FLORIDA INTERNATIONAL UNIVERSITY
Miami's public research university

Southeast Environmental Research Center
OE-148 Florida International University, Miami, FL 33199
305-348-3095, 305-348-4096 fax, http://serc.fiu.edu

8 May 2006

Gordon Romeis
South District Office
FDEP
PO Box 2549
Ft. Meyers, FL 33902-2549

Re: Little Venice Water Quality Monitoring Quarterly Report #13

Dear Mr. Romeis:

This letter serves to transmit the Little Venice Water Quality Monitoring Quarterly Report as per our FDEP contract #SP635. This second deliverable report consists of this letter along with corresponding figures.

Project Background

This report includes cumulative water quality and bacteriological data from 9 stations within the Little Venice subdivision (Fig. 1). A new sampling program was initiated June 15, 2005 in accordance with oversight panel recommendations. The period of record for this report is Sep. 15, 2005 to December 15, 2005. Water was collected weekly for bacteriological analysis by SYNAGRO for enumeration of fecal coliform and enterococci (colony forming units per 100 ml). Field parameters collected weekly at both the surface and bottom of the water column at each station include salinity, temperature (°C), and dissolved oxygen (DO). Water quality parameters monitored weekly at each station include total nitrogen (TN), total phosphorus (TP), and chlorophyll a (CHLA; µg l^{-1}). Monthly monitoring at each station included the dissolved nutrients nitrate+nitrite (NO_x), nitrite (NO_2), nitrate (NO_3), ammonium (NH_4), inorganic nitrogen (DIN), soluble reactive phosphate (SRP), and silicate ($Si(OH)_4$). Concentrations for all of these variables are reported in mg l^{-1} unless noted otherwise. In addition, monthly deployment of ISCO autosamplers at rotating sites were programmed to collect 12 samples per day over a 2 day period. These samples were analyzed for TN and TP. Hydrolab datasondes accompanied the autosamplers to measure and log temperature, salinity, DO, and pH on an hourly basis.

The objective of the Little Venice project is detect changes in water quality as a function of remediation activities. The initial experimental design was conceptually developed as a Before–After Control-Impact Design with multiple sites (BACI; Eberhart, 1976; Stewart-Oaten et al., 1986). This desing will allow us to apply traditional Before-After methods (BA; Green, 1979; Smith, 2002) where the data are treated as independent samples and are compared using diverse statistics (i.e two-sample test, F-tests). BACI will also allow us to use variations of such methodology (Eberhardt, 1976; Smith, 2002), where differences and ratios of measured parameters, between the control canal (Canal 4) and remedied sites may be used.

BACI statistical methods test whether differences in before-and-after conditions of the treated canals are different than before-and-after conditions in the control canal. The overall assumption is that significant differences between treatment and control are due to remediation activity, although causal inference is difficult to determine in this highly variable system. To help explain the inherent variability, the influence of several driving factors will be explored, among them: precipitation, wind, and tides. Traditional time-series analysis will be performed on the data sequences. Additionally, Cumulative Rate of Variation (CRV) and Cumulative Rate of Variation Difference methods (CRVD) will be used for analysis of the times-series. CRV and CRVD are graphical techniques, similar to CumSum time-series analysis, useful for unraveling the structure of time-series (Briceno and Callejon, 2006; in preparation). This extensive data analysis will have to wait until a full year of data is collected and will be included in the annual report.

Results

Figures 2-10 show bacterial counts (colony forming units, CFU) for the canal stations for the complete period of record by month and year. The FL State standard for single counts of fecal coliforms in bathing waters is 800 CFU/100ml while the EPA recommended standard for enterococci is 104 CFU/100ml. Exceedances of these standard and recommended values have been reviewed and adjusted to the number of observations.

Prior to remediation, 5 out of 1152 observations fecal coliforms counts exceeded the FL State standard (0.43%) and 60 enterococci counts exceeded the recommended level (5.21%). Average exceedances per quarter were 0.5 for fecal coliforms and 6.0 for enterococci. Post remediation observations (232) indicate that fecal coliform standard was exceeded 5 times (2.16%) while enterococci exceeded the recommended level 11 times (4.74%). During this current quarter, neither the FL State standard fecal coliform counts nor the EPA recommended standard counts for enterococci were exceeded. Because of the large interannual differences in bacterial counts, there were no significant statistical differences between monthly data from this quarter and those prior to remediation.

Figures 11-19 show time series of TN, TP, CHLA, salinity, and DO at all stations. The heads of the canals generally have the highest TN, TP and CHLA and lowest DO. State of Florida Rule 62-302.530, for Class II marine waters, specifies that DO “shall never be less than 4.0” mg l^{-1}. Prior to remediation, the average surface DO exceedances per quarter was 82 (60%) and 88 (70%) for bottom DO measurements. For this quarter, 37 DO exceedances in surface waters occurred (52%) with 47 (66%) occurring in bottom waters. Therefore, a significant decline in exceedances for DO was observed during this quarter.

There are no nutrient standards for Florida marine waters. However, State of Florida Rule 62-02.300(13), F.A.C. states that “particular consideration shall be given to the protection from nutrient enrichment of those presently containing very low nutrient concentrations: less than 0.3 milligrams per liter total nitrogen or less than 0.04 milligrams per liter total phosphorus.” Therefore, these benchmarks are included in the TN and TP graphs for illustrative purposes only.

Prior to remediation, the average number of events per quarter above these benchmarks was 66 for TN and 2 for TP. For this quarter, 46 out of 71 TN observations (65%) and 3 TP (4%) values were higher than the benchmarks. This is half of the expected exceedances for TN (from Phase 1), which coupled with the 60% decrease in the previous quarter is an encouraging sign. It is interesting that the incidence of elevated TP has increased during this period relative to TN. The average TN:TP ratio prior to remediation was 86.8; during this quarter it was 69.4. For the overall post remediation period the TN:TP ratio was 57.6, indicating that the system may be changing towards a more balanced stoichiometry.

It is important to remember that this remediation project is an attempt to improve water quality for the service area by ending the direct input of sewage to the soils and groundwater. It is also important to remember that direct input of sewage to the soils and groundwater has been occurring, on a continuous basis, since the residences were built in the 50's and 60's. No doubt there is a large reservoir of contaminated soil and rock which will take some unspecified time to depurate. In addition, there is a large reservoir of sediment with high organic content in the canals themselves due to regular wind transport of seagrass wrack. The combination of warm water and organic rich muds provide suitable habitat for preservation and possible regrowth of fecal coliform and enterococci bacteria (http://www.wrrc.hawaii.edu/tropicalind/Execsum.pdf). Therefore, we expect to see declines in bacterial numbers in the future but not as precipitously as might be anticipated.

If you have any questions about the content of this report, please do not hesitate to contact me at 305-348-4076, boyerj@fiu.edu or Henry Briceño at 205-348-1269, bricenoh@fiu.edu.

Sincerely,

Joseph N. Boyer, Ph.D.
Associate Director/Scientist

Henry O. Briceño, Ph.D.
Assistant Scientist

REFERENCES CITED

Briceno, H. and Callejon, A. (2006) The Cumulative Rate of Variation (CRV): A simple graphical tool for the exploration of time-series. To be submitted to ASLO:Methods

Eberhardt, L.L. (1976). Quantitative ecology and impact assessment, *Journal of Environmental Management* **4**, 27–70.

Green, R.H. (1979). *Sampling Design and Statistical Methods for Environmental Biologists*, Wiley, Chichester

Smith, E. (2002). BACI Design, *in* El-Shaarawi, A. and Piegorsh, W. (Edit), Encyclopedia of Environmetrics. Vol 1, pp 141-148. John Wiley & Sons, Ltd, Chichester.

Stewart-Oaten, A., Murdoch, W.W. & Parker, K.R. (1986). Environmental impact assessment: pseudoreplication in time? *Ecology* **67**, 929–940.

