Environmental and Social Analysis
Water Supply Modernization Program
SU-L1058

Fit for Disclosure Report
October 30, 2019

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The SWM considers this document as a draft version. The SWM reserves the right to revise the document based on further review of the information presented, the proposed project activities, and any public consultation held related to the project

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Prepared for the SWM
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Abbreviations

AMSL	Above mean sea level
ABS	General Bureau of Statistics
dB	Decibel
EA	Environmental Assessment
EBS	Energie Bedrijven Suriname (Electrical Company Suriname)
EHS	Environment, Health, and Safety
EPAR	Electricity Paramaribo
ESA	Environmental and Social Assessment
ESMP	Environmental and Social Management Plan
GRM	Grievance Redress Mechanism
IADB or IDB	Inter-American Development Bank
IFC	International Finance Corporation
NRW	Non-Revenue Water
SWM	Surinaamsche Waterleiding Maatschappij (Water Supply Company)
SWSMP	Suriname Water Supply Master Plan
TSS	Total Suspended Solids
WHO	World Health Organization

Executive Summary

Introduction

The Government of Suriname is seeking financing for the purposes of improving the efficiency, quality, and sustainability of the potable water services provided by the Suriname Water Supply Company (SWM) through a loan from the Inter-American Development Bank (IDB). The general objective of the "Water Supply Modernization Program" is to improve efficiency, quality, and financial and environmental sustainability of the potable water. The project will finance infrastructure works required to rehabilitate pump stations in poor conditions, increase treatment capacity to meet projected demands, and improve operational efficiency through the reduction of Non-Revenue Water (NRW).

Project Description

Activities financed under Component 1 of the proposed Loan will aim to and improve operational efficiency through the reduction of Non-Revenue Water (NRW). Additionally, Component 2 will address the more salient interventions under the framework of the Master Plan (SWSMP) and SWM current needs. The loan will finance infrastructure works required to rehabilitate pump stations in poor conditions and for SWM to increase the treatment capacity and be able to meet projected demands. The Program will finance only one of the two options identified by SWM: 1) Helena, Christina in Wanica, where an additional production capacity of 240 m3/h is required 2) Kampong Baroe, Groningen, and Tijgerkreek (Peperhol) in Saramacca, where an additional 300 m3/h are required in total. The definition of the intervention location(s) will be discussed with the Government of Suriname based on a technical analysis to confirm its feasibility, estimated costs, and cost-effectiveness. Prioritization criteria will be developed as part of the technical, environmental and social analysis.

Methodology

The ESA was conducted using different recognized standards, methods and approaches, and international best practices, including IDB's guidelines for Conducting Environmental Impact Assessment of Investment Projects and IFC Performance Standards. These methods and approaches are detailed in the relevant sections of this report.

The study had a general focus and was conducted in an area of 1 km radius of each water supply station. The indirect study area consisted of the service area of that specific water supply station including its expansion plans under the project.

To gather data, meetings were held with several SWM departments to gather background information on the project and understand the institutional functioning of the company. Field visits and surveys were carried out to determine and evaluate project impacts based on direct observations and professional judgment. A comprehensive review of literature was used to complement or supplement field data where it was unavailable. Individual interviews with stakeholders were conducted to capture public views and concerns about the water supply and the proposed project.

Legal and Institutional Framework

The framework for the current government policy is anchored in the Development Plan 2017-2021, named “Development Priorities of Suriname”. The Development Plan explicitly refers to water, stating that the availability of healthy drinking water is a necessary link in the social economic development of the society.

For environmental management, the country exercises a set of comprehensive environmental assessment guidelines which are voluntary and monitored by the National Institute for Environment and Development (NIMOS). Legislation on environmental and natural resource management is fragmented, dispersed between different pieces of legislation. Nevertheless, the proposed project is being developed in a legislative environment where four pieces of draft legislation and supplementary regulations on water have been prepared with stakeholder input and are awaiting discussion in the legislative bodies of Government.

Besides national legislation, Suriname is signatory to several international agreements and conventions related to Environmental Management, and Occupational Health and Safety.

Where national legislation is lacking, the project will follow IDB’s operational guidelines on i) safeguard compliance, ii) disaster risk management, iii) gender equality, iv) indigenous peoples and v) involuntary resettlement.

Biophysical Environment

The pump stations are located are located in the moist tropical climate in Suriname with average daily temperatures of 27 °C. In general, the air quality in Suriname deteriorates during dry conditions and improves during the wet season. During rainy seasons, rain suppresses dust particles in the atmosphere and alleviates air pollution. Dust emissions are further reduced by damp soil conditions. During the dry season, dust emissions generally increase as the soils become desiccated.

The pump stations are located in the young coastal plain which is is underlain by three major aquifers (A-sand, Coesewijne and Zanderij) within the geological formation named Corantijn Group. Groundwater in the study area is abstracted from the Coesewijne aquifer (Groningen, Kampong Baroe and Tijgerkreek pumping stations in the Saramacca district) and the A-zand aquifer (Helena Christina pumping station). \

The Helena Christina pumping station has eight wells abstracting groundwater at a depth of about 120 to 150 meters. The total average yield is 480 m3 / hr. The Tijgerkreek pumping station is comprised of 5 wells at depths ranging from 125 to 150 m, but only four are in operation. The production capacity is 280 m3 / h. The Groningen pumping station consists of 4 wells each with depth of 155 m and a total capacity of ± 120 m3 / h. The Kampong Baroe pumping station consists of 4 wells, but currently 3 of the four are operating with a total capacity of ± 80 m3 / h. In general, the groundwater quality presents high concentrations of iron, manganese and/or ammonium.

The vegetation consists mainly of low grass, and the terrestrial animals that may occur are those that commonly live close to humans, such as bats, rodents, snakes, lizards and birds. No endangered species are known to occur at the project areas.

Environmental Impact Assessment

In general, no significant negative impact to the environment has been identified. During construction, potential sources of air quality and climate change impacts include wind-blown sand exposed during earthworks and exhaust fumes of construction/drilling equipment. The magnitude of potential air quality impacts is considered to be negligible.
The potential impacts from noise and vibrations due to drilling activities are considered moderate, but with the implementation of the mitigation measures it will be reduced to minor effects.
A potential impact of concern is excessive extraction of groundwater that can lead to contamination of the aquifers, salinization of groundwater, decline and depletion of the groundwater wells.
The impacts from solid waste generated at project sites during the construction and operations phase are considered to be of minor effects. With the implementation of the proposed mitigation measures, those impacts will be reduced to negligible effects. Good housekeeping, an adequate purchasing policy for environmentally friendly products, and awareness programs with regard to recycling, re-use and reduction of waste generation are some recommendations to manage the solid waste generation and handling.
During operations, a major concern is the excessive extraction of groundwater that can lead to depletion of the aquifers, salinization of groundwater, decline and depletion of the groundwater wells. A groundwater extraction strategy should be implemented and build on the results of several geo-hydrological studies that had been conducted in the past years. This includes monitoring of the groundwater levels and quantities.
The backwash water that comes from the filters. and which is discharged directly into ditches or trenches next to the pumping stations may not have any ecological impact, but for sure has an aesthetical impact on the environment due to its brownish coloration. Therefore, the study suggests that backwash water should be first discharged in interceptors to retain material in suspended form.
The impact of noise from pumps and compressors to the surroundings is not considered a major issue. All pumps and compressors will be placed in isolated rooms. The use of proper PPE (e.g. earplugs) when entering those rooms should be mandatory.

Socio-Economic Environment

The two options for Component 2 of the project are located in different types of areas. Option 1, Helena Christina, is characterized by a semi-urban area and is located along a relatively busy connection road. People living in this area are usually employed near Paramaribo and use land for small agricultural activities to supplement their income. Electricity and water supply are available; however, the latter is hampered due to the perceived chlorine smell and taste of the water and fall out when there are electrical disruptions.
In contrast to Helena Christina, are the three sites in Saramacca located in a rural area. Two of the sites - Kampong Baroe and Tijgerkreek (Peperhol) - are neighboring businesses and/or social functions along busy connection roads. Groningen, on the other hand, is located along a rural sand road. People in all project sites are working locally in agriculture, oil exploration, government or private services (food sellers, supermarkets etc.). Electricity and water supply are available; however,

residents prefer to buy bottled water to drink because of the chlorine smell and taste in Kampong Baroe and Groningen and a muddy smell and taste in Tijgerkreek.
Near the Saramacca study sites there are three indigenous communities. Each of them has specific roots to traditions and practice traditional decision-making. Most of these communities have taps outside their houses for water supply.

Social Impact Assessment

The proposed project as part of component 2 expects to provide a major positive impact for residents living in either District Wanica or Saramacca because it will provide better water supply for all residents, including vulnerable groups. Also, an increased participation of men in water related decisions is expected with the implementation of the project.
During construction, the possibility of land acquisition for constructing wells on private land near Helena Christina needs adequate planning for any risks of delays during executinon become minor. Other potential moderate impacts are: i) traffic and traffic safety from major connection roads in Kampong Baroe, Tijgerkreek and Helena Christina, ii) disruption of water supply during the day can become a nuisance for residents at all project sites, iii) vulnerable groups, such as poor and indigenous people, are more prone to water supply disruptions because of limited means and this situation exists in all locations, and iv) occupational health and safety for workers on site because guidelines are currently outdated. With adequate management measures, all these potential impacts can be made minor.
During operations, no specific negative impacts are expected.

Recommendations and Conclusions

The two options were compared using environmental and social data. The analysis showed several moderate or less significant environmental and social impacts associated with upgrading water supply facilities. Mitigating these impacts would include taking measures in the design of the waters supply facilities.
Option 1 (Helena Christina) has a potential for land acquisition and this brings in an extra impact on the social environment. The scale of the impact is considerate moderate because of the lack of information on the location of the wells. It is recommended to examine land acquisition in more detail before making a recommendation for a specific Option.
Moreover, the expectation is that the program will improve people's access to water. In order to ensure that the indigenous community Maho benefits from the program, thus avoiding their exclusion, this analysis recommends financing the construction of pipes in home of residents who only have parcel taps, such as is the case in Maho.

1. Introduction

1.1 Background of the Project

The Republic of Suriname, through its Surinaamsche Water Supply Company (SWM) is seeking financing at the Inter-American Development Bank (IDB) for the purposes of improving efficiency, quality, and sustainability of the potable water services provided by SWM. Therefore, besides institutional strengthening of the SWM, two other strategies are being considered for improving the water supply, and these are:

- Non-Revenue Water (NRW) reduction

This component aims to reduce any loss of water due to physical losses (leaks and theft from the water system) or commercial losses unpaid or incorrect bills. The SWM will implement its 2015 NRW reduction strategy with specific focus in the Central (Paramaribo, Wanica, and Para) and Western (Nickerie) regions. Specific activities will include: i) Strengthening of the NRW unit, ii) installation of meters and service connections, iii) pressure management; and iv) energy efficiency.

- Upgrading Water Production Infrastructure

This component aims to increase the production capacity of the SWM to meet the projected 2040 demands guided by the capital works identified in the Suriname Water Supply Master Plan (SWSMP). It will finance infrastructure works required to rehabilitate pump stations in poor conditions and for SWM to increase the treatment capacity and be able to meet projected demands. SWM has identified two possible options for expanding its capacity and these are: i) Helena Christina, District Wanica where an additional production capacity of 240m3 / h is required, ii)) Kampong Baroe, Groningen and Tijgerkreek in District Saramacca where an additional 300m3/h are required in total.

In accordance with the Bank's Environmental and Safeguard Compliance Policy, this ex-ante environmental and social impact assessment is being completed by independent consultants. Therefore, SWM contracted the services of a consultant to conduct and a pre-design Environmental and Social Assessment (ESA) and Environmental and Social Management Plan (ESMP). A supplementary study was conducted on the NRW reduction.

1.2 Purpose of the ESA

The ESA process aims to ex-ante identify, predict and evaluate the environmental and social effects of the proposed project. The general purpose of conducting an ESA is to:

- Provide information for decision-making on the environmental and social consequences of proposed project by identifying potentially significant environmental and social effects and risk of the proposed project

- Promote environmentally sound sustainable development through the identification of appropriate enhancement and mitigation measures.

Recommendations made by an ESA may require the redesign of some components of the proposed project, require further studies and/or notify modifications which may alter the economic viability of the project or cause delay in its implementation.

More specifically, the ESA for the proposed water improvement Operation has the following purpose:

- Verify compliance of the proposed project with the Environment and Safeguards Compliance Policy of the IDB (OP-703), and be guided by the policies on Disaster Risk Management Policy (OP-704), Operational Policy on Gender Equality in Development (OP-761), Operative Policy on Indigenous Peoples (OP-765)
- Meet the requirements of national environmental and social legislation in Suriname
- Describe environmental and social aspects within the project sites, following the IDB guidelines on Assessing Biodiversity and Social Impact Assessment.
- Identify and assess particularly significant impacts associated with the proposed project, if there are any, but also moderate and minor impacts
- Provide an overview of environmental and social management plans to be implemented during the construction and operation phases of the proposed project.

1.3 Study Approach

The general approach to the ESA was guided by the principles of integrated environmental management and international best practice, modified where appropriate to reflect the scale of the project and other relevant factors such as time constraints.

The contracted responsibility of the study was assigned to Gwendolyn Smith Ph.D. Assistance was provided by the following experts: Serano Ramcharan MSc. (Biology/Environment), Dunja Burkhardt MSc. (Social Geography), Melvin Uiterloo MPh. (Health/GIS), Raisa Abendanon BSc. and Nancy Del Prado LLM. (Environmental Law/Policy). Each of these specialists contributed to specific parts of the baseline study and impact assessment.

1.3.1 Data Collection

Data collection was guided by the scientific principles of research, using both qualitative and quantitative data sources. Data for this study was collected in multiple ways, including:

- Meetings with SWM and other relevant individuals were held to gather background information on the project
- Desk-top review of existing literature using techniques to complement or supplement field data where it wasn't available.

- Field visits to 1) determine and evaluate the impacts of the project based on direct observations and professional judgment, 2) collect data for a more detailed analysis: individual interviews for determining social/environmental impacts and for the influence of gender factors.

1.3.2 Impact Assessment Methodology

The ESA was conducted using different recognized standards, methods and approaches, and international best practices. The study relied on a qualitative analysis was conducted based on IDB's guidelines for carrying out ESA studies and the categories of the World Bank International Finance Corporation (IFC)[1], used by international banks and finance institutions (Table 1).

Table 1: Performance standards of the International Finance Corporation

IFC Performance standard	
PS 1: Assessment and Management of Environmental and Social risks and Impacts	PS 1. Requires the identification and assessment of all social and environmental impacts and risks in the area where the project is implemented. The goal is to prevent and minimize the negative social and environmental impacts and ensure that affected communities are participating effectively.
PS 2: Labor and Working Conditions	PS 2. The goal is to document, maintain and improve the relationship between employee and employer through a fair treatment of employees and compliance with national labor laws.
PS 3: Resource Efficiency and Pollution Prevention	PS 3. Focuses on the implementation of the principles of the World Bank's Pollution Prevention and Abatement Handbook at policy level. The goal is to prevent or minimize pollutants resulting from the project activities.
PS 4: Community Health, Safety, and Security	PS 4. Aims, wherever possible, to minimize and manage the health and safety risks of local communities related to the project activities.
PS 5: Land acquisition and Involuntary Resettlement	PS 5. Demands that the need for involuntary resettlement should be avoided or minimized and that the negative effects are mitigated by effective consultations and adequate compensation.
PS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources	PS 6. Focuses on the protection and conservation of biodiversity and sustainable management of natural resources through the integration of needs for conservation and development priorities. The objectives of the standard are proposed elements of the Convention on Biological Diversity.
PS 7: Indigenous Peoples	PS 7. Promotes respect for the dignity, human rights, aspirations, cultures and customary livelihoods of indigenous people. Requires that adverse effects on the communities of indigenous peoples are avoided; mitigated or compensated in a culturally appropriate manner.

[1] http://www.ifc.org/wps/wcm/connect/115482804a0255db96fbffd1a5d13d27/PS_English_2012_Full-Document.pdf?MOD=AJPERES

For key potential impacts the ESA relied on the following methodology to determine the significance of each impact, based upon qualitative or quantitative assessment of the following:

- Magnitude
- Geographical scale
- Duration
- Probability of occurrence

The resulting impact was indicated by their significance class, which classes are defined as:

- **Major (significant) effect:** effect expected to be permanent or continuous and non-reversible on a national scale and/or have international significance.
- **Moderate (significant) effect:** long-term or continuous effect, but it is reversible and/or it has regional significance.
- **Minor (not significant) effect:** effect confined to the local area and/or of short duration, and it is reversible.
- **Negligible (not significant) effect:** effect not detectable.
- **Unknown effect:** insufficient data available to assess the significance of the effect.

In addition, impacts were classified as

● Positive: indicating whether the impact will have a positive (beneficial) effect; or

● Negative: indicating whether the impact will have a negative (adverse) effect on the environment, including affected people

The degree of detail enabled the determination of required mitigation and possible enhancement measures, respectively to prevent or reduce significant negative impacts and to promote any positive impacts already in the planning phase. The implementation of mitigation measures will reduce negative environmental impacts to an acceptable level.
After implementation of mitigation/enhancement measures the significance of the impacts again was determined.

The impact assessment methodology is described below.
The **significance** of an impact is defined as a combination of the **severity** of the impact occurring and the **probability** that the impact will occur. The significance of each identified impact was rated per the methodology set out below:

First the **intensity/magnitude/size, scale** and **duration** of the impact were determined according to Table 2, 3 and 4).

Table 2: Defining the intensity / magnitude / size of the negative impacts

Rating	Description of Rating for		
	Natural environment	**Socio-cultural**	**Health/safety**
High	Irreversible damage to highly valued species, habitats or ecosystems	Irreparable damage to highly valued items of cultural significance, or social functions or processes are severely altered	Event resulting in loss of life, serious injuries or chronic illness; hospitalization required
Medium	Reversible damage to species, habitats or ecosystems	Repairable damage to items of cultural significance, or impairment of social functions and processes	Event resulting in moderate injuries or illness; may require hospitalization
Low	Limited damage to biological or physical environment	Low-level damage to cultural items, or social functions and processes are negligibly altered (nuisance)	Event resulting in annoyance, minor injuries or illness, not requiring hospitalization
Negligible	No relevant damage to biological or physical environment	No damage is done to cultural items and social functions and processes are not altered	Event is not experienced by receptors or only occasional minor annoyance

Table 3: Defining the intensity / magnitude / size of the positive impacts

Rating	Description of Rating for		
	Natural environment	**Socio-cultural**	**Health/safety**
High	Direct benefits to species, habitats and resources with significant opportunities for sustainability	Benefits to local community and beyond	Health and safety will be significantly improved
Medium	Moderate benefits to species, habitats and resources with some opportunities for sustainability	Benefits to many households or individuals	Health and safety will be improved
Low	Minor benefits to species, habitats and resources with possible opportunities for sustainability	Benefits to few households or individuals	Health and safety will be slightly improved

Table 4: Defining duration and scale of the impact

Rating	Definition of Rating
Duration– *the time frame for which the impact will be experienced*	
Short-term (ST)	Up to 1 year
Medium-term (MT)	1 to 10 years
Long-term (LT)	More than 10 years
Scale– *the area in which the impact will be experienced*	
Small (SS)	Localized spot
Medium (MS)	Part of study area
Large (LS)	Study area or beyond

Then, the **Severity Rating** of the impact was determined by combining the **magnitude** of the impact with **duration** and **scale** of the impact (Table 5) as set out below.

Table 5: Determination of the Severity Rating of the impact

Magnitude	**High**	**Medium**	**Low**	**Negligible**
Duration and/or Scale				
LT-LS, LT-MS or MT-LS	High	High	Medium	Negligible
LT-SS, MT-MS, MT-SS, ST-MS or ST-LS	High	Medium	Low	Negligible
ST-SS	Medium	Low	Negligible	Negligible

The next step was to define the **probability** of an impact to occur, as defined below (Table 6).

Table 6: Defining the probability of the impact

Probability– *the likelihood of the impact occurring*	
High	Sure to happen, or happens often
Medium	Could happen, and has happened in Suriname before
Low	Possible, but only in extreme circumstances

Finally, the overall **significance** of the impact was determined as explained below (Table 7).

Table 7: Determination of the overall Significance of the impact

Severity	High	Medium	Low	Negligible
Probability				
High	Major	Moderate	Minor	Negligible
Medium	Major	Moderate	Minor	Negligible
Low	Major	Minor	Negligible	Negligible

1.3.3 Impact Mitigation

Practical mitigation measures and management actions were developed to avoid unnecessary damage to environmental and socio-economic resources and receptors, safeguard important resources, natural areas, habitats and ecosystems and protect humans and their associated social environment. Such measures were based on the nature of potential impacts to avoid, reduce remedy or compensate where the status of such impacts is negative, or to enhance and improve the impacts where it has a negative impact.

Major negative impacts were considered to be unacceptable and require mitigation (e.g. avoided, minimized, reduced or compensated for). For moderate negative impacts, the focus of specific mitigation measures is to reduce these to as low as reasonably practicable. Minor impacts can generally be controlled through the adoption of best practice management measures. Mitigation measures were identified and developed.

1.3.4. Stakeholder Involvement

Four meetings were held with SWM staff to acquire information on environmental and social issues. These meetings were supported with a site visit to get a better understanding of the local situation at each of the four pump stations.

Besides stakeholders from within SWM, a total of 72 people was randomly selected from the study area to provide input in the study. These stakeholders were involved as follows:

- A first group of stakeholders (32) were approached to collect information on their perception about water supply, quality, use and the potential impact of the project. Information was gathered by using guiding questions to initiate a conversation (Annex 2). The gathered input from stakeholders (Annex 3) was used as input in: i) the baseline study, and 2) the development of the consultation plan.
- A second group of stakeholders (40) were approached to participate in a gender survey (Annex 4 Ten stakeholders were at random chosen and interviewed at each direct study site. This amount

was determined based on the consultant's expertise working in this area, as it would provide a general idea about gender aspect in relation to water supply (data cannot be generalized). The gathered data was gathered using KOBO Toolbox software and processed using SPSS. The survey results are presented in the gender section of this report.

1.4 Assumptions and Limitations

The ESA process was subject to a number of assumptions and limitations, which should be considered when reading the information presented in this report. The consultant is confident that these assumptions and limitations don't compromise the integrity of the ESA. Relevant assumptions and limitations are:

- The ESA process assumes that sufficient environmental data can be obtained by specialists to enable to draft a defensible baseline description of the existing environment
- The ESA gives a general context about the potential impacts and additional specialist studies may be necessary after identification of impacts that need further detailed analysis such as resettlement etc.
- The ESA study provides an expert analysis and should not be categorized as a full ESA as described by the guidelines of the National Institute for Environment and Development in Suriname (NIMOS) in Suriname
- This study was conducted for the application process of the SU-L1058 loan and shall be used in this matter.
- The study was conducted in a time frame of **two-months** to comply with the timelines of the IDB.
- At the time of this study, the technical analysis for upgrading of the stations just commenced. Information on what type of interventions would be needed for infrastructure upgrade was not available. As a result, the environmental and social analysis had **a general focus**.

1.5 Structure of the ESA Report

This ESA report consists of eight chapters which provides the overall framework for implementing the water modernization program with sound environmental and social safeguards. The reports consist of the following chapters:

Chapter 1 Introduction - provides an introduction to and motivation for proposing the project, explains the purpose of this report and gives an overview of the approach to the ESA.

Chapter 2 Project Description - provides a description of the proposed infrastructure and the sites where this infrastructure should be rehabilitated/constructed.

Chapter 3 Analysis of Alternatives - provides an overview of the proposed project sites for construction of new water infrastructure or expansion of existing infrastructure and a discussion of alternatives.

Chapter 4 Legal and Institutional Framework - provides an overview of the international and national legal and regulatory framework on water resources and other relevant regulations, as well as the management instruments and institutions responsible for the project.

Chapter 5 Environmental and Social Baseline Conditions - describes the receiving biophysical and socio-economic environment in which the project occurs.

Chapter 6 Environmental and Social Impacts - identifies and assesses potential impacts associated with the proposed project and recommends mitigation and optimization measures.

Chapter 7 Environmental and Social Management Plan - describes the mitigation and management measures which can be taken to minimize adverse impacts of the Operation.

Chapter 8 Consultation Plan - provides an overview of the procedures necessary for an effective and inclusive public consultation process to engage stakeholders in the project.

Chapter 9 Conclusions and Recommendations - outlines the major findings of the study and recommendations for further implementation.

2. Project Description

2.1 Description of the Project

The general objective of the proposed operation is to improve efficiency, quality, and financial and environmental sustainability of the potable water services provided by SWM. Besides institutional strengthening, the proposed project will include the following components:

- Component 1: **Non -Revenue Water (NRW) reduction**. This component will be based on the 2015 NRW Reduction Strategy developed under SU-L1058 with specific focus in the Central (Paramaribo, Wanica, and Para) and Western (Nickerie[2]) regions of Suriname. Specific activities will include: (i) Strengthening of the NRW unit[3]; (ii) installation of meters and service connections; (iii) pressure management; and (iv) energy efficiency.
- Component 2: **Upgrading water production infrastructure.** SWM will need to increase its production capacity to meet the projected 2024 demands. This component will finance infrastructure works required to rehabilitate pump stations in poor conditions and for SWM to increase the treatment capacity and be able to meet projected demands.

This report presents the environmental and social analysis for component 2[4]. Activities financed under this component will address the more salient interventions under the framework of the Master Plan (SWSMP) and SWM current needs[5]. The component will finance infrastructure works required to rehabilitate pump stations in poor conditions and for SWM to increase the treatment capacity and be able to meet projected demands. Two options are being considered; both will address water supply concerns for the medium to long term in their respective Districts. Both options have comparable cost estimates.

The Program will finance only one of the two options identified by SWM: 1) Helena, Christina in Wanica, where an additional production capacity of 240m^3/h is required 2) Kampong Baroe, Groningen, and Tijgerkreek (Peperhol) in Saramacca, where an additional 300m^3/h are required in total[6]. The definition of the intervention location(s) will be discussed with the Government of Suriname based on a technical analysis[7] to confirm its feasibility, estimated costs, and cost-effectiveness.

[2] For Nickerie, the CDB is funding a feasibility study for expansion of production in the area, this will include also a NRW assessment of the area that will guide specific interventions of this Loan at that Region.

[3] The modality of the contract with a specialized NRW reduction company would provide for training of SWM's NRW unit staff. A Co-Management contract framework has been discussed as an option for SWM. The benefits considered are (i) the availability of adequate NRW reduction experience during execution of the Program, (ii) a dynamic and hands-on approach for NRW management knowledge transfer, (iii) SWM would maintain ownership of the NRW program which will be critical for its continued sustainability.

[4] A supplementary report present the environmental and social framework for the NRW activities.

[5] The Government of Suriname may finance this intervention since it is a high priority for the short term.

[6] This intervention was identified in the 2011 SWSMP with an estimated cost of US$4.1M. The technical analysis will update the estimated costs of the intervention.

[7] The technical analysis is expected to be available by the end of September 2019 and will be financed through TC SU-T1127

Prioritization criteria will be developed as part of the Technical Analysis to select the most cost-effective option.
The following interventions are considered at one or more of the selected stations:

Water sources

- Locating and drilling new water wells, including drilling, casing, construction of pump and riser pipe
- Rehabilitation of existing water wells
- Transmission line construction for raw water
- Transmission line construction for treated water
- Road restauration and pavement

Water treatment and pumping

- Rehabilitation or/and construction of new treatment facilities (including sedimentation/flocculation, aeration, filtration)
- Rehabilitation or/and construction of new storage tanks
- Rehabilitation or/and installation of electromechanical equipment
- Minor construction works at the site

Selection of the most feasible option is dependent on the technical, environmental and social analysis.

Table 8: Planned interventions for Component 2 of the SU-L1018 loan

	Option 1	Option 2		
Proposed work	**Helena Christina**	**Kampong Baroe**	**Groningen**	**Tijgerkreek (Peperhol)**
Water sources				
Locating and drilling new water wells	**X**	**X**	**X**	**X**
Rehabilitation of existing water wells	**X**			
Transmission line construction for raw water		**X**	**X**	**X**
Transmission line construction for treated water	**X**			
Road restauration and pavement			**X**	**X**
Water treatment and pumping				
Rehabilitation or/and construction of new treatment facilities (including sedimentation/flocculation, aeration, filtration)	**X**	**X**	**X**	**X**
Rehabilitation or/and construction of new storage tanks		**X**		
Rehabilitation or/and installation of electromechanical equipment	**X**	**X**	**X**	**X**
Minor construction works at the site	**X**	**X**	**X**	**X**

2.2 Study Area

The SWM water modernization program aims to improve water quality and distribution by potentially improving the infrastructure choosing from two options:

- Option 1: Upgrading water supply station Helena Christina
- Option 2: Upgrading water supply stations Kampong Baroe, Groningen and Tijgerkreek (Peperhol).

The choice of location is dependent on the outcomes of the technical, environmental and social analysis.

For the purpose of this study, the **direct study area** at each water supply station was set at 1 km radius (Red circles in Figure 1 and 2) based on the potential impacts as a result of construction works[8] required for water supply modernization (noise, vibration, soil erosion, air quality and dust, sediment transport, disturbance of water bodies, wastewater discharge, traffic safety, disease prevention).
The **indirect study area** consisted of the service area of that specific water supply station including its expansion plans under the project (Figure 1 and 2).

Figure 1: Study area of Option 1 located in District Wanica

[8] IFC. General EHS Guidelines: Construction and Decommissioning

Figure 2: Study area of Option 2 located in District Saramacca

2.2.1 Description of the study sites

a. Helena Christina

This site is located in an urban area approximately 15 km from Paramaribo along the Helena Christina road which is often used by travelers as a shortcut from the busy Indira Gandhiweg in the north (airport, recreation areas) to western-located neighborhoods. In this area, residents live on each side of the Helena Christina road and engage in small-scale agricultural production.
Commercial activities occurring in the study side are:

- To the north, commercial agricultural production activities
- To the south, sand excavation occurs approximately 400 m from the station.

Figure 3: Direct study area Helena Christina (Red circle)

b. Groningen

The site is located in the outskirts of the small-town Groningen, which is the capital of the District of Saramacca. The site's location is in a residential area along a sandy road (Kochweg) approximately 725m from the main road connecting Uitkijk and Groningen.
Specific characteristics of interest to the study are:

- To the north of the station there is a large forested area and a canal along which the water wells are located.
- The indigenous community of Columbia is located in the direct study area.
- The indigenous community of Grankreek is located in the indirect study area, approximately 4.9 km west from the station.

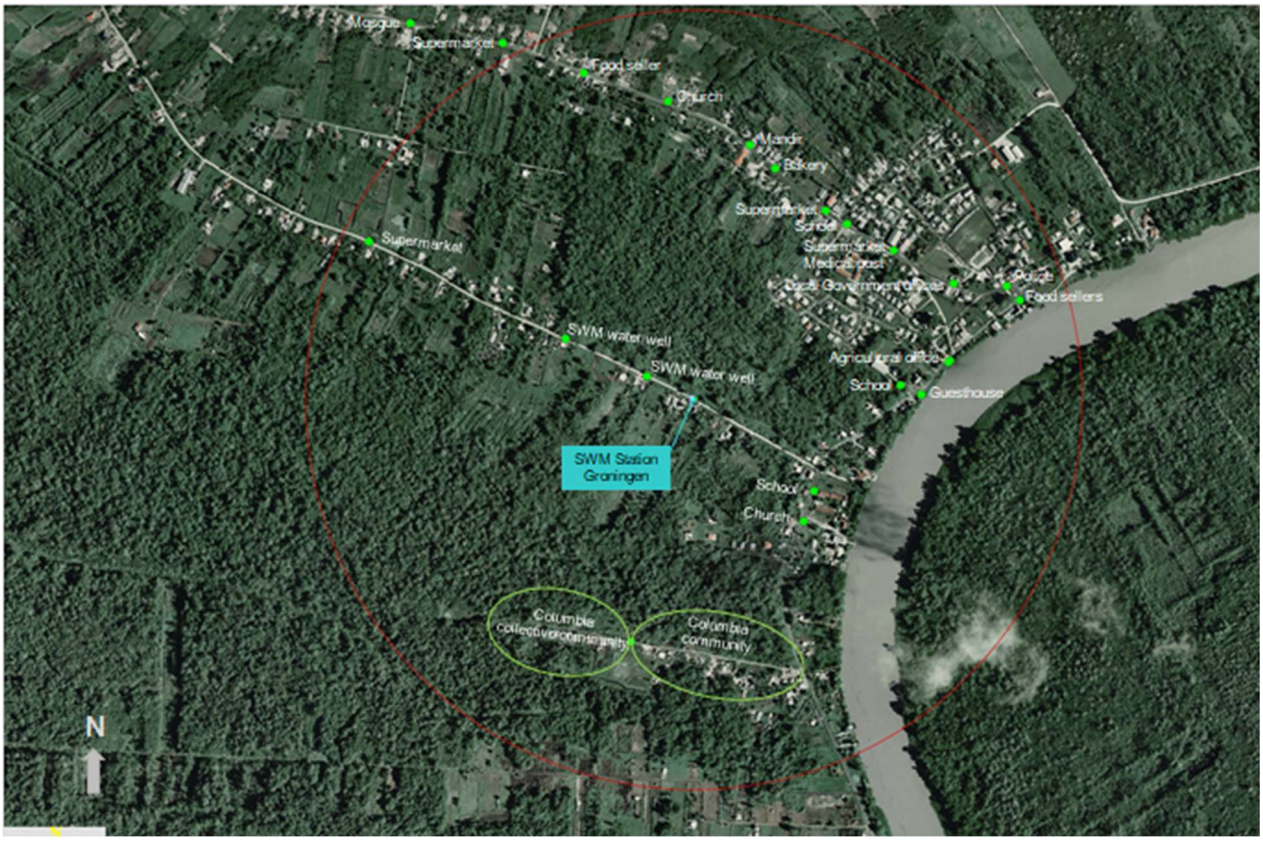

Figure 4: Direct study area in Groningen (Red circle)

c. Kampong Baroe

The site is located in a rural area along the asphalt road that connects Uitkijk and Groningen. The area is characterized by ribbon buildings along the road accompanied by:

- Small-scale agricultural production of bananas, watermelon, cassava, vegetables, poultry and pig farming
- Adjacent to the station, there is a mosque and a fully operational ornamental farm.
- The indigenous Kaliña community of Maho is located in the indirect study area, approximately 7 km southeast from the station.

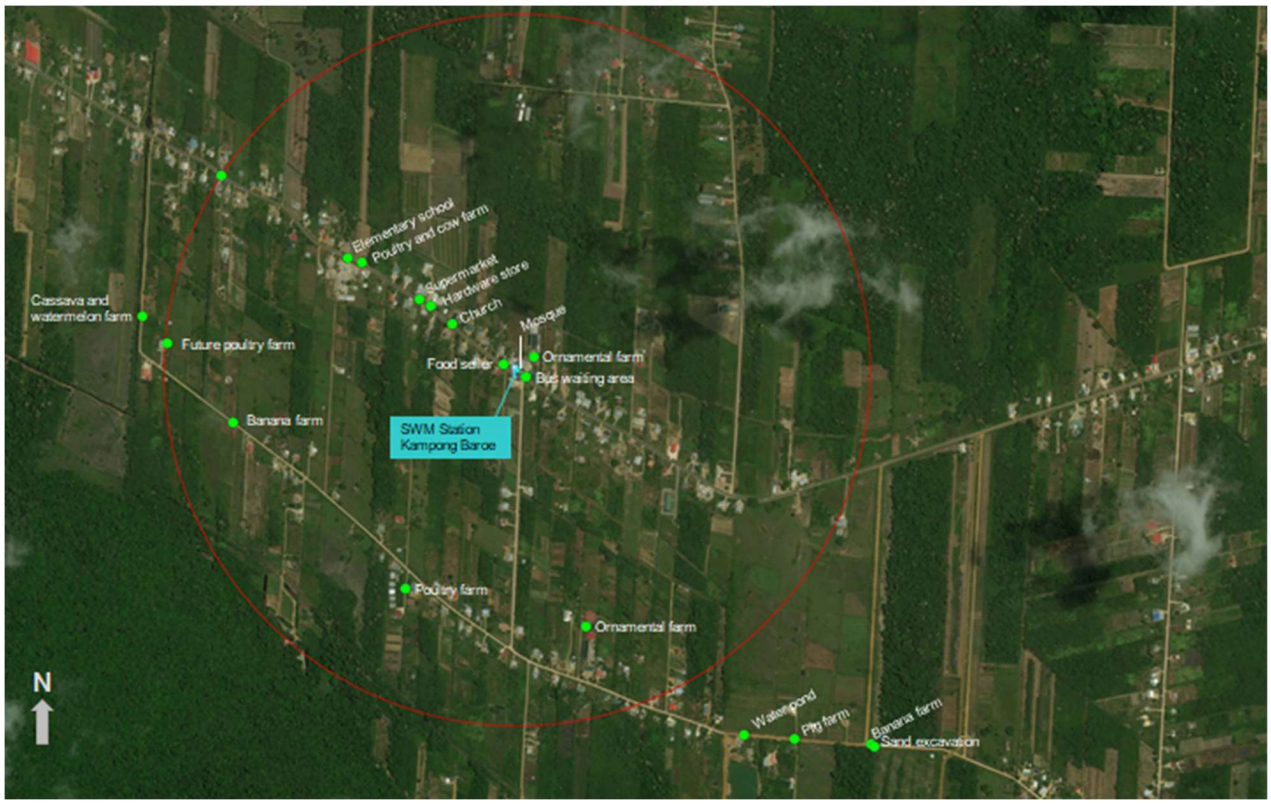

Figure 5: Direct study area in Kampong Baroe (Red circle)

d. Tijgerkreek (Peperhol)

The site is located in a rural area, along the east-west connection road. Residents mostly live on each side of the road, although a few houses can be found on the west side. Residents in the area practice agricultural production on a small-scale, either for own consumption or for selling.

- To the east, there is an irrigation canal supplying water coming from the Saramacca river.
- To the south and north, there are mostly forested lands, dispersed with agricultural farms.

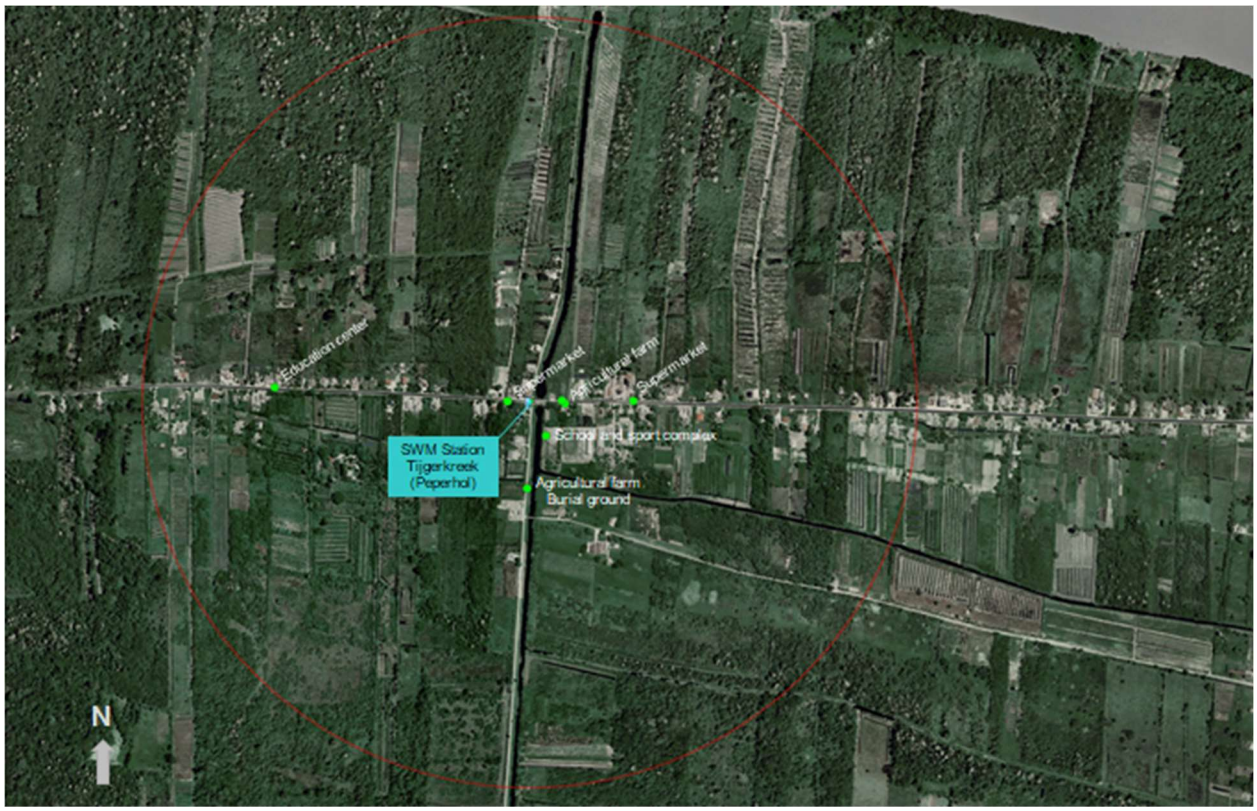

Figure 6: Direct study area in Tijgerkreek (Peperhol) (Red circle)

2.3 Brief Summary of the Suriname Water Supply Master Plan

The Suriname Water Supply Master Plan (SWSMP) aims to determine the infrastructure investment and institutional strengthening of SWM as the government-owned company responsible for potable water supply in Suriname. The plan was developed by consultant Genivar with local partner Ilaco in 2008 and is summarized below.

a. Situational Analysis

The plan provides a situational analysis of the water supply covering the coastal region and the hinterland.

