MINISTRY OF PUBLIC WORKS
DIRECTORATE RESEARCH AND SERVICES
SUB-DIRECTORATE RESEARCH AND INNOVATION
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Paramaribo – Suriname

STANDARD OPERATING PROCEDURES (SOP) 2024

Waterloopkundige Dienst Suriname (WLA)
(Hydraulic Research Division)

Document: **Standard Operating Procedures (SOP) 2024**

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This publication was produced with the support of the Global Climate Change Alliance Suriname Adaptation (GCCA+) Phase 2 Project, funded by the European Union (EU) and the United Nations Development Programme (UNDP), in collaboration with government partners

(Deze publicatie / print wordt ondersteund door het Global Climate Change Alliance Suriname Adaptation (GCCA+) Phase 2 Project, gefinancierd door de Europese Unie (EU) en United Nations Development Programme (UNDP), en de ondersteuning van de Overheid van Suriname)

Foreword

Water is one of our most vital resources, essential for life, economic development, and environmental sustainability. The Hydraulic Research Division (WLA) plays a crucial role in ensuring the integrity of our water systems, providing essential data and analysis that inform policy, safeguard public health, and support sustainable management of water resources. This Standard Operating Procedures (SOP) report is a testament to our commitment to maintaining the highest standards of excellence in our operations.

This document outlines the comprehensive procedures and protocols that guide our work, from data collection and monitoring to analysis and reporting. By adhering to these standardized practices, we ensure the accuracy, reliability, and consistency of the information we provide. These procedures have been meticulously developed through collaboration among our team members, incorporating best practices and the latest advancements in hydrological and water quality science.

Our SOPs are designed to equip all personnel with clear guidelines and protocols, facilitating efficient and effective operations. These standards reflect our dedication to operational integrity, scientific accuracy, and continual improvement. As our field evolves with new technologies and methodologies, this document will be regularly updated to incorporate emerging best practices and to address any operational challenges.

We recognize the critical importance of our work in protecting public health, supporting economic activities, and preserving our natural environment. The data and insights we provide are foundational to informed decision-making and effective water resource management. We extend our deepest gratitude to our team members for their expertise, diligence, and commitment to excellence.

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 support for drafting these invaluable SOPs.

It is our hope that this SOP report will serve as an invaluable resource, ensuring the highest standards of practice within the Hydrological and Water Quality Division. Together, we will continue to advance our mission of safeguarding water resources for current and future generations.

Sincerely,
Sergio Kadosoe BSc
Permanent Secretary
Directorate Research and Services
Ministry of Public Works

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Abbreviations & Glossary of Terms

AWLS	Automatic Water Level Station
AWS	Automatic Weather Station
ARS	Automatic Rain Station
BWKW	Hydropower Works Office
ECOLOG	Water Level Logger with built-in datalogger and telemetry
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
EU	European Union
GCCA+	Global Climate Change Alliance (project)
GI	General Instructions
HSEQ	Health, Safety, Environment, and Quality
IHO	International Hydrological Organization
ITCZ	Inter Tropical Convergence Zone
MDS	Meteorological Service Suriname (Meteorological Service Suriname)
NGO	Non-Governmental Organization
NIMOS	National Institute for Environment & Development in Suriname
NO2	Nitrogen dioxide
SO2	Sulphur dioxide
SOPs	Standard Operating Procedures
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Program
VEC	Valued Ecosystem Components
WLA	Waterloopkundige Dienst (Hydraulic Research Division)
WMO	World Meteorological Organization

INTRODUCTION

Writing the Standard Operating Procedures (SOP) is initiated by the Ministry of Public Works and supported by the UNDP. The SOP provides a standard working tool that can be used to install and maintain hydrological equipment, perform routine management of data collection, quality checking and data transmission. This document is valid for a limited period from the official date of publication. After three years, this document will be reissued without change, revised, or withdrawn by the Hydrological Service of Suriname (WLA).

Purpose

This Standard Operating Procedure for the Operation and Maintenance of hydrological Instruments applies to those activities involving the collection of data of various parameters such as floods, ground water, water speed and direction, and tidal movements, etc. The procedures include equipment and site selection factors, installation, operation and field measurement techniques for operation and maintenance of the hydrological stations. These procedures are to be followed to minimize variation and reduce errors and ensure accuracy in measurement of hydrological parameters. Once data are acquired, it must be reviewed for quality control by the WLA in accordance with respective national quality control standards and archived in national and regional data repositories as processed data. Only processed data will be used as credible data for any application, anywhere in other countries. Writing this SOP has been completed with incorporating input from the WLA and will include comments of reviewers, including national partners like UNDP. The subject covered in this SOP is not exhaustive and further input is invited from all users.

Background

Water is the natural capital of the growing world population. The timing and spatial distribution of surface water quantity—and the variability in quality of that water—define how we design and build the infrastructure necessary for our energy, agriculture, mining, transportation, services like tourism and industrial sectors. While water supports our infrastructure, it can also take lives. Droughts and floods are threats that require our constant vigilance. Our abilities to predict flooding, plan for droughts, and support healthy ecosystems are challenged by land-use and climate change. Safe drinking water sources and entire ecosystems depend on continuous improvements in our understanding of, and efforts to protect, our water resources. In fact, it is difficult to overstate the importance of the availability, reliability, and accuracy of data from water monitoring programs. Today's hydrometric monitoring networks range from volunteer stewardship of small watersheds to continental-scale programs. Collectively, they are the basis for every action taken to support beneficial uses of water and to minimize threats from water. There are five essential elements of a successful hydrological monitoring program:

1. Network design
2. Technology
3. Training
4. Quality management system
5. Data management

The day-to-day work of the stream hydrographer has changed substantially from even a decade ago. It is time to review how these changes impact the end-to-end system for collecting and publishing credible and defensible data. WLA aims at a modern "best practices" approach to hydrometric monitoring. The practice shall improve the availability, reliability, and accuracy of all of our water information assets. A quality management system (QMS) is a set of standard operating procedures that govern the data production process to ensure that the data are of consistent, known quality. The monitoring program requires clear objectives for 1) data quality, 2) service, and 3) security that are closely linked with the needs of the end users. The SOPs provide rules to direct and control an organization toward meeting these quality management objectives.

Who Should Use the SOP?

The primary users of this document will be line agencies, who collect or review and manage hydrological data for the local and regional water control information system. The users will include local, regional and national agencies that collect such data or use the data for resources management. In addition, WLA will refer to the SOP to understand the accuracy of the data that falls within the different standards categories. The SOP is organized in accordance with equipment used by WLA. For each equipment, a short reference is placed in this SOP as already specific instructions are provided in the respective manuals of the producers or the supplier. For greater details on equipment, please refer to manufacturer's website.

