Environmental Management and Monitoring Plan (EMMP) for the Optimized fluid handling capacity and efficiency project at the Jossiekreek Crude Treatment Facility

Final Draft Report

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List of Abbreviations

AAM	Acrylamide Monomere
AOI	Area of Interest
BFPD	Barrels of Fluid Per Day
BID	Background Information Document
BO	Bestuursopzichter (Government Supervisor)
BS&W	Basic Sediment & Water
CCU	Corporate Communication Upstream
CFT	Continuous Flow Tank
CFWKO	Cold Free Water Knockout
CR	Community Relations
CRP	Community Relations Plan
DAF	Dissolved Air Flotation
DC	District Commissioner
EC	Electrical Conductivity
EFA	Environmental Framework Act
EIA	Environmental Impact Assessment
EMMP	Environmental Management and Monitoring Plan
EOR	Enhanced Oil Recovery
ERP	Emergency Response Plan
ESIA	Environmental and Social Impact Assessment
EU	European Union
GKOD	Gas Knock Out Drum
HFWKO	Heated Free Water Knock Out
HPAM	Hydrolyzed Polyacrylamide
HSE	Health, Safety and Environment.
HSEQ	Health, Safety, Environment and Quality
HSSE	Health, Safety, Security and Environment
IFC	International Finance Corporation
IGF	Induced Gas Floatation
ILACO	ILACO Suriname N.V.
IOR	Improve Oil Recovery
ITCZ	Inter-Tropical Convergence Zone
LVV	Ministerie van Landbouw, Veeteelt en Visserij (Ministry of Agriculture, Animal Husbandry and Fisheries)
NIMOS	National Institute for Environment & Development in Suriname
OSHE	Occupational, Safety, Health, and Environmental
OSRP	Oil Spill Response Plan
OTP	Oil Treatment Package
PCS	Process Control System
PFPW	Polymer Flood Produced Water
PM	Particulate Matter
PPE	Personal Protective Equipment
PWT	Produced Water Treatment
QA/ QC	Quality Assurance/ Quality Control
S.B.	Staatsblad van de Republiek Suriname
SEP	Stakeholder Engagement Plan
Staatsolie	Staatsolie Maatschappij Suriname N.V.
TSS	Total Suspended Solids
VOC	Volatile Organic Compounds
WB	World Bank

Executive Summary

This document presents the results of the Environmental Management and Monitoring Plan (EMMP) for the "Optimized fluid handling capacity and efficiency project at the Jossiekreek Crude Treatment Plant".

The EMMP study has been conducted in accordance with national regulatory requirements (Milieu Raamwet S.B. 2020 no. 97/ Environmental Framework Act S.B. 2020 no. 97), the guidelines of the National Institute for Environment and Development in Suriname (NIMOS, March 2005, NIMOS August 2009, NIMOS, 2021), the NIMOS Procedure (NIMOS, December 2023), as well as international best practices.

The upgrade of the Jossie Plant has been classified as a Category B, Path 2 project by NIMOS and it was determined that only an EMMP is necessary for the current project. The EMMP study primarily involved a desk study, supplemented by field surveys, measurements (noise), and stakeholder consultations.

Environmental and Social baseline:
From the environmental baseline assessment, the following can be stated:

- The dominant wind direction in the study area are winds from the northeast during the day and more dominant from the east during the night.
- Baseline air quality measurements at the Jossie Plant show that particulate matter (PM), NO_2 and O_3 concentrations are within the WHO/IFC guidelines.
- Day and nighttime noise measurements and modelled levels for the current operation show that the current operation at the Jossie Plant is not expected to result in exceedance of the daytime WHO/IFC guideline of 55 dBA at the closest noise sensitive receptors (school and mosque) and nearest residents. However, during nighttime, the current operation at the Jossie Plant results in exceedances of the night-time IFC guideline of 45 dBA at the closest receptor locations. Elevated levels above the nighttime WHO/IFC standard are recorded in a radius of approximately 200 meters around the plant. Measures are required to minimize this noise impact.
- The Jossie Plant is drained by a system of ditches which end up in the canalized Jossiekreek to the west of the Plant and ultimately into the Saramacca River.

From the socio-economic baseline assessment, the following can be stated:

- Receptors within the project area are residents living concentrated along the Jossiekreekweg and the Smithfieldweg.
- Sensitive receptors within the area are a mosque (150 m. to the west) and a school (approximately 550 m. west from the entrance of the Jossie Plant).
- The closest resident is 100 m. to the west (at the livestock/ pig farm) from the Jossie Plant.
- Main concerns raised during the stakeholder consultations include:
    - Concerns regarding existing noise nuisance and possible increase of noise levels due upgrade of the Jossie Plant.
    - Impact on air and water quality.
    - Dust nuisance.

Potential impacts and mitigation measures
From the assessment of potential impacts of the upgrade of the Jossie Plant, there are five potential impacts with medium significance which can effectively be reduced to low after implementation of the proposed mitigation measures. The remaining impacts are low.

The table below presents a summary of the identified impacts with a medium or higher significance, mitigation measures and the residual impact for the upgrade of the Jossie Plant.

Table 1: Summary of the main identified impacts, mitigation measures and residual impact for upgrade Jossie Plant

Impacts	Impacts Assessment	Impact significance	Mitigation Measures	Residual Impact
Construction Phase				
Socio-economic	Nuisance (noise, dust, or otherwise) to the people living along the Jossiekreekweg	Impact: Minor Likelihood: Likely Risk rating: **Medium**	• Implement measures to minimize the impact on air quality and noise. • Reduce the number of transportation trips to the minimum (adequate planning). • Truck traffic and other transport of heavy equipment/machinery should be limited to daytime. • Register and address complaints according to the Staatsolie Grievance Redress Mechanism which is in place and operational.	Low
	Occupational Health and Safety: Incident and accidents	Impact: Moderate Likelihood: Possible Risk rating: **Medium**	• Proper planning and communication of ongoing production activities and construction works. • Proper marking/ fencing of construction areas • Ensure contractors follow Staatsolie Corporate Contractor Health, Safety and Environmental Management procedures and other health and safety related procedures.	Low
Operational phase				
Noise	Elevated noise levels caused by future (new) equipment resulting in nuisance for nearby residents	Impact: Moderate Likelihood: Possible Risk rating: **Medium**	• Regularly maintain engines of vehicles and equipment. • Operate and maintain exhaust systems and engines in accordance with the manufacturer's specifications. • Use preventative maintenance and repair programs. • Maintain awareness of exceeding speed limits and safe driving behavior. • Provide PPE for staff/personnel, as required. • Consider engineering measures to reduce noise levels such as high pressure (HP) pumps on variable frequency drive (VFD) or replacement of the transfer pumps with electrical engine pumps.	Low
Air Quality	Reduction of air quality for the pig farm as a result of emission of gases from the stack and operation of equipment.	Impact: Minor Likelihood: Likely Risk rating: **Medium**	• See equipment maintenance measures for noise. • Maintain awareness of exceeding speed limits and safe driving behavior to avoid dust. • In dry periods: spray the road near houses with water. • Operate and maintain the steam boiler in accordance with the manufacturer's specifications. • Keep a record of any complaints related to air quality and odor related issues.	Low

Impacts	Impacts Assessment	Impact significance	Mitigation Measures	Residual Impact
			• Undertake ambient air quality monitoring once the upgraded Jossie Plant is operational in order to verify the simulations. • Undertake isokinetic sampling of emissions once the upgraded Jossie Plant is operational in order to verify the simulated emission rates estimated in this assessment.	
Surface water quality	Discharge of produced water (containing dissolved salts, high oil content, trace metals, and back-produced polymer, residual chemical additives, etc.) in the Saramacca River	Impact: Major Likelihood: Unlikely Risk rating: **Medium**	• All produced water coming from the oil dehydration processing train will be passed to the upgraded produced water treatment system. • Continue to measure the water quality of the effluent. In case of discharges exceeding the IFC/ EU criteria, take appropriate measures to minimize the duration and volume. • Monitor surface water quality at the discharge point, upstream and downstream of the discharge point. • While discharge of back produced polymer is likely to dilute quickly so that safe levels of potentially harmful substances such as AAM are not exceeded, all PAMs contain some level of residual AAM due to an incomplete polymerization process (SRK, 2019). AAM migrates faster than PAM presenting a greater risk of dispersed contamination, but also degrades faster, as such the following is recommended: o Enhance monitoring efforts of AAM to verify the assumption that AAM constitutes 0.1% of HPAM concentration. o Establish a trigger value based on current calculations of AAM that would necessitate the sampling and testing. This proactive measure aims to ensure accurate monitoring and validation of the assumed correlation between AAM and HPAM concentrations, thereby safeguarding environmental and public health. o Obtain a discharge permit for AAM from NIMOS based on current calculations and/or established trigger value as mentioned above.	Low

Cumulative noise and air quality impacts: it should be noted that the future operations will positively contribute to reduction of VOC's. For noise, future operations will not have any significant contribution in increasing noise levels. Additional measures to address the cumulative noise and air quality impacts are:

- Consider engineering measures to reduce noise levels such as high pressure (HP) pumps on variable frequency drive (VFD) or replacement of the transfer pumps with electrical engine pumps.
- Consider exhaust mufflers or silencers on required equipment.
- Establish an effective buffer zone (e.g. vegetation screen, earth wall) between the plant and the nearest resident.
- If complaints regarding noise are received, carry out noise monitoring and take noise abatement measures if necessary.
- If complaints regarding air quality are received, carry out air quality monitoring and take measures if necessary.

The several mitigation measures, management, and monitoring requirements, as described in the EMMP must be implemented as part of normal operations by effectively incorporating the key components into daily activities, such as including environmental issues in the decision-making process, carrying out operations in accordance with the standard procedures, and maintaining complete records.

1 Introduction and Description of the project

This document presents the Standalone Environmental Management and Monitoring Plan (EMMP) for the Optimized fluid handling capacity and efficiency project at the Jossiekreek Crude Treatment Facility.

1.1 General

The Staatsolie Upstream operation develops available reserves in their oilfields by means of drilling production wells that are subsequently put into production. The produced fluids from these oilfields are transported through pipelines to two Crude Treatment Plants, namely TA-58 and Jossiekreek, for dehydration of the crude oil to meet internal customer (refinery) specifications.
One of the company's strategic goals is to sustain the yearly forecasted production target. Therefore, the implementation of Enhanced Oil Recovery (EOR) and Improved Oil Recovery (IOR) techniques aside from drilling new wells is inevitable for Staatsolie. Since April 2022, the EOR Technique, Full Scale Polymer Flooding has been implemented with the intention to drive more oil towards the producer wells. The produced fluid from the polymer flood affected wells is routed to the Jossiekreek Crude Treatment Plant, (**Figure 1**), resulting in an increase in produced fluid quantities to this Plant.

The increase in produced fluid to Jossiekreek Crude Treatment Plant will exceed the existing fluid handling and water treatment capacity of the plant by 2025. Furthermore, the Jossiekreek Crude Treatment Plant (Jossie Plant) will also receive the produced fluid with back produced polymer. The current process equipment at the Jossie Plant does not have the capacity required to process the polymer affected production flow to meet desired product specifications. From case studies related to polymer floods in the oil and gas industry it can be concluded that back-produced polymer will impact the separation efficiency of crude dehydration and water treatment. During the current treatment process at the current crude Treatment plant associated production gases are vented to the atmosphere from the Heated Free Water Knock Out (HFWKO) via a Gas Knock Out Drum (GKOD) and several atmospheric tanks (through the thief hatches or flame arrestors).

Taking into consideration the above-mentioned challenges and the Staatsolie Health, Safety, Environmental and Quality (HSEQ) policy, Staatsolie intends to execute the project "Optimized fluid handling capacity and efficiency project at the Jossiekreek Crude Treatment Plant", with the following objectives:

- Optimizing the fluid handling capacity and efficiency.
- Mitigating the risks associated with back produced polymer resulting from the full-scale Polymer Flood project.
- Collect and utilize production gases and minimize venting. Excess gas will be routed to a safe and centralized location high in the air for atmospheric release, in order to reduce exposure to surrounding areas and reduce/eliminate associated occupational health risks.

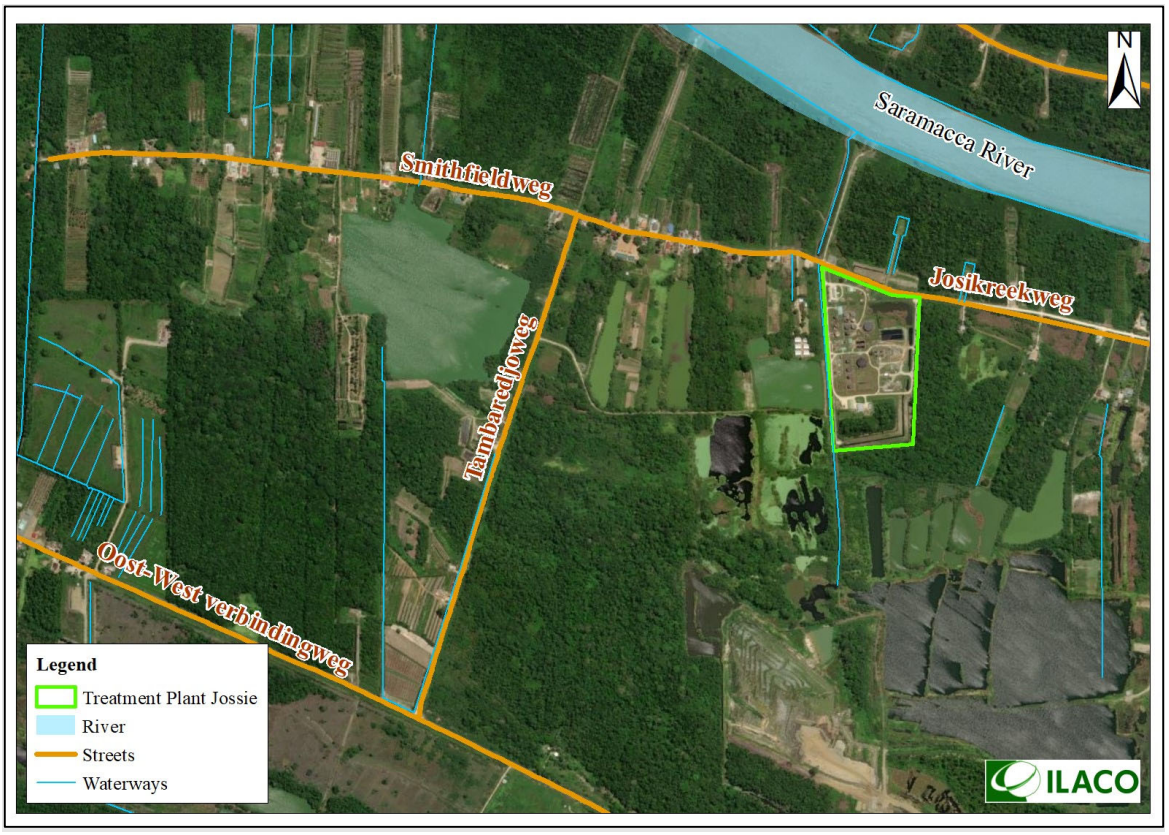


Figure 1: Locality map Jossie Plant

1.1.1 Project background and scope

The Optimized fluid handling capacity and efficiency project at the Jossie Plant has been classified as Category B-path 2 project by the National Institute for Environment and Development in Suriname (Nationaal Instituut voor Milieu en Ontwikkeling in Suriname - NIMOS), thus requiring a Limited Environmental and Social Impact Assessment (ESIA). Numerous ESIA's and specialist studies have already been conducted within or near the proposed project area. Consequently, as stated in the Screening Report by NIMOS (dated 28th March 2023), it has been determined that only a Standalone Environmental Management and Monitoring Plan (EMMP) is necessary for the current project.

The current study draws on previous ESIA's, specialist surveys, monitoring and compliance studies conducted within or near the proposed project area namely:

- P-all Projects Supply Suriname N.V., 2015. Environmental and Social Impact Assessment Jossiekreek Development Project 2015.
- SRK Consulting, 2019. Limited ESIA for the Polymer Flooding Enhanced Oil Recovery in the Tambaredjo Oilfield in Saramacca, Suriname.
- ILACO, 2023 Baseline Assessment on Air Emissions, Ambient Air Quality and Noise for the Upstream Operations of Staatsolie- Noise Baseline Report
- ILACO, 2023 Baseline Assessment on Air Emissions, Ambient Air Quality and Noise for the Upstream Operations of Staatsolie- Ambient Air Quality Baseline Report

Furthermore, the following documents that form part of the existing Environmental Management System for the Staatsolie Upstream operations, have been used:

- Environmental Aspects Register Treatment & Delivery (T&D) - Crude Treatment (March 2023)
- Occupational, Safety, Health, and Environmental (OSHE) Legal Obligation Register (July 2023).

The purpose and scope of the current study are as follows:

- Describe the existing environmental and socio-economic conditions which may affect or be affected by this optimized fluid handling capacity and efficiency project.
- Identify and engage with relevant stakeholders regarding the planned upgrade of the Jossie Plant.
- Identify, evaluate, update and/or amend the potential environmental and socio-economic impacts, both positive and negative, of the proposed project.
- Propose, review and/or update mitigation measures to avoid or minimize adverse effects, as well as measures that promote or enhance potential benefits.
- Provide appropriate recommendations to ensure that measures to prevent or minimize any adverse impacts during all the phases of project implementation are incorporated and establish an EMMP specifically tailored for the proposed project.

1.1.2 Project and study area

The project area is defined as the Jossiekreek Crude Treatment Plant located along the Jossiekreekweg, in the Groningen resort of the Saramacca District (see **Figure 1**). The plant is approx. 5 km away from the Oost-Westverbinding. The Jossiekreek Crude Treatment Plant can be reached from this main road via the Jossiekreekweg, or the Tambaredjoweg. The Jossiekreekweg is a local road with predominantly local traffic and traffic for the Jossiekreek Crude Treatment Plant (further referred as the Jossie Plant).

The EMMP study area, referred to as the study area, encompasses not only the project area itself (Jossie Plant), but also their immediate surroundings where potential impacts may arise.

1.1.3 Methodology

The study is executed in accordance with national regulatory requirements (Milieu Raamwet S.B. 2020 no. 97/ Environmental Framework Act S.B. 2020 no. 97), the Generic Environmental Impact Assessment Guidelines of the NIMOS (NIMOS, 2009 & 2021), the Social Impact Assessment Guidelines of NIMOS (2005) and the Generic Environmental Assessment Procedures (NIMOS, 2023). Additionally, it considers the Staatsolie Corporate Standards, including the Health Safety Environmental and Quality (HSEQ) Policy and Stakeholder Management Procedure, along with all relevant international standards, guidelines, and best practices from organizations such as the World Bank (WB) Group, the International Finance Corporation (IFC) and the World Health Organization (WHO).

As indicated, the current project is classified as a Category B-path 2 project, and as stated in the Screening Report by NIMOS (dated 28th March 2023) only an EMMP is required. The study was primarily conducted as a desk study, supplemented by field surveys, measurements (noise), and stakeholder consultations. Additionally, a public meeting will be convened following the submission of the draft EMMP report to NIMOS.

Baseline study

The environmental (biophysical) and socio-economic baseline studies have been conducted primarily as desk studies. This involved a review of previous ESIA's (Ch. 1.1.1), as well as recent data from other studies (not older than five years). Additional data and information were collected during these baseline studies by field visits and measurements. A field visit to the Jossie Plant and surrounding was conducted on the 18th of January 2024. The main objective was to identify the current activities, equipment at the facility, and existing emission points, as well as to determine the planned locations for new equipment and the nearby sensitive receptors in the surrounding area. For the biophysical environment, noise data were obtained through noise measurements conducted in January and March 2024. Specialist studies have been conducted for noise and air quality (impact assessment, including modeling) based on existing and collected data.

For the social-economic study, site visits have been conducted on the 18th and 26th of January 2024, and consultations with key stakeholders and residents were conducted between 18th of January and 7th of March 2024.

Impact assessment
As part of the Environmental Management System for the Staatsolie Upstream operations, an Environmental Aspect Register is available for the existing crude treatment facilities. This register includes a risk rating table for the assessment of potential impacts and an overview of the existing risks identified for the Jossie Plant. The identified risks in this register have been evaluated and shortcomings were identified and supplemented for the upgrade of the Jossie Plant, using the rating table. The risk rating table is included in **Appendix 2C.**

1.1.4 Team of Experts
ILACO Suriname N.V. (ILACO) has been awarded the contract to undertake the EMMP for the optimized fluid handling capacity and efficiency project for the Jossie Plant. The EMMP has been undertaken by a team of highly motivated experts with ample national and international experience and under conditions similar to the assignment. The team of experts is presented in the table below.

Table 2: Overview team of experts

ESIA Team	
Koenjbiharie Shareen, B.Sc.	Team Leader/Environmental Monitoring Specialist
Fortune Marie, B.Sc.	Daily Project Coordinator
Noordam Dirk, M.Sc.	Sr. ESIA Expert
Grobler Nick, B. Eng.	Modelling Expert
Nakchedi Amar, B.Sc.	Field Engineer
Naigi Arshna, B.Sc.	Stakeholder & Communication Specialist

1.2 Description of the EMMP
1.2.1 Scope of the EMMP
The EMMP applies to all Staatsolie activities associated with the upgrading of the Jossiekreek crude treatment facility including activities conducted on Staatsolie's behalf by contractors and subcontractors. This includes but is not limited to construction and operations as well as administrative support.

