Intended for
Bugesera Airport Company Limited

Date
January 2018

Project Number
UK11-24483

NEW BUGESERA INTERNATIONAL AIRPORT ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT REPORT- BIODIVERSITY

RAMBOLL ENVIRON

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11. BIODIVERSITY

11.1 Introduction

This chapter of the ESIA Report considers the potential impacts of the Proposed Project on biodiversity. It predicts and evaluates the potential impacts of the Proposed Project on biodiversity, arising from both the construction works and operation of the completed Proposed Project.

This chapter provides a description of the biodiversity baseline of the NBIA Project Area and identifies the potential impacts on the biological environment arising from the Project activities. The assessment follows the recommendations and requirements of the IFC Performance Standard 6 (PS 6): Biodiversity Conservation and Sustainable Management of Living Natural Resources, as well as the African Development Bank's Integrated Safeguards System in relation to Biodiversity. The chapter and accompanying appendices have been updated to provide additional information on biodiversity and wet season data.

This chapter is accompanied by the following technical appendices:

- Technical Appendix 11.1: Critical Habitat Assessment
- Technical Appendix 11.2: Biodiversity Baseline Data
- Technical Appendix 11.3: Ecosystem Services Review

11.2 Policy, Legal and Administrative Framework

The biodiversity assessment has considered relevant Rwandan legislation, applicable standards and guidelines for international finance, and international agreements to which Rwanda is a signatory. Applicable policy and legislation relevant to the ESIA are presented in Chapter 2 Policy, Legislative and Regulatory Framework, with those of particular relevance to biodiversity summarised in the following sub-sections.

11.2.1 International Agreements

Rwanda is a signatory to a number of conventions relevant to the biodiversity assessment. These are listed in Table 11-1:

Table 11-1: International Biodiversity Agreements

Name of Convention	Application
The International Convention on Biological Diversity and its habitat signed in Rio De Janeiro in Brazil on 5 June 1992, as approved by Rwanda Presidential Order No 017/01 of 18 March 1995.	The Convention is a multilateral treaty with three main goals. These are the conservation of biodiversity, the sustainable use of its components, and the fair and equitable sharing of benefits arising from genetic resources.
The Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA)	The agreement aims to conserve migratory water bird species.
The convention on International Trade and Endangered species of Wild Fauna and Flora (CITES), Washington (1973)	CITES is a multilateral treaty to protect endangered plants and animals. It aims to ensure that international trade in specimens of wild animals and plants does not threaten their survival.

Table 11-1: International Biodiversity Agreements	
Name of Convention	**Application**
The RAMSAR International Convention of February 2, 1971 on Wetlands of International importance, especially as water flows habitats as authorized to be ratified by Rwanda Law No 37/2003 of 29 December 2003.	The RAMSAR Convention is an international treaty for the conservation and sustainable use of wetlands.
Convention on the Conservation of Migratory Species of Wild Animals, (CMS), Bonn, 1979	The Convention on the Conservation of Migratory Species of Wild Animals (also known as CMS or the Bonn Convention) aims to conserve terrestrial, aquatic and avian migratory species throughout their range.
United Nations Convention to Combat Desertification (UNCCD)	The United Nations Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification, particularly in Africa (UNCCD) is a Convention to combat desertification and mitigate the effects of drought through national action programs that incorporate long-term strategies supported by international cooperation and partnership arrangements.

International conventions are implemented at the country level through its policies and legislation which are described in Section 11.1.3 below. However, the chapter takes into account biodiversity features that are the subject of the international conventions, particularly legally protected areas, internationally recognised areas (such as Ramsar sites) and migratory species. The chapter has applied the mitigation hierarchy to avoid, reduce, and compensate impacts to biodiversity.

11.2.2 Rwandan Institutional Framework

It is the responsibility of the Ministry of Infrastructure (MININFRA), together with the Rwanda Environment Management Authority (REMA), Rwanda Development Board (RDB) and their affiliated organisations to formulate policies concerning the conservation of biodiversity in Rwanda; designate and manage protected areas; to develop and implement plans and programmes; and to carry out activities in this scope and to provide coordination among all relevant institutions.

Relevant affiliated organisations and government departments associated and responsible for conservation and sustainable use of biodiversity in Rwanda are summarised in Table 11-2.

Table 11-2: Institutional Framework		
Institution	**Roles and Responsibilities**	**Application**
Ministry of Natural Resources (MINIRENA)	MINIRENA has the responsibility for developing land utilization policies (including surveying, land classification, land laws and land tenure); the development of environmental policies and procedures (including impact assessments), protection of natural resources (water, land, flora, and fauna), environmental legislation, biodiversity, and other environmental aspects informed by the Environment Law among others.	The policies and laws that promote protection of natural resources exist and can benefit biodiversity if implemented.

Table 11-2: Institutional Framework

Institution	Roles and Responsibilities	Application
Rwanda Development Board (RDB)	The institution is responsible for development projects and has a department responsible for EIA processes including reviewing all projects EIA reports before approval of the implementation of the projects.	Critical analysis of the EIA reports with specific attention to biodiversity.
Rwanda Environment Management Authority	The roles and responsibilities of REMA include: To advise the Government on legislative and other measures for the management of the environment or the implementation of relevant international conventions, treaties and agreements in the field of environment, as the case may deem necessary. To take stock and conduct comprehensive environmental audits and investigations, to prepare and publish biannual reports on the state of natural resources in Rwanda. To undertake research, investigations, surveys and such other relevant studies in the field of environment and disseminate the findings. To ensure monitoring and evaluation of development programs in order to control observance of proper safeguards in the planning and execution of all development projects, including those already in existence, that have or are likely to have significant impact on the environment. To render advice and technical support, where possible, to entities engaged in natural resource management and environmental protection.	Advice to avoid negative impacts on biodiversity.
Rwanda Natural Resources Authority (RNRA)	Rwanda Natural Resources Authority hosts the Departments: Land and Mapping, Integrated Water Resources, Geology and Mines, and Forestry and Nature Conservation. They are responsible for overseeing and management of national water resources, minerals, forests, national parks, and other protected areas.	The authority ensures that all natural resources in Rwanda are utilised sustainably for the present and future generations.

11.2.3 Rwandan National Policy, Laws and Regulations

Rwandan policies relating to biodiversity are summarised in Table 11-3 below. Laws and regulations for conservation and sustainable use of biodiversity in Rwanda is presented in Table 11-4. Of those listed, the most relevant to the Proposed Project is the Rwanda Environment Policy, 2003[1] and Rwanda Wildlife Policy, 2013[2], the Organic Law N° 04/2005 of 08/04/2005[3] and the Law N° 70/2013 of 02/09/2013 Governing Biodiversity in Rwanda[4].

[1] Republic of Rwanda Ministry of Lands, Resettlement and Environment (2003) Rwanda Environmental Policy.
[2] Republic of Rwanda Ministry of Trade and Policy (2013) Rwanda Wildlife Policy.
[3] Republic of Rwanda (2005) Organic Law No 04/2005 of 08/04/2005 Determining the Modalities of Protection, Conservation and the Promotion of the Environment in Rwanda. Official Gazette of the Republic of Rwanda.
[4] Republic of Rwanda (2013) Law N° 70/2013 of 02/09/2013 governing biodiversity in Rwanda

Table 11-3: Policy Framework on Biodiversity

Policy	Description	Application
Rwanda Environmental Policy, 2003	This policy's overall objective is to improve wellbeing of the people of Rwanda through sustainable utilization and fair development of natural resources, and the protection and rational management of ecosystems. The policy integrates Environmental aspects into all the development policies, planning and in all activities carried out at the national, provincial and local level, with the full participation of the population, conservation, preserve and restoration of ecosystems and maintenance of ecological and systems functions. The wildlife conservation goals set out in this policy are closely harmonised with other National Development Goals as set out in Vision 2020 and the Economic Development and Poverty Reduction Strategy – EDPRS. The Policy also supports and complements other sectoral policies in particular, the environment, biodiversity, forestry and water policies. The goal of this Policy is therefore to: provide a framework for conserving, in perpetuity, the country's wildlife, rich diversity of species, habitats and ecosystems for the well-being of its people of Rwanda and the global community. To achieve the stated goal, Government of Rwanda, on behalf of the people of Rwanda, and all the stakeholders will strive to: *I. Promote national level conservation planning ensuring that wildlife is protected;* *II. Develop and enhance National Parks;* *III. Create conditions where people and wildlife can co-exist and have as little negative impact on each other as possible;* *IV. Encourage wide stakeholder participation in the management of wildlife and equitable distribution of economic benefits;* *V. Build the human capacity for the management of wildlife at all levels of Government, civil society and the private sector; and* *VI. Develop institutional capacities to enable efficient and effective management of Wildlife.* *The precautionary principle states that "When an activity raises threats of harm to human health or the environment, precautionary measures shall be taken even if some cause and effect relationships are not fully established scientifically".*	Construction and operation activities associated with the Proposed Project has the potential to harm wildlife (i.e. flora and fauna) present at the sites, and by undertaking this ESIA, the potential impacts on wildlife have been identified, assessed and mitigation measures proposed for implementation by BAC. The precautionary principle has been applied in the completion of this chapter.

Table 11-3: Policy Framework on Biodiversity

Policy	Description	Application
Rwanda Wildlife Policy, 2013	The Rwanda Wildlife Policy aims to: Provide a framework for conserving, in perpetuity, country's wildlife, rich diversity of species, habitats and ecosystems for the well-being of its people of Rwanda and the global community. Achieve the stated goal, GOR, on behalf of the people of Rwanda, and all the stakeholders will strive to: • Promote national level conservation planning ensuring that wildlife is protected; • Develop and enhance National Parks; • Create conditions where people and wildlife can co-exist and have as little negative impact on each other as possible; • Encourage wide stakeholder participation in the management of wildlife and equitable distribution of economic benefits; • Build the human capacity for the management of wildlife at all levels of Government, civil society and the private sector; and • Develop institutional capacities to enable efficient and effective management of wildlife. Policy Principles include; sustainability, systematic (or integrated) conservation planning, management, wildlife conservation, parks as models, information exchange, application of adaptive management, social justice and equity, national security issues, and the precautionary principle.	Construction and operation activities associated with the Proposed Project have the potential to harm wildlife (i.e. flora and fauna) present at the sites, and by undertaking this ESIA, the potential impacts on wildlife have been identified, assessed and mitigation measures proposed for implementation by BAC. The precautionary principle has been applied in the completion of this chapter.
Land Policy, 2003	The policy also provides for development of land use plans based on suitability of the areas/lands thus distinguishing the different categories of land and their purpose. On the use and management of hillsides and marshlands, the policy stipulates that marshlands meant for agriculture should be cultivated after adequate planning and Environmental Impact Assessment.	A portion of the Expressway within the Proposed Project is situated within wetlands.

Table 11-4: Legal Framework Relevant to Biodiversity

Law	Aim and Purpose of the Law	Application
The Constitution of the Republic of Rwanda of 2003, revised in 2015	The Constitution of the Republic of Rwanda promotes the protection and sustainable management of the environment and encourages the rational use of natural resources.	By undertaking the biodiversity survey as part of the Environmental and Social Impact Assessment for Bugesera Airport, Bugesera Airport Company Limited is in compliance with this law. However, the company and its contractors must ensure that all proposed mitigation measures are implemented and biodiversity monitoring undertaken.
The Organic Law N° 04/2005 Of 08/04/2005 Determining The Modalities of Protection, Conservation And Promotion Of Environment In Rwanda	This Organic law aims at: • Conserving the environment, people and their habitats; • Setting up fundamental principles related to protection of environment, any means that may degrade the environment with the intention of promoting the natural resources, to discourage any hazardous and destructive means; • Promoting the social welfare of the population considering equal distribution of the existing wealth; • Considering the durability of the resources with an emphasis especially on equal rights on present and future generations; • Guarantee to all Rwandans sustainable development which does not harm the environment and the social welfare of the population; and • Setting up strategies of protecting and reducing negative effects on the environment and replacing the degraded environment. The framework of the law on the protection and management of natural resources centres on avoiding and reducing the disastrous consequences on environment.	By undertaking the biodiversity survey as part of the Environmental and Social Impact Assessment for Bugesera Airport, Bugesera Airport Company Limited is in compliance with this law. The chapter has applied the mitigation hierarchy to avoid, reduce, and compensate impacts to biodiversity.
Ministerial Order determining the length of land on shores of lakes and rivers transferred to public property - N°	This law sets the boundary for development and settlement activities next to water bodies. This Order aims at setting aside the length of land on shores of lakes and rivers affected in the public domain for environmental protection. The land within a distance of 50 m from the lakeshore, and the land within a distance of 10 m and 5 m from the shore of big rivers and small rivers respectively is public property.	Implementation of this ministerial order would protect sensitive areas for amphibian, fish and water birds breeding and survival.

Table 11-4: Legal Framework Relevant to Biodiversity

Law	Aim and Purpose of the Law	Application
007/16.01 of 15/07/2010	Law and statutory guidelines on Environmental Impact Assessment.	
Law N° 70/2013 Of 02/09/2013 Governing Biodiversity In Rwanda	This law provides for: • biodiversity planning and monitoring; • ecosystems, endangered and invasive species; • Bio-prospecting, access and benefit sharing; • Permits; and • Administrative sanctions.	Considering that the Airport Area and the Associated Facilities will affect biodiversity including invasive species, project activities must be undertaken in line with this law.
Prime Minister's Order N°. 006/03 of 30/01/2017, drawing up a List of Swamp Lands, their Characteristics and Boundaries and Determining Modalities of their Use, Development and Management	This Order draws up a list of swamp lands, their characteristics and boundaries and determines modalities of their use, development and management. The Order provides an inventory of swamps in Rwanda and their characteristics (Annexure 1) and the boundaries of swamp lands (Annexure 2). The Order further provides for the use, development and management of swamp lands. The following wetlands are listed in Bugesera District as proposed Ramsar Sites with management prescribed as Use under specific conditions: • Cyohoha Nord-Murago 14,345 - • Gashanga 14,135 ha • Kabarali 12,016 ha • Kidogo 7,539 ha • Mparo 4710 ha • Murago Umurago 20,801 ha • Nyabarongo-Akagera 15,718 ha • Nyarubande 19,096 ha • Rucahabi 25,691 ha • Cyandayi 5,303 ha • Rweru-Mugesera Nyabarongo 162,169 ha • Nyabarongo Aval 99,890 ha • Nyabarongo Amont 346,373 ha • Akanyaru Nord 12,3412 ha And the following are described as proposed Ramsar Sites with management with full protection: • Ngenda 12,796 ha • Lac Sake aval 7,478 ha • Mugesera aval 51,189 ha	As the Proposed Project will be in close proximity to swamp lands, cognisance must be taken of the Order. Article 18: Laws governing the use, development and management of protected swamp lands states that "*The use, development and management of protected swamp lands are governed by relevant laws.*"

Table 11-4: Legal Framework Relevant to Biodiversity

Law	Aim and Purpose of the Law	Application
Protected Animals and Plan Species: Ministerial Order N°. 007/2008 of 15/08/2008 Establishing the List of Protected Animal and Plant Species	This Order prohibits the hunting of species listed within appendix I of the Order. The plants listed in appendix II are protected from being either uprooted or cut without prior authorization from competent authorities.	Several of the animal species listed in appendix I of the Order were recorded within the Proposed Project Area of Influence (AOI), including: • Sitatunga • Hippopotamus • Black-headed Heron • Grey Crowned-crane • Swallow • Arrow-marked Babbler • Hamerkop • Sunbirds • Crocodile However, the construction of the Proposed Project will not require any hunting of any animal species. Construction workers will be strictly forbidden from hunting. A full list of plant species recorded within the Proposed Project AOI is provided in Technical Appendix 11.2. Two species listed on appendix II of the Order were recorded: • *Aloe vera* • *Erythrina abyssinica* Authorisation from Rwanda Water and Forestry Management Authority (Competent Authority) will be obtained before the listed plants are uprooted or cut. A walkover survey will be completed prior to vegetation clearance for the Expressway to identify the location of any protected plants and provisions will be put in place to arrange translocation to a safe receptor site.
Management of Forests Law N° 47bis/2013 of 28/06/2013	This Law determines the management and utilisation of forests in Rwanda. The Law deals with protection of forests and licenses to clear certain forests.	Although not located in a forest area, the protection and adequate management of trees and forests have been considered during the

Table 11-4: Legal Framework Relevant to Biodiversity		
Law	**Aim and Purpose of the Law**	**Application**
		construction and operation of the Proposed Project.

In addition to the international conventions and national laws mentioned in the previous sections, Rwanda has developed a number of national environmental strategies that include the National Biodiversity Strategy and Action Plan, June 2006 (Table 11-5).

Table 11-5: National Strategies of Relevance to Biodiversity		
Law	**Aim and Purpose of the Law**	**Application to Biodiversity**
National Biodiversity Strategy and Action Plan, June 2006	This plan includes hillsides and wetlands and protected areas as some of the areas that need to be conserved, and defines the objectives and priorities for the conservation and sustainable management of biodiversity.	In line with this plan, the activities at the Proposed Project should minimise negative impacts to biodiversity.

