Exhibit A-1

STANFORD CARR DEVELOPMENT, LLC

August 4, 2011

Mr. Watson Okubo
State of Hawaii, Department of Health
Clean Water Branch
919 Ala Moana Blvd. Room 301
Honolulu, HI 96814

Via PDF Only unless hardcopy is requested.

Re: State Land Use District Boundary Amendment Docket A9-721 Condition No. 10, County of Maui Zoning Ordinance 3613 Condition No. 19, Marine Water Quality Monitoring.

Dear Mr. Okubo

ATC Makena Holdings, LLC, in compliance with the above referenced conditions, respectfully submits the enclosed Marine Water Quality Monitoring Report prepared by Marine Research Consultants, Inc. dated May 13, 2011, for tests performed on March 6, 2011.

Should you have any questions, require a hardcopy, or require additional information please do not hesitate to contact me at (808) 547-2253, or by e-mail at bcollins@stanfordcarr.com.

Sincerely,

STANFORD CARR DEVELOPMENT, LLC
For ATC MAKENA HOLDINGS, LLC

Becky Broudy Collins
Vice President

Exhibit A-1

MARINE WATER QUALITY MONITORING

MAKENA RESORT, MAKENA, MAUI

WATER CHEMISTRY

REPORT 1-2011

(March 2011)

Prepared for

ATC Makena Holdings, LLC
c/o Stanford Carr Development, LLC
1100 Alakea St. 27th Floor
Honolulu, HI 96813

By

Marine Research Consultants, Inc.
1039 Waakaua Pl.
Honolulu, Hawaii 96822

Submitted

May 13, 2011

EXECUTIVE SUMMARY

The Makena Resort fronts approximately 5.4 miles of coastline of southeastern Maui, extending from Papanui Stream (Nahuna Point) on the north and Pu`u Olai (Ahihi Bay) on the south. However, only 0.58 miles of the Resort reaches to the actual shoreline. Within the Resort are two 18-hole golf courses (North and South Courses), as well as a hotel, sewage treatment plant and private residences. No part of the project involves direct alteration of the shoreline or nearshore marine environments. In the interest of assuring maintenance of the highest possible quality of the marine environment, condition No. 10 of the Declaration of Conditions pertaining to the Amendment of the District Boundary, as required by the Land Use Commission, dated April 17, 1998 stipulates the implementation of an ongoing marine monitoring program off the Makena Resort Development. Additionally, County of Maui Zoning Ordinance 3613 Condition 19 included requirements for similar monitoring. The primary goals of the program are twofold: 1) to assess the degree that materials used on land to enhance turf growth and landscaping, as well as other nutrient subsidies, leach to groundwater and subsequently reach the ocean, and 2) to determine the fate of these materials within the nearshore zone. In terms of determining fate, the question that is addressed is if the materials that originate from Resort activities disperse with little or no effect, or do they cause changes in water quality sufficient to alter marine biological community structure? The following report fulfils the requirements of these Conditions, and presents the results of water quality monitoring off the Makena Resort conducted on March 6, 2011. The report also incorporates the cumulative data from twenty-four past water chemistry surveys conducted in the area.

Survey methodology includes collection of 62 ocean water samples on four transects spaced along the projects ocean frontage and on one control transect. Site 1 is located at the northern boundary of the project, Site 2 is located near the central part of the Makena North Golf Course in the center of Makena Bay, Site 3A (initiated during the June 2007 survey) is located near the southern boundary of Maluaka Bay, Site 3 was downslope from the part of Makena South Golf Course that comes closest to the shoreline, and Control Site 4 is located to the south of Makena Resort near the northern boundary of the 'Ahihi-Kina`u Natural Area Reserve. Water samples were collected at 7 stations spaced along transects that extended from the shoreline out to the open coastal ocean (about 500 feet). At sampling stations where water depth exceeded about 3 feet, samples were collected at the surface and just above the sea floor. Water samples were analyzed for chemical criteria specified by DOH water quality standards for open coastal waters, as well as several additional criteria. In addition, water samples were collected from five irrigation wells and an irrigation lake located on the golf courses.

Results of analysis of water chemistry showed that constituents that occur in high concentration in groundwater (silica, nitrate-nitrogen) were found to be highest in ocean samples collected nearest to the shoreline, with progressively decreasing values moving away from shore into deeper water. Groundwater nutrient input was highest at Sites 1and 3A, but was also evident at the other three sites (2, 3, and 4). As Site 4 served as a control, and was not located in the vicinity of the Makena Resort, it is apparent that groundwater input is not solely a function of Resort land usage.

Vertical stratification of the water column was also evident on all transects with surface water having higher nutrient concentrations and lower salinities than samples from near the sea floor. The observed patterns of distribution with respect to both distance from shore and depth in the

water column indicate that physical mixing processes generated by tide, wind, waves and currents do not completely mix the water column from top to bottom.

Overall, measurements of turbidity and chlorophyll *a* were low throughout the sampling area, although values were slightly elevated close to the shoreline probably as a result of fragments of benthic algae washed up to the shoreline. These results indicate that at the time of sampling, nutrient input from land was not resulting in increases in plankton populations in nearshore waters. Turbidity in Makena Bay did not reflect a past episode of high runoff of upland soil from a flash flood in October 1999 that resulted in substantial impacts to water clarity within the Bay.

Other organic water chemistry constituents that do not occur in high concentrations in groundwater, such as ammonium nitrogen or organic nitrogen and phosphorus, were consistently low and did not show any distinctive patterns with respect to input from land.

Using an analytical tool that scales nutrient concentrations to salinity indicates that there were measurable increases of nitrate nitrogen in groundwater that enters the nearshore ocean at three survey sites. These subsidies, which are likely a result of land uses involving fertilizers, substantially increase the concentration of nitrate over natural groundwater flowing to the ocean. These subsidies were greatest in magnitude at Site 3, followed in order by Sites 3A and 1, which are located off the Makena Golf Course and adjacent residential areas. No subsidies of nitrate were apparent at Site 2 (Makena Landing) or Site 4 ('Ahihi-Kina`u). These data also indicate that the nutrients from groundwater that enter the ocean, both from natural and the human sources, are not being taken up by biotic communities in the nearshore zone. Rather, nutrients are mixed to background ocean values by physical processes including wind stirring and wave action.

Statistical tests of nutrient concentration scaled to salinity over time show no significant increases or decreases over the years of monitoring at any of the survey sites. The lack of such increases indicate that there has been no consistent change in nutrient input from land (either as an increase or decrease) to groundwater that enters the ocean over the past years.

Comparing values of water chemistry measured in the monitoring program to State of Hawaii Department of Health (DOH) water quality standards revealed that several measurements of nitrogen, phosphorus, turbidity and Chlorophyll *a* exceeded the DOH standards, particularly for "geometric mean" standards. Such exceedances occurred at all survey sites, including the control site that was far from any influence of the Makena Resort. The consistent exceedance of water quality standards is in large part a consequence of the standards lack of consideration of the natural effects of groundwater discharge to the nearshore ocean. Revision of DOH standards to account for such natural input has been implemented for the West Coast of the Island of Hawaii, and will hopefully be extended to the rest of the State in the near future.

As in past surveys, the results of the present monitoring find that there is an increase over natural conditions of dissolved inorganic nutrients (e.g., nitrate and sometimes to a lesser extent phosphate) in groundwater that enters the nearshore ocean at sampling sites downslope from parts of the Makena Resort. Without question, such input is a consequence of various land use activities. However, none of these inputs have increased significantly over time during the course of the monitoring program. The region where the subsidies occur is restricted to narrow zone that extends from the shoreline to several meters offshore, and as such is restricted to an area that is not suitable for coral communities to occur. Surveys of coral reef community structure that are also part of the ongoing monitoring program for the Makena Resort, as well as the noted lack of any nuisance algal aggregations in the nearshore area, indicate that the nutrient subsidies are presently not detrimental to marine community structure.

The next scheduled testing for the Makena Resort monitoring program is planned for the summer-fall season of 2011.

I. PURPOSE

The Makena Resort fronts approximately 5.4 miles of coastline of southeastern Maui, extending from Papanui Stream (Nahuna Point) on the north and Pu`u Olai (Ahihi Bay) on the south. However, only 0.58 miles of the Resort reaches to the actual shoreline. Within the Resort are two 18-hole golf courses (North and South Courses), as well as a hotel, sewage treatment plant and private residences. No part of the project involves direct alteration of the shoreline or nearshore marine environments.

Evaluations of other golf courses and other forms of resort development located near the ocean in the Hawaiian Islands reveal that there is detectable input to the coastal ocean of materials used for fertilization of turfgrass and landscaping (Dollar and Atkinson 1992). However, few, if any, effects that have been documented have been found to be detrimental to the marine ecosystem. Confirmation that the construction and responsible operation of the golf courses and other components of the Makena Resort does not cause any harmful changes to the marine environment requires rigorous and continual monitoring.

In the interest of assuring maintenance of excellent environmental quality in the Makena region, Condition No. 10, Declaration of Conditions pertaining to the Amendment of the District Boundary, as required by the Land Use Commission, dated April 17, 1998 stipulated the implementation of an ongoing marine monitoring program off the Makena Resort Development. In addition, County of Maui Zoning Ordinance 3613 Condition 19 included requirements for similar monitoring. The primary goals of the established monitoring program to satisfy these two requirements are twofold: 1) to assess the degree that materials used on land to enhance turf growth and landscaping, as well as other nutrient subsidies, leach to groundwater and subsequently reach the ocean, and 2) to determine the fate of these materials within the nearshore zone. In terms of determining fate, the question that is addressed is if the materials that originate from Resort activities disperse with little or no effect, or do they cause changes in water quality sufficient to alter marine biological community structure?

The rationale of the monitoring program is to conduct repetitive evaluations of water chemistry at the same locations at regular time intervals (twice per year). This strategy allows for determination of variations in effects from the Makena Resort in both space (at different locations along the shoreline) and time. It should be noted that water chemistry monitoring off the Makena area was initiated in 1995 on a voluntary basis, and has continued uninterrupted until the present. With the implementation of the Boundary Amendment and Zoning Conditions, it was determined that the ongoing voluntary monitoring protocol satisfied the stated requirements. Hence, the entire data set from 1995 onward is considered as part of the monitoring program. The following report presents the results of the twenty-fifth increment in the monitoring program, and contains data from water chemistry sampling conducted on March 6, 2011.

I. ANALYTICAL METHODS

Three survey sites directly downslope from the Makena Resort have been selected as sampling locations. A fourth site, located offshore of an area with minimal land-based development, particularly golf course operations, was selected as a control. During the June 2007 survey, another sampling location was added near the southern boundary of Maluaka Bay. It is anticipated that this station will remain part of the sampling protocol permanently. Figure 1 is a map showing the shoreline and topographical features of the Makena area, and the location of the North and South Golf Courses. All survey sites are depicted as transects perpendicular to the shoreline extending from the shoreline out to what is considered open coastal ocean (i.e., beyond the effects of activities on land). Survey Site 1 is located near the northern boundary of the project site off Nahuna Point; Survey Site 2 bisects Makena Bay near Makena Landing. Site 3 bisects the middle of the South course on the north side of Maluaka Point. Site 3A is on the southern corner of Maluaka Bay. Site 4, which is considered the Control site, is located near the northern boundary of the 'Ahihi-Kina`u natural area reserve north of the 1790 lava flow and approximately 1-2 miles south of the existing Makena Golf courses (Figure 1). The control site was located off a shoreline area with minimal land uses (i.e., residences near the shoreline and upslope ranchlands) rather than off the completely uninhabited 1790 lava flow. This location was selected as the most appropriate control site, as it is the farthest location from the Makena Resort with the same geophysical structural of the land area. The completely different geological structure of the lava flow off the natural reserve likely results in very different groundwater dynamics compared to the land area where the Makena Resort is located, hence making the lava flow an unsuitable control site.

In July of 2002, Site 3 was relocated from a location at the southern boundary of the project offshore of Oneloa Beach to the location directly off the Makena Golf Course, as described above. The relocation of Site 3 was deemed necessary as the original location consistently showed virtually no input of groundwater to the ocean. Such lack of groundwater discharge resulted in little potential for evaluating effects from the project. The new location of Site 3 is directly downslope from both the portion of the golf course nearest to the ocean, several newly constructed private residences, and a 3-acre recently restored wetland area. As a result, the new location represents an area that reflects the maximum influence on nearshore water quality from a variety of land uses and natural habitat.

All fieldwork for the present survey was conducted on March 6, 2011. Environmental conditions during sample collection consisted of mild winds (0-5 knots), sunny skies, and very little swell. Sample collection occurred during a tidal range of 0.9 to +0.5 feet. Rainfall measured in a gauge near Makena registered 0.26 inches on March 6, indicating significant rainfall preceding the sampling. In addition, during the weeks preceding the sampling there had been numerous episodes of heavy rainfall. This situation represented a marked change from surveys in 2009-2010 which were conducted during what was considered drought conditions.

Water samples were collected at stations along transects that extend from the highest wash of waves to between150-200 meters (m) offshore (about 500-650 feet), depending on the site. Such a sampling scheme is designed to span the greatest range of salinity with respect to freshwater efflux at the shoreline. Sampling was more concentrated in the nearshore zone because this area is most likely to show the effects of land-based activities. With the exception of the two stations closest to the shoreline (0 and 2 m offshore), samples were collected at two depths; a surface sample was collected within approximately 10 centimeters (cm) (~4 inches) of the sea surface, and a bottom sample was collected within one m (3 feet) of the sea floor.

Water samples from the shoreline to a distance of 10 m offshore were collected in triple-rinsed 1-liter polyethylene bottles by swimmers working from the shoreline. A digital refractometer was used to pinpoint the location of maximum groundwater flux to the ocean shoreline origin of each transect site. Water samples beyond 10 m from the shoreline were collected from a small boat using a 1.8-liter Niskin sampling bottle. This bottle was lowered to the desired depth in an open position where spring-loaded endcaps were triggered to close by a messenger released from the surface. Upon recovery, each sample was placed on ice until further processing in Honolulu. Water samples were also collected from five golf course irrigation wells (No's 2, 3, 4, 6, and10) and one irrigation lake on March 6, 2011.

Water quality parameters evaluated included the 10 specific criteria designated for open coastal waters in Chapter 11-54, Section 06 (Open Coastal waters) of the State of Hawaii Department of Health Water Quality Standards. These criteria include: total nitrogen (TN) which is defined as inorganic nitrogen [nitrate + nitrite nitrogen (NO_3^- + NO_2^-), ammonium (NH_4^+)], plus total organic nitrogen (TON), total phosphorus (TP) which is defined as inorganic phosphorus (PO_4^{3-}) plus total organic phosphorus, chlorophyll *a* (Chl *a*), turbidity, temperature, pH and salinity. In addition, orthophosphate phosphorus (PO_4^{3-}) and silica (Si) were reported because these constituents are sensitive indicators of biological activity and the degree of groundwater mixing, respectively.

Analyses for NO_3^- + NO_2^- (hereafter termed NO_3^-), NH_4^+ and PO_4^{3-}, were performed on filtered samples using a Technicon autoanalyzer according to standard methods for seawater analysis (Strickland and Parsons 1968, Grasshoff 1983). TN and TP were analyzed in a similar fashion on unfiltered samples following digestion. Total organic nitrogen (TON) and Total organic phosphorus (TOP) were calculated as the difference between TN and inorganic N, and TP and inorganic P, respectively. Limits of detection for the dissolved nutrients are 0.01 μM (0.14 μg/L) for NO_3^- and NH_4^+, 0.01 μM (0.31 μg/L) for PO_4^{3-}, 0.1 μM (1.4 μg/L) for TN and 0.1 μM (3.1 μg/L) for TP.

Chl *a* was measured by filtering 300 ml of water through glass fiber filters; pigments on filters were extracted in 90% acetone in the dark at -5°C for 12-24 hours, and the fluorescence before and after acidification of the extract was measured with a Turner Designs fluorometer (level of detection 0.01 μg/L). Salinity was determined using an AGE Model 2100 laboratory salinometer with a precision of 0.003‰.

In situ field measurements included water temperature, pH, dissolved oxygen and salinity which were acquired using an RBR Model XR-420 CTD calibrated to factory specifications. The CTD has a readability of 0.001°C, 0.001pH units, 0.001% oxygen saturation, and 0.001 parts per thousand (‰) salinity. Shoreline salinity was measured in the field using an Atago PAL-06S digital refractometer.

Nutrient, turbidity, Chl *a* and salinity analyses were conducted by Marine Analytical Specialists located in Honolulu, Hawaii. This laboratory possesses acceptable ratings from EPA-compliant proficiency and quality control testing.

III. RESULTS and DISCUSSION

A. General Overview

Table 1 shows results of all marine water chemical analyses for samples collected off Makena on March 6, 2011 with nutrient concentrations reported in micromolar units (μM). Table 2 shows similar results with nutrient concentrations presented in units of micrograms per liter (μg/L). Tables 3 and 4 show geometric means of ocean samples at Sites 1, 2 and 4 for 25 surveys, 16 surveys at Site 3, and 7 surveys from Site 3A, with nutrient concentrations shown in μM and μg/L, respectively. Table 5 shows water chemistry measurements (in units of μM and μg/L) for samples collected from irrigation wells and one irrigation lake located on the Makena Resort Golf Courses. Concentrations of twelve chemical constituents in surface and deep-water samples from the March 2011 sampling are plotted as functions of distance from the shoreline in Figures 2 and 3. Mean concentrations (±standard error) of twelve chemical constituents in surface and deep water samples as functions of distance from the shoreline at Sites 1-4 collected since 1995 and from Site 3A collected since 2007are plotted in Figures 4-18. In addition, data from the most recent sampling in March 2011 are also plotted on Figures 4-18.

During the March 2011 sampling, nearshore concentrations of dissolved Si, NO_3^- and TN on all five transects were elevated up to three orders of magnitude compared to samples collected at the farthest from shore (Figure 2, Tables 1 and 2). The horizontal gradients of nutrients were steepest on transect Sites 1 and 3A where NO_3^- at the shoreline (177 μM and 322 μM, respectively) was about 1,000-fold higher than the surface samples collected at the seaward ends of transects. At transect Sites 2, 3, and 4, peak values of NO_3^- at the shoreline (10, 41 and 16 μM, respectively) were about 100-fold higher than surface samples collected at the seaward ends of the transects (Figure 2, Table 1). Salinity displayed mirror images of the patterns for nutrients, with lowest salinity at the shoreline and rapidly increasing values with increasing distance from shore to near oceanic values (35‰) at the ends of the transects (Figure 3, Table 1). The lowest salinities were measured at the shorelines of Sites 1 and 3A with values of 7.1‰ and 3.5‰, respectively. Distinct horizontal gradients of salinity extended to a distance of 50-100 m from the shoreline at all five transect sites (Tables 1 and 2).

Horizontal gradients in the surface concentrations of phosphate phosphorus (PO_4^{3-}) and TP were also evident, with the steepest gradients at Sites 1 and 3A. Highest values in the samples collected near the shoreline, and progressively lower concentrations with increasing distance from shore. While there were distinct gradients in the concentrations of PO_4^{3-}, the magnitude of the range in values was far less than for Si, NO_3^- and TN (Figure 2, Tables 1 and 2) and the gradient extended out only to a distance of no more than 50 m from the shoreline. At site 3, no horizontal gradients were evident for PO_4^{3-} or TP during the March 2011 survey.

With no streams in the sampling area, nor heavy rainfall and subsequent surface runoff preceding sampling, the pattern of elevated Si, NO_3^-, PO_4^{3-} and TN with corresponding reduced salinity indicates groundwater entering the ocean near the shoreline. Low salinity groundwater, which contains high concentrations of Si, NO_3^-, TN and PO_4^{3-} (see values for well waters in Table 5), percolates to the ocean near the shoreline, resulting in a distinct zone of mixing in the nearshore region. The zone of mixing is discernible by distinct decreasing gradients of nutrients and increasing gradients of salinity with distance from shoreline. During periods of low tide when sea conditions are calm, the zone of mixing between groundwater and ocean water is most pronounced. The March 2011 sampling was conducted at low tide (~0.0 ft) with calm winds, resulting in a detectable zone of mixing extending through most of the sampling transects. Past monitoring surveys at Makena Resort conducted during periods of high tide and strong winds (e.g. December 2005) showed substantially smaller horizontal gradients than the present survey. Comparing the results of surveys conducted during different sea conditions clearly indicates that tidal state, as well as wind and wave energy, greatly effect groundwater mixing in the nearshore zone.

Dissolved nutrient constituents that are not usually associated with groundwater input (NH_4^+, TON, TOP) did not exhibit distinct horizontal gradients across the sampling transects (Table 1, Figure 2). The two highest concentrations of NH_4^+ were recorded in the shoreline sample at Control Site 4 (1.1 μM) and in the deep bottom sample 150 m from shore on the same transect (1.49 μM) (Table 1).

Turbidity was highest near the shoreline on all transects, with the exception of transect 3, where peak turbidity (0.60 ntu) occurred in the deep sample 10 m from the shoreline (Table 1, Figure 3). In previous surveys, turbidity has generally been highest on Transect 2 compared to the other sites. However, this was not the case in the present survey, nor was it the case in the previous survey in July 2010. Transect 2 bisects Makena Bay, which is semi-enclosed embayment with a silt/sand bottom rather than the predominantly "hard" reef or sand bottoms that occur at the other transect sites. In addition, it has been observed that during flash floods originating in the ranch lands upslope of the Makena Resort, terrigenous sediment may flow to the ocean in Makena Bay. As a result of wave-induced resuspension of the naturally occurring silt/sand substratum, as well as terrigenous runoff which may be partially retained within the embayment, turbidity has often been elevated on transect 2 relative to the other transect sites. It is important to note that in surveys conducted since July 2002, water clarity in Makena Bay has improved greatly compared to preceding surveys in 2001 which reflected conditions following substantial input of terrigenous materials from a flash-flood that occurred in October 1999. Since that time, a large retention basin has been constructed on the upper slopes of Makena Resort in the watershed that flows into Makena Bay.

Concentrations of Chl *a* were higher near the shoreline compared to offshore values at five survey sites in March 2011. Site 1 had a distinctly higher shoreline value (2.43 μg/L) compared to all other sites (Table 1 and Figure 3). Surface water temperature ranged between 24.3°C and 27.0°C during the March 2011 survey with the highest temperatures near the shoreline (Figure 3 and Tables 1 and 2).

In many areas of the Hawaiian Islands, input of low salinity groundwater to the nearshore ocean creates a distinct buoyant surface lens that can persist for some distance offshore. Buoyant surface layers are generally found in areas where turbulent processes (primarily wave action) are insufficient to completely mix the water column in the nearshore zone. Figures 2 -18 and Tables 1 and 2 show concentrations of water chemistry constituents with respect to vertical stratification. During the March 2011 survey, vertical stratification was evident for Si, NO_3^-, TN and salinity along all transects with the most pronounced gradients.

With respect to the other constituents of water chemistry, variations between surface and deep samples were generally small and showed no apparent trend with distance offshore (Figures 2-18).

B. Temporal Comparison of Monitoring Results

Figures 4-18 show mean concentrations (±standard error) of water chemistry constituents from surface and deep samples at Transect Sites 1-4 from monitoring surveys conducted between 1995 and 2011 and from Site 3A for monitoring surveys conducted from 2007 to 2011. In addition, the results of the most recent survey in March 2011 are also shown on each plot.

With a few exceptions, surface concentrations of Si, NO_3^- and TN during the March 2011 survey exceeded the mean plus standard error of past surveys on all transects except Control transect 4 (Figures 4-18). Deviations from the means were most notable at Site 1 where values of Si and NO_3^- were over 3-fold higher than the mean values (Figure 4), while salinity at the shoreline was about 5-fold lower than the overall survey mean (Figure 6). Smaller exceedances of the mean shoreline values occurred at transect sites 2, 3 and 3A (Figures 7, 10 and 16). Turbidity at the shoreline during the present survey was also higher than mean values at all five sites. At sites 3, 3A and 4, however, the differences were evident only within 5 m of the shoreline (Figures 12, 15 and 18). Measurements of Chl *a* at the shoreline during the March 2011 survey were distinctly higher than survey mean values at transect sites 1 and 3A, and lower than survey means at transect sites 2, 3 and 4 (Figures 6, 9, 12, 15 and 18). All of these variations between the values measured in the most recent survey, and the overall survey means can be a result of sampling during a period of particularly low mixing of groundwater and ocean water in the nearshore zone.

C. Conservative Mixing Analysis

A useful treatment of water chemistry data for interpreting the extent of material input from land is application of a hydrographic mixing model. In the simplest form, such a model consists of plotting the concentration of a dissolved chemical species as a function of salinity. Comparison of the curves produced by such plots with conservative mixing lines provides an indication of the origin and fate of the material in question (Officer 1979, Dollar and Atkinson 1992, Smith and Atkinson 1993).

Figure 19 shows plots of concentrations of four chemical constituents (Si, NO_3^-, PO_4^{3-}, and NH_4^+) as functions of salinity for samples collected in March 2010. Figures 20 and 21 show the same type of plot with data pooled by transect site for a composite of all past surveys, as well as for the most recent survey. Each graph also shows a conservative mixing line that was constructed by connecting the end member concentrations of open ocean water with irrigation well No. 6 located off the North Course of the Makena Resort (representative of groundwater upslope of the Makena Resort).

If the parameter in question displays purely conservative behavior (no input or removal from any process other than physical mixing), data points should fall on, or very near, the conservative mixing line. If, however, external material is added to the system through processes such as leaching of fertilizer nutrients to groundwater, data points will fall above the mixing line. If material is being removed from the system by processes such as uptake by biotic metabolic processes, data points will fall below the mixing line.

Dissolved Si represents a check on the model as this material is present in high concentration in groundwater, but is not a major component of fertilizer. In addition, Si is not utilized rapidly within the nearshore environment by biological processes. It can be seen in Figure 19 that when concentrations of Si are plotted as functions of salinity, most data points fall in a linear array on or near the conservative mixing line created by connecting endpoint concentrations from water collected from the upslope irrigation well and the open ocean. Such good agreement indicates that marine waters at the five transect sites are primarily a mixture of groundwater flowing beneath the project and ocean water. Several points from shoreline samples from transect Site 1 with salinities less than 30‰ fell below the mixing line (Figure 19). Over the course of monitoring, data points from Site 1 have consistently been below the Si mixing lines (Figure 20). At Site 3A, the four data points from March 2011 with salinities lower than 30 ‰ fell on or slightly above the conservative mixing line (Figures 19 and 20). Data plotted over the 7-year course of monitoring at this site also reveal consistently higher Si measurements at Site 3A (Figure 20). These results indicate that the groundwater from upslope Well No. 6 provides a valid representation of groundwater that enters the ocean following flow through the Makena development. Over the course of monitoring since 1995, the relationship between salinity and Si has remained nearly constant (Figure 20).

NO_3^- is the form of nitrogen most common in fertilizer mixes that are used for enhancing turf growth. When the concentrations of NO_3^- are plotted as functions of salinity, data from different transect prescribes distinctly different patterns (Figure 19). Data points from Transects 2 (Makena Bay) and 4 (Control transect) lie on the well water and ocean water conservative mixing line. The position of these two data arrays indicates that the source of NO_3^- entering the ocean at these sites contains little or no subsidies from activities on land. Inspection of the long-term mixing data (Figure 20) indicates that with the exception of two data points, all of the values of NO_3^- from Control Site 4 fall on, or very near, the conservative mixing line. Such a result validates that Site 4 is indeed a good water quality "control" area.

Conversely, data points from the nearshore samples at Transects 1, 3, and 3A all fall well above the conservative mixing line, indicating various subsidies of NO_3^- to the ocean from sources on land. Data points for Sites 1 and 3A are similar in slope, and are substantially less steep than data points from Site 3 (Figure 19). Such relationships indicate subsidies of NO_3^- at Transect sites 1, 3 and 3A are likely a result of leaching of golf course fertilizers to the groundwater lens. In addition to the golf courses, however, residences near the shoreline at Site 1 include landscaping and lawns, while residences and a wetland lie directly inshore from Site 3. Site 3A lies directly offshore of a residential community clubhouse that is currently under construction.

Transect Site 1 has also been used as a monitoring station for a similar evaluation of the effects of the Wailea Golf Courses on water chemistry that commenced in 1989. The lowest concentrations of NO_3^- relative to salinity at Transect site 1 occurred during the initial two years of study, with subsequent higher concentrations increasing since 1992. Hence, there appears to have been an increase of NO_3^- in nearshore waters since 1992 that was not occurring in 1989-1991. Completion of the Wailea Gold Course occurred in December 1993, while completion of the Makena North Course occurred in November 1993. As the southern region of the Wailea Course and the northern part of the Makena Course abut each other in the makai-mauka direction landward of ocean Transect 1, the increased concentrations of NO_3^- evident in Figure 19 may be a result of leaching of fertilizer materials from the combined golf courses to groundwater that enters the ocean in the sampling area.

Mixing analyses also indicate an ongoing input of NO_3^- at the shoreline of Stations 3 and 3A located off the existing Makena Golf Course and several new residences that have been constructed adjacent to the Golf Course (Figures 19 and 20). Such subsidies have been noted in past surveys, as can be seen in Figure 20. When the slopes of the data points for the March 2011 survey (red symbols) are compared to the slopes of combined sets of data points from past surveys (black and green symbols) it is evident that subsidies of NO_3^- have not increased during the most recent survey (Figure 20). Future monitoring will clarify if the trend of NO_3^- input to the ocean is indeed decreasing.

While the data reveal a long-term subsidy to the concentration of NO_3^- in groundwater and the nearshore zone at several of the sampling sites, the concentrations of NO_3^- fall in clearly linear relationship as functions of salinity. The linearity of the data array indicates that there is no detectable uptake of this material by the marine environment. Such lack of uptake indicates that the nutrients are not being removed from the water column by metabolic reactions that could change the composition of the marine environment. Rather, the nutrient subsidies are diluted to background oceanic levels by physical processes of wind and wave mixing. As a result, the increased nutrients do not appear to have the potential to cause alteration in biological community composition or function.

Similar situations have also been observed in other locales in the Hawaiian islands where nutrient subsidies from golf course leaching result in excess NO_3^- in the nearshore zone. At Keauhou Bay on the Big Island, it was shown that owing to the distinct vertical stratification in the nearshore zone, the excess nutrients never come into contact with benthic communities, thereby limiting the potential for increased uptake by benthic algae. In addition, the residence time of the high nutrient water was short enough within the embayment to preclude phytoplankton blooms. As a result, while NO_3^- concentrations doubled as a result of golf course leaching for a period of at least several years, there was no detectable negative effect to the marine environment (Dollar and Atkinson 1992). Owing to the unrestricted nature of circulation and mixing off the Makena project (no confined embayments) it is reasonable to assume that the excess NO_3^- subsidies that are apparent in the present study will not result in alteration to biological communities.

Indeed, surveys of the nearshore marine habitats off of Makena reveal a generally healthy coral reef that does not appear to exhibit any negative effects from nutrient loading, particularly in the form of abundant algal biomass (Marine Research Consultants 2006). In addition to the lack of negative impacts to offshore coral communities, inspection of the entire shoreline fronting the Makena Resort revealed that there are no areas where excessive algal growth is presently occurring.

The other form of dissolved inorganic nitrogen, NH_4^+, does not show a linear pattern of distribution with respect to salinity for either the March 2011 survey (Figure 19) or the entire monitoring program (Figure 21). Some samples with near oceanic salinity on Control transect 4 displayed the highest concentrations of NH_4^+. The lack of a correlation between salinity and concentration of NH_4^+ suggests that this form of nitrogen is not present in the marine environment as a result of mixing from groundwater sources. Rather, NH_4^+ is generated by natural biotic activity in the ocean waters off Makena.

PO_4^{3-} is also a major component of fertilizer, but is usually not found to leach to groundwater to the extent of NO_3^-, owing to a high absorptive affinity of phosphorus in soils. With the exception of data points from transect site 3A, all data points from March 2011 fell on or below the mixing line. This result indicates that with the exception of site 3A the source of PO_4^{3-} to the ocean is from naturally occurring groundwater. At site 3A, the elevated PO_4^{3-} is likely a result of golf course and residential landscaping, reflecting similar subsidies of NO_3^-.

D. Time Course Mixing Analyses

While it is possible to evaluate temporal changes from repetitive surveys conducted over time in terms of concentrations of water chemistry constituents (See Section C), a more informative and accurate method of evaluating changes over time is to utilize the results of scaling nutrient concentrations to salinity. As discussed above, the simple hydrographic mixing model consisting of plotting concentrations of nutrient constituents versus salinity eliminates the ambiguity associated with comparing only the concentrations of samples collected during multiple samplings at different stages of tide and weather conditions. Figures 22 and 23 show plots of Si and NO_3^-, respectively, as functions of salinity collected during each year of sampling (1995-2011). Also shown in Figures 22 and 23 are straight lines that represent the least squares linear regression fitted through concentrations of Si and NO_3^- as functions of salinity at each monitoring site for each year. Tables 6-8 show the numerical values of the Y-intercepts, slopes, and respective upper and lower 95% confidence limits of linear regressions fitted through the data points for Si, NO_3^-, and PO_4^{3-} as functions of salinity for each year of monitoring.

The magnitude of the contribution of nutrients originating from land based activities to groundwater will be reflected in both the steepness of the slope and the magnitude of the Y-intercept of the regression line fitted through the concentrations scaled to salinity (the Y-intercept can be interpreted as the concentration that would occur at a salinity of zero if the distribution of data points is linear). This relationship is valid because with increasing contributions from land, nutrient concentrations in any given parcel of water will increase with no corresponding change in salinity. Hence, if the contribution from land to groundwater nutrient composition is increasing over time, there would be progressive increases in the absolute value of the slopes, as well as the Y-intercepts of the regression lines fitted through each set of annual nutrient concentrations when plotted as functions of salinity. Conversely, if the contributions to groundwater from land are decreasing, there will be decreases in the absolute values of the slopes and Y-intercepts.

Plots of the values of the slopes (Figure 24) and Y-intercepts (Figure 25) of regression lines fitted though concentrations of Si, NO_3^- and PO_4^{3-} scaled to salinity during each survey year provide an indication of the changes that have been occurring over time in the nearshore ocean off the Makena Resort. As stated above, Si provides the best case for evaluating the effectiveness of the method, as Si is present in high concentration in groundwater but is not a component of fertilizers. NO_3^- and PO_4^{-3} are the forms of nitrogen and phosphorus that are found in high concentrations in groundwater relative to ocean water, and are the major nutrient constituents found in fertilizers.

Examination of Figures 24 and 25, as well as Tables 6-8 reveal that none of the slopes or Y-intercepts of Si, NO_3^- and PO_4^{3-} from 1995 to 2011 at any of the transect sites exhibit any indication of progressively increasing or decreasing values over the course of monitoring. The term "REGSLOPE" in Tables 6-8 denotes the values of the slopes and 95% confidence limits of linear regressions of the values of the yearly slopes and Y-intercepts as a function of time. For all sites, the span of the upper and lower 95% confidence limits of the REGSLOPE coefficients are not significantly different than zero, indicating that there is no statistically significant increase or decrease in the salinity-scaled concentrations of Si, NO_3^- and PO_4^{3-} over the course of the monitoring program (Tables 6-8).

For all three nutrients, there is little variation in either slopes or Y-intercepts during any single year at Site 1, located off the "5 Graves" area downslope from the juncture of the Wailea and Makena Resorts (Figures 24 and 25). Such lack of variation indicates relatively consistent concentrations of Si, NO_3^- and PO_4^{3-} in groundwater entering the ocean over the sixteen years of monitoring. Sites 2 (Makena Landing) and 4 ('Ahihi-Kina`u) also show relatively constant trends with time with the exception of 2001 which is marked by large spikes in Si and PO_4^{3-}. Such a fluctuation is not present for NO_3^- in 2001. Sampling in 2001 was conducted during a period of rough winter sea conditions marked by vigorous mixing of the water column. As a result, there was very weak linear relationship between nutrient concentrations and salinity.

At Site 3, located directly downslope for the point of the Makena Golf Course closest to the ocean, there is a trend of decreasing NO_3^- between 2002 and 2004, an increasing trend from 2004 to 2007, followed by another downturn in 2008 – 2009 (Figures 24 and 25). As a result of these reversing trends, there is no significant change over the seven-year period of monitoring. The multiple reversing trends may reflect changes in land use, such as variation in fertilizer application or construction-related activities in 2002-2004 versus 2004-2007. In June of 2008, the golf course fronting the ocean in this area was shut down for re-alignment and re-planting. Underground retention/filtration systems were also constructed to mitigate adverse affects of stormwater runoff. At the time of this survey, new turf grass had been applied but the course remained closed and the filtration systems were not yet operational.

F. Compliance with DOH Standards

Tables 1 and 2 also show samples that exceed DOH water quality standards for open coastal waters under "wet" and "dry" conditions. These criteria are applied depending upon whether the area is likely to receive less than (dry) or greater than (wet) 3 million gallons of groundwater and/or surface water input per mile per day. As it is not possible to accurately estimate groundwater and surface water discharge, both wet and dry standards are considered. DOH standards include specific criteria for three situations; criteria that are not to be exceeded during either 10% or 2% of the time, and criteria that are not to be exceeded by the geometric mean of samples. With only one or two samplings collected per year over more than 16 years, comparison of the 10% or 2% of the time criteria for any sample is not statistically meaningful. However, comparing sample concentrations to these criteria provide an indication of whether water quality is near the stated specific criteria.

Boxed values in Tables 1 and 2 show instances where measurements exceed the DOH standards under dry conditions, while boxed and shaded values show instances where measurements exceed DOH standards under wet conditions.

Results from the March 2011 survey indicated several measurements of NO_3^-, NH_4^+,TN and TP along all five transect sites exceeded the 10% DOH criteria under wet or dry conditions (Tables 1 and 2). Most of the instances where the DOH criteria for NO_3^- and TN were exceeded were from samples collected within 50 m of the shoreline. Five measurements of TP, six of turbidity and four measurements of Chl *a* exceeded the 10% DOH criteria under dry conditions. Under "wet" criteria, four measurements of TP and one measurement of Chl *a* exceeded the DOH criteria while no measurements of turbidity exceeded the standard. It is of interest to note that at Transect Site 4, which is considered the control station beyond the influence of the Makena Resort, exceedance of DOH criteria occurred for NO_3^-, $NH_4^+$and TN. At Site 4, an unusual exceedance of NH_4^+ occurred in the deep water 150 m offshore (Tables 1 and 2).

Tables 3 and 4 show geometric means of samples collected at the same locations during the twenty-four increments of the monitoring program at Sites 1, 2 and 4. Geometric means of samples collected over sixteen increments of sampling at Site 3 and seven increments of sampling at Site 3A are also shown. These tables also specify the samples that exceed the DOH geometric mean limits for open coastal waters under "dry" (boxed) and "wet" (boxed and shaded) conditions. For NO_3^-, NH_4^+, and TN numerous dry and wet standards were exceeded on all transects. Six samples of TP and nineteen samples of turbidity exceeded standards. All but three samples exceed the geometric mean standards for Chl *a*.

Site 4 is considered a control transect, in that it is not located offshore of a resort, golf course or dense residential development. It can be seen in Tables 3 and 4, however, that the number of samples that exceed geometric mean criteria at Site 4 are comparable to the other four sites, all of which are located downslope from the Makena Resort. Hence, Resort activities, including golf courses cannot be attributed as the sole (or even major) factor causing water quality to exceed geometric mean standards.

Several comments can be made regarding the present DOH water quality standards and how they apply to the monitoring program at the Makena Resort. As noted above, the category of water quality standards that are applicable for the Makena Monitoring program are "Open Coastal Waters." As the name implies, these standards apply to "open" waters that can be reasonably defined as "waters beyond the direct influence of land." In order to evaluate the effects of land uses on the nearshore ocean off Makena, the selected sampling regime collects water within a zone that extends from the shoreline to the open coastal ocean. As a result, sampling takes place within the region of ocean that is directly influenced by land. If the monitoring protocol were changed to include only those sampling locations beyond 50-100 m from shore (i.e., open coastal waters), which is completely valid with respect to meeting DOH regulatory compliance, virtually none of the factors discussed above relating to the effects of activities on land to the nearshore ocean would not be observed.

Initial steps have been taken by DOH to rectify this situation. During revision of the Department of Health water quality standards in 2004, a unique set of monitoring criteria was added for the West Coast of the Island of Hawaii (i.e., "Kona standards"). The rationale for these unique standards was the recognition that existing numerical "standards" represent offshore coastal waters that are beyond the natural confluence of land and the nearshore ocean. As a result, the West Hawaii standards recognize that groundwater entering the ocean at the shoreline contains substantially elevated nutrients relative to open coastal waters. As a result, the Kona criteria provide the potential to meet water quality standards with elevated nutrient concentrations resulting from natural sources of groundwater input. As the same processes of groundwater discharge to the coastal ocean have been documented in Maui, it is hopeful that similar new provisions of the water quality standards with soon be applicable to the South Maui area.

II. SUMMARY

- The twenty-fifth phase of water chemistry monitoring of the nearshore ocean off the Makena Resort was carried out on March 6, 2011. Sixty-two ocean water samples were collected on four transects spaced along the project ocean frontage and on one control transect. Site 1 was located at the northern boundary of the project, Site 2 was located near the central part of the Makena North Golf Course in the center of Makena Bay, Site 3A (initiated during the June 2007 survey) was located near the southern boundary of Maluaka Bay, Site 3 was downslope from the part of Makena South Golf Course that comes closest to the shoreline, and Control Site 4 was located to the south of Makena Resort near the northern boundary of the 'Ahihi-Kina`u Natural Area Reserve. Sampling transects extended from the shoreline out to the open coastal ocean. Water samples were analyzed for chemical criteria specified by DOH water quality standards, as well as several additional criteria. In addition, water samples were collected from five irrigation wells and an irrigation lake located on the golf courses.

- Water chemistry constituents that occur in high concentration in groundwater (Si, NO_3^- and TN) displayed distinct horizontal gradients with highest concentrations nearest to shore and decreasing concentrations moving seaward. Groundwater input (based on salinity) was greatest at Sites 1and 3A, but was also evident at the other three sites (2, 3, and 4). As Site 4 served as a control, and was not located in the vicinity of the Makena Resort, it is apparent that groundwater input is not solely a function of Resort land usage.

- Vertical stratification of the water column was also evident on all transects during March 2011, with most surface samples displaying higher nutrient and lower salinities than the corresponding bottom samples. The strong vertical and horizontal patterns of distribution indicate that physical mixing processes generated by tidal exchange, wind stirring, and breaking waves were not sufficient to completely mix the water column from surface to bottom throughout the sampling area at the time of the monitoring survey.

- Overall, values of Chl *a* and turbidity were considered low throughout the monitored area. Chl *a* was elevated near the shoreline compared to offshore samples, with Site 1 having distinctly higher values in nearshore samples. The elevated levels of Chl *a* in the nearshore zone are likely a result of broken fragments of benthic plants that broken from the bottom by wave action and washed to the shoreline. The low concentrations of Chl *a* through the water column indicates the lack of plankton blooms in the area. Turbidity was elevated in the shoreline samples at all five sites and was higher in magnitude at Sites 2 and 3A compared to the other sites. As with Chl *a*, elevated turbidity at the shoreline is likely a result of waveresuspended sediment at the shoreline. Site 2, located at the point where sediment-laden storm water runoff entered the ocean following a flash flood in October 1999 did not display substantially elevated turbidity during the present survey.

- Other organic water chemistry constituents that do not occur in high concentrations in groundwater (NH_4^+, TON, TOP) did not show any distinctive patterns with respect to horizontal gradients. Concentrations of NH_4^+, however, were elevated in the shoreline samples relative to offshore samples at three of the five sites.

- Scaling nutrient concentrations to salinity indicates that there were measurable subsidies of NO_3^- to groundwater that enters the nearshore ocean at three Transect sites. Results of the March 2011 monitoring indicated that these subsidies were greatest in magnitude at Site 3, followed by Sites 3A and 1. No subsidies of NO_3^- were apparent at Site 2 (Makena Landing) or Site 4 ('Ahihi-Kina`u). These subsidies, which are without doubt a result of land uses involving fertilizers, substantially increase the concentration of NO_3^- with respect to salinity in groundwater flowing to the ocean compared to natural groundwater. The area shoreward of Site 1 includes the juncture of the southern part of the Wailea Gold Course and the northern part of the Makena North Course, as well as residential development. Sites 3 and 3A are directly downslope from the Makena South Course in an area were the golf course extends to the shoreline. In addition, private residences are near completion upslope of Transect 3, and it is possible that a cesspool remains from a house that was recently torn down. Hence, the subsidies of NO_3^- noted at these sites may result from a combination of sources.

- Linear regression statistics of nutrient concentration plotted as functions of salinity are useful for evaluating changes to water quality over time. When the regression values of nutrient concentrations versus salinity are plotted as a function of time, there are no statistically significant increases or decreases over the sixteen years of monitoring at any of the survey sites. The lack of increase in these slopes and intercepts indicate that there has been no consistent change in nutrient input from land to groundwater that enters the ocean from 1995 to 2009 (2002 to 2009 at Site 2). At Site 3 off the Makena Resort South Golf Course, there was a progressive decrease in NO_3^- input between 2002 and 2004, followed by an increase between 2004 and 2007, and another decrease in 2008-2009. Further monitoring at this site will be of interest to note the future direction of the oscillating trends noted in the last seven years.

- Comparing water chemistry parameters to DOH standards revealed that several measurements of NO_3^-, NH_4^+ and TN, and a few of TP, turbidity and Chl *a* exceeded the DOH "not to exceed more than 10% of the time" criteria for dry and wet conditions of open coastal waters. It is apparent that the concentrations of NO_3^- in nearshore marine waters that contains a mixture of seawater and natural groundwater may exceed DOH criteria with no subsidies from human activities on land. Numerous values of NO_3^-, NH_4^+, TN, turbidity and Chl *a* exceeded specified limits for geometric means. Such exceedances occurred at all survey sites, including the control site that was far from any golf course influence. The consistent exceedance of water quality standards is in large part a consequence of the present DOH standards not accounting for the natural effects of groundwater discharge to the nearshore ocean.

- As in past surveys, there is a subsidy of dissolved inorganic nutrients (e.g., NO_3^- and sometimes to a lesser extent PO_4^{3-}) to groundwater that enters the nearshore ocean at sampling sites downslope from parts of the Makena Resort. Without question, such input is a consequence of various land use activities. However, none of these inputs have increased significantly over time. Surveys of coral reef community structure that are part of the ongoing monitoring program for the Makena Resort, as well as the noted lack of any nuisance algal aggregations in the nearshore area indicate that the nutrient subsidies are not detrimental to marine community structure.
- The next scheduled testing for the Makena Resort monitoring program is planned for the summer-fall season of 2011.

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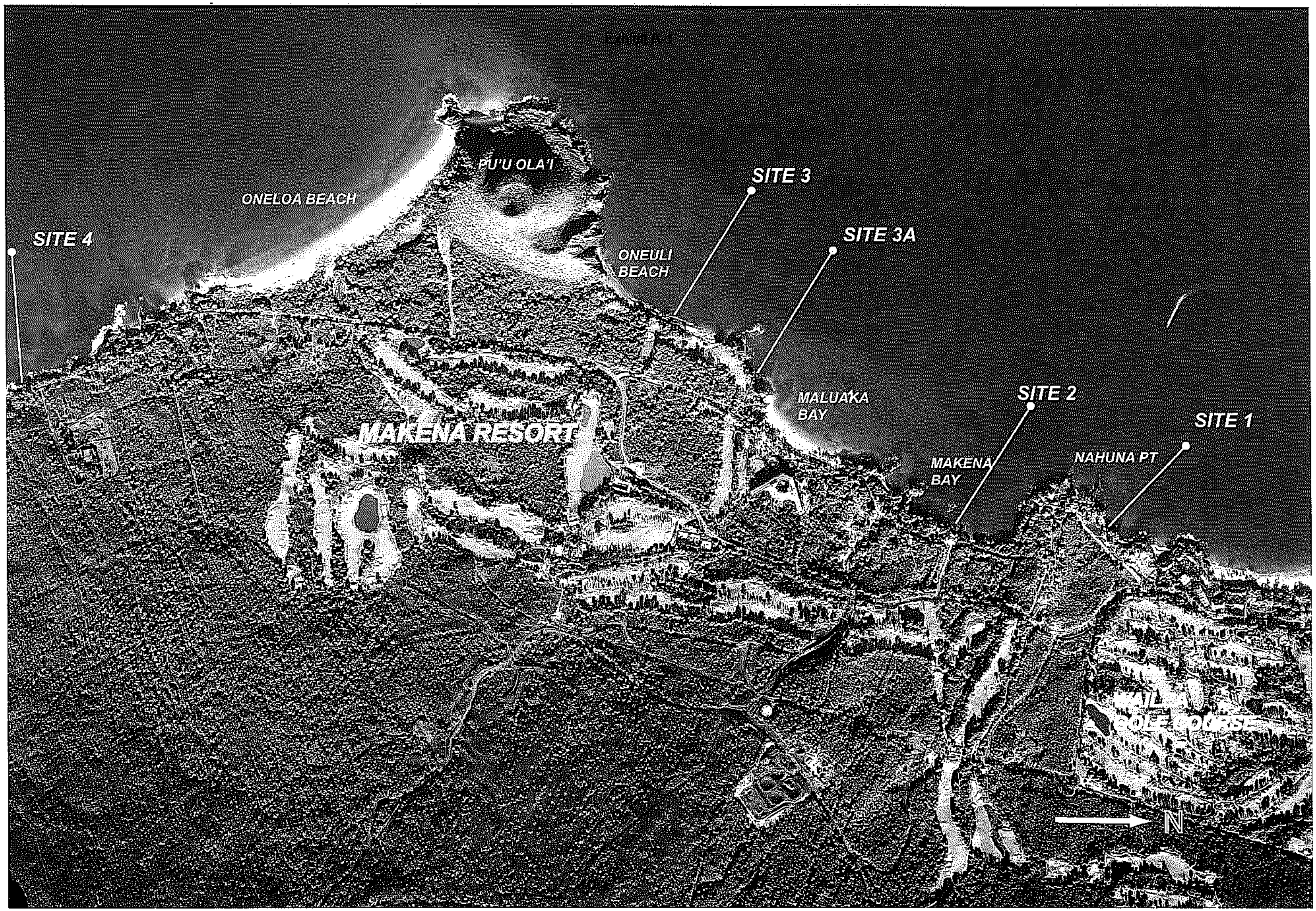

FIGURE 1. Aerial photograph of Makena Resort on southwest coastline of Maui. Also shown are locations of five water sampling transects that extend from the shoreline to 150-200 m from shore. The southern end of the Wailea golf course is visible at right.

TABLE 1. Water chemistry measurements from ocean water samples collected in the vicinity of the Makena Resort on March 6, 2011. Abbreviations as follows: DFS=distance from shore; S=surface; D=deep; BDL=below detection limit. Also shown are the State of Hawaii, Department of Health (DOH) "not to exceed more than 10% of the time" and "not to exceed more than 2% of the time" water quality standards for open coastal waters under "dry" and "wet" conditions. Boxed values exceed DOH 10% "dry" standards; boxed and shaded values exceed DOH 10% "wet" standards. For sampling site locations, see Figure 1.

