

Total Suspended Solids (SOOE Extended)

Please note that this section contains both “Methods and Data Sources” as well as “Additional Discussion” and additional tables and figures.

Methods and Data Sources

Trend analysis for total suspended solids was performed at the following stations:

- GRBAP (Adams Point between Great Bay and Little Bay)
- GRBGB (Great Bay)
- GRBCL (Chapmans Landing in the Squamscott River)
- GRBSQ (Squamscott River at the railroad trestle)
- GRBLR (Lamprey River)
- GRBOR (Oyster River)
- GRBUPR (Upper Piscataqua River)
- GRBCML (Portsmouth Harbor)
- HHR (Hampton River)
- GRBBR (Bellamy River)
- GRBCR (Cocheco River)

Samples collected at low tide at the trend stations were identified. Low-tide samples were used for the trend analysis to control for the effects of tides. The data for each station were averaged by month (there was rarely more than one sample in the same month) and then the number of months with data in each year was counted. Only data from the months April through December were used. (The station at Adams Point is monitored 12 months per year). Only years with at least seven months of data were included in statistical analysis. This was done in order to minimize bias from years for which the data do not reflect the full range of seasons. Linear regression was used to test for long-term trends. Both the full dataset and the annual median concentrations were regressed against the year variable. Trends were considered significant if the slope coefficient of the year variable was significant at a p-value of 0.05 or less. TSS concentrations greater than 100 mg/L were considered to be outliers and were excluded from analysis. The only exception was the Squamscott River (GRBSQ) station, where high TSS concentrations exceeding 100 mg/L have been observed throughout the 20-year monitoring period. Only 16 values across two stations had sampling events with high TSS concentrations, with 14 of those occurring at the Squamscott River Station.

For more information on sample collection and analysis methods, please see the most recent Quality Assurance Project Plan (<https://scholars.unh.edu/prep/419>).

Data for this indicator were provided by UNH and the Great Bay Estuary Water Quality Monitoring Program.

Additional Discussion

The full summary table for trends in suspended solids across 11 different monitoring stations demonstrates the large range in observed concentrations (Table 13.2). Annual median values between 2016 and 2021 ranged from 3.6 mg/L to as high as 54.1 mg/L. River monitoring stations

exhibited larger variability year to year, especially in the Lamprey, Oyster, Squamscott, and Cocheco Rivers. No other statistically significant temporal trends were evident in any of the additional stations (Coastal Marine Lab, Cocheco River, Bellamy River, Chapmans Landing).

(Note that table and figure numbers are continued from the State of Our Estuaries Report.)

For the Lamprey River Station, suspended solids have shown an increasing trend since 1992 (Figure 13.6). Although in 2021, the annual median concentration decreased 4.5x from the decadal high of 16.1 mg/L in 2020. In the most recent 10 years, intra-annual variability in suspended solid concentrations appears larger than in the 1990s or early 2000s. This pattern may relate to increased climate variability observed in recent years, with two significant droughts occurring in 2016 and 2020 (*Rockingham County, NH | U.S. Drought Monitor, 2023*) and increasing annual precipitation totals in the early 2000s and 2010s (Kunkel 2022). The Oyster River Station shows a similar increasing linear trend in suspended solids over time (Figure 13.7).

For the Squamscott River Station, there were 14 separate suspended solids measurements that exceeded 100 mg/L (Figure 13.8). These values spanned a seasonal range from April to September and encompassed years from 2006 to 2021. Outlier concentrations reached a high of 275.7 mg/L in May of 2009 and a low of 103.6 mg/L in September of 2021. Due to the random dispersion of high suspended solids concentrations across the full range of the Squamscott River dataset, it was decided to leave the outliers in for analysis. It is worth noting that if the 14 outliers are removed, then there is a significant increasing trend in suspended solids concentrations over time ($p < 0.05$). The last three years of data (2019-2021) show a steady increase in suspended solids from an annual median of 29.0 mg/L to 54.1 mg/L. At Chapman's Landing (Figure 13.11), a site located upriver from the Squamscott River Station, suspended solids show no linear temporal trend over time but do exhibit high variability both within and between years.

Suspended solids at both the Bellamy (Figure 13.9) and Cocheco Rivers (Figure 13.10) showed no temporal trend over time, possibly due to the small sampling size of only a few years. Annual median suspended solids concentrations are comparable at these two stations, with the Cocheco exhibiting slightly lower annual values than the Bellamy. Comparison of the entire TSS monitoring period for these two rivers reveals a median concentration of 13.2 mg/L for the Cocheco and an almost doubled median concentration (21.7 mg/L) for the Bellamy River.

