CITY OF Vancouver WASHINGTON

APPENDIX C

Water Quality Results by Station

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Appendix C: Water Quality Results by Station

Contents

Figures

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Water Quality Results

Water quality and trend analysis results are presented and described separately for each monitoring station in the sections below. Where applicable, each station section presents results and summarizes implications of:

- Water quality patterns within the WY2024 monitoring period
- Water quality criteria comparison for data collected during the WY2024 monitoring period
- Spatial trends (Friedman) in water quality within the WY2020 to WY2024 period
- Temporal trends (Kendall's Tau) in water quality within the 2011 to WY2024 period
- Results of water quality index calculation and trend analysis (Kendall's Tau)

A full set of figures are provided in the following appendices:

- Appendix D-2: Boxplots for the WY2024 monitoring period
- Appendix F: Spatial analysis Friedman test boxplots and heatmaps for the WY2020 to WY2024 period

Data and summary tables are provided in the following appendices:

- Appendix D-1: Summary statistics tables for the WY2024 monitoring period.
- Appendix E: Temporal trend analysis summary tables

In the following discussion of results, the description of "substantially different" is used to describe results from two discrete sets with non-overlapping interquartile ranges. Use of "significant" indicates statistically significant results.

Water quality criteria exceedances are noted for each station except for nutrients, which exceeded levels based on EPA's recommendation for the Willamette Valley in the majority of samples at all stations. *E. coli* water quality criteria are intended to be compared to geometric means and 90th percentile concentrations over a set period (90 days or less for ambient water quality sampling) with a minimum of three samples per averaging period. *E. coli* samples collected for this program do not meet these requirements for an averaging period and should not be interpreted that reaches of Burnt Bridge Creek were in or out of compliance during the entire monitoring period.

BBC10.4

The contributing area draining to the most upstream monitoring station, BBC10.4, consists primarily of residential land use with inputs from State Route 500 (SR 500) as well as some agriculture, commercial/industrial, and forest/field/other. Upstream riparian canopy cover within 0.5 mile of BBC10.4 is 25 percent. Septic systems are present within the BBC10.4 subbasin. Stormwater is conveyed to infiltration facilities such as dry wells, some stormwater treatment facilities, and untreated stormwater also discharges directly to the creek. Much of the stormwater to the south of the creek discharges to dry well facilities, without piped conveyance to the creek.

Monitoring at this station typically occurred in the morning as sampling was conducted from upstream to downstream stations.

WY2024

In WY2024, BBC10.4 generally had similar concentrations (overlapping interquartile ranges) to other stations for most parameters. As shown in the boxplots in Appendix D-2, the following parameters were unique from other stations:

- Water Temperature. The 7-DADmax temperature exceeded the criterion of 17.5°C for 25 percent of the monitoring period, which was the lowest number of all stations with continuous temperature monitoring.
- pH. At BBC10.4, pH was substantially (non-overlapping interquartile ranges) lower than all other stations for both base and storm flow events. Unlike most stations, the station sometimes exceeded the lower threshold of the water quality standard (one base flow event and four storm flow events). Low pH is typical in wetlands which are common upstream of BBC10.4.
- Dissolved Oxygen. Storm and base flow event dissolved oxygen concentrations were substantially lower than all stations except BBC5.9 and never met the water quality standard. Similar to pH, low dissolved oxygen is typical in wetlands which are common upstream of BBC10.4.
- Total Phosphorus. Storm flow total phosphorus concentrations were substantially greater than base flow concentrations, unlike most other stations where base and storm concentrations were not substantially different.
- Metals. Total and dissolved copper and zinc were monitored only during storm events for the WY2024 program. Copper and zinc concentrations were substantially lower than most other stations and never exceeded the water quality standard.
- *E. coli.* Concentrations were not substantially different than most other stations for either storm or base flow. The water quality criteria were exceeded during both base (90th percentile) and storm flow (geomean and 90th percentile).

Trend Analysis

Temporal Trends

The following temporal trends were detected based on the seasonal Kendall's Tau trends (Appendix E). Bold text indicates the trend is associated with improving water quality. Significant increasing trends in base flow samples were identified for the following parameters:

- Instantaneous water temperature (combined and dry seasons)
- 7-DADmax temperature (overall)
- Turbidity (combined and dry seasons)
- TSS (combined and dry seasons)
- Chloride (combined, wet, and dry seasons)
- Fecal coliform (combined and dry seasons)

Significant decreasing trends in base flow samples were identified for the following parameters:

- **Nitrate + nitrite** (combined and dry seasons)
- **Total nitrogen** (combined and dry seasons)

No significant trends were identified for storm flow results.

Spatial Trends

The following spatial trends were identified based on a Friedman and Nemenyi post-hoc test (Appendix F). Select parameters that exhibited significantly higher concentrations at BBC10.4 than other stations include:

- **Nitrogen**. Base and storm flow total nitrogen and nitrate + nitrite concentrations were significantly higher than seven other stations including COL0.0 and mainstem BBC stations BBC7.0 through BBC1.6.

Select parameters that exhibited significantly lower concentrations at BBC10.4 than multiple other stations include:

- **pH**. Base and storm flow pH measurements were significantly lower than most monitoring stations except for two during base flow (BUR0.0 and BBC5.9) and four during storm flow (BBC8.8, PET0.0, BUR0.0, and BBC5.9).
- **Dissolved Oxygen**. Base and storm flow dissolved oxygen concentrations were significantly lower than all monitoring stations except for two during base flow (PET0.0 and BBC5.9) and three during storm flow (PET0.0, BBC7.0, and BBC5.9).
- **Copper**. Base flow total and dissolved copper concentrations were significantly lower than at least six stations including PET0.0, BBC8.4, BBC7.0, BBC5.9, BBC2.6, and BBC1.6. Storm flow concentrations were significantly lower than at least four stations including PET0.0, BBC8.4, COL0.0, and BBC1.6.

- Zinc. Total zinc concentrations were significantly lower than seven stations during base flow (all tributary stations and BBC7.0, BBC5.9, BBC5.2, and BBC1.6) and two stations during storm flow (BUR0.0 and COL0.0). Dissolved zinc concentrations were significantly lower than two stations during base flow (BUR0.0 and COL0.0) and one station during storm flow (BUR0.0).

Target parameters that exhibited both significantly higher and lower concentrations at BBC10.4 than other stations include:

- Phosphorus.
    - Base flow total phosphorus and SRP concentrations were significantly lower than at least four stations including PET0.0, BBC5.9, BBC2.6, and BBC1.6.
    - Storm flow total phosphorus concentrations were significantly higher than one station (BUR0.0) and SRP concentrations were significantly higher than two stations (BUR0.0 and COL0.0).

Water Quality Index

The seasonal Kendall's Tau analysis on monthly WQI scores detected a significantly decreasing trend for the overall WQI score in both the combined and dry seasons. Significant trends in individual WQI scores were also detected at BBC10.4 for more parameters than any other station. Significant decreasing trends in individual WQI scores include:

- Dissolved oxygen
- Temperature
- Turbidity
- TSS
- Sediment
- Fecal coliform

Significant increasing trends in individual WQI scores include:

- Total nitrogen

The significant WQI trends at BBC10.4 were aligned with significant trends detected for the combined and dry seasons (base flow) trend analysis with the exception of dissolved oxygen.

The individual total nitrogen score was consistently the lowest individual WQI score (Figure C-1). Dissolved oxygen, nutrients, and phosphorus individual WQI scores all decreased between WY2023 and WY2024 which resulted in the decreased overall WY2024 WQI score compared to previous years.

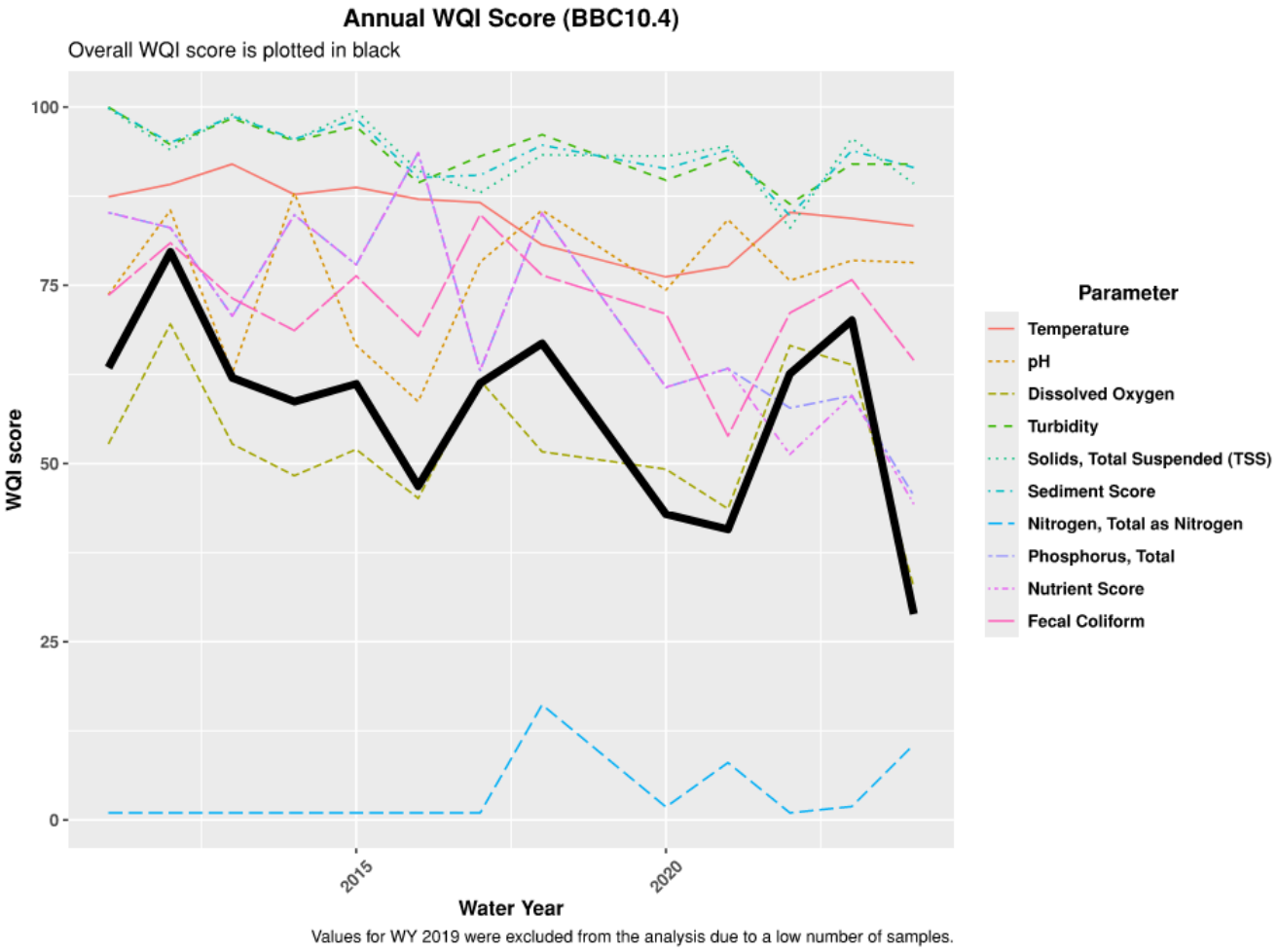

Figure C-1. Annual Water Quality Index Scores for BBC10.4 (WY2011 to WY2024)

BBC8.8

Monitoring station BBC8.8 is located approximately 70 feet upstream from the confluence with tributary Peterson Channel. The contributing area between BBC10.4 and BBC8.8 includes SR 500 and I-205, residential and commercial/industrial areas and a large golf course directly upstream of the monitoring station. Upstream riparian canopy cover within 0.5 mile of BBC8.8 is 52 percent. Stormwater is primarily managed through infiltration facilities such as dry wells, and the majority of septic systems are located just downstream of BBC10.4, south of the creek.

Monitoring at this station typically occurred in the morning as sampling was conducted from upstream to downstream stations. Key results pertaining to water quality at BBC8.8 are summarized below.

WY2024

In WY2024, BBC8.8 generally had similar concentrations (overlapping interquartile ranges) to other stations, particularly other upstream stations, for most parameters. As shown in the boxplots in Appendix D-2, the following parameters were unique from other stations:

- Water Temperature. The 7-DADmax temperature exceeded the criterion of 17.5°C for 59 percent of the monitoring period, which was the highest number of all stations with continuous temperature monitoring.
- pH. All base and storm flow pH measurements were within the applicable criteria except for one storm flow event which exceeded the lower criterion. Readings were generally similar to most other midstream mainstem monitoring stations.
- Dissolved Oxygen. Median base flow dissolved oxygen concentration (10.8 mg/L) was the highest of all stations but were otherwise not substantially different than other stations except for BBC10.4. Several base flow and a majority of storm flow dissolved oxygen concentrations were below the applicable criterion.
- Total Phosphorus. Storm flow total phosphorus concentrations were substantially greater than base flow concentrations, unlike most other stations where base and storm concentrations were not substantially different.
- Zinc. Total and dissolved zinc was monitored only during storm events for the WY2024 program. Zinc concentrations were generally comparable to other mainstem monitoring stations but exceeded the water quality standard during one event where dramatic spikes in zinc concentrations were observed at BBC8.8, BBC8.4, and BBC7.0 on April 25, 2024.
- *E. coli*. BBC8.8 *E. coli* bacteria concentrations were generally comparable to other stations and had the lowest base flow geomean (43.6 CFU/100 mL) and 90th percentile (66.8 CFU/100 mL). Base flow concentrations were within the applicable criteria, but storm flow concentrations exceeded both the geomean and 90th percentile criteria.

Trend Analysis

Temporal Trends

The following temporal trends were detected based on the seasonal Kendall's Tau trends (Appendix E). Bold text indicates the trend is associated with improving water quality. Significant increasing trends in base flow samples were identified for the following parameters:

- 7-DADmax temperature (overall)
- Turbidity (combined and dry seasons)
- Chloride (combined, wet, and dry seasons)
- Total lead (dry season)
- Fecal coliform (dry season)

Significant decreasing trends in base flow samples were identified for the following parameters:

- **Nitrate + nitrite** (combined and dry seasons)
- **Total nitrogen** (combined and dry seasons)
- ***E. coli*** (combined seasons)
- pH (wet season)
- Dissolved oxygen (dry season)

Significant trends in storm flow samples were identified for the following parameters:

- **Dissolved oxygen** had a significant increasing trend
- Chloride had a significant increasing trend

Spatial Trends

The following spatial trends were identified based on a Friedman and Nemenyi post-hoc test (Appendix F). Select parameters that exhibited significantly higher concentrations at BBC8.8 than other stations include:

- **Nitrogen**. Base flow total nitrogen and nitrate + nitrite concentrations were significantly higher than at least five stations including mainstem BBC stations BBC5.9 through BBC1.6. Storm flow concentrations followed a similar pattern and were significantly higher than at least four stations including BUR0.0, BBC2.6, and COL0.0.

Select parameters that exhibited significantly lower concentrations at BBC8.8 than other stations include:

- **Phosphorus**. Base flow total phosphorus and SRP concentrations were significantly lower than six stations including PET0.0 and mainstem BBC stations BBC7.0 through BBC1.6. Fewer significant differences were present during storm flow.

- **Copper**. Base and storm flow total and dissolved copper concentrations were significantly lower than at least four stations including PET0.0, BBC8.4, and BBC1.6.

Target parameters that exhibited both significantly higher and lower concentrations than other stations include:

- **Dissolved Oxygen**. Base flow dissolved oxygen concentrations were significantly higher than BBC10.4, PET0.0, BUR0.0, BBC7.0, and BBC5.9. Storm flow dissolved oxygen concentrations were significantly higher than three stations (BBC10.4, PET0.0, and BBC5.9) and lower than two stations (COL0.0 and BBC1.6).

Water Quality Index

The seasonal Kendall's Tau analysis on monthly WQI scores did not detect a significant trend for the overall WQI score. Two significant trends in individual WQI scores were detected at BBC8.8. Significant decreasing trends in individual WQI scores include:

- Turbidity

The significant increasing trend in individual WQI scores include:

- Total nitrogen

All significant trends at BBC8.8 were present in both combined and dry seasons' trend analysis.

The individual total nitrogen score was consistently the lowest individual WQI score (Figure C-2) which negatively impacted the overall WY2024 WQI. As indicated by the few significant trends, individual WQI scores were fairly consistent with the largest changes in recent years in fecal coliform and dissolved oxygen.

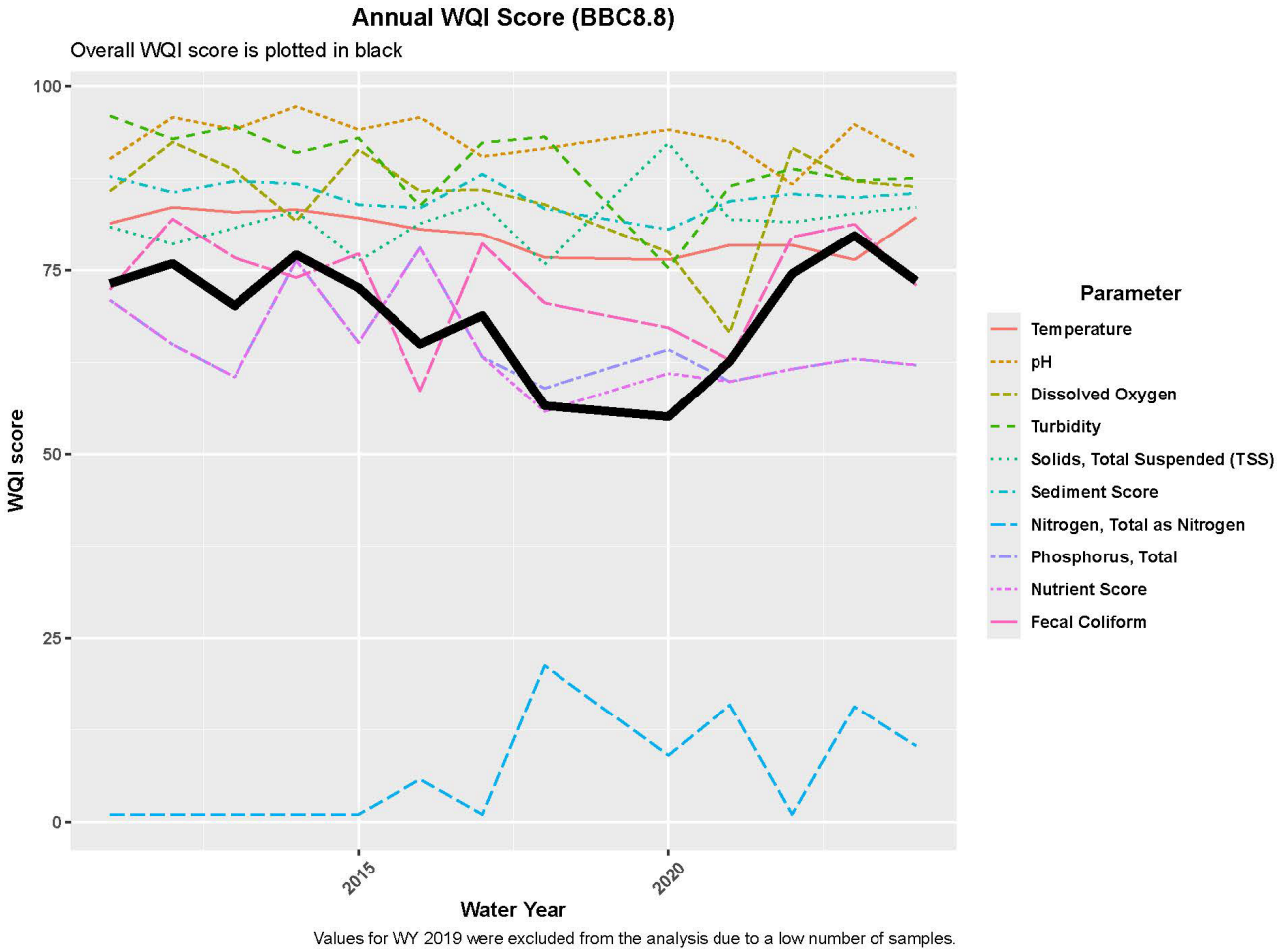

Figure C-2. Annual Water Quality Index Scores for BBC8.8 (WY2011 to WY2024)

PET0.0

Monitoring station PET0.0 is located in Peterson Channel (also known as Peterson Ditch), just upstream of its confluence with Burnt Bridge Creek. The subbasin draining to PET0.0 includes primarily residential land use but also includes a large portion of commercial and industrial land use. Upstream riparian canopy cover within 0.5 mile of PET0.0 is 46 percent. Peterson Channel enters Burnt Bridge Creek between stations BBC8.8 and BBC8.4.

The basin includes clusters of septic systems in the northwest and southeast portions of the basin. Stormwater is managed by catch basins directing flow through closed and perforated pipes to dry wells and bioretention facilities, with some areas draining directly to the creek. Dry season base flow in Peterson Channel is primarily sustained through high groundwater and industrial non-contact cooling water discharge that displays unique water quality characteristics that may affect water quality at the downstream station BBC8.4. Peterson Channel is Category 5 303(d) listed for *E. coli* and temperature.

Monitoring at this station typically occurred in the morning as sampling was conducted from upstream to downstream stations. Key results pertaining to water quality at PET0.0 are summarized below.

WY2024

In WY2024, tributary station PET0.0 exhibited some unique water quality characteristics that may impact downstream mainstem stations. As shown in the boxplots in Appendix D-2, notable water quality characteristics include:

- Water Temperature. The 7-DADmax temperature exceeded the criterion of 17.5°C for 39 percent of the monitoring period, which was the median percent exceedance for the eight stations selected for continuous temperature monitoring.
- pH. All pH readings were within the applicable criteria and were similar to nearby mainstem monitoring stations.
- Dissolved Oxygen. All dissolved oxygen concentrations during storm or base flow events were below the applicable water quality criterion. Concentrations were not substantially different than most stations except for certain downstream stations which were higher.
- Nutrients. Base flow SRP concentrations (median of 0.125 mg/L) were substantially higher than nearby upstream stations but were not substantially different than most other midstream and downstream stations. Storm flow concentrations (median of 0.048 mg/L) were substantially lower than base flow and were among the largest differences in median concentrations between event types. However, base and storm flow total phosphorus concentrations were not substantially different from each other and from most other stations.
- Copper. Total and dissolved copper was monitored only during storm events for the WY2024 program. Copper concentrations at PET0.0 were substantially higher than all mainstem BBC monitoring stations except for BBC8.4, which is located directly downstream of Peterson Channel, and BBC1.6, which is located directly downstream from Cold Creek which exhibited similarly high copper concentrations. Copper concentrations never exceeded the water quality criteria.

- ***E. coli.*** PET0.0 met the water quality criteria for *E. coli* during base flow events but exceeded the criteria (geomean and 90th percentile) during storm flow events. While concentrations were not substantially different from most other stations, the storm flow 90th percentile concentration (1,926 CFU/100 mL) was the second highest of all stations indicating relatively frequent elevated detections.

Trend Analysis

Temporal Trends

The following temporal trends were detected based on the seasonal Kendall's Tau trends (Appendix E). Bold text indicates the trend is associated with improving water quality. Significant increasing trends in base flow samples were identified for the following parameters:

- Conductivity (combined and dry seasons)
- Turbidity (combined and dry seasons)
- Nitrate + nitrite (combined, wet, and dry seasons)
- Total Kjeldahl nitrogen (dry season)
- Total nitrogen (combined and dry seasons)
- SRP (combined and dry seasons)
- Chloride (combined, wet, and dry seasons)

Significant decreasing trends in base flow samples were identified for the following parameters:

- pH (wet season)
- **Total phosphorus** (combined, wet, and dry seasons)
- **Dissolved lead** (wet season)

Significant trends in storm flow samples were identified for the following parameters:

- pH had a significant decreasing trend
- Turbidity had a significant increasing trend
- Dissolved zinc had a significant increasing trend

Spatial Trends

The following spatial trends were identified based on a Friedman and Nemenyi post-hoc test (Appendix F). Select parameters that exhibited significantly higher concentrations at PET0.0 than other stations include:

- **Copper**. Base and storm flow total copper concentrations were significantly higher than seven other stations including BBC10.4, BBC8.8, BUR0.0, BBC5.9, and BBC2.6. Base and storm flow dissolved copper concentrations were significantly higher than at least four stations including BBC10.4 and BBC8.8.

Select parameters that exhibited significantly lower concentrations at PET0.0 than other stations include:

- Dissolved Oxygen. Base and storm flow dissolved oxygen concentrations were significantly lower than at least four stations including BBC8.8, BBC2.6, COL0.0, and BBC1.6.
- Turbidity. Base and storm flow turbidity was significantly lower than at least six stations including BBC10.4, BBC8.8, BBC2.6, and BBC1.6. TSS followed a similar pattern with fewer significant differences.

Target parameters that exhibited both significantly higher and lower concentrations than other stations include:

- Nitrogen.
    - Base flow total nitrogen and nitrate + nitrite concentrations were significantly lower than at least two stations including BBC10.4 and BUR0.0.
    - Storm flow nitrate + nitrite concentrations were significantly higher than COL0.0 and BBC1.6, but total nitrogen concentrations were only significantly higher than COL0.0
- Phosphorus.
    - Base flow total phosphorus and SRP concentrations were significantly higher than at least four stations including BBC10.4, BBC8.8, BUR0.0, and COL0.0. Storm flow SRP concentrations were also significantly higher than BUR0.0 and COL0.0.
    - Storm flow total phosphorus concentrations were significantly lower than BBC2.6 and BBC1.6.

Water Quality Index

The seasonal Kendall's Tau analysis on monthly WQI scores detected a significantly decreasing trend for the overall WQI score in both the combined and dry seasons. Significant trends in individual WQI scores were also detected at PET0.0. Significant decreasing trends in individual WQI scores include:

- pH (wet season only)
- Turbidity
- Total Nitrogen
- Nutrient

Significant increasing trends in WQI that may indicate improving water quality include:

- Total Phosphorus (combined, wet, and dry seasons)

Except where noted, all significant trends at PET0.0 were present in the combined and dry seasons' trend analyses only.

The individual total nitrogen, total phosphorus, and nutrient WQI scores have been the lowest individual WQI scores in recent years (Figure C-3) and negatively impacted the overall WY2024 WQI. Patterns in these scores, particularly over the last four years, appear to be mirrored in the overall WQI scores.

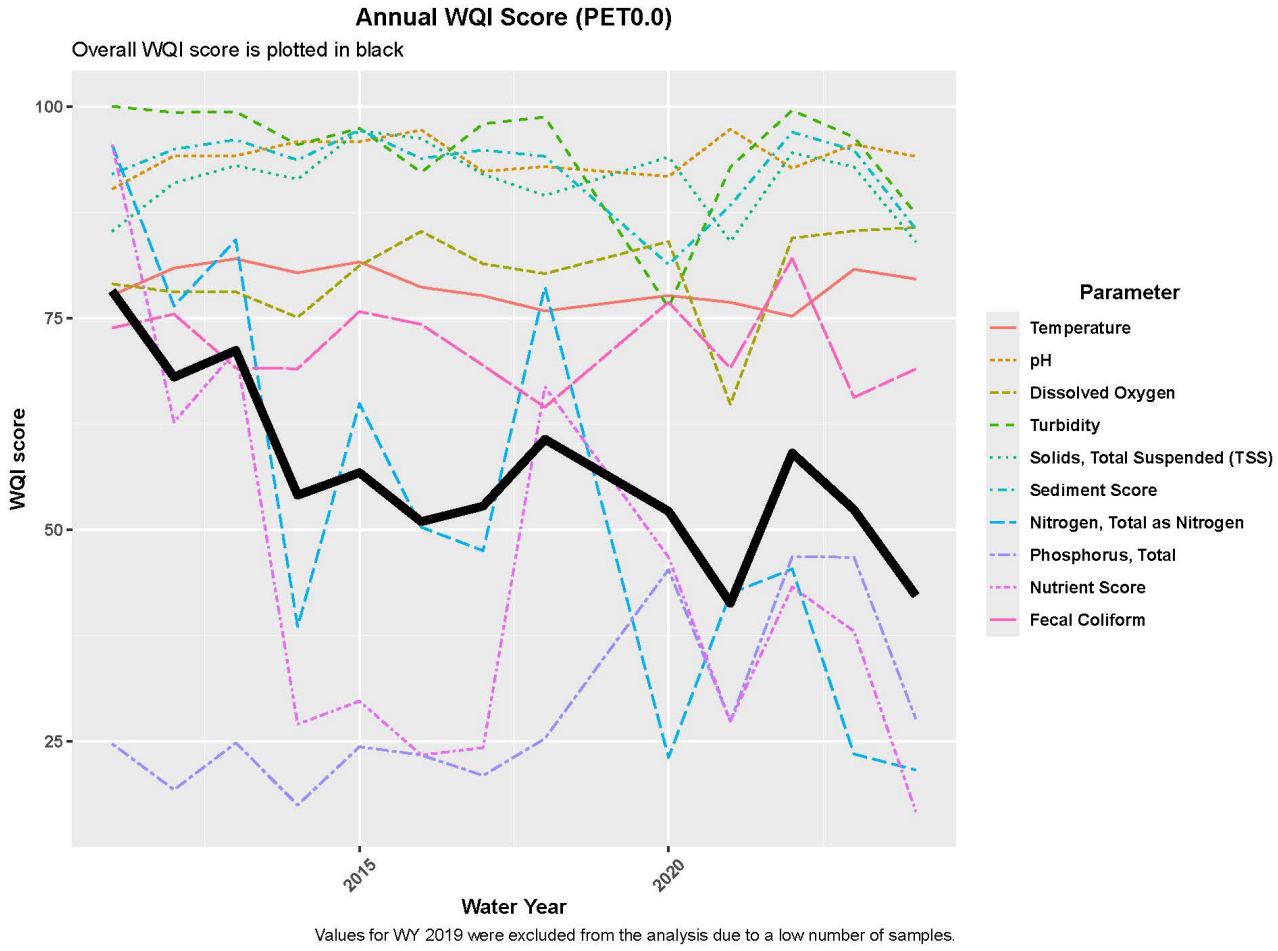

Figure C-3. Annual Water Quality Index Scores for PET0.0 (WY2011 to WY2024)

BBC8.4

The contributing area between BBC8.8 and BBC8.4 includes primarily residential and forested/open space land use. Upstream riparian canopy cover within 0.5 mile of the BBC8.4 is 38 percent. Septic systems are clustered in the eastern portion of the subbasin. Water quality at this station appears to be influenced by flow from Peterson Channel entering Burnt Bridge Creek between station BBC8.8 and BBC8.4.

WY2024

In WY2024, BBC8.4 generally had similar concentrations (overlapping interquartile ranges) to other stations, particularly other middle basin stations, for most parameters. However, certain parameters exhibited some unique characteristics which may represent influence from the nearby tributary Peterson Channel. As shown in the boxplots in Appendix D-2, the following parameters were unique from other stations:

- Water Temperature. The 7-DADmax temperature exceeded the criterion of 17.5°C for 31 percent of the monitoring period, which was below the median percent exceedance across all stations selected for continuous temperature monitoring.
- Dissolved Oxygen. Median base and storm flow dissolved oxygen concentrations (9.77 and 9.82 mg/L, respectively) were below the water quality criterion. Base flow concentrations were not substantially different than other stations except for BBC10.4, and storm flow concentrations were only substantially different than some upstream and downstream stations.
- Copper. Total and dissolved copper was monitored only during storm events for the WY2024 program. Total copper concentrations were substantially higher than other mainstem BBC stations except for BBC2.6 and BBC1.6. Dissolved copper concentrations were not substantially different than most stations but had the highest median concentration of all mainstem BBC stations except for BBC1.6 (1.86 ug/L). Copper concentrations never exceeded the water quality criteria.
- Zinc. Total and dissolved zinc was monitored only during storm events for the WY2024 program. Zinc concentrations were generally not substantially different from other mainstem BBC stations but exceeded the water quality criteria on one occasion on April 25, 2024, when zinc concentrations at several stations were abnormally elevated.
- *E. coli*. BBC8.4 met water quality criteria for *E. coli* concentrations during base flow events but exceeded the geomean and 90th percentile criteria during storm flow events. Concentrations were not substantially different than most mainstem BBC stations and generally exhibited relatively low concentrations. All storm flow concentrations were below the 90th percentile criterion except for one high storm flow detection (>2,420 CFU/100 mL).

Trend Analysis

Temporal Trends

The following temporal trends were detected based on the seasonal Kendall's Tau trends (Appendix E). Bold text indicates the trend is associated with improving water quality. Significant increasing trends in base flow samples were identified for the following parameters:

- 7-DADmax temperature (overall)
- pH (combined and dry seasons)
- Conductivity (combined and dry seasons)
- Turbidity (combined and dry seasons)
- SRP (combined and dry seasons)
- Chloride (combined, wet, and dry seasons)
- Dissolved lead (dry season)

Significant decreasing trends in base flow samples were identified for the following parameters:

- **TSS** (combined and dry seasons)
- **Nitrate + nitrite** (combined and dry seasons)

Significant trends in storm flow samples were identified for the following parameters:

- Chloride had a significant increasing trend

Spatial Trends

The following spatial trends were identified based on a Friedman and Nemenyi post-hoc test (Appendix F). Select parameters that exhibited significantly higher concentrations at BBC8.4 than other stations include:

- **Copper**. Base and storm flow total and dissolved copper concentrations were significantly higher than two to four stations including BBC10.4, BBC8.8, and BUR0.0 during base flow, and BBC10.4 and BBC8.8 during storm flow.

Select parameters that exhibited significantly lower concentrations at BBC8.4 than other stations include:

- **Phosphorus**. Base flow total phosphorus concentrations were significantly lower than BBC7.0, BBC5.9, and BBC1.6. Storm flow total phosphorus concentrations were significantly lower than BBC2.6 and BBC1.6.

Target parameters that exhibited both significantly higher and lower concentrations than other stations include:

- Dissolved Oxygen. Base and storm flow dissolved oxygen was significantly higher than at least one station including BBC10.4 but was significantly lower than at least one station including COL0.0.

Water Quality Index

The seasonal Kendall's Tau analysis on monthly WQI scores did not detect a significant trend in the overall WQI score at BBC8.4. Significant trends in individual WQI scores were detected at this station, this station is one of three stations with more increasing seasonal trends than decreasing. Significant decreasing trends in individual WQI scores include:

- Turbidity

Significant increasing trends in individual WQI scores include:

- pH
- Total suspended solids

All significant trends at BBC8.4 were present in both combined and dry seasons' trend analyses.

The individual total nitrogen score and, to a lesser extent, the total phosphorus and nutrient scores were consistently the lowest individual WQI scores (Figure C-4) and negatively impacted the overall WY2024 WQI.

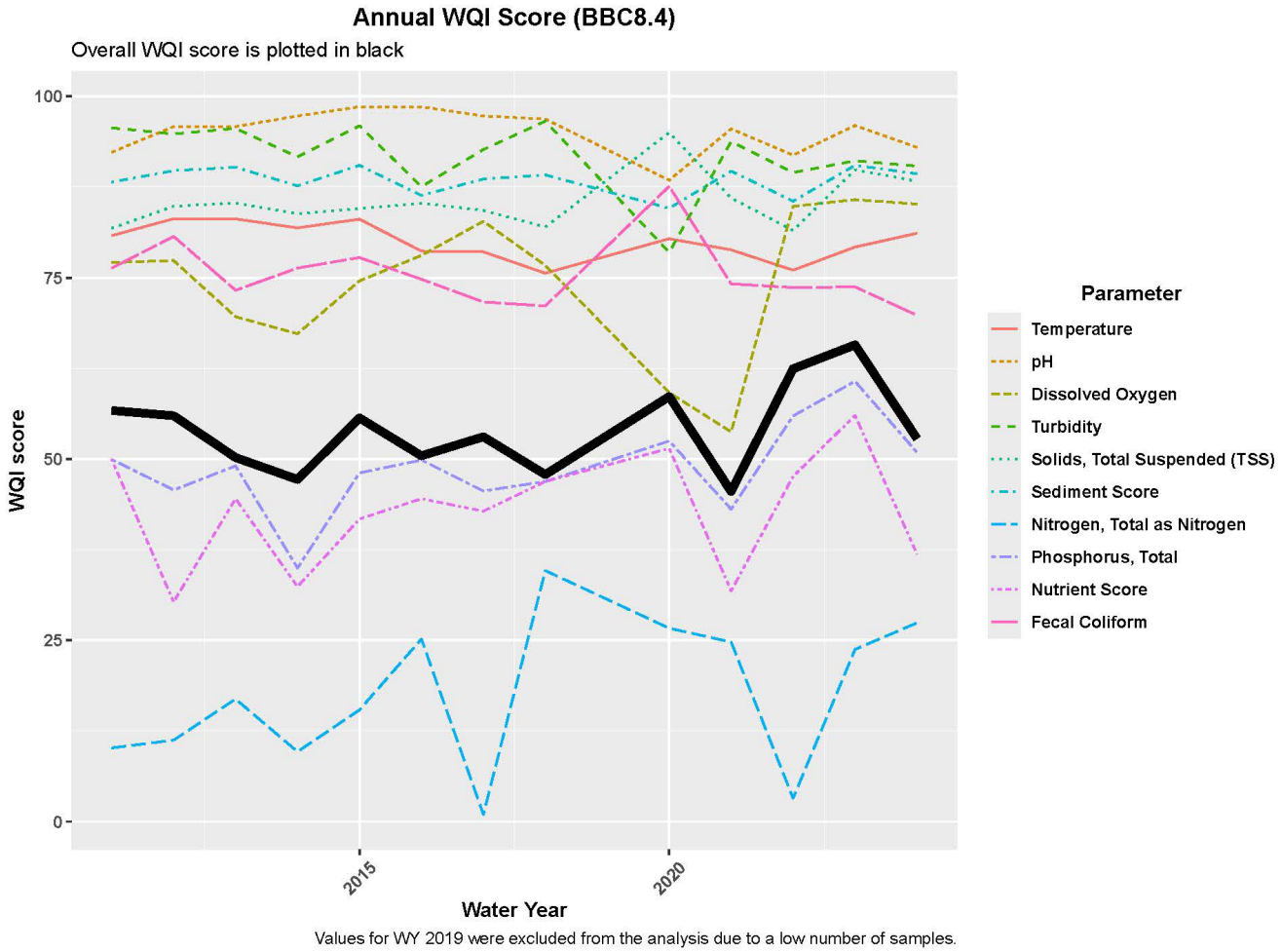

Figure C-4. Annual Water Quality Index Scores for BBC8.4 (WY2011 to WY2024)

BUR0.0

Monitoring station BUR0.0 is located in Burton Channel, about 1,000 feet upstream of its confluence with Burnt Bridge Creek downstream of BBC8.4 at the southern border of Meadowbrook Marsh. The subbasin draining to BUR0.0 includes primarily residential as well as commercial/industrial land use. Upstream riparian canopy cover within 0.5 mile of BUR0.0 is 28 percent.

Compared to other monitoring station subbasins, the area includes a relatively high septic system density with clusters of septic systems distributed throughout most of the subbasin. Most stormwater is managed by infiltration and discharge to the stream. Flows at this station during base flow events appear to be very low relative to the main BBC channel and other tributaries. Pollutant concentrations at BUR0.0 did not appear to impact water quality at the adjacent downstream BBC station BBC7.0, likely due to the relatively low flow volumes. Ecology has added 303(d) listings for Burton Channel as Category 5 for copper and zinc in addition to previously listed parameters (Main Text Table 1).

Monitoring at this station typically occurred in the morning as sampling was conducted from upstream to downstream stations. Key results pertaining to water quality at BUR0.0 are summarized below.

WY2024

In WY2024, tributary station BUR0.0 exhibited some unique water quality characteristics from nearby mainstem BBC stations. As shown in the boxplots in Appendix D-2, notable water quality characteristics include:

- pH. Base flow pH measurements were all within the water quality criteria but exceeded the lower criterion during one storm flow event. Storm and base flow pH readings were substantially lower than most other monitoring stations except some upstream mainstem BBC stations.
- Dissolved Oxygen. Base and storm flow median dissolved oxygen concentrations (9.23 and 9.99 mg/L, respectively) were below the water quality criterion. Dissolved oxygen concentrations were not substantially different than most other monitoring stations.
- Turbidity. Turbidity and, to a lesser extent, TSS exhibited some of the largest increases from base to storm flow (median turbidity of 2.12 and 13.8 NTU, respectively).
- Hardness. BUR0.0 had substantially lower hardness than all other stations except COL0.0. Lower hardness corresponds to lower calculated metals criteria, because metals are more toxic at lower hardness concentrations.
- Copper. Total and dissolved copper was monitored only during storm events for the WY2024 program. Total copper concentrations were substantially higher than most mainstem BBC stations, but dissolved copper concentrations were not substantially different. Copper concentrations exceeded the water quality criteria on one occasion at BUR0.0 on April 25, 2024.
- Zinc. Total and dissolved zinc was monitored only during storm events for the WY2024 program. Total and dissolved zinc concentrations were substantially higher than all mainstem BBC stations except for

BBC1.6 for total and BBC7.0 and BBC5.2 for dissolved. Zinc concentrations exceeded the water quality criteria on three occasions at BUR0.0 on December 5, 2023, January 8, 2024, and April 24, 2024.

- *E. coli*. BUR0.0 exceeded both the geomean and 90th percentile *E. coli* criteria for base and storm flow events.

Trend Analysis

Temporal Trends

The following temporal trends were detected based on the seasonal Kendall's Tau trends (Appendix E). Bold text indicates the trend is associated with improving water quality. Significant increasing trends in base flow samples were identified for the following parameters:

- Conductivity (combined and dry seasons)
- Turbidity (combined and dry seasons)
- SRP (combined and dry seasons)

Significant decreasing trends in base flow samples were identified for the following parameters:

- pH (combined, wet, and dry seasons)
- **Nitrate + nitrite** (combined and dry seasons)
- **Total nitrogen** (combined and dry seasons)

No significant trends in storm flow samples were identified.

Spatial Trends

The following spatial trends were identified based on a Friedman and Nemenyi post-hoc test (Appendix F). Select parameters that exhibited significantly higher concentrations at BUR0.0 than other stations include:

- **Chloride**. Base flow chloride concentrations were significantly higher than BBC10.4, PET0.0, BBC8.4, BBC5.9, COL0.0, and BBC1.6.
- **Zinc**. Base flow total and dissolved zinc concentrations were significantly higher than one and three stations, respectively, including BBC10.4. Storm flow total and dissolved zinc concentrations were significantly higher than seven and six stations, respectively, including BBC10.4, PET0.0, BBC8.4, BBC5.9, and BBC2.6.
- *E. coli*. Base flow *E. coli* concentrations were significantly higher than BBC8.8 and PET0.0. Few significant differences in *E. coli* concentrations were present across any station during storm flow events.

Select parameters that exhibited significantly lower concentrations at BUR0.0 than other stations include:

- Phosphorus. Base and storm flow total phosphorus and SRP concentrations were significantly lower than six stations including BBC5.9, BBC5.2, and BBC2.6.

Target parameters that exhibited both significantly higher and lower concentrations than other stations include:

- Dissolved Oxygen.
    - Base and storm flow dissolved oxygen concentrations were higher than two and three stations, respectively, including BBC10.4 and BBC5.9.
    - Base flow dissolved oxygen concentrations were lower than COL0.0 and BBC8.8
- Turbidity.
    - Base flow turbidity was significantly lower than all stations except for PET0.0, BBC5.2, and COL0.0.
    - Storm flow turbidity was significantly higher than PET0.0 and BBC5.9.
- Copper.
    - Base flow total and dissolved copper concentrations were significantly lower than all stations except for BBC10.4, BBC8.8, and COL0.0. Storm flow total copper concentrations were significantly lower than other tributary stations PET0.0 and COL0.0.
    - Storm flow dissolved copper was significantly higher than BBC10.4 and BBC8.8.

Water Quality Index

The seasonal Kendall's Tau analysis on monthly WQI scores did not detect a significant trend for the overall WQI score. Significant trends in individual WQI scores were detected at BUR0.0 for several parameters. Significant decreasing trends in individual WQI scores include:

- pH (combined, wet, and dry seasons)
- Dissolved Oxygen (dry season only)

Significant increasing trends in individual WQI scores include:

- Total Nitrogen (combined and dry seasons)

The individual total nitrogen score was consistently the lowest individual WQI score (Figure C-5) and negatively impact the overall WY2024 WQI score. Patterns in the overall WQI score appeared to loosely follow patterns present in fecal coliform, total phosphorus, and nutrients scores.

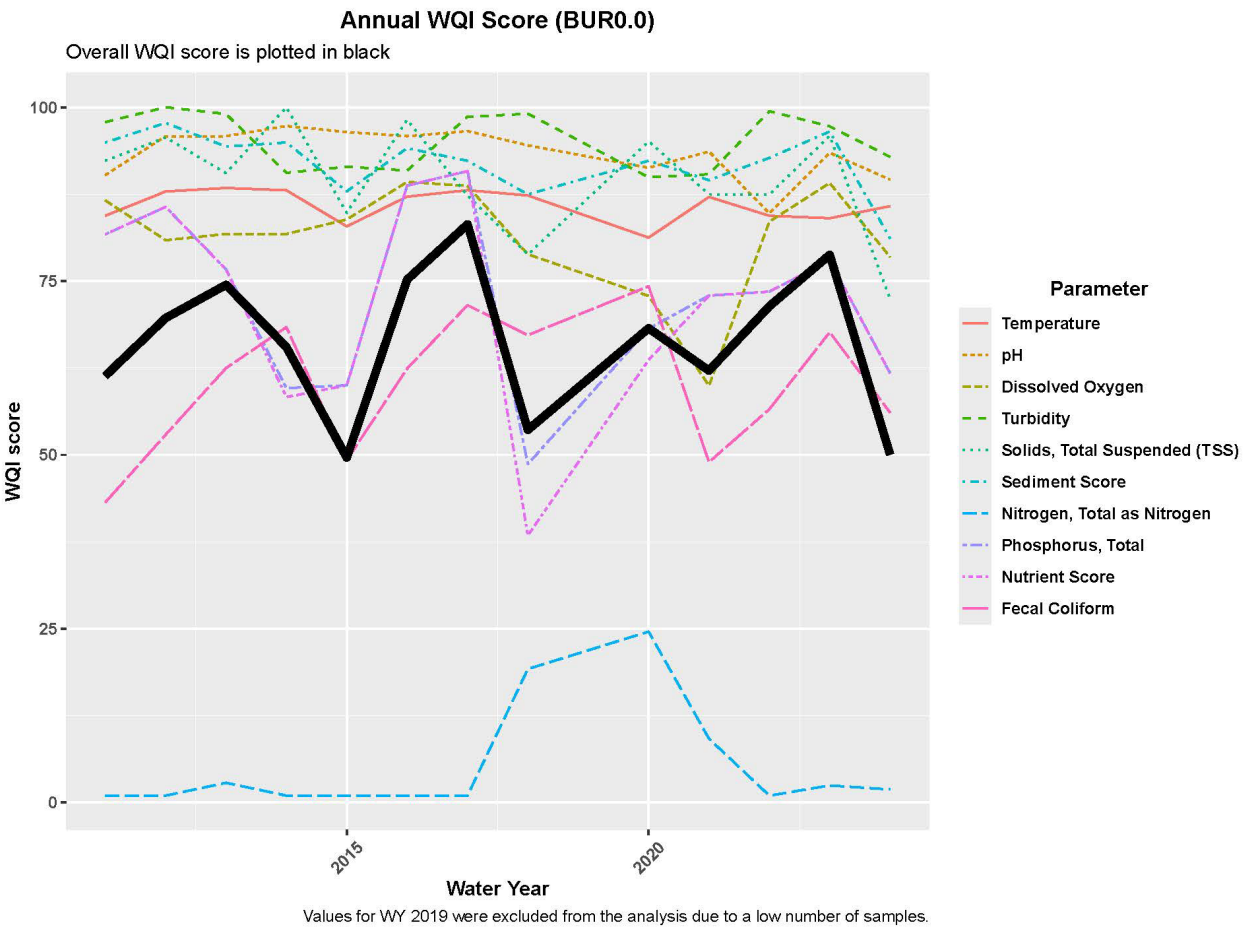

Figure C-5. Annual Water Quality Index Scores for BUR0.0 (WY2011 to WY2024)

BBC7.0

The contributing area between BBC8.4 and BBC7.0 includes primarily residential land use with inputs from SR 500 and commercial/industrial areas. This mid-basin reach flows through the central greenway corridor of the watershed. Upstream riparian canopy cover within 0.5 mile of BBC7.0 is 53 percent. The monitoring site is located immediately downstream of an extensive restoration project that reshaped the creek basin, expanding floodplains and adding stormwater treatment ponds north of the creek that discharge through wetlands. Vegetation has become established over the past 20 years and the large areas of open water attract waterfowl year-round. Septic systems are clustered throughout the subbasin. Stormwater in much of the basin is managed through infiltration facilities such as dry wells, in addition to conveyance that discharges to the creek.

