West Point Treatment Plant

Ongoing Marine Water Quality Monitoring

King County
Department of
Natural Resources and Parks
Water and Land Resources Division

Water Quality Report – Update June 23rd, 2017

OVERVIEW

As part of a long-term program, King County monitors water quality at 12 offshore and 20 beach locations (see Figure 1) to provide an understanding of water quality within the Puget Sound Central Basin, including at all treatment plant outfalls. The West Point Treatment Plant main outfall is the site labeled KSSK02 on the map, located 3,600 ft. offshore at approximately 230-ft deep. The county maintains a long-term dataset, over 50 years at some locations, which provides insight into natural variation. This monitoring program and dataset form the basis from which water quality conditions can be assessed that may be affected by the West Point wastewater discharge during its period of reduced treatment.

As of May 10th, repairs at West Point were completed to ensure that quality of secondary treated effluent will consistently meet all permit requirements for discharge to Puget Sound. King County has returned to a twice-per-month monitoring frequency at all offshore stations. This is the last bi-weekly update; a full water quality summary report will be provided later in 2017.

At the offshore sampling stations, dissolved oxygen, temperature, salinity, density (calculated), chlorophyll, and light intensity and transmission are measured throughout the entire water column from surface to bottom every two weeks. Additionally, nutrients, fecal indicator bacteria (FIB), suspended solids, and chlorophyll are measured at specific depths at each site, and phytoplankton composition and abundance are assessed at a subset of sites. Beach locations are monitored monthly for nutrients, FIB, temperature, and salinity.

Additional Monitoring: From the time treatment was reduced at the West Point plant through June 9th, the sampling frequency at a subset of four offshore long-term monitoring stations was increased to weekly. A new site at the emergency bypass outfall (EBO) was sampled weekly through June 9th. This frequency and variety of biological, chemical, and physical conditions can capture some impacts on ecosystem functions. From April 10th through June 9th, bacteria concentrations at a subset of six beach sampling stations were being monitored weekly. As of April 11th, a Submersible Ultraviolet Nitrate Analyzer (SUNA) sensor loaned to King County from the Washington State Dept. of Ecology has been used to support monitoring efforts. The SUNA sensor adds rapid measurements of nitrate and provides more information on variability from the surface to bottom.

Overall, the County's monitoring is sufficient to evaluate the most relevant water quality conditions that have the potential to result in any acute adverse effects to Puget Sound aquatic life.

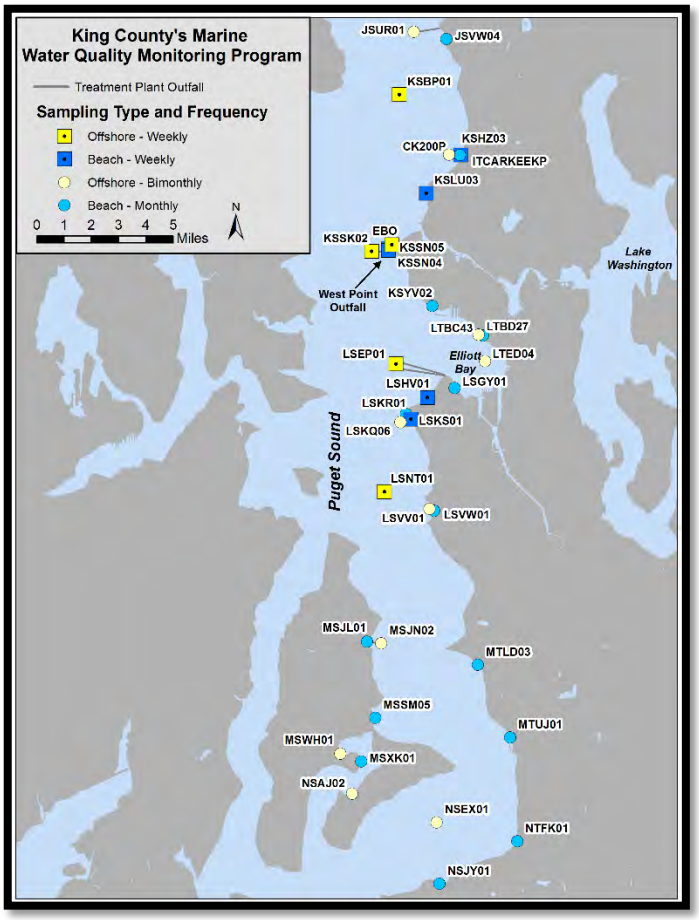

Figure 1. Map of King County's marine water quality monitoring stations.

The most recent data results available from the June 5th-7th (offshore and beach) sampling event are summarized below for three key water quality indicators. More data results are available in the appendix.

BACTERIA

Fecal coliforms, along with *Enterococcus*, are types of indicator bacteria that King County routinely monitor at freshwater and marine beaches, as well as offshore. These bacteria are found in the intestinal tracts and feces of humans and other warm-blooded animals, and can make their way into our waterways through various pathways. Although these bacteria are typically not pathogenic, they are important to monitor as an indicator that pathogens that make people sick may be present.

The State of Washington has a two part standard to protect human primary contact recreation and shellfish consumption in marine waters. The standard includes a 14 colony forming unit (CFU)/100 mL geometric mean average and a 43 CFU/100 mL peak concentration (the peak concentration is not to be exceeded in greater than 10% of samples). These standards are used for comparing data from multiple samples at a station rather than a single sample.

Comparing recent individual samples to the bacteria standards indicates that concentrations of fecal coliforms from both surface waters (Figure 2) and at depth at all offshore stations, including KSSK02 off of West Point, were low and all below the geometric mean standard and the peak standard during the early June sampling event. Concentrations of *Enterococcus* bacteria were also low and within historical ranges for the month of June. For data on subsurface and *Enterococcus* bacteria concentrations, see Appendix Table A-2.

Concentrations of bacteria at the subset of six beach stations sampled weekly, which includes beaches near West Point, were all below the state's peak water quality standard. However, station LSHV01 (Alki Beach) exceeded the geometric mean criteria (see Appendix Figure A-7). All fecal coliform and Enterococcus concentrations measured in early June at the six beach stations were within the historical range (Appendix Table A-2, Figure A-7).