In the coastal region, the water supply is relatively poor. Consumers experience lack of water, low/no water pressure, and poor water quality due to i) old distribution facilities, ii) high percentage of leakage in the water supply station, iii) pumping and treatment stations with low capacity, and iv) low amount of water in the system. These symptoms are especially noticeable in rural areas.

In the hinterland, water supply systems are constructed for a relatively small number of consumers which make it highly unsustainable. This situation can be improved with i) better coordination, ii) increased collaboration between different stakeholders, iii) standardization of the water supply and iv) use of technology.

b. Capital Investment Plan

The plan recommends for SWM to upgrade water supply facilities in the coastal region and the interior.

In the coastal region, several options for capital investments are available for each District, taking into account the quantity and quality of potable water from the source aquifers.

For the hinterland, capital investment are dependent on the unique conditions of each community and several other factors which influence decision making, such as: i) high level of contaminants (mercury due to gold mining activity), ii) community willingness to pay for water, iii) technical capacity of the community to do basic operations and maintenance of the system.

Maintenance Management Plans are required to address operational and maintenance needs for both regions.

c. Business Plan

The plan presents a financial analysis for SWM and makes recommendations on its tariff structure for the coastal region and the hinterland.

For the coastal region, a financial model is presented to evaluate current financial and operational sustainability of the water supply operations. Based on this model, water tariffs are calculated based on real costs of operations.

For the hinterland, financial management of water resources will be led by an autonomous government-owned entity. Transfer of stations from the Ministry of Natural Resources to the autonomous organization aims to create access to 100% of the hinterland population by 2024.

d. Legal and Institutional Requirements

The plan concludes that the current legislative framework is insufficient to manage and protect water resources and water supply, and this can be mitigated by creating an umbrella act on water and an independent regulatory body with a clear policy mandate. Furthermore, the plan proposes to improve the coordination and management between institutes responsible for water supply.

In terms of institutional capacity, the plan proposes a water quality monitoring program which should be implemented to meet water quality standards. Regular uptake of data through consumer satisfaction surveys will gain more insight into consumer behavior, as well as improve communication and confidence reporting with consumers. In addition, the plan presents a detailed stakeholder engagement plan to include key-stakeholders from all over the country in water planning and management.

3. Analysis of Alternatives

3.1 Proposed Project

The Water Supply system dates back from 1930s when pollution was still low and available water infrastructure was adequate for the population. The current population is estimated 108,231 for district Wanica (option 1 Helena Christina) and 17,685 for district Saramacca (option 2 Kampong Baroe, Groningen and Tijgerkreek) from Census data and this population is projected to increase with 6.6% and 4.8% by 2024, respectively. Water demand is projected to increase with 160.2m3 / h for Wanica and 112.4m3 / h for Saramacca by 2024[9].

In the current scheme, raw water is tapped from the A-sand aquifer for Helena Christina and the Coesewijne aquifer for Kampong Baroe, Groningen and Tijgerkreek (Peperhol). Raw and potable water does not always reach WHO standards. Issues such as excessive amounts of iron, ammonium and/or manganese are due to poor infrastructure and the absence of a water quality program[10]. Water is treated with chlorine which makes it hard for residents to drink, amongst other problems with release of sediments or high sulfate content. Residents depend on bottled water for drinking if they can afford it, or otherwise use wells and/or roof catchments.

The project will involve rehabilitation of already existing water systems which implies that there will be no major infrastructure setup in areas other than that of already existing water stations. Areas where land will be acquired for well construction, proper land acquisition should be carried out and resettlement should be avoided in the design phase. The project proposes an intervention in updating water sources, treatment and storage facilities to ensure safe and clean water for residents.

3.2 No Project Alternative

The no-project alternative is often defined by the baseline information and is crucial in the impact assessment because other alternatives are weighted with reference to it. The no-project alternative would mean that the project does not move forward.

Implementation of the project will improve water provision to the residents in Saramacca or Wanica districts (including supply to a new hospital). However, the no-project choice will lead to the following negative long-term impacts:

- There will be stagnated economic growth of the respective districts
- There will be reduced ability to create wealth for residents, given that they have less than optimal access to this basic need

This scenario is unacceptable on either environmental or social grounds.

[9] Suriname Water Supply Master Plan. Volume III: Capital Investment Plans for the Water Sector
[10] Suriname Water Supply Master Plan. Volume II: Situational Analysis of the Water Sector

3.3 Brief Description of Alternatives

The two options of intervention have similar environmental impacts, but the social impacts vary between the study sites. The following environmental and social criteria are important in choosing between the two options:

- Land acquisition for wells to be located at the Helena Christina site (Option 1). Because of the lack of the proximate location of wells, we make the following assumptions for well construction: i) wells are located near the street and there is plenty of land to choose wells of 20x20m, ii) land will have to be from third parties, or is Government owned, iii) wells will only take a small amount of the privately owned land and iv) resettlement should be avoided[11].
  When making these assumptions, it is highly likely that involuntary resettlement or economic displacement will not occur because there are multiple options to choose wells.
- Improvement of water quality at the Saramacca sites (Option 2). Interviewed residents have a perception that water has a chlorine taste and smell (Kampong Baroe, Groningen) or a muddy taste and smell (Tijgerkreek west).
- High-quality water availability in wells. Depletion of water wells can lead to salination and thus lower water quality.

However, this analysis has a general focus since specific information on the technical design was not available at the time of this study. Selection between the two options is possible when more technical information is available.

[11] These assumptions were acquired from the IDB.

4. Legal and Institutional Framework

4.1 Policy, Legal and Institutional Framework

4.1.1 Introduction

The legal basis for environmental protection in Suriname is provided by the Constitution (1987, last amended in 1992). It is stated that one of the social objectives of the State is directed towards *"The creation and promotion of conditions necessary for the protection of nature and for conservation of the ecological balance" (article 6g)*. Despite this constitutional provision, Suriname's environmental regulatory regime has not fully evolved. Current legislation originates from the Colonial period and is more focused on nature conservation rather than pollution control. Responsibility for the management of the environment and natural resources resides within different government institutions. In 1998, the National Institute for Environment and Development in Suriname (NIMOS) was established with a mission to initiate the development of a national legal and institutional framework for environmental policy and management in the interest of sustainable development in the Republic of Suriname. In 2000, NIMOS started the process to develop an Environmental Framework Act for Suriname. A first draft was formulated in 2002 and afterwards revised several times. Environmental Assessment Guidelines were released by NIMOS in 2005 and revised in 2009, and have since been implemented on a voluntary basis, or based on agreements between the Government and private companies. The companies referred to are mostly multi-nationals operating in the country as well as State-owned companies.

In 2013, a National Environmental Policy Office was created under the Cabinet of the President, with the role of overseeing NIMOS. The Office, called the Environmental Coordination Unit (ECU), did not become operational until late 2015. The ECU is responsible for formulating and coordinating environmental policy and environmental legislation and serves as the environmental focal point representing the country in the various environmental conventions to which it is party. NIMOS's current activities include review of ESIAs of proposed projects, environmental monitoring and enforcement of environmental mitigation plans, and education and outreach. NIMOS is also involved in grant-funded projects related to the environment. Most recently, the Draft Environmental Act has been submitted to Parliament for consideration and in the meantime NIMOS has started the process of formulating the implementation regulations under the Environmental Act.

This chapter provides an overview of the policies, legislation and institutions that form the enabling environment of the current project.

4.1.2 Policy and Legal Framework

This section summarizes the Policy and legal framework of Suriname that is applicable to SWM project activities. It encompasses environmental and health and safety aspects.

Policy

The framework for the current government policy is anchored in the Development Plan 2017-2021, named "Development priorities of Suriname". The Development Plan explicitly refers to water, stating that the availability of healthy drinking water is a necessary link in the social economic development of the society. The priorities of the Government in this light are the establishment of several new drinking water facilities and management, maintenance and re-innovation of existing and/or old facilities. In line with the Development Plan, four (4) pieces of legislation have been prepared under supervision of the Ministry of Natural Resources. This regards the Draft Acts on "Supervision Drinking Water Quality", "Ground Water", "Ground Water Protection Areas" and the "Water Authority Suriname". In addition, the Development Plan refers to the investments to increase the capacity of the drinking water production in the coastal plain.

Legislation

Suriname's legislation is exercised through a suite of different legislative instruments, including Laws or Acts of Parliament (*Wet, also called Landsverordening prior to 1975*), Decrees[12] (*Decreten*), and regulations which are in the form of State Orders (*Staatsbesluiten*), Presidential Orders (*Presidentiële besluiten*), Presidential Resolutions (*Presidentiële Resoluties*) and Ministerial Orders (*Ministeriële Beschikkingen*).

In general, the legislation regarding environmental and natural resource management is fragmented, dispersed between different pieces of legislation.

4.1.3 Legal Requirements for Environmental Assessment

The legal and regulatory framework for environmental impact assessments in Suriname is governed by the 'Nationaal Instituut voor Milieu en Ontwikkeling in Suriname' (NIMOS). NIMOS was established in 1998 as an autonomous Government Foundation and currently reports on its activities to the Environmental Coordination Department in the Cabinet of the President. The Office of Environmental and Social Assessments, a division of NIMOS, is responsible for the administration of ESIA processes in Suriname.

A draft Environmental Act has been developed as an environmental framework law in response to the 1992 Rio declaration. The draft Act lays down rules for the conservation, management and protection of a sound environment within the framework of sustainable development. The draft Act also provides guidance for EIA in Suriname. Currently, the Draft Environmental Management Act is at Parliament to

[12] Decrees date from the Period of Military Ruling (1980-1986) and have the same status as a law.

start the process for promulgation. A variety of stakeholders have already been consulted by Parliament.
Draft EIA Regulations, to be promulgated under the Environmental Act once in force, have also been developed since 2003 and contain requirements for EIA processes and public participation. The draft EIA Regulations are still being amended and are not yet in force.
NIMOS has published Guidelines for Environmental Assessment (EA) in Suriname. The Guidelines stipulate the EA process that should be undertaken if the environmental framework law and EIA Regulations were in place (NIMOS, 2017). The EA Guidelines are being applied by NIMOS as part of the project assessment process and project developers are expected to comply with the guidelines.
The EA Guidelines series consists of the following volumes:

- Volume I: Generic (2009)
- Volume II: Mining (2005)
- Volume III: Forestry (2005)
- Volume IV: Social Impact Assessment (2005)
- Volume V: Power Generation and Transmission Projects (2005)
- Volume VI: Aquaculture Projects (2011)
- Volume VII: Agriculture Project (2013)

As a supplement to the more comprehensive Environmental Assessment Guidelines (Volume I), NIMOS released a Guidance Note NIMOS Environmental Assessment Process (2017), which highlights the EA process that is implemented in the current legislative environment (prior to the promulgation of the Environmental Act and EIA Regulations). It defines five EIA process phases, viz. Screening, Scoping, Assessment, Review and Decision-making phases, and associated reporting requirements, as well as NIMOS decision-making timeframes.
At the conclusion of an EA process, NIMOS provides environmental advice regarding approval or denial of the project to the agency authorized to issue a permit to undertake the development or activity.

4.1.4 Legislation Relevant to the Project

National Water Resources Legislation

Water resources legislation in Suriname is out of date and does not comply with current social requirements. The Government has prepared four draft laws and implementation regulations to protect the water resources in Suriname, regulate drinking water quality and to support integrated water resource management.
This paragraph provides an overview of current water resources legislation, including relevant environmental laws and regulations and a brief description of the draft laws and regulations under preparations. It is noteworthy mentioning that SWM and other stakeholders have been closely involved in the preparations of the draft laws and regulations.

Table 9 gives an overview and a brief description of the water resources and relevant environmental related legislation relevant to the project.

Table 9: Relevant Environmental Legislation to the Project

Act	Content	Relevance to the project
Boorwet G.B. 1952 no. 93 (The Drilling Act)	Contains provisions to protect the soil by regulating particularly the treatment of the drill holes. The main purpose is to prevent the mixing of the components of the soil.	Drilling activities under this project must comply with this Act
Beheersgebied Noord Saramacca S.B. 2002 no.88 (Ministerial Order to designate North Saramacca as a MUMA S.B. 2002 no. 88	An area of coastal land bordered by the Coppename River in the west, and the boundary of the Saramacca District in the east. The area is further bordered by the Wayambo Road, the Saramacca River and the Coppename Road, including adjacent sea until the 6m depth contour is designated the North Saramacca Multiple Use Management Area	N/A
Beschikking gronduitgifte estuariene beheersgebieden 2005, S.B. 2005 mo. 16 (The Ministerial Order "Guidelines for land issuance in the estuarine management areas")	The regulation sets guidelines for the issuance and use of domain land in the estuarine management areas for the purpose to protect the natural functions of these areas e.g. coastal and shore protection, soil and water management, the breeding and feeding grounds for fish, shrimp and birds. When issuing domain land in the estuarine management areas the following terms and conditions apply: i) A strip of 500 meters on both sides of the rivers and a stroke of 200 meters on both sides of creeks is reserved for protection forest or special protected forest; ii)It is prohibited to withdraw water from the estuarine swamps; iii) The discharge of wastewater containing chemicals, pesticides are prohibited	N/A
Wetboek van Strafrecht G.B. 1911 no. 1 zlg. bij S.B. 2004 no. 105 (Penal Code)	Article 224 stipulates that "He that deliberately puts a substances in a well, pump, source, creek that is used as common good or sharing with others as a drinking water device, knowing that thereby the water will be polluted or can harm the health, will be punished by imprisonment not exceeding fifteen years".	When carrying out the work under the project, one must refrain from activities whereby substances harmful to life or health end up in the water.
Politie Strafwet G.B. 1915 no.77 zlg. bij S.BS.B. 1990 no. 24.	In this Code is stated that "The polluter of water in a well, water hole or a ditch or generally any water that will be used to	In carrying out activities under the project, one must

(Police Criminal Code)	drink or wash shall be punished with a fine or imprisonment not exceeding one month".	refrain from polluting the wells.
Waterleidingbesluit G.B. 1938 no.33.) The Water Supply Act	Obliges owners of buildings and houses to make use of the public water supply system. It prohibits the possession of water tanks and wells in the areas where the law is applicable. It is prohibited to own or possess wells, pits or others that are used to extract water, bins, barrels or other similar objects which will be used for the collection and / or storage of water. Above-mentioned is not applicable for water companies that have a license from the Government.	N/A
Concessiewet G.B. 1907 no.34 geldende tekst 1944 no.129 (The Concession Act)	Contains rules concerning the exploitation of the public utilities. The President can grant concession for the use of domain land for the construction and operation of works of public utility. The Suriname Water Company (SWM) operates as a concessionaire according to this law and concession was granted to the water supply company (SWM). However, the concession expired in 1982. However, the request for extension and expansion is pending.	According to a Protocol of transfer signed on 29 April 2013, drinking water systems in the districts of Wanica, Para and Saramacca were transferred from the Department of Water Supply from the Ministry of NH to the SWM.
Anchylostoomwet GB 1917 no. 83, geldende tekst GB 1937 No. 23 (The Anchylostomiasis act)	Contains rules for the protection of water wells against contamination from anchylostomiasis. This act prohibits the use of faeces as fertilizer and protects wells against contamination with faeces.	N/A
Muskietenbestrijdingswet GB 1952 no. 9 (The Mosquito's Act)	The objective of this Act is to prevent mosquito's from entering water tanks and other objects that contain water for domestic use.	N/A
Bouwbesluit G.B 1956 no. 30 zlg. bij S.B.2002 no.93 The Building State Order	Sets specific drainage and sewerage requirements for construction of buildings.	Building activities under this project must comply with this Act

Proposed Legislation

As the previous sections demonstrated, there is currently no comprehensive legislation that regulates the management of water sources in Suriname. However, currently there are four (4) pieces of draft legislation prepared for discussion in the Council of Ministers. In addition, subsidiary legislation for these laws is being prepared by the Ministry of Natural Resources with input from stakeholders.

Currently, it is not foreseeable when the legislation will be adopted. If by the time the project is implemented the legislation is in force, the activities must be in compliance with the law.
Below is a brief summary of the draft laws and regulations.

I. Concept Grondwaterwet (Draft Groundwater Act)

Draft Act concerning the extraction of groundwater (*Concept Grondwater wet*). According to this act it is prohibited to extract groundwater without a license from the Minister of Natural Resources. A Commission Water management will be established and one of the tasks is to advise the Minister in granting permits for water extraction. The permitting procedure is also regulated through this Act. In addition, the act also sets technical specifications for drilling.
The implementation regulation prepared under this draft Act sets out provisions regarding the technical specifications that a water company is required to meet for drilling and closing of wells, the expertise requirements that must be met by persons in charge of drilling activities and regulations with regard to drilling safety.

II. Concept wet Grondwater beschermingsgebieden (Draft Act on protection of Groundwater protection areas

Draft Act concerning the protection of groundwater protection areas. The protection of the catchment is to ensure that no bacteriological contaminated water, hydrocarbons or other toxic substances reach the wells within a period of 60 days. The 60-day period is crucial because the germs in the groundwater are naturally degraded within this period. Pollution will be mainly caused by surrounding wells, which are in contact with the aquifer from which water is extracted. The greatest risk of contamination of the groundwater is in many cases because the well is not sealed. Within the catchment is a strict protection regime required. With the ban system the act seeks to prevent that pollutants make the groundwater less suitable and that activities take place that can make harmful substances more easily accessible and that potential sources of contamination are introduced within the zone. Also, compensation for damage is regulated by this law. It regards damage that is caused by application of this law will be determined in fairness and paid by the Director of the Ministry responsible for water supply.
The implementation regulation under this draft Act regards the designation of harmful substances. Furthermore, the regulation prohibits to have, use, transport or to release these substances into the ground or into the soil without a written exemption

III. Concept wet Toezicht Drinkwaterkwaliteit (Act on Supervision of Drinking water quality)

The draft Act on supervision of water quality refers to standards that shall be set for drinking water quality and is applicable for all companies that supply potable water to the public.
Six (6) implementation regulations have been drafted for this Draft Act; One sets out the administrative fine as a sanction for a water company or drinking water company that acts contrary to an obligation,

command or prohibition referred to in the law. A categorization for the administrative fine is also made based on the nature, seriousness and repetition of the violation. The second appoints certain substances and their concentrations which are considered harmful that may not occur in drinking water. A third regulation sets out rules and guidelines concerning monitoring and testing of drinking water quality. The regulation further indicates that the best practices or additions of manuals relating to the testing of drinking water quality indicated by the WHO are always used. The fourth regulations regard *Limit values Drinking water components. It s*ets out the limit values for constituents and other quality standards for drinking water, whether imported or not. The fifth regulations are guidelines for a *Water Safety Plan. It se*ts out the information to be stated in a water safety plan and the further procedure for handling. The sixth regulation sets *Emergency procedures for drinking water quality.* Emergency procedures for drinking water quality in the event of detection of E. coli, thermotolerant coliforms or exceedance of chemical and radiological parameters in drinking water for commercial or industrial purposes are determined.

IV. Concept wet Surinaamse Waterautoriteit (Surinamese Water Authority Act)

The draft Surinamese Water Authority Act establishes the Suriname Water Authority (SWA). The SWA is responsible for the supervision, monitoring and advising of the water sector. With the establishment of the water Authority, water management will take place in a coordinated manner.

V. Ontwerp Milieuwet (Draft Environmental Act)

Other legislation that supports water management is the draft Environmental Act. This law is now being discussed by Parliament and a series of pollution control regulations under this draft law have already been formulated. The draft Environment Act provides management and protection of a healthy environment. A very important tool which will be introduced with the entry into force of the act is conducting environmental impact analysis for activities that may affect the environment. In this way in an early stage can be determined whether some development will have adverse effects on the environment and mitigation measures in the event of contamination. The draft law also lays down rules in what quantities, concentrations or under what conditions the deposit, release or escape of contaminants on land, in the soil, water or air, causes environmental pollution. When providing a so-called environmental permit, it will be determined under what conditions and levels contaminants may be deposited, released or discharged into the soil, water or air. In principle, the draft act consists of general rules concerning water pollution. However, at present it is uncertain when this draft will be approved in Parliament.

Occupational Health and Safety

The most central act in relation to occupational health and safety is the Labor Act (G.B. 1963 no. 163 as amended by S.B. 2001 no. 71). It deals with different aspects of labor such as working hours, shift work, night work, breaks, rest days, hazardous work, payment, labor inspection, etc. Other relevant pieces of legislation are the Industrial Accidents Act (G.B. 1947 no. 45, as amended by S.B. 2001 no. 66) and the Occupational health and safety Act (G.B. 1947 no.142 as amended by S.B. 1980 no. 116).

The Industrial Accidents Act aims to indemnify the worker, spouse, parents and children depending on the employee as well as the employer against financial consequences of industrial accidents and occupational diseases. These are accidents related to or during employment including fatal injuries, but also to the more gradual development of a sickness because of the performed labor. It is compulsory for employers to provide industrial insurance to its employees. The employer is in a personal capacity liable for industrial injuries or an occupational disease, if their employee is not insured. It is noteworthy to mention that the Labour Inspectorate should always be notified in case of industrial accidents and diseases.
The Occupational Safety and Health Act (OSHA) is a framework Act on Safety and hygiene in enterprises. Detailed rules are or should be laid down in subsidiary legislation. The Act is applicable to enterprises, including construction of buildings and public works and mining on own account. At present the subsidiary legislation consists of nine Safety regulations aimed at decreasing the likelihood of employment injuries and occupational diseases.

The laws and regulations of Suriname applicable to the proposed project activities are summarized in Table 10.

Table 10: Laws and Regulations applicable to the Project

Act	Content	Relevance to the project
Arbeidswet G.B. 1963 no. 163 zlg. Bij S.B. 2011 no. 71 (Labour Act)	To regulate different aspects of labor such as working hours, shift work, night work, breaks, rest days, hazardous work, payment, labor inspection, etc.	The provisions of this Law and requirements thereto are applicable to the Project.
Veiligheidswet G.B. 1947 no. 142 z.l.g. bij SB. 1980 no.116 (Occupational Safety and Health	To advance safety and hygiene in enterprises so that the chance of accidents and occupational diseases can be reduced to a minimum.	The provisions of this Law and requirements thereto are applicable to the Project.
Ongevallenwet G.B. 1947 z.l.g. bij S.B. 2007 no.26 (Industrial Accidents Act)	To indemnify the worker and his/her family against financial consequences of industrial accidents and occupational diseases	The provisions of this Law and requirements thereto are applicable to the Project
Safety regulation No.1	To prevent or diminish the risk of injuries in all enterprises.	The provisions of this regulation and requirements thereto are applicable to the Project
Safety regulation No. 2	To promote hygiene (order and the prevention of dust) in all enterprises.	The provisions of this regulation and requirements

		thereto are applicable to the Project
Safety regulation No. 3	To prescribe measures regarding first aid	The provisions of this regulation and requirements thereto are applicable to the Project
Safety regulation No. 4	To prevent the generation and spread of hazardous or irritating gas or dust, and to regulate their removal. It promotes hygiene in all enterprises.	The provisions of this regulation and requirements thereto are applicable to the Project
Safety regulation No. 5	To protect workers against hazards caused by the weight of loads to be transported by sea or inland waterways.	The provisions of this regulation and requirements thereto are applicable to the Project
Safety regulation No. 6	To prevent the occurrence of pneumoconiosis (a disease caused by inhalation of dust) or other disease caused by dust	The provisions of this regulation and requirements thereto are applicable to the Project
Safety regulation No. 7	To promote safe and comfortable working conditions related to inter alia hazardous or disturbing noises and vibrations.	The provisions of this regulation and requirements thereto are applicable to the Project
Safety regulation No. 8	To protect workers against ionizing radiation	N/A
Safety regulation No. 9	To prevent hazardous risks to health by inhalation of or exposure to noxious or irritating gases and fumes.	The provisions of this regulation and requirements thereto are applicable to the Project

4.1.5 Relevant International Conventions

Suriname is signatory to several international agreements and conventions relating to environmental management, Occupational Health and Safety. With regards to conventions being in force into the national legal system, it can be stated that Suriname has a mixed system; both monistic and dualistic.

According to the Constitution, treaty provisions that may be directly binding on citizens shall become effective upon its promulgation (monistic). Legal regulations in force in the Republic of Suriname shall not apply if they are incompatible with provisions of international agreements that are directly binding on citizens. The latter mostly regard human rights treaties. In the case where the international treaties provide for instruction norms towards the Government, they must be transformed into national legislation to be applicable (Dualistic). In general, environmental treaties provide instruction norms towards the Government. These Conventions usually require that legal and administrative matters are being implemented by governments. Table 11 provides a listing of the Conventions which are considered relevant to the current project.

Table 11: Listing of Conventions considered relevant to the Project

Agreement/ Convention	Notes/ Comments	Status	Relevance
Climate Change/ Air Quality			
Vienna Convention for the Protection of the Ozone Layer, 1985	Protection of the ozone layer, came into force in 1988,	Suriname acceded in 1997.	Sets international standards for protection of the ozone layer; emissions from project potential to harm ozone layer
Montreal Protocol on Substances that Deplete the Ozone Layer, 1989	Protection of the ozone layer.	Suriname acceded in 1997 but subsequent amendments not yet ratified.	As above
United Nations Framework Convention on Climate Change (UNFCCC)	Promote international cooperation to limit average temperature increases and resulting changes in climate. Promote international cooperation to adapt to these impacts.	Ratified by Suriname in 1997.	Sets international guidelines on restrictions of GHG emissions in order to prevent climate change; Project will emit greenhouse gases from power generation.
Kyoto Protocol, 1997	International agreement linked to the United Nations Framework Convention on Climate Change, which commits its Parties by setting internationally binding emission reduction targets.	Ratified by Suriname in 2006.	As above
Paris Agreement	International agreement linked to the United Nations Framework Convention on Climate Change that commits its Parties by promoting the mitigation of greenhouse gas emissions while fostering sustainable development.	Acceded in 2016.	Provides for controls on greenhouse gas emissions within Suriname's territory.

BIODIVERSITY/PROTECTED AREAS			
United Nations Convention on Biological Diversity, 1992	Promotes development of national strategies for the conservation and sustainable use of biological diversity. Often seen as the key document regarding sustainable development.	Ratified by Suriname in 1996. A National Biodiversity Strategy (2006) has been compiled as framework for a National Biodiversity Action Plan.	Sets guidelines for protection and promotion of biological diversity.
LABOR/HEALTH/SAFETY			
Constitution of the International Labour Organization	Promotes opportunities for women and men to obtain decent and productive work, in conditions of freedom, equity, security, and human dignity.	Suriname member since 1976.	Sets international labour standards.
Constitution of the World Health Organization	The attainment of People of highest possible level of health	Unknown	Standards for drinking water quality

4.1.6 International Best Practices

Where national legislation, standards or guidelines are lacking or where international standards are more stringent, international standards like the IDB's standards are applied where applicable. As the project is financed by the IDB, the OP-703 Environmental and Safeguards Compliance Policy, OP-704 Disaster Risk Management Policy, OP- 761 Operational Policy on Gender Equality in Development, OP -765 Operative Policy on Indigenous Peoples and OP-710 Involuntary Resettlement Policy and Directives will be used to guide the project.

IDB's safeguard policies and implementation guidelines contain comprehensive requirements for prevention and mitigation of undue harm to people and the environment. These policies also establish the standards for informing and consulting with the region's population that Bank-Financed Projects must meet.

I. Environmental and Safeguards Compliance Policy (OP-703)

With regard to the IDB Environmental and Social Safeguard Policies and Directives OP-703, the following aspects are of relevance from an environmental standpoint. The IDB has a threefold strategy for addressing environmental concerns: These are:

1. to enhance long-term development benefits to its member countries by integrating environmental sustainability outcomes in all Bank operations and activities and strengthening environmental management capacities in its borrowing member countries;
2. to ensure that all Bank operations and activities are environmentally sustainable as defined in its Policy, and
3. to foster corporate environmental responsibility within the Bank.

The Bank seeks to act to achieve these specific objectives by adopting measures to mainstream the environment into overall economic and social development, and to safeguard the environment in all Bank activities. Additionally, the Bank's Environmental and Safeguards Compliance Policy (OP-703) states that "the Bank will proactively support borrowing countries and clients in identifying and financing operations designed specifically to: (i) enhance environmental governance, policy development and institutional capacity building; (ii) reverse environmental deterioration; and (iii) promote the conservation and sustainable use of natural resources and ecological services."

With respect to the policy's mandate to safeguard the project its finances, the Bank categorizes projects according to the potential environmental and social impacts as either: (i) Category A – Operations that are likely to cause significant negative environmental and associated social impacts, or have profound implications affecting natural resources, (ii) Category B – Operations that are likely to cause mostly local and short-term negative environmental and associated social impacts and for which effective mitigation measures are readily available, and (iii) Category C – Operations that are likely to cause minimal or no negative environmental and associated social impacts (Directive B.3 of OP-703).

According to OP-703, the project has been categorized B.

II. OP-704 Disaster Risk Management Policy

This Disaster Risk Management Policy which emphasizes risk reduction, is intended to improve the institutional and policy framework of the Bank to support disaster risk management in order to help protect the socioeconomic development of borrowing member countries and improve the effectiveness of the Bank's assistance.

The policy has two interrelated specific objectives:

i) To strengthen the Bank's effectiveness in supporting its borrowers to systematically manage risks related to natural hazards by identifying these risks, reducing vulnerability and by preventing and mitigating related disasters before they occur; and

ii) To facilitate rapid and appropriate assistance by the Bank to its borrowing member countries in response to disasters in an effort to efficiently revitalize their development efforts and avoid rebuilding vulnerability.

Activities and instruments subject to this policy include the development and implementation of country strategies and country program dialogues, financial and nonfinancial products, public and private sector operations, financial intermediation, and relevant aspects of the Bank's project procurement practices.

This policy provides two lines of action addressing: (i) the prevention and mitigation of disasters that occur as a result of natural hazards, through programming and proactive project work at regional, national and local levels; and (ii) post disaster response to the impacts of natural hazard events, and physical damage (such as structural collapse and explosions) resulting from technological accidents or other types of disasters resulting from human activity.

III. OP- 761 Operational Policy on Gender Equality in Development

IDB's 2010 Policy on Gender Equality in Development is related not only to promoting greater gender equality and development opportunities, but also to safeguards-related issues concerning risks of adverse impacts that may affect men and women differently. Given existing inequalities and women's more limited access to resources and authority, a gender responsive approach means that the focus should be on enhancing women's opportunities and access, and to ensure that any adverse impacts the project may cause or contribute to do not fall disproportionately on women.

OP-761 states that IDB will assess adverse impacts on gender equality beginning in the initial stage of preparation. In case gender-based impacts are identified, a gender analysis will be included into the operation's social impact and risk assessments, generally as a chapter of the SIA report. Among others, such risks may include:

- Introducing unequal requirements for access to project economic opportunities and benefits;
- Disregarding the right of women to inherit and own land, homes, and other assets or natural resources;
- Introducing unpaid work unevenly;

- Introducing conditions that restrict the participation of women or men in project activities and benefits based on pregnancy, maternity/paternity leave, or marital status;
- Increasing the risks of gender-based violence, including sexual exploitation, human trafficking, and sexually transmitted diseases, including HIV/AIDS.

Where the gender analysis included in the SIA so indicates, specific mitigation measures will be included in the Environmental and Social Management Plan to prevent, avoid, or mitigate the potential gender-based risks and/or impacts, and will monitor those measures.

When gender-based impacts are identified in an operation supported by the IDB, the following aspects should be included within the SIA process and the ESMP at a minimum:

SIA Report

- **Stakeholder analysis and social baseline data**. Make sure that a specific analysis is done about men's and women's roles, views and priorities in relation to the project and potential constraints to women's participation in decision-making. The stakeholder mapping should specifically include women's organizations to ensure their active participation in the consultation process.
- **Expected social impacts and social risks**. Include potential adverse impacts on gender equality and risks of gender-based exclusion, such as: threats to women's ownership rights and risk of unfair compensation for loss of housing, land and access to natural resources and other assets; impacts on women's livelihoods; risk of increase of gender violence, including sexual exploitation and human trafficking; women's exclusion from project-derived economic opportunities and benefits, including paid work, training, credit, or business opportunities; cultural barriers to women's participation in consultation processes.

ESMP

- **Social mitigation measures**. Include specific mitigation measures in the Environmental and Social Management Plan to prevent, avoid, or mitigate potential gender-based risks and/or impacts.
- **Monitoring and assessment mechanisms**. Include gender-disaggregated indicators to monitor the implementation of the social aspects of IDB's Environmental and Social Management Plan.
- **Consultation, participation strategy and grievance mechanisms**. Ensure the equitable participation of women and men, making sure that affected women are included in a gender-sensitive and socio-culturally appropriate manner.

IV. Operative Policy on Indigenous Peoples (OP-765)

There are three indigenous tribes present in the study area, namely in Maho, Columbia and Grankreek. To assess whether OP-765 is applicable to the project, a separate study on the socio-cultural characteristics of these tribes will be conducted. Safeguarding Indigenous Peoples and their rights against adverse impacts and exclusion in IDB funded development projects is one of the main objectives of the Bank. IDB's OP-765 defines Indigenous Peoples as those who meet the following three criteria:

1. They are descendants of populations inhabiting Latin America and the Caribbean (LAC) at the time of conquest or colonization;
2. Irrespective of their legal status or current residence, they retain some or all of their original social, economic, political, linguistic, and cultural institutions and practices; and
3. They recognize themselves as belonging to Indigenous or pre-colonial cultures or peoples.

When OP-765 is triggered or applicable, an Indigenous Peoples Plan (IPP) is required to prevent or mitigate direct or indirect adverse impacts on Indigenous Peoples or their individual or collective rights or assets. This should at a minimum describe the following:

- Sociocultural impact evaluations (SCA); This will inform the activation of OP 765;
- Culturally appropriately consultation processes (all adverse impacts);
- Plan for mitigation measures, monitoring, and fair compensation (all adverse impacts);
- Good faith negotiation processes (when significant adverse impacts are detected); and
- Agreements (when significant adverse impacts are detected).

Table 12: Criteria for application of OP-765

<table>
<tr><th colspan="3">CRITERIA FOR TRIGGERING OP-765</th></tr>
<tr><th>Criteria</th><th>OP 765</th><th>OP 703</th></tr>
<tr><td>Ancestry: the descendants of populations inhabiting areas in LAC at the time of conquest or colonization.</td><td rowspan="3">Apply when it meets the three Criteria</td><td rowspan="3"></td></tr>
<tr><td>Culture: people who retain some or all their own social, economic, political, linguistic and cultural institutions and practices, irrespective of their legal status or current residence.</td></tr>
<tr><td>Self-identification: they recognize themselves as belonging to Indigenous or pre-colonial cultures or peoples</td></tr>
<tr><td>Other Vulnerable Groups (Afro descendants and others)</td><td></td><td>Apply. Specific evaluations, mitigation and consultation measures should be applied.</td></tr>
</table>

Other Vulnerable Groups

OP-703, directive B.5 states that any potential impacts must be properly evaluated, mitigated and managed. Preparation of proper Environmental and Social Assessments and associated management plans are required during the project design for vulnerable groups. Within the SIA process, this may include:

1. Analysis of social issues

- Screening and scoping for impacts; sociocultural analysis (SCA) and timely and adequate consultation and information dissemination process; examination of alternatives including a no project scenario.
- Economic analysis of project alternatives and, as applicable, by economic cost benefit assessments of the project's social impacts and/or the associated measures for the protection of vulnerable groups.

2. For mitigation measures, the plan must include:
- A presentation of the key direct and indirect social impacts and risks of the proposed operation; including socio-cultural impacts to vulnerable groups;
- The design of the proposed social/environmental measures to avoid, minimize, compensate and/or mitigate the key direct and indirect impacts and risks; the institutional responsibilities;
- The meaningful consultation and participation plan agreed for the operation; and
- The framework for the monitoring of social impacts and risks throughout the execution of the operation, including clearly defined indicators, monitoring schedules, responsibilities and costs.

3. Meaningful Consultations with Vulnerable Groups will be an integral part the environmental and social assessment process, Category "A" and "B" operations will require socio-culturally appropriately consultations with affected vulnerable groups to incorporate their views and concerns.

When OP-765 applies in an operation supported by IDB, three main components should be summarized in an SCA. Below are examples of issues to include.

1. **Baseline studies**

   Analysis of the legal framework related to Indigenous Peoples; characterization of the Indigenous communities; community structure and institutional functioning (norms, values, rules, customs, behaviors, and decision-making mechanisms); gender aspects; analysis of symbolic aspects (characterization of values, norms, traditions, customs, beliefs, aspirations and attitudes of local communities in relation to the project).

   Prepare a social vulnerability analysis (socio-economic vulnerability and potential risk of exclusion from expected project benefits); people's expectations, aspirations, perceptions and attitudes towards the project; sources of livelihood.

2. **Socio-cultural impact assessment**

   Existing liabilities and contextual risk; analysis of the risks to physical, territorial, or cultural integrity of the affected populations (including natural resources, food security, rights, economy, identity, etc.); analyze the possible impacts generated by the presence of construction workers; cultural changes and generational disruption potentially generated as a result of the project; analysis of risk of conflict.

   Analysis of potential indirect impacts related to tenancy and use of lands; analysis of other risks and possible adverse social impacts (including direct, indirect, and accumulative, induced or

residual impacts on Indigenous communities). Mitigation measures to manage the potential social risks and impacts.

3. **Culturally appropriate consultations**
   Public consultations with Indigenous Peoples. These measures would be additional to the consultation activities to be carried out in the context of the ones required by OP-703. These consultations should be socio-culturally appropriate, preferably using one or more Indigenous facilitators who can interpret and translate, ensuring that those people who don't speak the mainstream language have the opportunity to pose questions and express their opinions and concerns; that consultation events are held at times and in spaces that are accessible to the local Indigenous population, and that they respect the decision-making mechanisms of the Indigenous groups.

V. Involuntary Resettlement Operational Policy (OP-710)

We anticipate no resettlement to take place because it will be included as a condition to the project. For the purpose of completeness, we mention the Bank's Operation Policy 710 on Involuntary resettlement, in case it should be applied.

The objective of the policy is to minimize the disruption of the livelihood of people living in the project's area of influence, by avoiding or minimizing the need for physical displacement, ensuring that when people must be displaced, they are treated equitably and, where feasible, can share in the benefits of the project that requires their resettlement.

In cases of physical displacement, the IDB Operational Policy on Involuntary Resettlement and accompanying Principles and Guidelines define the instruments to be used in cases where operations supported by the IDB physically displace people. This policy covers any involuntary physical displacement caused by an IDB project.

Attention must be given to socio-cultural considerations, such as the cultural or religious significance of the land, the vulnerability of the affected population, and the availability of in-kind replacement for assets, especially when they have important intangible implications.

Guidance table		
	OP-710	**Op-703**
Physical Displacement	Resettlement Plan	
Economic Displacement (including loss of livelihood) that potentially leads to Physical Displacement	Resettlement Plan	

Loss of income (not land-based activities, even if location-based) including Expropriation of immovable assets - when not under 1 or 2		Compensation and Livelihood Restoration Plan (CLRP)

In IDB-supported projects in which borrowers use expropriation as the means to acquire land or structures for public benefit, OP 710 valuations guidelines (replacement and transactional cost) should be applied also under OP 703. This should be part of the compensation and livelihood restoration plan.

Relevant definitions for the situations highlighted above are:

- **Physical Displacement**. Involuntary resettlement of people affecting their residence and requiring physical relocation.
- **Displacement of land-based economic activity**. Significant displacement of economic activity by land acquisition or by limitations of land use that eventually will cause physical displacement of people.
- **Loss of income/loss of livelihood**. Includes temporary or permanent, absolute or partial when it is not directly related to land take for project implementation, even if location based. Loss of other immovable assets. Could include land belonging to a person but not used for economic activity or place of residence.

When OP-710 applies in an IDBs operation, the essential components of a Preliminary Resettlement Plan are:

- Identification of project impacts and affected populations;
- A legal framework for land acquisition and compensation;
- A detailed entitlement matrix, identifying categories of affected people, with corresponding compensation and assistance measures such as livelihood restoration;
- A description of how the RP will be implemented, with schedule, budget, and organizational responsibilities;
- A framework for public consultation, participation, and development planning;
- A description of provisions for redress of grievances; and
- An initial framework for monitoring, evaluation, and reporting.

The main components to be included in the final version of the Resettlement Plan need to be adapted to a specific project context.

When only OP-703 applies because there is economic (but not physical) displacement, the essential components of the Compensation and Livelihood Restoration Plan (CLRP) are the following:

- Identification of project impacts and affected economic activities (temporary, permanently; direct and indirect expected impacts, current legal situation of the activity, a legal framework for economic compensation; Entitlement matrix, identifying categories of affected economic activities (including illegal ones), and several options for compensation that those affected can choose among;

- A census of the individuals or families or businesses affected by economic displacement with a description and estimation of the amount of income lost;
- A description of how the CLRP will be implemented, with schedule, budget, and organizational responsibilities;
- A framework for public consultation, participation, and development planning;
- A description of provisions for redress of grievances; and
- An initial framework for monitoring, evaluation, and reporting

4.2 Institutional Framework for Environmental and Social Management

Several government departments and agencies play a role in environmental and social management in Suriname. Within this section only the main entities are discussed and their relevance to environmental, social and occupational health and safety are highlighted.

