8976 Wellington Road
Manassas, VA 20109

January 22, 2021

Gary Priscott
New York State Department of Environmental Remediation
1679 Route 11
Kirkwood, NY 13795

Re: Periodic Review Report and IC/EC Certification Submittal
IBM Gun Club, Former Burn Pit Area
Robinson Hill Road, Union, NY 13760
NYSDEC Site # C704044

Dear Mr. Priscott:

This letter serves to transmit copies of the Periodic Review Report and required IC/EC Certifications to the New York State Departments of Conservation (NYSDEC). The remedy performance monitoring work and the preparation of this report were completed by Sanborn, Head Engineering, P.C. (SHPC) in accordance with NYSDEC-approved Site Management Plan (SMP) for this project.

If you have any questions regarding the enclosed report, please contact me at 703-257-2580.

Regards,

Stephen P Brown

Stephen Brown
IBM Program Manager

Enclosures: 2020 Periodic Review Report and Certification Form

cc: Kevin O'Hara (Binghamton Country Club)
Eamonn O'Neil (NYSDOH)
Maureen Schuck (NYSDOH)

SANBORN HEAD ENGINEERING
Building Trust. Engineering Success.

20 Foundry Street
Concord, NH 03301

Stephen Brown, P.E.
IBM Corporate Environmental Affairs
8976 Wellington Road
Manassas, Virginia 20109

January 22, 2021
File No. 3526.05

Re: 2020 Periodic Review Report
IBM Gun Club – Former Burn Pit Area
Union, New York
BCP Agreement #C704044

Dear Mr. Brown:

This letter and attachments comprise the 2020 Periodic Review Report (PRR) of the remedy status for the above-referenced site. The PRR has been prepared on behalf of IBM by Sanborn, Head Engineering P.C. (SHPC) for submittal to the New York State Department of Environmental Conservation (NYSDEC) and Department of Health (NYSDOH), collectively the Departments, in accordance with the requirements of the Site Management Plan of April 2016 (SMP). We understand that a copy of this PRR will be provided to the Binghamton Country Club (Country Club), who took ownership of the site at the end of 2015.

This PRR includes the following:

Attachment A – Institutional and Engineering Controls Certification Form
Attachment B – Remedy Performance Testing Reports of April, September, and November 2020
Attachment C – Site-Wide Inspection Report for October 2020
Attachment D – Maintenance Reports for 2020

For the PRR Certification (Attachment A), the items in boxes 1, 2, and 3 list the questions/statements that the Country Club as the site owner has certified by adding a signature in Box 6. The items in Box 2A are technical matters pertaining to past Remedial Investigation reporting that SHPC certifies as IBM's Designated Representative based on our site inspection conducted in 2020. Additionally, SHPC, as representative of the remedial party (IBM), has endorsed Box 7, certifying that the information provided in Box 4 (pertaining to ECs), and Box 5 (overall certification) is true.

For clarity, a tabular summary of the certification responsibilities of the Country Club, as site owner, and SHPC, as representative of the remedial party, IBM, is provided below:

Binghamton Country Club	SHPC for IBM
▪ Box 1 and 2, Questions 1 through 6 – Institutional Controls ▪ Box 3 – Institutional Controls	▪ Box 2, Question 7 – Engineering Controls ▪ Box 2A, Questions 8 and 9 ▪ Box 4 ▪ Box 5 – Based on Country Club Certification of Boxes 1 through 3

The remaining components of this PRR include remedy performance testing summary memoranda (Attachment B) based on field sampling and laboratory analyses conducted in accordance with the SMP, and the annual site-wide inspection report (Attachment C) to assess the integrity of the remedy Engineering Controls (ECs) and compliance with Institutional Controls (ICs) outlined in the SMP. A report of routine maintenance is also included in Attachment D.

If you have any questions or comments, please contact us. We appreciate the opportunity to provide service to you on this important project.

Very truly yours,
SANBORN, HEAD ENGINEERING, P.C.

David Shea, P.E.
Sr. Vice President

Erica M. Bosse
Project Manager

Bradley A. Green, P.G.
Sr. Vice President

Encl. Attachment A – Executed Certification Form
Attachment B – Performance Testing Memorandum Reports
Attachment C – Site Inspection Memorandum Report
Attachment D – Maintenance Reports

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ATTACHMENT A

CERTIFICATION FORM

Enclosure 2
NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
Site Management Periodic Review Report Notice
Institutional and Engineering Controls Certification Form

Site Details **Box 1**

Site No. C704044

Site Name IBM Gun Club, Burn Pit

Site Address: Robinson Hill Road Zip Code: 13760
City/Town: Union
County: Broome
Site Acreage: 15.590

Reporting Period: January 1, 2020 to December 31, 2020

	YES	NO
1. Is the information above correct?	☑	☐
If NO, include handwritten above or on a separate sheet.		
2. Has some or all of the site property been sold, subdivided, merged, or undergone a tax map amendment during this Reporting Period?	☐	☑
3. Has there been any change of use at the site during this Reporting Period (see 6NYCRR 375-1.11(d))?	☐	☑
4. Have any federal, state, and/or local permits (e.g., building, discharge) been issued for or at the property during this Reporting Period?	☐	☑
If you answered YES to questions 2 thru 4, include documentation or evidence that documentation has been previously submitted with this certification form.		
5. Is the site currently undergoing development?	☐	☑

Box 2

	YES	NO
6. Is the current site use consistent with the use(s) listed below?	☑	☐
7. Are all ICs/ECs in place and functioning as designed?	☑	☐

IF THE ANSWER TO EITHER QUESTION 6 OR 7 IS NO, sign and date below and DO NOT COMPLETE THE REST OF THIS FORM. Otherwise continue.

A Corrective Measures Work Plan must be submitted along with this form to address these issues.

Not applicable

Signature of Owner, Remedial Party or Designated Representative Date

Box 2A

	YES	NO
8. Has any new information revealed that assumptions made in the Qualitative Exposure Assessment regarding offsite contamination are no longer valid?	☐	☑

If you answered YES to question 8, include documentation or evidence that documentation has been previously submitted with this certification form.

9. Are the assumptions in the Qualitative Exposure Assessment still valid? (The Qualitative Exposure Assessment must be certified every five years)	☑	☐

If you answered NO to question 9, the Periodic Review Report must include an updated Qualitative Exposure Assessment based on the new assumptions.

SITE NO. C704044 **Box 3**

Description of Institutional Controls

Parcel	Owner	Institutional Control
126.18-1-20	Binghamton Country Club	Ground Water Use Restriction Soil Management Plan Landuse Restriction Monitoring Plan Site Management Plan O&M Plan

The site is covered by an Environmental Easement which calls for the adhearence to a Site Management Plan (SMP). The property is restricted from use as a farm and/or a livestock breeding facility via local odinance/zoning. Residential use is allowed throughout the property, except for within the capped area, where restricted residential use is allowed. Groundwater use restrictions apply throughout the site, and a requirement to assess and abate impacts, if any, for soil vapor contamination applies throughout the site as well. Off site property within the contaminated plume area is also controlled institutionally via agreement between IBM and the owners of the Broome County Country Club. This agreement restricts groundwater use in a manner consistent with the above, and similarly requires assessment and abatement, as needed, for soil vapor contamination.

Box 4

Description of Engineering Controls

Parcel	Engineering Control
126.18-1-20	Groundwater Treatment System Cover System Fencing/Access Control

The site contains a capped area that is covered via Environmental Easement and is managed through the SMP. Groundwater is being treated in-situ via an enhanced biological degradation system.

Box 5

Periodic Review Report (PRR) Certification Statements

1. I certify by checking "YES" below that:

   a) the Periodic Review report and all attachments were prepared under the direction of, and reviewed by, the party making the certification;

   b) to the best of my knowledge and belief, the work and conclusions described in this certification are in accordance with the requirements of the site remedial program, and generally accepted engineering practices; and the information presented is accurate and compete.

YES	NO
☑	☐

2. If this site has an IC/EC Plan (or equivalent as required in the Decision Document), for each Institutional or Engineering control listed in Boxes 3 and/or 4, I certify by checking "YES" below that all of the following statements are true:

   (a) the Institutional Control and/or Engineering Control(s) employed at this site is unchanged since the date that the Control was put in-place, or was last approved by the Department;

   (b) nothing has occurred that would impair the ability of such Control, to protect public health and the environment;

   (c) access to the site will continue to be provided to the Department, to evaluate the remedy, including access to evaluate the continued maintenance of this Control;

   (d) nothing has occurred that would constitute a violation or failure to comply with the Site Management Plan for this Control; and

   (e) if a financial assurance mechanism is required by the oversight document for the site, the mechanism remains valid and sufficient for its intended purpose established in the document.

YES	NO
☑	☐

IF THE ANSWER TO QUESTION 2 IS NO, sign and date below and DO NOT COMPLETE THE REST OF THIS FORM. Otherwise continue.

A Corrective Measures Work Plan must be submitted along with this form to address these issues.

Not applicable

Signature of Owner, Remedial Party or Designated Representative

Date

IC CERTIFICATIONS
SITE NO. C704044

Box 6

SITE OWNER OR DESIGNATED REPRESENTATIVE SIGNATURE

I certify that all information and statements in Boxes 1,2, and 3 are true. I understand that a false statement made herein is punishable as a Class "A" misdemeanor, pursuant to Section 210.45 of the Penal Law.

I Kevin P. O'Hara (print name) at 1401 Robinson Hill Road, Endwell, NY 13760 (print business address),

am certifying as Representative of Binghamton Country Club as Property Owner (Owner or Remedial Party)

for the Site named in the Site Details Section of this form.

Signature of Owner, Remedial Party, or Designated Representative Rendering Certification

1/21/21
Date

IC/EC CERTIFICATIONS

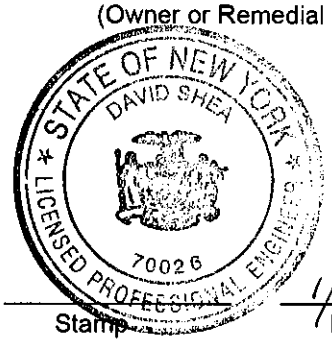
Box 7

Professional Engineer Signature

I certify that all information in Boxes 4 and 5 are true. I understand that a false statement made herein is punishable as a Class "A" misdemeanor, pursuant to Section 210.45 of the Penal Law.

I David Shea (print name) at Sanborn Head Engineering, P.C., 20 Foundry St, Concord, NH 03301 (print business address),

am certifying as a Professional Engineer for the IBM Corporation (Owner or Remedial Party)



David Shea
Signature of Professional Engineer, for the Owner or Remedial Party, Rendering Certification

Stamp (Required for PE)

1/22/2021
Date

ATTACHMENT B

PERFORMANCE TESTING MEMORANDUM REPORTS

APRIL 2020 PERFORMANCE TESTING

SANBORN HEAD ENGINEERING

8976 Wellington Road
Manassas, VA 20109

June 10, 2020

Gary Priscott
New York State Department of Environmental Conservation
1679 Route 11
Kirkwood, NY 13795

Re: Summary of April 2020 Water Quality Monitoring
IBM Gun Club, Former Burn Pit Area
Robinson Hill Road, Union, NY 13760
NYSDEC Site # C704044

Dear Mr. Priscott:

This letter serves to transmit copies of the Summary of April 2020 Water Quality Monitoring report. The remedy performance monitoring work and the preparation of this report were completed on behalf of IBM Corporation by Sanborn, Head Engineering, P.C. (SHPC) in accordance with NYSDEC-approved Site Management Plan (SMP) for this project.

If you have any questions regarding the enclosed report, please contact me at 703-257-2580.

Regards,

Stephen P Brown

Stephen Brown
IBM Program Manager

Enclosures: Summary of April 2020 Water Quality Monitoring

cc: Kevin O'Hara (Binghamton Country Club)
Eamonn O'Neil (NYSDOH)
Maureen Schuck (NYSDOH)
Harry Warner (NYSDEC)

SANBORN HEAD ENGINEERING
Building Trust. Engineering Success.

Stephen Brown, P.E.
IBM Corporation
8976 Wellington Road
Manassas, VA 20109

June 10, 2020
File No. 3526.05

Re: Summary of April 2020 Water Quality Monitoring
IBM Gun Club – Former Burn Pit Area
Union, New York
NYSDEC Site #C704044 (BCA Index #B7-0661004-05)

Dear Mr. Brown:

This letter report summarizes the scope and results of remedy performance monitoring conducted in April 2020 on behalf of IBM by Sanborn Head Engineering, PC (Sanborn Head). It describes the sampling event and provides tabular and graphical summaries of the field and laboratory data. The field work was conducted during the week of April 13, 2020 in general accordance with the scope and procedures described in Appendix J of the Site Management Plan (SMP).[1] Non-routine supplemental laboratory analyses were performed to inform potential improvements to the injection program. These supplemental analyses are discussed below.

This letter report will be included as a component of the annual Periodic Review Report, due in January 2021, and it has been prepared consistent with the Monitoring Reporting Requirements described in Section 3.6 of the SMP.

SCOPE OF WORK

The scope of work included:

- Limited groundwater elevation survey. The monitoring network is shown on Figure 1;
- Water quality sampling and laboratory analysis associated with the performance monitoring program;
- Water quality parameter field screening; and
- Supplemental sampling and analyses (compound-specific isotope analysis [CSIA] and quantitative polymerase chain reaction [qPCR] microbial census) to support evaluation of remediation progress and potential remedy improvements.

[1] Site Management Plan – April 2016 Revision, Brownfield Cleanup Program, IBM Gun Club – Former Burn Pit area, Union, New York, NYSDEC Site #C704044, BCA Index #B7-0661004-05, prepared on behalf of IBM by Sanborn, Head & Associates, Inc., April 25, 2016.

Groundwater Elevation Survey

From April 13 to 15, 2020, the depths to water in monitoring wells and injection boreholes were gauged in accordance with procedures described in Appendix G of the SMP. Based on the depth to water data and survey information, groundwater elevations were calculated for each location and are summarized in Table 1. Inferred groundwater elevation contours from the April 2020 measurement round are shown on Figure 2. In general, groundwater elevations from April 2020 were within the range of historical measurements but generally lower than water levels observed in April 2019. According to the National Weather Service, the Binghamton area recorded about average precipitation through the winter and the weeks prior to sampling. The intermittently observed seep #119 along the southern access road south of the capped seep area was present during April 2020 sampling; however, no additional new seeps along the periphery of the capped area were observed.

Water Quality Sampling

The scope of sampling is summarized in Table 2. Consistent with our discussions with NYSDEC on March 25, 2020, slight modifications and supplemental sampling and analyses was completed in April 2020 beyond the requirements described in the SMP, as further described below.

- Samples were collected for laboratory geochemical analysis instead of in-situ field geochemical testing to improve efficiency; and
- Samples were collected and submitted for laboratory analysis for CSIA and qPCR (further discussed below).

Exhibit 1 below summarizes the sampling methods used during the monitoring event. The quality assurance/quality control (QA/QC) samples collected for VOC analysis are summarized in Exhibit 2. Samples (including QA/QC samples) submitted for off-site laboratory analysis or field screening are tabulated in Exhibit 3. Laboratory and field analytical data are summarized in Table 3.

Exhibit 1 Summary of Sampling Methods

Sample Method	Number of Locations Sampled
Modified Low-Flow	15
Submerged Container (surface water)	5
Passive Diffusion Bag	5
FLUTE® Purge	0
Bailer	0
Purge Water Tote Sample	0

Exhibit 2 Summary of QA/QC Samples for VOC analysis

Total Sample Locations	24
Duplicate Samples	2
Matrix Spikes	1
Matrix Spike Duplicates	1
Field Blanks	2
Equipment Blanks	1
Trip Blanks	2

Exhibit 3 Summary of Analytical Type

Sample Type – Off-Site Laboratory	Laboratory	Number of Samples
VOCs	Eurofins	35
Total Organic Carbon	Eurofins	22
Geochemical Analyses	Eurofins	16
Volatile Fatty Acids	Pace	22
Light Gases (Ethane, Ethene, and Methane)	Pace	22
qPCR (Microbial census) & CSIA	Microbial Insights	8

As discussed in a conference call with NYSDEC on March 25, 2020, IBM elected to conduct supplemental CSIA and qPCR analysis at select monitoring locations during the three 2020 sampling events. Sampling locations[2] were selected along a longitudinal transect down the center of the historical plume, from the source area to the edge of the golf course to the south. Analyses were conducted to evaluate remediation progress, carbon demand, and the influence of temperature on degradation potential. CSIA and qPCR sampling will be conducted during routine monitoring events, with an adjusted schedule for 2020. Summer and fall sampling will be shifted to August and November to provide data points pre-and post-amendment injection (planned for August 2020). The shifted timing will also capture a greater range of groundwater temperatures to evaluate the combined effect of temperature and the addition of amendment on degradation.

Equipment Calibration

Exhibit 4 below summarizes the field instruments utilized during field sampling. The instruments were calibrated each morning and a calibration check was performed at the end of each day. Calibration records are kept on file and available upon request.

Exhibit 4 Summary of Field Instrumentation

INSTRUMENT	FIELD PARAMETER
YSI Water Quality Parameter Probe	Temperature, pH, Specific Conductance, Dissolved Oxygen, and Oxidation-reduction Potential
HACH 2100P Turbidimeter	Turbidity

[2] BP-6A, BP-9A, BP30A, BP-34A, BP-35A, BP-36A, BP-39A, and B-7

SUMMARY OF RESULTS

Geochemical and VOC Results

A summary of the groundwater quality data and inferences is presented on Figure 2. Figures 3 and 4 are interactive PDF figures presenting the geochemical data used to infer the geochemical conditions shown on Figure 2, and the microbial census results, respectively. Field sampling records and analytical laboratory reports are kept on file and available upon request.

Enhanced biochemical degradation of VOCs in groundwater is being monitored by: 1) tracking changes in concentration of the parent contaminant compound, trichloroethene (TCE), 2) tracking the presence of breakdown products of TCE, including the terminal breakdown products ethene and ethane, 3) tracking the presence of geochemical conditions favorable to biochemical conditions by reductive dehalogenation, and 4) the above described supplemental analysis (CSIA/qPCR) to inform the mechanisms and rates for contaminant degradation.

The field and laboratory data for April 2020 indicate remedy performance generally consistent with project performance goals established in the SMP, with some indications of potential changes noted below. Geochemical conditions generally remain within ranges that are favorable for reductive dehalogenation over most of the primary source area; however, as discussed in the 2019 PRR, an injection event is scheduled for August 2020.

As shown on Figure 2, the overall area of sulfate-reducing conditions, which are marginally conducive to reductive dehalogenation, and the overall area of methanogenic conditions, which are more conducive to reductive dehalogenation, are generally comparable to previous areas in September 2019. Areas of sulfate-reducing and methanogenic conditions have been generally consistent since the August 2017 injection. Figure 3 (an interactive PDF) presents the geochemical data used to infer the limits of sulfate-reduction and methanogenesis shown on Figure 2.

Exhibit 5 summarizes the April 2020 monitoring results for select key parameters in comparison to the previous monitoring results of September 2019. TCE and terminal breakdown product (ethene and ethane) concentrations are stable or have exhibited a favorable change in 68% and 47% of sampled wells, respectively.

Exhibit 5: April 2020 Results Compared to September 2019

Analyte	TCE	Ethene+Ethane	TOC	ORP	DO
	ug/L	ug/L	mg/L	mV	mg/L
Injection Boreholes					
IB-7	0.10	65	49		
A-13	<100	7,900	45		
B-4	1	35	25		
B-7	<250	130	410		
B-9	6	29	1,400		
Injection Displacement Zone					
BP-2A	58	190	3.6	-43	0.27
BP-4A	140	63	2.7	-54	0.20
BP-13A	4.2	0.0085	1.5	230	2.7
BP-36A	4,600	430	2.6	-42	0.21
Downgradient - on site					
BP-1A	100	9.8	13	110	0.34
BP-5A	32	0.044	20		
BP-6A	44,000	110	160	-66	0.060
BP-9A	360	64	1.8	-120	5.6
BP-34A	37,000	200	8.4	100	0.49
BP-35A	1,600	0.038	2.4	96	4.9
BP-37A	11	0.51	2.0	20	0.37
Downgradient - off site					
BP-31A	3.9	0.012	0.77	190	5.2
BP-38A	140	0.0097	1.6	230	7.3
BP-39A	50	0.69	1.8	220	9.8

Favorable Change	≥ 10% decline	≥ 10% increase	≥ 10% increase	≥ 10% decline	≥ 10% decline
Number of Wells	7	8	1	5	7
Stable	0 to ± 10%	0 to ± 10%	0 to ± 10%	0 to ± 10%	0 to ± 10%
Number of Wells	6	1	2	0	1
Unfavorable Change	≥ 10% increase	≥ 10% decline	≥ 10% decline	≥ 10% increase	≥ 10% increase
Number of Wells	6	10	16	8	5

Concentrations shown from April 2020 sampling event, rounded to 2 sig. figures.
Blank cell indicates lack of data in one or both events.

Exhibit 5 also summarizes results for total organic carbon (TOC) and geochemical data for oxidation-reduction potential (ORP) and dissolved oxygen (DO). The data indicate that 5 wells show a favorable or stable ORP change, compared to 8 wells in September. Eight wells also show a favorable or stable DO change, compared to 5 in September 2019.

TOC concentrations greater than the 100 milligrams per liter (mg/L) threshold to support enhanced biological degradation were measured at 2 of the 5 sampled injection boreholes, both in the B-line. TOC levels declined by 10 percent or more at all but one of the sampled injection boreholes and at 12 of the 14 sampled monitoring wells within the injection displacement zone and further downgradient. The decreasing trend in TOC concentrations down to levels less than 100 mg/L in most zones suggest continued consumption and that August 2020 is an appropriate time for an amendment injection, as further discussed below.

The average groundwater temperature decreased from 14.1°C in September 2019 to 6.8°C in April 2020, which is below average for past spring monitoring. Groundwater temperature above 10°C is thought to be most conducive to microbial activity.

CSIA and qPCR Results

The preliminary results from the supplemental CSIA and qPCR monitoring are presented below. An expanded discussion of these results will provide more insight after execution of the three rounds of sampling described above, and therefore a comprehensive discussion of the CSIA / qPCR results will be provided in future documents.

The results of CSIA for TCE, dichloroethene (primarily the *cis*- isomer [DCE]), and vinyl chloride (VC) are presented in Attachment A. In general, a trend of more positive numbers moving from high concentration areas to low concentration areas (i.e., from right to left as plotted on the attachment A charts) suggests evidence of reductive dehalogenation. Therefore, data that plots with a negative slope are indicative of reductive dehalogenation, while data with limited to no slope suggest other attenuation mechanisms (e.g., dilution, dispersion, sorption, volatilization) are responsible for the reduction in concentrations. As shown in Attachment A, there is limited indication of reductive dehalogenation of TCE based on this line of evidence; however, the negative slope of the DCE and VC CSIA results suggests reductive dehalogenation of DCE and VC is occurring.

The qPCR results are presented on the interactive Figure 4 along with a framework in the figure legend for evaluating the meaning of these results. The qPCR includes the population of *dehalococcoides* (DHC), and functional genes that can be responsible for reductive dehalogenation of TCE (tceA), DCE+VC (vcrA), VC (bvcaA), along with methanogen competitors that can adversely influence reductive dehalogenation (MGN). A brief summary of the qPCR results is presented below:

- **DHC** – DHC are bacteria that are known to be important for reductive dehalogenation. In general, the measured concentrations of DHC in April 2020 were marginal during the relatively cold (see temperature discussion above) spring sampling event. For perspective, the observed DHC concentrations in April 2020 were generally consistent with pre-remediation concentration measured in 2009.

- **Functional genes** – In general, the presence of functional genes confirms reductive dehalogenation of each compound is occurring. However, the absence of functional genes does not necessarily mean that reductive dehalogenation is not occurring; rather, it means that it was not measurable based on this line of evidence.

- ***tceA (TCE functional gene)*** – In April 2020, tceA was detected in only one location (BP-9A) suggesting there is limited evidence for reductive dehalogenation of TCE based on this assessment, which is consistent with the CSIA results for TCE that are described above.

- ***vcrA (DCE+VC functional gene)*** – In April 2020, vcrA was detected at concentrations that are suggestive of moderate levels of reductive dehalogenation, which is consistent with the findings of the CSIA for DCE and VC.

- ***bvcaA (VC functional gene)*** – In April 2020, bvcaA was not detected above laboratory reporting limits, suggesting there is limited evidence for reductive dehalogenation of VC based on this assessment. We note that this finding is not consistent with the results from the CSIA or the vcrA results, which suggest that VC is being degraded, and with the documented presence of ethene/ethane, which is produced when VC is degraded.

- **Methanogens** – Methanogens are competitor microbes to DHC, and their presence may inhibit reductive dehalogenation. In April 2020, methanogens were detected in all but one sample (BP-34A), which may suggest downward pressure on DHC populations. Methanogens should be distinguished from methanogenic subsurface geochemical conditions. Methanogenic geochemical conditions (i.e., conditions capable of producing methane) are conducive to reductive degradation, while the presence of methanogens could be detrimental.

Overall, the VOC and geochemical data continue to indicate a generally stable system, and that the timing is right for the planned injection event in August 2020. We note that the first round of supplemental CSIA and qPCR results support that DCE and VC are being degraded to varying degrees, and that evidence for reductive dehalogenation of TCE is limited. It is important to note that the majority of CVOC mass at the site is DCE (see pie charts on Figure 2). As such, the fact that DCE is being degraded, and that VC degradation is also occurring means that the groundwater remedy continues to reduce CVOC concentrations and to reduce mass flux across the property line. Further, while VC continues to be detected in on- and off-site wells, the presence of ethene/ethane, and the results from CSIA, suggest it is being degraded even in areas outside the direct influence of the injection wells.

On-going assessment of geochemical conditions along with additional supplemental CSIA and qPCR analysis will be completed before and after the August 2020 injection event, and these results will be conveyed to NYSDEC in future reports. This future assessment will include an evaluation of the effectiveness of the remedy, and on whether adjustments of the groundwater remedy are warranted. Please contact us if you have any questions.

Very truly yours,
SANBORN, HEAD ENGINEERING, P.C.

Bradley A. Green, P.G.
Vice President

Erica M. Bosse
Project Manager

David Shea, P.E.
Principal Engineer

EMB/BAG/DS:emb

Encl.	Table 1	Summary of Water Level Data
	Table 2	Scope of Performance Monitoring
	Table 3	Summary of April 2020 Performance Monitoring
	Table 4	Summary of April 2020 qPCR and CSIA Analysis
	Figure 1	Monitoring Location Plan
	Figure 2	Summary of April 2020 Groundwater Quality Conditions
	Figure 3	Summary of April 2020 Geochemical Conditions
	Figure 4	April 2020 Summary of qPCR results
	Attachment A	April 2020 CSIA Charts

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TABLES

Table 1
Summary of April 2020 Water Level Data
Summary Trip Report
IBM Gun Club - Former Burn Pit Area
Union, New York

Well Location	Reference Elevation (ft amsl)	Depth to Water (ft bgs)	Equivalent Potentiometric Elevation (ft amsl)
A-1	1391.11	5.60	1385.51
A-2	1390.68	5.06	1385.62
A-3	1392.74	14.63	1378.11
A-4	1397.56	20.50	1377.06
A-5	1397.40	21.81	1375.59
A-6	1397.86	21.14	1376.72
A-7	1397.28	20.31	1376.97
A-8	1396.81	19.27	1377.54
A-9	1396.47	18.93	1377.54
A-10	1396.06	19.10	1376.96
A-11	1395.73	10.41	1385.32
A-12	1395.59	18.42	1377.17
A-13	1394.25	17.16	1377.09
A-14	1394.61	13.79	1380.82
A-15	1393.47	15.60	1377.87
A-16	1398.14	7.73	1390.41
A-17	1395.48	10.19	1385.29
B-1	1385.26	7.53	1377.73
B-2	1384.71	7.73	1376.98
B-3	1385.48	4.21	1381.27
B-4	1385.03	5.28	1379.75
B-5	1383.99	8.11	1375.88
B-6	1384.48	5.86	1378.62
B-7	1385.33	8.15	1377.18
B-8	1384.90	18.31	1366.59
B-9	1385.21	16.33	1368.88
B-10	1384.69	4.38	1380.31
B-11	1384.40	4.79	1379.61
B-12	1383.87	4.61	1379.26
B-13	1384.50	4.61	1379.89
BP-1A	1395.67	13.69	1381.98
BP-2A	1396.89	10.28	1386.61
BP-4A	1391.96	11.73	1380.23
BP-5A	1391.09	14.20	1376.89
BP-6A	1393.95	13.13	1380.82
BP-7A	1388.89	12.16	1376.73
BP-8A	1384.53	9.95	1374.58
BP-9A	1379.17	11.78	1367.39
BP-10A	1381.74	13.05	1368.69
BP-11A	1384.80	12.49	1372.31
BP-12A	1386.64	15.05	1371.59
BP-13A	1398.89	11.82	1387.07
BP-14A	1379.46	29.17	1350.29
BP-15A	1388.32	16.44	1371.88

Table 1
Summary of April 2020 Water Level Data
Summary Trip Report
IBM Gun Club - Former Burn Pit Area
Union, New York

Well Location	Reference Elevation (ft amsl)	Depth to Water (ft bgs)	Equivalent Potentiometric Elevation (ft amsl)
BP-16A	1389.69	10.68	1379.01
BP-17A	1376.30	10.96	1365.34
BP-18A	1386.54	15.08	1371.46
BP-19A	1309.40	20.69	1288.71
BP-20A	1274.60	6.02	1268.58
BP-21A	1244.29	4.24	1240.05
BP-22A	1242.90	5.55	1237.35
BP-23A	1333.39	12.48	1320.91
BP-24A	1338.73	14.50	1324.23
BP-25A	1301.92	3.13	1298.79
BP-26A	1336.96	10.84	1326.12
BP-27A	1299.96	2.63	1297.33
BP-30A	1336.20	13.26	1322.94
BP-31A	1369.63	12.00	1357.63
BP-32A	1389.58	9.12	1380.46
BP-34A	1392.55	10.94	1381.61
BP-35A	1391.75	13.46	1378.29
BP-36A	1383.68	11.57	1372.11
BP-37A	1389.92	8.55	1381.37
BP-38A	1375.10	10.78	1364.32
BP-39A	1370.17	8.15	1362.02
GC-2A	1383.32	11.70	1371.62
IB-1	1392.20	6.67	1385.53
IB-2	1393.47	7.91	1385.56
IB-3	1393.07	10.41	1382.66
IB-4	1393.78	8.21	1385.57
IB-5	1393.88	11.19	1382.69
IB-6	1393.05	7.51	1385.54
IB-7	1393.23	7.67	1385.56
IB-8	1393.43	9.34	1384.09
IB-9	1393.62	8.06	1385.56

Notes:

1. This table summarizes depth to water measurements and calculated water table elevations recorded during the April 2020 performance monitoring round on April 13-15, 2020. Measurements were collected relative to the marked reference point at each location using a Heron Dipper T or Geotech water level meter.

2. Abbreviations
ft amsl = feet above mean sea level
ft bgs = feet below ground surface

Table 2
Summary of Routine and Performance Monitoring Program
IBM Gun Club - Former Burn Pit Area
Union, New York

Monitoring Type	Monitoring Location	Monitoring Location Type	Sample Method				Analytical Laboratory											Field Screening
			Low Flow	PDBs	Nitrogen Purge	Surface Water	VOCs	Light Gasses	TOC	VFAs	Total Iron	Ferrous Iron	Nitrate	Sufate	Sulfide	qPCR	CSIA	Water Quality Parameters
Routine Monitoring (August 2020)	BP-7A	Monitoring Well		x			x											x
	BP-8A	Monitoring Well		x			x											x
	BP-10A	Monitoring Well		x			x											x
	BP-11A	Monitoring Well		x			x											x
	BP-12A	Monitoring Well		x			x											x
	BP-14A	Monitoring Well		x			x											x
	BP-16A	Monitoring Well		x			x											x
	BP-17A	Monitoring Well		x			x											x
	BP-18A	Monitoring Well		x			x											x
	BP-19A	Monitoring Well		x			x											x
	BP-20A	Monitoring Well		x			x											x
	BP-21A	Monitoring Well		x			x											x
	BP-22A	Monitoring Well		x			x											x
	BP-23A	Monitoring Well		x			x											x
	BP-24A	Monitoring Well		x			x											x
	BP-25A	Monitoring Well		x			x											x
	BP-26A	Monitoring Well		x			x											x
	BP-27A	Monitoring Well		x			x											x
	BP-32A	Monitoring Well		x			x											x
	GC-2A	Monitoring Well		x			x											x
	GC-1, P-1	Multi-Depth			x		x											x
	GC-1, P-8	Multi-Depth			x		x											x
	BP-12D, P1	Multi-Depth			x		x											x
	BP-12D, P7	Multi-Depth			x		x											x
	BP-13D, P1	Multi-Depth			x		x											x
	BP-13D, P5	Multi-Depth			x		x											x
	BP-15D, P1	Multi-Depth			x		x											x
	BP-15D, P5	Multi-Depth			x		x											x
Performance Monitoring (April, August, and November 2020)	IB-7	Injection Borehole		x			x	x	x	x								
	A-13	Injection Borehole		x			x	x	x	x								
	B-4	Injection Borehole		x			x	x	x	x								
	B-7	Injection Borehole	x	x			x	x	x	x	x	x	x	x	x	x	x	x
	B-9	Injection Borehole		x			x	x	x	x								
	BP-1A	Monitoring Well	x				x	x	x	x	x	x	x	x	x			x
	BP-2A	Monitoring Well	x				x	x	x	x	x	x	x	x	x			x
	BP-4A	Monitoring Well	x				x	x	x	x	x	x	x	x	x			x
	BP-5A	Monitoring Well	x				x	x	x	x	x	x	x	x	x			x
	BP-6A	Monitoring Well	x				x	x	x	x	x	x	x	x	x	x	x	x
	BP-9A	Monitoring Well	x				x	x	x	x	x	x	x	x	x	x	x	x
	BP-13A	Monitoring Well	x				x	x	x	x	x	x	x	x	x			x
	BP-30A	Monitoring Well	x				x	x	x	x	x	x	x	x	x	x	x	x
	BP-31A	Monitoring Well	x				x	x	x	x	x	x	x	x	x			x
	BP-34A	Monitoring Well	x				x	x	x	x	x	x	x	x	x	x	x	x
	BP-35A	Monitoring Well	x				x	x	x	x	x	x	x	x	x	x	x	x
	BP-36A	Monitoring Well	x				x	x	x	x	x	x	x	x	x	x	x	x
	BP-37A	Monitoring Well	x				x	x	x	x	x	x	x	x	x			x
	BP-38A	Monitoring Well	x				x	x	x	x	x	x	x	x	x			x
	BP-39A	Monitoring Well	x				x	x	x	x	x	x	x	x	x	x	x	x
	111	Seep/spring				x	x											x
	112	Seep/spring				x	x											x
	113	Seep/spring				x	x											x
	118	Seep/spring				x	x											x
	SW-Z	Seep/spring				x	x											x
Total			**16**	**25**	**8**	**5**	**53**	**20**	**20**	**20**	**16**	**16**	**16**	**16**	**16**	**8**	**8**	**49**

Notes:
1. This table is intended to summarize the programs of routine and performance monitoring for remedy operations at the IBM Gun Club - Former Burn Pit Area starting in 2016. Additional monitoring points may be sampled based on field observations. "SW-Z" serves as a placeholder for sampling any on-site seep or spring that can be reasonably sampled. The table summarizes sample method, analytical laboratory analysis, and field screening.

2. Sample method:
"Low Flow" indicates samples will be collected by bladder pump using low flow techniques.
"PDBs" indicates that the well has sufficient water column to sample with passive diffusion bags - if conditions are observed to be different than anticipated, sampling will proceed using low flow techniques.
"Nitrogen purge" indicates that sample will be collected by purging the multi-level port with nitrogen (multi-level systems only).
"Surface water" samples will be collected using a clean glass vial.

3. Analytical laboratory samples:
"VOCs" indicates volatile organic compounds.
"Light gasses" includes methane, ethene and ethane.
"TOC" indicates total organic carbon.
"VFAs" indicates volatile fatty acids.
"qPCR" indicates quantitative polymerase chain reaction analysis (DNA-based analysis to quantify specific microorganisms and functional genes responsible for biodegradation)
"CSIA" indicates compound-specific isotope analysis (ratio of stable carbon isotopes in TCE, cDCE, and VC)

4. " Water quality parameters" indicates screening during well purging and water quality sampling by multi-parameter probes, e.g. by YSI® 556 multi-Probe meter or similar and HACH® turbidity meter or similar (low flow, multi-level system, bailer, and surface water sampling) or by water quality parameter sounding (PDB sampling). The water quality parameters may include temperature, specific conductance, oxidation-reduction potential, dissolved oxygen, pH, and turbidity. In addition surface water samples will include water clarity descriptors (transparency, translucence, or opaqueness, and color).

TABLE 3
SUMMARY OF APRIL 2020 PERFORMANCE MONITORING
Summary Trip Report
IBM Gun Club - Former Burn Pit Area
Union, New York

Analyte Name	Unit	BP-1A BP-1A Low Flow S 4/14/2020	BP-2A BP-2A Low Flow S 4/14/2020	BP-4A BP-4A Low Flow S 4/14/2020	BP-4A BP-4A_FD Low Flow FD 4/14/2020	BP-5A BP-5A Low Flow S 4/14/2020	BP-6A BP-6A Low Flow S 4/15/2020	BP-9A BP-9A Low Flow S 4/15/2020	BP-13A BP-13A Low Flow S 4/14/2020	BP-30A BP-30A Low Flow S 4/15/2020	BP-31A BP-31A Low Flow S 4/14/2020	BP-34A BP-34A Low Flow S 4/15/2020	BP-35A BP-35A Low Flow S 4/15/2020	BP-36A BP-36A Low Flow S 4/15/2020	BP-36A BP-36A_FD Low Flow FD 4/15/2020	BP-37A BP-37A Low Flow S 4/14/2020	BP-38A BP-38A Low Flow S 4/14/2020	BP-39A BP-39A Low Flow S 4/15/2020
VOLATILE ORGANIC COMPOUNDS (VOCs)																		
Trichloroethene (TCE)	µg/l	**100**	**58**	**140**	**140**	**32**	**44,000**	**360**	**4.2**	**5.6**	**3.9**	**37,000**	**1,600**	**3,900**	**4600**	**11**	**140**	**50**
Dichloroethene (cis-1,2-)	µg/l	**130**	**5,200**	**60**	**55**	**32**	**46,000**	**610**	**0.10 J**	**11**	**1.5**	**57,000**	**3,800**	**3,300**	**3,700**	**6.4**	**27**	**53**
Dichloroethene (trans-1,2-)	µg/l	**2.0 J**	**14 J**	**0.90 J**	**0.80 J**	**0.70 J**	**330**	**5.9 J**	<0.5	<0.5	<0.5	**79 J**	**4.6 J**	**8.9 J**	**8.8 J**	<0.5	**0.30 J**	**0.20 J**
Dichloroethene (1,1-)	µg/l	**0.50 J**	**8.6 J**	**0.70 J**	**0.70 J**	<2.5	**170 J**	**3.4 J**	<0.5	<0.5	<0.5	**76 J**	**4.8 J**	**9.6 J**	**8.9 J**	<0.5	<1	**0.20 J**
Tetrachloroethene (PCE)	µg/l	<2.5	<25	<1	<1	<2.5	<250	<10	<0.5	**1.2**	**0.60**	<250	<25	<50	<50	<0.5	<1	<0.5
Vinyl chloride	µg/l	**23**	**780**	**6.7**	**8.4**	<2.5	**650**	**74**	<0.5	**0.10 J**	<0.5	**970**	<25	**420**	**400**	**0.50 J**	<1	**4.7**
LIGHT GASSES																		
Ethane	µg/l	**2.9**	**0.49**	**44**	**49**	**0.023 J**	**1.8**	**25**	<0.1	**0.012 J**	<0.1	**5.3**	**0.027 J**	**74**	**82**	**0.34**	<0.1	**0.23**
Ethene	µg/l	**6.9**	**190**	**14**	**14**	**0.021 J**	**110**	**39**	<0.1	**0.038 J**	**0.012 J**	**190**	**0.011 J**	**330**	**350**	**0.17**	**0.0097 J**	**0.46**
Methane	µg/l	**410**	**1,200**	**6,400**	**7,000**	**0.26 J**	**130**	**7,700**	**0.62**	**0.12 J**	**0.15 J**	**1,200**	**0.28 J**	**10,000**	**11,000**	**680**	**0.86**	**24**
MOLAR CONCENTRATION																		
Trichloroethene (TCE)	µmol/l	0.76	0.44	1.1	1.1	0.24	330	2.7	0.032	0.043	0.030	280	12	30	35	0.084	1.1	0.38
Dichloroethene (cis-1,2-)	µmol/l	1.3	54	0.62	0.57	0.33	470	6.3	0.0010	0.11	0.015	590	39	34	38	0.066	0.28	0.55
Dichloroethene (trans-1,2-)	µmol/l	0.021	0.14	0.0093	0.0083	0.0072	3.4	0.061	ND	ND	ND	0.81	0.047	0.092	0.091	ND	0.0031	0.0021
Dichloroethene (1,1-)	µmol/l	0.0052	0.089	0.0072	0.0072	ND	1.8	0.035	ND	ND	ND	0.78	0.050	0.10	0.092	ND	ND	0.0021
Tetrachloroethene (PCE)	µmol/l	ND	ND	ND	ND	ND	ND	ND	ND	0.0072	0.0036	ND	ND	ND	ND	ND	ND	ND
Vinyl chloride	µmol/l	0.37	12	0.11	0.13	ND	10	1.2	ND	0.0016	ND	16	ND	6.7	6.4	0.0080	ND	0.075
Ethane	µmol/l	0.096	0.016	1.5	1.6	0.00076	0.060	0.83	ND	0.00040	ND	0.18	0.00090	2.5	2.7	0.011	ND	0.0076
Ethene	µmol/l	0.25	6.8	0.50	0.50	0.00075	3.9	1.4	ND	0.0014	0.00043	6.8	0.00039	12	12	0.0061	0.00035	0.016
Total	µmol/l	2.8	74	3.8	3.9	0.58	820	13	0.033	0.17	0.049	890	51	85	95	0.18	1.3	1.0
MOLAR PERCENTAGE																		
TCE	%	27	0.60	28	27	42	40	22	97	26	60	31	24	35	37	48	79	37
DCEs	%	48	73	17	15	58	58	51	3.1	68	31	66	76	40	40	38	21	53
VC	%	13	17	2.8	3.4	ND	1.3	9.4	ND	0.96	ND	1.7	ND	7.9	6.7	4.6	ND	7.3
Ethane+Ethene	%	12	9.2	52	54	0.26	0.49	18	ND	1.1	0.87	0.78	0.0025	17	16	9.9	0.026	2.3
VOLATILE FATTY ACIDS																		
Acetic Acid	mg/l	<0.1	**0.046 J**	<0.1	<0.1	<0.1	<1	**0.051 J**	<0.1	<0.1	<0.1	<0.1	<0.1	**0.20**	**0.20**	**0.068 J**	**0.064 J**	<0.1
Butyric Acid	mg/l	**0.024 J**	**0.025 J**	<0.1	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Hexanoic Acid	mg/l	<0.2	<0.2	<0.2	<0.2	<0.2	<2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
i-Hexanoic Acid	mg/l	<0.2	<0.2	<0.2	<0.2	<0.2	<2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
i-Pentanoic Acid	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	**0.070 J**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Lactic Acid	mg/l	<0.2	<0.2	<0.2	<0.2	<0.2	<2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Pentanoic Acid	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	**0.94 J**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Propionic Acid	mg/l	<0.1	**0.0024 J**	**0.0059 J**	**0.0020 J**	<0.1	**0.018 J**	**0.0020 J**	**0.0091 J**	**0.0016 J**	**0.0017 J**	<0.1	**0.0012 J**	**0.0018 J**	**0.0017 J**	**0.0027 J**	**0.0020 J**	**0.0021 J**
Pyruvic Acid	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
OTHER LABORATORY DATA																		
Carbon Tetrachloride	µg/l	<2.5	<25	<1	<1	<2.5	<250	<10	**1.3**	**0.20 J**	**0.10 J**	<250	<25	<50	<50	**0.20 J**	**0.80 J**	**0.10 J**
Total Organic Carbon	mg/l	**13**	**3.6**	**2.7**	**2.7**	**20**	**160**	**1.8**	**1.5**	**1.9**	**0.77 J**	**8.4**	**2.4**	**2.6**	**2.5**	**2.0**	**1.6**	**1.8**
WATER QUALITY PROBE DATA																		
Temperature	°C	**7.2**	**7.8**	**7.1**	**–**	**7.9**	**8.2**	**6.5**	**6.7**	**7.3**	**6.3**	**6.4**	**5.0**	**5.5**	**–**	**7.5**	**6.3**	**6.3**
Specific Conductance	uS/cm	**2,300**	**1,100**	**600**	**–**	**1700**	**4,800**	**490**	**110**	**120**	**340**	**1,300**	**850**	**680**	**–**	**580**	**180**	**130**
pH	s.u.	**7.2**	**6.8**	**7.6**	**–**	**6.9**	**7.0**	**7.6**	**6.0**	**6.2**	**7.2**	**7.2**	**7.3**	**6.9**	**–**	**6.9**	**5.9**	**6.3**
Oxidation/Reduction Potential	mV	**110**	**-43**	**-54**	**–**	**150**	**-66**	**-120**	**230**	**170**	**190**	**100**	**96**	**-42**	**–**	**20**	**230**	**220**
Dissolved Oxygen	mg/l	**0.34**	**0.27**	**0.20**	**–**	**4.0**	**0.060**	**5.6**	**2.7**	**5.3**	**5.2**	**0.49**	**4.9**	**0.21**	**–**	**0.37**	**7.3**	**9.8**
Turbidity	NTU	**0.25**	**1.2**	**0.48**	**–**	**0.54**	**4.8**	**2.8**	**0.81**	**1.3**	**2.6**	**0.97**	**1.2**	**0.97**	**–**	**4.8**	**1.3**	**3.2**
GEOCHEMISTRY																		
Iron	mg/l	**0.27**	**6.7**	<0.2	**–**	**0.076 J**	**3.1**	**0.14 J**	**0.045 J**	<0.2	**0.067 J**	**0.081 J**	**0.074 J**	**0.90**	**–**	**0.21**	**0.086 J**	**0.080 J**
Iron - Ferrous	mg/l	**0.12**	**7.0**	**0.032 J**	**–**	**0.016 J**	**4.3**	**0.079 J**	<0.1	<0.1	<0.1	**0.051 J**	<0.1	**0.98**	**–**	**0.12**	**0.017 J**	<0.1
Nitrate	mg/l	<0.5	<0.5	**0.59**	**–**	**0.59**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**0.61**	<0.5	**–**	<0.5	<0.5	<0.5
Sulfate	mg/l	**217**	**51**	**21**	**–**	**408**	**1,240**	**23**	**13**	**10**	**24**	**61**	**32**	**13**	**–**	**8.6**	**13**	**13**
Sulfide	µg/l	<0.3	**0.30 J**	<0.3	**–**	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	**–**	<0.3	<0.3	<0.3

TABLE 3
SUMMARY OF APRIL 2020 PERFORMANCE MONITORING
Summary Trip Report
IBM Gun Club - Former Burn Pit Area
Union, New York

Analyte Name	Unit	A-13	B-4	B-7	B-9	IB-7	111	112	113	118	119
		A-13	B-4	B-7	B-9	IB-7	111	112	113	118	119
		PDB	PDB	PDB/Low Flow	PDB	PDB	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
		S	S	S	S	S	S	S	S	S	
		4/14/2020	4/14/2020	4/14-15/2020	4/14/2020	4/14/2020	4/15/2020	4/15/2020	4/15/2020	4/15/2020	4/15/2020
VOLATILE ORGANIC COMPOUNDS (VOCs)											
Trichloroethene (TCE)	µg/l	<100	**1.1 J**	<250	**6.4 J**	**0.10 J**	**0.20 J**	**0.30 J**	**0.30 J**	**1.7**	**1.8**
Dichloroethene (cis-1,2-)	µg/l	**9,400**	**46**	**59 J**	**19**	**2.1**	<0.5	<0.5	<0.5	**2.1**	**2.9**
Dichloroethene (trans-1,2-)	µg/l	**27 J**	**0.80 J**	<250	<10	**1.2**	<0.5	<0.5	<0.5	<0.5	<0.5
Dichloroethene (1,1-)	µg/l	**14 J**	<5	<250	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Tetrachloroethene (PCE)	µg/l	<100	<5	<250	<10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Vinyl chloride	µg/l	**3,400**	**7.6**	<250	<10	<0.5	<0.5	<0.5	<0.5	<0.5	**0.50 J**
LIGHT GASSES											
Ethane	µg/l	**170**	**31**	**39**	**17**	**65**	–	–	–	–	–
Ethene	µg/l	**7,700**	**3.8**	**92**	**12**	**0.077 J**	–	–	–	–	–
Methane	µg/l	**9,500**	**24,000**	**5,200**	**5,900**	**19,000**	–	–	–	–	–
MOLAR CONCENTRATION											
Trichloroethene (TCE)	µmol/l	ND	0.0084	ND	0.049	0.00076	0.0015	0.0023	0.0023	0.013	0.014
Dichloroethene (cis-1,2-)	µmol/l	97	0.47	0.61	0.20	0.022	ND	ND	ND	0.022	0.030
Dichloroethene (trans-1,2-)	µmol/l	0.28	0.0083	ND	ND	0.012	ND	ND	ND	ND	ND
Dichloroethene (1,1-)	µmol/l	0.14	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethene (PCE)	µmol/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vinyl chloride	µmol/l	54	0.12	ND	ND	ND	ND	ND	ND	ND	0.0080
Ethane	µmol/l	5.7	1.0	1.3	0.57	2.2	–	–	–	–	–
Ethene	µmol/l	270	0.14	3.3	0.43	0.0027	–	–	–	–	–
Total	µmol/l	430	1.8	5.2	1.2	2.2	0.0015	0.0023	0.0023	0.035	0.052
MOLAR PERCENTAGE											
TCE	%	ND	0.47	ND	3.9	0.035	100	100	100	37	27
DCEs	%	23	27	12	16	1.5	ND	ND	ND	63	58
VC	%	13	6.8	ND	ND	ND	ND	ND	ND	ND	15
Ethane+Ethene	%	64	66	88	80	98	–	–	–	–	–
VOLATILE FATTY ACIDS											
Acetic Acid	mg/l	**81**	**45**	**34**	**310**	**0.15**	–	–	–	–	–
Butyric Acid	mg/l	**4.7**	**0.23**	**6.3**	**26**	**0.015 J**	–	–	–	–	–
Hexanoic Acid	mg/l	**0.43**	<0.2	**43**	**33**	<0.2	–	–	–	–	–
i-Hexanoic Acid	mg/l	**0.068 J**	<0.2	**0.51**	**1.7 J**	<0.2	–	–	–	–	–
i-Pentanoic Acid	mg/l	**0.39**	**0.13**	**0.67 J**	**13**	<0.1	–	–	–	–	–
Lactic Acid	mg/l	<2	<2	<2	<20	<0.2	–	–	–	–	–
Pentanoic Acid	mg/l	**0.36**	**0.0059 J**	**10**	**60**	**0.013 J**	–	–	–	–	–
Propionic Acid	mg/l	**4.2**	**1.1**	**25**	**530**	**0.076 J**	–	–	–	–	–
Pyruvic Acid	mg/l	**0.94**	**0.041 J**	**6.2**	**57**	<0.1	–	–	–	–	–
OTHER LABORATORY DATA											
Carbon Tetrachloride	µg/l	<100	<5	<250	<10	<0.5	<0.5	<0.5	<0.5	**0.10 J**	<0.5
Total Organic Carbon	mg/l	**45**	**25**	**410**	**1,400**	**49**	–	–	–	–	–
WATER QUALITY PROBE DATA											
Temperature	°C	–	–	**7.2**	–	–	**6.8**	**6.8**	**8.5**	**8.4**	**10**
Specific Conductance	uS/cm	–	–	**800**	–	–	**94**	**120**	**200**	**250**	**540**
pH	s.u.	–	–	**6.4**	–	–	**7.1**	**7.0**	**7.0**	**7.1**	**6.7**
Oxidation/Reduction Potential	mV	–	–	**-68**	–	–	**83**	**93**	**58**	**12**	**-7.5**
Dissolved Oxygen	mg/l	–	–	**0.23**	–	–	**11**	**9.8**	**8.9**	**10**	**2.5**
Turbidity	NTU	–	–	**14**	–	–	**17**	**9.4**	**11**	**2.8**	**3.9**
GEOCHEMISTRY											
Iron	mg/l	–	–	**17**	–	–	–	–	–	–	–
Iron - Ferrous	mg/l	–	–	**17**	–	–	–	–	–	–	–
Nitrate	mg/l	–	–	<0.5	–	–	–	–	–	–	–
Sulfate	mg/l	–	–	<5	–	–	–	–	–	–	–
Sulfide	µg/l	–	–	<0.3	–	–	–	–	–	–	–

Notes:

1. The table summarizes samples collected during the week of April 13, 2020 as part of performance monitoring at the IBM Gun Club former Burn Pit Area. Samples were analyzed both in the field and at fixed analytical laboratories as indicated on the table.

2. Analytical laboratory analysis was performed by Eurofins Lancaster Laboratories of Lancaster, Pennsylvania (Lancaster) and/or Pace Analytical (formerly Microseeps, Inc.) of Pittsburgh, Pennsylvania (Pace). Results are recorded in units indicated on the table. Detections of compounds are emboldened.

3. Definitions:
"S" indicates primary sample
"FD" indicates field duplicate
"PDB" indicates the sample was collected via a passive diffusion bag
"–" indicates the compounds were not analyzed for that particular sample.
"<" indicates the result was below the analytical detection limit.
"J" indicates that the laboratory data was below the lowest quantifiable limit and therefore estimated.
"ND" indicates that results were not detected above the analytical reporting limit or the calibration range of the field screening device.

4. Refer to the report text for further discussion. The sample plan can be referenced in Table 2 and the Site Management Plan.

TABLE 4
SUMMARY OF APRIL 2020 qPCR & CSIA ANALYSIS
Summary Trip Report
IBM Gun Club - Former Burn Pit Area
Union, New York

Analytical Method	Analyte	Units	BP-6A	BP-9A	BP-30A	BP-34A	BP-35A	BP-36A	BP-39A	B-7
			4/15/2020	4/15/2020	4/15/2020	4/15/2020	4/15/2020	4/15/2020	4/15/2020	4/14-15/2020
qPCR	Dehalococcoides (DHC)	cells/mL	6.42E+03	2.39E+02	2.50E+00	1.38E+03	6.12E+01	9.03E+03	2.20E+00	4.42E+03
	BAV1 Vinyl Chloride Reductase (bvcA)	cells/mL	<1.10E+00	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<2.50E+00
	tceA Reductase (tceA)	cells/mL	<1.10E+00	4.00E-01 J	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<2.50E+00
	Vinyl Chloride Reductase (vcrA)	cells/mL	1.55E+03	3.47E+01	2.00E-01 J	1.15E+03	5.40E+00	1.77E+03	2.00E-01 J	1.11E+03
	Methanogens	cells/mL	4.00E-01 J	2.00E-01 J	1.00E-01 J	<4.90E+00	4.00E+00 J	1.64E+01	3.50E+00 J	1.17E+03
CSIA	$^{13}C/^{12}C$ TCE	‰	-19.2	-20	-3.4	-20.5	-19.9	-21	-20.3	NA
	$^{13}C/^{12}C$ cis-DCE	‰	-24.4	-17.9	-10.3	-22.6	-20.6	-20.1	-15.9	-17.1
	$^{13}C/^{12}C$ Vinyl Chloride	‰	-34.8 J	-28	NA	-42.8 J	NA	-32.6	-27.7	NA

Notes:

1. The table summarizes samples collected during the week of April 13, 2020 as part of supplemental forensic sampling at the IBM Gun Club former Burn Pit Area. Samples were analyzed by Microbial Insights of Knoxville, Tennesee (MI). Results are recorded in units indicated on the table. qPCR compounds not detected above the analytical laboratory reporting limit are grayed out.

2. Definitions:
"qPCR" indicates quantitative polymerase chain reaction analysis, which is a DNA-based analysis used to quantify specific microorganisms and specific functional genes responsible for biodegradation.
"CSIA" indicates compound-specific isotope analysis, which identifies the ratio of carbon-13 to carbon-12 isotopes in the compounds of interest for this site (TCE, cDCE, and vinyl chloride)
“J” indicates that the laboratory data was below the lowest quantifiable limit and therefore estimated.
"NA" indicates that the compound was not detected in the VOC sample collected concurrently with the CSIA sample, so CSIA results are not applicable.

3. Refer to the report text for further discussion.

FIGURES

Last Edited By: hpothier

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Figure 1

Monitoring Location Plan

IBM Gun Club - Former Burn Pit Area

Union, New York

Drawn By:	H. Pothier
Designed By:	E. Bosse
Reviewed By:	B. Green
Project No:	3526.05
Date:	June 2020

Figure Narrative

This figure summarizes the locations of monitoring wells, multi-level monitoring systems, and surface water sampling points where depth to water is measured and water quality samples may be collected for field and analytical laboratory testing as part of routine and performance monitoring programs.

The locations of site features, including monitoring wells, seeps and springs, and culverts are based on field survey by Butler Land Surveying, LLC. of Little Meadows Pennsylvania in the period 2006 through 2012.

Refer to report text for further discussion.

Legend

- Parcel B Site Boundary
- Injection Borehole
- Observed Drainage Features (arrows indicate flow direction)
- Monitoring Well
- Multi-Level Monitoring Installation
- Surface Water Sampling Point
- Culvert

100 50 0 100 200 Feet

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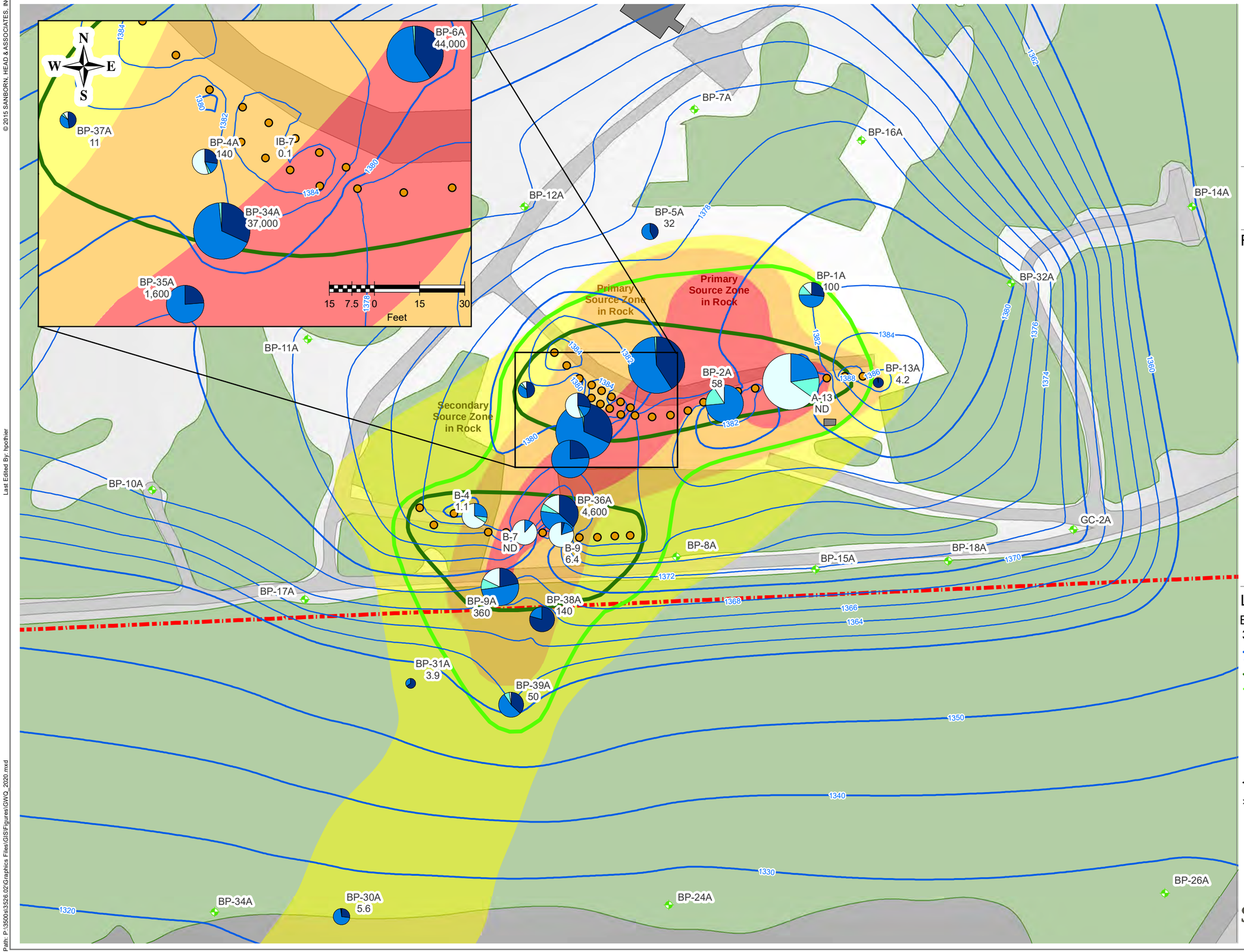

Figure 2

Summary of April 2020 Groundwater Quality Conditions

IBM Gun Club - Former Burn Pit Area

Union, New York

Drawn By:	H. Pothier
Designed By:	E. Bosse
Reviewed By:	B. Green
Project No:	3526.05
Date:	June 2020

Figure Narrative

This figure shows groundwater quality data and inference based on monitoring conducted April 14-15, 2020.

The groundwater data for site key VOCs including TCE, cDCE, vinyl chloride, and ethane/ethene from water table monitoring wells are presented as pie diagrams. The wedges of each pie diagram represent concentrations of the four compounds expressed in micromoles per liter (umol/L). The relative diameter of each pie diagram varies based on the sum of the five VOCs and tDCE at each location.

The inferred sulfate-reducing and methanogenic conditions are based on observations of oxidation-reduction potential (ORP), methane, sulfide, ferrous and total iron, and nitrate. Methanogenic conditions are characterized by methane concentrations ≥ 20 µg/L, sulfate reducing by sulfide ≥ 50 µg/L, iron reducing by Fe(II)/Fe(tot) ≥ 0.7 mg/L, and nitrate reduction by nitrate <1 mg/L. ORP is generally expected to be <200 for iron reduction, <100 for sulfate reduction, and <0 for methanogenic conditions. See Figure 3 for geochemical data.

Not all geochemical conditions are satisfied within the areas shown for sulfate-reducing and methanogenic conditions. The inferred areas assume the presence of a transition zone between sulfate-reducing and methanogenic, and the position and size of these zones are based on judgement of the combined data. Other interpretations are possible.

Refer to the report text for further discussion.

Legend

BP-34A
37,000 Well Name and April 2020 TCE Concentrations in Groundwater (µg/L).

Inferred Groundwater Contour
April 2020

Inferred Methanogenic Conditions

Inferred Sulfate-Reducing Conditions

Parent VOC (Trichloroethene)
Primary Daughter Product (*cis*-1,2DCE)
Secondary Daughter Product (Vinyl Chloride)
Terminal Breakdown Products (Ethane, Ethene)

Total Chlorinated Ethanes & Ethenes in Groundwater (µmol/L)

< 0.1
>0.1 to 1
>1 to 10
>10 to 100
>100

40 20 0 40 80
Feet

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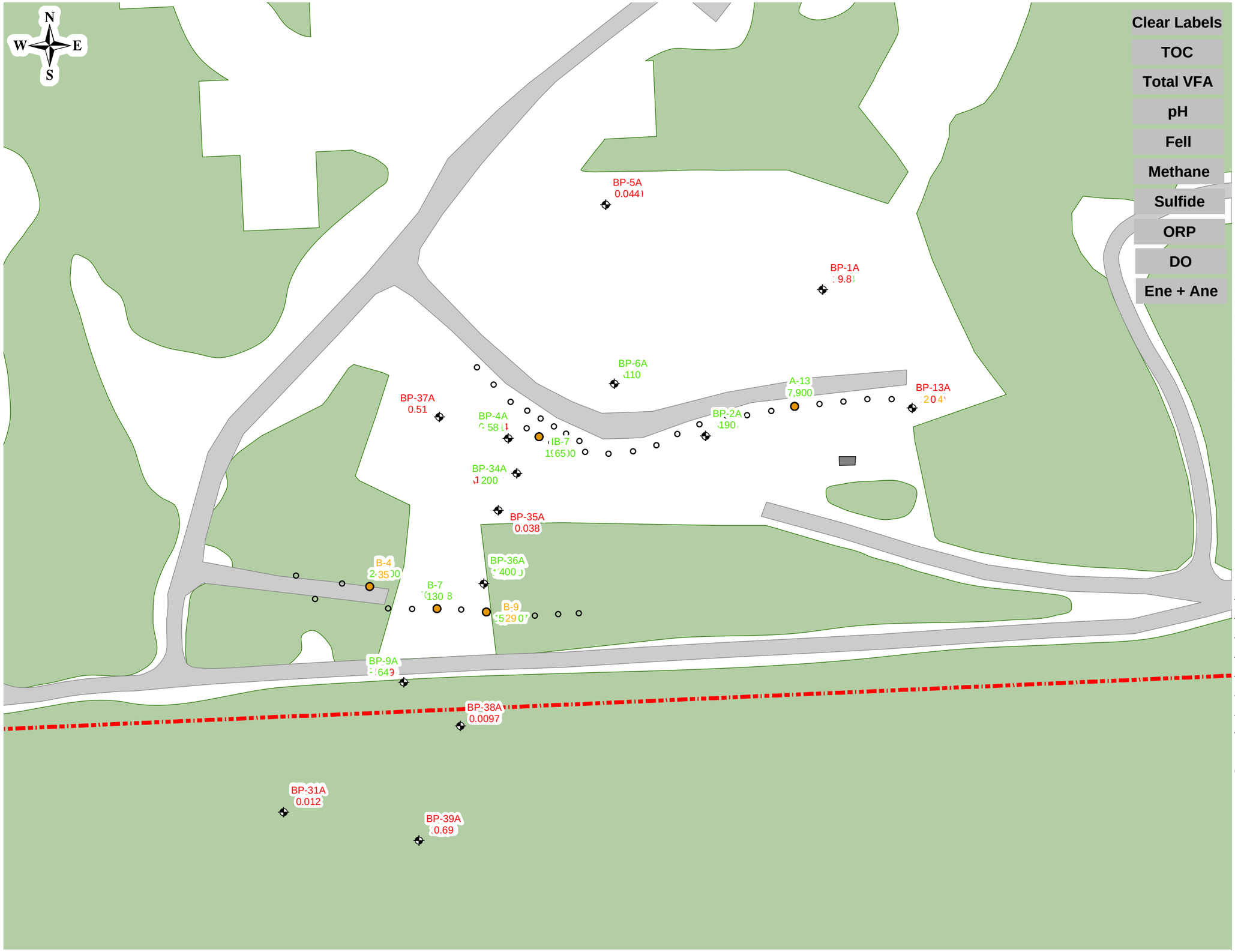

Clear Labels

TOC

Total VFA

pH

Fell

Methane

Sulfide

ORP

DO

Ene + Ane

Figure 3

April 2020 Assessment of Geochemical Conditions

IBM Gun Club - Former Burn Pit Area

Union, New York

Drawn By:	H. Pothier
Designed By:	E. Bosse
Reviewed By:	B. Green
Project No:	3526.05
Date:	June 2020

Figure Narrative

This figure supports a multiple lines of evidence assessment of what proportion of the primary and secondary source rock are under sulfate reducing and methanogenic conditions. Green labels indicate conditions conducive to reductive dehalogenation. Orange labels indicate reductive dehalogenation may be possible, but conditions are less conducive. Red labels indicate conditions where reductive dehalogenation is less likely.

Posted data is from the April 2020 sampling round.

Legend

DO mg/L	>5	2-5	<=2
ORP mV	>100	0-100	<=0
Sulfide µg/L	<10	10-50	>=50
Methane µg/L	<0.5	0.5-20	>=20
FeII mg/L	<1		>=1
pH SU	<6.3 or >7.5		6.3-7.5
Total VFA mg/L	<1		>=1
TOC mg/L	<4		>=4
Ethane + Ethene µg/L	<10	10-50	>=50

30 15 0 30 60

Feet

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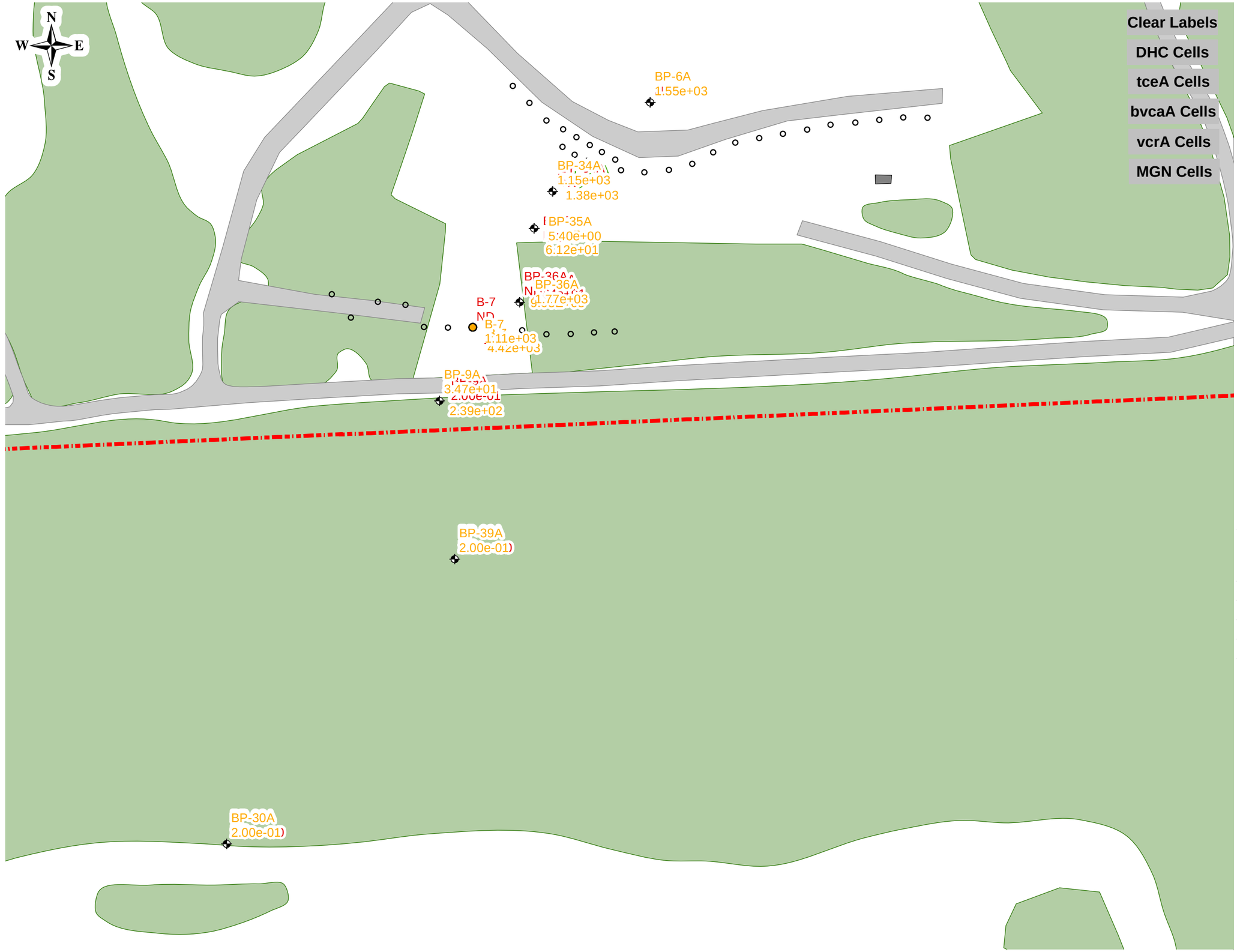

Figure 4

April 2020
Summary of qPCR

IBM Gun Club - Former Burn Pit Area

Union, New York

Drawn By:	H. Pothier
Designed By:	E. Bosse
Reviewed By:	B. Green
Project No:	3526.05
Date:	June 2020

Figure Narrative

This figure summarizes the results from analysis of Dehalococcoides (DHC) bacteria and functional genes to support a multiple lines of evidence assessment of reductive dehalogenation. Green labels indicate concentrations thought to be highly conducive to reductive dehalogenation. Orange labels indicate reductive dehalogenation is possible, but levels are less conducive. Red labels indicate conditions where there is limited or no evidence for reductive dehalogenation. Methanogens (MGN) are competitor microbes, where green indicates no methanogens were detected and red indicates their presence.

Legend

DHC (cells/mL)	$>10^1$	10^1 - 10^4	$>10^4$
tceA (cells/mL)	ND	ND - 10^7	$>10^7$
bvcaA (cells/mL)	ND	ND - 10^7	$>10^7$
vcrA (cells/mL)	ND	ND - 10^7	$>10^7$
MGN (cells/mL)	>ND	-	ND

DHC = *Dehalococcoides*

tceA = TCE reductase

bvcaA = BAV1 vinyl chloride reductase

vcrA = Vinyl chloride reductase

MGN = Methanogens

30 15 0 30 60

Feet

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ATTACHMENT A

CSIA CHARTS

Figure A.1
April 2020 CSIA Results - TCE
Summary of Water Quality Monitoring
IBM Gun Club - Former Burn Pit Area
Union, New York

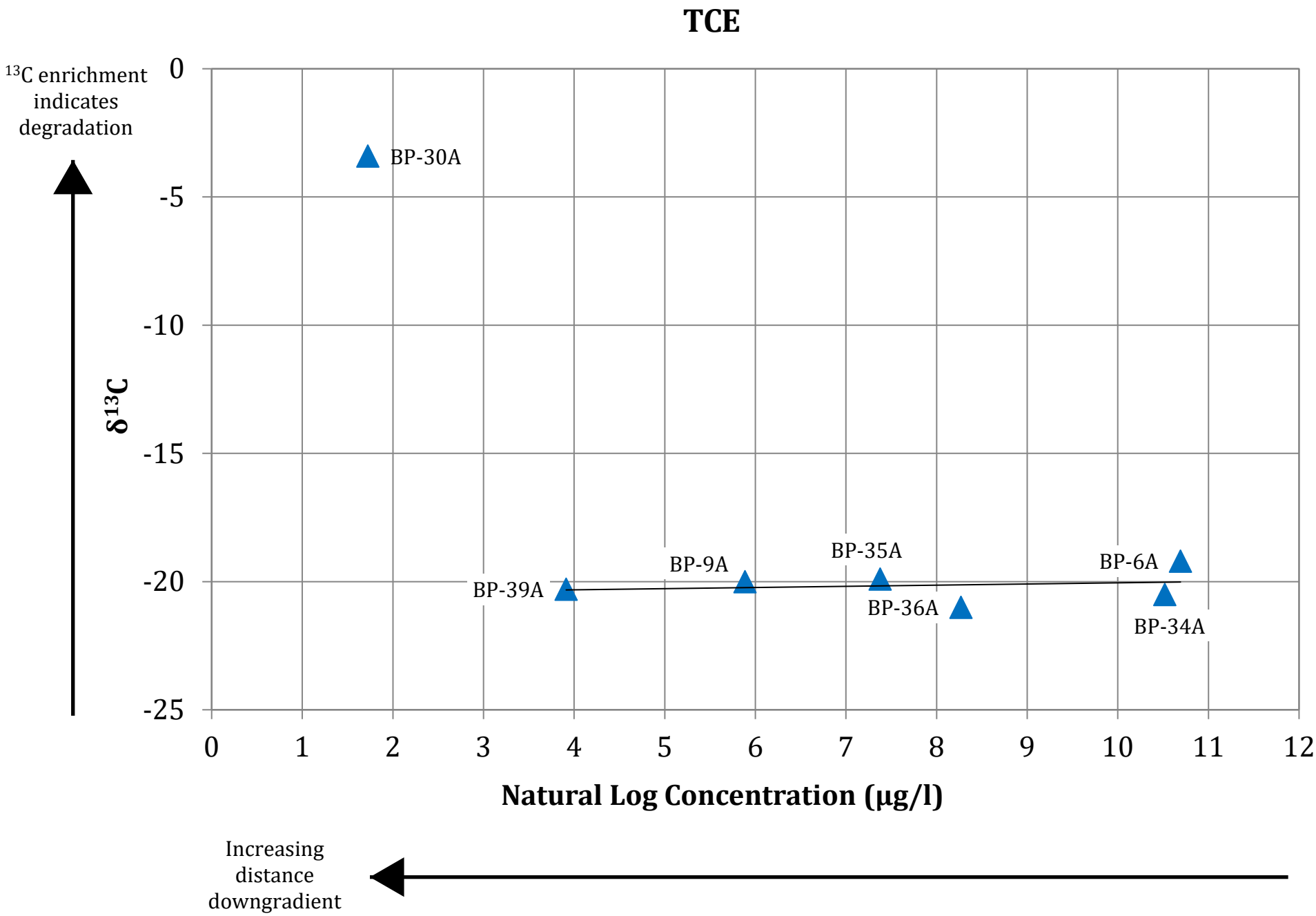


Figure A.2
April 2020 CSIA Results - cis-DCE
Summary of Water Quality Monitoring
IBM Gun Club - Former Burn Pit Area
Union, New York

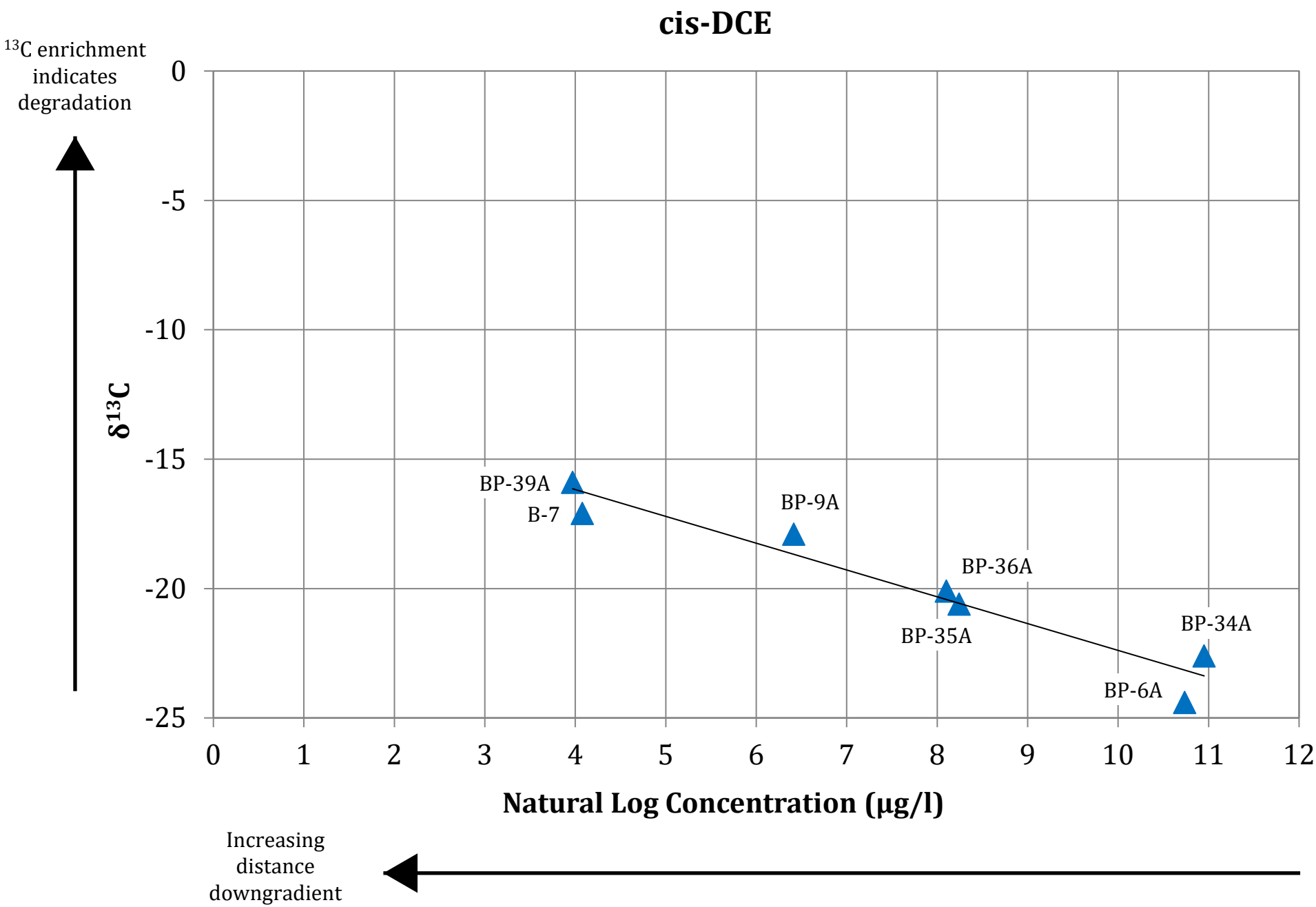
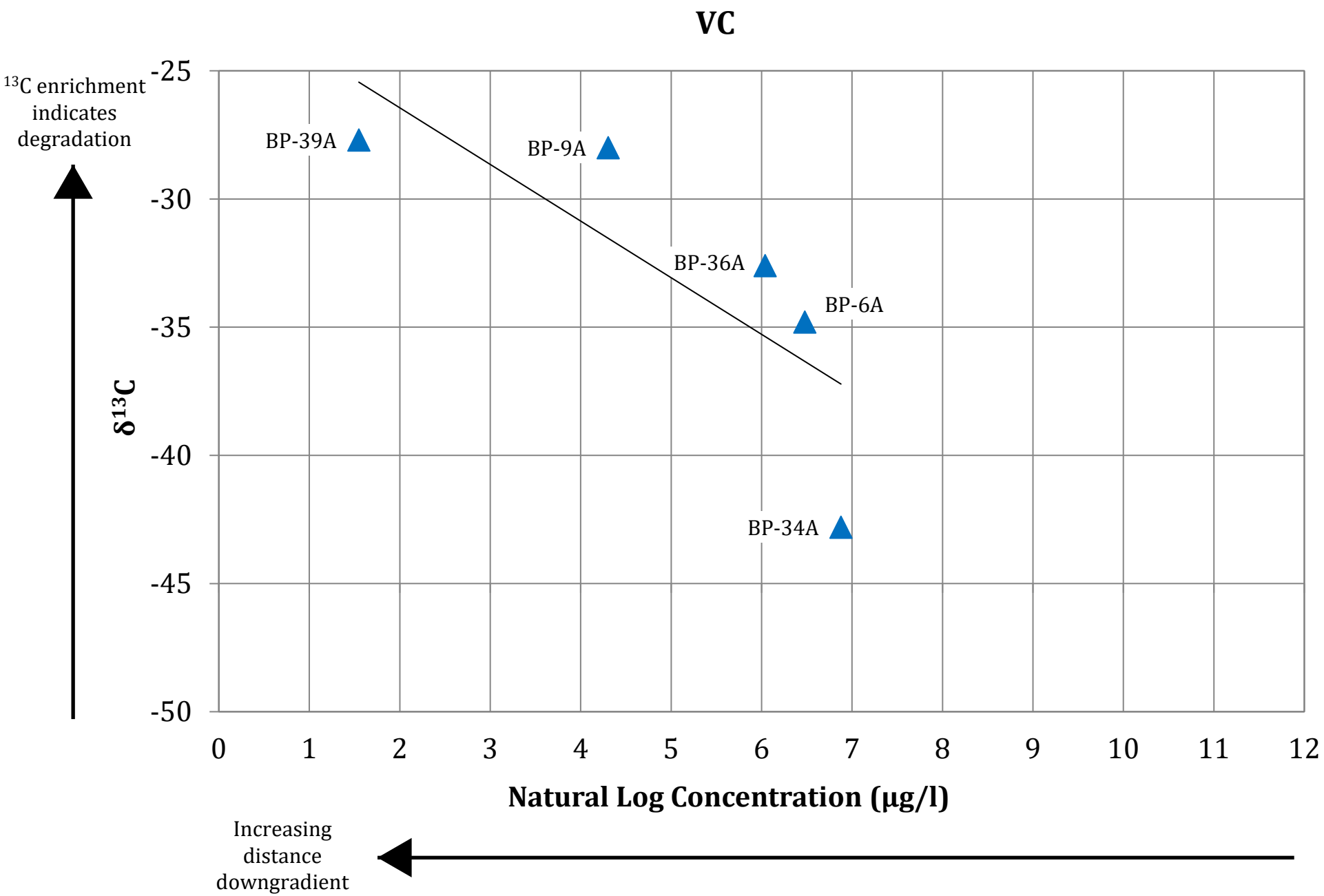


Figure A.3
April 2020 CSIA Results - VC
Summary of Water Quality Monitoring
IBM Gun Club - Former Burn Pit Area
Union, New York



SEPTEMBER 2020 PERFORMANCE TESTING

SANBORN HEAD ENGINEERING

8976 Wellington Road
Manassas, VA 20109

November 19, 2020

Gary Priscott
New York State Department of Environmental Conservation
1679 Route 11
Kirkwood, NY 13795

Re: Summary of September 2020 Water Quality Monitoring
IBM Gun Club, Former Burn Pit Area
Robinson Hill Road, Union, NY 13760
NYSDEC Site # C704044

Dear Mr. Priscott:

This letter serves to transmit copies of the Summary of September 2020 Water Quality Monitoring report. The remedy performance monitoring work and the preparation of this report were completed on behalf of IBM Corporation by Sanborn, Head Engineering, P.C. (SHPC) in accordance with NYSDEC-approved Site Management Plan (SMP) for this project.

If you have any questions regarding the enclosed report, please contact me at 703-257-2580.

Regards,

Stephen P Brown

Stephen Brown
IBM Program Manager

Enclosures: Summary of September 2020 Water Quality Monitoring

cc: Kevin O'Hara (Binghamton Country Club)
Eamonn O'Neil (NYSDOH)
Maureen Schuck (NYSDOH)
Harry Warner (NYSDEC)

SANBORN HEAD ENGINEERING
Building Trust. Engineering Success.

Stephen Brown, P.E.
IBM Corporation
8976 Wellington Road
Manassas, VA 20109

November 19, 2020
File No. 3526.06

Re: Summary of September 2020 Water Quality Monitoring
IBM Gun Club – Former Burn Pit Area
Union, New York
NYSDEC Site #C704044 (BCA Index #B7-0661004-05)

Dear Mr. Brown:

This letter report summarizes the scope and results of remedy performance monitoring conducted in September 2020 on behalf of IBM by Sanborn Head. It describes the sampling event and provides tabular and figure summaries of the field and laboratory data. The field work was conducted during the week of September 7, 2020 in general accordance with the procedures described in Appendix J of the Site Management Plan (SMP)[1]. IBM requested an extension for submittal of this report because of laboratory delays. The extension was granted in an email from the New York Department of Environmental Conservation (NYSDEC), dated October 23, 2020, which adjusted the submittal due date for this report to be November 20, 2020.

As previously approved by the NYSDEC, the typical sampling schedule was adjusted for 2020 to occur in April, September, and November to accommodate supplemental forensic analysis using quantitative polymerase chain reaction (qPCR) microbial census and compound-specific isotope analysis (CSIA) conducted during times of warmer groundwater conditions, and to occur immediately before and after an edible oil injection event. Accordingly, this report documents the annual comprehensive sampling round typically conducted in June. An amendment injection was conducted the week of September 14, 2020.

This letter report will be included as a component of the annual Periodic Review Report, due in January 2020, and it has been prepared consistent with the Monitoring Reporting Requirements described in Section 3.6 of the SMP.

SCOPE OF WORK

The scope of work included:

[1] Site Management Plan – April 2016 Revision, Brownfield Cleanup Program, IBM Gun Club – Former Burn Pit area, Union, New York, NYSDEC Site #C704044, BCA Index #B7-0661004-05, prepared on behalf of IBM by Sanborn, Head & Associates, Inc., April 25, 2016.

- Comprehensive groundwater elevation survey. The monitoring network is shown on Figure 1;
- Annual well inspection including depth-to-bottom measurements;
- Water quality sampling and laboratory analysis associated with the performance monitoring program;
- Water quality parameter field screening; and
- Supplemental sampling and analyses to support evaluation of remediation progress and potential remedy improvements.

Groundwater Elevation Survey

From September 8 to 10, 2020, the depths to water in monitoring wells and injection boreholes were gauged in accordance with procedures described in Appendix G of the SMP. Based on the depth to water data and survey information, groundwater elevations were calculated for each location. Depth to water measurements and groundwater elevations are summarized in Table 1. Inferred groundwater elevation contours are shown on Figure 2.

Groundwater levels in September 2020 were lower relative to previous gauging events, likely due to below average precipitation during the summer months. According to the National Weather Service, the Binghamton area recorded precipitation of 0.52 inches below average from June to September 2020. Groundwater flow directions are inferred to be consistent with historical monitoring and interpretation.

Water Quality Sampling

The scope of sampling as originally outlined in the SMP is included as Table 2. The scope was modified as follows:

- Samples were collected for laboratory geochemical analysis instead of in-situ field geochemical testing to improve efficiency;
- Due to water levels below the top of the passive diffusion bag (PDB), the samples from BP-7A, BP-8A, BP-12A, BP-14A, BP-32A, and GC-2A were collected with a dedicated bailer;
- Monitoring well BP-16A was found to be dry and thus was not sampled; and
- Multi-level Flute™ sampler ports BP-15D, P1 (18-25 feet below ground surface [ft bgs]) and BP-13D, P1 (21 to 25 ft bgs) were found to be dry and could not be sampled; and
- No new on-site seeps/springs were observed. The seep sampling location 119 first noted adjacent to BP-9A in 2017 and seep 118 were found to be dry and thus were not sampled this round.

Exhibit 1 below summarizes the sampling methods used during the monitoring event. The quality assurance/quality control (QA/QC) samples collected for VOC analysis are summarized in Exhibit 2. Samples (including QA/QC samples) submitted for off-site laboratory analysis or field screening are tabulated in Exhibit 3. Laboratory and field analytical data are summarized in Table 3.

Exhibit 1 Summary of Sampling Methods

Sample Method	Number of Locations Sampled
Modified Low-Flow	16
Submerged Container (surface water)	3
Passive Diffusion Bag	19
FLUTE® Purge	6
Bailer	6
Purge Water Tote Sample	1

Exhibit 2 Summary of QA/QC Samples for VOC analysis

Total Sample Locations	49
Duplicate Samples	5
Matrix Spikes	2
Matrix Spike Duplicates	2
Field Blanks	3
Equipment Blanks	1
Trip Blanks	3

Exhibit 3 Summary of Analytical Type

Sample Type – Off-Site Laboratory	Laboratory	Number of Samples
VOCs	Eurofins	65
Total Organic Carbon	Eurofins	23
Geochemical Analyses	Eurofins	14
Volatile Fatty Acids	Pace	23
Light Gases (Ethane, Ethene, and Methane)	Pace	23
qPCR (Microbial census)	Microbial Insights	8

Equipment Calibration

Exhibit 4 below summarizes the field instruments utilized during field sampling. The instruments were calibrated each morning and a calibration check was performed at the end of each day. Daily calibration forms are kept on file and are available upon request.

Exhibit 4 Summary of Field Instrumentation

INSTRUMENT	FIELD PARAMETER
YSI Water Quality Parameter Probe	Temperature, pH, Specific Conductance, Dissolved Oxygen, and Oxidation-reduction Potential
HACH 2100P Turbidimeter	Turbidity

SUMMARY OF RESULTS

Geochemical and VOC Results

A summary of the groundwater quality data and inferences is presented on Figure 2. A figure depicting the entire monitoring area, including the area south into the golf course, and summarizing key site VOCs plus carbon tetrachloride, is provided as Figure 3. Figure 4 is an interactive PDF presenting the geochemical data used to infer the geochemical conditions shown on Figure 2. Attachment A includes time-series charts of key geochemical and VOC results. Field sampling records and analytical laboratory reports are kept on file and available upon request.

Enhanced biochemical degradation of VOCs in groundwater is being monitored by: 1) tracking changes in concentration of the parent contaminant compound, trichloroethene (TCE), 2) tracking the presence of breakdown products of TCE, including the terminal breakdown products ethene and ethane, 3) tracking the presence of geochemical conditions favorable to biochemical conditions by reductive dehalogenation, and 4) supplemental analysis (compound specific isotope analysis [CSIA]/quantitative polymerase chain reaction [qPCR]) to inform the mechanisms and rates for contaminant degradation.

The field and laboratory data for September 2020 reflect conditions approximately three years after the last injection of edible oil amendment (i.e., electron donor to facilitate reductive dechlorination) in August 2017 and approximately one year following borehole redevelopment activities in March 2019. The results indicate remedy performance generally consistent with project performance goals established in the SMP, with some indications of potential changes noted below. Geochemical conditions generally remain within ranges that are favorable for reductive dechlorination over most of the source area and inferred core of the plume; however, as discussed in recent sampling reports, the August 2017 injection did not have as strong an affect as previous injections.

As shown on Figure 2, the overall area of sulfate-reducing conditions, which are marginally conducive to reductive dechlorination, is somewhat reduced in size to the north but continues to extend across the property boundary to encompass wells BP-38A and BP-39A to the south. The overall area of methanogenic conditions, which are more conducive to reductive dechlorination, are comparable to previous monitoring in April 2020 and slightly smaller relative to 2019 inferred areas. Figure 4 presents the geochemical data used to infer the limits of sulfate-reduction and methanogenesis shown on Figure 2.

Exhibit 5 below presents the September 2020 monitoring results for select key parameters in comparison to the previous monitoring results of April 2020. TCE and terminal breakdown product (ethene and ethane) concentrations have exhibited a favorable change or remained stable in 68% and 74% of sampled wells, respectively, which is slightly better than observed in April 2020. The geochemical data for oxidation-reduction potential (ORP) indicate that nine wells show a favorable or stable ORP change, compared to five wells in April. Six wells show a favorable or stable DO change, compared to seven wells with an observed favorable/stable change in April. Total organic carbon (TOC) concentrations greater than the 100 milligrams per liter (mg/l) threshold for biological degradation were

measured at two of the five sampled injection boreholes. TOC levels at monitoring wells within the injection displacement zone and further downgradient were similar to April 2020 values.

Exhibit 5: September 2020 Results Compared to April 2020

Analyte	TCE	Ethene+Ethane	TOC	ORP	DO
	ug/L	ug/L	mg/L	mV	mg/L
Injection Boreholes					
IB-7	<0.50	100	51		
A-13	<25	6,400	28		
B-4	1.1	10	10		
B-7	<250	250	500	14	0.90
B-9	19	73	1,300		
Injection Displacement Zone					
BP-2A	12	16	5.8	-53	2.9
BP-4A	110	88	3.0	-62	1.1
BP-13A	22	<2.0	1.8	110	4.4
BP-36A	1,200	650	3.4	-130	0.35
Downgradient - on site					
BP-1A	63	<2.0	19	200	8.9
BP-5A	12	<2.0	19	31	2.5
BP-6A	720	210	78	-72	6.8
BP-9A	580	85	1.5	-6.1	0.56
BP-34A	46,000	210	8.9	110	0.28
BP-35A	1,300	0.86	2.6	300	0.95
BP-37A	8.0	0.57	2.5	15	0.78
Downgradient - off site					
BP-31A	2.8	<2.0	<1.0	130	5.3
BP-38A	47	<2.0	0.74	170	1.8
BP-39A	80	0.32	1.7	62	1.8

Favorable Change	≥ 10% decline	≥ 10% increase	≥ 10% increase	≥ 10% decline	≥ 10% decline
Number of Wells	10	9	7	9	6
Stable	0 to ± 10%	0 to ± 10%	0 to ± 10%	0 to ± 10%	0 to ± 10%
Number of Wells	3	5	7	2	1
Unfavorable Change	≥ 10% increase	≥ 10% decline	≥ 10% decline	≥ 10% increase	≥ 10% increase
Number of Wells	6	5	5	4	8

Concentrations shown from September 2020 sampling event, rounded to 2 sig. figures.
Blank cell indicates lack of data in one or both events.

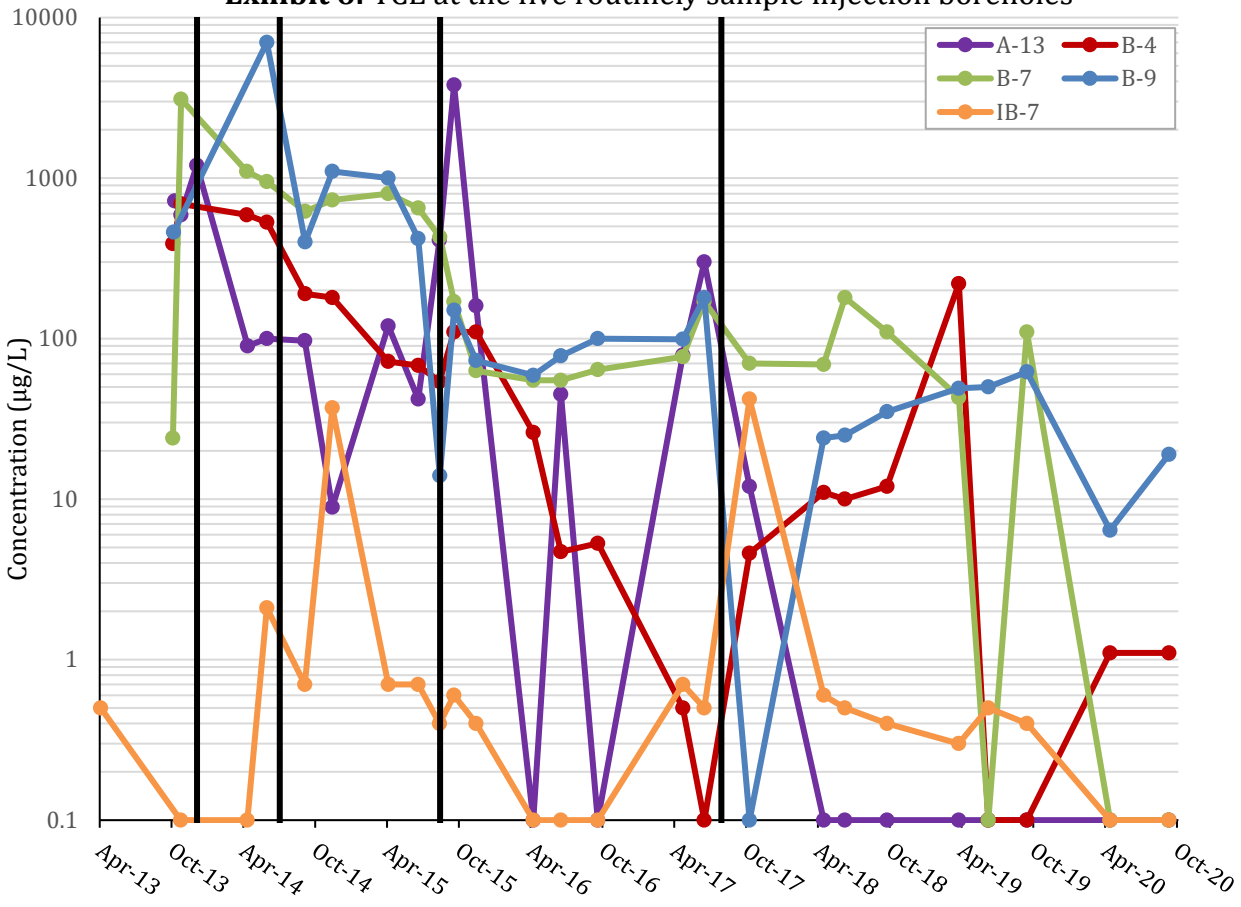
The marginal improvement of geochemical conditions conducive to reductive dechlorination observed in September 2020 is consistent with past monitoring events conducted during warmer weather. The average groundwater temperature increased from 7.1°C in April 2020

to 15°C in September 2020. Groundwater temperatures in September 2020 are more favorable to microbial activity than those during the April 2020 monitoring event.

Overall, the VOC and geochemical data continue to indicate a muted response to the injection of edible oil amendment in August 2017. As previously discussed, an injection was scheduled immediately following this sampling in September 2020. The outcomes of the injection along with the subsequent groundwater quality results will be reported in the Summary of Water Quality Monitoring documenting November 2020 sampling.

Exhibit 6 below shows the TCE concentrations for the five injection boreholes that are routinely sampled. Most of these injection boreholes continue to exhibit order of magnitude or greater decreases in TCE concentrations compared to historical high concentrations. Since the August 2017 injection, borehole A-13 has decreased to consistent non-detect concentrations. IB-7 has exhibited consistent decreasing concentrations. We note TCE was not detected in B-7, IB-7, and A-13 during this sampling round.

Exhibit 6: TCE at the five routinely sample injection boreholes



Note: Non-detects are plotted as 0.1 µg/L. The vertical black lines indicate site-scale amendment injections conducted in December 2013, July 2014, August 2015, and August 2017.

The vinyl chloride (VC) concentration at downgradient indicator well BP-39A, located across the former Gun Club property line, decreased during September 2020 sampling, well below the New York State Department of Environmental Conservation Class GA Groundwater quality standard of 2 µg/L. The relative proportion of VC fell below the proportion of terminal breakdown products ethene and ethane for the first time since fall of 2018. The decrease in VC also coincided with minor improvements in geochemical conditions, including ORP, perhaps due to the more beneficial warmer groundwater temperature.

The analytical data for key VOCs on Figure 3 for most monitoring locations farther downgradient to the south on the Binghamton Country Club property (e.g. BP-23A, BP-24A, BP-30A) indicate water quality generally consistent with the last sampling conducted at these locations in April 2020. Carbon tetrachloride continues to be monitored and is included on Figure 3 and Table 3 as a key site VOC identified during the remedial investigation. It continues to be detected in several locations (BP-10A, BP-13A, BP-18A, BP-20A, BP-26A, BP-27A, BP-30A, BP-38A, BP-39A, GC-2A GC-1_Port 1) at stable or decreasing concentrations compared to past monitoring.

Sampling results from the multilevel monitoring installations (e.g., GC-1, P8 [90 to 97 ft bgs] and BP-15D, P5 [119 to 126 ft bgs]), which screen productive fracture zones between the primary source rock and residential water supplies, do not indicate any adverse change in water quality.

CSIA and qPCR Results

The results of the qPCR census and CISA are presented in Table 4. Figure 5 is an interactive PDF presenting the qPCR results. The qPCR includes the population of *dehalococcoides* (DHC), and their associated functional genes that can be responsible for reductive dehalogenation of TCE (tceA), DCE+VC (vcrA), VC (bvcaA).

Additionally, populations of other microbes (*Dehalobacter* [DHBt], *Desulfitobacterium* [DSB], and *Desulfuromonas* [DSM]) capable of reductive dehalogenation, a functional gene that supports aerobic co-metabolic pathways (soluble methane monooxygenase [SMMO], and a methane competitor (MGN) that can adversely influence reductive dehalogenation, were also quantified. A brief summary of the qPCR results is presented below:

- **DHC -** DHC are bacteria that are known to be important for reductive dehalogenation. Two wells (BP-6A and BP-36A) met the threshold ($1x10^4$ cells/mL) for 'generally useful' bacterially driven reductive dechlorination in September 2020. The April 2020 sampling round did not yield any wells meeting these criteria; however, overall concentration trends were mixed, with DHC increasing or stable at 4 locations, and declining at 4 locations.

- **DHC Functional genes** – In general, the presence of functional genes confirms reductive dehalogenation of each compound is occurring. However, the absence of functional genes does not necessarily mean that reductive dehalogenation is not occurring; rather, it means that it was not measurable based on this line of evidence.

- ***tceA (TCE functional gene)*** – In September 2020, tceA was detected at three locations, with an increase relative to April 2020 at one location. Low counts suggest there are limited levels of reductive dehalogenation of TCE.

- ***vcrA (DCE+VC functional gene)*** – In September 2020, vcrA was detected at concentrations that are suggestive of moderate levels of reductive dehalogenation.

- ***bvcaA (VC functional gene)*** – In September 2020, bvcaA was detected above laboratory reporting limits in only one well (BP-6A), suggesting there is limited evidence for reductive dehalogenation of VC. We note that this finding is not consistent with the results from the vcrA results, which suggest that VC is being degraded, and with the documented presence of ethene/ethane, which is produced when VC is degraded.

- **DHBt, DSB, DSM –** A selection of locations[2] were analyzed for supplemental bacteria, in addition to DHC, also known to contribute to reductive dehalogenation. DHBt and DSB were found at levels above the beneficial threshold at BP-6A. DSM was detected at lower levels below the threshold at BP-30A and BP-39A. The extracts from samples collected from these locations in April 2020 were re-analyzed for these supplementary microbes. The April 2020 results are also shown in Table 4. No readily discernable trend between the April and September results was observed for these analytes.

- **MGN** – Methanogens are competitor microbes to DHC, and their presence may inhibit reductive dehalogenation. Methanogens should be distinguished from methanogenic subsurface geochemical conditions. Methanogenic geochemical conditions (i.e., conditions capable of producing methane) are conducive to reductive degradation, while the presence of methanogens could be detrimental. In September 2020, methanogens were detected in all but two locations (BP-30A and BP-6A), which may suggest downward pressure on DHC populations. We note that the BP-6A has relatively high counts of DHC cells and low counts of methanogen cells, suggesting subsurface conditions at this location are conducive to reductive dehalogenation.

- **SMMO** – the presence of functional gene SMMO may indicate the presence of aerobic microbial activity that can degrade TCE and VC. SMMO was generally not detected, suggesting this pathway may not be materially contributing to degradation.

The CSIA results from April and September 2020 samples are presented in Figures 6A – 6C. These data are fit with a linear regression. In general, a trend of more positive numbers moving from high concentration areas to low concentration areas (i.e., from right to left as plotted on the attachment A charts) suggests evidence of reductive dehalogenation. A negative slope is indicative of reductive dehalogenation, while limited to no slope suggest other attenuation mechanisms (e.g., dilution, dispersion, sorption, volatilization) are responsible for the reduction in concentrations. Linear regressions of CSIA data for TCE, DCE, and VC from samples collected in September 2020 are all negative, suggesting reductive dehalogenation is occurring. Most notably, the slope of linear regression for TCE in April

[2] BP-6A, BP-30A, BP-39A, B-7

was generally flat and is noticeably negative for September results, suggesting stronger evidence of reductive dehalogenation in September compared to April. A possible explanation for this increased evidence of TCE degradation is the higher groundwater temperatures in September compared to lower temperatures in April.

CLOSING

In summary, the September 2020 monitoring data collectively continue to support that degradation of CVOCs is occurring and that the rates of degradation are influenced by groundwater temperatures (i.e., higher temperatures correlate to higher rates of degradation). In some areas, such as between and downgradient of the injection lines, geochemical conditions and other indicator parameters suggest that subsurface geochemical conditions conducive to reductive dechlorination could be improved by re-injection of the edible oil amendment. Accordingly, and as described above, an edible oil injection was conducted immediately following the September 2020 groundwater sampling round. The next post-edible oil injection performance monitoring event will be conducted in November 2020.
Please contact us if you have any questions.

Very truly yours,
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Table 2 Scope of Routine and Performance Monitoring Program
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Figure 1 Monitoring Location Plan
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Figure 4 September 2020 Assessment of Reducing Conditions
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Attachment 1 Time-series charts of select compounds

TABLES

Table 1
Summary of September 2020 Water Level Data
Summary Trip Report
IBM Gun Club - Former Burn Pit Area
Union, New York

Well Location	Reference Elevation (ft amsl)	Depth to Water (ft Ref. Pt.)	Equivalent Potentiometric Elevation (ft amsl)
A-1	1391.11	7.10	1384.01
A-2	1390.68	6.90	1383.78
A-3	1392.74	13.61	1379.13
A-4	1397.56	20.08	1377.48
A-5	1397.40	21.65	1375.75
A-6	1397.86	20.88	1376.98
A-7	1397.28	20.28	1377.00
A-8	1396.81	19.21	1377.60
A-9	1396.47	18.71	1377.76
A-10	1396.06	19.12	1376.94
A-11	1395.73	10.74	1384.99
A-12	1395.59	17.74	1377.85
A-13	1394.25	17.14	1377.11
A-14	1394.61	13.62	1380.99
A-15	1393.47	15.24	1378.23
A-16	1398.14	8.93	1389.21
A-17	1395.48	8.53	1386.95
B-1	1385.26	11.68	1373.58
B-2	1384.71	10.87	1373.84
B-3	1385.48	6.99	1378.49
B-4	1385.03	8.79	1376.24
B-5	1383.99	11.50	1372.49
B-6	1384.48	8.05	1376.43
B-7	1385.33	8.48	1376.85
B-8	1384.90	17.26	1367.64
B-9	1385.21	15.40	1369.81
B-10	1384.69	6.98	1377.71
B-11	1384.40	7.23	1377.17
B-12	1383.87	8.17	1375.70
B-13	1384.50	8.40	1376.10
BP-1A	1395.67	17.55	1378.12
BP-2A	1396.89	14.02	1382.87
BP-4A	1391.96	14.21	1377.75
BP-5A	1391.09	18.40	1372.69
BP-6A	1393.95	15.61	1378.34
BP-7A	1388.89	>15.31	<1373.58
BP-8A	1384.53	>15.59	<1368.94
BP-9A	1379.17	13.45	1365.72
BP-10A	1381.74	15.50	1366.24
BP-11A	1384.80	15.09	1369.71
BP-12A	1386.64	>19.21	<1367.43
BP-12D Port 1	1388.19	>0.53[†]	<1387.66
BP-12D Port 2	1388.19	34.05	1354.14
BP-12D Port 3	1388.19	67.34	1320.85
BP-12D Port 4	1388.19	69.75	1318.44

Table 1
Summary of September 2020 Water Level Data
Summary Trip Report
IBM Gun Club - Former Burn Pit Area
Union, New York

Well Location	Reference Elevation (ft amsl)	Depth to Water (ft Ref. Pt.)	Equivalent Potentiometric Elevation (ft amsl)
BP-12D Port 5	1388.19	69.66	1318.53
BP-12D Port 6	1388.19	69.64	1318.55
BP-12D Port 7	1388.19	69.56	1318.63
BP-13A	1398.89	17.93	1380.96
BP-13D Port 1	1400.09	147.45	1252.64
BP-13D Port 2	1400.09	37.83	1362.26
BP-13D Port 3	1400.09	78.60	1321.49
BP-13D Port 4	1400.09	94.11	1305.98
BP-13D Port 5	1400.09	94.45	1305.64
BP-13D Port 6	1400.09	94.49	1305.60
BP-13D Port 7	1400.09	94.52	1305.57
BP-14A	1379.46	29.78	1349.68
BP-14D Port 1	1378.07	102.94	1275.13
BP-14D Port 2	1378.07	68.37	1309.70
BP-14D Port 3	1378.07	76.49	1301.58
BP-14D Port 4	1378.07	76.42	1301.65
BP-14D Port 5	1378.07	76.25	1301.82
BP-14D Port 6	1378.07	76.37	1301.70
BP-15A	1388.32	>16.92	<1371.4
BP-15D Port 1	1388.36	Dry	
BP-15D Port 2	1388.36	>51.21‡	<1337.15
BP-15D Port 3	1388.36	39.08	1349.28
BP-15D Port 4	1388.36	39.19	1349.17
BP-15D Port 5	1388.36	80.06	1308.30
BP-15D Port 6	1388.36	82.65	1305.71
BP-15D Port 7	1388.36	83.61	1304.75
BP-16A	1389.69	>16.12	<1373.57
BP-17A	1376.30	13.64	1362.66
BP-18A	1386.54	18.14	1368.40
BP-19A	1309.40	21.65	1287.75
BP-20A	1274.60	8.92	1265.68
BP-21A	1244.29	9.24	1235.05
BP-22A	1242.90	7.96	1234.94
BP-23A	1333.39	15.19	1318.20
BP-24A	1338.73	15.89	1322.84
BP-25A	1301.92	6.53	1295.39
BP-26A	1336.96	16.34	1320.62
BP-27A	1299.96	4.20	1295.76
BP-30A	1336.20	13.89	1322.31
BP-31A	1369.63	14.31	1355.32
BP-32A	1389.58	>17.95	<1371.63
BP-34A	1392.55	14.95	1377.60
BP-35A	1391.75	17.70	1374.05
BP-36A	1383.68	14.30	1369.38
BP-37A	1389.92	11.33	1378.59

Table 1
Summary of September 2020 Water Level Data
Summary Trip Report
IBM Gun Club - Former Burn Pit Area
Union, New York

Well Location	Reference Elevation (ft amsl)	Depth to Water (ft Ref. Pt.)	Equivalent Potentiometric Elevation (ft amsl)
BP-38A	1375.10	14.03	1361.07
BP-39A	1370.17	12.88	1357.29
GC-1 Port 1	1385.22	16.11	1369.11
GC-1 Port 2	1385.22	16.11	1369.11
GC-1 Port 3	1385.22	15.85	1369.37
GC-1 Port 4	1385.22	29.02	1356.20
GC-1 Port 5	1385.22	55.64	1329.58
GC-1 Port 6	1385.22	55.70	1329.52
GC-1 Port 7	1385.22	65.89	1319.33
GC-1 Port 8	1385.22	65.91	1319.31
GC-2A	1383.32	>21.23	<1362.09
IB-1	1392.20	7.92	1384.28
IB-2	1393.47	9.18	1384.29
IB-3	1393.07	10.44	1382.63
IB-4	1393.78	9.62	1384.16
IB-5	1393.88	15.40	1378.48
IB-6	1393.05	8.85	1384.20
IB-7	1393.23	8.92	1384.31
IB-8	1393.43	10.16	1383.27
IB-9	1393.62	9.42	1384.20

Notes:

1. This table summarizes depth to water measurements and calculated water table elevations recorded during the September performance monitoring round on September 8-10, 2020. Measurements were collected relative to the marked reference point at each location using a QED MP30 water level meter.

2. Abbreviations:
ft amsl = feet above mean sea level
ft Ref. Pt. = feet below well reference point.

3. "†" Water level meter obstructed at 0.53 ft.
"‡" Water level meter obstructed due to kink in tubing at 51.21 ft.

Table 2
Summary of Routine and Performance Monitoring Program
IBM Gun Club - Former Burn Pit Area
Union, New York

Monitoring Type	Monitoring Location	Monitoring Location Type	Sample Method				Analytical Laboratory											Field Screening
			Low Flow	PDBs	Nitrogen Purge	Surface Water	VOCs	Light Gasses	TOC	VFAs	Total Iron	Ferrous Iron	Nitrate	Sufate	Sulfide	qPCR	CSIA	Water Quality Parameters
Routine Monitoring (September 2020)	BP-7A	Monitoring Well		x			x											x
	BP-8A	Monitoring Well		x			x											x
	BP-10A	Monitoring Well		x			x											x
	BP-11A	Monitoring Well		x			x											x
	BP-12A	Monitoring Well		x			x											x
	BP-14A	Monitoring Well		x			x											x
	BP-16A	Monitoring Well		x			x											x
	BP-17A	Monitoring Well		x			x											x
	BP-18A	Monitoring Well		x			x											x
	BP-19A	Monitoring Well		x			x											x
	BP-20A	Monitoring Well		x			x											x
	BP-21A	Monitoring Well		x			x											x
	BP-22A	Monitoring Well		x			x											x
	BP-23A	Monitoring Well		x			x											x
	BP-24A	Monitoring Well		x			x											x
	BP-25A	Monitoring Well		x			x											x
	BP-26A	Monitoring Well		x			x											x
	BP-27A	Monitoring Well		x			x											x
	BP-32A	Monitoring Well		x			x											x
	GC-2A	Monitoring Well		x			x											x
	GC-1, P-1	Multi-Depth			x		x											x
	GC-1, P-8	Multi-Depth			x		x											x
	BP-12D, P1	Multi-Depth			x		x											x
	BP-12D, P7	Multi-Depth			x		x											x
	BP-13D, P1	Multi-Depth			x		x											x
	BP-13D, P5	Multi-Depth			x		x											x
	BP-15D, P1	Multi-Depth			x		x											x
	BP-15D, P5	Multi-Depth			x		x											x
Performance Monitoring (April, September, and November 2020)	IB-7	Injection Borehole		x			x	x	x	x								
	A-13	Injection Borehole		x			x	x	x	x								
	B-4	Injection Borehole		x			x	x	x	x								
	B-7	Injection Borehole	x	x			x	x	x	x	x	x	x	x	x	x	x	x
	B-9	Injection Borehole		x			x	x	x	x								
	BP-1A	Monitoring Well	x				x	x	x	x	x	x	x	x	x			x
	BP-2A	Monitoring Well	x				x	x	x	x	x	x	x	x	x			x
	BP-4A	Monitoring Well	x				x	x	x	x	x	x	x	x	x			x
	BP-5A	Monitoring Well	x				x	x	x	x	x	x	x	x	x			x
	BP-6A	Monitoring Well	x				x	x	x	x	x	x	x	x	x	x	x	x
	BP-9A	Monitoring Well	x				x	x	x	x	x	x	x	x	x	x	x	x
	BP-13A	Monitoring Well	x				x	x	x	x	x	x	x	x	x			x
	BP-30A	Monitoring Well	x	x			x	x	x	x	x	x	x	x	x	x	x	x
	BP-31A	Monitoring Well	x				x	x	x	x	x	x	x	x	x			x
	BP-34A	Monitoring Well	x				x	x	x	x	x	x	x	x	x	x	x	x
	BP-35A	Monitoring Well	x				x	x	x	x	x	x	x	x	x	x	x	x
	BP-36A	Monitoring Well	x				x	x	x	x	x	x	x	x	x	x	x	x
	BP-37A	Monitoring Well	x				x	x	x	x	x	x	x	x	x			x
	BP-38A	Monitoring Well	x				x	x	x	x	x	x	x	x	x			x
	BP-39A	Monitoring Well	x				x	x	x	x	x	x	x	x	x	x	x	x
	111	Seep/spring				x	x											x
	112	Seep/spring				x	x											x
	113	Seep/spring				x	x											x
	118	Seep/spring				x	x											x
	SW-Z	Seep/spring				x	x											x
		Total	**16**	**26**	**8**	**5**	**53**	**20**	**20**	**20**	**16**	**16**	**16**	**16**	**16**	**8**	**8**	**49**

Notes:
1. This table is intended to summarize the programs of routine and performance monitoring for remedy operations at the IBM Gun Club - Former Burn Pit Area. Additional monitoring points may be sampled based on field observations. "SW-Z" serves as a placeholder for sampling any on-site seep or spring that can be reasonably sampled. The table summarizes sample method, analytical laboratory analysis, and field screening.

2. Sample method:
"Low Flow" indicates samples will be collected by bladder pump using low flow techniques.
"PDBs" indicates that the well has sufficient water column to sample with passive diffusion bags - if conditions are observed to be different than anticipated, sampling will proceed using low flow techniques.
"Nitrogen purge" indicates that sample will be collected by purging the multi-level port with nitrogen (multi-level systems only).
"Surface water" samples will be collected using a clean glass vial.

3. Analytical laboratory samples:
"VOCs" indicates volatile organic compounds.
"Light gasses" includes methane, ethene and ethane.
"TOC" indicates total organic carbon.
"VFAs" indicates volatile fatty acids.
"qPCR" indicates quantitative polymerase chain reaction analysis (DNA-based analysis to quantify specific microorganisms and functional genes responsible for biodegradation)
"CSIA" indicates compound-specific isotope analysis (ratio of stable carbon isotopes in TCE, cDCE, and VC)

4. " Water quality parameters" indicates screening during well purging and water quality sampling by multi-parameter probes, e.g. by YSI® 556 multi-Probe meter or similar and HACH® turbidity meter or similar (low flow, multi-level system, bailer, and surface water sampling) or by water quality parameter sounding (PDB sampling). The water quality parameters may include temperature, specific conductance, oxidation-reduction potential, dissolved oxygen, pH, and turbidity. In addition surface water samples will include water clarity descriptors (transparency, translucence, or opaqueness, and color).

TABLE 3
SUMMARY OF SEPTEMBER 2020 PERFORMANCE MONITORING
Summary Trip Report
IBM Gun Club - Former Burn Pit Area
Union, New York

Analyte Name	Unit	BP-1A BP-1A Low Flow S 9/9/2020	BP-2A BP-2A Low Flow S 9/9/2020	BP-4A BP-4A Low Flow S 9/9/2020	BP-5A BP-5A Low Flow S 9/9/2020	BP-6A BP-6A Low Flow S 9/10/2020	BP-7A BP-7A PDB S 9/8/2020	BP-8A BP-8A PDB S 9/9/2020	BP-9A BP-9A Low Flow S 9/10/2020	BP-10A BP-10A PDB S 9/9/2020	BP-11A BP-11A PDB S 9/8/2020	BP-12A BP-12A PDB S 9/8/2020	BP-13A BP-13A Low Flow S 9/9/2020	BP-14A BP-14A Bailer S 9/9/2020	BP-17A BP-17A PDB S 9/8/2020	BP-18A BP-18A PDB S 9/9/2020	BP-18A BP-18A_FD PDB FD 9/9/2020	BP-19A BP-19A PDB S 9/8/2020	BP-20A BP-20A PDB S 9/8/2020
VOLATILE ORGANIC COMPOUNDS (VOCs)																			
Trichloroethene (TCE)	µg/l	**63**	**12 J**	**110**	**12**	**720**	<0.50	**2.4**	**580**	**3.5**	**2.1**	**0.57**	**22**	**0.14 J**	**1.4**	**2.9**	**3.1**	<0.50	**1.7**
Dichloroethene (cis-1,2-)	µg/l	**150**	**1,600**	**40**	**17**	**55,000**	<0.50	**1.3**	**2,100**	**0.73**	<0.50	<0.50	**1.6**	<0.50	<0.50	**0.79**	**0.83**	<0.50	<0.50
Dichloroethene (trans-1,2-)	µg/l	**0.76 J**	<25	**1.1**	<2.5	**150 J**	<0.50	<0.50	**28**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Dichloroethene (1,1-)	µg/l	<2.5	<25	**0.49 J**	<2.5	**100 J**	<0.50	<0.50	**5.9 J**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Tetrachloroethene (PCE)	µg/l	<2.5	<25	<1.0	<2.5	<250	<0.50	<0.50	<10	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	**0.11 J**
Vinyl chloride	µg/l	**1.2 J**	**30**	**12**	<2.5	**6,700**	<0.50	<0.50	**210**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
LIGHT GASSES																			
Ethane	µg/l	<1	<1	**46**	<1	**1.7**	–	–	**20**	–	–	–	<1	–	–	–	–	–	–
Ethene	µg/l	<1	**16**	**42**	<1	**210**	–	–	**65**	–	–	–	<1	–	–	–	–	–	–
Methane	µg/l	**3.7 J**	**30**	**5,900**	**4.8 J**	**68**	–	–	**11,000**	–	–	–	**2.8 J**	–	–	–	–	–	–
MOLAR CONCENTRATION																			
Trichloroethene (TCE)	µmol/l	0.48	0.091	0.84	0.091	5.5	ND	0.018	4.4	0.027	0.016	0.0043	0.17	0.0011	0.011	0.022	0.024	ND	0.013
Dichloroethene (cis-1,2-)	µmol/l	1.5	17	0.41	0.18	570	ND	0.013	22	0.0075	ND	ND	0.017	ND	ND	0.0081	0.0086	ND	ND
Dichloroethene (trans-1,2-)	µmol/l	0.0078	ND	0.011	ND	1.5	ND	ND	0.29	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dichloroethene (1,1-)	µmol/l	ND	ND	0.0051	ND	1.0	ND	ND	0.061	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethene (PCE)	µmol/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00066
Vinyl chloride	µmol/l	0.019	0.48	0.19	ND	110	ND	ND	3.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethane	µmol/l	ND	ND	1.5	ND	0.057	–	–	0.67	–	–	–	ND	–	–	–	–	–	–
Ethene	µmol/l	ND	0.57	1.5	ND	7.5	–	–	2.3	–	–	–	ND	–	–	–	–	–	–
Total	µmol/l	2.1	18	4.5	0.27	690	ND	0.032	33	0.034	0.016	0.0043	0.18	0.0011	0.011	0.030	0.032	ND	0.014
MOLAR PERCENTAGE																			
TCE	%	23	0.52	19	34	0.79	ND	58	13	78	100	100	91	100	100	73	73	ND	95
DCEs	%	76	94	9.6	66	83	ND	42	67	22	ND	ND	9.0	ND	ND	27	27	ND	ND
VC	%	0.93	2.7	4.3	ND	16	ND	ND	10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethane+Ethene	%	ND	3.2	67	ND	1.1	–	–	9.1	–	–	–	ND	–	–	–	–	–	–
VOLATILE FATTY ACIDS																			
Acetic Acid	mg/l	**4.8 J**	**1.30**	**0.54**	**1.2**	**11**	–	–	**0.64**	–	–	–	**2.9**	–	–	–	–	–	–
Butyric Acid	mg/l	<5	<1	<0.5	**0.13 J**	**1.2 J**	–	–	<0.5	–	–	–	<2.5	–	–	–	–	–	–
Hexanoic Acid	mg/l	<5	<1	**0.073 J**	**0.18 J**	<10	–	–	<0.5	–	–	–	**0.41 J**	–	–	–	–	–	–
i-Hexanoic Acid	mg/l	<5	<1	<0.5	<0.5	<10	–	–	<0.5	–	–	–	<2.5	–	–	–	–	–	–
i-Pentanoic Acid	mg/l	<5	<1	<0.5	<0.5	<10	–	–	<0.5	–	–	–	<2.5	–	–	–	–	–	–
Lactic Acid	mg/l	<5	**0.16 J**	<0.5	<0.5	<10	–	–	<0.5	–	–	–	<2.5	–	–	–	–	–	–
Pentanoic Acid	mg/l	<5	<1	<0.5	<0.5	**1.2 J**	–	–	<0.5	–	–	–	<2.5	–	–	–	–	–	–
Propionic Acid	mg/l	<5	<1	**0.066 J**	**0.087 J**	<10	–	–	<0.5	–	–	–	<2.5	–	–	–	–	–	–
Pyruvic Acid	mg/l	<5	<1	<0.5	<0.5	**8.4 J**	–	–	<0.5	–	–	–	<2.5	–	–	–	–	–	–
OTHER LABORATORY DATA																			
Carbon Tetrachloride	µg/l	<2.5	<25	<1.0	<2.5	<250	<0.50	<0.50	<10	**0.10 J**	<0.50	<0.50	**0.84**	<0.50	<0.50	**0.20 J**	**0.21 J**	<0.50	**0.086 J**
Total Organic Carbon	mg/l	**19**	**5.8**	**3.0**	**19**	**78**	–	–	**1.5**	–	–	–	**1.8**	–	–	–	–	–	–
WATER QUALITY PROBE DATA																			
Temperature	°C	**16**	**17**	**20**	**19**	**15**	**17**	–	**17**	**12**	**12**	**16**	**17**	–	**13**	**11**	–	**10**	**16**
Specific Conductance	uS/cm	**2,900**	**1,200**	**680**	**1,800**	**9,000**	**270**	–	**580**	**130**	**160**	**440**	**220**	–	**310**	**210**	–	**97**	**180**
pH	s.u.	**7.0**	**6.1**	**10**	**8.5**	**6.8**	**6.2**	–	**9.4**	**6.9**	**7.2**	**7.0**	**6.8**	–	**8.0**	**6.7**	–	**6.6**	**6.6**
Oxidation/Reduction Potential	mV	**200**	**-53**	**-62**	**31**	**-72**	**210**	–	**-6.1**	**50**	**68**	**120**	**110**	–	**79**	**79**	–	**96**	**89**
Dissolved Oxygen	mg/l	**8.9**	**2.9**	**1.1**	**2.5**	**6.8**	**7.1**	–	**0.56**	**2.7**	**2.9**	**5.0**	**4.4**	–	**7.0**	**4.4**	–	**6.9**	**3.1**
Turbidity	NTU	**2.6**	**9.4**	**2.5**	**18**	**4.4**	–	–	**5.7**	–	–	–	**8.1**	–	–	–	–	–	–
GEOCHEMISTRY																			
Iron	mg/l	–	**14 B**	<0.20	–	**12**	–	–	**0.16 J**	–	–	–	–	–	–	–	–	–	–
Iron - Ferrous	mg/l	**0.058**	**14**	**0.025 J**	–	<0.050	–	–	<0.050	–	–	–	–	–	–	–	–	–	–
Nitrate	mg/l	**1.3**	<0.50	<0.50	–	<0.50	–	–	<0.50	–	–	–	–	–	–	–	–	–	–
Sulfate	mg/l	**260 E**	**88 E**	**19**	–	**1,800**	–	–	**23**	–	–	–	–	–	–	–	–	–	–
Sulfide	µg/l	**1.4 J**	<2.0	<2.0	–	**0.76 J**	–	–	<2.0	–	–	–	–	–	–	–	–	–	–

TABLE 3
SUMMARY OF SEPTEMBER 2020 PERFORMANCE MONITORING
Summary Trip Report
IBM Gun Club - Former Burn Pit Area
Union, New York

Analyte Name	Unit	BP-21A	BP-22A	BP-23A	BP-24A	BP-24A	BP-25A	BP-26A	BP-27A	BP-30A	BP-31A	BP-31A	BP-32A	BP-34A	BP-35A	BP-35A	BP-36A	BP-36A	BP-37A
		BP-21A	BP-22A	BP-23A	BP-24A	BP-24A_FD	BP-25A	BP-26A	BP-27A	BP-30A	BP-31A	BP-31A_FD	BP-32A	BP-34A	BP-35A	BP-35A_FD	BP-36A	BP-36A_FD	BP-37A
		PDB	PDB	PDB	PDB	PDB	PDB	PDB	PDB	PDB/Low Flow	Low Flow	Low Flow	PDB	Low Flow	Low Flow	Low Flow	Low Flow	Low Flow	Low Flow
		S	S	S	S	FD	S	S	S	S	S	FD	S	S	S	FD	S	FD	S
		9/8/2020	9/8/2020	9/8/2020	9/8/2020	9/8/2020	9/8/2020	9/8/2020	9/9/2020	9/8,10/2020	9/9/2020	9/9/2020	9/10/2020	9/10/2020	9/10/2020	9/10/2020	9/10/2020	9/10/2020	9/9/2020
VOLATILE ORGANIC COMPOUNDS (VOCs)																			
Trichloroethene (TCE)	µg/l	<0.50	<0.50	**0.21 J**	**0.91**	**0.92**	**0.70**	**0.72**	**1.8**	**2.3**	**2.6**	**2.8**	**0.33 J**	**46,000**	**1,200**	**1,300**	**1,100**	**1,200**	**8.0**
Dichloroethene (cis-1,2-)	µg/l	<0.50	<0.50	<0.50	**0.72**	**0.71**	<0.50	<0.50	**0.40 J**	**5.4**	**0.54**	**0.58**	<0.50	**75,000**	**3,100**	**3,400**	**10,000**	**9,200**	**4.8**
Dichloroethene (trans-1,2-)	µg/l	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	**110 J**	**10 J**	**10 J**	**41 J**	**39 J**	<0.50
Dichloroethene (1,1-)	µg/l	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	**130 J**	<25	**3.9 J**	**19 J**	**18 J**	<0.50
Tetrachloroethene (PCE)	µg/l	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	**1.2**	**0.27 J**	**0.28 J**	<0.50	<250	<25	<25	<50	<50	<0.50
Vinyl chloride	µg/l	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	**1,600**	<25	<25	**1,600**	**1,700**	**0.32 J**
LIGHT GASSES																			
Ethane	µg/l	–	–	–	–	–	–	–	–	**0.36 J**	<1	<1	–	**5.2**	<1	<1	**21**	**23**	<1
Ethene	µg/l	–	–	–	–	–	–	–	–	<1	<1	<1	–	**200**	**0.72 J**	**0.86 J**	**540**	**630**	**0.57 J**
Methane	µg/l	–	–	–	–	–	–	–	–	**15**	**2.8 J**	**2.5 J**	–	**1,000**	**10**	**9.6**	**6,700**	**6,800**	**750**
MOLAR CONCENTRATION																			
Trichloroethene (TCE)	µmol/l	ND	ND	0.0016	0.0069	0.0070	0.0053	0.0055	0.014	0.018	0.020	0.021	0.0025	350	9.1	9.9	8.4	9.1	0.061
Dichloroethene (cis-1,2-)	µmol/l	ND	ND	ND	0.0074	0.0073	ND	ND	0.0041	0.056	0.0056	0.0060	ND	770	32	35	100	95	0.050
Dichloroethene (trans-1,2-)	µmol/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.1	0.10	0.10	0.42	0.40	ND
Dichloroethene (1,1-)	µmol/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.3	ND	0.040	0.20	0.19	ND
Tetrachloroethene (PCE)	µmol/l	ND	ND	ND	ND	ND	ND	ND	ND	0.0072	0.0016	0.0017	ND	ND	ND	ND	ND	ND	ND
Vinyl chloride	µmol/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	26	ND	ND	26	27	0.0051
Ethane	µmol/l	–	–	–	–	–	–	–	–	0.012	ND	ND	–	0.17	ND	ND	0.70	0.76	ND
Ethene	µmol/l	–	–	–	–	–	–	–	–	ND	ND	ND	–	7.1	0.026	0.031	19	22	0.020
Total	µmol/l	ND	ND	0.0016	0.014	0.014	0.0053	0.0055	0.018	0.092	0.027	0.029	0.0025	1,200	41	45	160	160	0.14
MOLAR PERCENTAGE																			
TCE	%	ND	ND	100	48	49	100	100	77	19	73	74	100	30	22	22	5.4	5.9	45
DCEs	%	ND	ND	ND	52	51	ND	ND	23	60	21	21	ND	67	78	78	65	62	36
VC	%	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.2	ND	ND	17	18	3.8
Ethane+Ethene	%	–	–	–	–	–	–	–	–	13	ND	ND	–	0.64	0	0	13	15	15
VOLATILE FATTY ACIDS																			
Acetic Acid	mg/l	–	–	–	–	–	–	–	–	**0.30 J**	**0.60**	**0.56**	–	**0.66**	**0.61**	**0.58**	**2.1**	**2.4**	**0.29 J**
Butyric Acid	mg/l	–	–	–	–	–	–	–	–	<0.5	<0.5	<0.5	–	**0.067 J**	<0.5	<0.5	<0.5	**0.064 J**	<0.5
Hexanoic Acid	mg/l	–	–	–	–	–	–	–	–	<0.5	**0.075 J**	**0.078 J**	–	<0.5	**0.087 J**	<0.5	<0.5	<0.5	<0.5
i-Hexanoic Acid	mg/l	–	–	–	–	–	–	–	–	<0.5	<0.5	<0.5	–	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
i-Pentanoic Acid	mg/l	–	–	–	–	–	–	–	–	<0.5	<0.5	<0.5	–	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Lactic Acid	mg/l	–	–	–	–	–	–	–	–	<0.5	**0.053 J**	<0.5	–	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Pentanoic Acid	mg/l	–	–	–	–	–	–	–	–	<0.5	<0.5	<0.5	–	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Propionic Acid	mg/l	–	–	–	–	–	–	–	–	<0.5	<0.5	<0.5	–	<0.5	<0.5	<0.5	**0.054 J**	**0.055 J**	<0.5
Pyruvic Acid	mg/l	–	–	–	–	–	–	–	–	<0.5	<0.5	<0.5	–	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
OTHER LABORATORY DATA																			
Carbon Tetrachloride	µg/l	<0.50	<0.50	<0.50	**0.076 J**	<0.50	<0.50	**0.36 J**	**0.24 J**	**0.38 J**	<0.50	<0.50	<0.50	<250	<25	<25	<50	<50	<0.50
Total Organic Carbon	mg/l	–	–	–	–	–	–	–	–	**1.2**	<1.0	<1.0	–	**8.9**	**2.6**	**2.5**	**3.4**	**3.3**	**2.5**
WATER QUALITY PROBE DATA																			
Temperature	°C	**14**	**15**	**12**	**12**	–	**16**	**11**	**18**	**13**	**14**	–	–	**17**	**20**	–	**18**	–	**19**
Specific Conductance	uS/cm	**570**	**770**	**260**	**180**	–	**160**	**420**	**200**	**160**	**350**	–	–	**1,400**	**900**	–	**820**	–	**690**
pH	s.u.	**7.4**	**7.8**	**7.2**	**6.8**	–	**7.4**	**6.7**	**6.2**	**6.6**	**7.5**	–	–	**6.9**	**7.3**	–	**6.9**	–	**8.7**
Oxidation/Reduction Potential	mV	**73**	**51**	**79**	**79**	–	**48**	**95**	**160**	**89**	**130**	–	–	**110**	**300**	–	**-130**	–	**15**
Dissolved Oxygen	mg/l	**0.74**	**1.8**	**0.88**	**4.0**	–	**3.6**	**7.8**	**3.1**	**5.2**	**5.3**	–	–	**0.28**	**0.95**	–	**0.35**	–	**0.78**
Turbidity	NTU	–	–	–	–	–	–	–	–	**18**	**18**	–	–	**0.99**	**7.5**	–	**1.4**	–	**3.5**
GEOCHEMISTRY																			
Iron	mg/l	–	–	–	–	–	–	–	–	**0.15 J**	**0.16 JB**	–	–	**0.12 J**	**1.7**	–	**2.3**	–	**0.050 JB**
Iron - Ferrous	mg/l	–	–	–	–	–	–	–	–	**13**	<0.050	–	–	**0.17**	<0.050	–	**0.64**	–	**0.061**
Nitrate	mg/l	–	–	–	–	–	–	–	–	**0.43 J**	<0.50 H	–	–	<0.50	<0.50	–	<0.50	–	**1.7**
Sulfate	mg/l	–	–	–	–	–	–	–	–	**15**	**25**	–	–	**60**	**35**	–	**14**	–	**9.8**
Sulfide	µg/l	–	–	–	–	–	–	–	–	<2.0	<2.0	–	–	<2.0	–	–	–	–	<2.0

TABLE 3
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IBM Gun Club - Former Burn Pit Area
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Analyte Name	Unit	BP-38A	BP-39A	GC-2A	A-13	B-4	B-7	B-9	IB-7	GC-1 Port 1	GC1 Port 8	BP-12D Port 1	BP-12D Port 7	BP-13D Port 5	BP-15D Port 5	111	112
		BP-38A	BP-39A	GC-2A	A-13	B-4	B-7	B-9	IB-7	GC-1,P1	GC1,P8	BP-12D,P1	BP-12D,P7	BP-13D,P5	BP-15D,P5	111	112
		Low Flow	Low Flow	PDB	PDB	PDB	PDB/Low Flow	PDB	PDB	FLUTe	FLUTe	FLUTe	FLUTe	FLUTe	FLUTe	Surface Water	Surface Water
		S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
		9/9/2020	9/10/2020	9/9/2020	9/11/2020	9/11/2020	9/10/2020	9/11/2020	9/11/2020	9/11/2020	9/11/2020	9/11/2020	9/11/2020	9/11/2020	9/11/2020	9/9/2020	9/9/2020
VOLATILE ORGANIC COMPOUNDS (VOCs)																	
Trichloroethene (TCE)	µg/l	**47**	**80**	**1.3**	<25	**1.1 J**	<250	**19**	<0.50	**32**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	**1.4**
Dichloroethene (cis-1,2-)	µg/l	**8.7**	**84**	**0.14 J**	**5,000**	**5.2**	**79 J**	**110**	**1.7**	**34**	**0.50**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Dichloroethene (trans-1,2-)	µg/l	<1.0	**0.24 J**	<0.50	**22 J**	<5.0	<250	<10	**1.8**	**0.15 J**	**0.092 J**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Dichloroethene (1,1-)	µg/l	<1.0	**0.25 J**	<0.50	**7.2 J**	<5.0	<250	<10	<0.50	**0.087 J**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Tetrachloroethene (PCE)	µg/l	<1.0	<0.50	<0.50	<25	<5.0	<250	<10	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Vinyl chloride	µg/l	<1.0	**0.12 J**	<0.50	**2,500**	**1.6 J**	<250	**6.7 J**	**0.36 J**	**4.2**	**0.11 J**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
LIGHT GASSES																	
Ethane	µg/l	<1	<1	–	**310**	**7.4**	**45**	**23**	**100**	–	–	–	–	–	–	–	–
Ethene	µg/l	<1	**0.32 J**	–	**6,100**	**2.6**	**200**	**50**	<1	–	–	–	–	–	–	–	–
Methane	µg/l	**4.5 J**	**6.8**	–	**8,000**	**35,000**	**13,000**	**15,000**	**24,000**	–	–	–	–	–	–	–	–
MOLAR CONCENTRATION																	
Trichloroethene (TCE)	µmol/l	0.36	0.61	0.0099	ND	0.0084	ND	0.14	ND	0.24	ND	ND	ND	ND	ND	ND	0.011
Dichloroethene (cis-1,2-)	µmol/l	0.090	0.87	0.0014	52	0.054	0.81	1.1	0.018	0.35	0.0052	ND	ND	ND	ND	ND	ND
Dichloroethene (trans-1,2-)	µmol/l	ND	0.0025	ND	0.23	ND	ND	ND	0.019	0.0015	0.00095	ND	ND	ND	ND	ND	ND
Dichloroethene (1,1-)	µmol/l	ND	0.0026	ND	0.074	ND	ND	ND	ND	0.00090	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethene (PCE)	µmol/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vinyl chloride	µmol/l	ND	0.0019	ND	40	0.026	ND	0.11	0.0058	0.067	0.0018	ND	ND	ND	ND	ND	ND
Ethane	µmol/l	ND	ND	–	10	0.25	1.5	0.76	3.3	–	–	–	–	–	–	–	–
Ethene	µmol/l	ND	0.011	–	220	0.093	7.1	1.8	ND	–	–	–	–	–	–	–	–
Total	µmol/l	0.45	1.5	0.011	320	0.43	9.4	3.9	3.4	0.66	0.0079	ND	ND	ND	ND	ND	0.011
MOLAR PERCENTAGE																	
TCE	%	80	41	87	ND	2.0	ND	3.7	ND	37	ND	ND	ND	ND	ND	ND	100
DCEs	%	20	58	13	16	13	8.6	29	1.1	53	78	ND	ND	ND	ND	ND	ND
VC	%	ND	0.13	ND	13	6.0	ND	2.7	0.17	10	22	ND	ND	ND	ND	ND	ND
Ethane+Ethene	%	ND	0.76	–	72	79	91	65	99	–	–	–	–	–	–	–	–
VOLATILE FATTY ACIDS																	
Acetic Acid	mg/l	**0.33 J**	**0.32 J**	–	**41**	**3.0**	**660**	**250**	**1.6 J**	–	–	–	–	–	–	–	–
Butyric Acid	mg/l	<0.5	<0.5	–	**1.1 J**	<2.5	**140**	**18 J**	<2.5	–	–	–	–	–	–	–	–
Hexanoic Acid	mg/l	<0.5	<0.5	–	<5	<2.5	**580**	**27**	<2.5	–	–	–	–	–	–	–	–
i-Hexanoic Acid	mg/l	<0.5	<0.5	–	<5	<2.5	<50	<5	<2.5	–	–	–	–	–	–	–	–
i-Pentanoic Acid	mg/l	<0.5	<0.5	–	<5	<2.5	**11 J**	**3.7 J**	<2.5	–	–	–	–	–	–	–	–
Lactic Acid	mg/l	**0.070 J**	<0.5	–	<5	<2.5	<50	<50	<2.5	–	–	–	–	–	–	–	–
Pentanoic Acid	mg/l	<0.5	<0.5	–	<5	<2.5	**170**	**51**	<2.5	–	–	–	–	–	–	–	–
Propionic Acid	mg/l	<0.5	<0.5	–	**0.76 J**	**0.28 J**	**520**	**370**	<2.5	–	–	–	–	–	–	–	–
Pyruvic Acid	mg/l	<0.5	<0.5	–	<5	<2.5	**67**	**43 J**	<2.5	–	–	–	–	–	–	–	–
OTHER LABORATORY DATA																	
Carbon Tetrachloride	µg/l	**1.0**	**0.17 J**	**6.2**	<25	<5.0	<250	<10	<0.50	**0.24 J**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Total Organic Carbon	mg/l	**0.74 J**	**1.7**	–	**28**	**10**	**500**	**1,300**	**51**	–	–	–	–	–	–	–	–
WATER QUALITY PROBE DATA																	
Temperature	°C	**15**	**17**	**13**	–	–	**16**	–	–	**11**	**13**	**11**	**11**	**11**	**11**	**17**	**17**
Specific Conductance	uS/cm	**420**	**190**	**140**	–	–	**890**	–	–	**510**	**520**	**410**	**1,000**	**650**	**610**	**150**	**160**
pH	s.u.	**6.5**	**6.9**	**6.4**	–	–	**8.4**	–	–	**7.0**	**7.4**	**6.8**	**7.3**	**7.7**	**7.8**	**6.1**	**6.4**
Oxidation/Reduction Potential	mV	**170**	**62**	**84**	–	–	**14**	–	–	**180**	**-49**	**170**	**91**	**-4.4**	**61**	**150**	**130**
Dissolved Oxygen	mg/l	**1.8**	**1.8**	**7.5**	–	–	**0.90**	–	–	**1.3**	**4.4**	**6.9**	**0.97**	**1.9**	**0.74**	**4.6**	**5.7**
Turbidity	NTU	**1.2**	**14**	–	–	–	**16**	–	–	–	–	–	–	–	–	**6.9**	**14**
GEOCHEMISTRY																	
Iron	mg/l	**0.28 B**	**0.48**	–	–	–	**35**	–	–	–	–	–	–	–	–	–	–
Iron - Ferrous	mg/l	**0.015 J**	<0.050	–	–	–	**1.0**	–	–	–	–	–	–	–	–	–	–
Nitrate	mg/l	<0.50	**0.47 J**	–	–	–	**0.33 J**	–	–	–	–	–	–	–	–	–	–
Sulfate	mg/l	**26**	**13**	–	–	–	<5.0	–	–	–	–	–	–	–	–	–	–
Sulfide	µg/l	<2.0	**0.95 J**	–	–	–	<2.0	–	–	–	–	–	–	–	–	–	–

TABLE 3
SUMMARY OF SEPTEMBER 2020 PERFORMANCE MONITORING
Summary Trip Report
IBM Gun Club - Former Burn Pit Area
Union, New York

Analyte Name	Unit	113 113 Surface Water S 9/9/2020	TOTE TOTE Purge Water S 9/11/2020
VOLATILE ORGANIC COMPOUNDS (VOCs)			
Trichloroethene (TCE)	µg/l	**0.13 J**	<5.0
Dichloroethene (cis-1,2-)	µg/l	<0.50	<5.0
Dichloroethene (trans-1,2-)	µg/l	<0.50	<5.0
Dichloroethene (1,1-)	µg/l	<0.50	<5.0
Tetrachloroethene (PCE)	µg/l	<0.50	<5.0
Vinyl chloride	µg/l	<0.50	<5.0
LIGHT GASSES			
Ethane	µg/l	–	–
Ethene	µg/l	–	–
Methane	µg/l	–	–
MOLAR CONCENTRATION			
Trichloroethene (TCE)	µmol/l	0.00099	ND
Dichloroethene (cis-1,2-)	µmol/l	ND	ND
Dichloroethene (trans-1,2-)	µmol/l	ND	ND
Dichloroethene (1,1-)	µmol/l	ND	ND
Tetrachloroethene (PCE)	µmol/l	ND	ND
Vinyl chloride	µmol/l	ND	ND
Ethane	µmol/l	–	–
Ethene	µmol/l	–	–
Total	µmol/l	0.00099	ND
MOLAR PERCENTAGE			
TCE	%	100	ND
DCEs	%	ND	ND
VC	%	ND	ND
Ethane+Ethene	%	–	–
VOLATILE FATTY ACIDS			
Acetic Acid	mg/l	–	–
Butyric Acid	mg/l	–	–
Hexanoic Acid	mg/l	–	–
i-Hexanoic Acid	mg/l	–	–
i-Pentanoic Acid	mg/l	–	–
Lactic Acid	mg/l	–	–
Pentanoic Acid	mg/l	–	–
Propionic Acid	mg/l	–	–
Pyruvic Acid	mg/l	–	–
OTHER LABORATORY DATA			
Carbon Tetrachloride	µg/l	<0.50	<5.0
Total Organic Carbon	mg/l	–	–
WATER QUALITY PROBE DATA			
Temperature	°C	**17**	–
Specific Conductance	uS/cm	**240**	–
pH	s.u.	**7.5**	–
Oxidation/Reduction Potential	mV	**97**	–
Dissolved Oxygen	mg/l	**7.7**	–
Turbidity	NTU	**30**	–
GEOCHEMISTRY			
Iron	mg/l	–	–
Iron - Ferrous	mg/l	–	–
Nitrate	mg/l	–	–
Sulfate	mg/l	–	–
Sulfide	µg/l	–	–

Notes:

1. The table summarizes samples collected during the week of September 8, 2020 as part of performance monitoring at the IBM Gun Club former Burn Pit Area. Samples were analyzed both in the field and at fixed analytical laboratories as indicated on the table.