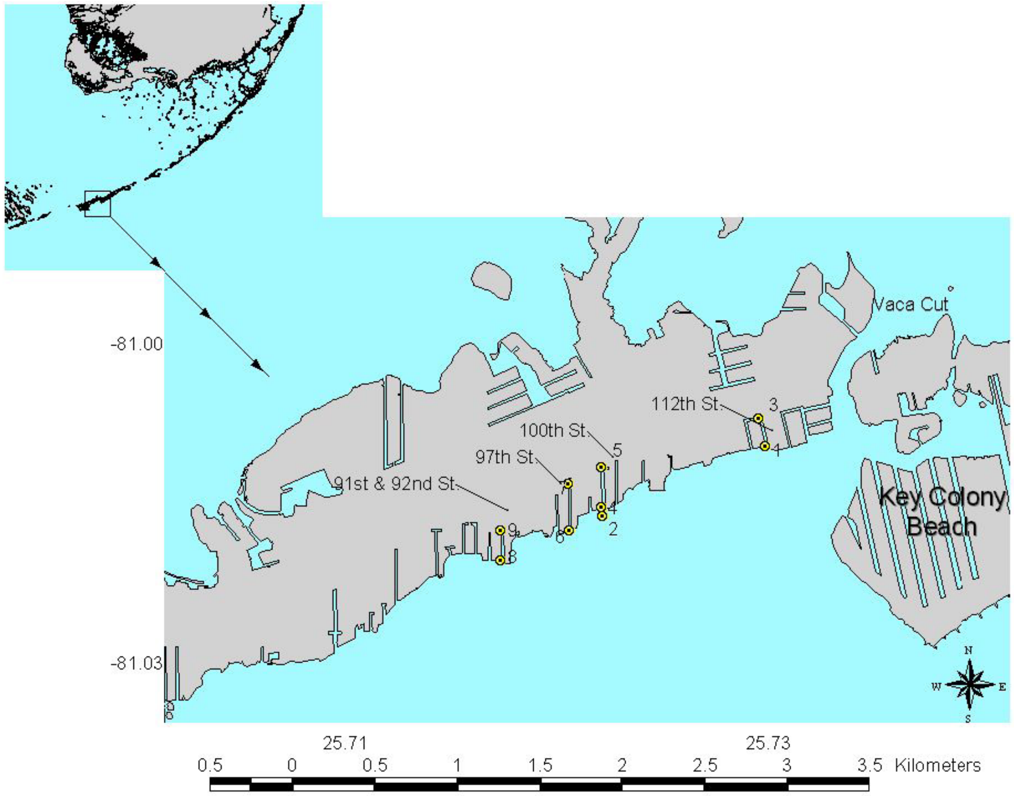

Figure 1. Studied sites in Little Venice Subdivision, Florida.