At the Coastal Marine Lab (Figure 13.12) in Portsmouth Harbor, concentrations of suspended solids are comparable to that of Adams Point and Great Bay Monitoring Stations. Between 2002 and 2016, the overall median concentration was 16.1 at the Coastal Marine Lab. This is only slightly larger than the overall median at Adams Point (15.0 mg/L) and slightly smaller than the median for the Great Bay Station (17.1 mg/L).

Additional Data, Tables, and Figures

Table 13.2: Total suspended solid (TSS) trends and median values at ten stations in the Great Bay Estuary and one station in the Hampton-Seabrook Estuary. Trends and values reflect low tide sampling only.

Location	Significant change in TSS concentration?	Dates for Trends in Column to Left	Range of Median Values 2016 -2021 (mg/L)	Range of Maximum Values 2016-2021 (mg/L)
Adams Point	Yes (increase)	1989-2021	15.7 – 21.6	25.2 – 50.4
Great Bay	Yes (increase)	2002-2021	16.1 – 23.2	24.6 – 96.9
Lamprey River	Yes (increase)	1992-2021	3.6 – 16.1	12.9 – 77.1
Oyster River	Yes (increase)	2004-2021	17.8 – 36.8	38.2 – 95.4
Squamscott River	No	2004-2021	29.0 – 54.1	96.9 – 217.9
Upper Piscataqua River	No	2007-2021	12.0 – 14.2	15.7 – 24.6
Hampton River	No	2018-2021	18.9 – 22.1	28.6 – 42.5
Coastal Marine Lab	No	2002-2016	20.7	25.4
Cocheco River	No	2016-2020*	8.6 – 18.7	22.1 – 33.6
Bellamy River	Insufficient data	2018	21.7	64.1
Chapmans Landing	No	1989-2018	31.2 – 37.0	52.1 – 65.0

