



Assessment of Estuarine Water Quality at Canaveral National Seashore

2024 Data Summary



Looking east across Mosquito Lagoon from Haulover Canal.
NPS / SECN

Assessment of estuarine water quality at Canaveral National Seashore: 2024 data summary

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Abstract

In July 2024 the Southeast Coast Network assessed water-quality at Canaveral National Seashore as part of the National Park Service Vital Signs Monitoring Program. Monitoring was conducted following methods developed by the Environmental Protection Agency (EPA) as part of the National Coastal Assessment Program (EPA 2014). Laboratory analysis measured chlorophyll *a* and total and dissolved concentrations of nitrogen and phosphorous. Field measurements included water temperature, pH, dissolved oxygen, and salinity. Water clarity, which requires a Secchi depth measurement, was calculated when possible. All measured parameters were rated as good, fair, or poor based on thresholds set by the EPA (2012).

The purpose of this document is to report the most recently collected data from the seashore as part of an ongoing long-term water-quality monitoring program. This report was designed to provide water-quality monitoring data to managers as a concise summary in the context of applicable federal standards developed by the EPA. Previous synoptic assessments of water-quality conditions at Canaveral National Seashore were conducted in July 2009, 2013, and 2019 as part of the NPS Inventory and Monitoring program's efforts.

Executive Summary

In July 2024 the Southeast Coast Network assessed water-quality at Canaveral National Seashore as part of the National Park Service Vital Signs Monitoring Program. Monitoring was conducted following methods developed by the Environmental Protection Agency (EPA) as part of the National Coastal Assessment Program (EPA 2014). Laboratory analysis measured chlorophyll *a* and total and dissolved concentrations of nitrogen and phosphorous. Field measurements included water temperature, pH, dissolved oxygen, and salinity. Water clarity, which requires a Secchi depth measurement, was calculated when possible. All measured parameters were rated as good, fair, or poor based on thresholds set by the EPA (2012).

Site level data are summarized as follows:

- Water clarity was rated good at five sites (17%), fair at five sites (17%), poor at seven sites (23%), and could not be assessed at thirteen sites (43%) due to shallow water.
- Chlorophyll *a* concentrations were rated good at twelve sites (40%), and fair at eighteen sites (60%).
- Dissolved inorganic nitrogen (DIN) concentrations were good at all thirty sites (100%).
- Dissolved inorganic phosphorus (DIP) concentrations were good at twenty-nine sites (97%) and fair at one site (3%).
- Dissolved oxygen concentrations (bottom) were rated good at seventeen sites (57%) and fair at twelve sites (40%) and poor at one site (3%).
- A water-quality condition summary index was calculated for each site sampled at Canaveral National Seashore based on the categorical assessments of chlorophyll *a*, DIN and DIP concentrations, dissolved oxygen, and water clarity. This summary index indicated good water-quality conditions at eleven sites (37%) and fair water quality conditions at nineteen sites (63%).
- See [supplemental materials](#) to compare the distribution of good, fair, and poor ratings for each parameter across the period of record.

Park level assessments are summarized as follows:

- Based on the summary water-quality index rating, overall water-quality conditions at Canaveral National Seashore during 2024 sampling were fair.
- The summary water-quality index rating is an improvement from a rating of poor in 2013 and 2019. The last summary water-quality index rating of fair occurred in 2009.

Introduction

Overview

Due to the importance of water resources to park management from ecological, regulatory, and visitor experience perspectives, estuarine water and sediment quality in and around parks were selected to be monitored by the National Park Service (NPS) Inventory and Monitoring Division's Southeast Coast Network (SECN; DeVivo et al. 2008). Since 2005, the network has employed a multiscale approach to assess estuarine resources in seven park units located in North Carolina, Georgia, and Florida. Data collected as part of this effort are intended to help resource managers: (1) better understand ecological processes and impacts caused by development, (2) make informed management decisions, and (3) form/maintain strategic partnerships to monitor and improve water quality conditions in and around park units. In addition, given the diverse and dynamic nature of estuaries, this monitoring is intended to capture the spatial and temporal variability of these systems. Monitoring at permanent fixed stations using continuous data loggers and discrete samples allow for evaluation of temporal patterns in core water quality parameters (dissolved oxygen, pH, salinity, temperature, and turbidity) and nutrients (nitrogen and phosphorus) and chlorophyll *a*.

While fixed-station monitoring provides fine resolution data to determine diel, monthly, and seasonal fluctuations in water quality, it lacks spatial extent. To fill this gap, spatial variability of water and sediment quality is determined with park-wide assessments every five years. These assessments include discrete sampling of nutrients, water quality parameters, and evaluation of sediment contaminants following methods developed by the Environmental Protection Agency-National Coastal Assessment Program. This monitoring approach leads to an understanding of the spatiotemporal status and variability of estuarine water quality and yields information useful to park management.

The Southeast Coast Network's monitoring approach is extensively documented in the Protocol for Monitoring Estuarine Water and Sediment Quality in Selected Southeast Coast Network Parks: Protocol Narrative (Starkey et al. 2023) and associated Standard Operating Procedures (SOPs). Version 1.0 of the protocol (Gregory et al. 2013a) was implemented between 2007 and 2018. Version 2.0 of the protocol was implemented 2019 to present and was updated to align with new technology and techniques documented in revised Standard Operating Procedures. Monitoring objectives remain consistent across both versions of the protocol.

Monitoring Objectives

The Southeast Coast Network identified an overall goal of monitoring the status and trends in water and sediment quality in estuaries surrounding SECN parks. To meet this goal, data are collected and analyzed to meet four specific monitoring objectives. These objectives remain consistent across both versions of the protocol (Gregory et al. 2013a; Starkey et al. 2023) and are listed below:

1. Determine diel and seasonal water-quality patterns for five core parameters (dissolved oxygen, salinity, temperature, pH, and turbidity) at selected coastal areas near SECN parks using fixed-station continuous data loggers.

2. Determine monthly and seasonal patterns in nutrients (nitrogen and phosphorus) and chlorophyll *a* at selected coastal areas near SECN parks by collecting discrete water samples.
3. Determine status and spatial variability of water and nutrient conditions in estuarine waters every five years near SECN parks.
4. Determine status and spatial variability of benthic sediment quality (organic contaminants, carbon, and metal levels) every 10 years in estuarine waters near SECN parks.

This report summarizes water-quality monitoring data collected during a parkwide assessment to address objective 3 at Canaveral National Seashore. Data were gathered from July 16 to July 18, 2024. The purpose of this document is to report the most recently collected data from the seashore as part of an ongoing long-term water-quality monitoring program. This report was designed to provide water-quality monitoring data to managers as a concise summary in the context of applicable federal standards developed by the Environmental Protection Agency (EPA). Previous synoptic assessments of water-quality conditions at Canaveral National Seashore were conducted in July 2009, 2013, and 2019 as part of SECN monitoring efforts (Gregory and Smith 2011; Gregory et al. 2013b; Starkey et al. 2020).

Study Area

Canaveral National Seashore

Natural resources at Canaveral National Seashore include a diverse assemblage of wildlife species, plant communities, geophysical features, and natural processes reflecting the complexity of the land/lagoon/sea interface of east central Florida (Figure 1). Throughout the seashore, the relationship between land and water is paramount. Unlike many barrier islands, Canaveral National Seashore has only a single dune ridge, averaging 12 feet (3.7 meters) in height. For the majority of its length the dune is quite stable, backed by a dense growth of saw palmetto (*Serenoa repens*) and several other species of hardy shrubs and grasses. Mosquito Lagoon, extending along the backside of Canaveral National Seashore's barrier island, is the northernmost part of the Indian River Lagoon. Containing the most diverse assemblage of aquatic species on the entire eastern seaboard, the 155-mile (249.4-kilometer) long Indian River Lagoon has been designated as an Estuary of National Significance by the Environmental Protection Agency and an Outstanding Florida Water by the State of Florida. Commercial shell fishing is extremely important to the local economy; recreational fishing and shrimping in the lagoon support a multimillion-dollar tourist industry. The estuary also acts as an important nursery area for several commercially important ocean-going species such as flounder, mullet, black drum and shrimp.

Canaveral National Seashore faces several complex issues regarding water quality in Mosquito Lagoon. The water in Mosquito Lagoon is designated by the State of Florida as Class II, which is suitable for shellfish propagation and harvesting. As shellfish have been depleted along other portions of the Atlantic coast, harvesting pressure has increased significantly in Mosquito Lagoon. Additionally, the seashore has long been concerned about the impact of commercial harvesting on hard clams (*Mercenaria* spp.) and eastern oysters (*Crassostrea virginica*). Fishermen are coming into Canaveral National Seashore in increasing numbers due to the growing popularity of fly-fishing for redfish, causing harvesting concerns and potential problems related to seagrass scarring by boat propellers. Oyster reefs along major boat channels have also been reported to be stressed or dying due to boat wakes (Wall et al. 2005). As a result, the park has been working with the University of Central Florida since 2008 on oyster reef and shoreline restoration (K. Kneifl, resource manager Canaveral National Seashore, personal communication). Mosquito control is another issue at Canaveral National Seashore. In the designation of lands for NPS management, both NASA and the State of Florida stipulated that Canaveral National Seashore must cooperate with the local mosquito control districts to control salt marsh mosquitoes (Walters et al. 2001).

