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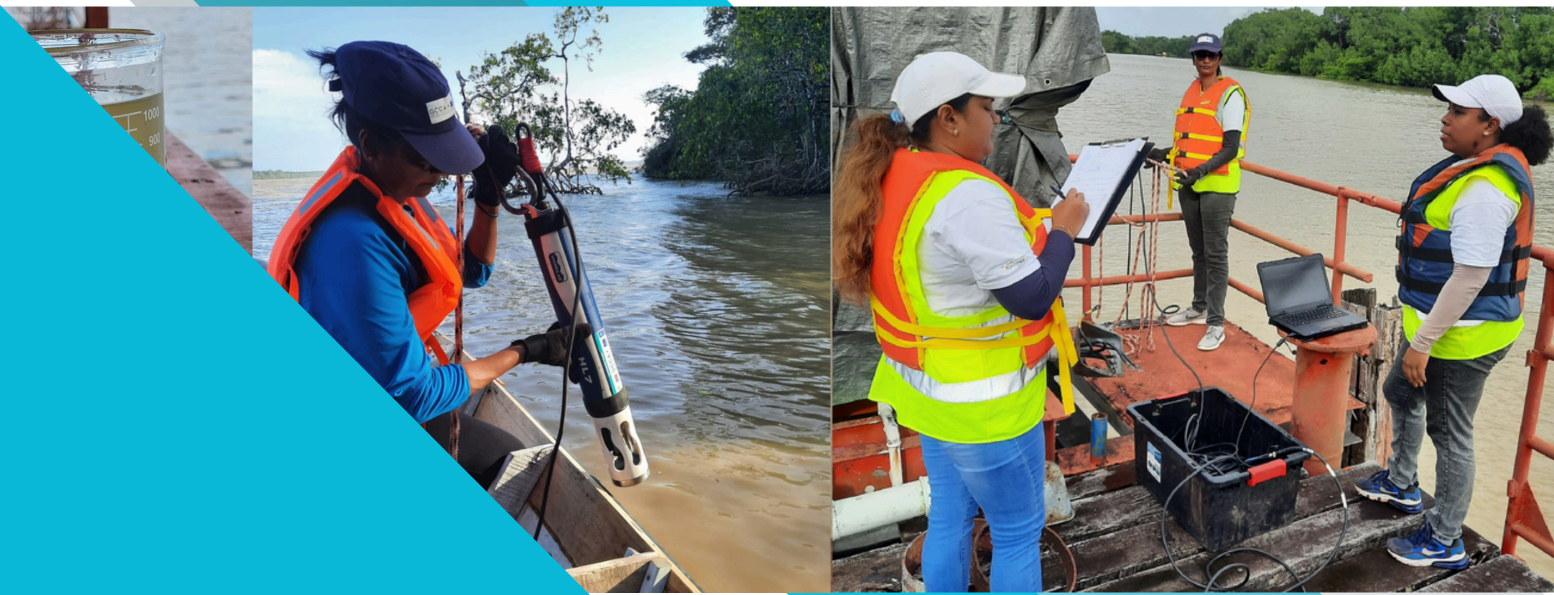
Paramaribo – Suriname

Water quality technical report for surface water resources in Suriname

October - December 2023



Hydraulic Research Division

GCCA+
THE GLOBAL CLIMATE CHANGE ALLIANCE PLUS INITIATIVE
Funded by the European Union
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Document: Water quality technical report for surface water resources in Suriname – second report

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Abbreviations

WLA	Hydraulic Research Division
UNDP	United Nations Development Program
GCCA	Global Climate Change Alliance
ILACO	International Land Development Consultants
Temp	Temperature
Cond	Conductivity
Sal	Salinity
Turb	Turbidity
TDS	Total Dissolved Solids
DO	Dissolved Oxygen
Fig	Figure
g/L	Gram per Liter
mg/L	Milligram per Liter
µS/cm	Microsiemens per centimeter
ppt	Parts Per Thousand
NTU	Nephelometric Turbidity Unit

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Executive Summary

This Water Quality Technical Report, covering the period from October to December 2023, presents an in-depth analysis of surface water resources in Suriname, conducted by the Hydraulic Research Division under the Ministry of Public Works. The report is the third in a series, highlighting significant findings, methodologies, and recommendations for improving water quality management in the region.

Key Highlights:

1. **Scope and Methodology:**
    - The study encompassed major rivers including the Corantijn, Coppename, Saramacca, and Nickerie Rivers, as well as the Coronie district.
    - Water quality assessments were conducted using the Hydrolab 7 instrument, measuring parameters such as pH, temperature, dissolved oxygen (DO), total dissolved solids (TDS), turbidity, conductivity, and salinity.
    - Data collection and analysis were supported by various stakeholders, including the Global Climate Change Alliance (GCCA+), the European Union (EU), and the United Nations Development Programme (UNDP).
2. **Findings:**
    - **Corantijn River:** Issues with turbidity sensor malfunctions were noted. Distinctions between inland and coastal water quality were observed, with coastal areas showing higher total dissolved solids (TDS) due to saltwater intrusion.
    - **Coppename River:** Higher turbidity levels were recorded at downstream locations, influenced by both natural processes and human activities.
    - **Saramacca River:** Notable variations in water quality were detected, reflecting different land uses and environmental conditions along the river.
    - **Nickerie River:** Elevated conductivity and salinity levels were linked to agricultural activities and saltwater intrusion.
    - **Coronie District:** Diverse water quality parameters were mapped, indicating distinct characteristics between freshwater and saltwater areas.
3. **Proposed Standards:**
    - The report references international water quality standards from the US Environmental Protection Agency (US EPA) and the Food and Agriculture Organization (FAO) to benchmark local measurements.
    - Recommendations are made to adopt these standards to ensure water safety for various uses, including agriculture, recreation, and drinking.

4. **Challenges and Limitations:**
    - The absence of established national water quality standards and a dedicated chemical laboratory for comprehensive testing was identified as a significant limitation.
    - Logistical challenges in accessing remote monitoring stations led to gaps in simultaneous data collection.
5. **Recommendations:**
    - The report advocates for the establishment of national water quality standards tailored to local conditions.
    - Enhanced collaboration with international organizations to secure technical and financial support for building local testing capabilities.
    - Continuous monitoring and data collection to update and refine water quality standards and management practices.

Conclusion: This report provides critical insights into the state of surface water quality in Suriname, underscoring the need for robust standards and improved monitoring infrastructure. The findings serve as a foundation for informed decision-making and strategic planning to safeguard Suriname's water resources, ensuring their sustainability and suitability for various uses.

Foreword

We are excited to present this comprehensive report on water quality in Suriname, with a special focus on our surface water sources. This document is the result of extensive collaboration among various stakeholders, and we are proud to share its findings and recommendations with you.

Our sincere gratitude goes to the Global Climate Change Alliance (GCCA+) phase 2 project, funded by the European Union (EU) and United Nations Development Programme (UNDP) Suriname for their continuous (financial and technical) support and cooperation in our efforts to improve water quality in our country.

We especially wish to acknowledge Dr. Jonathan Cox for his invaluable training, which has significantly enhanced our understanding of water quality analysis. Furthermore, we extend our thanks to the Water Forum Suriname for their dedication over six months (in 2022) of collaboration in collecting and analyzing water quality data in Coronie and Nickerie.

Thank you for your interest in this report. We hope that the findings and recommendations herein will contribute to a deeper understanding and improvement of water quality in Suriname.

1. Introduction

The Hydraulic Research Division (WLA) plays an essential role in managing our hydrological and water quality data for surface water sources. WLA falls under the Research and Services Directorate of the Ministry of Public Works. The department consists of three main sections: Scientific Research, Basic Measurement & Logistics, and Administration. Scientific research is mainly responsible for processing, storing, and analyzing the collected measurement data and its publication, as well as conducting scientific research. Basic Monitoring Network and Logistics is mainly responsible for preparing and implementing fieldwork, data collection and processing, and the service's logistics facilities.

The stakeholders of WLA are:

- Water Forum Suriname
- Anton de Kom University (A.D.E.K.)
- Agricultural Research Suriname (Celos)
- Ministry of Health (Central Laboratory)
- Ministry of Agriculture, Livestock, and Fisheries (L.V.V.)

This report presents the findings of a comprehensive assessment of water quality in Suriname, focusing on surface water sources. Water quality assessments were conducted between October and December 2023 in several rivers, including the Corantijn River, Coppename River, Saramacca River, Nickerie River and the Coronie district. The primary purpose of these assessments was to analyze the current water quality of our country's main rivers, identify potential pollution sources, and determine the suitability of water sources for various purposes. Additionally, it is important to note that this report builds on a previous collaborative pilot project with ILACO/Water Forum Suriname. This pilot project, which was carried out between July and December 2022, involved monitoring the water quality network in the Coronie and Nickerie districts.

A standardized procedure was employed to monitor water quality, utilizing the advanced instrument Hydrolab 7. Careful measurements determined crucial parameters such as pH, temperature, dissolved oxygen (DO), total dissolved solids (TDS), turbidity, conductivity, and salinity. These data are invaluable for understanding the dynamics of our water sources and developing appropriate water management and preservation strategies. The following chapters of this report will delve deeper into the measurements and findings regarding specific rivers, including the Corantijn, Coppename, Saramacca, district Coronie and Nickerie. With this report, we aim to provide better insight into the water quality of Suriname and contribute to measures to protect and preserve our water sources.

Findings: This report offers a comprehensive analysis of water quality in Suriname, with specific attention to surface water sources.

Conclusions: The data and analysis presented contribute to a better understanding of the current state of water quality in Suriname during the reporting period. This information can be used as a basis for further measures to improve water management and support evidence-based decision-making regarding surface water in Suriname.

1.1 Limitations

No established water quality standards for surface water have been laid down in policy. Water quality standards are crucial for ensuring the cleanliness and safety of our surface water. They are part of national environmental protection and public health policies and should be practical and specific, tailored to local conditions and water bodies. The aim is to protect public health and the ecosystem by preventing pollution, such as wastewater or toxic discharges.

We need data on various parameters to effectively assess water quality, including physical-chemical, bacteriological, and toxicological characteristics. While laboratory tests are currently limited, the available water quality data are collected based on on-site measured parameters such as pH, temperature, dissolved oxygen (DO), total dissolved solids (TDS), turbidity, conductivity, and salinity.

Currently, WLA can’t conduct laboratory tests due to the absence of a chemical laboratory. This document's proposed water quality standards are a first step and should be revised and expanded as more data becomes available.

2. Proposed International Water Quality Guidelines

Global standards for water quality

Water quality standards are established guidelines that define the desired condition of water bodies such as rivers, lakes, or coastal areas. These standards encompass various parameters to evaluate water suitability for different purposes, forming the foundation for water management and regulatory frameworks. Water quality standards primarily aim to uphold surface water quality, safeguard public health, preserve the environment, and facilitate diverse water uses like drinking, recreation, and industry.

The recommended water quality standards given by Water Forum Suriname in their report "1.2 WFS-Technical Report #2_Proposed WQ standards" for different water bodies include:

1) Standards for freshwater, including recreational use.
2) Standards for irrigation water intended for agricultural use.

The water quality standards of two international organizations, the United States Environmental Protection Agency (US EPA) and the Food and Agriculture Organization (FAO), are selected for further application. USEPA standards describe guidelines for human health, water consumption, and organism health, while FAO standards describe guidelines for water use in agriculture.

Table 1: *Overview of the proposed international standards for the selected physical parameters*

Parameters	Irrigation water, agriculture (FAO)	Freshwater (US EPA)
Temperature	-	-
Conductivity	<3000 uS/cm	0 – 1500 uS/cm
Turbidity	-	-
Salinity	-	-
Total Dissolved Solids	<2000 mg/L	<500 mg/L
Dissolved Oxygen	-	> 6 mg/L
pH	6.0 - 8.5	5.0 – 9.0

The measured values in this report are compared to the international standards of the US EPA and FAO to determine if the collected data falls within the predefined ranges for agricultural and recreational usage.

Note: Due to logistical challenges in reaching the monitoring stations, the following measurements along the same river were not conducted simultaneously. In many of the graphs, there is a two-month gap between the measurements taken at different stations.

3. The Corantijn River

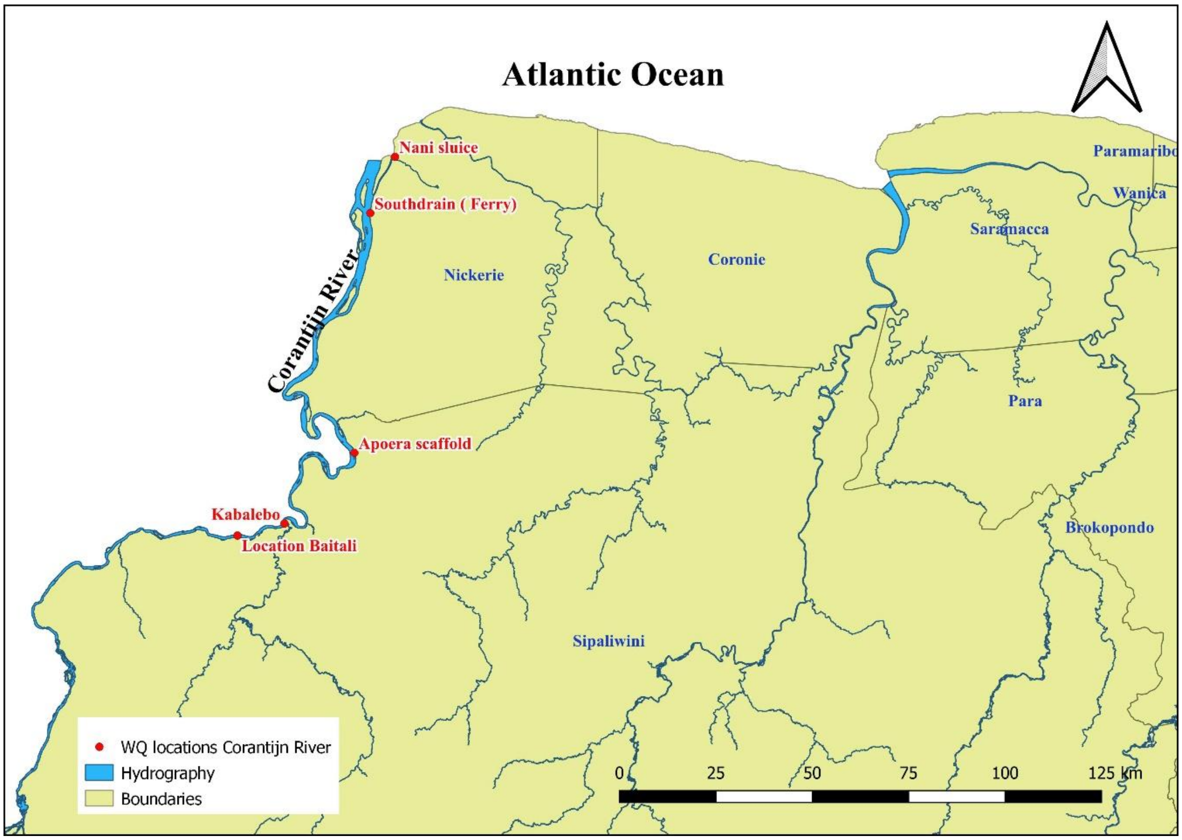

Figure 1: Water quality locations along the Corantijn River

The Corantijn River is located in northern South America and forms the border between Guyana and Suriname. It acts as a vital lifeline for the surrounding communities. In addition to facilitating the regular ferry service between Moleson Creek and South Drain, this river is also utilized for fishing activities and daily tasks of the local population, such as bathing, washing, and cultural events.

