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 May 12th, 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 April 27th, 2017 all of the wastewater coming into West Point Treatment Plant each day is going through full secondary treatment. Over the coming weeks, plant staff will continue fine-tuning the biological processes that are essential to secondary treatment.

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 up until now, the sampling frequency at a subset of four offshore long-term monitoring stations has been increased to weekly. A new site was added at the emergency bypass outfall and is also sampled weekly. This frequency and variety of biological, chemical, and physical conditions can capture some impacts on ecosystem functions. As of April 10th, bacteria concentrations at a subset of six beach sampling stations are monitored weekly. As of April 11th, a new Submersible Ultraviolet Nitrate Analyzer (SUNA) sensor was loaned to King County from the Washington State Dept. of Ecology to support additional monitoring efforts. The SUNA sensor adds rapid measurements of nitrate, and provides more information on the variability of nitrate in the water column from the surface to bottom. More details are shown in the appendix (Figures A-1 to A-5).

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.

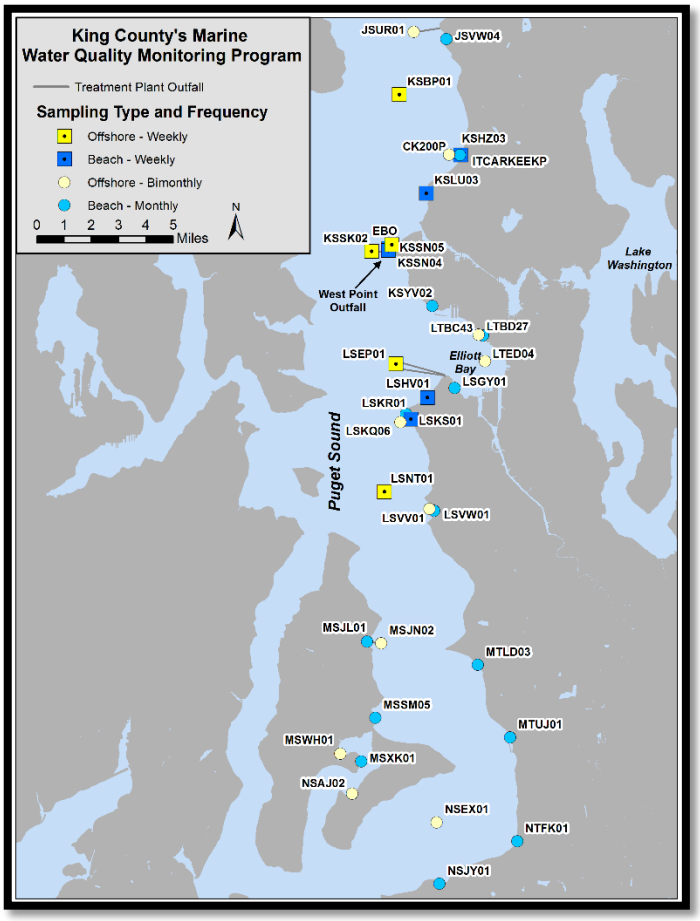

Figure 1. Map of King County's marine water quality monitoring stations.

The most recent data results available from April 17th thru the 19th (all offshore and beach bacteria) and April 24th thru the 26th (all offshore and beach) sampling events are summarized for three key water quality indicators below. More data results are available in the appendix.

BACTERIA

Fecal coliforms, along with *Enterococcus*, are a type of indicator bacteria that King County routinely monitors 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 surface waters at all offshore stations, including KSSK02 off of West Point, were all below the geometric mean standard and the peak standard during both sampling events in late April (Figure 2). Sub-surface bacteria concentrations were all low and below state water quality criteria as well. For data on subsurface and *Enterococcus* bacteria concentrations, see Appendix Table A-2.

Concentrations of bacteria at the subset of six stations sampled weekly, which includes beaches near West Point, were below state water quality standards in most cases. The exceptions were KSLU03 and LSKS01 (Golden Gardens and Richey Viewpoint, Alki) on April 19th. Both stations exceeded the geometric mean standard, but not the peak standard, and were within the range of values historically seen at these sites in April (see Appendix Figure A-8 and Table A-2).

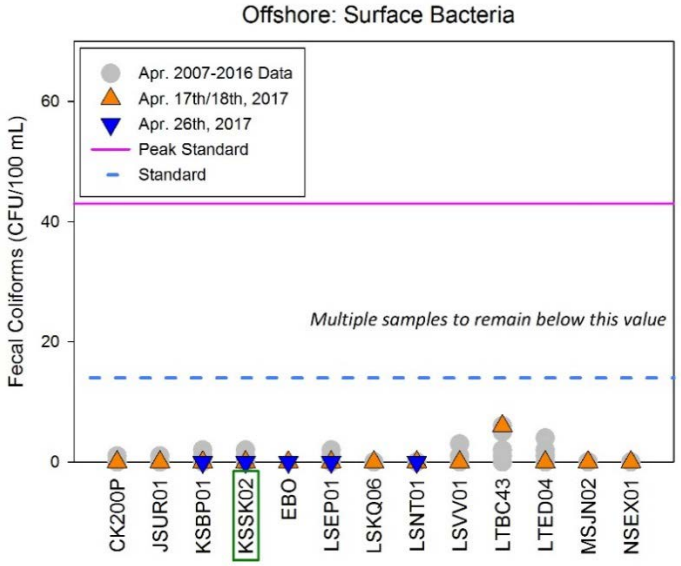

Figure 2. Bacteria levels of single samples collected near surface (1 meter) at offshore stations in Central Puget Sound during the late April 2017 sampling events are illustrated with historical bacteria levels. Note: station KSSK02, West Point outfall, highlighted.

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.

With one exception, all ammonia values in offshore waters in mid-April were low and well below the lowest (chronic) water quality criterion, which is based upon temperature, salinity, and pH factors (anticipated to be about 1.6 mg/L for April conditions). Although meeting the standard, the ammonia value at the deepest depth at the South Plant outfall station (LSEP01) on April 18th was higher than other stations and beyond the historical range for the last 10 years (Figure 3). Ammonia was also higher than normal on April 11th at this depth and may be associated with slightly higher South Plant discharge ammonia levels in April as a result of the plant treating additional solids from West Point during the restoration. Surface ammonia levels, including at the West Point and South Plant outfalls, were low (Appendix, Figure A-7).