*no sampling was done at this site in 2019

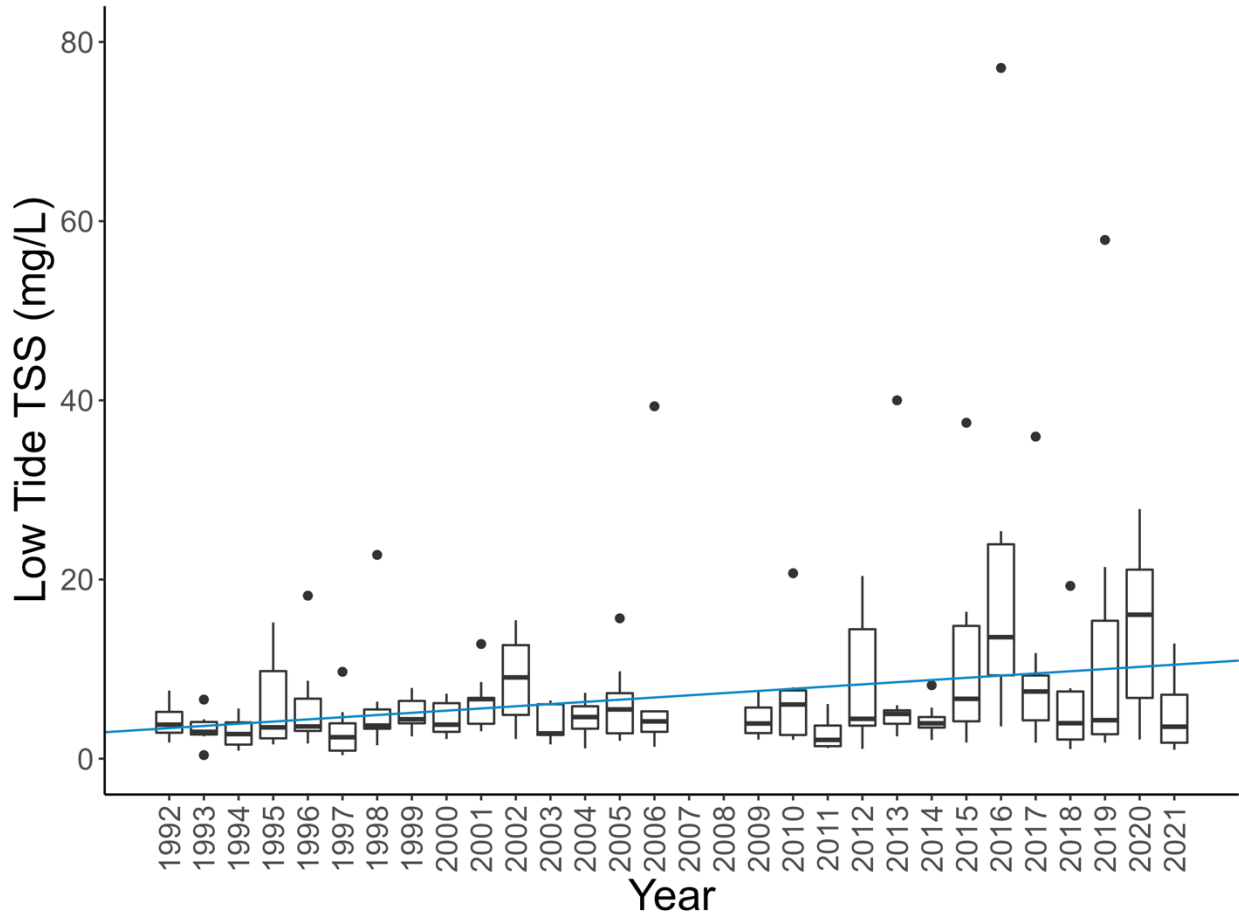


Figure 13.6: Total suspended solids at Lamprey River Station. Box and whisker chart of data collected at low tide only. The horizontal line in each box is the median. Boxes encompass the middle 50% of the data points. The horizontal line in each box is the median and the vertical whiskers encompass values within 1.5*interquartile range (99.7% of the data). “Outliers” are shown as individual points. Some years omitted due to insufficient data.