The EMMP is linked to and works together with the existing Environmental Aspects Register T&D, Legal Obligation Register and the following documents which are to be submitted by Staatsolie: Emergency Response Plan (ERP), the Oil Spill Response Plan (OSRP), Communication Plan (CP) and Waste Management Plan (WMP) for this project. All plans should also be in line with the Staatsolie procedures as considered relevant.

1.2.2 Purpose of the EMMP
The purpose of the EMMP is to set out the management and monitoring measures required to minimize the environmental impacts of construction, operations and decommissioning the project, and to ensure that responsibilities and appropriate resources are efficiently allocated to the project. The EMMP addresses all the phases of the project. This plan may be reviewed and where necessary, updated as required.

1.2.3 Structure of the EMMP

This EMMP is made up of eight chapters as follows:

- **Chapter 1: Introduction and Description of the Project**
  Provides a general introduction (including study area and methodology), brief background to the project, description of the EMMP and description of the updated bio-physical and socio-economic environment.
- **Chapter 2: Legal and Regulatory Framework**
  Provides an overview and relevant legislation and the regulatory framework for this project.
- **Chapter 3: Environmental Management Roles and Responsibilities**
  Sets out the roles and responsibilities for implementation of the EMMP, for environmental and social components and training requirements.
- **Chapter 4: Stakeholder Consultation**
  Explains the results of the conducted stakeholder consultation as part of the EMMP process.
- **Chapter 5: Environmental and Social Specifications**
  Explains the approach adopted to develop the environmental and social specifications and sets out the actual specifications of the impacts in tabular form. Additionally, the cumulative impacts of the project are also discussed.
- **Chapter 6: Monitoring and Reporting Requirements**
  Sets out the different monitoring and reporting requirements, which will enable Staatsolie to determine the environmental performance of the project and if the mitigation measures are implemented.
- **Chapter 7: Community Engagement and Grievance Redress Mechanism of Staatsolie**
  Sets out the communication plan, which will enable Staatsolie to engage with the different stakeholders during the execution of the project. Additionally, the grievance redress mechanism (complaint handling procedure) is discussed.
- **Chapter 8: Conclusion**
  Provides an overview of the conclusions for this project.

1.3 Project Description

As indicated in Chapter 1.1, Staatsolie intends to upgrade the Jossie Plant to be able to handle production fluids generated from Enhanced Oil Recovery (EOR) and Improve Oil Recovery (IOR) techniques applied in the oilfields. The objective is:

- Optimizing the fluid handling capacity and efficiency.
- Mitigating the risks associated with back produced polymer resulting from the full-scale Polymer Flood project.
- Collect and utilize production gases and minimize venting. Excess gas will be routed to a safe and centralized location high in the air for atmospheric release, in order to reduce exposure to surrounding areas and reduce/eliminate associated occupational health risks.

1.3.1 Scope overview

The current fluid handling capacity of Jossiekreek Crude Treatment Plant is 25,000 barrels fluid per day (BFPD). Staatsolie aims to increase the capacity to 38,000 BFPD. To increase the fluid handling capacity and efficiency of the plant and mitigate the risk associated with back produced polymer, upgrade of the current oil and water treatment process is required.

This project includes the following activities:

- Upgrade Oil Treatment part
- Upgrade Water Treatment part
- Slop oil handling (new)
- Sludge Handling (new)
- Centralized Cold Vent System (new).

The listing of equipment to be installed as part of this project is presented in subchapter 1.3.2.4.

1.3.2 Process Description

1.3.2.1 Description of the process of the existing facility

The current facility continuously receives well fluids from the oil fields. The process flow of the existing Jossie Plant is presented in **Figure 2**.

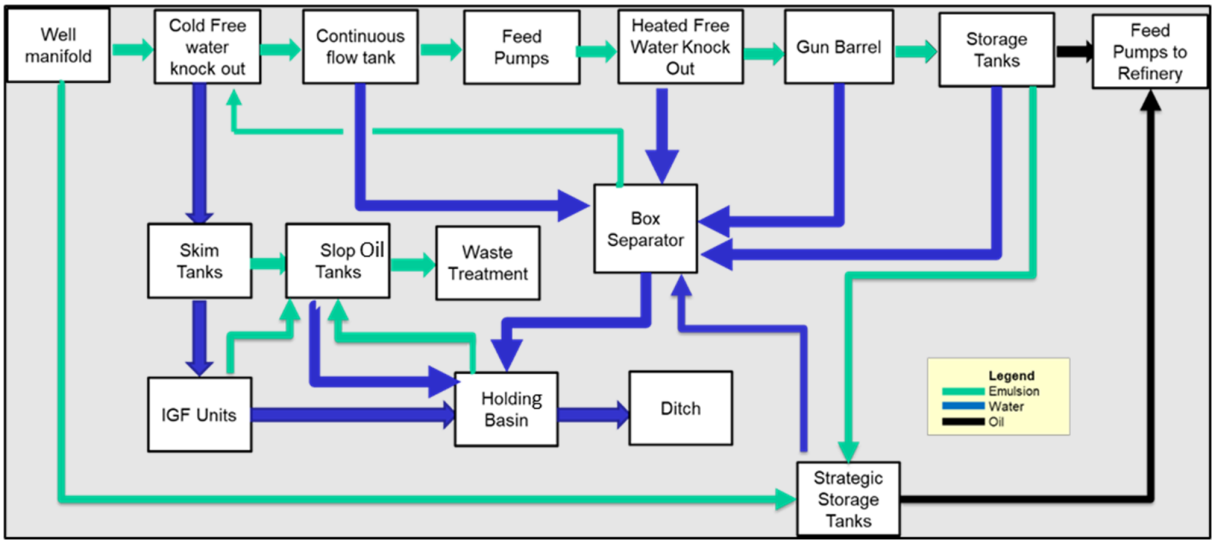


Figure 2: Process block flow diagram of the existing Jossie Plant

All fluids are routed to the Cold Free Water Knockouts (CFWKO's). There are two streams coming out of the Cold Free Water Knockout (CFWKO.): oil/water emulsion and free water.

1. Oil/water emulsion
    - This flow is collected in the Continuous Flow Tank (CFT) and pumped at a variable rate to the direct fired heaters (HFWKO) to reduce the emulsion viscosity
    - After heating, the oil passes through a wash tank (Gun Barrel) and flows into the Storage tanks.
    - In the storage tanks the oil is dewatered further until it reaches the desired specification of water in oil and is then pumped to the refinery via a 55km pipeline.

2. Free water separated from the Cold Free Water Knockout is routed by gravity as follows:
    - Skim tanks
    - Induced Gas Floatation (IGF) units
    - Holding Basin
    - Ditch

Water drained from the Continuous Flow tank (CFT), Heated Free Water Knock Out (HFWKO), Gunbarrel & Storage tanks are routed to the Box Separators which treats these smaller volumes of water to meet the desired effluent quality criteria and is then connected to the holding basin.
During the production and treatment of crude oil at the Jossie Plant, produced gases are emitted to the atmosphere through the flame arrestor vents on top of all tanks (majority from the Cold Free Water Knockout tank) and the HFWKO gas vent.

1.3.2.2 Description of the process of the envisioned upgraded facility

New Process

The new plant will be integrated into the existing facility. Some existing elements will remain as is while others shall undergo modifications. **Figure 3** gives an overview of the process flow of the upgraded Jossie Plant.

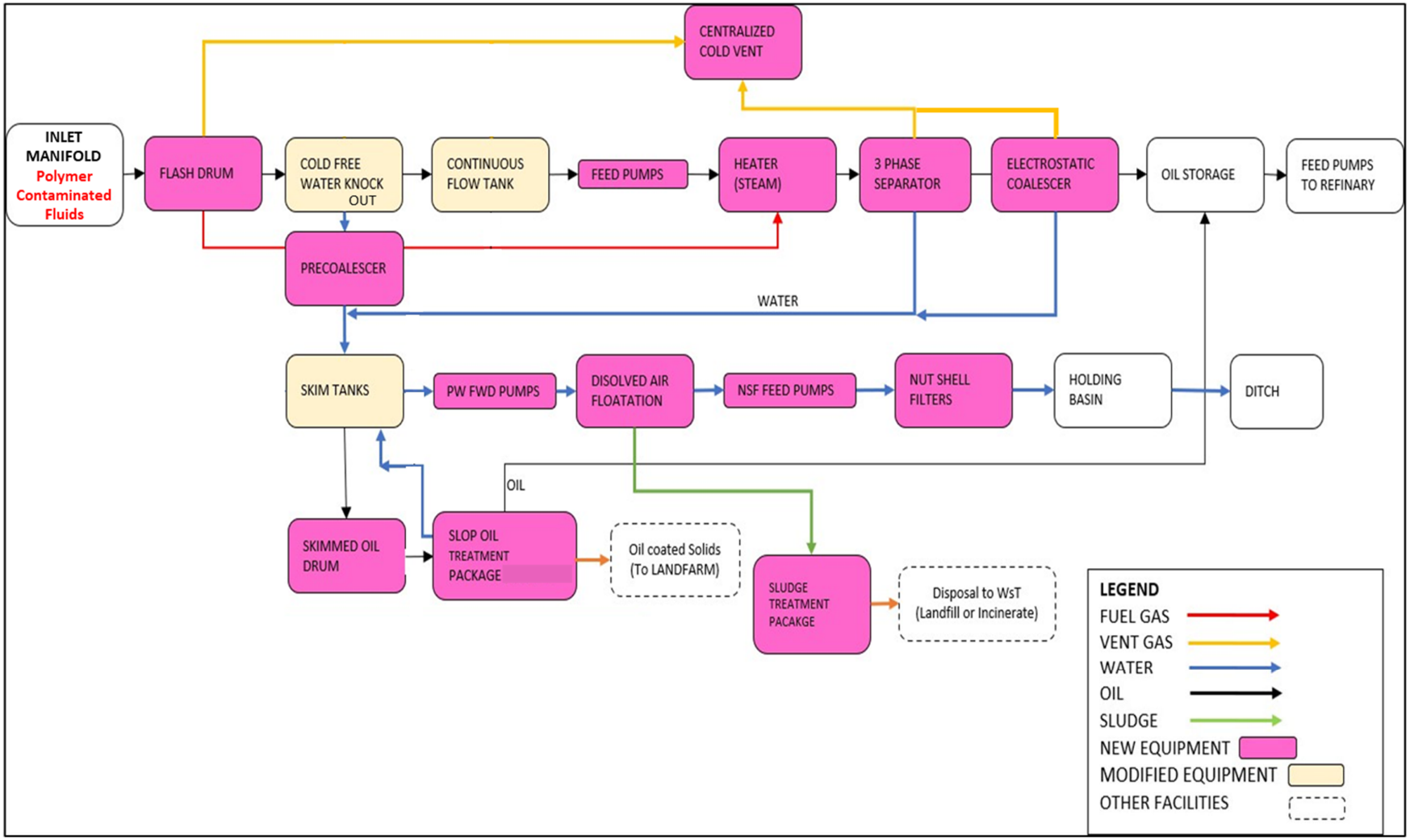


Figure 3: Overall process flow of the upgraded Jossie Plant

The project design basis of the upgraded Jossie Plant is included in **Table 3**.

Table 3: Design basis Jossiekreek Crude Treatment Plant upgrade

Plant Capacity	Design Conditions	Product Output Criteria	Effluent Criteria
38000 Barrels Fluid per day (BFPD): 6000 Barrels Oil per day (BOPD) 32000 BBLS Water per day (BWPD)	Plant Design life 25 Years Overdesign Margin: 10%	0.5% water in oil within 24h (export of end product)	10 ppm Oil in Water (discharged to the environment)

Detail Description of the process of the envisioned upgraded facility

The upgraded plant will receive mainly Polymer affected emulsion from the Tambaredjo-south & -mid production area.

Incoming well fluids will pass through the flash drum which shall flash off the majority of associated produced gases. The collected gases will be used as fuel for the burners of the steam boiler to generate steam. However, based on current and expected gas production, the volumes will not be sufficient to generate the required heat for steam generation. Therefore, crude oil will be used additionally as fuel for the burners. In the event the gas is below the minimum required value for stable burning in the burner, this gas shall be routed to the centralized cold vent instead.

The crude emulsion is then further routed to the Cold Free Water Knock Out Tankss (CFWKO's) for further treatment (Oil dehydration & Produced water treatment).

Oil dehydration:

With each step more water will be extracted from the oil emulsion. All removed water is then sent to the produced water system. The steps for the Polymer affected stream are listed below:

1. Collection and Initial Separation:
   The oil emulsion from the field is collected in the CFWKO, where the free water is separated by gravity from the emulsion. The free water is then sent to the water treatment package for further processing. The emulsion, now separated from the free water, is collected and buffered in the steam heated CFT for further processing in the oil treatment package.
2. Process Heating:
   The collected emulsion from the steam heated CFT is pumped through a crude oil heater, increasing the temperature to improve the dehydration process, further reducing the water content and viscosity of the emulsion for subsequent treatment. The emulsion is heated using steam.
3. Separation:
   The heated emulsion will then be sent to a 3-phase separator to separate the oil, water, and gases. The extracted gases will be sent to the gas vent header. The water will be pumped to the water treatment package. The crude will be pumped to the final separation vessel, the electrostatic coalescer.
4. Electrostatic Coalescence:
   In the electrostatic coalescer, the dispersed water droplets are removed from the crude. This vessel uses electromagnetic forces to coalesce small, dispersed water droplets to bigger ones for faster separation of water from oil. The accumulated water will be sent to the water treatment package, and the crude, now containing less than 0.5% water, will be sent to the crude cooler and then to the storage and transport facility.
5. Storage & Transport to Refinery
   After electrostatic coalescence the on-spec oil is collected in storage tanks and held ready to be pumped to the refinery after sample verification.

Produced Water Treatment

All produced water separated from the oil dehydration processing train will be sent to the produced water treatment. Produced water originates from the following:

- Cold Free Water Knock Out
- 3-phase separator
- Electrostatic coalescer

At each stage the produced water is being clarified as follows:

1. **Pre-coalescer:** a vessel with a coalescing media bed, with the purpose of enlarging the oil droplets in the produced water, so they are easier to separate in the downstream Skim Tank.
2. **Skim tanks:** the oil droplets will separate from the produced water and float at the top. This will be skimmed off. This is considered slop oil and will be sent to the slop oil treatment system. The water will be forwarded to a Dissolved Air Flotation unit.
3. **Dissolved Air Flotation:** The water will be fed via pumps to a Dissolved Air Flotation (DAF) unit which shall extract solids and sludge and further clarify the water. Extracted solids and sludge will be sent to the sludge treatment system.
4. **Nutshell filters:** the water from the DAF unit will pass through the nutshell filters to further clarify the water and obtain less than 10ppm oil in water which is the effluent criteria to discharge to the environment. The water containing less than 10ppm oil, will be sent to a holding basin before being discharged into the Saramacca River.

Slop Oil Treatment and Sludge Separation Package

Skimmed oil from the Skim Tanks and Box Separators, emulsion or "rag" layers from the 3-Phase Separator and Electrostatic Coalescer are collected in the Slop Oil Tanks.
The Sludge Tank receives slop oil from the Slop Oil Tanks via Slop Oil Pumps and sludge from the DAF unit in the PWT Package. The Sludge Tank will be fitted with a heat exchanger for maintaining the tank contents at 70-90°C. The tank supplies the Sludge Feed Pumps, which pump the slops (slop oil and sludge) to be processed in the 3-phase Decanter Centrifuge for oil/water/solids separation.
The Decanter Centrifuge separates the feed into three separate streams:

- An oil stream
- A water stream
- A sludge (solids) stream

The separated oil is sent to the Oil Storage Tanks for product export. The water stream is recycled to the Skim Tanks in the Produced Water Treatment Package. The sludge from the centrifuge is collected in a skip or chute and then disposed of at the Waste Management Facility.

Centralized Cold vent

As improvement of current atmospheric venting from the tanks the new design incorporates a Cold Vent stack with a sterile radius of 25m (restricted area). It was chosen to place this in the firewater pond as this provides a natural barrier (**Figure 4**). This will prevent gases from being vented near working areas low to the ground.

A Vent KO Drum is situated between the main vent header and the vent stack. The vent header gathers process vents and relief lines from the process plant and routes them to vent stack where gases can be safely released to the atmosphere. The Vent KO drum removes any entrained liquid from the vent stream to prevent liquid being ejected from the vent stack. Recovered liquids are recycled to the 3-Phase Separator.

The vent stack is sized for the worst emergency relief, which in this case is the fire case in the new oil processing area. The evaluation of relief cases and the height of the stack (27.5m) has been calculated based on API 521 guidelines. The vent stack is in a sterile area (which will be fenced off or otherwise protected from accidental human access). This is to prevent injury in the event of ignition of the vent plume.

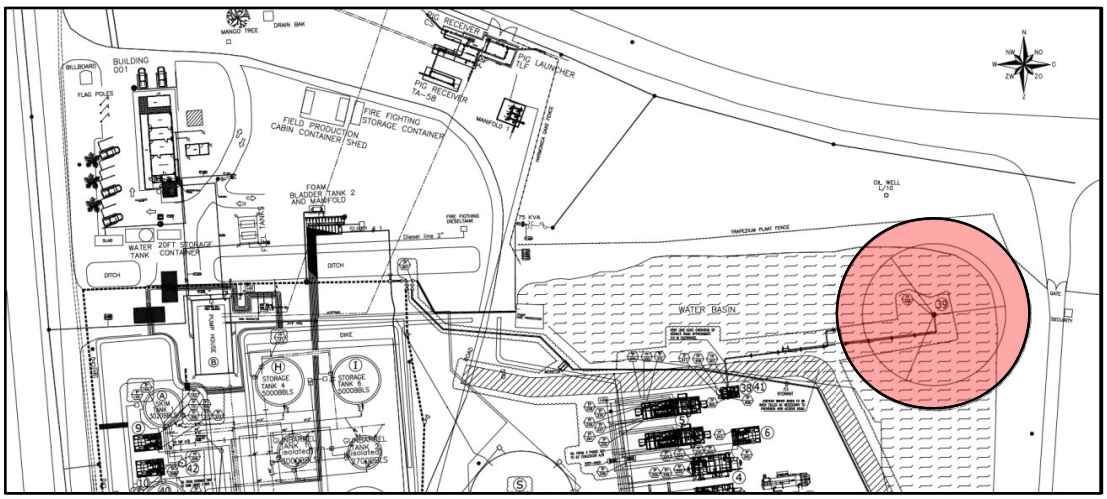


Figure 4: Centralized Location Cold Vent (indicated in red)

The Cold Vent will be constructed as a guided wire stack (**Figure 5**). This will be connected to the knockout drum which intends to capture liquids and release dry gas.

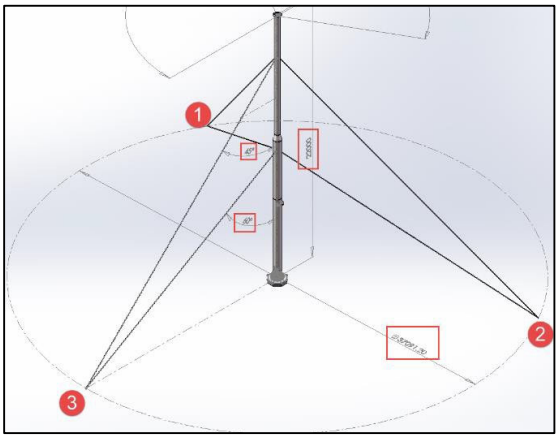


Figure 5: Design of the Cold Vent stack

In **Figure 6** the aerial view is provided with the areas where new equipment will be located as well as the location of the Cold Vent. In between existing tank areas smaller equipment such as pumps will be installed. In **Appendix 1** the plot layout is provided with the new and existing plant elements in which more details can be seen.