Monitoring at this station typically occurred in the late morning as sampling was conducted from upstream to downstream stations. Key results pertaining to water quality at BBC7.0 are summarized below.

WY2024

In WY2024, BBC7.0 generally had similar concentrations (overlapping interquartile ranges) to other mainstem BBC stations for most parameters. Differences between other BBC stations were generally most pronounced with the furthest up and downstream stations. As shown in the boxplots in Appendix D-2, the following parameters were unique from other stations:

- Water Temperature. The 7-DADmax temperature exceeded the criterion of 17.5°C for 42 percent of the monitoring period, which was slightly above the median percent exceedance across all stations selected for continuous temperature monitoring.
- Dissolved Oxygen. Median base flow dissolved oxygen (10.14 mg/L) was above the criterion, but most storm flow measurements (median of 9.51 mg/L) were below the criterion. Base flow concentrations were not substantially different than other stations, but storm flow concentrations were substantially higher than BBC10.4 and substantially lower than BBC2.6, COL0.0, and BBC1.6.
- TSS. Total suspended solids were substantially lower during storm events than base flow events at BBC7.0 which is unique among all monitoring stations which otherwise saw increases in TSS from base flow to storm flow.
- Zinc. Total and dissolved zinc was monitored only during storm events for the WY2024 program. Dissolved zinc was substantially higher than all mainstem BBC stations except BBC5.2 and had the third highest maximum concentration, which corresponded with the high concentrations observed at BBC8.8 and BBC8.4 on April 25, 2024. This was the only occasion on which the zinc concentration exceeded the water quality criteria.
- *E. coli*. BBC 7.0 met *E. coli* criteria for base flow events but exceeded both criteria during storm flow events. Concentrations were not substantially different from any other station during base or storm flow events.

Trend Analysis

Temporal Trends

The following temporal trends were detected based on the seasonal Kendall's Tau trends (Appendix E). Bold text indicates the trend is associated with improving water quality. Significant increasing trends in base flow samples were identified for the following parameters:

- Conductivity (combined and dry seasons)
- Turbidity (combined and dry seasons)
- SRP (combined and dry seasons)
- Hardness (wet season)
- Chloride (combined and dry season)
- Fecal coliform (combined and dry season)

Significant decreasing trends in base flow samples were identified for the following parameters:

- pH (wet season)
- Dissolved oxygen (combined and dry season)
- **Nitrate + nitrite** (combined and dry season)

Significant trends in storm flow samples were identified for the following parameters:

- **Total phosphorus** had a significant decreasing trend
- Chloride had a significant increasing trend
- Dissolved zinc had a significant increasing trend

Spatial Trends

The following spatial trends were identified based on a Friedman and Nemenyi post-hoc test (Appendix F). Select parameters that exhibited significantly higher concentrations at BBC7.0 than other stations include:

- **Zinc**. Storm flow dissolved zinc concentrations were significantly higher than PET0.0, BBC5.9, and BBC1.6.

Select parameters that exhibited significantly lower concentrations at BBC7.0 than other stations include:

- **Dissolved Oxygen**. Base and storm flow dissolved oxygen measurements were significantly lower than three stations including COL0.0 and BBC1.6. Base flow dissolved oxygen was significantly higher, however, than one station, BBC10.4.

Target parameters that exhibited both significantly higher and lower concentrations than other stations include:

- Turbidity.
    - Base flow turbidity was significantly higher than PET0.0, BUR0.0, and BBC5.2.
    - Storm flow turbidity was significantly lower than BBC2.6, COL0.0, and BBC1.6.
- Copper.
    - Base flow total and dissolved copper was significantly higher than four and three stations, respectively, including BBC10.4, BBC8.8, and BUR0.0.
    - Storm flow total and dissolved copper was significantly lower than four and two stations, respectively, including PET0.0 and COL0.0.

Water Quality Index

The seasonal Kendall's Tau analysis on monthly WQI scores detected a significantly increasing trend for the overall WQI score in the wet season only and was the only station with an increasing overall WQI trend. Significant trends in individual WQI scores were also detected at BBC7.0. Significant decreasing trends in individual WQI scores include:

- Turbidity
- Fecal coliform

Both individual WQI score significant trends at BBC7.0 were present in both combined and dry seasons' trend analyses.

Similar to other nearby BBC stations, the individual total nitrogen, total phosphorus, and nutrient scores were generally the lowest individual WQI scores (Figure C-6) and negatively impacted the overall WY2024 WQI. In addition to these individual scores, the overall WQI appeared to most closely mirror changes in dissolved oxygen and fecal coliform individual scores in recent years.

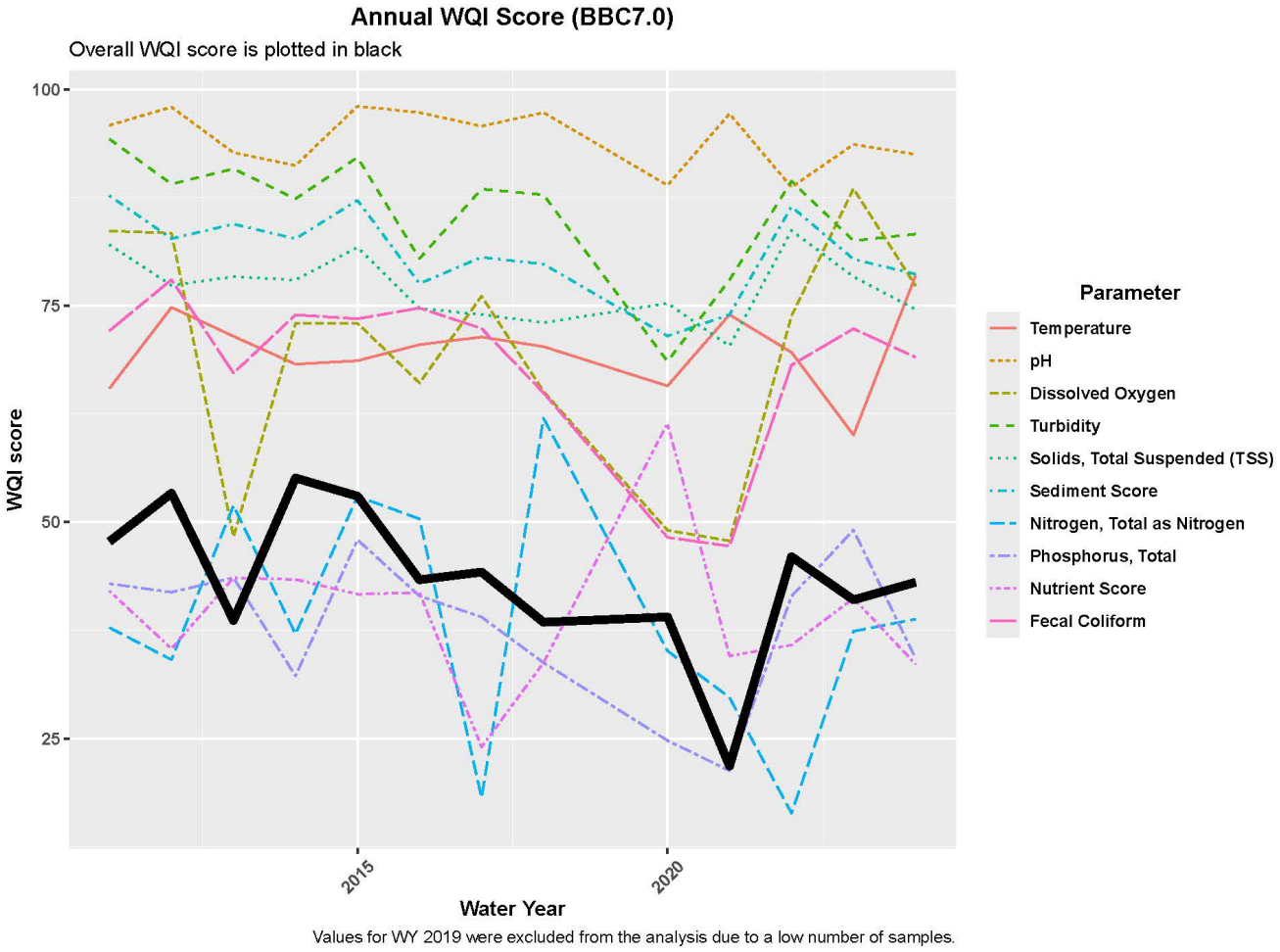

Figure C-6. Annual Water Quality Index Scores for BBC7.0 (WY2011 to WY2024)

BBC5.9

The contributing area between BBC7.0 and BBC5.9 includes primarily residential land use with inputs from commercial/industrial areas. Upstream riparian canopy cover within 0.5 mile of BBC5.9 is 34 percent. This segment of the stream also flows through the central greenway corridor of the watershed. There are relatively few septic systems. Stormwater is managed through infiltration facilities such as dry wells as well as conveyance that discharges to the creek.

Monitoring at this station typically occurred in the late morning as sampling was conducted from upstream to downstream stations. Key results pertaining to water quality at BBC5.9 are summarized below.

WY2024

In WY2024, BBC5.9 generally had similar concentrations (overlapping interquartile ranges) to other mainstem BBC stations for most parameters similar to BBC7.0. As shown in the boxplots in Appendix D-2, the following parameters were unique from other stations:

- Water Temperature. The 7-DADmax temperature exceeded the criterion of 17.5°C for 47 percent of the monitoring period, which was above the median and the second highest percent exceedance across all stations selected for continuous temperature monitoring.
- Dissolved Oxygen. Base flow dissolved oxygen concentrations were not substantially different from other mainstem BBC stations but had the second lowest median concentration (8.76 mg/L) which was below the water quality criterion. Storm flow dissolved oxygen concentrations were all below the water quality criterion and were substantially lower than all stations downstream from BBC5.9.
- Copper. Total and dissolved copper was monitored only during storm events for the WY2024 program. Copper concentrations at BBC5.9 were not substantially different than nearby mainstem BBC stations but exhibited some differences from further upstream and downstream stations. Maximum total and dissolved copper concentrations were the lowest of all stations. Copper did not exceed the water quality criteria during any event.
- *E. coli*. BBC5.9 exceeded the *E. coli* water quality criteria during base (90th percentile) and storm flow (geomean and 90th percentile) events. Concentrations were not substantially different than any other mainstem BBC station.

Trend Analysis

Temporal Trends

The following temporal trends were detected based on the seasonal Kendall's Tau trends (Appendix E). Bold text indicates the trend is associated with improving water quality. Significant increasing trends in base flow samples were identified for the following parameters:

- Conductivity (combined and dry seasons)

- Turbidity (combined and dry seasons)
- SRP (combined and dry seasons)
- Chloride (combined, wet, and dry seasons)
- Total zinc (combined seasons)

Significant decreasing trends in base flow samples were identified for the following parameters:

- pH (combined and wet seasons)
- TSS (combined and dry seasons)
- Nitrate + nitrite (combined and dry seasons)
- Fecal coliform (combined, wet, and dry seasons)

Significant trends in storm flow samples were identified for the following parameters:

- Total phosphorus had a significant decreasing trend
- Chloride had a significant increasing trend

Spatial Trends

The following spatial trends were identified based on a Friedman and Nemenyi post-hoc test (Appendix F). Select parameters that exhibited significantly higher concentrations at BBC5.9 than other stations include:

- Phosphorus. Base flow total phosphorus and SRP concentrations were significantly higher than five and three stations, respectively, including BBC10.4, BBC8.8, and BUR0.0. Storm flow total phosphorus and SRP concentrations followed a similar but less pronounced pattern with significantly higher concentrations than one (BUR0.0) and three (BBC8.8, BUR0.0, and COL0.0) stations, respectively.

Select parameters that exhibited significantly lower concentrations at BBC5.9 than other stations include:

- Dissolved Oxygen. Base and storm flow dissolved oxygen measurements were significantly lower than seven and six stations, respectively, including BBC8.8, BUR0.0, BBC5.2, BBC2.6, COL0.0, and BBC1.6.
- Turbidity and TSS. Storm flow turbidity and TSS were significantly lower than five and three stations, respectively, including BBC2.6, COL0.0, and BBC1.6. Fewer significant differences were present during base flow events.
- Zinc. Storm flow total and dissolved zinc concentrations were significantly lower than three and two stations, respectively, including BUR0.0 and COL0.0.

Target parameters that exhibited both significantly higher and lower concentrations than other stations include:

- Copper
    - Base flow total and dissolved copper concentrations were significantly higher than BBC10.4 and BUR0.0, but total copper concentrations were also significantly lower than PET0.0.

- Storm flow total and dissolved copper concentrations were significantly lower than four and two stations, respectively, including PET0.0 and COL0.0.

Water Quality Index

The seasonal Kendall's Tau analysis on monthly WQI scores did not detect a significant trend for the overall WQI score during any seasons. Significant trends were detected in individual WQI scores at BBC5.9. The significant decreasing trends in individual WQI scores include:

- Turbidity (combined and dry seasons)
- pH (wet season)

The significant increasing trends in individual WQI scores include:

- TSS (combined and dry seasons)
- Fecal coliform (combined and wet seasons)

The individual total nitrogen, nutrients, total phosphorus, and, to a lesser extent, the dissolved oxygen scores were consistently the lowest individual WQI scores (Figure C-7) and negatively impacted overall WQI at BBC5.9. Overall WQI scores did not appear to closely align with any individual WQI score. However, the decline in individual scores, particularly for fecal coliform, from WY2023 to WY2024, appears to drive the overall WQI decrease in WY2024 compared to WY2023.

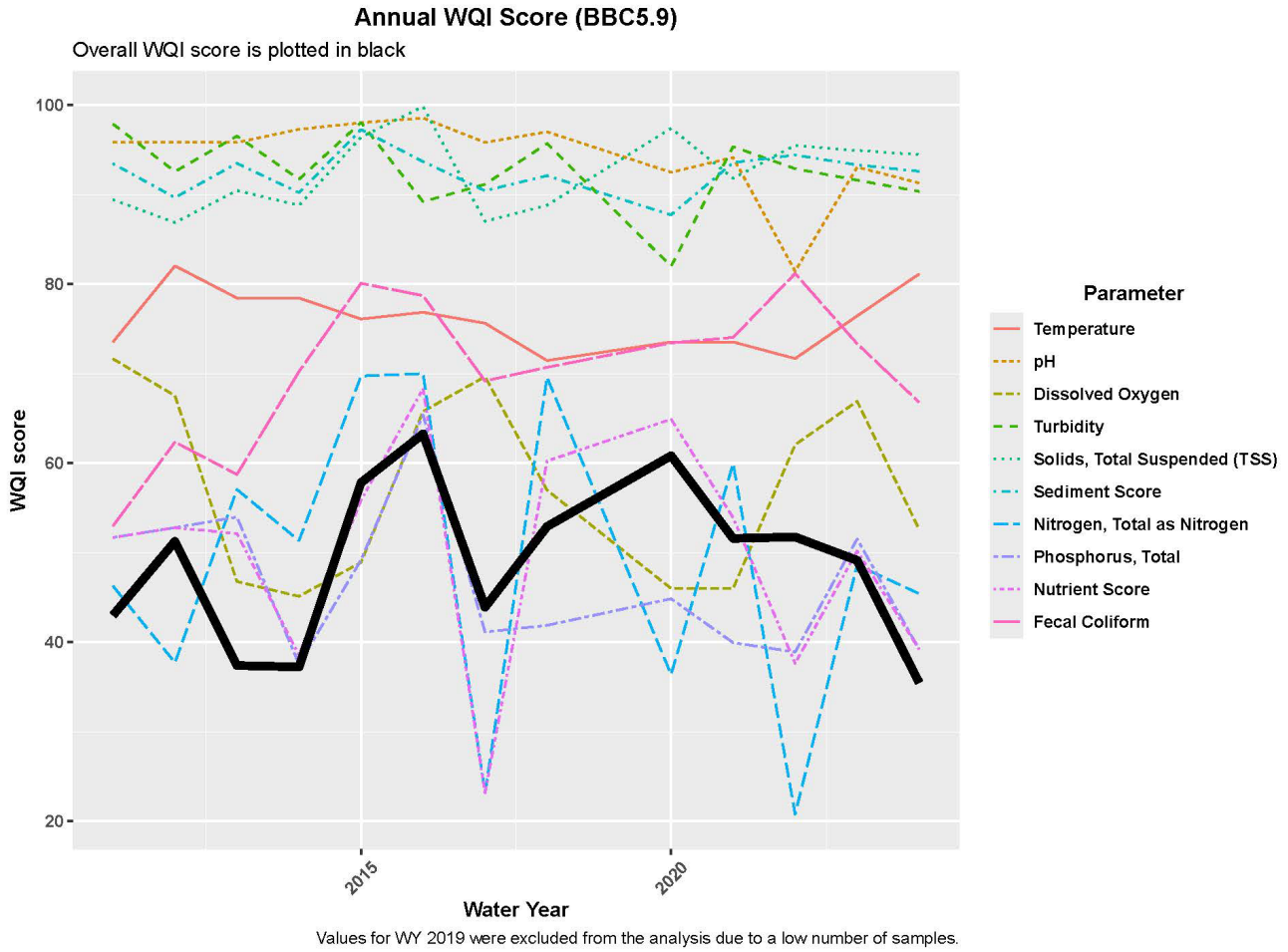

Figure C-7. Annual Water Quality Index Scores for BB5.9 (WY2011 to WY2024)

BBC5.2

The contributing area between BBC5.9 and BBC5.2 includes primarily residential land use with inputs from a large segment of E. Fourth Plain Blvd. with a small portion of SR 500 and commercial/industrial areas. Upstream riparian canopy cover within 0.5 mile of BBC5.2 is 40 percent. Septic systems are mostly clustered to the west of the creek and north of SR 500. Stormwater is largely managed through infiltration facilities such as dry wells as well as conveyance that discharges to the creek. Monitoring station BBC5.2 is located in a residential neighborhood with open access to the creek through private property. Potential localized sources of pollution at this station may include pet waste and fertilizer nutrient runoff.

Monitoring at this station typically occurred in the late morning or early afternoon as sampling was conducted from upstream to downstream stations. Key results pertaining to water quality at BBC5.9 are summarized below.

WY2024

Similar to BBC5.9, BBC5.2 generally had similar concentrations (overlapping interquartile ranges) to other mainstem BBC stations for most parameters during WY2024 with some exceptions. As shown in the boxplots in Appendix D-2, the following parameters were unique from other stations:

- Dissolved Oxygen. Median base flow dissolved oxygen concentration (9.54 mg/L) was below the water quality criterion whereas the median storm flow concentration (10.07 mg/L) was above the criterion. Dissolved oxygen concentrations at BBC5.2 did not exhibit many substantial differences from other mainstem BBC stations.
- Metals. Copper and zinc concentrations were not substantially different than most nearby mainstem BBC stations, but generally had low concentrations compared to other stations, particularly tributaries and downstream mainstem stations. No metals exceeded applicable water quality criteria during any events.
- *E coli.* Base flow *E. coli* bacteria concentrations were within water quality criteria while storm flow concentrations exceeded the geomean and 90th percentile criteria. Despite exceeding the criteria, BBC5.2 had relatively low concentrations during storm flow events and had the lowest storm flow 90th percentile of all stations (399 CFU/100 mL).

Trend Analysis

Temporal Trends

The following temporal trends were detected based on the seasonal Kendall's Tau trends (Appendix E). Bold text indicates the trend is associated with improving water quality. Significant increasing trends in base flow samples were identified for the following parameters:

- Conductivity (combined and dry seasons)

- SRP (combined and dry seasons)
- Chloride (combined and dry seasons)
- Total copper (dry season)

Significant decreasing trends in base flow samples were identified for the following parameters:

- TSS (combined and dry season)
- Nitrate + nitrite (combined and dry season)
- Fecal coliform (combined and dry season)

Significant trends in storm flow samples were identified for the following parameters:

- Total phosphorus had a significant decreasing trend
- Chloride had a significant increasing trend

Spatial Trends

The following spatial trends were identified based on a Friedman and Nemenyi post-hoc test (Appendix F). Select parameters that exhibited both significantly higher and lower concentrations than other stations include:

- Dissolved Oxygen. Base and storm flow measurements were significantly higher than BBC10.4 and BBC5.9 and were significantly lower than COL0.0.
- Zinc.
    - Storm flow total zinc was significantly lower than BUR0.0 and COL0.0.
    - Storm flow dissolved zinc and base flow total zinc were both significantly higher than one other station (BBC2.6 and BBC10.4, respectively).

Water Quality Index

The seasonal Kendall's Tau analysis on monthly WQI scores did not detect a significant trend for the overall WQI score during any seasons. Significant increasing trends in individual WQI scores were detected at BBC5.2, which was the only station without any decreasing significant trends. The significant increasing trends in individual WQI scores include:

- TSS
- Sediment Score
- Fecal coliform

All significant trends at BBC5.2 were present in both combined and dry seasons' trend analyses.

The individual total nitrogen, nutrients, and total phosphorus scores were consistently the lowest individual WQI scores (Figure C-8) and patterns in these individual scores appear to be mirrored in the overall WQI score more than other individual scores.

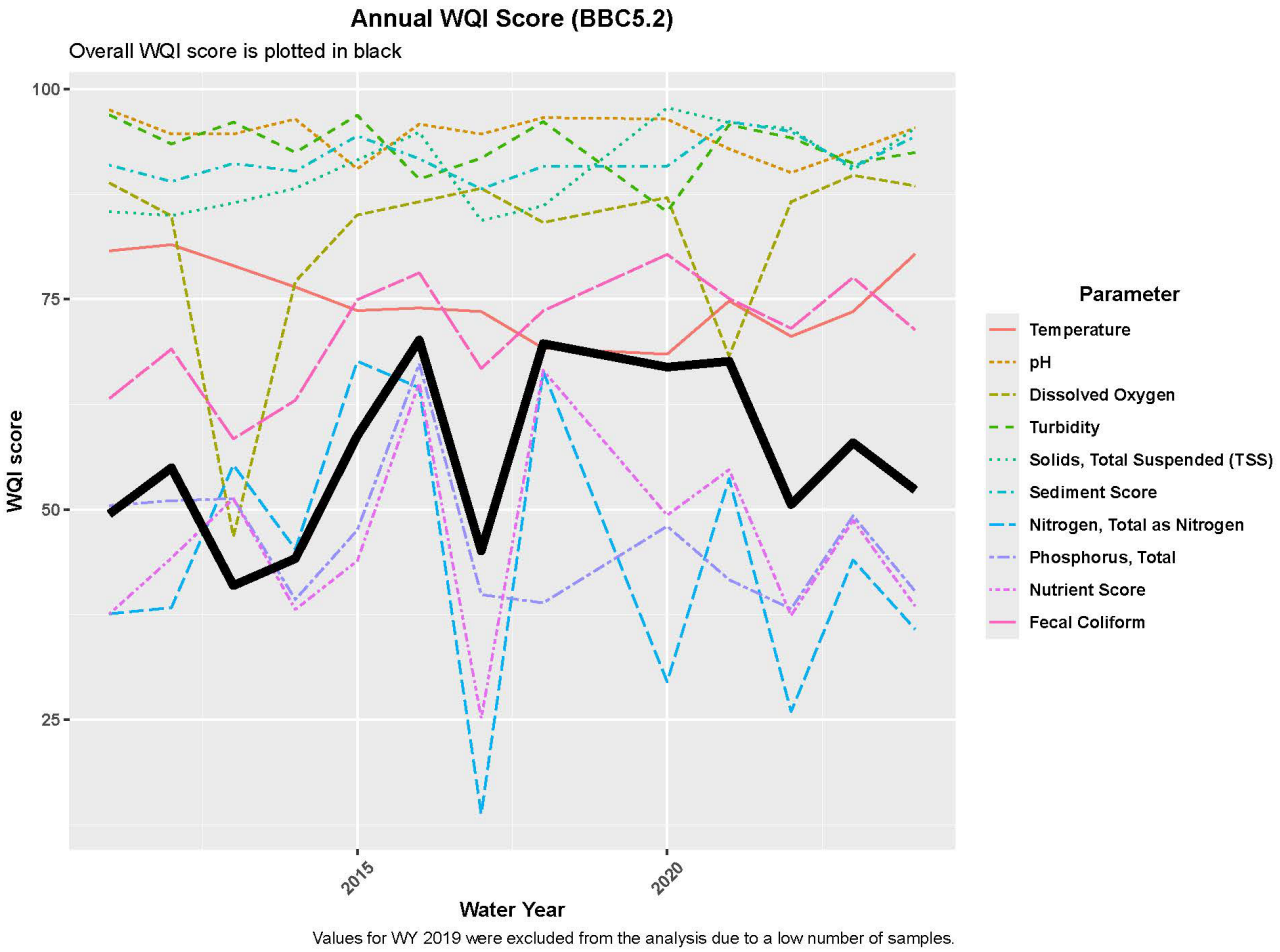

Figure C-8. Annual Water Quality Index Scores for BBC5.2 (WY2011 to WY2024)

BBC2.6

BBC2.6, located in Leverich Park, is the second furthest downstream main stem monitoring station. The contributing area between BBC5.2 and BBC2.6 includes primarily residential land use with inputs from a portion of SR 500 and commercial/industrial areas. Upstream riparian canopy cover within 0.5 mile of BBC2.6 is 46 percent. There is high septic system density in the basin, particularly to the north of the creek. Stormwater is managed through infiltration facilities such as dry wells as well as conveyance that discharges to the creek.

Monitoring at this station typically occurred in the early afternoon as sampling was conducted from upstream to downstream stations. Key results pertaining to water quality at BBC2.6 are summarized below.

WY2024

Located in the lower basin of the watershed, mainstem station BBC2.6 generally had similar concentrations (overlapping interquartile ranges) to other BBC stations in the lower reach for most parameters during WY2024 with some exceptions. As shown in the boxplots in Appendix D-2, the following parameters were unique from other stations:

- Water Temperature. The 7-DADmax temperature exceeded the criterion of 17.5°C for 39 percent of the monitoring period, which was equal to the median percent exceedance across all stations selected for continuous temperature monitoring.
- pH. All base and storm flow pH measurements were within the water quality criteria and were substantially higher than most other upstream and midstream BBC stations.
- Dissolved Oxygen. The median base flow dissolved oxygen concentration (9.47 mg/L) was below the water quality criteria while the median storm flow concentration (10.60 mg/L) was above the criterion. Concentrations were generally comparable to nearby downstream BBC stations.
- Turbidity. Turbidity increased substantially from base to storm flow events (medians of 3.59 and 14.5 NTU, respectively) and storm flow concentrations were substantially higher than all other mainstem BBC stations except for BBC1.6. This pattern was also present for TSS.
- Copper. Total and dissolved copper was monitored only during storm events for the WY2024 program. Total copper concentrations were substantially higher than other mainstem BBC stations except for BBC8.4 and BBC1.6 but had fewer dissolved copper substantial differences. Copper did not exceed the water quality criteria during any events.
- *E. coli*. Base and storm flow *E. coli* bacteria concentrations exceeded both the geomean and 90th percentile criteria. While base and storm flow *E. coli* concentrations were not substantially higher than other stations, the base flow geomean (152 CFU/100 mL) was the highest of all monitoring stations.

Trend Analysis

Temporal Trends

The following temporal trends were detected based on the seasonal Kendall's Tau trends (Appendix E). Bold text indicates the trend is associated with improving water quality. Significant increasing trends in base flow samples were identified for the following parameters:

- Conductivity (combined and dry season)
- Turbidity (combined, wet, and dry seasons)
- SRP (combined and dry seasons)
- Chloride (combined and dry seasons)

Significant decreasing trends in base flow samples were identified for the following parameters:

- **Nitrate + nitrite** (combined and dry seasons)

Significant trends in storm flow samples were identified for the following parameters:

- Total Kjeldahl nitrogen had a significant increasing trend
- Chloride had a significant increasing trend

Spatial Trends

The following spatial trends were identified based on a Friedman and Nemenyi post-hoc test (Appendix F). Select parameters that exhibited significantly higher concentrations at BBC2.6 than other stations include:

- **pH**. Base and storm flow pH measurements were significantly higher than multiple upstream and mainstem BBC stations including BBC10.4, BBC8.8, BBC7.0, and BBC5.9.
- **Dissolved Oxygen**. Base and storm flow dissolved oxygen measurements were significantly higher than three and four other stations, respectively, including BBC10.4, PET0.0, and BBC5.9.
- **Phosphorus**. Base flow total phosphorus and SRP were significantly higher than three and four stations, respectively, including BBC10.4, BBC8.8, and BUR0.0. During storm flow, concentrations of these two parameters were significantly higher than five and two other stations (BBC8.8, PET0.0, BBC8.4, BUR0.0, and BBC7.0 for total phosphorus and BUR0.0 and COL0.0 for SRP).

Select parameters that exhibited significantly lower concentrations at BBC2.6 than other stations include:

- **Zinc**. Base flow dissolved zinc concentrations were significantly lower than BUR0.0 and COL0.0 but no base flow significant differences were identified for total zinc. During storm flow, however, total and dissolved zinc concentrations were significantly lower than two and five stations, respectively, including BUR0.0 and COL0.0.

Target parameters that exhibited significantly higher and lower concentrations dependent on event type include:

- Copper.
    - Base flow total and dissolved copper concentrations were significantly higher than BBC10.4 and BUR0.0. Total copper was also significantly lower than PET0.0.
    - Storm flow total and dissolved copper concentrations were significantly lower than PET0.0 and COL0.0.

Water Quality Index

The seasonal Kendall's Tau analysis on monthly WQI scores did not detect a significant trend for the overall WQI score. Significant increasing trends were detected in one individual WQI score for BBC2.6 during the combined and dry seasons. Significant decreasing trends in individual WQI scores include:

- Turbidity

The individual total nitrogen, nutrient, and total phosphorus scores were, similar to other stations, the lowest individual WQI scores (Figure C-9) and negatively impacted the overall WY2024 WQI. Overall WQI scores did not appear to closely mirror any specific group of scores, but the recent decrease in overall WQI from WY2023 to WY2024 appears to be primarily driven by the three individual scores and fecal coliform score.

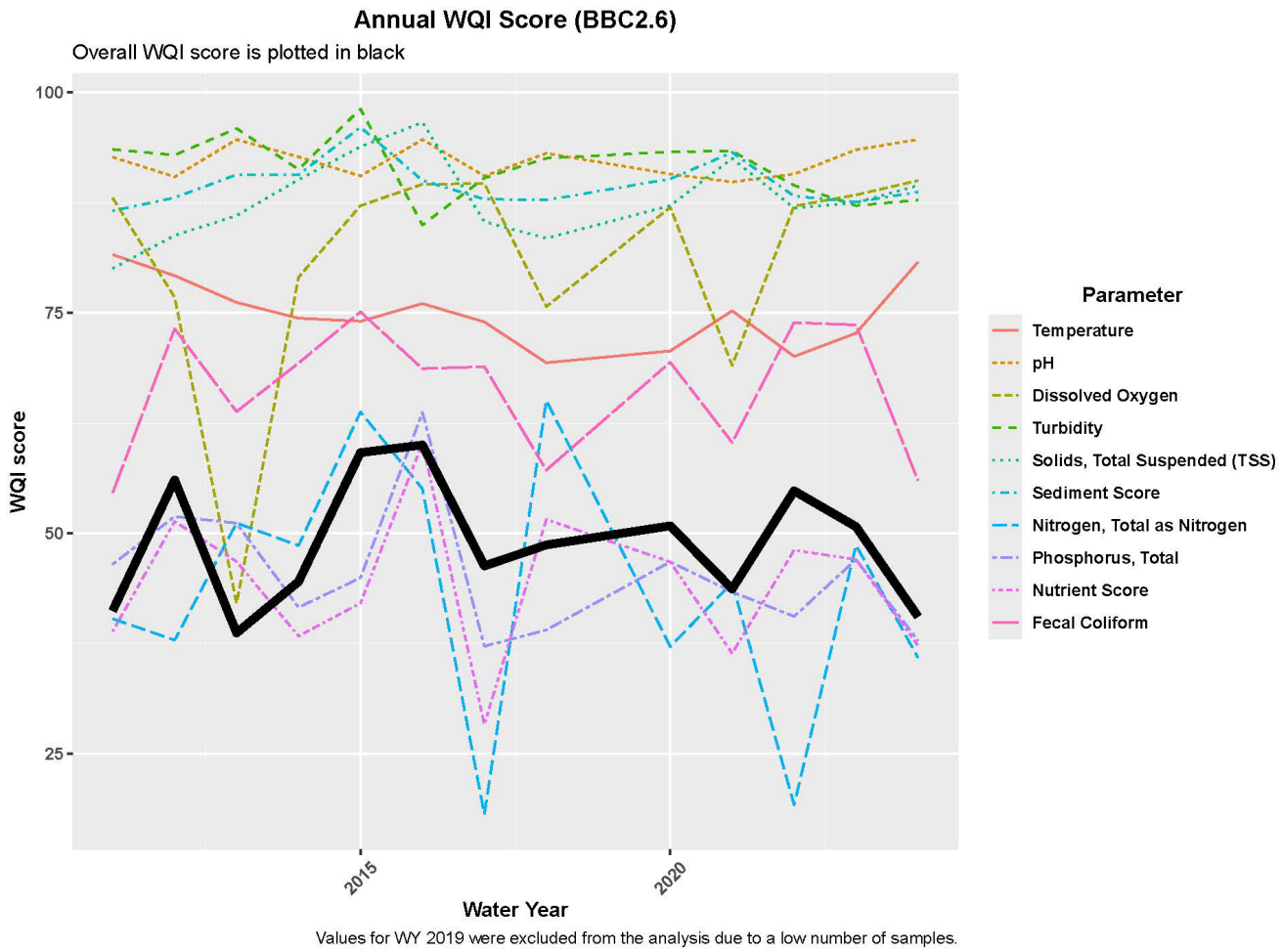

Figure C-9. Annual Water Quality Index Scores for BBC2.6 (WY2011 to WY2024)

COL0.0

Cold Creek is the third major tributary of Burnt Bridge Creek and connects to the main channel in between monitoring stations BBC 2.6 and BBC 1.6 at Hazel Dell Road. The associated monitoring station, COL0.0, is located just upstream of Cold Creek's confluence with Burnt Bridge Creek. The subbasin draining to COL0.0 includes primarily residential as well as substantial commercial/industrial land use. Upstream riparian canopy cover within 0.5 mile of COL0.0 is 56 percent.

The tributary is heavily influenced by its groundwater source during base flow conditions, which results in many noticeable differences from the main BBC channel and between the tributary's base and storm flow characteristics. The area includes septic systems distributed throughout most of the subbasin. Unlike contribution areas to the other monitoring stations, there are few mapped dry wells within the COL0.0 subbasin. Evidence of encampments have been noted by field staff around monitoring station COL0.0 along Cold Creek and in the Burnt Bridge Creek corridor.

Monitoring at this station typically occurred in the afternoon as sampling was conducted from upstream to downstream stations. Key results pertaining to water quality at COL0.0 are summarized below.

WY2024

In WY2024, tributary station COL0.0 exhibited some unique water quality characteristics from nearby mainstem BBC stations. As shown in the boxplots in Appendix D-2, notable water quality characteristics include:

- pH. Base and storm flow pH measurements were all within criteria and were substantially higher than all stations except for BBC2.6 and BBC1.6.
- Dissolved Oxygen. COL0.0 was the only monitoring station in WY2024 with all base and storm flow dissolved oxygen concentrations above the water quality criterion.
- Turbidity. Base flow turbidity (median of 4.00 NTU) was comparable to most stations with few substantial differences. However, storm flow turbidity (median of 35.2 NTU) was substantially higher than all other stations. This pattern was similar but not as pronounced for TSS.
- Copper. Total and dissolved copper was monitored only during storm events for the WY2024 program. Total copper was substantially higher than all other stations except tributary station PET0.0 and dissolved copper was substantially higher than all stations except BBC1.6. Copper exceeded the water quality criteria at COL0.0 on one occasion on December 5, 2023.
- Zinc. Total and dissolved zinc was monitored only during storm events for the WY2024 program. Total zinc was substantially higher than all other stations and dissolved zinc was substantially higher than all mainstem BBC stations except BBC7.0 and BBC5.2. Zinc did not exceed the water quality criteria during any events.
- *E. coli*. COL0.0 exceeded both *E. coli* criteria (geomean and 90th percentile) during base and storm flow events. Storm flow concentrations were substantially higher than mainstem BBC stations BBC8.4, BBC5.9, and BBC5.2 and had the highest geomean of any station (916 CFU/100 mL).

Trend Analysis

Temporal Trends

The following temporal trends were detected based on the seasonal Kendall's Tau trends (Appendix E). Bold text indicates the trend is associated with improving water quality. Significant increasing trends in base flow samples were identified for the following parameters:

- Conductivity (combined and dry seasons)
- Turbidity (combined and dry seasons)
- Nitrate + nitrite (combined and dry seasons)
- Total nitrogen (combined and dry seasons)
- SRP (combined and dry seasons)
- Chloride (dry season)
- Total copper (combined seasons)

Significant decreasing trends in base flow samples were identified for the following parameters:

- Dissolved oxygen (dry season)
- **Hardness** (combined, wet, and dry seasons)

No significant trends were identified in storm flow samples.

Spatial Trends

The following spatial trends were identified based on a Friedman and Nemenyi post-hoc test (Appendix F). Select parameters that exhibited significantly higher concentrations at COL0.0 than other stations include:

- **pH**. Base and storm flow pH measurements were significantly higher than other tributary stations and several upstream and midstream BBC stations including BBC10.4, BBC8.8, BBC7.0, and BBC5.9.
- **Dissolved Oxygen**. Base and storm flow dissolved oxygen measurements were significantly higher than most stations including BBC10.4, PET0.0, BBC8.4, BBC7.0, BBC5.9, and BBC5.2.
- **Turbidity**. Storm flow turbidity measurements were significantly higher than stations BBC8.8, PET0.0, BBC8.4, BBC7.0, BBC5.9, and BBC5.2. Fewer significant differences were present for base flow turbidity.
- **Zinc**. Base flow total and dissolved zinc concentrations were significantly higher than a few stations (BBC10.4 and BBC8.8 for total zinc and BBC10.4, BBC2.6, and BBC1.6 for dissolved zinc). Storm flow total and dissolved zinc concentrations were significantly higher than eight and five other stations respectively (all stations except for BUR0.0 and BBC1.6 for total zinc and PET0.0, BBC8.4, BBC5.9, BBC2.6, and BBC1.6 for dissolved zinc).
- ***E. coli***. Storm flow *E. coli* concentrations were significantly higher than BBC8.4, BBC7.0, and BBC5.9.

Select parameters that exhibited significantly lower concentrations at COL0.0 than other stations include:

- **Phosphorus**. Base flow total phosphorus was significantly lower PET0.0, BBC7.0, BBC5.9, BBC2.6, and BBC1.6. Storm flow SRP was significantly lower than BBC10.4, PET0.0, BBC7.0, BC5.9, BBC5.2, and BBC2.6.

Target parameters that exhibited significantly higher and lower concentrations dependent on event type include:

- **Copper**. Total copper was significantly lower than PET0.0, BBC8.4, and BBC7.0 during base flow events, but was significantly higher than all mainstem stations except for BBC1.6 during storm flow events. Dissolved copper followed a similar pattern between base and storm flow events.

Water Quality Index

The seasonal Kendall's Tau analysis on monthly WQI scores did not detect a significant trend for the overall WQI score. Significant decreasing trends in individual WQI scores were detected at COL0.0, but no significant increasing trends were identified. COL0.0 has a relatively high frequency of decreasing individual WQI trends. Significant decreasing trends in individual WQI scores include:

- Temperature
- Turbidity
- Total Nitrogen

All significant trends at COL0.0 were present in both combined and dry seasons' trend analyses only.

The individual total nitrogen score was consistently the lowest individual WQI score in recent years (Figure C-10) and negatively impacted the overall WY2024 WQI score. Relatively consistent high scores for temperature, pH, dissolved oxygen, turbidity, TSS, and sediment resulted in an overall WQI score that tracked closely with fluctuating fecal coliform, nutrients, and total phosphorus scores.

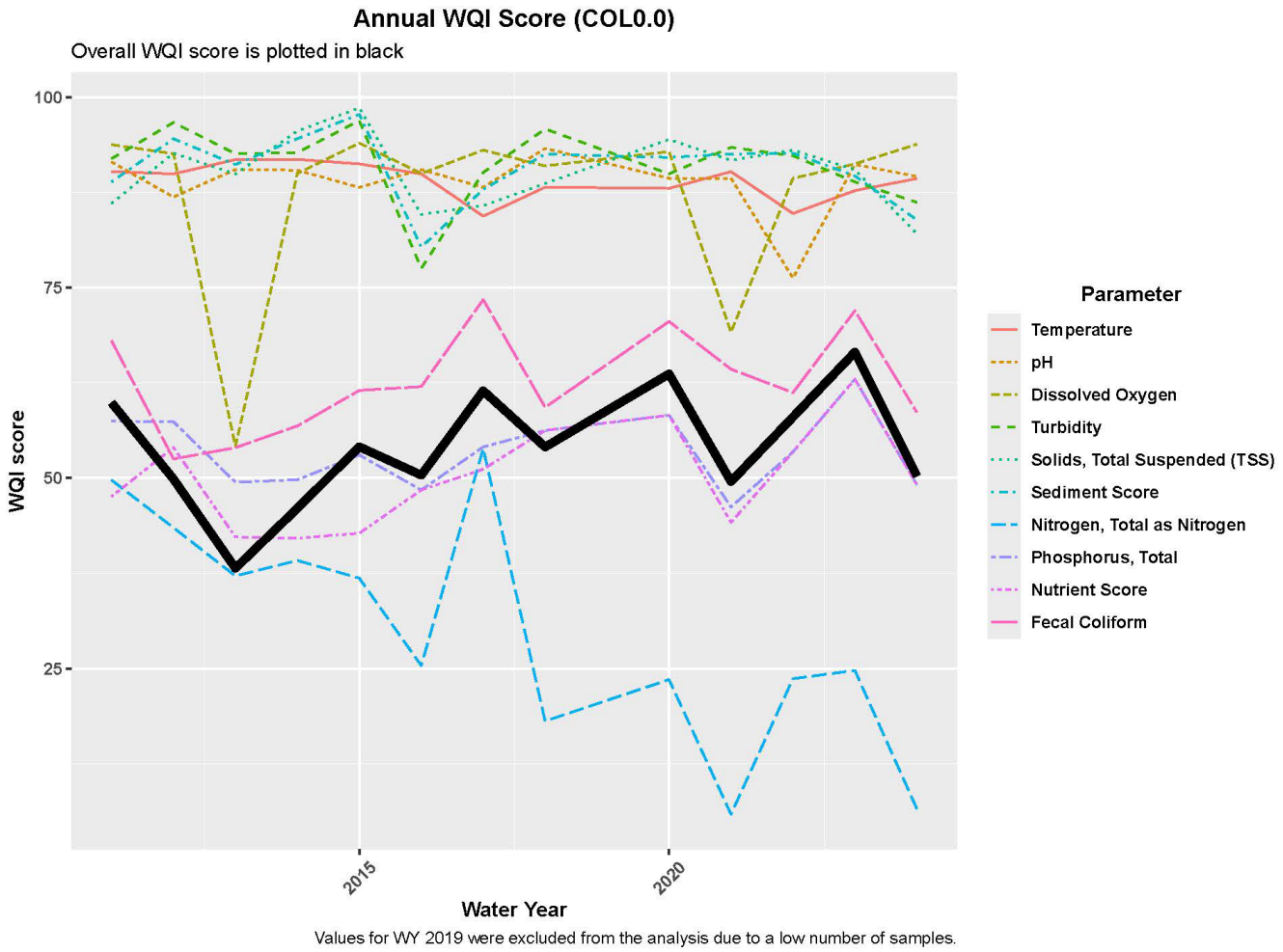

Figure C-10. Annual Water Quality Index Scores for COL0.0 (WY2011 to WY2024)

BBC1.6

BBC1.6, located along the Burnt Bridge Creek Greenway near Alki Road, is the most downstream monitoring location in the lower watershed basin. Water quality at this station is likely impacted by houseless encampments and influence from Cold Creek during storm flow conditions. The contributing area between BBC2.6 and BBC1.6, includes primarily residential land use with inputs from a portion of Interstate 5 (I-5) and commercial/industrial areas. Upstream riparian canopy cover within 0.5 mile of BBC1.6 is 56 percent. There are relatively few septic systems in the area. Stormwater is managed through infiltration facilities such as dry wells as well as conveyance that discharges to the creek.

Monitoring at this station typically occurred in the afternoon or late afternoon as sampling was conducted from upstream to downstream stations. Key results pertaining to water quality at BBC1.6 are summarized below.