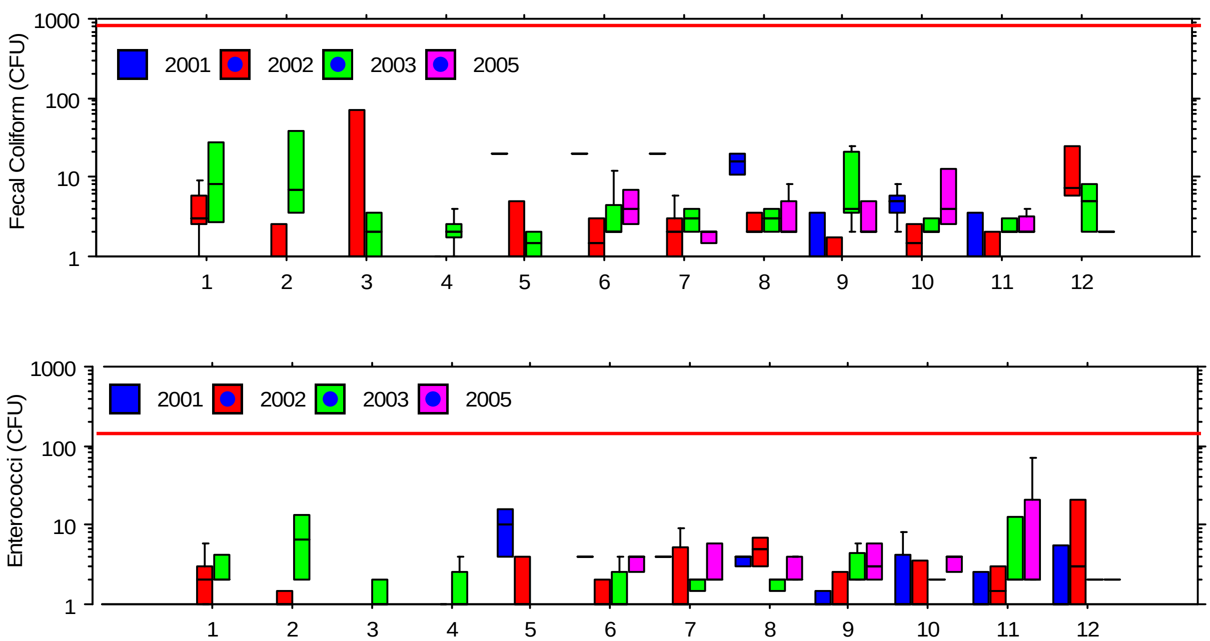

Figure 2. Station 2 – Near shore of the 100th Street Canal

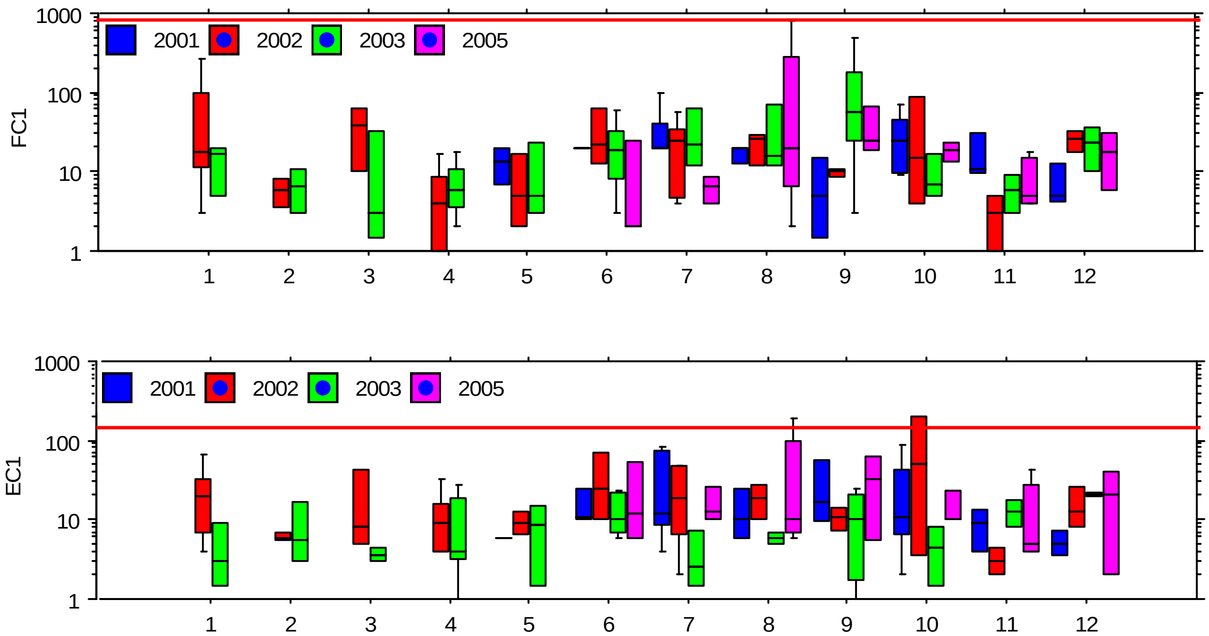

Figure 3. Station 1 - Mouth of the 112th Street Canal

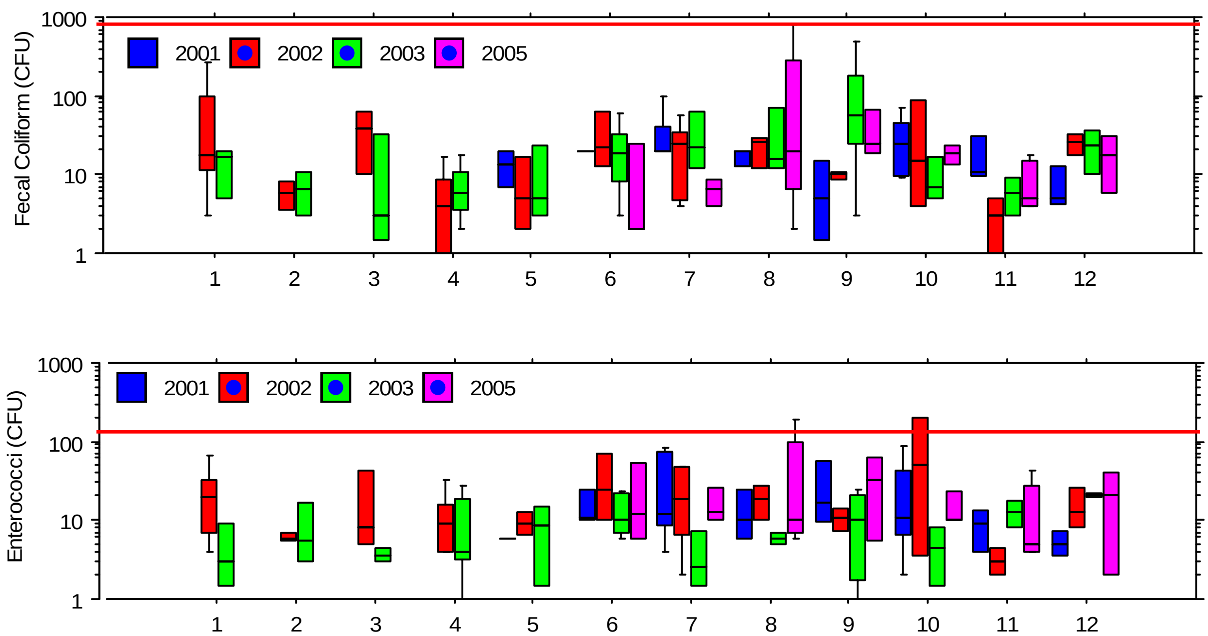

Figure 4. Station 3 – Head of the 112th Street Canal