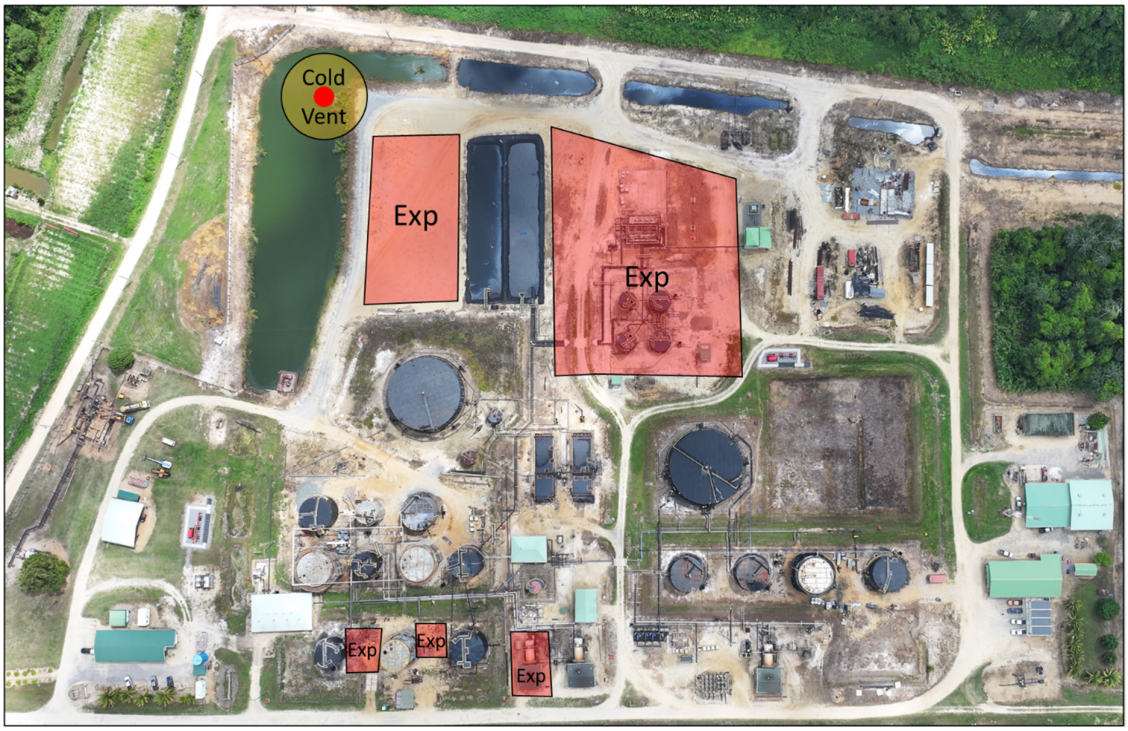


Figure 6: Envisioned expansion (exp.) areas with new plant elements.

1.3.2.3 Key differences with existing plant

The key differences between the existing and proposed upgrade plant are:

- Polymer affected flows shall be routed fully through the new process train.
- Process heating shall be via Indirect (steam powered) heaters (avoiding polymer fouling)
- Process Heating shall be up-to 95°C (as opposed to current 70-80°C)
- Gas blanketing (nitrogen) in the first treatment stages (CFWKO & CFT's) to prevent contamination by air.
- Inclusion of new processing units for oil treatment, water treatment, slop & sludge handling (according to **Table 4**).
- Inclusive of plant automation system utilizing a programmable logic controller (PLC) based Process Control System (PCS)
- Associated produced gases coming with the polymer contaminated fluids from the field will be flashed off in the Flash Drum and will be used as alternative fuel for the burners of the steam boiler.
- No more primary tank venting will take place. A Cold Vent system is included to relieve gases through a vent stack in a centralized location (outside of operational areas to minimize occupational health risks). It is also intended for the emergency relief of gases. Gas relief through the cold vent can only occur under the following conditions:
  - When the flash drum is in maintenance (planned)
  - Vessel Breathing: Gases released from pressure relief devices into the vent header in overpressure situations (abnormal)

1.3.2.4 Major Process equipment & pumps to be installed

An overview of the major process equipment and pumps that will be installed are included in the table below.

Table 4: Major Process equipment & pumps

Facility	Equipment and pumps
Oil Treatment package (OTP)	Crude Forwarding pumps (2x) 3 phase separators (2x) Electrostatic coalescer (2x) Wash Water Pumps (2x) Steam boiler (2x) Crude oil cooler (1x) Flash Drum (1x) Crude Oil Heater (2x)
Produced Water treatment (PWT) package	Pre Coalescer (2x), Skim Oil Buffer Tank (1x), Skim Oil Forwarding Pumps (2x) Produced Water Forwarding Pumps (2x), Pre-coalescer feed pumps (3x) Dissolved Air Floatation (2x) DAF Recirculation Pumps (2x), NSF Feed Pumps (2x), Nutshell Filters (3x), Media Scrubber Pumps (3x), Interconnecting piping network
Slop Oil Treatment & Sludge Separation Package	Heated Sludge Tank with Mixer (1x), Sludge Feed Pumps (2x), 3-phase Decanter Centrifuge (2x), Oily Filtrate Tank (1x), Oily Filtrate Transfer Pumps (2x) Recovered Oil Transfer Pump (1x) Recovered Oil Tank (1x) Interconnecting piping network. Recycle Water Tank (1x), Recycle Water Pumps (2x)
Centralized Cold Vent	Vent Knockout Drum (1x) Vent KO Drum Pump (2x) Vent Piping network Cold Vent Stack (1x)

1.3.3 Project Schedule

The project consists of the following phases:

- Engineering: engineering of all process equipment, tanks, and pumps, including a Hazard and Operability (HAZOP) study, sizing & design calculations, electrical & instrumentation, civil construction, and foundation calculations & drawings.
- Manufacturing: fabrication and assembly of all equipment and piping, including quality inspections and tests.
- Equipment transit and receipt: shipping from vendor location to Suriname of all equipment, including pressure vessels and tanks, Oil Treatment Package (OTP) skids and Produced Water Treatment (PWT) Package skids.
- Civil works execution: construction of foundations and fillings for PWT and OTP area.
- Construction: installation of PWT and OTP skids, pumps & free-standing equipment, piping, mechanical hook-up, and electrical & instrumentation hook-up.
- Commissioning and Start-up of the upgraded plant.

The project schedule and sequence of the Engineering phase, Supply Chain, Manufacturing, Construction and the Commissioning & Start-up phase are presented in the figure below.

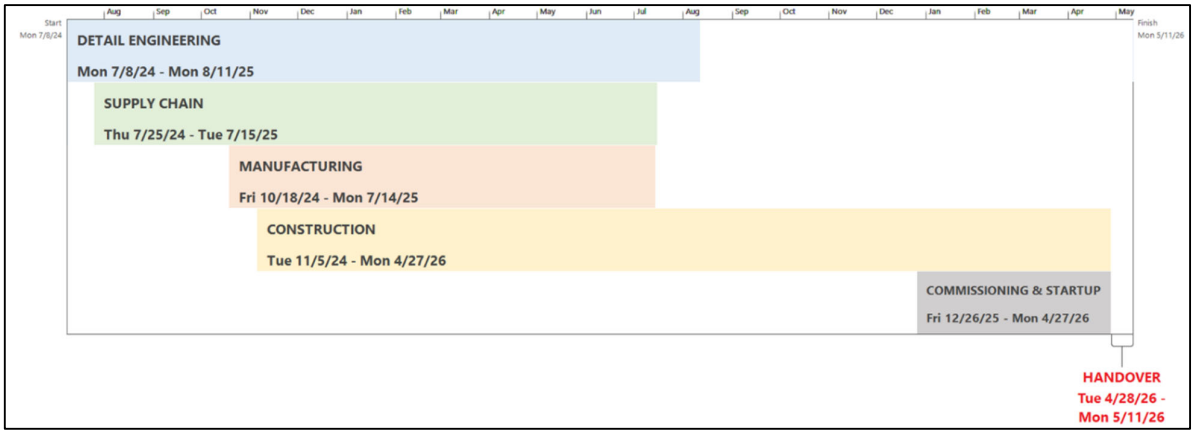


Figure 7: Project schedule for upgrade of the Jossie Plant

1.3.4 Equipment and manpower input

During the construction phase approximately three cranes and two excavators will be in operation simultaneously. The total manpower will be 50 people per day on average, excluding Jossie Plant operations personnel.

1.4 Bio-physical environment

1.4.1 Climate

Northern Suriname has consistently high temperatures and a high humidity, with the main variation being rainfall and the associated cloud cover. Average annual rainfall is 2,186 mm (1991-2022). The mean annual air temperature at Paramaribo is 27.3 º C, with a daily range of 7-10 ºC and an annual range of monthly mean temperatures of about 2-3 ºC. The weather of Suriname is mainly dictated by the northeast and southeast trade wind system called the Inter-Tropical Convergence Zone (ITCZ). The ITCZ passes over Suriname twice a year and results in four seasons based upon rainfall distribution (Scherpenzeel, 1977).

- Long Rainy Season — End April-Mid- August
- Long Dry season — Mid-August-Early December
- Short Rainy season — Early December-Early February
- Short Dry season — Early February-End April

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.

Rainfall

Recent mean monthly rainfall data (between 2008-2023) from stations Cultuurtuin, Zorg en Hoop, and Groningen, nearest station to the Jossie Plant, is presented in **Figure 8**.
Overall, a similar pattern is observed at the three stations. Higher average rainfall values are measured at Groningen between March and June, but this may be due to the fact that the data is of a shorter period compared to the other two stations.

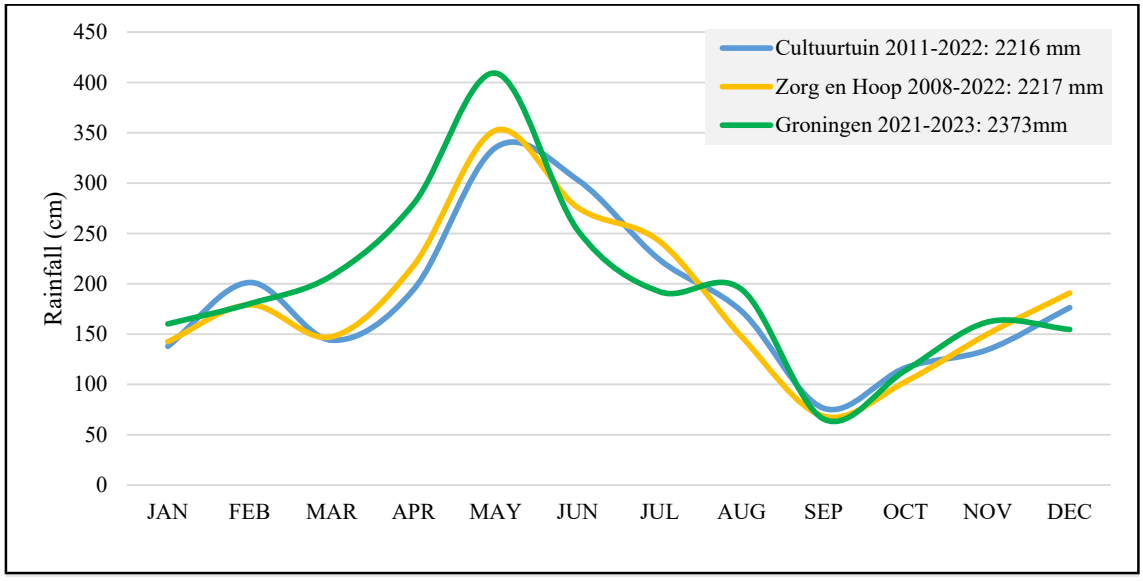


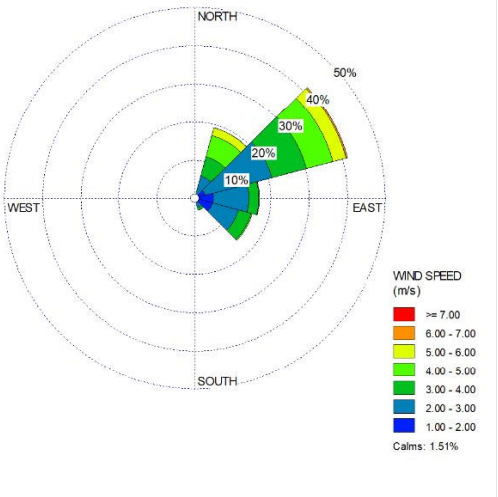
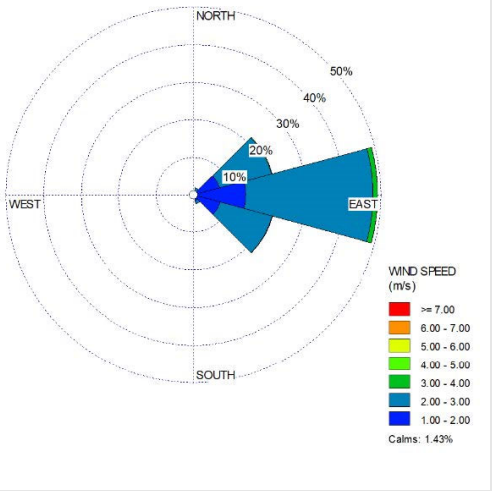
Figure 8: Mean monthly and total annual precipitation for regional stations

Wind speed and direction

Northern Suriname has northeast to southeast wind directions, 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. 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. During the day, the wind speed may increase to about 5 m/s, and in some seasons to 5-8 m/s, in particular in the February-April and the September-October periods.

Weather research and forecasting (WRF) modelled data for the study area also indicates a wind field dominated by winds from the northeast during the day, with wind more dominant from east during the night (**Table 5)**. Day- and nighttime average wind speeds are 2.95 m/s and 2.08 m/s respectively. Calm conditions occur for 1.5% of the time during the day and 1.43% during the night. The average temperature in the study area over the three-year period was 25.3°C and the average humidity 88.7% (AIRSHED, 2024). The day and nighttime wind field for the study area is presented in the table below.

Table 5: Day- and night-time wind field showing dominant northerly winds (WRF, 2021 to 2023)

Day-time wind field (07:00 to 22:00)	Night-time wind field (22:00 to 07:00)
	

1.4.2 Air quality

Baseline ambient air quality measurements were conducted at the Jossie Plant in June 2022 (ILACO, 2023). Besides the real time measurements, passive diffusive sampling was conducted using Radiello samplers for analysis on Volatile Organic Compounds (VOC). The sampling was executed between 8th and 13th August 2022. The real-time and passive sampling locations are presented in **Figure 9**. A summary of the air quality measurement results is included in **Appendix 3**.

From the real-time in-situ measurements the following was concluded (ILACO, 2023):

- The measured particulate matter (PM) data were below the WHO guidelines (2021) of respectively 15 µg/m^3 for $PM_{2.5}$ and 45 µg/m^3 for PM_{10}.
- The measured NO_2 and O_3 concentrations were within the WHO guidelines.
- High levels of SO_2 concentrations were measured, with the highest peak observed in the afternoon (12:00 PM – 5:00 PM) and lowest during nighttime (9:00 PM – 6:00 AM). These levels are common at petroleum plants and oil product processing plants, originating from local sources (Elem, 2014 & EPA, 2022) within a 100-500 m zone. The fluctuation can be explained by the strong influences of meteorological factors such as wind direction, wind speed and relative humidity.

From the Radiello sampling it can be concluded that ambient concentrations of all the analyzed Volatile Organic Compounds (such as Benzene, Toluene and Ethylbenzene) were low and below the applicable standards.

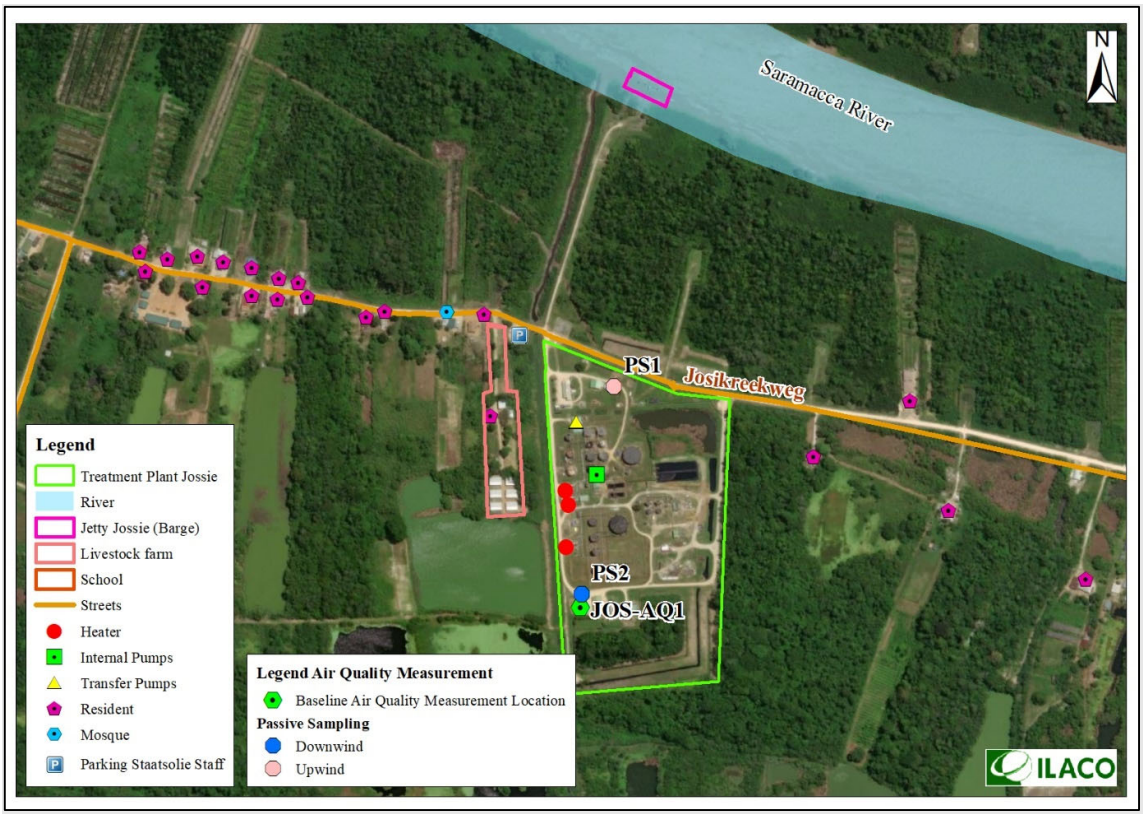


Figure 9: Overview Air Quality Measurement locations (2022)

1.4.3 Noise

Noise is recognized as a potential pollutant or nuisance during the planned activities in the project area. As part of the EMMP, noise measurements were conducted at the project site and at nearby residents during day- and nighttime in January and March 2024. Previous noise measurements conducted at the noise sources and nearby receptors (in April 2022) have also been considered (ILACO, 2023) The methodology and detailed results are presented in **Appendix 4**.

The main noise sources from the Jossie Plant are noise generated from the heaters (3x), transfer pumps (4x) and internal pumps (2x). The main noise sources and noise measurement locations are presented in **Figure 10**.

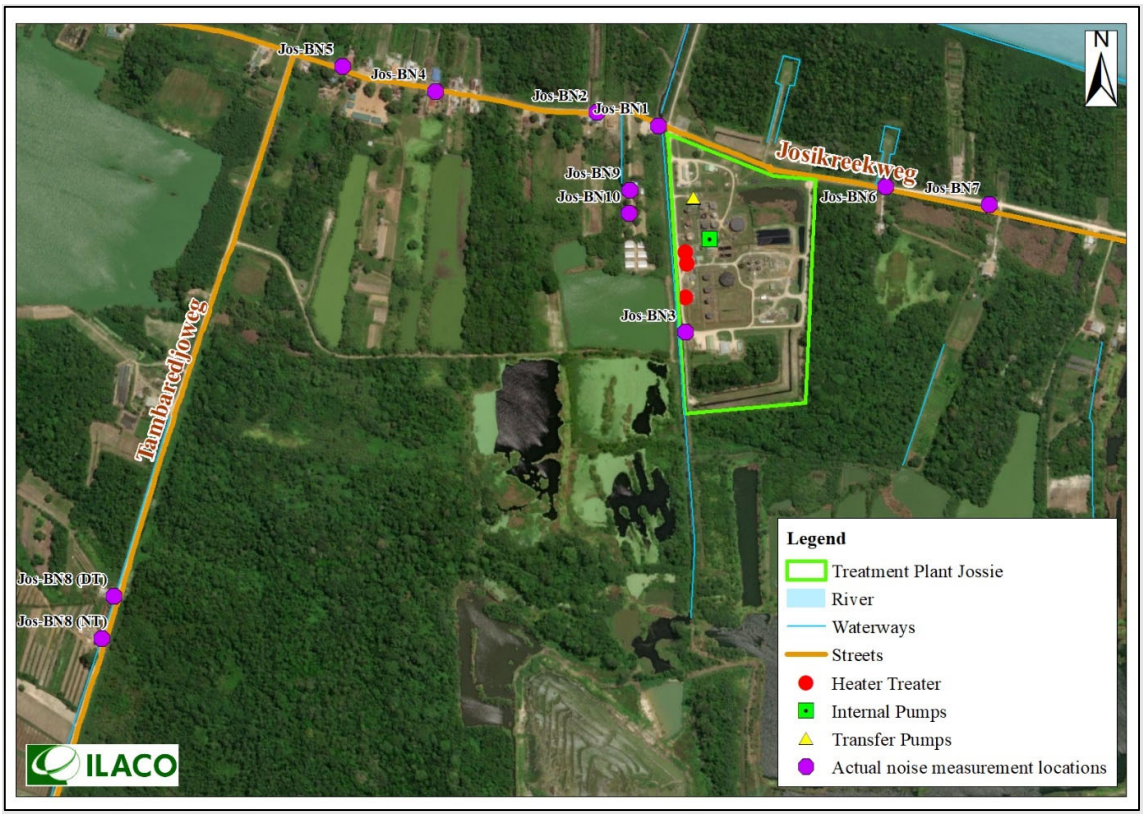


Figure 10: Overview noise measurement locations

The summary results of the noise measurements conducted in 2022 and 2024 are presented in the tables below.