WY2024

Mainstem station BBC1.6 generally exhibited similar concentrations (overlapping interquartile ranges) to upstream station BBC2.6 for most parameters during WY2024 with some exceptions which may be influenced by nearby tributary Cold Creek. As shown in the boxplots in Appendix D-2, the following parameters were unique from other stations:

- Water Temperature. The 7-DADmax temperature exceeded the criterion of 17.5°C for 32 percent of the monitoring period, which was below the median percent exceedance across all stations selected for continuous temperature monitoring.
- pH. All pH measurements were within water quality criteria during base and storm flow events. Field pH measurements were substantially higher than all other stations except BBC2.6 and COL0.0 during base and storm flow events.
- Dissolved Oxygen. Median base flow concentration (9.49 mg/L) was below the water quality criterion, but storm flow concentrations during all events were above the criterion.
- Turbidity. Storm flow turbidity (median of 18.1 NTU) was substantially higher than base flow turbidity (median of 5.0 NTU). Storm flow turbidity was also substantially higher than all other mainstem BBC stations except for BBC2.6.
- Copper. Total and dissolved copper was monitored only during storm events for the WY2024 program. Copper concentrations, particularly total copper, were substantially higher than most other mainstem BBC stations with the highest median (5.75 and 1.96 ug/L for total and dissolved copper, respectively) of any mainstem BBC station.
- *E. coli*. *E. coli* bacteria concentrations exceeded both criteria (geomean and 90th percentile) during base and storm flow events. Storm flow concentrations were substantially higher than mainstem BBC stations BBC8.4 and BBC5.9 and had the highest geomean of any mainstem BBC station (505 CFU/100 mL).

Trend Analysis

Temporal Trends

The following temporal trends were detected based on the seasonal Kendall's Tau trends (Appendix E). Bold text indicates the trend is associated with improving water quality. Significant increasing trends in base flow samples were identified for the following parameters:

- Conductivity (combined and dry seasons)
- Turbidity (combined and dry seasons)
- SRP (combined and dry seasons)
- Chloride (combined and dry seasons)

Significant decreasing trends in base flow samples were identified for the following parameters:

- **Nitrate + nitrite** (combined and dry seasons)
- **Hardness** (combined seasons)
- **Fecal coliform** (combined, wet, and dry seasons)

Significant trends in storm flow samples were identified for the following parameters:

- Nitrate + nitrite had a significant increasing trend.

Spatial Trends

The following spatial trends were identified based on a Friedman and Nemenyi post-hoc test (Appendix F). Select parameters that exhibited significantly higher concentrations at BBC1.6 than other stations include:

- **pH**. Base and storm flow pH measurements were significantly higher than multiple upstream and mainstem BBC stations including BBC10.4, BBC8.8, BBC7.0, and BBC5.9.
- **Dissolved oxygen**. Base and storm flow dissolved oxygen measurements were significantly higher than several upstream and mainstem BBC stations including BBC10.4, BBC7.0, and BBC5.9.
- **Phosphorus**. Base flow total phosphorus concentrations were significantly higher than BBC10.4, BBC8.8, BBC8.4, and BUR0.0. Storm flow total phosphorus concentrations were significantly higher than BBC8.8, PET0.0, BBC8.4, and BUR0.0. SRP exhibited a similar pattern during base flow but with fewer significant differences.
- **Copper**. Base and storm flow total and dissolved copper concentrations were significantly higher than multiple mainstem BBC stations including BBC10.4 and BBC8.8. The most significant differences were for storm flow total copper which was significantly higher than four mainstem BBC stations.

- **Zinc**. Storm flow dissolved zinc concentrations were significantly lower than several stations, including tributaries, BUR0.0, BBC7.0, and COL0.0. Total zinc base and storm flow concentrations were significantly higher than one other station but otherwise were not significantly different from other stations.

Water Quality Index

The seasonal Kendall's Tau analysis on monthly WQI scores did not detect a significant trend for the overall WQI score. Significant increasing trends were detected in one individual WQI score for BBC1.6 during the combined and dry seasons. Significant decreasing trends in individual WQI scores include:

- Turbidity

The individual total nitrogen, nutrient, and total phosphorus scores were, similar to other stations, the lowest individual WQI scores (Figure C-11) and negatively impacted the overall WY2024 WQI. Overall WQI scores did not appear to closely mirror any specific group of scores.

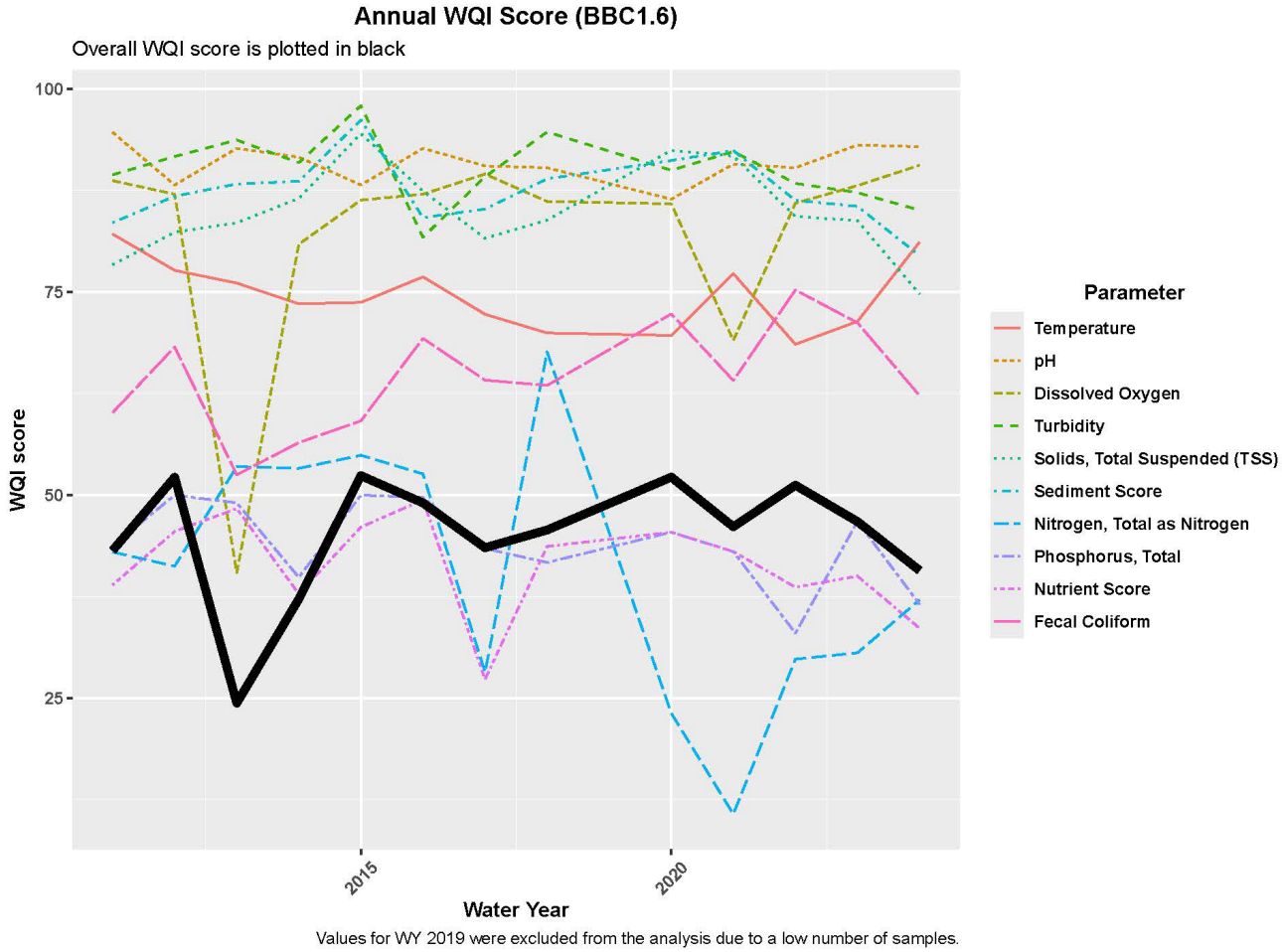

Figure C-11. Annual Water Quality Index Scores for BBC1.6 (WY2011 to WY2024)

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APPENDIX D

WY2024 Tables and Figures

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Table D-1. WY2024 Base Flow Summary Statistics Table										
Station	**Criteria[2]**	**n**	**Minimum**	**25th Percentile**	**Median**	**Mean[1]**	**75th Percentile**	**90th Percentile**	**Maximum**	**Percent Detected**
Conductivity (µS/cm)										
BBC10.4	NA	7	158	170	182	183	192	204	217	100%
BBC8.8	NA	7	158	170	182	181	188	199	210	100%
PET0.0	NA	7	201	214	239	229	244	247	247	100%
BBC8.4	NA	7	168	187	202	201	219	223	224	100%
BUR0.0	NA	7	186	201	203	206	209	221	231	100%
BBC7.0	NA	7	169	191	205	204	221	226	227	100%
BBC5.9	NA	7	169	190	204	204	222	228	230	100%
BBC5.2	NA	7	170	192	205	204	222	226	229	100%
BBC2.6	NA	7	171	194	208	206	224	228	228	100%
COL0.0	NA	7	195	239	276	254	277	278	278	100%
BBC1.6	NA	7	172	185	210	206	229	232	233	100%
Dissolved Oxygen (mg/L)										
BBC10.4	10	7	4.4	5.7	6.6	6.9	8.4	8.8	9.2	100%
BBC8.8	10	7	8.8	9.3	10.8	10.4	11.2	11.7	12.5	100%
PET0.0	10	7	8.7	9.1	9.4	9.3	9.6	9.6	9.7	100%
BBC8.4	10	7	8.6	8.9	9.8	9.8	10.8	11.0	11.1	100%
BUR0.0	10	7	7.8	9.0	9.2	9.7	10.8	11.0	11.0	100%
BBC7.0	10	7	7.7	8.3	10.1	9.7	10.6	11.5	12.3	100%
BBC5.9	10	7	5.7	7.2	8.8	8.4	9.7	10.1	10.7	100%
BBC5.2	10	7	9.1	9.2	9.5	10.1	10.7	11.3	12.0	100%
BBC2.6	10	7	9.3	9.3	9.5	10.4	11.4	12.0	12.8	100%
COL0.0	10	7	10.0	10.2	10.4	10.8	11.6	11.8	11.9	100%
BBC1.6	10	7	9.4	9.5	9.5	10.5	11.5	12.1	12.9	100%
***E. coli* (CFU/100mL)**										
BBC10.4	100-320	7	13	21	147	79	210	380	579	100%
BBC8.8	100-320	7	20	34	56	44	63	67	68	100%
PET0.0	100-320	7	10	62	105	82	133	255	435	100%
BBC8.4	100-320	7	11	42	66	67	132	234	326	100%
BUR0.0	100-320	7	15	59	84	124	374	867	1300	100%
BBC7.0	100-320	7	11	30	73	67	188	252	276	100%
BBC5.9	100-320	7	13	41	60	78	167	351	548	100%
BBC5.2	100-320	7	13	43	60	67	104	237	411	100%
BBC2.6	100-320	7	18	60	187	152	489	643	687	100%
COL0.0	100-320	7	15	48	99	112	299	611	980	100%
BBC1.6	100-320	7	11	40	276	109	336	362	387	100%
Nitrate+Nitrite as Nitrogen (mg/L)										
BBC10.4	0.15	7	1.1	1.4	1.9	1.8	2.1	2.3	2.4	100%
BBC8.8	0.15	7	1.0	1.4	1.6	1.7	2.0	2.2	2.4	100%
PET0.0	0.15	7	1.4	1.4	1.6	1.6	1.8	1.8	1.9	100%
BBC8.4	0.15	7	1.2	1.4	1.5	1.7	2.0	2.1	2.2	100%
BUR0.0	0.15	7	1.6	1.8	2.1	2.2	2.6	2.7	2.8	100%
BBC7.0	0.15	7	1.1	1.1	1.2	1.4	1.8	1.9	2.0	100%
BBC5.9	0.15	7	1.0	1.1	1.1	1.4	1.7	1.9	1.9	100%
BBC5.2	0.15	7	1.1	1.2	1.3	1.5	1.7	1.9	1.9	100%
BBC2.6	0.15	7	1.2	1.3	1.3	1.5	1.7	1.9	1.9	100%
COL0.0	0.15	7	1.6	1.8	1.9	1.9	2.0	2.2	2.2	100%
BBC1.6	0.15	7	1.2	1.3	1.4	1.5	1.7	1.8	1.9	100%
Nitrogen, Total as Nitrogen (mg/L)										
BBC10.4	0.38	7	1.6	2.1	2.2	2.3	2.6	2.9	2.9	100%
BBC8.8	0.38	7	1.4	2.1	2.4	2.5	2.9	3.5	3.7	100%
PET0.0	0.38	7	1.9	2.0	2.1	2.2	2.3	2.5	2.6	100%
BBC8.4	0.38	7	1.9	1.9	2.1	2.3	2.5	2.9	3.3	100%
BUR0.0	0.38	7	2.2	2.4	2.6	2.8	3.2	3.3	3.4	100%
BBC7.0	0.38	7	1.6	1.9	2.0	2.1	2.4	2.5	2.6	100%
BBC5.9	0.38	7	1.5	1.5	1.8	2.0	2.2	2.7	3.2	100%
BBC5.2	0.38	7	1.6	1.8	2.0	2.1	2.2	2.8	3.3	100%
BBC2.6	0.38	7	1.8	1.8	1.9	2.3	2.3	3.2	4.4	100%
COL0.0	0.38	7	2.0	2.2	2.4	2.7	2.6	3.5	4.6	100%
BBC1.6	0.38	7	1.6	1.8	2.1	2.1	2.3	2.6	2.8	100%
Nitrogen, Total Kjeldahl (mg/L)										
BBC10.4	NA	7	0.3	0.5	0.6	0.6	0.7	0.7	0.7	100%
BBC8.8	NA	7	0.4	0.7	0.7	0.8	1.0	1.2	1.4	100%
PET0.0	NA	7	0.3	0.5	0.6	0.6	0.7	0.8	0.8	100%
BBC8.4	NA	7	0.4	0.4	0.5	0.6	0.7	1.0	1.2	100%
BUR0.0	NA	7	0.4	0.5	0.6	0.6	0.7	0.8	1.0	100%
BBC7.0	NA	7	0.5	0.5	0.7	0.7	0.8	0.8	0.8	100%
BBC5.9	NA	7	0.4	0.4	0.5	0.6	0.6	0.9	1.4	100%
BBC5.2	NA	7	0.4	0.5	0.5	0.6	0.7	1.0	1.4	100%
BBC2.6	NA	7	0.5	0.5	0.6	0.8	0.6	1.4	2.5	100%
COL0.0	NA	7	0.3	0.4	0.4	0.8	0.5	1.5	3.0	100%
BBC1.6	NA	7	0.4	0.4	0.5	0.6	0.7	0.9	1.0	100%
Orthophosphate as Phosphorus (mg/L)										
BBC10.4	NA	7	0.06	0.07	0.08	0.08	0.09	0.09	0.10	100%
BBC8.8	NA	7	0.06	0.06	0.07	0.07	0.08	0.08	0.08	100%
PET0.0	NA	7	0.09	0.10	0.13	0.12	0.14	0.14	0.15	100%
BBC8.4	NA	7	0.07	0.08	0.09	0.09	0.10	0.11	0.12	100%
BUR0.0	NA	7	0.04	0.05	0.07	0.07	0.09	0.10	0.10	100%
BBC7.0	NA	7	0.08	0.08	0.11	0.10	0.11	0.12	0.13	100%
BBC5.9	NA	7	0.08	0.09	0.10	0.11	0.13	0.13	0.13	100%
BBC5.2	NA	7	0.08	0.08	0.10	0.10	0.13	0.13	0.14	100%
BBC2.6	NA	7	0.08	0.09	0.10	0.11	0.13	0.13	0.14	100%
COL0.0	NA	7	0.04	0.07	0.10	0.09	0.11	0.12	0.14	100%
BBC1.6	NA	7	0.07	0.09	0.12	0.12	0.14	0.14	0.15	100%

Table D-1. WY2024 Base Flow Summary Statistics Table										
Station	**Criteria[2]**	**n**	**Minimum**	**25th Percentile**	**Median**	**Mean[1]**	**75th Percentile**	**90th Percentile**	**Maximum**	**Percent Detected**
pH										
BBC10.4	6.5-8.5	7	6.4	6.5	6.6	6.6	6.7	6.8	6.9	100%
BBC8.8	6.5-8.5	7	6.8	7.1	7.4	7.3	7.5	7.6	7.7	100%
PET0.0	6.5-8.5	7	7.1	7.1	7.3	7.2	7.4	7.4	7.4	100%
BBC8.4	6.5-8.5	7	7.0	7.1	7.5	7.3	7.5	7.5	7.5	100%
BUR0.0	6.5-8.5	7	6.9	6.9	7.0	7.0	7.1	7.1	7.1	100%
BBC7.0	6.5-8.5	7	6.9	7.2	7.3	7.4	7.6	7.8	8.0	100%
BBC5.9	6.5-8.5	7	6.8	7.2	7.3	7.2	7.4	7.4	7.5	100%
BBC5.2	6.5-8.5	7	7.0	7.4	7.6	7.5	7.7	7.8	7.8	100%
BBC2.6	6.5-8.5	7	7.4	7.7	7.8	7.8	7.9	7.9	7.9	100%
COL0.0	6.5-8.5	7	7.7	7.9	8.0	7.9	8.0	8.1	8.1	100%
BBC1.6	6.5-8.5	7	7.5	7.7	7.8	7.8	7.9	7.9	8.0	100%
Phosphorus, Total										
BBC10.4	0.04	7	0.08	0.08	0.10	0.10	0.11	0.12	0.14	100%
BBC8.8	0.04	7	0.07	0.08	0.08	0.09	0.09	0.10	0.12	100%
PET0.0	0.04	7	0.09	0.10	0.11	0.12	0.13	0.15	0.17	100%
BBC8.4	0.04	7	0.09	0.10	0.10	0.10	0.11	0.11	0.11	100%
BUR0.0	0.04	7	0.04	0.05	0.08	0.07	0.09	0.10	0.10	100%
BBC7.0	0.04	7	0.10	0.11	0.12	0.12	0.13	0.13	0.14	100%
BBC5.9	0.04	7	0.09	0.10	0.11	0.11	0.12	0.13	0.13	100%
BBC5.2	0.04	7	0.10	0.10	0.11	0.11	0.12	0.12	0.13	100%
BBC2.6	0.04	7	0.09	0.10	0.10	0.11	0.12	0.13	0.13	100%
COL0.0	0.04	7	0.06	0.07	0.09	0.09	0.10	0.11	0.13	100%
BBC1.6	0.04	7	0.09	0.10	0.12	0.11	0.13	0.13	0.13	100%
Total Suspended Solids (mg/L)										
BBC10.4	NA	7	1.2	2.4	4.5	4.5	5.6	7.5	9.8	100%
BBC8.8	NA	7	1.2	3.5	3.6	5.9	8.0	10.6	13.8	100%
PET0.0	NA	7	1.6	2.4	3.0	6.1	3.1	12.8	27.4	100%
BBC8.4	NA	7	3.1	3.4	3.9	4.6	6.0	6.2	6.2	100%
BUR0.0	NA	7	1.0	1.4	2.4	10.7	10.0	27.4	48.9	86%
BBC7.0	NA	7	3.1	6.5	8.3	9.0	11.5	14.1	15.9	100%
BBC5.9	NA	7	2.1	2.6	3.2	3.7	3.8	5.3	7.6	100%
BBC5.2	NA	7	2.0	2.5	2.7	3.7	3.8	5.7	8.6	100%
BBC2.6	NA	7	1.8	3.2	5.7	5.4	6.5	8.4	11.1	100%
COL0.0	NA	7	1.0	2.0	2.7	5.8	5.4	12.2	22.3	100%
BBC1.6	NA	7	1.3	5.6	8.9	10.0	12.4	18.0	24.2	100%
Temperature (°C)										
BBC10.4	17.5	7	5.3	8.5	14.9	12.1	15.4	16.2	16.6	100%
BBC8.8	17.5	7	5.0	8.7	16.5	12.7	16.8	16.8	16.9	100%
PET0.0	17.5	7	12.3	13.1	15.4	15.0	16.8	17.5	17.6	100%
BBC8.4	17.5	7	7.7	9.7	15.8	13.4	16.9	17.2	17.2	100%
BUR0.0	17.5	7	6.6	9.7	13.4	12.1	14.6	15.5	15.9	100%
BBC7.0	17.5	7	5.6	9.4	17.2	13.4	17.3	17.5	17.9	100%
BBC5.9	17.5	7	4.7	9.2	17.0	13.1	17.2	17.2	17.2	100%
BBC5.2	17.5	7	5.3	9.3	17.2	13.3	17.3	17.4	17.4	100%
BBC2.6	17.5	7	4.3	9.1	17.0	13.0	17.1	17.2	17.3	100%
COL0.0	17.5	7	6.8	9.1	13.1	11.6	14.1	14.4	14.8	100%
BBC1.6	17.5	7	4.2	9.0	16.8	12.9	16.9	17.0	17.2	100%
Turbidity (NTU)										
BBC10.4	NA	7	1.6	2.0	2.2	3.5	4.9	6.8	7.2	100%
BBC8.8	NA	7	2.2	2.8	3.8	4.6	4.9	7.8	11.0	100%
PET0.0	NA	7	1.1	1.8	2.0	3.2	2.5	5.8	10.8	100%
BBC8.4	NA	7	1.9	3.0	3.7	3.5	4.2	4.5	4.5	100%
BUR0.0	NA	7	1.1	1.6	2.1	2.3	2.9	3.3	3.8	100%
BBC7.0	NA	7	2.4	4.3	5.4	5.6	7.1	7.7	8.6	100%
BBC5.9	NA	7	2.2	2.6	3.0	3.7	4.6	5.8	6.6	100%
BBC5.2	NA	7	2.1	2.2	2.5	3.4	4.0	5.7	6.7	100%
BBC2.6	NA	7	2.7	3.2	3.6	4.7	5.9	7.0	8.2	100%
COL0.0	NA	7	1.3	2.8	4.0	3.7	4.5	5.2	6.0	100%
BBC1.6	NA	7	2.3	4.0	5.0	5.2	6.8	7.7	7.8	100%

C = Celsius mg/L = milligram/L mL = milliliter NTU = nephelometric turbidity units CFU = Colony forming units MPN = Most probable number

[1]Geometric mean used for *E. coli* results

[2] Criteria outlined in Main Text Table 7

Table D-2. WY2024 Storm Summary Statistics Table										
Station	**Criteria[2]**	**n**	**Minimum**	**25th Percentile**	**Median**	**Mean[1]**	**75th Percentile**	**90th Percentile**	**Maximum**	**Percent Detected**
Conductivity (µS/cm)										
BBC10.4	NA	4	93	109	116	118	126	139	148	100%
BBC8.8	NA	4	76	103	112	112	121	136	147	100%
PET0.0	NA	4	68	89	109	116	136	162	179	100%
BBC8.4	NA	4	80	98	110	113	125	143	155	100%
BUR0.0	NA	4	32	39	52	68	81	115	137	100%
BBC7.0	NA	4	74	104	115	115	126	144	156	100%
BBC5.9	NA	4	93	116	129	126	138	148	155	100%
BBC5.2	NA	4	87	109	123	122	136	147	155	100%
BBC2.6	NA	4	84	91	98	109	115	139	155	100%
COL0.0	NA	4	43	53	68	81	96	126	146	100%
BBC1.6	NA	4	71	89	96	104	110	137	154	100%
Copper, Dissolved (µg/L)										
BBC10.4	NA	5	0.9	1.2	1.3	1.6	1.5	2.4	3.0	100%
BBC8.8	NA	5	1.0	1.5	1.5	2.0	1.7	3.3	4.3	100%
PET0.0	NA	5	1.8	2.2	2.3	3.6	2.8	6.5	9.0	100%
BBC8.4	NA	5	1.5	1.6	1.9	2.5	2.3	4.0	5.1	100%
BUR0.0	NA	5	1.2	1.3	2.1	3.3	2.2	6.6	9.6	100%
BBC7.0	NA	5	1.4	1.6	1.8	2.4	1.8	3.9	5.4	100%
BBC5.9	NA	5	1.5	1.7	1.8	1.8	1.9	1.9	1.9	100%
BBC5.2	NA	5	1.5	1.7	1.8	2.0	1.8	2.7	3.3	100%
BBC2.6	NA	5	1.4	1.7	1.7	2.3	1.8	3.8	5.0	100%
COL0.0	NA	5	2.2	2.9	3.1	4.0	5.7	6.0	6.1	100%
BBC1.6	NA	5	1.5	1.9	2.0	2.6	3.0	3.9	4.5	100%
Copper, Total (µg/L)										
BBC10.4	NA	5	1.2	2.2	2.3	2.4	2.5	3.4	4.0	100%
BBC8.8	NA	5	1.5	2.7	2.7	3.0	2.8	4.4	5.5	100%
PET0.0	NA	5	4.8	7.1	7.5	13.1	17.5	24.3	28.8	100%
BBC8.4	NA	5	2.9	3.2	4.1	5.6	8.3	9.0	9.4	100%
BUR0.0	NA	5	1.8	3.2	3.5	5.6	5.9	10.4	13.4	100%
BBC7.0	NA	5	2.5	2.5	2.6	3.4	2.7	5.1	6.8	100%
BBC5.9	NA	5	2.3	2.5	2.5	2.5	2.7	2.7	2.7	100%
BBC5.2	NA	5	2.4	2.5	2.7	3.1	2.8	4.3	5.2	100%
BBC2.6	NA	5	2.5	3.2	3.4	4.6	5.2	7.4	8.9	100%
COL0.0	NA	5	3.6	9.2	13.0	11.6	14.1	16.4	17.9	100%
BBC1.6	NA	5	2.6	4.0	5.8	5.7	7.1	8.3	9.0	100%
Dissolved Oxygen (mg/L)										
BBC10.4	10	5	6.9	7.1	8.3	7.8	8.4	8.5	8.5	100%
BBC8.8	10	5	8.9	9.1	9.9	9.7	10.0	10.2	10.4	100%
PET0.0	10	5	8.1	8.3	8.8	9.0	9.9	9.9	10.0	100%
BBC8.4	10	5	8.8	8.9	9.8	9.6	10.0	10.3	10.5	100%
BUR0.0	10	5	8.7	8.9	10.0	9.9	10.5	11.2	11.7	100%
BBC7.0	10	5	7.9	8.6	9.5	9.2	9.7	9.9	10.1	100%
BBC5.9	10	5	7.1	7.8	9.2	8.5	9.3	9.3	9.4	100%
BBC5.2	10	5	9.0	9.4	10.1	9.9	10.3	10.5	10.7	100%
BBC2.6	10	5	9.8	10.1	10.6	10.7	11.0	11.5	11.8	100%
COL0.0	10	5	10.6	10.8	11.3	11.3	11.6	12.1	12.5	100%
BBC1.6	10	5	10.0	10.3	10.8	10.8	11.1	11.6	12.0	100%
***E. coli* (CFU/100mL)**										
BBC10.4	100-320	5	21	155	308	250	400	1612	2420	100%
BBC8.8	100-320	5	50	148	163	193	400	489	548	100%
PET0.0	100-320	4	84	181	495	428	1186	1926	2420	100%
BBC8.4	100-320	5	100	112	154	252	245	1550	2420	100%
BUR0.0	100-320	5	93	345	736	507	921	1292	1540	100%
BBC7.0	100-320	4	43	104	241	191	440	588	687	100%
BBC5.9	100-320	5	79	118	196	201	291	485	615	100%
BBC5.2	100-320	5	68	200	308	229	345	399	435	100%
BBC2.6	100-320	5	64	237	411	311	600	702	770	100%
COL0.0	100-320	5	168	411	1600	916	2410	2416	2420	100%
BBC1.6	100-320	5	109	300	387	505	1300	1714	1990	100%
Hardness, Total as CaCO3 (mg/L)										
BBC10.4	NA	5	35	45	48	49	58	59	60	100%
BBC8.8	NA	5	28	41	44	48	54	66	74	100%
PET0.0	NA	5	34	35	45	47	58	62	64	100%
BBC8.4	NA	5	30	42	42	49	56	67	74	100%
BUR0.0	NA	5	15	23	24	28	30	41	49	100%
BBC7.0	NA	5	27	43	43	47	56	61	64	100%
BBC5.9	NA	5	35	45	55	56	57	74	86	100%
BBC5.2	NA	5	31	45	51	49	57	59	60	100%
BBC2.6	NA	5	30	39	39	48	57	67	73	100%
COL0.0	NA	5	22	27	35	37	46	53	57	100%
BBC1.6	NA	5	28	38	42	46	56	62	66	100%
Nitrate+Nitrite as Nitrogen (mg/L)										
BBC10.4	0.15	5	1.1	1.1	1.2	1.3	1.4	1.7	1.9	100%
BBC8.8	0.15	5	0.9	1.0	1.3	1.3	1.5	1.7	1.8	100%
PET0.0	0.15	5	0.5	1.0	1.2	1.2	1.5	1.6	1.7	100%
BBC8.4	0.15	5	0.9	0.9	1.4	1.3	1.4	1.6	1.8	100%
BUR0.0	0.15	5	0.2	0.3	0.5	0.7	1.0	1.4	1.8	100%
BBC7.0	0.15	5	0.6	0.9	1.1	1.1	1.2	1.4	1.6	100%
BBC5.9	0.15	5	0.7	1.1	1.2	1.1	1.3	1.4	1.5	100%
BBC5.2	0.15	5	0.6	1.0	1.0	1.1	1.1	1.4	1.5	100%
BBC2.6	0.15	5	0.6	0.7	0.9	1.0	1.3	1.4	1.5	100%
COL0.0	0.15	5	0.2	0.3	0.4	0.5	0.5	0.8	1.1	100%
BBC1.6	0.15	5	0.5	0.7	0.8	0.9	1.1	1.3	1.5	100%
Nitrogen, Total as Nitrogen (mg/L)										
BBC10.4	0.38	5	1.8	2.0	2.3	2.2	2.3	2.4	2.5	100%

Table D-2. WY2024 Storm Summary Statistics Table										
Station	**Criteria[2]**	**n**	**Minimum**	**25th Percentile**	**Median**	**Mean[1]**	**75th Percentile**	**90th Percentile**	**Maximum**	**Percent Detected**
BBC8.8	0.38	5	1.4	1.5	2.2	2.0	2.3	2.6	2.9	100%
PET0.0	0.38	5	1.2	1.6	1.9	1.8	2.1	2.1	2.1	100%
BBC8.4	0.38	5	1.6	1.7	1.9	1.9	2.0	2.1	2.2	100%
BUR0.0	0.38	5	0.5	0.6	1.2	1.2	1.6	2.0	2.2	100%
BBC7.0	0.38	5	1.2	1.3	1.8	1.9	2.1	2.6	2.9	100%
BBC5.9	0.38	5	1.4	1.5	1.8	1.8	2.1	2.1	2.1	100%
BBC5.2	0.38	5	1.2	1.4	1.7	1.7	1.8	2.1	2.2	100%
BBC2.6	0.38	5	1.2	1.5	1.6	1.8	2.2	2.4	2.5	100%
COL0.0	0.38	5	0.6	0.7	1.2	1.4	1.4	2.5	3.3	100%
BBC1.6	0.38	5	1.0	1.4	1.6	1.8	2.5	2.6	2.7	100%
Nitrogen, Total Kjeldahl (mg/L)										
BBC10.4	NA	5	0.6	0.7	0.9	0.8	0.9	1.0	1.1	100%
BBC8.8	NA	5	0.4	0.5	0.6	0.7	0.9	1.2	1.4	100%
PET0.0	NA	5	0.4	0.4	0.4	0.6	0.7	1.0	1.1	100%
BBC8.4	NA	5	0.4	0.5	0.6	0.6	0.6	0.7	0.8	100%
BUR0.0	NA	5	0.3	0.3	0.5	0.5	0.7	0.7	0.7	100%
BBC7.0	NA	5	0.4	0.5	0.6	0.8	0.8	1.4	1.8	100%
BBC5.9	NA	5	0.4	0.6	0.6	0.6	0.7	0.8	0.9	100%
BBC5.2	NA	5	0.4	0.6	0.6	0.6	0.7	0.8	0.8	100%
BBC2.6	NA	5	0.5	0.6	0.9	0.8	0.9	0.9	1.0	100%
COL0.0	NA	5	0.4	0.4	0.8	1.0	0.9	1.7	2.2	100%
BBC1.6	NA	5	0.5	0.6	0.9	0.9	1.2	1.3	1.4	100%
Orthophosphate as Phosphorus (mg/L)										
BBC10.4	NA	5	0.07	0.07	0.08	0.08	0.10	0.10	0.10	100%
BBC8.8	NA	5	0.05	0.07	0.07	0.07	0.07	0.07	0.08	100%
PET0.0	NA	4	0.04	0.05	0.05	0.05	0.06	0.07	0.08	100%
BBC8.4	NA	5	0.05	0.06	0.06	0.07	0.07	0.09	0.09	100%
BUR0.0	NA	5	0.02	0.02	0.03	0.03	0.04	0.06	0.08	100%
BBC7.0	NA	5	0.05	0.06	0.08	0.08	0.09	0.12	0.13	100%
BBC5.9	NA	5	0.07	0.07	0.09	0.09	0.12	0.12	0.12	100%
BBC5.2	NA	5	0.06	0.07	0.09	0.08	0.09	0.10	0.10	100%
BBC2.6	NA	5	0.05	0.06	0.08	0.07	0.08	0.09	0.10	100%
COL0.0	NA	5	0.03	0.03	0.03	0.04	0.05	0.05	0.05	100%
BBC1.6	NA	5	0.05	0.06	0.07	0.07	0.08	0.08	0.08	100%
pH										
BBC10.4	6.5-8.5	5	6.3	6.4	6.5	6.4	6.5	6.5	6.6	100%
BBC8.8	6.5-8.5	5	6.5	6.6	6.6	6.7	6.8	6.8	6.9	100%
PET0.0	6.5-8.5	5	6.6	6.7	6.7	6.7	6.8	6.8	6.9	100%
BBC8.4	6.5-8.5	5	6.7	6.8	6.9	6.9	7.0	7.0	7.0	100%
BUR0.0	6.5-8.5	5	6.4	6.5	6.6	6.6	6.7	6.7	6.8	100%
BBC7.0	6.5-8.5	5	6.7	6.7	6.9	6.9	7.0	7.1	7.1	100%
BBC5.9	6.5-8.5	5	6.7	6.8	6.9	6.9	7.0	7.0	7.1	100%
BBC5.2	6.5-8.5	5	7.0	7.0	7.1	7.1	7.1	7.2	7.2	100%
BBC2.6	6.5-8.5	5	7.2	7.2	7.2	7.3	7.5	7.5	7.5	100%
COL0.0	6.5-8.5	5	7.2	7.3	7.4	7.4	7.4	7.6	7.7	100%
BBC1.6	6.5-8.5	5	7.2	7.3	7.4	7.4	7.5	7.5	7.6	100%
Phosphorus, Total (mg/L)										
BBC10.4	0.04	5	0.10	0.12	0.12	0.13	0.14	0.14	0.14	100%
BBC8.8	0.04	5	0.09	0.11	0.11	0.11	0.12	0.13	0.14	100%
PET0.0	0.04	5	0.06	0.07	0.08	0.10	0.14	0.15	0.15	100%
BBC8.4	0.04	5	0.09	0.10	0.10	0.11	0.13	0.13	0.13	100%
BUR0.0	0.04	5	0.04	0.05	0.06	0.09	0.09	0.17	0.23	100%
BBC7.0	0.04	5	0.08	0.08	0.10	0.10	0.11	0.12	0.12	100%
BBC5.9	0.04	5	0.08	0.10	0.11	0.11	0.12	0.13	0.13	100%
BBC5.2	0.04	5	0.09	0.10	0.11	0.11	0.13	0.14	0.15	100%
BBC2.6	0.04	5	0.09	0.11	0.13	0.13	0.15	0.17	0.18	100%
COL0.0	0.04	5	0.05	0.09	0.14	0.17	0.19	0.29	0.35	100%
BBC1.6	0.04	5	0.09	0.11	0.13	0.14	0.17	0.19	0.21	100%
Total Suspended Solids (mg/L)										
BBC10.4	NA	5	5.5	7.7	9.5	10.2	13.9	14.3	14.6	100%
BBC8.8	NA	5	7.6	9.3	12.1	12.9	15.0	18.3	20.5	100%
PET0.0	NA	5	3.5	6.1	9.2	16.8	11.6	36.9	53.7	100%
BBC8.4	NA	5	6.7	7.8	9.9	13.9	14.8	24.0	30.2	100%
BUR0.0	NA	5	2.6	3.2	10.8	14.6	25.8	28.7	30.6	100%
BBC7.0	NA	5	3.2	4.0	4.5	4.8	4.7	6.3	7.4	100%
BBC5.9	NA	5	3.1	3.8	4.6	4.6	5.2	5.9	6.4	100%
BBC5.2	NA	5	4.7	5.8	5.9	7.5	7.0	11.3	14.1	100%
BBC2.6	NA	5	16.2	16.7	19.6	29.4	46.3	47.6	48.4	100%
COL0.0	NA	5	5.3	24.5	40.0	76.2	154.0	155.8	157.0	100%
BBC1.6	NA	5	13.5	20.4	24.8	38.9	67.0	68.1	68.8	100%
Temperature (°C)										
BBC10.4	17.5	5	7.6	9.1	10.4	10.4	11.8	12.5	12.9	100%
BBC8.8	17.5	5	7.6	9.1	10.6	10.5	12.0	12.6	13.0	100%
PET0.0	17.5	5	10.2	11.5	12.6	12.5	13.9	14.0	14.1	100%
BBC8.4	17.5	5	8.2	9.9	11.0	11.0	12.5	13.0	13.4	100%
BUR0.0	17.5	5	6.6	9.5	9.9	10.3	12.6	12.8	12.9	100%
BBC7.0	17.5	5	7.8	9.6	11.0	10.8	12.4	12.9	13.3	100%
BBC5.9	17.5	5	7.6	9.5	11.1	10.7	12.2	12.8	13.2	100%
BBC5.2	17.5	5	7.6	9.5	11.1	10.8	12.3	12.9	13.3	100%
BBC2.6	17.5	5	7.3	9.5	10.7	10.6	12.3	12.8	13.1	100%
COL0.0	17.5	5	6.5	9.0	10.3	10.2	12.6	12.6	12.6	100%
BBC1.6	17.5	5	7.2	9.5	10.7	10.6	12.4	12.8	13.0	100%
Turbidity (NTU)										
BBC10.4	NA	5	5.4	10.1	10.7	10.0	11.2	11.9	12.4	100%
BBC8.8	NA	5	6.8	7.3	12.1	10.7	12.3	13.8	14.8	100%
PET0.0	NA	5	3.7	5.3	7.3	10.3	10.0	19.2	25.3	100%

Table D-2. WY2024 Storm Summary Statistics Table										
Station	**Criteria[2]**	**n**	**Minimum**	**25th Percentile**	**Median**	**Mean[1]**	**75th Percentile**	**90th Percentile**	**Maximum**	**Percent Detected**
BBC8.4	NA	5	5.7	6.6	10.1	10.0	10.8	14.3	16.7	100%
BUR0.0	NA	5	5.4	9.1	13.8	15.4	24.2	24.4	24.5	100%
BBC7.0	NA	5	6.2	6.7	7.2	7.2	7.5	8.0	8.2	100%
BBC5.9	NA	5	3.7	4.8	5.6	5.5	6.0	6.8	7.3	100%
BBC5.2	NA	5	5.5	6.2	7.0	7.2	7.5	8.9	9.9	100%
BBC2.6	NA	5	7.9	12.5	14.5	16.5	21.3	24.2	26.2	100%
COL0.0	NA	5	8.6	31.0	35.2	44.0	70.5	73.0	74.6	100%
BBC1.6	NA	5	9.3	16.8	18.1	21.9	29.9	33.1	35.2	100%
Zinc, Dissolved (µg/L)										
BBC10.4	NA	5	7.2	12.7	16.7	14.6	17.1	18.5	19.4	100%
BBC8.8	NA	5	8.1	12.9	13.8	195.4	16.4	562.2	926.0	100%
PET0.0	NA	5	10.1	11.0	14.7	14.6	18.1	18.6	18.9	100%
BBC8.4	NA	5	8.9	11.5	13.5	145.3	16.4	412.2	676.0	100%
BUR0.0	NA	5	18.3	19.3	38.1	39.6	41.7	65.0	80.5	100%
BBC7.0	NA	5	13.9	18.5	21.1	45.2	24.3	98.5	148.0	100%
BBC5.9	NA	5	10.8	12.3	13.3	15.1	16.1	20.1	22.8	100%
BBC5.2	NA	5	12.9	13.2	15.7	19.4	22.1	28.6	32.9	100%
BBC2.6	NA	5	8.6	9.5	9.8	10.7	10.5	13.1	14.9	100%
COL0.0	NA	5	14.5	18.9	21.8	20.9	23.2	25.0	26.2	100%
BBC1.6	NA	5	10.0	10.1	11.4	11.7	12.6	13.8	14.6	100%
Zinc, Total (µg/L)										
BBC10.4	NA	5	6.7	18.5	21.3	18.9	23.4	24.0	24.4	100%
BBC8.8	NA	5	10.9	21.8	22.0	202.3	24.7	569.1	932.0	100%
PET0.0	NA	5	14.4	22.5	23.0	24.7	26.0	33.1	37.8	100%
BBC8.4	NA	5	11.9	22.8	22.8	157.3	25.2	432.5	704.0	100%
BUR0.0	NA	5	21.4	39.6	41.6	53.0	44.2	88.5	118.0	100%
BBC7.0	NA	5	18.2	23.2	25.6	51.1	29.3	107.1	159.0	100%
BBC5.9	NA	5	14.7	15.8	17.6	19.2	21.6	24.4	26.3	100%
BBC5.2	NA	5	16.9	17.8	21.1	26.2	26.8	39.7	48.3	100%
BBC2.6	NA	5	19.2	20.7	25.1	26.2	32.4	33.2	33.8	100%
COL0.0	NA	5	30.8	49.1	49.6	66.4	70.7	107.5	132.0	100%
BBC1.6	NA	5	19.6	27.2	28.8	34.1	43.1	48.4	51.9	100%

C = Celsius mg/L = milligram/L mL = milliliter NTU = nephelometric turbidity units CFU = Colony forming units MPN = Most probable number

