Report

Environmental and Social Management Framework (ESMF) Technical Annex: Preliminary Environmental and Social Assessment

Greater Nokoué Sustainable Urban Mobility Project (MUDP-GN), River Transport on Lake Nokoué, Benin

Status: Final/P03

Date: January 7, 2025

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Enhancing Society Together

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Document Title:	Environmental and Social Management Framework (ESMF) Technical Annex: Preliminary Environmental and Social Assessment of the Greater Nokoué Sustainable Urban Mobility Project (MUDP-GN), River Transport on Lake Nokoué, Benin
Subtitle:	
Status: Date:	BJ5927-RHD-ZZ-XX-RP-Z-0001
Project Name:	Contract 7214845
No. Project	Final/P03 7 janvier 2025
Manager:	Greater Nokoué Sustainable Urban Mobility Project
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Date:	07 January 2025
Classification:	Related Projects

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List of Abbreviations

ABE	: Beninese Environment Agency : Agency for the Integrated Development of Lake Ahémé and its Channels : French Development Agency : Territorial Agricultural Development Agency.
ADELAC AFD ANPT ARNP ARPN in Aadat Anat	: National Agency for Spatial Planning Promotion of Heritage and Tourism Development: Development and Rehabilitation of Lake Nokoué and the Porto Novo Lagoon: Rehabilitation Agency of the City of Porto-Novo: African Development Bank: World Bank: West African Development Bank: Autonomous Amortisation Fund: National Centre for the Management of Wildlife Reserves: National Centre for Teledictions: Environmental and Social Framework: Environmental and Social Management Framework: Interministerial Council for Water: National Water Council: Steering Committee (ARNP): Construction Phase - Environmental and Social Management Plan: Departmental Directorate of Agriculture, Livestock and Fisheries: Managing Directorate: General Directorate for Water: General Directorate for Environment and Climate: Directorate-General for Water, Forestry and Hunting: Department of Rural Engineering (APRM): Department of Fisheries Production (APRM): Environment and Social: Environmental and Social Impact Assessment: Strategic Environmental and Social Assessment: Environment, Health and Safety: Greenhouse Gases: Integrated Water Resources Management: Gesellschaft für Zusammenarbeit (German Cooperation): Hectare: African Biomass Energy Initiative (African Biomass Energy Initiative) International Finance Corporation: National Geographic Institute: Unknown: National Water Institute: National Institute of Agronomic Research of Benin; National Institute of Statistics and Demography: Institute of Fisheries and Oceanological Research of Benin: Ministry of Agriculture, Livestock and Fisheries: Ministry of Economy and Finance: Ministry of Water and Mines Ministry in charge of Development and Coordination of Government Action: Ministry of Living Environment and Transport in charge of Sustainable Development (formerly MCVDD): Ministry of Infrastructure and Transport: Ministry of Planning and Development: Not applicable: Environmental and Social Standards
BAD BM BOAD CAA CENAGREF CENATEL CES CGES CIE CNI CP C-PGES DDAEP DG DGEau DGEC DGEFC DGR DPH E&S EIES EESS ESS GES GIRE GIZ ha IEBA IFC IGN IN INE INRAB INSTAD IRHOB MAEP MEF MEM MDC	
MCVT	
WITH MPD NA NES	

NP NU OECD OIT ONG PAG PANGIRE PAPC PAPVS PGES PMUD-GN PND PNDF PNVV PPP PROMAC PROVAC PSDSA PURE PUGEMU TFP RHDHV SAGE SDAGE SDAL SEP	: Performance Standards : United Nations : Economic Organization for Co-operation and Development : International Labour Organization : Non-Governmental Organization : Government Action Programme : National Action Plan for Integrated Water Resources Management : Cotonou Stormwater Sanitation Programme : Secondary Cities Stormwater Sanitation Project : Environmental and Social Management Plan : Urban Mobility Project Sustainable of Greater Nokoué: National Development Plan: National Sectoral Development Program (e.g. Aquaculture): Porto-Novo Green City: Population-Planet-Profit: Project for the Promotion of Sustainable Aquaculture and the Competitiveness of Fisheries Value Chains: Inland Aquaculture Extension Project: Strategic Plan for the Development of the Agricultural Sector: Emergency Preparedness and Response Plans: Emergency Project for Environmental Management in Urban Areas: Technical and Financial Partner: Royal HaskoningDHV (Consultant): Water Resources Development and Management Plan: Water Resources Development and Management Master Plan: Beninese Coastal Development Master Plan Stakeholder Engagement Plan
SIRAT UAC UCP UE UNA ZIT	: Road Infrastructure and Regional Planning Company : University of Abomey Calavi : Project Coordination Unit (ARNP) : European Union : National University of Agriculture : Areas of Tourist Interest

[viii] Executive Summary

Introduction

As part of its 2021-2026 Action Program, the Government of the Republic of Benin, with the support of the World Bank Group, is developing the Greater Nokoué Sustainable Urban Mobility Project (MUDP-GN). In addition, the Government of Benin, through the Ministry of Living Environment and Transport in charge of Sustainable Development (MCVT) and the Agency for the Integrated Development of Lake Ahémé and its Channels (ADELAC), is undertaking the project of "Development and Rehabilitation of Lake Nokoué and the Lagoon of Porto Novo" (ARNP). Royal HaskoningDHV was the lead consultant throughout the definition phases of the ARNP project, which includes the development of lake transport on Lake Nokoué. This project, funded by Invest International, is still in its early stages, with the bankable report and the Environmental and Social Impact Assessment (ESIA) still to be prepared.

Objective of the Study

The Government of Benin has informed the World Bank of its wish to integrate lake transport into the MUDP-GN project. The SUMP-GN project is classified as high risk due to its scale, the sensitivity of the sector in which it operates, the geographical area concerned and the potential negative impacts it could have on the biophysical and human environments. This document has been prepared as a technical annex to the Environmental and Social Management Framework (ESMP) for the SUMP-GN transport project. It aims to gather all relevant data available at the pre-feasibility stage, concerning the baseline environmental and social situation, and to assess the impacts of inland waterway transport in line with the Bank's Environmental and Social Framework. Second, the report proposes comprehensive mitigation measures to help avoid or minimize these impacts to an acceptable level. It sets the stage for a full ESIA and covers the entire project lifecycle, including the preparation, construction, operation and decommissioning phases.

Description of Lake Transport

As part of the MUDP-GN project, transport on Lake Nokoué is envisaged from the port of the city of Abomey-Calavi, through the city of Cotonou (location of the port of Vossa) to the port of the city of Porto-Novo. The proposed ports at Abomey-Calavi and Cotonou-Vossa are located on the southern shore of Lake Nokoué and the port of Porto-Novo is located in the Porto-Novo lagoon.

The development of lake transport includes several infrastructural elements:

1.La construction of 3 ports and the ARNP connection road network provides in its Action Plan for the creation, rehabilitation and improvement (among other places) of three (3) lake ports in order to facilitate the transport of people and goods. These lake ports are located in Porto-Novo, Cotonou (Vossa) and Abomey-Calavi. Lake ports must be able to accommodate relatively large vessels and facilitate efficient and rapid loading and unloading. In addition, they must have space for related activities such as passenger holding areas, fishing-related storage and marketing activities, the transfer of goods to land transport (and vice versa) or to and from neighbouring markets, and processing industries.

2. Dredging of waterways and the creation of artificial islands Waterways must be dredged to allow ferry transport between Abomey-Calavi, Cotonou (Vossa) and Porto-Novo. The dredged materials will be used to create artificial ecological islands to improve the biodiversity of the lake and in particular that of the avifauna.

In addition to these infrastructural elements, the project also includes institutional elements and modifications to ensure appropriate and sustainable development of lake transport and safe commuter transport. It also includes the development of public-private partnerships leading to sustainable economic development.

Environmental and Social Impacts

The main objective of adding lake transport is to reduce pressure on the road network around the lake. The Cotonou metropolitan region is expected to experience further significant population growth in the coming years, and the projected mobility needs are expected to grow even further. The introduction of lake transport will reduce air pollution and improve air quality compared to autonomous growth.

The major impact of the proposed development on land is that space will have to be developed for the ferry and freight ports in Abomey-Calavi, Cotonou (Vossa) and Porto-Novo, as well as for the land-based connection infrastructure. The locations were chosen to best connect the ports to the existing road network and with as little involuntary displacement as possible. Nevertheless, the construction of the port of Cotonou will require the removal of some houses and workshops, and the expansion of the existing port in Abomey-Calavi and the associated modernization of the connecting road will require the relocation of economic activities along the existing road. The location of the planned port of Porto-Novo is on a plot of unused land in the public domain, east of the bridge connecting Porto-Novo to the south. The work on the bridge over the lagoon to Porto-Novo already planned will be crucial to create sufficient vertical clearance to allow transport by ferry.

A complicating factor in the creation of the port of Cotonou-Vossa is that the existing houses and workshops are based on waste. It will be necessary to determine to what extent this is also the case in Abomey-Calavi.

The major impact of lake transport on the aquatic level is that dredging is necessary to create and maintain waterways. In fact, Lake Nokoué, Ramsar site 1018, is facing increasing sedimentation and is becoming increasingly shallow. The creation of the channels will improve the flow of water into the lake, resulting in lower water temperatures and increased saltwater intrusion into the lake. These effects will have an impact on water quality and, consequently, on the biodiversity of the lake. Another important impact is that the creation of waterways implies the removal of acadjas from the trajectory of waterways.

The disposal of dredged material is another important impact of the creation of waterways. To this end, the construction of artificial islands is planned to improve the avifauna on Lake Nokoué.

Mitigation of Environmental and Social Impacts

As mentioned earlier about the impacts, the selection of port locations was based on:

- (1) a close connection to the existing road infrastructure and
- (2) a minimum of involuntary relocation of housing and economic activities.

Proper stakeholder management and sufficient compensation in line with World Bank standards are part of mitigating these impacts. The same principles apply to the acadjas located in the path of the proposed waterways and to the location of the port of Cotonou-Vossa. In addition to this, a proposed mitigation

measure is the creation of artificial fish ponds (also a mitigation measure in the ARNP) to provide a more sustainable livelihood for acadja fishermen.

The dredged materials will be partially used for the construction of the port platforms and the creation of groups of artificial islands. For the disposal of the remaining dredged material, a disposal site must be selected, which can be a lengthy process. The intention of creating the two groups of islets is to promote the ecological quality of Lake Nokoué and in particular the bird population and the increase of bird species. After construction, these islands will be offered to nature and will serve as a potential area for mangroves and provide nesting areas for birds.

In addition to the above-mentioned mitigation measures, other measures will be considered to minimize the environmental and social impacts of the construction and operation of waterways, ports and connecting roads. One of the next steps in the more detailed description of the plans will be the completion of a full Environmental and Social Impact Assessment in parallel with the design and detailed description of the project. Based on the information obtained from the ESIA and the design services, mitigation measures will be specified.

This report presents an assessment of the risks and impacts associated with ARNP and its interfaces with the SUNC-GN in accordance with the World Bank's Environmental and Social Framework. This report covers the entire project lifecycle, including the preparation, construction, operation and decommissioning phases. However, it is assumed that lake harbours will remain for an indefinite period of time and that waterways will disappear over time when maintenance dredging ceases.

1 Introduction

As part of its 2021-2026 Action Program, the Government of the Republic of Benin, with the support of the World Bank Group, is developing the Greater Nokoué Sustainable Urban Mobility Project (MUDP-GN). This project is expected to be the subject of a final investment decision by the Bank's Board of Directors in early 2025. In addition, the Government of Benin, through the Ministry of Living Environment and Transport in charge of Sustainable Development (MCVT) and the Agency for the Integrated Development of Lake Ahémé and its Channels (ADELAC), is undertaking the project of "Development and Rehabilitation of Lake Nokoué and the Lagoon of Porto-Novo" (ARNP). Royal HaskoningDHV was the lead consultant throughout the definition phases of the ARNP project, which includes the development of lake transport on Lake Nokoué and the Porto-Novo lagoon. This project, funded by Invest International, is still in its early stages, with the bankable report and the Environmental and Social Impact Assessment (ESIA) still to be prepared.

1.1 The Project

The Government of Benin has informed the World Bank of its wish to integrate lake transport into the MUDP-GN project. The SUNC-GN project is classified as a high-risk project in accordance with the World Bank's Environmental and Social Framework (ESF) due to its scale, the sensitivity of the sector in which it operates, the geographical area concerned and the risk of significant and irreversible potential negative impacts it could have on the biophysical and human environments.

For the purposes of the SUNC-GN, only the report of the second phase of the ARNP, Action Area No. 1 and part of Action Area No. 3 of this project are relevant. This report focuses on these specific components.

1.2 Our scope of intervention

Our scope of intervention for the Project includes the following elements:

- Identify the interfaces between the ARNP project and the SUMP-GN project
- Identify and assess the potential environmental and social (E&S) risks and impacts of the Lake Nokoué (ARNP) project, through ARNP and MUDP-GN documentation, in accordance with the World Bank's Environmental and Social Standards (ESS) set out in the World Bank's Environmental and Social Framework composed of ten (10) different NES scopes. A description of the WB SEN for the Project is provided in Appendix A10.
    - **At the request of the WB, the NES7 and NES9 Environmental and Social Standards are not covered by the scope of Royal HaskoningDHV. Therefore, the identification and assessment of E&S impacts, risks, and mitigation measures does not include these topics.**
- Develop a timeline for the implementation of mitigation measures to address the identified risks and impacts.
- Estimate the costs associated with conducting studies, surveys and implementing mitigation measures for the Lac Nokoué project.

1.3 Project Terms of Reference

1.3.1 Institutional framework

The institutional frameworks for ARNP and GURP-GN are detailed in Annexes A1 and A2.

1.3.2 Legal Framework

1.3.2.1 National Framework

The national legal framework for the conduct of E&S review reports in Benin is mainly composed of the following laws:

- Law No. 2019-40 of 7 November 2019 revising Law No. 90-32 of 11 December 1990 on the Constitution of the Republic of Benin, which stipulates that "everyone has the right to a healthy, satisfactory and sustainable environment, and has the duty to defend it. The State shall ensure the protection of the environment" (art. 27) and "The right to property shall be guaranteed to all. No one may be deprived of his property except for reasons of public utility and on condition of fair and prior compensation. (art. 11).

- Decree No. 2022-390 of 13 July 2022, relating to environmental assessment procedures in the Republic of Benin, requires an environmental and social impact assessment for any project likely to harm the environment and makes public consultations and hearings mandatory, depending on the scope of the project, during the environmental impact assessment process.
- Law No. 93-009 of 2 July 1993 on the forest regime in the Republic of Benin.
- Law No. 98-030 of 12 February 1999 on the framework law on the environment in the Republic of Benin.
- Decree No. 2003-332 of 27 August 2003 on solid waste management in the Republic of Benin.
- Law No. 2002-016 of 18 October 2004 on the wildlife regime in the Republic of Benin.
- Law No. 87-014 of 21 September 1987, governing the regulation of nature protection and hunting in the Republic of Benin, provides for restrictions on the feasibility of certain activities or projects in reserves or parks in order to preserve both species and their habitats (Articles 13 to 17).

- Decree 2022-063 of February 02, 2022 approving the statutes of the Beninese Environment Agency.
- Law No. 2006-17 of 17 October 2006 on the Mining Code and Mining Taxation in the Republic of Benin.
- Law No. 2010-44 of 21 October 2010 on water management in the Republic of Benin, which advocates Integrated Water Resources Management (IWRM) as a basic principle for water management in Benin. Article 1 of this law sets out the constitutional principle that "everyone has the right to a healthy, satisfactory and sustainable environment and has the duty to defend it. The State shall ensure the protection of the environment and the conservation of natural resources in general, in this case water".

- Decree No. 2011-281 of 2 April 2011 on the creation, attributions, organization and operation of environmental units in the Republic of Benin.
- Decree No. 2011-573 of 31 August 2011 establishing the Master Plan for Water Development and Management (SDAGE). It is a document for sustainable water planning and management, setting out the fundamental guidelines for optimal management and specifying priorities, water quantity and quality objectives and the measures to be taken to achieve them, in a given territory.

- Decree No. 2011-623 of 29 September 2011 laying down the procedure for the delimitation of the public water domain. This decree specifies the provisions governing the procedures for delimiting the public water domain - surface water and groundwater.
- Decree No. 2012-227 of 13 August 2012 establishing the Water Development and Management Scheme (SAGE). It is a document for sustainable water planning and management that sets the general objectives for the use, enhancement and quantitative and qualitative protection of water resources and aquatic ecosystems, as well as the preservation of wetlands, at the scale of a sub-basin or a group of sub-basins.
- Framework Law No. 2014-19 of 7 August 2014 on fisheries and aquaculture in the Republic of Benin, in conjunction with Ordinance No. 20/PR/MDRC/SP of 25 April 1966 on the general regulation of fishing in rivers, lakes, ponds, canals and lagoons.
- Decree No. 2015-029 of 20 January 2015 laying down the terms and conditions for the acquisition of rural land in the Republic of Benin.
- Law No. 2017-15 amending and supplementing Law No. 2013-01 of 14 August 2013 on the Land and Property Code in the Republic of Benin.
- Decree No. 2015-013 of 29 January 2015, relating to the composition and operating procedures of the commissions of inquiry of commodo and incommodo and compensation in matters of expropriation for reasons of public utility, specifies that everything that may be expropriated for reasons of public utility, provided that the affected party has a legal or customary right of ownership.

- Law No. 2018-10 of 2 July 2018 on the protection, development and enhancement of the coastline in the Republic of Benin.
- Law No. 2018-18 of 6 August 2018 on climate change in the Republic of Benin. This law sets out the measures that natural and legal persons must take in the face of climate change, with a view to preserving biodiversity.
- Law No. 2018-16 of 28 December 2018 on the Penal Code in the Republic of Benin.
- Law 2021-09 of 22 October 2021 on the protection of cultural heritage in the Republic of Benin.

- Article 182 of Act No. 98-004 of 27 January 1998 on the Labour Code of the Republic of Benin stipulates that "in order to protect the life and health of workers, the employer is required to take all necessary measures appropriate to the operating conditions of the enterprise".
- Law No. 2021-11 of 20 December 2021 on the punishment of gender-based offences and the protection of women in the Republic of Benin.
- Law No. 2021-14 of 20 December 2021 on the Code of Territorial Administration in the Republic of Benin.
- Law No. 2022-17 of 19 October 2022, amending Law No. 2020-37 of 3 February 2021, on the protection of the health of persons in the Republic of Benin.
- Law No. 2022-04 of 16 February 2022 on the Public Hygiene Code describes the public hygiene rules to be observed and serves as a basis for defining the systems to be implemented in each component of sanitation and for the adoption of appropriate behaviours. Its objective is to protect and promote public health.

1.3.2.2 Regional Framework

At the regional level, Benin has signed the following agreements with other African countries.

Table 1-1 Benin Regional Framework Relevant to the Project

Treaties, conventions and agreements	Rationale for the applicability of the Project
African Charter on Human and Peoples' Rights, adopted in Nairobi on 23 September 1981.	Carrying out the Project's activities requires the recruitment of manpower. It goes without saying that recruitment and working conditions must respect human rights.
African Convention on the Conservation of Nature and Natural Resources.	Completion of the project will result in slightly more land and water use. It could also lead to the degradation of wetlands and/or aquatic ecosystems due to construction and exploitation activities. It is therefore important to ensure the rational use and conservation of the natural resources present, especially as the site is part of Ramsar Site 1018.
Additional Act No. 01/2008/CCEG/UEMOA, adopting the WAEMU Common Policy for the Improvement of the Environment.	The Project must be carried out in a way that preserves sensitive natural ecosystems and biodiversity, avoiding pollution and damage to water and land resources as much as possible.
The Abidjan Convention, signed on 23 March 1981 and entered into force on 5 May 1984, aims to cooperate in the protection and development of the marine and coastal environment in the West and Central African region.	The project must be carried out taking into account the protection of the coastal and lake environment.

1.3.2.3 International Framework

The E&S exam is also drafted in accordance with international standards and the main conventions ratified by Benin.

The relevant conventions ratified by Benin are summarized in the table below.

Table 1-2 Benin's international framework relevant to the project

Conventions, treaties and agreements	Justification of the applicability of the Project
Convention on Wetlands of International Importance, adopted on 2 February 1971 in Ramsar	The project will be water-based. To this end, it is important to take measures to preserve and use water sustainably, in line with Benin's commitments. Most importantly, the project is located in a Ramsar site and Benin's commitments in this regard will have to be respected.
United Nations Framework Convention on Biological Diversity, adopted in Rio de Janeiro in 1992	The application of this treaty to the present project is justified by the damage that will be caused to the micro-ecosystem present on the site (disturbance, or even partial degradation).
United Nations Framework Convention on Climate Change, adopted in Rio de Janeiro in 1992.	The destruction of carbon sinks by deforestation and the production of GHGs by the decomposition of organic matter (plants and peat) and the machines that will be deployed explain the rationale for these international agreements and their applicability to the project.
Kyoto Protocol signed on 11 December 1997.	
The destruction of carbon sinks through deforestation and the production of GHGs through the decomposition of organic matter (plants and peat) and the machines that will be deployed	The destruction of carbon sinks by deforestation and the production of GHGs by the decomposition of organic matter (plants and peat) and the machines that will be deployed explain the rationale for these international agreements and their applicability to the project.

Conventions, treaties and agreements	Justification of the applicability of the Project
explain the rationale for these international agreements and their applicability to the project.	
Stockholm Convention on Persistent Organic Pollutants	
Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol on Substances that Deplete the Ozone Layer.	Motor boat traffic on the water will cause air pollution by CO emissions from engine exhaust gases.
Convention on the Elimination of All Forms of Discrimination against Women (CEDAW), 18 December 1979.	Women are a very important link in fishing and aquaculture activities. It is important to ensure from the outset of this project that women will not be discriminated against.
ILO (International Labour Organization) | Discrimination (Employment and Occupation) Convention, 1958 (No. 111).	During all phases of the project, any distinction, exclusion or preference based on race, colour, sex, religion, political opinion, national or social origin, which has the effect of nullifying or impairing equality of opportunity or treatment in employment or occupation, shall be prohibited. If forms of discrimination are discovered during the phases of the project, this law will be applied.
ILO (International Labour Organization) | Worst Forms of Child Labour Convention, 1999 (182).	During all phases of the project, the recruitment of labour/workers for this project must not include children. In this case, it is important to take into account the limits of this agreement.
ILO (International Labour Organization) | Minimum Age Convention, 1973 (No. 138).	The minimum age must not be lower than the age of completion of compulsory schooling and in no case lower than 15 years. In the case of a member whose economy and educational facilities are insufficiently developed, it may, after consultation with the employers' and workers' organizations concerned, where appropriate, set a minimum age of 14 years on a provisional basis. If any forms of child labour are discovered during the project phases, this law will be enforced.
ILO (International Labour Organization) | Forced Labour Convention, 1930 (No. 29)	Work on this project must not include forced labour. Companies selected for construction work must have a labour policy that complies with ILO standards. During the operational phase, no child labour or forced labour will be accepted and, in the event of such a case, a legal sanction will be applied.
ILO (International Labour Organization) | Abolition of Forced Labour Convention, 1957 (No. 105).	
ILO (International Labour Organization) | Convention concerning Social Policy (Basic Objectives and Standards), 22 June 1962.	The Convention establishes the general principle that all policies should be directed primarily at the well-being and development of the population and at the promotion of its desire for social progress.
Convention on the Elimination of All Forms of Discrimination against Women, 18 December 1979	International Declaration of the Rights of Women. It consists of six sections and 30 articles aimed at ending all forms of discrimination against women in the political, social, economic and cultural spheres.