The river originates from two headstreams, with the Boven-Corantijn or Nieuw river springing from the Acarai Mountains in the west near the border with Brazil. The river basin covers an area of approximately 67,600 km^2. In Wakay, on the right bank of the river, a pumping station is established to provide fresh irrigation water to rice fields, especially during dry seasons. However, the use of river water may lead to increased intrusion of saltwater, posing a concern for water quality and agriculture.

Upstream in the river, towards the inland areas of Suriname, the flow generally slows down as the river moves further inland and widens. Conversely, the flow can be stronger downstream towards the river's mouth in the Atlantic Ocean, especially during high tide. The width and depth of the river vary depending on tides and rainfall, making it a significant waterway for navigation and transportation. This river supports a diverse ecosystem and is of great importance to local communities and the district's biodiversity, with its management and preservation being crucial for sustainable development.

Table 2: Sipaliwini and Nickerie districts: overview of locations along the Corantijn River and their use of river water, including coordinates

River	**Location**	**Water use**	**Coordinates**
Corantijn	Baitali	- Transportation - Industrial purposes	4°59'36.27"N 57°26'15.72"W
	Kabalebo	- Drinking water - Agricultural irrigation	5°01'21.32"N 57°20'09.53"W
	Apoera	- Drinking water - Agriculture activities (irrigation) - Transportation - Recreation - Fishery	5°11'21.47"N 57°10'19.19"W
	Southdrain Ferry (Canawaima)	- Transportation - Agriculture activities (irrigation)	05°51'29.53" N 056°51'05.90" W
	Nani sluice		5°52'55.3"N 57°04'39.5"W

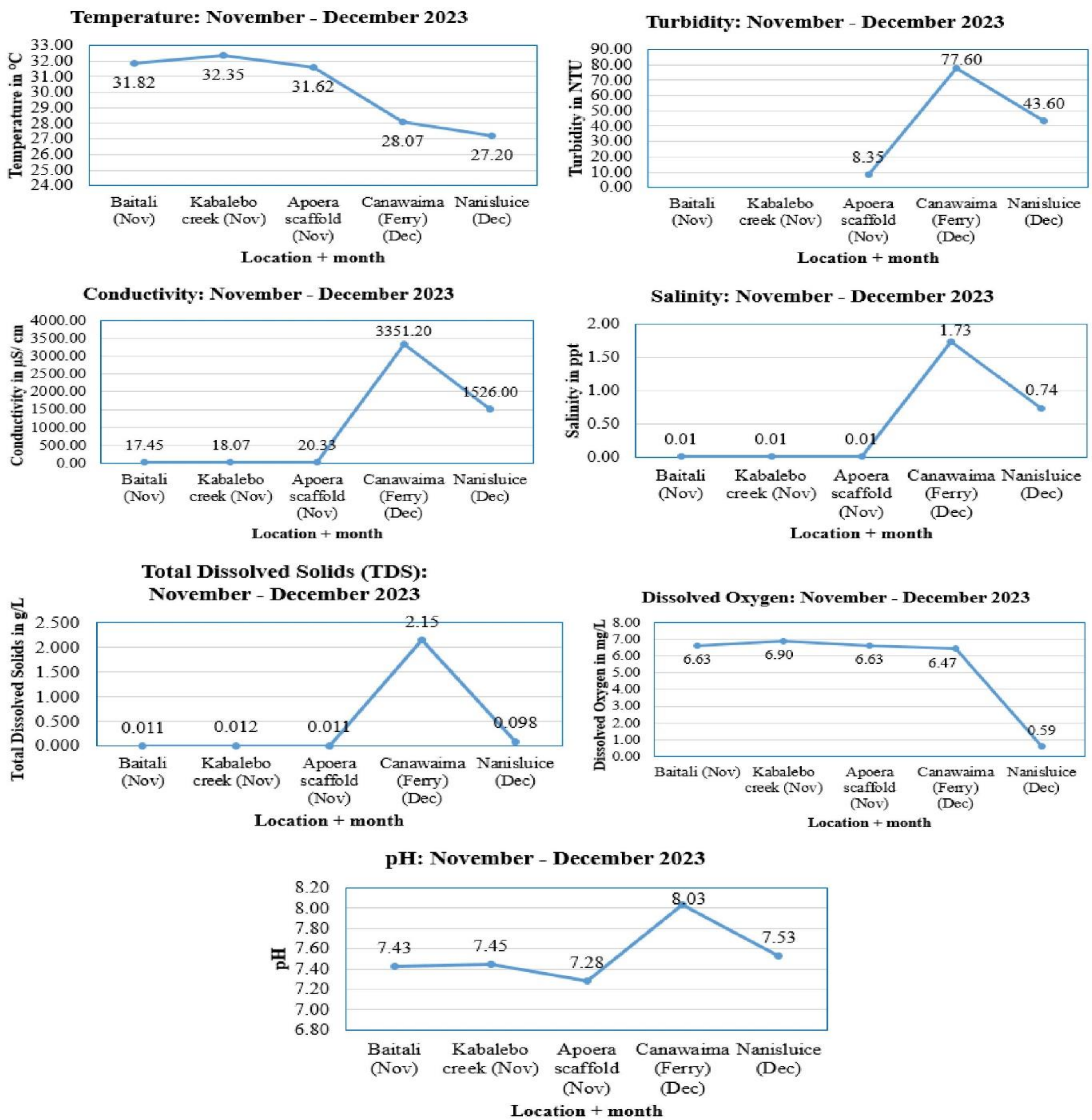

Figure 2: Graphical representation of water quality parameters at Baitali, Kabalebo, Apoera, Nani sluice and Southdrain Ferry (Canawaima)

Notes fig.2:

- *Due to technical issues, the turbidity sensor at the Baitali and Kabalebo locations did not function correctly in November 2023.*
- In this chart, we cover two separate districts and their respective time periods. Sipaliwini is located inland, while Nickerie is located on the coast.
- Differences between Sipaliwini and Nickerie locations:
  - The graph shows lower levels at Sipaliwini compared to Nickerie. This may be due to the geographical location, with Sipaliwini being further inland than Nickerie.
  - The distance from the sea also plays a role, with Nickerie located directly on the coast and experience more direct influence from saltwater sources.
  - The land use is also different, with Nickerie having more agricultural activities that can affect water quality. Natural processes such as river flows and soil conditions can also contribute to these differences.
- The noticeable peak in Total Dissolved Solids (TDS) at Ferry Canawaima in Nickerie may possibly be explained by natural processes such as sedimentation, where dissolved substances in the water are absorbed by sediment particles. On the other hand, the low levels of Dissolved Oxygen (DO) at Nani Sluis indicate reduced oxygen solubility, which can be caused by various factors such as eutrophication or disruption of natural oxygen-producing processes.

Table 3: Water Quality Measurements and Standards Comparison for Baitaili, Kabalebo, Apoera, *Southdrain Ferry (Canawaima)* and Nani sluice

Location and waterquality standards	Temperature (°C)	Turbidity (NTU)	Conductivity (µS/ cm)	Salinity (ppt)	Total Dissolved Solids (g/L)	Dissolved Oxygen (mg/L)	pH
Baitali Kabalebo	31.82	-	17.45	0.01	0.011	6.63	7.43
Kabalebo creek	32.35	-	18.07	0.01	0.012	6.90	7.45
Apoera scaffold	31.62	8.35	20.33	0.01	0.011	6.63	7.28
Southdrain Ferry (Canawaima)	28.07	77.60	3351.20	1.73	2.15	6.47	8.03
Nani sluice	27.20	43.60	1526.00	0.74	0.098	0.59	7.53
Freshwater (US EPA)	-	-	0 - 1500	-	<500	> 6.00	5.00 - 9.00
Irrigation water (FAO)	-	-	0 - 3000	-	0 - 2000		6.00 - 8.50

Notes table 3:

- The measured Dissolved Oxygen (DO) levels at Nani Sluice fall below the required standards for both freshwater and irrigation water usage.
- The conductivity levels measured at Southdrain Ferry (Canawaima) exceed those acceptable for irrigation water use, while at Nani Sluis, they surpass the limits suitable for freshwater use.

4. The Coppename River

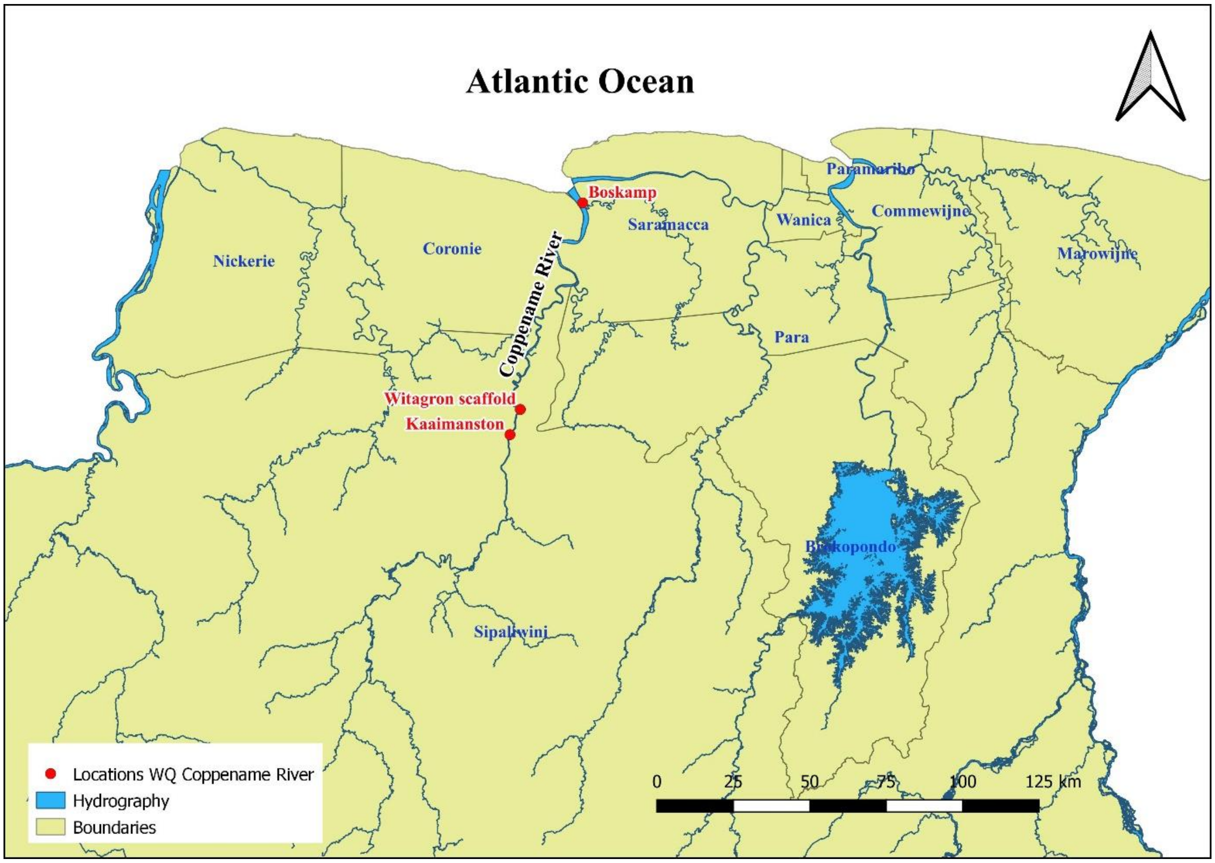

Figure 3: Water quality locations along the Coppename River

The Coppename River in Suriname is vital for the local economy and communities along its banks. Covering an area of 21,700 square kilometers, it offers a variety of activities.

The lower tidal area is largely undeveloped and characterized by extensive marshlands. Upstream, the river is used for daily activities such as bathing, washing, and transportation. Here, the river is calmer and less affected by tides.

Water levels are influenced by tides and can flow far inland during high tides. The river provides not only livelihood but also navigation and transportation.

With an average discharge of 500 m^3/s at the mouth and natural attractions like the Raleigh Falls, the Coppename River remains invaluable to Suriname.

