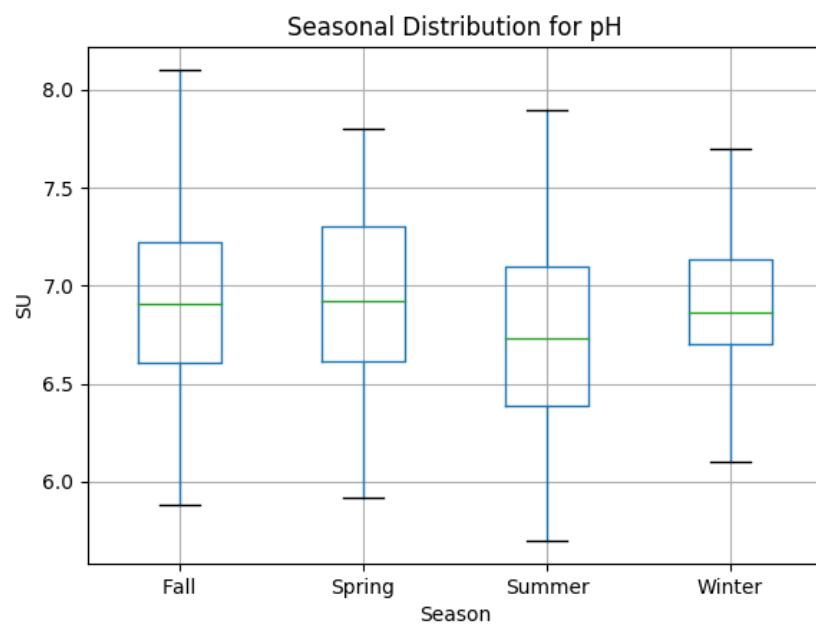


Figure 61: City of Little Rock Water Quality Parameters for pH by season

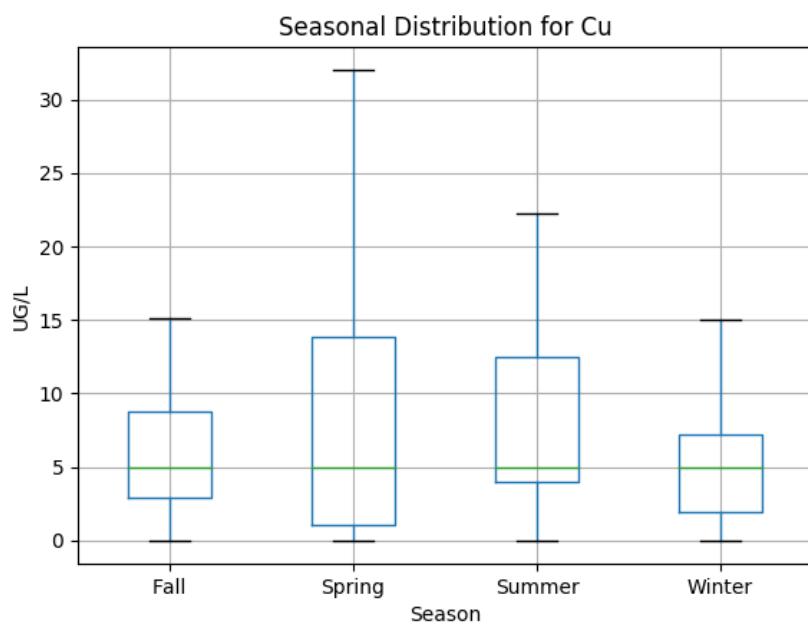


Figure 62: City of Little Rock Water Quality Parameters for Cu by season

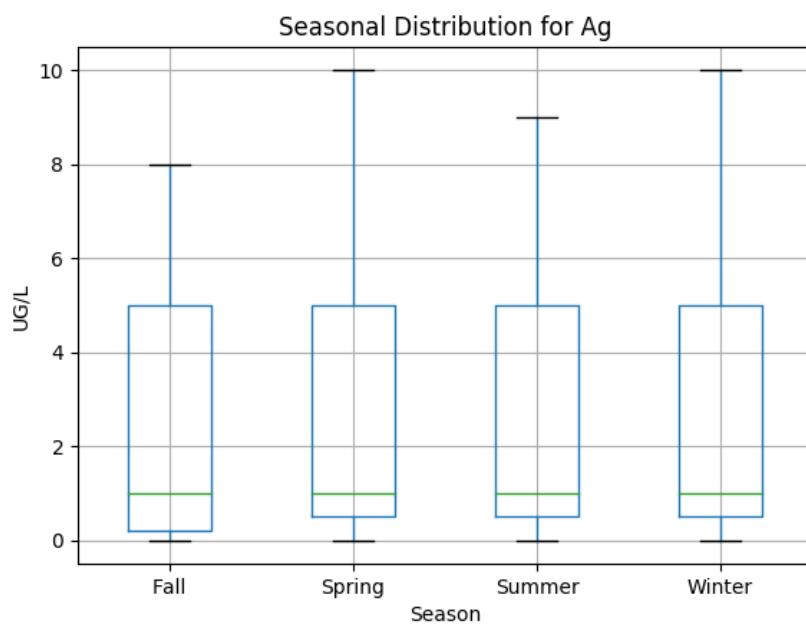


Figure 63: City of Little Rock Water Quality Parameters for Ag by season

Appendix G: Water Quality Trend Analysis

City of Little Rock Water Quality Parameters for se

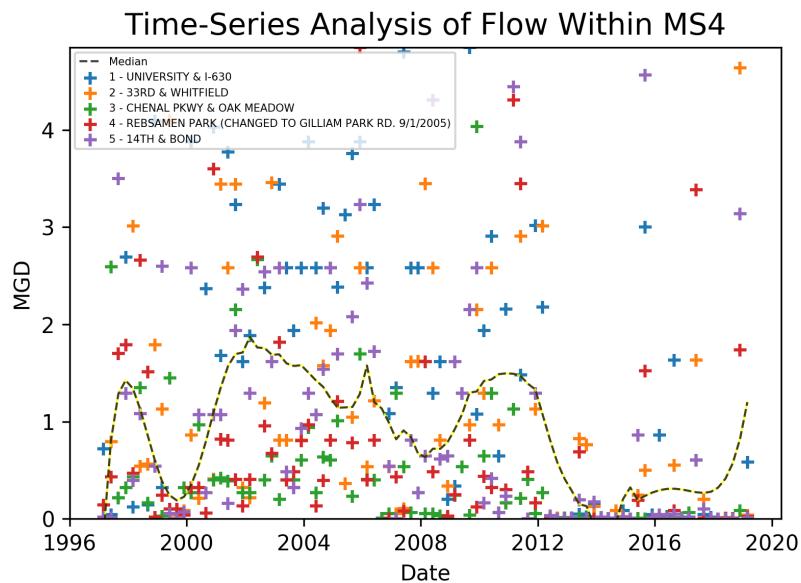


Figure 64: City of Little Rock Water Quality Parameters for se

Scatter plot of water quality measurements for se at each sampling location. The **median** line is the median for measurements at all locations passed through a noise-filtering algorithm for better legibility

City of Little Rock Water Quality Parameters for se

Scatter plot of water quality measurements for se at each sampling location. The **median** line is the median for measurements at all locations passed through a noise-filtering algorithm for better legibility

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City of Little Rock Water Quality Parameters for se