2. Analytical laboratory analysis was performed by Eurofins Lancaster Laboratories of Lancaster, Pennsylvania (Lancaster) and/or Pace Analytical (formerly Microseeps, Inc.) of Pittsburgh, Pennsylvania (Pace). Results are recorded in units indicated on the table. Detections of compounds are emboldened.

3. Definitions:
"S" indicates primary sample
"FD" indicates field duplicate
"PDB" indicates the sample was collected via a passive diffusion bag
"–" indicates the compounds were not analyzed for that particular sample.
"<" indicates the result was below the analytical detection limit.
"J" indicates that the laboratory data was below the lowest quantifiable limit and therefore estimated.
"B" indicates the compound was found in the blank and sample.
"E" indicates results were over the calibration range and should be considered estimated.
"H" indicates the sample was prepped or analyzed beyond the specified holding time.
"ND" indicates that results were not detected above the analytical reporting limit or the calibration range of the field screening device.

4. BP-30A and B-7 were sampled for geochem parameters via low flow and VOCs, light gasses, VFAs, and TOC via PDB. For BP-30A, all field parameters except turbidity are shown from PDB sampling.

5. Refer to the report text for further discussion. The sample plan can be referenced in Table 2 and the Site Management Plan.

TABLE 4
SUMMARY OF SEPTEMBER 2020 qPCR & CSIA ANALYSIS
Summary Trip Report
IBM Gun Club - Former Burn Pit Area
Union, New York

Analytical Method	Analyte	Units	BP-6A		BP-9A		BP-30A		BP-34A		BP-35A		BP-36A		BP-39A		B-7	
			4/15/2020	9/10/2020	4/15/2020	9/10/2020	4/15/2020	9/10/2020	4/15/2020	9/10/2020	4/15/2020	9/10/2020	4/15/2020	9/10/2020	4/15/2020	9/10/2020	4/15/2020	9/10/2020
qPCR	**Dechlorinating Bacteria**																	
	Dehalococcoides (DHC)	cells/mL	6.42E+03	3.78E+04	2.39E+02	3.58E+02	2.50E+00	6.00E-01	1.38E+03	2.39E+02	6.12E+01	7.00E-01	9.03E+03	3.03E+04	2.20E+00	2.40E+00	4.42E+03	4.31E+02
	BAV1 Vinyl Chloride Reductase (bvcA)	cells/mL	<1.10E+00	1.00E+00	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<1.00E+00	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<2.50E+00	<1.80E+00
	tceA Reductase (tceA)	cells/mL	<1.10E+00	3.00E-01 J	4.00E-01 J	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	6.00E-01 J	<5.00E-01	<5.00E-01	<5.00E-01	2.00E-01 J	<5.00E-01	<5.00E-01	<2.50E+00	<1.80E+00
	Vinyl Chloride Reductase (vcrA)	cells/mL	1.55E+03	1.36E+04	3.47E+01	1.27E+02	2.00E-01 J	<5.00E-01	1.15E+03	1.81E+02	5.40E+00	1.00E-01 J	1.77E+03	1.16E+04	2.00E-01 J	1.90E+00	1.11E+03	2.87E+02
	Dehalobacter spp.	cells/mL	4.64E+04	3.14E+05	-	-	1.09E+01	<5.00E+00	-	-	-	-	-	-	4.7E+00 J	<4.80E+00	<2.50E+01	<1.75E+01
	Desulfitobacterium spp.	cells/mL	1.46E+04	6.28E+04	-	-	1.08E+01	1.30E+00 J	-	-	-	-	-	-	3.20E+00 J	<4.80E+00	<2.50E+01	<1.75E+01
	Desulfuromonas spp.	cells/mL	6.58E+03	6.04E+02	-	-	1.00E-01 J	6.00E-01 J	-	-	-	-	-	-	3.00E-01 J	5.10E+00	<2.50E+01	<1.75E+01
	Functional Genes																	
	Methanogens	cells/mL	4.00E-01 J	<4.90E+00	2.00E-01 J	2.60E+01	1.00E-01 J	<5.00E+00	<4.90E+00	2.80E+00 J	4.00E+00 J	3.00E-01 J	1.64E+01	3.21E+02	3.50E+00 J	8.00E+00	1.17E+03	2.64E+03
	Soluble Methane Monooxygenase	cells/mL	<1.06E+01	7.80E+01	-	-	<4.6E+00	<5.00E+00	-	-	-	-	-	-	4.30E+01	<4.80E+00	<2.50E+01	<1.75E+01
CSIA	$^{13}C/^{12}C$ TCE	‰	-19.2	NA	-20	-12.0	-3.4	ND	-20.5	-16.8	-19.9	-15.9	-21	-5.1 J	-20.3	-14.2	NA	NA
	$^{13}C/^{12}C$ cis-DCE	‰	-24.4	-12.9	-17.9	-17.2	-10.3	ND	-22.6	-21.5	-20.6	-19.0	-20.1	-10.0	-15.9	-13.2	-17.1	-10.2
	$^{13}C/^{12}C$ Vinyl Chloride	‰	-34.8 J	-50.4	-28	-35.8	NA	NA	-42.8 J	-44.0 J	NA	NA	-32.6	-28.1	-27.7	NA	NA	NA

Notes:

1. The table summarizes samples collected during the week of September 7, 2020 as part of supplemental forensic sampling at the IBM Gun Club former Burn Pit Area. Samples were analyzed by Microbial Insights of Knoxville, Tennesee (MI). Results are recorded in units indicated on the table.

2. Definitions:
"qPCR" indicates quantitative polymerase chain reaction analysis, which is a DNA-based analysis used to quantify specific microorganisms and specific functional genes responsible for biodegradation.
"CSIA" indicates compound-specific isotope analysis, which identifies the ratio of carbon-13 to carbon-12 isotopes in the compounds of interest for this site (TCE, cDCE, and vinyl chloride)
"J" indicates that the laboratory data was below the lowest quantifiable limit and therefore estimated.
"NA" indicates that the compound was not detected in the VOC sample collected concurrently with the CSIA sample, so CSIA results are not applicable. For TCE in BP-6A and Vinyl Chloride in BP-39A, targets were below the limit of detection after required dilutions and were therefore not analyzed.
"ND" indicates not detected.
A blank cell indicates the sample was not analyzed for this parameter.

3. Refer to the report text for further discussion.

FIGURES

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Figure 1

Monitoring Location Plan

IBM Gun Club - Former Burn Pit Area

Union, New York

Drawn By:	H. Pothier
Designed By:	E. Bosse
Reviewed By:	B. Green
Project No:	3526.05
Date:	November 2020

Figure Narrative

This figure summarizes the locations of monitoring wells, multi-level monitoring systems, and surface water sampling points where depth to water is measured and water quality samples may be collected for field and analytical laboratory testing as part of routine and performance monitoring programs.

The locations of site features, including monitoring wells, seeps and springs, and culverts are based on field survey by Butler Land Surveying, LLC. of Little Meadows Pennsylvania in the period 2006 through 2012.

Refer to report text for further discussion.

Legend

- Parcel B Site Boundary
- Injection Borehole
- Observed Drainage Features (arrows indicate flow direction)
- Monitoring Well
- Multi-Level Monitoring Installation
- Surface Water Sampling Point
- Culvert

100 50 0 100 200 Feet

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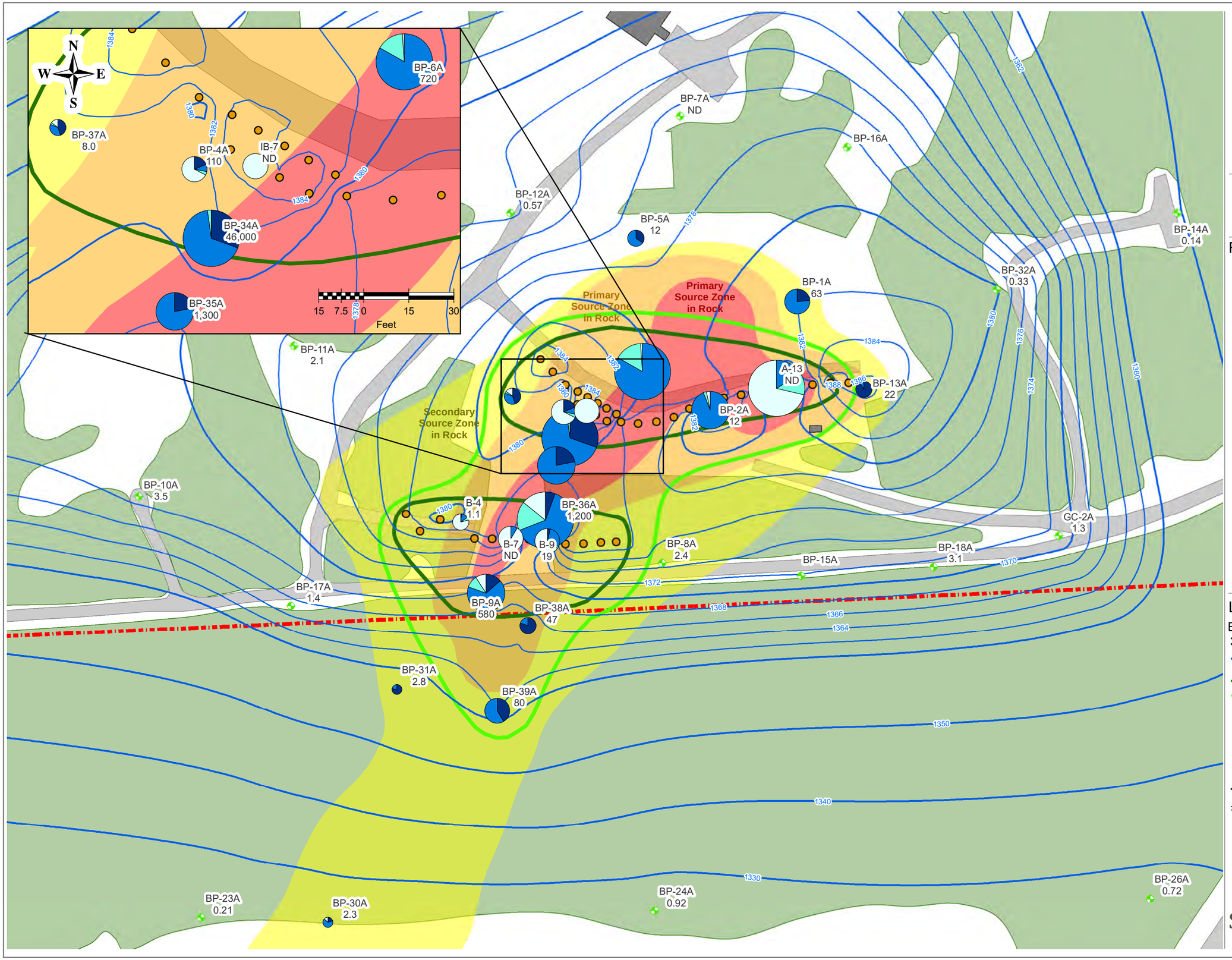

Figure 2

Summary of September 2020 Groundwater Quality Conditions

IBM Gun Club - Former Burn Pit Area
Union, New York

Drawn By:	H. Pothier
Designed By:	E. Bosse
Reviewed By:	B. Green
Project No:	3526.05
Date:	November 2020

Figure Narrative

This figure shows groundwater quality data and inference based on monitoring conducted September 8-11, 2020.

The groundwater data for site key VOCs including TCE, cDCE, vinyl chloride, and ethane/ethene from water table monitoring wells are presented as pie diagrams. The wedges of each pie diagram represent concentrations of the four compounds expressed in micromoles per liter (umol/L). The relative diameter of each pie diagram varies based on the sum of the five VOCs and tDCE at each location.

The inferred sulfate-reducing and methanogenic conditions are based on observations of oxidation-reduction potential (ORP), methane, sulfide, ferrous and total iron, and nitrate. Methanogenic conditions are characterized by methane concentrations ≥ 20 µg/L, sulfate reducing by sulfide ≥ 50 µg/L, iron reducing by Fe(II)/Fe(tot) ≥ 0.7 mg/L, and nitrate reduction by nitrate <1 mg/L. ORP is generally expected to be <200 for iron reduction, <100 for sulfate reduction, and <0 for methanogenic conditions. See Figure 3 for geochemical data.

Not all geochemical conditions are satisfied within the areas shown for sulfate-reducing and methanogenic conditions. The inferred areas assume the presence of a transition zone between sulfate-reducing and methanogenic, and the position and size of these zones are based on judgement of the combined data. Other interpretations are possible.

Refer to the report text for further discussion.

Legend

BP-34A
37,000 Well Name and September 2020 TCE Concentrations in Groundwater (µg/L).

Inferred Groundwater Contour September 2020

Inferred Methanogenic Conditions

Inferred Sulfate-Reducing Conditions

Parent VOC (Trichloroethene)
Primary Daughter Product (*cis*-1,2DCE)
Secondary Daughter Product (Vinyl Chloride)
Terminal Breakdown Products (Ethane, Ethene)

Total Chlorinated Ethanes & Ethenes in Groundwater (µmol/L)

< 0.1
>0.1 to 1
>1 to 10
>10 to 100
>100

40 20 0 40 80
Feet

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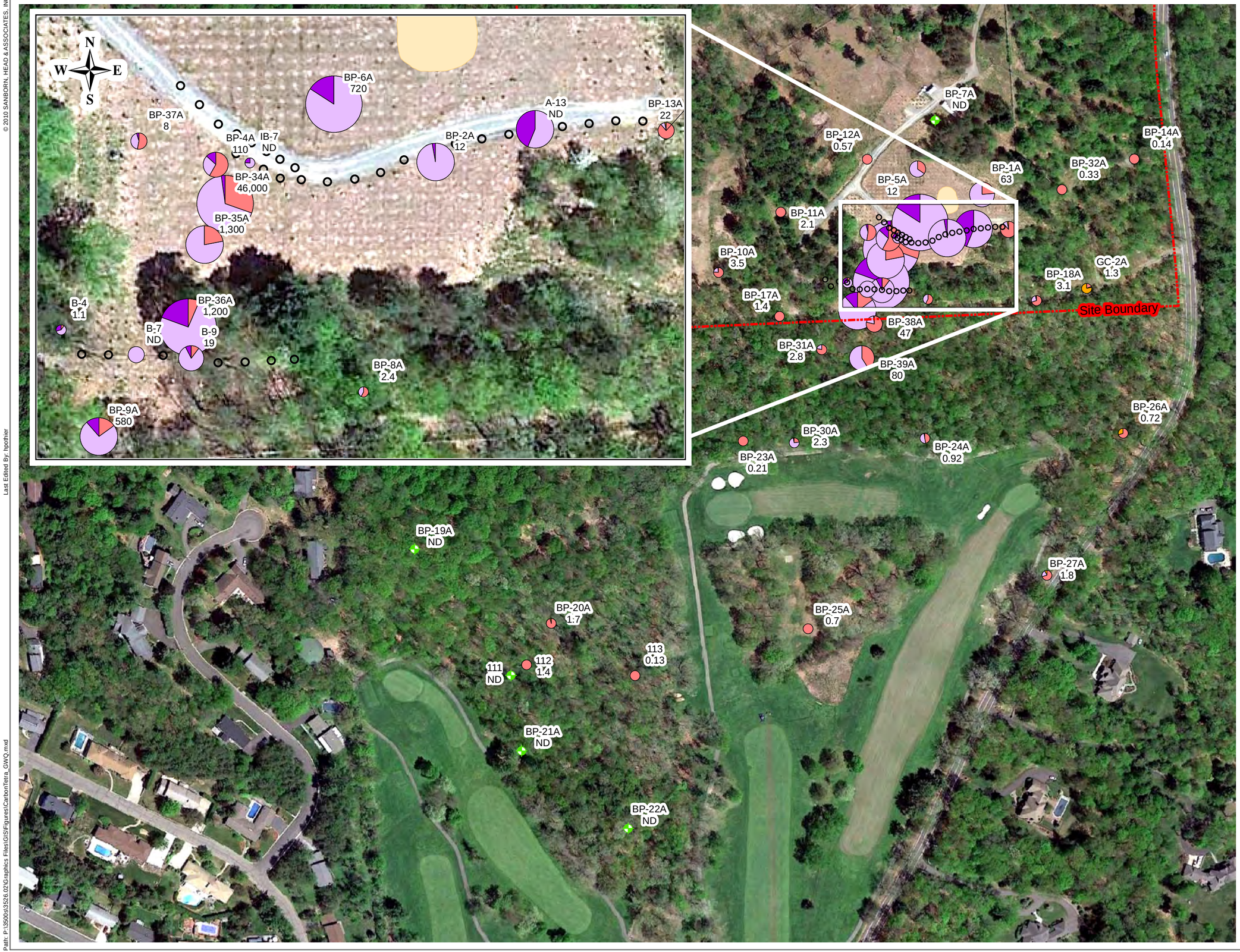

Figure 3

Groundwater Quality Conditions for Key Site VOCs - September 2020

IBM Gun Club - Former Burn Pit Area

Union, New York

Drawn By:	H. Pothier
Designed By:	E. Bosse
Reviewed By:	B. Green
Project No:	3526.05
Date:	November 2020

Figure Narrative

This figure depicts groundwater data for key site VOCs from monitoring of water table wells in September 2020.

The data for TCE, selected breakdown products, and carbon tetrachloride are presented as pie diagrams. The wedges of each pie diagram represent concentrations expressed in micrograms per liter (ug/L). The relative diameter of each pie diagram varies based on the sum of the VOCs at each location.

Refer to report text for further discussion.

Legend

Injection Boring

BP-34A
31,000
Well Name and September 2020 TCE Concentrations in Groundwater (µg/L).

- Trichloroethene (TCE)
- *cis*-1,2 Dichloroethene (*cis*-1,2 DCE)
- Vinyl Chloride (VC)
- Carbon Tetrachloride (CCl4)

Total Chlorinated Ethenes and Carbon Tetrachloride in Groundwater (µg/L)

<10
Not detected above lab reporting limits
>10 to 100
>100 to 1,000
>1,000 to 10,000
>10,000

25 12.5 0 25 50
Feet

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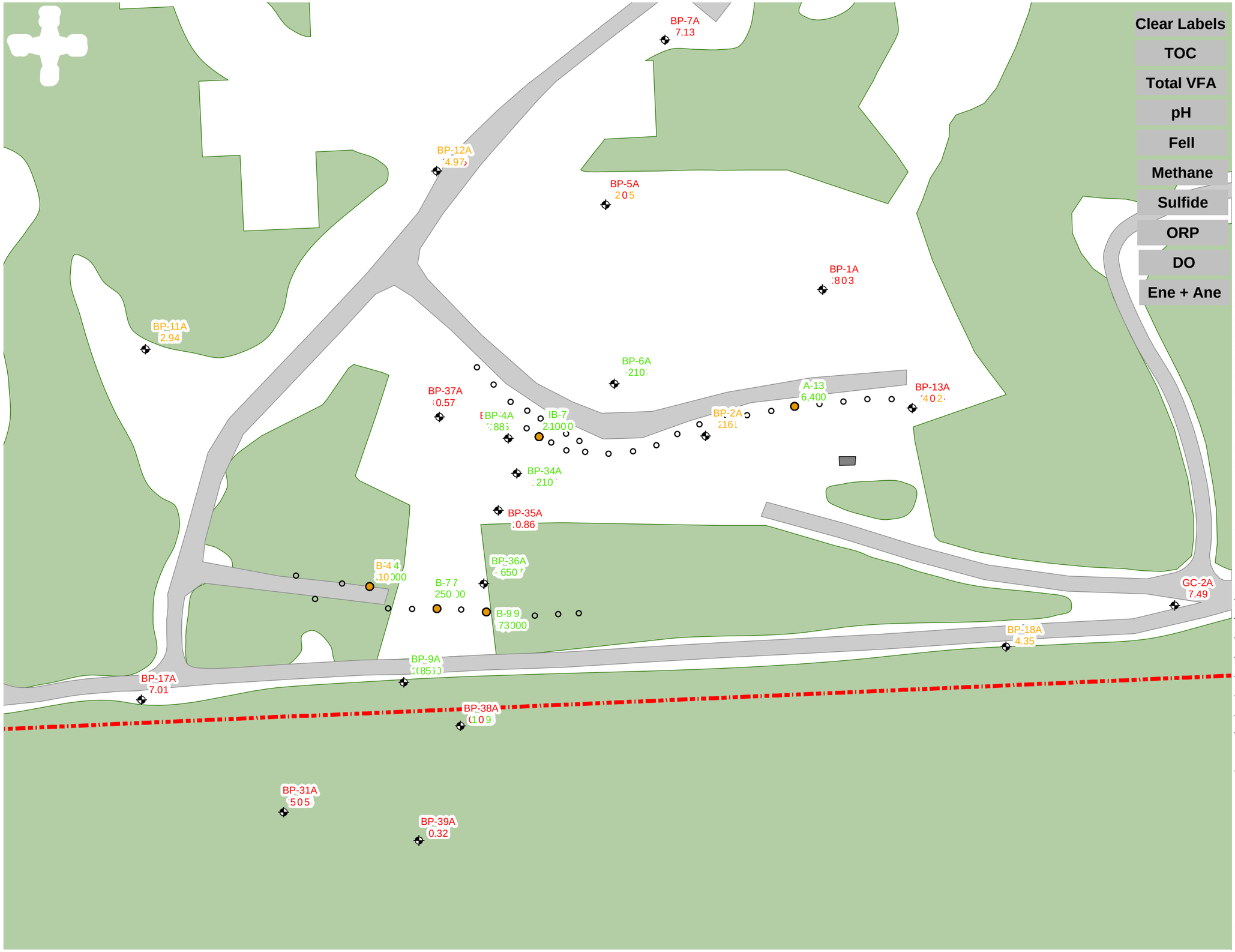

Clear Labels

TOC

Total VFA

pH

FeII

Methane

Sulfide

ORP

DO

Ene + Ane

Figure 4

September 2020 Assessment of Reducing Conditions

IBM Gun Club - Former Burn Pit Area

Union, New York

Drawn By:	H. Pothier
Designed By:	E. Bosse
Reviewed By:	B. Green
Project No:	3526.05
Date:	November 2020

Figure Narrative

This figure supports a multiple lines of evidence assessment of what proportion of the primary and secondary source rock are under sulfate reducing and methanogenic conditions. Green labels indicate conditions conducive to reductive dehalogenation. Orange labels indicate reductive dehalogenation may be possible, but conditions are less conducive. Red labels indicate conditions where reductive dehalogenation is less likely.

Posted data is from the April 2020 sampling round.

Legend

DO mg/L	>5	2-5	<=2
ORP mV	>100	0-100	<=0
Sulfide µg/L	<10	10-50	>=50
Methane µg/L	<0.5	0.5-20	>=20
FeII mg/L	<1		>=1
pH SU	<6.3 or >7.5		6.3-7.5
Total VFA mg/L	<1		>=1
TOC mg/L	<4		>=4
Ethane + Ethene µg/L	<10	10-50	>=50

30 15 0 30 60

Feet

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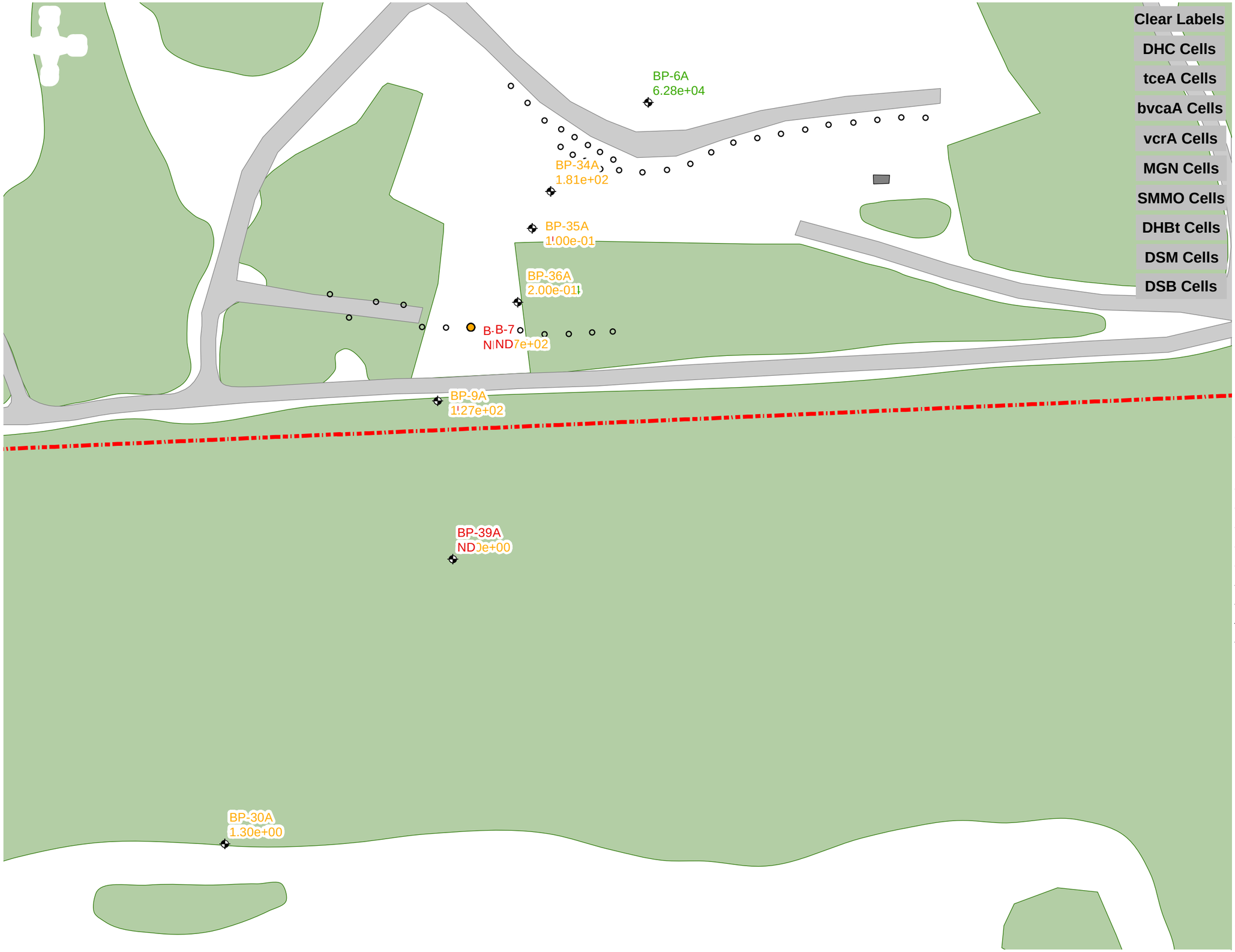

Figure 5

September 2020 Summary of qPCR

IBM Gun Club - Former Burn Pit Area

Union, New York

Drawn By:	H. Pothier
Designed By:	E. Bosse
Reviewed By:	B. Green
Project No:	3526.05
Date:	November 2020

Figure Narrative

This figure summarizes the results from analysis of Dehalococcoides (DHC) bacteria and functional genes to support a multiple lines of evidence assessment of reductive dehalogenation. Green labels indicate concentrations thought to be highly conducive to reductive dehalogenation. Orange labels indicate reductive dehalogenation is possible, but levels are less conducive. Red labels indicate conditions where there is limited or no evidence for reductive dehalogenation. Methanogens (MGN) are competitor microbes, where green indicates no methanogens were detected and red indicates their presence.

Legend

DHC (cells/mL)	$>10^1$	10^1 - 10^4	$>10^4$
tceA (cells/mL)	ND	ND - 10^7	$>10^7$
bvcaA (cells/mL)	ND	ND - 10^7	$>10^7$
vcrA (cells/mL)	ND	ND - 10^7	$>10^7$
MGN (cells/mL)	>ND	-	ND
SMMO (cells/mL)	ND	ND - 10^7	$>10^7$
DHBt (cells/mL)	ND	ND - 10^4	$>10^4$
DSM (cells/mL)	ND	ND - 10^4	$>10^4$
DSB (cells/mL)	ND	ND - 10^4	$>10^4$

DHC = *Dehalococcoides*

tceA = TCE reductase

bvcaA = BAV1 vinyl chloride reductase

vcrA = Vinyl chloride reductase

MGN = Methanogens

SMMO = Soluble Methane Monooxygenase

DHBt = Dehalobacter spp.

DSM = Desulfitobacterium spp.

DSB = Desulfuromonas spp.

30 15 0 30 60

Feet

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Figure 6A
September 2020 CSIA Results - TCE
Summary of Water Quality Monitoring
IBM Gun Club - Former Burn Pit Area
Union, New York

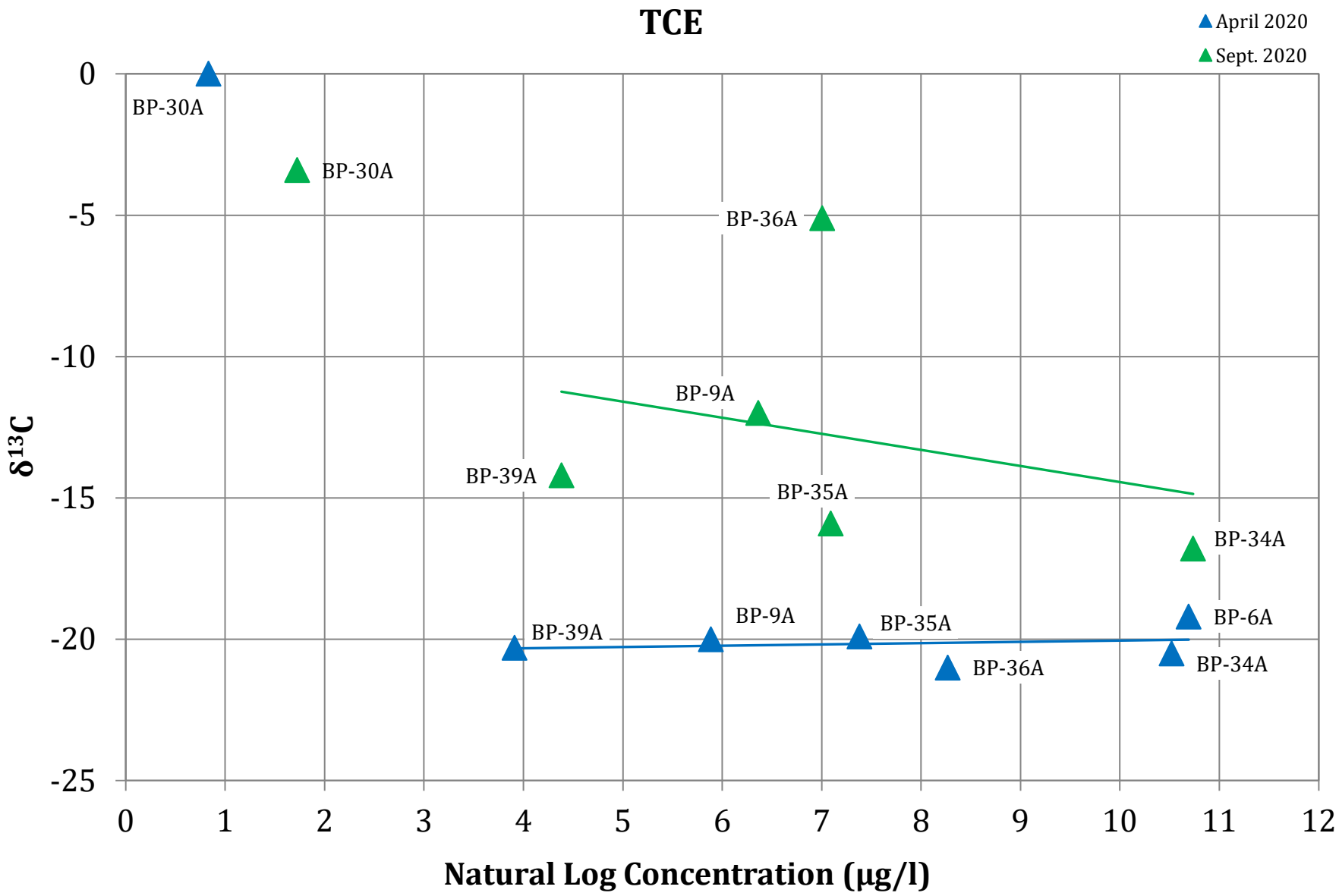


Figure 6B
September 2020 CSIA Results - cis-DCE
Summary of Water Quality Monitoring
IBM Gun Club - Former Burn Pit Area
Union, New York

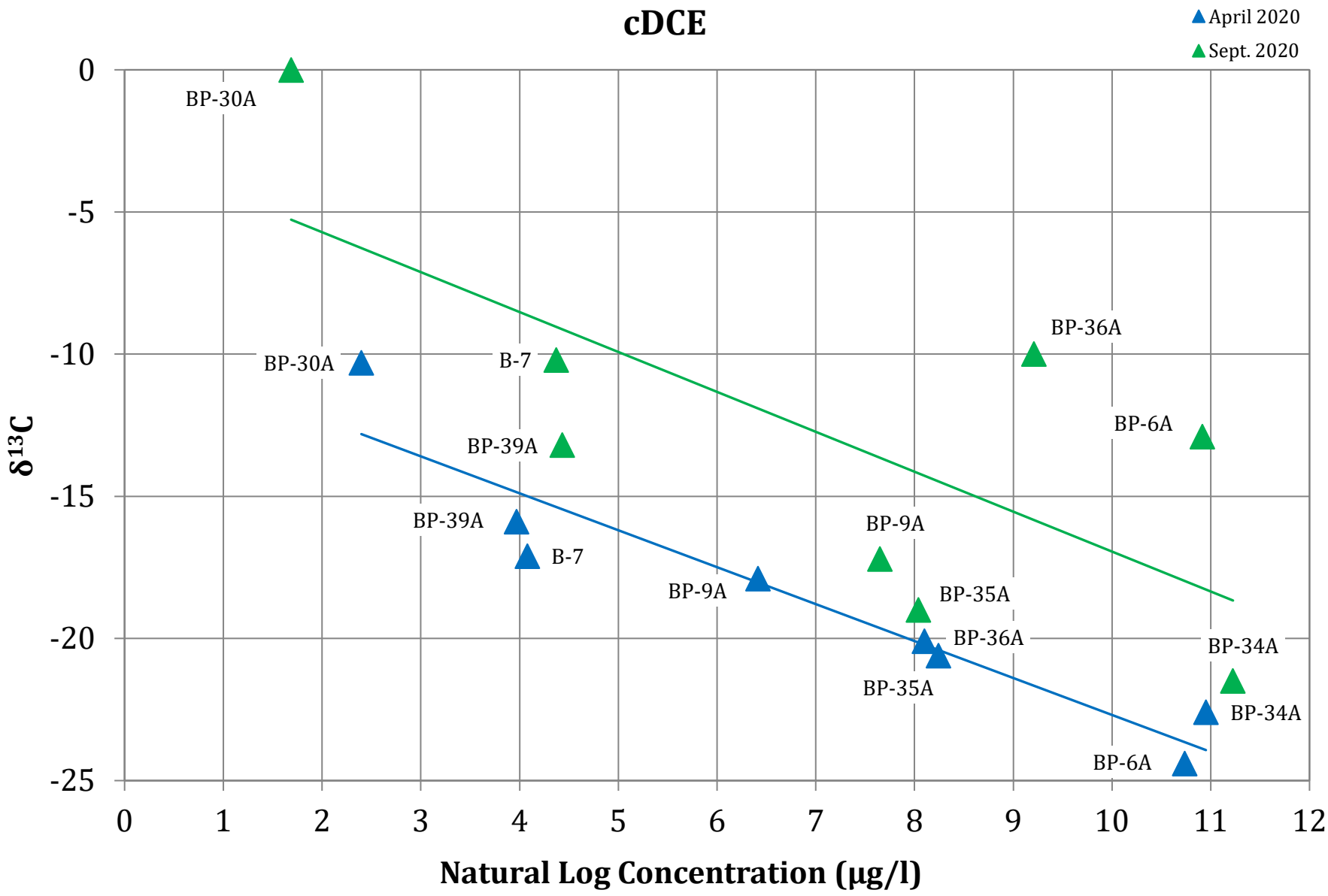
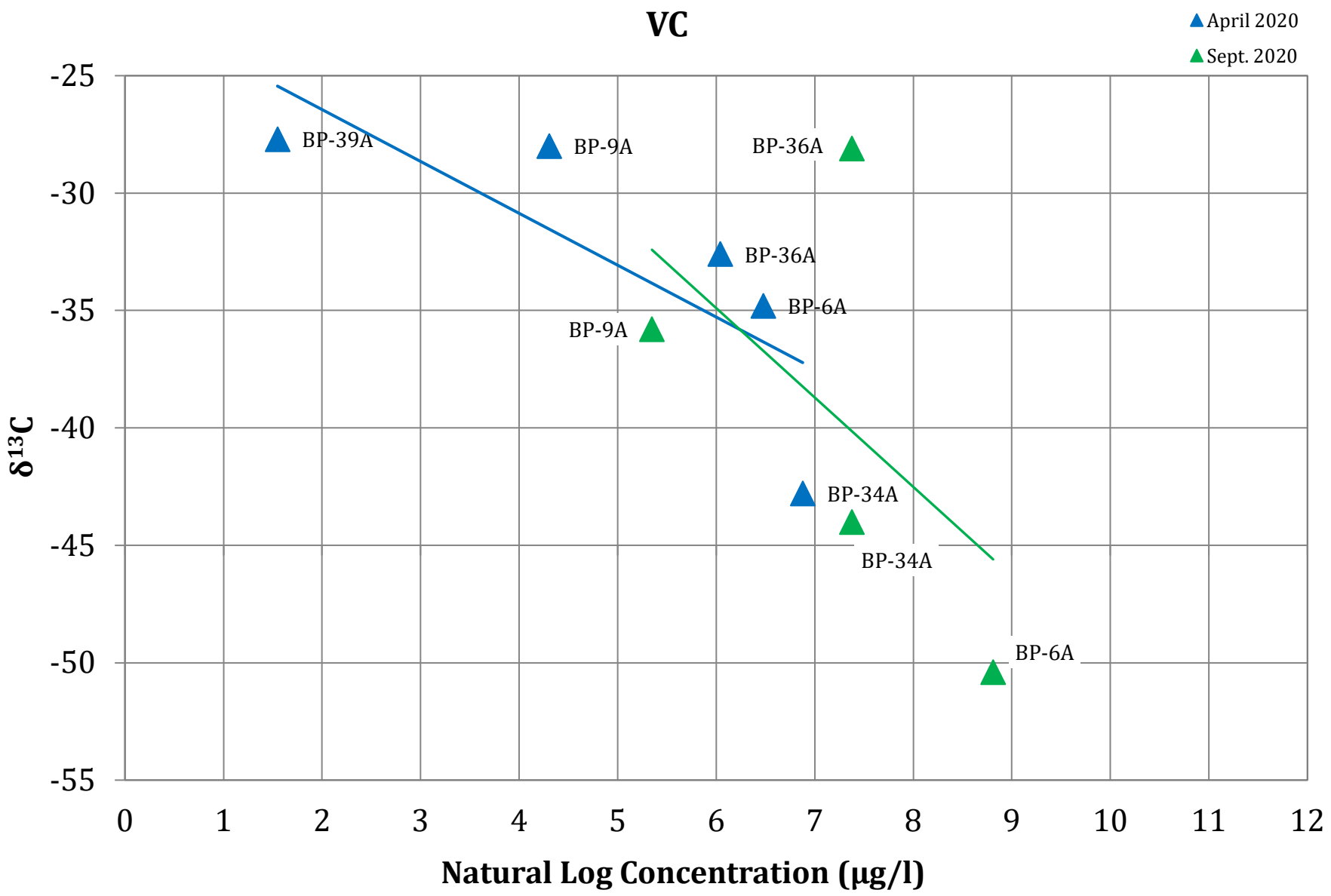


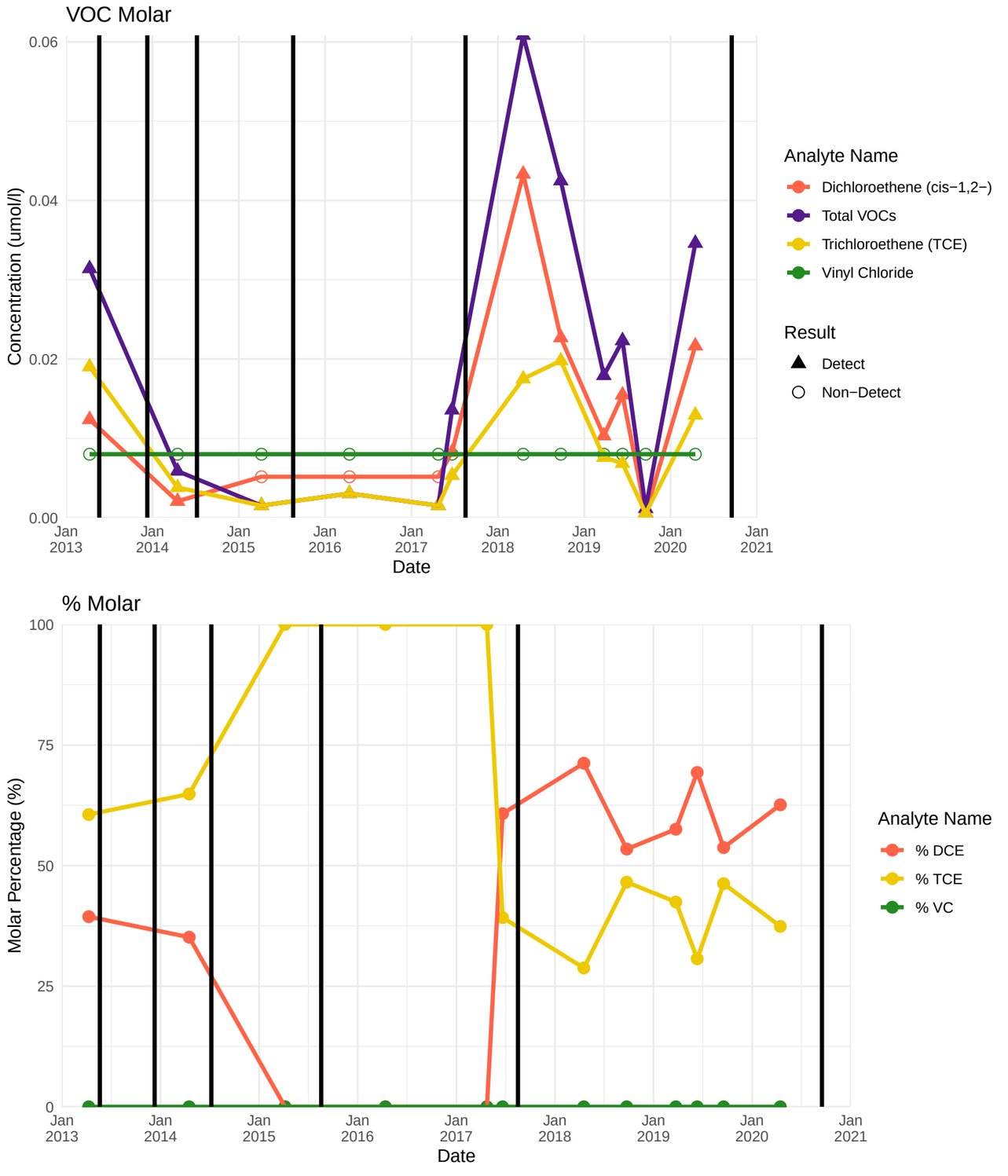
Figure 6C
September 2020 CSIA Results - VC
Summary of Water Quality Monitoring
IBM Gun Club - Former Burn Pit Area
Union, New York



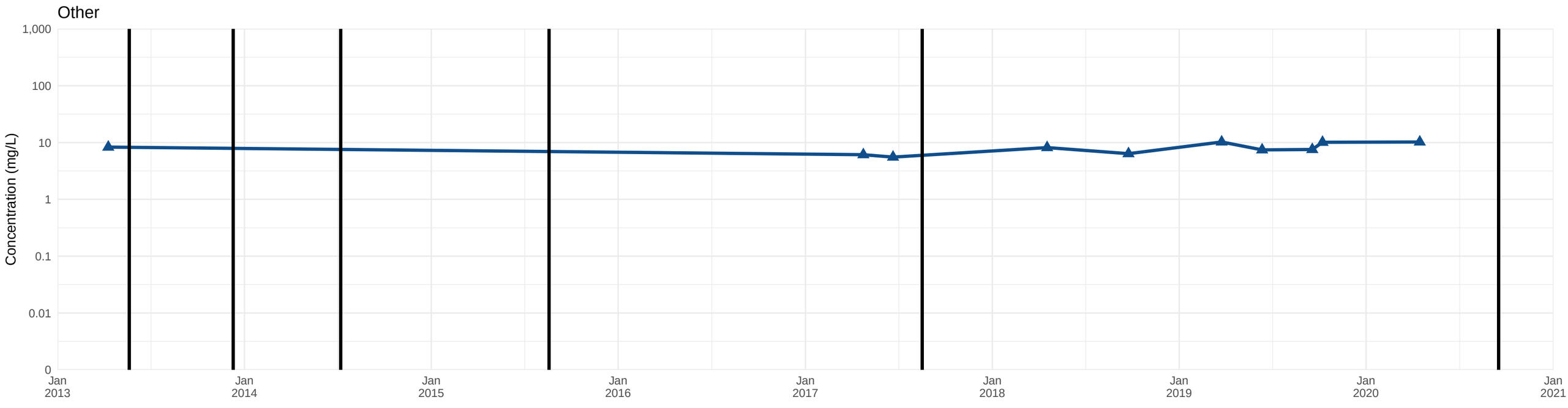
ATTACHMENT A

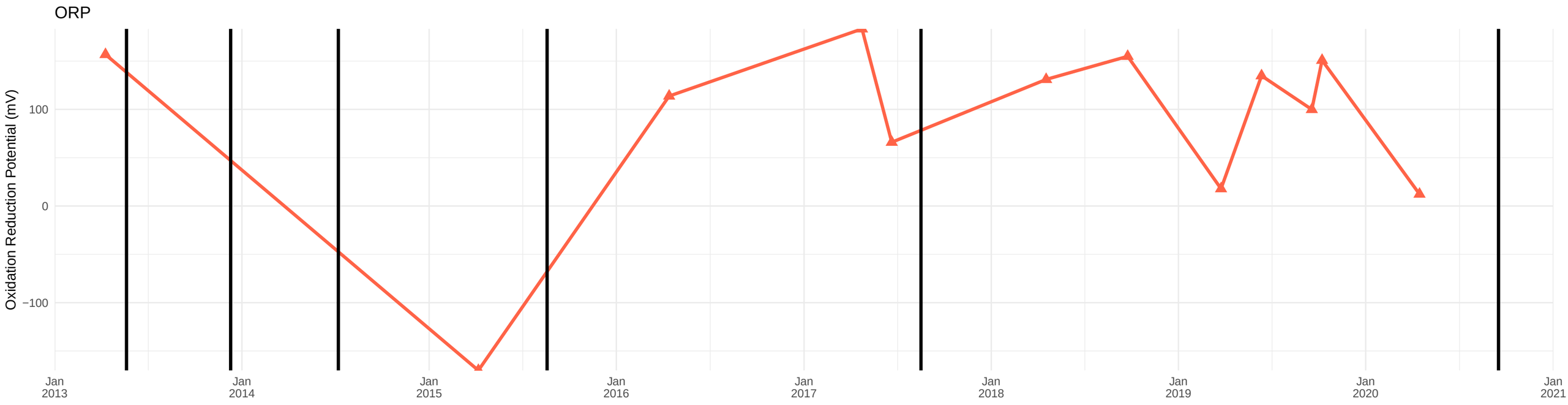
TIME-SERIES CHARTS OF SELECT CHEMICALS

Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.



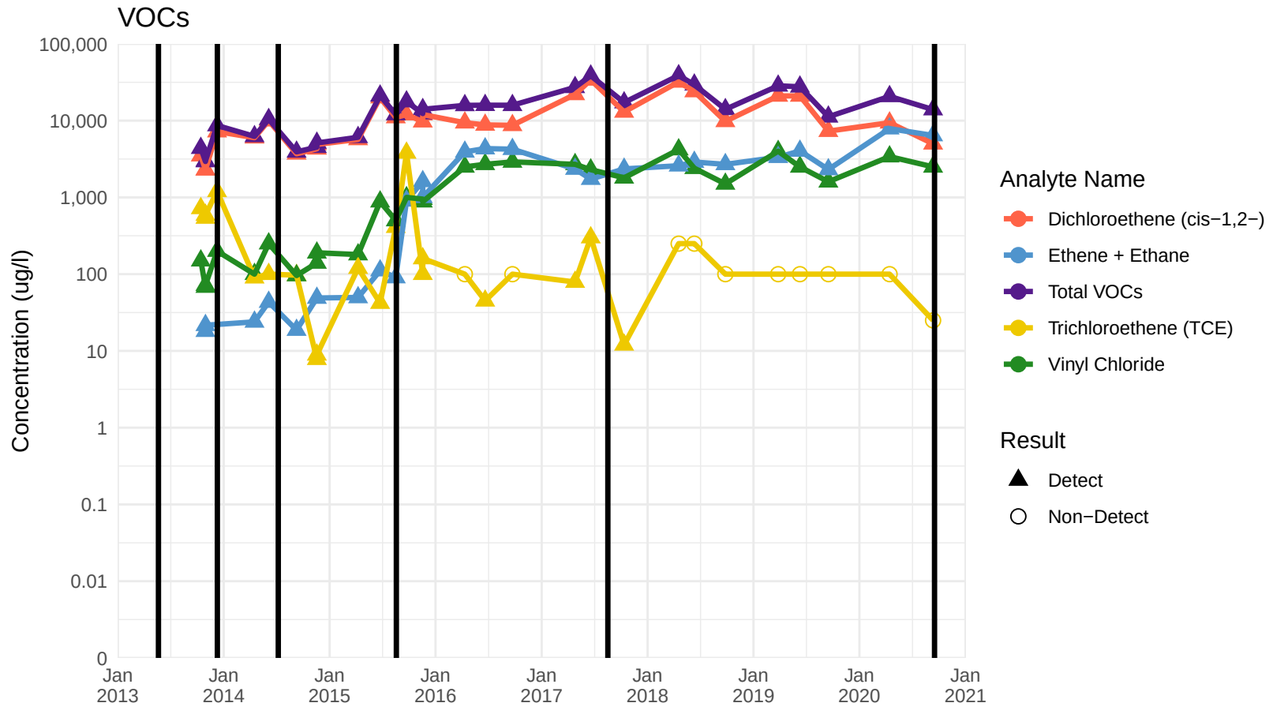
Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.

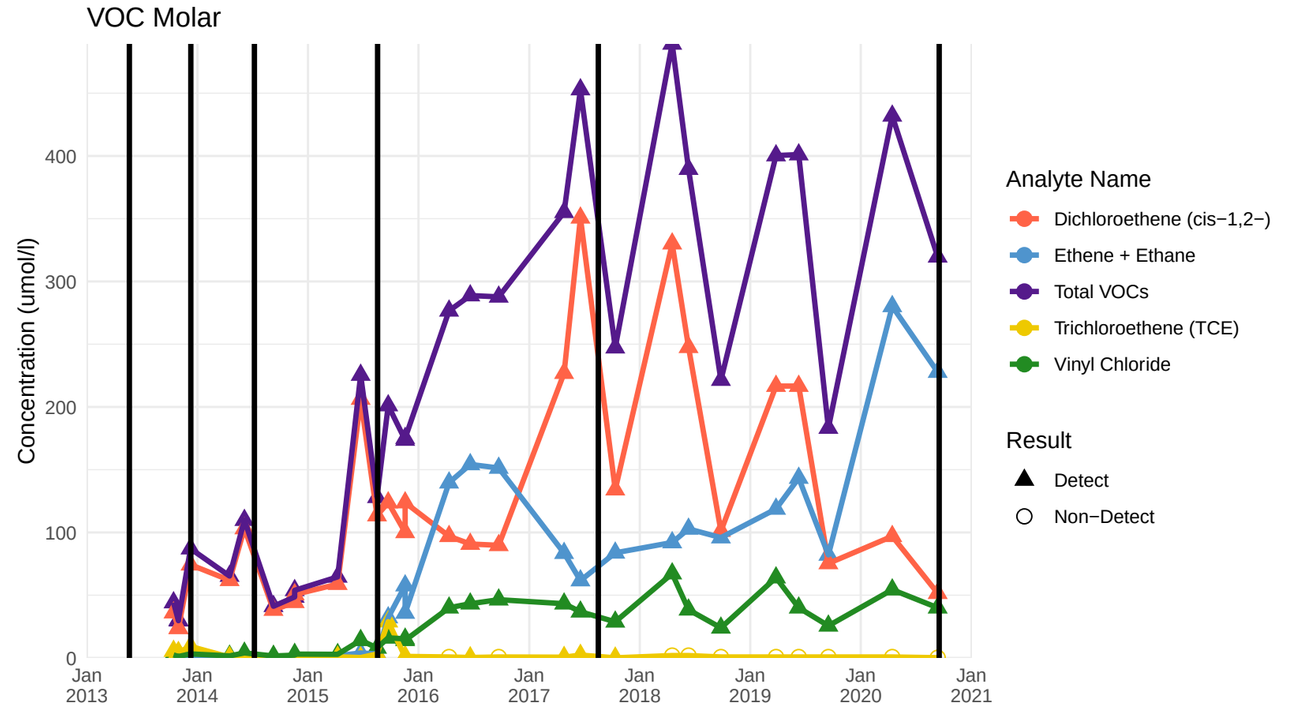


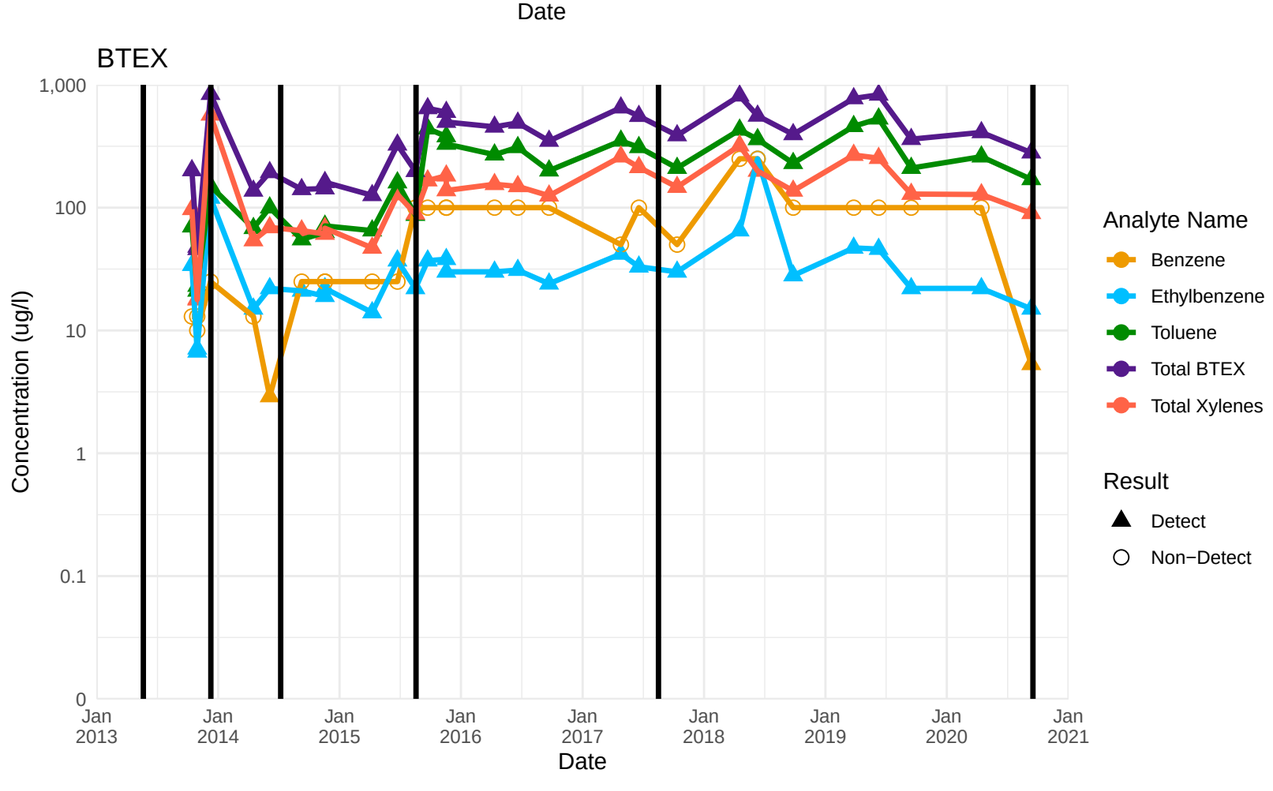


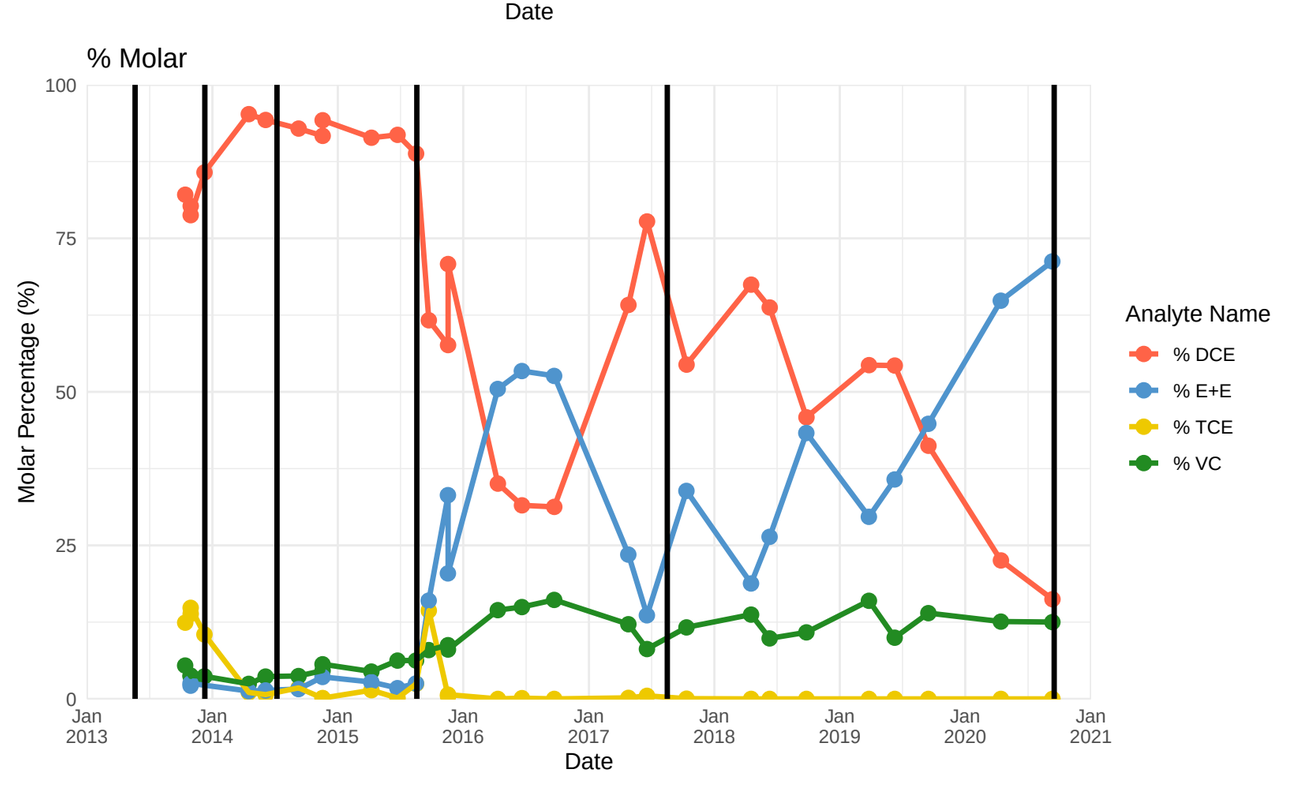
A−13

Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.



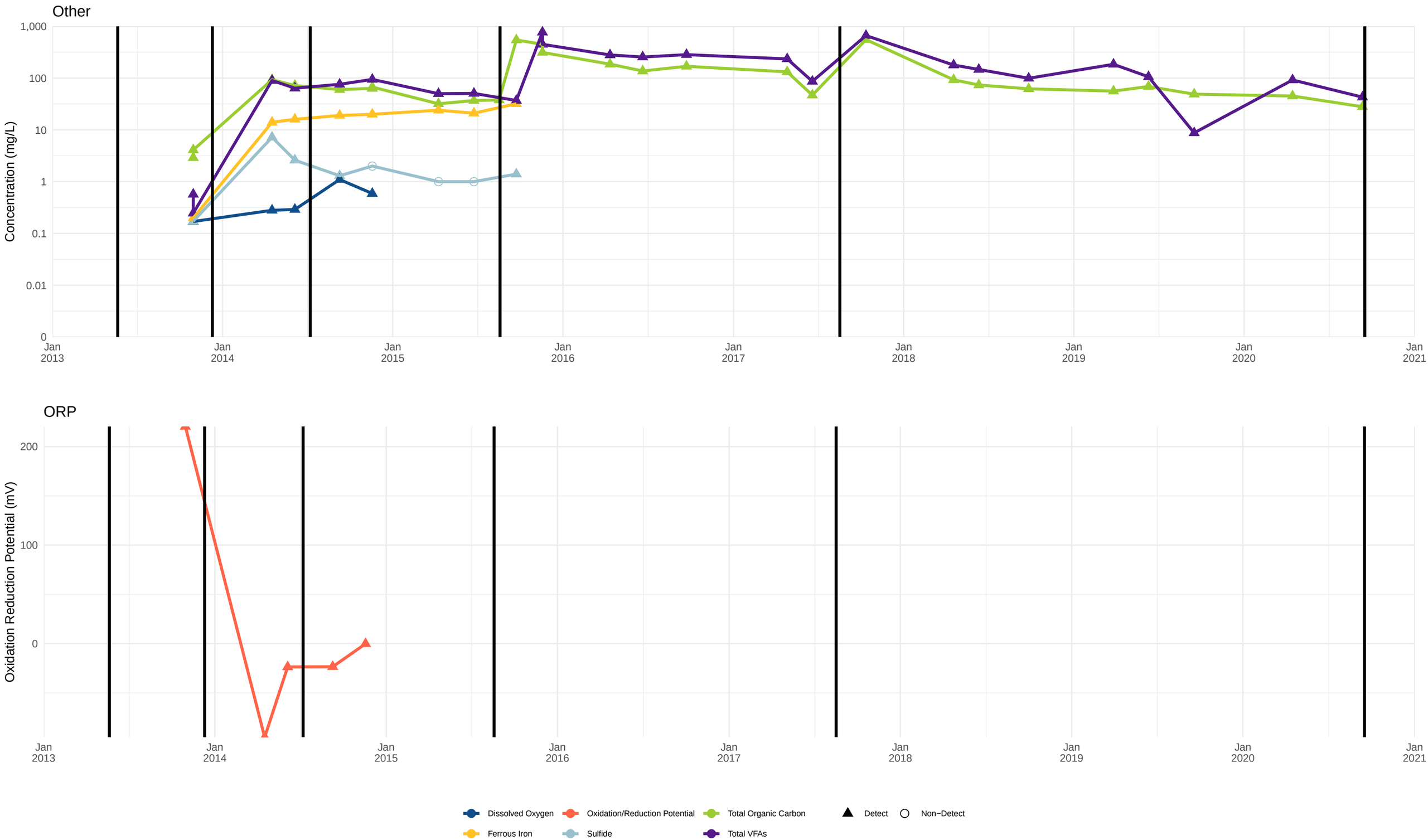






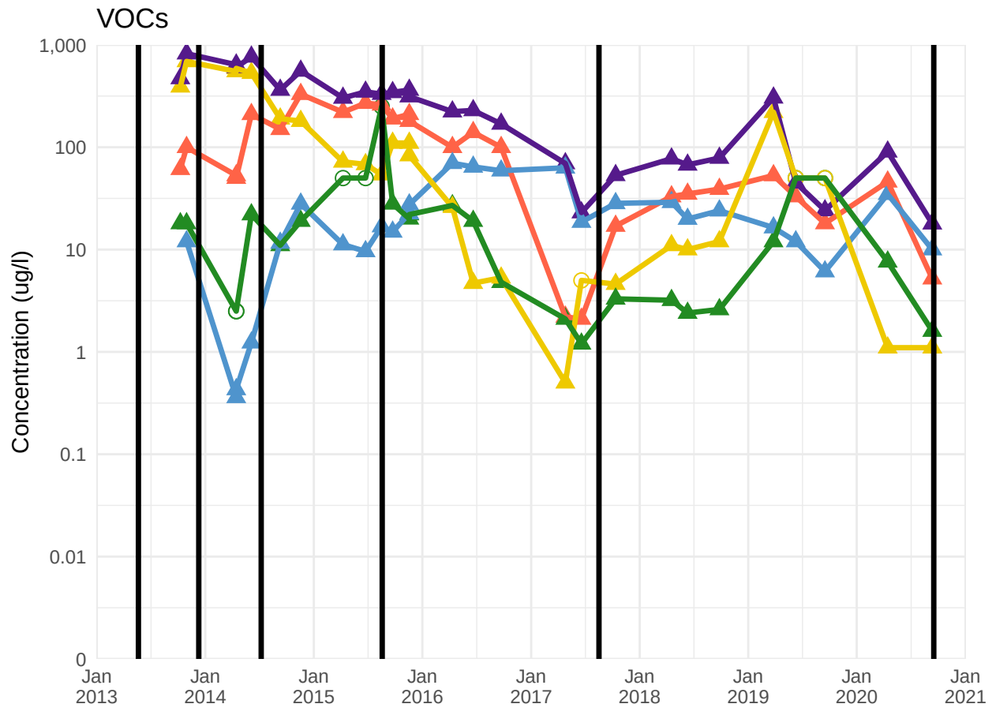
A−13

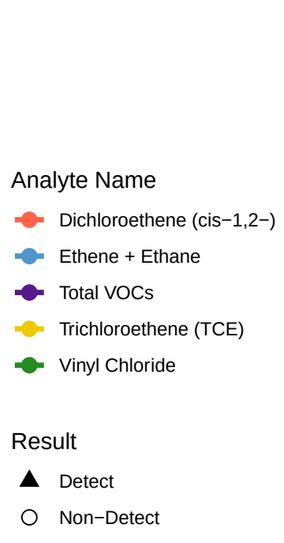
Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.

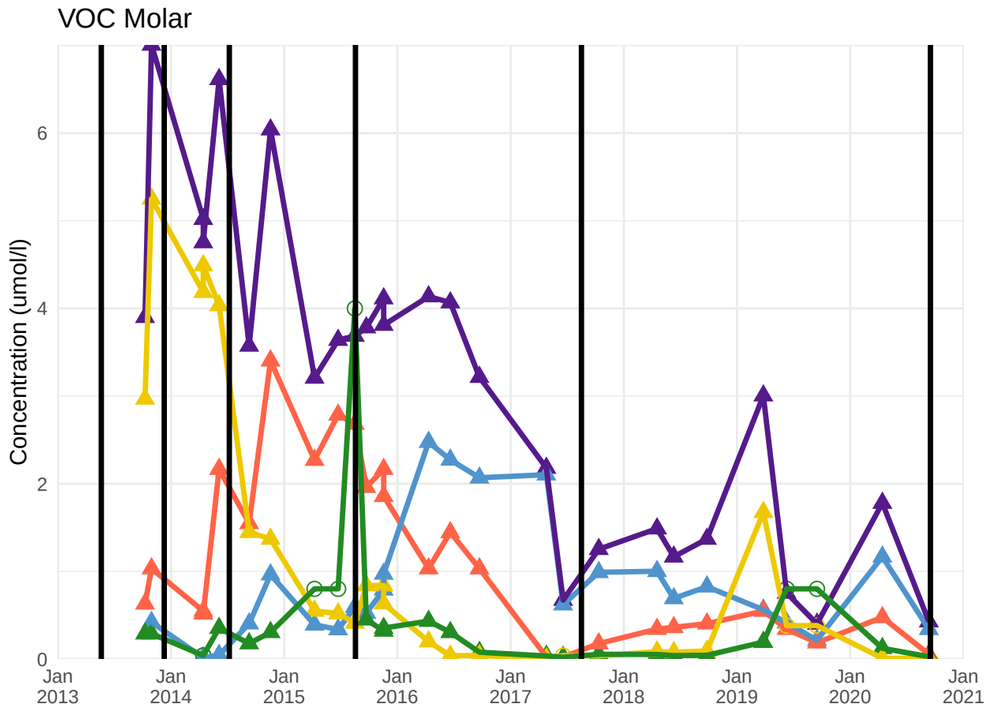


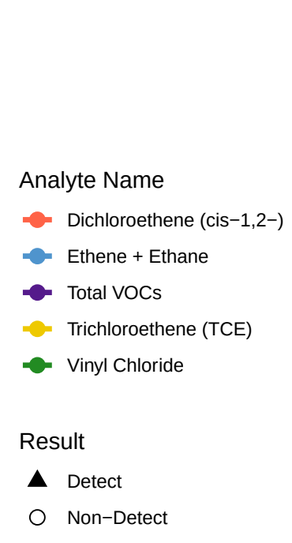
B−4

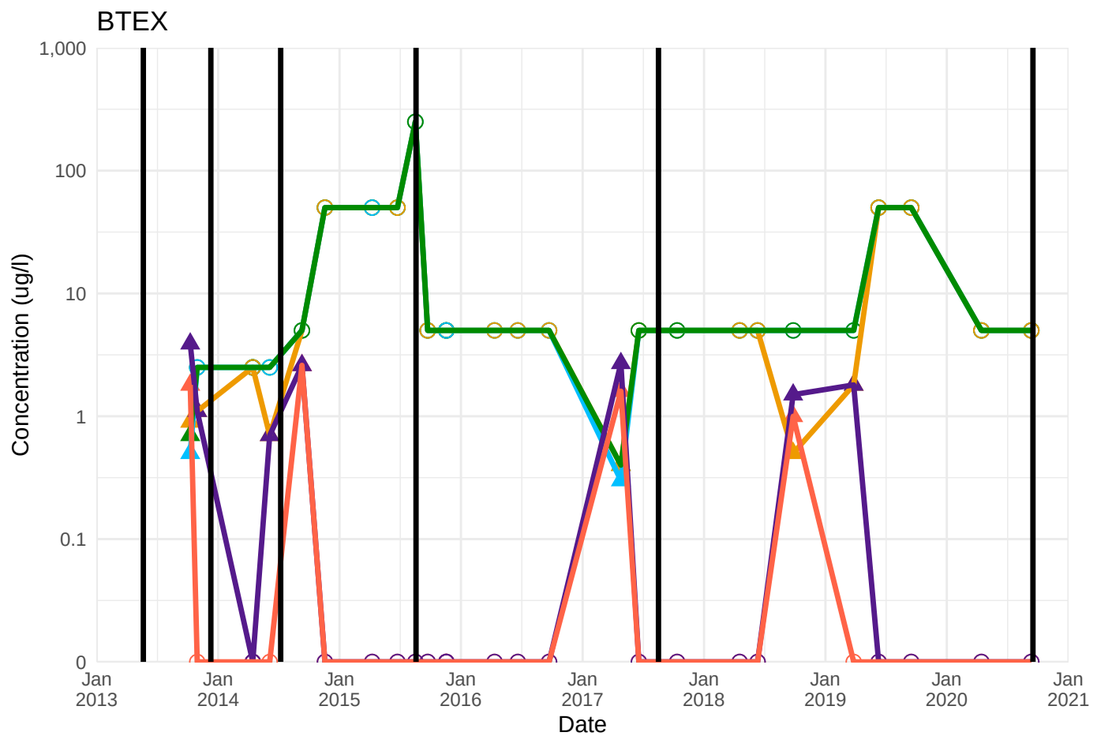
Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.

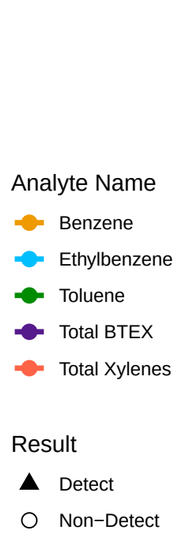


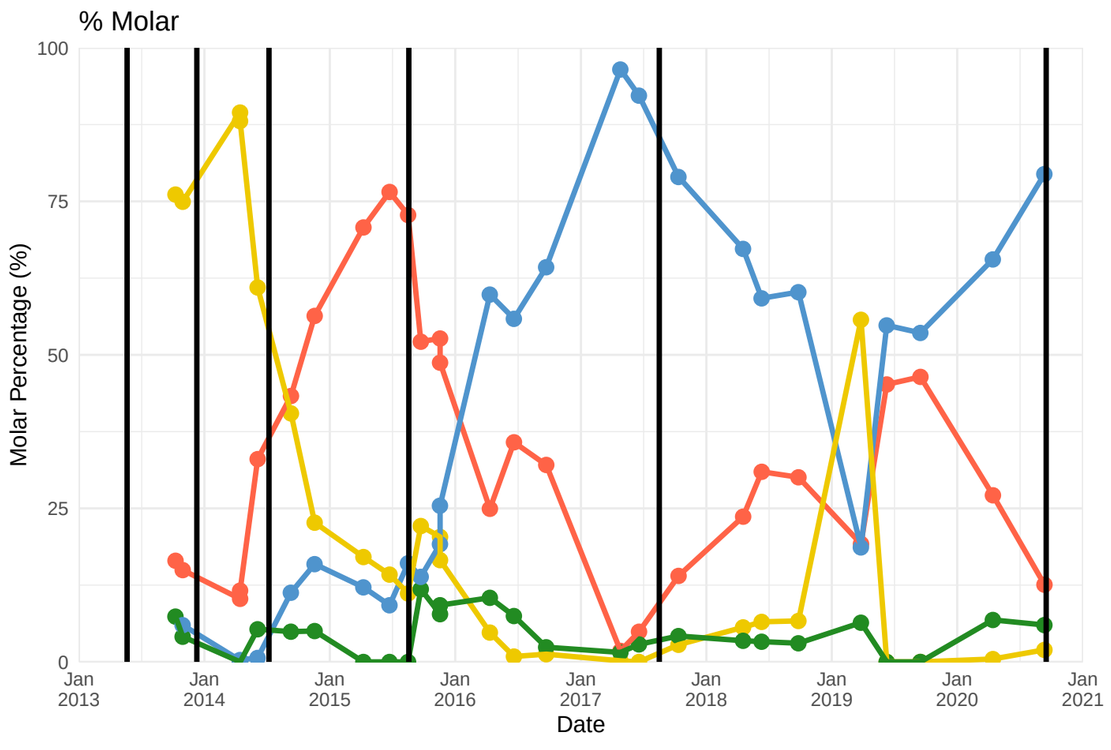


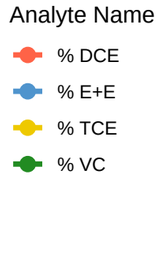






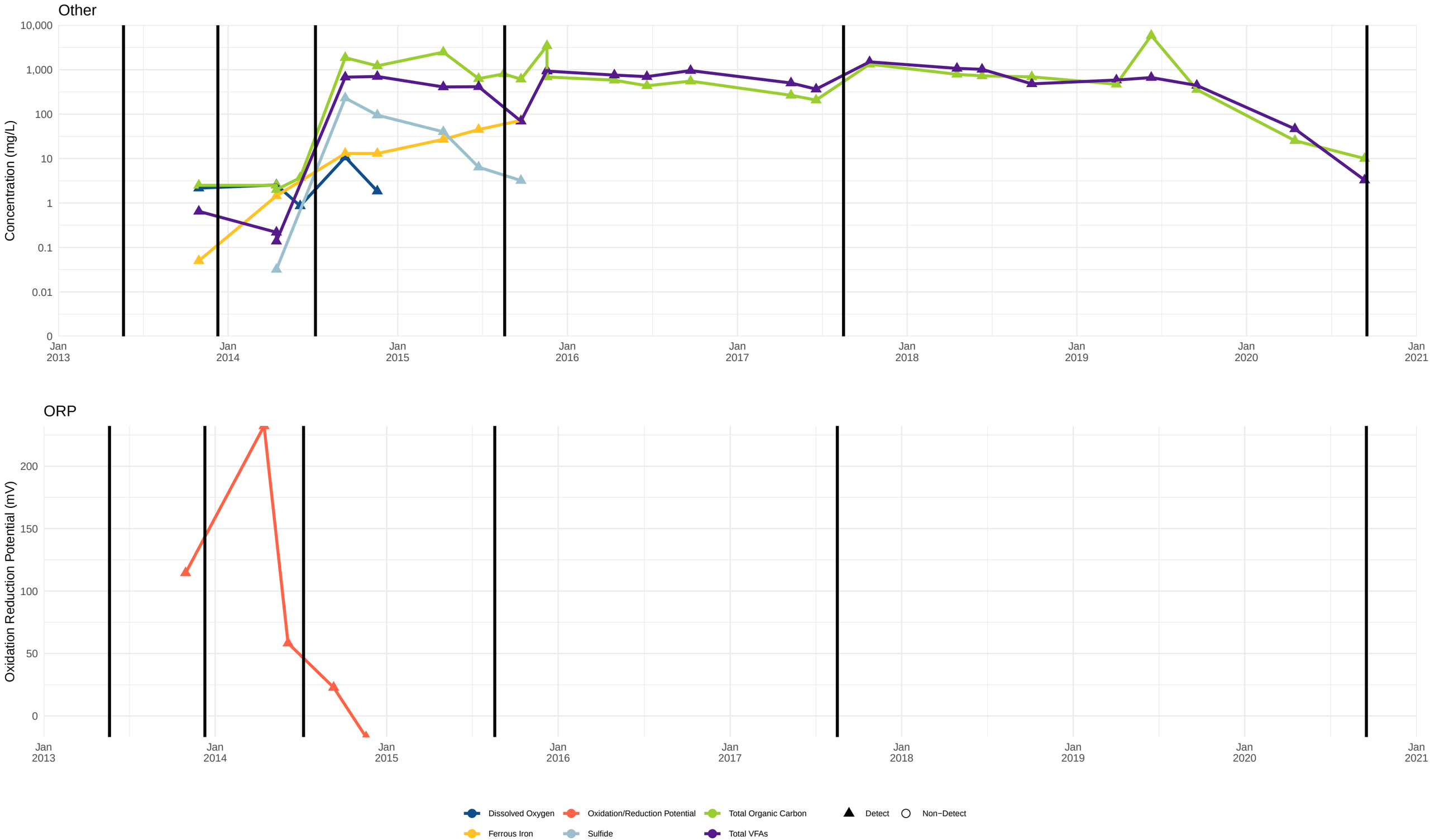






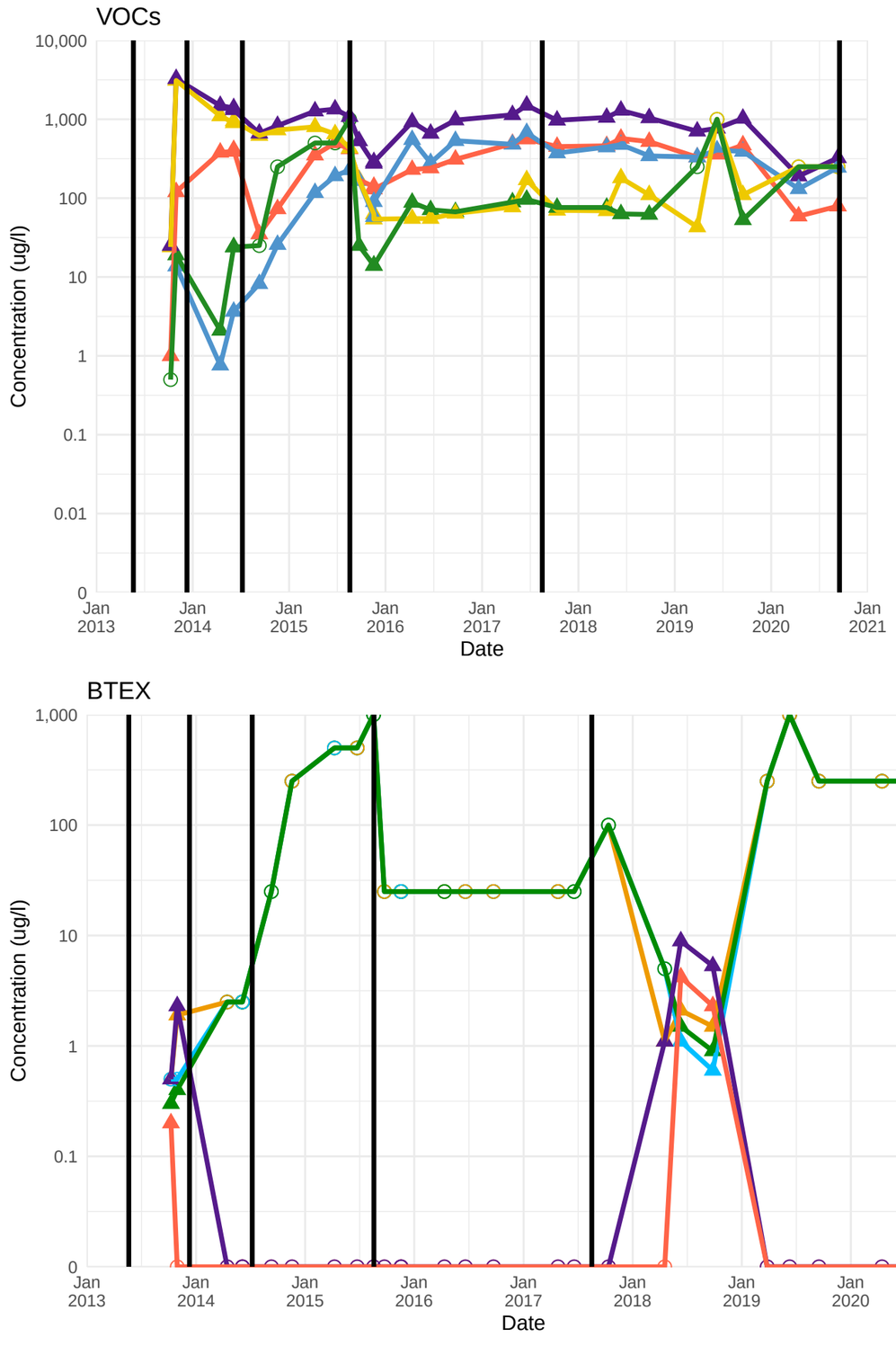
B−4

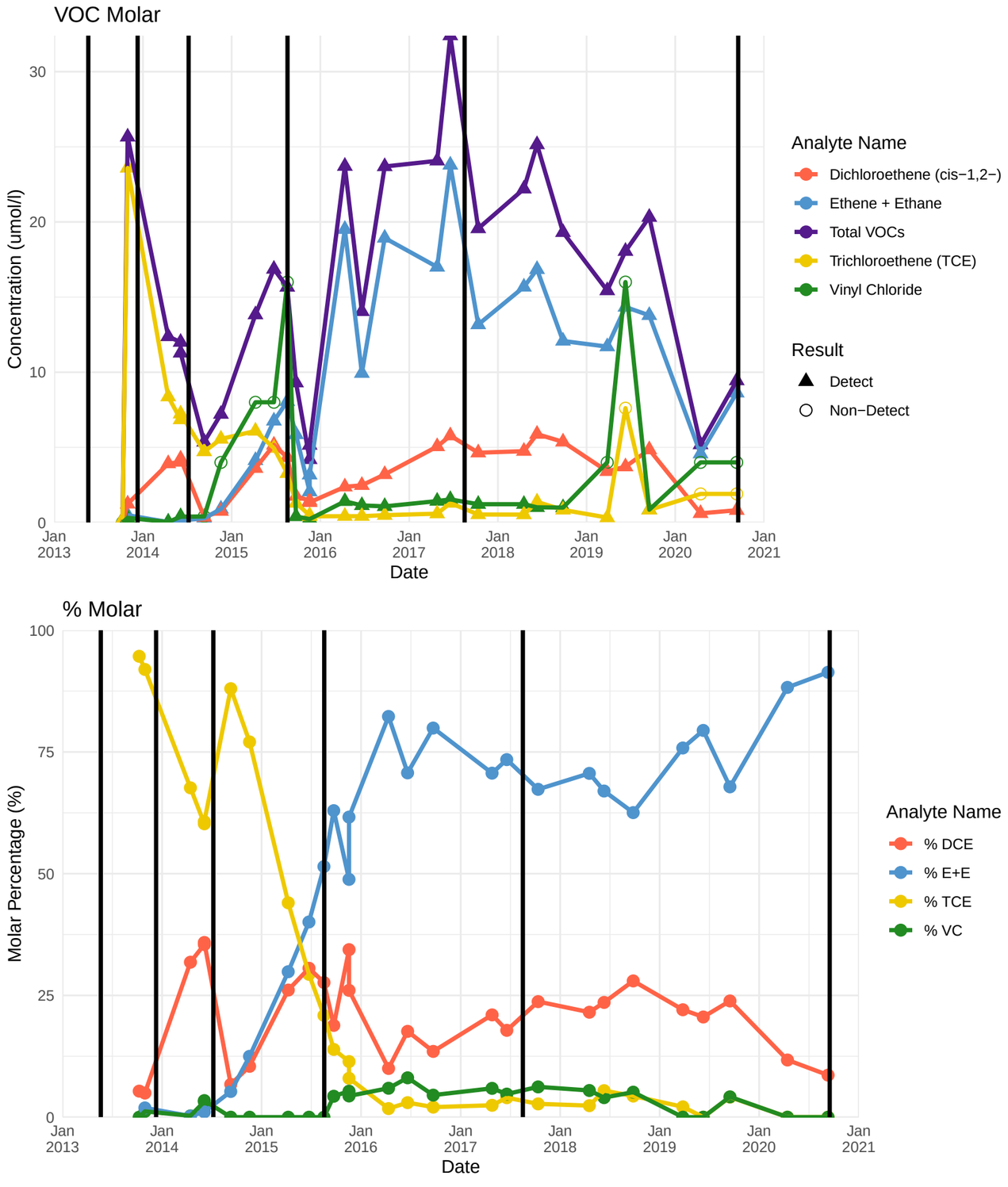
Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.



B−7

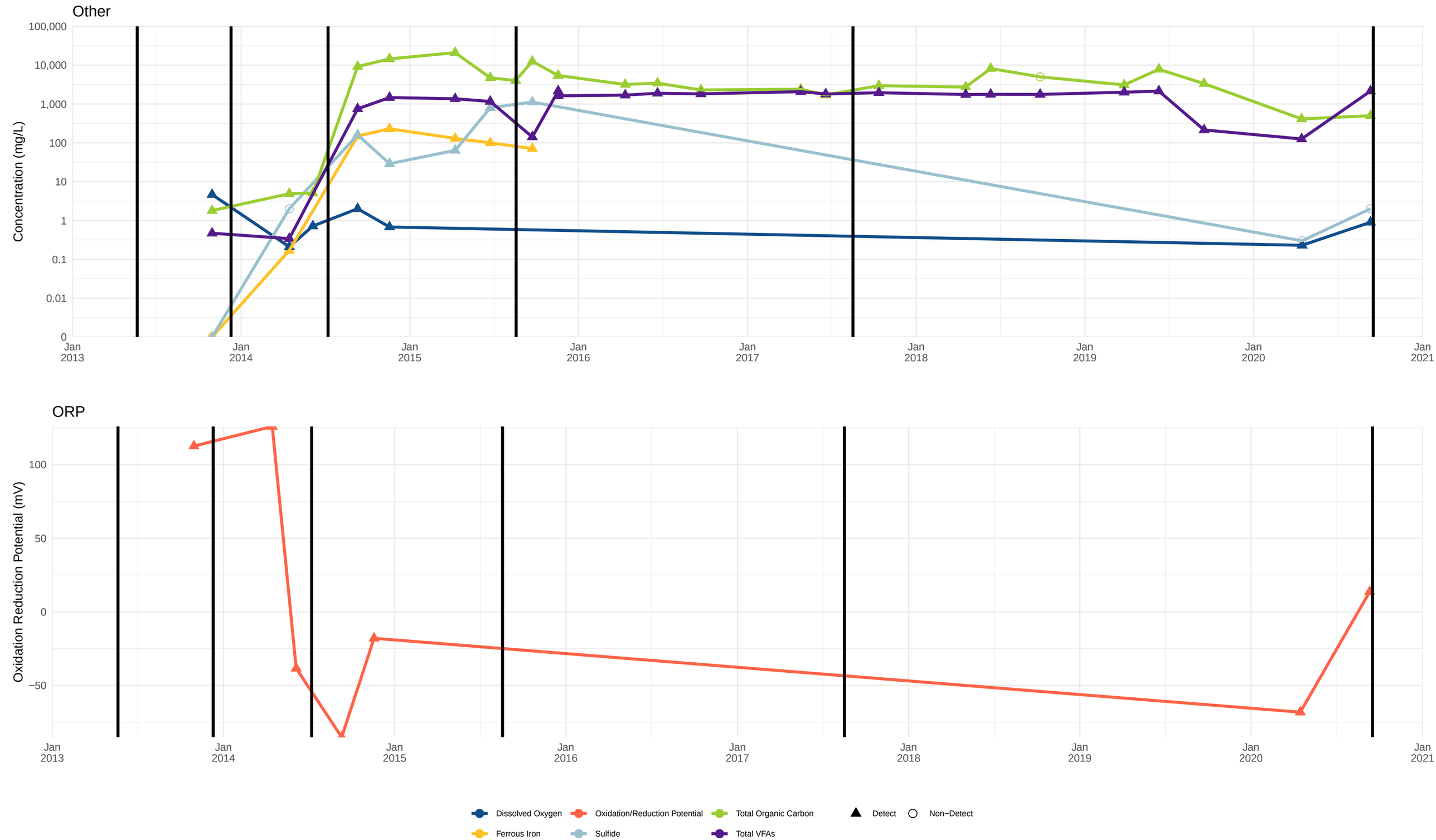
Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.





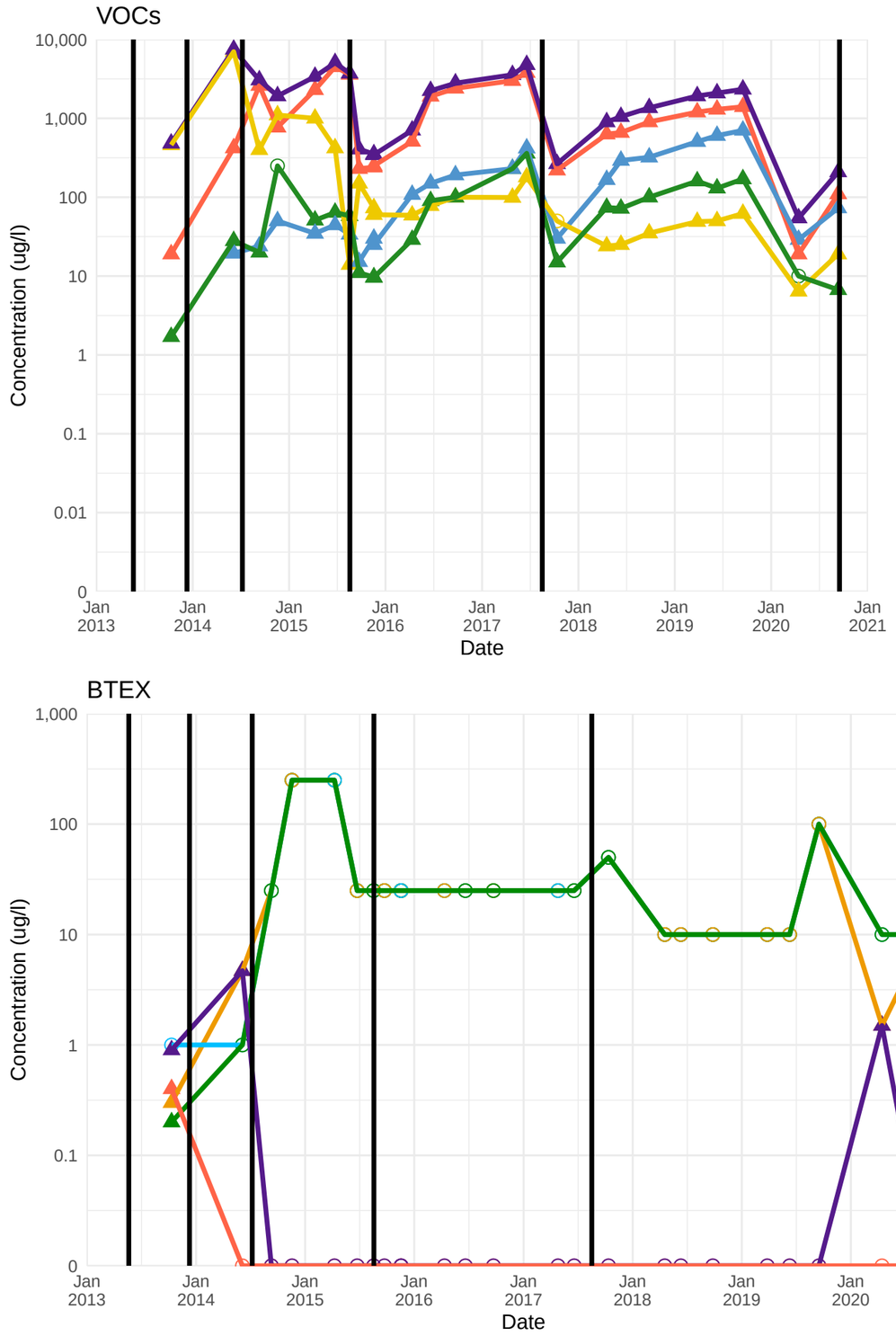
B−7

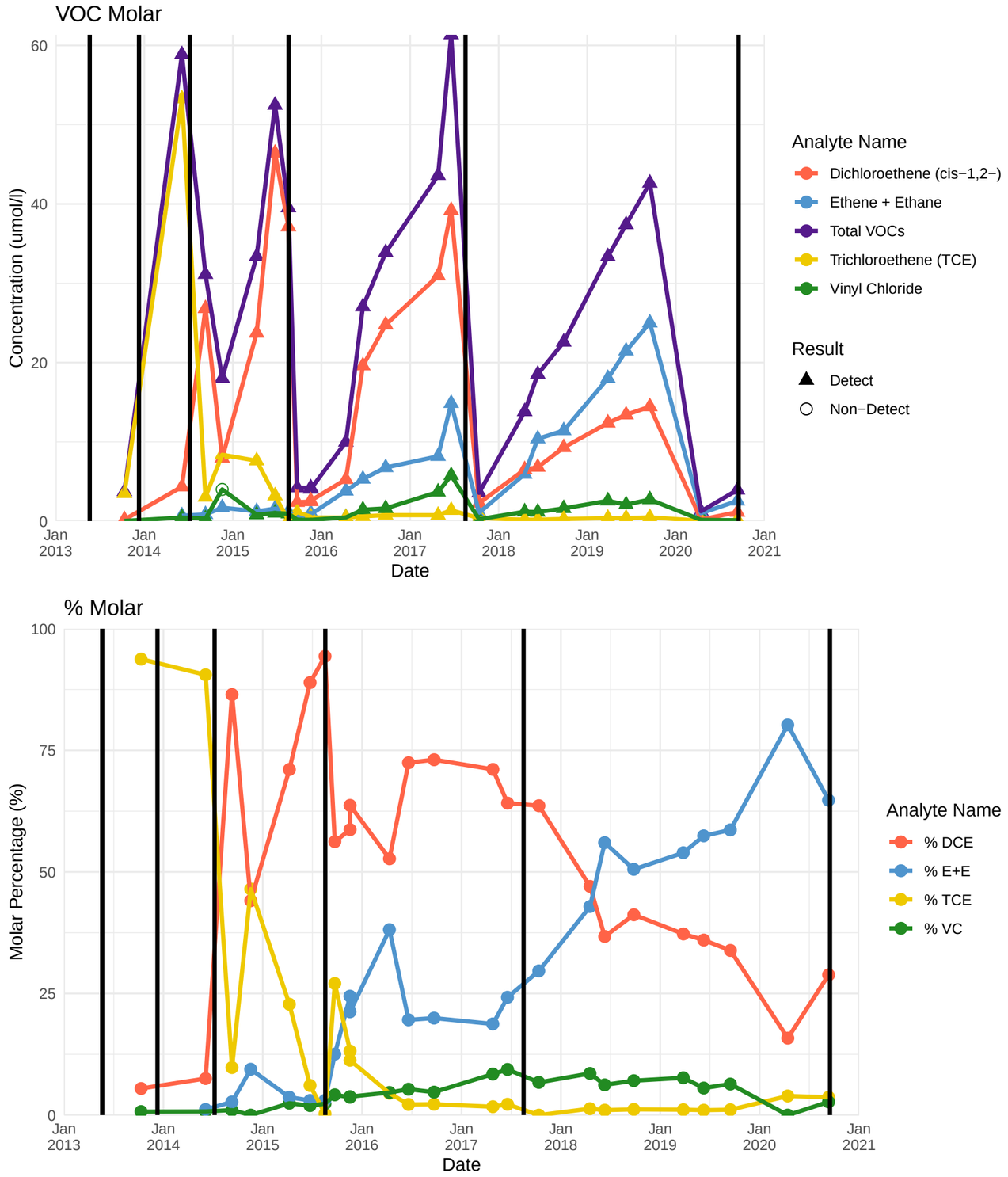
Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.



B−9

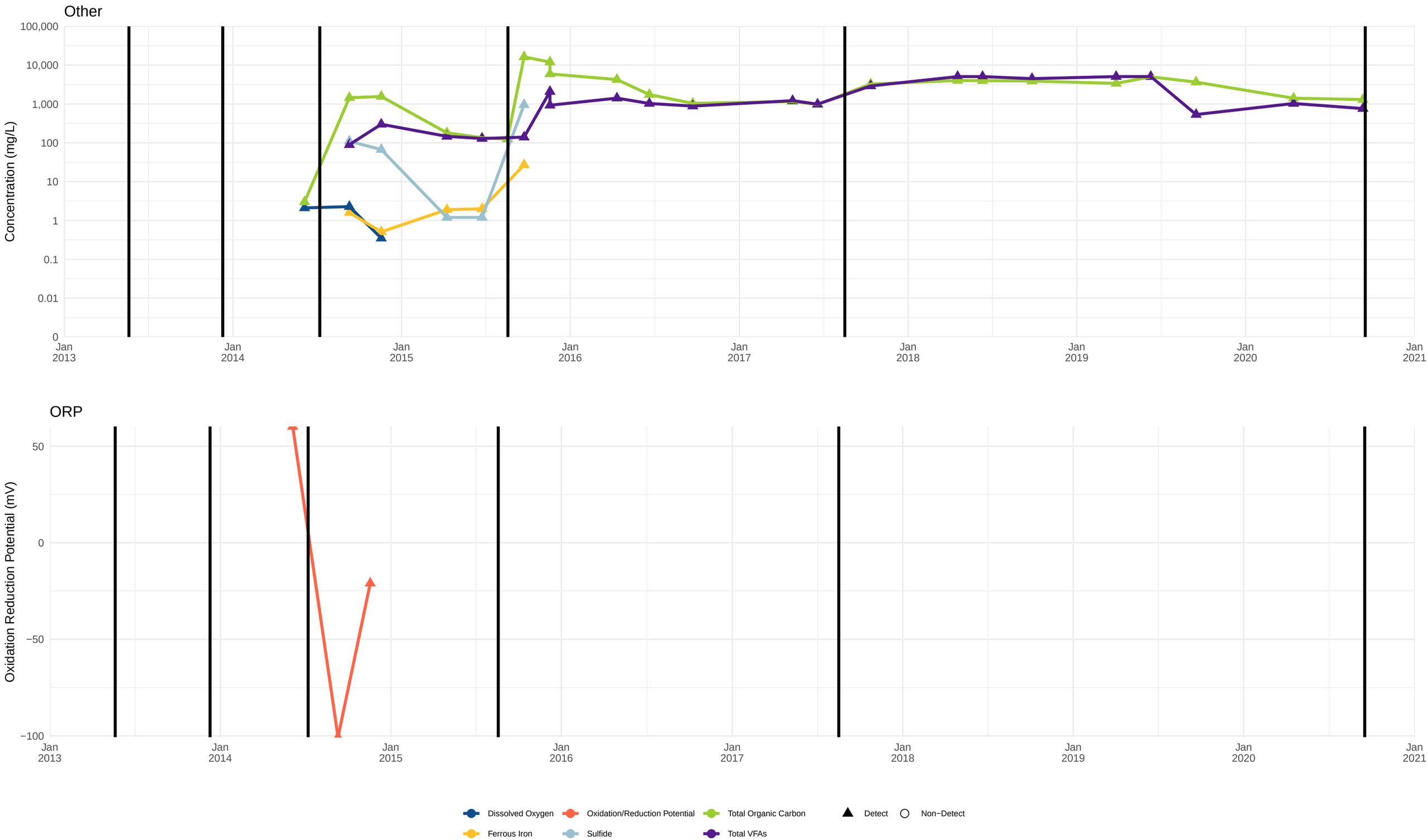
Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.





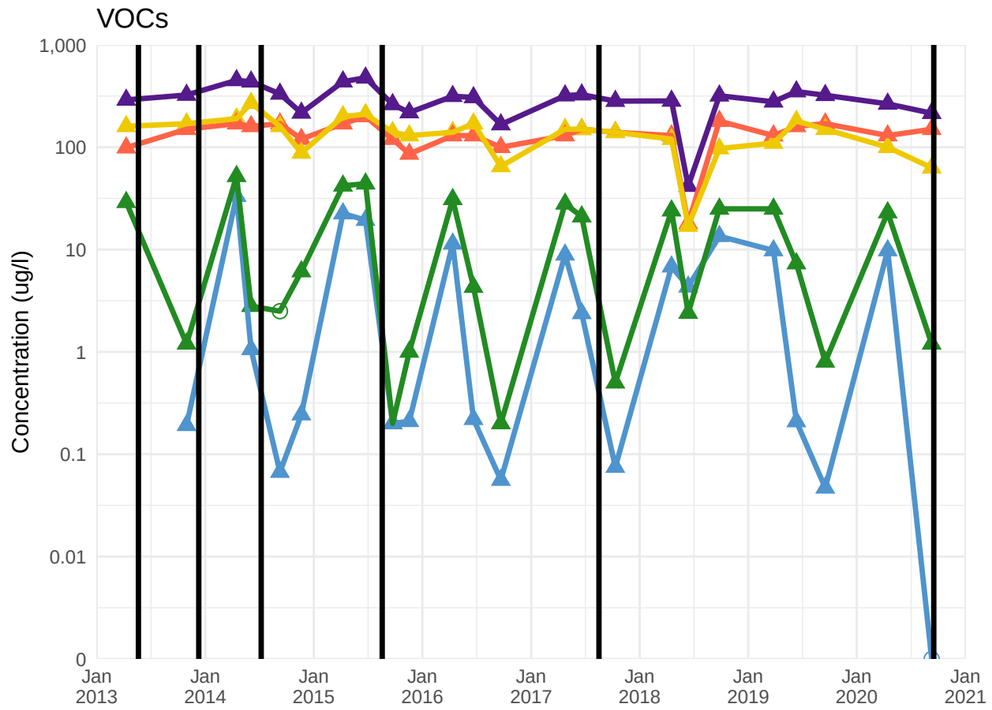
B−9

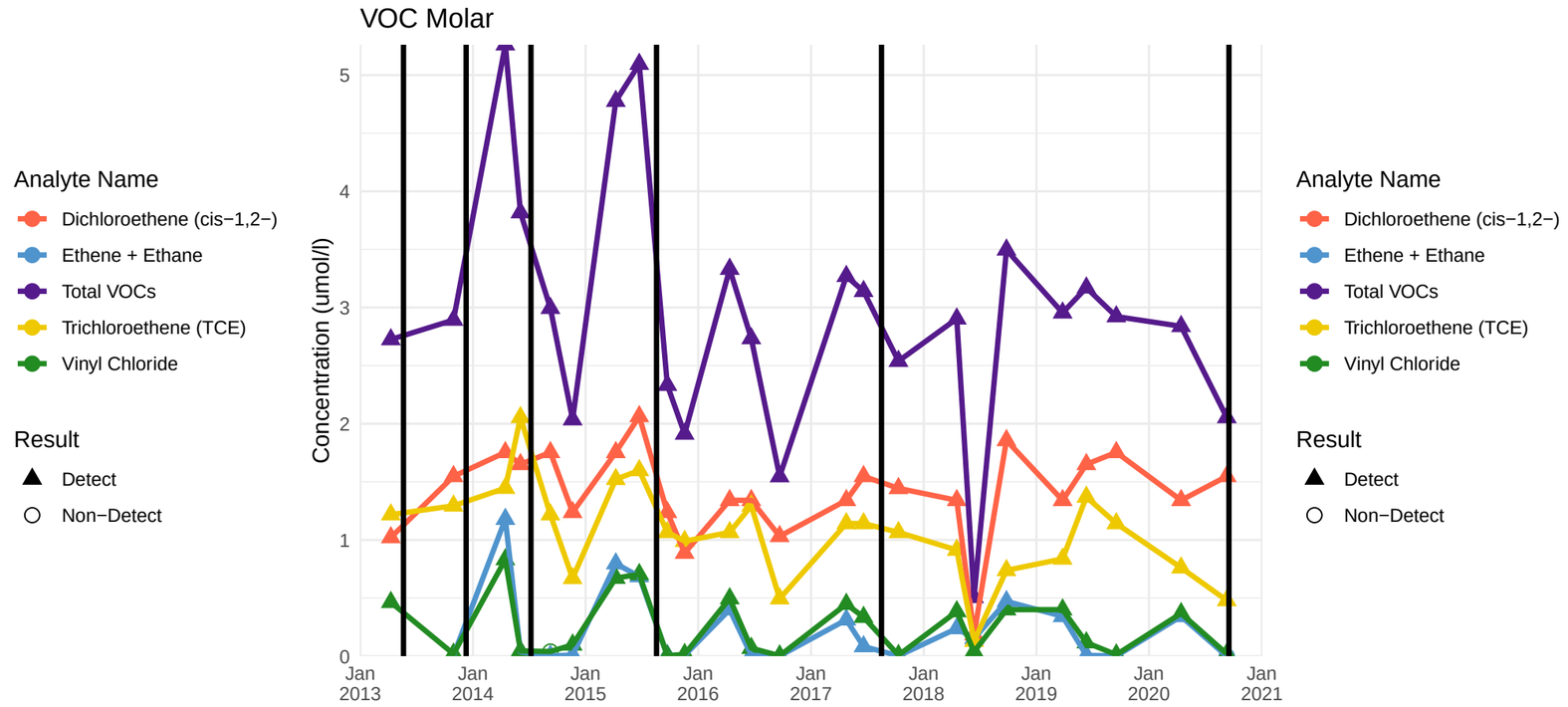
Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.

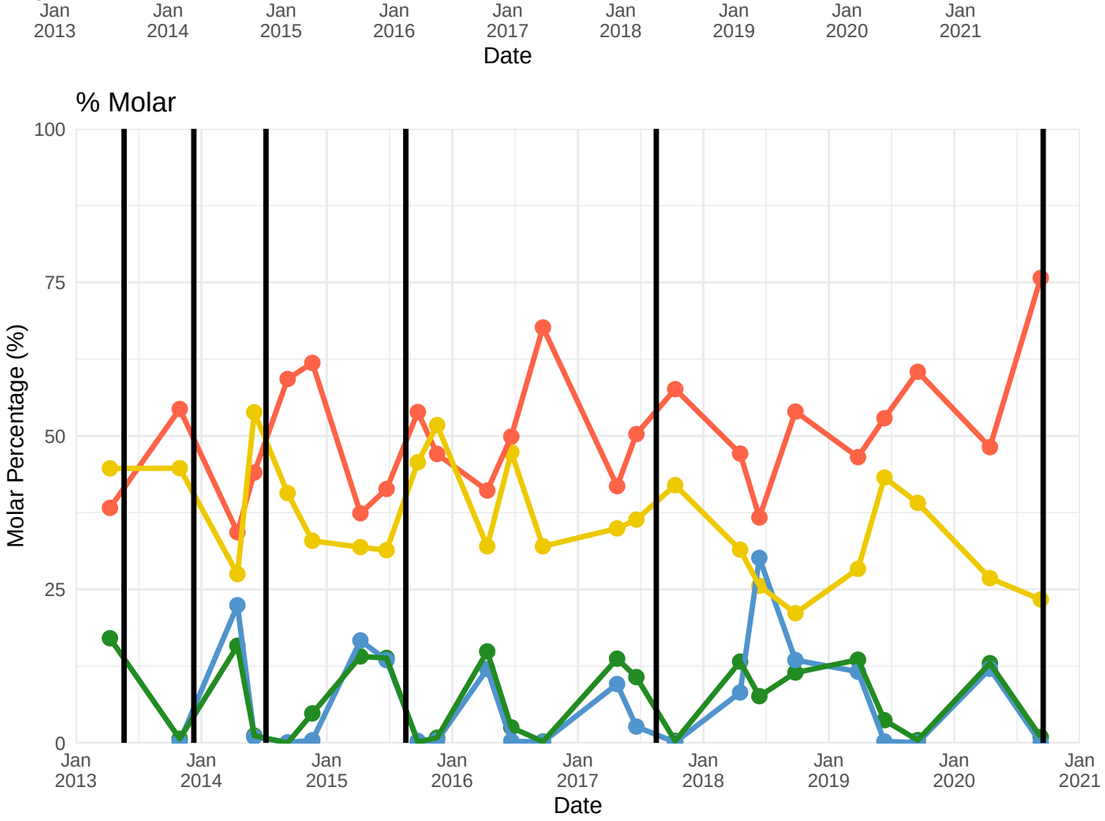


BP−1A

Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.

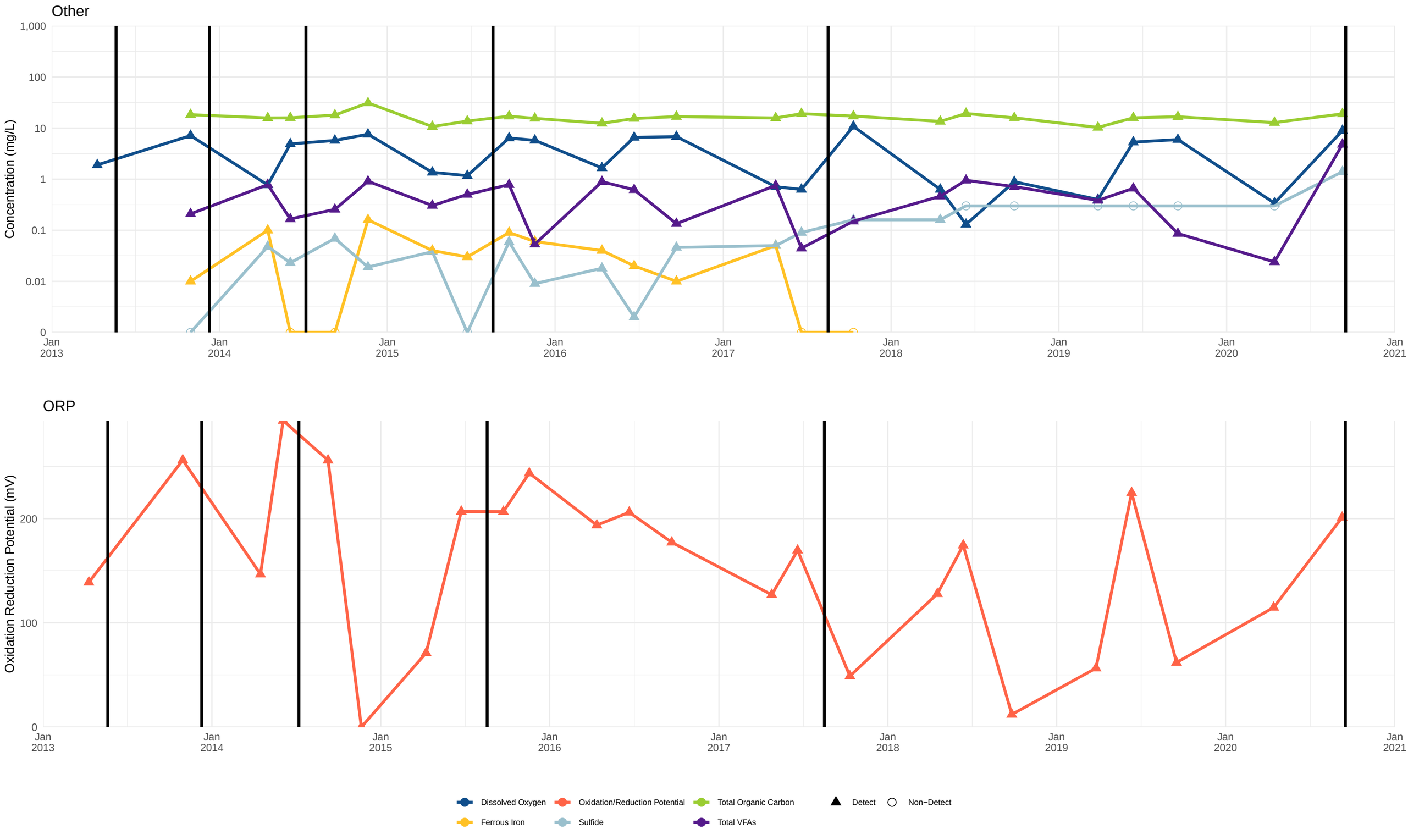






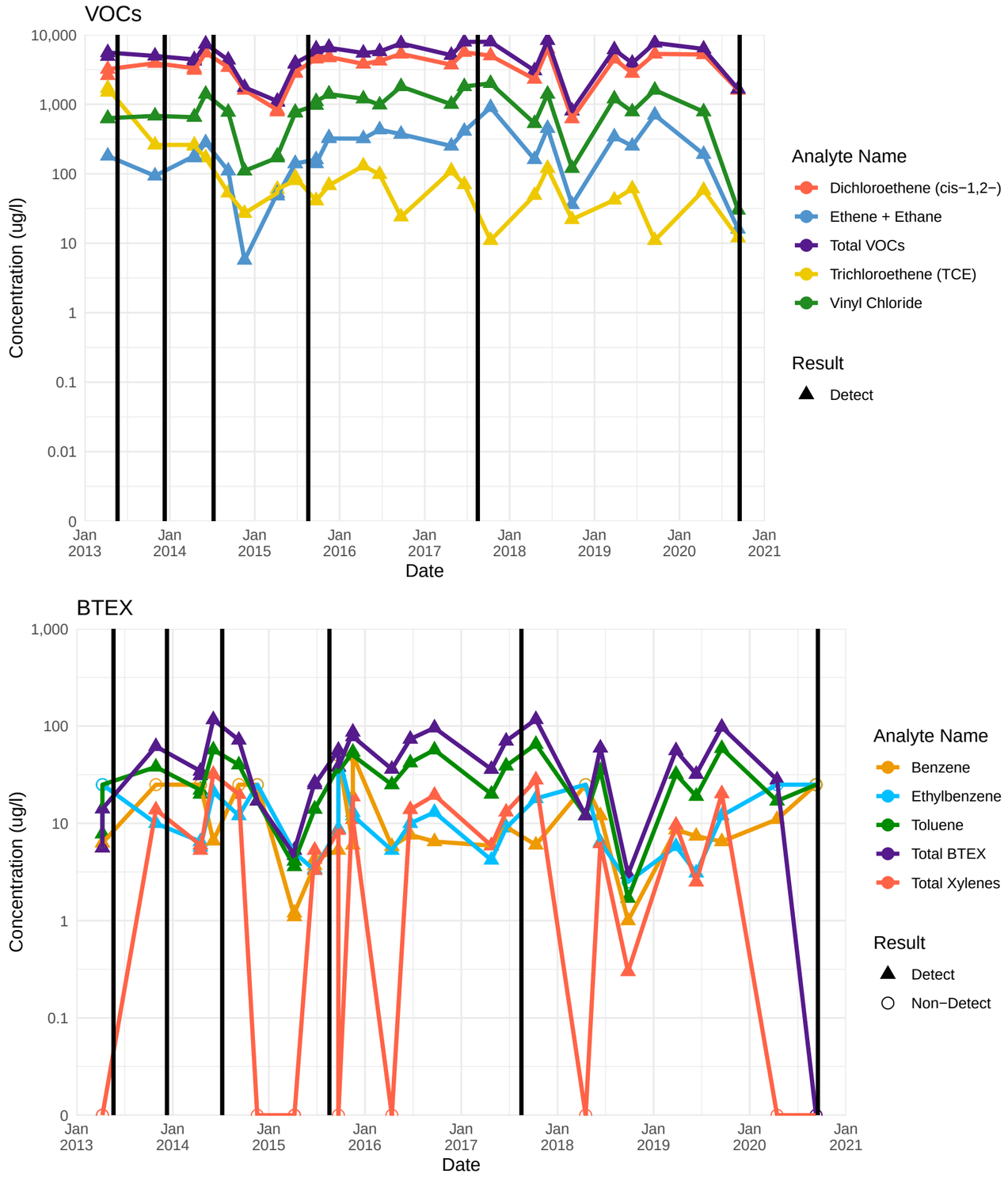
BP−1A

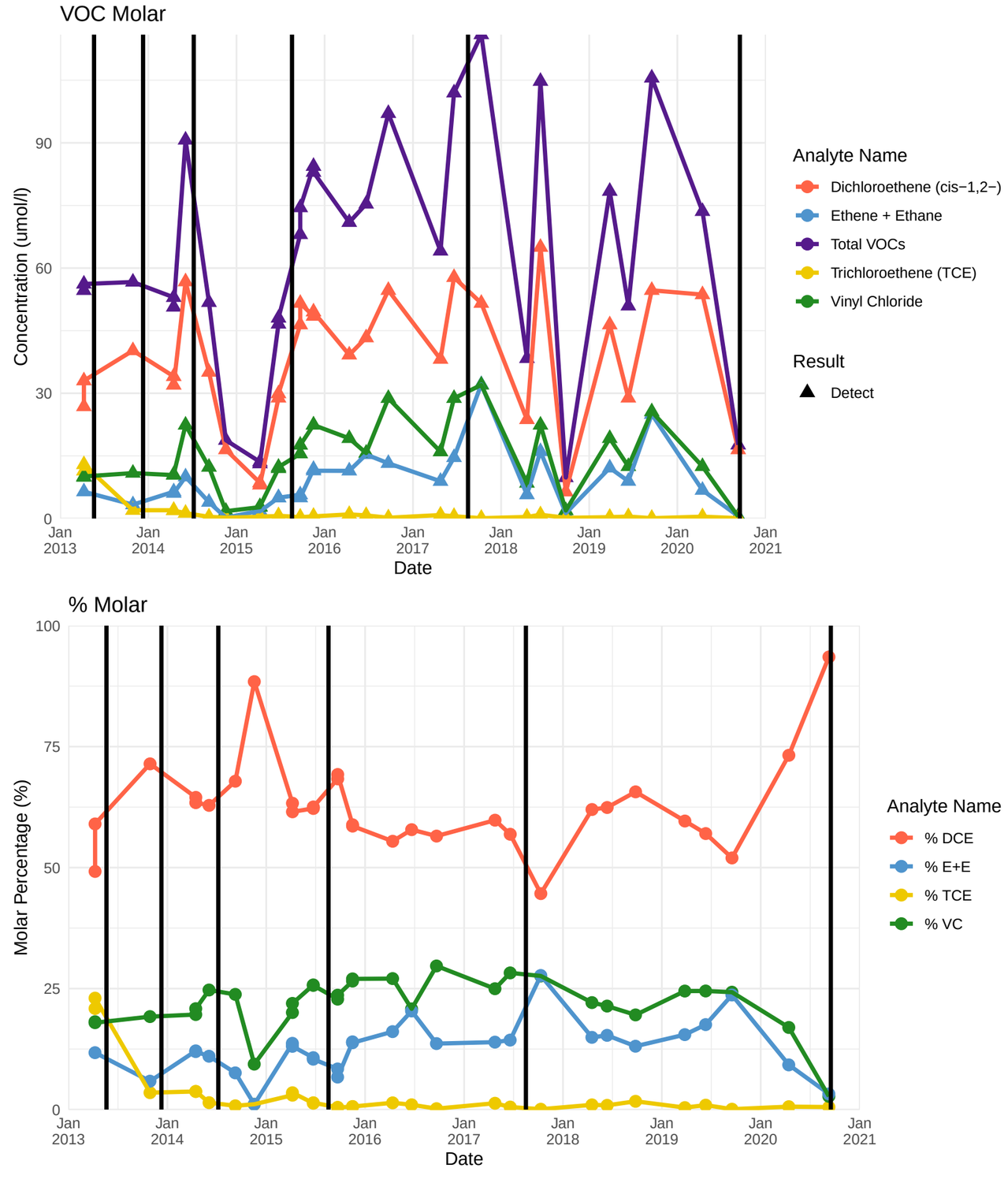
Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.



BP−2A

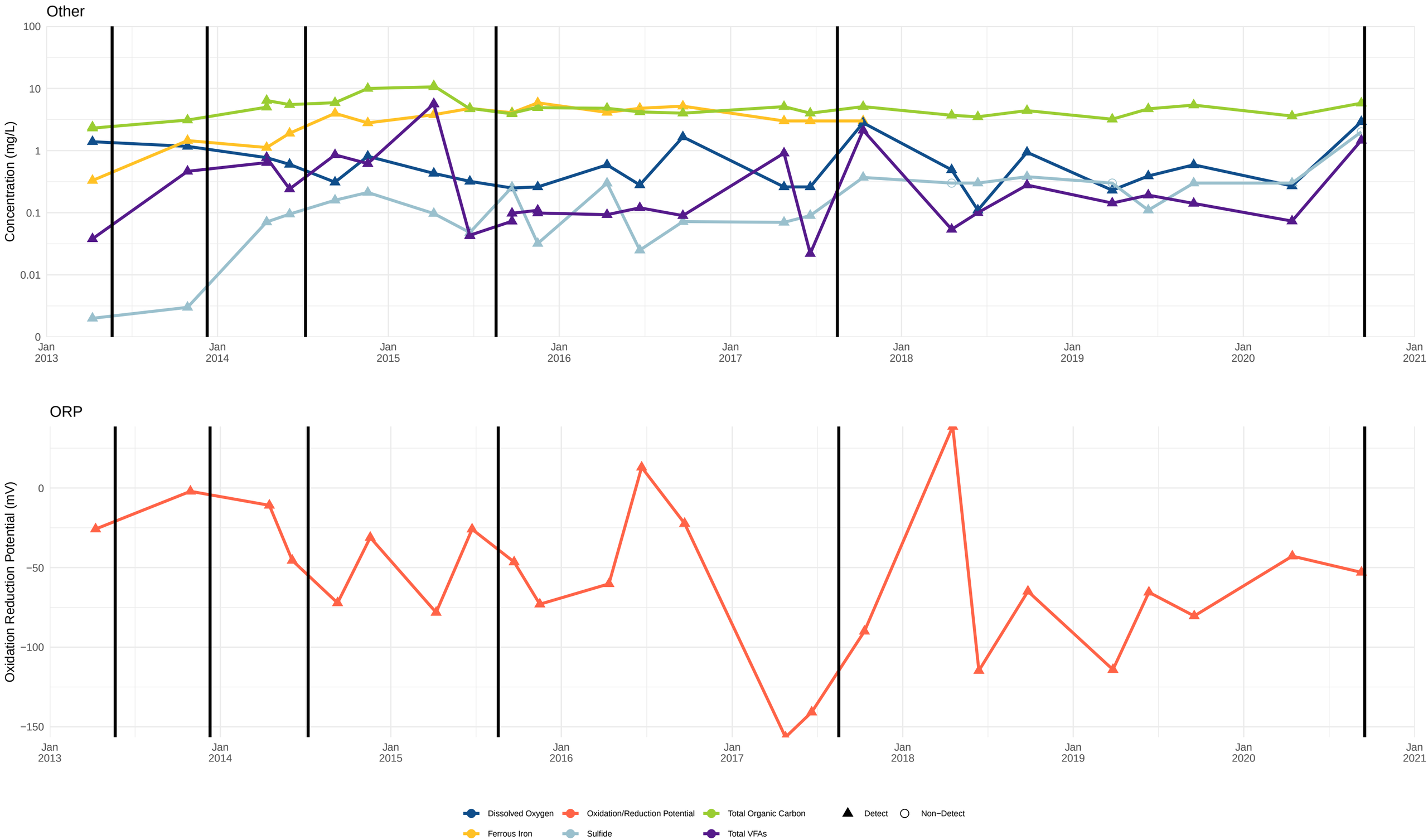
Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.





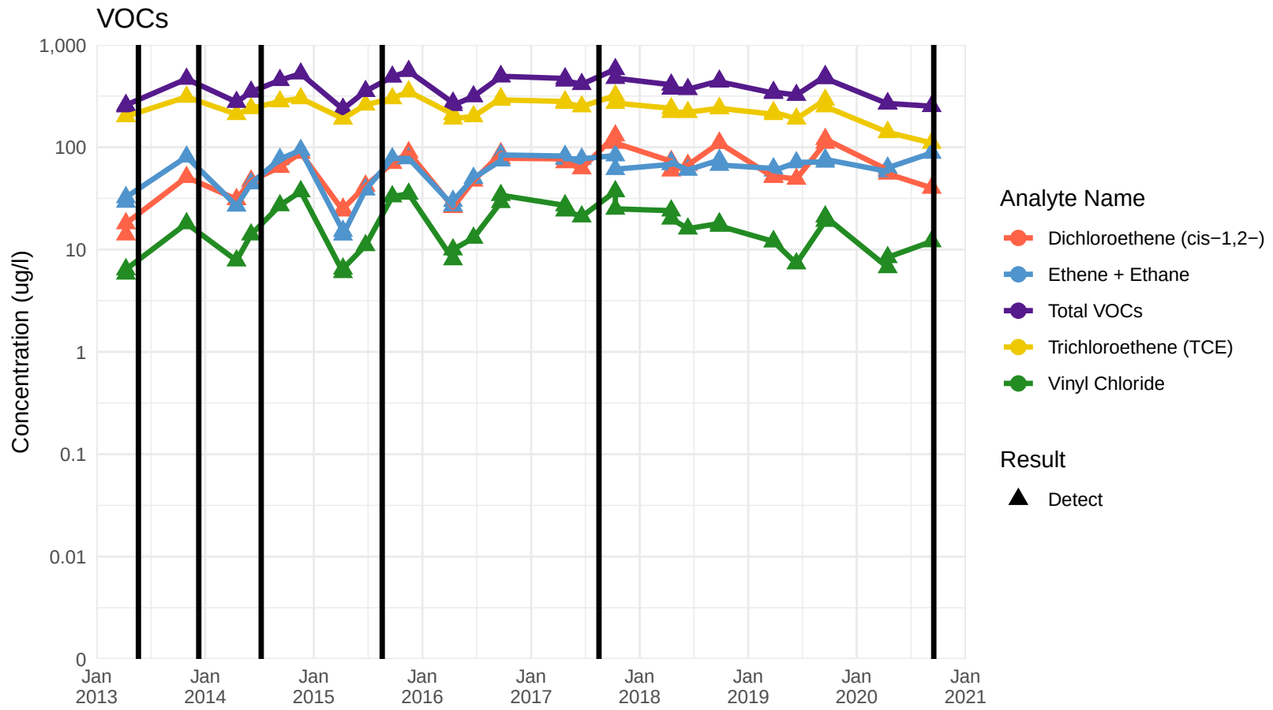
BP−2A

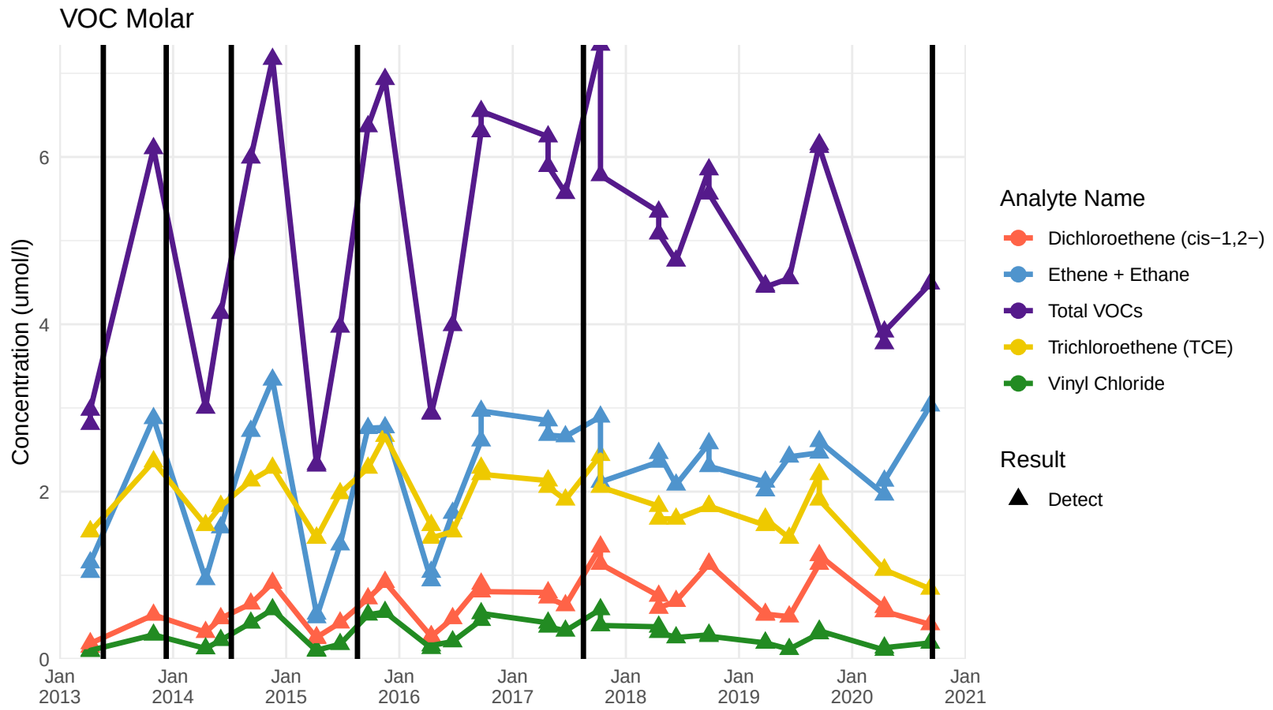
Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.