Since 2012, the lagoon water quality has been relatively impaired due to increased algal blooms caused by high phosphorus and nitrogen (Lapointe et al. 2015). The algal blooms have reduced water clarity and the sunlight reaching the seagrass and thereby likely contributed to seagrass die off in the lagoon (Rice et al. 1983; Virnstein et al. 2007). Continued monitoring of water-quality parameters is very important and the data is used by partners and in planning efforts.

Canaveral National Seashore Significant Waters Map

Southeast Coast Network
National Park Service
U.S. Department of the Interior

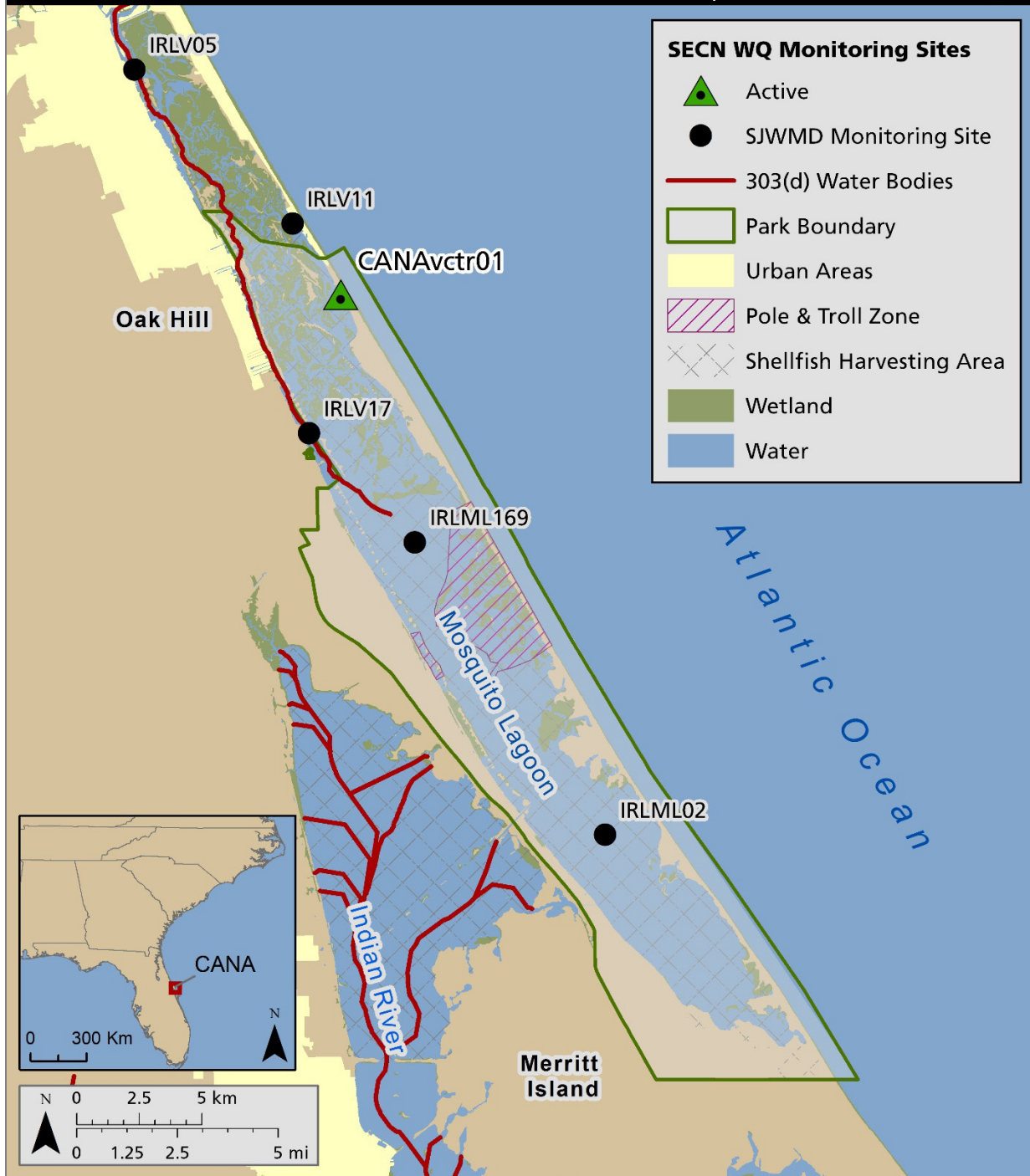


Figure 1. Map of fixed stations monitored by the Southeast Coast Network and St. Johns River Water Management District in Mosquito Lagoon, and significant waters in the vicinity of Canaveral National Seashore, in 2024. Indicated are areas of salt marsh (FWS 2024), urbanized area (USCB 2023), 303(d) listed water bodies (EPA 2022), and areas designated as having special uses or restrictions such as shellfish harvest areas. NPS / SECN

Methods

The water-quality assessment was conducted in estuarine waters in the vicinity of the Canaveral National Seashore following the methods developed by the EPA's National Coastal Assessment Program (EPA 2014). Descriptions of the water-quality parameters and the assessment criteria are from the EPA's National Coastal Assessment IV Report (EPA 2012). Methods used for these assessments were adapted and integrated into protocols tailored specifically to parks in the Southeast Coast Network (Starkey et al. 2023). Site selection and sampling methodology are briefly outlined in the following sections.

In 2024, thirty sites in Mosquito Lagoon were randomly selected for monitoring following methods developed by the EPA (Table 1, Figure 2; Stevens 1997; Stevens and Olsen 1999; Stevens and Olsen 2004). This method of randomly selecting spatially-balanced sites provides managers with a statistically valid estimate of the overall conditions of the assessed resource within or around the park.

Table 1. Site name, waterbody name and location, depth, coordinates, and chemical and physical attributes of sampling sites at Canaveral National Seashore, July 16–18, 2024. The table references site names used to present data in this report (Figure 2). All coordinates are in NAD83 Datum, in UTM zone 17. Salinity, pH, and water temperature were measured at a depth of 0.5 meters (1.6 feet) unless water depth was too shallow in which case it was measured at 0.1 meters (0.3 feet). [SAV—sub-aquatic vegetation; m—meters; °C—degrees Celsius; PSU—practical salinity units].

Site Name	Water Body	UTMX	UTMY	SAV	Debris	Site Depth (m)	Water Temp (°C)	pH	Salinity (PSU)
CANA01_2024	Mosquito Lagoon	524681	3181096	Yes	No	0.5	33.26	8.68	31.16
CANA02_2024	Mosquito Lagoon	518839	3191114	Yes	No	1.8	31.64	8.44	33.87
CANA03_2024	Mosquito Lagoon	513127	3202151	Yes	No	0.6	30.17	8.09	34.21
CANA04_2024	Mosquito Lagoon	518799	3192342	No	No	0.9	31.69	8.45	34.32
CANA05_2024	Mosquito Lagoon	531246	3175699	Yes	No	1.2	30.73	8.92	34.44
CANA06_2024	Mosquito Lagoon	524332	3181730	Yes	No	0.5	31.91	8.63	31.96
CANA07_2024	Mosquito Lagoon	520802	3189083	No	No	2.1	30.32	8.32	32.52
CANA08_2024	Mosquito Lagoon	514995	3201553	No	No	2.2	30.73	8.24	34.19
CANA09_2024	Mosquito Lagoon	531126	3173838	Yes	No	1.8	30.81	8.22	34.01
CANA10_2024	Mosquito Lagoon	527017	3179465	Yes	No	0.5	32.51	8.47	32.30
CANA11_2024	Mosquito Lagoon	520294	3188167	No	No	2.5	30.64	8.32	32.10
CANA12_2024	Indian River N. / ICW	515927	3194132	Yes	No	1.0	30.96	8.29	33.96
CANA13_2024	Mosquito Lagoon	532473	3173096	Yes	No	0.4	29.52	8.29	34.09
CANA14_2024	Mosquito Lagoon	527904	3174949	No	No	0.6	31.54	8.83	34.73
CANA15_2024	Mosquito Lagoon	522264	3183781	No	No	2.1	31.24	8.26	31.23
CANA16_2024	Mosquito Lagoon	517015	3193877	Yes	No	1.0	30.82	8.32	34.10
CANA17_2024	Mosquito Lagoon	532512	3172462	Yes	No	1.3	30.25	8.17	33.94
CANA18_2024	Mosquito Lagoon	520890	3185913	No	No	2.9	30.83	8.32	31.73
CANA19_2024	Mosquito Lagoon	522973	3185675	Yes	No	0.4	29.89	9.02	34.34
CANA20_2024	Mosquito Lagoon	521615	3191866	Yes	No	0.5	29.31	8.49	33.82
CANA21_2024	Mosquito Lagoon	530812	3176497	Yes	No	0.3	30.51	8.78	35.85

Table 1 (continued). Site name, waterbody name and location, depth, coordinates, and chemical and physical attributes of sampling sites at Canaveral National Seashore, July 16–18, 2024. The table references site names used to present data in this report (Figure 2). All coordinates are in NAD83 Datum, in UTM zone 17. Salinity, pH, and water temperature were measured at a depth of 0.5 meters (1.6 feet) unless water depth was too shallow in which case it was measured at 0.1 meters (0.3 feet). [SAV—sub-aquatic vegetation; m—meters; °C—degrees Celsius; PSU—practical salinity units].