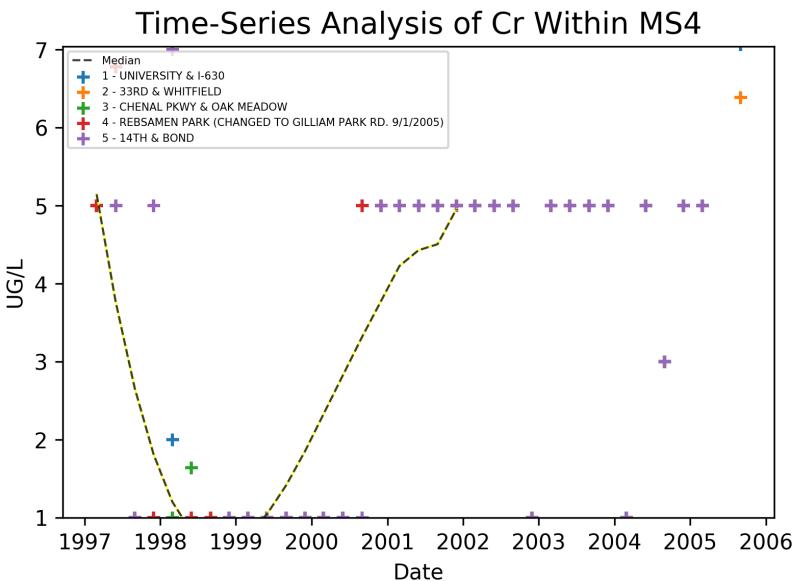


Figure 65: City of Little Rock Water Quality Parameters for se

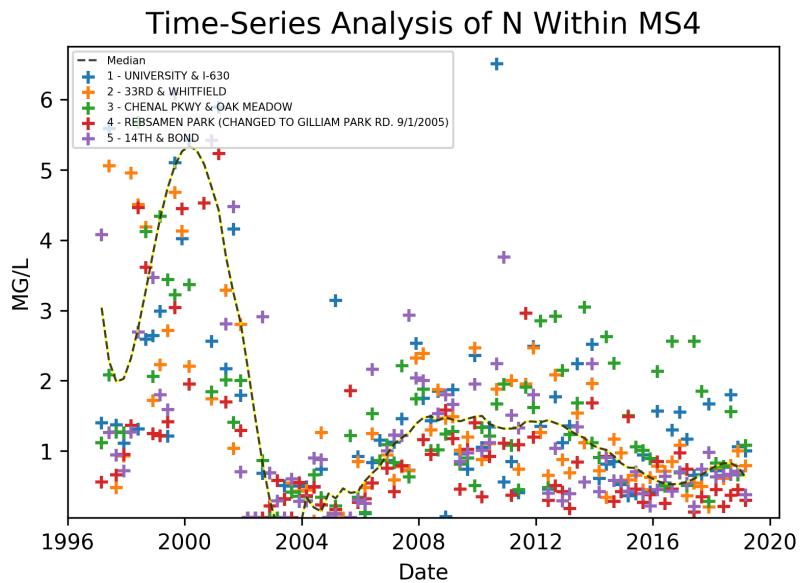


Figure 66: City of Little Rock Water Quality Parameters for se

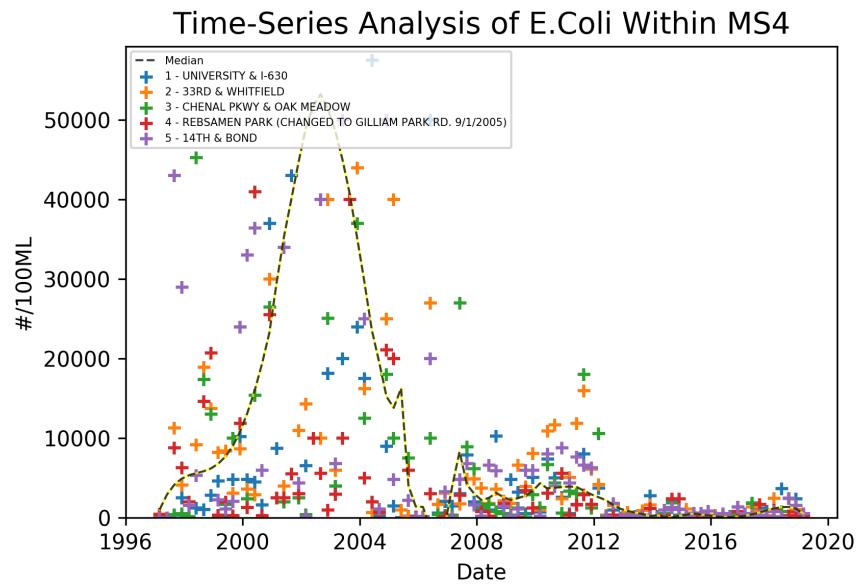


Figure 67: City of Little Rock Water Quality Parameters for se

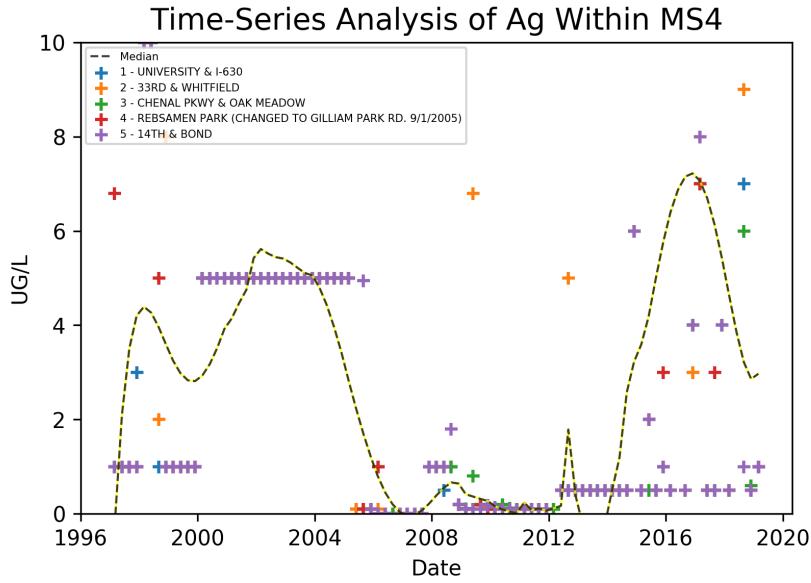


Figure 68: City of Little Rock Water Quality Parameters for se

Scatter plot of water quality measurements for se at each sampling location. The **median** line is the median for measurements at all locations passed through a noise-filtering algorithm for better legibility

City of Little Rock Water Quality Parameters for se

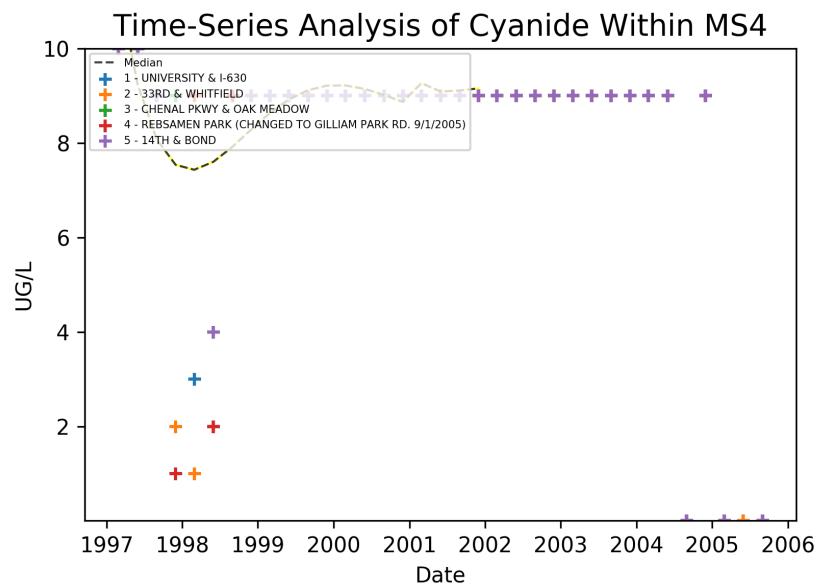


Figure 69: City of Little Rock Water Quality Parameters for se

Scatter plot of water quality measurements for se at each sampling location. The **median** line is the median for measurements at all locations passed through a noise-filtering algorithm for better legibility

City of Little Rock Water Quality Parameters for se

Scatter plot of water quality measurements for se at each sampling location. The **median** line is the median for measurements at all locations passed through a noise-filtering algorithm for better legibility

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City of Little Rock Water Quality Parameters for se

Scatter plot of water quality measurements for se at each sampling location. The **median** line is the median for measurements at all locations passed through a noise-filtering algorithm for better legibility