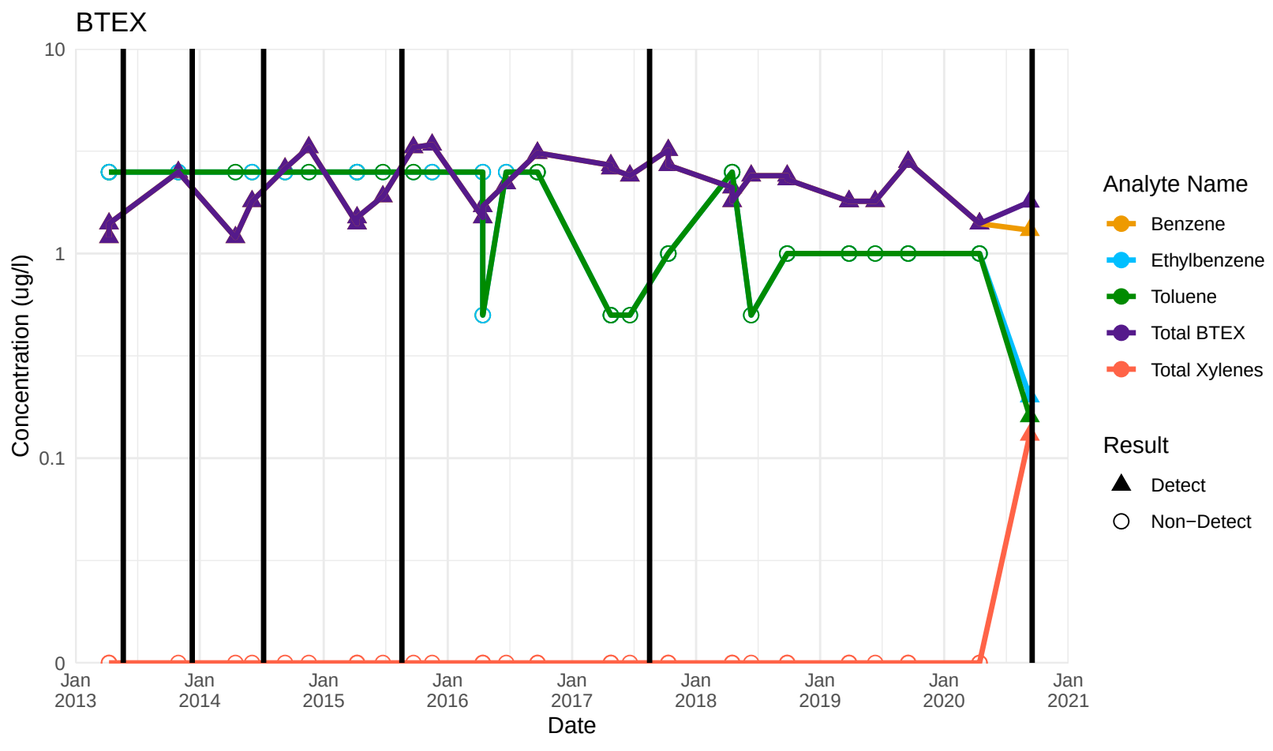


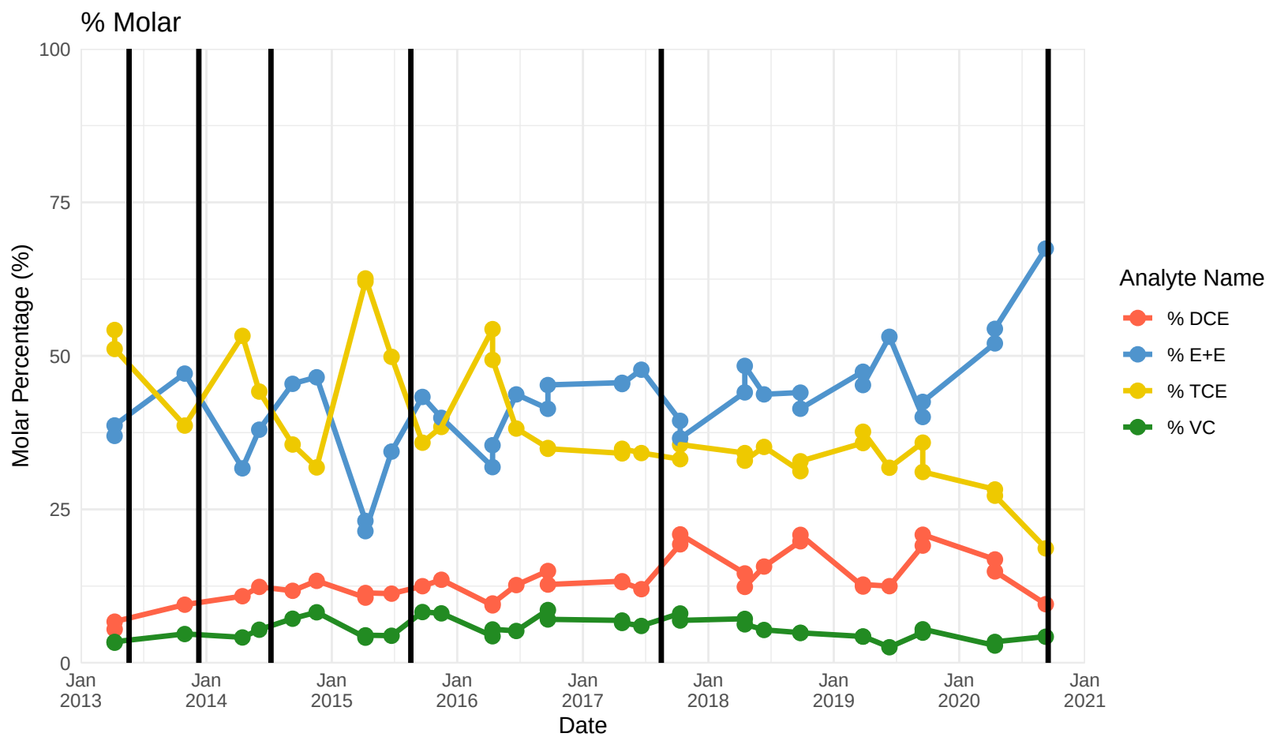
BP−4A

Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.



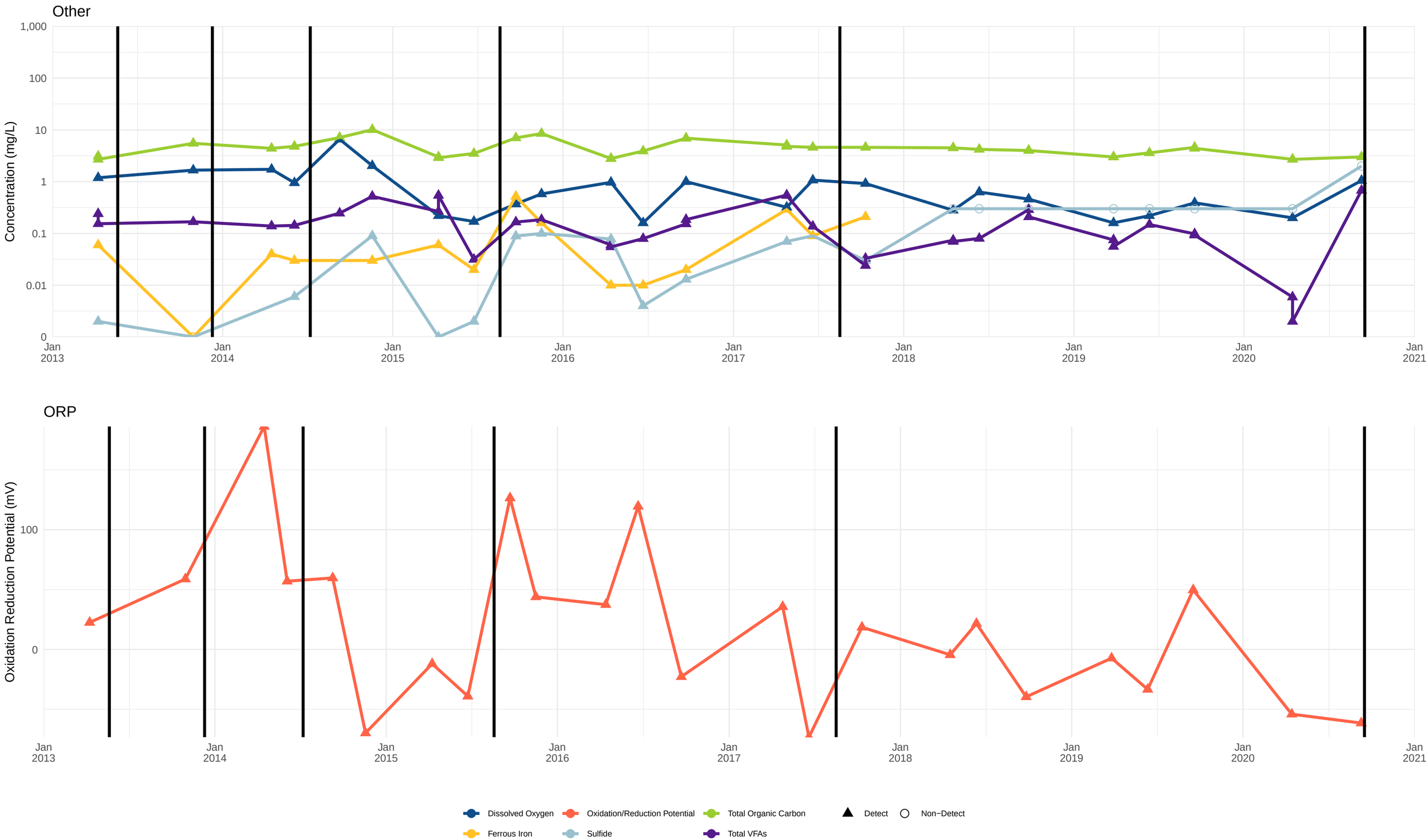






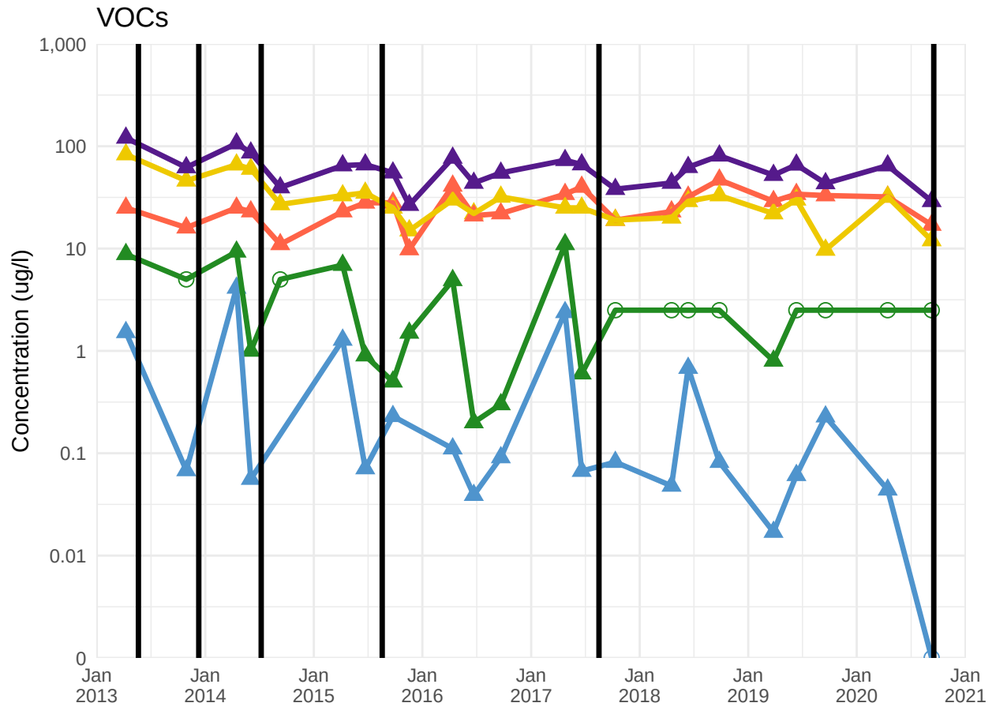
BP−4A

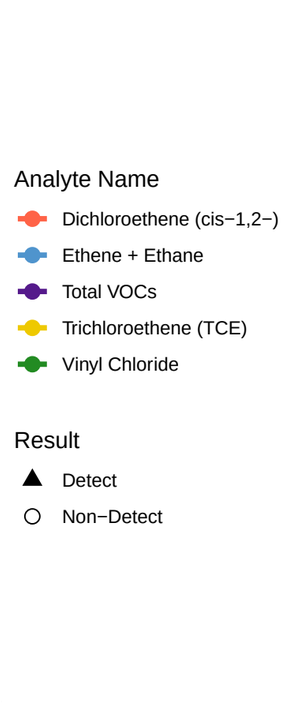
Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.

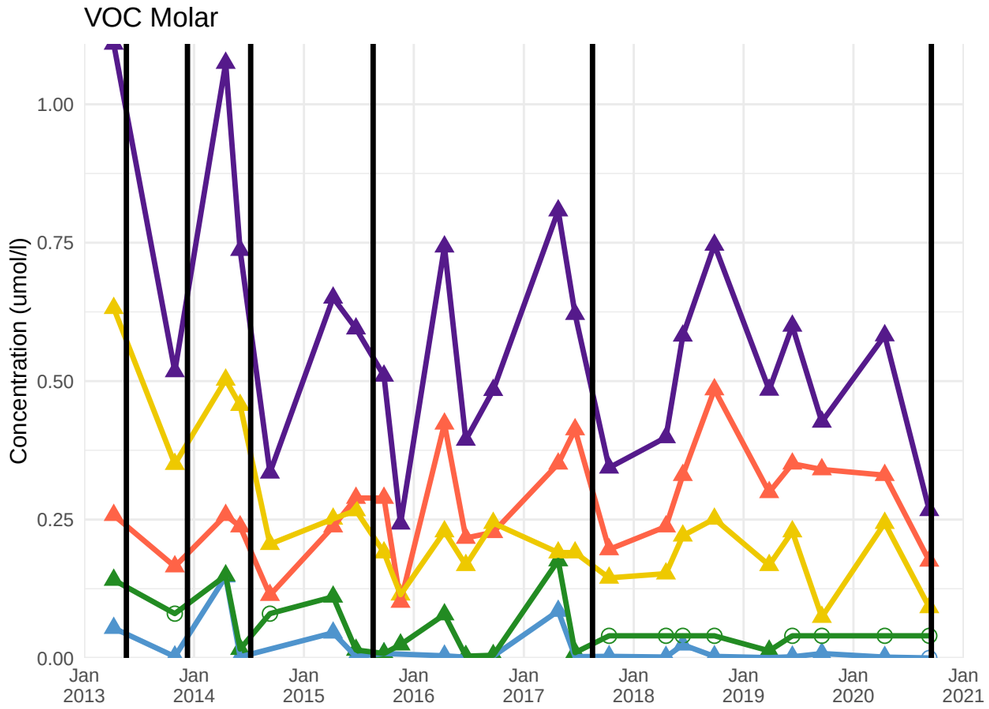


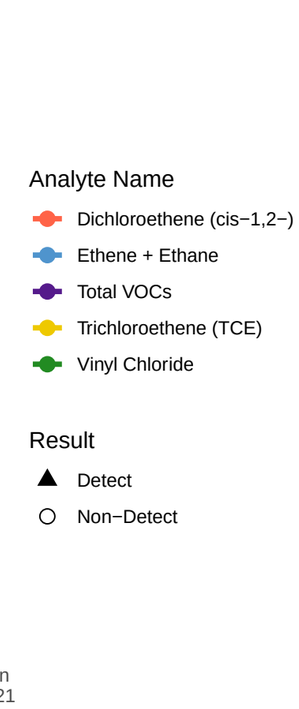
BP−5A

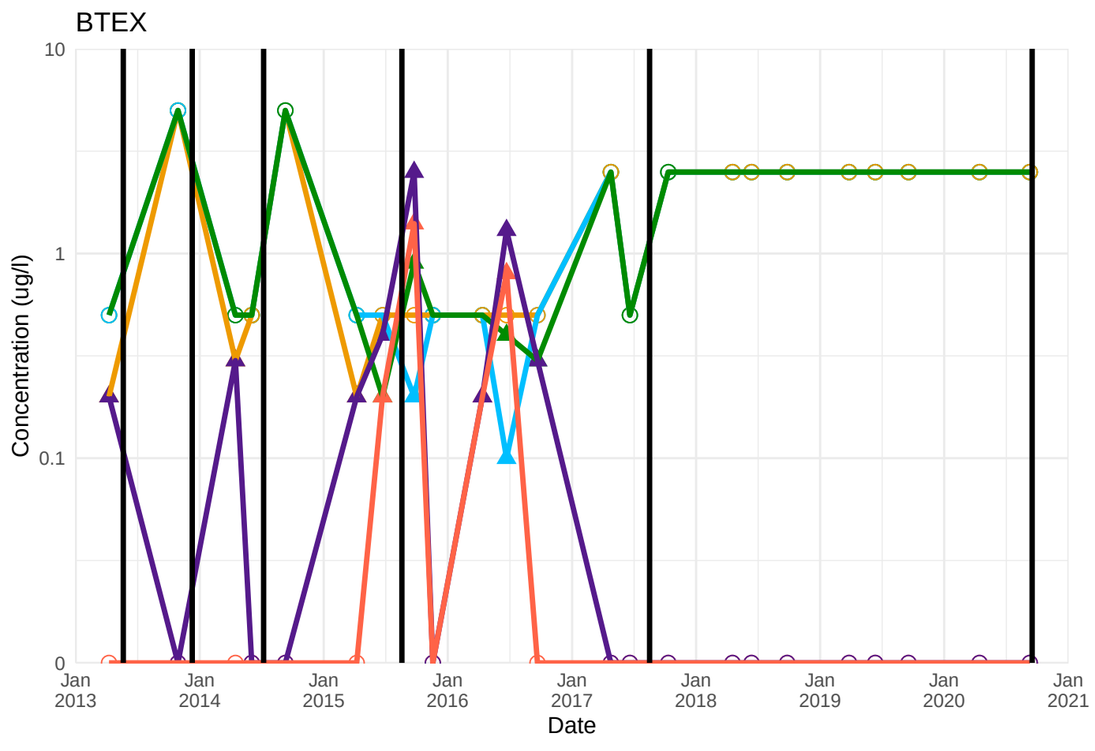
Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.

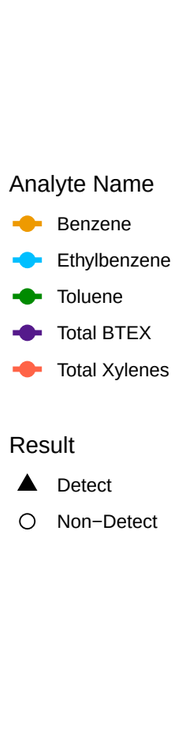


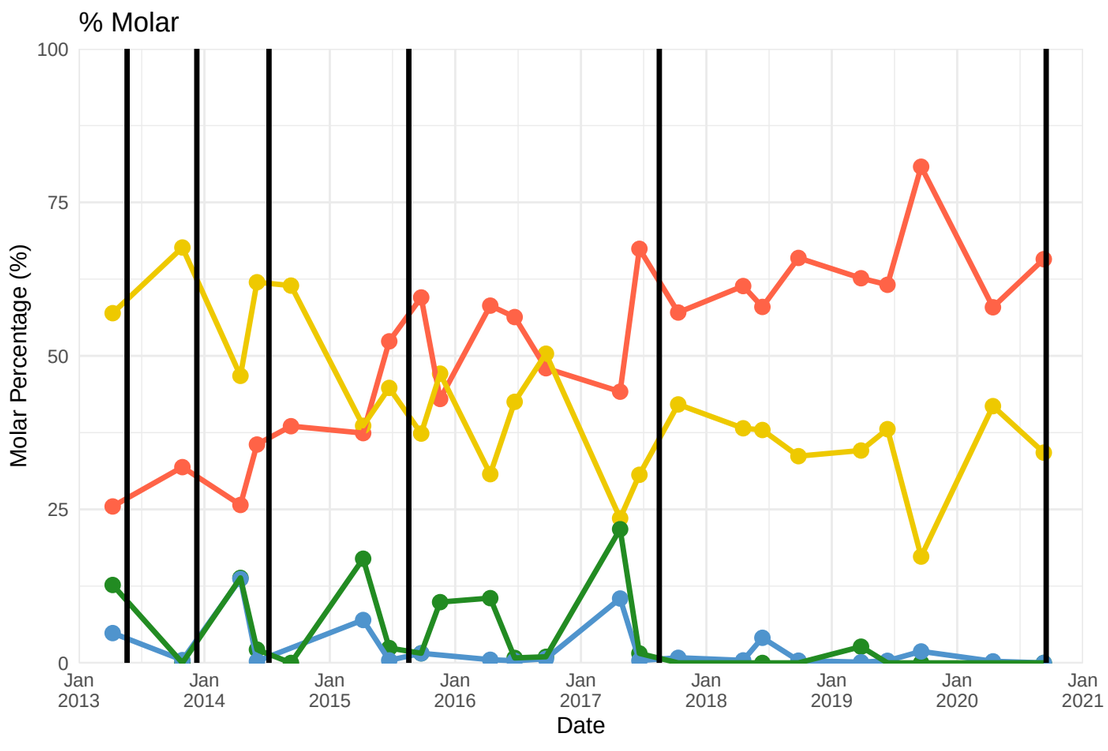


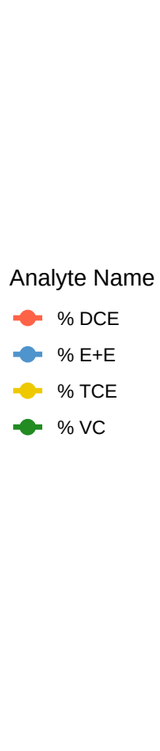






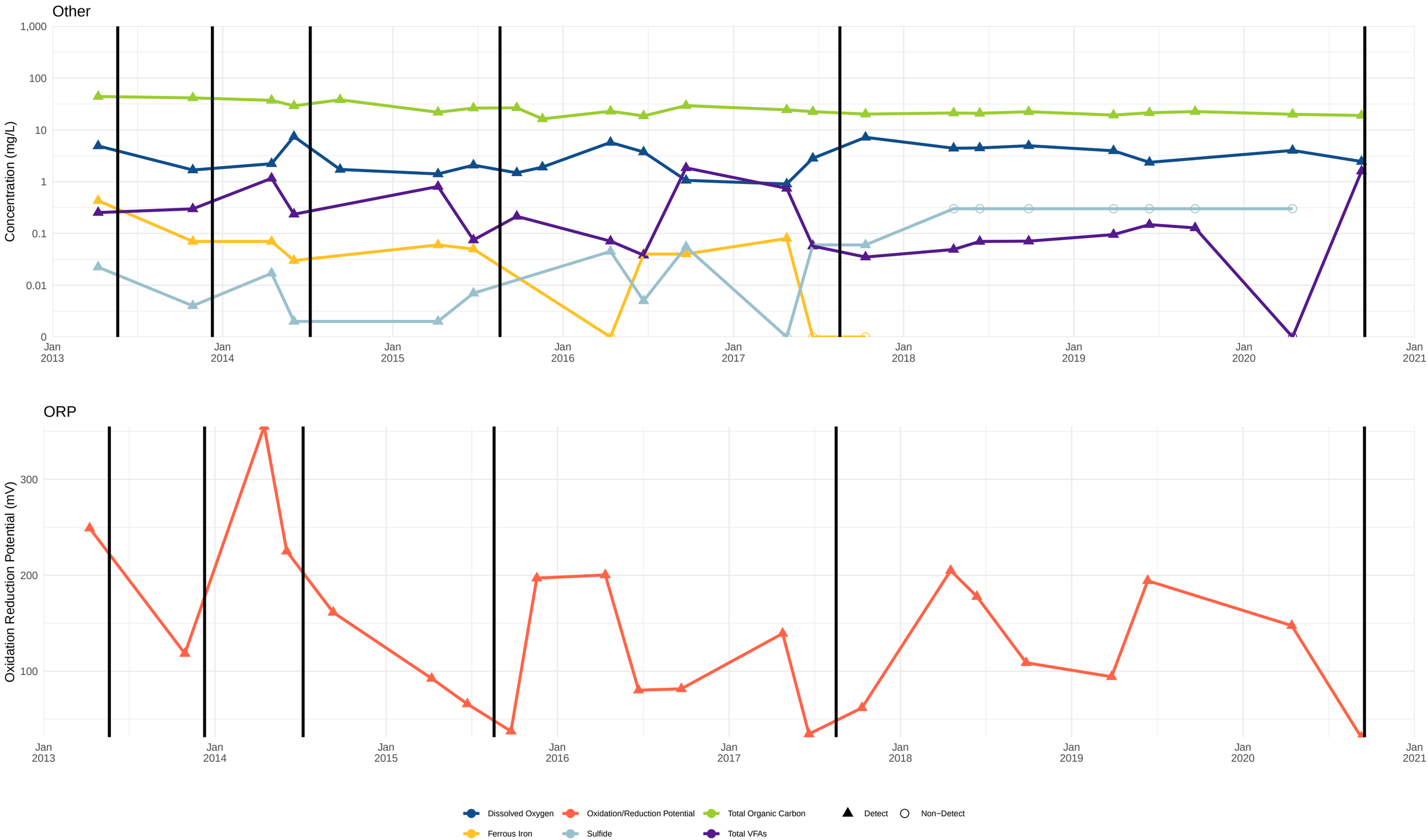






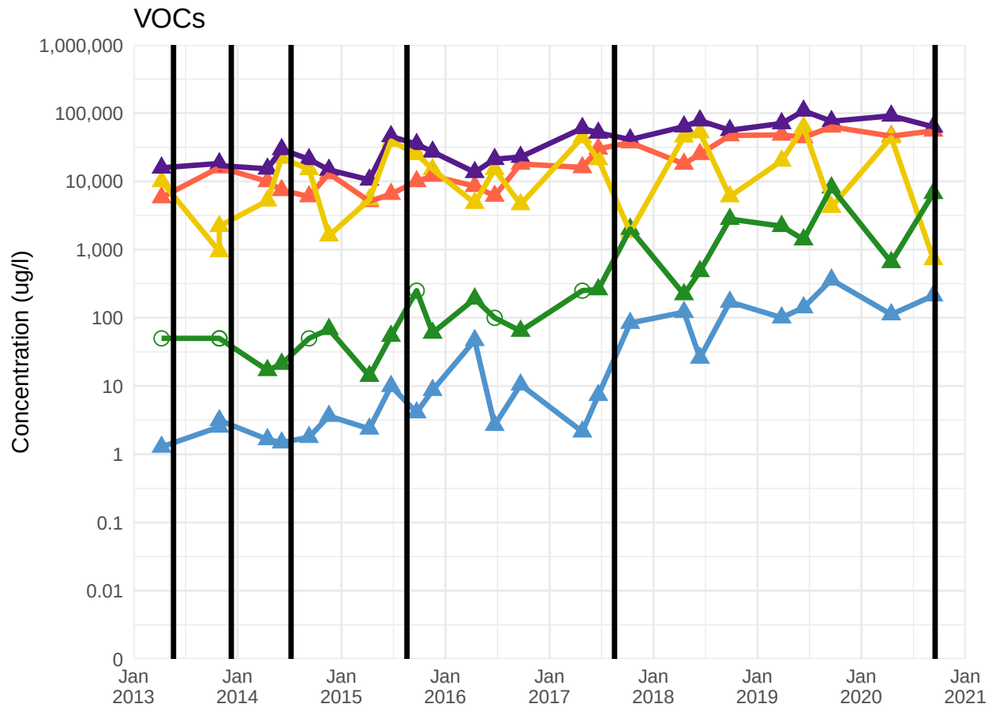
BP−5A

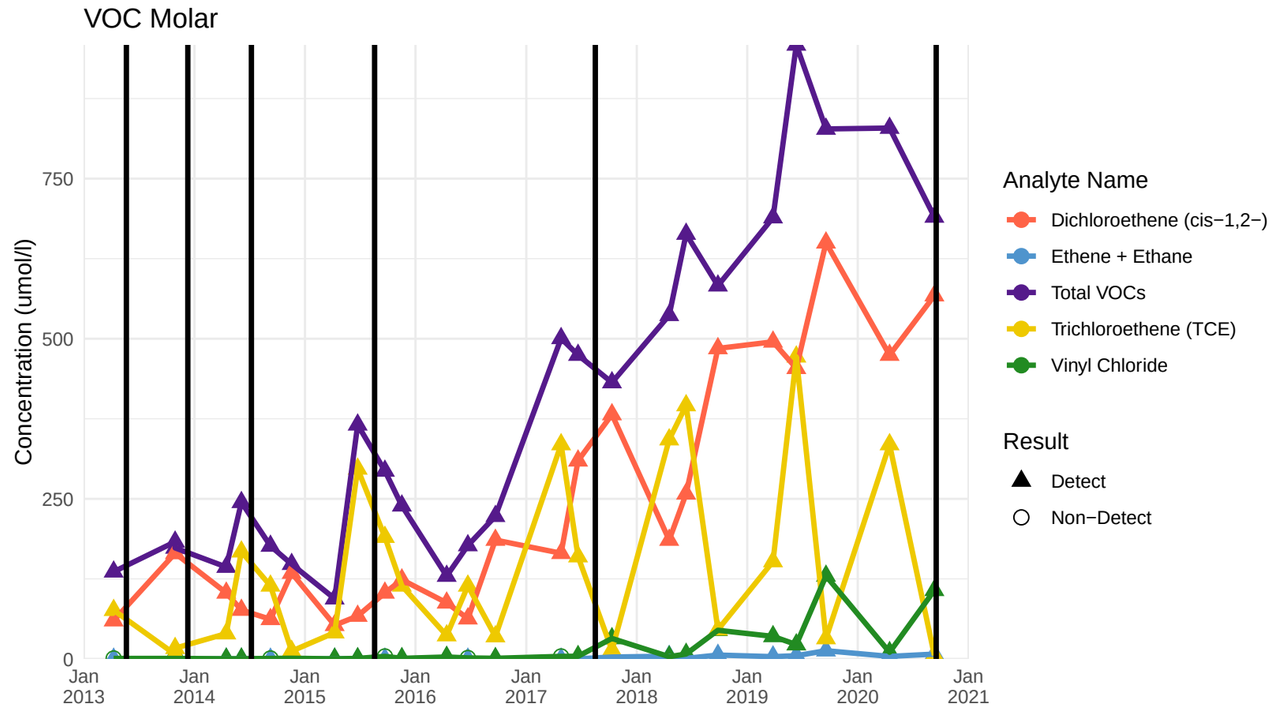
Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.

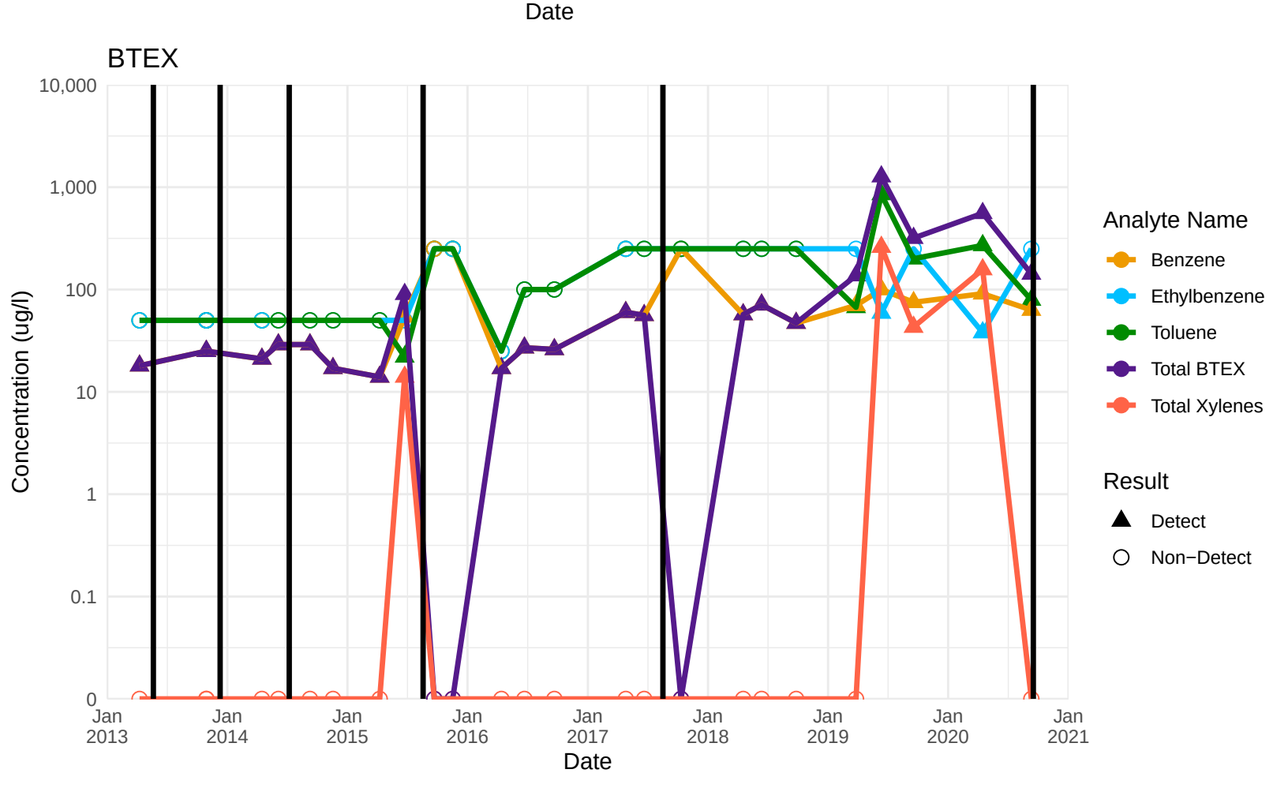


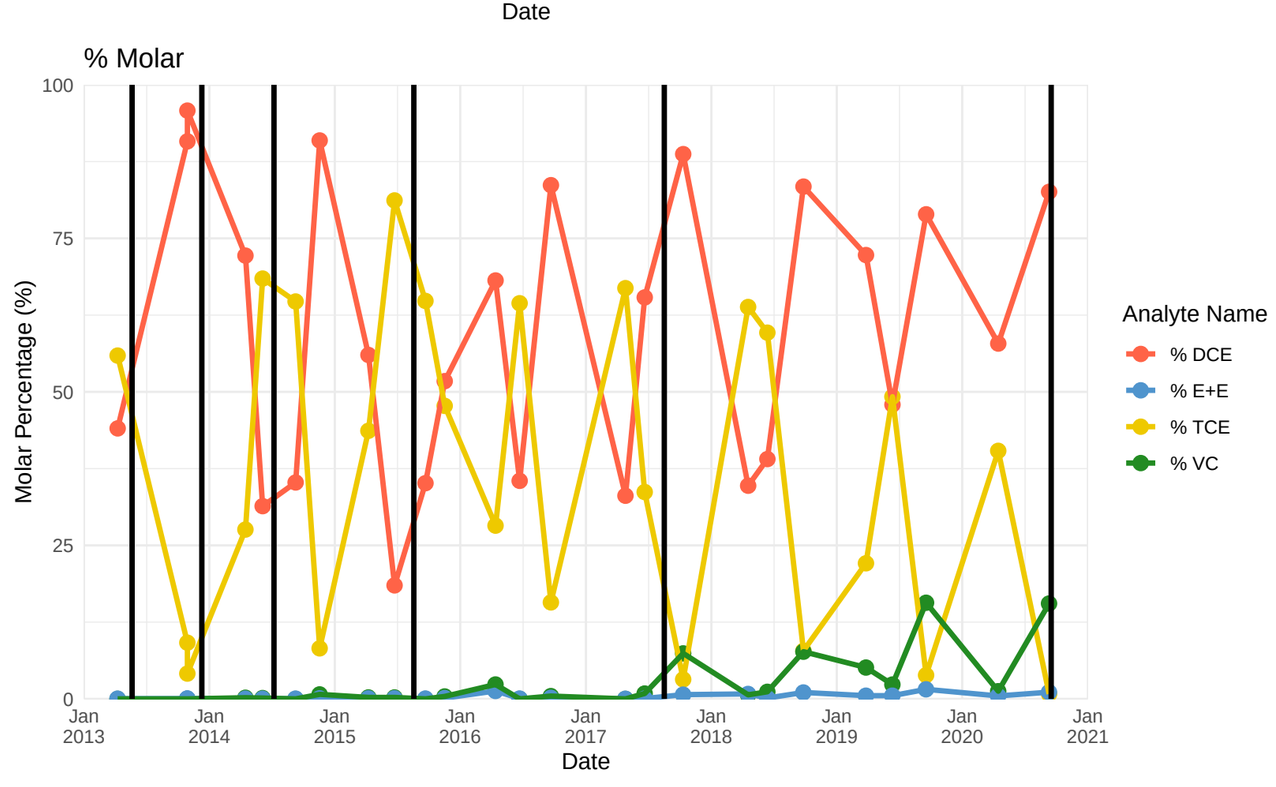
BP−6A

Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.



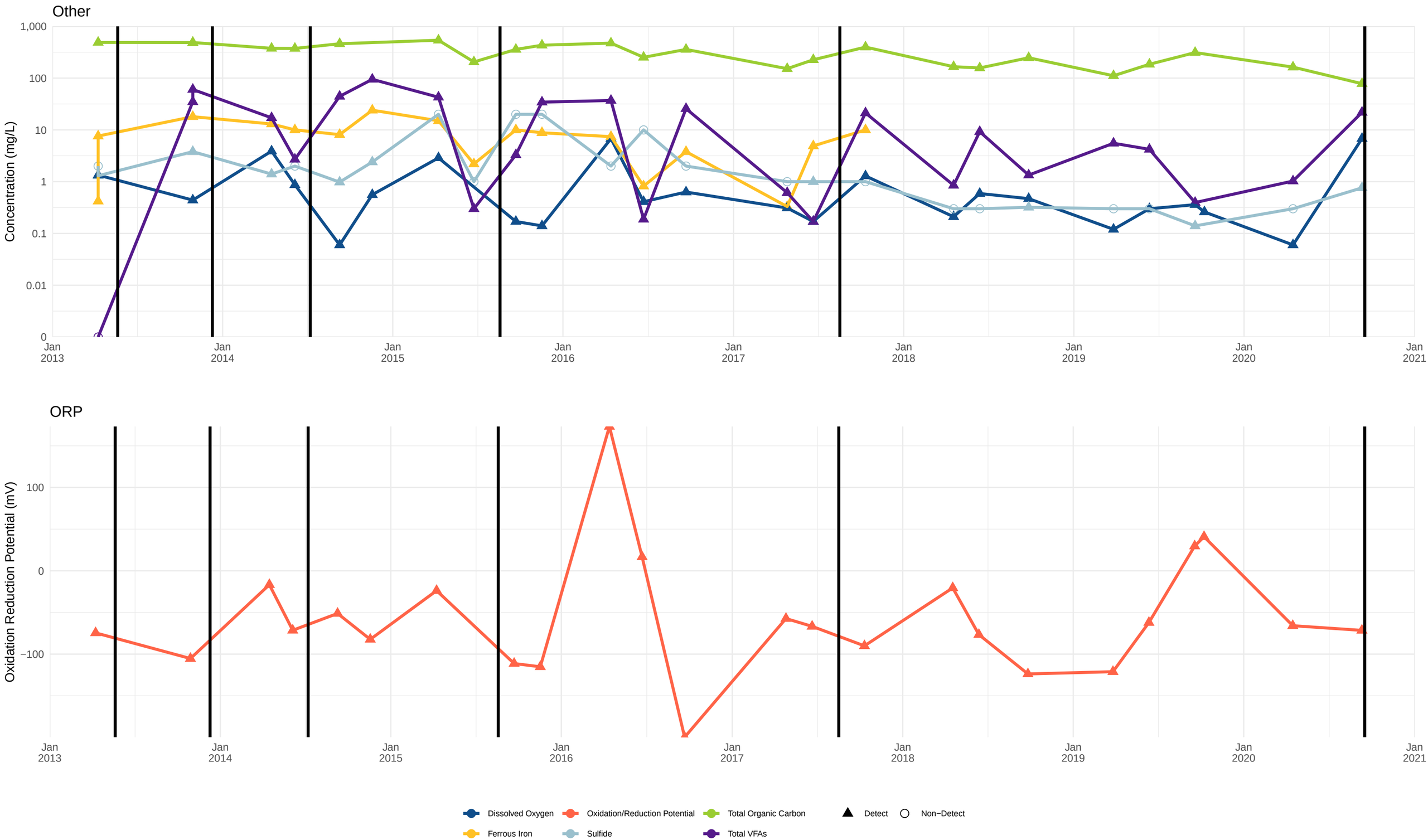






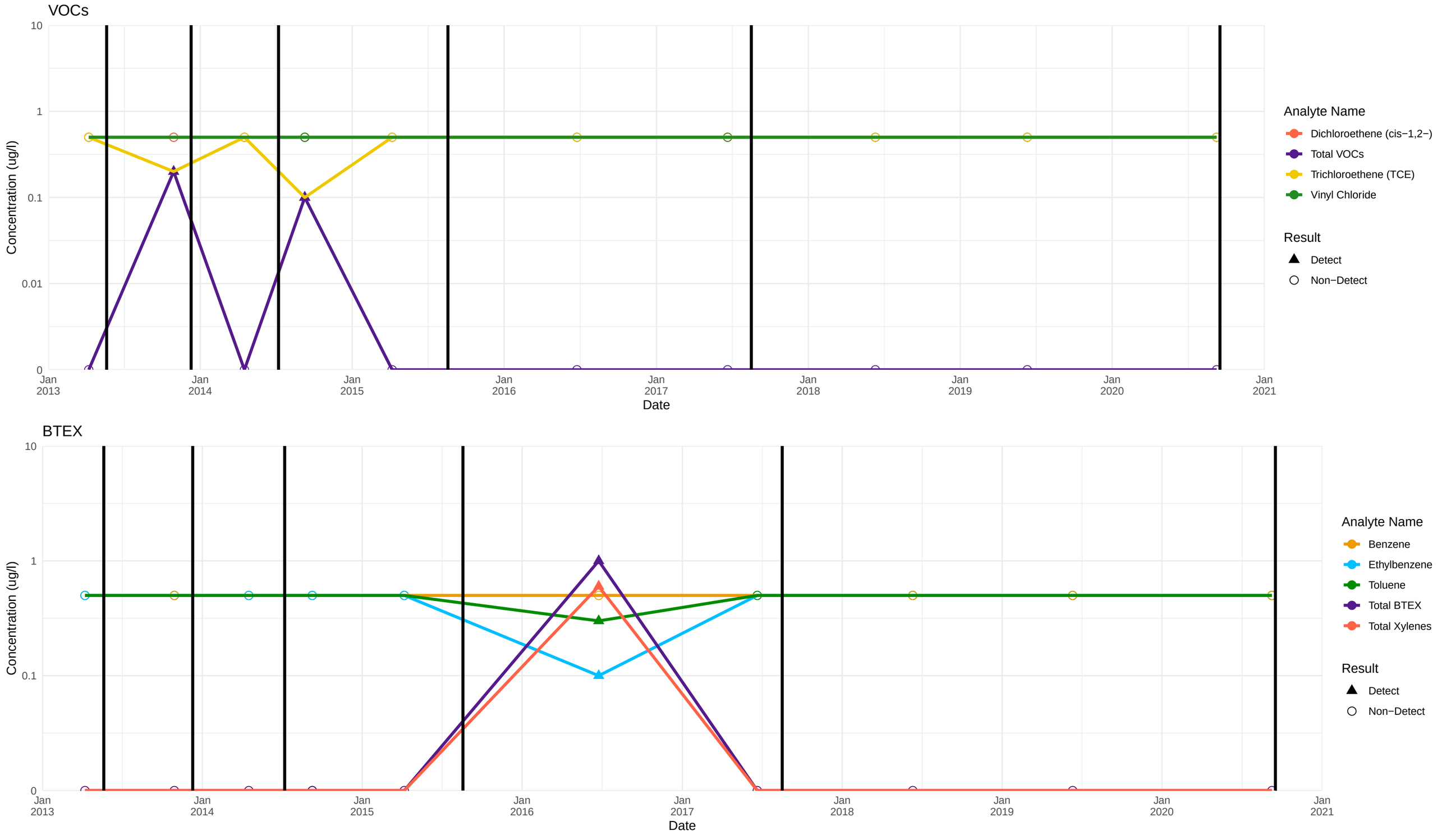
BP−6A

Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.



BP−7A

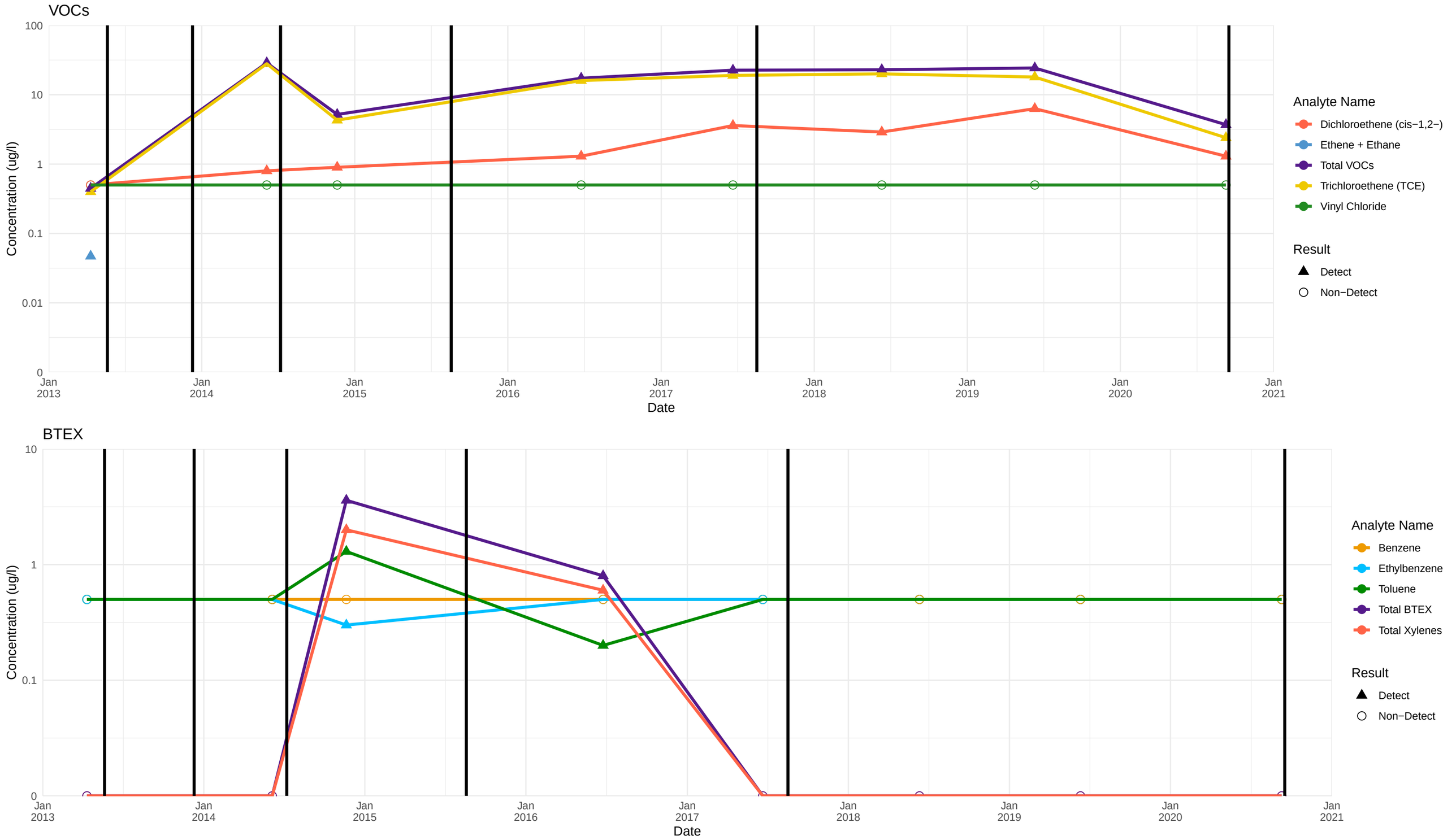
Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.



Sanborn, Head & Associates, Inc.

BP−8A

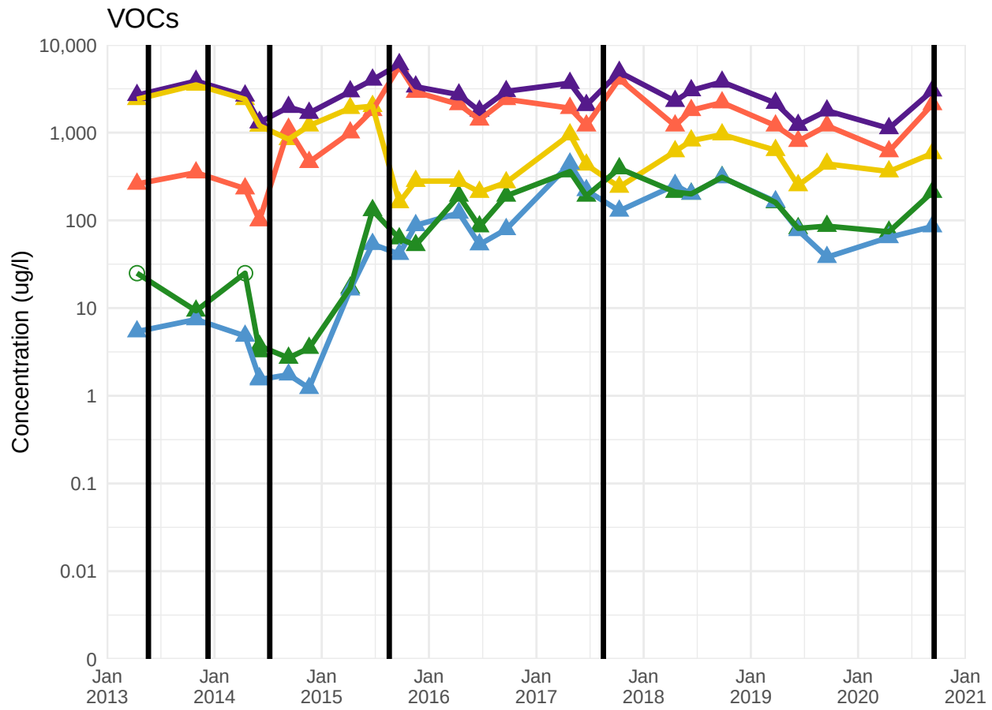
Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.

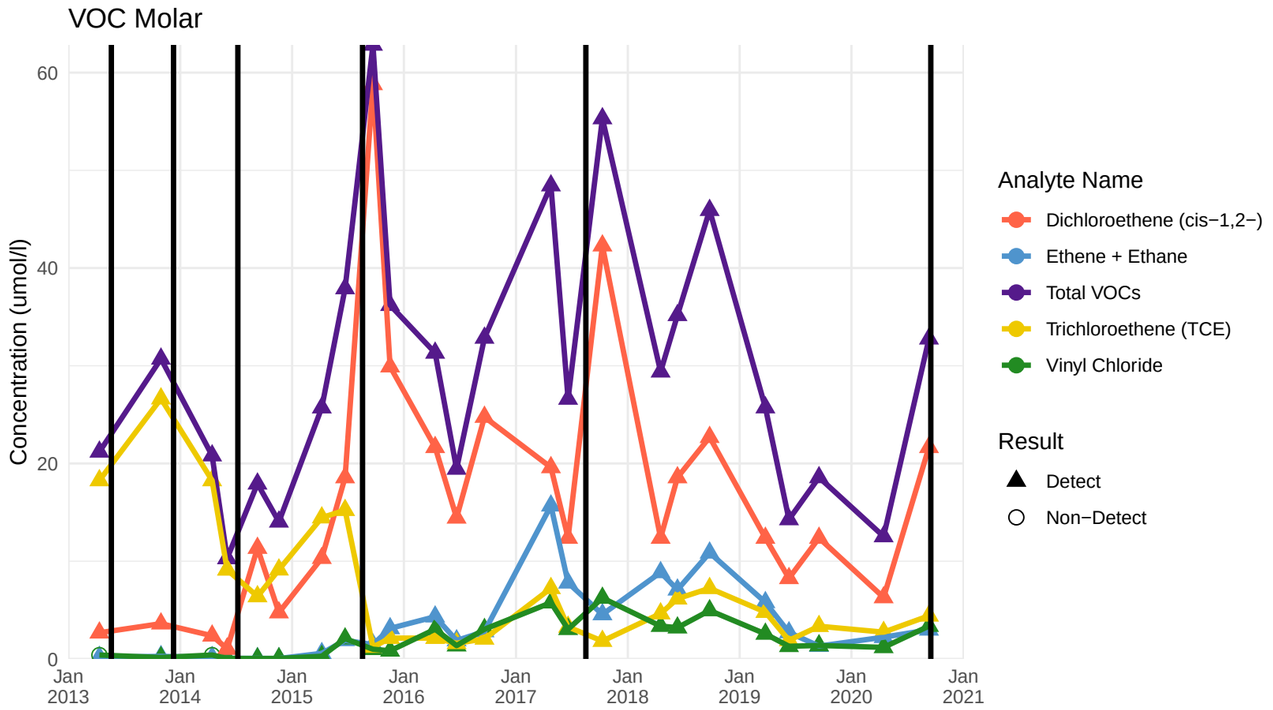


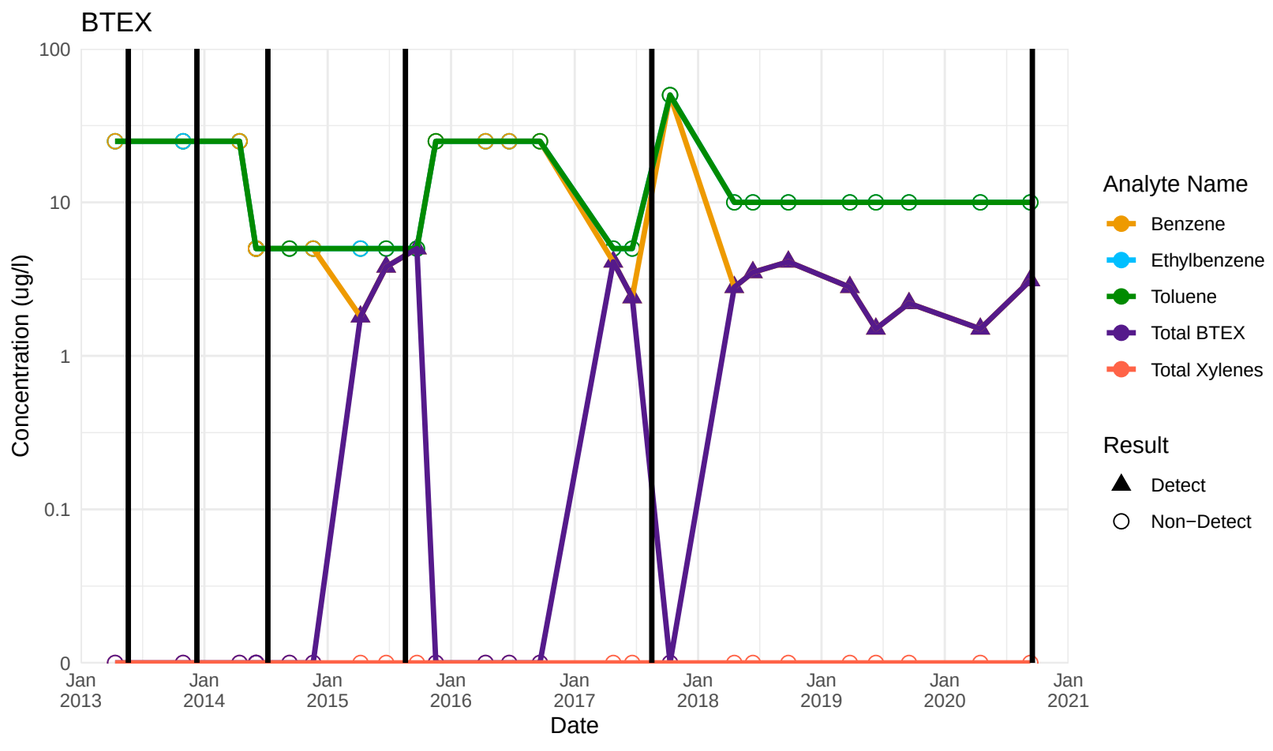
Sanborn, Head & Associates, Inc.

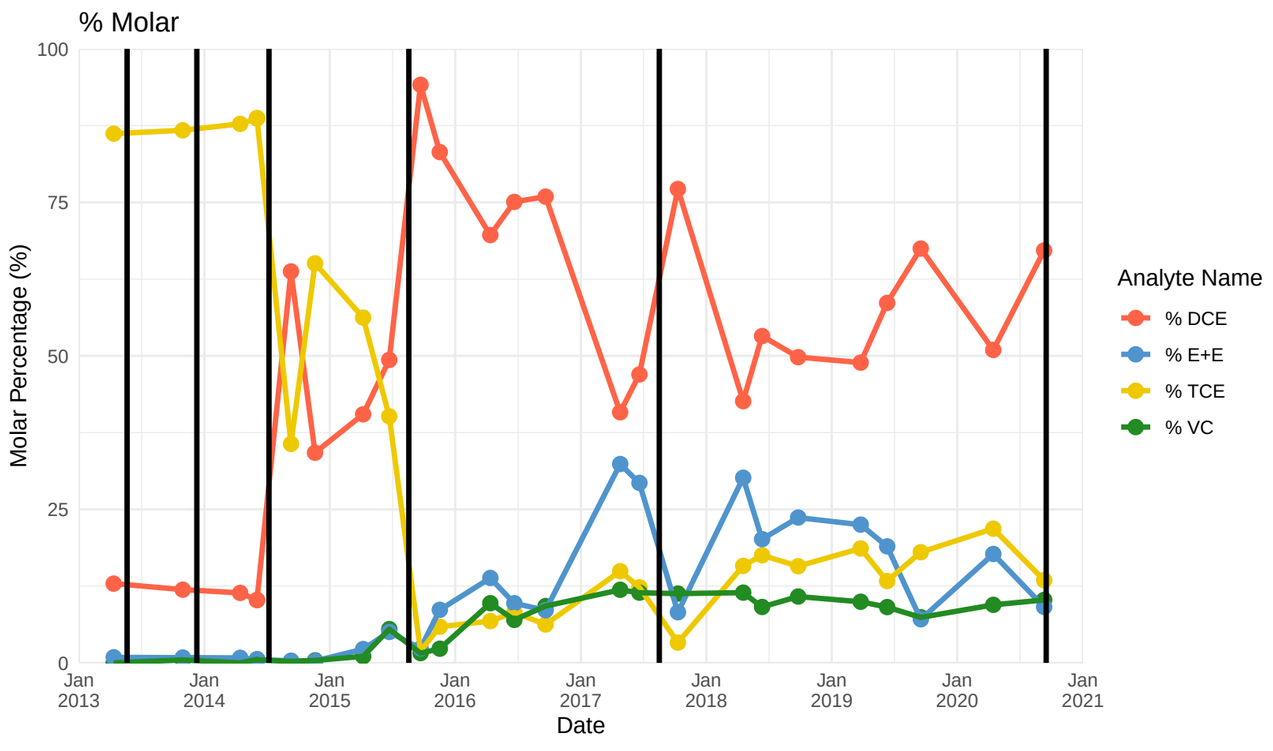
BP−9A

Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.



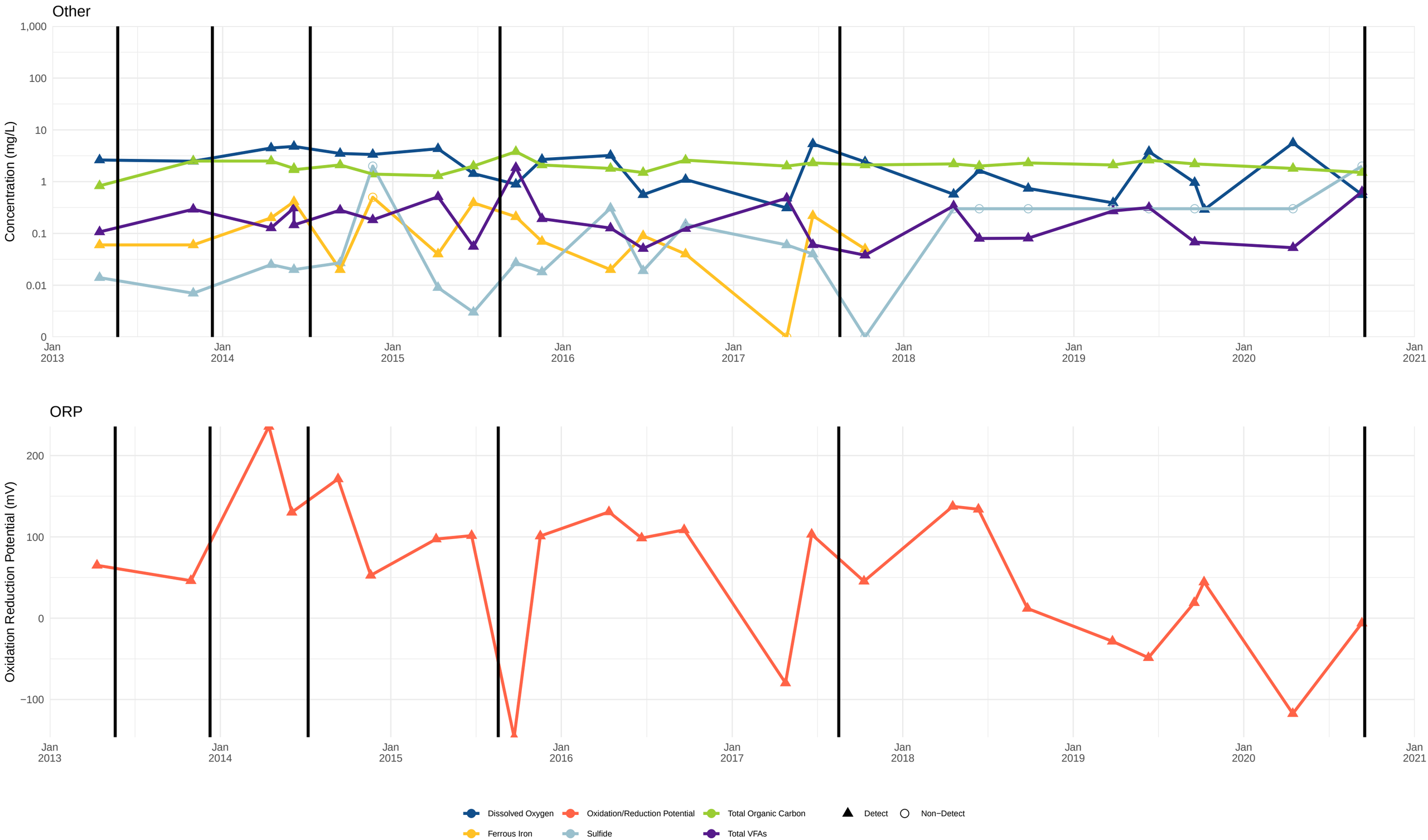






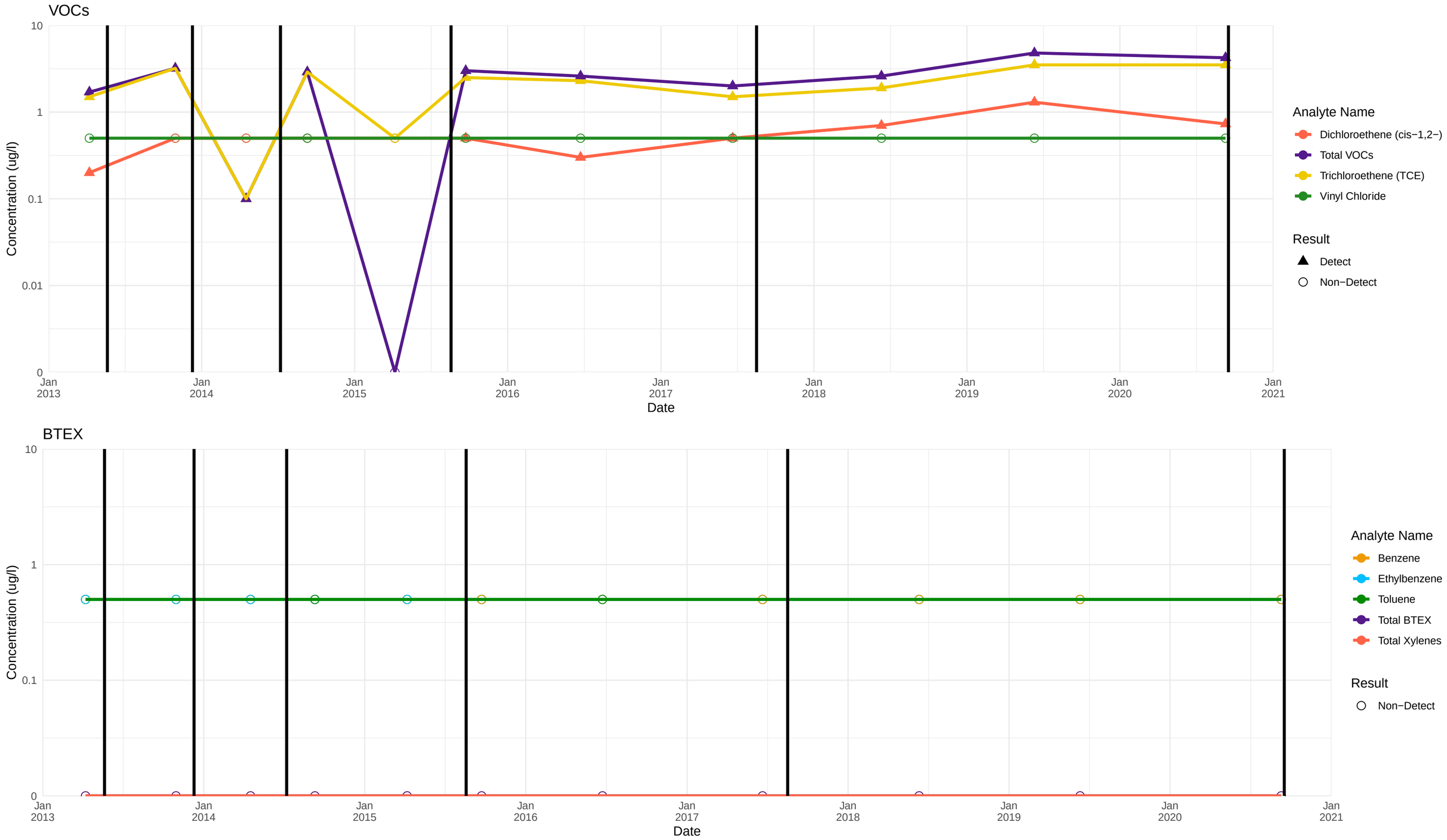
BP−9A

Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.



BP−10A

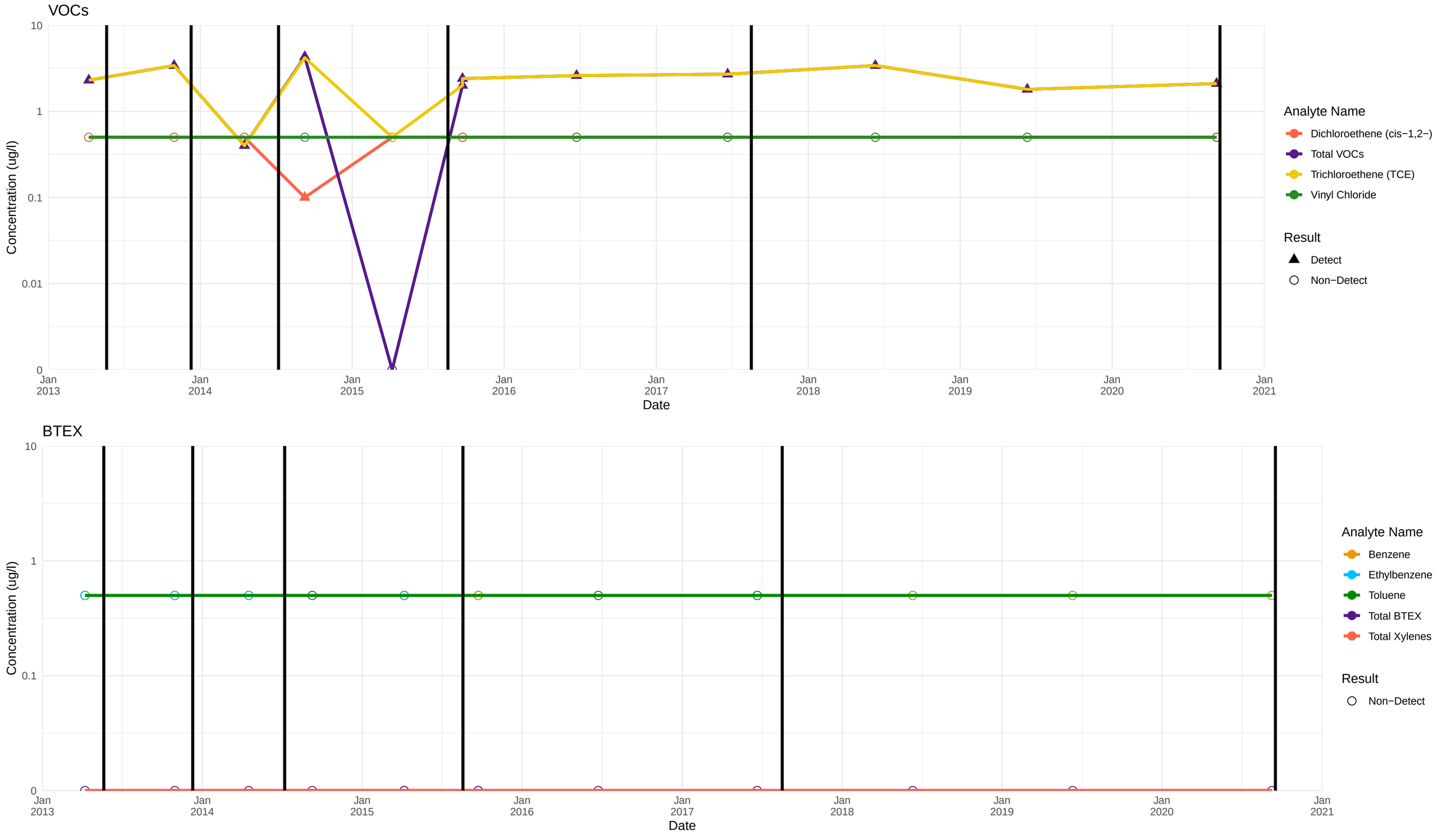
Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.



Sanborn, Head & Associates, Inc.

BP−11A

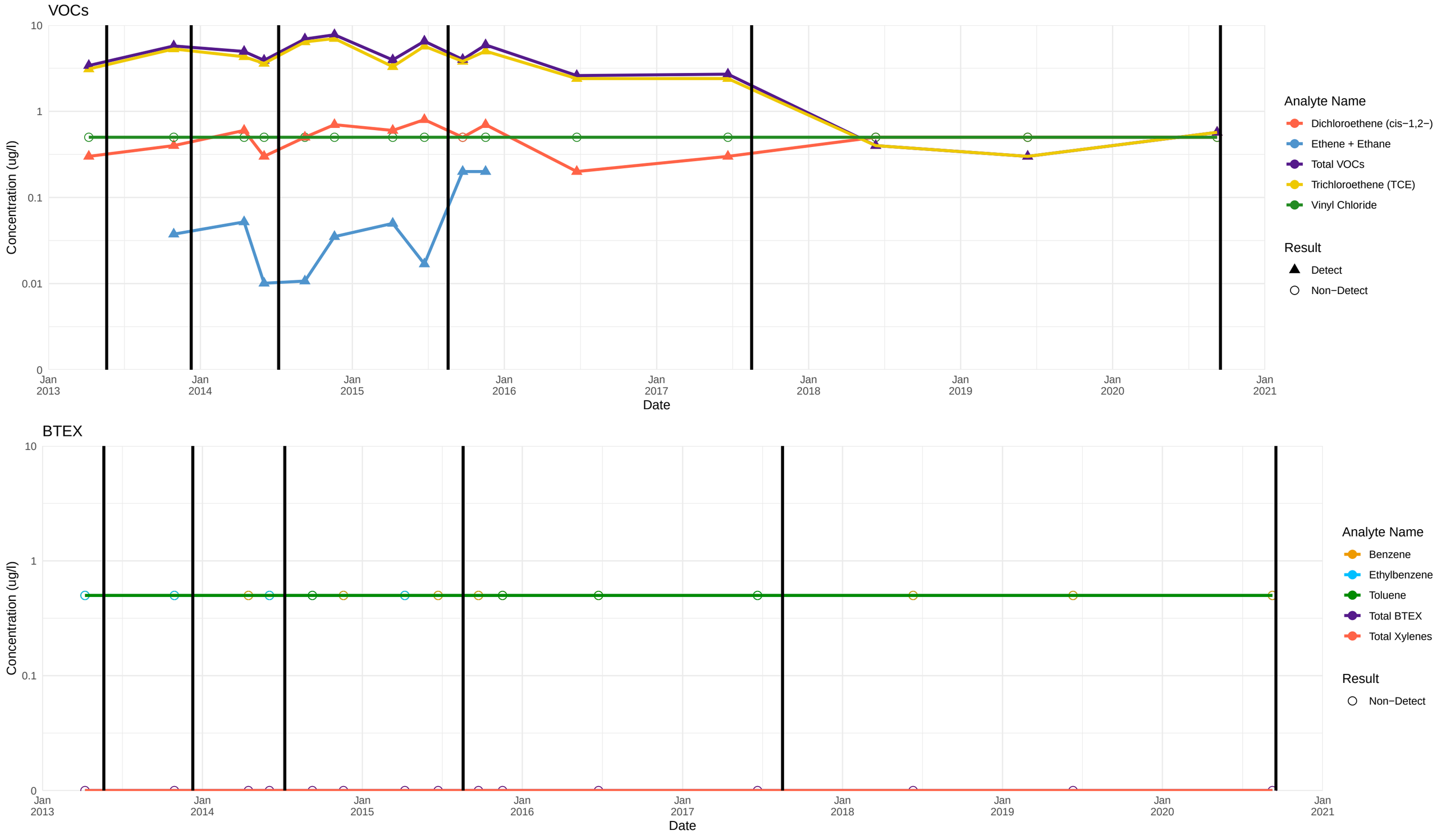
Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.



Sanborn, Head & Associates, Inc.

BP−12A

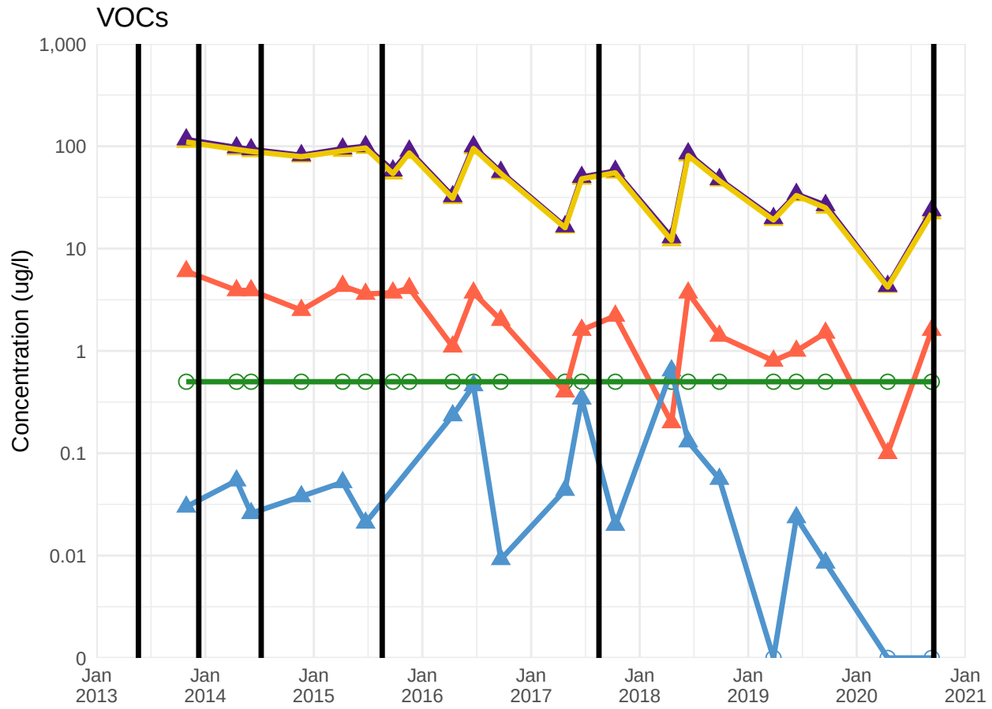
Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.

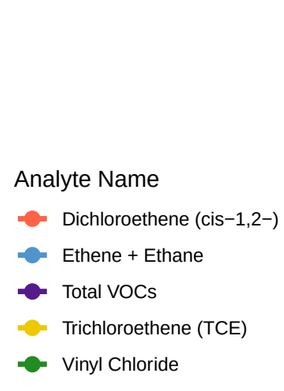


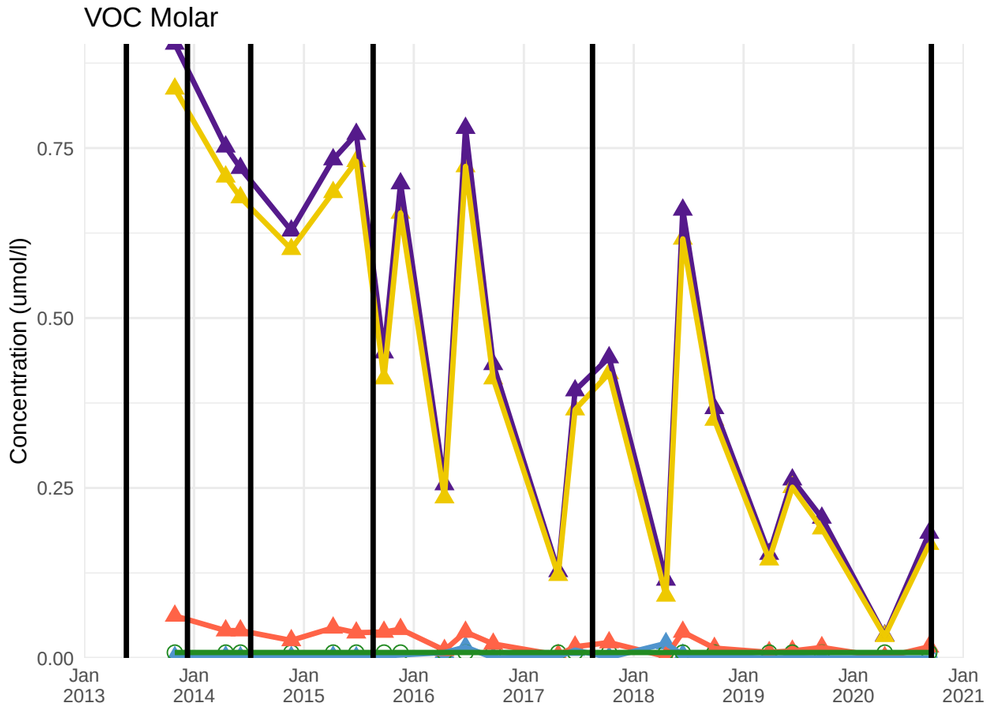
Sanborn, Head & Associates, Inc.

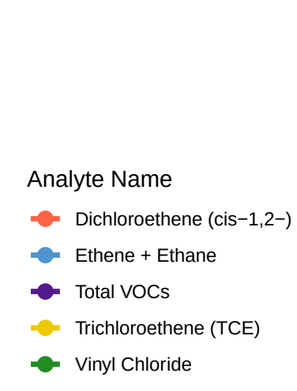
BP−13A

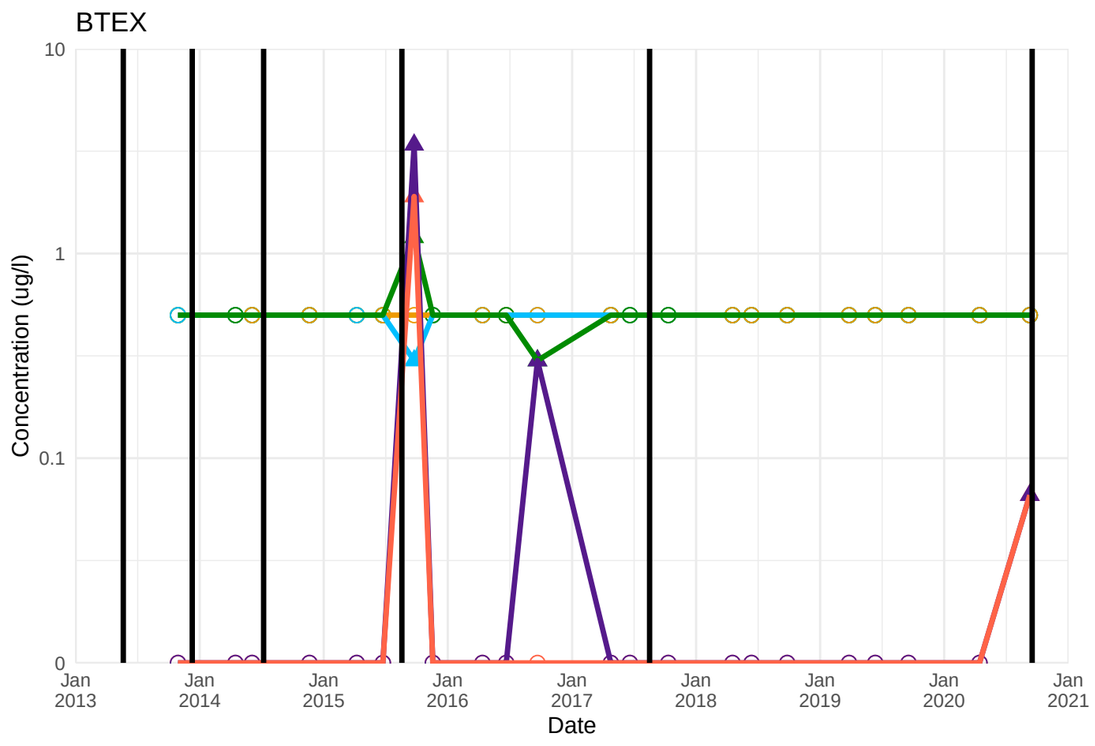
Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.

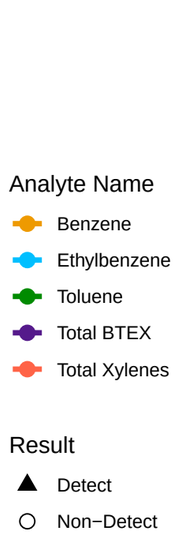


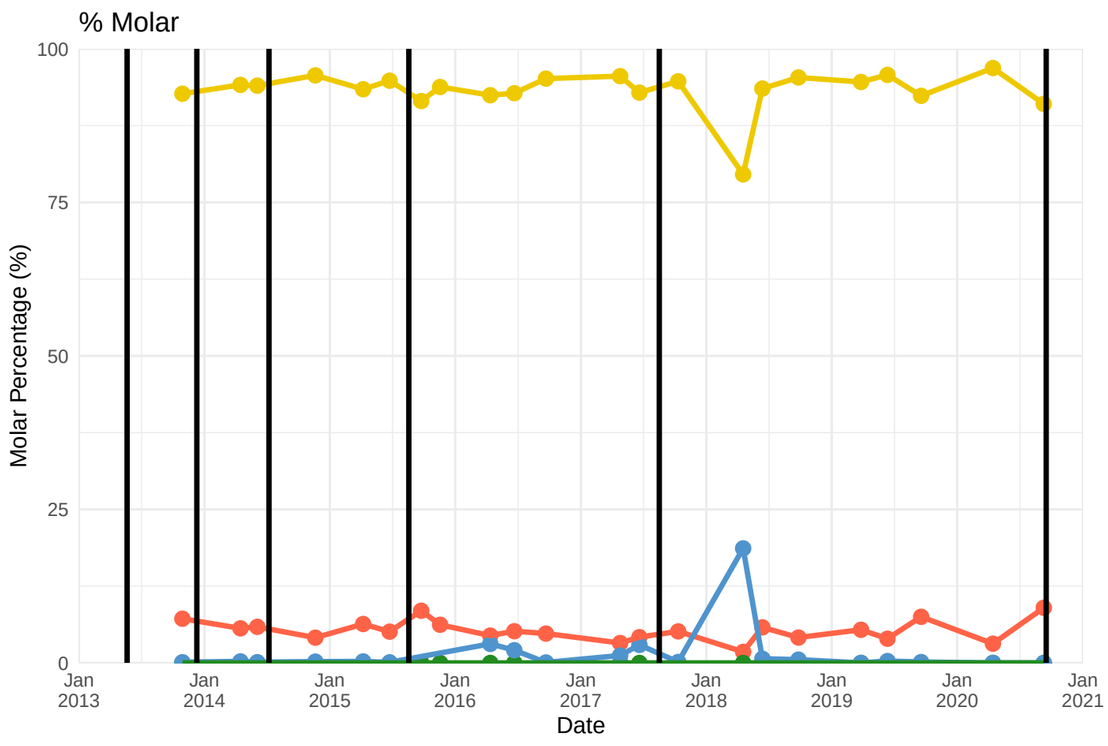


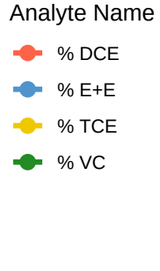








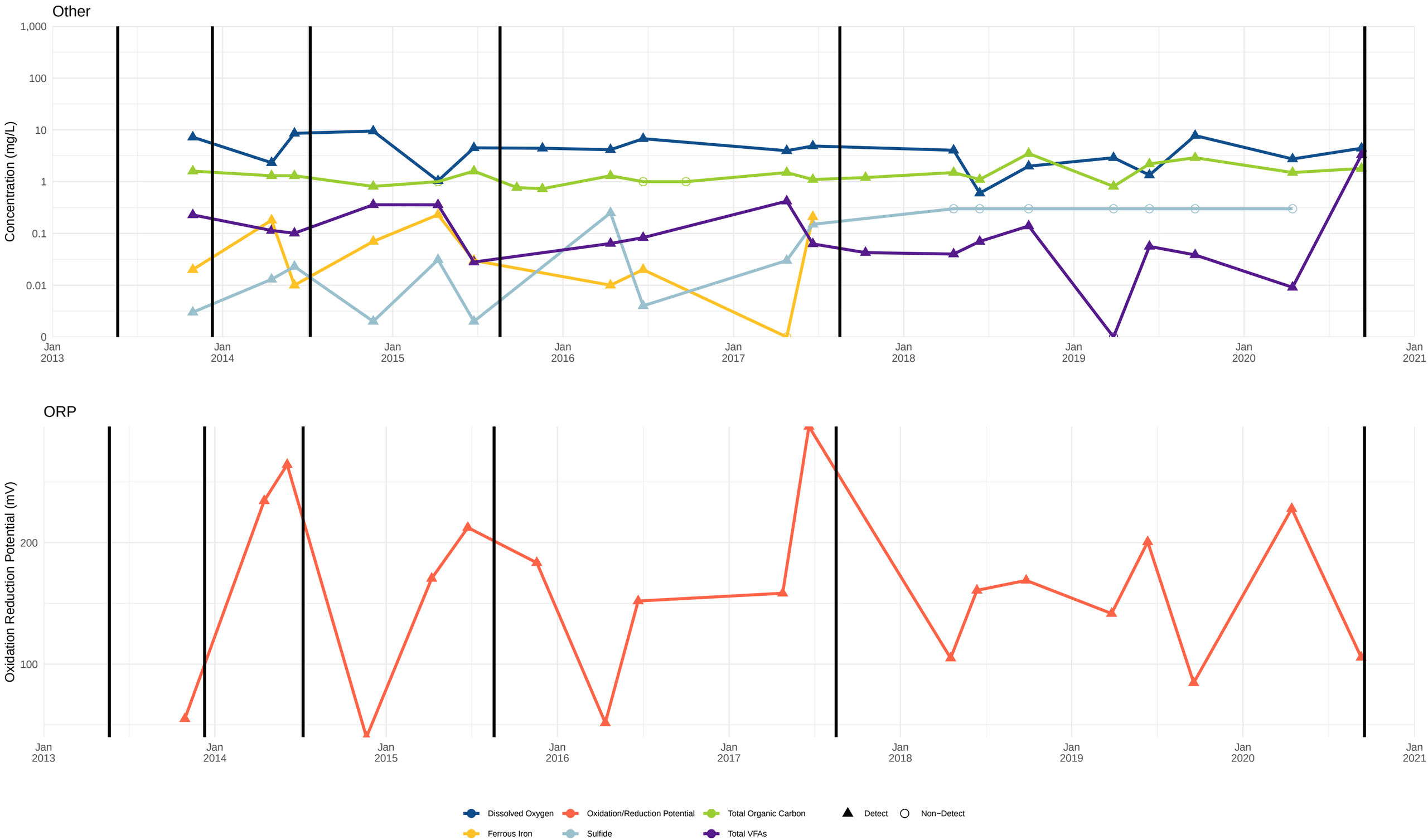




Sanborn, Head & Associates, Inc.

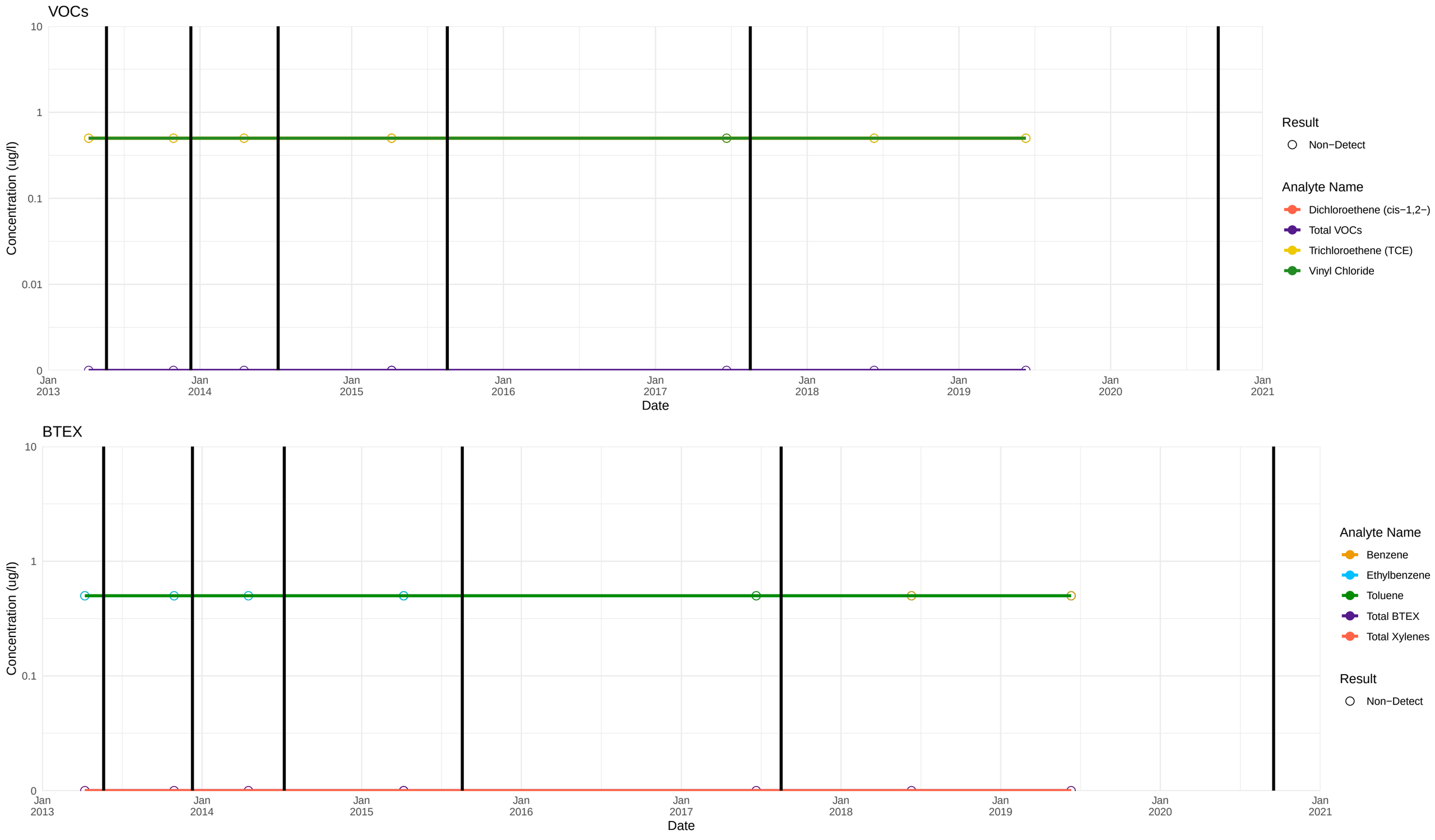
BP−13A

Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.



BP−16A

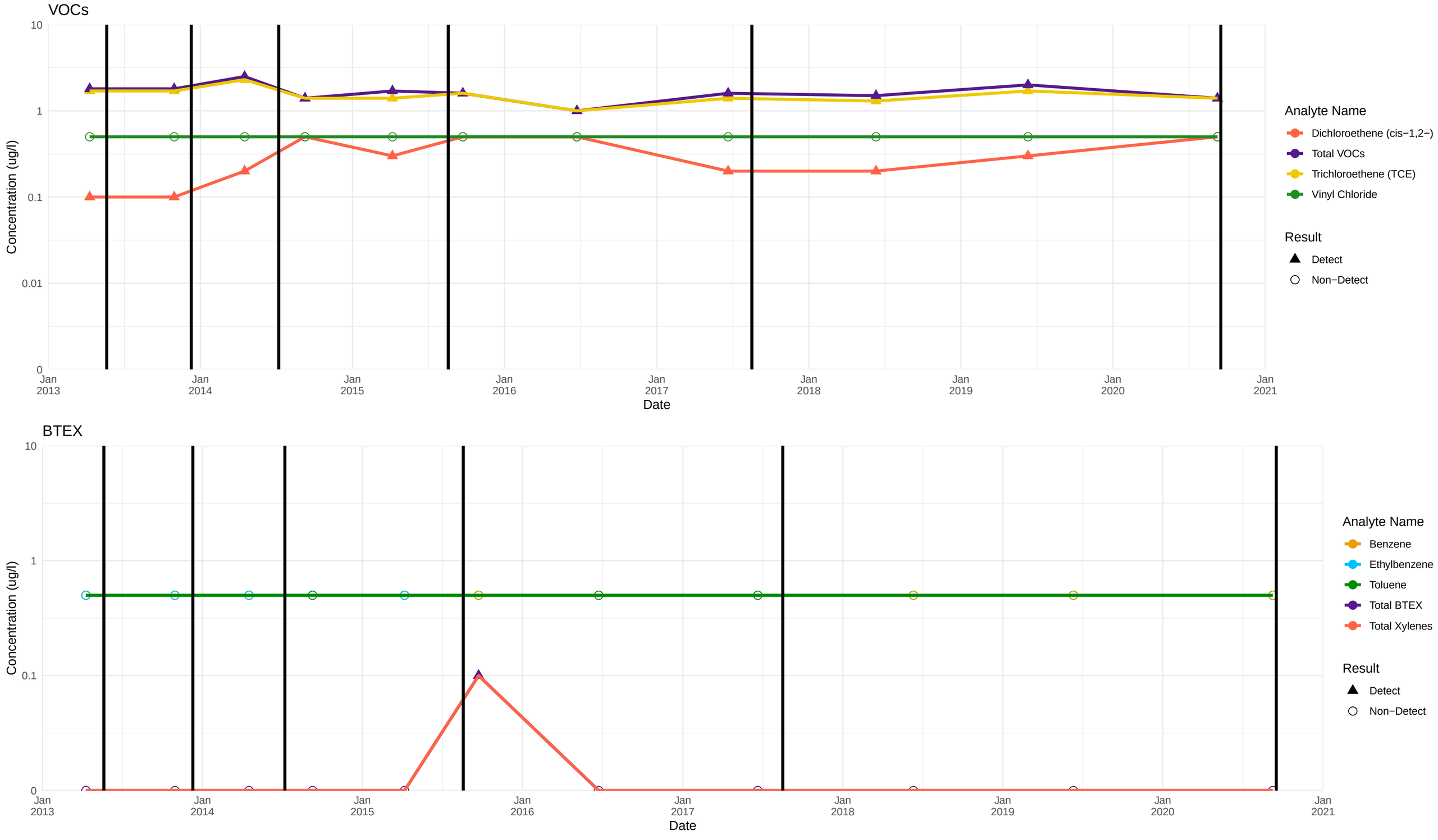
Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.



Sanborn, Head & Associates, Inc.

BP−17A

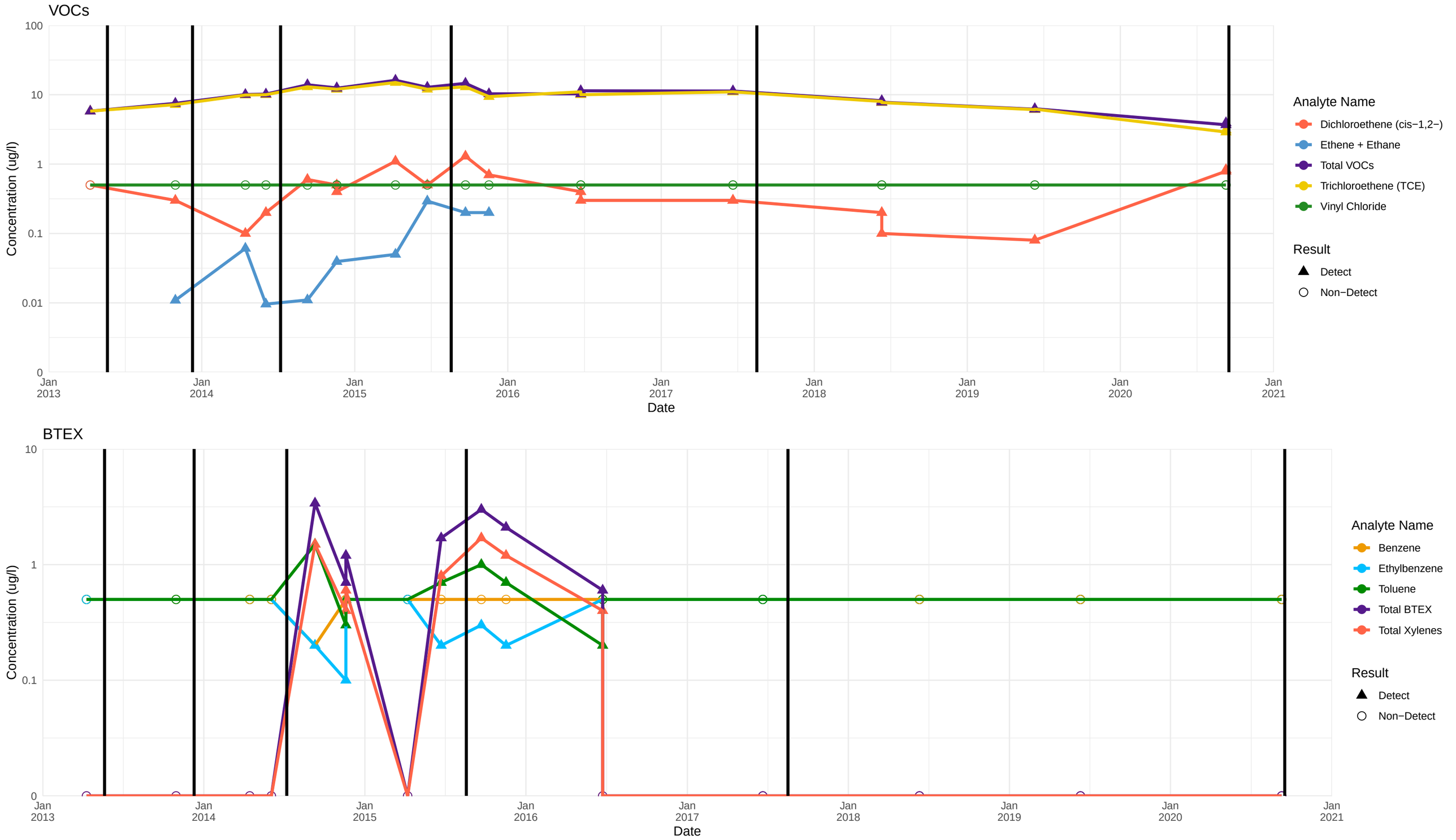
Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.



Sanborn, Head & Associates, Inc.

BP−18A

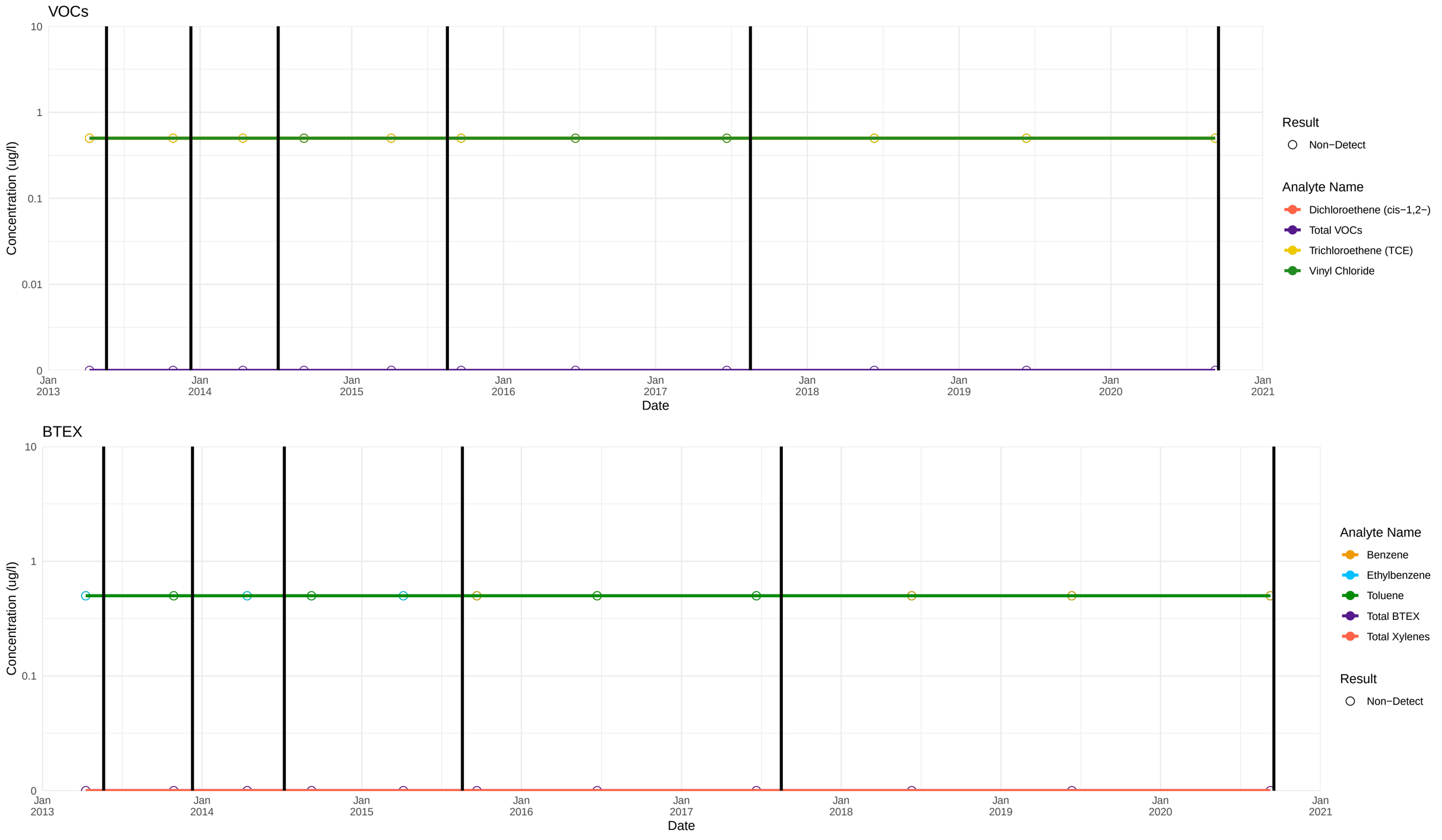
Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.



Sanborn, Head & Associates, Inc.

BP−19A

Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.



Sanborn, Head & Associates, Inc.

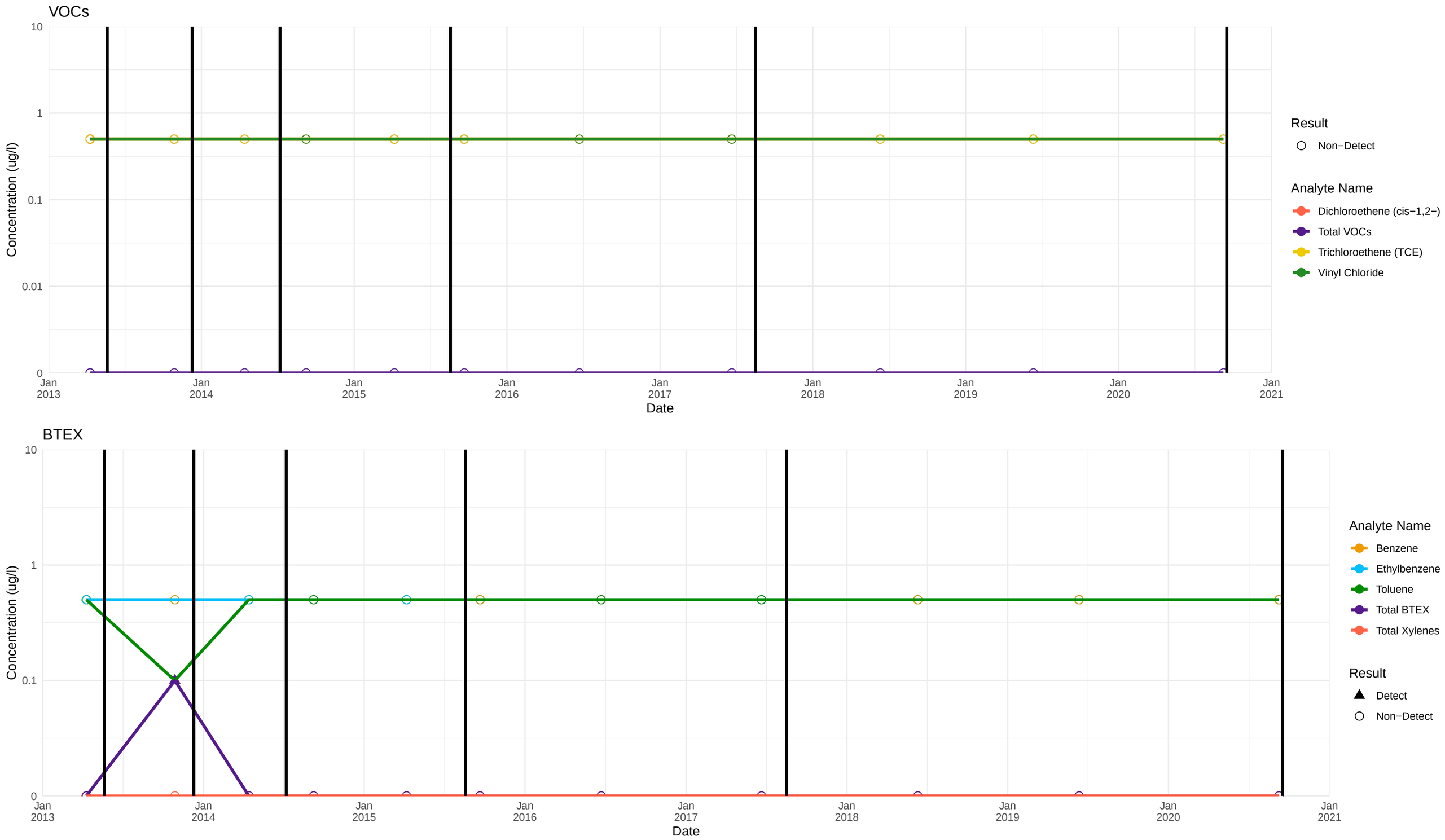
BP−20A

Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.

Sanborn, Head & Associates, Inc.

BP−21A

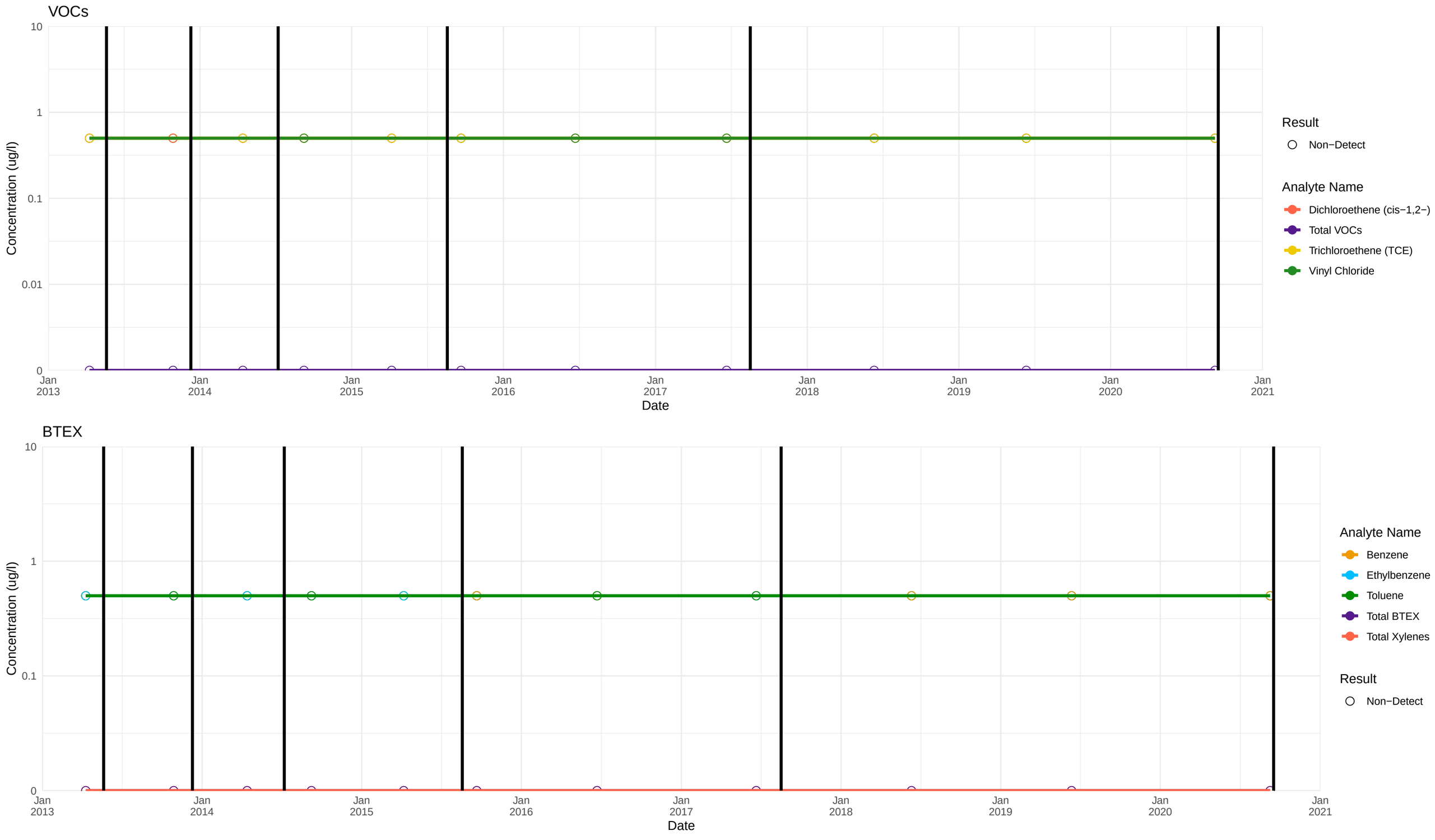
Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.



Sanborn, Head & Associates, Inc.

BP−22A

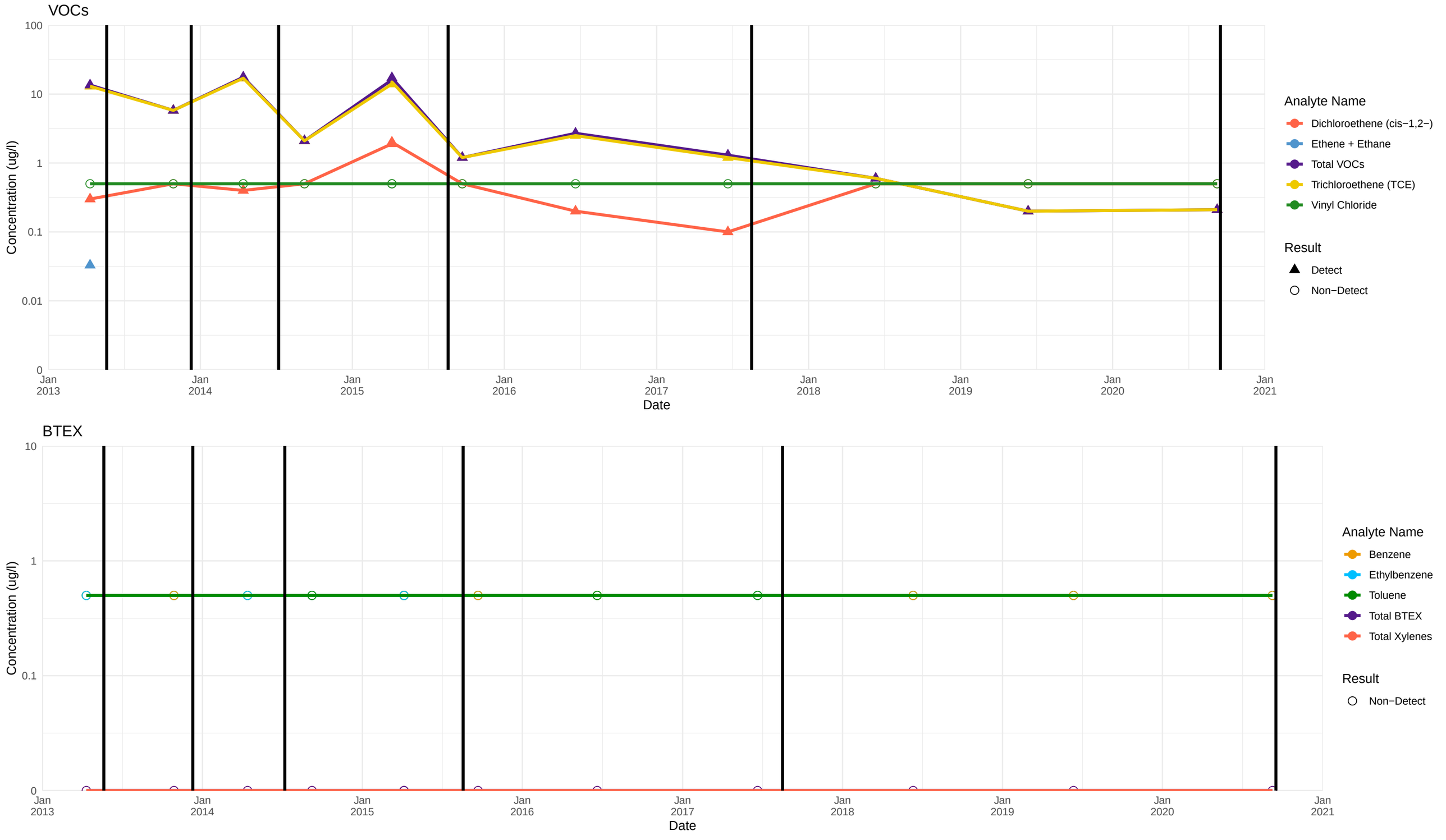
Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.



Sanborn, Head & Associates, Inc.

BP−23A

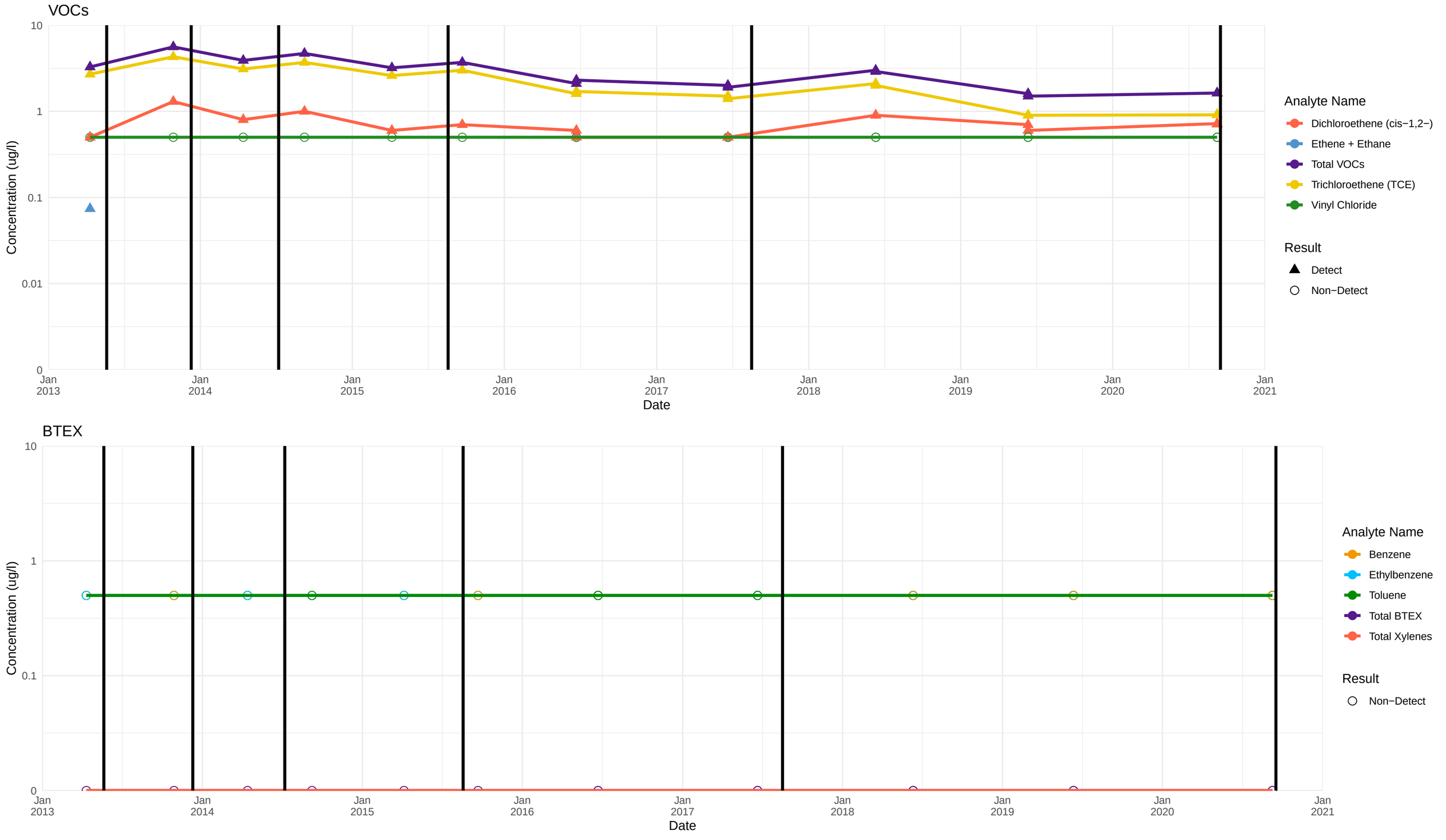
Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.



Sanborn, Head & Associates, Inc.

BP−24A

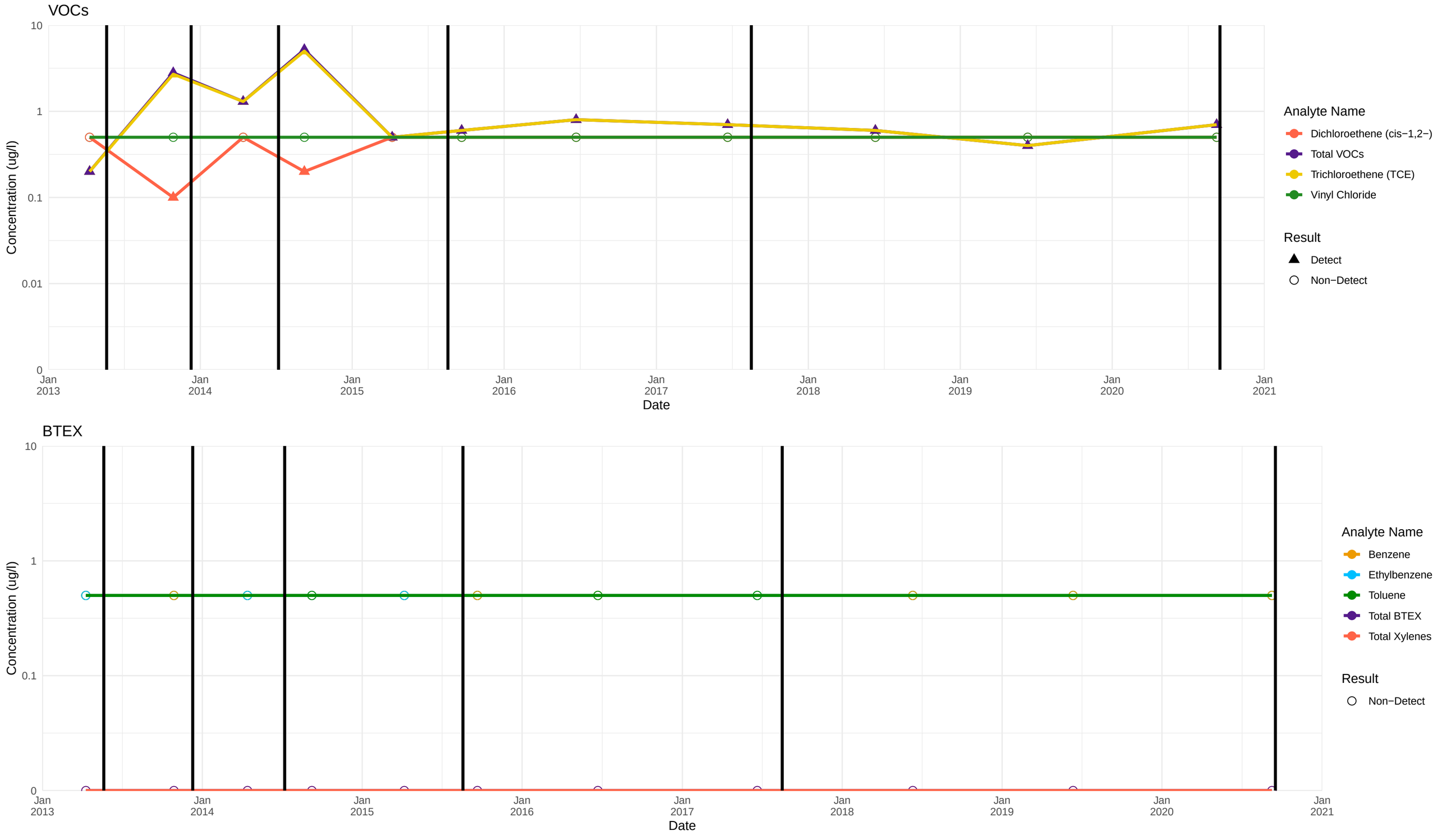
Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.



Sanborn, Head & Associates, Inc.

BP−25A

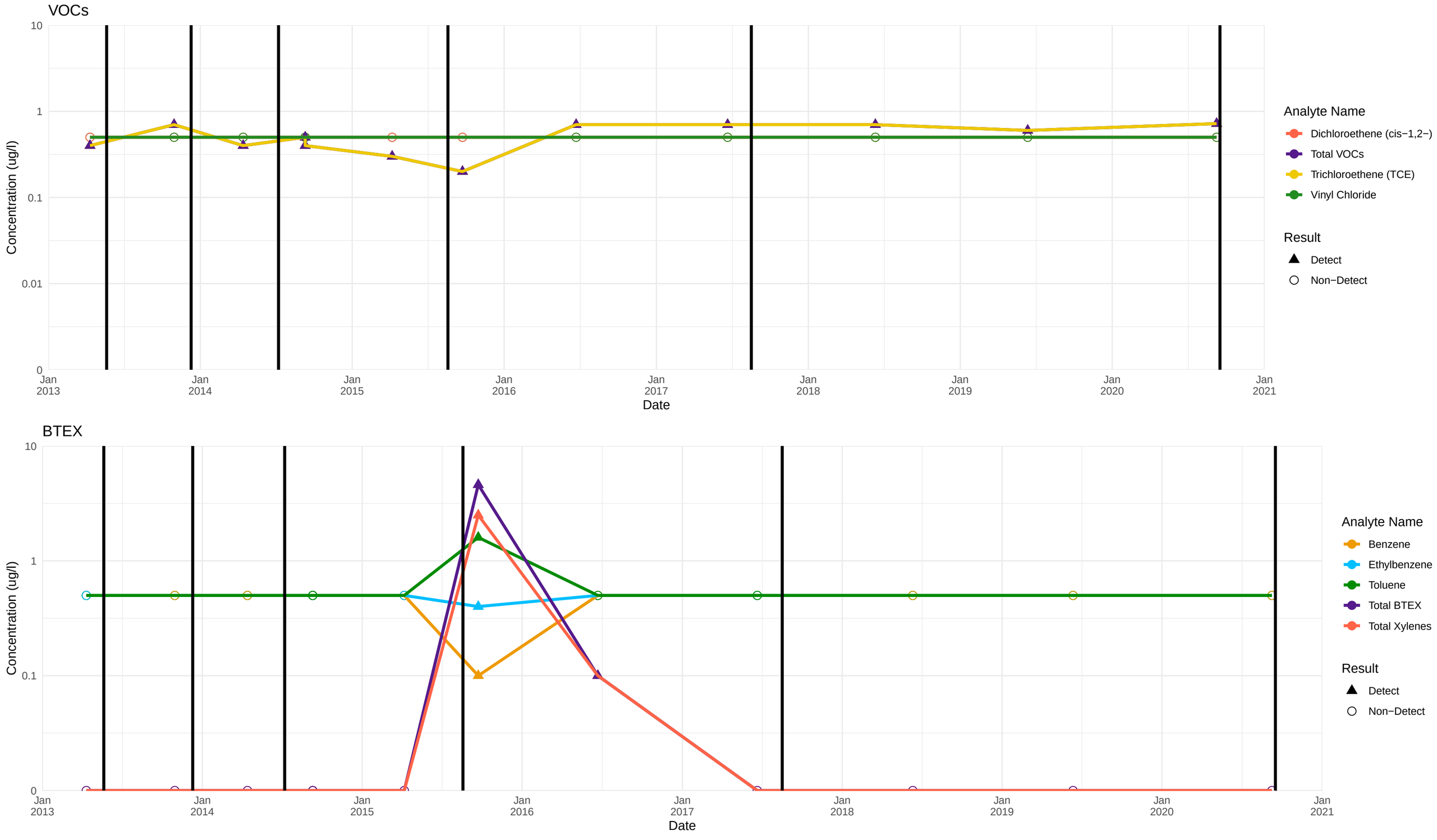
Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.



Sanborn, Head & Associates, Inc.

BP−26A

Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.



Sanborn, Head & Associates, Inc.

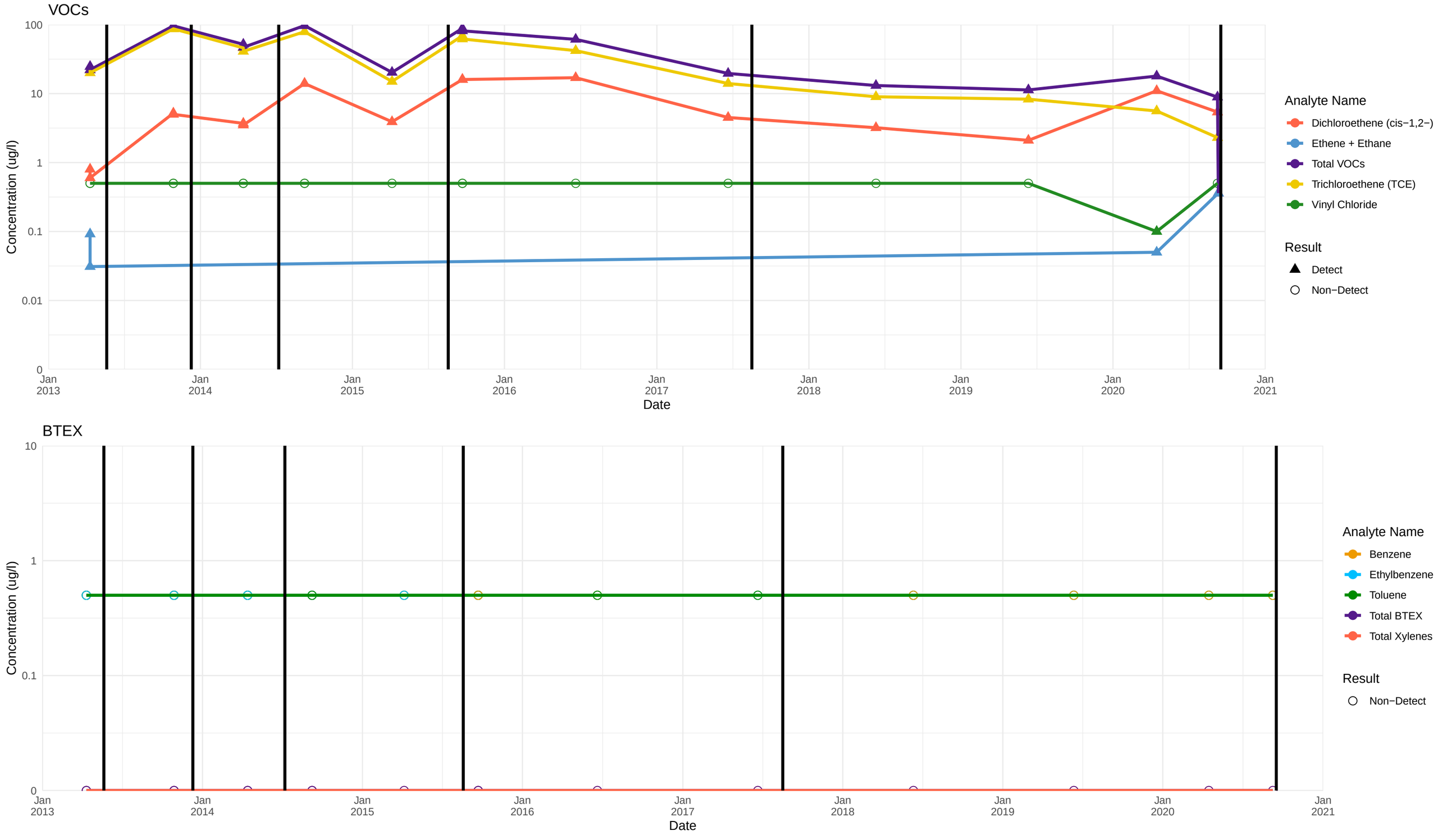
BP−27A

Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.

Sanborn, Head & Associates, Inc.

BP−30A

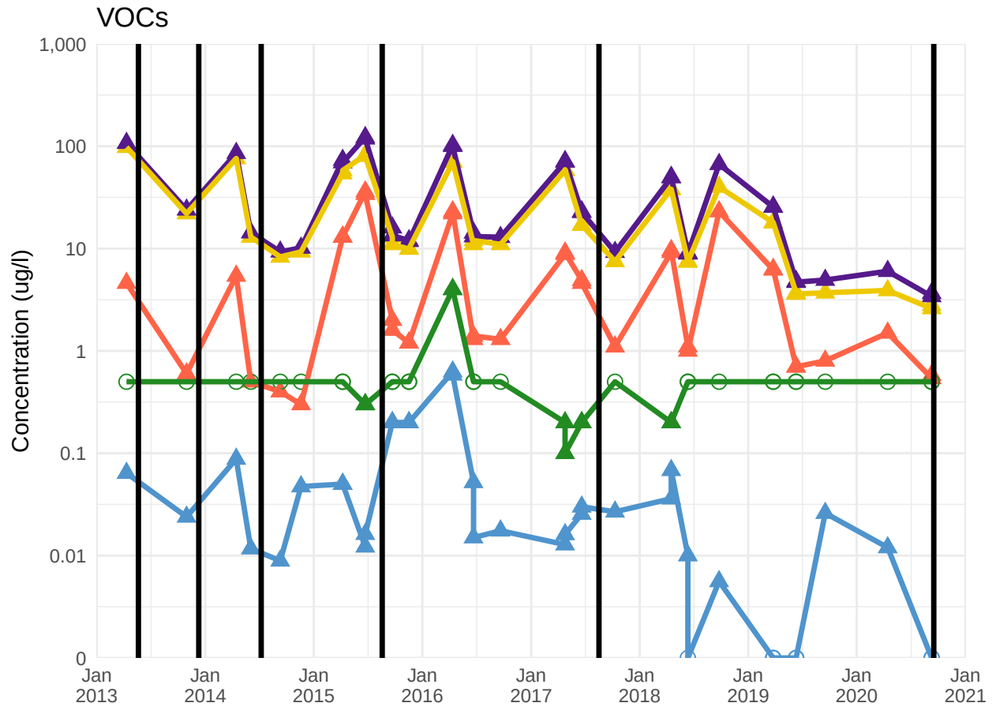
Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.

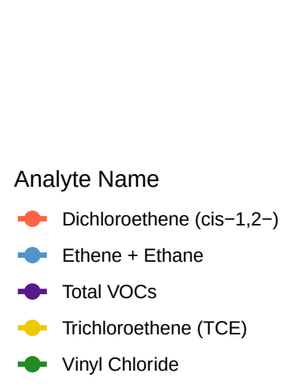


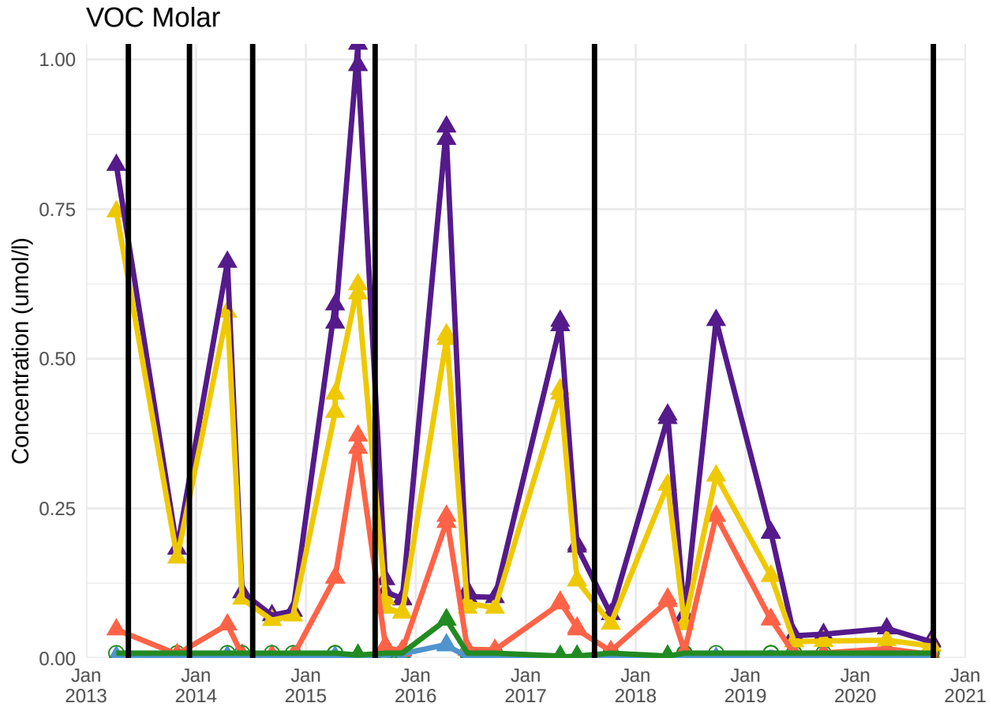
Sanborn, Head & Associates, Inc.

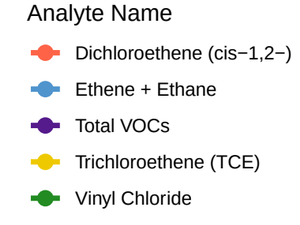
BP−31A

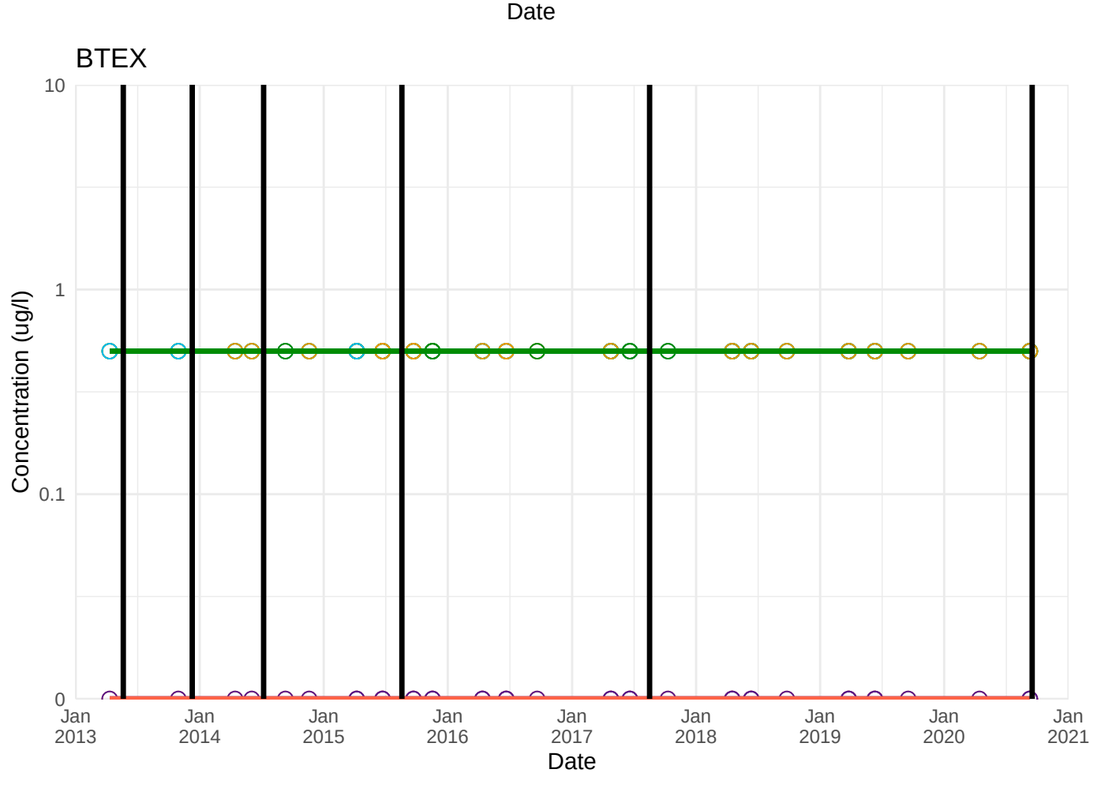
Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.