1.3.2.4 The World Bank's Environmental and Social Standards

Given the nature of the planned investments, certain World Bank Environmental and Social Standards (ESS) are selected to apply to the project in order to prevent and mitigate the negative impacts that could result

from the implementation of the project on the environment and the population.

- The applicable Environmental and Social Standards (ESS) of the World Bank's Environmental and Social Framework (ESF)1, as identified by the Bank, are:
  - ESS1: Assessment and management of environmental and social risks and impacts
  - ESS2: Work and Working Conditions
  - ESS3: Resource Efficiency and Pollution Prevention and Management
  - ESS4: Community Health and Safety
  - ESN5: Land acquisition, land use restrictions and involuntary resettlement
  - NES6: Conservation of biodiversity and sustainable management of living natural resources
  - NES8: Cultural Heritage
  - ESN10: Stakeholder Engagement and Information Disclosure

A description of the WB SEN related to the Project is provided in Appendix A10.

1.4 Purpose and Structure of the Report

This report is the final report of the environmental and social review. The objective of this report is to provide information on the environmental and social impacts of the Lake Nokoué Transport Project (ARNP) and its interfaces with the SUNC-GN. It is important to note that the ARNP plan and its associated Strategic Environmental and Social Assessment (SESA), which were approved by the Government of Benin, covered more infrastructure and dredging elements on Lake Nokoué than is now proposed to be included in the SUMP-GN.

The current environmental and social review will focus on lake transport within the boundaries defined in the SUNDP-GN, from Abomey-Calavi to Porto-Novo, via Cotonou-Vossa. The evaluation will be carried out against the ESC.

This document is structured as follows:

- Chapter 1 Introduction
- Chapter 2 Project Description
- Chapter 3 Description of the baseline situation based on available information
- Chapter 4 Identification and assessment of potential risks and impacts
- Chapter 5 Risk Mitigation Measures and Potential Impacts
- Chapter 6 Register of Public Participation in the Preparation of the EESS

1.5 Assumptions and Limitations

The conclusions and recommendations of this report are based on the information provided during the EESS process by the World Bank, as well as relevant data from Royal HaskoningDHV's previous work on the ARNP project. The conclusions and recommendations made here include the application of scientific principles and professional judgments to certain facts, with

[1] *The WB (Indigenous Peoples/Traditional Traditional Local Communities of Sub-Saharan Africa) and the WB (Financial Intermediaries) NES7 are not covered in this report.*

resulting subjective interpretations. The professional judgments expressed are based on experience as well as facts currently available within the limits of existing data, scope of work, budget and schedule.

The report cannot, and does not purporte, anticipate all changes in these conditions and circumstances that occur after the date of issuance of the documentation provided. To the extent that the client desires more definitive conclusions and recommendations than those that are justified by the facts currently available, it is specifically our intention that those set out here be considered as guidelines and not necessarily as a firm course of action, unless explicitly stated otherwise. We cannot rule out the possibility that information made available after the completion of this report and/or more detailed investigations may reveal information that may change the conclusions of this report. Royal HaskoningDHV cannot be held responsible for any errors or omissions that may be identified as a result of further research into imminent information.

2 Project Description

2.1 Project Context

The Beninese government is developing the Nokoué Sustainable Urban Mobility Project (MUDP-GN) with the support of the World Bank. It is composed of four components of which the improvement of urban mobility conditions in Greater Nokoué is of paramount importance.

Component 3 of the SUMP-GN focuses on improving urban mobility conditions. Part of this component will develop **climate-resilient and inclusive public transport infrastructure,** including: (i) multimodal road/road infrastructure and equipment to support public transport operations (dedicated bus lanes, stations/shelters, bus stations, depots and well-lit integration zones); and (ii) passenger transport infrastructure on Lake Nokoué and associated facilities (docks, , jetties, stations, access roads). This sub-component is the intersection between the World Bank's SUNP-GN and the "Development and Rehabilitation of Lake Nokoué and the Porto-Novo Lagoon" (ARNP) of the Dutch Cooperation (Invest International). In particular, it will provide public transport services on Lake Nokoué and the Porto-Novo lagoon, through sections of canals from Cotonou to Porto-Novo and from Cotonou to Abomey-Calavi, including with modern ports in Cotonou, Porto-Novo and Abomey-Calavi. SUMP-GN investments depend on the implementation of prior actions by the ARNP and the two investments are therefore considered to be associated[2].

The ARNP aims to provide solutions to the major problems related to the water bodies of Greater Nokoué, such as sedimentation and deterioration of water quality, banks, shoals, ecosystem, fish production, river transport conditions, etc. All this in a context of growing demographic pressure in the most urbanized area of the country. In addition, the impact of climate change could lead to sea level rise and more extreme flooding from the upstream basin, increasing the risk of flooding in the deltaic zone.

The rapid urbanization of Benin's coastal region has put considerable pressure on the existing road network, which is insufficient to meet the growing demand. The lack of public transport options has led to a heavy reliance on motorcycle taxis, an environmentally detrimental solution[3].

[2] *The World Bank's Environmental and Social Policy defines "associated facilities" as "facilities or activities that are not financed under the project and that, in the Bank's opinion, are: (a) directly and significantly related to the project; and (b) carried out, or planned to be carried out, concurrently with the project; and (c) necessary for the viability of the project and would not have been constructed, expanded or carried out if the project did not exist."*

[3] *Mobility and sustainable accessibility policy in Beninese cities. Final report. SSATP - Benin, March 2020.*

Figure 2-1 Overview map of Greater Nokoué, Benin (World Bank documentation, Project Information Document (PID), 22 June 2023)

2.2 Components of the ARNP Project

The ARNP project has three phases: the first phase focused on diagnosing the current situation and changing trends; the second phase defined a Vision and Action Plan comprising three areas of action and measures at a pre-feasibility level. These have been developed on the basis of the diagnosis of the current situation and the consultations and public participation undertaken since the beginning of the project. The third phase will involve the launch of a tender for the implementation of a priority project funded by the Netherlands and Benin.

The process of developing the Action Plan is led by the MCVT through ADELAC and the ARNP Steering Committee. During phase 1 of the ARNP project, five areas of action for the development and rehabilitation of the water bodies of Greater Nokoué were presented:

1. Development of river-lake transport.
2. Development of the shores of lakes and lagoons.
3. Modernization of fishing and development of fish farming.
4. Protection of ecosystems and development of tourism.
5. Development of the Cotonou channel to improve the circulation of water in Lake Nokoué.

During Phase 2 of the ARNP project, three areas of action composing the Action Plan were discussed and selected. On 3 May 2022, the ARNP Steering Committee agreed that the study should develop an Action Plan based on the first four areas, combining areas 3 and 4 as follows:

- **Domain n°1.** Development of river-lake transport.
- **Domain n°2.** Development of banks and shoals.
- **Domain n°3.** Promotion of fish production, ecology and tourism.

Only Action Area 1 and part of Action Area 3 of the ARNP are relevant to the lake transport component of the SUNMP-GN and are presented in this report.

Action area 1
Action area 1 concerns a set of measures aimed at providing a solution to the current limitations of river transport, considered one of the main challenges of Greater Nokoué. The waterways on the lake and lagoon connect production and sales centers, residential areas, and the workforce domestically and internationally. However, in the context of this mission, only national connections are taken into account. The objective is therefore to develop and modernize river and lake transport in Greater Nokoué to facilitate the transport of people and goods, which will contribute to the socio-economic development of the metropolitan area.

Transporting passengers by ferry will reduce travel times and traffic jams on the roads, especially during rush hour. There are many examples around the world where passenger transport on water is a viable solution offering an alternative to land transport. The system of Lake Nokoué and the lagoon of Porto-Novo provides a suitable base for this purpose. Port facilities are needed as well as navigation channels of sufficient depth.

The main constraints affecting river-lake transport are the following:

- The poor state of port facilities: lack of services and limited hinterland connectivity.
- Insufficient depth for the high-capacity waterways in the lake and lagoon, which are filled in by siltation, the invasion of water hyacinth and the numerous acadjas.
- Vertical guard at bridges, including the old bridge and the current Porto Novo bridge.

Action area 3
Action area n°3 aims to restore the productive function of Lake Nokoué and the Porto-Novo lagoon and their ecological value (RAMSAR site). It focuses on:

- The protection and enhancement of existing ecosystems.
- Strengthening their ecosystem services, such as fisheries (with shrimp as an example) and aquaculture, as well as tourism, flood protection and a pleasant living environment.

In the framework of action area n°3, only the construction of artificial islands on Lake Nokoué is relevant for the SUMP-GN and is presented in this report.

2.2.1 Creation, Rehabilitation and Improvement of Lake Harbours

The ARNP Action Plan provides for the creation, rehabilitation and improvement of three (3) lake ports to facilitate the movement of people and goods. These lake ports are located in Porto-Novo, Cotonou (Vossa) and Abomey-Calavi.

Lake ports must be able to accommodate relatively large vessels and facilitate efficient and rapid loading and unloading. In addition, they must have space for related activities such as passenger waiting rooms, fishing-related storage and marketing activities, the transfer of goods to land transport (and vice versa) or to

and from neighbouring markets, and processing industries.

During Phase 2 of the ARNP, various port location alternatives were evaluated and preferred alternatives were selected. The final design of the lake harbours will be decided during Phase 3 of the ARNP, but preliminary sketches of the harbour design are available. In this report, the identification and assessment of potential environmental and social impacts will be limited to selected lake harbour locations and will not extend to sketches of designed harbours.

The construction of lake ports will require backfilling. The dredging sediments of Lake Nokoué include a fraction of sand, part of which will be used to fill in the ports of Abomey-Calavi, Cotonou (Vossa) and Port-Novo. Detailed information on the location of the Lake Nokoué sand deposits is provided in Appendix A3.

2.2.1.1 Abomey-Calavi Lake Port

The proposed location for the Abomey-Calavi lake port, located at the geographical coordinates 6°26'51.10"N, 2°21'38.32"E, is the only alternative port location considered for Abomey-Calavi and was selected during phase 2 of the ARNP. The selected location includes an existing port, including a fish market and a tourist center. The current wharf serves as a facility for local fishermen and a starting point for Ganvié residents and tourists. The project provides for the rehabilitation and extension of the existing port infrastructure. The lake port will accommodate passenger transport, freight transport and fishing activities. In addition, Benin is currently building, with other funding, a small extension of the current port to facilitate the transport of citizens and tourists to the city of Ganvié. Any new extension of the port will have to take this specific investment into account.

Figure 2-2 Location of the selected port of Abomey-Calavi and port design sketch (Google Earth and Royal HaskoningDHV database, 2023)

2.2.1.2 Lake Port of Cotonou (Vossa)

The proposed location for the lake port of Cotonou (Vossa) is located at the geographical coordinates 6°23'22.86"N, 2°25'19.55"E. At this location, located west of the Cotonou Channel on the shore of Lake Nokoué, the lakeshore forms a curve that penetrates inland, making it an interesting location for backfilling. In addition, the neighborhood is relatively well served by Route 888, which can be extended to this area. This location was selected from three alternatives considered during Phase 2 of the ARNP. The first alternative location, located at 6°23'21.15"N, 2°25'16.33"E, was deemed inappropriate due to the presence of existing stands, requiring significant resettlement efforts. The second alternative location, adjacent to the Cotonou Channel near Dantokpa, was also ruled out. This location lacked sufficient space for adequate port infrastructure and would have required ships to navigate through the canal, which has limited accessibility due to insufficient road connectivity. The lake port of Cotonou (Vossa) will accommodate the transport of passengers and goods.

Figure 2-3 Location of the port of Cotonou (Vossa) selected and port design sketch (Google Earth and Royal HaskoningDHV database, 2023)

2.2.1.3 Port Lacustre de Porto-Novo

The proposed location for the lake port of Porto-Novo is located at the geographical coordinates 6°28'0.56"N, 2°37'23.59"E. This location was selected from two alternatives considered during Phase 2 of the ARNP. The rejected alternative, located west of the RNIE1, was deemed inappropriate due to the steep slope of the site and the bank, which would have made the land connection difficult and expensive. In addition, the space available for port development is very limited.

The selected location, east of the RNIE1, provides a more favourable site for development. In addition, there is currently no activity in this area, which means that the movement of people and activities is relatively low compared to other places. However, the existing Porto-Novo bridge, with its limited air draft, is a major challenge. To remedy this, a new deck with a higher air draft is required. The Beninese government has included the construction of this new bridge in its plans, in parallel with the ongoing road construction to Porto-Novo. Information gathered from "Porteo BTP", the road works contractor, indicates that the new bridge being designed will have an air draft of about 8 m, which would be significantly higher than the current air draft.

The lakeside port will accommodate both passenger and freight transport.

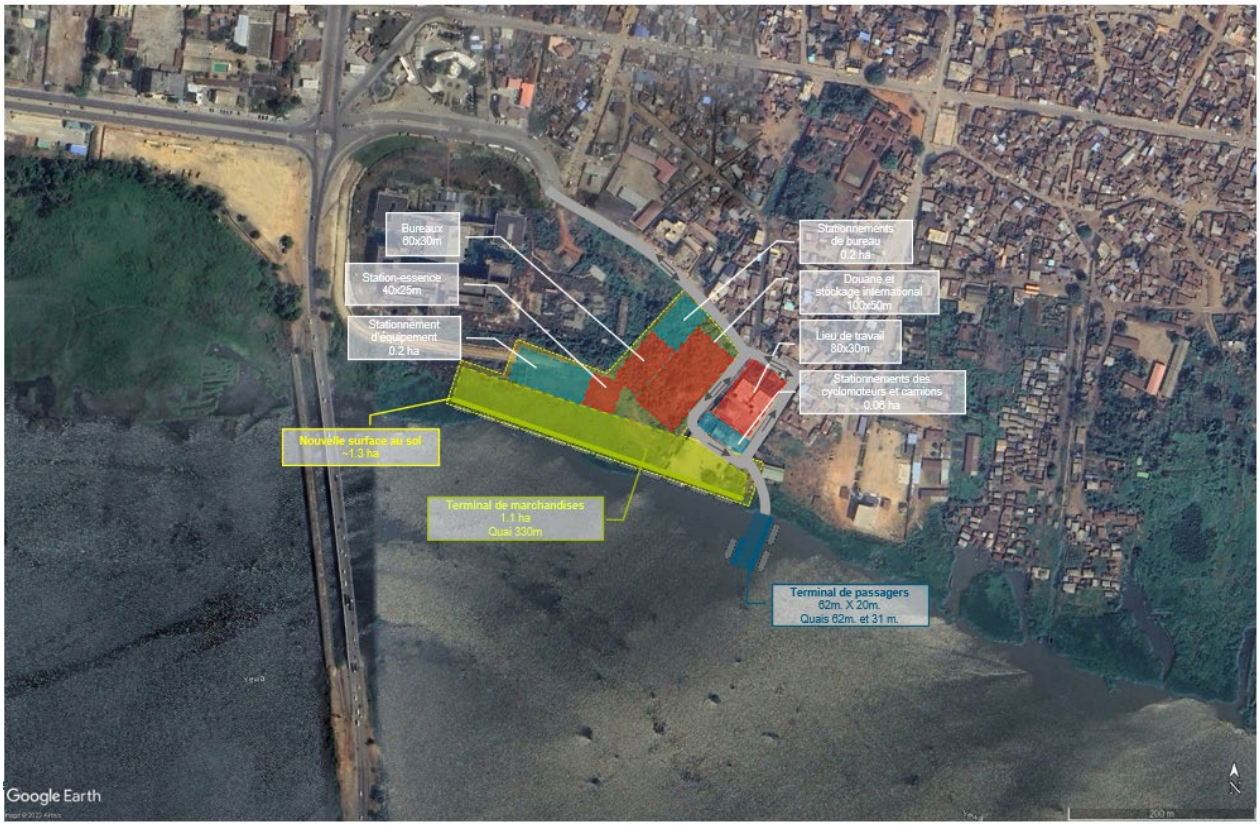

Figure 2-4 Location of the Port of Porto-Novo selected and port design sketch (Google Earth and Royal HaskoningDHV database, 2023)

2.2.2 Connecting Lake Ports to the Hinterland

To integrate the three (3) lake ports into the SUMP-GN plans, specific road sections have been identified as interfaces between the ARNP and SUMP-GN projects. These sections are based on the assumptions of Royal HaskoningDHV, as the PSUM-GN has not yet predefined an interface. The most likely road sections are shown below.

To ensure seamless integration between the two projects, these road sections will need to be constructed, upgraded or extended and include the following:

- Bus stops.
- Power stations for buses and motorcycles.
- Parking for motorbikes and buses.
- Access for small trucks.
- Development of road links with main roads.
- Pedestrian crossings.
- Lighting and signage.
- Wastewater treatment.

2.2.2.1 Lake Port of Abomey-Calavi

The road section identified as the interface between the Abomey-Calavi lake port of the ARNP and the RNIE2 of the MUDP-GN is highlighted in red in Figure 2-5. It is anticipated that the existing unnamed section of road will need to be significantly upgraded and widened to accommodate public transport between the RNIE2 and the lake port. An efficient return point must also be added to the infrastructure.

Figure 2-5 Location of the selected port of Abomey-Calavi and road upgrade requirements (Google Earth, 2024)

2.2.2.2 Lake Port of Cotonou (Vossa)

The road sections identified as interfaces between the Cotonou (Vossa) lake port of the ARNP and the RNIE1 of the SUMP-GN are highlighted in red in Figure 2-6. It is anticipated that existing road sections, including Highways 150 and 888, and the unnamed roundabout, will need to be upgraded to accommodate public transport between the RNIE1 and the lake port.

Figure 2-6 Location of the port of Cotonou (Vossa) selected and road upgrade requirements (Google Earth, 2024)

2.2.2.3 Port Lacustre de Porto-Novo

The section of road identified as the interface between the port of Porto-Novo of the ARNP and the RNIE1 of the MUDP-GN is highlighted in red in Figure 2-6. It is anticipated that the existing unnamed section of road will need to be upgraded and extended to accommodate public transport between the RNIE1 and the lake port.

Figure 2-7 Location of the Port of Porto-Novo selected and road upgrade requirements (Google Earth, 2024)

2.2.3 Dredging of Shipping Channels

Navigation on the lake and lagoon is severely hampered by obstacles in the waterways between the ports. Shallow depths, water hyacinth and acadjas (see Section 3.3.1.4) are the main barriers. To facilitate inland waterway transport, these obstacles must be eliminated or bypassed. Dredging and cleaning are the first steps. The interests of the acadja owners who need alternative livelihoods should be taken into account. Subsequent maintenance is also complex because water hyacinth is difficult to contain and sedimentation of shipping channels is likely to recur. The principles for dredging waterways are illustrated in Figure 2-8.

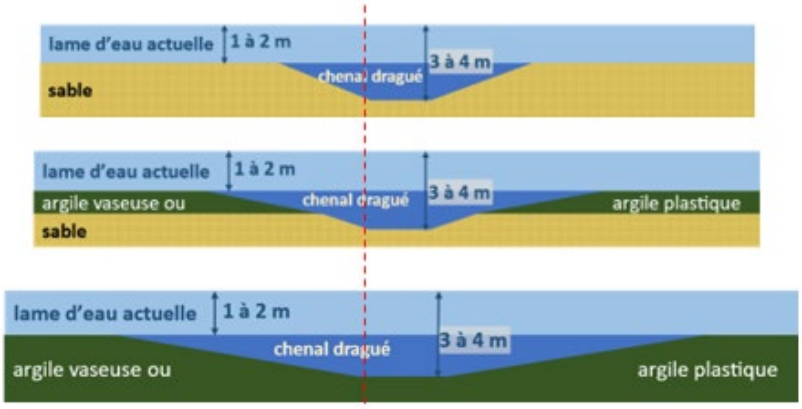

Figure 2-8 Dredged Channel Design Principles. The horizontal and vertical scales are not the same (Action Plan and Initial Investment Proposals, ARNP, January 2023)

The exact location of the waterways will be determined during Phase 3 of the ARNP project. This report is based on the estimation of potential waterways that should be selected. It should be noted that the information presented in this report may become obsolete if other waterways are chosen during Phase 3 of the ARNP project. Figure 2-9 shows the proposed waterways, highlighted in green.

Figure 9 Proposed waterways on Lake Nokoué and Porto-Novo Lagoon, highlighted in green, that are expected to be selected in Phase 3 of the ARNP (Strategic Environmental and Social Assessment, ARNP Project, Royal HaskoningDHV, June 25, 2024)

The bottom width of the proposed channel is 80 metres with a minimum depth of 3 metres. An additional depth of up to 4 metres would accommodate natural sedimentation. Maintenance dredging would be required every 2-3 years, essentially involving continuous dredging that regularly crosses each section.

The stability of the slopes of the submarine channel depends on the strength of the sand or clay. The first studies (July/August 2022[4]) revealed mainly plastic clay and muddy clay. These types of sediments require gentle slopes, gentler than 1:6 to 1:8. The disadvantage is that more unusable material has to be dredged and stored elsewhere. A channel dug in sandy materials would be preferable.

The estimated length of the waterways shown in Figure 2-9 is nearly 35 km. A rough estimate of the volume of sediment to be dredged to create a navigation channel with a depth of
3 to 4 meters and 80 meters wide, linking Porto Novo, Cotonou and Abomey-Calavi, is 9 to 10 million m³, or about 250,000 m3 to be dredged per km. This estimate depends on the technical specifications, in particular whether the dredging is carried out in more stable sediments (sand) or in less stable sediments (muddy clay) as described above.

2.2.3.1 Maintenance Dredging

The waterways will require regular maintenance because the dynamics of Lake Nokoué lead to regular silting. The frequency of maintenance will depend on morphology, sedimentation rates and sediment flows from upstream rivers and can be complex.