[1]Geometric mean used for *E. coli* results

[2] Criteria outlined in Main Text Table 7

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APPENDIX D-2

WY2024 Water Quality Figures

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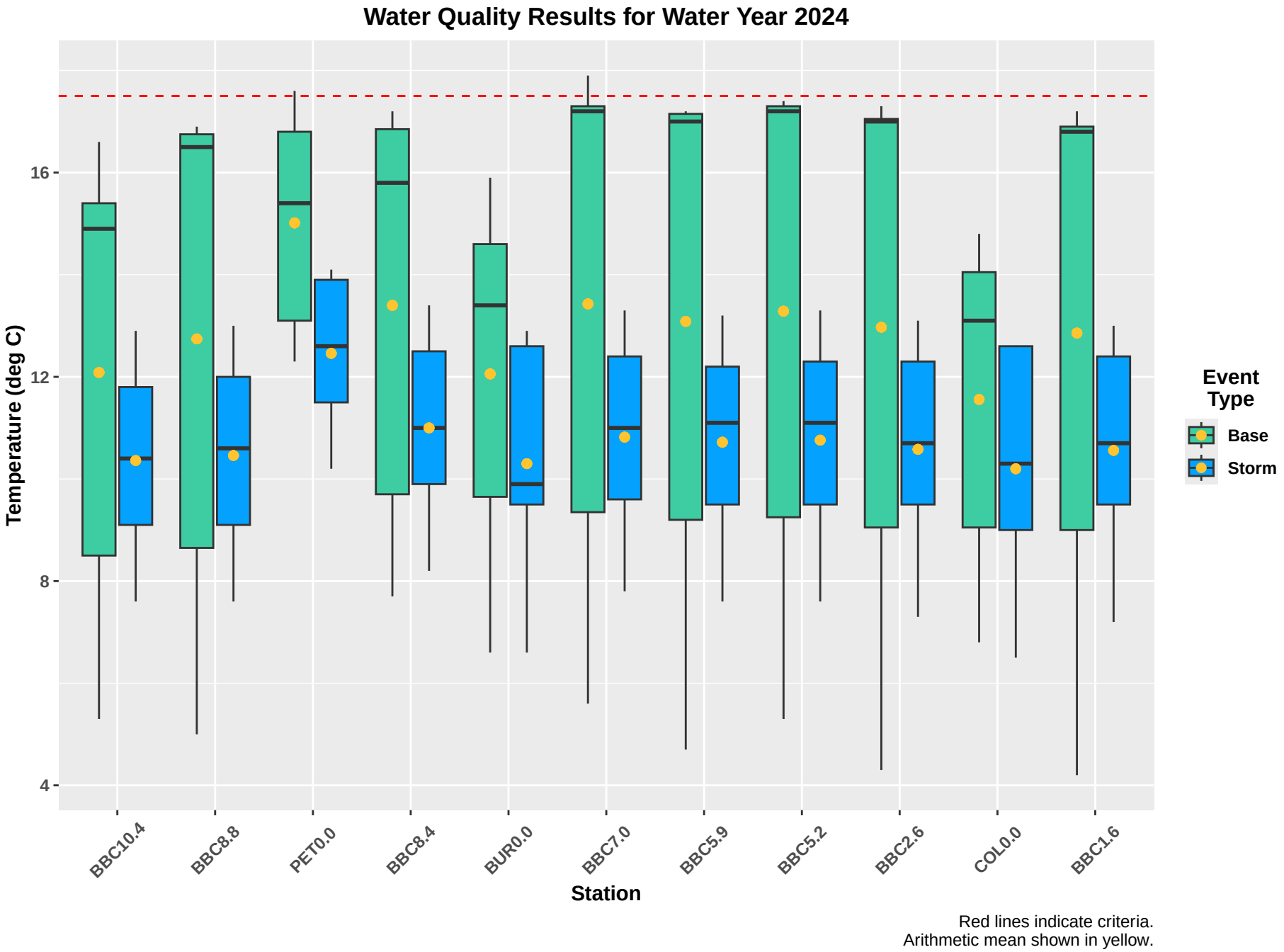
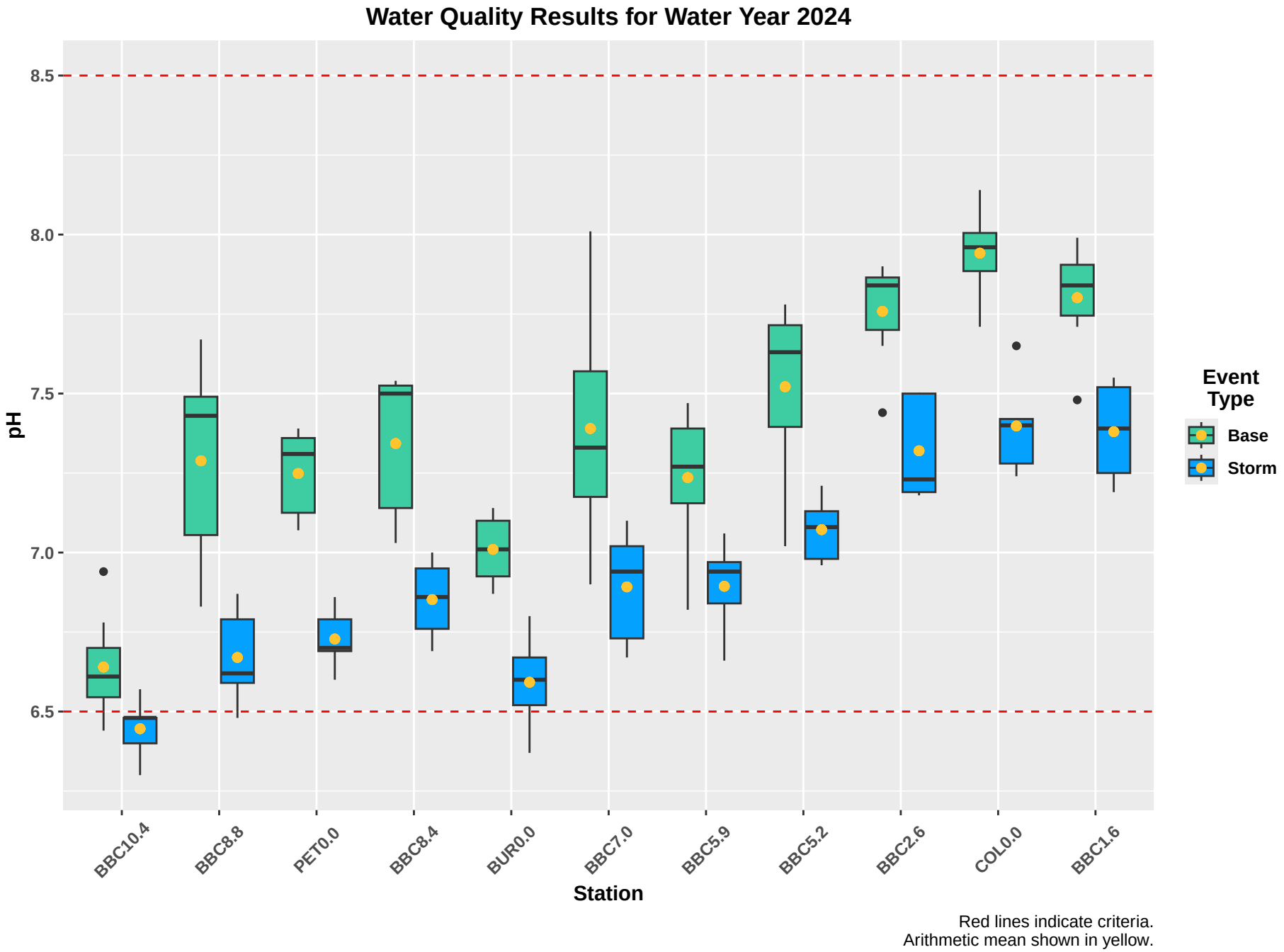
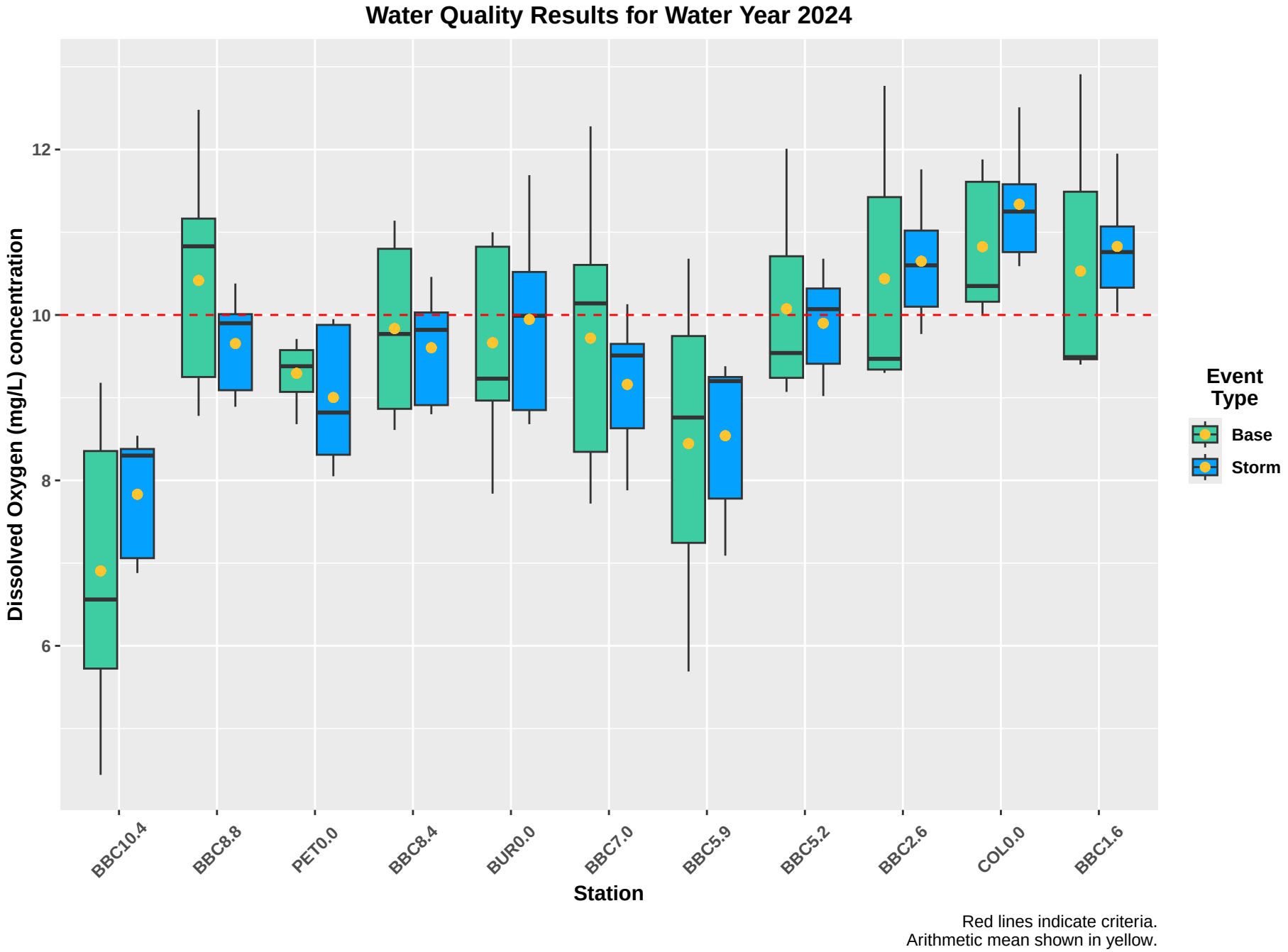
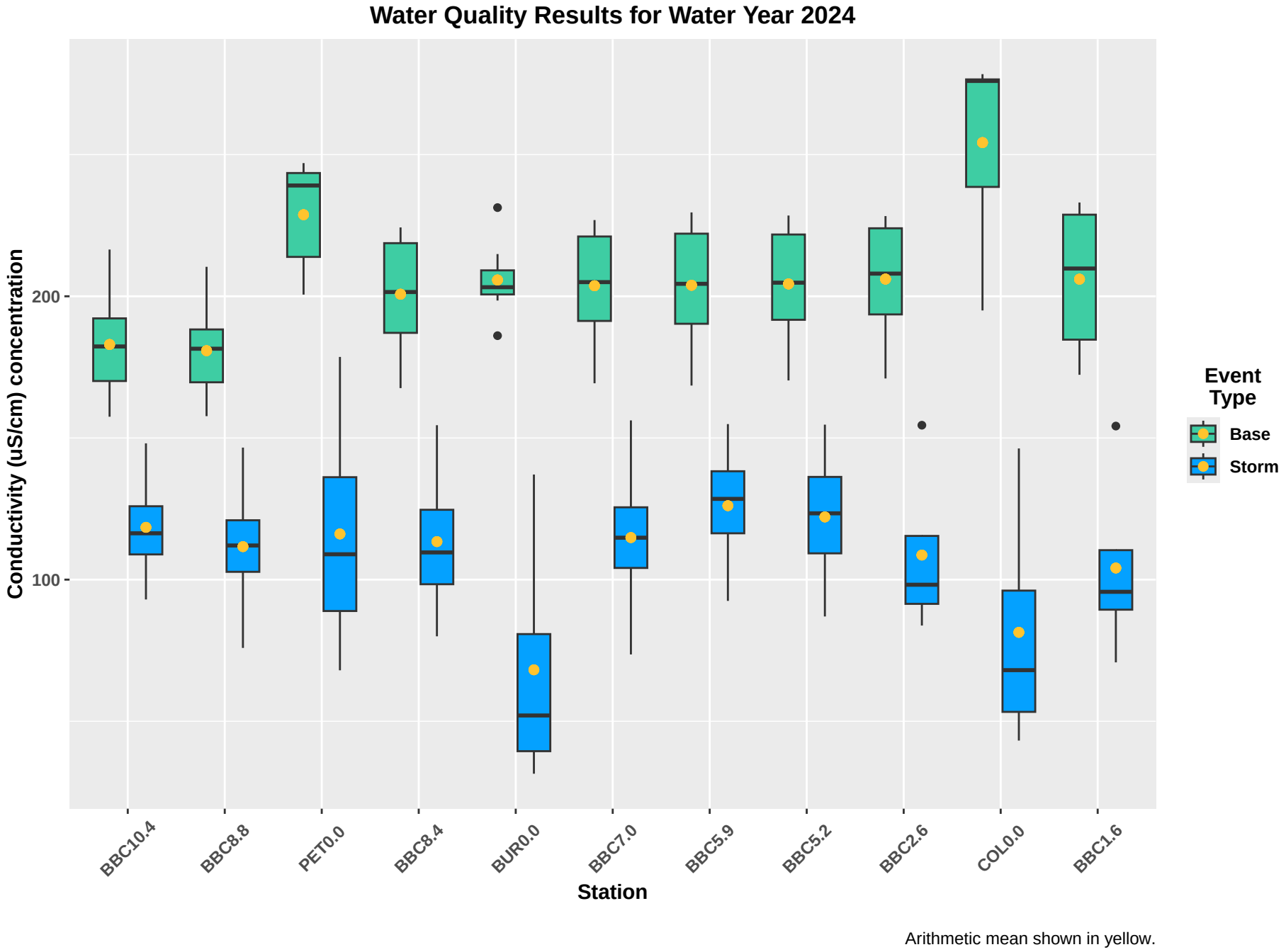
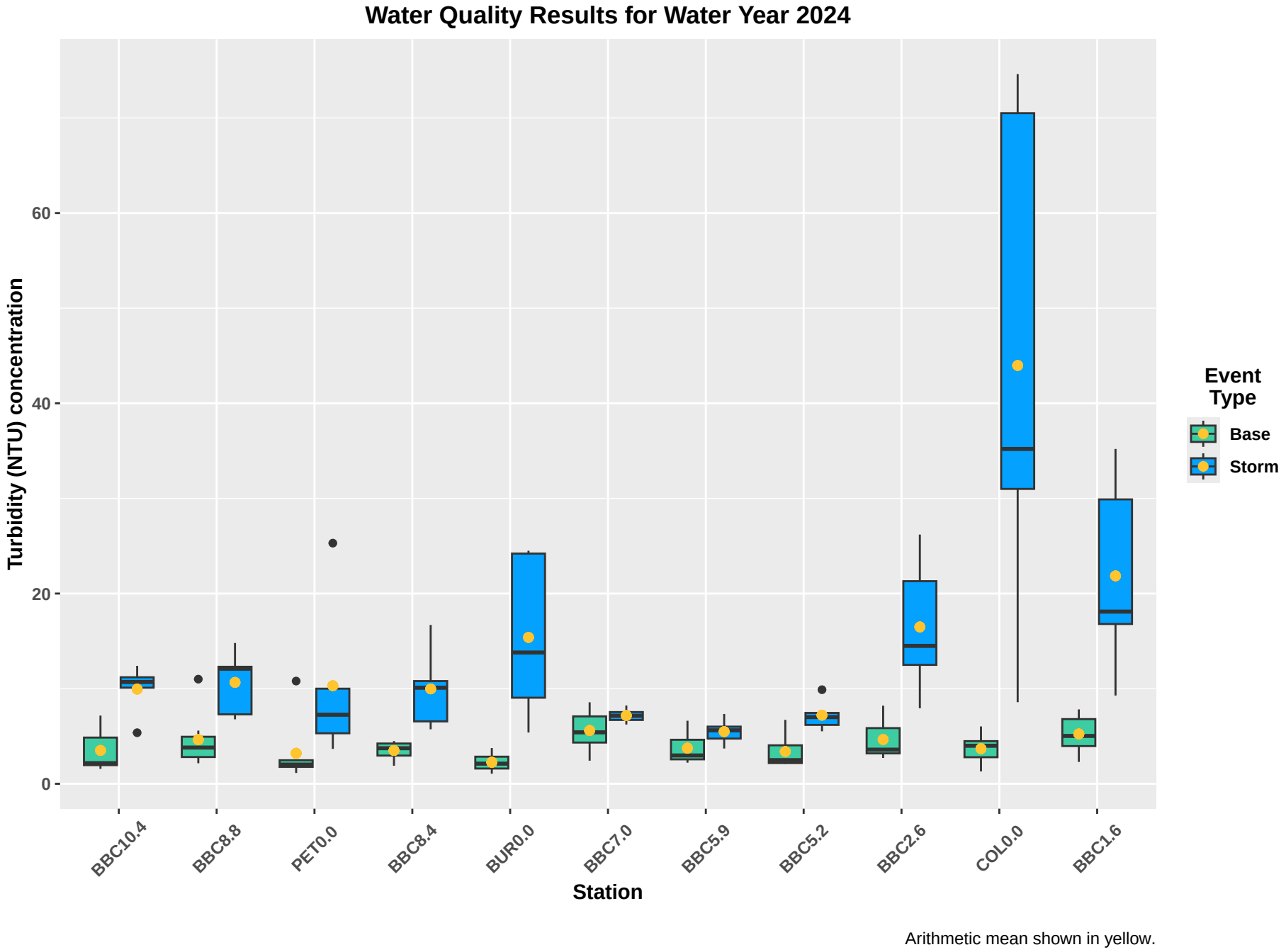

Water Quality Results for Water Year 2024
Temperature (deg C)
16
12
8
4
BBC10.4
BBC8.8
PET0.0
BBC8.4
BUR0.0
BBC7.0
BBC5.9
BBC5.2
BBC2.6
COL0.0
BBC1.6
Station
Event Type
Base
Storm
Red lines indicate criteria.
Arithmetic mean shown in yellow.


Water Quality Results for Water Year 2024
pH
8.5
8.0
7.5
7.0
6.5
BBC10.4
BBC8.8
PET0.0
BBC8.4
BUR0.0
BBC7.0
BBC5.9
BBC5.2
BBC2.6
COL0.0
BBC1.6
Station
Event Type
Base
Storm
Red lines indicate criteria.
Arithmetic mean shown in yellow.

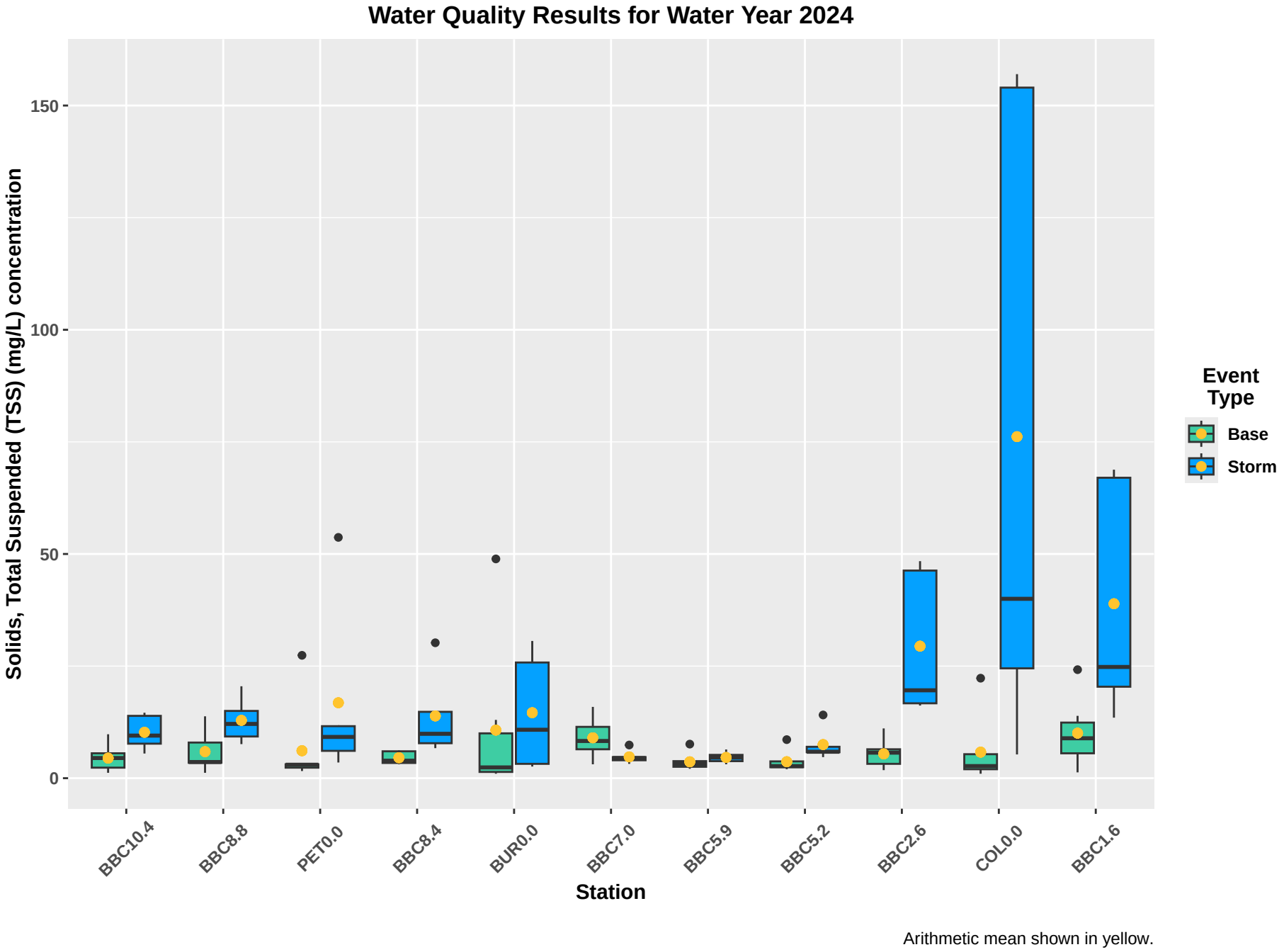

Water Quality Results for Water Year 2024
Dissolved Oxygen (mg/L) concentration
12
10
8
6
BBC10.4
BBC8.8
PET0.0
BBC8.4
BUR0.0
BBC7.0
BBC5.9
BBC5.2
BBC2.6
COL0.0
BBC1.6
Station
Event Type
Base
Storm
Red lines indicate criteria.
Arithmetic mean shown in yellow.



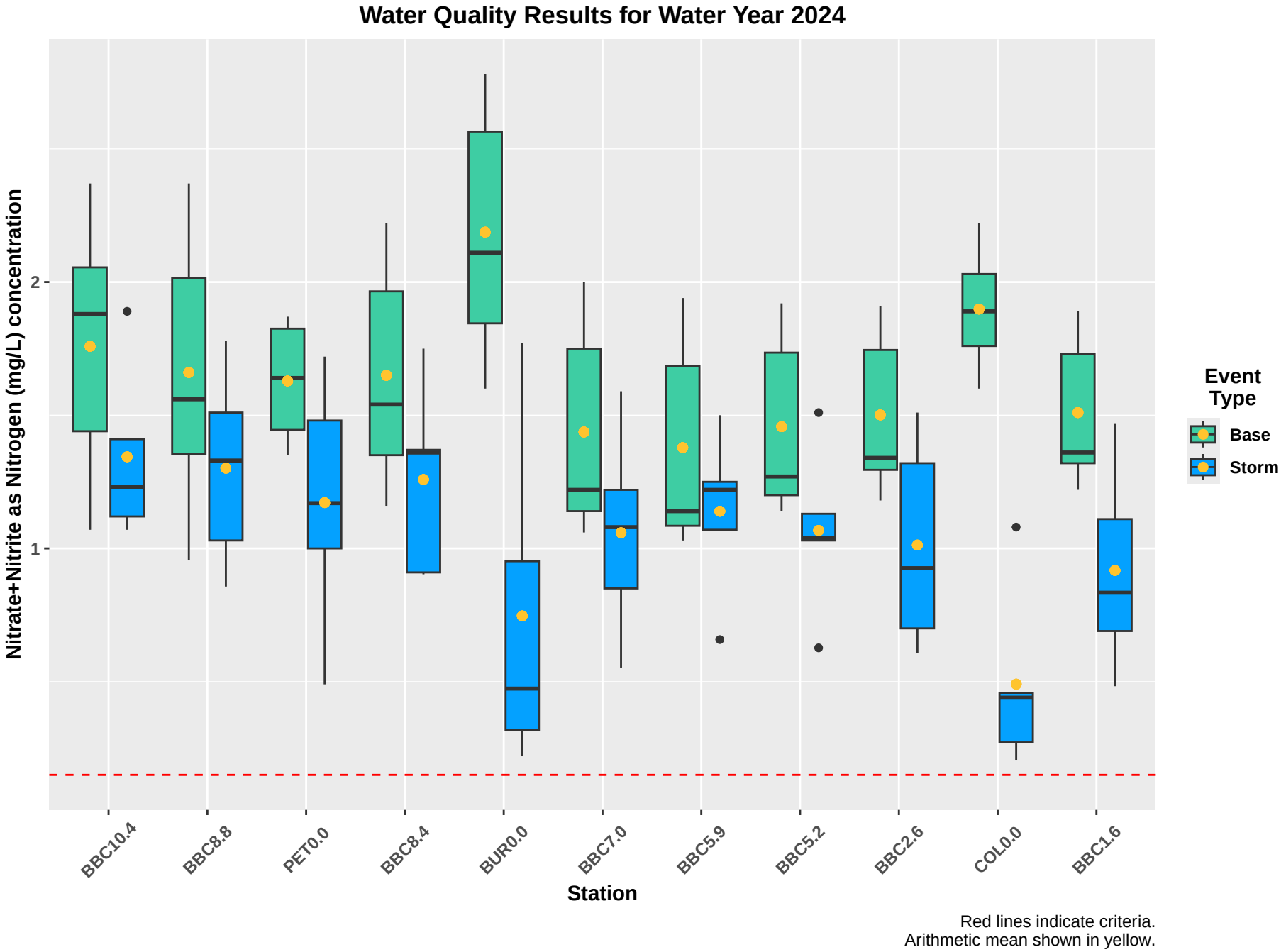
Arithmetic mean shown in yellow.

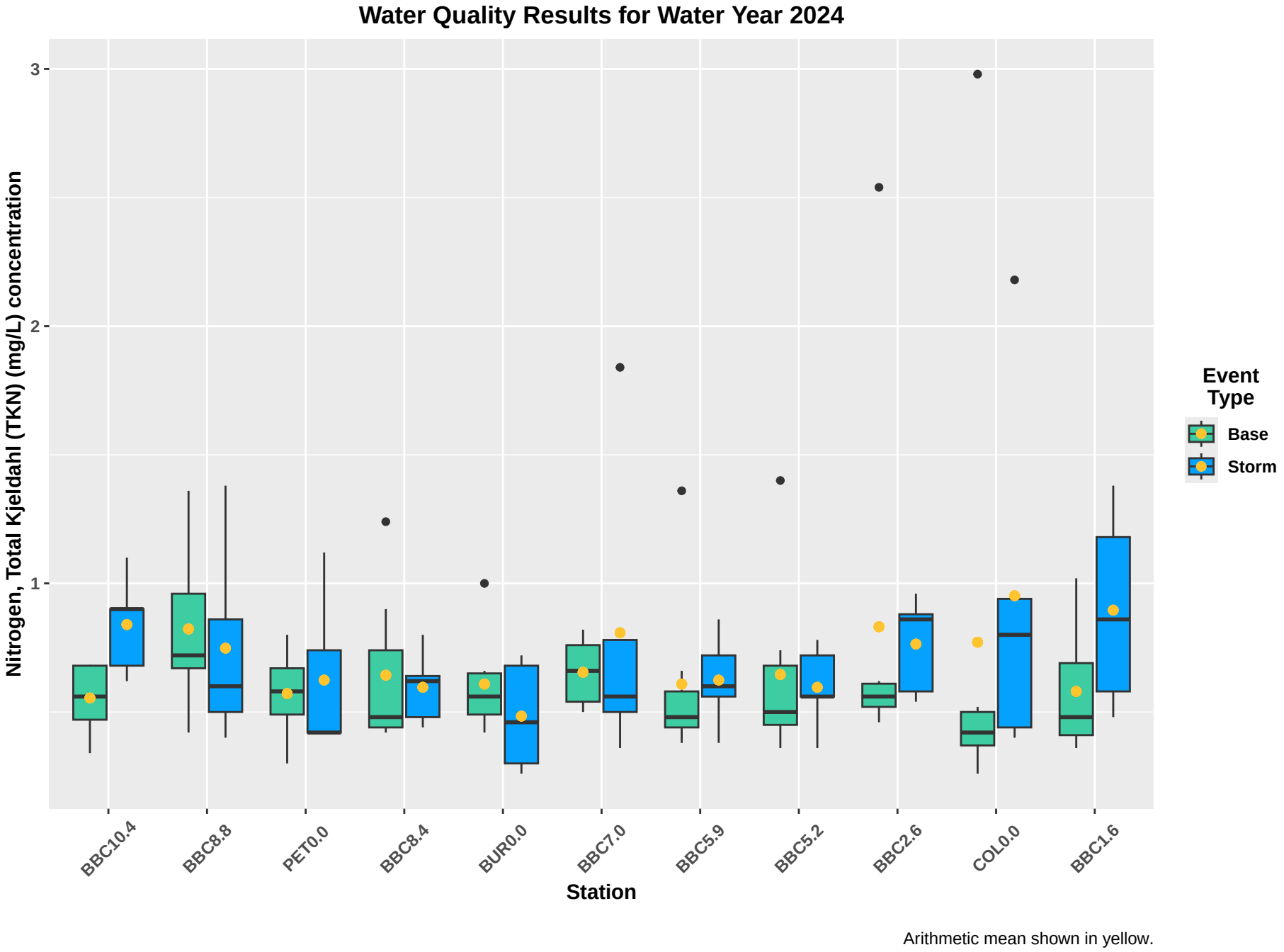


Arithmetic mean shown in yellow.



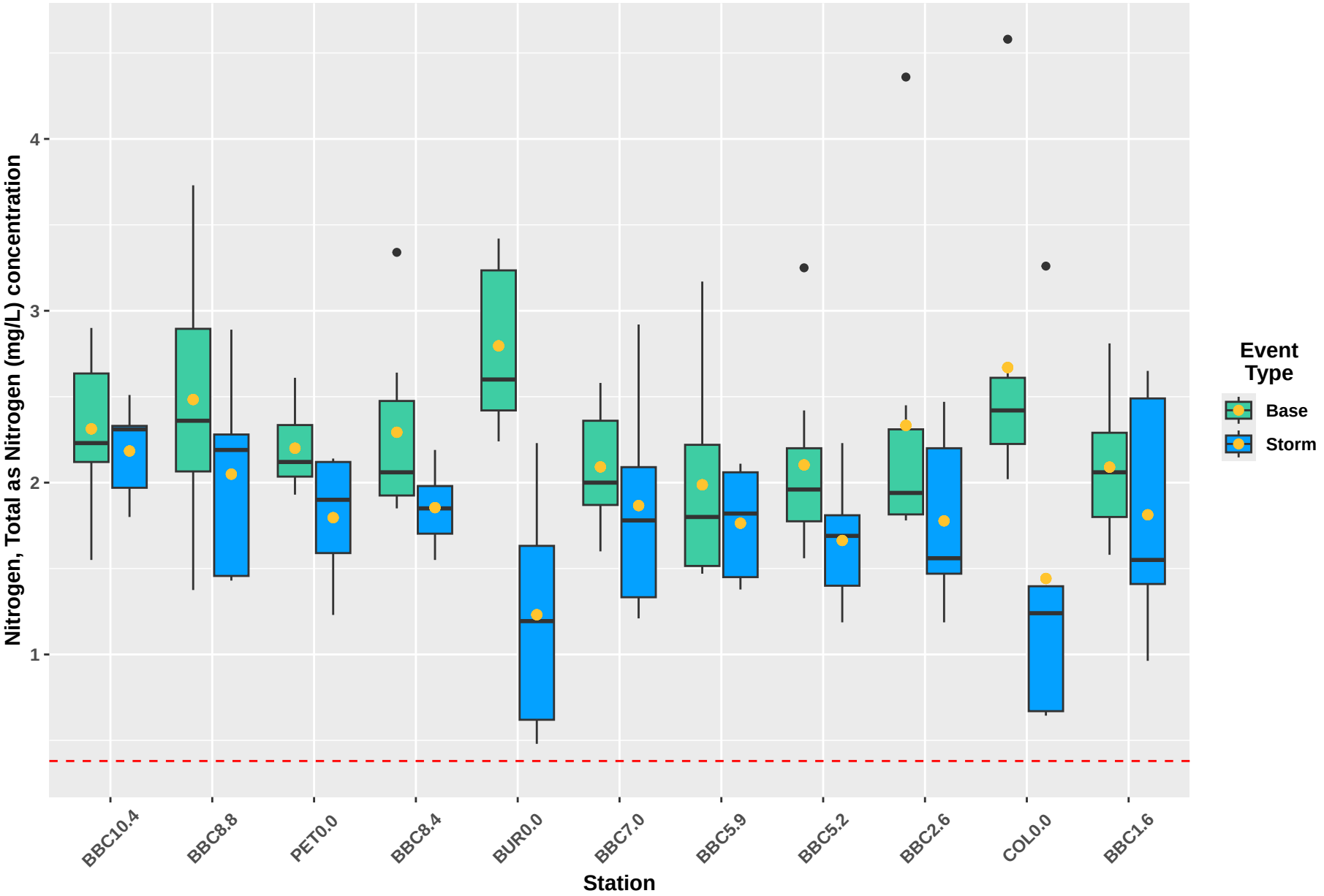
Arithmetic mean shown in yellow.


Water Quality Results for Water Year 2024
Nitrate+Nitrite as Nitrogen (mg/L) concentration
2
1
BBC10.4
BBC8.8
PET0.0
BBC8.4
BUR0.0
BBC7.0
BBC5.9
BBC5.2
BBC2.6
COL0.0
BBC1.6
Station
Event Type
Base
Storm
Red lines indicate criteria.
Arithmetic mean shown in yellow.

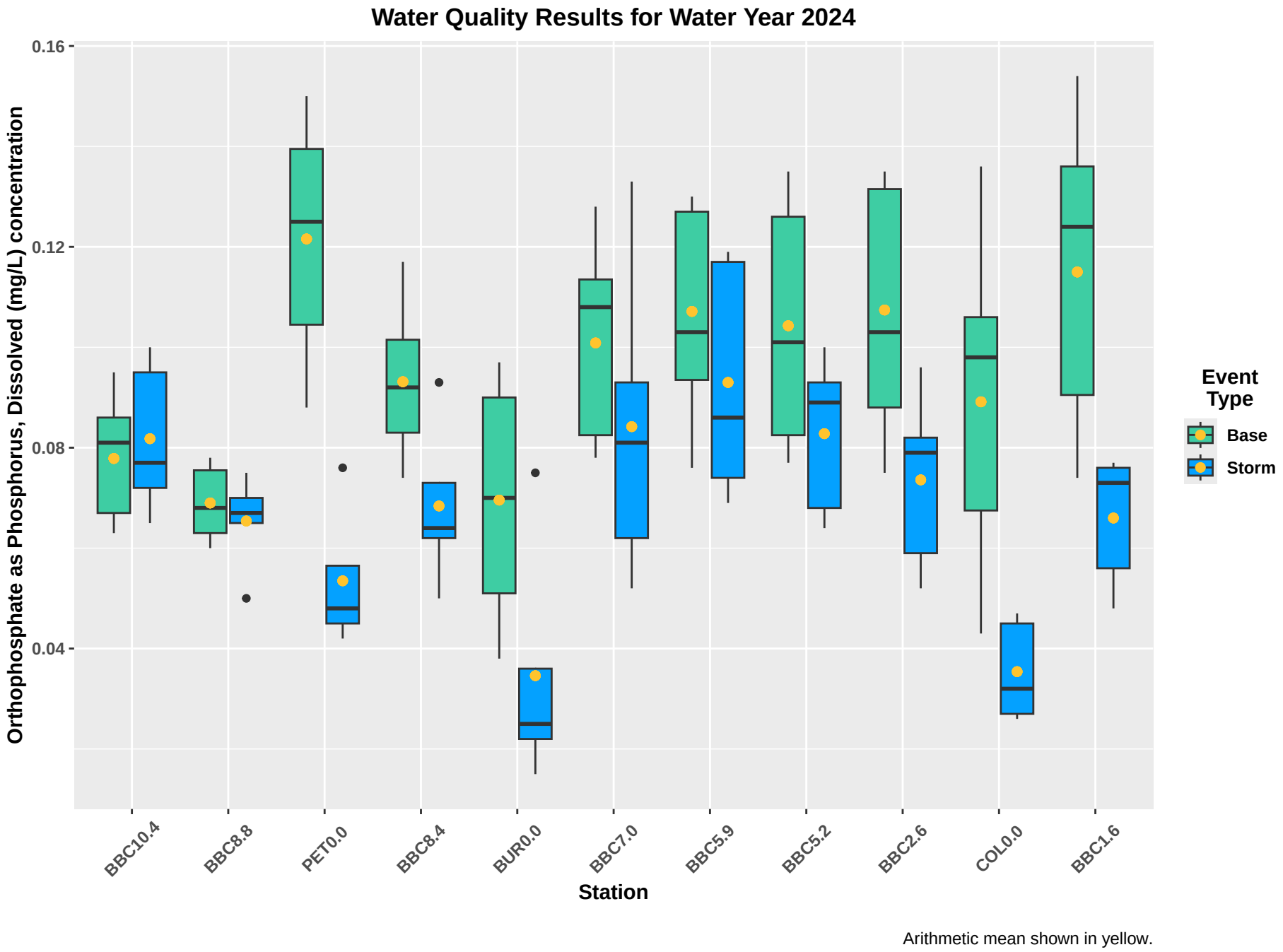


Arithmetic mean shown in yellow.

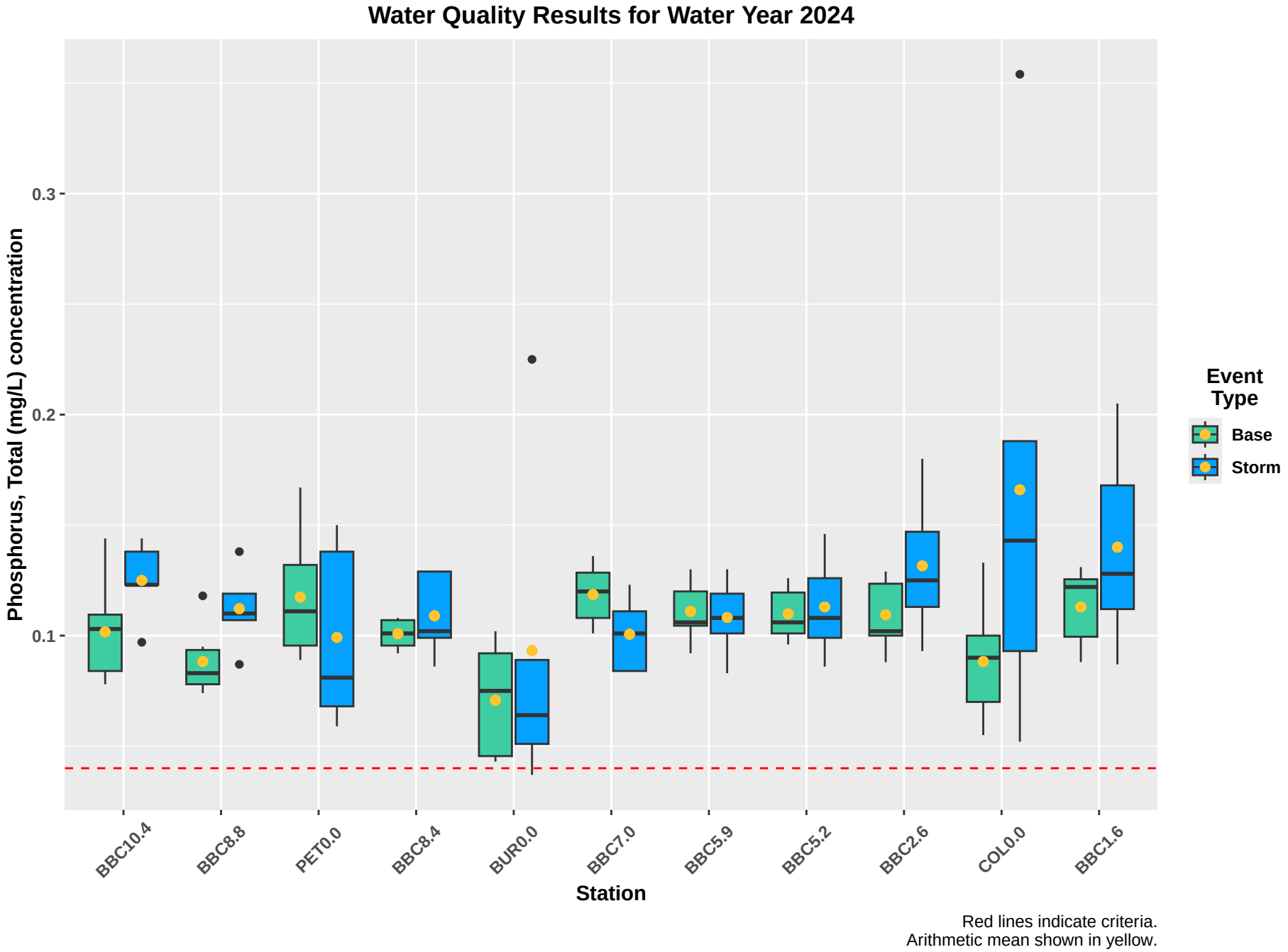
Water Quality Results for Water Year 2024

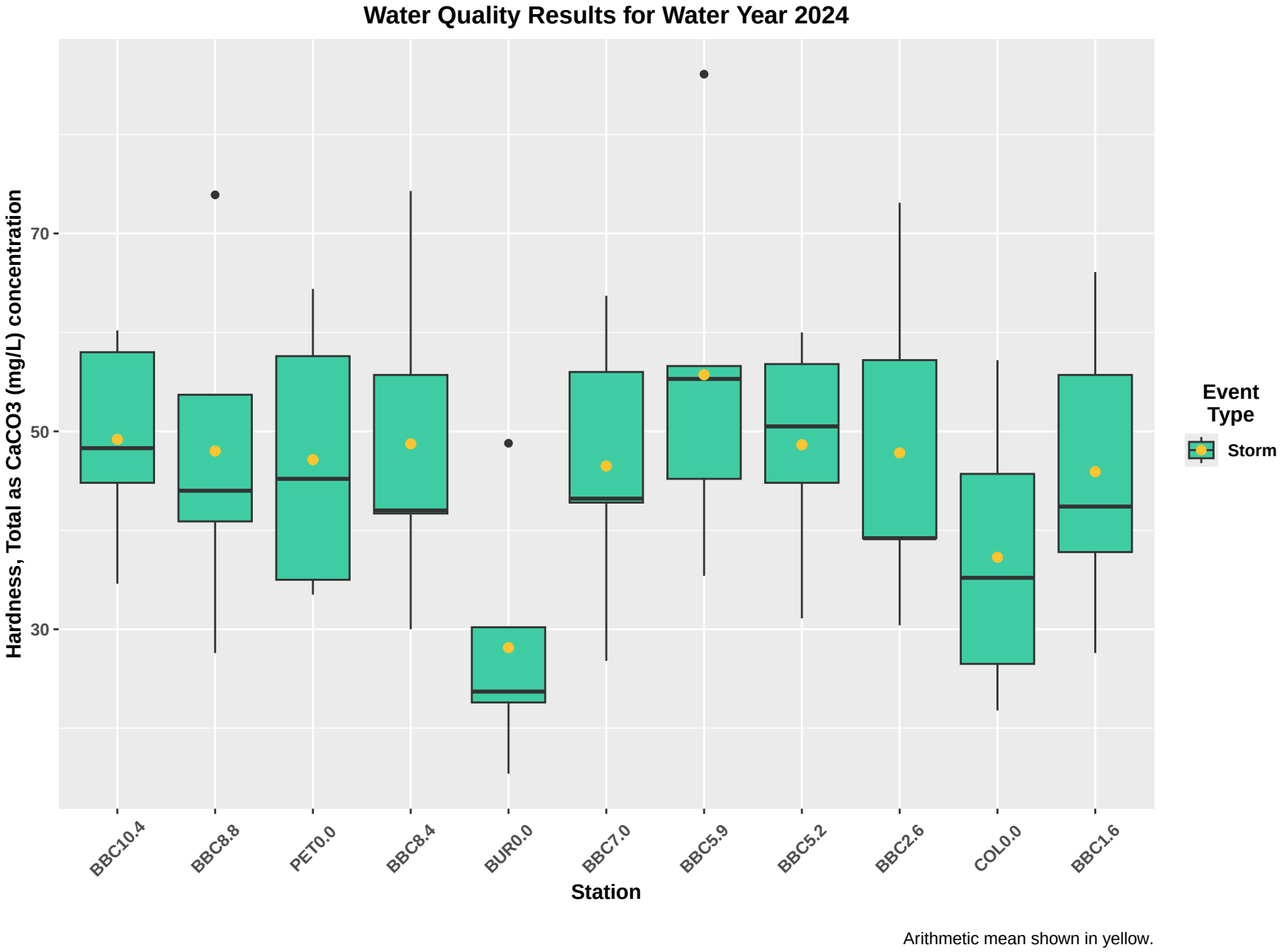


Red lines indicate criteria.
Arithmetic mean shown in yellow.

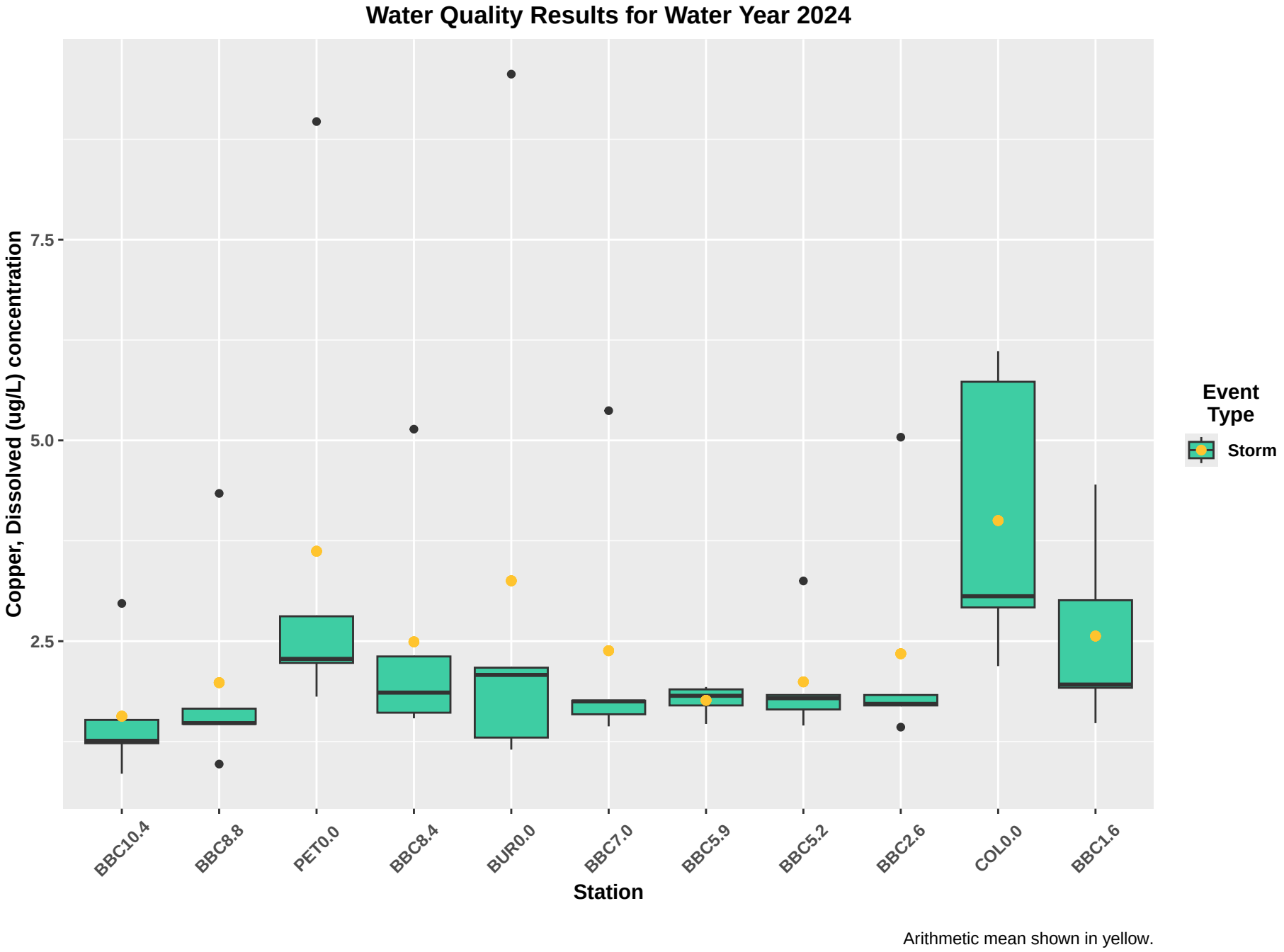


Arithmetic mean shown in yellow.


Water Quality Results for Water Year 2024
Phosphorus, Total (mg/L) concentration
0.3
0.2
0.1
BBC10.4
BBC8.8
PET0.0
BBC8.4
BUR0.0
BBC7.0
BBC5.9
BBC5.2
BBC2.6
COL0.0
BBC1.6
Station
Event Type
Base
Storm
Red lines indicate criteria.
Arithmetic mean shown in yellow.