1. ORGANISATION STRUCTURE MINISTRY OF PUBLIC WORKS

1.1 Introduction

The Ministry of Public Works has a history that began on January 1, 1856, when the Construction Department was founded by the merger of the civil and military construction departments. The Hydraulic Research Division (HRD) of the Ministry of Public Works is established in October 1962 and started the following year with its activities. This Division promotes the optimal use, management, control (flood control), and protection of the waters in Suriname.

1.2 The organization structure of the Ministry of Public Works

The Ministry consists of 4 directorates:

- The Directorate of Civil Technical Works.
- The Directorate of Construction and Urban Works.
- The Directorate of Public Green and Waste Management.
- The Directorate of Research and Services. (Mr. Sergio Kadosoe)

The Directorate of Research and Services is responsible for investigating the causes of phenomena that affect humans, animals, and biodiversity. Using raw and collected data, information for possible events (disasters) must be provided to the government and the public, in an effective and timely manner.

The Research and Services Directorate consists of four (4) sub-directorates:

- the Sub-Directorate for Research and Innovation (Mr. D. Bhaggoe).
- the Sub-Directorate for Services (Mr. B. Ori).
- The Sub-Directorate for Administrative Services (Mrs. Sitaram).
- the Sub-Directorate for Project Monitoring and Administration (Mr.S. Dhanikasingh).

The following departments fall under the **Sub-directorate of Research and Innovation:** Hydraulics Research Division (WLA), Soil Mechanics and Building Materials Laboratory (GMBL), ESIA & QHSE, Meteorological Service Suriname (MDS), Utilities Management (NUTS).

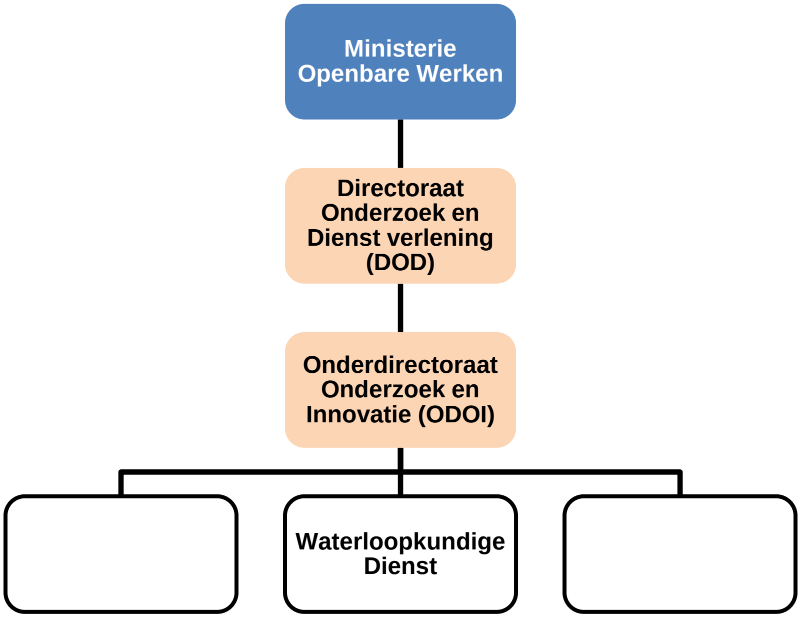


Figure 1: Organizational Structure of Ministry. Of Public Works

1.3 The Waterloopkundige Dienst (WLA).

In the new organization chart, the Hydraulic Research Division (WLA) is part of the Sub-Directorate for Research and Innovation (ODOI) of the Directorate for Research and Services (O&D). The aim of the service is to promote the optimal use, management, control (flood-control) and protection of the Surinamese waters. The activities include collecting, publishing and archiving basic data on hydraulic engineering, coordinating hydraulic research in the country, and maintaining contacts with other bodies in this field at national and international level.

The Organizational Structure

The current structure of the Hydraulics Service (WLA) is divided into three sections.

- Scientific Research Section
- Basic Monitoring Network and Logistics
- Administration Section

Each section is charged with its own tasks: Activities of the Hydraulics Service.

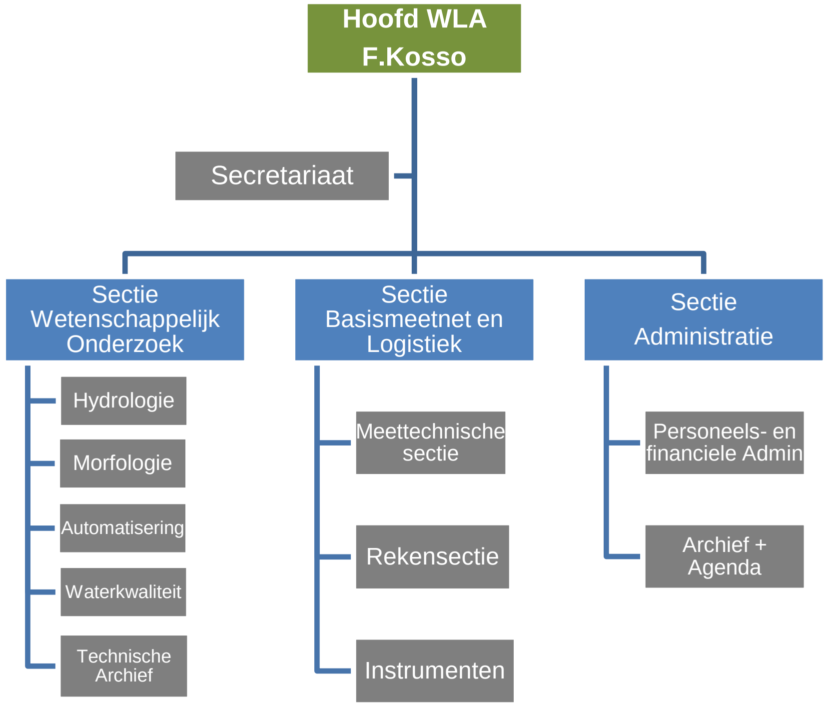


Figure 2: Organizational structure of WLA

Mission of the WLA

Collecting, publishing and archiving basic data on hydraulic engineering. Coordinating hydraulic research in the country and maintaining contacts with other authorities in this field at national - and international level.

Vision of the WLA

Given the importance of water and Suriname's place in the field of freshwater resources, viewed internationally, it is desirable that our waters are used sustainably. This requires adequate water management, upgrading and modernization and the service will make a significant contribution to this in terms of water quantity and water quality.

Core values of the WLA

1. Commitment and loyalty in delivery of products and services.
2. Integrity.
3. Professionalism in support of science, research, objectivity, impartiality, and excellence.
4. Mutual respect, cultural sensitivity and non-discrimination.