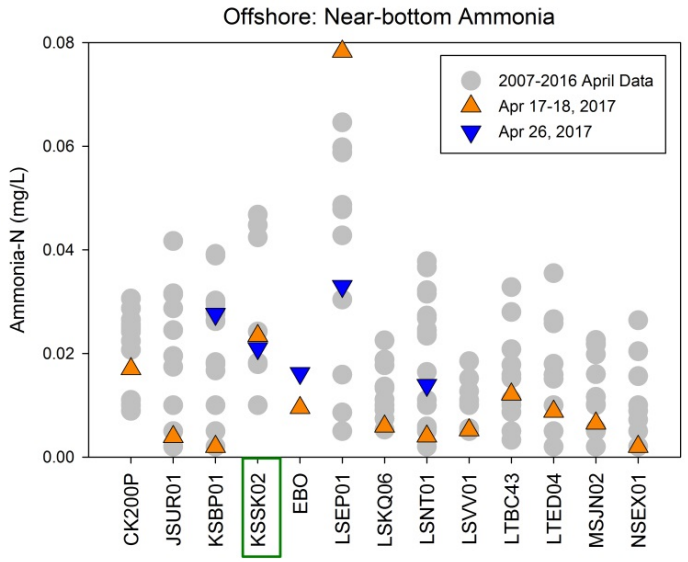

Figure 3. Ammonia levels collected at the deepest depth at offshore stations during the late April sampling events are shown with historical levels. Note: station KSSK02, the West Point outfall, is highlighted. The Emergency Bypass Station (EBO) was not routinely sampled prior to this event, so recent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

Nitrate + nitrite, orthophosphate, and silica at offshore stations for all depths were generally within normal seasonal ranges for all sites. The results of the SUNA sensor (shown in the Appendix) indicate patterns in nitrate concentrations are comparable to laboratory results, and better capture the entire water column. Most sites show higher nitrate particularly at near-bottom depths, which can be a typical seasonal pattern. Low nitrate/nitrite and silica surface water values, in addition to high chlorophyll-*a* values (particularly on April 17th/18th), indicate the occurrence of the spring phytoplankton (microalgae) bloom (see Appendix, Figure A-6). This is the typical timing of the spring bloom. Phytoplankton take up nutrients for growth, such as nitrate and silica, which lowers levels in the water when the bloom is large.

Nutrients in beach waters sampled on April 19th were all within typical seasonal ranges (see Appendix, Figures A-9 and -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 concentrations of 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 the 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. In addition, deep waters from the Pacific Ocean enter Puget Sound at depth and can result in naturally occurring low dissolved 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 offshore near-bottom data from late April show typical oxygen conditions for sites across Central Puget Sound, and all sites show oxygen levels above the state water quality standard (Figure 5).

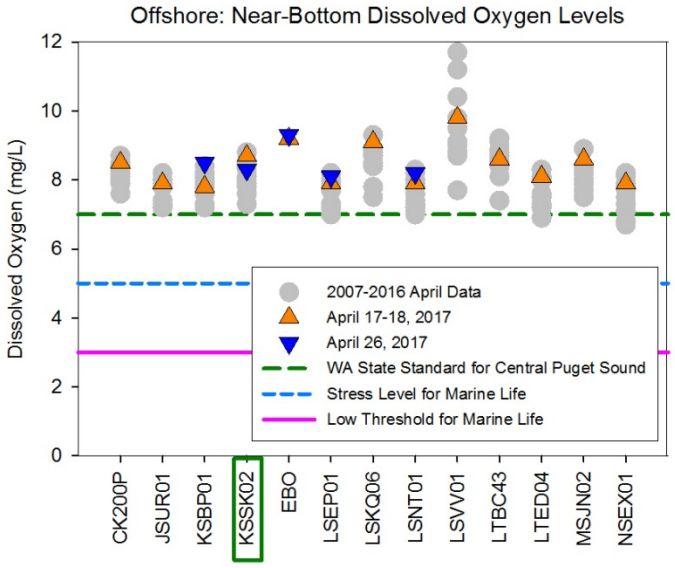

Figure 4. In Puget Sound, the lowest dissolved oxygen levels are typically found near the seafloor, so near-bottom oxygen levels are shown by site on top of historical oxygen conditions for the first half of April. Note: station KSSK02, West Point outfall, highlighted in green. The EBO site, Emergency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

Higher oxygen concentrations persist through the top to bottom of the water column, particularly at shallow

locations, such as the site near the Fauntleroy ferry terminal (LSVV01). Increased oxygen levels reflect continued spring growth of phytoplankton and other algae, which produce oxygen during the day. These conditions are typical for April.

SUMMARY

Water sample results collected between April 17rd-19th and April 24th-26th, 2017 are summarized below. Additional results are provided in the Appendix.

- Concentrations of fecal coliforms at offshore stations were below the geometric mean reference water quality standards as well as the peak standard in late April.
- Beach bacteria concentrations were within the range of expected values for the subset of six stations monitored weekly during the last two weeks of April. However, two stations (Golden Gardens and Richey Viewpoint on Alki) exceeded the geometric mean reference value, but not the peak water quality criterion.
- Surface ammonia levels were low at all sites.
- Although meeting the water quality criterion, the ammonia value at the deepest sampling depth was highest at the South Plant outfall on April 18th and higher than the historical range for the past 10 years. The results may reflect additional ammonia discharged from South Plant as a result of processing additional solids from West Point while restoration is underway.
- All other nutrients, which include nitrate/nitrite, orthophosphate, and silica results, were within expected values for offshore waters.
- The lower nitrate/nitrite and silica levels at the surface in addition to high chlorophyll-*a* values indicate the typical seasonal occurrence of the spring phytoplankton (microalgae) bloom. The timing of the phytoplankton bloom, and the phytoplankton's subsequent uptake of nutrients for growth, is consistent with historical data.
- Nutrients in beach waters were all within typical seasonal ranges for April.
- The SUNA nitrate sensor continues to better capture the changes in nitrate levels from top to bottom of the water column, and deep sites show higher nitrate at near-bottom depths (Appendix, Figures A-1 thru A-5).
- Near-bottom dissolved oxygen values were at healthy levels and all sites were above the state water quality standard.
- Higher dissolved oxygen levels continued through the end of April, particularly at shallow locations where light can reach and aquatic plants and algae can grow and produce oxygen. This reflects typical spring conditions.