Table 4: Sipaliwini and Saramacca districts: overview of locations along the Coppename River and their use of river water, including coordinates

River	**Location**	**Water use**	**Coordinates**
Coppename	Kaaimanston	- Hygiene and sanitation - Drinking water - Fishery - Recreation	5°05'26.67"N 56°06'25.82"W
	Witagron Scaffold		5°09'54.00"N 56°04'36.54"W
	Boskamp	- Navigation - Transportation - Fishery	05°46'31.68" N 055°53'30.29" W

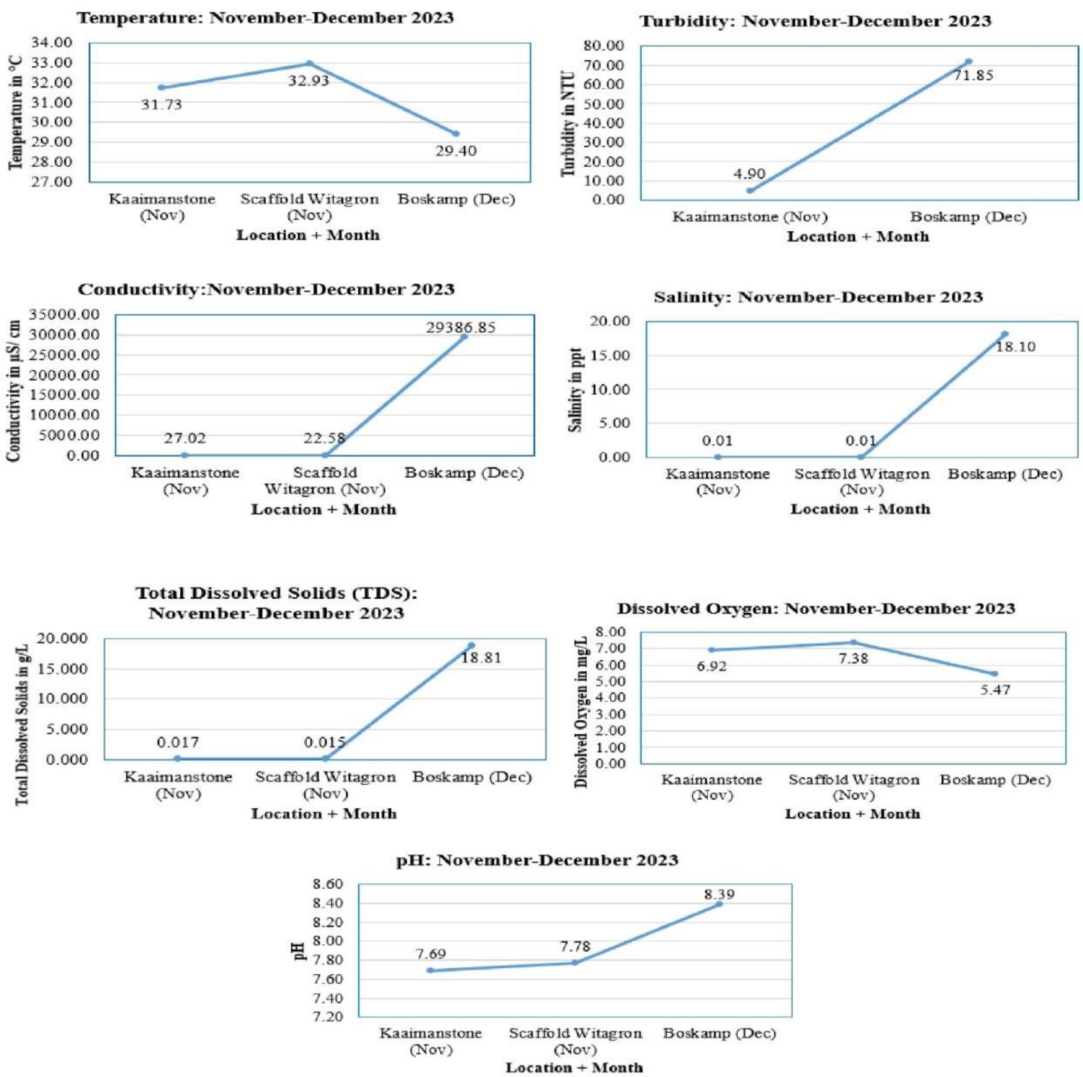

Figure 4: Graphical representation of water quality parameters at Kaaimanston, Witagron scaffold and Boskamp

Notes fig.4:

- *The turbidity sensor at the Witagron scaffold location did not function correctly in November due to technical issues.*
- District Sipaliwini, located further inland, generally exhibits lower water quality levels compared to district Saramacca, situated along the banks of the Coppename River.
- Boskamp shows significantly higher turbidity, indicating an increased presence of suspended particles or sediment in the water.
- The conductivity and total dissolved solids (TDS) levels are notably elevated at Boskamp, suggesting a higher concentration of salts or other substances.
- Salinity is negligible at Kaaimanston and Witagron Scaffold but significantly higher at Boskamp, indicating a greater presence of salts.
- Dissolved oxygen (DO) content is lower at Boskamp, indicating reduced oxygen levels in that area.
- The pH values demonstrate a gradual trend.
- These variations can be attributed to factors such as geographical location, proximity to sea influences, land use, natural processes, and potential human activities.

Table 5: Water Quality Measurements and Standards Comparison for Kaaimanston, Witagron Scaffold, Boskamp

Location and waterquality standards	**Temperature (°C)**	**Turbidity (NTU)**	**Conductivity (µS/ cm)**	**Salinity (ppt)**	**Total Dissolved Solids (g/L)**	**Dissolved Oxygen (mg/L)**	**pH**
Kaaimanston	31.73	4.90	27.02	0.01	0.017	6.92	7.69
Witagron Scaffold	32.93	-	22.58	0.01	0.015	7.38	7.78
Boskamp	29.40	71.85	29386.85	18.10	18.81	5.47	8.39
Freshwater (US EPA)	-	-	0 - 1500	-	<500	> 6.00	5.00 - 9.00
Irrigation water (FAO)	-	-	0 - 3000	-	0 - 2000		6.00 - 8.50

Notes table 5:

- The DO level measured at Boskamp does not meet the established standards for either freshwater or irrigation water use.
- The conductivity level measured at Boskamp is much higher than acceptable for both freshwater and irrigation water use.

5. The Saramacca River

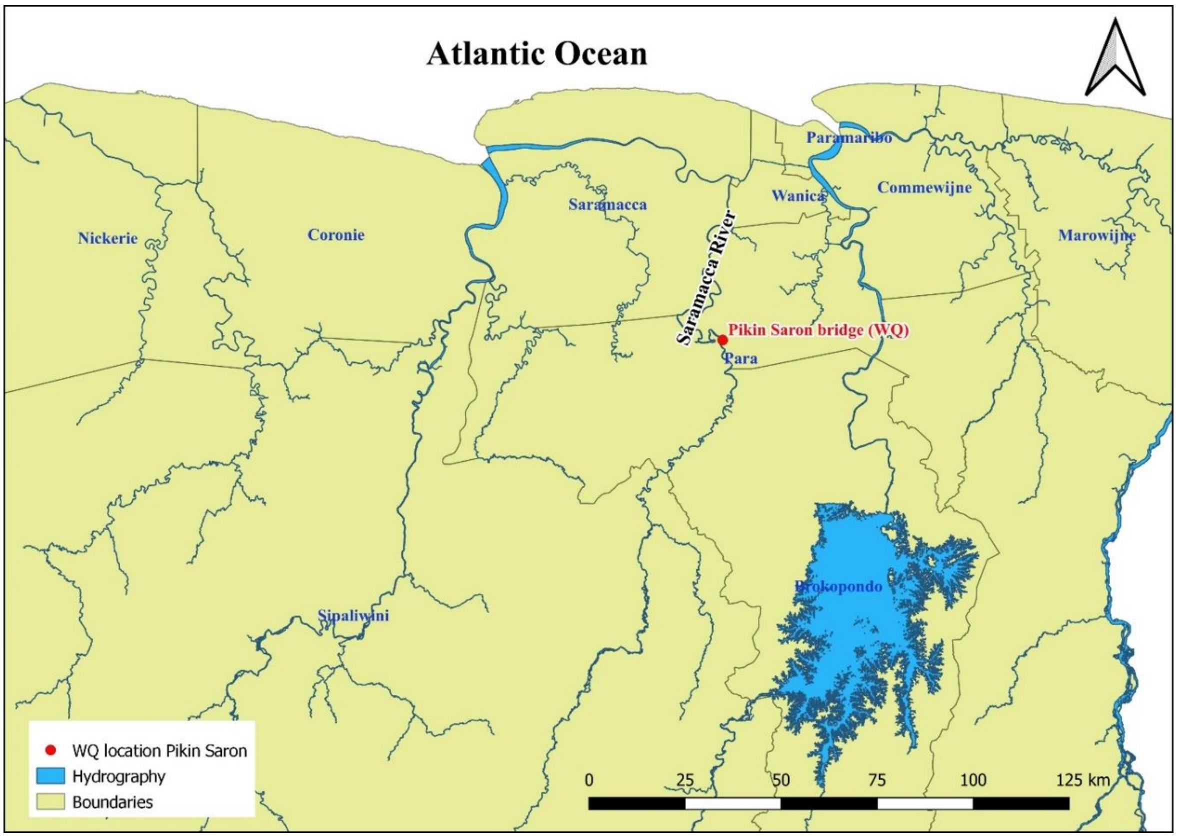

Figure 5: Water quality location along the Saramacca River

The Saramacca River, located in the districts of Sipaliwini, Para, and Saramacca in Suriname, is of great importance to the region. With a drainage basin of 9,400 km² and a length of 255 km, the river plays a crucial role in transporting goods and people to nearby agricultural areas. However, the presence of sandbanks in the estuary can hinder accessibility.

Primarily used for navigation, transportation, and local fishing, parts of the river basin are affected by gold mining and small-scale gold extraction, which can impact water quality and quantity.

The water level in the estuary is influenced by the semi-daily movement of Atlantic seawater, which penetrates far upstream. The salt wedge in the river is affected by tides, freshwater discharge, irrigation for agriculture, and discharges from rice paddies and other agricultural areas.

Table 6: Para district: overview of locations along the Saramacca River and their use of river water, including coordinates.

River	Location	Water use	Coordinates
Saramacca	Pikin Saron	- Navigation - Transportation - Local fishery	5°23'29.52"N 55°22'10.13"W

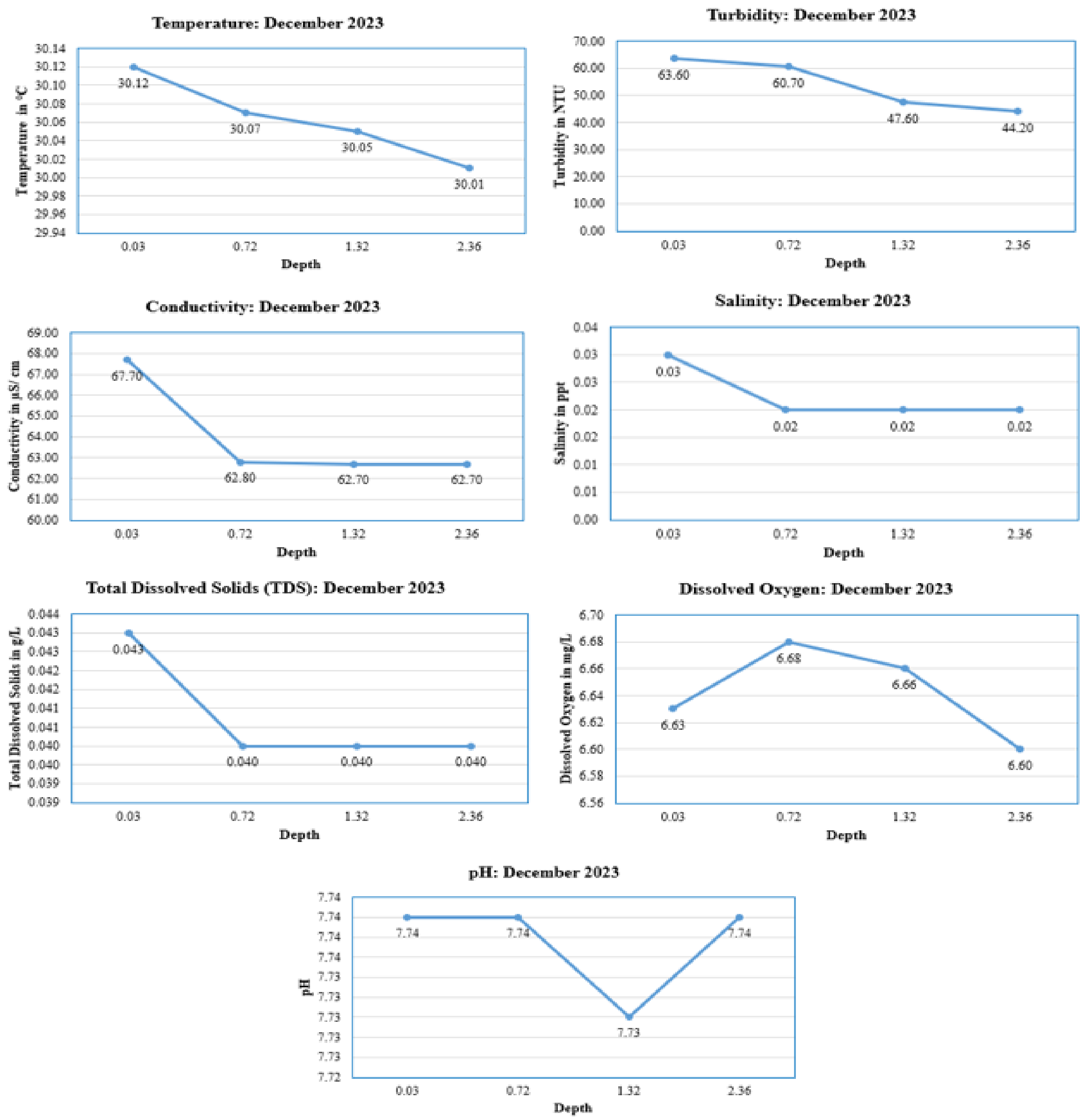

Figure 6: Graphical representation of water quality parameters at Pikin Saron

Notes fig.6:

It was decided to focus on the depth in these graphs to observe the variations in the measurements. Unfortunately, our team only managed to conduct one set of measurements during this period. Due to logistical issues we were unable to return and perform another set of measurements.

- The graphs illustrate a consistent trend in the observed water parameters with increasing depths.
- Surface water is warmer than deeper water, likely due to direct sunlight affecting upper layers more.
- Turbidity is higher closer to the surface, possibly from stirred-up sediment.
- Deeper water generally exhibits higher conductivity and salinity, indicating accumulated minerals.
- Total dissolved solids follow a similar pattern, with higher concentrations in deeper water.
- Surface water contains more dissolved oxygen due to plant oxygen production.
- pH remains stable across depths, indicating a consistent chemical environment.