Goals of the WLA

1. Promote the optimal use, management, control (flood control) and protection of the waters in Suriname.
2. Improve result-based decision support service for water incidents and events that threaten lives and livelihoods.
3. Enhance climate related water services to understand and adapt to climate-related risks.
4. Develop capacity to provide integrated and coupled monitoring, detection and forecast services to support assessment and management of water resources and water-related hazards.
5. Build competence to provide sector-relevant information for socio-economic development, and support development of integrated environmental services to foster healthy communities and ecosystems.
6. Sustain highly skilled professional workforce equipped with training, tools and infrastructure to fulfil the mission.

1.4 WLA FUNCTIONS AND RESPONSIBILITIES

Quality Management System

In creating the SOP, it was kept in mind the concept of “fitness for purpose”. End users of data must be able to develop a trust relationship with data providers based on their confidence that the quality management objectives—for data quality, service, and security–have been met with respect to their intended purpose. Quality is a result of observation and information production processes. These processes need to be enforced by formal compliance with documented Standard Operating Procedures. There are several industry sources for hydrometric standards, including:

- IHO The International Hydrological Organization.
- World Meteorological Organization (WMO) operational hydrology reports.
- US Geological Survey (USGS) techniques and methods.
- USGS techniques of water resources investigations.

A commitment to internationally accepted technical standards provide a basis for inter-comparability of data. Data produced by different agencies (or even by different hydrographers within the same agency) should have similar accuracy and precision. This means if hydrographers independently monitor the same gauge, the resultant discharge hydrographs would be very similar and without systematic bias. The service objectives address the completeness of the data (for given levels of quality assurance at different lag times since observation). Historically, hydrometric data was published annually, as aggregated daily values and extreme statistics. Today, the focus is on real-time, continuous publication of unit value data, collected by AWLS instruments.

Achieving the desired service objectives is primarily a function of the balance between:

- Staffing (e.g., response time for instrument failure).
- Equipment specifications (i.e., instrument reliability).
- Life-cycle management of equipment (i.e., calibration and control procedures).
- Efficiencies in data production (e.g., automated notifications, auto-corrections, and auto-publication). and

- Feedback from the data production process (e.g., sufficient hydrodata to support a continuous improvement process).

There is also an increasing expectation that data should be openly discoverable, searchable, and accessible. Harmonized standards for data interoperability are provided by the Open Geospatial Consortium (OGC), where Hydrometric data are valuable. There is large capital, human, and operational investments in discharge information. The security objectives aim to protect these investments over the life of the data. In a well-maintained data management environment, the value of the data accrues with time. Continuity between modern systems and historical archives must be managed with care and diligence.

The Global Climate Observing System (GCOS) Principles provide several best practices for maintaining data integrity when managing time series data. In particular: “The details and history of local conditions, instruments, operating procedures, data processing algorithms, and other factors pertinent to interpreting data (i.e., metadata and hydrodata) should be documented and treated with the same care as the data.” Best practices for data curating ensure that 1) the data are secure and stored out of harm’s way, 2) hydrodata are complete, and 3) documentation is available for any changes in methods that could potentially impact the integrity of the data. It is one thing to clearly articulate the desired data quality, service, and security objectives. Verifying that the quality objectives have been met is a two-step process. Quality control is a system of routine and consistent checks to ensure data integrity, completeness, and compliance with stated standard operating procedures. Quality assurance is a system of independent review procedures to verify that the data quality objectives are met. WLA has developed its own QMS.

Network design is an ongoing process with new stations being established and existing stations being discontinued as program priorities and funding evolve. Updating the design of a network is fundamentally a sampling problem. The challenge is to find the right balance between hydrometric monitoring objectives and site desirability.

WLA addresses evolving expectations for data reliability and timeliness. WLA is not yet certified. WLA doesn’t have a certified QMS or a structure of documents on procedures and work instructions in place that is certified. There are working procedures that are implemented according to national regulations.

1.5 The tasks of the different sections

1.5.1 Scientific Research Section

Tasks of the Scientific Research Section is to gain knowledge about the magnitude of the elements of the hydrological cycle. These are:

- Evaluation and analysis of observations for specialized investigations.
- Interpretation and reporting of data.
- Provision of guidance on water management, waterways, shore, coastal defense, etc.
- Researching to benefit hydraulic engineering works in Suriname.
- Surveying and measuring the waterways of Suriname.
- Researching the navigability and hydrological use of Surinamese waters.
- Establishment of a monitoring network for water quality research.

- Provision of advice on water use for agriculture, fisheries, industry, and ecology.
- Investigation of the impact of wastewater discharge on the water quality of the Suriname River.
- Collaboration on research in the estuarine zone with the Nature Conservation department.
- Provision of advice on water quality matters.
- Collaboration with the Fisheries Department on research in the Bigi Pan area.
- Development of computer programs for all WL.A. departments.
- Creation of a program archive.
- Streamlining of data processing.
- Enhancement of existing computer programs.
- Organization of comprehensive data.
- Management of the technical archive.
- Typesetting of yearbooks, reports, and other publications.
- Processing of measurement results for yearbooks and other publications.

1.5.2 Tasks of the Basic Monitoring Network and Logistics section

This section has the following responsibilities:

- Being accountable for gathering and processing essential hydraulic data across Suriname.
- Establishing and upkeeping a network of hydraulic monitoring stations in Surinamese waters.
- Managing data collection and primary processing for special research projects in the domain of Hydraulic Engineering and Water Quality of WLA, as well as projects commissioned by external parties.
- Overseeing the procurement, testing, management, and maintenance of necessary instruments and equipment for departmental measurements and projects.
- Overseeing the construction and upkeep of gauges, scaffolding, and other structures used for installing measuring instruments.
- Organizing the operational deployment of all vessels and vehicles of the department.
- Independently or through third parties, supervising maintenance and repair work on departmental buildings, grounds, vessels, and vehicles.
- Managing the collection, primary processing, and analysis of water quality data.
- Establishing and maintaining a Water Quality Network in Surinamese waters.

1.5.3 Tasks Section Administration

- Handling personnel matters
- Preparation of the annual budget and credit monitoring.
- Takes care of the purchase of all necessities.
- Management and provision of office and field supplies.

1.6 TRAINING OF KEY OFFICERS

1.6.1 On the Job training

Hydrographers need to have expertise in various disciplines to be highly effective. The measurement of flowing water is a sophisticated application of science and engineering principles. Decisions made in the field and for data interpretation require a basic understanding of physics, chemistry, biology, hydrology, hydrodynamics, fluvial geomorphology, math, and statistics. Additionally, the installation and operation of hydrometric monitoring equipment requires skills in plumbing, wiring, and programming. While there are limited options for training, WLA applies the principle of "On-the-Job" training. Investments in training improve data quality, increase productivity, improve gauge reliability, and enhance safety. Training is a continuous process to keep current with best practices as they apply to new and emerging practices.