Data Source: Jackson Estuarine Laboratory, UNH

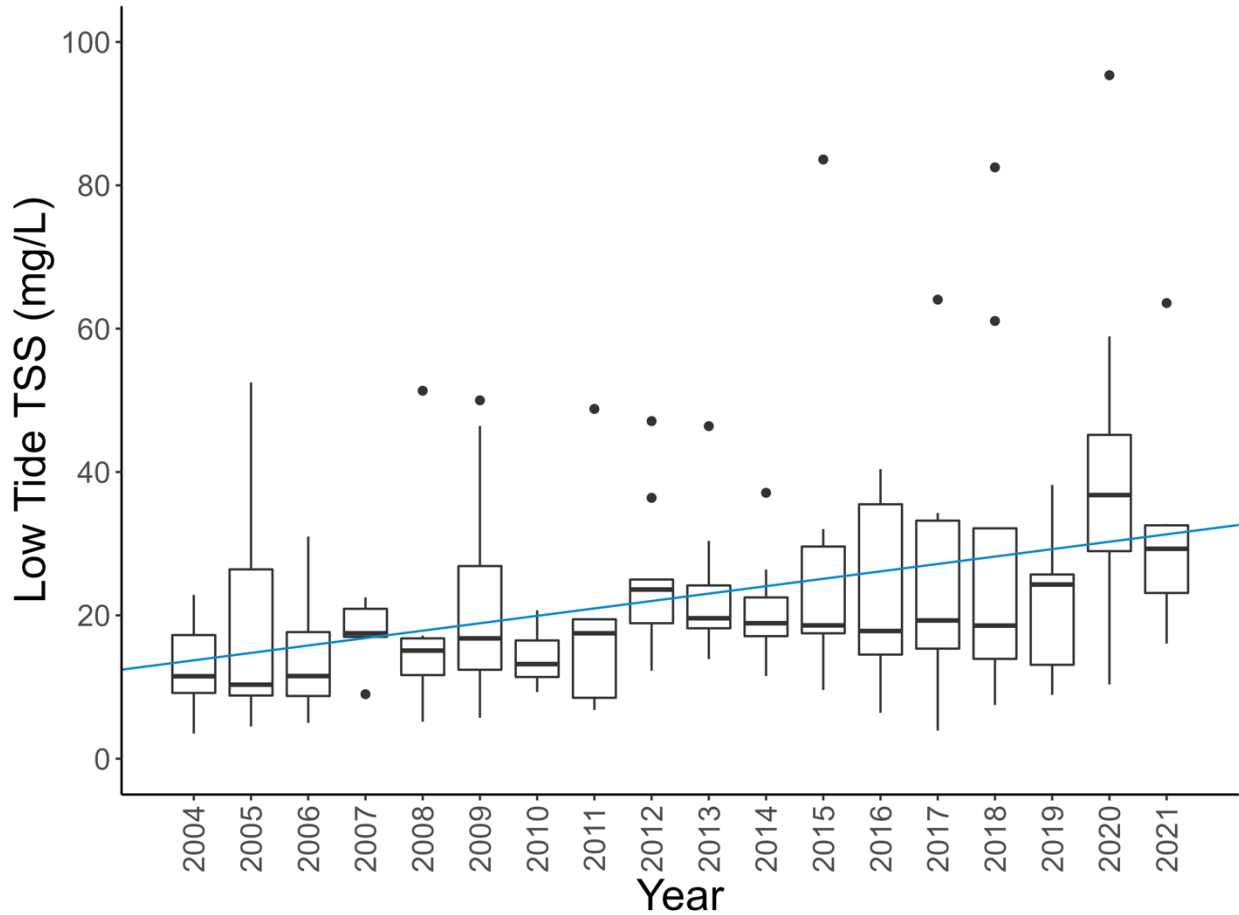


Figure 13.7: Total suspended solids at Oyster River Station. Box and whisker chart of data collected at low tide only. The horizontal line in each box is the median. Boxes encompass the middle 50% of the data points. The horizontal line in each box is the median and the vertical whiskers encompass values within 1.5*interquartile range (99.7% of the data). “Outliers” are shown as individual points.
Data Source: Jackson Estuarine Laboratory, UNH