11.2.4 International Standards

11.2.4.1 International Finance Corporation Performance Standards

The Proposed Project is committed to implementing the IFC Performance Standards (PS) in order to manage social and environmental risks and impacts. IFC PS6 covers areas of biodiversity conservation, ecosystem services and sustainable management of living resources, which are all fundamental to achieve sustainable development. The objectives of PS6 are outlined as follows:

- To protect and conserve biodiversity;
- To maintain the benefits from ecosystem services; and
- To promote the sustainable management of living natural resources through the adoption of practices that integrate conservation needs and development priorities.

The requirements of PS6 are applied to projects: (i) located in modified, natural, and critical habitats; (ii) that potentially impact on or are dependent on ecosystem services over which the client has direct management control or significant influence; or (iii) that include the production of living natural resources (e.g. agriculture, animal husbandry, fisheries and forestry) based on the risks and impacts identification process. Within modified, natural and critical habitat, the following requirements are applicable, *inter alia*:

Modified Habitats

"The client should minimise impacts on such biodiversity and implement mitigation measures as appropriate".

Natural Habitats

"The client will not significantly convert or degrade natural habitats, unless all of the following are demonstrated:

- *No other viable alternatives within the region exist for development of the project on modified habitat;*
- *Consultation has established the views of stakeholders, including Affected Communities, with respect to the extent of conversion and degradation; and*
- *Any conversion or degradation is mitigated according to the mitigation hierarchy.*

In areas of natural habitat, mitigation measures will be designed to achieve no net loss of biodiversity where feasible. Appropriate actions include:

- *Avoiding impacts on biodiversity through the identification and protection of set-asides;*
- *Implementing measures to minimise habitat fragmentation, such as biological corridors;*
- *Restoring habitats during operations and/or after operations; and*
- *Implementing biodiversity offsets."*

Critical Habitats

"In areas of critical habitat, the client will not implement any project activities unless all of the following are demonstrated:

- *No other viable alternatives within the region exist for development of the project on modified or natural habitats that are not critical;*
- *The project does not lead to measurable adverse impacts on those biodiversity values for which the critical habitat was designated, and on the ecological processes supporting those biodiversity values;*
- *The project does not lead to a net reduction in the global and/or national/regional population of any Critically Endangered or Endangered species over a reasonable period of time; and*
- *A robust, appropriately designed, and long-term biodiversity monitoring and evaluation programme is integrated into the client's management programme.*

In such cases where a client is able to meet the requirements defined in paragraph 17 [of PS6]*, the project's mitigation strategy will be described in a Biodiversity Action Plan and will be designed to achieve net gains of those biodiversity values for which the critical habitat was designated."*

IFC PS6 also include the following requirements in relation to designated areas:

In circumstances where a proposed project is located within a legally protected area or an internationally recognized area, the client will meet the requirements of paragraphs 13 through 19 of this Performance Standard, as applicable. In addition, the client will:

- *Demonstrate that the proposed development in such areas is legally permitted;*
- *Act in a manner consistent with any government recognized management plans for such areas;*
- *Consult protected area sponsors and managers, Affected Communities, Indigenous Peoples and other stakeholders on the proposed project, as appropriate; and*
- *Implement additional programs, as appropriate, to promote and enhance the conservation aims and effective management of the area.*

11.2.4.2 African Development Bank Integrated Safeguards System

The African Development Bank Integrated Safeguards System (AfDB ISS) sets out the environmental and social safeguards that the project owner is required to meet during project preparation and implementation. The AfDB has adopted five Operational Safeguards (OS), of which OS 3 relates to biodiversity. The specific objectives of the OS are to:

- *Conserve biological diversity and ecosystem integrity by avoiding or, if avoidance is not possible, reducing and minimising potentially harmful impacts on biodiversity;*
- *Endeavour to reinstate or restore biodiversity, including, where some impacts are unavoidable, through implementing biodiversity offsets to achieve "not net loss but net gain" of biodiversity;*

- *Protect natural, modified, and critical habitats; and*
- *Sustain the availability and productivity of priority ecosystem services to maintain benefits to the affected communities and sustain project performance.*

11.3 Assessment Methodology

11.3.1 Scope

The objective of the ecological baseline studies was to describe the biological environment within the Area of Influence (AoI). The AoI for biodiversity is defined by the potential pathway of impact with the largest spatial scope, which in this case is that of potential noise impacts. The results of detailed noise modelling show that the AoI to biodiversity is approximately 15 km (see Section 11.5). The biological environment includes designated sites (both protected by Rwandan Law as well unprotected sites that are Internationally Recognised Areas[5]), habitats (including terrestrial and freshwater), and their component species. The ecological baseline was characterised through a combination of secondary data and field surveys. The field surveys conducted in May and June 2017 included:

- **Flora**: to confirm the broad habitat type at the Proposed Project Area. The flora surveys also assessed habitat quality, provided a comprehensive plant species list for each habitat type and located any endemic, restricted-range, threatened flora, or invasive species in the Proposed Project Area;
- **Herptiles**: amphibian and reptiles within the AoI were surveyed using a combination of visual encounter surveys (VES), audio encounter surveys (AES) and dip netting;
- **Birds**: were surveyed using a combination of point counts, timed species counts, and timed observations.
- **Mammals**: were surveyed in combination with the other surveys and all incidental sightings were recorded.

Additional bird surveys were completed in October and November 2017 during the short wet season with the main objective to map the distribution of Important Bird Area (IBA) trigger species within wetlands in the vicinity of the Proposed Project. During the bird surveys, additional incidental sightings of mammals were recorded and local communities were informally consulted regarding the presence of large mammal species.

11.3.2 Baseline Characterisation

11.3.2.1 Secondary Data Review

A detailed review of secondary data was completed to obtain available information on biodiversity receptors in the Area of Influence. The results of the secondary data review were then used to inform the scope and design of the detailed methodologies for the field survey work. The secondary data review also provided contextual information about the status of biodiversity receptors (e.g. local, regional and global distribution, population size and level of extinction risk) and ecological information about the receptors (e.g. habitat requirements and behaviour of species) to assist with the valuation and assessment of potential impacts.

The secondary data review included an extensive review of published scientific literature, websites and other sources. References for published information quoted within the chapter are provided within the relevant sections. In order to identify the potential presence of plant

[5] IFC PS6 defines Internationally Recognised Areas as UNESCO Natural World Heritage Sites, UNESCO Man and the Biosphere Reserves, Key Biodiversity Areas (including, Important Bird Areas (IBA), Important Plant Areas (IPA) and Alliance for Zero Extinction Sites (AZE)), and wetlands designated under the Convention on Wetlands of International Importance (the Ramsar Convention).

and animal species of conservation importance within the Area of Influence, the International Union for Conservation of Nature (IUCN) Red List of Threatened Species (RL)[6] was searched to identify species with global ranges that overlapped with the Project Area of Influence. The classification system used by the IUCN RL, for representing the extinction risk of species is presented in Table 11-6. Species classified as VU or above on the IUCN Red List, are referred to collectively as 'threatened' species.

Table 11-6: International Union for Conservation of Nature Categories of Extinction Risk

Category	Definition
Extinct in the Wild (EXW)	A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalised population (or populations) well outside the past range.
Critically Endangered (CR):	Species facing an extremely high risk of extinction in the wild.
Endangered (EN):	Facing a very high risk of extinction in the wild.
Vulnerable (VU)	Facing a high risk of extinction in the wild.
Near Threatened (NT)	A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.
Data Deficient (DD)	Inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status.
Least Concern (LC)	A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.

11.3.2.2 Field Surveys

The following section summarises the ecology survey methodologies employed to describe the biodiversity baseline of the Project Area.

Vegetation and Flora

Vegetation and flora surveys comprised transects and plot sampling methods, as described by Brower *et al.*[7]. (Field and Laboratory Methods for General Ecology, 1997). Sampling locations were pre-selected prior to the site visits to ensure statistically robust results, and to reduce potential sources of sampling bias. Vegetation communities were classified according to the phyto-sociological methodology published classifications of White (1983)[8]. The surveys focussed on three main areas: the Airport Area, the Expressway and the Water Pipeline route. The cumulative species-area curves were plotted for each area to ensure that the number of samples in each area was considered sufficient. The Global Positioning System (GPS) coordinates were recorded for all locations sampled and plant species identified and recorded. In locations where vegetation had been cleared, the nearest intact vegetated area was sampled. Sampling was done at the Airport Area, Expressway, Water Pipeline routing and around wetland areas in the Proposed Project Area (Figure 11-1). The sample plots and their coordinates, vegetation types in each sample plot and the species composition of each sample plot were recorded and have

[6] IUCN 2017. The IUCN Red List of Threatened Species. Version 2017-1. <http://www.iucnredlist.org>. Downloaded on 12 May 2017.
[7] Brower, J.E., Zar, J.H., and von Ende, C.N. (1997). Field and Laboratory Methods for General Ecology. Fourth Edition. WCB McGraw-Hill. Boston, Massachusetts (USA).
[8] White F (1983). The Vegetation of Africa. Natural Resources Research No 20 UNESCO, Paris, p. 356.

been attached as an excel data sheet for flora (see Appendix 11.2). All the sampling for the vegetation survey was carried out during day time between 07:00 hr and 18:00 hr.

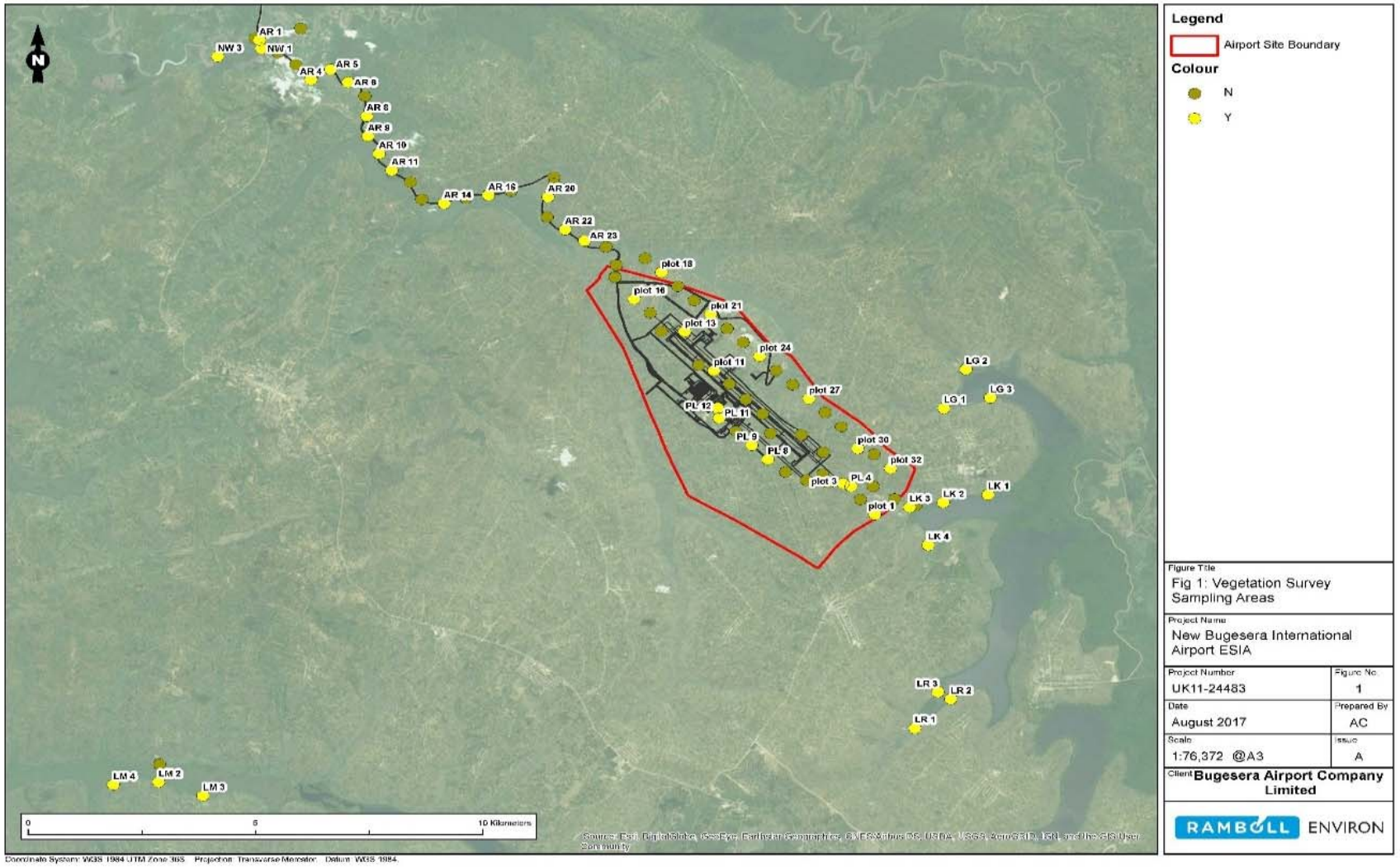

Figure 11-1: Image illustrating Sampling Areas for the Vegetation Survey within the Airport Project Area

Airport Area

Within the Airport Area, an 8 km transect was laid along the runway and 16 sampling plots were established at 500 m intervals. A second transect, parallel to the one established along the runway was established 1 km apart also with 16 sample plots at 500 m intervals. The size of each sample plot was 20 m by 40 m. A total of 32 sample plots were completed within the Airport Area.

Expressway Route

For the Expressway, a 14 km transect was established along the Expressway route and sampling was undertaken at 500 m intervals. The size of each sample plot was 20 m by 40 m. A total of 26 sample plots were completed along the Expressway route.

Water Pipeline Route

A transect was established along the 4 km Water Pipeline route and sampling was done at 500 m intervals. The size of each plot was 20 m by 40 m and a total of 12 sample plots were completed.

Wetland and Lake Areas

The line transect method was used to obtain data to assess the wetland vegetation. A line transect of between 1 - 2 km was established along the shoreline of the lakes and at wetland edges. The wetlands and lakes that were surveyed included: Nyabarongo Wetland/River, Akagera River, Mwesa Wetland, Lake Gashanga, Lake Kidogo, Lake Rumira, and Lake Murago. Plant species, vegetation types were identified and recorded along each of the line transects.

Amphibians and Reptiles

The herpetofauna survey at the Proposed Project Area was conducted using a combination of standardised visual encounters surveys (VES), standardised audio encounter surveys (AES), dip netting and community consultations. In each of the investigated areas, linear transects of 300–500 m were established and sampled during day time and at night. Eight transects were established in the Airport Project Area, five along the Expressway route, and one each for the water pipeline, Lake Kidogo, Lake Gashanga, Lake Rumila and Lake Murago. During the surveys, an inventory was produced in day light conditions between 09:00 – 12:00, and between the hours of 15:00 – 17:00, as well as during the night 20:00 – 23:00.

Standard reference books were consulted in the identification of the herpetofauna encountered. The books referenced include Schiotz (1972)[9], Schiotz (1972b)[10], De Witte (1937)[11], Drewes (1984)[12], Drewes and Vindum (1994)[13], Loveridge, (1957)[14], Welch (1982)[15], Stewart (1967)[16], and Wager (1965)[17]. The nomenclature of amphibians follows Channing & Howell (2006)[18] and

[9] Schiotz, A. (1972a) "The Superspecies Hyperolius viridiflavus (Anura)". Vidensk. Meddr dansk naturh. Foren. 134:21-76.
[10] Schiotz, A. (1972b) "The Treefrogs of Eastern Africa". Spolia zool. Mus. Haun. 25: 1-346.
[11] De Witte, G.F. (1937) "Batraciens et Reptiles. Exploration du Parc Albert". Mission, G..F. de Witte (1933-1935) Inst. Parcs Nat. Congo Belge, 33:xvii.
[12] Drewes, R.C. (1984) "A phylogenetic analysis of the Hyperoliidae (Anura): Tree frogs of Africa, Madagascar and the Seychelles. Occ. Pap. Calif. Acad. Sci. 139, 1-70.
[13] Drewes, R. C. & Vindum J. V. (1994) "Amphibians of the Impenetrable Forest, South-Western Uganda". J. Afr. Zool. 108(1), 55-70. Fellers, G. M.
[14] Loveridge, A. (1957) "Checklist of the reptiles and amphibians of East Africa". Bull. Of Mus. of Comparative Zoology, Harvard, Vol. 117(2) 153-362.
[15] Welch Kenneth, R. C. (1982) Herpetology of Africa. A Checklist and bibliography of the orders amphisbaenia, sauria and serpents.
[16] Stewart, M. (1967) Amphibians of Malawi; State University of New York.
[17] Wager, A. (1965) The Frogs of South Africa; Purnell and Sons PTY. LTD., Cape Town, P. 1-35.
[18] Channing, A. & Howell, K.M. (2006) Amphibians of East Africa. Edition Chimaira, Frankfurt am Main.

that of reptiles follows Spawls *et al.* (2002)[19]. The status of the different taxa as Albertine Rift regional endemics was assessed after Plumptre *et al.* (2007)[20]. Apart from species heard calling, where possible, individuals encountered were captured by hand. The specimens caught were identified on the spot, photographed and released. No specimens were taken for preservation.

[19] Spawl, S., Howels, K., Drewes, C. & Ashe, J. (2002) A field guide to the reptiles of East Africa. A & C Black Publishers, London and San Diego.

[20] Plumptre, A.J., Davenport, T.R.B., Behangana, M., Kityo, R., Eilu, G., Ssegawa, P., Ewango, C., Meirte, D., Kahindo, C., Herremans, M., Peterhans, J.K., Pilgrim, J.D., Wilson, M., Languy, M. & Moyer, D. (2007) The biodiversity of the Albertine Rift. Biological Conservation 134:178-194.