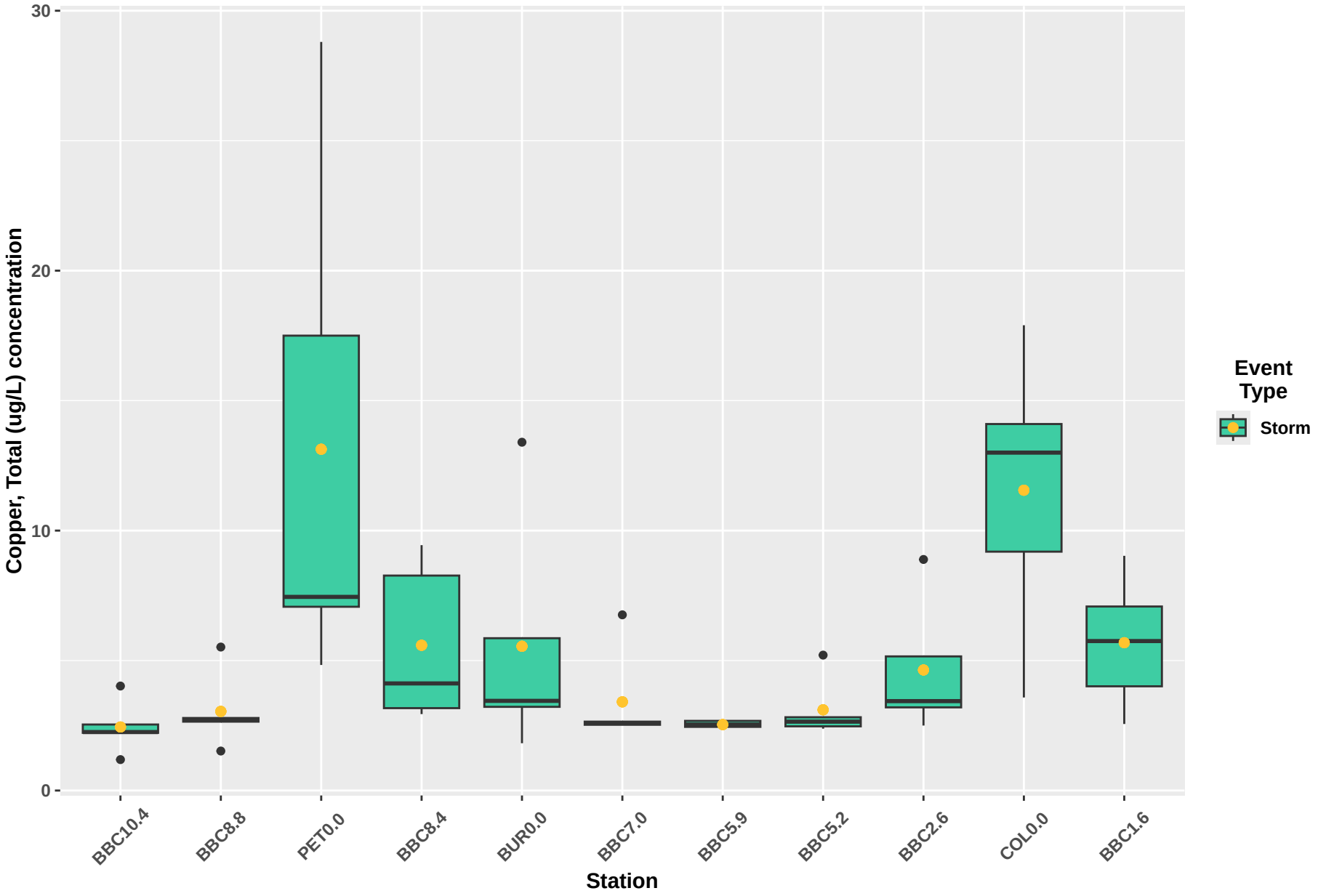


Arithmetic mean shown in yellow.

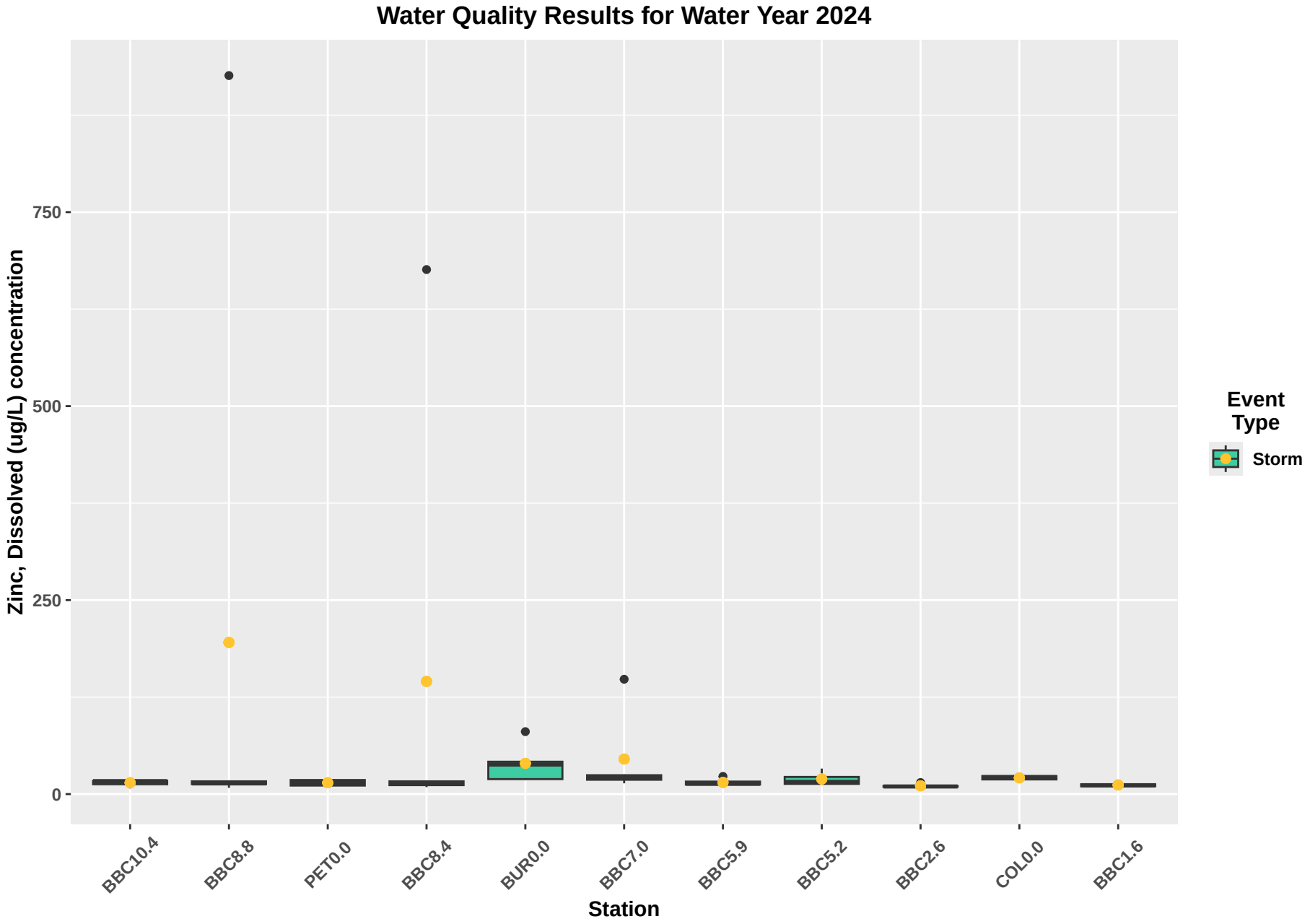


Arithmetic mean shown in yellow.

Water Quality Results for Water Year 2024

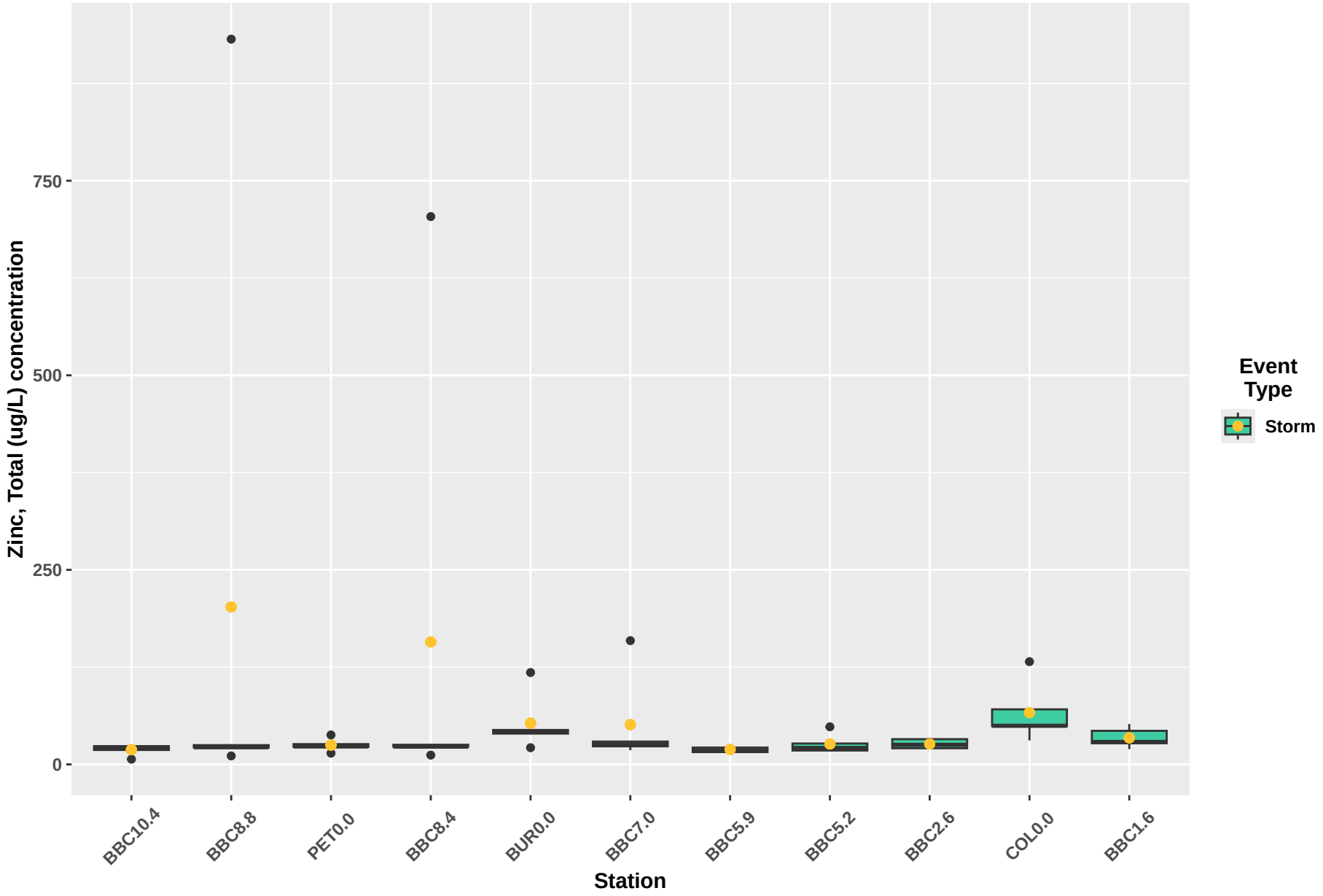


Arithmetic mean shown in yellow.

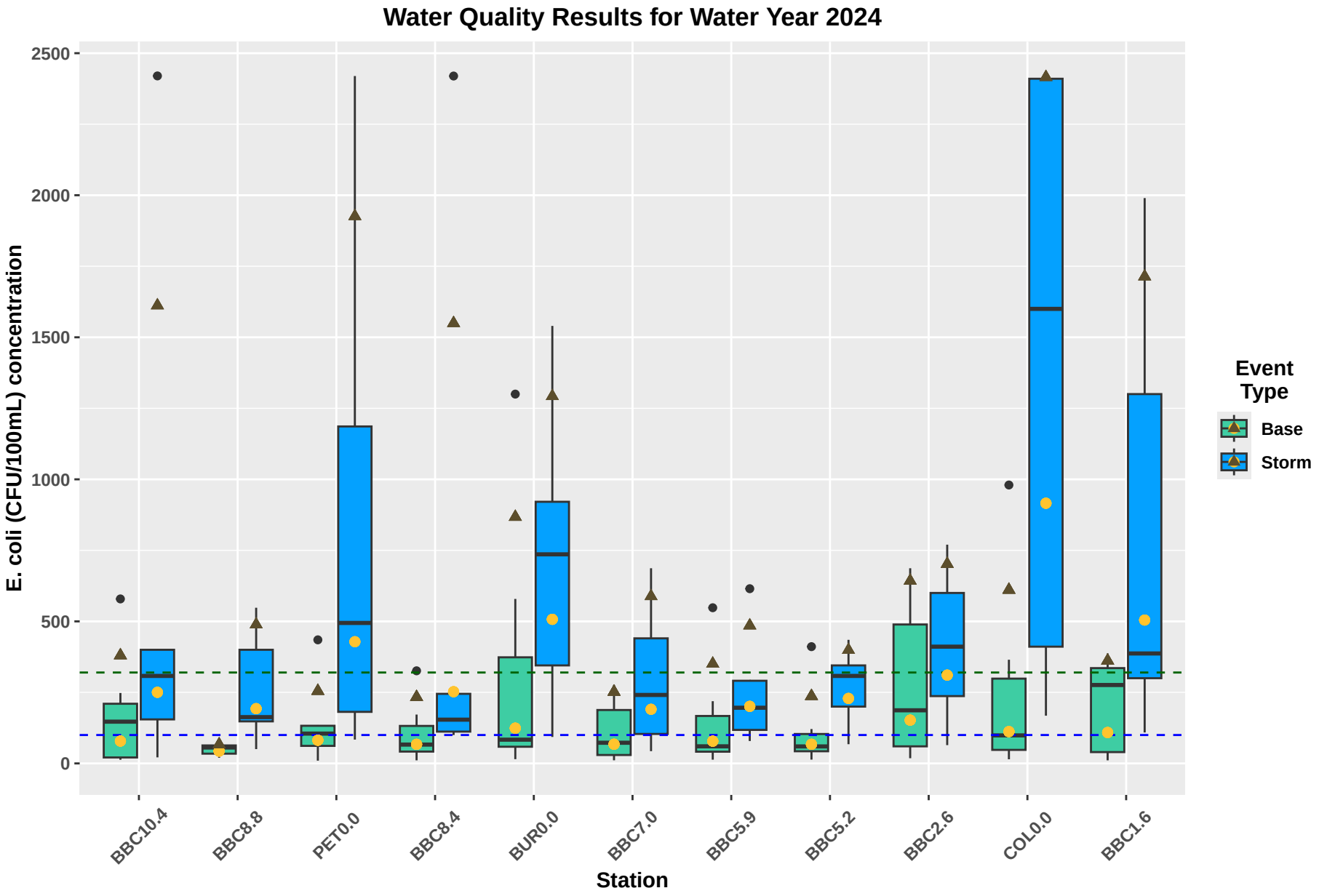


Arithmetic mean shown in yellow.

Water Quality Results for Water Year 2024



Arithmetic mean shown in yellow.



Blue lines indicate criteria for geometric mean.
Dark green lines indicate criteria for 90th percentile.
Geometric mean shown in yellow.
90th percentile shown as a brown triangle.

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APPENDIX F

Spatial Trend Figures

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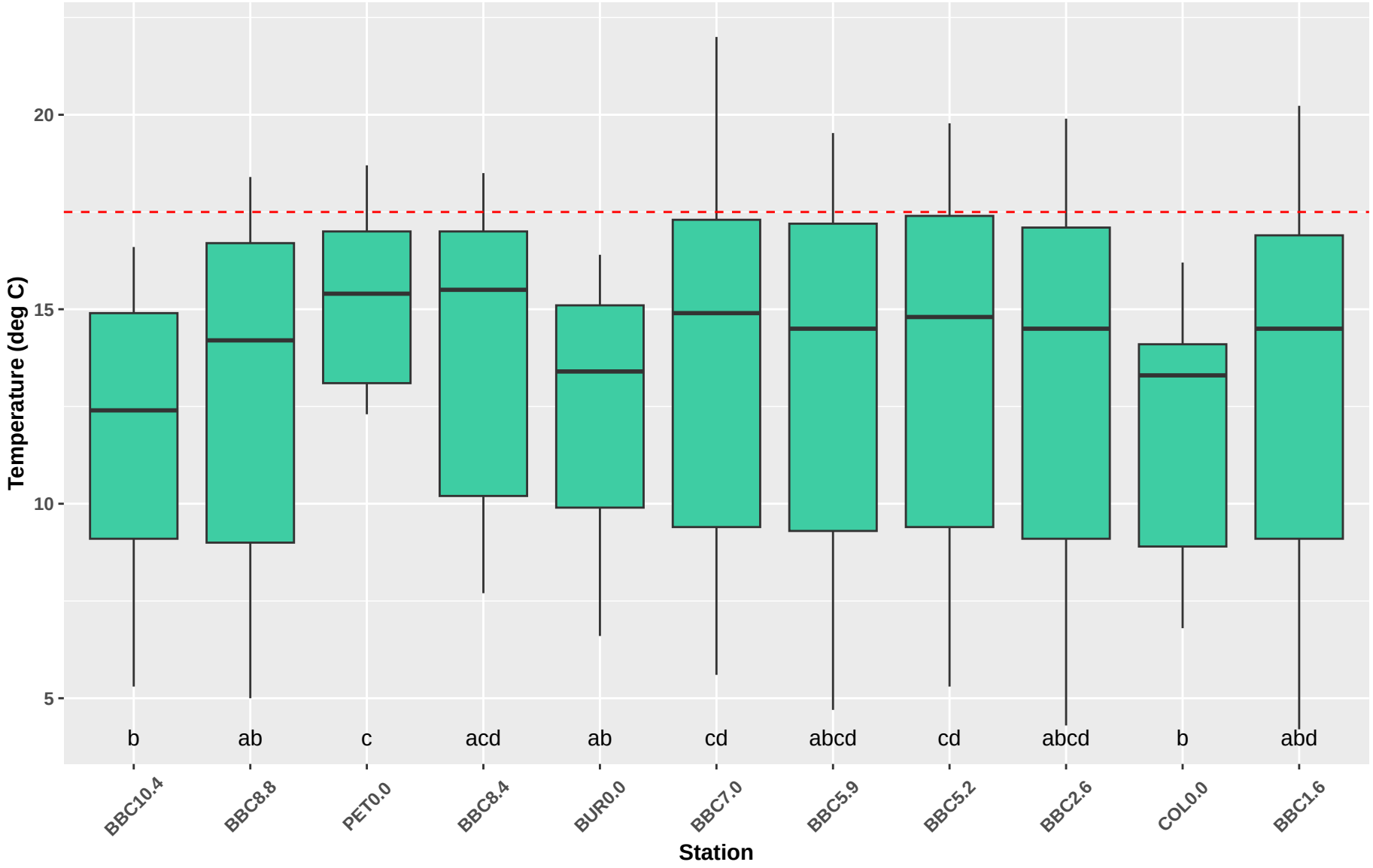
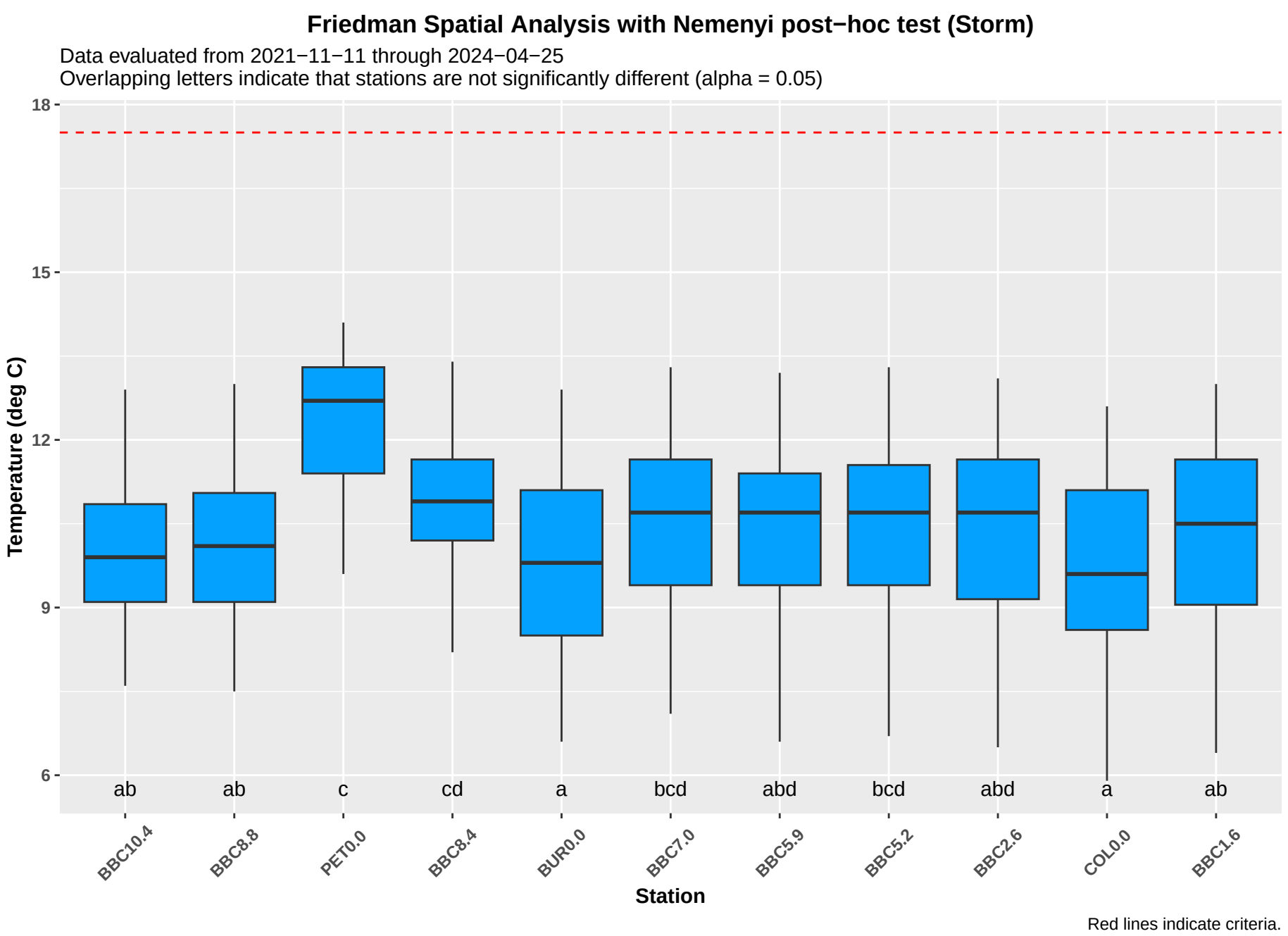
Friedman Spatial Analysis with Nemenyi post−hoc test (Base)

Data evaluated from 2021−11−17 through 2024−09−03
Overlapping letters indicate that stations are not significantly different (alpha = 0.05)

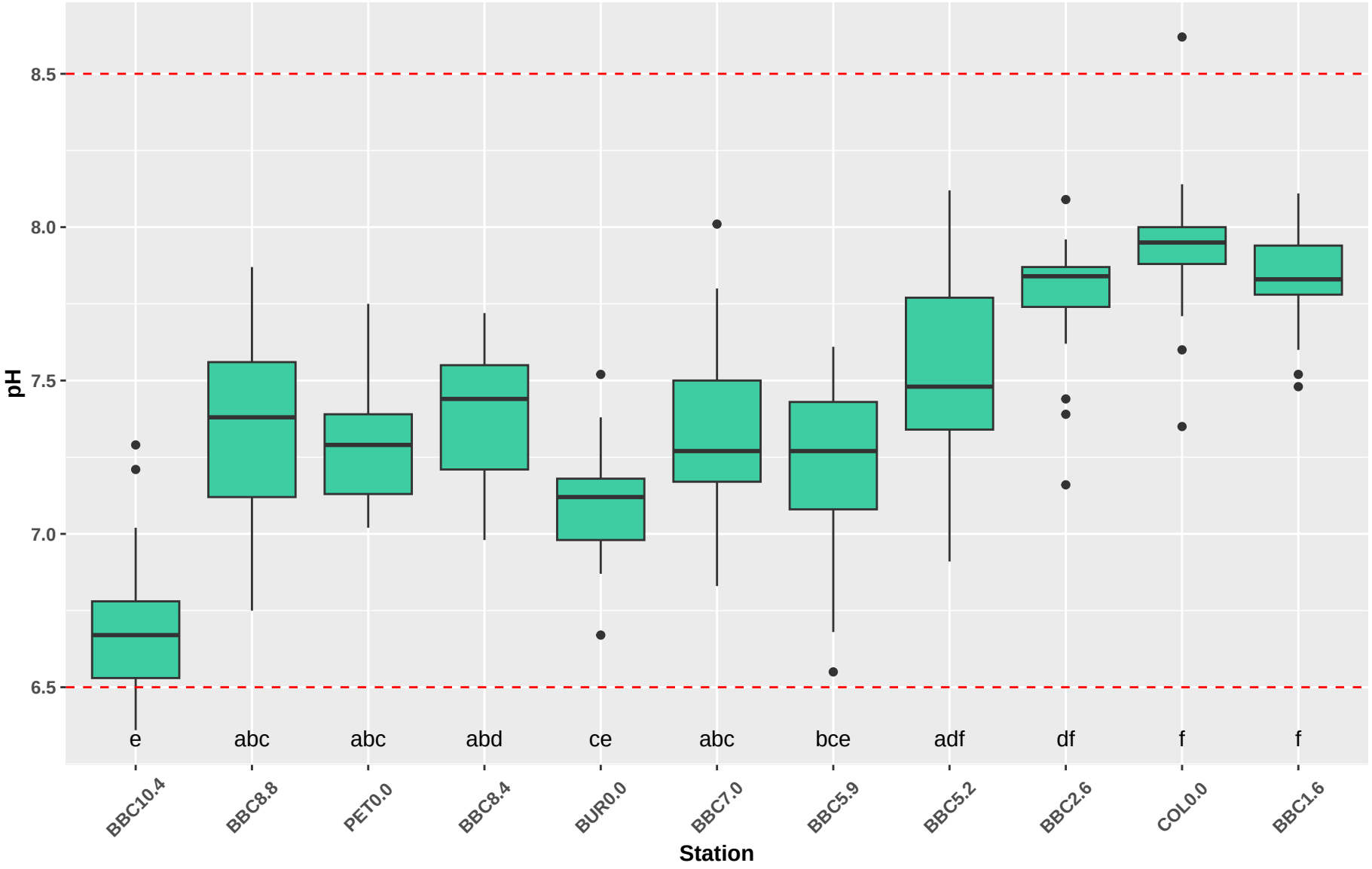


Red lines indicate criteria.


Friedman Spatial Analysis with Nemenyi post−hoc test (Storm)
Data evaluated from 2021−11−11 through 2024−04−25
Overlapping letters indicate that stations are not significantly different (alpha = 0.05)
Temperature (deg C)
18
15
12
9
6
ab
ab
c
cd
a
bcd
abd
bcd
abd
a
ab
BBC10.4
BBC8.8
PET0.0
BBC8.4
BUR0.0
BBC7.0
BBC5.9
BBC5.2
BBC2.6
COL0.0
BBC1.6
Station
Red lines indicate criteria.

Friedman Spatial Analysis with Nemenyi post−hoc test (Base)

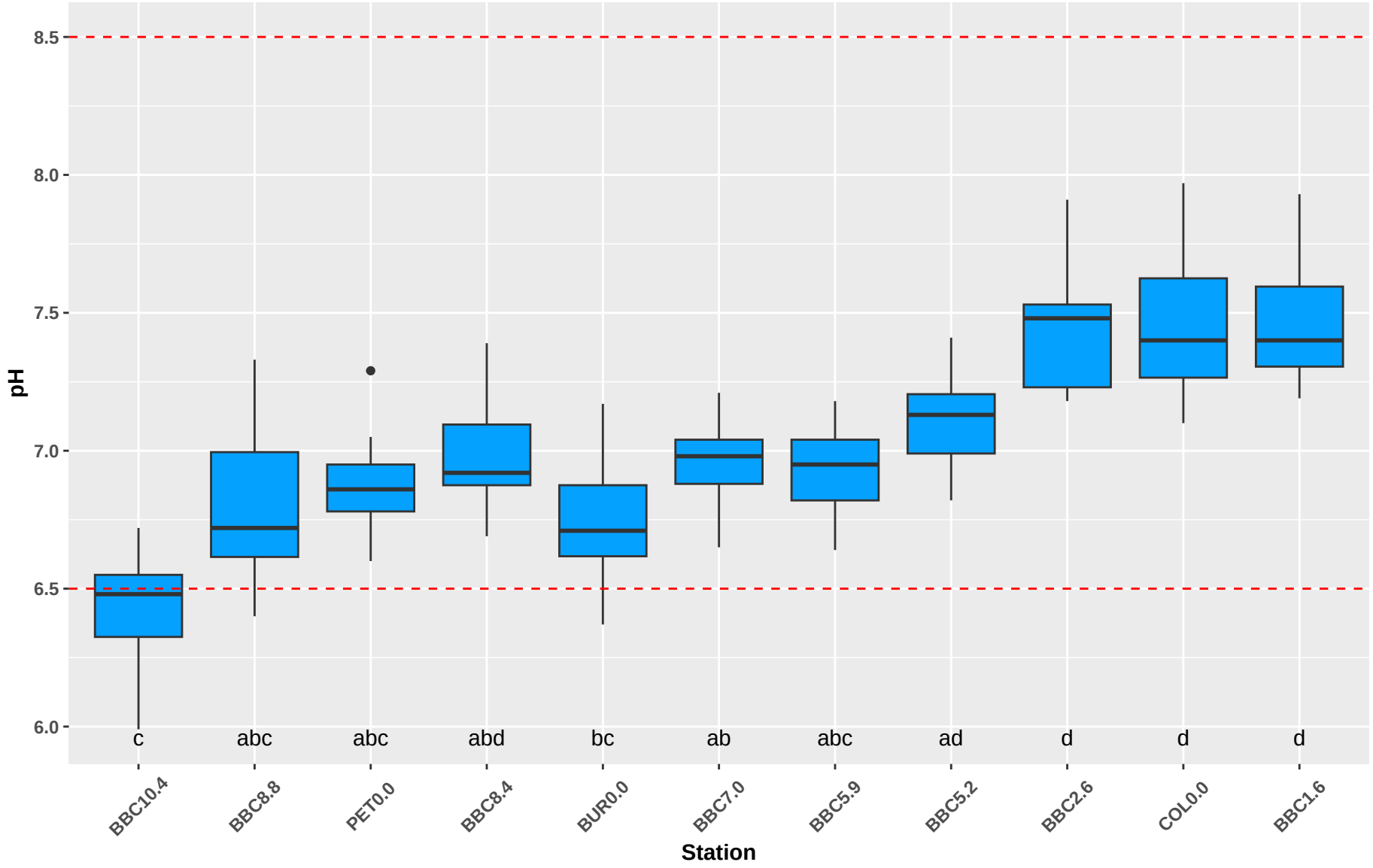
Data evaluated from 2021−11−17 through 2024−09−03
Overlapping letters indicate that stations are not significantly different (alpha = 0.05)



Red lines indicate criteria.

Friedman Spatial Analysis with Nemenyi post−hoc test (Storm)

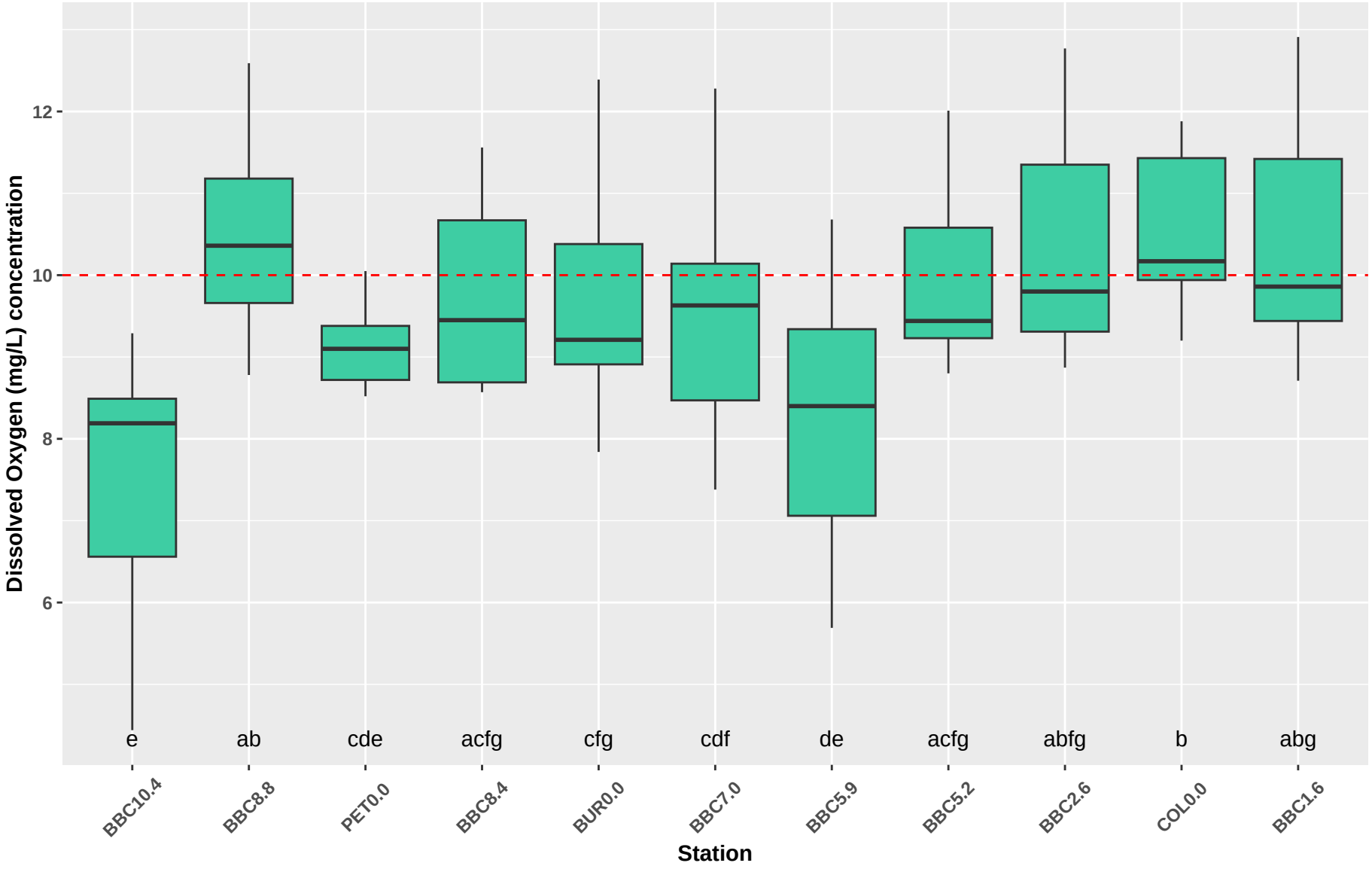
Data evaluated from 2021−11−11 through 2024−04−25
Overlapping letters indicate that stations are not significantly different (alpha = 0.05)



Red lines indicate criteria.
1 sampling event was not included in the Friedman test because not all stations were sampled.

Friedman Spatial Analysis with Nemenyi post−hoc test (Base)

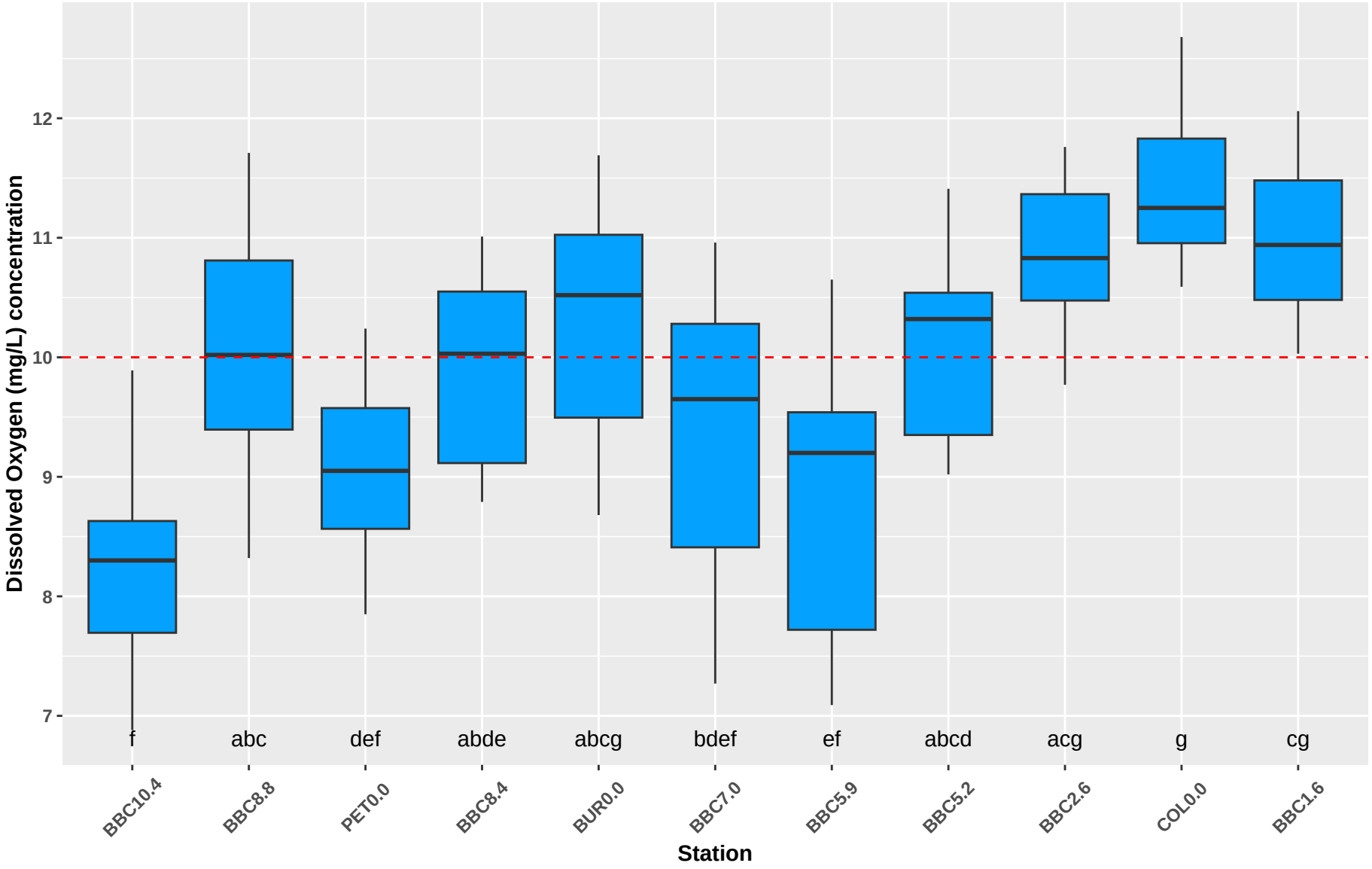
Data evaluated from 2021−11−17 through 2024−09−03
Overlapping letters indicate that stations are not significantly different (alpha = 0.05)



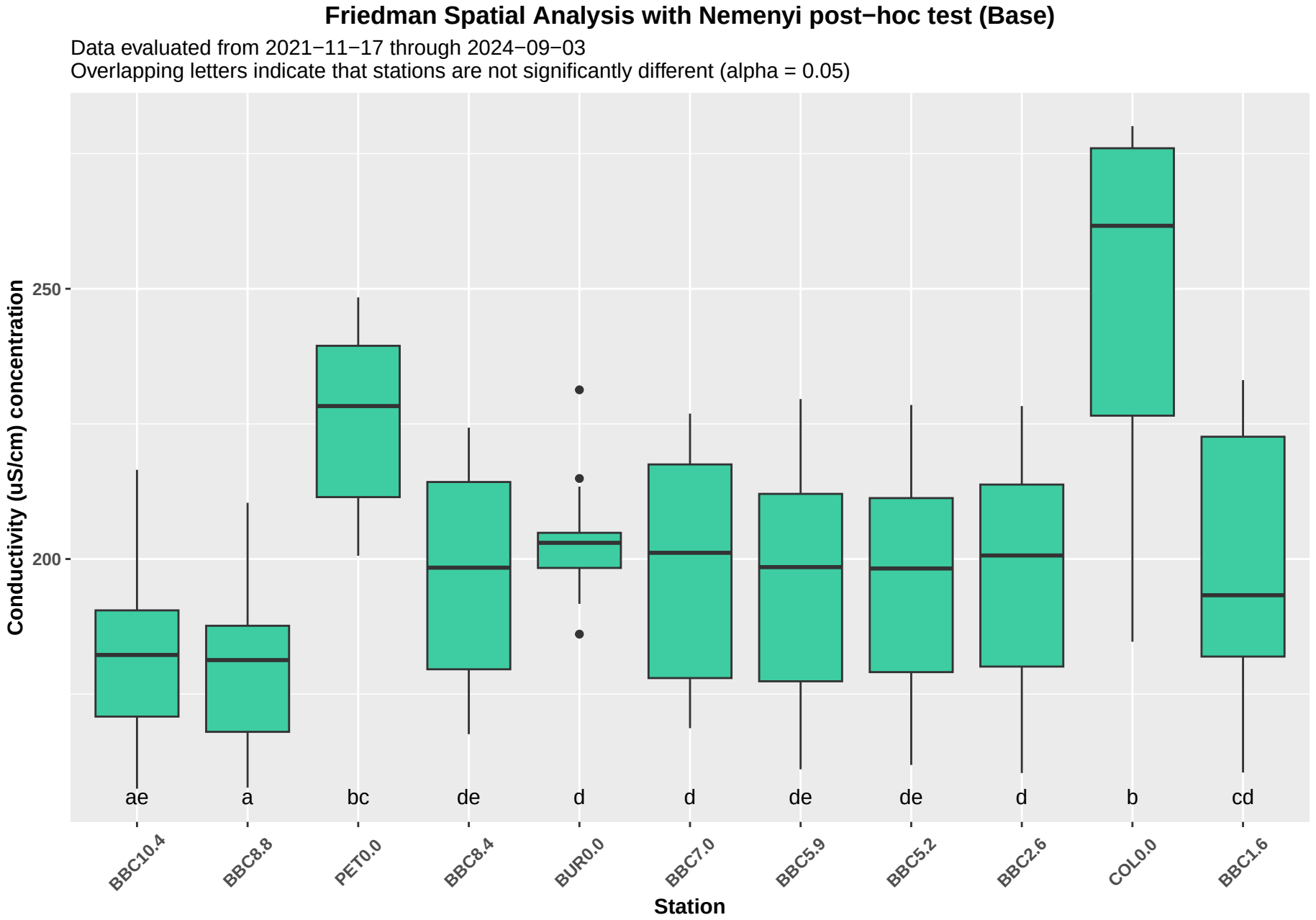
Red lines indicate criteria.

