Evaluation of Water Quality of Gannon Slough Before and After Tide Gate Replacement

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Introduction: Water quality monitoring to understand the conditions within Gannon Slough, tributary to Humboldt Bay, California was undertaken in July 2006. This effort was an attempt to document the effects on the upstream environment before and after the placement of a new tide gate which augments and existing 3 gate structure. The new tide gate was expected to partially restore tidal action in the lower reaches of Gannon Slough to increase sediment transport and flood routing while improving fish passage for a variety of aquatic inhabitants that includes ESA-listed species such as coho salmon (*Oncorhynchus kisutch)* while maintaining habitat for resident species such as tidewater gobies (*Eucylcogobius newberryi)*. Consequently, physical changes to the channel and the flow regime will be expected to create more variable water quality conditions typical of estuarine areas. While the study period was brief, collection of water quality data was expected to document baseline conditions prior to tide gate installation and initial effects of the new tide gate on water surface elevation (WSE), salinity, temperature, pH and dissolved oxygen.

An evaluation of the possible effects on water quality is needed to help managers: 1) understand changes to water quality upstream of the tide gate following installation of a new tide gate design and 2) manage the short term adjustments of the tide gate for the survival of a population of tidewater gobies during the summer low flow season.

Methods: A Hydrolab DataSonde ® was installed at each of two locations upstream of the existing tide gate; ~80 meters upstream of the new tide gate location and ~ 50 meters upstream of the confluence of Beith Creek (Figure 1). Sondes were placed for two weeks prior to and two weeks following tidegate replacement that occurred on July 17, 2006. Both sondes were programmed to monitor water temperature, specific conductance, salinity, pH, and dissolved oxygen at 30-minute intervals. The sonde placed at Site 1 also monitored water surface elevation (WSE) by recording depth relative to a known nearby elevation. Procedures for calibration, instrument installation, and quality assessment and control followed guidelines set forth in the protocol established by the Arcata Fish and Wildlife Office (Turner and Zedonis, 2006). Data from these instruments were analyzed in spreadsheets designed to evaluate the quality of each dataset. This will complement sonde data collected by Jeff Anderson Consulting Engineers downstream of the tide gate.

Results: Gannon Slough exhibited larger variations of Water Surface Elevation at Site 1 following the replacement of the tide gate relative to pre project conditions (Figure 2). The increase in tidal exchange likely drove changes in other water quality parameters. Effects on salinity were not easily discernable while temperature appeared to be more heavily influenced by the increased volume of bay water entering the slough. Maximum water temperatures were higher and diurnal swings were larger. Maximum pH appeared to be reduced alongside a stronger correlation to the mixed diurnal nature of the tides. Problems occurred with brand new dissolved oxygen probes at both sites which allowed water to enter the probe. The data for DO appears corrupted and is not reported here.

Site 2 did not record WSE but changes can be inferred by examination of salinity levels (Figure 3). Higher and more sustained salinity levels occurred following replacement of the tide gate. Additionally, daily salinity minimums were lower due to the ability of the slough to drain faster and more completely at ebb tides. Water temperature appeared to

undergo more rapid changes, perhaps due to reduced thermal mass at low tide followed by a sudden influx of bay water. At this upper site, pH showed similar patterns of the lower site, reduced daily maximums and a transition to a mixed diurnal signature.

Examination of similar 24 hour tidal cycles before and after replacement of the tide gate allows for a more detailed evaluation of the water quality parameters. Figures 4 and 5 compare DataSonde readings at ½ hour intervals over this shorter 24 hour time period to better visualize the changes to water quality. At site 1, WSE was lower at low tide and higher at high tide following replacement of the tide gate (Figure 4). Salinity did not show reduced levels during the lower low tide but were lower during the higher low tide. Water temperature was higher following tide gate replacement while pH was similar with a slight reduction during the higher low tide. Site 2 recorded an increase in diurnal swing of salinity and pH alongside higher water temperatures than prior to the tide gate replacement (Figure 5).