Table 13: Role of Government Institutions in the Project

Government Institutions	Role/Relevance to the project
Ministry of Natural Resources	Responsible for national policy with regards to minerals, water and energy. This includes reconnaissance, exploration and exploitation and management of these natural resources. The Ministry is also responsible for drinking water supply. The SWM is a parastatal company and falls under the Ministry of Natural Resources
Environmental Coordination Unit under the Cabinet of the President	Coordination of the preparation of environmental policy for the country and monitoring of its implementation. The unit also promotes the development of environmental legislation as well as implementation of environmental conventions.
NIMOS -National Institute for Environment and Development in Suriname	Functions as the environmental management agency in the country and administers the EIA process.
Nature Conservation Division (NCD) within the Ministry of Spatial Planning, Land and Forest Management (ROGB)	Responsible for the day to day management of protected areas in Suriname. A large part of the coastal area has the status of Multiple Use Management Area and falls under protection of the NCD. The NCD is also responsible for wildlife protection.
National Coordination Centre for Disaster Management, within the Ministry of Defense	Develops national policies on disaster management and acts as coordinator and facilitator in crisis and disaster management during crises and disasters.
Ministry of Labour	Supervision of compliance with worker rights and occupational health and safety regulations
Ministry of Public Health	Responsible for environmental health management, such as control of infectious disease, food and drinking water quality, sanitation, prevention of ship and aviation pollution, and disposal of industrial waste in collaboration with other relevant institutions.
Ministry of Public Works, Transport and Communication	Responsible for policy, planning and development of general architectural structure, and other civil engineering infrastructure, flood control and drainage, surface water and urban drainage, hydrological and meteorological monitoring, management of sewage treatment, technical provisions for traffic and public transport as well as management of all harbors.
Ministry of Regional Development	Responsible for the development of rural areas and the provision services outside Paramaribo. Duties in each of the ten districts are managed by district admirations, headed by District Commissioners

5. Environmental and Social Baseline Conditions

5.1 Environmental Baseline Information and Data

5.1.1 Climate

According to the Köppen classification, Suriname has three climate types, namely monsoon climate, tropical rainforest climate and a humid and dry climate. The typically warm and moist tropical climate in Suriname, is generally controlled by the bi-annual passage of the Inter –Tropical Convergence Zone (ITCZ); firstly, during the period December to February (known as the short wet season), and secondly, during the months of May – mid August (long wet season). The periods in between are the short dry season (February to the end of April) and the long dry season (middle of August to the beginning of December). It has been observed that at times the start of the rainy seasons is delayed, or it might rain considerably more in some years than others.
Furthermore, in some years the dry seasons may be warmer than normal, while in other years the dry seasons may be cooler than normal. An example of an exceptionally wet year is 2006, when due to large amounts of rainfall significant areas along the upstream of rivers were inundated. However, it was also noted that such an event seems to re-occur every 25-75 years[13]. Additionally, the surface conditions, such as the abundance of rivers and swamps and the presence of well-developed vegetation cover that produces substantial amounts of water vapor also contribute to the relatively high precipitation in the country[14].

a. Temperature

The mean air temperature is 25-27.5°C throughout the year in the north part of the country, and at around 23-25°C in the southern regions. The average daily temperature in the coastal region is 27 °C. January is the coldest month (average 26 °C) and September and October are the hottest months (average 31°C). The mean annual temperature in Paramaribo is 27.1° C (1901-1980). The daily maximum temperature is 30.5° C and the average daily minimum temperature is 22.8° C (Table 14).

Since 1960, the mean annual temperature in Suriname has increased by 0.2˚C, an average rate of 0.05˚C per decade. Various global climate models (GCMs) indicate that the temperature in Suriname will rise by about 2.6˚C to 3.5˚C by 2080[15]. In the coastal zone of Suriname, temperature observations over the past 47 years, have shown an increase of approximately 0.016 degrees per year on average

[13] Brinke, W. & Botterweg, J. 2006. Overstromingen in Suriname 2006: Oorzaken, herhalingskansen en preventiemaatregelen. Rijkswaterstaat Ministerie van Verkeer en Waterstaat.
[14] Urritia, Rocio B. 2008. Assessment of the 21st century climate change projections in tropical South America and the tropical Andes, Master thesis. University of Massachusetts Amherst.
[15] Dasai, M. Nurmohamed, R. 2013. Aanpassing van de dakconstructie van gebouwen in Suriname nu en bij klimaatverandering. Academic Journal of Suriname, 408-419.

(Meteorological station Cultuurtuin), while in the hinterland no significant trends in temperature change have been observed (Meteorological station Zanderij).

Table 14: Monthly *average rainfall between 2013 and 2017*[16]

Month / Year	2013	2014	2015	2016	2017
January	27.5	26.7	26.9	27.6	27.0
February	26.8	26.7	27.1	27.1	27.1
March	27.5	27.2	27.1	27.8	27.4
April	27.2	27.6	27.4	27.7	28.2
May	27.0	27.8	27.1	27.6	27.5
June	27.4	27.2	27.0	27.3	28.0
July	27.5	27.6	27.6	28.0	28.0
August	27.9	28.1	28.5	29.0	29.4
September	28.5	29.1	29.3	29.3	29.1
October	28.1	29.2	29.6	29.8	28.9
November	27.6	28.0	29.0	29.4	28.3
December	26.9	27.3	27.3	27.3	27.3

b. Relative humidity

In the coastal regions the air humidity on daily average is as high as 80-90 percent. In the central and southern regions of the country, daily air humidity decreases and averages about 75 percent. In the forest tracts air humidity depends, among others, on the penetration of sun radiation. Variation of relative air humidity in forest tracts lies within the limits of 70-100 percent and between 50-100 percent in open areas. The highest humidity values are recorded from May to July and the lowest from September to November[17].

c. Wind

In general, the wind in Suriname is weak; annual averages of about 1.3-1.6 on the scale of Beaufort (or 1-5m/s). The daily wind speed variation is higher and can reach up to 3-4 Beaufort (3- 8m/s). The mean wind speed is 1.3 Beaufort. Maximum mean wind speeds occur during the dry seasons attaining 1.6 Beaufort in February-April with a second peak in September and October. Minimum mean wind speeds of 1.0 Beaufort occur in January. Calm winds, i.e. winds with hourly average speeds less than 0.5 m/s, are very frequent. During the night and early morning, it is usually calm. Wind speeds of 20-

[16] Data retrieved from: ABS, 2018. Environmental Statistics
[17] National Coordination Centre for Disaster Relief. 2017. Disaster Risk Reduction Country Document for Suriname 2014

30 m/s have been occasionally recorded during thunderstorms, but only for a very short period and near the end of the rainy seasons (locally known as 'sibibusi').

Suriname is free of hurricanes. In the coastal zone wind speeds are usually higher than further inland. Measurement data from the Meteorological Service Suriname (MDS) for the period 1981-1990 shows that the average monthly wind speed in Suriname is approximately between 0.7 and 2.8 m/s, with maximums of about 5.4 m/s along the coast. Northern Suriname has a northeast to southeast wind direction, with the first dominating in the February-April and the latter during the July-September period. The other months show directions mostly ranging between northeast and southeast. At the coast the wind speed is 3-4 Beaufort during the day, becoming gradually weak to calm during the nocturnal hours in the interior.

d. Rainfall

One of the principal parameters of climatology is rainfall. For Suriname this is essential since the distribution of the four seasons is based upon rainfall. The country experiences two rain seasons: a major rain season when most of the country receives 250-400mm per month between May and July, and a minor rain season bringing around 150-200mm per month in November to January (Table 15).

Table 15: Monthly average rainfall between 2013 and 2017[18]

Month / Year	2013	2014	2015	2016	2017
January	120.8	140.1	178.8	46.8	201.6
February	329.3	211.6	141.1	158.0	214.8
March	145.8	91.7	234.7	137.3	262.4
April	253.0	183.5	197.1	269.5	206.4
May	333.4	211.4	339.3	302.0	268.4
June	176.9	271.1	250.5	201.8	251.1
July	181.2	182.2	174.2	156.4	228.2
August	171.5	118.9	102.8	110.7	46.6
September	60.5	40.8	24.7	86.2	73.8
October	76.9	38.3	9.7	37.9	50.3
November	101.8	61.4	57.4	39.8	68.7
December	171.7	131.6	119.4	152.9	178.8

Average annual rainfall was 2018 mm at Kwatta and 2186 mm at Groningen in the period between 2009 and 2014, compared to a long-term annual average of 2233 mm at Groningen and 2248 mm at Cultuurtuin, with a peak in May to July. Most areas can expect a monthly rainfall total of at least 200

[18] Data retrieved from: ABS, 2018 Environmental Statistics

mm and the wettest month for Suriname is May, with a monthly average value of about 325 mm. The long dry season commences at the middle of August and ends at the beginning of December. The driest months are normally September and October, often with a monthly average total of less than 100 mm a month. The rainfall average over the Central highlands, the interior and some parts of the coastal area record even less than 50 mm per month.

Inter-annual variations in climate in this region are caused by the El Niño Southern Oscillation (ENSO), which occurs once every 2-7 years. El Niño episodes bring drier conditions throughout the year, and bring warmer temperatures between June and August, whilst La Niña episodes bring wetter conditions throughout the year and cooler temperatures between June and August[19].

e. Air Quality

In general, the air quality in Suriname deteriorates during dry conditions and improves during the wet season. During rainy seasons, rain suppresses dust particles in the atmosphere and alleviates air pollution. Dust emissions are further reduced by damp soil conditions. During the dry season, dust emissions generally increase as the soils become desiccated.

5.1.2 Geology, Geomorphology and Topography

a. Topography

Suriname is divided in two main physiographic provinces namely the Precambrian Shield and the Coastal Plain or Basin, with different characteristics. They are both associated to different types of topography and geology. These affect the availability of surface and ground water in different ways.

The coastal plain or the northern portion of Suriname, comprising about 20% of the country, is composed of unconsolidated sedimentary formations from Cretaceous to Recent age. It extends inland about 40 km in the east and 140 km in the west. From the Precambrian shield to the sea, it can be subdivided into three landscapes from north to south:

- Young Coastal Plain
- Old Coastal Plain
- Savannah Belt

The Young Coastal plain has low-lying swamps and marshes interrupted by low lying east-west ridges; the elevation is mostly below 5 meters. The southern swamps are often deep swamps with a thick peat layer.

[19] UNDP Climate Change Country Profile

Polder areas have been established in the western Young Coastal plain south of Nickerie and west of Paramaribo along the Saramacca canal.

The Old Coastal plain is formed of coastal deposits formed during the Pleistocene interglacial period when the sea level was higher. Substantial erosion of the area took place during the last ice age with the lower parts now filled with clay and pegasse deposits. Elevations range from 1 to 12 meters. The Old Coastal plain is made up of the three distinct landforms; the Lelydorp landscape formed of infilled ridges, valleys and creeks; the Para landscape formed of infilled mud banks and gullies; and the Mara landscape formed of swampy areas covered with marine clays and/or pegasse.

The Savannah area is formed of Tertiary deposits brought down from the southern mountains. The deposits slope in a northerly direction and underlie the more recent Coastal deposits. The topography is flat with deeply incised creeks west of the Nickerie River with a more undulating landscape to the east. Elevations range from 10 to 100 meters.
The drainage pattern is not dense in the Coastal Plain. But there are some indications such that the drainage pattern in the Savannah and Old Coastal Plains has been affected by the underlining tectonic structure which affected the underlying Precambrian rock. The Savannah Belt presents an incised drainage pattern. It is less dense in the Old Coastal Plain and incipient in the Young Coastal Plain which was originally a swampy area, now being drained by a drainage system involving an important canal system.

The Precambrian shield is formed of hard igneous and metamorphic rocks comprising about 80% of the country. It is characterized by a series of step like planation or eroded plain surfaces. Higher areas are formed by erosion resistant bauxite or lateritic surfaces which have formed an erosion resistant surface. Some higher areas are inselbergs formed by outcrops of the underlying rocks. Much of the area lies below 250 meters in elevation with areas towards the border with Brazil rising to 500 meters. High areas generally do not exceed 750 meters, but there are a few peaks that rise above 1,000 m. The drainage pattern is associated to the structural lineation. This lineation, which may be associated to faults and/or joint systems, were caused by tectonic movements. This physiographical province is mostly covered by forest and scarcely populated. But some concentrated villages are installed along main rivers.

b. Geology

General Overview

Suriname is subdivided into a crystalline basement and a coastal plain. The basement area covers more than 80% of the country and forms part of the Guyana Shield, which stretches between the Orinoco and the Amazon rivers and includes eastern Venezuela, Guyana, Suriname, French Guyana, and northern Brazil. The crystalline basement is formed principally of igneous and metamorphic rocks, while the coastal plain, which stretches along the northern fringe of the shield area, is formed exclusively of sedimentary rocks.

The coastal plain is underlain by sedimentary rocks laid down since the Cretaceous era and forms the Corantijn Group. The Corantijn Group consists of rock units of the coastal plain. The sediments form a regular alternation of sands, clays, siltstones and minor shales.

The coastal basin contains an abundance of ground water under artesian conditions with water levels close to the ground surface. There are a few aquifers which are interconnected. This is the area of the project.
In the south under the Savannah and old coastal plain, the aquifers are directly recharged by rainfall.
In the north under the Young Coastal Plain the ground water system is essentially static with ground water ages ranging from 13,000 to 20,000 before present (BP). In some areas saltwater intrusion is affecting the groundwater quality.

Precambrian

The Precambrian Shield is underlain by hard rock of Precambrian age such as highly metamorphosed gneisses, charnokites and granulites (about 2,600 million years old), granites, metasediments and metavolcanics (1,810 million years old), reddish sandstones (1,600 million years old), gabbroic and doleritic sills and dikes (1,500 to 1,800 million years old). The metamorphosis process destroyed the primary porosity of the forming geological units, but some of these rocks are considered as very competent which means that they will easily break if structural forces are applied, which is what happened in this case.

Some younger doleritic narrow dikes were induced in a tectonic movement (227 million years old) through the Precambrian rocks. They are of the Triassic period but on a lithological point of view they are associated to the Precambrian rocks.
Different phases of tectonic movements have affected the structural integrity of some of these rocks at different times giving birth to systems of grabben, faults, joints, etc. These tectonic structures affected the surface water drainage pattern and may ease the movement of groundwater through a permeable system of fractures. Also, the Precambrian rocks are deeply weathered. Weathering can reach a maximum depth of 70 meters but are normally in the order of 15 to 30 meters for basic rocks and metasediments, and up to 16 m in granites. The weathering portion may act as a sponge and may be of interest if associated with an underlying linear structure such as a fault or joint system.

Sedimentary Formations

The sedimentary formations underlying the Coastal Plain and continuing offshore, and overlying the Precambrian rocks are composed of an alternation of very fine to coarse sediments such as clay, silt, fine sands and coarse sands still having their primary porosity and filled with water. The permeability of these formations is greatly affected by their granulometry and density, when the pore water salinity relates to the environment of deposition.

The sediment thickness starts from 0 m at the fringe of the Savannah up to an average of 2,000 m along the seashore. They are thicker offshore. In fact, all constituting units seems to dip, from the

Savannah Belt, in a North-West direction and their thickness seems also to increase in that direction, i.e. in the direction of Nickerie. Also, an interpreted down-fault may explain some sudden fall of the basement rock.
Through time and location, these sediments were deposited in different types of environment which affected their lithology and water content. Some were deposited in a marine environment, involving more fine material, which means less permeable but also brackish water as pore content. At some distance inland, or at a different depth, some others were deposited in a lagoon marked by strong evaporation involving sands with brackish water as pore content. Some were deposited in an inland site with at that moment a large fresh groundwater movement from the Precambrian Shield to the sea. Some units were also deposited on the seashore and have filled up older indented creeks or rivers. So, their thicknesses vary greatly without any indication from the surface, as for the salt content of the groundwater present in the pore system.

The geological setting can be summarized as follows from the bottom or the contact over the Precambrian rocks to the surface or from the older to the younger formation (Figure 8):

- Nickerie Formation of Late Cretaceous age.
- Lower Onverdacht Formation of Paleocene age.
- Upper Onverdacht Formation of Eocene age.
- A Sand Formation of Oligocene age.
- Coesewijne Formation of Miocene age.
- Zanderij Formation of Pliocene age.
- Coropina Formation of Pleistocene age.
- Demerara Formation of Holocene or recent age.

Nickerie Formation

The oldest sediment known in the Coastal Basin is the Nickerie Formation overlying the basement or Precambrian rock. It consists of a kaolinitic sand formation with gravel and multicolored shale (hard clay). The granular portion is coarser in some areas consisting of kaolinitic gravel and sand, calcareous with shells. This formation is found under the Young Coastal Basin and offshore but absent under the Older Coastal Basin as it is truncated by the rising basement rock. This unit has not been explored for groundwater as it is deep, but indices from oil exploration boreholes suggest that the pore water might be brackish. In the Nickerie area its top is met at about 600 m.

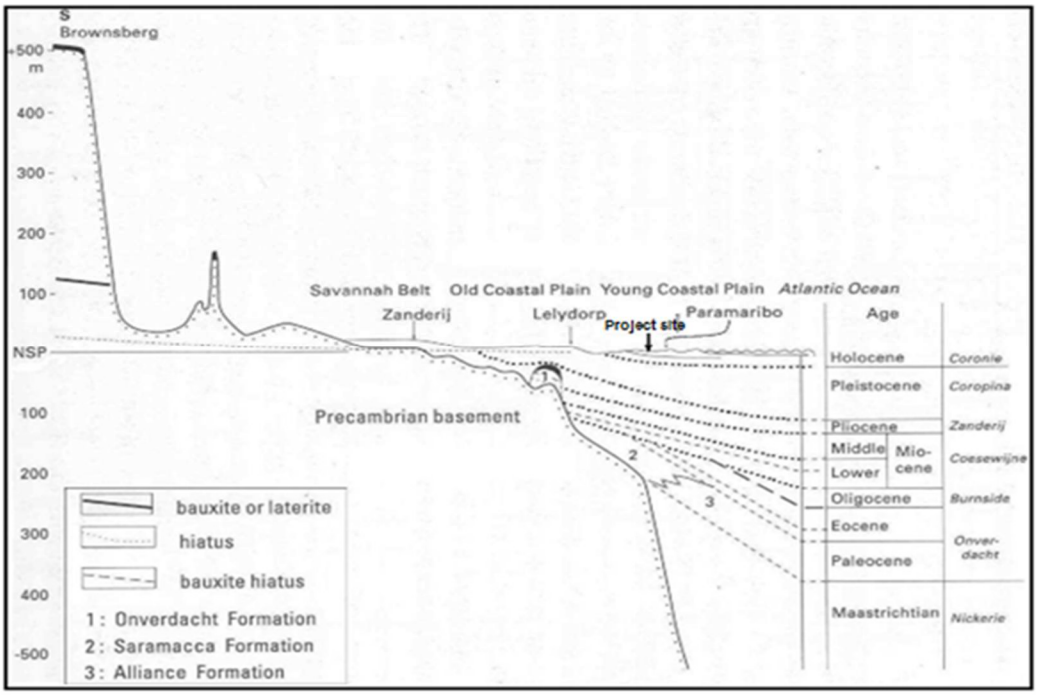

Figure 7: Geological cross section through northern Suriname[20]

Onverdacht Formation

The Lower Onverdacht Formation is composed of sediments going from coarse to fine grained sand with thin layers of kaolin or kaolinitic swamp clay to sandy clays and clayey sands. Its sedimentation probably occurred in lagoon conditions with very high salinity.

The Upper Onverdacht Formation corresponds to a bauxite belt, near the savannah belt being presently exploited, so cropping out there. It is underlain by a thick layer of kaolin followed by kaolinitic sands, becoming coarser toward the base.
In the Young Coastal area, the Onverdacht Formation is met deeper, being down faulted from the Bauxite Belt and is thicker than in the Savannah area. The top is at a depth of 150 to 200 m in the east and 400 to 450 in the west. They are lightly cemented in the Nickerie area.

A-Sand Formation

The A-Sand formation is composed mainly of more or less kaolinitic coarse-grained angular quartz sand with granulometry varying from fine to medium-grained sand to fine rounded quartz gravel, with occasional interbedded clay layers present in some places. The upper contact is quite regular, dipping

[20] Retrieved and modified from: Noordam & Teunissen (2009). Sediments and Geomorhology Baseline Study for SurinameRiver Dredging Project, in: SRK (2010). Environmental Impact Assessment for the Staatsolie Refinery Expansion Project Final Environmental Impact Assessment Report Volume 1 (Appendix C)

gently toward the North. It normally coincides to a contact with an overlying stiff grey clay. But locally, as in the Livorno area, the A-Sand is in direct contact with the overlying Coesewijne Formation. The lower contact is irregular and consists of the Onverdacht kaolinitic sands. The formation does not crop out but may get some recharge through the Coesewijne sand, where they are in direct contact. It thins inland and ends against the rising basement. In the Paramaribo area, it also thins east of the Suriname River, which is east of the Meerzorg area.

The A-Sand thickness and depth vary geographically. In the western side of the coastal area, it is about 80 m thick and begins at a depth of about 350 m. North of Paramaribo, it is about 50 m thick and begins at 180 m. It may be thicker where the deposition occurred on eroded valleys like those located west of Paramaribo.

Coesewijne Formation

The Coesewijne Formation consists of clay and sandy clay, with interbedded sands. These sands are normally less than 10 m thick. They count for a maximum of 60% of the thickness and normally between 20 and 50% of the formation and are more abundant in the upper part. The sand is medium to coarse grained and poorly sorted, generally with significant clay content.

That formation may have been deposited as deltas, possibly corresponding to early forms of the present rivers (Saramacca and Suriname).

Zanderij Formation

The Zanderij Formation may have been deposited in a coastal environment. It is composed of merely coarse angular quartz sand, more or less kaolinitic, with interbedded clays. There are two main facies, lower clayey facie, just over the Coesewijne Formation, and upper sandy facie. In the Paramaribo area, it is mainly composed of coarse sands and meets at a depth interval between 35 and 90 m. In the Nickerie area it is mainly composed of medium to coarse sands and meets between 50 and 200 m. At Rijsdijk, where it is composed of coarse and fine sand plus clayey sand, it is encountered at depths between 15 m in the south and 30 m in the north. Its thickness is irregular and more important where infilling buried valleys in the Coesewijne Formation. It crops out in the Savannah area.

Coropina Formation

The Coropina Formation is composed of a mix of clays with interbedded sands and sandy clay layers. It crops out in the area of the Old Coastal Plain and continues northward beneath the Demerara clay.

Demerara Formation

The top formation met in the Young Coastal Plain is the Demerara Formation composed of clay with some sand ridge along the coast.

c. Soil

All the pump stations studied in this assessment are located at the Young Coastal Plain in an area classified as Kwatta Landscape, consisting of ridge soils with sand and shells.

Figure 8: Overview of soils in the young coastal plain

5.1.3 Hydrology

a. Surface Water

The main waterways near the study area are the Saramacca River, Coesewijne swamp, the Coppename River within the Saramacca District, and the Suriname River and the Saramacca canal within the Wanica District. Other canals include the Tout Lui Faut canal and the Magenta canal. The Suriname river and the Saramacca canal are the main waterways important for domestic shipping and water management.

The Saramacca River

The Saramacca River is the main river flowing south of the study area within the Saramacca District. The Saramacca River finds its sources in the central highlands of Suriname. In the Young Coastal Plain, it flows from a northwesterly to a westerly direction and finally discharges into the Atlantic Ocean via the estuary of the Coppename River. The catchment area is about 9,000 km2. The lower part of the river is affected by the tidal regime of the Atlantic Ocean. Rice polders and human settlements occupy this part of the catchment. The drainage systems of the polders and settlements mainly discharge into

this river. On both sides of the lower Saramacca river rice is intensively cultivated where swamps are also located. The semi-diurnal movement of the Atlantic seawater mainly determines the water level in the estuary of the river. During the dry seasons, especially during the long dry season, seawater penetrates far into the river. In these periods the tidal effect reaches more than 240 km upstream. The range of the water level at station Carl Francois varies between +208 and –104 cm NSP[21].

Saramacca River Water Quality

Data reviewed from a study[22] done by Noordam in 2018 revealed that the pH in the Saramacca River is slightly acidic, while salinity is very low. Although increased levels in pH and EC have been measured in the long dry season, EC measurements were not above 1 mS. Thus, no indication of salt intrusion from the ocean was observed. Dissolved Oxygen is moderate with values of 5.5 mg/L. In both the rainy and dry season elevated levels of barium, zinc and diazinon were found in the Saramacca River adjacent to the Tambaredjo Polder. The same levels of barium and diazinon have also been measured in the Suriname and Coppename Rivers, with 6-12 µg/L barium and 0.3-0.7 µg/L diazinon. The fact that the Coppename River is considered an unpolluted river, it is stated that the elevated concentrations of barium and zinc represent natural background levels in these rivers. The diazinon levels in the canal are also considered to represent natural background levels, as they are in the same range as found in the rivers. However, the barium concentration in the canal exceeds the natural river levels which points to pollution. Also elevated levels for toluene and Total Petroleum Hydrocarbon measured in the rainy season are likely the result of an oil spill or leakage.

The Coesewijne Swamp

The Coesewijne swamp is situated south west of the study area and covers a major part of the Saramacca district. The Coesewijne swamp includes the lower Coesewijne River catchment and part of the area between the Coppename River and the Coesewijne River. The borders of the swamp are to the north and east the watershed of Coesewijne and Saramacca rivers, to the south the Tibiti river and the Old Coastal Plain and in the west the Coppename River. The Coesewijne swamp finds its sources in the Zanderij formation, the Old Coastal Plain and flows through the Coesewijne swamp area in a south to north direction. In the Young Coastal Plain, it flows from a northwesterly to a westerly direction and finally discharges into the Coppename River. The tidal influence penetrates far high up the river, about 20-25 km upstream the hydrometric station Grote Borfelt. The catchment area of the swamp is about 1,100 km^2. Depending on its water level the area of the swamp may extend over 800-900 km^2 during the rainy season when large areas are inundated. In the dry season however, the area of the swamp may reduce drastically. The runoff value depends mainly on two factors: rainfall and groundwater flow (from the Zanderij formation). The latter is the main source during the dry seasons. The swamp is a potential source of fresh irrigation water. Inflows to the swamp are a result of direct

[21] Amatali and Naipal. 1999. Water Resources Technical Report Climate Change Country Profile
[22] Noordam (2018a) Staatsolie Saramacca Power Plant ESIA. Baseline study and Impact assessment water quality

rainfall and groundwater flow from the Savannah area with the latter being the main source during the dry season.

The Coppename River

The Coppename River lies extremity west from the study area. The river finds its sources in the central highland of the Wilhelmina Mountains and flows from south to north into the Atlantic Ocean. The catchment area is about 21,700 km2. On both sides of the river there are large swamp areas namely, the Coronie swamp on the left side and the Coesewijne swamp on the right side. The semi-diurnal movement of the Atlantic seawater mainly determines the water level in the river estuary. During the dry seasons, especially during the long dry season, seawater penetrates far up the river. The range of the water level at station Boskamp varies between +293 to – 131 cm NSP[23].

The Suriname River

The Suriname River flows at the east of the study area in the Wanica District. The river finds its sources mainly in the Eilerts de Haan mountain range and to a lesser extent in the Van Asch van Wijck and the Wilhelmina Mountains. In the Young Coastal Plain the Suriname River meanders and causes erosion processes at certain locations and finally discharges into the Atlantic Ocean. The area of the catchment is about 16,500 km2. The semi-diurnal tidal movement of the Atlantic Ocean mainly determines the water level in the river estuary. During long dry season, seawater penetrates far up the river and the tidal effect reaches to Berg en Dal, which is about 164 km upstream from the outfall.

Suriname River Water Quality

Water quality sampling results[24] available from the Suriname River Dredging Project in 2019 revealed that electrical conductivity decreases upstream. Maximum concentrations of 38,000 µS/cm are recorded at the mouth of the Suriname River, with concentrations decreasing to 33 µS/cm. This is due to the salinity of sea water and the influence of tidal effects close to the mouth of the Suriname River.

The water quality samples are dominated by the presence of sodium, potassium and chloride. although some locations have more variable calcium concentrations. Chloride concentrations are variable but show a clear decrease upstream, ranging from a maximum of 1800 mg/L near the bridge to a minimum of 3.1 mg/L at Domburg. Concentrations of dissolved iron at the Paramaribo and Dijkveld bank, dissolved lead and dissolved copper both at the confluence of the Suriname River and Commewijne River have exceeded the United States Environmental Protection Agency (USEPA) National Recommended Water Quality Criteria (2006) for Saltwater and Freshwater. In addition, concentrations

[23] Amatali and Naipal .1999. Water Resources Technical Report Climate Change Country Profile
[24] SRK Consulting. 2000. Water and sediment quality study update for the proposed Suriname River dredging project

of total zinc, total lead, nitrate, total copper and total chromium have exceeded the Australian and New Zealand Environment and Conservation Council (ANZECC) Fresh and Marine Water Quality Guidelines (2000).

The Saramacca Canal

The Saramacca canal lies south of the study area in the Wanica district. The connection between the Suriname River and the Saramacca River via the Saramacca Canal makes transport through the built-in internal transit route possible. Moreover, the canal provides drainage of areas on both sides, but is not able to adequately drain all areas within Paramaribo, Wanica and Saramacca. Flooding occurs in all resorts during the rainy season[25]. To reduce flood risks, the recently approved Saramacca Canal System Rehabilitation Project will improve the critical drainage infrastructure in the Saramacca Canal to better drain water, as well as other targeted secondary and tertiary systems.

b. Groundwater

The coastal plain of Suriname including the study area is underlain by three major aquifers (A-sand, Coesewijne and Zanderij) within the Corantijn Group. Groundwater in the study area is abstracted from the Coesewijne aquifer (Groningen, Kampong Baroe and Tijgerkreek pumping stations in the Saramacca district) and the A-zand aquifer (Helena Christina pumping station).

The **Helena Christina pumping station** has eight wells abstracting groundwater from the A-Sand aquifer at a depth of about 120 to 150 meters. The total average yield is 480 m^3/hr, each well with an average of 60 m^3/hr.

At the **Tijgerkreek pumping station** there are five wells, but only four are in operation. The production capacity is 280 m_3 / h. The wells exploit groundwater from the Coesewijne aquifer with a depth ranging from 125 to 150 m.

The **Groningen pumping station** consists of four wells each with depth of 155 m and a total capacity of ± 120 m3 / h.

The **Kampong Baroe pumping station** consists of four wells as well, but currently three are operational with a total capacity of ± 80 m3 / h.

[25] Stichting Planbureau Suriname. 2014. Structuuranalyse Districten 2009-2013

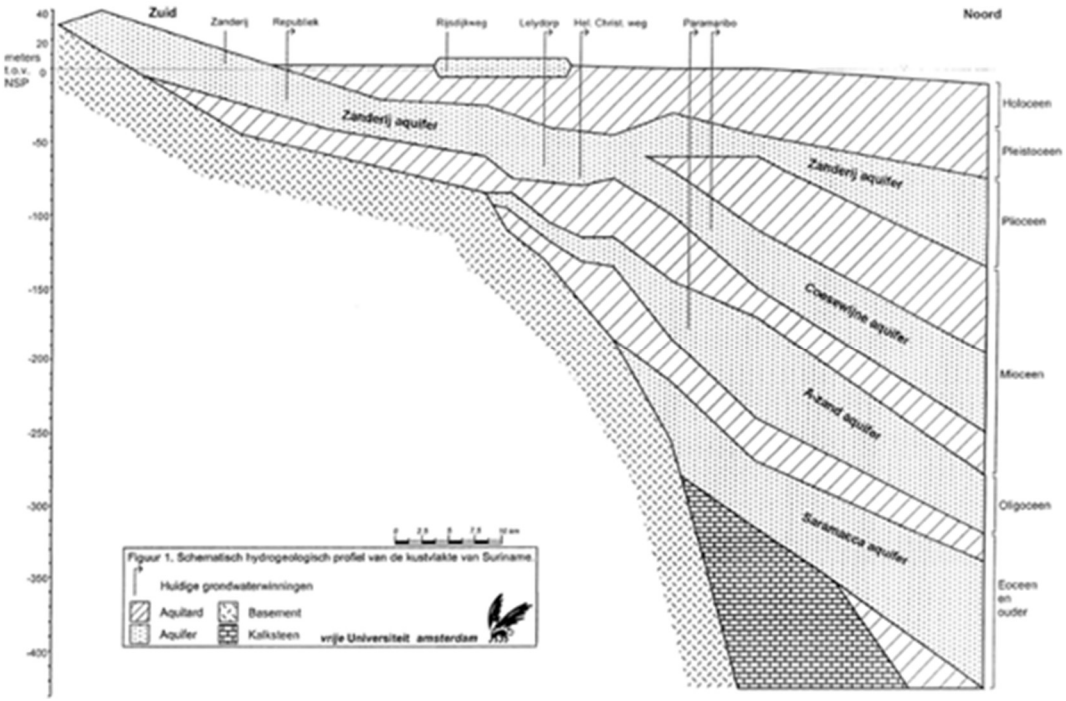

Figure 9: North- south hydro-geological profile of the coastal plain[26]

The A-sand Aquifer

The A-sand aquifer (in the Burnside Formation) at an approximate depth of 150m, contains freshwater in areas south of Paramaribo, bordered by the line Pont Buiten - Livorno - Lelydorp - Helena Christina - Koewarasan - Pont Buiten[27]. The aquifer increases in depth from 128 m to 180 m, roughly from south to north (Helena Christina to Tourtonne pumping stations). The thickness varies from 20 to 50 m. The coarse sands of the Oligocene Burnside Formation form a well-defined and interconnected unit of coarse sands and have good aquifer properties. Sand content varies between 60 to 85%. Also, in some parts along the coastal east-west road in Saramacca district the formation holds fresh groundwater (Burnside is absent south of the east-west road)[28]. In Paramaribo, the formation is being overexploited as can be observed in the rising salinities and large drawdowns of hydraulic heads. In Wanica there is still scope for additional development. The A-Sand aquifer is not directly recharged by rainwater, and it is suspected that upward leakage of groundwater from the older, underlying formation is likely. Groundwater in this formation is recovered by several pumping stations in Paramaribo for drinking water supply (WKPlein, Livorno, Leysweg, Tourtonne, Blauwgrond, Flora, Meerzorg), Uitkijk (Saramacca), Helena Christina (Wanica), Meerzorg (Commewijne), and Wageningen (Nickerie) [8].

[26] Suriname Water Resources Information System Suriname. http://www.swris.sr/
[27] Groen, K. 2006. Bescherming en beheer van grondwater in Suriname. Acacia Institute
[28] RTI International, 2016. Hydrogeological Assessment of the Coastal Aquifers in Suriname

The Coesewijne Aquifer

The Coesewijne aquifer contains freshwater in many locations of the coastal plain, south and west of Paramaribo bordered by the line Paramaribo - Leiding 9a - Groningen - Kampong Baroe - Tijgerkreek-van Hattemweg - Paramaribo. In the Wanica and Saramacca districts, 20 to 60 m thick layers of fresh groundwater are found in the Saramacca formation [8]. Further north, groundwater salinity increases gradually. The top of the aquifer is found at a depth of 65 m at de van Hattemweg and a thickness of 15 m, that increases to 30 m in Paramaribo. The Coesewijne sands are in hydraulic contact with the overlying Zanderij Formation, with groundwater flow in the southern Young Coastal Plain (Helena Christina road – Lelydorp) and diffusion in the northern Young Coastal Plain.

The Zanderij Aquifer

The Zanderij aquifer contains mostly brackish water in the Young Coastal Plain due to natural saltwater intrusion. Therefore, groundwater abstraction north of Lelydorp is unsuitable for drinking water. SWM abstracts groundwater at the pumping stations Republiek, Lelydorp, van Hattemweg, Moengo, Albina, La Vigilantia and previously Helena Christina. At Paramaribo the aquifer is found at depths of about 30-50 m. The Zanderij Formation is in hydraulic contact with the sandy deposits of the Coropina Formation (Lelydorp Deposits) south of Lelydorp. Groundwater abstraction at La Vigilania, Republiek and also Albina, Moengo, may be at risk, because the Zanderij aquifer in these areas is fairly shallow and almost reaches surface area. In 2001, total dissolved solids of the upper Zanderij aquifer was reported[29] to be of 1,265 to 1,843 mg/l at the nearby Koewarasan station, which is considered too saline for human consumption. Because of its local salinity, the Zanderij aquifer should not be considered as an option for further groundwater development. An exception to this statement would be for sites further south, where the salinity may be acceptable.

c. Groundwater Quality

Helena Christina Station

Low **chloride** concentrations with average values of 67 mg/l in raw water and 62 mg/l in potable water are observed in data obtained from SWM laboratory. Total **iron** and **ammonium** in raw water have an average of 4.8 and 0.93 mg/l respectively and both are reduced to an average of 0.11 and 0.21 mg/l respectively in potable water. However, **manganese** in raw water has average values of 0.2 mg/l compared to 0.25 mg/l in potable water. In addition, the manganese values are exceeding the SWM target value of ≤ 0.10 mg/l.

The average concentration of **sulphate** increases from of 60.9 mg/l (ranging from 38.53 to 102.74) in raw water to 84.78 mg/l (ranging from 75.42 to 94.14 mg/l) in potable water. It is not clear what the reason is.

[29] U. S. Army Corps of Engineers, 2001. Water resources assessment of Suriname

Table 16: Raw water and potable water quality from pumping station Helena Christina

SWM target value	≤ 250	≤ 0,10	0,50	≤ 50,0	≤ 250	≤ 0,10
	Cl- in mg/l	Mn in mg/l	NH4+ in mg/l	NO2- in mg/l	SO4 in mg/l	Totaal Fe in mg/l
	Raw water					
mean	**66.62**	**0.20**	**0.93**	**<0.05**	**60.89**	**4.78**
min	55	0.16	0.81	<0.05	38.53	4.36
max	83	0.24	1.04	<0.05	102.74	5.26
	Potable water					
mean	**62**	**0.25**	**0.21**	**<0.05**	**84.78**	**0.11**
min	60	0.1	0.21	<0.05	75.42	0.07
max	64	1.08	0.21	<0.05	94.14	0.14

Raw water includes water from wells and collection pipe at the station

Current treatment process. Groundwater is pumped into 3 sand filters to reduce mainly ammonia and iron. From the filters the water goes into 2 aeration tanks to remove CO_2 and to oxygenize the water. Hereafter, the water is stored in the storage tank from where it is distributed to the consumers.

Tijgerkreek (Peperhol) Station

High values of **ammonium** are measured in both raw water and potable water with average values of 5.22 mg/l and 3.13 mg/l respectively. Compared to the SWM target value of 0.50 mg/l, the ammonium concentration is exceeded. The ammonium value of 0.6 mg/l measured in potable water (PSTG-RW01MP01) significantly differs from the remaining four (4) values ranging from 2.05 to 4.78 mg/l with an average of 3.13 mg/l. It is doubted if this value is correct.

Manganese concentrations of 0.25 mg/l on average were observed in both raw water and potable water. These values exceed the SWM target value of ≤ 0.10 for manganese. There is a significant difference between three of the nitrate values in raw water with an average of 14.53 mg/l and the remaining ten values of <0.05 mg/l measured in the period January to July 2019. All three concentrations are dated from 10 April 19. It is possible that these measurements are incorrect,

because the average nitrate values measured in potable water better matches the remaining ten values of <0.05 mg/l in raw water.

Sulphate values in raw water range from 98.35 to 207.07 mg/l with an average of 127.99 mg/l. In potable water, sulphate values range from 103.13 to 152.56 with an average of 121.35 mg/l, which is below the SWM target value. It is doubted if the high sulphate value of 207.07 mg/l in raw water is correct, because it significantly differs from the remaining values.

Table 17: Raw water and potable water quality at pumping station Tijgerkreek

SWM target value	≤ 250	≤ 0,10	0,50	≤ 50,0	≤ 250	≤ 0,10
	Cl- in mg/l	Mn in mg/l	NH4+ in mg/l	NO2- in mg/l	SO4 in mg/l	Total Fe in mg/l
Raw water						
mean	**121.69**	**0.25**	**5.22**	**14.53**	**127.99**	**0.09**
min	112	0.22	4.72	13.81	98.35	0.05
max	133	0.28	5.4	15.27	207.07	0.19
Potable water						
mean	**131.2**	**0.25**	**3.13**	**0.19**	**121.34**	**0.10**
min	124	0.16	0.6	0.19	103.13	0.07
max	137	0.44	4.78	0.19	152.56	0.13

Raw water includes water from wells and collection pipe at the station

Current treatments process. Current treatment system consists of aeration and filtration process. Groundwater is pumped into the aeration tank and goes into two sand filters. Filtered water is stored in the storage tank and treated with calcium hypochlorite 65% before it is distributed to the consumers. The filters are backwashed once a day.

Groningen Station

The chloride and iron concentrations, respectively 99 mg/l and 0.08 mg/l on average in potable water represent a good condition. In both raw water and potable water similar concentrations of **sulphate** can be observed with average values of 84.38 mg/l and 83.12 mg/l respectively. It can be concluded that sulphate is not removed from the raw water and is still present is the potable water.

Manganese concentrations with an average of 0.32 mg/l in raw water are reduced to 0.16 mg/l in potable water. The concentration of 0.16 mg/l on average in potable water exceeds the SWM target, although there six of the nine samples are lower than the SWM target value.