[4] *Mission report of manual surveys by retaining casing and lithological description of sediments on lakes Toho, Porto-Novo, Nokoué and the Djonou bridge sector. National Water Institute, Produced by LSTEE and LEMEA in partnership with the Beninese Office for Geological and Mining Research (OBRGM); July/August 2022*

2.2.4 Reuse of Sediments in the Creation of Artificial Islands for Ecological Purposes

The creation of artificial islands can be a solution to reuse dredged sediments such as clay and mud. This is important because of the dredged material, only 34% (sand) can be used in construction or road infrastructure and the remaining 63% (clay and mud) need other destinations (such as islands). The removal of large quantities of sediment (action area 1) can be a challenge, especially when it is polluted or if the particle size distribution does not allow for direct reuse. But, as mentioned in paragraph 2.2.3, sediments can be reused without harming the environment. The creation of an artificial island can be a solution to reuse the dredged sediments. Various techniques can be applied to do this, but an example could be to create an outer shoreline with sediment-filled geotubes and use the area inside these tubes as a sediment disposal site. Since sediments are reused in their original environment, the quality of the sediments is likely to be the same as that of sediments already present and, therefore, negative ecological impacts are less. Once an island is completed, it can be colonized by nature, for example, as a bird island.

Of the potential group of small artificial islands, only two locations are relevant to the SUMP-GN and will be examined in more detail in this report. The precise location of the lake's artificial islands has not yet been determined and will be finalized during Phase 3 of the ARNP. Based on the current ARNP documentation, it is assumed that the two groups of artificial islands will be located on the east and west sides of Lake Nokoué. In addition, it is estimated that the total eastern artificial islands will have a diameter of 400 meters, while the total western artificial islands will have a diameter of 800 meters. The assessment of potential environmental and social impacts and risks in this report is based on these assumptions.

2.2.5 Zone d'Influence

The project's area of influence is located in the deltaic region of the Ouémé and Sô rivers and mainly covers the communes of Cotonou, Abomey-Calavi, Sèmè-Kpodji, Porto-Novo. It is served by Lake Nokoué (150 km²), the Porto-Novo lagoon (35 km²) and the Cotonou channel.

3 Description of the Baseline Based on Available Information

Information on the physical baseline comes from the Strategic Environmental and Social Assessment (SESA), carried out in 2022 for the ARNP, scientific websites and the Royal HaskoningDHV database.

3.1 Physical Reference Situation

Benin's coastal zone does not end at the country's borders: the coastal system is a continuum that spans several countries. Overall, the coastal zone is characterized by a deep ocean, a strong coastal current moving from west to east and carrying sand, with a succession of sandy beaches that are either heavily accreted or eroded depending on the location of river mouths, harbors, and groynes. Further inland, there is an alternation of strips of

land, mangroves, wetlands, lagoons and lakes, which can be connected to the ocean.

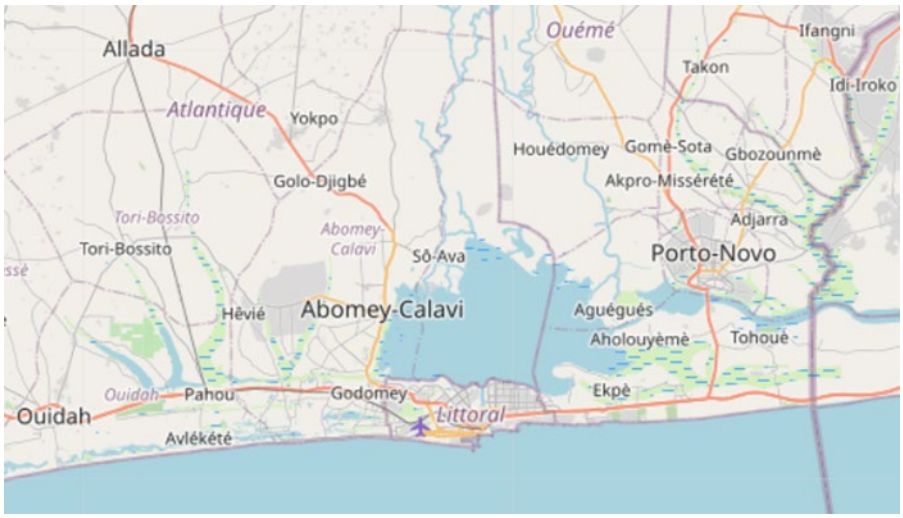

Figure 3-1 Benin's Coastal Lagoon in West Africa (Action Plan and Initial Investment Proposals, ARNP Phase 2 Report, January 2023)

3.1.1.1 Geological Context

The coastal zone includes the coastal plain and the southern plateau region. The coastal plain has three generations of sandy dune ridges, current or inherited from the recent Quaternary marine oscillations. These are the internal yellow sand cords, the grey sand midrange and the current and sub-current grey-brown sand cords. The southern plateau region corresponds to three individual lateritic ferruginous plateaus, formed by erosion and tectonic activity. These are the plateaus of Sakété, Allada and Comè. This region is bounded to the north by a central WSW-ENE trending depression, known as the Lama Depression. Offshore, the Beninese continental shelf covers an area of about 2800 km² between the 10 and 100 meter isobaths. Trapezoidal in shape, it is about 125 km long. Its width varies between 22 and 24 km in the west to Ouidah and reaches about 32 km at the Benin-Nigeria border in the east.

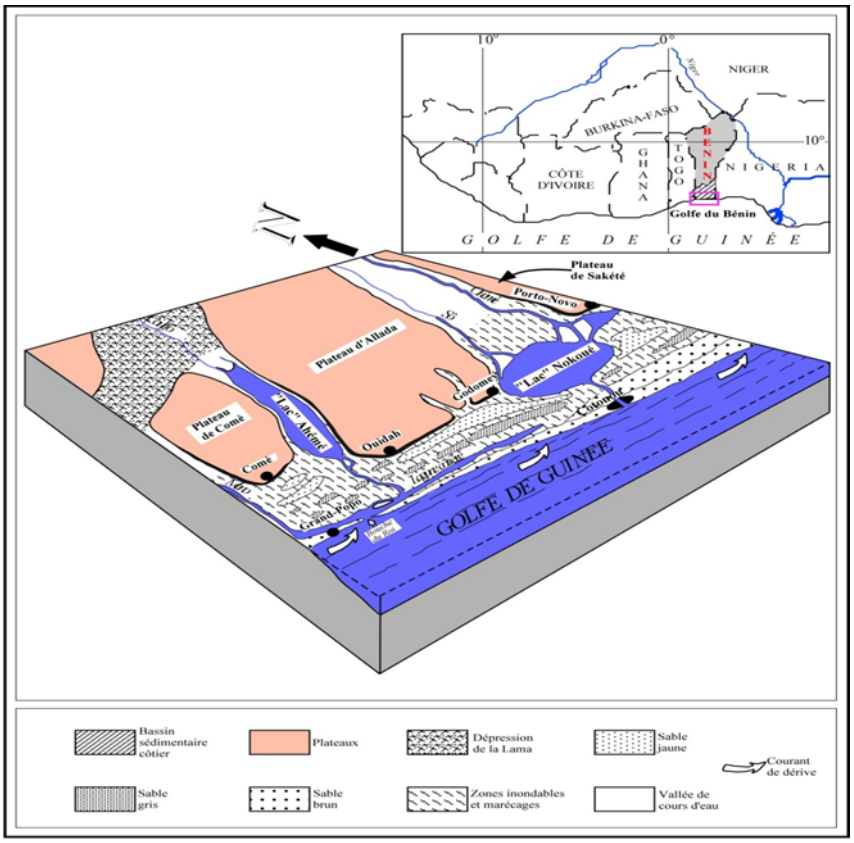

Figure 3-2 Sedimentary basin (Etat des lieux du delta de l'Ouémé, University of Abomey-Calavi, National Institut of Water, October 2019)

3.1.1.2 Groundwater resource

The south of Benin is part of the Coastal Sedimentary Basin (BSC), composed of alternating layers of more or less sandy or clayey layers, and gravel, pebbles or sandstones dating from the Cretaceous to the Quaternary. The BSC covers 10% of Benin's land area, but its groundwater resources, estimated at 600 million cubic meters, account for one-third of the country's total groundwater resources. The shallow aquifer, which can have high nitrate levels and questionable bacteriological quality, is generally unfit for consumption but is still used by the population, posing significant health risks (cholera).

With an average recharge of the Mio-Pliocene aquifer in the Allada and Sakété plateaus estimated at 160 million cubic metres per year, the projected drinking water needs are covered until 2030-2035 under average conditions. If we consider all the projected needs (drinking water, agriculture and industry), the balance is reached before 2030.

3.1.1.3 Climate

Rainfall

The climate of the coastal zone of Benin is essentially sub-humid, influenced mainly by the Atlantic Ocean. It is characterized by an annual alternation of four distinct seasons of unequal duration:

- A long rainy season: It runs from April to July and begins with thunderstorms and humid winds blowing from the southwest. The humidity is very high during this season.
- A short dry season: It occurs mainly in August. Humidity remains high during this season.

- A short rainy season: It follows the reduction of winds south of the eighth parallel and the weakening of Beninese currents between September and November. Humidity remains high.
- A long dry season: It lasts from December to March and is characterized by breezes and the Harmattan wind originating from the Libyan anticyclone. The wind is light and the humidity is relatively low.

Rainfall follows a regular decreasing gradient from west to east (1500 mm/year in Sèmè, 1300 mm/year in Cotonou, 1100 mm/year in Ouidah and 900 mm/year in Grand-Popo). In addition, the Benin-Togo coast is abnormally dry (800-1500 mm/year), which explains the absence of dense forests at these latitudes, unlike Côte d'Ivoire and Nigeria located at the same latitudes (Dahomey hole) **Error! Bookmark not defined..**

Temperature

Although they depend on the duration of sunshine and the maritime influence, the thermal variations in the coastal zone remain small; the annual average is about 27°C. The pattern of the average annual temperatures observed during the period 1961-2010 does not show a clear upward or downward trend, even if the observations show deviations of the order of -0.6°C to +0.8°C. Evapotranspiration ranges from 3.33 mm/day in July to 5.33 mm/day in February, with an annual average of 4.24 mm/day. The total annual sunshine is about 1,700 hoursError! **Bookmark not defined..**

Winds

The winds that blow along the Beninese coast are mainly from the southwest. These winds define two seasons according to their direction and speed: a high wind season during which wind speeds are quite high (with average minimums around 3.6 m/s in May and average maximums close to 5.12 m/s in August) and a light wind season during which wind speeds are lower (with average minimums: 3.15 m/s in December; average maximums: 4.55 m/s in March)Error! **Bookmark not defined..**

3.1.1.4 Climate Change

Climate change has manifested itself in an increase in the average annual temperature of 1°C over the last 60-70 years in the delta.

A decrease in rainfall of about 10% over the last 60 years has been observed throughout Benin, including in the Ouémé basin, with the exception of the coastal area (Cotonou station) which has seen an increase of about 7%. These variations are coupled with an increase in the frequency of extreme precipitation events related to climate change.

According to the Intergovernmental Panel on Climate Change (IPCC), sea levels are expected to rise significantly during the 21st century. By 2050, a sea level rise of about 30 centimetres is anticipated. Between 2070 and 2100, this rise could accelerate to between 50 and 80 centimetres. These projections pose a significant threat to Benin's coastal regions, particularly the urban areas surrounding Lake Nokoué, increasing the risk of coastal flooding.

3.1.1.5 Ocean and Beaches

It is in the middle of the ocean that the winds and waves develop which, from time to time, threaten the coast. The Beninese coast is particularly affected by the southwest swell in the form of long waves of 10 to 15 seconds, and extreme waves of duration of up to 18 seconds. The typical height of the swell is between 1 and 2 meters. With a return period of 10 to 20 years, regional storms occur with winds of about 18 m/s and waves reaching 21/2 meters and a period of 5 to 10 seconds. Benin's Early Warning System issues storm warnings, especially between June and August. The tide has an amplitude of 60 cm.

The prevailing swell from the southwest creates a current along the West African coast that carries sandy sediments from beaches and rivers that dump their waters and sediments into the ocean. In a state of equilibrium, this current supplies the beaches that remain more or less stable. In reality, human interventions disturb the flow of sediments.

Tides

The tides along the Beninese coast are semi-diurnal, which means that there are two high tides and two low tides each day. Table 3-1 summarizes the tidal conditions along the coast, based on the British Admiralty tide tables.-

Table 3-1 Water level statistics measured in Cotonou (State of play of the Ouémé delta, University of Abomey-Calavi, National Institute of Water, October 2019)

Description	Value (m ZH)
Mean High Spring Tides	+1.6
Mean High Neap Tides	+1.0
Mean Sea Level	+0.75
Mean Low Neap Tides	+0.4
Mean Low Spring Tides	-0.2

3.1.1.6 Lake Nokoué

Lake Nokoué is a shallow, eutrophic coastal lake located in the south of the Republic of Benin. It covers about 150 km² at low water and is 20 km long (east-west) and 11 km wide (north-south)[5].

In 1885, by opening an artificial channel between Lake Nokoué and the Atlantic coast through the coastal sandbar, man introduced a new element into the natural balance of the coastal system of southern Benin. The resulting imbalance immediately led to significant impacts on the environment and its exploitation by indigenous fishers. Nevertheless, a new equilibrium has gradually been established. This new balance was soon to be disturbed, however, by the construction in the late 1950s of a deep-water port in Cotonou, the existence of which completely changed the characteristics of the coastal current. The direct and indirect effects were so severe that in 1978 the authorities ordered the construction of a control dam near the mouth of the channel, the purpose of which was to control the

[5] *Djihouessi, Metogbe Belfrid, Mahougnon Bernauld Djihouessi, and Martin P. Aina. "A review of habitat and biodiversity research in Lake Nokoué, Benin Republic: Current state of knowledge and prospects for further research." Ecohydrology & Hydrobiology 19.1 (2019): 131-145.*

The dam was a major problem with the ingress of salt water into Lake Nokoué; but this dam immediately led to further unexpected disturbances, and its completion proved useless. The current situation, which is still unstable, is satisfactory for the fishermen of Lake Nokoué. However, it has very negative aspects for the development of Cotonou, a city where thousands of urban inhabitants are now victims of floods every year, sometimes of disastrous proportions due to their extent and duration, and which, in addition, threaten the health of the affected people as well as their homes6.

Water depths

In Lake Nokoué, the average and maximum depths are 1.3 m and 2.9 m respectively during periods of low water (dry season). Lake Nokoué deepens towards the Cotonou channel where the average and maximum bathymetries reach values of about 3 m and about 7 m[respectively 7].

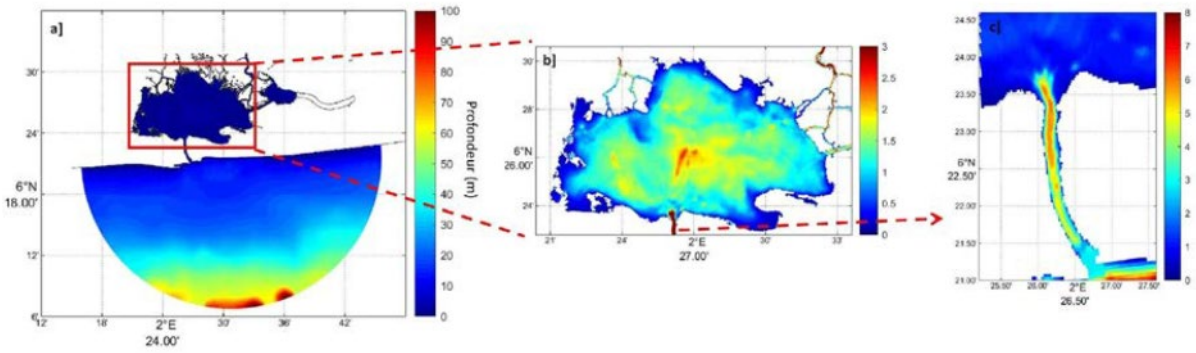

Figure 3-3 Water depths of Lake Nokoué and the Cotonou Channel (Hydrodynamic study of Lake Nokoué, IRHOB/ Institut de Recherche pour le Développement, December 2022)

River flows to Lake Nokoué

Total river flows to the lake range from a few m3/s during low water periods (January to May) to about 1200 m3/s during the 2018 flood. During the flood period, the Ouémé River had a flow of 800 m3/s and the Sô River 400 m3/s. The Djunou River, which flows into Lake Nokoué in its southwestern part, has flows consistently below 5 m3/s[7].

[6] *Vennetier Pierre. Coastal development and evolution of a lagoon system: a case study in Benin. In: Cahiers d'outre-mer. N° 176 - 44th year, October-December 1991. pp. 321-332.*

[7] *IRHOB, Institute of Research for Development. DELIVERABLE 1. "Report on the baseline hydrodynamic functioning of Lake Nokoué and its related systems" December 2022.*

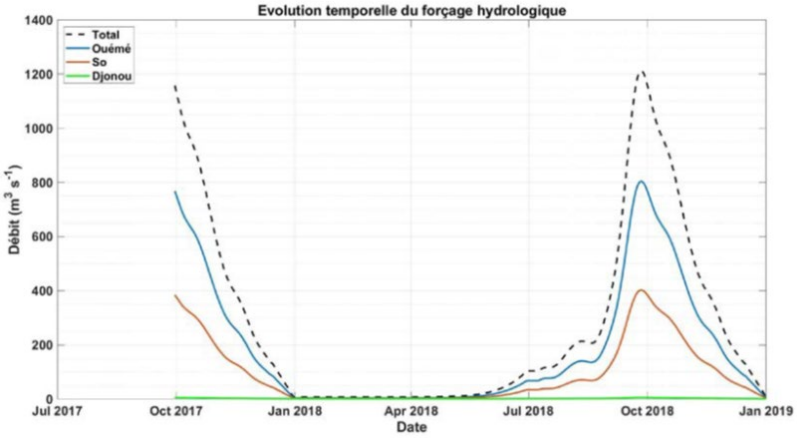

Figure 3-4 River flows to Lake Nokoué (Hydrodynamic study of Lake Nokoué, IRHOB/ Institut de Recherche pour le Développement, December 2022)

During the rainy season, water flows to Lake Nokoué can be up to fifty times higher than those observed during the dry season. This substantial increase in inflows, coupled with a decrease in outflows, leads to a rise in the water level of the lake8. Water flows during the rainy and dry seasons are presented in Annex A4.

Water level

Normally, between February and December, the water level of Lake Nokoué fluctuates between about 0.4 m during the low-water period and about 1.4 m during the high-water period. A graphical representation of these data is provided in Appendix A5.

Water circulation

Outside the rainy season, water circulation patterns are generally uniform throughout the lake, with minimal differences in flow between the surface and bottom layers. However, after the onset of the rainy season, the velocity of the surface water layers increases significantly compared to the lower layers. This leads to currents directed towards the ocean channel and the channel leading to Porto-Novo, Nigeria8. A graphical representation of these data is provided in Appendix A6.

Sedimentation Process

The sedimentation rate in the water bodies of Greater Nokoué is very high. Historical bathymetric data from Lake Nokoué show an average sedimentation of 2 to 3 cm/year over the last 40 years. This sedimentation leads to a reduction in water storage capacity, which affects the self-purification capacity of water bodies and aquatic productivity: a shallow depth reduces water quality, affects fishing and limits river transport.

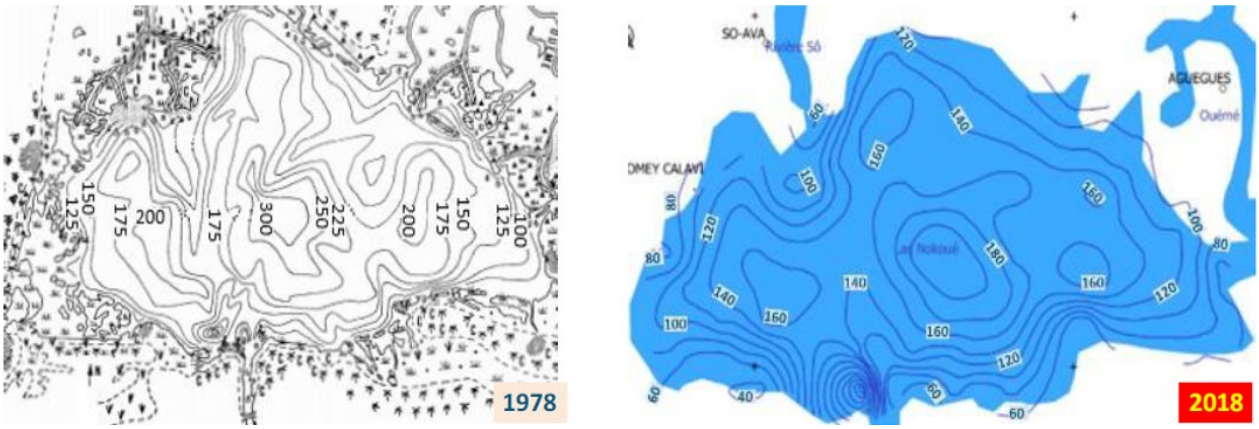

Figure 3-5 Sedimentation of Lake Nokoué water bodies between 1978 and 2018 (Strategic Environmental and Social Assessment, ARNP Project, Royal HaskoningDHV, June 25, 2024)

Sediment quality

In January 2023, as part of an Environmental Impact Assessment for the ARNP project, research on the quality of the lake's sediments was carried out on behalf of the World Bank. Based on the information retrieved, the following conclusions were drawn:

- Only the heavy metals Cadmium [Cd], Cobalt [Co], Copper [Cu], Lead [Pb], Manganese [Mn], Zinc [Zn] and Iron [Fe] are analyzed.
- It is unclear which layers are being analyzed and whether samples are combined in the laboratory prior to testing. As a result, it is not clear in which layers (clay, sandy clay, etc.) the high concentration values are measured. The extent of the contamination cannot be determined.

- On the basis of Dutch standards, the values of heavy metals do not exceed the intervention values. These are environmental standards used in the Netherlands to determine whether soil and groundwater contamination is severe enough to require remediation. These values are set for a variety of contaminants and indicate the concentration levels at which there is a significant risk to human health and the environment.

- Cadmium levels exceed Canadian standards and the TEC value. This indicates that the concentrations may have adverse effects on aquatic life.
- Additional investigations on other parameters:
    - Polycyclic aromatic hydrocarbons (PAHs): Contamination from industrial processes, vehicle emissions, waste disposal, and agricultural practices. May have significant adverse effects on ecosystems and human health.
    - Total petroleum hydrocarbons (TPH): Contamination from petroleum-based products (gasoline, lubricants). May have significant adverse effects on ecosystems and human health.

    - Commercial PCBs (Polychlorinated Biphenyls): Contamination from industrial and industrial activities
    - Organochlorine pesticides (POCs): Contamination from agriculture and industrial processes. Chlorobenzenes: Contamination from industrial activities, chemical manufacturing and waste disposal.

