

Estero Bay Aquatic Preserve

SEACAR Water Quality Analysis

Last compiled on 10 July, 2025

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Indicators

Nutrients

Total Nitrogen - Discrete

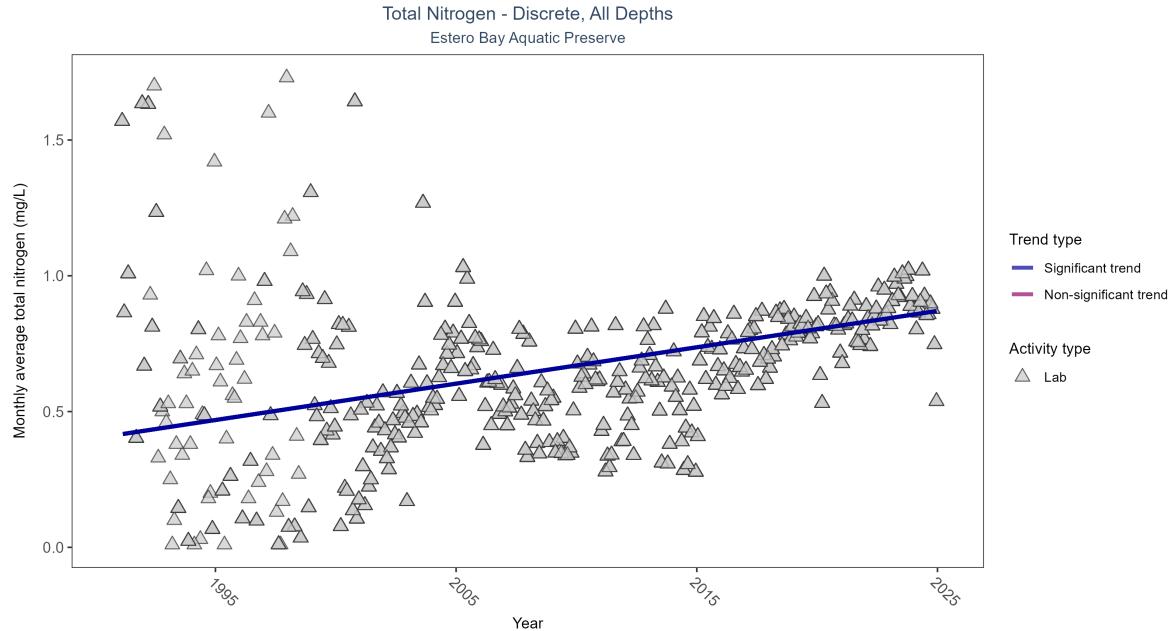


Figure 1: Scatter plot of monthly average total nitrogen over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only nitrogen values obtained from laboratory analyses (triangles) are included in the plot.

Table 1: Seasonal Kendall-Tau Results for - Total Nitrogen

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Lab	Significantly increasing trend	7953	34	1991 - 2024	0.64	0.32195	0.41526	0.01339	0

Monthly average total nitrogen increased by 0.01 mg/L per year.

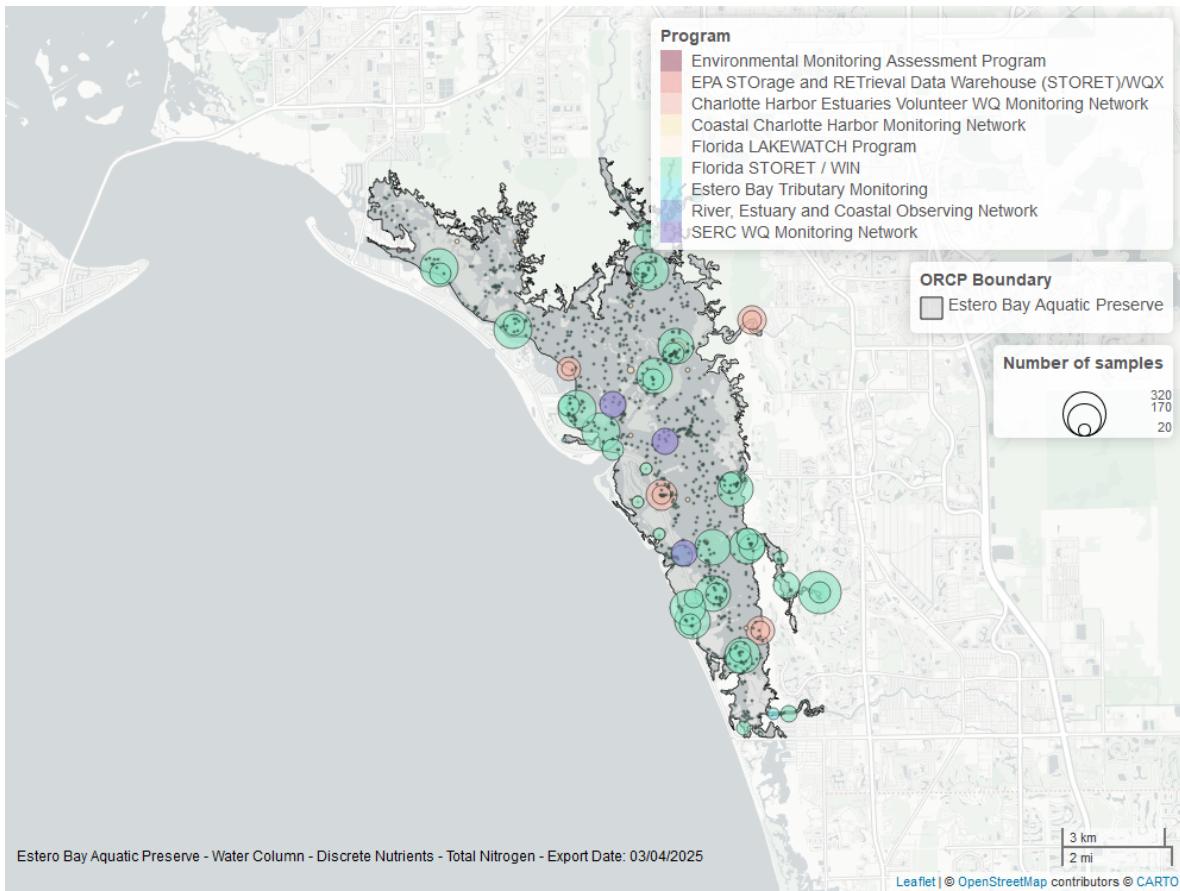


Figure 2: Map showing location of discrete water quality sampling locations within the boundaries of *Estero Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Total Phosphorus - Discrete

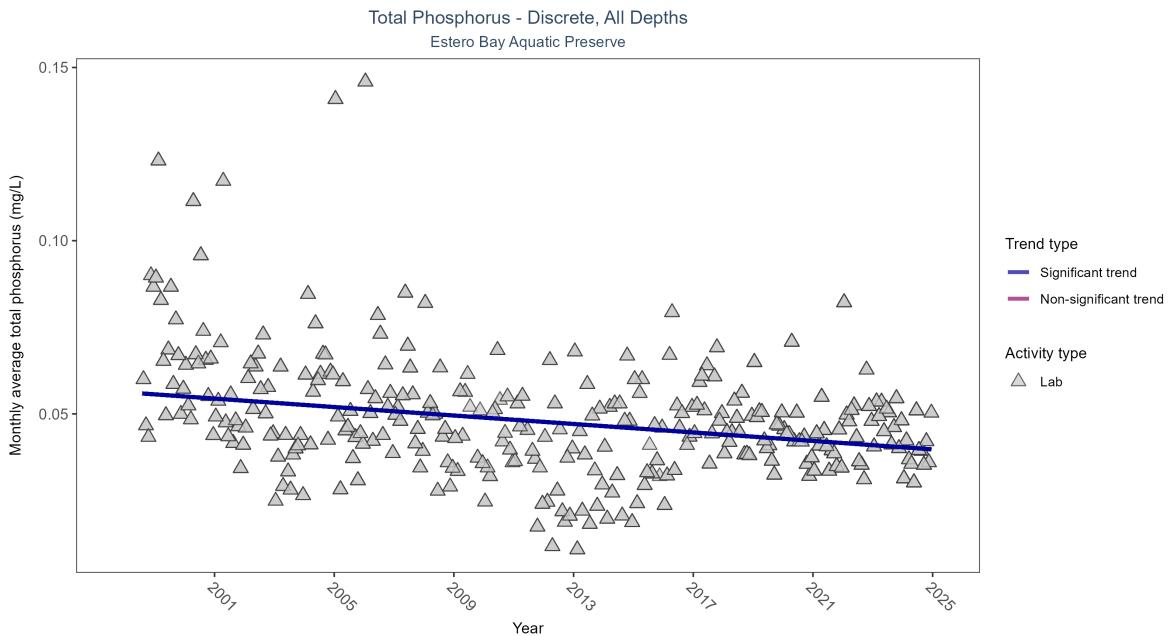


Figure 3: Scatter plot of monthly average total phosphorus over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only phosphorus values obtained from laboratory analyses (triangles) are included in the plot.

Table 2: Seasonal Kendall-Tau Results for - Total Phosphorus

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Lab	Significantly decreasing trend	3465	27	1998 - 2024	0.0427	-0.24808	0.05626	-0.00061	0

Monthly average total phosphorus decreased by less than 0.01 mg/L per year.

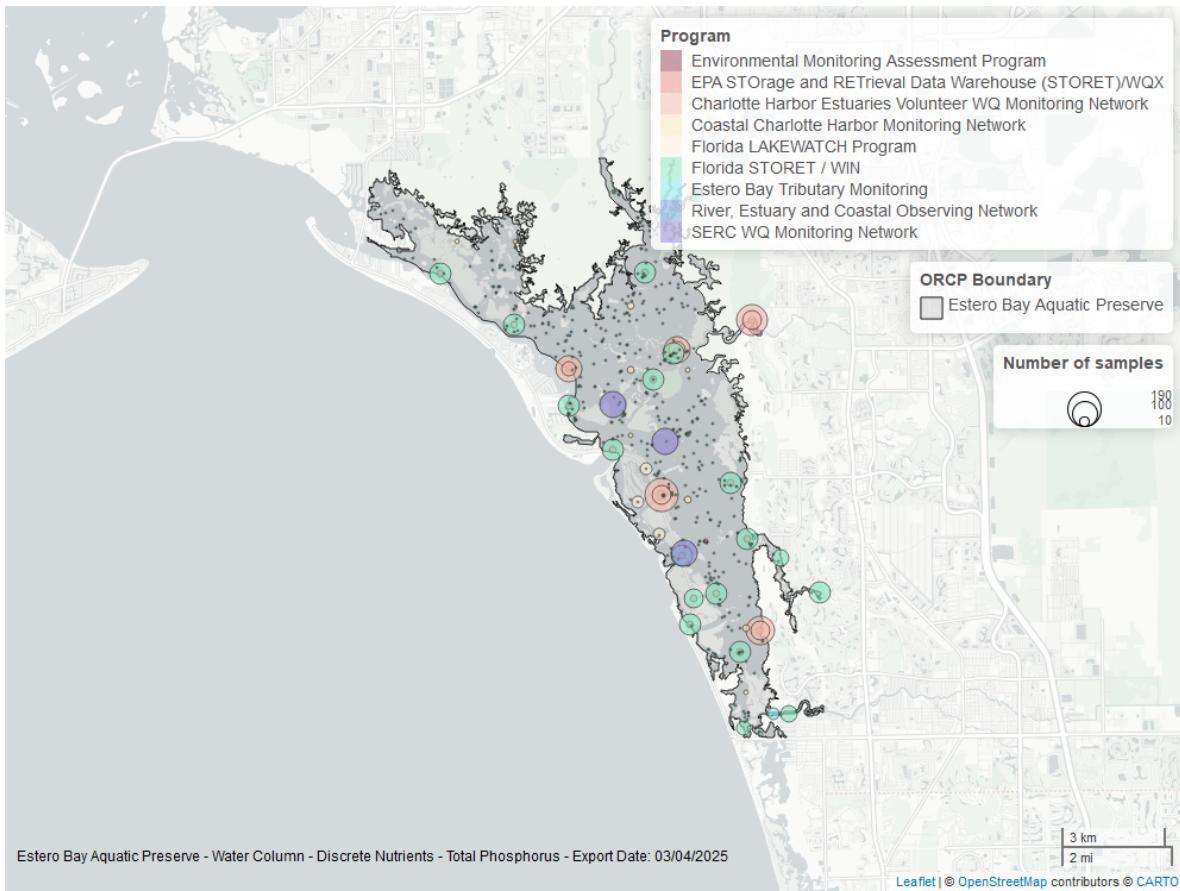


Figure 4: Map showing location of discrete water quality sampling locations within the boundaries of *Estero Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Water Quality

Dissolved Oxygen - Discrete

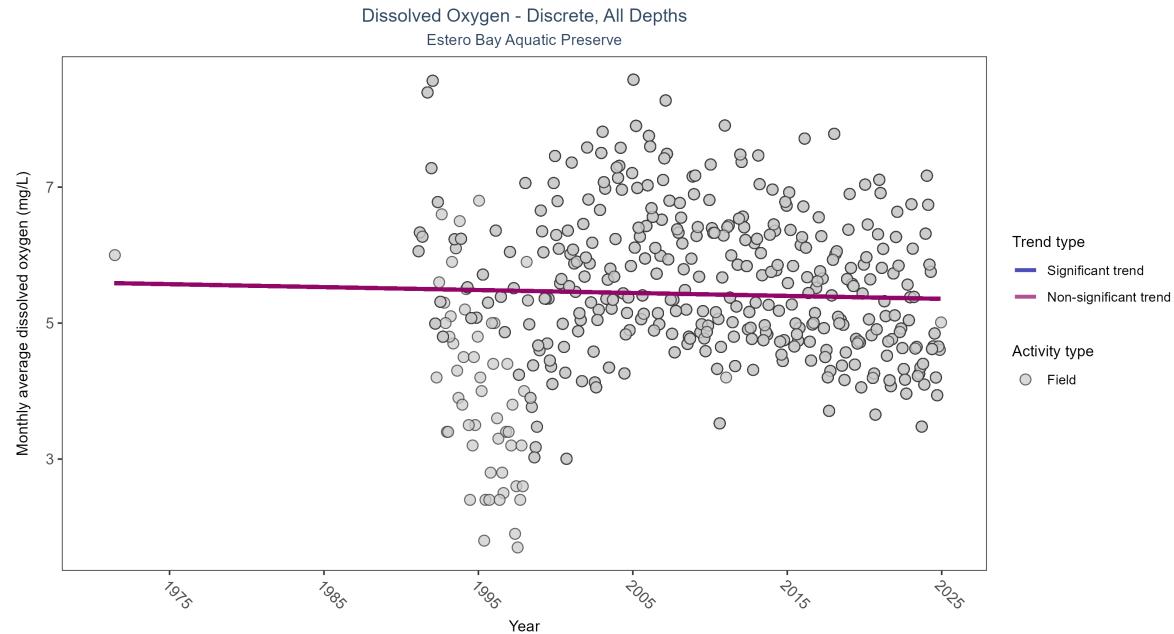


Figure 5: Scatter plot of monthly average dissolved oxygen over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only dissolved oxygen values measured in the field (circles) are included in the plot.