Table 7: Water Quality Measurements and Standards Comparison for Pikin Saron

Waterquality standards	**Depth (M)**	**Temperature (°C)**	**Turbidity (NTU)**	**Conductivity (µS/ cm)**	**Salinity (ppt)**	**Total Dissolved Solids (g/L)**	**Dissolved Oxygen (mg/L)**	**pH**
	0.03	30.12	63.60	67.70	0.03	0.043	6.63	7.74
	0.72	30.07	60.70	62.80	0.02	0.040	6.68	7.74
	1.32	30.05	47.60	62.70	0.02	0.040	6.66	7.73
	2.36	30.01	44.20	62.70	0.02	0.040	6.60	7.74
Freshwater (US EPA)		-	-	0 - 1500	-	<500	> 6.00	5.00 - 9.00
Irrigation water (FAO)		-	-	0 - 3000	-	0 - 2000		6.00 - 8.50

Notes table 7:

- The measurements taken at 'Pikin Saron' in the Saramacca River indicate that the water meets irrigation and freshwater standards.

6. District Coronie

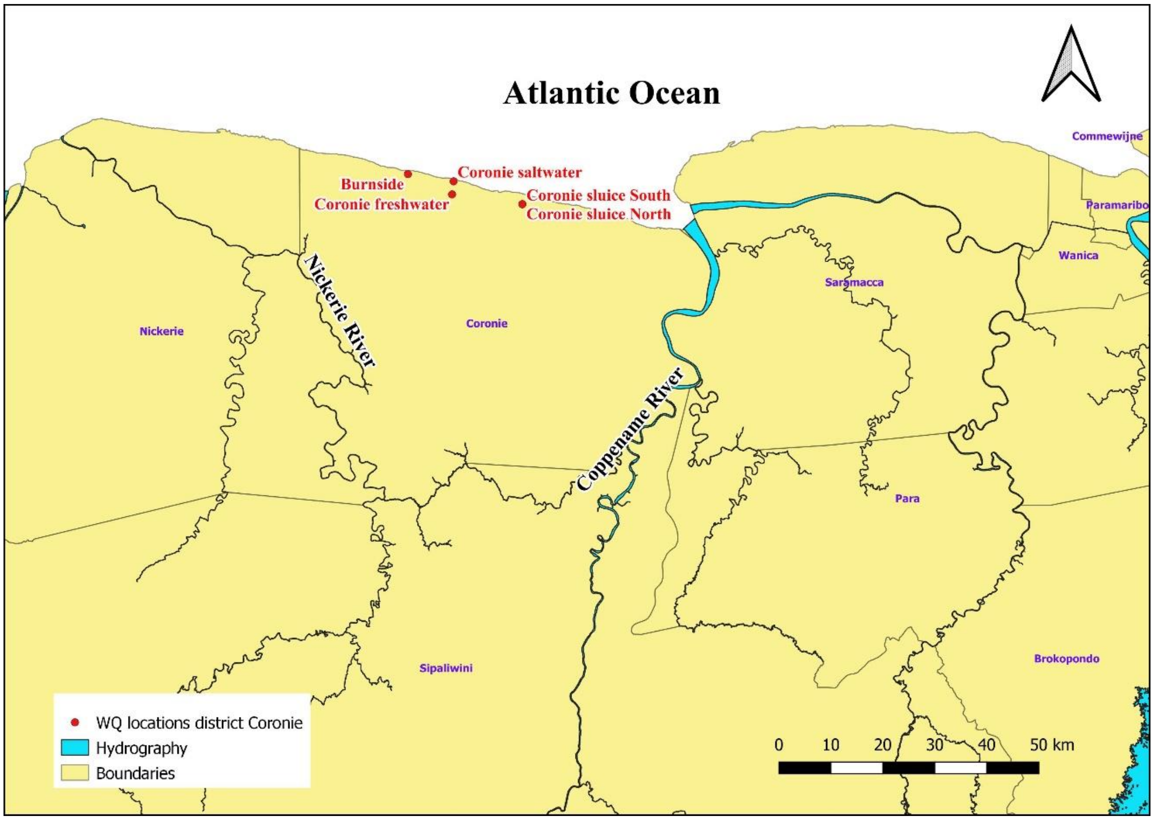

Figure 7: Water quality locations in Coronie district

Coronie is a district of Suriname, located on the coast and with Totness as its capital. It borders the Atlantic Ocean to the north, Saramacca to the east, Sipaliwini to the south and Nickerie to the west. The Totness Airstrip serves the district.

The Coronie Marsh is a natural freshwater reservoir in the coastal area of Suriname, with an area of approximately 250,000 hectares. The swamp is mainly flat and low-lying and is bordered by several rivers and the East-West Corridor. Water from the swamp is drained in two directions: to the east via locks and culverts and to the west, which benefits the rice culture along the Nickerie River. The Coronie Swamp plays a crucial role in the ecosystem, especially for vulnerable mangroves and migratory birds that use the area.

Table 8: Coronie district: overview of locations along the canal, swamp and their use of water, including coordinates.

District	Location	Water use	Coordinates
Coronie	Coronie North	- Transportation - Recreational - Agriculture activities (discharge and irrigation) - Fishery	5°50'57.70"N 56°12'58.48"W
	Coronie South		5°50'57.45"N 56°12'58.23"W
	Coronie fresh water	- Recreational (swimming, tourism) - Agriculture activities - Fishery - Sand mining	5°51'59.71"N 56°20'18.00"W
	Coronie salt water	- Salt mining - Aquaculture - Sea fishing - Tourism	5°53'21.15"N 56°20'08.10"W
	Burnside	- Agriculture activities - Recreational	5°54'06.47"N 56°24'54.63"W

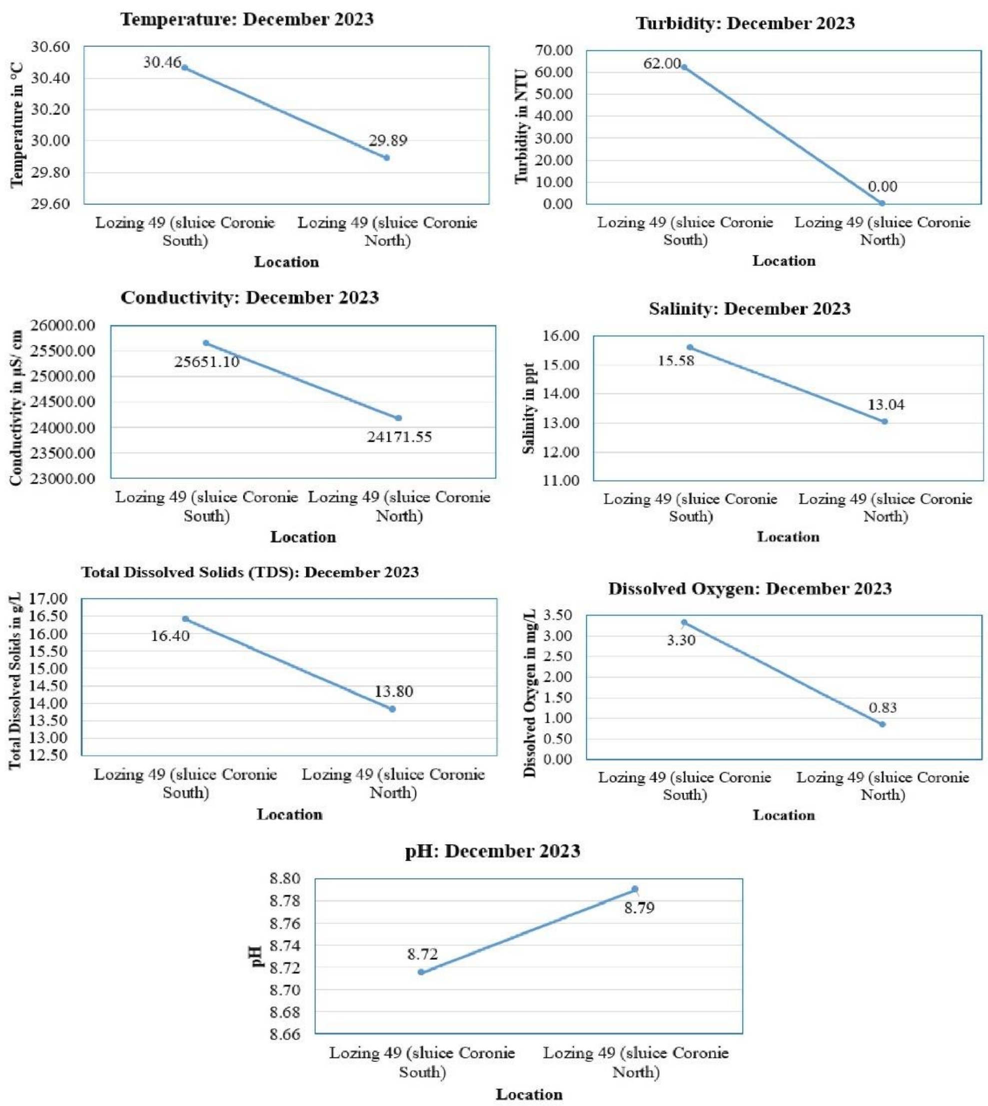

Figure 8: Graphical representation of water quality parameters at Coronie North and South

Notes fig.8:

- Coronie North and Coronie South graphs show a gradual decrease from high to low values for various parameters. Generally, Coronie South exhibits higher values than Coronie North. This trend can be attributed to local variations such as sedimentation, currents, and possibly the proximity to saltwater influences.

Table 9: Water Quality Measurements and Standards Comparison for Coronie North and South

Location and waterquality standards	**Temperature (°C)**	**Turbidity (NTU)**	**Conductivity (µS/ cm)**	**Salinity (ppt)**	**Total Dissolved Solids (g/L)**	**Dissolved Oxygen (mg/L)**	**pH**
Coronie North	29.89	0.00	24171.55	13.04	13.80	0.83	8.79
Coronie South	30.46	62.00	25651.10	15.58	16.40	3.30	8.72
Freshwater (US EPA)	-	-	0 - 1500	-	<500	> 6.00	5.00 - 9.00
Irrigation water (FAO)	-	-	0 - 3000	-	0 - 2000		6.00 - 8.50

Notes table 9:

- During this El Niño-influenced period, intensified drought has led to increased salinity and conductivity in the water, surpassing norms for irrigation and freshwater.
- The measured DO values at both Coronie North -and Coronie South do not meet the recommended standards for irrigation water and freshwater.

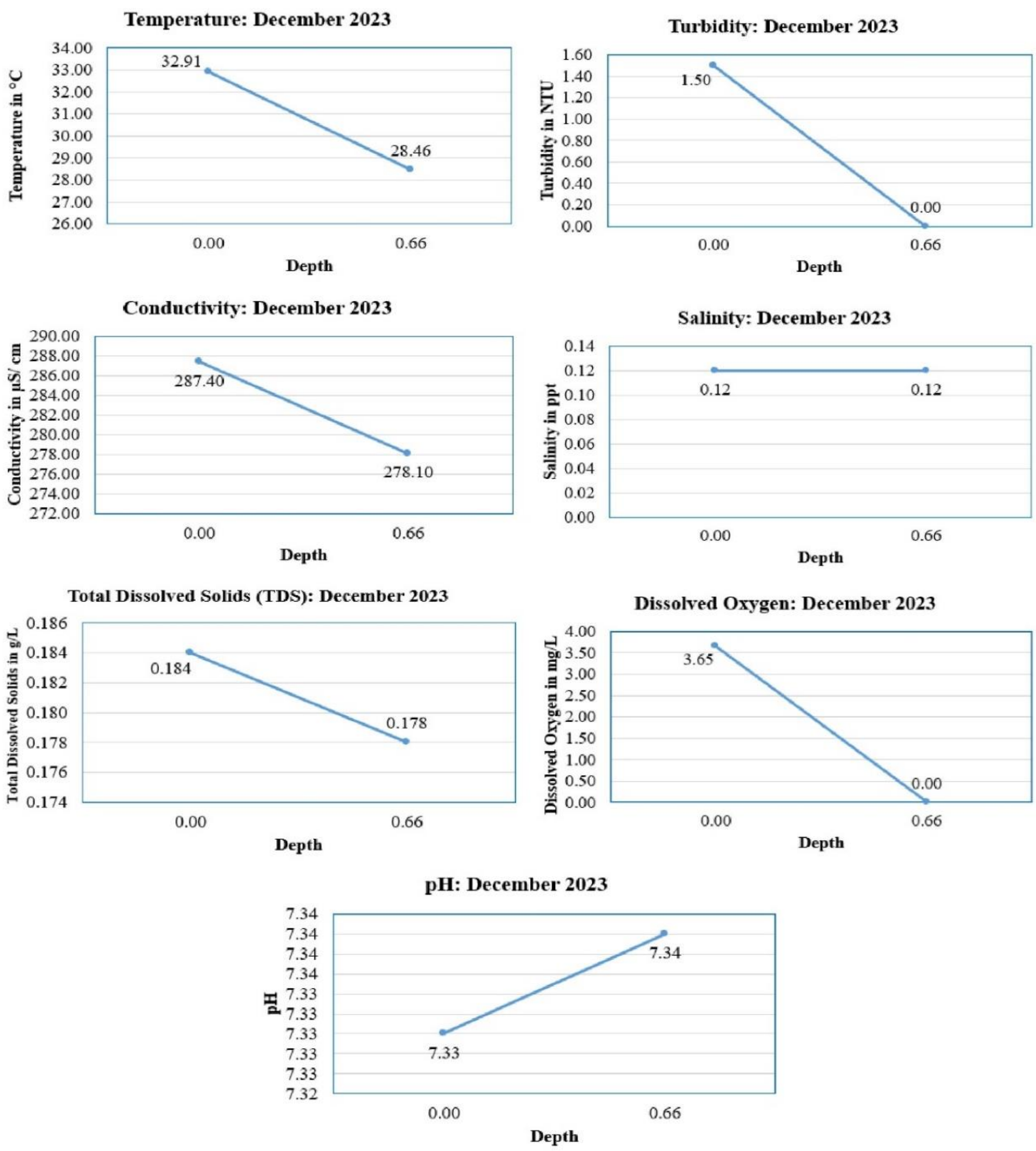

Figure 9: Graphical representation of water quality parameters at Coronie Freshwater

Notes fig.9:

- The graphs of Coronie fresh water show a gradual decrease from high to low values for several parameters. In general, the measurements show lower values as depth increases. This trend can be attributed to local variations and factors, such as sedimentation, currents and possibly the specific characteristics of this location in the river.