Table 6: Source noise measurement results (2022)

Location ID	Location Description	Daytime (7:00 – 22: 00 hrs.)		
		L10	L90	LAeq
		dB(A)		
JOS-EN1	On the west side of the Heater located approx. 4.5 m away from the axis of the road.	75.8	70.0	74.0
JOS-EN2	At the transfer pumps. The transfer pumps are located beneath a zinc roof.	92.5	91.0	91.7
JOS-EN3	At the east side of the internal pumps station. The internal pumps are located under a zinc roof.	86.1	84.2	85.3
	Exceeds the noise standards of 85 dBA for occupational health			

Table 7: Day and nighttime baseline noise measurement results (2022)

Location ID	Location Description	Daytime (7:00 – 22: 00 hrs.)			Nighttime (22:00 – 7:00 hrs.)		
		L10	L90	LAeq	L10	L90	LAeq
		dB(A)					
JOS-BN1	Along the south berm of the Jossiekreekweg, between the main entrance and parking space of the Jossie treatment plant. Approx. 250 m from heater and 150 m from transfer pumps.	56.9	51.7	56.5	50.8	47.4	49.3
JOS-BN2	Along the Jossiekreekweg, in front of a local mosque, approx. 150 m west from the entrance of the Jossie treatment plant. Approx. 320 m from heater.	59.5	44.8	60.3	47.3	45.1	46.2
JOS-BN3	At the backyard of the treatment plant. The backyard consists of an office with several other buildings and a parking area. Approx. 150 m from heater.	74.7	52.5	72.6	55.7	52.5	54.3
	Exceeds the noise standards of 55 dBA and 45dBA, respectively for daytime and nighttime, for residential areas.						
	Exceeds the noise standards of 70 dBA industrial and commercial area.						

The recent day and nighttime baseline noise measurement results are presented in **Table 8**. During the recent noise measurements two heaters, four transfer pumps and two internal pumps were in operation (full operation) during the day. An exception is formed by the March 7 (measurement at Jos-BN9 and BN10) when only half of the equipment was in operation. Also, during all the night measurements, only one heater treater, two transfer pumps and one internal pump were running (half operation).

Table 8: Day and nighttime baseline noise measurement results (2024)

Location ID	Location Description	Daytime (7:00 – 22:00 hrs.)			Nighttime (22:00 – 7:00 hrs.)		
		L10	L90	LAeq	L10	L90	LAeq
		dB(A)					
Jos-BN1	Along the south berm of the Jossiekreekweg, between the main entrance and parking space of the Jossie treatment plant.	56.4	52.5	55.2	56.4	53.6	55.3
Jos-BN2	Along the Jossiekreekweg, in front of a local mosque, approx. 150 m west from the entrance of the Jossie treatment plant.	49.6	46.4	48.7	47.1	45.2	46.2
Jos-BN3-1[1]	At the backyard of the treatment plant. The backyard consists of an office with several other building and a parking area.	57.7	53.1	55.8	-	-	-
Jos-BN3-2	At the backyard of the treatment plant. The backyard consists of an office with several other building and a parking area.	59.6	53.5	57.3	55.9	53.7	54.9
Jos-BN4	At the entrance of a resident, along the south berm of the Jossiekreekweg approx. 466 m west from the entrance of the Jossie treatment plant.	50.0	43.8	50.4	42.2	40.0	41.2
Jos-BN5	At the entrance of a resident, along the north berm of the Jossiekreekweg approx. 630 m west from the entrance of the Jossie treatment plant.	54.2	45.8	54.5	49.6	47.1	48.4

[1] During measurement Jos-BN3-1 the internal pumps were not in operation yet while at Jos-BN3-2 the internal pumps were also in operation besides the heaters and transfer pumps.

Jos-BN6	At the entrance of a resident, along the south berm of the Jossiekreekweg approx. 413 m east from the entrance of the Jossie treatment plant.	50.6	44.7	58.6	47.0	45.0	46.1
Jos-BN7	At the entrance of a resident, along the south berm of the Jossiekreekweg approx. 610 m east from the entrance of the Jossie treatment plant.	53.5	44.8	50.8	48.9	45.4	47.3
Jos-BN8	At the entrance of a resident, along the west berm of the Tambaredjoweg approx. 1.4 km southwest from the entrance of the Jossie treatment plant.	48.5	39.3	45.6	47.1	45.3	46.3
Jos-BN9	Near the residential house at the farm, approx. 127 m west from the entrance of the Jossie Plant.	56.2	54.4	55.5	56.1	54.7	55.5
Jos-BN10	At the farm, approx. 165 m west from the entrance of the Jossie Plant.	57.4	54.0	56.0	55.4	53.4	54.5
	Exceeds the noise standards of 55 dBA and 45dBA, respectively for daytime and nighttime, for residential areas.						
	Exceeds the noise standards of 70 dBA industrial and commercial area (applicable for location Jos-BN3)						

1.4.3.1 Daytime noise levels

The daytime LAeq noise levels along the Jossiekreekweg ranges between 49 and 59 dBA. In **Figure 11** the noise measurements near residents are shown in yellow, while measurements at the plant are shown in light orange. The noise measurements at non-residential areas are shown in white.
The higher LAeq values at residents are the result of passing vehicles and not from the noise at the Jossie Plant as can be concluded from the background levels (L90) (see **Table 8**). There is no daytime noise impact from the activities at the Jossie Plant for local residents. Furthermore, the measurements taken close to the Jossie Plant and the residents living in the house on the livestock farm slightly exceed the WHO/IFC guideline threshold of 55 dBA.

Figure 11: LAeq results from daytime measurements.

1.4.3.2 Nighttime noise measurements

Figure 12 presents the results of the nighttime noise measurements; the noise measurements near residents are shown in yellow, while measurements at the plant are shown in light orange. Noise measurements at non-residential areas are shown in white.

At all locations, the LAeq is only marginally above the background levels (L90) (see **Table 8**), indicating the absence of transient noises, such as vehicles. Insects and toads/frogs affect the noise levels at all locations, causing the LAeq to be higher than the WHO/IFC standard of 45 dBA for most residents (46-48 dBA).

Elevated levels above the WHO/IFC standard are recorded in a radius of approximately 200 meters around the plant. This includes the residents living in the house at the pig farm, where a LAeq of 56 dBA is recorded. Also, the L90 noise level is 56 dBA, indicating a continuous noise source, in this case the equipment at the Jossie Plant. There is no nighttime noise impact from the activities at the Jossie plant for local residents beyond 200 m.

Figure 12: Nighttime LAeq in the wider project area.

1.4.3.3 Noise Modelling of Current Operations at Jossie Plant

From the noise modelling conducted by AIRSHED (2024) it can be concluded that the current operation at the Jossie Plant is not expected to result in exceedance of the IFC guideline[2] of 55 dBA during daytime at the closest noise sensitive receptors (school and mosque) and nearest residents (see **Figure 13**). However, during nighttime, the current operation at the Jossie Plant results in exceedances of the night-time IFC guideline of 45 dBA at the closest receptor locations (BN9) (**Figure 14)**.

[2] The WHO/IFC states that noise impacts should be limited to a maximum increase above background levels of 3 dBA at the nearest receptor location off-site (IFC 2007).

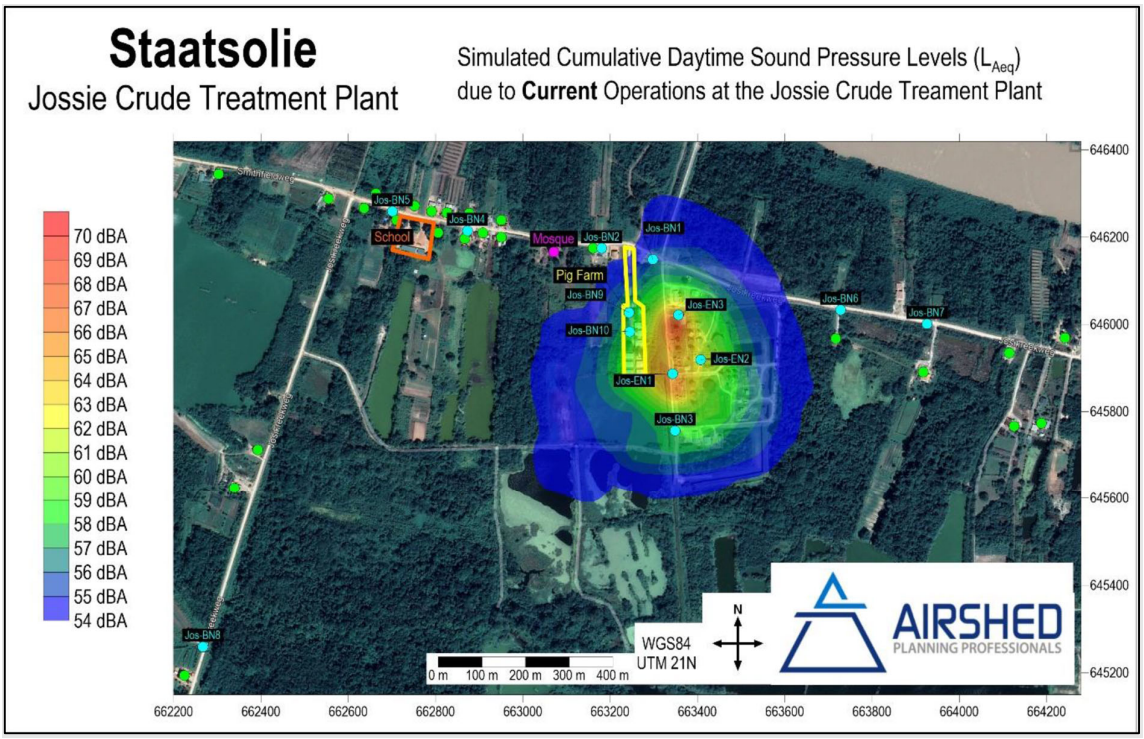


Figure 13: Simulated equivalent continuous day-time rating level (LAeq,d) due to Current Operations

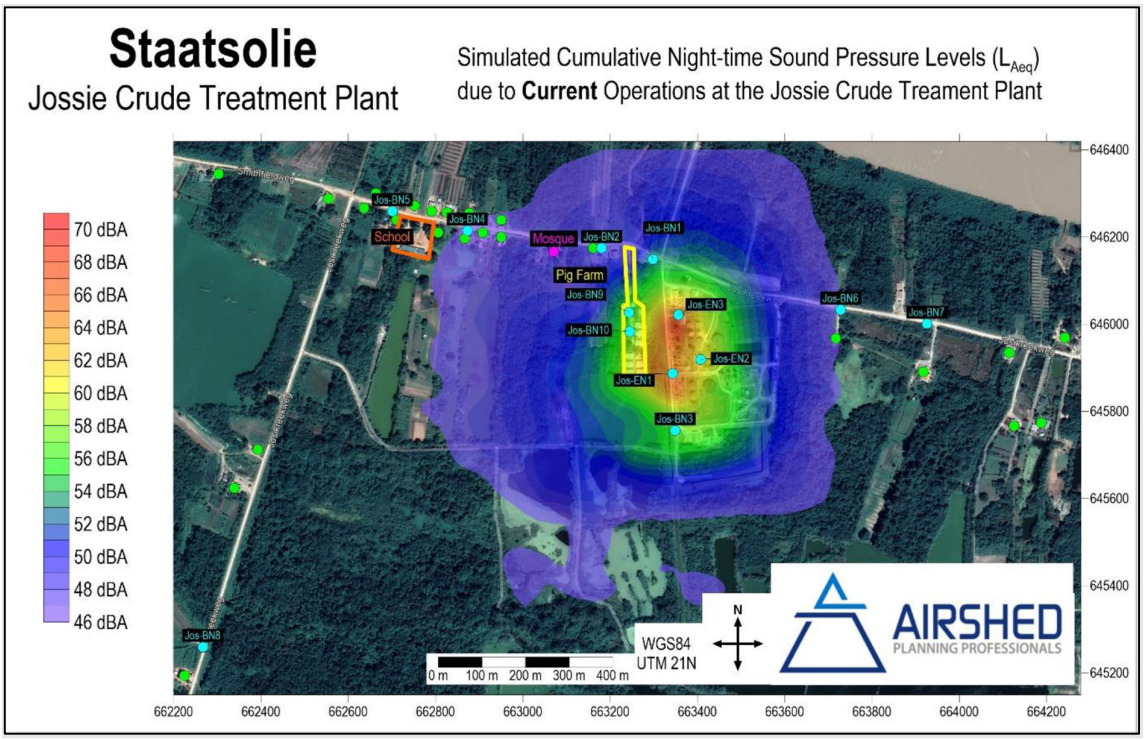


Figure 14: Simulated equivalent continuous night-time rating level (LAeq,n) due to Current Operations

1.4.4 Land and soil

The Jossie Plant is located in the flat and low-lying Young Coastal Plain, 400 meters south of the Saramacca River. The area is characterized by clay flats and sand and shell ridges. The area north of the Jossiekreekweg consists of river clay soils at an elevation of 1.5-2.0 m above mean sea-level. The road itself is constructed on a ridge, which is interrupted at the Jossie Plant drainage canal (**Figure 15**), a channelized creek; the Jossiekreek. The ridge is 1-3 meters higher than the neighboring river clay flat. A narrow strip in the north of the Jossie Plant site lies on the ridge, but most of the site is situated on clay soils at an elevation of approximately 1.0 meter above mean sea level, with sand and shells in the subsoil.

1.4.5 Hydrology

Jossiekreek

The Jossie Plant is drained by a system of ditches which end up in the south-north canal along the access road. This canal is actually a channelized creek; the Jossiekreek. At low tide, excess water is discharged through a sluice towards the Saramacca River. The canal also discharges excess water from some of the water-filled shell mining quarries south of the Jossie Plant (**Figure 15**).

In the northeast of the plant is a large water basin filled with stormwater, the fire water pond. Excess water from this basin is drained to a nearby ditch. Water from the Produced Water System ultimately ends up in a holding basin, from where it is also routed to a ditch at the site and from there to the outside canal, the Jossiekreek and then the Saramacca River.

The water ways on and near the Jossie Plant are indicated in the **Figure 15** below.

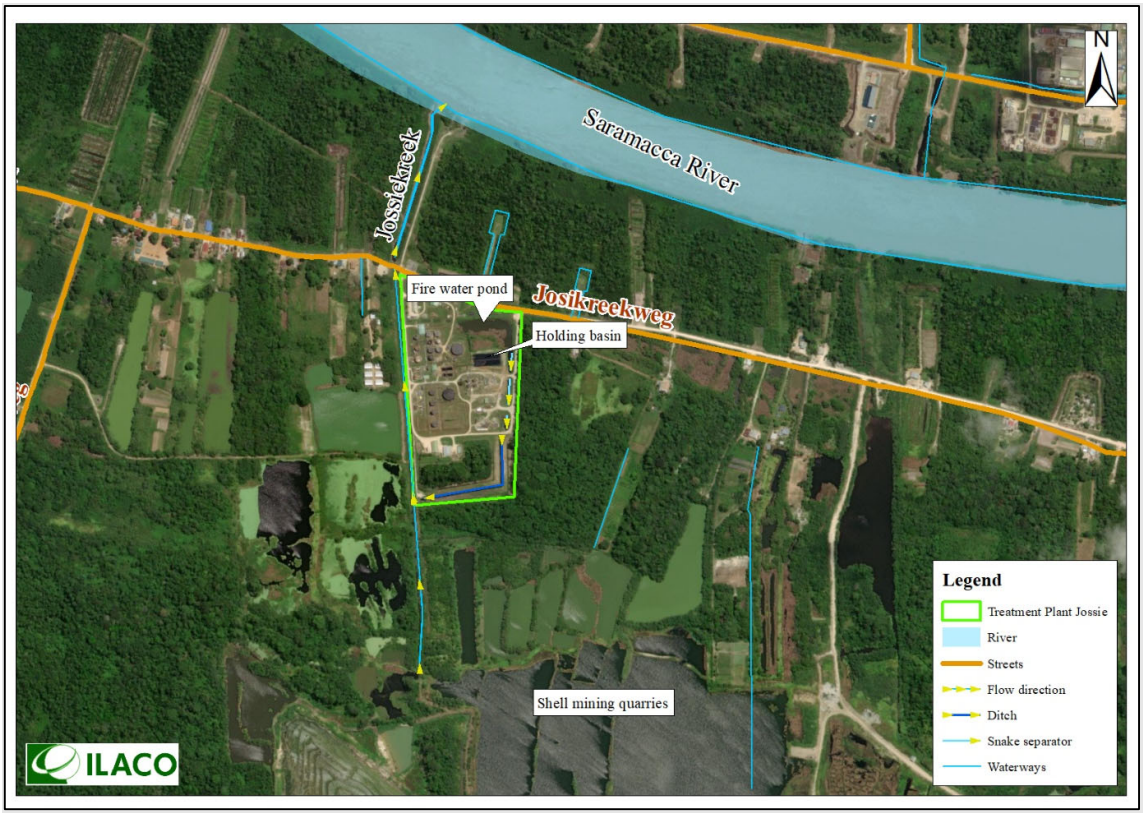


Figure 15: Waterways on and near the Jossie Plant

Saramacca River

The Saramacca River is one of the seven main rivers in the country with a drainage area of about 9,000 sq km. The Jossiekreek Crude Treatment Facility is situated on the left bank of the lower Saramacca River, which is affected by the tidal regime of the Atlantic Ocean. The semi-diurnal movement of the Atlantic seawater mainly determines the water level in the estuary of the river. The tidal amplitude moves upstream through rivers and creeks, far into the Young Coastal Plain, during which it is gradually

decreasing. During a tidal cycle a large volume of water is flowing into the river during the flood-flow and during the ebb-flow this same volume of water is flowing back towards the sea, together with the freshwater discharge from the river. The volume of water flowing into the river and back to the sea, the so-called tidal prism, depends upon the tidal range. The tidal volume of the Saramacca is about 50 million m^3 per tidal cycle.

During the dry seasons, especially during the Long Dry Season, when river discharge is low, seawater penetrates far into the river. In these periods the tidal effect reaches more than 240 km upstream (Amatali, 1993). The mean freshwater discharge at the outfall is estimated at about 225 cub m/sec. The maximum estimated freshwater discharge at the outfall is 1,260 cub m/sec. and the minimum is 4.6 cub m/sec. Peak flow occurs generally during the period May-June, while low flows occur in October and November (Amatali, 1993).

According to water level data collected during the period 1962-1965 at Sarah Maria, the mean high water is 1.23 m +NSP (Normal Suriname Level = approx. mean sea level) and the mean low water level is 0.68 m. -NSP (Hydraulic Research Division, 1987). Highest water levels may reach a level of 1.90 m +NSP, while lowest water levels may be 0.90 m-NSP.

Drainage of excess water from agricultural lands and industrial areas along the river is done by gravity through sluices. This implicates that the vast majority of drainage from (among others) the Jossie Plant will occur during outgoing water in the river also through a sluice (with automatic closing valve at high tide). During the rainy seasons, the discharge water from the Jossie Plant is mixed in the Jossie Creek with water from the upstream shell pits. During the dry season predominantly discharge water from the Jossie Plant will be discharged into the Saramacca River.

1.4.6 Water Quality

Jossiekreek

Previous water quality measurements provide the following summary of water quality in the Jossiekreek, the drainage canal near the Jossie Plant (P-all, 2015)[3]:

- The pH is basic (approximately 8.0), probably due to the fact that the canal also drains water from the shell mine-outs.
- The water is fresh to slightly brackish (salinity: 1.4-2.4 ppt).
- Dissolved Oxygen (DO) is moderate (51-67%).
- The water is slightly turbid (42-141 NTU).
- Oil & Grease is <10 mg/L, indicating the absence of significant oil pollution.

Effluent Jossie Plant

As part of the current operation of the Jossie Plant, water quality is monitored at several locations in the water treatment process and the effluent (before discharge in the Jossiekreek). As part of the monitoring program, several parameters such as pH, DO, Turbidity and Oil and Grease are monitored. The frequency of sampling varies from weekly to monthly, depending on the parameters.

The following is observed from the water quality monitoring data of the effluent from the Jossie Plant (Staatsolie, 2023- 2024):

- The average pH of the effluent is 7.5 and varies between 6.9 and 7.8. This is within the IFC discharge limit (pH between 6 and 9) for effluent into surface waterbodies and the USEPA freshwater aquatic life criteria (pH between 6.5 and 9).
- The DO of the effluent varies between 1.0 and 5.4 mg/L, indicating low oxygen levels. Surface water bodies that support most aquatic life, including fish and macroinvertebrates, typically have DO levels above 6.5 mg/L (US EPA).

[3] No other recent data is available for the Jossiekreek and surrounding.

- The turbidity of the effluent varies between 8 and 510 FTU. Exceedance of the maximum turbidity as reported by P-all, is only recorded in 10% of the cases. These exceedances are related to rainfall events.
- The average oil and grease in the effluent is 8.2 ppm, which is below the IFC standard of 10ppm. Exceedance of the 10-ppm threshold occurs in 30% of the cases, but exceedance is generally slight (only 10% of all cases above 20 ppm). The upgrade of the Jossie Plant is expected to result in a more efficient process with less hydrocarbon releases in the effluent and so further improvement will be realized.

Based on the water quality of the effluent from the Jossie Plant and the absence of other significant new wastewater discharge sources, it can be stated that the water quality in the Jossiekreek does not significantly differ from the one measured by P-all.