Site Name	Water Body	UTMX	UTMY	SAV	Debris	Site Depth (m)	Water Temp (°C)	pH	Salinity (PSU)
CANA22_2024	Mosquito Lagoon	523610	3179937	Yes	No	0.9	33.81	8.26	30.05
CANA23_2024	Mosquito Lagoon	520151	3188879	Yes	No	2.4	30.49	8.32	32.61
CANA24_2024	Indian River N. / ICW	514455	3196943	No	No	2.3	30.89	8.29	34.08
CANA25_2024	Mosquito Lagoon	528734	3174745	Yes	No	1.8	31.65	8.25	34.04
CANA26_2024	Mosquito Lagoon	528523	3178302	Yes	No	1.2	32.25	8.48	33.68
CANA27_2024	Mosquito Lagoon	526483	3182419	Yes	No	0.4	32.46	8.76	34.60
CANA28_2024	Indian River N. / ICW	516955	3192374	Yes	No	1.7	31.67	8.36	33.76
CANA29_2024	Mosquito Lagoon	530113	3172615	Yes	No	0.5	30.50	8.81	34.93
CANA30_2024	Mosquito Lagoon	528109	3176730	No	No	2.1	31.61	8.24	33.67

Canaveral National Seashore
2024 Parkwide Assessment Sampling Sites

Southeast Coast Network
National Park Service
U.S. Department of the Interior

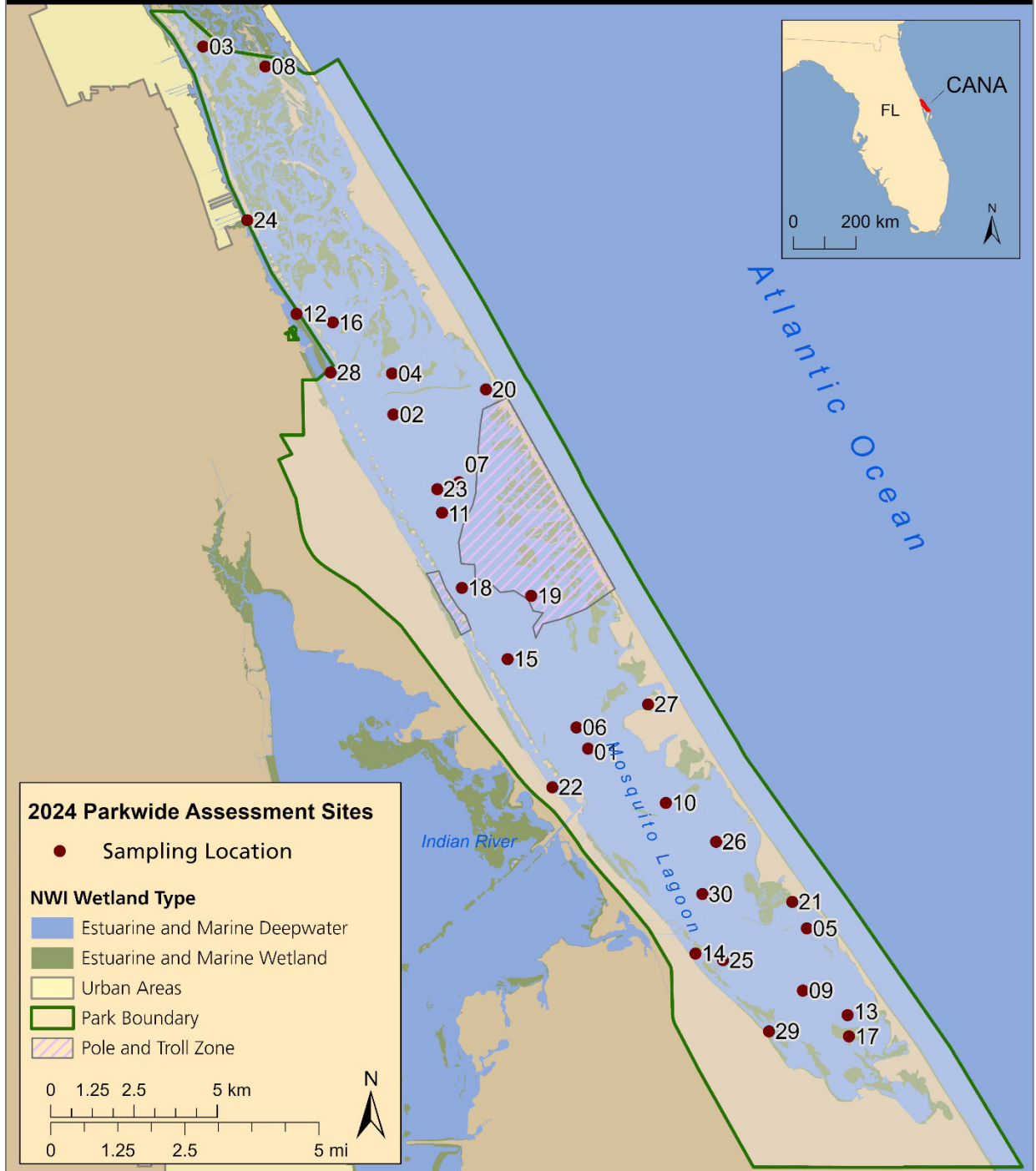


Figure 2. Map showing the location of parkwide assessment sites sampled in July 2024 at Canaveral National Seashore. NPS / SECN

Water-Quality Data Collection

The water-quality assessment conducted during this sampling period incorporated hydrographic profiles at 0.5–1.0 meter (1.6–3.3 feet) intervals at each site, to measure temperature, pH, dissolved oxygen, salinity and turbidity. Chlorophyll *a* and total dissolved nutrient samples were collected from 0.5 meters (1.6 feet) below the surface. Chlorophyll *a* samples were processed using known volumes of water samples that were filtered onto glass-fiber filters then refrigerated and submitted for laboratory analysis.

Water clarity was estimated at each site using a Secchi disk to determine light extinction depths, which were converted to light attenuation coefficients (k) using the equation: $k = c / \text{Secchi depth}$ (in meters) where “ c ” is a constant that corresponds to the water body’s naturally occurring clarity conditions (i.e., $c = 1.0$ for naturally turbid conditions, $c = 1.4$ for normal turbidity conditions, or $c = 1.7$ for waters supporting submerged aquatic vegetation (SAV) restoration [Smith et al. 2006; EPA 2016]). Canaveral National Seashore’s Mosquito Lagoon uses a constant (c) of 1.7 due to Indian River Lagoon’s designation as a SAV area (EPA 2016). This method of estimating water-clarity condition is generally used when information on light transmission in the water column is missing. The SECN is reporting derived values to maintain data consistency across network parks. Water clarity was not assessed at sites with excessive current or depths too shallow to ascertain an accurate Secchi measurement. Measures of turbidity from the hydrologic profile are used as a surrogate parameter when Secchi depths are not available. When sites were too shallow to access by boat or were in heavily trafficked channels where safety was a concern, alternate sites were used.

Water-Quality Assessment Criteria

The categorical assessments (e.g., good, fair, poor) use measurements of water clarity, chlorophyll *a*, dissolved inorganic nitrogen, dissolved inorganic phosphorus and bottom dissolved oxygen (Table 2) and are intended to characterize acutely degraded water-quality conditions at a site. The assessments do not consistently identify sites that experience occasional or infrequent hypoxia, nutrient enrichment, or decreased water clarity. Therefore, a rating of poor for the water-quality index means the site likely exhibited consistently poor conditions before or after the assessment period. If a site is designated fair or good, the site did not experience poor conditions on the date of sampling; however, the site could be characterized by poor conditions for short time periods.

Site assessments were also made using an index that combines the ratings for each parameter into a site-specific water-quality index rating. This index allows for general comparisons between sites in a park (Table 3) and can be used to summarize overall conditions in the waters around a park. This rating also allows general comparisons between parks and at the same park over time based on the percentage of sites that fall within the good, fair, or poor categories.

While not used to determine site and park condition ratings, turbidity at 0.5 meters (1.6 feet) and presence or absence of submerged aquatic vegetation (SAV) are useful parameters to gauge site health not otherwise captured by the EPA’s condition criteria. The SECN turbidity condition criteria (< 1.0 = good, 1.0 – 3.0 = fair, > 3.0 = poor) were developed specifically for CANA and were determined by comparing CANA water clarity condition ratings and turbidity data. These turbidity

criteria do not replace assessment of water clarity but are used as a surrogate parameter when Secchi depths are not available due to shallow water.

Table 2. Water-quality monitoring condition criteria for water-quality parameters collected by the Southeast Coast Network based on thresholds set by EPA (2012) [$\mu\text{g/L}$ —micrograms per liter; mg/L —milligrams per liter].

Rating	Water Clarity (k) ^A	Chlorophyll a ($\mu\text{g/L}$)	Dissolved Inorganic Nitrogen (DIN) (mg/L)	Dissolved Inorganic Phosphorus (DIP) (mg/L)	Dissolved Oxygen (mg/L)
Good	< 0.92	< 5	< 0.1	< 0.01	>5
Fair	0.92–1.61	5–20	0.1–0.5	0.01–0.05	2–5
Poor	> 1.61	> 20	> 0.5	> 0.05	<2

^A Light attenuation coefficients (k) were used to assess water-clarity conditions using criteria categories in Smith et al. (2006) which are comparable to the EPA (2012) criteria for the assessed water bodies.