TRANSECT SITE	DFS (m)	DEPTH (m)	PO_4^{3-} (µM)	NO_3^- (µM)	NH_4^+ (µM)	Si (µM)	TOP (µM)	TON (µM)	TP (µM)	TN (µM)	TURB (NTU)	SALINITY (ppt)	CHL a (µg/L)	TEMP (deg.C)	pH (std.units)	O2 % Sat
MAKENA 1	0 S	0.1	1.13	177.5	0.54	363.1	0.21	10.08	1.34	188.1	0.71	7.144	2.43	26.8	8.06	100.0
	2 S	0.1	0.85	122.6	0.01	222.9	0.18	6.68	1.03	129.3	0.48	19.117	0.77	27.0	8.13	99.0
	5 S	0.1	0.37	52.12	0.16	92.01	0.21	6.30	0.58	58.58	0.35	29.164	0.23	26.8	8.20	98.6
	5 D	1.0	0.20	20.46	0.10	41.95	0.25	5.94	0.45	26.50	0.24	32.535	0.19	25.3	8.22	97.6
	10 S	0.1	0.17	17.12	0.11	34.48	0.25	5.87	0.42	23.10	0.14	32.986	0.13	25.5	8.20	97.5
	10 D	1.7	0.10	7.17	0.21	15.61	0.27	6.21	0.37	13.59	0.22	34.189	0.10	25.4	8.18	97.6
	50 S	0.1	0.10	4.50	0.15	9.09	0.27	5.98	0.37	10.63	0.15	34.586	0.47	24.5	8.09	97.0
	50 D	4.4	0.06	0.24	0.18	1.67	0.26	5.14	0.32	5.56	0.12	35.105	0.16	24.8	8.14	97.2
	100 S	0.1	0.06	0.23	0.04	1.50	0.28	6.62	0.34	6.89	0.12	35.123	0.10	24.9	8.15	95.8
	100 D	6.2	0.04	0.17	0.14	1.28	0.27	6.03	0.31	6.34	0.16	35.137	0.09	24.9	8.16	95.7
	150 S	0.1	0.05	0.19	0.12	1.23	0.31	5.75	0.36	6.06	0.08	35.086	0.08	24.9	8.15	95.4
	150 D	11.7	0.07	0.10	0.11	1.36	0.30	6.41	0.37	6.62	0.09	35.099	0.07	24.9	8.15	94.5
MAKENA 2	0 S	0.1	0.19	9.69	0.15	31.15	0.33	7.73	0.52	17.57	1.84	33.064	0.35	26.9	8.16	100.4
	2 S	0.1	0.24	9.82	0.12	28.43	0.30	6.58	0.54	16.52	1.30	33.039	0.65	26.7	8.16	100.6
	5 S	0.1	0.12	7.20	0.09	22.96	0.30	6.02	0.42	13.31	0.50	33.614	0.25	25.9	8.17	101.2
	5 D	1.2	0.19	8.06	0.10	26.59	0.27	6.08	0.46	14.24	0.38	33.426	0.31	25.7	8.17	100.3
	10 S	0.1	0.12	3.60	0.03	12.81	0.30	5.46	0.42	9.09	0.21	34.314	0.15	25.9	8.17	100.1
	10 D	1.5	0.06	2.51	0.21	9.34	0.31	6.07	0.37	8.79	0.29	34.541	0.19	25.9	8.16	100.2
	50 S	0.1	0.08	1.31	0.06	5.43	0.29	6.26	0.37	7.63	0.41	34.926	0.14	24.6	8.13	99.9
	50 D	2.8	0.09	0.18	0.08	1.66	0.29	5.52	0.38	5.78	0.12	35.072	0.13	24.8	8.15	99.3
	100 S	0.1	0.09	0.13	0.04	1.28	0.29	6.35	0.38	6.52	0.11	35.125	0.16	24.9	8.15	99.2
	100 D	4.7	0.04	0.05	0.07	1.22	0.28	6.09	0.32	6.21	0.13	35.097	0.28	24.9	8.16	98.7
	150 S	0.1	0.02	0.06	0.02	1.15	0.28	5.43	0.30	5.51	0.12	35.109	0.09	24.9	8.16	98.2
	150 D	11.4	0.10	0.18	0.08	1.40	0.30	6.40	0.40	6.66	0.10	35.103	0.10	24.9	8.15	98.4
	200 S	0.1	0.05	0.12	0.12	1.29	0.30	6.38	0.35	6.62	0.10	35.125	0.09	24.9	8.16	98.2
	200 D	16.0	0.04	0.05	0.17	1.07	0.31	6.09	0.35	6.31	0.16	35.117	0.10	24.9	8.16	97.7
MAKENA 3-A	0 S	0.1	2.84	322.5	0.36	639.0	0.64	11.80	3.48	334.7	1.35	3.455	0.49	24.3	7.97	97.4
	2 S	0.1	3.00	294.7	BDL	583.5	0.40	5.44	3.40	300.1	0.30	6.614	0.21	24.3	7.79	96.4
	5 S	0.1	1.64	150.0	0.32	301.8	0.36	5.92	2.00	156.2	0.26	21.167	0.33	24.5	7.95	99.3
	5 D	1.0	0.68	61.15	0.20	127.7	0.26	6.17	0.94	67.52	0.28	28.669	0.41	24.6	8.07	99.8
	10 S	0.1	0.48	34.25	0.18	73.36	0.25	5.44	0.73	39.87	0.28	31.548	0.18	24.8	8.13	97.0
	10 D	1.8	0.25	11.72	0.11	29.92	0.27	6.30	0.52	18.13	0.24	33.787	0.22	25.0	8.16	99.0
	50 S	0.1	0.11	3.57	0.05	8.88	0.29	5.96	0.40	9.58	0.16	34.729	0.16	24.8	8.09	97.5
	50 D	4.3	0.13	0.71	0.26	2.75	0.28	6.30	0.41	7.27	0.17	35.011	0.09	24.8	8.13	94.4
	100 S	0.0	0.12	0.40	0.16	1.91	0.29	6.52	0.41	7.08	0.12	35.063	0.14	24.8	8.13	94.6
	100 D	5.0	0.12	0.27	0.26	1.50	0.28	6.26	0.40	6.79	0.11	35.086	0.12	24.9	8.14	94.8
	150 S	0.1	0.07	0.30	0.16	1.50	0.31	6.44	0.38	6.90	0.11	35.110	0.10	24.9	8.14	97.9
	150 D	11.5	0.07	0.05	0.15	1.37	0.31	6.28	0.38	6.48	0.13	35.085	0.10	24.8	8.15	96.4
MAKENA 3	0 S	0.1	0.10	41.03	0.21	34.31	0.28	5.60	0.38	46.84	0.40	33.693	0.25	25.5	8.17	102.7
	2 S	0.1	0.15	29.07	0.12	27.76	0.29	6.94	0.44	36.13	0.34	34.095	0.20	25.6	8.19	102.5
	5 S	0.1	0.17	21.36	0.21	23.44	0.31	5.96	0.48	27.53	0.32	34.307	0.22	25.6	8.18	101.4
	5 D	1.0	0.18	22.47	0.13	24.90	0.28	7.04	0.46	29.64	0.30	34.269	0.28	25.6	8.18	102.6
	10 S	0.1	0.14	9.08	0.35	10.61	0.29	7.39	0.43	16.82	0.24	34.708	0.19	25.5	8.20	100.3
	10 D	1.9	0.07	4.89	0.08	7.06	0.31	9.07	0.38	14.04	0.60	34.844	0.18	25.5	8.21	100.0
	50 S	0.1	0.08	0.75	0.07	3.58	0.30	8.53	0.38	9.35	0.19	35.027	0.13	24.8	8.13	99.4
	50 D	2.3	0.11	0.55	0.18	2.32	0.30	7.62	0.41	8.35	0.15	35.067	0.12	24.7	8.11	97.4
	100 S	0.1	0.10	0.18	0.03	1.43	0.30	9.75	0.40	9.96	0.14	35.113	0.07	24.7	8.14	97.3
	100 D	6.3	0.09	0.19	0.12	1.32	0.31	8.16	0.40	8.47	0.10	35.118	0.10	24.8	8.15	96.4
	150 S	0.1	0.06	0.19	0.07	2.04	0.29	4.95	0.35	5.21	0.12	35.108	0.06	24.8	8.14	97.2
	150 D	9.2	0.08	0.06	0.20	1.54	0.31	5.44	0.39	5.70	0.09	35.123	0.09	24.9	8.16	96.1
MAKENA 4	0 S	0.1	0.35	15.74	1.11	85.87	0.32	4.89	0.67	21.74	0.54	30.748	0.26	26.8	8.20	100.4
	2 S	0.1	0.34	15.26	0.06	83.08	0.32	6.07	0.66	21.39	0.39	30.946	0.18	26.3	8.20	100.3
	5 S	0.1	0.29	11.05	0.10	62.68	0.32	6.22	0.61	17.37	0.26	32.041	0.20	25.7	8.19	101.2
	5 D	1.0	0.25	8.35	0.05	49.46	0.34	6.14	0.59	14.54	0.22	32.737	0.27	25.8	8.18	100.4
	10 S	0.1	0.12	0.79	0.38	7.56	0.28	4.55	0.40	5.72	0.16	34.906	0.09	25.3	8.10	99.2
	10 D	2.0	0.13	0.81	0.07	7.11	0.27	5.26	0.40	6.14	0.18	34.884	0.13	25.3	8.11	99.4
	50 S	0.1	0.13	3.60	0.18	16.60	0.29	5.56	0.42	9.34	0.15	34.407	0.12	24.7	8.12	97.2
	50 D	4.4	0.09	0.25	0.03	2.71	0.29	5.40	0.38	5.68	0.12	35.059	0.07	24.7	8.11	96.3
	100 S	0.1	0.08	0.12	0.07	1.86	0.29	5.77	0.37	5.96	0.15	35.063	0.07	24.7	8.13	95.5
	100 D	6.4	0.10	0.11	0.04	2.68	0.28	6.57	0.38	6.72	0.16	35.035	0.10	24.7	8.12	96.2
	150 S	0.1	0.09	0.12	0.06	2.31	0.28	5.73	0.37	5.91	0.10	35.049	0.08	24.7	8.14	95.9
	150 D	7.7	0.07	0.04	1.49	2.11	0.29	4.67	0.36	6.20	0.12	35.043	0.08	24.7	8.15	95.3
DOH WQS	DRY	10%	0.71	0.36					0.96	12.86	0.50	*	0.50	**	***	****
		2%	1.43	0.64					1.45	17.86	1.00		1.00			
	WET	10%	1.00	0.61					1.29	17.85	1.25	*	0.90	**	***	****
		2%	1.78	1.07					1.93	25.00	2.00		1.75			

* Salinity shall not vary more than ten percent form natural or seasonal changes considering hydrologic input and oceanographic conditions.

** Temperature shall not vary by more than one degree C. from ambient conditions.

***pH shall not deviate more than 0.5 units from a value of 8.1.

****Dissolved Oxygen not to be below 75% saturation.

TABLE 2. Water chemistry measurements from ocean water samples (in µg/L) collected in the vicinity of the Makena Resort on March 6, 2011. Abbreviations as follows: DFS=distance from shore; S=surface; D=deep; BDL=below detection limit. Also shown are the State of Hawaii, Department of Health (DOH) "not to exceed more than 10% of the time" and "not to exceed more than 2% of the time" water quality standards for open coastal waters under "dry" and "wet" conditions. Boxed values exceed DOH 10% "dry" standards; boxed and shaded values exceed DOH 10% "wet" standards. For sampling site locations, see Figure 1.

TRANSECT SITE	DFS (m)	DEPTH (m)	PO_4^{3-} (µg/L)	NO_3^- (µg/L)	NH_4^+ (µg/L)	Si (µg/L)	TOP (µg/L)	TON (µg/L)	TP (µg/L)	TN (µg/L)	TURB (NTU)	SALINITY (ppt)	CHL a (µg/L)	TEMP (deg.C)	pH (std.units)	O2 % Sat
MAKENA 1	0 S	0.1	35.03	2485	7.56	10204	6.51	141.12	41.54	2634	0.71	7.144	2.43	26.8	8.06	100.0
	2 S	0.1	26.35	1717	0.14	6264	5.58	93.52	31.93	1810	0.48	19.117	0.77	27.0	8.13	99.0
	5 S	0.1	11.47	729.7	2.24	2585	6.51	88.20	17.98	820.1	0.35	29.164	0.23	26.8	8.20	98.6
	5 D	1.0	6.20	286.4	1.40	1179	7.75	83.16	13.95	371.0	0.24	32.535	0.19	25.3	8.22	97.6
	10 S	0.1	5.27	239.7	1.54	968.9	7.75	82.18	13.02	323.4	0.14	32.986	0.13	25.5	8.20	97.5
	10 D	1.7	3.10	100.4	2.94	438.6	8.37	86.94	11.47	190.3	0.22	34.189	0.10	25.4	8.18	97.6
	50 S	0.1	3.10	63.00	2.10	255.4	8.37	83.72	11.47	148.8	0.15	34.586	0.47	24.5	8.09	97.0
	50 D	4.4	1.86	3.36	2.52	46.9	8.06	71.96	9.92	77.84	0.12	35.105	0.16	24.8	8.14	97.2
	100 S	0.1	1.86	3.22	0.56	42.2	8.68	92.68	10.54	96.46	0.12	35.123	0.10	24.9	8.15	95.8
	100 D	6.2	1.24	2.38	1.96	36.0	8.37	84.42	9.61	88.76	0.16	35.137	0.09	24.9	8.16	95.7
	150 S	0.1	1.55	2.66	1.68	34.6	9.61	80.50	11.16	84.84	0.08	35.086	0.08	24.9	8.15	95.4
	150 D	11.7	2.17	1.40	1.54	38.2	9.30	89.74	11.47	92.68	0.09	35.099	0.07	24.9	8.15	94.5
MAKENA 2	0 S	0.1	5.89	135.7	2.10	875.3	10.23	108.2	16.12	246.0	1.84	33.064	0.35	26.9	8.16	100.4
	2 S	0.1	7.44	137.5	1.68	798.9	9.30	92.12	16.74	231.3	1.30	33.039	0.65	26.7	8.16	100.6
	5 S	0.1	3.72	100.8	1.26	645.2	9.30	84.28	13.02	186.3	0.50	33.614	0.25	25.9	8.17	101.2
	5 D	1.2	5.89	112.8	1.40	747.2	8.37	85.12	14.26	199.4	0.38	33.426	0.31	25.7	8.17	100.3
	10 S	0.1	3.72	50.40	0.42	360.0	9.30	76.44	13.02	127.3	0.21	34.314	0.15	25.9	8.17	100.1
	10 D	1.5	1.86	35.14	2.94	262.5	9.61	84.98	11.47	123.1	0.29	34.541	0.19	25.9	8.16	100.2
	50 S	0.1	2.48	18.34	0.84	152.6	8.99	87.64	11.47	106.8	0.41	34.926	0.14	24.6	8.13	99.9
	50 D	2.8	2.79	2.52	1.12	46.6	8.99	77.28	11.78	80.92	0.12	35.072	0.13	24.8	8.15	99.3
	100 S	0.1	2.79	1.82	0.56	36.0	8.99	88.90	11.78	91.28	0.11	35.125	0.16	24.9	8.15	99.2
	100 D	4.7	1.24	0.70	0.98	34.3	8.68	85.26	9.92	86.94	0.13	35.097	0.28	24.9	8.16	98.7
	150 S	0.1	0.62	0.84	0.28	32.3	8.68	76.02	9.30	77.14	0.12	35.109	0.09	24.9	8.16	98.2
	150 D	11.4	3.10	2.52	1.12	39.3	9.30	89.60	12.40	93.24	0.10	35.103	0.10	24.9	8.15	98.4
	200 S	0.1	1.55	1.68	1.68	36.2	9.30	89.32	10.85	92.68	0.10	35.125	0.09	24.9	8.16	98.2
	200 D	16.0	1.24	0.70	2.38	30.1	9.61	85.26	10.85	88.34	0.16	35.117	0.10	24.9	8.16	97.7
MAKENA 3-A	0 S	0.1	88.04	4515	5.04	17957	19.84	165.2	107.9	4686	1.35	3.455	0.49	24.3	7.97	97.4
	2 S	0.1	93.00	4126	BDL	16397	12.40	76.16	105.4	4202	0.30	6.614	0.21	24.3	7.79	96.4
	5 S	0.1	50.84	2099	4.48	8481	11.16	82.88	62.00	2187	0.26	21.167	0.33	24.5	7.95	99.3
	5 D	1.0	21.08	856.1	2.80	3587	8.06	86.38	29.14	945.3	0.28	28.669	0.41	24.6	8.07	99.8
	10 S	0.1	14.88	479.5	2.52	2061	7.75	76.16	22.63	558.2	0.28	31.548	0.18	24.8	8.13	97.0
	10 D	1.8	7.75	164.1	1.54	840.8	8.37	88.20	16.12	253.8	0.24	33.787	0.22	25.0	8.16	99.0
	50 S	0.1	3.41	49.98	0.70	249.5	8.99	83.44	12.40	134.1	0.16	34.729	0.16	24.8	8.09	97.5
	50 D	4.3	4.03	9.94	3.64	77.3	8.68	88.20	12.71	101.8	0.17	35.011	0.09	24.8	8.13	94.4
	100 S	0.0	3.72	5.60	2.24	53.7	8.99	91.28	12.71	99.12	0.12	35.063	0.14	24.8	8.13	94.6
	100 D	5.0	3.72	3.78	3.64	42.2	8.68	87.64	12.40	95.06	0.11	35.086	0.12	24.9	8.14	94.8
	150 S	0.1	2.17	4.20	2.24	42.2	9.61	90.16	11.78	96.60	0.11	35.110	0.10	24.9	8.14	97.9
	150 D	11.5	2.17	0.70	2.10	38.5	9.61	87.92	11.78	90.72	0.13	35.085	0.10	24.8	8.15	96.4
MAKENA 3	0 S	0.1	3.10	574.4	2.94	964.1	8.68	78.40	11.78	655.8	0.40	33.693	0.25	25.5	8.17	102.7
	2 S	0.1	4.65	407.0	1.68	780.1	8.99	97.16	13.64	505.8	0.34	34.095	0.20	25.6	8.19	102.5
	5 S	0.1	5.27	299.0	2.94	658.7	9.61	83.44	14.88	385.4	0.32	34.307	0.22	25.6	8.18	101.4
	5 D	1.0	5.58	314.6	1.82	699.7	8.68	98.56	14.26	415.0	0.30	34.269	0.28	25.6	8.18	102.6
	10 S	0.1	4.34	127.1	4.90	298.1	8.99	103.46	13.33	235.5	0.24	34.708	0.19	25.5	8.20	100.3
	10 D	1.9	2.17	68.46	1.12	198.4	9.61	126.98	11.78	196.6	0.60	34.844	0.18	25.5	8.21	100.0
	50 S	0.1	2.48	10.50	0.98	100.6	9.30	119.42	11.78	130.9	0.19	35.027	0.13	24.8	8.13	99.4
	50 D	2.3	3.41	7.70	2.52	65.2	9.30	106.68	12.71	116.9	0.15	35.067	0.12	24.7	8.11	97.4
	100 S	0.1	3.10	2.52	0.42	40.2	9.30	136.50	12.40	139.4	0.14	35.113	0.07	24.7	8.14	97.3
	100 D	6.3	2.79	2.66	1.68	37.1	9.61	114.24	12.40	118.6	0.10	35.118	0.10	24.8	8.15	96.4
	150 S	0.1	1.86	2.66	0.98	57.3	8.99	69.30	10.85	72.94	0.12	35.108	0.06	24.8	8.14	97.2
	150 D	9.2	2.48	0.84	2.80	43.3	9.61	76.16	12.09	79.80	0.09	35.123	0.09	24.9	8.16	96.1
MAKENA 4	0 S	0.1	10.85	220.4	15.55	2412.9	9.92	68.46	20.77	304.4	0.54	30.748	0.26	26.8	8.20	100.4
	2 S	0.1	10.54	213.6	0.84	2334.5	9.92	84.98	20.46	299.5	0.39	30.946	0.18	26.3	8.20	100.3
	5 S	0.1	8.99	154.7	1.40	1761.3	9.92	87.08	18.91	243.2	0.26	32.041	0.20	25.7	8.19	101.2
	5 D	1.0	7.75	116.9	0.70	1389.8	10.54	85.96	18.29	203.6	0.22	32.737	0.27	25.8	8.18	100.4
	10 S	0.1	3.72	11.06	5.32	212.4	8.68	63.70	12.40	80.08	0.16	34.906	0.09	25.3	8.10	99.2
	10 D	2.0	4.03	11.34	0.98	199.8	8.37	73.64	12.40	85.96	0.18	34.884	0.13	25.3	8.11	99.4
	50 S	0.1	4.03	50.40	2.52	466.5	8.99	77.84	13.02	130.8	0.15	34.407	0.12	24.7	8.12	97.2
	50 D	4.4	2.79	3.50	0.42	76.2	8.99	75.60	11.78	79.52	0.12	35.059	0.07	24.7	8.11	96.3
	100 S	0.1	2.48	1.68	0.98	52.3	8.99	80.78	11.47	83.44	0.15	35.063	0.07	24.7	8.13	95.5
	100 D	6.4	3.10	1.54	0.56	75.3	8.68	91.98	11.78	94.08	0.16	35.035	0.10	24.7	8.12	96.2
	150 S	0.1	2.79	1.68	0.84	64.9	8.68	80.22	11.47	82.74	0.10	35.049	0.08	24.7	8.14	95.9
	150 D	7.7	2.17	0.56	20.87	59.3	8.99	65.38	11.16	86.80	0.12	35.043	0.08	24.7	8.15	95.3
DOH WQS		DRY	10%	10.00	5.00				30.00	180.00	0.50	*	0.50	**	***	****
			2%	20.00	9.00				45.00	250.00	1.00		1.00			
		WET	10%	14.00	8.50				40.00	250.00	1.25	*	0.90	**	***	****
			2%	25.00	15.00				60.00	350.00	2.00		1.75			

* Salinity shall not vary more than ten percent form natural or seasonal changes considering hydrologic input and oceanographic conditions.
** Temperature shall not vary by more than one degree C. from ambient conditions.
***pH shall not deviate more than 0.5 units from a value of 8.1.
****Dissolved Oxygen not to be below 75% saturation.

TABLE 3. Geometric mean data from water chemistry measurements (in µM) off the Makena Resort collected since August 1995 from Sites 1, 2, and 4 (N=25); since June 2002 from Site 3 (N=16) and since June 2007 from Site 3-A (N=7). For geometric mean calculations, detection limits were used in cases where sample was below detection limit. Abbreviations as follows: DFS=distance from shore; S=surface; D=deep. Also shown are State of Hawaii, Department of Health (DOH) geometric mean water quality standards for open coastal waters under "dry" and "wet" conditions. Boxed values exceed DOH GM 10% "dry" standards; boxed and shaded values exceed DOH GM 10% "wet" standards. For sampling site locations, see Figure 1.

TRANSECT SITE	DFS (m)	PO_4^{3-} (µM)	NO_3^- (µM)	NH_4^+ (µM)	Si (µM)	TOP (µM)	TON (µM)	TP (µM)	TN (µM)	TURB (NTU)	SALINITY (ppt)	CHL a (µg/L)	TEMP (deg.C)	pH	O2
MAKENA 1	0 S	0.23	41.83	0.38	70.16	0.24	7.72	0.54	57.24	0.35	25.841	0.93	25.6	8.12	102.8
	2 S	0.17	28.23	0.18	50.19	0.26	8.27	0.46	40.58	0.29	29.797	0.87	25.6	8.15	103.0
	5 S	0.12	11.16	0.13	24.13	0.26	8.01	0.41	23.64	0.23	32.257	0.57	25.6	8.16	103.8
	5 D	0.11	8.56	0.20	19.61	0.27	7.55	0.40	19.47	0.19	33.183	0.49	25.6	8.16	104.5
	10 S	0.10	4.10	0.15	10.90	0.26	7.57	0.37	13.33	0.19	34.092	0.37	25.7	8.15	104.6
	10 D	0.10	2.44	0.21	7.24	0.28	7.50	0.39	11.07	0.17	34.390	0.38	25.6	8.15	103.7
	50 S	0.08	2.58	0.21	7.26	0.27	7.37	0.36	11.27	0.16	34.409	0.31	25.7	8.14	99.9
	50 D	0.08	0.29	0.13	2.45	0.28	7.34	0.37	8.00	0.12	34.799	0.27	25.6	8.14	98.6
	100 S	0.08	1.04	0.16	4.72	0.27	6.85	0.37	9.66	0.13	34.548	0.24	25.7	8.13	97.5
	100 D	0.07	0.10	0.09	1.99	0.28	7.38	0.36	7.73	0.10	34.846	0.21	25.6	8.15	96.9
	150 S	0.08	0.32	0.16	3.00	0.27	7.33	0.37	8.60	0.12	34.729	0.19	25.8	8.14	96.6
	150 D	0.08	0.07	0.13	1.78	0.28	7.14	0.37	7.46	0.10	34.848	0.17	25.6	8.15	97.0
MAKENA 2	0 S	0.19	4.36	0.38	23.08	0.32	8.43	0.55	14.47	0.92	33.328	0.84	25.8	8.13	97.3
	2 S	0.18	3.88	0.26	19.95	0.32	8.05	0.53	13.28	0.66	33.529	0.82	25.8	8.13	98.4
	5 S	0.17	3.17	0.28	15.21	0.29	7.31	0.48	11.58	0.48	33.998	0.62	25.7	8.13	98.2
	5 D	0.17	2.94	0.33	14.68	0.31	7.52	0.50	11.87	0.45	34.051	0.80	25.7	8.13	97.6
	10 S	0.12	1.77	0.22	9.85	0.30	5.71	0.44	9.53	0.32	34.360	0.43	25.7	8.14	98.0
	10 D	0.11	1.14	0.28	8.14	0.30	7.22	0.44	9.32	0.28	34.474	0.50	25.7	8.14	97.2
	50 S	0.10	1.22	0.28	7.61	0.32	7.67	0.44	9.72	0.25	34.441	0.34	25.6	8.13	96.8
	50 D	0.11	0.23	0.25	3.15	0.30	7.61	0.43	8.35	0.18	34.789	0.37	25.6	8.14	96.4
	100 S	0.09	0.47	0.20	4.15	0.29	7.40	0.40	8.43	0.16	34.633	0.29	25.7	8.12	97.0
	100 D	0.08	0.14	0.20	2.30	0.29	7.25	0.38	7.80	0.13	34.821	0.27	25.6	8.14	96.1
	150 S	0.09	0.23	0.22	3.03	0.28	7.46	0.39	8.11	0.13	34.770	0.23	25.7	8.14	96.1
	150 D	0.08	0.09	0.16	2.00	0.29	7.60	0.39	7.99	0.10	34.845	0.22	25.6	8.15	96.5
	200 S	0.07	0.11	0.17	2.26	0.29	7.37	0.37	7.91	0.11	34.840	0.24	25.8	8.15	97.3
	200 D	0.07	0.05	0.20	1.69	0.29	7.85	0.38	8.19	0.10	34.873	0.24	25.6	8.16	96.5
MAKENA 3-A	0 S	1.47	189.4	0.65	356.19	0.32	10.46	1.85	202.8	0.29	12.689	0.31	24.8	7.84	94.8
	2 S	0.88	135.4	0.31	248.35	0.30	5.78	1.40	145.9	0.21	18.917	0.38	25.1	7.84	95.5
	5 S	0.35	40.35	0.42	84.13	0.37	10.28	0.85	68.30	0.21	28.169	0.37	25.2	7.95	96.8
	5 D	0.21	21.18	0.41	48.51	0.30	8.37	0.61	36.69	0.19	31.471	0.39	25.3	8.02	97.3
	10 S	0.09	8.55	0.26	23.31	0.29	8.19	0.43	21.88	0.14	33.262	0.21	25.5	8.06	97.4
	10 D	0.06	1.69	0.24	6.62	0.28	7.20	0.38	10.55	0.14	34.580	0.26	25.4	8.08	99.5
	50 S	0.08	2.20	0.25	8.79	0.28	8.13	0.40	12.84	0.13	34.426	0.16	25.8	8.08	98.0
	50 D	0.06	0.13	0.37	2.94	0.29	8.33	0.38	9.03	0.12	34.820	0.15	25.5	8.10	98.8
	100 S	0.08	0.90	0.11	4.97	0.28	7.42	0.38	9.37	0.10	34.726	0.16	25.8	8.09	96.1
	100 D	0.10	0.03	0.35	2.02	0.29	7.60	0.40	8.12	0.09	34.930	0.13	25.5	8.11	98.4
	150 S	0.06	0.13	0.15	2.95	0.31	8.27	0.38	9.58	0.11	34.828	0.13	25.6	8.10	97.1
	150 D	0.05	0.02	0.28	1.52	0.29	7.64	0.35	8.04	0.11	34.945	0.16	25.4	8.11	99.5
MAKENA 3	0 S	0.12	9.03	0.35	19.06	0.28	6.20	0.46	24.52	0.28	33.726	0.52	25.7	8.13	100.8
	2 S	0.15	14.56	0.27	25.07	0.27	5.80	0.48	29.00	0.29	33.723	0.56	25.8	8.11	100.8
	5 S	0.12	9.43	0.22	17.15	0.29	7.80	0.47	22.71	0.21	34.046	0.35	25.8	8.11	100.8
	5 D	0.13	6.19	0.21	13.01	0.28	7.05	0.44	17.99	0.20	34.311	0.42	25.7	8.11	100.1
	10 S	0.09	4.52	0.26	9.65	0.29	7.53	0.41	15.43	0.18	34.432	0.26	25.7	8.11	99.3
	10 D	0.08	2.47	0.19	6.86	0.30	7.80	0.40	12.79	0.16	34.629	0.28	25.6	8.12	99.2
	50 S	0.08	1.64	0.19	5.61	0.28	7.61	0.38	11.09	0.14	34.653	0.22	25.7	8.11	95.4
	50 D	0.09	0.36	0.18	2.73	0.29	7.83	0.39	8.74	0.10	34.827	0.21	25.6	8.12	93.4
	100 S	0.08	0.45	0.22	2.99	0.29	7.66	0.38	8.81	0.11	34.799	0.16	25.6	8.12	95.4
	100 D	0.06	0.10	0.24	1.83	0.30	7.11	0.37	7.66	0.09	34.852	0.17	25.6	8.13	95.2
	150 S	0.05	0.14	0.14	2.15	0.29	6.90	0.35	7.56	0.10	34.821	0.14	25.6	8.15	95.7
	150 D	0.06	0.07	0.12	1.72	0.29	6.96	0.36	7.31	0.10	34.879	0.17	25.6	8.16	96.7
MAKENA 4	0 S	0.23	41.83	0.38	70.16	0.24	7.72	0.54	57.24	0.35	25.841	0.93	25.6	8.12	99.2
	2 S	0.17	28.23	0.18	50.19	0.26	8.27	0.46	40.58	0.29	29.797	0.87	25.6	8.15	100.6
	5 S	0.12	11.16	0.13	24.13	0.26	8.01	0.41	23.64	0.23	32.257	0.57	25.6	8.16	102.0
	5 D	0.11	8.56	0.20	19.61	0.27	7.55	0.40	19.47	0.19	33.183	0.49	25.6	8.16	102.0
	10 S	0.10	4.10	0.15	10.90	0.26	7.57	0.37	13.33	0.19	34.092	0.37	25.7	8.15	100.1
	10 D	0.10	2.44	0.21	7.24	0.28	7.50	0.39	11.07	0.17	34.390	0.38	25.6	8.15	100.0
	50 S	0.08	2.58	0.21	7.26	0.27	7.37	0.36	11.27	0.16	34.409	0.31	25.7	8.14	94.4
	50 D	0.08	0.29	0.13	2.45	0.28	7.34	0.37	8.00	0.12	34.799	0.27	25.6	8.14	93.9
	100 S	0.08	1.04	0.16	4.72	0.27	6.85	0.37	9.66	0.13	34.548	0.24	25.7	8.13	94.2
	100 D	0.07	0.10	0.09	1.99	0.28	7.38	0.36	7.73	0.10	34.846	0.21	25.6	8.15	93.0
	150 S	0.08	0.32	0.16	3.00	0.27	7.33	0.37	8.60	0.12	34.729	0.19	25.8	8.14	95.7
	150 D	0.08	0.07	0.13	1.78	0.28	7.14	0.37	7.46	0.10	34.848	0.17	25.6	8.15	94.4
DOH WQS GEOMETRIC MEAN	DRY	0.25	0.14					0.52	7.86	0.20	*	0.15	**	***	
	WET	0.36	0.25					0.64	10.71	0.50		0.30			

* Salinity shall not vary more than ten percent form natural or seasonal changes considering hydrologic input and oceanographic conditions.

** Temperature shall not vary by more than one degree C. from ambient conditions.

***pH shall not deviate more than 0.5 units from a value of 8.1.

TABLE 4. Geometric mean data (in μg/L) from water chemistry measurements (in μM) off the Makena Resort collected since August 1995 for Sites 1, 2, and 4 (N=25); since June 2002 from Site 3 (N=16) and since June 2007 from Site 3-A (N=7). For geometric mean calculations, detection limits were used in cases where sample was below detection limit. Abbreviations as follows: DFS=distance from shore; S=surface; D=deep. Also shown are State of Hawaii, Department of Health (DOH) geometric mean water quality standards for open coastal waters under "dry" and "wet" conditions. Boxed values exceed DOH GM 10% "dry" standards; boxed and shaded values exceed DOH GM 10% "wet" standards. For sampling site locations, see Figure 1.

TRANSECT SITE	DFS (m)	PO_4^{3-} (μg/L)	NO_3^- (μg/L)	NH_4^+ (μg/L)	Si (μg/L)	TOP (μg/L)	TON (μg/L)	TP (μg/L)	TN (μg/L)	TURB (NTU)	SALINITY (ppt)	CHL a (μg/L)	TEMP (deg.C)	pH	O2
MAKENA 1	0 S	7.10	585.8	5.30	1971	7.40	108.10	16.70	801.7	0.35	25.841	0.93	25.6	8.12	102.8
	2 S	5.20	395.3	2.50	1410	8.00	115.80	14.20	568.3	0.29	29.797	0.87	25.6	8.15	103.0
	5 S	3.70	156.3	1.80	677.8	8.00	112.10	12.60	331.1	0.23	32.257	0.57	25.6	8.16	103.8
	5 D	3.40	119.8	2.80	550.8	8.30	105.70	12.30	272.6	0.19	33.183	0.49	25.6	8.16	104.5
	10 S	3.00	57.40	2.10	306.2	8.00	106.00	11.40	186.6	0.19	34.092	0.37	25.7	8.15	104.6
	10 D	3.00	34.10	2.90	203.4	8.60	105.00	12.00	155.0	0.17	34.390	0.38	25.6	8.15	103.7
	50 S	2.40	36.10	2.90	203.9	8.30	103.20	11.10	157.8	0.16	34.409	0.31	25.7	8.14	99.9
	50 D	2.40	4.00	1.80	68.82	8.60	102.80	11.40	112.0	0.12	34.799	0.27	25.6	8.14	98.6
	100 S	2.40	14.50	2.20	132.6	8.30	95.90	11.40	135.2	0.13	34.548	0.24	25.7	8.13	97.5
	100 D	2.10	1.40	1.20	55.90	8.60	103.30	11.10	108.2	0.10	34.846	0.21	25.6	8.15	96.9
	150 S	2.40	4.40	2.20	84.27	8.30	102.60	11.40	120.4	0.12	34.729	0.19	25.8	8.14	96.6
	150 D	2.40	0.90	1.80	50.00	8.60	100.00	11.40	104.4	0.10	34.848	0.17	25.6	8.15	97.0
MAKENA 2	0 S	5.80	61.00	5.30	648.3	9.90	118.00	17.00	202.6	0.92	33.328	0.84	25.8	8.13	97.3
	2 S	5.50	54.30	3.60	560.4	9.90	112.70	16.40	185.9	0.66	33.529	0.82	25.8	8.13	98.4
	5 S	5.20	44.30	3.90	427.2	8.90	102.30	14.80	162.1	0.48	33.998	0.62	25.7	8.13	98.2
	5 D	5.20	41.10	4.60	412.4	9.60	105.30	15.40	166.2	0.45	34.051	0.80	25.7	8.13	97.6
	10 S	3.70	24.70	3.00	276.7	9.20	79.90	13.60	133.4	0.32	34.360	0.43	25.7	8.14	98.0
	10 D	3.40	15.90	3.90	228.7	9.20	101.10	13.60	130.5	0.28	34.474	0.50	25.7	8.14	97.2
	50 S	3.00	17.00	3.90	213.8	9.90	107.40	13.60	136.1	0.25	34.441	0.34	25.6	8.13	96.8
	50 D	3.40	3.20	3.50	88.48	9.20	106.50	13.30	116.9	0.18	34.789	0.37	25.6	8.14	96.4
	100 S	2.70	6.50	2.80	116.6	8.90	103.60	12.30	118.0	0.16	34.633	0.29	25.7	8.12	97.0
	100 D	2.40	1.90	2.80	64.61	8.90	101.50	11.70	109.2	0.13	34.821	0.27	25.6	8.14	96.1
	150 S	2.70	3.20	3.00	85.11	8.60	104.40	12.00	113.5	0.13	34.770	0.23	25.7	8.14	96.1
	150 D	2.40	1.20	2.20	56.18	8.90	106.40	12.00	111.9	0.10	34.845	0.22	25.6	8.15	96.5
	200 S	2.10	1.50	2.30	63.48	8.90	103.20	11.40	110.7	0.11	34.840	0.24	25.8	8.15	97.3
	200 D	2.10	0.70	2.80	47.47	8.90	109.90	11.70	114.7	0.10	34.873	0.24	25.6	8.16	96.5
MAKENA 3-A	0 S	45.50	2652	9.10	10005	9.90	146.50	57.30	2840.9	0.29	12.689	0.31	24.8	7.84	94.8
	2 S	27.20	1897	4.30	6976	9.20	80.90	43.30	2043.7	0.21	18.917	0.38	25.1	7.84	95.5
	5 S	10.80	565.1	5.80	2363	11.40	143.90	26.30	956.6	0.21	28.169	0.37	25.2	7.95	96.8
	5 D	6.50	296.6	5.70	1362.6	9.20	117.20	18.80	513.8	0.19	31.471	0.39	25.3	8.02	97.3
	10 S	2.70	119.7	3.60	654.8	8.90	114.70	13.30	306.4	0.14	33.262	0.21	25.5	8.06	97.4
	10 D	1.80	23.60	3.30	186.0	8.60	100.80	11.70	147.7	0.14	34.580	0.26	25.4	8.08	99.5
	50 S	2.40	30.80	3.50	246.9	8.60	113.80	12.30	179.8	0.13	34.426	0.16	25.8	8.08	98.0
	50 D	1.80	1.80	5.10	82.58	8.90	116.60	11.70	126.4	0.12	34.820	0.15	25.5	8.1	98.8
	100 S	2.40	12.60	1.50	139.6	8.60	103.90	11.70	131.2	0.10	34.726	0.16	25.8	8.09	96.1
	100 D	3.00	0.40	4.90	56.74	8.90	106.40	12.30	113.7	0.09	34.930	0.13	25.5	8.11	98.4
	150 S	1.80	1.80	2.10	82.9	9.60	115.80	11.70	134.1	0.11	34.828	0.13	25.6	8.1	97.1
	150 D	1.50	0.20	3.90	42.70	8.90	107.00	10.80	112.6	0.11	34.945	0.16	25.4	8.11	99.5
MAKENA 3	0 S	3.70	126.40	4.90	535.4	8.60	86.80	14.20	343.4	0.28	33.726	0.52	25.7	8.13	100.8
	2 S	4.60	203.9	3.70	704.2	8.30	81.20	14.80	406.1	0.29	33.723	0.56	25.8	8.11	100.8
	5 S	3.70	132.0	3.00	481.7	8.90	109.20	14.50	318.0	0.21	34.046	0.35	25.8	8.11	100.8
	5 D	4.00	86.60	2.90	365.5	8.60	98.70	13.60	251.9	0.20	34.311	0.42	25.7	8.11	100.1
	10 S	2.70	63.30	3.60	271.1	8.90	105.40	12.60	216.1	0.18	34.432	0.26	25.7	8.11	99.3
	10 D	2.40	34.50	2.60	192.7	9.20	109.20	12.30	179.1	0.16	34.629	0.28	25.6	8.12	99.2
	50 S	2.40	22.90	2.60	157.6	8.60	106.50	11.70	155.3	0.14	34.653	0.22	25.7	8.11	95.4
	50 D	2.70	5.00	2.50	76.69	8.90	109.60	12.00	122.4	0.10	34.827	0.21	25.6	8.12	93.4
	100 S	2.40	6.30	3.00	83.99	8.90	107.20	11.70	123.3	0.11	34.799	0.16	25.6	8.12	95.4
	100 D	1.80	1.40	3.30	51.40	9.20	99.50	11.40	107.2	0.09	34.852	0.17	25.6	8.13	95.2
	150 S	1.50	1.90	1.90	60.39	8.90	96.60	10.80	105.8	0.10	34.821	0.14	25.6	8.15	95.7
	150 D	1.80	0.90	1.60	48.31	8.90	97.40	11.10	102.3	0.10	34.879	0.17	25.6	8.16	96.7
MAKENA 4	0 S	7.10	585.8	5.30	1971	7.40	108.10	16.70	801.7	0.35	25.841	0.93	25.6	8.12	99.2
	2 S	5.20	395.3	2.50	1410	8.00	115.80	14.20	568.3	0.29	29.797	0.87	25.6	8.15	100.6
	5 S	3.70	156.3	1.80	677.8	8.00	112.10	12.60	331.1	0.23	32.257	0.57	25.6	8.16	102.0
	5 D	3.40	119.8	2.80	550.8	8.30	105.70	12.30	272.6	0.19	33.183	0.49	25.6	8.16	102.0
	10 S	3.00	57.40	2.10	306.2	8.00	106.00	11.40	186.6	0.19	34.092	0.37	25.7	8.15	100.1
	10 D	3.00	34.10	2.90	203.4	8.60	105.00	12.00	155.0	0.17	34.390	0.38	25.6	8.15	100.0
	50 S	2.40	36.10	2.90	203.9	8.30	103.20	11.10	157.8	0.16	34.409	0.31	25.7	8.14	94.4
	50 D	2.40	4.00	1.80	68.82	8.60	102.80	11.40	112.0	0.12	34.799	0.27	25.6	8.14	93.9
	100 S	2.40	14.50	2.20	132.6	8.30	95.90	11.40	135.2	0.13	34.548	0.24	25.7	8.13	94.2
	100 D	2.10	1.40	1.20	55.90	8.60	103.30	11.10	108.2	0.10	34.846	0.21	25.6	8.15	93.0
	150 S	2.40	4.40	2.20	84.27	8.30	102.60	11.40	120.4	0.12	34.729	0.19	25.8	8.14	95.7
	150 D	2.40	0.90	1.80	50.00	8.60	100.00	11.40	104.4	0.10	34.848	0.17	25.6	8.15	94.4
DOH WQS GEOMETRIC MEAN	DRY	3.50	2.00					16.00	110.00	0.20	*	0.15	**	***	
	WET	5.00	3.50					20.00	150.00	0.50		0.30			

* Salinity shall not vary more than ten percent form natural or seasonal changes considering hydrologic input and oceanographic conditions.

** Temperature shall not vary by more than one degree C. from ambient conditions.

***pH shall not deviate more than 0.5 units from a value of 8.1.

TABLE 5. Water chemistry measurements in μM and μg/L (shaded) from irrigation wells and an irrigation lake collected in the vicinity of the Makena Resort on March 6, 2011. For sampling site locations, see Figure 1.

WELL	PO_4^{3-} (μM)	PO_4^{3-} (μg/L)	NO_3^- (μM)	NO_3^- (μg/L)	NH_4^+ (μM)	NH_4^+ (μg/L)	Si (μM)	Si (μg/L)	TOP (μM)	TOP (μg/L)	TON (μM)	TON (μg/L)	TP (μM)	TP (μg/L)	TN (μM)	TN (μg/L)	SALINITY (ppt)
2	2.64	81.84	143.5	2009.3	2.40	33.60	711.2	19984.7	0.56	17.36	10.96	153.44	3.20	99.20	156.9	2196.3	1.878
3	2.08	64.48	130.2	1822.2	0.00	0.00	689.6	19377.8	0.96	29.76	10.64	148.96	3.04	94.24	140.8	1971.2	2.003
4	2.00	62.00	119.4	1672.2	0.40	5.60	654.7	18397.6	0.96	29.76	6.08	85.12	2.96	91.76	125.9	1762.9	1.738
6	2.32	71.92	178.0	2492.0	79.52	1113.28	562.6	15810.2	0.32	9.92	21.20	296.80	2.64	81.84	278.7	3902.1	1.571
10	2.64	81.84	146.3	2048.5	1.12	15.68	636.6	17889.6	0.72	22.32	17.36	243.04	3.36	104.16	164.8	2307.2	1.898
IL10	0.80	24.80	40.3	564.5	78.72	1102.08	561.3	15772.0	1.92	59.52	106.96	1497.44	2.72	84.32	226.0	3164.0	2.039

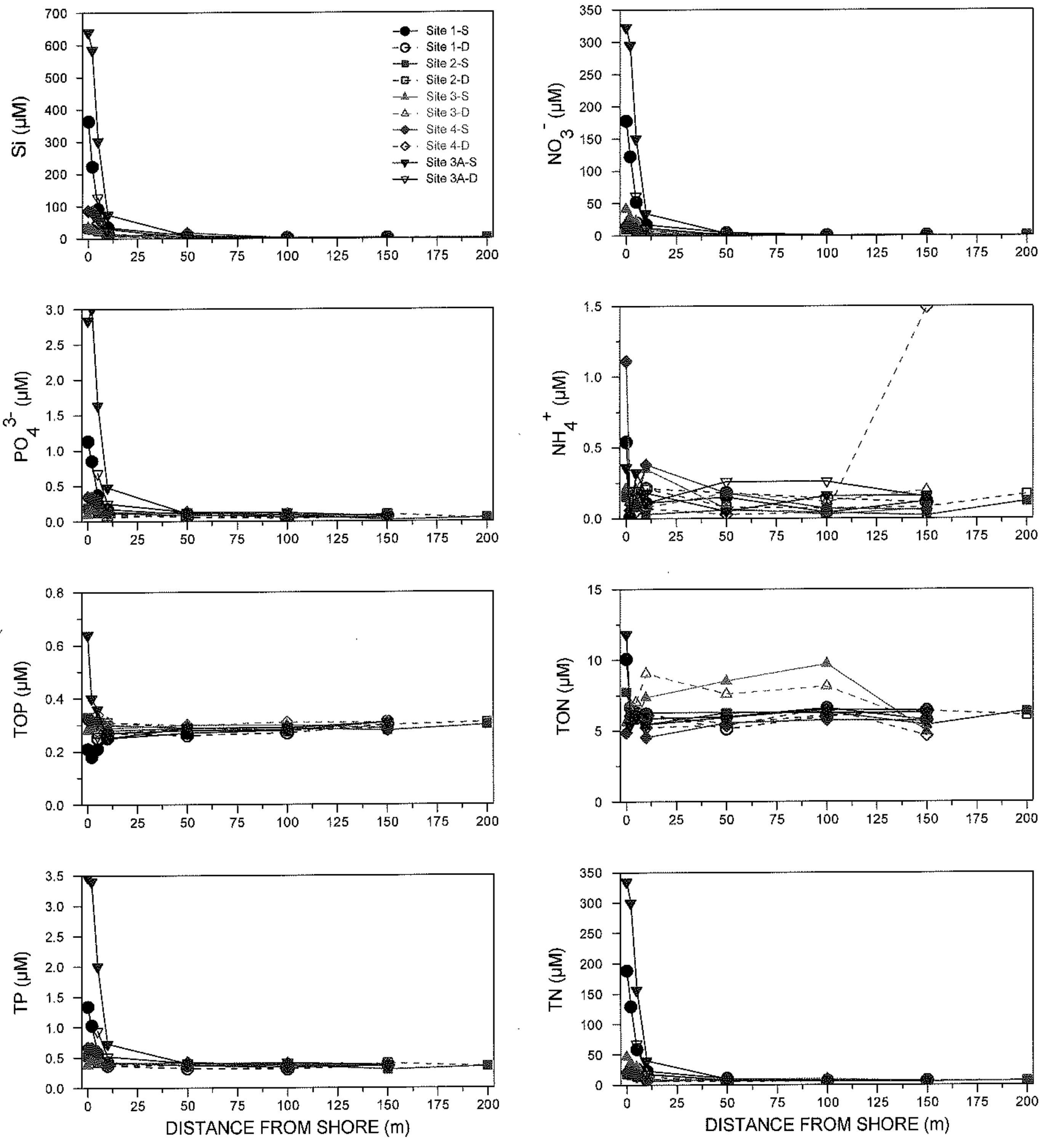

FIGURE 2. Plots of dissolved nutrients in surface (S) and deep (D) samples collected on March 6, 2011 as a function of distance from the shoreline in the vicinity of Makena Resort. For site locations, see Figure 1.

Exhibit A-1

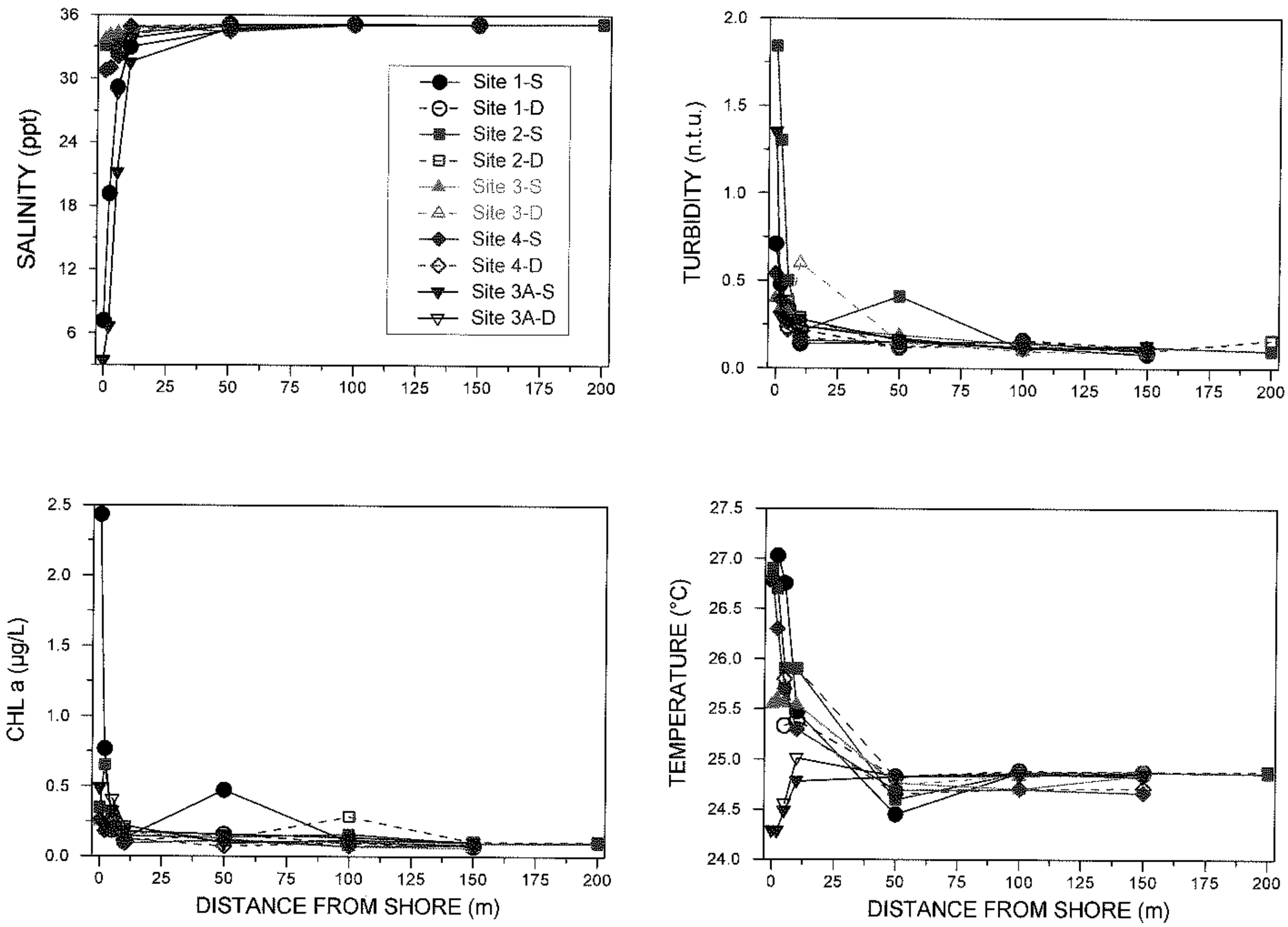

FIGURE 3. Plots of water chemistry constituents in surface (S) and deep (D) samples collected on March 6, 2011 as a function of distance from the shoreline in the vicinity of Makena Resort. For site locations, see Figure 1.

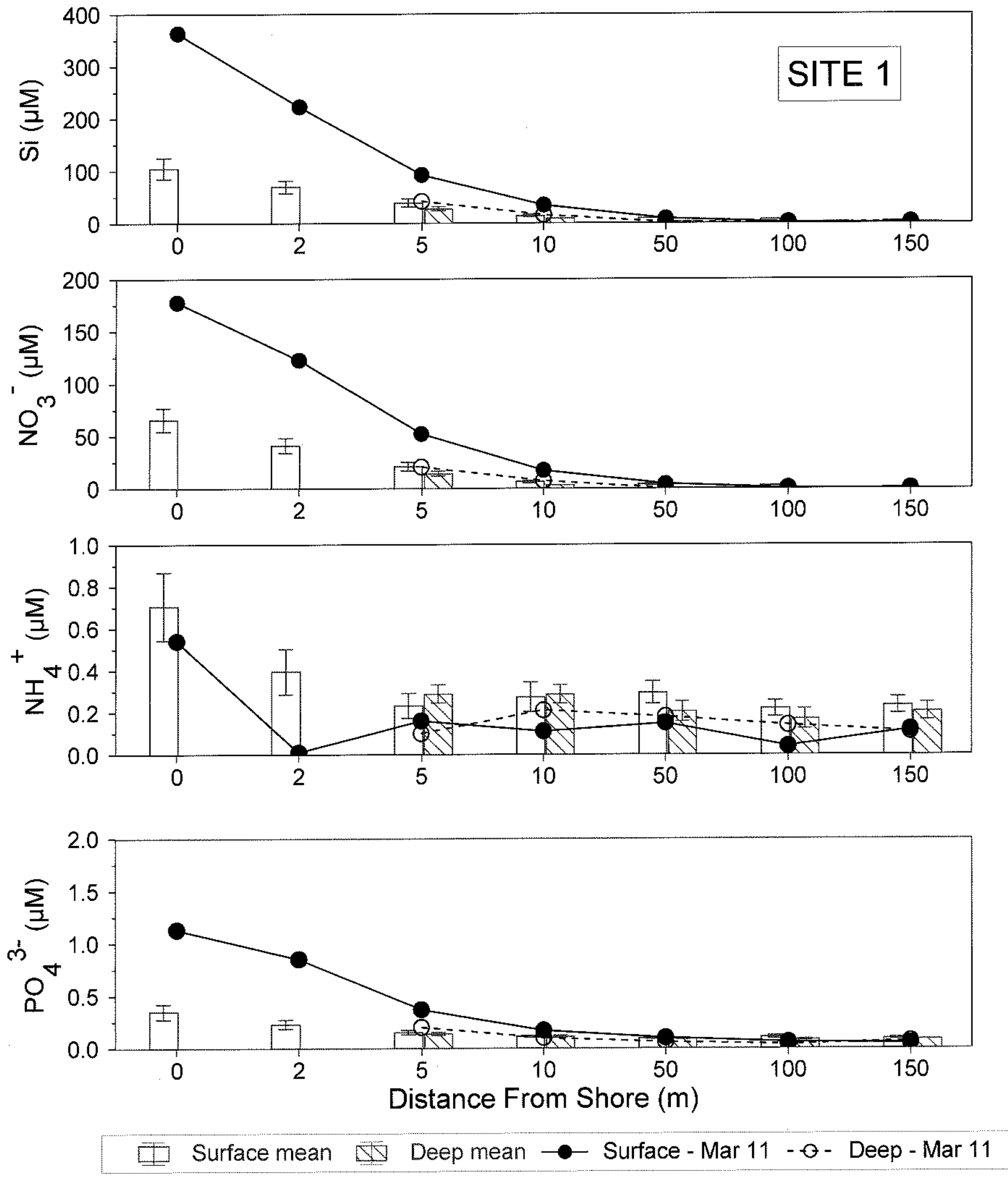

FIGURE 4. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 1, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=25). Error bars represent standard error of the mean. For site location, see Figure 1.