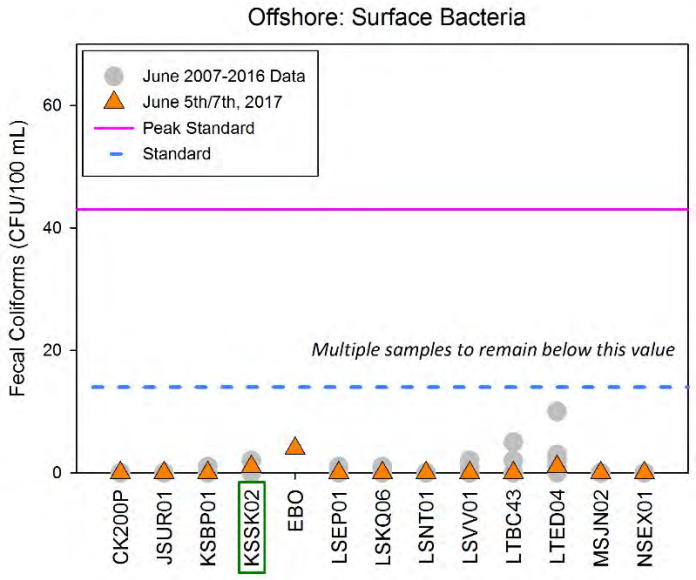

Figure 2. Bacteria (fecal coliforms) levels of single samples collected near surface (1 meter) at offshore stations in Central Puget Sound during the early June 2017 sampling event are illustrated with historical bacteria levels. Note: station KSSK02, West Point outfall, highlighted. The Emergency Bypass Station (EBO) was not routinely sampled prior to this event, so recent data cannot be compared to prior years.

NUTRIENTS

Nutrients, such as nitrogen compounds (ammonia and nitrate) and orthophosphate, are essential elements for aquatic plants and algae. Silica is a micronutrient needed by some algae and other organisms for skeletal growth. However, excess nutrients can cause a sudden increase in aquatic plants that can lead to unfavorable conditions. High ammonia concentrations can be toxic to aquatic organisms, including fish.

All ammonia values in offshore waters in early June were below the lowest (chronic) water quality criterion, which is based upon temperature, salinity, and pH factors (anticipated to be about 1.4 mg/L for early June conditions). Ammonia levels at the deepest depth at King County's South Plant outfall station (LSEP01) were elevated compared to historical values (Figure 3). Elevated ammonia values at the South Plant outfall have been observed for four of the past seven sampling weeks. These elevated ammonia concentrations are likely a result of South Plant treating additional solids from the West Point plant and slightly higher ammonia levels in the effluent. Since the most recent sampling trip in early June, supplemental trucking of excess solids to South Plant has ceased. Surface ammonia levels, including at the West Point and South Plant outfalls, were low.

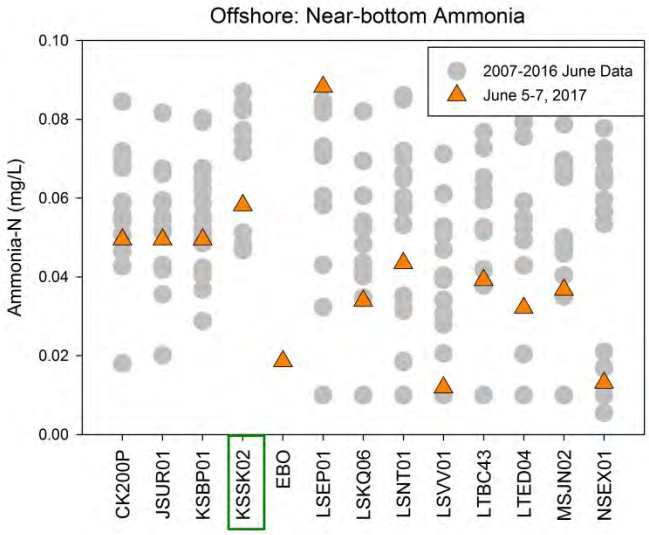

Figure 3. Ammonia levels collected at the deepest depth at offshore stations during the early June sampling event are shown with historical levels. Note: station KSSK02, the West Point outfall, is highlighted. The Emergency Bypass Station (EBO) was not routinely sampled prior to this event, so recent data cannot be compared to prior years.

Nitrate + nitrite, orthophosphate, and silica at offshore stations for all depths, except the surface, were within normal seasonal ranges for all sites. However, similar to the prior month, nitrate/nitrite, orthophosphate and silica surface water values were low due to the on-going spring phytoplankton bloom that began in mid-April. Phytoplankton (microalgae) take up nutrients for growth which lowers levels in the water when the bloom is large. The bloom was evident throughout the Central Basin, larger in the southern portion, as indicated by high chlorophyll-*a* values (Appendix, Figure A-6). The results of the SUNA sensor (Appendix Figures A-1 to A-5) also show low nitrate in the surface water layer due to phytoplankton uptake. Warmer surface water temperatures combined with lower salinities from rain and river run-off have continued to maintain stronger separation of surface water layers from deep, concentrating phytoplankton in the surface.

DISSOLVED OXYGEN

Dissolved oxygen is important for marine life, and can control the presence or absence of species. Aquatic life requires a certain amount of oxygen dissolved in the water to live, and different species have different tolerances. Waters with high dissolved oxygen are considered healthy for sustaining many species.

Plants and algae produce oxygen during the day. In deep waters, it can be too dark for plant growth and is separated from surface mixing with air, so processes like decomposition by bacteria can result in low dissolved oxygen. Human inputs of organic materials and decay of sinking algae at depth may decrease oxygen levels. Also, deep waters from the Pacific Ocean enter Puget Sound and can result in naturally occurring low oxygen levels.

The State of Washington dissolved oxygen standard to protect aquatic life depends on the designated waterbody use. For Central Puget Sound, the one-day minimum dissolved oxygen standard is 7 mg/L for waters of extraordinary quality. At the dissolved oxygen level of 5 mg/L, biological stress can be induced on marine life. If dissolved oxygen levels fall below 3 mg/L, then this can displace or potentially result in death of some marine species.

The most recent data from early June show healthy near-bottom oxygen levels for all offshore sites across Central Puget Sound (Figure 4), continuing typical spring conditions observed since April and within historical ranges. From the surface to bottom of the water column, dissolved oxygen levels were above the state water quality standard.