Table 10: Water Quality Measurements and Standards Comparison for Coronie fresh water

Waterquality standards	**Depth (M)**	**Temperature (°C)**	**Turbidity (NTU)**	**Conductivity (μS/ cm)**	**Salinity (ppt)**	**Total Dissolved Solids (g/L)**	**Dissolved Oxygen (mg/L)**	**pH**
	0.66	28.46	0.00	278.10	0.12	0.178	0.00	7.34
	0.00	32.91	1.50	287.40	0.12	0.184	3.65	7.33
Freshwater (US EPA)	-	-	-	0 - 1500	-	<500	> 6.00	5.00 - 9.00
Irrigation water (FAO)	-	-	-	0 - 3000	-	0 - 2000		6.00 - 8.50

Notes table 10:

- The DO values measured at both depths fall below the recommended standards for irrigation water and freshwater use.

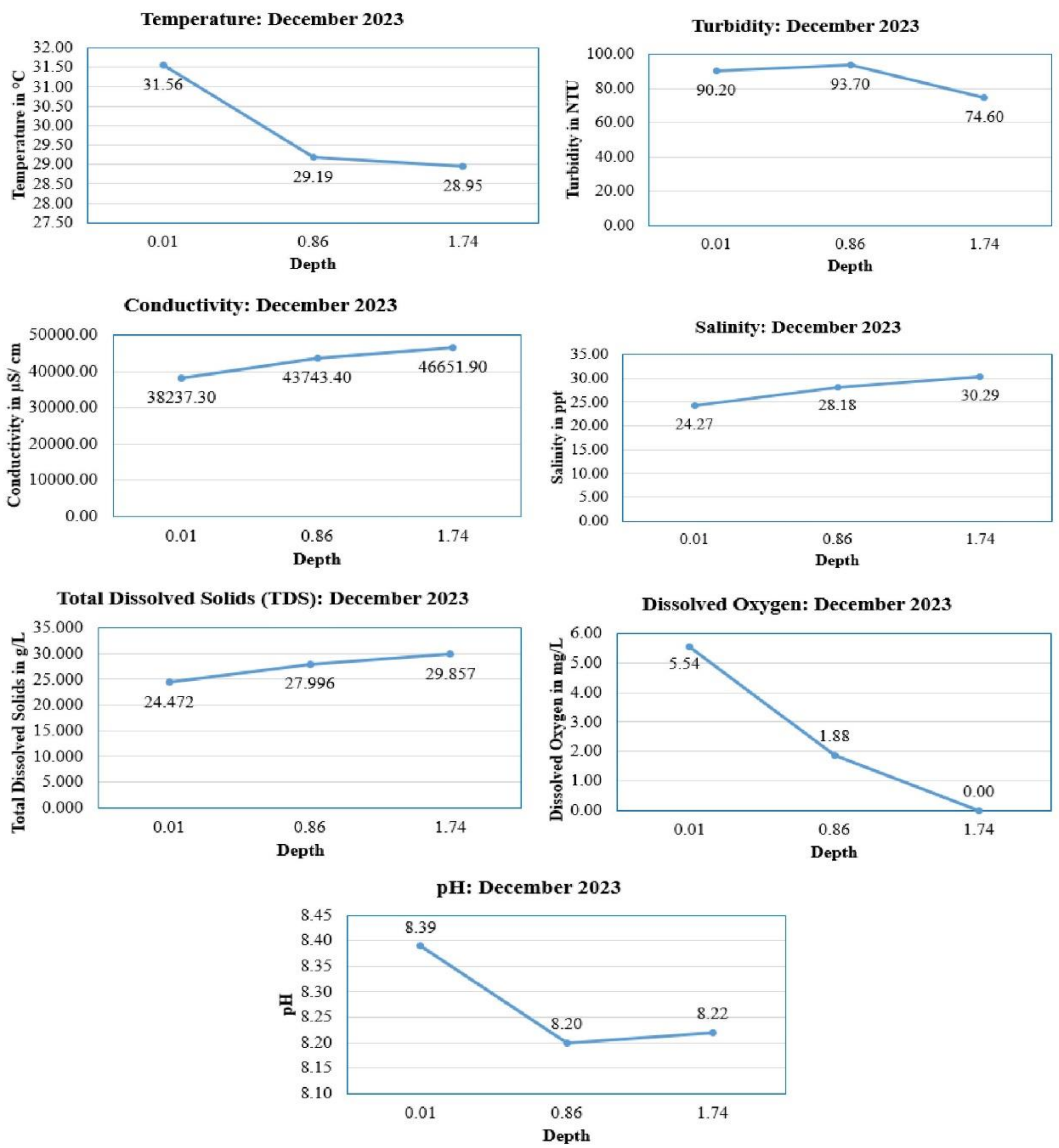

Figure 10: Graphical representation of water quality parameters at Coronie salt water

Notes fig.10:

- In Coronie's saltwater, temperature decreases as we go deeper, which is a common characteristic of saltwater layers due to reduced sunlight exposure. Turbidity, the cloudiness of the water, also decreases with depth as suspended particles settle.
- Conductivity rises with depth, indicating more dissolved salts and minerals in deeper waters. This increase is mirrored by the rising salinity, showing higher salt concentrations in deeper saltwater layers.
- Total Dissolved Solids (TDS) levels follow a similar pattern, increasing with depth as more salts and minerals dissolve into the water. Meanwhile, dissolved oxygen decreases at deeper levels, possibly due to reduced aeration and biological activity.
- The pH of the water remains slightly alkaline overall, with minor variations in deeper layers.

Table 11: Water Quality Measurements and Standards Comparison for Coronie salt water

Waterquality standards	**Depth (M)**	**Temperature (°C)**	**Turbidity (NTU)**	**Conductivity (µS/ cm)**	**Salinity (ppt)**	**Total Dissolved Solids (g/L)**	**Dissolved Oxygen (mg/L)**	**pH**
	0.01	31.56	90.20	38237.30	24.27	24.472	5.54	8.39
	0.86	29.19	93.70	43743.40	28.18	27.996	1.88	8.20
	1.74	28.95	74.60	46651.90	30.29	29.857	0.00	8.22
Freshwater (US EPA)	-	-	-	0 - 1500	-	<500	> 6.00	5.00 - 9.00
Irrigation water (FAO)	-	-	-	0 - 3000	-	0 - 2000		6.00 - 8.50

Notes table 11:

- Coronie's saltwater has a high conductivity at different depths. The measured values are not suitable for irrigation and freshwater, but it falls within the normal range for seawater 50,000 microsiemens per centimeter (uS/cm)
- The measured DO values at all depths do not meet the recommended irrigation water and freshwater standards.

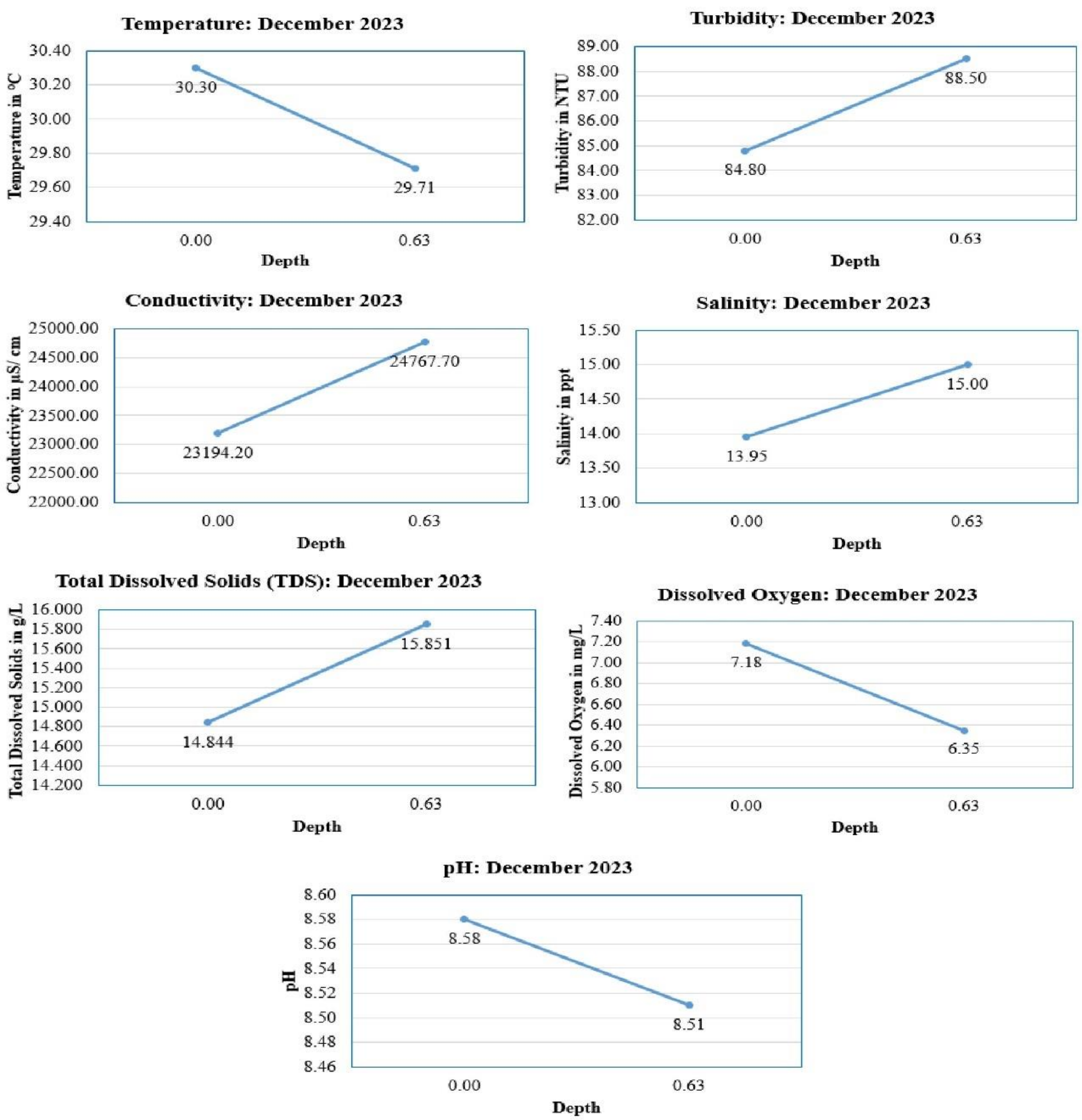

Figure 11: Graphical representation of water quality parameters at Burnside

Notes fig.11:

- Temperature: The temperature decrease slightly as depth increases, likely due to reduced exposure to sunlight and a greater influence of cooler underlying layers.
- Turbidity: Turbidity increases with depth, indicating the presence of suspended particles and sediments.
- Conductivity: Higher conductivity with increasing depth suggests the presence of dissolved salts and minerals, possibly due to sedimentation.
- Salinity: Increasing depth indicates higher salinity, possibly due to saltwater intrusion and sediments.
- Total Dissolved Solids (TDS): Increasing TDS values indicate more dissolved solids in deeper water, possibly due to sedimentation and salts.
- Dissolved Oxygen (DO): Lower oxygen levels in deeper water can be caused by biological activity and limited aeration, especially in sediment-rich environments.
- pH: The pH remains slightly basic and is generally suitable for saltwater environments, but it can vary with depth.

Table 12: Water Quality Measurements and Standards Comparison for Burnside

Waterquality standards	Depth (M)	Temperature (°C)	Turbidity (NTU)	Conductivity (µS/ cm)	Salinity (ppt)	Total Dissolved Solids (g/L)	Dissolved Oxygen (mg/L)	pH
	0.00	30.30	84.80	23194.20	13.95	14.844	7.18	8.58
	0.63	29.71	88.50	24767.70	15.00	15.851	6.35	8.51
Freshwater (US EPA)	-	-	-	0 - 1500	-	<500	> 6.00	5.00 - 9.00
Irrigation water (FAO)	-	-	-	0 - 3000	-	0 - 2000		6.00 - 8.50

Notes table 12:

- During this El Niño-influenced period, intensified drought has increased salinity and conductivity in the water, surpassing norms for irrigation and freshwater.

7. The Nickerie River

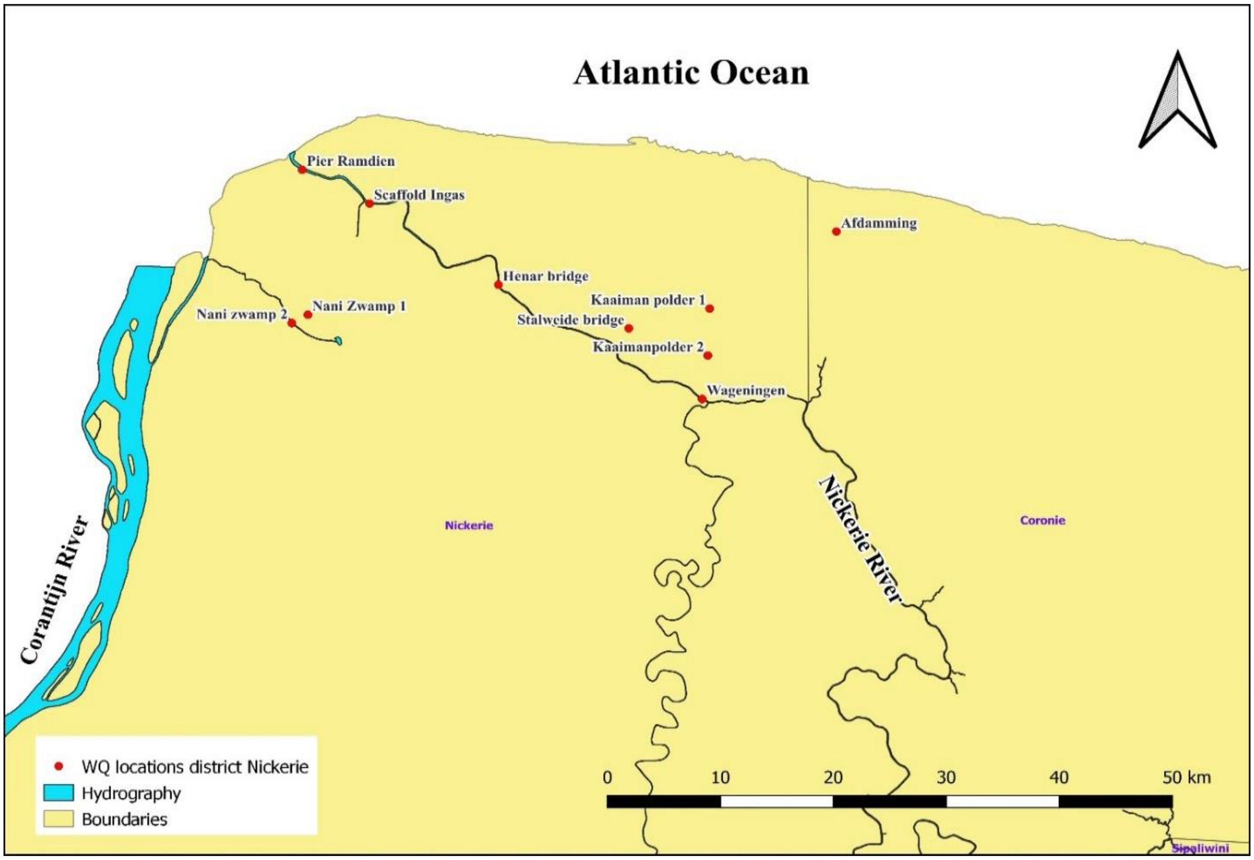

Figure 12: Water quality locations in district Nickerie

The Nickerie River, located in the northwest of Suriname, is crucial for various activities, including irrigation and drainage of rice paddies and other agricultural areas. Local communities also rely on the river for daily needs such as bathing, washing clothes and dishes, transportation, cultural activities, and fishing.