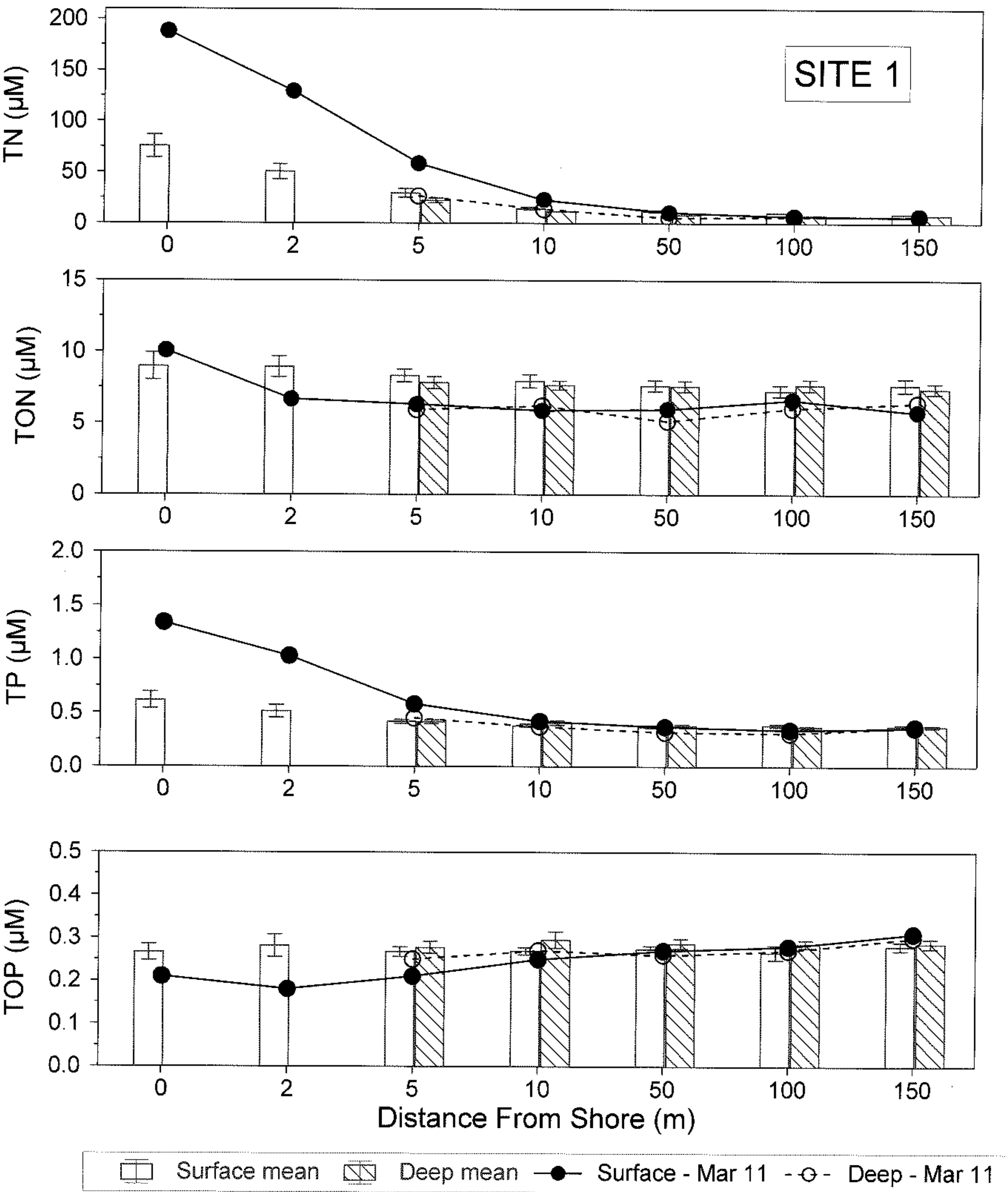

FIGURE 5. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 1, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=25). Error bars represent standard error of the mean. For site location, see Figure 1.

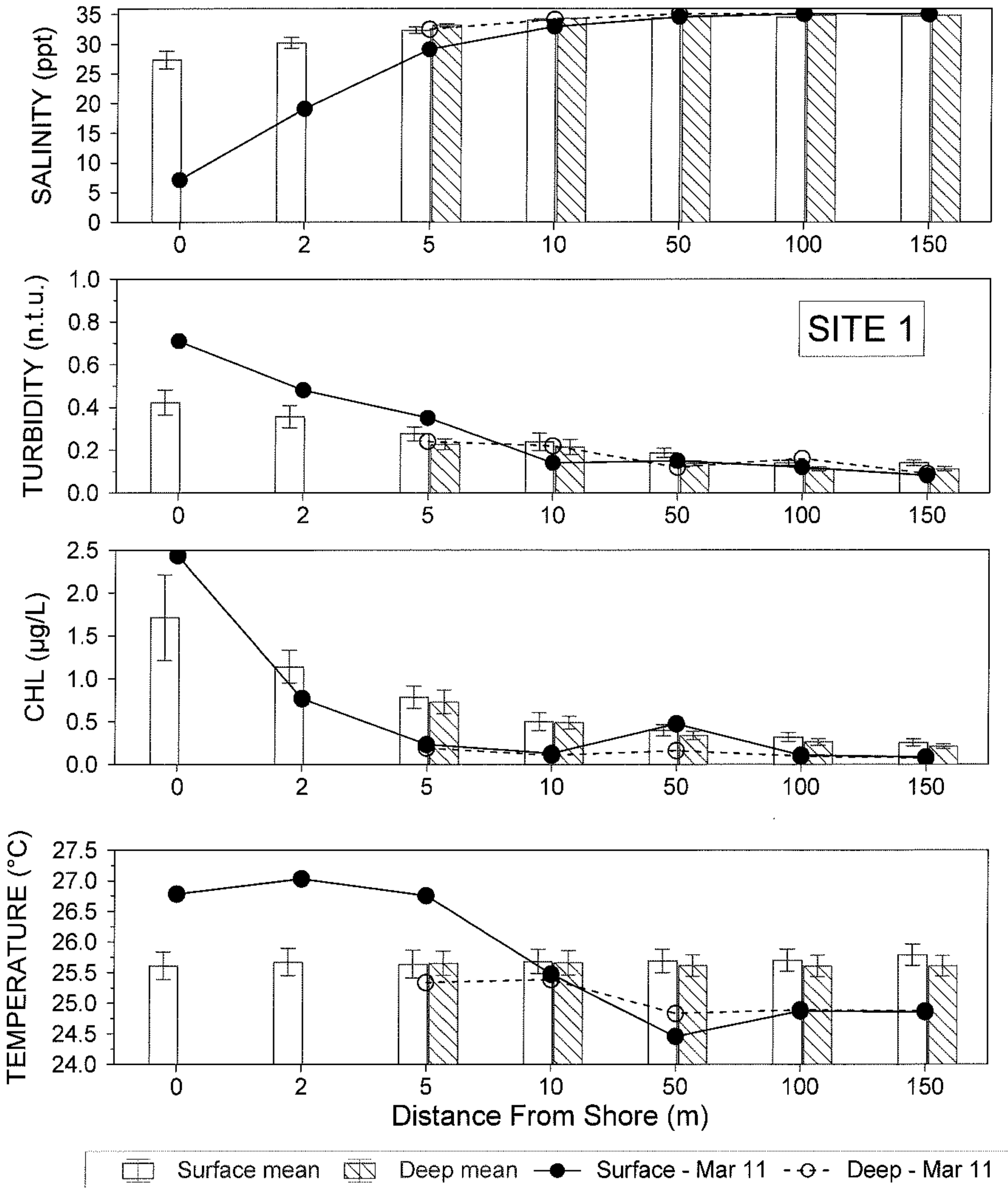

FIGURE 6. Plots of water chemistry constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 1, offshore of the Makena Resort. Data points and connected lines from samples collected during the most survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=25). Error bars represent standard error of the mean. For site location, see Figure 1.

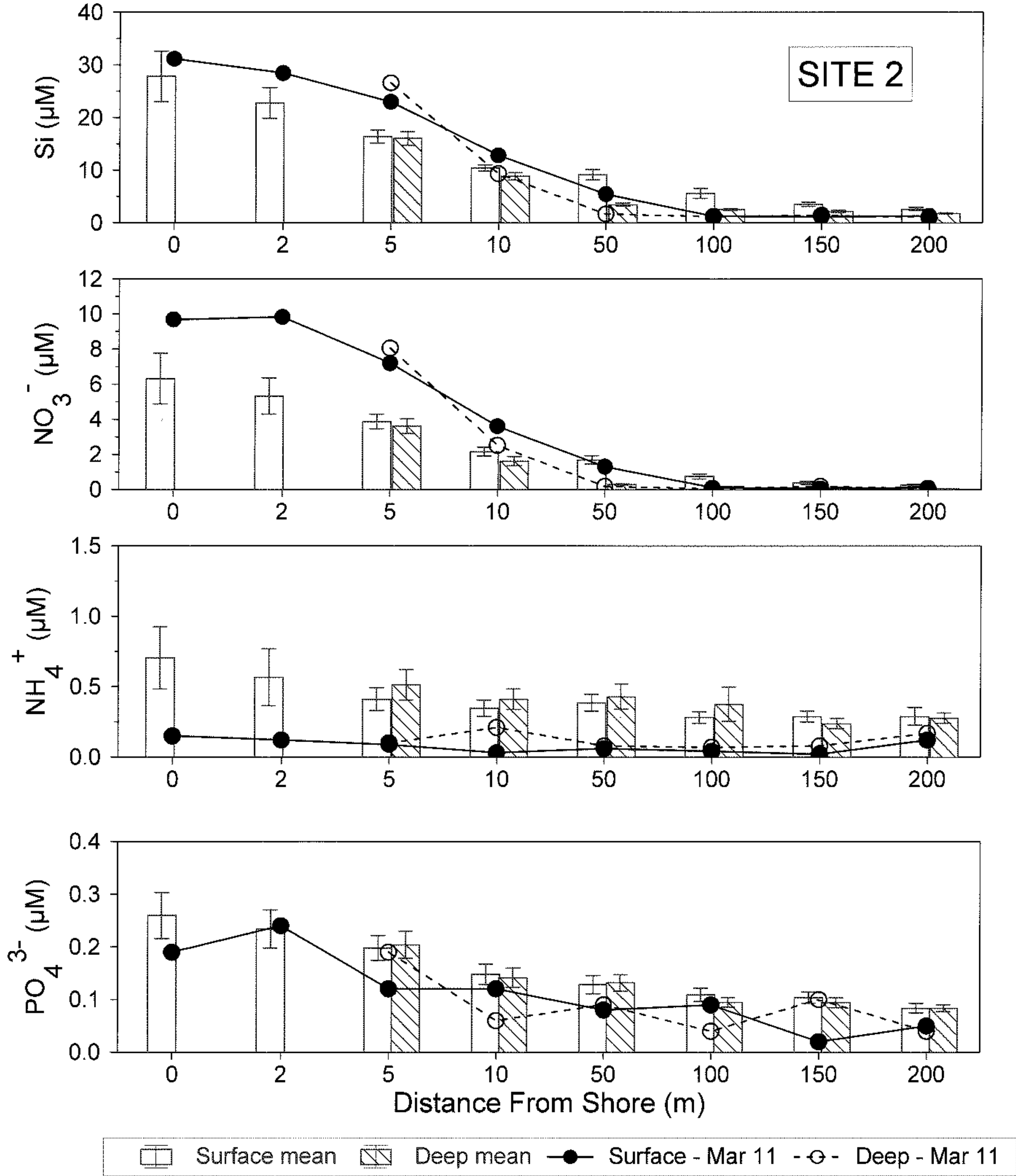

FIGURE 7. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 2, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=25). Error bars represent standard error of the mean. For site location, see Figure 1.

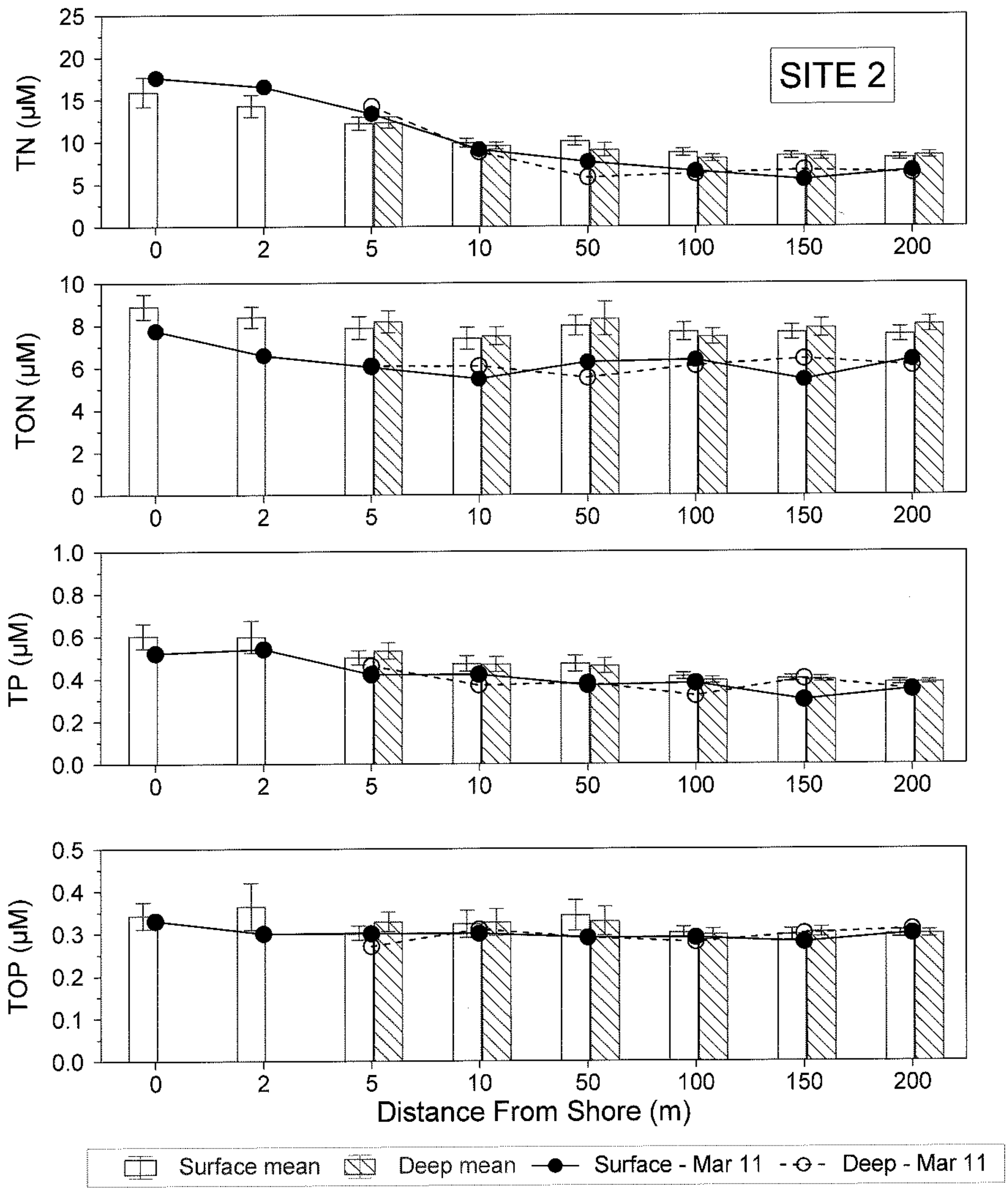

FIGURE 8. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 2, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=25). Error bars represent standard error of the mean. For site location, see Figure 1.

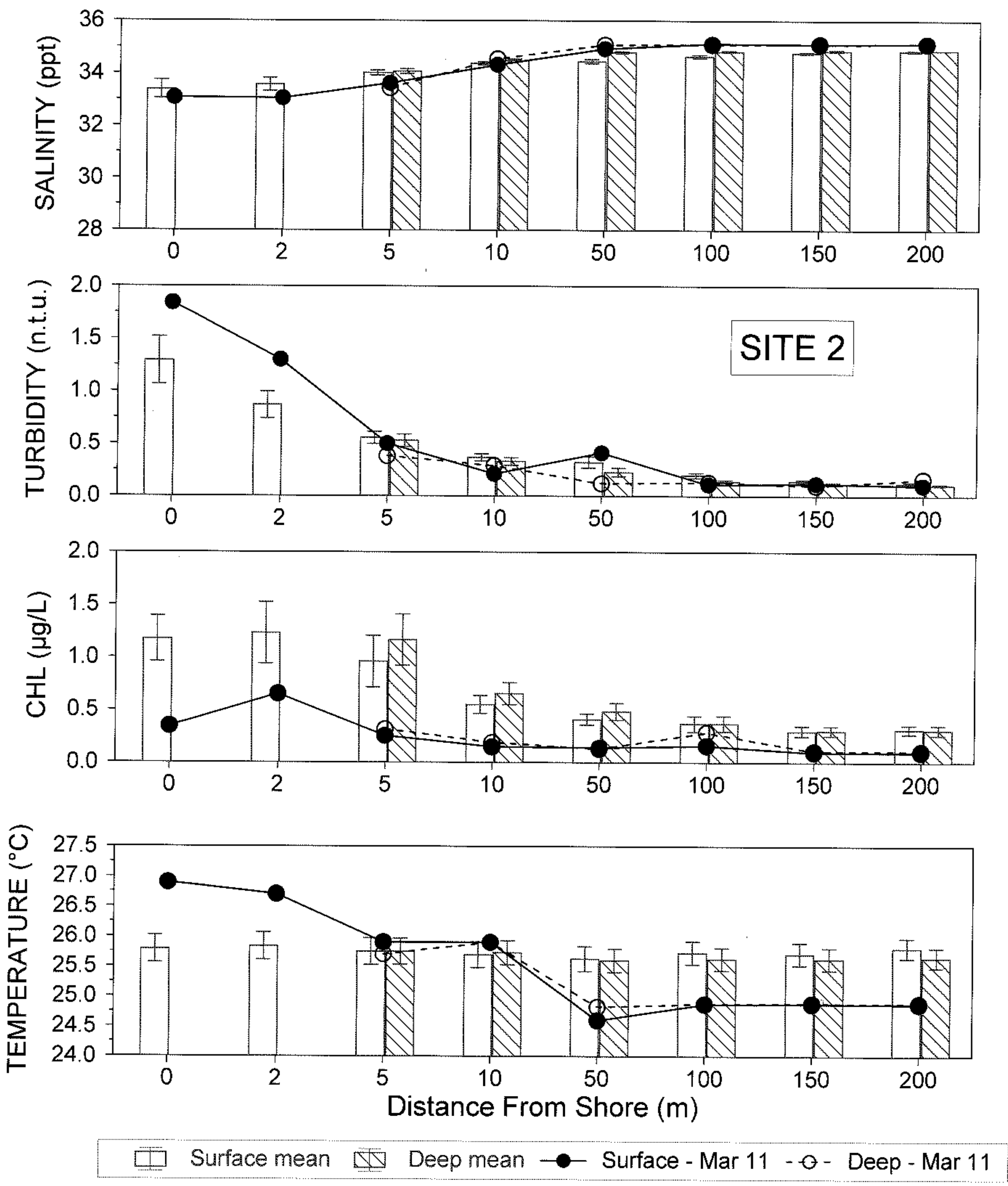

FIGURE 9. Plots of water chemistry constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 2, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey,bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=25). Error bars represent standard error of the mean. For site location, see Figure 1.

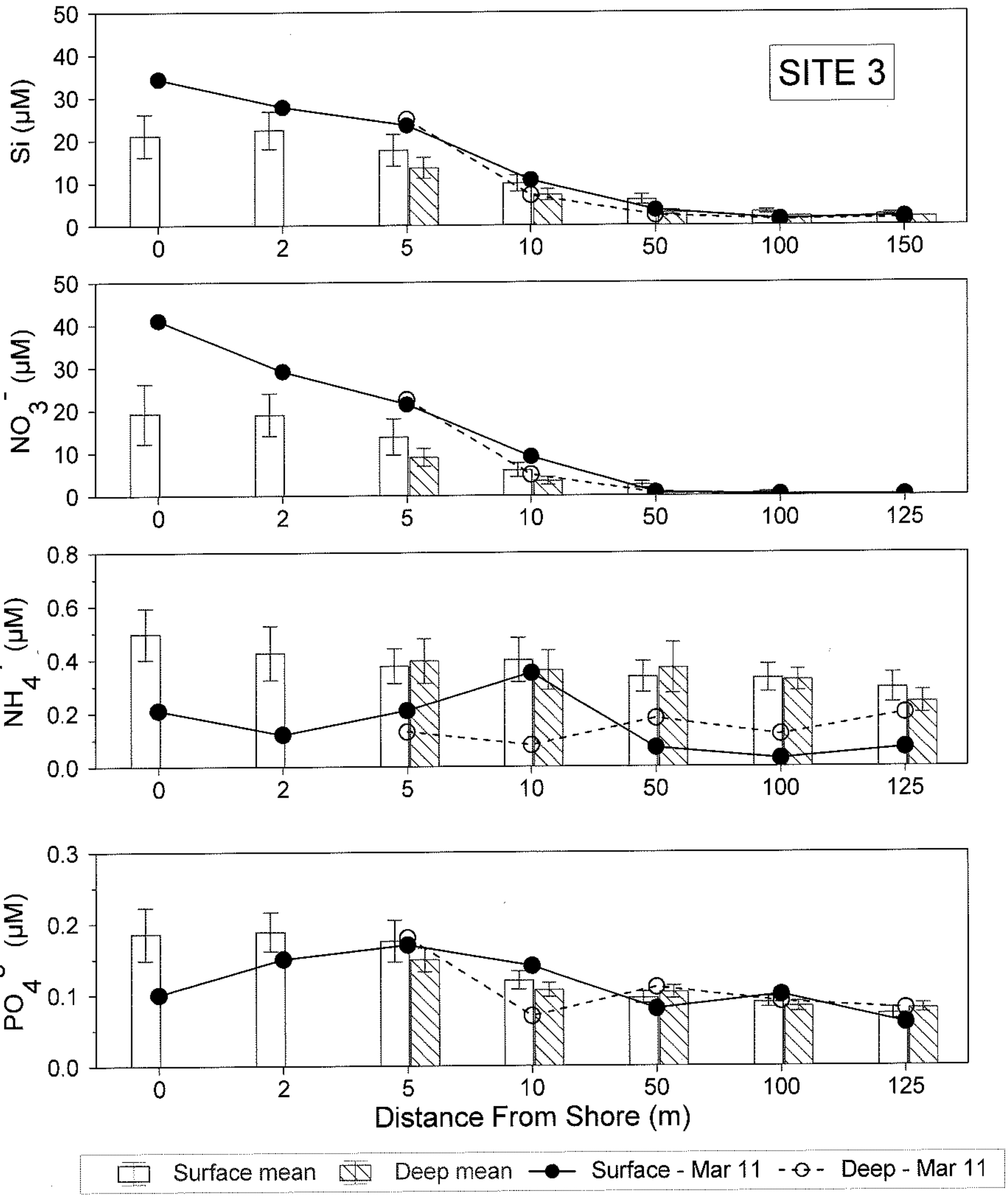

FIGURE 10. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 3, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=25). Error bars represent standard error of the mean. For site location, see Figure 1.

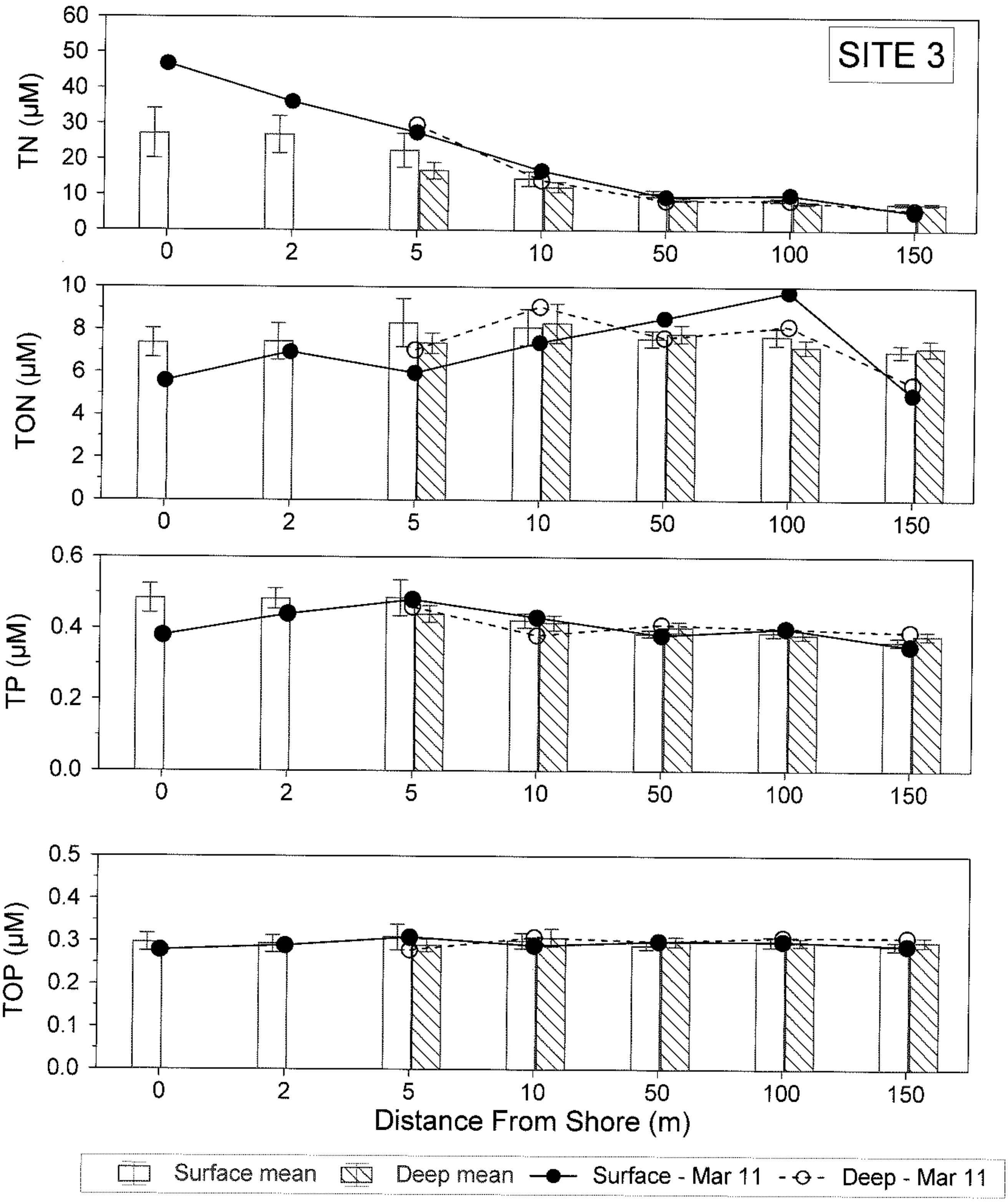

FIGURE 11. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 3, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=25). Error bars represent standard error of the mean. For site location, see Figure 1.

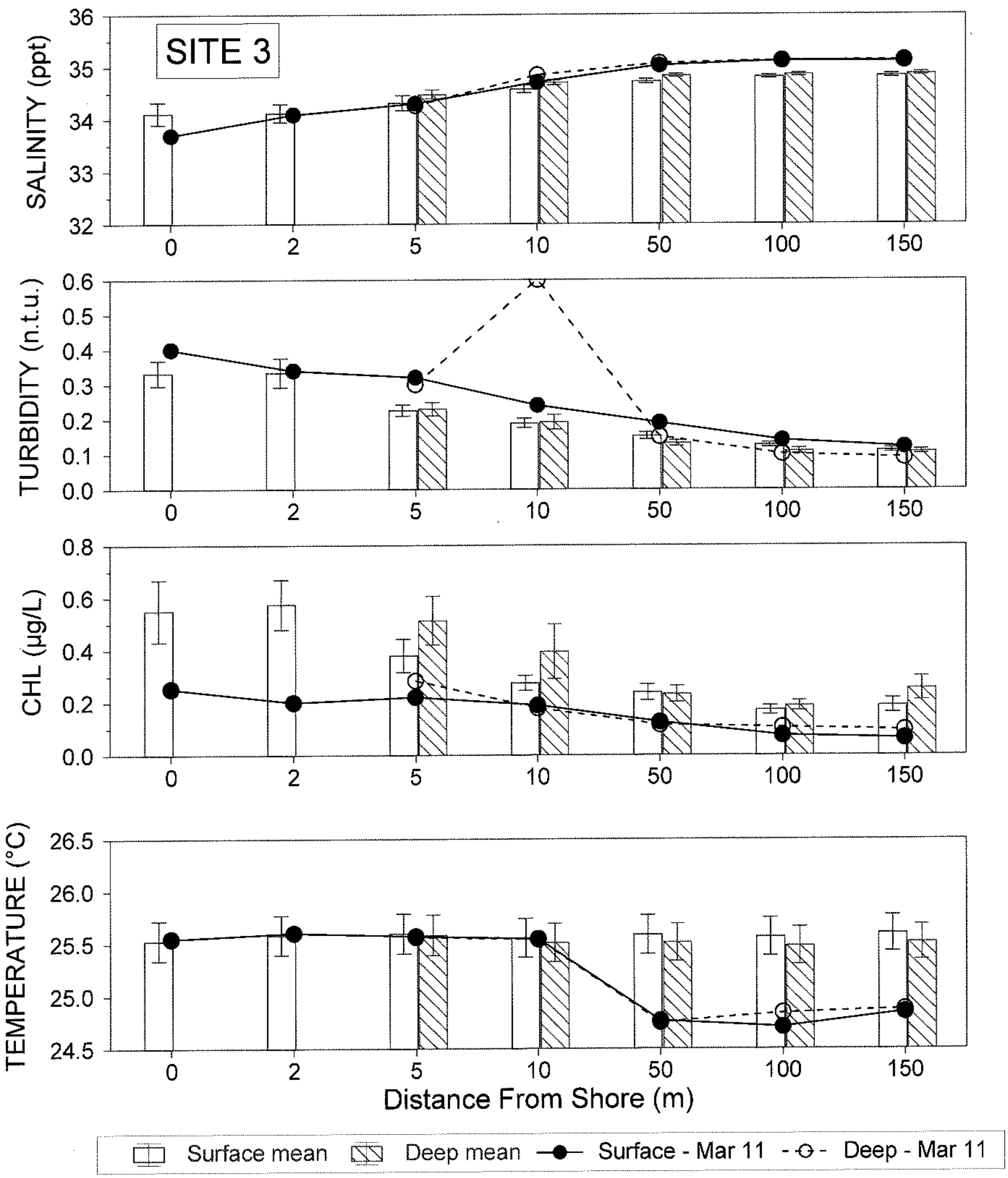

FIGURE 12. Plots of water chemistry constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 3, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=25). Error bars represent standard error of the mean. For site location, see Figure 1.

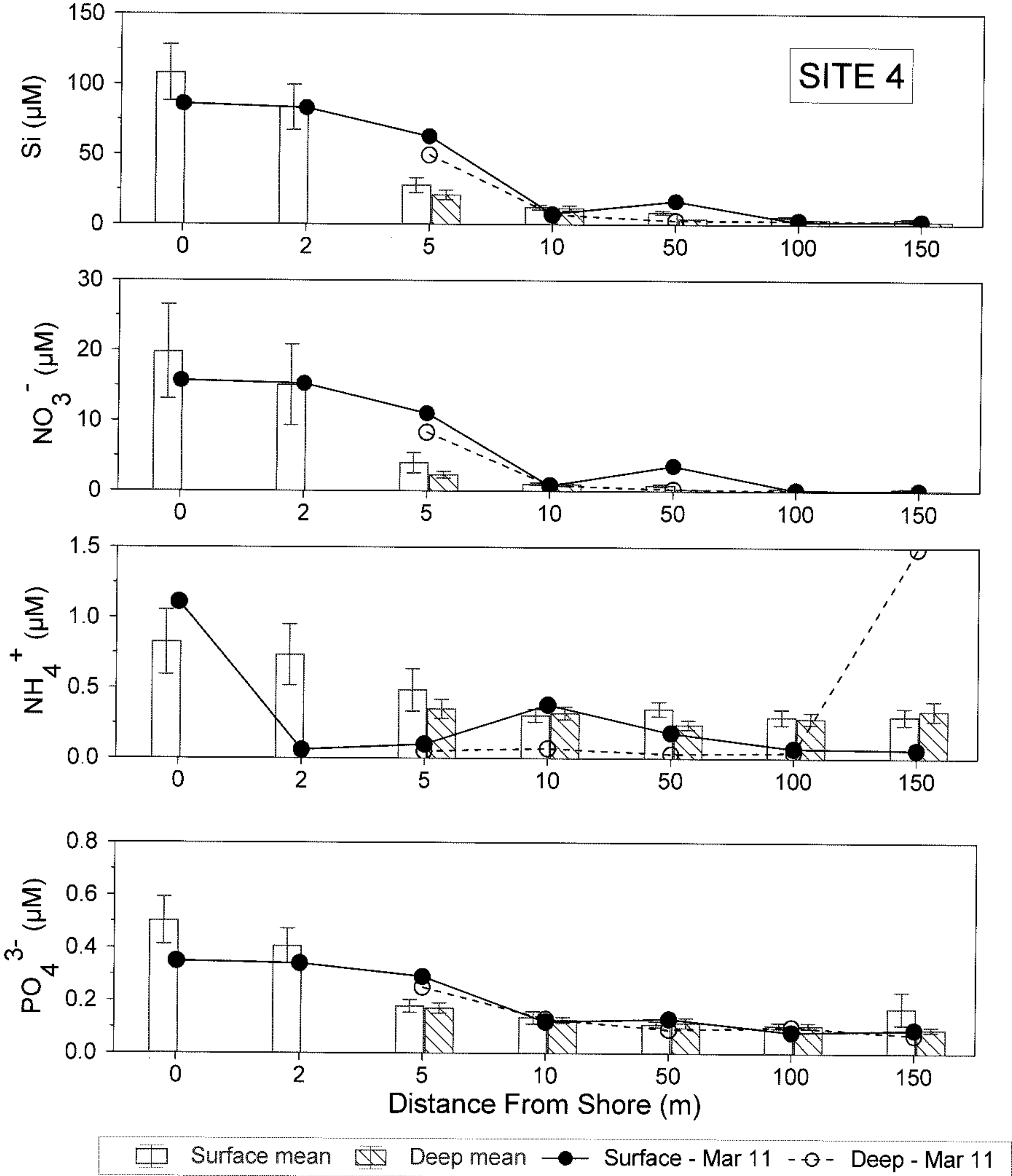

FIGURE 13. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 4, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=25). Error bars represent standard error of the mean. For site location, see Figure 1.

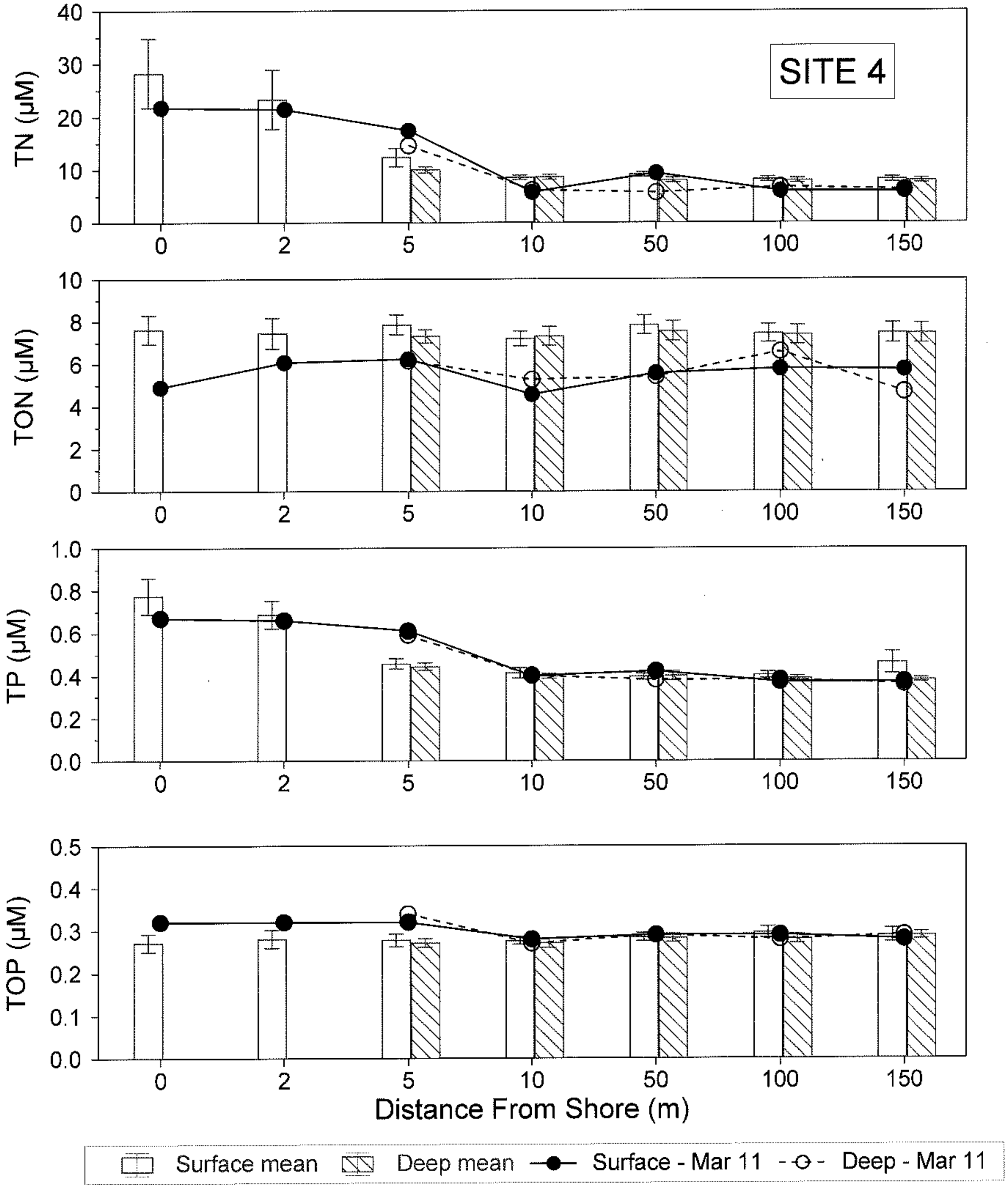

FIGURE 14. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 4, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=25). Error bars represent standard error of the mean. For site location, see Figure 1.

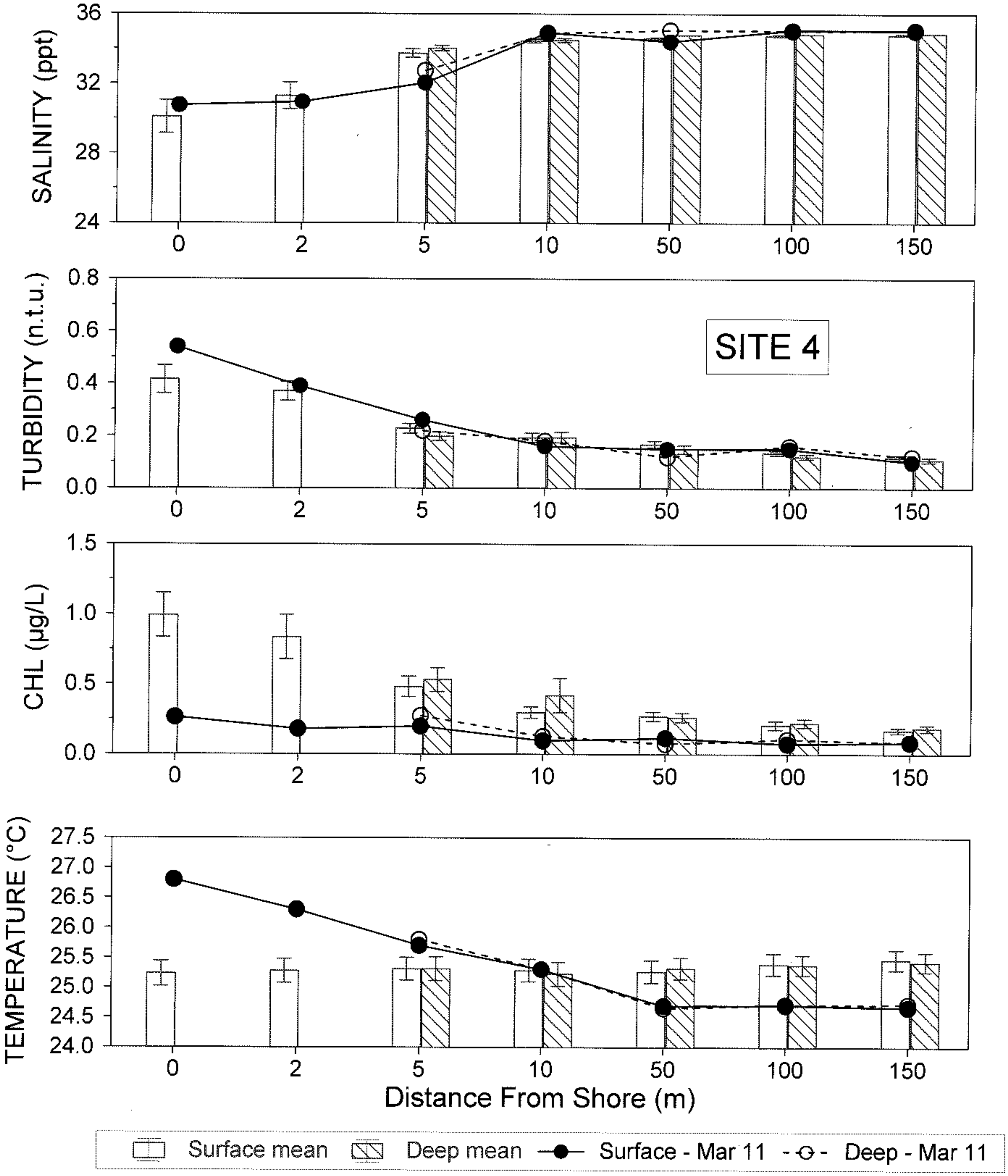

FIGURE 15. Plots of water chemistry constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 4, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=25). Error bars represent standard error of the mean. For site location, see Figure 1.

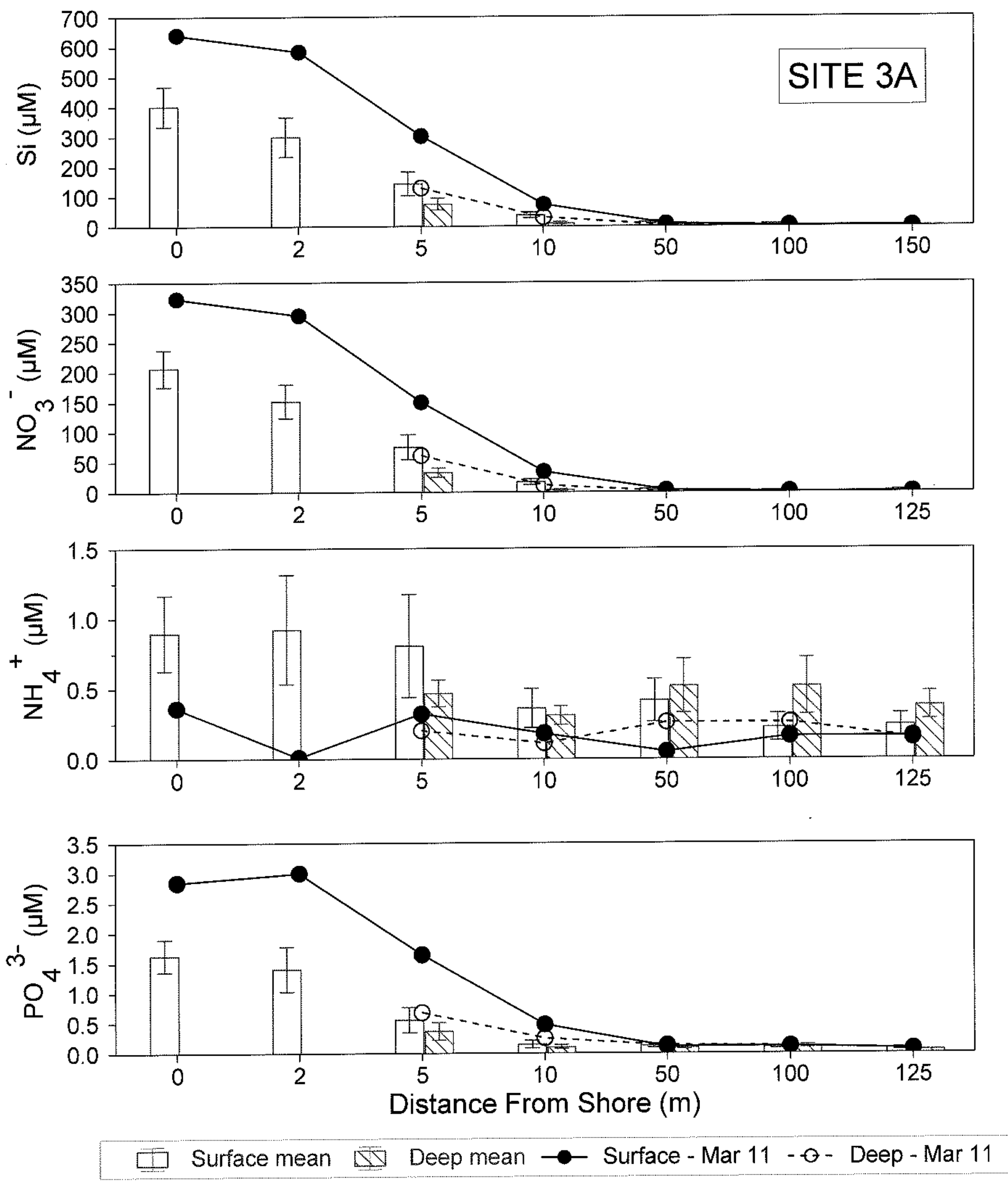

FIGURE 16. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 3A, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since June 2007 (N=7). Error bars represent standard error of the mean. For site location, see Figure 1.

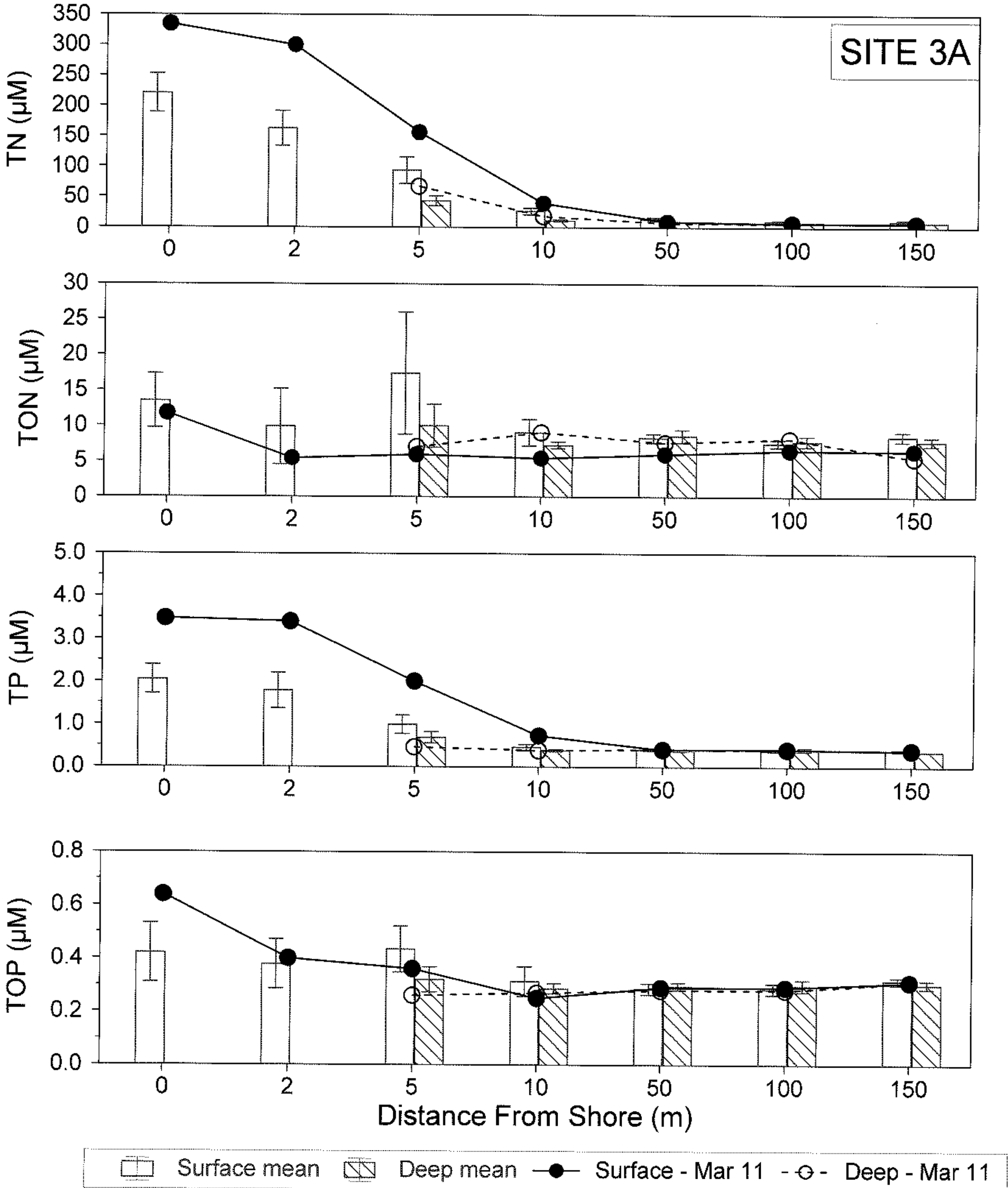

FIGURE 17. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 3A, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since June 2007 (N=7). Error bars represent standard error of the mean. For site location, see Figure 1.

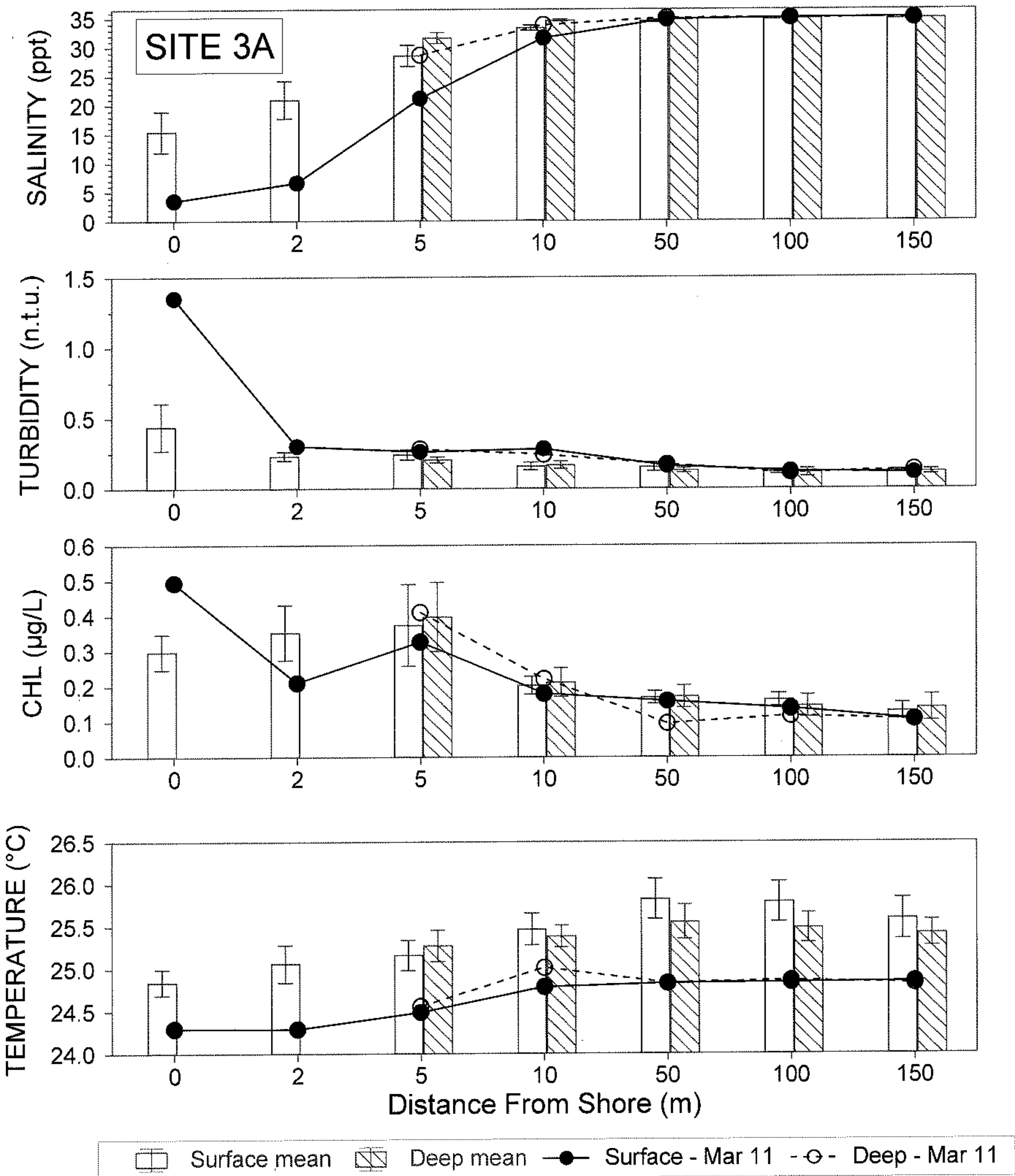

FIGURE 18. Plots of water chemistry constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 3A, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since June 2007 (N=7). Error bars represent standard error of the mean. For site location, see Figure 1.

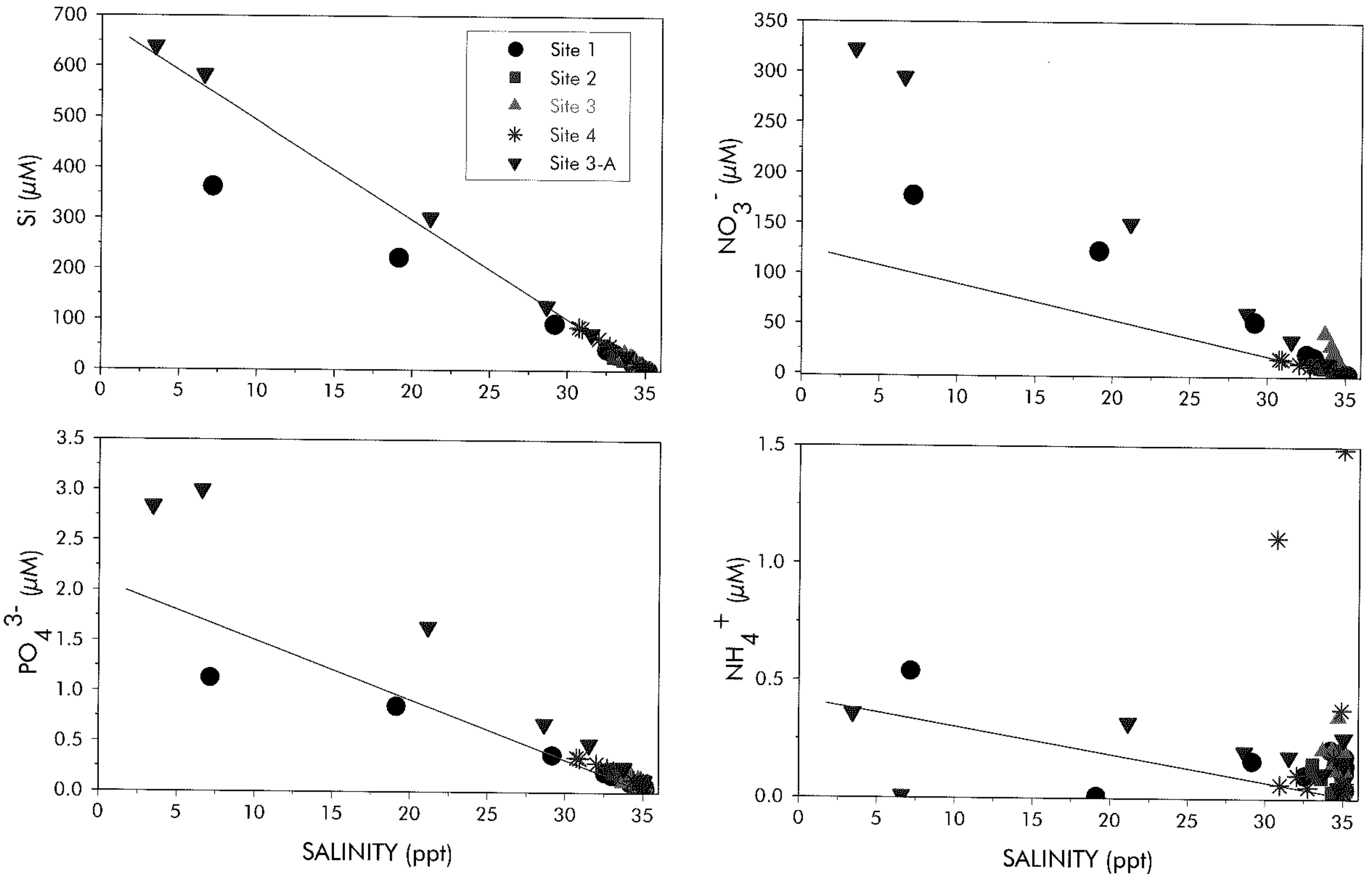

FIGURE 19. Mixing diagram showing concentration of dissolved nutrients from samples collected offshore of the Makena Resort on March 6, 2011 as functions of salinity. Solid red line in each plot is conservative mixing line constructed by connecting the concentrations in open coastal water with water from an irrigation well upslope of the Makena Golf Courses. For sampling site locations, see Figure 1.