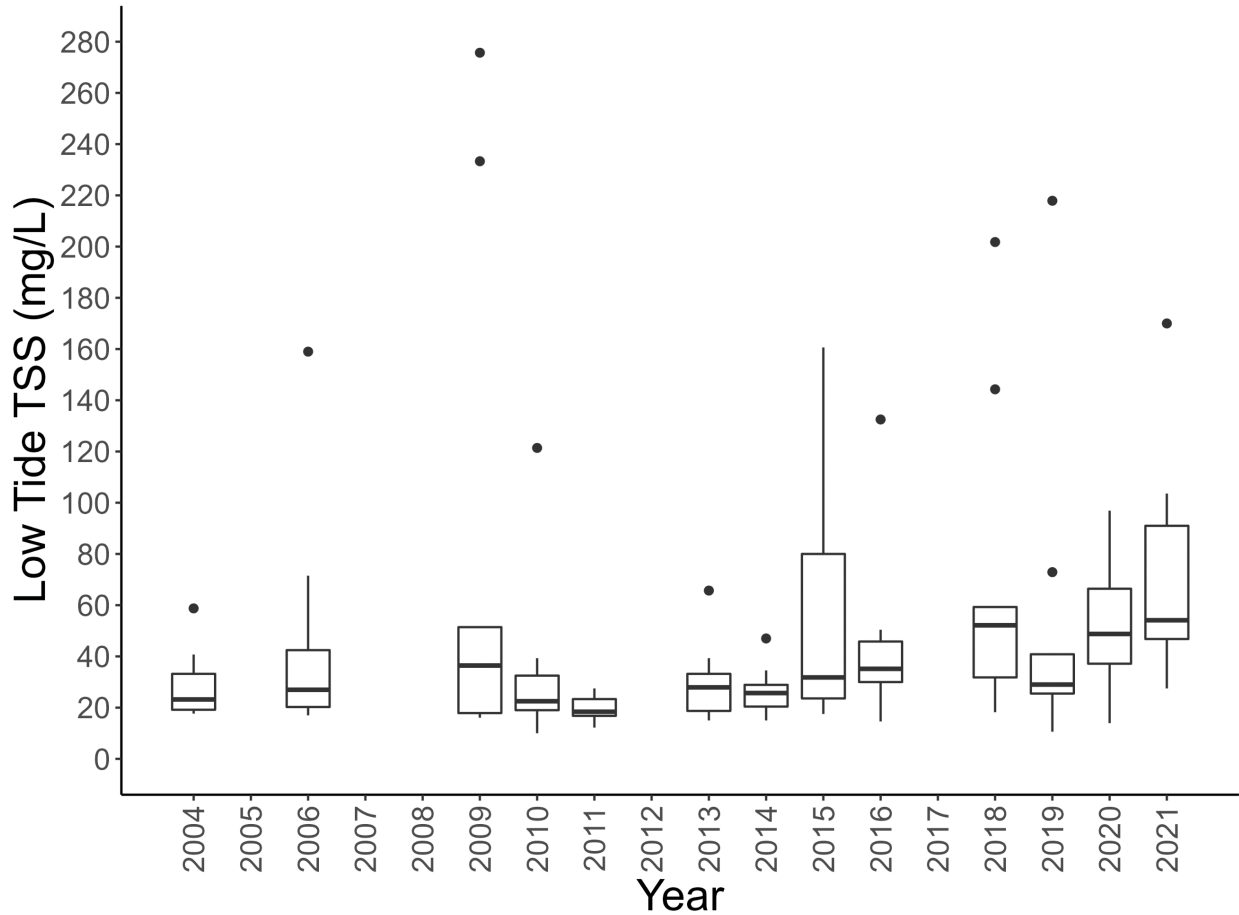


Figure 13.8: Total suspended solids at Squamscott River Station. Box and whisker chart of data collected at low tide only. The horizontal line in each box is the median. Boxes encompass the middle 50% of the data points. The horizontal line in each box is the median and the vertical whiskers encompass values within 1.5*inter-quartile range (99.7% of the data). “Outliers” are shown as individual points. Some years were omitted due to insufficient or missing data.

Data Source: Jackson Estuarine Laboratory, UNH

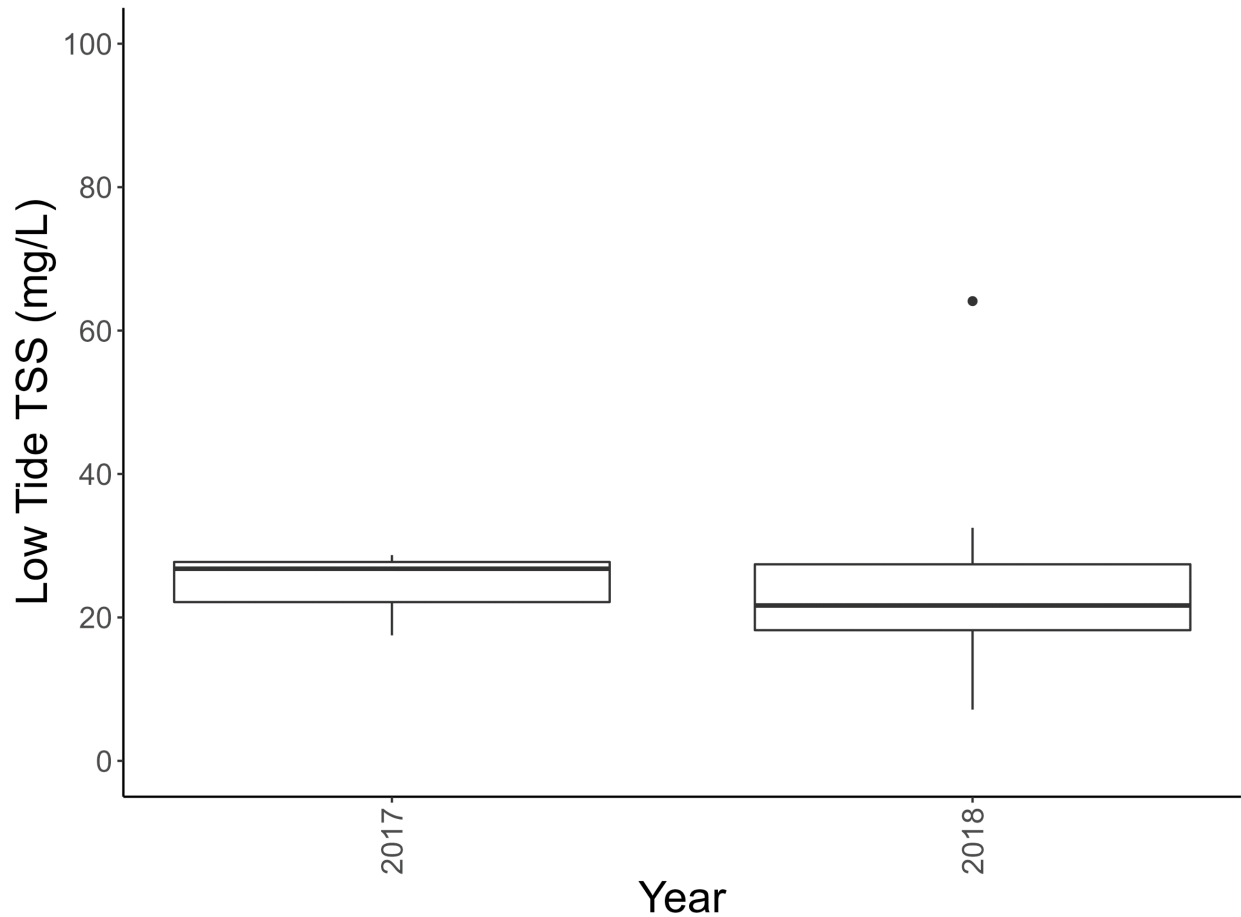


Figure 13.9: Total suspended solids at Bellamy River Station. Box and whisker chart of data collected at low tide only. The horizontal line in each box is the median. Boxes encompass the middle 50% of the data points. The horizontal line in each box is the median and the vertical whiskers encompass values within 1.5*interquartile range (99.7% of the data). “Outliers” are shown as individual points. Note 2017 has only 3 data points.