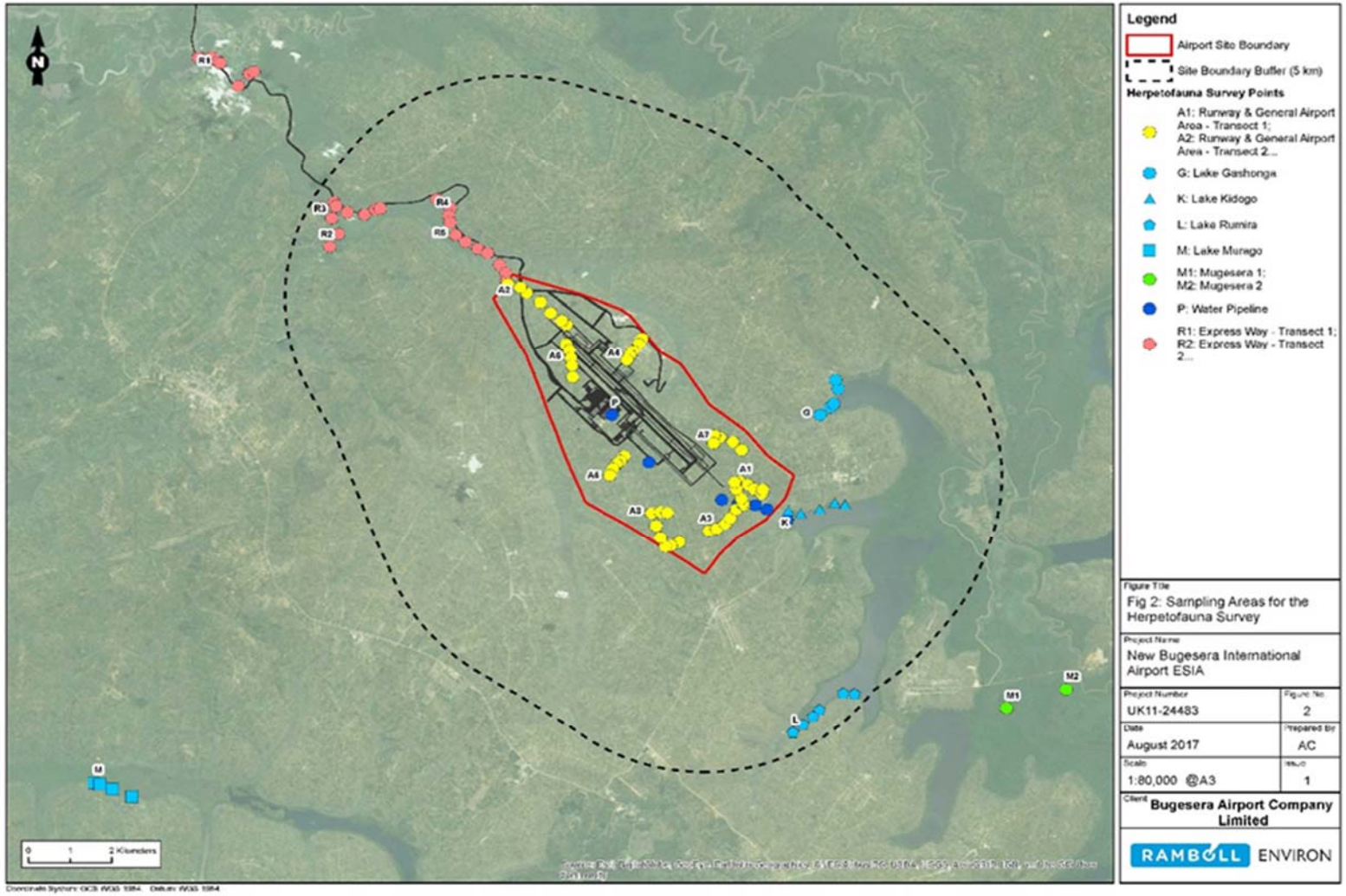

Figure 11-2: Image illustrating Sampling Areas for the Herpetofauna Survey (Source Google Earth)

Visual Encounter Surveys (VES)

VES were conducted along transects. This involved walking through an established transect in the Proposed Project Area, searching for amphibians and reptiles for two hours per site per sampling. The visual searches included examination of hiding places such as under logs, crevices, stones, leaf litter and crevices. Herpetofauna species were detected by sight and their numbers recorded. Transect walks were conducted both during day and at night.

Audio Encounter Surveys (AES)

Males of many anuran species vocalise. AES exploit the species-specific behaviour of male amphibians in reproductive condition making distinctive species-specific calls to advertise their positions to potential mates and rivals. This method requires the knowledge of amphibian calls. The specialist completing the surveys has a good knowledge of amphibian calls/vocals accumulated over the years of involvement in amphibian studies. Transect walks were conducted through the study area for two hours attentively listening to calling amphibians. Species heard calling and their numbers were noted, with species identified by the surveyors in the field from their calls. Transect walks were conducted both during day and at night. The counts were then used to estimate or determine: (1) relative abundance of calling males and (2) species composition.

Dip Netting

Some herpetofauna are more aquatic than others, with some spending most of their time in water. Using a dip net, waterbodies were dip netted. Species and individuals caught were noted.

Local Consultations

Local people can be a valuable source of information. Resident community members are constantly in touch with their environment. The residents were consulted on the presence of herpetofauna in the Proposed Project Area. These were identified to the survey team in the local language, describing their appearance and colour pattern. The local names were then used to establish the English common name. Informal consultations were conducted by asking older people found in the project area at the time of sampling.

Birds

Surveys completed May and June 2017

Birds were surveyed using a combination of point counts (PC), timed species counts (TSC) and timed observations (TO). The three methods were used in bird assessment mainly to explore species diversity and achieve a comprehensive bird checklist of the Project Area. The survey locations, GPS coordinates and habitat types are presented in Table 11-7 and Figure 11-3. Birds were identified based on the Field Guide to the Birds of East Africa (Stevenson and Fanshawe, 2002)[21].

Table 11-7: Survey Locations, Coordinates and Habitat Type

Location	Method	Coordinates (zone 36 m, UTM WGS 1984)		Habitat Description
		Start	End	
Gatwe-Bitaba wetland	TO	X-0182004 Y-9767617		Wetland

[21] Stevenson, T. & Fanshawe, J. 2002. Field Guide to the Birds of East Africa. T & AD Poyser, London.

Table 11-7: Survey Locations, Coordinates and Habitat Type				
Lake Rumira	TO	X-0191467 Y-9755780	X-0190751 Y-9755215	Lake edge
Lake Murago	TO	X-0173675 Y-9753445	X-0174395 Y-9753138	The wetland dominated by *Typha sp.*
Lake Kidogo	PC	X-0190413 Y-9760318		Wetland edges fringed by farmed land, dominated by *Griveria* trees in the cultivated lands
Lake Kidogo	PC	X-0190240 Y-9760363		
Airport bush land	PC	X-0184687 Y-9766056		Terrestrial habitat
Airport bush land	PC	X-0184687 Y-9764269		Bushland
Runway	PC	X-0184783 Y-9764560		
Mwesa wetland	PC	X-0183203 Y-9766132		The tip of the wetland close to the west end of the runway and where the Expressway joins the airport peripherals
Karambi wetland	PC	X-0179270 Y-9767268	X-0179189 Y-9767128	Thick swamp, edged by cultivated areas growing vegetables, near and north of Nyamata Town
Mwoogo wetland	PC	X-0180304 Y-9767952	X-0181875 Y-9768145	Wetland marshes fringed with cultivated farmed land along the edges
Mwoogo wetland	PC	X-0181993 Y-9767805		Wetland edge with open water ponds and pools on its edge, near Mwesa
Express way	PC	X-0179051 Y-9767821	X-0179220 Y-9766390	Wetland edge
Airport bush land	TO	X-0187537 Y-9759606	X-0186810 Y-9760235	Fallow bushed land dominated by *Lantana camara*
Airport bush land	TO	X-0189020 Y-9261909		Fallow dominated by *Vernonia amygadalina* and eucalyptus
Airport bush land	TO	X-0186200 Y-9761737	X-0185781 Y-9761287	Area dominated by a young upcoming fallow
Airport bush land	TO	X-0188238 Y-9759860	X-0188238 Y-9760304	Area dominated by *Lantana camara and Vernonia amygadalina*
Start of the runway	TO	X-0188967 Y-9761100	X-0189532 Y-9760947	Rejuvenating fallow with cleared eucalyptus stumps, *Hyperhenia*, and an undulating slope
End of the runway	TO	X-0184795 Y-9765053	X-0184619 Y-9765417	The area dominated by a rejuvenating scrub with *Lantana*

Table 11-7: Survey Locations, Coordinates and Habitat Type				
				camara and Vernonia amygadalina, no trees
Rurenge wetland	TSC	X-0179269 Y-9768022	X-0180304 Y-9767953	A wetland partially cultivated and papyrus being degraded
Nyabarongo wetland	TSC	X-01766481 Y-9771618	X-0175934 Y-9771585	The start point of Expressway. Along the wetland at the edge with acacia on the slope and the papyrus reed swamps in the valley bottom
Lake Gashanga	TSC	X-0190937 Y-9762804		Degraded wetland with remaining patches, flooding along the shores
Water pipeline	TSC	X-0189197 Y-9760595	X-0190182 Y-9759845	The area is mainly covered by bushed fallow, with the areas towards Lake Kidogo covered by maize gardens
Karambi, Kaziramere, Rurenge wetland	TSC	X-0177291 Y-9771000	X-0176940 Y-9771407	Wetland dominated swamps mixed with marshes
Airport bush land	TSC	X-0189061 Y-9760567	X-0188842 Y-9761098	Cultivated and scrub bushed land
Airport bush land	TSC	X-0186622 Y-9764691	X-0186675 Y-9763814	Fallows dominated by*Lantana camara and Vernonia amygadalina*
Airport bush land	TSC	X-0186497 Y-9762896	X-0187073 Y-9763588	Rejuvenating land cover with no trees
Airport bush land	TSC	X-0185240 Y-9760919		Fallow and gardens of sorghum adjacent to the airport land

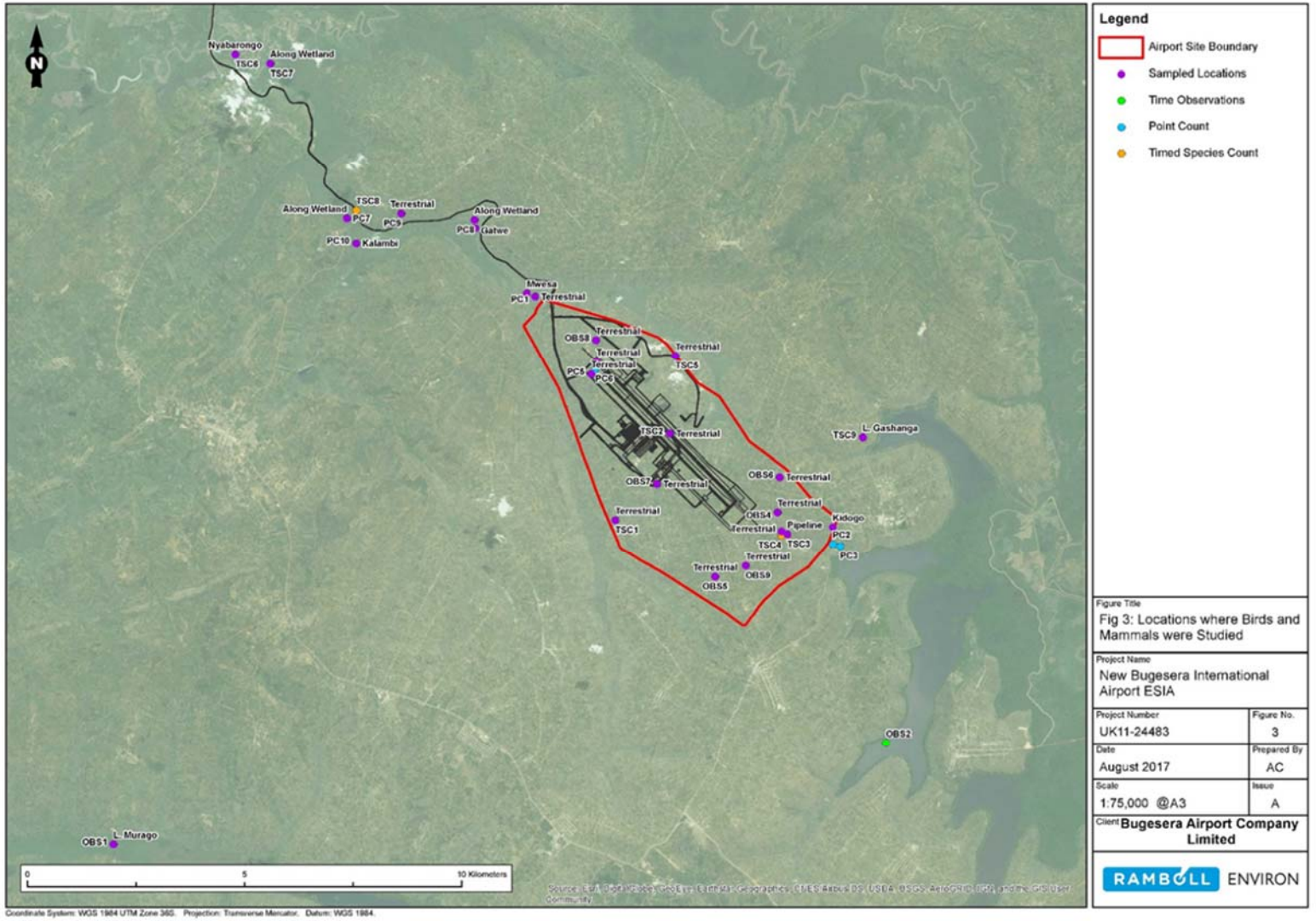

Figure 11-3: Location of the Sites and Habitats where Birds and Mammals were Studied in May and June 2017

Point Counts (PCs)

Surveys using the PC method were applied to collect avian data in and around the Project Area. It involved recording all birds seen or heard for a period of 15 minutes. This was done at every selected point uniformly before moving on to the next point (Bibby *et al.*, 2000)[22]. A minimum of two points were completed for each habitat type.

The method aimed at providing a useful estimate of relative abundance of recorded species within the selected points. Where possible, the avifaunal survey took into account the fact that many birds that should be detected during counts would actually be missed (Davies, 2002)[23]. Thus, a species was counted immediately when it was heard or seen and provided with a total estimated number in the given time. Counting the species again would only happen in another PC at a different location and at a different point in time. While applying the PC method, distance between the surveyor to a species heard or seen is always considered. However, in this assessment distance was not estimated, although all species considered to be interacting within the site were counted. A surveyed point was not repeated for a count; rather, a repetition was achieved in studying other areas. This was because the area had about 90% uniformity in terms of habitat composition. The entire Project Area qualifies to be defined as a fine-grained habitat, see (Bibby *et al.*, 2000). It is apparent that this method has been applied in Rwanda to study diversity of birds (Gatesire *et al.*, 2014)[24].

Timed Species Counts (TSC)

The TSC technique provides a quick and simple method for gaining a measure of the relative abundance of bird species in a fairly large defined area and it has an advantage of covering a bigger area than PCs or transects (Pomeroy, 1992)[25]. TSCs are essentially repeated species lists that summarise the first time each species is first identified by sight or sound (Pomeroy and Dranzoa, 1997)[26]. It has been observed previously that TSCs easily accumulate species faster than PCs and so are better at picking up rare species in any selected study area. Also, density estimates using PCs would not be possible for these rare species as they might be missed most of the time.

The TSCs were conducted once on every site that was surveyed within the Proposed Project Area. At the beginning of every TSC, a start and end times and the GPS coordinates were recorded. The application of TSCs aim at producing relative abundance and for the more rapid production of a species list. Normally in the use of this method, the practice is that every bird seen during the survey is recorded according to how it appears in an hour's count. Those species that appeared in the first 10 minutes were scored with 6, 10-20 minutes with 5, 20-30 minutes scored with 4, 30-40 minutes scored with 3, 40-50 minutes with 2, 50-60 minutes with 1, as described in Pomeroy (1992). The species usually scored between 10 – 40 minutes are regarded as common species within that area, while the lowest scores normally indicate rare species within the area (Pomeroy, 1992). This method helped in exploring common and abundant species and the rare species.

[22] Bibby CJ, Burgess ND, Hill DA and Mustoe SH (2000). Bird Census Techniques, 2nd Edition. Academic Press, London.

[23] Davies, G. (2002). African Forest Biodiversity - A field survey mammal for vertebrates. Published by Earthwatch EuropeInstitute.

[24] Gatesire, T, Nsabimana, D, Nyiramana, A, Seburanga, J, L, & Mirville, M.O. (2014) Bird Diversity and Distribution in relation to Urban Landscape Types in Northern Rwanda. Volume 2014, Article ID 157824, 12 pages http://dx.doi.org/10.1155/2014/157824

[25] Pomeroy D. (1992) Counting Birds: a Guide to Assessing Numbers, Biomass and Diversity of Afrotropical Birds. AWF Technical Handbook Series no. 6. African Wildlife Foundation, Nairobi, Kenya

[26] Pomeroy, D. and Dranzoa, C. (1997) Methods of studying the distribution, diversity and abundance of birds in East Africa – some quantitative approaches. African J. Ecol., 35: 110–123

Timed Observations (TO)

When using TO, onehour duration bird species counts are conducted within the selected area of study, as is done for TSCs. However, the observation method does not use scores, rather it records the total numbers of a species seen or heard at a particular spot. The difference with PCs is that more time is spent on studying the number of individuals.