Future Monitoring Needs: Future water quality monitoring should consist of additional sonde deployments during a period that contains a similar tidal cycle that was monitored the previous season. Monitoring for WSE will document the physical changes in the channel that drive parameters such as salinity, temperature, pH and dissolved oxygen. Species such as the tidewater goby are known to inhabit a wide range of water quality conditions. However, increases in the rate of change of parameters such as WSE and salinity may impact known or assumed thresholds of tolerable habitat conditions. Future monitoring of these parameters can be compared against pre project data in order to make any appropriate adjustments to the new tide gate to ensure habitable conditions exist for the tidewater goby.

Citations:

Turner R., and P. Zedonis, 2006. Arcata Fish and Wildlife Service's 2006 Multiprobe Maintenance and Deployment Protocol. U.S. Fish and Wildlife Service, In Press.

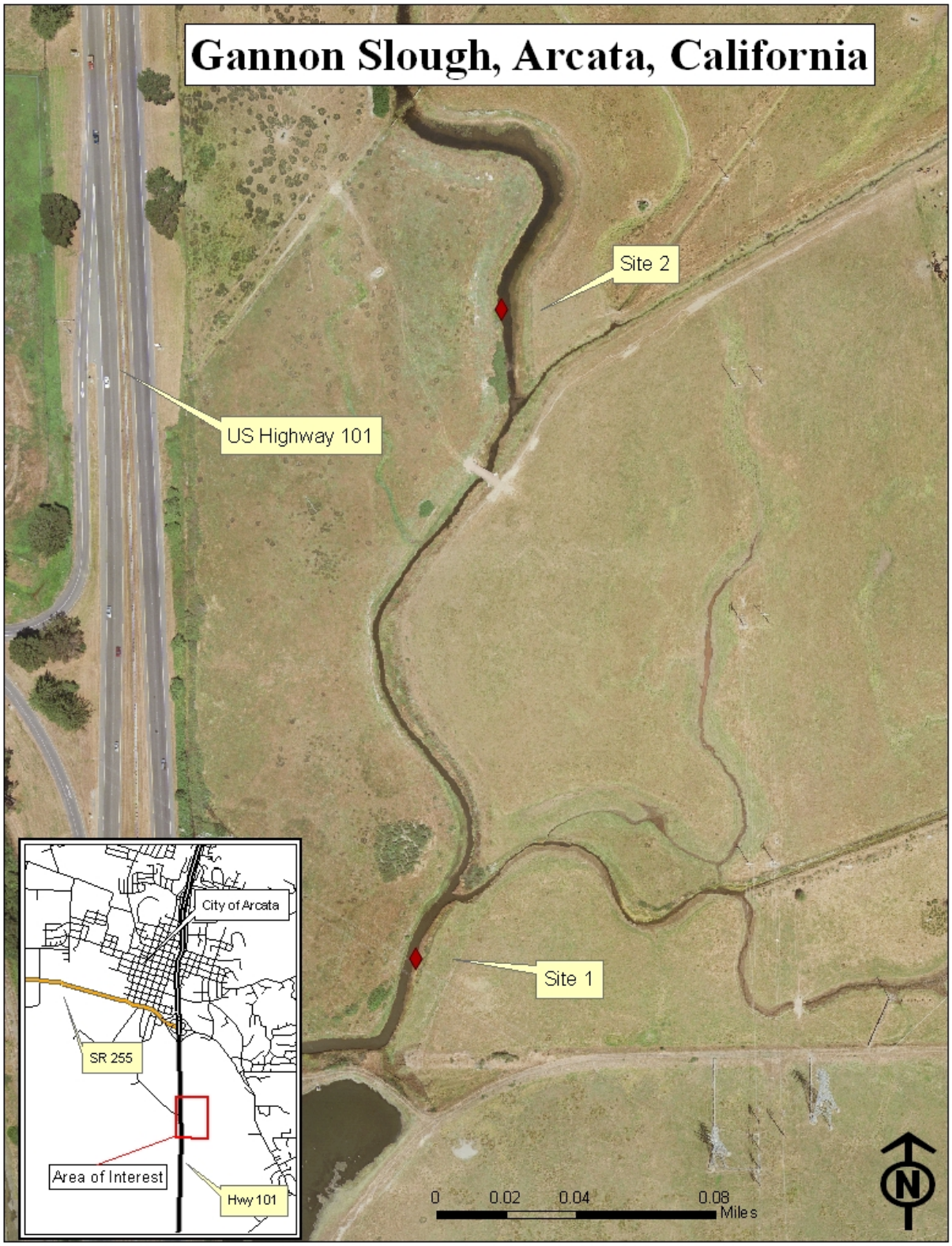

Figure 1. Map of Gannon Slough, Arcata, California with water quality monitoring sites.