Water Temperature

The temporal evolution of water temperature is observed and modelled in Ladji (mouth of Lake Nokoué with the Cotonou channel) between February and December. It fluctuates on average between 27 degrees Celsius in August and 30 degrees Celsius in December. June to October marks the lowest water temperature. In the centre of Lake Nokoué, over the period from February to November, the water temperature fluctuates on average between 27.5 degrees Celsius in August and 30 degrees Celsius in May. As in Ladji, the water temperature is coldest between June and October. During the rainy season, the temperature in the lakes drops by 2 to 3 degrees in the centre of the lake and by 3 degrees at the entrance to the outlet of the lake8. A graphical representation of these data is provided in Appendix A7.

Salinity Distribution
Under normal conditions, between December and May, Lake Nokoué experiences a significant increase in salinity, from about 0 PSU to 25 PSU. This period coincides with the long dry season and the beginning of the rainy season. Subsequently, from June to November, salinity levels decrease from 25 PSU to 0 PSU, a trend that coincides with the rainy season8. A graphical representation of these data is provided in Appendix A8.

3.2 Ecological Reference Situation

3.2.1 Site Ramsar

Benin's coastal zone, which includes Ramsar Site 1018, is rich in biodiversity (flora, avian fauna, terrestrial and aquatic fauna) and provides a multitude of ecosystem services. The Ramsar status obliges Benin, through the Benin Environment Agency (EBA), to report on the state of conservation of the site. Unfortunately, the state of the natural environment continues to deteriorate. This unique ecological ensemble is threatened by the very strong pressure of human activities in the coastal zone (destruction of forests and mangroves, destruction of wildlife habitats, enormous proliferation of acadjas, disposal of solid waste and sewage, chemical pollution, uncontrolled sand extraction, etc.).

3.2.2 Fauna of Lake Nokoué

The fauna of Lake Nokoué includes a wide variety of species under and above the water. The most important species are mentioned below.

Banks and water surface

- Macroinvertebrates: insects, molluscs, annelids, nematodes and arachnids
- Crabs: mainly land crabs such as the colored crab (Cardiosoma armatum), burrowing crabs and mangrove crabs (Aratus pisoni and Ucides cordatus)
- Birds: more than 120 species recorded (45% migratory and 55% resident): African cormorant and jacana, egrets, kingfishers, grey heron, black kite

Water column and bottom [8]

- Zooplankton: Copepods, cladocerans, rotifers, nauplii, nematodes and protozoa, with a dominance of copepods, rotifers and cladocerans in the waters of Lake Nokoué.

- Phytoplankton: 106 species have been identified in Lake Nokoué and 57 species in the Porto-Novo lagoon[1]. Detailed description in Appendix A9.
- Macro-invertebrates: Insects (50% of the species present), molluscs and crustaceans (40%) and annelids, nematodes and arachnids (less than 10%).
- Forty (40) species of fish were recorded (in 2019) in Lake Nokoué and thirty-two (32) in the Porto-Novo lagoon. The most abundant families were the Cichlidae, followed by the Clupeidae and the Gobiidae in Lake Nokoué; and the Cichlidae followed by the Gobiidae and the Mugilidae in the Porto-Novo lagoon.
- Fish population: Fluctuations in fish populations have been observed, both temporally and spatially, sometimes with significant variations due to ecological factors (biotic and abiotic) that accompany the hydro-climatic cycle observed in the Greater Nokoué region. Analysis of growth parameters concluded that the fish stock is underexploited. Nevertheless, recruitment into the stock (biomass) is lower than mortality losses, which means that the current state of rational exploitation is only apparent and could quickly tip over into overexploitation9.

- Invertebrate species present in highly eutrophic and polluted environments: Molluscs and oligochaetes.
- Shrimps: Giant tiger shrimp (Penaeus monodon), pink shrimp (Farfantepenaeus notialis), tiger shrimp (Melicertus kerathurus), deep-sea pink shrimp (Parapenaeus longirostris), Guinea shrimp (Parapenaeopsis atlantica).
- Crabs: Freshwater crab (Callinectes amnicola), mangrove crabs (Aratus pisoni and Ucides cordatus).
- Oysters: Mangrove oyster (Crassostrea gasar).
- Mammals: Sitatunga, African manatee.

3.2.3 Vegetation of Lake Nokoué

Floristic diversity has decreased considerably. 95% of the southern and western shores of Lake Nokoué are now urbanized, compared to less than 5% in 1970. The number of species in periodically flooded areas fell from 16 to 4 in 2006. The dominant species on the shores since 2000 is the Paspalum vagina

Floristic diversity has decreased considerably. 95% of the southern and western shores of Lake Nokoué are now urbanized, compared to less than 5% in 1970. The number of species in periodically flooded areas fell from 16 to 4 in 2006. The dominant species on the shoreline since 2000 is Paspalum vaginatum. Echinochloa pyramidalis (formerly present on the eastern shore of Lake Nokoué) has been gradually replaced by agricultural plantations, particularly sugar cane. Cyperus papyrus (formerly present on the western shore of Lake Nokoué) has completely disappeared, giving way to Typha australis.

The river-lagoon system has floating vegetation dominated by Eichhornia crassipes, commonly known as water hyacinth, whose extent varies according to the seasons and salinity. During the high-water season (rainy season and flooding), Eichhornia crassipes covers up to 15% of Lake Nokoué. During the low-water season (dry season), it almost completely disappears from Lake Nokoué, while other floating plants are observed throughout the year throughout the river-lagoon system[8].

[8] *OmiDelta-INE. "State of play of the Ouémé delta", Thematic Report n°9/9 Natural Ecosystems, October 2019.*

3.3 Human Environment

3.3.1 Demographics

In Benin, Greater Nokoué – the urbanized area around Lake Nokoué and the Porto-Novo lagoon – is a vast agglomeration of more than 3.5 million inhabitants, in continuous development. In 2021, the population of the four coastal departments (Ouémé, Littoral, Atlantique and Mono) was estimated at 4.7 million, including 3.7 million in the Greater Nokoué urban area, representing 30% of the Beninese population (12.5 million). According to projections (World Bank, UN, Benin), the population of the delta will reach 4.7 million by 2030 and 7 million by 2050, about double the current population. By that time, a large part of the municipalities of the delta will be urbanized.

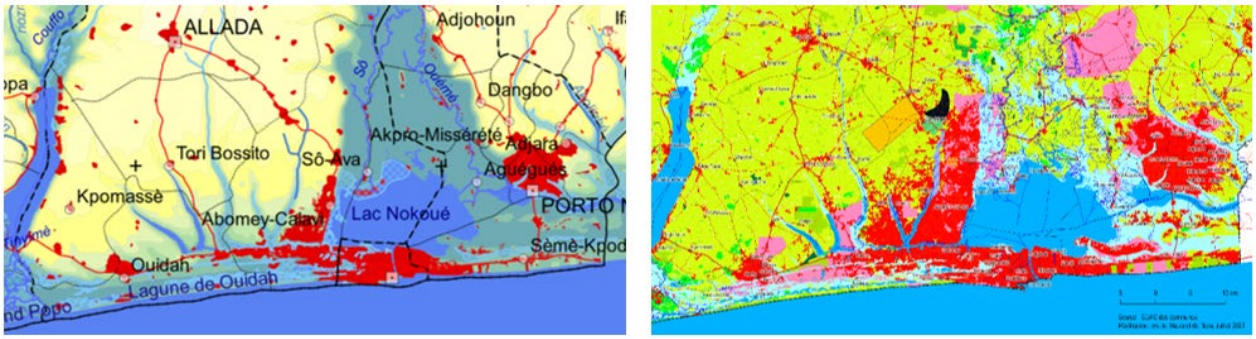

Figure 3-6 Urbanization in 2020 (left) and projected urbanization in 2050 (right) (Action Plan and Initial Investment Proposals, ARNP Phase 2 Report, January 2023)

Villages on stilts of Ganvié

A peculiarity of Lake Nokoué is the presence of human dwellings built on stilts on the surface of the water in the northwestern part, known as the villages of Ganvié. These settlements are home to about 40,000 people.

3.3.2 Tourism

The National Agency for the Promotion of Heritage and Tourism Development (ANPT) estimates that Benin uses only 2 to 5% of its international tourism potential. Although tourism is not widely developed in Benin, the coastal area and its surroundings present attractions such as Ganvié, and there is good potential for ecotourism development in the wetlands and resorts near Cotonou.

The Beninese coastal zone is characterized by the presence by the Ministry of Tourism of major tourist attractions that are exploited in an irrational manner. Four Zones of Tourist Interest (ZIT) are distinguished: the estuarine ZIT (lower Mono valley), the lake ZIT (Lake Ahémé, Lake Nokoué), the deltaic ZIT (lower Ouémé valley) and the coastal dune ZIT (sandy beaches, coastal lagoons).

3.3.3 Socio-economic development

On the economic and social front, Benin has enjoyed fairly steady GDP growth in recent years (6.6% in 2021) but this GDP remains very modest (about USD 10 billion). The Human Development Index also grew steadily until 2010 but has stabilized since then and has remained stable since 2019. As for the incidence of

monetary poverty, it is high (40% in 2015 and 38.5% in 2021). In short, although social indicators have improved, Benin has a social marginalization that is quantitatively and qualitatively widespread and structurally entrenched. Almost all relevant indicators, such as income, gender and education, point to serious inequalities.

Benin is facing a food production deficit that places it in a situation of chronic food insecurity. This deficit is offset by imports, even though Benin's agricultural and aquaculture potential seems to be very rich. As for the supply of drinking water, the situation remains worrying.

3.3.4 Fishing Activity

Fisheries play a vital role because of its contribution to reducing unemployment and meeting the protein needs of the population. Inland fishing on Lake Nokoué contributes to more than 40% of the animal protein consumed in Benin.

Acadja

Lake Nokoué is an important contributor to inland fisheries production in Benin, mainly due to the practice of acadja fishing. This method of fishing consists of attracting fish and crustaceans into an artificial grove planted in the open waters of the lakes; then to surround the shrub park with a net to easily catch the fish. Acadja is designed to mimic the natural habitat associated with lake shores that many fish species use for breeding, refuge, and feeding during the dry season. The shrub grove is not removed after the fish is harvested and its decomposition can therefore influence the water quality of the lake.

4 Identification and Assessment of Potential Risks and Impacts

This chapter presents a preliminary identification of the main potential environmental and social impacts of the ARNP, Phase 2, action area n°1 (only the Porto-Novo canal via Cotonou to Abomey-Calavi and the 3 associated ports) and part of action area n°3 (construction of ecological islands) and interfaces between the ARNP and the MUDP-GN (mainly new roads or road improvements). Potential impacts are ranked using the World Bank Group's Environmental and Social Standards (ESS) for Environmental and Social Sustainability. The list of activities and impacts may be updated as project details, such as waterways and road interfaces, are finalized in later stages.

This impact assessment provides a preliminary frame of reference to be taken into account when developing the full ESIA for the SUNC-GN project and to be annexed to the Environmental and Social Management Framework (ESMP) of the SUMP-GN.

4.1 Risk and Impact Assessment Methodology

All potential impacts that may result from the Project, whether positive or negative, will be identified, including direct, indirect and cumulative impacts. Potential impacts are assessed based on their severity, duration, magnitude and likelihood. On this basis, the impacts are classified into three levels of significance:

- Major impact (red): A major impact is a significant negative effect that could have serious long-term consequences. It could lead to irreversible damage, significant loss of biodiversity or serious social disruption.
- Moderate impact (orange): A moderate impact is a significant negative effect that could have significant consequences in the short or medium term. It could lead to temporary environmental degradation, the displacement of communities or the loss of livelihoods.
- Low impact (yellow): A low impact is a minor negative effect that is not expected to have significant long-term consequences. It could cause temporary discomfort or minor environmental disturbance.
- No impact / positive impact (green): No negative effects are expected. A positive impact is a beneficial effect that could have significant or moderate positive consequences in the short, medium or long term. It can improve social welfare, improve livelihoods, reduce pollution, or contribute to economic growth.

Table 4-1 provides a complete categorization of the identified and assessed impacts of the Project, categorized according to the levels of significance described above. Measures to mitigate or enhance each impact are developed, and residual impacts are highlighted, as shown in Table 5-1.

4.2 Potential Risks and Negative Impacts

Table 4-1 identifies the environmental and social impacts of adding lake transport to the SUMP-GN Before reading the table, a few highlights are summarized in this text.

The main purpose of adding lake transportation is to relieve pressure on the road network around the lake. The Cotonou metropolitan region is expected to experience further significant population growth in the coming years, and the expected mobility needs are expected to increase even further. The introduction of lake transport will reduce air pollution and improve air quality compared to autonomous growth.

The major impact of the proposed development on land is that space will have to be freed up for the ferry and cargo ports in Abomey-Calavi, Cotonou (Vossa) and Porto Novo and for the land connection infrastructure. The locations were chosen to better connect the ports to the existing road network and with as little unintentional relocation as possible. Nevertheless, the construction of the port of Cotonou (Vossa) will require the relocation of some houses and workshops, and the extension of the existing port of Abomey-Calavi and the associated modernization of the connecting road in particular will require the relocation of economic activities along the existing road. The location of the planned port of Porto-Novo is on an unused parcel of land east of the bridges connecting Porto-Novo to the south. The work already planned on the bridge over the lagoon to Porto-Novo will be crucial to create enough air guard to allow transport by ferry.

An aggravating factor for the creation of the port of Cotonou-Vossa is that the existing houses and workshops are based on waste. The demolition of these structures would require a review of the disposal of the associated waste, prior to the start of construction. To what extent this is also the case in Abomey-Calavi will have to be studied.

The major impact of lake transport on the water side is that dredging is necessary to create and maintain waterways. Indeed, Lake Nokoué, located in Ramsar site 1018[9], is facing increasing sedimentation and is becoming increasingly shallow. The creation of the channels will improve water flow, resulting in lower water temperatures and greater intrusion of salt water into the lake. These effects will have an impact on the quality of the water and consequently on the biodiversity of the lake. Another important impact is that the creation of waterways leads to the elimination of acadjas from the waterway route.

The removal of dredged sediment is another important impact of the creation of waterways. To this end, the construction of artificial islands is planned to improve the avian fauna on Lake Nokoué.

In addition to these highlighted impacts, other impacts will occur related to the construction and operation of waterways, ports and connecting roads. These are described below in Table 4-1.

Table 4-1 Identification and assessment of negative impacts and risks of the ARNP and SUMP-GN interface in accordance with the World Bank's Environmental and Social Standards (ESS).

World Bank NES	Project Activities	Assessed Negative Environmental and Social Risks/Impacts	Importance de l'impact
NES1: Assessment and Management of Environmental and Social	All activities.	• The precise nature of the plans to be implemented through the SUNC-GN ESIAs, and thus ARNP Action Areas 1 and 3, as well as the SUNC-GN interfaces, has not yet been determined. This means that a possible future evaluation of the project	

[9] *Lower Ouémé Valley, Porto-Novo Lagoon, Lake Nokoué*

World Bank NES	Project Activities	Assessed Negative Environmental and Social Risks/Impacts	Importance de l'impact
Risks and Impacts		could lead to different levels of detail, assessments and conclusions.	
NES2: Working and Employment Conditions	Construction and operation of the lake port, dredging and maintenance, dredging, updating/construction of the road interface ARNP/PMUD-GN et Construction of artificial islands	• Although the risk of involuntary, compulsory and child labour may be perceived as low in southern Benin, it remains a potential concern. • Potential discrimination based on gender, ethnicity or religion can restrict employment opportunities for workers.	
		• Occupational health and safety for personnel mobilized on board dredging vessels and on land for construction work (potential hazards such as road accidents, trespassing, falls overboard, drowning, etc.). In the local context, this risk is considered high. • Risks to the health and safety of workers mobilized to remove potentially polluted soil from the lake port sites during the preparatory and construction phases (Soil quality unknown at this stage). In the local context, this risk is considered high.	
SRS3: Resource Efficiency and Pollution Prevention and Management	Construction and operation of the lake port, dredging and maintenance, dredging, updating/construction of the road interface ARNP/PMUD-GN et Construction of artificial islands	• Installation and construction work at the lake port and interface sites (ARNP/PMUD-GN) will generate noise, vibration, airborne dust and greenhouse gas emissions from the operation of construction machinery. • Installation and construction work at the lake port and interface sites (ARNP/PMUD-GN) can generate soil and water pollution from hazardous and non-hazardous wastes, accidental fuel spills, and hazardous chemicals and materials. In the local context, this risk is considered a serious possibility. • Increased water and land transport during the operation phase can generate pollution of water, sediment, soil, air and greenhouse gas emissions (e.g. vehicle emissions, accidental fuel spills on land and water bodies). In the local context, this risk is considered a serious possibility. • (temporary) increase in water turbidity and suspension of potentially polluted organic matter is assessed as occurring during dredging.	

World Bank NES	Project Activities	Assessed Negative Environmental and Social Risks/Impacts	Importance de l'impact
		• Risks of pollution when extracting potentially polluted soils from the lake port sites during the preparatory and construction phases (Soil quality unknown at this stage, but much of these areas is filled with solid waste).	
	Reuse of dredged sediments for the construction of two (2) artificial islands.	• Plastic and muddy clay excavated during dredging activities will be used for the construction of the two (2) groups of artificial islands. Any excess dredged material may be used for the development of other small artificial islands under the RNA project or disposed of elsewhere on the shore (next item of the assessment). Contamination of water bodies in and around artificial islands, including heavy metals, resulting from the use of polluted dredged material in the construction of artificial islands is not the case for most heavy metals. In some cases, increased levels of cadmium in sediments may, once dissolved, have an adverse effect on aquatic life (details provided in Appendix A11).	
	Disposal of unused dredged material.	• At this stage of the ARNP project, the final disposal sites for dredged muddy clay and plastic clay have not been identified. This current lack of disposal sites is estimated to lead to a significant extension of the project and to cause planning problems.	
		• Based on the assessment carried out for ARNP, the disposal of dredged material at terrestrial sites such as agricultural areas is unlikely to result in environmental pollution from heavy metals. In some cases, increased levels of cadmium in sediments may, once dissolved, have an adverse effect on aquatic life (details provided in Appendix A11).	
NES4: Community Health and Safety	Lake Port Construction & Operation, Dredging & Maintenance, Dredging, Interface Road Update/Construction ARNP/PMUD-GN.	• The health and safety of communities during the construction and operation phases are considered real risks. These risks can include road accidents in and around ports due to increased traffic and commuters, as well as shipping-related accidents, such as falls overboard and even drowning. Especially in bad weather, the risk of collisions between water buses or water buses and cargo ships increases. • Risks to the health and safety of communities when extracting potentially polluted soil from lake port sites during the preparatory and construction phases (Soil quality unknown at this stage) are considered high.	

World Bank NES	Project Activities	Assessed Negative Environmental and Social Risks/Impacts	Importance de l'impact
		• The risk of accidents resulting from the handling of hazardous materials during the maintenance and refuelling of construction equipment and vehicles, as well as vessels during the operation phase, is considered low.	
NES5: Land acquisition, land use restrictions and involuntary resettlement	Lake port construction, dredging, updating/construction of interface roads ARNP/PMUD-GN et Artificial Island Locations	• A (temporary) disruption of the livelihoods of groups dependent on access to water and ports, such as fishermen, youth, vendors, smugglers, tour guides, etc., is expected.	
		• Risk of physical and economic displacement related to lake port sites: • People currently residing or working in the area designated as a selected site for the development of the lake port of Cotonou (Vossa) should be displaced. Although the selected site reduces the number of displacements compared to the first proposed site, the fact remains that some houses and/or (workshops) need to be demolished for the port and in particular for the road leading to the port. In addition, some acadjas are most likely located either on the site of the port or in the path of the new canal.	
		• People currently working in the area designated as a selected site for the development of the Abomey-Calavi lake port, which includes an open-air fishing market, a tourist centre and a jetty used by residents and tourists of Ganvié. Their economic relocation during the construction phase is anticipated.	
		• The area designated as the selected site for the development of the lagoon port of Porto-Novo is located on empty and unused government land. No physical or economic travel is planned.	
		• Risk of physical and economic displacement along interface roads linked to lake port sites: • The existing road leading to the site of the proposed Abomey-Calavi lake port will need to be significantly improved, including widening, to cope with the increase in traffic. This section of road is lined with a large number of existing shops, accommodations and other businesses.	
		• The access roads to Vossa are already two separate lanes with the possibility of making them 2*2 lanes. While it is possible to avoid the relocation of existing businesses along the road, the	

World Bank NES	Project Activities	Assessed Negative Environmental and Social Risks/Impacts	Importance de l'impact
		level of the road may still result in some displacement.	
		• The access road to Porto-Novo can easily be made 2*2 lanes if the empty government area can be used on the grounds of the "proposed new parliament building". The location of the proposed new road does not imply the relocation of any existing shops, accommodations or other businesses.	
		• Physical and economic displacement risks related to the trajectory of waterways: • Owners and users of acadjas and fish vendors (usually women) with plots along the proposed canal between Abomey-Calavi and Cotonou and Porto-Novo and planned artificial islands are to be displaced.	
		• Changes in water quality and salinity levels due to increased saltwater intrusion through the new canals may impact Lake Nokoué's ecosystem services, including fishing activities and thus the economic activity of both men and women. (Refer to ESS6 for more details.)	
NES6: Conservation of biodiversity and sustainable management of living natural resources	Dredging and dredging maintenance and construction of artificial islands.	• Temporary disturbance during dredging will result in increased turbidity which can negatively impact the biodiversity and ecology of the lake. At least temporarily (during dredging) and most likely only during the dry season. During the rainy season, the strong flow of water to the sea will reduce the impact of turbidity.	
		• Disturbance of macro-invertebrates and fish species due to noise and vibration from dredging and lake harbour construction activities (e.g. pilotage activities) is a potential risk and the impact may take several years. However, compared to the total size of Lake Nokoué, this impact is relatively small.	
		• Change in ecological values caused by changes in local bathymetry. The impact is generally considered positive because the current water levels of the lake are very low, which leads to an increase in water temperature and therefore a reduction in biodiversity. An increase in water depth will lead to a (partial) drop in water temperature and attract species that have been extinct for decades, thus improving biodiversity.	