Ammonium in raw water reduces with an average of 4.61 mg/l to 1.26 mg/l in potable water. However, the SWM target 0.50 mg/l for ammonium is not met.

Table 18: Raw water and potable water quality at pumping station Groningen

SWM target value	≤ 250	≤ 0,10	0,50	≤ 50,0	≤ 250	≤ 0,10
	Cl- in mg/l	Mn in mg/l	NH4+ in mg/l	NO2- in mg/l	SO4 in mg/l	Total Fe in mg/l
Raw water						
mean	**94.33**	**0.32**	**4.61**	**0.28**	**84.38**	**0.84**
min	79	0.23	4.41	0.28	73.15	0.1
max	123	0.55	4.92	0.28	110.28	1.58
Potable water						
mean	**99**	**0.16**	**1.26**	**<0.05**	**83.12**	**0.08**
min	93	0.07	1	<0.05	79.86	0.07
max	107	0.37	1.51	<0.05	86.41	0.08

Raw water includes water from wells and collection pipe at the station

Current treatment process. Groundwater is pumped into 2 open filters. The filters consist of gravel and sand. After filtration the water is stored in 2 storage tanks, where it is treated with calcium hypochlorite 65% before it is distributed.

Kampong Baroe Station

Data obtained from SWM lab represent **chloride** concentrations of 109 mg/l in raw water and 171 mg/l in potable water on average. However, three of the nine values measured each on separate days (8, 11 and 12 of February 2019) differ significantly 261 mg/l, 275 mg/l (max) and 222 mg/l respectively from the remaining values.

The **manganese** values observed in raw water and potable water respectively 0.31 and 0.29 mg/l on average are both above the SWM target value of ≤ 0.10 mg/l.
From the data can be observed that the **sulphate** concentration of 97.14 mg/l on average in potable water is much higher than in raw water (<0.05 mg/l). However, the concentration of sulphate on average in potable water is still below the SWM target value

Table 19: Raw water and potable water quality at pumping station Kampong Baroe

	Cl- in mg/l	Mn in mg/l	NH4+ in mg/l	NO2- in mg/l	SO4 in mg/l	Total Fe in mg/l
SWM target value	≤ 250	≤ 0,10	0,50	≤ 50,0	≤ 250	≤ 0,10
Raw water						
mean	**109**	**0.31**	**1.90**	**<0.05**	**<0.05**	**3.99**
min	82	0.26	1.88	<0.05	<0.05	3.24
max	133	0.38	1.92	<0.05	<0.05	4.37
Potable water						
mean	**171**	**0.29**	**0.14**	**0.42**	**97.14**	**0.27**
min	120	0.16	<0.03	<0.05	82.88	<0.05
max	**275**	0.36	0.14	0.42	116.94	0.72

Raw water includes water from wells and collection pipe at the station

Current treatment process. Groundwater is pumped into 2 open filters that are filled with gravel and sand. Filtered water is then stored in the storage tank and treated with calcium hypochlorite 65% before it is distributed.

Water Quality Distribution Net Groningen, Kampong Baroe & Tijgerkreek

The mean iron concentration of 0.09 mg/l in the Groningen distribution net is below the SWM target value of 0.1 mg/l for potable water. In Kampong Baroe and Tijgerkreek however, the average concentration of iron of 0.13 mg/l for both areas exceed the SWM target value but is still below the maximum value of 0.3 mg/l for the WHO drinking water quality standards.

It was observed that eight (8) of the 29 samples in the distribution net in Kampong Baroe exceed the SWM target value for iron. Moreover, only three (3) respectively, 0.47 mg/l, 0.31 mg/l and 0.52 mg/l of the 29 samples exceed the WHO drinking water quality standard for iron. In the Tijgerkreek distribution net, only one sample of 0.46 mg/l Fe exceeds the WHO drinking water quality standard.

Table 20: Water quality distribution net Groningen, Kampong Baroe and Tijgerkreek

		Total Fe in mg/l
SWM target value		Max 0.1 mg/l
Distribution net Pumping station Groningen		
	mean	**0.09**
	min	0.05
	max	0.29
Distribution net Pumping station Kampong Baroe		
	mean	**0.13**
	min	0.05
	max	0.52
Distribution net Pumping station Tijgerkreek		
	mean	**0.13**
	min	0.05
	max	0.51

Current treatment process. The water treatment process is the same at all pumping stations: Groundwater extracted from the aquifer is pumped (or sprayed) into a mechanical filter that consist of gravel and sand. By spraying the water into the filter, the water is being oxygenized. Usually the water goes through 2 mechanical filters

5.1.4 Noise

In the absence of specific or absolute noise level limits in Suriname, potential noise from the pumping stations have been evaluated against the noise level guidelines established by the International Finance Corporation. According to the IFC General Environmental Health and Safety Guidelines[30], noise impacts at residential areas should not exceed 55 dBA (LAeq) during the daytime; and 45 dBA (LAeq) during nighttime periods (Table 21).

Table 21: IFC noise levels guidelines

Receptor	One Hour L_{Aeq} (dBA)	
	Daytime	Nighttime
	07:00-22:00	22:00-07:00
Residential; Institutional; Educational	55	45
Industrial; Commercial	70	70

Although no regular noise monitoring program exist within SWM, noise measurements were conducted at least once for each pumping station within the study area (Table 22). However, those measurements were performed in or near the areas of the locations of compressors and pumps. Therefore, the results of those measurements cannot be used as baseline for ambient noise. Noise measurements should be done at the nearest (sensitive) receptors.

Table 22: Results of noise measurements at SWM pumping stations

Pumping station	**Location**	**dB**
Tijgerkreek	Compressor/pumping room	90.5
Groningen	Pumping room	90
Kampong Baroe	Pumping room	89
Helena Christina	Compressor room	92
	Compressor room entrance front door	92
	Entrance door on right side	93
	Entrance door between compressor and boiler room	86

Nonetheless, these SWM noise measurements are good indications that appropriate Personal Protective Equipment (PPE) should be used by any person that enters those areas. That means that areas for use of specific PPE's should be demarcated.

[30] IFC. 2007. General EHS Guidelines

5.1.5 Terrestrial Ecology

a. Wildlife

The natural wildlife at the project locations has disappeared due to the loss of habitat. Only species that are associated with human presence have been observed were birds and reptiles. Figure 10-13 indicate that all locations do have more insect feeding bird species. It is obvious that bird species of more open space areas live in the direct surrounding of the study sites. Also, the areas are quite disturbed and open areas. None of the bird species are of concern to the IUCN red list.

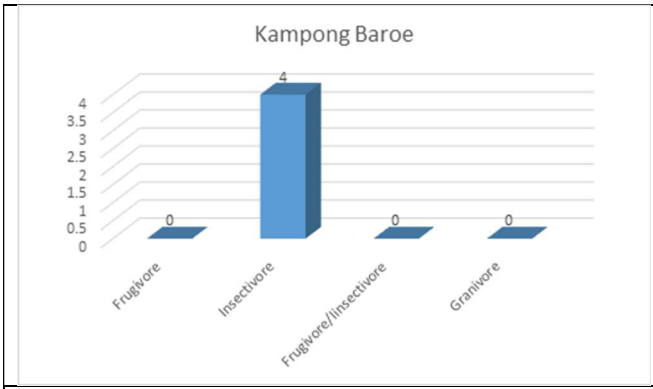

Figure 10: Bird groups found at Kampong Baroe station

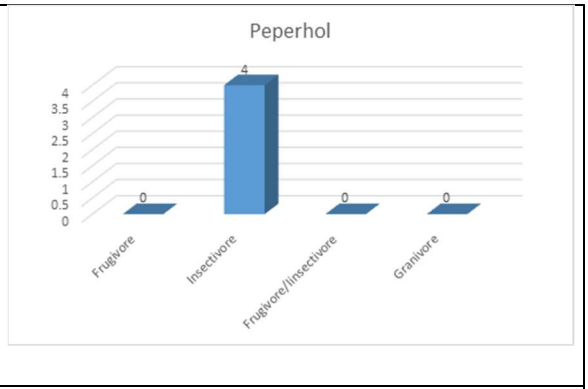

Figure 11: Bird groups found at Tijgerkreek (Peperhol) station

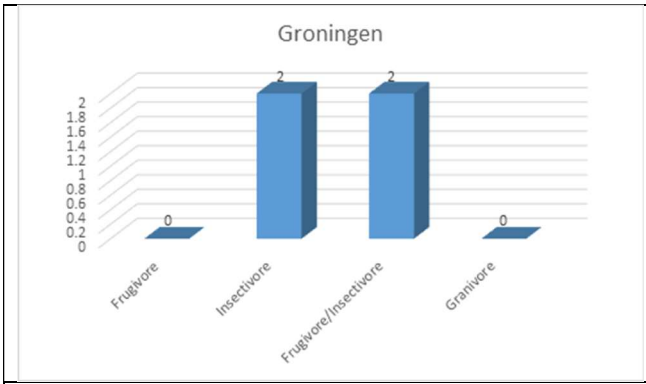

Figure 12: Bird groups *found at Groningen station*

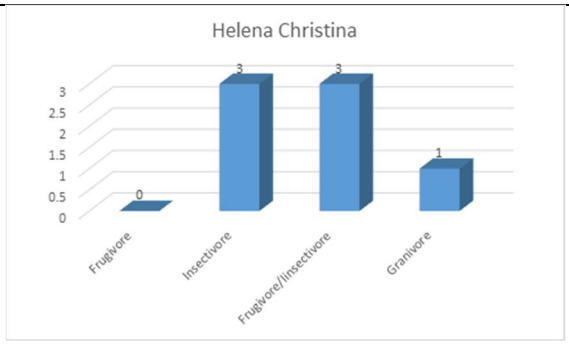

Figure 13: Bird groups found at Helena Christina station

Table 23 provides an overview of the bird species and their habitat preference. The habitat preference classification is according Ottema et al.[31]

[31] Ottema, O.H. RIbot J. and Spaans, A. 2009. Annotated checklist of the Birds of Suriname

Table 23: An overview of all bird species grouped to their habitat of occurrence

Species	Scientific name	Habitat
PSITTACIDAE		
Brown-throated Parakeet	*Aratinga pertinax*	CO, SV, HU
Green-rumped Parrotlet	*Forpus passerinus*	SC, HU
THAMNOPHILIDAE		
Black-crested Antshrike	*Sakesphorus canadensis*	MN, SC, HU, RI
TYRANNIDAE		
Pied Water-Tyrant	*Fluvicola pica*	MN, FW, HU
Tropical Kingbird	*Tyrannus melancholicus*	SV, RI, HU, MN, CO, FO
Great Kiskadee	*Pitangus sulphuratus*	MN, CO, SV, RI, HU
HIRUNDINIDAE		
White-winged Swallow	*Tachycineta albiventer*	MN, CO, SV, RI
Gray-breasted Martin	*Progne chalybea*	MN, CO, FO, SV, RI, HU
MIMIDAE		
Tropical Mockingbird	*Mimus gilvus*	SV, HU
TURDIDAE		
Pale-breasted Thrush	*Turdus leucomelas*	SV, HU
THRAUPIDAE		
Blue-gray Tanager	*Thraupis episcopus*	SV, HU
Palm Tanager	*Thraupis palmarum*	SV, HU
Silver-beaked Tanager	*Ramphocelus carbo*	SC, SV, HU

Legend
CO= coastal brackish lagoons and swamps
FO=forests
FW=freshwater habitats
HU=human altered landscapes
MN=mangroves
RI=riverine habitats
SC=scrub and brush habitats
SV=savannas and airstrips constructed in the interior

No mammal species were found, the locations were open and surrounded by human settlements. Most likely, small rodents and opossums are mammals that might still live in the surroundings of the stations. The Common opossum (*Didelphis marsupialis*) is often found as roadkill and is a good indication of its presence around human settlements. This species is likely present and is of non-concern according to the IUCN red list.

b. Flora

The original vegetation around the pump station was cleared many years ago when subsequent developments took place in the area.
Observations done at the different project areas show that all plants were common species for these vegetation types, and no vulnerable, rare or endangered plant species were recorded. As such, no sensitive ecological areas are found in the study area.
The forest patches that are scarcely found, consist of elements from secondary vegetation with Cecropia trees.

- Around kampong Baroe a few natural growing Cecropia tree species were found, but in its direct surrounding people plant vegetables and fruiting trees, such as: Brede bon/Broodvrucht (*Artocarpus altilis***)**, Nangka/Koa (*Artocarpus heterophyllus*), Pompelmoes (*Citrus maxima*), Pumpkin (*Cucurbita sp*.), Kankong *(Ipomoea aquatica).*
- The only cultivated crops that were found aside the Tijgerkreek Pompstation at Peperhol, were Okra plants (*Abelmoschus esculent).*
- At Groningen, cassava (*Manihot esculenta*) could be found and a few fruiting trees (*Citrus sp*, and Mango).
- Across the location at Helena Christina, fields of Poe/Lauki (*Lagenaria siceraria*) and Bittermelon/Sopropo (*Momordica charantia*) were found.

5.1.6 Natural Disasters

a. Flooding

Suriname is one of the most vulnerable countries in the world to the impact of coastal, fluvial and pluvial floods[32]. Around 30 percent of Suriname is within a few meters above mean sea level and is therefore particularly susceptible to coastal flooding. During rainy seasons, the young coastal plain, characterized by flat low-lying formations of heavy marine clays usually overlain by a peat layer, and elevations around 1 (± 0.5) meter above MSL, is extremely sensitive to inundation resulting from poor drainage conditions. Flooding in the highly populated urban areas exacerbated by high tides occurs

[32] Ministry of Public Works Transportation and Communication. (2017). Paramaribo Strategic Flood Risk Assessment. World Bank, ACP-EU Natural Risk Reduction Program. Washington DC: International Bank for Reconstruction and Development

frequently every year. Severe flooding because of torrential rains also occurs in the less densely populated interior such as experienced in 2006 and 2008.

b. Severe Winds

From 2010 to 2017 occurrences of severe winds in eight (8) district areas including Wanica and Saramacca have been recorded[33]. In Paramaribo (2010, 2012, 2013, 2015 & 2016) and Wanica (2010, 2011, 2012, 2013 & 2015) the highest number of severe winds have been registered. Accordingly, Commewijne (2010, 2014 & 2017) has experienced a number of three occurrences, while Marowijne (2012& 2013) & Nickerie (2012 & 2014) a number of two occurrences have registered. In Coronie (2014), Saramacca (2014) & Para (2015) only one event of severe winds was recorded. The main impacts include torn away roofs/ damaged dwellings, human injuries (with 1 death in 2015) and damaged electric poles. Noteworthy to mention, is that the available data does not indicate which impact(s) occur specifically in a district area.

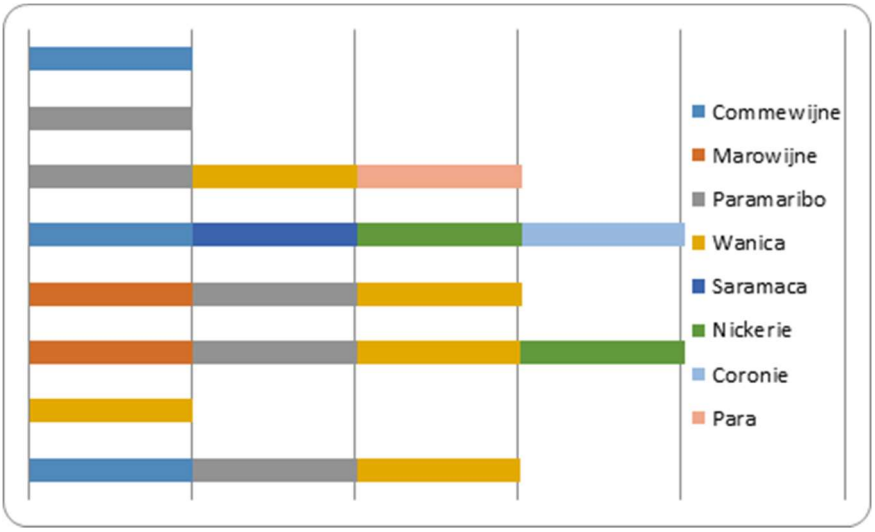

Figure 14: District areas in Suriname affected by severe winds (2010 -2017)[34]

Extreme weather conditions often occur related to El Niño and La Niña events. A connection has been postulated between extremely dry conditions in Suriname and strong El Niño events, as well as between extremely wet conditions in the country with strong La Niña events. Extreme weather conditions are also observed during sibibusi (torrential rain accompanied by strong wind) events, when wind speeds of up to 30m/s occur (over 100 km/hour; 67 mph; 58 knots). Such winds can cause significant damage in urban areas. To date, it is unclear how global climatic circulation affect extreme weather patterns in Suriname. Events such as sibibusis and strong variations in rainfall have not been consistently observed, and therefore no analyses have been produced[35].

[33] Algemeen Bureau voor Statistiek. 2018. 8ste Milieu Statistieken Publicatie. Paramaribo
[34] ABS, 2018. Environmental statistics
[35] Ministry of ATM, 2013

Disaster Risk

Climate change increases Suriname's disaster risks due to frequent occurrence of intensified rainfalls in short time intervals. However, trends in changing rainfall patterns are not clearly observed. Maximum values for 1 and 5-day rainfall events show little consistent change. Projections from Global Climate Models (GCM) are also inconclusive and show that average daily rainfall totals could vary between +40% and –65% by 2090s. Maximum 1-day rainfall totals tend to suggest an increase during the November to January and February to April periods, particularly in the southern parts of the country. Therefore, although uncertainties exist due to the lack of data, climate change is likely to have a significant impact to Suriname, especially on the hydrological cycle causing more intense rainfall events.

Climate change may have significant impact on the recharge of the phreatic groundwater in the savannah and local sand ridges that are recharged by infiltrating rainwater. Recharge of this groundwater, presently estimated at 350 to 500 mm/yr will drastically decline due to reductions in rainfall, increases in overland flow during the more frequent rainstorms, and increases in evapotranspiration. This will lead to declining groundwater levels and possibly intrusion of brackish water. Effects may become noticeable after 2040, but only around the pumping stations at Republiek, Moengo/Wonoredjo, and Albina[36].

Sea level rise may lead to saltwater intrusion in the major rivers, which restricts the possibility of river water intake or riverbank water infiltration into wells. Also, groundwater levels will rise in the coastal plain in general. In combination with higher frequency of rainstorms, this may lead to more frequent waterlogging. Additional measures may be needed to safeguard the infrastructure and functioning of the pumping stations in the coastal plain.

5.1.7 Climate Change

A far as hydrology is concerned, the most important effects resulting from global climate are the rise in sea level and the changes in rainfall and evaporation. Mean sea level at Suriname is expected to rise 0.40 m by 2040 and 0.85 m by 2100[37]. The rise in sea level will lead to an upstream shift of the fresh/brackish boundary in the major rivers.

Rise in river water levels will also affect large parts of the coastal plain, where they are hydraulically connected by creeks and canals to the rivers. Groundwater levels will rise, and salinization may take place. Extreme events like high intensity rains will occur more frequently (Min. ATM, 2013). As a result, temporary flooding will take place more frequently. In combination with the higher levels of surface waters, this may provoke waterlogging where drainage is insufficient. The rise in water levels and

[36] RTI International. Hydrogeological Assessment of the Coastal Aquifers of Suriname (HACAS), volume 1 2016
[37] Nurmohamed, 2016. Unpublished

insufficient drainage may affect SWM infrastructure and operations. Risk and calamity policies are warranted.

Groundwater recharge will decrease in the future in the coastal plain. Based on various publications estimates are given in Technical Memo 2 (Volume III) for future recharge[38]; Groundwater recharge is expected to be 28% and 86% lower in 2040 and 2100, respectively for the savannah area. However, most recharge does not reach the productive aquifers but is quickly drained from the clayey soils in the coastal plain. Only the Zanderij aquifer in the savannah zone and the sand ridges in the coastal plain receive recharge, which is about 350 to 500 mm/yr at present.

Groundwater pumping stations at Republiek, Wonoredjo, and Albina are located near the savannah zone and could notice influence from the reduced recharge in the adjoining savannah. Lower groundwater recharge will lead to a decline of water levels in the savannah zone. However, this may be compensated by rising surface water levels in the coastal plain because of sea level rise.
Production at these stations is relatively low and does not surpass the natural recharge in the surrounding area. Also, in this area, no large-scale groundwater production is foreseen. All in all, climate change effects for these stations will be limited. No adaptive measures are foreseen.
The fresh groundwater in the Zanderij, Coesewijne, A Sand, and Saramacca aquifers is stagnant fossil water, formed by deep groundwater circulation during the Pleistocene and early Holocene. Climate change will not affect the groundwater salinity pattern and the production capacity of these aquifers. Present and projected SWM pumping stations are not at risk.

Suriname has quite a different vulnerability profile than much of the rest of the Caribbean. Suriname has a large coastal area where 97% of the population is found, yet due to its geographic location and topography,
The primary hazard facing Suriname is flooding[39]. This large country is also exposed to other forms of hydro-meteorological hazards. For example, an El Niño Southern Oscillation (ENSO) event in 1997/98 resulted in a severe drought, where lagoons, swamps and rainforest creeks dried up[40]. Suriname has not experienced severe impacts from tropical storms or hurricanes because it is to the south of the typical hurricane path, though seasonal and heavy rainfall events create flooding issues at times. There are no volcanoes and the earthquake threat are also quite small[41]. There have been no reports of major damaging landslide disasters in recent times[42].

[38] Groen, 2002; Nurmohamed et al., 2008; Min. ATM, 2013
[39] Tawjoeram, 2006; Government of Suriname, 2004
[40] CDERA, 2003
[41] Tawjoeram, 2006
[42] EM-DAT: The OFDA/CRED International Disaster Database, 2011.

5.2 Socio-economic Baseline Information and Data

5.2.1 Archeological Sites

A list of registered pre-Columbian archeological sites in Suriname was published by well-known archeologist A.H. Versteeg, who conducted archeological research in Suriname between 1975 and 1982. There are no archeological sites found in the direct study areas, only a few in the indirect area of study. None of the archeological sites will interfere with the construction activities in the direct or indirect study area.

Table 24 provides an overview of the archeological sites in the indirect study area of Tijgerkreek. Table 25 provides an overview of the archaeological sites in the indirect study area of Helena Christina.

Table 24: Archeological sites in the indirect study site in Tijgerkreek

Number and site name	Coordinates (CBL Map)	Found by (name) and year	Description	Culture
Sur-40 Tambaredjo-3	5c (317.40/963.68)	1957 D.C. Geijskes	Settlement with graves	Koriabo
Sur-41 Tambaredjo-1	5c (316.20/965.35)	1954 D.C. Geijskes	Settlement with graves	Kwatta
Sur-42 Tambaredjo-2	5c (318.34/965.60)	1957 D.C. Geijskes	Settlement with graves	Kwatta
Sur-159 Tijgerkreek	5c (309.60/965.60)	1971 J. van der Heide	settlement	Koriabo

Table 25: Archeological sites in the indirect study site in Helena Christina

Number and site name	Coordinates (CBL Map)	Found by (name) and year	Description	Culture
Sur-106 Lelydorp: Van Hattemweg	13b (347.10/947.95)	Ch. J. Zschusschen	Settlement	Koriabo
Sur-348 Houttuinen	14a (361.40/953.75)	1976 F.C. Bubberman	settlement	unknown

5.2.2 Population and Demography

According to official statistics presented in the 2012 Census, Suriname has a total population of 541,638 of which approximately half (45%) live in the urban district of Paramaribo. The urban district

of Wanica accounted for 118,222 people in 2012, which made up for 22% of the total population, while the more rural district of Saramacca had a population of 17,480, which made up only 3% of the total population.

a. Population

District Wanica

District Wanica encompasses an area of 442km^2 and consists of seven resorts. Table 26 gives an overview of the area, population and population density of the resorts belonging to the district of Wanica. In this area, the resort of Lelydorp is largest in size, but has the lowest population density.

Population density. While the resorts of Koewarasan and De Nieuwe Grond account for the highest population in the district, resort De Nieuwe Grond shows the highest population density of 688 people per square km compared to the rest. The SWM plant of Helena Christina is located in resort De Nieuwe Grond.

Gender. The gender division in the district of Wanica shows a slightly higher percentage in women. Of the population in Wanica 49% are men, and 51% women.

Table 26: Population, density and area data of District Wanica[43]

District	Resort	Area (km^2)	Population 2012	Population density 2012
Wanica	Kwatta	62	14,151	228.2
	Saramaccapolder	28	10,217	364.9
	Koewarasan	71	27,713	390.3
	De Nieuwe Grond	38	26,161	688.4
	Lelydorp	149	18,663	125.3
	Houttuin	58	15,656	269.9
	Domburg	37	5,661	153.0
Total		**443**	**118,222**	**266.9**

Age. The population of Wanica is relatively young compared to other districts. People in the age group between 15-59 form the largest group, they make up for 65% of the district population of Wanica, followed by the age group between 0-14 (27%) and the people age 60 and older (7%) (Figure 15).

[43] ABS Census, 2012

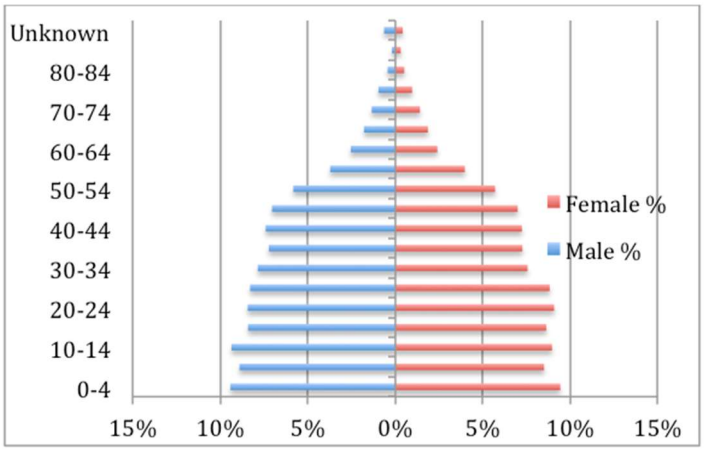

Figure 15: Age distribution in district Wanica. Source: ABS, 2012

District Saramacca

The more rural district of Saramacca covers an area of 3,636km^2 and consists of six resorts (Table 27). The resort Calcutta is by far the largest in area size but has the lowest population density compared to the rest.

Population density. The smallest resort in area size, Groningen, has the highest population density, followed by resort Jarikaba, which also has the most inhabitants. The SWM plants of Groningen, Kampong Baroe and Tijgerkreek (Peperhol) are located in the resorts Groningen, Kampong Baroe and Tijgerkreek respectively.

Gender. The gender division in Saramacca shows a different picture compared to the urban districts Wanica and Paramaribo. There are more men than women in Saramacca, the percentages being 53% male and 47% female respectively.

Table 27: Population, density and area data of District Saramacca[44]

District	Resort	Area (km^2)	Population in 2012	Population density in 2012
Saramacca	Calcutta	1655	1,647	1.0
	Tijgerkreek	241	3,244	13.5
	Groningen	57	2,818	49.4
	Kampong Baroe	684	2,248	3.3
	Wayamboweg	872	1,560	1.8
	Jarikaba	127	5,963	47.0
Total		**3,636**	**17,480**	**4.8**

[44] ABS Census, 2012

Age. The population in Saramacca shows a similar age pattern to the population in Wanica. People from the age group 15-59 form the largest group (65%) of the district population, followed by the age group 0-14 (26%) and the people age 60 and older (10%) (Figure 16).

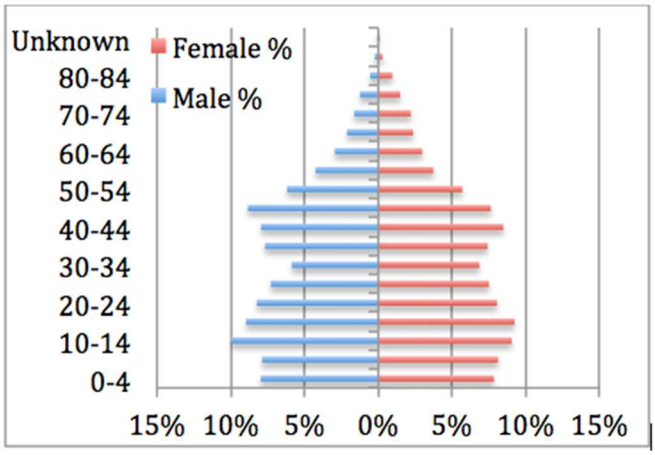

Figure 16: Age distribution in District Saramacca[45]

b. Population Growth

The district Wanica shows the highest population growth rate compared to other districts of Suriname. Wanica has shown a population increase of 37,5% from 2004 to 2012 and has a projected increase of 12% from 2012 to 2020. In comparison, the district of Saramacca has shown a slower increase in population of 9.4% between 2004 and 2012. Both districts differ from the overall pattern in Paramaribo which has shown a negative growth of -0.8%.

The increase in population in Wanica over recent years is caused by a combination of urbanization and migration from Paramaribo and the interior. This has resulted in a land use 'transfer' from mostly agricultural to housing. More recently, a few housing projects have developed in Wanica as well to accommodate the increased need for housing. Persons that moved to Wanica were particularly between 15-29 years and seeking jobs and education opportunities.

c. Ethnicity and Religion

Descendants from India are the largest ethnic group present in the district of Wanica (43,8%), followed by Indonesia-descendants (17,9%), descendants from African slaves-maroons (15,3%), population

[45] ABS Census, 2012

with mixed ethnicity (9,9%) and Creoles (9,3%). Smaller groups of people are formed by the Indigenous peoples (1,5%), Chinese (0,8%) and others.

The district of Saramacca shows a similar picture about the presence of ethnic groups. Descendants from India are the largest ethnic group present (53,4%), followed by Indonesia-descendants (19,8%), population with mixed ethnicity (11%). Smaller groups of people are formed by Creoles (6,8%), Indigenous peoples (5,9%) and others.

Religion is strongly connected with ethnicity: traditionally Indians practice Hinduism, Indonesia-descendants are Muslim, and Creoles are Christians. The main religion practiced in the district of Wanica is Hinduism (38%) followed by Islam (18.5%) and Roman Catholic (14.2%). The main religion practiced in Saramacca district is Hinduism (44.6%). Other religions practiced in this district include Christianity (23.5%), Islam (18.8%), and other religions (3%).

5.2.3 Education

The education system in Suriname is divided into three segments[46]: primary, secondary and tertiary education (Table 28).

Table 28: Overview of the education system in Suriname

Type	Age group	Institutes
Primary education	Ages 4-6	Pre-primary education “kleuteronderwijs” (K.O. schools) (optional)
	Ages 6-12	Primary school “Gewoon Lager Onderwijs”(G.L.O. schools) (mandatory)
Secondary education	Ages 13 to 16	Junior secondary education “Voortgezet Onderwijs voor Junior” (VOJ schools)
	4-year duration	Secondary general education “Meer Uitgebreid Lager Onderwijs (M.U.LO. schools)
	1-4-year duration	Secondary vocational education “Lager Beroepsonderwijs” (LBO schools)
	Ages 17 to 19	Senior secondary education “Voortgezet Onderwijs voor Senior” (VOS schools)

[46] Menke (2016) Mozaïk van het Surinaamse Volk, volkstellingen in demografisch, economisch en sociaal perspectief

Type	Age group	Institutes
	3-year duration	Pre-university education “Voorbereidend Wetenschappelijk Onderwijs” (VWO schools)
	2-year duration	Continued secondary education “Hoger Algemeen Voortgezet Onderwijs” (HAVO schools)
	1-4 years	Higher vocational education (Institute for secondary economic and administrative education “IMEAO”, Middelbare Handelsavondschool (MHAS) and Technical education Natuurtechnisch Instituut (NATIN) and pedagogical institutes
Tertiary education	Age 19 and older	Anton de Kom University of Suriname (ADEK) Higher vocational education (HBO schools) Institute for teacher training “Instituut voor de Opleiding van Leraren” (IOL schools)

a. Enrollment

Compulsory education in Suriname runs from age 7 to 12, but only primary education is mandatory. Nationwide, on average, children stay in school for 7.2 years. From the age of 4, 91% are enrolled in primary education. When reaching the age of 12, children are eligible for secondary education, however only approximately half of this age group will continue school.

In Suriname, the literacy rate of adults (15 years and older) is 93% and is approximately equal among men and women – 95/94%). For youth between 15 and 24 years, the literacy rate is 98% and is approximately equal among men and women – 98/99%.

Overall, women dominate all levels of education. Only in primary education, the number of boys enrolled is slightly higher than that of girls, but the trend is reversed at the higher education levels[47]. Figure 17 shows the results of the Suriname Child Labor Survey (SCLS) report of the total interviewed children per district between the ages 5 and 17 attending school in 2017. For district Saramacca more boys were enrolled in school in 2017 than girls, which contrasts with district Wanica where the opposite is noticed. With an average of 264 students enrolled in each GLO facility, Wanica has a higher enrollment percentage by 23% above the national average enrollment of 215 students in each GLO school[48].

[47] Suriname Child Labour Survey (2017) Research Institute for Social Sciences (IMWO) and International Labour Organization (ILO) [online] https://www.ilo.org/wcmsp5/groups/public/---ed_norm/---ipec/documents/publication/wcms_663335.pdf

[48] Smith et.al. (2014)Voorlopige Sociale Effecten Analyse Project Spoorbaan Paramaribo-Onverwacht

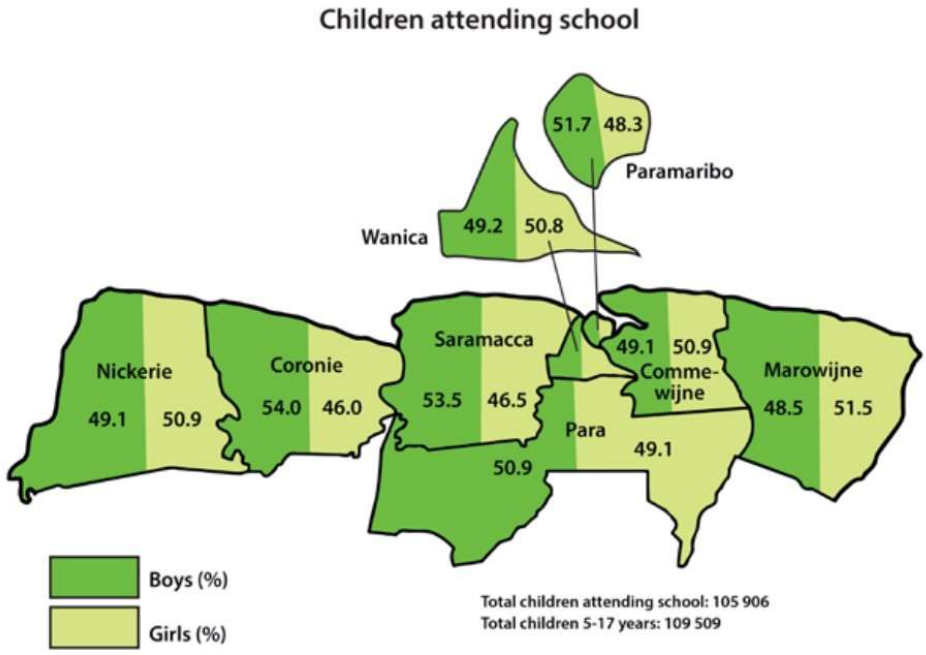

Figure 17: Suriname Child Labor Survey (SCLS) report of the total interviewed children per district between the ages 5 and 17 attending school in 2017

b. Educational Facilities

The overall number of schools in Wanica is much higher than in Saramacca, but both districts lack facilities for tertiary education. Students either must travel to Paramaribo to enroll in tertiary education or stop their education. Table 29 and 30 show the numbers and types of educational facilities for respectively district Wanica and Saramacca.

Table 29: Number and type of educational facility in the resorts of Wanica[49].

Resort	KO	GLO	LBGO	LTS	MULO	VOS	BO
Kwatta	6	6	1		1	2	1
Saramaccapolder	4	4	1		2		
Koewarasan	8	8	2		2		2
Nieuwe Grond	13	13	1		3	1	1
Lelydorp	11	11	1	2	2	2	1
Houttuin	5	5	1		1		
Domburg	4	4			1		
Total	51	51	7	2	12	2	3

Table 30: Number and type of educational facility in the resorts of Saramacca[50]

Resort	Pre-K	KO	GLO	LBGO	MULO	BO	VOS
Calcutta			2				
Tijgerkreek			2	1	1		
Groningen	1	3	3		1		
Wayambo		1	2				1
Kampong Baroe		2	2			1	
Jarikaba		3	3		1		
Total	1	9	14	1	3	1	1

c. Educational Levels

Table 31 shows the proportion of the population age 15 and older by highest level of education in 2012. There is a trend seen between the more rural district of Saramacca and the urban districts Wanica and Paramaribo. Saramacca scores higher in primary and lower education but the score decreases the higher the level of education becomes. Wanica and Paramaribo show a similar pattern.

[49] National Bureau of Planning, 2014
[50] National Bureau of Planning, 2014

Table 31: Persons age 15+ of the non-institutional population by highest education level for Wanica, Saramacca and Paramaribo[51]

Education level	Wanica	Saramacca	Paramaribo
None/Kindergarten	8.6%	9%	7%
Primary	38%	44%	28%
Lower Vocational & Other Junior Secondary education	35%	30%	35%
Senior Secondary General + Senior Secondary Vocational and Technical education + Teachers Training College	10%	7%	15%
Higher Vocational education + University	3%	1.6%	6%
Other	0.6%	0.3%	0.7%
Unknown	5%	8.4%	8%

5.2.4 Employment and Income

The Government of Suriname is the largest employer in the country. In 2018, the average annual income of Government employees was SRD 2,577 (U$ 339) for male workers and SRD 3,019 (U$ 397) for female workers[52]. The percentage registered men and women that are unemployed was 8.2% for males and 19.2% for females.

However, there is a lack of general data on income and income distribution, mainly because interviewees gave insufficient responses during the Population Census in 2004 as well as in 2012.

District Wanica

According to the Public and Housing Census 2014 executed by the General Bureau of Statistics (ABS), 65.24% of the household heads (28,939) in Wanica are registered as employed. 35% of the employed people in this district (41,315) were females and 65% were males. On the contrary, from the group of unemployed people (4,408), 61% were females and 39% of males.

Employed people have professions that vary from smallest group of “lower services and sales workers” (18.3%), to the largest group of “higher legislators, senior officers and managers” (5.4%) (Table 32).

[51] ABS Census, 2012

[52] Neuman, Morman, 2019. Country Diagnostic Assessment and Recommendations for Food & Nutrition Security (FNS) in Suriname

Table 32: The total active population in Wanica (non-institutional including special groups in the age category 15-64 years) divided according to profession[53]

Occupational group	Active population	Percentage
Legislators, Senior officers, and Managers	2236	5.4
Professionals	3329	8.0
Technicians and Associate professionals, and Armed Forces	3023	7.3
Clerks	3042	7.3
Service Workers and Shop and Market Sales Workers	7555	18.3
Skilled Agricultural and Fishery Workers	2632	6.4
Craft and related trade Workers	6472	15.7
Plant and Machine Operators	3742	9.0
Elementary occupations	6607	16.0
Unknown	2677	6.5
Total	41315	

When assessing the type of industry in which the active population from Wanica is employed, the majority has a job in state affairs/policy (14.4%), followed by trade (13.1%) and construction (7.1%) (Table 33).

Table 33: The total active population in Wanica divided by industry/sector[54]

Industry / Sector	Active population	Percentage
A. Agriculture, Husbandry and Fisheries	1569	4%
B. Mining	1536	4%
C. Industry	2684	6%
D. Production and Distribution of Electricity and Gas	277	1%
E. Collection, Purification and Distribution of Water	209	1%
F. Construction	2940	7%
G. Trade	5411	13%
H. Transportation and Storage	1981	5%

[53] ABS 2014
[54] ABS, 2014

I. Hotels and Restaurants	822	2%
J. Information and Communication	472	1%
K. Financial and Insurance Activities	564	1%
L. Activities regarding Real Estate/Property	54	0%
M. Professionals and Technicians	406	1%
N. Administrative and Supporting Services	1054	3%
O. State Affairs/Policy	5939	14%
P. Education	2649	6%
Q. Health Services and Social Services	1665	4%
R. Arts, Entertainment and Recreation	505	1%
S. Other services	481	1%
T. Household/cleaning services	2452	6%
U. Activities of extraterritorial organizations and other legal bodies	24	0%
X. Unknown	7621	18%
Total	41,315	

District Saramacca

According to Census performed by the General Bureau of Statistics (ABS) in 2012, 53.6% of the inhabitants are employed, while only 3.8% are unemployed in district Saramacca. Employed people have professions that vary from the smallest group of “basic professions” (29.3%), to the largest group of “higher and secondary technical and specialist specialty incl. armed forces” (6.2%) (Table 34).

Table 34: The total active population in Saramacca (non-institutional including special groups in the age category 15-64 years) divided according to profession[55]

Occupational group	Active population	Percentage
Higher & secondary technical and specialist specialty incl. Armed forces	360	6%
Administrative professions	351	6%
Lower service and commercial professions	964	17%
Skilled workers in Agriculture and fisheries	941	16%
Craftsmen and craftswomen	663	11%
Operators of fab installations, and machine and assembly staff	661	11%
Basic professions	1695	29%
Unknown	144	2%
Total	5779	

The State Oil company employs 229 people from the Saramacca district. Besides this company, two local contractors hire people. However, no database is available that gives insight in the number of employees that are hired from these contractors. The main jobs performed by contractors are: i) maintenance of flow line dams, ii) chemical maintenance (removing weeds), iii) weeding/cutting grass, iv) clean-up after an oil spill, v) cleaning offices, vi) tractor drivers and vii) excavator drivers (occasionally).