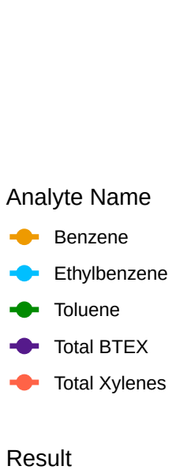


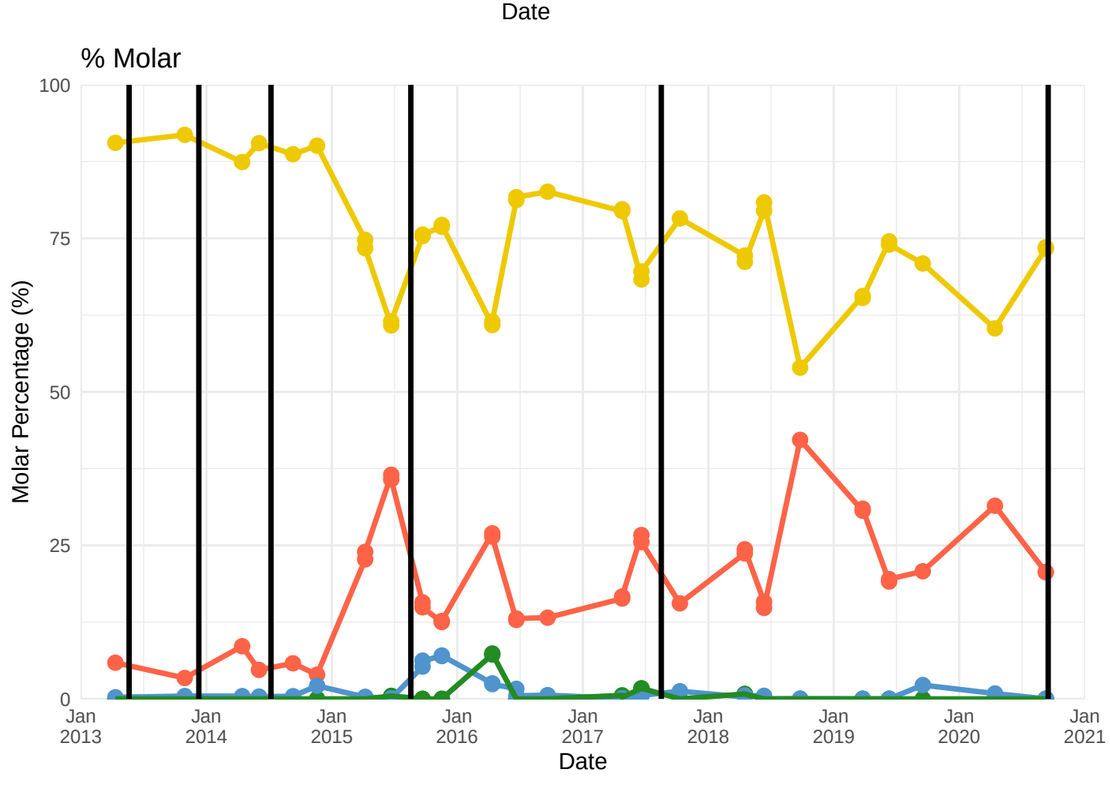


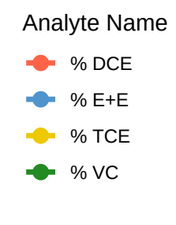








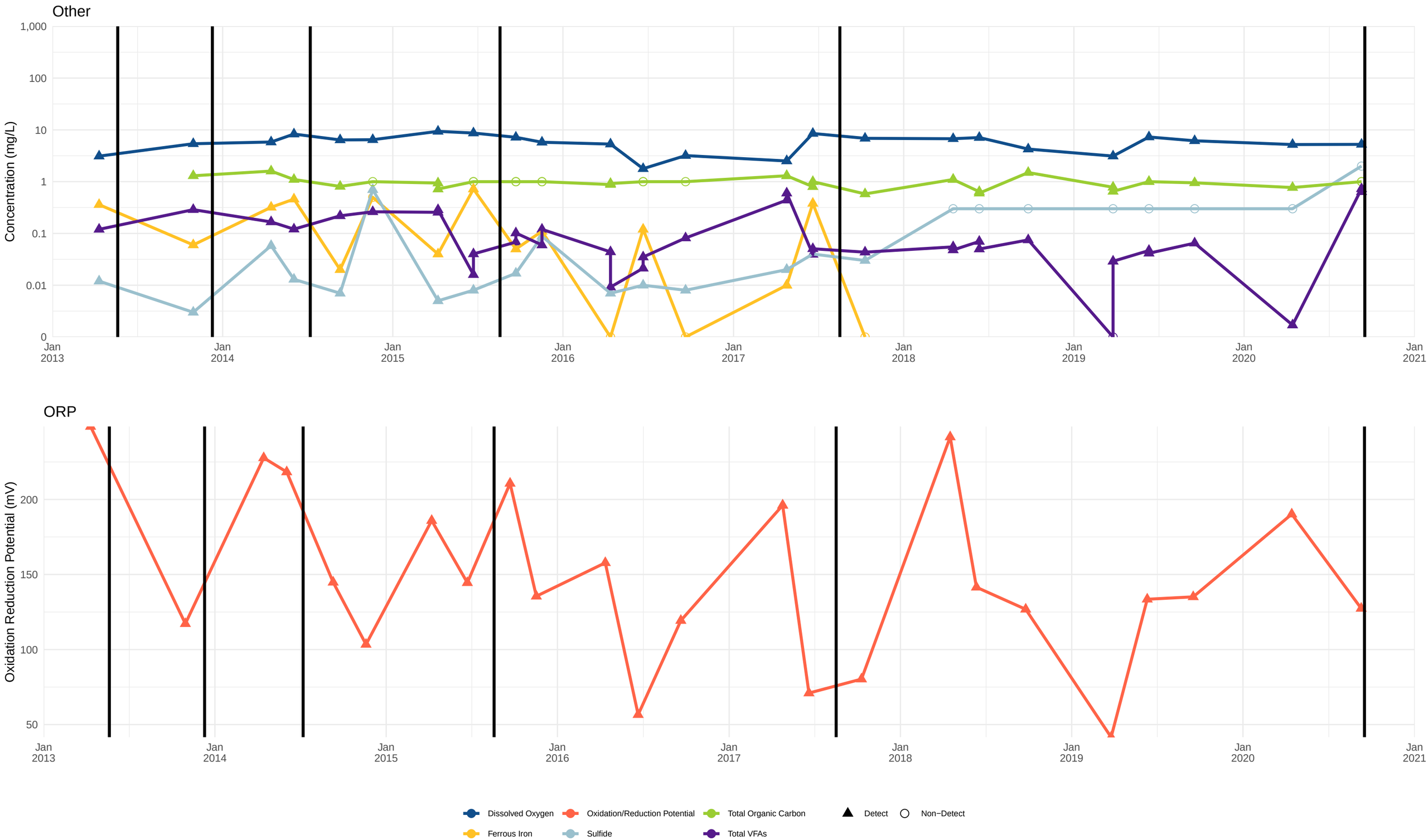




Sanborn, Head & Associates, Inc.

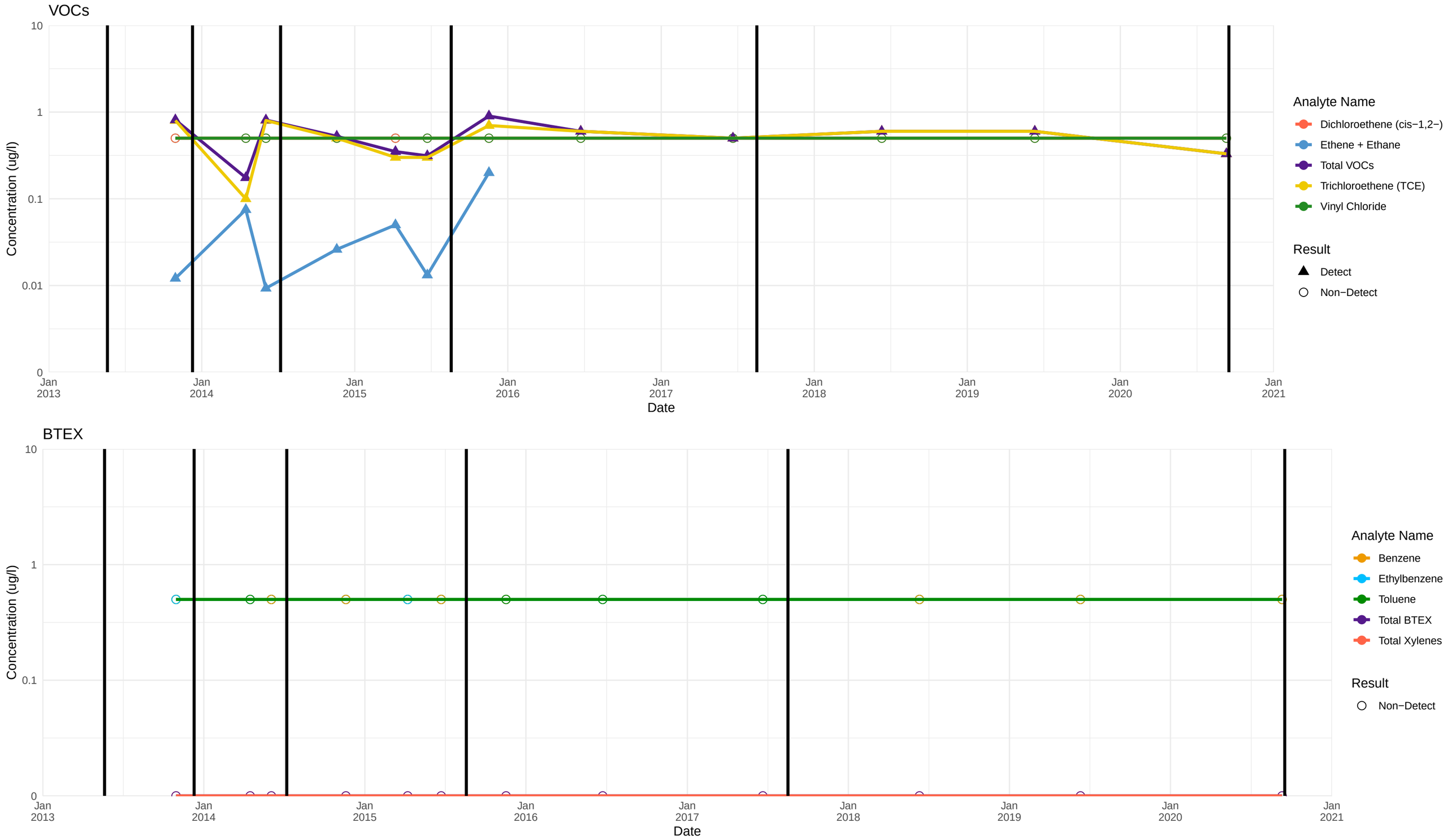
BP−31A

Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.



BP−32A

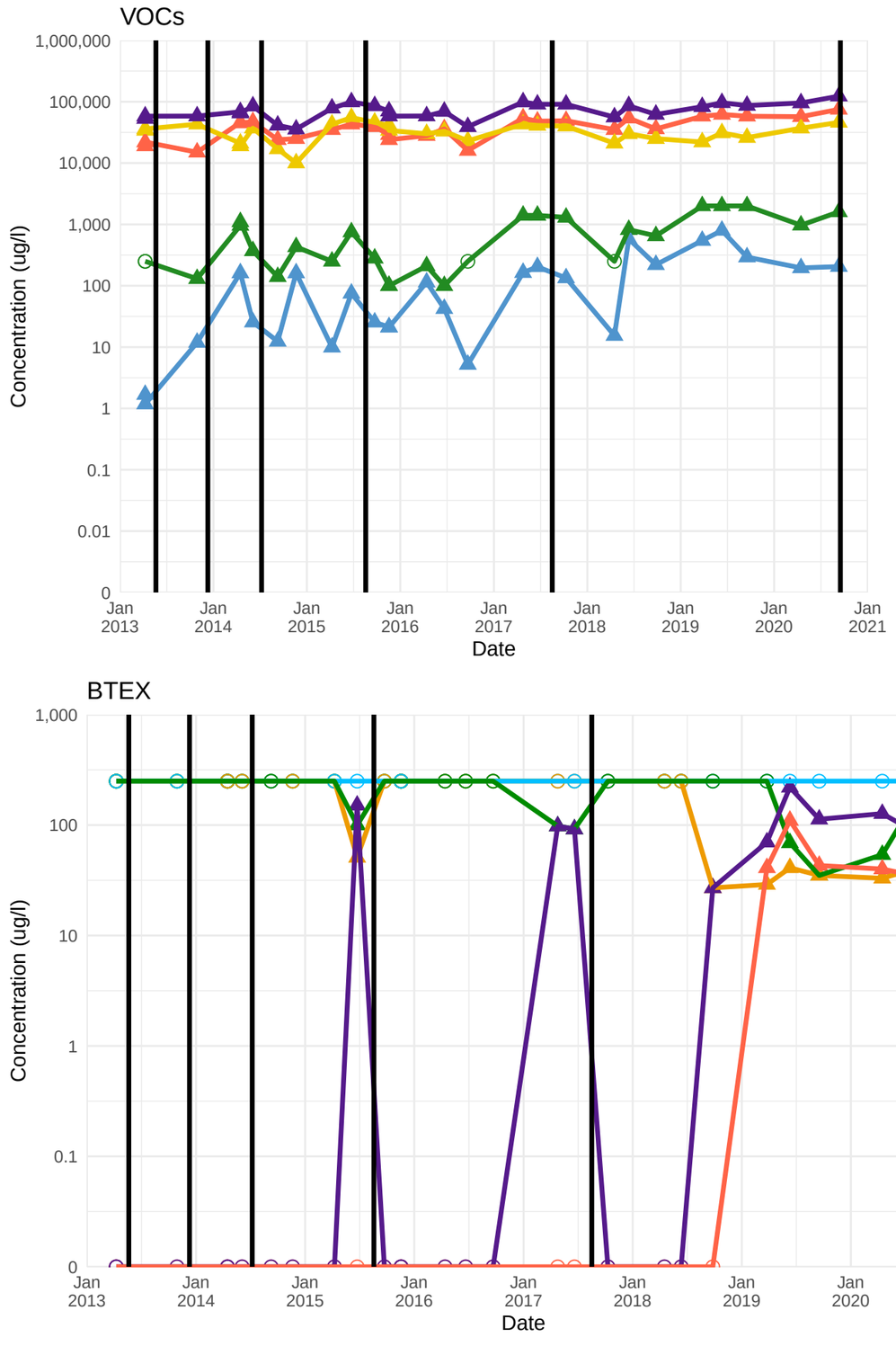
Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.

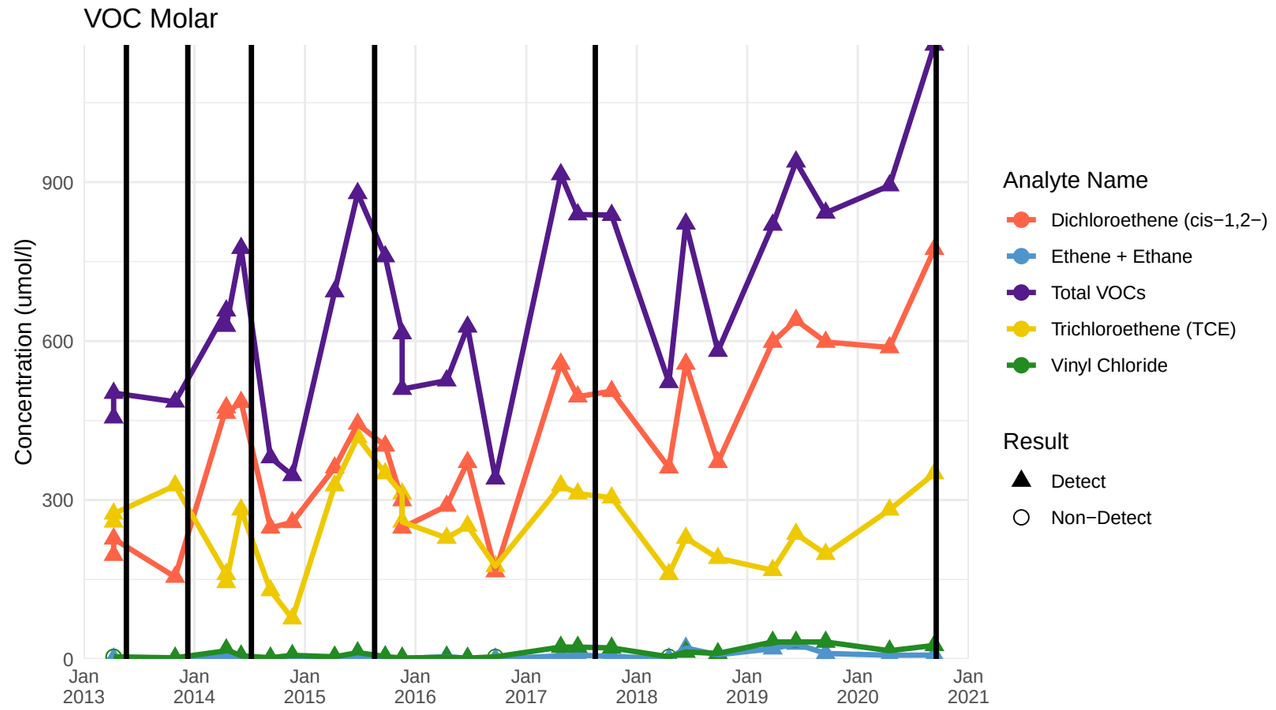


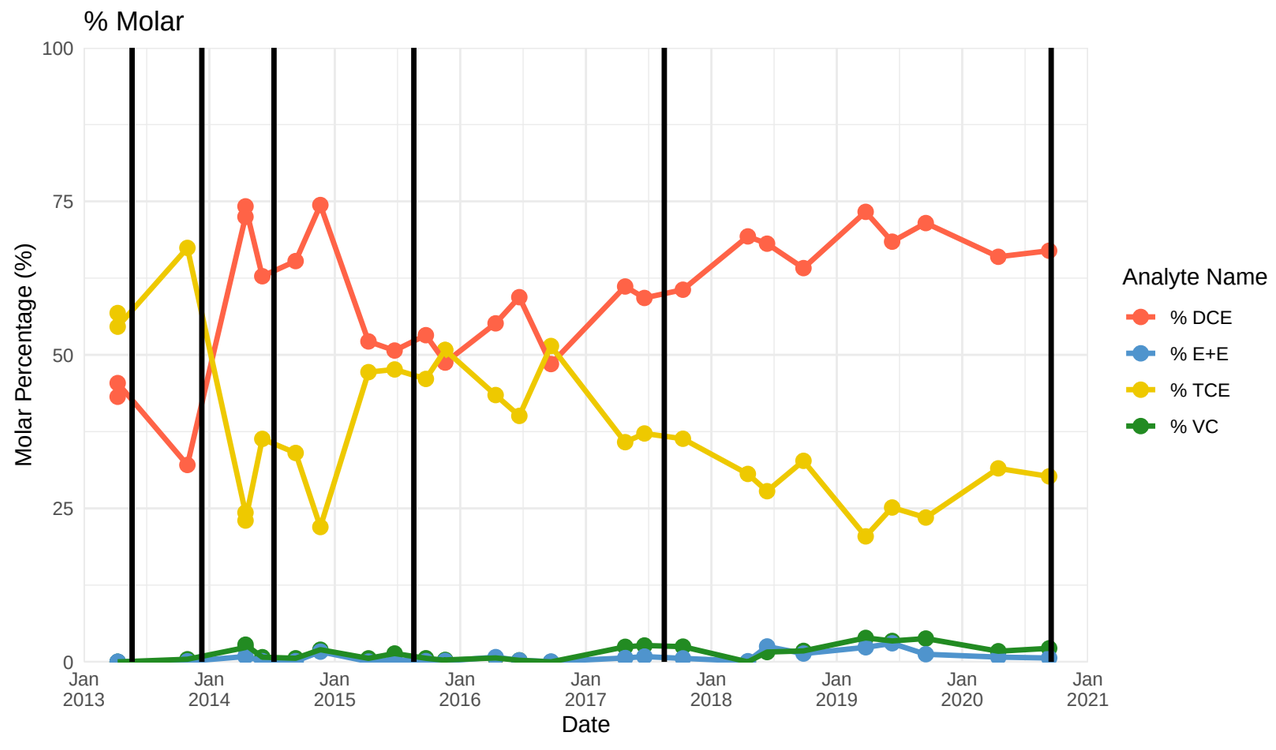
Sanborn, Head & Associates, Inc.

BP−34A

Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.

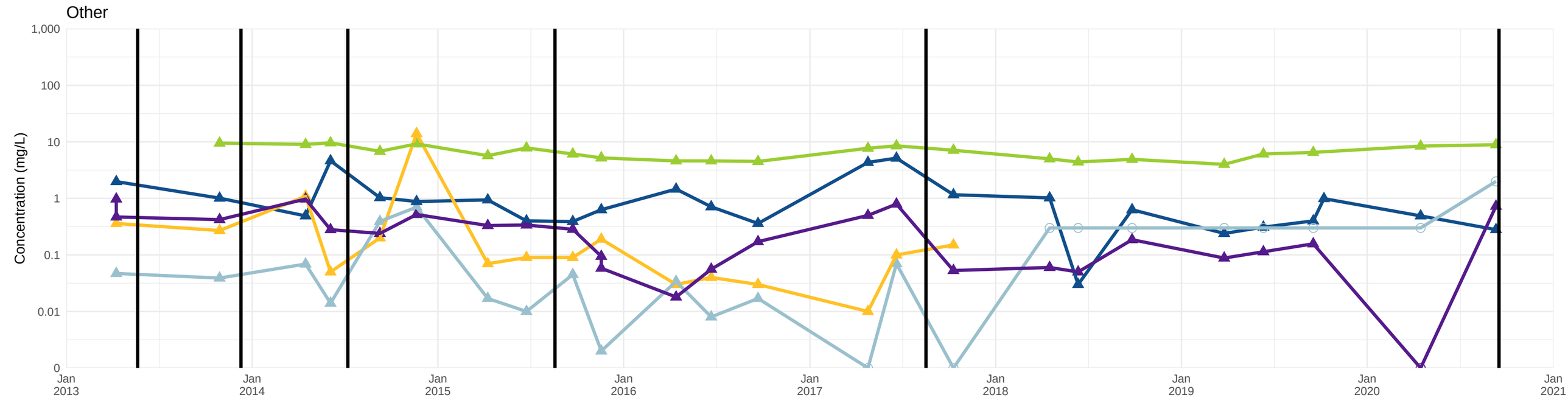


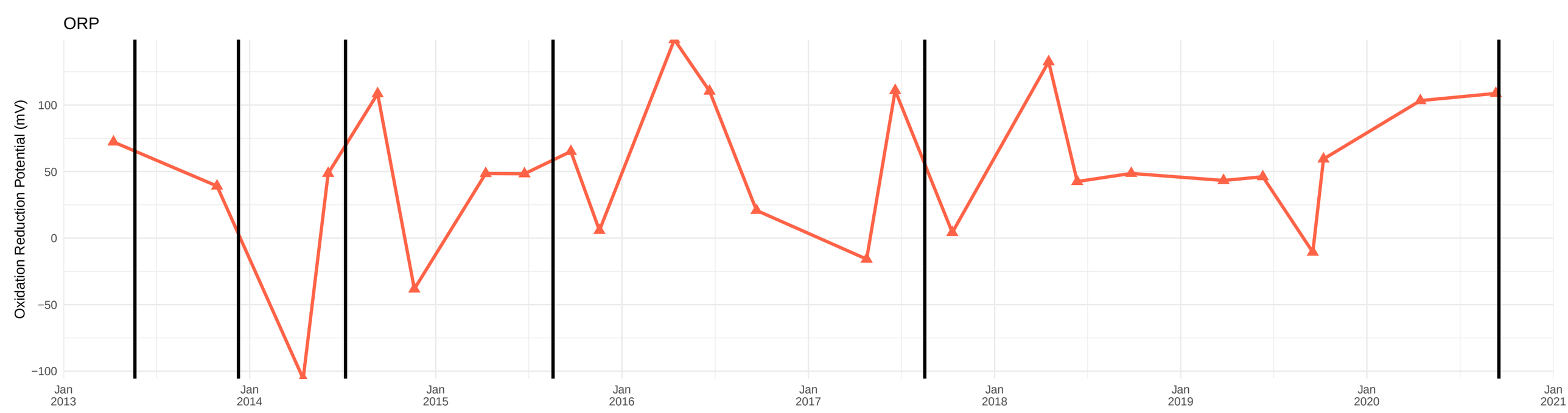




BP−34A

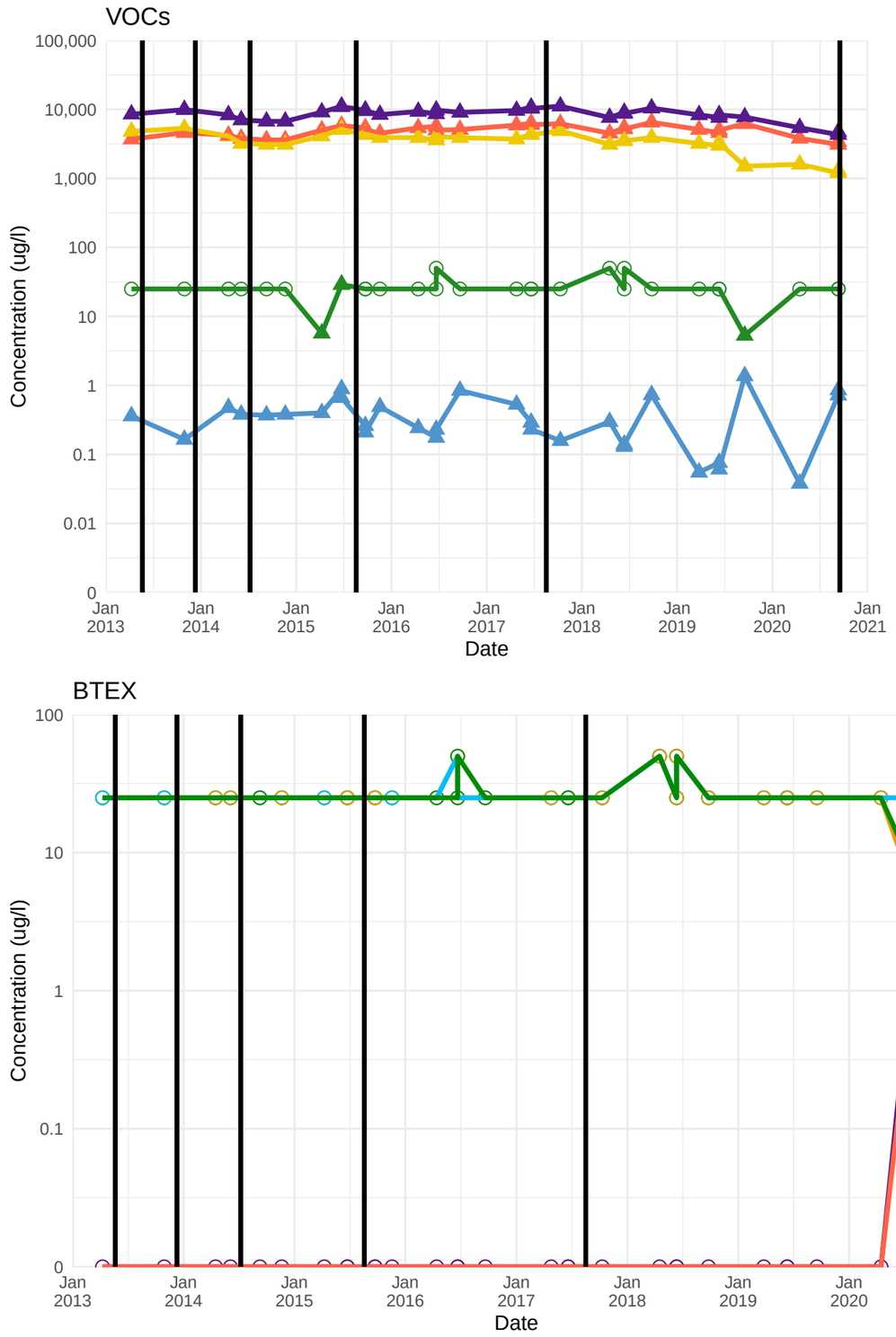
Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.

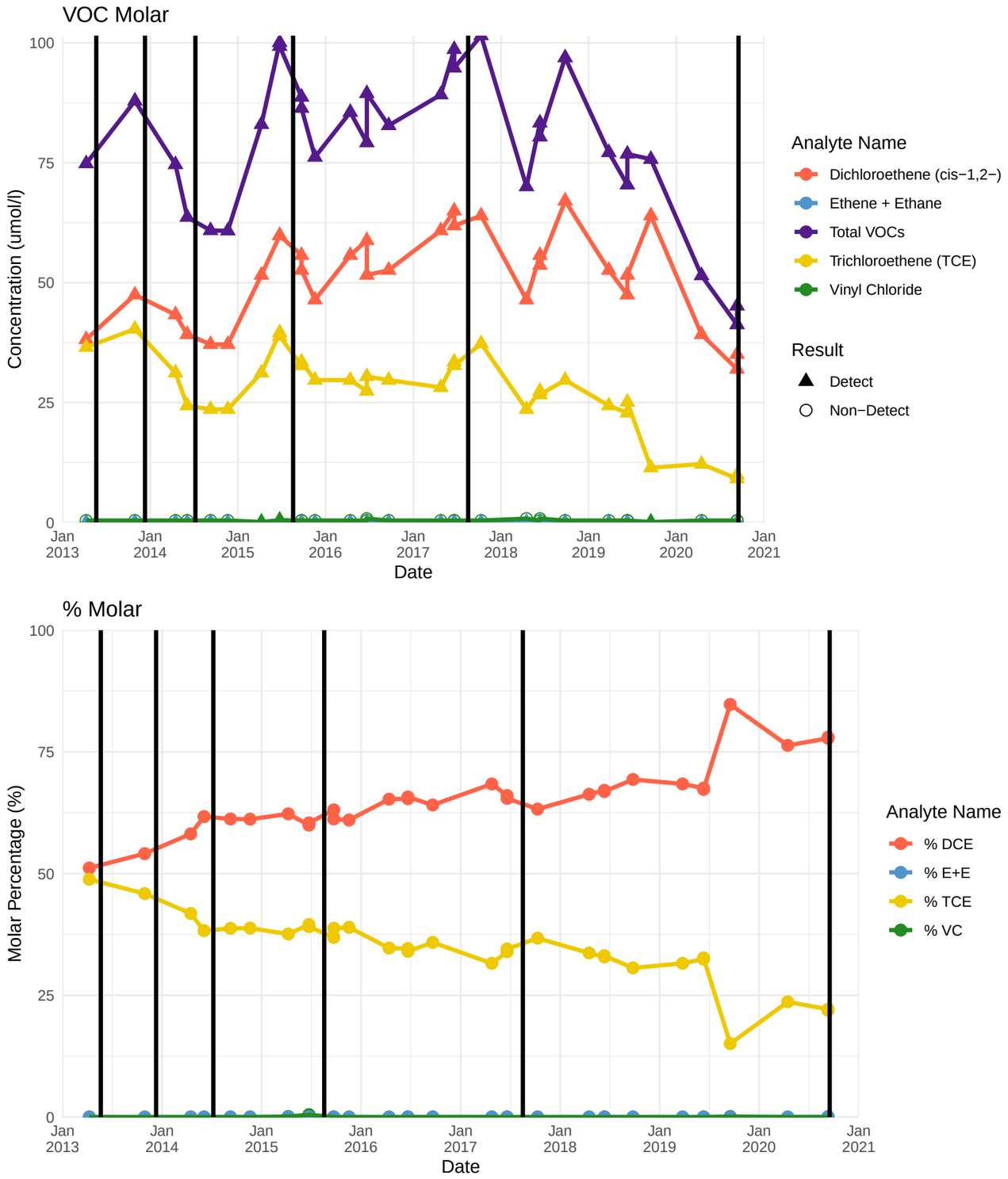




BP−35A

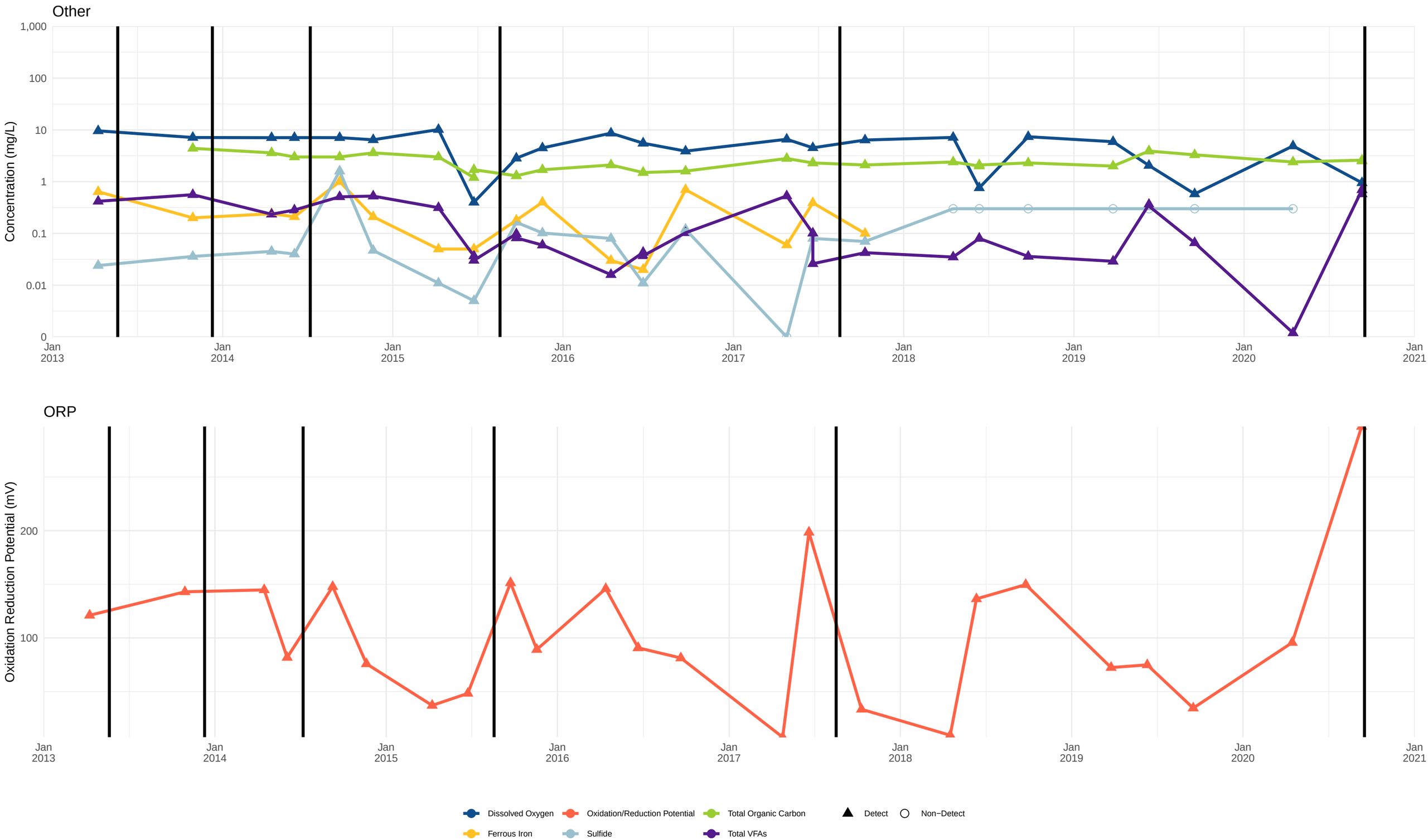
Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.





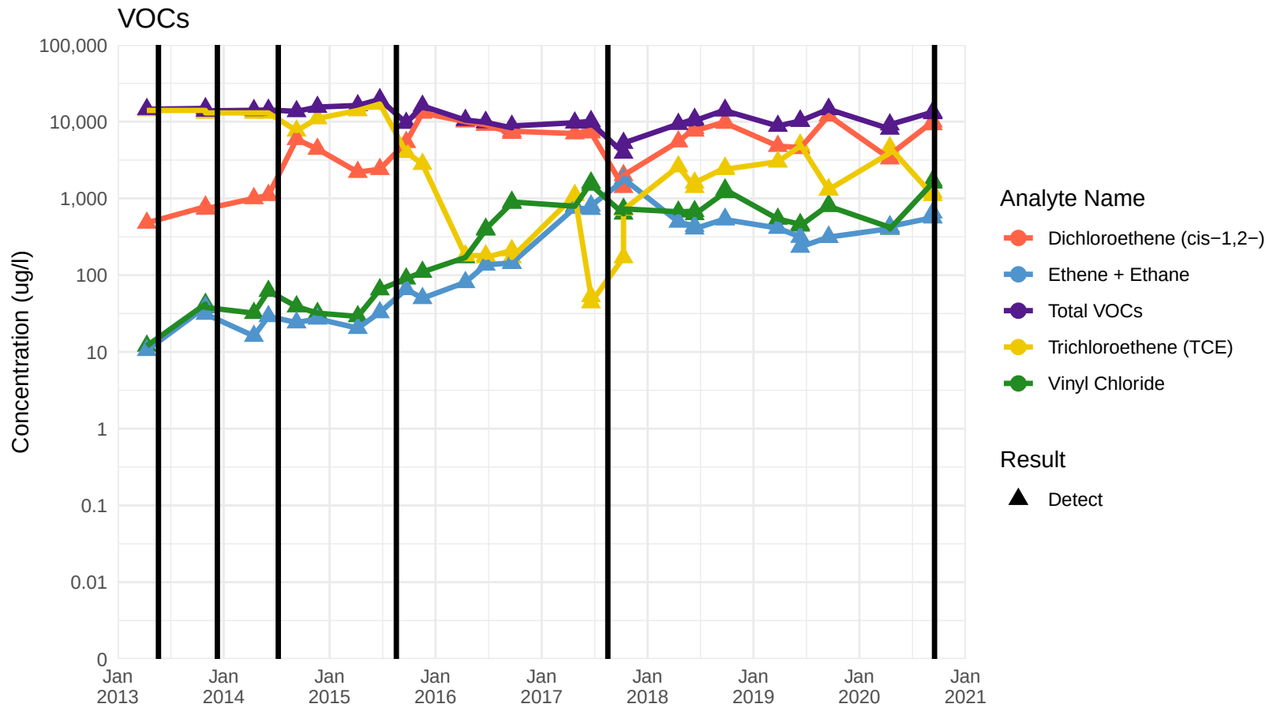
BP−35A

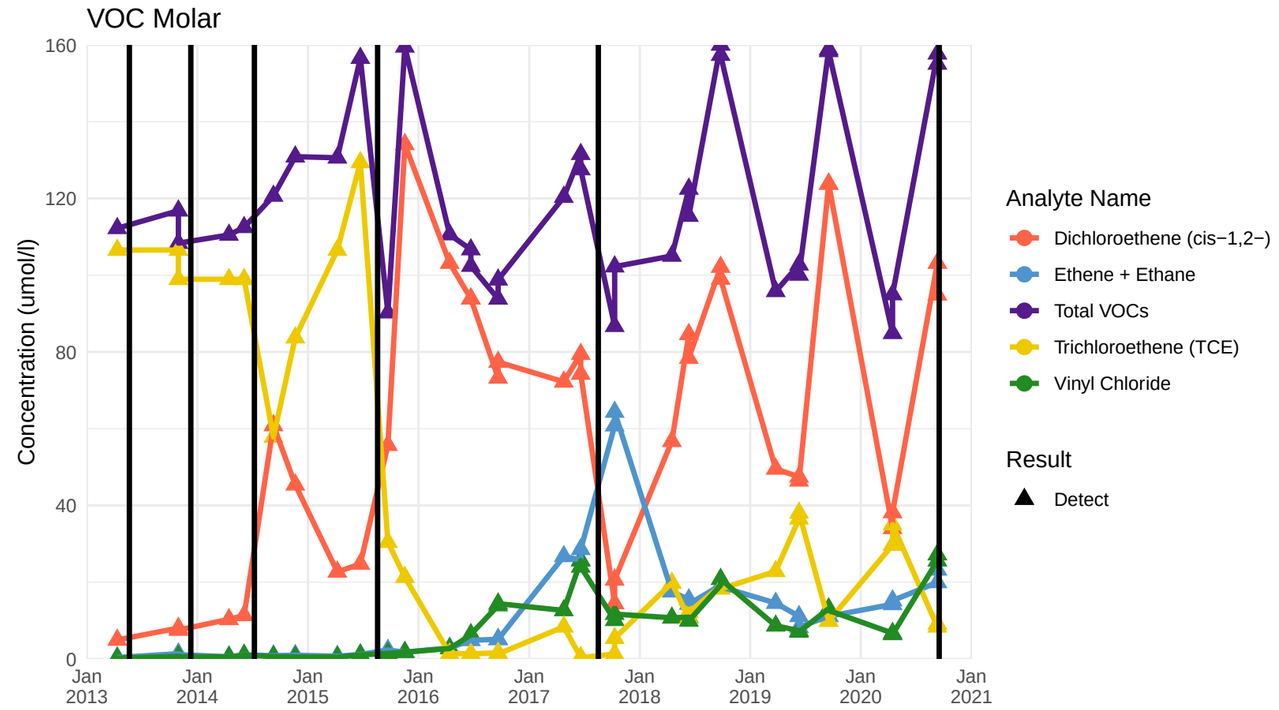
Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.

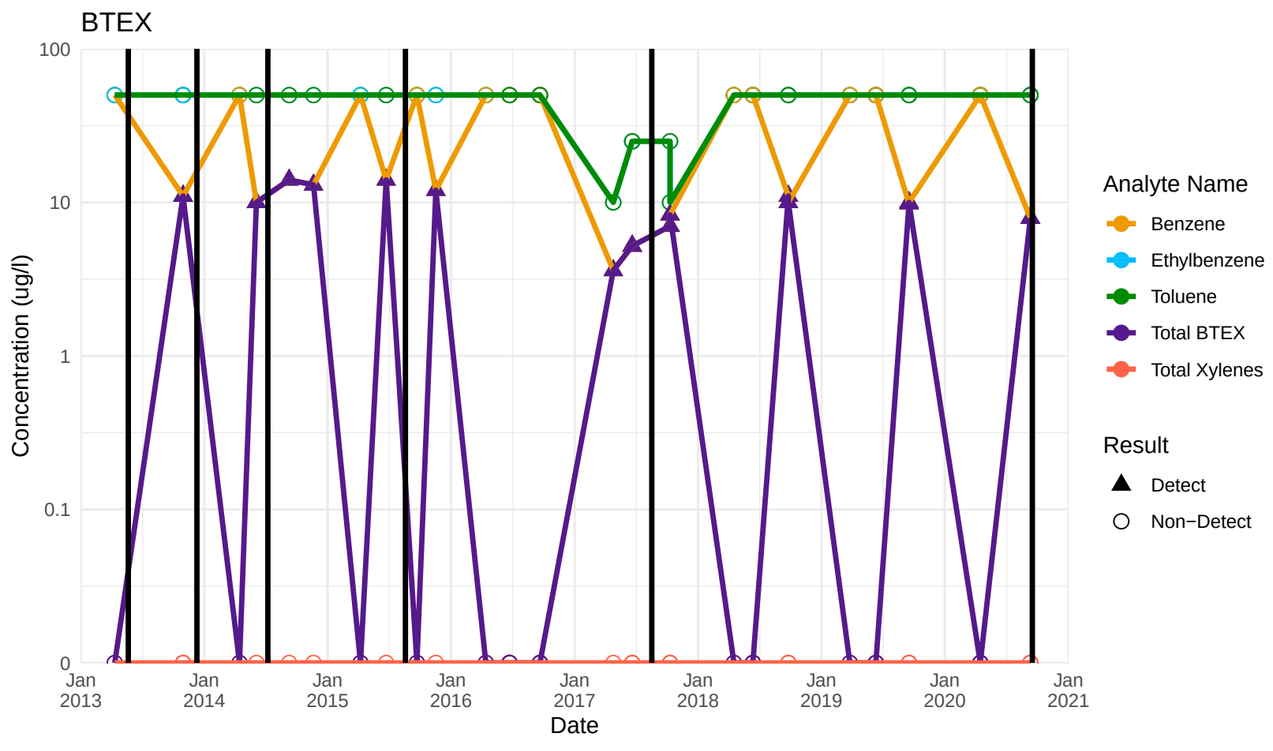


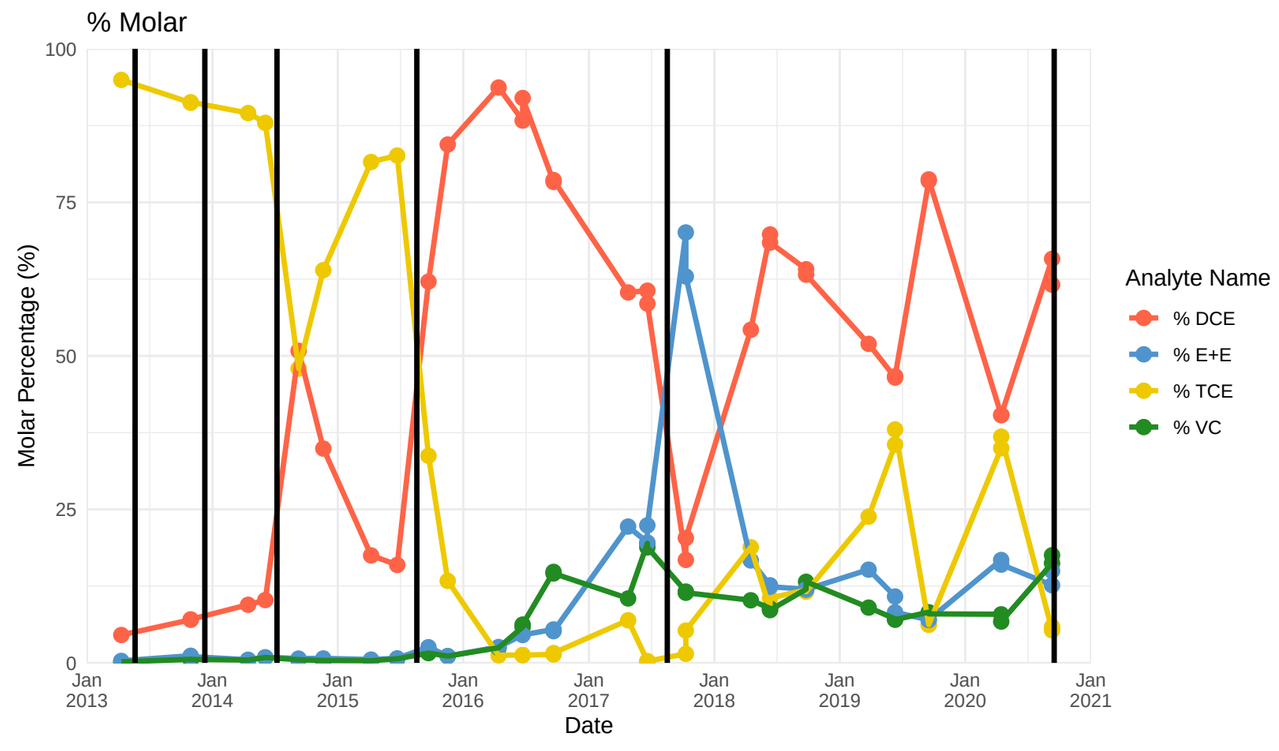
BP−36A

Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.



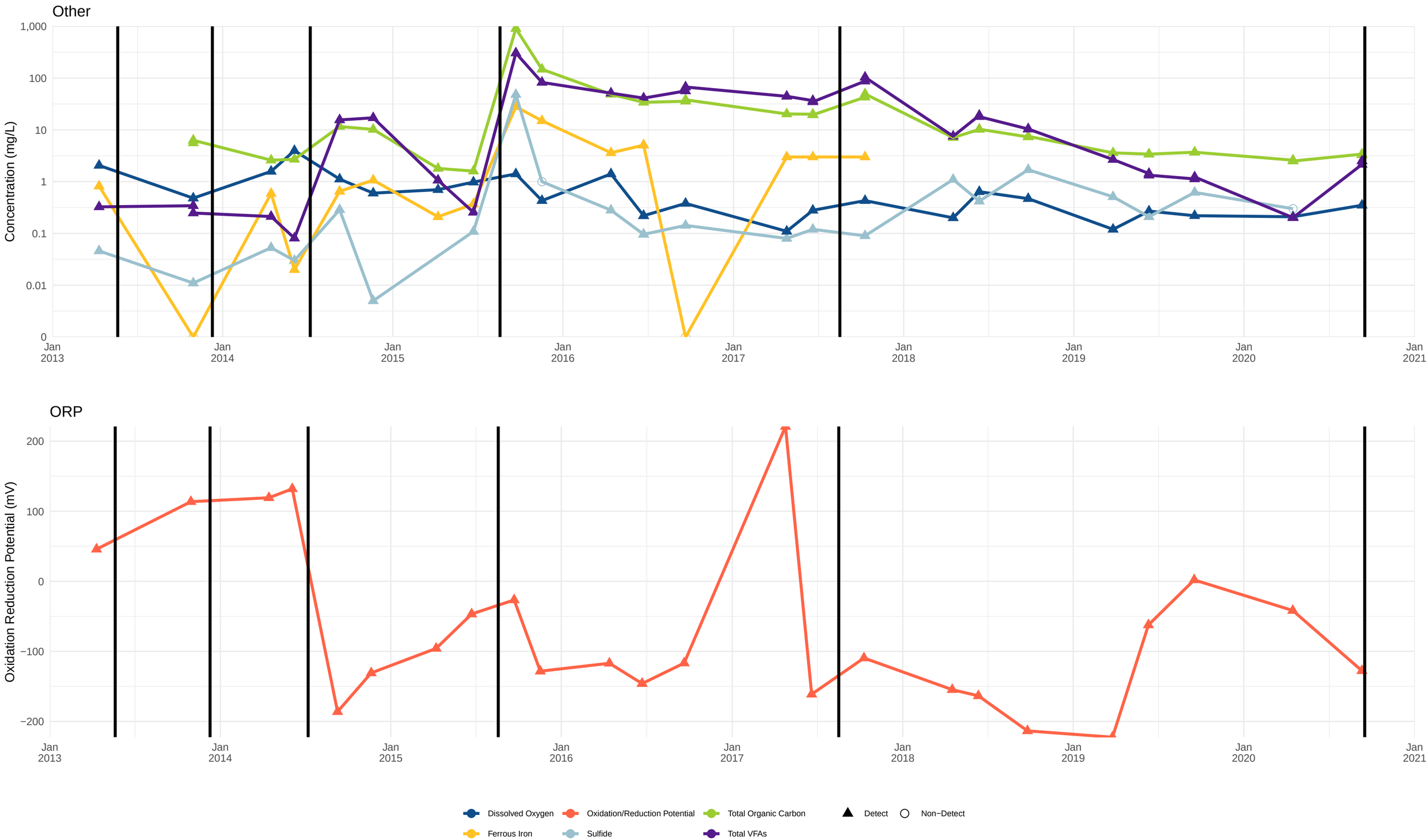






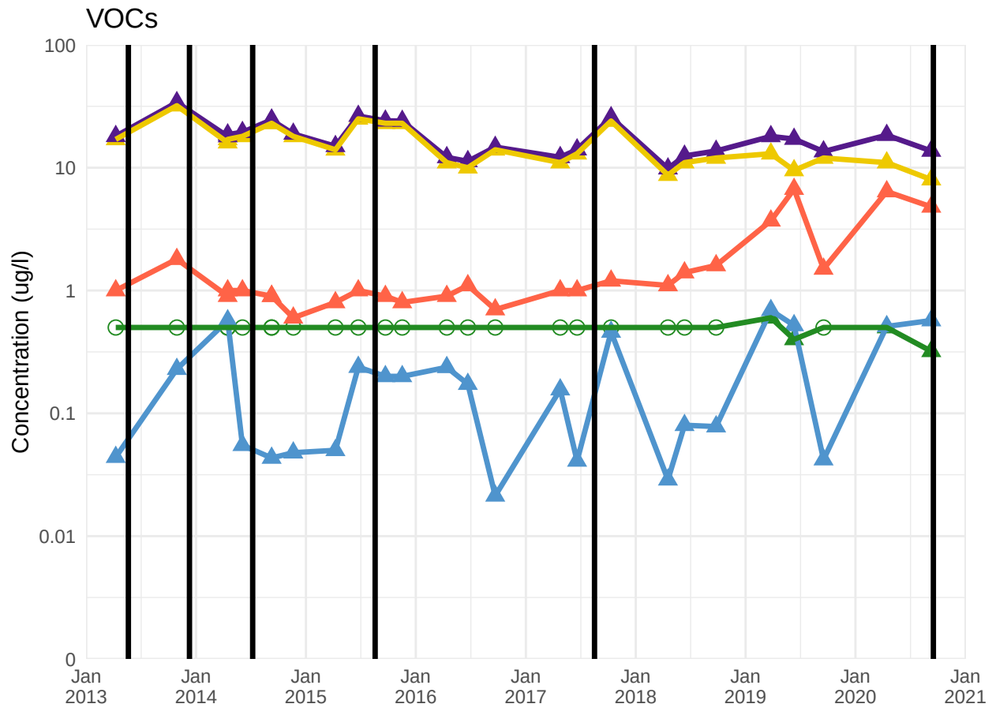
BP−36A

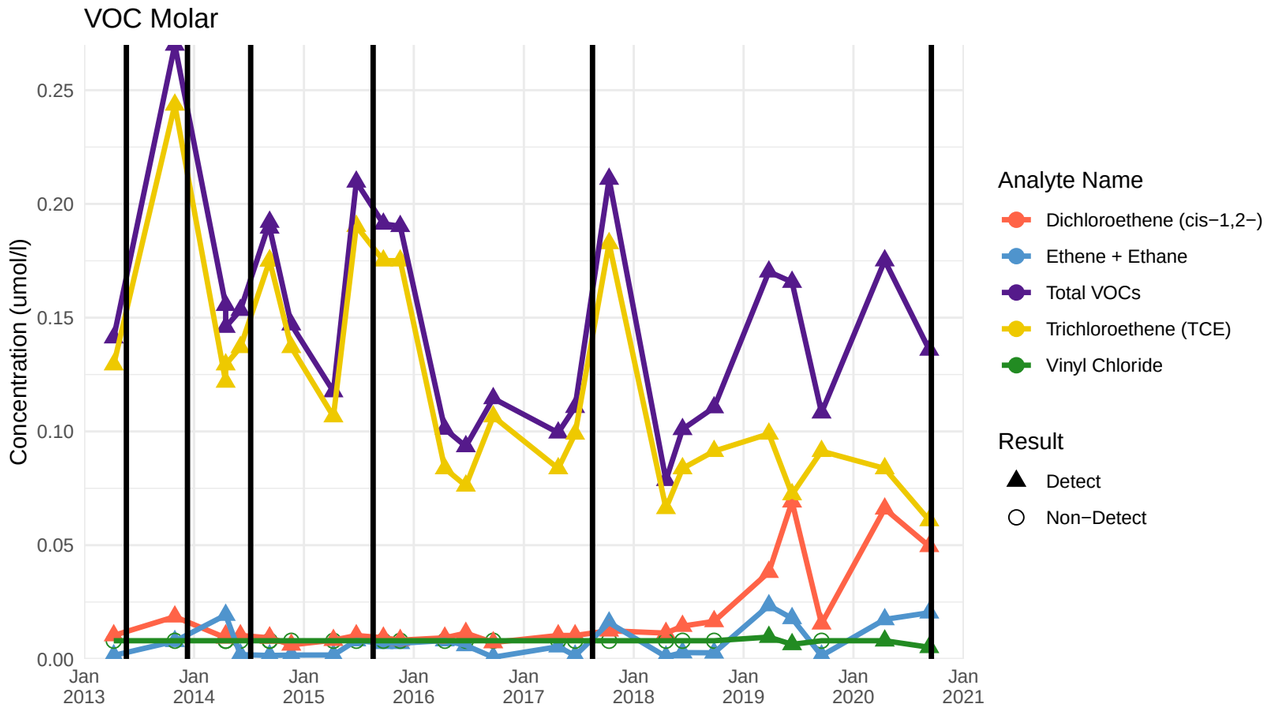
Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.

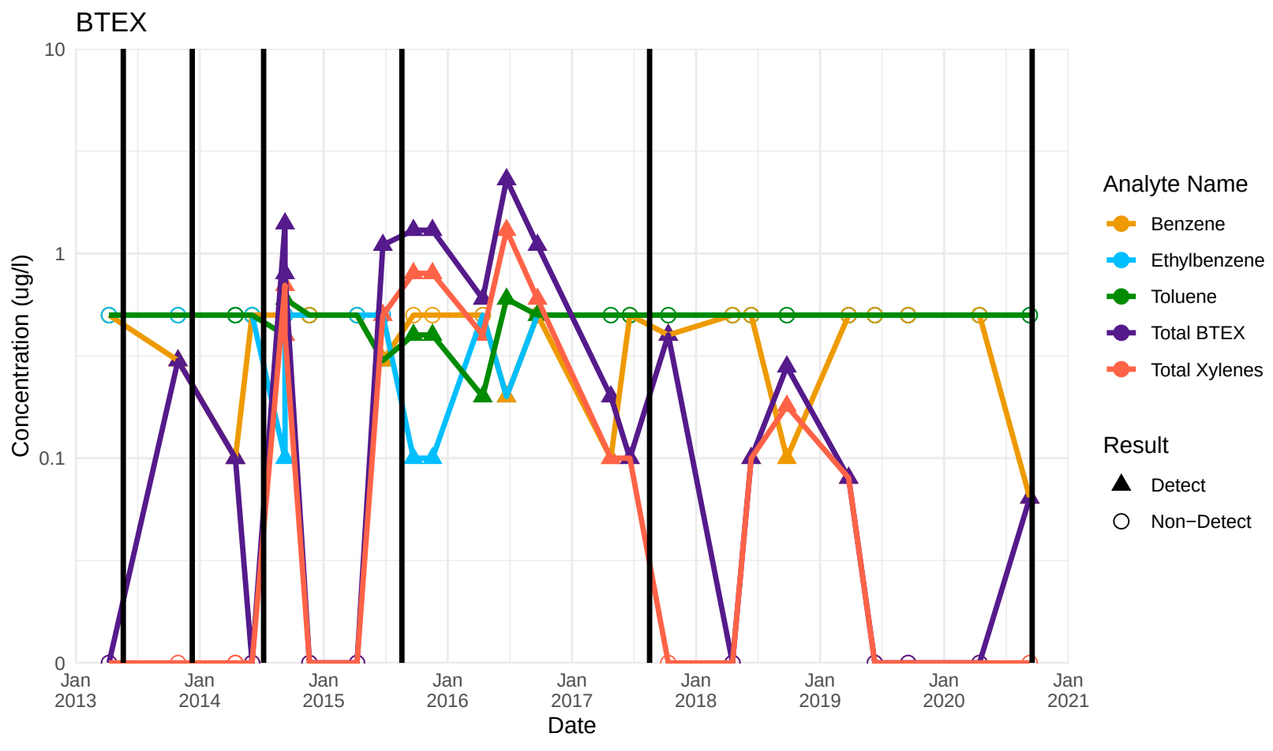


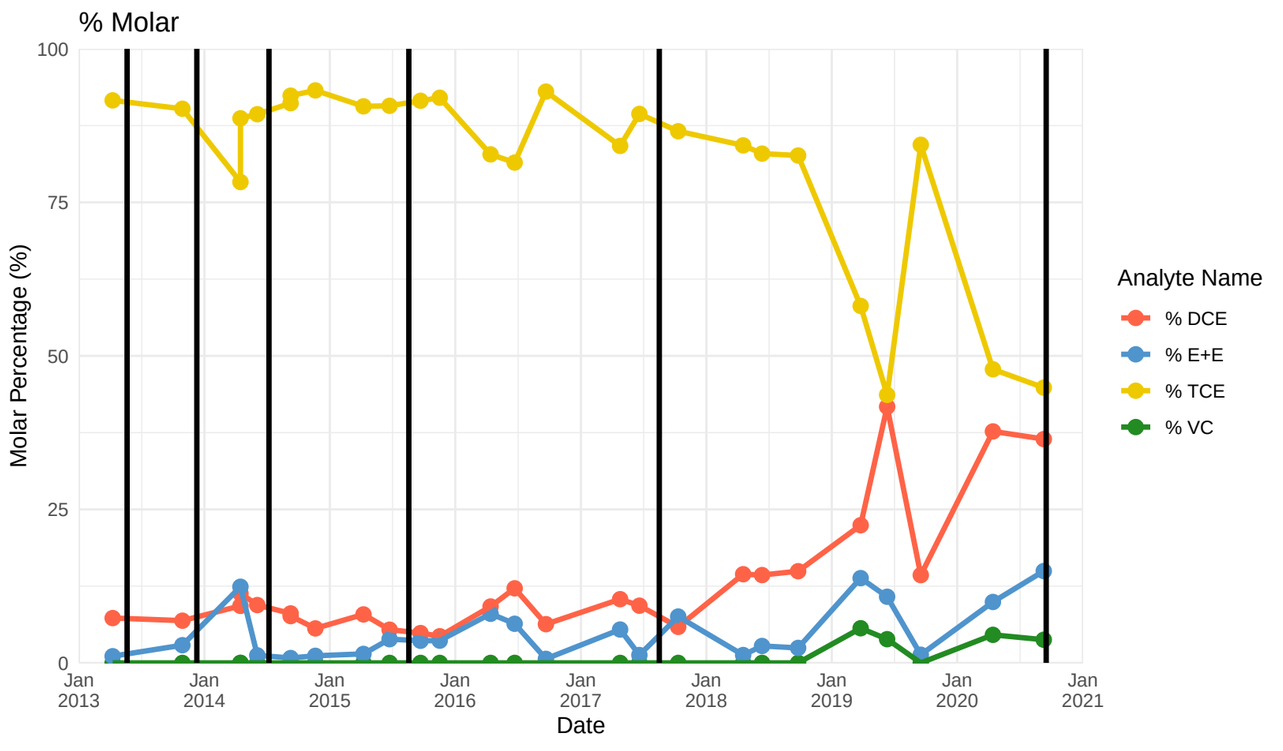
BP−37A

Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.



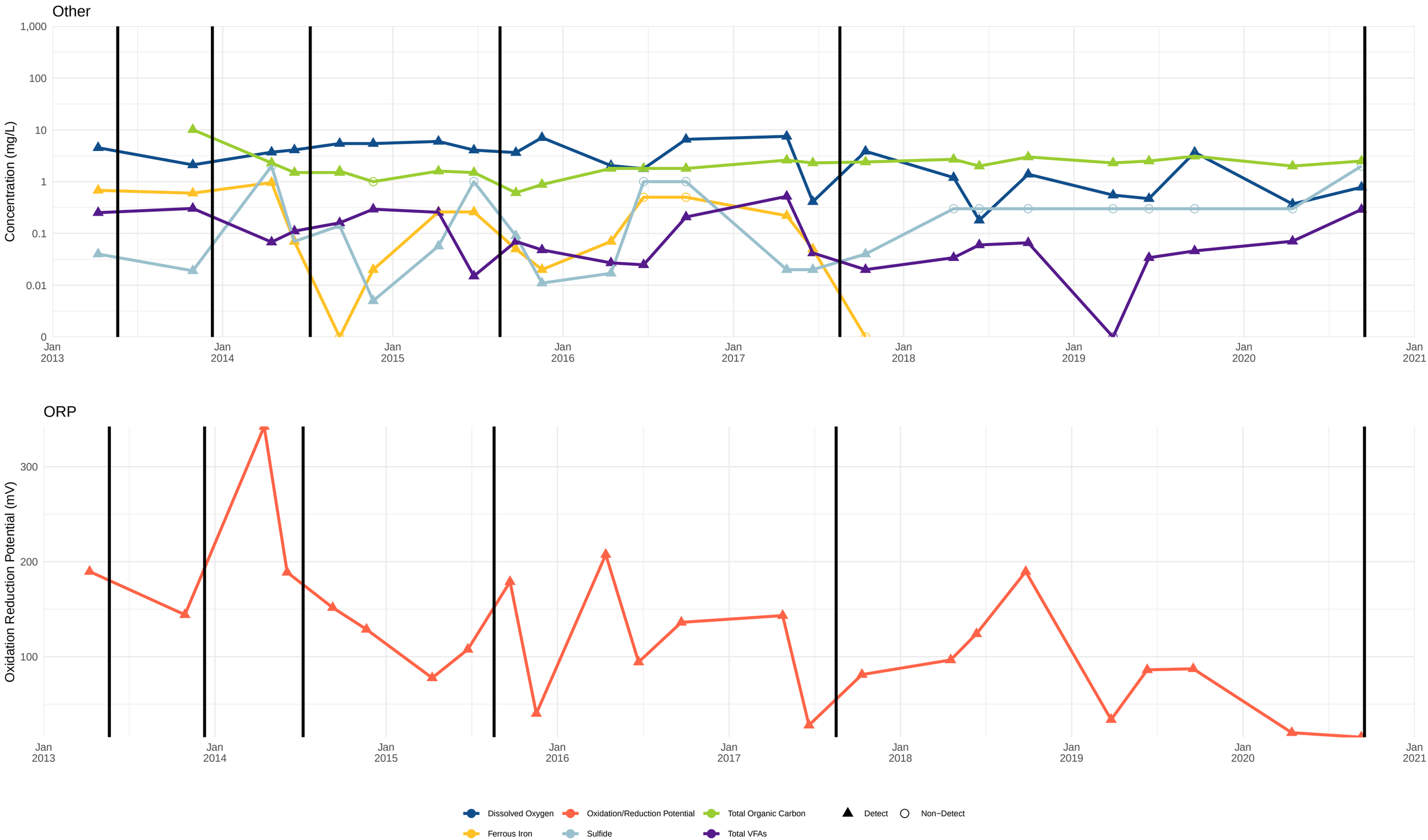






BP−37A

Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.



BP−38A

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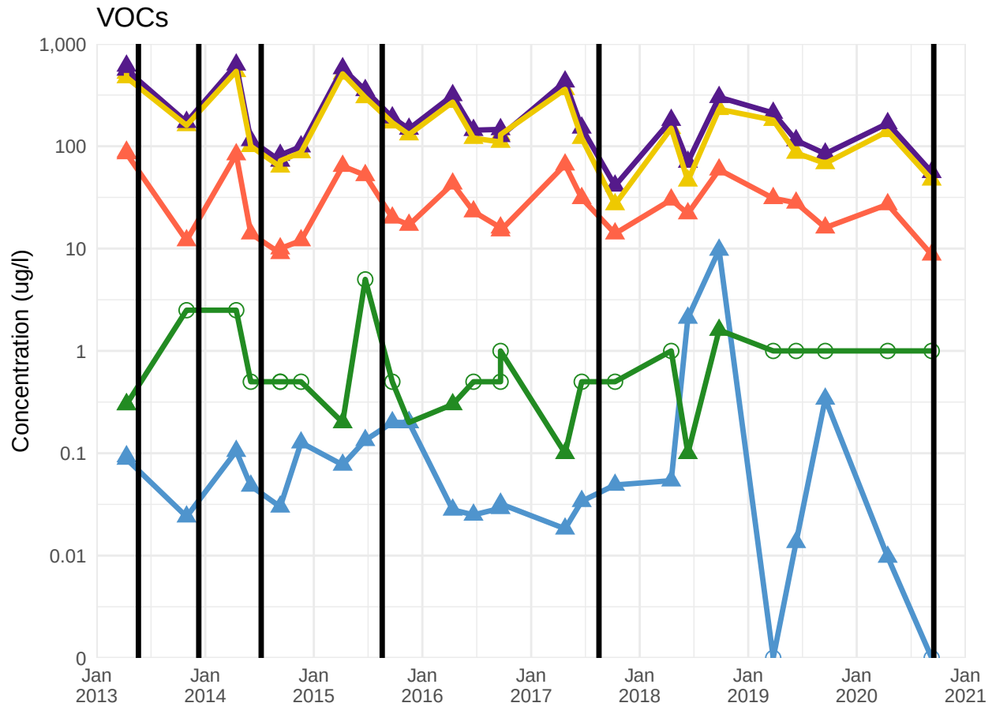
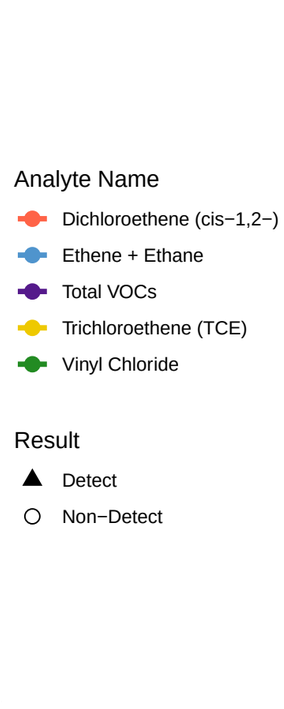
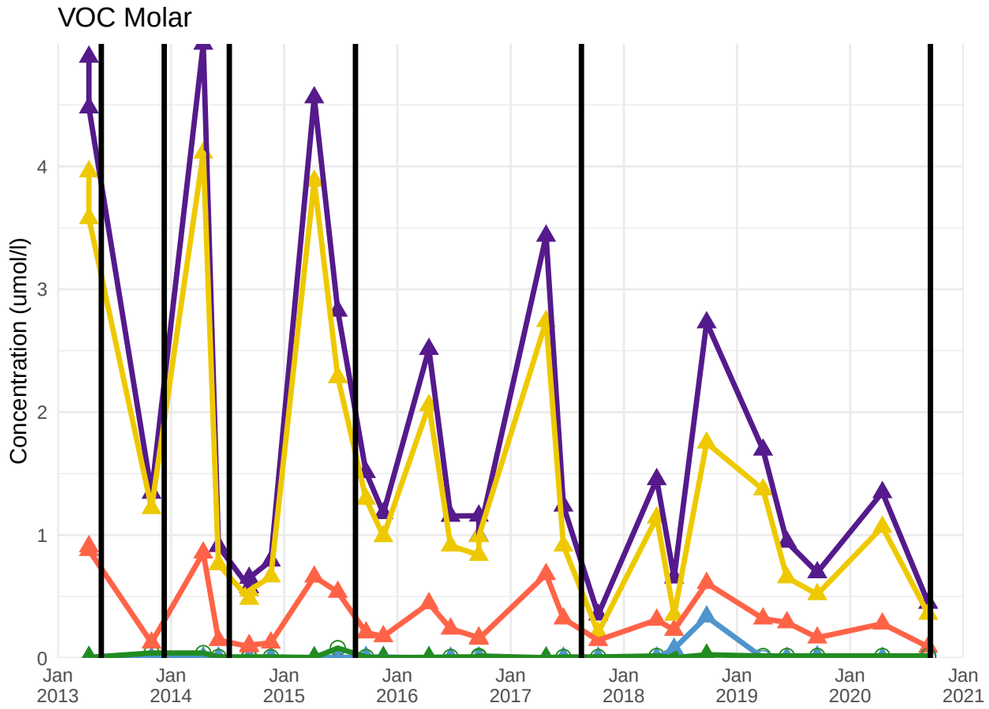
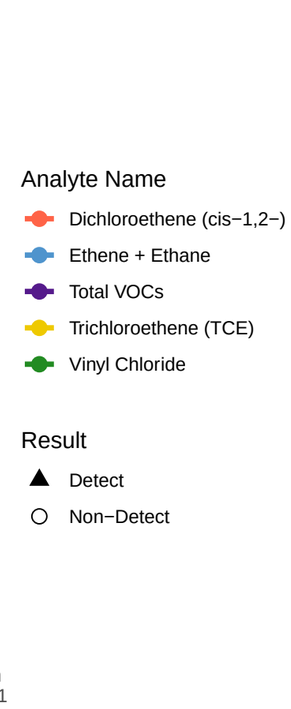
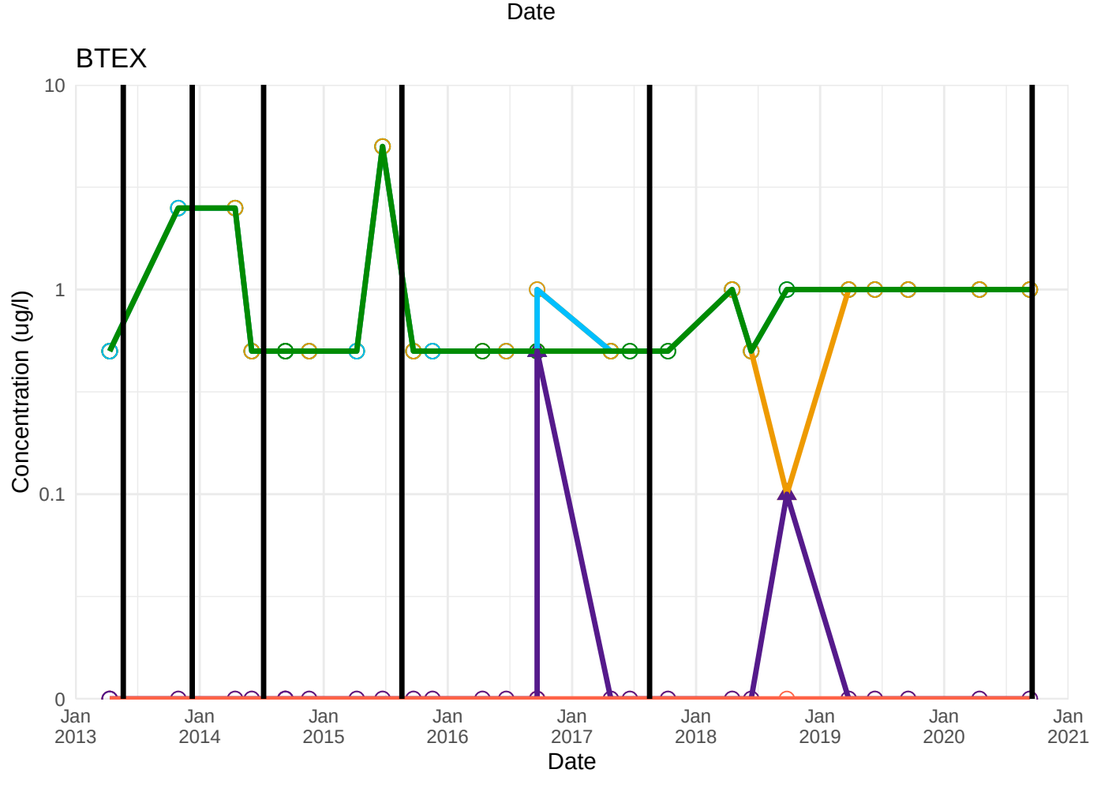
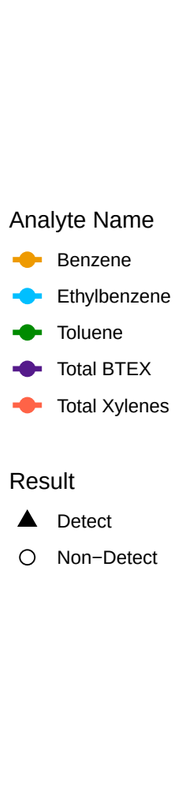


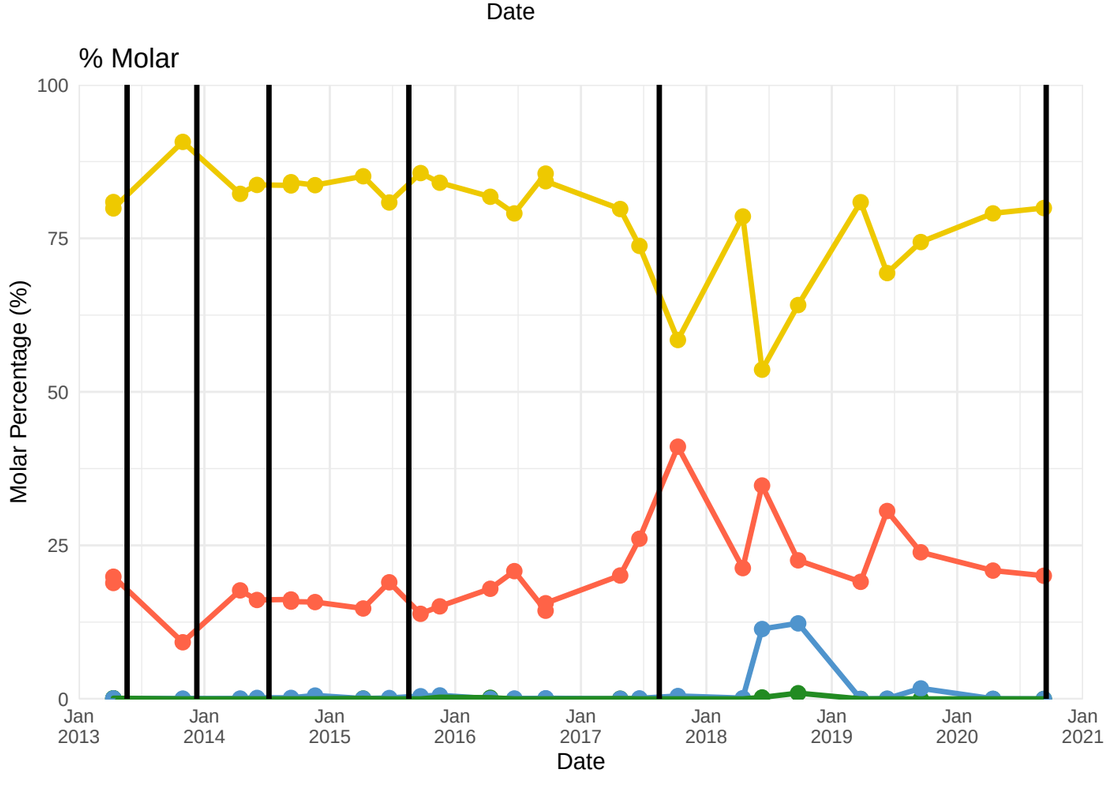


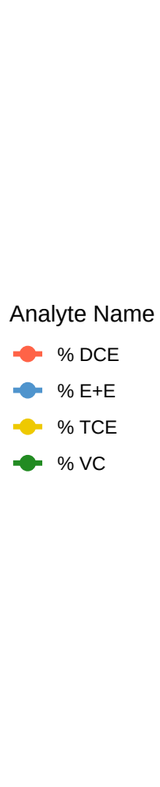








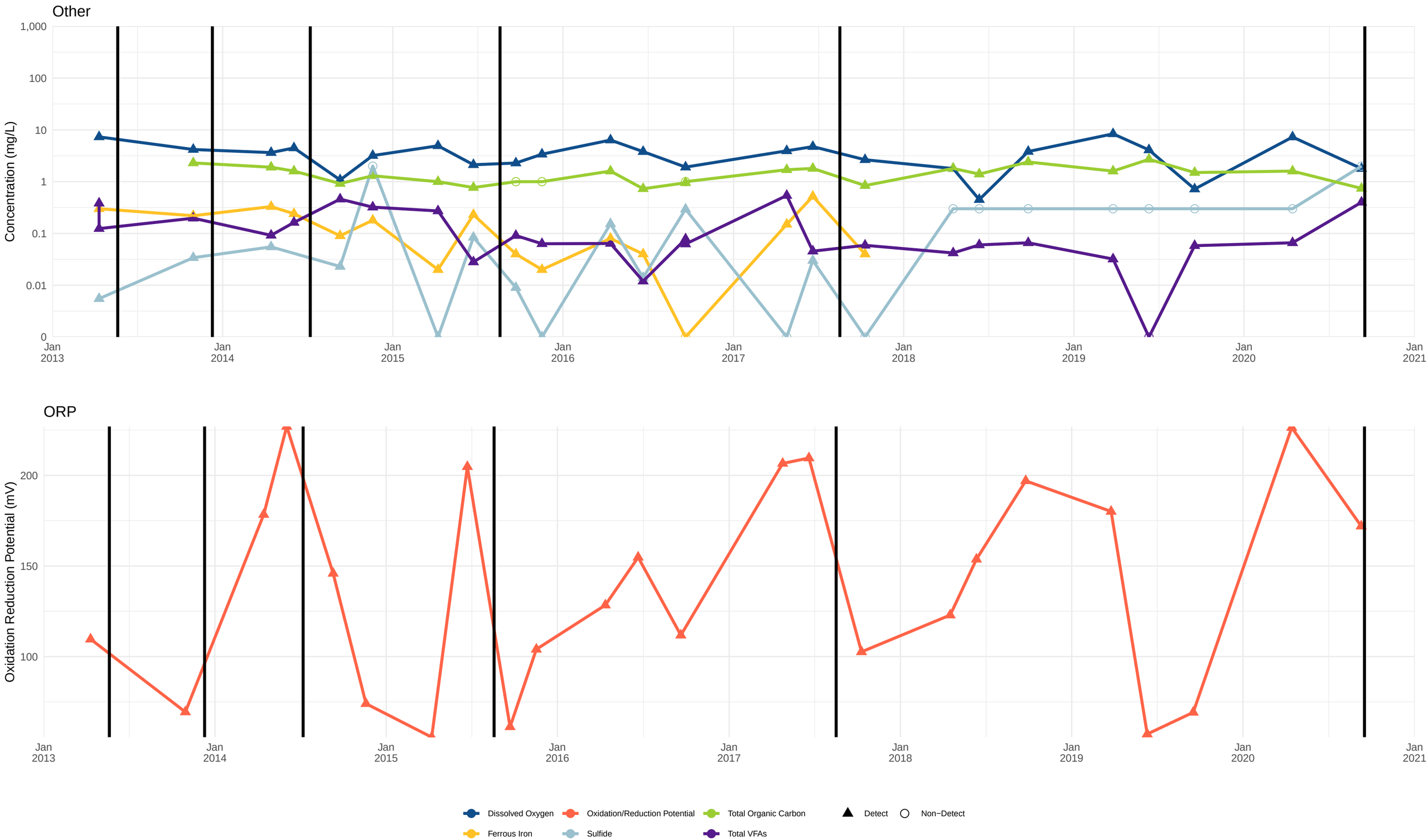




Sanborn, Head & Associates, Inc.

BP−38A

Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.



BP−39A

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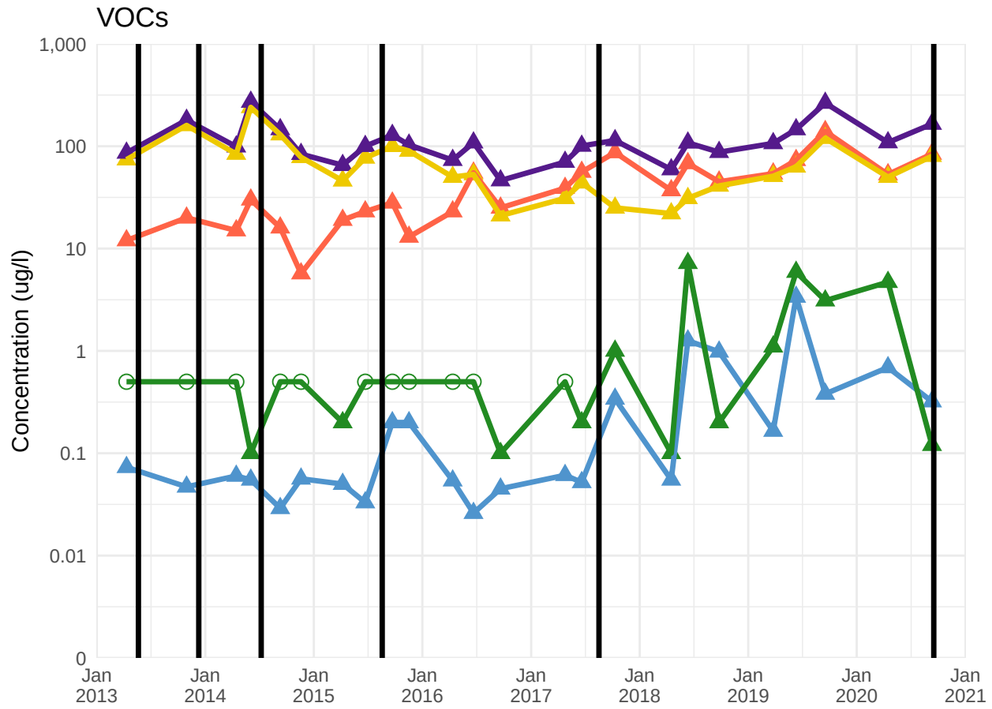
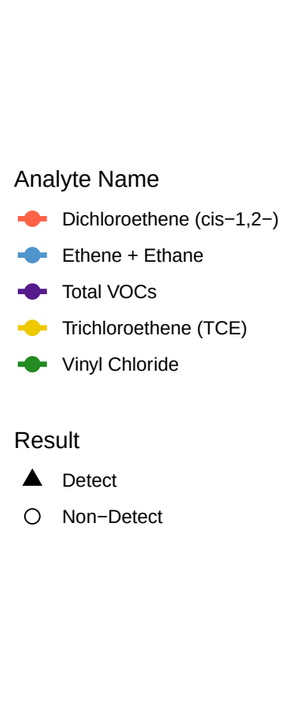
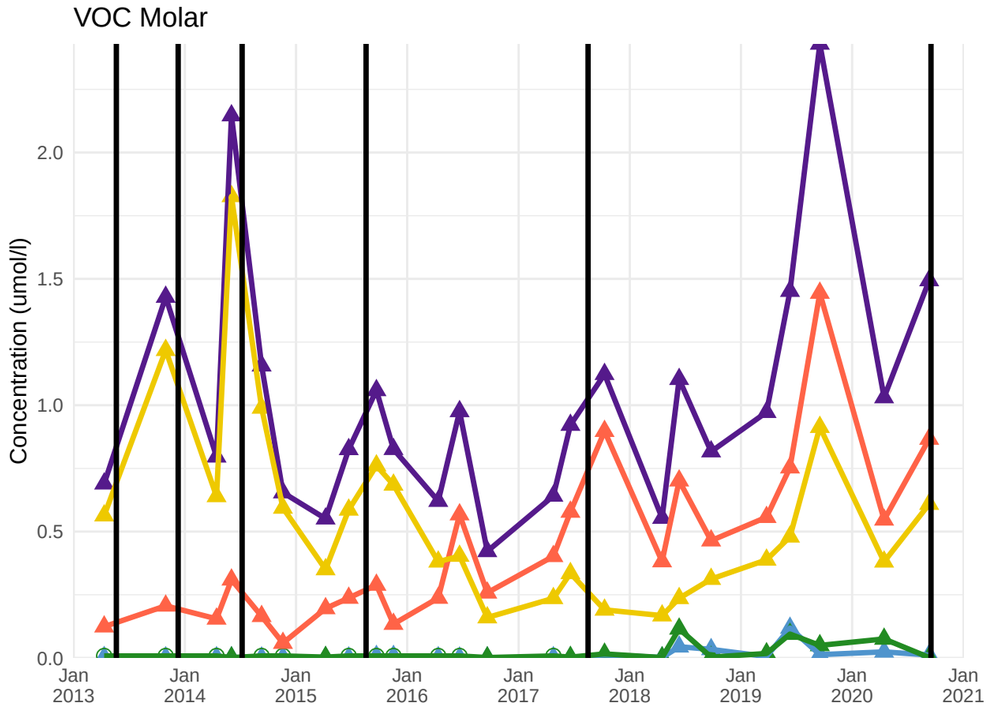
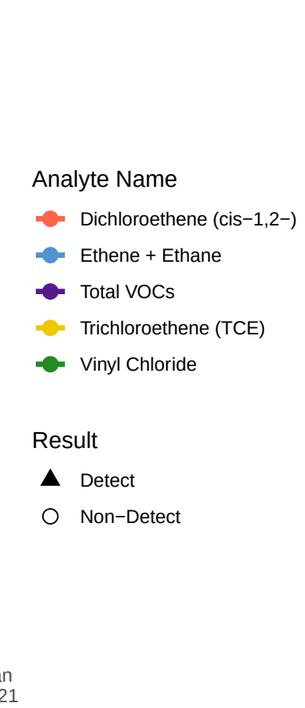
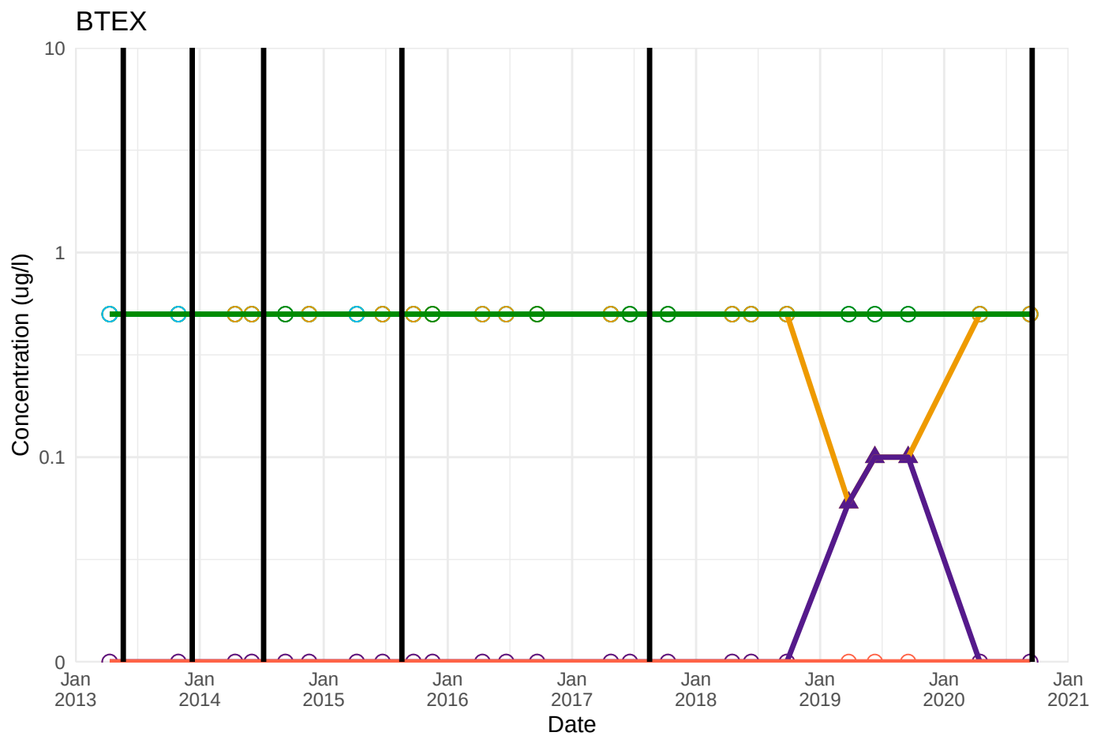
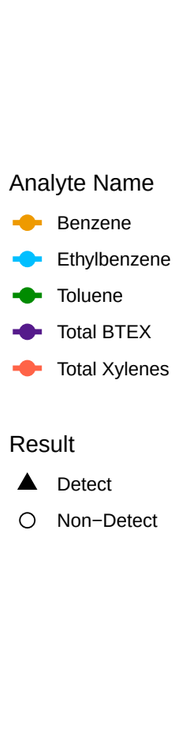


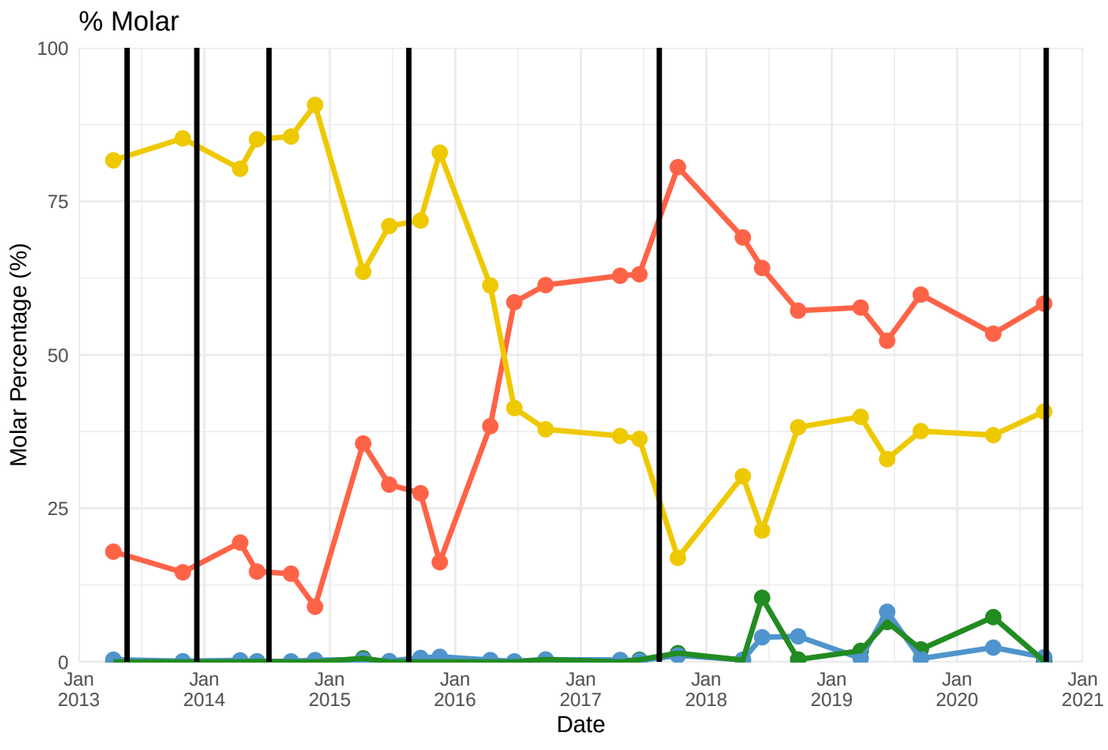


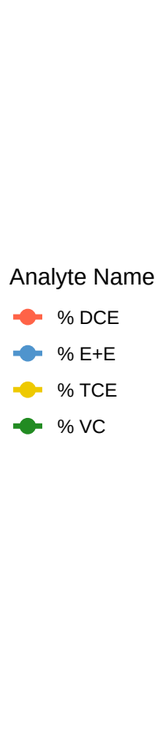








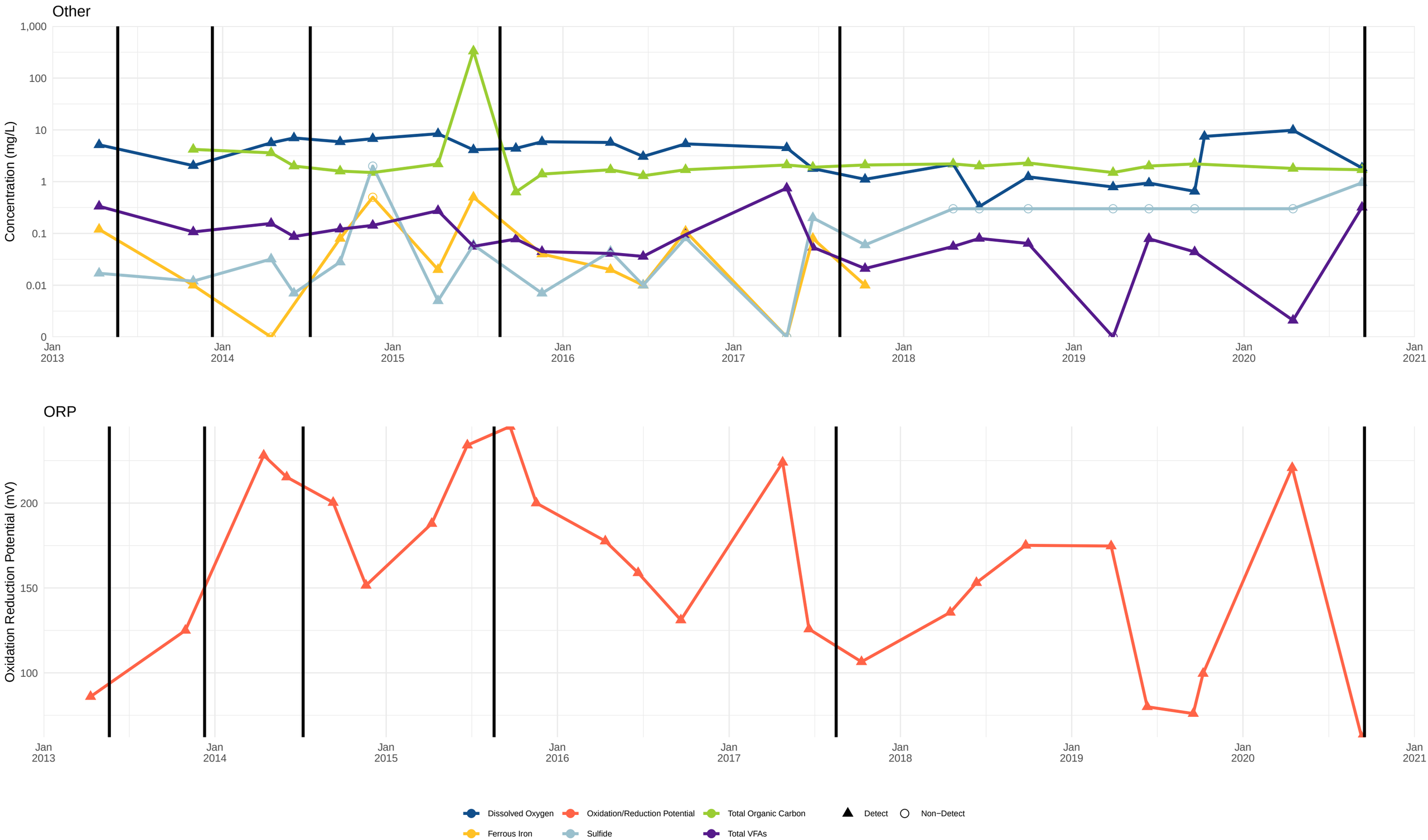




Sanborn, Head & Associates, Inc.

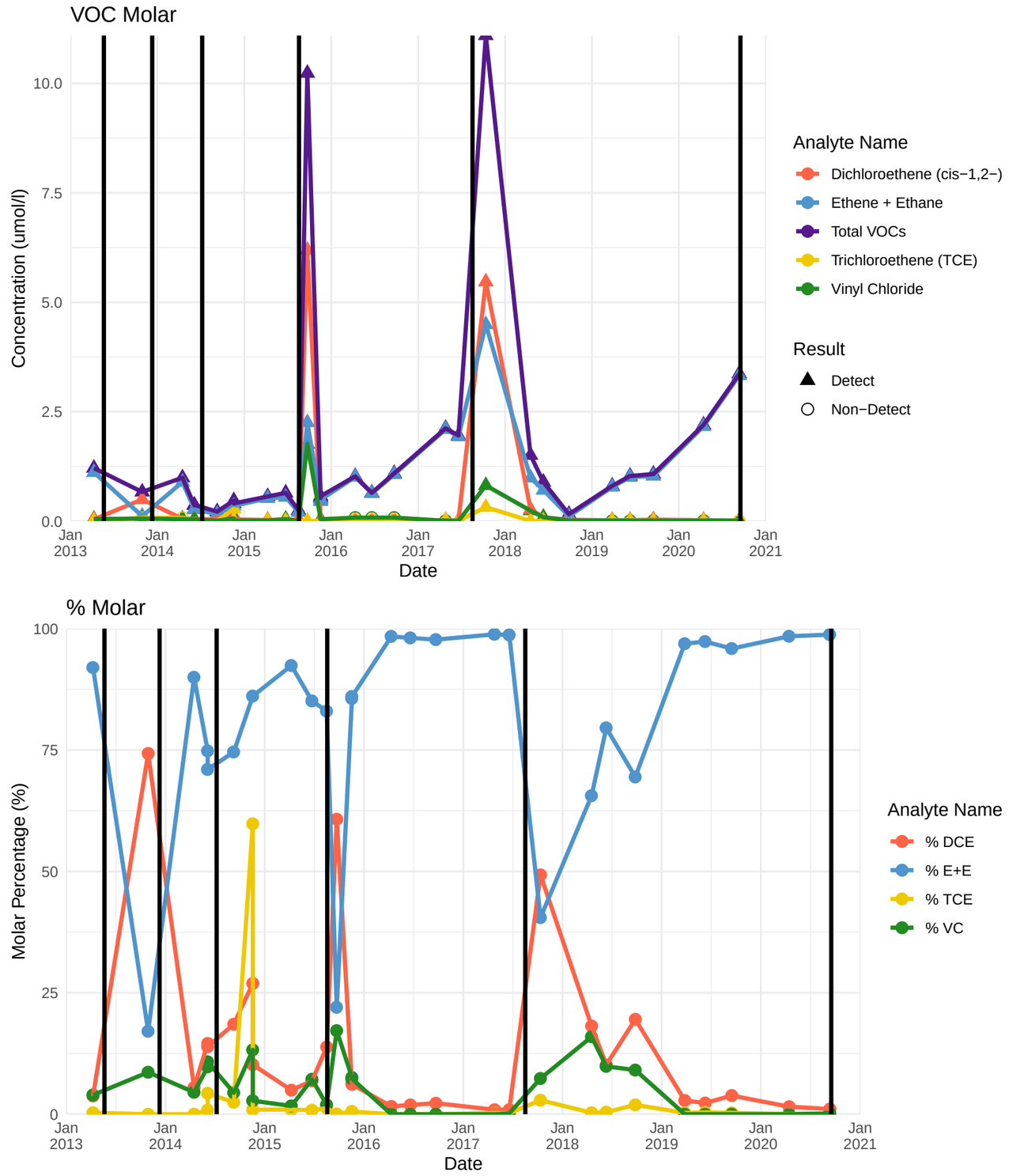
BP−39A

Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.



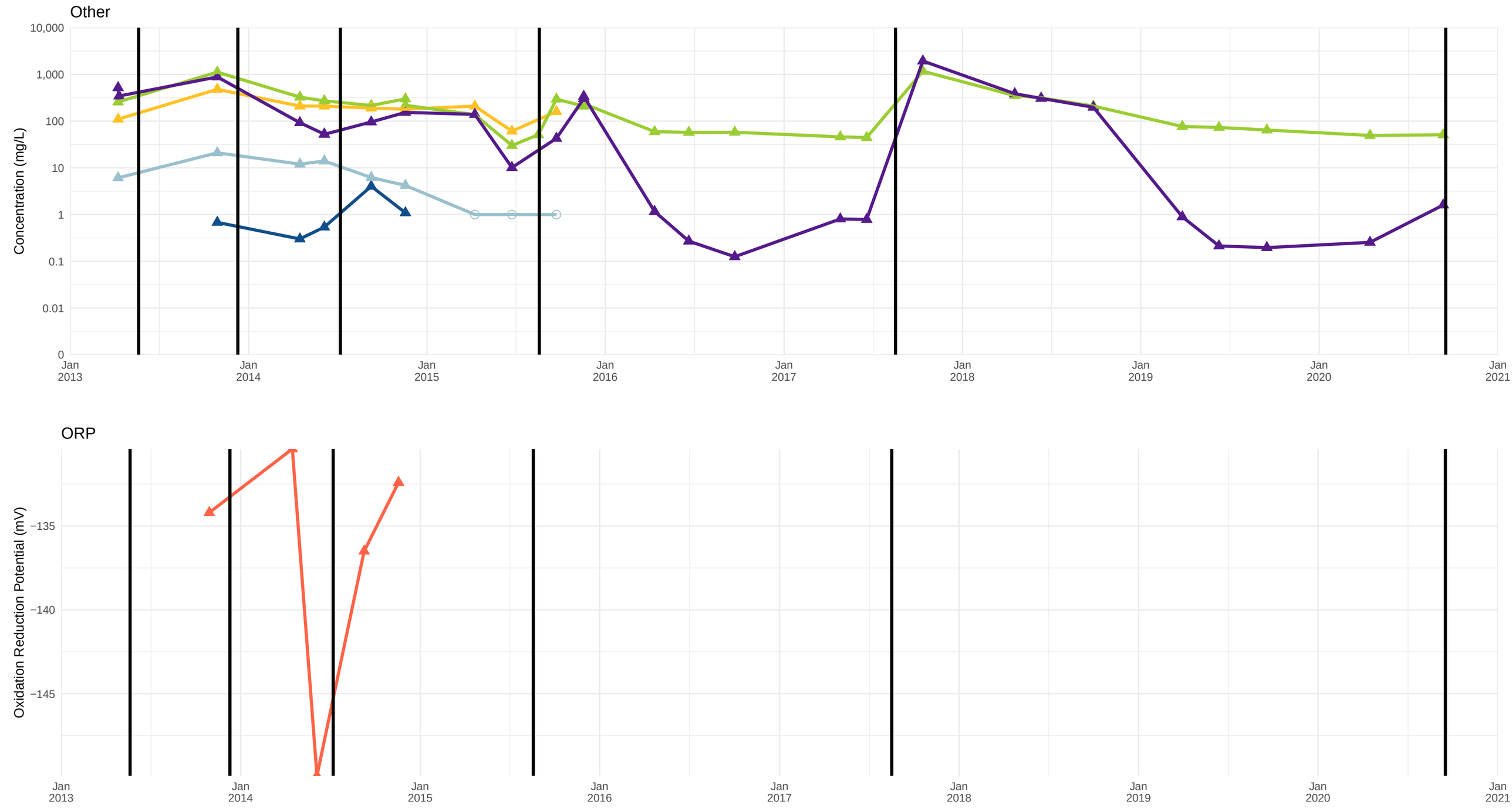
IB−7

Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.



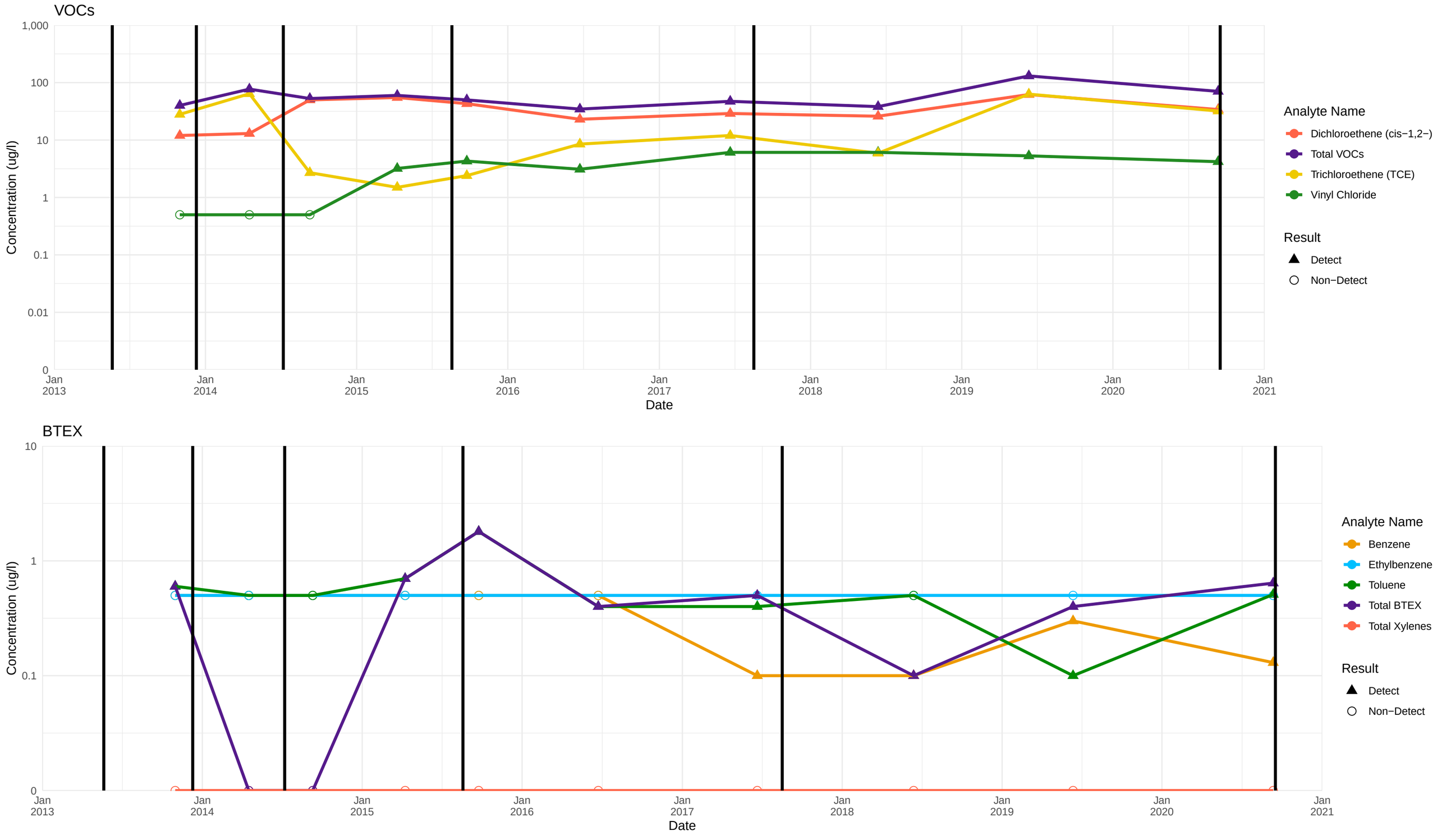
IB−7

Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.



GC−1 Port 1

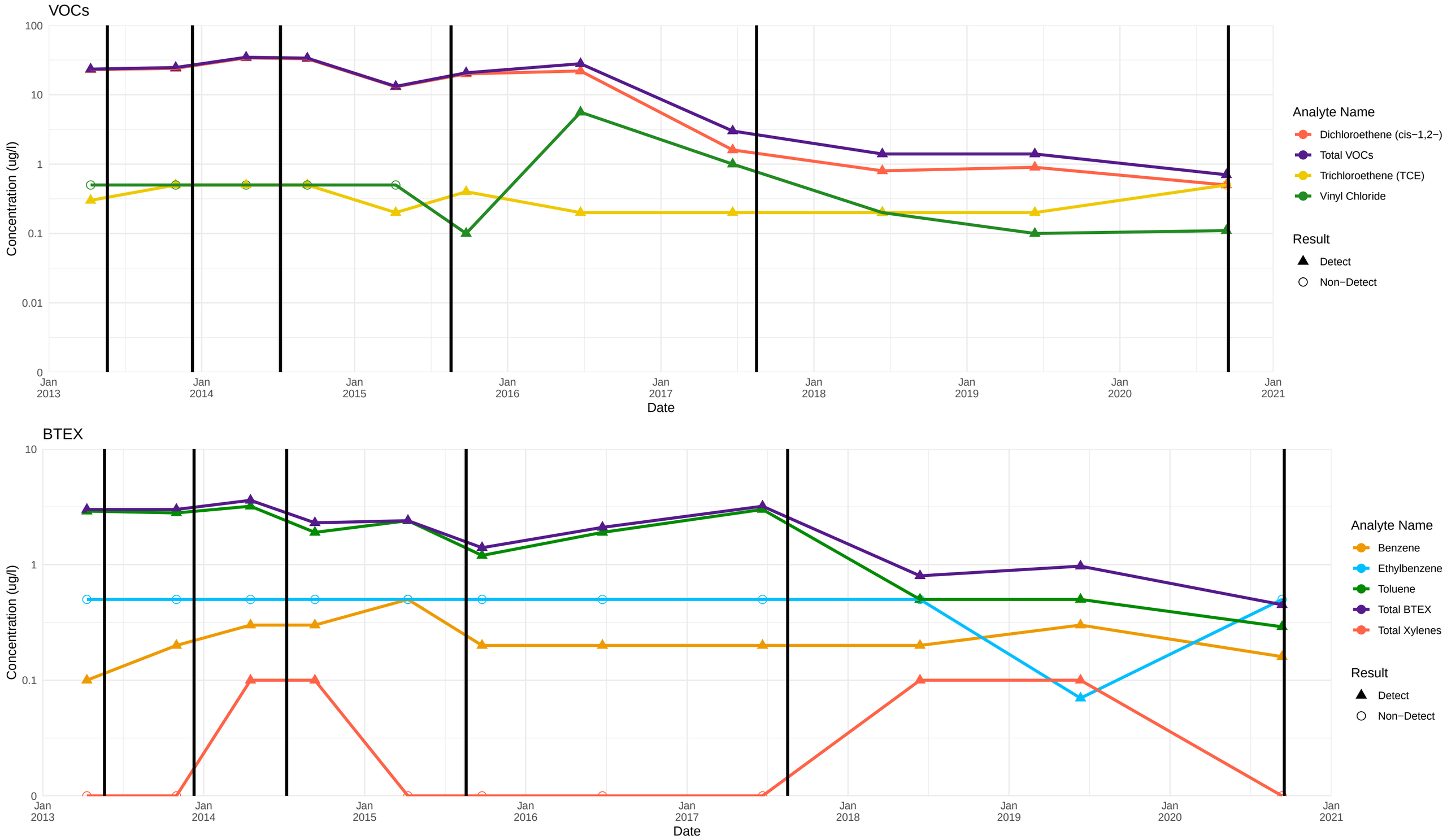
Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.



Sanborn, Head & Associates, Inc.

GC−1 Port 8

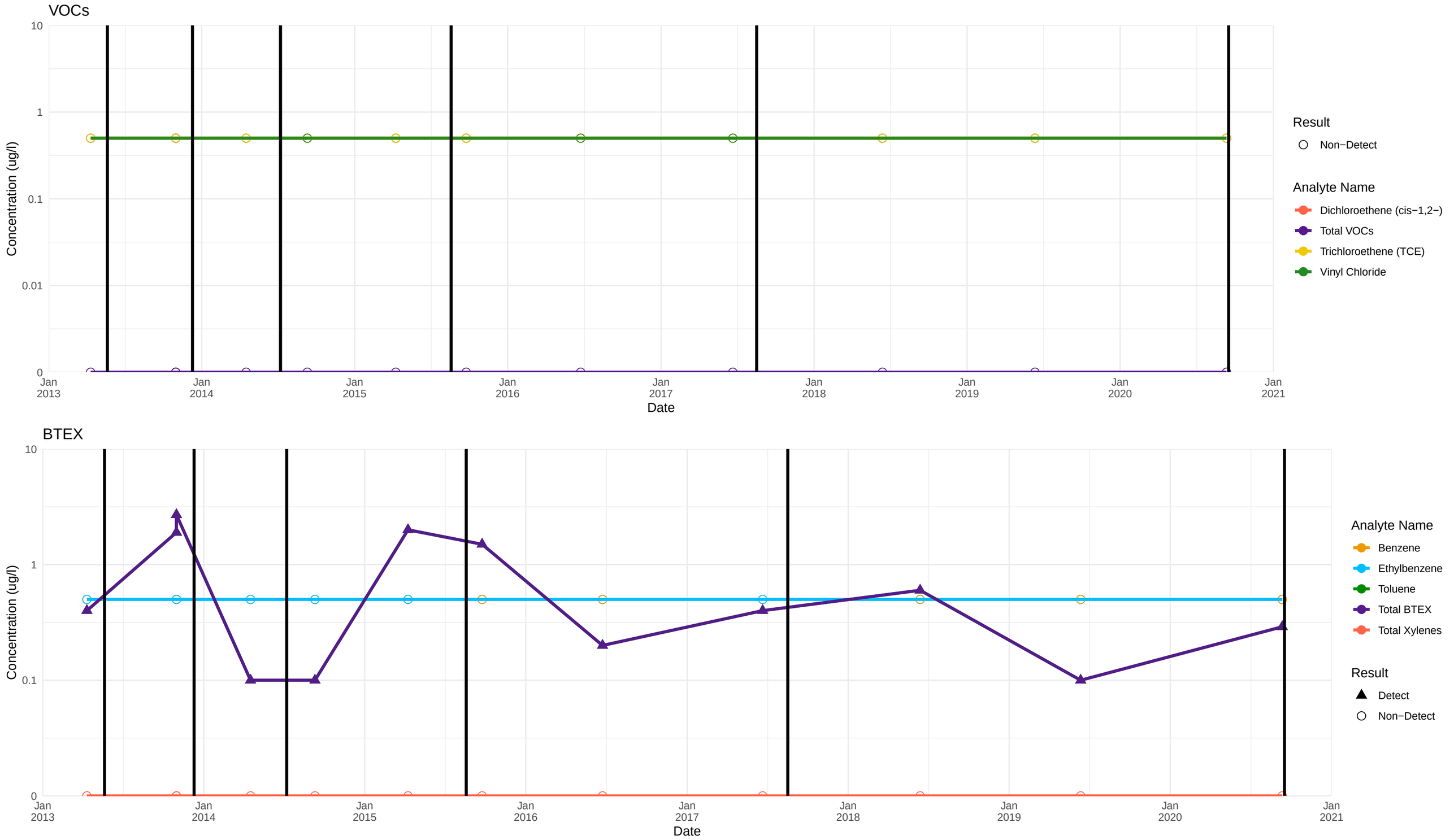
Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.



Sanborn, Head & Associates, Inc.

BP−12D Port 1

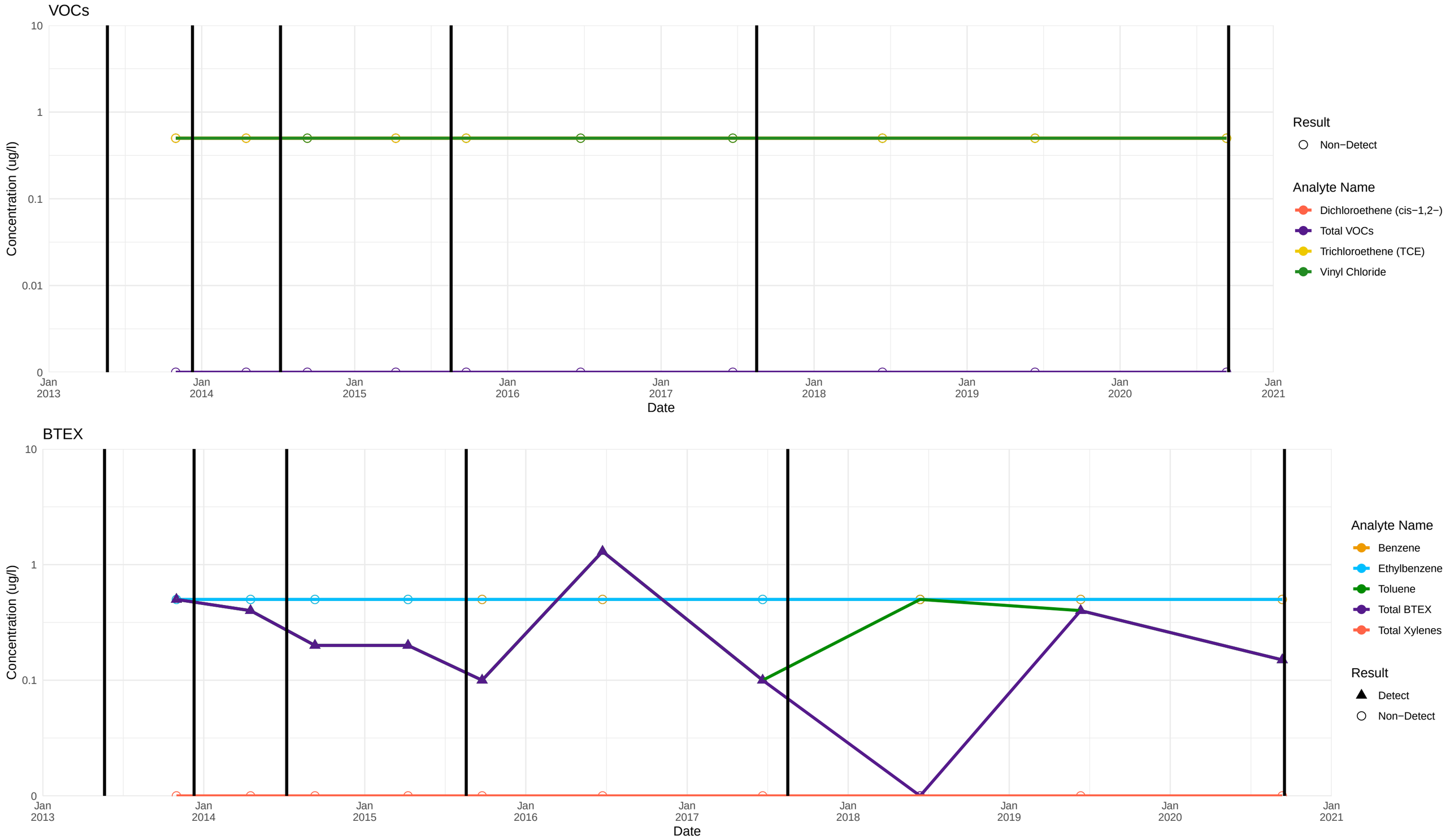
Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.



Sanborn, Head & Associates, Inc.

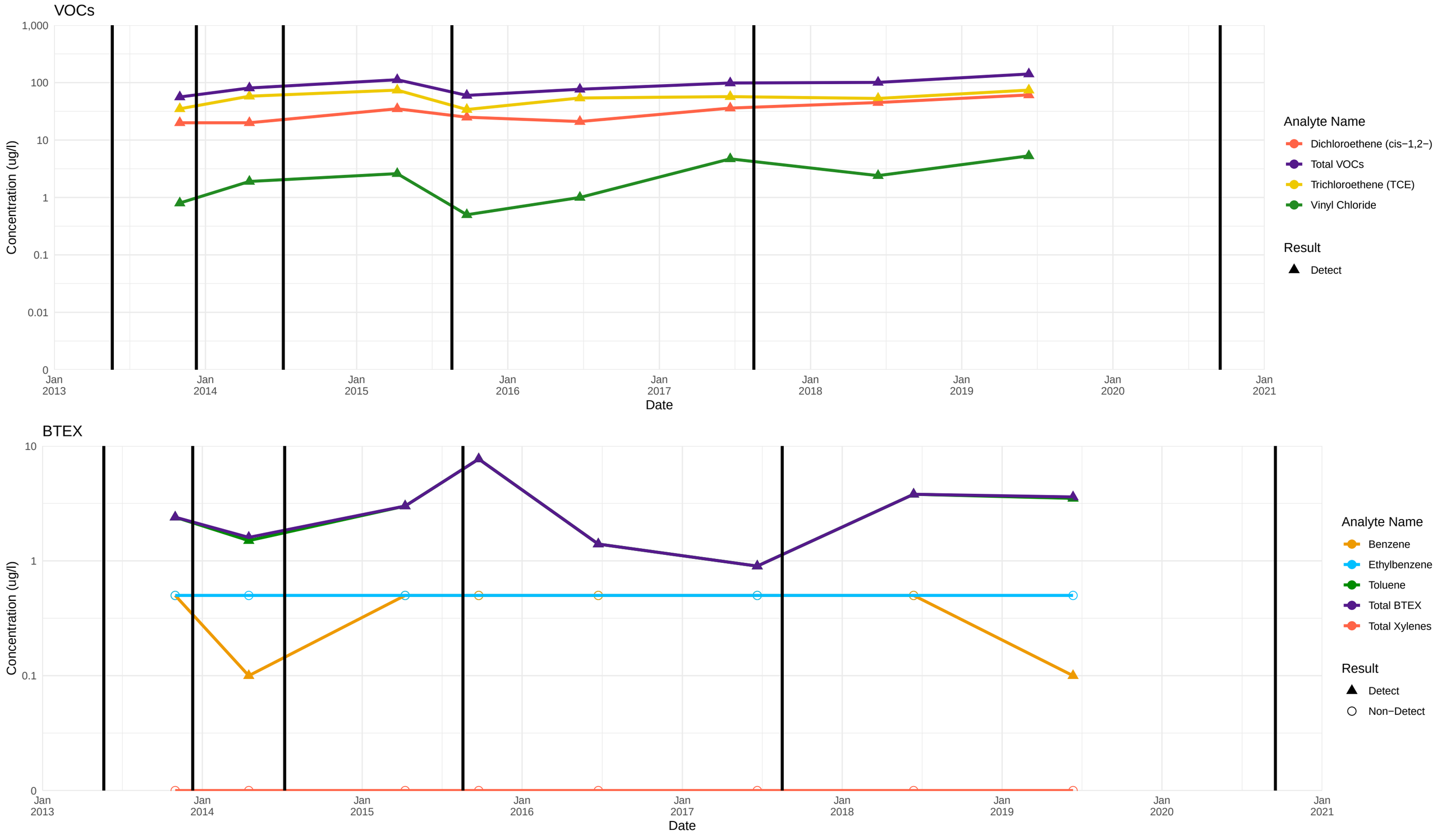
BP−12D Port 7

Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.



BP−13D Port 1

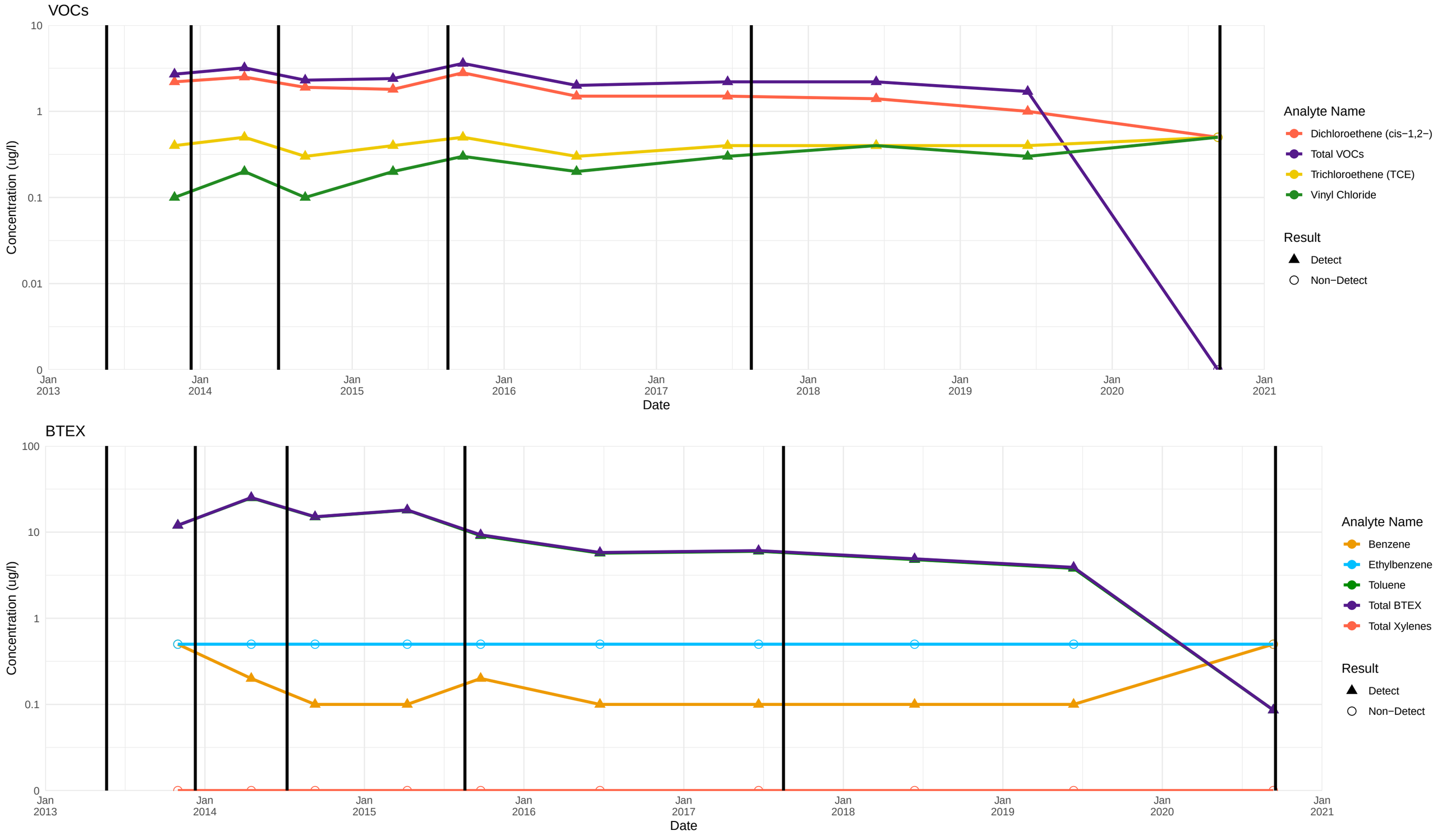
Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.



Sanborn, Head & Associates, Inc.

BP−13D Port 5

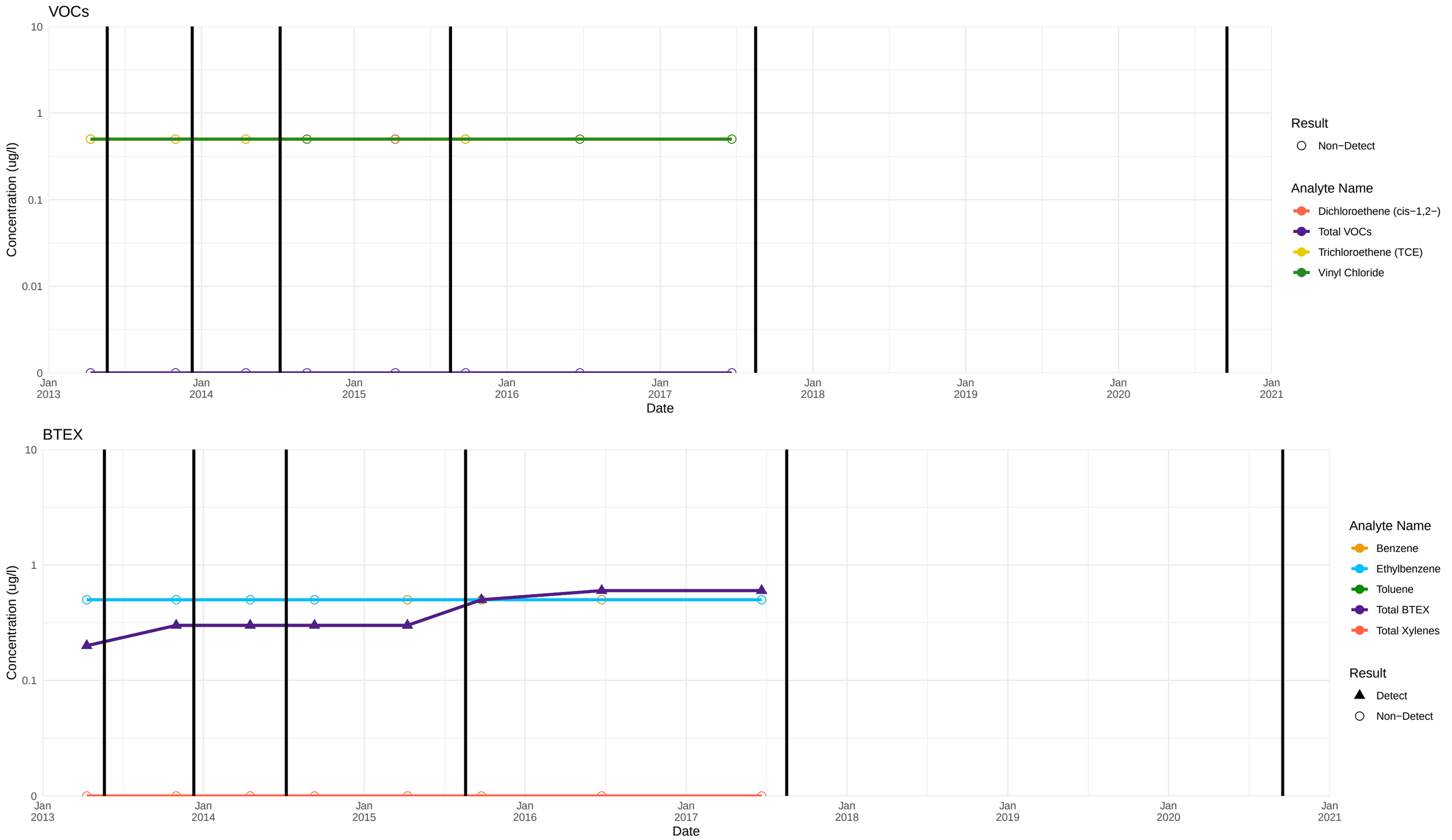
Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.



Sanborn, Head & Associates, Inc.

BP−14D Port 1

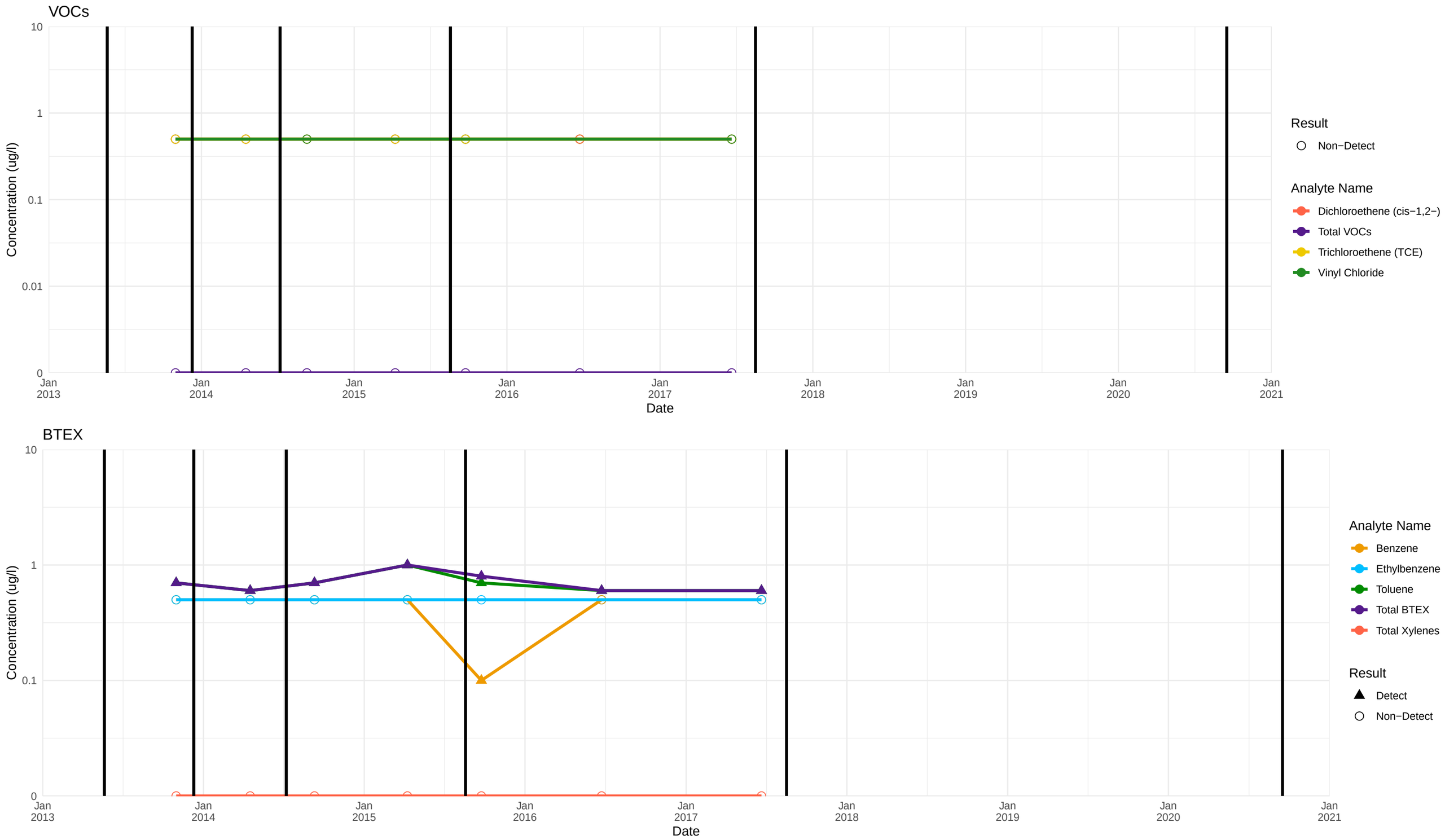
Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.



Sanborn, Head & Associates, Inc.

BP−14D Port 5

Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.



Sanborn, Head & Associates, Inc.