World Bank NES	Project Activities	Assessed Negative Environmental and Social Risks/Impacts	Importance de l'impact
		• The new waterways (canals) will result in increased salinity levels in Lake Nokoué during periods of low water and a prolonged period of high salinity of approximately thirty (30) days. Although general environmental conditions between September and February are expected to remain relatively unchanged, these changes may have implications for the lake's ecosystem, including an increase in marine species and a one-month delay in the fishing season for brackish water species10. These conclusions are based on a hydrodynamic study carried out prior to the ARNP-1 project. Although the study covers all the waterways to be dredged, only the connection between Abomey-Calavi, Cotonou and Porto-Novo is detailed in this report. Therefore, the impacts on the salinity of Lake Nokoué, although less significant than expected, cannot be ignored.	
	Transport fluvial	• The increase in the number of ships can lead to a disturbance of ecological values through noise and vibration. However, this impact is considered low because the number of water buses is not very high and the boats will only pass through the canal 2-4 times per hour.	
	Update/build interface roads ARNP/PMUD-GN	• Disturbance of terrestrial flora and fauna due to the expansion of the road network is considered to be low.	
NES8: Cultural Heritage	Lake port construction, dredging, updating/construction of interface roads ARNP/PMUD-GN	• Based on the limited information currently available, including an initial review of sites, interface roads and assumed waterways, the selected lake port sites do not appear to encompass cultural heritage sites. However, as we cannot exclude it, we assess the impact as low.	
NES10: Stakeholder engagement and disclosure	All activities.	• Insufficient stakeholder involvement and lack of disclosure of information throughout the project lifecycle can lead to significant conflicts, loss of trust and negative public perception of the project. However, from the outset of the ARNP project, an intensive process of stakeholder engagement was implemented. In addition, the proposed plan for Lake Nokoué has been presented to the relevant government agencies at the national and municipal levels, as well as to a number of NGOs operating in the Benin Delta and to representatives of the private sector. As we have no information on how stakeholder engagement will be implemented in the next	

[10] *IRHOB, Institute of Research for Development. DELIVERABLE 2. "Study report on the probable response of Lake Nokoué to different scenarios (dredging/embankments, regulation of the flows of the Ouémé, extreme floods)" July 2023.*

World Bank NES	Project Activities	Assessed Negative Environmental and Social Risks/Impacts	Importance de l'impact
		phase, we see this aspect as a serious impact if not done through an intensive process of stakeholder engagement.	

4.3 Potential Positive Impacts

Dredging and maintenance dredging activities

The implementation of dredging and maintenance activities will contribute in part to alleviating the current problem of sedimentation in Lake Nokoué. By removing accumulated sediment, these activities will increase the volume of the water body, the speed of water to the lake's outlets, and improve its natural self-purification processes. In addition, dredged materials can be reused for the creation of ecological artificial islands (building with nature), providing a potentially favourable habitat for mangrove ecosystems and contributing to the preservation of the ecological importance of the Ramsar site.

Reduce ground transportation congestion

By improving river transport on Lake Nokoué, the project aims to reduce traffic congestion in Cotonou. This will not only reduce air pollution and improve air quality, but also decrease travel times for commuters and freight transport, thus improving food safety and reducing the tendency for traffic accidents. In addition, the project contributes to the overall economic development of the region by facilitating the movement of goods and people and improving employment.

4.4 Cumulative Risks and Impacts

Northern Bypass Highway

The "Northern Bypass Highway" is a major infrastructure project initiated by the Government of Benin to alleviate traffic congestion in the Cotonou metropolitan area. This project involves the construction of a new highway that will bypass the city from (to) the Autonomous Port of Cotonou, reducing traffic on existing roads and improving connectivity between Cotonou and other regions[11]. This project is expected to stimulate economic activity and improve transportation efficiency in the region.

The "Northern Bypass Highway" will run along the shore of the lake, requiring the restructuring of a significant area south and west of Lake Nokoué. At the time of writing, the specific details regarding the project's start date and precise location remain undetermined. The road could have positive and negative impacts on the lake port of Cotonou (Vossa). If the project route includes the lake port, it could adversely affect port operations. Conversely, the project could have a positive impact on the lake port by increasing the number of people using its facilities.

This project is outside the scope of the World Bank's SUNDP-GN.

[11] https://lanation.bj/actualites/conseil-des-ministres-des-etudes-diligentees-pour-actualiser-le-projet-de-contournement-nord-de-Cotonou

Project to reinvent the lakeside town of Ganvié

The strategic objectives of this project are (1) to improve the living conditions of the inhabitants of Ganvié and (2) to make Ganvié a showcase for lake tourism, an authentic, atypical and original destination. The expected results are as follows: (1) the lake near Ganvié is cleaned up and waste is better managed, (2) 2,500 houses are rehabilitated, (3) basic socio-economic infrastructure adapted to the lake environment is built (floating markets, health centre, college, social life space, logistics platform) and (4) the Abomey-Calavi jetty is built[12].

This project includes the adaptation of the port of Abomey-Calavi and is currently underway. Any new project should take into account the results of this project. However, at Royal HaskoningDHV, little is known about the technical design of the new port.

Cotonou Rainwater Sanitation Program

One of the main new drainage channels to evacuate rainwater to Lake Nokoué is located in the same area as the proposed new port in Vossa-Cotonou. Any new project should take into account the operation of this new drain. This means that one of the roads to be improved may require a stronger bridge than currently planned due to the presence of the new Drain[13].

[12] *https://lanation.bj/actualites/conseil-des-ministres-des-etudes-diligentees-pour-actualiser-le-projet-de-contournement-nord-de-Cotonou*

[13] *https://www.gouv.bj/article/2616/*

5 Risk Mitigation Measures and Potential Impacts

This chapter assesses the environmental and social impacts of the project. Mitigation measures are proposed for all impacts assessed. Chapter 4 provides a list of activities and impacts. This list may be updated as project details, such as waterways and road interfaces, are finalized in later stages. This list forms the basis for the impact assessment.

5.1 Environmental and Social Issues Related to World Bank NES

Table 5-1 presents the proposed mitigation measures to minimize the environmental and social impacts of adding lake transport to the NG-SUMP. Before reading the table, some mitigation measures are summarized here.

As already mentioned in the context of the impacts, the selection of port locations was based on:

- (1) a close connection with the existing road infrastructure, and
- (2) (2) a minimum of involuntary relocation of housing and economic activities.

Good stakeholder management and adequate compensation in line with World Bank standards are among the measures to mitigate these impacts. The same principles apply to the acadjas located in the path of the proposed waterways and to the location of the port of Cotonou-Vossa. In addition, a proposed mitigation measure is the creation of artificial fishing ponds (also a mitigation measure in the ARNP) to provide a more sustainable livelihood for acadja fishermen.

The dredged material will be used in part for the construction of port sites and the creation of artificial island groups. For the disposal of the remaining dredged material, it is necessary to select a disposal site, which can be a time-consuming process. The intention of creating the two groups of small islands is to promote the ecological quality of Lake Nokoué and in particular the bird population and the increase in bird species. After construction, these islands will be offered to nature and will serve as potential areas for mangroves and nesting areas for birds.

In addition to the mitigation measures outlined above, other measures will be considered to minimize the environmental and social impacts of the construction and operation of waterways, ports, and connecting roads. One of the next steps to further detail the plans will be to complete a full Environmental and Social Impact Assessment alongside the design and detail of the project. Based on this more detailed information, mitigation measures will be specified.

Table 5-1 below presents an assessment of the risks and impacts associated with ARNP and its interfaces with the NG-SUMP, as estimated in this report. At this stage of the project, it is difficult to estimate an impact/risk level, as no information is yet available. This report covers the entire project lifecycle, including the preparation, construction, operation and decommissioning phases. However, it is assumed that lake

harbours will remain in place during the design lifecycle and that waterways will disappear over time when maintenance dredging ceases.

When performing all actions listed in the table, the impacts and risks are considered manageable. However, this is based on the current knowledge of the project. If detailed project designs are developed, new or increased impacts and risks are possible and an updated assessment should be carried out if additional measures are required.

Table 5-1 Mitigation measures for impacts and risks related to ARNP and the SUMP-GN interfaces in accordance with the World Bank's ESS

World Bank NES	Assessed E&S Negative Risk/Impact	Impact signification	Mitigation measures	Residual impact
SEN 1: Assessment and Management of Environmental and Social Risks and Impacts	The precise nature of the plans to be implemented in the framework of the ESIA of the ARNP and HUNGP-GN projects, and therefore on ARNP action areas 1 and 3, as well as on the SUNP-GN interfaces, remains to be determined.		Develop an environmental and social policy for the project, in line with the World Bank's Sustainable Development Strategy and Invest International's Environmental and Social Governance and Impact Policy.	
			Prepare detailed Environmental and Social Impact Assessments (ESIAs) for the ARNP and the SUMP-GN interfaces with the ARNP.	
			The contractor of the works must prepare and implement the Environmental and Social Management Plan (C-PGES), including the responsibilities, schedule, monitoring and organization for the next projects of the project by the contractors.	
			Develop an E&S organizational chart, a description of the roles and responsibilities of each position involved in E&S aspects, to be prepared for the World Bank, for Invest International, but also for the contractors.	
ESS2: Work and Working Conditions	Although the risk of involuntary, compulsory and child labour may be perceived as low in southern Benin, it remains a potential concern.		The contractor for the construction phase must have applicable labour policies in place. During the tendering process, contractual rules and regulations to ensure appropriate working and employment conditions will be an essential element. The Government of Benin and the World Bank will jointly monitor compliance with these standards. In doing so, this risk is assessed as having no impact.	
	Potential discrimination based on gender, ethnicity or religion can restrict workers' employment opportunities.			
	Occupational health and safety for personnel mobilized on board dredging vessels and on shore for construction work (e.g., potential hazards include road accidents, trespassing on the		Develop a health and safety policy and health and safety management plan that all suppliers/contractors must adhere to. The Government of Benin and the World Bank will jointly monitor compliance with these standards. In doing so, the risks of health problems and	

World Bank NES	Assessed E&S Negative Risk/Impact	Impact signification	Mitigation measures	Residual impact
	site, falling overboard, drowning, etc.)		security will be greatly reduced, but they can never be totally excluded and will no longer be significant.	
	Risks to the health and safety of workers mobilized to remove potentially polluted soil from lake port sites during the preparation and construction phases (soil quality is unknown at this stage).			
NES3: Resource Efficiency and Information Pollution Prevention and Management	Installation and construction work at the lake port and interface sites (ARNP/PMUD-GN) will generate noise, vibration, airborne dust and greenhouse gas emissions due to the operation of the site's machinery.		Fugitive dust emissions are generated during the construction of lake harbours, channel dredging and operational activities. Air emissions come from land-based and marine sources during the construction and operation of lake harbours. Recommendations for the control and management of air emissions from typical construction and operation activities are contained in the World Bank's general guidelines on environment, health and safety. At all stages of the project, vehicles and vessels must be maintained in accordance with the manufacturer's specifications and awareness campaigns on good practices to limit air emissions in general and greenhouse gas emissions must be carried out (prohibition of burning waste on site, compliance with speed limits, etc.). etc.)	
	Installation and construction work at the lake port and interface sites (ARNP/PMUD-GN) can result in soil and water pollution from hazardous and non-hazardous wastes, accidental spills of fuel, chemicals and hazardous materials. In the local context, this risk is considered a serious possibility.		The contractor must include in its C-PGES (construction) a water quality management plan to prevent water quality impacts on the sensitive ecosystems of Lake Nokoué. This plan must address water quality issues such as stormwater, washwater, wastewater and pollution prevention. Stormwater and wastewater from port facilities must be managed in accordance with the recommendations contained in the World Bank's general guidelines on environment, health and safety. Vehicles and vessels must be maintained in accordance with the manufacturer's specifications to prevent pollution from fuel spills.	

World Bank NES	Assessed E&S Negative Risk/Impact	Impact signification	Mitigation measures	Residual impact
			To prevent pollution of soil and water bodies, awareness-raising campaigns on good practices in the event of accidental pollution should be carried out during the preparation and construction phases of the project.	
			Yards must be equipped with drums and a secondary containment system for the storage of used oil on a sealed surface. Solid hazardous waste must be sent to approved treatment and disposal facilities. Awareness campaigns for construction workers on general hygiene and cleanliness of the site should be carried out regularly. During the preparation and construction phases of the project, hazardous materials must be stored under appropriate conditions (hermetically sealed and placed on a drip tray in case of leakage). Awareness campaigns on the management of hazardous materials must be conducted.	
			Fuel dispensing equipment must be equipped with "break" hose connections that allow for emergency interruption of flow if the refuelling connection is broken by movement. Refueling equipment should be inspected prior to refueling activities to ensure that all components are in good condition.	
			When all of the above mitigation measures are implemented, the impacts and risks are minimal, but can never be excluded and are no longer significant.	
	Increased sea and land transport during the operation phase can lead to pollution of water, sediment, soil, air and greenhouse gas emissions. (e.g. vehicle emissions, accidental fuel spills on land and water bodies). In the local context, this risk is considered a serious possibility.		The contractor (licence holder) must include in its Environmental and Social Management and Monitoring Plan for the Operation (O-PGES) a water quality management plan to prevent water quality impacts on the sensitive ecosystems of Lake Nokoué. According to the World Bank, liquid effluents associated with land-based activities in ports (such as construction activities, vehicle maintenance and washing, storage and transfer of fuel and equipment, etc. Washwater from land and sea activities may contain oily residues. Stormwater and wastewater from port facilities should be managed in accordance with the recommendations of the World Bank's general guidelines for NES. Vehicles and Ships	

World Bank NES	Assessed E&S Negative Risk/Impact	Impact signification	Mitigation measures	Residual impact
			must be maintained in accordance with the manufacturer's specifications to prevent pollution from fuel spills.	
			In order to prevent pollution of soil and water bodies, awareness-raising campaigns on good practices in case of accidental pollution must be carried out during the operation phase of the project by the contractor (licence holder).	
			Lake ports are to be equipped with drums and a secondary containment system for the storage of used oil on a watertight surface. Solid hazardous waste must be sent to approved treatment and disposal facilities. Campaigns to raise awareness among port workers about general hygiene and cleanliness of sites must be carried out regularly. Hazardous materials must be stored in appropriate conditions (hermetically sealed and placed on a drip tray in case of leakage); Campaigns to raise awareness among port workers about the management of hazardous materials must be carried out.	
			Fuel dispensing equipment must be equipped with "break" hose connections that allow for emergency interruption of flow if the refuelling connection is broken by movement. Refueling equipment should be inspected prior to refueling activities to ensure that all components are in good condition. As part of the operation, fuel storage is to be managed in accordance with the World Bank's NES guidelines for ports, harbours and terminals.	
			The plans of the SUNDP-GN include technical assistance to develop a motorcycle taxi fleet renewal strategy and the deployment of an electric motorcycle taxi fleet in Greater Nokoué. The lake's ports should include power plants to accommodate electric vehicles. The development of a strategy for the renewal of the boat fleet and the deployment of a fleet of electric boats on Lake Nokoué should be considered.	
			When all of the above mitigation measures are implemented, the impacts and risks are minimal, but can never be excluded and are no longer significant.	

World Bank NES	Assessed E&S Negative Risk/Impact	Impact signification	Mitigation measures	Residual impact
	(Temporary) increase in water turbidity and suspension of potentially polluted organic matter.		Depending on the site parameters, the appropriate dredging method should be selected in order to increase the accuracy of the dredging and minimize turbidity. The project shall carry out a risk assessment of the dredging activities as part of the development of a dredging management plan, in order to define the dredging method, the zone of influence (assessment of sensitive ecological receptors, possibly through a sediment plume propagation model), the measures to mitigate the negative effects on biodiversity and water quality, and relevant environmental monitoring parameters and indicators. According to the World Bank's Environment, Health and Safety (EHS) guidelines, the dredging schedule must take into account seasonal factors such as migration periods (fish and birds), breeding and growing seasons (lake flora), feeding timing and periods when ecosystem resilience is reduced (after extreme weather events). When all of the above mitigation measures are implemented, the impacts and risks will be minimal, but can never be excluded and will no longer be significant.	
	Pollution risks during the removal of potentially polluted soil at lake port sites during the preparation and construction phases (soil quality is unknown at this stage).		The chemical properties of the soil on the site of the lake port will be characterized, in particular in Abomey-Calavi and Cotonou (Vossa), before the start of the construction phase. Depending on the site parameters, appropriate soil excavation techniques will be selected to minimize the potential spread of contaminated soil in the sensitive ecosystems of Lake Nokoué. Hazardous solid waste must be sent to approved treatment and disposal services. When all of the above mitigation measures are implemented, impacts and risks will be minimal but can never be completely ruled out.	
	The plastic and muddy clay excavated during the dredging activities will be used for the construction of the two (2) artificial islands. Excess dredged material may be used for the development of other smaller artificial islands under the ARNP project or disposed of elsewhere. Contamination of water bodies, in particular by heavy metals, resulting from the use of polluted dredged materials for the construction of artificial islands		The project must develop a Dredging Management Plan in order to characterize the chemical and physical composition and behavior of the sediments to be dredged; define the area of influence (assessment of sensitive ecological receptors); define mitigation measures to address negative impacts (e.g. on biodiversity and water quality), as well as relevant environmental monitoring parameters and indicators. The construction schedule for artificial islands should take into account seasonal factors such as migration periods (e.g., fish and birds); breeding and growing periods (e.g., lake flora); the timing of feeding and the	

World Bank NES	Assessed E&S Negative Risk/Impact	Impact signification	Mitigation measures	Residual impact
	is not the case for most heavy metals. In some cases, increased levels of cadmium in sediments can, once dissolved, have an adverse effect on aquatic life (details provided in Appendix A11).		periods of low ecosystem resilience (e.g., after extreme weather events). An assessment of artificial island sites should include the assessment of the impacts of candidate artificial island sites, to ensure as far as possible that construction activities do not interfere with commercial and recreational uses of the site's environment, nor do they produce negative impacts on sensitive ecosystems, species and habitats. When all of the above mitigation measures are implemented, impacts and risks will be minimal (non-significant) or non-existent.	
	At this stage of the ARNP project, final disposal sites for dredged muddy clay and plastic clay have not been identified. Based on the assessment carried out for the ARNP, the disposal of dredged material is not expected to result in environmental pollution from heavy metals. In some cases, increased levels of cadmium in sediments may, once dissolved, have an adverse effect on aquatic life (details provided in Appendix A11).		The project must develop a Dredging Management Plan in order to identify and evaluate the options and sites for the disposal of dredged material, to characterize the chemical and physical composition and behaviour of the sediments to be dredged, to characterize the reference environmental context of the disposal site(s); define the zone of influence (assessment of sensitive ecological receptors - possibly by modelling the spread of the sediment plume); identify mitigation measures to address adverse impacts on the disposal site area(s) (e.g. on biodiversity, water and soil quality), as well as relevant environmental monitoring parameters and indicators. In accordance with the World Bank's EHS Guidelines, the timing of disposal activities should take into account seasonal factors such as migration periods (e.g., fish and birds); breeding and growing periods (e.g., lake flora); timing of feeding and periods of low ecosystem resilience (e.g., after extreme weather events). A disposal site assessment must include an assessment of the impacts of the candidate disposal site, to ensure that the deposit of dredged material does not interfere with commercial and recreational uses of the site's environment, or negatively impact sensitive ecosystems, species and habitats. The disposal site for the remaining sediment must be clearly delineated and fenced to prevent spills.	

World Bank NES	Assessed E&S Negative Risk/Impact	Impact signification	Mitigation measures	Residual impact
			When all of the above mitigation measures are implemented, impacts and risks will be minimal, but can never be completely ruled out and will no longer be significant.	

SEN 4: Community Health and Safety	The health and safety of communities during the construction and operation phases are considered real risks. These risks can include road accidents in and around ports due to increased traffic and commuters, as well as accidents related to water transport, such as falls overboard and even drowning. The risk of collisions between ferries or ferries and cargo ships increases, especially in bad weather.		In order to reduce the risk of accidents and collisions between vessels, institutional arrangements should be made. A basic water policy and legislative structure exist to regulate transport and port operations, but they need to be updated and capacities improved to ensure their effective functioning and a new legislative framework to regulate new activities in this policy area. The involvement of the Ministry of the Interior/Justice will also be necessary. The Government of Benin will monitor compliance with the new legislative framework. More specifically: for lake transport, the following accompanying measures must be integrated into the project:
			• Updating the legal framework
			  • Regulations relating to the navigation police
			  • the rate of transport taxes;
			• The operationalization of the "supervisory commission" of river and lake transport;
			• The development of a manual of procedures for the issuance of administrative acts such as:
			  • navigation permits,
			  • exploitation
			  • certificate of competence or driving licence,
			  • registration and registration of vessels,
			  • recognition of approved inter-municipal and inter-state jetties,
			  • inspections, etc.
			• The definition and delimitation of navigation, fishing and sand exploitation areas
			• The definition of modern piers integrating the security and defence forces, customs, etc.	

World Bank NES	Assessed E&S Negative Risk/Impact	Impact signification	Mitigation measures	Residual impact
			Introduction of community safety issues during the construction and operation of lake ports, as they are common to those of most major infrastructure or industrial facilities and are included in the World Bank's February 2017 EHS guidelines for ports, harbours and terminals.	
			The contractor in charge of the work must prepare and implement a Contractor Environmental and Social Management Plan (C-PGES), which must contain explicit traffic management measures. This plan must be audited by the World Bank and Invest International. Traffic signs should be aimed at the local population, written in French and, if possible, use images instead of text.	
			The contractor/licensee shall develop and implement an Environmental and Social Management and Monitoring Plan for the Operation (O-PGES), which shall contain a Community Health and Safety Plan with explicit safety management measures.	
			As part of C-PGES and O-PGES, Emergency Preparedness and Response Plans (PUR) must be prepared to inform communities of the risks and the measures to be taken to address them. Emergency preparedness and response plans must be ready and operational prior to construction and operation, respectively. In its PUR, the project promoter must develop measures to assist and collaborate with potentially affected communities and local government agencies in their preparations to respond effectively to emergencies, especially when their participation and collaboration are necessary to ensure an effective response.	
			When all of the above mitigation measures are implemented, impacts and risks are minimal, but can never be excluded.	
	Risks to the health and safety of communities when removing potentially polluted soil from lake port sites during the preparation and construction phases (soil quality is unknown at this stage).		The contractor prepares and implements a C-ESMP, which contains a community health and safety plan with explicit health management measures. As part of the C-PGSE, a PUR must be prepared to inform communities of the risks and the measures to be taken to address them.	