Table 3. Condition criteria used for water-quality assessment summaries at individual sampling sites and parks.

Rating	Site Water-Quality Index Rating ^A	Park Water-Quality Index Rating ^A
Good	A maximum of one indicator is rated fair, and no indicators are rated poor.	Less than 10% of sites are in poor condition, and more than 50% of sites are in good condition.
Fair	One indicator is rated poor, or two or more indicators are rated fair.	10% to 20% of sites are in poor condition, or 50% or less of sites are in good condition.
Poor	Two or more of the five indicators are rated poor.	More than 20% of sites are in poor condition.
Missing	Two components of the indicator are missing and the available indicators do not suggest a fair or poor rating.	NA

^A Park and site water-quality index ratings are adapted from ratings established by the EPA (2012).

Results

Parameter-Based Water Condition Assessments

Figures 3–7 illustrate the spatial distribution of sampling sites and the corresponding ratings for water clarity, chlorophyll *a*, dissolved inorganic nitrogen (DIN), dissolved inorganic phosphorus (DIP), and bottom-reading dissolved oxygen (DO) based on each parameter’s corresponding condition category. Inset graphs on Figures 3–7 show the proportion of sites in the assessed area that were placed in each rating category. The map and graph in Figure 8 summarize Canaveral National Seashore’s water-quality conditions during the assessment. Site-specific water-quality data for each parameter are also presented in Table 4. In addition to the SECN’s standard assessments based on EPA protocols, Figures 9 and 10 provide site condition for turbidity and presence/absence of SAV. For comparison with past assessments, maps and condition rating summary graphs for sample years 2009–2019 can be found in the [supplementary materials](#). The [data package](#) contains data and associated metadata used in the preparation of this report.

Site level data are summarized as follows:

- Water clarity was rated good at five sites (17%), fair at five sites (17%), poor at 7 sites (23%), and could not be assessed at thirteen sites (43%) due to shallow water.
- Chlorophyll *a* concentrations were rated good at twelve sites (40%), and fair at eighteen sites (60%).
- Dissolved inorganic nitrogen concentrations were good at all thirty sites (100%).
- Dissolved inorganic phosphorus concentrations were good at 29 sites (97%) and fair at one site (3%).
- Dissolved oxygen concentrations (bottom) were rated good at seventeen sites (57%), fair at twelve sites (40%) and poor at one site (3%).
- A water-quality condition summary index was calculated for each site sampled at Canaveral National Seashore based on the categorical assessments of chlorophyll *a*, DIN and DIP concentrations, dissolved oxygen, and water clarity. This summary index indicated good water-quality conditions at eleven sites (37%) and fair water quality conditions at nineteen sites (63%). By comparison, in 2019 the summary index indicated good water-quality conditions at only one site (3.3%), fair conditions at 16 sites (53.3%) and poor conditions at thirteen sites (43.3%). Graphs of each parameter’s condition rating throughout the period of record are provided in the [supplemental materials](#).

Park level assessments are summarized as follows:

- Based on the summary water-quality index rating, overall water-quality conditions at Canaveral National Seashore during 2024 sampling were fair.
- The distribution of good, fair, and poor ratings for each parameter across the period of record can be seen using the maps provided in the [supplemental materials](#).

- The summary water-quality index rating is an improvement from a rating of poor in 2013 and 2019. The last summary water-quality index rating of fair occurred in 2009 (see [supplemental materials](#)).

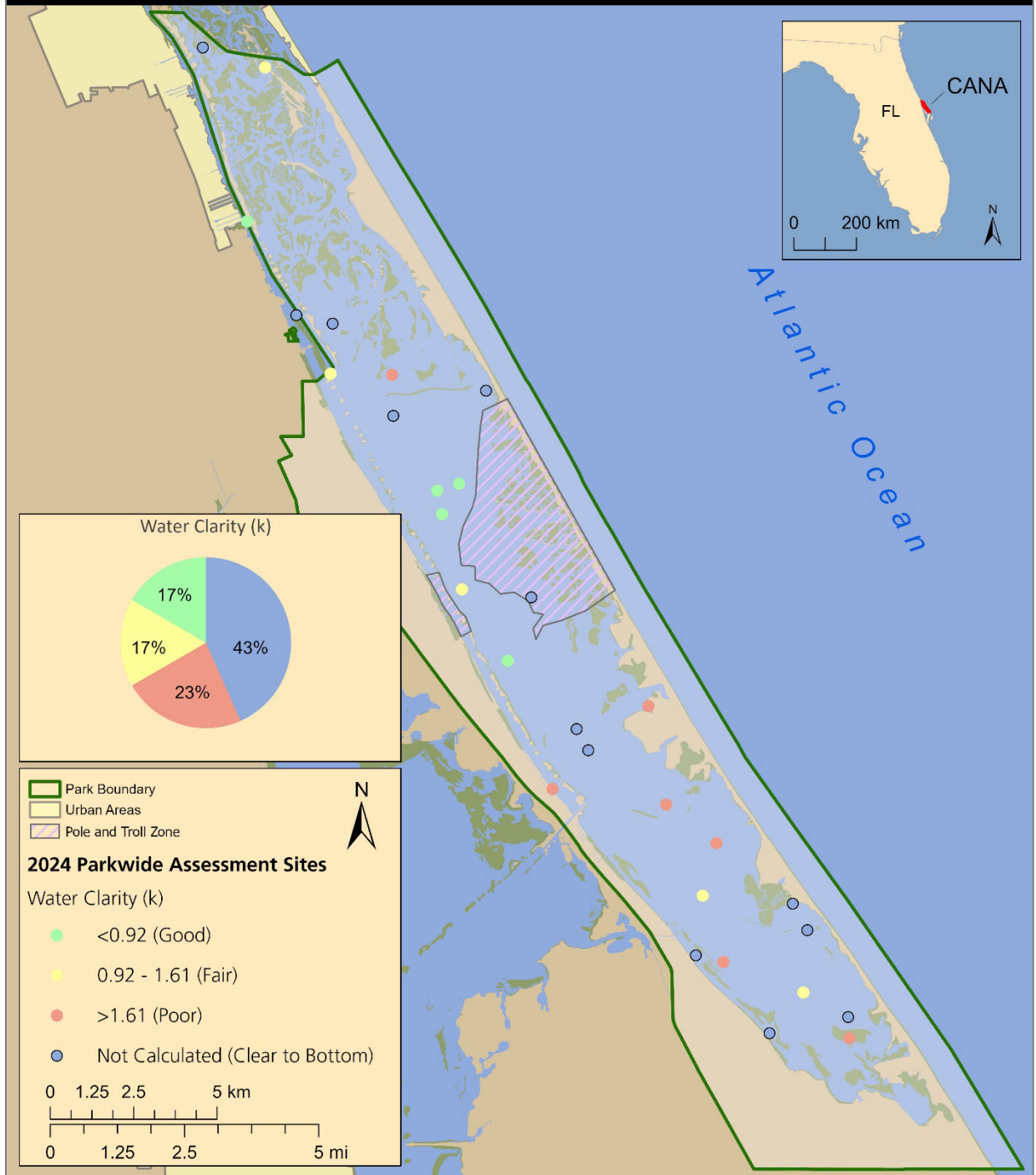


Figure 3. Water clarity ratings for sites sampled at Canaveral National Seashore July 16–18, 2024. Inset graph shows the percent of sites in each condition category [Green—good; yellow—fair; red—poor; blue—not calculated, clear to bottom]. NPS / SECN