1.6.2 Recurrent training of key personnel.

- The key personnel of the WLA require the continuing development of their knowledge and skills related to their respective responsibilities. This shall be accomplished through periodic training and refresher courses in all the disciplines for which the technical officers are responsible. They shall be required to undergo recurrent training/refresher training at the interval of every two years.
- Participation in seminars and workshops organized by IHO, international/regional related organizations as UNDP, and WLA can also enable these personnel to widen their horizons and share experience with experts from other states or organizations.
- The key personnel shall attend the workshops, seminars and trainings overseas within the region to understand and keep up with the new procedures and practices of IHO recommendations.

1.6.3 Training records of the key personnel

- WLA shall maintain the training records of each key personnel in their respective files.
- The Secretariat of WLA is responsible for keeping the training records of the key personnel updated and secured.

1.7 Operational flow of the WLA

WLA is involved in the following projects.

1.7.1 GCCA+ project (Fase II)

Project activities:

- Support for climate change adaptation in Suriname through integrated water management, sustainable use and coastal ecosystem management
- Installation of water level instruments in the coastal area and at the same time carrying out water quality measurements.
- Constant contact with foreign organizations such as the Caribbean Institute for Meteorology & Hydrology (CIMH)), for capacity building and guidance.
- Downloading, processing and analyzing the data from the already operational observation stations.

- Project status 2023: In progress. Of the 24 locations, 10 have already been completed. The others are in the process of preparation and execution. Due to the shortage of staff, activities are difficult. An attempt has been made to finish everything in March 2024.

1.7.2 Saramacca canal system rehabilitation project

Project activities:

- The rehabilitation and improvement of the Saramacca canal system aims to address the drainage problems in Greater Paramaribo.
- The activities for this project include the collection of water levels from 9 measuring points and the sampling of water quality parameters from 12 measuring points in and around the Saramacca Canal.
- Project status: In progress. Domineekreek, Welgedacht A, and Doorsteeksluis stations are currently out of order due to being defective or missing.

1.7.3 The Bio-Plateaux Project

(Phase II) Research project Marowijne River basin (Suriname-French-Guyana).

Project activities: -BIO-PLATEAUX II.

- The Bio-Plateaux project aims to facilitate the exchange of information on water and the biodiversity of aquatic environments between French Guiana and its neighbors, Brazil and Suriname. The focus is on the catchment areas of the Oyapock and the Maroni (Marowijne river). The interest of the three countries is to gain a better understanding of water resources, their use and the related impacts in the river basins.
    - Data collection from 7 observation stations along the Marowijne, Lawa and Tapanahony rivers river.
    - Daily data collection is done by the French, because Suriname has been collecting data since 2017 but, has no operational monitoring stations in this area.
- Project status: Phase l was from 2019 – 2022. Phase II, is in progress and is from 2022 – 2026. Activities are in full swing. It involves the contraction of field services every 3 months, maintenance of the stations, data collection, processing, provision of information and the exchange of information and techniques. Maintenance of the stations takes place every 3 months in which Surinamese stakeholders also participate. The partnership will continue in 2024 and will end in 2026.

1.7.4 Water Quality Monitoring Project

- **Project activities:** Measurements were taken to monitor the water quality of Suriname and in particular the coastal strip. During the felling (of trees) services in connection with the GCCA+ phase 2 project, water quality sampling was carried out. Also in the regular field services, WQ measurements are carried out at various locations (Groot Paramaribo, Saramacca canal and surrounding areas).
- Project status: - In progress Sampling will be carried out between 1 and 3 months.

1.7.5 ACTO project (Research Amazon River Basin)

- **Project activities:** The aim of this project is to generate a Regional Cross-Border Action plan with actions based on the needs of access to drinking water services, basic sanitation and waste management, the availability and quantity and quality of water in the Amazon by taking into account its social and structural access.
  - Online meetings every 3 months together with various stakeholders in Suriname on the one hand and the ACTO experts on the other.
  - Inventory of available data and activities of stakeholders.
  - Knowledge exchange and capacity building / technical support.
  - Fundraising to boost the monitoring and quality of the building in Suriname.
  - Discussion of achieved results and Evaluation.
- Project status: Already executed: - Following a remote sensing and google earth training.
  In progress: knowledge and data exchange for the purpose of setting up a MAP BIOMAS. All Member States have already done the work and the EAP has been updated each time. Suriname is not yet ready to provide all the data.

2. MEASUREMENT

2.1 General Proposed International Water Guidelines

According to the "WQ report May-September 2023 FINAL. Global standards for water", 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.

O*verview 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.

Most of the elements required for hydrological purposes can be measured by automatic instrumentation. Hydrological observing stations are designed so that representative measurements (or observations) can be taken according to the type of station involved. Thus, a station can make observations to meet requirements. Where stations are used for several purposes, for example, aviation, synoptic and climatological purposes, the most stringent requirement will dictate the precise location of an observing site and its associated sensors. Outdoor instruments should be installed on a. Very open sites which are satisfactory for most instruments are unsuitable for rain gauges. For such sites, the rainfall catch is reduced in conditions other than light winds and some degree of shelter is needed. If in the instrument enclosure surroundings, maybe at some distance, objects like trees or buildings obstruct the horizon significantly, alternative viewpoints should consider. Routine quality control checks carried out at the station or at a central point should be designed to detect equipment faults at the earliest possible stage.

2.2 Measurements WLA

The term “standard” and other similar terms denote the various instruments, methods and scales used to establish the uncertainty of measurements. A nomenclature for standards of measurement is given in the *International Vocabulary of Basic and General Terms in Hydrology.*
The following units are used for hydrological observations by WLA:

- Precipitation (total amount) in millimeters (mm) or kilograms per m–2 (kg m–2).
- Precipitation intensity, *Ri*, in millimeters per hour (mm h–1) or kilograms per m–2 per second (kg m–2 s–1).
- Evaporation data measured in 0.1mm.

Also often used internationally but not (yet) implemented by WLA are:

- Visibility in meters (m).
- Duration of sunshine in hours (h).

2.3 WLA Network Design

The design process begins with the end in mind. Locations upstream and downstream of dams or diversions are both useful, but for very different purposes. An upstream location is an integration of all runoff process occurring in the contributing watershed, whereas a downstream location is rich in information about what will be happening in receiving aquatic and riparian ecosystems. A good location is one where the variation in discharge is sensitive to the phenomena of interest. The monitoring objectives determine which parameters need to be included in the network design. The WMO *Guide to Hydrological Practices* recommends the station densities. Ultimately the pragmatic station density in a region is a function of risk tolerance. These regional-scale density recommendations may be inadequate to fully characterize local-scale threats from flooding or to provide the needed guidance for local-scale water supply management. Risk tolerance is often particularly high in the developing world, resulting in a perpetual need to react to, rather than prevent, water related crises.