BP−15D Port 5

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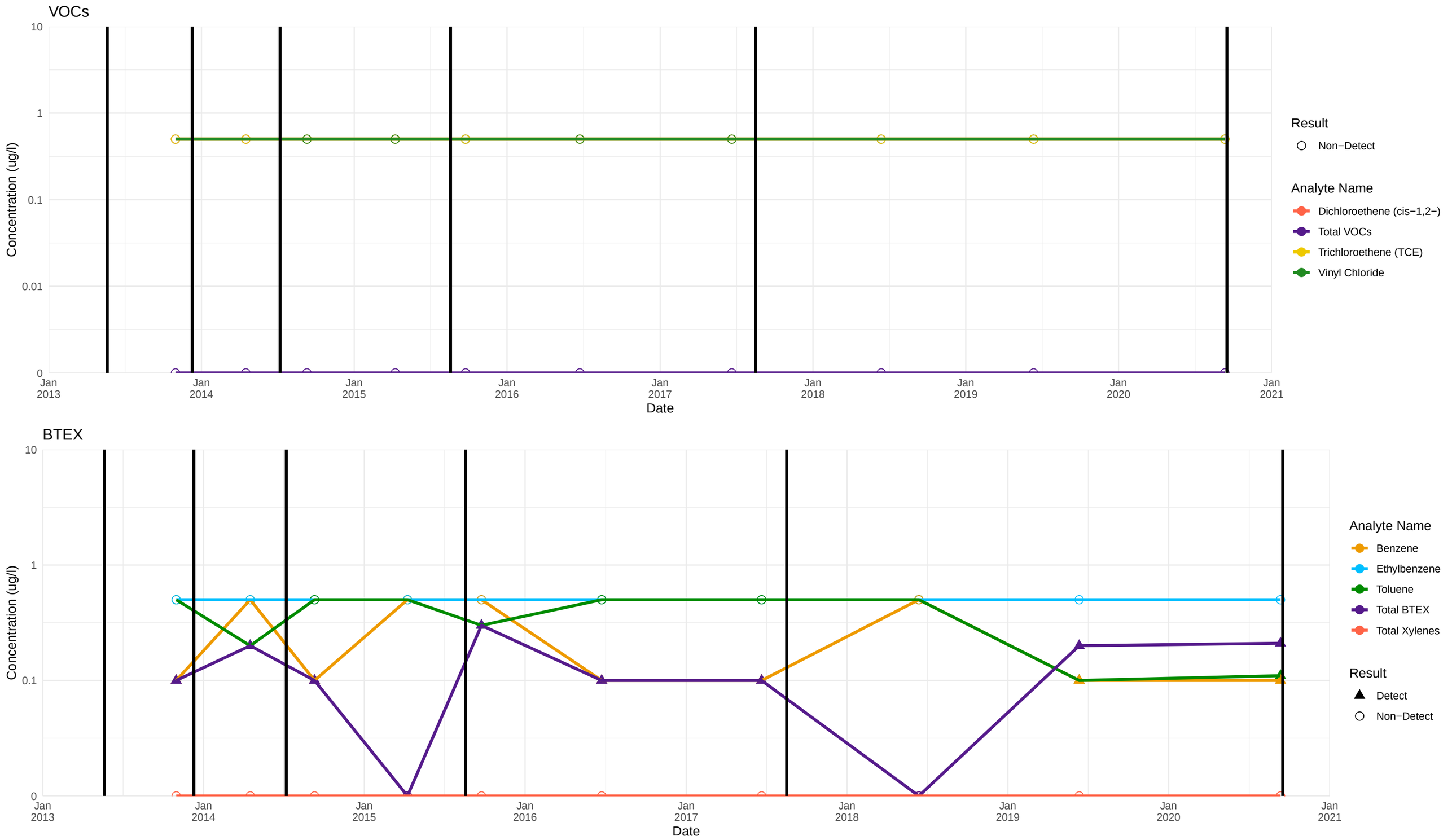
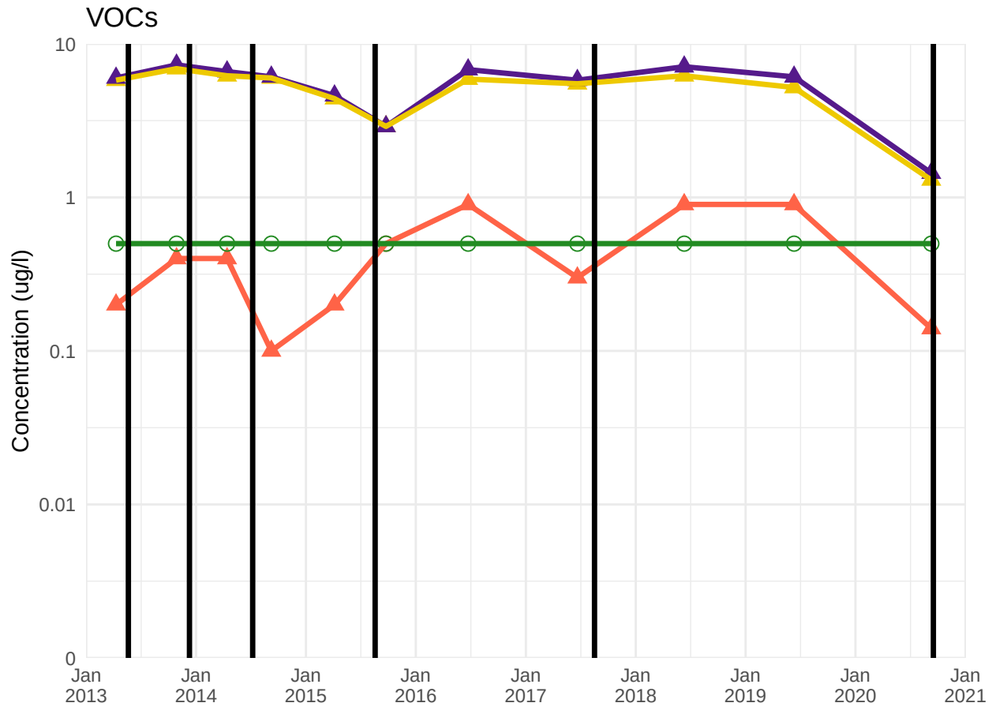
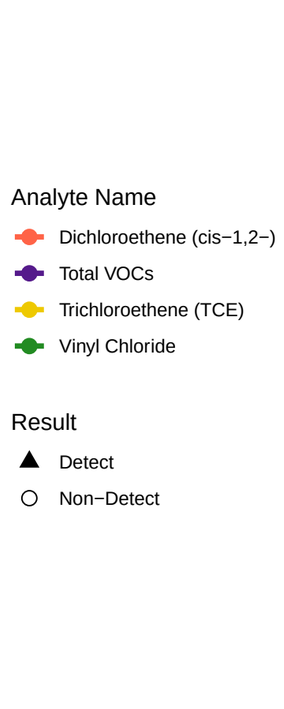


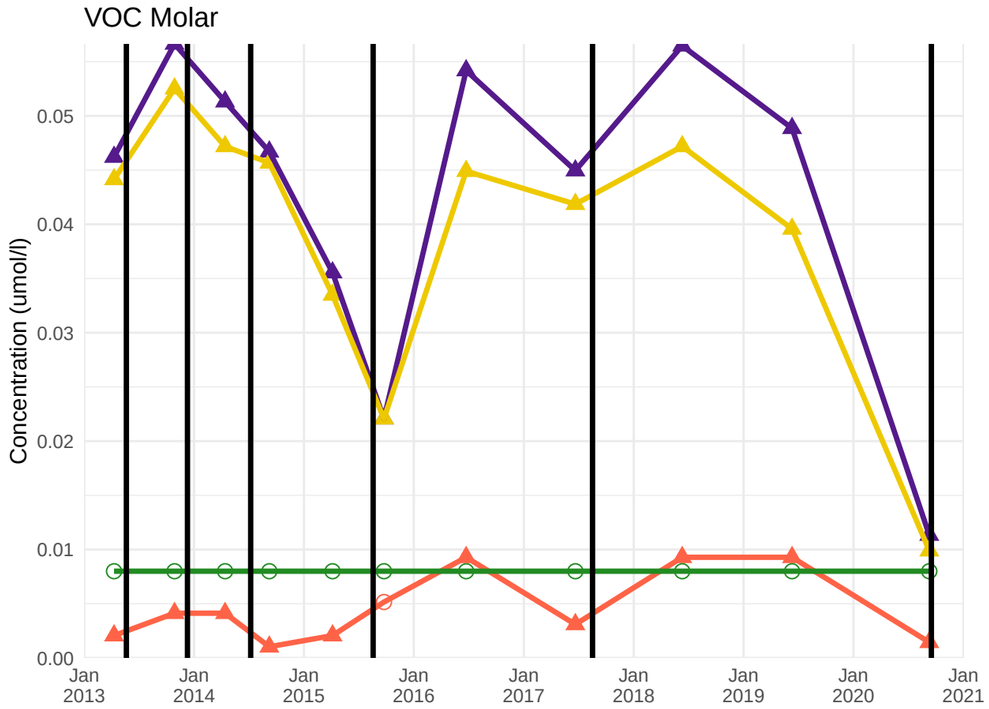
Sanborn, Head & Associates, Inc.

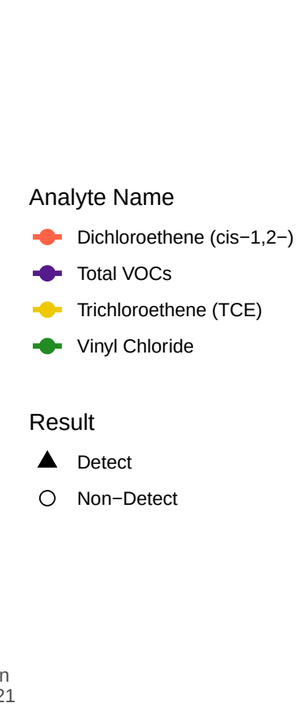
GC−2A

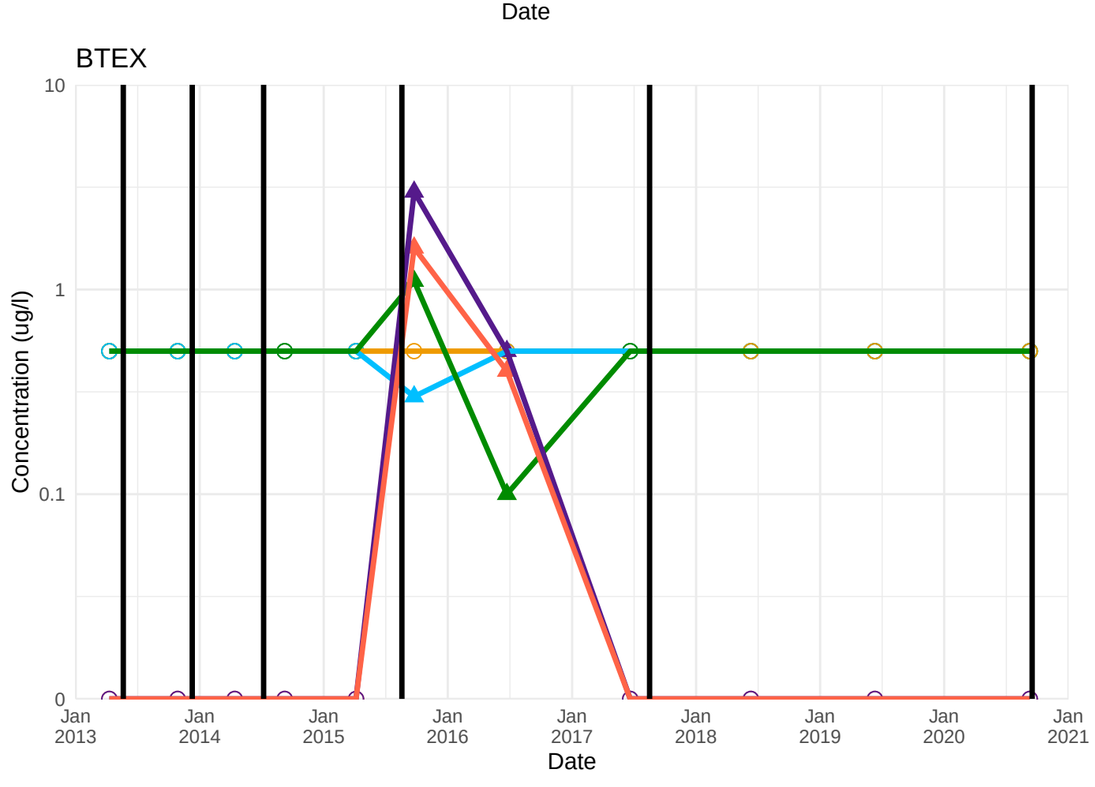
Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.

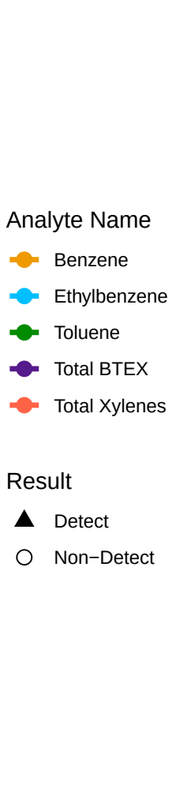


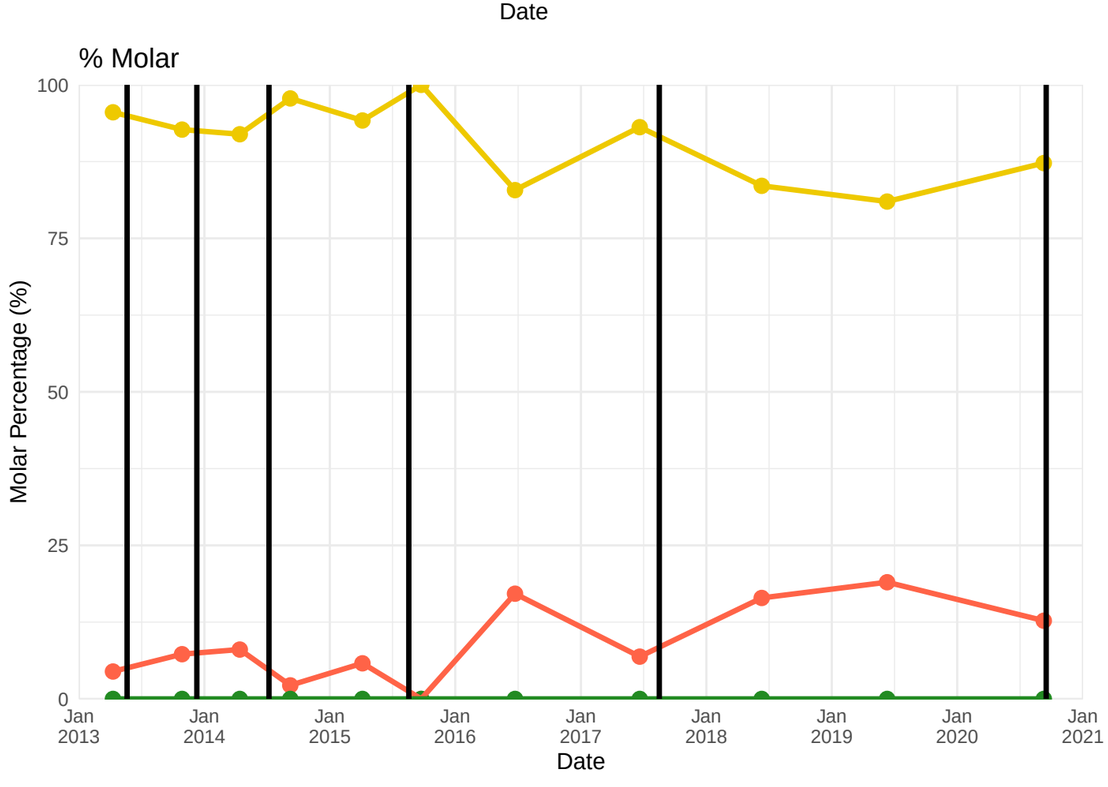


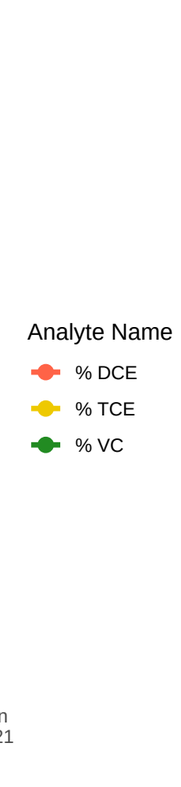






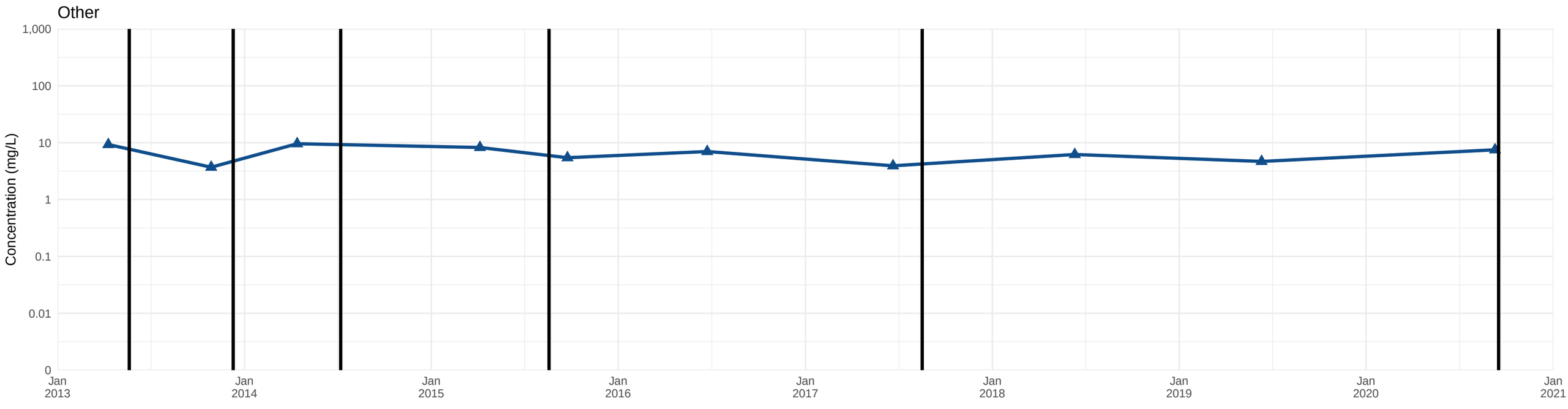


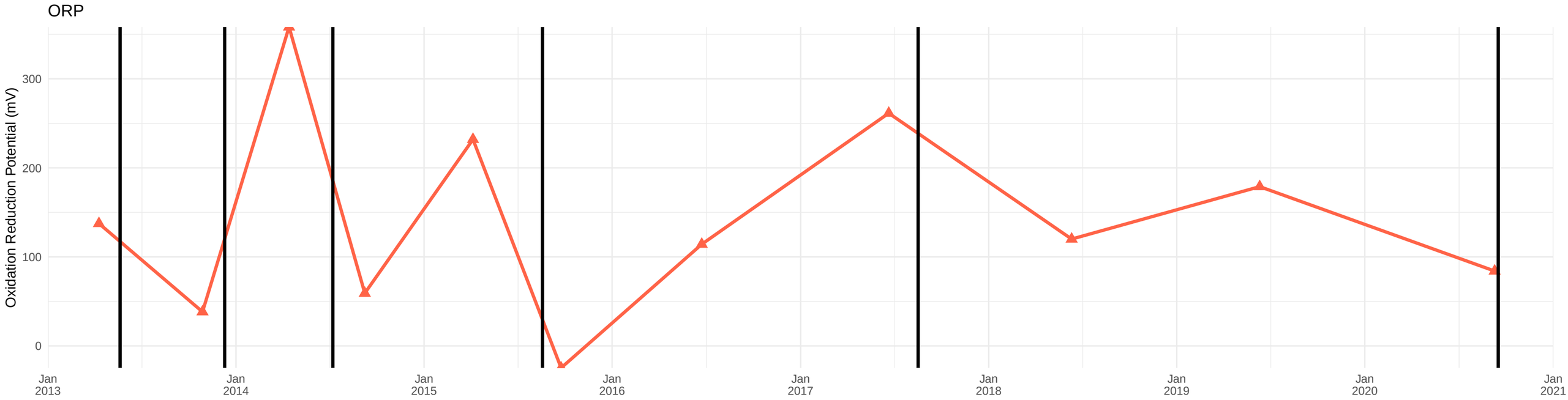




GC−2A

Notes: (1) Where applicable, non−detects are plotted at reporting limit. Summed (total) concentrations are plotted at zero.(2) Black vertical lines indicate amendment injection events.





NOVEMBER 2020 PERFORMANCE TESTING

SANBORN HEAD ENGINEERING

SANBORN HEAD ENGINEERING
Building Trust. Engineering Success.

Stephen Brown, P.E.
IBM Corporation
8976 Wellington Road
Manassas, VA 20109

January 13, 2021
File No. 3526.06

Re: Summary of November 2020 Water Quality Monitoring
IBM Gun Club – Former Burn Pit Area
Union, New York
NYSDEC Site #C704044 (BCA Index #B7-0661004-05)

Dear Mr. Brown:

This letter report summarizes the scope and results of remedy performance monitoring conducted in November 2020 on behalf of IBM by Sanborn Head. It describes the sampling event and provides tabular and figure summaries of the field and laboratory data. The field work was conducted during the week of November 9, 2020 in general accordance with the procedures described in Appendix J of the Site Management Plan (SMP).[1]

As previously approved by the New York State Department of Environmental Conservation (NYSDEC), the typical sampling schedule was adjusted for 2020 to occur in April, September, and November to accommodate supplemental forensic analysis using quantitative polymerase chain reaction (qPCR) microbial census and compound-specific isotope analysis (CSIA) conducted during times of warmer groundwater conditions, and to occur immediately before and after an edible oil injection event. The injection event was conducted the week of September 14, 2020 following the previous sampling event during the week of September 7, 2020.

This letter report will be included as a component of the annual Periodic Review Report, due in January 2021, and it has been prepared consistent with the Monitoring Reporting Requirements described in Section 3.6 of the SMP.

SCOPE OF WORK

The scope of work included:

- Comprehensive groundwater elevation survey. The monitoring network is shown on Figure 1;

[1] Site Management Plan – April 2016 Revision, Brownfield Cleanup Program, IBM Gun Club – Former Burn Pit area, Union, New York, NYSDEC Site #C704044, BCA Index #B7-0661004-05, prepared on behalf of IBM by Sanborn, Head & Associates, Inc., April 25, 2016.

- Water quality sampling and laboratory analysis associated with the performance monitoring program;
- Water quality parameter field screening; and
- Supplemental sampling and analyses to support evaluation of remediation progress and potential remedy improvements.

Groundwater Elevation Survey

From November 9 to 11, 2020, the depths to water in monitoring wells and injection boreholes were gauged in accordance with procedures described in Appendix G of the SMP. Based on the depth to water data and survey information, groundwater elevations were calculated for each location. Depth to water measurements and groundwater elevations are summarized in Table 1. Inferred groundwater elevation contours are shown on Figure 2.

Groundwater levels in November 2020 were slightly higher than those recorded in September 2020 but remained lower than typical. According to the National Weather Service, the Binghamton area recorded approximately one inch above average precipitation in the two months following the September 2020 sampling round. As shown on Figure 2, groundwater flow directions are generally consistent with historical monitoring and interpretation.

Water Quality Sampling

The scope of sampling as originally outlined in the SMP is included as Table 2. The scope was modified as follows:

- Samples were collected for laboratory geochemical analysis (i.e., total iron, ferrous iron, nitrate, sulfate, and sulfide) instead of in-situ field geochemical testing to improve efficiency;
- Due to insufficient water volume, the sample collected from BP-5A was collected via peristaltic pump, and the samples of field screening water quality parameters and volatile fatty acid samples were not collected;
- The passive diffusion bag (PDB) was inadvertently not re-installed in IB-7 following the injection event in September 2020; therefore, the November 2020 sample was collected via peristaltic pump; and
- No new on-site seeps/springs were observed. The seep sampling location 119 first noted adjacent to BP-9A in 2017 was dry in November 2020 and therefore was not sampled this round.

Exhibit 1 below summarizes the sampling methods used during the monitoring event. The quality assurance/quality control (QA/QC) samples collected for VOC analysis are summarized in Exhibit 2. Samples (including QA/QC samples) submitted for off-site laboratory analysis or field screening are tabulated in Exhibit 3. Laboratory and field analytical data are summarized in Table 3.

Exhibit 1 Summary of Sampling Methods

Sample Method	Number of Locations Sampled
Modified Low-Flow	14
Submerged Container (surface water)	4
Passive Diffusion Bag	4
FLUTE® Purge	0
Peristaltic Pump Grab	2
Purge Water Tote Sample	0

Exhibit 2 Summary of QA/QC Samples for VOC analysis

Total Sample Locations	24
Duplicate Samples	2
Matrix Spikes	1
Matrix Spike Duplicates	1
Field Blanks	3
Equipment Blanks	1
Trip Blanks	2

Exhibit 3 Summary of Analytical Type (includes QA/QC analyses)

Sample Type – Off-Site Laboratory	Laboratory	Number of Samples
VOCs	Eurofins	34
Total Organic Carbon	Eurofins	21
Geochemical Analyses	Eurofins	16
Volatile Fatty Acids	Pace	21
Light Gases (Ethane, Ethene, and Methane)	Pace	22
qPCR (Microbial census)	Microbial Insights	8

Equipment Calibration

Exhibit 4 below summarizes the field instruments utilized during field sampling. The instruments were calibrated each morning and a calibration check was performed at the end of each day. Daily calibration forms are kept on file and are available upon request.

Exhibit 4 Summary of Field Instrumentation

INSTRUMENT	FIELD PARAMETER
YSI Water Quality Parameter Probe	Temperature, pH, Specific Conductance, Dissolved Oxygen, and Oxidation-reduction Potential
HACH 2100P Turbidimeter	Turbidity

SUMMARY OF RESULTS

Geochemical and VOC Results

A summary of the groundwater quality data and inferences is presented on Figure 2. Figure 3 is an interactive PDF presenting the geochemical data used to infer the geochemical conditions shown on Figure 2. Attachment A includes time-series charts of key geochemical and VOC results. Field sampling records and analytical laboratory reports are kept on file and available upon request.

Enhanced biochemical degradation of VOCs in groundwater is being monitored by: 1) tracking changes in concentration of the parent contaminant compound, trichloroethene (TCE), 2) tracking the presence of breakdown products of TCE, including the terminal breakdown products ethene and ethane, 3) tracking the presence of geochemical conditions favorable to biochemical conditions by reductive dehalogenation, and 4) supplemental analysis (compound specific isotope analysis [CSIA]/quantitative polymerase chain reaction [qPCR]) to inform the mechanisms and rates for contaminant degradation.

The field and laboratory data for November 2020 reflect conditions approximately two months after the recent injection of edible oil amendment (i.e., electron donor to facilitate degradation) in September 2020. The results indicate remedy performance generally consistent with project performance goals established in the SMP, with some indications of potential changes noted below. Geochemical conditions generally remain within ranges that are favorable for reductive dechlorination over most of the source area and inferred core of the plume. As shown on Figure 2, the overall area of sulfate-reducing conditions, which are marginally conducive to reductive dechlorination, is reduced to the south, no longer encompassing BP-38A and BP-39A. Methanogenic conditions, which are more conducive to reductive dechlorination, are similar to conditions observed in September 2020, prior to the injection. Similar to past injections, there was not an immediate effect of increasing these areas or generating more favorable conditions. Except for the inferred reduction of methanogenic conditions between the A- and B-line injection boreholes first observed in April 2017, these areas have not drastically changed since the first injections in to the A-line and B-line, conducted in December 2013 and July 2014, respectively. Figure 3 presents the geochemical data used to infer the limits of sulfate-reduction and methanogenesis shown on Figure 2.

Exhibit 5 below presents the November 2020 monitoring results for select key parameters in comparison to the previous monitoring results of September 2020. TCE and terminal breakdown product (ethene and ethane) concentrations have exhibited a favorable change or remained stable in 58% and 63% of sampled wells, respectively, which is fewer than what was observed in September 2020 just before the injection. Similarly, geochemical data for oxidation-reduction potential (ORP) and dissolved oxygen (DO) indicate overall stable or less favorable conditions compared to September.

In November 2020, total organic carbon (TOC) concentrations greater than the 100 milligrams per liter (mg/l) ideal level for injection boreholes were measured at all the five sampled injection boreholes, compared to two in September 2020, consistent with the addition of a carbon source during the injection.

TOC levels at monitoring wells within the injection displacement zone were about the same as September levels, and generally consistent with historical observations. TOC concentrations in BP-36 have typically been influenced by injections; TOC increased in BP-36A by three orders of magnitude (OoM) about 2 months after the August 2015 injection, and by about a half OoM following the August 2017 injection. However, concentrations did not respond to the September 2020 injection, suggesting that carbon delivery may be reduced in this area. In general, TOC concentrations have been steadily declining in BP-36A

since the high of 906 milligrams per liter (mg/L) observed in September 2015. Other wells in the injection displacement zone have not historically exhibited an increase in TOC following injections. TOC concentrations in monitoring wells further downgradient were improved, especially at BP-6A and BP-9A, where about one order of magnitude increase in TOC concentrations were observed in November 2020 following the September 2020 injection. Marginal increases in TOC are typically observed in BP-6A following injections. The TOC concentration in BP-9A in November 2020 was the highest observed since monitoring began.

In general, the geochemical conditions at the site as shown on Figures 2 and 3 and Exhibit 5 indicate that the conditions continue to be favorable for biological degradation, however the geochemical response to the latest injection has been marginal and may indicate that carbon delivery is reduced in certain areas compared to previous injections.

Exhibit 5: November 2020 Results Compared to September 2020

Analyte	TCE	Ethene+Ethane	TOC	ORP	DO
	ug/L	ug/L	mg/L	mV	mg/L
Injection Boreholes					
IB-7	11	85	770		
A-13	170	3,700	390		
B-4	<50	72	1,000		
B-7	<500	420	390	33	0.33
B-9	<500	49.6	1,700		
Injection Displacement Zone					
BP-2A	75	17	6.3	-76	1.2
BP-4A	150	85	4.1	140	1.4
BP-13A	68	<1	1.8	430	4.5
BP-36A	3,300	480	3.5	-71	0.64
Downgradient - on site					
BP-1A	<250	<1	19	420	3.3
BP-5A	8.1	1.9			
BP-6A	790	1,400	280	81	0.87
BP-9A	17	190	23	-110	0.80
BP-34A	23,000	65	6.8	3.0	1.4
BP-35A	1,600	0.34	3.5	100	3.4
BP-37A	10	0.51	2.0	91	2.7
Downgradient - off site					
BP-31A	2.4	<1	0.80	94	5.4
BP-38A	38	<1	0.84	130	1.4
BP-39A	43	<1	1.6	190	5.2

Favorable Change	≥ 10% decline	≥ 10% increase	≥ 10% increase	≥ 10% decline	≥ 10% decline
Number of Wells	6	5	9	6	5
Stable	0 to ± 10%	0 to ± 10%	0 to ± 10%	0 to ± 10%	0 to ± 10%
Number of Wells	5	7	6	0	2
Unfavorable Change	≥ 10% increase	≥ 10% decline	≥ 10% decline	≥ 10% increase	≥ 10% increase
Number of Wells	8	7	3	8	7

Concentrations shown from November 2020 sampling event, rounded to 2 sig. figures.
Blank cell indicates lack of data in one or both events.

While the monitored in-situ remediation approach for the site has been and continues to be effective, IBM is voluntarily proceeding with an optimization evaluation of the September 2020 injection event, which will assess the overall effects of the injection, supplemental forensic analysis (qPCR/CSIA), and feasibility-level evaluations of potential improvements to the remedy. The above-described voluntary remedial optimization assessment is expected to be submitted to NYSDEC in early Q3 2021.

CSIA and qPCR Results

The results of the qPCR census and CSIA are presented in Table 4. Figure 4 is an interactive PDF presenting the qPCR results. The qPCR includes the population of *dehalococcoides* (DHC), and their associated functional genes that can be responsible for reductive dehalogenation of TCE (tceA), DCE+VC (vcrA), VC (bvcaA).

Additionally, populations of other microbes (*Dehalobacter* [DHBt], *Desulfitobacterium* [DSB], and *Desulfuromonas* [DSM]) capable of reductive dehalogenation, a functional gene that supports aerobic co-metabolic pathways (soluble methane monooxygenase [SMMO], and a methane competitor (MGN) that can adversely influence reductive dehalogenation, were also quantified. A brief summary of the qPCR results is presented below:

- **DHC -** DHC are bacteria that are known to be important for reductive dehalogenation. Concentrations higher than the threshold of $1x10^4$ cells/mL thought to be conducive to reductive dehalogenation were observed at two wells (BP-6A and BP-36A) in November 2020, the same as September 2020. However, overall concentration trends in November 2020 indicate DHC increasing or stable at 7 out of 8 locations compared to September 2020.

- **DHC Functional genes** – In general, the presence of functional genes confirms reductive dehalogenation of each compound is occurring. However, the absence of functional genes does not necessarily mean that reductive dehalogenation is not occurring; rather, it means that it was not measurable based on this line of evidence.

  - ***tceA (TCE functional gene)*** – In September 2020, tceA was detected at three locations, at increased levels compared to September 2020. Overall, continued low tceA counts suggest there are limited rates of reductive dehalogenation of TCE.

  - ***vcrA (DCE+VC functional gene)*** – In November 2020, vcrA was detected at concentrations similar to past monitoring and at levels that are suggestive of moderate levels of reductive dehalogenation.

  - ***bvcaA (VC functional gene)*** – In November 2020, bvcaA was detected above laboratory reporting limits in only one well (BP-39A), suggesting there is limited evidence for reductive dehalogenation of VC. We note that this finding is not consistent with the results from the vcrA results, which suggest that VC is being degraded, and with the documented presence of ethene/ethane, which is produced when VC is degraded.

- **DHBt, DSB, DSM –** A selection of locations[2] were analyzed for supplemental bacteria, in addition to DHC, also known to contribute to reductive dehalogenation. DHBt and DSB were found at levels above the beneficial threshold at BP-6A. Most were detected in sampled wells, however, at levels below the beneficial threshold. In general, concentration of these bacteria increased from April to November.

[2] BP-6A, BP-30A, BP-39A, B-7

- **MGN** – Methanogens are competitor microbes to DHC, and their presence may inhibit reductive dehalogenation. Methanogens should be distinguished from methanogenic subsurface geochemical conditions. Methanogenic geochemical conditions (i.e., conditions capable of producing methane) are conducive to reductive degradation, while the presence of methanogens could be detrimental. In November 2020, methanogens were detected in all but one location (BP-34A), which may suggest downward pressure on DHC populations. Additionally, concentrations increased compared to September 2020 levels.

- **SMMO** – the presence of functional gene SMMO may indicate the presence of aerobic microbial activity that can degrade TCE and VC. SMMO was generally not detected, suggesting this pathway may not be materially contributing to degradation.

The CSIA results from April, September, and November 2020 samples are presented in Figures 5A – 5C. These data are fit with a linear regression. In general, a trend of more positive numbers moving from high concentration areas to low concentration areas (i.e., from right to left as plotted on the Figure 5 charts) suggests evidence of reductive dehalogenation. A negative slope is indicative of reductive dehalogenation, while limited to no slope suggest other attenuation mechanisms (e.g., dilution, dispersion, sorption, volatilization) are responsible for the reduction in concentrations. Linear regressions of CSIA data for TCE, DCE, and VC from samples collected in November 2020 are all negative, suggesting reductive dehalogenation is occurring.

Most notably, the slope of linear regression for TCE in April was generally flat, and is noticeably negative for September and November results, suggesting stronger evidence of reductive dehalogenation in the fall compared to April. However, the overall data for TCE show that values for November are more negative compared to September (i.e., the linear fit for November falls below the line for September), suggesting less degradation occurring in November compared to September. There is no apparent trend for cDCE and VC values from September to November.

CLOSING

In summary, the November 2020 monitoring data collectively continue to support that degradation of CVOCs is occurring. However, effects of the September 2020 injection were not immediately apparent in observed VOC concentrations or geochemical conditions, apart from higher TOC concentrations in the injection boreholes and at select downgradient wells. The effects of the injection will be assessed again following the April 2021 sampling event, approximately seven months following the injection. A remedy optimization assessment report to be submitted in early Q3 2021 will evaluate the most recent injection and a full year of supplemental forensic analysis and will also provide a feasibility analysis of potential remedy improvements.

Please contact us if you have any questions.

Very truly yours,
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Encl. Table 1 Summary of November 2020 Water Level Data
Table 2 Scope of Routine and Performance Monitoring Program
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Figure 1 Monitoring Location Plan
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Figure 4 November 2020 Summary of qPCR
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Attachment A Time-series charts of select compounds

P:\3500s\3526.02\Source Files\202011 Trip Report\20210112 Nov 2020 Data Rpt.docx

TABLES

Table 1
Summary of November 2020 Water Level Data
Summary Trip Report
IBM Gun Club - Former Burn Pit Area
Union, New York

Well Location	Reference Elevation (ft amsl)	Depth to Water (ft Ref. Pt.)	Equivalent Potentiometric Elevation (ft amsl)
A-1	1391.11	6.25	1384.86
A-2	1390.68	6.54	1384.14
A-3	1392.74	4.60	1388.14
A-4	1397.56	6.07	1391.49
A-5	1397.40	8.88	1388.52
A-6	1397.86	4.25	1393.61
A-7	1397.28	2.67	1394.61
A-8	1396.81	1.20	1395.61
A-9	1396.47	4.85	1391.62
A-10	1396.06	2.14	1393.92
A-11	1395.73	11.04	1384.69
A-12	1395.59	11.93	1383.66
A-13	1394.25	17.58	1376.67
A-14	1394.61	2.40	1392.21
A-15	1393.47	3.79	1389.68
A-16	1398.14	9.23	1388.91
A-17	1395.48	11.51	1383.97
B-1	1385.26	12.57	1372.69
B-2	1384.71	10.90	1373.81
B-3	1385.48	8.23	1377.25
B-4	1385.03	7.71	1377.32
B-5	1383.99	11.13	1372.86
B-6	1384.48	8.59	1375.89
B-7	1385.33	6.35	1378.98
B-7	1385.33	6.35	1378.98
B-8	1384.90	2.31	1382.59
B-9	1385.21	5.78	1379.43
B-10	1384.69	5.83	1378.86
B-11	1384.40	8.13	1376.27
B-12	1383.87	7.91	1375.96
B-13	1384.50	7.46	1377.04
BP-1A	1395.67	16.91	1378.76
BP-2A	1396.89	14.09	1382.80
BP-4A	1391.96	14.64	1377.32
BP-5A	1391.09	16.80[†]	1374.29
BP-6A	1393.95	17.63	1376.32
BP-7A	1388.89	13.89	1375.00
BP-8A	1384.53	15.48	1369.05
BP-9A	1379.17	13.09	1366.08
BP-10A	1381.74	13.99	1367.75
BP-11A	1384.80	12.63	1372.17
BP-12A	1386.64	15.26	1371.38
BP-13A	1398.89	14.88	1384.01
BP-14A	1379.46	29.47	1349.99
BP-15A	1388.32	Dry	
BP-16A	1389.69	12.97	1376.72
BP-17A	1376.30	13.24	1363.06

Table 1
Summary of November 2020 Water Level Data
Summary Trip Report
IBM Gun Club - Former Burn Pit Area
Union, New York

Well Location	Reference Elevation (ft amsl)	Depth to Water (ft Ref. Pt.)	Equivalent Potentiometric Elevation (ft amsl)
BP-18A	1386.54	17.46	1369.08
BP-19A	1309.40	21.69	1287.71
BP-20A	1274.60	6.42	1268.18
BP-21A	1244.29	10.81	1233.48
BP-22A	1242.90	8.04	1234.86
BP-23A	1333.39	13.92	1319.47
BP-24A	1338.73	14.32	1324.41
BP-25A	1301.92	4.51	1297.41
BP-26A	1336.96	15.10	1321.86
BP-27A	1299.96	4.68	1295.28
BP-30A	1336.20	13.00	1323.20
BP-30A	1336.20	13.04	1323.16
BP-31A	1369.63	13.73	1355.90
BP-32A	1389.58	14.69	1374.89
BP-34A	1392.55	18.30	1374.25
BP-35A	1391.75	18.42	1373.33
BP-36A	1383.68	14.10	1369.58
BP-37A	1389.92	10.93	1378.99
BP-38A	1375.10	13.97	1361.13
BP-39A	1370.17	9.25	1360.92
GC-2A	1383.32	22.59	1360.73
IB-1	1392.20	7.29	1384.91
IB-2	1393.47	8.52	1384.95
IB-3	1393.07	10.36	1382.71
IB-4	1393.78	8.84	1384.94
IB-5	1393.88	16.02	1377.86
IB-6	1393.05	8.11	1384.94
IB-7	1393.23	8.24	1384.99
IB-8	1393.43	11.44	1381.99
IB-9	1393.62	8.61	1385.01

Notes:

1. This table summarizes depth to water measurements and calculated water table elevations recorded during the November performance monitoring round on November 9-11, 2020. Measurements were collected relative to the marked reference point at each location using a QED MP30 water level meter.

2. Abbreviations:
ft amsl = feet above mean sea level
ft Ref. Pt. = feet below well reference point.

3. "†" Water level below top of pump

Table 2
Summary of Routine and Performance Monitoring Program
IBM Gun Club - Former Burn Pit Area
Union, New York

Monitoring Type	Monitoring Location	Monitoring Location Type	Sample Method				Analytical Laboratory											Field Screening
			Low Flow	PDBs	Nitrogen Purge	Surface Water	VOCs	Light Gasses	TOC	VFAs	Total Iron	Ferrous Iron	Nitrate	Sufate	Sulfide	qPCR	CSIA	Water Quality Parameters
Routine Monitoring (September 2020)	BP-7A	Monitoring Well		x			x											x
	BP-8A	Monitoring Well		x			x											x
	BP-10A	Monitoring Well		x			x											x
	BP-11A	Monitoring Well		x			x											x
	BP-12A	Monitoring Well		x			x											x
	BP-14A	Monitoring Well		x			x											x
	BP-16A	Monitoring Well		x			x											x
	BP-17A	Monitoring Well		x			x											x
	BP-18A	Monitoring Well		x			x											x
	BP-19A	Monitoring Well		x			x											x
	BP-20A	Monitoring Well		x			x											x
	BP-21A	Monitoring Well		x			x											x
	BP-22A	Monitoring Well		x			x											x
	BP-23A	Monitoring Well		x			x											x
	BP-24A	Monitoring Well		x			x											x
	BP-25A	Monitoring Well		x			x											x
	BP-26A	Monitoring Well		x			x											x
	BP-27A	Monitoring Well		x			x											x
	BP-32A	Monitoring Well		x			x											x
	GC-2A	Monitoring Well		x			x											x
	GC-1, P-1	Multi-Depth			x		x											x
	GC-1, P-8	Multi-Depth			x		x											x
	BP-12D, P1	Multi-Depth			x		x											x
	BP-12D, P7	Multi-Depth			x		x											x
	BP-13D, P1	Multi-Depth			x		x											x
	BP-13D, P5	Multi-Depth			x		x											x
	BP-15D, P1	Multi-Depth			x		x											x
	BP-15D, P5	Multi-Depth			x		x											x
Performance Monitoring (April, September, and November 2020)	IB-7	Injection Borehole		x			x	x	x	x								
	A-13	Injection Borehole		x			x	x	x	x								
	B-4	Injection Borehole		x			x	x	x	x								
	B-7	Injection Borehole	x	x			x	x	x	x	x	x	x	x	x	x	x	x
	B-9	Injection Borehole		x			x	x	x	x								
	BP-1A	Monitoring Well	x				x	x	x	x	x	x	x	x	x			x
	BP-2A	Monitoring Well	x				x	x	x	x	x	x	x	x	x			x
	BP-4A	Monitoring Well	x				x	x	x	x	x	x	x	x	x			x
	BP-5A	Monitoring Well	x				x	x	x	x	x	x	x	x	x			x
	BP-6A	Monitoring Well	x				x	x	x	x	x	x	x	x	x	x	x	x
	BP-9A	Monitoring Well	x				x	x	x	x	x	x	x	x	x	x	x	x
	BP-13A	Monitoring Well	x				x	x	x	x	x	x	x	x	x			x
	BP-30A	Monitoring Well	x	x			x	x	x	x	x	x	x	x	x	x	x	x
	BP-31A	Monitoring Well	x				x	x	x	x	x	x	x	x	x			x
	BP-34A	Monitoring Well	x				x	x	x	x	x	x	x	x	x	x	x	x
	BP-35A	Monitoring Well	x				x	x	x	x	x	x	x	x	x	x	x	x
	BP-36A	Monitoring Well	x				x	x	x	x	x	x	x	x	x	x	x	x
	BP-37A	Monitoring Well	x				x	x	x	x	x	x	x	x	x			x
	BP-38A	Monitoring Well	x				x	x	x	x	x	x	x	x	x			x
	BP-39A	Monitoring Well	x				x	x	x	x	x	x	x	x	x	x	x	x
	111	Seep/spring				x	x											x
	112	Seep/spring				x	x											x
	113	Seep/spring				x	x											x
	118	Seep/spring				x	x											x
	SW-Z	Seep/spring				x	x											x
		Total	**16**	**26**	**8**	**5**	**53**	**20**	**20**	**20**	**16**	**16**	**16**	**16**	**16**	**8**	**8**	**49**

Notes:
1. This table is intended to summarize the programs of routine and performance monitoring for remedy operations at the IBM Gun Club - Former Burn Pit Area. Additional monitoring points may be sampled based on field observations. "SW-Z" serves as a placeholder for sampling any on-site seep or spring that can be reasonably sampled. The table summarizes sample method, analytical laboratory analysis, and field screening.

2. Sample method:
"Low Flow" indicates samples will be collected by bladder pump using low flow techniques.
"PDBs" indicates that the well has sufficient water column to sample with passive diffusion bags - if conditions are observed to be different than anticipated, sampling will proceed using low flow techniques.
"Nitrogen purge" indicates that sample will be collected by purging the multi-level port with nitrogen (multi-level systems only).
"Surface water" samples will be collected using a clean glass vial.

3. Analytical laboratory samples:
"VOCs" indicates volatile organic compounds.
"Light gasses" includes methane, ethene and ethane.
"TOC" indicates total organic carbon.
"VFAs" indicates volatile fatty acids.
"qPCR" indicates quantitative polymerase chain reaction analysis (DNA-based analysis to quantify specific microorganisms and functional genes responsible for biodegradation)
"CSIA" indicates compound-specific isotope analysis (ratio of stable carbon isotopes in TCE, cDCE, and VC)

4. " Water quality parameters" indicates screening during well purging and water quality sampling by multi-parameter probes, e.g. by YSI® 556 multi-Probe meter or similar and HACH® turbidity meter or similar (low flow, multi-level system, bailer, and surface water sampling) or by water quality parameter sounding (PDB sampling). The water quality parameters may include temperature, specific conductance, oxidation-reduction potential, dissolved oxygen, pH, and turbidity. In addition surface water samples will include water clarity descriptors (transparency, translucence, or opaqueness, and color).

TABLE 3
SUMMARY OF NOVEMBER 2020 PERFORMANCE MONITORING
Summary Trip Report
IBM Gun Club - Former Burn Pit Area
Union, New York

Analyte Name	Unit	BP-1A BP-1A Low Flow S 11/11/2020	BP-2A BP-2A Low Flow S 11/11/2020	BP-4A BP-4A Low Flow S 11/11/2020	BP-4A BP-4A_FD Low Flow FD 11/11/2020	BP-5A BP-5A Low Flow S 11/11/2020	BP-6A BP-6A Low Flow S 11/11/2020	BP-9A BP-9A Low Flow S 11/11/2020	BP-13A BP-13A Low Flow S 11/11/2020	BP-30A BP-30A Low Flow S 11/10/2020	BP-31A BP-31A Low Flow S 11/10/2020	BP-34A BP-34A Low Flow S 11/11/2020	BP-35A BP-35A Low Flow S 11/10/2020	BP-36A BP-36A Low Flow S 11/10/2020	BP-36A BP-36A_FD Low Flow FD 11/10/2020	BP-37A BP-37A Low Flow S 11/11/2020	BP-38A BP-38A Low Flow S 11/10/2020	BP-39A BP-39A Low Flow S 11/10/2020
VOLATILE ORGANIC COMPOUNDS (VOCs)																		
Trichloroethene (TCE)	µg/l	<250	**75**	**110**	**150**	**8.1**	**790**	**17**	**68**	**2.1**	**2.4**	**23,000**	**1,600**	**3,300**	**2,900**	**10**	**38**	**43**
Dichloroethene (cis-1,2-)	µg/l	**110 J**	**660**	**77**	**59**	**8.5**	**21,000**	**1,000**	**1.8**	**4.0**	**0.39 J**	**34,000**	**2,600**	**7,800**	**7,300**	**1.3**	**9.9**	**44**
Dichloroethene (trans-1,2-)	µg/l	<250	**2.2 J**	<1.0	**0.59 J**	<2.5	<250	**6.4 J**	<0.50	<0.50	<0.50	<250	**3.8 J**	**20 J**	**50**	<0.50	<1.0	**0.18 J**
Dichloroethene (1,1-)	µg/l	<250	<5.0	**0.60 J**	**0.72 J**	<2.5	<250	**3.3 J**	**0.14 J**	<0.50	<0.50	**65 J**	**4.5 J**	**23 J**	**40 J**	<0.50	<1.0	**0.068 J**
Tetrachloroethene (PCE)	µg/l	<250	<5.0	<1.0	<1.0	<2.5	<250	<10	**0.065 J**	**1.2**	**0.27 J**	<250	<25	<50	<50	<0.50	<1.0	<0.50
Vinyl chloride	µg/l	<250	**29**	**10**	**9.9**	**2.2 J**	**6,600**	**230**	<0.50	<0.50	<0.50	**260**	<25	**1,000**	**1,900**	<0.50	<1.0	<0.50
LIGHT GASSES																		
Ethane	µg/l	<1	<1	**55**	**51**	<1	**1.0**	**32**	<1	<1	<1	**2.6**	<1	**28**	**29**	<1	<1	<1
Ethene	µg/l	<1	**17**	**30**	**28**	**1.9**	**1,400**	**160**	<1	<1	<1	**62**	**0.34 J**	**450**	**440**	**0.51 J**	<1	<1
Methane	µg/l	**8.1**	**110**	**7,300**	**6,800**	**5.5**	**40**	**12,000**	**4.1 J**	**4.1 J**	**3.9 J**	**480**	**11**	**8,800**	**9,200**	**38**	**4.1 J**	**4.8 J**
MOLAR CONCENTRATION																		
Trichloroethene (TCE)	µmol/l	ND	0.57	0.84	1.1	0.062	6.0	0.13	0.52	0.016	0.018	180	12	25	22	0.076	0.29	0.33
Dichloroethene (cis-1,2-)	µmol/l	1.1	6.8	0.79	0.61	0.088	220	10	0.019	0.041	0.0040	350	27	80	75	0.013	0.10	0.45
Dichloroethene (trans-1,2-)	µmol/l	ND	0.023	ND	0.0061	ND	ND	0.066	ND	ND	ND	ND	0.039	0.21	0.52	ND	ND	0.0019
Dichloroethene (1,1-)	µmol/l	ND	ND	0.0062	0.0074	ND	ND	0.034	0.0014	ND	ND	0.67	0.046	0.24	0.41	ND	ND	0.00070
Tetrachloroethene (PCE)	µmol/l	ND	ND	ND	ND	ND	ND	ND	0.00039	0.0072	0.0016	ND	ND	ND	ND	ND	ND	ND
Vinyl chloride	µmol/l	ND	0.46	0.16	0.16	0.035	110	3.7	ND	ND	ND	4.2	ND	16	30	ND	ND	ND
Ethane	µmol/l	ND	ND	1.8	1.7	ND	0.033	1.1	ND	ND	ND	0.086	ND	0.93	0.96	ND	ND	ND
Ethene	µmol/l	ND	0.61	1.1	1.0	0.068	50	5.7	ND	ND	ND	2.2	0.012	16	16	0.018	ND	ND
Total	µmol/l	1.1	8.5	4.7	4.6	0.25	380	21	0.54	0.064	0.024	540	39	140	150	0.11	0.39	0.78
MOLAR PERCENTAGE																		
TCE	%	ND	6.7	18	25	24	1.6	0.62	96	25	76	33	31	18	15	71	74	42
DCEs	%	100	81	17	13	35	58	50	3.7	64	17	65	69	58	51	12	26	58
VC	%	ND	5.5	3.4	3.4	14	29	18	ND	ND	ND	0.77	ND	11	20	ND	ND	ND
Ethane+Ethene	%	ND	7.2	62	58	27	13	32	ND	ND	ND	0.43	0.031	12	11	17	ND	ND
VOLATILE FATTY ACIDS																		
Acetic Acid	mg/l	**6.8**	**1.6 J**	**0.38 J**	**0.38 J**	**–**	**15 J**	**37**	**0.39 J**	**0.40 J**	**0.31 J**	**0.60**	**0.38 J**	**0.87 J**	**0.55**	**0.34 J**	**0.37 J**	**0.55**
Butyric Acid	mg/l	<5	<2.5	<0.5	<0.5	**–**	<25	**0.61**	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5
Hexanoic Acid	mg/l	**0.65 J**	**0.36 J**	<0.5	<0.5	**–**	<25	**0.28 J**	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5
i-Hexanoic Acid	mg/l	<5	<2.5	<0.5	<0.5	**–**	<25	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5
i-Pentanoic Acid	mg/l	<5	<2.5	<0.5	<0.5	**–**	<25	**0.078 J**	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5
Lactic Acid	mg/l	<5	<2.5	**0.061 J**	**0.054 J**	**–**	<25	<0.5	**0.053 J**	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5
Pentanoic Acid	mg/l	<5	<2.5	<0.5	<0.5	**–**	<25	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5
Propionic Acid	mg/l	<5	<2.5	<0.5	<0.5	**–**	<25	**2.1**	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5
Pyruvic Acid	mg/l	<5	<2.5	<0.5	<0.5	**–**	<25	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5
OTHER LABORATORY DATA																		
Carbon Tetrachloride	µg/l	<250	<5.0	<1.0	<1.0	<2.5	<250	<10	**1.5**	**0.29 J**	<0.50	<250	<25	<50	<50	**0.12 J**	**0.58 J**	**0.17 J**
Total Organic Carbon	mg/l	**19**	**6.3**	**3.1**	**4.1**	**–**	**280**	**23**	**1.8**	**2.0**	**0.80 J**	**6.8**	**3.5**	**3.5**	**3.2**	**2.0**	**0.84 J**	**1.6**
WATER QUALITY PROBE DATA																		
Temperature	°C	**15**	**15**	**15**	**–**	**–**	**14**	**14**	**14**	**17**	**12**	**14**	**16**	**12**	**–**	**15**	**15**	**13**
Specific Conductance	uS/cm	**2,900**	**1,300**	**1,200**	**–**	**–**	**12,000**	**470**	**260**	**130**	**380**	**1,300**	**920**	**770**	**–**	**710**	**400**	**180**
pH	s.u.	**7.2**	**6.6**	**7.4**	**–**	**–**	**6.7**	**7.4**	**6.5**	**5.9**	**7.7**	**7.1**	**7.6**	**7.0**	**–**	**6.8**	**6.9**	**6.2**
Oxidation/Reduction Potential	mV	**420**	**-76**	**140**	**–**	**–**	**81**	**-110**	**430**	**220**	**94**	**3.0**	**100**	**-71**	**–**	**91**	**130**	**190**
Dissolved Oxygen	mg/l	**3.3**	**1.2**	**1.4**	**–**	**–**	**0.87**	**0.80**	**4.5**	**5.5**	**5.4**	**1.4**	**3.4**	**0.64**	**–**	**2.7**	**1.4**	**5.2**
Turbidity	NTU	**3.2**	**2.6**	**0.61**	**–**	**–**	**8.8**	**15**	**2.4**	**2.0**	**4.5**	**6.2**	**2.0**	**0.90**	**–**	**0.76**	**1.1**	**3.1**
GEOCHEMISTRY																		
Iron	mg/l	**0.33**	**6.6**	**0.085 J**	**–**	**0.066 J**	**9.8**	**0.22**	<0.20	**0.050 J**	**0.075 J**	**0.12 J**	**0.073 J**	**4.3**	**–**	<0.20	<0.20	**0.13 J**
Iron - Ferrous	mg/l	**0.023 J**	**6.1**	**0.020 J**	**–**	**0.17**	**11**	<0.050	<0.050	**0.015 J**	<0.050	**0.13**	**0.016 J**	**4.0**	**–**	<0.050	<0.050	<0.050
Nitrate	mg/l	**1.2**	**0.54**	<0.50	**–**	**1.1**	<0.50	<0.50	<0.50	**0.54**	**0.32 J**	<0.50	**0.45 J**	<0.50	**–**	<0.50	<0.50	**1.1**
Sulfate	mg/l	**260**	**82**	**24**	**–**	**330**	**1,700**	**2.3 J**	**13**	**9.2**	**27**	**84**	**65**	**50**	**–**	**9.5**	**29**	**13**
Sulfide	µg/l	<2.0	<2.0	<2.0	–	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	–	<2.0	<2.0	<2.0

TABLE 3
SUMMARY OF NOVEMBER 2020 PERFORMANCE MONITORING
Summary Trip Report
IBM Gun Club - Former Burn Pit Area
Union, New York

Analyte Name	Unit	A-13	B-4	B-7	B-9	IB-7	111	112	113	118
		A-13	B-4	B-7	B-9	IB-7	111	112	113	118
		PDB	PDB	PDB/Low Flow	PDB	PDB	Surface Water	Surface Water	Surface Water	Surface Water
		S	S	S	S	S	S	S	S	S
		11/12/2020	11/12/2020	11/10/2020	11/12/2020	11/12/2020	11/10/2020	11/10/2020	11/10/2020	11/10/2020
VOLATILE ORGANIC COMPOUNDS (VOCs)										
Trichloroethene (TCE)	µg/l	**170 J**	<50	<500	<500	**11**	**0.34 J**	**0.57**	**0.15 J**	**0.23 J**
Dichloroethene (cis-1,2-)	µg/l	**8,200**	**8.3 J**	**83 J**	<500	**48**	<0.50	<0.50	<0.50	**0.084 J**
Dichloroethene (trans-1,2-)	µg/l	<1000	<50	<500	<500	**1.5**	<0.50	<0.50	<0.50	<0.50
Dichloroethene (1,1-)	µg/l	<1000	<50	<500	<500	**0.18 J**	<0.50	<0.50	<0.50	<0.50
Tetrachloroethene (PCE)	µg/l	<1000	<50	<500	<500	**0.068 J**	<0.50	<0.50	<0.50	<0.50
Vinyl chloride	µg/l	**1,000**	<50	<500	<500	**8.7**	<0.50	<0.50	<0.50	<0.50
LIGHT GASSES										
Ethane	µg/l	**99**	**48**	**59**	**9.6**	**29**	–	–	–	–
Ethene	µg/l	**3,600**	**24**	**360**	**40**	**56**	–	–	–	–
Methane	µg/l	**5,000**	**30,000**	**22,000**	**8,500**	**23,000**	–	–	–	–
MOLAR CONCENTRATION										
Trichloroethene (TCE)	µmol/l	1.3	ND	ND	ND	0.084	0.0026	0.0043	0.0011	0.0018
Dichloroethene (cis-1,2-)	µmol/l	85	0.086	0.86	ND	0.50	ND	ND	ND	0.0009
Dichloroethene (trans-1,2-)	µmol/l	ND	ND	ND	ND	0.015	ND	ND	ND	ND
Dichloroethene (1,1-)	µmol/l	ND	ND	ND	ND	0.0019	ND	ND	ND	ND
Tetrachloroethene (PCE)	µmol/l	ND	ND	ND	ND	0.00041	ND	ND	ND	ND
Vinyl chloride	µmol/l	16	ND	ND	ND	0.14	ND	ND	ND	ND
Ethane	µmol/l	3.3	1.6	2.0	0.32	0.96	–	–	–	–
Ethene	µmol/l	130	0.86	13	1.4	2.0	–	–	–	–
Total	µmol/l	240	2.5	16	1.7	3.7	0.0026	0.0043	0.0011	0.0026
MOLAR PERCENTAGE										
TCE	%	0.54	ND	ND	ND	2.3	100	100	100	67
DCEs	%	35	3.4	5.5	ND	14	ND	ND	ND	33
VC	%	6.7	ND	ND	ND	3.8	ND	ND	ND	ND
Ethane+Ethene	%	56	97	95	100	80	–	–	–	–
VOLATILE FATTY ACIDS										
Acetic Acid	mg/l	**200**	**400**	**160**	**240**	**460**	–	–	–	–
Butyric Acid	mg/l	**29**	**51**	**29**	**92**	**98**	–	–	–	–
Hexanoic Acid	mg/l	<5	<5	**25**	**6.1**	**1.5 J**	–	–	–	–
i-Hexanoic Acid	mg/l	<5	<5	<5	<5	<5	–	–	–	–
i-Pentanoic Acid	mg/l	**1.0 J**	<5	<5	**3.0 J**	**3.4 J**	–	–	–	–
Lactic Acid	mg/l	<5	<5	<5	<5	<5	–	–	–	–
Pentanoic Acid	mg/l	**7.5**	**11**	**22**	**34**	**15**	–	–	–	–
Propionic Acid	mg/l	**410**	**610**	**160**	**550**	**540**	–	–	–	–
Pyruvic Acid	mg/l	**6.8**	**7.5**	**7.2**	**21**	**14**	–	–	–	–
OTHER LABORATORY DATA										
Carbon Tetrachloride	µg/l	<1000	<50	<500	<500	<0.50	<0.50	<0.50	<0.50	<0.50
Total Organic Carbon	mg/l	**390**	**1,000**	**390**	**1,700**	**770**	–	–	–	–
WATER QUALITY PROBE DATA										
Temperature	°C	–	–	**14**	–	–	**14**	**14**	**13**	**13**
Specific Conductance	uS/cm	–	–	**1,400**	–	–	**140**	**180**	**250**	**410**
pH	s.u.	–	–	**5.5**	–	–	**6.3**	**6.2**	**7.0**	**6.9**
Oxidation/Reduction Potential	mV	–	–	**33**	–	–	**370**	**360**	**400**	**380**
Dissolved Oxygen	mg/l	–	–	**0.33**	–	–	**7.6**	**7.4**	**9.8**	**11**
Turbidity	NTU	–	–	**>1,000**	–	–	**24**	**120**	**6.5**	**7.5**
GEOCHEMISTRY										
Iron	mg/l	–	–	**44**	–	–	–	–	–	–
Iron - Ferrous	mg/l	–	–	**39**	–	–	–	–	–	–
Nitrate	mg/l	–	–	<0.50	–	–	–	–	–	–
Sulfate	mg/l	–	–	<5.0	–	–	–	–	–	–
Sulfide	µg/l	–	–	<2.0	–	–	–	–	–	–

Notes:

1. The table summarizes samples collected during the week of November 9, 2020 as part of performance monitoring at the IBM Gun Club former Burn Pit Area. Samples were analyzed both in the field and at fixed analytical laboratories as indicated on the table.

2. Analytical laboratory analysis was performed by Eurofins Lancaster Laboratories of Lancaster, Pennsylvania (Lancaster) and/or Pace Analytical (formerly Microseeps, Inc.) of Pittsburgh, Pennsylvania (Pace). Results are recorded in units indicated on the table. Detections of compounds are emboldened.

3. Definitions:
"S" indicates primary sample
"FD" indicates field duplicate
"PDB" indicates the sample was collected via a passive diffusion bag
"–" indicates the compounds were not analyzed for that particular sample.
"<" indicates the result was below the analytical detection limit.
"J" indicates that the laboratory data was below the lowest quantifiable limit and therefore estimated.
"ND" indicates that results were not detected above the analytical reporting limit or the calibration range of the field screening device.

4. Refer to the report text for further discussion. The sample plan can be referenced in Table 2 and the Site Management Plan.

TABLE 4
SUMMARY OF NOVEMBER 2020 qPCR & CSIA ANALYSIS
Summary Trip Report
IBM Gun Club - Former Burn Pit Area
Union, New York

Analytical Method	Analyte	Units	BP-6A			BP-9A			BP-30A		
			04/15/20	09/10/20	11/11/20	04/15/20	09/10/20	11/11/20	04/15/20	09/10/20	11/10/20
qPCR	**Dechlorinating Bacteria**										
	Dehalococcoides (DHC)	cells/mL	6.42E+03	3.78E+04	1.91E+05	2.39E+02	3.58E+02	6.47E+02	2.50E+00	6.00E-01	7.00E-01
	BAV1 Vinyl Chloride Reductase (bvcA)	cells/mL	<1.10E+00	1.00E+00	<5.00E-01	<5.00E-01	<5.00E-01	<1.10E+00	<5.00E-01	<5.00E-01	<5.00E-01
	tceA Reductase (tceA)	cells/mL	<1.10E+00	3.00E-01 J	<5.00E-01	4.00E-01 J	<5.00E-01	<1.10E+00	<5.00E-01	<5.00E-01	<5.00E-01
	Vinyl Chloride Reductase (vcrA)	cells/mL	1.55E+03	1.36E+04	4.70E+04	3.47E+01	1.27E+02	5.36E+01	2.00E-01 J	<5.00E-01	<5.00E-01
	Dehalobacter spp.	cells/mL	4.64E+04	3.14E+05	6.06E+05	-	-	-	1.09E+01	<5.00E+00	7.56E+01
	Desulfitobacterium spp.	cells/mL	1.46E+04	6.28E+04	6.09E+05	-	-	-	1.08E+01	1.30E+00 J	1.11E+02
	Desulfuromonas spp.	cells/mL	6.58E+03	6.04E+02	3.18E+02	-	-	-	1.00E-01 J	6.00E-01 J	2.70E+00 J
	Functional Genes										
	Methanogens	cells/mL	4.00E-01 J	<4.90E+00	9.00E-01 J	2.00E-01 J	2.60E+01	3.33E+02	1.00E-01 J	<5.00E+00	2.10E+00 J
	Soluble Methane Monooxygenase	cells/mL	<1.06E+01	7.80E+01	<5.00E+00	-	-	-	<4.6E+00	<5.00E+00	<4.70E+00
CSIA	$^{13}C/^{12}C$ TCE	‰	-19.2	NA	NA	-20	-12.0	NA	-3.4	ND	8.1 J
	$^{13}C/^{12}C$ cis-DCE	‰	-24.4	-12.9	-0.9	-17.9	-17.2	-13.1	-10.3	ND	5.2
	$^{13}C/^{12}C$ Vinyl Chloride	‰	-34.8 J	-50.4	-33.8	-28	-35.8	-28.9	NA	NA	NA

TABLE 4
SUMMARY OF NOVEMBER 2020 qPCR & CSIA ANALYSIS
Summary Trip Report
IBM Gun Club - Former Burn Pit Area
Union, New York

Analytical Method	Analyte	Units	BP-34A			BP-35A			BP-36A		
			04/15/20	09/10/20	11/11/20	04/15/20	09/10/20	11/10/20	04/15/20	09/10/20	11/10/20
qPCR	**Dechlorinating Bacteria**										
	Dehalococcoides (DHC)	cells/mL	1.38E+03	2.39E+02	3.00E+03	6.12E+01	7.00E-01	3.70E+00	9.03E+03	3.03E+04	3.98E+04
	BAV1 Vinyl Chloride Reductase (bvcA)	cells/mL	<5.00E-01	<1.00E+00	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01
	tceA Reductase (tceA)	cells/mL	<5.00E-01	6.00E-01 J	<5.00E-01	<5.00E-01	<5.00E-01	4.00E-01 J	<5.00E-01	2.00E-01 J	<5.00E-01
	Vinyl Chloride Reductase (vcrA)	cells/mL	1.15E+03	1.81E+02	1.18E+03	5.40E+00	1.00E-01 J	7.00E-01	1.77E+03	1.16E+04	7.04E+03
	Dehalobacter spp.	cells/mL	-	-	-	-	-	-	-	-	-
	Desulfitobacterium spp.	cells/mL	-	-	-	-	-	-	-	-	-
	Desulfuromonas spp.	cells/mL	-	-	-	-	-	-	-	-	-
	Functional Genes										
	Methanogens	cells/mL	<4.90E+00	2.80E+00 J	<4.80E+00	4.00E+00 J	3.00E-01 J	1.83E+01	1.64E+01	3.21E+02	1.63E+02
	Soluble Methane Monooxygenase	cells/mL	-	-	-	-	-	-	-	-	-
CSIA	$^{13}C/^{12}C$ TCE	‰	-20.5	-16.8	-18.4	-19.9	-15.9	-19.4	-21	-5.1 J	-17.3
	$^{13}C/^{12}C$ cis-DCE	‰	-22.6	-21.5	-22.9	-20.6	-19.0	-22.1	-20.1	-10.0	-18.6
	$^{13}C/^{12}C$ Vinyl Chloride	‰	-42.8 J	-44.0 J	NA	NA	NA	NA	-32.6	-28.1	-43.5

TABLE 4
SUMMARY OF NOVEMBER 2020 qPCR & CSIA ANALYSIS
Summary Trip Report
IBM Gun Club - Former Burn Pit Area
Union, New York

Analytical Method	Analyte	Units	BP-39A			B-7		
			04/15/20	09/10/20	11/10/20	04/15/20	09/10/20	11/10/20
qPCR	**Dechlorinating Bacteria**							
	Dehalococcoides (DHC)	cells/mL	2.20E+00	2.40E+00	6.60E+00	4.42E+03	4.31E+02	2.82E+02
	BAV1 Vinyl Chloride Reductase (bvcA)	cells/mL	<5.00E-01	<5.00E-01	1.00E-01 J	<2.50E+00	<1.80E+00	<4.30E+00
	tceA Reductase (tceA)	cells/mL	<5.00E-01	<5.00E-01	1.40E+00	<2.50E+00	<1.80E+00	1.00E+00 J
	Vinyl Chloride Reductase (vcrA)	cells/mL	2.00E-01 J	1.90E+00	1.60E+00	1.11E+03	2.87E+02	6.99E+01
	Dehalobacter spp.	cells/mL	4.7E+00 J	<4.80E+00	2.00E+02	<2.50E+01	<1.75E+01	<4.35E+01
	Desulfitobacterium spp.	cells/mL	3.20E+00 J	<4.80E+00	1.49E+01	<2.50E+01	<1.75E+01	<4.35E+01
	Desulfuromonas spp.	cells/mL	3.00E-01 J	5.10E+00	5.40E+00	<2.50E+01	<1.75E+01	<4.35E+01
	Functional Genes							
	Methanogens	cells/mL	3.50E+00 J	8.00E+00	4.10E+00 J	1.17E+03	2.64E+03	1.04E+04
	Soluble Methane Monooxygenase	cells/mL	4.30E+01	<4.80E+00	<4.80E+00	<2.50E+01	<1.75E+01	<4.35E+01
CSIA	$^{13}C/^{12}C$ TCE	‰	-20.3	-14.2	-14.2	NA	NA	-18.5
	$^{13}C/^{12}C$ cis-DCE	‰	-15.9	-13.2	-10.2	-17.1	-10.2	-18.9
	$^{13}C/^{12}C$ Vinyl Chloride	‰	-27.7	NA	NA	NA	NA	NA

Notes:

1. The table summarizes samples collected during the week November 9, 2020 as part of supplemental forensic sampling at the IBM Gun Club former Burn Pit Area. Samples were analyzed by Microbial Insights of Knoxville, Tennesee (MI). Results are recorded in units indicated on the table.

2. Definitions:
"qPCR" indicates quantitative polymerase chain reaction analysis, which is a DNA-based analysis used to quantify specific microorganisms and specific functional genes responsible for biodegradation.
"CSIA" indicates compound-specific isotope analysis, which identifies the ratio of carbon-13 to carbon-12 isotopes in the compounds of interest for this site (TCE, cDCE, and vinyl chloride)
"J" indicates that the laboratory data was below the lowest quantifiable limit and therefore estimated.
"NA" indicates that the compound was not detected in the VOC sample collected concurrently with the CSIA sample, so CSIA results are not applicable. For TCE in BP-6A and Vinyl Chloride in BP-39A, targets were below the limit of detection after required dilutions and were therefore not analyzed.
"ND" indicates not detected.
A blank cell indicates the sample was not analyzed for this parameter.

3. Refer to the report text for further discussion.

FIGURES

Figure 1

Monitoring Location Plan

IBM Gun Club - Former Burn Pit Area

Union, New York

Drawn By:	H. Pothier
Designed By:	E. Bosse
Reviewed By:	B. Green
Project No:	3526.05
Date:	January 2021

Figure Narrative

This figure summarizes the locations of monitoring wells, multi-level monitoring systems, and surface water sampling points where depth to water is measured and water quality samples may be collected for field and analytical laboratory testing as part of routine and performance monitoring programs.

The locations of site features, including monitoring wells, seeps and springs, and culverts are based on field survey by Butler Land Surveying, LLC. of Little Meadows Pennsylvania in the period 2006 through 2012.

Refer to report text for further discussion.

Legend

- Parcel B Site Boundary
- Injection Borehole
- Observed Drainage Features (arrows indicate flow direction)
- Monitoring Well
- Multi-Level Monitoring Installation
- Surface Water Sampling Point
- Culvert

100 50 0 100 200 Feet

SANBORN HEAD

Last Edited By: hpothier

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Figure 2

Summary of November 2020 Groundwater Quality Conditions

IBM Gun Club - Former Burn Pit Area

Union, New York

Drawn By:	H. Pothier
Designed By:	E. Bosse
Reviewed By:	B. Green
Project No:	3526.05
Date:	January 2021

Figure Narrative

This figure shows groundwater quality data and inference based on monitoring conducted November 9-12, 2020.

The groundwater data for site key VOCs including TCE, cDCE, vinyl chloride, and ethane/ethene from water table monitoring wells are presented as pie diagrams. The wedges of each pie diagram represent concentrations of the four compounds expressed in micromoles per liter (umol/L). The relative diameter of each pie diagram varies based on the sum of the five VOCs and tDCE at each location.

The inferred sulfate-reducing and methanogenic conditions are based on observations of oxidation-reduction potential (ORP), methane, sulfide, ferrous and total iron, and nitrate. Methanogenic conditions are characterized by methane concentrations ≥ 20 µg/L, sulfate reducing by sulfide ≥ 50 µg/L, iron reducing by Fe(II)/Fe(tot) ≥ 0.7 mg/L, and nitrate reduction by nitrate <1 mg/L. ORP is generally expected to be <200 for iron reduction, <100 for sulfate reduction, and <0 for methanogenic conditions. See Figure 3 for geochemical data.

Not all geochemical conditions are satisfied within the areas shown for sulfate-reducing and methanogenic conditions. The inferred areas assume the presence of a transition zone between sulfate-reducing and methanogenic, and the position and size of these zones are based on judgement of the combined data. Other interpretations are possible.

Refer to the report text for further discussion.

Legend

BP-34A
23,000
Well Name and November 2020 TCE Concentrations in Groundwater (µg/L).

Inferred Groundwater Contour
November 2020

Inferred Methanogenic Conditions

Inferred Sulfate-Reducing Conditions

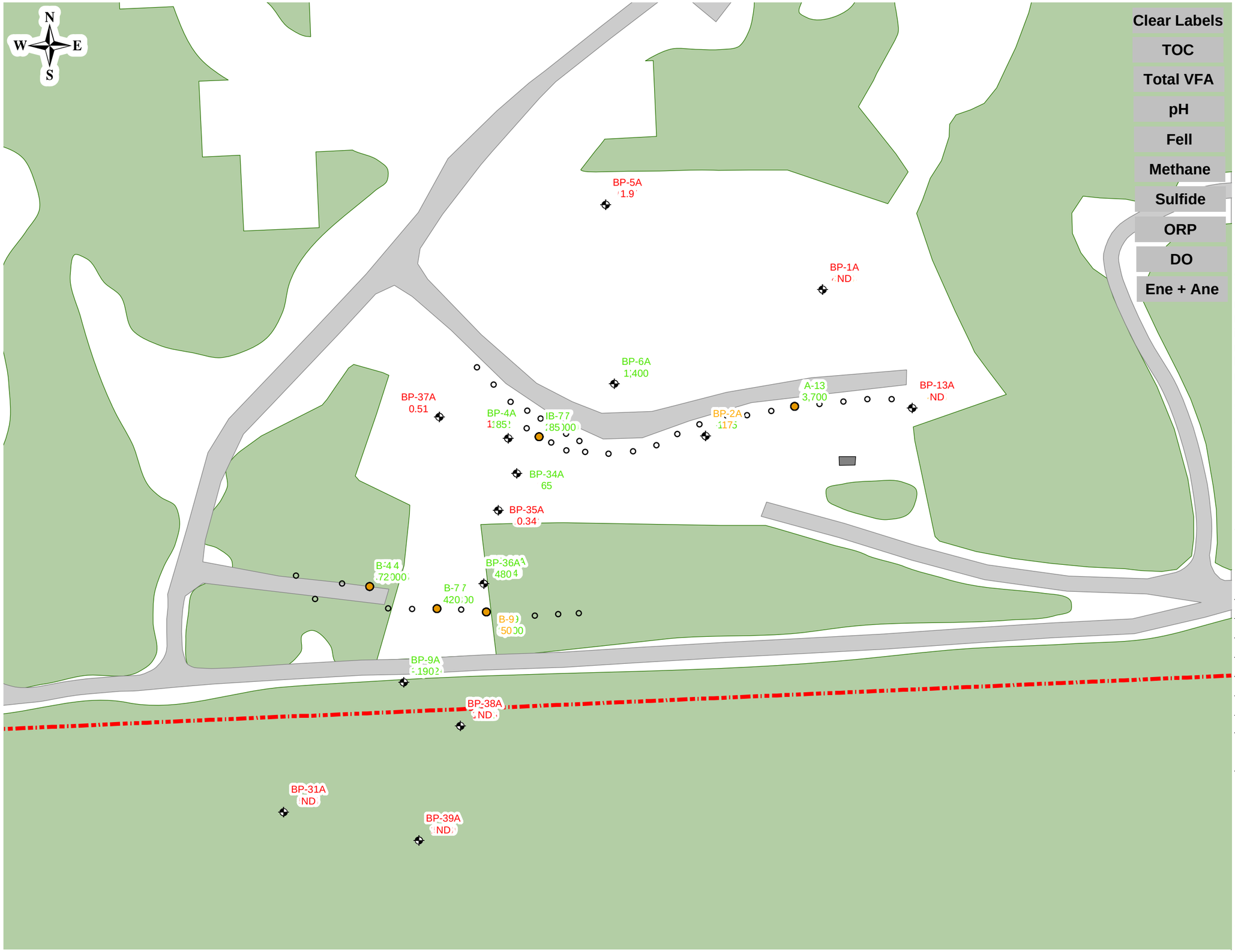
Parent VOC (Trichloroethene)
Primary Daughter Product (*cis*-1,2DCE)
Secondary Daughter Product (Vinyl Chloride)
Terminal Breakdown Products (Ethane, Ethene)

Total Chlorinated Ethanes & Ethenes in Groundwater (µmol/L)

< 0.1
>0.1 to 1
>1 to 10
>10 to 100
>100

40 20 0 40 80
Feet

SANBORN HEAD



Clear Labels

TOC

Total VFA

pH

FeII

Methane

Sulfide

ORP

DO

Ene + Ane

Figure 3

November 2020 Assessment of Reducing Conditions

IBM Gun Club - Former Burn Pit Area

Union, New York

Drawn By:	H. Pothier
Designed By:	E. Bosse
Reviewed By:	B. Green
Project No:	3526.05
Date:	January 2021

Figure Narrative

This figure supports a multiple lines of evidence assessment of what proportion of the primary and secondary source rock are under sulfate reducing and methanogenic conditions. Green labels indicate conditions conducive to reductive dehalogenation. Orange labels indicate reductive dehalogenation may be possible, but conditions are less conducive. Red labels indicate conditions where reductive dehalogenation is less likely.

Posted data is from the November 2020 sampling round.

Legend

DO mg/L	>5	2-5	<=2
ORP mV	>100	0-100	<=0
Sulfide µg/L	<10	10-50	>=50
Methane µg/L	<0.5	0.5-20	>=20
FeII mg/L	<1		>=1
pH SU	<6.3 or >7.5		6.3-7.5
Total VFA mg/L	<1		>=1
TOC mg/L	<4		>=4
Ethane + Ethene µg/L	<10	10-50	>=50

30 15 0 30 60

Feet

SANBORN HEAD

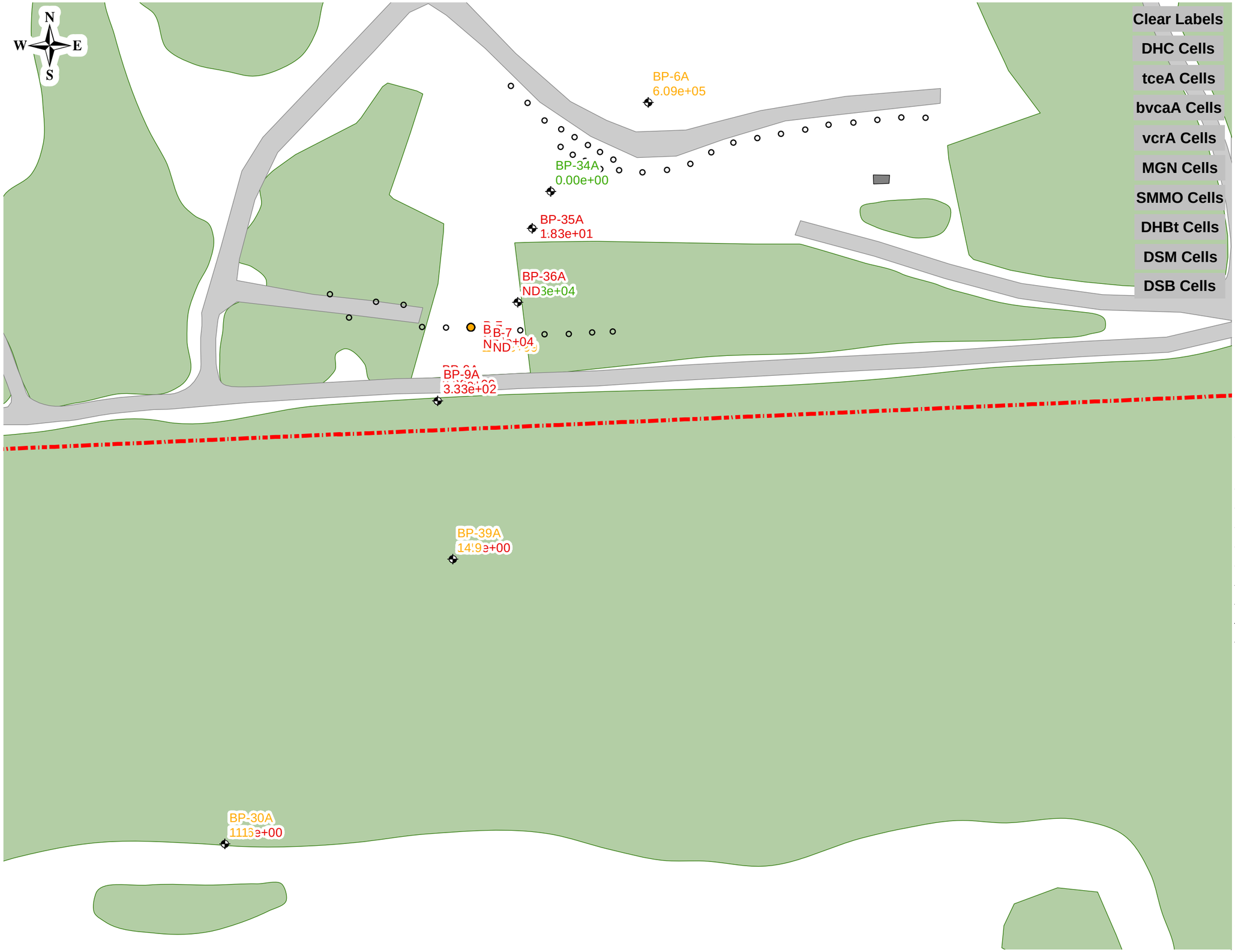


Figure 4

November 2020 Summary of qPCR

IBM Gun Club - Former Burn Pit Area

Union, New York

Drawn By:	H. Pothier
Designed By:	E. Bosse
Reviewed By:	B. Green
Project No:	3526.05
Date:	January 2021

Figure Narrative

This figure summarizes the results from analysis of Dehalococcoides (DHC) bacteria and functional genes to support a multiple lines of evidence assessment of reductive dehalogenation. Green labels indicate concentrations thought to be highly conducive to reductive dehalogenation. Orange labels indicate reductive dehalogenation is possible, but levels are less conducive. Red labels indicate conditions where there is limited or no evidence for reductive dehalogenation. Methanogens (MGN) are competitor microbes, where green indicates no methanogens were detected and red indicates their presence.

Legend

DHC (cells/mL)	$<10^1$	10^1 - 10^4	$>10^4$
tceA (cells/mL)	ND	ND - 10^7	$>10^7$
bvcaA (cells/mL)	ND	ND - 10^7	$>10^7$
vcrA (cells/mL)	ND	ND - 10^7	$>10^7$
MGN (cells/mL)	>ND	-	ND
SMMO (cells/mL)	ND	ND - 10^7	$>10^7$
DHBt (cells/mL)	ND	ND - 10^4	$>10^4$
DSM (cells/mL)	ND	ND - 10^7	$>10^7$
DSB (cells/mL)	ND	ND - 10^7	$>10^7$

DHC = *Dehalococcoides*

tceA = TCE reductase

bvcaA = BAV1 vinyl chloride reductase

vcrA = Vinyl chloride reductase

MGN = Methanogens

SMMO = Soluble Methane Monooxygenase

DHBt = Dehalobacter spp.

DSM = Desulfitobacterium spp.

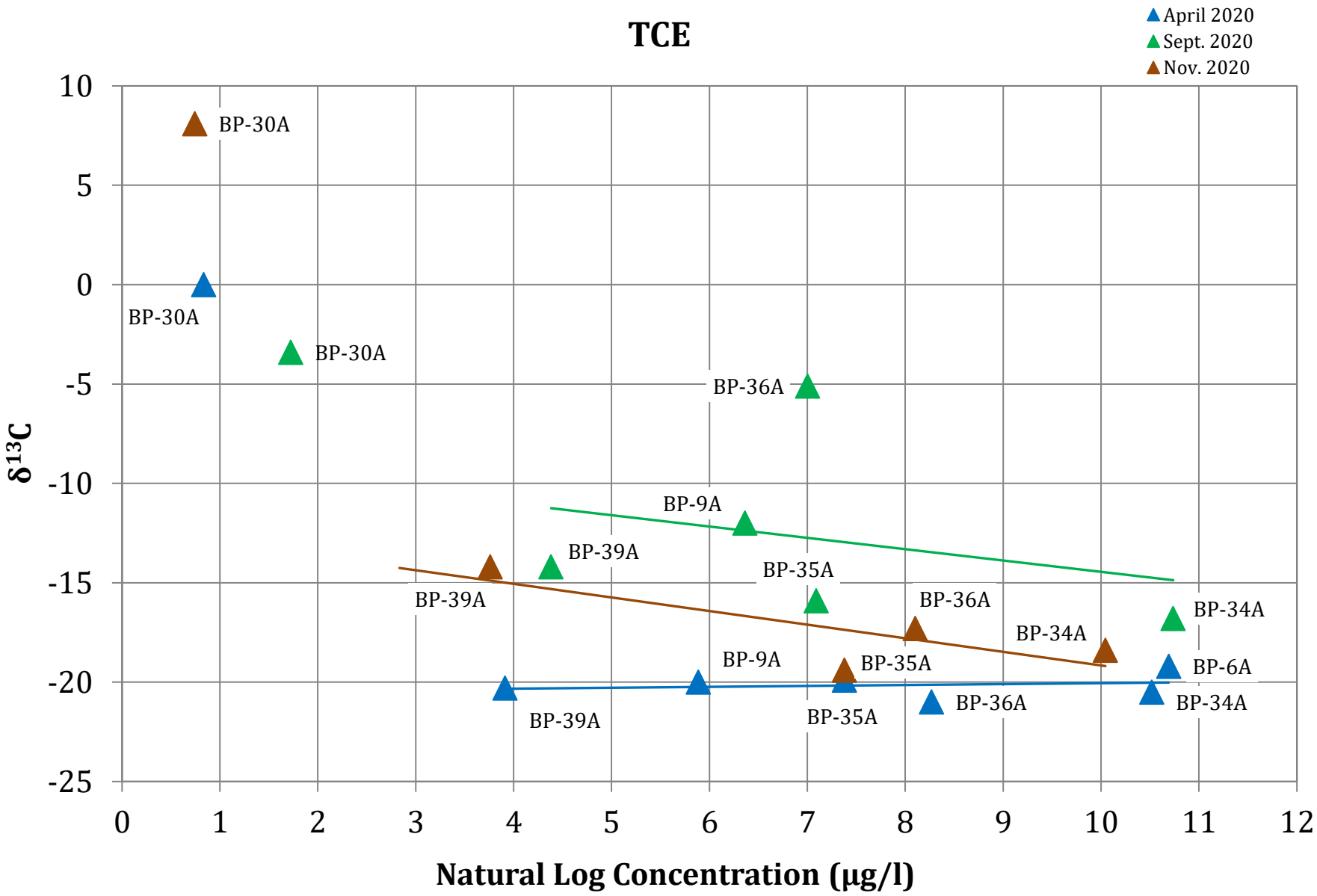
DSB = Desulfuromonas spp.

30 15 0 30 60

Feet

SANBORN HEAD

Figure 5A
November 2020 CSIA Results - TCE
Summary of Water Quality Monitoring
IBM Gun Club - Former Burn Pit Area
Union, New York



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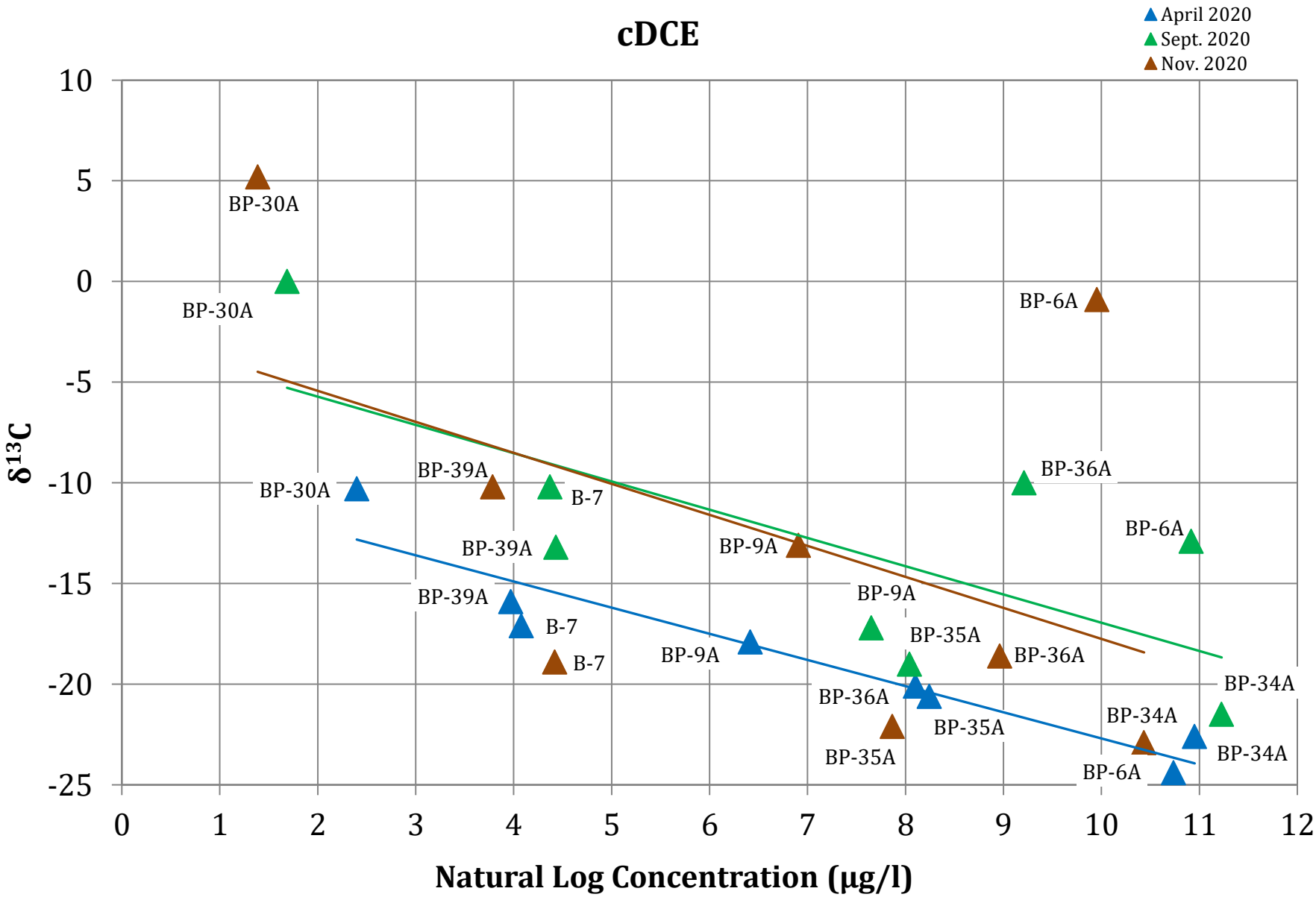
202011_CSIA_Charts

Sanborn, Head & Associates, Inc.

Figure 5B
November 2020 CSIA Results - cis-DCE
Summary of Water Quality Monitoring
IBM Gun Club - Former Burn Pit Area
Union, New York



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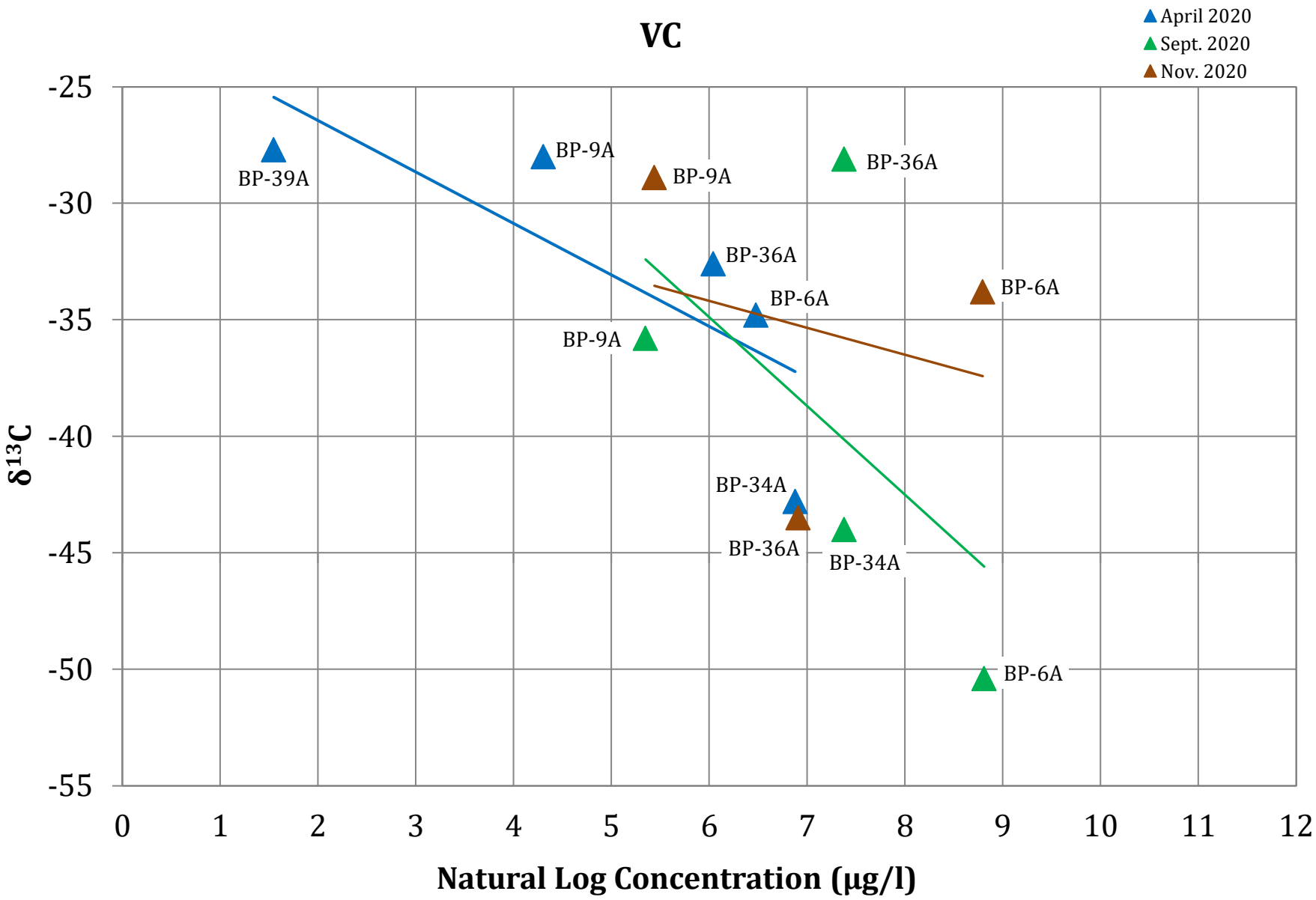
202011_CSIA_Charts

Sanborn, Head & Associates, Inc.

Figure 5C
November 2020 CSIA Results - VC
Summary of Water Quality Monitoring
IBM Gun Club - Former Burn Pit Area
Union, New York



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202011_CSIA_Charts

Sanborn, Head & Associates, Inc.

ATTACHMENT A

TIME-SERIES CHARTS OF SELECT CHEMICALS

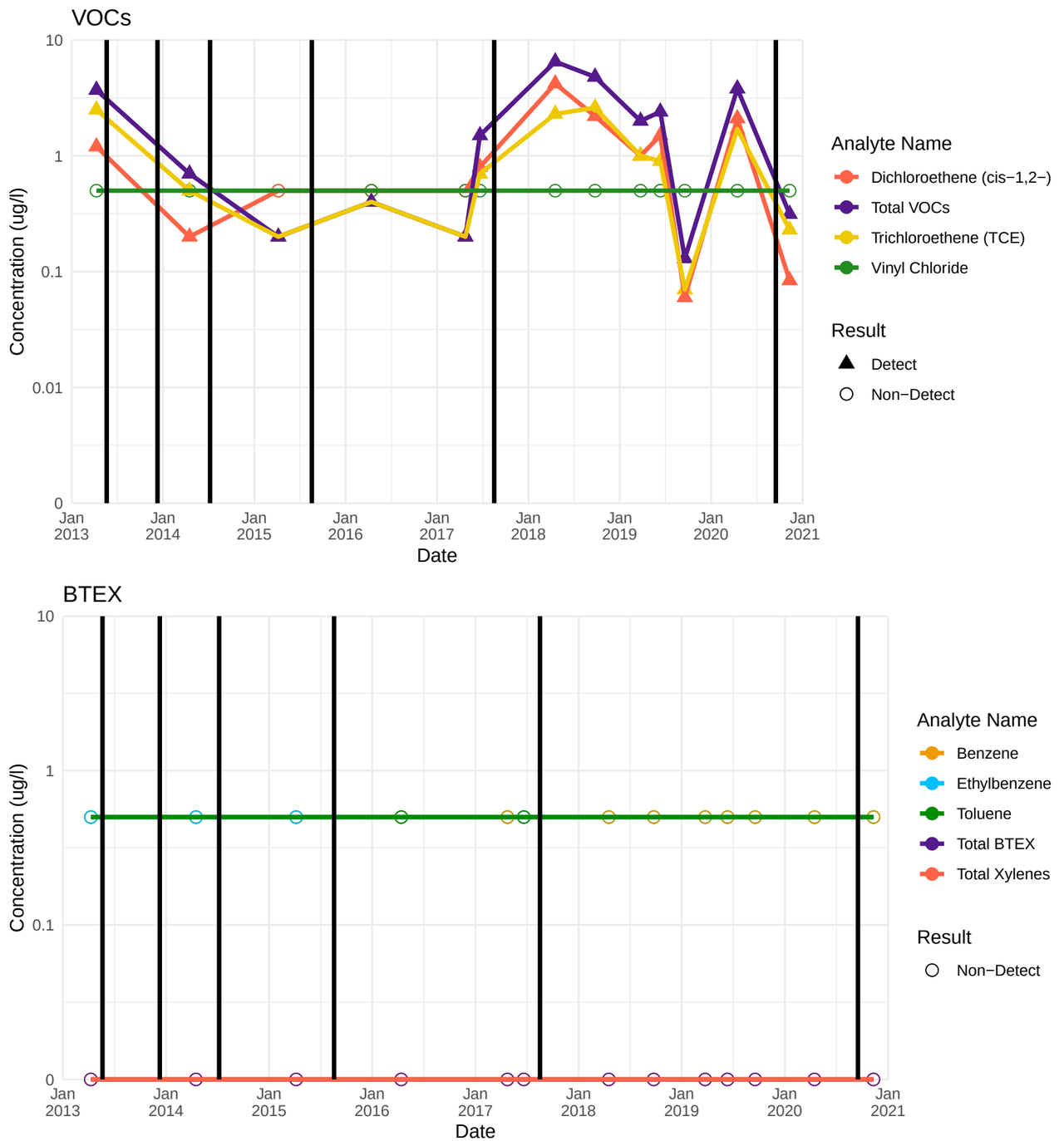
118

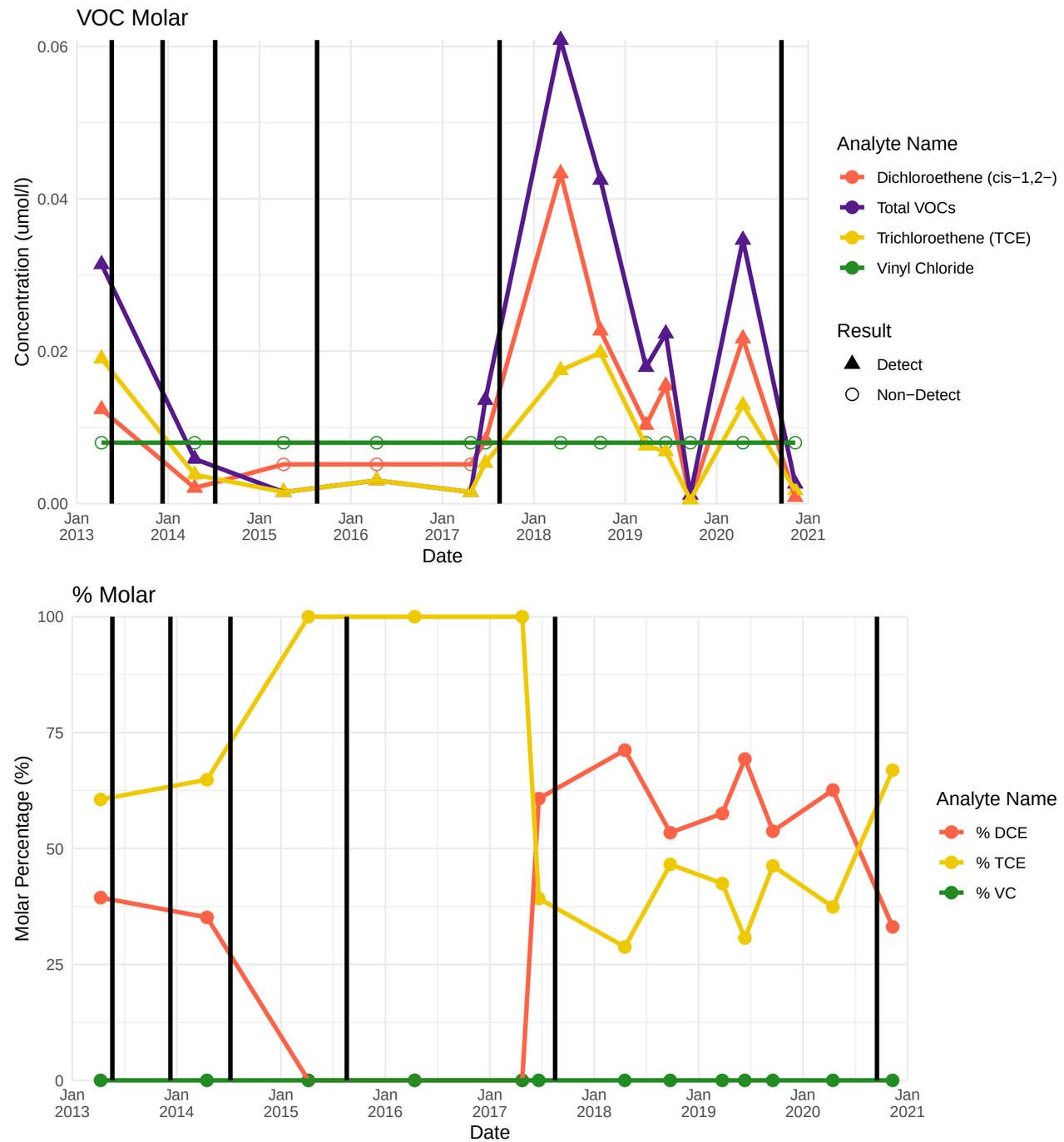
Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.





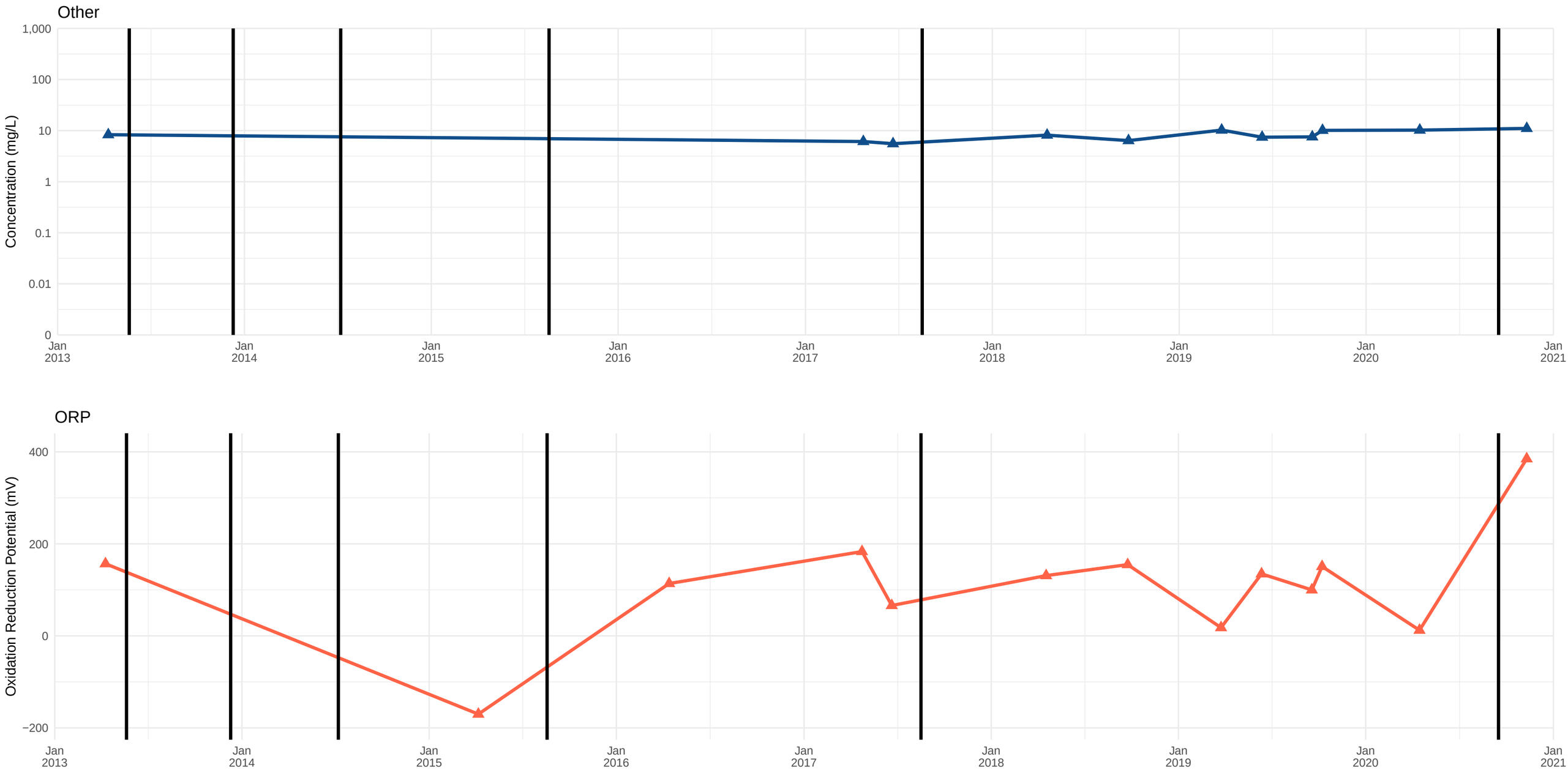
118

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.



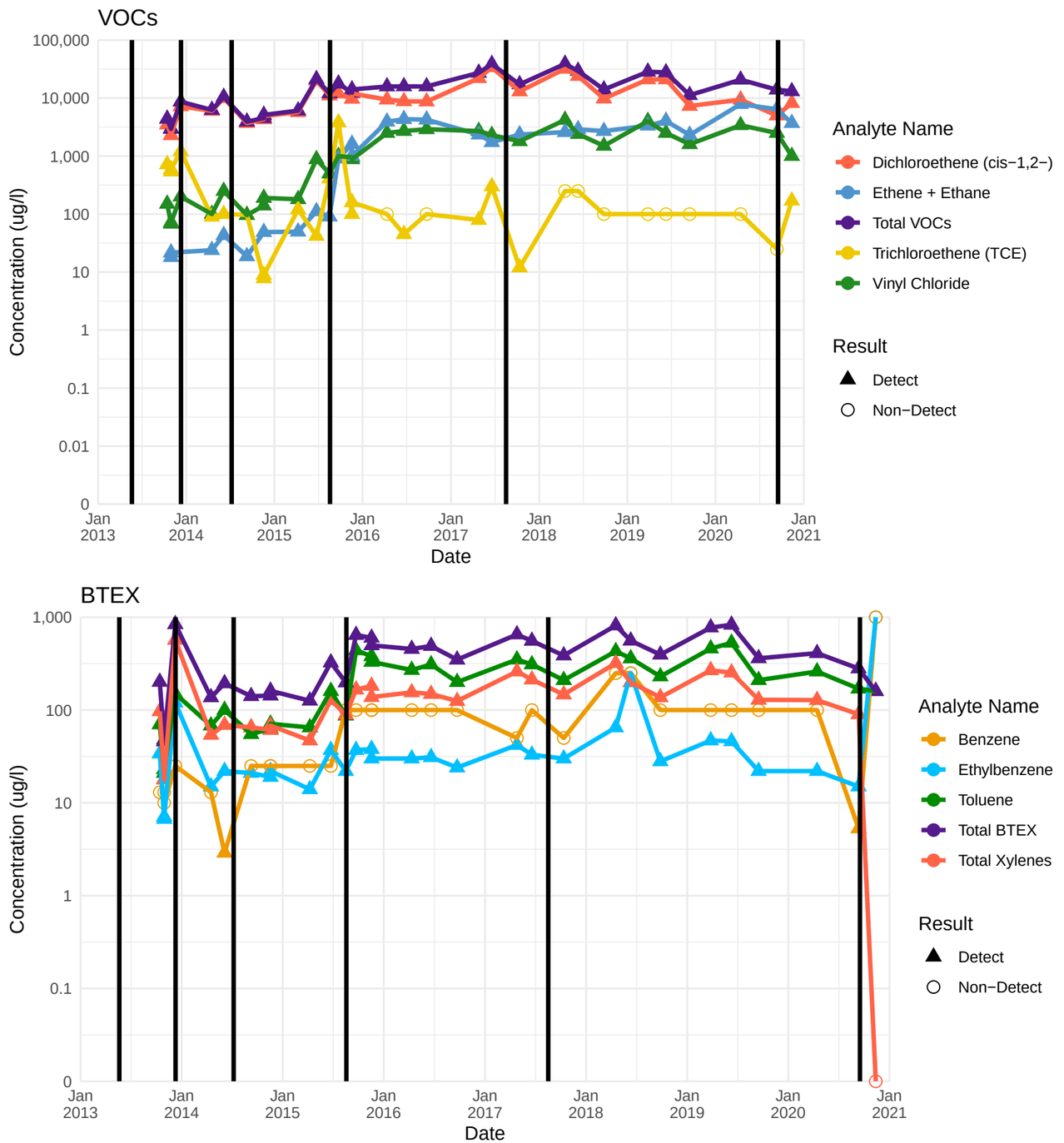
A−13

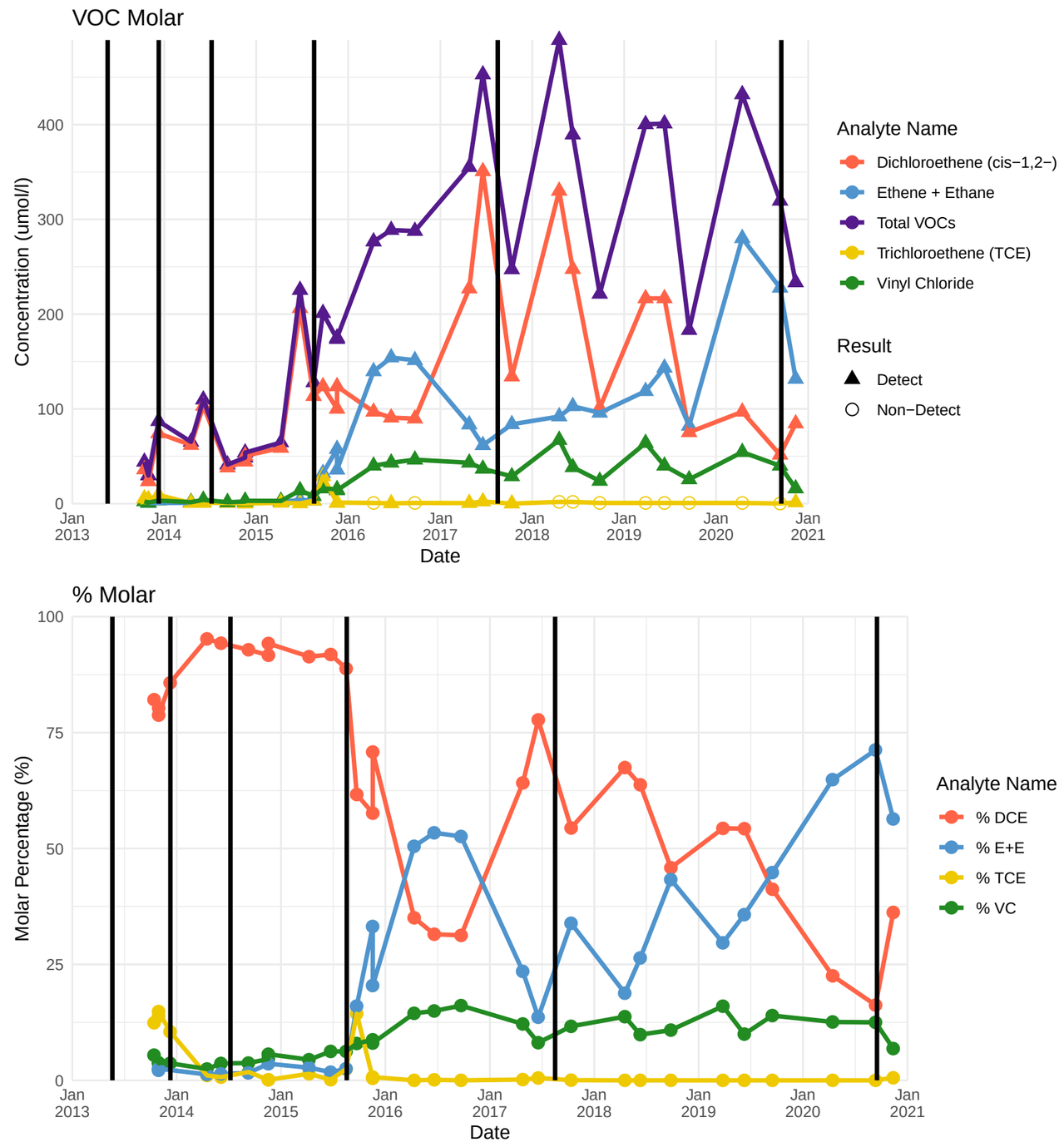
Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.





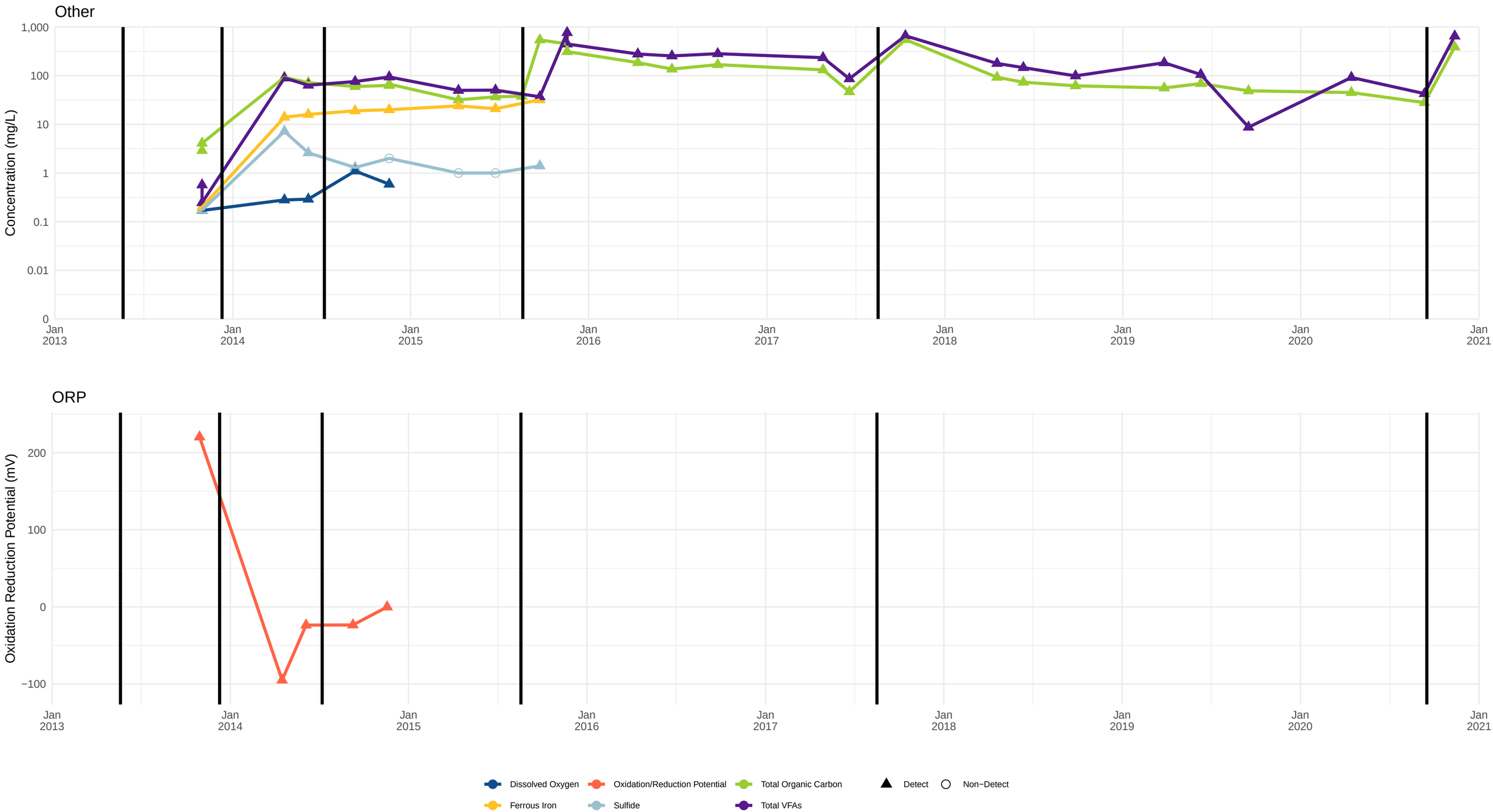
A−13

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.



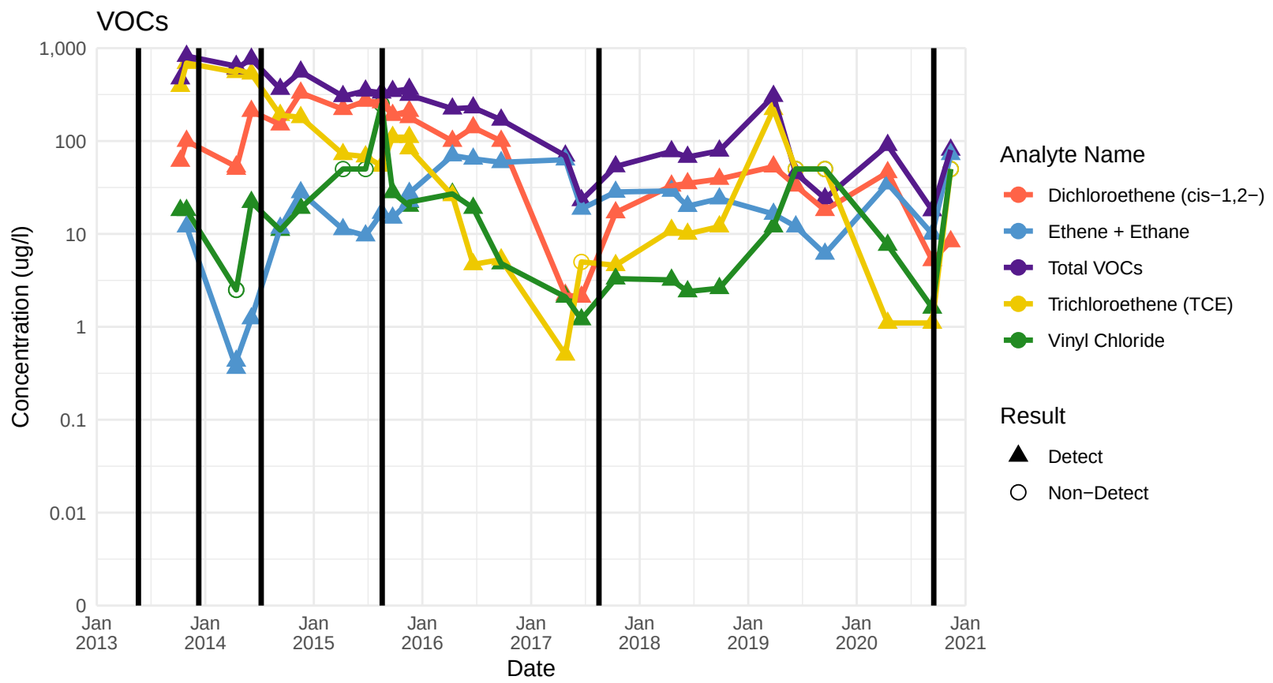
B−4

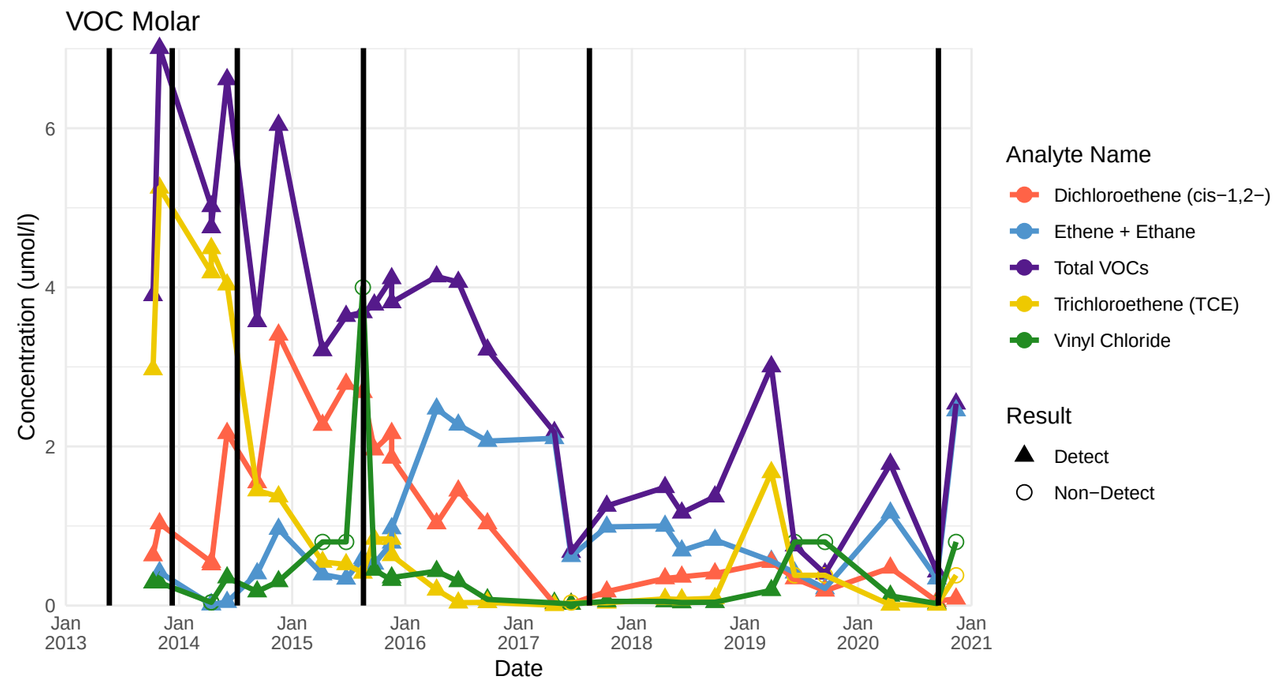
Notes:

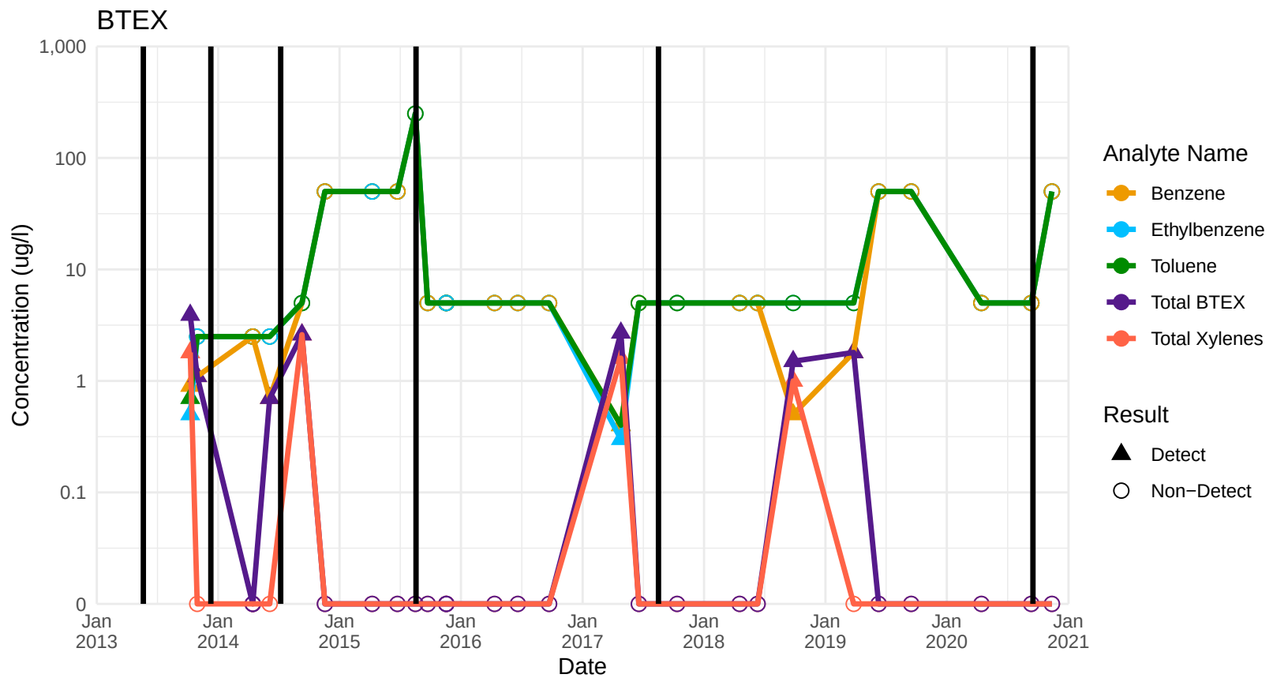
(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

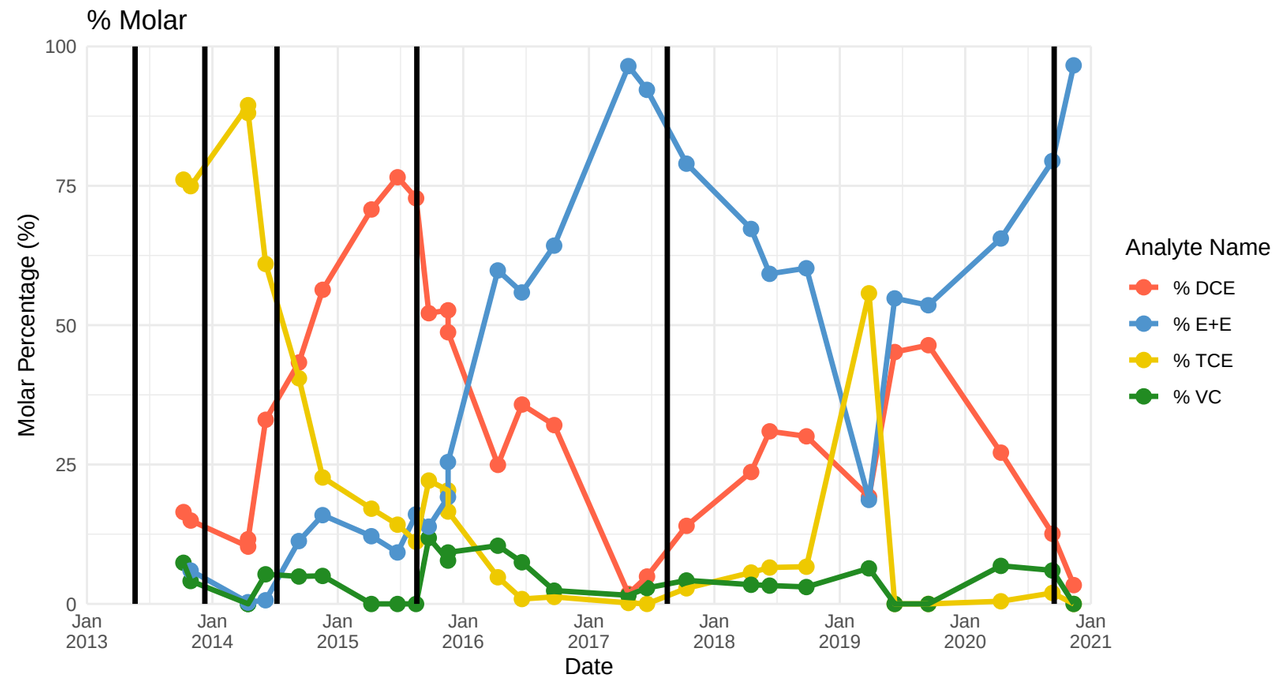
(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.









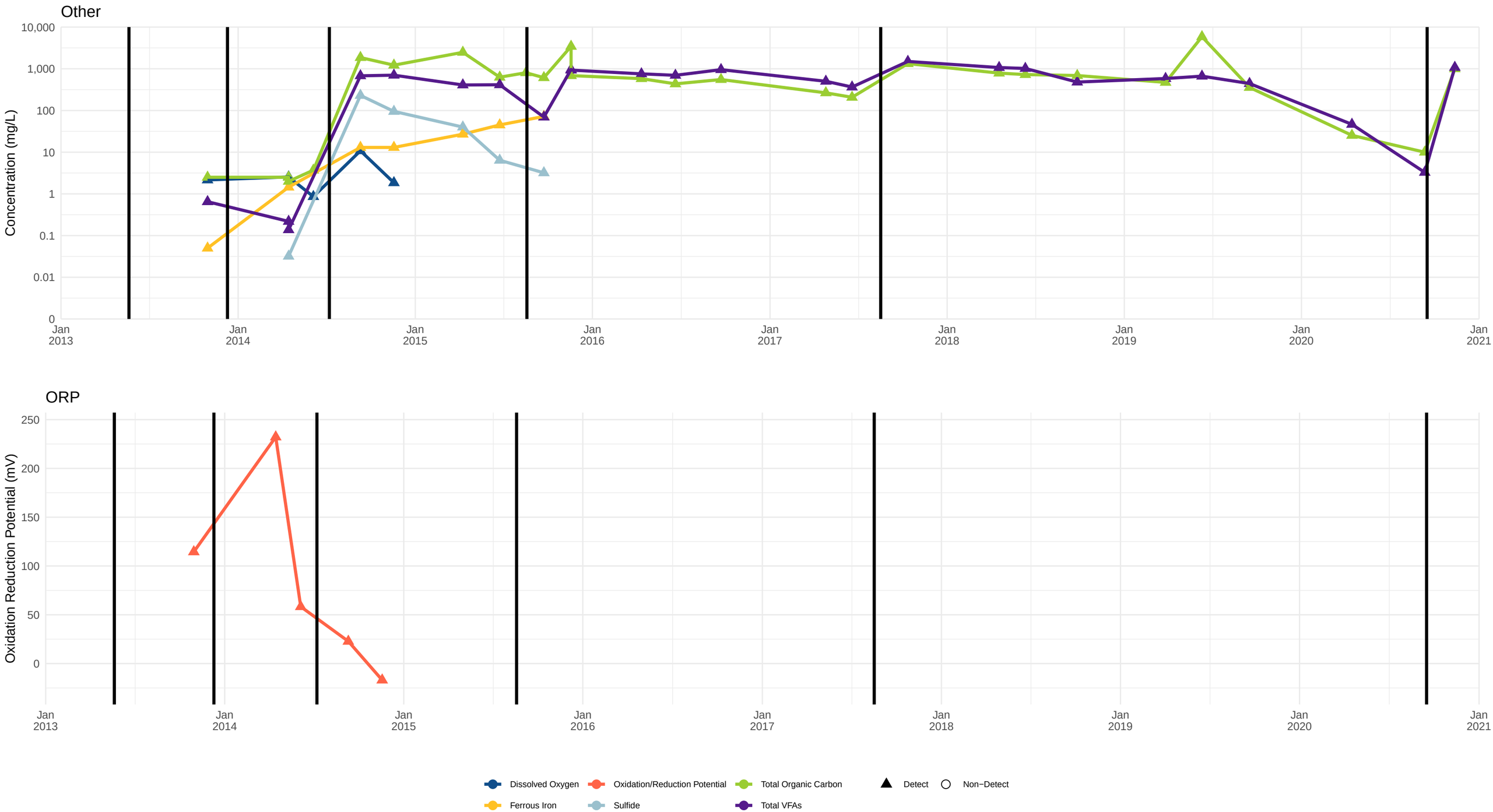
B−4

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.