Table 3: Seasonal Kendall-Tau Results for - Dissolved Oxygen

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Field	No significant trend	11622	35	1971 - 2024	5.78	-0.03637	5.58952	-0.00431	0.311

Dissolved oxygen showed no detectable trend between 1971 and 2024.

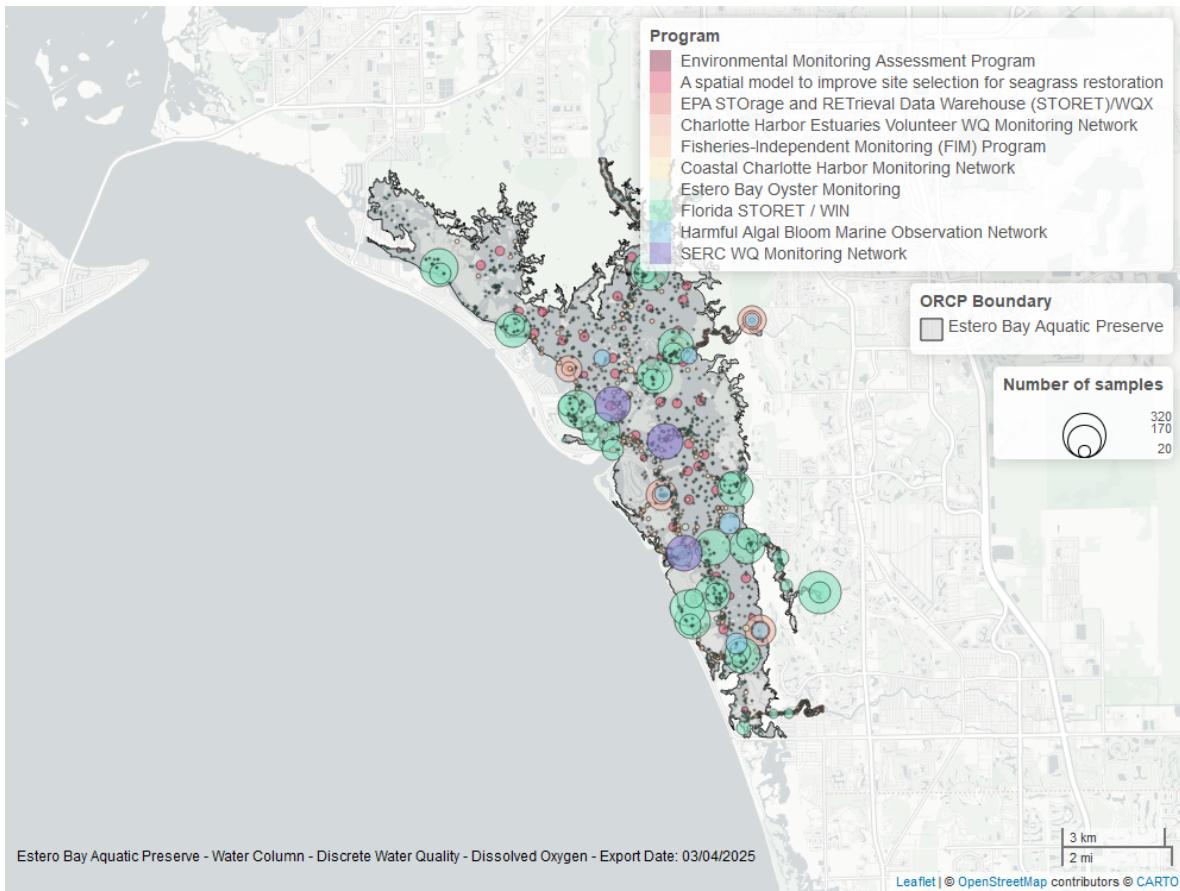


Figure 6: Map showing location of discrete water quality sampling locations within the boundaries of *Estero Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Dissolved Oxygen - Continuous

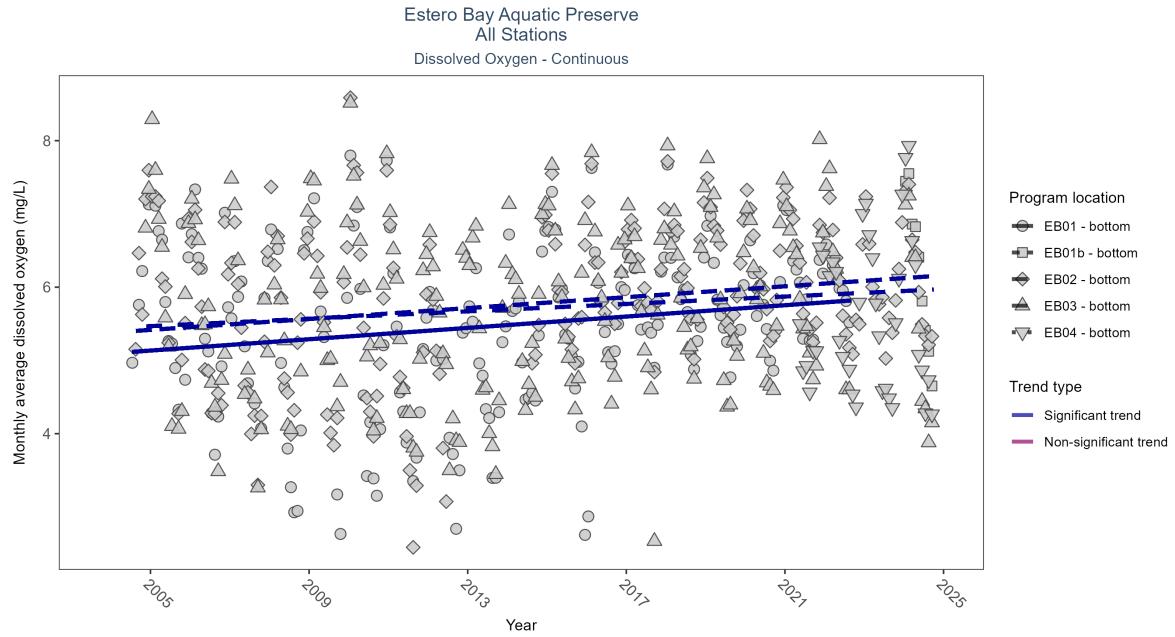


Figure 7: Scatter plot of monthly average dissolved oxygen over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 4: Seasonal Kendall-Tau Results - Dissolved Oxygen

Program Location	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
EB01	Significantly increasing trend	478415	19	2004 - 2022	5.6	0.22	5.1	0.04	0
EB02	Significantly increasing trend	478256	20	2004 - 2024	6.0	0.25	5.38	0.04	0
EB03	Significantly increasing trend	465070	20	2004 - 2024	5.9	0.16	5.44	0.03	0.0014
EB04	Insufficient data to calculate trend	101087	4	2021 - 2024	5.6	-	-	-	-
EB01b	Insufficient data to calculate trend	23562	1	2024 - 2024	6.3	-	-	-	-

At three program locations, monthly average dissolved oxygen increased between 0.03 and 0.04 mg/L per year. There was insufficient data to fit a model for two locations.

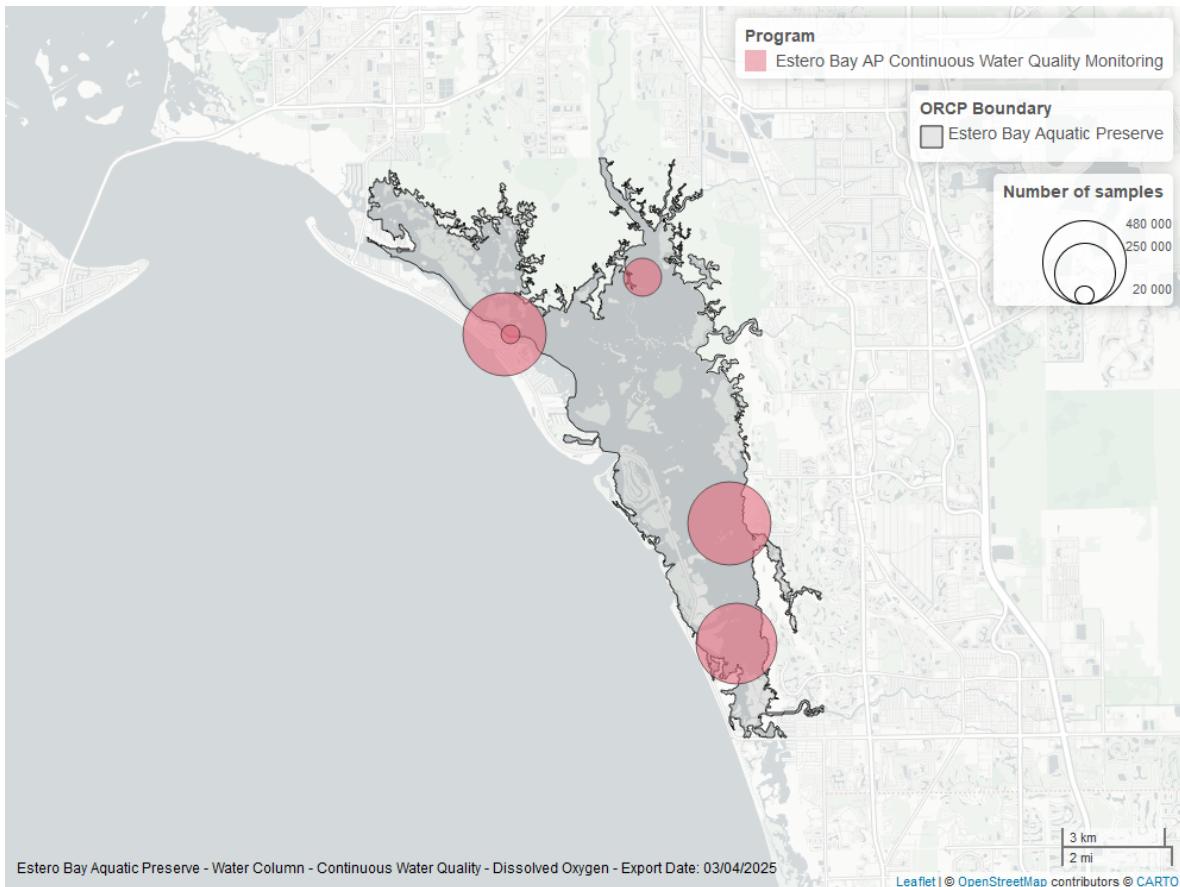


Figure 8: Map showing location of dissolved oxygen continuous water quality sampling locations within the boundaries of *Estero Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Dissolved Oxygen Saturation - Discrete

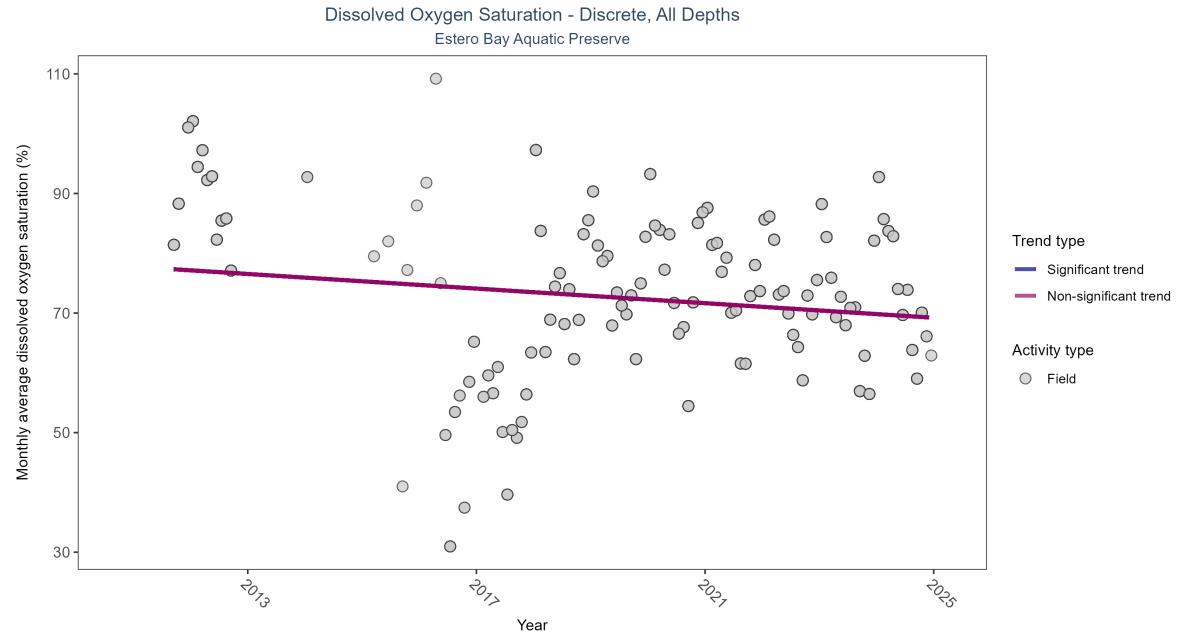


Figure 9: Scatter plot of monthly average dissolved oxygen saturation over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only dissolved oxygen saturation values measured in the field (circles) are included in the plot.

Table 5: Seasonal Kendall-Tau Results for - Dissolved Oxygen Saturation

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Field	No significant trend	2738	13	2011 - 2024	81.8	-0.13685	77.75699	-0.61029	0.0542

Dissolved oxygen saturation showed no detectable trend between 2011 and 2024.