In addition to the aforementioned monitoring efforts, Staatsolie is also tracking the concentration of Hydrolyzed Polyacrylamide (HPAM) in the effluent discharge into the Jossiekreek. While Acrylamide Monomere (AAM) is the primary parameter of interest[4] (SRK, 2019), Staatsolie has encountered challenges in monitoring this parameter due to the lack of local analysis capabilities. In addition, the high solubility of AAM, makes in-situ measurements preferable but unfortunately currently without any success. As a result, AAM is now being conservatively estimated from HPAM concentrations, assuming that AAM constitutes 0.1% of PAM (SRK, 2019). An analysis of the HPAM concentrations in the effluent and the corresponding AAM concentrations reveals the following:

- The HPAM concentration in the effluent ranged from 0 and 28 ppm (0- 28000 µg/L) between February 2014 and April 2024.
- The calculated AAM concentration ranged from 0 - 28 µg/L, which is below the aquatic threshold of 33.8 µg/L as set by the European Union (EU, 2002).

Saramacca River

Some historical data for the Saramacca River are presented in Hydraulic Research Division (1987). It is mentioned that the silt content at Uitkijk (km 104), upstream of Sarah Maria (km 73), varies between 0.03 - 0.80 g/l, whilst at Huwelijkszorg (km 53) it varies between 0.03 - 1.30 g/l. Considering the limit of 300 mg Cl/l (limit of salt intrusion), equivalent to 500 mg salt/l or an approximate Electrical Conductivity (EC) of 1,000 µS/cm (1 mS/cm), this limit is located near km 37, about 6 km down-stream of Carl Francois during peak flows, while during low flows it is located near km 89, about 5 km upstream of Groningen.

As part of the ESIA study for the Production Development in the Farmersland Area, water samples have been collected of in the Saramacca River (Noordam, 2014. Noordam (2014) reports slightly acid to neutral water. The Electrical Conductivity (EC) of the river water in the rainy season is generally very low (10-74 µS/cm), pointing to fresh water. A higher EC is recorded in the dry season (1,774 µS/cm), when water is slightly brackish, due to the upriver intrusion of the salt limit. This is in line with the general picture. Water quality in-situ measurements conducted by ILACO in 2018 and 2019 reported the similar findings for pH and EC (ILACO, 2019). The river has almost clear to slightly turbid water, as can also be deduced from Secchi and Total Suspended Solids (TSS) values. The influence of incoming seawater can be deduced from the higher TSS at Huwelijkszorg. Nutrients (nitrogen and phosphorus) in the river water are low. There are no signs of eutrophication in the sampled river water. The Chemical Oxygen Demand (COD) in the sampled river is between 9 and 47 mg/L. These low COD can be attributed to the low salt content (low EC) and the low quantity of organic compounds. Oil & Grease levels are well below the level of 10 mg/L, which Staatsolie keeps as its limit for Oil and Grease. However, the presence of Oil and Grease in the samples is unexpected, because no trace of such

[4] AAM is classified as a probable human carcinogen and is known to cause neurotoxic effects, particularly at high exposure levels. It can lead to symptoms such as muscle weakness, numbness, and impaired coordination. Because of its highly solubility in water, its low potential to partition to organic matter, and its low volatilization potential in water; it is considered a key environmental pollutant associated with the use of PAMs (SRK, 2019, chapter 6.3.2).

compounds (e.g. like an oil sheen) was detected while sampling. Summarizing, it is concluded that in the rainy season the river water near the study area is slightly turbid, brown, slightly acid to neutral, fresh, with low nutrient levels and a low COD, and that it is apparently unpolluted. In the dry season, with low flows, the river water will become more saline and increasingly turbid as a result of the intrusion of the sea (Noordam, 2014).

Since 2022, Staatsolie has been monitoring the Saramacca River and the Jossiekreek. The locations are shown in **Figure 16**. The results over the period 2022-2024 are presented in **Table 9** and **Table 10**. The findings in **Table 9** are in line with the information presented above. However, the Electrical Conductivity in December 2023 and March 2024 is higher than the one measured before in the dry period. The data reflects the prolonged dry conditions that occurred from September 2023 up to April 2024. The sampled river water from this period can be characterized as slightly brackish to moderately brackish. The elevated salinity also affected the COD. Dissolved Oxygen (DO) is moderate to high, which is normal for a flowing river.

With respect to the metals, it is observed that none of the levels poses an acute risk for aquatic life. The same holds for chronic risks, with the exception of mercury and lead. Mercury levels exceed the chronic criterion for aquatic freshwater life (CCC) on a few occasions at locations SAR 01, SAR 02 and SAR 03, but in particular at SAR 02, downstream of the Jossie Plant. The averages over the whole measuring period are, however, below the CCC limit. Mercury levels in the Jossiekreek (SAR 04) are always below the CCC limit, so it is unlikely that the Jossie Plant is the source of the elevated mercury levels.

Lead levels are above the CCC limit at all sampling locations, at respectively 33% (SAR 04), 40% (SAR 03), 60% (SAR 01) and 80% (SAR 02) of the time. Averages at SAR 03 (upstream), SAR 01 (Jossiekreek outlet) and SAR 04 (Jossiekreek) are slightly above or below the critical level of 2.5 µg/L at which chronic risk to aquatic life could occur. Downstream location SAR 02 on average has elevated lead levels that pose significant chronic risks for aquatic life. Previous water quality data of the Saramaca River (SRK, 2019 and ILACO, 2019) did not report elevated levels of lead. The source of the elevated lead levels in the water cannot be established, with the currently available data. Further research is required to explain these elevated levels.

Figure 16: Sampling locations Saramacca River and Jossiekreek 2022- 2024

SAR 02: Saramacca River, 4 km downstream of discharge point Jossie Plant into river.
SAR 01: Saramacca River in front of discharge point Jossie Plant into river.
SAR 04: Jossiekreek near sluice.
SAR 03: Saramacca River, 1 km upstream of discharge point Jossie Plant into river and opposite discharge point of Sarah Maria.

Table 9: Analytical results for general parameters

	Electrical conductivity (µS/cm)				pH				Oil & Grease (mg/L)				COD (mg/L)				DO (mg/L)			
	SAR 02	SAR 01	SAR 04	SAR 03	SAR 02	SAR 01	SAR 04	SAR 03	SAR 02	SAR 01	SAR 04	SAR 03	SAR 02	SAR 01	SAR 04	SAR 03	SAR 02	SAR 01	SAR 04	SAR 03
8-Apr-22	71	68	64	64	6.7	6.5	6.2	6.1	< 0.1	< 0.1	< 0.1	< 0.1	10	18	19	19	6.4	6.1	7.3	6.1
23-Jun-22	74	61	71	64	6.7	6.6	6.5	6.1	2.5	2.0	2.4	3.1	63	43	30	48	6.4	6.7	7.5	6.0
28-Dec-22	73	53	72	58	6.5	6.4	6.6	6.4	1.4	1.0	4.3	0.8	28	25	22	23	7.4	7.2	6.2	7.7
13-Dec-23	7,359	6,647		5,005	7.8	7.5		7.7	5.2	6.4		3.6	306	220		96	6.6	6.6		6.9
28-Mar-24	6,567	7,563		8,680	8.1	8.0		8.0	2.9	3.8		2.6	107	204		576	8.4	8.1		8.2
12-Jun-24	58	76		51	6.8	6.5		6.3	0.0	0.0		0.0	59	66		51	5.1	4.2		4.0

Table 10: Results of surface water metals analyses (µg/L) and testing against US EPA criteria for freshwater

	Arsenic				Cadmium				Chromium				Copper				Mercury			
	SAR 02	SAR 01	SAR 04	SAR 03	SAR 02	SAR 01	SAR 04	SAR 03	SAR 02	SAR 01	SAR 04	SAR 03	SAR 02	SAR 01	SAR 04	SAR 03	SAR 02	SAR 01	SAR 04	SAR 03
8-Apr-22	0.73	1.04	2.36	0.68	0.11	0.02	<0.01	<0.01	2.88	2.98	3.37	2.80	7.99	7.27	10.35	10.63	1.36	0.07	0.06	0.05
23-Jun-22	0.51	1.05	0.36	0.57	<0.01	<0.01	<0.01	<0.01	1.46	1.41	1.41	1.40	19.41	13.49	24.10	20.89	0.09	0.07	0.07	0.08
28-Dec-22	0.91	1.11	1.23	0.82	0.02	0.04	0.03	0.02	2.88	2.43	3.46	2.54	74.40	66.55	61.60	71.16	1.20	0.76	0.74	0.87
13-Dec-23	3.87	6.02		3.04	0.03	0.05		0.02	4.58	5.65		4.17	8.79	10.07		6.41	0.62	1.16		0.26
14-Jul-24	2.09	2.00		1.38	0.01	0.01		<0.01	5.46	3.65		3.23	10.44	7.23		9.48	<0.05	<0.05		<0.05
CCC	150				-				11				-				0.77			
CMC	340				1.8				16				-				1.40			

	Nickel				Lead				Vanadium				Zinc			
	SAR 02	SAR 01	SAR 04	SAR 03	SAR 02	SAR 01	SAR 04	SAR 03	SAR 02	SAR 01	SAR 04	SAR 03	SAR 02	SAR 01	SAR 04	SAR 03
8-Apr-22	2.99	4.89	4.64	3.28	3.42	0.74	1.82	0.81	2.81	2.77	3.03	2.74	39.09	4.93	5.29	5.33
23-Jun-22	2.88	2.66	3.61	2.38	3.45	2.93	3.98	4.76	1.70	1.77	1.53	1.50	16.47	10.36	19.05	13.90
28-Dec-22	4.63	4.08	3.69	5.10	2.37	1.92	1.91	1.79	5.42	5.32	5.96	4.88	13.95	9.30	10.92	13.68
13-Dec-23	44.34	8.56		4.63	2.96	4.52		2.01	9.10	10.65		8.52	26.71	29.39		27.58
14-Jul-24	4.43	5.18		3.85	4.52	2.90		2.69	7.63	4.85		4.28	51.97	18.40		21.89
CCC	52				2.5				-				120			
CMC	470				65				-				120			

CCC: Criterion Continuous Concentration (chronic - freshwater)
CMC: Criterion Maximum Concentration (acute-freshwater)
Yellow highlight: Value exceeds CCC for freshwater

1.4.7 Biological resources

The project will be developed within the existing limits of the Jossie Plant, so no clearing of vegetation is necessary. The fauna in the surrounding area is expected to be typical for man-made and man-affected ecosystems, with animal species that are adapted to, tolerating, or able to cope with the presence of men in general, forest clearing, bush fires (habitat destruction), noise, hunting and fishing pressure, and trapping.

1.5 Socio-Economic Environment

1.5.1 Geographic and Demographic Information

The Jossie Plant is situated in the resort Groningen, the smallest resort with an area of 57 km^2, in the Saramacca District. The Groningen resort has a total population of 3045, the third highest populated resort of the district (Districtsplan Saramacca, March 2023), see **Figure 17**.

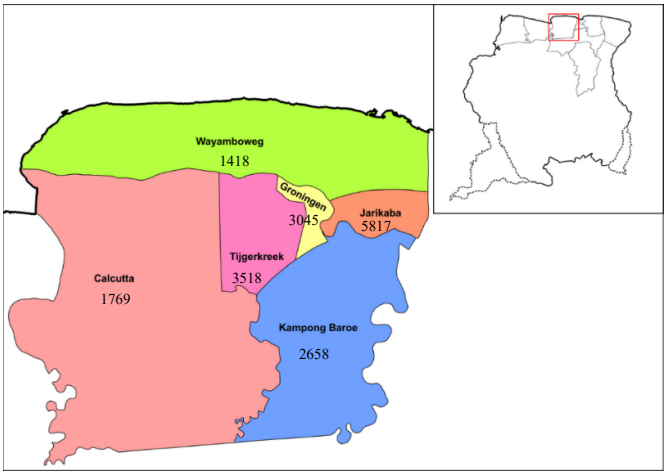


Figure 17: Overview resorts of Saramacca and number of residents

The Jossie Plant is situated in a quiet rural area along the Jossiekreekweg. The population in the area is concentrated as ribbon-building along the Jossiekreekweg and the Smithfieldweg (**Figure 18**) and is heterogeneous with a slight dominance of Hindustanis and Javanese. Along the Tambaredjoweg only a few residents (4) were observed. The closest resident was observed approximately 100 m west (on the pig farm) from the Jossie Plant entrance. During site visits conducted on the 18th and 26th of January 2024, some abandoned houses (5) were also observed along the Jossiekreekweg (**Figure 18,** green dots).

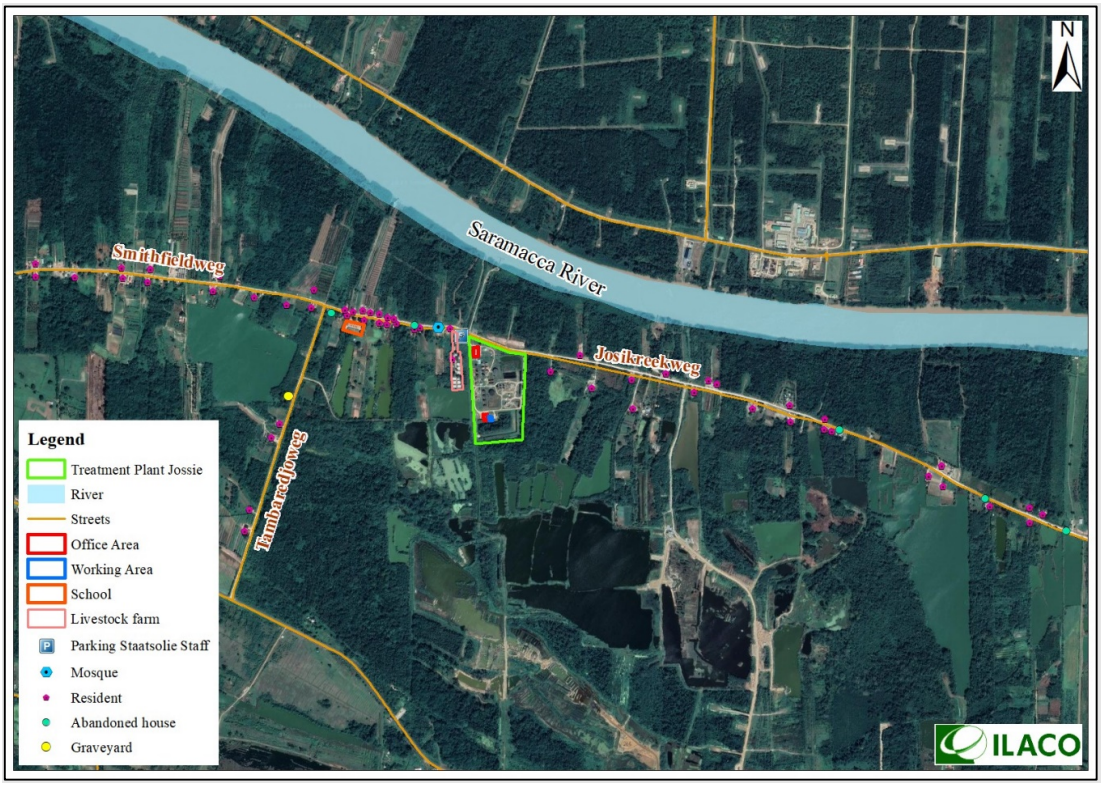


Figure 18: Overview of land use and receptors near the Jossie Plant

1.5.2 Economic activities

Apart from oil exploitation and crude oil treatment by Staatsolie, the main activity in the area is horticulture on small plots. Some vegetable crops that were observed are plantain/banana, eggplants, tomato, peanuts, and cassava (**Photo 1- Photo 4**). Most people also have chickens, and some also have a few cattle. Next to the Jossie Plant to the west there is a livestock (pig) farm with pigpens, chicken, and other small cattle **(P**hoto **5**). Sand and shell quarrying has been an important activity in the past, as can be deduced from the many lakes that have been created as a result. Still some quarrying is taking place, but not in the neighborhood of the Jossie Plant.

Photo 1: Tomato field along the Jossiekreekweg

Photo 2: Banana field along the Tambaredjoweg

Photo 3: Cabbage field along the Jossiekreekweg

Photo 4: Eggplant field along the Smithfieldweg

Photo 5: Chicken and other small cattle (goat and sheep) at the livestock (pig) farm located on the west side of the Jossie Plant

1.5.3 Services

There is an elementary school along the Jossiekreekweg, approximately 550 m west of the Jossie Plant. At approx. 150 m from the entrance of the plant there is a mosque observed (**Figure 18**).

1.5.4 Archaeology

Two archaeological sites are known for the area: SUR-41 and SUR-42 (**Figure 19**), both situated on shell/sand ridges, respectively approx. 1200m and 560m from the center of the Jossie Plant. It concerns pre-Columbian settlements with graves of the Kwatta Culture. The Kwatta Culture developed in this area from 800 Anno Domini (AD) on, and it is known for its craftsmanship in stone and shell. Apart from that the Kwatta Culture are known for their complex death culture (Versteeg, 2003).

Figure 19: Location of archaeological sites in the Jossiekreek area

1.5.5 Planned Developments

In the latest District plan of Saramacca (March 2023), paving of the Jossiekreekweg is included as a planned project. Another planned activity is expanding the livestock farm, located west of the Jossie Plant, with shrimp farming activities. As part of this expansion, it is planned to use water from nearby quarries and the Jossiekreek (personal communication on the 22nd of February 2024 with Mr. Soerdien, owner of the farm). There are no other known planned developments near the project area.

2 Legal and Institutional Framework

2.1 National Law and Regulations

The laws and regulations that apply to Staatsolie's Upstream operations are recorded in the "Occupational, Safety, Health, and Environmental (OSHE) Legal Obligations Register" of July 2023. The required compliance activities (procedures or measures) are described in this register. Reference is made to this register for the applicable measures of this project.

Staatsolie is dedicated to ensuring compliance in accordance with these regulatory issues, including draft ones like the subsidiary legislation of the Milieu Raamwet S.B. 2020 no. 97 (Environmental Framework Act (EFA) S.B. 2020 no. 97).

As there are two archaeological sites within the vicinity of the Jossie Plant, the Monuments Act has been added below, because of the (slight) possibility that archaeological finds may be encountered at the project site.

Monumentenwet 2002 S.B. 2002 no. 72 (Monuments Act 2002 SB 2002 no. 72).
The law provides protection to historical and archaeological sites, but only after Suriname's Minister of Education has declared a site to be a monument, based on the advice of the Monuments Committee.
Relevant related articles:

- Art. 7 paragraph 1 and 2b and art. 15 paragraph 1b, which prohibit the destruction, demolition, disturbance or transformation of monuments.
- Art 17 paragraph 1 prohibits excavation on archaeological sites, without prior permission of the Minister in charge of the management of monuments and archaeological sites.
- Art. 21 paragraph 1 and 2 states that finds of a suspected monumental (including archaeological) asset must report it to the District Commissioner of the district in which the find was made within thirty working days of the find.

Given the absence of Suriname national guidelines in case of archaeological finds, such procedures should be consistent with internationally recognized good practice as described in the ICOMOS (1990) Charter for the Protection and Management of the Archaeological Heritage.

Other national guidelines relevant for this project are the "Richtlijnen voor de Inrichting van Opslagplaatsen voor Chemicalien" (Guidelines for the Design of Storage Sites for Chemicals) of NIMOS (April 2009) and the "Minimale Voorwaarden voor Constructie en Reparatie" (Minimum conditions for construction & repair) of NIMOS (July 2012).

2.2 International Best Practices

Where national legislation, standards or guidelines are lacking or where international standards are more stringent, international standards are applied where applicable.

World Bank/ IFC Guidelines

For the proposed project, the World Bank International Finance Corporation (IFC) Environmental, Health, and Safety (EHS) General guidelines[5] and the specific IFC - EHS guidelines for Onshore Oil and Gas Development[6] are used.

[5] IFC, 2007.General Environmental, Health, and Safety Guidelines.
http://www.ifc.org/wps/wcm/connect/115482804a0255db96fbffd1a5d13d27/PS_English_2012_Full-Document.pdf?MOD=AJPERES

[6] https://documents1.worldbank.org/curated/en/858751486372860509/pdf/112103-ENGLISH-Onshore-Oil-and-Gas-Development-PUBLIC.pdf

Air quality guidelines
Management of air emissions resulting from typical construction activities are assessed with the IFC General EHS Guidelines. These guidelines indicate that projects with significant sources of air emissions, and potential for significant impacts to ambient air quality, should prevent or minimize impacts by ensuring that:

- Emissions do not result in pollutant concentrations that reach or exceed relevant ambient quality guidelines and standards by applying national legislated standards, or in their absence, the current WHO Air Quality Guidelines[7] or other internationally recognized sources[8].

Emissions do not contribute a significant portion to the attainment of relevant ambient air quality guidelines or standards. As a general rule, this Guideline suggests 25 percent of the applicable air quality standards to allow additional, future sustainable development in the same airshed.
Further, the California Environmental Protection Agency (EPA) (2007) Ambient Air Quality Standard for H_2S has also been used for the assessment.