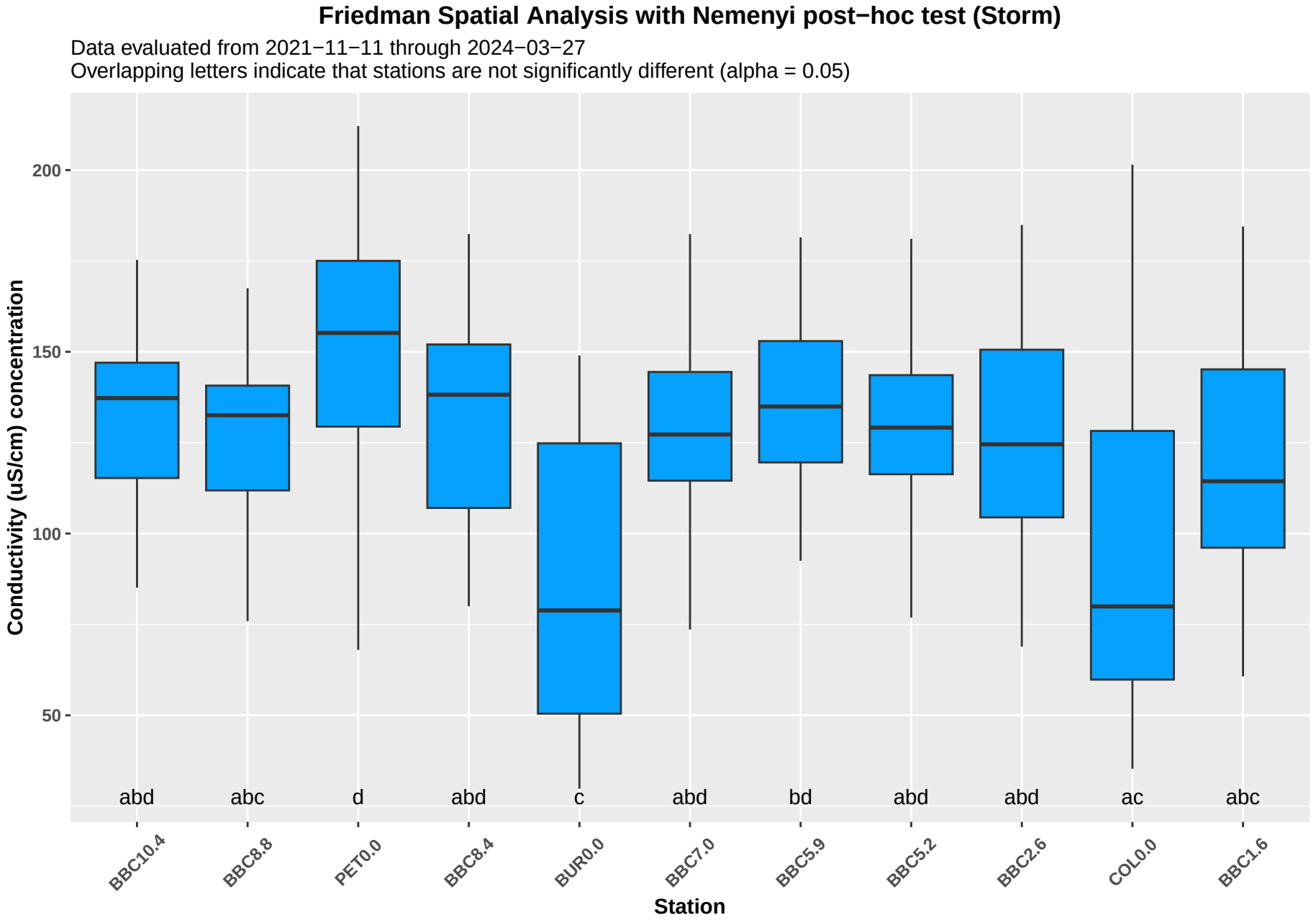
Friedman Spatial Analysis with Nemenyi post−hoc test (Storm)

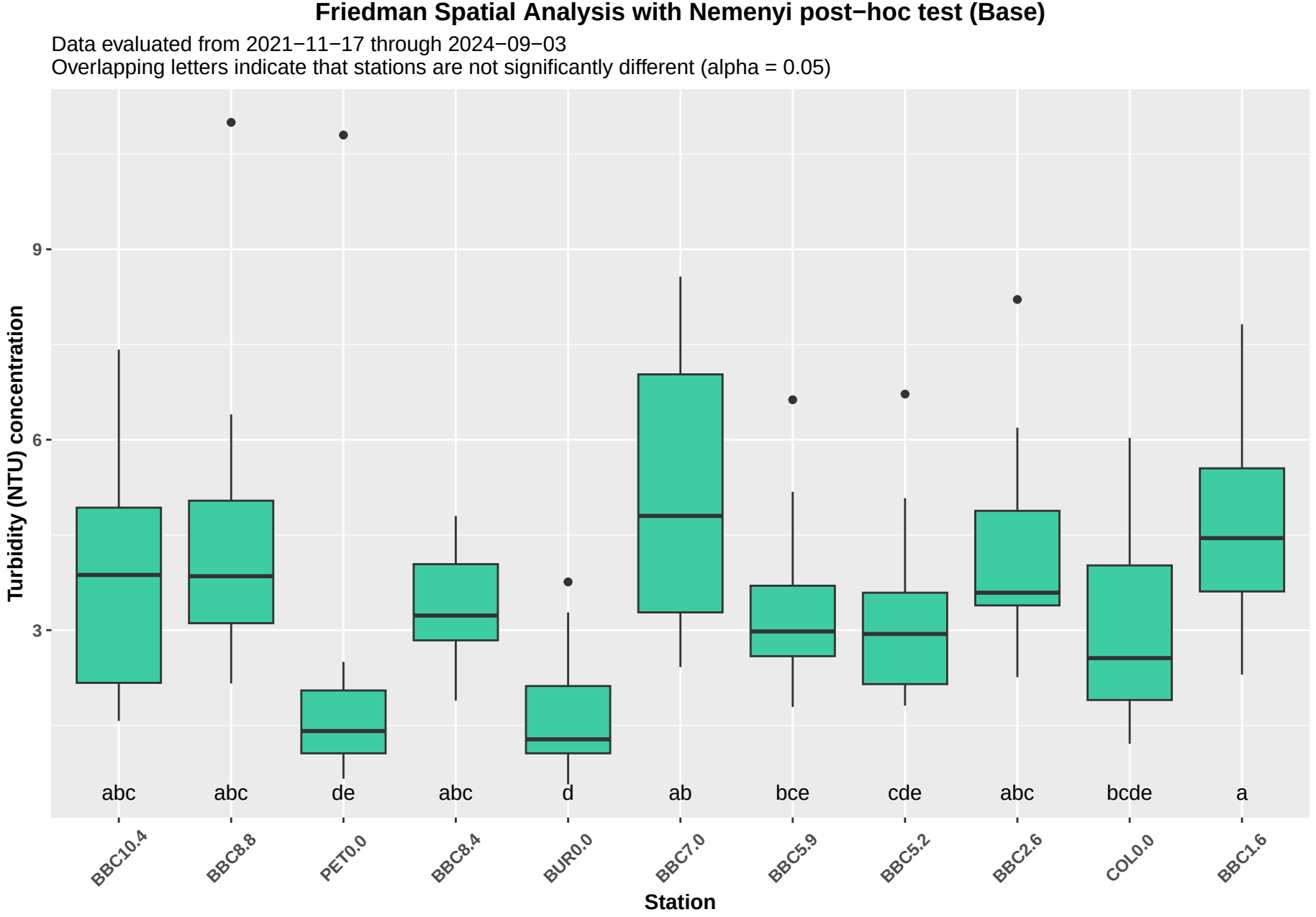
Data evaluated from 2021−11−11 through 2024−04−25
Overlapping letters indicate that stations are not significantly different (alpha = 0.05)

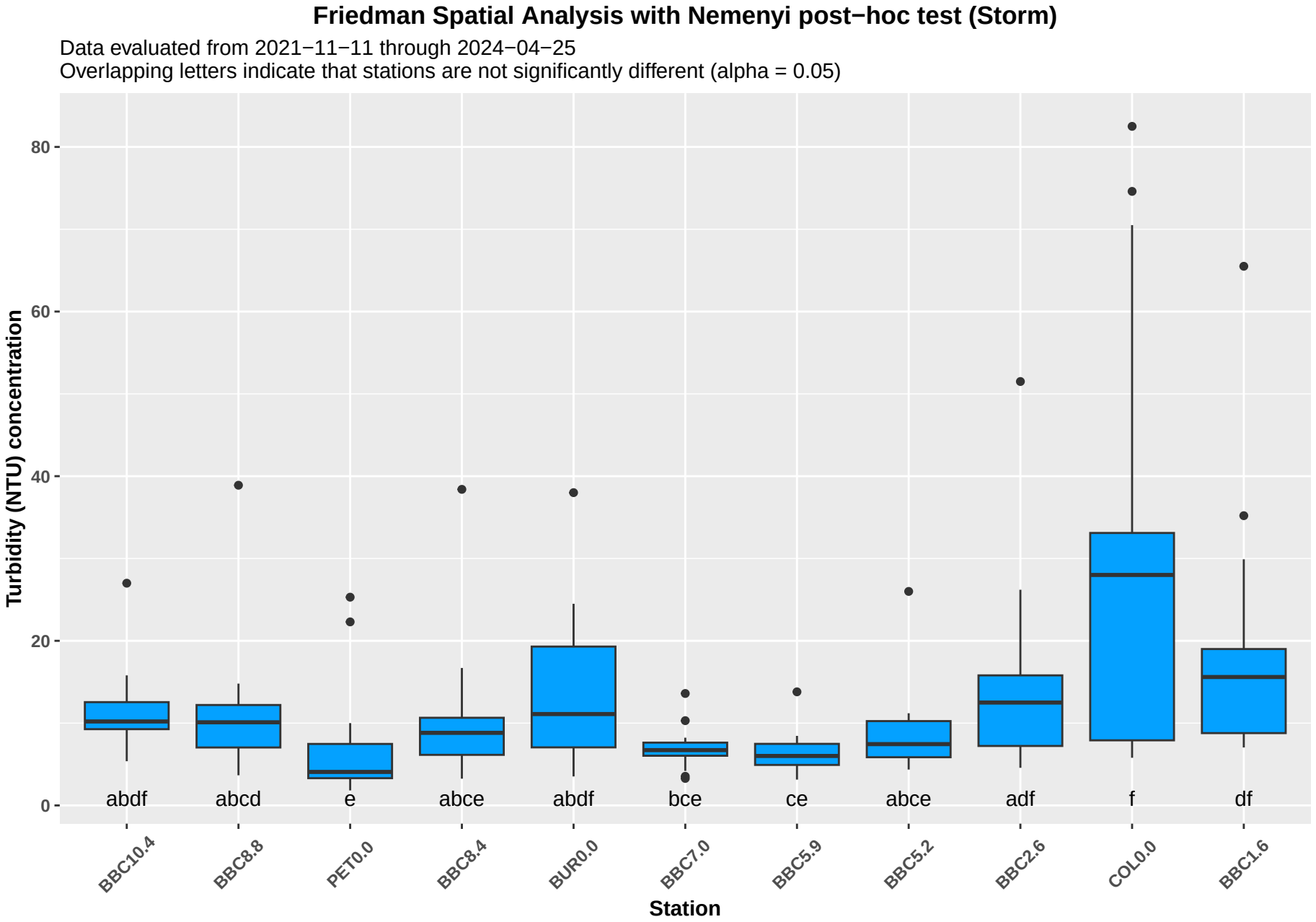


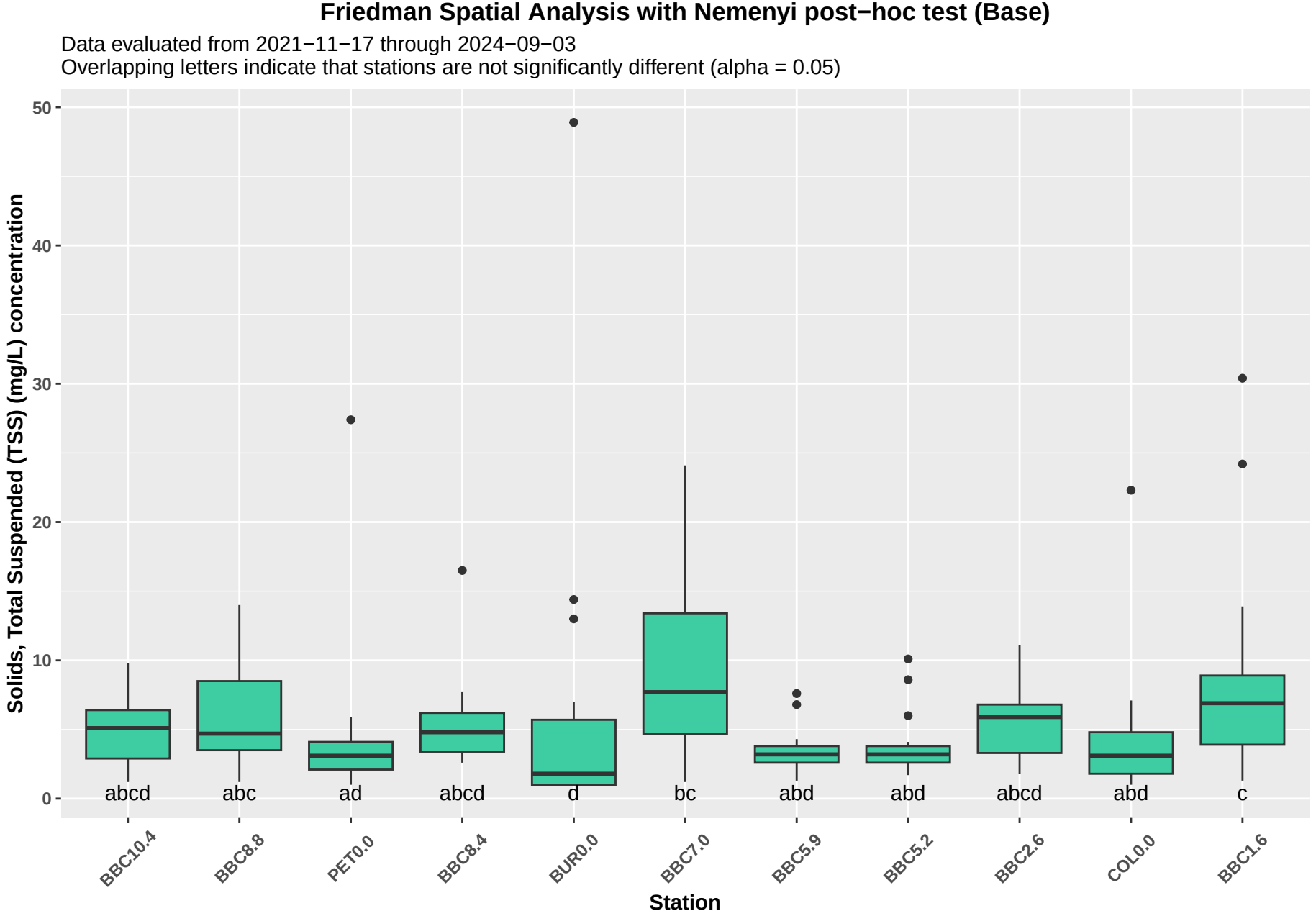
Red lines indicate criteria.

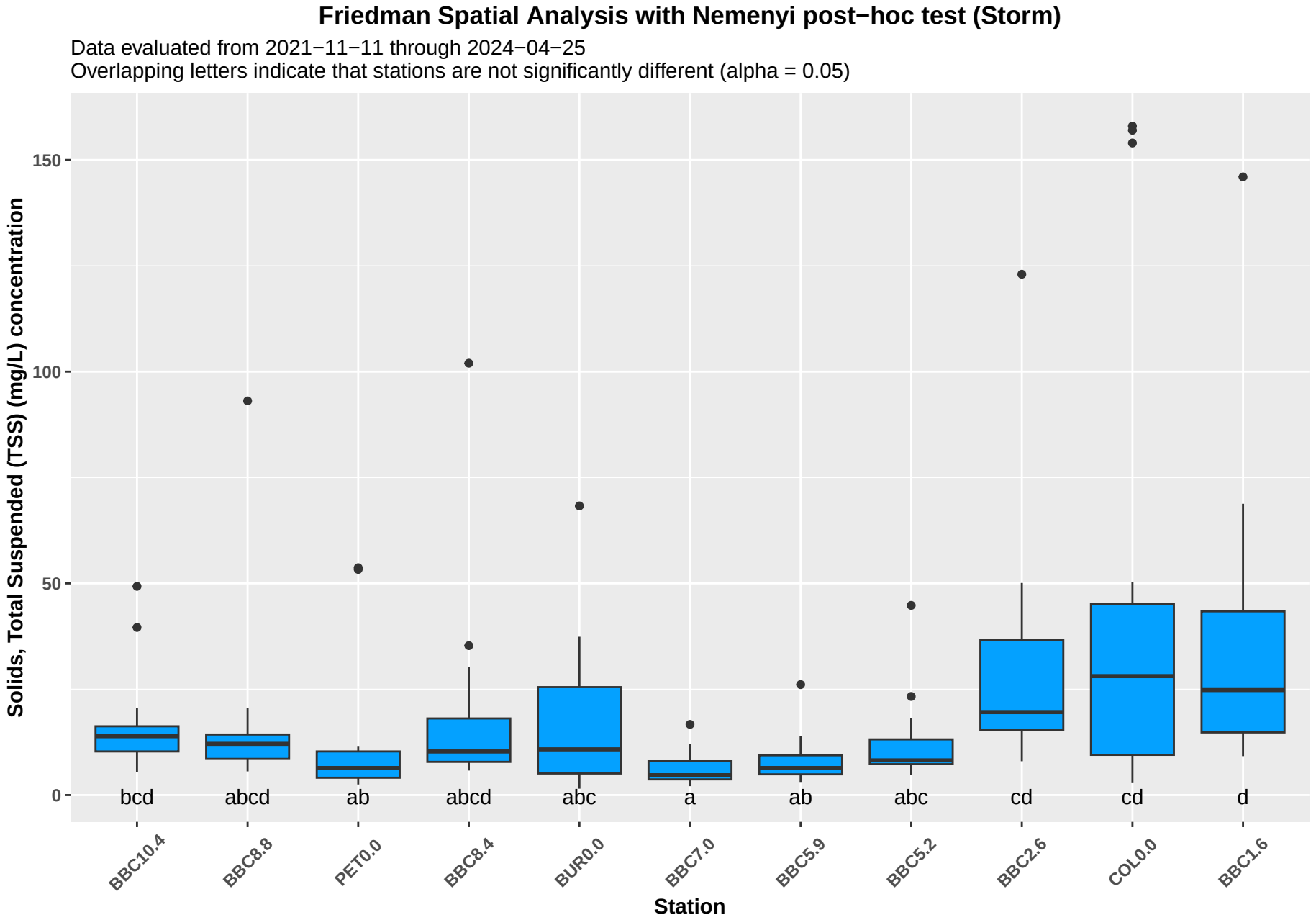

Friedman Spatial Analysis with Nemenyi post−hoc test (Base)
Data evaluated from 2021−11−17 through 2024−09−03
Overlapping letters indicate that stations are not significantly different (alpha = 0.05)
Conductivity (uS/cm) concentration
250
200
ae
a
bc
de
d
d
de
de
d
b
cd
BBC10.4
BBC8.8
PET0.0
BBC8.4
BUR0.0
BBC7.0
BBC5.9
BBC5.2
BBC2.6
COL0.0
BBC1.6
Station

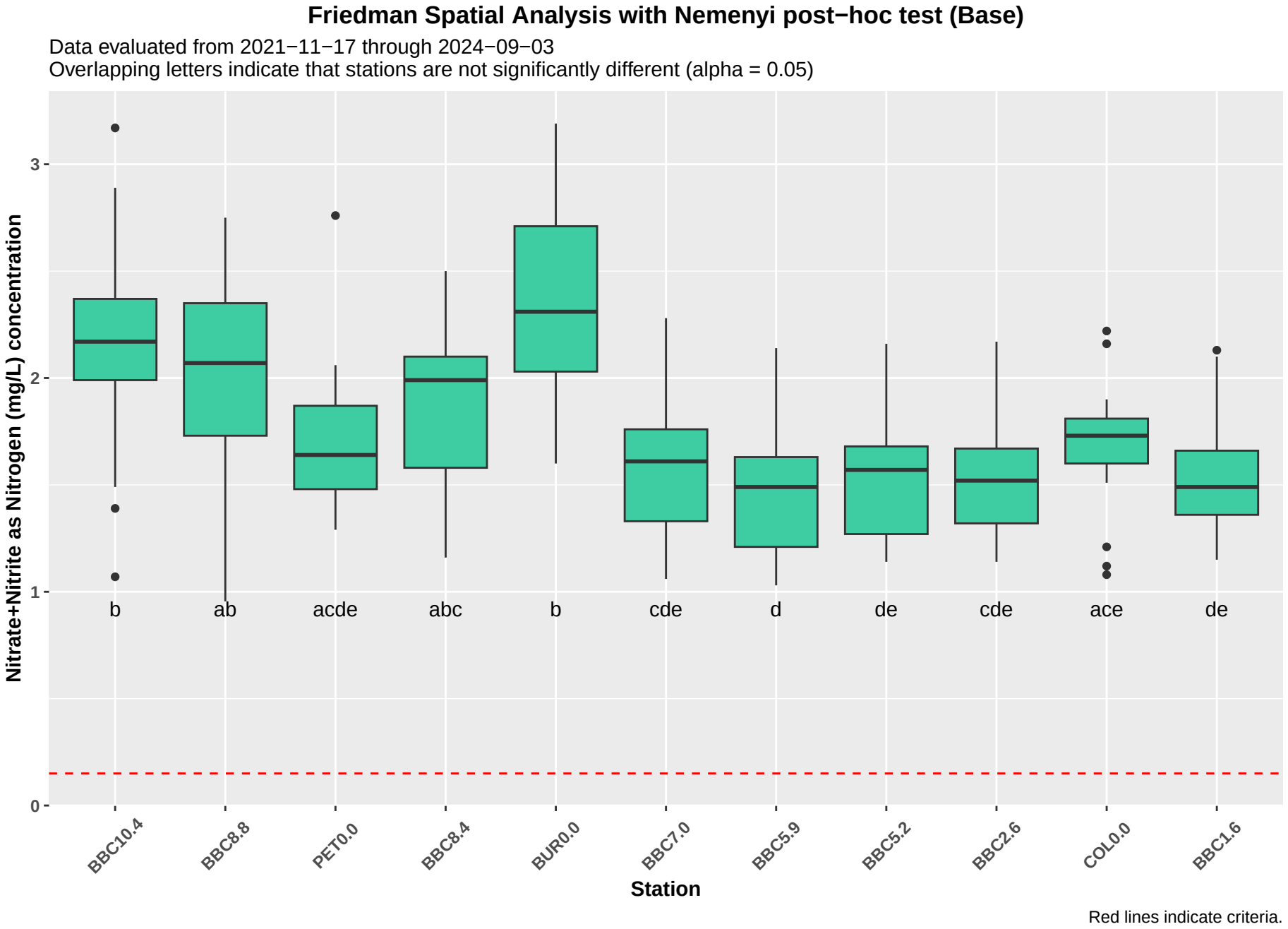

Friedman Spatial Analysis with Nemenyi post−hoc test (Storm)
Data evaluated from 2021−11−11 through 2024−03−27
Overlapping letters indicate that stations are not significantly different (alpha = 0.05)
Conductivity (uS/cm) concentration
200
150
100
50
abd
abc
d
abd
c
abd
bd
abd
abd
ac
abc
BBC10.4
BBC8.8
PET0.0
BBC8.4
BUR0.0
BBC7.0
BBC5.9
BBC5.2
BBC2.6
COL0.0
BBC1.6
Station

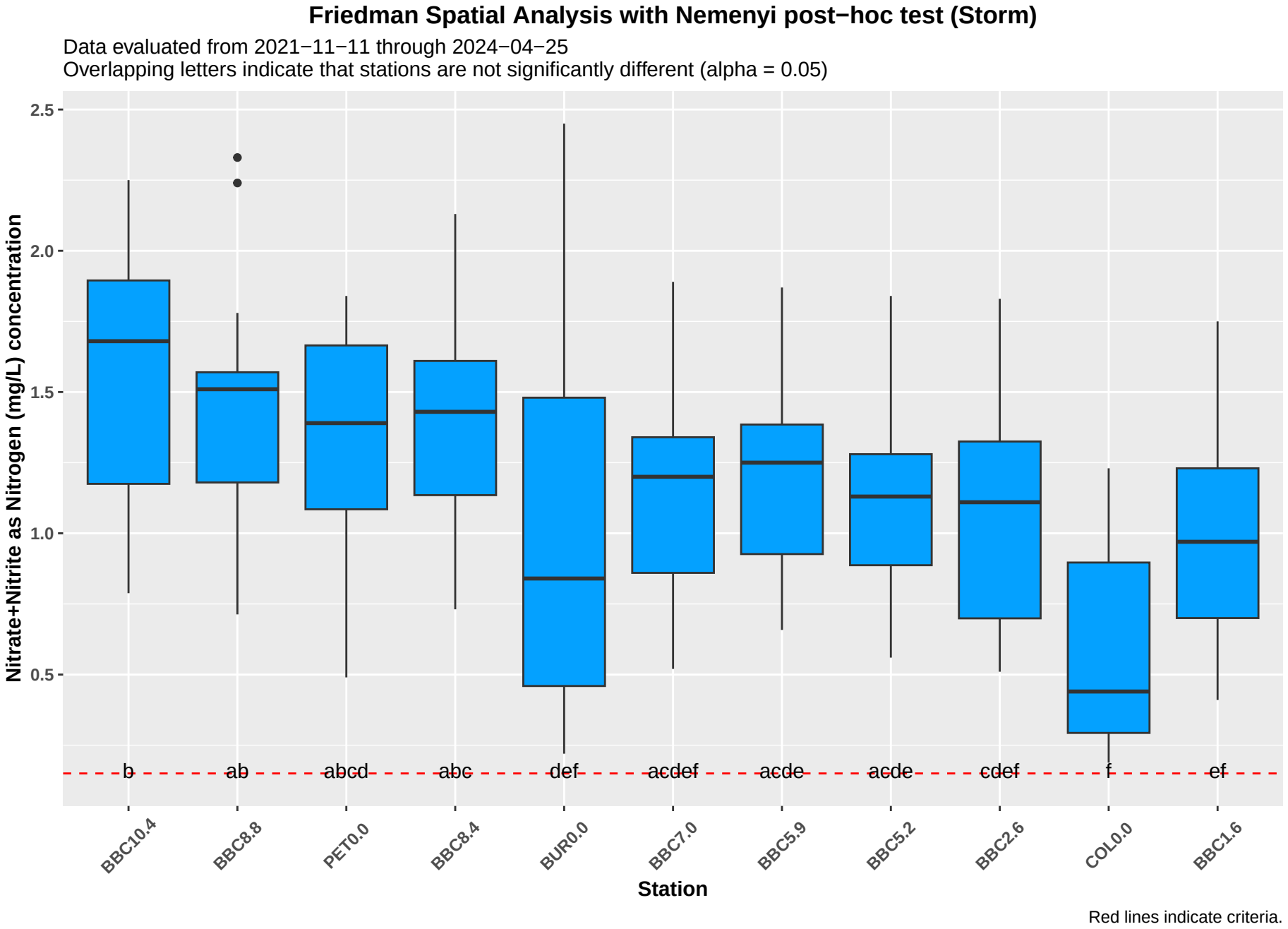

Friedman Spatial Analysis with Nemenyi post−hoc test (Base)
Data evaluated from 2021−11−17 through 2024−09−03
Overlapping letters indicate that stations are not significantly different (alpha = 0.05)
Turbidity (NTU) concentration
9
6
3
abc
abc
de
abc
d
ab
bce
cde
abc
bcde
a
BBC10.4
BBC8.8
PET0.0
BBC8.4
BUR0.0
BBC7.0
BBC5.9
BBC5.2
BBC2.6
COL0.0
BBC1.6
Station

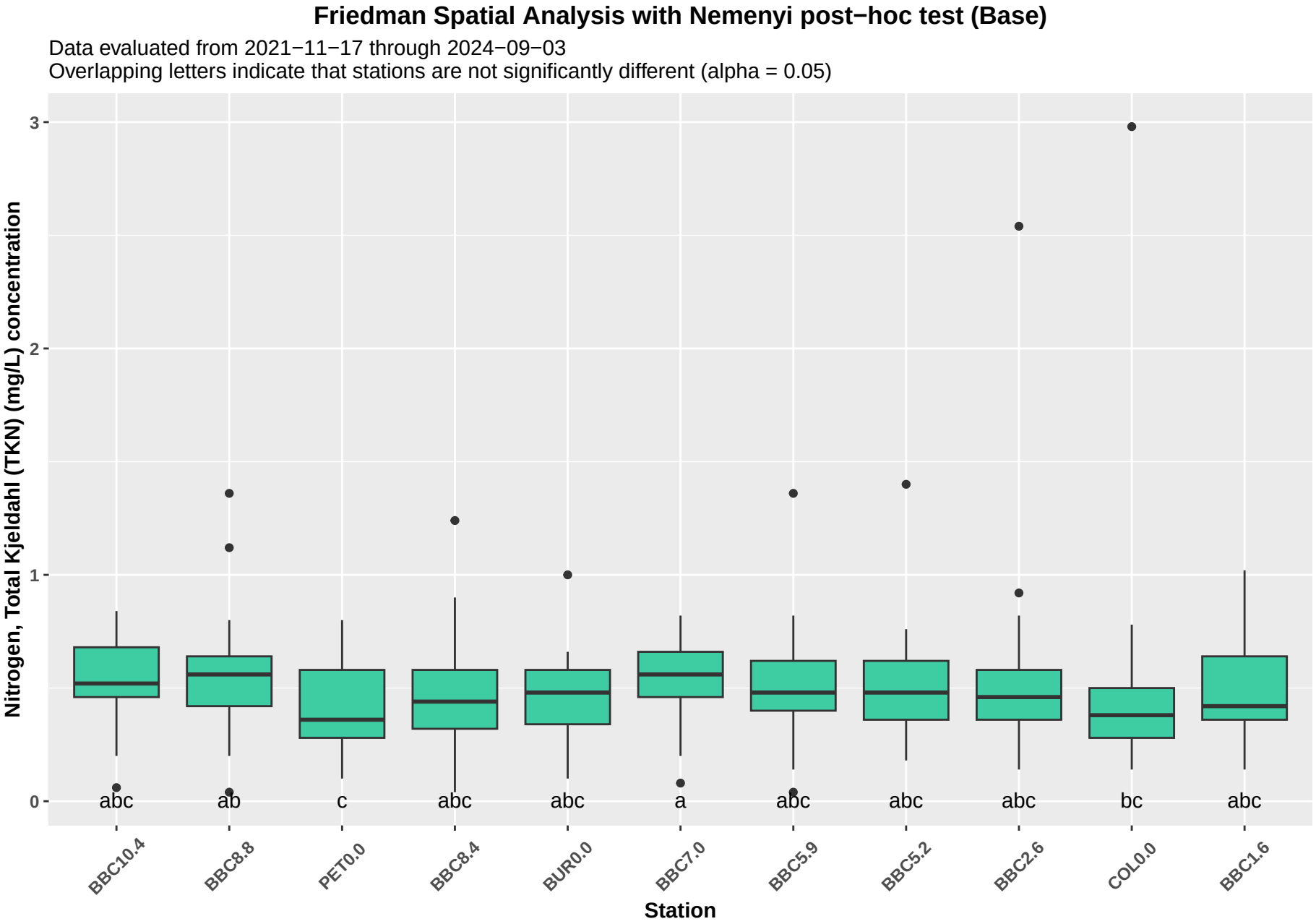

Friedman Spatial Analysis with Nemenyi post−hoc test (Storm)
Data evaluated from 2021−11−11 through 2024−04−25
Overlapping letters indicate that stations are not significantly different (alpha = 0.05)
Turbidity (NTU) concentration
0
20
40
60
80
abdf
abcd
e
abce
abdf
bce
ce
abce
adf
f
df
BBC10.4
BBC8.8
PET0.0
BBC8.4
BUR0.0
BBC7.0
BBC5.9
BBC5.2
BBC2.6
COL0.0
BBC1.6
Station

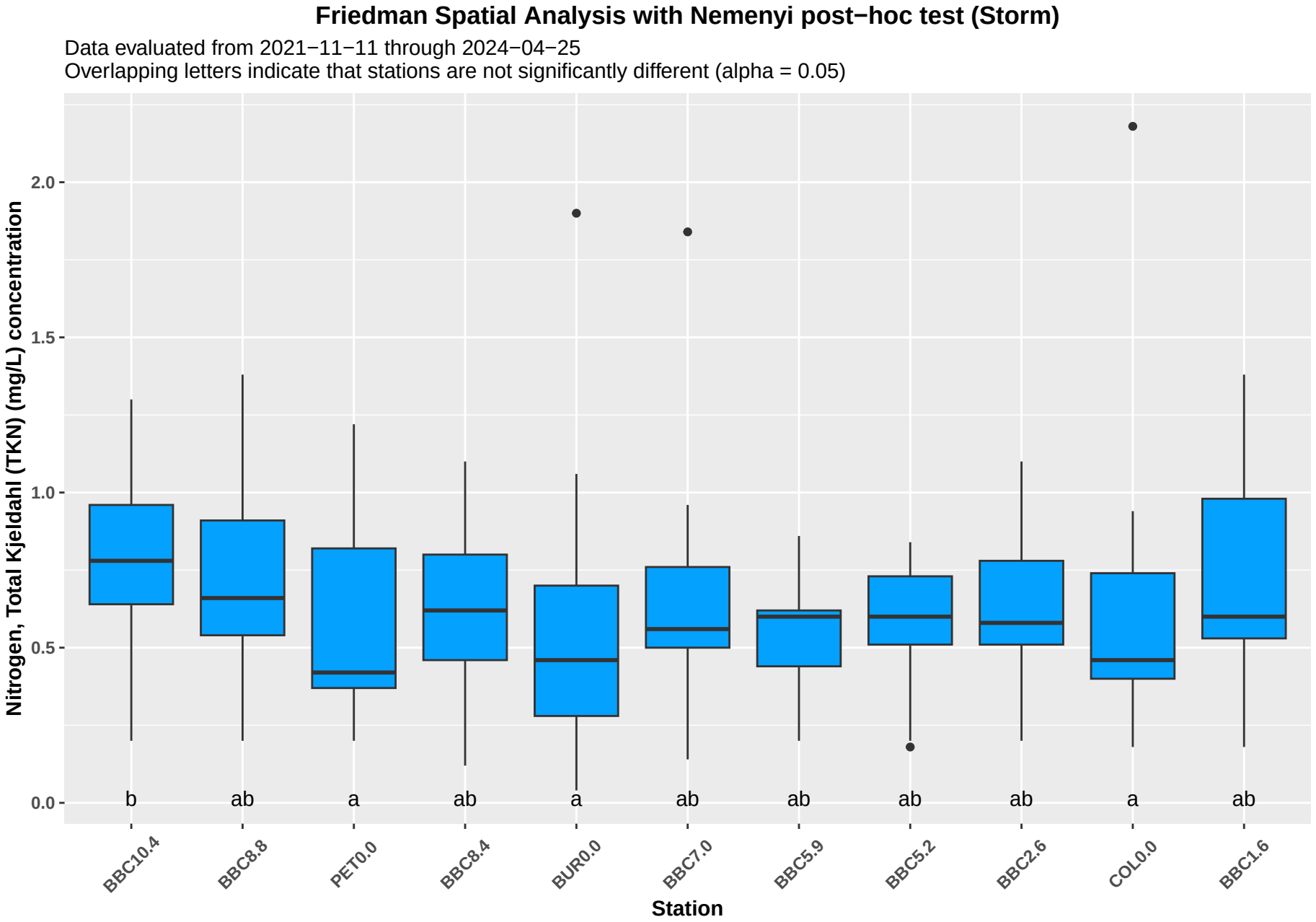

Friedman Spatial Analysis with Nemenyi post−hoc test (Base)
Data evaluated from 2021−11−17 through 2024−09−03
Overlapping letters indicate that stations are not significantly different (alpha = 0.05)
Solids, Total Suspended (TSS) (mg/L) concentration
50
40
30
20
10
0
abcd
abc
ad
abcd
d
bc
abd
abd
abcd
abd
c
BBC10.4
BBC8.8
PET0.0
BBC8.4
BUR0.0
BBC7.0
BBC5.9
BBC5.2
BBC2.6
COL0.0
BBC1.6
Station


Friedman Spatial Analysis with Nemenyi post−hoc test (Storm)
Data evaluated from 2021−11−11 through 2024−04−25
Overlapping letters indicate that stations are not significantly different (alpha = 0.05)
Solids, Total Suspended (TSS) (mg/L) concentration
150
100
50
0
bcd
abcd
ab
abcd
abc
a
ab
abc
cd
cd
d
BBC10.4
BBC8.8
PET0.0
BBC8.4
BUR0.0
BBC7.0
BBC5.9
BBC5.2
BBC2.6
COL0.0
BBC1.6
Station


Friedman Spatial Analysis with Nemenyi post−hoc test (Base)
Data evaluated from 2021−11−17 through 2024−09−03
Overlapping letters indicate that stations are not significantly different (alpha = 0.05)
Nitrate+Nitrite as Nitrogen (mg/L) concentration
0
1
2
3
b
ab
acde
abc
b
cde
d
de
cde
ace
de
BBC10.4
BBC8.8
PET0.0
BBC8.4
BUR0.0
BBC7.0
BBC5.9
BBC5.2
BBC2.6
COL0.0
BBC1.6
Station
Red lines indicate criteria.

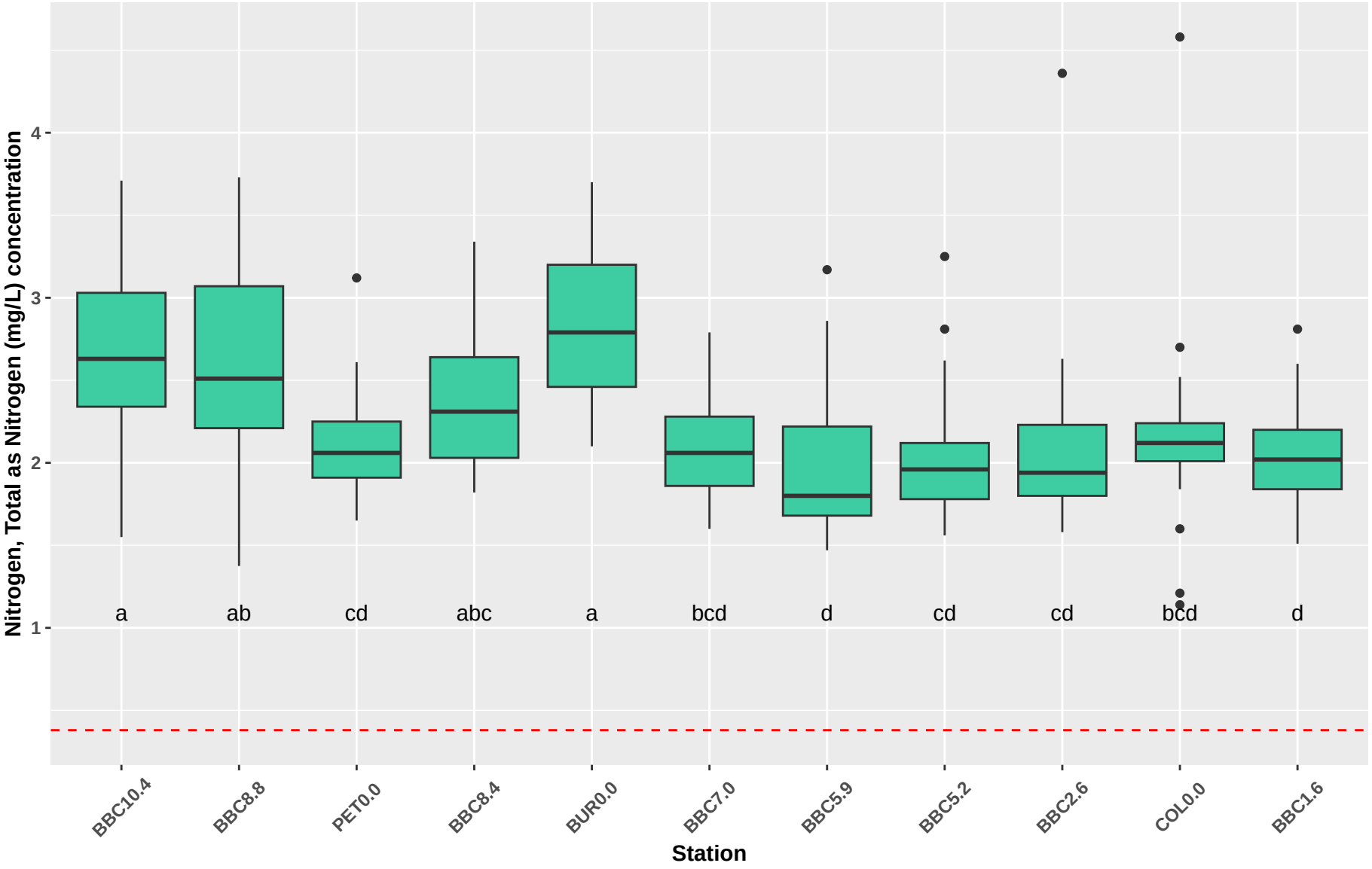

Friedman Spatial Analysis with Nemenyi post−hoc test (Storm)
Data evaluated from 2021−11−11 through 2024−04−25
Overlapping letters indicate that stations are not significantly different (alpha = 0.05)
Nitrate+Nitrite as Nitrogen (mg/L) concentration
2.5
2.0
1.5
1.0
0.5
b
ab
abcd
abc
def
acdef
acde
acde
cdef
f
ef
BBC10.4
BBC8.8
PET0.0
BBC8.4
BUR0.0
BBC7.0
BBC5.9
BBC5.2
BBC2.6
COL0.0
BBC1.6
Station
Red lines indicate criteria.


Friedman Spatial Analysis with Nemenyi post−hoc test (Base)
Data evaluated from 2021−11−17 through 2024−09−03
Overlapping letters indicate that stations are not significantly different (alpha = 0.05)
Nitrogen, Total Kjeldahl (TKN) (mg/L) concentration
3
2
1
0
abc
ab
c
abc
abc
a
abc
abc
abc
bc
abc
BBC10.4
BBC8.8
PET0.0
BBC8.4
BUR0.0
BBC7.0
BBC5.9
BBC5.2
BBC2.6
COL0.0
BBC1.6
Station


Friedman Spatial Analysis with Nemenyi post−hoc test (Storm)
Data evaluated from 2021−11−11 through 2024−04−25
Overlapping letters indicate that stations are not significantly different (alpha = 0.05)
Nitrogen, Total Kjeldahl (TKN) (mg/L) concentration
2.0
1.5
1.0
0.5
0.0
b
ab
a
ab
a
ab
ab
ab
ab
a
ab
BBC10.4
BBC8.8
PET0.0
BBC8.4
BUR0.0
BBC7.0
BBC5.9
BBC5.2
BBC2.6
COL0.0
BBC1.6
Station

Friedman Spatial Analysis with Nemenyi post−hoc test (Base)

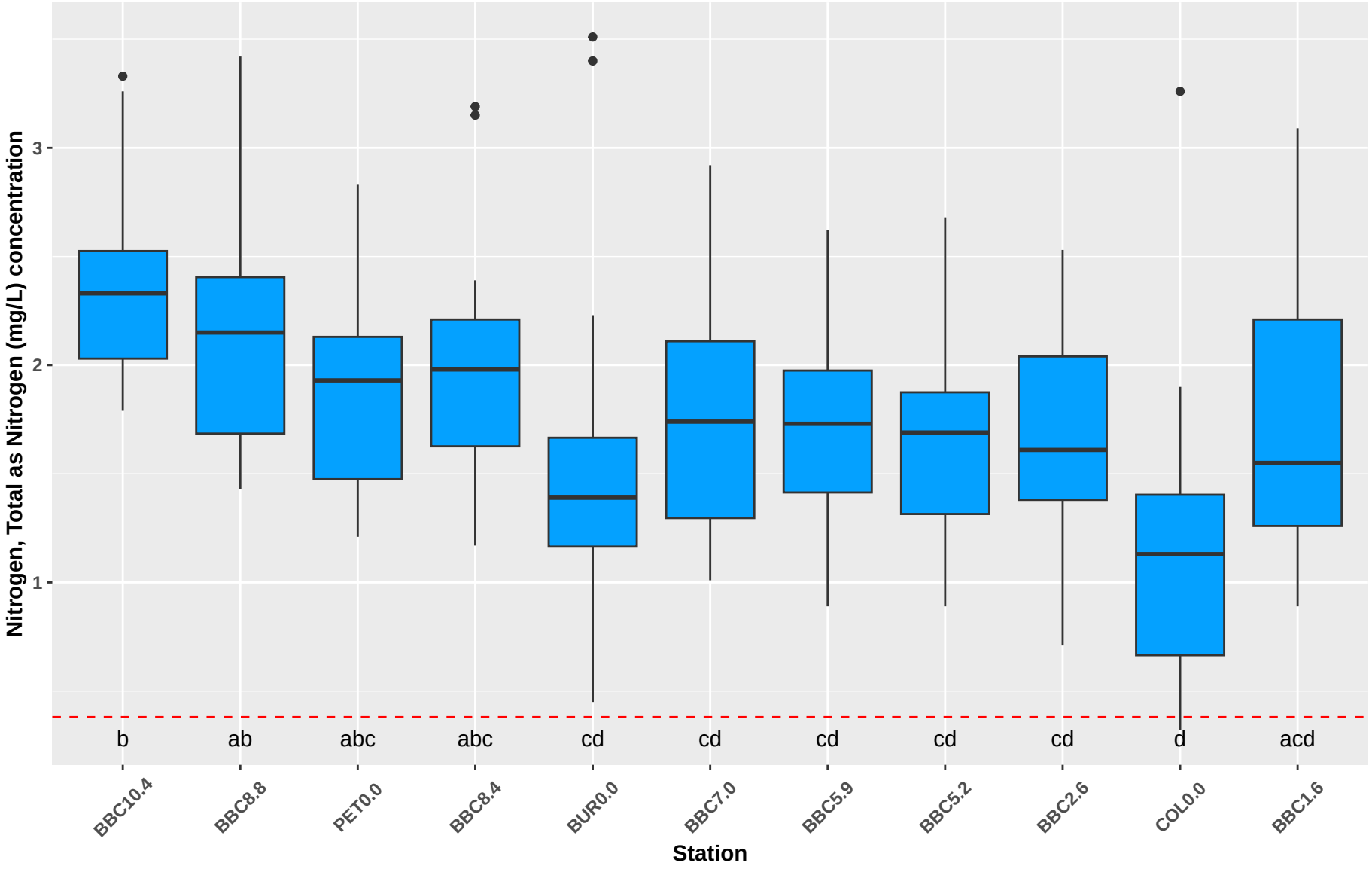
Data evaluated from 2021−11−17 through 2024−09−03
Overlapping letters indicate that stations are not significantly different (alpha = 0.05)



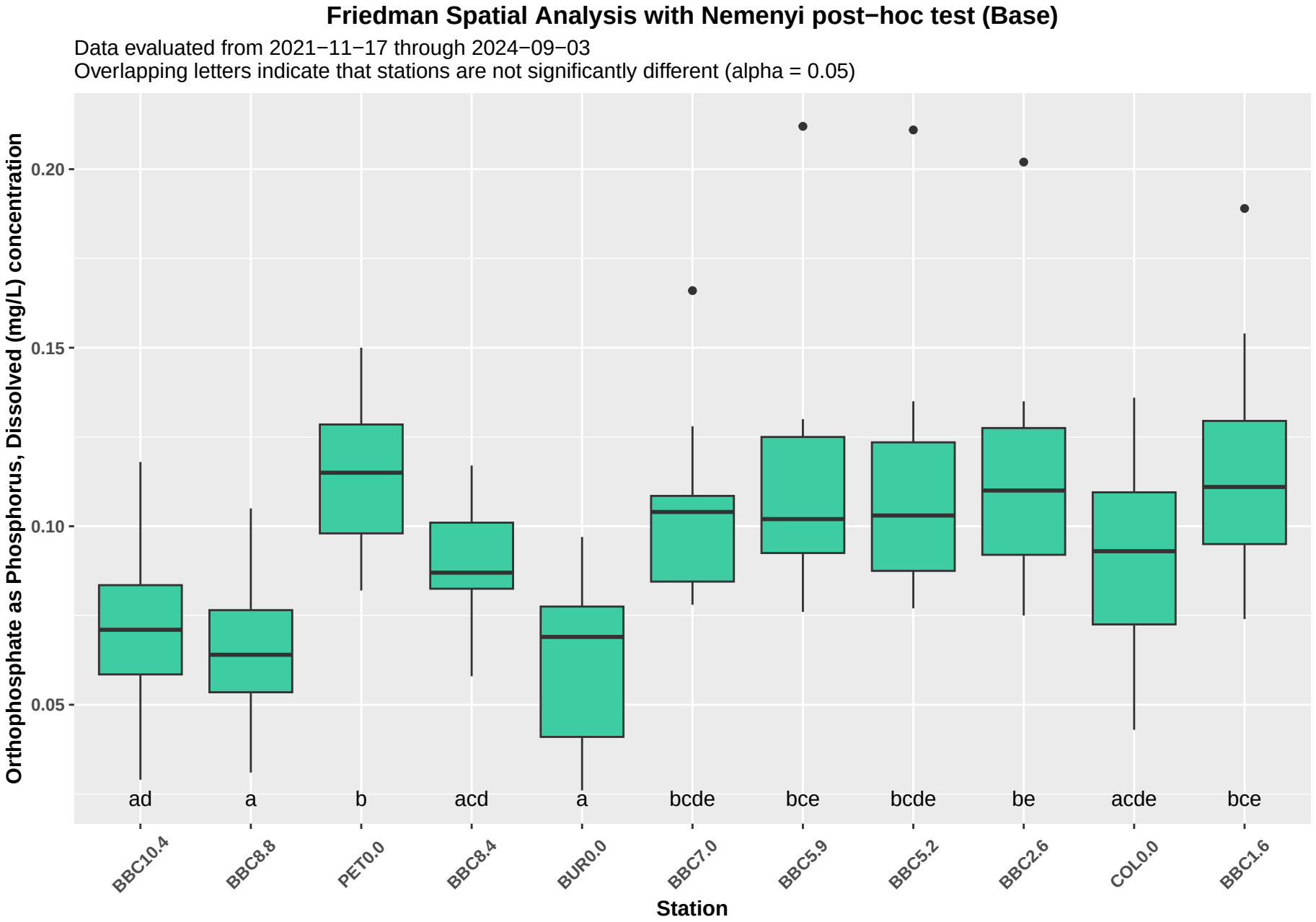
Red lines indicate criteria.