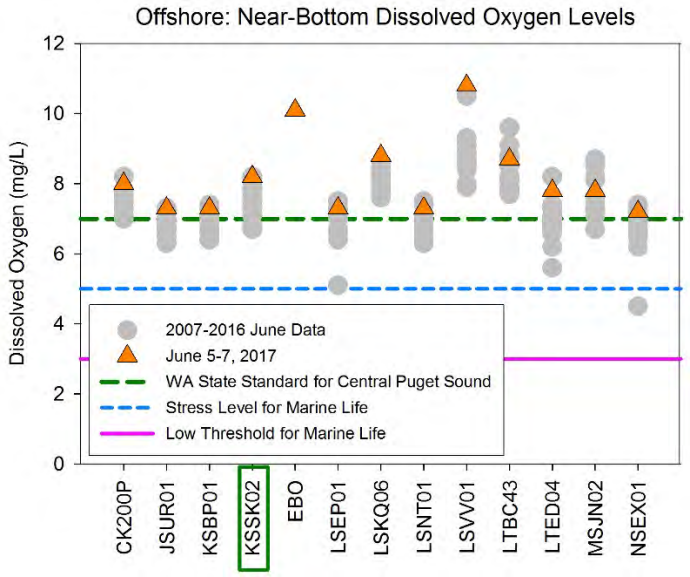

Figure 4. In Puget Sound, the lowest dissolved oxygen levels are typically found near the seafloor, so near-bottom oxygen levels are shown by site on top of historical oxygen conditions for early June. Note: station KSSK02, West Point outfall, highlighted in green. The EBO site, Emergency Bypass Outfall, was added recently, so no historical data are available.

During this sampling event, oxygen levels were highest near the surface as a result of the spring phytoplankton growth and oxygen production across all sites (Appendix Figures A-1 to A-5).

JUNE SUMMARY

Water sample results collected between June 5th and 7th, 2017 are summarized below. Additional results are provided in the Appendix.

- Concentrations of fecal coliforms in surface waters at offshore stations were below the geometric mean reference water quality standards as well as the peak standard in early June. Corresponding *Enterococcus* concentrations were also low.
- Beach bacteria concentrations were typical at all six stations monitored in early June. One sample value was above the geometric mean water quality criterion at one site (Alki Beach), but below the peak water quality criterion.
- Surface ammonia levels were within normal ranges at all sites and depths. Near-bottom ammonia levels at the South Plant outfall were elevated in early June.
- Nitrate/nitrite, orthophosphate, and silica results were within expected seasonal values for offshore waters at all depths except the surface. Low nutrient levels at the surface in addition to high chlorophyll-*a* values indicate the continuance of the regularly-occurring spring phytoplankton bloom which began in mid- April.
- Near-bottom dissolved oxygen values were at healthy levels and all sites were above the state water quality standard across all depths.
- High dissolved oxygen levels were observed in early June in surface and shallow waters, reflecting the growth of phytoplankton and other algae which produce oxygen. This shows a continuing of typical spring conditions since April.

Puget Sound sunset. (Source: Kimberle Stark)

FINAL SUMMARY HIGHLIGHTS

Water quality results during the increased weekly monitoring period from February 21st to June 7th, 2017:

BACTERIA

- Fecal coliform concentrations in surface waters throughout the monitoring period were below water quality standards at all offshore stations, including samples near West Point's main and emergency bypass outfalls (EBO).
  - One sample measured near the surface by the South Plant outfall in early April was elevated, but still below the peak water quality standard.
- Fecal coliform bacteria concentrations at beach stations, including those near West Point, were generally within historical ranges for each site. One sample collected during this timeframe from one of the two beach stations near West Point had an elevated concentration but was below the peak criterion.
- Other beach stations periodically exceeded state water quality criteria for bacteria, but those stations also had historical exceedances for a variety of reasons.
- *Enterococcus* concentrations generally reflected those of fecal coliforms and were low and within historical ranges at both offshore and beach stations.
  - Despite low fecal coliform concentrations, *Enterococcus* concentrations were occasionally above historical levels during the first three sampling events in May near West Point's main and emergency bypass outfalls. The reason for this discrepancy is unknown; however, *Enterococcus* is capable of surviving longer in the marine environment. Concentrations were low and within historic ranges during the two subsequent monitoring events.

NUTRIENTS

- Nutrients have been within expected historical ranges at all the sites monitored, including at the West Point outfall. One exception is that surface nutrient values across Puget Sound have been lower than historical levels due to phytoplankton uptake from vigorous spring bloom conditions since April.
- The timing of the spring phytoplankton bloom, as indicated by chlorophyll levels, was typical based on historical data. The phytoplankton drew down nutrient concentrations in surface waters after the start of the bloom, which is a regular occurrence in the spring.
  - Warmer surface water temperatures combined with lower salinities from rain and river run-off created stronger separation of surface water layers from deep, concentrating phytoplankton in the near-surface.
- Near bottom ammonia levels at the South Plant outfall met the water quality standard but were elevated for 4 of the 14 sampling weeks above historical levels, likely due to South Plant treating additional solids from the West Point plant.
- Nutrients at all beach sites were within normal seasonal ranges.

DISSOLVED OXYGEN

- Dissolved oxygen concentrations were at healthy levels for all offshore sites and all depths throughout the monitoring period and above the state water quality standard for Central Puget Sound.
- Dissolved oxygen levels have been typical of spring conditions, and high surface concentrations reflect the growth and oxygen production from phytoplankton during the spring bloom.