Noise guidelines
In the absence of specific national guidelines for noise levels, the international standards (WHO/IFC) for community-based noise limits, also used by NIMOS, are applied (see **Table 11)**. The noise impacts should not exceed the levels presented in **Table 11** or result in a maximum increase in background levels of 3 dB (A) at the nearest receptor location off-site.

Table 11: Applicable Outdoor Noise Standards for Community-based noise (WHO/IFC EHS General)

Receptor	Maximum Allowable Ambient Noise Levels 1-hour LAeq (dBA)	
	Daytime 07:00-22:00	Nighttime 22:00-07:00
Residential; institutional; educational	55	45
Industrial; commercial	70	70

Surface water quality guidelines
The United States Environmental Protection Agency (USEPA) criteria for aquatic life CCC (Criteria Continuous Concentration) are used for assessment of surface water quality. The aquatic life criteria for toxic chemicals are the highest concentration of specific pollutants or parameters in water that are not expected to pose a significant risk to the majority of species in a given environment or a narrative description of the desired conditions of a water body being "free from" certain negative conditions.

For the assessment of discharge of produced water (effluent) to surface waters, the EHS guidelines for Onshore Oil and Gas Development are used. Further, the aquatic threshold limit for AAM by the EU (2002) is used.

2.3 Staatsolie Environmental Management System

Compliance with the provisions of several Staatsolie documents that address Health, Safety, Environmental (HSE) and Community Relations issues is also mandatory, principally:

- **Health, Safety Environmental and Quality (HSEQ) Policy**: in which Staatsolie demonstrates a firm commitment to Health, Safety, Environment and Quality (HSEQ) by effectively using an integrated management system **(Appendix 2A)**. The Code of Conduct in which Staatsolie provides the basic rules that serve as a behavioral compass, and reflect their philosophy and mode of operation and Alcohol and Drugs Policy form an integrated part of the HSEQ Policy;
- **Stakeholder Management Procedure:** is aimed at properly considering, communicating and managing communities and other stakeholders' socio – environmental interests and expectations while performing its business **(Appendix 2B)**;

[7] Available at the World Health Organization (WHO). http://www.who.int/en
[8] For example, the United States National Ambient Air Quality Standards (NAAQS) (http://www.epa.gov/air/criteria.html) and the relevant European Council Directives (Council Directive 1999/30/EC of 22 April 1999 / Council Directive 2002/3/EC of February 12, 2002).

- **Risk Management Policy**: explains the principles that Staatsolie will follow for managing risk. The policy also outlines the process for managing risk, and who at Staatsolie is responsible for the different aspects of risk management **(Appendix 2C)**; and
- **Staatsolie procedures**: general procedures to guide Staatsolie's operations so that it complies with the HSEQ policy. Procedures applicable to this project are listed in **Appendix 2D**.
- **Environmental Aspects Register Treatment & Delivery (T&D) - Crude Treatment (March 2023):**
- **Occupational, Safety, Health, and Environmental (OSHE) Legal Obligations Register (July 2023):** outlines the laws and regulations that apply to Staatsolie's Upstream operations with regard to health, safety, and the environment.

3 Environmental Management Roles and Responsibilities

3.1 Roles and Responsibilities

This paragraph is intended to ensure that an accountability process is defined and implemented to make certain that responsibilities are performed effectively. The general roles and responsibilities of various parties are outlined in the section below.

3.1.1 The Owner's team

Different processes will be executed during the project. All processes within Staatsolie are owned by a Process Owner. The following table indicates the different processes that will take place during the project and the responsible Process Owner.

Table 12: Process Owners and responsibilities

Process	**Process Owner**
Project planning	Manager Projects & Engineering Support (P&ES)
Design, engineering and construction activities related to the upgrade of the Jossiekreek Treatment Plant	Manager Projects & Engineering Support (P&ES)
Operation of the upgraded Jossiekreek Treatment Plant	Manager Treatment & Delivery (T&D)
Decommissioning	Manager Treatment & Delivery (T&D)
Position	**Responsibility, including HSE**
Upstream Director	Overall accountability for HSE matters for all upstream operations. Overall accountability for management of the project, including environmental management aspects. Responsibility for the execution of the project and HSE matters related to this project.
Production Asset Manager	Overall responsibility for HSE matters with regards to activities during the construction, operational and decommissioning phase.
Treatment & Delivery Manager	Responsibility for HSE matters related to the construction activities and the operation of the Crude Treatment Facility. Responsibility for taking into account HSE matters during execution of the project. Responsibility for the management of the environmental aspects during execution of the civil works, operation and decommissioning.
Projects & Engineering Support Manager	Responsibility for HSE matters related to site preparation and construction. Responsibility for taking into account HSE matters during project execution.
Acting Sr. Head Health Safety Security Environment (HSSE) Upstream	Responsibility to support the operations and monitor the performance regarding HSE and Community matters.
Environmental Engineer	Overall responsibility for Environmental Support for the project.
Corporate Communication Upstream Head	Overall accountability of Community and Public Relations support for all Staatsolie operations and activities.

Corporate Communication Officer	Overall responsibility of Community Relations support for the project and all other legal matters regarding the activities
Staatsolie Employees and contractors	Should be aware of the EMMP requirements and adhere to the relevant mitigation measures.

The **Treatment & Delivery Manager and Projects & Engineering Support Manager** shall:

- Ensure that the key on-site staff (contractor-supervisors) are duly informed of the EMMP and associated responsibilities and implications of this EMMP prior to commencement of construction (in order to minimize undue delays);
- Inform key on-site staff through initial environmental awareness training of their roles and responsibilities in terms of the EMMP;
- Create a safe working environment during the construction and operational phase
- Ensure that a copy of the EMMP shall be available to all on site Construction Supervisors;
- Inform the environmental engineer one week before the date of the commencement of the project (this date being the day on which preparations activities will start);
- Perform weekly HSE inspections based on the weekly EMMP checklist and submit compliance reports every 2 weeks to the Environmental Engineer (based on reporting scheme in paragraph 6.2 Reporting);
- Ensure that method statements are submitted to the Environmental Engineer for a task requiring such;
- Ensure that action items to rectify non-compliance are closed out in a timely and satisfactory manner.

The **Acting Sr. Head HSE Upstream** shall:

- Undertakes spot inspections to determine compliance with the EMMP and monitor the activities of the contractor on site with regards to the requirements outlined in this EMMP;
- Identify areas of non-compliance and propose action items to rectify them in consultation with the Project Manager/ Project Leader.
- Alert when action items intended to remedy non-compliance are not closed out in a timely and satisfactory manner;
- Compile compliance reports;
- Submit reports on the implementation of the EMMP and compliance to the NIMOS;

3.1.2 Staatsolie Divisions/Process Owner-representatives and Contractors

The Process Owner-representatives and Contractors delivering services to the project have a duty to demonstrate respect and care for the environment in which they are operating. The Process Owner-representatives and Contractors shall comply with the specifications of the EMMP and abide by the instructions of relevant Process Owners and the Acting Sr. Head HSSE Upstream regarding the implementation of this EMMP. The Process Owner-representatives and Contractors shall report to the relevant process owner and the Acting Sr. Head HSSE Upstream on all matters pertaining to the EMMP.

The representatives of Process Owners shall:

- Ensure that copies of the EMMP be available at their offices, and shall also ensure that all personnel on site (including Sub-Contractors and their staff, and suppliers) are familiar with and understand the requirements of the EMMP;
- Ensure that all activities under their control are undertaken in accordance with the following:
    - o Health, Safety, Environment and Quality Policy,
    - o Stakeholder Engagement Procedure,
    - o All applicable Staatsolie Procedures,
    - o This EMMP.
- Ensure that all employees and sub-contractors comply with this EMMP
- Execute daily HSE inspections and any non-compliance with the specifications of the EMMP should be reported immediately.

- Compile Method Statements as listed hereunder;
- Ensure that any problems and non-conformances are remedied in a timely manner, to the satisfaction of the responsible process owner;
- Ensure that all personnel are aware of the Contingency Plans and are adequately trained therein;
- Compile the required reports (see **Table 25**) to be submitted to the Upstream HSE Head.

Method statements are to be compiled by parties responsible for construction works (working on heights, confined spaces, near pipes and power lines and other potentially risky activities) for approval by their Process Owner, who reviews and endorses them. The Acting Sr. Head HSSE Upstream must receive a copy of the method statement for review 2 weeks before commencement of the activity and if there are any issues regarding the environmental specifications, he/ she shall make these known to the Process Owner within a week. The method statement typically shall cover applicable details including, but not limited to:

- A reference to the Environmental Specifications;
- Description of the activities to be undertaken;
- Location where activities will be undertaken,
- Construction drawings;
- Map of the location;
- Materials and equipment requirements;
- How and where material will be stored;
- The containment (or action to be taken if containment is not possible) of leaks or spills of any liquid or material that may occur;
- Timing of activities (start and end dates).
- Assurance that the landowner/user is aware of the planned activity.

The following method statements for construction shall be submitted to the Process Owner not less than two weeks prior to the intended date of commencement of the activity:

- Site preparation;
- Construction activities;

The Process Owner Representatives shall abide by these approved method statements. **Appendix 2E** provides a pro forma method statement sheet that must be completed by the process owner for each activity requiring a method statement as specified in here above. A checklist has been included in **Appendix 2F** to facilitate the random and weekly site inspection for the project site. These completed checklists must be submitted to the Acting Sr. Head HSSE Upstream at the end of each week.

3.2 Environmental Training

Environmental awareness training courses shall be run for all personnel on site. It is incumbent upon the Process Owner to convey the objectives of the EMMP and the specific provisions of the EMMP to all personnel involved in the construction and operation of the upgraded Jossiekreek Crude Treatment Plant.

Environmental training must cover the specific environmental management requirements as set out in the EMMP but must also ensure that all on-site staff are aware of and familiar with the relevant requirements and principles/objectives of the HSE Policy, applicable procedures and the EMMP. The Process Owner will initialize the training sessions for all new or additional staff and the HSE department shall support with Environmental Awareness Courses. The Process Owner shall ensure that all his/her staff attends the awareness courses to be held not less than one week before the commencement date of the construction activities.

Where applicable, the Field Supervisors shall provide job-specific training on an ad hoc basis when workers, Staatsolie employees as well as contractor personnel, are engaged in activities that require method statements. A copy of the EMMP shall be available on site, and the Field Supervisors shall ensure that all the personnel on site (including Sub-Contractors and their staff) as well as suppliers are familiar with and understand the specifications contained in the EMMP.

Operation training will include information on:

- Emergency response procedure
- Health, Safety and Environmental (HSE) risk (working on heights, confined spaces, etc.)
- Firefighting and spill containment and cleanup
- Waste minimization, handling and disposal methods
- Handling and storage of hazardous materials/substances, including fuels, oils, chemicals

4 Stakeholder Consultation

4.1 General

Stakeholder engagement and consultation are integral components that run throughout the EIA process. The purpose of stakeholder engagement is to ensure that stakeholders are consulted beforehand about the project and its potential environmental and social impacts. The process offers stakeholders the opportunity to make comments, suggestions, and voice any concerns, which are then considered during the preparation of the EMMP report and the development of mitigation measures and management plans for the project.

The study commenced with the official Contract Signing. The project approval and the official kick-off meeting were held on the 23rd of October 2023. On the 9th of November 2023, NIMOS was consulted regarding the approach, methodology, and additional concerns to be included in the study. Since this study only involved the compilation of an EMMP, a scoping phase was not deemed necessary. Several stakeholders, including government organizations and a selection of random residents, have been consulted during the baseline assessment phase. A Background Information Document (BID) containing a non-technical summary of the project and the EMMP study process, was drafted and shared with the stakeholders either prior or during the meetings.

Prior to the stakeholder consultations, a stakeholder list of key stakeholders was drafted with input from Staatsolie. Individual stakeholder meetings were held with the Saramacca District Commissioner's Office on the 31st of January 2024 and on February the 27th with the Ministry of Agriculture, Animal Husbandry, and Fisheries (LVV) at Groningen-Saramacca. Subsequently, the resident survey was conducted between 18th of January and 7th of March 2024, with residents being randomly selected within the study area in the Jossiekreekweg, Smithfieldweg and Tambaredjoweg. The strategy for the survey was to interview households that were at home at that time and willing to participate. A questionnaire was developed for the survey (**Appendix 5C**). The goal was to inform them about the project and identify their concerns regarding the planned upgrade of the Jossie plant. An overview of the consulted stakeholders is presented in the table below.

Table 13: List of consulted stakeholders

Date	Time (approx.)	Stakeholder	Type of meeting	Platform
Government organizations				
9-Nov-23	14:00- 14:15	NIMOS	One-on-One	Zoom (Online)
31-Jan-24	11:00- 12:00	The District Commissioner of Saramacca	One-on-One	Physical in Saramacca
27-Feb-24	10:00- 10:45	The Ministry of Agriculture, Animal Husbandry and Fisheries (Min. LVV)- Resort Groningen	One-on-One	By phone call
Other area users				
26-Jan- 24	12:00-12:30	School	Individual	Physical in Jossiekreekweg
22-Feb- 24	09:00- 10:00	Owner Livestock (pig) farm	Individual	Physical in Paramaribo
Residents – 22 respondents				
18-Jan-24	13:00- 16:00	Residents Jossiekreekweg (3)	Individual	Physical in Jossiekreekweg
26-Jan-24	9.00-16.00	Residents Jossiekreekweg (10)	Individual	Physical in Jossiekreekweg
		Residents Tambaredjoweg (2)	Individual	Physical in Tambaredjoweg
		Residents Smithfieldweg (4)	Individual	Physical in Smithfieldweg
31-01-24	09:00- 11:00	Residents Jossiekreekweg (3)	Individual	Physical in Jossiekreekweg

4.2 Stakeholder Consultation Results

During the resident survey, 22 residents living in the Jossiekreekweg, Tambaredjoweg and the Smithfieldweg were consulted. As many women as men were interviewed. Most of the respondents (9) were between 40 and 60 years old, followed by respondents between 20 and 40 years (7). The other 5 respondents were older than 60 years. Further, it was observed that most of the respondents (17) live longer than 10 years in the area. Regarding the existing complaint, which involves the current activities on the Jossie Plant, the following is observed (see **Figure 20**):

- Fourteen of the respondents have no complaints, but two have had complaints in the past regarding vibration (around 7 years ago) and noise. Another four hear the noise or experience a vibration (vibrating of windows) but have no complaints, because they are already used to it, or higher noise levels are experienced incidentally such as in case of power outage in the area.
- Five respondents have a complaint regarding noise, one of which also complains about vibrations. The noise nuisance is mostly experienced during nighttime and sometimes during daytime.
- Three respondents have a complaint regarding vibration, one of which also complains about the noise. The vibration complaint was indicated as vibrating of windows (2x) and causing a crack in the house (1x)
- Two respondents have a complaint regarding dust. One mentioned that this is caused by the high driving speed of Staatsolie contractors (mostly), even though the road is regularly sprinkled with water during dry periods.

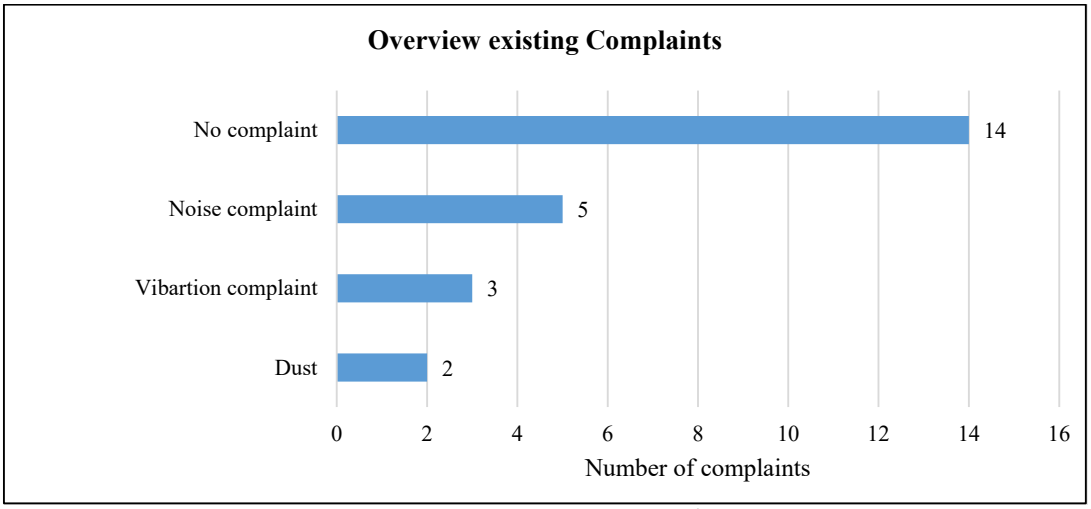


Figure 20: Overview existing complaints near Jossie plant (N=22[9])

Of the nine residents with a complaint only one reported this to Staatsolie.
Regarding communication from Staatsolie with the lresidents:

- Thirteen responded positive: they are informed about activities, there are at least 3 meetings a year, etc.
- Two had no earlier communication with Staatsolie as during daytime these residents are usually not available at their residence.
- One resident was not satisfied as no information was received earlier.
- And the other six residents had no feedback.

[9] More than one complaint as response is possible.

A summary of concerns voiced during the stakeholder consultation is presented in the table below.

Table 14: Results stakeholder meetings and resident survey

Stakeholder Category	Stakeholder	Concerns related to the project	Staatsolie feedback
Government	Representatives of the District Commissioner of Saramacca	• There are previous noise complaints regarding the pumps at the Jossie plant. Noise is audible within a radius of 1 km and clearly within 0.5 km from the plant. • Potential increase of noise levels from the Jossie plant due installation of larger and more modern pumps. • The impact of exhaust emissions and the construction of the vent stack near the Jossiekreekweg, closer to the residents' living environment • The risk of oil leaks, given the aging condition of the pipelines along the main roads and increased capacity. • The project should not have a negative impact on the air quality, water quality, soil, and infrastructure.	• A previous complaint that was submitted during a community meeting held on the 1st of December 2022, was checked but the complainant had moved. The remaining housemates did not indicate that they have a complaint. • With the results from the noise level measurements and mitigation measures of this project the necessary interventions will be made to reduce the hindrance.
	The Ministry of Agriculture, Animal Husbandry and Fisheries (Min. LVV)- Resort Groningen	• The communication and relationship between Staatsolie and LVV seem to be limited, although farmers are informed if there are any issues.	-
Other area users	School	• There were no concerns raised regarding the project.	-
	Owner Livestock (pig) farm	• Existing noise hindrance for his workers living on the farm. Hence additional noise measurements should be conducted on his terrain. • Impact on air quality • Impact on water quality of the Jossiekreek as the owner is planning to use water from the Jossiekreek for new planned activities on the farm (aquaculture).	• The owner of the farm removed the vegetation that was intended as a buffer against noise hindrance from the plant. He said he did this because of the mosquitoes. It should be noted that this vegetation zone was located on Staatsolie terrain on the west side of the Jossiekreek. • It should be noted that the pig farmer also discharges water from the pig stalls into the Jossiekreek.

Stakeholder Category	Stakeholder	Concerns related to the project	Staatsolie feedback
Residents	Random selected	• There is an existing noise hindrance mostly during night-time. Will there be an increase of noise levels? • Vibration caused by the burners (referring to the heaters) causing windows to vibrate. • Dust nuisance due to driving speed of Staatsolie Contractors • The nearby water-filled shell mining quarries discharge their water through the Jossiekreek and another main canal located on the east side of the Jossie Plant (not used by Staatsolie). The discharge through the east side canal is not optimal causing a large portion of nearby resident's agriculture land being flooded. The Jossie Plant should not obstruct the discharge of water from the quarries through the Jossiekreek.	• Staatsolie regularly sprays the Jossiekreek road in the dry season.

Other concerns or requests that were raised during the resident survey are:
1. The school head requested if besides the Jossiekreekweg, the terrain of the school could also be sprayed during the dry periods.
2. Installation of street lighting where not present yet along the Jossiekreek.
3. Maintenance of the Jossiekreekweg as the DC refers to Staatsolie for the maintenance.
4. Support in improving the drainage system of the area by installing a culvert at the north south canal, located on the east side near the plant (GPS 21N: 664399 645900). The culvert should be placed on-level to only discharge excess water.

Based on the consultations, it can be concluded that stakeholders generally welcome the upgrade of the plant and development in the area. In summary, their concerns include addressing concerns related to noise, vibration, air quality (dust generation and emissions from the plant) and water quality.
Further, it is recommended that Staatsolie establish/ maintain effective communication and engagement with relevant stakeholders. Sharing information and raising awareness within the community is crucial throughout all phases of the project.

4.3 Stakeholder Engagement Plan

A Stakeholder Engagement Plan (SEP) has been developed for the project to ensure a consistent procedure is followed during all stakeholder engagement activities. Several stakeholders were consulted during the EMMP study phase. The planning for the consultation, prior to the start and during the project, is presented in the table below. The SEP may be updated during the execution of the project.