Originating from the Bakhuis Mountains, the river primarily flows northward, serving an area of approximately 10,100 km². The watershed can be divided into three parts: the lower part with rice paddies and settlements, the middle part with marshy areas, and the upper part outside the tidal zone. The width of the Nickerie River varies from about 50 meters to 150 meters at the mouth, with an average depth of around 20 meters.

This river supports rice cultivation, with farmers using water from the river for irrigation. Riverboats are used for transporting rice and other goods, while the port of Nieuw-Nickerie serves as a major export point. In addition to economic activities, the Nickerie River offers opportunities for recreation and tourism, such as boat trips and birdwatching along the banks.

The water level is influenced by tidal movements from the Atlantic Ocean, with saltwater able to penetrate far inland during the dry season, affecting the ecosystem. Preserving the water quality and ecosystem of the Nickerie River is essential due to its economic and ecological value. Measures for careful management and sustainable development are needed to mitigate pollution and excessive use.

Table 13: In Nickerie district: overview of locations along the Nickerie River and their use of river water, including coordinates

River	**Location**	**Water use**	**Coordinates**
Nickerie	Nani swamp	- Agriculture activities (irrigation) - Recreation (swimming) - Fishery	05°50'01.94" N 057°00'13.41" W
	Stalweide bridge	- Agriculture activities (irrigation) - Fishery	05°45'23.84" N 056°41'10.71"W
	Kaaimanpolder bridge	- Fishery	5°50'18.0"N 56°40'55.3"W
	Ramdien pier	- Fishery	5°57'12.4"N 57°00'28.0"W
	Scaffold Ingas		5°55'31.7"N 56°57'14.0"W
	Henar bridge	- Navigation - Transportation - Fishery	5°51'28.5"N 56°51'02.4"W
	Wageningen	- Livelihood (washing of clothes and dishes etc.) - Agriculture activities - Fishery	05°45'43.87" N 056°41'12.00" W
	Afdamming	- Fishery - Hunting	05°54'07.75" N 056°34'49.58" W

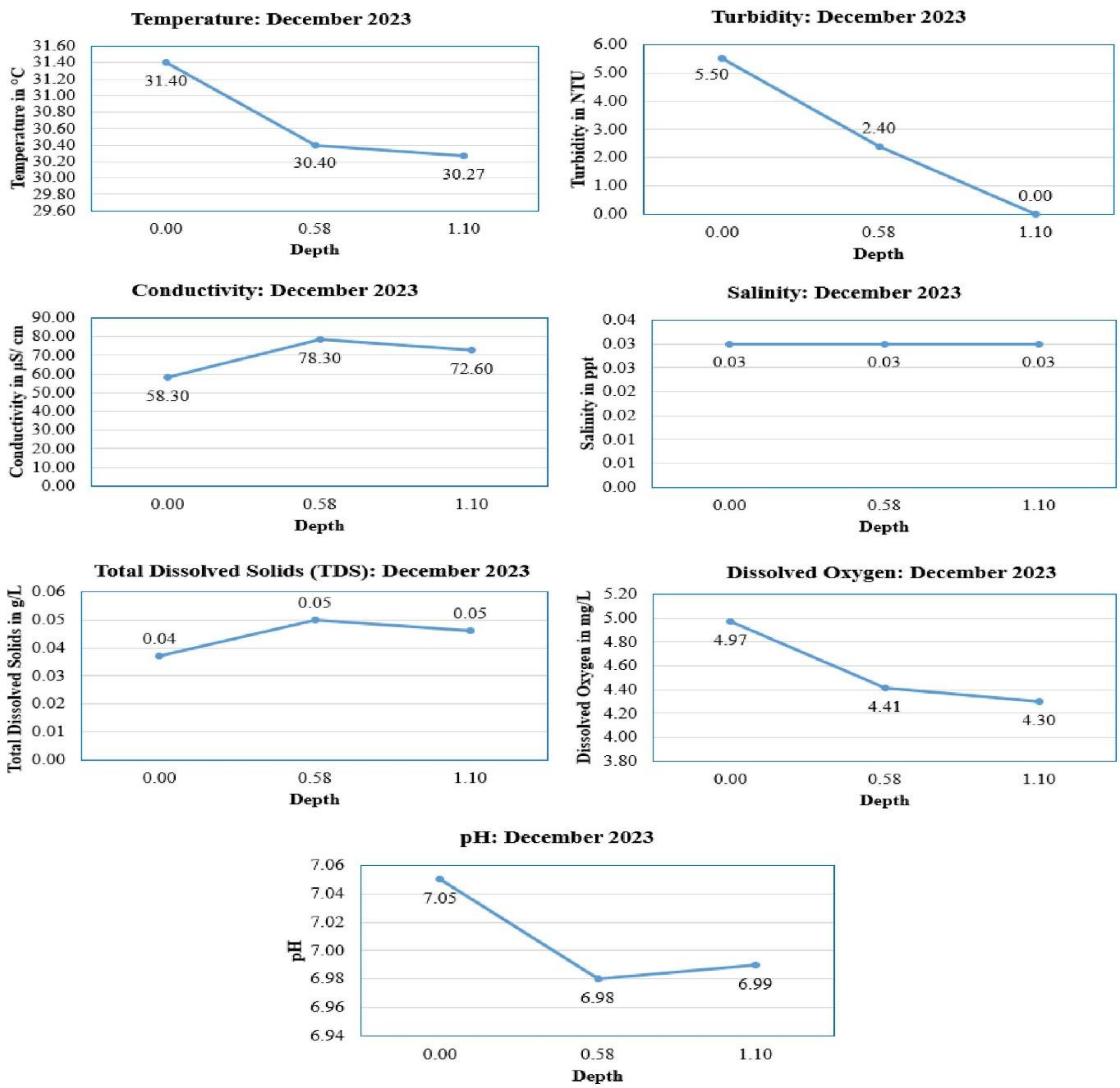

Figure 13: Graphical representation of water quality parameters at Kaaimanploder bridge 1

Notes fig.13:

- Temperature: The temperature decreases slightly as depth increases, possibly due to reduced exposure to sunlight and a greater influence of cooler underlying layers.
- Turbidity: Turbidity decreases with increasing depth, which may indicate the reduction of suspended solids and sediments.
- Conductivity: Higher conductivity with increasing depth suggests the presence of dissolved salts and minerals, possibly due to sedimentation.
- Salinity: Salinity remains consistently low at all depths, suggesting stable salt concentration.
- Total Dissolved Solids (TDS): TDS remains consistently low at all depths, suggesting stable levels of dissolved solids in the water.
- Dissolved Oxygen (DO): Lower oxygen levels in deeper water can be caused by biological activity and limited aeration, especially in sediment-rich environments.
- pH: The pH values show a slight decrease as depth increases, which may be caused by biological processes in deeper water.

Table 14: Water Quality Measurements and Standards Comparison for Kaaimanpolder bridge 1

Waterquality standards	**Depth (M)**	**Temperature (°C)**	**Turbidity (NTU)**	**Conductivity (µS/ cm)**	**Salinity (ppt)**	**Total Dissolved Solids (g/L)**	**Dissolved Oxygen (mg/L)**	**pH**
	0.00	31.40	5.50	58.30	0.03	0.037	4.97	7.05
	0.58	30.40	2.40	78.30	0.03	0.050	4.41	6.98
	1.10	30.27	0.00	72.60	0.03	0.046	4.30	6.99
Freshwater (US EPA)	-	-	-	0 - 1500	-	<500	> 6.00	5.00 - 9.00
Irrigation water (FAO)	-	-	-	0 - 3000	-	0 - 2000		6.00 - 8.50

Notes table 14:

- The measured DO values at all the depths do not meet the recommended standards for irrigation water and freshwater.

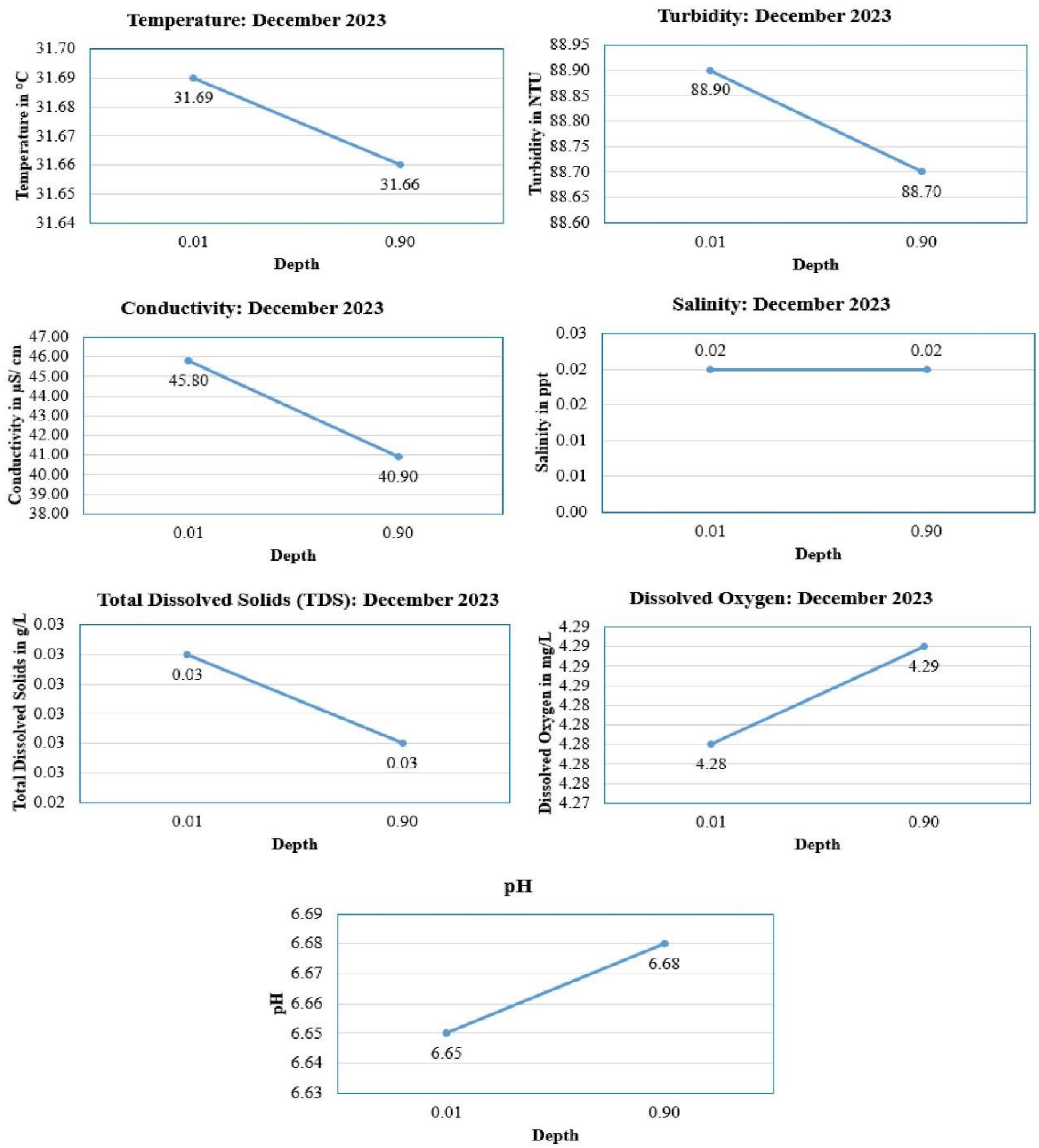

Figure 14: Graphical representation of water quality parameters at Kaaimanploder bridge 2

Notes fig.14:

- The water quality in the Kaaimanpolder changes significantly with increasing depth.
- Temperature, turbidity, conductivity, and TDS decrease significantly with depth, mainly due to reduced exposure to sunlight and thermal fluctuations, sediments, agricultural runoff, and reduced oxygen supply in deeper waters.
- Salinity remains low and constant, primarily from freshwater sources without salt infiltration.
- Dissolved oxygen also remains stable, but this variation is mainly influenced by the decrease in oxygen supply in deeper waters due to biological activity.
- pH values are stable and suitable for freshwater habitats at all depths.

Table 15: Water Quality Measurements and Standards Comparison for Kaaimanpolder Bridge 2

Water quality standards	Depth (M)	Temperature (°C)	Turbidity (NTU)	Conductivity (µS/ cm)	Salinity (ppt)	Total Dissolved Solids (g/L)	Dissolved Oxygen (mg/L)	pH
	0.01	31.69	88.90	45.80	0.02	0.029	4.28	6.65
	0.90	31.66	88.70	40.90	0.02	0.026	4.29	6.68
Freshwater (US EPA)	-	-	-	0 - 1500	-	<500	> 6.00	5.00 - 9.00
Irrigation water (FAO)	-	-	-	0 - 3000	-	0 - 2000		6.00 - 8.50

Notes Table 15:

- However, the measured dissolved oxygen values at all depths do not meet the recommended irrigation water and freshwater standards.