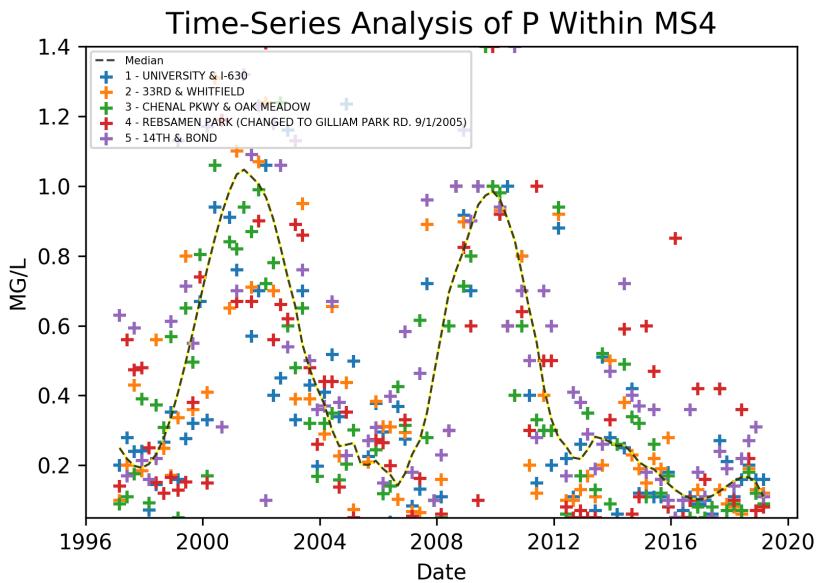


Figure 70: City of Little Rock Water Quality Parameters for se

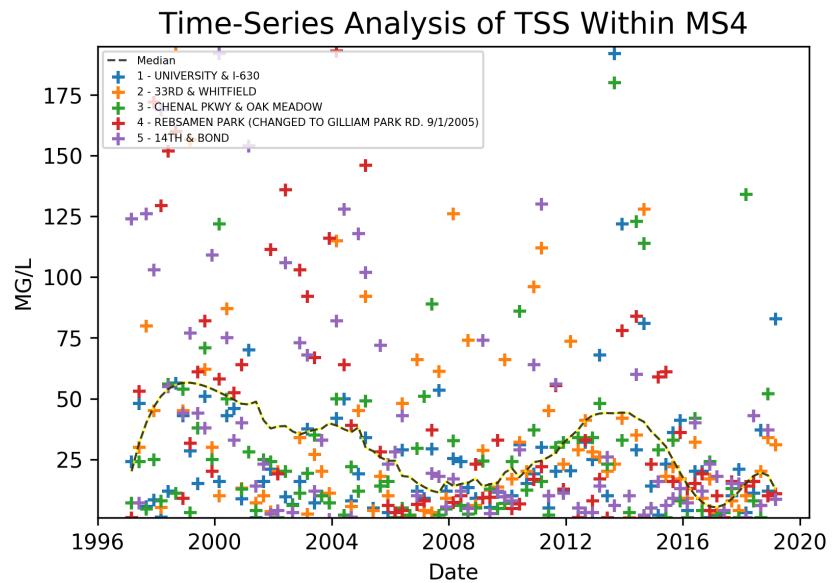


Figure 71: City of Little Rock Water Quality Parameters for se

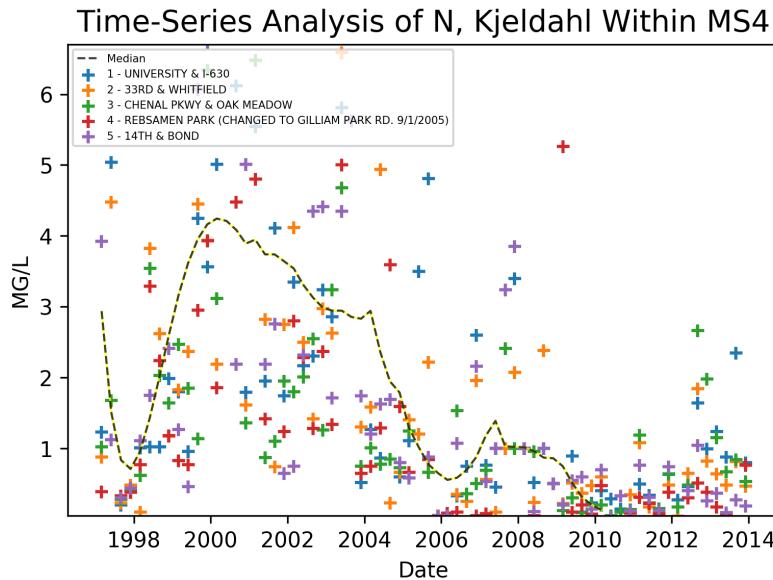


Figure 72: City of Little Rock Water Quality Parameters for se

City of Little Rock Water Quality Parameters for se

Scatter plot of water quality measurements for se at each sampling location. The **median** line is the median for measurements at all locations passed through a noise-filtering algorithm for better legibility

City of Little Rock Water Quality Parameters for se

Scatter plot of water quality measurements for se at each sampling location. The **median** line is the median for measurements at all locations passed through a noise-filtering algorithm for better legibility

City of Little Rock Water Quality Parameters for se

Scatter plot of water quality measurements for se at each sampling location. The **median** line is the median for measurements at all locations passed through a noise-filtering algorithm for better legibility

City of Little Rock Water Quality Parameters for se

Scatter plot of water quality measurements for se at each sampling location. The **median** line is the median for measurements at all locations passed through a noise-filtering algorithm for better legibility