Exhibit A-1

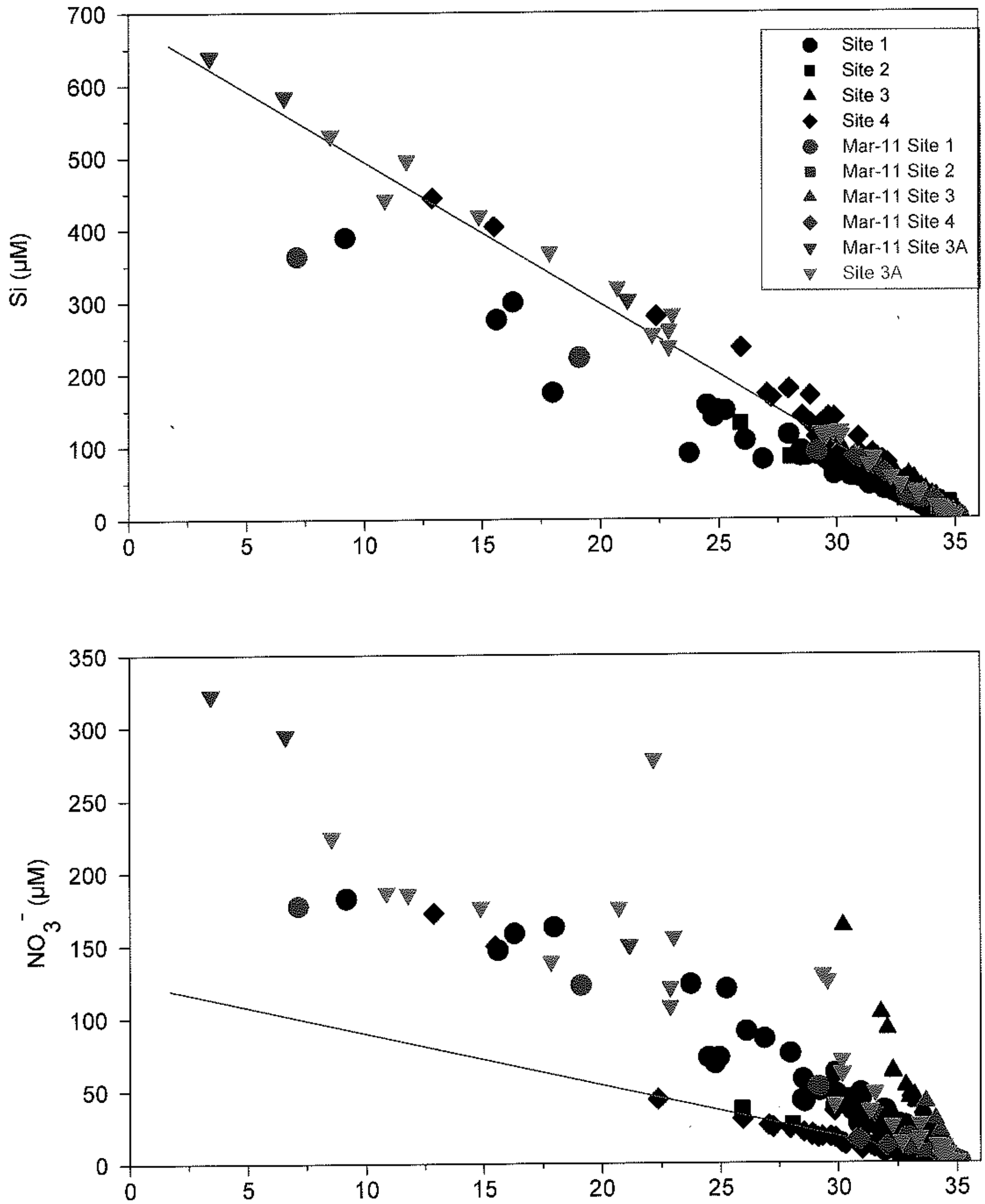

FIGURE 20. Silicate and nitrate, plotted as a function of salinity for surface samples collected since August 1995 at four sites offshore of the Makena Golf Course. Black symbols represent combined data from surveys conducted between August 1995 and July 2010. Green symbols represent data from surveys at Site 3A commencing in June 2007. Red symbols are data from most recent survey. Solid red line in each plot is conservative mixing line constructed by connecting the concentrations in open coastal water with water from golf course irrigation well #4. For sampling site locations, see Figure 1.

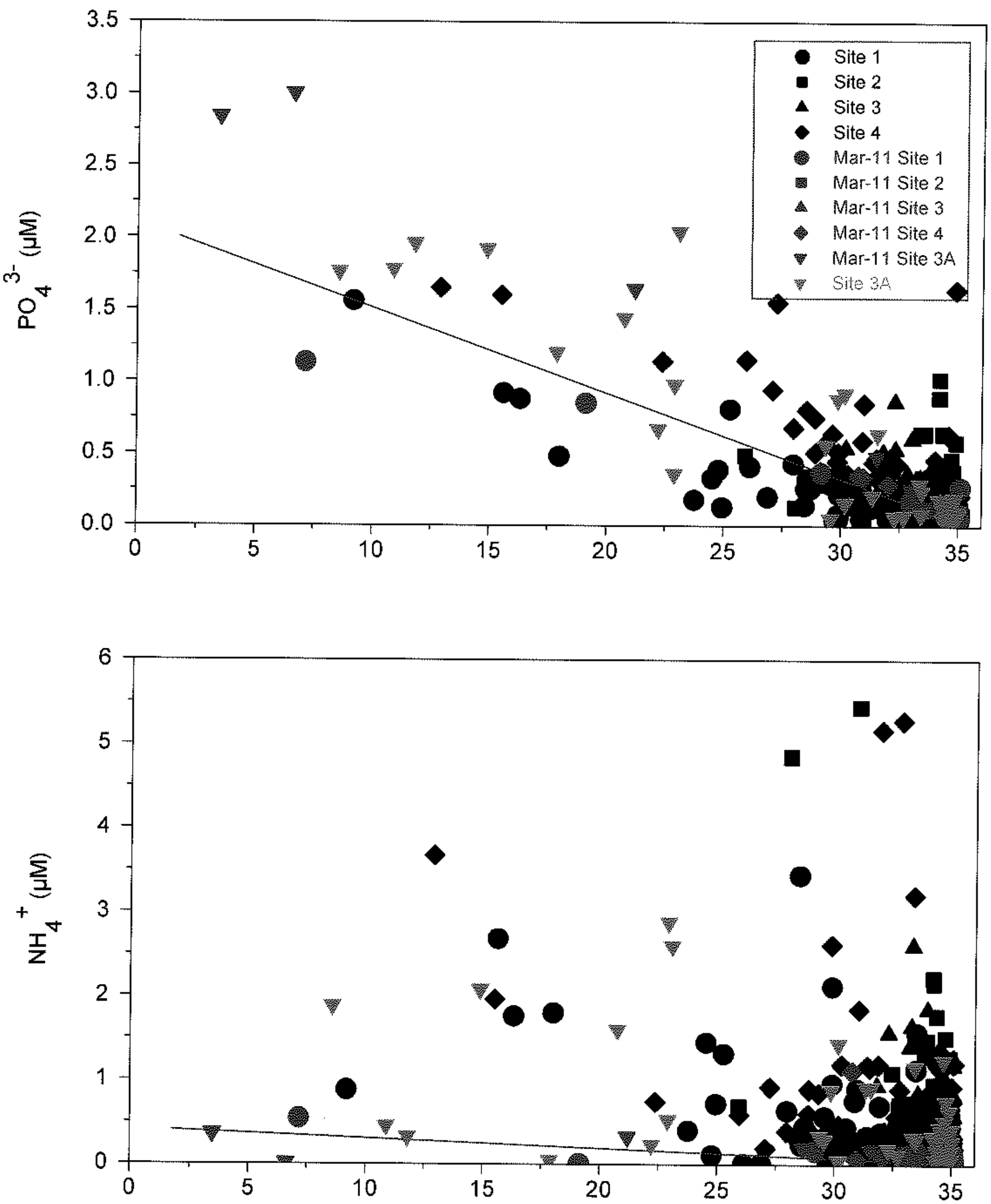

FIGURE 21. Phosphate and ammonium, plotted as a function of salinity for surface samples collected since August 1995 at four sites offshore of the Makena Golf Course. Black symbols represent combined data from surveys conducted between August 1995 and July 2010. Green symbols represent data from surveys at Site 3A commencing in June 2007. Red symbols are data from the most recent survey. Solid red line in each plot is conservative mixing line constructed by connecting the concentrations in open coastal water with water from golf course irrigation well #4. For sampling site locations, see Figure 1.

Exhibit A-1

TABLE 6. Linear regression statistics (y-intercept and slope) of concentrations of silica as functions of salinity from four ocean transect sites off of the Makena Resort collected during monitoring surveys from 1995 to March 2011 (Transect Site 3 has been monitored since 2002; Trasect Site 3A since 2007). Also shown are standard errors and upper and lower 95% confidence limits around the y-intercepts and slopes."REGSLOPE" indicates regression statistics for slope of yearly coefficients as a function of time. For location of transect sites, see Figure 1.

SILICA -Y-INTERCEPT

YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 1				
1995	522.34	12.18	491.03	553.66
1996	629.56	11.05	605.49	653.64
1997	504.17	2.83	496.89	511.46
1998	484.14	2.44	477.86	490.41
1999	479.11	9.89	457.55	500.66
2000	528.68	5.87	513.58	543.77
2001	625.85	10.91	597.82	653.88
2002	502.98	8.68	480.66	525.30
2003	625.85	10.91	597.82	653.88
2004	546.00	8.33	527.84	564.16
2005	466.59	11.09	442.42	490.75
2006	487.68	24.60	434.08	541.28
2007	491.19	34.99	414.95	567.42
2008	371.80	16.96	334.85	408.75
2009	457.28	10.01	431.54	483.02
2010	515.27	7.85	495.09	535.45
2011	463.22	8.04	442.56	483.88
REGSLOPE	**-6.04**	**3.04**	**-12.52**	**0.43**
SITE 2				
1995	468.41	85.54	248.51	688.30
1996	549.09	177.83	164.91	933.28
1997	567.57	9.71	543.80	591.33
1998	563.20	37.23	472.10	654.30
1999	466.74	95.75	261.37	672.11
2000	770.15	27.32	703.31	837.00
2001	1254.31	74.17	1072.82	1435.81
2002	577.53	29.40	505.60	649.46
2003	505.05	20.10	461.94	548.15
2004	565.31	93.71	364.33	766.29
2005	339.08	33.78	266.64	411.52
2006	553.48	62.93	418.51	688.45
2007	443.05	17.15	406.27	479.84
2008	402.41	73.66	244.42	560.41
2009	501.76	9.02	479.69	523.82
2010	490.17	22.77	434.46	545.87
2011	484.20	15.22	446.96	521.44
REGSLOPE	**-9.98**	**9.96**	**-31.22**	**11.26**
SITE 3A				
2007	714.10	5.58	701.94	726.27
2008	805.12	9.00	785.52	824.73
2009	646.37	7.80	626.32	666.43
2010	750.91	5.70	736.26	765.56
2011	716.69	6.27	700.57	732.82
REGSLOPE	**-4.90**	**20.98**	**-71.68**	**61.87**
SITE 3				
2002	931.92	27.54	861.13	1002.71
2003	984.76	41.58	894.16	1075.35
2004	632.75	127.62	354.68	910.82
2005	704.38	52.31	590.40	818.35
2006	928.22	64.18	788.40	1068.05
2007	722.80	15.07	689.97	755.63
2008	1058.06	48.59	952.18	1163.94
2009	943.91	40.06	840.94	1046.89
2010	962.57	74.39	771.34	1153.79
2011	851.11	37.41	754.95	947.26
REGSLOPE	**9.27**	**15.97**	**-27.57**	**46.10**
SITE 4				
1995	710.45	8.83	687.74	733.15
1996	917.33	13.38	888.18	946.47
1997	776.74	3.53	767.66	785.82
1998	841.35	6.75	824.00	858.70
1999	823.63	24.78	769.63	877.62
2000	946.97	12.51	914.80	979.14
2001	1403.91	260.13	735.22	2072.61
2002	767.85	4.37	756.63	779.08
2003	854.37	29.88	789.26	919.48
2004	843.49	37.55	761.67	925.31
2005	703.97	14.00	673.47	734.46
2006	735.05	14.01	704.53	765.57
2007	710.11	7.14	694.56	725.66
2008	712.32	18.22	672.63	752.01
2009	715.30	7.99	694.75	735.84
2010	673.09	6.27	656.98	689.21
2011	683.29	8.16	662.30	704.27
REGSLOPE	**-13.12**	**8.18**	**-30.57**	**4.32**

SILICA - SLOPE

YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 1				
1995	-15.08	0.38	-16.05	-14.12
1996	-18.05	0.32	-18.75	-17.34
1997	-14.43	0.08	-14.65	-14.21
1998	-13.83	0.07	-14.02	-13.64
1999	-13.63	0.29	-14.27	-12.99
2000	-15.08	0.18	-15.54	-14.62
2001	-17.76	0.32	-18.57	-16.94
2002	-14.38	0.26	-15.05	-13.72
2003	-17.76	0.32	-18.57	-16.94
2004	-15.68	0.25	-16.23	-15.14
2005	-13.31	0.33	-14.02	-12.61
2006	-13.88	0.76	-15.53	-12.23
2007	-14.11	1.14	-16.59	-11.62
2008	-10.46	0.52	-11.59	-9.33
2009	-12.98	0.30	-13.76	-12.20
2010	-14.78	0.28	-15.49	-14.06
2011	-13.03	0.27	-13.74	-12.33
REGSLOPE	**0.18**	**0.09**	**0.00**	**0.37**
SITE 2				
1995	-13.47	2.51	-19.93	-7.00
1996	-15.62	5.15	-26.75	-4.49
1997	-16.26	0.29	-16.96	-15.56
1998	-16.11	1.08	-18.76	-13.45
1999	-13.21	2.78	-19.18	-7.23
2000	-22.06	0.80	-24.02	-20.11
2001	-35.68	2.12	-40.87	-30.49
2002	-16.54	0.86	-18.64	-14.44
2003	-14.37	0.59	-15.63	-13.11
2004	-16.23	2.73	-22.09	-10.38
2005	-9.61	0.98	-11.70	-7.52
2006	-15.82	1.83	-19.75	-11.89
2007	-12.54	0.51	-13.64	-11.45
2008	-11.41	2.14	-15.99	-6.83
2009	-14.32	0.27	-14.98	-13.66
2010	-13.97	0.67	-15.61	-12.33
2011	-13.74	0.44	-14.83	-12.65
REGSLOPE	**0.29**	**0.28**	**-0.31**	**0.90**
SITE 3A				
2007	-20.35	0.19	-20.75	-19.94
2008	-22.96	0.28	-23.57	-22.36
2009	-18.28	0.26	-18.96	-17.61
2010	-21.44	0.19	-21.94	-20.94
2011	-20.32	0.23	-20.91	-19.72
REGSLOPE	**0.16**	**0.62**	**-1.81**	**2.13**
SITE 3				
2002	-26.75	0.81	-28.83	-24.68
2003	-28.10	1.21	-30.73	-25.47
2004	-18.19	3.69	-26.24	-10.14
2005	-20.11	1.51	-23.40	-16.83
2006	-26.56	1.89	-30.67	-22.46
2007	-20.60	0.44	-21.56	-19.63
2008	-30.22	1.41	-33.29	-27.14
2009	-26.90	1.17	-29.90	-23.91
2010	-27.56	2.19	-33.18	-21.93
2011	-24.19	1.08	-26.97	-21.41
REGSLOPE	**-0.25**	**0.46**	**-1.30**	**0.80**
SITE 4				
1995	-20.55	0.27	-21.25	-19.85
1996	-26.23	0.40	-27.10	-25.37
1997	-22.27	0.11	-22.55	-21.99
1998	-24.07	0.20	-24.58	-23.56
1999	-23.50	0.73	-25.10	-21.90
2000	-27.12	0.37	-28.08	-26.16
2001	-39.92	7.42	-58.99	-20.86
2002	-21.99	0.13	-22.34	-21.65
2003	-24.36	0.91	-26.34	-22.39
2004	-24.27	1.10	-26.66	-21.88
2005	-20.11	0.41	-21.00	-19.22
2006	-20.96	0.41	-21.86	-20.06
2007	-20.27	0.23	-20.77	-19.78
2008	-20.33	0.53	-21.49	-19.17
2009	-20.34	0.24	-20.95	-19.73
2010	-19.14	0.19	-19.62	-18.66
2011	-19.40	0.24	-20.03	-18.77
REGSLOPE	**0.39**	**0.23**	**-0.11**	**0.88**

Exhibit A-1

TABLE 7. Linear regression statistics (y-intercept and slope) of concentrations of nitrate as functions of salinity from four ocean transect sites off of the Makena Resort collected during monitoring surveys from 1995 to March 2011 (Transect Site 3 has been monitored since 2002; Trasect Site 3A since 2007). Also shown are standard errors and upper and lower 95% confidence limits around the y-intercepts and slopes. "REGSLOPE" indicates regression statistics for slope of yearly coefficients as a function of time. For location of transect sites, see Figure 1.

NITRATE -Y-INTERCEPT

YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 1				
1995	326.50	7.10	308.25	344.75
1996	336.49	4.62	326.41	346.56
1997	406.96	1.93	402.00	411.93
1998	268.90	1.55	264.91	272.89
1999	225.24	5.32	213.66	236.83
2000	309.77	3.36	301.14	318.41
2001	336.53	9.69	311.61	361.44
2002	278.21	17.43	233.40	323.03
2003	421.29	7.81	404.28	438.30
2004	442.33	4.89	431.68	452.99
2005	296.36	7.44	280.16	312.56
2006	361.76	7.20	346.08	377.45
2007	305.06	15.88	270.45	339.67
2008	330.95	7.18	315.29	346.60
2009	231.91	3.07	224.01	239.81
2010	253.63	4.57	241.88	265.38
2011	233.77	10.13	207.74	259.81
REGSLOPE	**-3.68**	**3.21**	**-10.53**	**3.17**
SITE 2				
1995	119.87	12.03	88.95	150.79
1996	106.36	18.44	66.53	146.19
1997	193.75	5.64	179.95	207.55
1998	166.93	5.33	153.89	179.97
1999	116.21	14.04	86.10	146.32
2000	142.07	2.83	135.13	149.01
2001	154.93	7.65	136.21	173.64
2002	180.82	58.78	36.98	324.66
2003	163.36	6.31	149.82	176.91
2004	145.36	10.55	122.74	167.99
2005	102.66	9.11	83.13	122.19
2006	124.74	4.89	114.26	135.22
2007	134.27	3.25	127.30	141.24
2008	108.01	12.87	80.41	135.61
2009	142.21	9.04	120.08	164.34
2010	135.27	10.49	109.60	160.94
2011	163.21	2.39	157.37	169.05
REGSLOPE	**-0.43**	**1.36**	**-3.33**	**2.47**
SITE 3A				
2007	354.33	49.92	245.56	463.11
2008	448.07	7.75	431.19	464.95
2009	283.99	14.63	246.38	321.60
2010	283.25	1.86	278.48	288.02
2011	361.54	2.77	354.41	368.66
REGSLOPE	**-15.04**	**23.27**	**-89.11**	**59.02**
SITE 3				
2002	847.45	52.35	712.88	982.01
2003	693.24	39.54	607.10	779.38
2004	463.72	90.73	266.04	661.40
2005	535.53	47.19	432.72	638.34
2006	856.96	48.22	751.91	962.02
2007	1233.34	18.23	1193.63	1273.06
2008	899.91	41.92	808.57	991.25
2009	827.18	19.10	778.08	876.29
2010	924.44	35.54	833.09	1015.80
2011	1019.29	31.64	937.96	1100.62
REGSLOPE	**39.10**	**22.25**	**-12.21**	**90.42**
SITE 4				
1995	111.38	6.47	94.74	128.02
1996	118.34	1.63	114.79	121.89
1997	122.56	1.29	119.25	125.88
1998	112.77	1.87	107.97	117.57
1999	109.13	3.30	101.94	116.33
2000	118.51	0.75	116.58	120.43
2001	100.93	54.85	-40.08	241.94
2002	118.91	3.25	110.56	127.25
2003	113.78	2.76	107.77	119.79
2004	134.97	4.64	124.86	145.07
2005	114.59	4.47	104.85	124.33
2006	119.85	1.76	116.03	123.68
2007	269.24	10.13	247.16	291.32
2008	62.93	4.05	54.11	71.74
2009	107.17	1.51	103.30	111.04
2010	148.96	16.96	105.35	192.57
2011	126.20	3.06	118.33	134.07
REGSLOPE	**1.66**	**2.06**	**-2.73**	**6.06**

NITRATE - SLOPE

YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 1				
1995	-9.49	0.22	-10.05	-8.92
1996	-9.67	0.14	-9.97	-9.38
1997	-11.70	0.06	-11.85	-11.55
1998	-7.72	0.05	-7.84	-7.60
1999	-6.44	0.16	-6.79	-6.10
2000	-8.91	0.10	-9.17	-8.65
2001	-9.60	0.28	-10.32	-8.88
2002	-7.99	0.52	-9.31	-6.66
2003	-12.09	0.23	-12.60	-11.58
2004	-12.74	0.15	-13.06	-12.42
2005	-8.48	0.22	-8.96	-8.01
2006	-10.40	0.22	-10.89	-9.92
2007	-8.73	0.52	-9.86	-7.60
2008	-9.52	0.22	-10.00	-9.05
2009	-6.65	0.09	-6.89	-6.41
2010	-7.31	0.16	-7.72	-6.89
2011	-6.53	0.35	-7.42	-5.64
REGSLOPE	**0.11**	**0.09**	**-0.09**	**0.31**
SITE 2				
1995	-3.47	0.35	-4.38	-2.56
1996	-3.05	0.53	-4.20	-1.89
1997	-5.57	0.17	-5.97	-5.16
1998	-4.79	0.16	-5.17	-4.41
1999	-3.31	0.41	-4.19	-2.43
2000	-4.08	0.08	-4.29	-3.88
2001	-4.41	0.22	-4.95	-3.88
2002	-5.19	1.72	-9.40	-0.99
2003	-4.68	0.18	-5.07	-4.28
2004	-4.19	0.31	-4.84	-3.53
2005	-2.94	0.26	-3.50	-2.37
2006	-3.57	0.14	-3.88	-3.27
2007	-3.85	0.10	-4.06	-3.64
2008	-3.09	0.37	-3.89	-2.29
2009	-4.10	0.27	-4.76	-3.43
2010	-3.88	0.31	-4.64	-3.13
2011	-4.64	0.07	-4.81	-4.47
REGSLOPE	**0.01**	**0.04**	**-0.07**	**0.10**
SITE 3A				
2007	-9.57	1.67	-13.20	-5.93
2008	-12.81	0.24	-13.33	-12.29
2009	-7.98	0.49	-9.25	-6.72
2010	-8.15	0.06	-8.32	-7.99
2011	-10.29	0.10	-10.55	-10.03
REGSLOPE	**0.32**	**0.69**	**-1.88**	**2.52**
SITE 3				
2002	-24.49	1.53	-28.43	-20.56
2003	-19.86	1.15	-22.36	-17.35
2004	-13.37	2.63	-19.09	-7.64
2005	-15.33	1.36	-18.29	-12.37
2006	-24.61	1.42	-27.70	-21.52
2007	-35.51	0.54	-36.68	-34.34
2008	-25.78	1.22	-28.43	-23.12
2009	-23.65	0.56	-25.08	-22.22
2010	-26.57	1.05	-29.26	-23.88
2011	-29.06	0.91	-31.41	-26.71
REGSLOPE	**2185.79**	**1291.79**	**-793.07**	**5164.66**
SITE 4				
1995	-3.26	0.20	-3.77	-2.75
1996	-3.40	0.05	-3.50	-3.29
1997	-3.53	0.04	-3.63	-3.43
1998	-3.24	0.05	-3.38	-3.10
1999	-3.13	0.10	-3.34	-2.92
2000	-3.40	0.02	-3.46	-3.34
2001	-2.87	1.56	-6.89	1.15
2002	-3.44	0.10	-3.70	-3.19
2003	-3.28	0.08	-3.46	-3.09
2004	-3.89	0.14	-4.18	-3.59
2005	-3.29	0.13	-3.57	-3.00
2006	-3.43	0.05	-3.54	-3.31
2007	-7.87	0.32	-8.58	-7.17
2008	-1.79	0.12	-2.05	-1.54
2009	-3.07	0.04	-3.18	-2.95
2010	-4.30	0.50	-5.60	-3.00
2011	-3.59	0.09	-3.82	-3.35
REGSLOPE	**-0.05**	**0.06**	**-0.18**	**0.08**

Exhibit A-1

TABLE 8. Linear regression statistics (y-intercept and slope) of concent orthophosphate phosphorus as functions of salinity from four ocean transect sites off of the Makena Resort collected during monitoring surveys from 1995 to March 2011 (Transect site 3 has been monitored since 2002; Trasect Site 3A since 2007). Also shown are standard errors and upper and lower 95% confidence limits around the y-intercepts and slopes. For location of transect sites, see Figure 1.

PHOSPHATE -Y-INTERCEPT

YEAR	*Coefficients*	*Std Err*	*Lower 95%*	*Upper 95%*
SITE 1				
1995	1.04	0.14	0.68	1.39
1996	1.78	0.12	1.52	2.03
1997	1.40	0.12	1.10	1.69
1998	1.10	0.06	0.95	1.25
1999	1.07	0.12	0.80	1.34
2000	0.89	0.12	0.59	1.19
2001	2.16	0.76	0.22	4.11
2002	1.12	0.68	-0.64	2.88
2003	0.48	0.19	0.06	0.90
2004	2.71	0.17	2.33	3.08
2005	-0.02	0.14	-0.34	0.29
2006	1.36	0.13	1.08	1.65
2007	1.07	0.20	0.64	1.50
2008	0.89	0.13	0.61	1.16
2009	0.87	0.38	-0.12	1.85
2010	1.86	0.18	1.40	2.31
2011	1.46	0.11	1.18	1.74
REGSLOPE	**0.00**	**0.03**	**-0.07**	**0.06**
SITE 2				
1995	0.15	0.63	-1.46	1.76
1996	2.03	1.59	-1.41	5.48
1997	3.70	0.25	3.10	4.31
1998	3.55	1.44	0.03	7.07
1999	3.68	5.55	-8.22	15.58
2000	12.78	1.18	9.89	15.66
2001	30.73	3.12	23.09	38.37
2002	6.67	1.68	2.57	10.77
2003	3.57	0.31	2.90	4.24
2004	5.76	0.53	4.62	6.91
2005	-0.95	2.96	-7.31	5.40
2006	1.88	0.57	0.67	3.10
2007	0.22	0.26	-0.34	0.78
2008	1.50	1.14	-0.95	3.95
2009	1.54	0.34	0.71	2.38
2010	1.70	1.31	-1.49	4.90
2011	2.55	0.44	1.47	3.64
REGSLOPE	**-0.29**	**0.37**	**-1.08**	**0.50**
SITE 3A				
2007	2.39	0.24	1.86	2.93
2008	4.43	0.49	3.36	5.50
2009	2.60	0.15	2.21	2.99
2010	2.75	0.29	2.01	3.48
2011	3.43	0.14	3.07	3.79
REGSLOPE	**0.04**	**0.30**	**-0.92**	**1.00**
SITE 3				
2002	4.62	2.31	-1.31	10.55
2003	7.38	0.99	5.24	9.53
2004	7.40	0.78	5.70	9.10
2005	3.17	0.53	2.03	4.32
2006	7.32	1.16	4.80	9.84
2007	4.46	0.46	3.47	5.45
2008	4.01	1.13	1.56	6.47
2009	3.12	2.67	-3.74	9.99
2010	6.25	2.27	0.41	12.09
2011	1.37	0.95	-1.07	3.82
REGSLOPE	**-0.36**	**0.21**	**-0.84**	**0.13**
SITE 4				
1995	2.44	0.15	2.04	2.84
1996	3.08	0.13	2.79	3.37
1997	2.95	0.09	2.71	3.19
1998	3.50	0.46	2.32	4.67
1999	3.26	0.14	2.96	3.55
2000	3.29	0.20	2.77	3.82
2001	-19.16	22.66	-77.41	39.09
2002	3.98	0.15	3.60	4.35
2003	4.13	1.29	1.33	6.93
2004	4.75	0.79	3.04	6.47
2005	2.12	0.38	1.28	2.95
2006	2.15	0.40	1.28	3.02
2007	2.65	0.09	2.46	2.83
2008	2.98	0.67	1.52	4.44
2009	1.51	0.65	-0.16	3.19
2010	0.76	0.47	-0.46	1.97
2011	2.23	0.08	2.01	2.44
REGSLOPE	**0.02**	**0.28**	**-0.57**	**0.61**

PHOSPHATE - SLOPE

YEAR	*Coefficients*	*Std Err*	*Lower 95%*	*Upper 95%*
SITE 1				
1995	-0.03	0.00	-0.04	-0.02
1996	-0.05	0.00	-0.06	-0.04
1997	-0.04	0.00	-0.05	-0.03
1998	-0.03	0.00	-0.03	-0.02
1999	-0.03	0.00	-0.03	-0.02
2000	-0.02	0.00	-0.03	-0.01
2001	-0.06	0.02	-0.12	0.00
2002	-0.03	0.02	-0.08	0.02
2003	-0.01	0.01	-0.02	0.00
2004	-0.08	0.01	-0.09	-0.06
2005	0.00	0.00	-0.01	0.01
2006	-0.04	0.00	-0.04	-0.03
2007	-0.03	0.01	-0.04	-0.02
2008	-0.02	0.00	-0.03	-0.02
2009	-0.02	0.01	-0.05	0.01
2010	-0.05	0.01	-0.07	-0.04
2011	-0.04	0.00	-0.05	-0.03
REGSLOPE	**0.00**	**0.00**	**0.00**	**0.00**
SITE 2				
1995	0.00	0.02	-0.05	0.04
1996	-0.06	0.05	-0.16	0.04
1997	-0.10	0.01	-0.12	-0.09
1998	-0.10	0.04	-0.20	0.00
1999	-0.10	0.16	-0.44	0.25
2000	-0.36	0.03	-0.45	-0.28
2001	-0.87	0.09	-1.09	-0.65
2002	-0.19	0.05	-0.31	-0.07
2003	-0.10	0.01	-0.12	-0.08
2004	-0.16	0.02	-0.20	-0.13
2005	0.03	0.09	-0.15	0.21
2006	-0.05	0.02	-0.09	-0.02
2007	0.00	0.01	-0.02	0.01
2008	-0.04	0.03	-0.11	0.03
2009	-0.04	0.01	-0.07	-0.02
2010	-0.05	0.04	-0.14	0.05
2011	-0.07	0.01	-0.10	-0.04
REGSLOPE	**0.01**	**0.01**	**-0.01**	**0.03**
SITE 3A				
2007	-0.07	0.01	-0.09	-0.05
2008	-0.13	0.02	-0.16	-0.09
2009	-0.07	0.01	-0.09	-0.06
2010	-0.07	0.01	-0.10	-0.05
2011	-0.09	0.01	-0.11	-0.08
REGSLOPE	**0.00**	**0.01**	**-0.03**	**0.03**
SITE 3				
2002	-0.13	0.07	-0.30	0.04
2003	-0.21	0.03	-0.27	-0.15
2004	-0.21	0.02	-0.26	-0.16
2005	-0.09	0.02	-0.12	-0.06
2006	-0.21	0.03	-0.28	-0.13
2007	-0.13	0.01	-0.16	-0.10
2008	-0.11	0.03	-0.18	-0.04
2009	-0.09	0.08	-0.29	0.11
2010	-0.18	0.07	-0.35	-0.01
2011	-0.04	0.03	-0.11	0.03
REGSLOPE	**0.01**	**0.01**	**0.00**	**0.02**
SITE 4				
1995	-0.07	0.00	-0.08	-0.06
1996	-0.09	0.00	-0.09	-0.08
1997	-0.08	0.00	-0.09	-0.07
1998	-0.10	0.01	-0.13	-0.06
1999	-0.09	0.00	-0.10	-0.08
2000	-0.09	0.01	-0.10	-0.07
2001	0.55	0.65	-1.11	2.21
2002	-0.11	0.00	-0.12	-0.10
2003	-0.11	0.04	-0.19	-0.02
2004	-0.13	0.02	-0.18	-0.08
2005	-0.06	0.01	-0.08	-0.03
2006	-0.06	0.01	-0.08	-0.03
2007	-0.07	0.00	-0.08	-0.07
2008	-0.08	0.02	-0.13	-0.04
2009	-0.04	0.02	-0.09	0.01
2010	-0.02	0.01	-0.06	0.02
2011	-0.06	0.00	-0.07	-0.05
REGSLOPE	**0.00**	**0.01**	**-0.02**	**0.02**

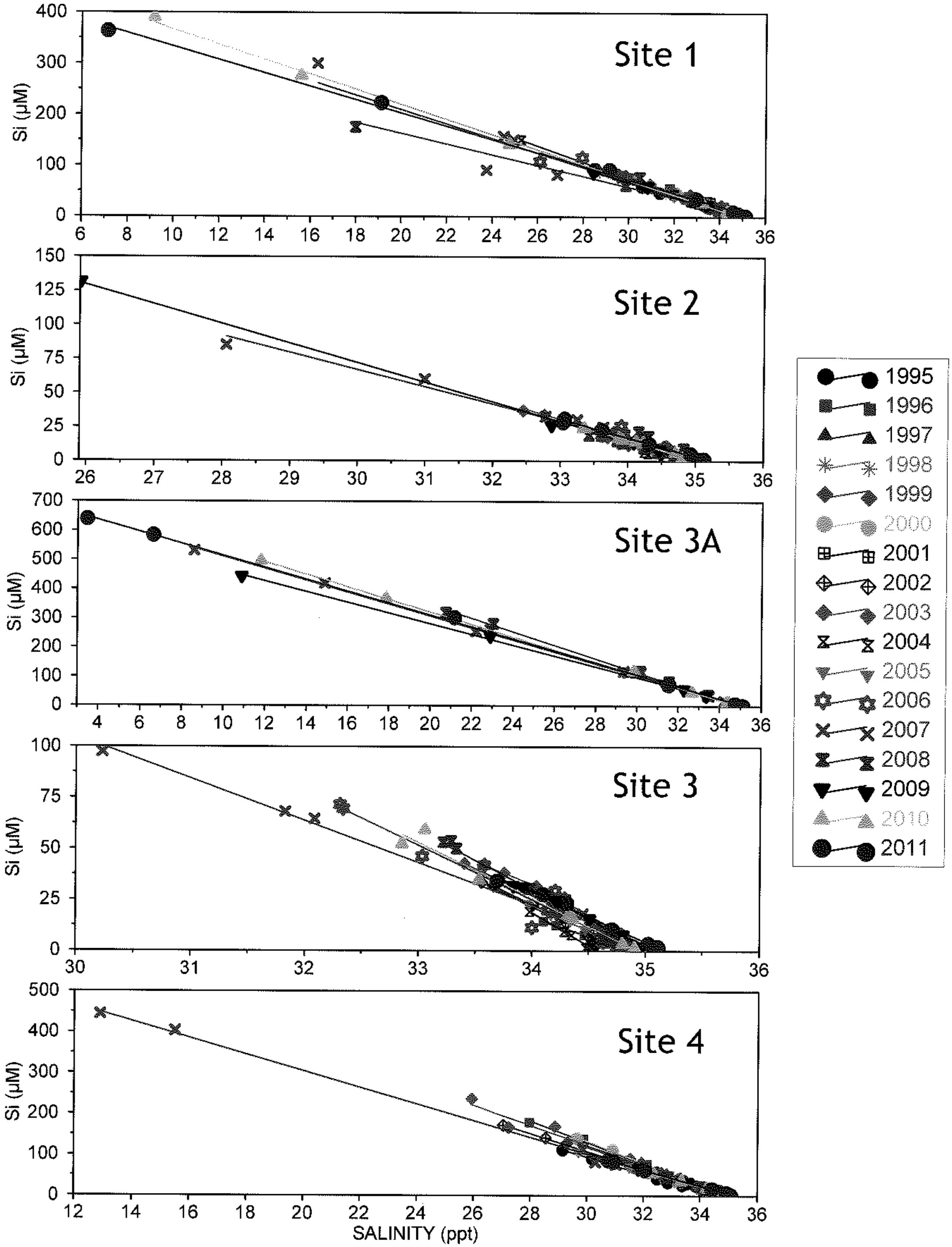

FIGURE 22. Mixing diagram showing yearly concentrations of silicate as functions of salinity from samples collected during annual monitoring surveys at five transect sites offshore of the Makena Resort (Site 3A since 2007). Note axis scale changes between sites. Straight lines are linear regressions through data points for each year. For sampling site locations, see Figure 1.

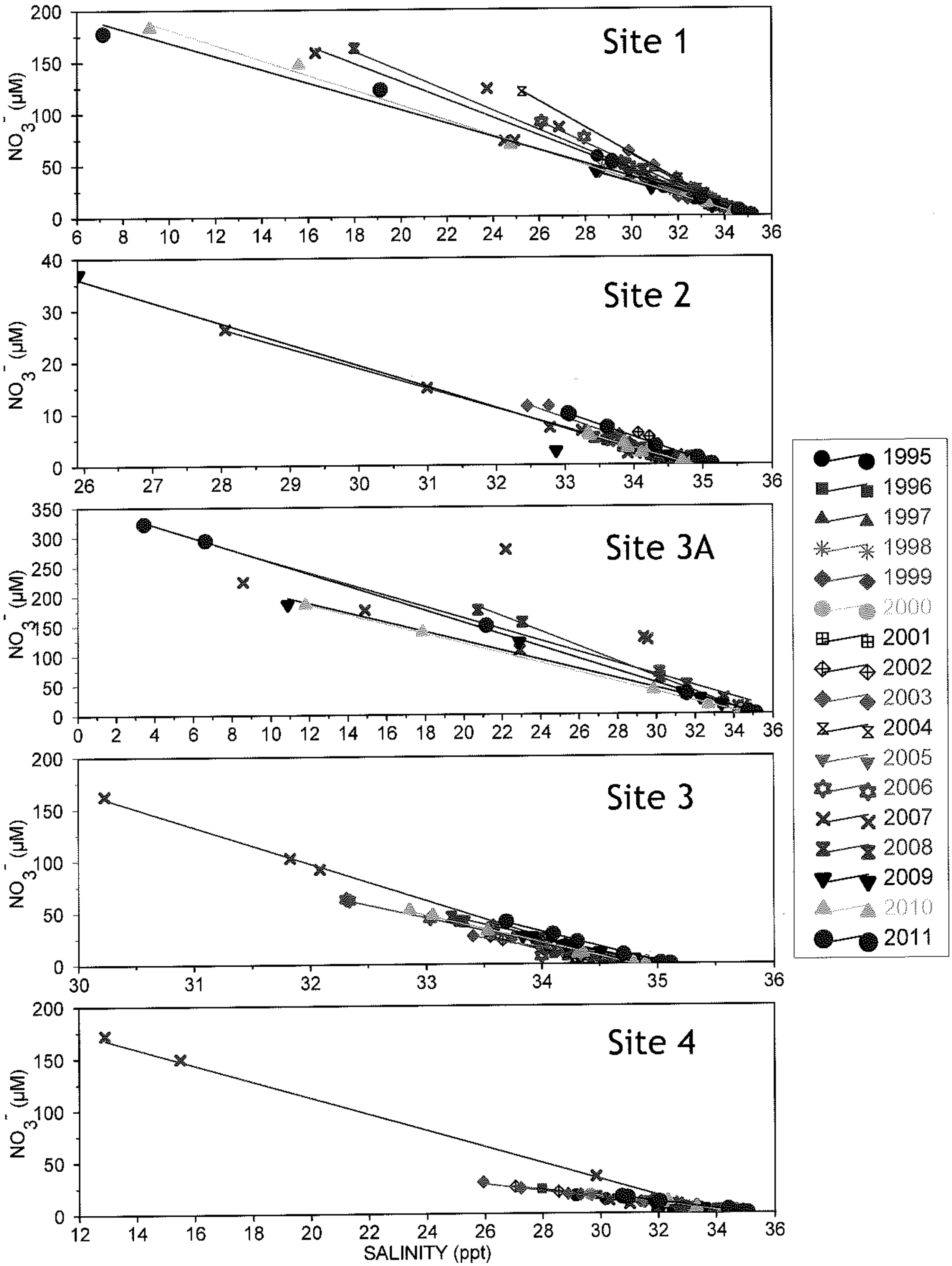

FIGURE 23. Mixing diagram showing yearly concentrations of nitrate as functions of salinity from samples collected during annual monitoring surveys at five transect sites offshore of the Makena Resort (Site 3A since 2007). Note axis scale changes between sites. Straight lines are linear regressions through data points for each year. For sampling site locations, see Figure 1.

Exhibit A-1

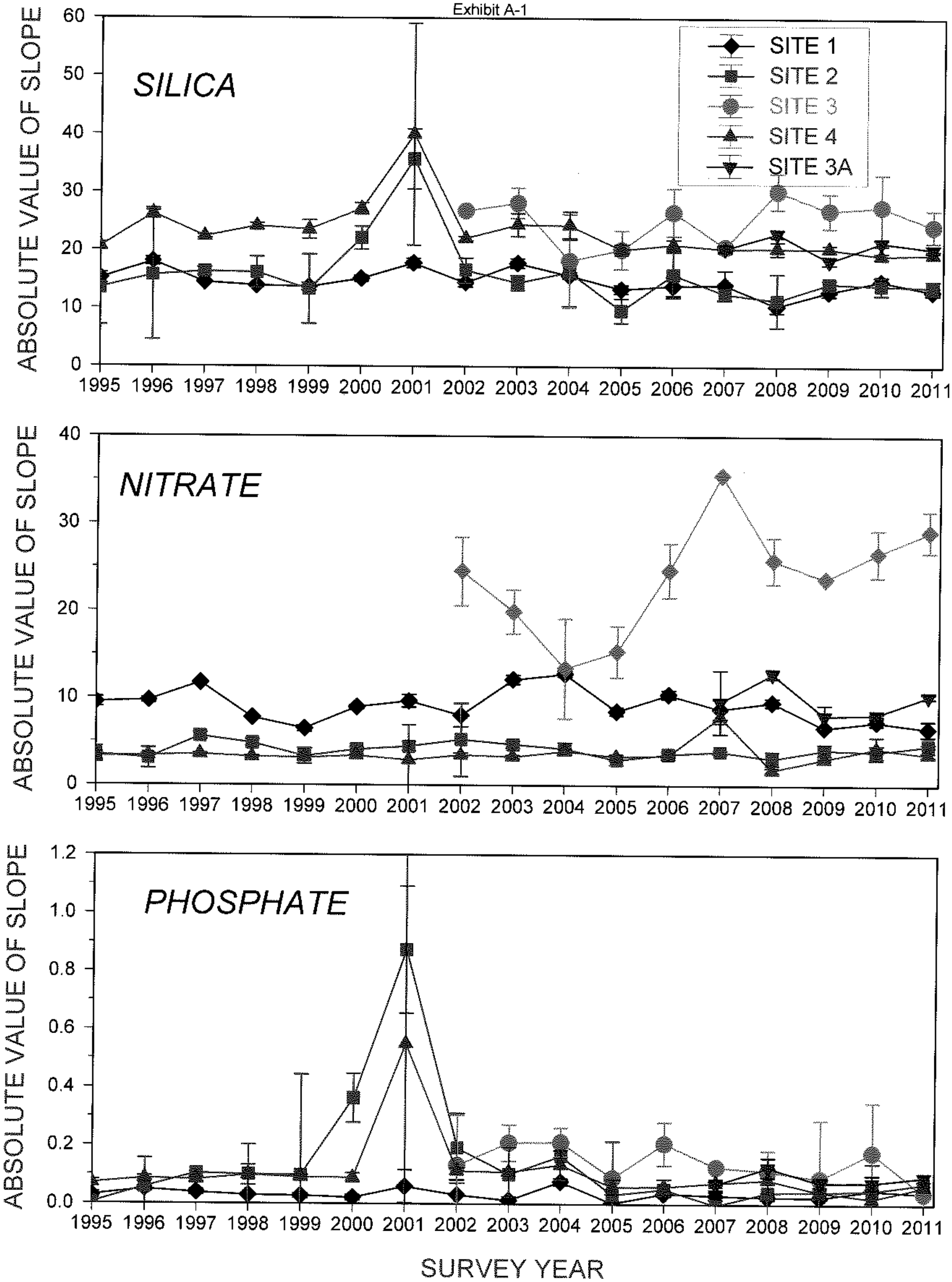

FIGURE 24. Time-course plots of absolute values of slopes of linear regressions of concentrations of silca, nitrate and phosphate as functions of salinity collected annually at each of the transect monitoring stations off the Makena Resort (Site 3A began in June 2007). Error bars are 95% confidence limits (Note error bar for Site 4 Phosphate is off scale). For locations of sampling transect sites, see Figure 1.

Exhibit A-1

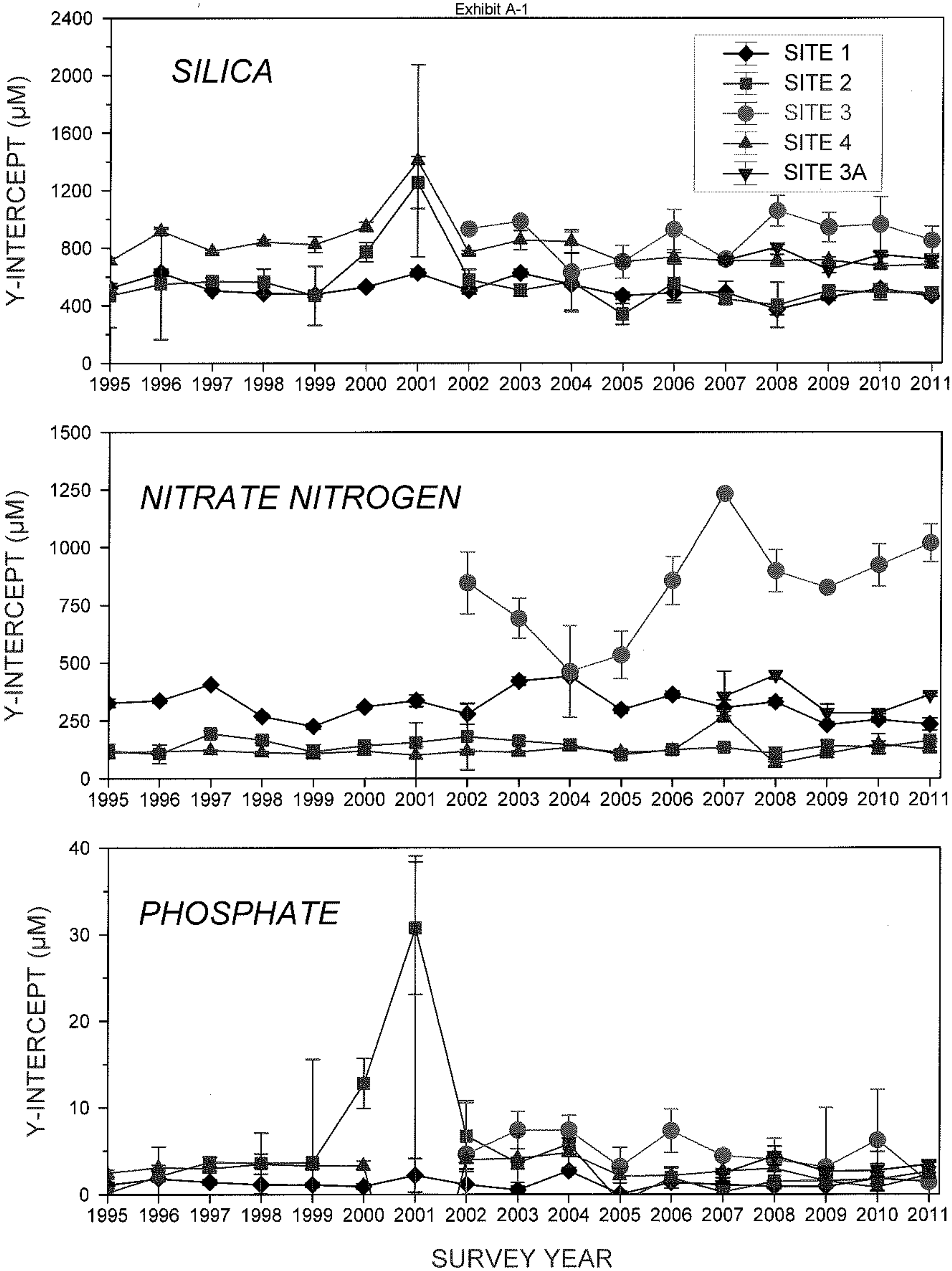

FIGURE 25. Time-course plots of Y-intercepts of linear regressions of concentrations of silca, nitrate and phosphorus as functions of salinity collected annually at each of the transect monitoring stations off the Makena Resort (Site 3A began in June 2007). Error bars are 95% confidence limits. For locations of sampling transect sites, see Figure 1.

STANFORD CARR DEVELOPMENT, LLC

January 6, 2012

Mr. Watson Okubo
State of Hawaii, Department of Health
Clean Water Branch
919 Ala Moana Blvd. Room 301
Honolulu, HI 96814

Via PDF Only unless hardcopy is requested.

Re: State Land Use District Boundary Amendment Docket A9-721 Condition No. 10, County of Maui Zoning Ordinance 3613 Condition No. 19, Marine Water Quality Monitoring.

Dear Mr. Okubo

ATC Makena Holdings, LLC, in compliance with the above referenced conditions, respectfully submits the enclosed Marine Water Quality Monitoring Report prepared by Marine Research Consultants, Inc. dated January 6, 2012, for tests performed on October 16, 2011.

Should you have any questions, require a hardcopy, or require additional information please do not hesitate to contact me at (808) 547-2253, or by e-mail at bcollins@stanfordcarr.com.

Sincerely,

STANFORD CARR DEVELOPMENT, LLC
For ATC MAKENA HOLDINGS, LLC

Becky Broudy Collins
Vice President

Exhibit A-2

MARINE WATER QUALITY MONITORING

MAKENA RESORT, MAKENA, MAUI

WATER CHEMISTRY

REPORT 2-2011

(October 2011)

Prepared for

ATC Makena Holdings, LLC
c/o Stanford Carr Development, LLC
1100 Alakea St. 27th Floor
Honolulu, HI 96813

By

Marine Research Consultants, Inc.
1039 Waakaua Pl.
Honolulu, Hawaii 96822

Submitted

January 6, 2012

EXECUTIVE SUMMARY

The Makena Resort fronts approximately 5.4 miles of coastline of southeastern Maui, extending from Papanui Stream (Nahuna Point) on the north and Pu`u Olai (Ahihi Bay) on the south. However, only 0.58 miles of the Resort reaches to the actual shoreline. Within the Resort are two 18-hole golf courses (North and South Courses), as well as a hotel, sewage treatment plant and private residences. No part of the project involves direct alteration of the shoreline or nearshore marine environments. In the interest of assuring maintenance of the highest possible quality of the marine environment, condition No. 10 of the Declaration of Conditions pertaining to the Amendment of the District Boundary, as required by the Land Use Commission, dated April 17, 1998 stipulates the implementation of an ongoing marine monitoring program off the Makena Resort Development. Additionally, County of Maui Zoning Ordinance 3613 Condition 19 included requirements for similar monitoring. The primary goals of the program are twofold: 1) to assess the degree that materials used on land to enhance turf growth and landscaping, as well as other nutrient subsidies, leach to groundwater and subsequently reach the ocean, and 2) to determine the fate of these materials within the nearshore zone. In terms of determining fate, the question that is addressed is if the materials that originate from Resort activities disperse with little or no effect, or do they cause changes in water quality sufficient to alter marine biological community structure? The following report fulfils the requirements of these Conditions, and presents the results of water quality monitoring off the Makena Resort conducted on October 16, 2011. The report also incorporates the cumulative data from twenty-five past water chemistry surveys conducted in the area.

Survey methodology includes collection of 62 ocean water samples on four transects spaced along the projects ocean frontage and on one control transect. Site 1 is located at the northern boundary of the project, Site 2 is located near the central part of the Makena North Golf Course in the center of Makena Bay, Site 3A (initiated during the June 2007 survey) is located near the southern boundary of Maluaka Bay, Site 3 was downslope from the part of Makena South Golf Course that comes closest to the shoreline, and Control Site 4 is located to the south of Makena Resort near the northern boundary of the 'Ahihi-Kina`u Natural Area Reserve. Water samples were collected at 7 stations spaced along transects that extended from the shoreline out to the open coastal ocean (about 500 feet). At sampling stations where water depth exceeded about 3 feet, samples were collected at the surface and just above the sea floor. Water samples were analyzed for chemical criteria specified by DOH water quality standards for open coastal waters, as well as several additional criteria. In addition, water samples were collected from five irrigation wells and an irrigation lake located on the golf courses.