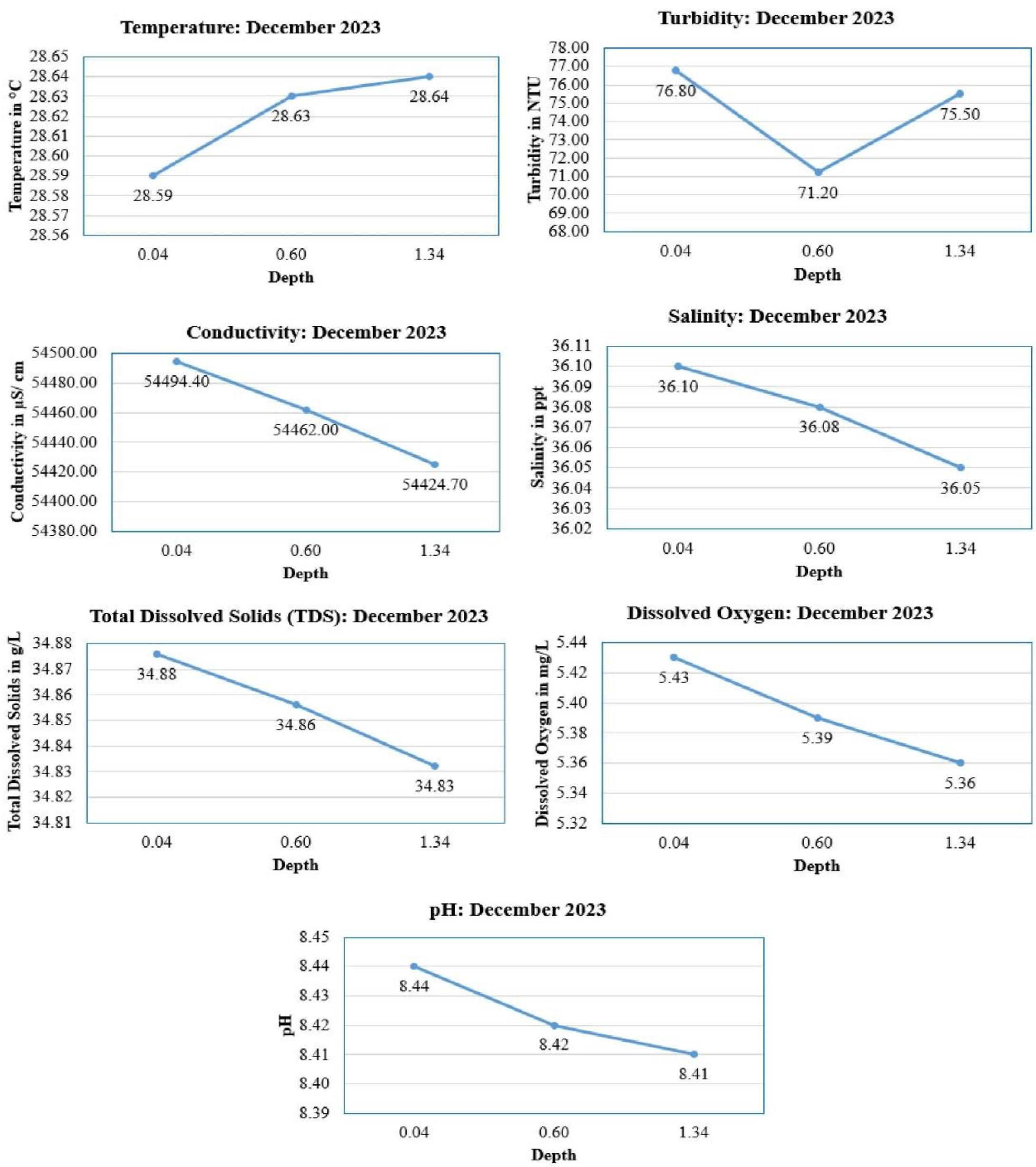

Figure 15: Graphical representation of water quality parameters at Ramdien pier

Notes fig.15:

- The following observations were made regarding water quality at the Ramdien pier.
- The temperature increases slightly with depth, possibly due to slow heat transfer in deeper water layers.
- The turbidity shows a varying pattern, likely caused by sedimentation and changes in water currents.
- The conductivity, salinity, TDS, DO and pH decrease with increasing depth, possibly due to salt infiltration from the environment, resulting in higher salinity, reduced oxygen supply and biological activity.
- pH values remain stable, indicating that the water still has a mildly alkaline character.

Table 16: Water Quality Measurements and Standards Comparison for Ramdien pier

Waterquality standards	Depth (M)	Temperature (°C)	Turbidity (NTU)	Conductivity (μS/ cm)	Salinity (ppt)	Total Dissolved Solids (g/L)	Dissolved Oxygen (mg/L)	pH
	0.04	28.59	76.80	54494.40	36.10	34.88	5.43	8.44
	0.60	28.63	71.20	54462.00	36.08	34.86	5.39	8.42
	1.34	28.64	75.50	54424.70	36.05	34.83	5.36	8.41
Freshwater (US EPA)	-	-	-	0 - 1500	-	<500	> 6.00	5.00 - 9.00
Irrigation water (FAO)	-	-	-	0 - 3000	-	0 - 2000		6.00 - 8.50

Notes table 16:

- However, the measured DO values at all the depths do not meet the recommended standards for irrigation water and freshwater.
- Additionally, the measured Conductivity at Ramdien pier is high at different depths, rendering the water unstable for irrigation and freshwater, but falling within the normal range for seawater, typically around 50,000 microsiemens per centimeter (uS/cm)

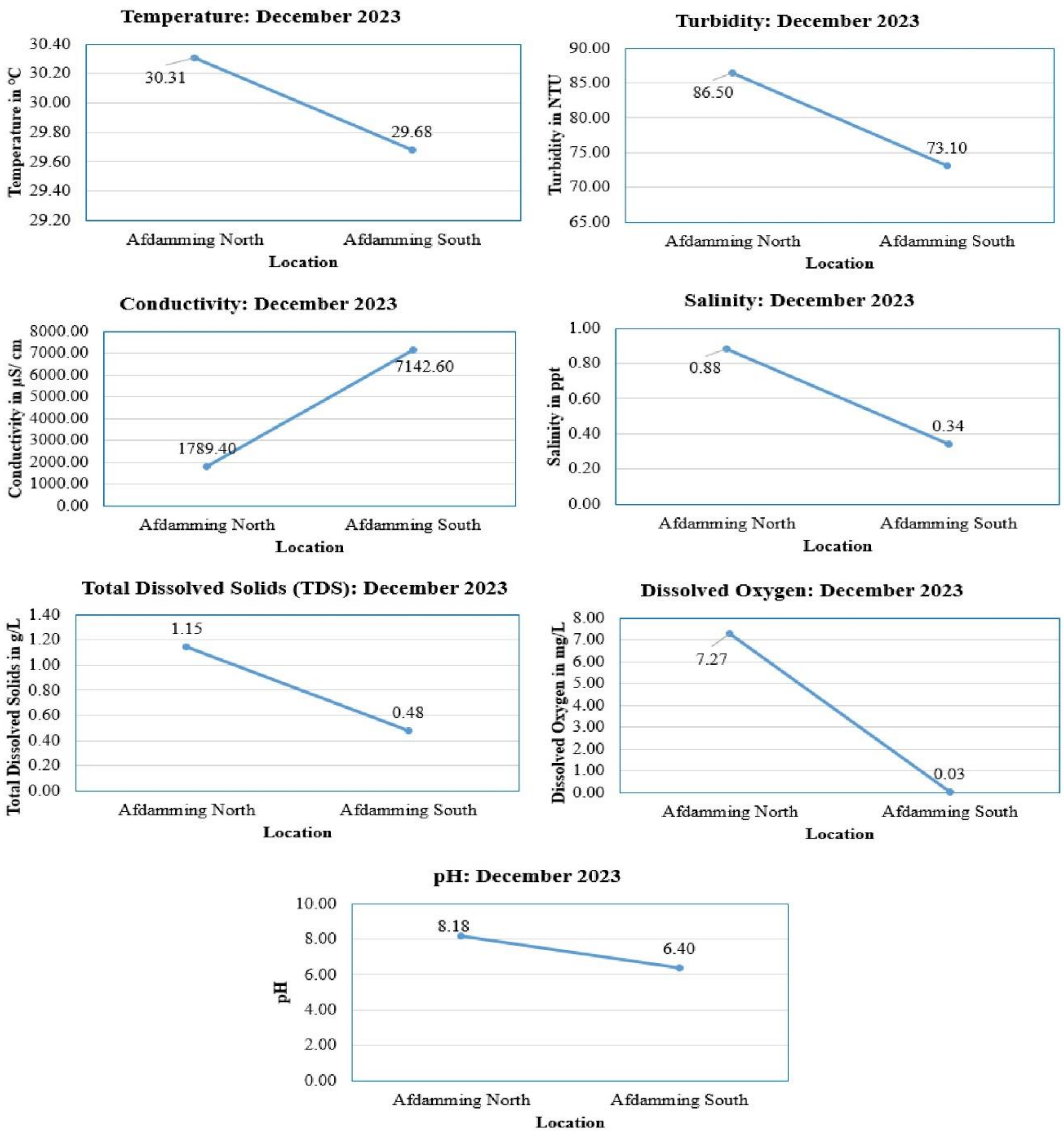

Figure 16: Graphical representation of water quality parameters at Afdamming

Notes fig.16:

- Temperature: Reduced solar radiation or atmospheric conditions may explain the drop in temperature.
- Turbidity: Reduced sedimentation due to reduced sediment discharge during drought can reduce turbidity.
- Salinity and Total Dissolved Solids (TDS): Higher evaporation than salt water input during drought can decrease salinity and TDS.
- Conductivity: Reduced dilution from rain and increased evaporation during drought can increase conductivity.
- Dissolved oxygen (DO): Reduced biological activity due to lower temperatures and reduced flow can decrease dissolved oxygen.
- pH: Chemical reactions and changes in CO_2 concentration due to biological processes and lower temperatures can affect pH.

Table 17: Water Quality Measurements and Standards Comparison for Afdamming

Location and waterquality standards	Temperature (°C)	Turbidity (NTU)	Conductivity (µS/ cm)	Salinity (ppt)	Total Dissolved Solids (g/L)	Dissolved Oxygen (mg/L)	pH
Afdamming North	30.31	86.50	1789.40	0.88	1.145	7.27	8.18
Afdamming South	29.68	73.10	7142.60	0.34	0.476	0.03	6.40
Freshwater (US EPA)	-	-	0 - 1500	-	<500	> 6.00	5.00 - 9.00
Irrigation water (FAO)	-	-	0 - 3000	-	0 - 2000		6.00 - 8.50

Notes table 17:

- The measured conductivity values at Afdamming South are higher than recommended for freshwater and irrigation water.
- The measured conductivity values at Afdamming North are recommended for freshwater, but not for irrigation water.
- The measured DO values at Afdamming South do not meet the advisory standards for irrigation water and freshwater.

At other locations such as Nani Swamp, Stalweide Bridge, Ingas, Henar Bridge and Wageningen, we could only carry out measurements using a bucket. We collected water samples in a bucket and assessed their quality at these locations. This allowed us to take only one measurement, which we could not include in our graph.

Table 18: Water Quality Measurements and Standards Comparison for Nani Swamp, Stalweide Bridge, Ingas, Henar Bridge, and Wageningen

Location and waterquality standards	**Temperature (°C)**	**Turbidity (NTU)**	**Conductivity (µS/ cm)**	**Salinity (ppt)**	**Total Dissolved Solids (g/L)**	**Dissolved Oxygen (mg/L)**	**pH**
Nani Swamp Bridge 1	28.49	77.70	45.40	0.02	0.03	3.48	7.62
Nani Swamp Bridge 2	28.43	70.90	81.38	4.48	5.21	6.45	7.88
Stalweide bridge	33.04	81.00	22.50	0.09	0.142	4.37	7.15
Ingas	27.85	79.40	37495.60	23.72	24.00	4.77	8.29
Henar bridge	31.58	80.40	6713.00	3.64	4.30	4.93	7.62
Wageningen	31.34	87.70	38.70	0.01	0.025	5.05	6.73
Freshwater (US EPA)	-	-	0 - 1500	-	<500	> 6.00	5.00 - 9.00
Irrigation water (FAO)	-	-	0 - 3000	-	0 - 2000		6.00 - 8.50

Notes Table 18:

- The measured conductivity values at Ingas and Henar Bridge are higher than recommended for freshwater and irrigation water.
- The measured DO values at all locations except Nani Swamp Bridge 2 do not meet the advisory standards for irrigation water and freshwater.

8. Conclusions and Recommendations

The water sources in coastal areas are diverse and include fresh and saltwater. Freshwater sources, such as rivers, marshes, man-made waterways, and lakes, serve various purposes: agriculture, fishing, industry, shipping, drinking water, recreation, and habitation. Simultaneously, saltwater sources, such as seawater and tidal areas, are actively utilized for activities like shipping, fishing, industry, and recreation, playing a crucial role in the ecological balance of coastal ecosystems.

From October to December, fluctuations in river water levels have been observed, possibly caused by natural processes such as saltwater intrusion, sedimentation, seasonal changes, and human activities such as agriculture and mining.

Key findings from the research include:

- Settlements along waterways rely on freshwater for their daily needs.
- Downstream turbidity is caused by small-scale mining, potentially affecting the fish population.
- Freshwater from Nani Swamp in Nickerie is crucial for rice irrigation due to its richer nutrients compared to water from the Corentyne River.
- Sweetwater from the Coronie moeras in Coronie is vital for preserving the mangrove population along the coast due to the required freshwater-saltwater balance.
- Elevated salt levels in Nickerie and Coronie may affect the availability of freshwater, posing a challenge to settlements and coastal ecological habitats.
- El Niño is a climate phenomenon that occurs periodically, raising the surface temperature of the Pacific Ocean and causing global weather changes such as droughts and floods.
- During El Niño events, coastal areas may experience higher sea levels and reduced rainfall, exacerbating saltwater intrusion and threatening freshwater supplies.
- Appropriate sanitation facilities along waterways are crucial for maintaining water quality for recreational activities.

The information about El Niño originates from the meteorological service of Suriname. This service provides valuable insights into climate phenomena.

The comprehensive water quality assessment conducted regions, including the Corantijn River, the Coppename River, the Nickerie River and the Coronie district, reveals fluctuations that are not always align with desired standards for various purposes, with some parameters showing higher or lower values than the USEPA standards for freshwater and the FAO standards for irrigation.