Data Source: Jackson Estuarine Laboratory, UNH

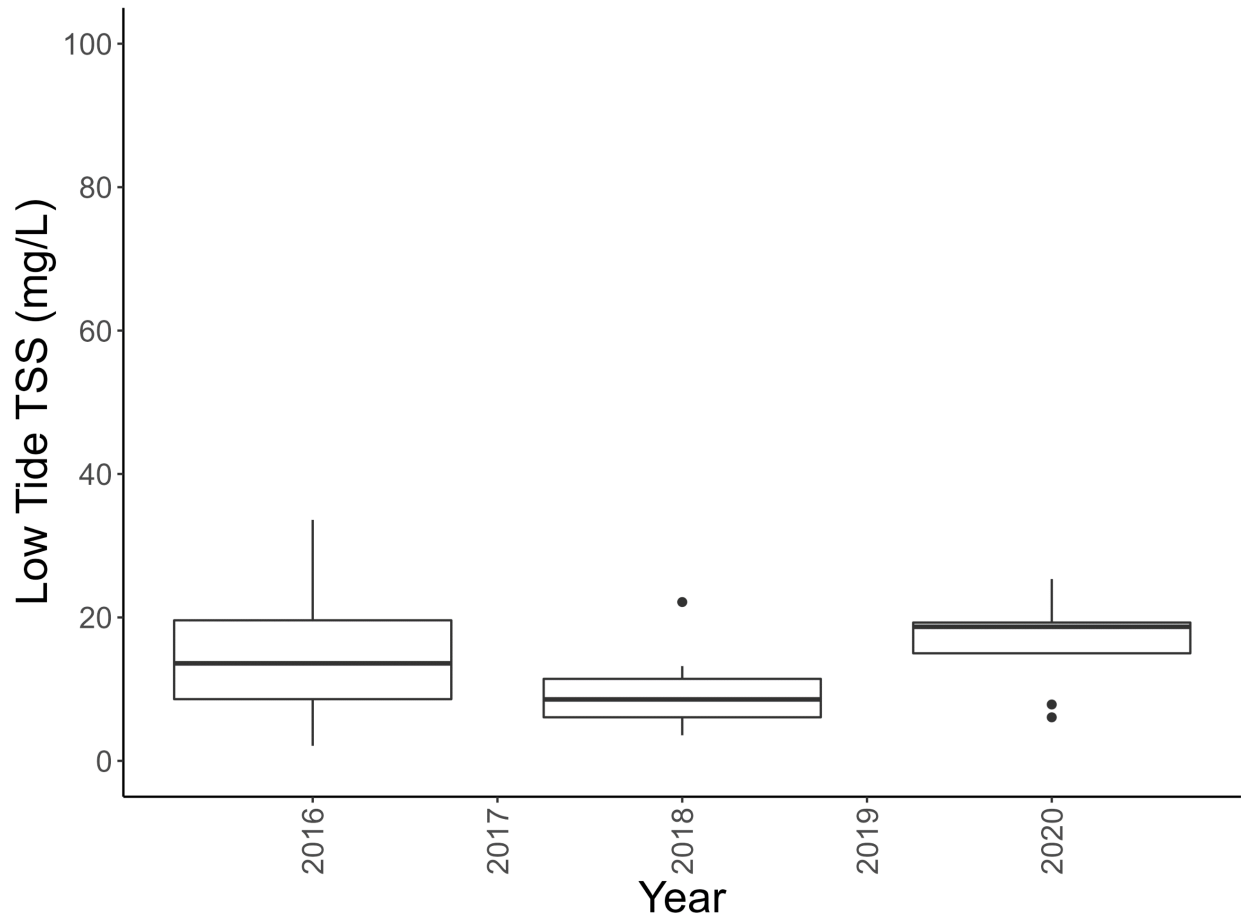


Figure 13.10: Total suspended solids at Cocheco River Station. Box and whisker chart of data collected at low tide only. The horizontal line in each box is the median. Boxes encompass the middle 50% of the data points. The horizontal line in each box is the median and the vertical whiskers encompass values within 1.5*interquartile range (99.7% of the data). “Outliers” are shown as individual points. Some years omitted due to insufficient data.