The surveys were sampled from those points that were thought to have a considerable diversity and abundant bird populations from the overview. For all selected points, GPS coordinates were obtained for the geo-referencing of these points. TA minimum distance of 800 m was maintained between each sample location.

Playback

Playback equipment was used in locations adjacent to wetlands, with the particular aim of identifying the occurrence of qualifying species of the nearby Important Bird Area (see Section 11.3.1). The playback used calls for each of the IBA trigger species.

Surveys Completed in October and November 2017

The objective of the surveys completed in October and November 2017 were to map the distribution of IBA trigger species within the wetlands within the AOI of the Proposed Project. These surveys were required due to the imprecise delineation of the Nyabarongo Wetlands IBA by Birdlife International, and also that wetland habitats in the region are under high threat from agriculture and other human activities so it was important to obtain an up to date baseline.

The survey used playback methodology where the calls of each of the trigger species were broadcast on a continuous loop for 15 minutes at each survey point count. The majority of the species' calls and songs were obtained from the xeno-canto website[27]. Sample locations were selected using aerial images of the area, focussing on areas of wetland habitat. For large areas of wetland, sample locations were selected at approximately 500 m intervals. Smaller and isolated patches of wetland were also sampled. Due to the dense impenetrable natural of papyrus swamp, the majority of the sample locations were selected at the wetland edge. The lakeside edge of the wetland within Lake Rumira was sampled from a boat. In addition to the IBA trigger species, all other bird species observed were recorded at each point count location. A total of 84 playback point counts were completed (Figure 11–4).

[27] http://www.xeno-canto.org

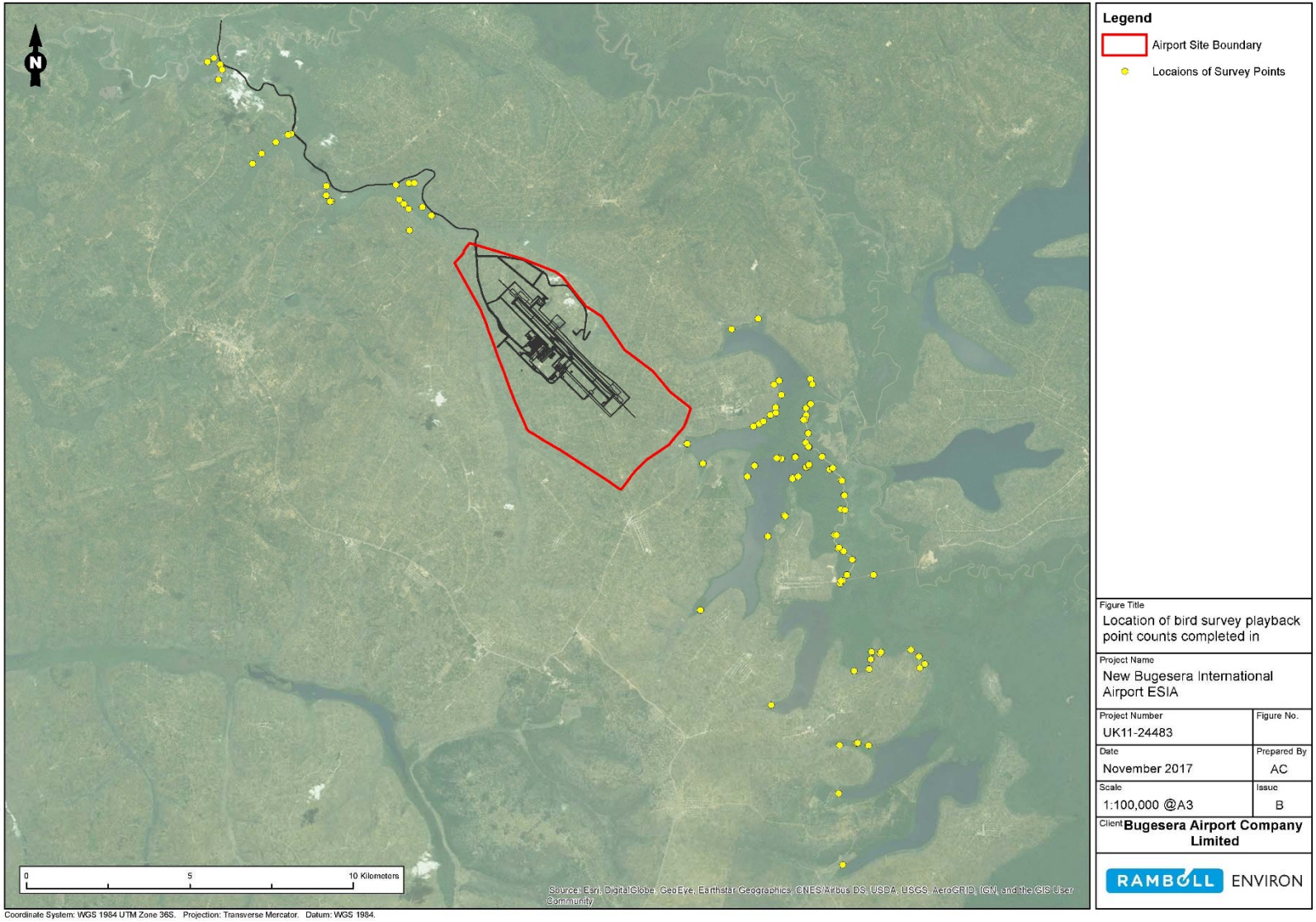

Figure 11-4: Locations of the Playback Point Counts Completed in October and November 2017

Mammals

The survey targeted both small and large mammals using simple methods as advised in Bennun *et al.* 2004[28] of direct and indirect observations. The mammal survey was combined with other survey methodologies completed and involved recording all signs of mammal presence including tracks, faecal material, and footprints. Additional information on mammal species were obtained from community consultations, both in May/June 2017 and in October/November 2017.

11.3.3 Evaluation of Significance

The assessment of impacts to biodiversity receptors follows the methodology detailed in Chapter 3: Impact Assessment Methodology. For adverse impacts, significance is assigned based on determining impact magnitude and receptor sensitivity. Biodiversity receptor sensitivity is assigned as either negligible, low, medium or high based on the definitions detailed in Table 11-8. Biodiversity receptors that do not meet the definitions for either low, medium or high are assessed as negligible sensitivity and are not included within the impact assessment. Impact magnitude is assigned as either very low, low, medium or high.

Table 11-8: Biodiversity Sensitivity Criteria

Sensitivity Level	Receptor	Criteria
High	Designated Sites	All designated sites are assessed as High sensitivity including: • Internationally Recognised Areas (e.g. UNESCO Natural World Heritage Sites, UNESCO Man and the Biosphere Reserves, Key Biodiversity Areas (KBA), and wetlands designated under the Convention on Wetlands of International Importance (the Ramsar Convention)). • A legally protected area, which has designated conservation status categories Ia to IV under the IUCN Classification.
	Habitats	Habitats that trigger critical habitat under the following IFC PS6 Criteria: • Criterion 4: Highly threatened and/or unique; and • Criterion 5: Key evolutionary processes. Habitats that support species of high sensitivity or represents a key component of designated site.
	Species	Species populations that trigger critical habitat under the following IFC PS6 Criteria: • Criterion 1: Critically Endangered (CR) and/or Endangered (EN) species; • Criterion 2: Endemic and/or restricted-range species; and/or • Criterion 3: Migratory and/or congregatory species. Species that represent a key component of a designated site (e.g. IBA trigger species).
Medium	Designated Sites	N/a

[28] Bennun, L, Davies, G, Howell, K, Newing, H, & Linkie, M, (2004) African forest biodiversity: A field survey manual for vertebrates, Earthwatch Institute, UK.

Table 11-8: Biodiversity Sensitivity Criteria		
	Habitats	Natural habitats that do not meet the criteria for critical habitats. Habitats that support species of medium sensitivity.
	Species	Nationally/regionally important concentrations of a Vulnerable (VU) species, or locally important concentrations of Critically Endangered (CR) and/or Endangered (EN) species. Locally important populations of endemic/range-restricted species. Locally important populations of migratory species.
Low	Designated Sites	N/a
	Habitats	Modified habitats that do not meet the criteria for critical habitats. Habitats that support species of Low sensitivity.
	Species	Locally important populations of Near Threatened (NT) or Vulnerable (VU) species.
Negligible	Designated Sites	N/a
	Habitats	Entirely artificial habitats such as concrete hard surfaces, roads, urban areas etc.
	Species	Non-threatened species, common species with wide spread distributions (i.e. not endemic or range-restricted) and non-migratory species.
N/a: Not Applicable		

IFC PS6 sets out definitions for modified, natural and critical habitats as follows:

- Modified habitats: '*areas that may contain a large proportion of plant and/or animal species of non-native origin, and/or where human activity has substantially modified an area's primary ecological functions and species composition. Modified habitats may include areas managed for agriculture, forest plantations, reclaimed coastal zones, and reclaimed wetlands*.'
- Natural habitats: '*areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area's primary ecological functions and species composition*'.
- Critical habitat: '*areas with high biodiversity value, including (i) habitat of significant importance to Critically Endangered and/or Endangered species; (ii) habitat of significant importance to endemic and/or restricted-range species; (iii) habitat supporting globally significant concentrations of migratory species and/or congregatory species; (iv) highly threatened and/or unique ecosystems; and/or (v) areas associated with key evolutionary processes.*'

Each of the habitats described in the baseline description section of this chapter are assessed as being either modified or natural habitat according to the IFC PS6 definitions. Technical Appendix 11.1 provides a detailed assessment of critical habitat within the Proposed Project Area, and the findings are summarised in Section 11.3.2 of this chapter. All critical habitats are assessed to be of high sensitivity according to the criteria detailed in Table 11-7.

11.3.4 Ecosystem Services

Within the scope of IFC PS6, it is important to evaluate ecosystem services that a particular site offers, which include "benefits that people, including businesses, derive from ecosystems". Accordingly, IFC defines four types of ecosystem services (IFC, 2012):

- Provisioning services, which are the products people obtain from ecosystems;
- Regulating services, which are the benefits people obtain from the regulation of ecosystem processes;
- Cultural services, which are the non-material benefits people obtain from ecosystems; and
- Supporting services, which are the natural processes that maintain the other services.

IFC requires that a project owner carries out a systematic review to identify priority ecosystem services, which is referred to as an Ecosystem Services Review (ESR). For the purposes of PS6 implementation and the ESR, ecosystem services are categorised as two types:

- Type I: Provisioning, regulating, cultural and supporting ecosystem services, over which the client has direct management control or significant influence, and where impacts on such services may adversely affect communities; and
- Type II: Provisioning, regulating, cultural and supporting ecosystem services, over which the client has direct management control or significant influence, and on which the project directly depends for it.

The ESR and impact assessment for the Proposed Project is provided in Technical Appendix 11.3.

11.4 Baseline Conditions

11.4.1 Regional and National Biodiversity Context

The Proposed Project Area is located in the Tropical and Subtropical Grasslands, Savannas, and Scrublands Biome and the Victorian Basin Forest-Savanna Mosaic Ecoregion. This ecoregion covers over 165,000 km^2, including parts of Uganda, Tanzania, Rwanda, Burundi and Kenya. Within this ecoregion, African forest ecosystems converge with those from east African forest-savanna mosaics. The ecoregion's scattered lakes, rivers and marshes add to the great diversity of habitats supporting a wide variety of species.

The diverse ecosystems in Rwanda include Afroalpine vegetation at the Virunga Mountains, Afromontane bamboo (Kindt *et al.* 2011[29]), gallery forests, grassland, woodland, wetlands and aquatic forests, forested areas and agro-ecosystems. All of these ecosystems are very rich in flora and fauna (Twagiramungu, 2006[30]). Rwanda has wetlands composed of marshes, lakes, rivers and brooks, representing around 14.9% of the national territory of which 6.3% consist of marshes and 8.6% of lakes, watercourses and pools of permanent or seasonal fresh water (Twagiramungu, 2006). In the Central and the Eastern part of the country, wide marshes

[29] Kindt, R., Lillesø, J.-P. B., van Breugel, P., Bingham, M., Sebsebe Demissew, Dudley, C., Friis, I., Gachathi, F., Kalema, J., Mbago, F., Minani, V., Moshi, H. N., Mulumba, J., Namaganda, M., Ndangalasi, H.J., Ruffo, C.K., Jamnadass, R. and Graudal, L. (2011) Potential natural vegetation of eastern Africa. Volume 5: Description and tree species composition for other potential natural vegetation types. Forest & Landscape Working Paper 65-2011

[30] Twagiramungu, F. (2006). Environmental profile of Rwanda.

include the Nyabarongo, Akanyaru and Akagera river valleys. Many cuvette lakes connect with rivers. The Proposed Project Area is in proximity to wetlands located in valley bottoms, including the Nyabarongo, Akagera, Mwesa, Gashanga, Kidogo, Rumira, Kibirizi and the Murago wetland systems. The vegetation type in wetland areas is characterised by White (1983[31]) as swamp and aquatic vegetation. Much of the areas between wetland valley bottoms is dominated by cultivated farmland.

11.4.2 National Protected Areas

According to the Convention on Biological Diversity (1992)[32], a protected area is defined as a portion of land, aquatic or sea environment which is geographically delimited, dedicated especially to the protection and the preservation of biological diversity and its natural and cultural resources; hence this geographic area must be legally indicated, regulated and managed by effective, legal means or others.

According to this definition of protected areas, Rwanda has four types of protected areas, which include national parks (Akagera, Nyungwe and Volcanoes National Park); forest reserves (e.g. Gishwati, Iwawa Island and Mukura Forest Reserves); forests of cultural importance (e.g. Buhanga Forest); and wetlands of global importance (e.g. Rugezi-Bulera-Ruhondo Ramsar site). Besides the forests with a legal status of protected areas, there are other forests of cultural importance (e.g. Busaga Forest in Muhanga District) and other remnant natural forests, which are more or less protected by law. The current law on forests prohibits human activity in natural forests (REMA, undated).

The Proposed Project Area is located outside existing protected areas. The nearest protected area is Akagera National Park, which is approximately 40 km away to the northeast of the Proposed Project. Akagera National Park is not situated within the AOI and therefore will not be impacted by the Proposed Project. No Alliance for Zero Extinction (AZE) Sites are located in Rwanda and the Proposed Project Area is located outside of the Eastern Afromontane Biodiversity Hotspot that covers western Rwanda.

One Ramsar site occurs in Rwanda, Rugezi-Burera-Ruhondo Marsh Ramsar site, which is located in a flooded valley near Rwanda's northern border with Uganda, approximately 60 km northwest of the Proposed Project Area, as shown in Figure 11-5. This is situated outside of the Proposed Project AOI and will not be impacted by the Proposed Project.

According to the Rwanda Environment Management Authority (REMA) website[33], a number of wetlands within the vicinity of Kigali have been proposed as potential Ramsar sites. These wetlands were identified during a workshop held in April 2013 and included Nyabarongo-Aval wetland and Nyabarongo-Amont wetland. Recently, the Prime Minister's Order N° 006/03 of 30/01/2017 has drawn up a list of swamp lands, their characteristics and boundaries and determining modalities of their use, development and management. This has included numerous swamps listed as proposed Ramsar Sites, including many in Bugesera District (Table 11-4). Within annex II of the Order, most of the swamps are prescribed management use under specific conditions, and a few are afforded full protection, although it is not clear from the Order what this protection comprises on the ground.

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[31] White F (1983). The Vegetation of Africa. Natural Resources Research No 20 UNESCO, Paris, p. 356

[32] CBD (2015). CBD Press Brief. Wetlands and Ecosystem Services. Available from: https://www.cbd.int/waters/doc/wwd2015/wwd-2015-press-briefs-en.pdf

[33] http://www.rema.gov.rw/index.php?id=10&tx_ttnews%5Btt_news%5D=105&cHash=3f1fe7052b455f27c8fc81b1bb76357b, 28/11/2017

The most recent (2015) national report on the implementation of the Ramsar convention on wetlands,[34] provides no indication on the status of the proposed sites. According to ACNR (ACNR pers. Comm.) It is understood that the Ramsar designation process of assessing their status to support its designation under Ramsar convention begun in November 2017 (ACNR personal communication) and therefore it will be some time before this is completed. As the sites are not currently designated as Ramsar sites, they are not assessed as such in this chapter. However, all of the relevant wetlands in the Proposed Project AOI are located within the Nyabarongo Wetlands IBA and therefore assessed as an internationally recognised area in the following sub-section, conferring the same requirements as Ramsar sites under lender standards. As such, additional conservation programmes will be developed as part of the Project Biodiversity Action Plan (BAP) to promote and enhance the IBA and, if designated, the Ramsar site. The development of any additional protected area or legislation is the responsibility of Government. However, through the stakeholder engagement programme developed as part of the Project BAP, the Project will make best endeavours to promote the protection of the IBA wetlands through the Ramsar designation process.