City of Little Rock Water Quality Parameters for se

Scatter plot of water quality measurements for se at each sampling location. The

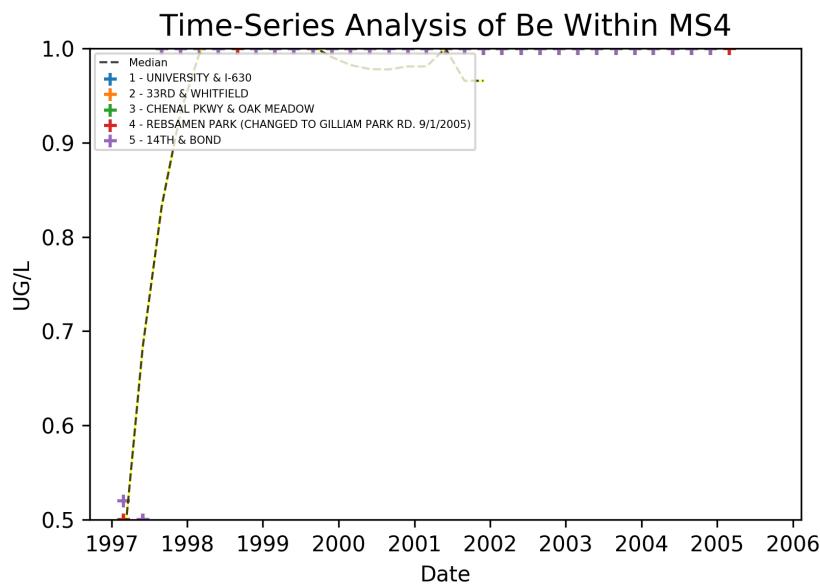


Figure 73: City of Little Rock Water Quality Parameters for se

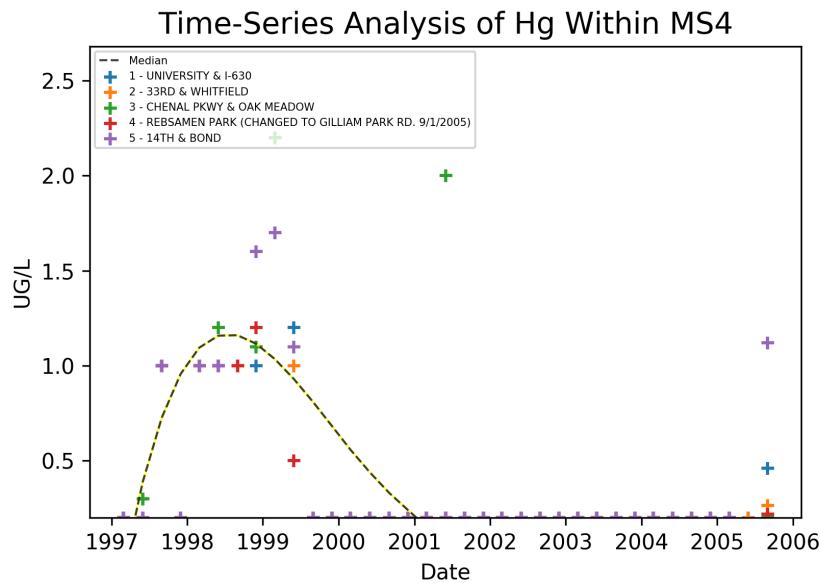


Figure 74: City of Little Rock Water Quality Parameters for se

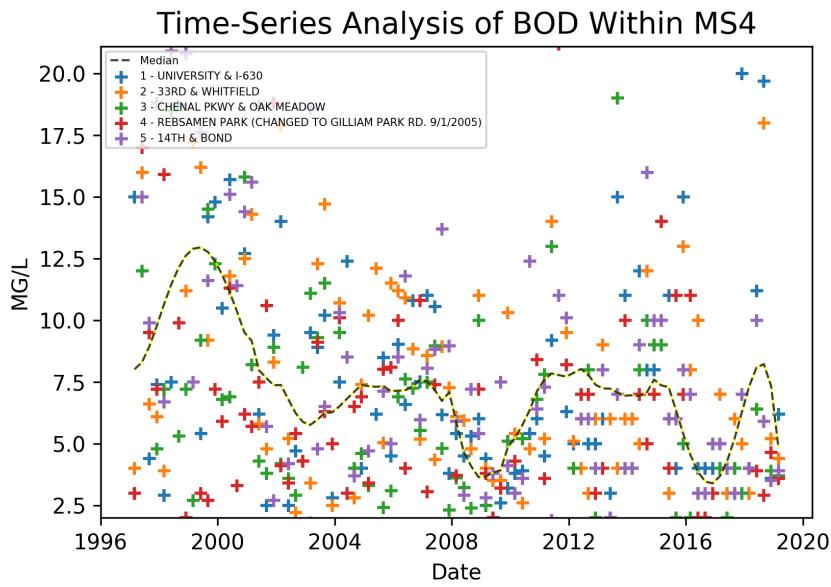


Figure 75: City of Little Rock Water Quality Parameters for se

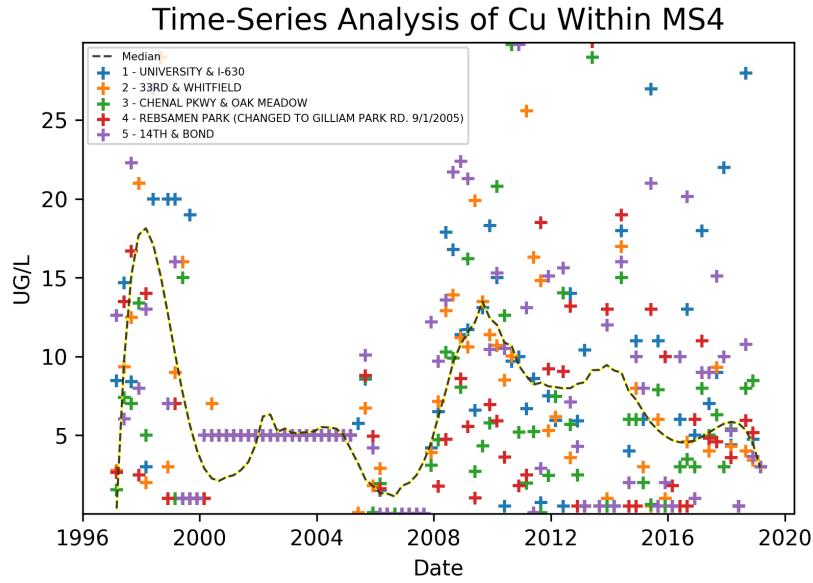


Figure 76: City of Little Rock Water Quality Parameters for se

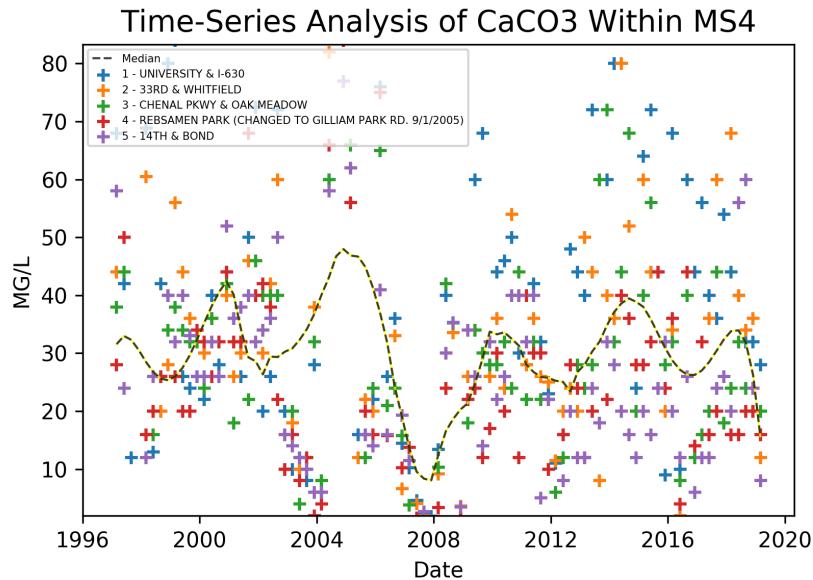


Figure 77: City of Little Rock Water Quality Parameters for se

median line is the median for measurements at all locations passed through a noise-filtering algorithm for better legibility