King County field staff member, pictured in the foreground, collecting water samples from one of the beach sites on the east side of Vashon Island (site MSSM05). The samples are brought back to the King County Environmental Lab and analyzed for fecal indicator bacteria and nutrient concentrations, as well as measurements taken for water temperature and salinity.
(Source: S. Jaeger)

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: April, Part 2, Marine Water Quality Data

The following graphs and tables display data from the April 17th – 19th and April 24th – 26th 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

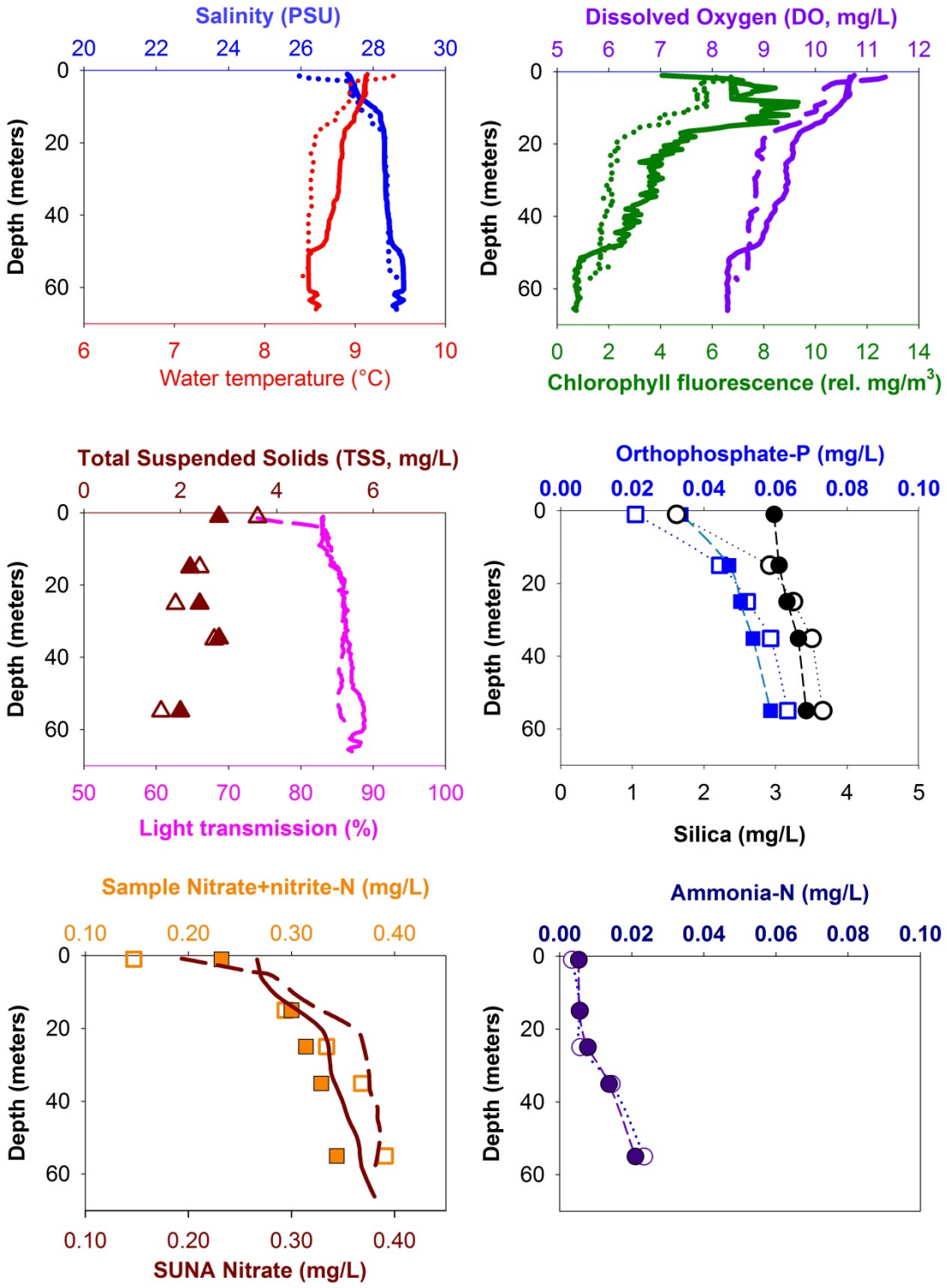

Figure A-1. Offshore water column profile (lines) and discrete water quality results (points) from the second two weeks of April 2017 at the West Point Outfall. Dashed lines and open symbols show the April 17th/18th sampling event and solid lines and solid symbols show the April 26th sampling event. *Note: shown on the lower left plot, on April 17th the difference between the SUNA nitrate sensor (dashed line) and water sample results (open squares) are attributed to a difference in the water between the down and up casts, such as due to boat drift or currents.*

