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 9th, 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 will return to a twice-per-month monitoring frequency at all offshore stations, the EBO station will no longer be sampled, and beach station monitoring will return to a monthly frequency.

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: During 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 was added at the emergency bypass outfall (EBO) and is also sampled weekly. 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.

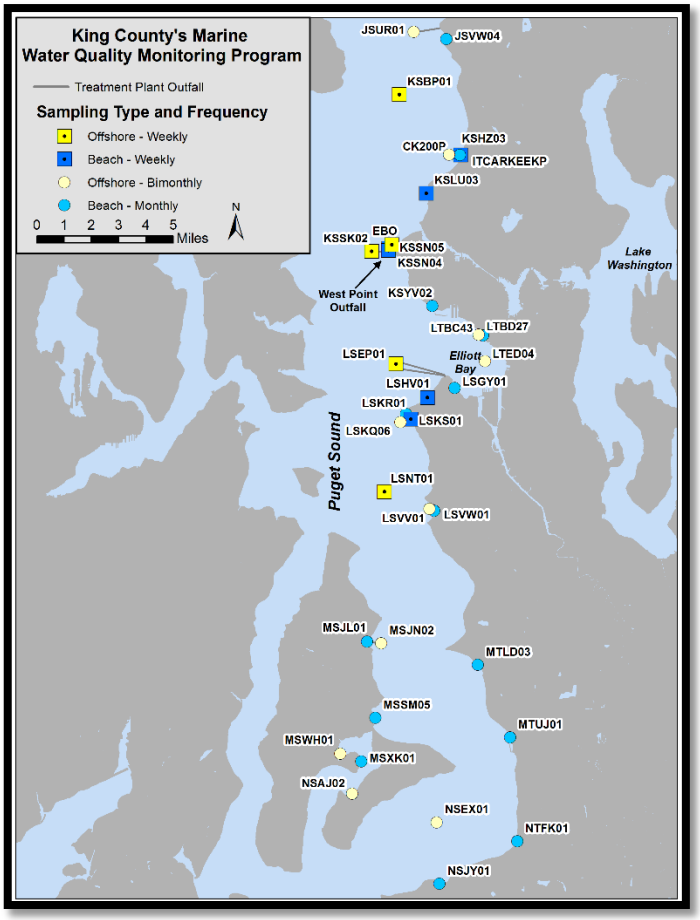

Figure 1. Map of King County's marine water quality monitoring stations.

The most recent data results available from the May 15th-16th and May 24th (offshore) and May 17th, 22nd, and 30th (beach) sampling events 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 both sampling events in late May. Despite no fecal coliform detections at the West Point outfall site, *Enterococcus* concentrations were elevated at the two deepest depths on May 15th. The reason for the discrepancy between fecal coliform and *Enterococcus* levels is unknown; however, the latter is capable of surviving longer in the marine environment. 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, some sample values at stations KSLU03 (Golden Gardens), KSSN05 (West Point South Beach), and LSKS01 (Alki – Richey Viewpoint) were above the geometric mean criteria once (KSLU03 & KSSN05) or twice (LSKS01) (see Appendix Figure A-8). Fecal coliform concentrations at KSLU03 and *Enterococcus* values at ITCARKEEKP (Carkeek Park) were slightly elevated, while all others were within the historical range for May (Appendix Table A-2).

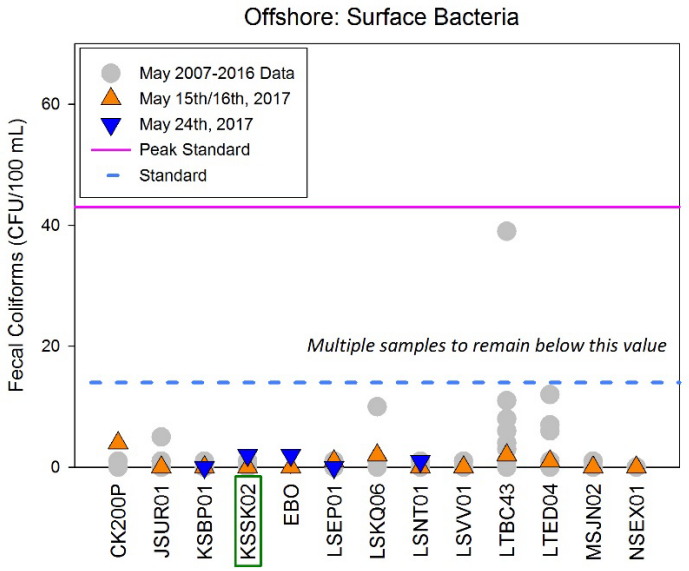

Figure 2. Bacteria (fecal coliforms) levels of single samples collected near surface (1 meter) at offshore stations in Central Puget Sound during the late May 2017 sampling events are illustrated with historical bacteria levels. Note: station KSSK02, West Point outfall, highlighted.

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 mid-to-late May were below the lowest (chronic) water quality criterion, which is based upon temperature, salinity, and pH factors (anticipated to be about 2.2 mg/L for May conditions). Ammonia values at the deepest depth at the South Plant outfall station (LSEP01) were elevated for both sampling weeks compared to historical values (Figure 3). An elevated value at the South Plant outfall was also observed on April 18th, but subsequent results until May 16th were within the typical range. These elevated ammonia results are likely a consequence of South Plant treating additional solids from the West Point plant and slightly higher ammonia levels in the effluent. Surface ammonia levels, including at the West Point and South Plant outfalls, were low (Appendix, Figure A-6).

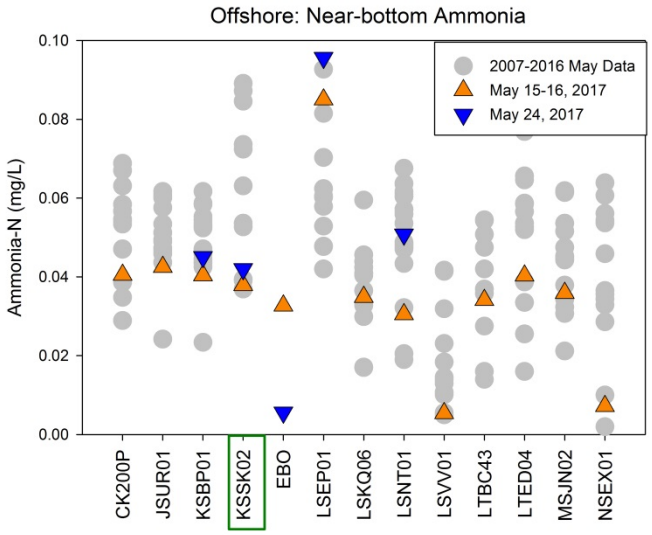

Figure 3. Ammonia levels collected at the deepest depth at offshore stations during the second half of May are shown with historical levels. Note: station KSSK02, the West Point outfall, is highlighted. The Emergency Bypass Station (EBO) was not routinely sampled prior to this event, so recent data cannot 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 early May, nitrate/nitrite and silica surface water values were either lower than normal or near the low range for historical values due to the regularly-occurring spring phytoplankton bloom that began in mid-April. Surface nutrients were especially low on May 24th. Phytoplankton (microalgae) take up nutrients for growth, such as nitrate and silica, which lowers levels in the water when the bloom is large. The bloom was evident throughout the Central Basin (but smaller in Elliott Bay) in mid-to-late May 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 at the surface.