[34] https://www.ramsar.org/sites/default/files/documents/2014/national-reports/COP12/cop12_nr_rwanda.pdf, 28/11/2017

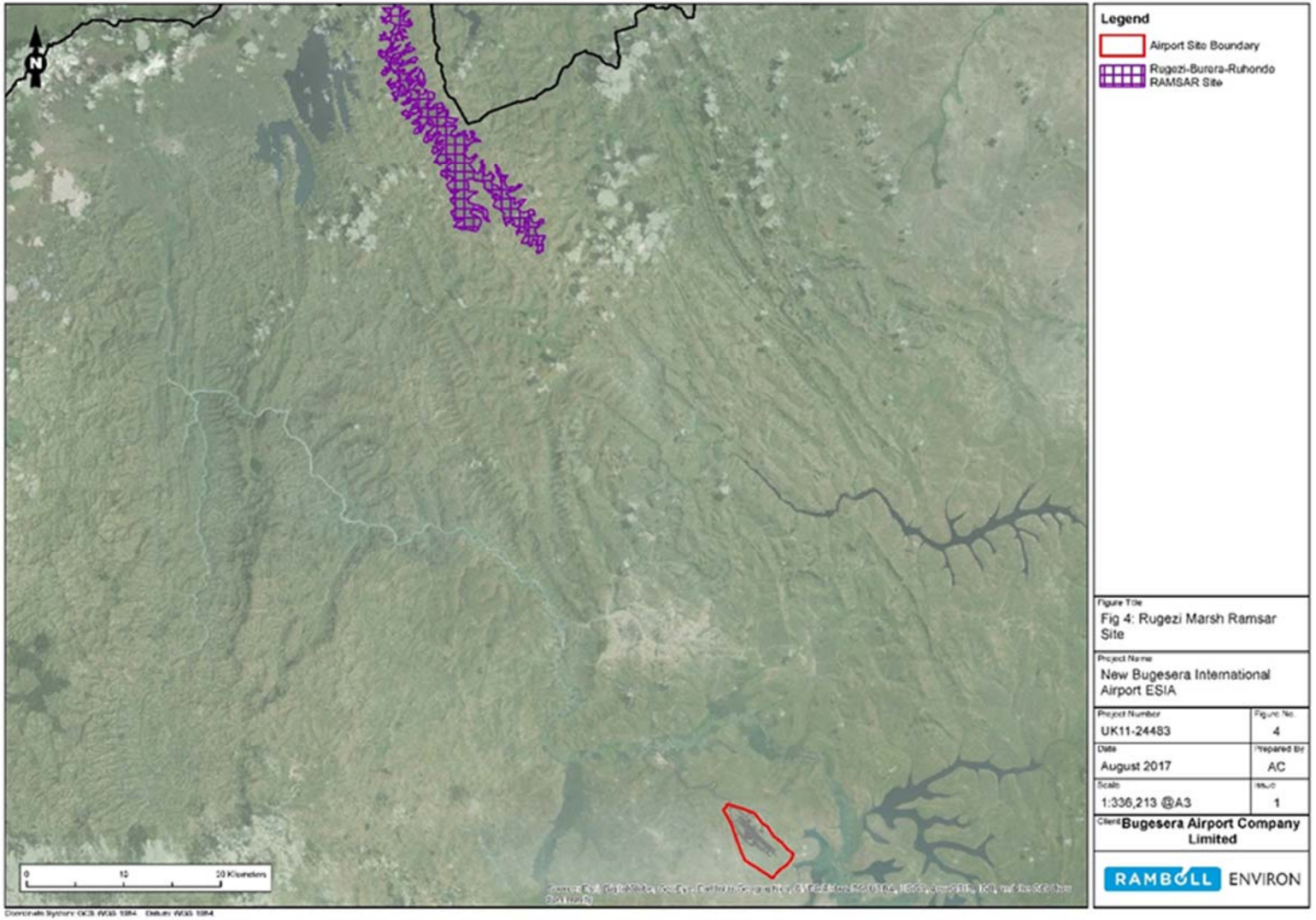

Figure 11-5: Location of Rugezi-Burera-Ruhondo Marsh Ramsar Site in Relation to the Proposed Project Area

11.4.3 Internationally Recognised Areas

The Proposed Project Area includes parts of the Nyabarongo Wetlands IBA[35], which is an internationally recognised area as defined by IFC PS6. The Nyabarongo wetlands IBA covers 10,000 ha and is recognised for internationally important populations of the following trigger species:

- Papyrus Gonolek *Laniarius mufumbiri;*
- Carruthers's Cisticola *carruthersi;*
- Papyrus Yellow Warbler *Calamonastides gracilirostris* (*Chloropeta gracilirostris*);
- White-winged Swamp-warbler *Bradypterus carpalis;*
- Black-lored Babbler *Turdoides sharpei;*
- Northern Brown-throated Weaver *Ploceus castanops;*
- White-collared Oliveback *Nesocharis ansorgei*; and
- Papyrus Canary *Crithagra koliensis*.

The wetlands in the vicinity of the Proposed Project were surveyed with the objective of mapping the distribution of IBA trigger species. The delineation of the IBA boundary by Birdlife International is currently not precise, partly reflecting lack of data previously available to the organisation. The results of the October/November 2017 bird survey, provide a very robust dataset by which to update the IBA boundary with a high level of precision. The results are presented in detail in Section 11.4.3.5 of this chapter.

The most recent IBA monitoring assessment completed by Birdlife International concluded that the threat score (pressure) to the IBA was high due to the combination of agricultural expansion and intensification (from both agro-industry and small-holders), hunting and collecting of terrestrial animals, as well as from invasive species (covering 10-49% of the area). In addition, the assessment states that little or none of the site is covered by conservation action (<10%).

11.4.3.1 Vegetation and Flora

The overall Proposed Project Area, including the Airport Area, Expressway and Water Pipeline, is characterised by the following main vegetation types: anthropic landscapes, grassland, wooded grassland, bush land, thicket, swamp and aquatic vegetation (Figure 11-6). Detailed descriptions of each vegetation type are provided in the following sub-sections. A total of 103 plant species were recorded in the different vegetation types (Technical Appendix 11.2).

The most common species recorded in these vegetation types were *Lantana camara, Vernonia amygadalina, Senna spectabilis, Pennisetum purpureum, Panicum maximum, Holcus lanatus, Bidens pilosa, Markhamia lutea, Ricinus communis, Tithonia diversifolia, Eucalyptus saligina Euphorbia tirucalli, Agave sisalana, Leonotis mollissima, Senna alata, Zea mays, Musa acumulata, Sorghum vulgare, Ipomomea batatas, Manihot esculanta, Cyprus papyrus, Vossia cuspidate, Grevillea robusta, Colocasia esculanta, Typja latifolia, Mimosa pigra, Phaseolus vulgaris.*

[35] http://datazone.birdlife.org/site/factsheet/nyabarongo-wetlands-iba-rwanda/map, 22/08/2017

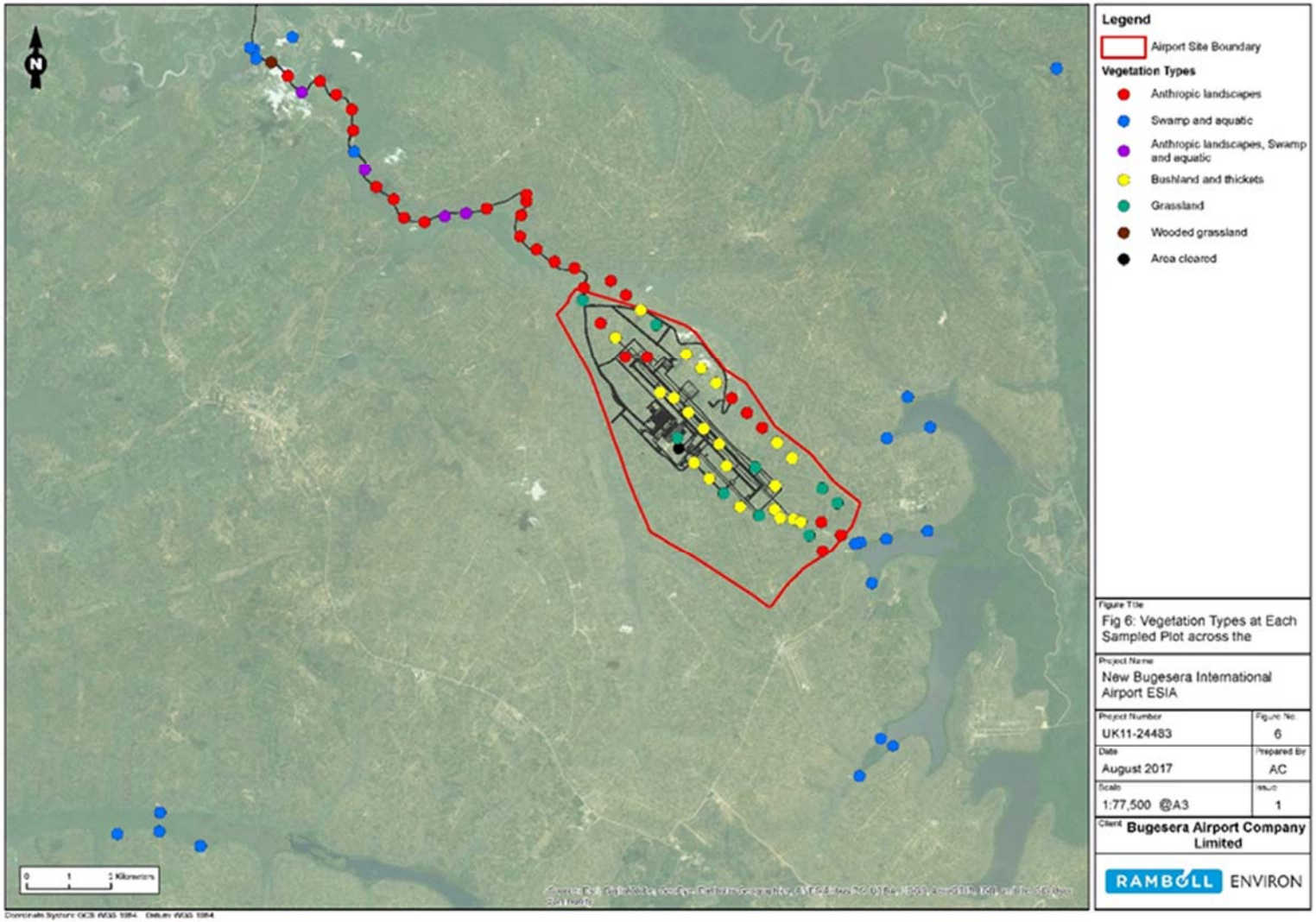

Figure 11-6: Vegetation Types at Each Sampled Plot across the Proposed Project Area

Anthropic Landscapes Vegetation

Anthropic landscapes vegetation has been profoundly altered by human activity and few natural stands remain (Figure 11-7). Often the only trees are self-sown individuals of species of economic importance, such as *Markhamia lutea*, *Erythrina abyssinica*, *Ficus natalensis*, *Mangifera indica*, which have been permitted to remain, giving the landscape a park-like appearance (wooded farmland) (White, 1983). At the time of the survey most of the areas were cultivated with seasonal crops like maize, potatoes, sorghum, beans and cassava. Perennial crops like bananas and coffee are also cultivated. The cropped areas are generally divided up into numerous small plots (or gardens) and form terraces on the valley sides. Some areas had been left uncultivated as fallow land. Mixed cropping is also practiced as observed in most of the gardens surveyed. In many cases, cultivation is taking place right down to the edge of wetlands, which occupy the valley floors and in some cases has extended a few metres into the wetland (Figure 11-7a). In some of these areas, farmers have formed raised beds surrounded by small shallow ditches to grow crops. such as sweet potato and arrowroot.

Most areas along the Expressway route have anthropic landscapes vegetation (Figure 11-7). A total of 22 plots (85%) of Express route has anthropic landscapes vegetation. Eight plots (25%) in the Airport Area and two (17%) plots along the water pipeline route were covered with anthropic landscapes vegetation.

Anthropic landscape vegetation recorded within the Study Area are all considered to be modified habitats as defined by IFC PS6.

Figure 11-7: Anthropic Landscape Vegetation along Wetland Edge (a), along Expressway (b and c) and (d) showing typical terraced valley side with isolated trees.

Grassland Vegetation

Grassland is land covered with grasses, including *Holcus lanatus*, *Pennisetum purpureum*, *Panicum maximum* and other herbs such as *Bidens pilosa and Leonotis mollissima*. Grassland is sometimes completely devoid of woody plants, but such pure grassland is often intimately associated in mosaic or zonally with lightly wooded communities. Some sections of the Airport Area were identified as having grassland vegetation and these amounted to nine plots (28%). The water pipeline route had only three plots (25%) with grassland vegetation and only one plot (3%) had grassland vegetation along the Expressway route.

The grassland habitats recorded within the Proposed Project Area are all considered to be modified habitats as defined by IFC PS6. The community used to carry out cultivation in the area of the Airport Area before they were relocated for the Proposed Project. At the present, the area is used for grazing cattle, goats and sheep by the nearby communities, as shown in Figure 11-8b. Some of the trees appear to have been recently cut as evidenced by presence of tree stumps in the area and some areas have been modified as a result of sand and clay mining for brick making (Figure 11-8c).

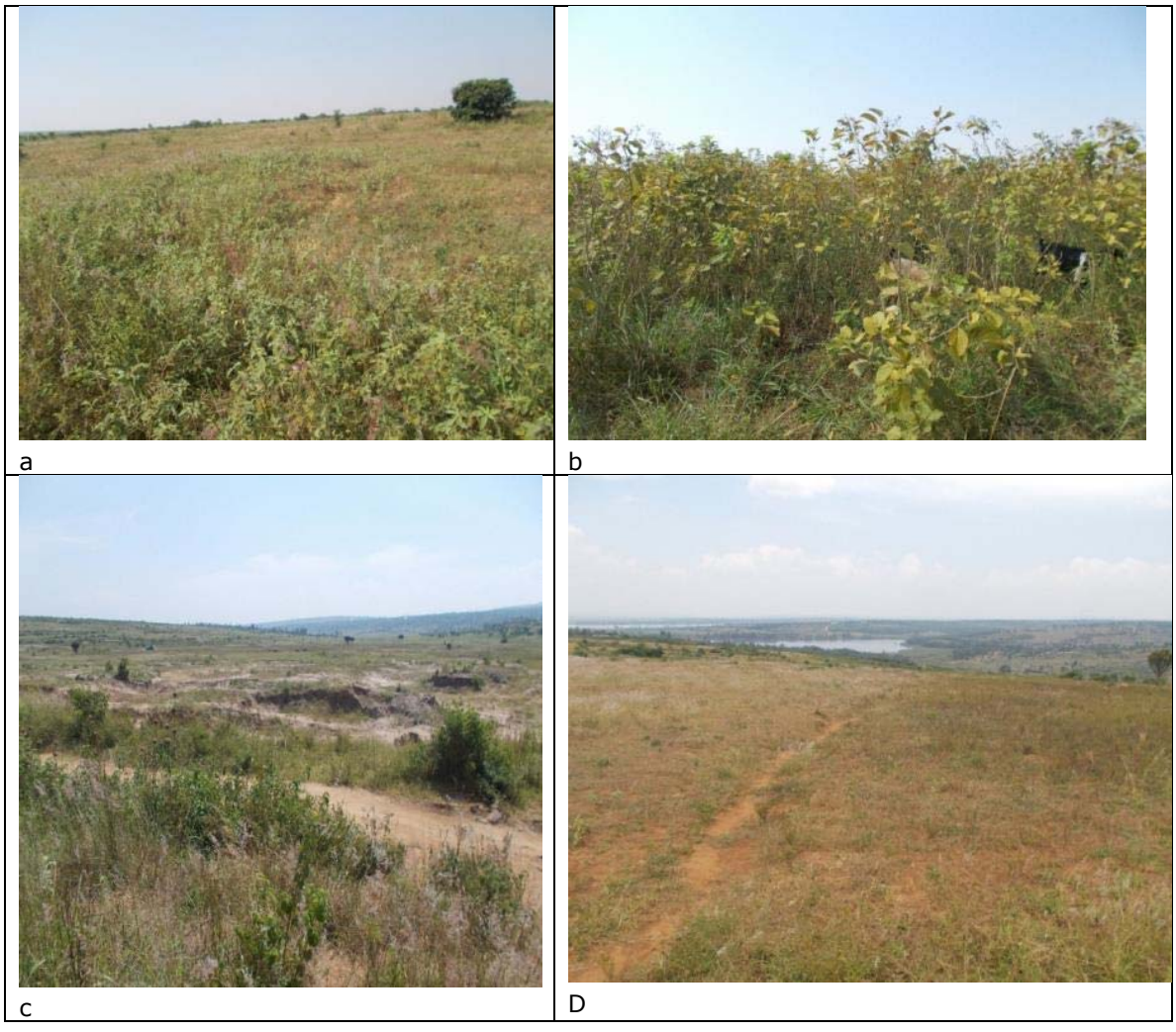

Figure 11-8: Grassland Vegetation across the Airport Area

Wooded Grassland

Wooded grassland is land covered with grasses and other herbs, with scattered or, more rarely, grouped woody plants, which are often, but not necessarily, trees. The woody plants cover between 10% and 40% of the surface. In this vegetation, Acacia species and *Egarotis curvula*

are dominant. The wooded grassland vegetation was only recorded in one sample plot (plot 34) along the Expressway route (Figure 11-9). The area is also used for grazing, which may have modified the woodland vegetation that previously existed.