Results of analysis of water chemistry showed that constituents that occur in high concentration in groundwater (silica, nitrate-nitrogen) were found to be highest in ocean samples collected nearest to the shoreline, with progressively decreasing values moving away from shore into deeper water. While groundwater nutrient input was evident at all four sampling locations, it was highest in magnitude at Site 3A, located directly downslope from the Makena Resort. As Site 4 served as a control, and was not located in the vicinity of the Makena Resort, it is apparent that groundwater input is not solely a function of Resort land usage.

Vertical stratification of the water column was not clearly evident on any transect with surface water not having higher nutrient concentrations and lower salinities than samples from near the sea floor. The observed patterns of distribution with respect to both distance from shore and depth in the water column indicate that physical mixing processes generated by tide, wind, waves and currents mix the water column from top to bottom.

Overall, measurements of turbidity and chlorophyll *a* were low throughout the sampling area, although values were slightly elevated close to the shoreline probably as a result of resuspension of fine-grained marine sediments (turbidity) and fragments of benthic algae washed up to the shoreline (Chl *a*). These results indicate that at the time of sampling, nutrient input from land was not resulting in increases in plankton populations in nearshore waters. Low turbidity in Makena Bay (transect Site 2) suggests mitigation of the effects of t a past episode of high runoff of upland soil from a flash flood in October 1999 that resulted in substantial impacts to water clarity within the Bay.

Other organic water chemistry constituents that do not occur in high concentrations in groundwater, such as ammonium nitrogen or organic nitrogen and phosphorus, were consistently low and did not show any distinctive patterns with respect to input from land.

Analyses that scale nutrient concentrations to salinity reveal that there were measurable increases of nitrate nitrogen in to naturally occurring groundwater that enters the nearshore ocean at three survey sites (Sites 1, 3 and 3A). These subsidies, which are likely a result of land uses involving fertilizers, substantially increase the concentration of nitrate over natural groundwater flowing to the ocean. These subsidies were greatest in magnitude at Sites 3 and 3A, followed by Site 1, all of which are located off the Makena Golf Course and adjacent residential areas. No subsidies of nitrate were apparent at Site 2 (Makena Landing) or Site 4 ('Ahihi-Kina`u). The lack of distinguishable upward curvature of these data arrays indicate that the nutrients from groundwater that enter the ocean, both from natural and the human sources, are not being taken up by biotic communities in the nearshore zone. Rather, nutrients are mixed to background ocean values by physical processes including wind stirring and wave action.

Statistical tests of nutrient concentration scaled to salinity over time show no significant increases or decreases over the years of monitoring at any of the survey sites. The lack of such increases suggests that there has been no consistent change in nutrient input from land (either as an increase or decrease) to groundwater that enters the ocean over the past years.

Comparing values of water chemistry measured in the monitoring program to State of Hawaii Department of Health (DOH) water quality standards revealed that several measurements of nitrogen, phosphorus, turbidity and Chlorophyll *a* exceeded the DOH standards, particularly for "geometric mean" standards. Such exceedances occurred at all survey sites, including the control site that was removed from influences of the Makena Resort. The consistent exceedance of water quality standards is in large part a consequence of the natural effects of groundwater discharge to the nearshore ocean, as well as physical mixing processes that occur near the shorelines of all coastal areas. Revision of DOH standards to account for such natural input has been implemented for the West Coast of the Island of Hawaii, and will hopefully be extended to the rest of the State in the near future.

As in all past surveys, the results of the most recent increment of monitoring reveal that there is an increase over natural conditions of dissolved inorganic nutrients (e.g., nitrate and sometimes to a lesser extent phosphate) in groundwater that enters the nearshore ocean at sampling sites downslope from parts of the Makena Resort. Without question, such input is a consequence of various land use activities. However, none of these inputs have increased significantly over time during the 16-year course of the monitoring program. The region where the subsidies occur is restricted to narrow zone that extends from the shoreline to several meters offshore, and as such is restricted to an area that is not suitable for coral communities to occur. Surveys of coral reef community structure that are also part of the ongoing monitoring program for the Makena Resort, as well as the continued lack of any nuisance algal accumulations in the nearshore area, indicate that the nutrient subsidies are presently not detrimental to marine community structure.

The next scheduled testing for the Makena Resort monitoring program is planned for the spring-summer season of 2012.

I. PURPOSE

The Makena Resort fronts approximately 5.4 miles of coastline of southeastern Maui, extending from Papanui Stream (Nahuna Point) on the north and Pu`u Olai (Ahihi Bay) on the south. However, only 0.58 miles of the Resort reaches to the actual shoreline. Within the Resort are two 18-hole golf courses (North and South Courses), as well as a hotel, sewage treatment plant and private residences. No part of the project involves direct alteration of the shoreline or nearshore marine environments.

Evaluations of other golf courses and other forms of resort development located near the ocean in the Hawaiian Islands reveal that there is detectable input to the coastal ocean of materials used for fertilization of turfgrass and landscaping (Dollar and Atkinson 1992). However, few, if any, effects that have been documented have been found to be detrimental to the marine ecosystem. Confirmation that the construction and responsible operation of the golf courses and other components of the Makena Resort does not cause any harmful changes to the marine environment requires rigorous and continual monitoring.

In the interest of assuring maintenance of excellent environmental quality in the Makena region, Condition No. 10, Declaration of Conditions pertaining to the Amendment of the District Boundary, as required by the Land Use Commission, dated April 17, 1998 stipulated the implementation of an ongoing marine monitoring program off the Makena Resort Development. In addition, County of Maui Zoning Ordinance 3613 Condition 19 included requirements for similar monitoring. The primary goals of the established monitoring program to satisfy these two requirements are twofold: 1) to assess the degree that materials used on land to enhance turf growth and landscaping, as well as other nutrient subsidies, leach to groundwater and subsequently reach the ocean, and 2) to determine the fate of these materials within the nearshore zone. In terms of determining fate, the question that is addressed is if the materials that originate from Resort activities disperse with little or no effect, or do they cause changes in water quality sufficient to alter marine biological community structure?

The rationale of the monitoring program is to conduct repetitive evaluations of water chemistry at the same locations at regular time intervals (twice per year). This strategy allows for determination of variations in effects from the Makena Resort in both space (at different locations along the shoreline) and time. It should be noted that water chemistry monitoring off the Makena area was initiated in 1995 on a voluntary basis, and has continued uninterrupted until the present. With the implementation of the Boundary Amendment and Zoning Conditions, it was determined that the ongoing voluntary monitoring protocol satisfied the stated requirements. Hence, the entire data set from 1995 onward is considered as part of the monitoring program. The following report presents the results of the twenty-sixth increment in the monitoring program, and contains data from water chemistry sampling conducted on October 16, 2011.

I. ANALYTICAL METHODS

Three survey sites directly downslope from the Makena Resort have been selected as sampling locations. A fourth site, located offshore of an area with minimal land-based development, particularly golf course operations, was selected as a control. During the June 2007 survey, another sampling location was added near the southern boundary of Maluaka Bay. It is anticipated that this station will remain part of the sampling protocol permanently. Figure 1 is a map showing the shoreline and topographical features of the Makena area, and the location of the North and South Golf Courses. All survey sites are depicted as transects perpendicular to the shoreline extending from the shoreline out to what is considered open coastal ocean (i.e., beyond the effects of activities on land). Survey Site 1 is located near the northern boundary of the project site off Nahuna Point; Survey Site 2 bisects Makena Bay near Makena Landing. Site 3 bisects the middle of the South course on the north side of Maluaka Point. Site 3A is on the southern corner of Maluaka Bay. Site 4, which is considered the Control site, is located near the northern boundary of the 'Ahihi-Kina`u natural area reserve north of the 1790 lava flow and approximately 1-2 miles south of the existing Makena Golf courses (Figure 1). The control site was located off a shoreline area with minimal land uses (i.e., residences near the shoreline and upslope ranchlands) rather than off the completely uninhabited 1790 lava flow. This location was selected as the most appropriate control site, as it is the farthest location from the Makena Resort with the same geophysical structural of the land area. The completely different geological structure of the lava flow off the natural reserve likely results in very different groundwater dynamics compared to the land area where the Makena Resort is located, hence making the lava flow an unsuitable control site.

In July of 2002, Site 3 was relocated from a location at the southern boundary of the project offshore of Oneloa Beach to the location directly off the Makena Golf Course, as described above. The relocation of Site 3 was deemed necessary as the original location consistently showed virtually no input of groundwater to the ocean. Such lack of groundwater discharge resulted in little potential for evaluating effects from the project. The new location of Site 3 is directly downslope from both the portion of the golf course nearest to the ocean, several newly constructed private residences, and a 3-acre recently restored wetland area. As a result, the new location represents an area that reflects the maximum influence on nearshore water quality from a variety of land uses and natural habitat.

All fieldwork for the present survey was conducted on October 16, 2011. Environmental conditions during sample collection consisted of mild winds (0-5 knots), sunny skies, and very little swell. Sample collection at the shoreline occurred during a falling tide with a tidal range of 1.0 to +0.7 feet.

Water samples were collected at stations along transects that extend from the highest wash of waves to between150-200 meters (m) offshore (about 500-650 feet), depending on the site. Such a sampling scheme is designed to span the greatest range of salinity with respect to freshwater efflux at the shoreline. Sampling was more concentrated in the nearshore zone because this area is most likely to show the effects of land-based activities. With the exception of the two stations closest to the shoreline (0 and 2 m offshore), samples were collected at two depths; a surface sample was collected within approximately 10 centimeters (cm) (~4 inches) of the sea surface, and a bottom sample was collected within one m (3 feet) of the sea floor.

Water samples from the shoreline to a distance of 10 m offshore were collected in triple-rinsed 1-liter polyethylene bottles by swimmers working from the shoreline. A digital refractometer was used to pinpoint the location of maximum groundwater flux to the ocean shoreline origin of each transect site. Water samples beyond 10 m from the shoreline were collected from a small boat using a 1.8-liter Niskin sampling bottle. This bottle was lowered to the desired depth in an open position where spring-loaded endcaps were triggered to close by a messenger released from the surface. Upon recovery, each sample was placed on ice until further processing in Honolulu. Water samples were also collected from eight golf course irrigation wells (No's 1, 2, 3, 4, 6, 8, 10 and 11) and one irrigation lake on October 16, 2011.

Water quality parameters evaluated included the 10 specific criteria designated for open coastal waters in Chapter 11-54, Section 06 (Open Coastal waters) of the State of Hawaii Department of Health Water Quality Standards. These criteria include: total nitrogen (TN) which is defined as inorganic nitrogen [nitrate + nitrite nitrogen (NO_3^- + NO_2^-), ammonium (NH_4^+)], plus total organic nitrogen (TON), total phosphorus (TP) which is defined as inorganic phosphorus (PO_4^{3-}) plus total organic phosphorus, chlorophyll *a* (Chl *a*), turbidity, temperature, pH and salinity. In addition, orthophosphate phosphorus (PO_4^{3-}) and silica (Si) were reported because these constituents are sensitive indicators of biological activity and the degree of groundwater mixing, respectively.

Analyses for NO_3^- + NO_2^- (hereafter termed NO_3^-), NH_4^+ and PO_4^{3-}, were performed on filtered samples using a Technicon autoanalyzer according to standard methods for seawater analysis (Strickland and Parsons 1968, Grasshoff 1983). TN and TP were analyzed in a similar fashion on unfiltered samples following digestion. Total organic nitrogen (TON) and Total organic phosphorus (TOP) were calculated as the difference between TN and inorganic N, and TP and inorganic P, respectively. Limits of detection for the dissolved nutrients are 0.01 μM (0.14 μg/L) for NO_3^- and NH_4^+, 0.01 μM (0.31 μg/L) for PO_4^{3-}, 0.1 μM (1.4 μg/L) for TN and 0.1 μM (3.1 μg/L) for TP.

Chl *a* was measured by filtering 300 ml of water through glass fiber filters; pigments on filters were extracted in 90% acetone in the dark at -5°C for 12-24 hours, and the fluorescence before and after acidification of the extract was measured with a Turner Designs fluorometer (level of detection 0.01 μg/L). Salinity was determined using an AGE Model 2100 laboratory salinometer with a precision of 0.003‰.

In situ field measurements included water temperature, pH, dissolved oxygen and salinity which were acquired using an RBR Model XR-420 CTD calibrated to factory specifications. The CTD has a readability of 0.001°C, 0.001pH units, 0.001% oxygen saturation, and 0.001 parts per thousand (‰) salinity. Shoreline salinity was measured in the field using an Atago PAL-06S digital refractometer.

Nutrient, turbidity, Chl *a* and salinity analyses were conducted by Marine Analytical Specialists located in Honolulu, Hawaii. This laboratory possesses acceptable ratings from EPA-compliant proficiency and quality control testing.

III. RESULTS and DISCUSSION

A. General Overview

Table 1 shows results of all marine water chemical analyses for samples collected off Makena on October 16, 2011 with nutrient concentrations reported in micromolar units (μM). Table 2 shows similar results with nutrient concentrations presented in units of micrograms per liter (μg/L). Tables 3 and 4 show geometric means of ocean samples at Sites 1, 2 and 4 for 25 surveys, 16 surveys at Site 3, and 7 surveys from Site 3A, with nutrient concentrations shown in μM and μg/L, respectively. Table 5 shows water chemistry measurements (in units of μM and μg/L) for samples collected from irrigation wells and one irrigation lake located on the Makena Resort Golf Courses. Concentrations of twelve chemical constituents in surface and deep-water samples from the October 2011 sampling are plotted as functions of distance from the shoreline in Figures 2 and 3. Mean concentrations (±standard error) of twelve chemical constituents in surface and deep water samples as functions of distance from the shoreline at Sites 1-4 collected since 1995 and from Site 3A collected since 2007are plotted in Figures 4-18. In addition, data from the most recent sampling in October 2011 are also plotted on Figures 4-18.

During the October 2011 sampling, nearshore concentrations of dissolved Si, NO_3^- and TN on all five transects were elevated two to four orders of magnitude compared to samples collected in the open coastal ocean farthest from shore (Figure 2, Tables 1 and 2). The horizontal gradients of nutrients were steepest on transect 3A where NO_3^- at the shoreline (121 μM) was about 1,000-fold higher than the surface samples collected at the seaward end of the transect. On transects 1, 3, and 4, peak values of NO_3^- at the shoreline (18, 12 and 7 μM, respectively) were over 100-fold higher than surface samples collected at the seaward ends of the transects (Figure 2, Table 1). Shoreline values of NO_3^- on transect 2 also displayed a horizontal gradient but to a lesser extent than the other four sites. Salinity displayed mirror images of the patterns for nutrients, with lowest salinity at the shoreline and rapidly increasing values with increasing distance from shore to near oceanic values (35‰) at the ends of the transects (Figure 3, Table 1). The lowest salinities were measured at the shoreline of Site 3A with a value of 25.5‰. Distinct horizontal gradients of salinity extended to a distance of 5-10 m from the shoreline at all five transect sites (Tables 1 and 2).

Surface concentrations of phosphate phosphorus (PO_4^{3-}) and TP were highest near the shoreline at transect Site 3A (2.21 and 2.46 μM, respectively) while at the other sites maximum concentrations of PO_4^{3-} and TP was 0.20 and 0.48 μM, respectively (Table 1, Figure 2). With the exception of transect Site 3A; strong horizontal gradients were not evident for PO_4^{3-} or TP during the October 2011 survey.

With no streams in the sampling area, nor heavy rainfall and subsequent surface runoff preceding sampling, the pattern of elevated Si, NO_3^-, PO_4^{3-} and TN with corresponding reduced salinity indicates groundwater entering the ocean near the shoreline. Low salinity groundwater, which contains high concentrations of Si, NO_3^-, TN and PO_4^{3-} (see values for well waters in Table 5), percolates to the ocean near the shoreline, resulting in a distinct zone of mixing in the nearshore region. The zone of mixing is discernible by distinct decreasing gradients of nutrients and increasing gradients of salinity with distance from shoreline. During periods of low tide when sea conditions are calm, the zone of mixing between groundwater and ocean water is most pronounced. The October 2011 sampling was conducted near low tide (~0.6 ft) with light winds and a slight surface swell, resulting in a small zone of mixing extending only 10 m from the shoreline. Past monitoring surveys at Makena Resort conducted during periods of high tide and strong winds (e.g. December 2005) showed substantially smaller horizontal gradients than the present survey. Comparing the results of surveys conducted during different sea conditions clearly indicates that tidal state, as well as wind and wave energy, greatly effect groundwater mixing in the nearshore zone.

Dissolved nutrient constituents that are not usually associated with groundwater input (NH_4^+, TON, TOP) did not exhibit distinct horizontal gradients across the sampling transects (Table 1, Figure 2). Distinctly higher concentrations of NH_4^+ were recorded near the shoreline at Site 3A (3.55 μM) and at Site 1 (0.65 M) compared to the other three sites (Table 1). Surface concentration of TON was also elevated in the nearshore samples at Site 3A (Table 1, Figure 2).

Turbidity was highest near the shoreline on all transects and decreased with increasing distance from the shoreline (Tables 1 and 2, Figure 3). The highest turbidity recorded during the October 2011 survey occurred on transect 4 (1.4 ntu). In previous surveys, turbidity has generally been highest on Transect 2 compared to the other sites. However, this was not the case in the present survey, nor was it the case in the previous two surveys (July 2010 and March 2011). Transect 2 bisects Makena Bay, which is semi-enclosed embayment with a silt/sand bottom rather than the predominantly "hard" reef or sand bottoms that occur at the other transect sites. In addition, it has been observed that during flash floods originating in the ranch lands upslope of the Makena Resort, terrigenous sediment may flow to the ocean in Makena Bay. As a result of wave-induced resuspension of the naturally occurring silt/sand substratum, as well as terrigenous runoff which may be partially retained within the embayment, turbidity has often been elevated on transect 2 relative to the other transect sites. It is important to note that in surveys conducted since July 2002, water clarity in Makena Bay has improved greatly compared to preceding surveys in 2001 which reflected conditions following substantial input of terrigenous materials from a flash-flood that occurred in October 1999. Since that time, a large retention basin has been constructed on the upper slopes of Makena Resort in the watershed that flows into Makena Bay.

In October 2011concentrations of Chl a were higher near the shoreline compared to offshore values at all five survey sites. Values of Chl a were of the same magnitude at all five survey sites (Table 1 and Figure 3). Surface water temperature ranged between 25.8°C and 27.3°C among the five sites during the October 2011 survey (Figure 3 and Tables 1 and 2).

In many areas of the Hawaiian Islands, input of low salinity groundwater to the nearshore ocean creates a distinct buoyant surface lens that can persist for some distance offshore. Buoyant surface layers are generally found in areas where turbulent processes (primarily wave action) are insufficient to completely mix the water column in the nearshore zone. Figures 2 -18 and Tables 1 and 2 show concentrations of water chemistry constituents with respect to vertical stratification. During the October 2011 survey, vertical stratification was not clearly evident for nutrients or salinity on any of the transects.

B. Temporal Comparison of Monitoring Results

Figures 4-18 show mean concentrations (±standard error) of water chemistry constituents from surface and deep samples at Transect Sites 1-4 from monitoring surveys conducted between 1995 and 2011 and from Site 3A for monitoring surveys conducted from 2007 to 2011. In addition, the results of the most recent survey in October 2011 are also shown on each plot.

Surface concentrations of Si, NO_3^- and TN on all transects during the October 2011 survey were lower than the mean values of all past surveys (Figures 4, 7, 10, 13, 16). Several values of NH_4^+ measured during the October 2011 survey were double that of the mean value (Figure 16). Salinity at stations located within 5-10 meters of the shoreline was consistently higher in the October 2011 samples compared to overall survey means (Figures 6, 15 and 18). Turbidity at stations near the shoreline during the most recent survey was similar to overall mean values with the exception of transect 4 (Control off 'Ahihi-Kina`u), where turbidity near the shoreline was elevated (Figure 15). Measurements of Chl a during October 2011 were substantially lower on all transects than the mean values, while temperature was consistently higher than the mean values at all five transect sites (Figures 6, 9, 12, 15 and 18). All of these variations between the values measured in the most recent survey, and the overall survey means can be a result of sampling during a period of relatively high mixing of groundwater and ocean water in the nearshore zone owing to wind and wave action. None of the comparisons of the most recent sampling results to the mean values calculated for the entire monitoring regime indicate any recent negative effects to nearshore water quality.

C. Conservative Mixing Analysis

A useful treatment of water chemistry data for interpreting the extent of material input from land is application of a hydrographic mixing model. In the simplest form, such a model consists of plotting the concentration of a dissolved chemical species as a function of salinity. Comparison of the curves produced by such plots with conservative mixing lines provides an indication of the origin and fate of the material in question (Officer 1979, Dollar and Atkinson 1992, Smith and Atkinson 1993).

Figure 19 shows plots of concentrations of four chemical constituents (Si, NO_3^-, PO_4^{3-}, and NH_4^+) as functions of salinity for samples collected in October 2011. Figures 20 and 21 show the same type of plot with data pooled by transect site for a composite of all past surveys, as well as for the most recent survey. Each graph also shows a conservative mixing line that was constructed by connecting the end member concentrations of open ocean water with irrigation well No. 4 located off the North Course of the Makena Resort (representative of groundwater upslope of the Makena Resort).

If the parameter in question displays purely conservative behavior (no input or removal from any process other than physical mixing), data points should fall on, or very near, the conservative mixing line. If, however, external material is added to the system through processes such as leaching of fertilizer nutrients to groundwater, data points will fall above the mixing line. If material is being removed from the system by processes such as uptake by biotic metabolic processes, data points will fall below the mixing line.

Dissolved Si represents a check on the model as this material is present in high concentration in groundwater, but is not a major component of fertilizer. In addition, Si is not utilized rapidly within the nearshore environment by biological processes. It can be seen in Figure 19 that when concentrations of Si are plotted as functions of salinity, all data points fall in a linear array on or close to, but slightly below the conservative mixing line created by connecting endpoint concentrations from water collected from the upslope irrigation well and the open ocean. Such good agreement indicates that marine waters at the five transect sites are primarily a mixture of groundwater flowing beneath the project and ocean water. Over the course of monitoring, data points from Site 1 have consistently been below the Si mixing lines (Figure 20). Data plotted over the course of monitoring from Site 3A, located directly off of the Makena Golf Course consistently fall close to the mixing line (Figure 20). These results indicate that the groundwater from upslope Well No. 4 provides a valid representation of groundwater that enters the ocean following flow through the Makena development. Over the course of monitoring since 1995, the relationship between salinity and Si has remained nearly constant (Figure 20).

NO_3^- is the form of nitrogen most common in fertilizer mixes that are used for enhancing turf growth. When the concentrations of NO_3^- are plotted as functions of salinity, data from each transect prescribe distinctly different patterns (Figure 19). Data points from Transects 2 (Makena Bay) and 4 (Control transect) lie close to the conservative mixing line. The location of these data arrays indicates that the source of NO_3^- entering the ocean at these sites contains little or no subsidies from activities on land. Inspection of the long-term mixing data (Figure 20) indicates that with the exception of two data points, all of the values of NO_3^- from Control Site 4 fall on, or very near, the conservative mixing line. Such a result validates that Site 4 is indeed a good "control" area that is not greatly affected by activities on land.

Conversely, data points from the nearshore samples at Transects 1, 3, and 3A all fall well above the conservative mixing line, indicating various subsidies of NO_3^- to the ocean from sources on land (Figure 19). Data points for Sites 3 and 3A are similar in slope, and are substantially steeper than data points from Site 1 (Figure 19). Such relationships indicate subsidies of NO_3^- at transect Sites 1, 3 and 3A are likely a result of leaching of golf course fertilizers to the groundwater lens. In addition to the golf courses, however, residences near the shoreline at Site 1 include landscaping and lawns, while residences and a wetland lie directly inshore from Site 3. Site 3A lies directly offshore of the golf course and a residential community clubhouse that is currently under construction.

Transect Site 1 has also been used as a monitoring station for a similar evaluation of the effects of the Wailea Golf Courses on water chemistry that commenced in 1989. The lowest concentrations of NO_3^- relative to salinity at Transect site 1 occurred during the initial two years of study, with subsequent higher concentrations increasing since 1992. Hence, there appears to have been an increase of NO_3^- in nearshore waters since 1992 that was not occurring in 1989-1991. Completion of the Wailea Gold Course occurred in December 1993, while completion of the Makena North Course occurred in November 1993. As the southern region of the Wailea Course and the northern part of the Makena Course abut each other in the makai-mauka direction landward of ocean Transect 1, the increased concentrations of NO_3^- evident in Figure 19 may be a result of leaching of fertilizer materials from the combined golf courses to groundwater that enters the ocean in the sampling area.

Mixing analyses also indicate an ongoing input of NO_3^- at the shoreline of Stations 3 and 3A located off the existing Makena Golf Course and several new residences that have been constructed adjacent to the Golf Course (Figures 19 and 20). Such subsidies have been noted in past surveys, as can be seen in Figure 20. When the slopes of the data points for the October 2011 survey (red symbols) are compared to the slopes of combined sets of data points from past surveys (black and green symbols) subsidies of NO_3^- have not increased during the most recent survey (Figure 20). Future monitoring will clarify if the trend of NO_3^- input to the ocean is indeed decreasing.

While the data reveal a long-term subsidy to the concentration of NO_3^- in groundwater and the nearshore zone at several of the sampling sites, the concentrations of NO_3^- fall in clearly linear relationship as functions of salinity. The linearity of the data array indicates that there is little or no detectable uptake of this material by the marine environment. Such lack of uptake indicates that the nutrients are not being removed from the water column by metabolic reactions that could change the composition of the marine environment. Rather, the nutrient subsidies are diluted to background oceanic levels by physical processes of wind and wave mixing. As a result, the increased nutrients do not appear to have the potential to cause alteration in biological community composition or function.

Similar situations have also been observed in other locales in the Hawaiian islands where nutrient subsidies from golf course leaching result in excess NO_3^- in the nearshore zone. At Keauhou Bay on the Big Island, it was shown that owing to the distinct vertical stratification in the nearshore zone, the excess nutrients never come into contact with benthic communities, thereby limiting the potential for increased uptake by benthic algae. In addition, the residence time of the high nutrient water was short enough within the embayment to preclude phytoplankton blooms. As a result, while NO_3^- concentrations doubled as a result of golf course leaching for a period of at least several years, there was no detectable negative effect to the marine environment (Dollar and Atkinson 1992). Owing to the unrestricted nature of circulation and mixing off the Makena project (no confined embayments) it is reasonable to assume that the excess NO_3^- subsidies that are apparent in the present study will not result in alteration to biological communities.

Indeed, surveys of the nearshore marine habitats off of Makena reveal a generally healthy coral reef that does not appear to exhibit any negative effects from nutrient loading, particularly in the form of abundant algal biomass (Marine Research Consultants 2006). In addition to the lack of negative impacts to offshore coral communities, inspection of the entire shoreline fronting the Makena Resort revealed that there are no areas where excessive algal growth is presently occurring.

The other form of dissolved inorganic nitrogen, NH_4^+, does not show a linear pattern of distribution with respect to salinity for either the October 2011 survey (Figure 19) or the entire monitoring program (Figure 21). The lack of a correlation between salinity and concentration of NH_4^+ suggests that this form of nitrogen is not present in the marine environment as a result of mixing from groundwater sources. Rather, NH_4^+ is generated by natural biotic activity in the ocean waters off Makena.

PO_4^{3-} is also a major component of fertilizer, but is usually not found to leach to groundwater to the extent of NO_3^-, owing to a high absorptive affinity of phosphorus in soils. With the exception of data points from transect site 3A, all data points from October 2011 fell on or below the mixing line. This result indicates that with the exception of site 3A the source of PO_4^{3-} to the ocean is from naturally occurring groundwater. At site 3A, the elevated PO_4^{3-} is likely a result of golf course and residential landscaping, reflecting similar subsidies of NO_3^-.

D. Time Course Mixing Analyses

While it is possible to evaluate temporal changes from repetitive surveys conducted over time in terms of concentrations of water chemistry constituents (See Section C), a more informative and accurate method of evaluating changes over time is to utilize the results of scaling nutrient concentrations to salinity. As discussed above, the simple hydrographic mixing model consisting of plotting concentrations of nutrient constituents versus salinity eliminates the ambiguity associated with comparing only the concentrations of samples collected during multiple samplings at different stages of tide and weather conditions. Figures 22 and 23 show plots of Si and NO_3^-, respectively, as functions of salinity collected during each year of sampling (1995-2011). Also shown in Figures 22 and 23 are straight lines that represent the least squares linear regression fitted through concentrations of Si and NO_3^- as functions of salinity at each monitoring site for each year. Tables 6-8 show the numerical values of the Y-intercepts, slopes, and respective upper and lower 95% confidence limits of linear regressions fitted through the data points for Si, NO_3^-, and PO_4^{3-} as functions of salinity for each year of monitoring.

The magnitude of the contribution of nutrients originating from land based activities to groundwater will be reflected in both the steepness of the slope and the magnitude of the Y-intercept of the regression line fitted through the concentrations scaled to salinity (the Y-intercept can be interpreted as the concentration that would occur at a salinity of zero if the distribution of data points is linear). This relationship is valid because with increasing contributions from land, nutrient concentrations in any given parcel of water would increase with no corresponding change in salinity. Hence, if the contribution from land to groundwater nutrient composition is increasing over time, there would be progressive increases in the absolute value of the slopes, as well as the Y-intercepts of the regression lines fitted through each set of annual nutrient concentrations when plotted as functions of salinity. Conversely, if the contributions to groundwater from land are decreasing, there will be decreases in the absolute values of the slopes and Y-intercepts.

Plots of the values of the slopes (Figure 24) and Y-intercepts (Figure 25) of regression lines fitted though concentrations of Si, NO_3^- and PO_4^{3-} scaled to salinity during each survey year provide an indication of the changes that have been occurring over time in the nearshore ocean off the Makena Resort. As stated above, Si provides the best case for evaluating the effectiveness of the method, as Si is present in high concentration in groundwater but is not a component of fertilizers. NO_3^- and PO_4^{-3} are the forms of nitrogen and phosphorus that are found in high concentrations in groundwater relative to ocean water, and are the major nutrient constituents found in fertilizers.

Examination of Figures 24 and 25, as well as Tables 6-8 reveal that none of the slopes or Y-intercepts of Si, NO_3^- and PO_4^{3-} from 1995 to 2011 at any of the transect sites exhibit any indication of progressively increasing or decreasing values over the course of monitoring. The term "REGSLOPE" in Tables 6-8 denotes the values of the slopes and 95% confidence limits of linear regressions of the values of the yearly slopes and Y-intercepts as a function of time. For all sites, the span of the upper and lower 95% confidence limits of the REGSLOPE coefficients are not significantly different than zero, indicating that there is no statistically significant increase or decrease in the salinity-scaled concentrations of Si, NO_3^- and PO_4^{3-} over the course of the monitoring program (Tables 6-8).

For all three nutrients, there is little variation in either slopes or Y-intercepts during any single year at Site 1, located off the "5 Graves" area downslope from the juncture of the Wailea and Makena Resorts (Figures 24 and 25). Such lack of variation indicates relatively consistent concentrations of Si, NO_3^- and PO_4^{3-} in groundwater entering the ocean over the sixteen years of monitoring. Sites 2 (Makena Landing) and 4 ('Ahihi-Kina`u) also show relatively constant trends with time with the exception of 2001 which is marked by large spikes in Si and PO_4^{3-}. Such a fluctuation is not present for NO_3^- in 2001. Sampling in 2001 was conducted during a period of rough winter sea conditions marked by vigorous mixing of the water column. As a result, there was very weak linear relationship between nutrient concentrations and salinity.

At Site 3, located directly downslope for the point of the Makena Golf Course closest to the ocean, there is a trend of decreasing NO_3^- between 2002 and 2004, an increasing trend from 2004 to 2007, followed by another downturn in 2007 – 2009 (Figures 24 and 25). As a result of these reversing trends, there is no significant change over the seven-year period of monitoring. The multiple reversing trends may reflect changes in land use, such as variation in fertilizer application or construction-related activities in 2002-2004 versus 2004-2007. In June of 2008, the golf course fronting the ocean in this area was shut down for re-alignment and re-planting. Underground retention/filtration systems were also constructed to mitigate adverse affects of stormwater runoff. At the time of the October 2011 survey, new turf grass had been applied but the course remained closed and the filtration systems were not yet operational.

F. Compliance with DOH Standards

Tables 1 and 2 also show samples that exceed DOH water quality standards for open coastal waters under "wet" and "dry" conditions. These criteria are applied depending upon whether the area is likely to receive less than (dry) or greater than (wet) 3 million gallons of groundwater and/or surface water input per mile per day. As it is not possible to accurately estimate groundwater and surface water discharge, both wet and dry standards are considered. DOH standards include specific criteria for three situations; criteria that are not to be exceeded during either 10% or 2% of the time, and criteria that are not to be exceeded by the geometric mean of samples. With only one or two samplings collected per year over more than 16 years, comparison of the 10% or 2% of the time criteria for any sample is not statistically meaningful. However, comparing sample concentrations to these criteria provide an indication of whether water quality is near the stated specific criteria.

Boxed values in Tables 1 and 2 show instances where measurements exceed the DOH standards under dry conditions, while boxed and shaded values show instances where measurements exceed DOH standards under wet conditions.

Results from the October 2011 survey indicated several measurements of NO_3^-, NH_4^+,TN and TP along all five transect sites exceeded the 10% DOH criteria under wet or dry conditions (Tables 1 and 2). All of the instances where the DOH criteria for NO_3^- and TN were exceeded were from samples collected within 5 m of the shoreline. Three measurements of NH_4^+, two measurements of TP and turbidity each and one measurement of Chl *a* exceeded the 10% DOH criteria under dry conditions. Under "wet" criteria, three measurements of NH_4^+, one measurement of TP and turbidity each exceeded the DOH criteria while no measurements of Chl *a* exceeded the standard. It is of interest to note that at Transect Site 4, which is considered the control station beyond the influence of the Makena Resort, exceedance of DOH criteria occurred for NO_3^-, TN and turbidity.

Tables 3 and 4 show geometric means of samples collected at the same locations during the twenty-six increments of the monitoring program at Sites 1, 2 and 4. Geometric means of samples collected over seventeen increments of sampling at Site 3 and eight increments of sampling at Site 3A are also shown. These tables also specify the samples that exceed the DOH geometric mean limits for open coastal waters under "dry" (boxed) and "wet" (boxed and shaded) conditions. For NO_3^-, NH_4^+, and TN numerous dry and wet standards were exceeded on all transects. Eight samples of TP and seventeen samples of turbidity exceeded standards. All but eight samples exceed the geometric mean standards for Chl *a*.

Site 4 is considered a control transect, in that it is not located offshore of a resort, golf course or dense residential development. It can be seen in Tables 3 and 4, however, that the number of samples that exceed geometric mean criteria at Site 4 are comparable to the other four sites, all of which are located downslope from the Makena Resort. Hence, Resort activities, including golf courses cannot be attributed as the sole (or even major) factor causing water quality to exceed geometric mean standards.

Several comments can be made regarding the present DOH water quality standards and how they apply to the monitoring program at the Makena Resort. As noted above, the category of water quality standards that are applicable for the Makena Monitoring program are "Open Coastal Waters." As the name implies, these standards apply to "open" waters that can be reasonably defined as "waters beyond the direct influence of land." In order to evaluate the effects of land uses on the nearshore ocean off Makena, the selected sampling regime collects water within a zone that extends from the shoreline to the open coastal ocean. As a result, sampling takes place within the region of ocean that is directly influenced by land. If the monitoring protocol were changed to include only those sampling locations beyond 50-100 m from shore (i.e., open coastal waters), which is completely valid with respect to meeting DOH regulatory compliance, virtually none of the factors discussed above relating to the effects of activities on land to the nearshore ocean would not be observed.

Initial steps have been taken by DOH to rectify this situation. During revision of the Department of Health water quality standards in 2004, a unique set of monitoring criteria was added for the West Coast of the Island of Hawaii (i.e., "Kona standards"). The rationale for these unique standards was the recognition that existing numerical "standards" represent offshore coastal waters that are beyond the natural confluence of land and the nearshore ocean. As a result, the West Hawaii standards recognize that groundwater entering the ocean at the shoreline contains substantially elevated nutrients relative to open coastal waters. As a result, the Kona criteria provide the potential to meet water quality standards with elevated nutrient concentrations resulting from natural sources of groundwater input. As the same processes of groundwater discharge to the coastal ocean have been documented in Maui, it is hopeful that similar new provisions of the water quality standards with soon be applicable to the South Maui area.

II. SUMMARY

- The twenty-sixth phase of water chemistry monitoring of the nearshore ocean off the Makena Resort was carried out on October 16, 2011. Sixty-two ocean water samples were collected on four transects spaced along the project ocean frontage and on one control transect. Site 1 was located at the northern boundary of the project, Site 2 was located near the central part of the Makena North Golf Course in the center of Makena Bay, Site 3A (initiated during the June 2007 survey) was located near the southern boundary of Maluaka Bay, Site 3 was downslope from the part of Makena South Golf Course that comes closest to the shoreline, and Control Site 4 was located to the south of Makena Resort near the northern boundary of the 'Ahihi-Kina`u Natural Area Reserve. Sampling transects extended from the shoreline out to the open coastal ocean. Water samples were analyzed for chemical criteria specified by DOH water quality standards, as well as several additional criteria. In addition, water samples were collected from eight irrigation wells and an irrigation lake located on the golf courses.

- Water chemistry constituents that occur in high concentration in groundwater (Si, NO_3^- and TN) displayed distinct horizontal gradients with highest concentrations nearest to shore and decreasing concentrations moving seaward. Groundwater input (based on salinity) was greatest at Site 3A, but was also evident at all other sites. As Site 4 served as a control, and was not located in the vicinity of the Makena Resort, it is apparent that groundwater input is not solely a function of Resort land usage.

- Vertical stratification of the water column was not clearly evident during October 2011, with most surface samples not displaying higher nutrient and lower salinities than the corresponding bottom samples. The lack of strong vertical patterns of distribution indicate that physical mixing processes generated by tidal exchange, wind stirring, and breaking waves were sufficient to mix the water column from surface to bottom throughout the sampling area at the time of the monitoring survey.

- Overall, values of Chl *a* and turbidity were elevated near the shoreline compared to offshore samples, with Control Site 4 having the highest values of turbidity in nearshore samples. The elevated levels of Chl *a* and turbidity in the nearshore zone are likely a result of broken fragments of benthic plants that broken from the bottom by wave action and washed to the shoreline. The low concentrations of Chl *a* through the water column indicates the lack of plankton blooms in the area. Site 2, located at the point where sediment-laden storm water runoff entered the ocean following a flash flood in October 1999 did not display substantially elevated turbidity during the present survey suggesting that the effects of the flood have been fully mitigated.

- Other organic water chemistry constituents that do not occur in high concentrations in groundwater (NH_4^+, TON, TOP) did not show any distinctive patterns with respect to horizontal gradients. Concentrations of NH_4^+, however, were elevated in the shoreline samples at transect Site 3A.

- Scaling nutrient concentrations to salinity indicates that there were measurable subsidies of NO_3^- to groundwater that enters the nearshore ocean at three Transect sites. Results of the October 2011 monitoring indicated that these subsidies were greatest in magnitude at Sites 3 and 3A, followed by Site 1. No subsidies of NO_3^- were apparent at Site 2 (Makena Landing) or Control Site 4 ('Ahihi-Kina`u). These subsidies, which are without doubt a result of land uses involving fertilizers, substantially increase the concentration of NO_3^- with respect to salinity in groundwater flowing to the ocean compared to natural groundwater. The area shoreward of Site 1 includes the juncture of the southern part of the Wailea Gold Course and the northern part of the Makena North Course, as well as residential development. Sites 3 and 3A are directly downslope from the Makena South Course in an area were the golf course extends to the shoreline. In addition, private residences are near completion upslope of Transect 3, and it is possible that a cesspool remains from a house that was recently torn down. Hence, the subsidies of NO_3^- noted at these sites may result from a combination of sources.

- Linear regression statistics of nutrient concentration plotted as functions of salinity are useful for evaluating changes to water quality over time. When the regression values of nutrient concentrations versus salinity are plotted as a function of time, there are no statistically significant increases or decreases over the sixteen years of monitoring at any of the survey sites. The lack of increase in these slopes and intercepts indicate that there has been no consistent change in nutrient input from land to groundwater that enters the ocean from 1995 to 2011 (2002 to 2011 at Site 2). At Site 3 off the Makena Resort South Golf Course, there was a progressive decrease in NO_3^- input between 2002 and 2004, followed by an increase between 2004 and 2007, and another decrease in 2008-2011. Further monitoring at this site will be of interest to note the future direction of the oscillating trends noted in the last seven years.

- Comparing water chemistry parameters to DOH standards revealed that several measurements of NO_3^- and TN, and a few of NH_4^+, TP, turbidity and Chl *a* exceeded the DOH "not to exceed more than 10% of the time" criteria for dry and wet conditions of open coastal waters. It is apparent that the concentrations of NO_3^- in nearshore marine waters that contains a mixture of seawater and natural groundwater may exceed DOH criteria with no subsidies from human activities on land. Numerous values of NO_3^-, NH_4^+, TN, turbidity and Chl *a* exceeded specified limits for geometric means. Such exceedances occurred at all survey sites, including the control site that was far from any golf course influence. The consistent exceedance of water quality standards is in large part a consequence of the present DOH standards not accounting for the natural effects of groundwater discharge to the nearshore ocean.

- As in past surveys, there is a subsidy of dissolved inorganic nutrients (e.g., NO_3^- and sometimes to a lesser extent PO_4^{3-}) to groundwater that enters the nearshore ocean at sampling sites downslope from parts of the Makena Resort. Without question, such input is a consequence of various land use activities. However, none of these inputs have increased over time. Surveys of coral reef community structure that are part of the ongoing monitoring program for the Makena Resort, as well as the continued lack of any nuisance algal aggregations in the nearshore area indicate that the nutrient subsidies are not detrimental to marine community structure.

- The next scheduled testing for the Makena Resort monitoring program is planned for the spring-summer season of 2012.

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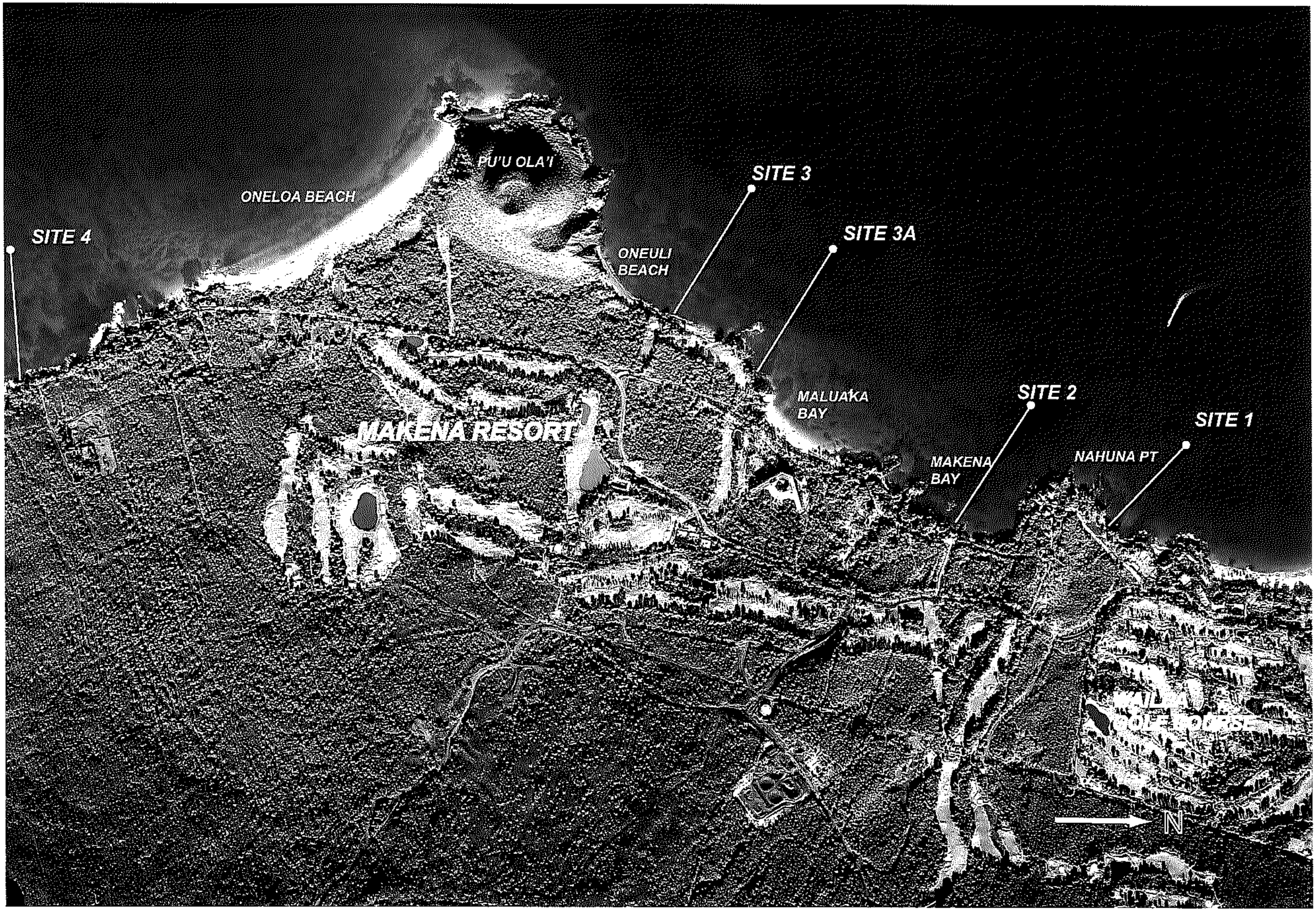


FIGURE 1. Aerial photograph of Makena Resort on southwest coastline of Maui. Also shown are locations of five water sampling transects that extend from the shoreline to 150-200 m from shore. The southern end of the Wailea golf course is visible at right.

Exhibit A-2

TABLE 1. Water chemistry measurements from ocean water samples collected in the vicinity of the Makena Resort on October 16, 2011. Abbreviations as follows: DFS=distance from shore; S=surface; D=deep; BDL=below detection limit. Also shown are the State of Hawaii, Department of Health (DOH) "not to exceed more than 10% of the time" and "not to exceed more than 2% of the time" water quality standards for open coastal waters under "dry" and "wet" conditions. Boxed values exceed DOH 10% "dry" standards; boxed and shaded values exceed DOH 10% "wet" standards. For sampling site locations, see Figure 1.

TRANSECT SITE	DFS (m)	DEPTH (m)	PO_4^{3-} (μM)	NO_3^- (μM)	NH_4^+ (μM)	Si (μM)	TOP (μM)	TON (μM)	TP (μM)	TN (μM)	TURB (NTU)	SALINITY (ppt)	CHL a (μg/L)	TEMP (deg.C)	pH (std.units)	O2 % Sat
MAKENA 1	0 S	0.1	0.04	17.86	0.10	39.96	0.30	7.19	0.34	25.15	0.38	32.675	0.24	25.5	8.28	100.9
	2 S	0.1	0.07	4.03	0.65	12.90	0.31	5.93	0.38	10.61	0.21	34.351	0.33	26.7	8.33	117.6
	5 S	0.1	0.11	10.91	0.07	24.59	0.30	5.78	0.41	16.76	0.46	33.636	0.17	26.8	8.32	118.6
	5 D	1.0	0.10	12.22	0.06	26.98	0.31	5.64	0.41	17.92	0.44	33.488	0.57	26.7	8.33	116.4
	10 S	0.1	0.07	0.45	0.06	2.28	0.30	5.80	0.37	6.31	0.19	34.996	0.09	26.1	8.18	103.1
	10 D	1.7	0.07	0.16	0.07	1.93	0.31	5.59	0.38	5.82	0.12	35.009	0.04	26.0	8.18	100.7
	50 S	0.1	0.09	0.29	0.06	2.22	0.30	5.29	0.39	5.64	0.08	35.056	0.07	26.1	8.17	98.6
	50 D	4.4	0.08	0.05	0.03	1.80	0.33	5.50	0.41	5.58	0.08	35.122	0.07	26.0	8.20	101.6
	100 S	0.1	0.07	0.03	0.04	1.59	0.31	5.39	0.38	5.46	0.08	35.039	0.07	26.0	8.21	102.2
	100 D	6.2	0.07	0.03	0.05	1.77	0.31	6.01	0.38	6.09	0.09	35.037	0.10	26.0	8.21	103.2
	150 S	0.1	0.06	0.03	0.09	1.52	0.32	5.65	0.38	5.77	0.11	35.056	0.06	26.2	8.21	99.4
	150 D	11.7	0.08	0.02	0.08	1.50	0.31	5.59	0.39	5.69	0.12	35.038	0.07	25.9	8.21	103.5
MAKENA 2	0 S	0.1	0.15	2.05	0.17	12.90	0.31	5.49	0.46	7.71	0.44	34.435	0.18	26.6	8.27	99.6
	2 S	0.1	0.14	2.39	0.09	15.24	0.30	6.29	0.44	8.77	0.43	34.313	0.28	26.8	8.28	115.6
	5 S	0.1	0.12	2.48	0.05	13.12	0.29	5.46	0.41	7.99	0.18	34.445	0.17	26.9	8.25	116.9
	5 D	1.2	0.15	2.43	0.04	13.00	0.28	6.64	0.43	9.11	0.15	34.432	0.09	27.0	8.25	116.9
	10 S	0.1	0.10	0.33	0.06	2.18	0.30	5.41	0.40	5.80	0.10	34.994	0.13	26.0	8.18	100.5
	10 D	1.5	0.11	0.18	0.03	2.79	0.30	6.74	0.41	6.95	0.17	34.988	0.09	26.0	8.18	95.4
	50 S	0.1	0.06	0.08	0.03	1.92	0.32	8.39	0.38	8.50	0.10	35.008	0.08	26.1	8.18	97.5
	50 D	2.8	0.12	0.10	0.02	3.06	0.32	6.04	0.44	6.16	0.15	34.976	0.09	26.0	8.19	94.8
	100 S	0.1	0.07	0.06	0.12	1.96	0.32	5.15	0.39	5.33	0.10	35.013	0.06	26.1	8.20	99.8
	100 D	4.7	0.10	0.09	0.04	2.22	0.31	5.67	0.41	5.80	0.13	35.011	0.13	26.1	8.20	99.4
	150 S	0.1	0.12	0.10	BDL	2.05	0.33	6.86	0.45	6.96	0.14	35.004	0.05	26.1	8.20	99.9
	150 D	11.4	0.11	0.02	0.03	1.63	0.30	5.65	0.41	5.70	0.07	35.041	0.09	26.0	8.21	100.8
	200 S	0.1	0.04	0.07	0.05	1.97	0.26	5.11	0.30	5.23	0.10	35.006	0.06	26.2	8.20	100.0
	200 D	16.0	0.14	0.06	0.07	1.94	0.30	6.20	0.44	6.33	0.12	35.009	0.07	26.0	8.20	101.7
MAKENA 3-A	0 S	0.1	0.90	121.2	0.03	182.96	0.17	10.61	1.07	131.8	0.27	25.534	0.12	26.3	8.08	106.2
	2 S	0.1	2.21	38.62	3.53	58.58	0.25	64.38	2.46	106.5	0.16	32.269	0.15	26.1	8.23	106.4
	5 S	0.1	0.34	26.01	3.55	42.69	0.25	4.81	0.59	34.37	0.15	33.060	0.08	26.7	8.27	106.8
	5 D	1.0	0.21	11.80	0.20	21.35	0.29	7.24	0.50	19.24	0.15	34.128	0.08	27.0	8.30	106.6
	10 S	0.1	0.06	0.34	0.13	2.30	0.29	6.32	0.35	6.79	0.11	35.025	0.07	26.0	8.21	104.3
	10 D	1.8	0.06	0.32	0.04	2.50	0.22	6.15	0.28	6.51	0.09	34.992	0.09	26.0	8.17	95.8
	50 S	0.1	0.06	0.16	0.09	2.11	0.22	6.09	0.28	6.34	0.07	35.009	0.05	26.1	8.20	102.8
	50 D	4.3	0.09	0.37	0.05	2.49	0.28	7.81	0.37	8.23	0.08	34.984	0.10	26.0	8.17	94.7
	100 S	0.0	0.11	0.13	0.12	1.98	0.29	6.21	0.40	6.46	0.11	35.041	0.06	26.1	8.20	103.1
	100 D	5.0	0.14	0.02	0.10	1.75	0.28	5.82	0.42	5.94	0.08	35.017	0.09	26.0	8.21	103.0
	150 S	0.1	0.15	BDL	0.04	2.09	0.29	6.53	0.44	6.57	0.14	35.037	0.09	26.1	8.20	102.2
	150 D	11.5	0.15	0.01	0.07	3.79	0.29	6.05	0.44	6.13	0.12	34.950	0.07	26.0	8.21	103.8
MAKENA 3	0 S	0.1	0.08	11.40	0.14	20.98	0.19	7.96	0.27	19.50	0.34	34.283	0.12	27.3	8.28	103.8
	2 S	0.1	0.08	11.57	0.21	20.93	0.21	7.60	0.29	19.38	0.26	34.321	0.18	27.3	8.28	107.2
	5 S	0.1	0.17	6.29	0.06	12.42	0.28	7.32	0.45	13.67	0.23	34.643	0.13	27.3	8.28	114.5
	5 D	1.0	0.19	6.46	0.03	7.15	0.23	7.58	0.42	14.07	0.23	34.615	0.15	27.3	8.29	113.5
	10 S	0.1	0.10	0.36	0.11	2.02	0.19	5.76	0.29	6.23	0.09	35.019	0.07	26.1	8.19	94.9
	10 D	1.9	0.12	0.32	0.01	2.28	0.25	6.60	0.37	6.93	0.06	35.015	0.08	26.1	8.18	94.3
	50 S	0.1	0.11	0.23	0.05	2.15	0.25	6.13	0.36	6.41	0.06	35.014	0.05	26.1	8.17	94.9
	50 D	2.3	0.10	0.03	0.09	2.01	0.25	6.32	0.35	6.44	0.06	35.330	0.08	26.1	8.19	98.7
	100 S	0.1	0.13	0.16	0.11	2.13	0.26	5.49	0.39	5.76	0.05	35.014	0.06	26.1	8.19	100.9
	100 D	6.3	0.16	0.17	0.11	2.13	0.28	5.76	0.44	6.04	0.05	35.008	0.07	26.0	8.19	99.5
	150 S	0.1	0.08	0.02	0.12	2.20	0.28	7.76	0.36	7.90	0.13	35.031	0.10	26.1	8.20	102.4
	150 D	9.2	0.11	BDL	0.12	1.38	0.28	8.37	0.39	8.49	0.10	35.069	0.07	26.0	8.21	103.1
MAKENA 4	0 S	0.1	0.04	6.82	0.08	41.05	0.26	8.57	0.30	15.47	1.40	32.998	0.24	26.7	8.35	113.9
	2 S	0.1	0.20	7.39	0.05	41.66	0.28	6.59	0.48	14.03	0.58	32.986	0.19	26.6	8.34	113.4
	5 S	0.1	0.16	3.56	BDL	24.22	0.22	5.90	0.38	9.46	0.28	33.907	0.15	26.7	8.32	120.9
	5 D	1.0	0.17	2.98	0.01	20.93	0.21	6.52	0.38	9.51	0.26	34.095	0.27	26.6	8.32	108.2
	10 S	0.1	0.08	0.30	0.03	3.21	0.28	6.82	0.36	7.15	0.11	34.960	0.09	26.6	8.14	108.1
	10 D	2.0	0.10	0.17	BDL	3.26	0.26	6.25	0.36	6.42	0.24	34.962	0.07	26.6	8.13	122.7
	50 S	0.1	0.10	0.22	0.02	3.17	0.24	5.75	0.34	5.99	0.11	34.982	0.08	25.8	8.13	94.6
	50 D	4.4	0.12	0.23	0.05	3.09	0.24	5.51	0.36	5.79	0.14	35.000	0.10	25.8	8.14	90.8
	100 S	0.1	0.06	0.17	0.04	2.04	0.27	5.59	0.33	5.80	0.10	35.038	0.10	25.8	8.17	97.6
	100 D	6.4	0.09	0.14	0.04	2.35	0.27	5.81	0.36	5.99	0.09	35.021	0.08	25.9	8.17	90.5
	150 S	0.1	0.06	0.01	0.06	1.46	0.26	5.49	0.32	5.56	0.08	35.043	0.07	25.8	8.20	102.6
	150 D	7.7	0.06	0.01	0.03	1.92	0.27	5.45	0.33	5.49	0.08	35.038	0.06	26.0	8.19	99.9
DOH WQS	DRY	10%	0.71	0.36					0.96	12.86	0.50	*	0.50	**	***	****
		2%	1.43	0.64					1.45	17.86	1.00		1.00			
	WET	10%	1.00	0.61					1.29	17.85	1.25	*	0.90	**	***	****
		2%	1.78	1.07					1.93	25.00	2.00		1.75			

* Salinity shall not vary more than ten percent form natural or seasonal changes considering hydrologic input and oceanographic conditions.
** Temperature shall not vary by more than one degree C. from ambient conditions.
***pH shall not deviate more than 0.5 units from a value of 8.1.
****Dissolved Oxygen not to be below 75% saturation.