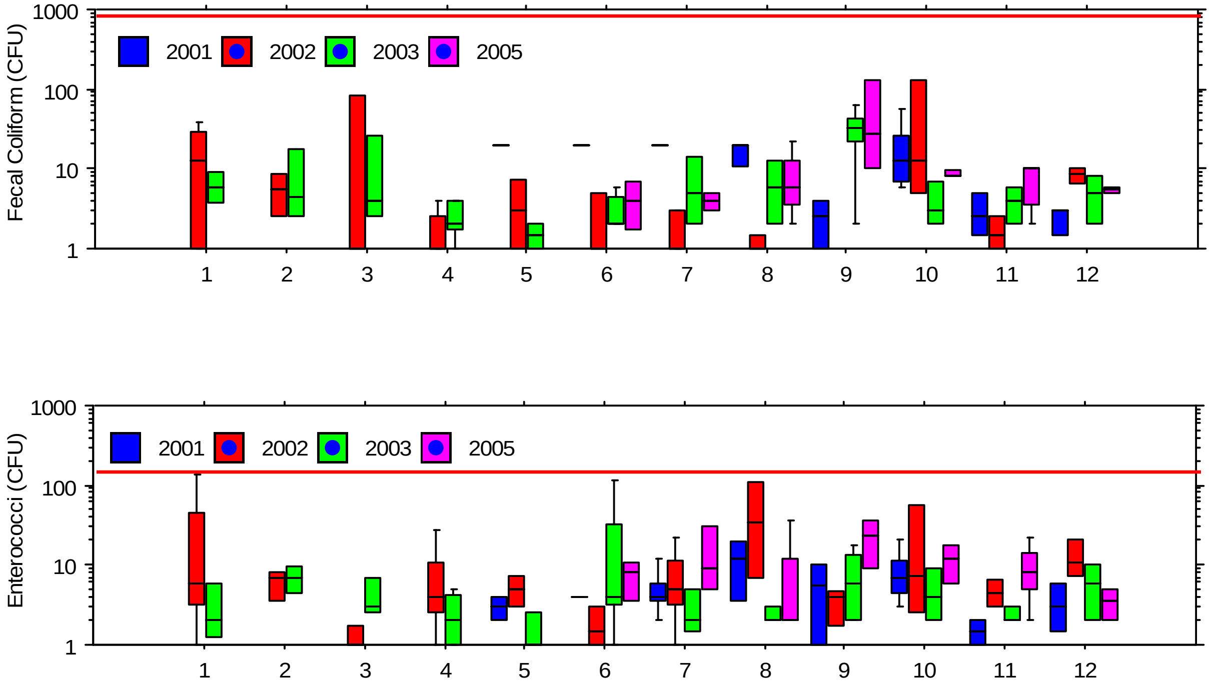

Figure 5. Station 4 – Mouth of the 100th Street Canal

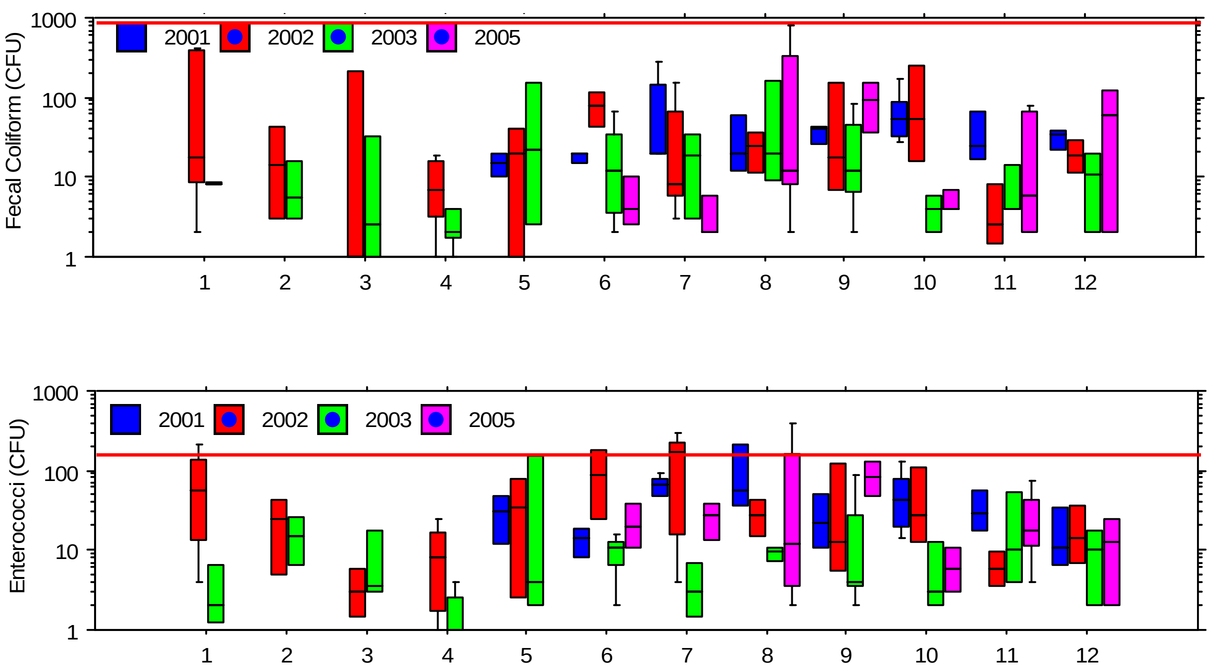

Figure 6. Station 5 – Head of the 100th Street Canal

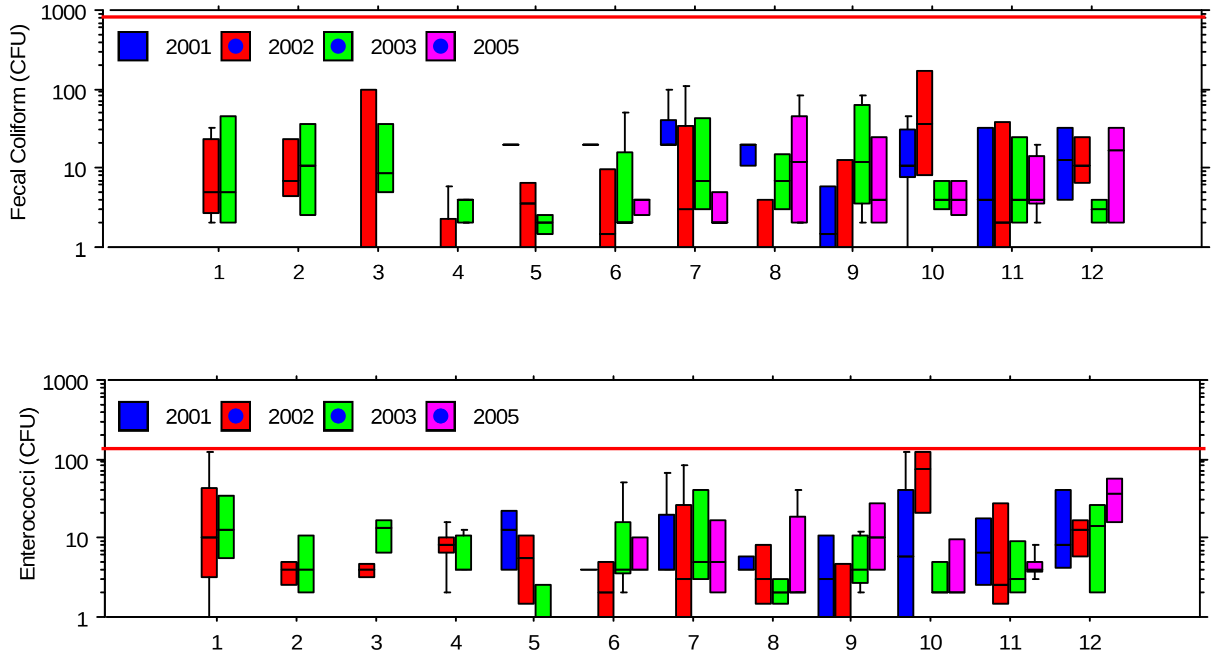

Figure 7. Station 6 – Mouth of the 97th Street Canal