Elliott Bay and downtown Seattle. (Source: Wendy Eash-Loucks)

FOR MORE INFORMATION

- **King County Marine & Sediment Assessment Group:** http://green2.kingcounty.gov/marine
- **Download Water Column Data:** http://green2.kingcounty.gov/marine/Download
- **West Point Marine Monitoring:** http://www.kingcounty.gov/depts/dnrp/wtd/system/west/west-point-restoration/marine-monitoring.aspx
- **Wastewater Incidence Response:** http://kingcounty.gov/depts/dnrp/wtd/response/incident-response.aspx

Appendix: June, Part 1, Marine Water Quality Data

The following graphs and tables display data from the June 5th – 7th marine monitoring events. General water quality data are shown by site. For the offshore sites, parameters shown include water temperature, salinity, dissolved oxygen, relative chlorophyll fluorescence, total suspended solids, percent light transmission, nutrient concentrations, and fecal indicator bacteria. Nutrients include nitrate and nitrite, ammonia, orthophosphate, and silica water samples. Starting April 11th, nitrate concentrations were also measured through the water column from top to bottom with a Submersible Ultraviolet Nitrate Analyzer (SUNA). For this report, SUNA nitrate data are preliminary, and subsequent review may result in revisions to final data. For the beach sites sampled in the second half of the month, parameters shown include fecal indicator bacteria, nitrate and nitrite, and ammonia. For this sampling event, only bacteria data were collected for the weekly beach sites. For more explanation of parameters and sampling methods, see the marine monitoring program website: http://green2.kingcounty.gov/marine/

Description of station locators from the map on the first page (Figure 1) are given in the table below. Data from a subset of stations from the routine monitoring program are displayed to provide context for data collected near the West Point Treatment Plant and Treatment Plant Outfall. For more details on all monitoring stations, see the marine monitoring plan.

Table A-1. Sampling stations that include data in this summary report. The following data graphs and tables in the Appendix are from the stations highlighted in blue.

Offshore Stations

Locator	Description
JSUR01	Brightwater Treatment Plant Outfall
KSBP01	Point Jefferson
CK200P	Carkeek CSO Treatment Plant Outfall
KSSK02	West Point Treatment Plant Outfall
EBO	Emergency Bypass Outfall for West Point
LTBC43	Elliott West CSO Treatment Plant Outfall
LTED04	Central Elliott Bay
LTXQ01	Henderson/MLK CSO Treatment Plant Outfall
LSEP01	South Treatment Plant Outfall
LSKQ06	Alki CSO Treatment Plant Outfall
LSNT01	Mid-Passage between Fauntleroy/Vashon
LSVV01	Barton CSO Outfall
MSJN02	Vashon Treatment Plant Outfall
NSEX01	East Passage

Beach Stations

Locator	Description
ITCARKEEKP	Carkeek Park
KSLU03	Golden Gardens
KSSN04	West Point North, Discovery Park
KSSN05	West Point South, Discovery Park
LSHV01	Alki Beach
LSKS01	Constellation Park

Offshore Water Quality: KSSK02 – West Point Outfall

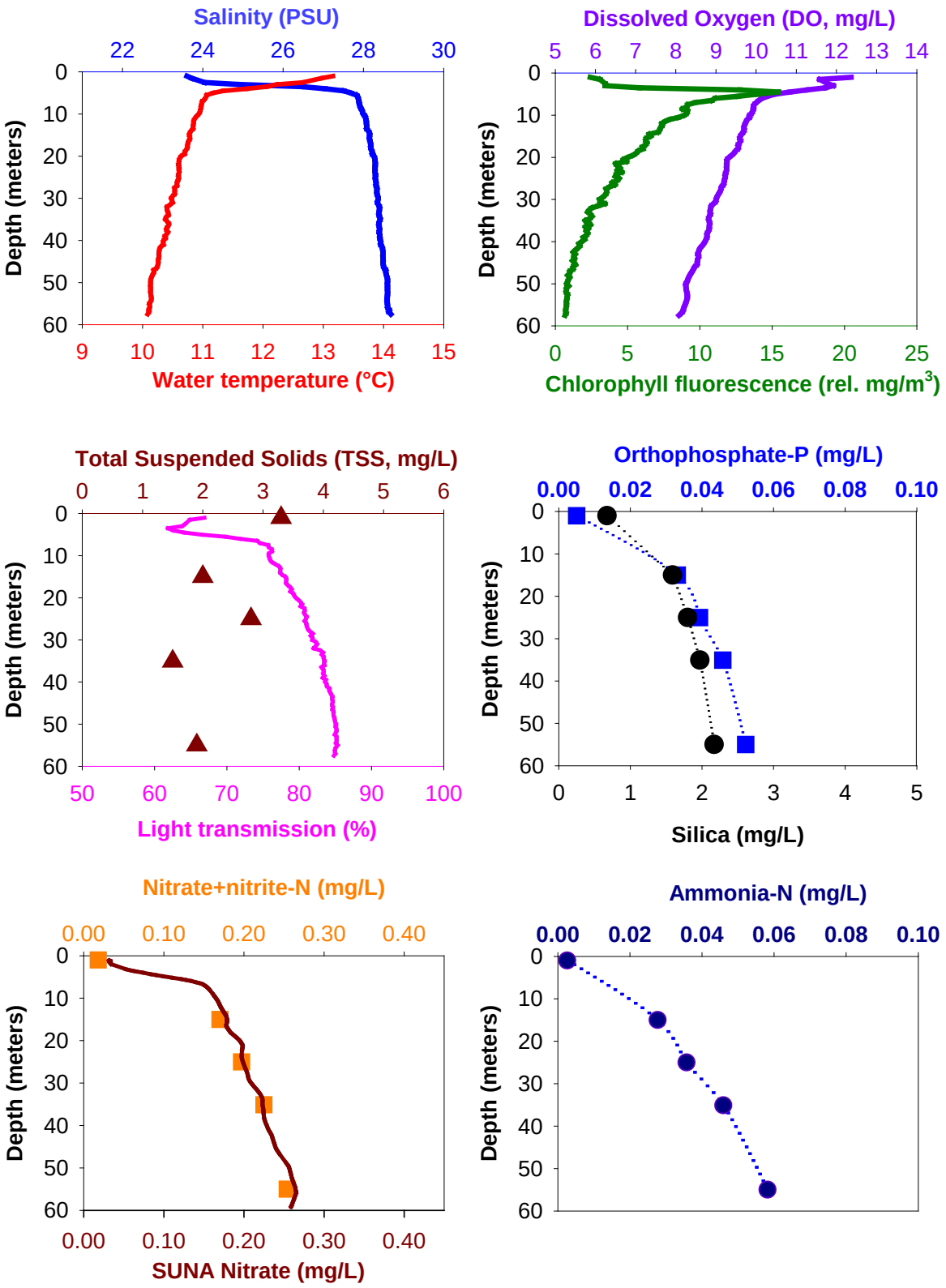

Figure A-1. Offshore water column profile (lines) and discrete water quality results (points) from early June 2017 at the West Point Outfall. On the lower left plot, preliminary averaged SUNA nitrate data are shown with lines, while the water sample results (squares) are combined nitrate and nitrite concentrations.