Exhibit A-2

TABLE 2. Water chemistry measurements from ocean water samples (in µg/L) collected in the vicinity of the Makena Resort on October 16, 2011. Abbreviations as follows: DFS=distance from shore; S=surface; D=deep; BDL=below detection limit. Also shown are the State of Hawaii, Department of Health (DOH) "not to exceed more than 10% of the time" and "not to exceed more than 2% of the time" water quality standards for open coastal waters under "dry" and "wet" conditions. Boxed values exceed DOH 10% "dry" standards; boxed and shaded values exceed DOH 10% "wet" standards. For sampling site locations, see Figure 1.

TRANSECT SITE	DFS (m)	DEPTH (m)	PO_4^{3-} (µg/L)	NO_3^- (µg/L)	NH_4^+ (µg/L)	Si (µg/L)	TOP (µg/L)	TON (µg/L)	TP (µg/L)	TN (µg/L)	TURB (NTU)	SALINITY (ppt)	CHL a (µg/L)	TEMP (deg.C)	pH (std.units)	O2 % Sat
MAKENA 1	0 S	0.1	1.24	250.0	1.40	1123	9.30	100.7	10.54	352.1	0.38	32.675	0.24	25.5	8.28	100.9
	2 S	0.1	2.17	56.42	9.10	362.5	9.61	83.02	11.78	148.5	0.21	34.351	0.33	26.7	8.33	117.6
	5 S	0.1	3.41	152.7	0.98	691.0	9.30	80.92	12.71	234.6	0.46	33.636	0.17	26.8	8.32	118.6
	5 D	1.0	3.10	171.1	0.84	758.1	9.61	78.96	12.71	250.9	0.44	33.488	0.57	26.7	8.33	116.4
	10 S	0.1	2.17	6.30	0.84	64.07	9.30	81.20	11.47	88.34	0.19	34.996	0.09	26.1	8.18	103.1
	10 D	1.7	2.17	2.24	0.98	54.23	9.61	78.26	11.78	81.48	0.12	35.009	0.04	26.0	8.18	100.7
	50 S	0.1	2.79	4.06	0.84	62.38	9.30	74.06	12.09	78.96	0.08	35.056	0.07	26.1	8.17	98.6
	50 D	4.4	2.48	0.70	0.42	50.58	10.23	77.00	12.71	78.12	0.08	35.122	0.07	26.0	8.20	101.6
	100 S	0.1	2.17	0.42	0.56	44.68	9.61	75.46	11.78	76.44	0.08	35.039	0.07	26.0	8.21	102.2
	100 D	6.2	2.17	0.42	0.70	49.74	9.61	84.14	11.78	85.26	0.09	35.037	0.10	26.0	8.21	103.2
	150 S	0.1	1.86	0.42	1.26	42.71	9.92	79.10	11.78	80.78	0.11	35.056	0.06	26.2	8.21	99.4
	150 D	11.7	2.48	0.28	1.12	42.15	9.61	78.26	12.09	79.66	0.12	35.038	0.07	25.9	8.21	103.5
MAKENA 2	0 S	0.1	4.65	28.70	2.38	362.5	9.61	76.86	14.26	107.9	0.44	34.435	0.18	26.6	8.27	99.6
	2 S	0.1	4.34	33.46	1.26	428.2	9.30	88.06	13.64	122.8	0.43	34.313	0.28	26.8	8.28	115.6
	5 S	0.1	3.72	34.72	0.70	368.7	8.99	76.44	12.71	111.9	0.18	34.445	0.17	26.9	8.25	116.9
	5 D	1.2	4.65	34.02	0.56	365.3	8.68	92.96	13.33	127.5	0.15	34.432	0.09	27.0	8.25	116.9
	10 S	0.1	3.10	4.62	0.84	61.26	9.30	75.74	12.40	81.20	0.10	34.994	0.13	26.0	8.18	100.5
	10 D	1.5	3.41	2.52	0.42	78.40	9.30	94.36	12.71	97.30	0.17	34.988	0.09	26.0	8.18	95.4
	50 S	0.1	1.86	1.12	0.42	53.95	9.92	117.5	11.78	119.0	0.10	35.008	0.08	26.1	8.18	97.5
	50 D	2.8	3.72	1.40	0.28	85.99	9.92	84.56	13.64	86.24	0.15	34.976	0.09	26.0	8.19	94.8
	100 S	0.1	2.17	0.84	1.68	55.08	9.92	72.10	12.09	74.62	0.10	35.013	0.06	26.1	8.20	99.8
	100 D	4.7	3.10	1.26	0.56	62.38	9.61	79.38	12.71	81.20	0.13	35.011	0.13	26.1	8.20	99.4
	150 S	0.1	3.72	1.40	BDL	57.61	10.23	96.04	13.95	97.44	0.14	35.004	0.05	26.1	8.20	99.9
	150 D	11.4	3.41	0.28	0.42	45.80	9.30	79.10	12.71	79.80	0.07	35.041	0.09	26.0	8.21	100.8
	200 S	0.1	1.24	0.98	0.70	55.36	8.06	71.54	9.30	73.22	0.10	35.006	0.06	26.2	8.20	100.0
	200 D	16.0	4.34	0.84	0.98	54.51	9.30	86.80	13.64	88.62	0.12	35.009	0.07	26.0	8.20	101.7
MAKENA 3-A	0 S	0.1	27.90	1696.4	0.42	5141	5.27	148.5	33.17	1845	0.27	25.534	0.12	26.3	8.08	106.2
	2 S	0.1	68.51	540.7	49.44	1646	7.75	901.3	76.26	1491	0.16	32.269	0.15	26.1	8.23	106.4
	5 S	0.1	10.54	364.1	49.72	1200	7.75	67.34	18.29	481.2	0.15	33.060	0.08	26.7	8.27	106.8
	5 D	1.0	6.51	165.2	2.80	599.9	8.99	101.4	15.50	269.4	0.15	34.128	0.08	27.0	8.30	106.6
	10 S	0.1	1.86	4.76	1.82	64.63	8.99	88.48	10.85	95.06	0.11	35.025	0.07	26.0	8.21	104.3
	10 D	1.8	1.86	4.48	0.56	70.25	6.82	86.10	8.68	91.14	0.09	34.992	0.09	26.0	8.17	95.8
	50 S	0.1	1.86	2.24	1.26	59.29	6.82	85.26	8.68	88.76	0.07	35.009	0.05	26.1	8.20	102.8
	50 D	4.3	2.79	5.18	0.70	69.97	8.68	109.3	11.47	115.2	0.08	34.984	0.10	26.0	8.17	94.7
	100 S	0.0	3.41	1.82	1.68	55.64	8.99	86.94	12.40	90.44	0.11	35.041	0.06	26.1	8.20	103.1
	100 D	5.0	4.34	0.28	1.40	49.18	8.68	81.48	13.02	83.16	0.08	35.017	0.09	26.0	8.21	103.0
	150 S	0.1	4.65	BDL	0.56	58.73	8.99	91.42	13.64	91.98	0.14	35.037	0.09	26.1	8.20	102.2
	150 D	11.5	4.65	0.14	0.98	106.5	8.99	84.70	13.64	85.82	0.12	34.950	0.07	26.0	8.21	103.8
MAKENA 3	0 S	0.1	2.48	159.6	1.96	589.5	5.89	111.4	8.37	273.0	0.34	34.283	0.12	27.3	8.28	103.8
	2 S	0.1	2.48	162.0	2.94	588.1	6.51	106.4	8.99	271.3	0.26	34.321	0.18	27.3	8.28	107.2
	5 S	0.1	5.27	88.06	0.84	349.0	8.68	102.5	13.95	191.4	0.23	34.643	0.13	27.3	8.28	114.5
	5 D	1.0	5.89	90.44	0.42	200.9	7.13	106.1	13.02	197.0	0.23	34.615	0.15	27.3	8.29	113.5
	10 S	0.1	3.10	5.04	1.54	56.76	5.89	80.64	8.99	87.22	0.09	35.019	0.07	26.1	8.19	94.9
	10 D	1.9	3.72	4.48	0.14	64.07	7.75	92.40	11.47	97.02	0.06	35.015	0.08	26.1	8.18	94.3
	50 S	0.1	3.41	3.22	0.70	60.42	7.75	85.82	11.16	89.74	0.06	35.014	0.05	26.1	8.17	94.9
	50 D	2.3	3.10	0.42	1.26	56.48	7.75	88.48	10.85	90.16	0.06	35.330	0.08	26.1	8.19	98.7
	100 S	0.1	4.03	2.24	1.54	59.85	8.06	76.86	12.09	80.64	0.05	35.014	0.06	26.1	8.19	100.9
	100 D	6.3	4.96	2.38	1.54	59.85	8.68	80.64	13.64	84.56	0.05	35.008	0.07	26.0	8.19	99.5
	150 S	0.1	2.48	0.28	1.68	61.82	8.68	108.6	11.16	110.6	0.13	35.031	0.10	26.1	8.20	102.4
	150 D	9.2	3.41	BDL	1.68	38.78	8.68	117.2	12.09	118.9	0.10	35.069	0.07	26.0	8.21	103.1
MAKENA 4	0 S	0.1	1.24	95.48	1.12	1154	8.06	120.0	9.30	216.6	1.40	32.998	0.24	26.7	8.35	113.9
	2 S	0.1	6.20	103.5	0.70	1171	8.68	92.26	14.88	196.4	0.58	32.986	0.19	26.6	8.34	113.4
	5 S	0.1	4.96	49.84	BDL	680.6	6.82	82.60	11.78	132.4	0.28	33.907	0.15	26.7	8.32	120.9
	5 D	1.0	5.27	41.72	0.14	588.1	6.51	91.28	11.78	133.1	0.26	34.095	0.27	26.6	8.32	108.2
	10 S	0.1	2.48	4.20	0.42	90.20	8.68	95.48	11.16	100.1	0.11	34.960	0.09	26.6	8.14	108.1
	10 D	2.0	3.10	2.38	BDL	91.61	8.06	87.50	11.16	89.88	0.24	34.962	0.07	26.6	8.13	122.7
	50 S	0.1	3.10	3.08	0.28	89.08	7.44	80.50	10.54	83.86	0.11	34.982	0.08	25.8	8.13	94.6
	50 D	4.4	3.72	3.22	0.70	86.83	7.44	77.14	11.16	81.06	0.14	35.000	0.10	25.8	8.14	90.8
	100 S	0.1	1.86	2.38	0.56	57.32	8.37	78.26	10.23	81.20	0.10	35.038	0.10	25.8	8.17	97.6
	100 D	6.4	2.79	1.96	0.56	66.04	8.37	81.34	11.16	83.86	0.09	35.021	0.08	25.9	8.17	90.5
	150 S	0.1	1.86	0.14	0.84	41.03	8.06	76.86	9.92	77.84	0.08	35.043	0.07	25.8	8.20	102.6
	150 D	7.7	1.86	0.14	0.42	53.95	8.37	76.30	10.23	76.86	0.08	35.038	0.06	26.0	8.19	99.9
DOH WQS		DRY	10%	10.00	5.00				30.00	180.00	0.50	*	0.50	**	***	****
			2%	20.00	9.00				45.00	250.00	1.00		1.00			
		WET	10%	14.00	8.50				40.00	250.00	1.25	*	0.90	**	***	****
			2%	25.00	15.00				60.00	350.00	2.00		1.75			

* Salinity shall not vary more than ten percent form natural or seasonal changes considering hydrologic input and oceanographic conditions.

** Temperature shall not vary by more than one degree C. from ambient conditions.

***pH shall not deviate more than 0.5 units from a value of 8.1.

****Dissolved Oxygen not to be below 75% saturation.

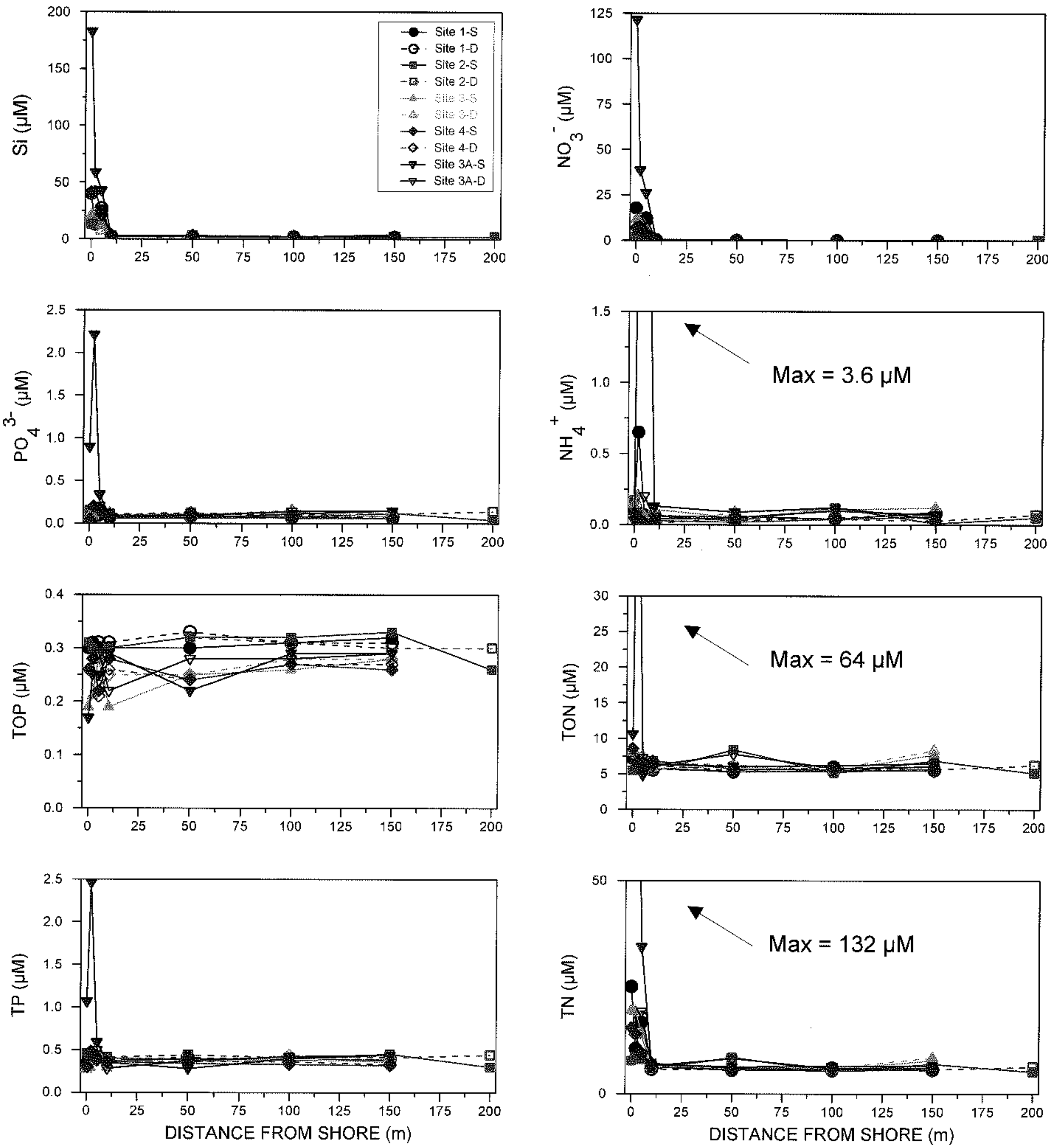


FIGURE 2. Plots of dissolved nutrients in surface (S) and deep (D) samples collected on October 16, 2011 as a function of distance from the shoreline in the vicinity of Makena Resort. For site locations, see Figure 1.

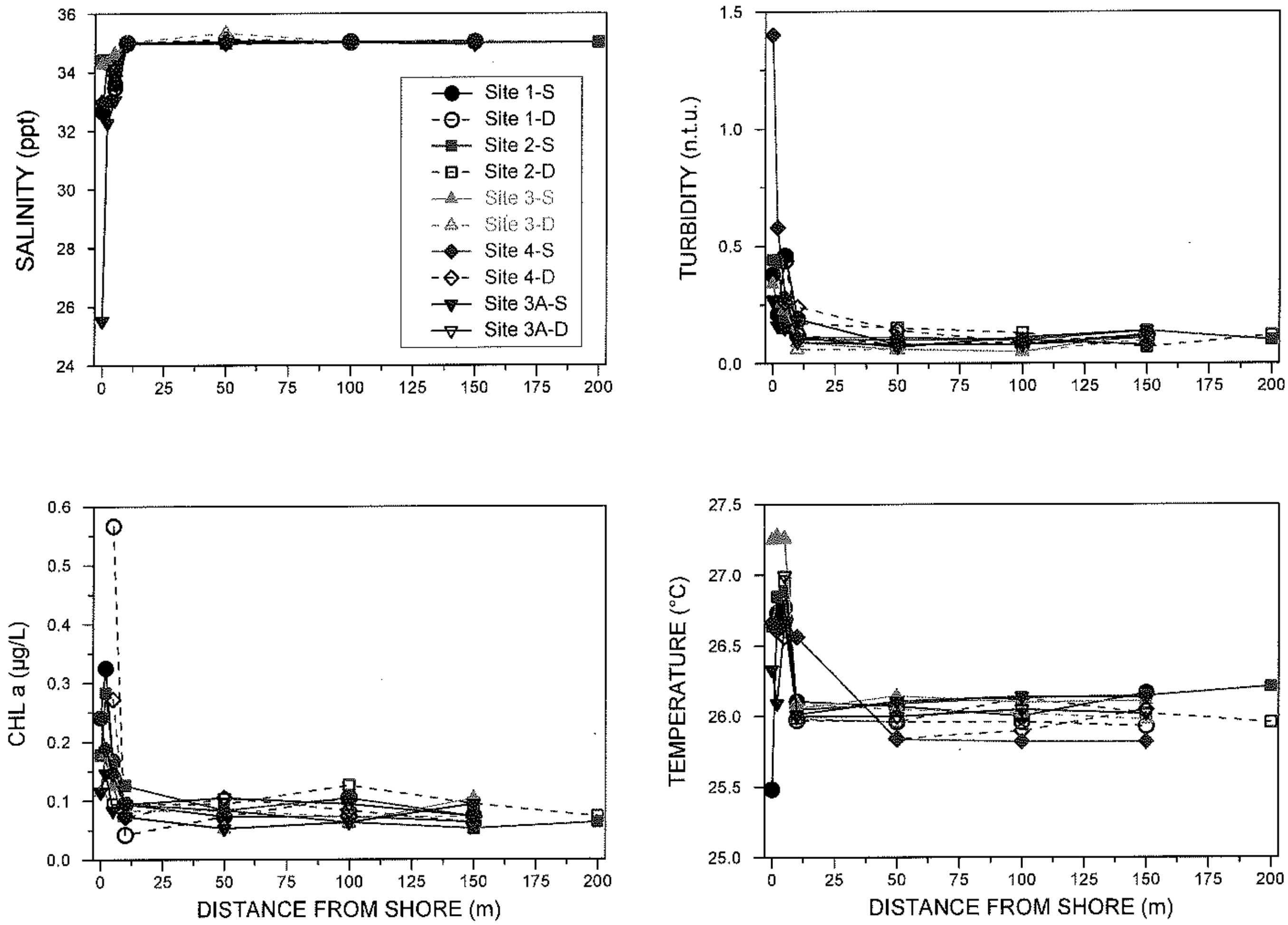


FIGURE 3. Plots of water chemistry constituents in surface (S) and deep (D) samples collected on October 16, 2011 as a function of distance from the shoreline in the vicinity of Makena Resort. For site locations, see Figure 1.

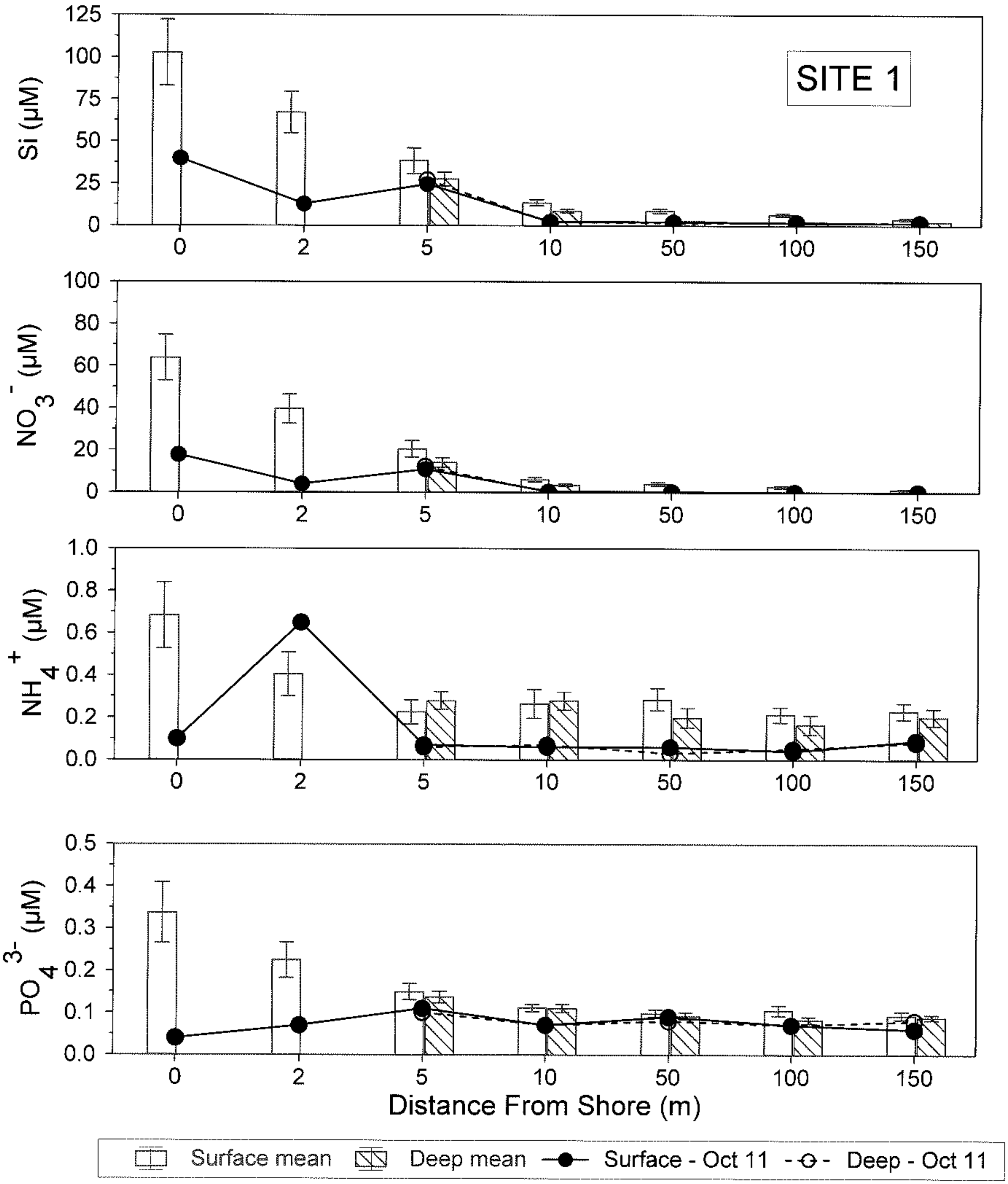


FIGURE 4. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 1, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=26). Error bars represent standard error of the mean. For site location, see Figure 1.

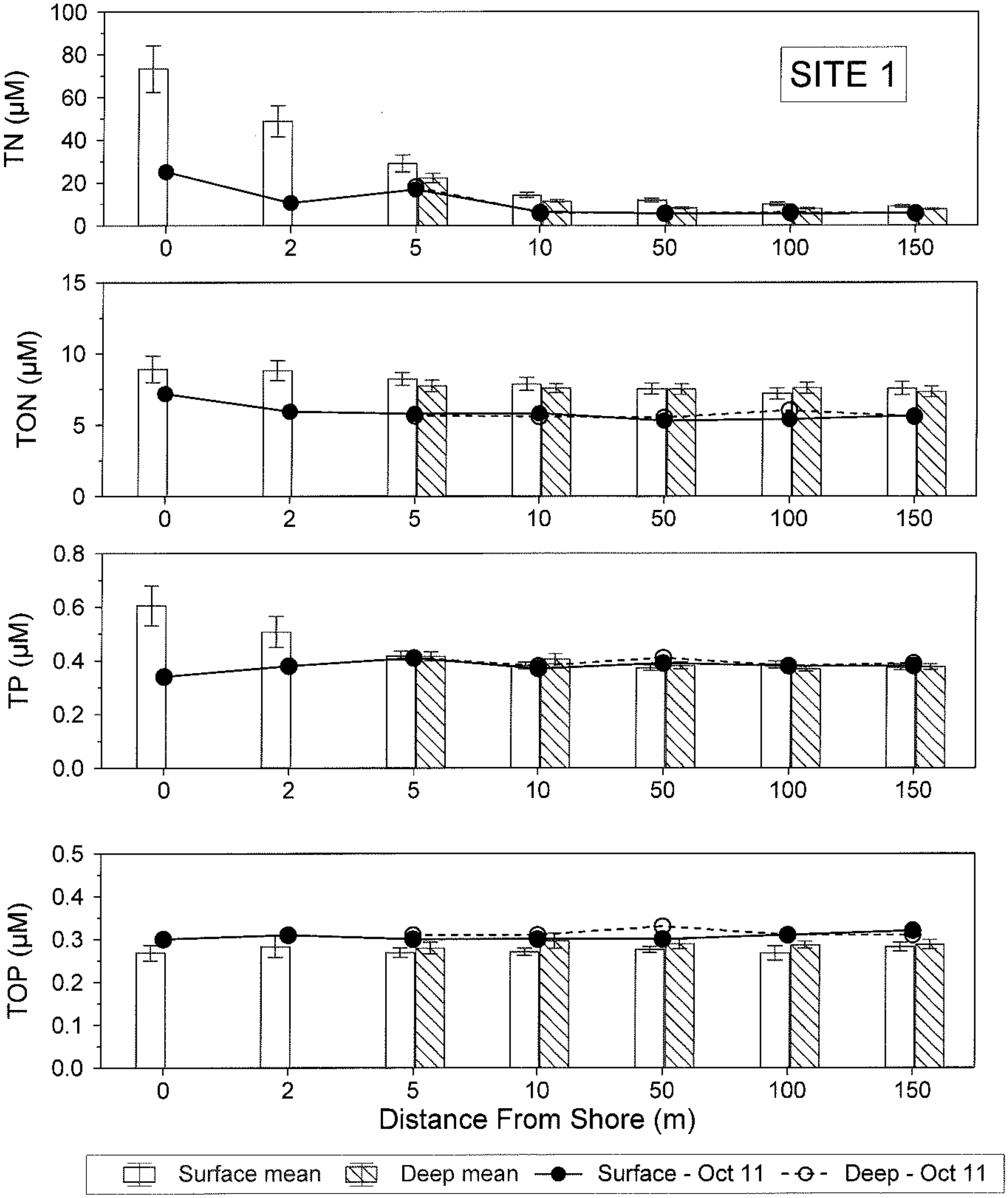


FIGURE 5. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 1, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=26). Error bars represent standard error of the mean. For site location, see Figure 1.

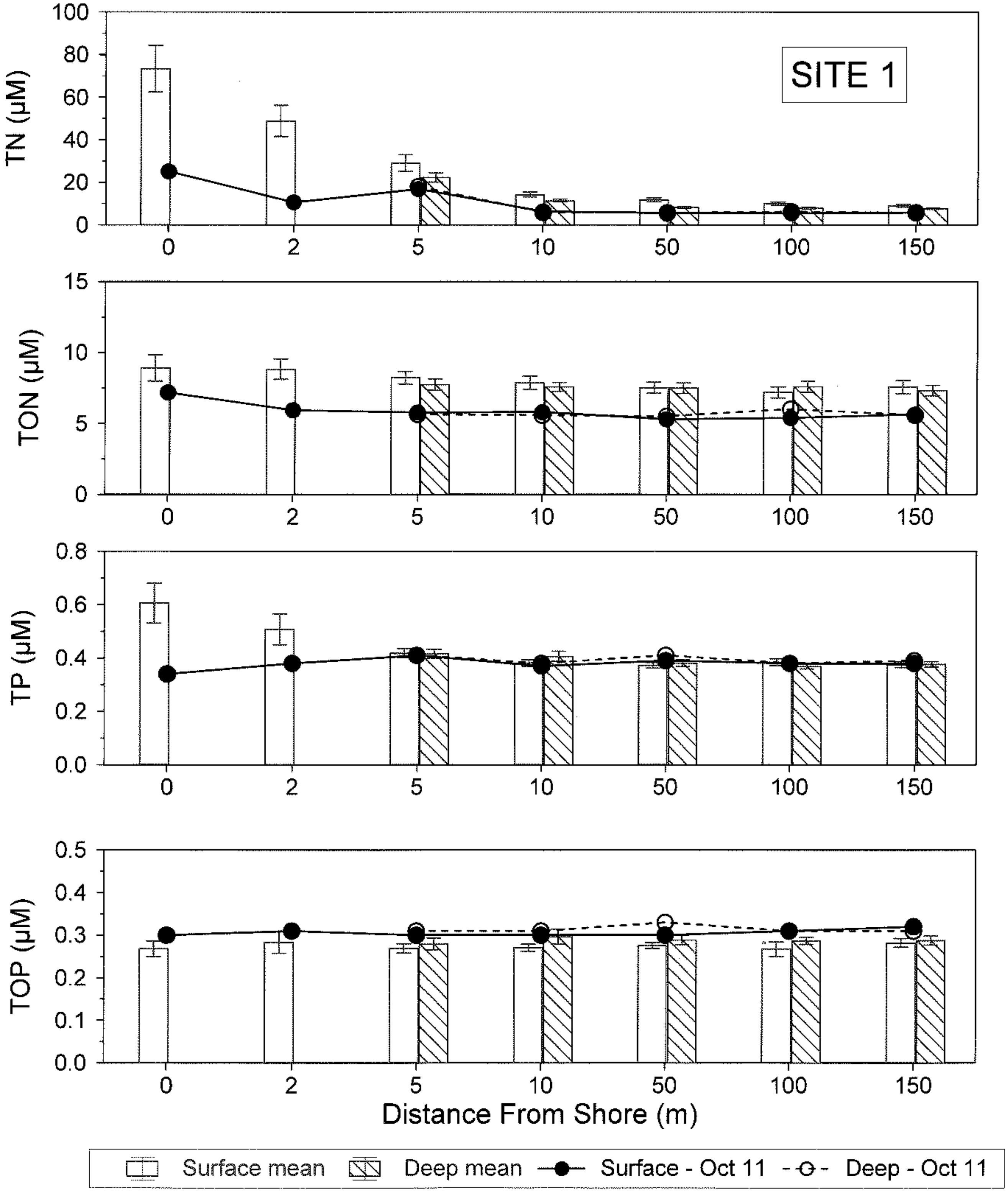


FIGURE 5. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 1, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=26). Error bars represent standard error of the mean. For site location, see Figure 1.

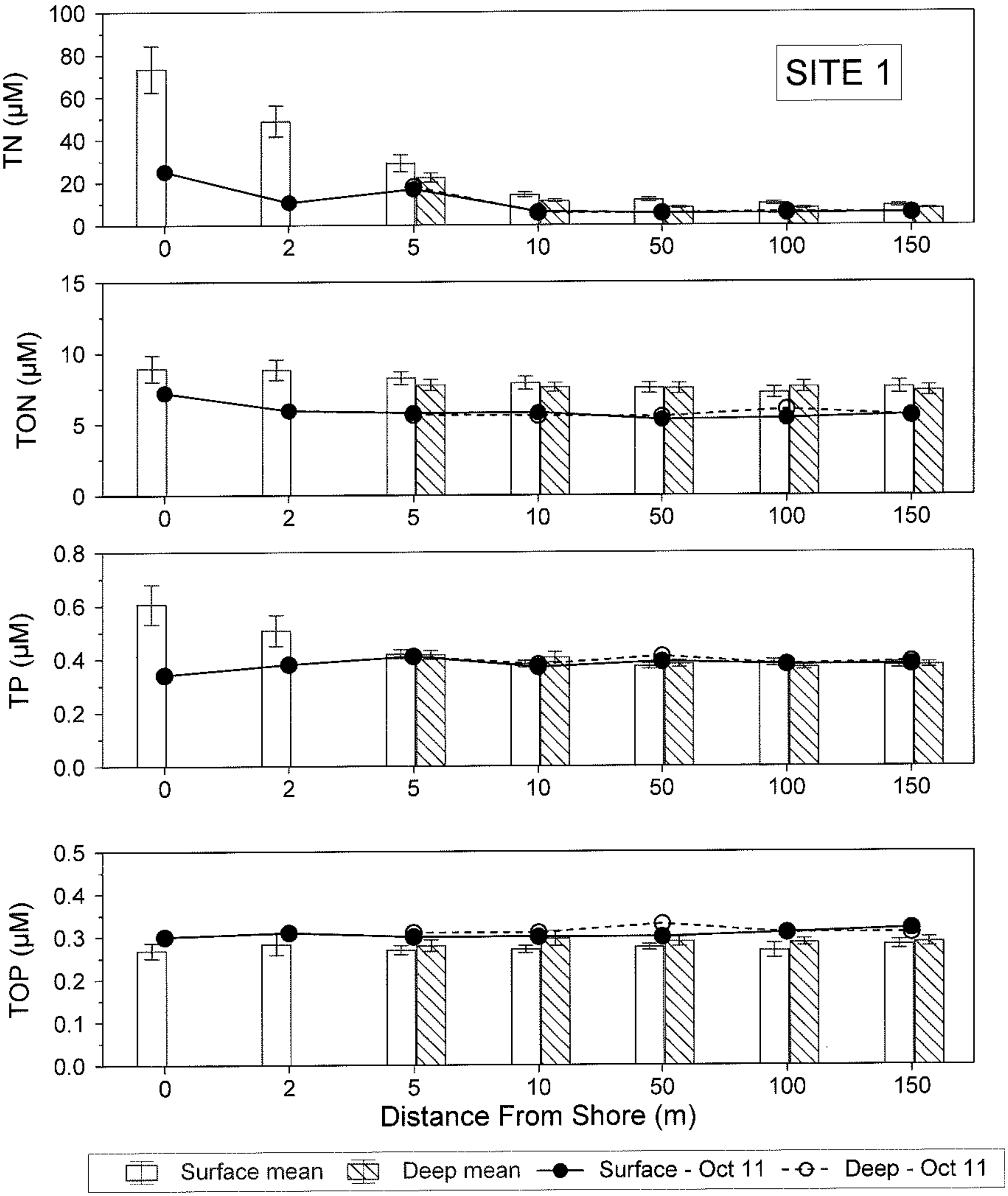


FIGURE 5. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 1, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=26). Error bars represent standard error of the mean. For site location, see Figure 1.

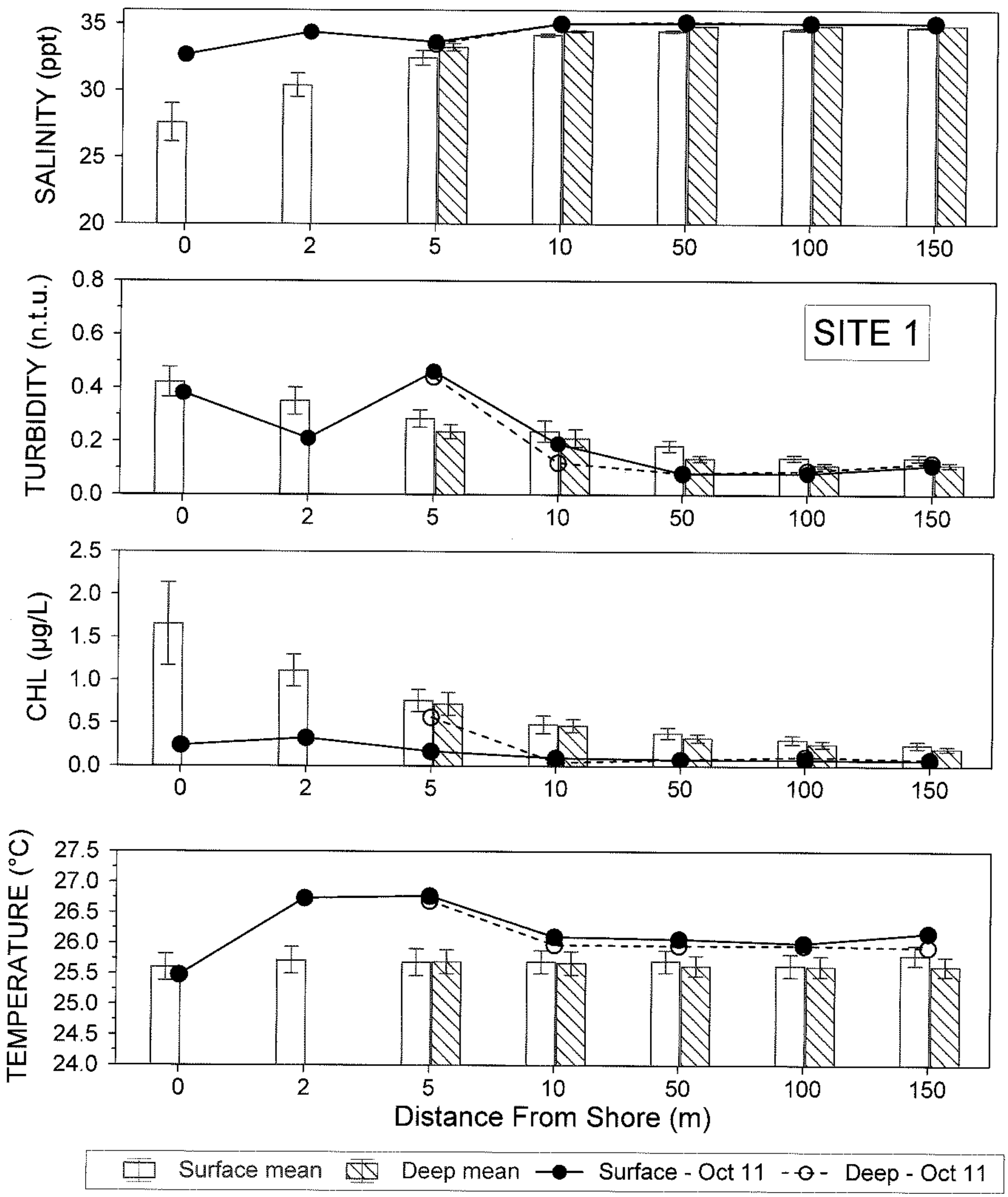


FIGURE 6. Plots of water chemistry constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 1, offshore of the Makena Resort. Data points and connected lines from samples collected during the most survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=26). Error bars represent standard error of the mean. For site location, see Figure 1.

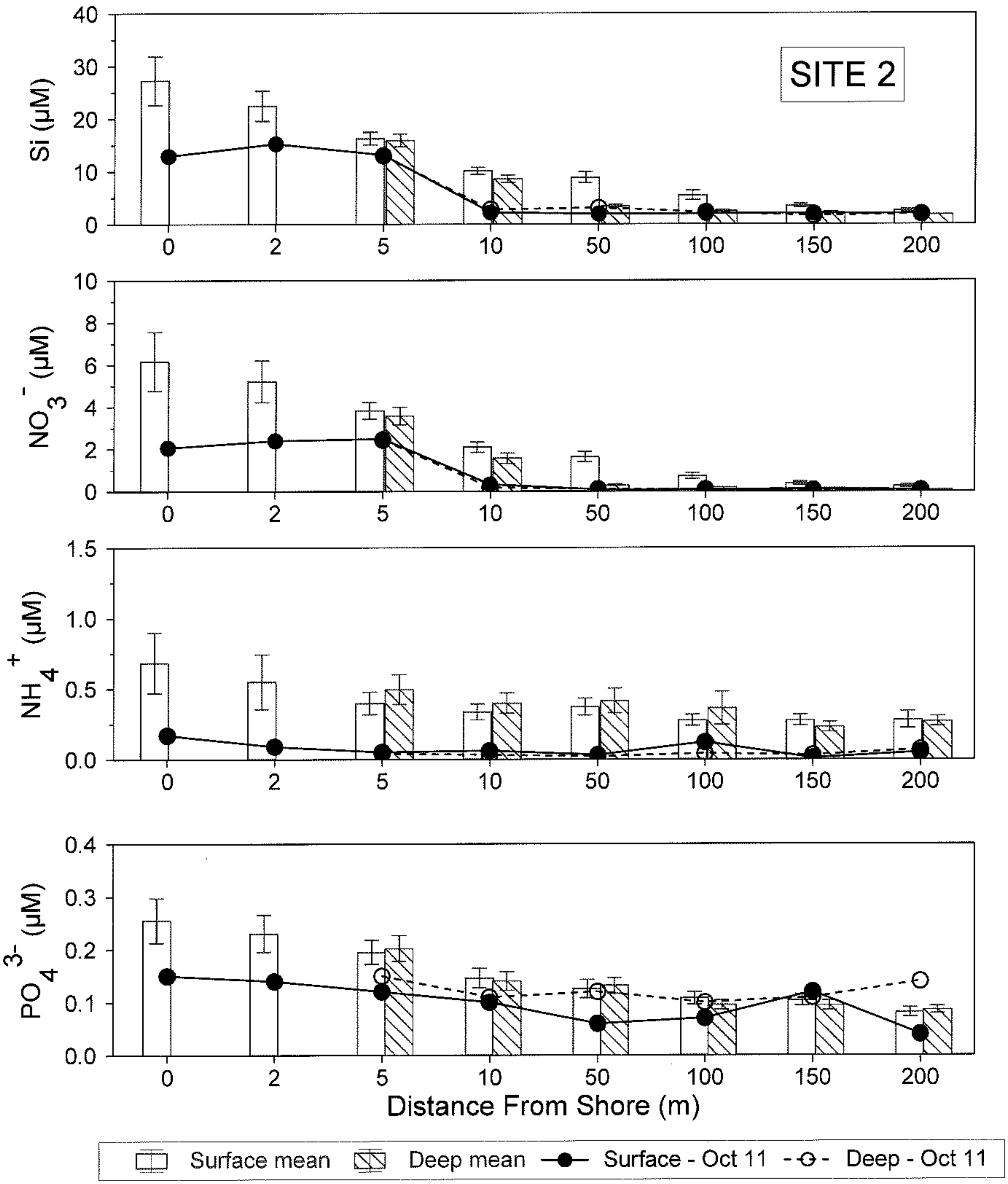


FIGURE 7. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 2, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=26). Error bars represent standard error of the mean. For site location, see Figure 1.

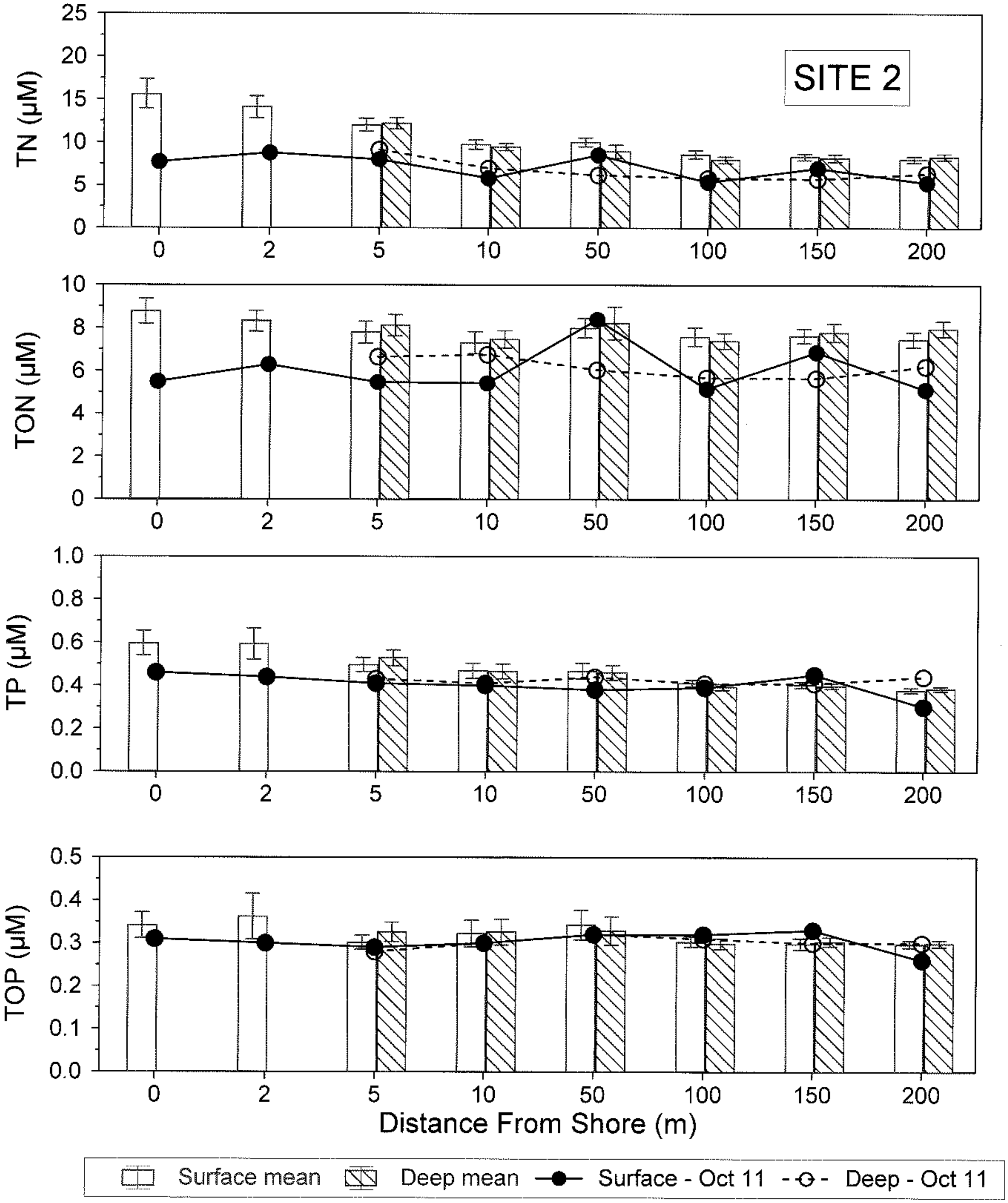


FIGURE 8. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 2, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=26). Error bars represent standard error of the mean. For site location, see Figure 1.

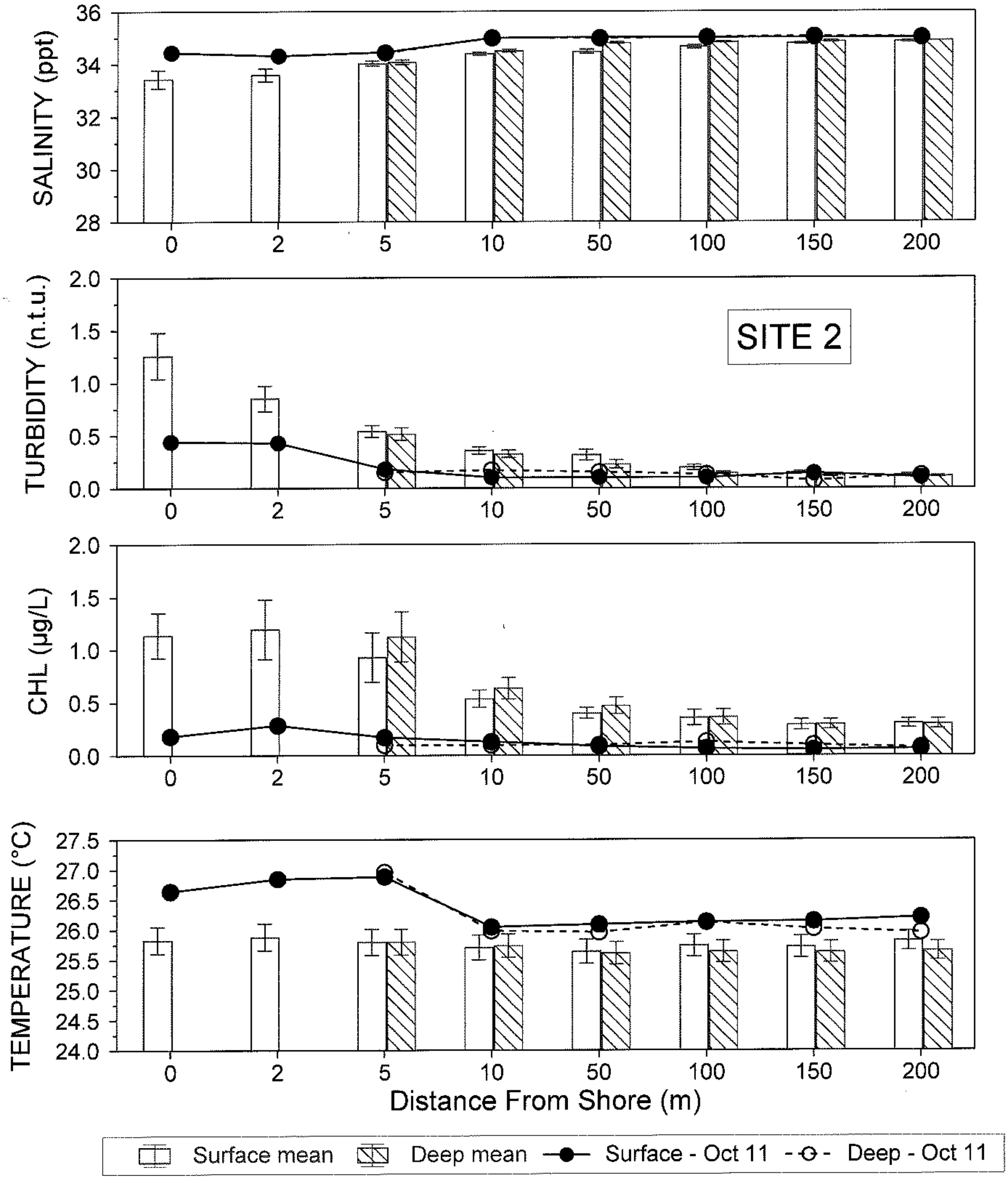


FIGURE 9. Plots of water chemistry constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 2, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey,bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=26). Error bars represent standard error of the mean. For site location, see Figure 1.

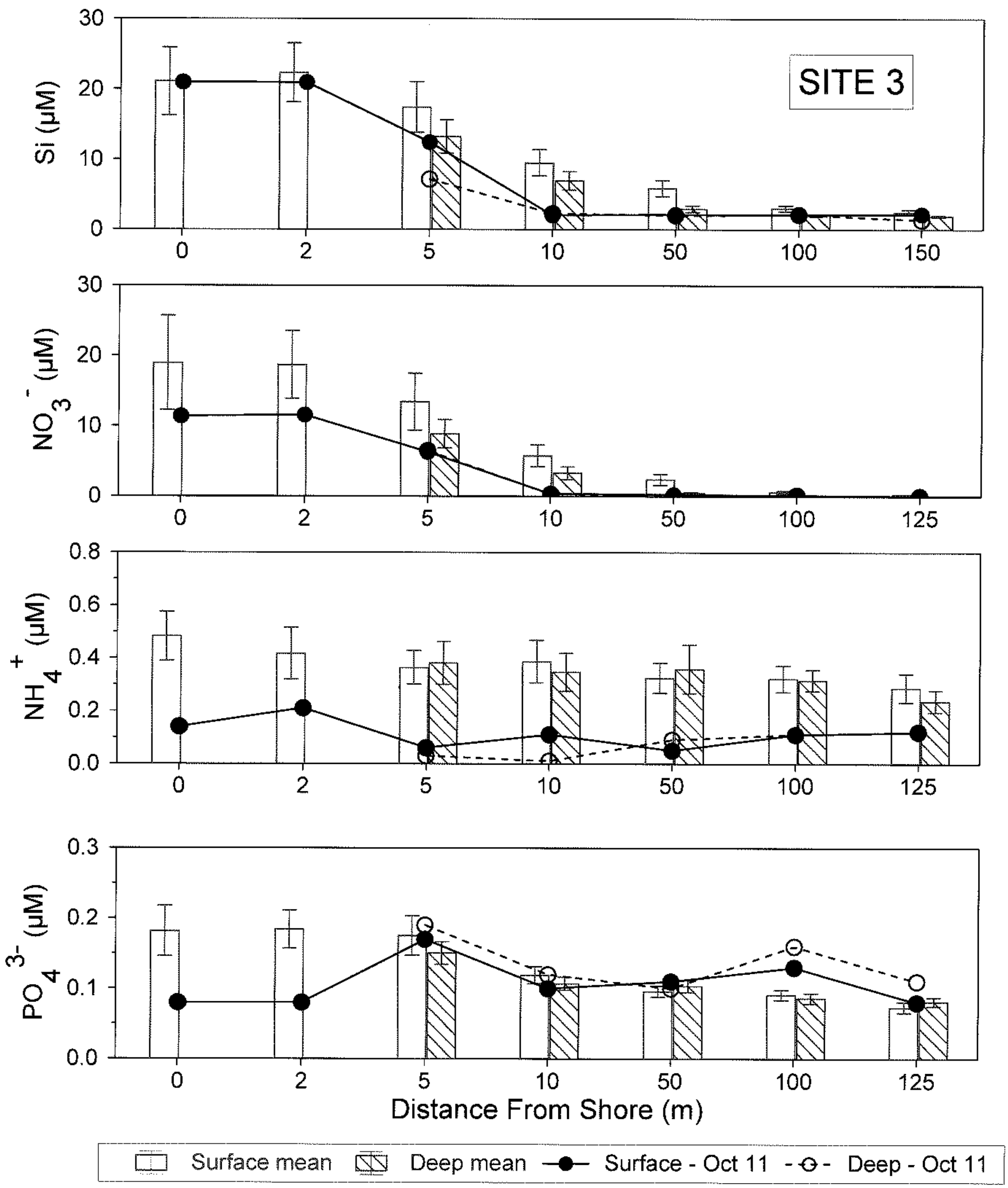


FIGURE 10. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 3, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=26). Error bars represent standard error of the mean. For site location, see Figure 1.