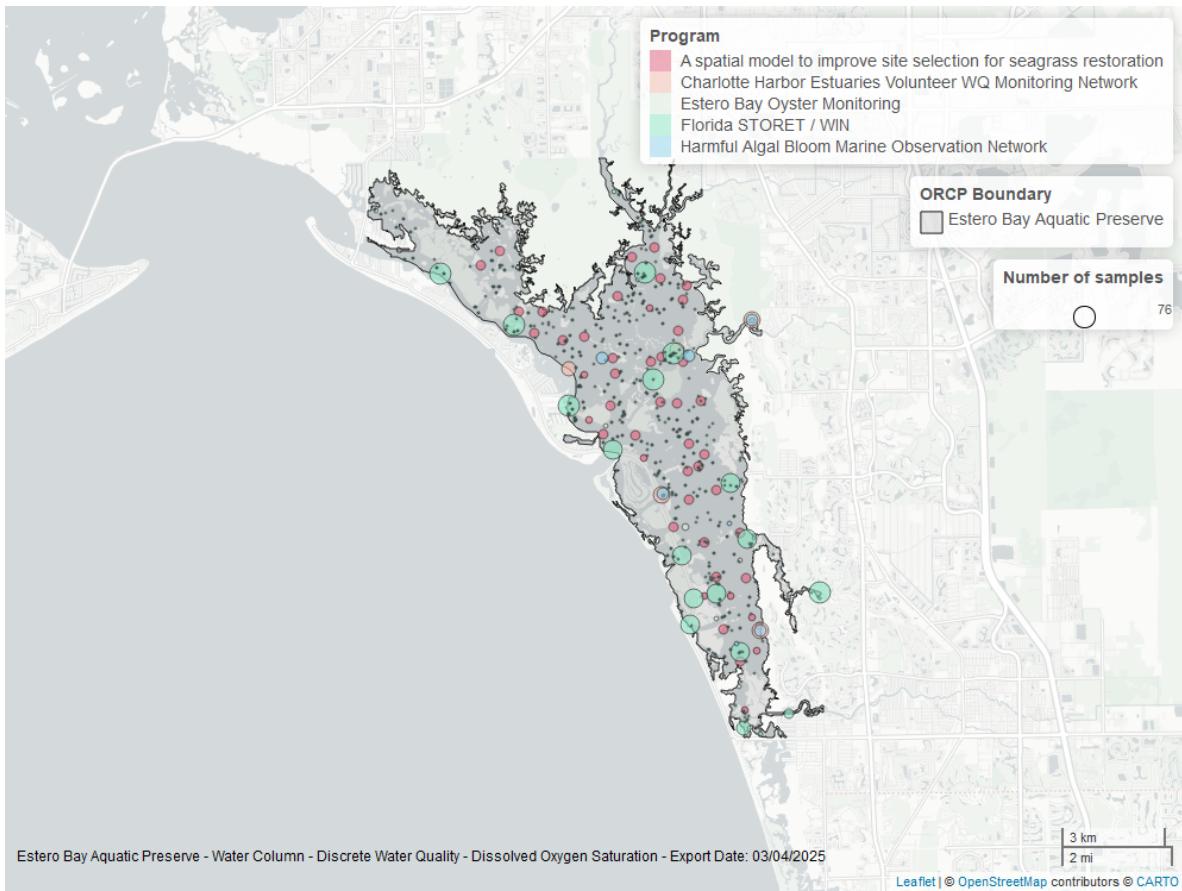


Figure 10: Map showing location of discrete water quality sampling locations within the boundaries of *Estero Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Dissolved Oxygen Saturation - Continuous

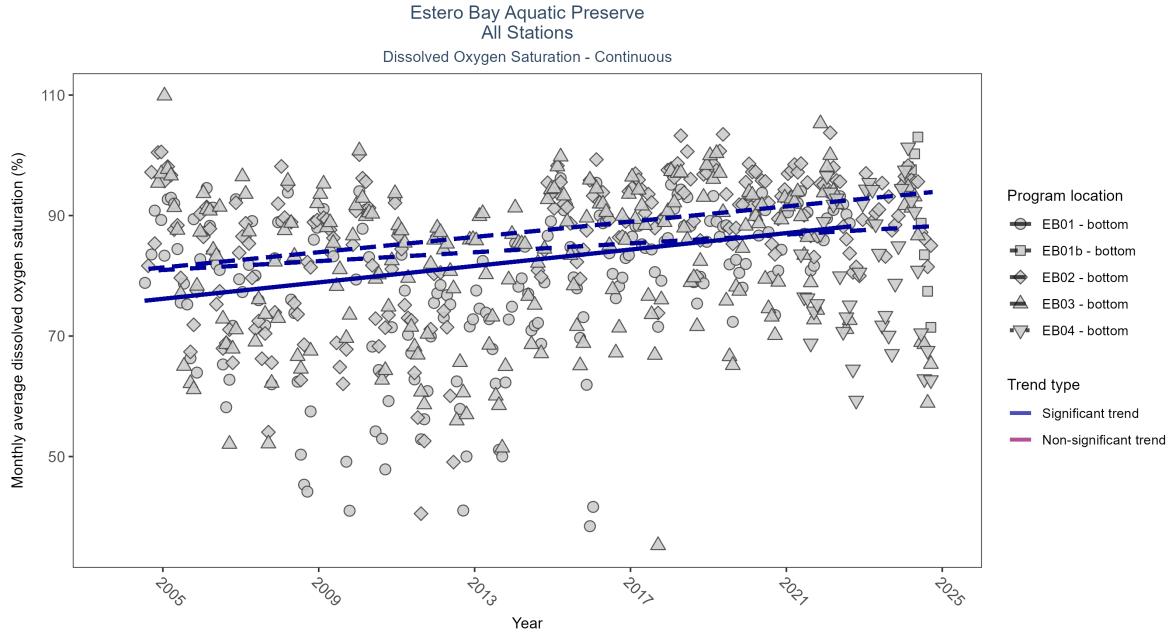


Figure 11: Scatter plot of monthly average dissolved oxygen saturation over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 6: Seasonal Kendall-Tau Results - Dissolved Oxygen Saturation

Program Location	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
EB01	Significantly increasing trend	480233	19	2004 - 2022	81.6	0.31	75.5	0.68	0
EB02	Significantly increasing trend	478493	20	2004 - 2024	87.8	0.37	80.74	0.63	0
EB01b	Insufficient data to calculate trend	23563	1	2024 - 2024	90.3	-	-	-	-
EB03	Significantly increasing trend	466596	20	2004 - 2024	83.6	0.22	80.59	0.37	0
EB04	Insufficient data to calculate trend	111351	4	2021 - 2024	81.6	-	-	-	-

At three program locations, monthly average dissolved oxygen saturation increased between 0.37 and 0.68% per year. There was insufficient data to fit a model for two locations.

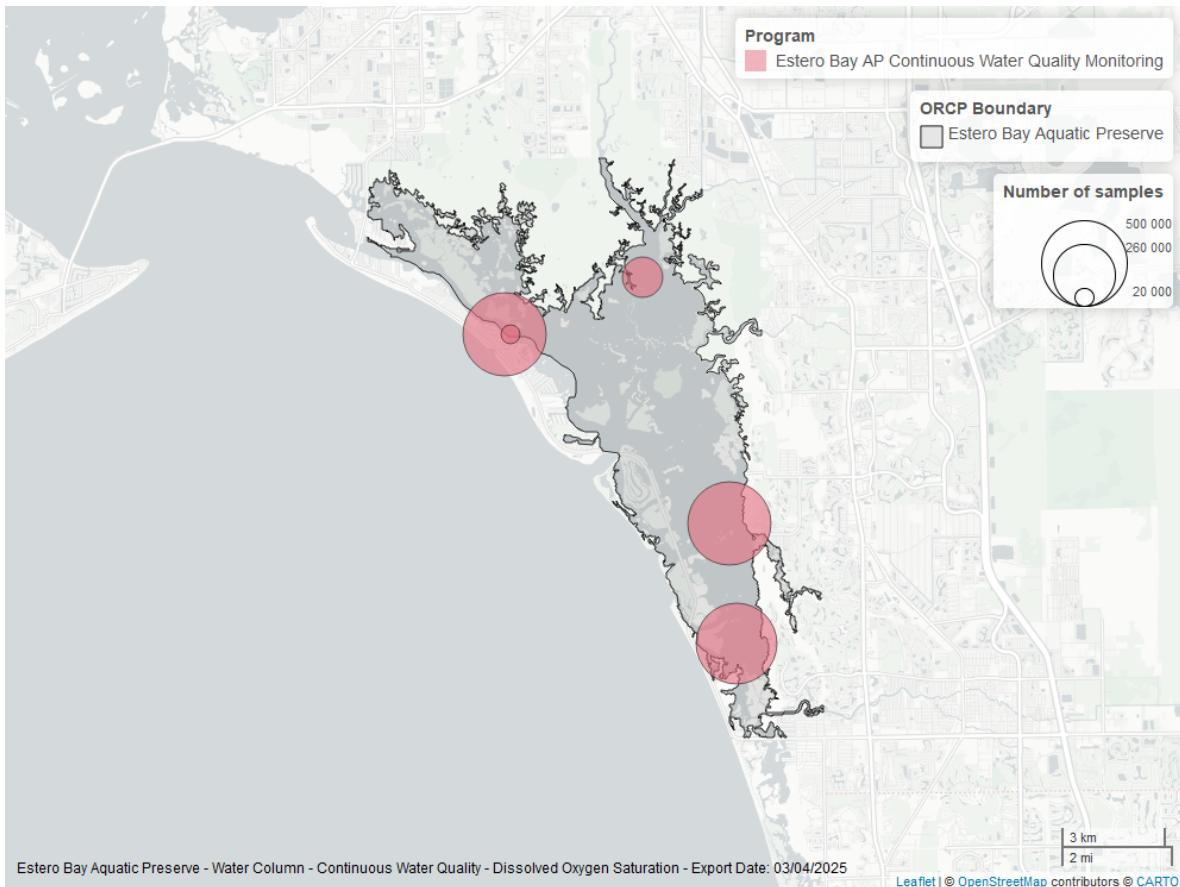


Figure 12: Map showing location of dissolved oxygen saturation continuous water quality sampling locations within the boundaries of *Estero Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Salinity - Discrete

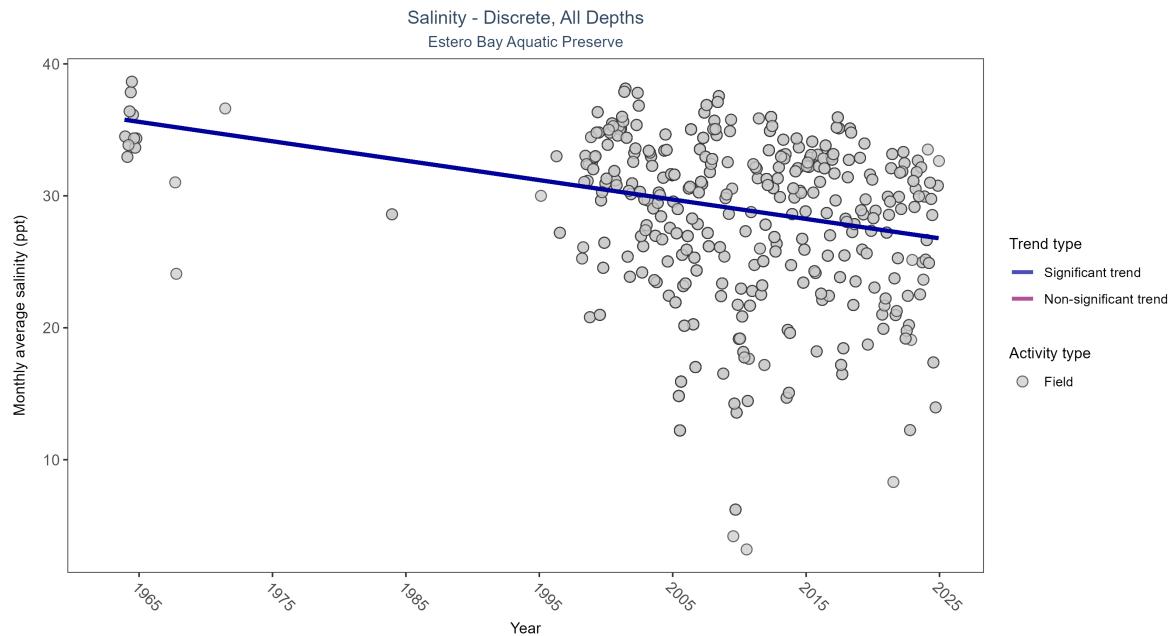


Figure 13: Scatter plot of monthly average salinity over time. If the time series included ten or more years of discrete observations, significant (blue) or non-significant (magenta) trend lines are also shown. Discrete salinity values derived from grab samples analyzed in the field (circles) or the laboratory (triangles) are both included in the plot.

Table 7: Seasonal Kendall-Tau Results for - Salinity

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
All	Significantly decreasing trend	5322	34	1963 - 2024	32.285	-0.27053	35.90011	-0.14715	0

Monthly average salinity decreased by 0.15 ppt per year.

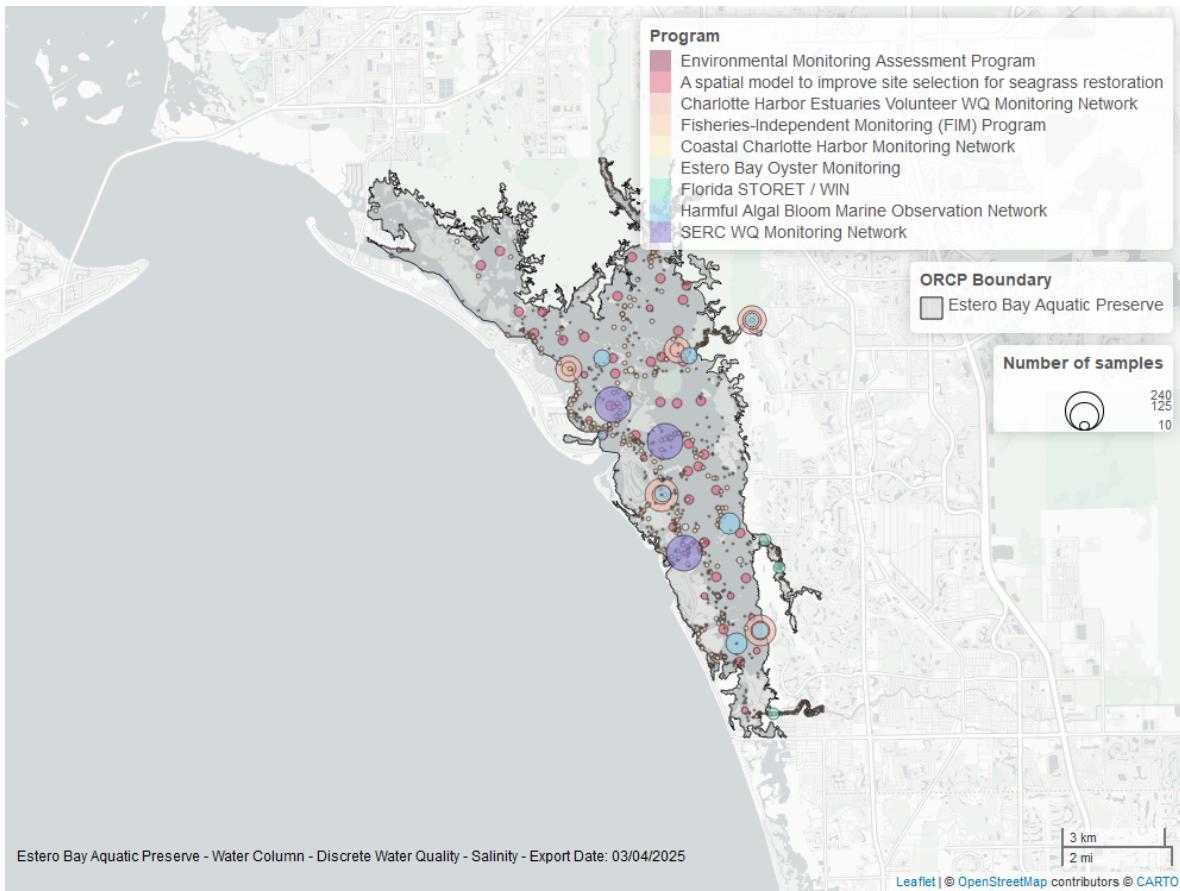


Figure 14: Map showing location of discrete water quality sampling locations within the boundaries of *Estero Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Salinity - Continuous