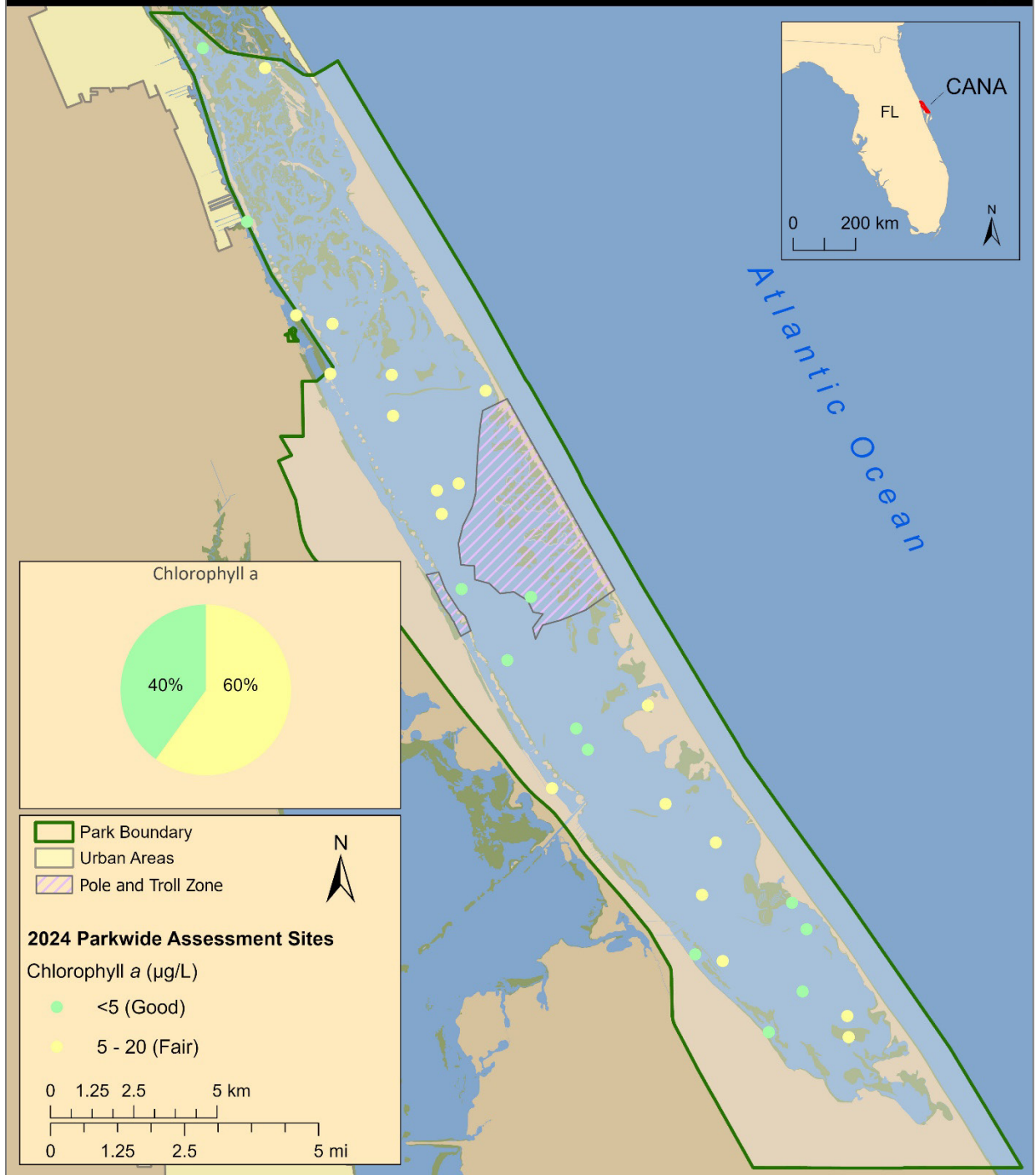


Figure 4. Chlorophyll a concentrations for sites sampled at Canaveral National Seashore July 16–18, 2024. Inset graph shows the percent of sites in each condition category [Green—good; yellow—fair].
NPS / SECN

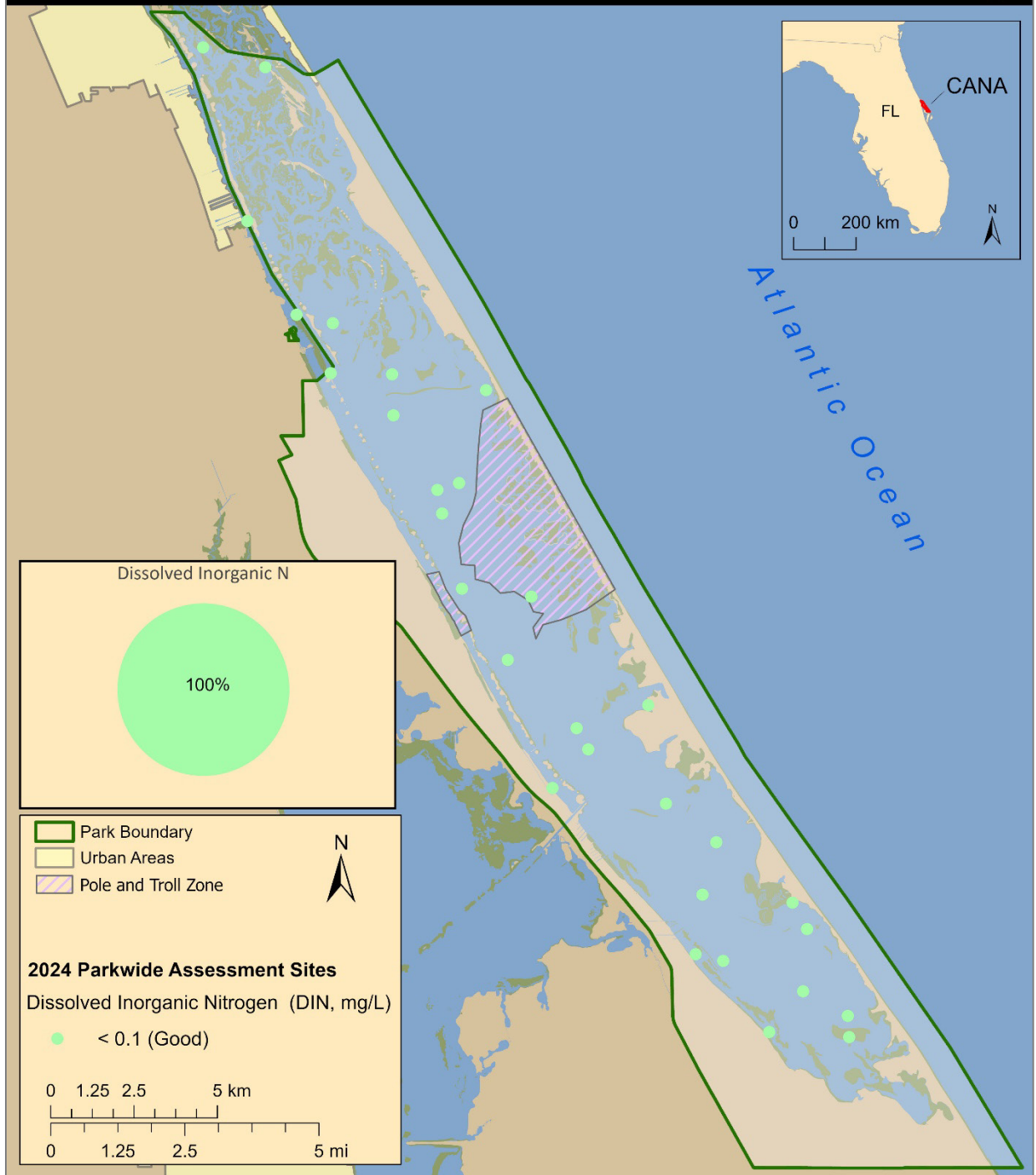


Figure 5. Dissolved inorganic nitrogen concentrations for sites sampled at Canaveral National Seashore July 16–18, 2024. Inset graph shows the percent of sites in each condition category [Green—good].
NPS / SECN

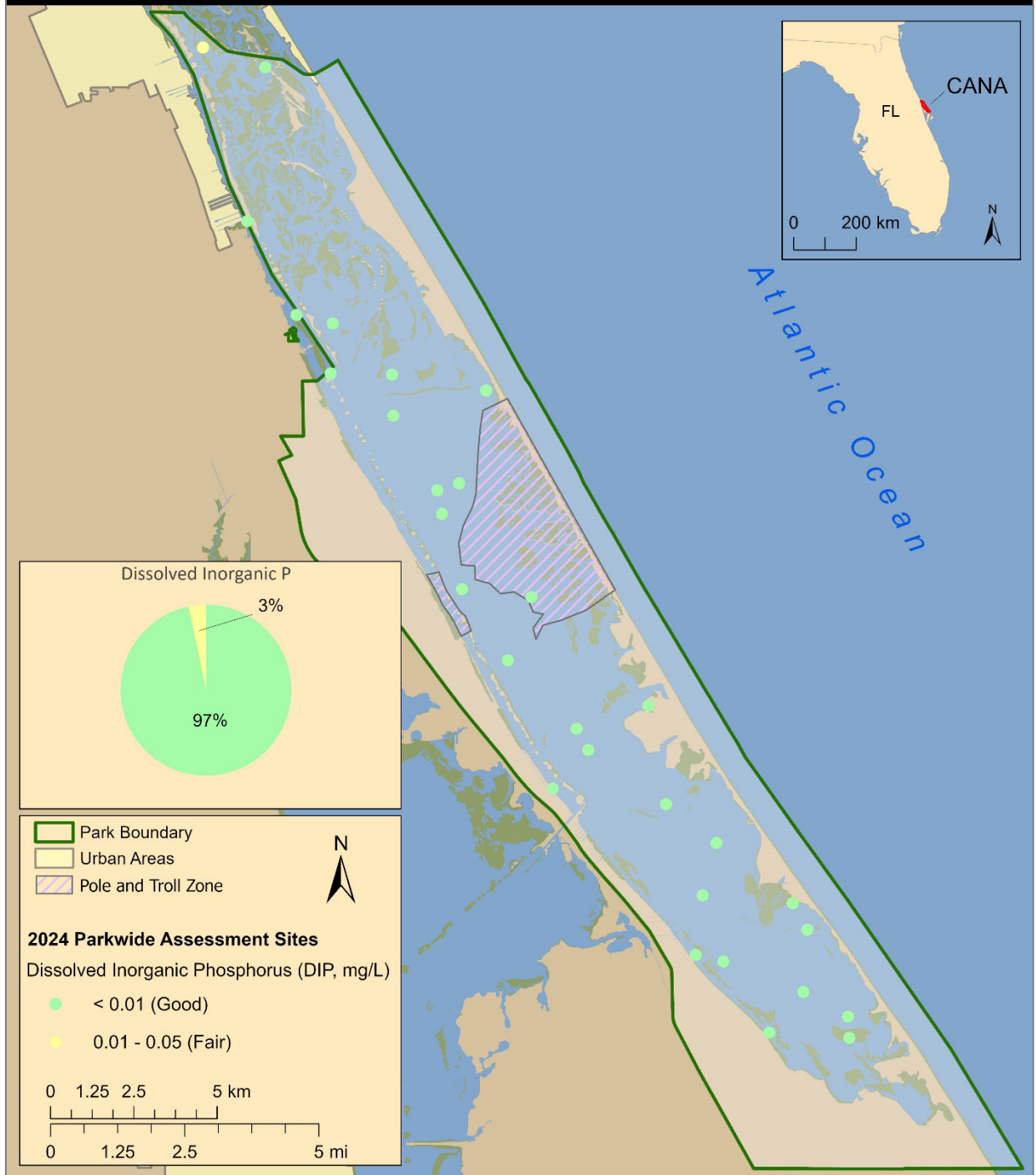


Figure 6. Dissolved inorganic phosphorus concentrations for sites sampled at Canaveral National Seashore July 16–18, 2024. Inset graph shows the percent of sites in each condition category [Green—good; yellow—fair]. NPS / SECN