City of Little Rock Water Quality Parameters for se

Scatter plot of water quality measurements for se at each sampling location. The **median** line is the median for measurements at all locations passed through a noise-filtering algorithm for better legibility

City of Little Rock Water Quality Parameters for se

Scatter plot of water quality measurements for se at each sampling location. The **median** line is the median for measurements at all locations passed through a noise-filtering algorithm for better legibility

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City of Little Rock Water Quality Parameters for se

Scatter plot of water quality measurements for se at each sampling location. The **median** line is the median for measurements at all locations passed through a noise-filtering algorithm for better legibility

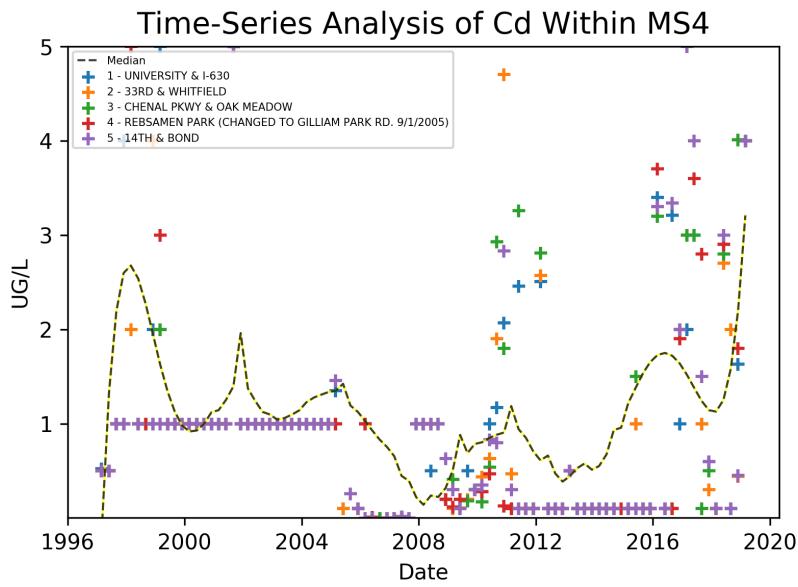


Figure 78: City of Little Rock Water Quality Parameters for se

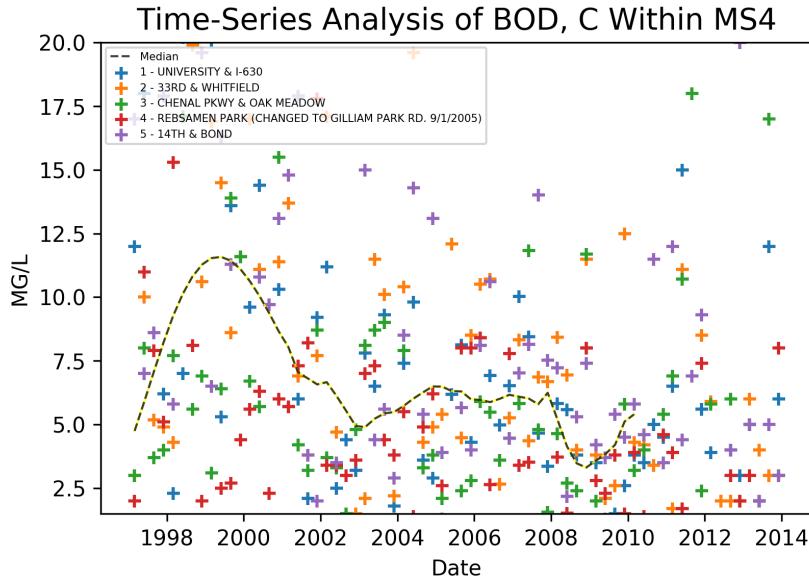


Figure 79: City of Little Rock Water Quality Parameters for se

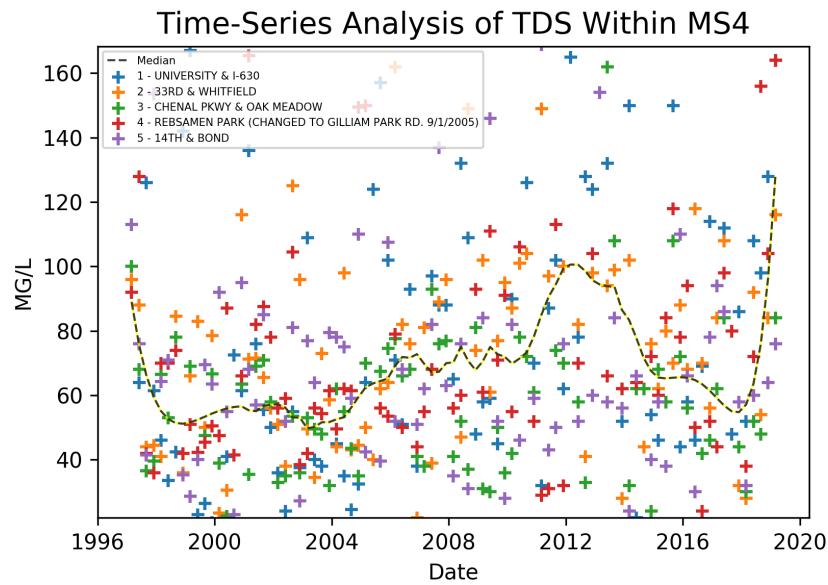


Figure 80: City of Little Rock Water Quality Parameters for se

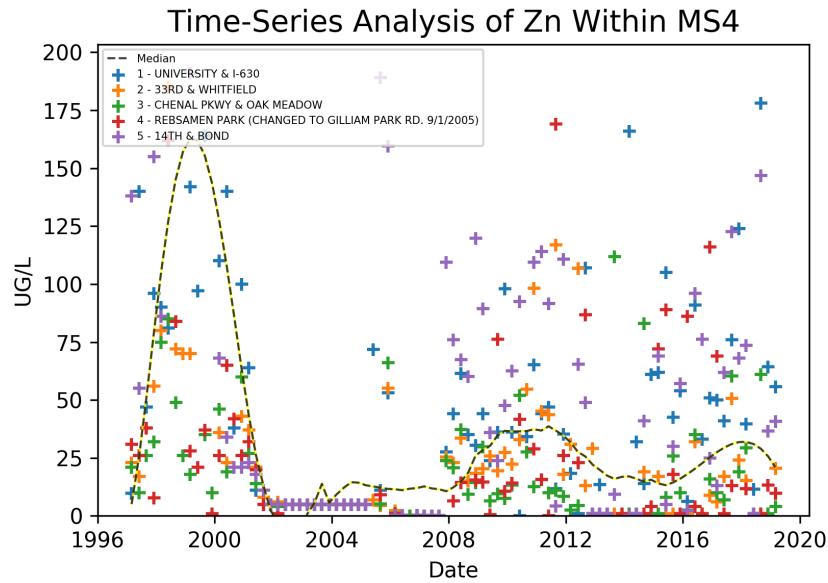


Figure 81: City of Little Rock Water Quality Parameters for se

City of Little Rock Water Quality Parameters for se