5.2.5 Health

General Health Situation in Suriname

According to the demographic data 2013-2015 from the General Bureau for Statistics Suriname (ABS) the national crude birth rate[56] is 18.30. The life expectancy in Suriname for males at birth is 70.07, for females 75.25, with a mean (median) age of death for males of 60.27 (64.28) and 64.45 (70.74) for females.

The most important water related diseases in the context of the water supply modernization program are:

[55] ABS, 2014

[56] The number of live births per 1000 mid-year population

- Water-borne diseases, which occurs when organisms that can survive in water are ingested through contaminated drinking water. Examples of these water-borne diseases are: Dysentery caused by Shigella; acute diarrhea that can be caused by Rotavirus, Giardia lamblia, Escherichia coli, Campylobacter and others; typhoid fever and leptospirosis.
- Water shortage diseases, which includes many kinds of infections such as diarrhea, contagious skin and eye infection, and occurs when scarcity of accessible water supplies makes washing and personal cleanliness difficult and infrequent.
- Water-based diseases which occurs when humans are infected when in contact with water wherein parasitic helminths such as schistosomes are that are spending part of their lifecycle in intermediate host organisms that live in freshwater causing Schistosomiasis.

Acute diarrhea disease is still the leading cause of global morbidity and mortality particularly among young children in resource-limited countries, due to lack of piped water supply, poor water-storage practices, lack of vigilant hand washing, poor sanitation and not treating water in the home. In 2011 the Bureau of Public Health reported that in 2011 the number of children under 5 years of age that died was 233. According to UNICEF, three percent of all deaths under five-year-old in Suriname were due to diarrhea in 2010.

Schistosomiasis is no longer an issue for Suriname, as Suriname has implemented Schistosomiasis control and elimination programs resulting in reduced prevalence of the disease and is being regarded as a minimal risk country in terms of schistosomiasis.

Health Situation in District Wanica

Availability of health services. In Wanica, there are five private health centers and various clinics of the Regional Health Service (RGD) located (Table 35). The different health services provided to a total of 132.645 clients[57] includes general consultation, care for patients with chronic disease, screening for breast cancer, prenatal, neonatal care, and toddler care.

[57] RGD, 2019, data for water supply modernization program

Table 35: Overview of Healthcare in District Wanica[58]

Resort	Health Clinic	Doctors	Nurses	Health centers	Mid-wives	Dentists	Mother-Child consultation centers	Blood testing centers	Pharmacies
Kwatta		7	11	3		2	2		
Saramacca-polder	4	5	11			1	1		
Koewarasan		6	5		3		2		
Nieuwe Grond	9	12	11	1	1	3	1	1	1
Lelydorp	4	7	16	4	1	9	1	2	
Houttuin		4	4	1	1		1		
Domburg		2	4	3		1	1		
Total	17	43	62	12	6	16	9	3	1

Fertility and mortality. The annual number of live births for the years 2013-2016, was the highest in 2016 (2367) and the lowest in 2013(2330), the crude birth rate in 2012 was 19.56, which was higher than the national crude birth rate[59] (18.30). With regard to mortality, in 2012 both the infant mortality rate[60] (12.98) and mortality rate of children age under 5 years[61] (15.14) were lower compared to the rates seen in 2016, 15.63 and 17.74 respectively

Diseased persons according to disease type. Surveillance data, which includes data about water related diseases is not routinely collected and stored in a database at the Regional Health Services (RGD). The only routine data registered, and available upon request at the RGD, was data about the number of people with HIV, Diabetes Mellitus and Hypertension. The diseases most of the population are suffering from, are hypertension (40.35%, n= 29.656), followed by diabetes mellitus (26.28%), while only a few are diagnosed for cancer (1.62%). Water related diseases are not on the top 10 list of most occurring diseases in this district; in 2018 420, diarrhea cases for children under 5 years old, and 848 cases for 5 years and older were reported by the clinics from the “Lelydorp” area; district Wanica south-west.

[58] Ministry of Regional Development

[59] The number of live births per 1000 mid-year population

[60] The number of live born children who died under one year of age in a certain year per 1000 live births in the same year

[61] Mortality of children aged 0-4 years per 1000 live births

Leading causes of death. Cardiovascular diseases are the main cause of death in Wanica (39.57%), followed by external causes of death (19.78%), and diabetes mellitus (14.09%).

Table 36: Leading causes of death recorded in Wanica District in 2011[62]

	Cause of Death	Number of Deaths Wanica	Percentage
1	Cardiovascular diseases	146	39.57%
2	External causes (accidents and violence)	73	19.78%
3	Maligned neoplasm / Neoplasms	49	13.28%
4	Diseases originating during the perinatal period	49	13.28%
5	Diabetes mellitus	52	14.09%
	Total	369	

Health Situation in District Saramacca

Availability of health services. Saramacca has 3 private health care providers and 4 polyclinics of the Regional Health Service (RGD) (Table 37). The different health services provided to a total of 16.970 clients includes general consultation, care for patients with chronic disease, screening for breast cancer, prenatal, neonatal care, and toddler care.

Table 37: Overview of Healthcare in District Wanica. Source: Ministry of Regional Development

Resort	Health Clinic	Doctors	Nurses	Health centers	Mother-Child consultation centers	Morgue	Ambulances
Calcutta	1	2	5				1
Tijgerkreek	1	2	8	1			1
Groningen	1	2	4	1	1	1	1
Wayambo	1	1					
Kampong Baroe	1	1	1		1		
Jarikaba	2	1	8		1		
Total	7	10	26	2	3	1	3

[62] Punwasi 2012, Doodsoorzaken in Suriname: 2010-2011

Fertility and mortality. The annual number of live births for the years 2013-2016 was the highest in 2013 (263) and the lowest in 2016 (233), the crude birth rate in 2012 was 14.53 which was lower than the national crude birth rate (18.30). With regard to mortality, in 2012, both the infant mortality rate (15.75) and under age 5 mortality rate (19.69) were higher compared to the rates seen in 2016 (8.51 for both indicators).

Diseased persons according to disease type. Surveillance data, which includes data about water related diseases is not routinely collected and stored in a database at the Regional Health Services (RGD). The only routine data registered, and available upon request at the RGD, was data about the number of people with HIV, Diabetes Mellitus and Hypertension. According to this data set, 985 clients are suffering from hypertension, 155 from diabetes mellitus, and 7 from HIV in this district (Table 38).

Water related diseases are not on the top 10 list of most occurring diseases in this district; in 2018 there were 212 cases for children under 5 years old, and 481 cases for 5 years and older.

Leading causes of death. Cardiovascular diseases are the main cause of death in Saramacca (42.19%), followed by external causes of death (20.31%), and diabetes mellitus (14.06%)[63].

Table 38: Leading causes of death recorded in Saramacca district in 2011[64]

	Cause of Death	Number of Deaths Saramacca	
1	Cardiovascular diseases	27	42.19%
2	External causes (accidents and violence)	13	20.31%
3	Maligned neoplasm / Neoplasms	11	17.19%
4	Diabetes mellitus	9	14.06%
5	Diseases originating during the perinatal period	4	6.25%
	Total	369	

5.2.6 Gender

Suriname has committed itself internationally, regionally and nationally to eliminate gender inequalities. Although an increasing trend of women participation within government bodies is being seen, women are still underrepresented in political and decision-making positions[65].

Women in the age-group 15-64 years count for only 36.9% of the total workforce (188,229) and are regarded as the largest group jobseekers. Men are more active in the industrial sector, while women are predominantly seen in the service sector.

[63] Punwasi 2012, Doodsoorzaken in Suriname: 2010-2011

[64] Punwasi 2012, Doodsoorzaken in Suriname: 2010-2011

[65] Situation of women and men in Suriname Participation

As the legal framework (including customary law), implies, men and women have equal rights with regard to land ownership and control, however in practice tribal groups do not have legal rights on their land, and therefore are vulnerable to economic activities in their living areas, carried out by outsiders who have acquired legal mandates to exploit the resources available in these lands[66].
Except for the primary education level, fewer boys are enrolled compared to girls, whereas boy enrollment decreases with the increase in educational level. In general, 60% of the households in Suriname are led by men.[67]

Gender Survey

A small gender survey was held with residents living within one kilometer of each of the direct study sites in Kampong Baroe, Groningen and Tijgerkreek/Peperhol (District of Saramacca) and Helena Christina (District of Wanica). For each location, ten people (total of 40 people) were randomly selected and interviewed and asked to answer questions on the following topics:

- Household composition and ethnicity
- Vulnerability
- Availability of water in the house
- Main water source
- Use of water
- Decision making about water use.

The survey provided information below that was used for the further development of the impact assessment and associated management plan.

District Wanica

Household composition and ethnicity. A total of 10 households were in-depth interviewed in the district of Wanica. Most of these households are married couples/families (60%) followed by a smaller number of widows (20%) and single persons living with their parents (20%). The households are predominantly headed by men (70%) with an average of 3.5 people per household. 50% of the total interviewed households have an average of 2 minors per household with an average age of 8 years. Typically, all households are of Indian descent.

Vulnerability. Of the ten households that were interviewed, two (20%) can be categorized as vulnerable. Both households are single women headed households and one also having health related problems (diabetes).

Availability of water in the house. All ten households have running water in both their kitchen as well as in their bathroom/toilet.

Main water source. Most of the households (60%) use a combination of water sources (SWM tap water combined with rainwater and/or well water). Only 40% of the households use tap water as their only water source.

[66] Country Diagnostic Assessment and Recommendations for Food & Nutrition Security (FNS) in Suriname
[67] Multiple Indicator Cluster Survey 2018 Suriname. Unicef/ABS. July 2019

Use of water. 90% of the households use water for bathing, washing clothes, cleaning and drinking.
Decision making about water use. The survey further shows, either women alone or women joint by their men take decisions about water use. Half of the encountered households do not get involved in discussions with outsiders about water related problems they experience in their home. The households we interviewed indicated to have people at home during the day, mostly women, as well during the night.

District Saramacca

Household composition and ethnicity. A total of 30 households were in-depth interviewed in the district of Saramacca. Most (57%) of the households consisted of married couples/families, followed by a smaller amount of couples/families living together (27%), single persons (10%) and widows (7%). Households are predominantly headed by men (83%) and consist of an average number of 5 people per household. 77% of the total interviewed households have an average of 2 minors per household with an average age of 10 years. Most of the households are of Indian-descent (50%) and Indonesian-descent (30%), followed by a fewer amount of Indigenous people (10%) and people of mixed ethnicity (6,7%) and others.

Vulnerability. Of the total number of 30 households surveyed in Saramacca, three are categorized as a vulnerable group (10%). These are single women headed households, and two out of the three vulnerable households are extra vulnerable, having a combination of multiple vulnerability indicators: single women headed households, indigenous/ maroon origin and having health related problems (diabetes).
Availability of water in the house. Most households (90%) have running water in either the kitchen or bathroom/toilet. Only two households showed they have to get their water from a distance varying between 40-50 meters.
Main water source. Most of the households (50%) use a combination of tap water from SWM and either rain or well water. Rainwater is predominantly used as drinking water, back-up water and for watering plants. A slightly smaller number of households (47%) use SWM water as their only water source. A fewer amount uses a community faucet (3%) in the area of Columbia and Grankreek. Almost all households use the house' water supply only for their own family (do not share), with the exception of one family who did share with others, and two other families (indigenous people) who were using community faucets.
Use of water. Only 37% of the households interviewed use the SWM tap water for drinking. The remaining 63% either purchases their drinking water or collects rainwater. However, all households use the SWM water for cooking, bathing, washing clothes, cleaning and in the dry season for watering plants and in some cases farming.
Decision-making about water use. This survey further shows that predominantly women (83%) make decisions about the use of water. More than 25% of the encountered households don't get involved in discussions with outsiders about water-related problems they experience at home. 87.8% of these households consists of persons of age 18 years or older. Almost 100% of the residents are

at home during the night, but during the day, only a few people are at home. The people at home during the day are mostly women (75% of households interviewed).

5.2.7 Socio-cultural Characteristics of Vulnerable Groups

Vulnerability and Water Supply

Indigenous people belong to the most vulnerable group in Suriname. Their water supply and sanitation circumstances are as follows[68]:

Water supply. Indigenous people have lower access (36.2%) to piped water into their dwelling (or premises) compared to any other ethnicity in Suriname (52-72.7%). Also, indigenous people belong to the group with the lowest percentage of households with drinking water on their premises (6.8% compared to other ethnicities between 0.7-2.1%).

Water quality. Approximately half (54.9%) the indigenous people in Suriname have an improved drinking water source located near their home, free from pathogens (*Escherichia coli*) and available when needed. This percentage follows a similar pattern as non-indigenous households (47.6-69-9%). 20% of indigenous people use appropriate water treatment methods such as boiling water, bleach/chlorine, water filter or solar disinfection.

Sanitation. About 90.5% of the indigenous people in Suriname have access to improved sanitation facilities such as piped sewage systems septic tanks, pit latrines or composting toilets. Excreta is either removed by service providers, buried or never removed at all. Approximately 1% of households engage in unsafe disposal of excreta from on-site sanitation facilities.

Indigenous People in the Study Area

Indigenous people are living in the study area in district Saramacca. The district houses 1028[69] indigenous people, which accounts for 5.1% of the total population of indigenous people in the country. Two indigenous groups are dominant in this area: Lokono (Arowak) and the Kaliña (Caraib). In the study area, we identified three indigenous settlements: Maho, Grankreek and Colombia (Figure 18).

a. Indigenous People in Maho

Maho is a collectively operating village from Kaliña origin. Maho was established in the 1800s and was known for its relatively large concentration of indigenous people in the area led by a spiritual leader. Currently, approximately 25 people live in Maho because most people left the village for the following reasons: distant work locations, inadequate utilities and poor public transport. Field reports suggest Maho has a significant amount of drug users. The village is led by a female captain (Astrid Toenaje) who was chosen in a traditional fashion. Traditional decision-making still occurs in traditional meetings (krutu).

[68] Multiple Indicator Cluster Survey 2018 Suriname. Unicef/ABS. July 2019.

[69] ABS, Census statistics 2012

Maho has been engaged in a long-standing dispute with private landowners (some of them are engaged in sand mining) in Saramacca. This dispute has resulted in violence between Maho residents and private landowners and various public protests without any significant resolution to the problem. In 2009, together with VIDS (Association of Indigenous Village Leaders), the village has submitted the case to the IACHR. In the meantime, disputes with indigenous people in the Maho area are still ongoing[70]. Further research on land claims of people from Maho will be assessed in the socio-cultural study.

b. Indigenous People in Columbia

People from Colombia originally came from Maho. The shared history between the two villages has led them to bundle together in their advocacy for water supply and quality. Currently, Colombia counts between 150-200 inhabitants and its leadership is divided:

- The eastern part is led by a traditional leader (Basja Comvalius) but has a system of individual land ownership.
- The western part values collective land ownership and is represented by Mr. Zaalman. This part of the community has close ties with Maho, as well with the indigenous umbrella organization VIDS and indigenous platform ESAV. Together with Maho, they advocate for availability of clean water

In both parts of Colombia, traditional decision-making still occurs in traditional meetings (krutu).
Further research on land claims of people from Columbia will be assessed in the socio-cultural study.

c. Indigenous People in Grankreek

Grankreek houses indigenous people from both Lokono and Kaliña origin. The community has a traditional structure consisting of a female captain (Angelique Palmtak) and 4 supporting basjas. Residents have individual land ownership, and this was chosen because they would lose their land due to outside pressure.
Traditional decision-making still occurs in traditional meetings (krutu).
Further research on land claims of people from Grankreek will be assessed in the socio-cultural study.

[70] International Work Group for Indigenous Affairs. The Indigenous World 2018.

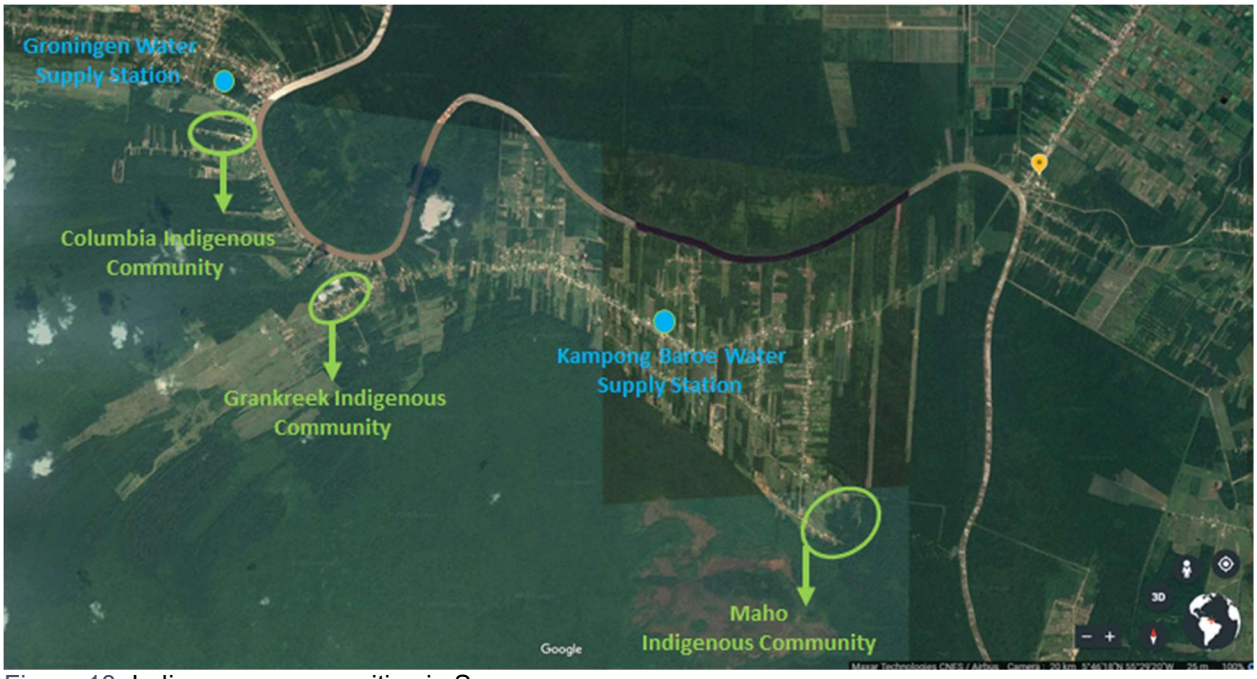

Figure 18: Indigenous communities in Saramacca

5.2.8 Land acquisition

SWM is confronted with land acquisition once a new well needs to be constructed on land owned or leased by someone else. Although this is a new activity, the company has successfully completed land acquisition on a case by case basis, yet, these cases have not involved people's displacement but only use of people's agricultural lands.

SWM had to deal with land acquisition when wells were being constructed and operated on privately owned parcels used for agricultural production near the Van Hattemweg station in District Para. In this case, the following measures were taken:

1. Determine the exact location of the wells using GPS coordinates
2. Assess tenure status of the land to be acquired with the national office of Geographic Land Information Systems (GLIS). In case a specific parcel is subject to land lease, SWM can use its close relationship with the State to pursue landowners to cooperate.
3. Gather contact information from the landowners
4. Conduct an information session with the landowners to present the plans for well construction and operational requirements.
5. Negotiate with landowners about access to land and potential compensation. Negotiation includes the highest level of SWM management.
6. Execution of well construction.

Because of the lack of the proximate location of wells, we make the following assumptions for well construction: i) wells are located near the street and there is plenty of land to choose wells of 20x20m, ii) land will have to be from third parties, or is Government owned, iii) wells will only take a small amount of the privately owned land and iv) resettlement should be avoided[71]. When making these assumptions, it is highly likely that involuntary resettlement or economic displacement will not occur because there are multiple options to choose wells.

Yet, there is always a chance for displacement of economic activities or involuntary resettlement when technical design information is incomplete to make a full assessment, which is the case in this study. In case there is physical displacement of people or economic activities, SWM should follow procedures as outlined in Table 39.

Table 39: Comparison SWM and IDB guidelines on involuntary resettlement

Theme	Current SWM procedures	IDB guidelines on (OP-710)	Suggestions for improvement
Baseline study			
Social analysis	Data gathered on: -Number of people affected by the project, household size and composition -Legal status of land	Assess number and socio-economic status of people affected by the project	Include in baseline study: -Livelihood resources and activities -Sources of income -Physical infrastructure such as housing etc. -Health indicators -Census/inventory of all living beings that are affected by the construction of wells
Risk Assessment	None	Conduct a risk assessment to assess whether the project will cause impoverishment	Risk analysis to assess loss of land, physical structures, livelihood, income, marginalization, food insecurity
Resettlement planning			
Consultation and participation with affected people	Information session with affected people	The affected people should be included in the resettlement planning to ensure that the needs and expectations of the people affected are included	Consultation sessions with affected people gathering views and assessing aspirations and set joint criteria for: -compensation -other benefits and services provided -institutional and procedural issues in relationship affected persons-SWM including conflict resolution

[71] These assumptions were acquired from the IDB.

Entitlement	None	Rights of affected people must be included in the resettlement planning	Determine the affected people's right to: -Information about the project delivered in a culturally sensitive way -Compensation and other benefits due to construction of wells on their land
Activities, timetable and budget	Negotiation with affected people executed by SWM highest management	The resettlement program should provide an opportunity for development. As such it is preferable to avoid simple cash compensation, and to offer options that combine land-for-land and/or services projects with training or extension, and perhaps an element of cash compensation or credit	-Develop different packages for compensation that can be offered to affected persons. -Train a designated team to negotiate with stakeholders based on their interests. Team should receive training in negotiation and mediation.
Monitoring and evaluation	None	The arrangements for reporting, monitoring and evaluation should be included in the resettlement plan	Set up a structure for monitoring and evaluation of the resettlement activity include relationship management with the affected people.

5.2.9 Water Infrastructure

SMW is responsible for potable drink water availability in Suriname. Yet, historically, water to rural areas was supplied by the Water Supply Department of the Ministry of Natural resources. SMW is gradually taking over this task in its efforts to provide high quality drinking water for all Suriname citizens.

District Wanica

Water Supply. Water supply in the district is provided by 6 stations (Table 40). SWM is constantly working on the further expansion and upgrading of the water supply system. Some residents in the resorts of Koewarasan, Domburg, Houttuin, Kwatta and Saramaccapolder rely on wells and stored rainwater for drinking water. Other areas - Nieuwe Grond and Domburg - receive drinking water in trucks from the Water Supply Department of the Ministry of Natural Resources.

The Helena Christina station produces 567m3/h potable water. The station deals with overcapacity of water filters, resulting in water with low PH and high levels of nitrite and manganese[72]. Water is treated with prefilters, aeration towers, sand filters and then chlorinated with injectors. Water is stored in 2 tanks with 1200m3 capacity. An additional 240m3/h water is needed to supply resident and the newly established Wanica hospital with a 12.6 km transport pipeline running in an east-west direction. For this, two additional wells and a new treatment plant are needed which will be part of this project.

Table 40: Production stations of SWM 2014-2017 for the Central Branch[73]

Production Station	Year in use	2014		2015		2016		2017	
		Aver.Prod. m3/h	storage cap	Aver.Prod. m3/h	storage cap.	Aver.Prod. m3/h	storage cap	Aver.Prod. m3/h	Storage cap.
Van Hattem weg	1997	1018	2,400/ 4,800	1046	7000	1036	4,981/ 2,144	1016	4,981/ 2,144
Helena Christina	2002	531	2,400	499	2,400	513	4,440	556	4,440
Koewarasan	2009	382	1,200	393	1,200	403	786	353	786
Leiding 9a	2009	574	1,400	576	1,400	560	783	540	783
La Vigilantia	2012	227	450	224	600	250	389	267	389
Uitkijk	2012	131		118	230	139	177	125	177

Potable water is supplied to approximately 34,000 households in the Wanica area[74]. Residents have water meters installed and user volumes are calculated and charged. Residents pay for water in Lelydorp, which is 4-5 km from the area, dependent on where they live.

Water Quality. In Wanica, 34.2% of 1867 household members are exposed to E. coli in their source water[75].

The Helena Christina station sometimes produces potable water that has a higher manganese content than allowed (see section 5.1.3).

Field interviews with residents in the Helena Christina study area showed the following perception about the water supply:

- Water pressure is good except when there are electric outages which causes water to stop running in many households.
- Sometimes water has a chlorine smell and taste or is dirty. Most people drink SWM water.
- As a back-up, people rely on self-made wells and rainwater for household use.
- Some people transferred from SWM water to self-made wells because of the high-water costs.

[72] Advise notice for expansion Helena Christina. SWM

[73] ABS, 2018. Environmental statistics

[74] SWM verbruikersdata 2017

[75] Multiple Indicator Cluster Survey 2018 Suriname. Unicef/ABS. July 2019

Sanitation. In Wanica, 92.4% of residents have a septic tank and most of the remaining people rely on other ways of improved sanitation which occurs through pit latrines, composting toilets and piped sewer systems. Excreta is either removed by service providers, buried or never removed at all. Approximately half (53.1%) of households engage in unsafe disposal of excreta from on-site sanitation facilities[76].

District Saramacca

Water Supply. Since 2016, SWM became responsible for the water supply of all water production centers in Saramacca (Uitkijk, Groningen, Kampong Baroe, Tijgerkreek and Boskamp) after a long period of coverage by the Water Supply Department of the Ministry of Natural Resources. Not all areas are connected to the SWM water distribution network. These unconnected areas receive drinking water in one or more of three ways: i) water transport in trucks, ii) self-constructed wells at a depth of approximately 2 meter and iii) simple rainwater collecting systems with small pumps. In the dry season, however, the level of the groundwater drops below 2 to 3 meter and groundwater becomes scarce due to limited rainfall.

Water production capacity is low to meet the growing demand in Kampong Baroe, Groningen and Tijgerkreek.

- **Kampong Baroe**. The station relies on 3 operating wells and needs one additional well to cover the increasing consumer demand. Water is treated with an open aeration system, sand filter, chlorine injector and then stored in 300 m3 capacity tank. Additional wells and storage capacity are needed, as well as a closed treatment system.
- **Groningen**. The station relies on 4 wells from but only can operate 3 because of lack of power supply. Water is treated with 2 open aeration systems, 2 sand filters, chlorine injector and then stored in 480 m3 capacity tanks. Additional wells and storage capacity are needed, as well as a closed treatment system.
- **Tijgerkreek (Peperhol**). The station relies on 5 wells providing 120 m3/hr water. Water treatment includes aeration and sand filtration, after which water is stored in 200m3 tanks. Construction of a dry and wet filtration system has started, which will be followed by rehabilitation of the aeration system and pumps. The station also provides water to Boskamp and to State Oil company. An additional well is needed to upgrade production capacity.

[76] Multiple Indicator Cluster Survey 2018 Suriname. Unicef/ABS. July 2019

Table 41: Water production capacity and number of connections from the water supply service in Saramacca, 2015-2016[77]

	2015		2016		2017	
Station	**Prod.Cap** (m^3/day)	**Connec-tions**	**Prod.Cap** (m^3/day)	**Connec-tions**	**Prod.Cap** (m^3/day)	**Connec-tions**
Saramacca						
Uitkijk	-	-	Operations transferred to SWM		No info	No info
Groningen	600	899				
Kampong Baroe	450	882				
Boskamp	80	85				
Tijgerkreek	3,240	1,381				
Saramacca Total	**4,370**	**3,247**			**24,451**	**2,984**

The stations in Saramacca provided approximately 3000 connections in 2017[78]. Residents have no water meters installed and therefore SWM charges every user a basic connection fee (U$ 2.33). Payments can be made by the cashier at station Groningen or in Paramaribo. User volumes will be calculated and added to the basic fee once individual meters are installed. Water loss will become a serious issue once SWM will start metering/billing individual water use.

Water Quality.
In Saramacca, more than half (56%) of people are exposed to E. coli in their source water[79].

Currently, the Kampong Baroe station has difficulty with filtering iron and manganese to acceptable WHO standards. The stations at Groningen and Tijgerkreek reports high amounts of manganese and ammonium at times (see section 5.1.3).

Field interviews with residents in the study area supplied information about the general **perception** about SWM drinking water:

- **Kampong Baroe**. Residents in this area prefer to buy drinking water and use SWM water for cooking, bathing and cleaning. Residents think the water has too much chlorine, and sometimes also has a brown color (especially when SWM is working on the water supply system). Water runs intermittently due to low pressure. As a back up to the low quality and quantity of water, residents create 2m deep wells or catch rainwater during the rainy seasons. Residents with a reservoir and pump have generally no problems with discontinued water supply.
- **Groningen**. Residents in this area also prefer to buy drinking water and use SWM water for cooking, bathing and cleaning. Similar to Kampong Baroe, residents think the water has too much chlorine, and sometimes also has a brown color (especially when SWM is working on the water

[77] ABS, 2018. SWM, 2017
[78] SWM verbuikersdata 2017
[79] Multiple Indicator Cluster Survey 2018 Suriname. Unicef/ABS. July 2019

supply system). Water pressure is low during peak hours (early morning and late afternoon) so residents either fill buckets with water for supply when water pressure is low, collect rainwater or install a reservoir and pump. Residents immediately surrounding SWM incidentally deal with high volume of runoff water into their lots, leaving plant roots to be exposed (Picture a and b in Figure 19). A full report of stakeholder input is found in Annex 3.

- **Tijgerkreek (Peperhol)**. Residents in this area prefer to buy drinking water and use SWM water only for cooking, bathing and cleaning. Residents think the water has a muddy taste and smell, and sometimes it has a yellowish color. Water pressure is perceived as good, yet, water stops running when the station has no electric supply. Residents immediately surrounding the station experience a constant odor coming from hydrogen sulfate gas. They report aluminum zinc roofing deteriorates faster than normal (Picture c in Figure 19). A full report of stakeholder input is found in Annex 3.

Sanitation. In Saramacca, 86.7% of people have a septic tank, and most of the remaining people rely on other ways of improved sanitation which occurs through pit latrines, composting toilets and piped sewer systems. Excreta is either removed by service providers, buried or never removed at all. 70.9% of households engage in unsafe disposal of excreta from on-site sanitation facilities[80].

Picture a: Evidence of run-off water from SWM station to neighbors as perceived by residents

Picture b: Exposed roots due to run-off water as perceived by residents

Picture c: Potential aluminum roof damage as perceived by residents

Figure 19: Perceived social effects surrounding SWM stations

Indigenous People

Water supply and Quality. In the indigenous communities located near the stations in Saramacca, water is supplied to taps located near the houses. Reservoirs/pump systems are rarely seen in these communities. Residents still use creeks for recreational purposes and cooling down during hot days. Some characteristics of these specific areas are:

[80] Multiple Indicator Cluster Survey 2018 Suriname. Unicef/ABS. July 2019

- **Maho**. Only the southern part of the village has SWM water supply. Maho has several outside located taps from which residents collectively tap water for general household activities. Due to intermittent water supply, residents rely on nearby wells to collect water. Residents think the water has a weird smell. Several families have left Maho because of the poor water situation (families with babies, people who need clean water for medical purposes).
- **Grankreek**. Similar to Maho, resident have outside taps to collect water. When the water has a chlorine smell or taste, they collect water from a northern-located creek for drinking, cooking and bathing as an alternative.
- **Columbia**. Residents rely on outside taps to collect water. Residents are aware of the chlorine smell but drink the water anyway because they lack alternatives.

5.2.10 Energy and Transportation

a. Energy

District Wanica

Electricity is supplied by the Government-owned company Energie Bedrijven Suriname (EBS) from the following sources: i) energy generated by hydropower (Afobakadam in district Brokopondo), ii) energy generated through diesel generators in Paramaribo, iii) energy generated by diesel generators from State Oil Company and Suralco LLC.

In Wanica, most residential areas are connected to the electricity grid. Over the years there has been a 25% increase in the number of connections in Wanica from approximately 35,000 to 44,000 (see Figure 20). Besides the higher use, residents had to pay more for electricity. According to ABS[81], in the period 2013-2017, the registered price increase was 262.5% for household connections, 40.9% for commercial connections and 77.1% for industrial connections.

Once there is an electrical outage, the area is depleted of water supply due to the lack of a backup generator at the Helena Christina station. On average over the period 2014-2018, electric outages occurred for approximately 32 hours per year. For 2017 and 2018, outages take on average more than 3 hours while before that time outages were much shorter: 2.19 hours in 2014, 2.21 hours in 2015 and 1.27 hours in 2016[82] (Figure 21).

[81] ABS. 2018. 8th Environment statistics publication. Suriname: General Bureau of Statistics. Statistical yearbook 2016/2017 Suriname. Suriname: General Bureau of statistics-Suriname.

[82] EBS stroomuitval Helena Christina. SWM data

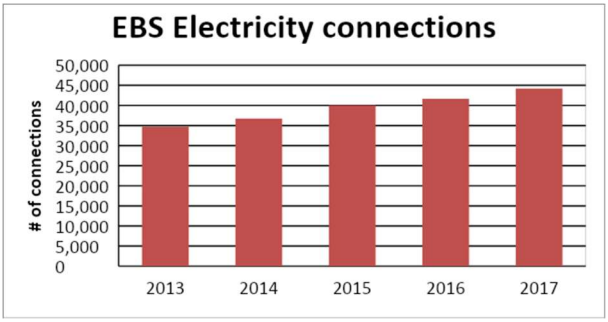

Figure 20: EBS electricity connections in Wanica 2013-2017

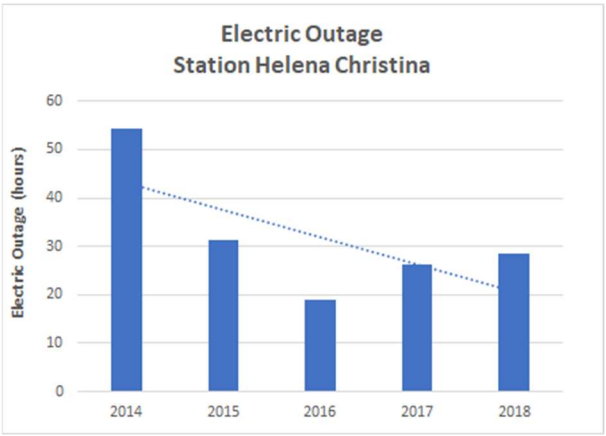

Figure 21: Electric outage at station Helena Christina 2014-2018

District Saramacca

Electricity. The electricity supply is provided by the Energie Bedrijven Suriname (EBS). Almost all residential areas are connected to the electricity grid. The current number of connections for Saramacca was 5101 in 2013 and increased to approximately 12,000 in 2017.

In Tijgerkreek, the area is depleted of water supply when there is an electrical outage because of SWM lacks a backup generator.

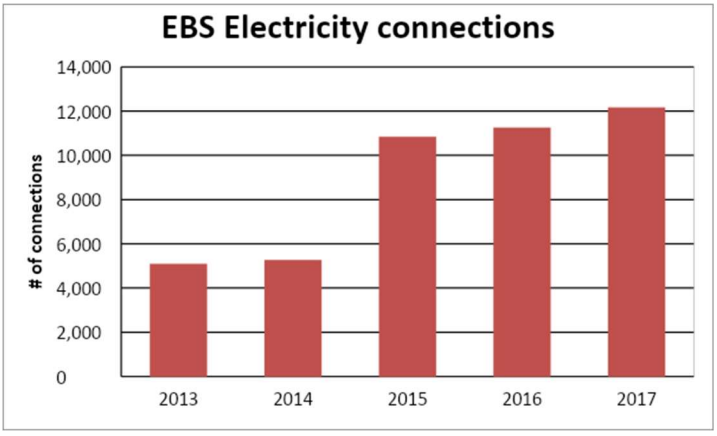

Figure 22: EBS electricity connection in Saramacca 2013-2017

c. Roads and Transportation

Traffic safety has been a major concern in Suriname. The annual amount of traffic victims recorded has been on the high-end of the world average of 21 fatalities per 100.000 inhabitants[83]. Suriname recorded 75 fatalities in 2016 - this roughly equals to 15 fatalities per 100.000 inhabitants. This amount has remained high in the last seven years.

District Wanica

Road Network. The road network in Wanica is characterized by a system of main roads running both East-West and North-South. These main roads are bordered with secondary and tertiary roads, which provide access to the areas on either side from the main roads. In 2017, the majority of roads in Wanica were sandy roads (630.6 km, 57.7%), followed by asphalt roads (376.74 km, 34.4%). A small number of roads are paved (86.4km, 7.9%)[84].

The station Helena Christina is located along a paved road.

Road Transportation. Transport is mainly provided by private taxis and private bus operators. Public services from the National Transport Company run buses on a scheduled service from Paramaribo to Helena Christina on set hours five times a day from Monday through Saturday.

Waterways. Wanica's main waterways are the North-South running Suriname river and the East-West running Saramacca canal (Figure 23). Both these waterways are used for shipping and water management.
Domestic shipping occurs mainly through the Saramacca canal, especially wood logs and other raw materials coming from the extractive industry. Although this canal can drain areas on both the north and south, it has insufficient capacity to adequately remove access water from Paramaribo, Wanica and Saramacca.

[83] World Health Organization, 2009. Global Status Report on Road Safety. Switzerland.

[84] ABS. 2018. 8th Environment statistics publication. Suriname: General Bureau of Statistics.

Figure 23: Wanica's main waterways

District Saramacca

Road Network. The road network in Saramacca is characterized by a system of main roads running both East-West and North-South. These main roads are bordered with secondary and tertiary roads, which provide access to the areas on either side from the main roads. In 2017 Saramacca had 128.1 km (43.1%) of asphalt roads, 2.3 km (0.7%) of roads were paved, and 166.7 km (56.1%) were sandy roads[85].
The stations in Kampong Baroe and Tijgerkreek are located along paved roads, and station Groningen is located along a sandy road.

Road Transportation. Public transport is provided by locally operating private bus services and public sector government bus services (NVB)[86].
Tijgerkreek (Peperhol). NVB and privately-owned companies run busses from Paramaribo to Tijgerkreek along the East-West road respectively five and four times a day on a set schedule of Monday through Saturday.
Groningen, Kampong Baroe and Maho. NVB runs busses from Groningen through Kampong Baroe to Maho three times a day on a set schedule of Monday through Saturday, and Sunday/holiday schedule two times a day.
A direct bus route between Tijgerkreek and Groningen doesn't exist. People who want to make this journey have to take the bus to the crossing (rotunda) at the East-West road and then have two options: i) wait for a bus with on average waiting time of 1-2 hours, ii) ask for a ride from someone else.

[85] ABS. 2018. 8th Environment statistics publication. Suriname: General Bureau of Statistics.
[86] http://nvbnv.sr/

Air Transportation. Large banana and rice companies use small airplanes for supporting agricultural production. These airfields are mostly located at or near the agricultural company site.

Waterways. Water transport mainly takes place for industrial purposes, in particular via the Saramacca river near Catharina Sofia and Sara Maria operations, where ships from the State Oil company transport heavy petroleum via de Suriname river to the Atlantic Ocean.

Figure 24: Saramacca's main waterways

5.2.11 Other Activities in the Area

a. Oil Exploration

The State Oil Company of Suriname conducts appraisal activities to establish the presence of producible reservoirs, find more reserves, and secure future development drilling programs and upgrade contingent reserves. The company focuses on the northern strip between the East-West road and the Atlantic Ocean stretching from Paramaribo.

The proximity of oil exploration activities to the project is explained below and in Figure 25.

- Helena Christina station is located in the Weg naar Zee exploration block.
- Kampong Baroe station is located in the Uitkijk exploration block. Staatsolie is planning to carry out an appraisal drilling program of four wells in this area between 2018-2021[87].
- Groningen is located in the Tambaredjo exploration block.

[87] Environmental and Social Impact Assessment (ESIA) for the Uitkijk Appraisal Drilling Program (ADP) 2018 Draft ESIA Report- November 2018

- Tijgerkreek (Peperhol) station is located in the Calcutta exploration block. In this block, both dry- and wetland operations are being executed for oil extraction.

According to the annual plan of the company[88], these onshore drilling operations will be continuing and potentially expanding to the Coppename Nature reserve, located north in the area of the Tijgerkreek station.

Figure 25: Location of study sites and State oil exploration blocks

[88] 2017 Annual Report Staatsolie

b. Agriculture and Animal Husbandry

District Wanica

The Helena Christina station is located in Wanica district which has a suburban-agricultural character: Most houses are located along the roads and adjacent to these houses, there exists agricultural activity, totaling approximately 1,250 ha of cultivated lands.

Between 10 and 40% of the land owned by households is being used for planting crops and other activities such as:

- Annual crops: paddy, vegetables, cassava and other roots, watermelon, peanuts and other legumes
- Permanent crops: banana and plantain, citrus, coconut and other fruits
- Milk production: dairy production on pasture lands.

An overview of the land use for agriculture in Wanica is shown in Figure 26.