World Bank NES	Assessed E&S Negative Risk/Impact	Impact signification	Mitigation measures	Residual impact
			When all of the above mitigation measures are implemented, the impacts and risks will be minimal, but can never be excluded and will no longer be significant.	
	When all of the above mitigation measures are implemented, the impacts and risks will be minimal, but can never be excluded and will no longer be significant.		C-PGES and O-PGES must contain the management of hazardous materials. As part of the operation, fuel storage is to be managed in accordance with the World Bank's EHS guidelines for ports and terminals. When all of the above mitigation measures are implemented, the impacts and risks will be minimal, but they can never be ruled out and will no longer be significant.	
SR5: Land acquisition, land use restrictions and involuntary resettlement	(temporary) disruption during the construction of livelihoods of groups that depend on access to water and ports, such as fishermen, youth, vendors, smugglers, tour guides, etc.		A comprehensive study must be undertaken to assess those temporarily affected by the disruption to their operations before construction begins. The survey should highlight vulnerable groups (e.g. women, children, the elderly, people with disabilities). Further monitoring is needed to determine whether affected populations can receive adequate compensation. A grievance mechanism must be in place and maintained throughout the life cycle of the project. When all of the above mitigation measures are implemented, the impacts and risks are minimal, but they can never be ruled out and are no longer significant.	
	Risk of physical and economic displacement related to the lake's port sites: • Individuals currently residing or working in the area designated as a selected site for the development of the lake port of Cotonou (Vossa). Although the selected site reduces the number of trips compared to the first proposed site, the fact remains that some houses, academies and/or workshops		The location of the lake harbour was strategically chosen to minimize potential economic and physical travel. As detailed plans for the port of the lake and the SMPU-NG/ARNP interfaces are still being developed, care should be taken to minimize any further displacement. A comprehensive study must be undertaken to assess the physical and economic displacement of affected populations as well as those temporarily affected by the disruption of their activities before construction begins. The survey should highlight vulnerable groups (e.g. women, children, the elderly, people with disabilities). Further monitoring is needed to determine whether displaced populations can access comparable economic opportunities and whether they have received adequate compensation. In addition, the resettlement and	

World Bank NES	Assessed E&S Negative Risk/Impact	Impact signification	Mitigation measures	Residual impact
	must be demolished for the port or for the road leading to the port. • In addition, some academies will be abolished for the location of the port and the new canal.		Land acquisition records must be made accessible to all those affected by displacement. A grievance mechanism must be in place and maintained throughout the life cycle of the project.	
	• Individuals currently working in the area designated as a selected site for the development of the Abomey-Calavi lake port, which includes an open-air fishing market, a tourist centre and a jetty used by Ganvié residents and tourists ( ). Economical travel is to be expected during the construction phase.			
	• The area designated as a selected site for the development of the lake port of Porto-Novo is located on empty and unused government land. No physical or economic travel is planned.			
	Risk of physical and economic displacement along the interface roads linked to the lake's port sites: • The existing road leading to the Abomey-Calavi lake port site will require significant improvements, including widening, to cope with the increase in traffic. This section of road is bordered by a large number of		A comprehensive study must be undertaken to assess the physical and economic displacement of affected populations as well as those temporarily affected by the disruption of their activities before construction begins. The survey should highlight vulnerable groups (e.g. women, children, the elderly, people with disabilities). Further monitoring is needed to determine whether displaced populations can access comparable economic opportunities and whether they have received adequate compensation. In addition, resettlement plans and land acquisition records must be made accessible to all those affected by displacement. A grievance mechanism must be in place and maintained throughout the life cycle of the project.	

World Bank NES	Assessed E&S Negative Risk/Impact	Impact signification	Mitigation measures	Residual impact
	shops, housing and other businesses.		When all of the aforementioned mitigation measures are implemented, impacts and risks will be less but will remain high and significant due to the possible demolition of homes and workshops.	
	• The access roads to Vossa are already 2 separate lanes with the possibility of upgrading them to 2*2 lanes. While the relocation of existing businesses along the route should be avoided, it could still occur.		Priority should be given to the road improvement solution that avoids physical and economic travel. If such an alternative is not feasible, a comprehensive study should be undertaken to assess the physical and economic displacement of affected populations as well as those temporarily affected by the disruption of their activities before construction work begins. The survey should highlight vulnerable groups (women, children, the elderly, people with disabilities). Further monitoring is needed to determine whether displaced populations can access comparable economic opportunities and whether they have received adequate compensation. In addition, resettlement plans and land acquisition records must be made accessible to all those affected by displacement. A grievance mechanism must be in place and maintained throughout the life cycle of the project. When all of the above mitigation measures are implemented, the impacts and risks will be lower and no longer material.	
	• The access road to Porto-Novo can easily be converted into a 2*2 if the empty government area can be used on the land of the "proposed new parliament building". The road does not line up with any existing shops, housing or other activities.		A comprehensive study must be undertaken to assess the physical and economic displacement of affected populations as well as those temporarily affected by the disruption of their activities prior to the commencement of construction activities. The survey should highlight vulnerable groups (women, children, the elderly, people with disabilities). Further monitoring is needed to determine whether displaced populations can access comparable economic opportunities and whether they have received adequate compensation. In addition, resettlement plans and land acquisition records must be made accessible to all those affected by displacement. A grievance mechanism must be in place and maintained throughout the life cycle of the project. When all of the above mitigation measures are implemented, the impacts and risks will be less and will no longer be significant or non-existent.	
	Physical and economic travel risks related to the waterway trajectory:		A comprehensive sociological study should be conducted to identify the locations of the acadjas, their owners and the fish sellers, who are often women belonging to vulnerable groups. Further monitoring will be needed to assess whether the owners of acadjas and the	

World Bank NES	Assessed E&S Negative Risk/Impact	Impact signification	Mitigation measures	Residual impact
	• Owners and users of acadjas and fish sellers (usually women) owning plots along the planned canal between Abomey-Calavi, Cotonou and Porto-Novo and projected artificial islands.		Displaced fish vendors have benefited from comparable economic opportunities and adequate compensation. In addition, resettlement plans and land acquisition records must be made accessible to all those affected by displacement. A grievance mechanism must be in place and maintained throughout the life cycle of the project. When all of the above mitigation measures are implemented, the impacts and risks will be less, but will remain high and significant due to the potential loss of revenue.	
	Changes in water quality and salinity levels due to increased saltwater intrusion through the new canals may impact Lake Nokoué's ecosystem services, including fishing activities (see SSE6 for more details). (See NES6 for details).		Post-dredging monitoring studies will be carried out to assess the services provided by the Lake Nokoué ecosystem and its potential impacts on fishing activities. In case of negative impacts, a comprehensive sociological study must be carried out to identify the affected populations (fishermen and fish sellers, usually women). Further monitoring is needed to determine whether affected populations can receive adequate compensation. A grievance mechanism must be in place and maintained throughout the project lifecycle. When all of the above mitigation measures are implemented, the impacts and risks will be less and no longer material.	
NES6: Conservation of biodiversity and sustainable management of living natural resources	Temporary disturbances caused by dredging will result in increased turbidity that could negatively impact the lake's biodiversity and ecology. At least temporarily (during dredging) and most likely only seasonally during the dry season. During the rainy season, the strong flow of water to the sea will reduce the impact of turbidity.		Depending on the site parameters, the appropriate dredging method should be selected in order to increase the accuracy of the dredging and minimize turbidity. The project shall carry out a risk assessment of the dredging activities as part of the development of a dredging management plan, in order to define the dredging method, the zone of influence (assessment of sensitive ecological receptors, possibly through a sediment plume propagation model), the measures to mitigate the negative effects on biodiversity and water quality, as well as relevant environmental monitoring parameters and indicators. According to the World Bank's EHS guidelines, the dredging schedule should take into account seasonal factors such as migration periods (fish and birds), breeding and growing seasons (lake flora), feeding timing, and periods when ecosystem resilience is reduced (e.g., after extreme weather events). When all of the above mitigation measures are implemented, the impacts and risks will be less and no longer material.	

World Bank NES	Assessed E&S Negative Risk/Impact	Impact signification	Mitigation measures	Residual impact
	Disturbance of macroinvertebrates and fish species due to noise and vibration from dredging activities and the construction of lake harbours (e.g. heave activities) is a possible risk and the impact can take several years.		Guidance on noise management, setbacks and acceptable noise levels can be found in the World Bank's General EHS Guidelines. As the project is located at RAMSAR site 1018, the measures to prevent, minimize and control underwater noise from pile driving in lake harbours, dredging and maintenance dredging are as follows:	
	Change in ecological values caused by changes in local bathymetry. The impact is generally considered positive because the current water levels of the lake are very low, leading to increased water temperatures and, consequently, a reduction in biodiversity. The increase in water depth will lead to a (partial) drop in water temperature and attract species that have been extinct for decades, thus improving biodiversity.		The project will include an Environmental and Social Management Plan (ESMP) to guide development activities. As part of the ESMP, post-dredging monitoring studies will be carried out to assess the new temperature dynamics and its potential impacts on the biodiversity of Lake Nokoué. In the event of adverse impacts, appropriate mitigation measures will be proposed and implemented.	

World Bank NES	Assessed E&S Negative Risk/Impact	Impact signification	Mitigation measures	Residual impact
	The dredging operations of the waterways will result in an increase in salinity levels in Lake Nokoué during periods of low water and a prolonged period of high salinity of approximately thirty (30) days. Although overall environmental conditions between September and February are expected to remain relatively unchanged, these alterations could have implications for the lake's ecosystem, including an increase in marine species and a one-month delay in the fishing season for brackish water species. These conclusions are based on a hydrodynamic study carried out prior to the ARNP-1 project. Although the study includes all the waterways to be dredged, only the connection between Abomey-Calavi, Cotonou and Porto-Novo is detailed in this report. Therefore, the impacts on the salinity of Lake Nokoué, although less significant than anticipated, cannot be neglected.		The project will include an Environmental and Social Management Plan (ESMP) to guide development activities. As part of the ESMP, post-dredging monitoring studies will be carried out to assess the potential impacts on the salinity dynamics of Lake Nokoué and on local biodiversity. Appropriate mitigation measures will be proposed and implemented.	
NES8: Cultural Heritage	Based on the limited information currently available, including an initial site review, the locations of selected lake ports, presumed interface routes and waterways do not appear to encompass cultural heritage sites.		A detailed cultural heritage survey should be carried out before construction work begins to identify potential cultural heritage sites and mitigate potential impacts. Establish a formal procedure for chance search before construction begins. When the above mitigation measures are implemented, impacts and risks will be reduced to zero.	
NES10: Stakeholder engagement and disclosure	Insufficient stakeholder engagement and lack of disclosure of information throughout the project lifecycle can lead to significant conflicts, loss of trust, and negative public perception of the project. However, from the outset of the ARNP project, a		A detailed stakeholder engagement plan should be developed and implemented prior to the commencement of construction activities. Regular consultations with identified stakeholders, including local communities, government agencies, and other relevant parties, should be conducted throughout the project lifecycle. The results of these consultations should be taken into account in the ESIA and in the team's technical design, in order to minimise environmental and social risks and impacts. The	

World Bank NES	Assessed E&S Negative Risk/Impact	Impact signification	Mitigation measures	Residual impact
	Intensive stakeholder engagement process has been implemented. In addition, the proposed plan for Lake Nokoué was presented to relevant government agencies at the national and municipal levels, as well as to a number of NGOs operating in the Benin Delta area and to representatives of the private sector.		The project's grievance mechanism, which addresses concerns and complaints, must be communicated during these consultations. In addition, information regarding the scope of the project, timing, potential environmental and social impacts, mitigation measures, the stakeholder engagement process and future opportunities for public consultation should be made public through the appropriate channels.	

5.1.1 Potential Impacts and Risks and Measures During the Decommissioning Phase

Potential impacts during the preparation, construction and operation phases have been extensively mentioned in Table 4-1 and Table 5-1. For the sake of completeness, the impacts of decommissioning are mentioned in this paragraph.

The decommissioning of the new lake ports is not planned in the short or even long term. Nevertheless, by proactively considering a possible decommissioning phase, a circular design approach can be implemented. This approach would facilitate the reuse of materials if lake ports were eventually to be decommissioned due to factors such as relocation, a shift to other types of vessels, or the need for urban development on land.

The conditions at the time of decommissioning are unknown at this stage. Environmental and social legislation may evolve, new opportunities for the reuse of materials may emerge, and socio-economic conditions as well as government policies may influence future development patterns in the country.

The decommissioning phase can present potential environmental and social risks and impacts, including health and safety issues, risks of forced or unintentional labour, air and noise pollution, dust emissions and increased traffic. The main environmental impact should be waste generation. The decommissioning process is not expected to result in job losses for lake port workers, as they may retrain to other sectors or regions depending on prevailing economic conditions. The decommissioning process is expected to generate temporary jobs as part of the demolition of port infrastructure. While some of the materials can be reused in construction projects, a significant amount is expected to become solid waste requiring proper disposal.

6 Reporting on Public Participation

The Public Participation Report presented here documents the consultations held during the preparation of the Strategic Environmental and Social Assessment (SESA) of the Phase's Action Plan 2 of the ARNP [14] project, which has been approved by the Beninese Environment Agency (EBA), the regulatory authority for EESS procedures in Benin. In accordance with national and international SEA regulations, a transparent and inclusive public consultation process was conducted throughout the SEA process to involve all relevant stakeholders.

In addition to meetings with the ARNP Steering Committee, the identified stakeholders were consulted regularly from the beginning of the project:

- During phase 1, a consultation tour with the populations living around Lake Nokoué and the Porto-Novo lagoon was undertaken in January 2022, as a first step. Following the tour, two consultation workshops were held with representatives of the parties

[14] *Strategic Environmental and Social Assessment, ARNP Project, Royal HaskoningDHV, 25 June 2024.*

stakeholders in Cotonou in February 2022. These workshops were preceded by targeted interviews with key stakeholders.

- Then, in Phase 2, a number of meetings were held with government stakeholders, in particular relevant agencies and ministries. In this context, in April and June 2022, eight workshops were organized with participants from various sectors (State, grassroots, NGOs, dredging/sand companies), as well as meetings with experts and meetings with potential Technical and Financial Partners (TFPs).

These processes were conducted with the goal of informing, gathering opinions and positions taken, and contextualizing issues related to the project. This chapter focuses exclusively on the workshops and concerns raised that are directly relevant to the scope of the project.

Box 1: Summary of stakeholder feedback on Phase 1 of the ARNP

During Phase 1 of the ARNP, 10 representatives of communities and cities were invited to one-day workshops, a first cycle in the communities themselves and twice in Cotonou. The following organizations and groups have been invited:

- Local communities: Fishermen and fisherwomen; women selling fish, river transport companies, sand extraction companies, fish farmers, market gardeners
- Organized Groups: Water Hyacinth Processors, Tourism
- Local authorities: Town hall, local ministerial offices The objectives of these workshops were to:
- Identify key stakeholders and community representatives interested in the project.
- Disseminate information to relevant stakeholders to raise awareness of the project.
- Increase the understanding of the project's stakeholders, including its context, objectives, opportunities and constraints.
- Gather feedback from relevant stakeholders to enrich the development of the project and ensure that the expected results appropriately meet the relevant needs of the people involved.

The most important comments from stakeholders were: By local communities:

- Decline in fish production
- Pollution of the lake
- Salinity of the lagoon
- Insufficient support and capacity building in the development of fish ponds
- Shortage of storage space for fishery products
- Shortage of good fish markets
- Invasion by aquatic plants, especially water hyacinth
- Erosion of the banks By organized groups and local authorities:
- Large parts of the lake bottom are very muddy
- Severe pollution of the lake and lagoon and the resulting poor water quality
- Shoreline Solid Waste Pollution
- Difficult commercial hyacinth collection
- Lack of sufficient markets to market water hyacinth products
- Flooding of irrigated arable land and reduced agricultural yields.
- Unclear land ownership
- Huge seasonal growth of water hyacinth
- The property/water tax is not sufficiently collected
- The beautiful view of the lake is not commercialized

Box 2: Summary of stakeholder feedback at the end of Phase 1 of the ARNP

At the end of Phase 2 of the ARNP, the final results of the project were presented to representatives of non-governmental stakeholder groups and governmental organizations.

- For the non-governmental stakeholder workshop, representatives of the following stakeholders were invited: transport companies, vegetable producers, fishers, women fish sellers, local NGOs working on and around the lake and lagoon, port managers, dredging companies.

• For the government stakeholder workshop, representatives of the following stakeholders were invited: all the town halls of the cities around the lake and lagoon, relevant ministries (such as Fisheries, Tourism, Transport, Environment, Spatial Planning, etc.), ecologists, environmentalists. The objectives of these workshops were to:

- Present the vision for the development of the water bodies to the target groups.
- Share the results of Phase 2, including the Action Plan for the next few years.

- Discuss the three proposed areas of investment and their environmental and socio-economic impact: (i) the development of river transport through dredging and port development, (ii) the development of shorelines and shoals, and (iii) the development of fisheries and aquaculture with protected areas.

The most important comments from stakeholders were:

- Overall, from all representatives of the different stakeholders, there was real satisfaction with the proposed vision and the three proposed areas of investment. However, feedback was provided to improve the plan and ensure a reduction in social and environmental impact. Relevant to this report were:

- Dredging must take into account the conditions of geomorphological and environmental equilibrium to avoid the risk of landslides (especially at shoals) in the long term and ecological disasters.
- Sediment extraction from water bodies and shoals could lead to increased erosion upstream of these ecosystems. It is suggested that this coherent solution package should include actions to limit this erosion upstream and avoid the rapid filling of these ecosystems.
- The package of coherent solutions on the shoreline and lowlands, as defined in the vision, does not sufficiently integrate agricultural aspects. This is all the more important as the Ministry of Agriculture has already planned various developments, particularly in the Calavi area, for fish farming purposes.
- The modernisation of the shores (including the new ports) must take account of local specificities so as not to have developments that only take into account urban development without taking into account rural realities. It is therefore necessary to ensure the maintenance of riparian habitats and associated fauna.
- Steps will have to be taken to establish a link between the Reinventing Ganvié (RG) project and the D2B project. As part of the RG project, it is planned to build 3 quays in the western area of Lake Nokoué. The construction of the wastewater treatment plant and docks requires a lot of sand that could come from the ARNP investment program.

6.1 ARNP Steering Committee

Meetings with the ARNP Steering Committee, the Project Coordination Unit and the consulting team took place in February, October and December 2022. At each meeting, a progress report was prepared and discussions took place on the reports and proposals, leading to directions and decisions for the further process.

6.2 Summary of Actions Implemented in the Context of the EESS

Details of the meetings and workshops with stakeholders held during Phases 1 and 2 of the ARNP project are provided in Appendices A12 and A13.

Table 6-1 Actions undertaken and methodological approach (Strategic Environmental and Social Assessment, ARNP project, Royal HaskoningDHV, 25 June 2024)

Actions	Methodological approach	Implementation period
Tour du lac	• Focus groups with a special focus on women • Team meetings at the municipal level	January 2022
Meetings with government agencies, GAP projects and private companies	• Individual interviews • Team meeting	February 2022
Consultation of local stakeholders	• Communications on the context of the project, summary of the conclusions of the tour of the lake, coherent solutions • Work in mixed professional social groups with a women-only circle • Plenary discussion of the results of the group discussions	February 2022
Consultation workshop for state actors	• Communications on the context of the project, summary of the conclusions of the tour of the lake, coherent solutions • Plenary Discussions	February 2022
Information workshop on coherent solutions	• Communication • Exchanges	April 2022
Thematic workshops on policy areas	• Communication • Exchanges	June 2022
Steering Committee Working Sessions	• Meeting	October 2022
Meetings with the town halls of Porto-Novo and Cotonou	• Meeting and visiting possible sites for lake ports	December 2022
Steering Committee Working Sessions	• Meeting	October and December 2022

6.3 Results of Actions Implemented in Connection with the EESS

Table 6-2 Results of actions implemented in connection with the EESS (Strategic Environmental and Social Assessment, ARNP Project, Royal HaskoningDHV, 25 June 2024)

Num.	Process	Results
1	Tour du lac	• Information from local communities • Information for local authorities and decentralised services • Collect and review the environmental and social impacts of the project • Consideration of stakeholder views in the formulation of options
2	One-on-one interviews with government agencies, MAP projects, and private companies	• Information from sectoral ministries and agencies • Implement a synergy of actions around the project
3	Consultation workshop with key stakeholders	• Consider the different perspectives of stakeholders
4	Consultation workshop for state actors	• Open discussion on sensitive topics such as acadjas • Specific concerns of women addressed in the project
5	Information workshop on coherent solutions	• Collection of expert opinions on fishing, transport and dredging. • Obtain advice from local and government authorities
6	Project-specific workshops	• Advice of technical experts on environmental and social assessment.
7	Working sessions and field visits for lake ports	• Good understanding of the local situation • Potential sites with investment opportunities for lake ports
8	Working sessions with the steering committee	• Adaptation of the holistic vision of the ARNP project to national policy.

Annex

A1 ARNP Institutional Framework

Water management in Benin is governed by:

- Institutional arrangements – central administration, national consultation framework (National Water Council (CNE)), coordination framework (Interministerial Commission for Water (CIE)), management structures (Basin Agency), consultation bodies (Basin Committee) for national river basins, transboundary basin authorities, etc.
- Legal and regulatory texts – the law on water management and its implementing texts;
- Planning documents – PANGIRE, SDAGE, SAGE, Delta Plan;
- Technical tools – monitoring networks, laboratories, databases, etc.
- Study and research centres – INE, IRHOB, CENATEL.
- This system should contribute to the integrated management of the country's water resources, particularly in the Ouémé delta. It appears that water management remains difficult, particularly surface water management, but also groundwater. The situation described in the previous sections reflects this observation. The integration of this management, or lack thereof, and its implementation are major challenges.

Water management affects a multitude of interests. Therefore, any intervention – or non-intervention – – that might be necessary deserves a concerted approach. In the event of intervention, the responsible structure (political and/or executive) should promote the consultation process for each project or programme of projects. Although consultation platforms exist (e.g. CNE, CIE), they remain subject to many constraints and lack efficiency. To date, there is no structural consultation platform covering the administrative area in which the ARNP project is implemented (the five major urban municipalities of Greater Nokoué: Ouidah, Abomey-Calavi, Cotonou, Sèmè-Kpodji and Porto-Novo; extended to the municipality of Ouidah). The body that comes closest to this is the Grand Nokoué intermunicipality, which still suffers from many constraints and lacks efficiency. Overall, meetings are organized on an ad hoc basis within the framework of a program or project, which does not allow for synergy in the involvement of stakeholders.

In order to ensure that the various interests are taken into account by the project and to ensure the coordination of the project, the Government of Benin, through the Ministry of Living Environment and Sustainable Development, has set up by Order 2021 No. 002/MCVDD/DC/SGM/DGEC/ADELAC/SA (002SGG21) the bodies for the implementation of the project, namely: a Steering Committee (SC) and a Project Coordination Unit (PCU), whose responsibilities and composition are specified below. The UCP is placed under the authority of the Minister of Living Environment and Sustainable Development.

The responsibilities of the Steering Committee are as follows:

- The Board of Directors is the steering and decision-making body;
- The PC provides political oversight and approves the general orientations of the ANRP project;
- The CP ensures that the management and impact of the project is taken into account in the State's development policies and strategies, and that the project has the necessary synergy with other sectoral projects.

In order to ensure the integration of the various interests and synergy with other sectoral projects in the lake and lagoon area, the CP is composed of the following partners:

- President: DG Environment and Climate (MCVT)
- Vice-President: DG Mines (MEM)

- Rapporteur: DG Agency for the Integrated Development of the Economic Zone of Lake Ahémé and its Channels (ADELAC/MCVT)
- Members (11):
  - DG Agriculture, Livestock and Fisheries – Ouémé (MAEP)
  - DG Transports Fluvio-Lagunaires (MCVT)
  - DG Eau (MEM)
  - DG National Agency for the Promotion of Heritage and Tourism Development (Presidency)
  - DG Beninese Environment Agency (MCVT)
  - DG Agency for the Rehabilitation of the City of Porto-Novo (MCVT)
  - Director of Sanitation and Urban Roads (MCVT)
  - Head of the Environmental Monitoring Laboratory (MCVT)
  - Head of the Legal Unit at the MPD
  - Portfolio Manager Netherlands at CAA (MEF)
  - Representative of the Embassy of the Kingdom of the Netherlands.