Friedman Spatial Analysis with Nemenyi post−hoc test (Storm)

Data evaluated from 2021−11−11 through 2024−04−25
Overlapping letters indicate that stations are not significantly different (alpha = 0.05)

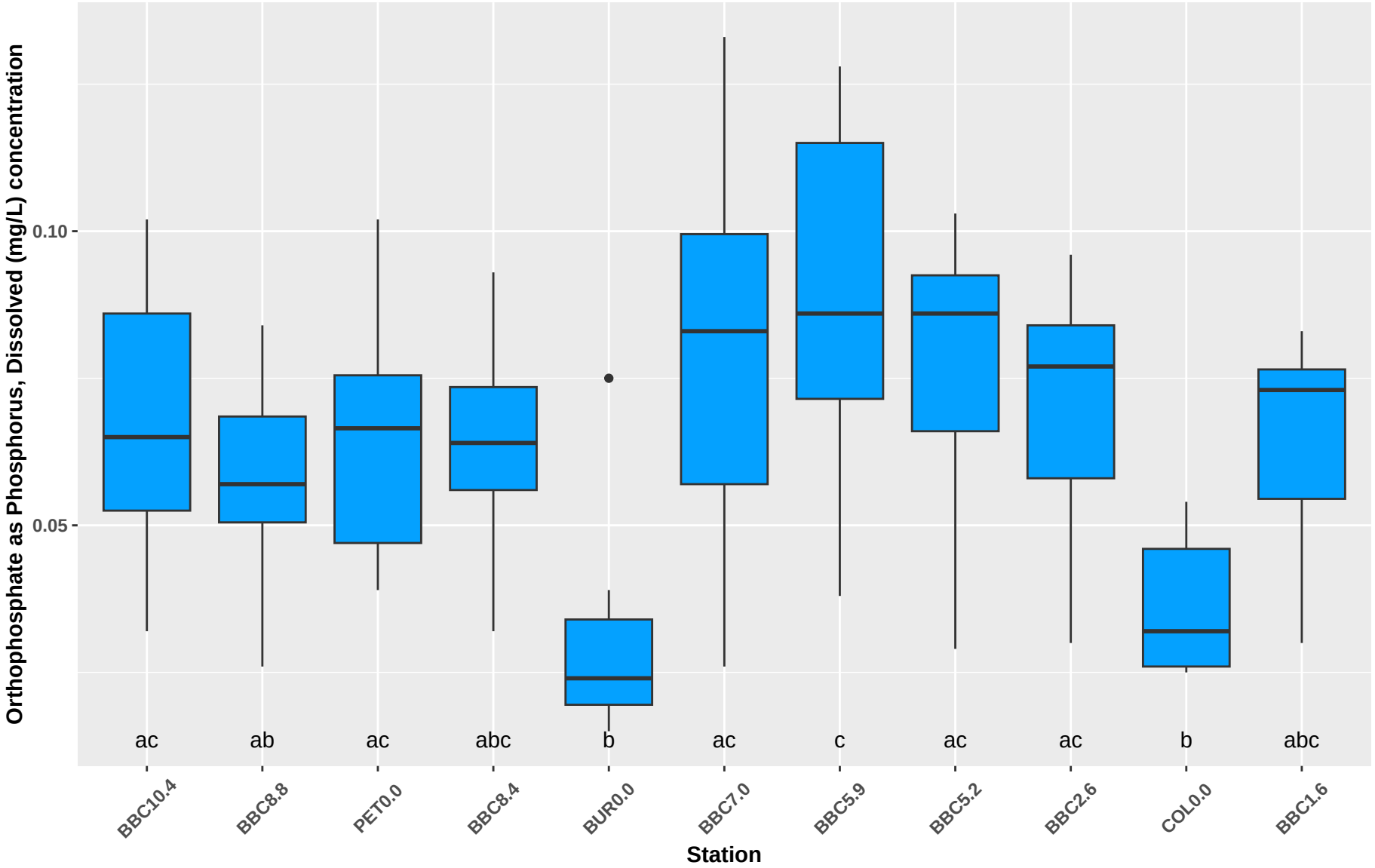


Red lines indicate criteria.

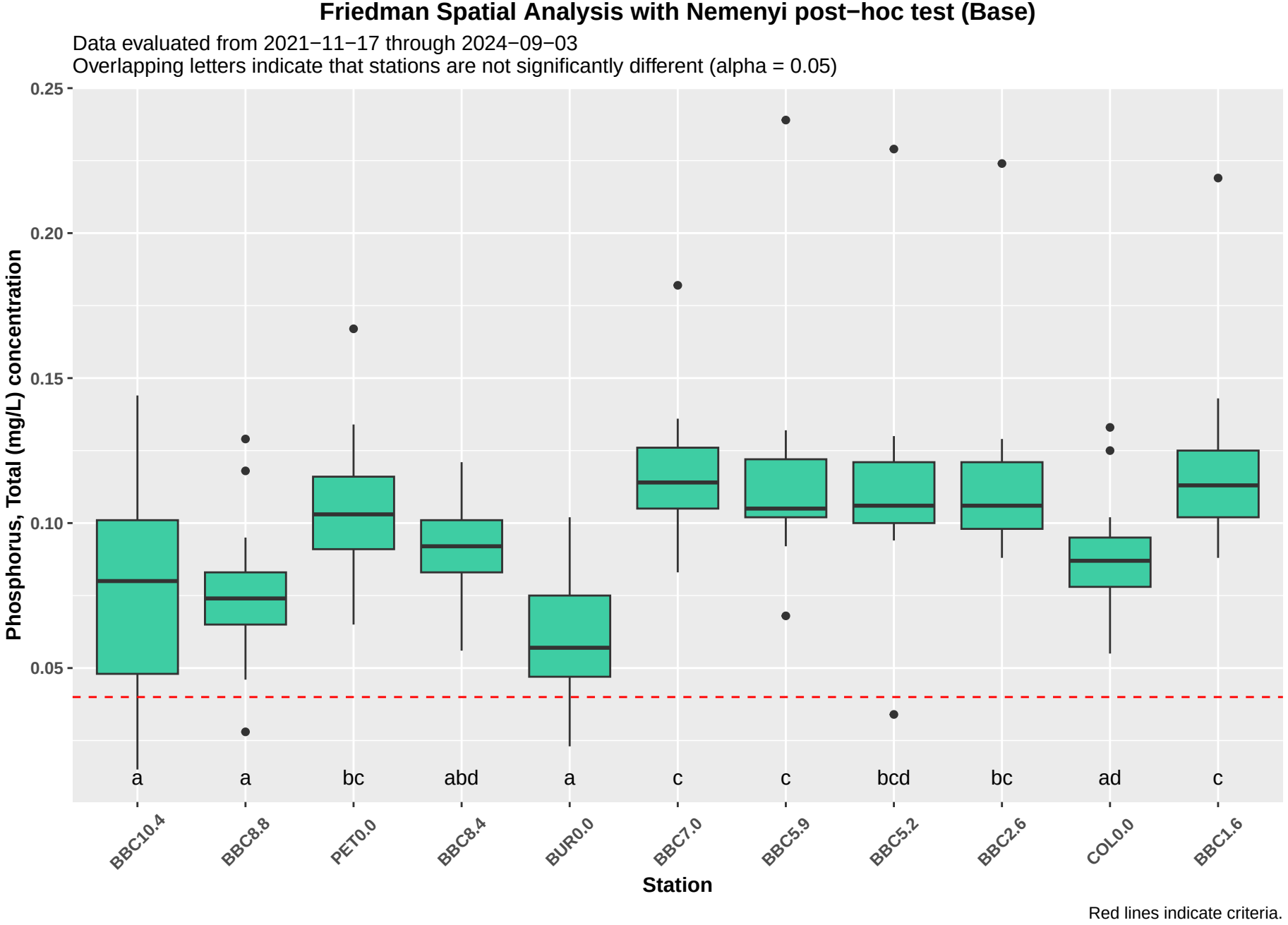

Friedman Spatial Analysis with Nemenyi post−hoc test (Base)
Data evaluated from 2021−11−17 through 2024−09−03
Overlapping letters indicate that stations are not significantly different (alpha = 0.05)
Orthophosphate as Phosphorus, Dissolved (mg/L) concentration
0.20
0.15
0.10
0.05
ad
a
b
acd
a
bcde
bce
bcde
be
acde
bce
BBC10.4
BBC8.8
PET0.0
BBC8.4
BUR0.0
BBC7.0
BBC5.9
BBC5.2
BBC2.6
COL0.0
BBC1.6
Station

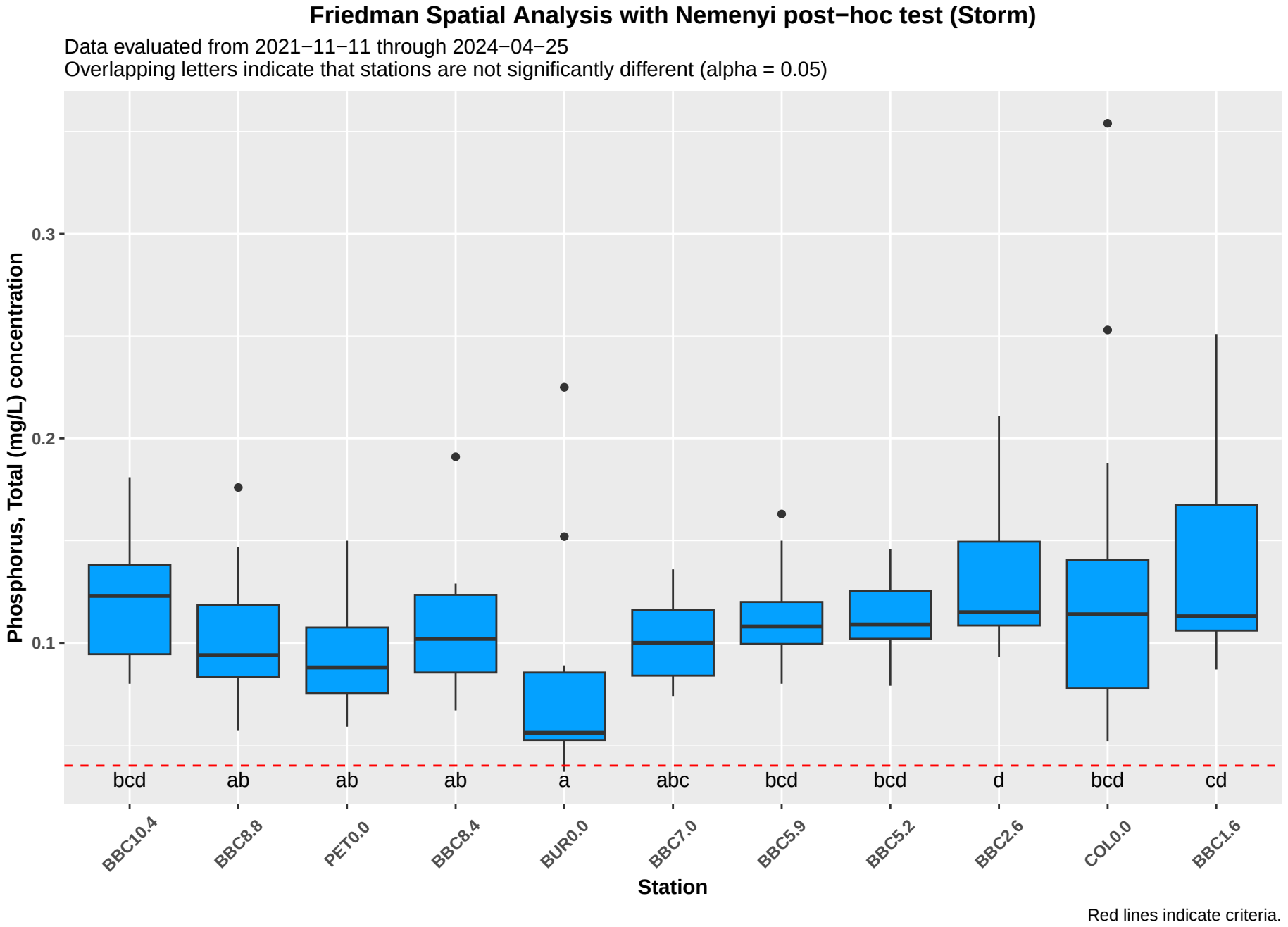
Friedman Spatial Analysis with Nemenyi post−hoc test (Storm)

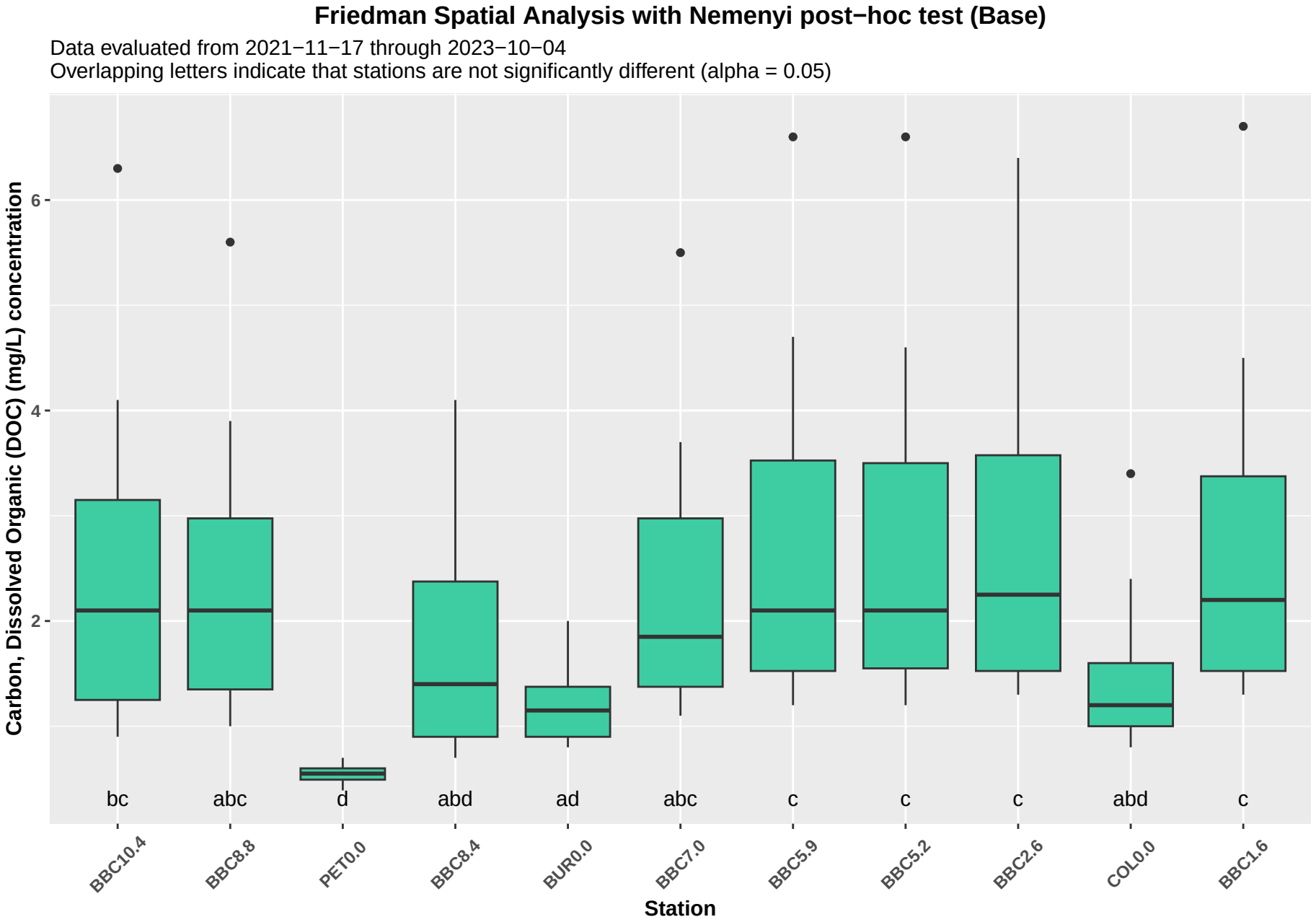
Data evaluated from 2021−11−11 through 2024−04−25
Overlapping letters indicate that stations are not significantly different (alpha = 0.05)

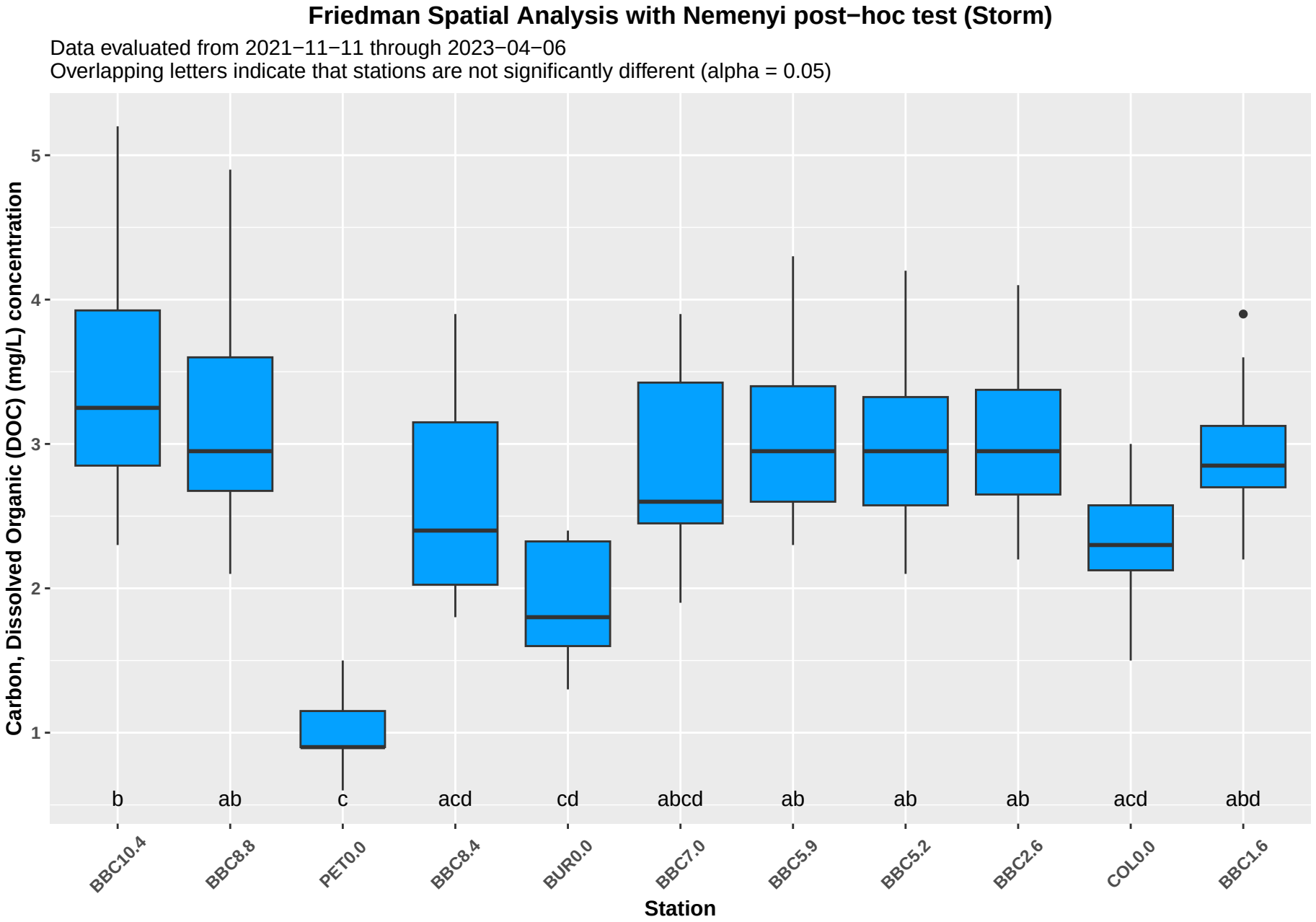


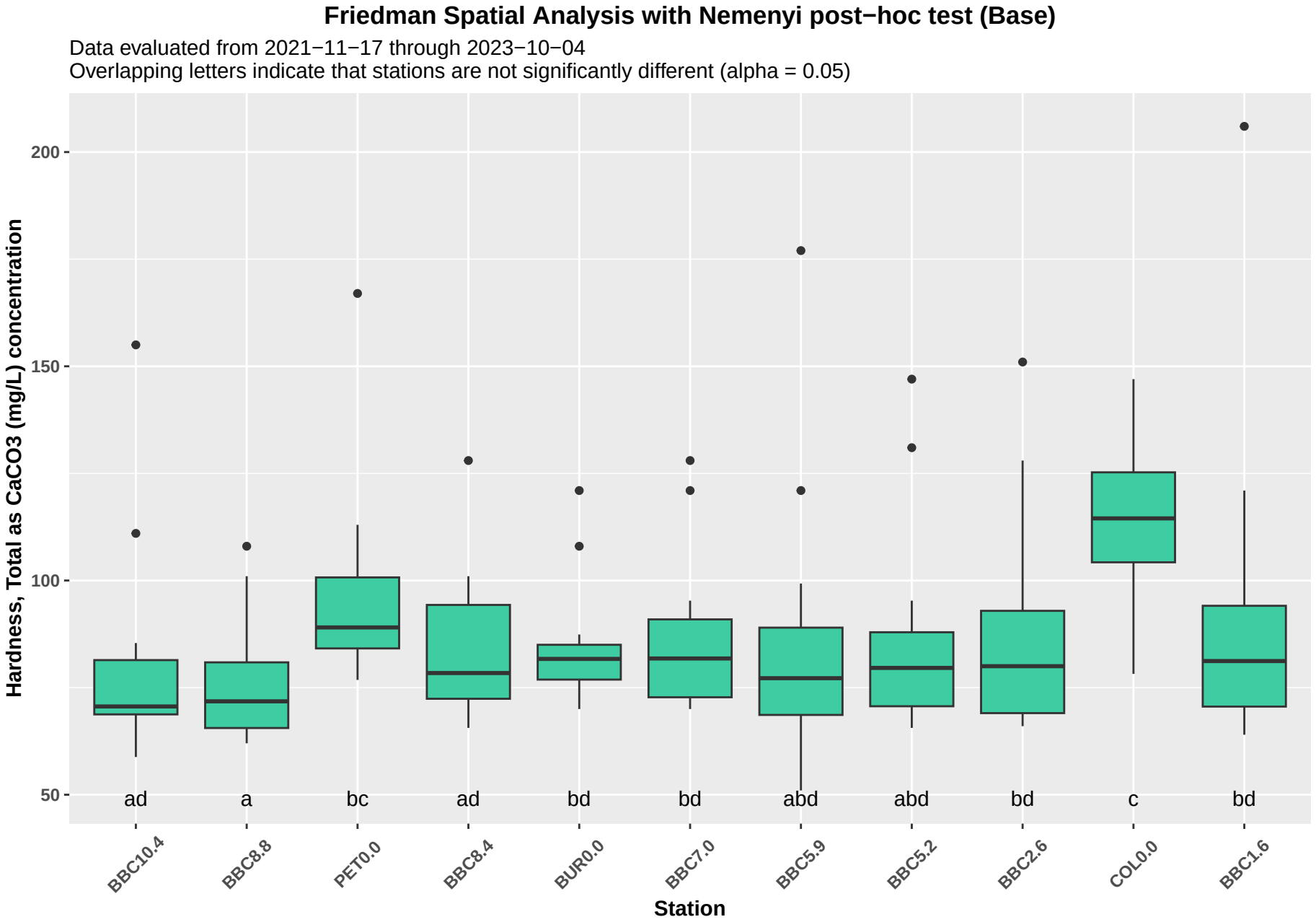
1 sampling event was not included in the Friedman test because not all stations were sampled.

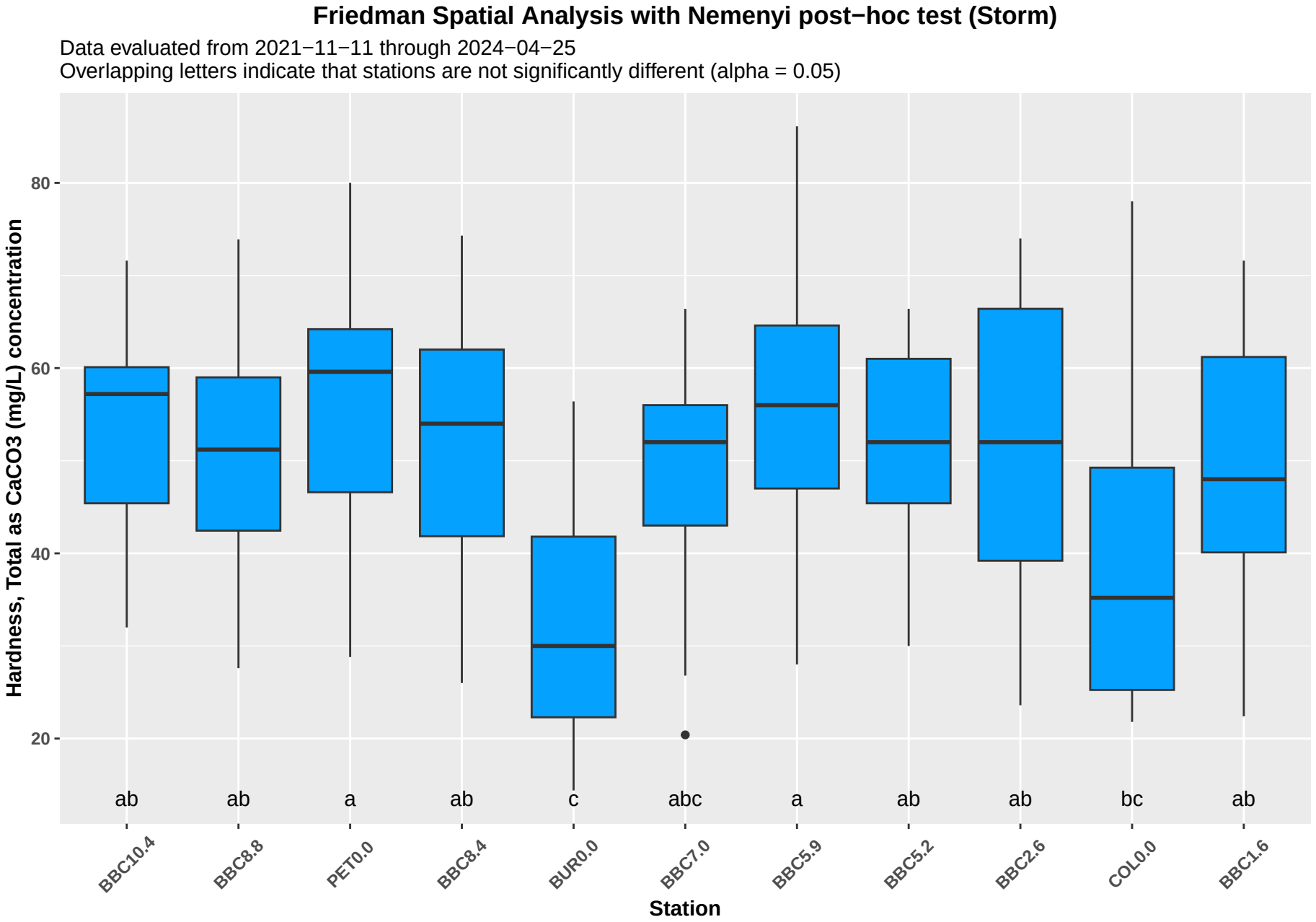

Friedman Spatial Analysis with Nemenyi post−hoc test (Base)
Data evaluated from 2021−11−17 through 2024−09−03
Overlapping letters indicate that stations are not significantly different (alpha = 0.05)
Phosphorus, Total (mg/L) concentration
0.25
0.20
0.15
0.10
0.05
a
a
bc
abd
a
c
c
bcd
bc
ad
c
BBC10.4
BBC8.8
PET0.0
BBC8.4
BUR0.0
BBC7.0
BBC5.9
BBC5.2
BBC2.6
COL0.0
BBC1.6
Station
Red lines indicate criteria.

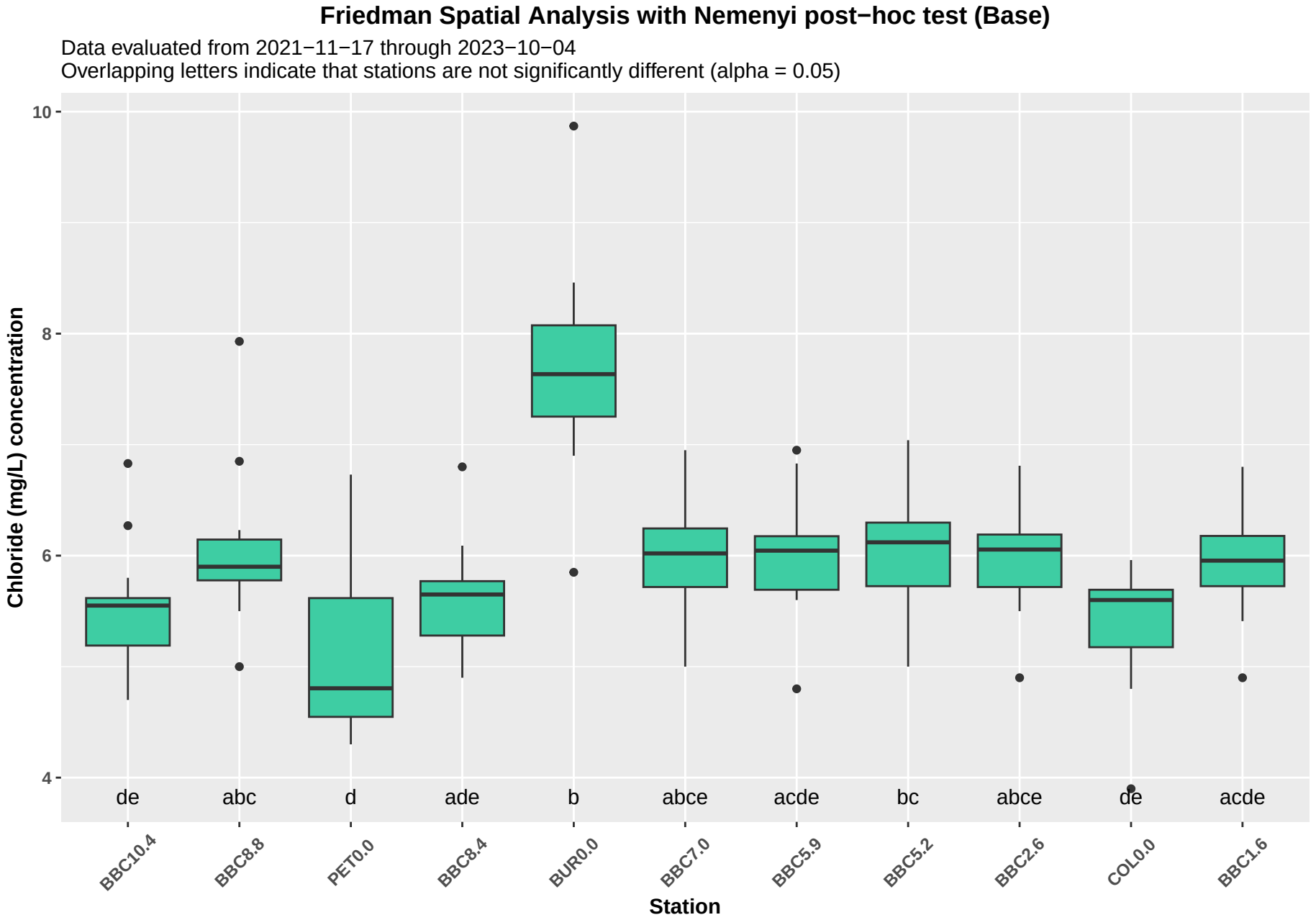

Friedman Spatial Analysis with Nemenyi post−hoc test (Storm)
Data evaluated from 2021−11−11 through 2024−04−25
Overlapping letters indicate that stations are not significantly different (alpha = 0.05)
Phosphorus, Total (mg/L) concentration
0.3
0.2
0.1
bcd
ab
ab
ab
a
abc
bcd
bcd
d
bcd
cd
BBC10.4
BBC8.8
PET0.0
BBC8.4
BUR0.0
BBC7.0
BBC5.9
BBC5.2
BBC2.6
COL0.0
BBC1.6
Station
Red lines indicate criteria.

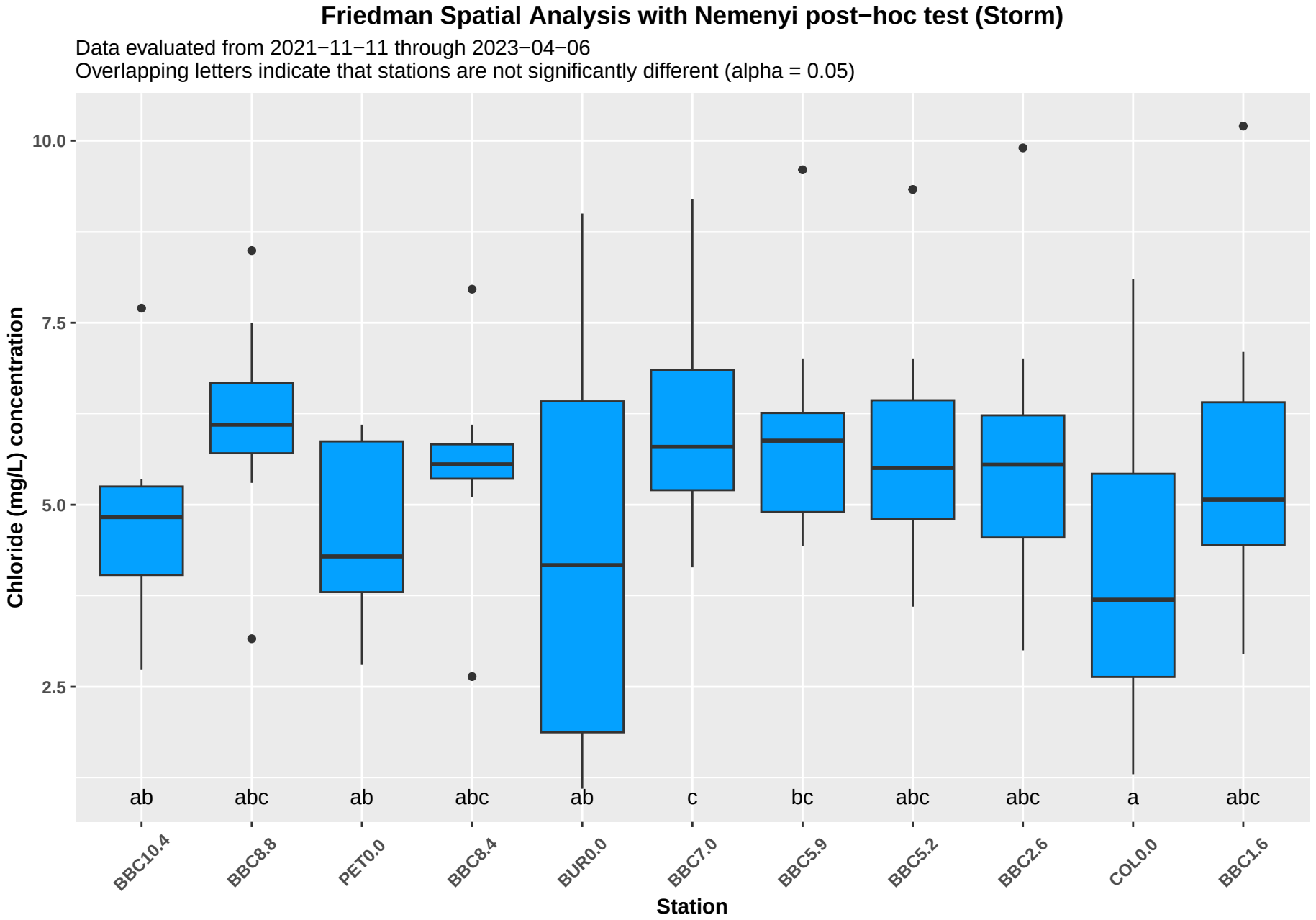

Friedman Spatial Analysis with Nemenyi post−hoc test (Base)
Data evaluated from 2021−11−17 through 2023−10−04
Overlapping letters indicate that stations are not significantly different (alpha = 0.05)
Carbon, Dissolved Organic (DOC) (mg/L) concentration
6
4
2
bc
abc
d
abd
ad
abc
c
c
c
abd
c
BBC10.4
BBC8.8
PET0.0
BBC8.4
BUR0.0
BBC7.0
BBC5.9
BBC5.2
BBC2.6
COL0.0
BBC1.6
Station

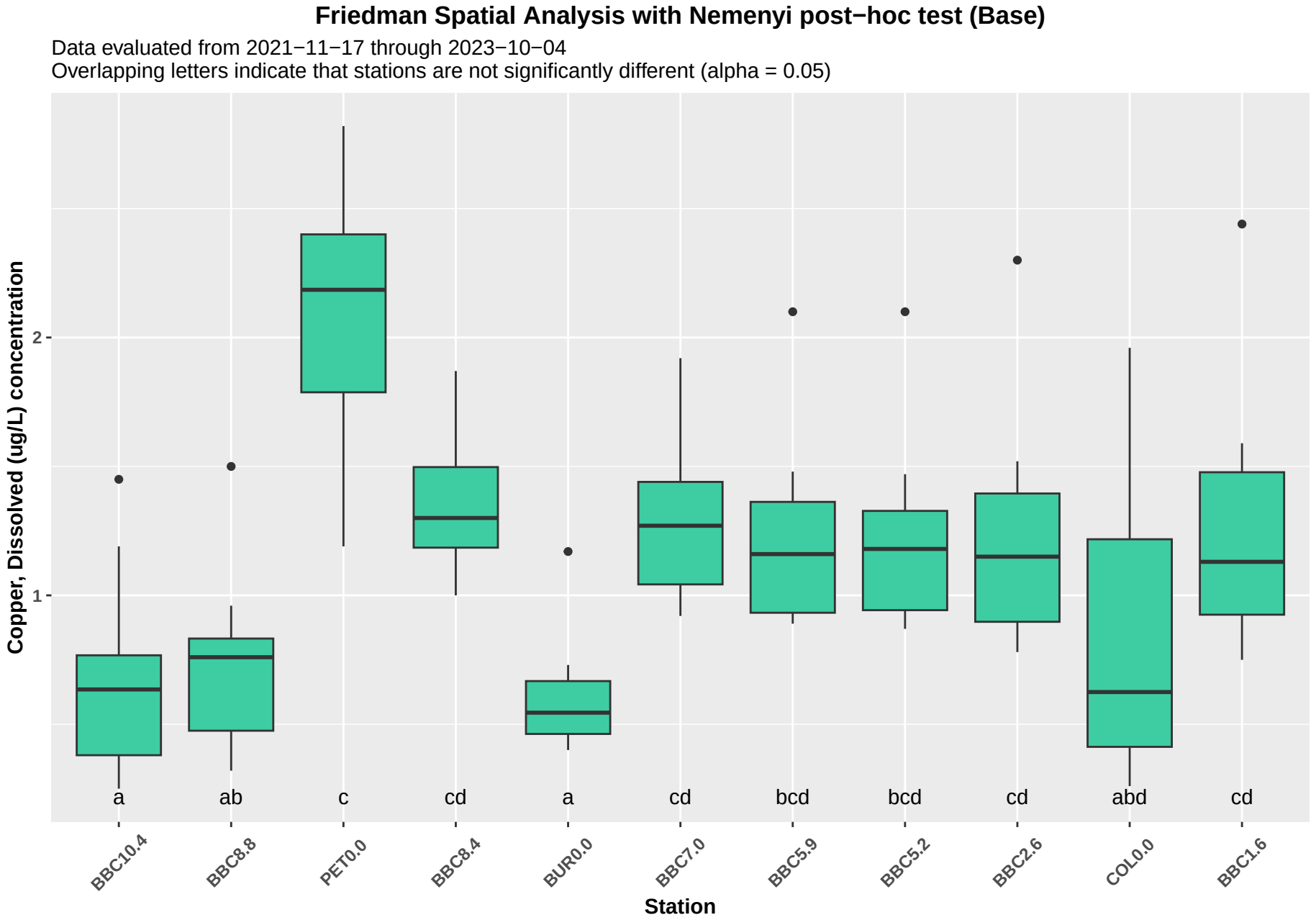

Friedman Spatial Analysis with Nemenyi post−hoc test (Storm)
Data evaluated from 2021−11−11 through 2023−04−06
Overlapping letters indicate that stations are not significantly different (alpha = 0.05)
Carbon, Dissolved Organic (DOC) (mg/L) concentration
5
4
3
2
1
b
ab
c
acd
cd
abcd
ab
ab
ab
acd
abd
BBC10.4
BBC8.8
PET0.0
BBC8.4
BUR0.0
BBC7.0
BBC5.9
BBC5.2
BBC2.6
COL0.0
BBC1.6
Station

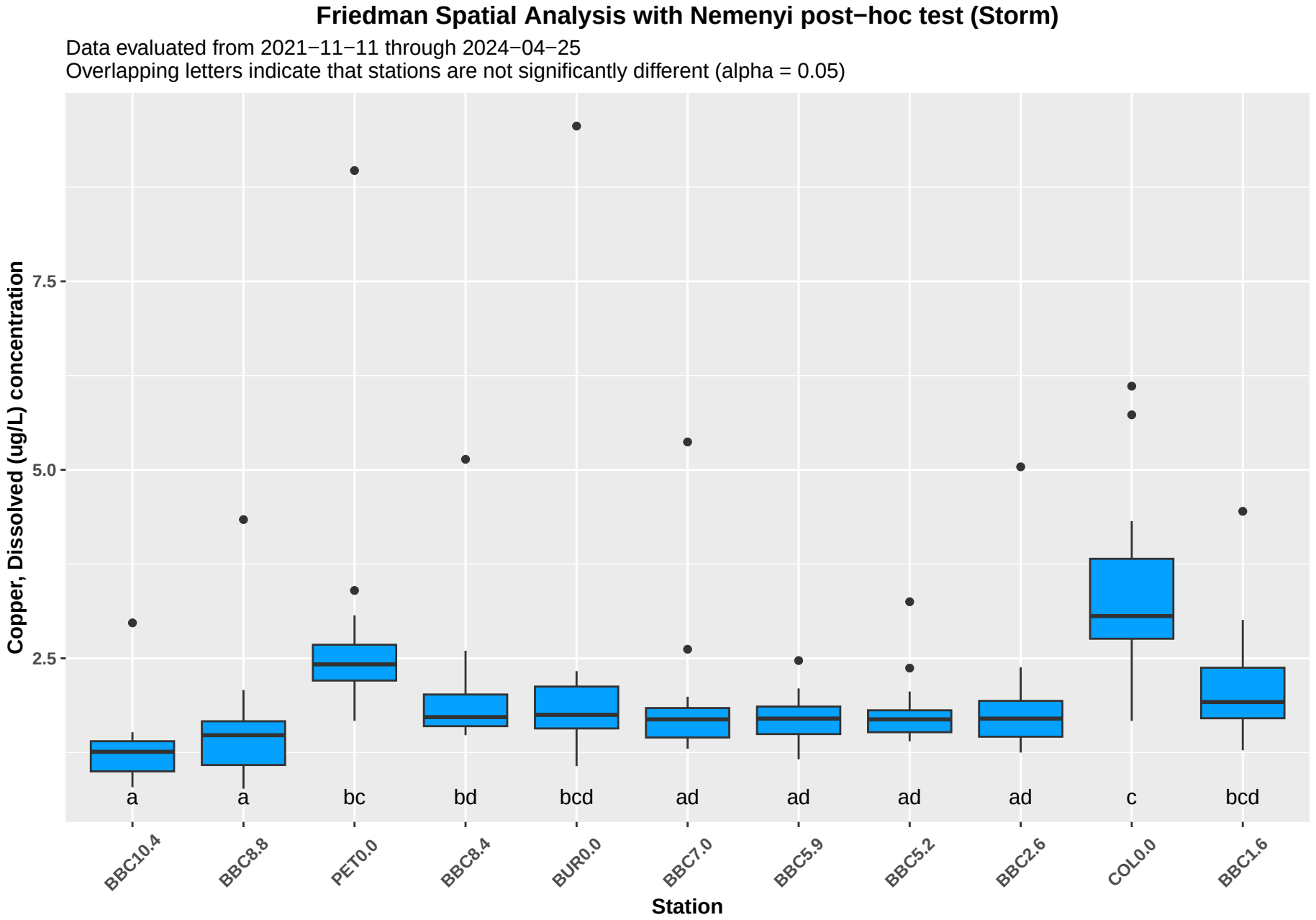

Friedman Spatial Analysis with Nemenyi post−hoc test (Base)
Data evaluated from 2021−11−17 through 2023−10−04
Overlapping letters indicate that stations are not significantly different (alpha = 0.05)
Hardness, Total as CaCO3 (mg/L) concentration
200
150
100
50
ad
a
bc
ad
bd
bd
abd
abd
bd
c
bd
BBC10.4
BBC8.8
PET0.0
BBC8.4
BUR0.0
BBC7.0
BBC5.9
BBC5.2
BBC2.6
COL0.0
BBC1.6
Station