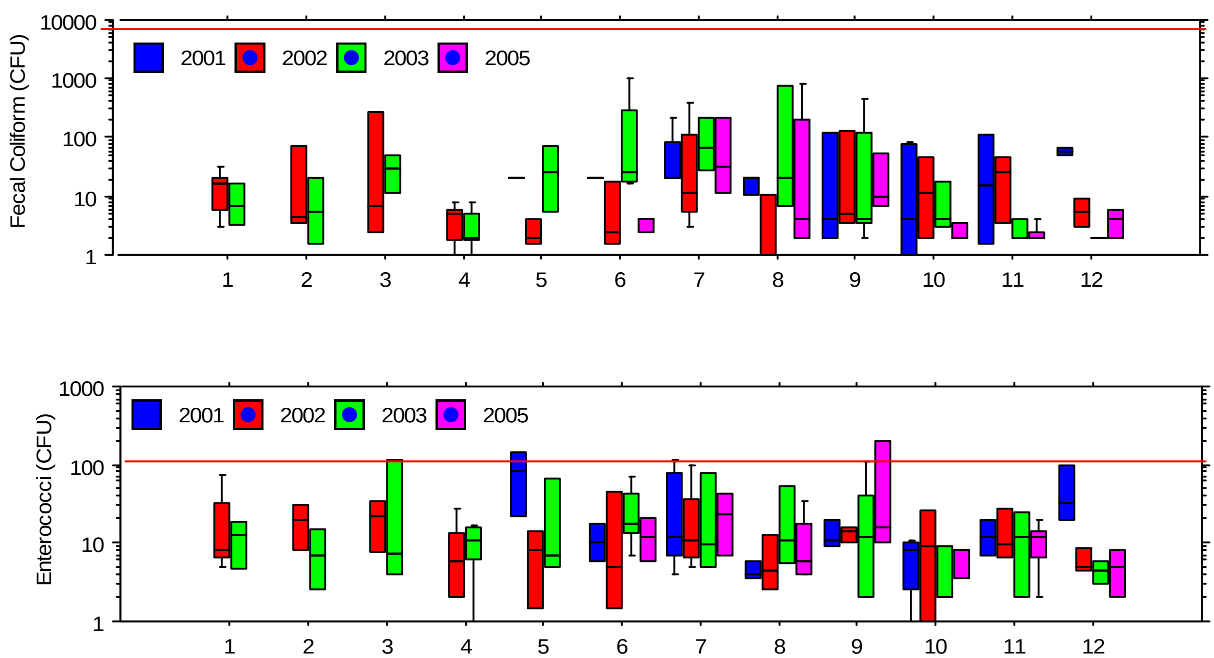

Figure 8. Station 7 – Head of the 97th Street Canal

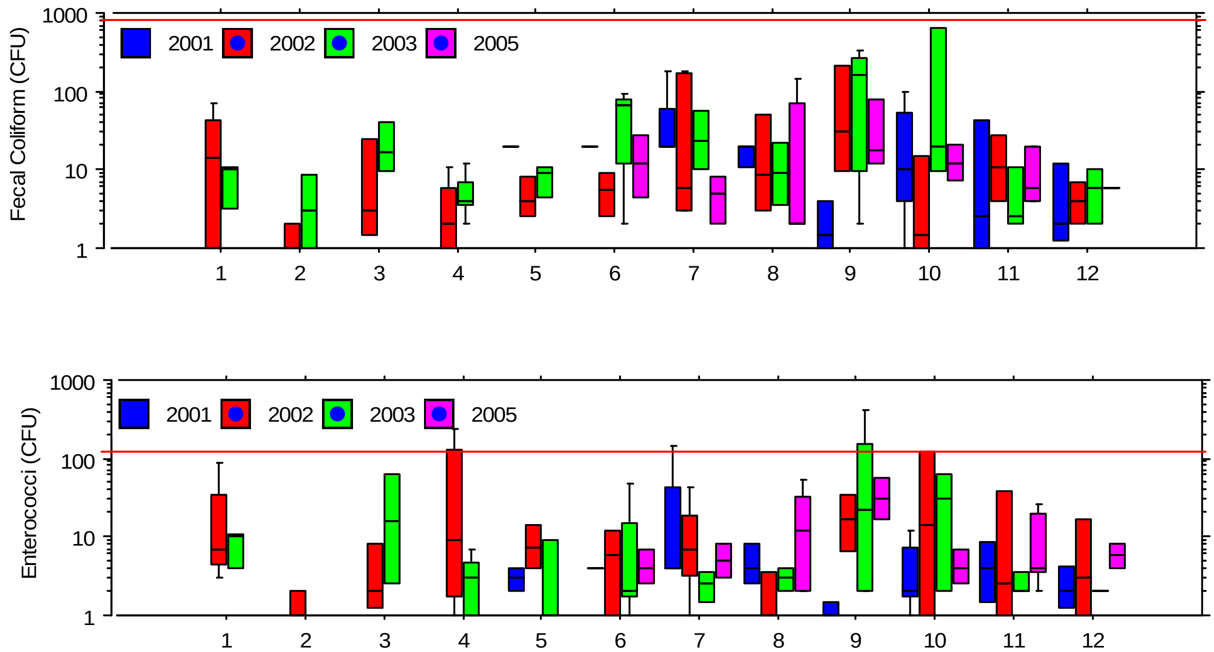

Figure 9. Station 8 – Mouth of the 91th Street Canal

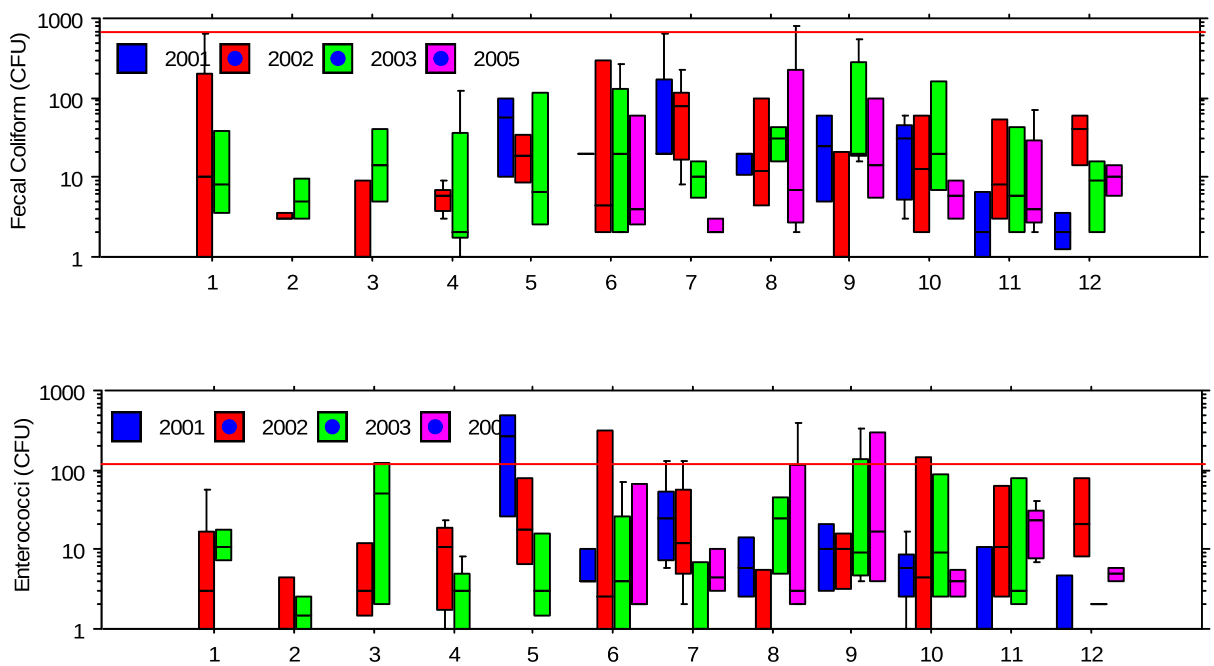

Figure 10. Station 9 – Head of the 91th Street Canal