The small area of wooded grassland habitat recorded within the Proposed Project Area is considered to be modified habitat as defined by IFC PS6. Of the woody species recorded, 75% were native and 25% of the woody species recorded were non-native. The area was degraded with some trees previously cut, evidenced by presence of stumps.

Figure 11-9: Wooded Grassland Vegetation along the Expressway Route

Bushland and Thicket Vegetation

Bushland is land of which 40% or more is covered by bushes. For this reporting, a bush is defined as a woody plant intermediate in habit between a shrub and a tree. Bushes are usually between 3 m and 7 m tall, but can be smaller or larger (White 1983). In thicket, the bushes are so densely interlaced as to form an impenetrable community except along tracks made by animals. In most types of bushland, larger or smaller patches of thicket also occur without significant change in floristic composition. Within the Project Area, bushland and thicket vegetation is dominated by *Lantana camara, Senna spectabilis* and *Vernonia amygalina*. Approximately 50% (16 plots) of the Airport Area are covered by bushland and thickets (Figure 11.10). There were five plots (42%) with bushland and thicket vegetation at the Water Pipeline route and no plot was recorded having bushland and thicket vegetation along the Expressway Route. The vegetation is rejuvenating, formerly the area was used for agriculture. With less anthropogenic activities in the area following relocation, it shows signs of developing into woodland vegetation.

Whilst bushland and thickets would have likely been the dominant natural vegetation in the Bugesera District[36], the bushland and thicket habitats recorded within the Proposed Project Area are all considered to be modified habitats as defined by IFC PS6. All bushland and thicket plots had non-native species recorded as being dominant, with 20 out of 21 plots recorded to have *Lantana camara* present, which is an alien invasive species native to South America. The

[36] Rwanda Environment Management Authority (REMA) (2007) Pilot Integrated Ecosystem Assessment of Bugesera

prevalence of Lantana camera may be partially attributable to its relative tolerance to drought conditions that persisted during an extended period between 1999 and 2002, as well as the first decade of the 21st century (REMA, 2007).

Figure 11-10: Bushland and Thicket at the Airport Site Dominated by *Lantana camara*

Swamp and Aquatic Vegetation

Swamp and aquatic vegetation includes plant communities that are either permanently waterlogged or waterlogged for extended periods of the year (swamp), as well as truly aquatic vegetation that occurs in deeper water (White 1983) and can include floating vegetation. Both swamp and aquatic ecosystems are dependent on the underlying hydrology and in the Proposed Project AOI they form a single complex ecosystem with the many lakes, ponds and pools. Permanent swamp is the dominant vegetation in the valley bottoms and around the edges of the many lakes within the Area of Influence. There are six large lakes in the Proposed Project AOI. These large range in size from 225 ha (Lake Kidogo) to 280 ha (Lake Rumira) and are all shallow, ranging between 2.5 m to 4 m depth (REMA, 2007). The lakes are naturally recharged by precipitation. The lakes generally have low levels of truly aquatic vegetation largely comprising non-native invasive species of Common Water Hyacinth *Eichhornia crassipes,* Blue Lotus *Nymphaea nouchali,* and American White Waterlily *Nymphaea odorat.* According to secondary data, about 50 species of plankton are found in these ecosystems, from the following families: Chlorophyceae, Cynaphyceae, Pyraphytes, Bacillariophyceae, Cynophyceae, Pyrophytes, Euglenophyceae, and Diatomophyceae (REMA, 2009). According to REMA (2007), the lakes are rich in plankton and from time to time are affected by cynaphyceae blooms which reduce the transparency to less than 20 cm. This indicates that eutrophication may be a problem, possibly caused from poor sanitation and soil erosion from surrounding farmland.

A total 59 plant species were recorded in the wetland areas. Of these, 15 were wetland species. The wetlands associated with Lake Gashanga, Lake Kidogo, Lake Rumira and Lake Murago (located to the east of the Airfield Area) are dominated by Papyrus Sedge *Cyperus papyrus*

(Figure 11-11a and Figure 11-12). The wetlands adjacent to the Expressway Route are more dominated by Giant Reedmace *Typha latifolia*, with Papyrus sedge ranging from 0-30% cover (Figure 11-11b and Figure 11-12). Varying proportions of other species include grasses such as *Vossia cuspida* and Common Reed *Phragmites australis*, woody shrubs of *Mimosa pigra*, and locally ferns. The other swamp and aquatic plant species included *Polygonum pensylvanicum*, *Persicaria pensylvanica*, *Cyperus alternifolius*, *Polygonum coccineum*, *Setaria glauca*, *Polygonum coccineum* and *Pistia stratiotes.*

In some locations, wetlands have been modified with agriculture. Cultivation is often carried out down to the edge of the wetlands (Figure 11-7a). Within the Nyabarongo River corridor, north of the Proposed Project, *Saccharum officinarum* (sugarcane) is widely planted (Figure 11-11d). In several areas, the harvesting of both Papyrus sedge and Giant reedmace was observed, often for use as a mulch within the cropped farmland (11-11c). In some areas, the swamp vegetation showed signs of recent burning. According to literature sources, this is sometime done as a means of hunting animals in the swamp. It also appears that in some locations outside of the Proposed Project Area, burning is used in effort to remove Papyrus to enable cultivation of crops such as rice.

Although the narrow edges of wetlands have been modified with human agricultural activities, the majority of swamp and aquatic habitats still perform the primary ecological functions and have species composition of native origin and are considered natural habitats as defined by IFC PS6.

Figure 11-11: Swamp and Aquatic Vegetation (a= Swamp dominated by papyrus, b= Swamp dominated by *Typha sp* c= local communities harvesting Papyrus and d= sugarcane planted adjacent to the Nyabarongo River)

Threatened and Endemic Species

About 280 species of flowering plants from Rwanda are considered to be endemic to the Albertine Rift and of these endemic species, about 20 are restricted to Rwanda[37]. However, no threatened or endemic species of plant were identified as potentially present in the desk study and no threatened or endemic species were recorded during the field surveys.

11.4.3.2 Alien Invasive Species

The Global Invasive Species Database (2015)[38] defines invasive alien species as non-native organisms that cause, or have the potential to cause, harm to the environment, economies, or human health. Invasive species reproduce rapidly, out-compete native species for food, water and space, and are one of the main causes of global biodiversity loss. There are estimated to be over 480,000 invasive species, both plants and animals, worldwide (Chenje, 2015)[39]. Invasive Alien Species are widely recognised as one of the major factors of global change (Jones, 2014)[40]. Invasive species rank among the greatest threats to native biodiversity and ecosystems worldwide (Allen *et al.*, 2015)[41]. Invasive alien species are the second greatest cause of biodiversity loss on the planet, with only habitat destruction posing a greater threat (Global Environment Facility, 2003)[42].

These invasive species occur in different parts of the world and they are present in a range of types and forms. A total number of 32 plant species are reported as Invasive Alien Plant Species in Rwanda (BIOCEM-RD Ltd, 2016)[43]. Among them, the top ten most harmful species reported were *Lantana camara*, Common Water Hyacinth, *Mimosa pigra*, Water Cabbage *Pistia stratiotes*, *Solanum chrysotrichum*, *Acacia mearnsii*, *Acacia melanoxylon*, *Caesalpinia decapetala*, *Agave sisalana* and *Tithonia diversifolia* (BIOCEM-RD Ltd, 2016).

Of the top ten most harmful species, six were recorded in the Proposed Project Area and these were *Lantana camara* (present across almost the entire Airport Area), Common Water Hyacinth *Eichhornia crassipes*, *Mimosa pigra*, Water Cabbage *Pistia stratiotes*, *Agave sisalana* and *Tithonia diversifolia*. Other invasive plant species that were recorded in the Proposed Project Area include: Blue Lotus, American White Waterlily, *Cupressus lusitanica*, *Bambusa vulgaris*, *Agentum conzyoides*, *Senna spectabilis*, *Eucalyptus saligina*, *Brugmansia suaveolens* and *Psidium guajava*. Therefore, a total of 15 non-native invasive plant species were recorded across the Proposed Project Area.

[37] REMA (2009) "Rwanda State of Environment and Outlook Report" Rwanda Environment Management Authority

[38] Global Invasive Species Database. (2015). Available from: http://www.issg.org/database/species/search.asp?

[39] Chenje, M. (2015). Invasive alien species. Available from: https://scholar.google.com/scholar?oe=utf-8andum=1andie=UTF-8andlrandq=related:WCub912WEz2MdM:scholar.google.com/

[40] Jones, K.L. (2014). Changes in Cropping Patterns, Resilience and Invasive Plant Species in Social-Ecological Systems: A Study of the Home Gardens of Kerala, India. Proceedings of the International Conference on Invasive Alien Species Management. 70-85.

[41] Allen, C.R., Uden, D.R., Johnson, A.R., Angeler, D.G., and Venette, R.C. (2015). Spatial modelling approaches for understanding and predicting the impacts of invasive alien species on native species and ecosystems. Pest Risk Modelling and Mapping for Invasive Alien Species, 162pg.

[42] Global Environment Facility. (2003). Removing Barriers to Invasive Plant Management in Africa. Available from: http://www.inspiralpathways.com/uploads/1/6/7/1/16715958/rbipma_project_document_may_06.pdf. Accessed on 13/04/2017.

[43] BIOCEM-RD Ltd. (2016). Study to assess the impacts of invasive alien species (Flowering plants, fish and insects) in natural forests, agro-ecosystems, lakes and wetland ecosystems in Rwanda and develop their management plans. REMA Final Report.

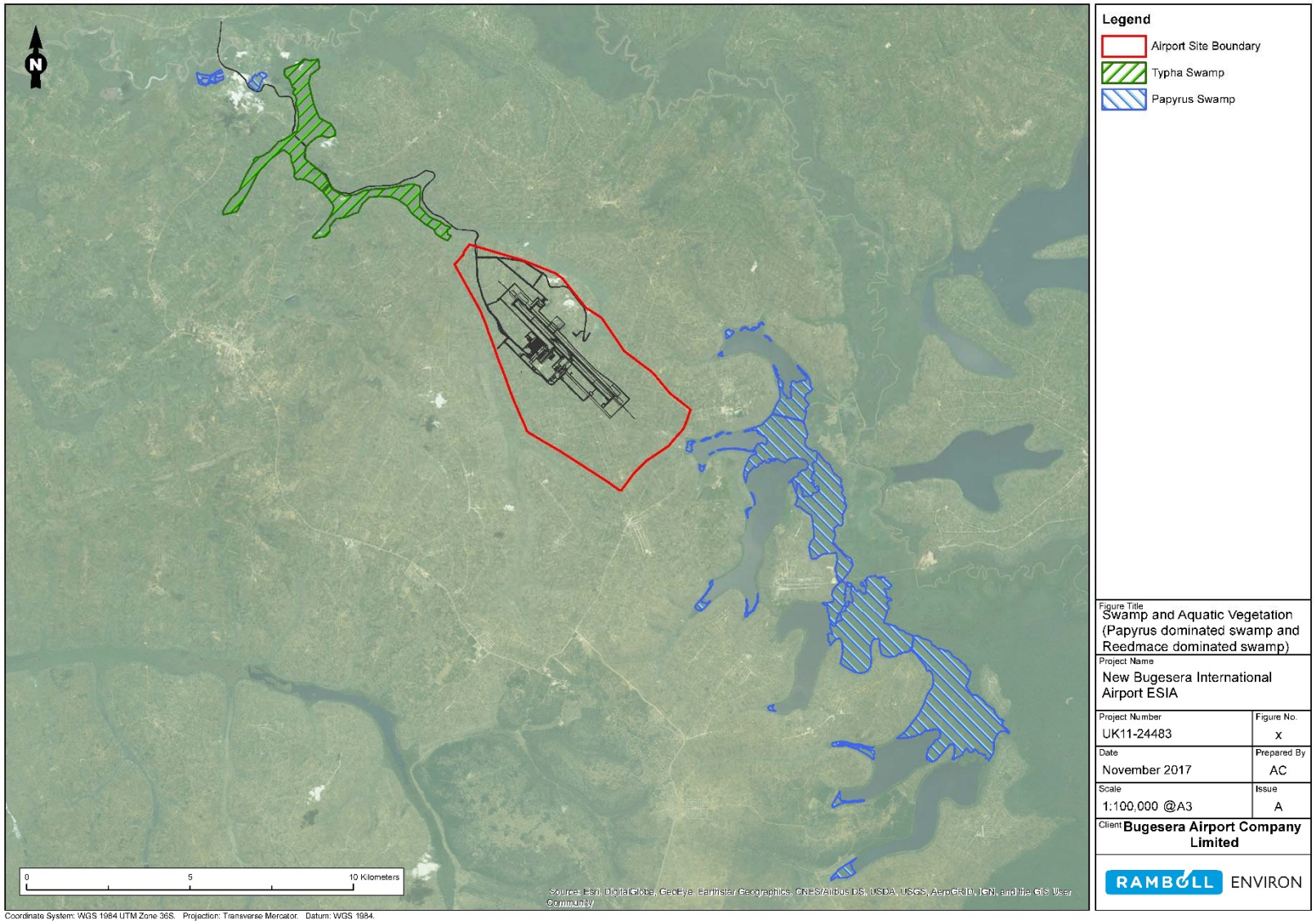

Figure 11-12: Swamp and Aquatic Vegetation (Papyrus dominated swamp and Reedmace dominated swamp)

11.4.3.3 Fish

According to the fishbase website[44], a total of 77 fish species are present in Rwanda, including both native and introduced species. Of these, according to the IUCN Red list, four Critically Endangered and three endangered fish species occur in Rwanda, all except one of which have global distributions that do not overlap with the Project Area of Influence (Table 11-9). According to Living National Treasures[45], seven potentially endemic fish species occur in Rwanda. These are also listed in Table 11-9, although do not necessarily meet the IFC definition of endemic or range-restricted species.[46] The fishbase website only cites three endemic species.

A single species listed in Table 11-9, Ningu *Labeo victorianus,* has a global distribution that overlaps with Proposed Project AoI and therefore potentially impacted. According to literature sources, Ningu was once one of the most important fisheries along the rivers of Lake Victoria[47], but that during the 1950s the catches of this species decreased dramatically as a result of intensive and unregulated gill-net fishing across river mouths[48]. However, Ningu is still cited as representing an important dietary and income source within the Bugesera District (MINELA 2011)[49] and therefore assumed to be present within the Project AOI. As the species is likely to occur in the Project AOI, Ningu has been included in the Critical Habitat Assessment (Technical Appendix 11.1). .

Table 11-9: Endangered and Endemic Fish Species Present in Rwanda

Species	IUCN Red list and Endemic Status	Additional Information
Ishinja / Rwasa barb *Barbus ruasae* (*Labeobarbus ruasae*)	CR and range-restricted	This species is only known from the Mukungwa River, an affluent of the Nyabarongo River in the Upper Akagera system in Rwanda. Global distribution does not overlap with Proposed Project AoI and considered to be absent.
Brachystephanus roseus	EN	This is a rather scarce species from the mountains of the Albertine Rift. Global distribution does not overlap with Proposed Project AoI and considered to be absent.
Chiloglanis ruziziensis	CR and range-restricted	Endemic to the Rusizi River where it is restricted to the rocky fast flowing stretches of the river. It has an extent of occurrence <100 km² and area of occupancy <10 km². Global distribution does not overlap with Proposed Project AoI and considered to be absent.
Chiloglanis asymetricaudalis	EN and range restricted	Only known from two locations in the Rusizi and Luiche rivers. Global distribution does not overlap with Proposed Project AoI and considered to be absent.
Bulera Haplo / Amahere	EN and Endemic	Known from only three restricted locations in Lakes Bulera and Luhondo and the River Mukungwa (Upper Akagera system in North Rwanda). Global distribution

[44] Froese, R. and D. Pauly. Editors. 2017. FishBase. World Wide Web electronic publication. www.fishbase.org, version (06/2017).
[45] Living National Treasures http://lntreasures.com/rwandaa.html, downloaded 17 May 2017.
[46] An endemic species is defined as one that has ≥ 95% of its global range inside the country or region of analysis. For freshwater systems, standardized thresholds have not been set at the global level. However an IUCN study of African freshwater biodiversity applied a threshold of 20,000 km² for range-restricted fish.
[47] Ogutu-Ohwayo (undated) The fisheries of Lake Victoria: Harvesting biomass at the expense of biodiversity
[48] FishBase team RMCA & Geelhand, D. 2016. Labeo victorianus. The IUCN Red List of Threatened Species 2016: e.T60318A47182908. http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T60318A47182908.en. Downloaded on 24 November 2017.
[49] MINELA (2011) Impacts Assessment And Evaluation Of The Pilot Project For Introduction Of Rainwater Harvesting And Utilization Techniques In Bugesera District (Cuep Project). Ministry Of Environment and Lands.