Site selection affects the following outcomes:

- Data persistence (i.e., a well-selected location should produce data for generations to come)
- Data quality (e.g., conformance with underlying assumptions)
- Data representativeness (i.e., relevance to ungauged locations)
- Operational costs (e.g., site access)
- Liability risks (i.e., occupational and/or public safety)
- Selection of methods (e.g., use of rating curve vs. index velocity method)
- Reliability risks (e.g., exposure to vandalism)

With so much at stake, a significant investigation is warranted for any change in network size. Unfortunately, water resource managers often come under pressure with direction to expand or contract the network on short notice (for example, to make the change by fiscal year end). Thus, many important decisions are made in haste. As a best practice, network design should be an ongoing process with preparedness to make wise choices on short notice. Selecting the best technology for a given location is more complex than ever before.

WLA has installed automated equipment for measuring to support operations. These devices are integrated automatic systems for acquisition, processing, dissemination and display in real time of hydrological parameters affecting operations.

OTT ECOLOG 800		
	DISTRICT / RIVER	LOCATION
1	Saramacca / Saramacca	Groningen
2	Commewijne / Suriname	Nieuw-Amsterdam
3	Saramacca / Coppename	Boskamp
4	Coronie	Zoutwater

5	Nickerie / Nickerie	Monding
6	Nickerie / Nickerie	Henar

OTT ECOLOG 500		
	DISTRICT / RIVER	LOCATION
1	Marowijne / Cottica	Moengo
2	Commewijne / Commewijne	Alliance
3	Commewijne / Commewijne	Stolkertsijver
4	Wanica / Suriname	Domburg
5	Brokopondo / Suriname	Stoneiland
6	Brokopondo / Suriname	Brokopondo
7	Coronie	Coronie Zwamp
8	Nickerie / Nickerie	Wageningen
9	Sipaliwini / Nickerie	Mozeskreek

AUTOMATIC WATER LEVEL STATION		
	DISTRICT / RIVER	LOCATION
1	Sipaliwini / Corantijn	Kabalebo
2	Sipaliwini / Suriname	Pokigron
3	Para / Coppename	Pikin Saron
4	Sipaliwini / Coppename	Kaaimanston
5	Nickerie / Nickerie	Bigi Pan
6	Nickerie	Nani zwamp
7	Nickerie / Corantijn	Nani sluis
8	Nickerie / Corantijn	Apoera
9	Marowijne / Marowijne	Albina

3. Technology

3.1 Considerations

Hydrometric network operators must consider several additional factors:

- **Reliability requirements**: An acceptable mean time between failures.
- **Accuracy in the deployed setting:** The blanking distance of some acoustic Doppler current profilers, for example, may be too great to correctly measure discharge for some stream geometries.
- **Cost of site access**: For remote sites, the incremental costs of an acoustic Doppler velocity meter for use with an index-velocity model may be easily recouped by reduced site visits.
- **Local site factors:** High sediment transport, algal blooms, and river ice are all factors that warn against deploying expensive submersible technology.
- **Instrument sensitivity and precision:** Relates to the time and effort spent on post-processing of the data.
- **Training and familiarity:** Limiting the variety of products deployed in a region can greatly reduce both the training burden and the likelihood of blunders caused by a lack of familiarity with a specific device.

Total Cost of Ownership.

Factors that affect the total cost of ownership of technology include the initial capital cost, field calibration and service frequency requirements, unscheduled field visits to repair or replace, time and effort spent on corrections and post-processing of the data, data lost due to sensor failure, amount of data degraded by high uncertainty, and supplies (e.g., compressed gas and/or power source). Money saved at the time of purchase can be easily exceeded by operations and maintenance costs.

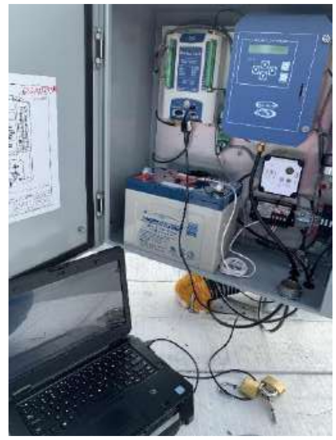
Low-cost monitoring equipment does, nonetheless, have its place. For example, in monitoring a high-risk location (e.g., during excessive spill at a dam site), one needs to get as much data as possible before the sensor is inevitably lost or destroyed. There can be as much as an order of magnitude of difference in the cost of sensors. Low-cost sensors have also led to the concept of “a network as a sensor” where several redundant sensors can be deployed at a gauge. In some cases, it is advantageous to use the average of these independent, if imprecise, measurements and also get a measure of the aggregate uncertainty. This concept also lends itself to deploying many low-cost sensors to sample landscapes at the scale of space-based observation systems. In the context of total cost of operation, telecommunication technologies offer a significant improvement in data reliability as a result of real-time station health monitoring and improvements in the timing of stream gauging activities.

No investment in technology can compensate for poor choices in data collection and data handling. Errors by procedural blunders are the most difficult to detect and correct in data post-processing. Training accelerates the rate that competencies are gained while simultaneously reducing the frequency of blunders. Training is, arguably, more important than ever. The demographic in WLA today has a double hump of new recruits and pre-retirees, creating an urgent need to compensate for loss of experience with improvements in knowledge.

3.2 Equipment

3.2.1 AUTOMATIC WATER LEVEL STATION





The Automatic Water Level Station from OTT Hydromet is designed for the accurate and continuous monitoring of water levels in various water bodies, such as rivers, lakes, reservoirs, and groundwater wells. Here's a detailed breakdown of how it works:

Components

1. **Sensors**:
    - **Pressure Sensors**: Measure the water level based on the pressure exerted by the water column above the sensor.
    - **Bubbler Sensor**: The compressed air produced by a piston pump flow via a measuring tube and the bubble chamber into the water to be measured. The pressure created in the measuring tube is directly proportional to the water column above the bubble chamber. The bubbler sensor determines the barometric air and bubble pressure one after the other. By taking the difference between the two signals, the bubbler sensor calculates the height of the water level above the bubble chamber.

2. **Data Logger**:
    - Collects and stores data from the sensors.
    - Equipped with a memory card or internal storage for data archiving.
    - Programmable for various logging intervals.

3. **Power Supply**:
    - Typically solar panels with battery backup for remote or field installations.
    - May include AC power options for permanent installations.

4. **Communication Modules**:
    - Satellite modems for remote data transmission.
    - Options for local data retrieval via USB or Bluetooth.

5. **Enclosure**:

• Weatherproof housing to protect electronic components from environmental conditions.