Nitrate/nitrite levels at beach stations were all within the normal seasonal range on May 17th and ammonia levels were either within the normal seasonal range or slightly lower than normal for a few sites (Appendix, Figure A-9 and A-10).

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 late May show healthy near-bottom oxygen levels for all offshore sites across Central Puget Sound (Figure 4), continuing typical spring conditions observed since April.

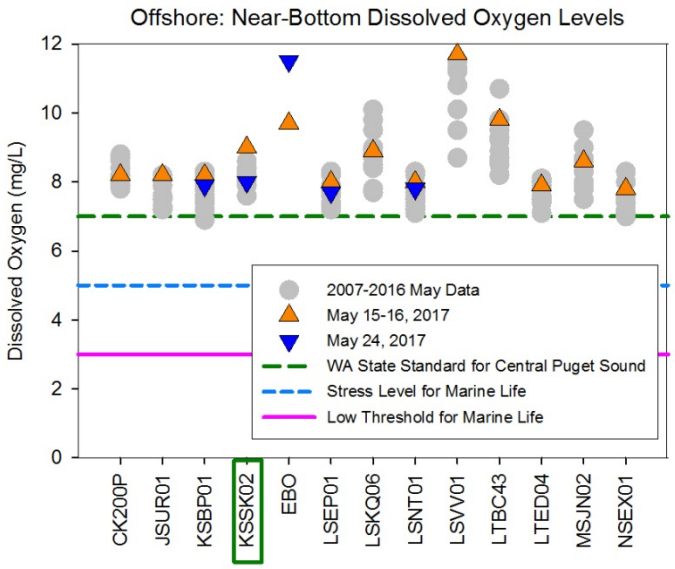

Figure 4. In Puget Sound, the lowest dissolved oxygen levels are typically found near the seafloor, so near-bottom oxygen levels are shown by site on top of historical oxygen conditions for the second half of May. Note: station KSSK02, West Point outfall, highlighted in green. The EBO site, Emergency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

From the surface to bottom of the water column, dissolved oxygen levels were above the state water quality standard. On May 24th, oxygen levels were particularly high at the surface as a result of rising spring phytoplankton growth and oxygen production across all

sites (Appendix Figures A-1 to A-5). This is related to warmer surface water temperatures and lower salinities from rain and river run-off that in turn create stronger separation of surface water layers from deep, concentrating phytoplankton in the surface layers (see Appendix A-7 for more discussion).

SUMMARY

Water sample results collected between May 15th and May 30th, 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 late May.
- *Enterococcus* concentrations deep at the West Point outfall station were higher than at other offshore stations despite no untreated discharges occurring during that time. The reason for the discrepancy of concentrations of the two bacteria types is unknown.
- Beach bacteria concentrations were typical at four of the six stations monitored weekly during the last three weeks of May. However, fecal coliform concentrations at Golden Gardens, and *Enterococcus* concentrations at Carkeek Park were slightly elevated above normal. Some sample values were above the geometric mean water quality criterion at three stations (Golden Gardens, West Point South, and Alki – Richey Viewpoint), but not the peak water quality criterion.
- All ammonia levels were below the lowest (chronic) water quality criterion.
- Surface ammonia levels were low and within normal ranges at all sites and depths. Near-bottom ammonia levels at the South Plant outfall were elevated for both sampling weeks in mid-to-late May.
- Nitrate/nitrite, orthophosphate, and silica results were within expected seasonal values for offshore waters at all depths except the surface.
- Low nitrate/nitrite and silica 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.
- Higher dissolved oxygen levels were observed in late May 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.

One example of zooplankton (Megalops, which is a larval development stage of crabs) found in May from zooplankton net tows in Puget Sound, pictured under a microscope, roughly the size of a grain of rice. These young crabs float and live in the water column until they settle out. They typically feed on phytoplankton and smaller zooplankton. (Source: Lyndsey Swanson)

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: May, Part 2, Marine Water Quality Data

The following graphs and tables display data from the May 15th – 17th, 22nd, 24th, and 30th 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
KSYV02	Magnolia