Offshore Water Quality: KSBP01 – Point Jefferson

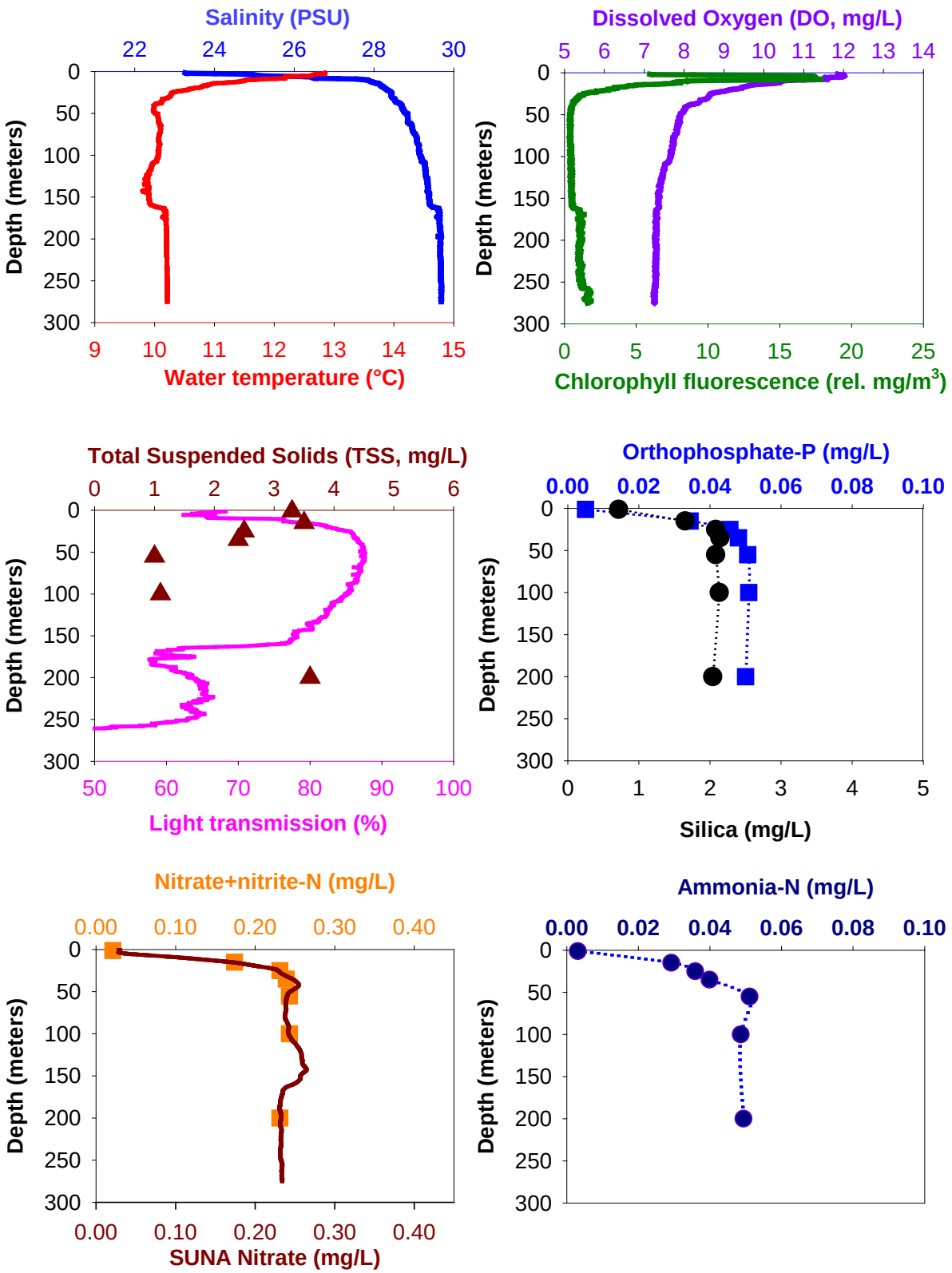

Figure A-2. Offshore water column profile (lines) and discrete water quality results (points) from early June 2017 at Point Jefferson. On the lower left plot, preliminary averaged SUNA nitrate data are shown with lines, while the water sample results (squares) are combined nitrate and nitrite concentrations.