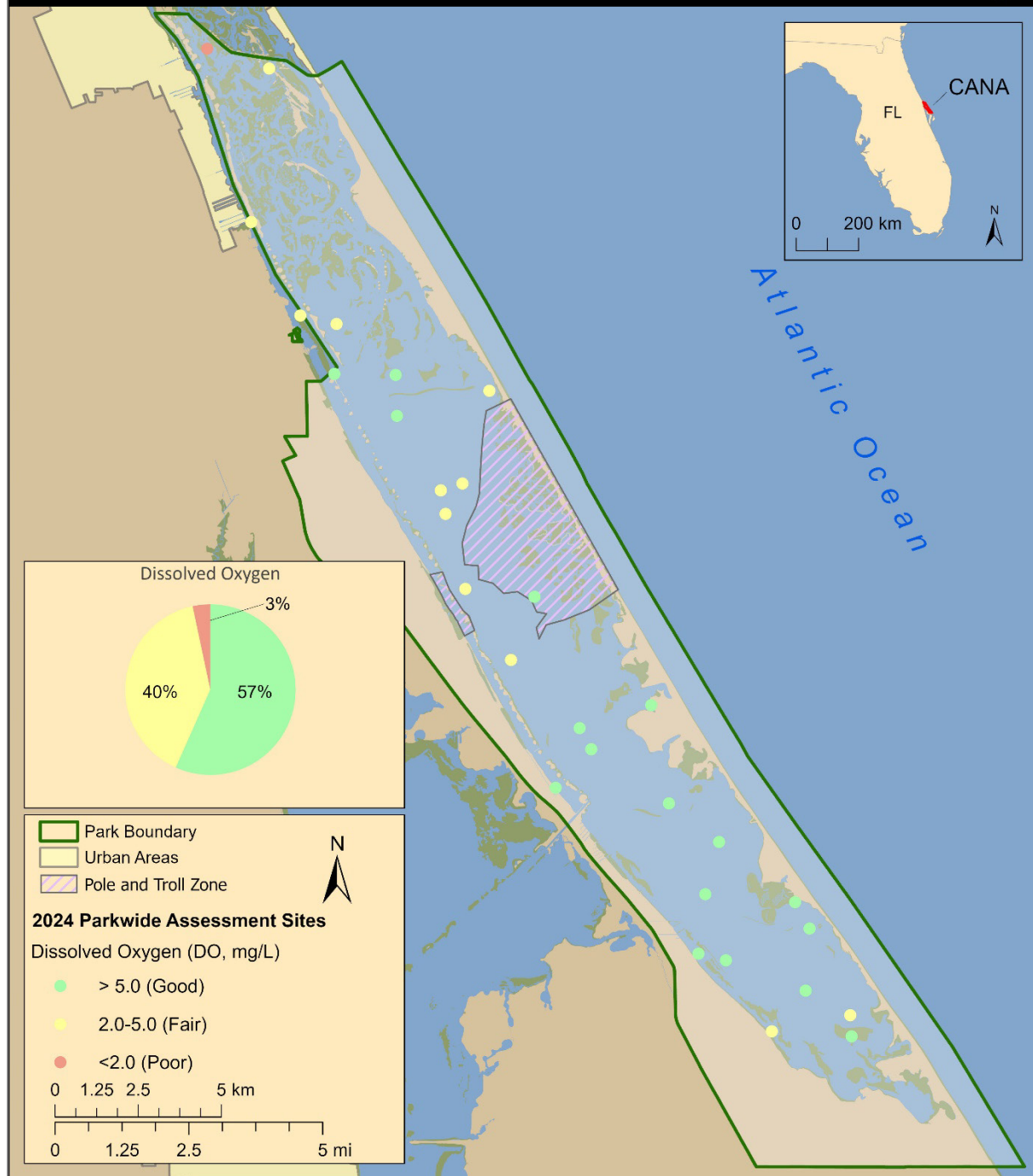


Figure 7. Dissolved oxygen concentrations for sites sampled at Canaveral National Seashore July 16–18, 2024. Inset graph shows the proportion of sites in each condition category [Green—good; yellow—fair; red—poor]. NPS / SECN

Canaveral National Seashore
2024 Site Water Quality Index Rating

Southeast Coast Network
National Park Service
U.S. Department of the Interior

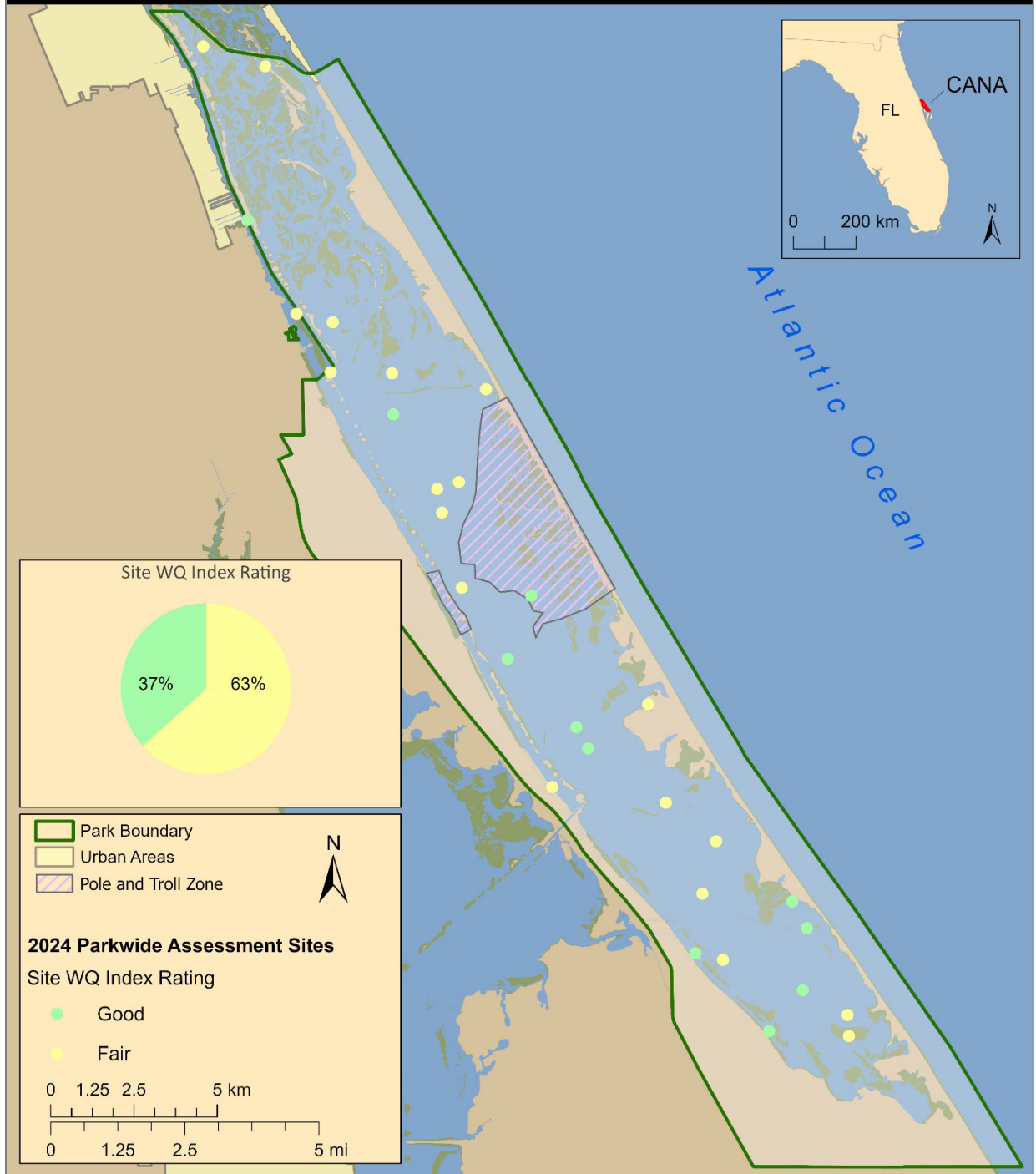


Figure 8. Water-quality index rating for sites sampled at Canaveral National Seashore July 16–18, 2024. Inset graph shows the proportion of sites in each condition category [Green—good; yellow—fair].
NPS / SECN

Table 4. Water-quality parameter values and assessment conditions for sampling sites in Mosquito Lagoon at Canaveral National Seashore July 16–18, 2024. Water clarity was assessed using light attenuation values (k) using a constant (1.7) for estuarine waters that are supporting submerged aquatic vegetation (SAV) restoration (Smith et al. 2006) and assessment categories that correspond to EPA (2012). Condition of other assessed parameters based on EPA (2012) [Green^D —good; yellow^E —fair; red^F —poor; ^G result was less than or equal to the Method Detection Limit [MDL reported]; k— light attenuation coefficient; µg/L—micrograms per liter; N—Nitrogen; mg/L—milligrams per liter; P— Phosphorous; "—" — data not collected]. Dissolved oxygen concentrations are taken near the bottom (deepest reading).