The Board of Directors is the decision-making body that selects proposals for investment projects, taking into account environmental and social aspects.

Table Main ministries, institutions and organizations involved in water bodies in the coastal zone.

		Institution	Global Responsibilities
1.	In the	Ministry of Living Environment and Transport in charge of Sustainable Development Ministries (formerly MCVDD) and its agencies involved (ADELAC, ABE, ANAT, ANPT, ARVPN, ...)	Planning, Public works, Transport, transport routes, ports, landing stages
2.	Water bodies of the Fisheries zone	Ministry of Agriculture, Livestock and Livestock (mainly DPH)	Fish production, fishing, livestock farming
3.	Coastal	Ministry of Water and Mines	Consultation, IWRM, surface water quality, sediment extraction
4.	Other government departments	• Ministry of Finance • Donors, the most important.	Financing

A2 Institutional Framework of the SUMP-GN

The environmental administration in Benin is headed by the Minister in charge of the Environment. An analysis of the institutional framework identifies several key institutional actors and their services involved in the implementation of this project.

- Ministry of Living Environment, Transport and Sustainable Development (MCVT):
- In order to achieve Benin's objective of giving priority to the environment, as enshrined in its constitution, a Ministry in charge of the environment was created in 1991. Currently called the Ministry of Living Environment, Transport and Sustainable Development (MCVT), it is responsible, among other things, for:
  - Define and periodically update the national policy on the environment, climate change management, reforestation and protection of fauna and flora, and implement related strategies and actions;
  - Develop and implement policies related to the fight against climate change and water, air and soil pollution;
  - Mobilize funding for the implementation of policies, plans, programs and projects in the sectors concerned;
  - Monitor and preserve marine, coastal and river ecosystems;
  - Monitor Benin's implementation of sustainable development commitments and international and regional conventions relating to its areas of competence. Within this Ministry, the main services to be involved in the implementation of the SUMP-GN are:
    - Beninese Environment Agency (EBA): A public institution created in 1995, it is responsible for the implementation of the national environmental policy adopted by the government as part of its development plan.
    - Directorate-General for the Environment and Climate (DGEC): Responsible for the development of national environmental policy.
    - Departmental Directorate of the Living Environment, Transport and Sustainable Development (DDCVT): Responsible for monitoring and controlling the application of standards and legislative and regulatory texts in the fields of the environment, nature protection, etc.
    - Environmental Units: These are functional units within all sectoral ministries and municipalities.
    - General Directorate of Water, Forests and Hunting (DGEFC): Responsible for the management of forest resources at the national level.
    - Ministry of Economy and Finance (MEF): Responsible for the design, implementation, monitoring and evaluation of the government's general economic, financial and monetary policy.
- National Agency for Land and Land (ANDF): Responsible for strengthening and simplifying access to land for the State and its local authorities.
- Ministry of Health (MOH): Responsible for the design and monitoring and evaluation of the State's health policy.
- Ministry of Labour and Public Service (MPTF): Responsible for defining, developing and monitoring the evaluation of the State's labour and civil service policy.

- Ministry of the Interior and Public Security (MISP): Responsible for ensuring the implementation and monitoring and evaluation of the orientations of the State's policy on internal security programming.
- Ministry of Social Affairs and Microfinance (MASM): Responsible for defining, promoting, steering, coordinating the implementation, monitoring and evaluation of State policy in the fields of social protection and child protection.
- Ministry of Decentralization and Local Governance (MDGL): Responsible for defining, monitoring and evaluating the State's policy on decentralization, deconcentration, local governance and grassroots development.
- Project Coordination Unit (PCU): Responsible for the coordination and management of fiduciary activities, monitoring and evaluation, environmental management and communication.
- Prefectures: Responsible for ensuring the application of national guidelines by the municipalities.
- Municipalities: Responsible for taking all measures to preserve public hygiene, improve the living conditions of the population and protect natural resources.
- Civil Society Organizations: Play a very important role in protecting the environment at the local level and mobilizing beneficiaries.

A3 Underground Sand Deposits of Lake Nokoué

Figure Areas identified for sand dredging potential (hatched in yellow) (Action Plan and Initial Investment Proposals, ARNP, January 2023)

A4 Seasonal Variations in Water Flow

The figures below illustrate typical water flow patterns during periods of low and high water. The arrows and numbers in red represent the average flow rates, as determined from the rating curves evaluated. The arrows and numbers in green represent the hypothetical (unmeasured) flows, inferred from previous analyses or from the conservation of mass. The double arrows and numbers in black represent the maximum tidal flows observed.

During the rainy season, water flows in the lake can be up to fifty times higher than those observed during the dry season.

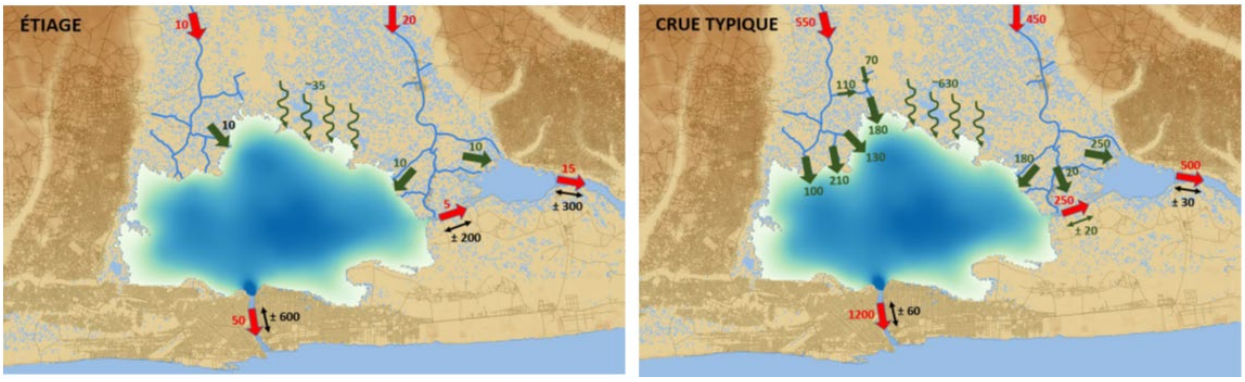

Figure Seasonal variations in water flow in the Lake Nokoué region. On the left, low water period, on the right, high water period (Hydrodynamic study of Lake Nokoué, IRHOB/ Research Institute for Development, December 2022)

A5 Water level in Lake Nokoué

Temporal evolution of the water level observed (in red) and modelled (in blue) at Ladji (mouth of Lake Nokoué with the Cotonou Canal) between February and December 2018.

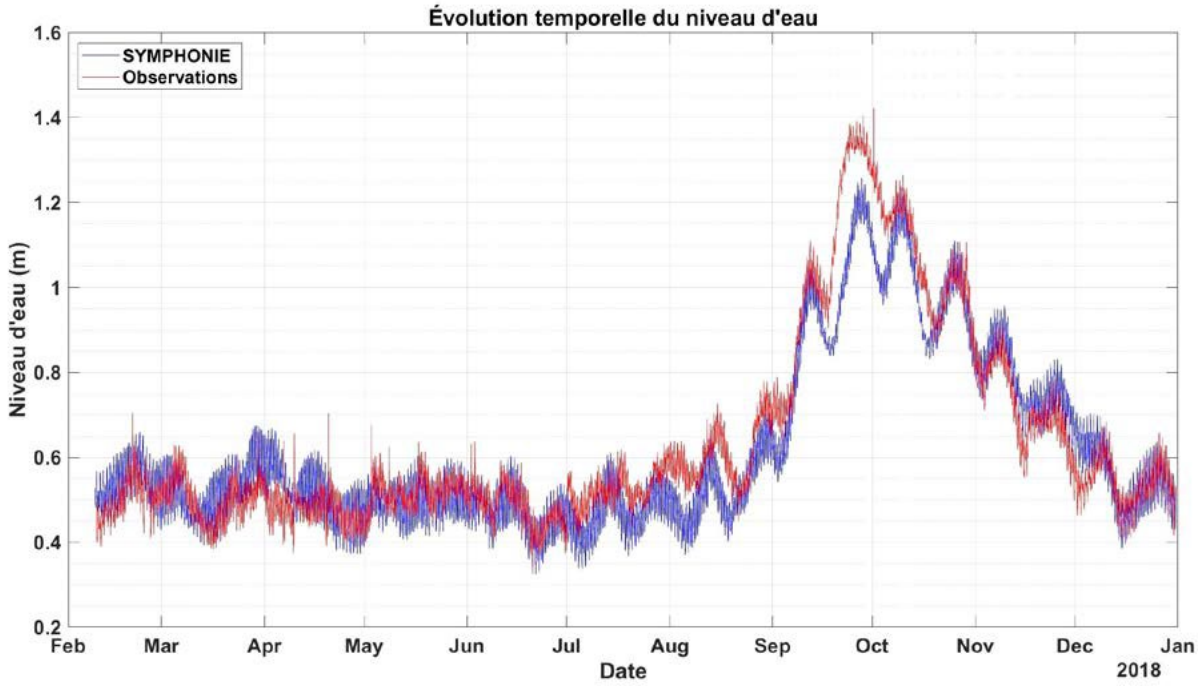

Figure Water level in Lake Nokoué (Hydrodynamic study of Lake Nokoué, IRHOB/ Research Institute for Development, December 2022)

A6 Water circulation in Lake Nokoué

The colours represent the intensity of the currents (in cm/s), while the streamlines are marked by black arrows.

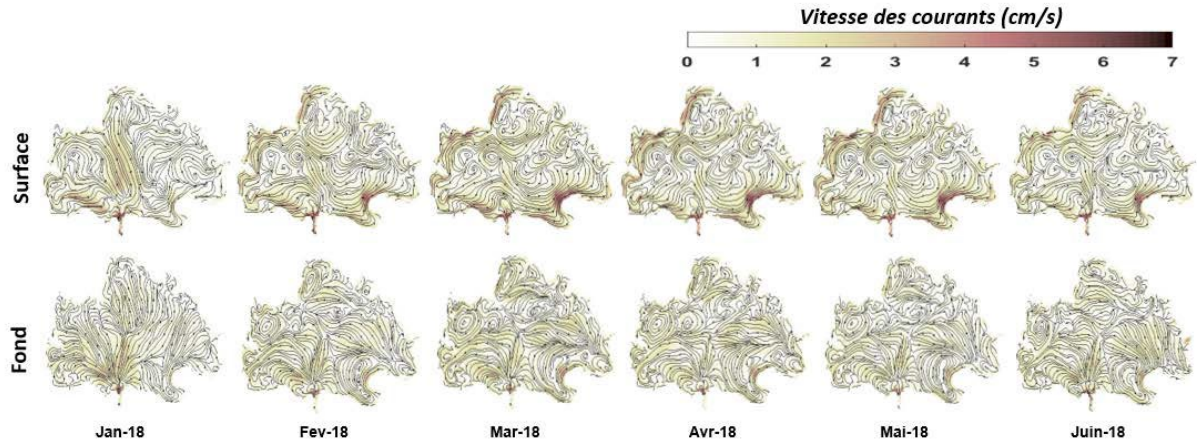

Figure Average surface (top line) and bottom (bottom line) circulation in Lake Nokoué between January and June (Hydrodynamic study of Lake Nokoué, IRHOB/ Institut de Recherche pour le Développement, December 2022)

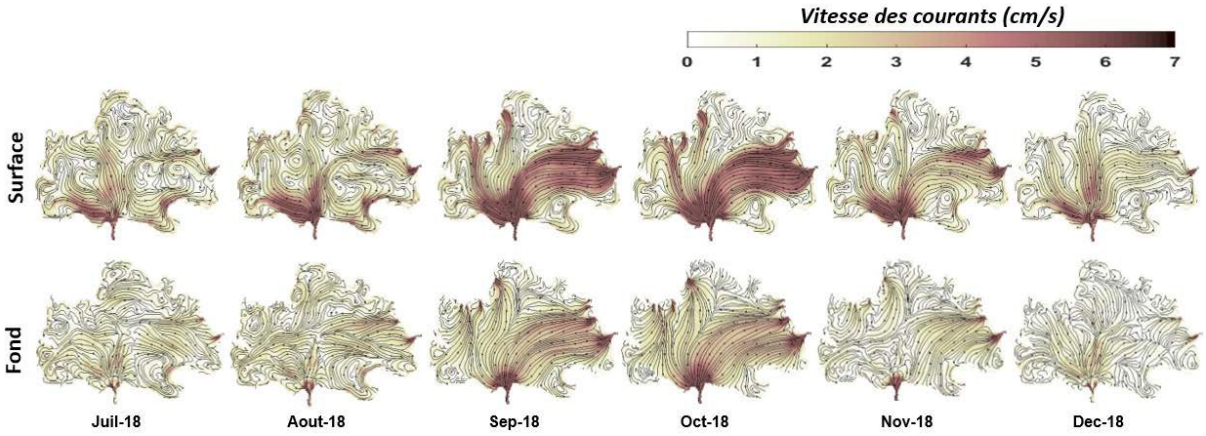

Figure Average surface (top line) and bottom (bottom line) circulation in Lake Nokoué between July and December 2018 (Hydrodynamic study of Lake Nokoué, IRHOB/ Institut de Recherche pour le Développement, December 2022)

A7 Water temperature of Lake Nokoué

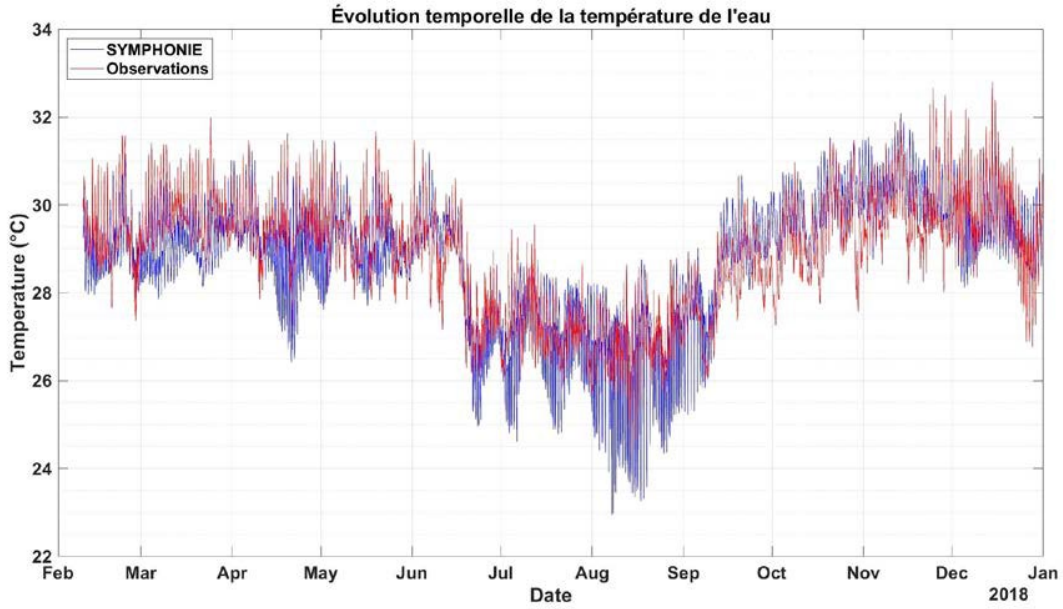

Figure Temporal evolution of the temperature observed (in red) and modelled (in blue) in Ladji (mouth of Lake Nokoué with the Cotonou Canal) between February and December 2018 (Hydrodynamic study of Lake Nokoué, IRHOB/ Institut de Recherche pour le Développement, December 2022)

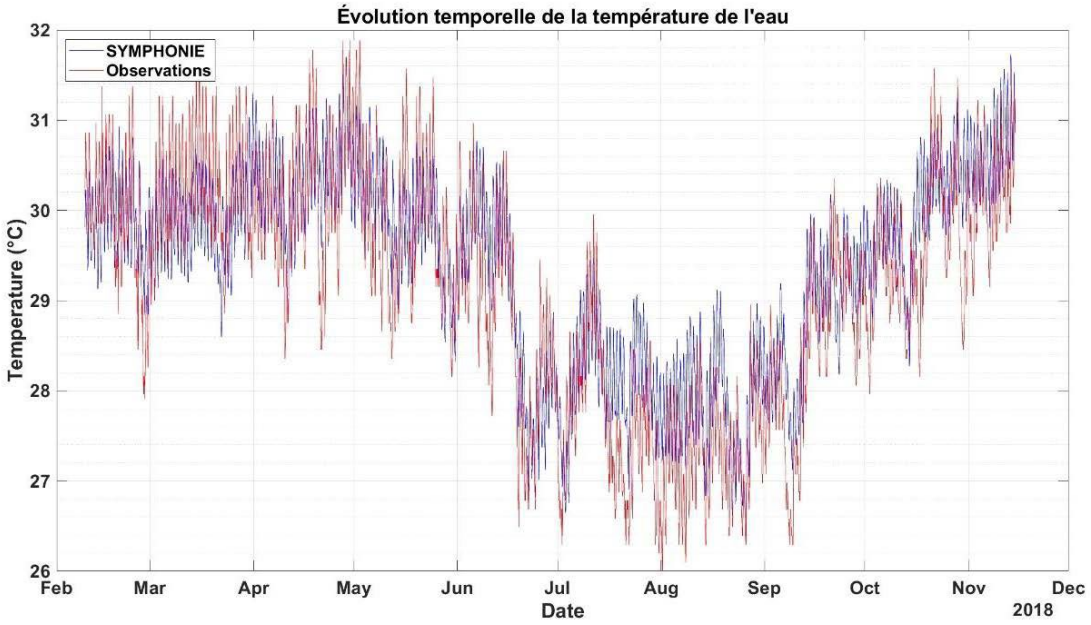

Figure Temporal evolution of the temperature observed (in red) and modelled (in blue) in the center of Lake Nokoué between February and November 2018 (Hydrodynamic study of Lake Nokoué, IRHOB/ Institut de Recherche pour le Développement, December 2022)

A8 Distribution of Salinity in Lake Nokoué

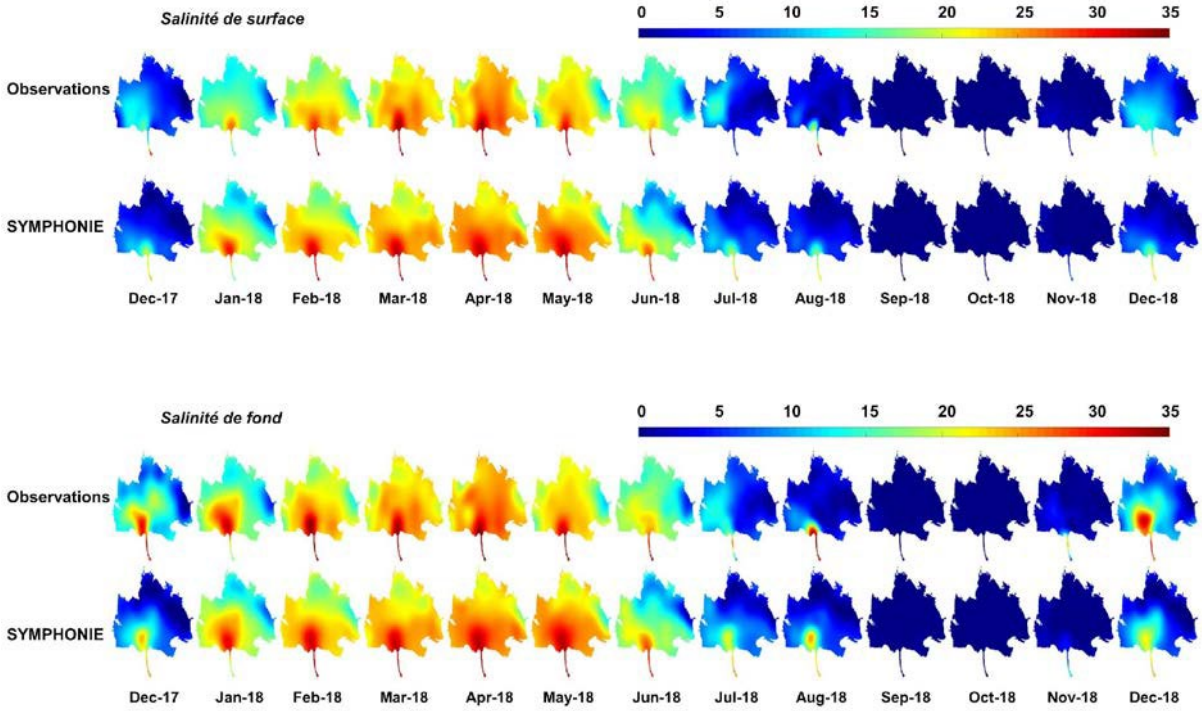

Figure: Monthly distribution of the bottom salinity of Lake Nokoué. In-situ data are presented on the top row, while fields modeled by SYMPHONIE are presented on the bottom row (Hydrodynamic Study of Lake Nokoué, IRHOB/ Institut de Recherche pour le Développement, December 2022)

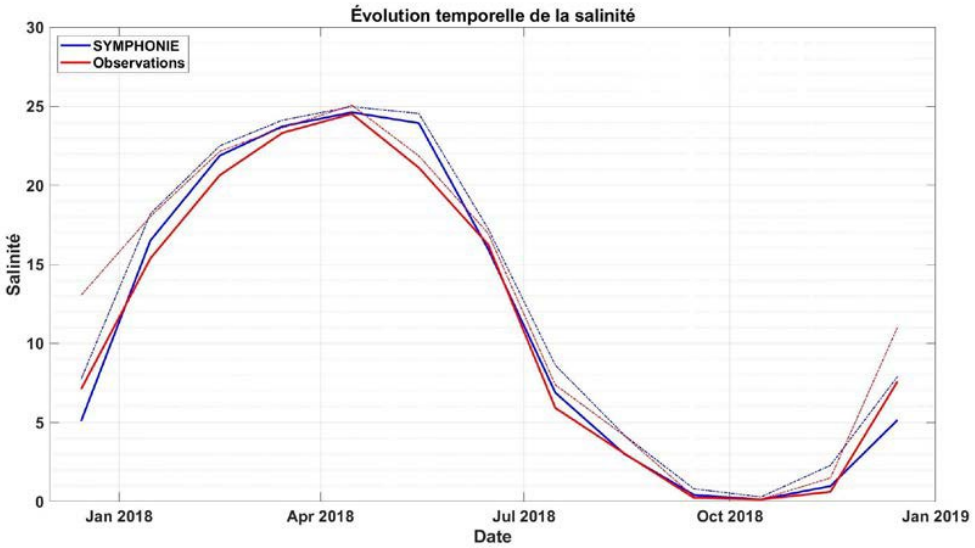

Figure Monthly evolution of the average salinity in Lake Nokoué, measured (in red) and modelled by SYMPHONIE (in blue) between December 2017 and December 2018. Surface salinities are indicated by bold lines and bottom salinities by fine dotted lines. (Hydrodynamic study of Lake Nokoué, IRHOB/ Institut de Recherche pour le Développement, December 2022)

A9 Phytoplankton population

During the ARNP, the following report was made:

LEMEA/FAST/UAC, IRHOBE, LSTE/INE. "State of knowledge and current state of water quality, the structure of 77hytoplankton, macroinvertebrates and the fish population of the lagoon complex of "Grand Nokoué", September 2023.