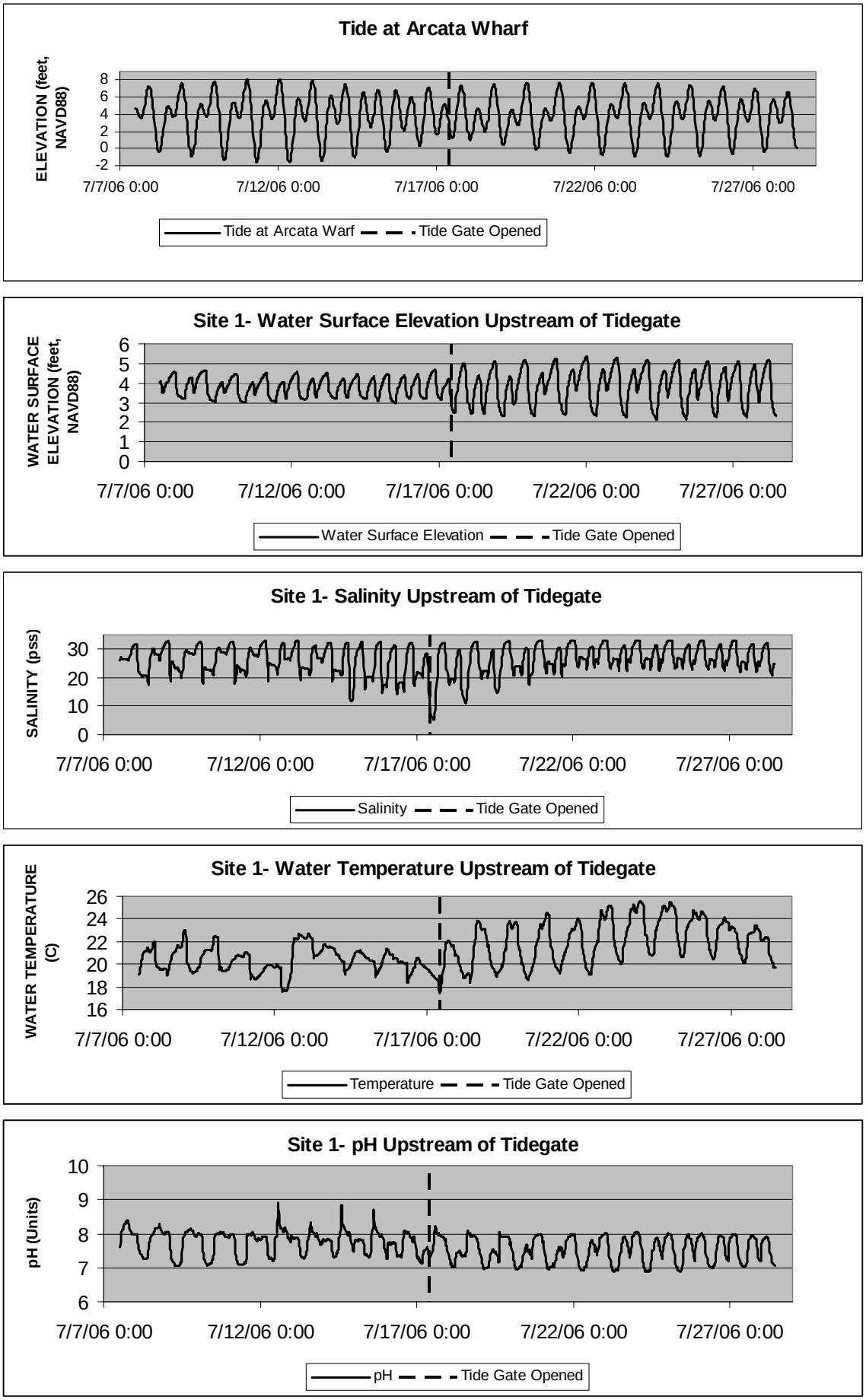

Figure 2. Tide level and water quality parameters at site 1.