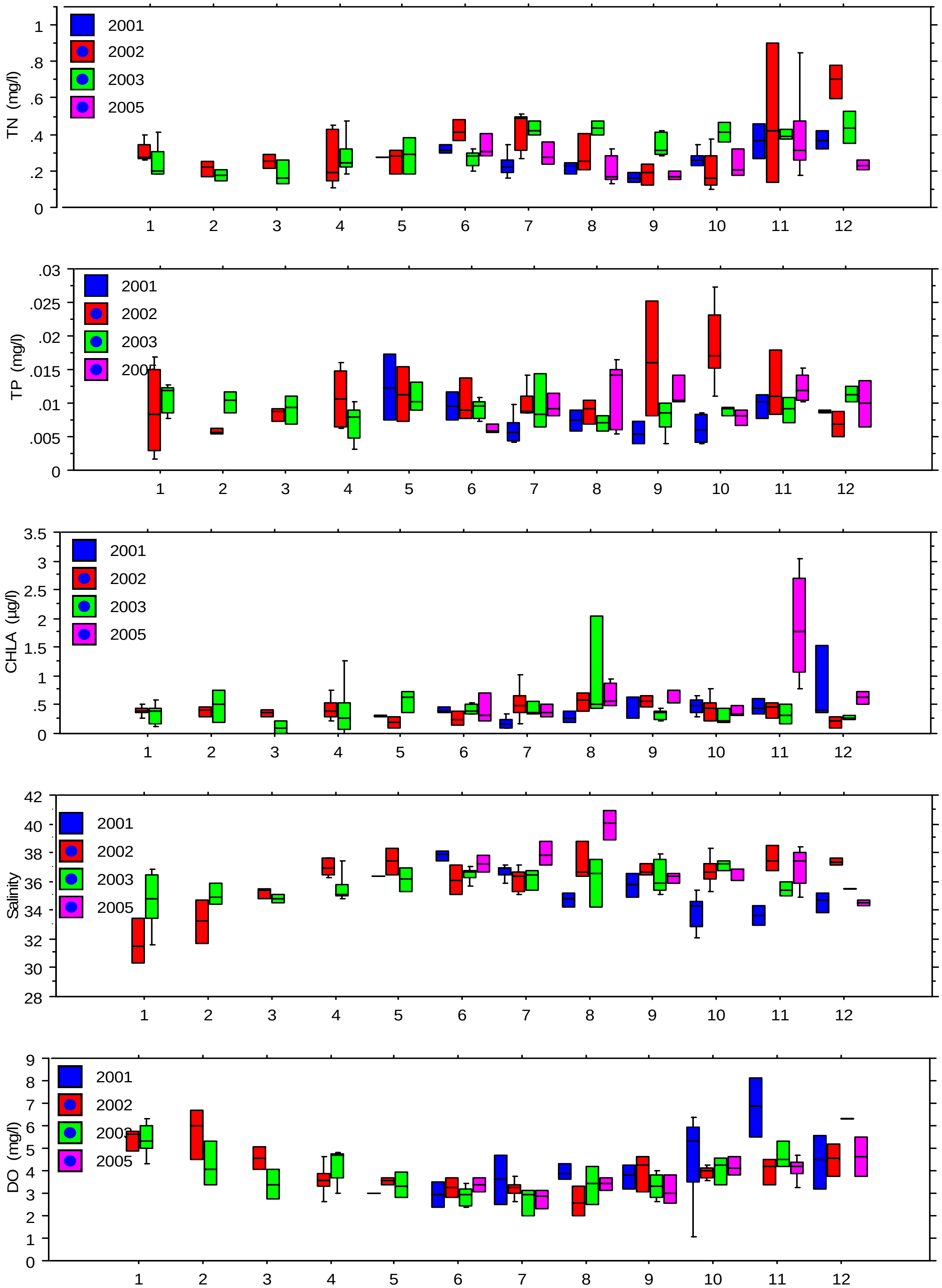

Figure 11. Station 1 - Mouth of the 112th Street Canal

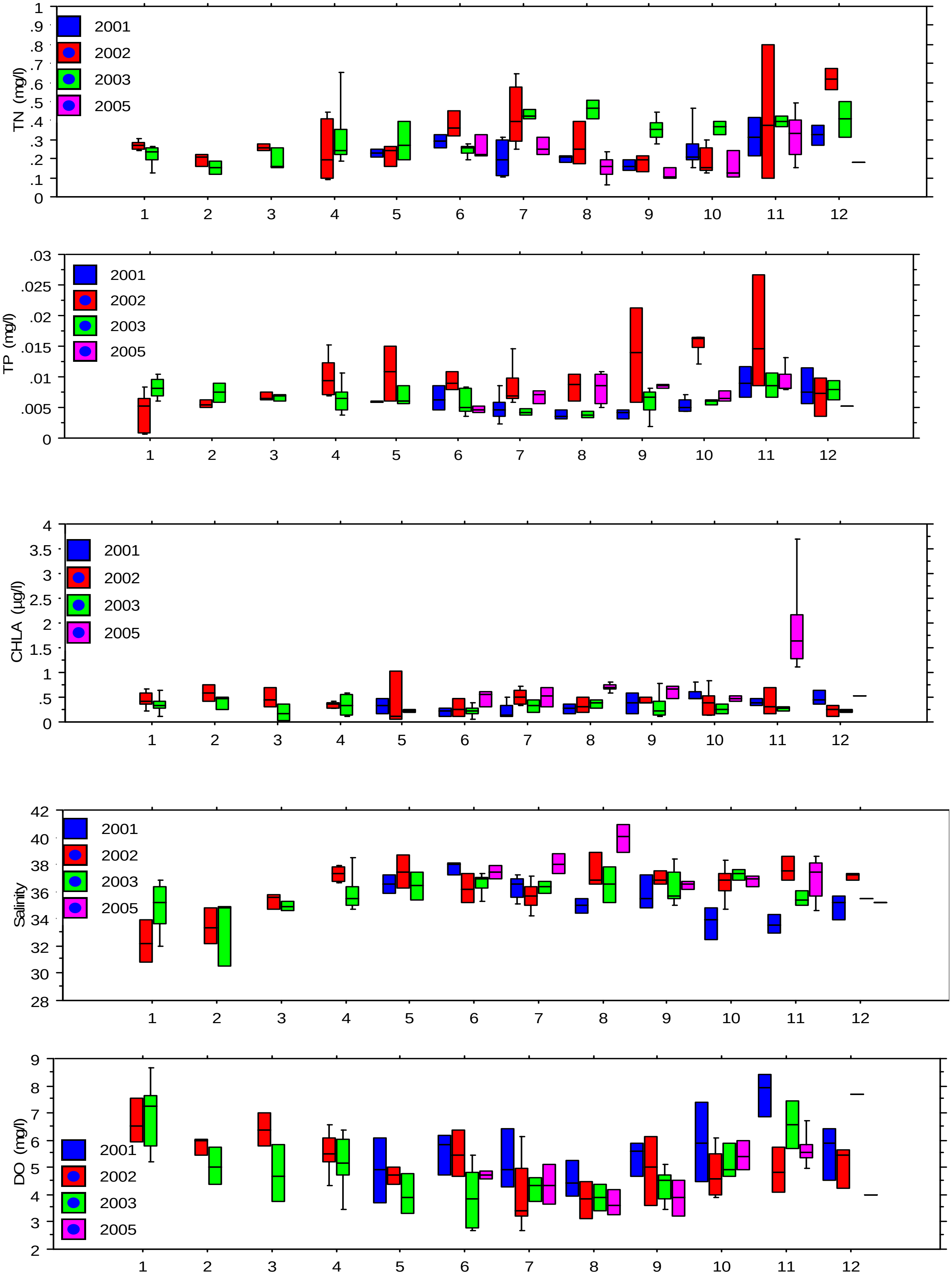

Figure 12. Station 2 – Near shore of the 100th Street Canal

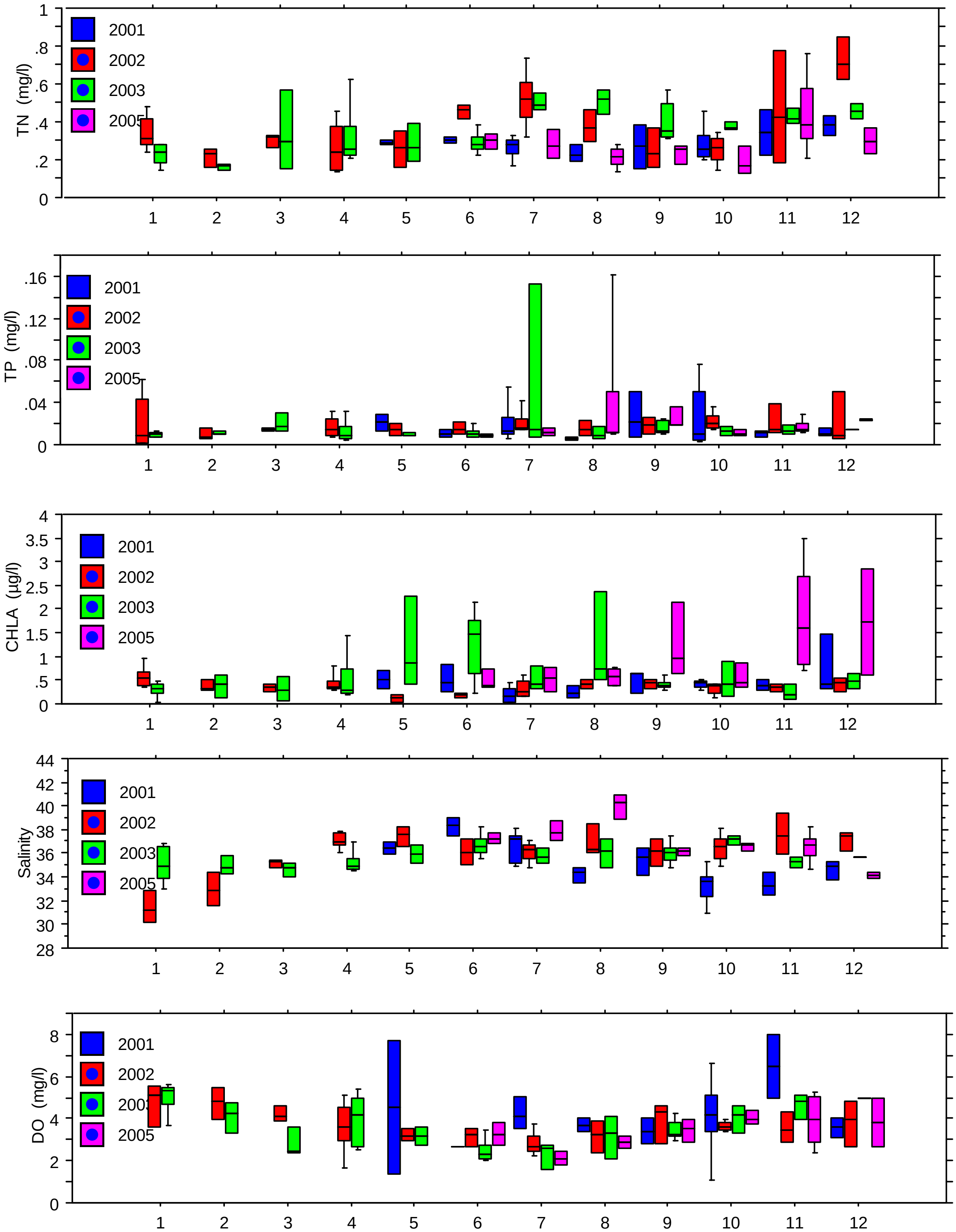

Figure 13. Station 3 – Head of the 112th Street Canal