Table 15: Stakeholder Engagement Plan

Stakeholder (Who)	Information sharing (What)	Frequency (When)	Communication method (How)
Prior to the start and during the project (responsibility of the Applicant)			
Government institutes (DC)	Announcement regarding general information and/ or update planning about the project such as construction activities.	Prior to the start and during the project	During regular communication Phone calls
Directly affected stakeholders (nearest residents)			Posters/ Flyers Phone calls Field visits Focus group meetings

5 Environmental Impacts, Risks and Mitigation

The general principles contained within this chapter shall apply to all activities for the duration of the Upgrade of the Jossie plant. The fundamental approach adopted in the compilation of this EMMP is that management effort should be focused on environmental and social aspects to prevent impacts from occurring, i.e., a proactive approach. Proactive measures are then backed up with reactive measures, which serve to minimize the severity or significance of the impact, if it cannot be prevented at source.

The environmental and social impacts as part of the current activities on the Jossie Plant are described in the existing Staatsolie Environmental Aspects Register. The potential environmental and social impacts and risks associated with the upgrade of the Jossie Plant are identified and evaluated in this Chapter. The key considerations for the main potential impacts (noise and air quality) are also described.

Mitigation and management measures for all potential environmental and social impacts are developed. These measures and the following further detail are included in an environmental and social specification table (**Table 22)**:

- Impacts;
- Impact significance
- Prescribed mitigation measure(s);
- Environmental control objectives for each impact (or cluster of impacts);
- Compliance reporting requirements, including method and frequency of reporting.
- Monitoring and performance evaluation, including performance indicators and monitoring methods; and
- Identification of the person(s) responsible for implementation of the mitigation measure(s).

5.1 Noise

Key considerations

The closest receptors to the project site are the staff/personnel working on the Jossie Plant. The nearest residents are the residents living on the pig farm, approximately 100 m west from the entrance of the Jossie Plant.

The baseline noise levels at the receptors along the Jossiekreekweg varies between 49- 59 dBA during daytime. The higher LAeq values are the result of passing vehicles. Noise levels closer to the plant (parking area, office area and on the pig farm, including at the resident on the pig farm) slightly exceed the WHO/IFC daytime guideline threshold of 55 dBA. During nighttime the noise levels varied between 41 and 55 dBA along the Jossiekreekweg. Elevated levels above the WHO/IFC nighttime guideline threshold are recorded in a radius of approximately 200 meters around the plant. This includes the residents living in the house at the pig farm, where a LAeq of 56 dBA is recorded.

Impact Assessment: <u>Noise impacts (nuisance) on human receptors</u>

Construction phase

The noise sources during the construction phase of this project are noise from the construction works such as movement of construction vehicles, use of power tools such as grinders and drills.

Table 16: Significance of impact of noise nuisance in the construction phase

	Impact	***Likelihood***	***Risk Scale***
Without mitigation	Minor	Possible	Low
Proposed mitigation measures: • Regularly maintain engines of vehicles and equipment. • Operate and maintain exhaust systems and engines in accordance with the manufacturer's specifications. • Use preventative maintenance and repair programs. • Maintain awareness of exceeding speed limits and safe driving behavior. • Limit construction activities to the daytime and inform residents within the 200m in case of noisy activities. Avoid using equipment that generates a lot of noise during nighttime and on weekends. • Provide PPE for staff/personnel, as required.			
With mitigation	Low	Unlikely	Very Low

Operational phase
The noise sources during the operation phases of the upgraded Jossie Plant will include noise from existing and new equipment.

For further assessment of the noise impact in the operational phase, an environmental noise impact modelling study has been undertaken (AIRSHED, 2024a), which is annexed (**Appendix 6**). The modelling results indicate that the proposed expansion only is expected to have an insignificant increase of noise levels at sensitive receptor locations including the pig farm. However, the day- and night-time noise impact of the Jossie operations at the nearby sensitive receptor locations and the pig farm is expected to remain the same as the current (baseline) situation described above. This impact comes from the main sources of noise at the current Jossie plant which includes most notably the transfer pumps and the heater treaters.
Measures should be implemented to minimize the noise impact from the existing operation. This will be further described under the section Cumulative Impacts (Chapter 5.4).

Table 17: Significance of impact of noise nuisance in the operational phase

	Impact	***Likelihood***	***Risk Scale***
Without mitigation	Moderate	Possible	Medium
Proposed mitigation measures: Regularly maintain engines of vehicles and equipment. • Operate and maintain exhaust systems and engines in accordance with the manufacturer's specifications. • Use preventative maintenance and repair programs. • Maintain awareness of exceeding speed limits and safe driving behavior. • Provide PPE for staff/personnel, as required.			
With mitigation	Minor	Unlikely	Low

5.2 Air Quality

Key considerations

Construction phase

Air pollution during the construction phase of the project includes dust in the form of particulate matter (PM) emitted during earthworks civil foundation and filling activities at the OTP and PWT area and from the movement of project traffic. Further, emissions from heavy equipment and project traffic.

Impact Assessment: <u>Impaired human health or nuisance caused by poor air quality</u>

Table 18: Significance of impact of air quality in the construction phase

	Impact	***Likelihood***	***Risk Scale***
Without mitigation	Minor	Possible	Low
Proposed mitigation measures: • See equipment maintenance measures for noise. • Maintain awareness of exceeding speed limits and safe driving behavior to avoid dust. • In dry periods: spray the road near houses with water.			
With mitigation	Low	Unlikely	Very Low

Operational phase

Air pollution during the operational phase of the project includes emissions from the plant and from project traffic. Within the design of the upgraded plant mitigation measures are included for air quality. Associated produced gases coming with the polymer contaminated fluids from the field will be flashed off in the Flash Drum and will be used as alternative fuel for the burners of the steam boiler. In the case of maintenance of the flash drum and during vessel breathing, gases will be relief through the Cold Vent System.

A separate study has been compiled to assess the air quality impacts for the project based on modelling (AIRSHED, 2024b). This study is annexed (**Appendix 7**). It can be stated that the upgrade of the Jossie Plant will result in a significant reduction in VOC emissions and a reduction in H_2S emissions. However, the new to be installed boiler is expected to result in an increase in the emissions of combustion products, such as NO_2, SO_2 and PM, but the impact is expected to be low. The findings for the sensitive receptors, the Jossie Plant and Pig farm are described below.

<u>Sensitive receptors:</u>

- Simulated PM, NO_2 and SO_2 concentrations due to current and future operations are below the WHO Air Quality Guidelines (AQGs 2021) at all sensitive receptor locations (the school, mosque, and residences along the Jossiekreekweg).
- Simulated VOC concentrations are below the assessment criteria of 200 µg/m³ at all sensitive receptor locations (the school, mosque, and residences along the Jossiekreekweg).
- Simulated H_2S concentrations are well below the WHO 24-hour guideline for health impacts of 150 µg/m³ at all sensitive receptor locations. The 98th percentile hourly H_2S concentrations emitted by the future plant still exceed the 7 µg/m³ (WHO) at the sensitive receptors to the west of the Jossie plant. Hence, some individuals will be able to recognize the distinct smell of H_2S emissions from the Jossie plant from time to time. However, the simulated concentrations are below the California EPA guideline value of 42 µg/m³ where odor detection would be more widespread and discomforting.

Table 19: Significance of impact of air quality in the operational phase for sensitive receptors

	Impact	*Likelihood*	*Risk Scale*
Without mitigation	Minor	Possible	Low
Proposed mitigation measures: • See equipment maintenance measures for noise. • Maintain awareness of exceeding speed limits and safe driving behavior to avoid dust. • In dry periods: spray the road near houses with water. • Operate and maintain the steam boiler in accordance with the manufacturer's specifications. • Keep a record of any complaints related to air quality and odor related issues.			
With mitigation	Low	Unlikely	Very Low

Jossie Plant

- Simulated pollutant concentrations within the Jossie plant are well below the occupational health guidelines for all pollutants, which are a few orders of magnitude higher than ambient guidelines. However, workers operating close to emission sources, such as tank vents, could be exposed to higher concentrations. It is recommended that workers be encouraged to report any air quality or odor issues and that respirators be worn in areas with known high VOC concentrations.

Table 20: Significance of impact of air quality in the operational phase for Jossie Plant

	Impact	*Likelihood*	*Risk Scale*
Without mitigation	Minor	Possible	Low
Proposed mitigation measures: • See equipment maintenance measures for noise. • Maintain awareness of exceeding speed limits and safe driving behavior to avoid dust. • In dry periods: spray the road near houses with water. • Operate and maintain the steam boiler in accordance with the manufacturer's specifications. • Provide PPE and gas detector for staff/personnel, as required. • Keep a record of any complaints related to air quality and odor related issues.			
With mitigation	Low	Possible	Low

Pig farm

- Simulated PM, NO_2 and SO_2 due to current and future operations exceed the WHO Air Quality Guideline (AQGs, 2021) at the nearby pig farm. However, the concentrations are below the WHO Interim Targets[10] at the pig-farm, and the health of workers is unlikely to be negatively impacted by criteria pollutant emissions from the Jossie plant. Simulated concentrations of these pollutants are further well below the critical levels for animals.
- Simulated VOC concentration at the pig farm from the current operation is 2134.7 µg/m³ and with the future operations this will significantly decrease to 397.4 µg/m³. However, these simulated concentrations still exceed the assessment criteria of 200 µg/m³ but are well below the human discomfort[11] level of 3 000 µg/m³.
- Simulated H_2S concentrations are well below the WHO 24-hour guideline for health impacts of 150 µg/m³ at the pig farm. The 98th percentile hourly H_2S concentrations emitted by the future

[10] Given that air pollution levels in developing countries frequently far exceed the recommended WHO AQGs, interim target (IT) levels were included in the (WHO, 2021) update. These are higher than the WHO AQGs themselves, to promote steady progress towards meeting the WHO AQGs. There are between two and four interim targets starting at WHO interim target-1 (IT-1) as the most lenient and IT-3 or IT-4 as more stringent targets before reaching the AQGs. The WHO permits a 1% frequency of exceedance per calendar year.
[11] The discomfort range indicates that the possibility exists that some sensitive individuals might experience irritation such as a sore throat, runny nose, or eye irritation.

plant still exceed the 7 µg/m³ (WHO) at the pig farm to the west of the Jossie plant. Hence, individuals at the pig farm will be able to recognize the distinct smell of H_2S emissions from the Jossie plant from time to time. The simulated concentrations do not exceed the California EPA guideline value of 42 µg/m³ where odor detection would be more widely spread and discomforting.

Table 21: Significance of impact of air quality in the operational phase for the pig farm

	Impact	***Likelihood***	***Risk Scale***
Without mitigation	Moderate	Possible	Medium
Proposed mitigation measures: • See equipment maintenance measures for noise. • Maintain awareness of exceeding speed limits and safe driving behavior to avoid dust. • In dry periods: spray the road near houses with water. • Operate and maintain the steam boiler in accordance with the manufacturer's specifications. • Keep a record of any complaints related to air quality and odor related issues. • Undertake ambient air quality monitoring once the upgraded Jossie Plant is operational in order to verify the simulations. • Undertake isokinetic sampling of emissions once the upgraded Jossie Plant is operational in order to verify the simulated emission rates estimated in this assessment.			
With mitigation	Minor	Possible	Low

5.3 Environmental and Social Specification

The mitigation and management measures of potential environmental and social impacts are presented in the table below.

Table 22: Environmental and Social Specification table

Impacts	Impacts Assessment	Impact significance	Residual Impact	Environmental management objective	Mitigation Measures	Responsibility	Monitoring & Performance Evaluation		Compliance reporting
							Performance indicators	Monitoring Methods	
Construction Phase									
Noise	Increased noise levels during construction due to construction works, project traffic, use of heavy machinery and equipment (power tools, grinders, and drills)	Impact: Minor Likelihood: Possible Risk rating: **Low**	Very Low	To prevent nuisance due to noise	• Regularly maintain engines of vehicles and equipment. • Operate and maintain exhaust systems and engines in accordance with the manufacturer's specifications. • Use preventative maintenance and repair programs. • Maintain awareness of exceeding speed limits and safe driving behavior. • Limit construction activities to the daytime and inform residents within the 200m in case of noisy activities. Avoid using equipment that generates a lot of noise during nighttime and on weekends. • Provide PPE for staff/personnel, as required.	Manager Projects & Engineering Support (P&ES) Acting Sr. Head HSSE Upstream / CCU Head	Vehicle maintenance log Number of Complaints PPE provided	Visual observations and inspections Maintenance log	Method statement Weekly EMMP Checklist Complaint report
Air quality	Dust emissions from earthworks and construction work at OTP & PWT area (civil foundation and landfilling activities) and the movement of project traffic along Jossiekreekweg Emissions from heavy equipment and project traffic (transport of materials)	Impact: Minor Likelihood: Possible in dry periods Risk rating: **Low**	Very Low	To prevent deterioration of air quality.	• See equipment maintenance measures for noise. • Maintain awareness of exceeding speed limits and safe driving behavior to avoid dust. • In dry periods: spray the road near houses with water.	Manager Projects & Engineering Support (P&ES)	Vehicle maintenance Log Number of complaints	Continuous visual observations for dust in dry periods Maintenance logs	Weekly EMMP checklist Complaint report
Surface water	Water pollution due to spilled and leaked fuel during construction	Impact: Minor Likelihood: Possible Risk rating: **Low**	Very Low	To prevent surface water pollution and the resulting consequences for aquatic life	• Any spill will be localized and is not expected to be able to move far from its origin. Have spill kits and secondary containment available. • Proper maintenance of heavy equipment and vehicles. • Have an oil spill contingency plan in place. • Follow the Staatsolie procedures for maintenance and clean-up of spills. • Conduct frequent monitoring to detect any spill or leak as soon as possible.	Manager Treatment & Delivery (T&D)	Number of spills	Visual observations (oil, turbidity)	Method Statement Weekly EMMP Checklist

Waste	Environmental pollution due to improper management of solid and liquid waste during the construction phase	Impact: Minor
		Likelihood: Possible
		
		Risk rating: **Low**
			Low	Proper collection and disposal of waste	• Minimize waste generation and recycle as much as possible.
					• Manage waste according to Staatsolie Waste Management Plan:
					  ○ Store solid waste in a designated area in covered drums for collection and disposal.
					  ○ Provide rubbish bins for litter at appropriate locations and arrange for regular collection.
					  ○ Depending on the waste type, this will be recycled, reused, or disposed of in a suitable facility.
					  ○ All hazardous materials, including oil and contaminated soil, will be stored separately, and disposed of according to Staatsolie requirements
						Manager P&ES
						
						Manager T&D
							Waste Management Plan
							
							Awareness among Employees
							
							Waste log
								Housekeeping inspection
								
								Visual observation: weekly inspections using the EMMP checklist.
								
								Waste log records
									Weekly EMMP Checklist

Impacts	Impacts Assessment	Impact significance	Residual Impact	Environmental management objective	Mitigation Measures	Responsibility	Monitoring & Performance Evaluation		Compliance reporting
							Performance indicators	Monitoring Methods	
					• Notify the contractor about the WMP and require its implementation				
Socio-economic	Nuisance (noise, dust, or otherwise) to the people living along the Jossiekreekweg	Impact: Minor Likelihood: Likely Risk rating: **Medium**	Low	To avoid complaints and maintain good name of the company	• Implement measures to minimize impacts on air quality and noise • Reduce the number of transportation trips to the minimum (adequate planning) • Truck traffic and other transport of heavy equipment/machinery should be limited to daytime. • Register and address complaints according to the Staatsolie Grievance Redress Mechanism which is in place and operational.	Acting Sr. Head HSSE Upstream / CCU Head Manager T&D	Number of complaints	See monitoring for noise and air quality impacts Monitoring of complaints through the Staatsolie GRM	Complaint report Weekly EMMP Checklist
	Occupational Health and Safety: Incident and accidents	Impact: Moderate Likelihood: Possible Risk rating: **Medium**	Low	To avoid/minimize the risk of incidents and accidents.	• Proper planning and communication of ongoing production activities and construction works. • Proper marking/ fencing of construction areas • Ensure contractors follow Staatsolie Corporate Contractor Health, Safety and Environmental Management procedures and other health and safety related procedures.	Manager P&ES Manager T&D	Awareness training program Number of incidents	Training and awareness (toolbox meetings) Number of safety talks Visual observations	Incident Report Weekly EMMP Checklist

Cultural resources	Disturbance or destruction of archaeological sites	Impact: Moderate
		Likelihood: Unlikely
		
		Risk rating: **Low**
			Very low	To prevent loss of cultural resources.	• Create awareness amongst construction staff regarding the significance of such finds and indicators of the presence of such sites (especially bones, exposed bottles, pieces of earthenware, metal, pottery sherds, bed structures, spots with deviating terrain and vegetation).
					• Follow measures of the chance find procedure (Appendix 2G):
					  ○ Cease all construction activities in the area, if a potential site is noticed, and cordon off the area
					  ○ Notify the Districts-Commissioner and request that the Archaeological Service conducts a preliminary assessment of the site.
					  ○ Allow that a detailed assessment of the site is undertaken by, or on behalf of, the Archaeological Service, if deemed necessary in the preliminary assessment.
					  ○ Follow recommendations made in preliminary and/or detailed assessment, as appropriate.
						Process Owner	Awareness of staff and workers
							No damage to site if any
							Assessment completed, if necessary
								Awareness
								
								Visual inspection
								
								Report of the Archaeological Service
									Complete weekly EMMP checklist

Operational phase									
Noise	Elevated noise levels caused by future (new) equipment resulting in nuisance for nearby residents	Impact: Moderate Likelihood: Possible Risk rating: **Medium**	Low	To prevent increased nuisance due to noise	• Regularly maintain engines of vehicles and equipment. • Operate and maintain exhaust systems and engines in accordance with the manufacturer's specifications. • Use preventative maintenance and repair programs. • Maintain awareness of exceeding speed limits and safe driving behavior. • Provide PPE for staff/personnel, as required.	Acting Sr. Head HSSE Upstream Manager T&D	Number of complaints	Noise measurements once the project is operational to check actual noise levels. In case of complaints: measure noise levels at the complainant and implement measures as required. Maintenance logs.	Noise monitoring report

Impacts	Impacts Assessment	Impact significance	Residual Impact	Environmental management objective	Mitigation Measures	Responsibility	Monitoring & Performance Evaluation		Compliance reporting
							Performance indicators	Monitoring Methods	
Air Quality	Reduction of air quality for sensitive receptors as a result of emission of gases from the stack and operation of equipment.	Impact: Minor Likelihood: Possible Risk rating: **Low**	Very Low	To prevent deterioration of air quality.	• See equipment maintenance measures for noise. • Maintain awareness of exceeding speed limits and safe driving behavior to avoid dust. • In dry periods: spray the road near houses with water. • Operate and maintain the steam boiler in accordance with the manufacturer's specifications. • Keep a record of any complaints related to air quality and odor related issues.	Acting Sr. Head HSSE Upstream Manager T&D	Number of complaints Emission rates verified	Continuous visual observations during dry periods Maintenance logs Air quality monitoring (ambient air quality measurements and isokinetic sampling for emission rates.)	Complaint report Air quality monitoring report
	Reduction of air quality for Jossie Plant as a result of emission of gases from the stack and operation of equipment.	Impact: Minor Likelihood: Possible Risk rating: **Low**	Low	To prevent deterioration of air quality.	• See equipment maintenance measures for noise. • Maintain awareness of exceeding speed limits and safe driving behavior to avoid dust. • In dry periods: spray the road near houses with water. • Operate and maintain the steam boiler in accordance with the manufacturer's specifications. • Provide PPE and gas detector for staff/personnel, as required. • Keep a record of any complaints related to air quality and odor related issues.				
	Reduction of air quality for the pig farm as a result of emission of gases from the stack and operation of equipment.	Impact: Minor Likelihood: Likely Risk rating: **Medium**	Low	To prevent deterioration of air quality.	• See equipment maintenance measures for noise. • Maintain awareness of exceeding speed limits and safe driving behavior to avoid dust. • In dry periods: spray the road near houses with water. • Operate and maintain the steam boiler in accordance with the manufacturer's specifications. • Keep a record of any complaints related to air quality and odor related issues. • Undertake ambient air quality monitoring once the upgraded Jossie Plant is operational in order to verify the simulations. • Undertake isokinetic sampling of emissions once the upgraded Jossie Plant is operational in order to verify the simulated emission rates estimated in this assessment.				
Surface water quality	Discharge of produced water (containing dissolved salts, oil content, trace metals, back-produced polymer, residual chemical additives, etc.) in the Saramacca River	Impact: Major Likelihood: Unlikely Risk rating: **Medium**	Low	To prevent surface water pollution and consequent impacts to vegetation and animals	• All produced water coming from the oil dehydration processing train will be passed to the upgraded produced water treatment system. • Continue to measure the water quality of the effluent. In case of discharges exceeding the IFC/ EU criteria, take appropriate measures to minimize the duration and volume. • Monitor surface water quality at the discharge point, upstream and downstream of the discharge point. • While discharge of back produced polymer is likely to dilute quickly so that safe levels of potentially harmful substances such as AAM are not exceeded, all PAMs contain some level of residual AAM due to an incomplete	Acting Sr. Head HSSE Upstream Manager T&D	Number of complaints Water quality at discharge point	Visual observations (oil and turbidity) Water quality monitoring	Water quality monitoring report

Impacts	Impacts Assessment	Impact significance	Residual Impact	Environmental management objective	Mitigation Measures	Responsibility	Monitoring & Performance Evaluation		Compliance reporting
							Performance indicators	Monitoring Methods	
					polymerization process (SRK, 2019). AAM migrates faster than PAM presenting a greater risk of dispersed contamination, but also degrades faster, as such the following is recommended: ○ Enhance monitoring efforts of AAM to verify the assumption that AAM constitutes 0.1% of HPAM concentration. ○ Establish a trigger value based on current calculations of AAM that would necessitate the sampling and testing. This proactive measure aims to ensure accurate monitoring and validation of the assumed correlation between AAM and HPAM concentrations, thereby safeguarding environmental and public health. ○ Obtain a discharge permit for AAM from NIMOS based on current calculations and/or established trigger value as mentioned above.				
Waste	Environmental pollution due to improper management of solid (including polymer containing sludge) and liquid waste during the operational phase	Impact: Minor Likelihood: Possible Risk rating: **Low**	Low	Proper collection and disposal of waste	• Minimize waste generation and recycle as much as possible. • Manage waste according to Staatsolie Waste Management Plan: ○ Store solid waste in a designated area in covered drums for collection and disposal. ○ Provide rubbish bins for litter at appropriate locations and arrange for regular collection. ○ Depending on the waste type, this will be recycled, reused, or disposed of in a suitable facility. • All hazardous materials, including polymer containing sludge, will be stored separately, and disposed of according to Staatsolie requirements. • Treat sludge through bioremediation at the Staatsolie Waste Management Facility.	Manager P&ES Manager T&D	Waste Management Plan Awareness among Employees Waste log	Housekeeping inspection Waste log records	Weekly EMMP Checklist
Socio-economic	Nuisance (noise, dust, or otherwise) to the people living along the Jossiekreekweg	Impact: Minor Likelihood: Possible Risk rating: Low	Low	To avoid complains and maintain good name of the company	• Register and address complaints according to the Grievance Redress Mechanism which is in place and operational. • Ensure maintenance schedule for combustion equipment and that maintenance on the equipment is done accordingly. • In dry periods: maintain a low driving speed. • In dry periods: spray the road near houses with water; keep the road sufficiently moist.	Acting Sr. Head HSSE Upstream / CCU Head Manager T&D	Number of complaints	See monitoring for noise and air quality impacts Monitoring of complaints through the Staatsolie GRM	Complaint report

5.4 Cumulative Impacts

Cumulative impacts are defined as "the combination of multiple impacts from existing projects, the proposed project, and/or anticipated future projects that may result in significant adverse and/or beneficial impacts that would not be expected in case of a stand-alone project" (IFC, 2006).