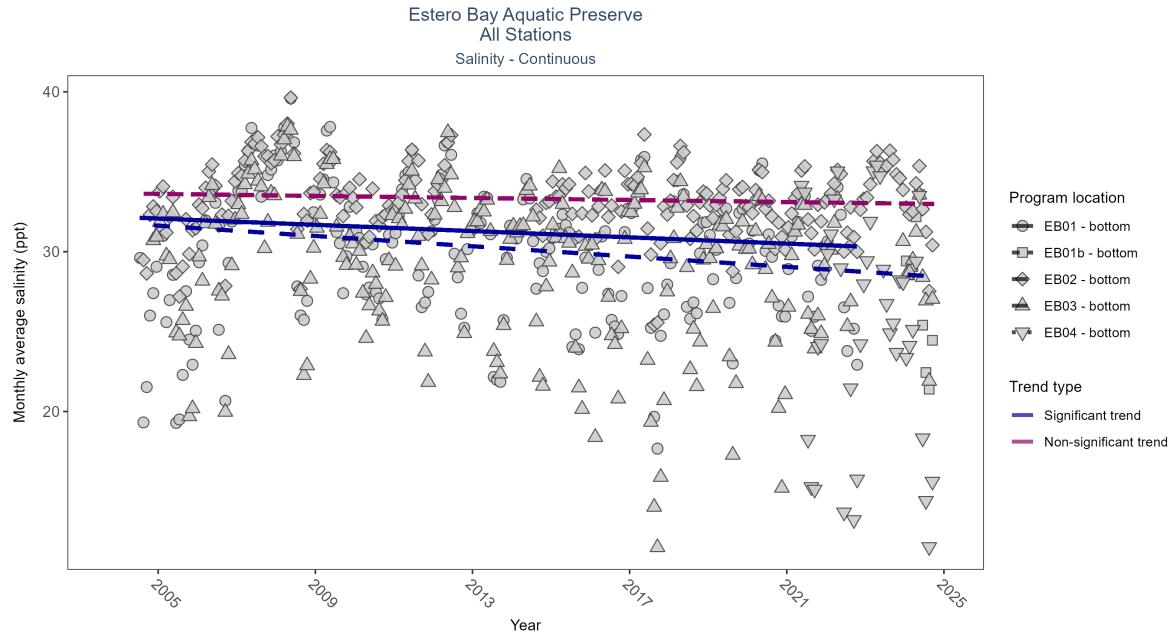


Figure 15: Scatter plot of monthly average salinity over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 8: Seasonal Kendall-Tau Results - Salinity

Program Location	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
EB01	Significantly decreasing trend	567163	19	2004 - 2022	30.7	-0.13	32.17	-0.1	0.011
EB02	No significant trend	566154	20	2004 - 2024	33.6	-0.08	33.65	-0.03	0.0882
EB01b	Insufficient data to calculate trend	23534	1	2024 - 2024	28.0	-	-	-	-
EB03	Significantly decreasing trend	561328	21	2004 - 2024	30.8	-0.23	31.79	-0.16	0
EB04	Insufficient data to calculate trend	110779	4	2021 - 2024	27.3	-	-	-	-

At two program locations, monthly average salinity decreased by 0.1 ppt per year at one site and by 0.16 ppt per year at the other. No detectable change in monthly average salinity was observed at one location. There was insufficient data to fit a model for two locations.

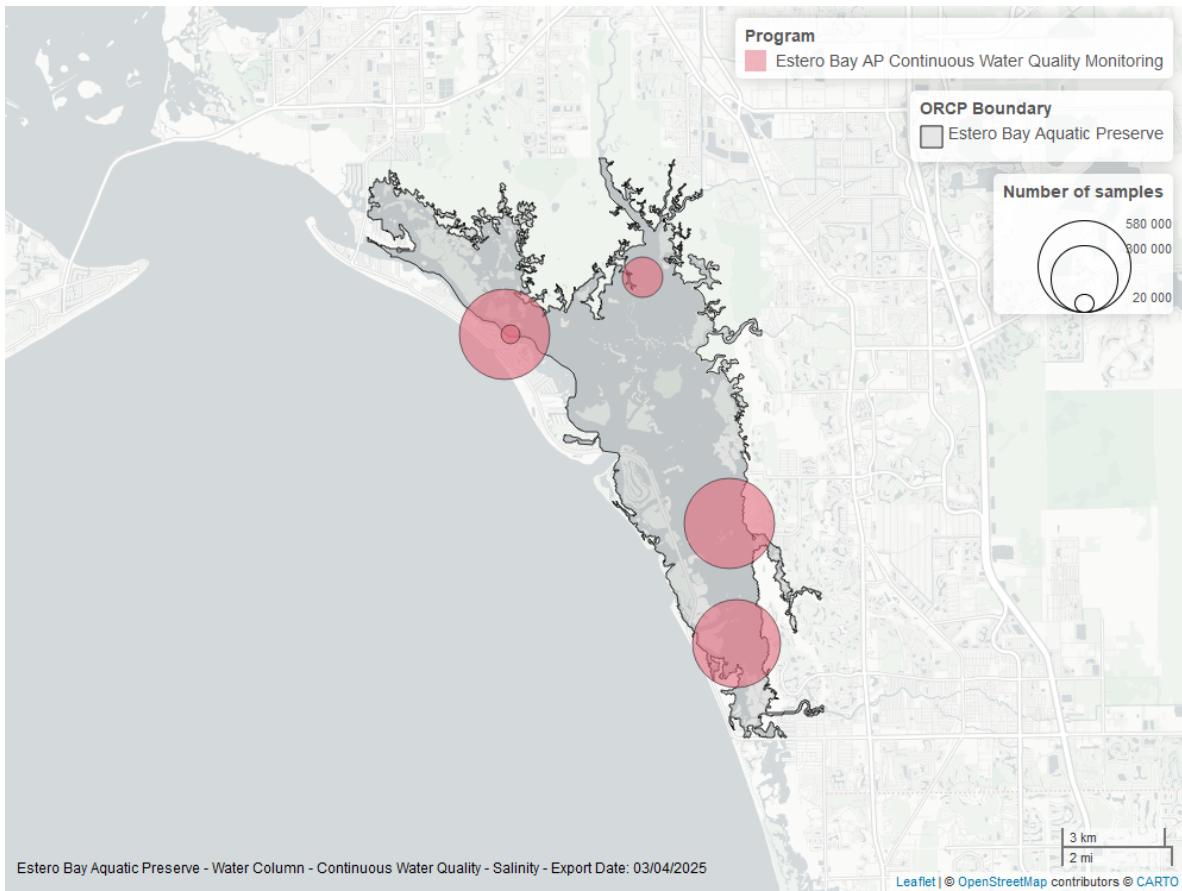


Figure 16: Map showing location of salinity continuous water quality sampling locations within the boundaries of *Estero Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Water Temperature - Discrete

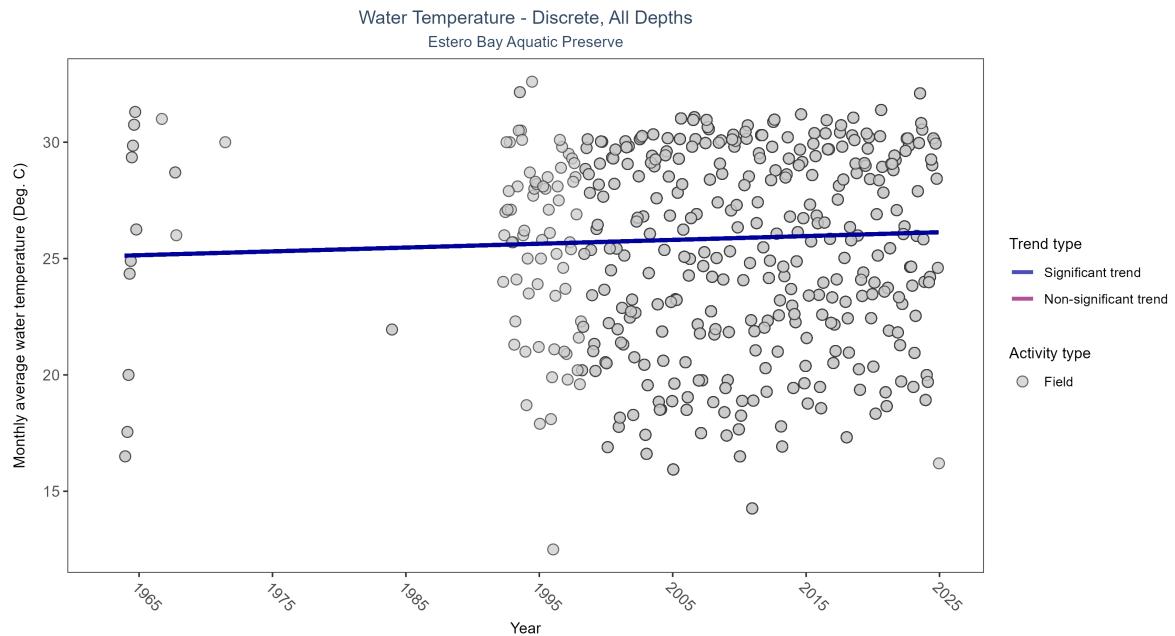


Figure 17: Scatter plot of monthly average water temperature over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only water temperature measurements taken in the field (circles) are included in the plot.

Table 9: Seasonal Kendall-Tau Results for - Water Temperature

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Field	Significantly increasing trend	11243	39	1963 - 2024	26	0.09147	25.11041	0.01646	0.0088

Monthly average water temperature increased by 0.02°C per year.

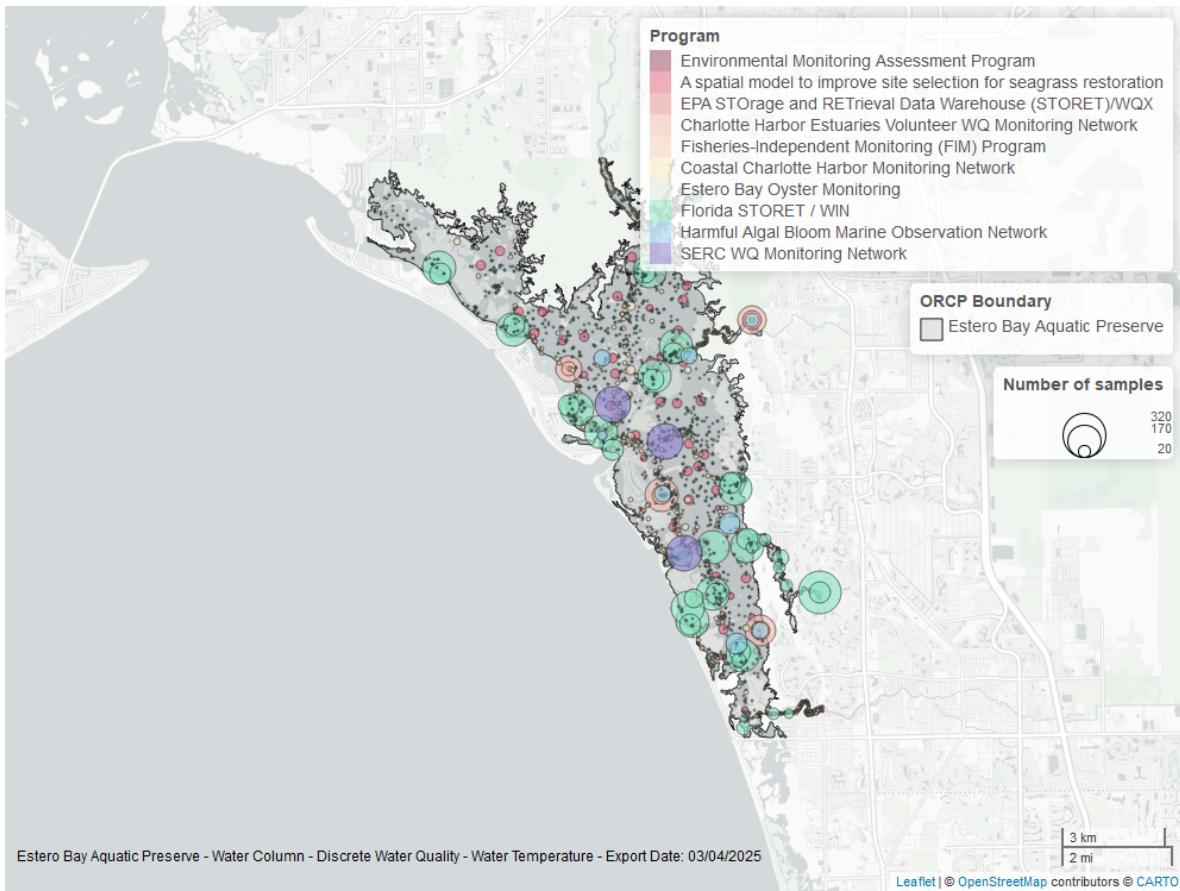


Figure 18: Map showing location of discrete water quality sampling locations within the boundaries of *Estero Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Water Temperature - Continuous

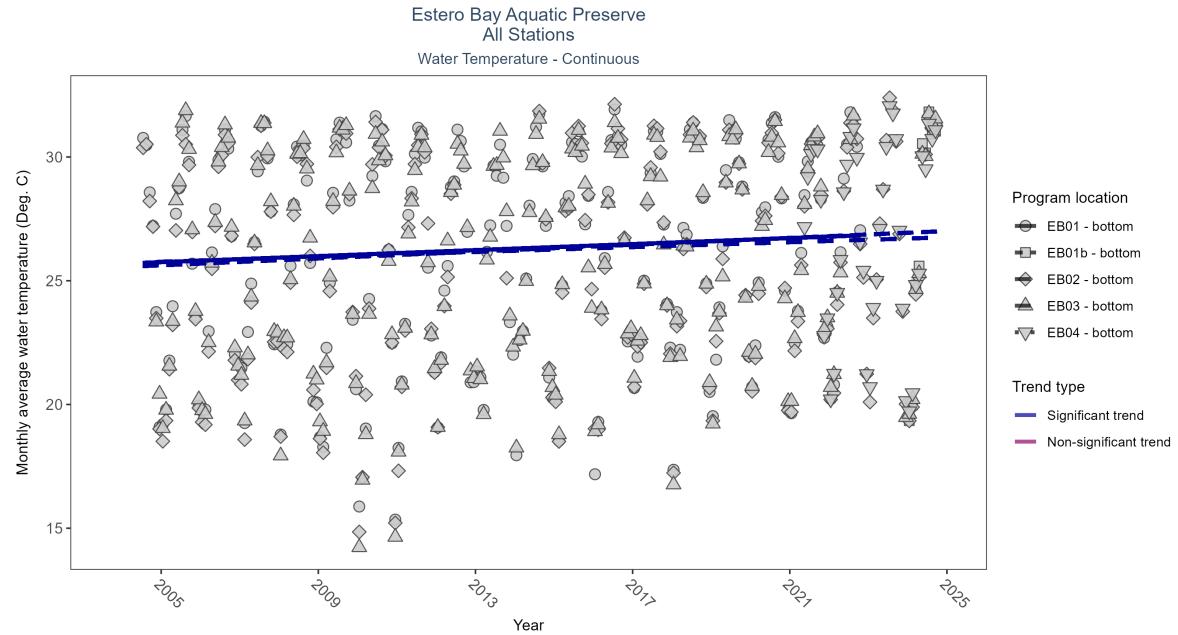


Figure 19: Scatter plot of monthly average water temperature over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 10: Seasonal Kendall-Tau Results - Water Temperature

Program Location	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
EB01	Significantly increasing trend	617636	19	2004 - 2022	26.8	0.25	25.69	0.06	0
EB02	Significantly increasing trend	609843	21	2004 - 2024	26.6	0.33	25.55	0.07	0
EB01b	Insufficient data to calculate trend	23561	1	2024 - 2024	29.7	-	-	-	-
EB03	Significantly increasing trend	600244	21	2004 - 2024	26.5	0.19	25.72	0.05	0.0002
EB04	Insufficient data to calculate trend	118843	4	2021 - 2024	27.8	-	-	-	-

At three program locations, monthly average water temperature increased between 0.05 and 0.07°C per year. There was insufficient data to fit a model for two locations.