Site	Water Clarity (k) ^A	Chlorophyll a (µg/L) ^B	Dissolved Oxygen (DO, mg/L) ^B	Dissolved Inorganic Nitrogen (DIN, mg/L) ^B	Dissolved Inorganic Phosphorus (DIP, mg/L) ^B	Total Dissolved Nitrogen (mg/L) ^{B,C}	Total Dissolved Phosphorus (mg/L) ^{B,C}	Site WQ Index Rating
CANA01_2024	N/A	1.95 ^D	11.1 ^D	0.013 ^D	0.0034 ^{D, G}	1.02	0.012	Good ^D
CANA02_2024	N/A	6.92 ^E	6.6 ^D	0.020 ^D	0.0034 ^{D, G}	0.84	0.012	Good ^D
CANA03_2024	N/A	4.80 ^D	1.5 ^F	0.067 ^D	0.0227 ^E	0.89	0.034	Fair ^E
CANA04_2024	2.1 ^F	10.56 ^E	5.3 ^D	0.018 ^D	0.0034 ^{D, G}	0.88	0.008	Fair ^E
CANA05_2024	N/A	3.58 ^D	6.6 ^D	0.016 ^D	0.0034 ^{D, G}	0.96	0.009	Good ^D
CANA06_2024	N/A	4.38 ^D	9.5 ^D	0.011 ^D	0.0034 ^{D, G}	0.99	0.013	Good ^D
CANA07_2024	0.8 ^D	9.67 ^E	4.0 ^E	0.043 ^D	0.0034 ^{D, G}	0.94	0.008	Fair ^E
CANA08_2024	1.4 ^E	10.93 ^E	3.7 ^E	0.023 ^D	0.0056 ^D	0.88	0.018	Fair ^E
CANA09_2024	1.1 ^E	4.85 ^D	5.6 ^D	0.012 ^D	0.0034 ^{D, G}	0.84	0.006	Good ^D
CANA10_2024	3.4 ^F	14.24 ^E	7.5 ^D	0.011 ^D	0.0034 ^{D, G}	0.91	0.011	Fair ^E
CANA11_2024	0.8 ^D	5.21 ^E	4.7 ^E	0.049 ^D	0.0034 ^{D, G}	0.95	0.010	Fair ^E

^A Light attenuation coefficients (k) were used to assess water-clarity conditions using criteria categories in Smith et al. (2006) which are comparable to the EPA (2012) criteria for the assessed water bodies.

^B Where µg/L = micrograms per liter, N = Nitrogen; mg/L = milligrams per liter; P = Phosphorous.

^C There are no EPA condition criteria for TDN and TDP.

^D Conditions are assessed as good using parameters from the EPA (2012) (also with a green background).

^E Conditions are assessed as fair using parameters from the EPA (2012) (also with a yellow background).

^F Conditions are assessed as poor using parameters from the EPA (2012) (also with a red background).

^G Result was less than or equal to the Method Detection Limit [MDL reported].

Table 4 (continued). Water-quality parameter values and assessment conditions for sampling sites in Mosquito Lagoon at Canaveral National Seashore July 16–18, 2024. Water clarity was assessed using light attenuation values (k) using a constant (1.7) for estuarine waters that are supporting submerged aquatic vegetation (SAV) restoration (Smith et al. 2006) and assessment categories that correspond to EPA (2012). Condition of other assessed parameters based on EPA (2012) [Green ^D —good; yellow ^E —fair; red ^F —poor; ^G result was less than or equal to the Method Detection Limit [MDL reported]; k— light attenuation coefficient; µg/L—micrograms per liter; N—Nitrogen; mg/L—milligrams per liter; P—Phosphorous; "-" — data not collected]. Dissolved oxygen concentrations are taken near the bottom (deepest reading).

Site	Water Clarity (k) ^A	Chlorophyll a (µg/L) ^B	Dissolved Oxygen (DO, mg/L) ^B	Dissolved Inorganic Nitrogen (DIN, mg/L) ^B	Dissolved Inorganic Phosphorus (DIP, mg/L) ^B	Total Dissolved Nitrogen (mg/L) ^{B,C}	Total Dissolved Phosphorus (mg/L) ^{B,C}	Site WQ Index Rating
CANA12_2024	N/A	5.06 ^E	3.5 ^E	0.026 ^D	0.0067 ^D	0.85	0.021	Fair ^E
CANA13_2024	N/A	5.88 ^E	2.1 ^E	0.014 ^D	0.0034 ^{D, G}	0.95	0.009	Fair ^E
CANA14_2024	N/A	4.99 ^D	5.9 ^D	0.011 ^D	0.0034 ^{D, G}	1.05	0.008	Good ^D
CANA15_2024	0.8 ^D	2.90 ^D	4.6 ^E	0.055 ^D	0.0034 ^{D, G}	1.01	0.017	Good ^D
CANA16_2024	N/A	5.93 ^E	3.6 ^E	0.016 ^D	0.0034 ^{D, G}	0.75	0.014	Fair ^E
CANA17_2024	1.9 ^F	7.13 ^E	5.2 ^D	0.011 ^D	0.0060 ^D	0.94	0.021	Fair ^E
CANA18_2024	1.1 ^E	3.78 ^D	3.9 ^E	0.047 ^D	0.0034 ^{D, G}	0.98	0.014	Fair ^E
CANA19_2024	N/A	3.74 ^D	6.7 ^D	0.011 ^D	0.0034 ^{D, G}	0.97	0.012	Good ^D
CANA20_2024	N/A	19.39 ^E	3.4 ^E	0.051 ^D	0.0034 ^{D, G}	0.97	0.014	Fair ^E
CANA21_2024	N/A	1.91 ^D	6.1 ^D	0.011 ^D	0.0034 ^{D, G}	1.05	0.010	Good ^D
CANA22_2024	1.7 ^F	5.80 ^E	7.2 ^D	0.041 ^D	0.0034 ^{D, G}	0.99	0.014	Fair ^E

^A Light attenuation coefficients (k) were used to assess water-clarity conditions using criteria categories in Smith et al. (2006) which are comparable to the EPA (2012) criteria for the assessed water bodies.

^B Where µg/L = micrograms per liter, N = Nitrogen; mg/L = milligrams per liter; P = Phosphorous.

^C There are no EPA condition criteria for TDN and TDP.

^D Conditions are assessed as good using parameters from the EPA (2012) (also with a green background).

^E Conditions are assessed as fair using parameters from the EPA (2012) (also with a yellow background).

^F Conditions are assessed as poor using parameters from the EPA (2012) (also with a red background).

^G Result was less than or equal to the Method Detection Limit [MDL reported].

Table 4 (continued). Water-quality parameter values and assessment conditions for sampling sites in Mosquito Lagoon at Canaveral National Seashore July 16–18, 2024. Water clarity was assessed using light attenuation values (k) using a constant (1.7) for estuarine waters that are supporting submerged aquatic vegetation (SAV) restoration (Smith et al. 2006) and assessment categories that correspond to EPA (2012). Condition of other assessed parameters based on EPA (2012) [Green^D —good; yellow^E —fair; red^F —poor; ^G result was less than or equal to the Method Detection Limit [MDL reported]; k— light attenuation coefficient; µg/L—micrograms per liter; N—Nitrogen; mg/L—milligrams per liter; P—Phosphorous; "-" — data not collected]. Dissolved oxygen concentrations are taken near the bottom (deepest reading).

Site	Water Clarity (k) ^A	Chlorophyll a (µg/L) ^B	Dissolved Oxygen (DO, mg/L) ^B	Dissolved Inorganic Nitrogen (DIN, mg/L) ^B	Dissolved Inorganic Phosphorus (DIP, mg/L) ^B	Total Dissolved Nitrogen (mg/L) ^{B,C}	Total Dissolved Phosphorus (mg/L) ^{B,C}	Site WQ Index Rating
CANA23_2024	0.9 ^D	5.49 ^E	4.9 ^E	0.05 ^D	0.0034 ^{D, G}	0.95	0.015	Fair ^E
CANA24_2024	0.8 ^D	4.55 ^D	3.7 ^E	0.020 ^D	0.0045 ^D	0.86	0.021	Good ^D
CANA25_2024	1.7 ^F	5.73 ^E	5.8 ^D	0.012 ^D	0.0034 ^{D, G}	0.84	0.013	Fair ^E
CANA26_2024	1.7 ^F	10.92 ^E	7.2 ^D	0.011 ^D	0.0034 ^{D, G}	0.89	0.015	Fair ^E
CANA27_2024	4.3 ^F	15.89 ^E	6.5 ^D	0.014 ^D	0.0034 ^{D, G}	1.04	0.011	Fair ^E
CANA28_2024	1.1 ^E	10.21 ^E	5.7 ^D	0.011 ^D	0.0039 ^D	0.87	0.019	Fair ^E
CANA29_2024	N/A	4.68 ^D	4.4 ^E	0.011 ^D	0.0034 ^{D, G}	1.10	0.016	Good ^D
CANA30_2024	1.4 ^E	5.91 ^E	6.6 ^D	0.011 ^D	0.0034 ^{D, G}	0.96	0.014	Fair ^E

^A Light attenuation coefficients (k) were used to assess water-clarity conditions using criteria categories in Smith et al. (2006) which are comparable to the EPA (2012) criteria for the assessed water bodies.