Offshore Water Quality: EBO – Emergency Bypass Outfall

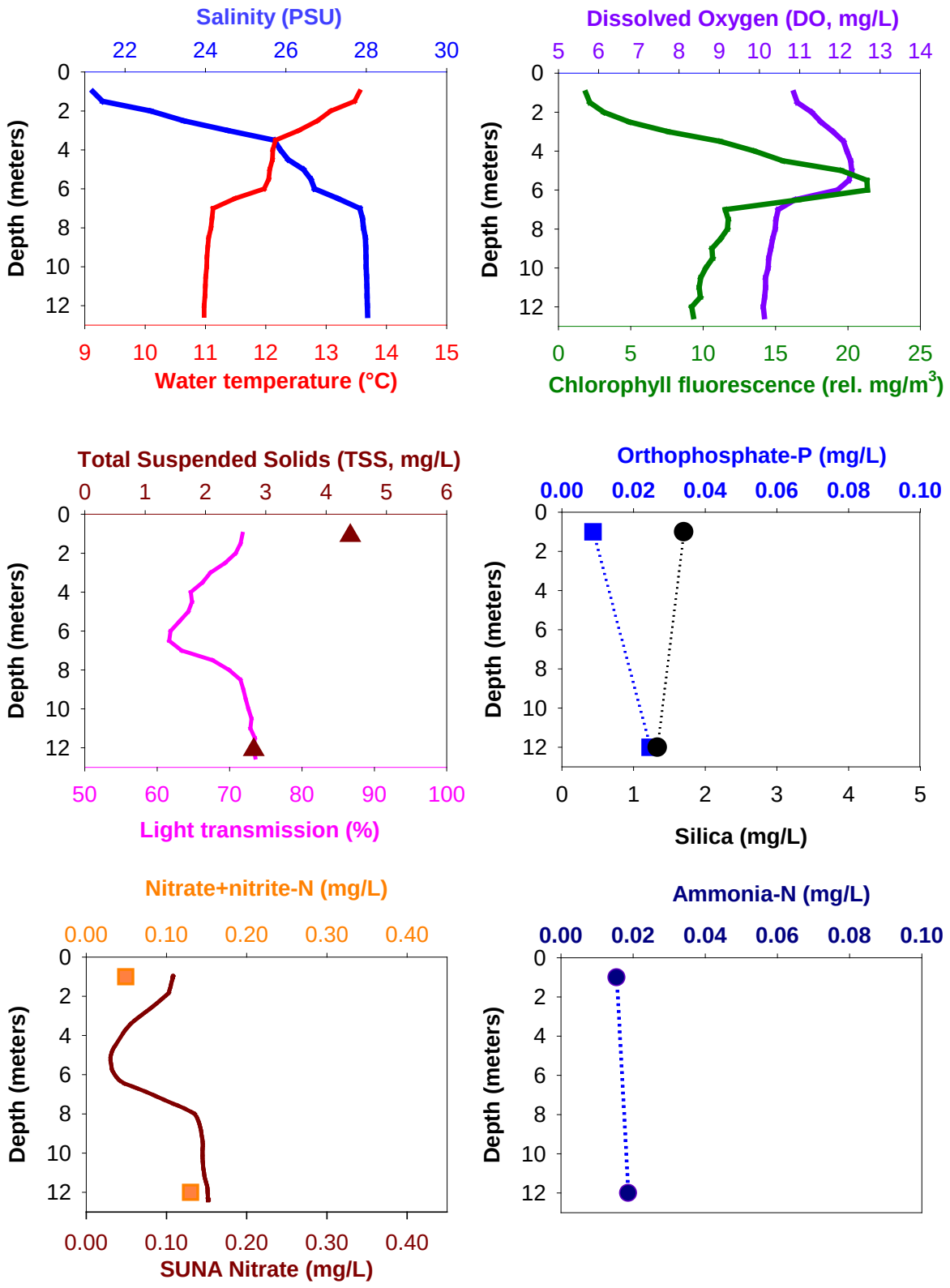

Figure A-3. Offshore water column profile (lines) and discrete water quality results (points) from early June 2017 at West Point's emergency bypass outfall. On the lower left plot, preliminary averaged SUNA nitrate data are shown with lines, while the water sample results (squares) are combined nitrate and nitrite concentrations.

Offshore Water Quality: LSEP01 – South Plant Outfall

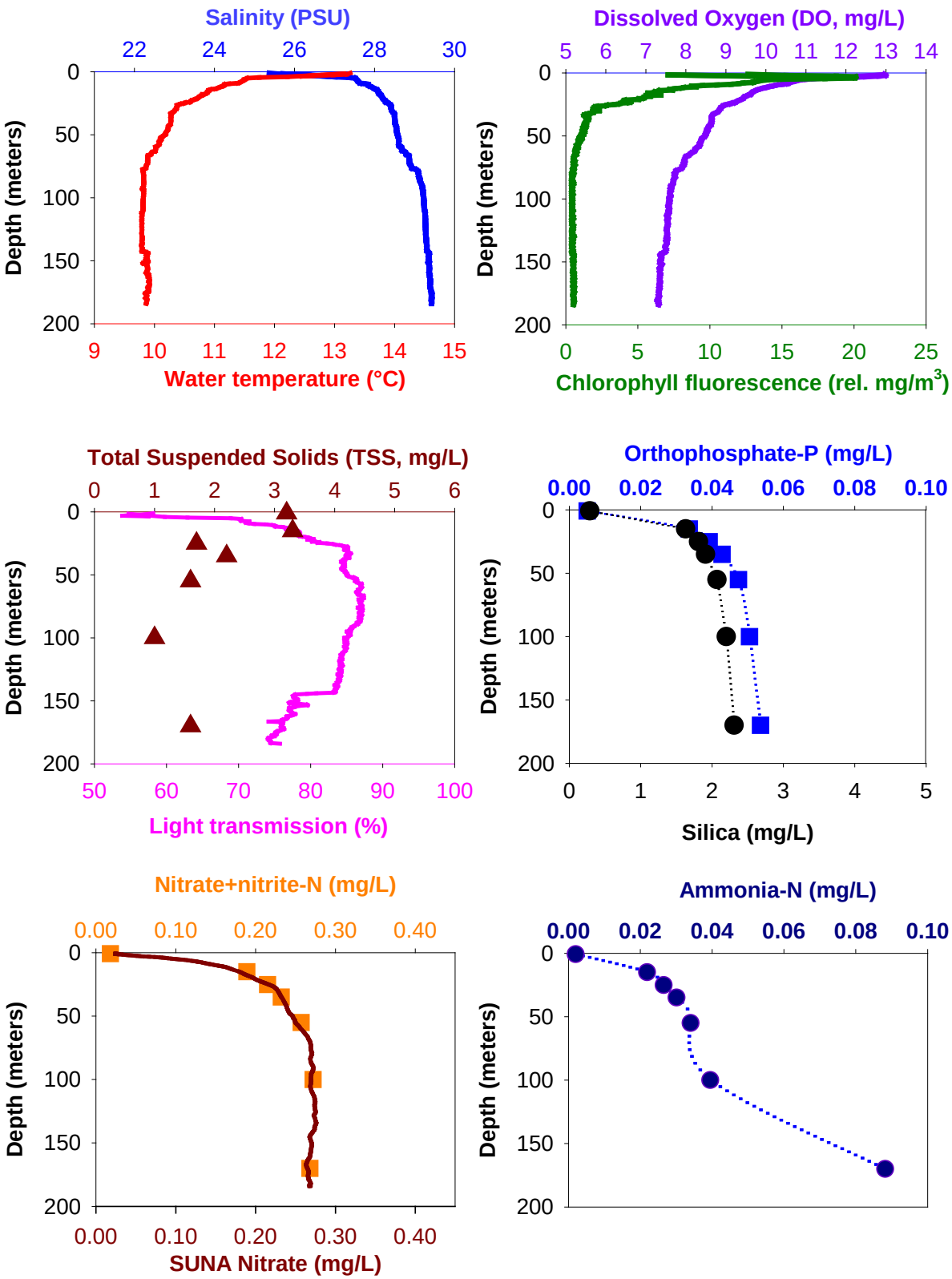

Figure A-4. Offshore water column profile (lines) and discrete water quality results (points) from early June 2017 at the South Plant Outfall. On the lower left plot, preliminary averaged SUNA nitrate data are shown with lines, while the water sample results (squares) are combined nitrate and nitrite concentrations.