Functionality

1. **Data Collection**:
   - The sensor measures the water level at preset intervals.
   - Data is transmitted to the data logger in real-time or at scheduled intervals.
2. **Data Storage and Transmission**:
   - Logged data is stored in the data logger's memory.
   - Data can be transmitted to a central server via wireless communication modules.
   - Local data retrieval can be done through physical connection if needed.
3. **Data Processing and Analysis**:
   - Data is processed using algorithms to account for factors such as temperature and barometric pressure (for pressure sensors).
   - Real-time data and historical trends are analyzed to monitor water levels.
4. **Alerts and Alarms**:
   - Configurable thresholds can trigger alerts for high or low water levels.
   - Alerts can be sent via SMS, email, or other communication methods.
5. **Integration with Hydrological Networks**:
   - Data can be integrated into broader hydrological and meteorological networks for comprehensive water resource management.
   - Compatible with various data platforms for visualization and analysis.

Applications

- Flood monitoring and early warning systems.
- Water resource management for agriculture and irrigation.
- Hydroelectric power generation monitoring.
- Environmental research and conservation efforts.
- Municipal water supply management.

Advantages

- **Real-time Monitoring**: Provides up-to-date information on water levels.
- **High Accuracy**: Advanced sensors ensure precise measurements.
- **Remote Accessibility**: Data can be accessed remotely, reducing the need for frequent site visits.
- **Scalability**: Can be deployed in various environments and scaled as needed.
- **Durability**: Designed to withstand harsh environmental conditions.

Overall, the OTT Hydromet Automatic Water level Station offers a robust solution for continuous and reliable water level monitoring, helping to manage water resources effectively and mitigate risks associated with water-related hazards.

Installing an Automatic Water Level Station (AWLS) involves several steps to ensure accurate and reliable water level monitoring.

3.2.2 INSTALLING: PREPARATION, CONFIGURATION, MAINTENANCE

Installing an Automatic Water Level Station (AWLS) involves several steps to ensure accurate and reliable water level monitoring. Here's a detailed guide to the installation process:

Preparation

1. **Site Selection**:
    - Choose a representative location for the water body to be monitored.
    - Ensure accessibility for installation and maintenance.
    - Avoid locations with strong currents, obstacles, or human activities that may affect measurements.
2. **Gather Necessary Equipment**:
    - AWLS unit (including sensors and data logger)
    - Mounting brackets or poles
    - Enclosure and protective covers
    - Cables and connectors
    - Tools (screwdrivers, drill, etc.)
    - Power supply (e.g., solar panels and batteries or mains power)

Installation Steps

1. **Sensor Placement**:
    - **Pressure Sensor**: Securely mount the pressure sensor underwater at the desired depth. Ensure it is free from obstructions and securely fixed.
2. **Data Logger Installation**:
    - Place the data logger in a weatherproof enclosure.
    - Mount the enclosure on a stable structure, such as a pole or wall, at a safe height above the water level.
    - Connect the sensors to the data logger using appropriate cables and connectors.
3. **Power Supply Setup**:
    - **Solar Panels**: Install the solar panels in a location with maximum sun exposure. Connect the panels to batteries and the data logger.
    - **Mains Power**: If available, connect the data logger to a reliable mains power source.
4. **Communication Module Installation**:
    - Install the communication module (GSM/GPRS, 3G/4G modem, or satellite transmitter) within the data logger's enclosure.
    - Position the antenna for optimal signal reception.

Configuration

1. **Data Logger Settings**:
    - Program the data logger with the desired logging frequency and data settings.
    - Set up alarm thresholds for high and low water levels if needed.
2. **Communication Settings**:
    - Configure the communication settings to transmit data to a central server or cloud platform.

- Test the connection to ensure reliable data transmission.

Testing and Calibration

1. **Initialization and Calibration**:
   - Power on the data logger and verify that all sensors are functioning correctly.
   - Calibrate the sensors according to the manufacturer's instructions to ensure accurate measurements.
2. **Verification**:
   - Check initial data for consistency and accuracy.
   - Verify communication by ensuring data is correctly transmitted to the central server.

Maintenance

1. **Regular Inspection**:
   - Periodically check the physical condition of sensors, enclosures, and power supply.
   - Clean the sensors to prevent buildup of debris or algae.
2. **Calibration and Updates**:
   - Perform regular calibrations to maintain measurement accuracy.
   - Update the data logger firmware if necessary.
3. **Data Analysis and Reporting**:
   - Regularly analyze collected data to identify trends and anomalies.
   - Use the data for reporting and decision-making in water management and environmental protection.

3.2.3 WORKFLOW, AND SOP FOR DATA COLLECTION AND MANAGEMENT FOR THE AWLS

Workflow

1. **Survey and Site Preparation**:
   - Conduct a site survey to determine the best installation location.
   - Prepare the site by clearing obstacles and setting up mounting structures.
2. **Install Sensors and Data Logger**:
   - Securely install the sensors at the designated locations.
   - Mount the data logger and connect all components.
3. **Power and Communication Setup**:
   - Install and connect the power supply system.
   - Set up and test the communication module.
4. **System Configuration and Testing**:
   - Program and calibrate the data logger.
   - Conduct initial tests to ensure proper operation and data transmission.
5. **Final Inspection and Maintenance Plan**:
   - Perform a final inspection to verify the installation.
   - Establish a maintenance schedule for regular inspections and calibrations.

By following these steps, you can effectively install an Automatic Water Level Station to provide reliable and accurate water level monitoring.

Standard Operating Procedure (SOP) for Data Management of an Automatic Water Level Station

This SOP outlines the procedures for managing data from an Automatic Water Level Station. It ensures consistent and accurate data collection and management.

1. Data Collection

- **Configuration**:
  - ✓ Set the data logger to the desired sampling interval (e.g., every 15 minutes).
  - ✓ Ensure the correct time and date settings on the data logger.
- **Data Logging**:
  - ✓ The data logger should continuously record water level data.
  - ✓ Ensure redundancy by having a backup power source and data storage.
- **Data Transmission**:
  - ✓ Configure the system to transmit data to a central database at regular intervals if remote monitoring is used.
  - ✓ Verify successful data transmission periodically.

2. Data Retrieval and Management

- **Data Retrieval**:
  - ✓ **Satellite Data Reception**:

    Satellite Reception System: Use a satellite receiver system capable of capturing data transmitted by NOAA satellites, which typically include weather and environmental data.
- **Data Download and Decoding**:
  - ✓ **Receive Data**: Capture satellite data transmissions containing hydrological information.
  - ✓ **Decoding**: Use the HydroMet application, that is specially developed for Suriname, to decode the received data into a usable format. This might involve interpreting signals and converting raw data into readable formats. This application is specially designed for the AWS, ARS (MDS) and AWLS (WLA) data.
- **Data Storage**:
  - ✓ Store raw data in a secure and organized database.
  - ✓ Maintain a backup of all data on a regular basis.
- **Data Quality Control**:
  - ✓ Regularly review data for anomalies or errors.
  - ✓ Apply correction algorithms if necessary, documenting any changes made.
- **Data Analysis**:
  - ✓ Use appropriate software tools for data analysis and visualization.
  - ✓ Generate reports summarizing the water level trends and any significant events.
  - ✓

3. Maintenance

- **Routine Inspections**:
  - ✓ Conduct visual inspections of the equipment regularly (e.g., monthly).
  - ✓ Check for physical damage, corrosion, or biofouling on the sensors.
- **Calibration**:

- ✓ Recalibrate sensors at regular intervals (e.g., quarterly) or as recommended by the manufacturer.
- ✓ Document all calibration activities and results.