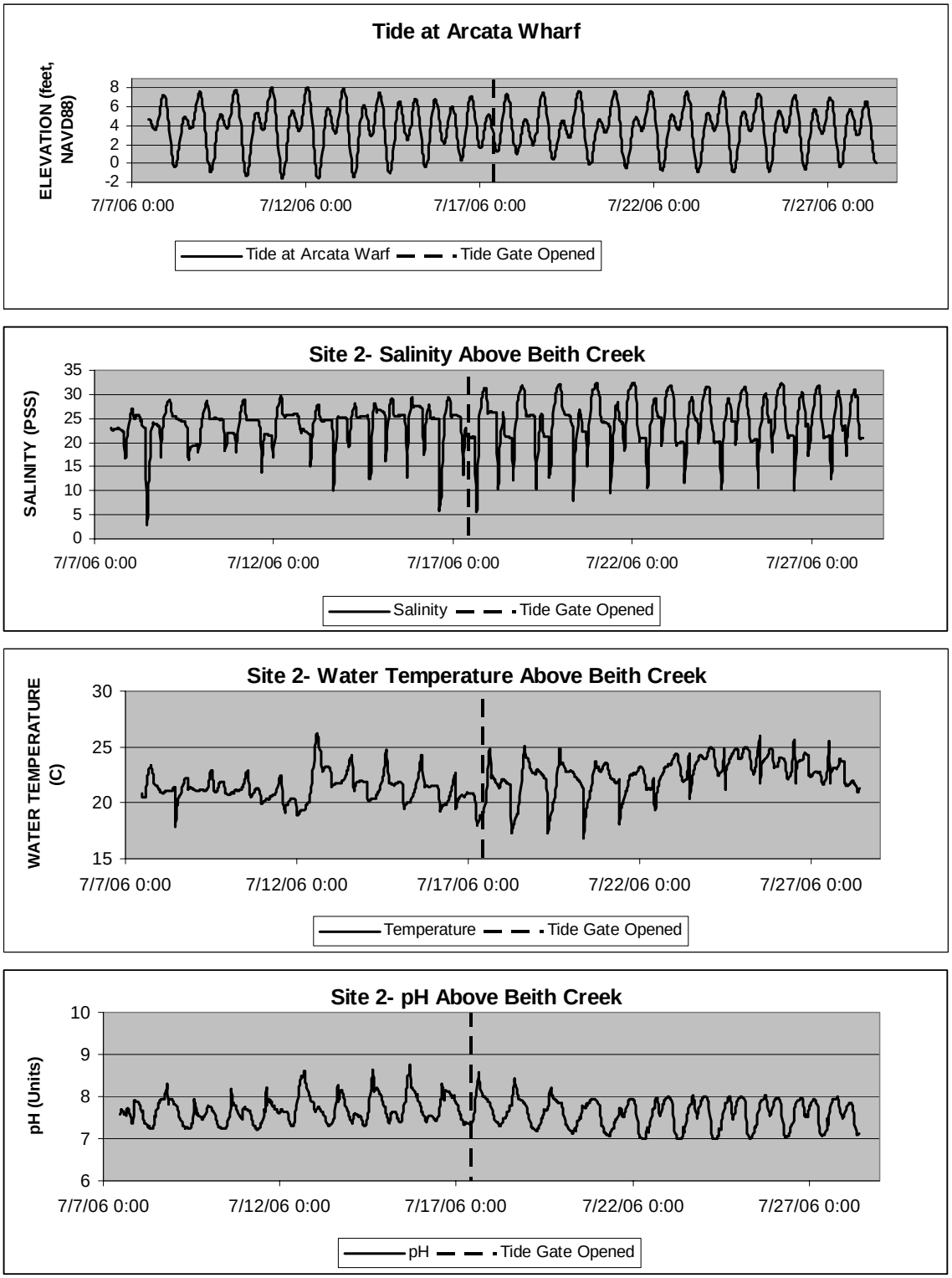

Figure 3. Tide level and water quality parameters at Site 2.