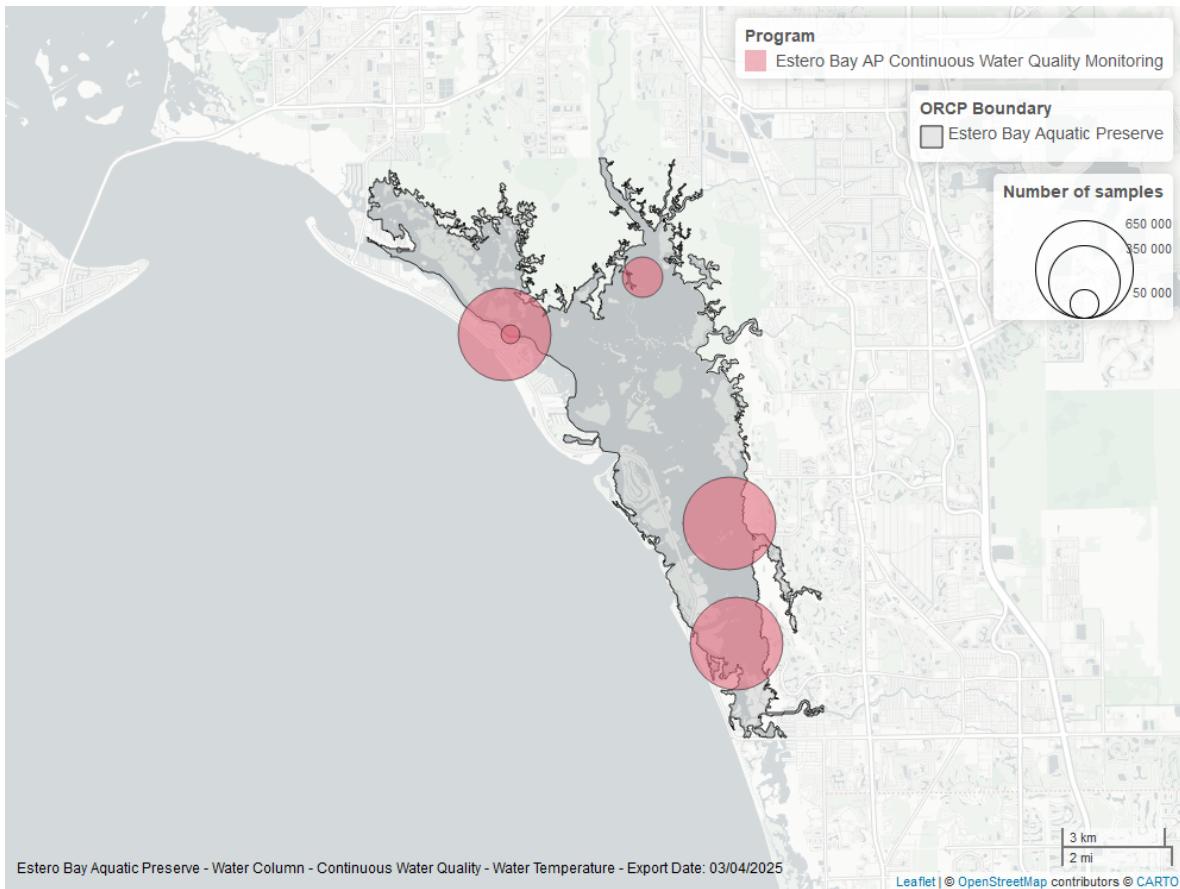


Figure 20: Map showing location of water temperature continuous water quality sampling locations within the boundaries of *Estero Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

pH - Discrete

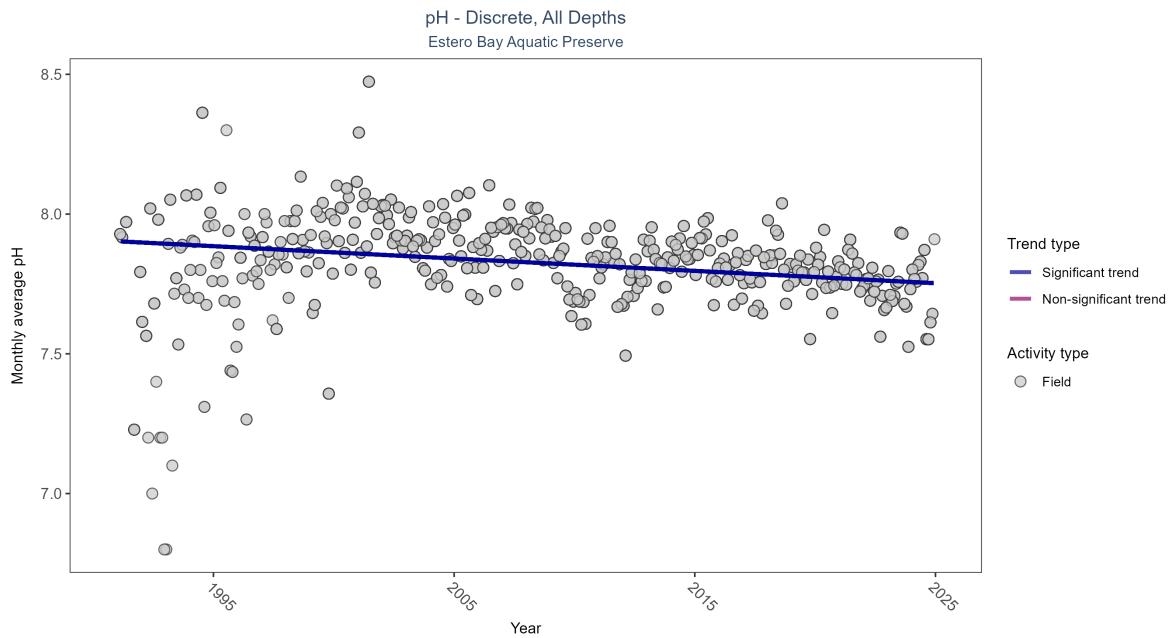


Figure 21: Scatter plot of monthly average pH over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only pH values measured in the field (circles) are included in the plot.

Table 11: Seasonal Kendall-Tau Results for - pH

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Field	Significantly decreasing trend	10977	34	1991 - 2024	7.9	-0.19861	7.90276	-0.00442	0

Monthly average pH decreased by less than 0.01 pH units per year.

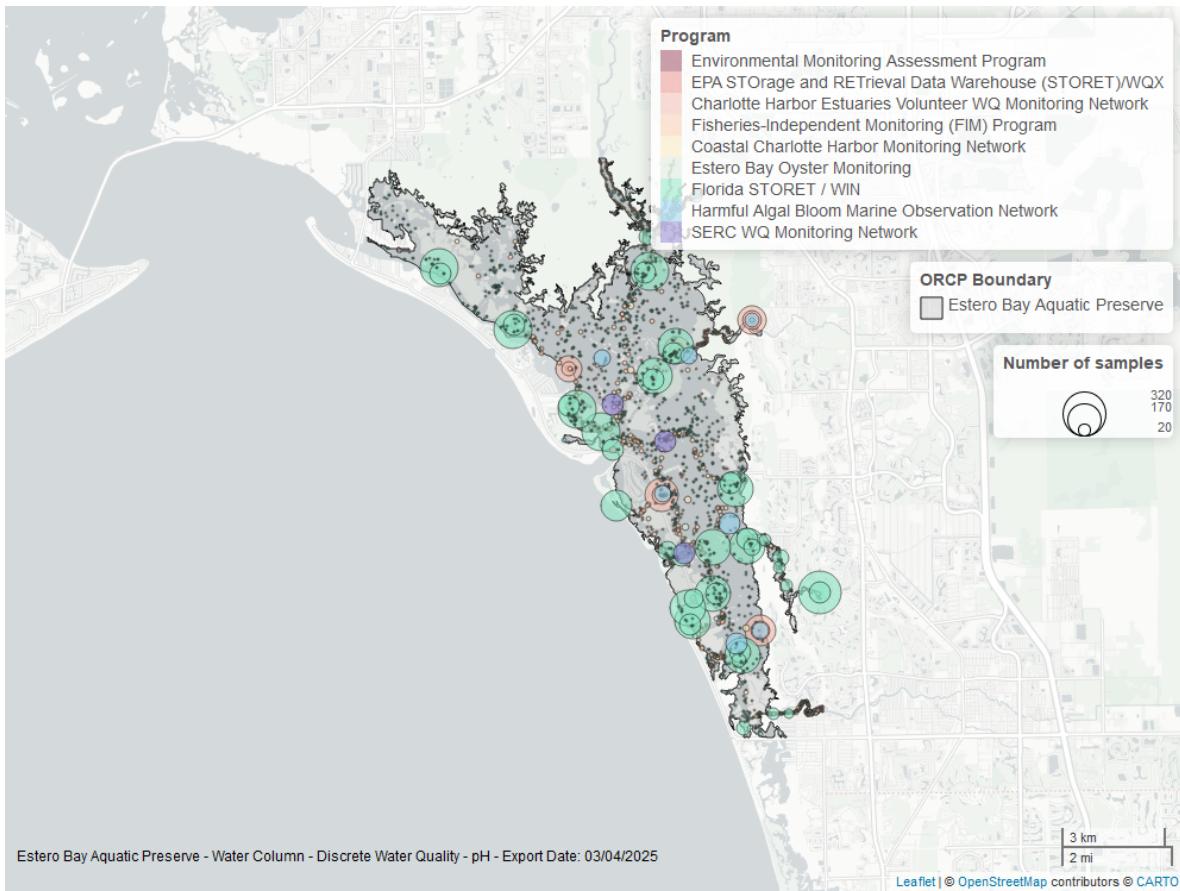


Figure 22: Map showing location of discrete water quality sampling locations within the boundaries of *Estero Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

pH - Continuous

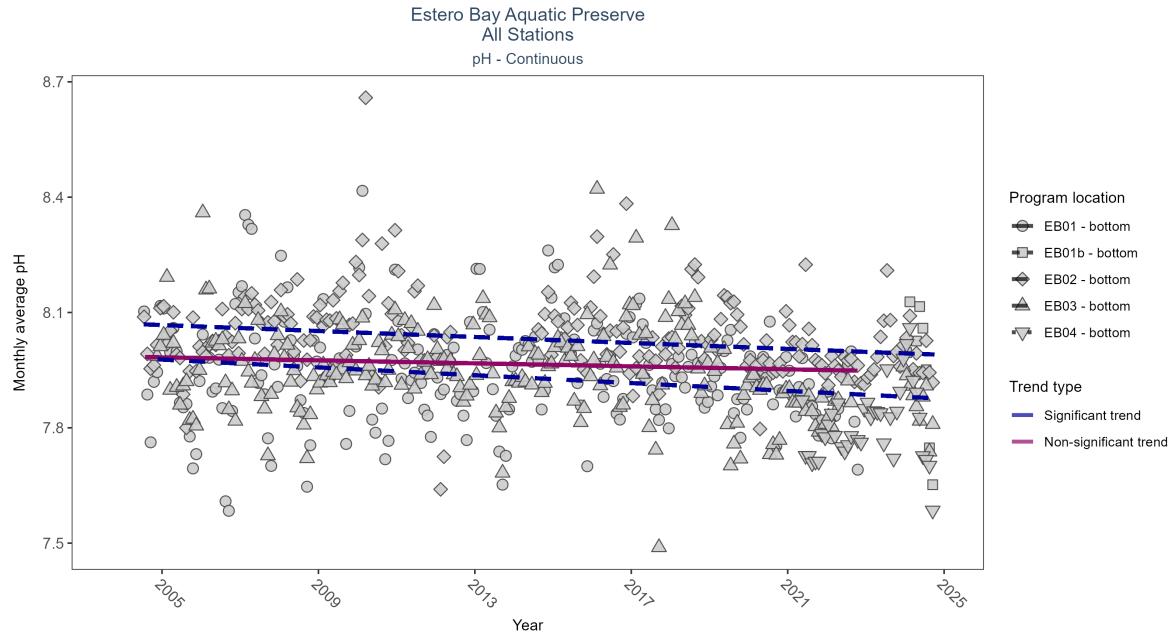


Figure 23: Scatter plot of monthly average pH over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 12: Seasonal Kendall-Tau Results - pH

Program Location	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
EB01	No significant trend	562188	19	2004 - 2022	7.9	-0.08	7.99	0	0.1157
EB02	Significantly decreasing trend	547192	20	2004 - 2024	8.0	-0.2	8.07	0	0.0001
EB01b	Insufficient data to calculate trend	23563	1	2024 - 2024	8.0	-	-	-	-
EB03	Significantly decreasing trend	553331	21	2004 - 2024	7.9	-0.21	7.98	-0.01	0
EB04	Insufficient data to calculate trend	113849	4	2021 - 2024	7.8	-	-	-	-

At two program locations, monthly average pH decreased by less than 0.01 pH units per year at one site and by 0.01 pH units per year at the other. No detectable change in monthly average pH was observed at one location. There was insufficient data to fit a model for two locations.