B−7

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

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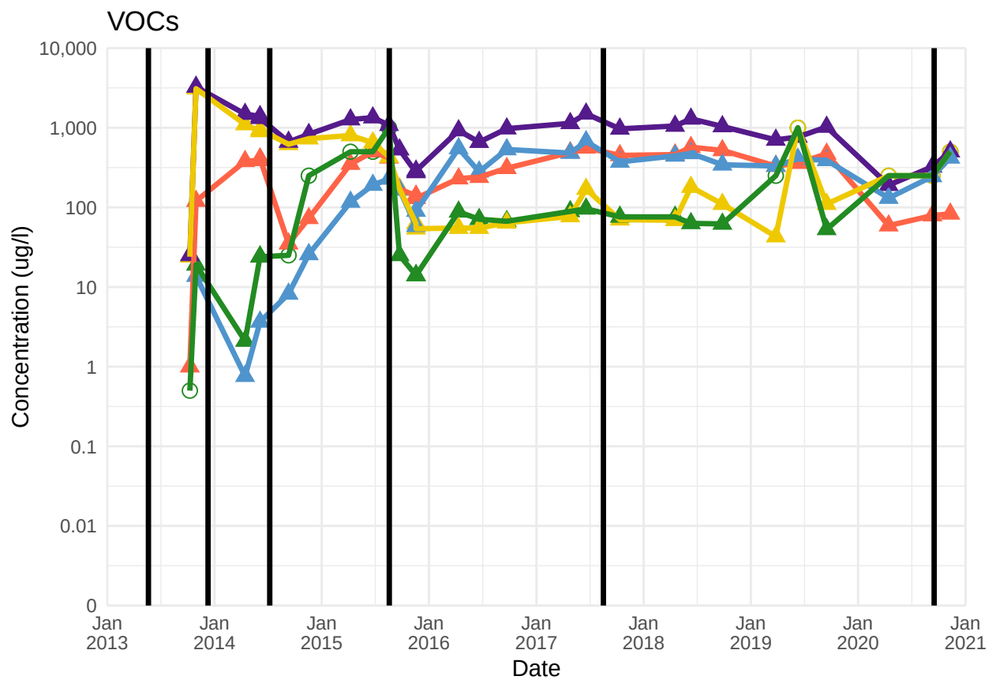
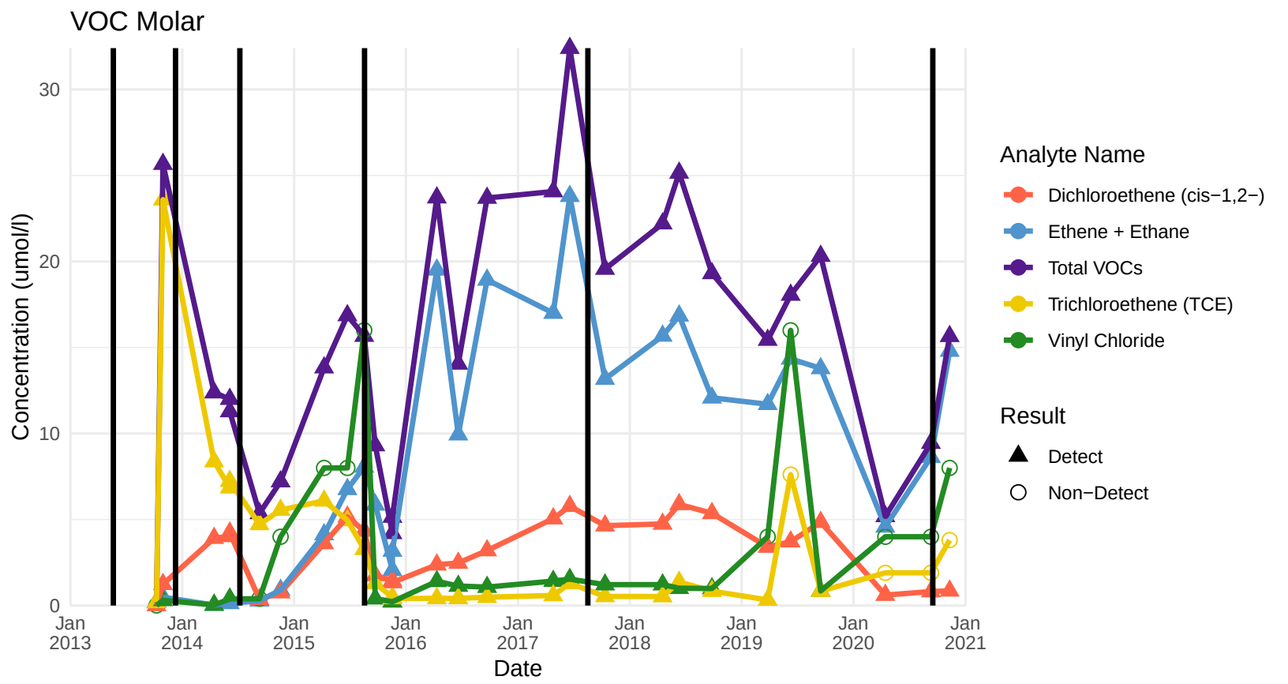
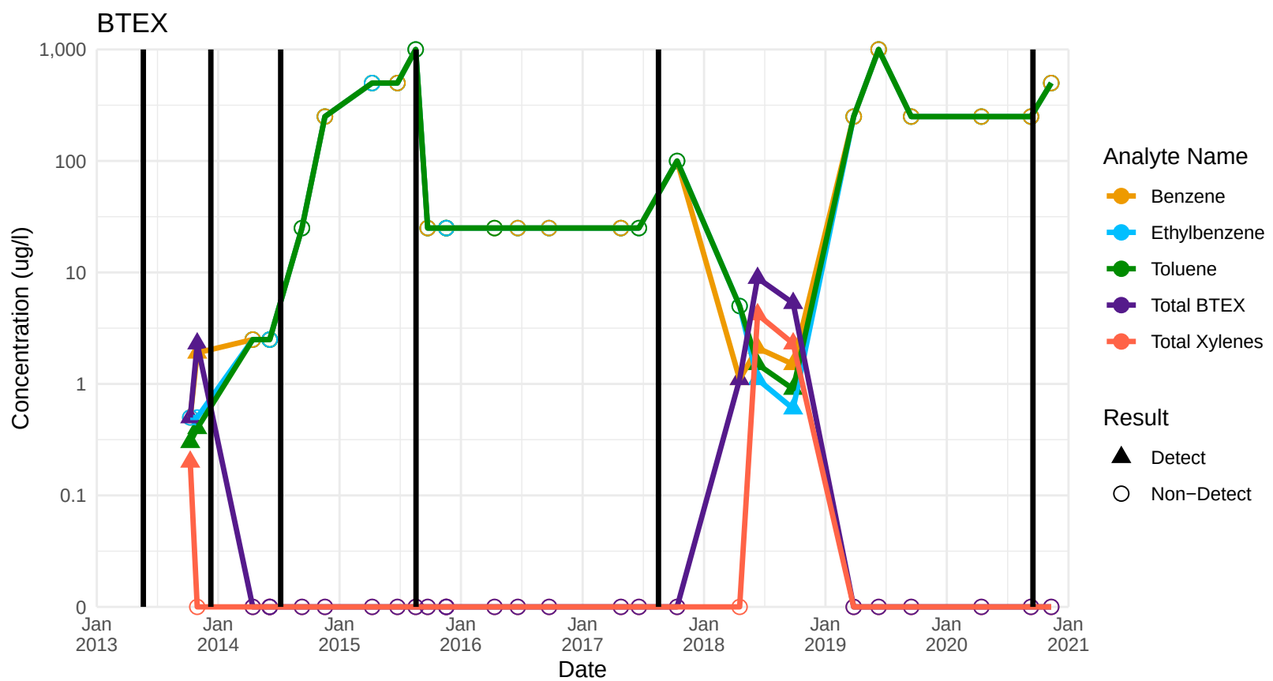
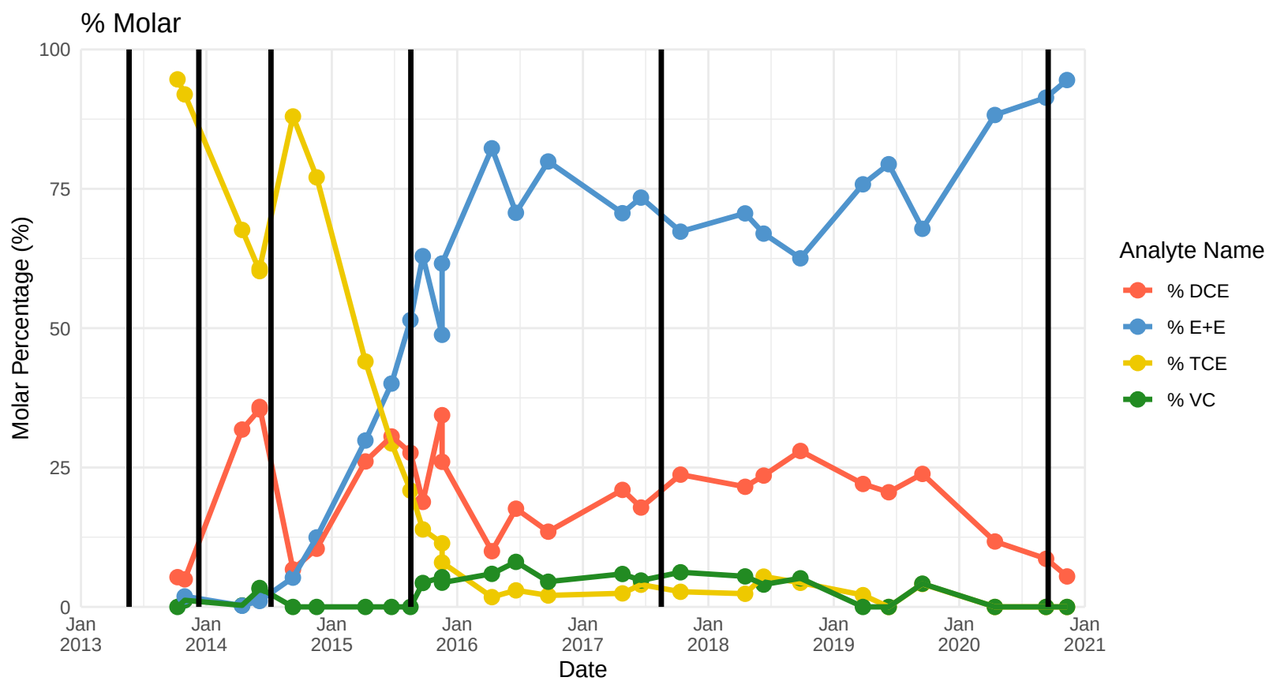








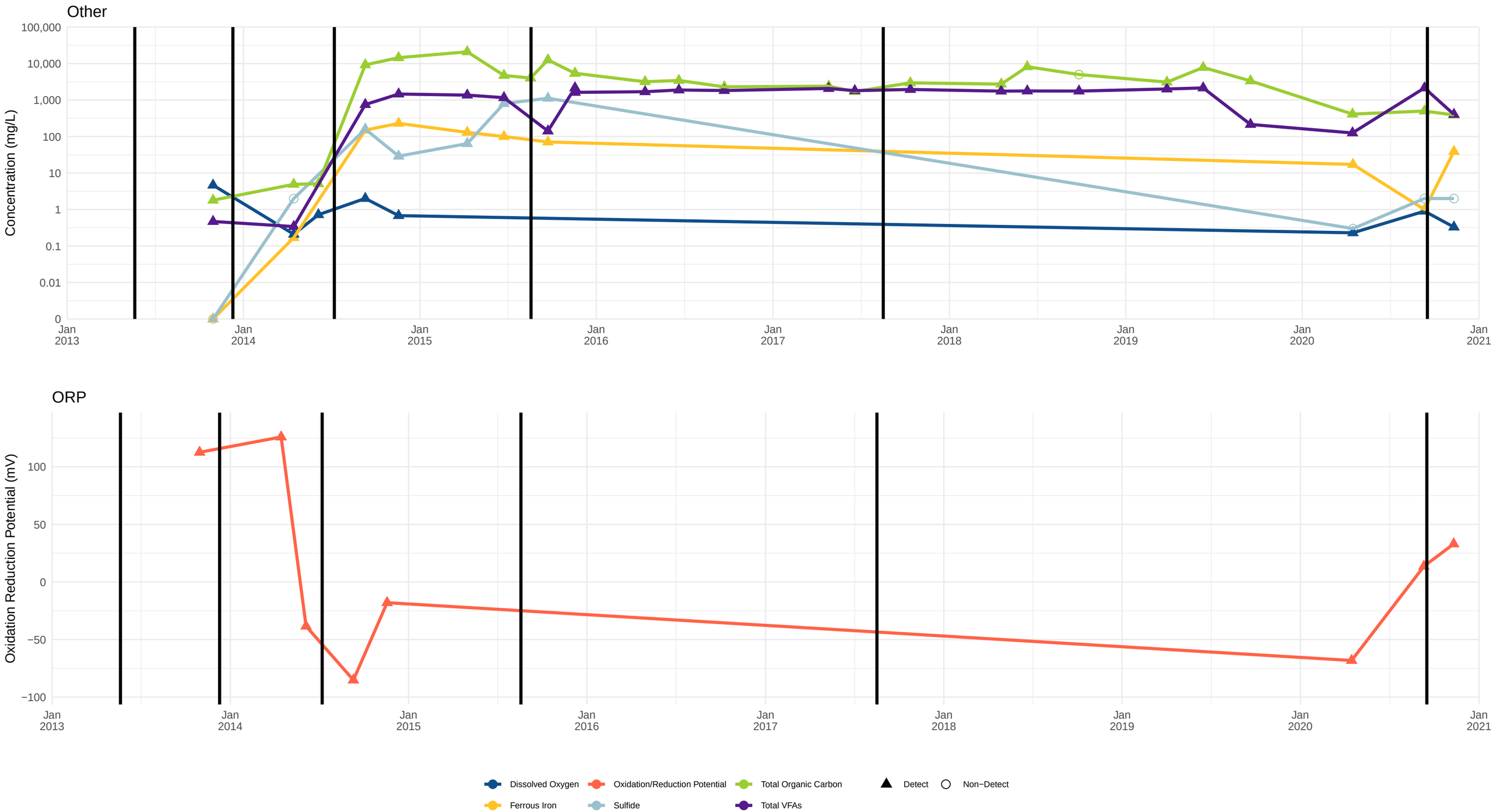
B−7

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.



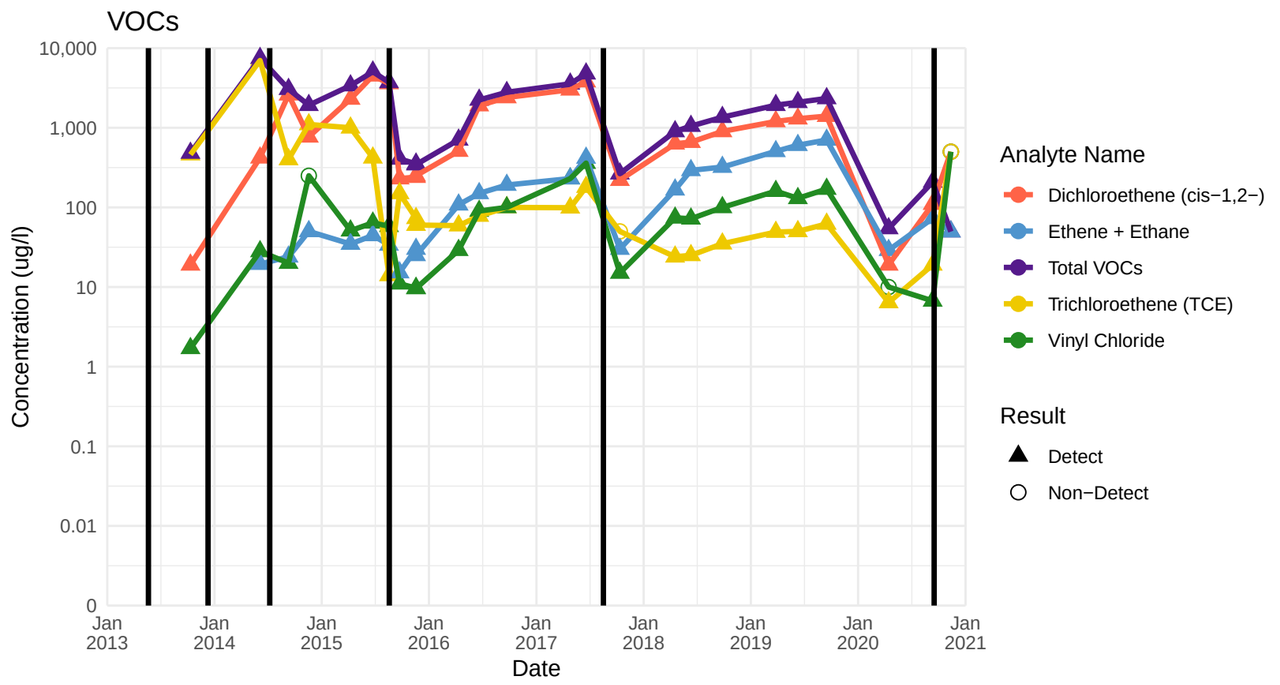
B−9

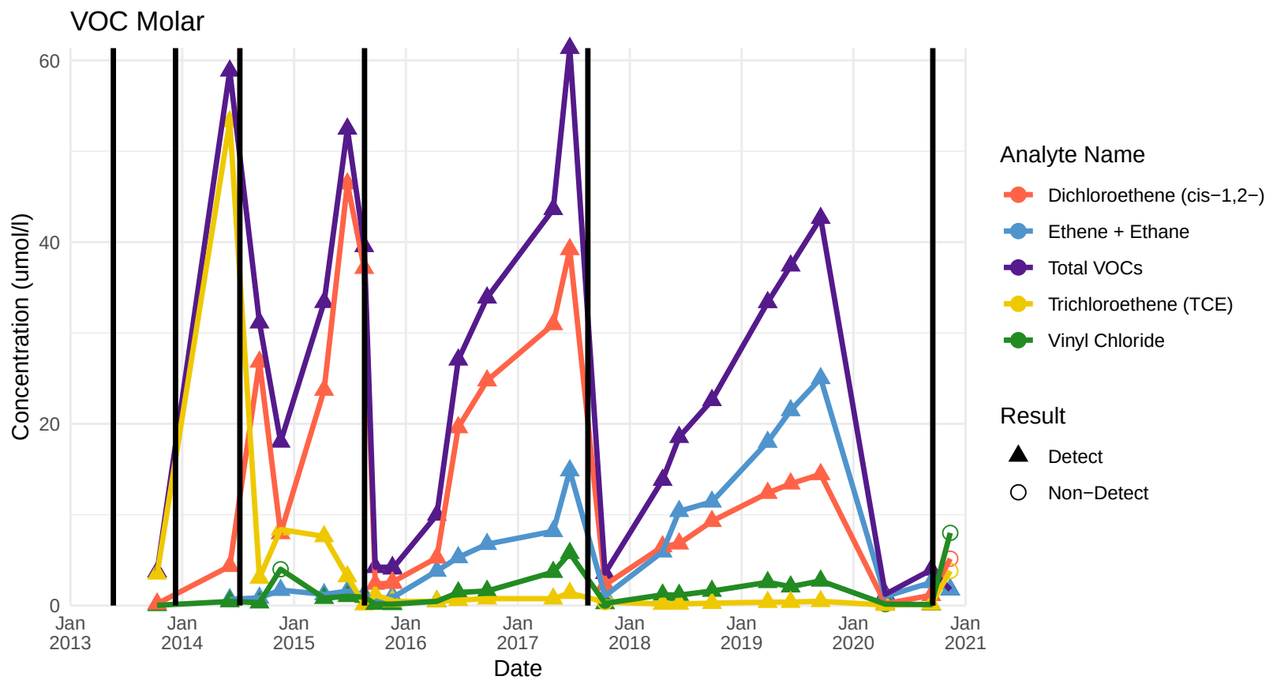
Notes:

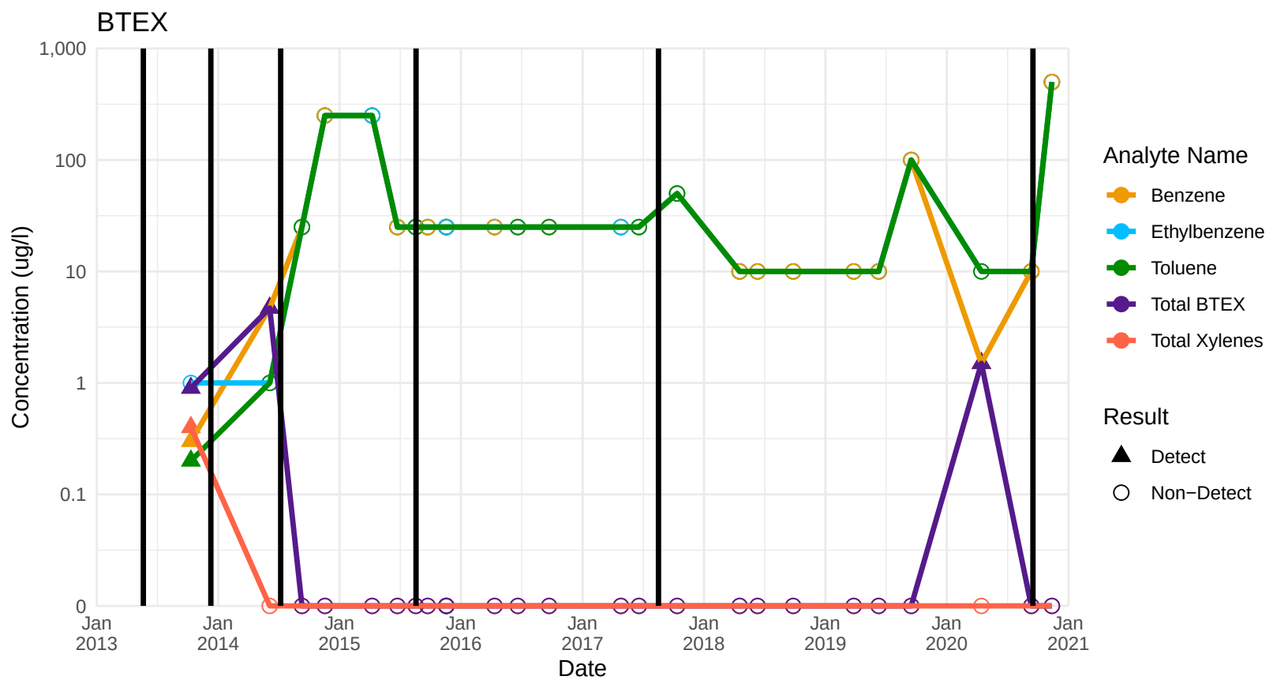
(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

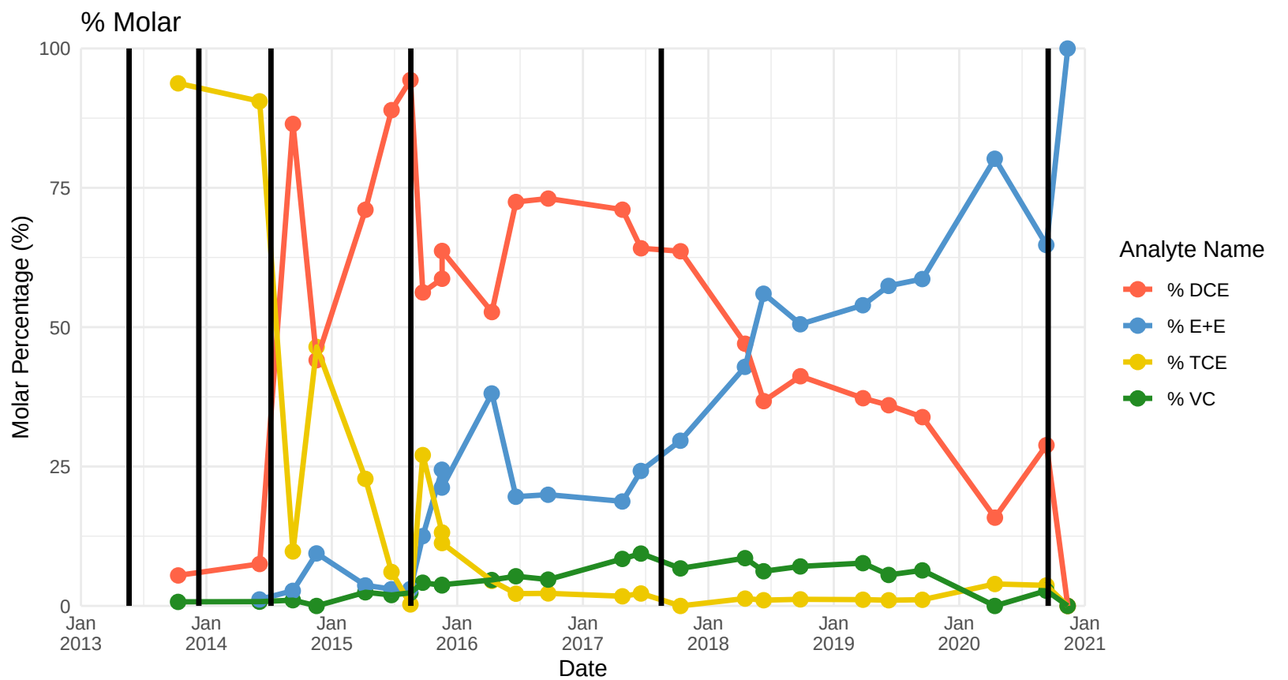
(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.









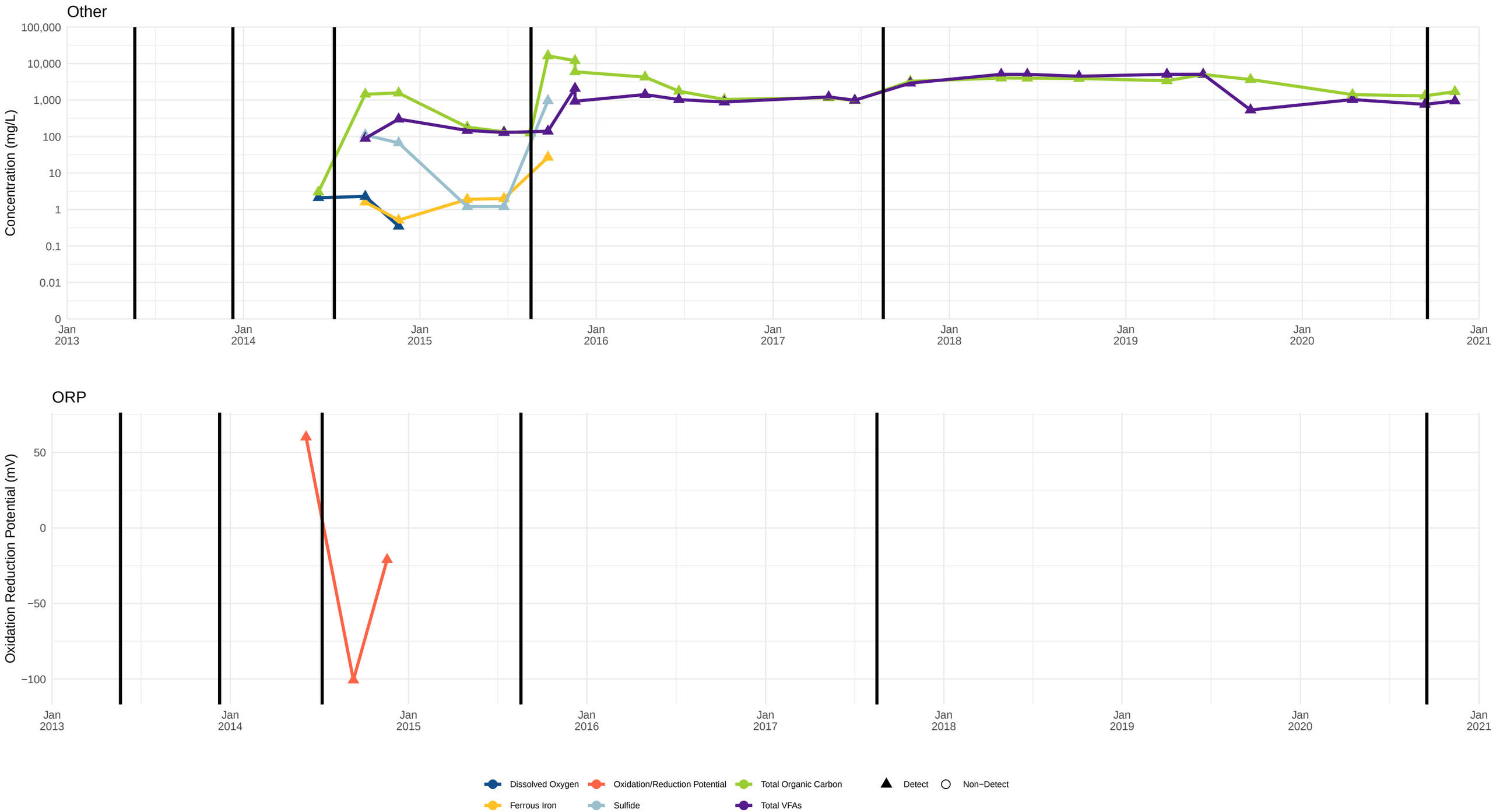
B−9

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.



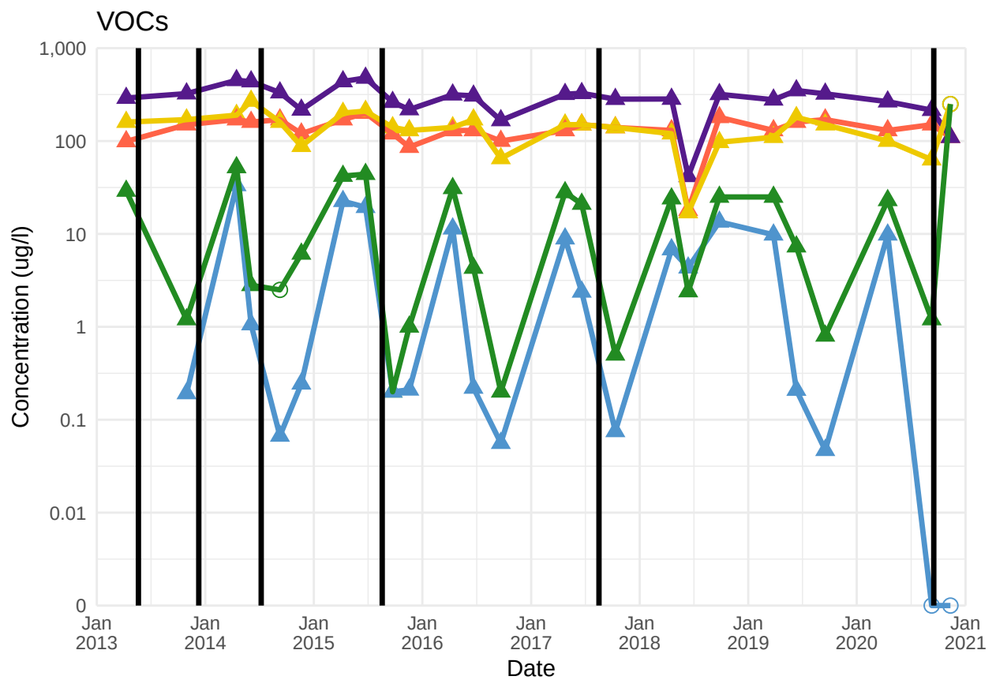
BP−1A

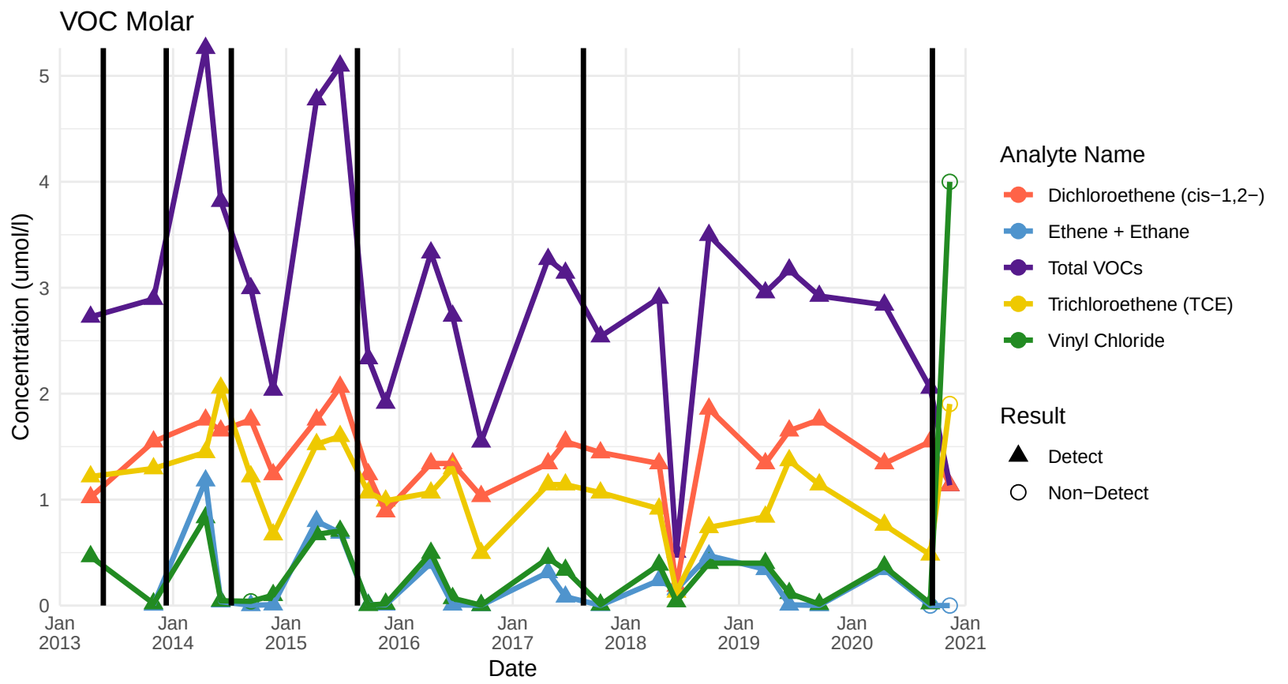
Notes:

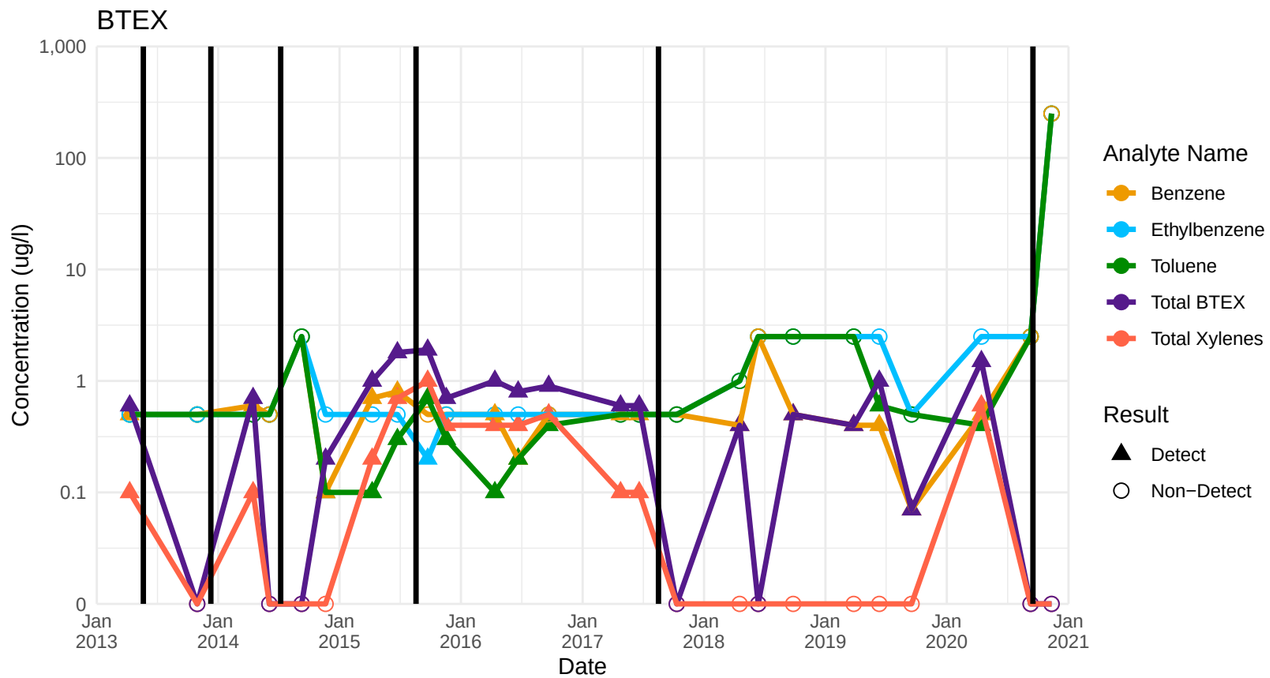
(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

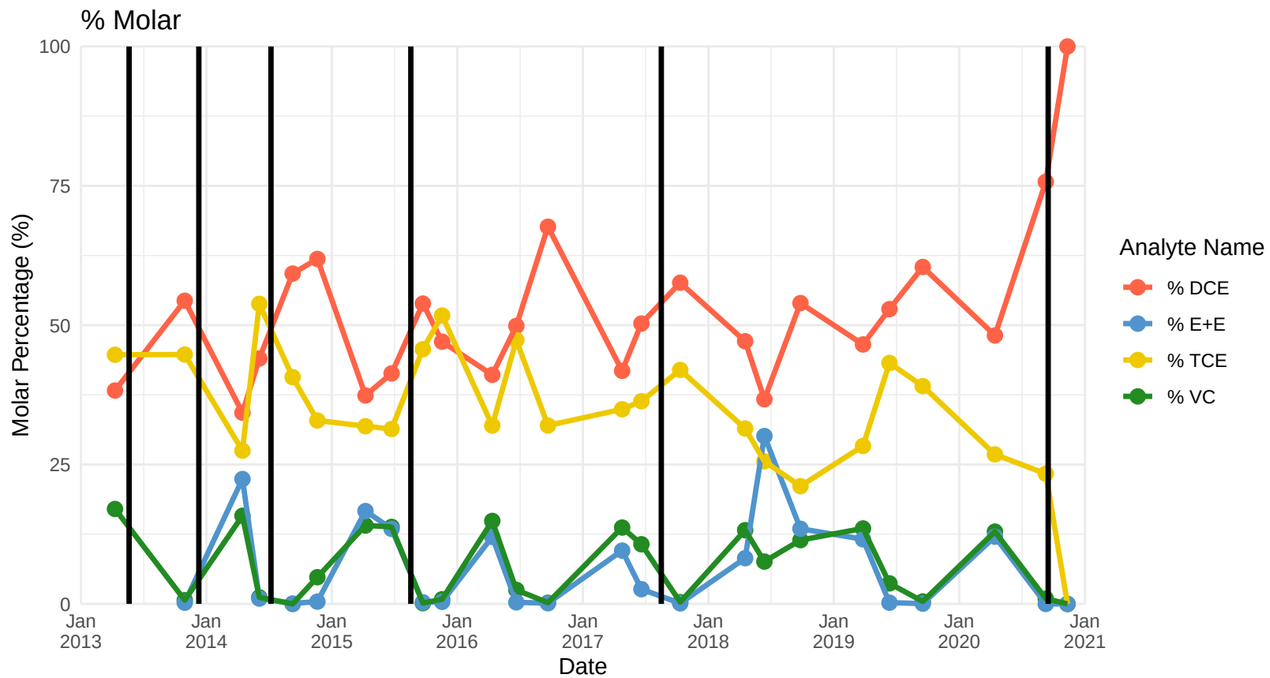
(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.









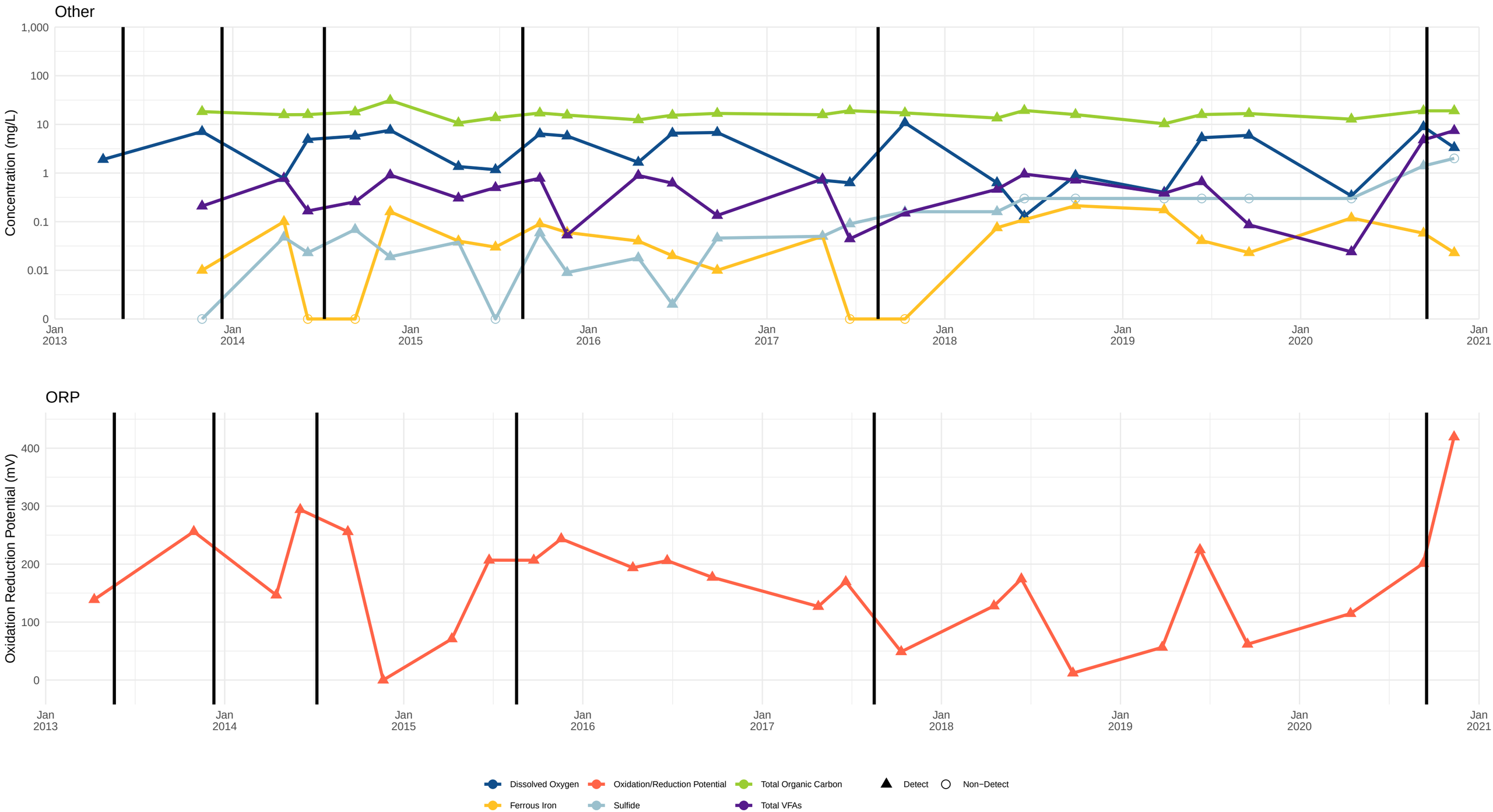
BP−1A

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.



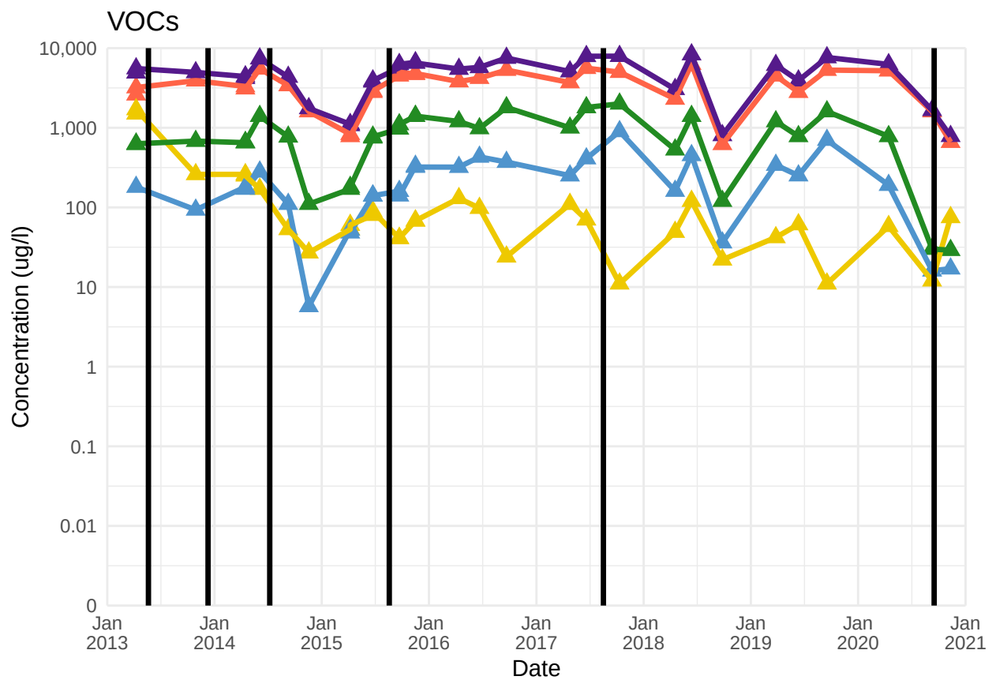
BP−2A

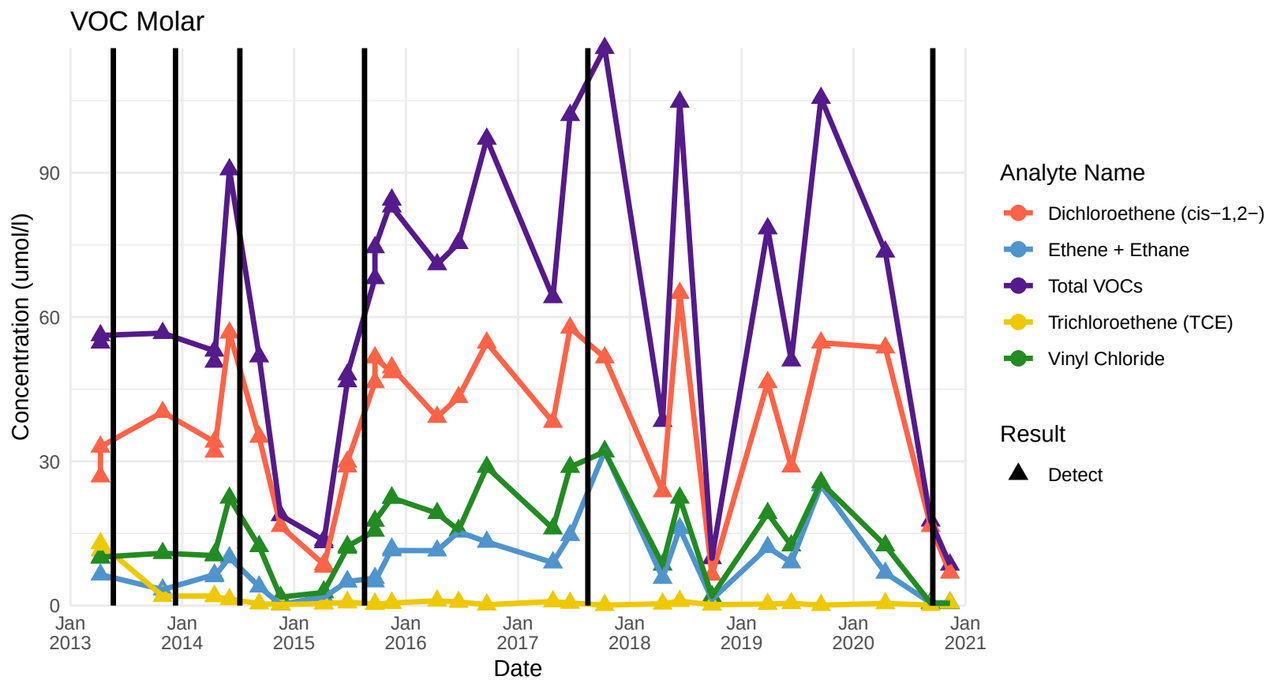
Notes:

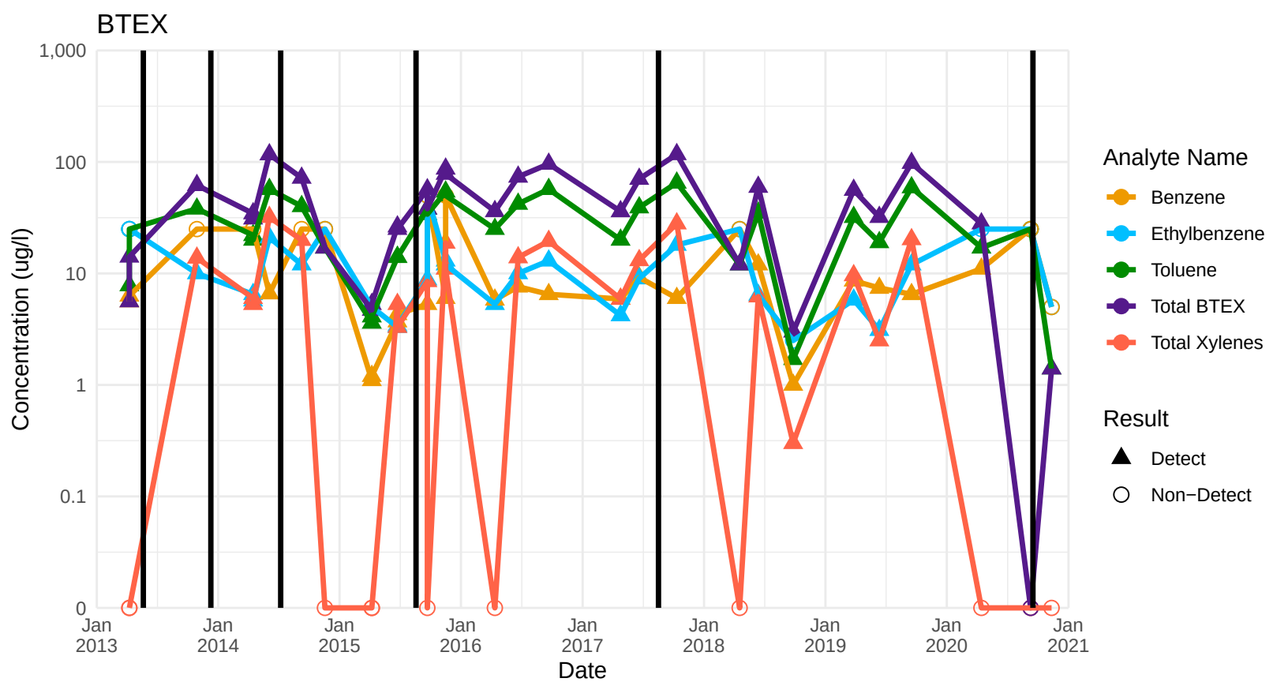
(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

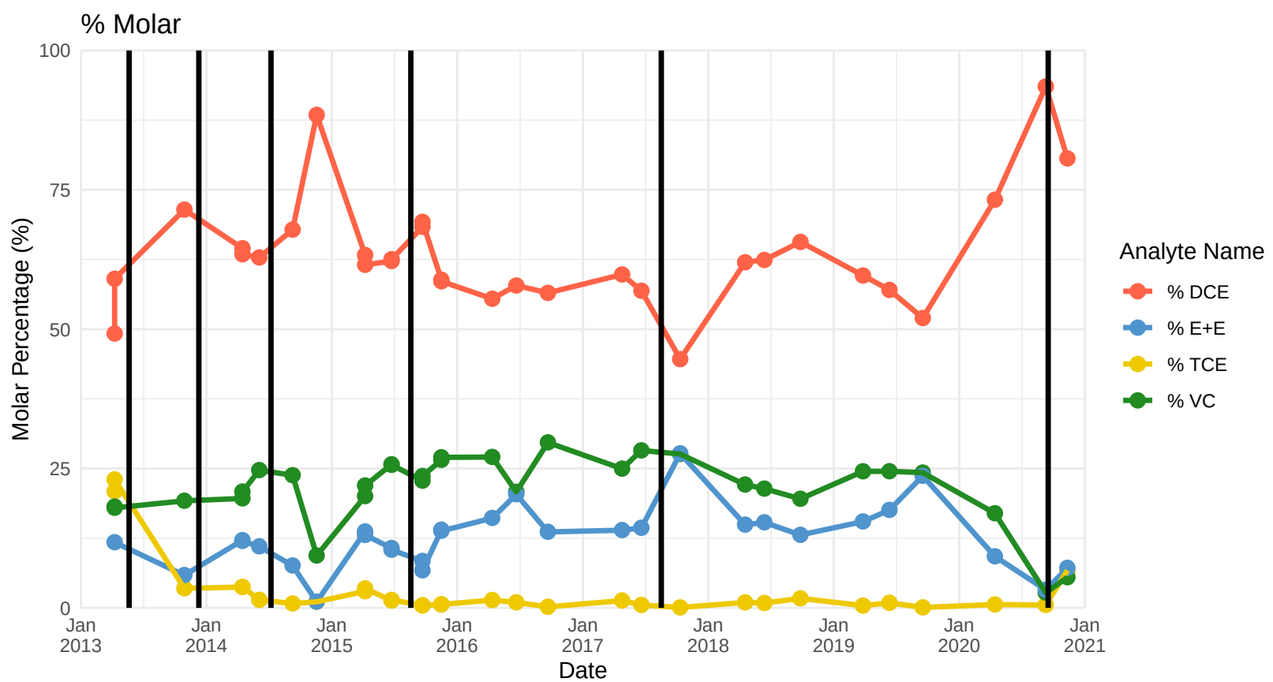
(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.









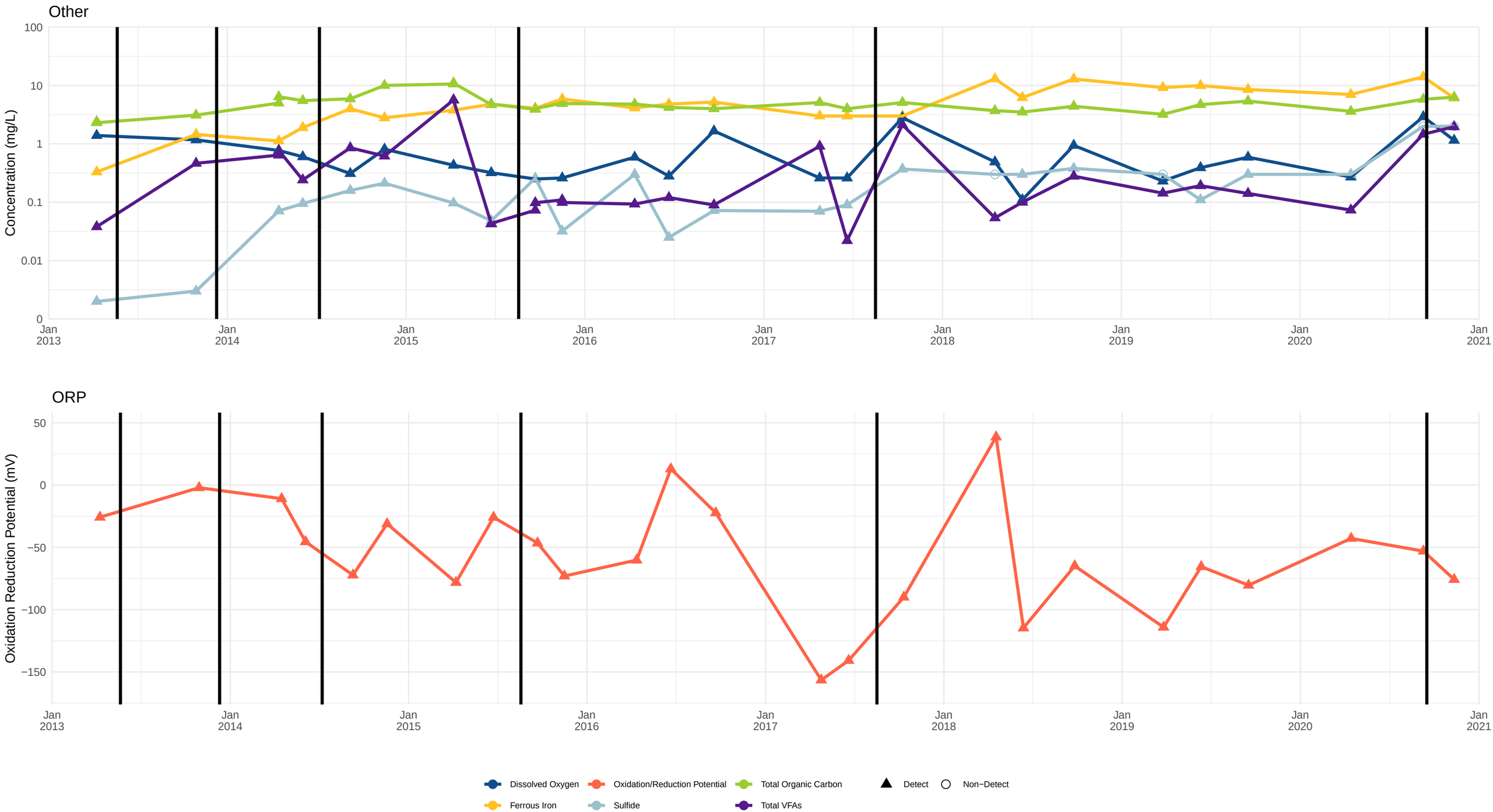
BP−2A

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.



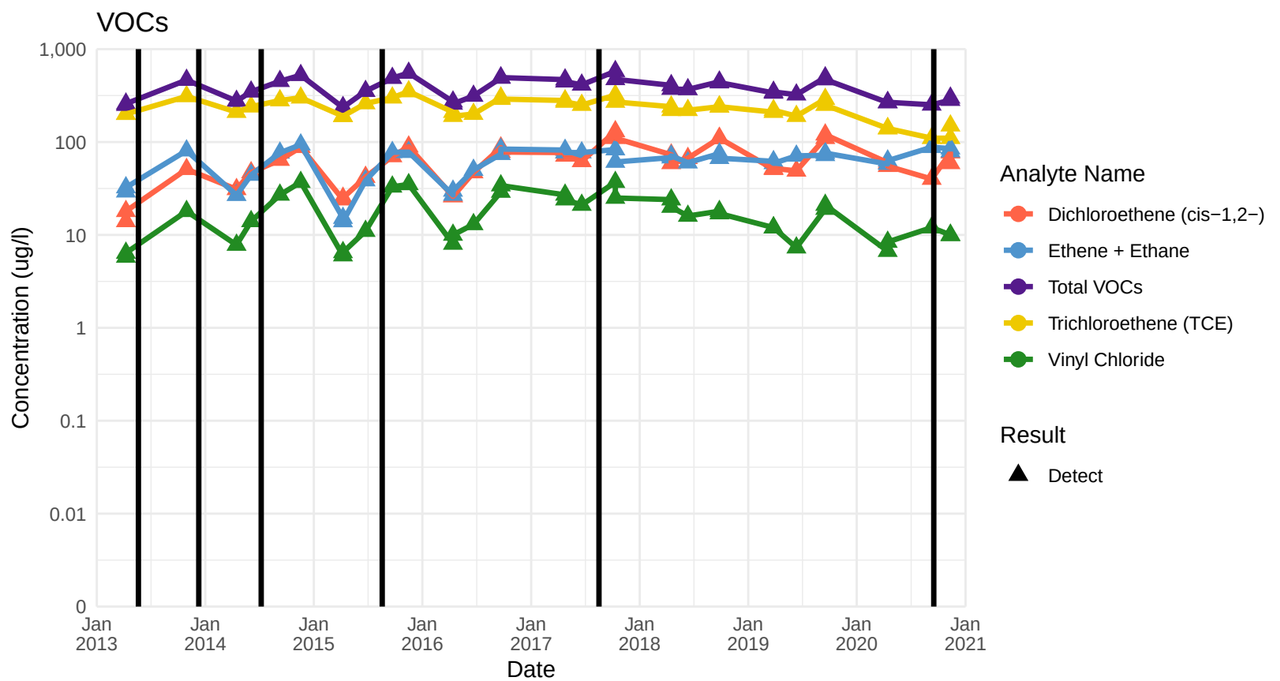
BP−4A

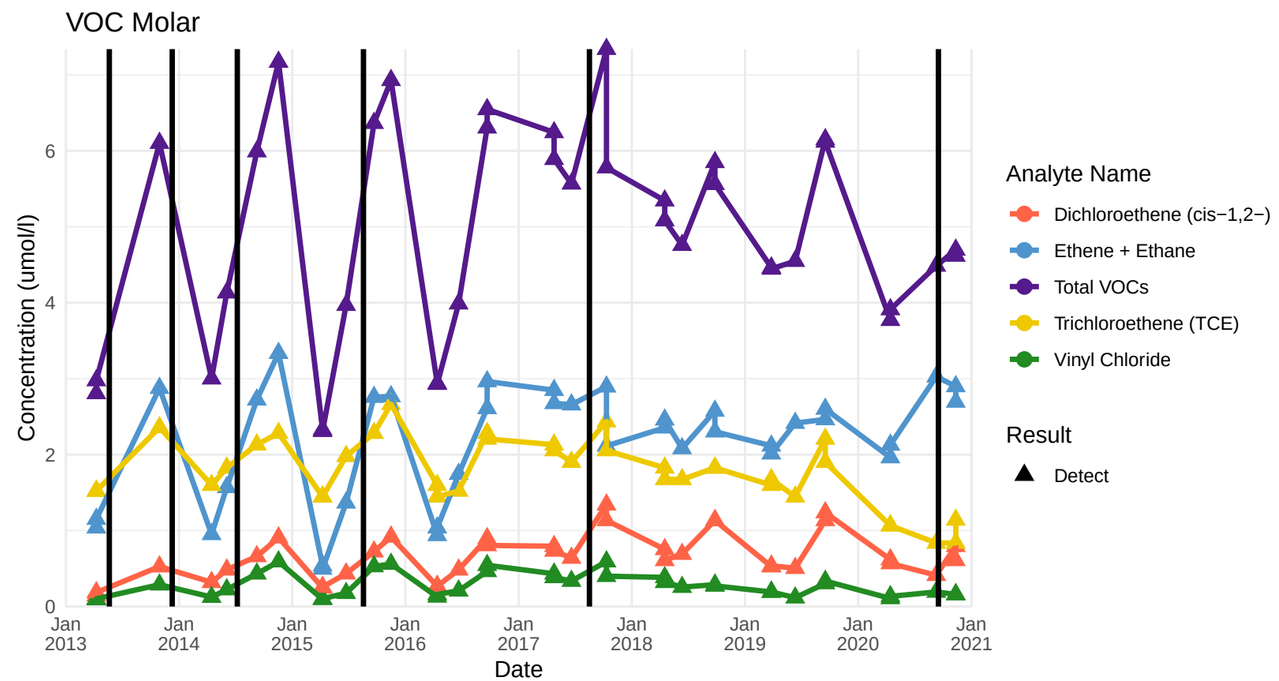
Notes:

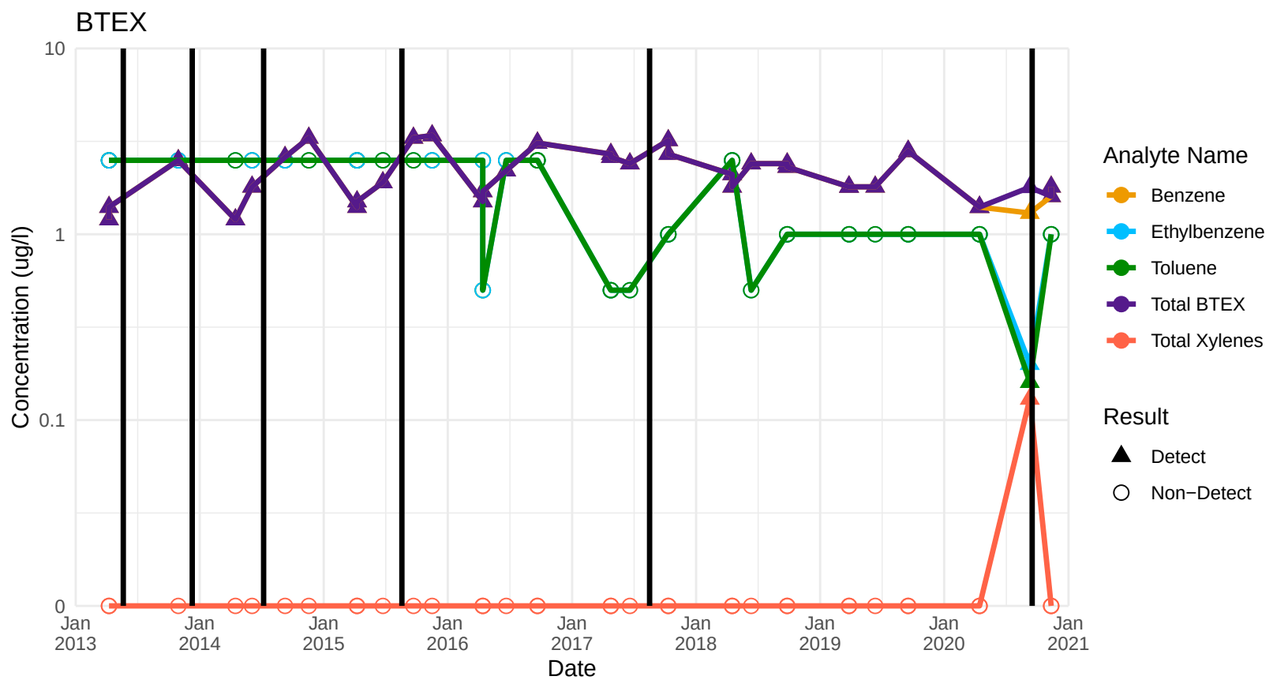
(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

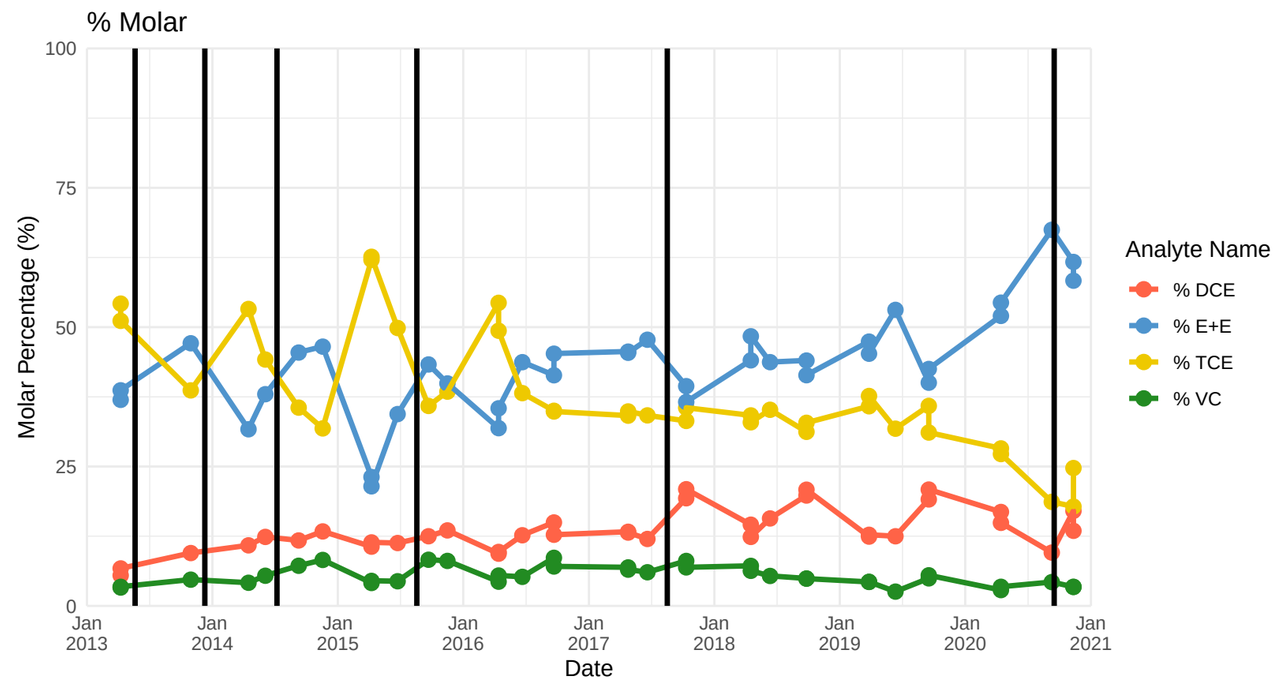
(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.









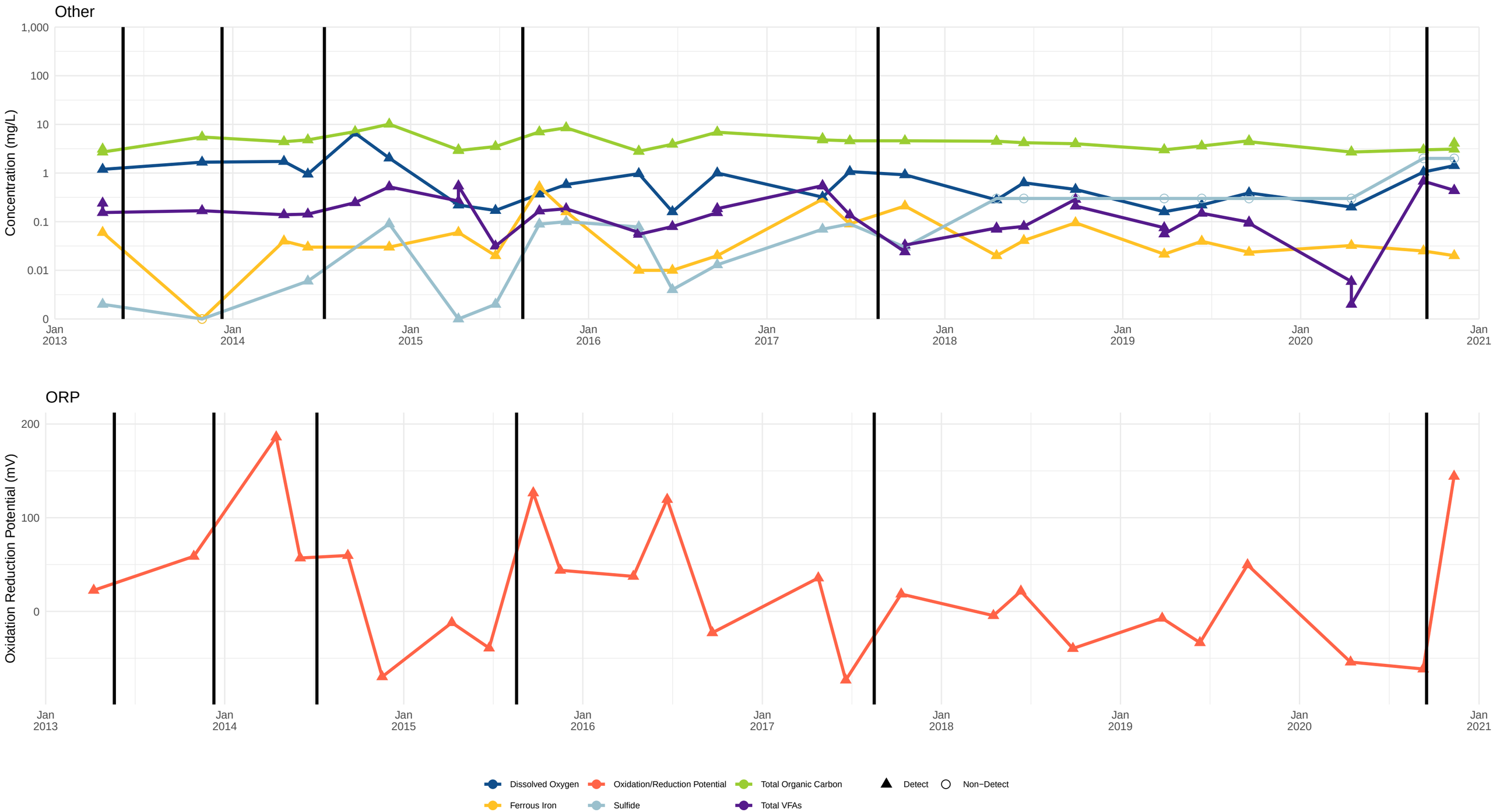
BP−4A

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.



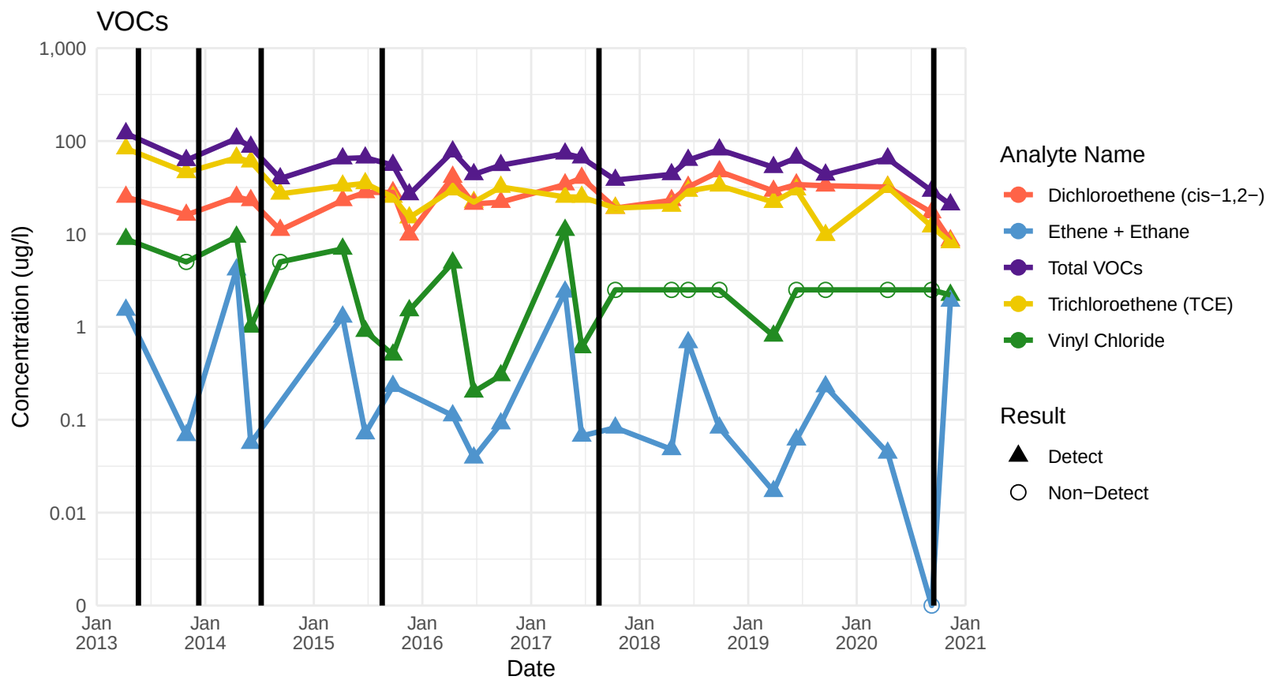
BP−5A

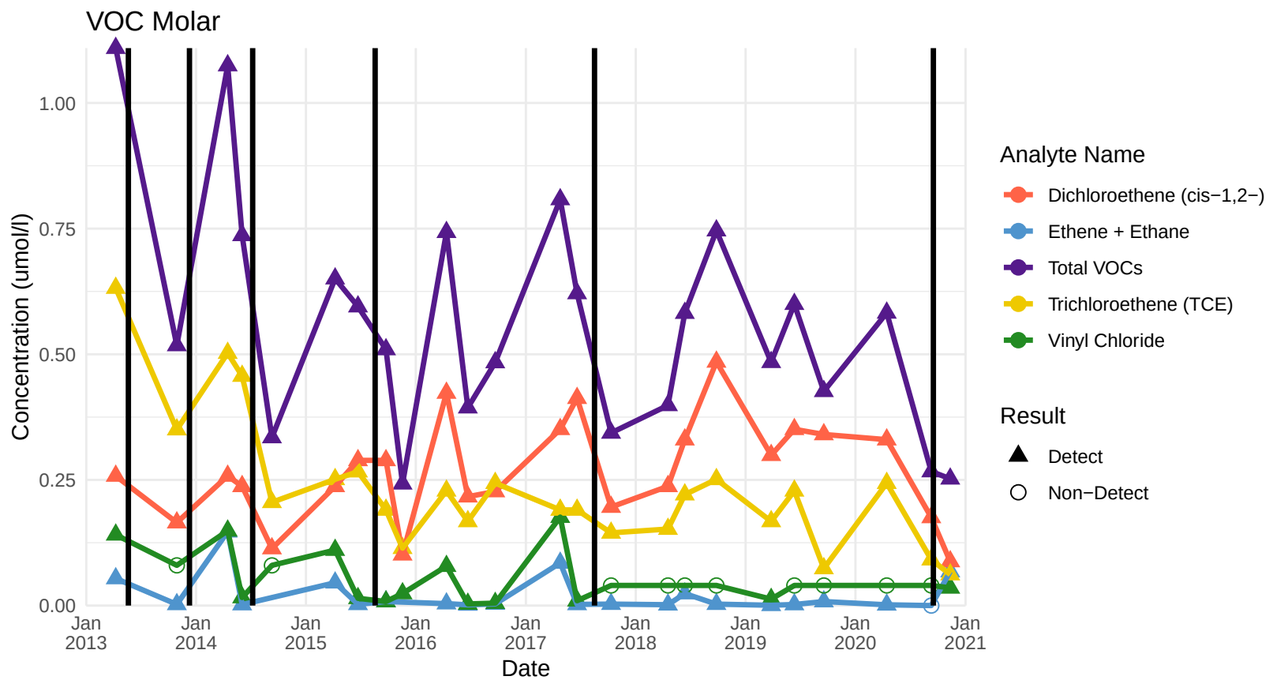
Notes:

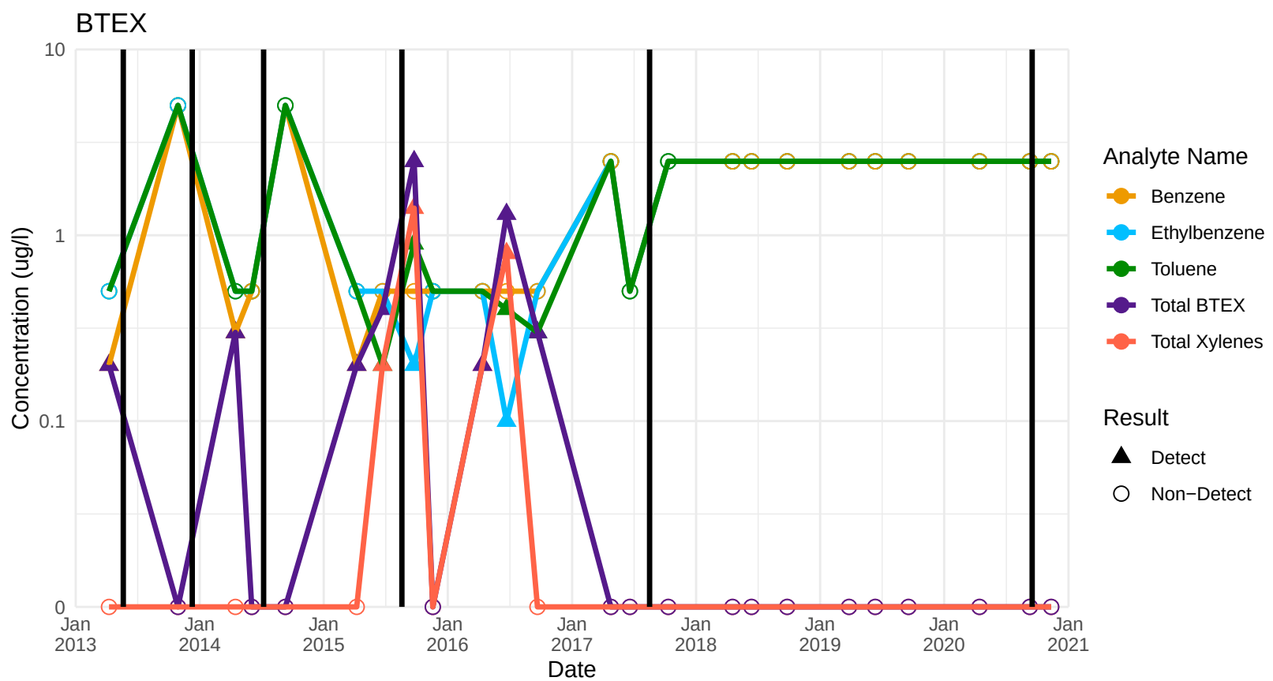
(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

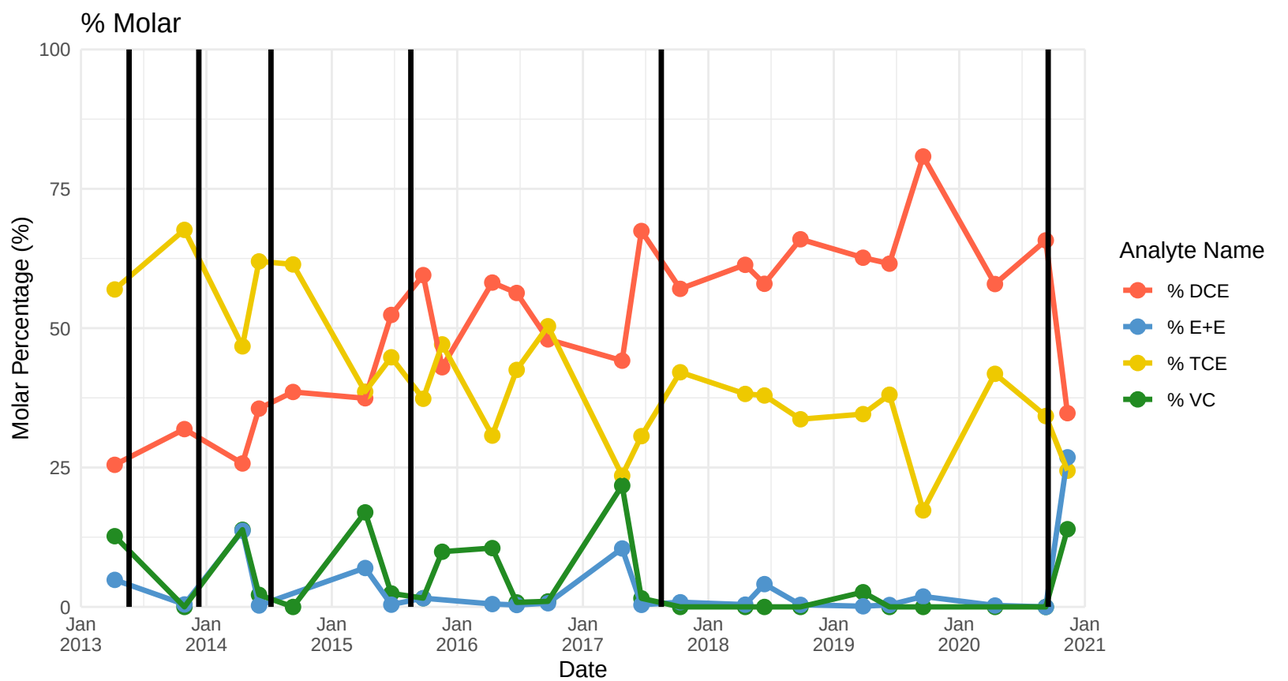
(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.









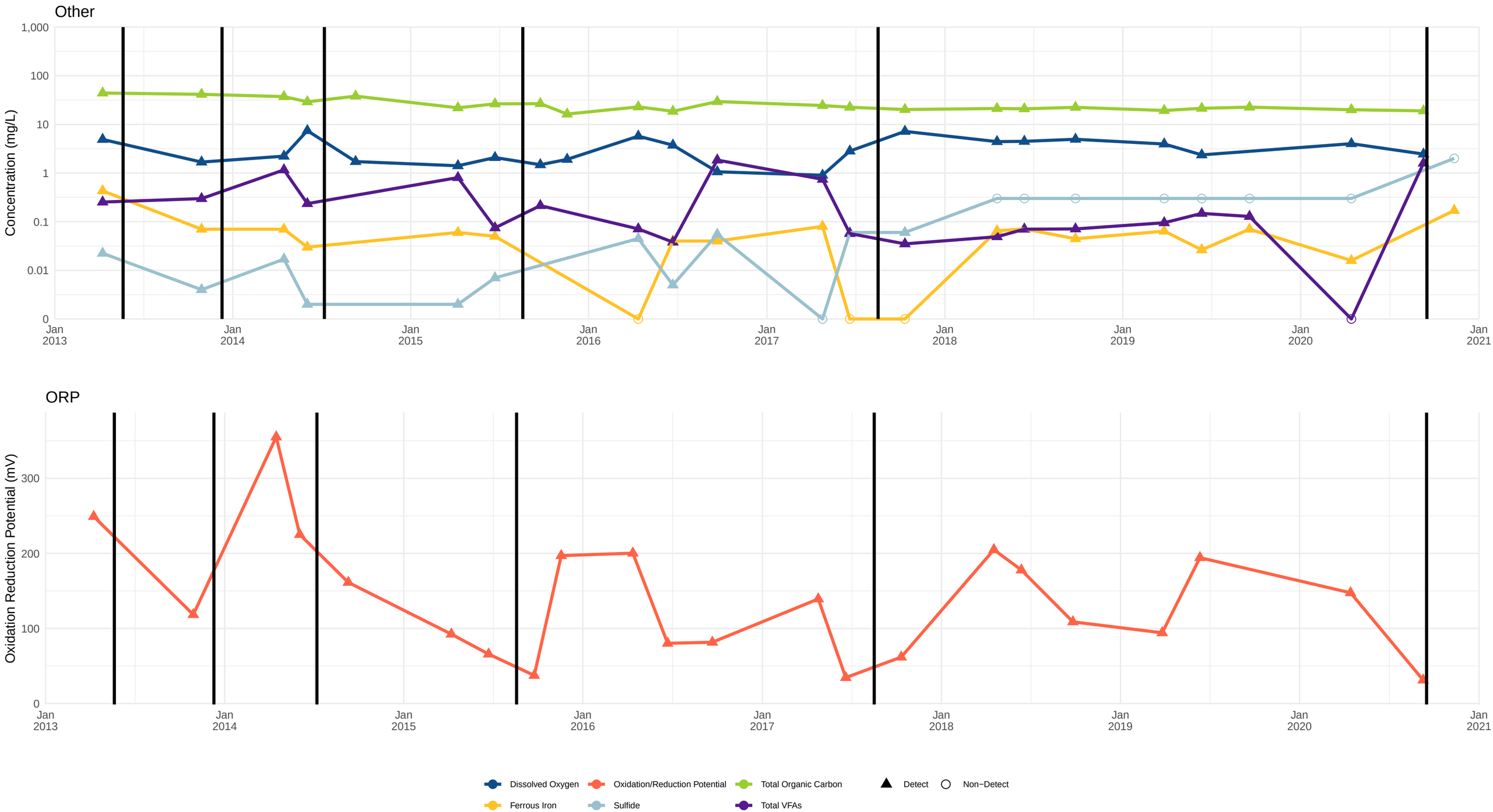
BP−5A

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.



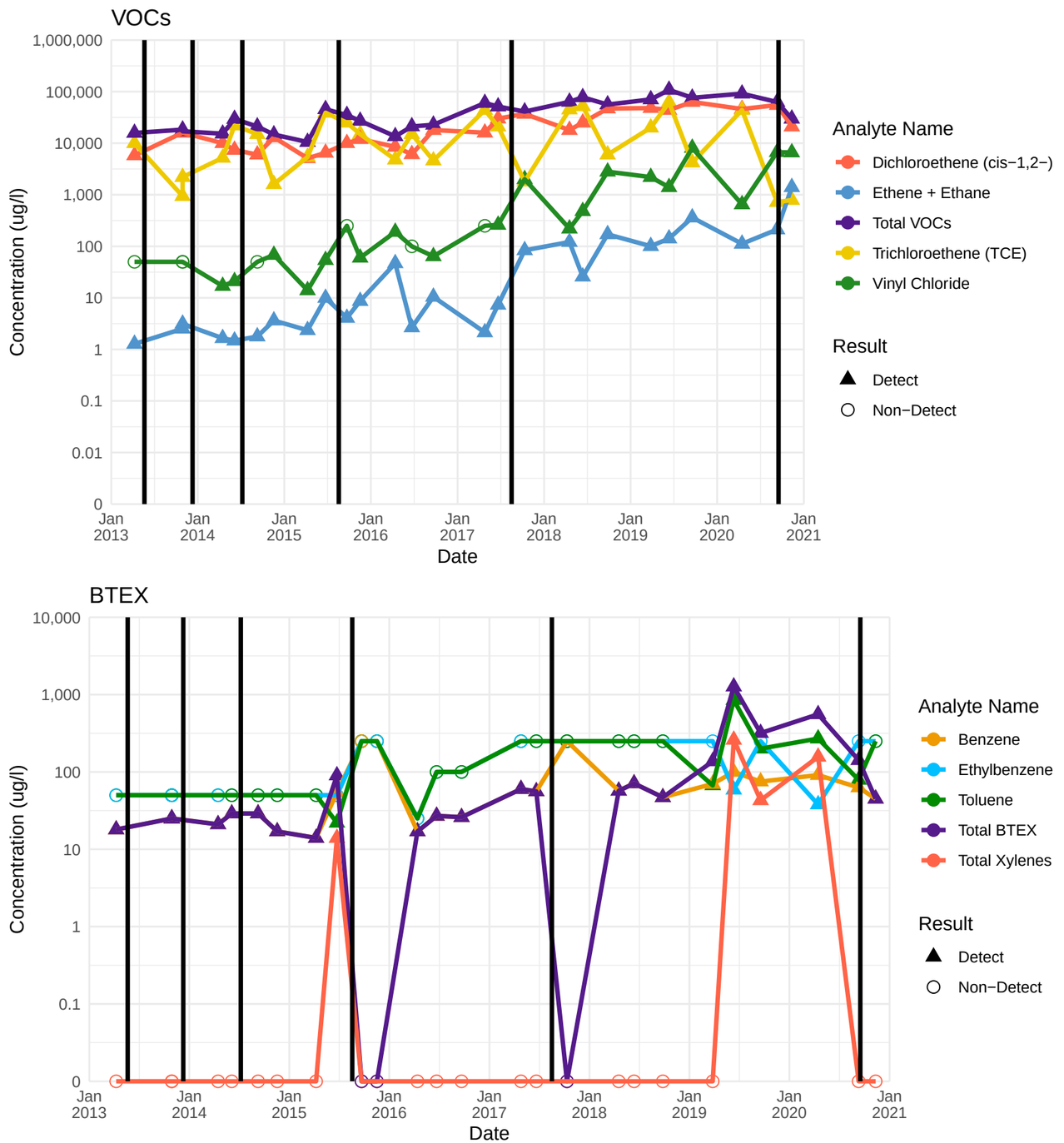
BP−6A

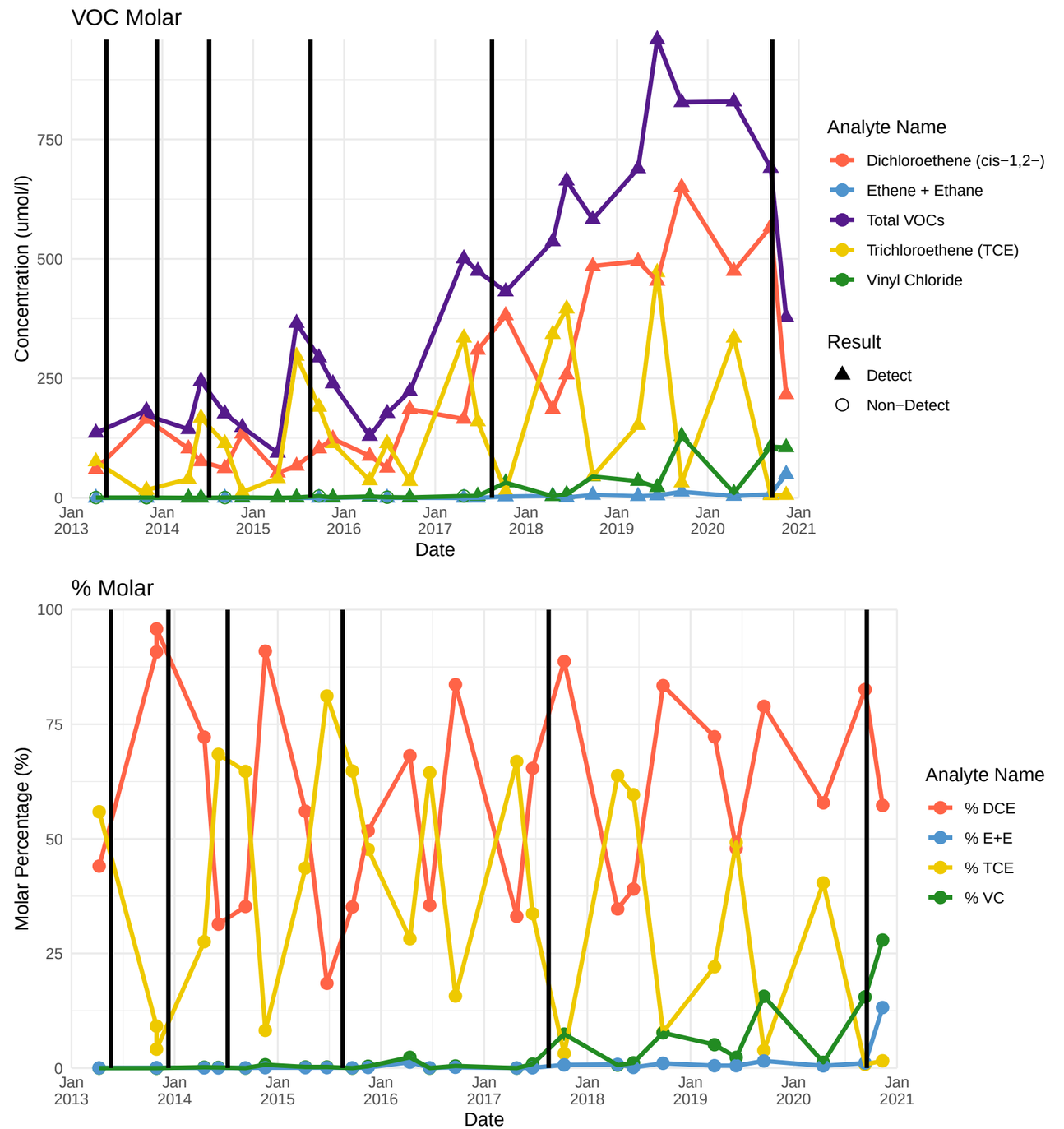
Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.





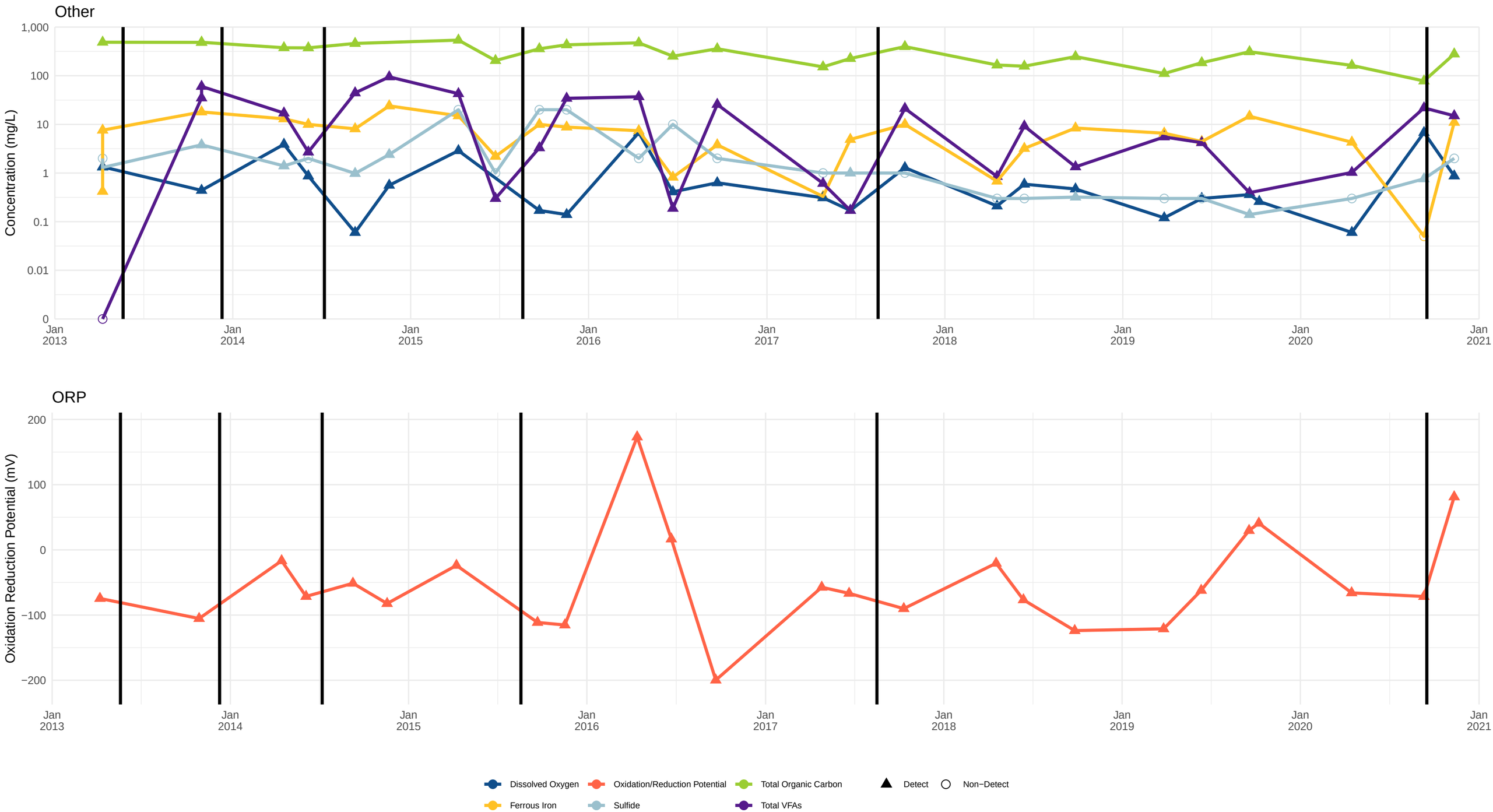
BP−6A

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.



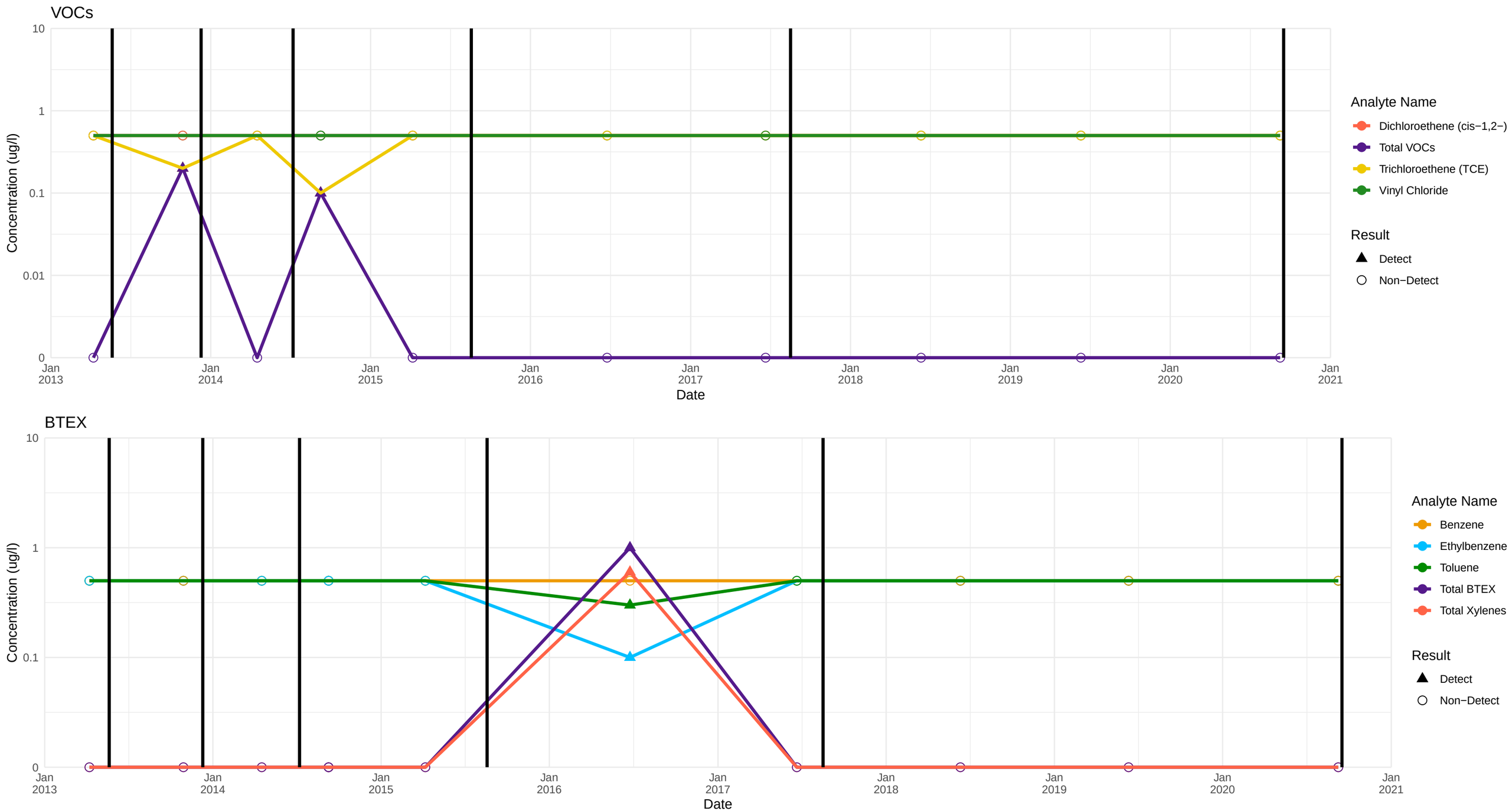
BP−7A

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.



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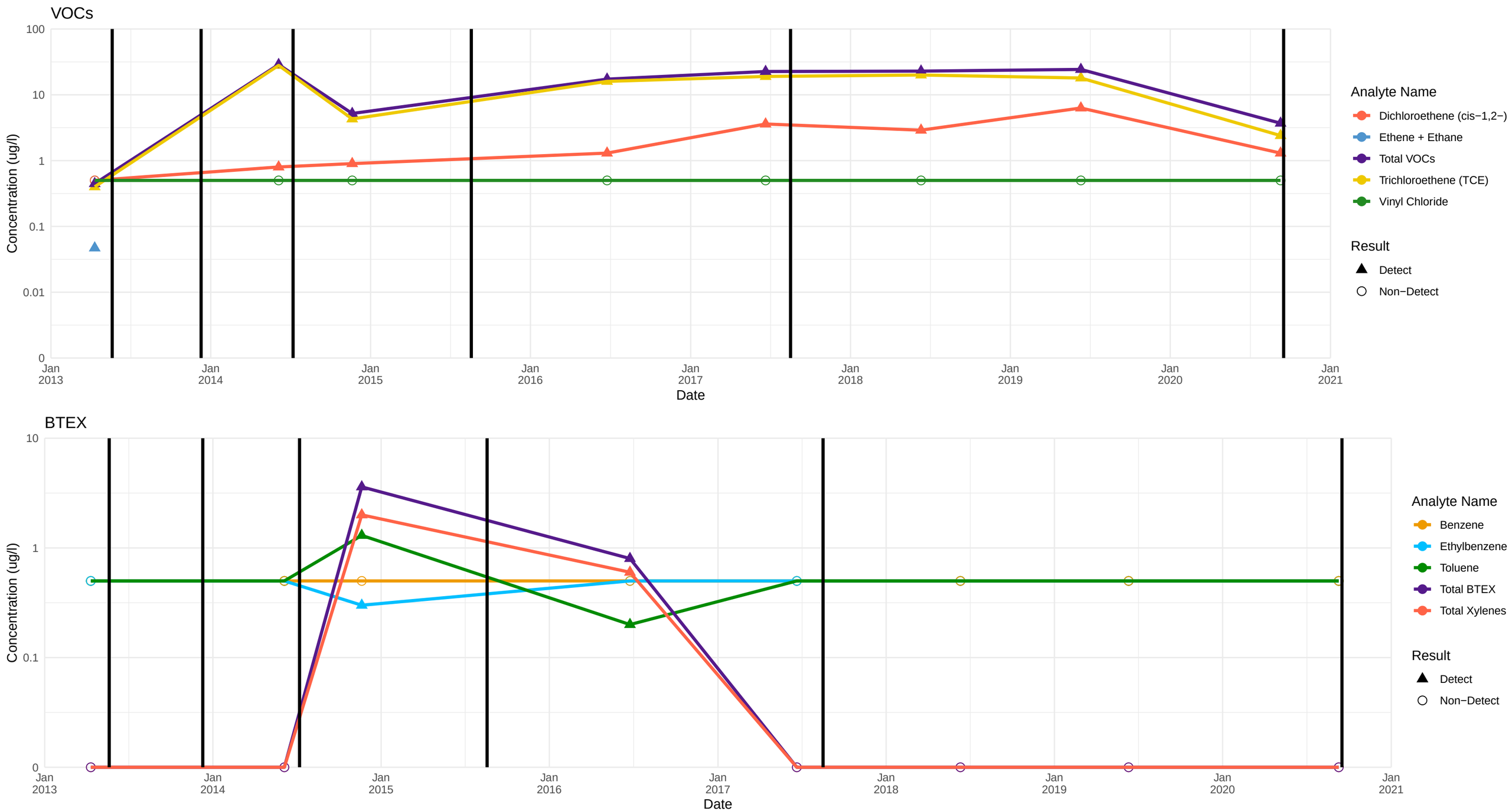
BP−8A

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.



Sanborn, Head & Associates, Inc.

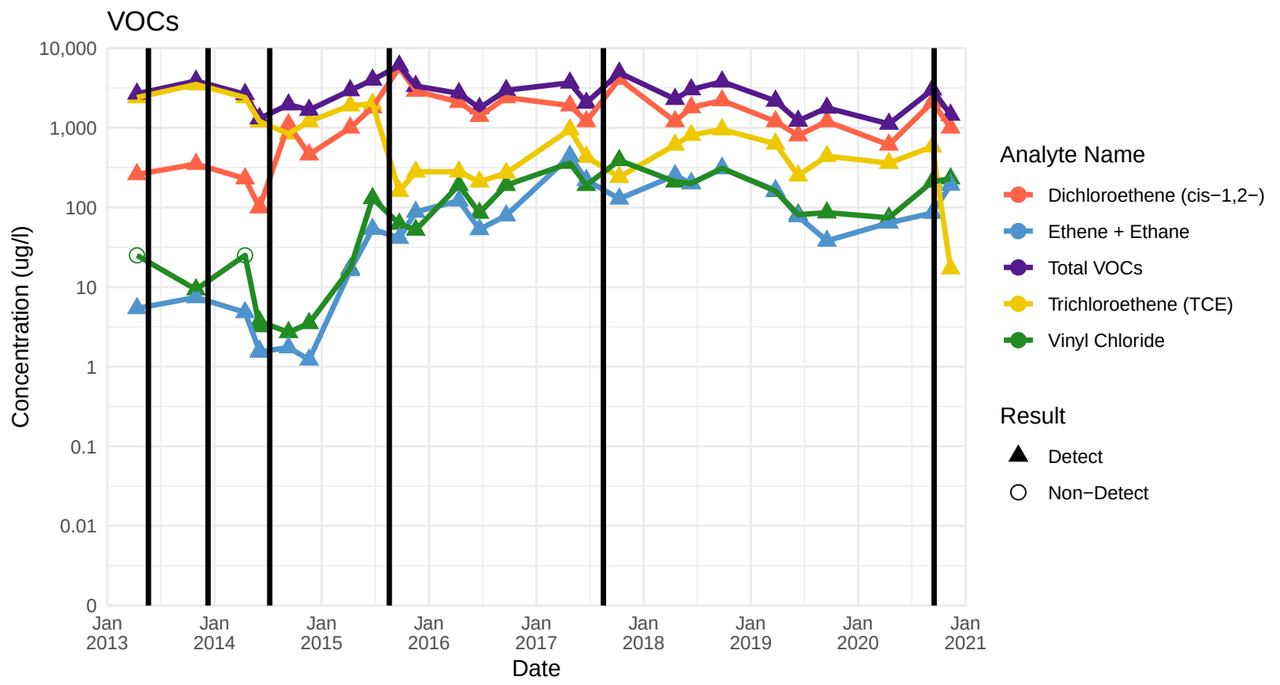
BP−9A

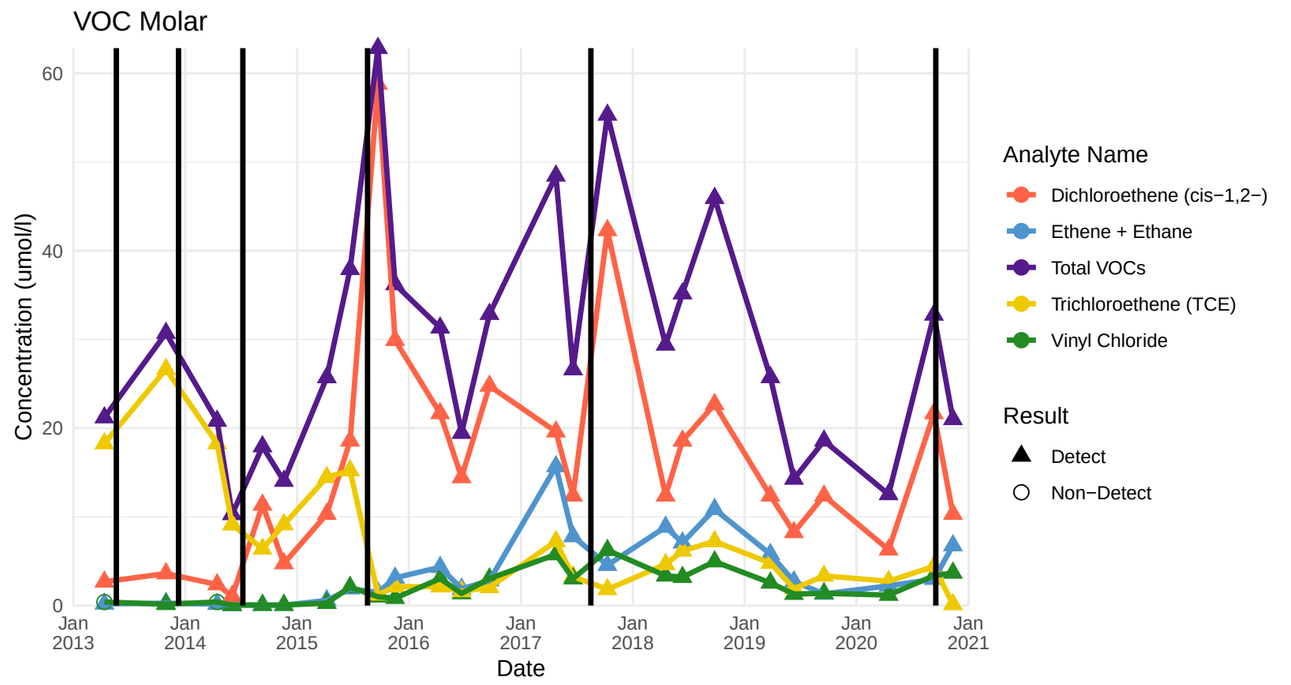
Notes:

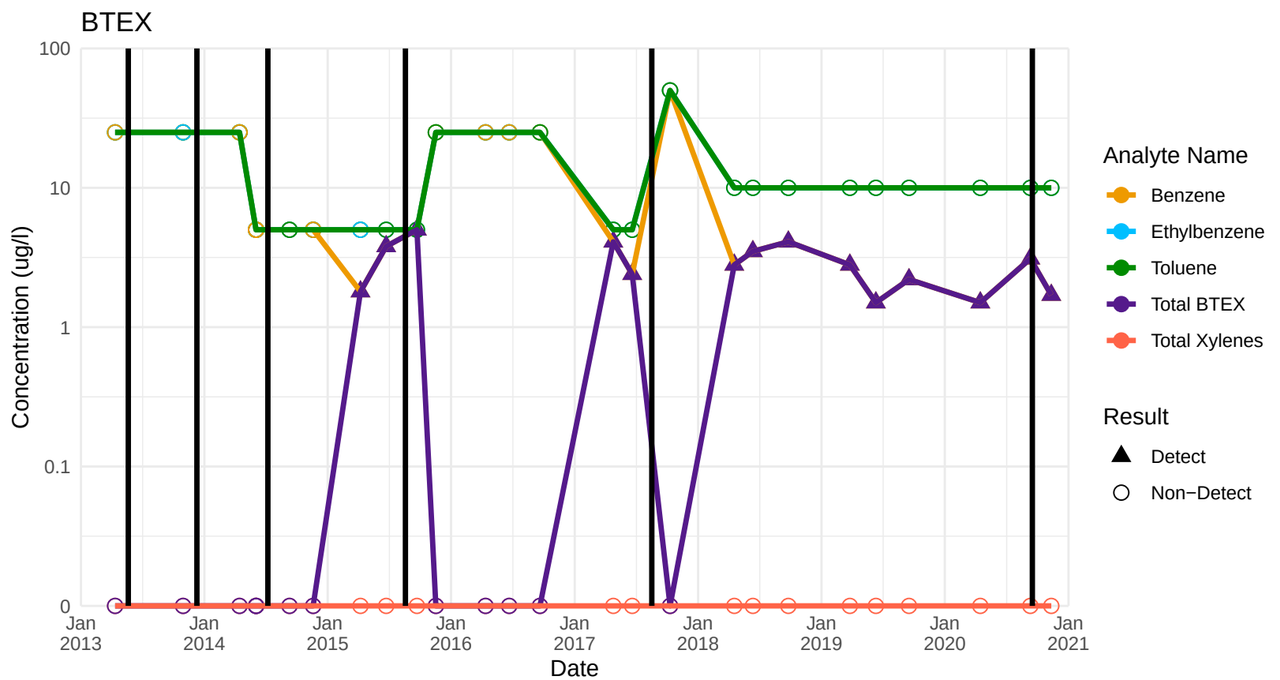
(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

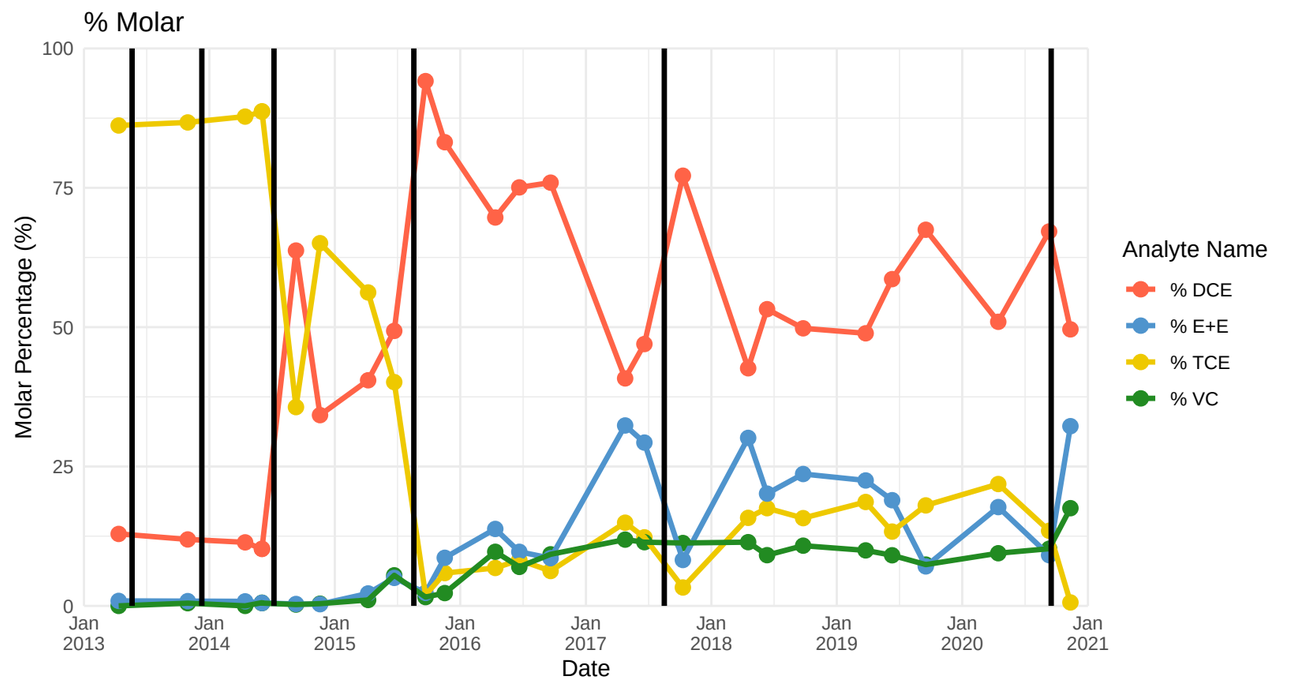
(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.









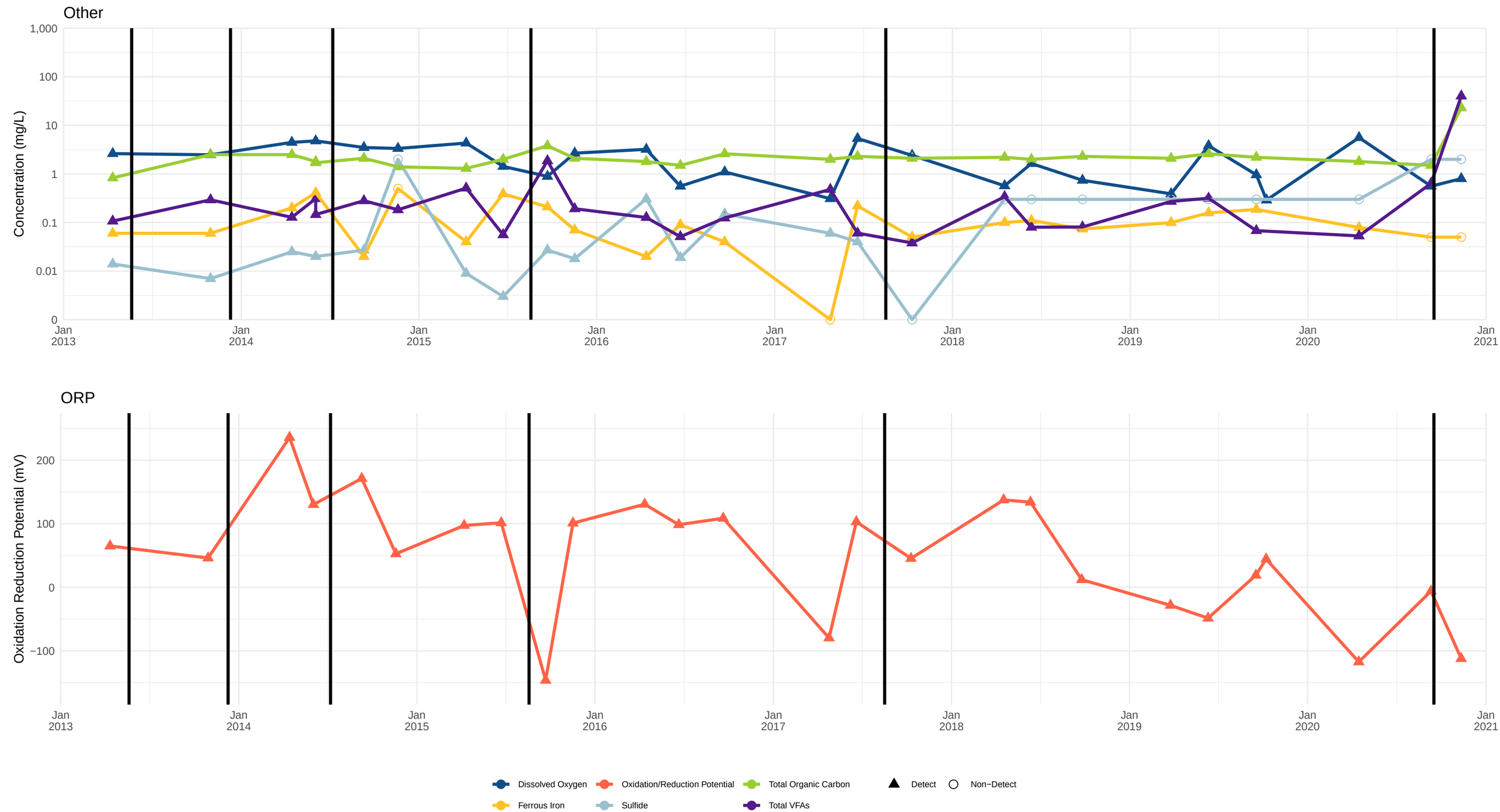
BP−9A

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.



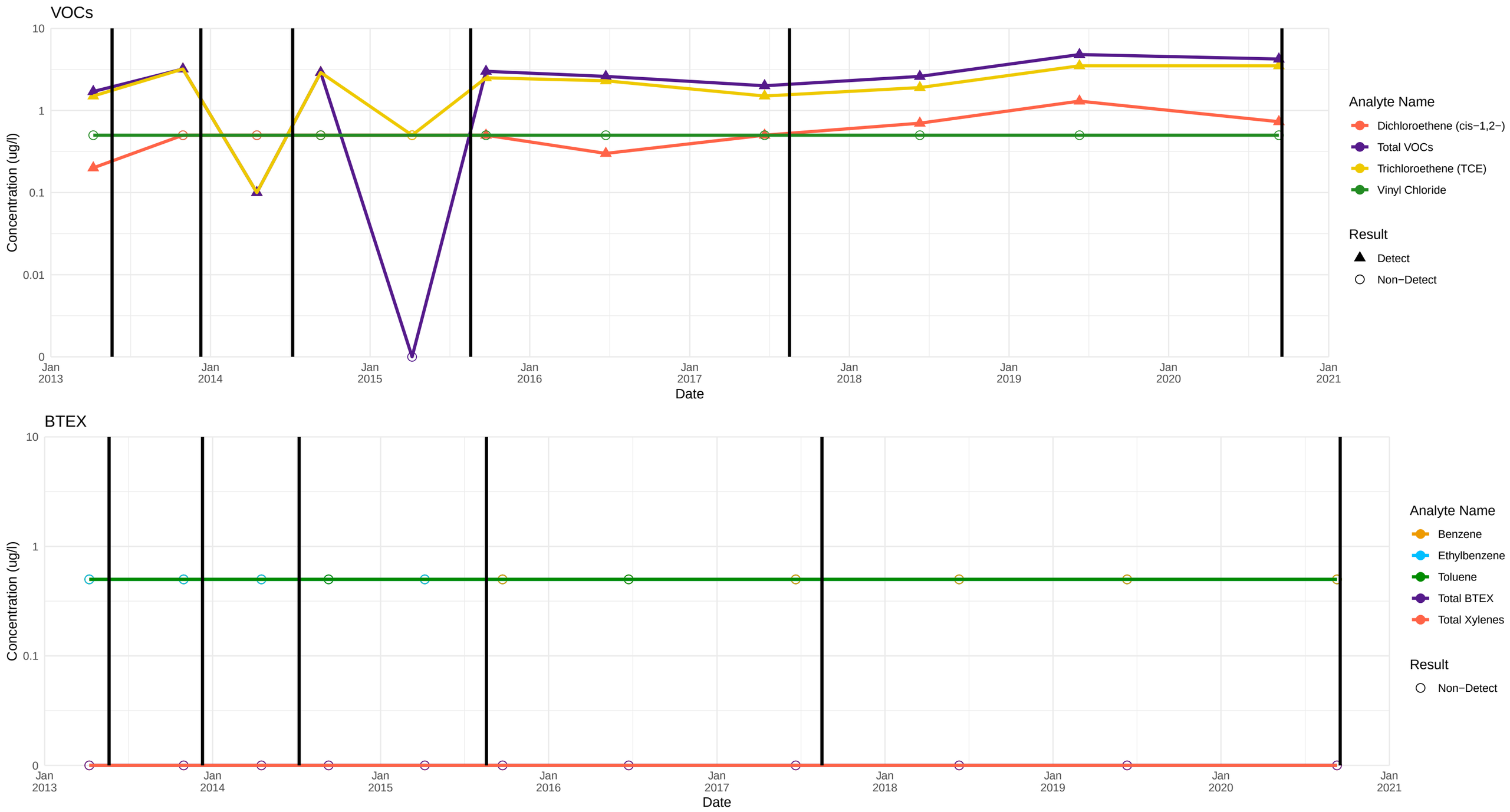
BP−10A

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.



BP−11A

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.

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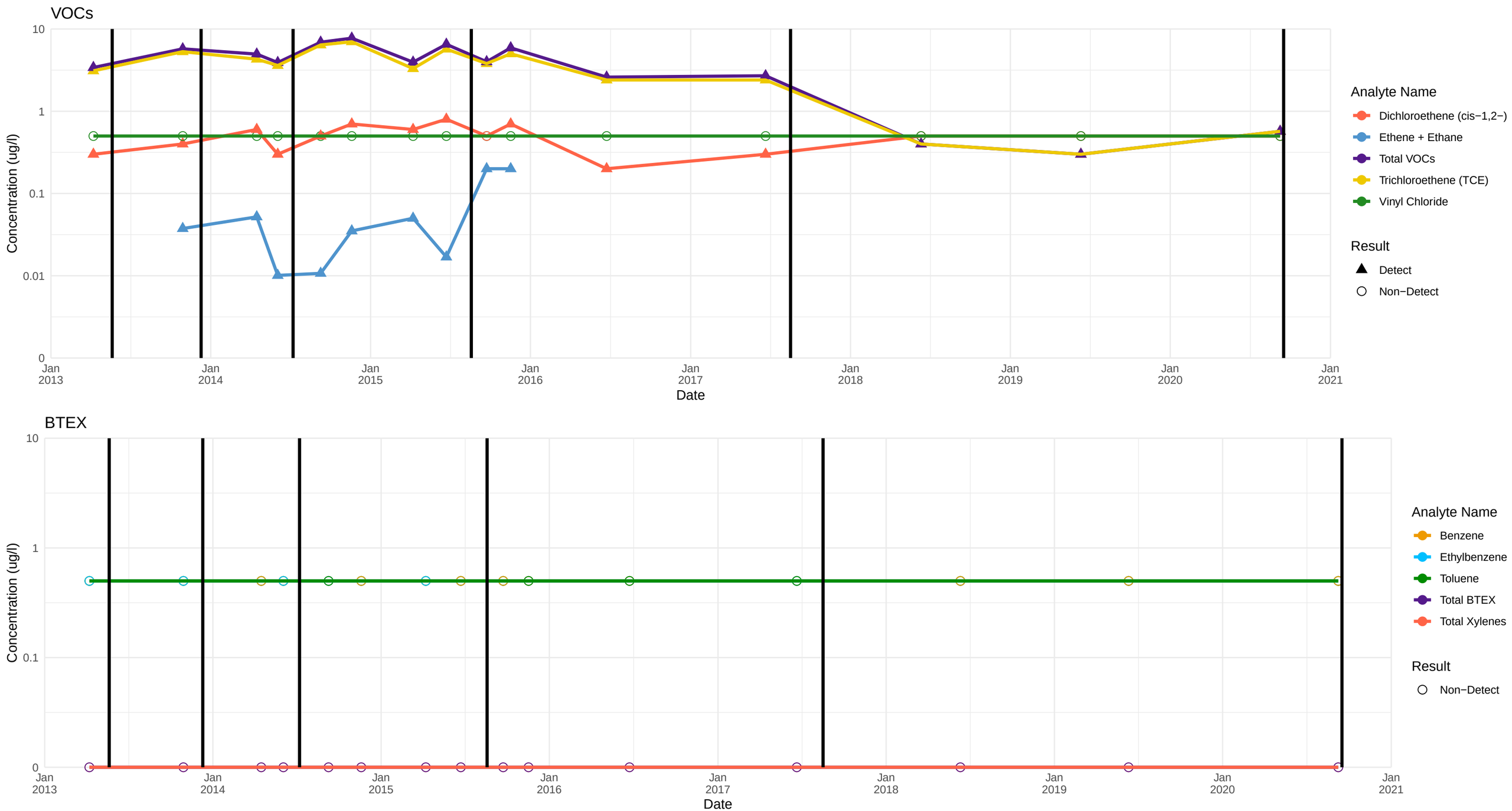
BP−12A

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.



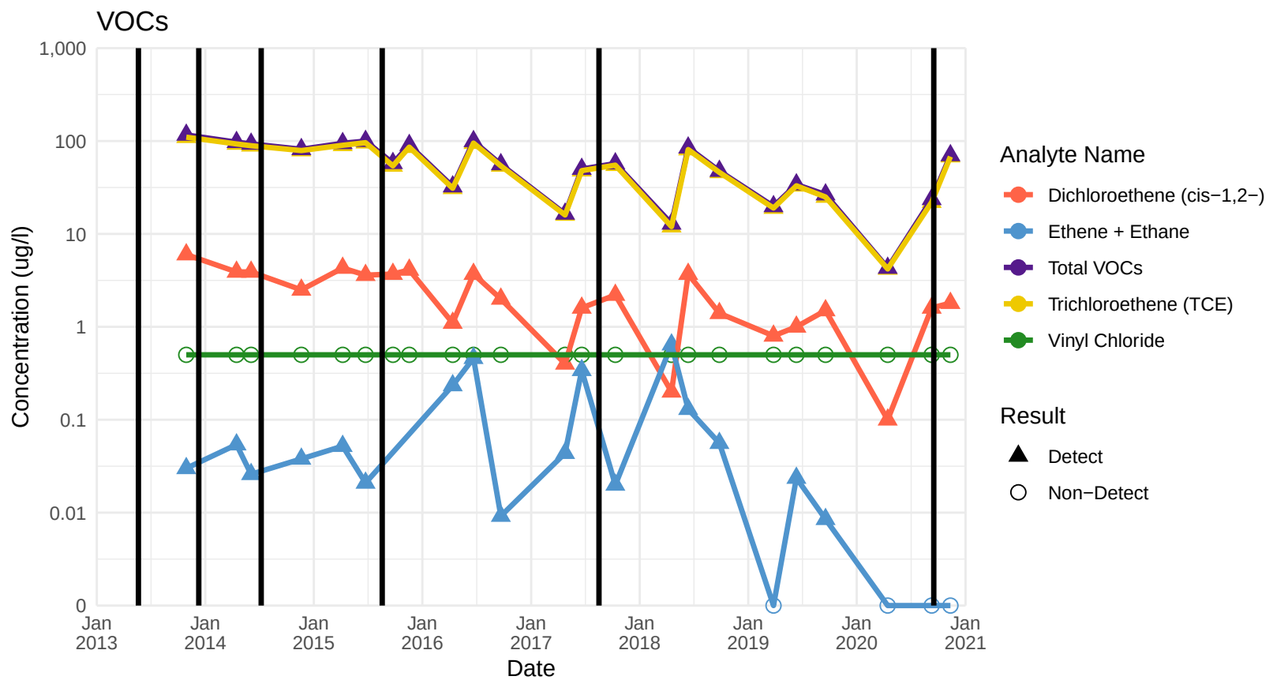
BP−13A

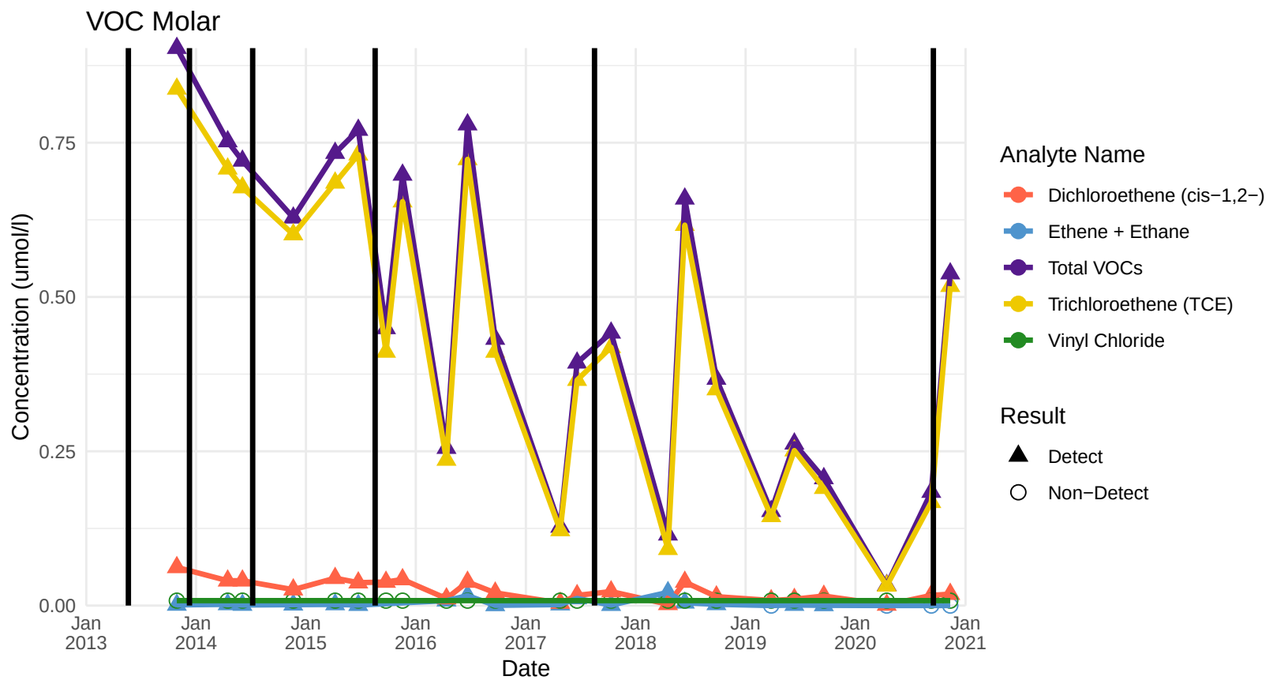
Notes:

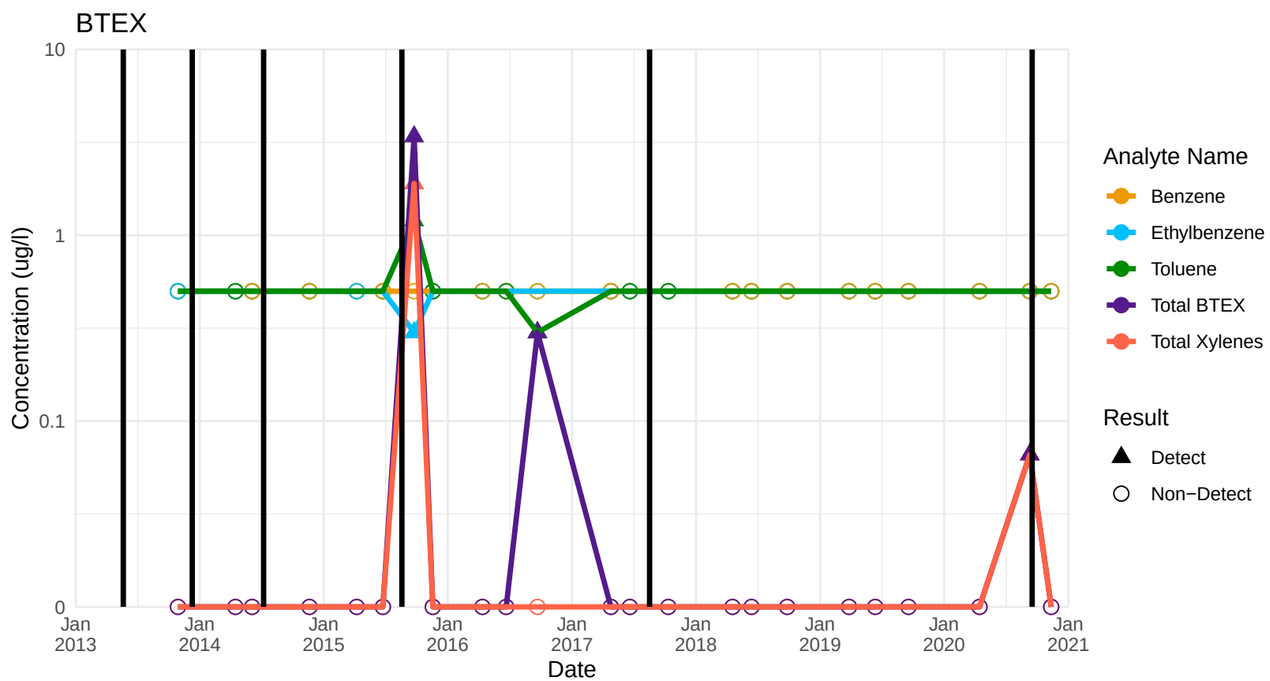
(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

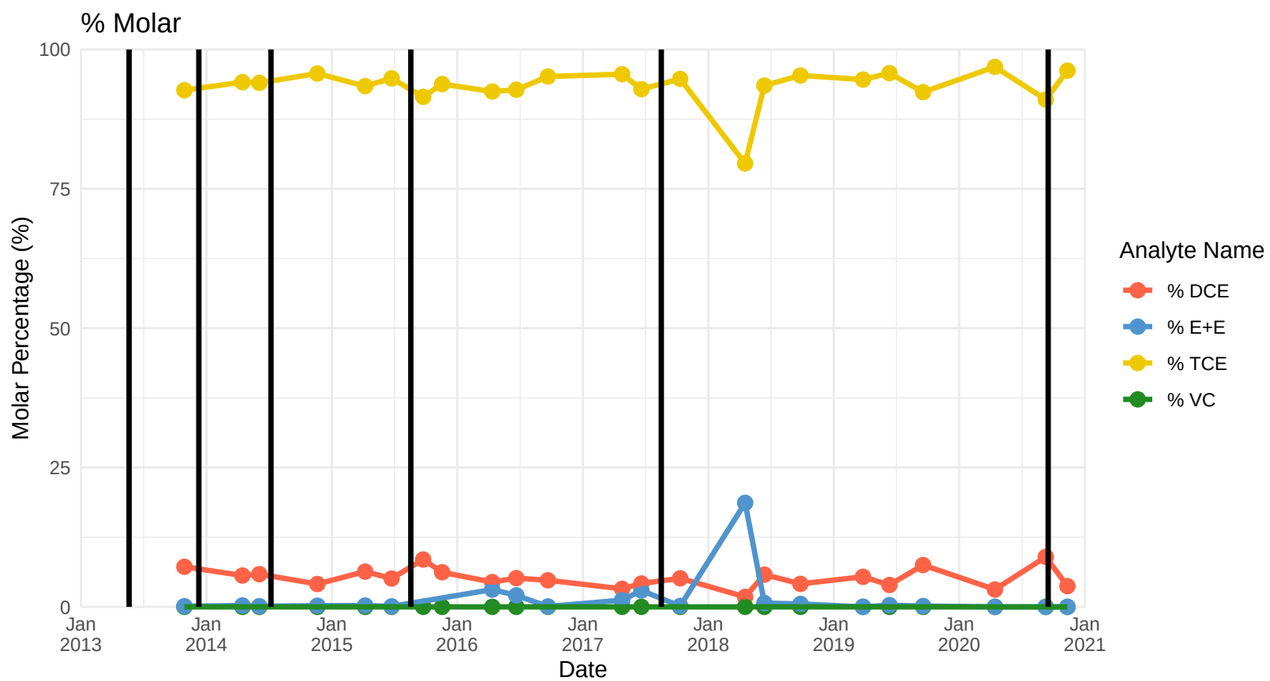
(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.









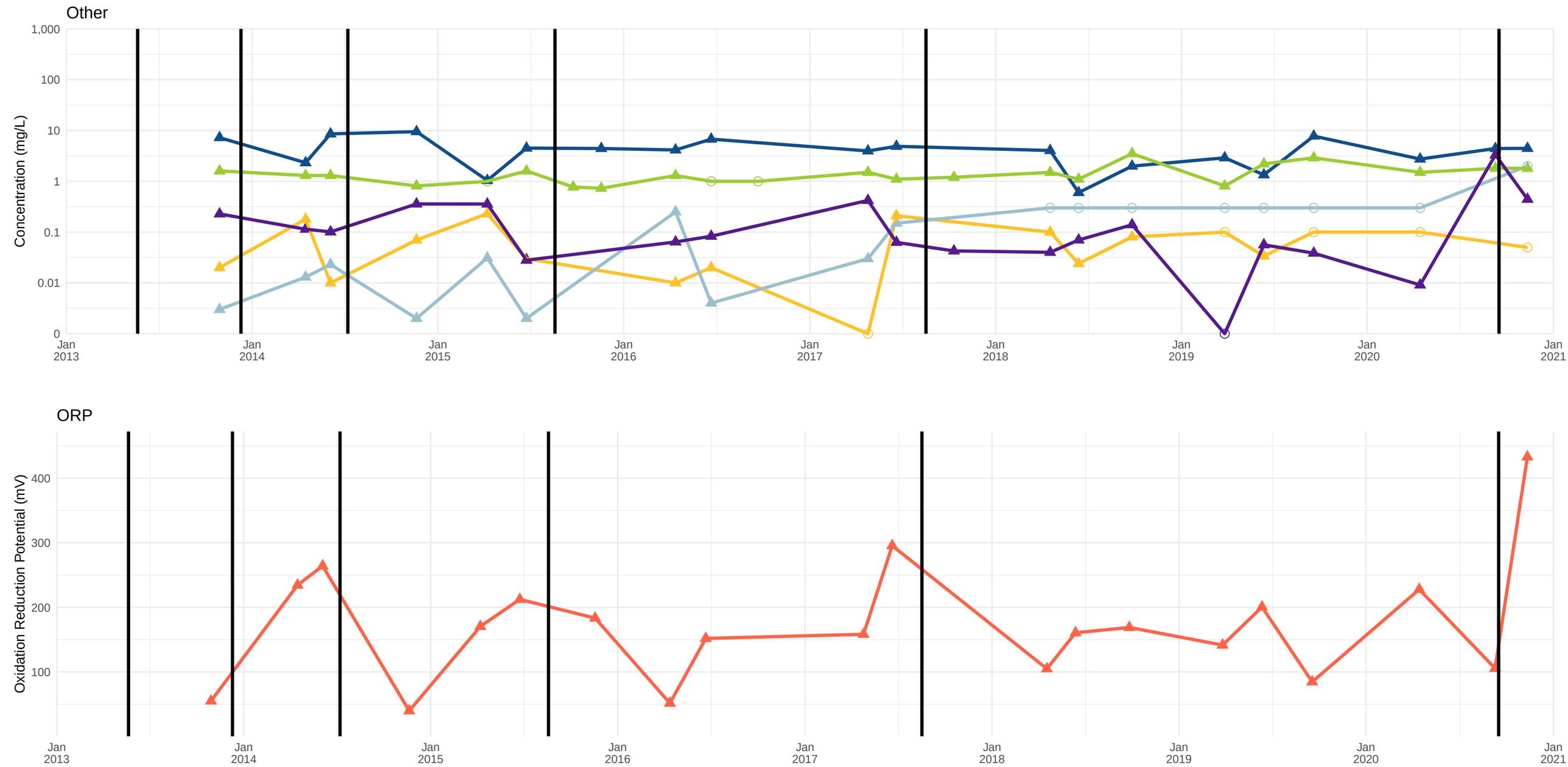
BP−13A

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.



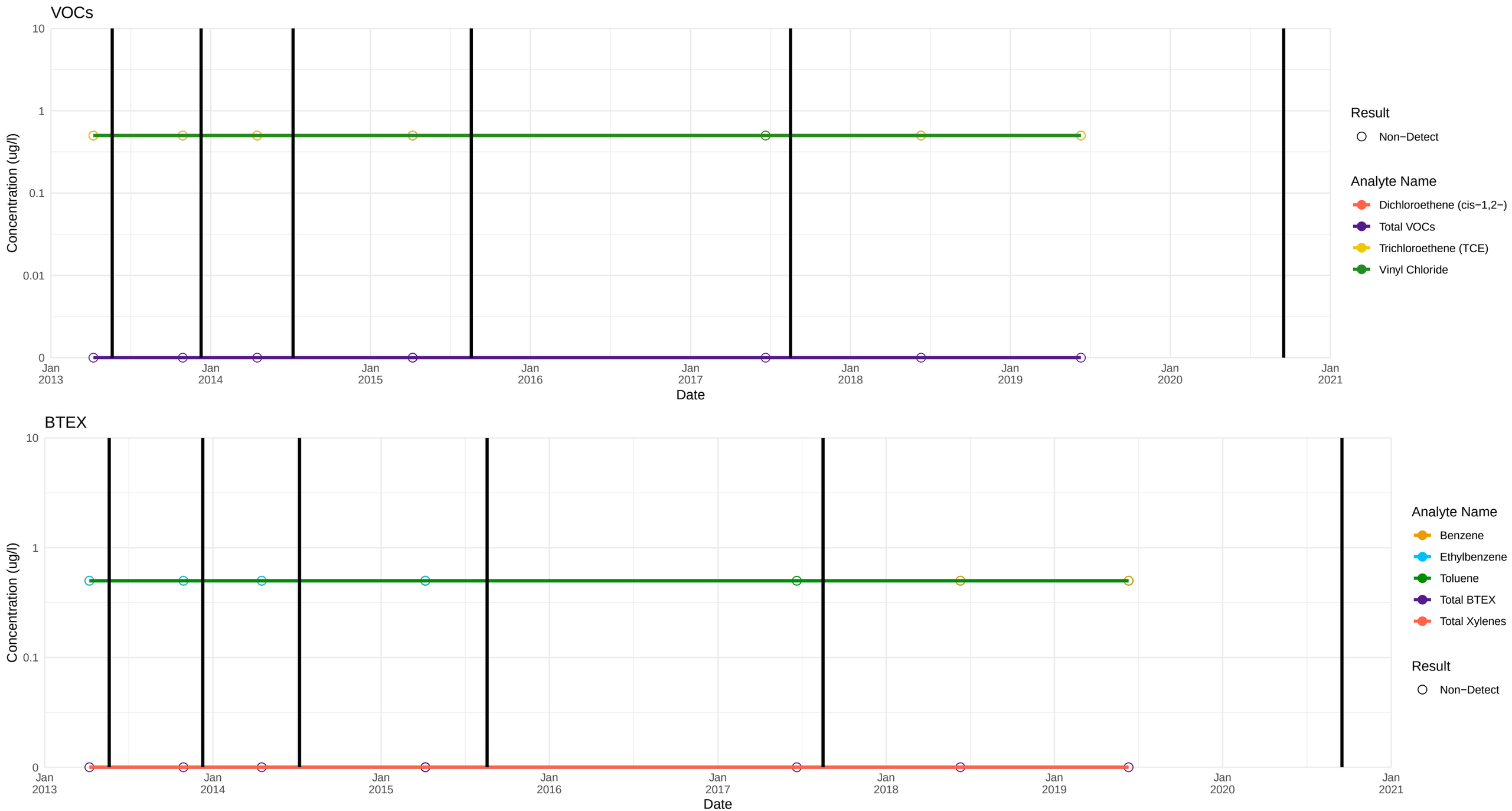
BP−16A

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.