Some parameters exhibit values exceeding or falling below the recommended thresholds set by regulatory bodies such as the USEPA and FAO. Notably, dissolved oxygen concentration (DO) measurements frequently register levels significantly below the freshwater standard of 6 mg/l. It is essential to acknowledge that multiple factors, including flow rate, temperature, depth, and the presence of aquatic life influence DO levels. Consequently, a low DO value does not necessarily signify an immediate high risk but necessitates comprehensive assessment with other relevant parameters. A proactive approach involving regular monitoring and implementing robust management strategies is imperative to address these fluctuations and ensure sustainable water quality management. Continuous surveillance can accommodate long-term variations, guaranteeing consistent water quality standards in coastal water bodies.

Recommendations

Concrete Actions for Improving Water Quality: Recommendations from the Hydraulic Research Division

1. Conduct large-scale water quality tests to determine a wide range of parameters, including pesticides, heavy metals (such as lead and mercury), nutrients, and other potential contaminants.
2. Promote collaboration among stakeholders: Encouraging collaboration between government agencies, businesses, and local communities is essential. By fostering partnerships, effective strategies for water resource management and addressing water-related challenges can be developed.
3. Public awareness initiatives: Increasing public awareness about water quality and the consequences of human activities is crucial. Educational campaigns can inform communities about water conservation practices, measures to reduce pollution, and the need for sustainable water use.
4. Expansion of monitoring systems: To gain a fuller understanding of fluctuations in water quality across different seasons, it is recommended that existing monitoring systems be expanded. This may involve adding more monitoring points, increasing the frequency of data collection, and utilizing advanced monitoring technologies.
5. Allocation of substantial financial resources: Adequate financial resources must be allocated to implement sustainable water management measures and ongoing monitoring. Additional funding can be invested in water quality programs, taking into account the specific needs of the community and long-term goals for sustainable water management.

Thorough analysis and consultation with stakeholders can help determine the required financial resources.

References:

- ILACO WFS Technical Report #1_Assessment current uses of surface water
- Food and Agriculture Organization (FAO) (2015). The State of Suriname's Biodiversity for Food and Agriculture
- Water quality standards from the US EPA

Annex 1: Procedure Water Quality measurement

- ✓ Step 1 the date and time of the instrument must first be synchronized with the tablet or laptop.
- ✓ Step 2 lower the sensor into the water so that all sensors are just covered, check the depth reading.
- ✓ Step 3 Slowly lower the sensor to the bottom of the location to be measured and measure the depth.
- ✓ Step 4 Raise the sensor 10 cm from the bottom using the depth sensor and record the depth.
- ✓ Step 5 The second measurement should be taken at 80% of the depth
- ✓ Step 6 Is followed by the third measurement. This measurement takes place at 60% of the depth.
- ✓ Step 7 The fourth measurement is taken at 40% of the depth.
- ✓ Step 8 The fifth measurement is taken at 20% of the depth.
- ✓ Step 9 The next measurement is taken at 0.50 meters from the surface.
- ✓ Step 10 The sensor is lowered to the 1st measurement to take a sample. This will serve as the first check.
- ✓ Step 11 The sensor is then returned to just below the surface and another measurement is taken. This will be the second check.

Workflow for Water Depth Measurement

- ➢ Synchronize Date and Time:
- ➢ Ensure that the instrument's date and time are synchronized with the tablet or laptop.

- ➢ Initial Depth Check:
- ➢ Lower the sensor into the water until all sensors are just covered, and check the depth reading.

- ➢ Depth Measurement Process:
- ➢ Slowly lower the sensor to the bottom of the measurement location and record the depth.

- ➢ 10 cm Above Bottom:
- ➢ Raise the sensor 10 cm from the bottom using the depth sensor and record the depth.

- 80% Depth Measurement:
- Take the second measurement at 80% of the depth.

- 60% Depth Measurement:
- Take the third measurement at 60% of the depth.

- 40% Depth Measurement:
- Take the fourth measurement at 40% of the depth.

- 20% Depth Measurement:
- Take the fifth measurement at 20% of the depth.

- 0.50 Meters from Surface:
- Take the next measurement at 0.50 meters from the water surface.

- Sample Check - 1st Measurement:
- Lower the sensor to the depth of the first measurement and take a sample for the initial check.

- Surface Measurement - Second Check:
- Return the sensor just below the water surface and take another measurement for the second check.

This clear and concise workflow ensures systematic and accurate water depth measurements, allowing for proper checks and data validation at each step.

Depths may vary depending on tides, environment and specific conditions. This procedure is carried out to check the river stratification. The last two checks are performed to ensure that there has been no change in the previous sampling times

Depth variations are contingent upon tide fluctuations, environmental factors, and specific conditions. This protocol is enacted to assess the stratification of the river. The final two validations are executed to ascertain the absence of alterations in the preceding sampling instances.

Annex 2: Pictures of various locations

1. Water quality measurement at Apoera scaffold 	2. Water quality measurements from a boat Corantijn River 
3. Water quality measurement at Witagron 	4. Water quality measurement from a boat Kabalebo creek 

Annex 3: Tables of all measurements

Corantijn River												
Location	**Time (H)**	**Weather (sunny, rainy, cloudy)**	**Depth (m)**	**Temperature (°C)**	**Turbidity (NTU)**	**Conductivity (µS/ cm)**	**Salinity (ppt)**	**Total Dissolved Solids (g/L)**	**Dissolved Oxygen (mg/L)**	**pH**	**Color**	**Observation**
1. Baitali Kabalebo	11:44	sunny	2.23	31.79	0	17.8	0.01	0.011	6.61	7.55	clear	low water
			1.2	31.79	0	17.4	0.01	0.011	6.63	7.42		
			0.59	31.83	0	17.3	0.01	0.011	6.64	7.38		
			0.03	31.88	0	17.3	0.01	0.011	6.62	7.36		
AVERAGE				31.82		17.45	0.01	0.011	6.63	7.43		
2. Kabalebo creek	12:22	sunny	1.93	32.26	0	17.8	0.01	0.011	6.93	7.46	clear	low water
			0.96	32.39	0	18.2	0.01	0.012	6.91	7.42		
			0.03	32.4	0	18.2	0.01	0.012	6.87	7.47		
AVERAGE				32.35		18.07	0.01	0.012	6.9	7.45		
3. Apoera scaffold	10:08	sunny	1.72	31.52	0	19.8	0.01	0.011	6.61	7.25	clear	floating particles
			0.85	31.55	0	18.4	0.01	0.01	6.64	7.28		strong current
			0.02	31.7	8.5	24.5	0.01	0.014	6.65	7.36		
			1.76	31.69	8.2	18.6	0.01	0.01	6.62	7.24		check
AVERAGE				31.62	8.35	20.33	0.01	0.011	6.63	7.28		
DECEMBER												
Southdrain ferry (Canawaima)	10:00		bucket	28.07	77.6	3351.2	1.73	2.15	6.47	8.03	milky brown	
Nanisluice	7:12		bucket	27.2	43.6	1526	0.74	0.098	0.59	7.53	milky light brown	sluice closed, flowing water

Coppename River												
Location	**Time (H)**	**Weather (sunny, rainy, cloudy)**	**Depth (m)**	**Temperature (°C)**	**Turbidity (NTU)**	**Conductivity (µS/ cm)**	**Salinity (ppt)**	**Total Dissolved Solids (g/L)**	**Dissolved Oxygen (mg/L)**	**pH**	**Color**	**Observation**
Kaaimanston	9:41	sunny	0.69	31.41	0.5	27	0.01	0.018	6.93	7.99	clear	high water
	10:00	sunny	0.95	31.76	4.9	27	0.01	0.017	6.87	7.6		
			0.44	31.81	0	27	0.01	0.017	6.84	7.61		
			0.03	31.85	0	27.2	0.01	0.017	6.96	7.66		
			0.96	31.8	0	26.9	0.01	0.017	6.98	7.59		check
AVERAGE				31.73	4.9	27.02	0.01	0.017	6.92	7.69		
Scaffold Witagron	13:24	sunny	1.43	32.87	0	21.1	0.01	0.014	7.45	7.73	clear	floating particles, low water
			0.77	32.91	0	21.1	0.01	0.014	7.35	7.78		
			0.02	32.96	0	26.3	0.01	0.017	7.38	7.85		
			1.41	32.96	0	21.8	0.01	0.014	7.34	7.74		check
AVERAGE				32.93		22.58	0.01	0.015	7.38	7.78		
DECEMBER												
Boskamp	10:28	sunny	1.26	29.38	56.9	29688.3	18.31	19	5.45	8.39	milkey dark brown	low water, strong current
			0.7	29.44	43.6	29405.8	18.12	18.82	5.47	8.38		
			0	29.34	97.4	29358.2	18.08	18.79	5.49	8.38		
			1.24	29.45	89.5	29095.1	17.9	18.62	5.48	8.39		check
AVERAGE			0.8	29.4	71.85	29386.85	18.1	18.81	5.47	8.39		

District Coronie

Location	Time (U)	Weather	Depth (m)	Temperature(°C)	Turbidity (NTU)	Conductivity ((µS/ cm)	salinity(ppt)	Total Dissolved Solids (g/L)	Dissolved Oxygen (mg/L)	pH	Color	Observation
Lozing 49 (Coronie sluice South)	11:07	Sunny	1.72	29.52	84	25608.9	15.56	16.39	1.91	8.66	Light brown	There were floating particles and dirty water
			0.86	30.09	82	25653.2	15.53	16.36	3.15	8.72		
			0.02	32.24	82	25815.5	15.72	16.522	6.01	8.79		
			1.71	30	0	25526.8	15.5	16.337	2.14	8.69		Control
			1.08	30.46	62	25651.1	15.58	16.402	3.3	8.72		Average
Lozing 49 (Coronie sluice North	11:32	Sunny	1.64	29.09	0	25482.4	15.47	16.309	0	8.85	Light brown	There were floating particles
			0.88	29.34	0	25557.7	15.52	16.357	0	8.93		
			0.01	31.67	0	20168.8	5.69	6.508	3.33	8.44		
			1.64	29.45	0	25477.3	15.47	16.03	0	8.94		Control
			1.04	29.89	0	24171.55	13.04	13.801	0.83	8.79		Average
Coronie fresh water	12:33	Sunny	0.66	28.46	0	278.1	0.12	0.178	0	7.34	Milkey light brown	There were floating particles, low tide
			0	32.91	1.5	287.4	0.12	0.184	3.65	7.33		
			0.33	30.69	0.75	282.75	0.12	0.181	1.83	7.34		Average
Coronie salt water	12:53	Sunny	1.74	28.95	74.6	46651.9	30.29	29.857	0	8.22	Milkey light brown	There were floating particles, low tide
			0.86	29.19	93.7	43743.4	28.18	27.996	1.88	8.2		
			0.01	31.56	90.2	38237.3	24.27	24.472	5.54	8.39		
			1.71	29.31	86.3	46001.6	29.82	29.441	0	8.23		Control
			1.08	29.75	86.2	43658.55	28.14	27.942	1.86	8.26		Average
Burnside	13:30	Sunny	0.63	29.71	88.5	24767.7	15	15.851	6.35	8.51	Milkey light brown	
			0	30.3	84.8	23194.2	13.95	14.844	7.18	8.58		

District Nickerie

Location	Time (U)	Weather	Depth (m)	Temperature(°C)	Turbidity (NTU)	Conductivity ((µS/ cm)	salinity(ppt)	Total Dissolved Solids (g/L)	Dissolved Oxygen (mg/L)	pH	Color	Observation
Afdamming North	13:58	Sunny		30.31	86.5	1789.4	0.88	1.145	7.27	8.18	Milkey dark brown	The measurement was carried out in a bucket due to the difficult-to-access environment, characterized by rocks and a high water level
Afdamming South	14:10	Sunny	0.7	28.93	73.5	7141.8	0.34	0.475	0	6.48		
			0	30.43	72.7	7143.4	0.34	0.476	0.06	6.31		
			0.35	29.68	73.1	7142.6	0.34	0.476	0.03	6.4		Average
Kaaimanpolder bridge 1	14:35	Sunny	1.1	30.27	0	72.6	0.03	0.046	4.3	6.99	Milkey light brown	There were floating particles,
			0.58	30.4	2.4	78.3	0.03	0.05	4.41	6.98		
			0	31.4	5.5	58.3	0.03	0.037	4.97	7.05		
			1.1	30.25	98.3	73.6	0.03	0.047	4.24	6.23		Controle
Kaaimanpolder bridge 2	15:10	Sunny	0.9	31.66	88.7	40.9	0.02	0.026	4.29	6.68	Milkey light brown	There was low tide and brown and dirty water
			0.01	31.69	88.9	45.8	0.02	0.029	4.28	6.65		
Wageningen	16:00	Sunny		31.34	87.7	38.7	0.01	0.025	5.05	6.73		The measurement was carried out in a bucket because of the difficult-to-reach water, characterized by a lot of mud

District Nickerie

salinity(ppt)	Time (U)	Weather	Depth (m)	Temperature(°C)	Turbidity (NTU)	Conductivity ((µS/ cm)	salinity(ppt)	Total Dissolved Solids (g/L)	Dissolved Oxygen (mg/L)	pH	Color	Observation
Henar Bridge	18:15	Sunny		31.58	80.4	6713	3.64	4.3	4.93	7.62	Milkey dark brown	The measurement was carried out in a bucket because the current was too strong and the water was low
Ramdien pier	7:10	Cloudy	1.34	28.64	75.5	54424.7	36.05	34.83	5.36	8.41	Milkey brown	
			0.6	28.63	71.2	54462	36.08	34.86	5.39	8.42		
			0.04	28.59	76.8	54494.4	36.1	34.88	5.43	8.44		
			1.27	28.66	63.6	54392.7	36.03	34.81	5.4	8.45		Controle
Ingas	8.25	Sunny		27.85	79.4	37495.6	23.72	24	4.77	8.29	Milkey light brown	The measurement was carried out in a bucket because the current was too strong
Nani Swamp Bridge 1	8:50	Cloudy		28.49	77.7	45.4	0.02	0.03	3.48	7.62	Milkey Light brown	The measurement was carried out in a bucket due to low water.
Nani Swamp Bridge 2	9:20	Cloudy		28.43	70.9	81.38	4.48	5.21	6.45	7.88	Milkey light brown	The measurement was carried out in a bucket due to low water. Oil layer and it was overgrown with aquatic plants