From this report, the following inventory is drawn:

The phytoplankton inventory identified 106 species in Lake Nokoué and 57 species in the lagoon of Porto-Novo. In Lake Nokoué, the dominant phytoplankton species in November were *Aulacoseira granulata* (27%), *Chroococcus subnudus* (13%) and *Microcystis sp.* (7%). But in January, *Aulacoseira granulata* (10%), Chaetoceros sp. (9%), Cyclotella menighiniana (6%), *Oedogonium sp.* (6%), *Thalasosira lacustris* (12%) and *Trachelomonas* sp. (13%) dominate the environment. In March, most of these species were replaced by others such as *Chaetorus* (16%), *Gyrosigma sp.* (12%), *Aulacoseira granulata* (8%), *Trachelomonas sp.* (5%) and *Euglena oxyuris* (5%), which were themselves replaced in June by a blend composed of *Eunotia sp.* (29%), *Mastogloia sp.* (21%), *Aulacoseira granulata* (13%) and Euglena sp. (5%). In August, the environment was populated by *Chaetoceros sp.* (33 *%), Closterium gracilla* (5%), *Synedra ulna* (5%) and *Lyngbya sp.* (5%).

In the Porto-Novo lagoon, phytoplankton were dominated in November by *Cyclotella menighiniana* (8%), *Melosira granulata* (7%), *Phacus sp.* (6%), *Lopocynclis fusiformis* (6%), *Phacus platalea* (6%), *Peridinium cintum* (5%) and *Anabaena sp.* (5%), and in January by *Melosira granulata* (77%) and *Chetoceros sp.* (7%). This blend was replaced in March by *Nitzschia sp.* (49%), *Gyrosigma sp.* (7%), *Peridinium cintum* (6%) and *Coscinodiscus sp.* (6%). All of these species disappeared in June, replaced by another assemblage including *Eunotia sp.* (50%), *Pinnulartia sp.* (7%), *Cymatopleura solea* (7%), *Fragilaria ulna* (6%) and *Aulacoseira granulata* (5%). Finally, the species characteristic of the lake population during the August survey were *Aulacoseira granulata* (10%), *Oscillatoria sp.* (10%), *Lyngbya sp.* (9%), *Synedra ulna* (8%), *Closterium gracilla* (8%) and *Fragilaria ulna* (6%).

A10 World Bank Environmental and Social Standards (ESS)

- **Environmental and Social Standard 1 (ESS1): Assessment and Management of Environmental and Social Risks and Impacts**

The ESS1 standard defines the borrower's responsibilities for assessing, managing and monitoring the environmental and social risks and impacts associated with each stage of a project supported by the Bank in the context of the financing of investment projects, in order to achieve environmental and social results in line with environmental and social standards.

- **Environmental and Social Standard 2 (ESS2): Work and Working Conditions**

The SSE2 recognizes the importance of job creation and income generation in the pursuit of poverty reduction and inclusive economic growth. Borrowers can promote good worker-management relations and enhance the development benefits of a project by treating project workers fairly and providing them with safe and healthy working conditions.

- **Environmental and Social Standard 3 (ESS3): Resource Efficiency and Pollution Prevention and Management**

The SSE3 recognizes that economic activity and urbanization often generate air, water and soil pollution, and consume limited resources that can threaten people, ecosystem services and the environment at local, regional and global levels. The current and projected atmospheric concentration of greenhouse gases (GHGs) threatens the well-being of current and future generations. At the same time, more efficient use of resources, pollution prevention and avoidance of GHG emissions, and mitigation technologies and practices have become more accessible and feasible.

- **Environmental and Social Standard 4 (ESS4): Community Health and Safety**

ESS4 recognizes that project activities, equipment, and infrastructure can increase the community's exposure to risks and impacts. In addition, communities that are already subject to climate change impacts may also experience accelerated or intensified impacts as a result of project activities.

- **Environmental and Social Standard 5 (ESS5): Land Acquisition, Land Use Restrictions and Involuntary Resettlement**

ESS5 recognizes that project-related land acquisition and land use restrictions can have negative impacts on communities and individuals. Project-related land acquisition or land use restrictions can result in physical displacement (resettlement, loss of residential land or loss of housing), economic displacement (loss of land, assets or access to assets, resulting in loss of income sources or other livelihoods), or both. The term "involuntary resettlement" refers to these impacts. Resettlement is considered involuntary when affected individuals or communities do not have the right to refuse land acquisition or land use restrictions that result in displacement.

- **Environmental and Social Standard 6 (ESS6): Conservation of biodiversity and sustainable management of living natural resources**

The SSE6 recognizes that the protection and conservation of biodiversity and the sustainable management of living natural resources are fundamental to sustainable development. Biodiversity is defined as the

variability between living organisms from all sources, including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; This includes diversity within species, between species and ecosystems. Biodiversity is often the basis of ecosystem services valued by humans. Impacts on biodiversity can therefore often be detrimental to the provision of ecosystem services.

- **Environmental and Social Standard 8 (ESS8): Cultural Heritage**

The SSE8 recognises that cultural heritage provides continuity in tangible and intangible forms between the past, present and future. People identify with cultural heritage as a reflection and expression of their evolving values, beliefs, knowledge, and traditions. Cultural heritage, in its many manifestations, is important as a source of valuable scientific and historical information, as an economic and social asset for development, and as an integral part of people's cultural identity and practices. The HSE8 sets out measures to protect cultural heritage throughout the life cycle of the project.

- **Environmental and Social Standard 10 (ESS10): Stakeholder Engagement and Information Disclosure**

This SSE recognises the importance of open and transparent engagement between the borrower and project stakeholders as an essential element of international good practice. Effective stakeholder engagement can improve the environmental and social sustainability of projects, improve project acceptance, and contribute significantly to the successful design and implementation of projects.

A11 Sediment Quality Assessment in Lake Nokoué

Introduction and Purpose

For the ARNPARNP, an assessment of the sediment quality of Lake Nokoué and the Porto-Novo Lagoon was carried out over the period 2022/2023. d. In this note, Royal HaskoningDHV assesses whether the information provided by the ARNP provides sufficient information on the quality of the sludge and sediment in the lake to be used for the environmental assessment of the SUNC-GN (partial transport in the lake) project.

The following reports are used to determine sediment quality:

- 1: Mission report of manual surveys by retaining casing and lithological description of sediments on lakes Toho, Porto-Novo, Nokoué and the Djonou bridge sector, LSTEE and LEMEA September 2023;
- 2: Project for the development and rehabilitation of Lake Nokoué and the Porto-Novo lagoon, develop2build project, State of knowledge and current state of water quality, phytoplankton structure, macroinvertebrates and fish population of the lagoon complex of "greater Nokoué" (Lake Nokoué, Porto-Novo lagoon, Djonou River, Lake Toho-Todougba), LEMEA, IRHOB CBRSI and LSTEE, September 2023;
- 3: Project for the development and rehabilitation of Lake Nokoué and the lagoon of Porto – Novo: quality of sediments of Lake Nokoué, Toho, the lagoon of Porto – Novo and the Djonou sector, LSTEE and LEMEA September 2023.

Based on this information, we assess whether the soil quality of the dredged sediments can be used to build the ecological islands or to deposit the sediments on the agricultural fields on the shoreline.

Research Summary

The rivers that flow into Lake Nokoué influence the quality of the sediments as well as the various industries that discharge their wastewater into the lake. In January 2023, research was carried out in the sediments of "Lake Nokoué" to determine the physical and chemical characteristics of the sediments. This was done within the framework of the project (ARNP) for the development and rehabilitation of Lake Nokoué and the Porto-Novo pond.

During the research, sediment was collected from 43 boreholes in the lake. Of these holes, 32 were at a depth of 10 m below bottom level, 4 drill holes were between 2 and 4 metres below bottom level, and 7 drill holes were drilled to a depth of 10.5, 11 or 11.5 metres below the sediment surface. Sediment samples were collected at depths of 0.3, 2, 5 and 8 metres below bottom level. The sediment layers consist of a layer of shells (0-0.5 m below bottom level) with different layers of clay or sandy clay. Under the clay layers (sandy) there is a layer of sand up to the maximum depth of 10 meters. For a complete explanation of the sediment structure, we refer to the research report. Samples were taken from each layer. It is unclear whether mixed samples were collected in the laboratory or whether each sample is analyzed individually.

The samples were analyzed for heavy metals (Cadmium [Cd], Cobalt [Co], Copper [Cu], Lead [Pb], Manganese [Mn], Zinc [Zn], Iron [Fe]). For iron, only a percentage is given. Iron is not evaluated.

The results of laboratory analyses for heavy metals were evaluated based on the Macdonald et al. Macdonald et al. (Development and evaluation of consensus-based sediment quality guidelines for

freshwater ecosystems, 2000) and probable effect concentration (PEC).

Other sources of contamination include agricultural runoff (pesticides and nutrients), municipal waste (landfill and city runoff) and industrial discharges (heavy metals, mineral oils, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs)). These sediment quality guidelines are used to assess sediment quality in aquatic environments and predict the potential for adverse effects on sediment-dwelling organisms.

- Threshold effect concentration (TEC): This is the concentration below which adverse effects on aquatic life are not expected. It represents a safe level for most organizations.
- Probable effect concentration (PEC): This is the concentration above which adverse effects are expected to occur most frequently. It indicates a higher risk of harm to aquatic organisms.

The TEC and PEC values determined by Macdonald et al. 2000 are shown in the table below:

Macdonald (2000) TEC and CEP Values Table

ETM	With	Cr	Zn	Like	CD	Pb
TEC (mg/kg)	31	43,3	121	9,79	0,99	35,6
CEE (mg/kg)	149	111	459	33	4,98	128
0,3 m	18.79		86.74		1.88	28.88
2,0 m	16,6		68.62		1.51	27.2
5,0 m	22,97		57.94		2.71	16.96
8,0 m	23,24		57.42		3.63	18.88

In Report 3, the average values of heavy metals are compared to previous research conducted on the sediments of Lake Nokoué. The values of lead, iron, and manganese are higher than those found in previous research. Zinc, copper and cadmium are lower than those obtained in previous research.

When comparing the mean values with the CET and the PEC, zinc, copper and lead are below the reference value. Cadmium in the upper layers contains values above TEC but below PEC. The remaining metals could not be assessed as the TEC and CEE have not yet been determined. The report indicates that the sediment contains cadmium levels that could pose a danger to the environment and benthic organisms.

Regulatory framework

The results of the research described above are evaluated on the basis of Dutch and Canadian standards. Instead of using average values, maximum values are used in the worst case.

Dutch standards The results of the chemical analysis of soil and groundwater were compared with Dutch standards for soil and groundwater quality. The regulatory document applicable to soil and groundwater standards is the "Bodemsanering Circular 2013". This document provides detailed guidelines and standards

for the assessment and remediation of contaminated soils; in the Netherlands. The intervention values described in the Bodemsanering Circular are based on a careful review of scientific research, risk assessment and a commitment to the protection of human health and the environment. These values are derived from a combination of factors, including toxicological studies, epidemiological data, environmental standards, and a comprehensive understanding of the potential risks associated with various contaminants.

In the Netherlands, the quality of dredged material (sediment) is assessed according to the standards of the Soil Quality Decree (Bbk), which sets the rules for spreading soil and dredged material on or in soil or surface water. The Soil Quality Decree distinguishes three functions for surface waters: region-specific agriculture/nature, and dispersal. For the application of dredged materials in fresh water surface, the dispersion function applies. This means that dredged material must not have adverse effects on water quality and the ecosystem. Dredged material must comply with the maximum values of the parameters specified in the soil quality regulation. In addition, the dredged material must originate from the same or a comparable water body, and the application must align with the water management plan of the water authority having jurisdiction.

The specific class for dredged material in surface fresh water is T.106. This means that dredged material is suitable for freshwater dispersal, provided it meets the applicable standards. In addition to this, there is also the class of dredged material intended for use in freshwater bodies and receiving sediments (T.103a, T.103b) and the class of dredged soils and cuttings when applied to land (T.101) or soil of interest.

In the following table, the values for these classes are shown.

Canadian Standards In Canada, soil quality is assessed using the Soil Quality Guidelines (SQG). These guidelines provide recommended concentration levels for various contaminants in soil, such as heavy metals and organic compounds. Levels are established based on scientific assessments of potential risks to human health and the environment.

Sediment quality is assessed using the Interim Sediment Quality Guidelines (AQGs) and the Probable Effect Level (PEL). The QISQ indicates the concentration below which no adverse effects on aquatic life are expected, while the PEL represents the concentration at which adverse effects are likely. These standards guide the assessment of sediment contamination and assist in decision-making regarding the management of contaminated sites.

In practice, these guidelines are applied by regulatory agencies, environmental consultants, and institutions to assess and manage the impact of contaminants in soil, groundwater, and sediment. Compliance with these standards ensures that environmental quality is maintained and potential risks are minimized.

The table below shows the Dutch and Canadian standards and the maximum values for heavy metals are evaluated.

Table Values of Dutch and Canadian standards and evaluation of the maximum values measured during the research in 2023.

Metal	Dutch standards			Canadian	Maximum values per depth			
mg/kg DM	T.103a/b	N° T.106	N° T.101	SQG	0,3 m	2 months	5 months	8 months
Cadmium [Cd]	14	14	13	0.6	1.88	1.51	2.71	3.63
Cobalt [Co]	240	240	190	-	32.19	26.93	33.04	32.03
Copper [Cu]	190	190	190	35.7	18.79	16.5	22.97	23.24
Lead [Pb]	580	580	530	35	28.88	27.2	16.96	18.88
Manganès and [Mn]	-	-	-	-	1488.12	1403.76	1038.08	853.45
Zinc [Zn]	2000	2000	720	123	86.74	68.62	57.94	57.42

Based on the evaluation of the maximum values with the Dutch and Canadian standards as well as the PEC and TEC, only the cadmium values are higher than the Canadian standards and the CET. This indicates that, according to Macdonald et al. (2000), cadmium concentrations in sediments can have adverse effects on aquatic life. However, the value is lower than the PEC, so the effects are not expected to occur more frequently. For manganese, there are no standards available.

The results show that cadmium concentrations in the 0.3 and 2 metre layers are highest in the northern part of the lake. As in the deeper layers, the highest concentrations are found in the southern parts of the lake. Based on the results, it is unclear where and in which sediment layer concentrations are above the TEC and/or Canadian standards.

Conclusion/Recommendations

Based on the information retrieved, the following conclusions can be drawn:

- Only the heavy metals Cadmium [Cd], Cobalt [Co], Copper [Cu], Lead [Pb], Manganese [Mn], Zinc [Zn] and Iron [Fe] are analyzed.
- It is unclear which layers are being analyzed and whether samples are combined in the laboratory prior to testing. For this reason, it is not clear in which layers (clay, sandy clay, etc.) the high concentration values are measured. The extent of the contamination cannot be determined.
- On the basis of Dutch standards, the values of heavy metals do not exceed the intervention values. These are environmental standards used in the Netherlands to determine when soil and groundwater contamination is severe enough to require remediation. These values are set for a variety of contaminants and indicate the concentration levels at which there is a significant risk to human health and the environment.
- Cadmium levels exceed Canadian standards and the CET value. This indicates that the concentrations may have adverse effects on aquatic life.
- To get a complete picture of potential environmental risks, it is recommended to also look for other parameters:

- Polycyclic aromatic hydrocarbons (PAHs): Contamination from industrial processes, vehicle emissions, waste disposal, and agricultural practices. May have significant adverse effects on ecosystems and human health.
- Total petroleum hydrocarbons (TPH): Contamination with petroleum-based products (gasoline, lubricant). May have significant adverse effects on ecosystems and human health.

- Polychlorinated biphenyls (PCBs): Contamination from industrial and commercial activities.
- Organochlorine pesticides (OCPs): Contamination from agriculture and industrial processes. Chlorobenzenes: Contamination from industrial activities, chemical manufacturing, and waste disposal.
- Tributyltins (TBT): Contamination from industrial and commercial activities (e.g., antifouling paint).
- Dioxins (PCDD/PCBE): Contamination from industrial processes (e.g., pesticides, metallurgy), diesel exhaust, waste incineration.
- Other heavy metals (As, Cr, Ni, Hg, Ba, Mo): Contamination from industrial activities, agriculture, mining or urbanization.
- Cyanide: Contamination from mining, metal plating, gasworks, and chemical manufacturing.

A12 Public Participation in the Preparation of the EESS – Phase 1

- **Tour of the lake and lagoon**

The visit to Lake Nokoué and the Porto-Novo pond was the very first step in the consultation process implemented within the framework of the ARNP project. The objective of this approach was to inform stakeholders about the project, to gather their consent and their proposals in order to evaluate, from the outset, the environmental and social issues that the project's choices are likely to generate, and to anticipate the means of mitigating them. The tour allowed us to identify the main stakeholders: local communities, civil society organizations and groups, municipal and government authorities.

The various actors identified around Lake Nokoué and the Porto-Novo pond, grouped into three categories of stakeholders: local communities, non-governmental organizations (NGOs) and government and local authorities.

- **Targeted interviews**

In order to consolidate the achievements of the tour of Lake Nokoué and the Porto-Novo pond, meetings were organized with sectoral ministries, structures in charge of PAG projects, specialized companies and technical partners in the project area. These meetings were also an opportunity to explain the issues at stake in the stakeholder consultation workshop and to invite representatives of these various bodies to attend.

The table below summarizes the interviews conducted as part of this first phase of the project.

Table Summary of the targeted interviews conducted during Phase 1 of the ARNP project (Strategic Environmental and Social Assessment, ARNP project, Royal HaskoningDHV, 25 June 2024)

No.	Categories	Organisations
1	Sector Ministries	• Directorate-General for River and Lagoon Transport • General Directorate of Mines • Fisheries Production Department • Ministry of Finance
2	PAG	• National Agency for the Promotion of Tourism (ANPT) • Northern Bypass Project • Agency for the Rehabilitation of the City of Porto-Novo
3	Specialized companies	• Boskalis • INE Laboratory
4	TFP	• APB • EU

- **Stakeholder consultation**

Two group consultations were held in February 2022 with stakeholders (field and state actors) in a participatory and inclusive manner. One of the objectives was to share with these stakeholders the synthesis of the findings of the tour of Lake Nokoué and the Porto-Novo pond, and to discuss the coherent solutions proposed by the project team. It should be noted that the findings of the grassroots stakeholder consultation were presented to the state's stakeholder group.

Table of stakeholders engaged in group consultations (Strategic Environmental and Social Assessment, ARNP project, Royal HaskoningDHV, June 25, 2024)

Type of consultation	Stakeholder category	Stakeholder groups/organizations
Consultation with key stakeholders	Local community	• Fishermen (7) • Mareyeuses (6) • River transporters (3) • Fish farmers (9) • Market gardeners (4) • Sand and dredging companies (2)
	Groups and non-governmental organizations	• ONG d'abeilles (1) • Green Guardian (1) • Yevev ONG (1)
	Administration municipale	• Cotonou City Hall (3) • Mairie de Porto-Novo (1)
Consultation with government authorities	Administration central	• ANPT (1) • APRM (1) • Data collection (1) • DGEau (1) • ADAT (7) • DDAEP Littoral (1) • DDAEP Ouémé (2) • MIT 1 • ARPN/MCVT (1)
	TFP	• APB (1)

A13 Public Participation in the Preparation of the ESA – Phase 2

- **Solutions Information Workshops**

The second phase of the ARNP project started with information workshops in April 2022 on the three action areas. A total of four workshops were held to discuss the lines of action with the resource persons identified among the stakeholders.

Table Profiles of Stakeholders and Stakeholder Groups/Organisations (Strategic Environmental and Social Assessment, ARNP Project, Royal HaskoningDHV, 25 June 2024)

Ateliers d'information	Stakeholder profile	Stakeholder groups/organizations
Transport fluvial	• Expert in mobility in lagoon systems • Water and Forestry Inspectorate • Expert in natural resources and living environment • Dock managers • Director of a company specialising in inland waterway transport	• ADELAC • Republican Police Headquarters • River transport company (Only God) • Mairies de Porto-Novo • Mairie d'Ab! - Calavi • Ministry of Infrastructure and Transportation • Fisheries Production Department • Université d'Abomey-Calavi
Dragage/construction	• Environmental Regulation and Control Specialist • Civil Engineer • Expert in sedimentology	• Porto-Novo Rehabilitation Agency • Mairie de Porto-Novo • Université d'Abomey-Calavi • UNA • ADELAC • EBA (MCVT)
Fishing and fish farming	• Expert in fisheries and aquaculture • Fish species specialist • Aquaculture Technician • Expert in local governance	• IEBA • DPH • User control • ADAT • EBA • Mairie de Porto-Novo • ARNP
Protected Area Management	• Specialist in biological and ecological monitoring of water bodies • Wetland Specialist • Landscaping expert • Development and Infrastructure Specialist	• User control • DPH • CENAGREF/MCVT • UNA • CFEB • DGR • ADAT • EBA • ARNP

- **Technical workshops**

During this second round of Phase 2 workshops in June 2022, a total of four technical workshops were held. Only one workshop is relevant to the project.

Summary table of actions undertaken and methodological approach (Strategic Environmental and Social Assessment, ARNP project, Royal HaskoningDHV, 25 June 2024)

Ateliers d'information	Stakeholder profile	Stakeholder groups/organizations
Workshop on Environmental, Social and Safety Issues	• Academics • Sector ministries	• EBA • Anat/MSCV • UNA • User control • INRAB • ARPN

- **Information and working sessions with TFPs, technical meetings**

In this second phase, discussions and meetings continued throughout 2022 with donors and technical partners, including the French Development Agency (AFD), the Embassy of the Netherlands, the local consortium of laboratories, the municipalities of Porto-Novo and Cotonou, and the ministries and agencies concerned, in order to enrich the discussions and obtain new commitments for the project.

In October and December 2022, 2 working sessions with the Steering Committee were held to discuss the holistic vision for Greater Nokoué.