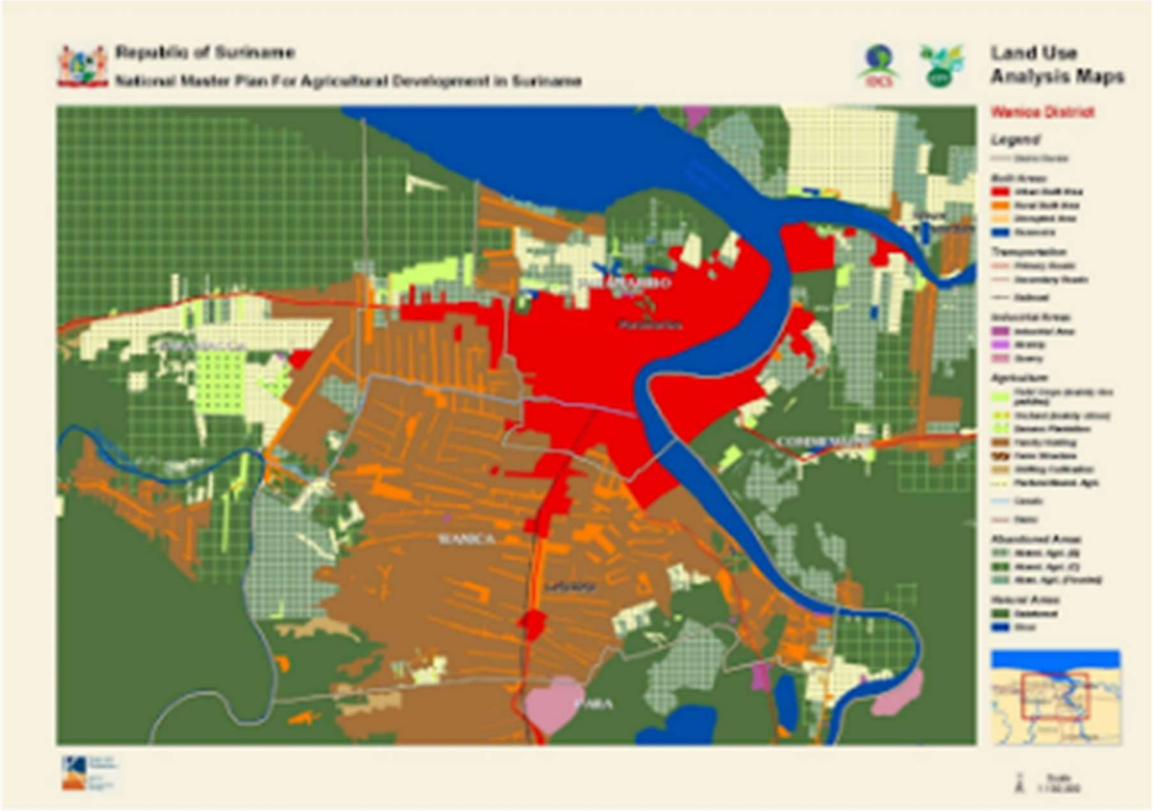

Figure 26: Agricultural land-use map of Wanica Source: Kaplan, 2016

District Saramacca

The Groningen, Kampong Baroe and Tijgerkreek (Peperhol) stations are located in district Saramacca characterized by a large variety of agricultural activities, totaling about 2,180 hectares:

- Family-run agriculture, usually small-holdings or collective farms cultivating crops paddy, vegetables and roots, bananas and plantains and citrus
- Banana plantations and wide-scale privately owned territories: i) banana plantations of 939 and 170 hectare and located along the eastern side, adjacent to Wanica, ii) a 1473 hectare agricultural area near Uitkijk, iii) a 2,685 hectares in area between the banana plantations and the main road.
- Part of it is abandoned but has not been covered by forest.
- Abandoned lands. Some of it may be used for pasture.

Agricultural crops are mainly watered by canals or self-made wells. Field interviews reported incidents of dying vegetables (pepper, eggplant, celery) and dying animals (birds) when supplying chlorine-containing tap water[89].
An overview of the land use for agriculture in Saramacca is shown in Figure 27.

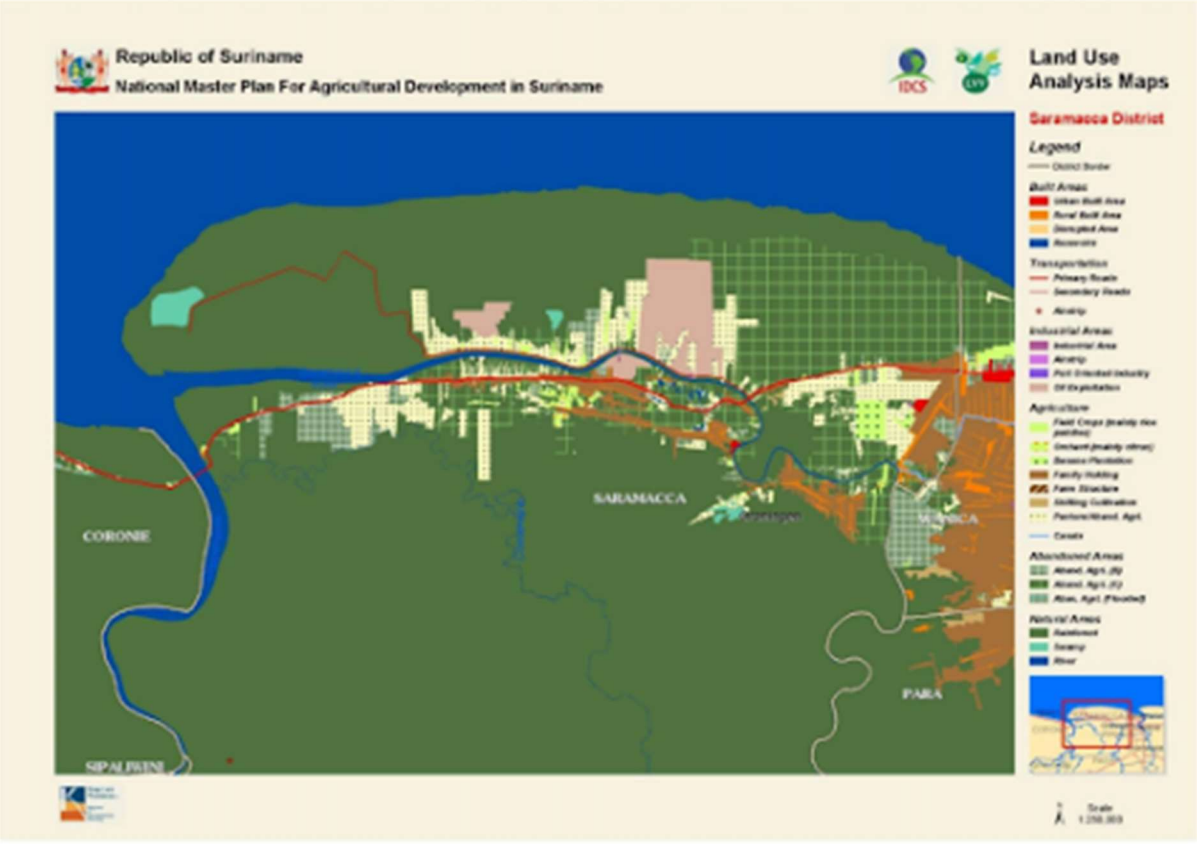

Figure 27: Agricultural land-use map of Saramacca. Source: Kaplan, 2016

[89] The National Master Plan for Agricultural Development in Suriname. 2016. Kaplan Planners Ltd.

6. Environmental and Social Impact Assessment

This chapter provides an analysis of the potential direct and indirect impacts, both positive and negative, that will result from the proposed construction and operations phases. The criteria used to determine the significance of each impact are presented in Section 1.3.2.

6.1 Identification and Analysis of Environmental Impacts

The activities of this project consist mainly of the rehabilitation of 4 pump stations in poor conditions and to increase the treatment capacity to be able to meet expected demands. Therefore, it is not expected that the existing land use at all project locations will be changed. Nonetheless, some temporary minor impacts on the environment might occur during both the construction and operational phase.

Through the impact assessment, appropriate and practicable management measures are recommended to address the impacts. The mitigation measures are intended to avoid, minimize and/or reduce potential negative impacts while optimization measures are intended to generate, maximize and/or enhance potential benefits of the project. A comprehensive suite of relevant mitigation or optimization measures are presented in each impact table.

6.1.1 Potential Soil Contamination

Leaks and spills from vehicles and machinery during the construction and operations phases may potentially contaminate soil resources. This could directly affect the shallow groundwater in the project site.

The quantities of pollutants that may be released into the environment from leaks and spills are likely to be small during normal construction and operations phase activities. Nevertheless, such leaks and spills, and the resulting impact on soil resources, may occur frequently. The impact is considered reversible but can be medium-term if no mitigation measures are implemented. Potential impact of contamination of soil from small leaks and spills during the construction and operations phases is therefore considered to be of negligible effect when mitigation measures are applied (Table 42).

Table 42: Significance of potential contamination of soil resources from small leaks and spills

Environmental Impact:		Potential contamination of soil resources from small leaks and spills.				
Without mitigation	Positive/ Negative	Magnitude	Duration	Scale	Probability	Overall
	Negative	Medium	MT	SS	Medium	Moderate
Key mitigation measures/Recommendations:						
• Conduct preventive maintenance for vehicles and machinery to reduce/avoid leaks.						
• Use spill prevention measures such as drip trays during refueling, bunds around storage tanks, etc. to capture spills and contain any leaks.						
• Ensure all on site staff are trained in the use of spill prevention measures						
• Clean up any spills (including existing spills) immediately, through containment and removal of free product and appropriate rehabilitation or disposal of contaminated soils.						
With mitigation		Magnitude	Duration	Scale	Probability	Overall
		Low	ST	SS	Low	Negligible

6.1 2 Landscape Changes (Visual Impacts)

The proposed expansion and enhancement project will not change the current landscape character but will contribute to the continuing development of the distribution area of each pump station. The impact during the construction and operations phases is therefore assessed to be of negligible effect, with or without the implementation of the recommended mitigation measures (Table 43).

Table 43: Significance of impact on landscape (visual quality)

Environmental Impact:		7.1.1.2. Landscape changes (visual impacts)				
Without mitigation	Positive/ Negative	Magnitude	Duration	Scale	Probability	Overall
	Negative	Low	ST	SS	Low	Negligible
Key mitigation measures/Recommendations:						
• Create green areas and/or plant trees around the perimeter of the site to act as a visual screen.						
With mitigation		Magnitude	Duration	Scale	Probability	Overall
		Low	LT	SS	Low	Negligible

6.1.3 Impact on Land Use

Land uses near the project sites comprise agricultural and residential activities. The potential impact on current land use in the surrounding areas during the construction and operations phases is considered negligible as project activities occur only at the existing pump stations. (Table 44).

Table 44: Significance of impact on land use

Environmental Impact:		Impact on land use				
Without mitigation	Positive/ Negative	Magnitude	Duration	Scale	Probability	Overall
	Negative	Low	LT	SS	Low	Negligible
Key mitigation measures/Recommendations:						
• Create green areas and/or plant trees around the perimeter of the site to act as a visual screen between building complex and nearby visual receptors. .						
With mitigation		Magnitude	Duration	Scale	Probability	Overall
		Low	LT	SS	Low	Negligible

6.1.4 Air quality Impacts from Emissions

Emissions can occur during the preparation of the land (e.g. demolition of existing infrastructure, land clearing, and earth moving), and during construction. They can vary substantially from day to day, depending on the level of activity, the specific operations being undertaken, and the weather conditions.

The expected air pollutants emitted from the construction site that can influence the air quality in surrounding areas, are:

- Emissions from mobile equipment, and
- Dust as result from increased traffic, vehicular movements, piling of construction material, and landscaping.

The magnitude of potential air quality impacts from the above sources is considered to have a medium effect on the environment, as follows:

- Earthworks will take place
- Construction materials, such as sands, will be transported to and stocked on site
- Number of heavy equipment will increase
- Emissions of exhaust fumes.

The impacts from the construction phase are expected to be medium-term (only during construction lifetime). The potential impact of reduced air quality on surrounding communities during the construction phase therefore is assessed to be of moderate effect, but with the implementation of mitigation measures it can be reduced to negligible effects (Table 45).

Table 45: Significance of reduction in air quality and impaired human health due to construction phase emissions

Environmental Impact:		Reduction in air quality and impaired human health				
Without mitigation	Positive/ Negative	Magnitude	Duration	Scale	Probability	Overall
	Negative	Medium	ST	SS	Medium	Minor
Key mitigation measures/Recommendations:						
• Maintain all generators, vehicles, and other equipment in good working order to minimise exhaust fumes						
• Spray stockpiles with water during windy and dry conditions						
With mitigation		Magnitude	Duration	Scale	Probability	Overall
		Low	ST	SS	low	Negligible

During the operations phase, the impacts on air quality are considered negligible as the electrical will not produce emissions.

6.1.5 Impacts on Climate Change

The movement of construction vehicles and the transport of construction materials, equipment and workers to and from work sites as well as the construction of the transmission lines for raw and treated water may cause traffic jams along the access roads. The number and duration of traffic jams due to activities from the project are expected to increase moderately during the construction phase. This will result in the increase of greenhouse emissions that contribute to climate change. Therefore, the impacts from air emissions on climate change are considered of moderate effect during the construction phase. With the implementation of the mitigation measures, those impacts can be reduced to minor effects (Table 46). During the operation phase the impact is expected to be of minor effect.

Table 46: Significance of impacts on climate change

Environmental Impact:		Impacts on Climate Change				
Without mitigation	Positive/ Negative	Magnitude	Duration	Scale	Probability	Overall
	Negative	Medium	ST	MS	High	Moderate
Key mitigation measures/Recommendations:						
• Maintain all equipment in proper working order to avoid excessive gas emission						
• Communicate with the traffic police when transporting materials or working at access roads that may cause traffic jams						
• Where possible, avoid activities that may cause traffic jams during the rush hours.						
With mitigation		Magnitude	Duration	Scale	Probability	Overall
		Medium	ST	MS	Low	Minor

6.1.6 Noise and Vibration Impacts

Noise and vibration measurements have not been conducted during this study. The assessment of noise and vibration impact on the surrounding communities during the construction phase is based mainly on assumptions and field observations.

It is expected that this impact will be temporary (at most for the duration of the construction phase, although not all construction phase activities will generate the same level of noise or vibration) and will be localized. The intensity of the potential impact is rated as moderate, due to the uncertainties around the noise-generating activities on site. However, the impacts may be reduced to minor effects when necessary measures are taken (Table 47).

Table 47: Significance of impact of noise on surrounding communities during the construction phase

Environmental Impact:		Noise and vibration impacts				
Without mitigation	Positive/ Negative	Magnitude	Duration	Scale	Probability	Overall
	Negative	Medium	ST	MS	High	Moderate
Key mitigation measures/Recommendations:						
• Maintain all equipment in proper working order to avoid excessive noise generation						
• If complaints regarding noise are received from residents, consider installing partial screening around the noisiest activities and/or mufflers on noisy equipment						
• Where possible, restrict working times during construction to between 7 am and 5 pm on weekdays. Notify any nearby receptors if noisy construction work is planned outside of those times						
With mitigation		Magnitude	Duration	Scale	Probability	Overall
		Medium	ST	MS	Low	Minor

Noise and vibrations during the operations phase are likely to be caused by the pumps and compressors as well as vehicles of employees but are unlikely to cause damage or nuisance as this equipment is already being used at the current pump stations.

6.1.7 Impacts on Water Resources

Surface Water

Small amounts of pollutants (e.g. hydrocarbons) might enter the trenches during construction phase, due to leaks and small spills. In the operation phase, the impact to those trenches are likely to be caused by the discharge of backwash water from the filters. This water usually contains high concentration of iron, manganese and/or ammonium. However, the trenches are constructed with the main purpose to receive discharge water from all types of sources along its way. This would be the

case at Helena Christina and Kampong Baroe. At Groningen and Tijgerkreek, it is not recommended to discharge directly into the canal adjacent to the pumping stations, as these canals are larger and flow directly into the Saramacca River. In order to avoid direct discharge of water rich in iron, manganese, ammonium or any other pollutant into the environment, it is recommended that all pumping stations are provided with interceptors where the excess of pollutants can be trapped. The interceptors should be cleaned up regularly and the sediments can be disposed of at landfills (Table 48).

Table 48: Significance of impact on trenches during the operation phase

Environmental Impact:		Impact of increased turbidity and sedimentation in the trenches or canals during the operation phase				
Without mitigation	Positive/ Negative	Magnitude	Duration	Scale	Probability	Overall
	Negative	Medium	MT	SS	Low	Minor
Key mitigation measures/Recommendations:						
• Construct interceptors at all pumping stations to trap sediment and excessive pollutants						
• Clean up interceptors regularly to maintain optimal performance						
With mitigation		Magnitude	Duration	Scale	Probability	Overall
		Low	ST	SS	Low	Negligible

Groundwater

Leaks and spills of contaminants on land during construction and operations phase activities may contaminate underlying groundwater. Contamination is unlikely to penetrate further than the sub-surface groundwater at the project sites.

The extraction of groundwater, on the other hand, may cause some significant impacts, such as:

- Excessive pumping can overdraw the groundwater storage. When groundwater is pumped out faster than it is replenished over the long-term the groundwater volume will decline and subsequently, this will lead to depletion of the aquifer;
- Salinization of groundwater. Excessive pumping out of groundwater may also lead to intrusion of saline groundwater. Over time the fresh groundwater will be substituted by saline groundwater which will lead to the closing of the groundwater well.
- Contamination of aquifer. Drilling and operating groundwater wells must be conducted in such way that contamination of the aquifer should be prevented. SWM procedures for drilling and groundwater well management must be followed strictly.

Table 49 presents the significance of impact to groundwater wells

Table 49: Significance of potential contamination of groundwater resources.

Environmental Impact:		Potential contamination and depletion of groundwater resources				
Without mitigation	Positive/ Negative	Magnitude	Duration	Scale	Probability	Overall
	Negative	Medium	MT	SS	Medium	Moderate
Key mitigation measures/Recommendations:						
• Follow SWM procedures for drilling and management of groundwater wells						
• Conduct studies regarding the replenishment of groundwater, especially in the project areas						
• Ensure that extraction of groundwater is done sustainably						
• Monitor the quality of the groundwater						
With mitigation		Magnitude	Duration	Scale	Probability	Overall
		Low	MT	SS	Low	Minor

6.1.8 Impacts from Solid Waste

It is expected that during the construction phase lots of waste will be generated. Construction waste may be generated from site clearance, landscaping, demolition of existing facilities, and road works. In addition, packaging materials, disposable (kitchen) material from the workers, removed/substituted meters and pipes will also be part of the generated solid waste at the construction site. During the operations phase, the project sites will have more office waste, such as papers, disposable material, etc.

Waste recycling possibilities are still limited in Suriname. Therefore, all of the generated waste will likely be disposed of in the public landfill at Ornamibo or other in district Saramacca.

The impacts from solid waste is considered to be minor during both the construction and operations phase. With the implementation of the mitigation measures, those impacts will be reduced to negligible effects (Table 50).

Table 50 : Significance of impacts from solid waste

Environmental Impact:		Impacts from solid waste				
Without mitigation	Positive/ Negative	Magnitude	Duration	Scale	Probability	Overall
	Negative	Low	MT	SS	Medium	Minor
Key mitigation measures/Recommendations:						
• Develop and implement waste management plan during construction and operation phase						
• Identify local waste handlers to encourage recycling or re-use of certain waste types						
• Segregate waste at the project sites to reduce waste generation						
• Adopt proper policy for purchase of products to reduce waste generation as much as possible						
With mitigation		Magnitude	Duration	Scale	Probability	Overall
		Negligible	ST	SS	Low	Negligible

6.1.9 Summary of Environmental Impacts

In Table 51 a summary of potential environmental impacts is presented.

Table 51: Summary of potential environmental impacts

				Option 1	Option 2		
	Impact		Positive +/ Negative -	Helena Christina	Kampong Baroe	Groningen	Tijgerkreek (Peperhol)
	During Construction						
C.1	Potential Soil Contamination	Without mitigation	-	Moderate	Moderate	Moderate	Moderate
		With mitigation	-	Negligible	Negligible	Negligible	Negligible
C.2	Landscape Changes (Visual Impacts)	Without mitigation	-	Negligible	Negligible	Negligible	Negligible
		With mitigation	-	Negligible	Negligible	Negligible	Negligible
C.3	Land Use	Without mitigation	-	Negligible	Negligible	Negligible	Negligible
		With mitigation	-	Negligible	Negligible	Negligible	Negligible
C.4	Air quality from Emissions	Without mitigation	-	Minor	Minor	Minor	Minor
		With mitigation	-	Negligible	Negligible	Negligible	Negligible
C.5	Impacts on Climate Change	Without mitigation	-	Moderate	Moderate	Moderate	Moderate
		With mitigation	-	Minor	Minor	Minor	Minor
C.6	Noise and Vibration Impacts	Without mitigation	-	Moderate	Moderate	Moderate	Moderate
		With mitigation	-	Minor	Minor	Minor	Minor

C.7	Waste Generation and Disposal	Without mitigation	-	Moderate	Moderate	Moderate	Moderate
		With mitigation	-	Minor	Minor	Minor	Minor
	During Operations						
O.1	Potential Soil Contamination	Without mitigation	-	Moderate	Moderate	Moderate	Moderate
		With mitigation	-	Negligible	Negligible	Negligible	Negligible
O.2	Air Quality from Emissions	Without mitigation	-	Minor	Minor	Minor	Minor
		With mitigation	-	Negligible	Negligible	Negligible	Negligible
O.3	Impacts on Climate Change	Without mitigation	-	Moderate	Moderate	Moderate	Moderate
		With mitigation	-	Minor	Minor	Minor	Minor
O.4	Noise and Vibration Impacts	Without mitigation	-	Moderate	Moderate	Moderate	Moderate
		With mitigation	-	Minor	Minor	Minor	Minor
O.5	Waste Generation and Disposal	Without mitigation	-	Moderate	Moderate	Moderate	Moderate
		With mitigation	-	Minor	Minor	Minor	Minor

6.2 Identification and Analysis of Social Impacts

This section describes and assesses the potential impacts of the projects on the socio-economic environment, as well as the gender considerations.

6.2.1 Land Acquisition

The project may involve the construction of two new wells on land owned by third parties (non-SWM) once Option 1 (Helena Christina) is chosen. Residents occupying these lands may use land for housing and income generating activities such as agricultural or livestock production, which is quite common in the Helena Christina area. The aim of the water supply project should avoid the need for physical displacement. Yet, the livelihood of people in the study area can be affected/altered.

Because of the lack of the proximate location of wells, we make the following assumptions for well construction: i) wells are located near the street and there is plenty of land to choose wells of 20x20m, ii) land will have to be from third parties, or is Government owned, iii) wells will only take a small amount of the privately owned land[90]. When making these assumptions, it is likely that involuntary resettlement or economic displacement can be avoided in design because there are multiple options to choose wells. Yet, there is always a chance for displacement of economic activities or involuntary resettlement when design information is incomplete to make a full assessment, which is the case in this study.

Land acquisition will pose a moderate risk to the project (Table 52). The implementation of recommended management measures would reduce the magnitude and of the negative impact, because good rapport with residents and adequate land acquisition procedures are expected to lower the negative effect to the residents. The overall impact then becomes minor.

[90] These assumptions were acquired from the IDB.

Table 52: Significance of impact of construction on land acquisition

Social Impact:		Land acquisition				
Without mitigation	Positive/ Negative	Magnitude	Duration	Scale	Probability	Overall
	Negative	Medium	LT	SS	High	Moderate
Key mitigation measures/Recommendations:						
• Update/revise procedures and work instructions on land acquisition						
• Establish and maintain open communication and transparency with affected residents						
• Prepare and implement a land acquisition plan						
With mitigation		Magnitude	Duration	Scale	Probability	Overall
		Low	LT	SS	High	Minor

6.2.2 Labor and Working Conditions

The project is expected to be constructed by contractors as Terms of References are currently being developed. Project construction should promote adequate working conditions for which requirements are outlined in the Suriname Safety Act 1947.

The construction sector is prone to heavy workloads/extended working hours and this has been widely practiced, making construction has the 3rd highest number of casualties in Suriname.

In case daily working hours need extension above the legally allowed 8.5 hours or on Sundays/holidays, a special permit is required. However, now that Suriname exists in an economic depression, construction workers can become motivated to work extra hours, which can cause fatigue and pose a safety risk.

Construction work is characterized by short-term labor with low-entry levels; no diplomas are required which makes workers easily replaceable. Labor rights of short-term workers often are neglected and therefore efforts should be made to protect such rights in the same way as full-time workers.

In case labor rights are violated, construction workers should have an opportunity to complain. Mechanisms to handle grievances in projects are not required under Suriname law and therefore are often non-existent. Therefore, grievance redress should be available to protect all construction workers against unfair and unsafe workplaces.

Violation of labor and working conditions can occur at the building sites of all SWM pump stations during the time of construction. Labor rights violations are expected to have low-level damage to the social function of the workers, leading to an overall negligible impact (Table 53).

The implementation of recommended management measures wouldn't reduce the magnitude of the negative impact, because the risk for violating labor rights will stay the same. However, the measure will stimulate good working relations and fair treatment, an indicator of a better quality of life at the job site.

Table 53: Significance of impact of construction on labor rights violation

Social Impact:		Violation labor rights (All study sites)				
Without mitigation	Positive/ Negative	Magnitude	Duration	Scale	Probability	Overall
	Negative	Low	ST	SS	Medium	Negligible
Key mitigation measures/Recommendations:						
• Include environmental and social requirements of this report in the TOR for contractor						
• Prepare and implement a health and safety plan including stipulation on workers' awareness about labor rights						
• Post posters explaining workers' rights on strategic locations on site						
• Project management should plan and monitor over-work hours						
• Establishment of grievance redress mechanism						
• Workers, contractors and subcontractors are hired based on the existing labor rights policies (gender inclusion and equal treatment of workers)						
With mitigation		Magnitude	Duration	Scale	Probability	Overall
		Low	ST	SS	Medium	Negligible

6.2.3 Occupational Health and Safety

Health and safety hazards include those that come from physical, chemical and other hazards associated with the construction process. Building multi-level storage tanks and filtration system can pose dangers to workers:

- Falling or getting struck by falling objects which can cause injury to head, eyes other body parts, and sometimes even death.
- Injuries coming from manual handling of building materials and tools, such as sawing, grinding etc.
- Unexpected moving objects from on-site traffic can put workers at risk
- Slip and fall in places that are not properly maintained
- Injury from repetitive motion, over-exertion, and manual handling
- Waste hazards coming from lubricants that leaked into the soil
- Handling of toxic materials such as chlorine injectors
- Intense light released when welding iron and other metals
- Handling of asbestos containing materials
- Faulty electrical breakers, panels, cables, cords etc. can cause (deadly) electrical shock to workers
- Excessive noise (>85dB) for more than 8 hours.

Construction-related occupational health and safety hazards are expected to occur inside and outside the fences of the SWM stations (the latter because of moving objects). SWM's occupational health and safety standards need improvement to cover all risks identified for the current project.

The overall impact is categorized as moderate (Table 54). The implementation of recommended management measures (in compliance with the local safety laws and regulations) would reduce the probability of a health and safety injury because protective measures are taken. The overall impact then becomes minor.

Table 54: Significance of impact for occupational hazards

Social Impact:		Occupational health and safety (All study sites)				
Without mitigation	Positive/ Negative	Magnitude	Duration	Scale	Probability	Overall
	Negative	High	ST	SS	Medium	Moderate
Key mitigation measures/Recommendations:						
• Include environmental and social requirements of this report in the TOR for contractor						
• Promote use of Personal Protective Equipment (PPE) on site: safety glasses, plastic helmets, ear plugs, safety shoes, and gloves						
• Keep clear traffic ways on site and signs						
• Keep designated areas for material handling, including hazardous materials						
• Implement general Health and Safety Plan for construction and operations						
• Promote use of fall protection devices, such as rails or other barriers able to support a weight of 200 pounds						
• Develop fire prevention plan for hot work and other fire hazards						
• Selection of tools and workstations that reduce force requirements and holding times						
• Implement administrative controls into work processes, such as job rotations and rest or stretch breaks						
• Require licenses and work permits for hazard-prone tasks						
With mitigation		Magnitude	Duration	Scale	Probability	Overall
		High	ST	SS	Low	Minor

6.2.4 Nuisance

The building construction project comes with release of noise. Moving earth and materials can cause excessive noise release for construction workers on site, as well as people residing in the surrounding areas. This is particularly important because all stations have neighbors, either residents, business or social groups. Neighbors have reported noise with previous projects constructed by SWM.

The potential impact of nuisance is expected for the short term, only during project construction. Because of the lack of information on noise release, the magnitude of the effect is considered to be medium. The moderate effect (Table 55) may also be felt outside the construction site which will affect the surrounding residential neighborhoods.

The implementation of recommended management measures would reduce the probability of nuisance having effect on construction workers to negligible. However, the impact of nuisance on

surrounding businesses and residential areas is still present. Therefore, the overall impact stays minor.

Table 55: Significance of impact for nuisance

Social Impact:		Nuisance (All study sites)				
Without mitigation	Positive/ Negative	Magnitude	Duration	Scale	Probability	Overall
	Negative	Low	ST	MS	High	Minor
Key mitigation measures/Recommendations:						
• Include environmental and social requirements of this report in the TOR for contractor						
• Instruct workers to wear protective equipment - ear plugs, eye goggles						
• Post warning signs in areas of high noise and dust levels instructing workers to wear protective equipment						
• In the dry season, spraying against dust release will be promoted						
• Develop and implement a Health and Safety education for construction and operations						
• Maintain an open communication with neighbors about timing of release of excessive noise and dust						
• Disseminate a pamphlet to surrounding communities to inform them about times/dates of nuisance						
With mitigation		Magnitude	Duration	Scale	Probability	Overall
		Low	ST	MS	High	Minor

6.2.5 Community Health and Safety

Traffic and Traffic-related accidents

All project sites but Groningen are located along major connection asphalt roads. The roads are considered rural connecting roads and are not as busy as connecting roads in urban areas. Vehicles and other motorized traffic are allowed relatively high speeds of 50 km/h or higher. Normally vehicles have higher speeds than allowed, a phenomenon that is normal practice because the Police sporadically enforces traffic laws. The traffic fatality rate is relatively high in Suriname.

The proposed construction activities will increase the use of (heavy) vehicles for earth movement, supply/discharge of materials and transportation of persons. Also, parking of construction-related vehicles will be required in-and around the stations. Especially in Kampong Baroe and Groningen, there have been incidents reported over parking at the neighbors.

The potential impact of construction-related traffic is for the short-term. The effect is expected to expand to the main roads and connecting roads, thus in part of the study area. The impact can be overall categorized as moderate (Table 56).

Managing the risk of traffic-related accidents and injuries should include the adoption of safety measures on the roads. The implementation of recommended management measures would reduce the risk of traffic related accidents. The overall impact then becomes minor.

Table 56: Significance of construction on traffic and traffic-related accidents

Social Impact:		Traffic and traffic-related accidents				
Without mitigation	Positive/ Negative	Magnitude	Duration	Scale	Probability	Overall
	Negative	Medium	ST	MS	Medium	Moderate
Key mitigation measures/Recommendations:						
• Include environmental and social requirements of this report in the TOR for contractor						
• Minimize pedestrian interaction with construction and supply vehicles by construction of pedestrian walkways						
• Create room for parking vehicles for construction without interfering with activities of neighbors						
• Coordinate with neighbors in Kampong Baroe and Grningen for using common areas and private areas for parking						
• Collaborate with authorities to improve signage, visibility and overall safety of roads (Road Improvement Plan)						
• Educate workers and local communities about the changing situation during construction with a flyer						
• Dedicate persons to warn road users about changing conditions with signs						
• Have firs aid services on site in case of injuries						
• Coordinate with the nearest emergency room (Academic Hospital) to provide services in case of accidents on site, and with helicopter ambulance services						
• Create health and safety plan for construction and operations						
With mitigation		Magnitude	Duration	Scale	Probability	Overall
		Medium	ST	MS	Low	Minor

6.2.6 Disruption of Activities

Water Supply

With project construction, residents in the study area will be facing interruptions in water supply during the day when construction occurs. This disruption will affect residents from the four study sites differently: in Wanica, women are predominantly at home and will be affected while in study sites in Saramacca, most people are not at home during the day. For the latter, disruption of water supply is expected to have an impact, especially if it occurs after they come home (2-3pm) and during peak hours (6-8 pm).

Interruptions in water supply will be short, will affect the catchment area of each pump station and has a high probability to occur. The overall impact is moderate.

The implementation of recommended management measures would enable residents to prepare for water outages and other problems related to water supply, and this may improve the quality of life during construction. The overall impact then becomes minor.

Table 57: Significance of impact of construction on water supply in the area

Social Impact:		Disruption of water supply in the area (All study sites)				
Without mitigation	Positive/ Negative	Magnitude	Duration	Scale	Probability	Overall
	Negative	Medium	ST	LS	High	Moderate
Key mitigation measures/Recommendations:						
• Inform surrounding residents, businesses and social functions weekly about planned disruption of water on a weekly basis						
• Reach out to collaborate with surrounding residents, businesses and social functions to find solutions to problems that may arise from disruption						
• Enable the grievance redress mechanism with local modality for uptake of grievances						
With mitigation		Magnitude	Duration	Scale	Probability	Overall
		Low	ST	LS	High	Minor

Economic and Social Activities

Two of the pump stations in Saramacca have ongoing economic and social activities in their immediate surroundings: i) Kampong Baroe is located next to a mosque and an ornamental business plant, ii) Tijgerkreek (Peperhol) is located next to a supermarket. Construction will likely interfere with the activities of these neighbors during the day. The business operates during normal business hours and the mosque mostly has activities at night, but sometimes it is active during the morning hours.

Interruptions in economic and social activities will only occur during construction as most residents are employed in both districts. The effect is expected to be localized, making the overall impact negligible (Table 58).
The implementation of recommended management measures would not reduce the magnitude of the negative impact, because the nuisance will stay the same. However, the measure will stimulate good relations with the neighbors, an indicator of a better quality of life for them.

Table 58: Significance of impact of construction on economic and social activities in the area

Social Impact:		Disruption of economic and social activities in the area (All study sites)				
Without mitigation	Positive/ Negative	Magnitude	Duration	Scale	Probability	Overall
	Negative	Low	ST	SS	High	Negligible
Key mitigation measures/Recommendations:						
• Inform neighboring business and social functions weekly about planned activities						
• Reach out to collaborate with surrounding residents, businesses and social functions to find solutions to problems that may arise from disruption						
• Enable the grievance redress mechanism with local modality for uptake of grievances						
With mitigation		Magnitude	Duration	Scale	Probability	Overall
		Low	ST	SS	High	Negligible

6.2.7 Communicable Diseases

Disease Prevention

Increased incidence of communicable (sexually transmitted diseases, such as HIV/AIDS) and vector-borne diseases can pose a threat to anyone working/residing in the study sites during construction. Communicable diseases are caused by the social behavior of in-fluxing workers. For vector-borne diseases there is a higher risk because of the close vicinity to the water supply sources (wells, tanks etc.) as these can serve as a breeding ground for water-borne diseases.

Once local people get infected with communicable diseases, they have the potential to spread the disease rapidly, affect large areas, and cause short-term disruption in daily activities. The project does not specify the number of influx workers, yet it is not expected to be more than 50. The overall effect can be categorized as minor.

The implementation of recommended management measured would reduce the scale and keep disease localized and prevent disease from spreading. The overall impact then becomes negligible.

Table 59: Significance of impact of construction on communicable diseases in the area

Social Impact:		Disease prevention				
Without mitigation	Positive/ Negative	Magnitude	Duration	Scale	Probability	Overall
	Negative	Medium	ST	LS	Low	Minor
Key mitigation measures/Recommendations:						
• Regular screening and treatment of workers						
• Create health and safety plan including training requirements to raise awareness among workers about disease prevention with an information sharing strategy						
• Provide first aid health services through an on-site facility with a certified medical officer (nurse)						
• Establish a direct link with authorities to understand disease status of wider area						
• Provide access to nearby medical facilities, control programs and doctors						
• Eliminate standing water on site						
• Promote the use of repellents in the rainy season						
With mitigation		Magnitude	Duration	Scale	Probability	Overall
		Medium	ST	SS	Low	Negligible

6.2.8 Social Equality

Vulnerable Groups

Those who experience either single or multiple vulnerability due to low income, low status, single-headed households or complete dependence on SWM tap-water supply (sometimes outside the house) , may have extra trouble with storage options for water when the water supply will be shut down during the construction phase. These vulnerable groups might lack means to buy storage bins to capture enough water and manpower to carry these bins.

The effect of disruption of water supply on vulnerable groups is expected to be medium in the total study area, making the overall impact moderate (Table 60).

The implementation of recommended management measures would enable vulnerable groups to prepare for water outages and other problems related to water supply, without disruption of their monthly spending pattern. This will lower the magnitude of the impact affecting these groups. The overall impact then becomes minor.

Table 60: Significance of impact of construction on social equality in the area

Social Impact:		Social equality: vulnerable groups (All sites)				
Without mitigation	Positive/ Negative	Magnitude	Duration	Scale	Probability	Overall
	Negative	Medium	ST	LS	High	Moderate
Key mitigation measures/Recommendations:						
• Inform households about the planned shutdowns and water works e.g. flushing of local water distribution system						
• Make storage options available for particular households (bins) to avoid them to spend more money than they have budgeted						
• Make manpower available to help vulnerable groups prepare for water shutdowns						
With mitigation		Magnitude	Duration	Scale	Probability	Overall
		Medium	ST	SS	Low	Negligible

6.2.9 Social Equality

Water Quality

In Saramacca, people don't drink SWM tap water because of the odd smells and taste, and sometimes the presence of dirt and residue. Most people rely on alternative sources of drinking water (bottled water, wells or roof catchments). However, poor people (including indigenous people) don't have the means to buy bottled water, construct a well, or capture rainwater in large bins. As a result, they have to drink lower-quality tap water, and this creates a social inequality issue in the district. Although expected, the project doesn't set specific targets for improvement of water quality.

The potential positive impact of the project during operations is to remove this inequality issue for the long term. The effect of providing high quality water (for drinking purposes) is expected to benefit many people living in the catchment area of the project. The impact can be overall categorized as major (Table 61).

Table 61: Significance of potential impact of social equality

Social Impact:		Social equality: Water quality (Kampong Baroe, Groningen, Tijgerkreek/Peperhol)				
Without mitigation	Positive/ Negative	Magnitude	Duration	Scale	Probability	Overall
	Positive	Medium	LT	LS	Medium	Major
Key mitigation measures/Recommendations:						
• Not applicable						
With mitigation		Magnitude	Duration	Scale	Probability	Overall
		NA	NA	NA	NA	NA

6.2.9 Gender Equality

Increased Decision-making of Men

In Saramacca, women predominantly make decisions about water use in their households, while in Wanica these decisions are taken by women alone or women joint by their husband or living partner. The proposed project can provide a window of opportunity to inform people about SWM future plans with regards to water supply/quality and save usage of water and is this way involve both men and women equally.

The potential positive impact of the project during operations is that there might be an increase in decision making of men alone (or joint by women) in favor of water use and therefore reduce the pressure on the water distribution system. The anticipated change will be less use and lower bills, and this is expected to benefit many people living in the catchment area of the project. The impact can be overall categorized as major (Table 62).

Table 62: Significance of potential impact of gender equality

Social Impact:		Gender equality: Increased decision-making of men (All sites)				
Without mitigation	Positive/ Negative	Magnitude	Duration	Scale	Probability	Overall
	Positive	Medium	LT	LS	Medium	Major
Key mitigation measures/Recommendations:						
• Not applicable						
With mitigation		Magnitude	Duration	Scale	Probability	Overall
		NA	NA	NA	NA	NA

6.2.10 Summary of Social Impacts

In Table 63 a summary of potential social impacts is presented.

Table 63: Summary of potential social impacts

				Option 1	Option 2		
	Impact		Positive +/ Negative -	Helena Christina	Kampong Baroe	Groningen	Tijgerkreek (Peperhol)
	During construction						
C.1	Land acquisition	Without mitigation	-	Moderate			
		With mitigation	-	Minor			
C.2	Labor and Working Conditions	Without mitigation	-	Negligible	Negligible	Negligible	Negligible
		With mitigation	-	Negligible	Negligible	Negligible	Negligible
C.3	Occupational Health and Safety	Without mitigation	-	Moderate	Moderate	Moderate	Moderate
		With mitigation	-	Minor	Minor	Minor	Minor
C.4	Nuisance	Without mitigation	-	Minor	Minor	Minor	Minor
		With mitigation	-	Minor	Minor	Minor	Minor
C.5	Community Health and Safety: Traffic and traffic-related accidents	Without mitigation	-	Moderate	Moderate		Moderate
		With mitigation	-	Minor	Minor		Minor
C.6	Disruption of Activities: Water Supply	Without mitigation	-	Moderate	Moderate	Moderate	Moderate
		With mitigation	-	Minor	Minor	Minor	Minor
C.7	Disruption of Activities:	Without mitigation	-		Negligible		Negligible

	Economic and Social Activities	With mitigation	-		Negligible		Negligible
C.8	Communicable Diseases	Without mitigation	-	Minor	Minor	Minor	Minor
		With mitigation	-	Negligible	Negligible	Negligible	Negligible
C.9	Social Equality: Vulnerable Groups	Without mitigation	-	Moderate	Moderate	Moderate	Moderate
		With mitigation	-	Minor	Minor	Minor	Minor
	During Operations						
O.1	Social Equality: Water Quality		+		Major	Major	Major
O.2	Gender Equality: Increased decision making of men		+		Major	Major	Major

6.3 Viability of the Operation

The proposed project has moderate or less significant environmental and social impacts which can become minor or negligible when implementation of proposed mitigation and management measures are implemented. The operation is environmentally and socially viable with full implementation of the ESMP.

In addition, potentially, a significant positive impact will be made when considering upgrading water quality. However, the project description gave insufficient information about what improvement will be made on the quality of water, and thus this potential impact is excluded from the viability analysis.