- **Troubleshooting**:
  - ✓ Address any issues with data transmission or sensor malfunctions promptly.
  - ✓ Keep a log of troubleshooting activities and solutions.
- **Cleaning**:
  - ✓ Clean the sensors and equipment periodically to prevent biofouling and debris accumulation.

4. Reporting

- **Regular Reports**:
  - ✓ Generate regular reports (e.g., monthly, quarterly) summarizing water level data.
  - ✓ Include graphs, statistics, and any anomalies or significant observations.
- **Incident Reports**:
  - ✓ Document any incidents that affect data quality or sensor functionality.
  - ✓ Provide a detailed account of the issue, actions taken, and outcomes.

5. Documentation and Records

- **Logbooks**:
  - ✓ Maintain a logbook for all activities related to the water level station.
  - ✓ Include installation details, calibration records, maintenance activities, and data retrieval logs.
- **Data Archives**:
  - ✓ Archive historical data systematically for future reference and analysis.
  - ✓ Ensure data integrity and security in the storage system.

Conclusion

This SOP provides a comprehensive guide for the setup, operation, maintenance, and data management of an Automatic Water Level Station. Following these procedures will help ensure accurate, reliable, and consistent water level monitoring.

4. STANDARD OPERATING PROCEDURE FOR STATIONS

4.1 Maintaining the Station

To have a station working properly, it is important to respect some basic rules.

- A global cleaning is necessary around the station (housing especially) to give a secure and good access to the house.
- Inside the house, clean regularly (remove dust, insects etc.).
- Cut the grass often.
- Clean the solar panel once a week.
- Remove dust and leaves from the funnel of the rain gauge.
- Maintain an open area around the rain gauge (cut the branches to avoid covering the rain gauge).
- Clean the staff gauges once a month to remove algae and mud.
- Check the battery voltage and solar voltage.
- Check battery voltage. It must be equal or greater than 12 V.
- Check solar voltage. It must be greater than battery voltage.
- Clean solar panel.
- Check if solar panel is covered with dust and clean with water and soft cloth.
- Trim trees, long bushes around the solar panel that is obstructing sunlight falling on the solar panel.
- Check for loose or no connection.

4.2 Field Inspection

Check list for every visit	• Laptop Computer • Communication cable USB to Serial port • Shelter key • Screw diver • Multi-meter • Tap meter • Flashlight (if necessary) • Pencil • Field note book • Etc….
Basic rules	• A global cleaning is necessary around the station (housing especially) to give a secure and good access to the house. • Inside the house, clean regularly (remove dust, insects…) • Cut the grass often. • Clean the solar panel once a week. • Remove dust and leaves from the funnel of the rain gauge. • Maintain an open area around the rain gauge (cut the branches to avoid covering the rain gauge). • Clean the staff gauges once a month to remove algae and mud.

	• Open a logbook to note any intervention within the station (visit, setup modification, adjustment of initial values…). • With the datalogger (RTDL-2011) proceed to the adjustment of the water level if needed (see specific SOP).

5. Documentation

5.1 Hydrodata

- Hydrodata is essential and should be kept current and be easily obtainable. A station logbook and station inspection form should be used for documenting the station metadata. The updates should also be delivered to the main office for updating the metadata database.
- Any significant changes should be recorded in the station logbook and dated.
- Photographs are useful if they have been taken at sufficient distance to show the instrument and its terrain background. Such photographs should be taken from all cardinal direction
- Station information (incl. Site acceptance test).
- Instrument information (incl. FAT).
- Contact person.
- Network (communication) information.
- Observations (type etc.).
- Inspection forms (changes, maintenance etc.). Maintenance and service documents, calibration documents, metadata database, instrumentation database (serial numbers etc.)
- Network information.
- Station information:
  - Station name and station index number(s).
  - Geographical coordinates.
  - Elevation above mean sea level
  - Types of soil, physical constants and profile of soil.
  - Types of vegetation and condition.
- Local topography description.

5.2 Major database elements can be followed by the manual of the selling company.

Information from the manual provides:

- Type of AWLS, manufacturer, model, serial number.
- Observing program of the station: parameters measured, reference time, times at which observations/measurements made and reported.
- The datum level to which atmospheric pressure data of the station refer.
- Contact information, such as name and mailing address, electronic mail address, and telephone numbers.
- Complete history of the station with dates and details of all changes.
- Establishment, interruptions and closure of the station.
- Inspection information: comments about the site, exposure, quality of observations and station operation.

Individual instrument information:

- Sensor type, manufacturer, model, serial number.
- Principle of operation.
- Method of measurement/observation.
- Type of detection system.
- Performance characteristics.
- Unit of measurement and measuring range.
- Resolution, accuracy (uncertainty), time constant, time resolution, output averaging time.
- Siting and exposure: location, shielding, height above ground (or level of depth).
- Date of installation.
    - Data acquisition: sampling interval, averaging interval and type.
    - Correction procedures
    - Calibration data and time of calibration
    - Preventive and corrective maintenance.
- Recommended/ scheduled maintenance.
- Calibration procedures including frequency.
- Procedure description.
- Data-processing information regarding each individual meteorological element:
    - Measuring/observing program: time of observations, reporting frequency, data output
    - Data-processing method/procedure/algorithm.
    - Formula to calculate the element.
- Mode of observation/measurement.
    - Processing interval.
    - Reported resolution.
    - Input source (instrument, element, etc.).
- Constants and parameter values.
    - Data handling and transmission information
    - Quality control procedures/algorithms.
    - Quality control flag definition
    - Constants and parameter values.
- Processing and storage procedures.
- Method of transmission.
- Data format.
- Transmission time and transmission frequency.

6. Data Management

Improvements to hydrological monitoring programs often focus on field-based technologies. What is frequently overlooked is how the data are managed after acquisition. Hydrologic data are complex. Stream hydrographers are responsible for storing, validating, analyzing, and reporting on vast amounts of water data.

Specialized hydrologic data management systems are available to meet the evolving needs of hydrologists and to support current industry standards for water information management. Software designed specifically for hydrologists is required to achieve excellence and effectiveness in any hydrological monitoring program. The advantages of modern data management systems are explored next.

The quality management system establishes the credibility of the data production process. One important role of the data management system is to establish the defensibility of the data by providing evidence of compliance with the QMS. This means the data management system must preserve the full history of the data, including who did what, when, how, and why. As a best practice, raw data must be preserved intact, and all changes must be recorded and be reversible, if needed. This means that data can be rolled back in time to show exactly what edits, corrections, approvals, or notes were applied at any point in time. This is particularly important when dynamically publishing data using webpages or Web services as opposed to static documents. The complete history (of who did what, when, where, how, and why) supports peer quality control and supervisory quality assurance. This history confirms the second half of the quality management mantra: "Say what you do, do what you say."