Offshore Water Quality: KSSK02 – West Point Outfall

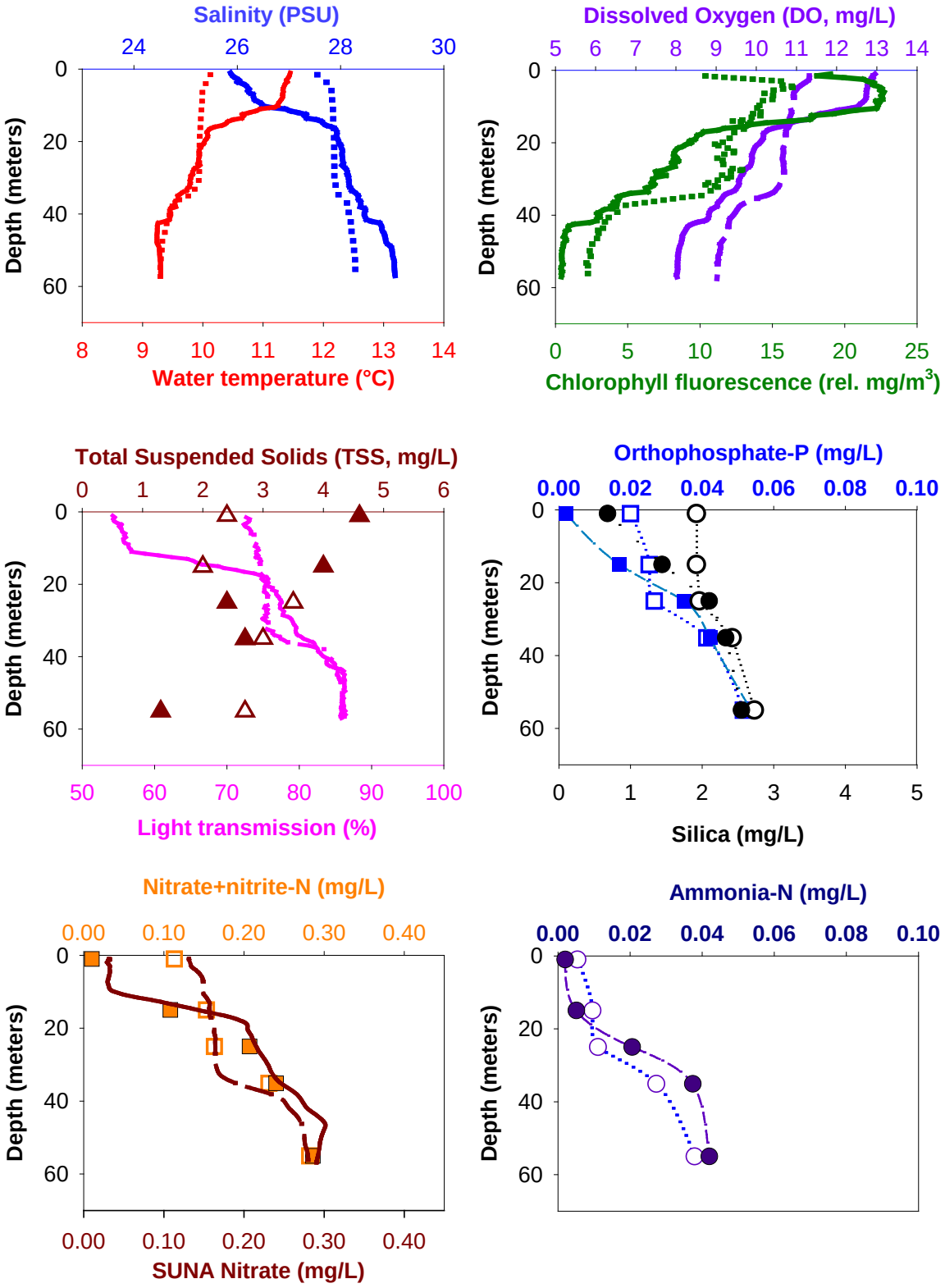

Figure A-1. Offshore water column profile (lines) and discrete water quality results (points) from the second two weeks of May 2017 at the West Point Outfall. Dashed lines and open symbols represent the May 15th/16th sampling event and solid lines and solid symbols represent the May 24th sampling event. 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

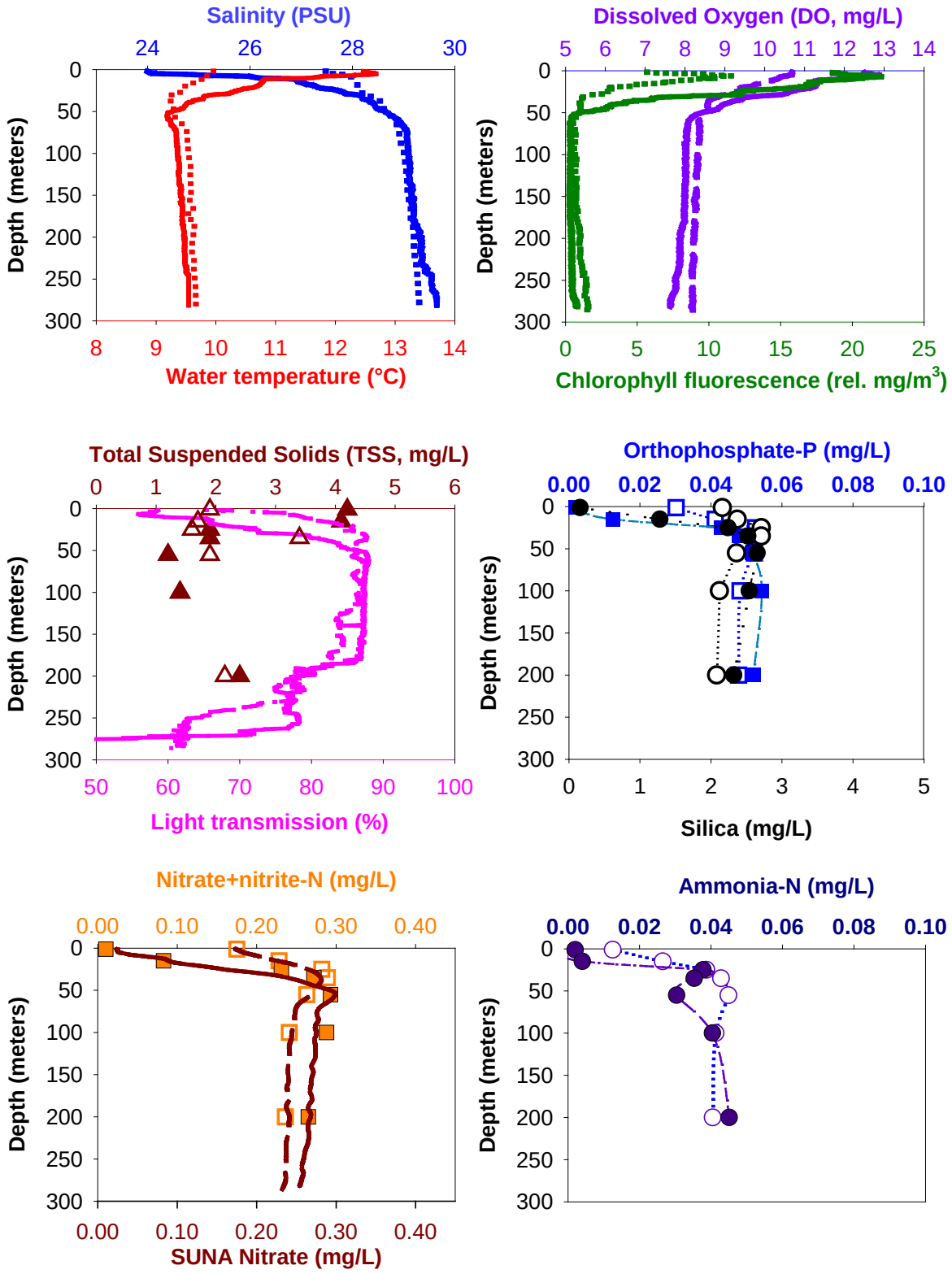

Figure A-2. Offshore water column profile (lines) and discrete water quality results (points) from the second two weeks of May 2017 at Point Jefferson. Dashed lines and open symbols represent the May 15th/16th sampling event and solid lines and solid symbols represent the May 24th sampling event. On 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