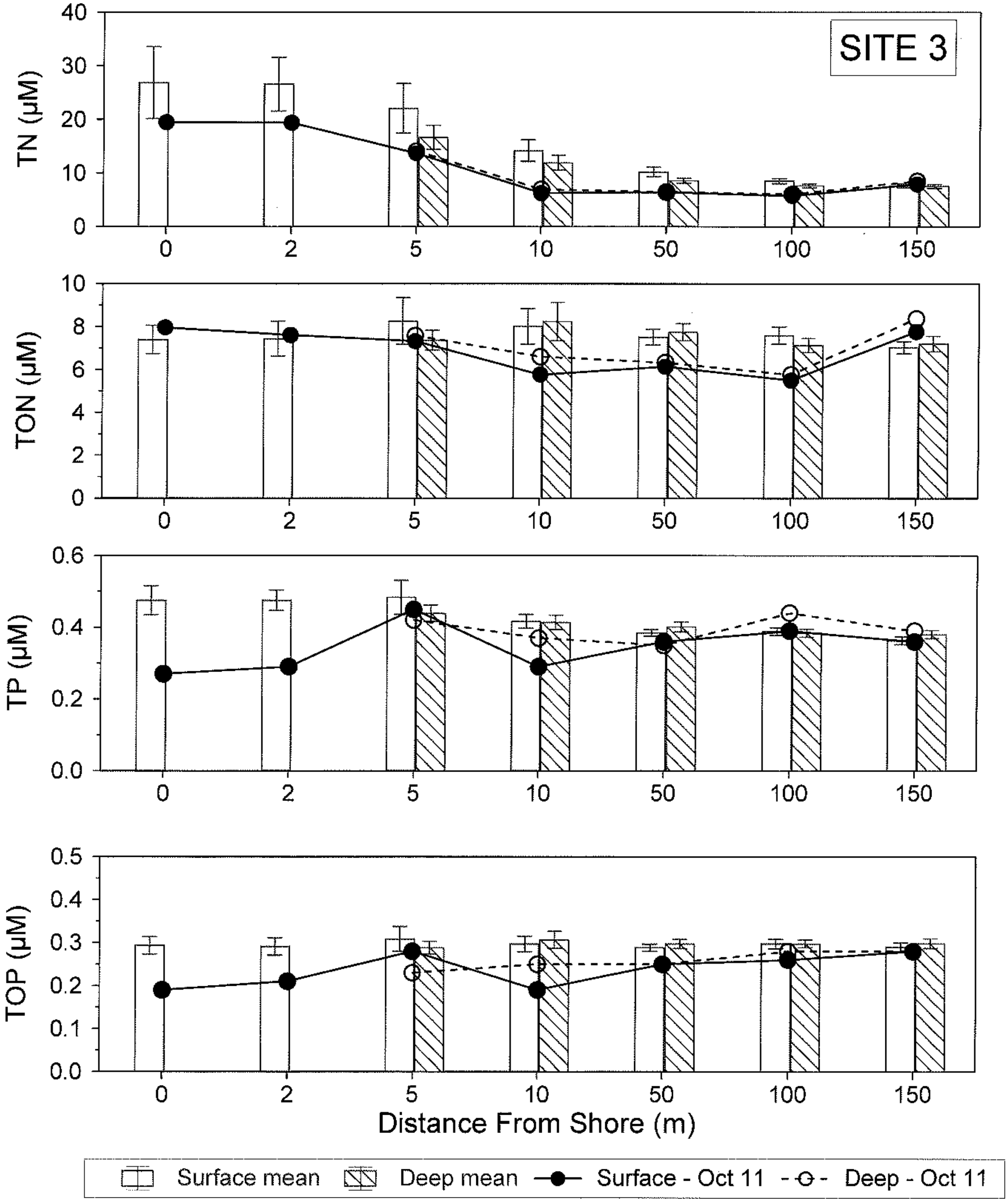


FIGURE 11. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 3, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=26). Error bars represent standard error of the mean. For site location, see Figure 1.

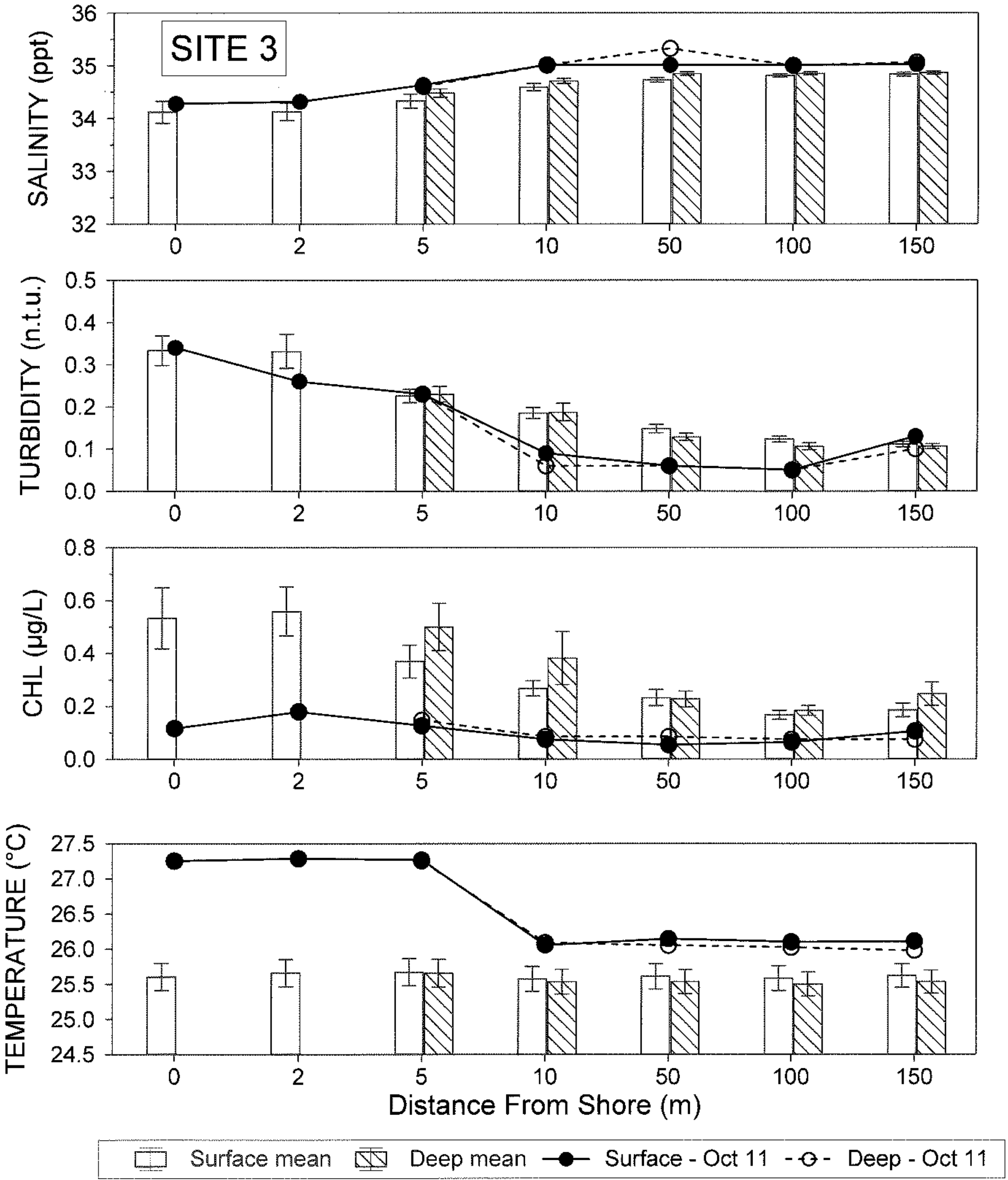


FIGURE 12. Plots of water chemistry constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 3, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=26). Error bars represent standard error of the mean. For site location, see Figure 1.

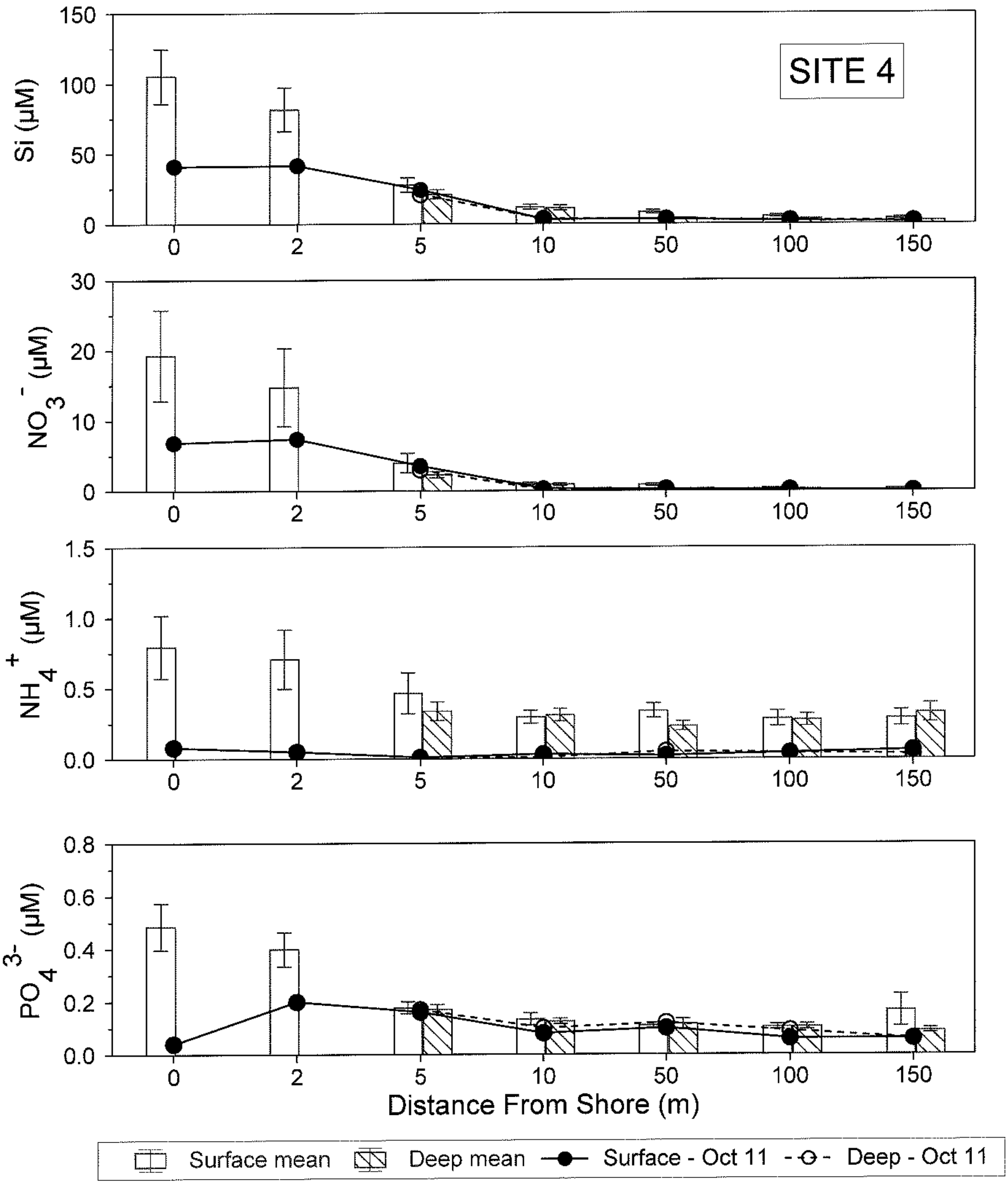


FIGURE 13. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 4, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=26). Error bars represent standard error of the mean. For site location, see Figure 1.

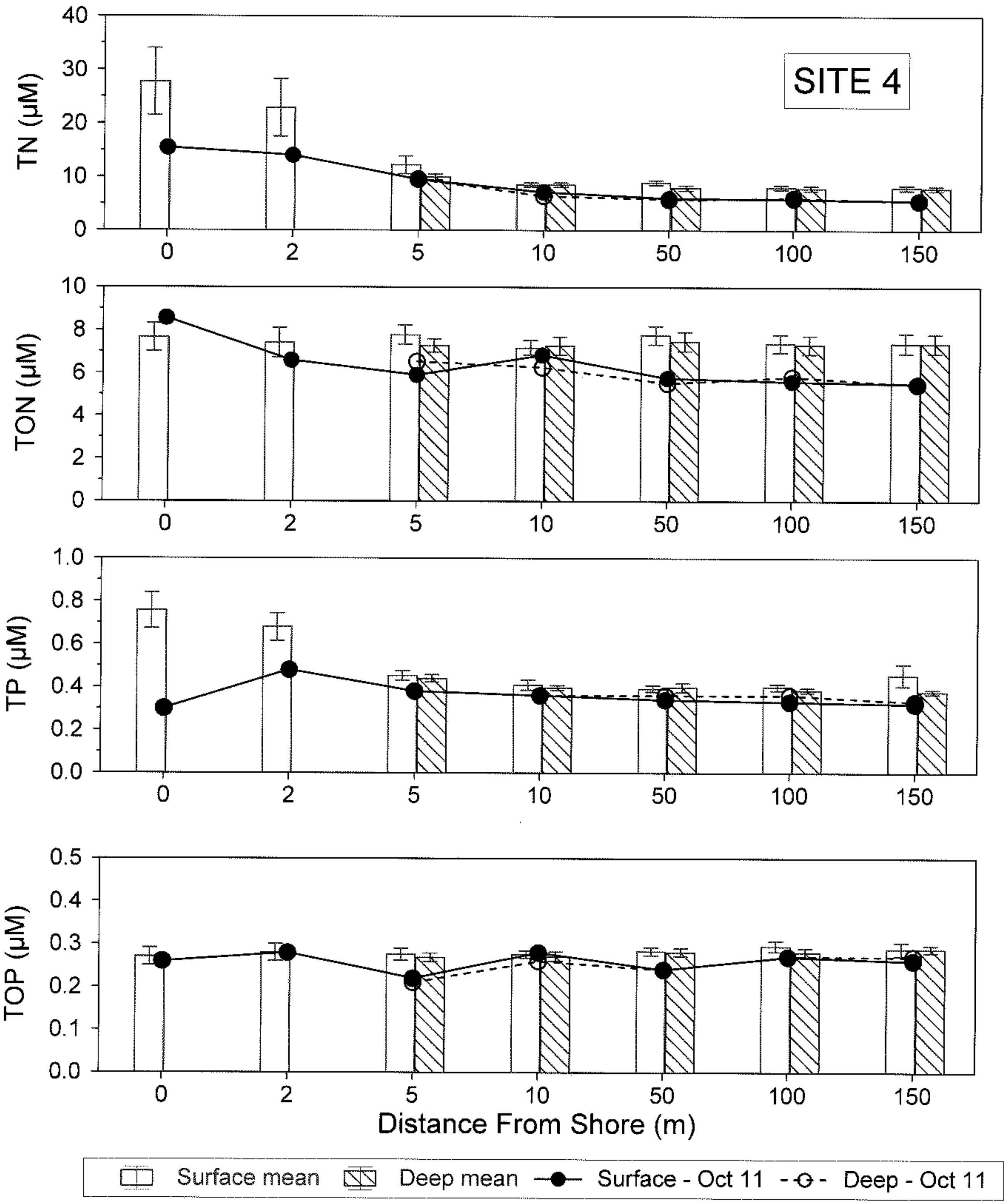


FIGURE 14. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 4, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=26). Error bars represent standard error of the mean. For site location, see Figure 1.

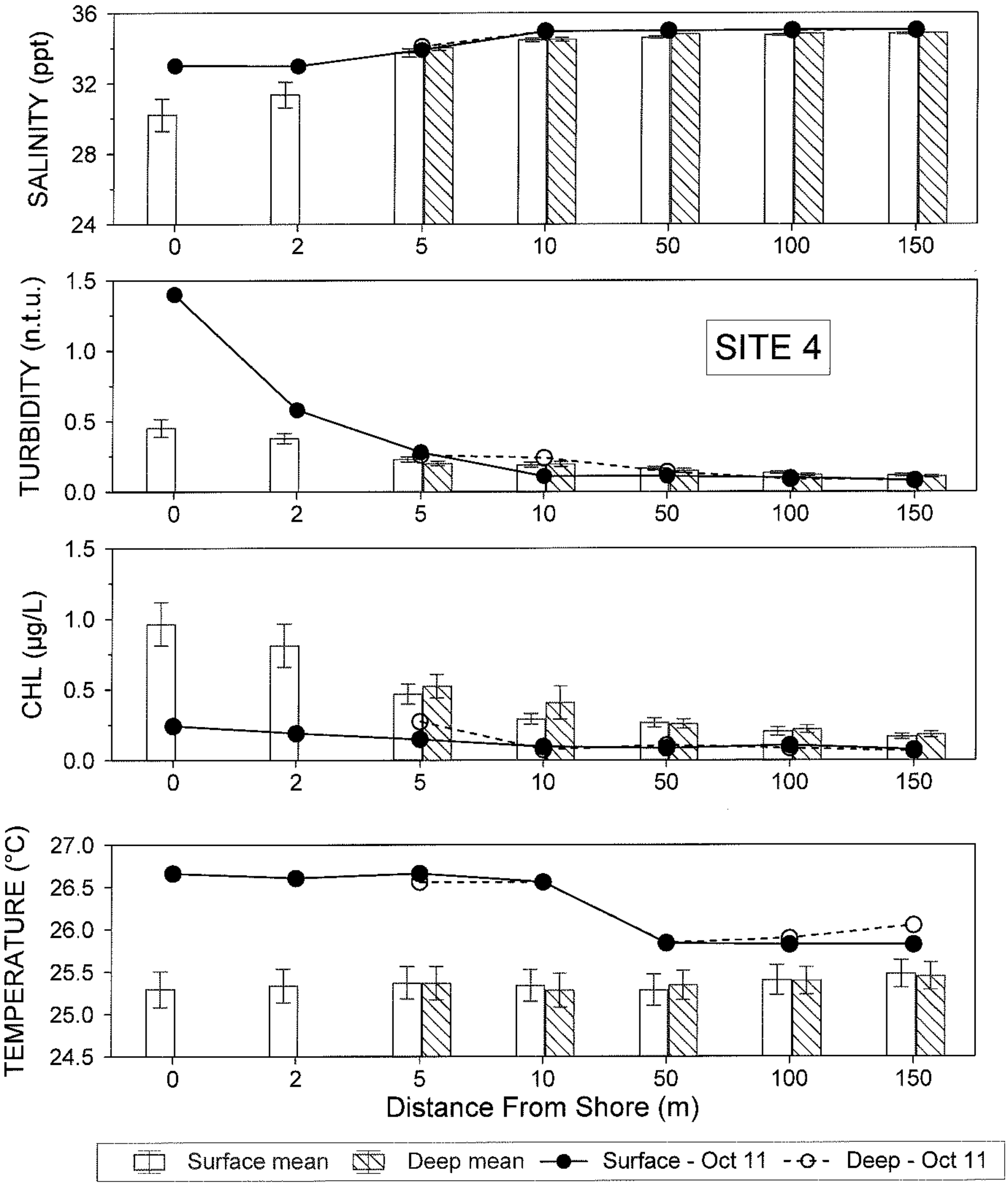


FIGURE 15. Plots of water chemistry constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 4, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=26). Error bars represent standard error of the mean. For site location, see Figure 1.

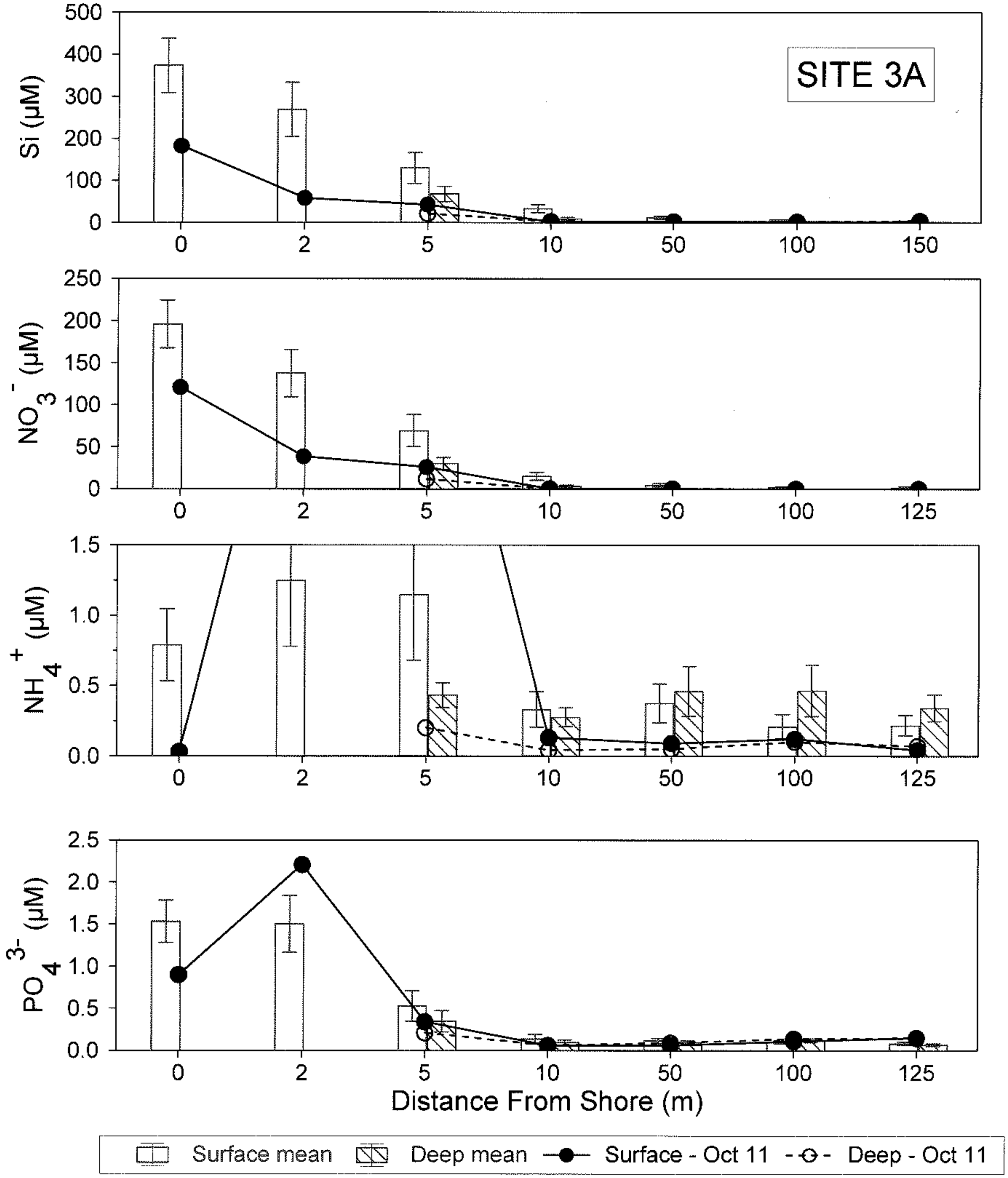


FIGURE 16. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 3A, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since June 2007 (N=8). Error bars represent standard error of the mean. For site location, see Figure 1.

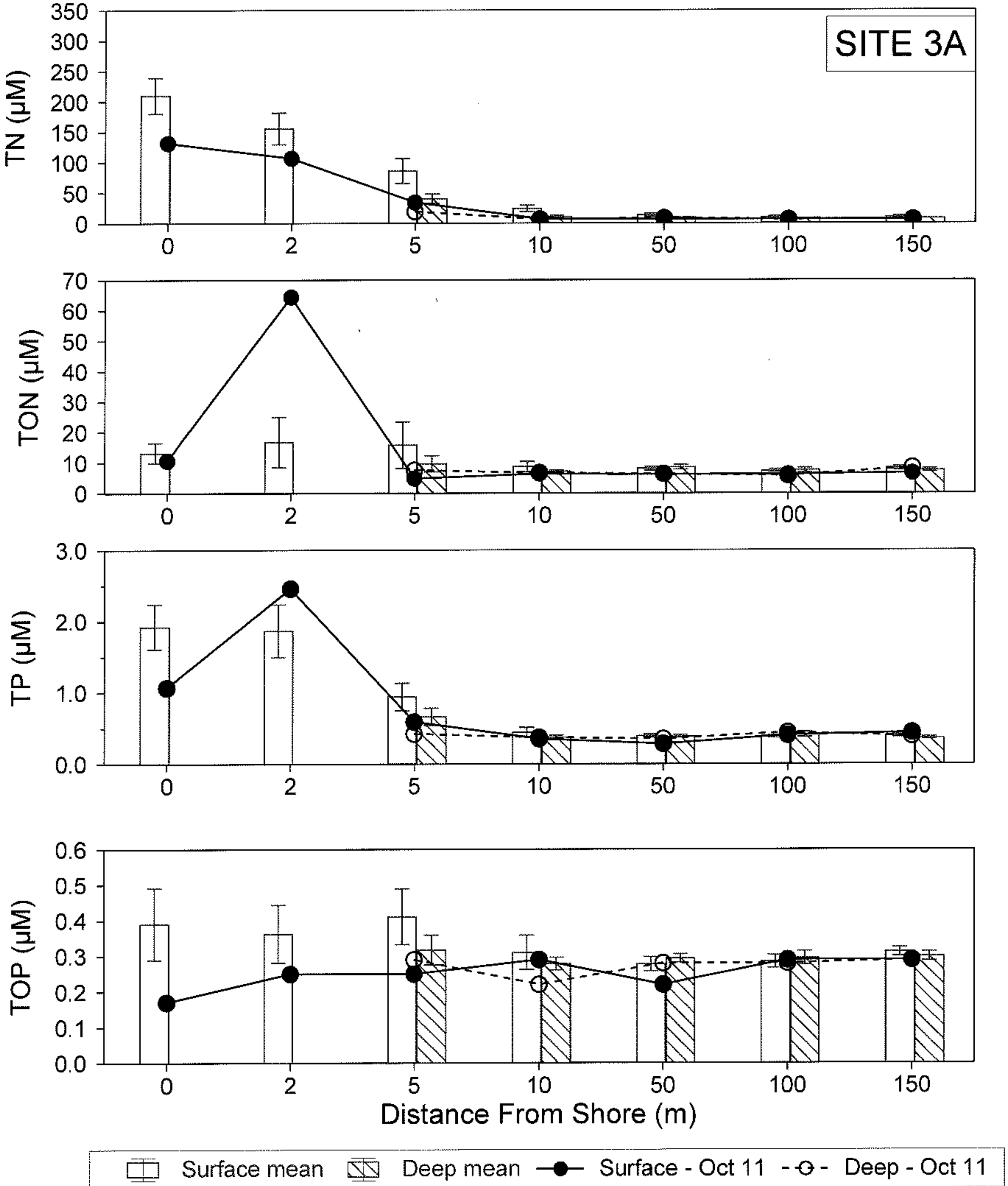


FIGURE 17. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 3A, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since June 2007 (N=8). Error bars represent standard error of the mean. For site location, see Figure 1.

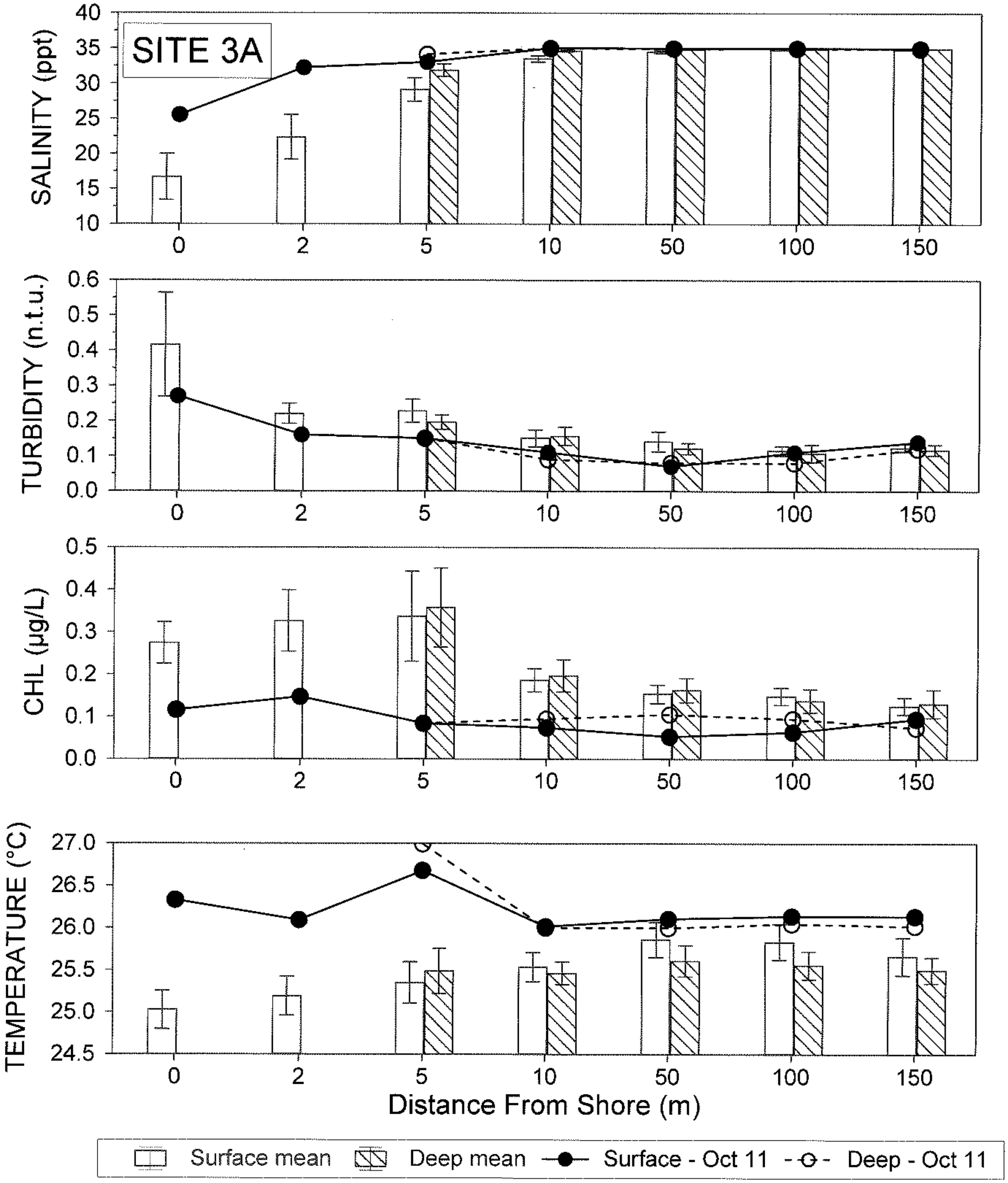


FIGURE 18. Plots of water chemistry constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 3A, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since June 2007 (N=8). Error bars represent standard error of the mean. For site location, see Figure 1.

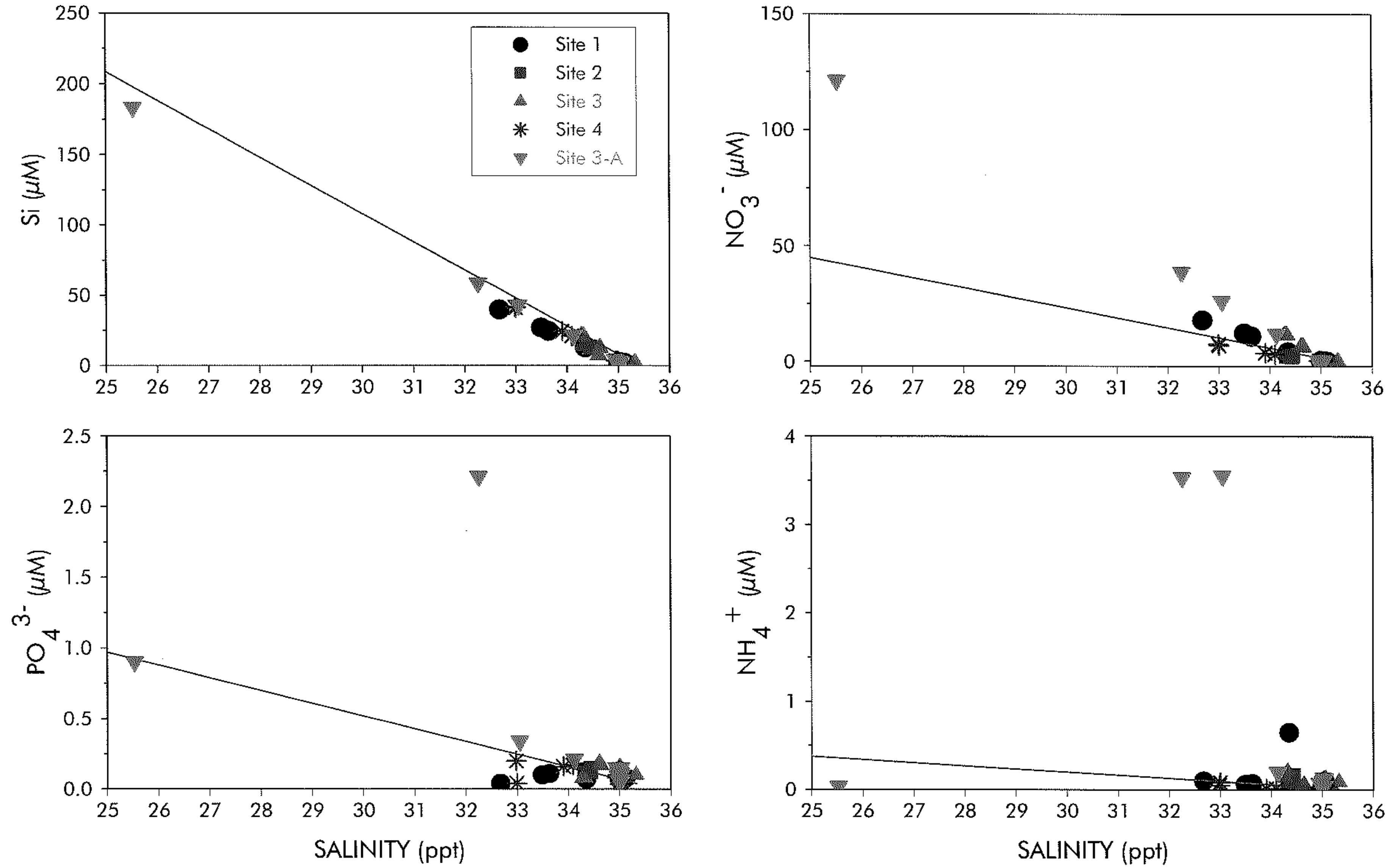
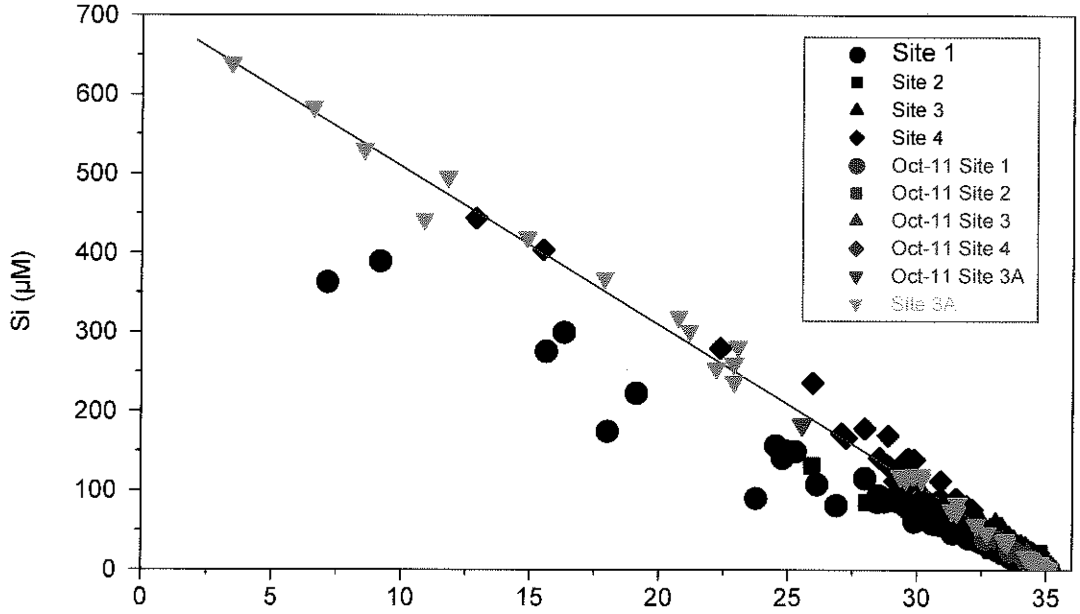


FIGURE 19. Mixing diagram showing concentration of dissolved nutrients from samples collected offshore of the Makena Resort on October 16, 2011 as functions of salinity. Solid red line in each plot is conservative mixing line constructed by connecting the concentrations in open coastal water with water from an irrigation well upslope of the Makena Golf Courses. For sampling site locations, see Figure 1.



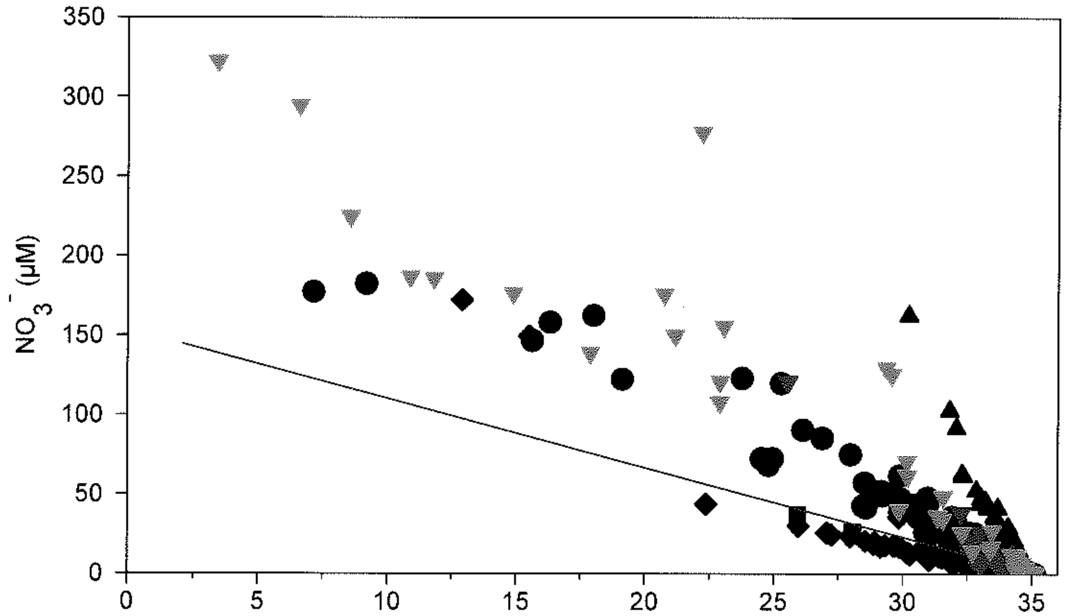


FIGURE 20. Silicate and nitrate, plotted as a function of salinity for surface samples collected since August 1995 at four sites offshore of the Makena Golf Course. Black symbols represent combined data from surveys conducted between August 1995 and March 2011. Green symbols represent data from surveys at Site 3A commencing in June 2007. Red symbols are data from most recent survey. Solid red line in each plot is conservative mixing line constructed by connecting the concentrations in open coastal water with water from golf course irrigation well #4. For sampling site locations, see Figure 1.

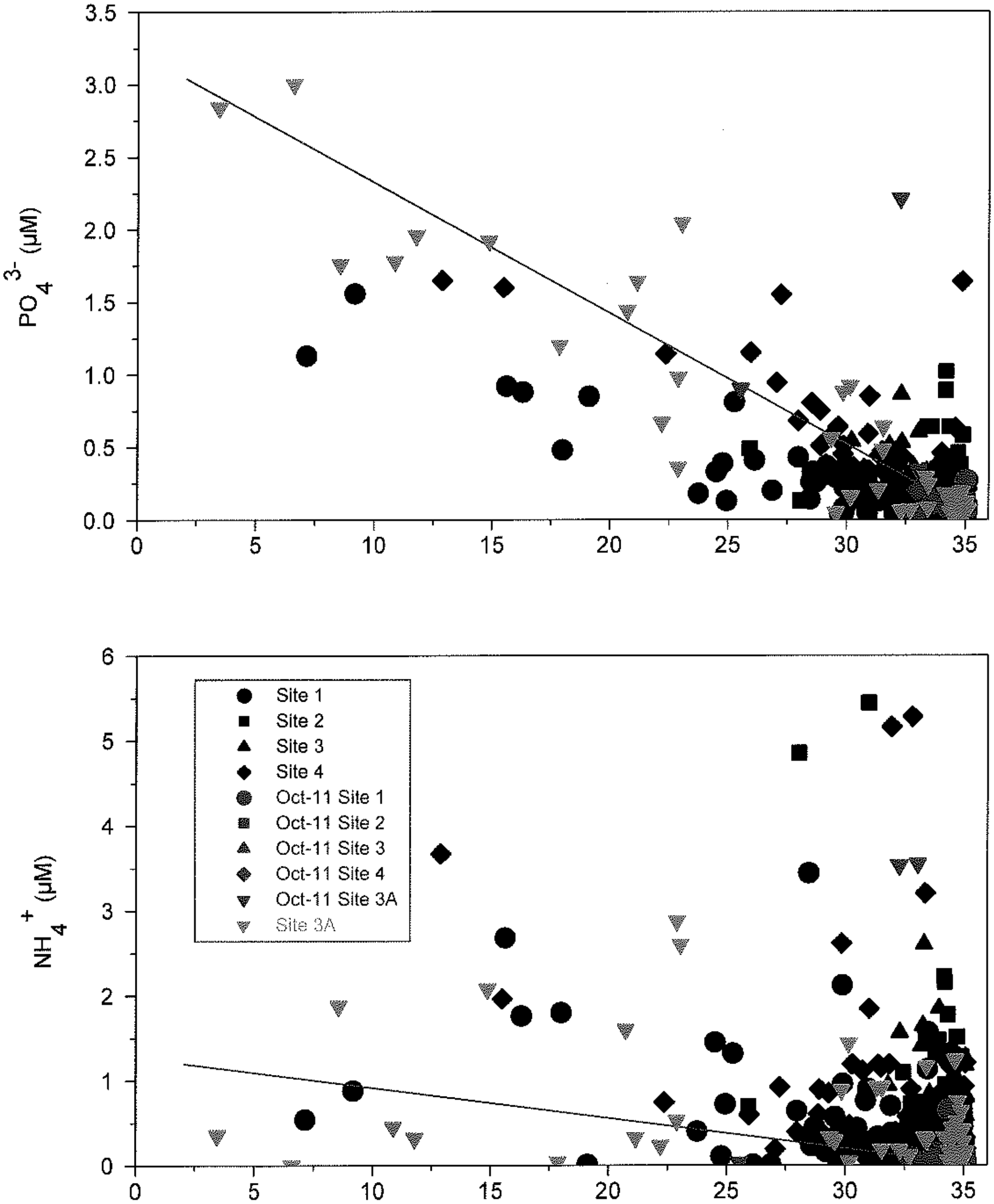


FIGURE 21. Phosphate and ammonium, plotted as a function of salinity for surface samples collected since August 1995 at four sites offshore of the Makena Golf Course. Black symbols represent combined data from surveys conducted between August 1995 and March 2011. Green symbols represent data from surveys at Site 3A commencing in June 2007. Red symbols are data from the most recent survey. Solid red line in each plot is conservative mixing line constructed by connecting the concentrations in open coastal water with water from golf course irrigation well #4. For sampling site locations, see Figure 1.

Exhibit A-2

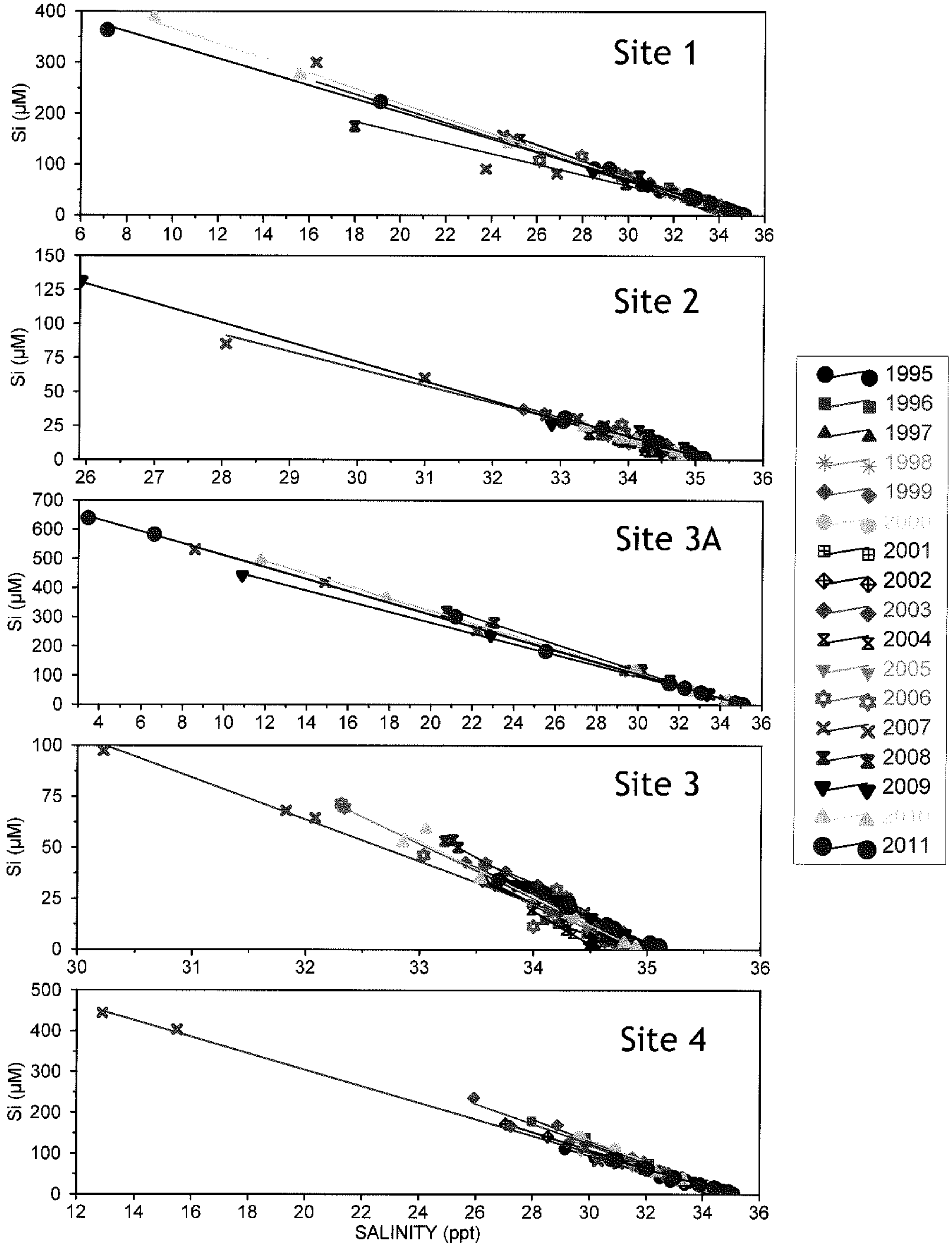


FIGURE 22. Mixing diagram showing yearly concentrations of silicate as functions of salinity from samples collected during annual monitoring surveys at five transect sites offshore of the Makena Resort (Site 3A since 2007). Note axis scale changes between sites. Straight lines are linear regressions through data points for each year. For sampling site locations, see Figure 1.

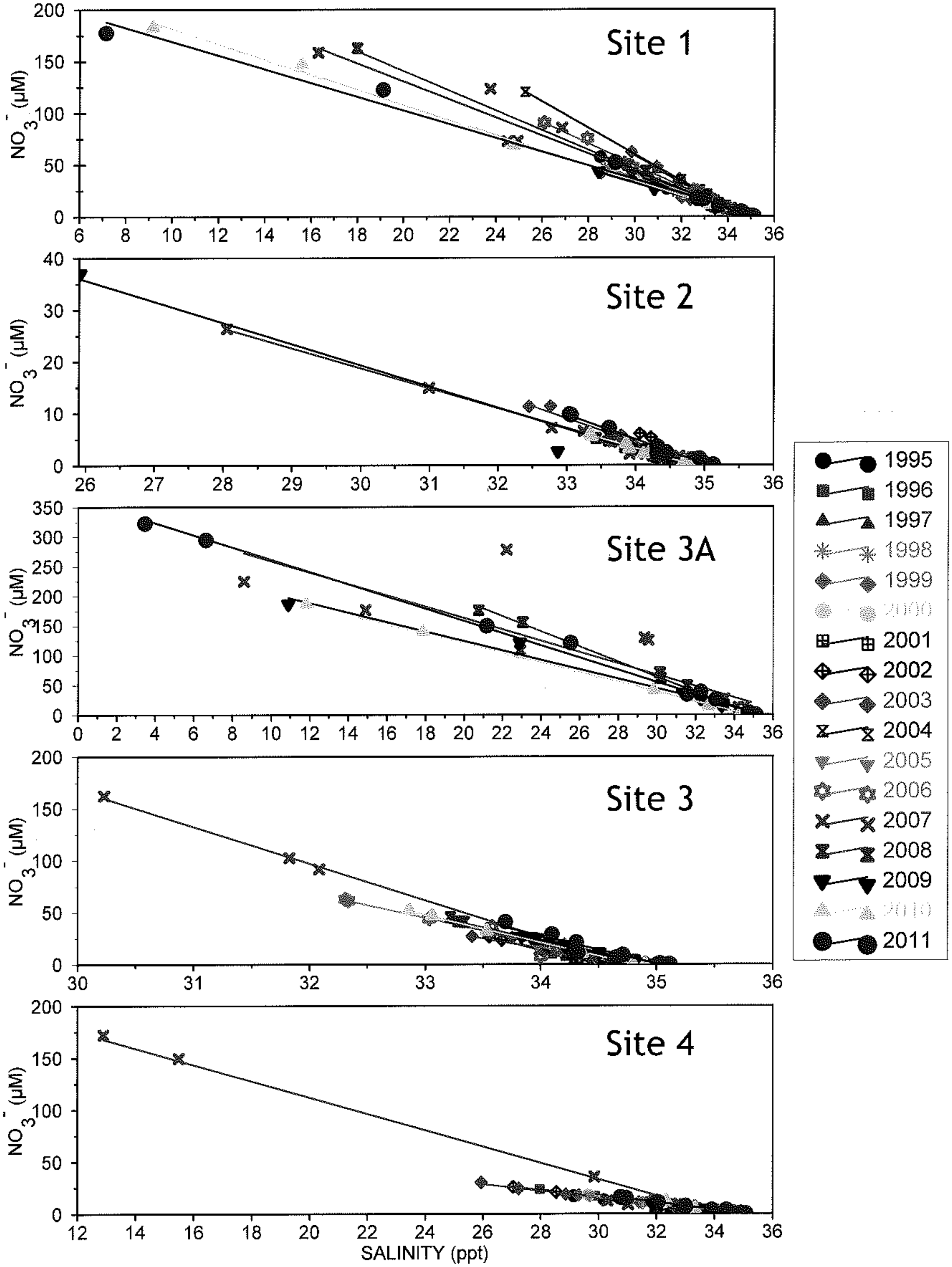


FIGURE 23. Mixing diagram showing yearly concentrations of nitrate as functions of salinity from samples collected during annual monitoring surveys at five transect sites offshore of the Makena Resort (Site 3A since 2007). Note axis scale changes between sites. Straight lines are linear regressions through data points for each year. For sampling site locations, see Figure 1.