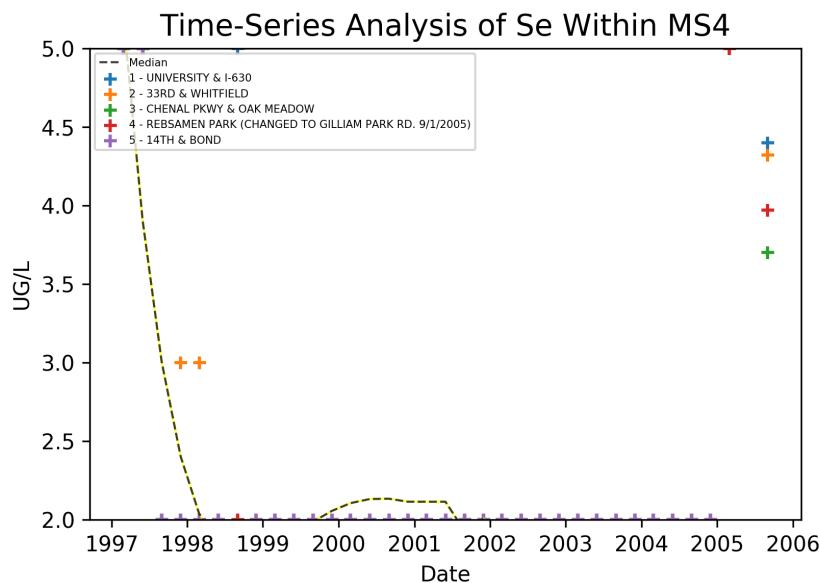


Figure 82: City of Little Rock Water Quality Parameters for se

Scatter plot of water quality measurements for se at each sampling location. The **median** line is the median for measurements at all locations passed through a noise-filtering algorithm for better legibility

City of Little Rock Water Quality Parameters for se

Scatter plot of water quality measurements for se at each sampling location. The **median** line is the median for measurements at all locations passed through a noise-filtering algorithm for better legibility

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Scatter plot of water quality measurements for se at each sampling location. The **median** line is the median for measurements at all locations passed through a noise-filtering algorithm for better legibility

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Scatter plot of water quality measurements for se at each sampling location. The **median** line is the median for measurements at all locations passed through a noise-filtering algorithm for better legibility

City of Little Rock Water Quality Parameters for se

Scatter plot of water quality measurements for se at each sampling location. The **median** line is the median for measurements at all locations passed through a