The current operations at the Jossie Plant and the construction activities for the upgrade of the plant were considered for the assessment of the potential cumulative impact(s). The construction activities for the upgrade of the Jossie Plant will take place while the current production activities on the Jossie Plant is ongoing. The cumulative impacts are described in the table below.

Table 23: Cumulative impact analysis

Component	Description	Cumulative impact	Mitigation measures
Noise	Project related construction activities and existing operation noise could affect receptors.	The noise impact from both the current and future operation is considered to have a medium impact (impact; moderate and likelihood: possible). From the noise assessment it can be concluded that the main noise sources are from the existing plant. The current main noise sources are the transfer pumps and heaters. Mitigation measures are required to reduce this impact of the existing plant.	• Consider engineering measures to reduce noise levels such as high pressure (HP) pumps on variable frequency drive (VFD) or replacement of the transfer pumps with electrical engine pumps. • Consider exhaust mufflers or silencers on required equipment. • Consider the establishment of buffer zones (e.g. vegetation screen) in between the plant and closest residents. • If complaints regarding noise are received, carry out noise monitoring and take noise abatement measures if necessary. After implementation of these mitigation measures the impact will be reduced from medium till low.
Air Quality	Combined project related air quality emission (the plant and project traffic) and emission from the existing operation could affect receptors.	The simulated dispersion modelling results indicate that the upgrade of the Jossie Plant will result in a decrease in VOC and H_2S concentrations throughout the study area. For VOC the upgrade of the plant has an overall positive effect. The boiler, however, is expected to result in an increase in the emissions of combustion products, such as NO_2, SO_2 and PM. Depending on the operation, this may cause nuisance for the nearby residents living on the pig farm. Mitigation measures are required to reduce this impact. .	• Consider the establishment of buffer zones (e.g. vegetation screen) in between the plant and closest residents • If complaints are received, carry out air quality monitoring and take measures if necessary.

6 Environmental Monitoring Plan

This section provides a description of the methods that will be used to monitor performance against EMMP commitments and the way the monitoring results will be reported.

6.1 Monitoring

Respective Process Owners together with the HSSE Upstream Division are responsible for monitoring the performance of on-site personnel against the commitments of the EMMP. Overall control of this function will lie with the Acting Sr. Head HSSE Upstream, and responsibility for day-to-day monitoring will lie with the Process Owner representatives. The Process Owner is obliged to and will have the power to suspend activities if they do not comply with the performance standards specified in the EMMP. The following principal items will be monitored:

- Correct implementation of EMMP;
- Compliance with Method Statements; and
- Physical parameters and indicators, e.g., water quality, air quality and noise levels

The overall project impact management summary table is included in **Appendix 8**.

6.1.1 Physical monitoring framework

Staatsolie is committed to the implementation and completion of the upgrade of the Jossie plant, in accordance with the highest environmental standards. Our goal is to maintain this throughout the duration of the project by implementing an environmental monitoring program. The objectives of the monitoring framework are:

- To assess the actual impacts of the proposed project;
- To evaluate the effectiveness of the inherent and additional mitigation measures that have been proposed to minimize the environmental impact of the project;
- To ensure environmental compliance with relevant local, international and company requirements; and
- To provide feedback to Staatsolie on learnings for other future projects.

One of the means to achieve the above objectives is physical monitoring. The monitoring framework is presented in **Table 24**.

Table 24: Monitoring framework program for the upgrade of the Jossie plant

Aspect	Parameters	Frequency	Monitoring locations
Construction phase			
Surface Water quality	Visual inspection (spills, oil sheen), using the weekly checklist	Weekly during inspections	At the effluent discharge point, upstream and downstream of the effluent discharge point in the Jossiekreek
Operation phase			
Surface water[12]	• pH • EC • Dissolved oxygen • Chemical oxygen demand • Total Petroleum Hydrocarbon (TPH)[13] • Selected metals: initially analyze for a comprehensive suite of metals and select parameters for future monitoring based on those results. • Acrylamide Monomere (AAM)	• Monthly (except for AAM) • For AAM based on established trigger value. Two times per months: collect one sample for analysis on AAM when calculated AAM concentration is equal or above the trigger value and then one sample after 10 days to verify breakdown of AAM).	At discharge point Upstream of the discharge point(s) in the Saramacca River, beyond the reach of the tidal push from discharge point, for baseline value Downstream of the discharge point(s) in the Saramacca River, ~at the western boundary of the Tambaredjo Oilfield
Effluent[14]	• pH • EC • Total Suspended Solids • Phenols • Sulfides • Chlorides (or calculate based on EC value)[15] • Heavy metals (Arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, vanadium, and zinc.) • Oil and Grease • TPH[13] • HPAM • AAM	HPAM: monthly AAM: based on established trigger value. Two times per month: collect one sample for analysis on AAM when calculated AAM concentration is equal or above the trigger value and then one sample after 10 days to verify breakdown of AAM). Enhance monitoring efforts based on trigger values (as soon as possible). Other parameters: • Weekly once upgraded operations are established. • Further frequency to be determined based on results.	After treatment, prior to discharge

[12] As included in the Limited ESIA for Polymer Flooding Enhanced Oil Recovery in the Tambaredjo Oilfield (SRK, 2019).

[13] It is proposed to analyze TPH instead of Oil and Grease that was proposed by SRK (2019) as TPH indicates the compounds derived from crude oil. Oil and Grease are a larger group of contaminants including fatty and oily substances not derived from crude oil, such as animal fats and cooking oils. As Oil and Grease is currently being monitored by Staatsolie, it is therefore recommended that three representative samples, preferably with a range from high to low, is taken in Duplo and that Oil and Grease as well as TPH are determined for comparison.

[14] Parameters as required by the IFC-EHS Guidelines for Onshore Oil and Gas Development.

[15] EC (µS)= 2.95 x Cl (mg/L). The standards for chloride are 600 mg/l (average), 1200 mg/L (maximum). Expressed into EC this becomes 1765 and 3540 µS respectively.

Noise	Noise levels	Once the upgraded plant is operational to assess the change from baseline levels measured during the 2022 and 2024 campaigns and verify the noise propagation simulation results. In case of complaints during operational phase.	At noise sources and nearby residents At the nearest residents (with complaint)
Air Quality	Emission rates through isokinetic sampling and gas flow rate at the: • Cold Vent Stack: VOC and H_2S • Steam Boiler: PM, SO_2, NOx and CO	Once the upgraded Jossie Plant is fully operational Further monitoring: yearly	Cold Vent Stack Steam Boiler
	Ambient Air Quality: VOCs, H_2S, SO_2, NOx and PM	• Once the upgraded Jossie Plant is fully operational: preferably twice covering both dry and wet seasons. • Further monitoring to be determined after first monitoring campaign and in case of regular complaints.	At the receptor with complaint (expected at the pig farm)

6.1.2 Environmental and Social Inspections

To determine the compliance with the Environmental and Social Specifications as indicated in Chapter 5, weekly environmental inspections will be undertaken during the construction phase by the Process Owners. To facilitate these inspections a checklist has been developed, see **Appendix 2G**: Weekly Checklist.

During the operation phase monthly/ quarterly inspections should be conducted by the Process Owner and Staatsolie HSSE Representative.

6.1.3 Data and information management

Environmental data should be stored in Staatsolie Environmental Statistics database, which allows systematic storage and manipulation of data, and will permit rapid retrieval for the purposes of internal and external reporting. The Staatsolie HSSE Representative will ensure that relevant environmental data of the project is provided for this database. In order to ensure a consistent and coherent system for documenting the implementation of the EMMP, all written records and other information will be stored in a filing system that is compatible with the requirements of the existing HSE Management System. This comprises standardized forms, documents and reporting procedures.

6.2 Reporting

The frequency and nature of reporting of environmental management performance will depend upon the nature of the activity and aspect that is being managed. The table below summarizes the formal reporting schedule that will be used for the upgrade of the Jossie plant.

Table 25: Regular reports and report lines

Report Name	Description	Frequency	Responsibility of	Receiver
Weekly report of safety talks	Reports of talks	Weekly	All Process Owners	Acting Sr. Head HSSE Upstream
Weekly HSE Inspection	Compliance with EMMP	Weekly during construction	All Process Owners	Acting Sr. Head HSSE Upstream
Incidents	Report type and consequences for loss of days	When accidents occur	All Process Owners	Acting Sr. Head HSSE Upstream
Method statement	Method statements	One week before commencement of the construction activities for which it is needed	All Process Owners	Acting Sr. Head HSSE Upstream
Complaints	Report each complaint and its settlement according to the Grievance Redress Mechanism	Directly after complaint is received	Corporate Communication Officer	Acting Sr. Head HSSE Upstream
Water quality monitoring reports	Reports of water quality monitoring for the project during the construction and operational phase	Quarterly	Manager T&D	Acting Sr. Head HSSE Upstream
Stakeholder Engagement report	Report on implementation of Communication Plan, and compliance with EMMP	Quarterly	Corporate Communication Officer	Acting Sr. Head HSSE Upstream

Based on data from the above-mentioned internal reports, HSSE Representative will compile a Project Compliance and Monitoring Report that will be sent to NIMOS.

6.2.1 Feedback

Feedback on performance will be communicated to the appropriate parties concerned (including NIMOS). Any substandard performance will trigger a process that notifies the responsible party of the nature of the issue and indicates the actions that are required to rectify the situation. This will be followed up by further monitoring to ensure that the substandard performance has been corrected.

7 Community Engagement and Grievance Redress Mechanism of Staatsolie

Staatsolie has a Stakeholder Engagement Procedure that aims to perform business activities in such a way that the communities' interest and expectations with regards to socio-environmental aspects are properly considered and managed. Stakeholder engagement is the responsibility of the Corporate Communication Upstream (CCU) department of Staatsolie. In addition, to Staatsolie Stakeholder Engagement Procedure, the SEP for the project, outlined in subchapter 4.3, will assist the stakeholder engagement process during the execution of the project, by enabling the disclosure and dissemination of important information about the project (activities) to all relevant stakeholders that may be impacted. Key objectives of the communication plan and the SEP are:

- to acquire, maintain or strengthen productive relationships with stakeholders identified during the consultation process, conducted prior to the start of the project;
- to ensure that any additional stakeholder that may be impacted by the project is identified and included in the communication for the remainder of the project lifecycle;
- to ensure transparent, efficient, and regular dispersal of key project information;
- to provide stakeholders with an opportunity to raise issues or concerns about the project and to ensure that such feedback is addressed in a suitable manner; and
- to avoid conflicts or conflicting situations from emerging.

Staatsolie also has a Grievance Redress Mechanism/ complaint procedure that is followed in case of complaints (see **Figure 21**). Complaints can be reported to all personnel of Staatsolie, who should report this within one working day to the CCU department. All complaints are registered in a software allowing that complaints can be registered and monitored in the system at any time and from anywhere. There are also complaint forms available at the security posts for registration of complaints after working hours, which are later shared with CCU for registration in the system.

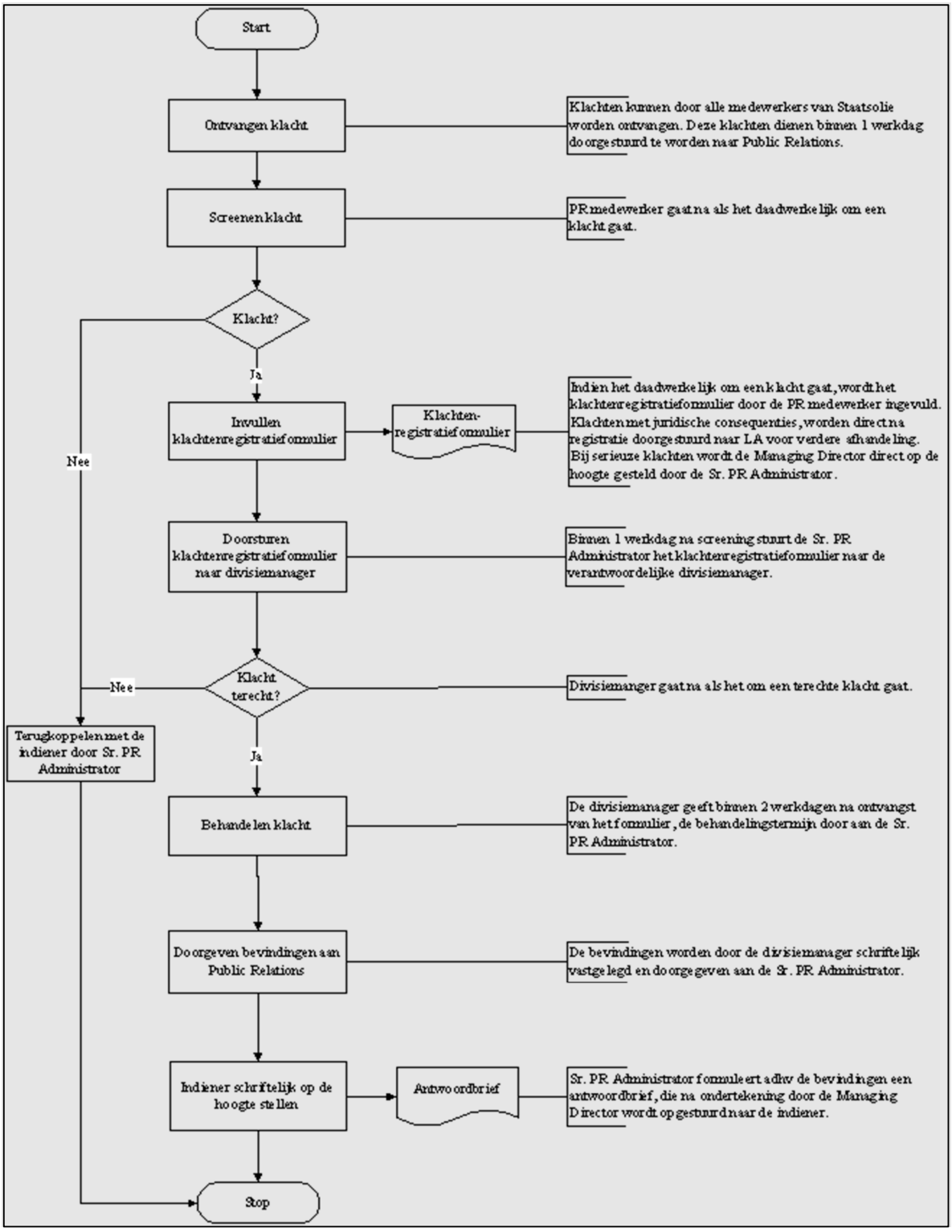


Figure 21: Overview Grievance Redress Mechanism of Staatsolie

8 Conclusion

This chapter presents the conclusions and recommendations of the EMMP for the "Optimized fluid handling capacity and efficiency project at the Jossiekreek Crude Treatment Plant".

The EMMP study has been conducted in accordance with national regulatory requirements (Milieu Raamwet S.B. 2020 no. 97/ Environmental Framework Act S.B. 2020 no. 97), the guidelines of the National Institute for Environment and Development in Suriname (NIMOS, March 2005, NIMOS August 2009, NIMOS, 2021), the NIMOS Procedure (NIMOS, December 2023), as well as international best practices.

The upgrade of the Jossie Plant has been classified as a Category B, Path 2 project by NIMOS and it was determined that only an EMMP is necessary for the current project. The EMMP study primarily involved a desk study, supplemented by field surveys, measurements (noise), and stakeholder consultations.

Environmental and Social baseline:
From the environmental baseline assessment, the following can be stated:

- The dominant wind direction in the study area are winds from the northeast during the day and more dominant from the east during the night.
- Baseline air quality measurements at the Jossie Plant show that particulate matter (PM), NO_2 and O_3 concentrations are within the WHO/IFC guidelines.
- Day and nighttime noise measurements and modelled levels for the current operation show that the current operation at the Jossie Plant is not expected to result in exceedance of the daytime WHO/IFC guideline of 55 dBA at the closest noise sensitive receptors (school and mosque) and nearest residents. However, during nighttime, the current operation at the Jossie Plant results in exceedances of the night-time IFC guideline of 45 dBA at the closest receptor locations. Elevated levels above the nighttime WHO/IFC standard are recorded in a radius of approximately 200 meters around the plant. Measures are required to minimize this noise impact.
- The Jossie Plant is drained by a system of ditches which end up in the canalized Jossiekreek to the west of the plant and ultimately into the Saramacca River.

From the socio-economic baseline assessment, the following can be stated:

- Receptors within the project area are residents living concentrated along the Jossiekreekweg and the Smithfieldweg.
- Sensitive receptors within the area are a mosque (150 m. to the west) and a school (approximately 550 m. west from the entrance of the Jossie Plant).
- The closest resident is 100 m. to the west (at the livestock/ pig farm) from the Jossie Plant.
- Main concerns raised during the stakeholder consultations include:
    - Concerns regarding existing noise nuisance and possible increase of noise levels due upgrade of the Jossie Plant.
    - Impact on air and water quality.
    - Dust nuisance.

Potential impacts and mitigation measures
From the assessment of potential impacts of the upgrade of the Jossie Plant, there are five impacts with medium significance which can effectively be reduced to low after implementation of the proposed mitigation measures. The remaining impacts are low.

Cumulative noise and air quality impacts: it should be noted that the future operations will positively contribute to reduction of VOC's. For noise, future operations will not have any significant contribution in increasing noise levels. Additional measures to address the cumulative noise and air quality impacts are:

- Consider engineering measures to reduce noise levels such as high pressure (HP) pumps on variable frequency drive (VFD) or replacement of the transfer pumps with electrical engine pumps
- Consider exhaust mufflers or silencers on required equipment.
- Establish an effective buffer zone (e.g. vegetation screen, earth wall) between the plant and the nearest resident.
- If complaints regarding noise are received, carry out noise monitoring and take noise abatement measures if necessary.
- If complaints regarding air quality are received, carry out air quality monitoring and take measures if necessary.

The several mitigation measures, management, and monitoring requirements, as described in the EMMP must be implemented as part of normal operations by effectively incorporating the key components into daily activities, such as including environmental issues in the decision-making process, carrying out operations in accordance with the standard procedures, and maintaining complete records.

Recommendations

Based on the findings of the EMMP study the following is recommended:

1. Implement the EMMP during all phases of the project as part of normal operations by effectively incorporating the key components into daily activities.
2. Maintain lines of communication, according to the Staatsolie Stakeholder Engagement Procedure and Stakeholder Engagement Plan (SEP), with the nearby residents in the vicinity of the Jossie Plant.
3. Ensure that nearby residents are aware of the Staatsolie Grievance Redress Mechanism/ complaint procedure and how to utilize it. Further, register and adequately address complaints according to this procedure.
4. Conduct ongoing monitoring and assessment of environmental performance during the construction and operational phase and take corrective actions in case of non-compliances.

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10 Appendices