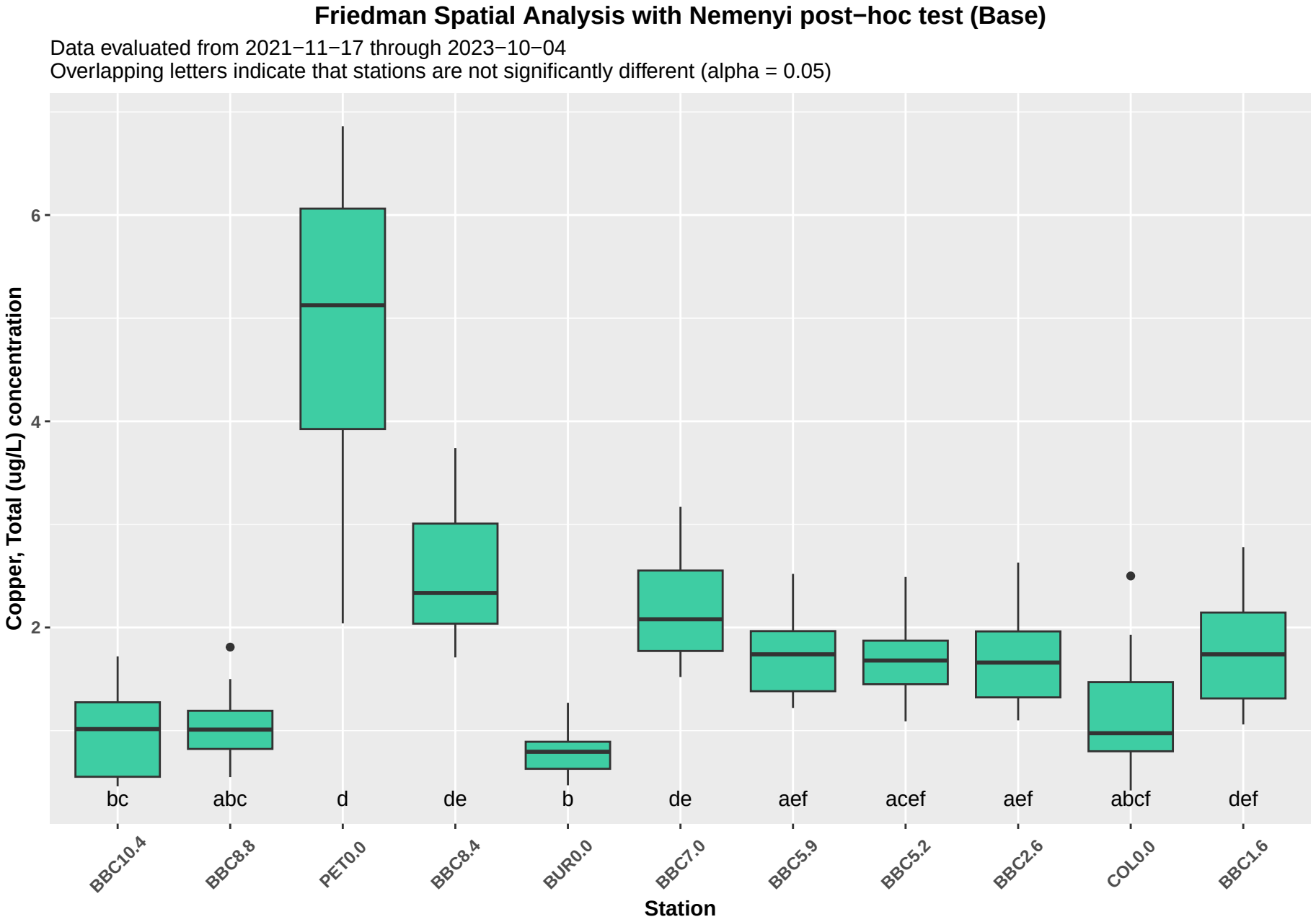

Friedman Spatial Analysis with Nemenyi post−hoc test (Storm)
Data evaluated from 2021−11−11 through 2024−04−25
Overlapping letters indicate that stations are not significantly different (alpha = 0.05)
Hardness, Total as CaCO3 (mg/L) concentration
80
60
40
20
ab
ab
a
ab
c
abc
a
ab
ab
bc
ab
BBC10.4
BBC8.8
PET0.0
BBC8.4
BUR0.0
BBC7.0
BBC5.9
BBC5.2
BBC2.6
COL0.0
BBC1.6
Station

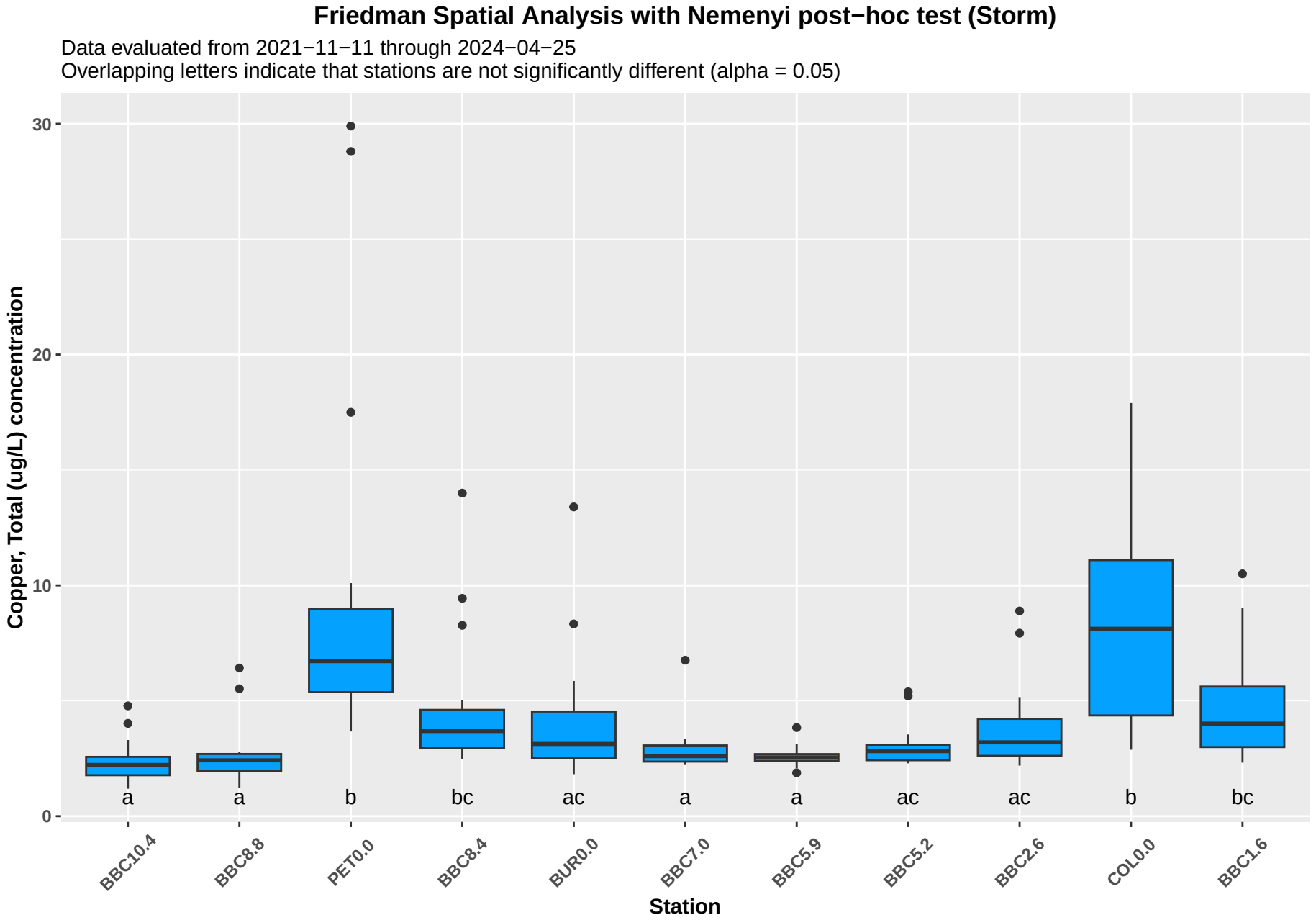

Friedman Spatial Analysis with Nemenyi post−hoc test (Base)
Data evaluated from 2021−11−17 through 2023−10−04
Overlapping letters indicate that stations are not significantly different (alpha = 0.05)
Chloride (mg/L) concentration
10
8
6
4
de
abc
d
ade
b
abce
acde
bc
abce
de
acde
BBC10.4
BBC8.8
PET0.0
BBC8.4
BUR0.0
BBC7.0
BBC5.9
BBC5.2
BBC2.6
COL0.0
BBC1.6
Station

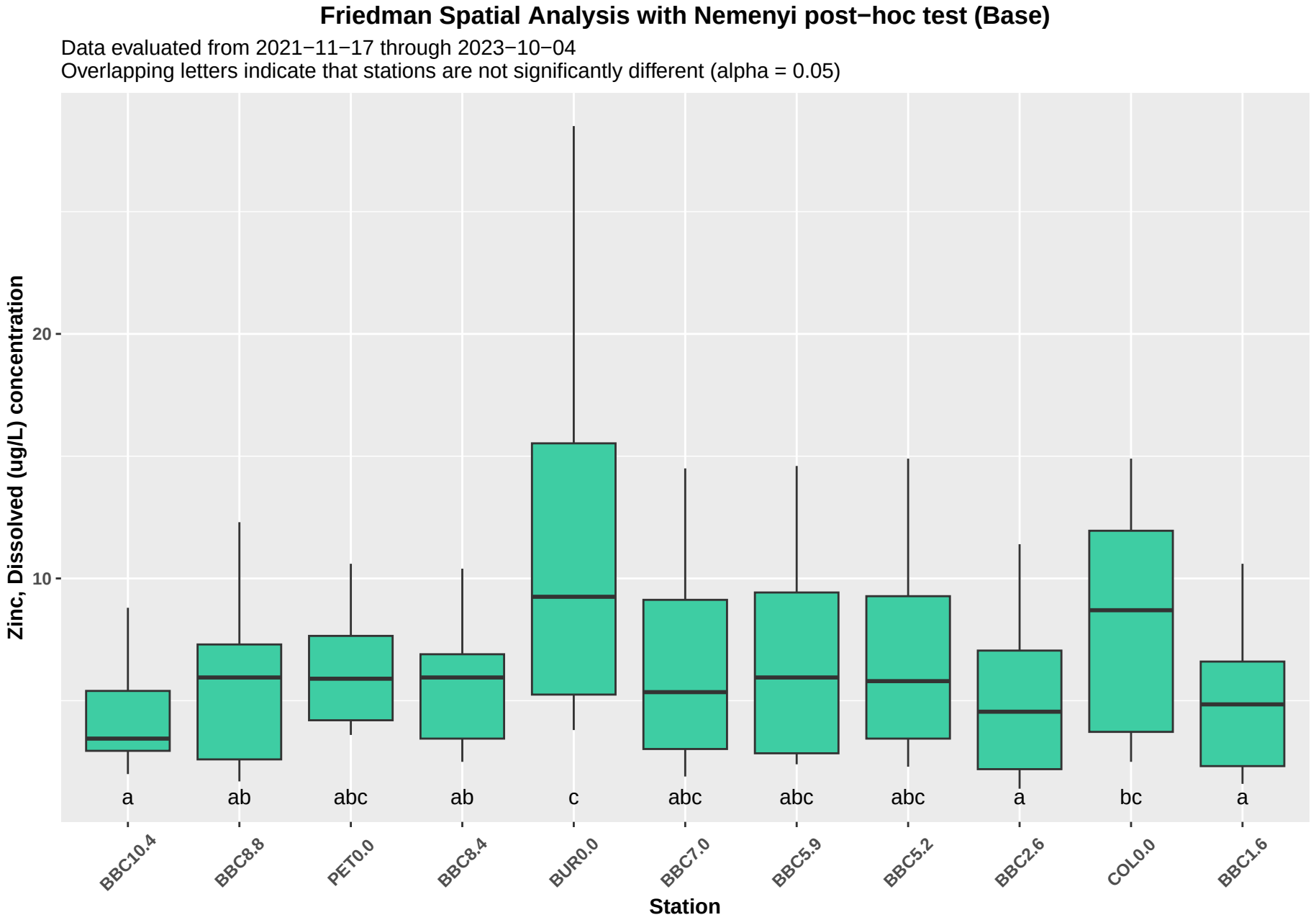

Friedman Spatial Analysis with Nemenyi post−hoc test (Storm)
Data evaluated from 2021−11−11 through 2023−04−06
Overlapping letters indicate that stations are not significantly different (alpha = 0.05)
Chloride (mg/L) concentration
10.0
7.5
5.0
2.5
ab
abc
ab
abc
ab
c
bc
abc
abc
a
abc
BBC10.4
BBC8.8
PET0.0
BBC8.4
BUR0.0
BBC7.0
BBC5.9
BBC5.2
BBC2.6
COL0.0
BBC1.6
Station

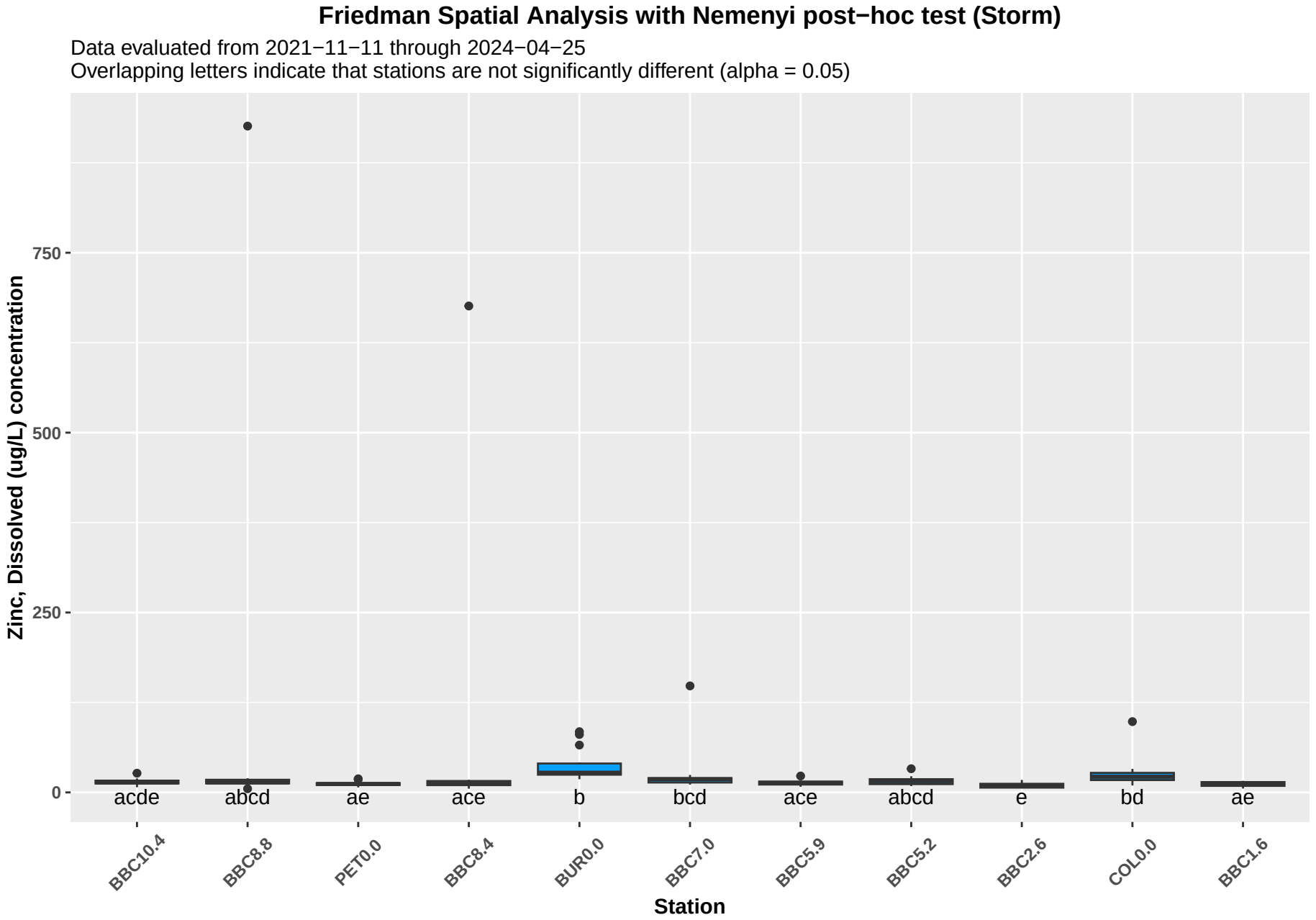

Friedman Spatial Analysis with Nemenyi post−hoc test (Base)
Data evaluated from 2021−11−17 through 2023−10−04
Overlapping letters indicate that stations are not significantly different (alpha = 0.05)
Copper, Dissolved (ug/L) concentration
2
1
a
ab
c
cd
a
cd
bcd
bcd
cd
abd
cd
BBC10.4
BBC8.8
PET0.0
BBC8.4
BUR0.0
BBC7.0
BBC5.9
BBC5.2
BBC2.6
COL0.0
BBC1.6
Station


Friedman Spatial Analysis with Nemenyi post−hoc test (Storm)
Data evaluated from 2021−11−11 through 2024−04−25
Overlapping letters indicate that stations are not significantly different (alpha = 0.05)
Copper, Dissolved (ug/L) concentration
7.5
5.0
2.5
a
a
bc
bd
bcd
ad
ad
ad
ad
c
bcd
BBC10.4
BBC8.8
PET0.0
BBC8.4
BUR0.0
BBC7.0
BBC5.9
BBC5.2
BBC2.6
COL0.0
BBC1.6
Station


Friedman Spatial Analysis with Nemenyi post−hoc test (Base)
Data evaluated from 2021−11−17 through 2023−10−04
Overlapping letters indicate that stations are not significantly different (alpha = 0.05)
Copper, Total (ug/L) concentration
6
4
2
bc
abc
d
de
b
de
aef
acef
aef
abcf
def
BBC10.4
BBC8.8
PET0.0
BBC8.4
BUR0.0
BBC7.0
BBC5.9
BBC5.2
BBC2.6
COL0.0
BBC1.6
Station

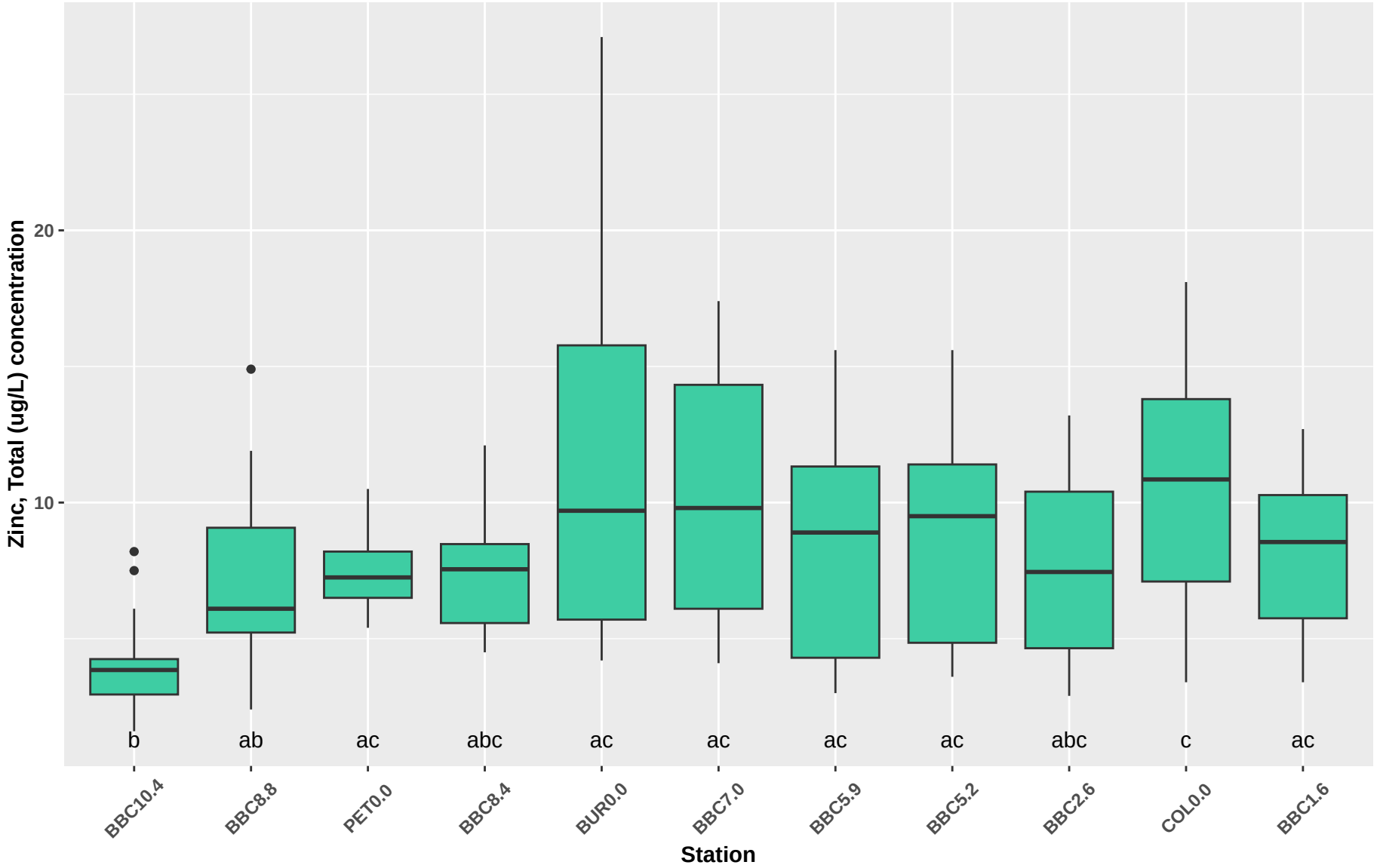

Friedman Spatial Analysis with Nemenyi post−hoc test (Storm)
Data evaluated from 2021−11−11 through 2024−04−25
Overlapping letters indicate that stations are not significantly different (alpha = 0.05)
Copper, Total (ug/L) concentration
30
20
10
0
a
a
b
bc
ac
a
a
ac
ac
b
bc
BBC10.4
BBC8.8
PET0.0
BBC8.4
BUR0.0
BBC7.0
BBC5.9
BBC5.2
BBC2.6
COL0.0
BBC1.6
Station

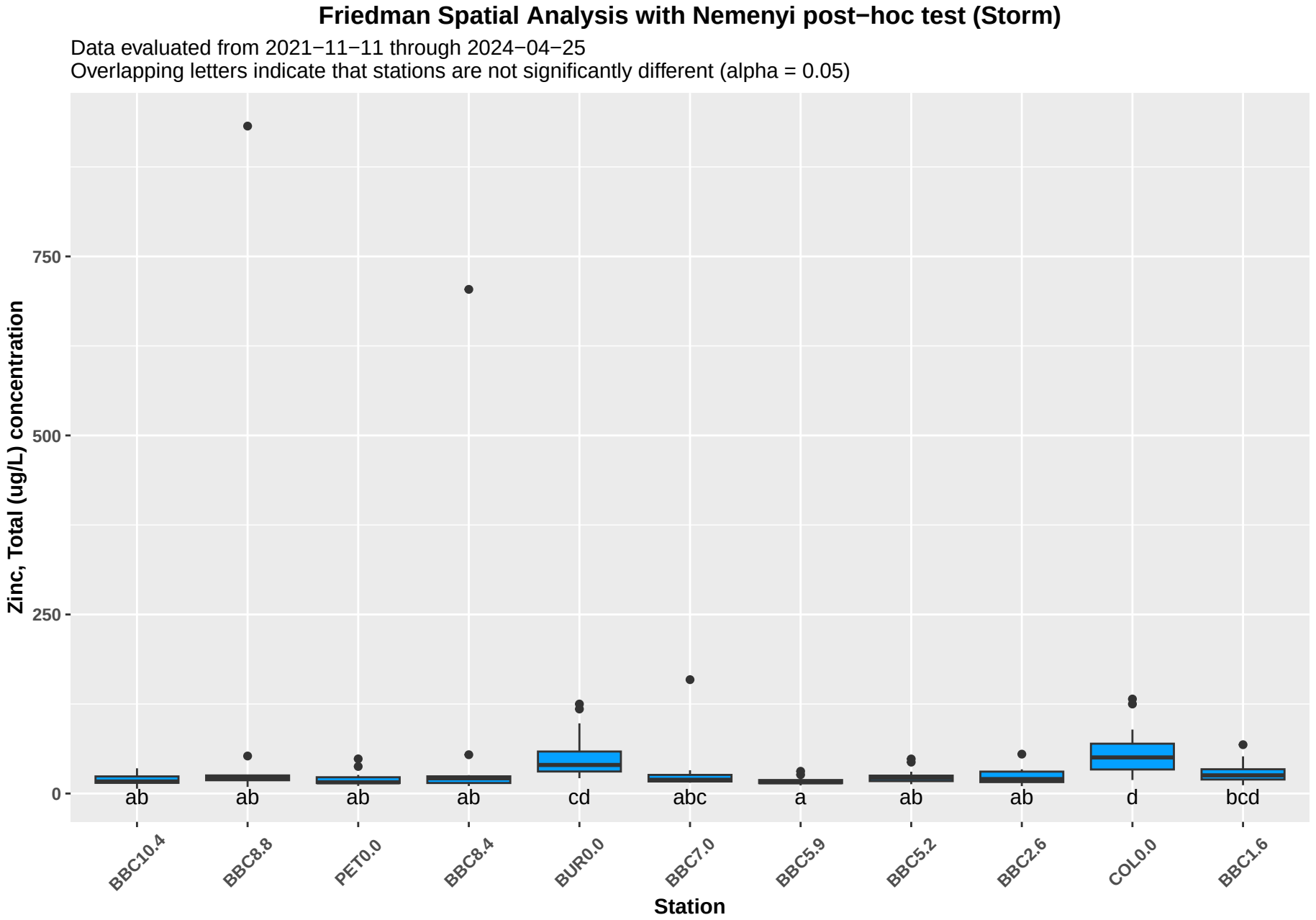

Friedman Spatial Analysis with Nemenyi post−hoc test (Base)
Data evaluated from 2021−11−17 through 2023−10−04
Overlapping letters indicate that stations are not significantly different (alpha = 0.05)
Zinc, Dissolved (ug/L) concentration
20
10
a
ab
abc
ab
c
abc
abc
abc
a
bc
a
BBC10.4
BBC8.8
PET0.0
BBC8.4
BUR0.0
BBC7.0
BBC5.9
BBC5.2
BBC2.6
COL0.0
BBC1.6
Station


Friedman Spatial Analysis with Nemenyi post−hoc test (Storm)
Data evaluated from 2021−11−11 through 2024−04−25
Overlapping letters indicate that stations are not significantly different (alpha = 0.05)
Zinc, Dissolved (ug/L) concentration
750
500
250
0
acde
abcd
ae
ace
b
bcd
ace
abcd
e
bd
ae
BBC10.4
BBC8.8
PET0.0
BBC8.4
BUR0.0
BBC7.0
BBC5.9
BBC5.2
BBC2.6
COL0.0
BBC1.6
Station

Friedman Spatial Analysis with Nemenyi post−hoc test (Base)

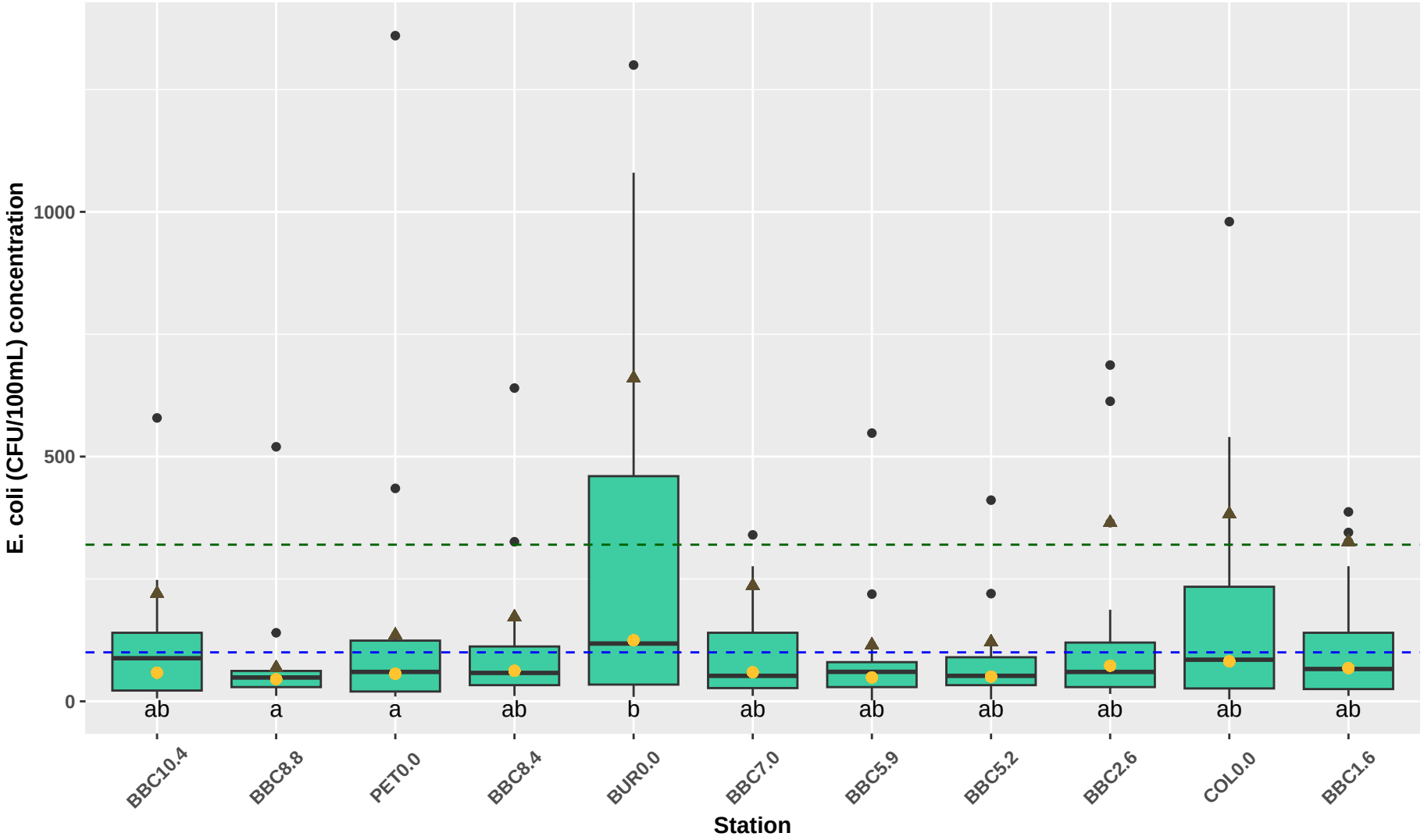
Data evaluated from 2021−11−17 through 2023−10−04
Overlapping letters indicate that stations are not significantly different (alpha = 0.05)




Friedman Spatial Analysis with Nemenyi post−hoc test (Storm)
Data evaluated from 2021−11−11 through 2024−04−25
Overlapping letters indicate that stations are not significantly different (alpha = 0.05)
Zinc, Total (ug/L) concentration
750
500
250
0
ab
ab
ab
ab
cd
abc
a
ab
ab
d
bcd
BBC10.4
BBC8.8
PET0.0
BBC8.4
BUR0.0
BBC7.0
BBC5.9
BBC5.2
BBC2.6
COL0.0
BBC1.6
Station

Friedman Spatial Analysis with Nemenyi post−hoc test (Base)

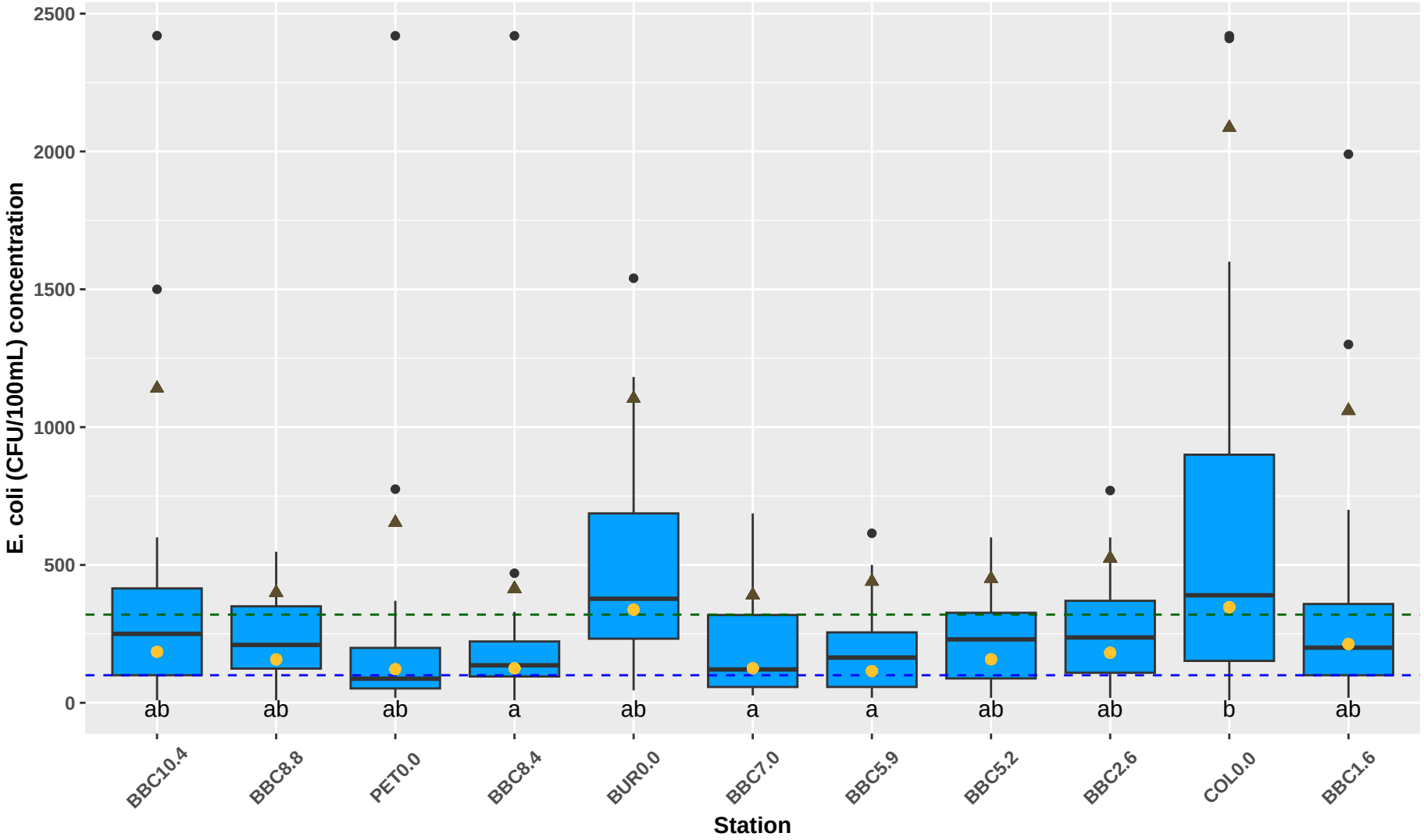
Data evaluated from 2021−11−17 through 2024−09−03
Overlapping letters indicate that stations are not significantly different (alpha = 0.05)



Blue lines indicate criteria for geometric mean.
Dark green lines indicate criteria for 90th percentile.
Geometric mean shown as a yellow circle.
90th percentile shown as a brown triangle.
1 sampling event was not included in the Friedman test because not all stations were sampled.

Friedman Spatial Analysis with Nemenyi post−hoc test (Storm)

Data evaluated from 2021−11−11 through 2024−04−25
Overlapping letters indicate that stations are not significantly different (alpha = 0.05)



Blue lines indicate criteria for geometric mean.
Dark green lines indicate criteria for 90th percentile.
Geometric mean shown as a yellow circle.
90th percentile shown as a brown triangle.
2 sampling events were not included in the Friedman test because not all stations were sampled.

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APPENDIX G

Comparison to Other Studies

HERRERA
Science + Planning + Design

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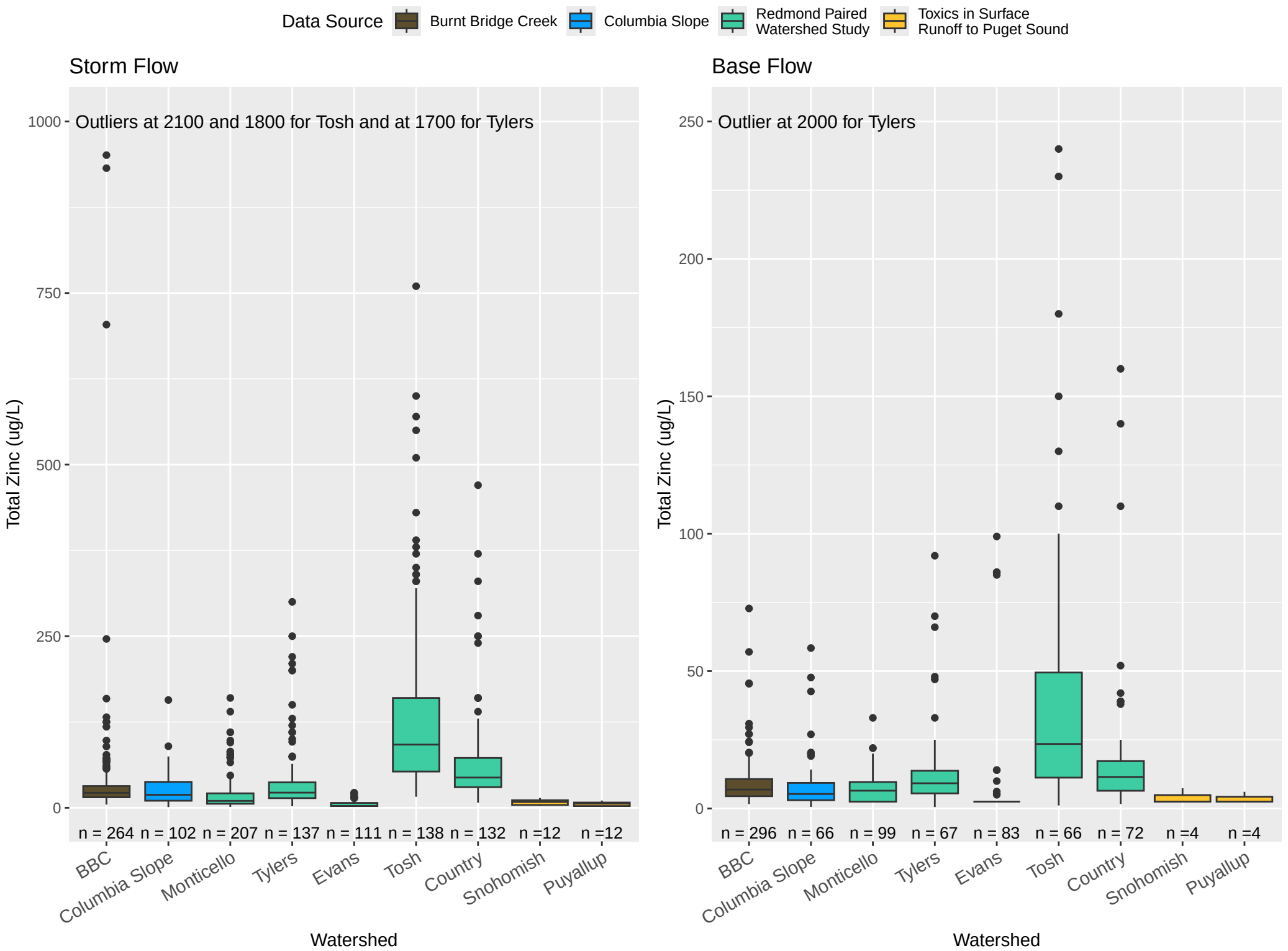
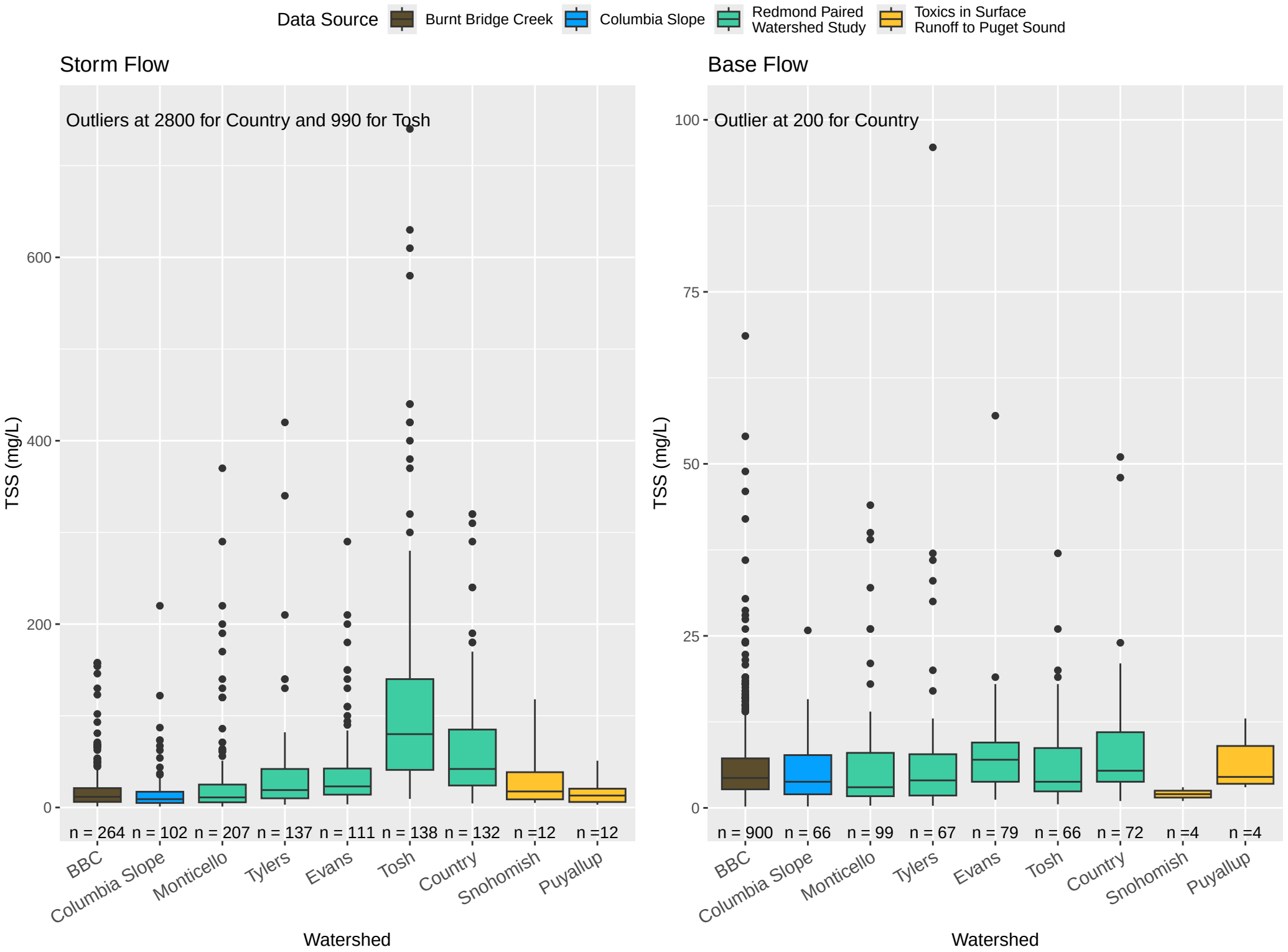
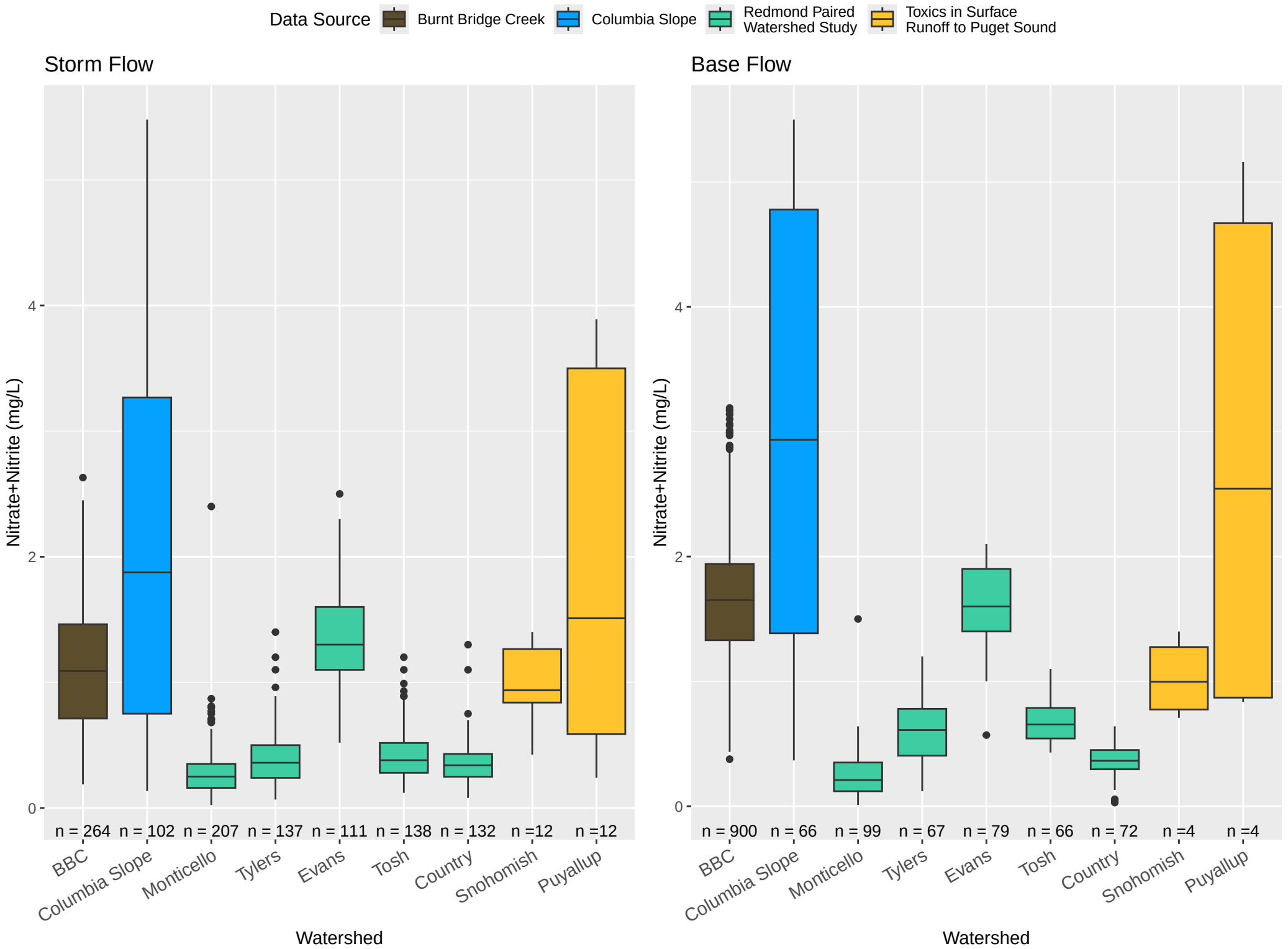
Burnt Bridge Creek Comparison to Other Studies in Residential Basins



Burnt Bridge Creek Comparison to Other Studies in Residential Basins



Burnt Bridge Creek Comparison to Other Studies in Residential Basins



Burnt Bridge Creek Comparison to Other Studies in Residential Basins