Offshore Water Quality: KSBP01 – Point Jefferson

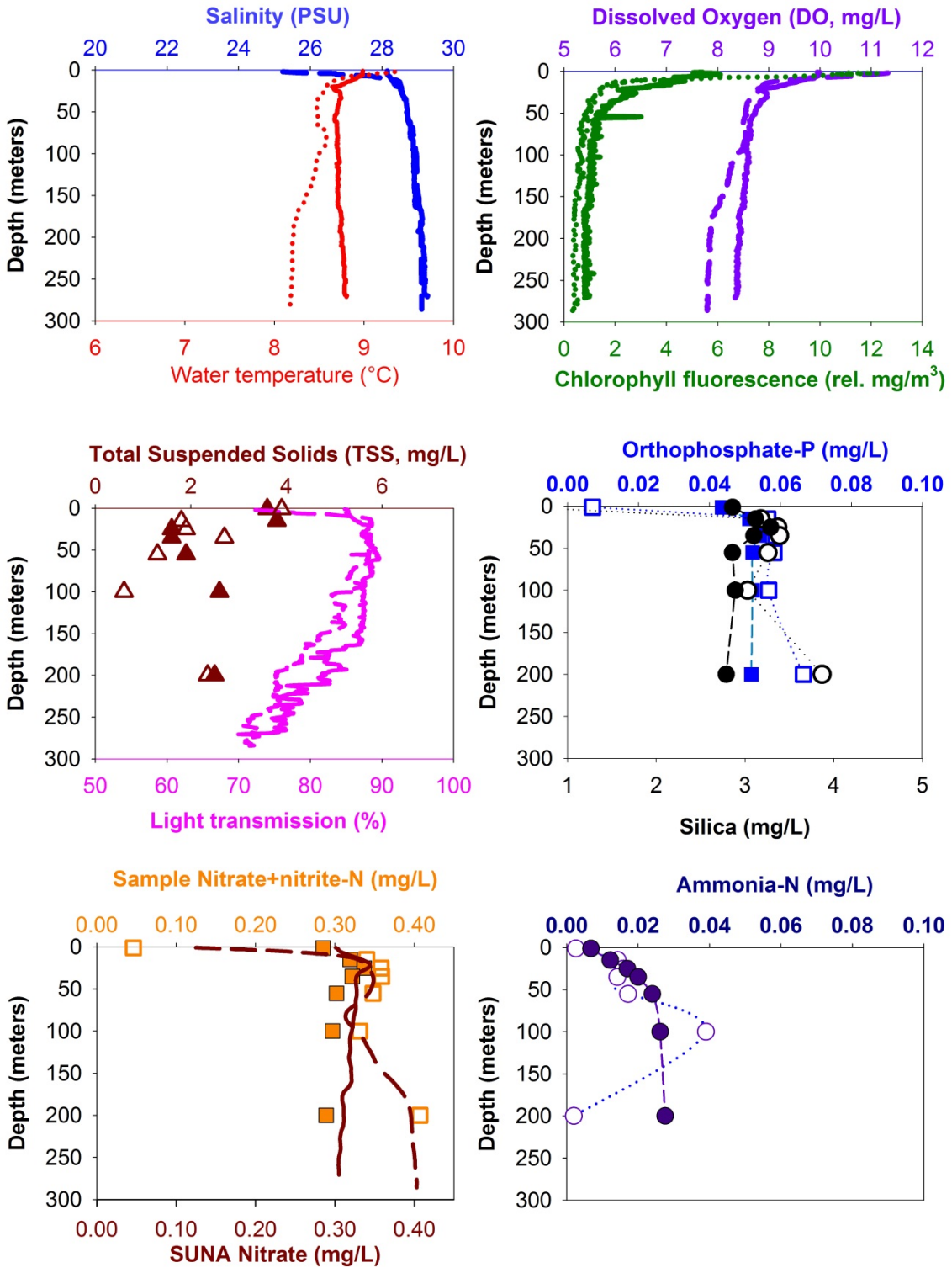

Figure A-2. Offshore water column profile (lines) and discrete water quality results (points) from the second two weeks of April 2017 at Point Jefferson. Dashed lines and open symbols represent the April 17th/18th sampling event and solid lines and solid symbols represent the April 26th sampling event. 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

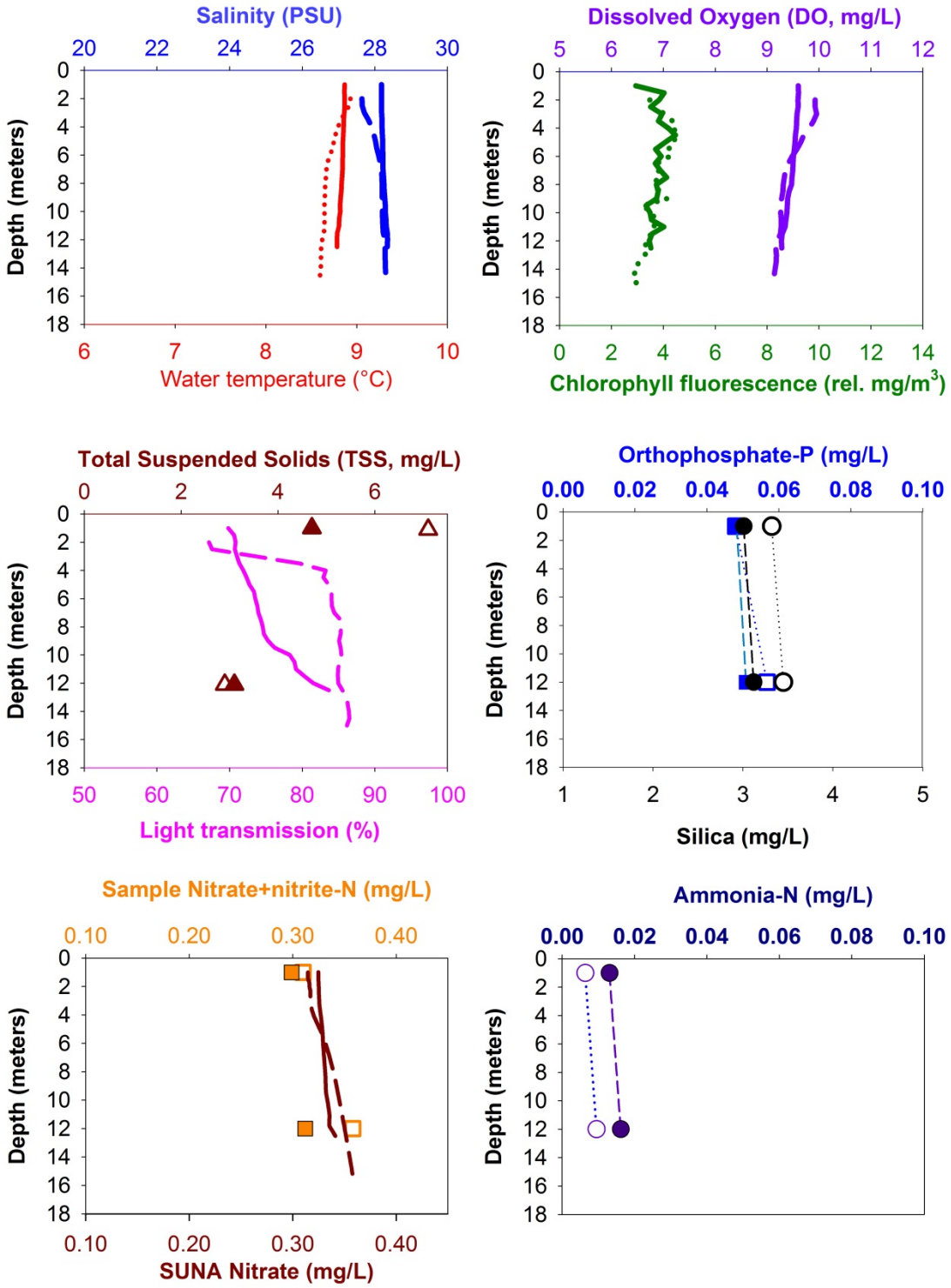

Figure A-3. Offshore water column profile (lines) and discrete water quality results (points) from the second two weeks of April 2017 at West Point's emergency bypass outfall. Dashed lines and open symbols represent the April 17th/18th sampling event and solid lines and solid symbols represent the April 26th 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