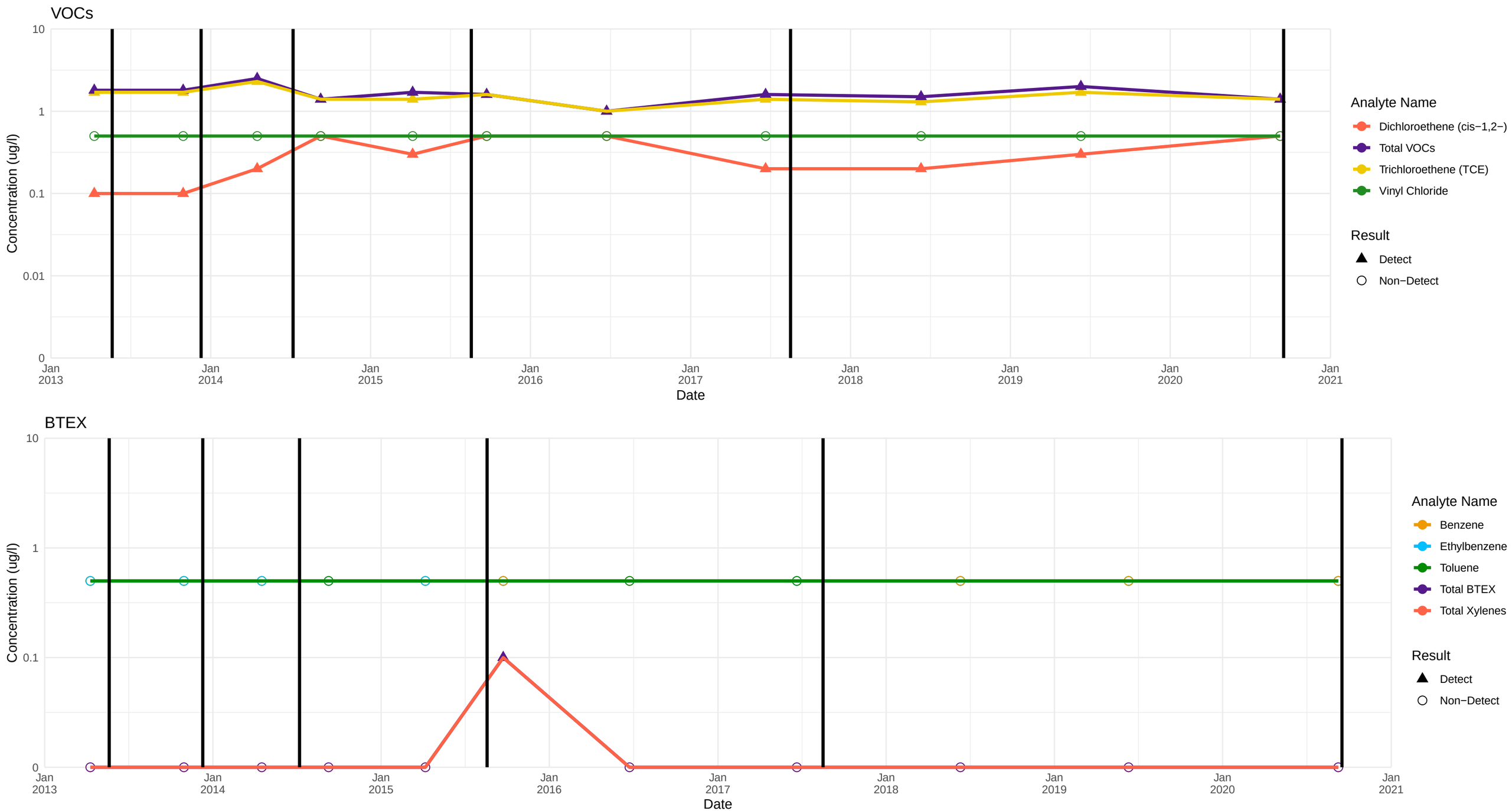
BP−17A

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.



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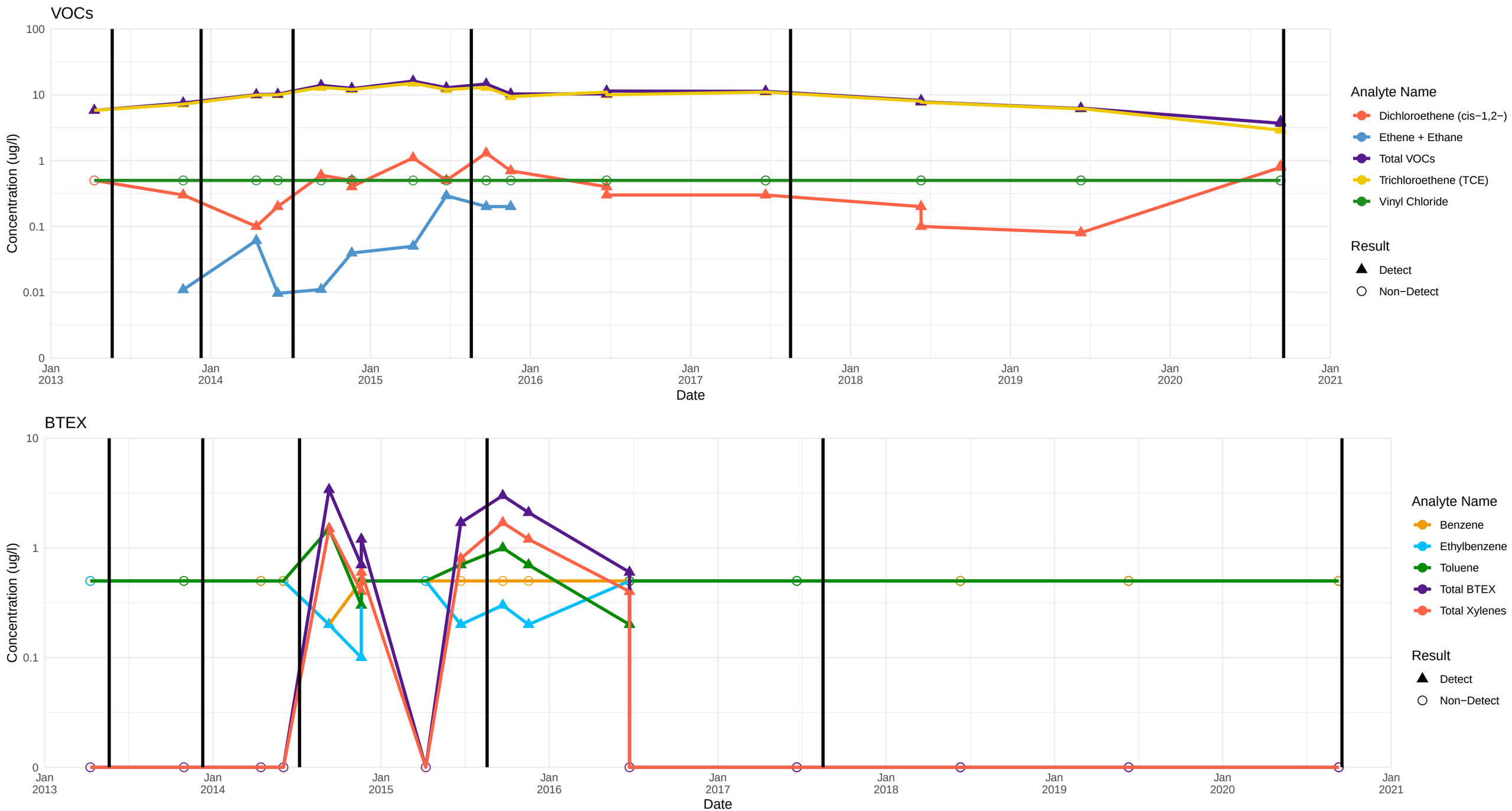
BP−18A

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.



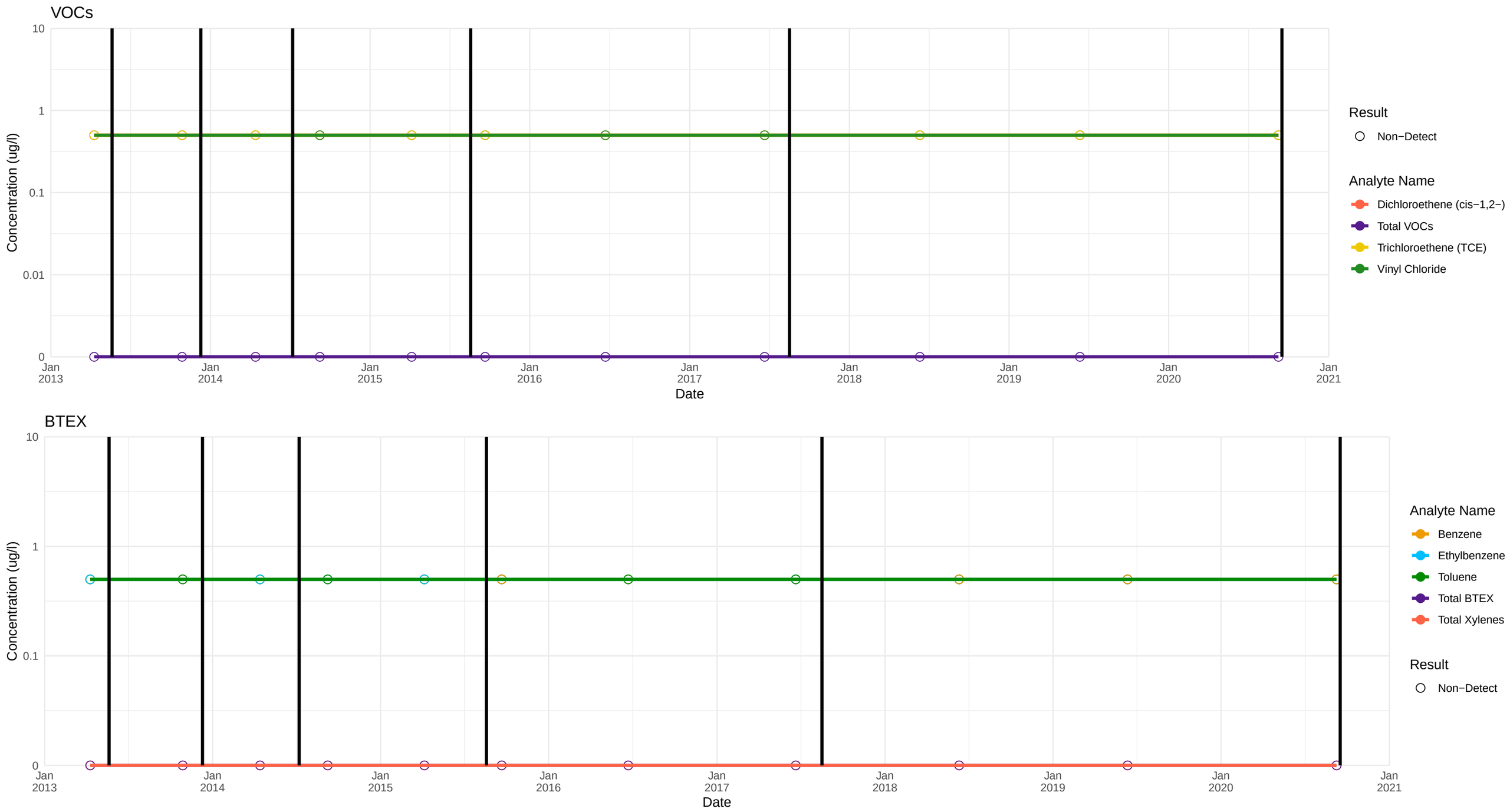
BP−19A

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.



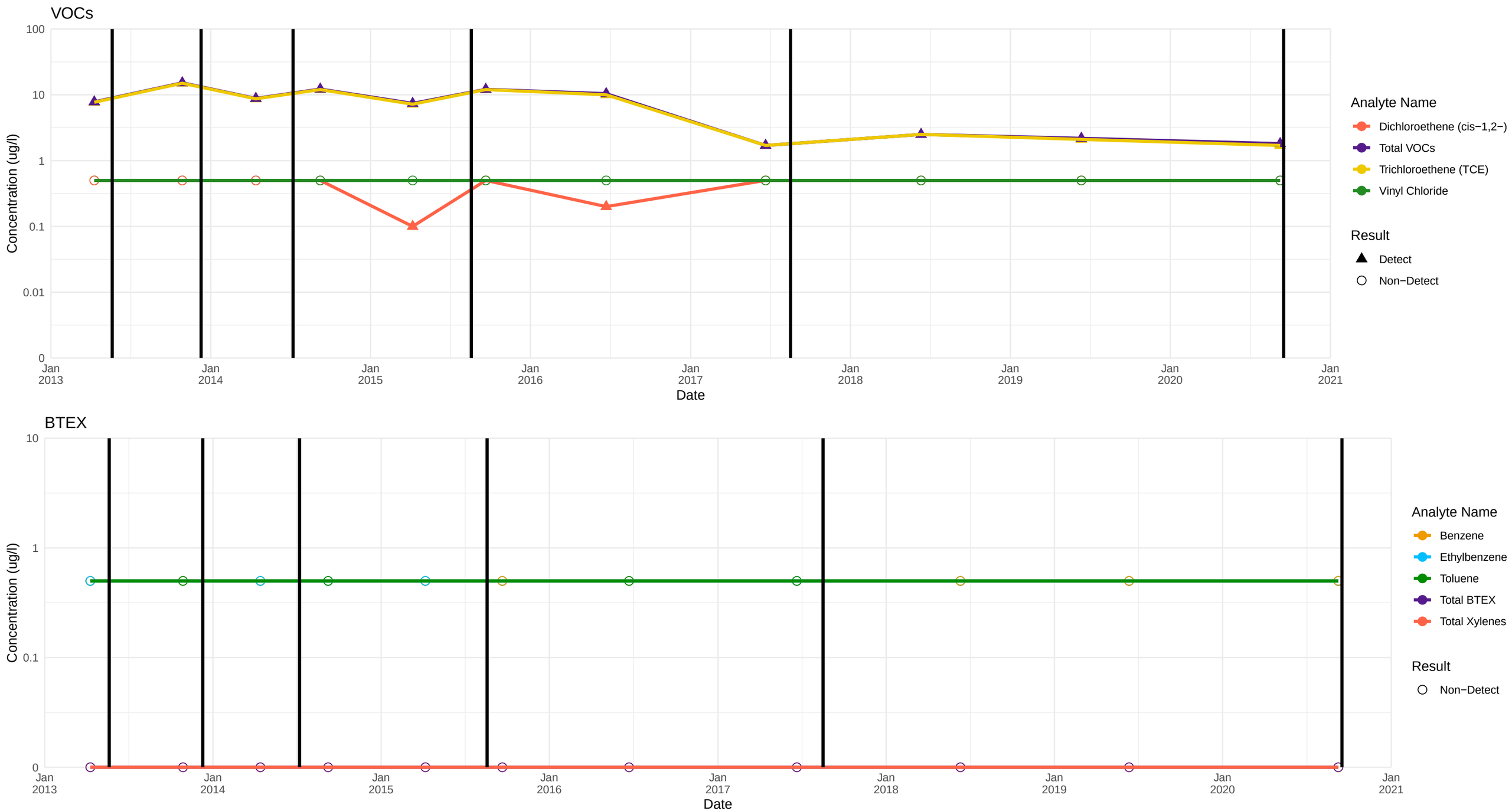
BP−20A

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.



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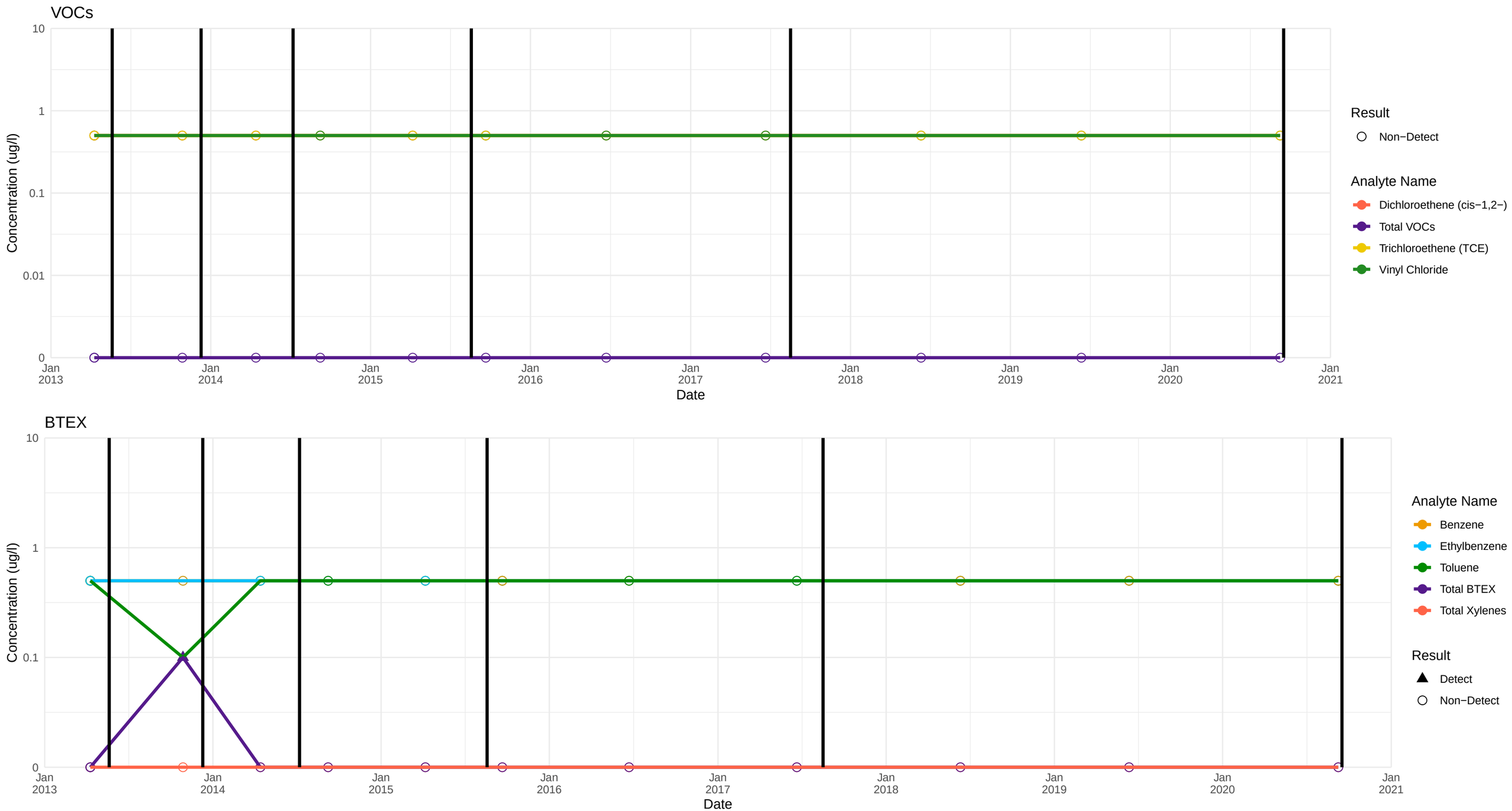
BP−21A

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.



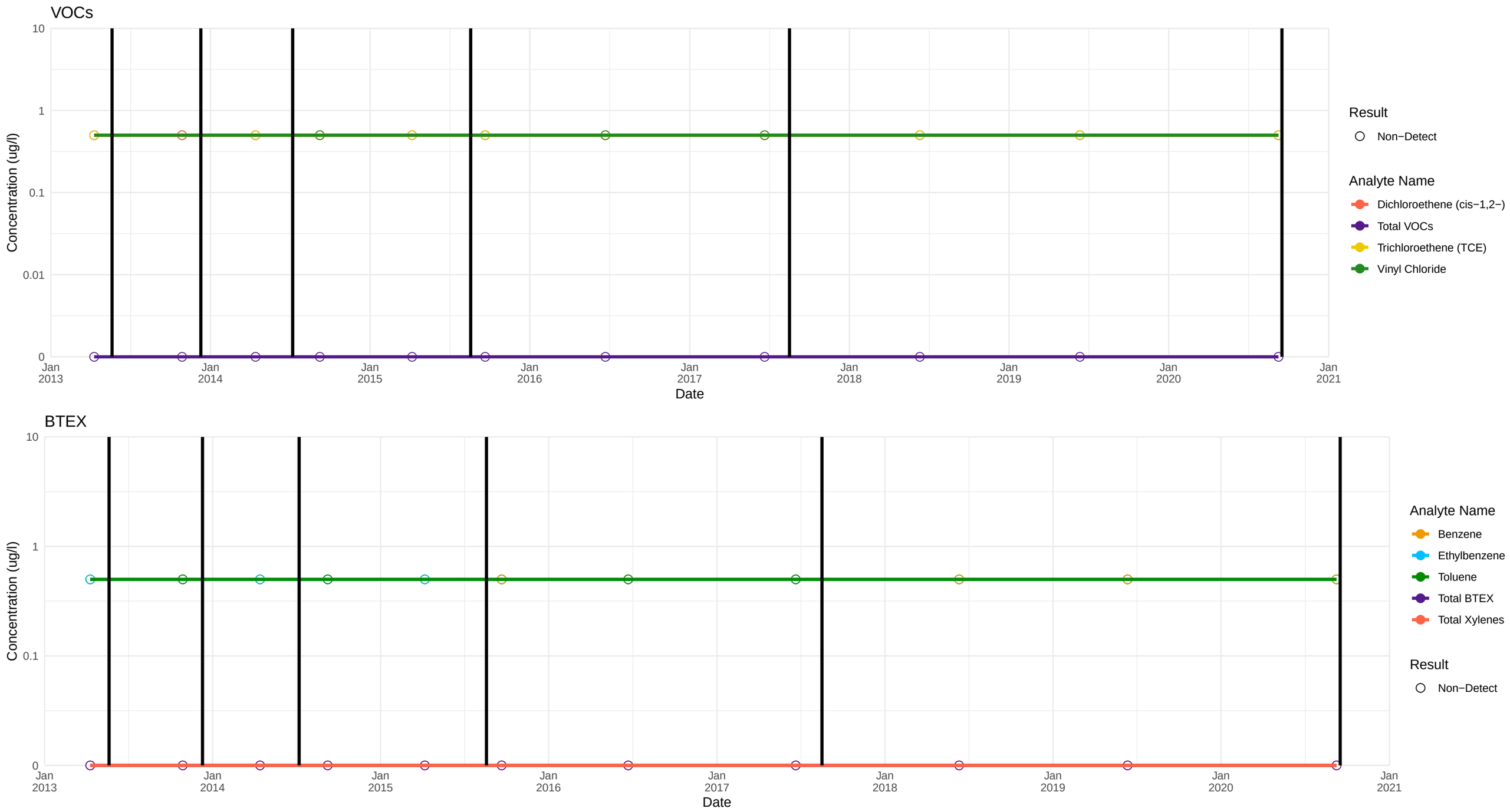
BP−22A

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.



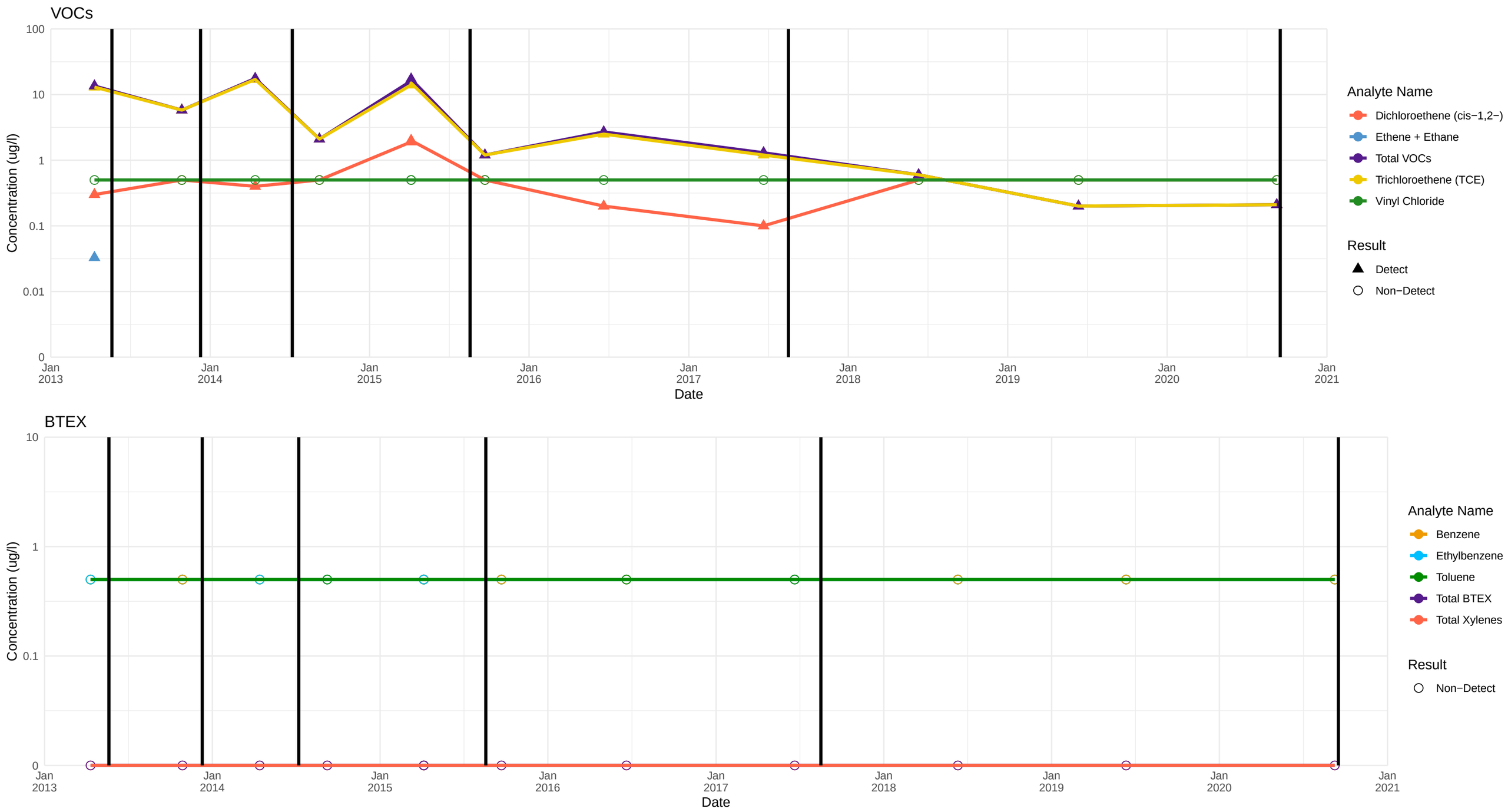
BP−23A

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.



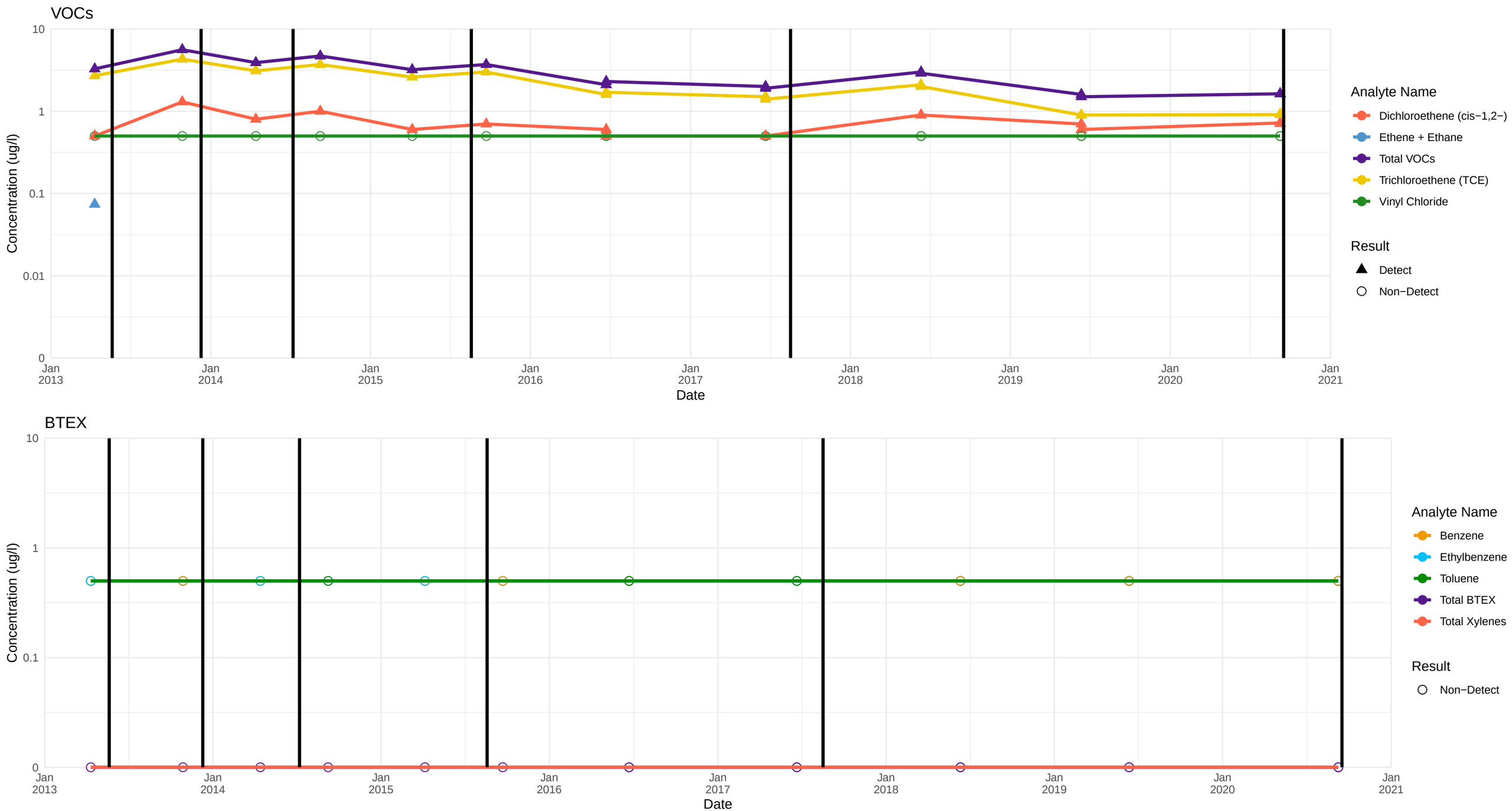
BP−24A

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.



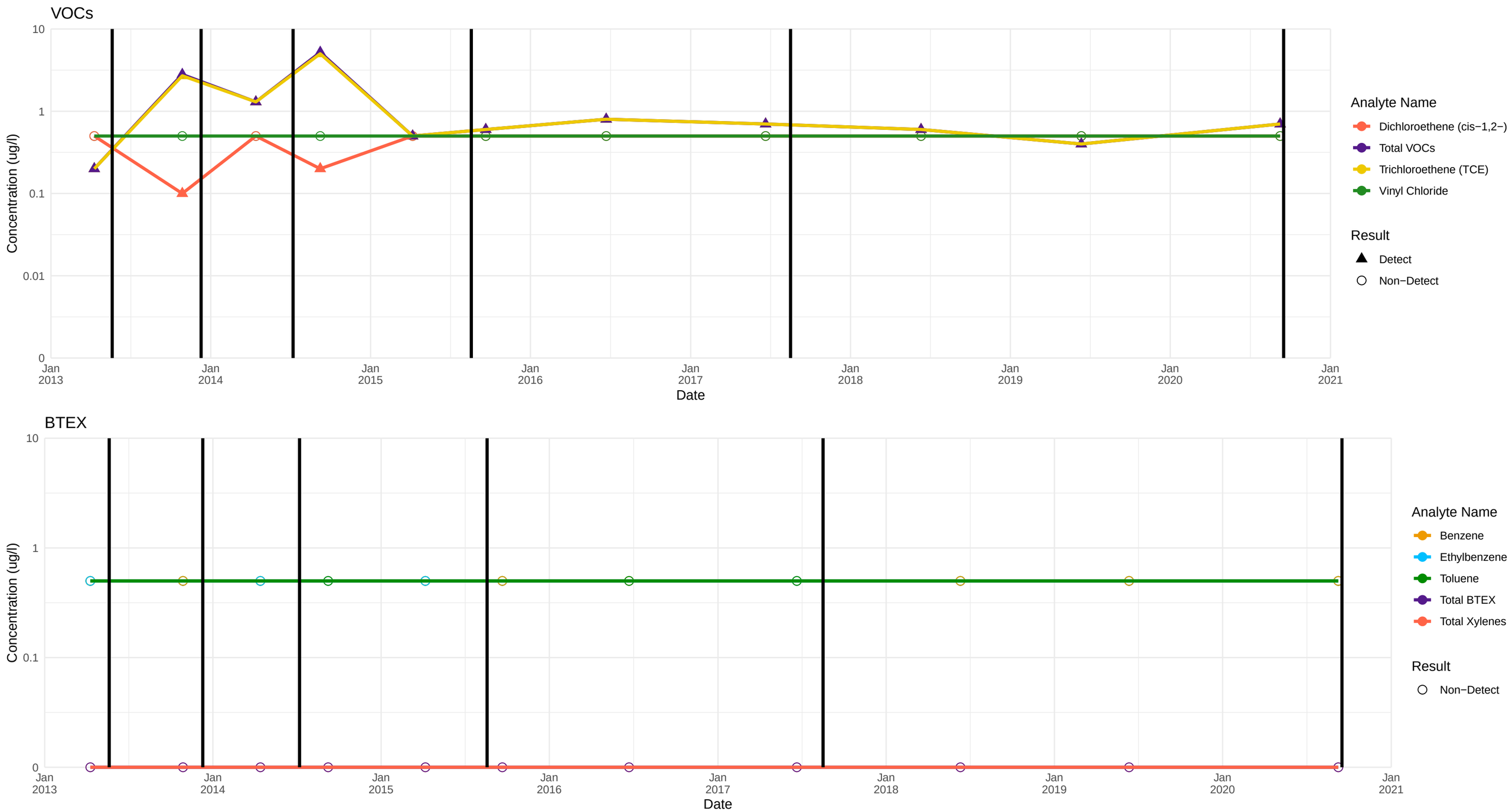
BP−25A

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.



Sanborn, Head & Associates, Inc.

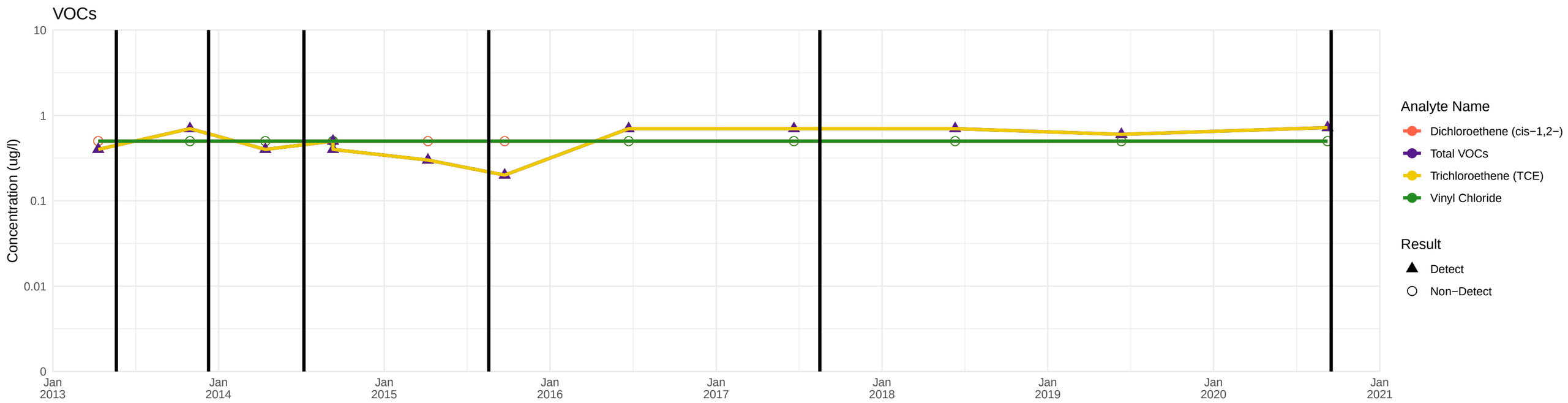
BP−26A

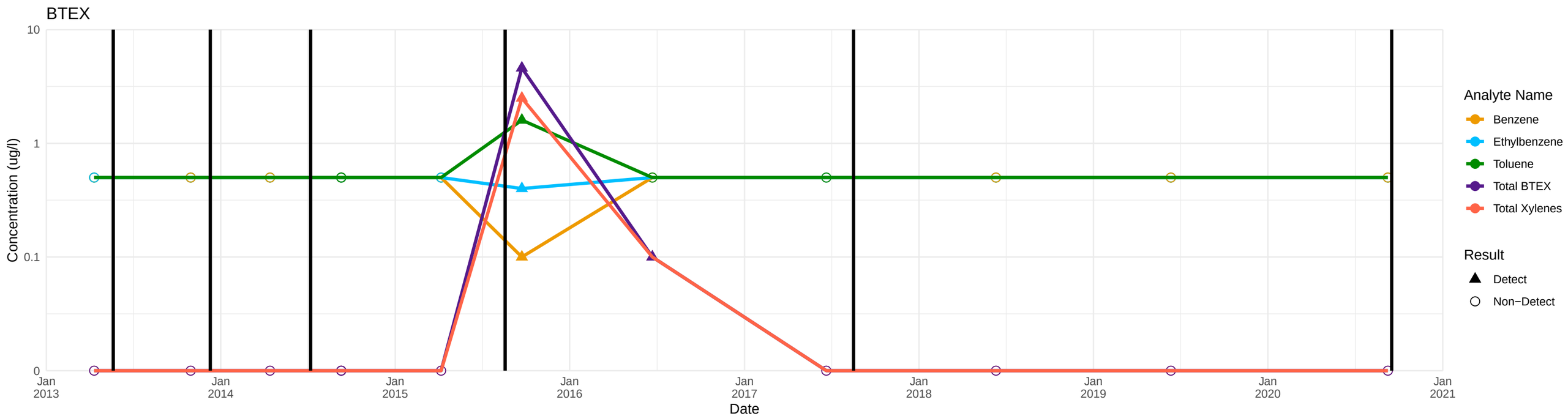
Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.





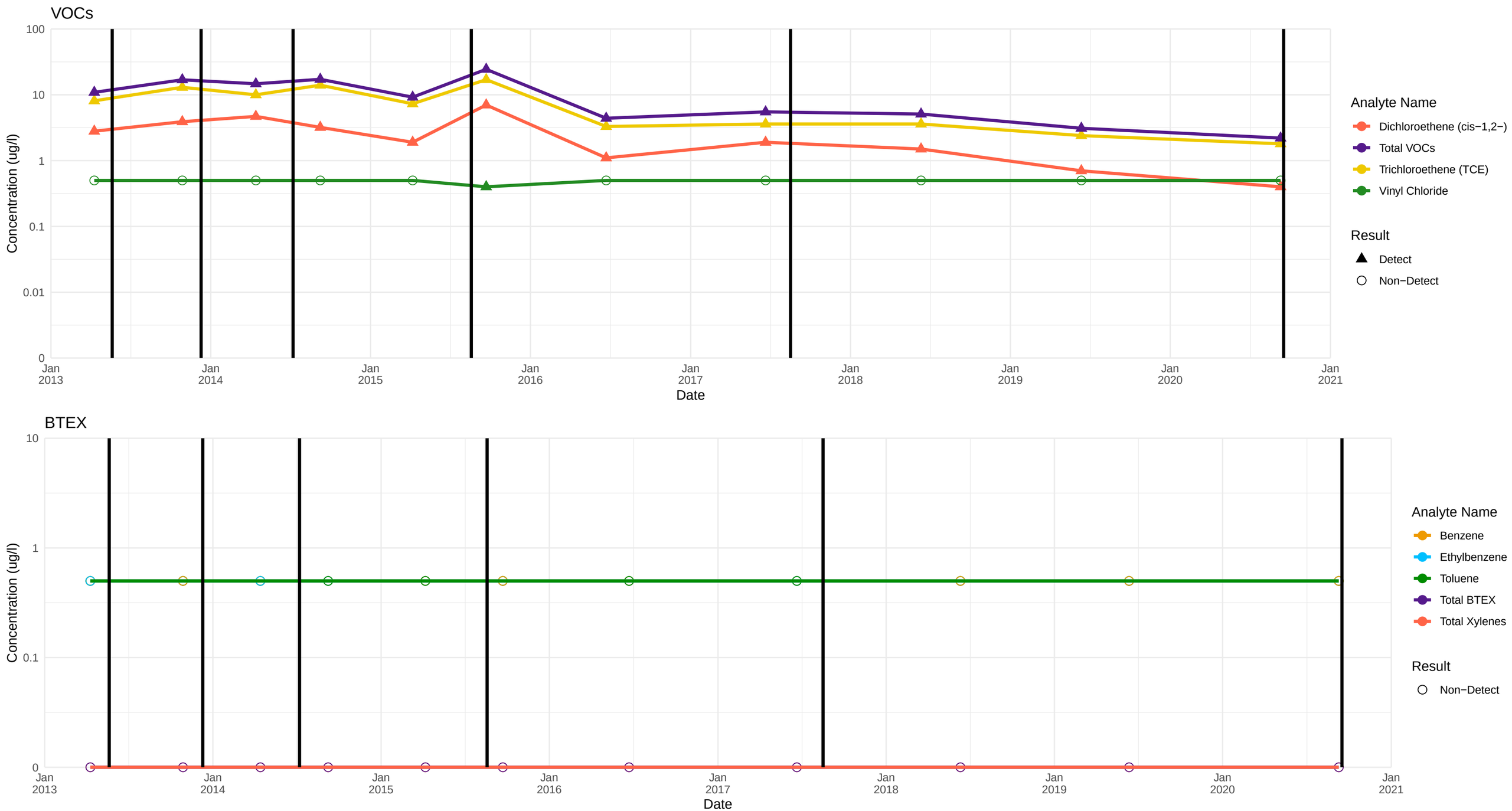
BP−27A

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.



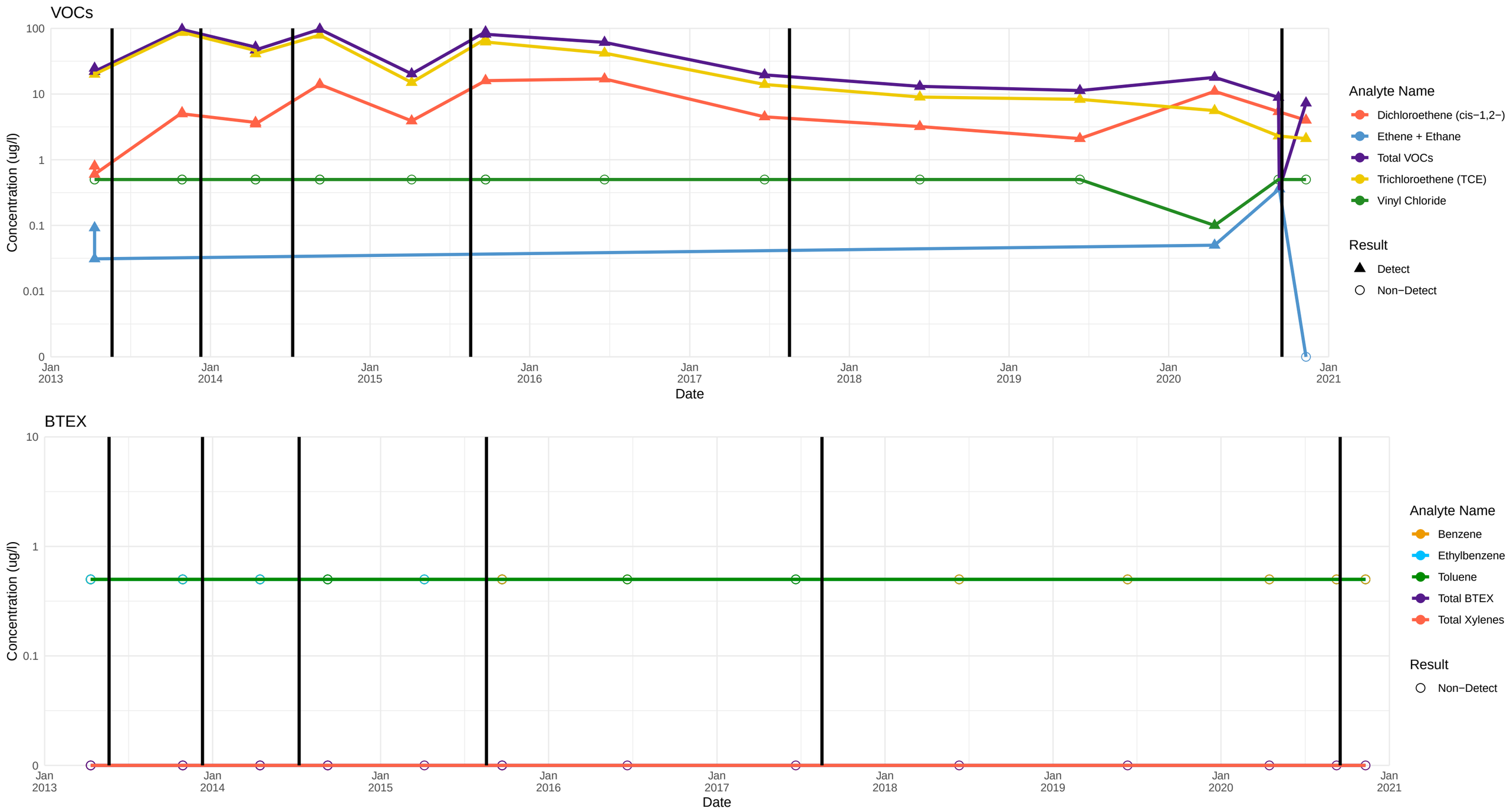
BP−30A

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.



Sanborn, Head & Associates, Inc.

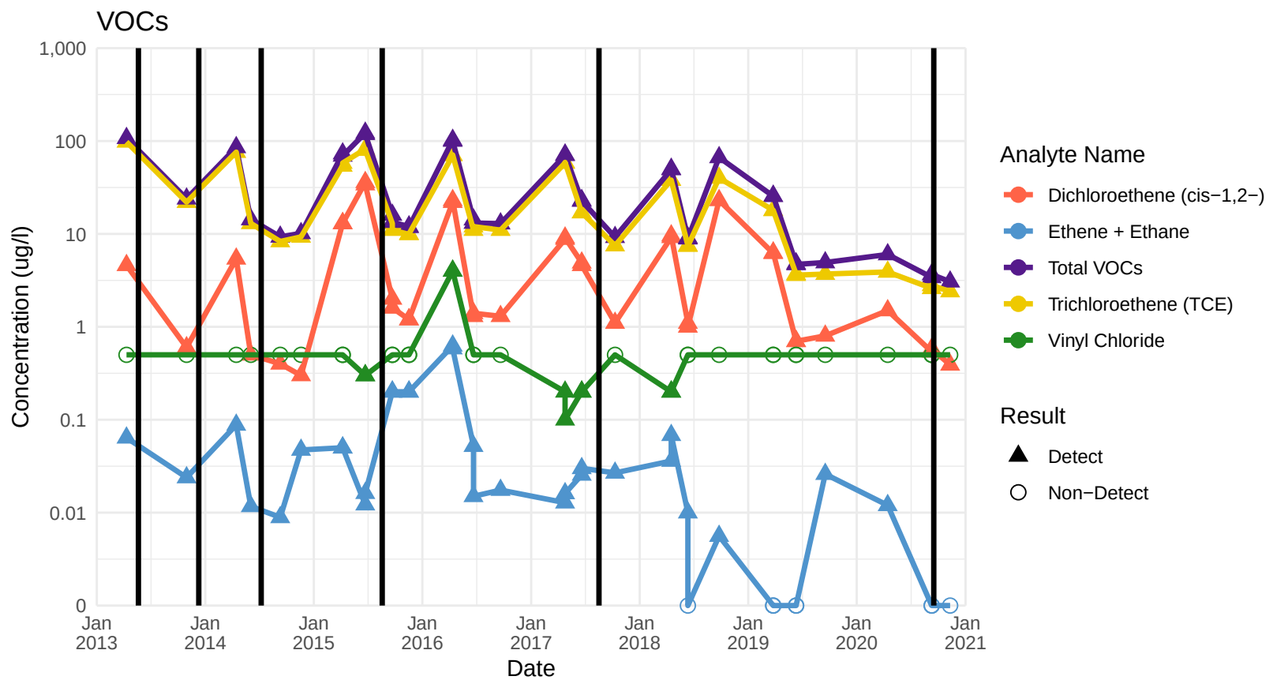
BP−31A

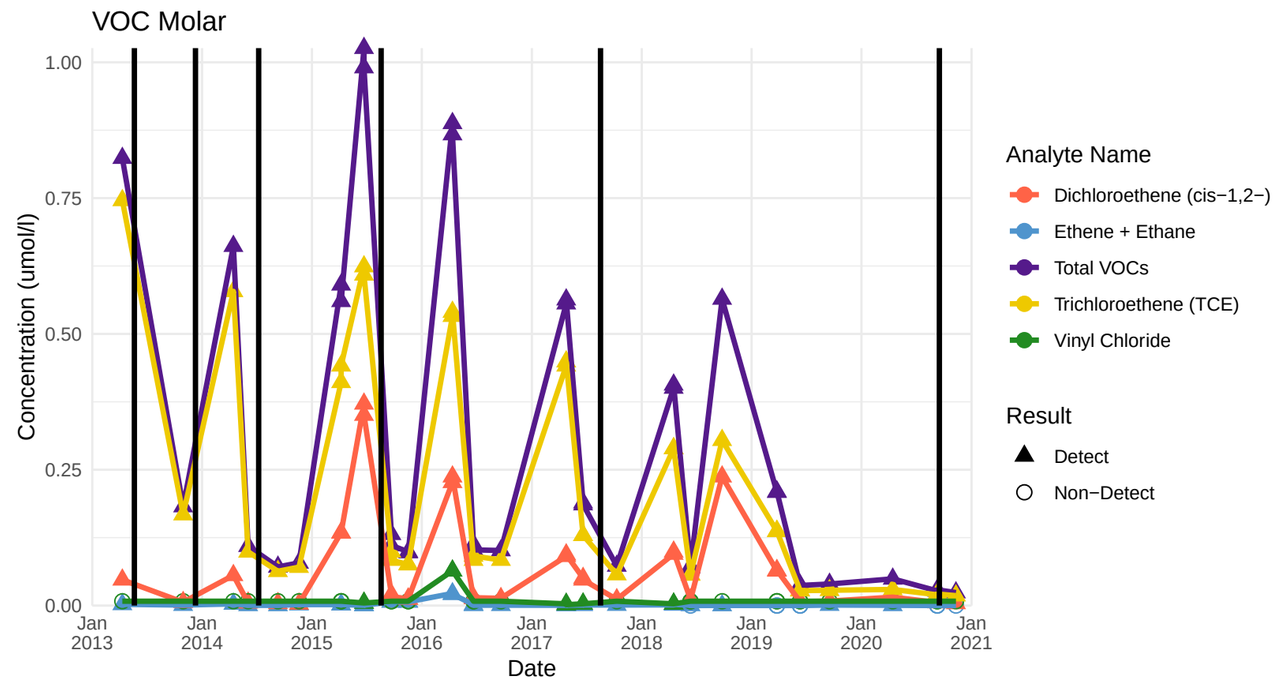
Notes:

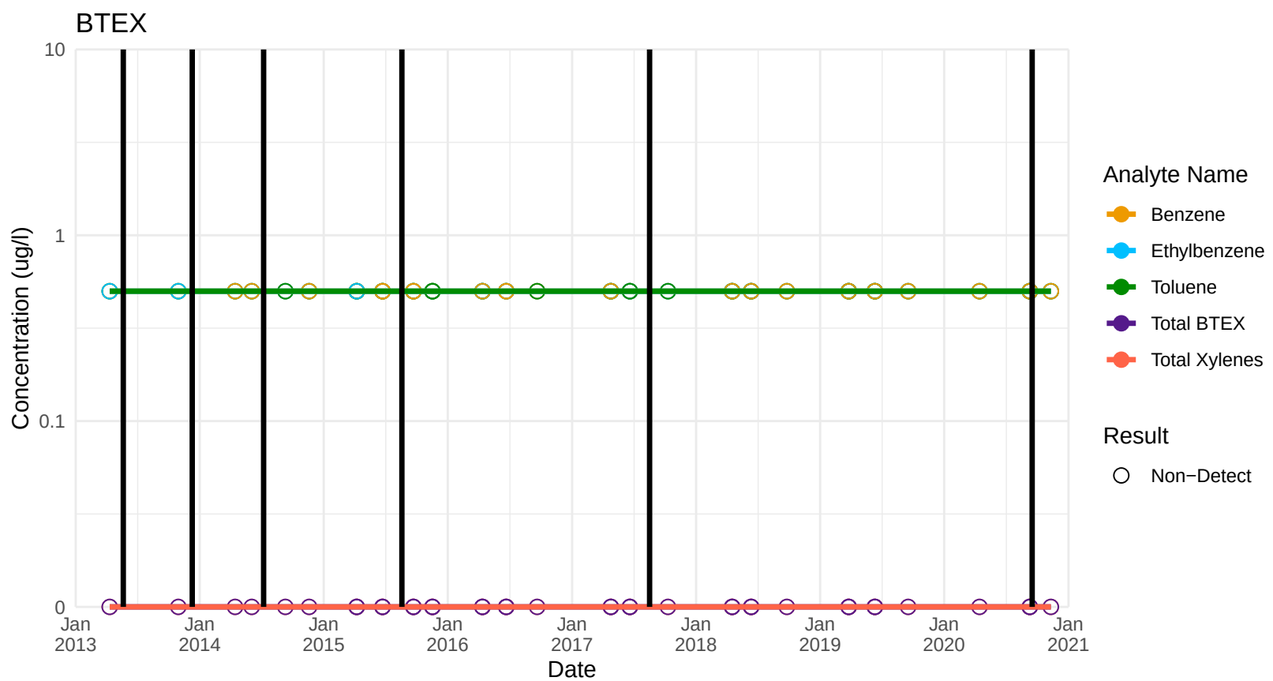
(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

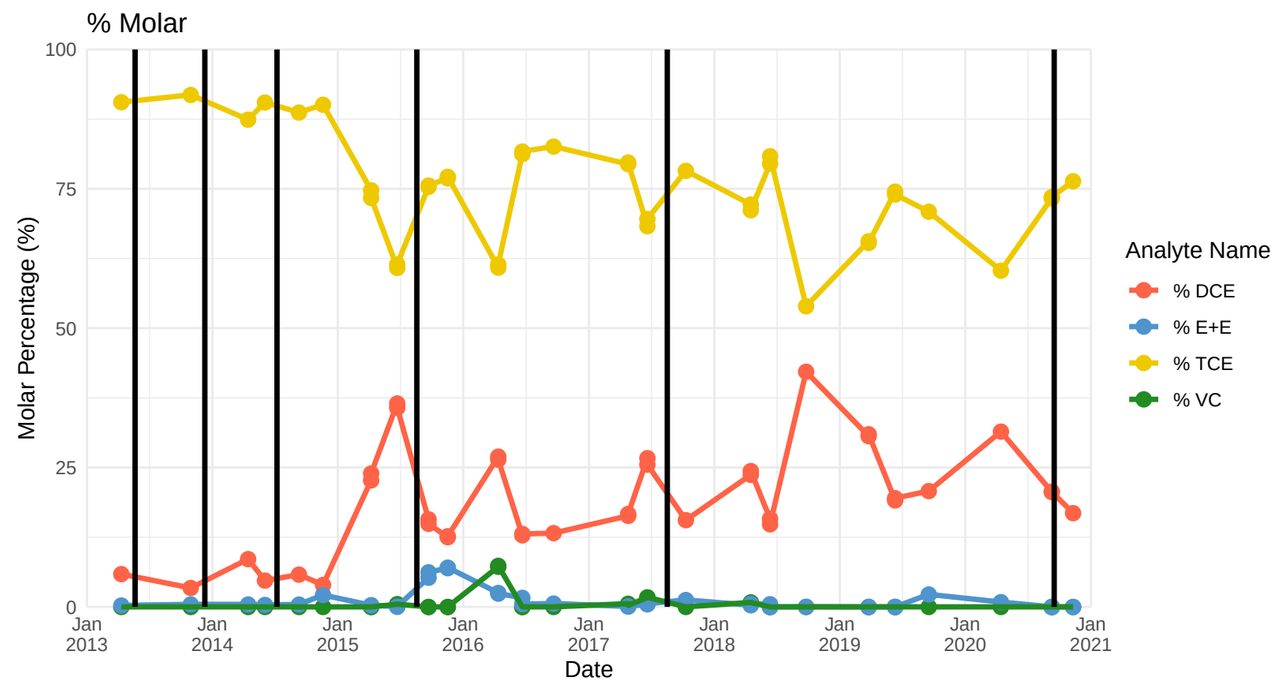
(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.









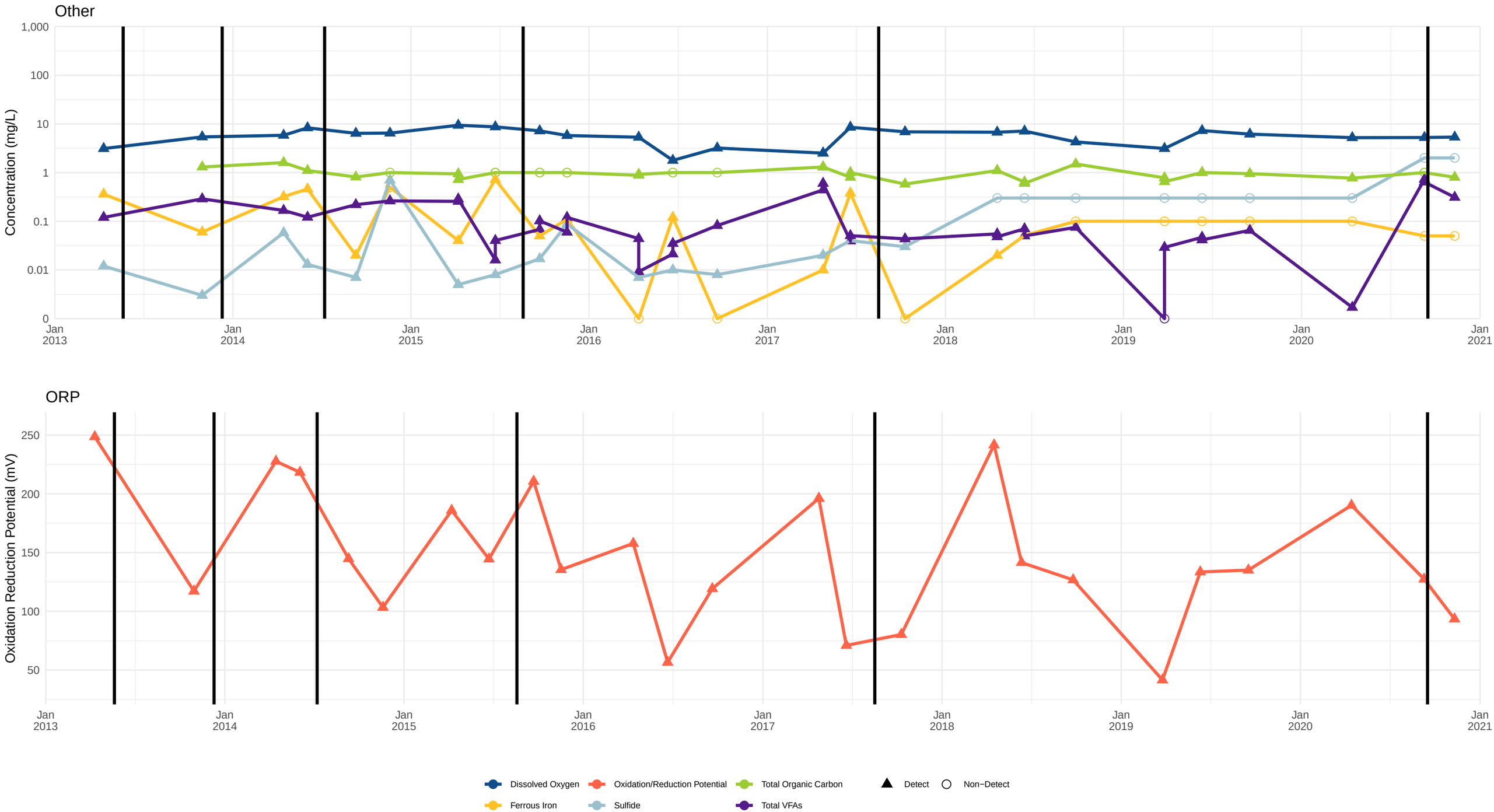
BP−31A

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.



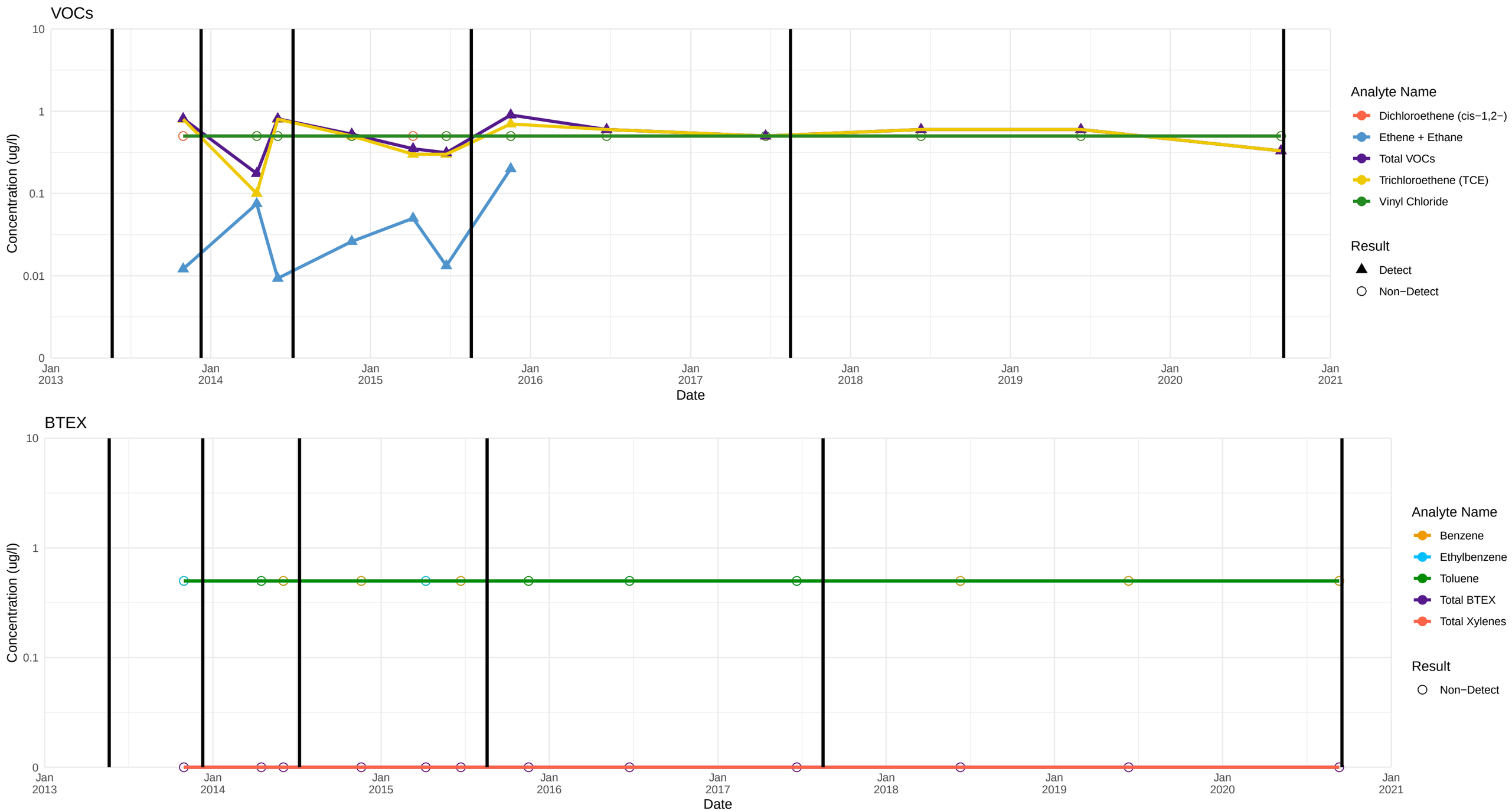
BP−32A

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.



Sanborn, Head & Associates, Inc.

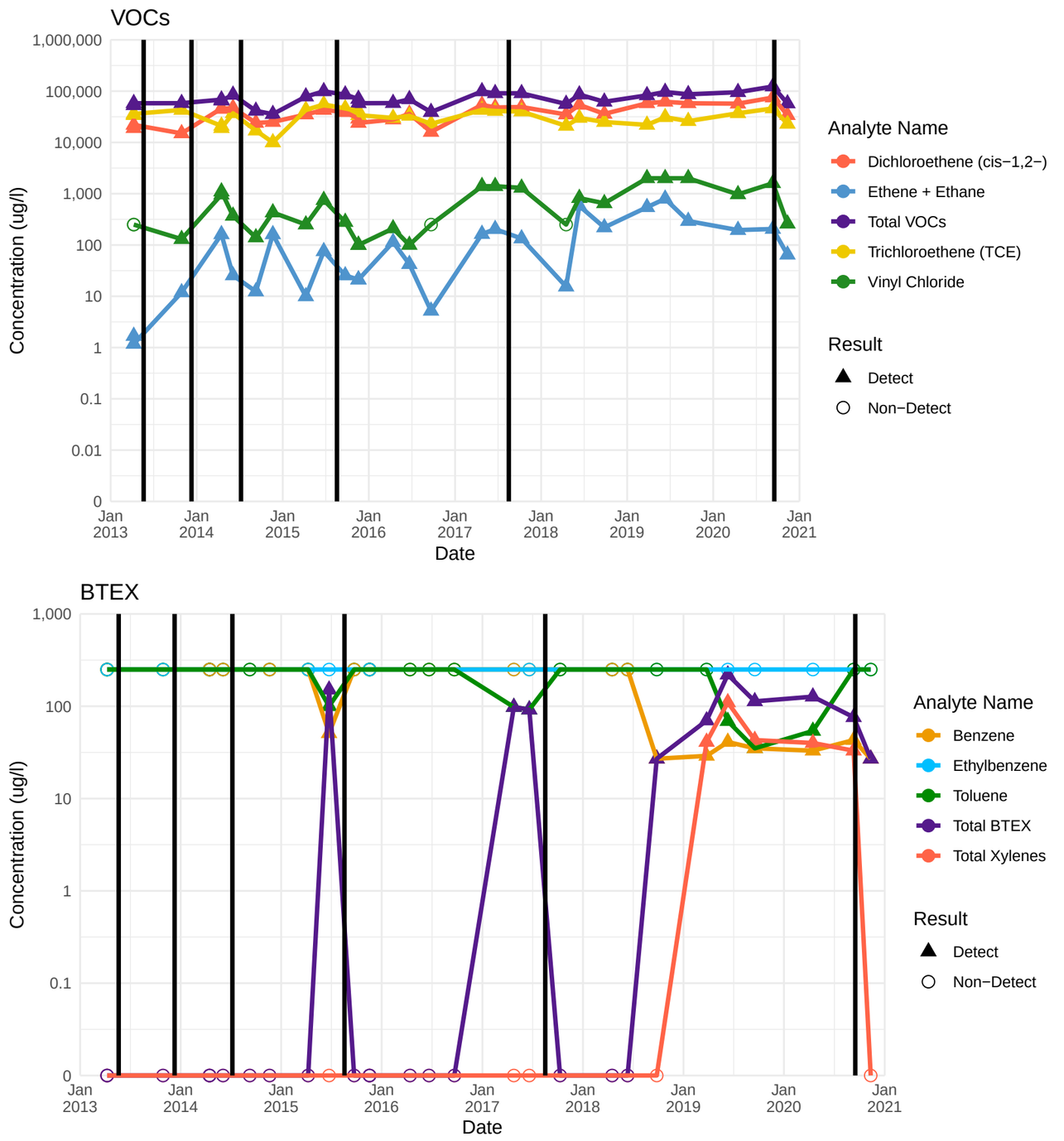
BP−34A

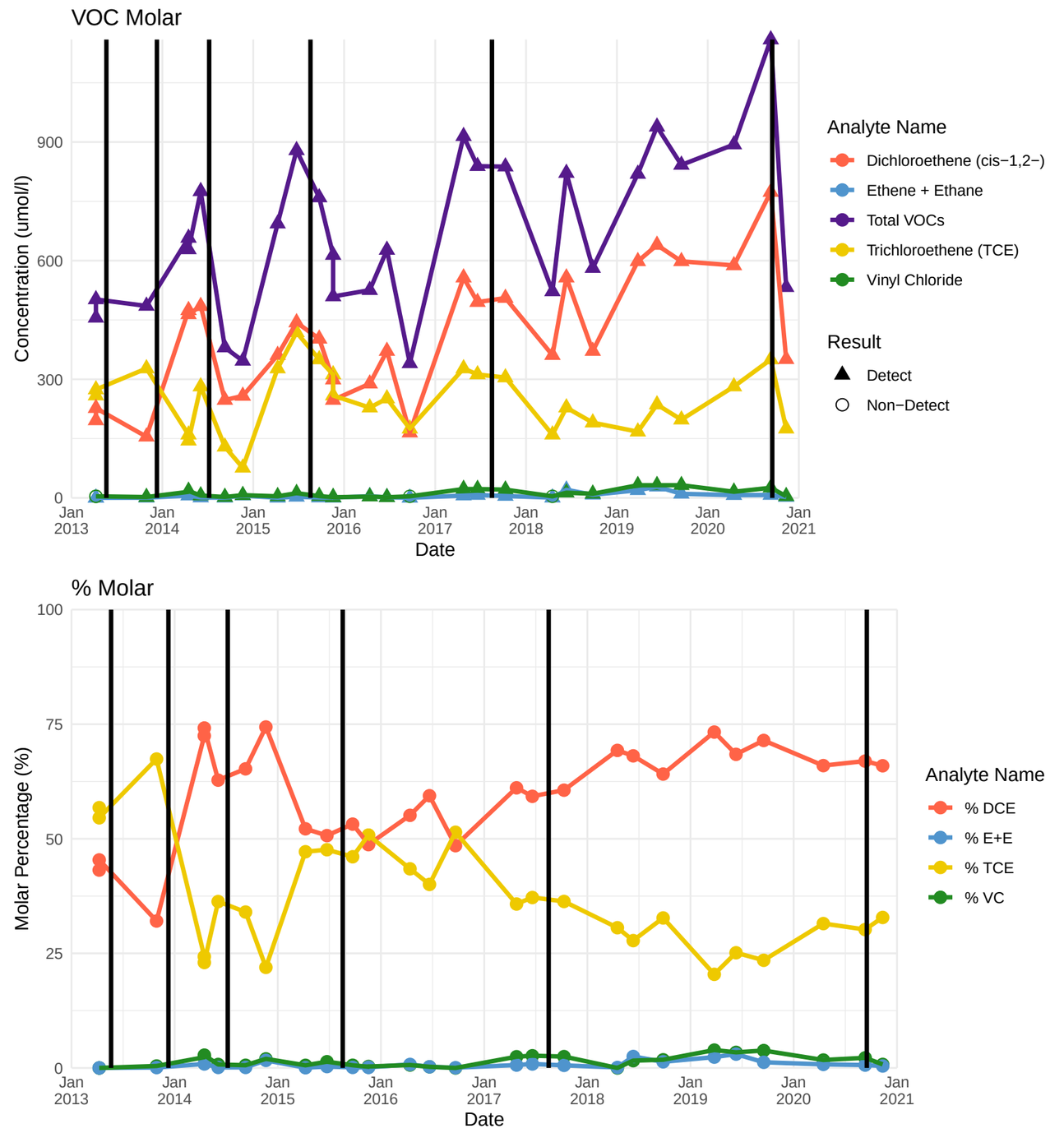
Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.





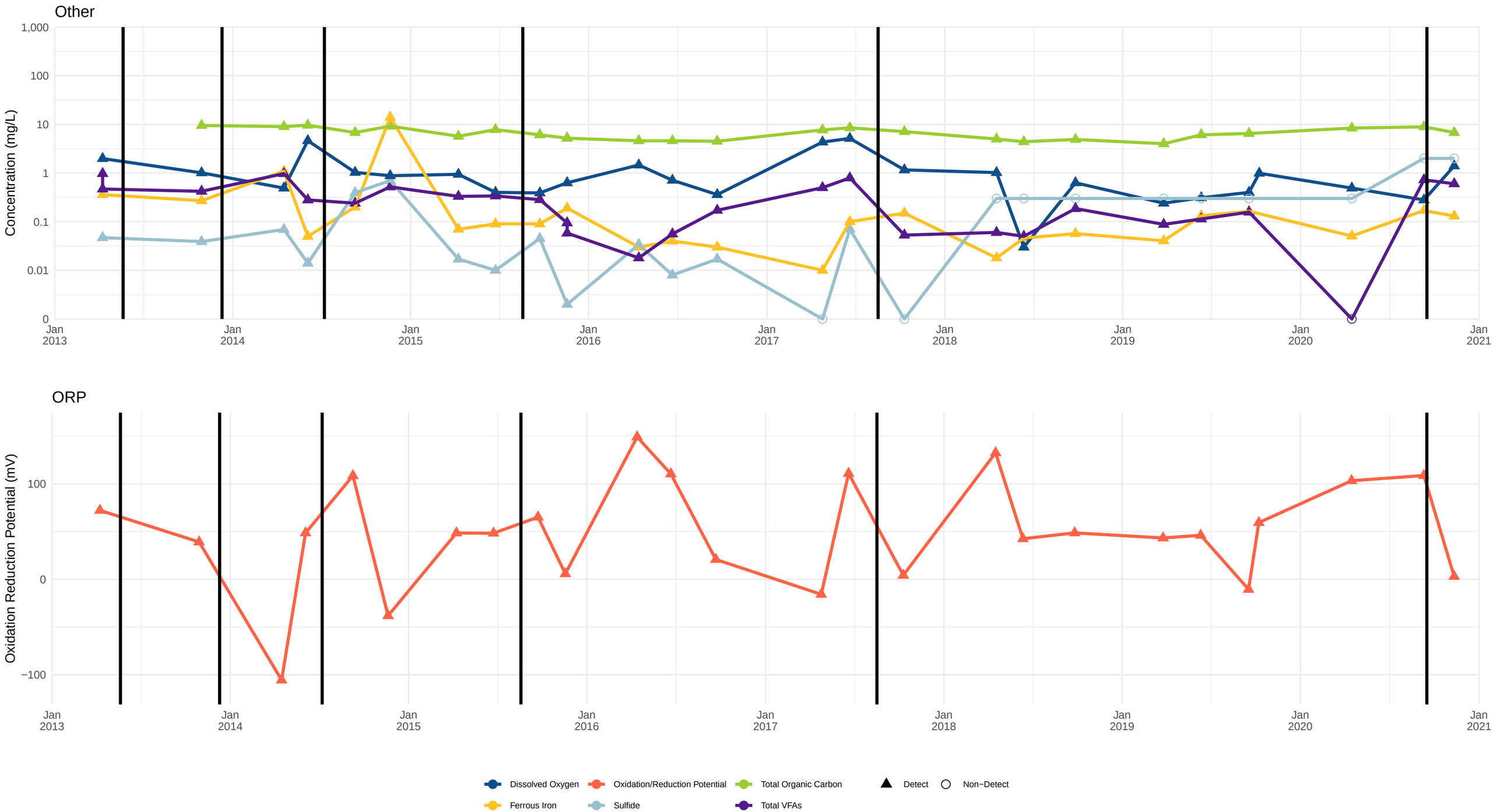
BP−34A

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.



BP−35A

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

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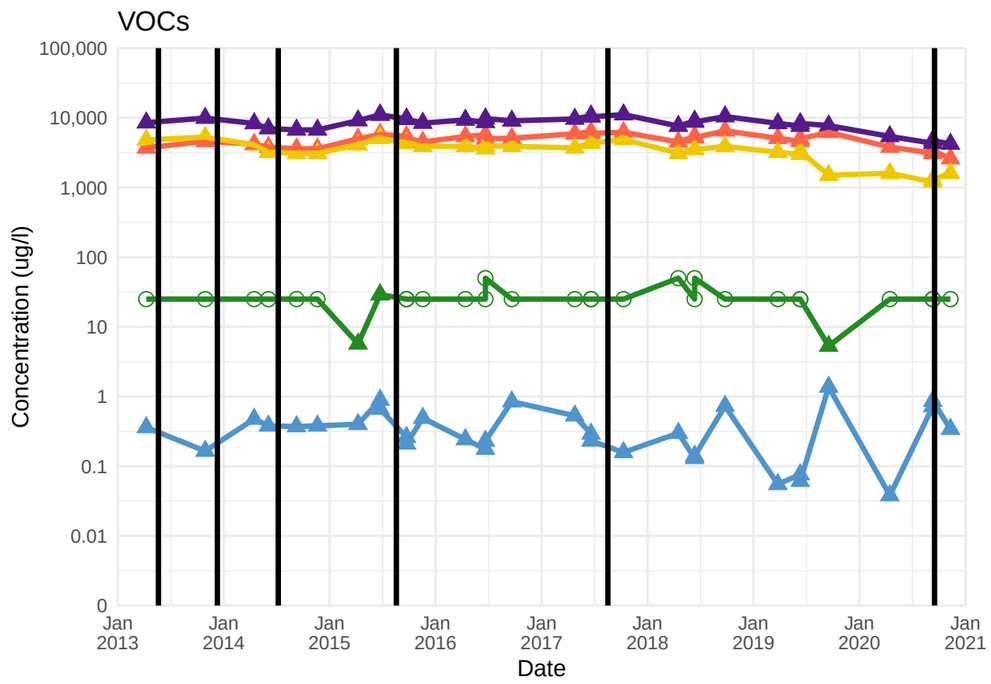

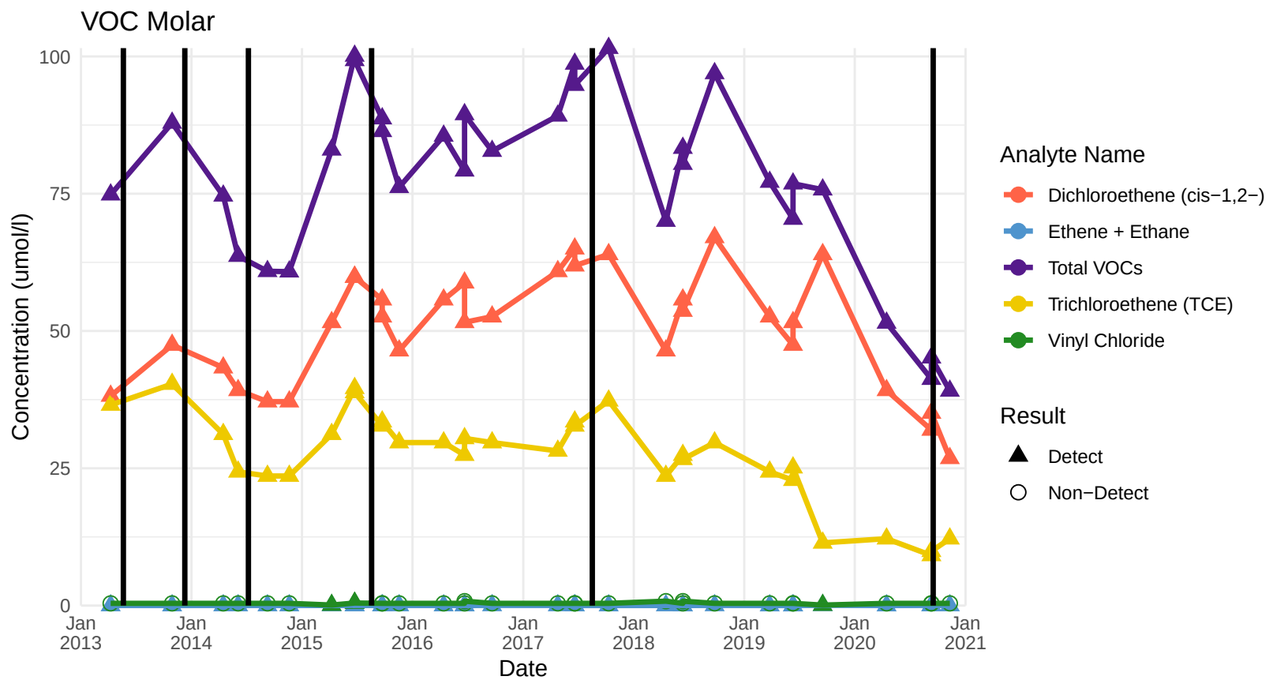

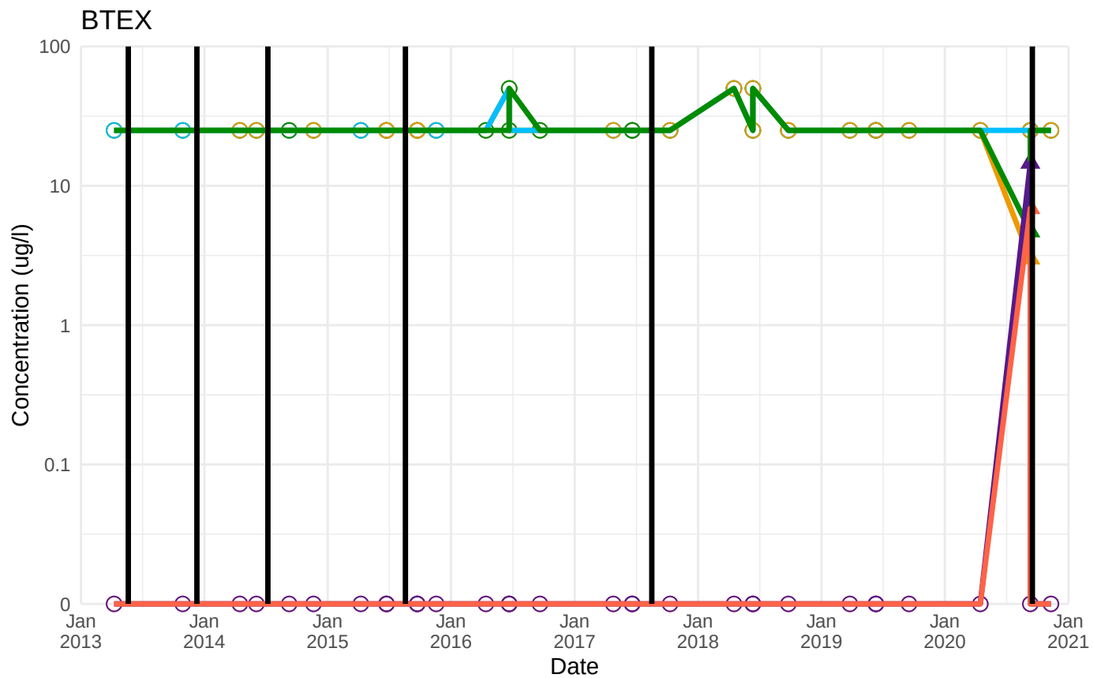

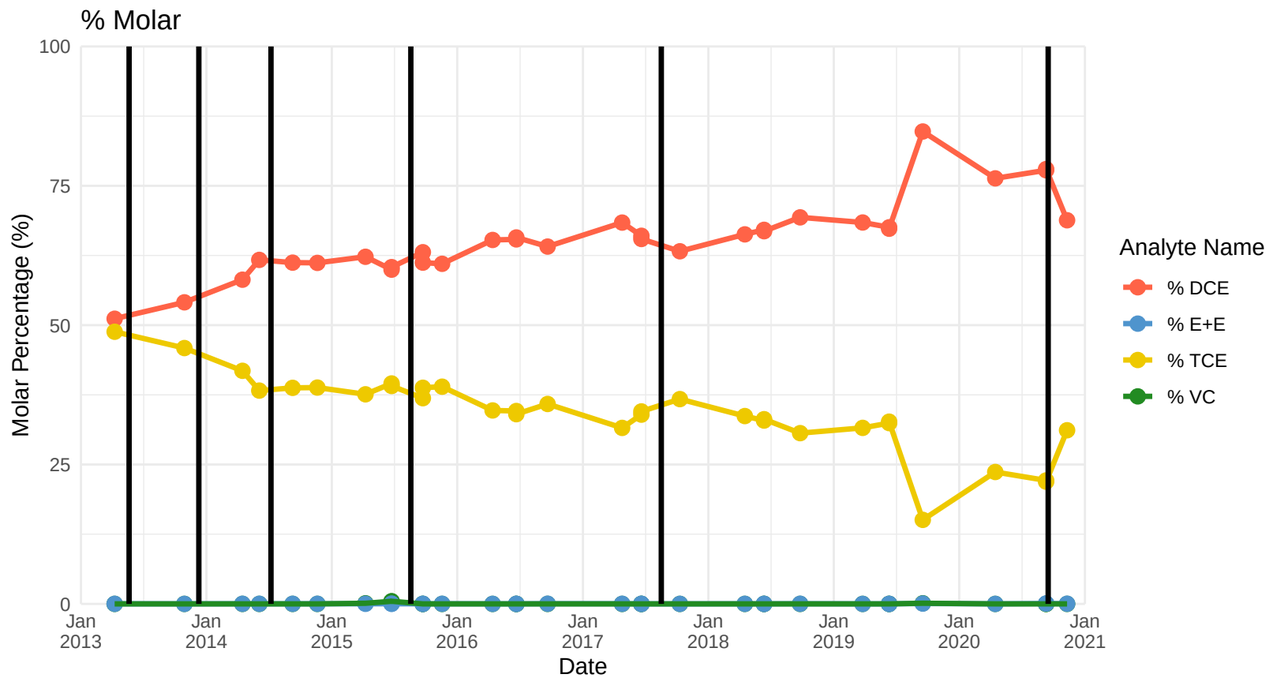

BP−35A

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

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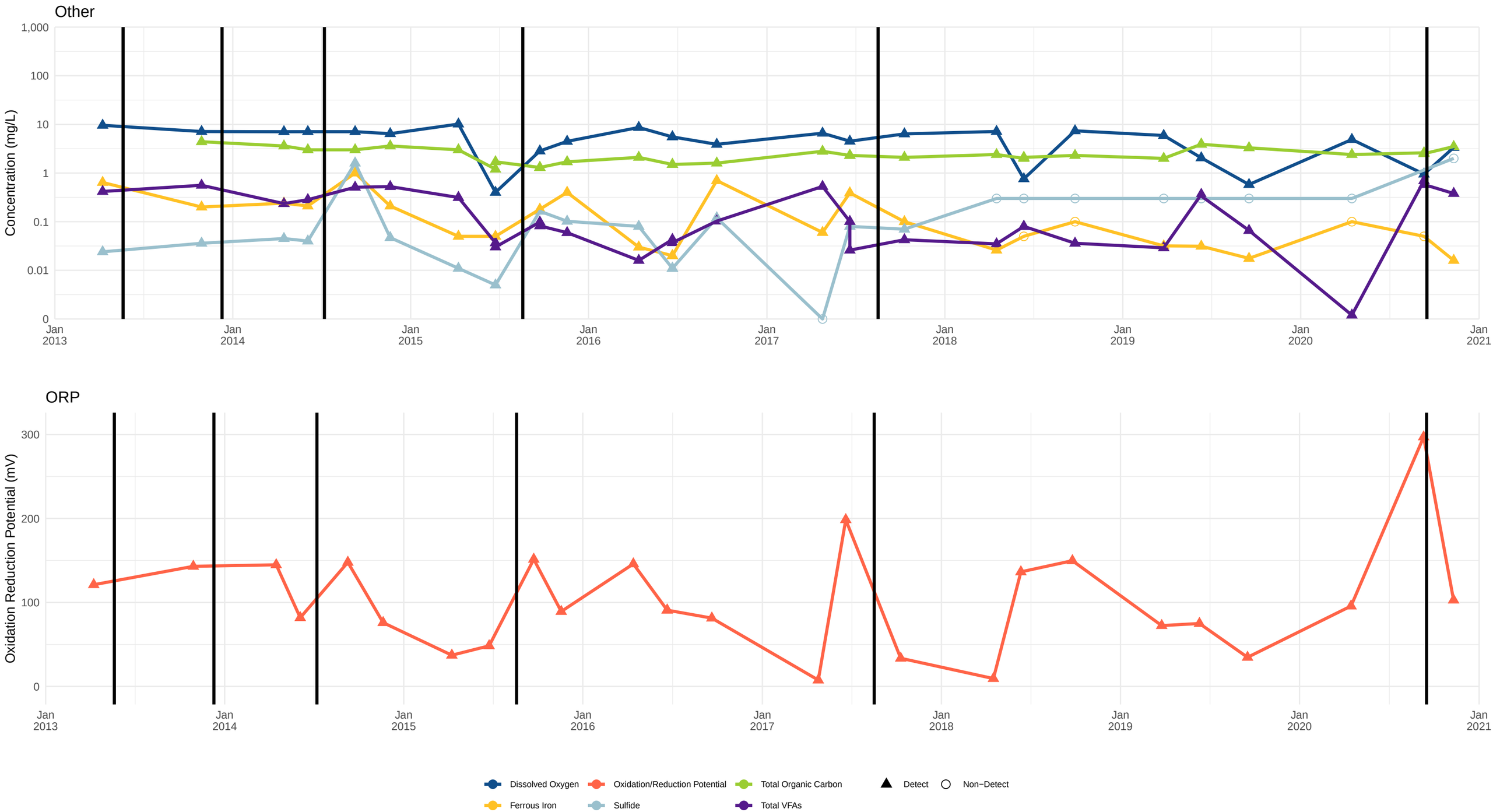

BP−36A

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

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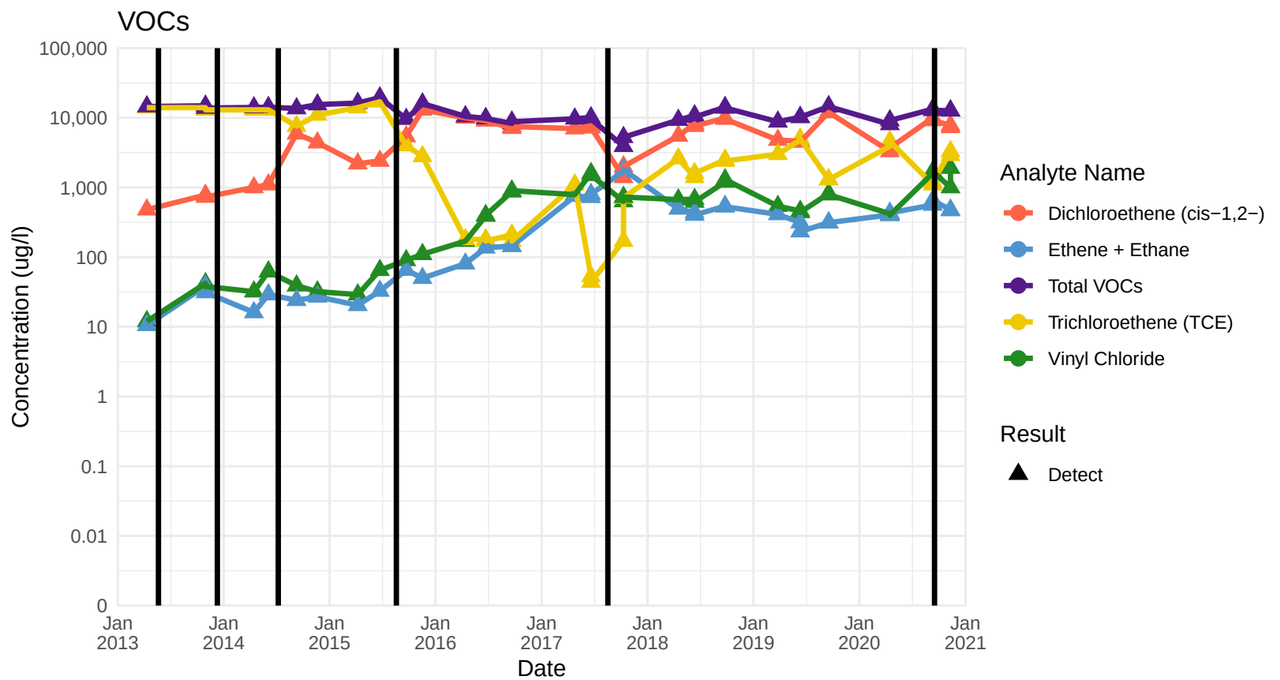

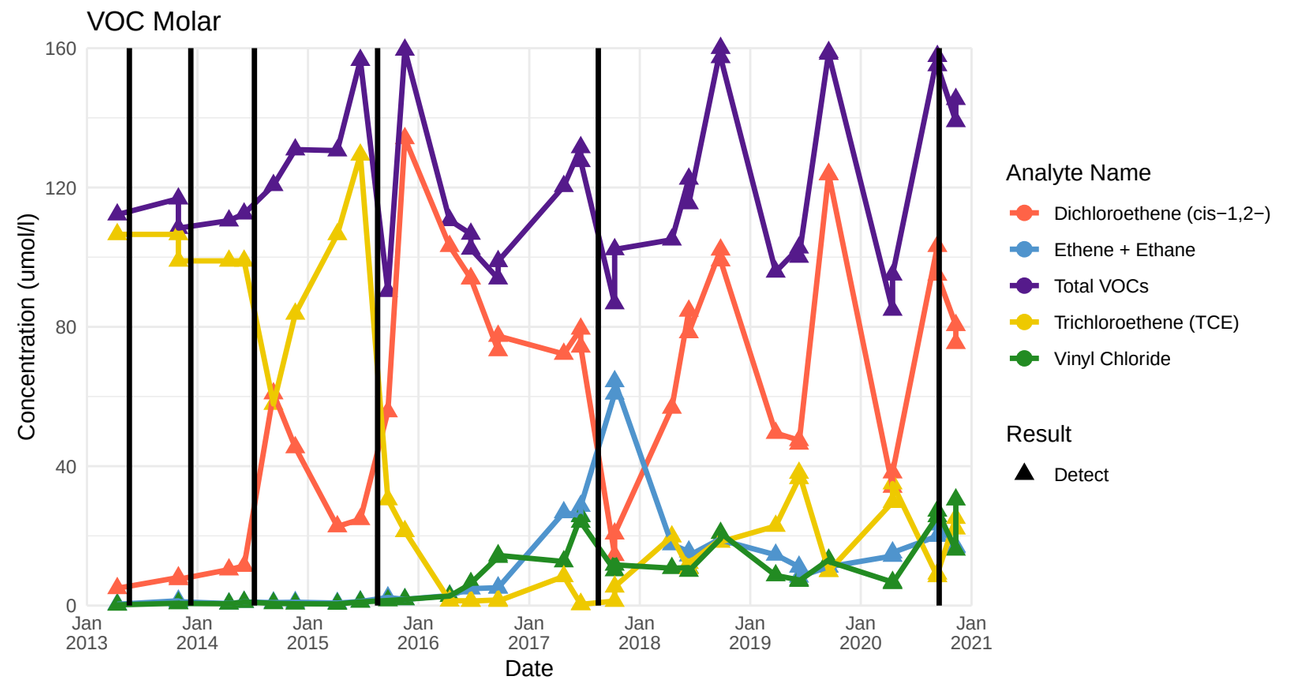

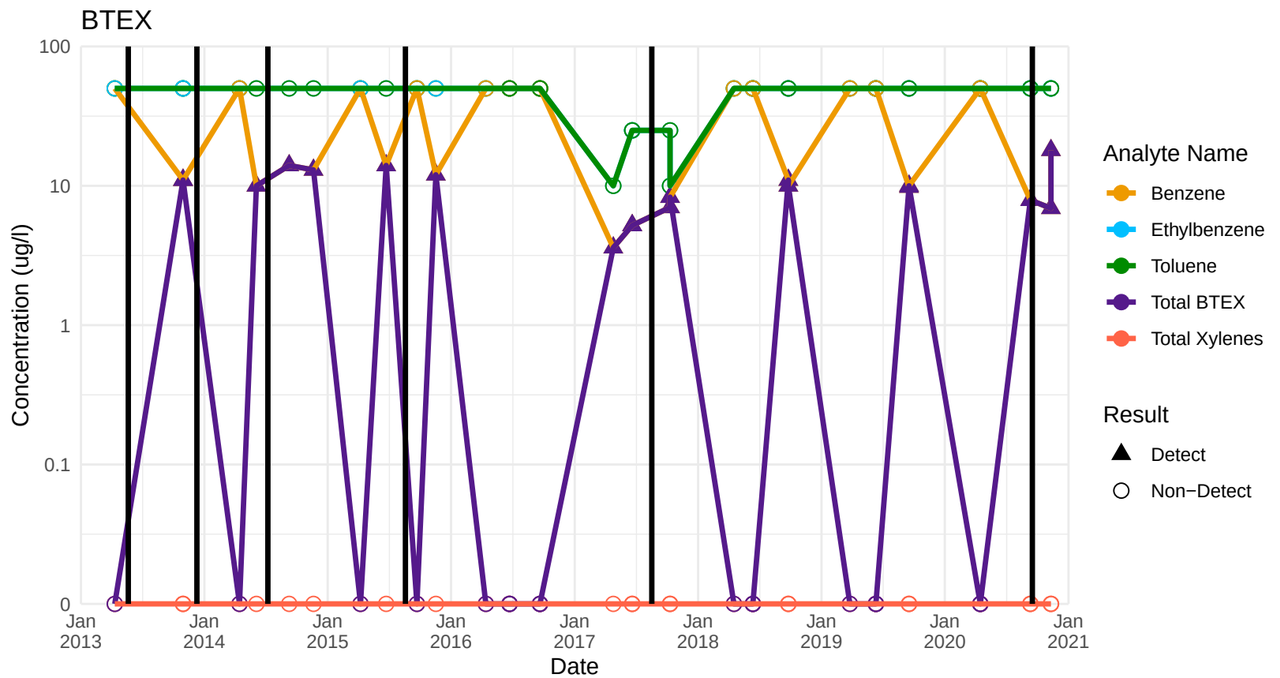

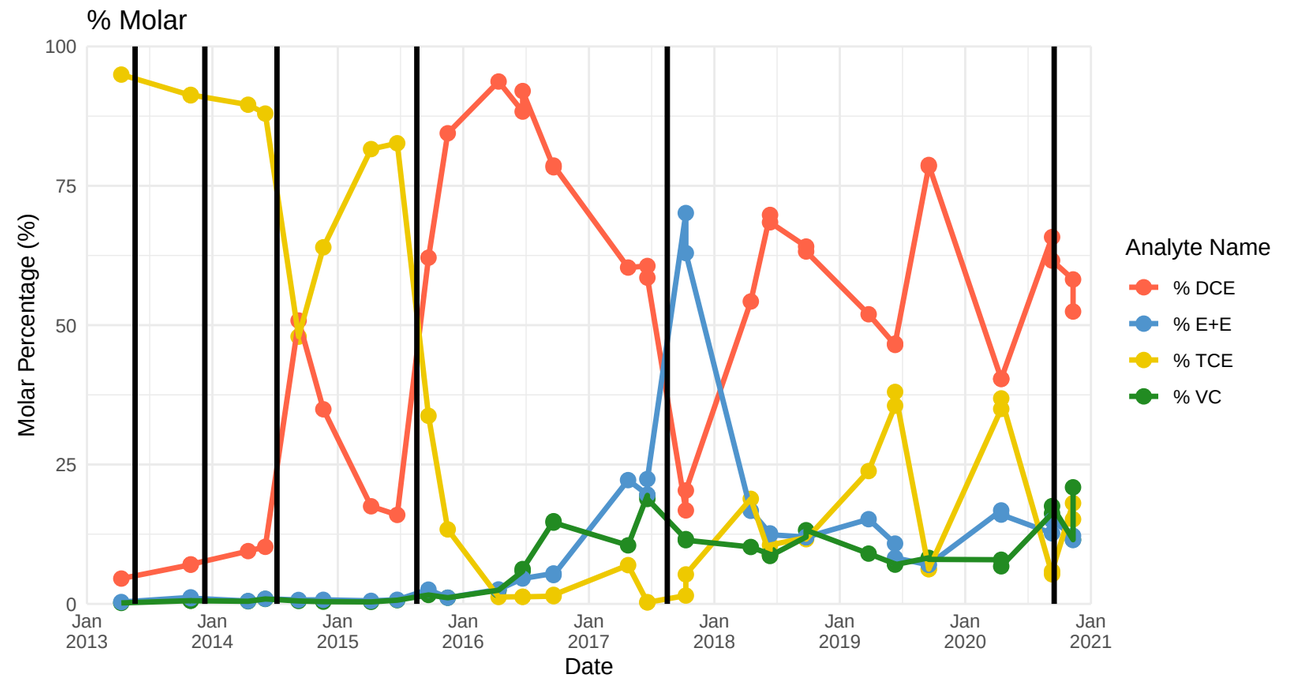

BP−36A

Notes:

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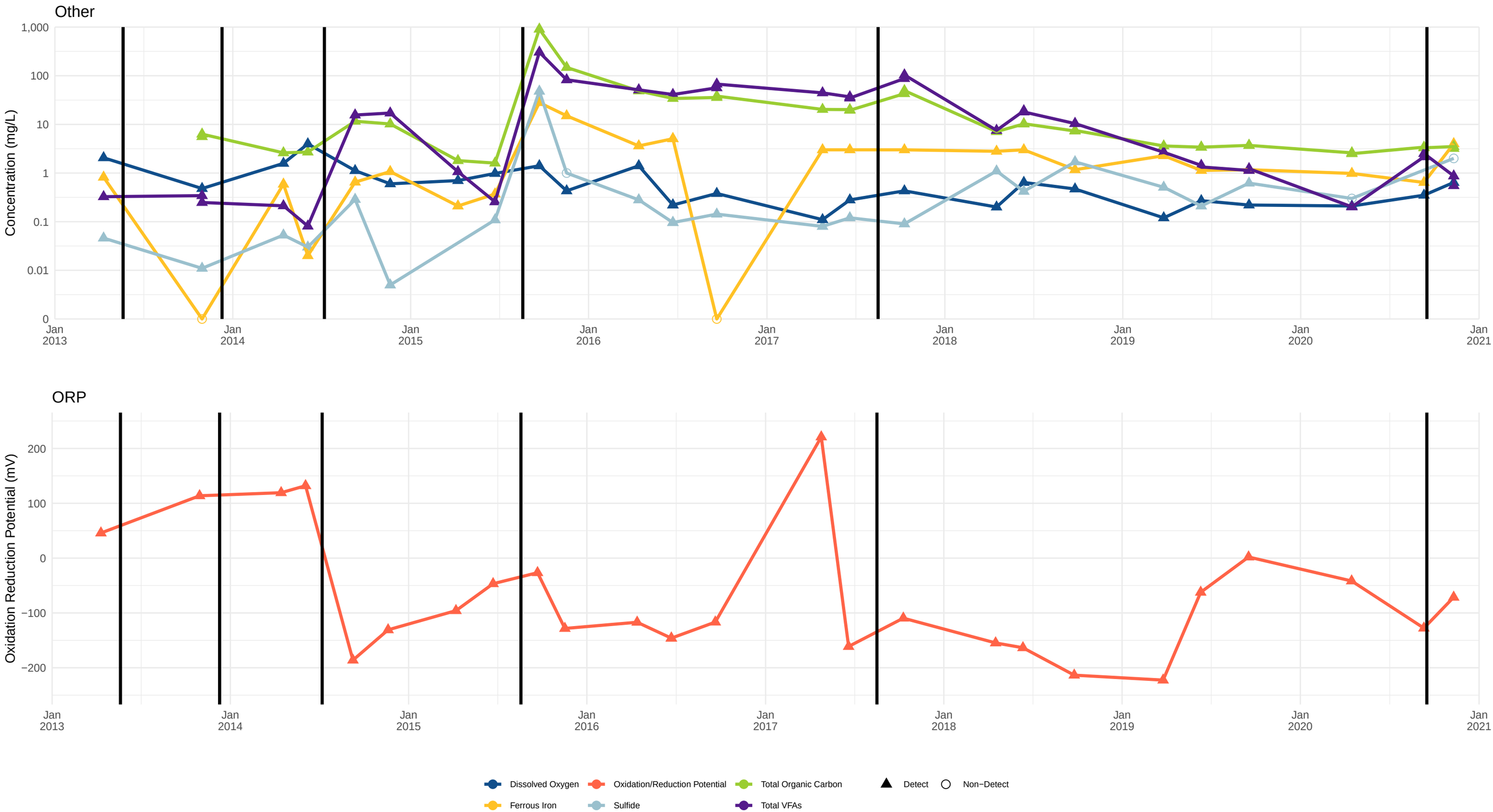

BP−37A

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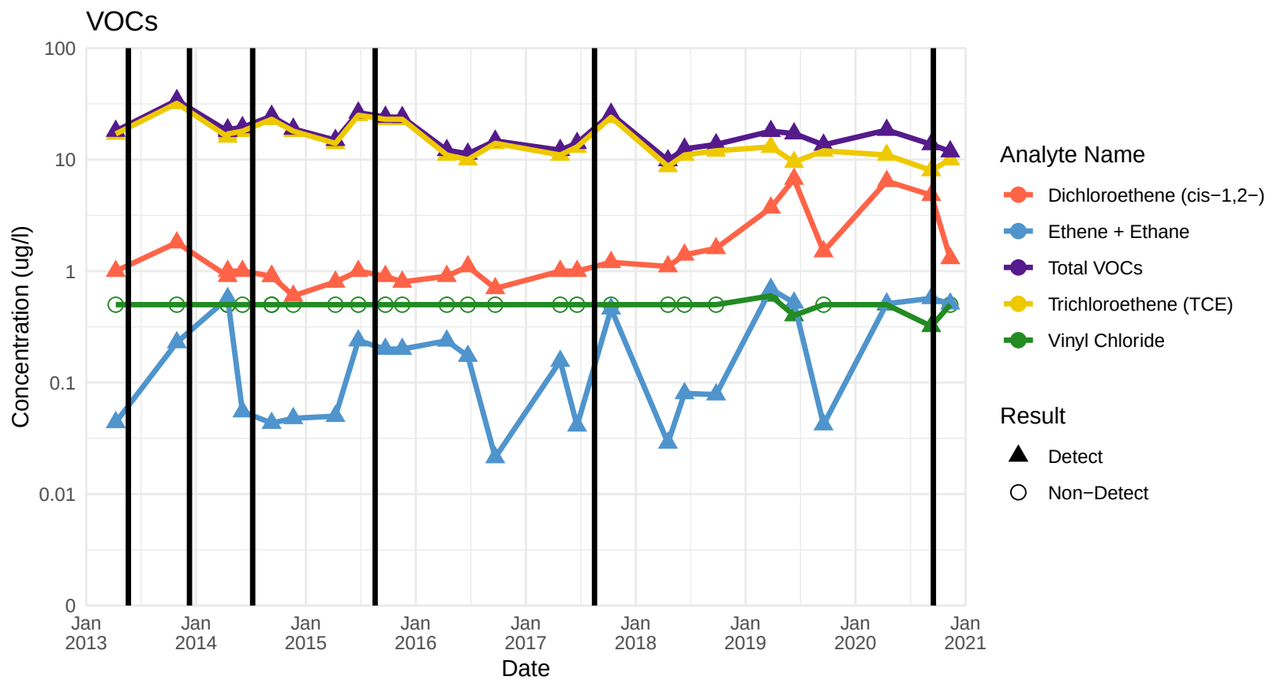

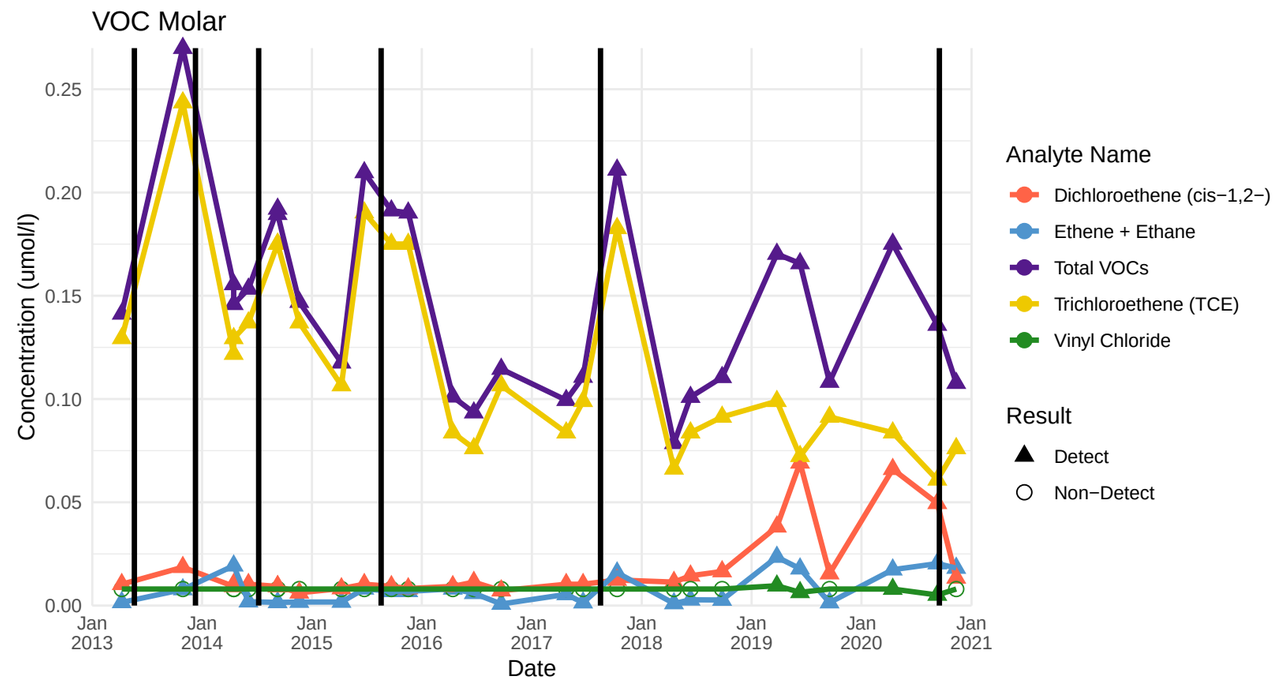

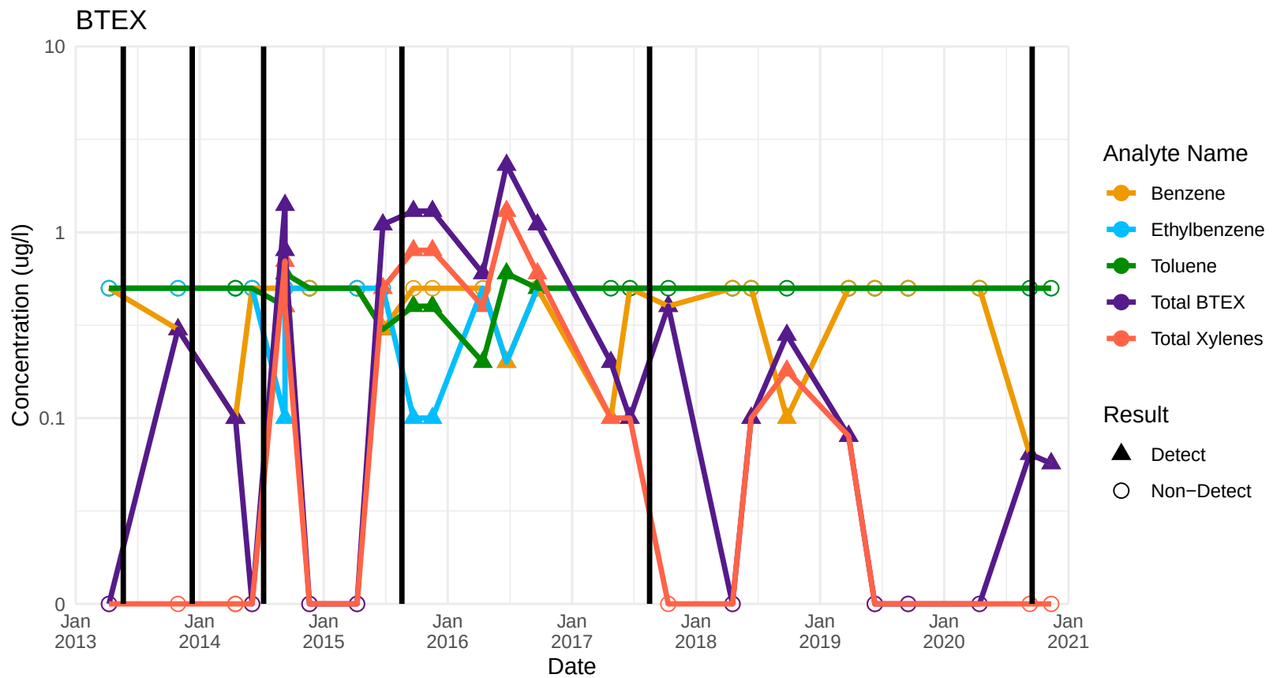

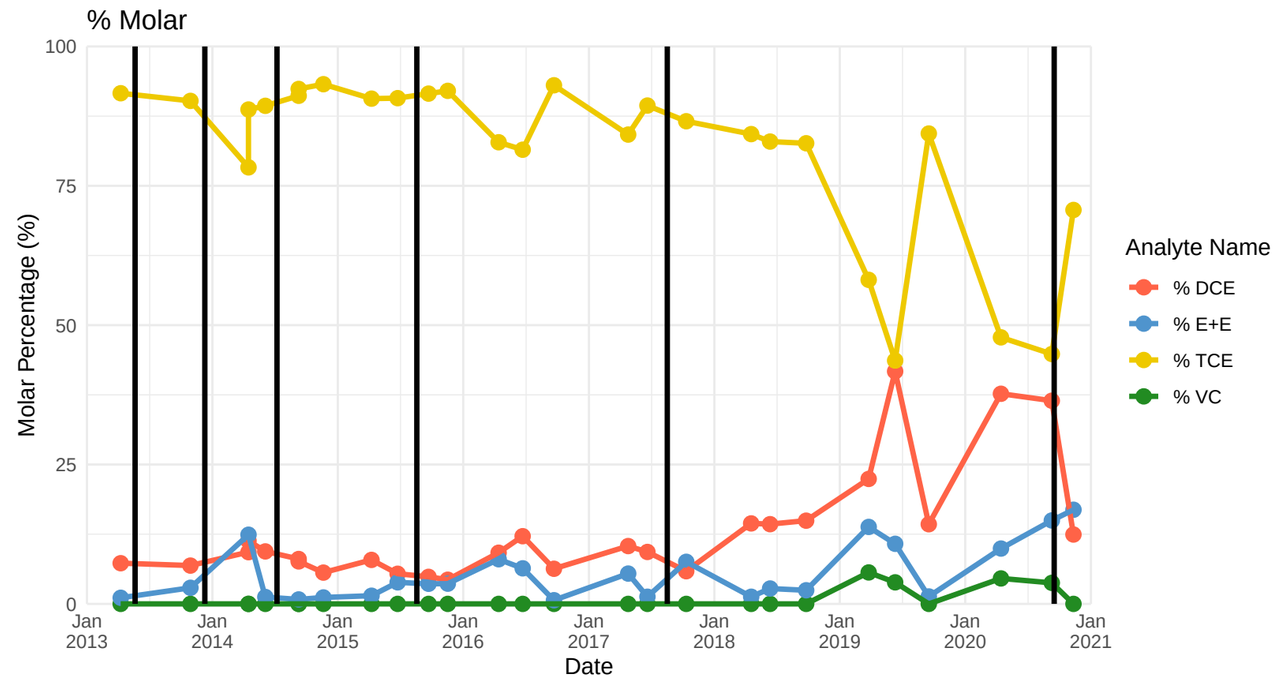

BP−37A

Notes:

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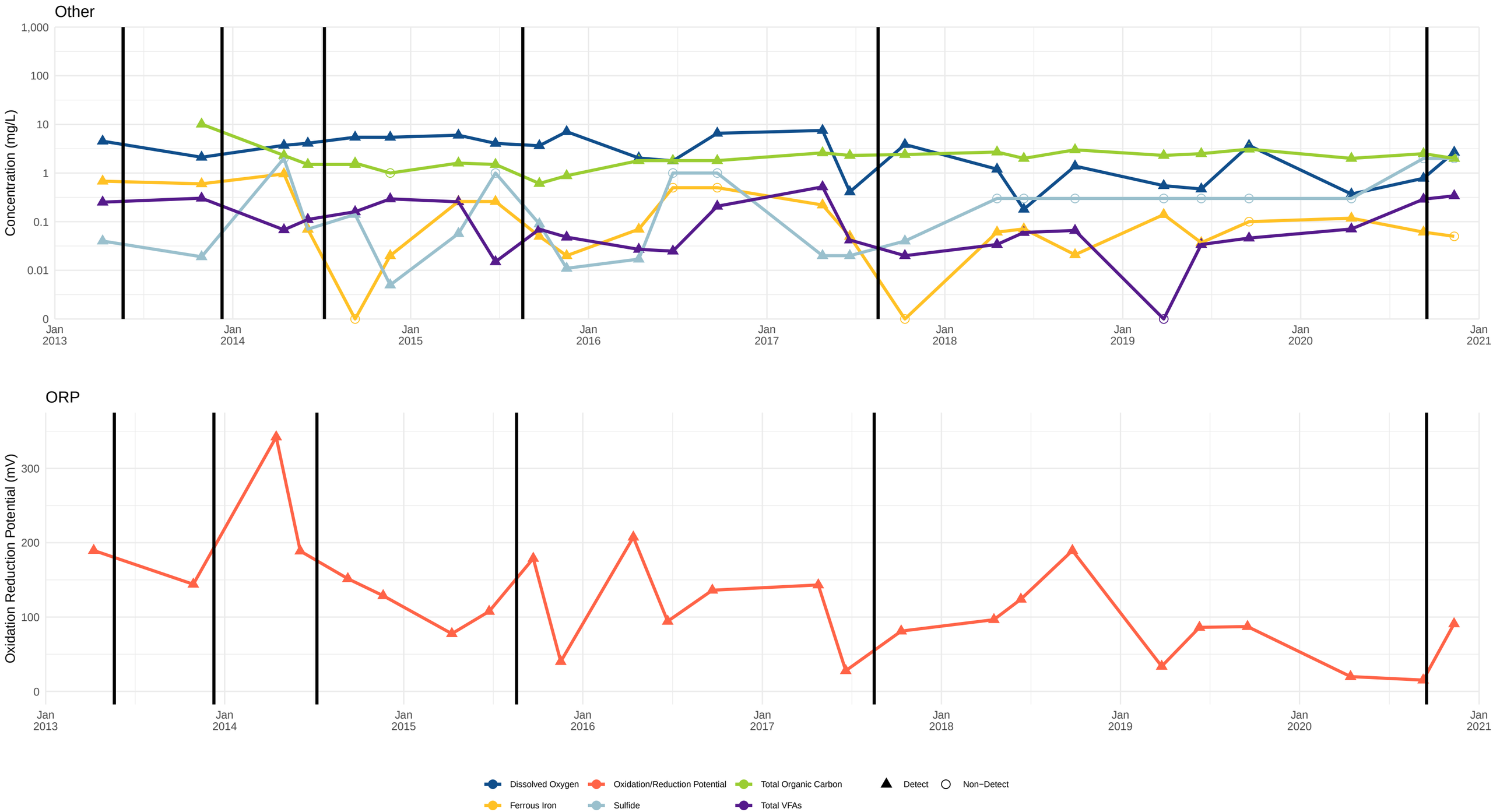

BP−38A

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

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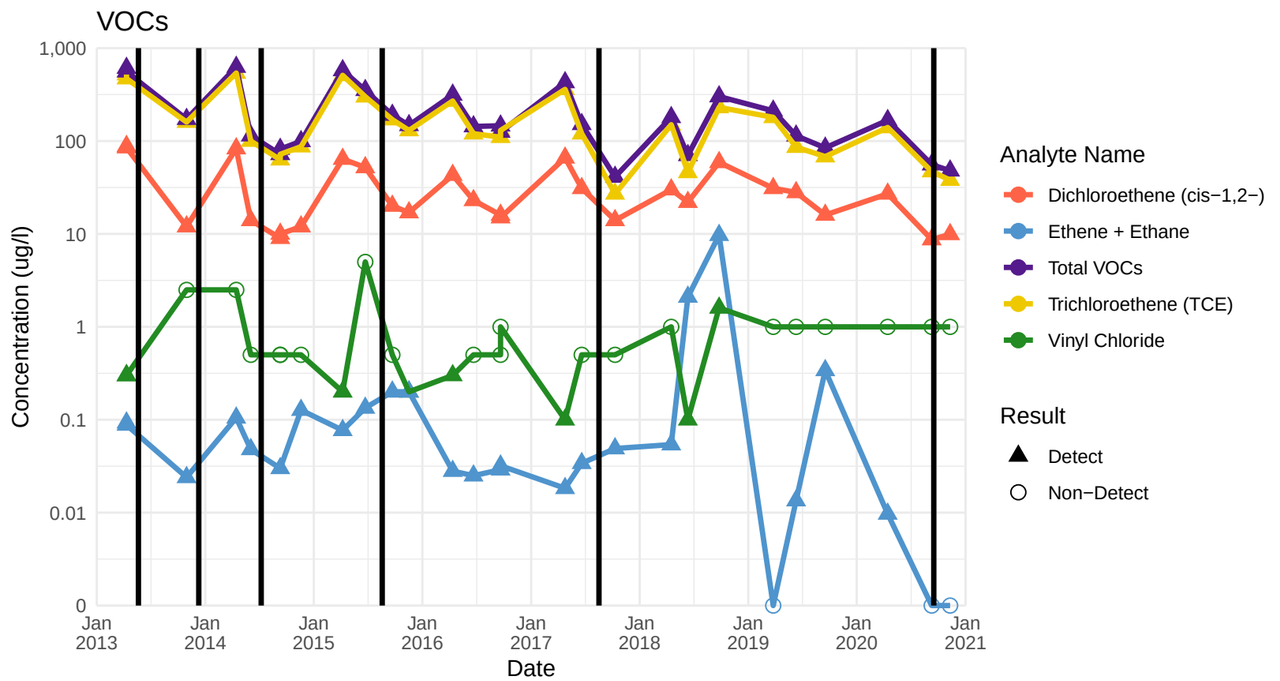

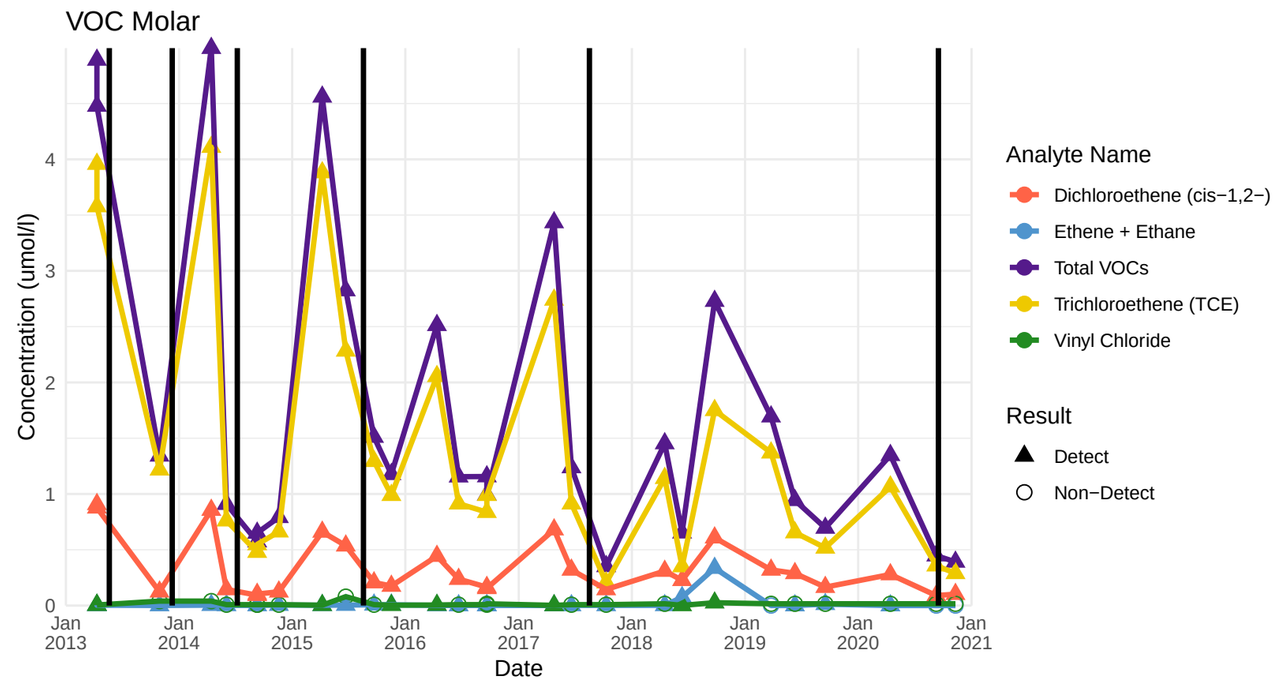

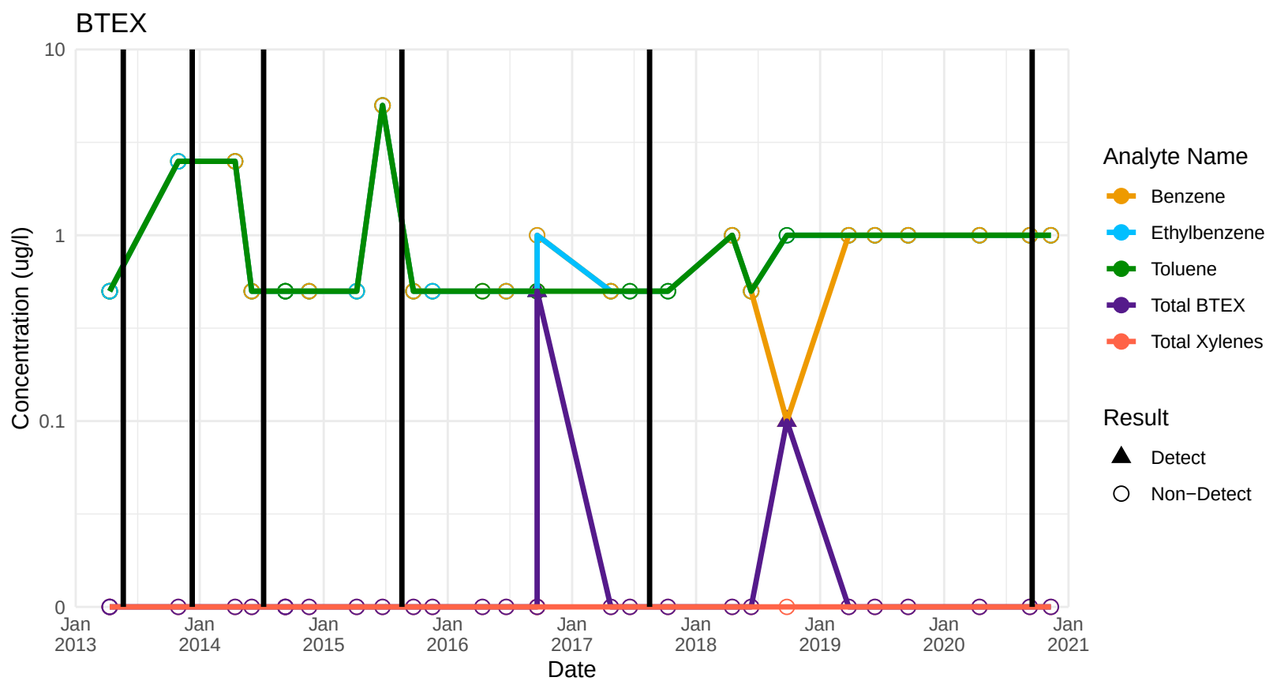

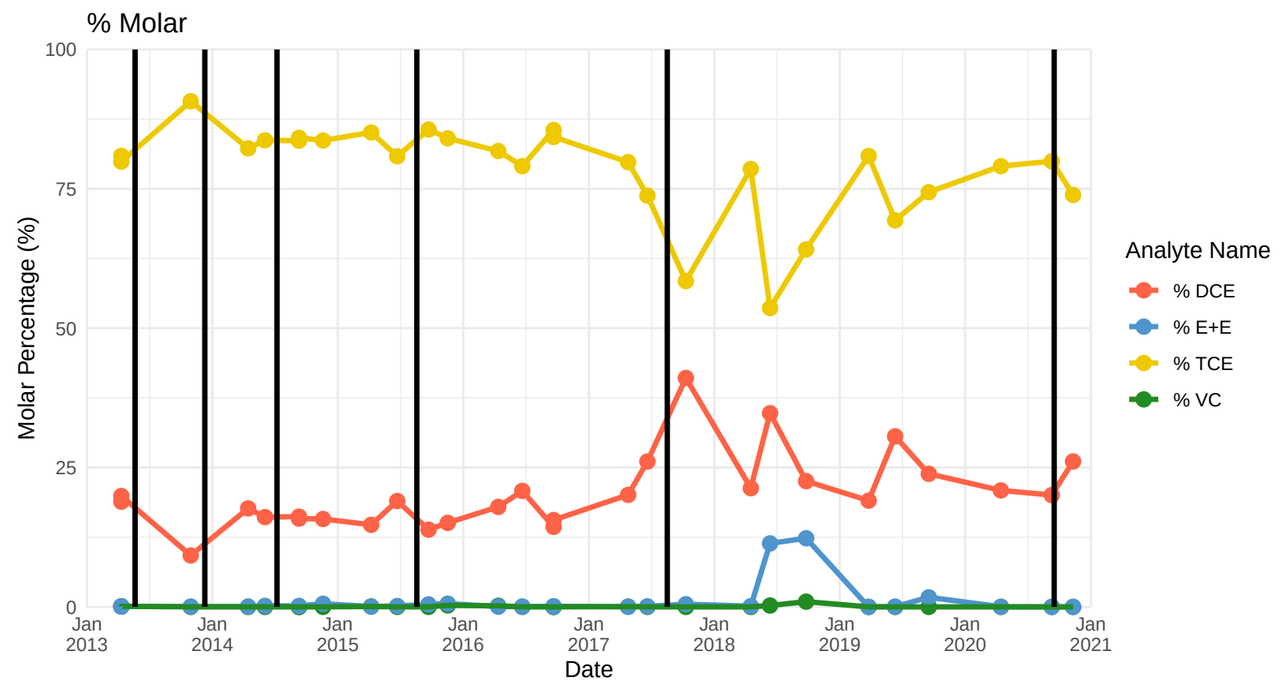

BP−38A

Notes:

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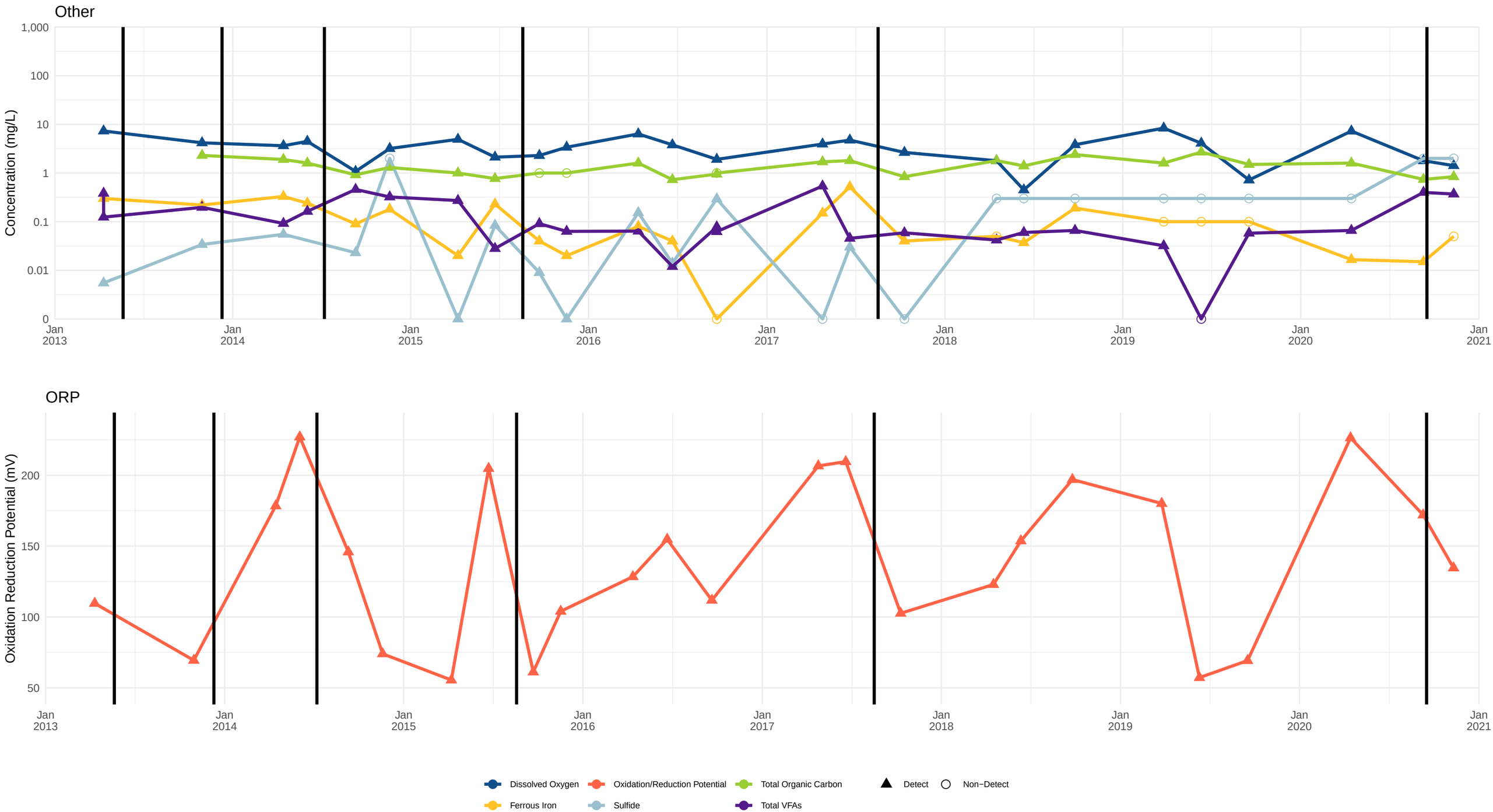

BP−39A

Notes:

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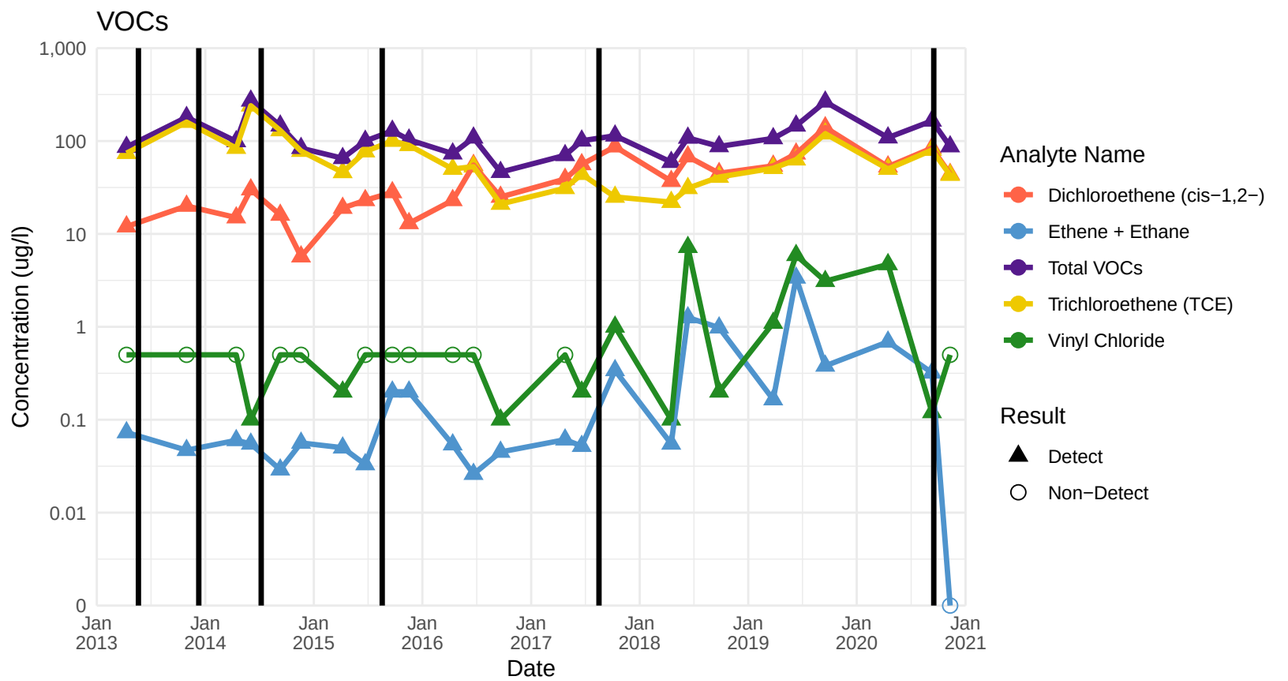