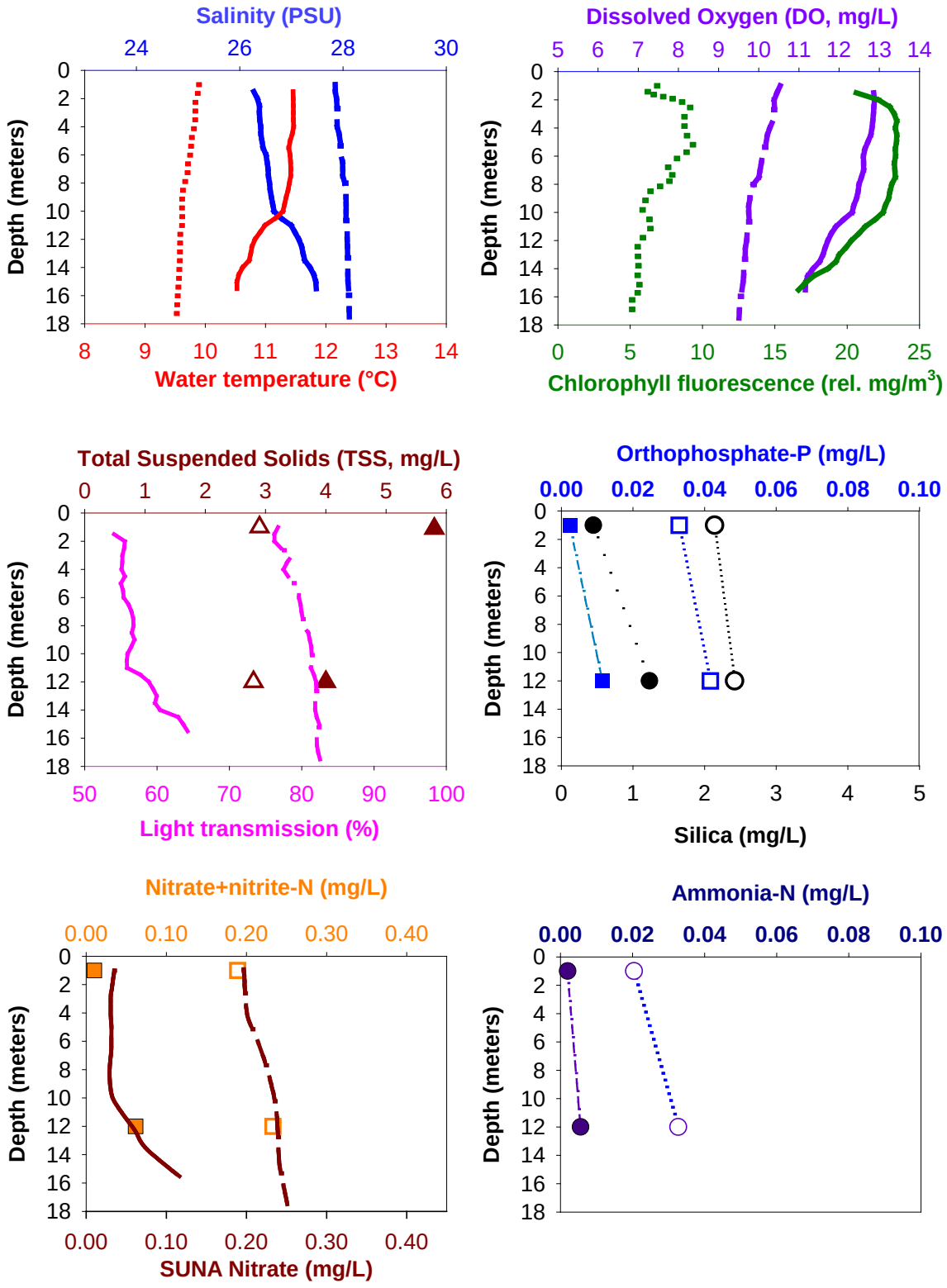

Figure A-3. Offshore water column profile (lines) and discrete water quality results (points) from the second two weeks of May 2017 at West Point's emergency bypass outfall. Dashed lines and open symbols represent the May 15th/16th sampling event and solid lines and solid symbols represent the May 24th sampling event. 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