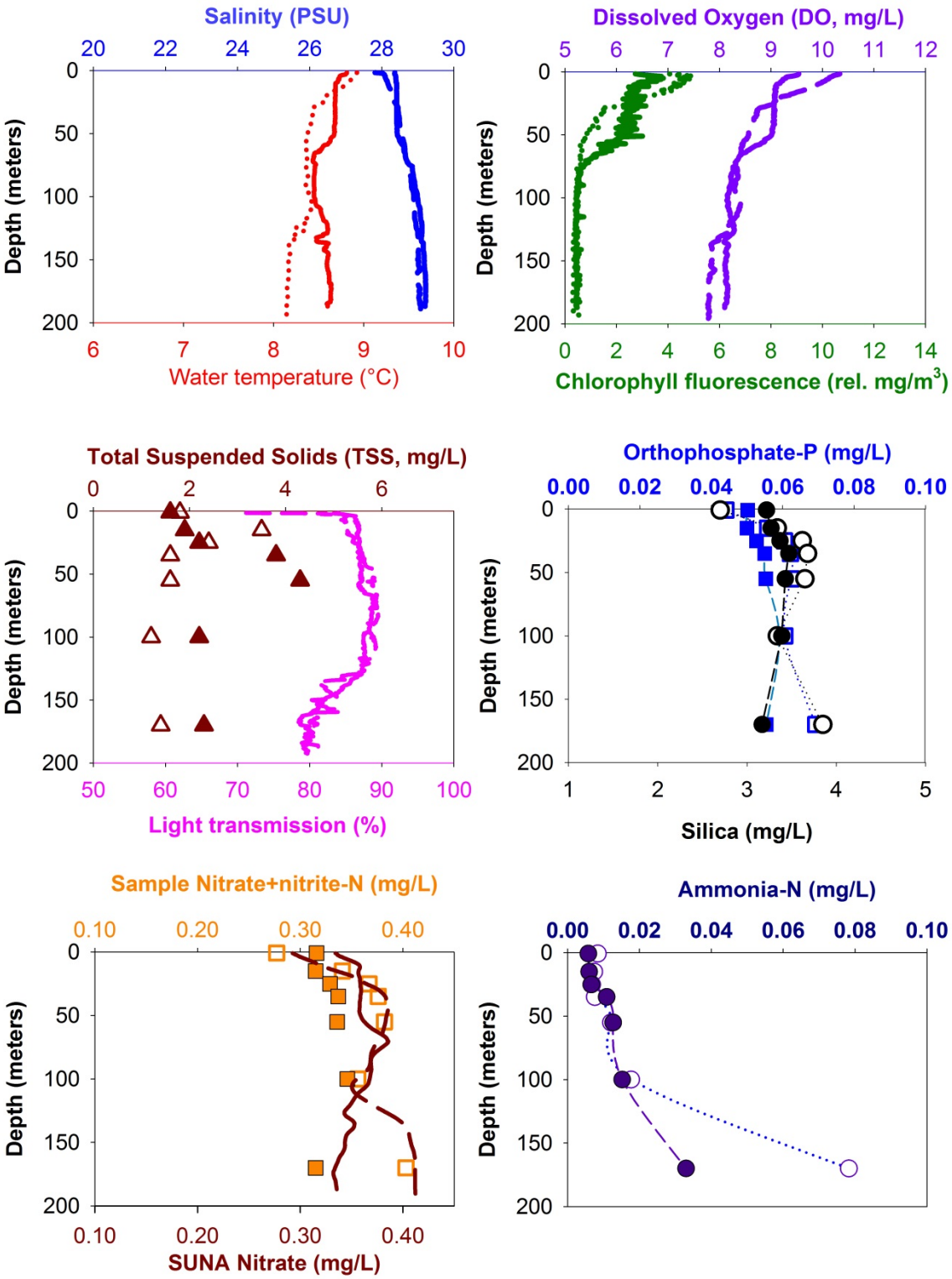

Figure A-4. Offshore water column profile (lines) and discrete water quality results (points) from the second two weeks of April 2017 at the South Plant Outfall. Dashed lines and open symbols represent the April 17th/18th sampling event and solid lines and solid symbols represent the April 26th sampling 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

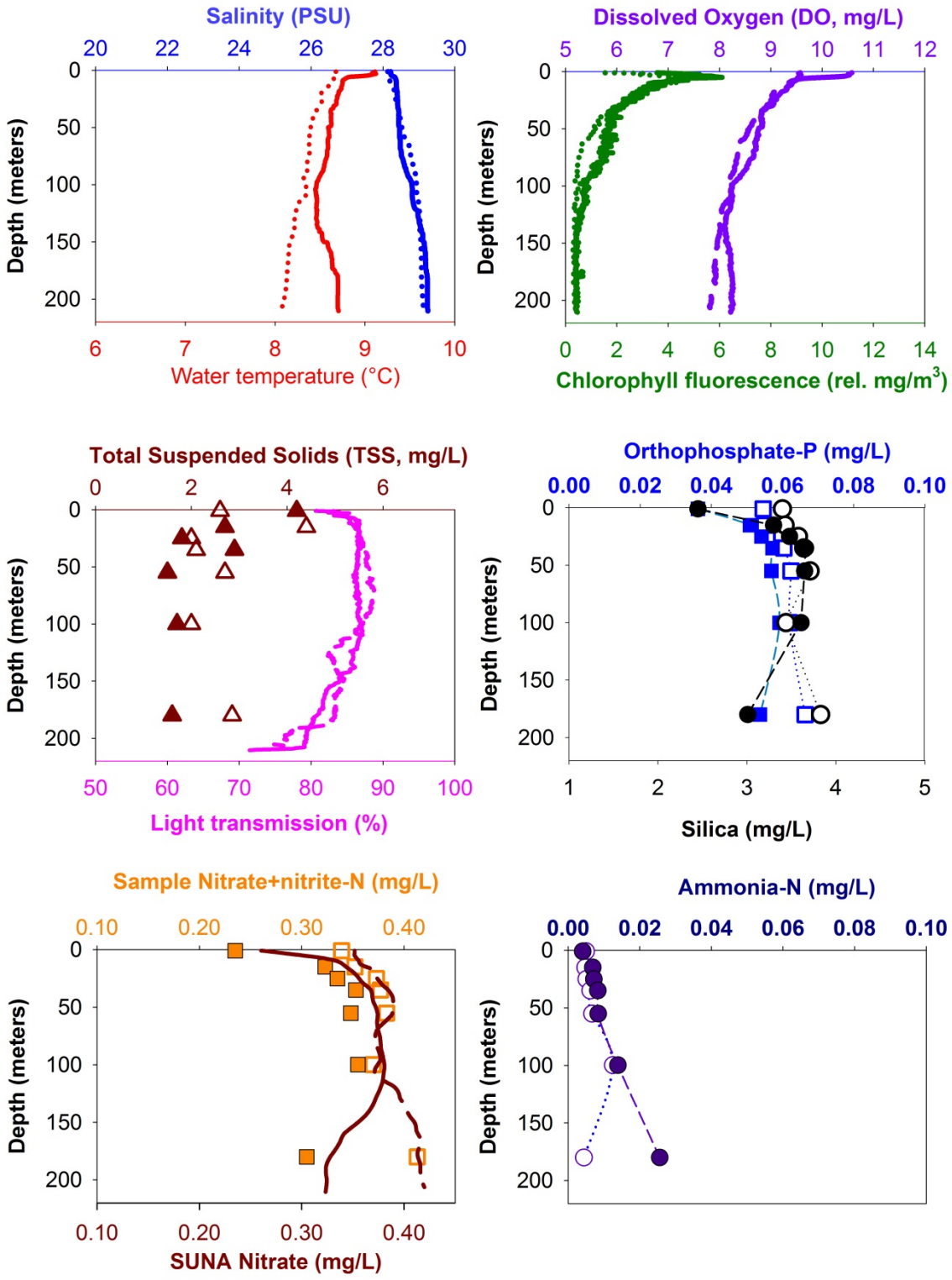

Figure A-5. Offshore water column profile (lines) and discrete water quality results (points) from the second two weeks of April 2017 at Point Williams. Dashed lines and open symbols represent the April 17th/18th sampling event and solid lines and solid symbols represent the April 26th sampling event. 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