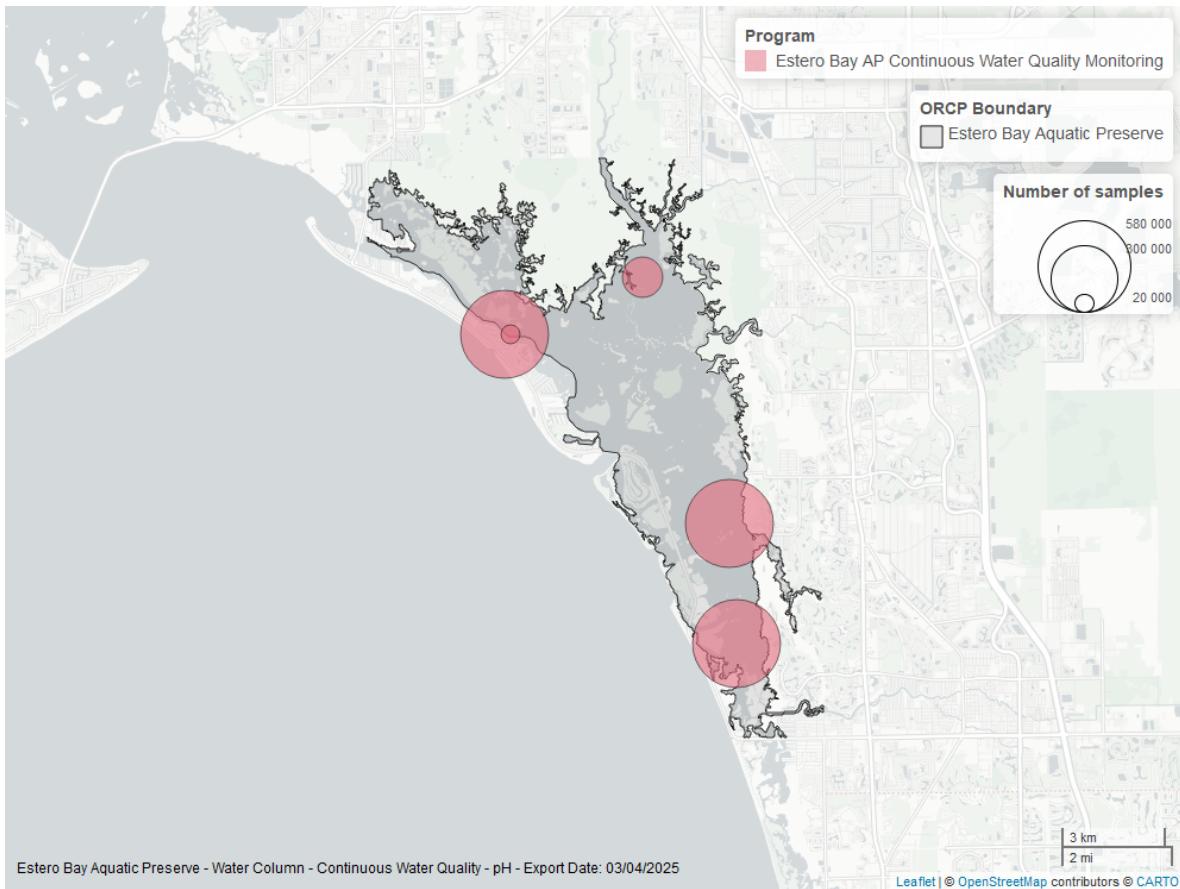


Figure 24: Map showing location of ph continuous water quality sampling locations within the boundaries of *Estero Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Water Clarity

Turbidity - Discrete

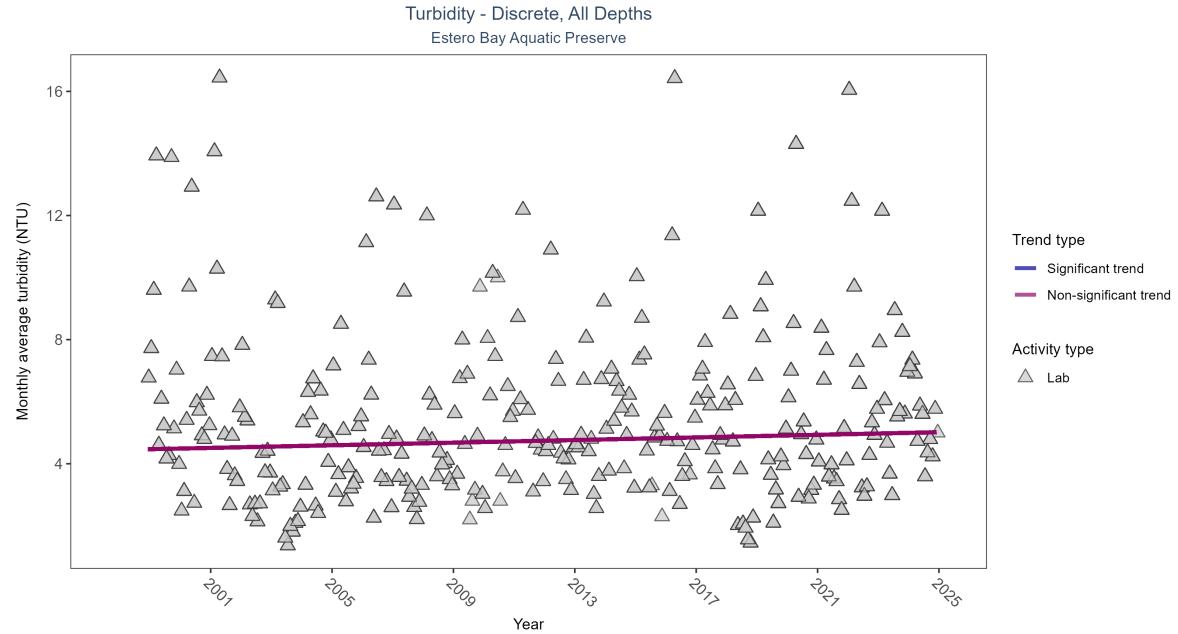


Figure 25: Scatter plot of monthly average turbidity over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only turbidity values measured in the laboratory (triangles) are included in the plot.

Table 13: Seasonal Kendall-Tau Results for - Turbidity

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Lab	No significant trend	3042	27	1998 - 2024	4	0.05612	4.44689	0.02107	0.1541

Turbidity showed no detectable trend between 1998 and 2024.

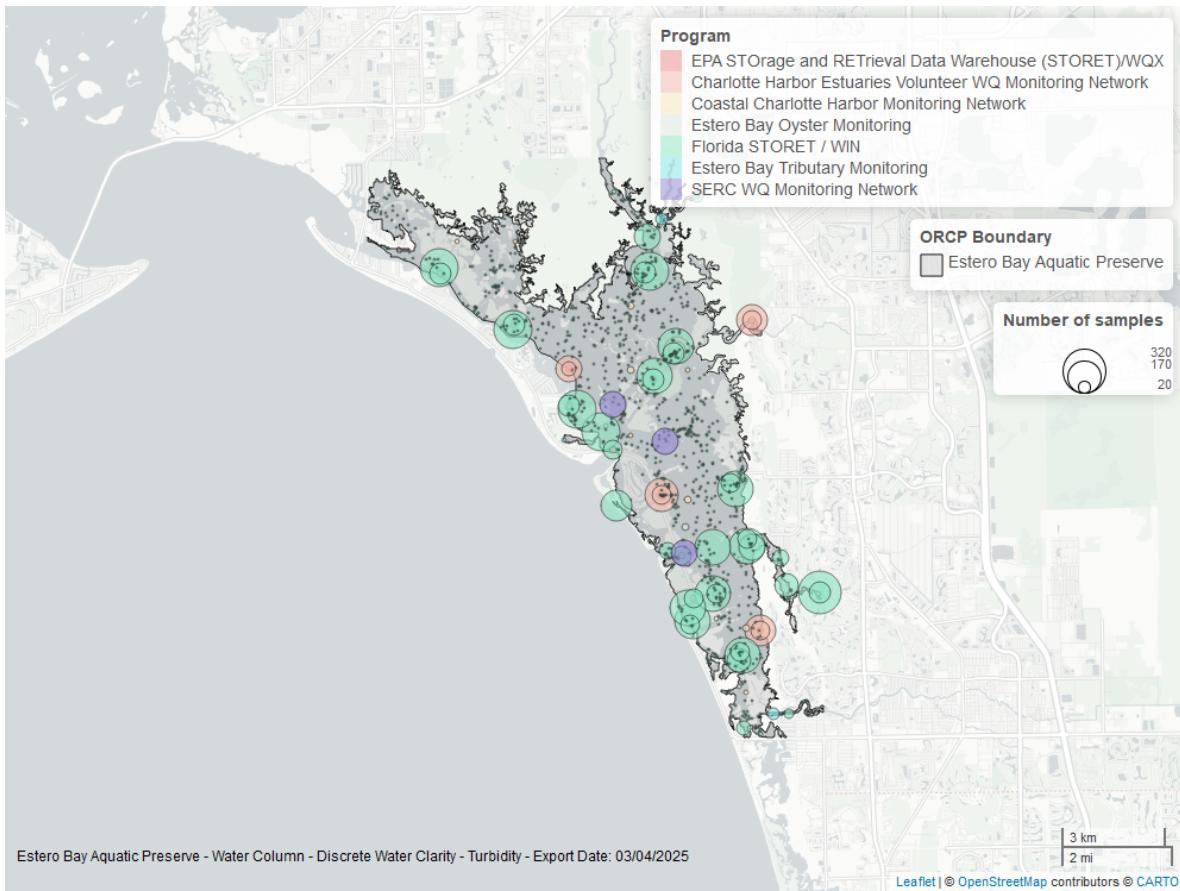


Figure 26: Map showing location of discrete water quality sampling locations within the boundaries of *Estero Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Turbidity - Continuous

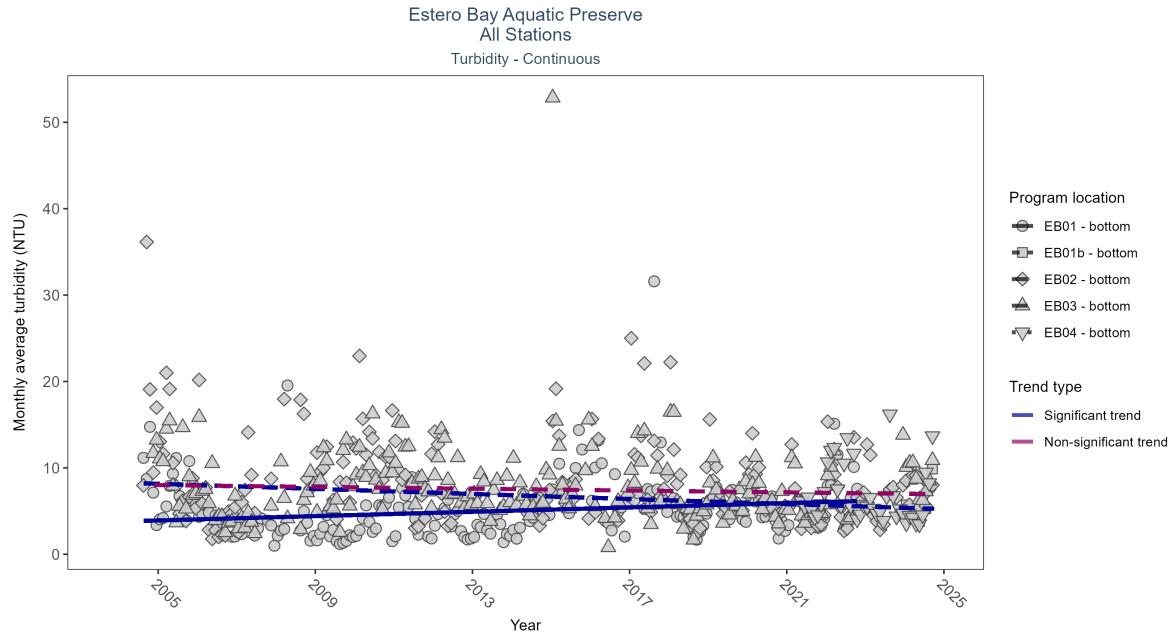


Figure 27: Scatter plot of monthly average turbidity over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 14: Seasonal Kendall-Tau Results - Turbidity

Program Location	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
EB01	Significantly increasing trend	510965	19	2004 - 2022	4	0.18	3.79	0.13	0.0005
EB01b	Insufficient data to calculate trend	22383	1	2024 - 2024	5	-	-	-	-
EB02	Significantly decreasing trend	460772	20	2004 - 2024	5	-0.18	8.3	-0.15	0.0011
EB03	No significant trend	441554	21	2004 - 2024	6	-0.08	8.07	-0.05	0.1586
EB04	Insufficient data to calculate trend	108414	4	2021 - 2024	5	-	-	-	-

At one program location, monthly average turbidity increased by 0.13 NTU per year. At one program location, monthly average turbidity decreased by 0.15 NTU per year. No detectable change in monthly average turbidity was observed at one location. There was insufficient data to fit a model for two locations.

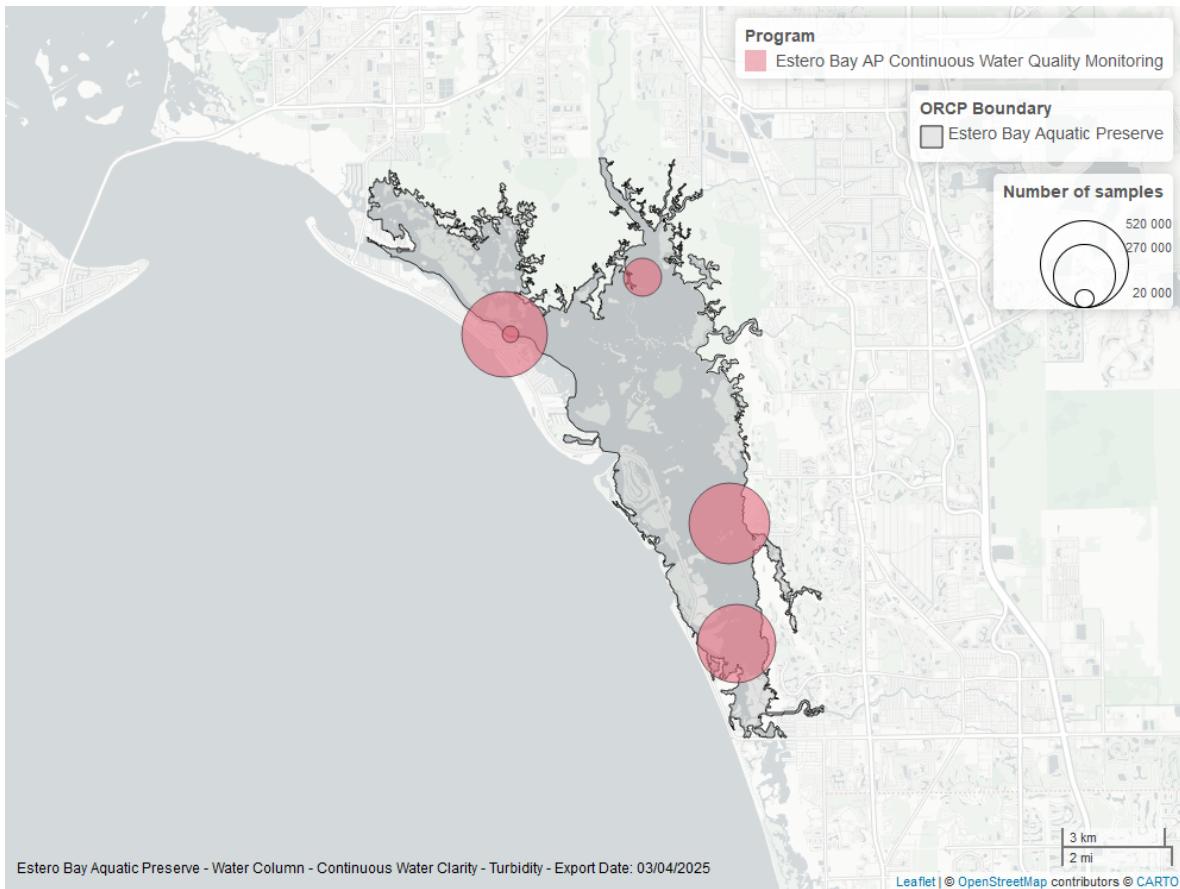


Figure 28: Map showing location of turbidity continuous water quality sampling locations within the boundaries of *Estero Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Total Suspended Solids - Discrete

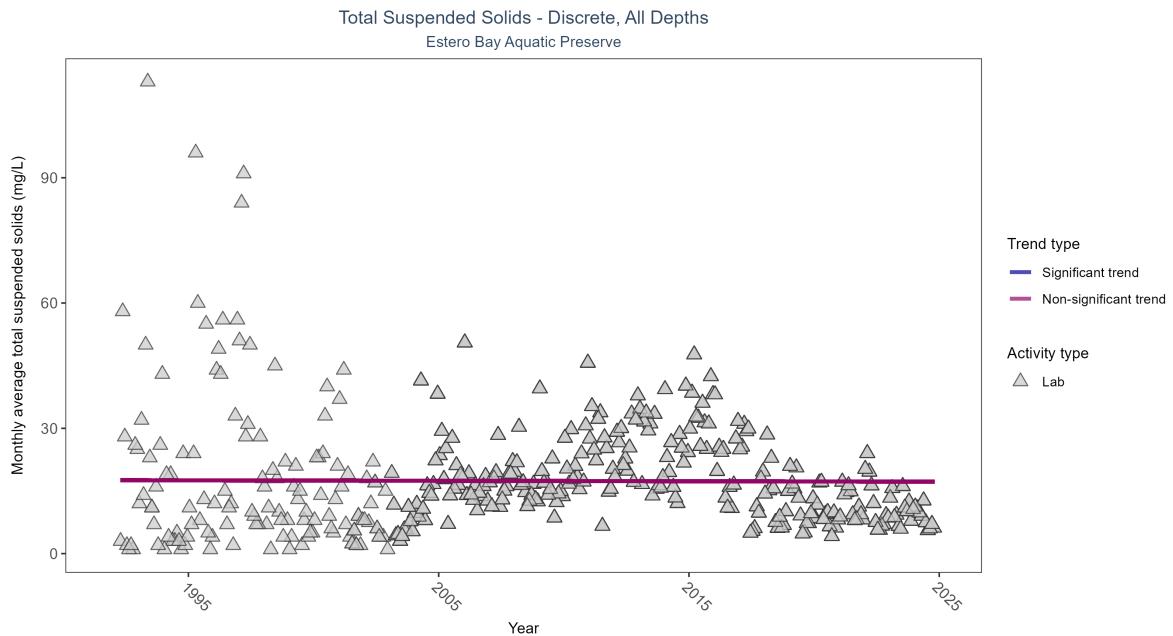


Figure 29: Scatter plot of monthly average total suspended solids (TSS) over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only TSS values obtained from laboratory analyses (triangles) are included in the plot.