Data Source: Jackson Estuarine Laboratory, UNH

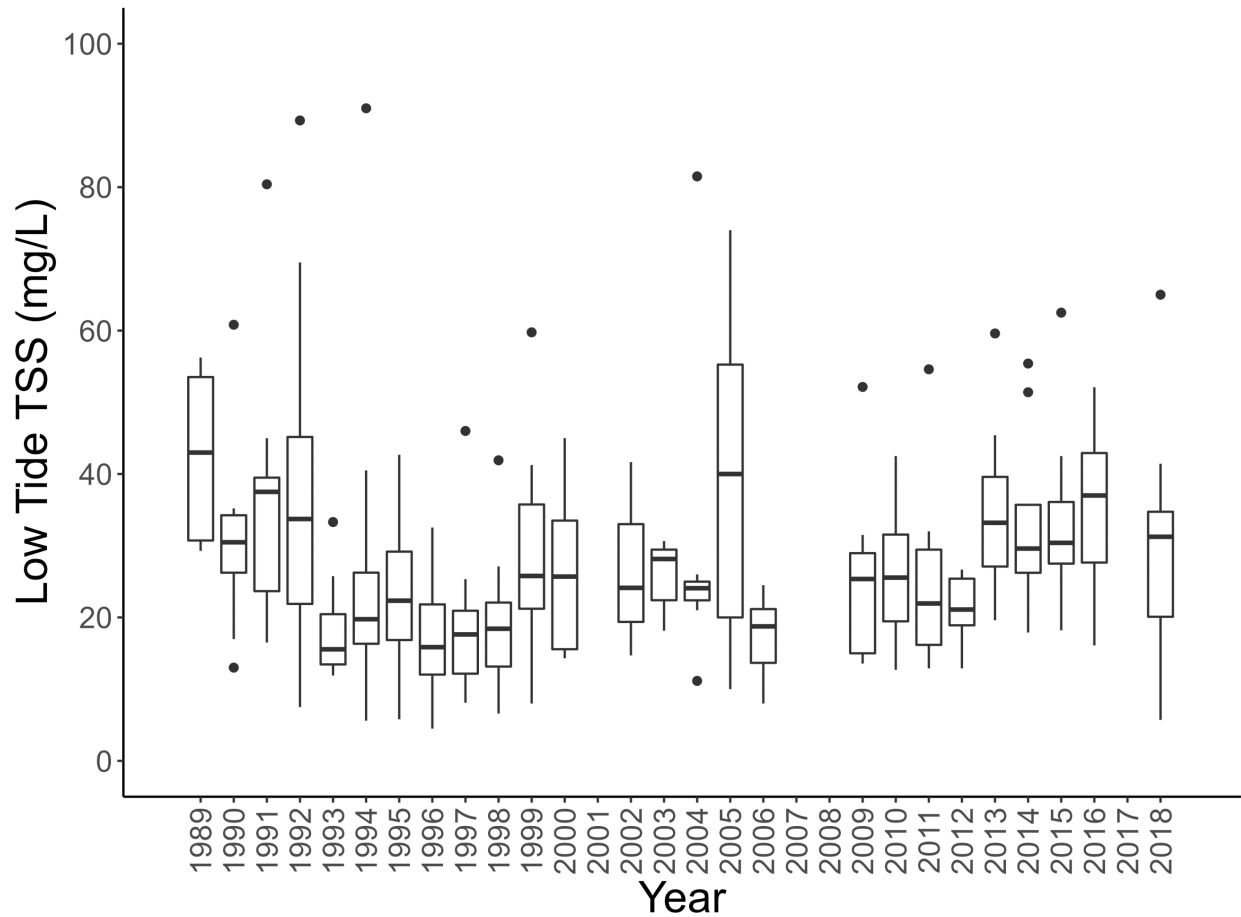


Figure 13.11: Total suspended solids at the Chapman’s Landing Station. Box and whisker chart of data collected at low tide only. The horizontal line in each box is the median. Boxes encompass the middle 50% of the data points. The horizontal line in each box is the median and the vertical whiskers encompass values within 1.5*inter-quartile range (99.7% of the data). “Outliers” are shown as individual points. Some years omitted due to insufficient data.