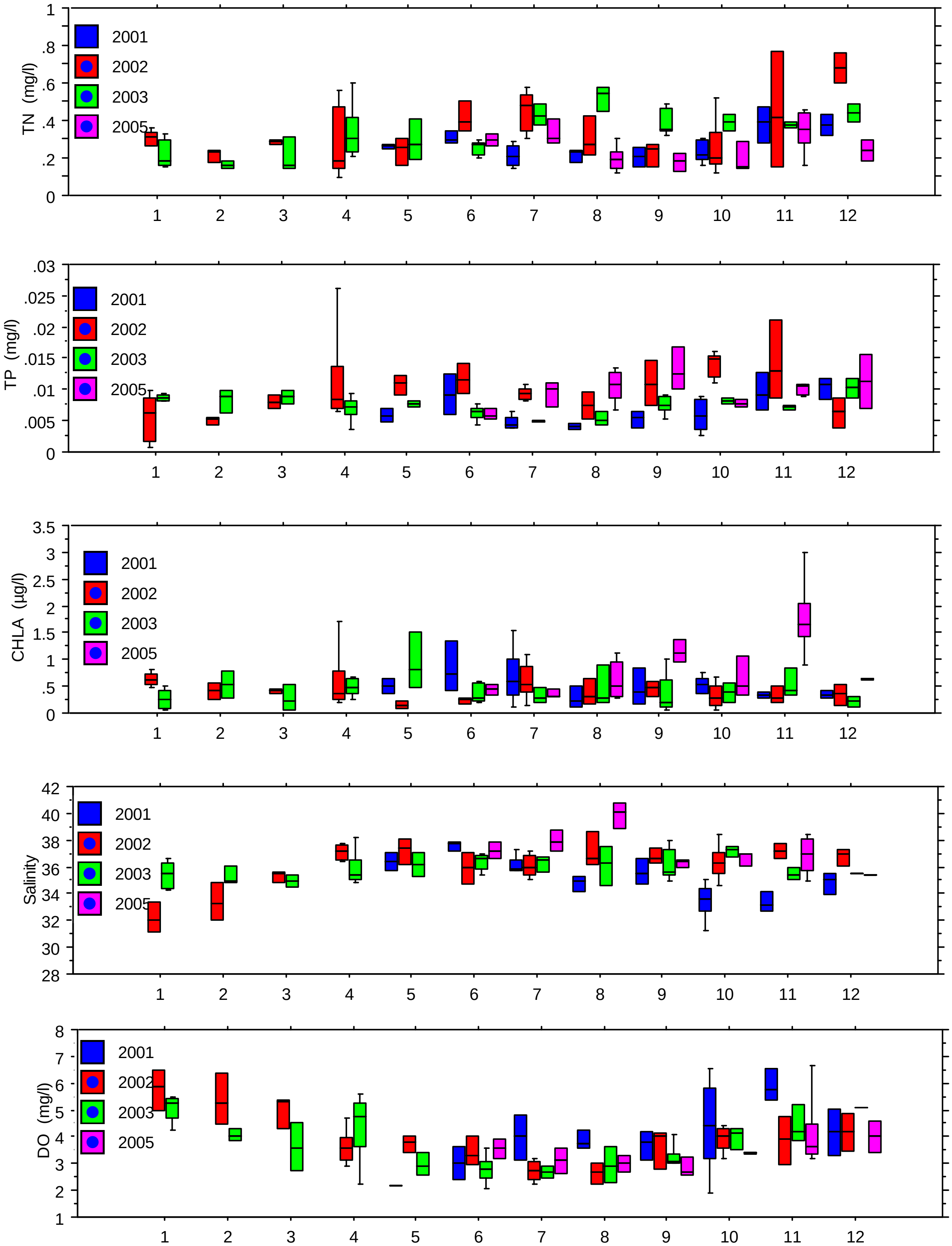

Figure 14. Station 4 – Mouth of the 100th Street Canal

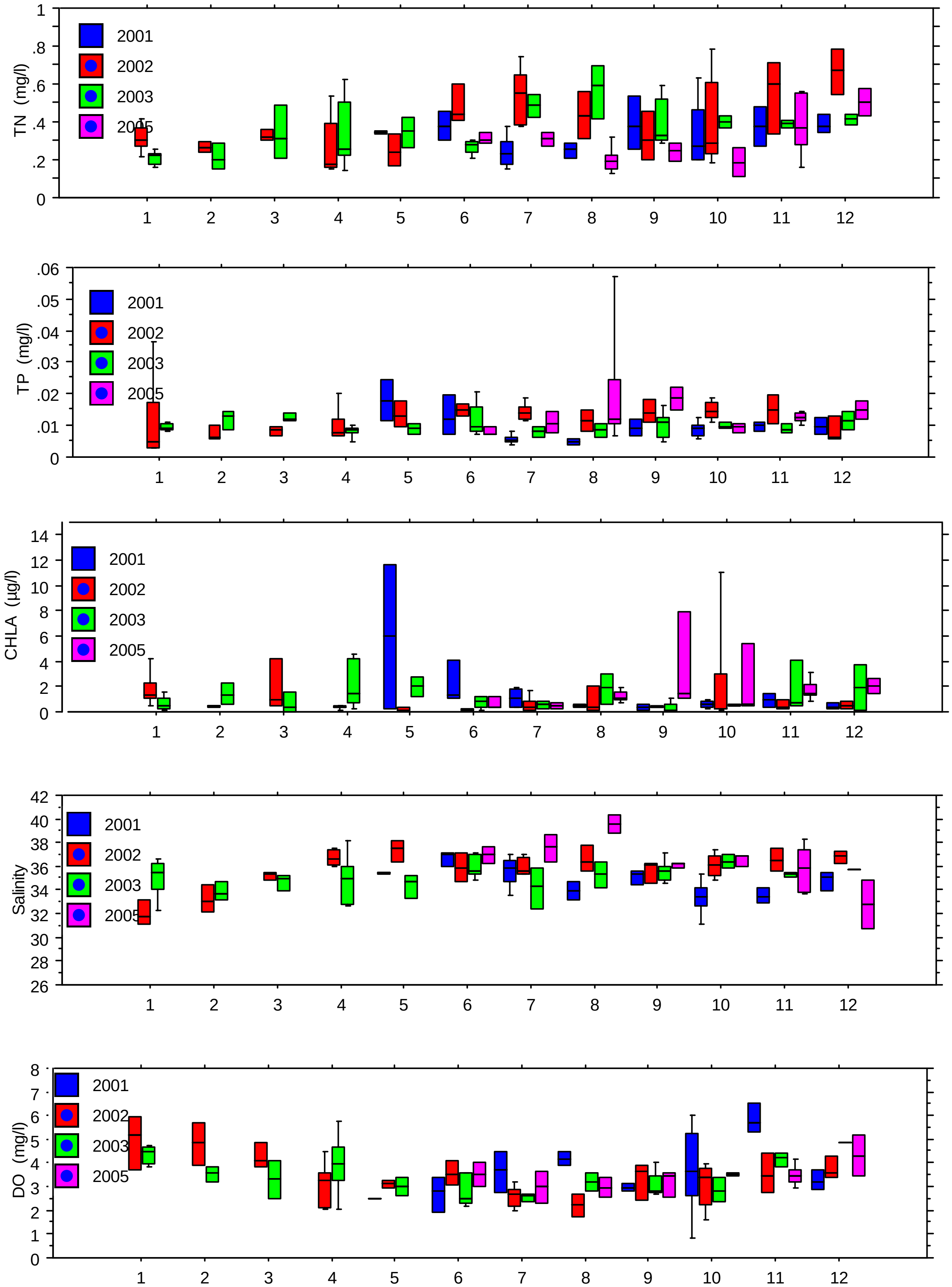

Figure 15. Station 5 – Head of the 100th Street Canal

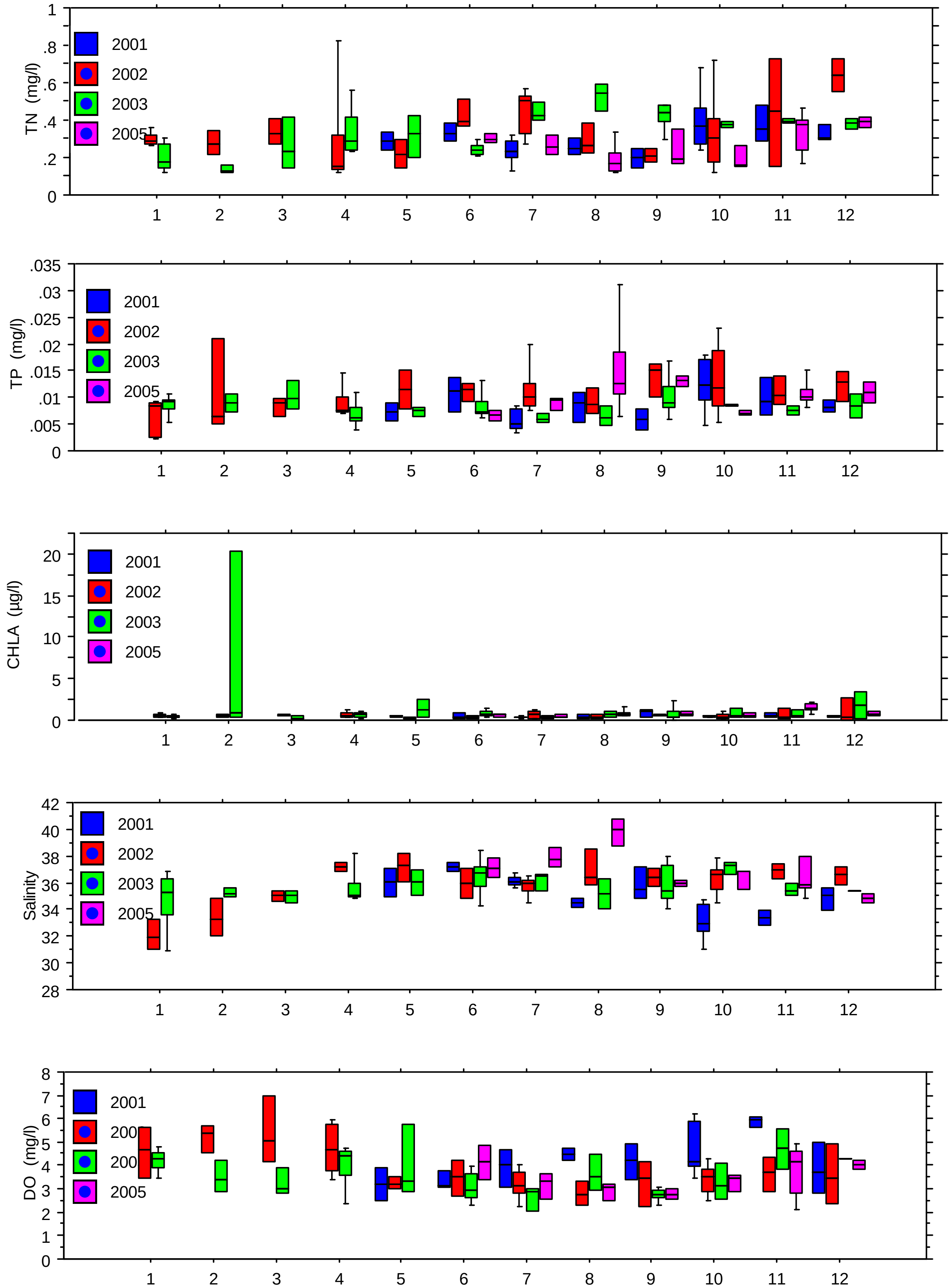

Figure 16. Station 6 – Mouth of the 97th Street Canal