Table 15: Seasonal Kendall-Tau Results for - Total Suspended Solids

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Lab	No significant trend	5468	33	1992 - 2024	13.9	-0.00942	17.57222	-0.01047	0.7822

Total suspended solids showed no detectable trend between 1992 and 2024.

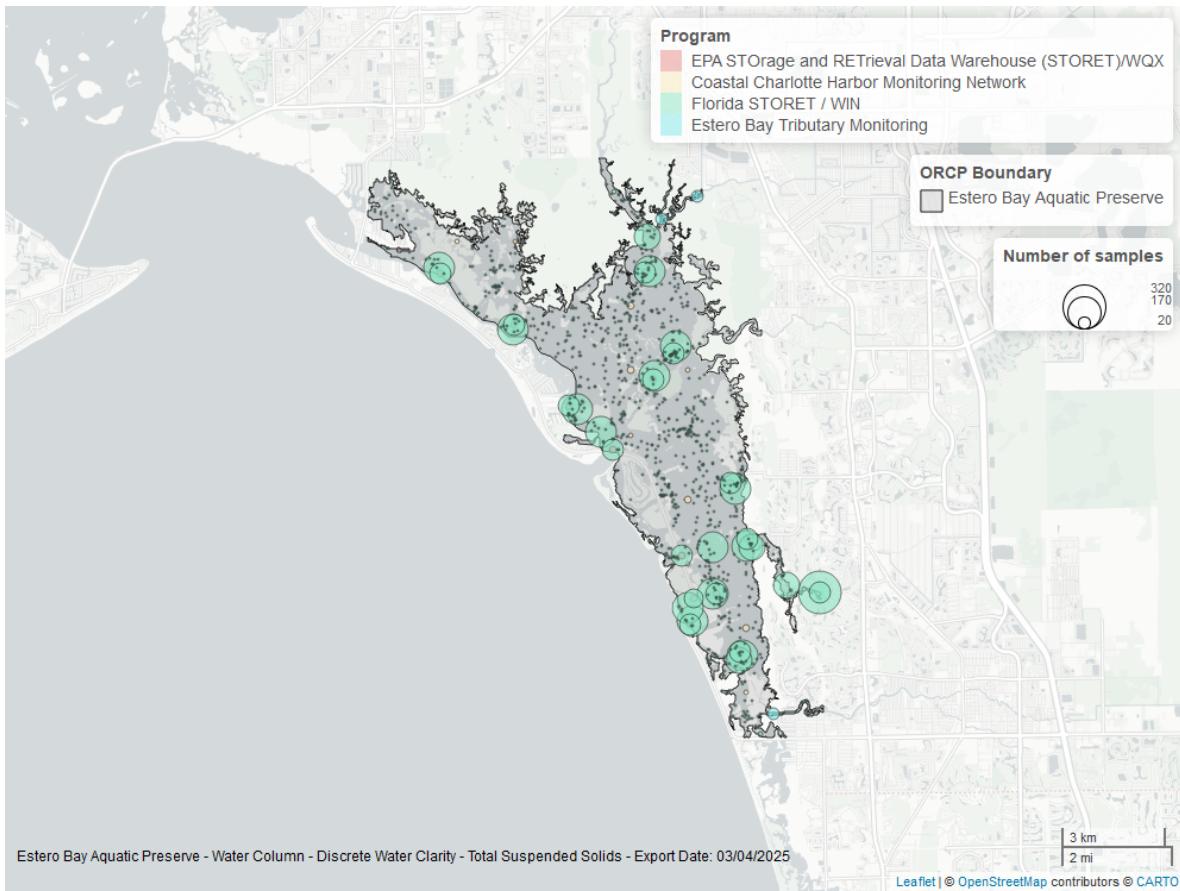


Figure 30: Map showing location of discrete water quality sampling locations within the boundaries of *Estero Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Chlorophyll a, Uncorrected for Pheophytin - Discrete

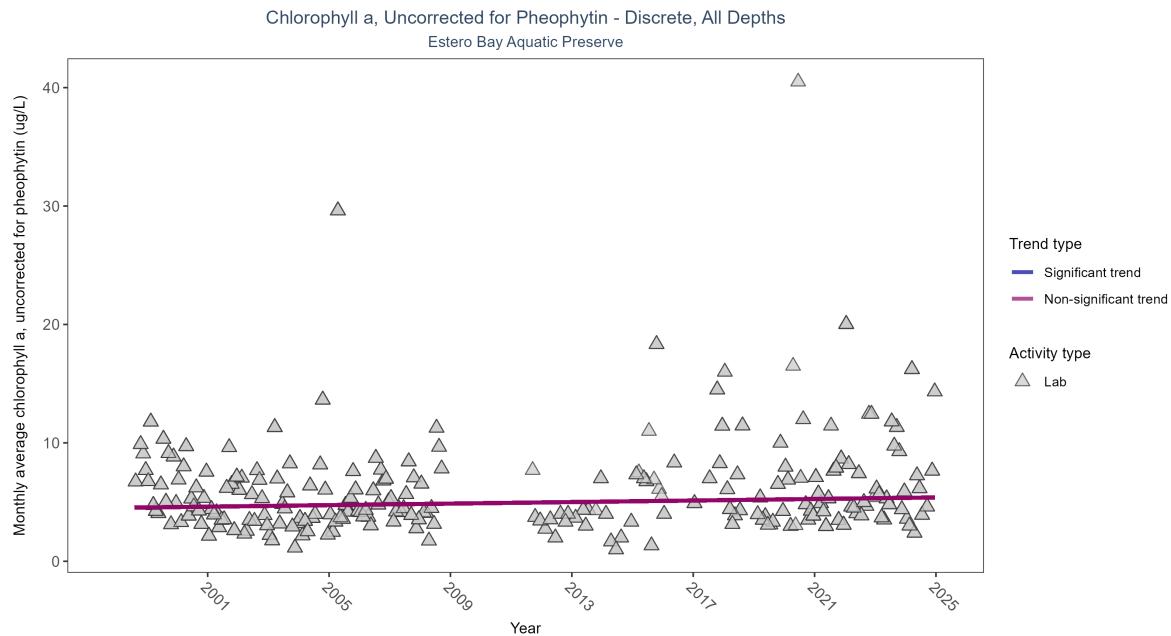


Figure 31: Scatter plot of monthly average levels of chlorophyll a, uncorrected for pheophytin, over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only laboratory-analyzed chlorophyll a (triangles) is included in the plot.

Table 16: Seasonal Kendall-Tau Results for - Chlorophyll a, Uncorrected for Pheophytin

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Lab	No significant trend	1245	25	1998 - 2024	4.3271	0.08734	4.51467	0.03239	0.0592

Chlorophyll a, uncorrected for pheophytin, showed no detectable trend between 1998 and 2024.

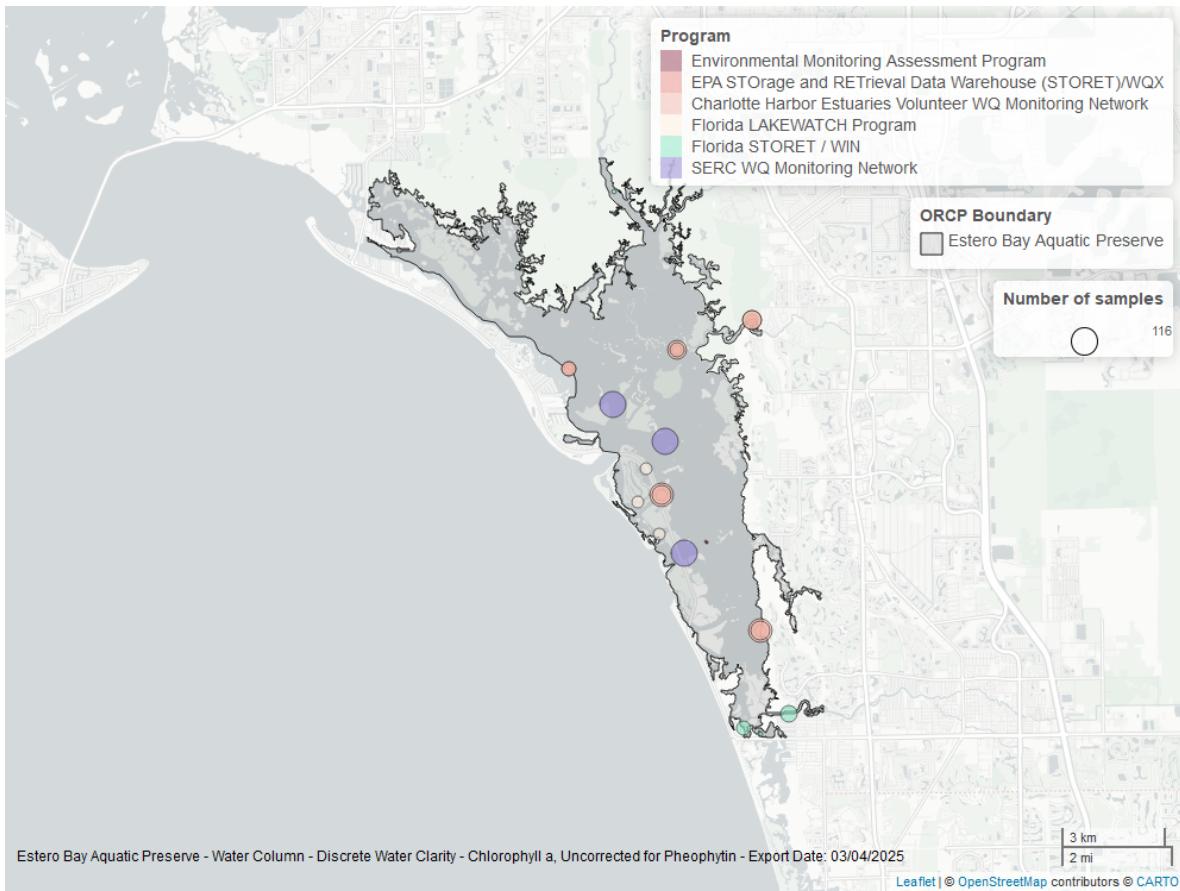


Figure 32: Map showing location of discrete water quality sampling locations within the boundaries of *Estero Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Chlorophyll a, Corrected for Pheophytin - Discrete

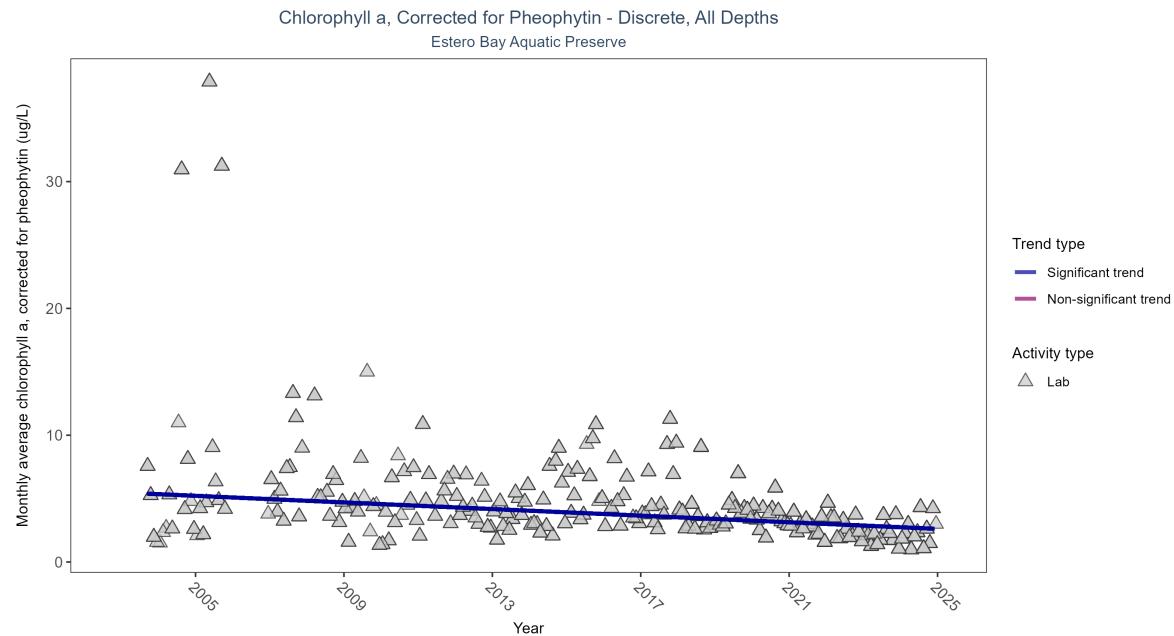


Figure 33: Scatter plot of monthly average levels of chlorophyll a, corrected for pheophytin, over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only laboratory-analyzed chlorophyll a (triangles) is included in the plot.

Table 17: Seasonal Kendall-Tau Results for - Chlorophyll a, Corrected for Pheophytin

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Lab	Significantly decreasing trend	2545	22	2003 - 2024	2.7	-0.28994	5.47927	-0.13036	0

Monthly average chlorophyll a, corrected for pheophytin, decreased by 0.13 $\mu\text{g}/\text{L}$ per year, indicating an increase in water clarity.