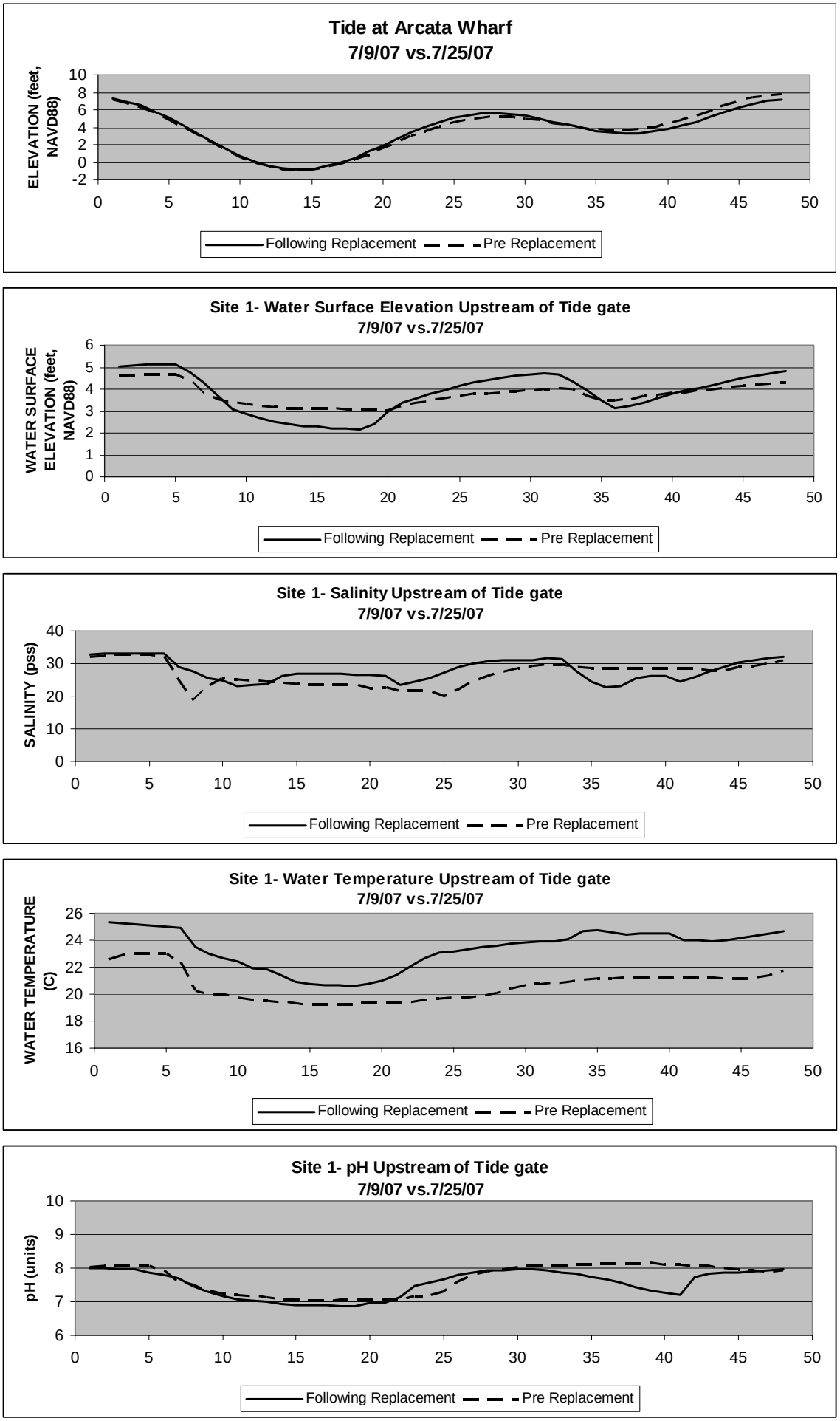

Figure 4. Tide level and water quality parameters at Site 1, 7/9/07 and 7/25/07