^B Where µg/L = micrograms per liter, N = Nitrogen; mg/L = milligrams per liter; P = Phosphorous.

^C There are no EPA condition criteria for TDN and TDP.

^D Conditions are assessed as good using parameters from the EPA (2012) (also with a green background).

^E Conditions are assessed as fair using parameters from the EPA (2012) (also with a yellow background).

^F Conditions are assessed as poor using parameters from the EPA (2012) (also with a red background).

^G Result was less than or equal to the Method Detection Limit [MDL reported].

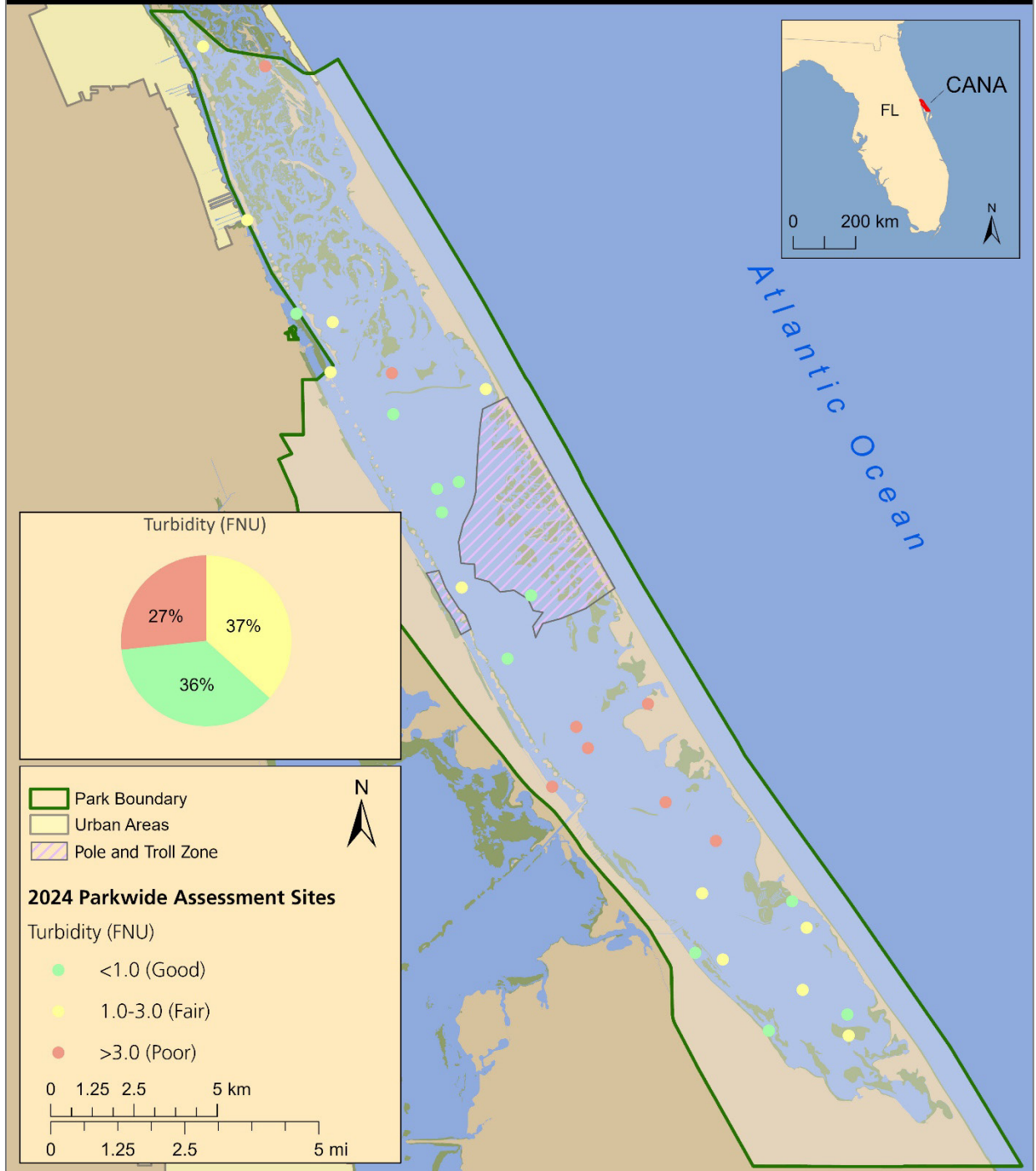


Figure 9. Turbidity readings at sites sampled at Canaveral National Seashore July 16–18, 2024. Inset graph shows the proportion of sites in each SECN condition category for turbidity at CANA [Green—good; yellow—fair; red—poor]. NPS / SECN

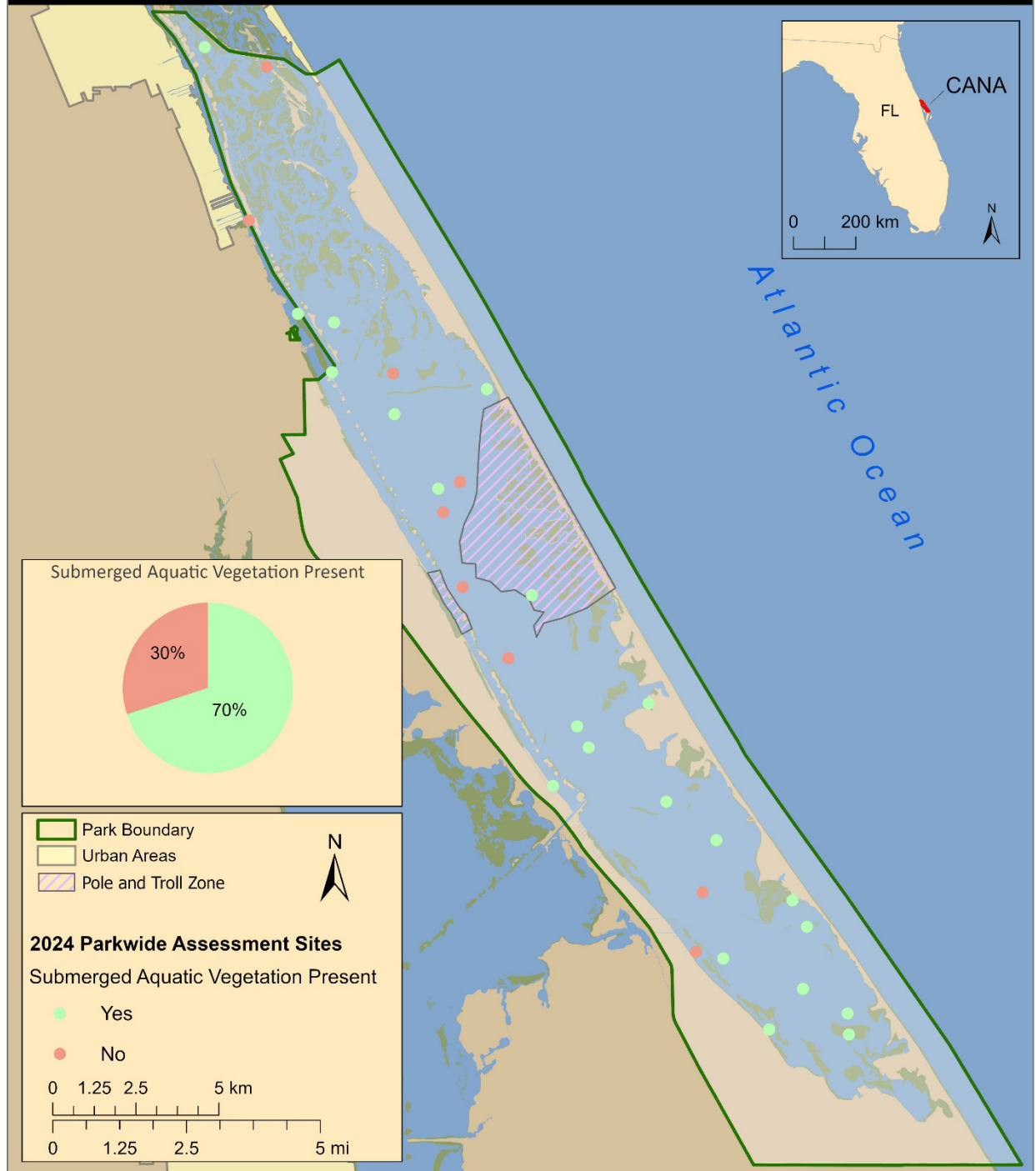


Figure 10. Submerged aquatic vegetation presence/absence for sites sampled at Canaveral National Seashore July 16–18, 2024. Inset graph shows the proportion of sites in each condition category [Green—yes; red—no]. NPS / SECN

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