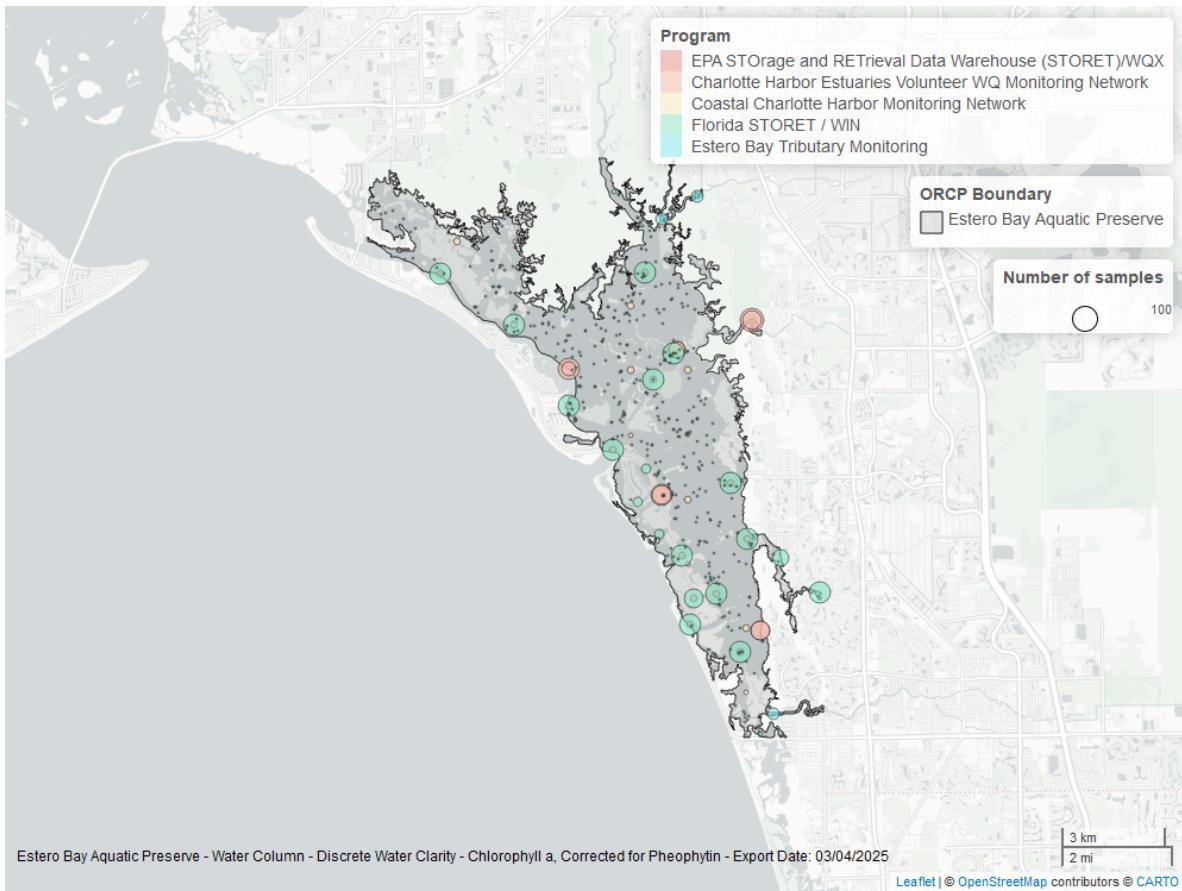


Figure 34: Map showing location of discrete water quality sampling locations within the boundaries of *Estero Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Secchi Depth - Discrete

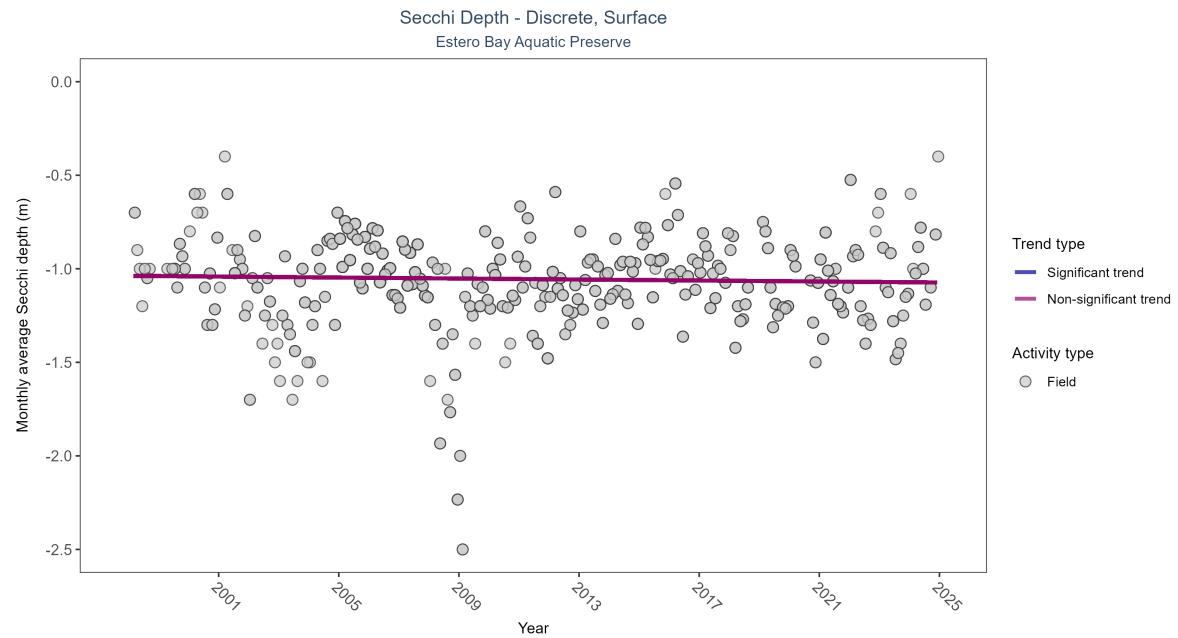


Figure 35: Scatter plot of monthly average Secchi depth over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Secchi depth is only measured in the field (circles).

Table 18: Seasonal Kendall-Tau Results for - Secchi Depth

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Field	No significant trend	3388	27	1998 - 2024	-0.9	-0.03045	-1.03761	-0.00132	0.4075

Secchi depth showed no detectable trend between 1998 and 2024.

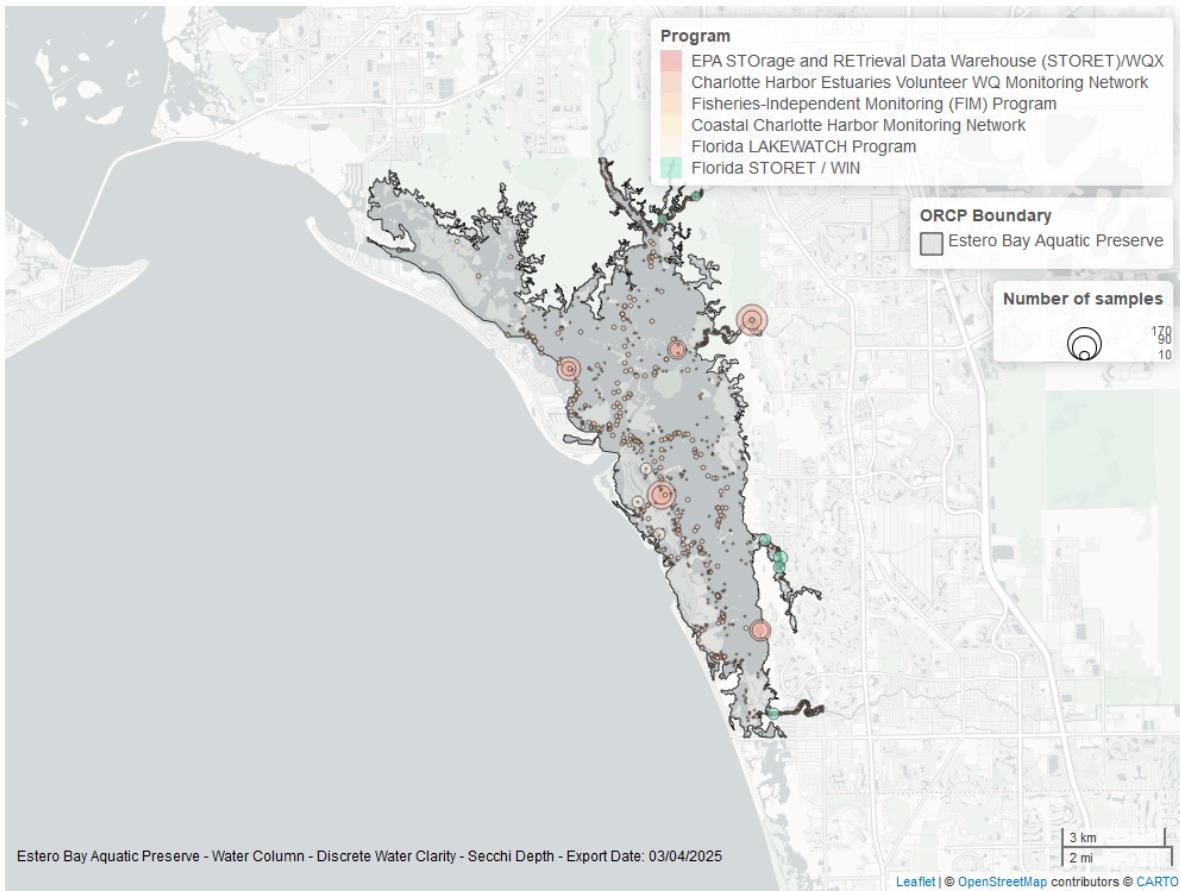


Figure 36: Map showing location of discrete water quality sampling locations within the boundaries of *Estero Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Colored Dissolved Organic Matter - Discrete

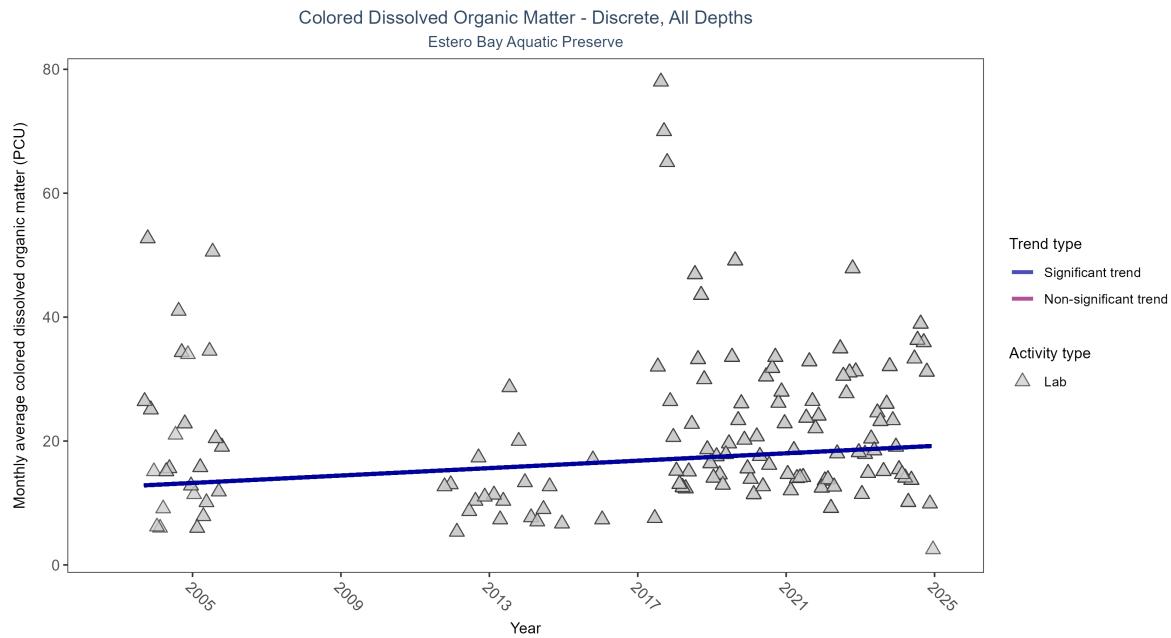


Figure 37: Scatter plot of monthly average colored dissolved organic matter (CDOM) over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only laboratory-analyzed CDOM (triangles) is included in the plot.

Table 19: Seasonal Kendall-Tau Results for - Colored Dissolved Organic Matter

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Lab	Significantly increasing trend	1984	17	2003 - 2024	14.4	0.19752	12.63436	0.29925	0.0031

Monthly average colored dissolved organic matter increased by 0.3 PCU per year, indicating a decrease in water clarity.

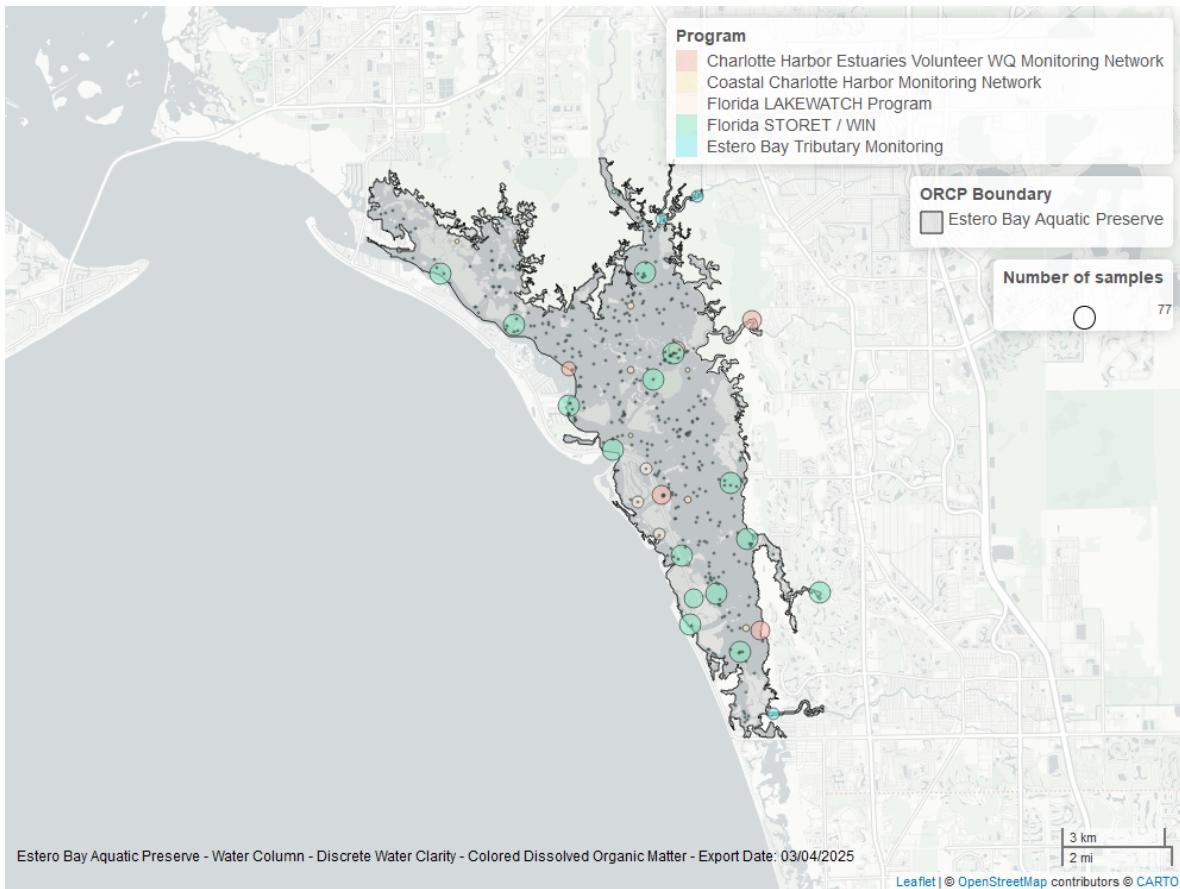


Figure 38: Map showing location of discrete water quality sampling locations within the boundaries of *Estero Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.