Table 11-9: Endangered and Endemic Fish Species Present in Rwanda		
Haplochromis erythromaculatus		does not overlap with Proposed Project AoI and considered to be absent.
Ningu *Labeo victorianus*	CR	*Labeo victorianus*, locally known as Ningu, is a regional endemic cyprinid of the Lake Victoria basin. Global distribution overlaps with Proposed Project AoI and therefore potentially present.
Varicorhinus platystoma (*Labeobarbus platystomus*)	CR and range-restricted	*Varicorhinus platystomus* is only known from the Mukungwa River, a fast-flowing river in the upper Akagera system in Rwanda. Global distribution does not overlap with Proposed Project AoI and considered to be absent.
Snoek's Kivu Haplo Haplochromis insidiae	LC	Endemic to Lake Kivu (Rwanda and Democratic Republic of Congo). Global distribution does not overlap with Proposed Project AoI and considered to be absent.
Orangetail Kivu Haplo Haplochromis microchrysomelas	Ex	Endemic to Lake Kivu (Rwanda and Democratic Republic of Congo). Global distribution does not overlap with Proposed Project AoI and considered to be absent.
Red Kivu Haplo *Haplochromis rubescens*	LC	Endemic to Lake Kivu (Rwanda and Democratic Republic of Congo). Global distribution does not overlap with Proposed Project AoI and considered to be absent.
Barbus microbarbis	Ex	Considered likely to be extinct in the Wild and previous global distribution does not overlap with Proposed Project AoI and considered to be absent.
Varicorhinus ruandae	NT	*Varicorhinus ruandae* is know from only three locations, one in Rwanda and two in Burundi. The IUCN Redlist suggests that its global range could overlap with the Proposed Project AOI although the population size and trend are not known, but it is rare in fisheries catches[50]. As it is not endangered or critically endangered and is not range restricted or endemic, it is not assessed for triggering Critical Habitat.

11.4.3.4 Amphibians and Reptiles

Introduction

As in many other African countries, the diversity of the Rwandan herpetofauna and their distribution within the country are far from being fully assessed. In regional treatments of herpetofauna, Rwanda is usually either not covered (Schiøtz 1975[51]; Channing & Howell 2006[52]) or the presence and distribution of species in Rwanda is extrapolated from data from outside

[50] FishBase team RMCA & Geelhand, D. 2016. Varicorhinus ruandae. The IUCN Red List of Threatened Species 2016: e.T61306A47244799. http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T61306A47244799.en. Downloaded on 27 November 2017

[51] Schiøtz A. (1975) The treefrogs of Eastern Africa. – Steenstrupia: Copenhagen.

[52] Channing, A. & Howell, K.M. (2006) Amphibians of East Africa. Edition Chimaira, Frankfurt am Main.

the country (e.g. Branch 2005[53]; Spawls et al. 2006[54], IUCN 2013[55], Frost 2013[56]) or coarsely described based on information from the middle of the 20th Century (Schiøtz 1999[57], Frost 2013). Despite the fact that herpetological field work has been conducted for more than a century, the country must be considered poorly explored in comparison to other countries of the region like Tanzania, Kenya and Uganda.

Currently, about 40 amphibian species have been reported for Rwanda (summarised by Frost 2013) however considering the limited field work carried out so far, the country is expected to be richer in species than current data indicate (Andreone *et al.* 2008[58]). A herpetofauna inventory has been previously conducted in the Mugesera wetlands by M. Dehling in 2011 as part of the larger team that conducted an inventory of four wetland networks in Rwanda (Fischer, E. 2011[59]). This inventory was completed approximately 8 km to the south east of the Proposed Project Area (Figure 11-13). This study makes an additional contribution of distribution records of the herpetofauna of Rwanda, as well as providing additional records of species likely to occur within the Proposed Project Area. The results of the 2011 M Dehling study are detailed in this section along with the results of the Project-specific fieldwork.

[53] Branch B. (2005) A Photographic Guide to Snakes, other reptiles and amphibians of East Africa. – Struik Publishers: Cape Town.

[54] Spawl, S., Howell, K. & Drewes, C. (2006) Pocket Guide to the Reptiles and Amphibians of East Africa. A & C Black Publishers, London.

[55] IUCN (2013) IUCN Red List of Threatened Species. Version 2016-1. www.iucnredlist.org

[56] Frost D. R. (2013) Amphibian Species of the World: an Online Reference. Version 5.6. – American Museum of Natural History, NY, USA. Available from http://research.amnh.org/herpetology/amphibia/index.html (last accessed 26 August 2013).

[57] Schiøtz A. (1999) Treefrogs of Africa. – Edition Chimaira: Frankfurt am Main.

[58] Andreone F., Channing A., Drewes R., Gerlach J., Glaw F., Howell K., Largen M., Loader S., Lötters S., Minter L., Pickersgill M., Raxworthy C., Rödel M.-O., Schiøtz A., Vallan D. & Vences M. (2008) Amphibians of the afrotropical realm. pp. 53-58 in: Stuart S. N., Hoffman M., Chanson J. S., Cox N. A., Berridge R. J., Ramani P. & Young B. E. (eds.) Threatened amphibians of the world. – Lynx Editions: Barcelona, Spain; IUCN: Gland Switzerland; and Conservation International: Arlington, Virginia. xv + 758 pp.

[59] Fischer, E. (2011) "Biodiversity Inventory for Key Wetlands in Rwanda. Final Report to Rwanda Environment Management Authority.

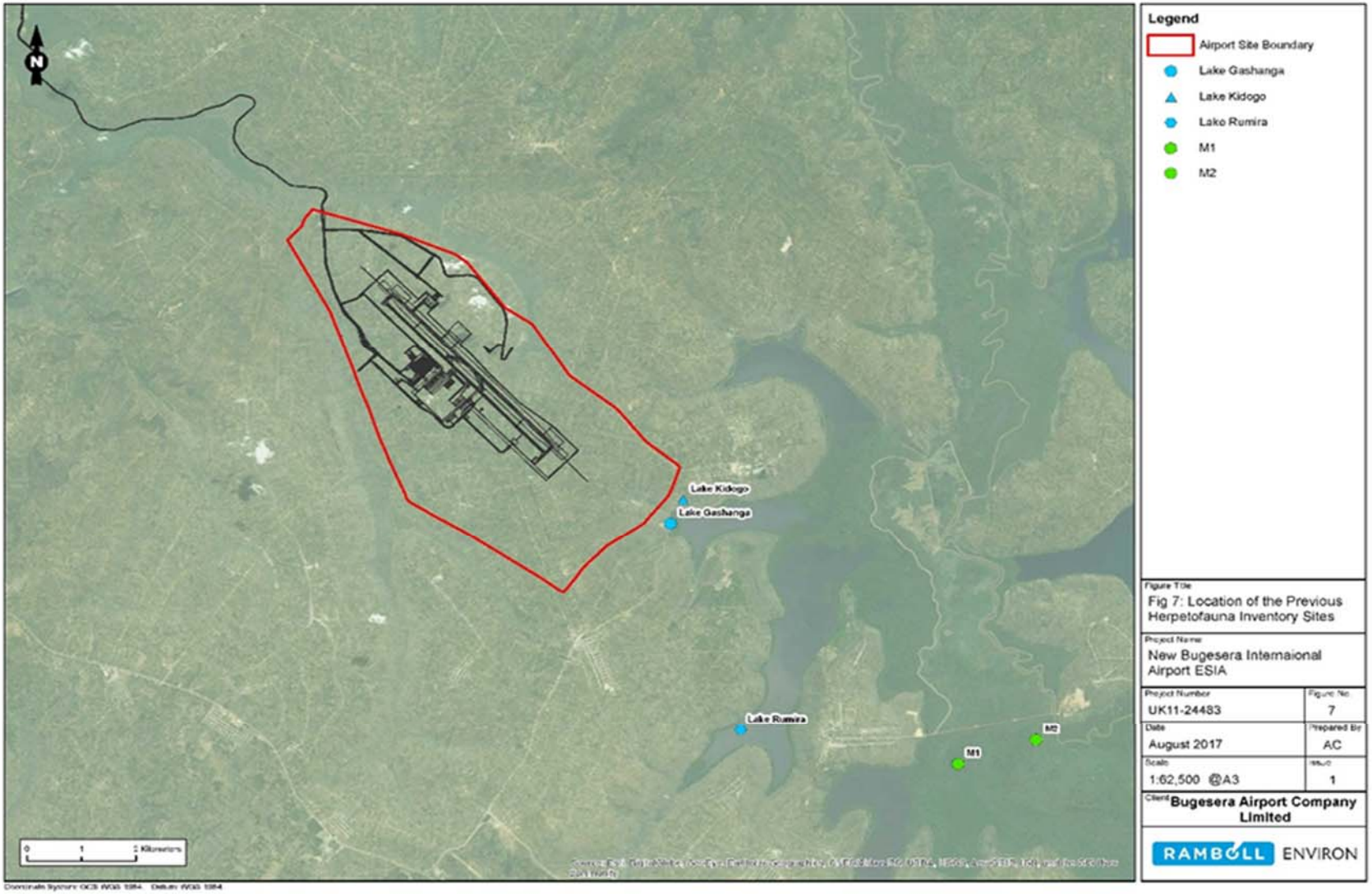

Figure 11-13: Location of the Previous Herpetofauna Inventory Sites (M1 and M2)

Amphibians

A total of 10 amphibian species belonging to five genera and four families were recorded during the field survey (Technical Appendix 11.2). This represents 71% of the amphibians recorded by M. Dehling in the nearby Mugesera wetland in 2011 (Technical Appendix 11.2). *Phrynobatrachus natalensis* was the most abundant species encountered with 204 individuals, followed by *Ptychadena mascareniensis, Hyperolius viridiflavus* and *Phrynobatrachus mababiensis*, with 183, 159 and 143 individuals encountered respectively. *Kassina senegalensis, Hyperolius kivuensis*, and *Ptychadena porosissima* were the least abundant. The Expressway and the water pipeline transects recorded nine species and seven species respectively.

Table 11-10 shows the amphibian species encountered and recorded for each of the different sites sampled in the Proposed Project Area and Figure 11-14 illustrates the numbers of species genera and families encountered in each of the sampled areas.

Table 11-10: Amphibian Species List for Bugesera International Airport Project and Surrounding Areas

Species	IUCN Redlist Status*	Endemic Status**	Mugesera Wetland (Dehling, 2011)***	Lake Kidogo	Lake Gashanga	Lake Rumila	Lake Murago	Airport Area	Expressway (Nyabarongo & Mwesa Wetlands)	Water Pipeline
				Number of Individuals Recorded at Each Location						
Amietophrynus gutturalis	LC	W			1	2				
Amietophrynus regularis	LC	W	Y							
Afrixalus quadrivittatus	LC	W	Y							
Hyperolius acuticeps	LC	W	Y							
Hyperolius kivuensis	LC	W	Y	13	7				25	3
Hyperolius lateralis	LC	GL	Y							
Hyperolius viridiflavus	LC	W	Y	27	5	16	55		51	5
Hyperolius nasutus	-	W		7	2				60	
Kassina senegalensis	LC	W	Y						11	
Phrynobatrachus kakamikro	LC	GL	Y							
Phrynobatrachus natalensis	LC	W	Y	43	11	30	60		53	7

Table 11-10: Amphibian Species List for Bugesera International Airport Project and Surrounding Areas

Species	IUCN Redlist Status*	Endemic Status**	Mugesera Wetland (Dehling, 2011)***	Lake Kidogo	Lake Gashanga	Lake Rumila	Lake Murago	Airport Area	Expressway (Nyabarongo & Mwesa Wetlands)	Water Pipeline
				Number of Individuals Recorded at Each Location						
Phrynobatrachus mababiensis	-	W		32	9	30	21		50	1
Xenopus victorianus	LC	GL	Y							
Ptychadena anchietae	LC	W	Y	17		3	35		25	6
Ptychadena mascareniensis	LC	W	Y	39	19	43	47	3	19	13
Ptychadena porosissima	LC	W	Y	21	5				9	3
Amietia angolensis	LC	W	Y							
Total Number of Species Recorded at Each Location			**14**	**8**	**8**	**6**	**5**	**1**	**9**	**7**

*** IUCN Redlist Status LC = Least Concern, - = not currently assessed by the IUCN Redlist**

**** Endemic Status: = W=widespread in Africa; GL=regional endemic of the Great Lake region.**

*****Mugesera: Y = previous presence recorded for Mugesera Wetland Area by M. Dehling in 2011.**

Nine species of amphibians were recorded along the 14.5 km Expressway transect, which was more than other sample locations. This was followed by Lake Kidogo and Lake Gashanga for which eight species were recorded for each. The site with the least number of species was across the Airport Area. Only one species was encountered in this area. Along the Water Pipeline, seven species of amphibians were recorded. Most of these amphibians were recorded towards the water extraction point on Lake Kidogo. The Water Pipeline was more diverse than Lake Rumila and Lake Murago, and the Airport Area. Lake Rumila and the Expressway had more genera than the rest of the sampled sites, with a record of four. Lake Rumila was the site with the most amphibian families represented.

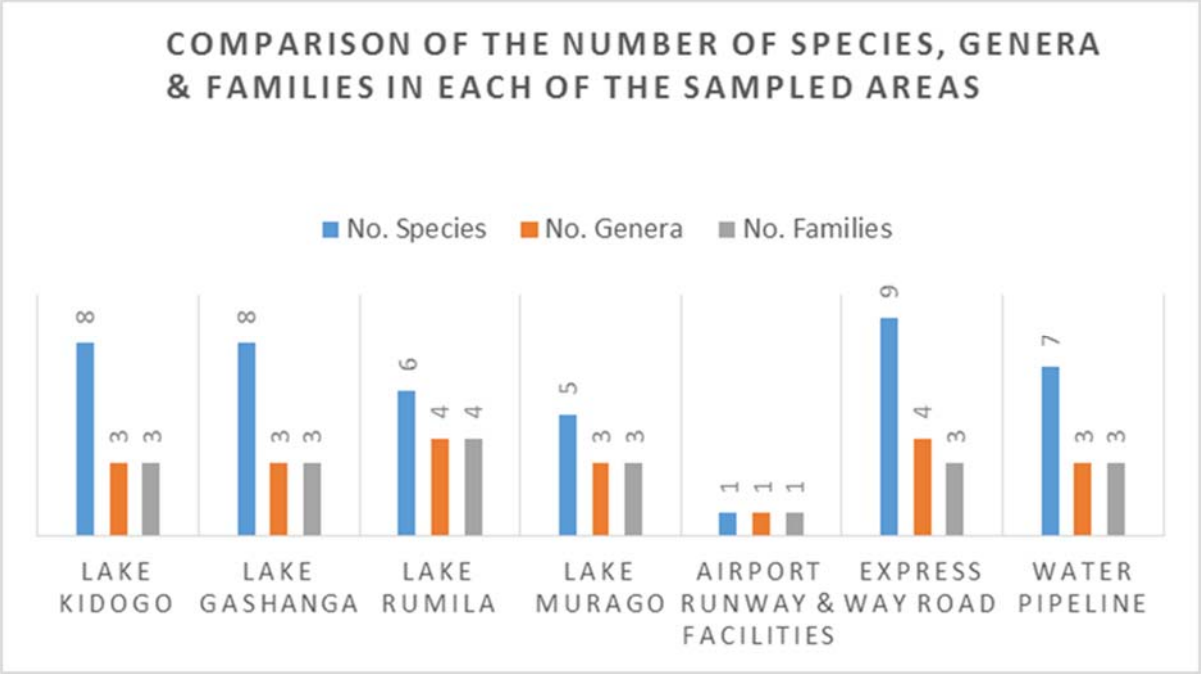

Figure 11-14: Number of Amphibian Species Recorded at Each Sampling Site

Reptiles

The majority of the species recorded within the field survey were identified across the Airport Area rather than the rest of the sampled sites. Three species of reptiles belonging to three genera and three families were recorded. Two species of reptiles were recorded at Lake Kidogo and Lake Rumila, while one species was recorded along the Expressway and one along the Water Pipeline routes respectively (Figure 11-15). In total, four reptile species were recorded belonging to four genera and four families, representing 67% of species recorded by M. Dehling in Mugesera Wetland in 2011 (Table 11-11). The Striated Skink *Mabuya striata* was the most abundant species with 35 individuals recorded. Nile Crocodile *Crocodylus niloticus*, were recorded in both Lake Kidogo and Lake Rumila. It is likely that the species also occurs in the other large lakes in the area.

Table 11-11: Reptilian Species List for New Bugesera International Airport Different Sites

Species	IUCN Redlist Status*	Endemic Status**	Mugesera Wetland (Dehling, 2011)***	Lake Kidogo	Lake Gashanga	Lake Rumila	Lake Murago	Airport Area	Expressway (Nyairongo & Mwesa Wetlands)	Water Pipeline
Crocodylidae										
Nile Crocodile *Crocodylus niloticus*	LC	W		x		x				
Elliot's Groove-throated Chameleon *Trioceros ellioti*	-	GL	Y							
Colubridae										
Philothamnus heterolepidotus	-	W	Y							
Elapidae										
Naja melanoleuca	-	W	Y							
Naja nigricollis	-	W	Y					1		
Geckonidae										
Cnemaspis quattuorseriatus	-	W						2		
Pelomedusidae										
Black-bellied Hinged Terrapin *Pelusios subniger*	LC	W	Y							
Scincidae										
Striated Skink *Mabuya striata*	-	W		6		11		7	9	2
Viperidae										
Bitis arietans	-	W	Y							
Total Number of Species Recorded at each Location			**6**	**2**	**0**	**2**		**3**	**1**	**1**

Table 11-11: Reptilian Species List for New Bugesera International Airport Different Sites

*** IUCN Redlist Status LC = Least Concern, - = not currently assessed by the IUCN Redlist**

**** Endemic Status: = W=widespread in Africa; GL=regional endemic of the Great Lake region.**

*****Mugesera: Y = previous presence recorded for Mugesera Wetland Area by M. Dehling in 2011.**

X = denotes present but number of individuals not counted.