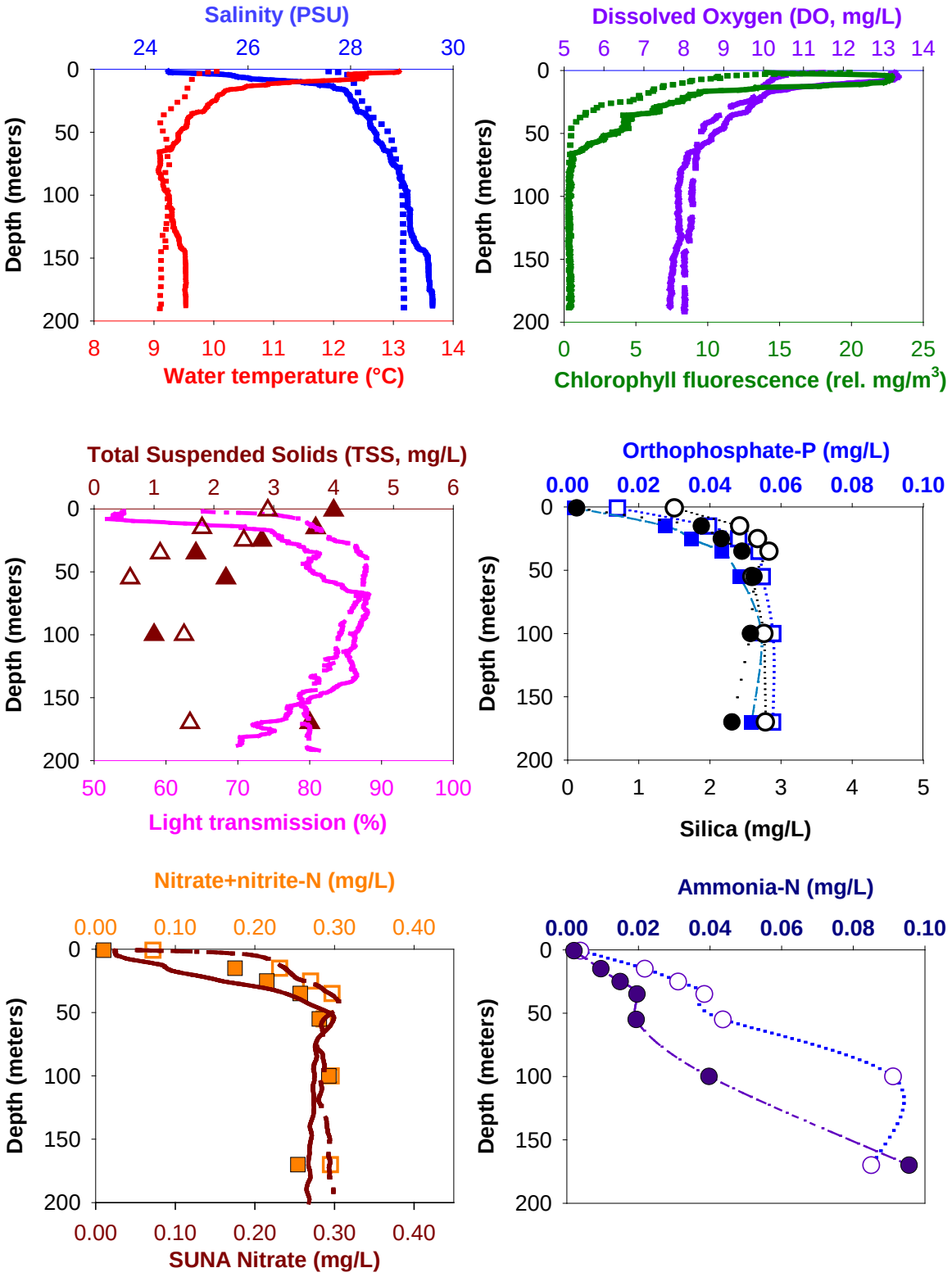

Figure A-4. Offshore water column profile (lines) and discrete water quality results (points) from the second two weeks of May 2017 at the South Plant Outfall. Dashed lines and open symbols represent the May 15th/16th sampling event and solid lines and solid symbols represent the May 24th sampling event. 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

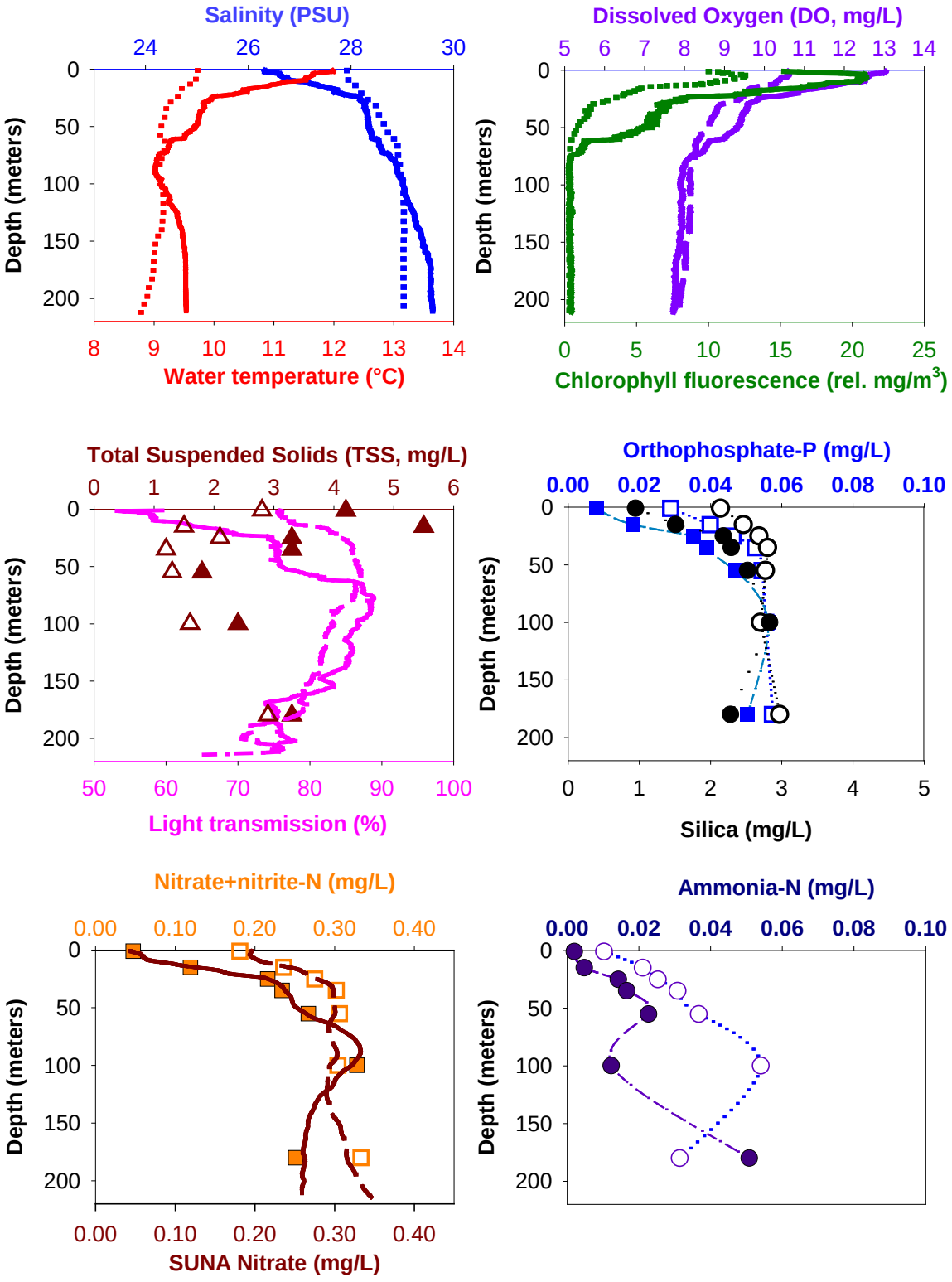

Figure A-5. Offshore water column profile (lines) and discrete water quality results (points) from the second two weeks of May 2017 at Point Williams. Dashed lines and open symbols represent the May 15th/16th sampling event and solid lines and solid symbols represent the May 24th sampling event. On the 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