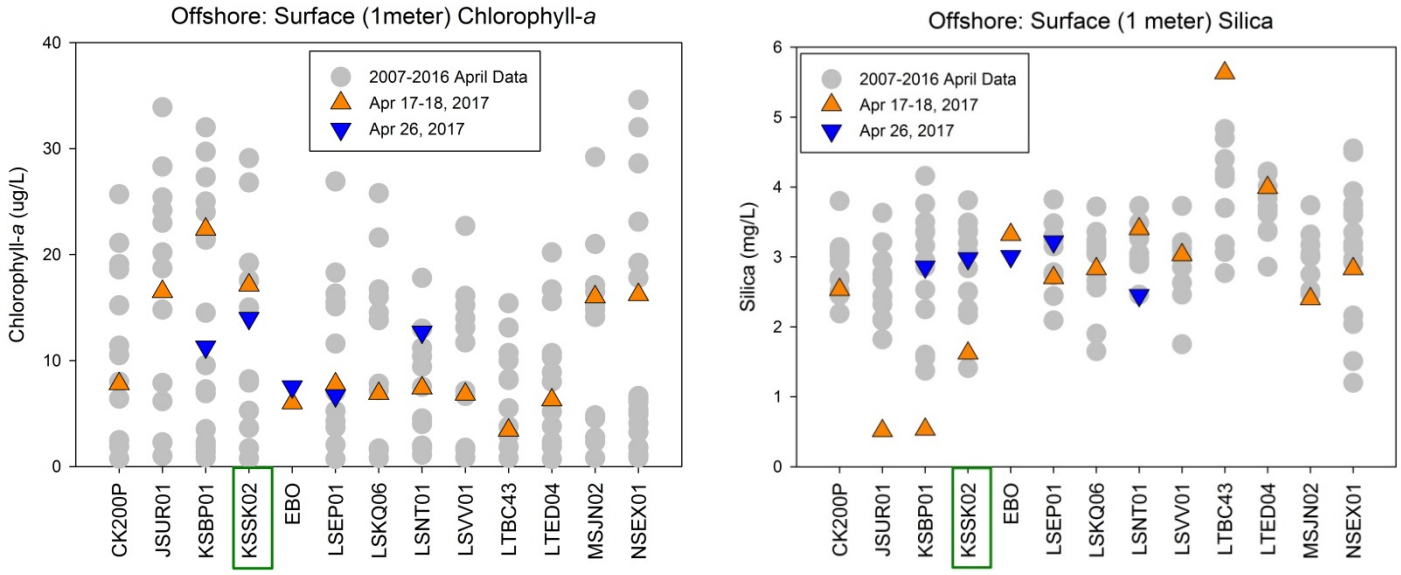

Figure A-6. Offshore surface water results for chlorophyll-*a* (on left) from the second two weeks in April 2017. Chlorophyll-*a* is a pigment present in phytoplankton and is used as an indicator of phytoplankton biomass. The high values in mid-April indicate the presence of the spring phytoplankton bloom, particularly in the northern and southern areas of the Central Puget Sound Basin. Offshore surface water results for silica are shown on the right. The low values in mid-April at the northernmost stations (sites JSUR01 and KSBP01) are due to phytoplankton uptake. Nitrate/nitrite (not shown) also show the same low values at the surface due to phytoplankton uptake.

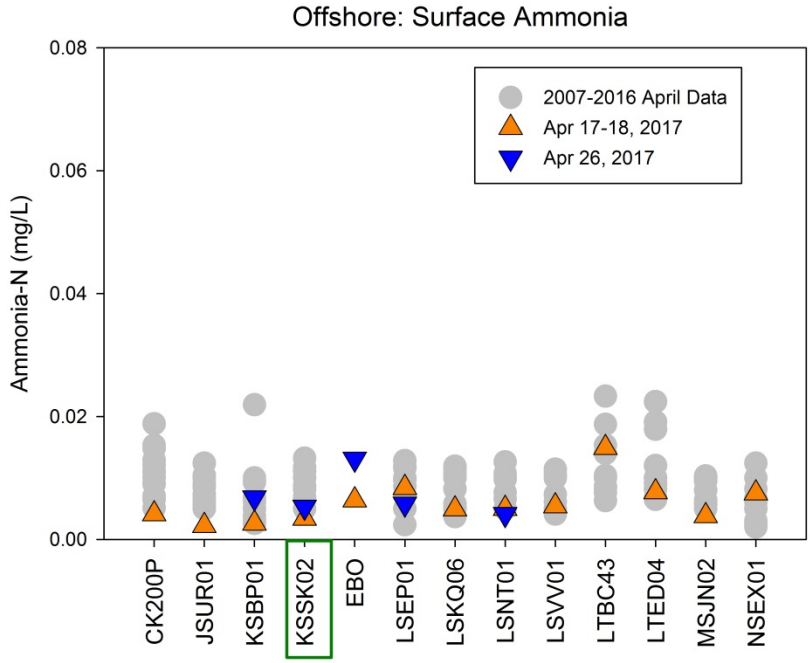

Figure A-7. Offshore surface water results for ammonia from the second two weeks in April 2017. The West Point outfall station is indicated by the green box.