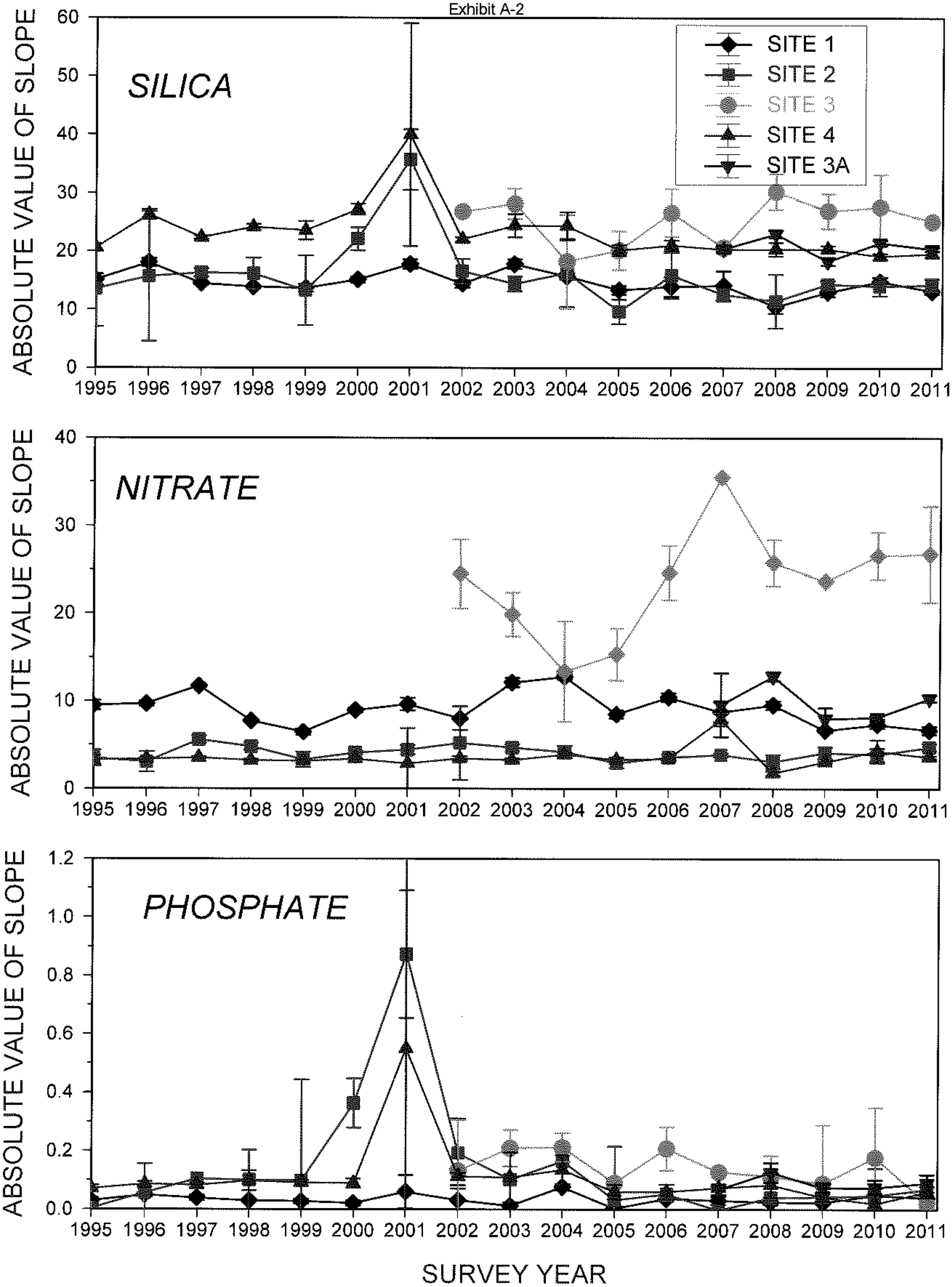


FIGURE 24. Time-course plots of absolute values of slopes of linear regressions of concentrations of silca, nitrate and phosphate as functions of salinity collected annually at each of the transect monitoring stations off the Makena Resort (Site 3A began in June 2007). Error bars are 95% confidence limits (Note error bar for Site 4 Phosphate is off scale). For locations of sampling transect sites, see Figure 1.

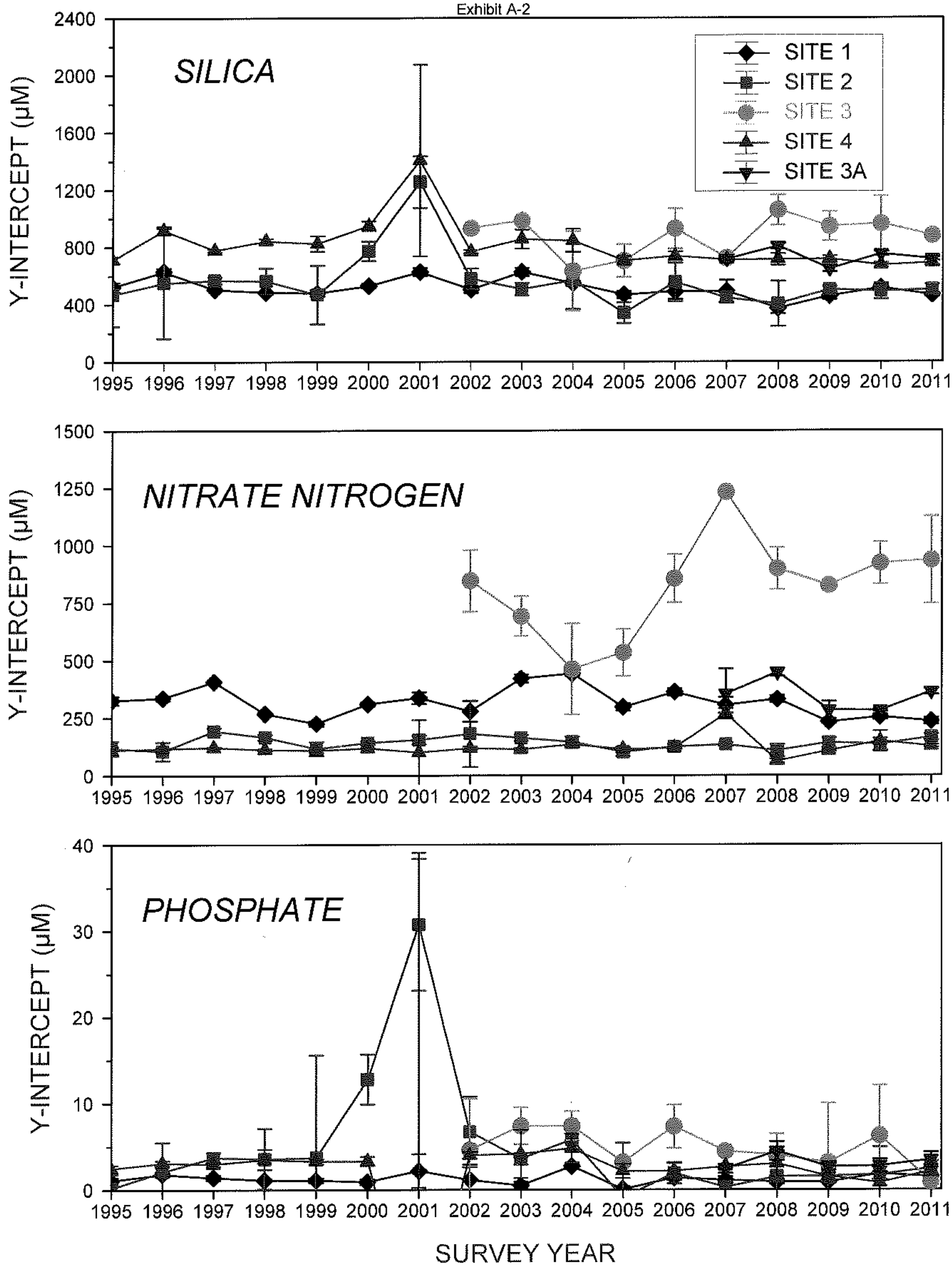


FIGURE 25. Time-course plots of Y-intercepts of linear regressions of concentrations of silca, nitrate and phosphorus as functions of salinity collected annually at each of the transect monitoring stations off the Makena Resort (Site 3A began in June 2007). Error bars are 95% confidence limits. For locations of sampling transect sites, see Figure 1.

TABLE 3. Geometric mean data from water chemistry measurements (in μM) off the Makena Resort collected since August 1995 from Sites 1, 2, and 4 (N=26); since June 2002 from Site 3 (N=17) and since June 2007 from Site 3-A (N=8). For geometric mean calculations, detection limits were used in cases where sample was below detection limit. Abbreviations as follows: DFS=distance from shore; S=surface; D=deep. Also shown are State of Hawaii, Department of Health (DOH) geometric mean water quality standards for open coastal waters under "dry" and "wet" conditions. Boxed values exceed DOH GM 10% "dry" standards; boxed and shaded values exceed DOH GM 10% "wet" standards. For sampling site locations, see Figure 1.

TRANSECT SITE	DFS (m)	PO_4^{3-} (μM)	NO_3^- (μM)	NH_4^+ (μM)	Si (μM)	TOP (μM)	TON (μM)	TP (μM)	TN (μM)	TURB (NTU)	SALINITY (ppt)	CHL a (μg/L)	TEMP (deg.C)	pH	O_2 % sat.
MAKENA 1	0 S	0.21	40.49	0.36	68.65	0.24	7.70	0.53	55.46	0.35	26.075	0.88	25.6	8.13	102.6
	2 S	0.16	26.19	0.19	47.63	0.26	8.16	0.46	38.54	0.29	29.960	0.84	25.7	8.16	104.2
	5 S	0.12	11.15	0.12	24.15	0.26	7.91	0.41	23.33	0.24	32.309	0.55	25.7	8.16	105.1
	5 D	0.11	8.67	0.19	19.85	0.27	7.47	0.40	19.41	0.20	33.195	0.49	25.7	8.17	105.5
	10 S	0.10	3.77	0.15	10.26	0.26	7.50	0.37	12.95	0.19	34.127	0.35	25.7	8.15	104.5
	10 D	0.10	2.19	0.20	6.88	0.28	7.42	0.39	10.80	0.17	34.414	0.34	25.7	8.15	103.5
	50 S	0.08	2.37	0.20	6.93	0.27	7.28	0.36	10.97	0.16	34.434	0.29	25.7	8.14	99.8
	50 D	0.08	0.27	0.13	2.42	0.28	7.26	0.37	7.89	0.12	34.812	0.26	25.6	8.14	98.8
	100 S	0.08	0.91	0.15	4.52	0.27	6.79	0.37	9.45	0.12	34.566	0.23	25.6	8.14	97.8
	100 D	0.07	0.10	0.09	1.98	0.28	7.32	0.36	7.66	0.10	34.853	0.20	25.6	8.15	97.3
	150 S	0.08	0.29	0.16	2.92	0.27	7.25	0.37	8.47	0.12	34.741	0.19	25.8	8.14	96.8
	150 D	0.08	0.07	0.13	1.77	0.28	7.07	0.37	7.38	0.10	34.855	0.16	25.6	8.15	97.4
MAKENA 2	0 S	0.19	4.24	0.37	22.57	0.32	8.29	0.55	14.12	0.89	33.370	0.79	25.8	8.14	97.5
	2 S	0.18	3.81	0.25	19.75	0.32	7.97	0.53	13.07	0.65	33.558	0.78	25.9	8.14	99.9
	5 S	0.16	3.14	0.26	15.13	0.29	7.23	0.47	11.42	0.46	34.015	0.59	25.8	8.14	99.8
	5 D	0.17	2.92	0.31	14.61	0.31	7.49	0.50	11.75	0.43	34.065	0.73	25.8	8.14	99.2
	10 S	0.12	1.66	0.21	9.30	0.30	5.70	0.44	9.35	0.31	34.384	0.41	25.7	8.14	98.2
	10 D	0.11	1.06	0.25	7.81	0.30	7.20	0.44	9.22	0.28	34.493	0.46	25.7	8.14	97.1
	50 S	0.10	1.10	0.26	7.22	0.32	7.70	0.44	9.67	0.24	34.462	0.32	25.6	8.13	96.9
	50 D	0.11	0.22	0.23	3.14	0.30	7.55	0.43	8.25	0.18	34.797	0.35	25.6	8.14	96.3
	100 S	0.09	0.44	0.19	4.03	0.29	7.30	0.40	8.28	0.16	34.647	0.27	25.7	8.13	97.2
	100 D	0.08	0.13	0.18	2.29	0.29	7.18	0.38	7.72	0.13	34.829	0.26	25.6	8.14	96.4
	150 S	0.09	0.22	0.19	2.99	0.29	7.44	0.39	8.06	0.13	34.779	0.21	25.7	8.14	96.3
	150 D	0.08	0.08	0.15	1.98	0.29	7.51	0.39	7.89	0.10	34.852	0.22	25.6	8.15	96.8
	200 S	0.06	0.11	0.16	2.24	0.29	7.26	0.37	7.78	0.11	34.847	0.23	25.8	8.15	97.4
	200 D	0.07	0.05	0.19	1.70	0.29	7.77	0.38	8.11	0.10	34.879	0.23	25.6	8.16	96.8
MAKENA 3-A	0 S	1.38	179.08	0.44	327.73	0.30	10.47	1.73	192.20	0.29	13.848	0.28	25.0	7.87	96.2
	2 S	0.99	115.77	0.42	207.32	0.29	7.81	1.50	140.29	0.20	20.223	0.34	25.2	7.89	96.8
	5 S	0.35	38.19	0.55	77.29	0.35	9.35	0.81	62.68	0.20	28.738	0.31	25.3	7.99	98.0
	5 D	0.21	19.69	0.37	43.78	0.30	8.22	0.60	33.85	0.18	31.792	0.33	25.5	8.05	98.4
	10 S	0.09	5.71	0.23	17.45	0.29	7.93	0.42	18.90	0.13	33.477	0.19	25.5	8.07	98.2
	10 D	0.06	1.37	0.19	5.86	0.27	7.06	0.37	9.93	0.14	34.631	0.23	25.5	8.09	99.0
	50 S	0.08	1.58	0.22	7.35	0.27	7.84	0.38	11.76	0.12	34.498	0.14	25.9	8.10	98.6
	50 D	0.07	0.14	0.29	2.88	0.29	8.26	0.38	8.92	0.11	34.841	0.14	25.6	8.11	98.3
	100 S	0.08	0.70	0.11	4.43	0.28	7.25	0.38	8.95	0.10	34.765	0.14	25.8	8.10	97.0
	100 D	0.10	0.03	0.30	1.98	0.29	7.35	0.40	7.81	0.09	34.941	0.12	25.6	8.12	98.9
	150 S	0.06	0.10	0.13	2.82	0.31	8.03	0.39	9.14	0.12	34.854	0.12	25.7	8.12	97.7
	150 D	0.05	0.01	0.23	1.70	0.29	7.42	0.36	7.77	0.11	34.946	0.14	25.5	8.12	100.0
MAKENA 3	0 S	0.12	9.15	0.33	19.17	0.27	6.29	0.45	24.19	0.29	33.759	0.49	25.8	8.14	101.1
	2 S	0.15	14.37	0.27	24.80	0.26	5.89	0.47	28.32	0.29	33.758	0.53	25.9	8.12	101.4
	5 S	0.12	9.21	0.21	16.83	0.29	7.77	0.47	22.04	0.21	34.081	0.33	25.9	8.12	102.0
	5 D	0.13	6.21	0.18	12.56	0.28	7.08	0.44	17.73	0.20	34.329	0.40	25.8	8.12	101.3
	10 S	0.09	3.89	0.24	8.80	0.28	7.41	0.40	14.62	0.17	34.466	0.25	25.7	8.12	98.9
	10 D	0.08	2.19	0.16	6.42	0.30	7.73	0.40	12.34	0.15	34.652	0.27	25.6	8.12	98.8
	50 S	0.08	1.46	0.18	5.30	0.28	7.51	0.38	10.74	0.13	34.674	0.20	25.7	8.11	95.4
	50 D	0.09	0.31	0.17	2.68	0.29	7.73	0.39	8.59	0.10	34.856	0.20	25.6	8.13	93.7
	100 S	0.08	0.42	0.21	2.93	0.29	7.51	0.38	8.59	0.11	34.811	0.15	25.7	8.12	95.8
	100 D	0.06	0.10	0.23	1.84	0.29	7.02	0.38	7.55	0.08	34.862	0.17	25.6	8.13	95.5
	150 S	0.05	0.12	0.14	2.15	0.29	6.95	0.35	7.58	0.10	34.834	0.14	25.7	8.15	96.1
	150 D	0.06	0.06	0.12	1.70	0.29	7.04	0.36	7.37	0.10	34.890	0.16	25.6	8.16	97.1
MAKENA 4	0 S	0.21	40.49	0.36	68.65	0.24	7.70	0.53	55.46	0.35	26.075	0.88	25.6	8.13	100.4
	2 S	0.16	26.19	0.19	47.63	0.26	8.16	0.46	38.54	0.29	29.960	0.84	25.7	8.16	101.7
	5 S	0.12	11.15	0.12	24.15	0.26	7.91	0.41	23.33	0.24	32.309	0.55	25.7	8.16	103.5
	5 D	0.11	8.67	0.19	19.85	0.27	7.47	0.40	19.41	0.20	33.195	0.49	25.7	8.17	102.6
	10 S	0.10	3.77	0.15	10.26	0.26	7.50	0.37	12.95	0.19	34.127	0.35	25.7	8.15	100.7
	10 D	0.10	2.19	0.20	6.88	0.28	7.42	0.39	10.80	0.17	34.414	0.34	25.7	8.15	101.7
	50 S	0.08	2.37	0.20	6.93	0.27	7.28	0.36	10.97	0.16	34.434	0.29	25.7	8.14	94.4
	50 D	0.08	0.27	0.13	2.42	0.28	7.26	0.37	7.89	0.12	34.812	0.26	25.6	8.14	93.7
	100 S	0.08	0.91	0.15	4.52	0.27	6.79	0.37	9.45	0.12	34.566	0.23	25.6	8.14	94.4
	100 D	0.07	0.10	0.09	1.98	0.28	7.32	0.36	7.66	0.10	34.853	0.20	25.6	8.15	92.9
	150 S	0.08	0.29	0.16	2.92	0.27	7.25	0.37	8.47	0.12	34.741	0.19	25.8	8.14	96.1
	150 D	0.08	0.07	0.13	1.77	0.28	7.07	0.37	7.38	0.10	34.855	0.16	25.6	8.15	94.7
DOH WQS GEOMETRIC MEAN	DRY		0.25	0.14				0.52	7.86	0.20	*	0.15	**	***	
	WET		0.36	0.25				0.64	10.71	0.50		0.30			

* Salinity shall not vary more than ten percent form natural or seasonal changes considering hydrologic input and oceanographic conditions.

** Temperature shall not vary by more than one degree C. from ambient conditions.

***pH shall not deviate more than 0.5 units from a value of 8.1.

TABLE 4. Geometric mean data (in μg/L) from water chemistry measurements (in μM) off the Makena Resort collected since August 1995 for Sites 1, 2, and 4 (N=26); since June 2002 from Site 3 (N=17) and since June 2007 from Site 3-A (N=8). For geometric mean calculations, detection limits were used in cases where sample was below detection limit. Abbreviations as follows: DFS=distance from shore; S=surface; D=deep. Also shown are State of Hawaii, Department of Health (DOH) geometric mean water quality standards for open coastal waters under "dry" and "wet" conditions. Boxed values exceed DOH GM 10% "dry" standards; boxed and shaded values exceed DOH GM 10% "wet" standards. For sampling site locations, see Figure 1.

TRANSECT SITE	DFS (m)	PO_4^{3-} (μg/L)	NO_3^- (μg/L)	NH_4^+ (μg/L)	Si (μg/L)	TOP (μg/L)	TON (μg/L)	TP (μg/L)	TN (μg/L)	TURB (NTU)	SALINITY (ppt)	CHL a (μg/L)	TEMP (deg.C)	pH	O_2 % sat.
MAKENA 1	0 S	6.50	567.1	5.00	1928	7.40	107.80	16.40	776.7	0.35	26.075	0.88	25.6	8.13	102.6
	2 S	4.90	366.8	2.60	1338	8.00	114.20	14.20	539.7	0.29	29.960	0.84	25.7	8.16	104.2
	5 S	3.70	156.1	1.60	678.4	8.00	110.70	12.60	326.7	0.24	32.309	0.55	25.7	8.16	105.1
	5 D	3.40	121.4	2.60	557.6	8.30	104.60	12.30	271.8	0.20	33.195	0.49	25.7	8.17	105.5
	10 S	3.00	52.80	2.10	288.2	8.00	105.00	11.40	181.3	0.19	34.127	0.35	25.7	8.15	104.5
	10 D	3.00	30.60	2.80	193.3	8.60	103.90	12.00	151.2	0.17	34.414	0.34	25.7	8.15	103.5
	50 S	2.40	33.10	2.80	194.7	8.30	101.90	11.10	153.6	0.16	34.434	0.29	25.7	8.14	99.8
	50 D	2.40	3.70	1.80	67.98	8.60	101.60	11.40	110.5	0.12	34.812	0.26	25.6	8.14	98.8
	100 S	2.40	12.70	2.10	127.0	8.30	95.10	11.40	132.3	0.12	34.566	0.23	25.6	8.14	97.8
	100 D	2.10	1.40	1.20	55.62	8.60	102.50	11.10	107.2	0.10	34.853	0.20	25.6	8.15	97.3
	150 S	2.40	4.00	2.20	82.02	8.30	101.50	11.40	118.6	0.12	34.741	0.19	25.8	8.14	96.8
	150 D	2.40	0.90	1.80	49.72	8.60	99.00	11.40	103.3	0.10	34.855	0.16	25.6	8.15	97.4
MAKENA 2	0 S	5.80	59.30	5.10	634.0	9.90	116.10	17.00	197.7	0.89	33.370	0.79	25.8	8.14	97.5
	2 S	5.50	53.30	3.50	554.8	9.90	111.60	16.40	183.0	0.65	33.558	0.78	25.9	8.14	99.9
	5 S	4.90	43.90	3.60	425.0	8.90	101.20	14.50	159.9	0.46	34.015	0.59	25.8	8.14	99.8
	5 D	5.20	40.80	4.30	410.4	9.60	104.90	15.40	164.5	0.43	34.065	0.73	25.8	8.14	99.2
	10 S	3.70	23.20	2.90	261.2	9.20	79.80	13.60	130.9	0.31	34.384	0.41	25.7	8.14	98.2
	10 D	3.40	14.80	3.50	219.4	9.20	100.80	13.60	129.1	0.28	34.493	0.46	25.7	8.14	97.1
	50 S	3.00	15.40	3.60	202.8	9.90	107.80	13.60	135.4	0.24	34.462	0.32	25.6	8.13	96.9
	50 D	3.40	3.00	3.20	88.20	9.20	105.70	13.30	115.5	0.18	34.797	0.35	25.6	8.14	96.3
	100 S	2.70	6.10	2.60	113.2	8.90	102.20	12.30	115.9	0.16	34.647	0.27	25.7	8.13	97.2
	100 D	2.40	1.80	2.50	64.33	8.90	100.50	11.70	108.1	0.13	34.829	0.26	25.6	8.14	96.4
	150 S	2.70	3.00	2.60	83.99	8.90	104.20	12.00	112.8	0.13	34.779	0.21	25.7	8.14	96.3
	150 D	2.40	1.10	2.10	55.62	8.90	105.10	12.00	110.5	0.10	34.852	0.22	25.6	8.15	96.8
	200 S	1.80	1.50	2.20	62.92	8.90	101.60	11.40	108.9	0.11	34.847	0.23	25.8	8.15	97.4
	200 D	2.10	0.70	2.60	47.75	8.90	108.80	11.70	113.5	0.10	34.879	0.23	25.6	8.16	96.8
MAKENA 3-A	0 S	42.70	2508	6.10	9206	9.20	146.60	53.50	2692	0.29	13.848	0.28	25.0	7.87	96.2
	2 S	30.60	1621	5.80	5824	8.90	109.30	46.40	1965	0.20	20.223	0.34	25.2	7.89	96.8
	5 S	10.80	534.8	7.70	2171	10.80	130.90	25.00	877.8	0.20	28.738	0.31	25.3	7.99	98.0
	5 D	6.50	275.7	5.10	1229.8	9.20	115.10	18.50	474.1	0.18	31.792	0.33	25.5	8.05	98.4
	10 S	2.70	79.90	3.20	490.2	8.90	111.00	13.00	264.7	0.13	33.477	0.19	25.5	8.07	98.2
	10 D	1.80	19.10	2.60	164.6	8.30	98.80	11.40	139.0	0.14	34.631	0.23	25.5	8.09	99.0
	50 S	2.40	22.10	3.00	206.5	8.30	109.80	11.70	164.7	0.12	34.498	0.14	25.9	8.1	98.6
	50 D	2.10	1.90	4.00	80.90	8.90	115.60	11.70	124.9	0.11	34.841	0.14	25.6	8.11	98.3
	100 S	2.40	9.80	1.50	124.4	8.60	101.50	11.70	125.3	0.10	34.765	0.14	25.8	8.1	97.0
	100 D	3.00	0.40	4.20	55.62	8.90	102.90	12.30	109.3	0.09	34.941	0.12	25.6	8.12	98.9
	150 S	1.80	1.40	1.80	79.2	9.60	112.40	12.00	128.0	0.12	34.854	0.12	25.7	8.12	97.7
	150 D	1.50	0.10	3.20	47.75	8.90	103.90	11.10	108.8	0.11	34.946	0.14	25.5	8.12	100.0
MAKENA 3	0 S	3.70	128.10	4.60	538.5	8.30	88.00	13.90	338.8	0.29	33.759	0.49	25.8	8.14	101.1
	2 S	4.60	201.2	3.70	696.6	8.00	82.40	14.50	396.6	0.29	33.758	0.53	25.9	8.12	101.4
	5 S	3.70	128.9	2.90	472.8	8.90	108.80	14.50	308.6	0.21	34.081	0.33	25.9	8.12	102.0
	5 D	4.00	86.90	2.50	352.8	8.60	99.10	13.60	248.3	0.20	34.329	0.40	25.8	8.12	101.3
	10 S	2.70	54.40	3.30	247.2	8.60	103.70	12.30	204.7	0.17	34.466	0.25	25.7	8.12	98.9
	10 D	2.40	30.60	2.20	180.3	9.20	108.20	12.30	172.8	0.15	34.652	0.27	25.6	8.12	98.8
	50 S	2.40	20.40	2.50	148.9	8.60	105.10	11.70	150.4	0.13	34.674	0.20	25.7	8.11	95.4
	50 D	2.70	4.30	2.30	75.28	8.90	108.20	12.00	120.3	0.10	34.856	0.20	25.6	8.13	93.7
	100 S	2.40	5.80	2.90	82.30	8.90	105.10	11.70	120.3	0.11	34.811	0.15	25.7	8.12	95.8
	100 D	1.80	1.40	3.20	51.69	8.90	98.30	11.70	105.7	0.08	34.862	0.17	25.6	8.13	95.5
	150 S	1.50	1.60	1.90	60.39	8.90	97.30	10.80	106.1	0.10	34.834	0.14	25.7	8.15	96.1
	150 D	1.80	0.80	1.60	47.75	8.90	98.60	11.10	103.2	0.10	34.890	0.16	25.6	8.16	97.1
MAKENA 4	0 S	6.50	567.1	5.00	1928	7.40	107.80	16.40	776.7	0.35	26.075	0.88	25.6	8.13	100.4
	2 S	4.90	366.8	2.60	1338	8.00	114.20	14.20	539.7	0.29	29.960	0.84	25.7	8.16	101.7
	5 S	3.70	156.1	1.60	678.4	8.00	110.70	12.60	326.7	0.24	32.309	0.55	25.7	8.16	103.5
	5 D	3.40	121.4	2.60	557.6	8.30	104.60	12.30	271.8	0.20	33.195	0.49	25.7	8.17	102.6
	10 S	3.00	52.80	2.10	288.2	8.00	105.00	11.40	181.3	0.19	34.127	0.35	25.7	8.15	100.7
	10 D	3.00	30.60	2.80	193.3	8.60	103.90	12.00	151.2	0.17	34.414	0.34	25.7	8.15	101.7
	50 S	2.40	33.10	2.80	194.7	8.30	101.90	11.10	153.6	0.16	34.434	0.29	25.7	8.14	94.4
	50 D	2.40	3.70	1.80	67.98	8.60	101.60	11.40	110.5	0.12	34.812	0.26	25.6	8.14	93.7
	100 S	2.40	12.70	2.10	127.0	8.30	95.10	11.40	132.3	0.12	34.566	0.23	25.6	8.14	94.4
	100 D	2.10	1.40	1.20	55.62	8.60	102.50	11.10	107.2	0.10	34.853	0.20	25.6	8.15	92.9
	150 S	2.40	4.00	2.20	82.02	8.30	101.50	11.40	118.6	0.12	34.741	0.19	25.8	8.14	96.1
	150 D	2.40	0.90	1.80	49.72	8.60	99.00	11.40	103.3	0.10	34.855	0.16	25.6	8.15	94.7
DOH WQS GEOMETRIC MEAN		DRY	3.50	2.00				16.00	110.00	0.20	*	0.15	**	***	
		WET	5.00	3.50				20.00	150.00	0.50		0.30			

* Salinity shall not vary more than ten percent form natural or seasonal changes considering hydrologic input and oceanographic conditions.

** Temperature shall not vary by more than one degree C. from ambient conditions.

***pH shall not deviate more than 0.5 units from a value of 8.1.

TABLE 5. Water chemistry measurements in µM and µg/L (shaded) from irrigation wells and an irrigation lake collected in the vicinity of the Makena Resort on October 16, 2011. For sampling site locations, see Figure 1.

WELL	PO_4^{3-} (µM)	PO_4^{3-} (µg/L)	NO_3^- (µM)	NO_3^- (µg/L)	NH_4^+ (µM)	NH_4^+ (µg/L)	Si (µM)	Si (µg/L)	TOP (µM)	TOP (µg/L)	TON (µM)	TON (µg/L)	TP (µM)	TP (µg/L)	TN (µM)	TN (µg/L)	SALINITY (ppt)
1	2.32	71.92	131.2	1836.8	1.60	22.40	532.4	14960.4	0.16	4.96	23.52	329.28	2.48	76.88	156.3	2188.5	1.366
2	3.12	96.72	145.0	2030.6	0.72	10.08	683.7	19211.4	0.08	2.48	26.80	375.20	3.20	99.20	172.6	2415.8	2.177
3	3.28	101.68	147.2	2060.8	1.12	15.68	726.2	20407.3	0.08	2.48	11.76	164.64	3.36	104.16	160.1	2241.1	2.073
4	3.04	94.24	144.9	2028.3	1.20	16.80	668.0	18770.8	0.16	4.96	7.44	104.16	3.20	99.20	153.5	2149.3	2.056
6	2.40	74.40	172.1	2409.1	2.32	32.48	559.9	15733.8	0.40	12.40	18.24	255.36	2.80	86.80	192.6	2697.0	1.561
8	2.80	86.80	115.0	1609.4	1.52	21.28	607.8	17078.1	0.24	7.44	17.52	245.28	3.04	94.24	134.0	1876.0	2.413
10	2.88	89.28	175.9	2462.9	2.56	35.84	643.2	18073.9	0.24	7.44	12.88	180.32	3.12	96.72	191.4	2679.0	2.029
11	2.88	89.28	117.3	1641.9	1.36	19.04	621.2	17455.7	0.24	7.44	19.20	268.80	3.12	96.72	137.8	1929.8	4.160
IL10	0.72	22.32	73.8	1033.8	15.92	222.88	513.4	14427.7	1.52	47.12	46.96	657.44	2.24	69.44	136.7	1914.1	1.743

TABLE 6. Linear regression statistics (y-intercept and slope) of concentrations of silica as functions of salinity from four ocean transect sites off of the Makena Resort collected during monitoring surveys from 1995 to October 2011 (Transect Site 3 has been monitored since 2002; Trasect Site 3A since 2007). Also shown are standard errors and upper and lower 95% confidence limits around the y-intercepts and slopes.'REGSLOPE' indicates regression statistics for slope of yearly coefficients as a function of time. For location of transect sites, see Figure 1.

Exhibit A-2

SILICA -Y-INTERCEPT

YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 1				
1995	522.34	12.18	491.03	553.66
1996	629.56	11.05	605.49	653.64
1997	504.17	2.83	496.89	511.46
1998	484.14	2.44	477.86	490.41
1999	479.11	9.89	457.55	500.66
2000	528.68	5.87	513.58	543.77
2001	625.85	10.91	597.82	653.88
2002	502.98	8.68	480.66	525.30
2003	625.85	10.91	597.82	653.88
2004	546.00	8.33	527.84	564.16
2005	466.59	11.09	442.42	490.75
2006	487.68	24.60	434.08	541.28
2007	491.19	34.99	414.95	567.42
2008	371.80	16.96	334.85	408.75
2009	457.28	10.01	431.54	483.02
2010	515.27	7.85	495.09	535.45
2011	464.80	5.70	452.37	477.22
REGSLOPE	**-6.01**	**3.04**	**-12.49**	**0.46**
SITE 2				
1995	468.41	85.54	248.51	688.30
1996	549.09	177.83	164.91	933.28
1997	567.57	9.71	543.80	591.33
1998	563.20	37.23	472.10	654.30
1999	466.74	95.75	261.37	672.11
2000	770.15	27.32	703.31	837.00
2001	1254.31	74.17	1072.82	1435.81
2002	577.53	29.40	505.60	649.46
2003	505.05	20.10	461.94	548.15
2004	565.31	93.71	364.33	766.29
2005	339.08	33.78	266.64	411.52
2006	553.48	62.93	418.51	688.45
2007	443.05	17.15	406.27	479.84
2008	402.41	73.66	244.42	560.41
2009	501.76	9.02	479.69	523.82
2010	490.17	22.77	434.46	545.87
2011	501.35	17.35	464.13	538.56
REGSLOPE	**-9.65**	**9.97**	**-30.89**	**11.60**
SITE 3A				
2007	714.10	5.58	701.94	726.27
2008	805.12	9.00	785.52	824.73
2009	646.37	7.80	626.32	666.43
2010	750.91	5.70	736.26	765.56
2011	715.44	5.06	704.42	726.45
REGSLOPE	**-5.15**	**20.98**	**-71.93**	**61.62**
SITE 3				
2002	931.92	27.54	861.13	1002.71
2003	984.76	41.58	894.16	1075.35
2004	632.75	127.62	354.68	910.82
2005	704.38	52.31	590.40	818.35
2006	928.22	64.18	788.40	1068.05
2007	722.80	15.07	689.97	755.63
2008	1058.06	48.59	952.18	1163.94
2009	943.91	40.06	840.94	1046.89
2010	962.57	74.39	771.34	1153.79
2011	880.51	26.78	822.17	938.85
REGSLOPE	**10.87**	**15.83**	**-25.62**	**47.36**
SITE 4				
1995	710.45	8.83	687.74	733.15
1996	917.33	13.38	888.18	946.47
1997	776.74	3.53	767.66	785.82
1998	841.35	6.75	824.00	858.70
1999	823.63	24.78	769.63	877.62
2000	946.97	12.51	914.80	979.14
2001	1403.91	260.13	735.22	2072.61
2002	767.85	4.37	756.63	779.08
2003	854.37	29.88	789.26	919.48
2004	843.49	37.55	761.67	925.31
2005	703.97	14.00	673.47	734.46
2006	735.05	14.01	704.53	765.57
2007	710.11	7.14	694.56	725.66
2008	712.32	18.22	672.63	752.01
2009	715.30	7.99	694.75	735.84
2010	673.09	6.27	656.98	689.21
2011	688.21	7.10	672.74	703.68
REGSLOPE	**-13.03**	**8.18**	**-30.46**	**4.41**

SILICA - SLOPE

YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 1				
1995	-15.08	0.38	-16.05	-14.12
1996	-18.05	0.32	-18.75	-17.34
1997	-14.43	0.08	-14.65	-14.21
1998	-13.83	0.07	-14.02	-13.64
1999	-13.63	0.29	-14.27	-12.99
2000	-15.08	0.18	-15.54	-14.62
2001	-17.76	0.32	-18.57	-16.94
2002	-14.38	0.26	-15.05	-13.72
2003	-17.76	0.32	-18.57	-16.94
2004	-15.68	0.25	-16.23	-15.14
2005	-13.31	0.33	-14.02	-12.61
2006	-13.88	0.76	-15.53	-12.23
2007	-14.11	1.14	-16.59	-11.62
2008	-10.46	0.52	-11.59	-9.33
2009	-12.98	0.30	-13.76	-12.20
2010	-14.78	0.28	-15.49	-14.06
2011	-13.13	0.18	-13.52	-12.74
REGSLOPE	**0.18**	**0.09**	**-0.01**	**0.37**
SITE 2				
1995	-13.47	2.51	-19.93	-7.00
1996	-15.62	5.15	-26.75	-4.49
1997	-16.26	0.29	-16.96	-15.56
1998	-16.11	1.08	-18.76	-13.45
1999	-13.21	2.78	-19.18	-7.23
2000	-22.06	0.80	-24.02	-20.11
2001	-35.68	2.12	-40.87	-30.49
2002	-16.54	0.86	-18.64	-14.44
2003	-14.37	0.59	-15.63	-13.11
2004	-16.23	2.73	-22.09	-10.38
2005	-9.61	0.98	-11.70	-7.52
2006	-15.82	1.83	-19.75	-11.89
2007	-12.54	0.51	-13.64	-11.45
2008	-11.41	2.14	-15.99	-6.83
2009	-14.32	0.27	-14.98	-13.66
2010	-13.97	0.67	-15.61	-12.33
2011	-14.24	0.50	-15.31	-13.16
REGSLOPE	**0.28**	**0.28**	**-0.32**	**0.89**
SITE 3A				
2007	-20.35	0.19	-20.75	-19.94
2008	-22.96	0.28	-23.57	-22.36
2009	-18.28	0.26	-18.96	-17.61
2010	-21.44	0.19	-21.94	-20.94
2011	-20.35	0.17	-20.72	-19.99
REGSLOPE	**0.15**	**0.62**	**-1.82**	**2.12**
SITE 3				
2002	-26.75	0.81	-28.83	-24.68
2003	-28.10	1.21	-30.73	-25.47
2004	-18.19	3.69	-26.24	-10.14
2005	-20.11	1.51	-23.40	-16.83
2006	-26.56	1.89	-30.67	-22.46
2007	-20.60	0.44	-21.56	-19.63
2008	-30.22	1.41	-33.29	-27.14
2009	-26.90	1.17	-29.90	-23.91
2010	-27.56	2.19	-33.18	-21.93
2011	-25.06	0.77	-26.74	-23.37
REGSLOPE	**-0.30**	**0.45**	**-1.34**	**0.75**
SITE 4				
1995	-20.55	0.27	-21.25	-19.85
1996	-26.23	0.40	-27.10	-25.37
1997	-22.27	0.11	-22.55	-21.99
1998	-24.07	0.20	-24.58	-23.56
1999	-23.50	0.73	-25.10	-21.90
2000	-27.12	0.37	-28.08	-26.16
2001	-39.92	7.42	-58.99	-20.86
2002	-21.99	0.13	-22.34	-21.65
2003	-24.36	0.91	-26.34	-22.39
2004	-24.27	1.10	-26.66	-21.88
2005	-20.11	0.41	-21.00	-19.22
2006	-20.96	0.41	-21.86	-20.06
2007	-20.27	0.23	-20.77	-19.78
2008	-20.33	0.53	-21.49	-19.17
2009	-20.34	0.24	-20.95	-19.73
2010	-19.14	0.19	-19.62	-18.66
2011	-19.57	0.21	-20.03	-19.11
REGSLOPE	**0.38**	**0.23**	**-0.11**	**0.88**

Exhibit A2

TABLE 7. Linear regression statistics (y-intercept and slope) of concentrations of nitrate as functions of salinity from four ocean transect sites off of the Makena Resort collected during monitoring surveys from 1995 to October 2011 (Transect Site 3 has been monitored since 2002; Trasect Site 3A since 2007). Also shown are standard errors and upper and lower 95% confidence limits around the y-intercepts and slopes. "REGSLOPE" indicates regression statistics for slope of yearly coefficients as a function of time. For location of transect sites, see Figure 1.

NITRATE -Y-INTERCEPT

YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 1				
1995	326.50	7.10	308.25	344.75
1996	336.49	4.62	326.41	346.56
1997	406.96	1.93	402.00	411.93
1998	268.90	1.55	264.91	272.89
1999	225.24	5.32	213.66	236.83
2000	309.77	3.36	301.14	318.41
2001	336.53	9.69	311.61	361.44
2002	278.21	17.43	233.40	323.03
2003	421.29	7.81	404.28	438.30
2004	442.33	4.89	431.68	452.99
2005	296.36	7.44	280.16	312.56
2006	361.76	7.20	346.08	377.45
2007	305.06	15.88	270.45	339.67
2008	330.95	7.18	315.29	346.60
2009	231.91	3.07	224.01	239.81
2010	253.63	4.57	241.88	265.38
2011	235.52	6.82	220.66	250.37
REGSLOPE	**-3.65**	**3.21**	**-10.49**	**3.19**
SITE 2				
1995	119.87	12.03	88.95	150.79
1996	106.36	18.44	66.53	146.19
1997	193.75	5.64	179.95	207.55
1998	166.93	5.33	153.89	179.97
1999	116.21	14.04	86.10	146.32
2000	142.07	2.83	135.13	149.01
2001	154.93	7.65	136.21	173.64
2002	180.82	58.78	36.98	324.66
2003	163.36	6.31	149.82	176.91
2004	145.36	10.55	122.74	167.99
2005	102.66	9.11	83.13	122.19
2006	124.74	4.89	114.26	135.22
2007	134.27	3.25	127.30	141.24
2008	108.01	12.87	80.41	135.61
2009	142.21	9.04	120.08	164.34
2010	135.27	10.49	109.60	160.94
2011	166.23	6.33	152.64	179.81
REGSLOPE	**-0.37**	**1.37**	**-3.29**	**2.55**
SITE 3A				
2007	354.33	49.92	245.56	463.11
2008	448.07	7.75	431.19	464.95
2009	283.99	14.63	246.38	321.60
2010	283.25	1.86	278.48	288.02
2011	364.51	5.48	352.58	376.45
REGSLOPE	**-14.45**	**23.47**	**-89.13**	**60.24**
SITE 3				
2002	847.45	52.35	712.88	982.01
2003	693.24	39.54	607.10	779.38
2004	463.72	90.73	266.04	661.40
2005	535.53	47.19	432.72	638.34
2006	856.96	48.22	751.91	962.02
2007	1233.34	18.23	1193.63	1273.06
2008	899.91	41.92	808.57	991.25
2009	827.18	19.10	778.08	876.29
2010	924.44	35.54	833.09	1015.80
2011	936.86	87.11	747.07	1126.65
REGSLOPE	**34.61**	**22.33**	**-16.89**	**86.10**
SITE 4				
1995	111.38	6.47	94.74	128.02
1996	118.34	1.63	114.79	121.89
1997	122.56	1.29	119.25	125.88
1998	112.77	1.87	107.97	117.57
1999	109.13	3.30	101.94	116.33
2000	118.51	0.75	116.58	120.43
2001	100.93	54.85	-40.08	241.94
2002	118.91	3.25	110.56	127.25
2003	113.78	2.76	107.77	119.79
2004	134.97	4.64	124.86	145.07
2005	114.59	4.47	104.85	124.33
2006	119.85	1.76	116.03	123.68
2007	269.24	10.13	247.16	291.32
2008	62.93	4.05	54.11	71.74
2009	107.17	1.51	103.30	111.04
2010	148.96	16.96	105.35	192.57
2011	126.90	2.74	120.94	132.87
REGSLOPE	**1.68**	**2.06**	**-2.72**	**6.08**

NITRATE - SLOPE

YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 1				
1995	-9.49	0.22	-10.05	-8.92
1996	-9.67	0.14	-9.97	-9.38
1997	-11.70	0.06	-11.85	-11.55
1998	-7.72	0.05	-7.84	-7.60
1999	-6.44	0.16	-6.79	-6.10
2000	-8.91	0.10	-9.17	-8.65
2001	-9.60	0.28	-10.32	-8.88
2002	-7.99	0.52	-9.31	-6.66
2003	-12.09	0.23	-12.60	-11.58
2004	-12.74	0.15	-13.06	-12.42
2005	-8.48	0.22	-8.96	-8.01
2006	-10.40	0.22	-10.89	-9.92
2007	-8.73	0.52	-9.86	-7.60
2008	-9.52	0.22	-10.00	-9.05
2009	-6.65	0.09	-6.89	-6.41
2010	-7.31	0.16	-7.72	-6.89
2011	-6.66	0.21	-7.12	-6.19
REGSLOPE	**0.11**	**0.09**	**-0.09**	**0.31**
SITE 2				
1995	-3.47	0.35	-4.38	-2.56
1996	-3.05	0.53	-4.20	-1.89
1997	-5.57	0.17	-5.97	-5.16
1998	-4.79	0.16	-5.17	-4.41
1999	-3.31	0.41	-4.19	-2.43
2000	-4.08	0.08	-4.29	-3.88
2001	-4.41	0.22	-4.95	-3.88
2002	-5.19	1.72	-9.40	-0.99
2003	-4.68	0.18	-5.07	-4.28
2004	-4.19	0.31	-4.84	-3.53
2005	-2.94	0.26	-3.50	-2.37
2006	-3.57	0.14	-3.88	-3.27
2007	-3.85	0.10	-4.06	-3.64
2008	-3.09	0.37	-3.89	-2.29
2009	-4.10	0.27	-4.76	-3.43
2010	-3.88	0.31	-4.64	-3.13
2011	-4.74	0.18	-5.14	-4.35
REGSLOPE	**0.01**	**0.04**	**-0.07**	**0.10**
SITE 3A				
2007	-9.57	1.67	-13.20	-5.93
2008	-12.81	0.24	-13.33	-12.29
2009	-7.98	0.49	-9.25	-6.72
2010	-8.15	0.06	-8.32	-7.99
2011	-10.31	0.18	-10.71	-9.92
REGSLOPE	**0.32**	**0.69**	**-1.89**	**2.52**
SITE 3				
2002	-24.49	1.53	-28.43	-20.56
2003	-19.86	1.15	-22.36	-17.35
2004	-13.37	2.63	-19.09	-7.64
2005	-15.33	1.36	-18.29	-12.37
2006	-24.61	1.42	-27.70	-21.52
2007	-35.51	0.54	-36.68	-34.34
2008	-25.78	1.22	-28.43	-23.12
2009	-23.65	0.56	-25.08	-22.22
2010	-26.57	1.05	-29.26	-23.88
2011	-26.75	2.51	-32.22	-21.28
REGSLOPE	**-0.98**	**0.65**	**-2.47**	**0.52**
SITE 4				
1995	-3.26	0.20	-3.77	-2.75
1996	-3.40	0.05	-3.50	-3.29
1997	-3.53	0.04	-3.63	-3.43
1998	-3.24	0.05	-3.38	-3.10
1999	-3.13	0.10	-3.34	-2.92
2000	-3.40	0.02	-3.46	-3.34
2001	-2.87	1.56	-6.89	1.15
2002	-3.44	0.10	-3.70	-3.19
2003	-3.28	0.08	-3.46	-3.09
2004	-3.89	0.14	-4.18	-3.59
2005	-3.29	0.13	-3.57	-3.00
2006	-3.43	0.05	-3.54	-3.31
2007	-7.87	0.32	-8.58	-7.17
2008	-1.79	0.12	-2.05	-1.54
2009	-3.07	0.04	-3.18	-2.95
2010	-4.30	0.50	-5.60	-3.00
2011	-3.62	0.08	-3.79	-3.44
REGSLOPE	**-0.05**	**0.06**	**-0.18**	**0.08**

TABLE 8. Linear regression statistics (y-intercept and slope) of concentrations of orthophosphate phosphorus as functions of salinity from four ocean transect sites off of the Makena Resort collected during monitoring surveys from 1995 to October 2011 (Transect site 3 has been monitored since 2002; Trasect Site 3A since 2007). Also shown are standard errors and upper and lower 95% confidence limits around the y-intercepts and slopes. For location of transect sites, see Figure 1.

PHOSPHATE -Y-INTERCEPT

YEAR	*Coefficients*	*Std Err*	*Lower 95%*	*Upper 95%*
SITE 1				
1995	1.04	0.14	0.68	1.39
1996	1.78	0.12	1.52	2.03
1997	1.40	0.12	1.10	1.69
1998	1.10	0.06	0.95	1.25
1999	1.07	0.12	0.80	1.34
2000	0.89	0.12	0.59	1.19
2001	2.16	0.76	0.22	4.11
2002	1.12	0.68	-0.64	2.88
2003	0.48	0.19	0.06	0.90
2004	2.71	0.17	2.33	3.08
2005	-0.02	0.14	-0.34	0.29
2006	1.36	0.13	1.08	1.65
2007	1.07	0.20	0.64	1.50
2008	0.89	0.13	0.61	1.16
2009	0.87	0.38	-0.12	1.85
2010	1.86	0.18	1.40	2.31
2011	1.47	0.11	1.24	1.70
REGSLOPE	**0.00**	**0.03**	**-0.07**	**0.07**
SITE 2				
1995	0.15	0.63	-1.46	1.76
1996	2.03	1.59	-1.41	5.48
1997	3.70	0.25	3.10	4.31
1998	3.55	1.44	0.03	7.07
1999	3.68	5.55	-8.22	15.58
2000	12.78	1.18	9.89	15.66
2001	30.73	3.12	23.09	38.37
2002	6.67	1.68	2.57	10.77
2003	3.57	0.31	2.90	4.24
2004	5.76	0.53	4.62	6.91
2005	-0.95	2.96	-7.31	5.40
2006	1.88	0.57	0.67	3.10
2007	0.22	0.26	-0.34	0.78
2008	1.50	1.14	-0.95	3.95
2009	1.54	0.34	0.71	2.38
2010	1.70	1.31	-1.49	4.90
2011	2.46	0.37	1.66	3.26
REGSLOPE	**-0.29**	**0.37**	**-1.08**	**0.50**
SITE 3A				
2007	2.39	0.24	1.86	2.93
2008	4.43	0.49	3.36	5.50
2009	2.60	0.15	2.21	2.99
2010	2.75	0.29	2.01	3.48
2011	3.42	0.41	2.53	4.31
REGSLOPE	**0.04**	**0.30**	**-0.92**	**1.00**
SITE 3				
2002	4.62	2.31	-1.31	10.55
2003	7.38	0.99	5.24	9.53
2004	7.40	0.78	5.70	9.10
2005	3.17	0.53	2.03	4.32
2006	7.32	1.16	4.80	9.84
2007	4.46	0.46	3.47	5.45
2008	4.01	1.13	1.56	6.47
2009	3.12	2.67	-3.74	9.99
2010	6.25	2.27	0.41	12.09
2011	0.86	0.75	-0.79	2.50
REGSLOPE	**-0.39**	**0.22**	**-0.89**	**0.12**
SITE 4				
1995	2.44	0.15	2.04	2.84
1996	3.08	0.13	2.79	3.37
1997	2.95	0.09	2.71	3.19
1998	3.50	0.46	2.32	4.67
1999	3.26	0.14	2.96	3.55
2000	3.29	0.20	2.77	3.82
2001	-19.16	22.66	-77.41	39.09
2002	3.98	0.15	3.60	4.35
2003	4.13	1.29	1.33	6.93
2004	4.75	0.79	3.04	6.47
2005	2.12	0.38	1.28	2.95
2006	2.15	0.40	1.28	3.02
2007	2.65	0.09	2.46	2.83
2008	2.98	0.67	1.52	4.44
2009	1.51	0.65	-0.16	3.19
2010	0.76	0.47	-0.46	1.97
2011	2.15	0.30	1.51	2.80
REGSLOPE	**0.02**	**0.28**	**-0.57**	**0.61**

PHOSPHATE - SLOPE

YEAR	*Coefficients*	*Std Err*	*Lower 95%*	*Upper 95%*
SITE 1				
1995	-0.03	0.00	-0.04	-0.02
1996	-0.05	0.00	-0.06	-0.04
1997	-0.04	0.00	-0.05	-0.03
1998	-0.03	0.00	-0.03	-0.02
1999	-0.03	0.00	-0.03	-0.02
2000	-0.02	0.00	-0.03	-0.01
2001	-0.06	0.02	-0.12	0.00
2002	-0.03	0.02	-0.08	0.02
2003	-0.01	0.01	-0.02	0.00
2004	-0.08	0.01	-0.09	-0.06
2005	0.00	0.00	-0.01	0.01
2006	-0.04	0.00	-0.04	-0.03
2007	-0.03	0.01	-0.04	-0.02
2008	-0.02	0.00	-0.03	-0.02
2009	-0.02	0.01	-0.05	0.01
2010	-0.05	0.01	-0.07	-0.04
2011	-0.04	0.00	-0.05	-0.03
REGSLOPE	**0.00**	**0.00**	**0.00**	**0.00**
SITE 2				
1995	0.00	0.02	-0.05	0.04
1996	-0.06	0.05	-0.16	0.04
1997	-0.10	0.01	-0.12	-0.09
1998	-0.10	0.04	-0.20	0.00
1999	-0.10	0.16	-0.44	0.25
2000	-0.36	0.03	-0.45	-0.28
2001	-0.87	0.09	-1.09	-0.65
2002	-0.19	0.05	-0.31	-0.07
2003	-0.10	0.01	-0.12	-0.08
2004	-0.16	0.02	-0.20	-0.13
2005	0.03	0.09	-0.15	0.21
2006	-0.05	0.02	-0.09	-0.02
2007	0.00	0.01	-0.02	0.01
2008	-0.04	0.03	-0.11	0.03
2009	-0.04	0.01	-0.07	-0.02
2010	-0.05	0.04	-0.14	0.05
2011	-0.07	0.01	-0.09	-0.04
REGSLOPE	**0.01**	**0.01**	**-0.01**	**0.03**
SITE 3A				
2007	-0.07	0.01	-0.09	-0.05
2008	-0.13	0.02	-0.16	-0.09
2009	-0.07	0.01	-0.09	-0.06
2010	-0.07	0.01	-0.10	-0.05
2011	-0.09	0.01	-0.12	-0.06
REGSLOPE	**0.00**	**0.01**	**-0.03**	**0.03**
SITE 3				
2002	-0.13	0.07	-0.30	0.04
2003	-0.21	0.03	-0.27	-0.15
2004	-0.21	0.02	-0.26	-0.16
2005	-0.09	0.02	-0.12	-0.06
2006	-0.21	0.03	-0.28	-0.13
2007	-0.13	0.01	-0.16	-0.10
2008	-0.11	0.03	-0.18	-0.04
2009	-0.09	0.08	-0.29	0.11
2010	-0.18	0.07	-0.35	-0.01
2011	-0.02	0.02	-0.07	0.03
REGSLOPE	**0.01**	**0.01**	**0.00**	**0.03**
SITE 4				
1995	-0.07	0.00	-0.08	-0.06
1996	-0.09	0.00	-0.09	-0.08
1997	-0.08	0.00	-0.09	-0.07
1998	-0.10	0.01	-0.13	-0.06
1999	-0.09	0.00	-0.10	-0.08
2000	-0.09	0.01	-0.10	-0.07
2001	0.55	0.65	-1.11	2.21
2002	-0.11	0.00	-0.12	-0.10
2003	-0.11	0.04	-0.19	-0.02
2004	-0.13	0.02	-0.18	-0.08
2005	-0.06	0.01	-0.08	-0.03
2006	-0.06	0.01	-0.08	-0.03
2007	-0.07	0.00	-0.08	-0.07
2008	-0.08	0.02	-0.13	-0.04
2009	-0.04	0.02	-0.09	0.01
2010	-0.02	0.01	-0.06	0.02
2011	-0.06	0.01	-0.08	-0.04
REGSLOPE	**0.00**	**0.01**	**-0.02**	**0.02**