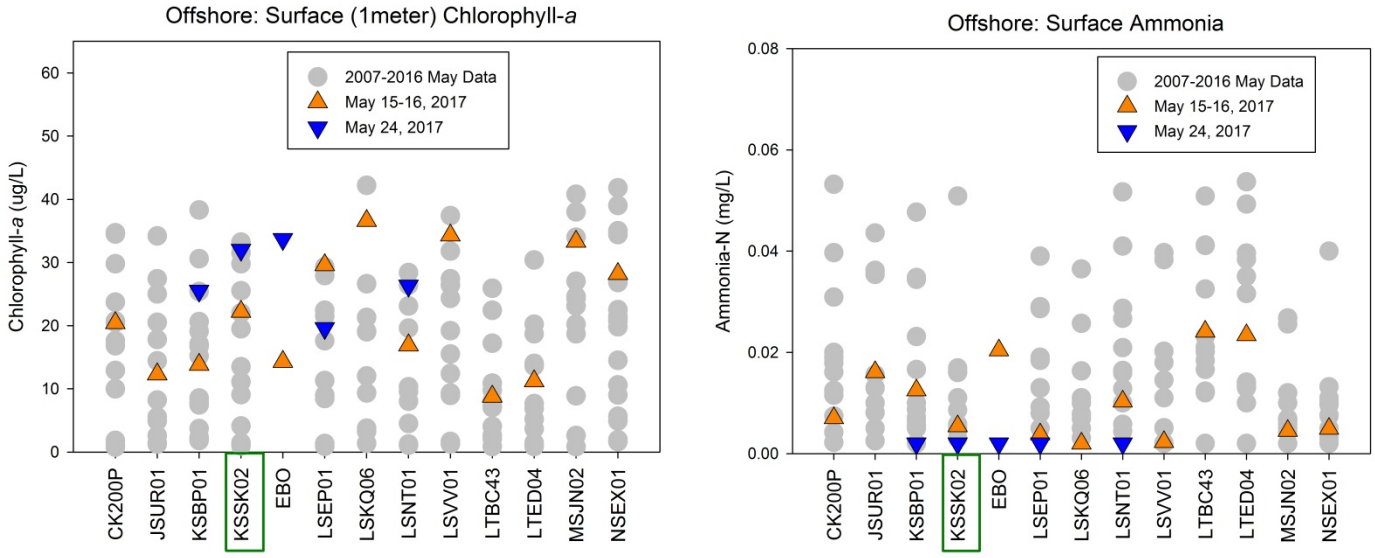

Figure A-6. Offshore surface water results for chlorophyll-*a* (on left) from the last two weeks in May 2017. Chlorophyll-*a* is a pigment present in phytoplankton and is used as an indicator of phytoplankton biomass. The high values indicate the presence of the spring phytoplankton bloom. Offshore surface water results for ammonia are shown on the right.

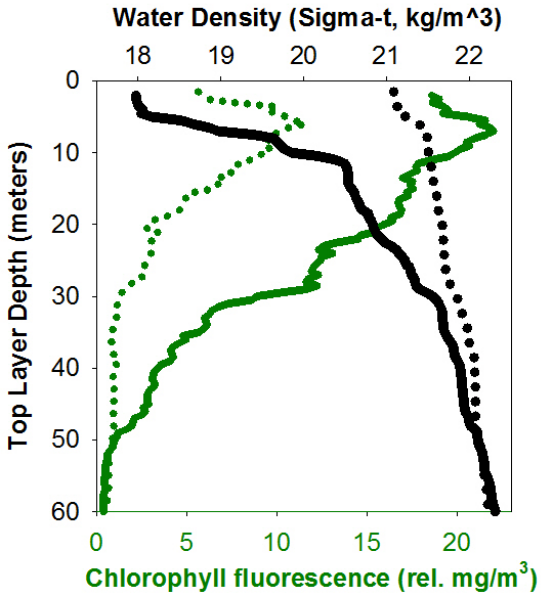

Figure A-7. Example of top layer water properties at the Point Jefferson site (KSBP01), zoomed-in to the top 60-m from Figure A-2 for density and chlorophyll only. Dashed lines represent the May 15th sampling event and solid lines represent the May 24th sampling event. Water density is related to temperature and salinity, where less dense waters have warmer temperatures and/or lower salinity. The sharper changes in density over depth from May 24th (solid black line) result in stronger water layers with less vertical mixing, compared to May 15th (dotted line). These physical changes result in further increases in chlorophyll (solid green line) from phytoplankton, which concentrate in the surface layers. This is a typical process that happens in the spring with warming temperatures and increasing river run-off.