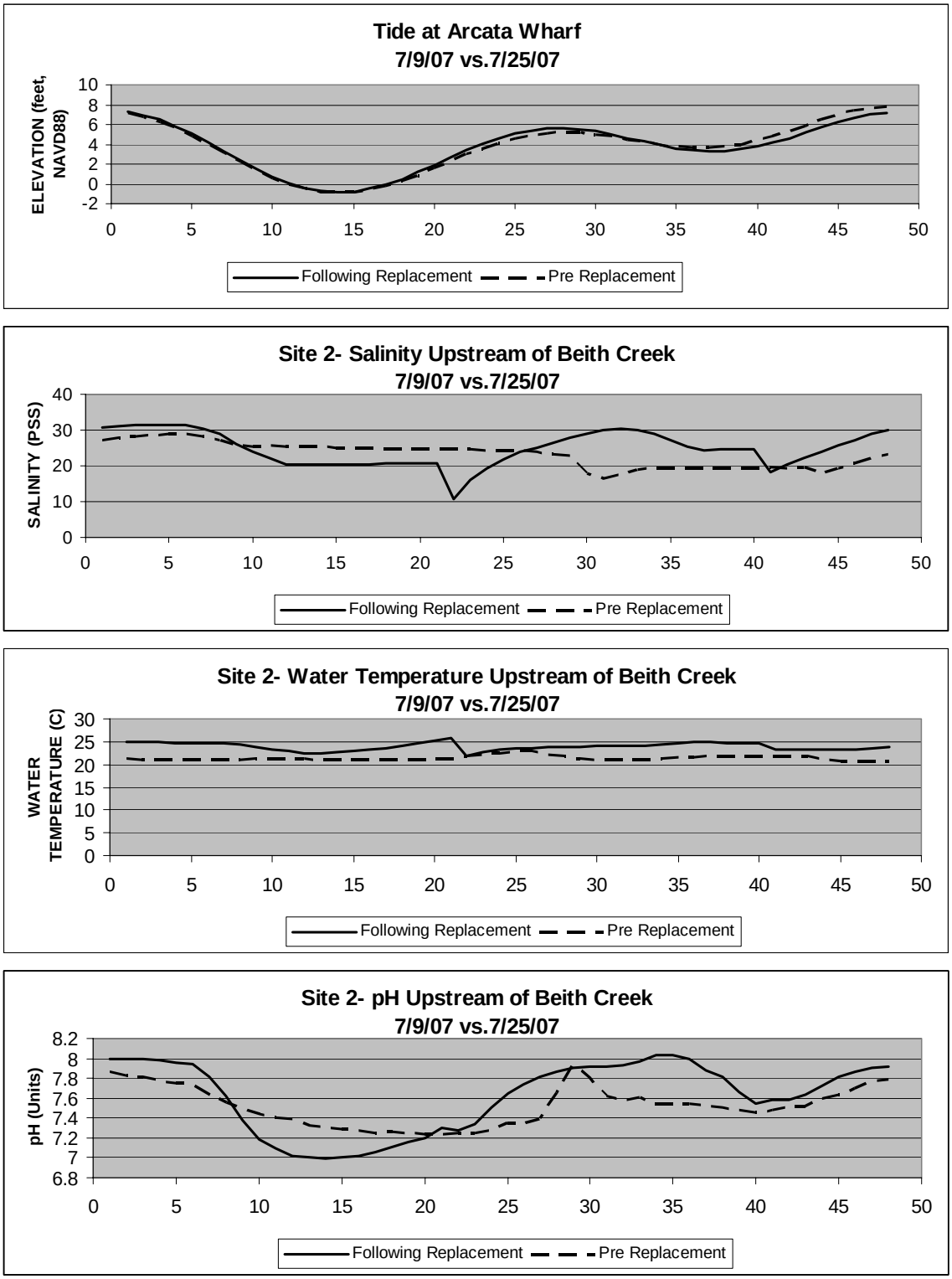

Figure 5. Tide level and water quality parameters at Site 2, 7/9/07 and 7/25/07.