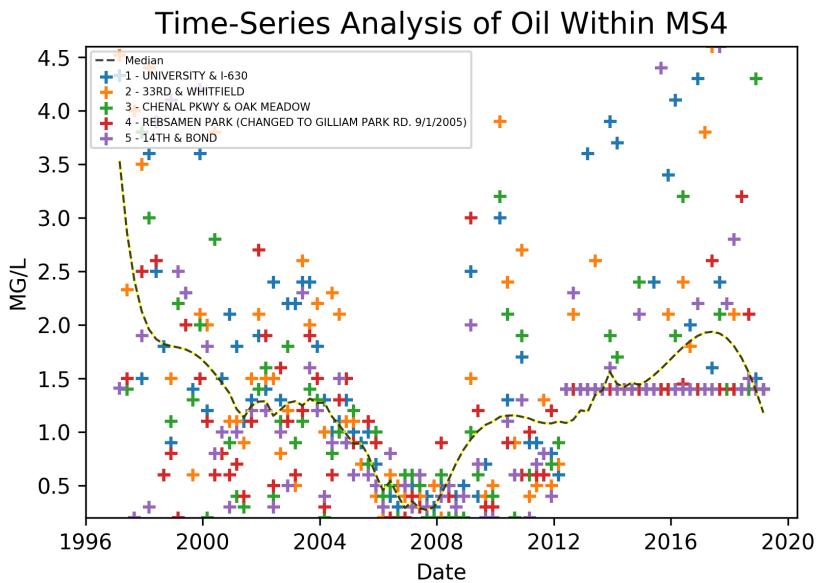


Figure 83: City of Little Rock Water Quality Parameters for se

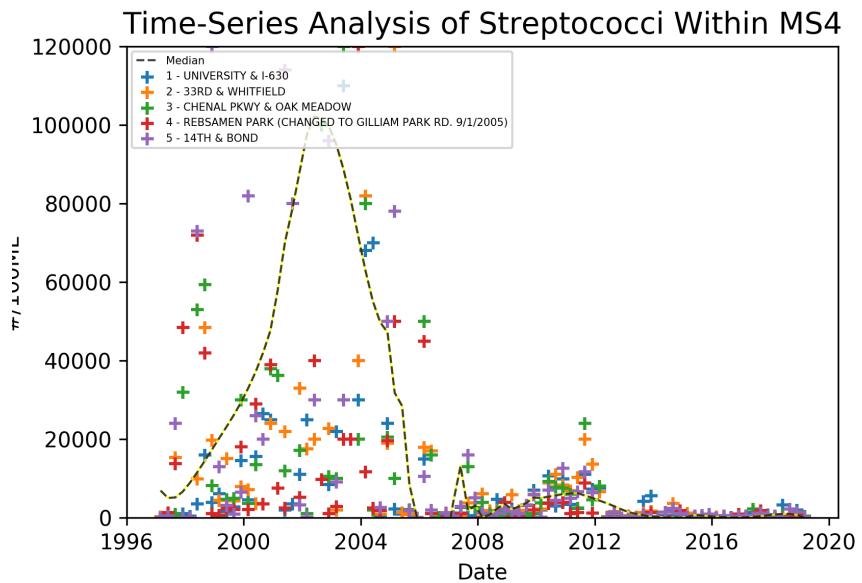


Figure 84: City of Little Rock Water Quality Parameters for se

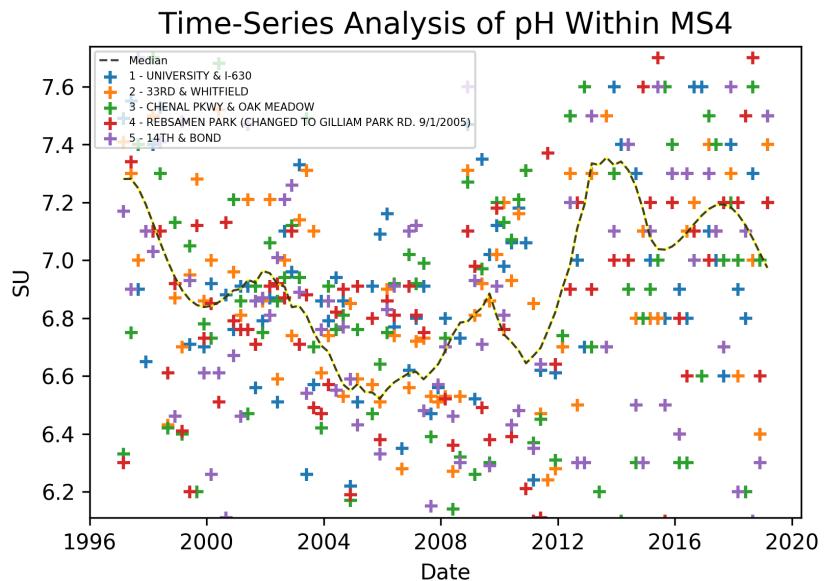


Figure 85: City of Little Rock Water Quality Parameters for se

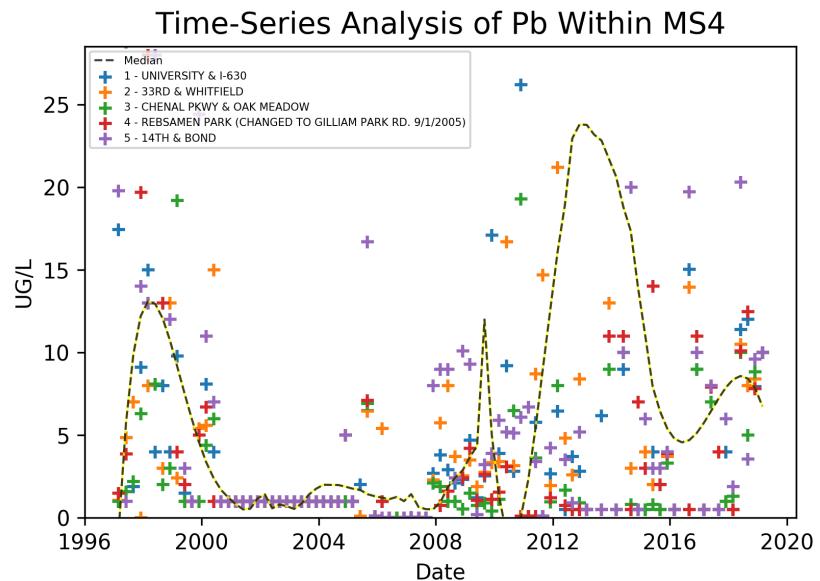


Figure 86: City of Little Rock Water Quality Parameters for se

noise-filtering algorithm for better legibility

City of Little Rock Water Quality Parameters for se

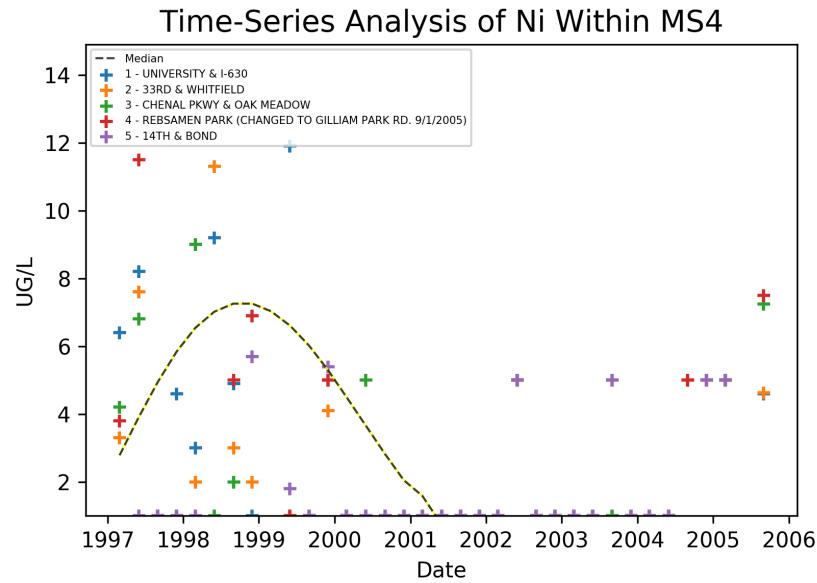


Figure 87: City of Little Rock Water Quality Parameters for se

Scatter plot of water quality measurements for se at each sampling location. The **median** line is the median for measurements at all locations passed through a noise-filtering algorithm for better legibility