Fecal Indicator Bacteria: Offshore and Beaches

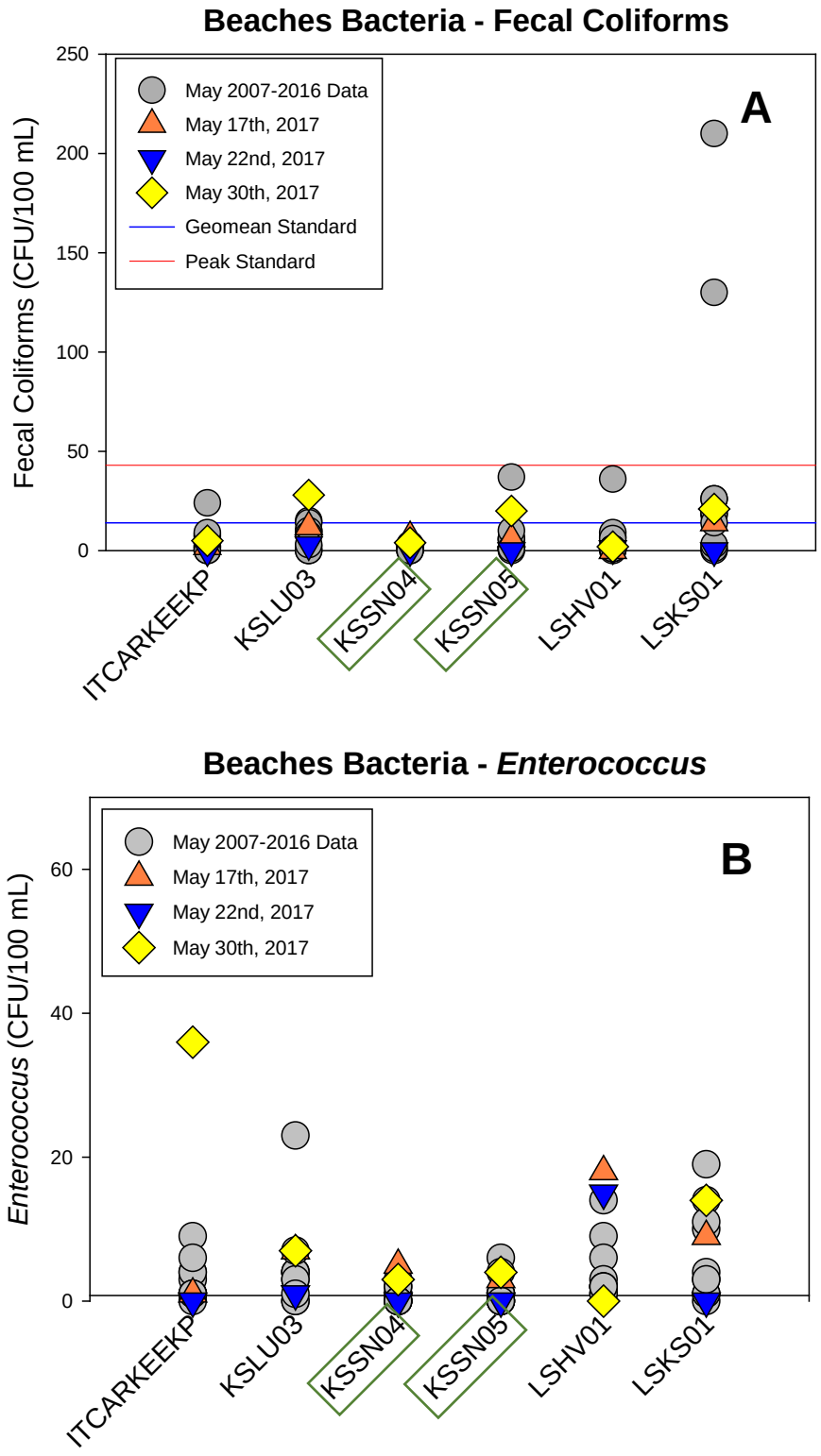

Figure A-8. Bacteria concentrations (**A.** Fecal coliforms; **B.** *Enterococcus*) of single samples collected at a subset of beach stations during the last three weeks of May 2017 sampling event are illustrated with historical bacteria concentrations. Although not appropriate to compare single samples 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 last three weeks of May, 2017. Stations near West Point Treatment Plant Outfall are highlighted.

	Station	Date	Depth (m)	Fecal Coliform (CFU/100 mL)	*Enterococcus* (CFU/100 mL)
Offshore	KSBP01	5/15/2017	1.1	0	46
	KSSK02	5/15/2017	1.0	0	0
	KSSK02	5/15/2017	25.0	0	17
	KSSK02	5/15/2017	55.1	0	24
	EBO	5/15/2017	1.0	0	1
	EBO	5/15/2017	12.0	0	1
	LSEP01	5/16/2017	1.0	1	0
	LSEP01	5/16/2017	100.0	1	0
	LSEP01	5/16/2017	170.0	0	0
	LSNT01	5/16/2017	1.0	0	2
	KSBP01	5/24/2017	1.1	0	0
	KSSK02	5/24/2017	1.1	2	1
	KSSK02	5/24/2017	25.0	0	0
	KSSK02	5/24/2017	55.1	0	0
	EBO	5/24/2017	1.1	2	0
	EBO	5/24/2017	12.0	1	0
	LSEP01	5/24/2017	1.1	0	0
	LSEP01	5/24/2017	100.0	0	1
	LSEP01	5/24/2017	170.0	0	0
	LSNT01	5/24/2017	1.1	1	1
Beaches	ITCARKEEKP	5/17/2017	--	2	1
	KSLU03	5/17/2017	--	12	7
	KSSN04	5/17/2017	--	7	5
	KSSN05	5/17/2017	--	6	3
	LSHV01	5/17/2017	--	0	18
	LSKS01	5/17/2017	--	14	9
	ITCARKEEKP	5/22/2017	--	0	0
	KSLU03	5/22/2017	--	3	1
	KSSN04	5/22/2017	--	0	0
	KSSN05	5/22/2017	--	0	0
	LSHV01	5/22/2017	--	1	15
	LSKS01	5/22/2017	--	0	0
	ITCARKEEKP	5/30/2017	--	5	36
	KSLU03	5/30/2017	--	28	7
	KSSN04	5/30/2017	--	4	3
	KSSN05	5/30/2017	--	20	4
	LSHV01	5/30/2017	--	2	0
	LSKS01	5/30/2017	--	21	14