Fecal Indicator Bacteria: Offshore and Beaches

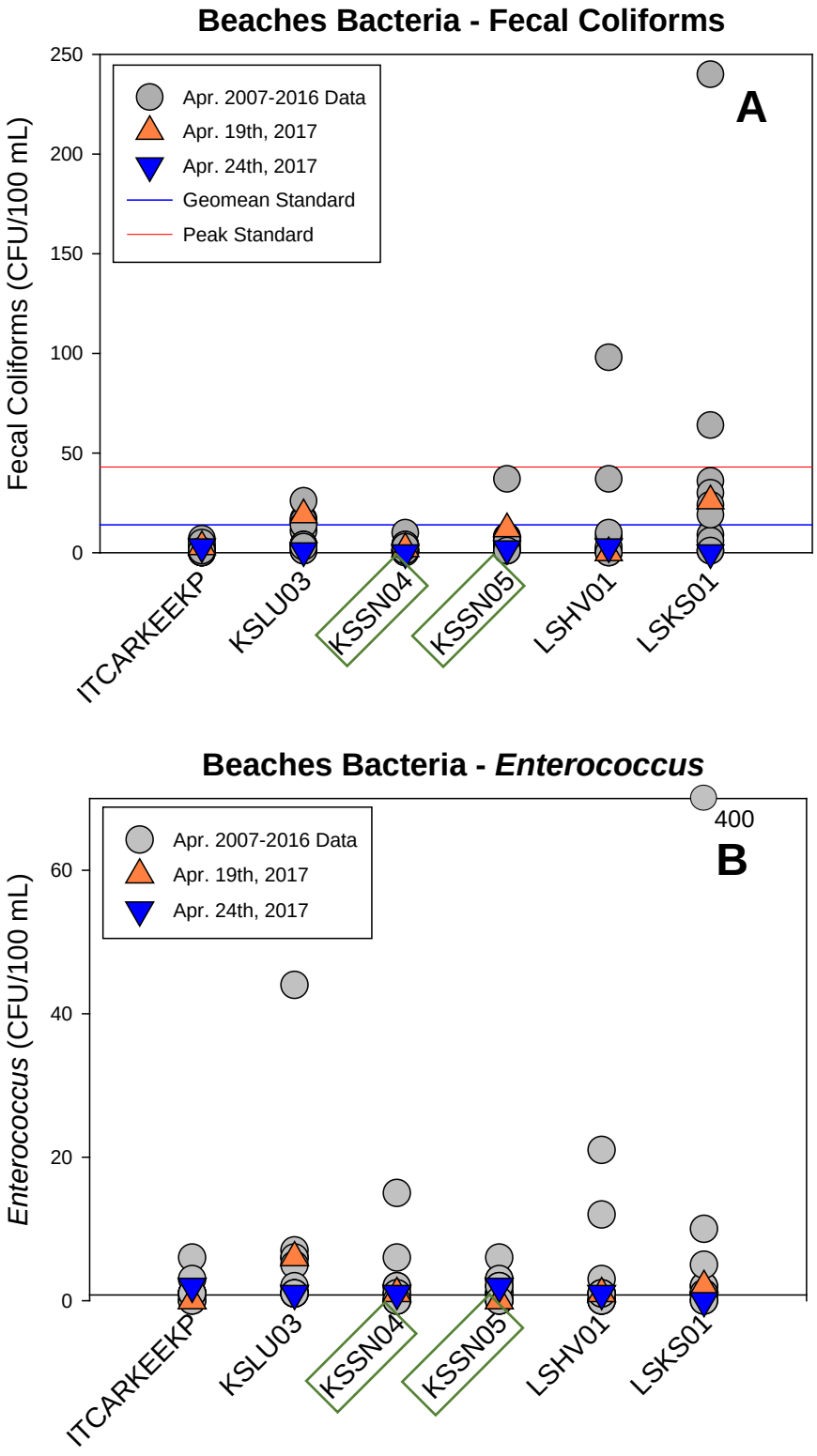

Figure A-8. Bacteria concentrations (**A.** Fecal coliforms; **B.** *Enterococcus*) of single samples collected at a subset of beach stations during the second two weeks of April 2017 sampling event are illustrated with historical bacteria concentrations. Although not appropriate to compare single samples 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 second two weeks of April, 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	4/17/2017	1.0	0	0
	KSSK02	4/17/2017	1.2	0	0
	KSSK02	4/17/2017	25.2	0	0
	KSSK02	4/17/2017	54.9	0	1
	EBO	4/17/2017	1.1	0	0
	EBO	4/17/2017	12.1	0	0
	LSEP01	4/18/2017	1.1	0	0
	LSEP01	4/18/2017	100.0	0	0
	LSEP01	4/18/2017	170.0	1	1
	LSNT01	4/18/2017	1.0	0	0
	KSBP01	4/26/2017	1.0	0	0
	KSSK02	4/26/2017	1.0	0	3
	KSSK02	4/26/2017	12.1	0	0
	KSSK02	4/26/2017	54.9	0	1
	EBO	4/26/2017	1	0	2
	EBO	4/26/2017	12.1	0	0
	LSEP01	4/26/2017	1.0	0	0
	LSEP01	4/26/2017	99.9	0	0
	LSEP01	4/26/2017	170.0	0	0
	LSNT01	4/26/2017	1.0	0	0
Beaches	ITCARKEEKP	4/19/2017	--	3	0
	KSLU03	4/19/2017	--	19	6
	KSSN04	4/19/2017	--	2	1
	KSSN05	4/19/2017	--	12	0
	LSHV01	4/19/2017	--	0	1
	LSKS01	4/19/2017	--	26	2
	ITCARKEEKP	4/24/2017	--	3	2
	KSLU03	4/24/2017	--	1	1
	KSSN04	4/24/2017	--	0	1
	KSSN05	4/24/2017	--	2	2
	LSHV01	4/24/2017	--	3	1
	LSKS01	4/24/2017	--	0	0