Offshore Water Quality: LSNT01 – Point Williams

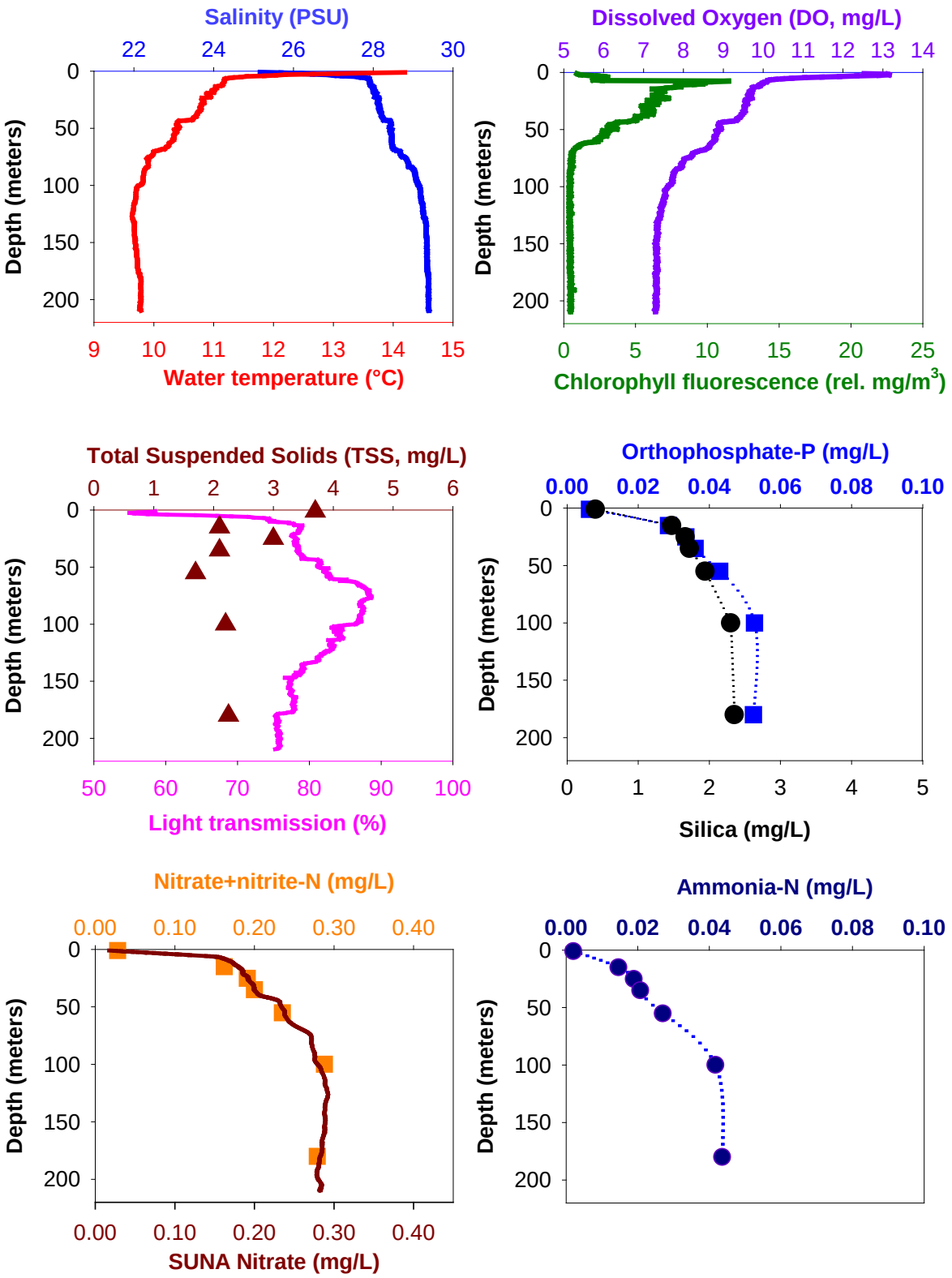

Figure A-5. Offshore water column profile (lines) and discrete water quality results (points) from early June 2017 at Point Williams. On the lower left plot, preliminary averaged SUNA nitrate data are shown with lines, while the water sample results (squares) are combined nitrate and nitrite concentrations.

Offshore Water Quality: Other Interesting Results

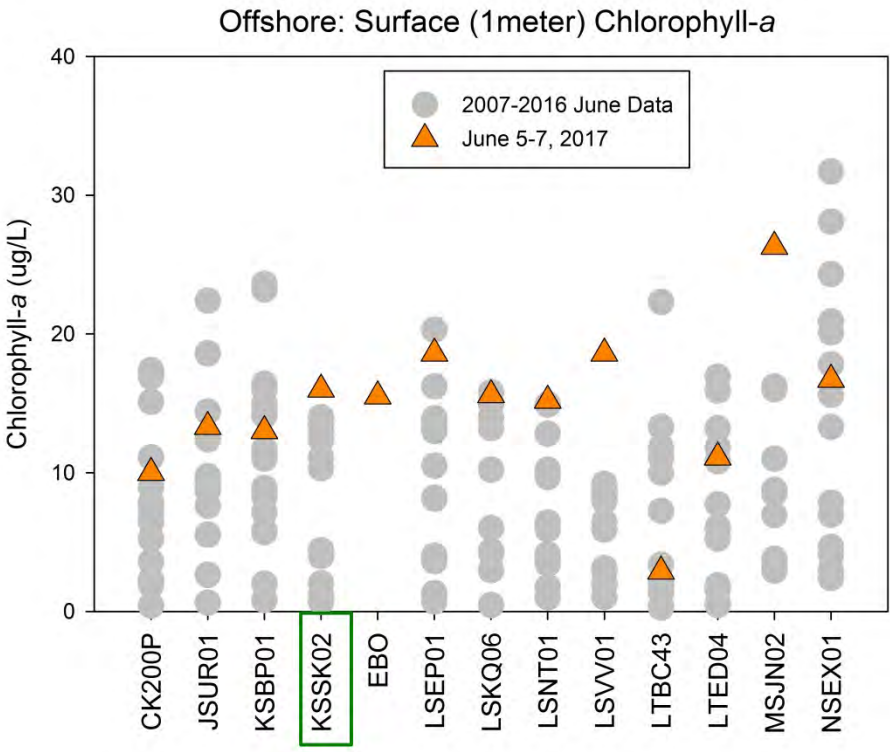

Figure A-6. Offshore surface water results for chlorophyll-*a* from early June 2017. Chlorophyll-*a* is a pigment present in phytoplankton and is used as an indicator of phytoplankton biomass. The high values indicate the on-going presence of the spring phytoplankton bloom.