6.1 Real-Time Data and Automation.

A modern hydrometric monitoring system delivers data dynamically in real time. Ideally, the best data are continuously available and can be served using international standards for interoperability. This means that end users benefit as soon as new data are appended, erroneous values are filtered, corrections are applied, rating curves are updated, or shift corrections are applied. The best solutions also provide end users with informative metadata about the quality and status of the data. Data can be filtered based on the state of the data in the QMS process. Archival quality data are clearly identified and "locked" from further editing.

With modern hydrometric monitoring systems, discharge derivation models are calibrated with respect to underlying hydraulic science and engineering principles. The result is:

- Improved confidence in extrapolation (within the range of known channel geometry);
- Improved agreement on a solution (i.e., different hydrographers will independently produce similar results); and
- Improved defensibility of results (i.e., rating curve parameters help to constrain the solution).

It is often necessary to accommodate shifting channel control conditions with corrections to the stage-discharge model. The best solutions for managing shift corrections include the inspection and interpretation of field observations, residuals plot, and time series visualizations.

6.2 Reporting and Publication.

The best data management systems provide for continuity in reporting with customizable report templates that can be tailored to match legacy reports. New, high-value reports can be developed from scratch or by modifying templates for industry standard reports. The content for the reports can be filtered according to status in the QMS so that reports of archival quality data can be readily produced for conventional publication. Access to Web services provides the ability to dynamically publish data, based on metadata filters, using industry-wide standards. For WLA the formats of the WMO are compatible as weather and hydrological stations often come together. WLA shall select which are appropriate for the activities of the service.

7. STANDARD OPERATING PROCEDURES FOR STATION CALIBRATION

Standard Operating Procedures (SOP) for station calibration normally consists of three parts:

1. What parts of the calibration processes should be in-house and what should be outsourced?
2. Processes and tasks included in the calibration.
3. Documentation that must be done.

Calibration depends on the instrumentation. Analog instrumentation needs the calibration of the logger. For digital instruments, only replacement is required. Depending on the manufacturer a known value can be put in the instrument and after measuring the deviation from the equipment's reading, a needed correction can be implemented. Therefore, digital instrumentation will be highly recommended for the future updates. This way, the required maintenance knowledge at the station level is minimal and all the calibration is focused on the calibration laboratory and the key personnel in the main office.

WLA has not yet the SOP for hydrological instrument calibration.

8. Annexes

8.1 PROVISIONAL JOB DESCRIPTION OF KEY MANAGEMENT AND TECHNICAL PERSONNEL

PROVISIONAL JOB DESCRIPTION of TECHNICAL WATER QUALITY PERSONNEL

- **High School Diploma or GED (Poly Technic College/Institute for Advanced Teaching college in Chemical Analyst**
- **Associate's Degree**: Often, a degree in environmental science, biology, chemistry, or a related field is preferred or required. Some positions might accept a high school diploma with relevant coursework.

Skills and Knowledge

- **Understanding of Water Quality Standards and Regulations**: Familiarity with local, state, and federal water quality regulations.
- **Laboratory Skills**: Experience with water sampling, testing procedures, and use of laboratory equipment.
- **Analytical Skills**: Ability to analyze data and interpret results from water quality tests.
- **Technical Skills**: Proficiency with computer software for data entry and analysis, such as Microsoft Excel or specialized water quality software.

Certifications

- **Certifications**: Some positions may require or prefer certifications such as Water Quality Technician Certification, OSHA safety certification, or other relevant environmental certifications.

Experience

- **Field or Laboratory Experience**: While not always required, experience in a related field or laboratory setting can be beneficial.

Other Requirements

- **Driver's License**: A valid driver's license may be required for fieldwork.
- **Physical Fitness**: The ability to perform physically demanding tasks, such as lifting heavy equipment or hiking to remote locations.

As Soft skills, is important to have:

- **Attention to Detail**: Precision in conducting tests and recording data.
- **Communication Skills**: Ability to communicate findings and procedures effectively, both in writing and verbally.
- **Problem-Solving Skills**: Ability to troubleshoot issues and find solutions in the field or lab.

8.2 Annex 2: Approach for water quality measurement

If in de future hydro-stations all also entrusted to measure water quality. Then the following positioning have to be taken into consideration regarding positioning of measuring equipment.

For precision check purposes, the collocated monitors must be at least x meter apart
for samplers having flow rates.

SITING CRITERIA FOR OPEN-PATH MONITORING STATIONS

Minimum Siting Standards for Open-path Stations
Criteria Minimum distance (meters):

- Path length 100
- Path height 3
- Spacing from supporting structure(s) 1
- Spacing from obstructions 2*h*; where *h* is equal to obstruction height
- Spacing from piles 10
- Spacing from bridges 10
- Spacing from minor sources 500

MAXIMUM PATH LENGTH
The monitoring path length must not exceed 1 kilometer for analyzers in
neighborhood, urban, or regional scale. For middle scale monitoring sites, the monitoring path length must not exceed 300 meters. In areas subject to frequent periods of dust, fog, and rain, consideration should be given to a shortened monitoring path length to minimize loss of monitoring data due to these temporary optical obstructions.

HORIZONTAL AND VERTICAL PLACEMENT

SPACING FROM OBSTRUCTION

A monitoring path must be clear of bridges, or other optical obstructions, including potential obstructions that may move due to water speed, human activity, growth of vegetation, etc. At least 90% of the monitoring path must have unrestricted waterflow and be located away from obstacles.

SPACING FROM BRIDGES

Minimum Separation Distance between bridges and Monitoring Paths
River average daily traffic, ships per day. The minimum distance is 1 (meters).

CUMULATIVE INTERFERENCES

SITE REPORT

Each fixed monitoring station shall have a site report, which should document at least the following:

1. Name;
2. Address;
    - Probe and Monitoring Path Siting Criteria for water Quality Monitoring
3. Geographical Coordinates;
4. Inception Date;
5. Monitoring Objectives;
6. Measured Pollutants;
7. Scale Representativeness; (complete details for each pollutant)
8. Local Sources of Pollutants;
9. Detailed Siting Assessment; and
10. Actual Pictures from the inlet, probe or the monitoring path towards all compass directions.

Site reports shall be reviewed at least annually and shall be updated when necessary.

MINISTRY OF PUBLIC WORKS
DIRECTORATE RESEARCH AND SERVICES
SUB-DIRECTORATE RESEARCH AND INNOVATION
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Paramaribo – Suriname

THE GLOBAL CLIMATE CHANGE ALLIANCE PLUS INITIATIVE
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