Beach Nutrients: Nitrate + Nitrite

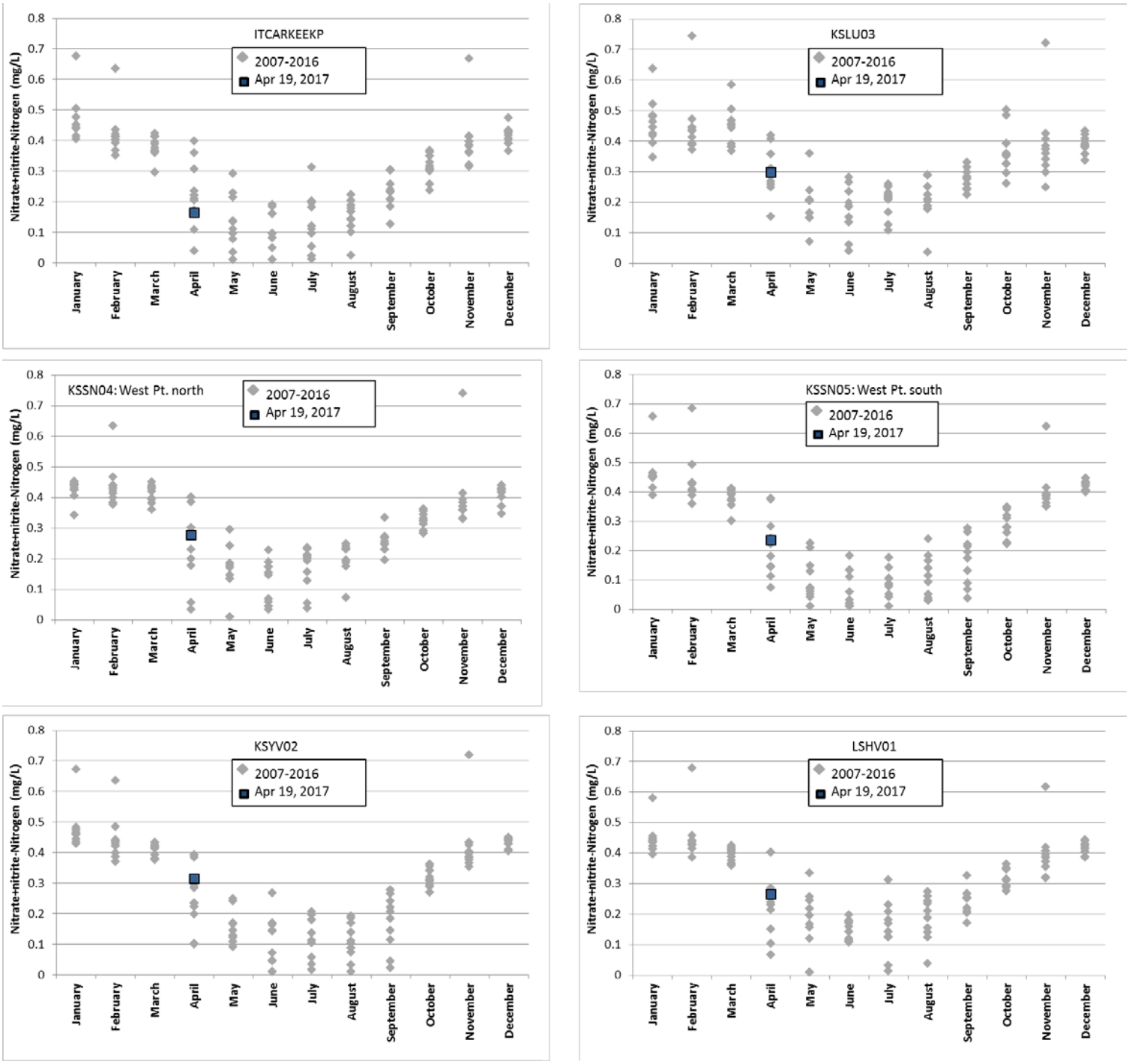

Figure A-9. Nitrate+nitrite values for six beach stations sampled on April 19th, 2017 (blue squares) compared to historical values for April. Additional months are shown to indicate the yearly seasonal cycle and where the current month falls in that cycle.

Beach Nutrients: Ammonia

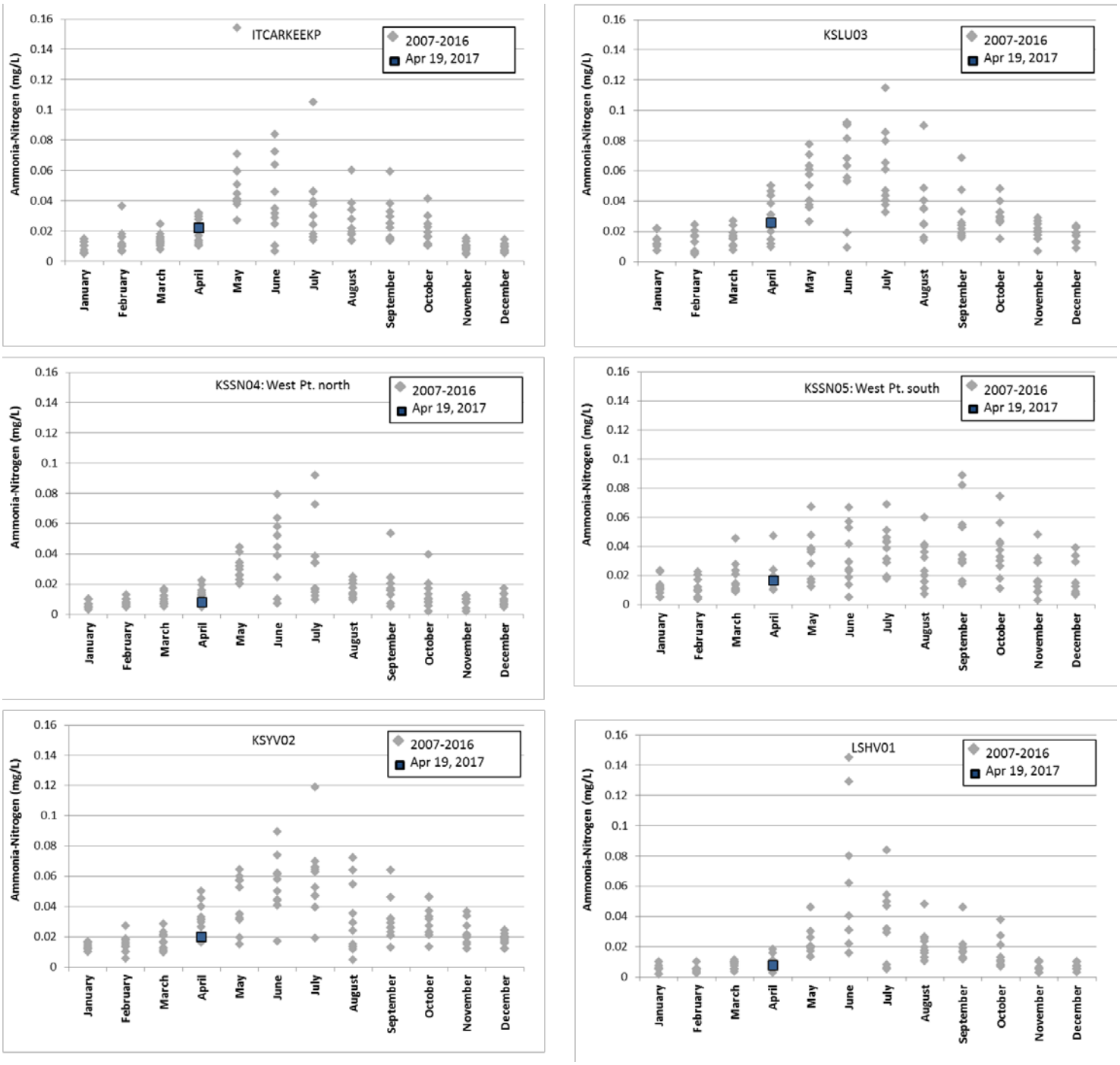

Figure A-10. Ammonia values for six beach stations sampled on April 19th, 2017 (blue squares) compared to historical values for April. Additional months are shown to indicate the yearly seasonal cycle and where the current month falls in that cycle.