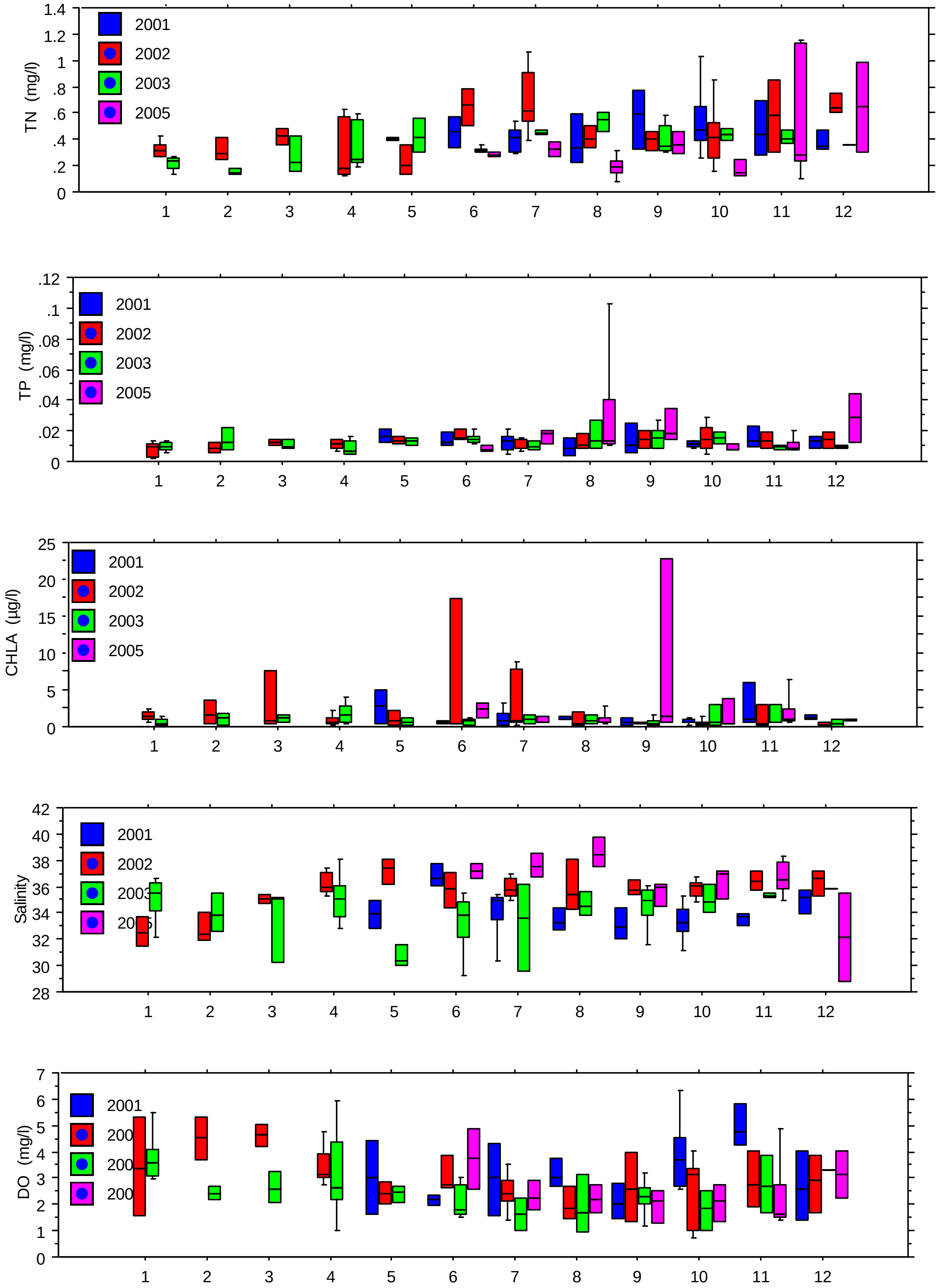

Figure 17. Station 7 – Head of the 97th Street Canal

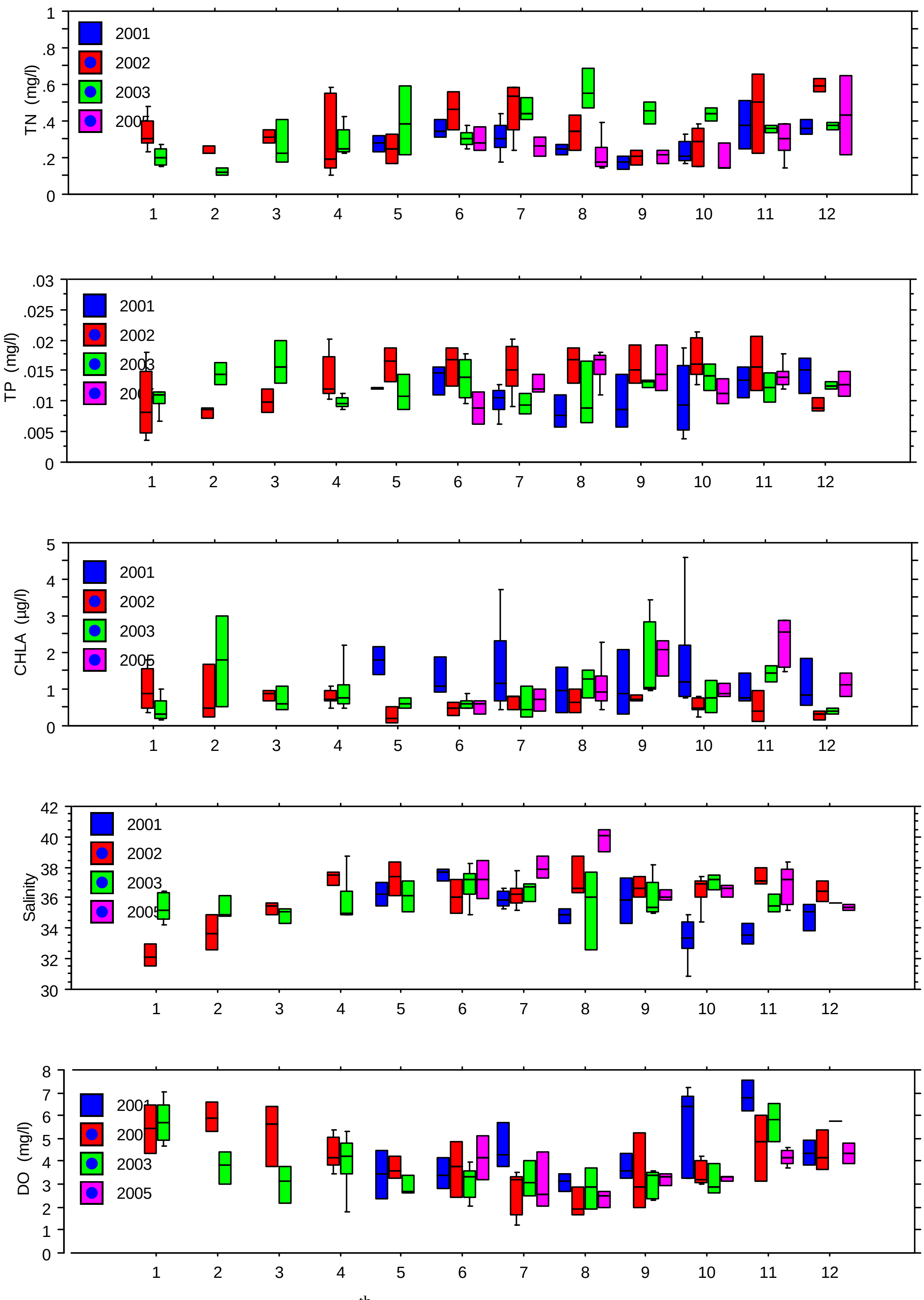

Figure 18. Station 8 – Mouth of the 91th Street Canal

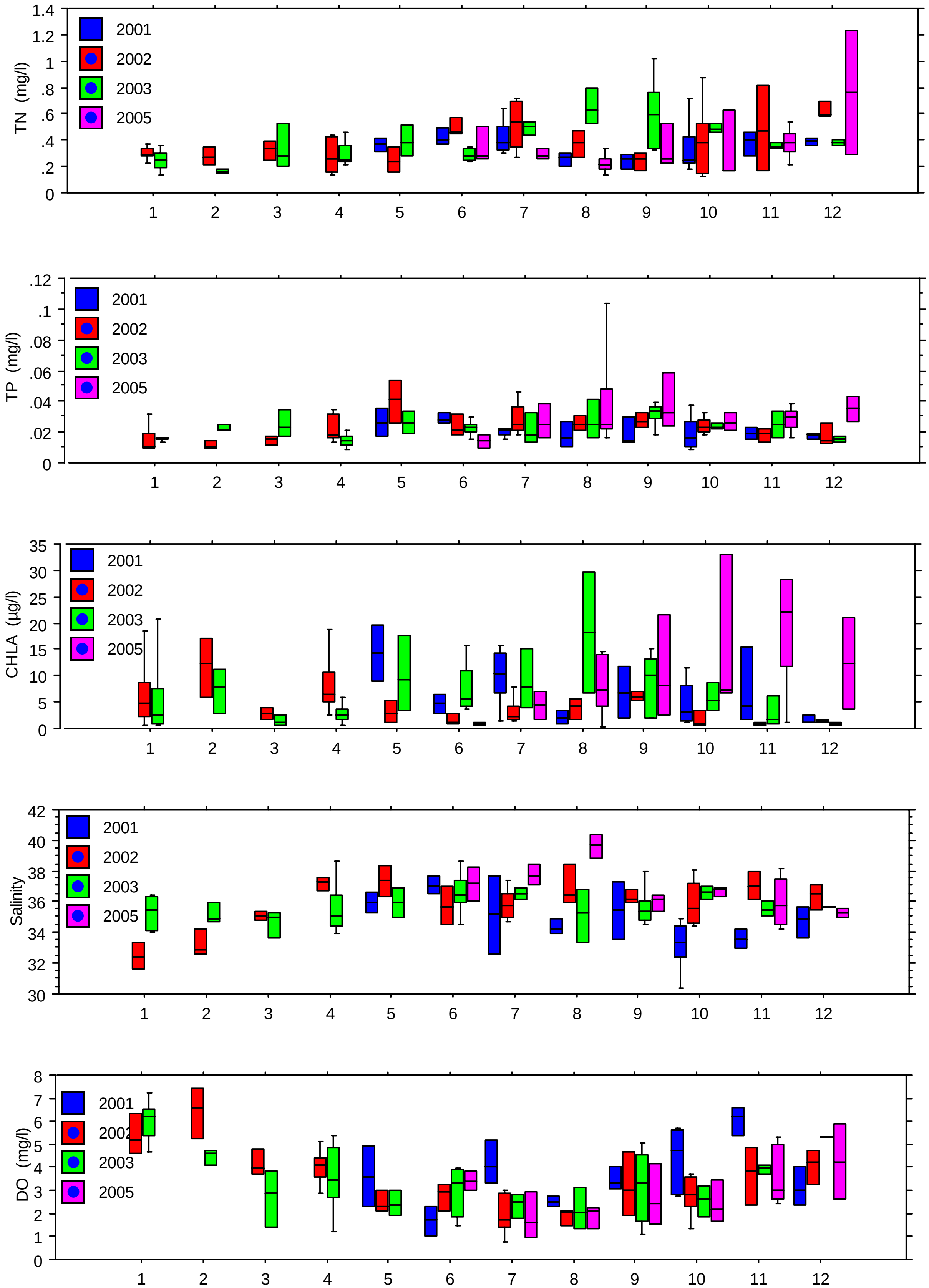

Figure 19. Station 9 – Head of the 91th Street Canal