Fecal Indicator Bacteria: Offshore and Beaches

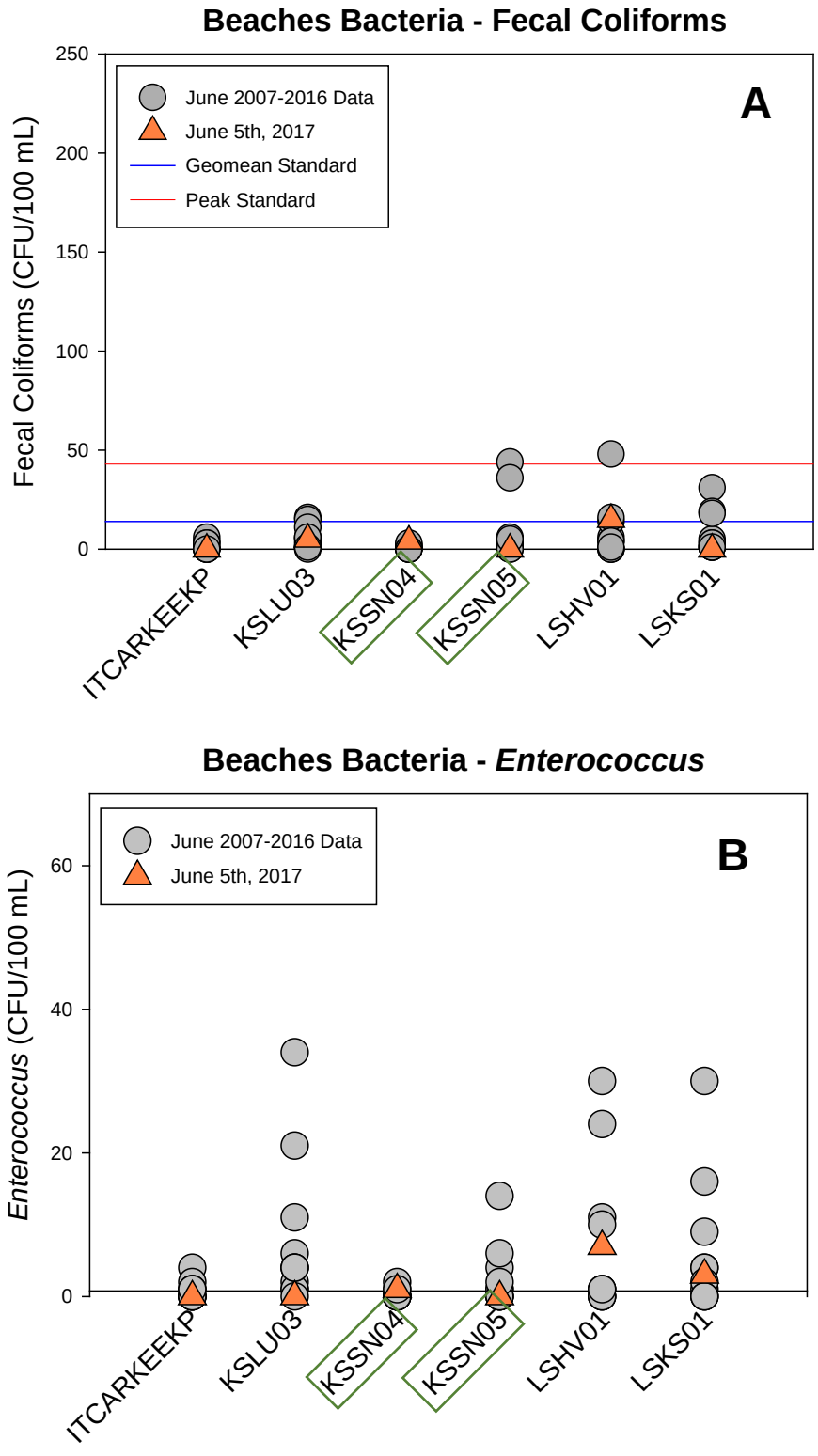

Figure A-7. Bacteria concentrations (**A.** Fecal coliforms; **B.** *Enterococcus*) of single samples collected at a subset of beach stations during the early June 2017 sampling event are illustrated with historical bacteria concentrations. Although not appropriate to compare single samples to Washington State water quality criteria, the state's geometric mean and peak standards for primary contact recreational and shellfish harvesting uses are provided for reference. Note: KSSN04 and KSSN05, near the West Point outfall are highlighted.

Table A-2. Offshore fecal indicator bacteria concentrations at select monitoring sites during the early June 2017 sampling event. Stations near West Point Treatment Plant Outfall are highlighted.

	Station	Date	Depth (m)	Fecal Coliform (CFU/100 mL)	*Enterococcus* (CFU/100 mL)
Offshore	KSBP01	6/5/2017	1.1	0	1
	KSSK02	6/5/2017	1.0	1	0
	KSSK02	6/5/2017	25.0	0	0
	KSSK02	6/5/2017	55.0	0	0
	EBO	6/5/2017	1.1	4	4
	EBO	6/5/2017	12.1	0	0
	LSEP01	6/7/2017	1.0	0	0
	LSEP01	6/7/2017	100.0	0	0
	LSEP01	6/7/2017	170.0	0	0
	LSNT01	6/7/2017	1.1	0	0
Beach	ITCARKEEKP	6/5/2017	--	0	0
	KSLU03	6/5/2017	--	5	0
	KSSN04	6/5/2017	--	4	1
	KSSN05	6/5/2017	--	0	0
	LSHV01	6/5/2017	--	15	7
	LSKS01	6/5/2017	--	0	3