7. Environmental and Social Management Plan

The application of appropriate and practical management measures is intended to avoid, reduce potential negative impacts and optimize measures to generate, maximize and/or enhance potential benefits of the project. Key management measures are summarized in this section. Recommendations regarding monitoring requirements and contingency plans are also presented in this section. The ESMP is also designed with the long-term aims of:

- Encouraging and achieving the highest environmental and social performance and response from all employees and contractors
- Ensuring that management efforts are proactive and focused to prevent impacts from occurring
- Supplementing the proactive approach with reactive measures to minimize the severity or significance of any impacts that cannot be prevented at source.

Therefore, the ESMP serves as a tool to guide management and monitoring of impacts, and in the event that impacts are found to be higher than initially predicted in the ESA, additional mitigation measures should be implemented to control, reduce or prevent impacts from occurring.

7.1 Description of the Proposed Mitigation Measures

The mitigation measures for the environmental and social risks which are discussed and assessed in the ESA report is presented in Table 64 for Environmental Mitigation Measures and Table 65 for Social Mitigation Measures.

These tables also provide an overview of the monitoring and performance evaluation (indicators, monitoring methods and frequency) of the proposed mitigation measures.

Table 64: Recommendations for Environmental Mitigation Measures

No.	Management Aspect	Recommendations	Responsible Person	Monitoring and Performance Evaluation		
				Performance Indicators	Monitoring Methods	Monitoring Frequency
Construction Phase						
C.1	Potential Soil Contamination	Conduct preventive maintenance for vehicles and machinery to reduce/avoid leaks.	SWM	Preventive Maintenance Schedule	Inspection	According to Manufacturer Manual
		Use spill prevention measures such as drip trays during refueling, bunds around storage tanks, etc. to capture spills and contain any leaks.	SWM	Number of spills	Incident report	Monthly
		Ensure all on site staff are trained in the use of spill prevention measures	SWM	Number of training	Training track record	As needed
		Clean up any spills (including existing spills) immediately, through containment and removal of product and appropriate rehabilitation or disposal of contaminated soils.	SWM	Number of spills	Incident report	Monthly
C.2	Landscape Changes (Visual Impacts)	Create green areas and/or plant trees around the perimeter of the site to act as a visual screen.	SWM	Number of trees planted	Observation	Quarterly

C.3	Land Use	Create green areas and/or plant trees around the perimeter of the site to act as a visual screen between building complex and nearby visual receptors. .	SWM	Number of trees planted	Observation	Quarterly
C.4	Air quality from Emissions	Maintain all generators, vehicles, and other equipment in good working order to minimise exhaust fumes	SWM	Preventive Maintenance Schedule	Inspection	According to Manufacturer Manual
		Spray stockpiles with water during windy and dry conditions	SWM	Dust suppression record	Inspection	Weekly
C.5	Impacts on Climate Change	Maintain all equipment in proper working order to avoid excessive gas emission	SWM	Preventive Maintenance Schedule	Inspection	According to Manufacturer Manual
C.6	Noise and Vibration Impacts	Maintain all equipment in proper working order to avoid excessive noise generation (see Table 66 and 67).	SWM	Preventive Maintenance Schedule	Inspection	According to Manufacturer Manual
		If complaints regarding noise are received from residents, consider installing partial screening around the noisiest activities and/or mufflers on noisy equipment	SWM	Number of complaints	Inspection	Monthly
C.7	Waste generation and disposal	Develop and implement waste management plan during construction and operation phase	SWM	Amount of waste disposed of	Waste record	Monthly

Operational phase						
O.1	Potential Soil Contamination	Conduct preventive maintenance for vehicles and machinery to reduce/avoid leaks.	SWM	Preventive Maintenance Schedule	Inspection	According to Manufacturer Manual
		Use spill prevention measures such as drip trays during refueling, bunds around storage tanks, etc. to capture spills and contain any leaks.	SWM	Number of spills	Incident report	Monthly
		Ensure all on site staff are trained in the use of spill prevention measures	SWM	Number of training	Training track record	As needed
		Clean up any spills (including existing spills) immediately, through containment and removal of free product and appropriate rehabilitation or disposal of contaminated soils (See Table 66).	SWM	Number of spills	Incident report	Monthly
O.2	Air quality from Emissions	Maintain all generators, vehicles, and other equipment in good working order to minimise exhaust fumes	SWM	Preventive Maintenance Schedule	Inspection	According to Manufacturer Manual
		Spray stockpiles with water during windy and dry conditions	SWM	Dust suppression record	Inspection	Weekly

O.4	Noise and Vibration Impacts	Maintain all equipment in proper working order to avoid excessive noise generation (See Table 67)	SWM	Preventive Maintenance Schedule	Inspection	According to Manufacturer Manual
		If complaints regarding noise are received from residents, consider installing partial screening around the noisiest activities and/or mufflers on noisy equipment	SWM	Number of complaints	Inspection	Monthly
O.5	Waste generation and disposal	Develop and implement waste management plan during construction and operation phase	SWM	Amount of waste disposed of	Waste record	Monthly
O.6	Increased turbidity and sedimentation in the trenches or surface water	Construct interceptors at all pumping stations to trap sediment and excessive pollutants	SWM	Water quality record	Field and lab measurements	Monthly
		Clean up interceptors regularly to maintain optimal performance	SWM	Number of clean ups	Inspection	Monthly
O.7	Contamination and depletion of groundwater resources	Follow SWM procedures for drilling and management of groundwater wells	SWM	Number of incidents	Inspection	Monthly
		Ensure that extraction of groundwater is done sustainably	SWM	Production record	Production record	Monthly
		Monitor the quality of the groundwater	SWM	Water quality record	Field and lab measurements	Monthly

Table 65: Recommendations regarding Social Mitigation Measures

No	Management Aspect	Recommendations	Responsible Person	Monitoring and Performance Evaluation		
				Performance Indicators	Monitoring Methods	Monitoring Frequency
Construction Phase						
C.1	Land acquisition	Revise procedures and work instructions for land acquisition	SWM	Procedures and work instructions	Operations manual	Pre-construction phase
		Prepare and implement land acquisition plan	SWM		Land acquisition plan	
		Establish and maintain open communication and transparency with affected residents	SWM	Number of meetings	Communication report	

C.2	Labor and working conditions	Prepare and implement a health and safety plan including stipulation on workers' awareness about labor rights	SWM/ Contractor/ Ministry of Labor	Number of accidents	Safety records	Monthly
		Include environmental and social requirements of this report in the TOR for contractor			TOR	
		Post posters explaining workers' rights on strategic locations on site		Visual observations		Quarterly
		Project management should plan and monitor over-work hours		Overwork policy	Employment records	
		Establishment of grievance redress mechanism		Number of complaints	Database on grievance redress	
		Workers, contractors and subcontractors are hired based on the existing labor rights policies		Hiring policy	Employment records	

C.3	Occupational health and safety	Promote use of Personal Protective Equipment (PPE) on site: safety glasses, plastic helmets, ear plugs, safety shoes, and gloves	Construction Contractor	Number of accidents	Safety records	Monthly
		Keep clear traffic ways on site and signs				
		Keep designated areas for material handling, including for hazardous materials				
		Implement general Health and Safety Plan				
		Include environmental and social requirements of this report in the TOR for contractor			TOR	
		Promote use of fall protection devices, such as rails or other barriers able to support a weight of 200 pounds		Number of accidents	Safety records	Monthly
		Develop fire prevention plan for hot work and other fire hazards				
		Selection of tools and workstations that reduce force requirements and holding times				
		Implement administrative controls into work processes, such as job rotations and rest or stretch breaks				
		Require licenses and work permits for hazard-prone tasks		Licenses		

		Update/revise/develop OHS guidelines including general ad program-specific protection	SWM	Procedures and work instructions	Operations manual	
C.4	Nuisance	Instruct workers to wear protective equipment - ear plugs, eye goggles	Construction Contractor	Percentage of workers who received instructions	Employment record	Quarterly
		Post warning signs in areas of high noise and dust levels instructing workers to wear protective equipment		Visual observations		
		In the dry season, spraying against dust release will be promoted (road to Groningen)				
		Include environmental and social requirements of this report in the TOR for contractor			TOR	
		Develop and implement a Health and Safety education program for workers		Program outcome	Program report	Quarterly
		Maintain open communication with neighbors about timing of release of excessive noise and dust	SWM/Construction Contractor	Number of meetings	Communication report	
		Disseminate a pamphlet to surrounding communities to inform them about times/dates of nuisance				

C.5	Community Health and Safety: Traffic and traffic-related accidents	Minimize pedestrian interaction with construction and supply vehicles by construction of pedestrian walkways	Ministry of Public Works/ Police/Construction Contractor	Number of road accidents	Road safety records	Monthly
		Create room for parking vehicles for construction without interfering with activities of neighbors	Construction Contractor			
		Coordinate with neighbors in Kampong Baroe and Groningen for using common areas and private areas for use/parking				
		Collaborate with authorities to improve signage, visibility and overall safety of roads (Road Improvement Plan)				
		Educate workers and local communities about the changing situation during construction with a flyer				
		Create health and safety plan for construction and operations				
		Include environmental and social requirements of this report in the TOR for contractor			TOR	
		Have first aid services on site in case of injuries		Number of first-aid accidents	Health report	Monthly
		Coordinate with the nearest emergency room to provide services in case of				

		accidents on site (including ambulance services)				
C.6	Disruption of activities in the area: Water Supply	Inform surrounding residents, businesses and social functions weekly about planned disruption in water supply on a weekly basis	SWM/Construction Contractor	Emails, letters etc.	Communication report	Monthly
		Reach out and collaborate with surrounding residents, businesses and social functions to find solutions to problems that may arise from disruption				
		Enable the grievance redress mechanism with local modality for uptake of grievances	SWM	Number of grievances resolved within time frame	Grievance report	Monthly
C.7	Disruption of activities in the area: Economic and Social Activities	Inform neighboring businesses and social functions weekly about planned activities	SWM/Construction Contractor	Emails, letters etc.	Communication report	Monthly
		Reach out and collaborate with surrounding businesses and social functions to find solutions to problems that may arise from construction activities				
		Enable the grievance redress mechanism with local modality for uptake of grievances	SWM	Number of grievances resolved within time frame	Grievance report	Monthly

C.8	Communicable Diseases	Regular screening and treatment of workers	Construction Contractor	Number of sick persons	Health records	Monthly
		Create health and safety plan including training requirements to raise awareness among workers about disease prevention with an information sharing strategy				
		Establish direct link with authorities to understand disease status of wider area				
		Provide access to nearby medical facilities, control programs and doctors				
		Promote the use of repellents in the rainy season				
		Eliminate standing water on site		Visual observation		
C.9	Social Equality: Vulnerable Groups	Inform households about the planned shutdowns and water works e.g. flushing of the local water distribution system	SWM	Emails, letters etc.	Communication report	Monthly
		Make storage options available for these particular households (e.g. bins), to avoid them to spend more money than they have budgeted		Number of bins distributed at vulnerable groups	Project reports	Biweekly
		Make manpower available to help vulnerable groups prepare for shutdowns		Number of households helped with manpower		

7.2 Worker Health and Safety

7.2.1 Goals and Objectives

SWM is obliged to implement all reasonable precautions to protect the health and safety of its workers. The goal of this workers health and safety plan is to exercise reasonable precautions and manage the principal risks to occupational health and safety when implementing the water supply modernization program.

The objectives are:

- Improve all existing regulations on SWM worker health and safety
- Develop worker safety and health guidelines for new structures and equipment to be constructed under the new program in Helena Christina (option 1) or Kampong Baroe, Groningen and Tijgerkreek (option 2).

7.2.2 Improvement of General OHS Guidelines

SWM's occupational health safety guidelines are summarized in their Safety Book. This book outlines the requirements for each worker (including contractors) when working under supervision of SWM. Following IFC requirements on Occupational Health and Safety (OHS) guidelines, some recommendations for improvement are given in Table 66.

Table 66: Assessment of current safety regulations/book

Gap/ Constraint	Guidelines in SWM Safety Book	Recommendations for improvement following IFC OHS guidelines	Type of improvement
Workers and supervisors	The book provides regulations for both workers and supervisors which can be confusing to the reader	Maintain a general safety book for workers and an addendum specifically for supervisors	S
Personal safety	The book starts with regulations that require PPE, but this topic is only discussed at the end	The chapter on housekeeping (personal safety) should come before the different safety regulations. Include a table with hazards and required PPE for workers Areas where PPE's are required should be delimited and signs of required PPE's should be placed	S/A
Language	The language of the book is complicated and contains grammatical errors	The language should be: 1) simplified for workers from all levels to understand what is meant, 2) include examples, 3) review by a Dutch language editor	F

Rationale	Explanation on why safety measures have to be taken are missing	Improve explanation of why safety measures have to be taken - make a link between hazard and required action	A
Benchmarks	There are no company benchmarks for workers to assess when they are required to take action. Decisions are made based on personal benchmarks	Include benchmarks in the safety regulations, where applicable	A
Reporting	The book suggests workers to report different hazards. but there lacks designation of the body/person they have to report to	Include the person or body to which workers have to report and create reporting templates	A
Training	No mention of OHS training requirements for workers, contractors, and visitors	Include OHS training requirements for workers, contractors and visitors	A
Chemical safety	No mention of chemical safety* including transport and use of hazardous chemicals	Include section on chemical safety including transport, use, storage and disposal of hazardous chemicals	A
Emergency preparedness and response	No mention of emergency response measures	Include section on emergency response measures for general operational related hazards and sudden disasters	A

Legend
S=structural, A=addition, F=formulation

Occupational health instructions are also given in the work instruction “Personal Hygiene” (O WB S W 011). This instruction was unavailable at the time of this study.

7.2.3 Program-Specific OHS Guidelines

The ongoing process to identify and assess hazards in order to fix them is a core element of any effective safety and health plan. Failure to identify or recognize hazards is frequently one of the “root causes” of workplace injuries, illnesses, and incidents and indicates that the safety and health program is ineffective. Hazard assessment can lead to opportunities to improve program performance.

In addition to the general OHS safety requirements, the following guidelines should apply for the water supply program (Table 67).

Table 67: OHS guidelines specific to the Modernization Water Supply Program

Proposed work	Potential hazard	Proposed OHS guidelines
Water sources		
Locating and drilling new water wells	High levels of noise (>85dB)	Use earplugs Delimit area where PPE's are required Place signs of required PPE's
Rehabilitation of existing water wells		
	Power lines and electric cables at the worksite	-Inventory and verification of underground electrical wires -Locate power lines and avoid cross-connections -Check all electrical equipment working properly -Ensure Tag Out-Lock Out Verification (TOLOV) procedure is in place and implemented
Transmission line construction for raw water	Live power lines	-Have trained workers on site -Deactivate live power lines before work -Keep distance from hot wires unless trained for its use
Transmission line construction for treated water		
	Work at heights on poles and structures	-Test structures for integrity prior to undertaken work -Develop and implement a fall protection program: inspection, maintenance, replacement of fall protection equipment and rescue in case of fall -Use safety belt and second belt when using tools at heights -Use appropriate tool bag
	Electric and magnetic fields	-Research exposure levels -Training of workers -Identify and label safety zones -Safety action plan when workers are exposed to high levels
	Exposure to chemicals	-Train personnel to apply pesticides -Respect post-treatment intervals with pesticide application

Road restauration and pavement	Traffic safety	-Establishment of work zones to separate workers on foot from traffic and equipment -Reduction of maximum vehicle speeds in work zones -Training of workers in safety issues such as hazards working around equipment and vehicles
	Chemical hazards	-Use of correct asphalt product and correct temperature for application -Maintenance of work vehicles and machinery to minimize air emissions
	High levels of noise	Use earplugs
Water treatment and pumping		
Rehabilitation or/and construction of new treatment facilities (including sedimentation/flocculation, aeration, filtration) Rehabilitation or/and construction of new storage tanks Rehabilitation or/and installation of electromechanical equipment Minor construction works at the site	Accidents and injuries	-Install railing around process tanks and pits - Use fall protection equipment when working at heights -Maintain work areas to minimize slipping and tripping hazards -Use proper techniques for trenching and shoring -Implement fire and explosion prevention measures -Implement traffic controls when repairing mains adjacent to roadways such as work zones, reduced speed, high visibility safety apparel, proper illumination for night work -Locate underground utilities before digging
	Chemical exposure and hazardous atmospheres	-Implement a safety training program for workers handling chlorine, ammonia and asbestos -Prepare emergency response and an escape plan -Install safety showers and eye wash stations at site -Ventilate enclosed processing areas and periodically sample air quality where applicable -Prohibit eating, smoking, drinking except in designated areas
	High levels of noise	Use earplugs

7.3 Contingency Plan

Planning for emergencies can lessen the impact of most emergency situations. The contingency plan is a guide for SWM staff to follow in case of an emergency to ensure public health is protected during and services are restored after the emergency. Preparing an effective contingency plan is a structured process that will involve coordination of staff from the public water system and other key organizations. An effective plan incorporates the natural or man-made emergencies a system can reasonably expect and should incorporate information from the system's vulnerability analysis and vulnerability assessment.

Vulnerability Analysis

SWM needs to prepare a system vulnerability analysis to adequately develop a water system contingency plan. A vulnerability analysis is intended to indicate how SWM would operate in emergency or disaster situations. A vulnerability analysis will disclose how well the company provides service to its customers under normal operating conditions and more particularly under abnormal or emergency conditions. In order to be effective, the vulnerability analysis must be done in a detailed, structured manner. The primary results of the analysis will be an identification of points of system vulnerability, a prioritized schedule for elimination of major points of system vulnerability, estimates of the reduced system capability (quality and quantity) caused by emergency situations, and the time required to return the system to normal operation after the occurrence. The analysis would best be accomplished in three steps:

1. The first step is to inventory and characterize seven water system components which should be analyzed for failures that might incapacitate the system. These include the source of water, the treatment facilities, the transmission and distribution lines, storage facilities, water system personnel, records (plans, operating manuals, etc.), and indirect components. Indirect components include electric power, supplies and materials, communications including telemetry and facility and personnel security. (The last two indirect components may also be classified as direct components depending upon the individual system.) The analysis should go into detail about the system, such as identifying valve locations and spacing, spare pumps, storage capacity, stocks of expendable materials and spare parts, operator training, and system records.
   The inventory should also identify existing weak spots within the system, such as corroded valves, severely corroded chlorination equipment, defective electrical wiring, severely pitted pump impellers. This first step serves two functions – it creates a detailed portrait of the entire system and it identifies potential weak spots within a system which, for one reason or another, cannot be easily rectified within a short time span. Apparently minor items may increase the severity of a problem during an emergency situation. Once potential problem areas are identified, corrective measures should be prioritized, and steps taken to correct these deficiencies. Timetables for implementation, including time and funding commitments should be established.

2. The next step in the vulnerability analysis process is to estimate service capability during emergency conditions. The idea is to anticipate as many potential system breakdowns as possible.

Breakdowns should be categorized as the results of natural disasters, man-made crises, or operational failures. For example, an emergency condition may be distribution system leaks caused by earth movements (a natural disaster), treatment plant shut down caused by vandalized controls (a man-made crisis), or an inactive flocculation basin caused by the breakdown of an intake pump (an operational failure). The extent of the emergency condition should include the probable severity of the event, such as the severity of the earthquake, the amount of damage to system controls, or the severity of the problems encountered with broken pumps. After identifying all possible failures, SWM should estimate the quality and/or quantity of water available under the conditions created by each identifiable failure. These estimates will permit the water utility to predetermine the water quality and/or quantity that would be available for customer service during all conceivable emergency situations. All estimates should be made for the system as it exists (including known weak spots) and for the system after remedial measures have been taken (which will improve the system's reliability). Seven water system components should be analyzed for failures that might incapacitate the system. These include the source of water, treatment facilities, transmission and distribution lines, storage facilities, water system personnel, records (plans, operating manuals, etc.), and indirect components (electric power, supplies and materials, communications including telemetry and facility and personnel security).

3. One last step required is to complete the analysis – estimate how long the system would have to operate on a reduced basis under each emergency situation. This estimate needs to include anything that will impact how long it will take to return to normal service, including the time needed for procuring any materials, parts, and outside services, the time needed to repair damaged system components, the time necessary to sterilize contaminated components, or the availability of trained personnel. This portion of the analysis allows SWM to estimate potential down time and to develop a plan for alternate water supplies when a significant loss of capability occurs over an extended period of time.

7.4 Proposed EHS Management System

Within SWM, some elements of EHS management are already in place, but other aspects need to be developed. It is important that all the elements are incorporated into the EHS management system. An initial status review should be carried out to obtain information on the scope, adequacy, and implementation of the current management system. The initial status review will indicate where SWM stands with respect to managing EHS related risks.

Environmental Health and Safety Policy

Top management should set in place procedures to define, document, and endorse a formal EHS policy for the company. The policy should clearly outline the roles and expectations for SWM, EHS personnel, and individual employees. It should be developed in communication with EHS personnel to ensure that all major concerns are adequately addressed.

The EHS policy should at least state intent to:

- prevent or mitigate both human and economic losses arising from accidents, adverse occupational exposures, and environmental events
- build EHS considerations into all phases of the operations
- achieve and maintain compliance with laws and regulations
- continually improve EHS performance.

The EHS policy and policy statement should be reviewed, revalidated, and where necessary, revised by top management as often as necessary. It should be communicated and made readily accessible to all employees and made available to relevant interested parties, as appropriate.

Management Commitment

Management commitment to EHS performance is one of the most critical elements to EHS program success and to the development of a strong culture of safety within SWM. Therefore, the management system document should establish management commitment with a formal statement of intent, which defines actions of how performance goals are supported.

Planning

Planning is an integral part of all elements of the management system and to be effective involves the design and development of suitable processes and organizational structure to manage EHS aspects and their associated risk control systems proportionately to the needs, hazards, and risks of the company.

Implementation

The design of management arrangements should reflect the company's business needs and the nature of their risks. However, there should be appropriate activity across all elements of the model (policy; planning; implementation; performance measurement, audits, and change management; and management review).

Specifically, SWM should make arrangements to cover the following key areas:

- overall plans and objectives, including employees and resources, for the company to implement its policy
- operational plans to implement arrangements to control identified risks
- contingency plans for foreseeable emergencies and to mitigate their effects (e.g., prevention, preparedness, and response procedures)
- plans covering the management of change of either a permanent or a temporary nature (e.g., associated with new processes or plant working procedures, production fluctuations, legal requirements, and organizational and staffing changes)
- plans covering interactions with other interested parties (e.g., control, selection, and management of contractors; liaison with emergency services; visitor control)
- performance measures, audits, and status reviews
- corrective action implementation
- plans for assisting recovery and return to work of any staff member who is injured or becomes ill through work activities
- communication networks to management, employees, and the public
- clear performance and measurement criteria defining what is to be done, who is responsible, when it is to be done, and the desired outcome
- education and training requirements associated with EHS
- document control system
- contractors should have written safety plans and qualified staff whose qualifications are thoroughly reviewed before a contract is awarded. All contractor personnel should be required to comply with SWM's safety policies and plans.

Performance Measurement

The primary purpose of measuring EHS performance is to judge the implementation and effectiveness of the processes established for controlling risk. Performance measurement provides information on the progress and current status of the arrangements (strategies, processes, and activities) used by SWM to control risks to EHS. Measurement information includes data to judge the management system by:

- gathering information on how the system operates in practice,
- identifying areas where corrective action is necessary, and
- providing a basis for continual improvement.

All of the components of the EHS management system should be adequately inspected, evaluated, maintained, and monitored to ensure continued effective operation. Risk assessment and risk control should be reviewed in the light of modifications or technological developments. Results of evaluation activities are used as part of the planning process and management review, to improve performance and correct deficiencies over time.

Management Review of EHS Management System

Top management should review the company's EHS management system at regular intervals to ensure its continuing suitability, adequacy, and effectiveness. This review includes assessing

opportunities for improvement and the need for changes in the management system, including the EHS policy and objectives. The results of the management review should be documented.
Among other information, a management review should include the following:

- results of EHS management system audits
- results from any external audits
- communications from interested parties
- extent to which objectives have been met
- status of corrective and preventive actions
- follow-up actions from previous management reviews
- recommendations for improvement based on changing circumstances.

The outputs from management review should include any decisions and actions related to possible change to EHS policy, objectives, and other elements of the management system, consistent with the commitment to continual improvement.

The management system review ensures a regular process that evaluates the EHS management system in order to identify deficiencies and modify them. Systemic gaps, evidence that targets are not being met, or compliance issues that are discovered during compliance or risk assessments indicate a possible need for revision to the management system or its implementation.

7.5 Program Management for the ESMS

Overall Coordination. The HSEQ Department should have overall responsibility for the implementation of the ESMS. This Department should coordinate its efforts with the Operations and Production Departments for technical implementation and with the Information Department for informing the community living around the project construction sites.

Staff Assignment. HSEQ should assign at least one senior staff member for overall coordination. Each project site should have one local staffer who is assigned with supervision of the contractor and SWM staff on EHS matters.
Social-related matters, such as grievance redress mechanism and information sharing with residents, will be handled by one assigned staff member from the Information Department. This person can also work with the local government authorities for support.
Resettlement planning (if needed) and public consultation should be planned and supervised with an outside expert because of the limited experience with this sensitive issue.

Activities. The following activities will be carried for ESMS implementation of moderate impacts during construction and operation phases:

Environmental management

- Manage the environmental, health and safety management program
- Develop and deploy EHS procedures
- Ensure contractors are complying with the EHS requirements
- Carry out job hazard analyses
- Conduct incident investigations
- Perform EHS inspections
- Ensure that environmental, health, and safety training is delivered
- Ensure EHS regulatory compliance
- Monitor EHS performance
- Maintenance of EHS records
- Prepare regular EHS reports
- Review and update EHS program

Social management

- Coordinate with staff in SWM to establish rapport with residents
- Update contractor TOR including all ESMS recommendations
- Develop resettlement plan
- Implement public consultation
- Develop/update procedures on involuntary resettlement
- Implement grievance redress mechanism
- Develop general health and safety plan for contractors to use
- Develop/update OHS guidelines
- Development of information sharing materials for residents
- Create provisions for water supply disruption vulnerable groups (bins, manpower)
- Monitoring of environmental, health and safety on site
- Environmental awareness program implementation (optional)

Time Schedule. Activities are outlined for the ESMS are shown in the Table below. For this time schedule, it is assumed that construction will take up to 6 months.

Table 68: Time schedule for execution of the ESMS

	Activity	**Design**	**Construction**						**Operations**		
	Month	0	1	2	3	4	5	6	7	8	9
Environmental management											
1	Manage the environmental, health and safety management program		**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
2	Develop and deploy EHS procedures	**X**									
3	Ensure contractors are complying with the EHS requirements		**X**	**X**	**X**	**X**	**X**				
4	Carry out job hazard analyses		**X**	**X**	**X**	**X**	**X**				
5	Conduct incident investigations		**X**	**X**	**X**	**X**	**X**				
6	Perform EHS inspections		**X**	**X**	**X**	**X**	**X**				
7	Ensure that environmental, health, and safety training is delivered	**X**									
8	Ensure EHS regulatory compliance		**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
9	Monitor EHS performance		**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
10	Maintenance of EHS records		**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
11	Prepare regular EHS reports		**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
12	Review and update EHS program		**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**

Social management											
1	Coordinate with staff in SWM to establish rapport with residents	**X**									
2	Update contractor TOR including all ESMS recommendations	**X**									
3	Develop resettlement plan	**X**									
4	Implement public consultation inclusive support to stakeholders	**X**									
5	Develop/update procedures on involuntary resettlement	**X**									
6	Implement grievance redress mechanism	**X**									
7	Develop general health and safety plan for contractors to use	**X**									
8	Develop/update OHS guidelines	**X**									
9	Development of information sharing materials for residents	**X**									
10	Create provisions for water supply disruption vulnerable groups (bins, manpower)		**X**	**X**	**X**	**X**	**X**	**X**			
11	Monitoring of environmental, health and safety on site		**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
12	Environmental education program implementation								**X**	**X**	**X**

Indicative Budget. The budget gives a rough indication of the costs for the ESMS. This budget is general given the lack of detailed information on the technical aspects and the choice of Option. Staff assignment and operational aspects from SWM departments are not considered in this budget.

Table 69: Indicative budget for ESMS implementation

	Post	Reference to ESMP	Details	Costs (U$)
1	**Personnel**		SWM staff	0
	Land acquisition plan	Social impact C.1	Social expert	10,000
	Environmental education baseline survey and training		Social expert	10,000
	EHS training for SWM workers	Environmental impact	Environmental expert	10,000
	Logistics for water bin distributions	Social impact C.9	Logistics person	1,000
2	**Materials**			3,000
	Information sharing materials			5,000
	Water bins	Social impact C.9		10,000
	Campaign advertising			
3	**Consultations (incl NRW)**			
	Venue			2,000
	Food and drinks			3,000
4	**Transportation**			
	Transportation of water bins	Social impact C.9		3,000
	Transportation for consultations			2,000
5	**NRW related costs**	NRW ESMF	see supplementary study	20,000
	Total			79,000

7.6 Environmental Education Plan

7.6.1 Current Situation

Environmental education one of the tasks of SWM's information department. With three staff members, the information department is responsible for a series of activities including i) social media management including channeling grievances to customer service from this medium, and ii) general information sharing activities: information session for elementary schoolchildren, weekly radio programs, TV programs and during special events e.g. water week. Also, middle and high school students can obtain general information about water and water operations from this department. Recently, SWM has started airing a program about water quality on TV for which they have received positive feedback from the general public.

With the transfer of management from the Ministry of Natural Resources to SWM in 2016, the treatment process was changed, and water was being chlorinated. SWM had limited means to inform consumers of this change and at the same time, build their capacity on environmental and social issues. As a result, amongst others, the general perception of water quality is low because consumers believe that there is excess chlorine in the water (Helena Christina, Kampong Baroe, Groningen) or they are confronted with a muddy taste and smell (Tijgerkreek).

7.6.2 Goals

The ultimate goal of this environmental education plan is to have water users that are “aware of, and concerned about, the environment and its associated problems, and which has the knowledge, skills, attitudes, motivations and commitment to work individually and collectively toward solutions of current problems and the prevention of new ones”.
With regard to the water modernization project, this means to sensitize water users to the environmental and social problems with regard to water quality and use. Water users should develop skills to make responsible decisions and are committed to act upon these decisions, especially for the sustainable use of water.

The following goals are envisaged for having a sustained environmental education program:

1. Strengthen SWM’s capacity to provide comprehensive environmental education programs and activities
2. Increase environmental awareness of water users in various target areas
3. Create local support networks as a means of surveillance and implementation of environmental education programs

7.6.3 Action Items

The following action items are needed to reach the goals (Table 70).

Table 70: Action plan for environmental education in SWM

Goal 1: Strengthen SWM’s capacity to provide comprehensive environmental education programs	
Objective 1: Increase the number of environmental educators at the SWM	Proposed activities: • Train/educate selected individuals at region level to be responsible for environmental education • Institutionalize those individuals with appointed position and budget • Ensure continuous training opportunities for appointed individuals internationally to stay up to date
Objective 2: Develop key media contacts with reporters and other contacts as an opportunity to environmentally educate the public about sustainable water management	Proposed activities: • Identify media contacts that can contribute to SWM sustainable water strategy • Develop and send information packages to those media contact to promote future use
Objective 3: Measure environmental awareness levels among key target audiences	Proposed activities: • Quantitative and qualitative surveys of awareness-levels of water users conducted periodically (at least once a year)

Objective 4: Increase planning and funding efforts for environmental education	Proposed activities: • Structurally incorporate results from environmental education surveys and discussions in regular planning activities • Ensure budget for environmental education through regular Government funding and active seeking of donor funds at third parties
Goal 2: Increase environmental awareness of water users in various target areas	
Objective 1: Develop and disseminate information materials to water users using a targeted approach for rural areas	Proposed activities: • Design pamphlets on water-management related issues according to targeted group's culture, socio-economic status, activities and gender • Disseminate pamphlets to water users through regional offices, youth clubs and other means
Objective 2: Organize environmental education events and provide opportunities for public participation	Proposed activities: • Organize school quizzes in collaboration with local schoolteachers • Organize or add-on to local community events to engage the public in water education
Objective 3: Improve public access to quality environmental education information and resources.	Proposed activities: • Include environmental education in social media postings • Create library for resources on SWM website for the public to access • Create simple district level libraries at local rural offices for basic information (fact sheets and documents)
Objective 4: Organize regular radio/TV programs for target audiences in appropriate formats	Proposed activity: • Create and broadcast radio and TV programs to demonstrate how individual behaviors and daily choices are related to a healthy environment

Goal 3: Create local support networks as a means of surveillance and implementation of environmental education	
Objective 1: Select and appoint local youth to create water clubs and become eyes and ears on the ground	Proposed activity: • In collaboration with local schools, create youth water clubs, where youth will function as promoters in SWM activities (awareness surveys, surveillance with cellphones, and other activities)
Objective 2: Structurally network with water scientists from other places than SWM (University etc., water forum) to regularly discuss environmental and social water problems	Proposed activities: • Hold a biyearly discussion on integrated water management with water scientists with environmental education as one topic for discussion • Incorporate input from these discussion in regular environmental education planning efforts
Objective 3: Collaborate with local organizations who are engaged in environmental education activities in Suriname.	Proposed activities: • Identify organizations for collaboration using risk-management tools • Collaborate with selected organizations to combine efforts to lower costs e.g. use field structures, contacts etc.

8. Consultation Plan

8.1 Short Description of the Project

This consultation plan was compiled to provide an overall framework for implementation of the proposed activities under the loan SU-L1058 “Water Supply Modernization Program” sought by the Government of Suriname to be financed by the IDB. The Government is seeking this financing for the purposes of improving the efficiency, quality, and sustainability of the potable water services provided by the Suriname Water Supply Company (SWM).

The general objective of the proposed operation is to improve efficiency, quality, and financial and environmental sustainability of the potable water services provided by SWM. The specific objective of Component 2 is to increase availability of water supply services in critical areas of Suriname through upgrading water production infrastructure.

Activities financed under this component will address the more salient interventions under the framework of the Master Plan (SWSMP) and SWM current needs. The component will finance infrastructure works required to rehabilitate pump stations in poor conditions and for SWM to increase the treatment capacity and be able to meet projected demands. Two options are being considered; both will address water supply concerns for the medium to long term in their respective Districts. Both options have comparable cost estimates.

The Program will finance only one of the two options identified by SWM: 1) Helena, Christina in Wanica, where an additional production capacity of 240m^3/h is required; 2) Kampong Baroe, Groningen, and Peperhol in Saramacca, where an additional 300m^3/h are required in total. The definition of the intervention location(s) will be discussed with the Government of Suriname based on a technical analysis to confirm its feasibility, estimated costs, and cost-effectiveness. Prioritization criteria will be developed as part of the Technical Analysis to select the most cost-effective option.

A second part of the project targets Non-Revenue Water (NRW) reduction. This component aims to reduce any loss of water due to physical losses (leaks and theft from the water system) or commercial losses unpaid or incorrect bills. The SWM will implement its 2015 NRW reduction strategy with specific focus in the Central (Paramaribo, Wanica, and Para) and Western (Nickerie) regions. Specific activities will include: i) Strengthening of the NRW unit, ii) installation of meters and service connections, iii) pressure management; and iv) energy efficiency.

Following the IDB’s Environmental and Safeguards Policies, the project’s environmental and social impacts and risk of the infrastructure to be financed were determined for the construction and operational phases of the project.

The project will bring a set of moderate impacts that can become minor or negligible with mitigation and management measures.

For the **physical environment**, potential significant impact on the aquifer can occur if excessive extraction is conducted. Therefore, it is necessary that water production from the wells is monitored closely to avoid excessive extraction as well as contamination or salinization of the groundwater. During construction, a series of moderate impacts are expected from influences from climate change, noise and vibration and waste generation and disposal. A minor impact is expected from air quality derived from emissions. Both moderate and minor impacts can become negligible with adequate mitigation measures. Further examination on noise is needed due to lack of data.
During operations, a potential moderate impact can occur from soil contamination, impacts on climate change, noise and vibration and waste generation and disposal. These impacts can become minor or negligible with adequate mitigation measures.

For the **social environment**, during construction, mitigation and management measures are necessary to avoid resettlement issues of well construction at the Helena Christina site, mainly through choices in the design of the works. Other moderate impacts on the surrounding social environment at specific sites are: i) occupational health and safety, ii) traffic and traffic related accidents, and iii) disruption of economic and social activities, iv) social inequality with vulnerable groups e.g. indigenous people, women etc. All these moderate impacts become minor or negligible with adequate management measures.
During operations, positive impacts are expected to occur when the water quality is improved and when there is increased participation of men in decision-making on water issues.

8.2 Identification of the Stakeholders

Stakeholder engagement envisages to involve people who may be affected by the project or can influence the project. Stakeholders were identified using the categorization of their interest in the project and their level of influence over the project as: i) high interest/high influence, ii) high interest/low influence, iii) low interest/low influence (Table 71).

Table 71: Identified stakeholders for the water supply modernization project

Stakeholder	Area/location					General interest
	PAR	HC	KB	GRO	TIJ	
High interest/high Influence						
SWM, Department of Planning and Research	X					Provide safe drink water to all residents in the service area
SWM, Department Operations	X					
SWM local management	X	X	X	X	X	
Ministry of Public Works	X	X	X	X	X	
Ministry of Natural Resources	X	X	X	X	X	Overall coordination national water supply
Inter-American Development Bank	X					Loan preparation according to IDB operational guidelines
Ministry of Natural Resources, Water Supply Department	X	X	X	X	X	On demand drink water supply
Local Government: District commissioner (DCs) and officials (BOs)	X	X	X	X	X	Be aware of, and provide support to the activities planned by SWM
High interest/low influence						
Commercial farmers (agriculture, livestock)		X	X	X	X	Water for pesticide application, watering plants or drinking of cattle
Food sellers			X	X		Clean water for food preparation
School			X	X	X	Water for flushing bathrooms and cleaning
Supermarkets, hardware and other store owners		X	X	X	X	Water for flushing bathrooms and cleaning
Medical clinic/post			X	X		Clean water for operations
Religious worship houses			X	X		Water for flushing bathrooms and cleaning
Fire station				X		
Police				X		
Chamber of Commerce				X		
Telesur communication	X			X		, ,

Energy Company Suriname	X			X		
Agricultural office (LVV)				X		
Guesthouse				X		
Education center					X	
Women's groups		X	X	X	X	Clean water for livelihood
Single headed households		X	X	X	X	Clean water for livelihood
Indigenous community in Maho			X			Clean water for livelihood
Indigenous community in Columbia				X		Clean water for livelihood
Indigenous community in Grankreek				X		Clean water for livelihood
Households with collection bin or well		X	X	X	X	Clean water for livelihood
Households connected to tap		X	X	X	X	Clean water for livelihood
Low interest/low influence						
Sand excavator		X	X			No disturbance in operations
Staatsolie oil operation			X	X	X	No disturbance in operations

Legend: PAR=Paramaribo
HC=Helena Christina
KB=Kampong Baroe
GRO=Groningen
TIJ=Tijgerkreek (Peperhol)

Vulnerable stakeholders

Vulnerable stakeholders were identified (Red colored Xs in Table 71) on the basis of their low socio-economic status and low level of influence over the project:

- Indigenous community of Maho, Grankreek and Columbia
- Households connected to the tap in areas where water quality is low
- Single-headed households in all areas

Both these relatively poor group of residents in the study areas are unable to purchase bottled water or don't have the means to acquire other ways to collect water (well, collection bin/pump system) than from the tap. They are completely dependent on the availability and quality of SWM tap water.

In addition to these two groups, are rural women in a lower status position than men. We found four women's groups in Wanica of which one is active and concentrates on social cultural wellbeing and

two active sport groups. In Saramacca, we identified six women's groups which are all sport oriented. One of these is inactive and of two we were unable to acquire information at the time of the study (Table 72).

Table 72: Women's groups in District Wanica and Saramacca

Name women's organization	Address	Contact person	Telephone	Type of organization	Activity status
District Wanica					
Vr. Org. Curacaoweg en omgeving	Curacao Weg	Mevr. Djojoseparto, M	08787381	Sociocultural and well-being	Active
Paliom	Palisade weg			Neighborhood development	In-Active
Queens Sunshine	Indira Gandhiweg	Halfhide Martha	08689485	Sport	Active
Vr.org Altona Weg	Altona Weg	Mevr. Marijke	08558721	Sport	Active
District Saramacca					
Volleyball association Kampong Baroe	Kampong baroe weg	Mevr. Kromobongso	08878716	Sport	Active
The Friends	Saramacca weg 54		8891288	Sport	In-Active
SV Grankreek	Grankreek	Van brussel nancy	8734215	Sport	Active
SV Family	Grankreek	Taloon	8844860	Sport	Active
SCVM	Wayambo weg			Sport	
Slagbalvereniging Wayambo star	Wayambo weg	Koenjbiharie	8508805	Sport	

Vulnerable stakeholders should be supported for participating in the consultations by providing transportation in case the location is at a distance.

8.3 Procedure for Consultations

8.3.1 Present Situation

Only recently, SWM has been confronted with community consultations, after taking over stations from the Ministry of Natural Resources in the interior. The current procedure for community consultation is:

1. Prepare plans for necessary intervention
2. Conduct a risk assessment of what aspects may have an impact on the community's ability to have high quality water available. This assessment doesn't include environmental or social indicators.
3. Contact the traditional leaders to conduct a consultation meeting. This may require help from the District Commissioner of the respective district.
4. Organize a consultation meeting and obtain community's views

5. Adjust plans to include community views

Specific procedures how to conduct consultation meetings are still being developed. This consultation plan will provide a series of protocols on how to conduct different types of meetings in compliance with international guidelines on stakeholder engagement.