Beach Nutrients: Nitrate + Nitrite

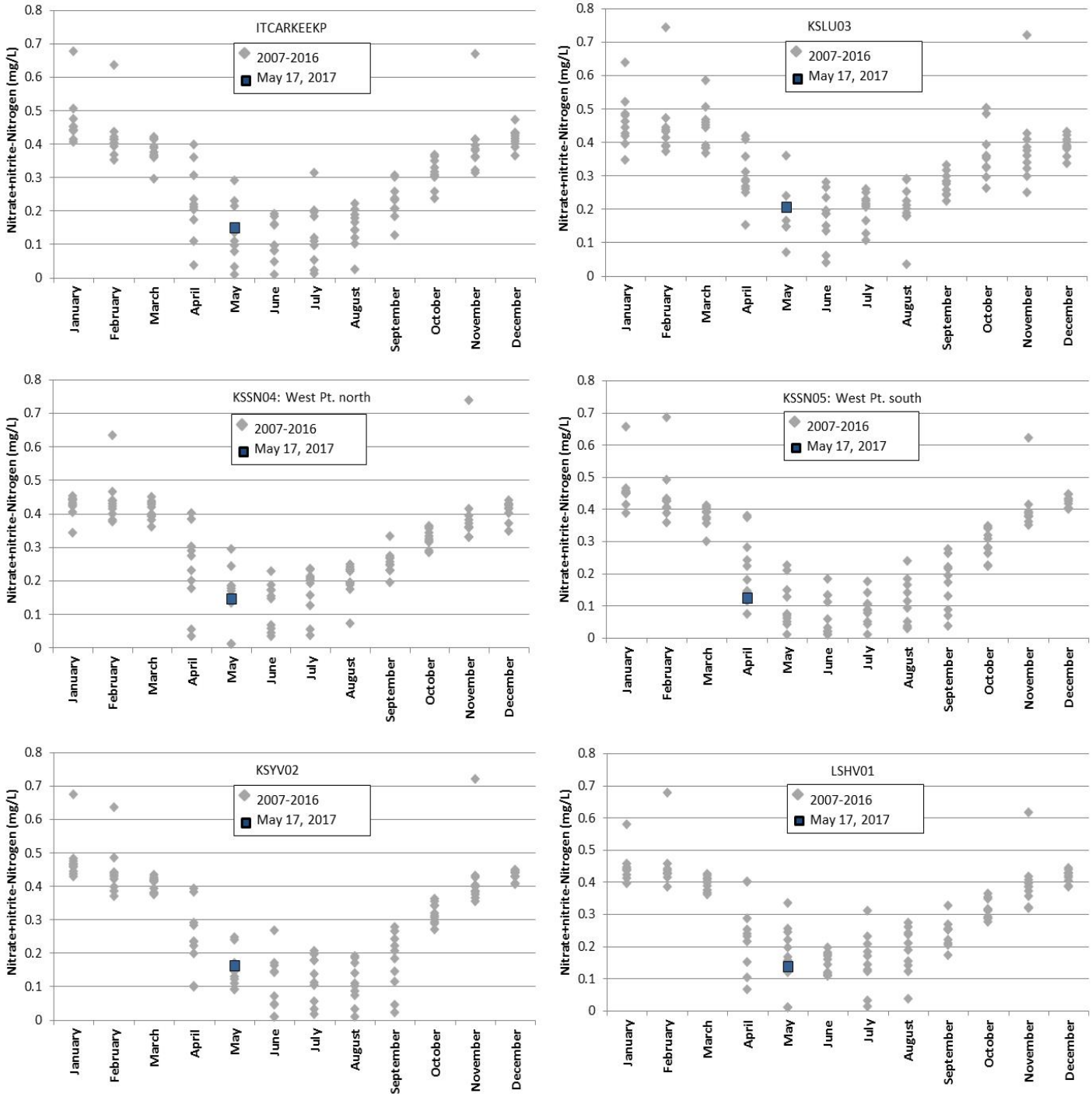

Figure A-9. Nitrate + nitrite values for six beach stations sampled on May 17th, 2017 (blue squares) compared to historical values for May. Additional months are shown to indicate the yearly seasonal cycle and where the current month falls in that cycle.

Beach Nutrients: Ammonia

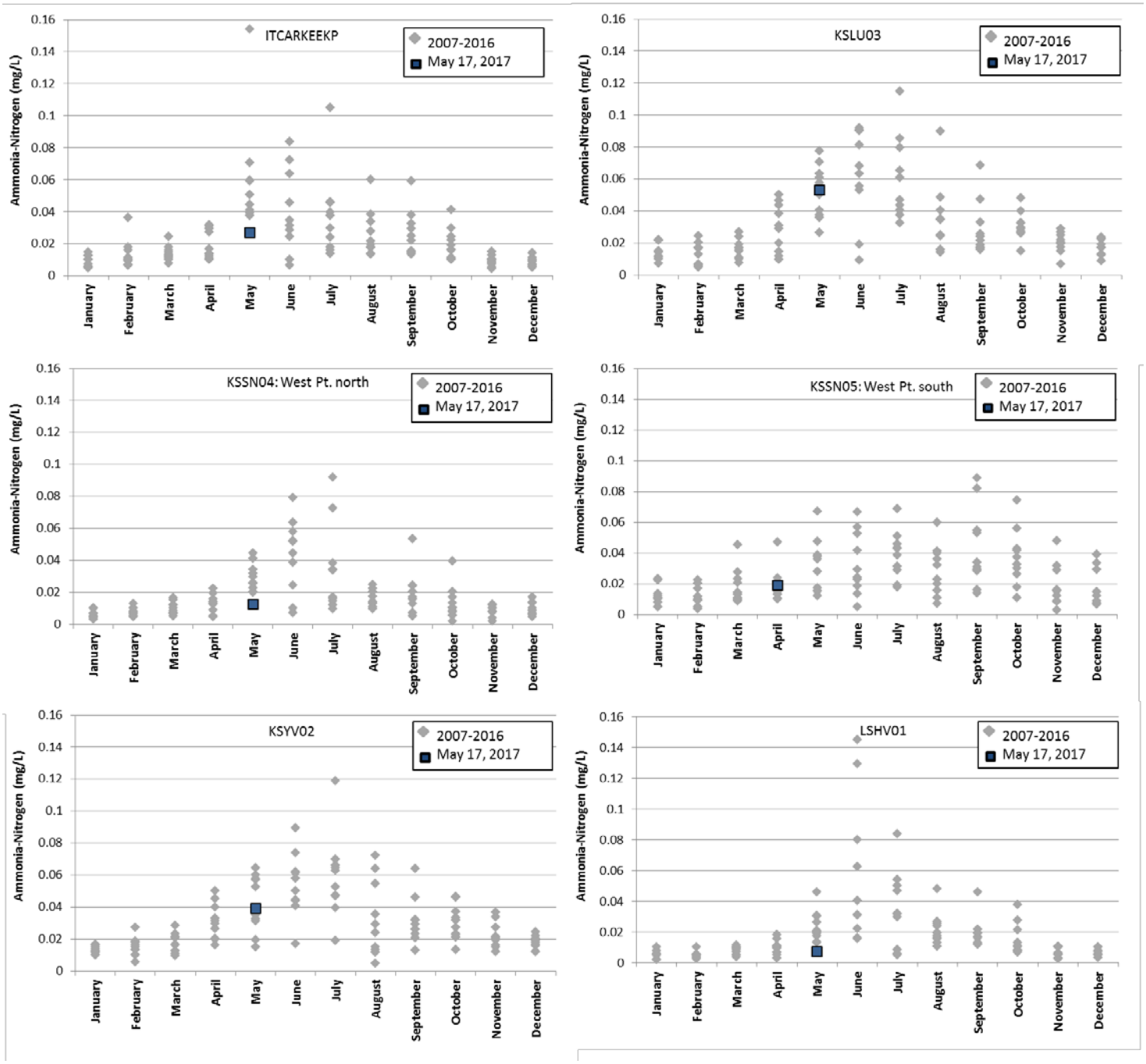

Figure A-10. Ammonia values for six beach stations sampled on May 17th, 2017 (blue squares) compared to historical values for April. Additional months are shown to indicate the yearly seasonal cycle and where the current month falls in that cycle.