Data Source: Jackson Estuarine Laboratory, UNH

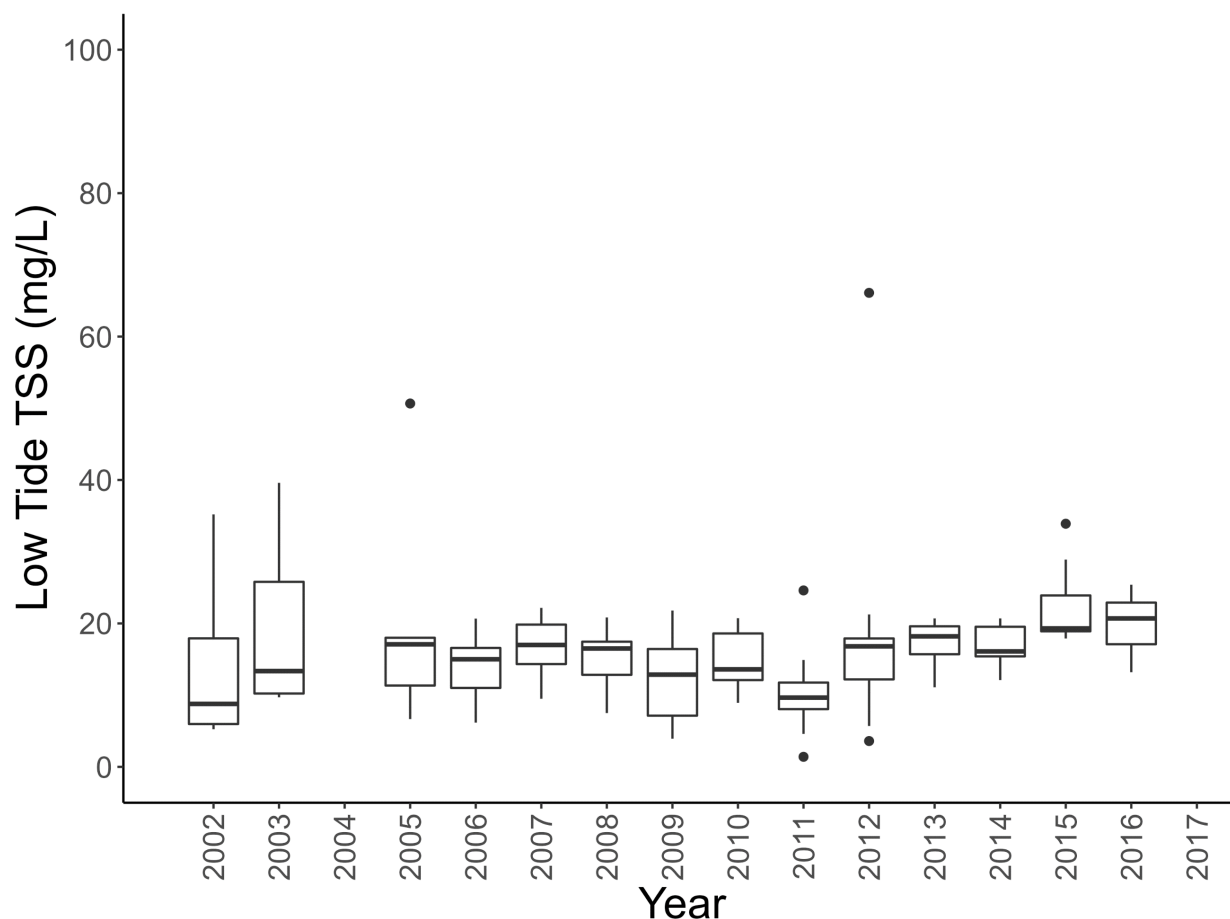


Figure 13.12: Total suspended solids at the Coastal Marine Lab (Portsmouth Harbor) Station. Box and whisker chart of data collected at low tide only. The horizontal line in each box is the median. Boxes encompass the middle 50% of the data points. The horizontal line in each box is the median and the vertical whiskers encompass values within 1.5*inter-quartile range (99.7% of the data). “Outliers” are shown as individual points. Some years omitted due to insufficient data.

Data Source: Jackson Estuarine Laboratory, UNH

Acknowledgements and Credit

Anna Mikulis (UNH) with contributions from Miguel Leon (UNH), Kalle Matso (PREP), Easton White (UNH), Lara Martin (UNH), and Tom Gregory (UNH).

References

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