8.3.2 Objective

The overall objective of stakeholder engagement for the proposed project is to ensure effective inclusion of groups and individuals that have a stake or interest in the water project. The plan presented here provides a strategy for engagement of stakeholders in the proposed water project. Besides this overall goal, there are several secondary objectives discussed below:

- Transparency. When water users know what's going to happen in their vicinity, they will have more trust in the project. It is important to provide adequate information to the stakeholders and catch grievances as early as possible.
- Accountability. The project unfolds in rural areas with households as primary stakeholders and therefore it should hold these stakeholders responsible for agreements made in the project planning and execution phases.
- Conflict resolution. Disputes between SWM and water users can emerge and resolving these would benefit from using skills and tools for conflict resolution e.g. negotiation and mediation.

8.3.3 Guiding Principles

Well-designed stakeholder engagement adheres to several guiding principles, which derive from IDB guideline on meaningful stakeholder participation and guidelines from the International Finance Corporation (IFC). An overview of these guidelines is provided in Annex 1. The principles for stakeholder engagement should be the following:

- Principle 1: Respect for diverse socio-cultural characteristics of water users. The proposed project sites house groups who each have distinct socio-cultural characteristics related to water use. The project respects this diversity and will develop specific methods for engagement to ensure effective inclusion of the groups.
- Principle 2: Consider gender aspects. Men and women use water differently because of the difference in customary roles in the household. The project will consider these differences in its design and implementation.
- Principle 3: Ensure transparency and effective communication. Stakeholders will need to get sufficient information to know what to expect. It is extremely important to inform them through adequate channels, on time and in a format they understand.
- Principle 4: Ensure sufficient space for inclusion of views. Every stakeholder should be able to include their views in the project when they think this is necessary. Specific provisions will be made to facilitate the different groups.

- Principle 5: Recognize vulnerable stakeholders. Stakeholders who exists in a disadvantageous situation in terms of lifestyle, financial means, education, health status will be engaged using special methods and techniques.
- Principle 6: Provide an opportunity for grievance and feedback redress. The project will create an opportunity for stakeholders to voice their feedback and grievances in an easily accessible format.
- Principle 7: Consider each stakeholder as an individual. Our research shows that stakeholders don't like to discuss water issues with others, and therefore should all be informed separately to convey information.

8.3.4 Approach

When needed, stakeholders will be engaged in SWM water supply activities on three participation levels (Figure 28):

1. Information sharing. SWM will inform stakeholders about the plans to get them acquainted with the different components of the project. This action implies one-way information transfer: from SWM to the local consumers. The consumers will have an opportunity to engage by asking for clarification on the proposed plans in the design phase.
2. Consultation. This means that SWM offers an option for stakeholders to provide input. Consultation action implies two-way information transfer: the project will offer options and listens to the feedback given on these options by stakeholders before construction starts.
3. Feedback/grievance redress. Stakeholders will have an opportunity to submit feedback and grievances during project construction and operations.

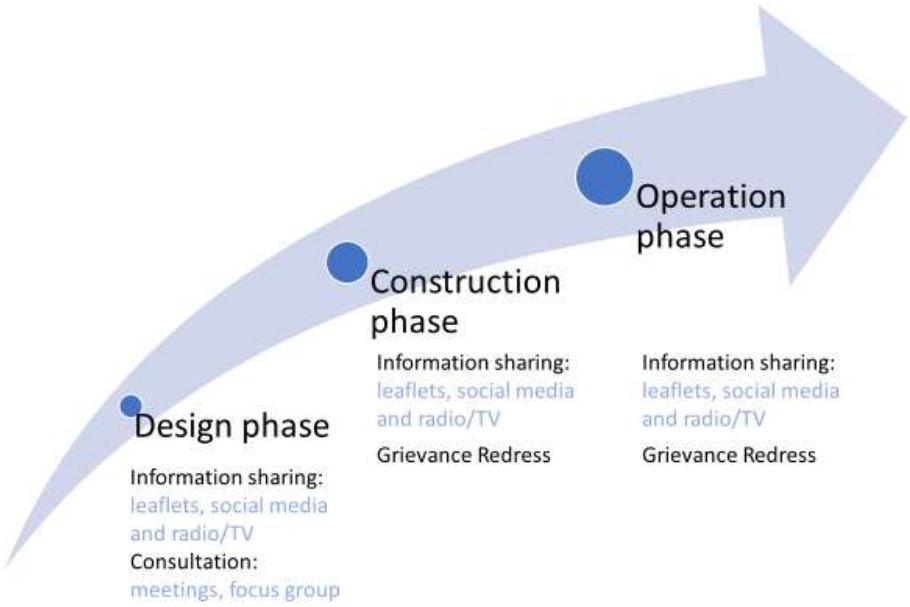

Figure 28: Overview of stakeholder engagement activities for the water supply program

8.3.5 Activities

The proposed activities to sensitize and involve stakeholders is presented for the design, construction and operations phase of the project.

Information Sharing

a. Design Phase

Information sharing activities that occur before project construction in the **design phase**.

Present Situation
Stakeholders in the study area currently receive information about SWM through i) TV and radio announcements in case of large areas under construction and ii) discourse among residents in the neighborhood, iii) an information sharing leaflet when a small area is worked at e.g. street, iii) information sharing meetings in case of specific projects, and in some cases vi) face to face interaction with SWM employees.
However, filed reports reveal that in many cases, residents haven't received information about upcoming plans and are confronted with it when the work is already being executed.
Information sharing during operations should occur in **one or more of the following ways**:

- Social media

Approximately half of the Suriname population uses Facebook (54.5% in 2017). Using Facebook as an active information sharing source has improved SWM's visibility after its initiation in April 2019. Information should follow the same format as the information leaflets and should be posted at least 2 weeks before execution takes place.

- Radio/TV programs

SWM sends out information weekly through radio programs in Dutch and is translated in Sranan Tongo and sometimes Javanese. Radio programs should be aired 2 weeks before project execution and repeated during the two weeks up to execution. Occasionally TV programs are developed and aired.

- Focus groups

Focus groups are a structured process for interviewing a small group of individuals, in this case women, usually between 8 and 12. The purpose is to obtain in-depth views regarding the topic of concern. Obtaining consensus is not a goal, but it conveys how the community feels about environmental and social impacts associated with the construction of the water supply station.

- Information Leaflet

SWM normally disseminates information leaflets to clients when there will be activities causing disruption of water supply or other activities that may cause nuisance or interference with the client's

daily activities for more than 3 hours. Information leaflets should be disseminated at least 2 weeks before execution of activities takes place.

Information leaflets should be targeted to specific audiences based on their educational level and language preference, and will have the following information to convey a clear message:

- *WHY*. Provide an explanation of the wider project including its goals and objectives.
- *WHERE*. Provide a description of the area and a map where the activities will be carried out.
- *WHAT*. Provide a detailed explanation of the type of activities SWM will conduct and what type of interference the client may expect e.g. SWM will enter your lot to work on the meter, and will measure pressure on the meter with equipment that will make noise etc.
- *WHO*. Provide information to clients on which SWM staff will be coming to do the work and how to recognize them (car, uniform etc.).
- *WHEN*. Provide information during which time the planned activities will be carried out.

Assessment of the currently used information leaflets shows areas for improvement (Table 73).

Table 73: Assessment of SWM information leaflets

	Present situation, when...	**Areas for improvement**
GENERAL	Information is delivered in high-level Dutch	Simpler choice of words Use of other languages, if applicable
WHY	Project name is given	Provide project goals and objectives
WHERE	Description of the work area is given	Provide a map of the work area
WHAT	Type of activities are listed but not explained	Provide a detailed explanation of the activities to be carried out Provide an explanation what type of interference can be expected
WHO	No information is given on who will conduct the work	Provide information on who is coming to conduct the work and how to recognize them
WHEN	Duration of activities is given	None

b. Construction and Operations Phase

Information sharing also should occur during the **construction and operations phase** of the project.

Consultation

a. Design Phase

Consultation occurs before project construction in the **design phase**.

- Consultation meetings

Consultations meetings aim to discuss the project in more detail once the stakeholders are sufficiently informed about it. During these sessions, stakeholders will have an opportunity to provide input by giving comments and suggestions, and also ask questions. A protocol for conducting such meetings is given in Table 74.

Table 74: Protocol for conducting consultation meetings

Topic	Content
Invitation	
Project description	Wider explanation of project and its potential positive impact
Statement on stakeholder input	• Statement of importance of opportunity for stakeholders to hear about the plans and ask questions • Type of input expected from the stakeholders e.g. questions, comments and suggestions • Gratitude for being a valued SWM stakeholder (customer)
Meeting details	• Clear goal of the meeting e.g. providing information and soliciting comments and suggestions • Duration of the meeting • Location of the meeting. Information about any support for reaching the location (free buses, compensation etc.) should also be provided
Contact details	Contact information in case stakeholders have questions about the consultation meeting
Meeting	
Team presentation	Presentation of the team responsible for project execution (background and function) Discussion of project scope, positive and negative impacts as well as mitigation measures
Statement on stakeholder input	• Statement of importance of opportunity for stakeholders to hear about the plans and ask questions • Type of input expected from the stakeholders e.g. questions, comments and suggestions • Gratitude for being a valued SWM stakeholder (customer)
Solicit stakeholder input	• Presentation of project plans • Solicit questions, comments and suggestions from stakeholders and provide answers, if possible
Follow-up	• Information on what will happen with the input stakeholders provided in the meeting e.g adjust plans

	• Information on how to access the report of the meeting. This report will explain what input was considered for further project planning
Grievance redress	Information on how to submit a grievance
Contact details	• Contact information in case stakeholders have questions
Report	
Meeting details	• Date of meeting • Location of meeting • Goal of meeting • Target group • Language (and if applicable, translation) • Photos
Provided information	• Summary of presentation made to stakeholders
Stakeholder input	• Document response of each stakeholder in a table with the following columns: 1) name of stakeholder, 2) affiliation, 3) input provided by the stakeholder, 4) categorization of input as question, comment or suggestion, 5) answer provided by the team
Participants list	• Scan of original participant list with each stakeholder's 1) name, 2) address, 3) telephone number or email, 5) signature for attendant
Adjustment of project plans as deemed necessary	

Consultations with Indigenous Peoples

Consultations with indigenous people living near the study sites in Maho, Grankreek and Columbia should be conducted respecting their institutions, culture and rights as stipulated in the United Nations Convention on the Rights of Indigenous Peoples (UNDRIP). Information sharing and consultation activities with indigenous people should follow a more elaborate process than those held for western-oriented stakeholders.

Indigenous communities discuss issues in a meeting, so called *krutu*, in which they employ customary ways to reach decisions. Every group has their own customary ways, and this is unique to their location and historic development. The krutu usually take longer than common meetings because everyone has an opportunity to say something and the decision-making occurs horizontally, usually directed by the strongest voice.

SWM should work together with the indigenous communities to organize the krutu, following the protocol in Table 75.

Table 75: Protocol for krutu meetings with indigenous communities

Topic	Content
Preparation	
Pre-consult with communities	Visit the community (probably multiple times) to: • Explain the project and area of influence • Verify representation and best method of communication with group • Identify local interest groups (stakeholder identification) • Identify sensitivities that need to be considered during consultation • Verify language and translation, if applicable • Discuss best format to convey information in leaflets, meetings etc. • If applicable, discuss the FPIC process in case some development will happen on tribally occupied land
Strategize and design	• Design engagement process using appropriate participatory tools • Design appropriate information sharing materials considering educational levels, language
Invitation	
Announcement of the krutu	The community will announce the meeting and invite community members in their own cultural way
Logistical arrangement	Set logistical arrangement of krutu with community including location, facilitator, food and drinks, rapporteur, translators
Meeting 1 (krutu): Information sharing	
Introduction	• The community will open the meeting and introduce the topic of the krutu • Community presents project team and they will be responsible to present themselves (background and function)
Project presentation	• Community allows SWM team to present project plans and potential impacts in simple language and without graphs and other complex pictures • SWM team ends with statement of importance of opportunity for stakeholders to hear about the plans and ask questions
Deliberation	Community will have own process to solicit questions, comments and suggestions from its members
Conclusion	Community will conclude and thank SWM
Follow-up	• SWM assesses with community for a follow-up krutu for consultation • Details are given on how the community gets the report • Contact information in case stakeholders have questions or want to submit a grievance
Assessment	SWM assesses participation during the meeting. In case some groups didn't participate, SWM discuss this with the community leaders. Separate sessions (focus groups) may be necessary to solicit their views from these groups

Invitation

Announcement of the krutu	The community will announce the meeting and invite community members in their own cultural way
Logistical arrangement	Set logistical arrangement of krutu with community including location, facilitator, food and drinks, rapporteur, translators
Meeting 2 (krutu): Consultation	
Introduction	• The community will open the meeting and introduce the topic of the krutu • Community presents project team and they will be responsible to present themselves (background and function)
Short repeat of project plans	• Community allows SWM team to present project plans in short format
Deliberation	Community will have own process to solicit questions, comments and suggestions from its members
Grievance redress	Information on how to submit a grievance
Assessment	• SWM assesses participation during the meeting. In case some groups didn't participate, SWM discuss this with the community leaders. • Separate consultations may be necessary to solicit their views from these groups
Report of both meetings	
Meeting details	• Date of meeting • Location of meeting • Goal of meeting • Target group • Language (and if applicable, translation) • Photos
Provided information	• Summary of presentation made to stakeholders
Stakeholder input	• Document response of each stakeholder in a table with the following columns: 1) input provided by the community, 2) categorization of input as question, comment or suggestion, 3) answer provided by the team
Participants list	• Scan of original participant list with each stakeholder's 1) name, 2) village, 3) telephone number, 5) signature for attendance
Adjustment of project plans as deemed necessary	

Grievance Redress

Grievance redress occurs during the **construction and operations phases** of the project.

Present situation

SWM handles interruptions in water supply and grievances together. The current procedure for handling grievances is shown in Table 76.

Table 76: Current procedure for handling grievances

Procedure	Details
Uptake	• Consumers can submit grievances in several ways: i) at the SWM office in Paramaribo, ii) Email, iii) telephone number to customer service, iv) Facebook, or via v) the distribution department (surveillance teams), production department (stations) or laboratory. • All interruptions/grievances are collected by customer service and inserted into the computer system (or after working hours on hardcopy).
Screening	• After receipt, the grievance is directed into three types: i) interruptions and leakages, ii) billing issues, and iii) contaminated/dirty water, iv) other problems. • Grievances focusing on interruptions and leakages have high priority and are directed to the distribution department which aims to resolve the problem within 3 days, and if not possible, at the latest in 7 days. On average, approximately 1000 interruptions/leakages occur in Paramaribo, Wanica, Para (Region Central) and more than 95% is resolved between 3 days. The high rate of success is dependent on coordination between the different departments (consumer service, information, distribution, operations) via a Whatsapp group. Department of Public Relations informs clients when there are disruptions in water supply expected. • Other grievances are as much as possible handled by the customer relations department. In case other departments are needed, customer service coordinates this effort.
Handling	• Grievance handling follows a set procedure “Handling of client notifications”. Grievances are received and then transferred to the designated department for further handling. Once the department fixes the problem, the case is closed and registered as such by customer service in the SWM database.

From Figure 77 it is evident, consumers in the study area have no way to submit individuals’ grievances at the stations in district Wanica and Saramacca. These consumers are often sent to SWM Paramaribo to submit a grievance.

Field interviews suggest that consumers at the study locations are i) hesitant to submit a grievance by phone or in person because everyone knows each other or ii) they have lost belief in the system because they haven’t received any response after submitting a complaint locally (see Annex 3).

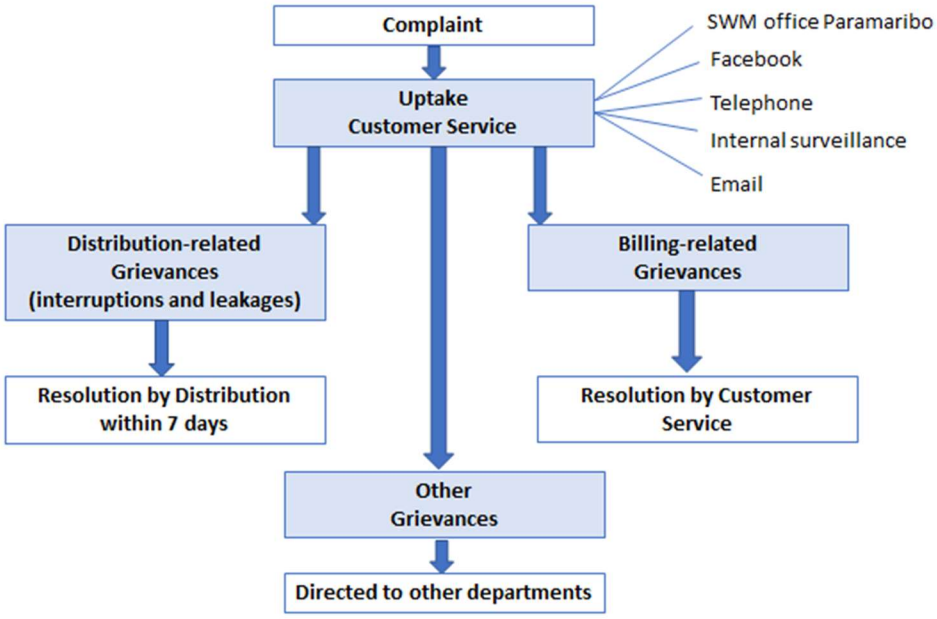

Table 77: Current grievance redress mechanisms at SWM

Goal

The goal of the grievance redress mechanism (GRM) is to channel grievances into an acceptable, institutionalized mechanism during program operations. The GRM should become a modality to resolve problems that consumers bring forward to have better project outcomes.

Procedure

The GRM will build on the current grievance procedure within the SWM. Suggestions for improvement of this procedure are shown in Table 78.

Table 78: Proposed procedure for grievance redress

	Current SWM Procedure	Suggested improvement to comply with IDB/IFC	Amendment to procedure
Uptake	Office in PBM SMS and Whatsapp Phone number Facebook	Increase accessibility of GRM to local stations in Wanica and Saramacca	• Uptake of grievances at local stations: -Local SMS/Whatsapp number -suggestion/complaint box for consumers to submit written grievance • Registrar grievance into SWM system
Handling	Follow procedure "Handling of client notifications"	Include provisions for dispute resolution, when needed	• When there is a seemingly unresolvable dispute with a customer, SWM should choose a meditation approach. Mediation opens doors to parties to collaboratively come up with their own solutions. The most important part is that mediation does not end up in win-lose situations, where one party wins and the other loses. *Option 1: Self-Problem Solving* The preferable method to use to resolve the dispute is problem solving. SWMs trained staff can act as the mediator to positively influence the interaction process but does not interfere with the decision-making ability of parties. *Option 2: External-Party Problem Solving* In case there are disputes with problems that have been recurring or there are discrepancies about facts or data, the SWM decides for intervention of an external mediator. An external party helps parties get involved to sort out difficult issues, improve communication and possibly reach an agreement. • Prepare for a mediation session. Preparation includes selecting a strategy, collecting and analyzing background information and designing a mediation plan. After which, the SWM or external mediator conducts the meeting with the disputants. Observers and witnesses may be present in these meetings to ensure transparency. The outcome of a successful problem- solving meeting is a settlement agreement: a contractual agreement between the two parties. This contract is in developed in a similar fashion as a performance-based contractual agreement: the disputants will sign this agreement and are obliged to comply with its stipulations. • If no acceptable solution is found, the SWM makes an outcome report of the problem-solving session. The report is conveyed to the complainant and all other parties. The complainant can then choose submitting an appeal to the Ministry of Natural Resources.

Monitoring	-	In case of dispute resolution, monitoring is necessary of the agreement reached	• The SWM should monitor the settlement agreement, which will have defined, clear and measurable milestones. Each milestone will be documented as part of an internal monitoring system for tracking grievances. The monitoring system can be a simple database from which information can be analyzed to recognize grievance patterns, identify causes of grievance and evaluate how effectively grievances are handled by SWM. • Complainants will periodically be informed by the progress made on the settlement agreement (time frame outlined in the settlement agreement). In case parties don't comply with the agreement, the Government of Suriname can interfere through its Ministry of Natural Resources. If the agreement is properly executed, the case is closed and stored digitally in the SWM archive.
		Give consumer information about the status of their case	• Give access to consumers to track progress on grievance cases online
Reporting	-	Report back to stakeholders on functioning of GRM	• Publish reports on grievance redress periodically on the SWM website

8.4 Implementation of Stakeholder Engagement

8.4.1 Institutional Structure

In the past, SWM has technically prepared projects and then executed them for improving the supply of potable water for Suriname citizens. Including stakeholders is an activity which occurs occasionally and is currently handled by technical staff (see present situation 8.3.1).

For a more structural approach, stakeholder engagement should be handled by the information department. This department already has experience in communication and could assign one staff member to specialize in coordinating stakeholder engagement activities.

Table 79: Requirements for SWM officer responsible for stakeholder engagement

Tasks on Stakeholder Engagement	Required training
1. Prepare meetings with stakeholders incl. logistics, cultural appropriateness, format, invitation, etc.	
2. Facilitate stakeholder meetings e.g. information sharing and consultation meetings	Facilitation training
3. Document all stakeholder engagement activities e.g. meetings reports, grievances	
4. Set up and maintain grievance registrar online system for SWM	
5. Oversee uptake of grievances at the local stations and centralize to customer relations system in SWM Paramaribo	
6. Train staff at the stations to manage relations with key stakeholders e.g. neighbors, owners of land where wells are located etc.	Conflict resolution training
7. Collaborate with local authorities (District Commissioner etc.) for supporting SWM engagement activities	
8. Prepare biannual summary report on stakeholder engagement for monitoring purposes and improvement	

8.4.2. Action Plan

Upgrading Water Supply Facilities

An overview of the activities for meaningful stakeholder engagement for the ESA is given in Table 80. Specific considerations for ESA consultations are:

- Stakeholders to be invited for consultations are selected based on the option chosen
- Regular consultation meetings should be scheduled in the late afternoon to include women and men in the households

- Consultations with indigenous peoples should be held in the village, and preferably scheduled in the afternoon or on Saturday morning.
- Transportation should be supplied to ensure people can reach the consultation location as distances in rural areas can be relatively large and bus services are limited.
- A focus group session with women organizations to address specific women issues.

Table 80: Action plan for stakeholder engagement for upgrading water supply facilities

Task	**Activity**	**Week**							
		1	2	3	4	5	6	7	8
Design and construction									
Regular consultation	Information sharing	**X**							
	Invitation consultation meeting	**X**							
	Conduct consultation meeting		**X**						
	Report consultation meeting		**X**						
	Adjustment of project plans			**X**					
Consultation indigenous communities (if needed)	Preparation	**X**							
	Invitation information sharing meeting	**X**							
	Conduct information sharing meeting		**X**						
	Report information sharing meeting		**X**						
	Invitation consultation meeting		**X**						
	Conduct consultation meeting			**X**					
	Report consultation meeting			**X**					
	Adjustment of project plans				**X**				

Focus group women	Invite women for focus group	**X**							
	Conduct focus group session		**X**						
Information sharing during construction	Inform stakeholders on progress program through social media, radio/TV and information leaflet					**X**	→ every 2-3 weeks		
Uptake of grievances	Active grievance redress mechanism					**X**	→		

Non-Revenue Water Reduction

An overview of meaningful stakeholder engagement activities for NRW reduction is shown in Table 81. Specific considerations for NRW consultations are:

- Stakeholders to be invited for consultations are from Paramaribo
- Regular consultation meetings should be scheduled in the morning because most stakeholders are Government or private sector officials.

Table 81: Action plan for stakeholder engagement for NRW

Task	**Activity**	**Week**							
		1	2	3	4	5	6	7	8
NRW operations									
Regular consultation (Paramaribo)	Information sharing	**X**							
	Invitation consultation meeting	**X**							
	Conduct consultation meeting		**X**						
	Report consultation meeting		**X**						
	Adjustment of project plans			**X**					
Information sharing during NRW operations	Inform stakeholders on Activities through social media, radio/TV and information leaflet				**X**	→			
Uptake of grievances	Active grievance redress mechanism				**X**	→			

8.5 Monitoring and Evaluation

This section presents a monitoring and evaluation framework for stakeholder engagement. The following aspects will be monitored during the process that starts in the design phase and runs throughout the operational phase:

- Stakeholder participation during the stakeholder meetings.
- Social media performance by tracking the amount of likes and positive and negative comments on Facebook and Instagram.
- Feedback and grievance redress from stakeholders will be tracked and handled by the project.

The indicators for monitoring are presented in Table 82.

Table 82: Indicators for monitoring of stakeholder engagement

Focus	Indicator	Baseline	Target	Sources of verification	Frequency of data collection
Participation	% of invited participants show up in meetings	Amount in consultation plan	>50%	Meeting reports	Monthly
	% of active speakers in meetings		>10	Meeting reports	Monthly
	% of participants (women/men) actively engage in program design		>20%	Meeting reports	N/A
Social media	Amount of Facebook users like the SWM project page	0	>500	Facebook	Monthly
	Number of negative messages posted on Facebook	0	<30% of all messages	Facebook	Monthly
Grievance redress	% of registered grievances resolved within set time frame	0	>90%	Facilitation team	Monthly

Period evaluation of stakeholder engagement will occur every 6 months. The SWM officer responsible for stakeholder engagement in the Information Department will prepare a summary report including a report of meetings, social media and grievance redress. The report will be discussed at the project management level and subsequently, management will insert the lessons learnt and recommendations into the engagement plans for the next 6 months.

9. Conclusions and Recommendations

This Chapter presents the general conclusions that have been drawn from the ESA process and which should be considered when evaluating the project.

The proposed options, Helena Christina (Option 1) located in district Wanica and Kampong Baroe, Groningen and Tijgerkreek (Option 2) located in district Saramacca have been evaluated based on the environmental and social impacts. The environmental and social assessment has a **general focus** and was primarily based on secondary data and a limited number of field data for both biophysical as social analysis. The analysis showed several moderate or less significant environmental and social impacts associated with upgrading water supply facilities.

For the **physical environment**, during construction and operations, there is a potential for soil and water contamination which is expected to have a moderate impact on the environment, as well as the possibility of depletion of water resources. With adequate mitigation and monitoring measures, including water quality and quantity monitoring, this impact can become negligible or manageable if detected. Other moderate impacts are expected for the long term from climate change, noise and vibration from equipment and from waste generation and disposal. All these impacts can become minor or negligible.

For the **social environment**, during construction, mitigation and management measures are necessary to deal with land acquisition for well construction at the Helena Christina site, which is considered to have a moderate impact. Other moderate impacts on the surrounding social environment of specific sites are: i) occupational health and safety, ii) traffic and traffic related accidents, and iii) disruption of economic and social activities, iv) social inequality with vulnerable groups e.g. indigenous people, women etc. All these moderate impacts become minor or negligible with adequate management measures.

During operations, major positive impacts are expected to occur when the water quality is improved and when there is increased participation of men in decision-making on water issues. A moderate negative impact is expected from land acquisition, which can become minor with management measures at the Helena Christina site.

Recommendation on site selection

The two options were compared using only environmental and social data. Environmental impacts are quite similar in all stations. However, for social impacts there is a difference. Option 1 (Helena Christina) has a potential for land acquisition and this brings in an extra impact on the social environment. The scale of the impact is unknown because of the lack of data but is expected to be minor with adequate mitigation measures. It is recommended to examine land acquisition in more detail before making a recommendation for a specific Option.

Moreover, a potential exists to improve people's accessibility to water in this water supply modernization program. If the project would construct pipes in home of residents who only have parcel

taps, it would make a greater positive impact on these people's quality of life (for example in indigenous community in Maho).

Recommendations on design

From the mitigation and occupational health measures, the following are having specific focus on the design of the water supply infrastructure:

- Use spill protection measures such as drip trays during refueling, bunds around storage tanks etc. to capture spills and contain any leaks
- Create green areas and or plant/trees around the perimeter of the site to act as a visual screen
- When noise complaints are received, consider partial screening around the noisiest activities and/or mufflers on noisy equipment.
- Construct interceptors at all pumping stations to trap sediment and excessive pollutants
- Post warning signs in areas of high noise and dust levels instructing workers to
- Create room for parking vehicles during construction without interfering with neighbors
- Minimize pedestrian interaction with construction and supply vehicles by construction of walkways
- Have traffic controls and signage on site
- Create room for enabling grievance redress mechanism on site for uptake of local grievances
- Create area for safe storage and preparation of hazardous chemicals e.g. chlorine
- Delimit area where PPE is required and provide signage
- Ventilate enclosed areas that are subject to changing air quality
- Install safety showers and eye wash stations on site.

Moreover, this analysis recommends financing the construction of pipes in home of residents who only have parcel taps, such as is the case in Maho.

ANNEXES

Annex 1: IFC and IDB guidelines on stakeholder engagement

Guiding principles	IFC	IDB
Stakeholder identification	-Articulate projects' area of influence -Stakeholder mapping -Gather socio-economic information on vulnerable groups -Verify stakeholder representation and pre-consult with indigenous people on issues, sensitivities, representation, means and formats, FPIC	-Identify the priority issues: environmental and social risks/opportunities/concerns -Identify stakeholder categories -Stakeholder analysis disaggregated by gender and vulnerable groups
Information disclosure	-Early information disclosure to support consultation -Provide meaningful information and address uncertainties/risks - Make information accessible to stakeholders	-Information disclosure to relevant groups available in appropriate locations, languages and formats -Stakeholders should have sufficient time to review and discuss information among themselves before being asked to participate in consultation events
Stakeholder consultation	-Prepare a stakeholder engagement plan -Consult/joint analysis/decision-making about project using participatory tools -Document and incorporate feedback -Report back to the stakeholders -Gender considerations	-Prepare a consultation plan taking into account local institutional mechanisms and decision-making processes -Consultation process attuned to include all groups and stakeholders -Measures to protect people from retaliation
Negotiation and partnerships	-Negotiate joint activities and collaborative efforts	
Grievance management	-Develop grievance redress process and publicize it -Make it accessible to all stakeholders -Respond in timely and transparent matter - Keep good records and report back	-Develop grievance redress mechanism (GRM) and integrate into the projects' Environmental and Social Management System -GRM system should have mandate and authority to address and resolve concerns -Integrate stakeholders in the design of the GRM -GRM should be easily accessible

Stakeholder involvement in project monitoring	-Promote participatory monitoring	-Baseline data collection to make comparison between “before and after” project intervention -ESA update to reflect outcomes of stakeholder process -Consultation of stakeholders on relevance and validity of data, proposed action plans, management structures and institutional arrangements Provisions for adaptive mechanisms e.g. participatory monitoring
Reporting to stakeholders	-Report on progress of commitments to stakeholders -Reach a wide multi-stakeholder audience	-Convey that stakeholder contributions will inform project decision-making -Keep and share records of consultation events
Management functions	-Coordinate activities and assign overall responsibility -Hire, train and deploy the right personnel -Communicate the strategy internally -Develop and maintain a stakeholder database -Develop and maintain a commitment register -Manager contractor/third-party risk -Track changes in quality of relations	-Integrate stakeholder engagement into management structure -Provide evidence that stakeholders views have been considered in project decisions -Provide evidence and mechanisms that stakeholder inputs have contributed to mitigation i.e. avoiding, minimizing, or compensating for adverse impacts

Annex 2: Guiding questions for stakeholder interviews

Topic	Guiding questions	Target group
General water supply, quality and use	Do you have enough water available to drink, cook, wash, bathe and clean? If not, what do you do to get it?	General for all stakeholders
	For those with tap water supply in the house, do you have continuous water supply during the day and night? If not, what happens?	
	Do you think the quality of the water you get is sufficient for drinking?	
	Have there ever been problems with the quality of drinking water? E.g. pollution etc.	
Disaster risk management	Have there been any type of disasters before with water that interfered with your drinking water supply e.g. flooding etc.?	
Standing water	Are there any standing water issues in the area?	
Project impact	What are your concerns when water supply will be interrupted when SWM will execute this project, more specifically with the following activities: • Installation of valves • Development of new wells • Construction works at the station • Road construction • Construction of storage tanks • Installation of pumps	
	What suggestions do you have to overcome these concerns to have minimal disturbance in your daily activities?	
Indigenous people	What type of indigenous people live here? (tribe) How many families/people do you think are living here?	Maho, Columbia and Grankreek
	What types of houses are they living in? (huts, stone houses, wooden houses, other)	
	Where do they get their water and electricity from?	
	How are you represented? (Overarching chief/captain, organization, self). What is the best way to contact you?	
	Do you make decisions collectively, individually or in any other way? How much time does it normally take to make a decision?	
	Do you have collective land? If so, what area is considered tribal land?	
	What type of livelihood activities are you and the rest of the tribe engaged in?	
	Are there any organizations that represent specific groups (e.g. women, youth, music etc.)?	

Agriculture/fishing /logging	What type of agricultural activities are going on in the area?	Enterprises in study area
	Where do these agricultural enterprises get their water from?	
	What types of agricultural chemicals are used?	
	How is waste oil being disposed of?	
	Are there any activities related to burning going on here? If yes, how frequently are they occurring?	

Annex 3: Input from stakeholders

Stakeholder	Input from stakeholder	Type of input: C=comment S=suggestion Q=question
Helena Christina		
Multiple households	Pressure of the water supply is good. Water supply stops when there is an electrical outage which happens almost daily	C
Multiple households	We drink the water but sometimes it smells like chlorine or has a brown color (when SWM flushes)	C
Multiple households	It is very difficult to plan when SWM doesn't notify us when they are shutting off the water supply. They can notify us with written notifications, radio and social media	S
Multiple households	Best time to terminate water supply is between 12-14.00 h	S
Multiple households	We don't complain, we resolve our own problems with water by exploiting alternative water sources	S
Household	Paying the SWM bill is very difficult because we need to drive far away (to Lelydorp) to do so.	C
Multiple households	When we complain, SWM Helena Christina doesn't want to uptake the grievance but sends us to Paramaribo	C
Multiple agricultural farmers	Our own wells are used as a backup when there is no drinking water, and for watering plants and giving water to animals. Plants and animals don't grow well with SWM water	C
Agricultural farmer	SWM water is too expensive. We completely transferred to well-water for drinking and farming	C
Neighbor to SWM	Neighbor is worried about the water that is being released by SWM into their ditches and lot (animals and plans are flooded)	C
Kampong Baroe		
Multiple households	Water quality has been reduced since the transfer of station to SWM	C
Multiple households	Quality of water is poor: sometimes water has brown residue and has a chlorine smell and taste, and sometimes a yellow color	C
Multiple households	There is hardly any communication with SWM. Incidentally SWM informs us that they will flush using written notifications	C

Multiple households	People who don't have a tank/pump see intermittent water supply during 9-10.00h and 16-18.00h	C
Multiple households	SWM water makes us sick (diarrhea) and therefore we buy bottled water to drink	C
Multiple households	It is very difficult to plan when SWM doesn't notify us when they are shutting off the water supply. They can notify us with written notifications, radio and social media	S
Multiple households	We have submitted a complaint many times, but we haven't received any response. Would be better if we have other means of submitting grievance	S
Multiple households	We don't want to complain because we live in a small town. We will resolve our own problems with water by exploiting alternative water sources	S
Multiple households	We don't want to complain about the water supply because we are dependent on SWM and this is a small town. So how should we voice our views?	Q
Multiple households	Best time to terminate water supply is between 13-16.00 h	S
Multiple agricultural farmers	Our own wells are used as a backup when there is no drinking water, and for watering plants and giving water to animals. Plants and animals don't grow well with SWM water	C
Household	Paying the SWM bill is very difficult because we need to drive far away (to Groningen) to do so.	C
Household	Singing birds are dying from SWM water	C
Food seller	We are directly connected to the SWM network. Water supply is poor: there is no water supply between 8-13.00h	C
Neighbor to SWM	Neighbor will transfer to well water for plant production because plants aren't doing well with SWM water Neighbor is worried about the water that is being released by SWM onto their lot. Neighbor has repeatedly complained about this at SWM Road to SWM is owned by neighbor and needs to be maintained properly Neighbor is concerned about potential dust release and noise from future construction	C
Neighbor to SWM	Neighbor would like to have limited interference of SWM when parking heavy equipment at their lot	C
Groningen		
Multiple households	Water quality has been reduced since the transfer of station to SWM	C

Multiple households	SWM water makes us sick (diarrhea) and therefore we buy bottled water to drink	C
Multiple households	We have submitted a complaint many times, but we haven't received any response	C
Multiple households	We want to pay for water, but the cashier is frequently closed without reason. Sometimes we are getting a fine for being late, which is unfair	C
Multiple households	Quality of water is poor: sometimes water has brown residue and has a chlorine smell and taste, and sometimes a brown color	C
Multiple households	Best time to terminate water supply is between 14-17.00 h	S
Multiple households	We don't want to complain because it doesn't help. We will resolve our own problems with water by exploiting alternative water sources	S
Multiple households	When we complain, SWM Groningen doesn't want to uptake the grievance but sends us to Paramaribo	C
Multiple households	There is hardly any communication with SWM. Incidentally SWM informs us that they will flush using written notifications	C
Multiple households	SWM water makes us sick (diarrhea) and therefore we buy bottled water to drink	C
Indigenous community Maho	People have moved away because of the poor water situation. Water has a weird smell and is only available parts of the day. We will construct a well as backup plan. Some parts of the village (area of Cabenda's) has no water connection. We have submitted a grievance, but we feel that we aren't heard.	C
Indigenous community Grankreek	Water has a weird smell and is only available parts of the day. The nearby creek serves as a backup when the water quality is poor.	C
Indigenous community Columbia	Water pressure is less during peak hours. When the water quality is low, they buy water to drink. They don't want to complain but resolve issues by themselves.	C
Multiple households	SWM water makes us sick (diarrhea) and therefore we buy bottled water to drink	C
Neighbor to SWM	Neighbor doesn't drink water due to chlorine smell and taste. Neighbor is concerned about noise, which was experienced with earlier construction projects. Neighbor has low water pressure at times. Neighbor is worried about the water that is being released by SWM onto her lot (soil erosion)	C
Neighbor to SWM	Neighbor doesn't drink water due to chlorine smell and taste. Neighbor is concerned about noise, which was experienced with earlier construction projects.	C

	Neighbor has low water pressure at times. Neighbor is worried about the water that is being released by SWM onto her lot (flooding animals).	
Tijgerkreek (Peperhol)		
Multiple households	Water quality has been reduced since the transfer of station to SWM	C
Multiple households	Quality of water is poor: sometimes water has muddy color, smell and taste. Color is yellow or misty. Prefer to buy water to drink	C
Multiple households	Pressure of the water supply is good. Water supply stops when there is an electrical outage	C
Multiple households	SWM water makes us sick (stomach issues) and therefore we buy bottled water to drink	C
Multiple households	For paying water, we have to go to Groningen and there is no bus connection between Tijgerkreek and Groningen. We have to go to the rotunda with the bus and from there, find a ride to Groningen	C
Multiple households	We don't want to complain because it doesn't help. We will resolve our own problems with water by exploiting alternative water sources	S
Multiple households	There is hardly any communication with SWM. They don't inform us when they are working on the supply system	C
Multiple households	We don't want to complain about the water supply because we are dependent on SWM and this is a small town. So how should we voice our views?	Q
Multiple households around station	Experience weird smell	C
Agricultural farmer	Water quality from ditches can't be used and is poor due to high content of chemical residue	-
Neighbor to SWM	Alumina-zinc roofing sheets have rust stains and those sheets deteriorate faster than others. Experience a weird smell. Experience flooding from SWM at certain times.	C
Neighbor to SWM	Alumina-zinc roofing sheets have rust stains and those sheets deteriorate faster than others. Experience a weird smell. Don't want to complain and become a bad neighbor.	C

Annex 4: Gender survey

Gender and Water usage survey: Paramaribo, Wanica, Para and Saramacca (each 10)

Date:

Location: GPS

Interviewer:

	Interview questions
Interviewee	-Sex: man/woman -Age … -Marital status: married, living together, divorced, single, widowed, other -Ethnicity: creole/Indian/Indonesian/Caucasian/indigenous/mixed/other -Vulnerable group: LGBT/single women household
Household	-Head of household: man/woman - How many people in the household? - How many people in the household are minors (below 18 years of age)? List each kid's age -Who is usually home during the day? Women/man/kid 1/kid 2/kid 3 etc. -Who is usually home during the night? Women/man/kid 1/kid 2/kid 3 etc.
House	-Does your house have a: Kitchen with running water Kitchen without running water Flushing toilet Non-flushing toilet Latrine Douche with running water Bath without running water
Water source	-Where do you get your water from: rain/community faucet/SWM faucet/well/creek-river/other -Do you have to get your water from distance? If yes, from how far (…km) -Is the water source used by you only or also by others? Only me/others (…persons)
Water use	Table -Activity: cooking, bathing, washing clothes, cleaning tools/equipment, cleaning house, farming incl. processing, other…. -Who uses it: mother, father, kid 1, kid 2 etc. -At what time do they use it: early morning, late morning, early afternoon, late afternoon, night
Decision-making	-Who makes the decisions about water use in the house? mother, father, kid 1, kid 2 etc. -Who participates in discussions about water use with others outside of the household? mother, father, kid 1, kid 2 etc.