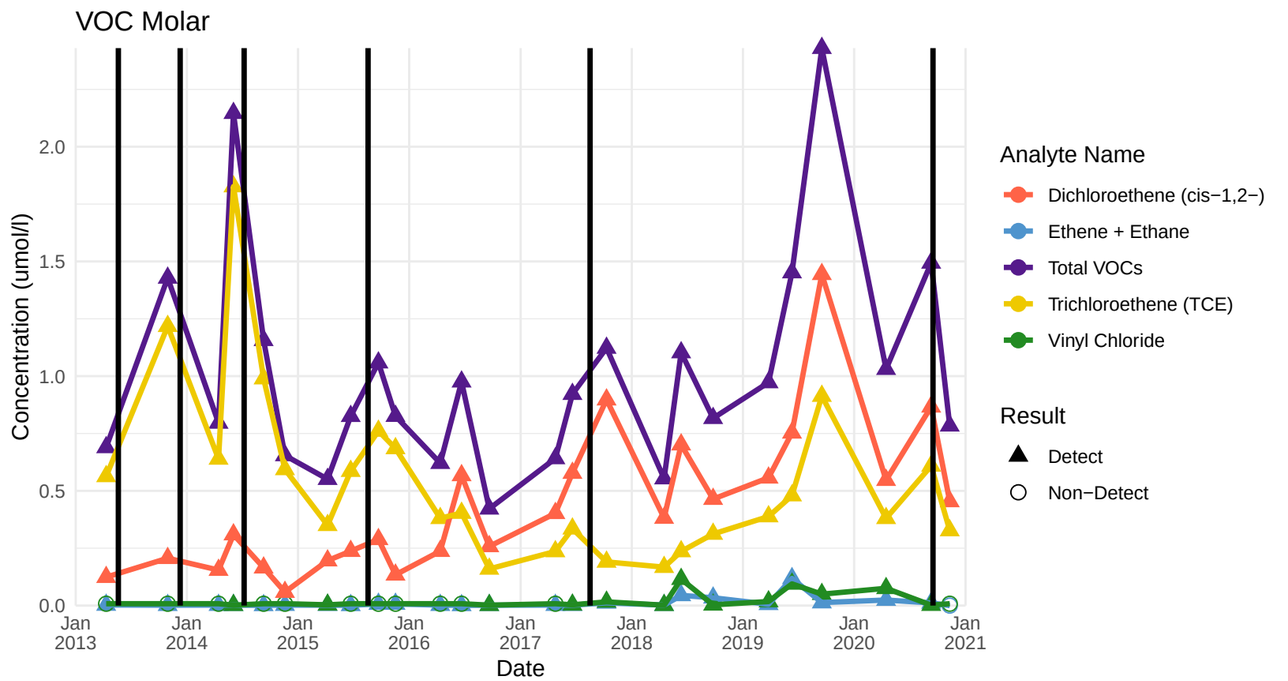

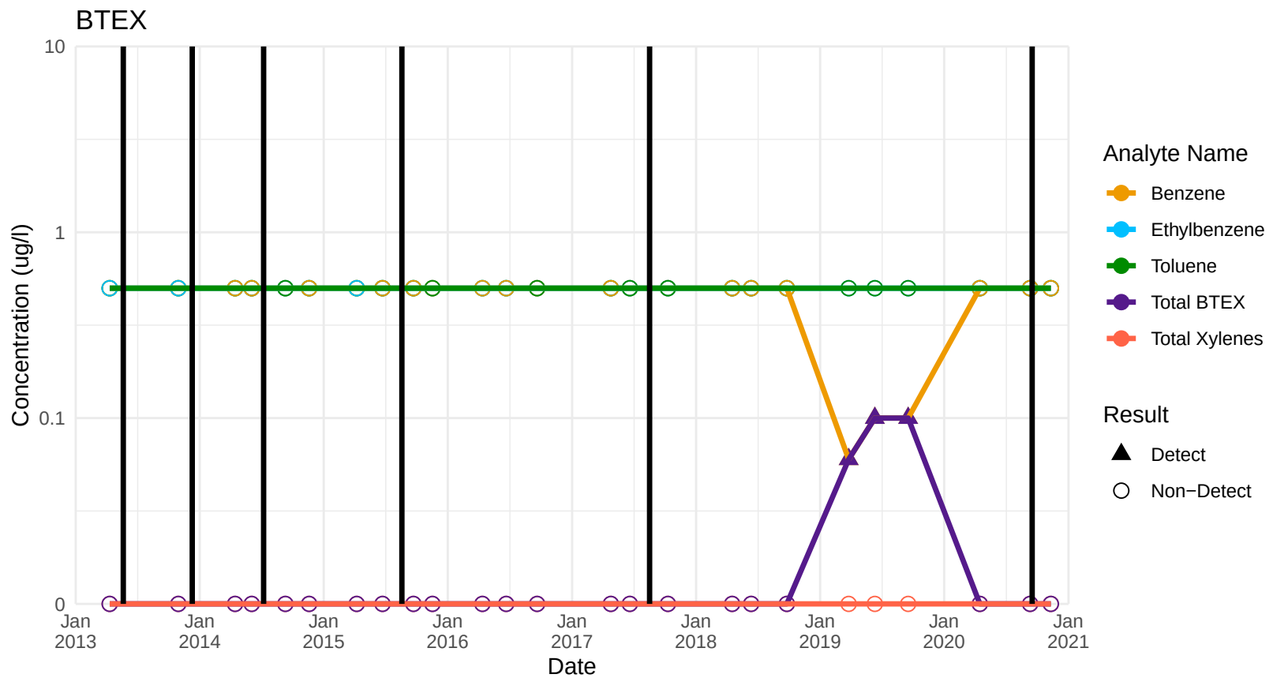

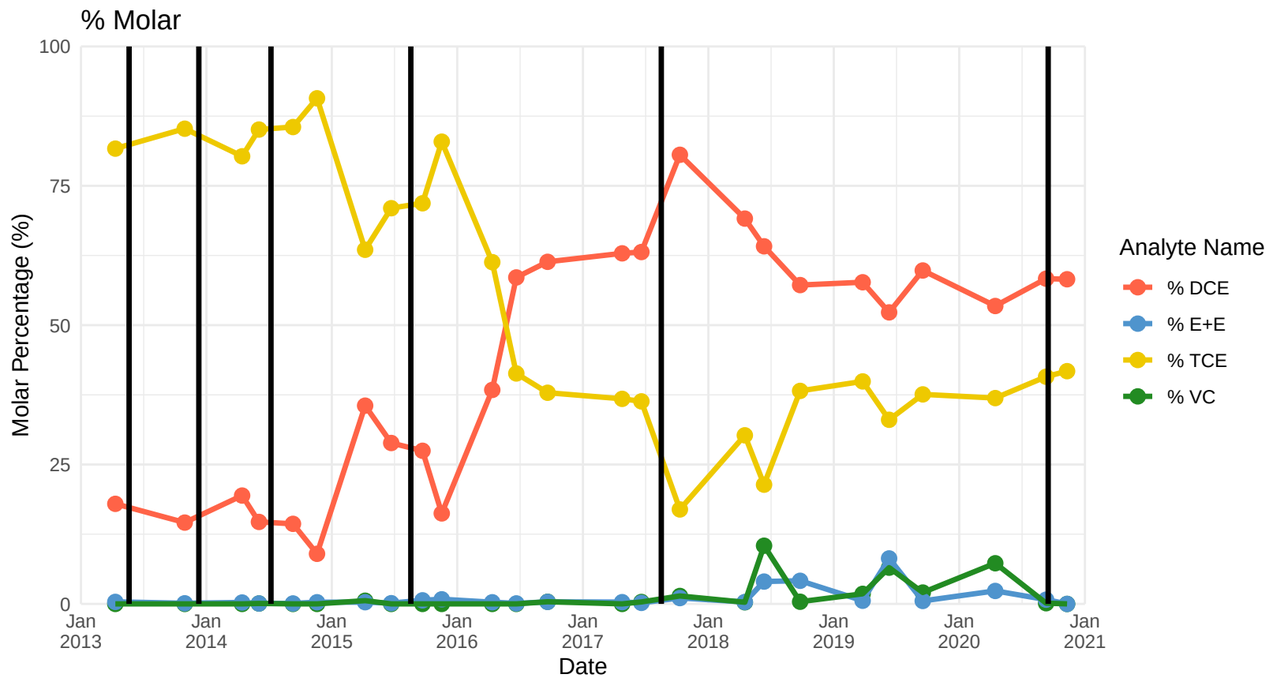

BP−39A

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

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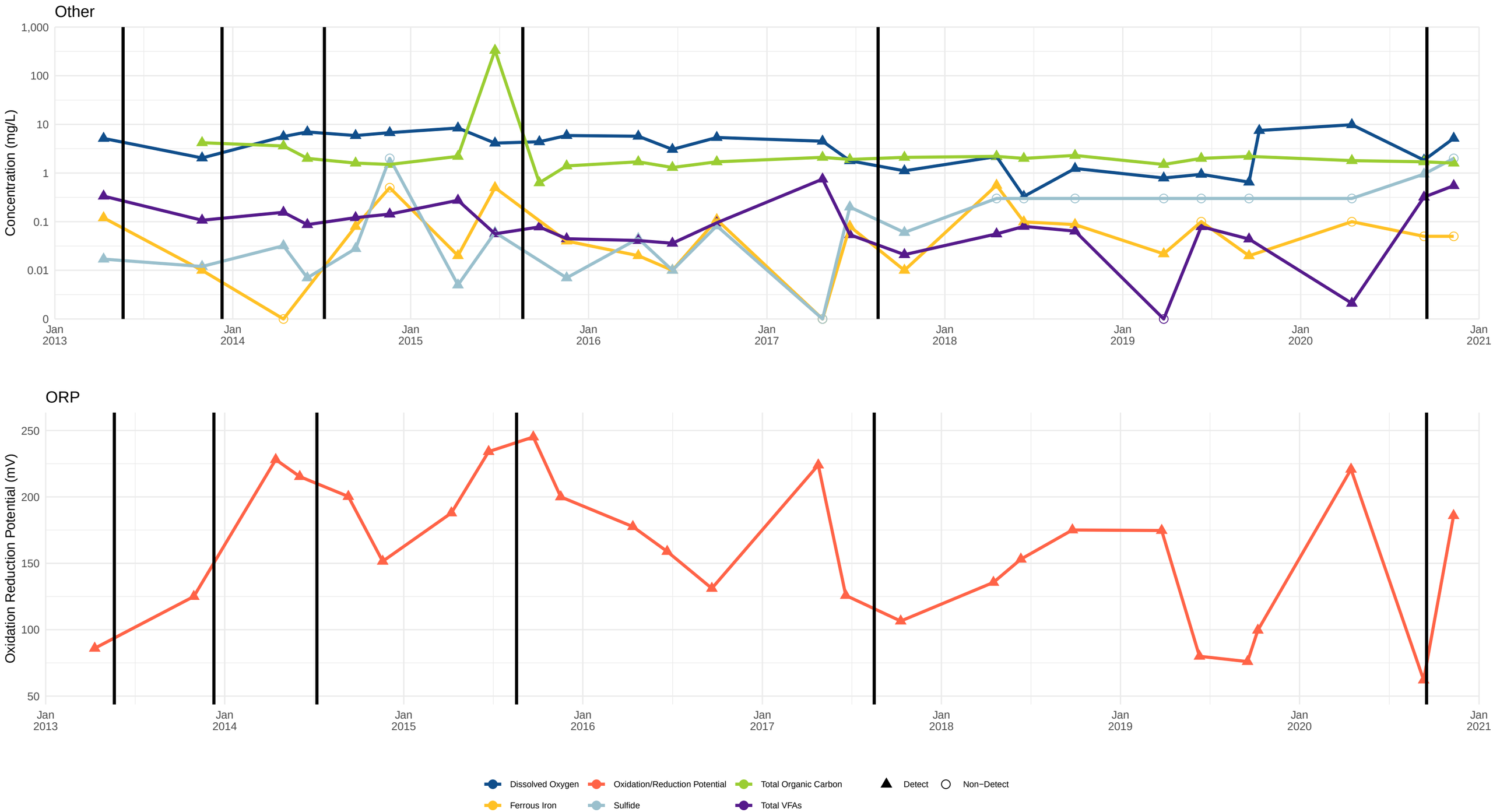


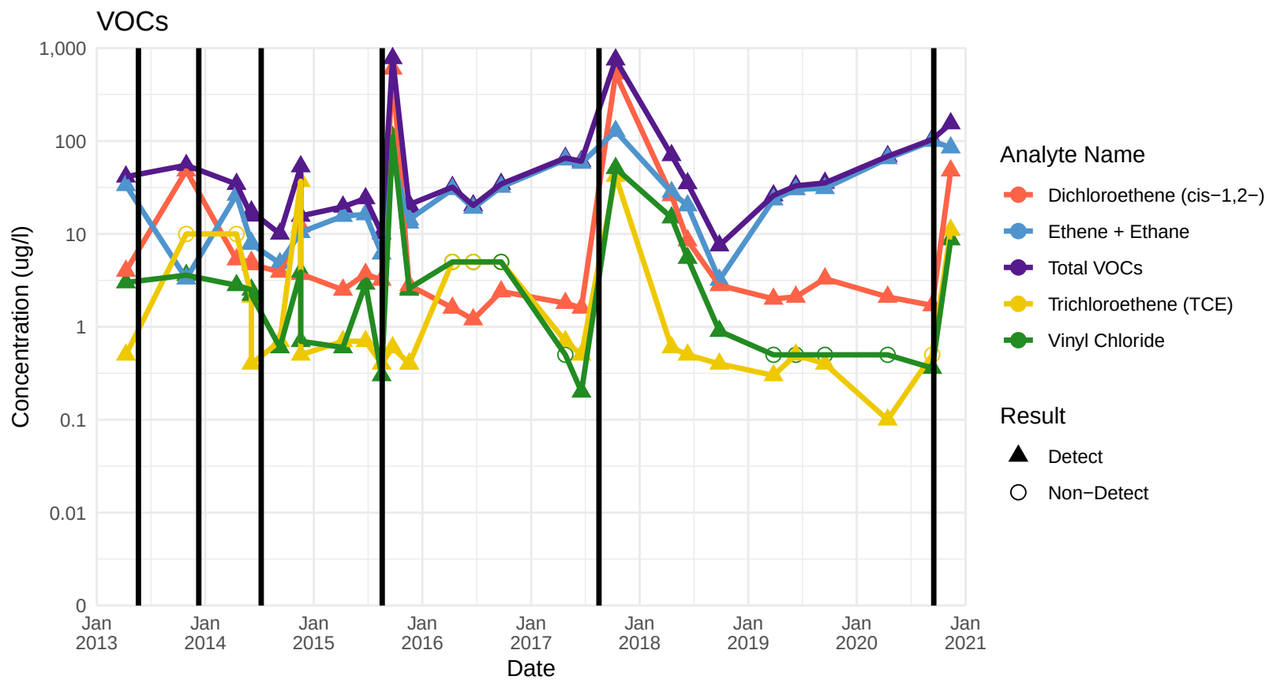
IB−7

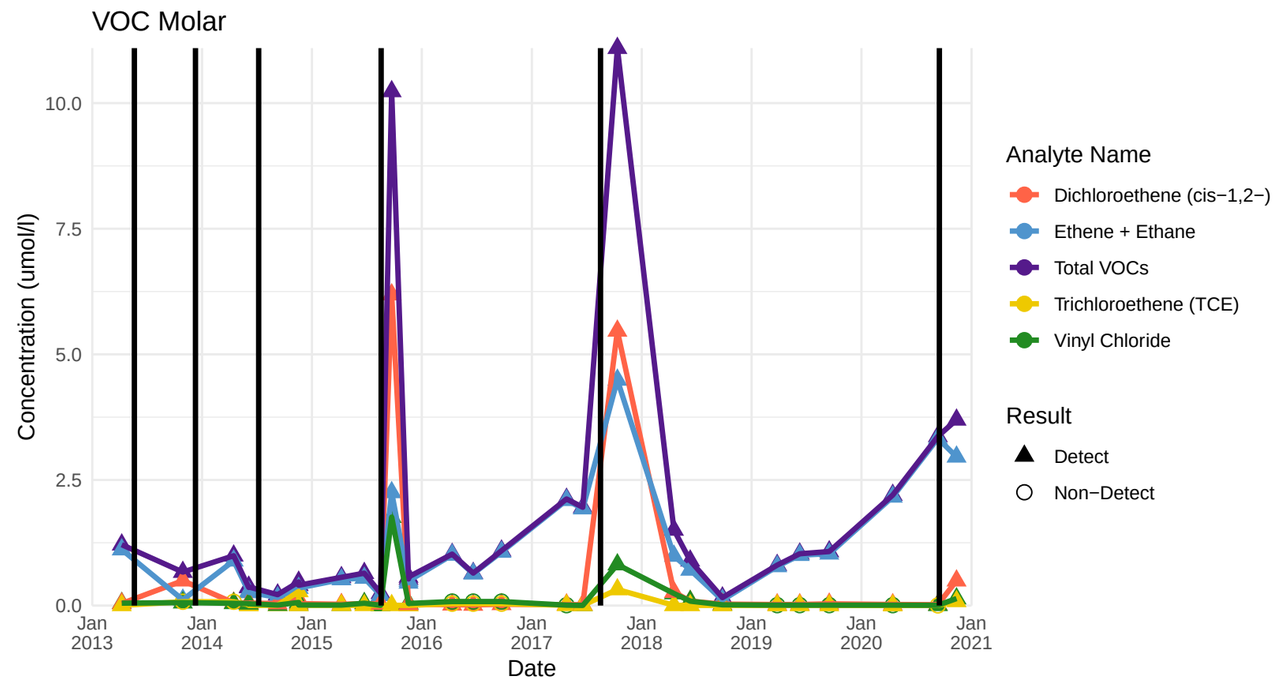
Notes:

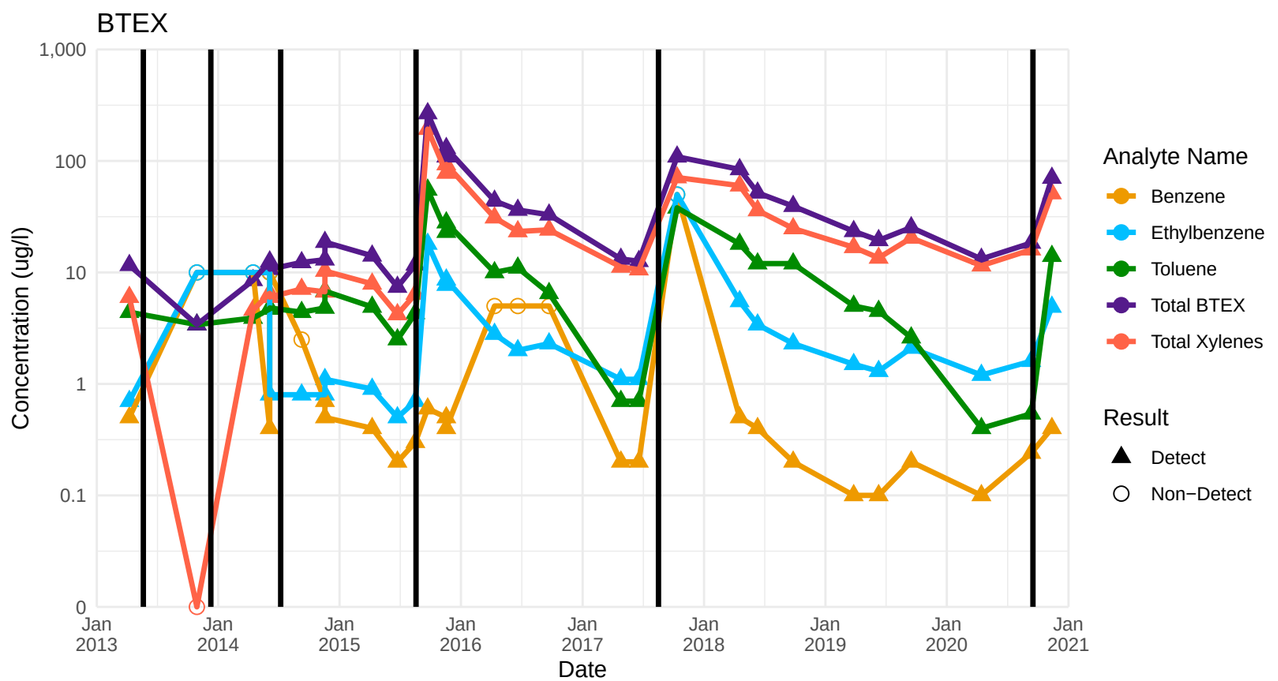
(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

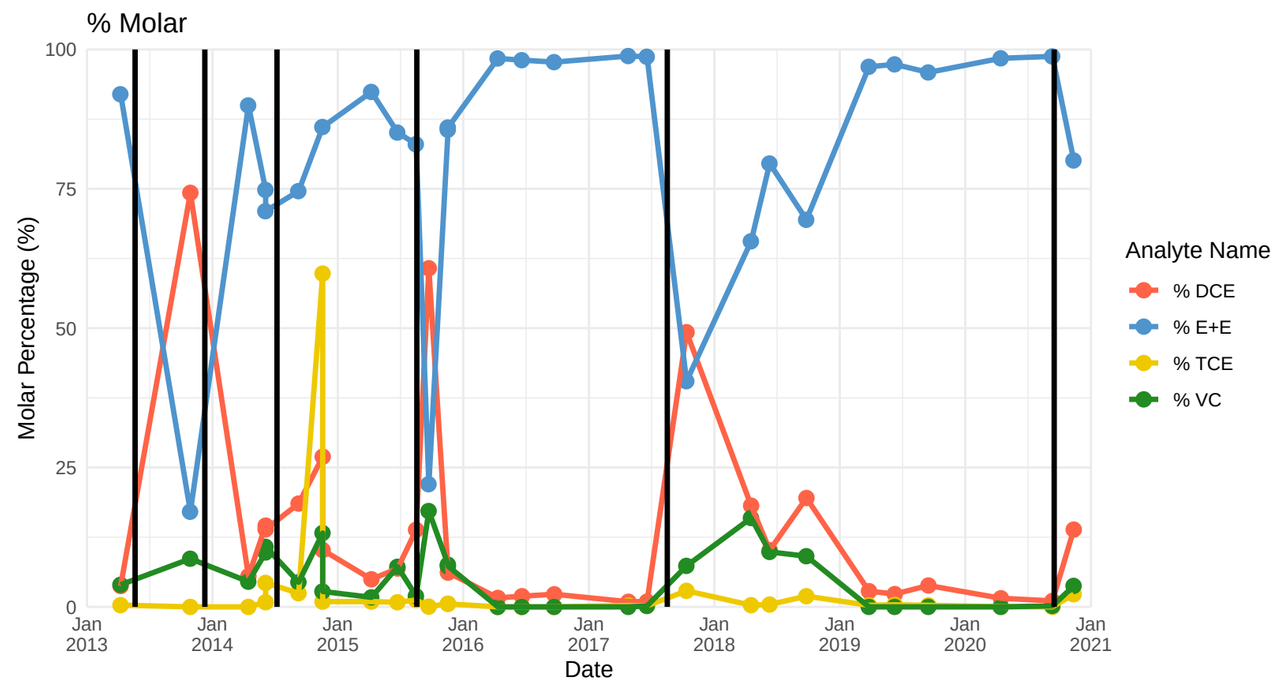
(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.









IB−7

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

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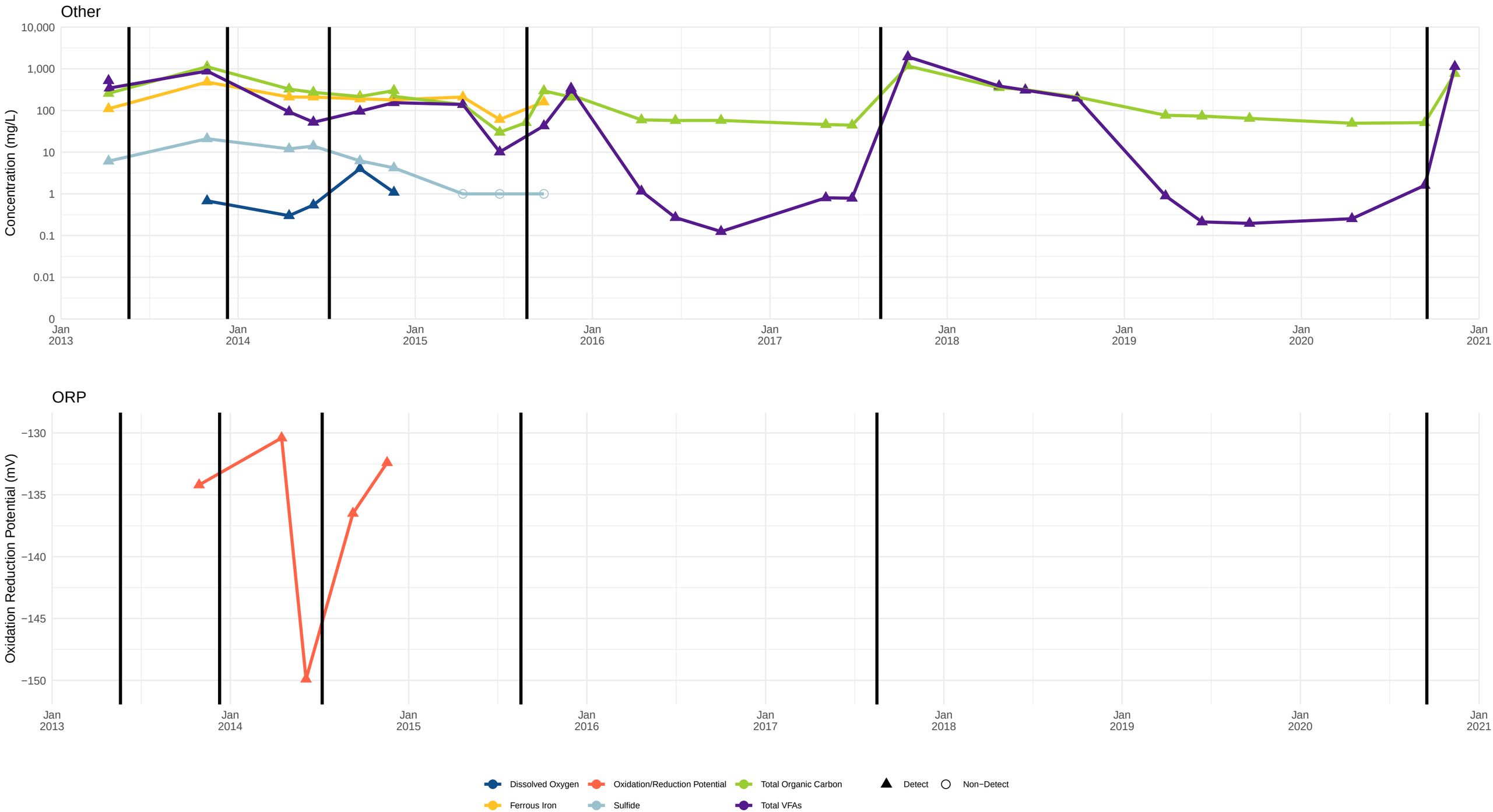


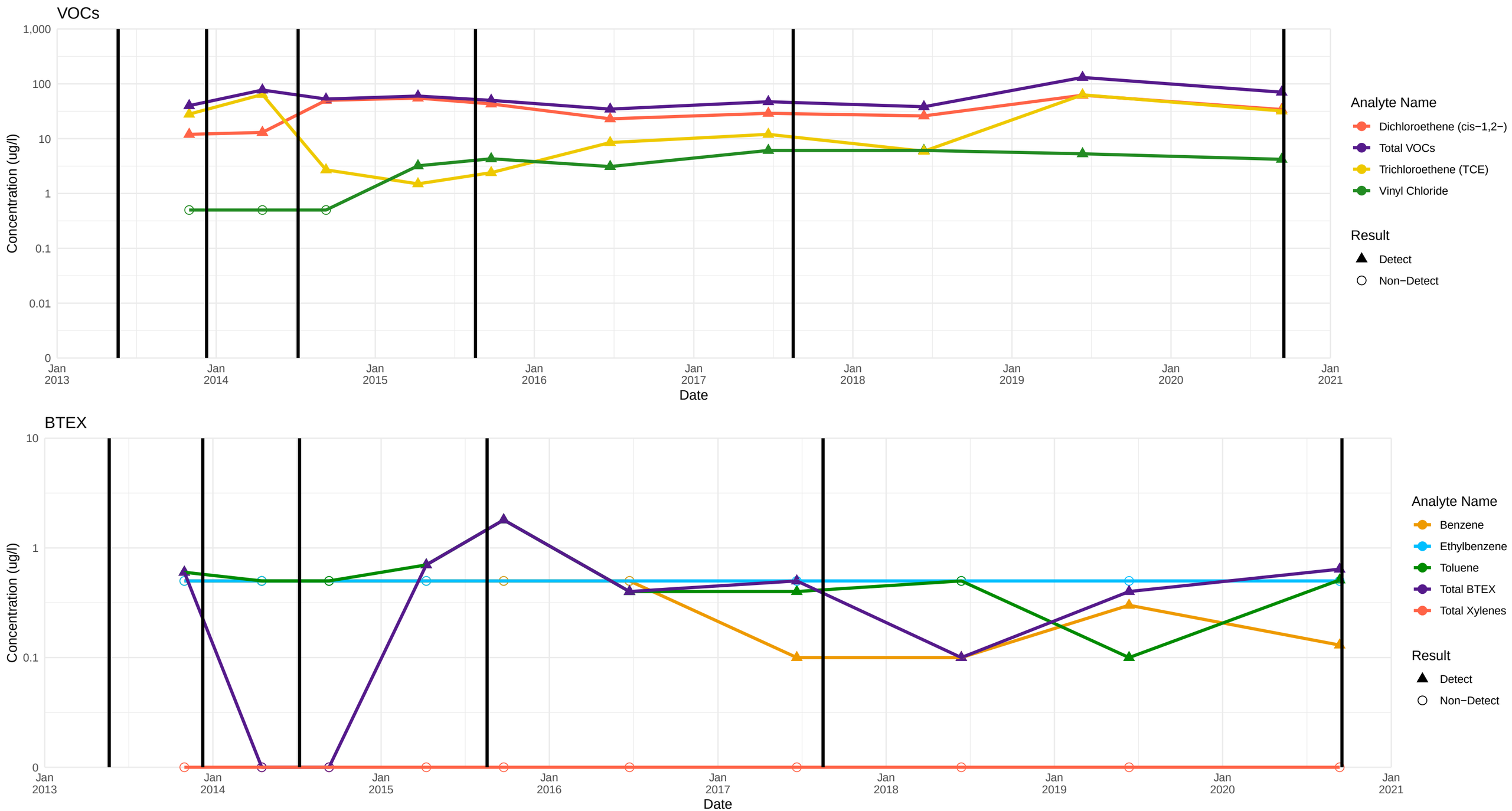
GC−1 Port 1

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.



Sanborn, Head & Associates, Inc.

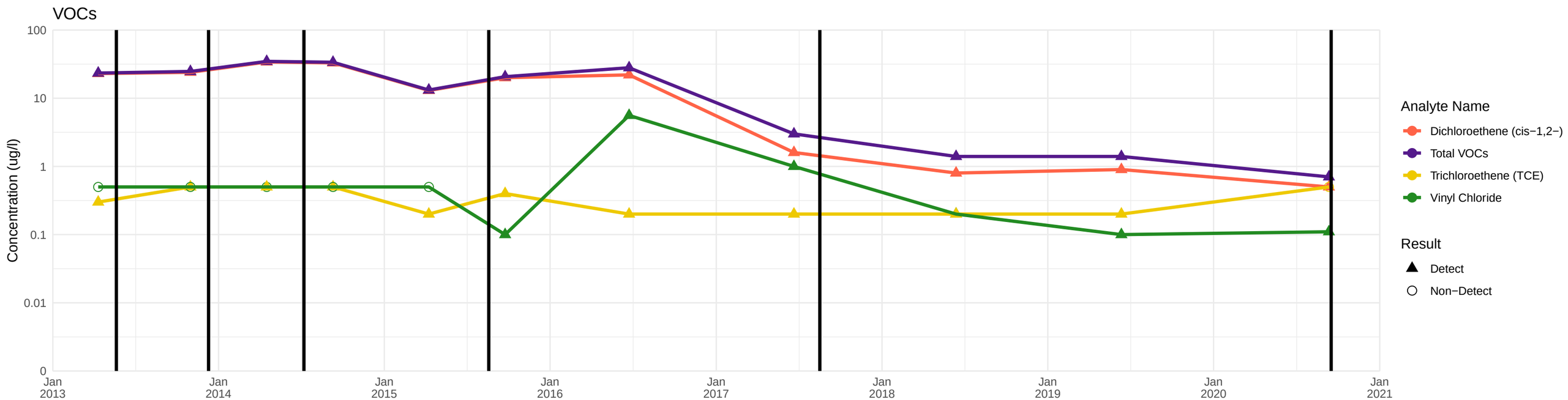
GC−1 Port 8

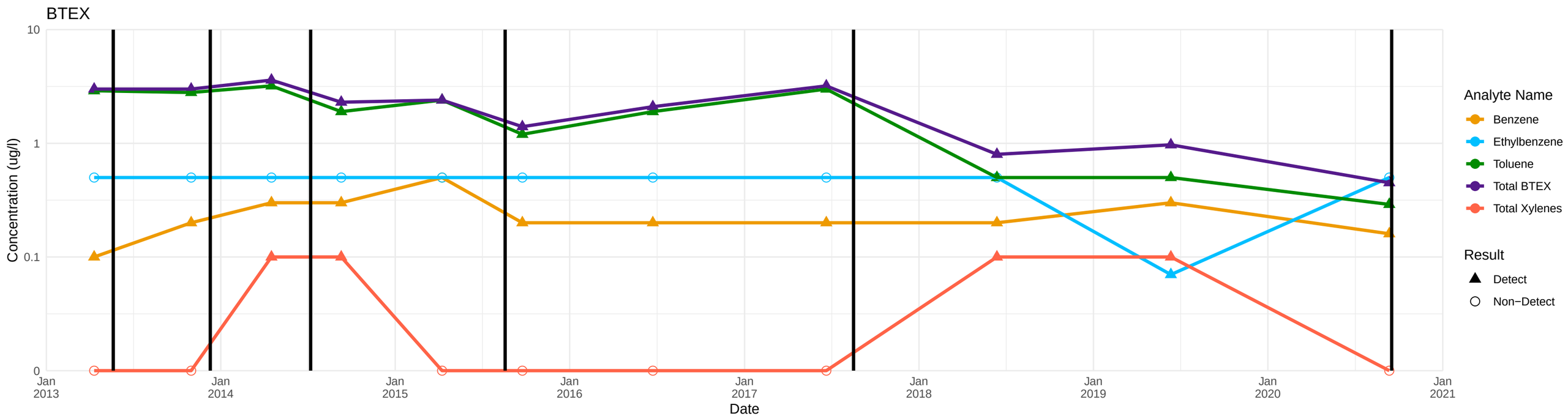
Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.





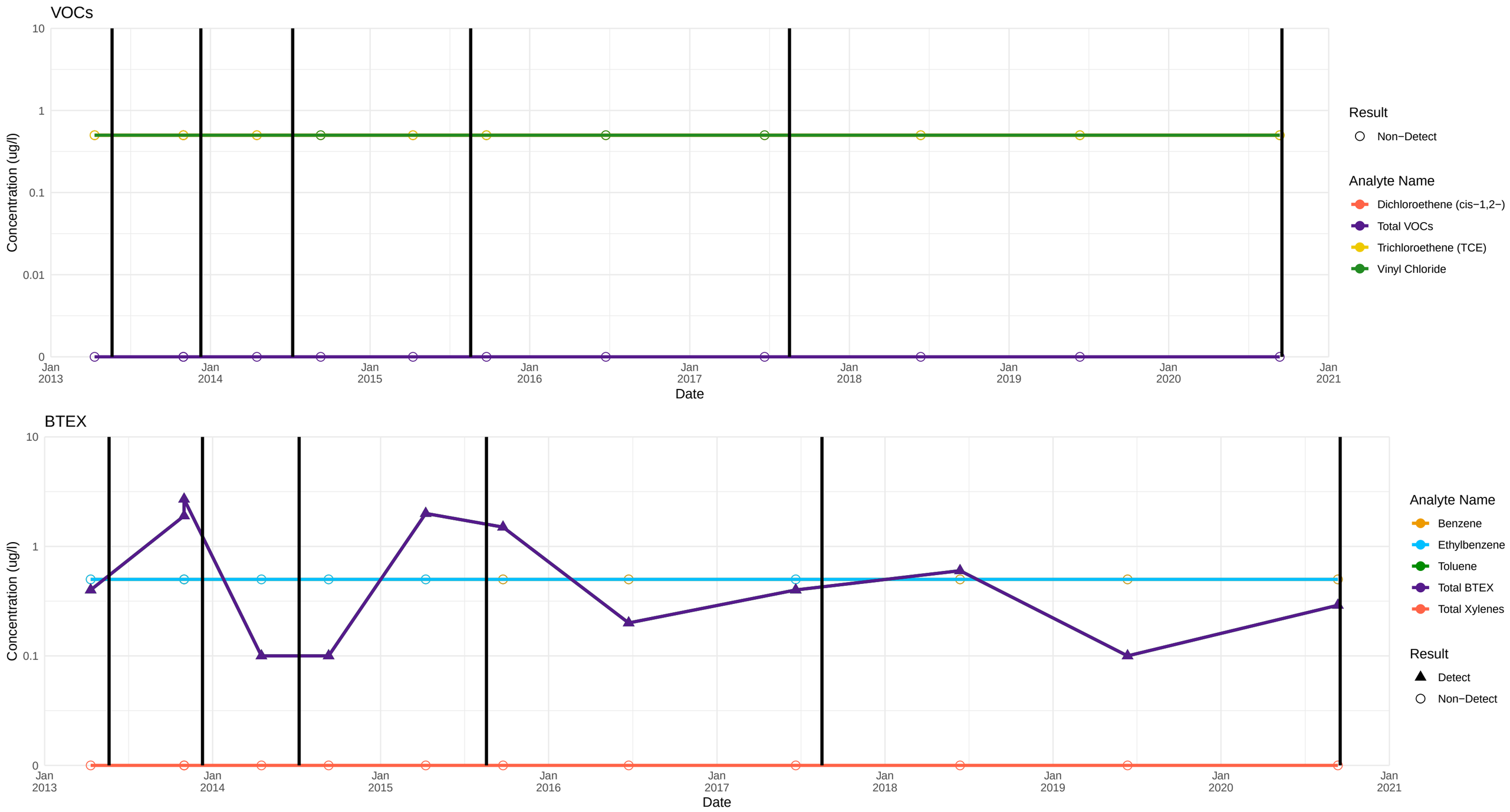
BP−12D Port 1

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.



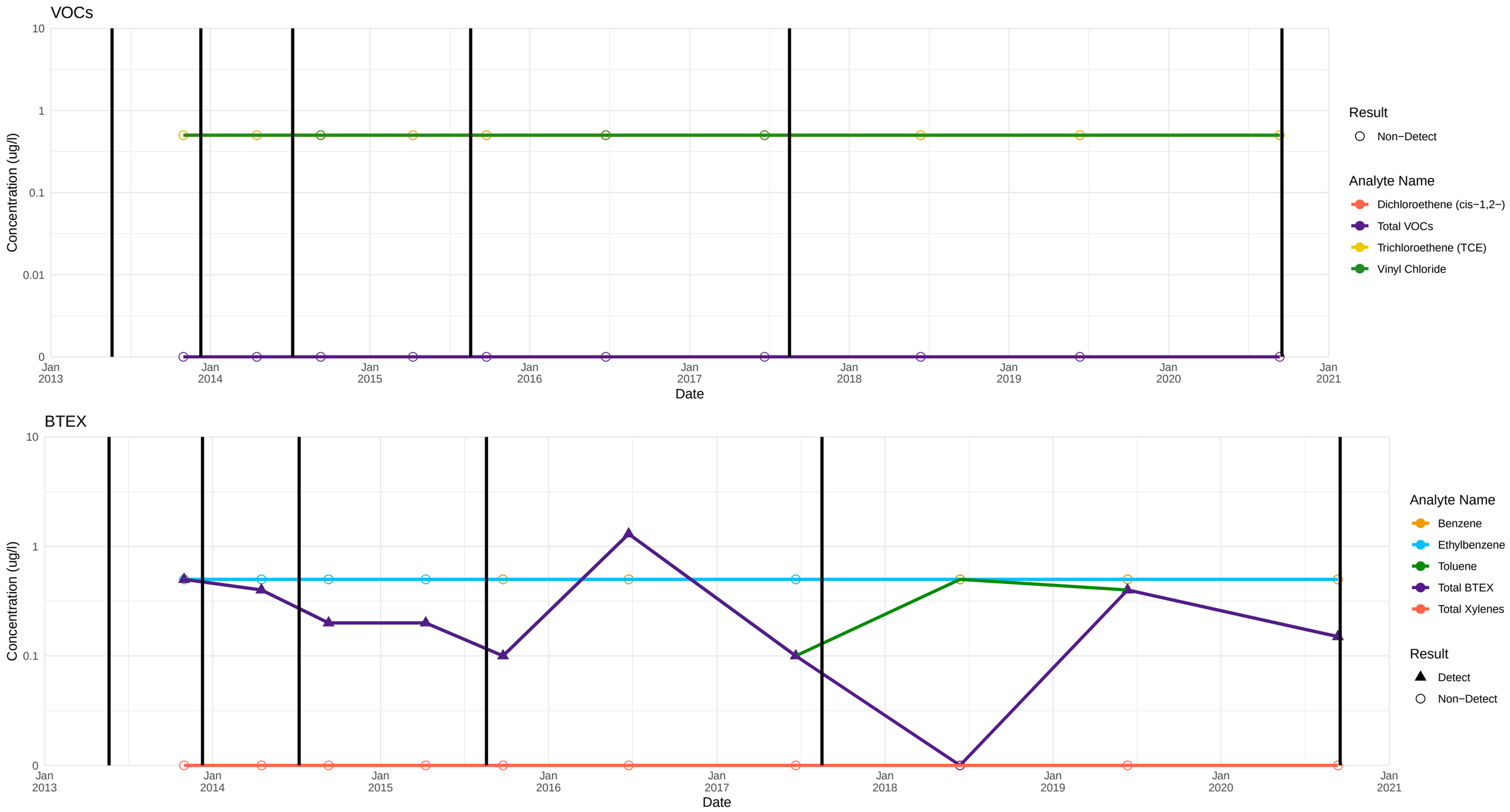
BP−12D Port 7

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.



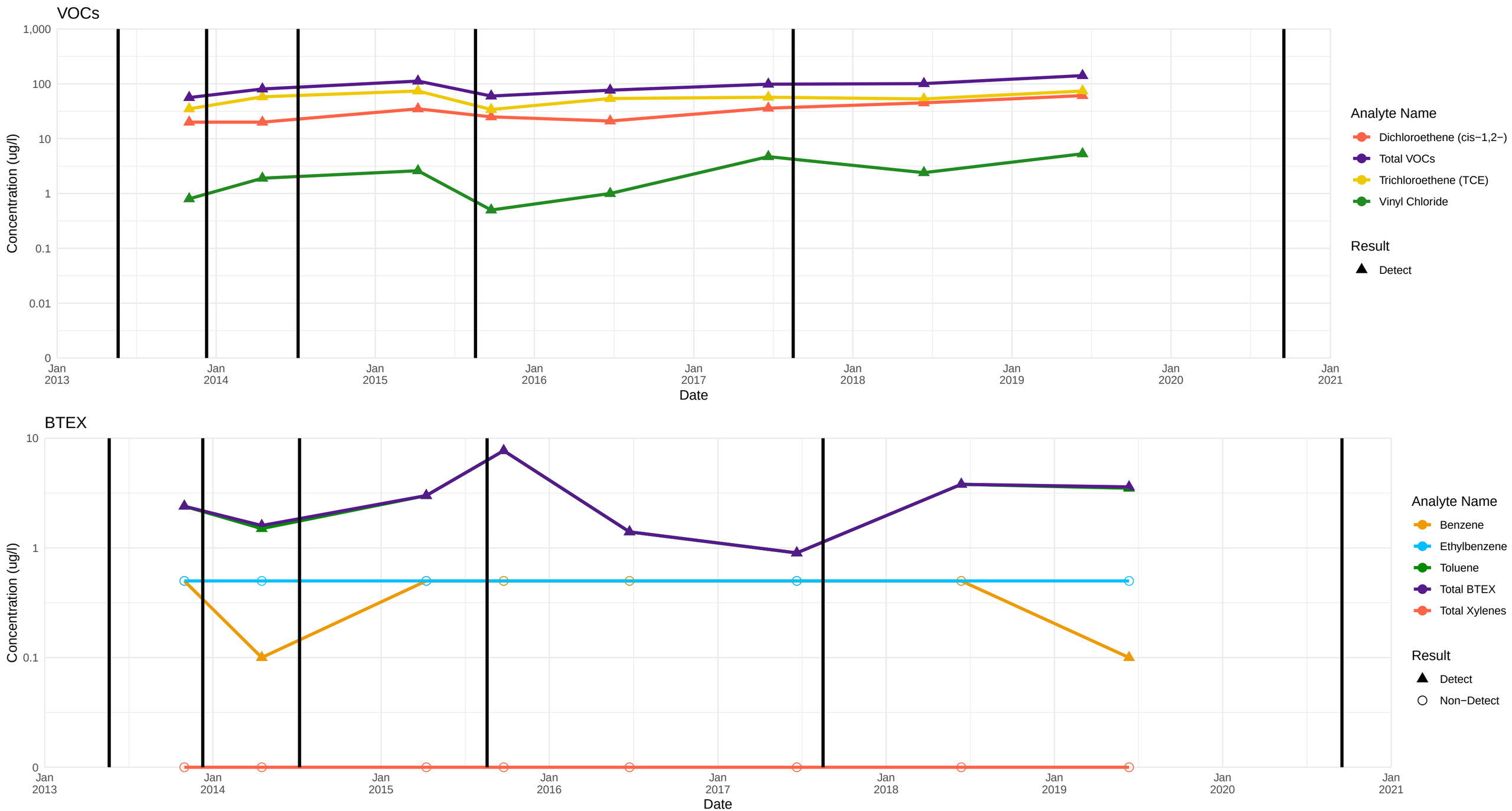
BP−13D Port 1

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.



Sanborn, Head & Associates, Inc.

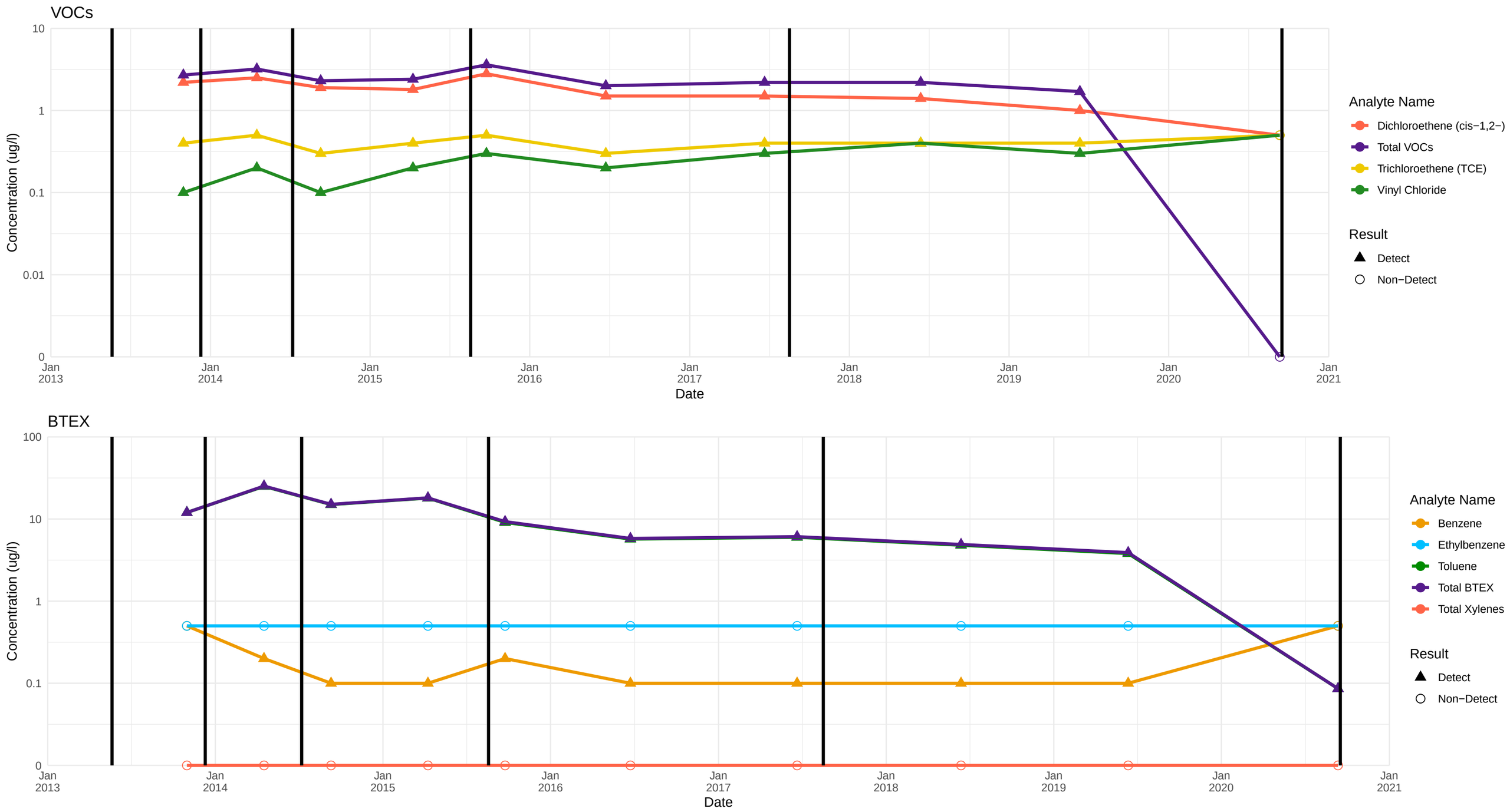
BP−13D Port 5

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.



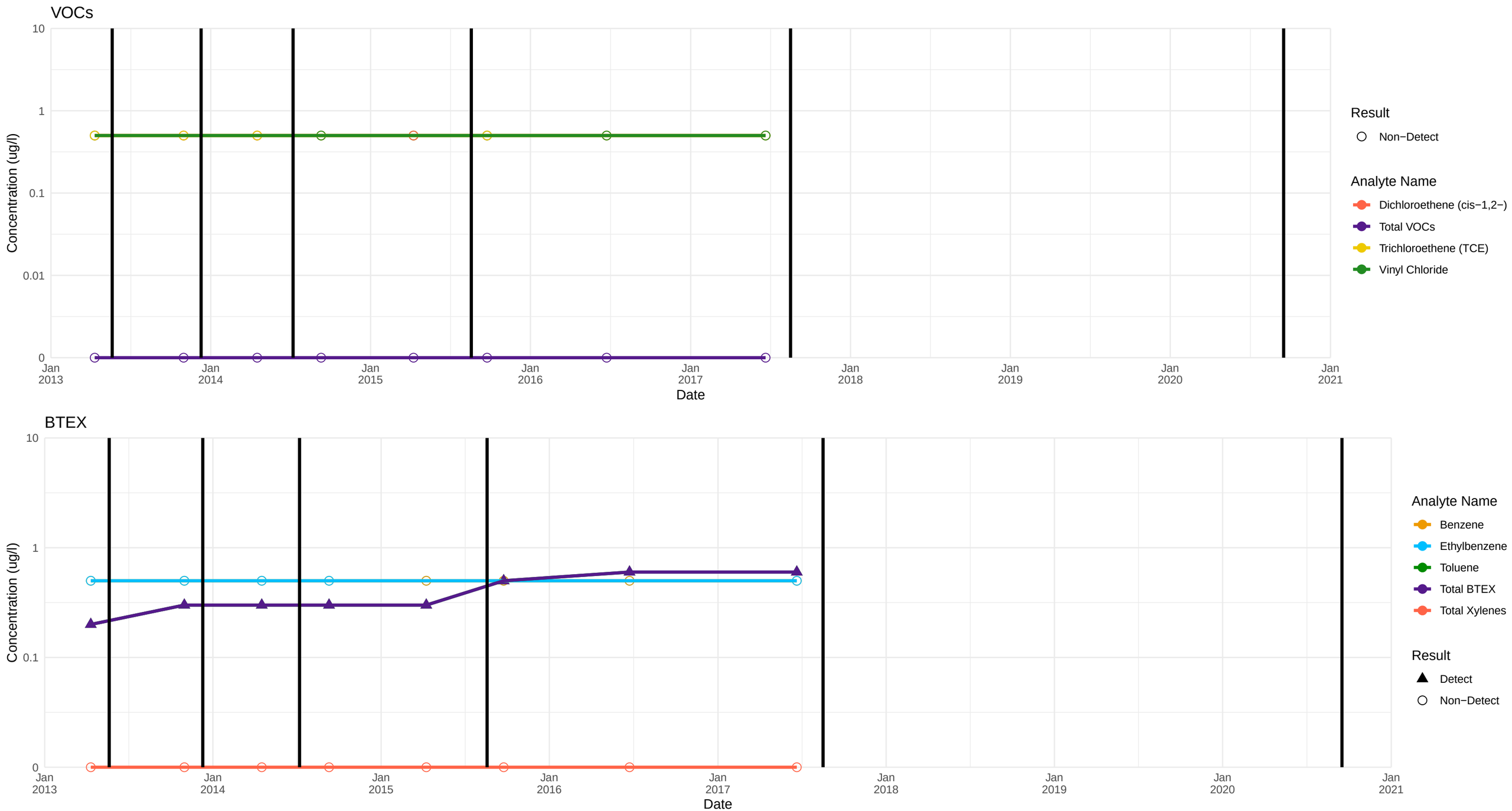
BP−14D Port 1

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.



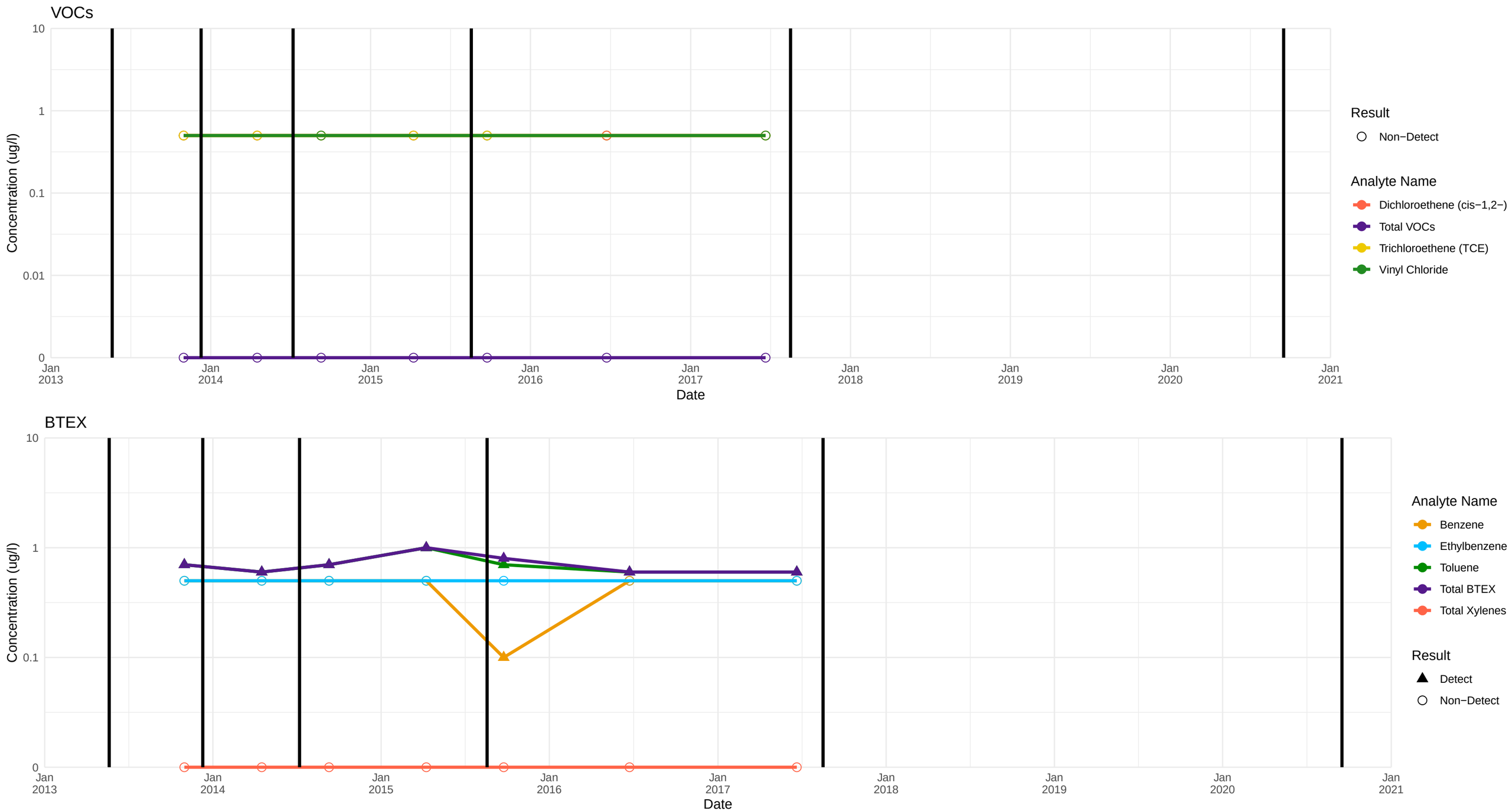
BP−14D Port 5

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.



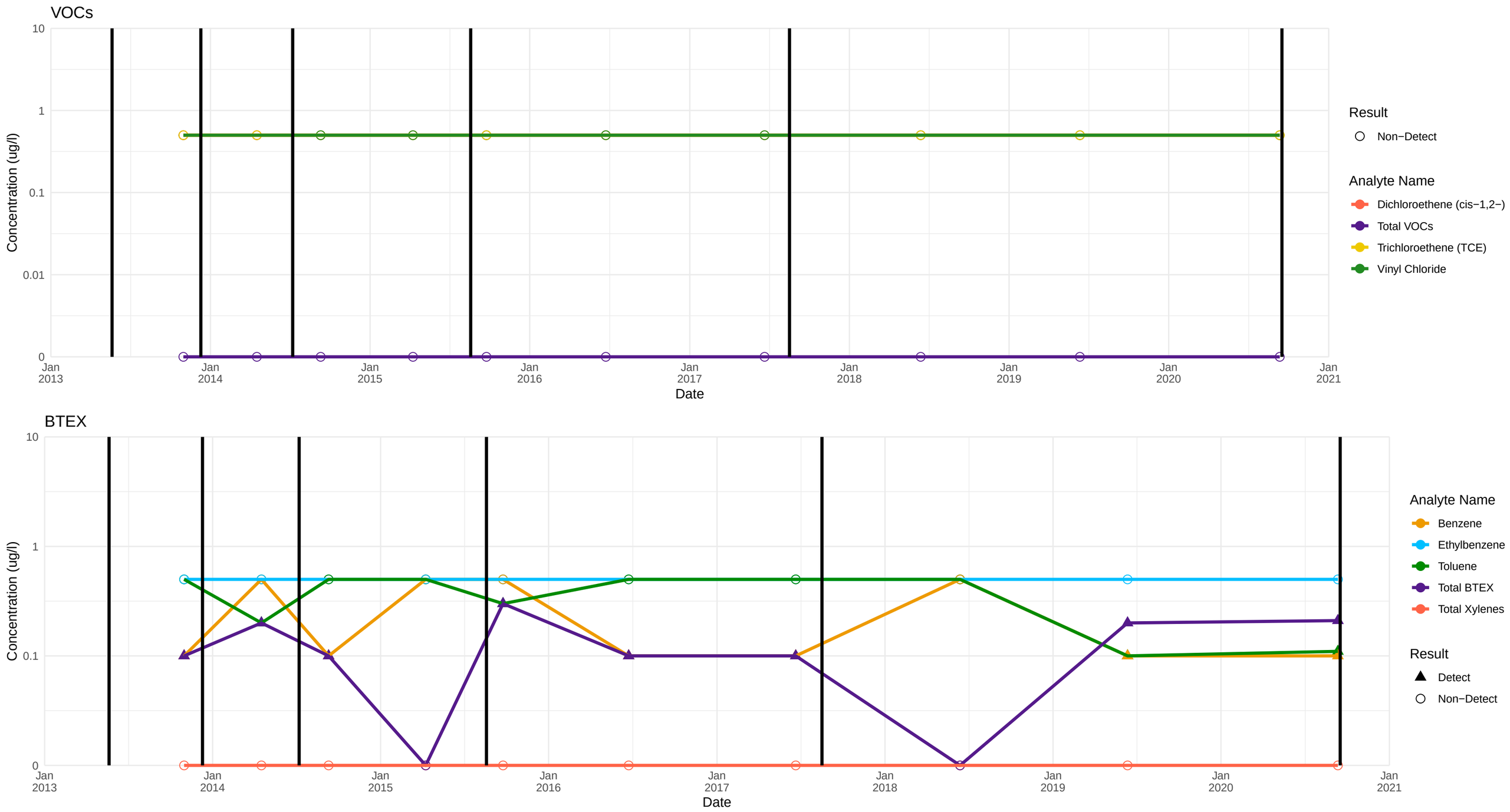
BP−15D Port 5

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.



Sanborn, Head & Associates, Inc.

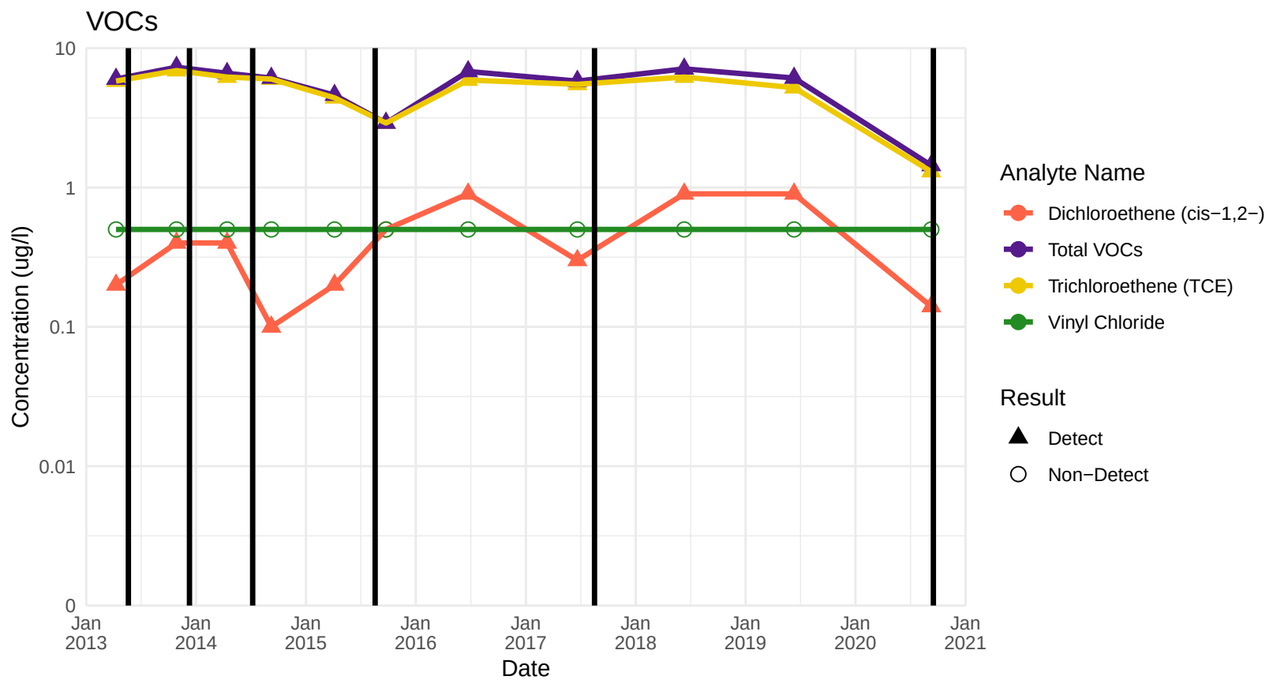
GC−2A

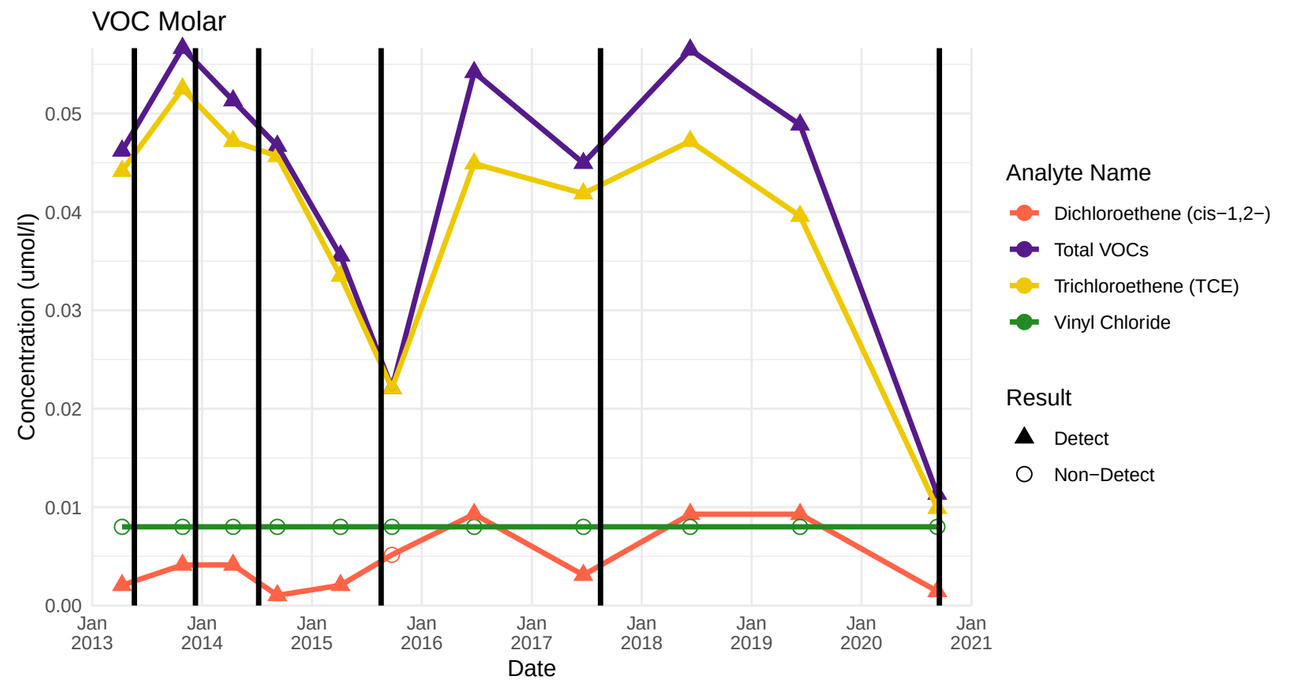
Notes:

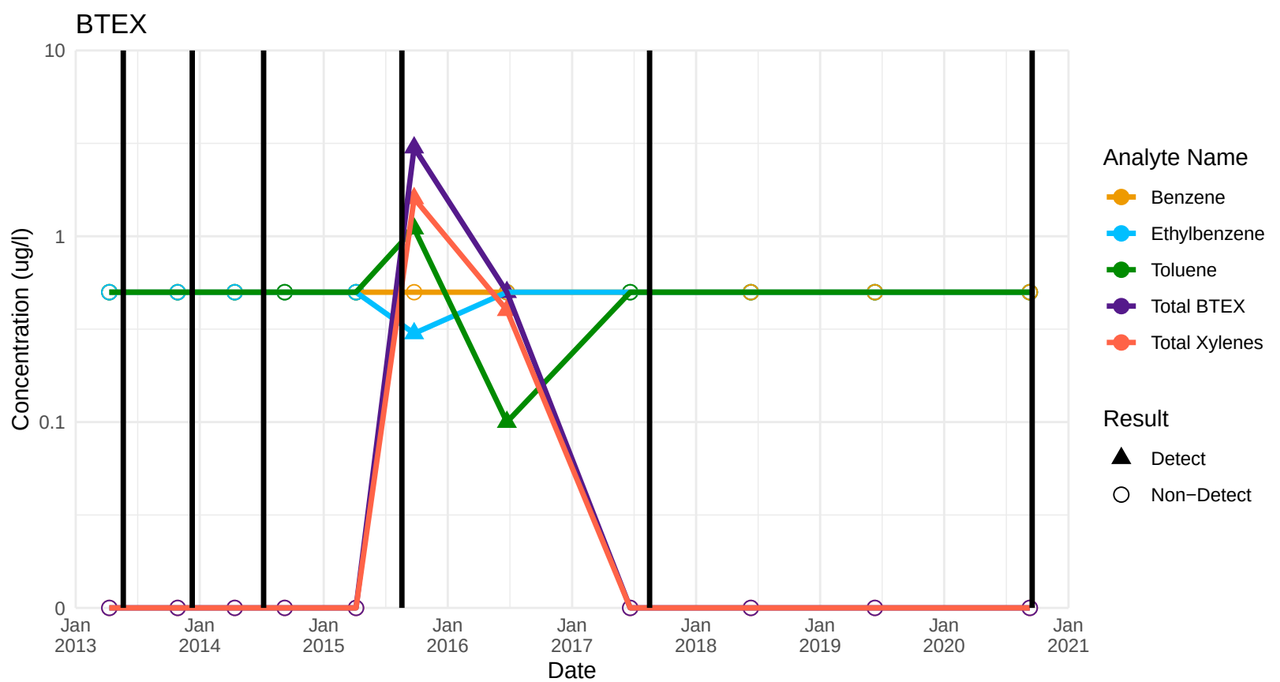
(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

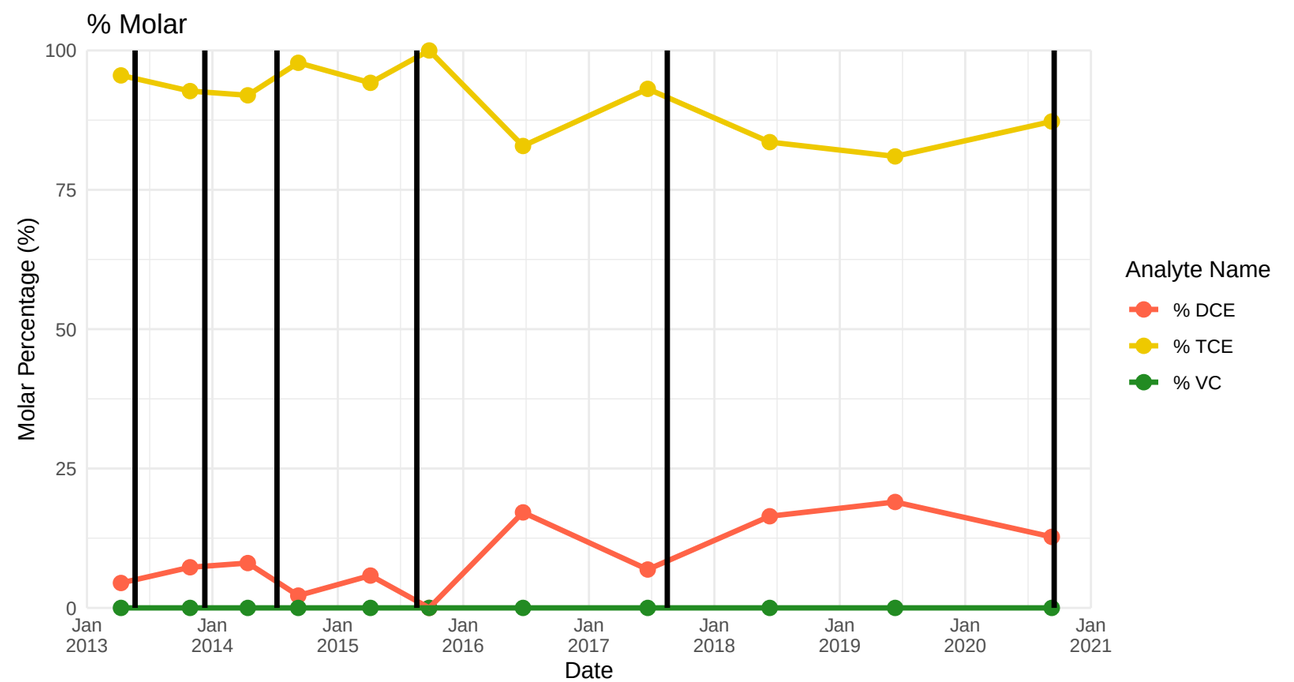
(2) Black vertical lines indicate amendment injection events.

(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.









GC−2A

Notes:

(1) Where applicable, non−detects are plotted at reporting limit and are shown with hollow symbols. Summed (total) concentrations are plotted at zero.

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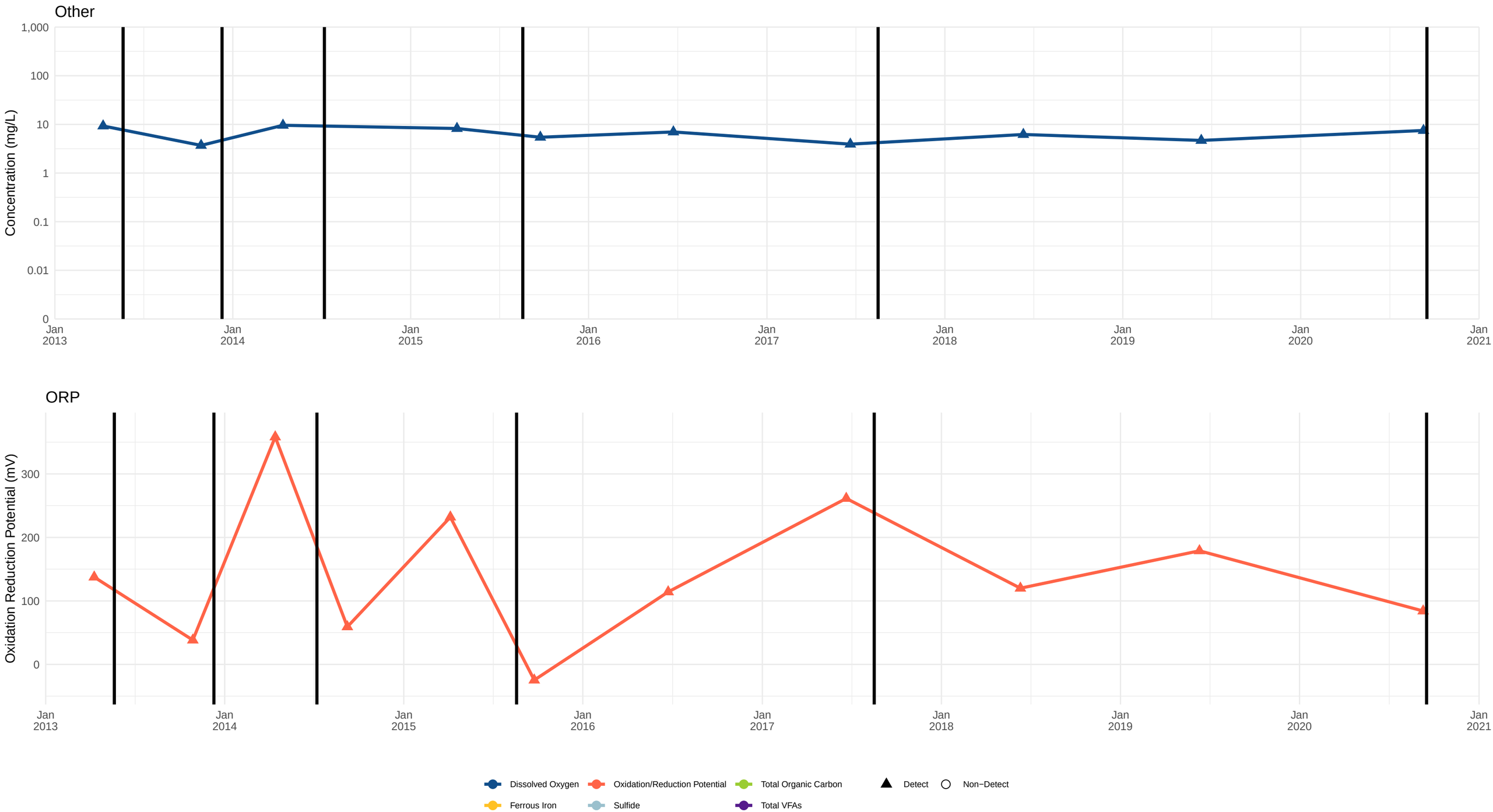
(3) Reporting limits can fluctuate based on sample dilutions performed by the lab due to varying concentrations of other compounds, some of which may not be shown in these time series, matrix interference like the presence of amendment oil droplets, or other factors.



ATTACHMENT C

SITE INSPECTION MEMORANDUM REPORT

OCTOBER 2020 SITE WIDE INSPECTION

SANBORN HEAD ENGINEERING

SANBORN HEAD ENGINEERING
Building Trust. Engineering Success.

20 Foundry Street
Concord, NH 03301

Stephen Brown, P.E.
IBM Corporation
8976 Wellington Road
Manassas, VA 20109

December 2, 2020
File No. 3526.05

Re: Site-Wide Inspection – October 2020
IBM Gun Club – Former Burn Pit Area
Union, New York
NYSDEC Site #C704044 (BCA Index #B7-0661004-05)

Dear Mr. Brown:

This letter transmits the findings of the 2020 Site-Wide Inspection completed for the IBM Gun Club, Former Burn Pit Area (Site). Site-wide inspections under the Site Management Plan (SMP) are being conducted annually. This inspection report will also be included with the next Periodic Review Report required by the SMP, due in January 2021.

BACKGROUND AND SCOPE

The Site-Wide Inspection was conducted in accordance with the Monitoring Plan included as Section 3.0 of the SMP using the Site Wide Inspection Checklist included as Appendix K.1 of that document. The inspection included visual review of the condition of the soil cap that covers contaminated soils, and the soil fill placed within the area of historical seeps. The site inspection was conducted on October 1 to 2, 2020 and included:

- A review of the Site, and conditions on lands downgradient of the Site, related to compliance with the Institutional Controls (ICs) outlined in SMP Section 2.3 and the Environmental Easement;
- A visual review of the cover system associated with the deed restricted area as outlined in SMP Section 3.2, and seep fill area, to observe for potential settlement, erosion, or other conditions that could be considered detrimental to the effectiveness of these components of the Engineering Control (EC) remedy;
- A review of the conditions of tree plantings and grass cover that constitute the phytoremediation component of the EC remedy as described under SMP Section 4.2.1. During this visit, we conducted a general reconnaissance and a comprehensive tree mortality survey.

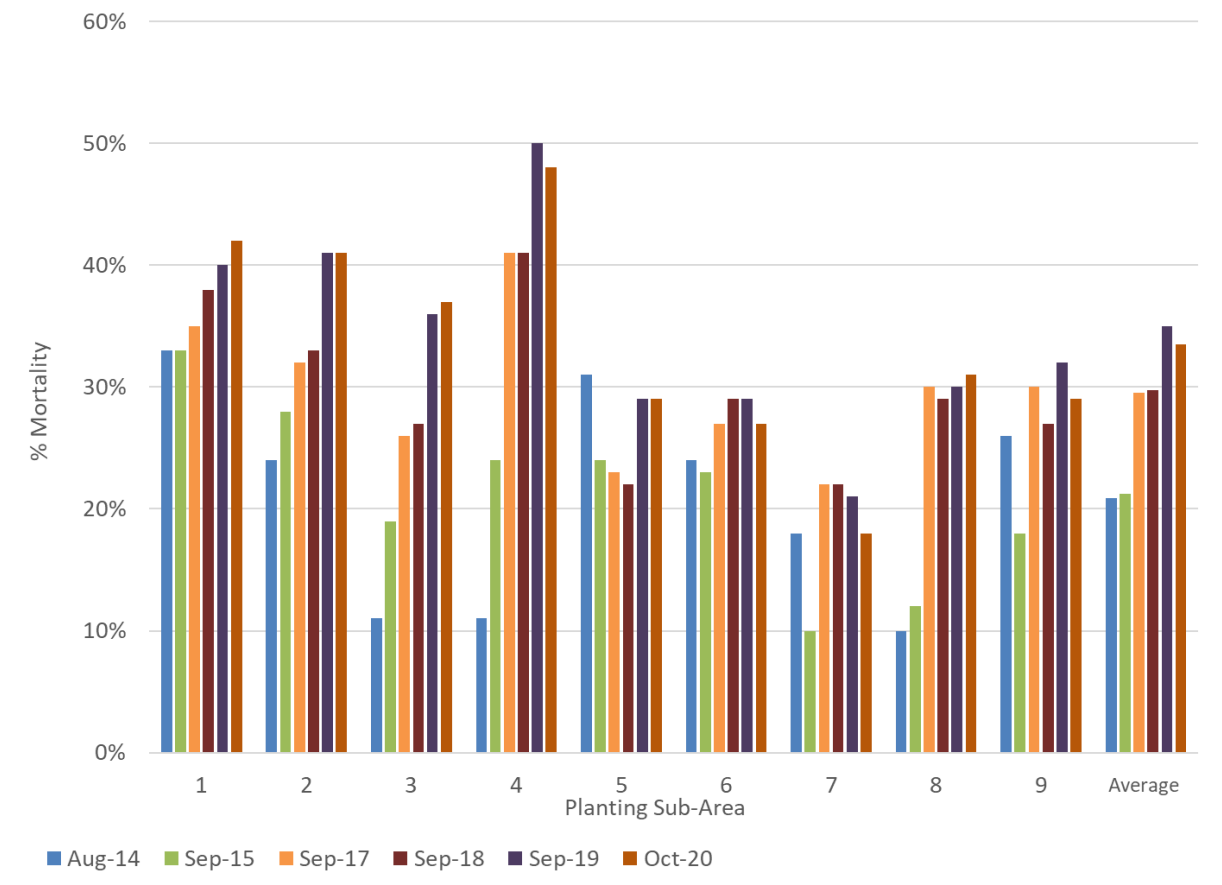
In addition, we reviewed general Site conditions related to site fencing, security, and the list of notifications required under the SMP. The findings and observations from this visit are noted in the inspection checklist included as Attachment A. An annotated inspection figure is included as Attachment B, and photos are included in Attachment C.

SUMMARY OF FINDINGS

In general, as outlined in the attached checklist, the inspection found the condition of the Site to be consistent with the design intent of the ECs, and the use of the Site and surrounding area is consistent with the ICs and the human exposure assessment on which the remedy is based. Summary observations are as follows:

- The capped area remains intact with no evidence of settlement, cracking, animal burrows, or other breaches;
- The capped area is vegetated with well-established grass and tree cover. According to the National Weather Service, the region was subject to average precipitation in the three months preceding the October 2020 inspection;
- Poplar trees initially planted as tree poles have grown to an average height of 18 to 22 feet, while poplar trees initially planted as cuttings have grown an average of 8 to 10 feet. Tree mortality compared to initial planting in 2013 is shown in Exhibit 1 below and on the attached figure (Attachment B) and ranged from 18% to 48%, with Area 4 exhibiting the highest mortality and Area 7 the lowest. Further discussion is provided in the Closing below;

Exhibit 1: Summary of tree mortality percentage



- In 2018, we observed evidence of some movement of the soil fill in the seep area moving down slope towards the southern access road. Conditions have not changed or worsened since that time. Tree and grass coverage are well established and there is no evidence of slope failure. We will continue to monitor the slope; and

- The former Gun Club building was torn down on October 1, 2020.

CLOSING

Under the SMP, IBM had proposed to replant trees as needed to bring the tree cover up to 75% of the initial planting density, allowing for 25% mortality. Overall site average mortality recorded in October was approximately 34%, compared to 35% in June 2019, September 2019, and June 2020. We do not think that replanting of trees is warranted at this time given: 1) the continuing growth progress of live trees; 2) the apparent stabilization of overall average mortality around or below 30% in Areas 5, 6, 7, and 8, as shown in the above histogram, with some improvements compared to 2019; 3) a good portion of the mortality is located in areas outside of the primary and secondary source rock (Areas 1 and 4); and 4) replanting would require tracking of mechanized equipment across the cap area, which might damage the cap and live trees.

We note also that the goal of less than 25% mortality may not be achievable in areas that exhibit conditions that are not conducive to tree growth (e.g. shallow bedrock, encroachment of woody brush, poor infiltration in the capped area), and re-planting may lead to the same result. For example, the highest tree mortality is observed in Area 4, which has the highest proportion of other native woody bushes and trees and is often shaded.

Indicators of successful remedy implementation other than tree mortality continue to be realized, including reduction of the number of seeps in the southern portion of the plume near the property boundary and ongoing evidence of reductive dehalogenation.

If you have any questions, please contact us. We appreciate the opportunity to provide service to IBM on this important project.

Very truly yours,
SANBORN, HEAD ENGINEERING, P.C.

David Shea
David Shea, P.E.
Principal

Erica Bosse
Erica M. Bosse
Project Manager

Bradley A. Green
Vice President / Senior Associate

EMB/BAG/DS:emb

Encl. Attachment A - Site Wide Inspection Checklist
Attachment B - Annotated Site Inspection Map
Attachment C – Photographs

P:\3500s\3526.02\Work\202010 Site wide inspection\20201119 Inspection Cover Letter.docx

Attachment A
Site Wide Inspection Checklist - October 2020
IBM Gun Club - Former Burn Pit Area
NYSDEC Site No. C704044

Part 1: General Information

Site Name: IBM Gun Club, Former Burn Pit Area Date of Inspection: October 2, 2020

Summary of Remedy:

-Capping the primary VOC source area and residual surficial soils with an engineered low permeability clean soil fill;

-Placement and compaction of engineered soil fill within a topographic depression south of the Burn Pit Area;

-Phytoremediation - establishing and maintaining grass and tree cover to limit infiltration recharge and enhance direct uptake of VOC-containing shallow groundwater; and

-Enhanced biochemical degradation - engineered introduction of amendments shown to enhance biochemical destruction of VOCs.

Part 2: Inspection Specifics

Inspector: Erica Bosse/ Michael Fuerte Title: Project Manager/ Project Engineer

Inspector Contact Information: Sanborn Head Engineering, P.C.

Type of Inspection:

Site-wide inspection	☑
Soil cover system monitoring	☑
Routine well inventory and review	☑
Routine phytoremediation monitoring	☑
Non-routine storm event or other emergency	☐
Non-routine EC failure/ performance modifications	☐

Remarks

Weather/ Temperature: Fog early, then sun 50s-60s

Part 3: On-site Documents & Records Verification

	Readily Available	Up-to-date	Location/ remarks
Daily access/security logs	☑	☑	
Site Management Plan	☑	☑	
Health & Safety Plan	☑	☑	
Current underground injection control permit	☐	☐	Removed from trailer after evidence of trespassing and attempted break-in. All records are available and up to date in the project files.
Monitoring records	☑	☐	
Routine maintenance reports	☑	☐	
Non-routine maintenance reports	☑	☐	
Site-wide inspection reports	☑	☐	

Part 4: Review of Institutional Controls (SMP Section 2.3)

	True	False	Not Applicable
The property is only used for restricted residential, commercial, and industrial uses within the Track 4 Cleanup area;	☑	☐	☐
The property is only used for residential, restricted residential, commercial, and industrial uses throughout the remainder of the site;	☑	☐	☐
The property is not used for a higher level use, such as unrestricted use without additional remediation and amendment of the Easement with approval by NYSDEC;	☑	☐	☐
Activities on the property that will disturb remaining contaminated material conducted in accordance with the SMP;	☑	☐	☐
The use of groundwater within and adjacent to the currently established plume or updated plume based on groundwater monitoring is prohibited as a source of potable or process water, without necessary water quality treatment	☑	☐	☐
Any buildings developed within the Track 4 Cleanup area evaluated for vapor intrusion, and any potential impacts that are identified are monitored or mitigated	☑	☐	☐
No vegetable gardens or farming within the Track 4 Cleanup area	☑	☐	☐

Narrative/ Other Notes:

The site remains undeveloped with no buildings and is not used for agriculture.

Part 5: Review of Engineering Controls

5a: Soil Cover System Monitoring - Deed Restricted Area (SMP Section 3.2)

Monuments and Signage

- ☐ Damaged/missing signage
- ☐ Damaged monuments
- ☐ Location(s) shown on map
- ☑ Photo-documented

Remarks: Signage is as constructed, bollards could use a coat of paint.

Settlement (Low spots)

- ☐ Location(s) shown on map
- ☐ Photo-documented
- ☑ Settlement not evident

Approx. ft^2 _____
Depth _____
Remarks None observed

Cracks

- ☐ Location(s) shown on map
- ☐ Photo-documented
- ☑ Cracking not evident

Length _____
Width _____
Depth _____

Remarks None observed

Erosion

- ☐ Location(s) shown on map
- ☐ Photo-documented
- ☑ Erosion not evident

Approx. ft^2 _____
Depth _____
Remarks _____

Holes

- ☐ Location(s) shown on map
- ☐ Photo-documented
- ☑ Holes not evident

Approx. ft^2 _____
Depth _____
Remarks None observed

Vegetative Cover

- ☑ Photo-documented
- ☑ Grass properly established
- ☐ No signs of stress

Remarks No major bare areas observed.

Attachment A
Site Wide Inspection Checklist - October 2020
IBM Gun Club - Former Burn Pit Area
NYSDEC Site No. C704044

Wet Areas/Water Damage **None apparent**

- ☐ Wet areas — Approx. ft^2 _____ ☐ Shown on site map
- ☐ Ponding — Approx. ft^2 _____ ☑ Photo-documented
- ☐ Seeps — Approx. ft^2 _____ ☐ Wet areas not evident
- ☐ Soft subgrade — Approx. ft^2 _____ Remarks No evidence of water damage.

Slope Instability **None apparent**

- ☐ Location(s) shown on map — Approx. ft^2 _____
- ☐ Photo-documented — Remarks None observed
- ☑ Slope instability not evident

Narrative/ other notes:

The grass is well established. Mowing is conducted twice per year.

5b: Soil Fill - Seep Area

Settlement (Low spots)

- ☐ Location(s) shown on map
- ☐ Photo-documented
- ☑ Settlement not evident

Approx. ft^2 _____
Depth _____
Remarks None observed

Cracks

- ☐ Location(s) shown on map
- ☐ Photo-documented
- ☑ Cracking not evident

Length _____
Width _____
Depth _____

Remarks None observed

Erosion

- ☐ Location(s) shown on map
- ☐ Photo-documented
- ☑ Erosion not evident

Approx. ft^2 _____
Depth _____
Remarks None observed

Holes

- ☐ Location(s) shown on map
- ☐ Photo-documented
- ☑ Holes not evident

Approx. ft^2 _____
Depth _____
Remarks None observed

Vegetative Cover

- ☑ Photo-documented
- ☑ Grass properly established
- ☐ No signs of stress

Remarks _____

Wet Areas/Water Damage **None apparent**

- ☐ Wet areas — Approx. ft^2 _____
- ☐ Ponding — Approx. ft^2 _____
- ☐ Seeps — Approx. ft^2 _____
- ☐ Soft subgrade — Approx. ft^2 _____

- ☐ Shown on site map
- ☑ Photo-documented
- ☐ Wet areas not evident

Remarks The historical seep at the base of the capped area was observed to be dry at the time of the inspection.

Slope Instability

☑ Location shown on map
☑ Photo-documented
☐ Slope instability not evident

Approx. ft^2 _____

Remarks _____

Narrative / other notes:

During the 2018 annual inspection, a silt fence present as the base of the seep area since construction was observed to be partially covered by soil material from above. Conditions have not worsened/changed since that time.

Attachment A
Site Wide Inspection Checklist - October 2020
IBM Gun Club - Former Burn Pit Area
NYSDEC Site No. C704044

5c: Phytoremediation\Tree Condition (SMP Section 4.2.1)

Area #1 ☑ Photo Mark Map ☑	Poles	Representative height 15-20'		
		Representative canopy width		
			% Mortality	42%
	Cuttings	Representative height 10-15'		
		Representative canopy width		
Area #2 ☑ Photo Mark Map ☑	Poles	Representative height 15-20		
		Representative canopy width		
			% Mortality	41%
	Cuttings	Representative height 15-Oct		
		Representative canopy width		
Area #3 ☑ Photo Mark Map ☑	Poles	Representative height 15-20'		
		Representative canopy width		
			% Mortality	37%
	Cuttings	Representative height 10-15'		
		Representative canopy width		
Area #4 ☑ Photo Mark Map ☑	Poles	Representative height 10-12'		
		Representative canopy width		
			% Mortality	48%
	Cuttings	Representative height 8-10'		
		Representative canopy width		
Area #5 ☑ Photo Mark Map ☑	Poles	Representative height 16-18'		
		Representative canopy width		
			% Mortality	29%
	Cuttings	Representative height 8-10'		
		Representative canopy width		

Attachment A
Site Wide Inspection Checklist - October 2020
IBM Gun Club - Former Burn Pit Area
NYSDEC Site No. C704044

Area #6 ☑ Photo Mark Map ☑	Poles	Representative height 20-25' Representative canopy width	% Mortality	27%
	Cuttings	Representative height 8-10' Representative canopy width		
Area #7 ☑ Photo Mark Map ☑	Poles	Representative height 20-25' Representative canopy width	% Mortality	18%
	Cuttings	Representative height N/A Representative canopy width		
Area #8 ☑ Photo Mark Map ☑	Poles	Representative height 20-30' Representative canopy width	% Mortality	31%
	Cuttings	Representative height N/A Representative canopy width		
Area #9 ☑ Photo Mark Map ☑	Poles	Representative height 18-20' Representative canopy width	% Mortality	29%
	Cuttings	Representative height N/A Representative canopy width		

Narrative / other notes:

On average, cuttings were observed to have grown about 2 ft since the September 2019 inspection, while poles were observed to grow approximately 4-8 ft. Poplar tree mortality by area ranged from 18 to 48% with an average of about 34%, which is slightly improved since the 2019 inspection. Compared to 2019, mortality was stable or improved in 6 out of 9 planting areas.

Mortality may be explained by sun exposure, depth to rock/planting depth, or other factors.

Plantings along the periphery of the capped area/near the natural tree line were observed to be crowded out shaded by existing woody bushes and trees, especially in Areas 3, 4, 5 and 8.

Part 6: Review of Monitoring and Injection Well Network Inspection

Conditions consistent with Monitoring and Injection Well Inspection Checklist ☑

List deviations, if any The comprehensive well inspection was completed in September 2020, conditions were observed to be similar in October 2020.

Seep Area Monitoring

Seep area dry ☐ New seeps/ springs/ wet areas observed? ☐

Remarks No new seeps observed.

Narrative / other notes:

Attachment A
Site Wide Inspection Checklist - October 2020
IBM Gun Club - Former Burn Pit Area
NYSDEC Site No. C704044

Part 7 - Review of Access/General Site Conditions

Condition of fencing Fence panels intact around entire perimeter. Barbed wire brackets had fallen in two spots.

Remarks One small tree is resting on the fence in the NW corner of the larger parcel, no fence damage was observed.

Condition of monuments and signage Intact as constructed

Remarks

Obvious signs of vandalism/trespassing? Bonfire area still present outside the perimeter fence, does not appear

Remarks to be as active as in the past. The former Gun Club building, located outside the perimeter fence, was demolished on October 1, 2020.

Condition of access roads and lanes Intact as constructed. Starting to get overgrown. Gravel access roads

Remarks in capped area mostly grassed over.

Investigation derived waste

Frac Tank/ Water Tank

- ☐ N/A
- ☑ Good condition
- ☐ Needs maintenance

Remarks About 100 gallons of sampling purge water in Tote #1.

Approximate volume generated since last inspection 100

	Yes	No
Documentation of IDW analytical results readily available	☐	☑

Location/ Remarks September 2020 purge water sample indicated levels of VOCs below the detection limits and could be discharged to the ground. Purge water will be discharged to the ground during the November 2020 sampling round.

Narrative / other notes:

Attachment A
Site Wide Inspection Checklist - October 2020
IBM Gun Club - Former Burn Pit Area
NYSDEC Site No. C704044

Part #8 Notifications

We are not aware of any planned change in use by the Binghamton Country Club	Not Applicable	Yes	No
A. 60-day advance notice of any proposed changes in site use	☑	☐	☐
B. 7-day advance notice of proposed ground-intrusive activities	☑	☐	☐
C. 48-hour notice of any damage or defect to the engineering controls	☑	☐	☐
D. Verbal notice by noon the following day of any emergency (fire, flood, etc.) that reduces the effectiveness of engineering controls	☑	☐	☐
E. Follow-up status report on emergency actions within 45 days	☑	☐	☐
F. 60-day advance notice of any change in site ownership	☑	☐	☐
G. New owner's contact information confirmed in writing within 15 days of ownership change	☑	☐	☐

Part #9 Action Items

	Action Item	Proposed time frame
Routine maintenance	IBM contractor, Groundwater Sciences Corporation, Inc. to mow grass	Spring 2021
Non-routine maintenance	Repair BP-15A PVC riser	Next time drill rig is on site
	Repair GC-2A bollard	Next time drill rig is on site
	Fix barbed wire brackets	2021
	Replace B-7 royer cap	2021
Other		

Attachment B

Annual Site-Wide Inspection, Conducted October 2, 2020

Conducted by Erica Bosse & MIchael Fuerte

Small tree on perimeter fence

Bonfire area

29%
41%
37%
31%
42%
27%
29%
48%
18%

119.6'
113.7'
116.8'
145.3'
124.4'
124.3'
121.1'
113.7'
115.6'

BP-33A BP-7A BP-16A BP-14A BP-14D BP-32A BP-11A BP-12D BP-12A BP-5A BP-5 BP-1A BP-1 BP-3 BP-6A BP-6 BP-17A BP-4A BP-4 BP-7 BP-35A BP-2A BP-2 BP-13D BP-13A BP-10A GC-1 BP-36A GC-2A BP-8A BP-18A BP-15A BP-15D BP-9A BP-17A BP-38A BP-31A BP-39A

NOTES:

1. THIS FIGURE IS INTENDED TO ACCOMPANY THE SITE-WIDE INSPECTION CHECKLIST AND WILL BE USED TO MARK CONDITIONS OF NOTE RECORDED ON THE INSPECTION CHECKLIST FORM. THE SITE WIDE INSPECTION IS REQUIRED AS AN ELEMENT OF THE REMEDIAL PROGRAM AT THE IBM GUN CLUB, BURN PIT UNDER THE NEW YORK STATE BROWNFIELD CLEANUP PROGRAM ADMINISTERED BY NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION. THE SITE IS IN THE PROCESS OF BEING REMEDIATED IN ACCORDANCE WITH BROWNFIELD CLEANUP AGREEMENT #C7044, WHICH WAS EXECUTED ON AUGUST 26, 2005 AND LAST AMENDED ON APRIL 26, 2012.
2. REFER TO THE SITE MANAGEMENT PLAN AND FINAL ENGINEERING REPORT FOR ADDITIONAL NOTES AND LEGEND INFORMATION.

LEGEND

- EXISTING 10-FOOT CONTOUR
- EXISTING 2-FOOT CONTOUR
- AS-BUILT 10-FOOT CONTOUR
- AS-BUILT 2-FOOT CONTOUR
- EXISTING CHAIN-LINK FENCE
- AS-BUILT CHAIN-LINK FENCE
- EXISTING TREE LINE
- EXISTING UTILITY LINE
- EXISTING EDGE OF PAVED ROAD
- EXISTING EDGE OF GRAVEL PATH
- AS-BUILT EDGE OF GRAVEL PATH
- SURVEYED EXTENT OF MARKER LAYER
- BP-6 EXISTING MONITORING WELL LOCATION AND DESIGNATION
- IB-4 EXISTING INJECTION WELL LOCATION AND DESIGNATION
- A-1 AS-BUILT INJECTION WELL LOCATION AND DESIGNATION
- DEED RESTRICTION BOUNDARY
- MONUMENT TO DOCUMENT DEED RESTRICTED AREA
- MONUMENT TO DOCUMENT DEED RESTRICTED AREA WITH SIGNAGE INSTALLED
- SURVEYED TREE PLANTING LIMITS
- ③ PHYTOREMEDIATION AREA BOUNDARY AND DESIGNATION
- PRIMARY SOURCE ROCK
- SECONDARY SOURCE ROCK
- LOCATION OF DEAD POPLAR CUTTING (INSIDE CAP AREA) AND POPLAR POLE (OUTSIDE CAP AREA)
- 27% TREE MORTALITY

SANBORN HEAD ENGINEERING

GRAPHICAL SCALE
60' 30' 0 60' 120'

NO.	DATE	DESCRIPTION	BY

DRAWN BY: E. WRIGHT
DESIGNED BY: J. SANBORN
REVIEWED BY: D. SHEA
PROJECT MGR: E. BOSSE
PIC: D. SHEA
DATE: NOVEMBER 2020

SITE WIDE INSPECTION MEMO
IBM GUN CLUB - FORMER BURN PIT AREA
UNION, NEW YORK

PROJECT NUMBER: 3526.05

SITE MANAGEMENT PLAN

FIGURE NUMBER: 1

ATTACHMENT C
INSPECTION PHOTOGRAPHS

Photo 1: Tree and grass cover looking east across Phytoremediation Area 1.

Photo 2: Tree and grass cover looking in Phytoremediation Areas 2 (left) and 5 (right), looking southeast.

Photo 3: Phytoremediation Area 4, looking east from Area 5.

Photo 4: Phytoremediation Area 5, looking west towards Area 6.

Photo 5: Looking south from Phytoremediation Area 1 to Area 6.

Photo 6: Looking north across Phytoremediation Area 7 from the southern gravel access road.

Photo 7: Approximately 30’ tall poplar planting located in Phytoremediation Area 8, looking north.

Photo 8: Phytoremediation Area 9 looking north from the gravel cap access road.

Photo 9: Southern gravel access road, looking west from approximately BP-8A

Photo 10: Small tree resting on the perimeter fence in the area of BP-10A.

Photo 11: Looking NW at the bonfire area outside the perimeter fence to the west.

Photo 12: Former location of Gun Club building located outside of the perimeter fence along the main entrance.

ATTACHMENT D

MAINTENANCE REPORTS

Routine Maintenance Report Form
IBM Gun Club - Former Burn Pit Area
BCP Site No. C704044

Field Representative:	Matt Stein	Position: Field Manager
Company:	Sanborn Head	Date: 6/15/2020

System Type (circle one)

Monitoring Well
Injection Well
Soil Fill in Seep Area
Soil Cap
(Phytoremediation)

Maintenance activities:

Collection and compositing of four topsoil samples from within the 4 areas marked on the field sketch. Samples were submitted for analysis of nutrients, pH, and organic matter. Sample results did indicate the need for fertilization.

Modifications to the system:

None

Field Representative Date

Matthew T. Stein

6/15/2020

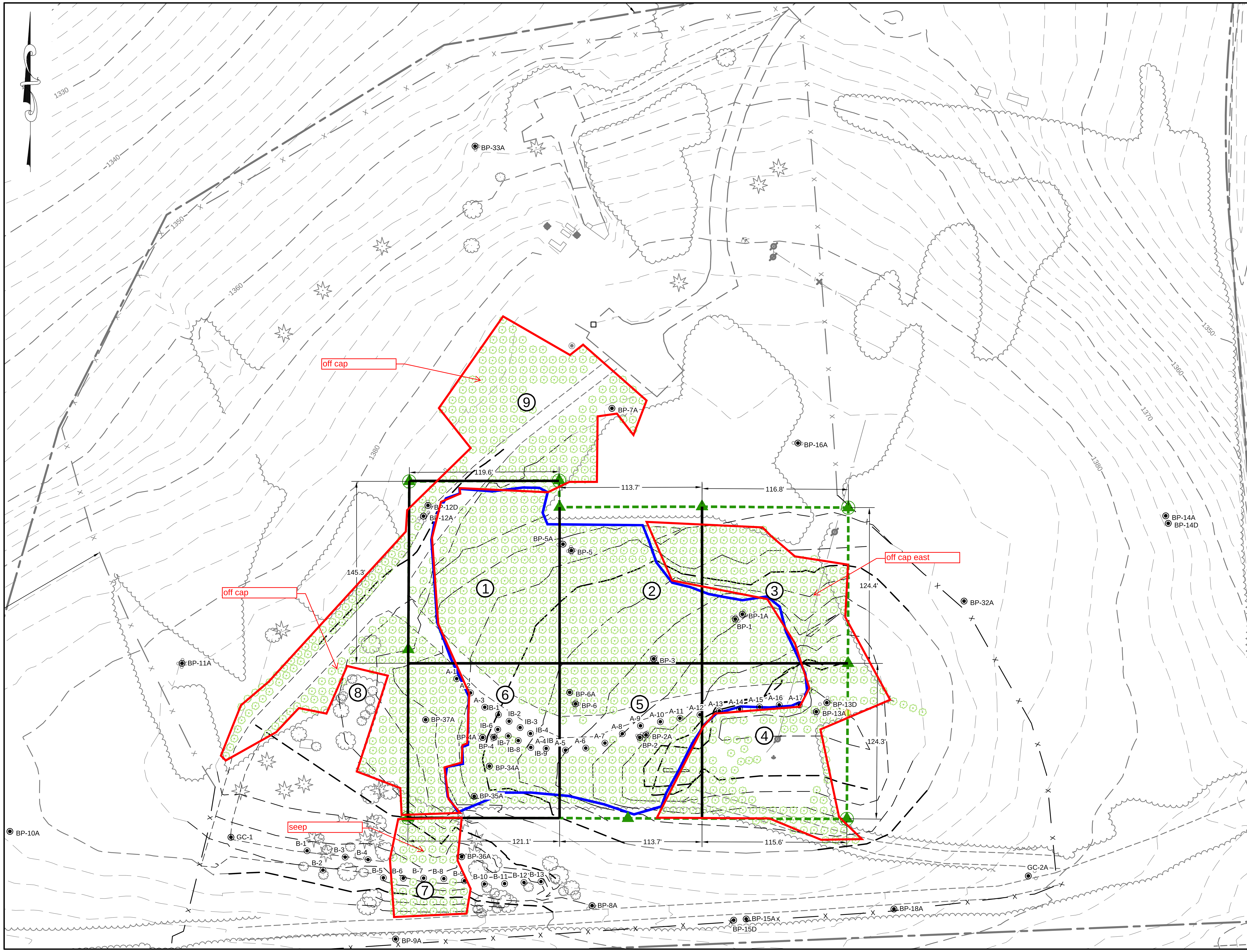
Erica Bosse

6/15/2020

Attachments:

- ☐ None
- ☐ Photographs
- ☒ Field Sketch
- ☐ Invoices/ Receipts
- ☐ Other

SANBORN HEAD



NOTES:

1. THIS FIGURE IS INTENDED TO ACCOMPANY THE SITE-WIDE INSPECTION CHECKLIST AND WILL BE USED TO MARK CONDITIONS OF NOTE RECORDED ON THE INSPECTION CHECKLIST FORM. THE SITE WIDE INSPECTION IS REQUIRED AS AN ELEMENT OF THE REMEDIAL PROGRAM AT THE IBM GUN CLUB, BURN PIT UNDER THE NEW YORK STATE BROWNFIELD CLEANUP PROGRAM ADMINISTERED BY NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION. THE SITE IS IN THE PROCESS OF BEING REMEDIATED IN ACCORDANCE WITH BROWNFIELD CLEANUP AGREEMENT #C7044, WHICH WAS EXECUTED ON AUGUST 26, 2005 AND LAST AMENDED ON APRIL 26, 2012.

2. REFER TO THE SITE MANAGEMENT PLAN AND FINAL ENGINEERING REPORT FOR ADDITIONAL NOTES AND LEGEND INFORMATION.

LEGEND

Symbol	Description
1350	EXISTING 10-FOOT CONTOUR
	EXISTING 2-FOOT CONTOUR
1380	AS-BUILT 10-FOOT CONTOUR
	AS-BUILT 2-FOOT CONTOUR
X	EXISTING CHAIN-LINK FENCE
X	AS-BUILT CHAIN-LINK FENCE
	EXISTING TREE LINE
	EXISTING UTILITY LINE
	EXISTING EDGE OF PAVED ROAD
	EXISTING EDGE OF GRAVEL PATH
	AS-BUILT EDGE OF GRAVEL PATH
	SURVEYED EXTENT OF MARKER LAYER
BP-6	EXISTING MONITORING WELL LOCATION AND DESIGNATION
IB-4	EXISTING INJECTION WELL LOCATION AND DESIGNATION
A-1	AS-BUILT INJECTION WELL LOCATION AND DESIGNATION
	DEED RESTRICTION BOUNDARY
	MONUMENT TO DOCUMENT DEED RESTRICTED AREA
	MONUMENT TO DOCUMENT DEED RESTRICTED AREA WITH SIGNAGE INSTALLED
	SURVEYED TREE PLANTING LIMITS
3	PHYTOREMEDIATION AREA BOUNDARY AND DESIGNATION

SANBORN | HEAD ENGINEERING

GRAPHICAL SCALE

60' 30' 0 60' 120'

NO.	DATE	DESCRIPTION	BY

DRAWN BY: M. HILDENBRAND
DESIGNED BY: J. SANBORN
REVIEWED BY: D. CARR
PROJECT MGR: E. BRADSTREET
PIC: D. SHEA
DATE: AUGUST 2014

SITE MANAGEMENT PLAN
IBM GUN CLUB - FORMER BURN PIT AREA
UNION, NEW YORK

SITE INSPECTION PLAN

PROJECT NUMBER: 3526.02

FIGURE NUMBER: 1

Routine Maintenance Report Form
IBM Gun Club - Former Burn Pit Area
BCP Site No. C704044

Field Representative:	Erica Bosse (Sanborn Head)	Position: Project Manager
Company:	Bruce Spence (Groundwater Sciences)	

System Type (circle one)

Monitoring Well
Injection Well
Soil Fill in Seep Area
Soil Cap
(Phytoremediation)

Maintenance activities:

Sanborn Head coordinated with Groundwater Sciences personnel to mow the grass within the area of tree planting in June and October 2020. We provided a marked-up field sketch of the areas to mow, but were not present at the time of mowing. In visits to the site after mowing, it was observed that mowing was completed with no damage to the capped area.

Modifications to the system: None

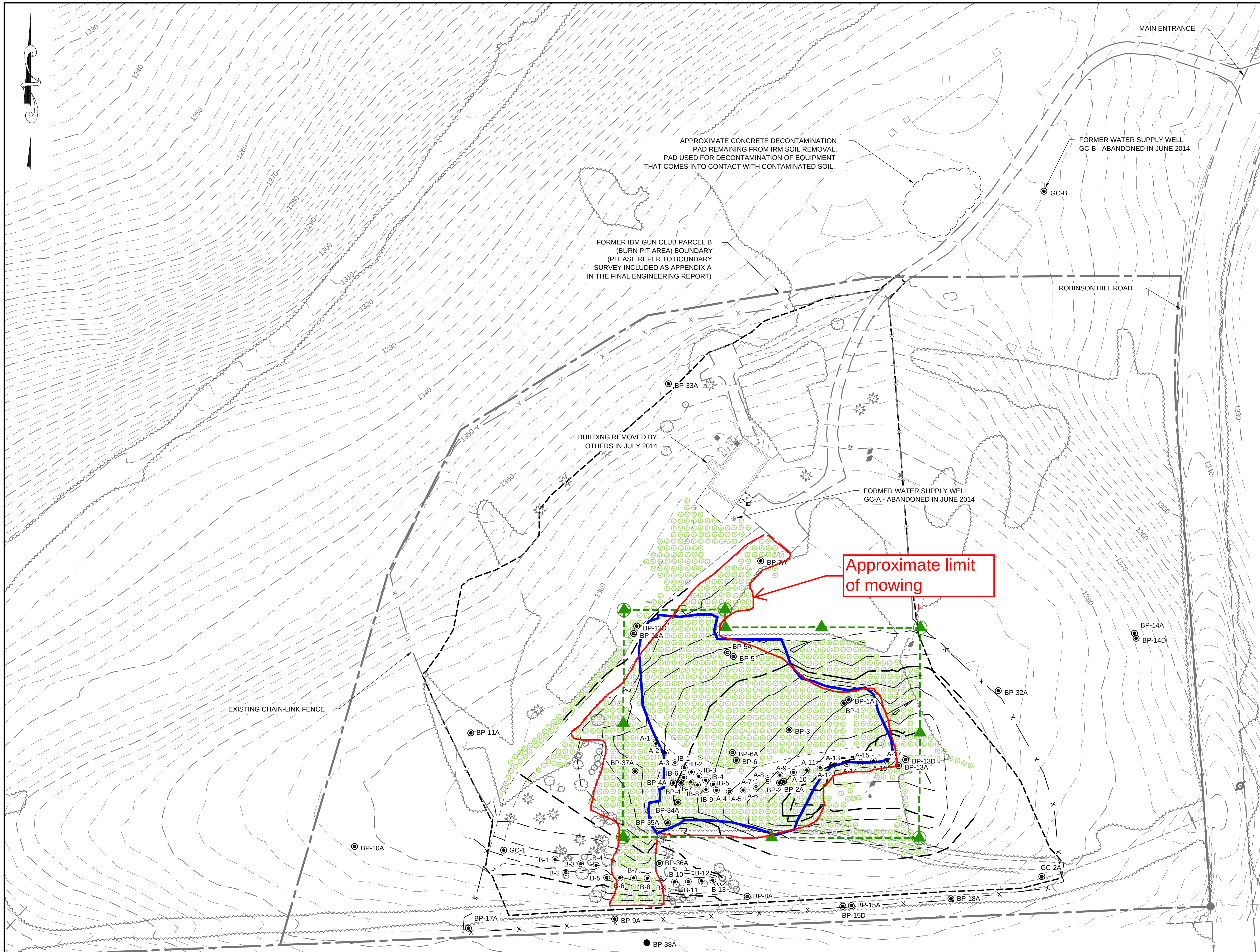
Field Representative Date
Erica Bosse
10/30/2020

Reviewed By Date
David Shea
10/30/2020

Attachments:

- ☐ None
- ☐ Photographs
- ☒ Field Sketch
- ☐ Invoices/ Receipts
- ☐ Other

SANBORN HEAD



NOTES:

1. WITH THE EXCEPTION OF THE FEATURES IDENTIFIED UNDER NOTE 3, THE BASE MAP WAS DEVELOPED FROM THE FOLLOWING SURVEY DATA MERGED BY SANBORN, HEAD & ASSOCIATES, INC. (SANBORN HEAD):
   A. WITHIN THE LIMITS SHOWN ON THE PLAN VIEW FIGURE AS DENOTED IN THE LEGEND THE TOPOGRAPHY AND SITE FEATURES REFLECT FIELD GROUND SURVEY DOCUMENTED ON A PLAN ENTITLED "TOPOGRAPHIC SURVEY OF FORMER IBM GUN CLUB", PREPARED BY BUTLER LAND SURVEYING, LLC (BUTLER) OF LITTLE MEADOWS, PENNSYLVANIA AND PROVIDED TO SANBORN HEAD IN DIGITAL FORMAT. TOPOGRAPHY REPRESENTS SITE CONDITIONS ON MARCH 28, 2012. ORIGINAL SCALE: 1" = 50'. THE MARCH 2012 SURVEY WAS CONDUCTED TO OBTAIN REFINED TOPOGRAPHIC DATA FOR THE AREA THAT WILL BE AFFECTED BY SOIL EXCAVATION AND CAPPING AND TO ESTABLISH PROJECT BENCHMARKS.
   B. OUTSIDE THE AREA OF MARCH 2012 FIELD SURVEY THE TOPOGRAPHY AND SITE FEATURES ARE FROM A PHOTOGRAMMETRIC SURVEY PLAN PREPARED BY BUTLER AND PROVIDED TO SANBORN HEAD IN DIGITAL FORMAT. THE PHOTOGRAMMETRIC MANUSCRIPT DATED AUGUST 11, 2008 WAS BASED ON AERIAL PHOTOGRAPHY FLOWN IN AUGUST, 2007.
   C. AS-BUILT CONTOURS WERE DEVELOPED BY KEYSTONE ASSOCIATES OF BINGHAMTON, NEW YORK AND WERE BASED ON FIELD SURVEYS CONDUCTED BY KEYSTONE ON OCTOBER 29 AND 30 AND NOVEMBER 7, 2013, AND JUNE 24, 2014.
2. THE VERTICAL DATUM IS BASED ON THE NAVD OF 1988 AND THE HORIZONTAL DATUM IS BASED ON THE NEW YORK STATE PLANE COORDINATE SYSTEM, CENTRAL ZONE. THE APPROXIMATE GLOBAL COORDINATES FOR THE SITE ARE: LONGITUDE - W76° 0' 20", LATITUDE - N42° 7' 57.6".
3. THE EXTENT OF THE MARKER LAYER WAS SURVEYED BY KEYSTONE ASSOCIATES OF BINGHAMTON, NY ON SEPTEMBER 18, 2013. THE REMAINING AS-BUILT FEATURES WERE SURVEYED BY KEYSTONE ON OCTOBER 29 AND 30, 2013 AND NOVEMBER 7, 2013.

LEGEND

1350	EXISTING 10-FOOT CONTOUR
	EXISTING 2-FOOT CONTOUR
1380	AS-BUILT 10-FOOT CONTOUR
	AS-BUILT 2-FOOT CONTOUR
X	EXISTING CHAIN-LINK FENCE
X	AS-BUILT CHAIN-LINK FENCE
	EXISTING TREE LINE
	EXISTING UTILITY LINE
	APPROXIMATE LIMIT OF MARCH 2012 FIELD SURVEY (SEE NOTE 1A)
	EXISTING EDGE OF PAVED ROAD
	EXISTING EDGE OF GRAVEL PATH
	AS-BUILT EDGE OF GRAVEL PATH
	SURVEYED EXTENT OF MARKER LAYER
BP-6	EXISTING MONITORING WELL LOCATION AND DESIGNATION
IB-4	EXISTING INJECTION WELL LOCATION AND DESIGNATION
A-1	AS-BUILT INJECTION WELL LOCATION AND DESIGNATION
	DEED RESTRICTION BOUNDARY
	MONUMENT TO DOCUMENT DEED RESTRICTED AREA
	MONUMENT TO DOCUMENT DEED RESTRICTED AREA WITH SIGNAGE INSTALLED
	SURVEYED TREE PLANTING LIMITS

SANBORN | HEAD ENGINEERING

GRAPHICAL SCALE

60' 30' 0 60' 120'

NO.	DATE	DESCRIPTION	BY

DRAWN BY: M. HILDENBRAND
DESIGNED BY: J. SANBORN
REVIEWED BY: D. CARR
PROJECT MGR: E. BRADSTREET
PIC: D. SHEA
DATE: OCTOBER 2014

FINAL ENGINEERING REPORT
IBM GUN CLUB - FORMER BURN PIT AREA
UNION, NEW YORK

LOCATION PLAN

PROJECT NUMBER: 63526.00

FIGURE NUMBER: 4

Routine Maintenance Report Form
IBM Gun Club - Former Burn Pit Area
BCP Site No. C704044

Field Representative:	Sam Jacobson	Position: Field Representative
Company:	Sanborn Head	Date: 9/14 to 9/17/2020

System Type (circle one)	Monitoring Well	Soil Cap
	Injection Well	Phytoremediation
	Soil Fill in Seep Area	Enhanced Biochemical Degradation

Maintenance activities:

- Injected a mixture of water and commercially-available emulsified oil substrate into the subsurface to enhance in-situ biochemical degradation, as summarized in the attached memo

The table below summarizes the recent past injection history providing perspective for the design of the September 2020 injection:

Event Date	Scope	Approximate Gallons Dilute Amendment	Comments
June 2010	Pilot Test Boreholes	21	About 2.3 gallons of amendment diluted 11:1 were injected per borehole.
November 2010	Pilot Test Boreholes	54	About 6 gallons of amendment diluted 11:1 were injected per borehole.
May 2013	Pilot Test Boreholes	327	About 8 to 70 gallons of amendment diluted 10:1 were injected per borehole.
December 2013	A-Series Boreholes	640	Between 29 and 44 gallons of amendment diluted 19:1 were injected per borehole.
July 2014	B-Series Boreholes	811	Between 46 and 67 gallons of amendment diluted 19:1 were injected per borehole.
August 2015	Select A- and B-Series Boreholes	1,180	Approximately 11 to 280 gallons of amendment diluted 19:1 were injected per borehole. Injection was completed in 26 of 39 boreholes within the A- and B-Series line of boreholes targeted within the primary source rock and higher transmissivity zones.
August 2017	Select A- and B-Series Boreholes	1,812	Approximately 13 to 200 gallons of amendment diluted 19:1 were injected per borehole. Injection was completed in 27 of 39 boreholes within the A- and B-Series line of boreholes targeted within the primary source rock and higher transmissivity zones.
September 2020	Select A- and B-Series Boreholes	1,902	Approximately 20 to 250 gallons of amendment diluted 19:1 were injected per borehole. Injection was completed in 27 of 39 boreholes within the A- and B-Series line of boreholes targeted within the primary source rock and higher transmissivity zones.

Routine Maintenance Report Form
IBM Gun Club - Former Burn Pit Area
BCP Site No. C704044

Injection volume record and field notes are attached.

Modifications to the system:

Addition of edible soybean oil to the subsurface.

Field Representative Date

9/24/2020

Reviewed By Date

9/24/2020

Attachments:

- ☐ None
- ☐ Photographs
- ☐ Field Sketch
- ☐ Invoices/ Receipts
- ☒ Other
  Memo & Field Records

SANBORN HEAD

SANBORN HEAD
Building Trust. Engineering Success.

MEMORANDUM

To: File

From: Sam Jacobson

File: 3526.02

Date: September 24, 2020

Re: Documentation of 2020 A- and B-Line Amendment Injection
Former IBM Gun Club Burn Pit Area
Union, New York

cc: Brad Green, Erica Bosse

This memorandum was prepared to serve as a record of the amendment injection work conducted from September 14 to September 17, 2020. This amendment injection was conducted as part of the site-scale remedy and involved injection of a mixture of water and commercially-available emulsified oil substrate into the subsurface to enhance in situ biochemical degradation of chlorinated VOCs, principally trichloroethene (TCE) and related biochemical breakdown products. The MSDS for the EOS Pro emulsified oil product used in the injections is included as Attachment A.

As outlined in Table 1, approximately 1,902 gallons of diluted amendment were introduced to the subsurface, with approximately 1,132 gallons via the A-line injection boreholes and 770 gallons via the B-line injection boreholes. Diluted amendment was created by mixing about 14 gallons of EOS Pro with 261 gallons of treated groundwater at a 19:1 ratio in 275-gallon totes, meeting the intent of the design outlined below. Injections were completed by Cascade Environmental and Technical services out of Montpelier, Vermont, the same subcontractor who successfully completed the amendment injections in 2017.

BACKGROUND

The injection was conducted after site scale remedy construction, including re-grading and consolidation of metal-containing soils, placement and compaction of a low permeability soil cap, establishment of grassed vegetation and trees, construction of crushed stone access lanes, and drilling and construction of 30 injection boreholes. The earthwork construction was largely completed in September 2013. During spring 2014, the soil cap and surrounding area were re-graded, additional topsoil was placed and compacted, and vegetation was planted.

The physical completion information for the A- and B-line injection boreholes is included in Table 1. The table includes results from the 2015 and 2017 A- and B-line injection event as well as measurements from the 2020 injection event. The depth to fluid was measured with a laser water level meter prior to starting the injection and is included in Table 1.

Design of the Amendment Injection

Consistent with the procedure for amendment injection, injections were conducted one borehole at a time. The designed dose and locations were identical to the 2017 injection event, with an injection averaging 70 gallons of mixed amendment per borehole.

This design intends to distribute amendment into the subsurface in a fence-line perpendicular to groundwater flow. The target injection volumes in Table 1 were developed in consideration of hydraulic displacement volumes and called for injection of about 1,810 gallons including about 90 gallons of amendment product. The injection volume was intended as a guide for a volume of amendment and chase water equivalent to the fracture pore space within about a 26-foot radius of the injection boreholes which are spaced about 16 feet apart[1].

As shown on Table 1, the actual injected volumes were roughly equivalent to the designed amount of injected amendment. Following amendment injections, when possible, eight gallons of treated groundwater was injected to "chase" the amendment further into the subsurface.

SUMMARY OF FIELD WORK

Overview

The injection process was initiated on Tuesday September 15, 2020. In total, seven 275-gallon plastic totes of amendment were mixed in a 19:1 ratio of activated carbon-treated groundwater water to EOS Pro Emulsified soybean oil product. The treated groundwater was obtained from the Garfield Avenue treatment facility in Endicott, New York and was used because carbon-treated groundwater is generally devoid of oxygen and would not contain chlorine found in potable municipal water. About 115 milliliters (ml) of a vitamin B supplement was also added to each tote consistent with the manufacturer's recommendations. During mixing, nitrogen gas was bubbled in the tank to aid in de-oxygenating the solution and to enrich the solution with nitrogen gas that would continue to off-gas and limit the introduction of oxygen into the solution.

Injections began at borehole location A-15 and progressed west. The packer was inflated to approximately 140 pounds per square inch (psi) using nitrogen supplied by the drillers.

[1] *The injection volume (amendment plus chase water) was selected to be the equivalent of hypothetical fracture pore volume for a 26-foot radius of an injection borehole at the observed saturated thickness based on water levels recorded during seasonal high periods in April 2014; assuming an effective fracture porosity of about 5x10-4 which is the median of recorded in site-specific testing of boreholes screening the uppermost highly fractured rock.*

The subcontractors prepared an in-line "bleeder" valve to aid in safely de-pressurizing the system.

The injection pressure was monitored with an in-line pressure gauge and the injection flow rate was monitored by tracking the change in amendment volume through graduations on the tote, a yard stick, and a stopwatch. For a 275-gallon tote, one (1) inch is equivalent to 7.4 gallons. The nominal average intake flow rate was about 11 gal/min. The average injection pressure was highly variable. Some boreholes readily accepted amendment with minimal pressure while others received amendment under pressures greater than 50 psi. The overall average injection pressure is just under 40 psi.

Pressure injection was completed with a single packer system inflated fully within casing. The manufactured casing is generally smoother than the borehole wall, limiting the chance of short circuiting due to irregularities in the borehole wall. The 2017 and 2020 injection events used a packer designed for a nominal 6-inch diameter borehole. During approximately 10 injections, amendment short-circuited around the packer and rose to the surface. Future injections may use a packer with a larger diameter to improve the seal.

In general, both amendment and chase water were successfully delivered into the fractured bedrock under pressurized conditions. Specific comments regarding the ability of each borehole to accept amendment are summarized within Table 1. At some locations, the borehole did not accept amendment, even at pressures great enough (at or around 100 psi) to bend the packer pipe and raise the drill rig. In 2019, injection boreholes were mechanically re-developed to increase the likelihood that amendment could be accepted. In some boreholes (e.g., B-10, A-9) accepted more amendment in 2020 than in 2017. Despite the development activities to flush the fractures, some boreholes (e.g., B-6) did not accept the target volume of amendment.

Amendment was observed seeping at ground surface when injecting in borehole B-10 during the 2020 injections, which was also observed in B-4, B-5, and B-10 during the 2017 injections. Surface seepage suggest a flow path between the portion of the fracture network intercepted by this borehole and the surface under pressurized conditions. Less seepage observed in 2020 compared to 2017 may be attributed to lower water levels due to below average precipitation.

While injecting, water surfaces were observed in neighboring wells. Table 1 summarizes observed hydraulic influence in neighboring boreholes during injections. Hydraulic connection observed in 2020, across site injection borings, appears to be unidirectional and restricted to neighboring wells.

EMB/BAG: snj

Encl. Table 1 – Summary of 2020 Amendment Injection
Attachment A – MSDS Sheet for EOS Pro Emulsified Soybean Oil Amendment
Attachment B – Location Plan

EOS Remediation, LLC

MATERIAL SAFETY DATA SHEET

EOS PRO, EOS LS, EOS 450, EOS XR

1. MANUFACTUER AND EMERGENCY CONTACT

Manufacturer:

EOS Remediation, LLC
1101 Nowell Road
Raleigh, NC 27607
www.EOSRemediation.com
Phone: 919-873-2204
Fax: 919-873-1074

24-Hour Emergency Contact:

ChemTel Inc.
Phone: 1-800-255-3924
International
Phone: 813-248-0585

Date of Preparation:
January 9, 2013

2. HAZARDOUS INGREDIENTS / IDENTITY INFORMATION

COMPONENT(S)	% by WEIGHT	CAS NO.	EXPOSURE LIMITS		
			OSHA PEL-TWA	ACGIH TLV-TWA	NIOSH REL-TWA
Soybean Oil	45 - 60*	8001-22-7	Mist: 15 mg/m^3 (total) 5 mg/m^3 (respirable)	NE	Mist: 10 mg/m^3 (total) 5 mg/m^3 (respirable)
Emulsifiers Trade Secret [1,2]	1 - 10	Proprietary	NE	NE	NE
Soluble Substrates Trade Secret [1,2]	4 - 8	Proprietary	Mist: 15 mg/m^3 (total) 5 mg/m^3 (respirable)	Mist: 10 mg/m^3	NE
Organic Substrate Trade Secret [1]	0 - 10	Proprietary	NE	Mist: 10 mg/m^3	NE
Food Additives / Preservatives Trade Secret [1]	0.1 - 1	Proprietary	NE	NE	NE
Nutrients / Extracts Trade Secret [1,2]	0 - 1	Proprietary	NE	NE	NE
Water	Balance	7732-18-5	NE	NE	NE

NE - Not established

1 - The precise composition of this product is proprietary information. A more complete disclosure will be provided to a physician in the event of a medical emergency.

2 - The soluble substrates and emulsifiers are generally recognized as safe for food contact.

* - Percentage of soybean oil varies by product.

3. PHYSICAL / CHEMICAL CHARACTERISTICS

pH:	Neutral
Boiling Point:	212°F
Specific Gravity:	0.96-0.98; 0.92 (pure oil phase)
Vapor Pressure:	Not established
Melting Point:	Liquid at room temperature
Percent Volatile by Volume (%):	25 - 48 (as water)
Vapor Density:	Heavier than air
Evaporation Rate:	Not established
Solubility in Water:	Dispersible
Appearance and Odor:	White liquid with vegetable oil odor

4. FIRE AND EXPLOSION HAZARD DATA

Flash Point:	>300°F
Flammable Limits:	Not established
Extinguishing Media:	CO_2, foam, dry chemical Note: Water, fog and foam may cause frothing and spattering.
Special Fire Fighting Procedures:	Wear self-contained breathing apparatus and chemical resistant clothing. Use water spray to cool fire exposed containers.
Unusual Fire Hazards:	Burning will cause oxides of carbon.
Unusual Explosion Hazards:	None

5. REACTIVITY DATA

Stability:	Stable
Incompatibility:	Strong acids and oxidizers
Hazardous Decomposition Products:	Thermal decomposition may produce oxides of carbon.
Hazardous Polymerization:	Will not occur
Conditions to Avoid:	None known

6. HEALTH HAZARD DATA

Routes of Entry:	Ingestion, dermal
Health Hazards:	
Acute:	Potential eye and skin irritant
Chronic:	None known
Carcinogenicity:	
N.T.P:	No
IARC:	No
OSHA:	No
Signs and Symptoms of Exposure:	None known
Medical Conditions Aggravated by Exposure:	None known

Emergency First Aid Procedures:

Inhalation:	Remove to fresh air.
Eyes:	Flush with water for 15 minutes; if irritation persists see a physician.
Skin:	Wash with mild soap and water.
Ingestion:	Product is non-toxic. If nausea occurs, induce vomiting and seek medical attention.

7. PRECAUTIONS FOR SAFE HANDLING AND USE

Handling and Storage:	Do not store near excessive heat or oxidizers.
Other Precautions:	None
Spill Response:	Soak up with dry absorbent and flush area with large amounts of water.
Waste Disposal Methods:	Dispose of according to Federal and local regulations for non-hazardous waste.

8. CONTROL MEASURES

Respiratory Protection:	Not normally required.
Ventilation:	Local exhaust
Protective Gloves:	Recommended
Eye Protection:	Recommended
Other Protective Clothing or Equipment:	None

9. TRANSPORTATION INFORMATION

UN Hazard Class: N/A

10. ADDITIONAL INFORMATION

The information contained herein is based on available data and is believed to be correct. However, EOS Remediation, LLC makes no warranty, expressed or implied, regarding the accuracy of this data or the results to be obtained thereof. This information and product are furnished on the condition that the person receiving them shall make his/her own determination as to the suitability of the product for his/her particular purpose.

Attachment B
2020 Injection Record
IBM Gun Club - Former Burn Pit Area
Union, New York

Location I.D.	General Exploration Information						2020 Injection Measurements													
	Depth to Bottom (ft bgs)	Top of Casing (ft ags)	Depth to Bottom (ft bTOC)	Casing Depth (ft bgs)	Length of Open Borehole (ft)	Depth to Bottom of Casing (ft bTOC)	Depth to Water (ft bTOC)	Above or Below Casing (A or B)	Unsaturated Interval (ft)	Saturated Thickness (ft)	Saturated Borehole Volume (gal)	Proposed 2020 Dose (gal)	Actual Amendment Injected (gal)	Difference between target and actual dose	Proposed Chase Water (gal)	Actual Chase Water Injected (gal)	Nominal Radius of Influence (ft)	Approximate Injection Pressure	Approximate Injection Rate gpm	Comments
A-1	12.3	2.6	14.9	6.6	5.7	9.2	7.1	Above	0	7.8	11.5	40	41	-1	8	8	23	10	13.2	High pressure needed initially, then amendment accepted.
A-2	12.8	1.9	14.7	6	6.8	7.9	6.9	Above	0	7.8	11.5	30	33	-3	8	8	21	20	6.4	
A-3	14.4	3.4	17.8	8	6.4	11.4	13.61	Below	0	4.19	6.2	30	30	0	8	3	26	40	4.6	Amendment at surface. Bubbles observed in A-2 during injection.
IB-6	19.8	2.95	22.75	7.3	12.5	10.25	8.85	Above	0	13.9	9.0	150	150	0	8	8	31	5	27.3	Tote refilled mid-injection.
IB-2	19.4	3.07	22.47	7.4	12	10.47	9.18	Above	0	13.29	8.6	90	100	-10	8	8	26	20	10.8	
IB-7	19.9	2.83	22.73	7.6	12.3	10.43	8.92	Above	0	13.81	9.0	100	123	-23	8	8	28	15	14.6	Bubbles in IB-2 during injection.
IB-4	20.3	2.78	23.08	8.3	12	11.08	9.62	Above	0	13.46	8.7	40	41	-1	8	8	18	10	18.3	Bubbles in IB-7 during injection.
IB-9	20.2	2.42	22.62	8.9	11.3	11.32	9.42	Above	0	13.2	8.6	30	30	0	8	8	16	10	22.4	
A-4	19.7	2.4	22.1	9	10.7	11.4	20.08	Above	0	2.02	3.0	40	22	18	8	5	34	100	5	
A-5	19.9	3.2	23.1	10	9.9	13.2	21.65	Above	0	1.45	2.1	30	30	0	8	8	47	60	19.1	Potential subtle influence in A-4 during injection. Amendment readily accepted under pressure.
A-6	20.1	2.4	22.45	10	10.05	12.4	20.88	Above	0	1.57	2.3	20	60	-40	8	8	61	80	4.4	

Attachment B
2020 Injection Record
IBM Gun Club - Former Burn Pit Area
Union, New York

Location I.D.	General Exploration Information						2020 Injection Measurements													
	Depth to Bottom (ft bgs)	Top of Casing (ft ags)	Depth to Bottom (ft bTOC)	Casing Depth (ft bgs)	Length of Open Borehole (ft)	Depth to Bottom of Casing (ft bTOC)	Depth to Water (ft bTOC)	Above or Below Casing (A or B)	Unsaturated Interval (ft)	Saturated Thickness (ft)	Saturated Borehole Volume (gal)	Proposed 2020 Dose (gal)	Actual Amendment Injected (gal)	Difference between target and actual dose	Proposed Chase Water (gal)	Actual Chase Water Injected (gal)	Nominal Radius of Influence (ft)	Approximate Injection Pressure	Approximate Injection Rate gpm	Comments
A-7	18.6	3.1	21.7	10	8.6	13.1	20.28	Above	0	1.42	2.1	40	41	-1	8	0	49	85	1.5	
A-8	17.7	3.5	21.2	11	6.7	14.5	19.21	Above	0	1.99	2.9	80	44	36	8	0	44	60	5	Filled to top of casing.
A-9	17.0	3.17	20.2	11	6	14.17	18.71	Above	0	1.46	2.1	20	31	-11	8	7	47	60	7.2	
A-10	16.9	2.7	19.6	11	5.9	13.7	19.12	Above	0	0.48	0.7	40	43	-3	8	2	88	55	9.4	Filled to top of casing.
A-12	17.8	2.7	20.5	10	7.8	12.7	17.74	Below	0	2.76	4.1	40	48	-8	8	8	42	45	2.9	High injection pressure bent injection piping. Amendment began leaking around packer.
A-13	17.2	2.7	19.9	10	7.2	12.7	17.14	Below	0	2.76	4.1	120	215	-95	8	10	83	5	11.4	Filled to ground surface.
A-14	16.5	2.0	18.5	8	8.5	10	13.62	Below	0	4.88	7.2	40	30	10	8	0	23	0	24.5	Filled to top of casing.
A-15	16.1	2.0	18.1	8	8.1	10	15.24	Below	0	2.86	4.2	100	21	79	8	0	25	20	13.2	Filled to top of casing.
											Totals:	1080	1132	-52						
B-4	17	2.18	19.18	6	11	8.18	8.79	Above	0	10.39	15.3	150	150	0	8	8	36	15	18.2	No seepage or bubbling in nearby wells detected

Attachment B
2020 Injection Record
IBM Gun Club - Former Burn Pit Area
Union, New York

Location I.D.	General Exploration Information						2020 Injection Measurements													
	Depth to Bottom (ft bgs)	Top of Casing (ft ags)	Depth to Bottom (ft bTOC)	Casing Depth (ft bgs)	Length of Open Borehole (ft)	Depth to Bottom of Casing (ft bTOC)	Depth to Water (ft bTOC)	Above or Below Casing (A or B)	Unsaturated Interval (ft)	Saturated Thickness (ft)	Saturated Borehole Volume (gal)	Proposed 2020 Dose (gal)	Actual Amendment Injected (gal)	Difference between target and actual dose	Proposed Chase Water (gal)	Actual Chase Water Injected (gal)	Nominal Radius of Influence (ft)	Approximate Injection Pressure	Approximate Injection Rate gpm	Comments
B-5	17.4	2.5	19.9	7	10.4	9.5	11.5	Above	0	8.4	12.3	80	141	-61	8	8	39	40	5.3	Slow and steady. No evidence of seepage during injections.
B-6	18.7	2.3	21	7	11.7	9.3	8.05	Above	0	12.95	19.0	50	124	-74	8	8	29	10	18.6	Bubbling in B-5 and B-7 during in jections. After~1.25 min, injection pressure dropped and amendment is injected.
B-7	19.4	2.5	21.9	7	12.4	9.5	8.48	Above	0	13.42	19.7	60	25	35	8	0	13	70	2.8	Amendment at surface. Outside of packer had rust colored material caked to the outside. It was easily scraped off but is a potential source of short circuiting during injections.
B-8	17.9	1.9	19.8	7	10.9	8.9	17.26	Above	0	2.54	3.7	60	37	23	8	0	35	70	2.4	Amendment at surface. No hydraulic influence seen in neighboring wells, no seepage at surface.
B-9	18.4	2.8	21.2	8	10.4	10.8	15.4	Below	1.0087	5.8	8.5	240	37	203	8	0	23	70	3.2	Amendment at surface. No hydraulic influence seen in neighboring wells, no seepage at surface.
B-10	17.35	3	20.35	6	11.35	9	6.98	Above	0	13.37	19.7	90	256	-166	8	8	41	5	16.1	Two injections conducted. First achieved target dose in approximately 5 minutes. The second was a make up dose for B-9. Seep detected in roadway after second dosing.
											Totals:	730	770	-40						