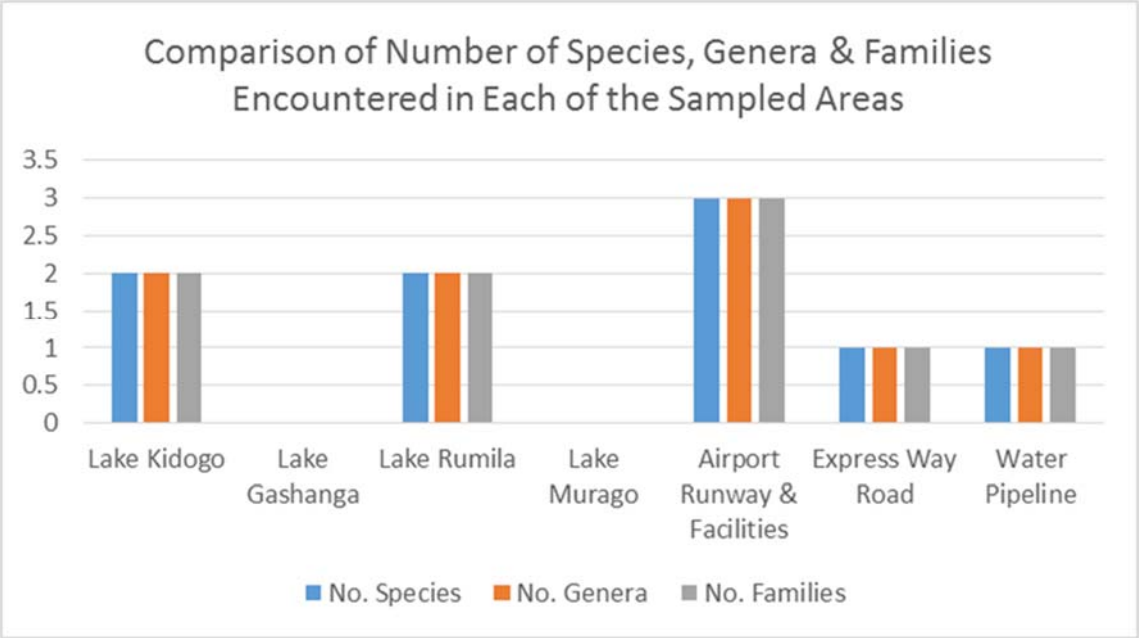

Figure 11-15: Reptile Species Recorded at Each Sample Site

Threatened and Endemic Species

Based on the initial desk study, no threatened species of amphibian or reptile are likely to occur within the Proposed Project Area. According to Living National Treasures website[60] three endemic amphibian species occur in Rwanda. These include Jackie's Reed Frog *Hyperolius jackie*, Fischer's Caecilian *Boulengerula fischeri* and Rwanda Long Reed Frog *Hyperolius rwandae*. Only one of these species, Rwanda Long Reed Frog *Hyperolius rwandae*, has an extent of occurrence that overlaps with the location of the Proposed Project. The IUCN RL states that this species has been recorded within the Mugesera and Akagera wetlands[61] and that the species is abundant in all known sites in ponds, swamps in farmland and open natural wetlands[62]. However, the 2011 Dehling survey did not record the species from Mugesera and it was not recorded within the Proposed Project Area during the current study despite an intensive effort. Based on the survey evidence it concluded that the species is unlikely to occur within the Proposed Project AOI.

The Living National Treasures website also lists a single endemic reptile species, the Rwandan Snake-eater *Polemon leopoldi*. This poorly-known species appears only to have been recorded from Rwanda, where it was taken from the Rwankeri region at an elevation of 2,200 masl[63] and therefore is unlikely to occur within the Proposed Project AoI.

According to the IUCN Red List, all the amphibians and reptiles recorded within the Proposed Project Area are of Least Concern (LC). No rare, endangered or endemic amphibian species were recorded in the Area of Influence during the field surveys. One species, Mwanza frog or Lake Victoria Clawed Frog *Xenopus victorianus*, has previously been recorded in the area and is endemic to the Great Lake region, but has a large range within this and does not meet the IFC criteria for a range-restricted species. Similarly, one reptile species, Elliot's Groove-throated

[60] Living National Treasures http://lntreasures.com/rwandaa.html

[61] IUCN SSC Amphibian Specialist Group. 2016. *Hyperolius rwandae*. The IUCN Red List of Threatened Species 2016: e.T48081486A48081529. http://dx.doi.org/10.2305/IUCN.UK.2016-1.RLTS.T48081486A48081529.en

[62] IUCN SSC Amphibian Specialist Group. 2016. Hyperolius rwandae. The IUCN Red List of Threatened Species 2016: e.T48081486A48081529. http://dx.doi.org/10.2305/IUCN.UK.2016-1.RLTS.T48081486A48081529.en. Downloaded on 24 November 2017.

[63] Wagner, P., Safari, I. & Chenga, J. 2014. *Polemon leopoldi.* The IUCN Red List of Threatened Species 2014: e.T13264660A13264666. http://dx.doi.org/10.2305/IUCN.UK.2014-3.RLTS.T13264660A13264666.en.

Chameleon or Montane Side-striped Chameleon *Trioceros ellioti*, has previously been recorded in the area and is endemic to the Great Lake region, but has a large range within this and does not meet the IFC criteria for a range-restricted. Therefore, critical habitat determination for amphibian and reptile species is not required.

11.4.3.5 Birds

Baseline Results

May/June 2017 Survey Results

A total of 124 bird species were recorded across the Proposed Project Area in May and June 2017. The total was composed of 43 families with *Timaliidae* being the most abundant. This compares to 115 species recorded during field surveys that informed the 2010 ESIA for the NBIA.

A full list of species and their recorded numbers per surveyed point is included in Technical Appendix 11.2. The most common species that were recorded virtually in all sites included Red-eyed Dove *Streptopelia semitorquata*, Speckled Mousebird *Colius striatus*, African Pied Wagtail *Motacilla aguimp*, Common Bulbul *Pycnonotus barbatus*, White-Browed Robin-Chat *Cossypha heuglini*, Brown-backed Scrub-Robin *Cercotrichas hartlaubi*, Black-Lored Babbler *Turdoides sharpei*, Grey-backed Fiscal *Lanius excubitoroides*, and Red-cheeked Cordon-bleu *Uraeginthus bengalus*.

In relation to bird communities, the habitats on-site can be categorised into four main broad habitat types : wetland, grassland, farmland and bushland. The main species recorded during the survey are were typical of farmland and bushland, with few forest indicators and only one forest specialist was seen in the Project Area (Table 11-12). The other dominant species were wetland dependants. The following table provides the lumped results as dominant broad habitats representative species.

Table 11-12: Avifauna Species Identified during the Baseline Study in May and June 2017

Habitat	Species Recorded
Farmland / Bushland	47
Wetland	27
Grassland	10
Forest (generalist)	19
Forest (specialist)	1

Water Bird Species

For the purposes of the International Wetlands Census, Wetlands International defines the term water birds including all grebes, cormorants, pelicans, herons, egrets, storks, ibises, spoonbills, flamingos, ducks, geese, swans, cranes, rails, jacanas, shorebirds, gulls, terns and skimmers. In addition, raptors, kingfishers and other birds largely dependent on food resources in these habitats are often reported[64]. In line with the British Trust for Ornithology (BTO) Wetlands Birds Survey (WeBS)[65], this chapter excludes passerine species from the definition of water birds; however, the wetland IBA trigger species, which are all passerines are discussed in detail in the following sub-section. Between the two surveys completed in May/June 2017 and October/November 2017, a total of 49 water bird species were recorded. A greater number of

[64] https://www.wetlands.org/our-approach/healthy-wetland-nature/international-waterbird-census/#sites
[65] https://www.bto.org/volunteer-surveys/webs/taking-part/core-counts-methods

water bird species were recorded in October/November 2017 than in May/June 2017, possibly as a result of the greater level of survey effort targeted towards wetland habitats. The water bird species recorded in 2017 are presented in Table 11-13 below, along with numbers of individuals recorded in May/June and the proportion of point counts at which the species were recorded in October/November 2017. The proportion of point counts at which a species was recorded within wetland habitats provides an indication of relative abundance and distribution within the area surveyed.

All of the large waterbodies within the Project AOI were surveyed with excellent coverage of the open water areas, comprising Lake Kidogo, Lake Rumira, Lake Gashanga, Lake Miravi, Lake Kilimbi and Lake Gaharwa. The lakes do not appear to support large concentrations of water birds. Small numbers of the fish-eating raptors African Fish Eagle and Osprey were observed at each of the lakes. Wading birds were restricted to small numbers of mostly individual Sandpipers, widely spaced around the lake shores. Kingfishers, especially Pied and Malachite Kingfishers were widespread. In the case of Malachite Kingfisher usually singularly, and for Pied Kingfishers in pairs or small family groups. The majority of water birds were observed at the edge of the papyrus and Typha swamps, associated with small pools and ponds. The largest concentration of water birds was recorded at two locations; one close to the Expressway route and the other within the Gashora Marshland east of the Project AOI. However, as can be seen from Table 11-13, the numbers in all cases were not large and certainly far short of the Ramsar Criterion 5: that considers a wetland internationally important if it regularly supports 20,000 or more water birds.

Table 11-13: List of Water Bird Species Recorded in 2017

English Name	Scientific Name	Number of Individuals Recorded [1]	Number of Point Count Locations Recorded / Percentage (Number of Individuals Recorded)
		May / June 2017	October / November 2017
Long-Tailed Cormorant	*Phalacrocorax africanus*	1	4/5%
Great Cormorant	*Phalacrocorax carbo*	0	1/<1%
Pink-Backed Pelican	*Pelecanus rufescens*	x	0
Cattle egret	*Bubulcus ibis*	0	1/<1%
Squacco Heron	*Ardeola ralloides*	x	1/<1%
Little Bittern	*xobrychus minutus*	0	1/<1%
Rufous-bellied Heron	*Ardeola rufiventris*	0	1/<1%
Striated Heron (Green-backed Heron)	*Butorides striata*	0	1/<1%
Little Egret	*Egretta garzetta*	10	5/6%
Intermediate Egret	*Egretta intermedia*	11	x
Purple Heron	*Ardea purpurea*	x	0
Grey Heron	*Ardea cinerea*	1	3/4%

Table 11-13: List of Water Bird Species Recorded in 2017			
Black-headed Heron	*Ardea melanocephala*	0	4/5%
Sacred Ibis	*Threskiornis aethiopica*	100	6/7% (maximum count 21 individuals)
Hamerkop	*Scopus umbretta*	0	3/4%
Yellow-Billed Stork	*Mycteria ibis*	x	4/5% (maximum count 14 individuals)
Hadada Ibis	*Bostrychia hagedash*	0	17/20%
Glossy Ibis	*Plegadis falcinellus*	0	1/<1%
African Spoonbill	*Platalea alba*	0	3/4%
White-Faced Whistling Duck	*Dendrocygna viduata*	x	2/3% (maximum count 21 individuals)
Knob-billed Duck	*Sarkidiornis melanotos*	0	2/2%
Spur-Winged Goose	*Plectopterus gambensis*	2	11/13% (maximum count 11 individuals)
Hottentot Teal	*Anas hottentota*	100	1/<1% (16 individuals)
Yellow-billed duck	*Anas undulata*	0	1/<1%
Osprey	*Pandion haliaetus*	0	4/5%
African Fish Eagle	*Haliaeetus vocifer*	2	18 / 21%
African Marsh Harrier	*Circus ranivorus*	1	10/12%
Eurasian Marsh Harrier	*Circus aeruginosus*	0	1/<1%
Black Crake	*Amaurornis flavirostris*	x	16/19%
African Water Rail	*Rallus caerulescens*	0	1/<1%
Red-Knobbed Coot	*Fulica cristata*	1	0
Common Moorhen	*Gallinula chloropus*	1	3/4%
Lesser Moorhen	*Paragallinula angulata*	0	1/<1%
African Jacana	*Actophilornis africanus*	0	8/10%
Lesser Jacana	*Microparra capensis*	0	1/<1%
Grey Crowned-crane	*Balearica regulorum*	0	3/4%
Black-winged stilt	*Himantopus himantopus*	0	Recorded outside point counts - 4 individuals
Long-Toed Lapwing	*Vanellus crassirostris*	6	3/4%
Senegal Lapwing	*Vanellus lugubris*	0	1/<1%
African Wattled Lapwing	*Vanellus senegallus*	0	2/2%
Three Banded Plover	*Charadrius tricollaris*	0	1/<1% (2 individuals)
Marsh Sandpiper	*Tringa stagnatilis*	0	2/2%

Table 11-13: List of Water Bird Species Recorded in 2017			
Wood Sandpiper	*Tringa glareola*	0	4/5%
Common Sandpiper	*Actitis hypoleucos*	0	5/6%
Green Sandpiper	*Tringa ochropus*	0	1/<1%
Black-tailed Godwit	*Limosa limosa*	0	1/<1%
Malachite Kingfisher	*Corythornis cristata*	1	15/18%
Pied Kingfisher	*Ceryle rudis*	4	16/19%
Giant Kingfisher	*Megaceryle maxima*	0	1/<1%
1: denotes a species recorded as present but numbers of individuals not counted			

Assessment of the Wetland Biome-Restricted Bird Communities (IBA Trigger Species)

As described in Section 11.3.1.1, the Proposed Project Area includes relevant parts of the Nyabarongo Wetlands IBA, which is an internationally recognised area as defined by IFC PS6. The Nyabarongo wetlands IBA is recognised for internationally important populations of the following species:

- Papyrus Gonolek *Laniarius mufumbiri;*
- Carruthers's Cisticola *Cisticola carruthersi;*
- Papyrus Yellow Warbler *Calamonastides gracilirostris* (*Chloropeta gracilirostris*);
- White-winged Swamp-warbler *Bradypterus carpalis;*
- Black-lored Babbler *Turdoides sharpie;*
- Northern Brown-throated Weaver *Ploceus castanops;*
- White-collared Oliveback *Nesocharis ansorgei*; and
- Papyrus Canary *Crithagra koliensis*.

A consultation meeting was held with Association pour la Conservation de la Nature au Rwanda (ACNR) regarding the status of the IBA. ACNR indicated that the Nyabarongo Wetlands IBA is not accurately mapped, and they were not aware of any management plan for the wetland and no comprehensive survey of the IBA has been undertaken so far. Therefore, targeted bird surveys were completed during October and November 2017 to provide accurate distribution and relative abundance for IBA trigger species within the wetlands within the AOI. During the field surveys completed in May and June 2017, three of the IBA trigger species were recorded: Papyrus Gonolek, Black-lored Babbler and White-winged Swamp-warbler. During the targeted wetland surveys in October and November 2017, seven out of eight of the IBA trigger species were recorded. Only White-collared Oliveback was not recorded and is presumed to be absent in the survey area, at least during the season surveyed. In addition, Red-Chested Sunbird *Cinnyris erythrocercus* was recorded. This is another biome-restricted species that is an IBA trigger species for both the Akanyaru Wetlands IBA and the Akagera National Park IBA due to its dependence on wetlands. Therefore, this species is also discussed in this sub-section as it is a potential future IBA trigger species for the IBA.

Papyrus Gonolek

This species was recorded in nearly half of all of the 84 point counts completed in October and November 2017 (Figure 11-16). It was present in nearly all of the survey locations that comprised papyrus dominated swamp. Only in small isolated patches of papyrus, or where papyrus swamp was limited to a thin lake fringe was the species absent from this habitat. During the October/November 2017 surveys, the species was not recorded from the *Typha* dominated

swamp alongside the Expressway Route, although it was recorded twice in this area during the May/June 2017 surveys. In the majority of survey locations, a single pair of birds were observed, although on four occasions up to four birds were recorded, possibly when two adjacent territories were present. The species responded very quickly and strongly to the sound of the playback, suggesting that the species is highly territorial. The species was recorded by ANCR within the Nyabarongo wetlands in 2003.

Carruthers's Cisticola

Carruther's Cisticola has a very similar appearance to Winding Cisticola *Cisticola marginatus*, although the calls of the two species are highly distinctive. Both species were recorded in close proximity to each other. Carruther's Cisticola however was strongly associated with papyrus dominated swamp, whereas Winding Cisticola was seen more frequently in wetland edge and degraded wetlands. Carruther's Cisticola was recorded in 26 locations, 31% of the playback points (Figure 11-17). The species responded strongly to the sound of playback, which often stimulated display and territorial response behaviour. In many of the recorded locations, pairs of birds were present. The behaviour observed suggests that the birds were holding breeding territories. The species was not recorded by ANCR within the Nyabarongo wetlands in 2003, although it is likely to have been present at the time.

Papyrus Yellow Warbler

Papyrus Yellow Warbler was only recorded in a single location (Figure 11-18). This may reflect the actual rarity of the species in the area, or it may reflect poor response to the playback. Only a single playback track was obtainable from the xeno-canto website and this was not a high-quality recording. The species is unobtrusive and would normally be very difficult to observe within the dense papyrus swamp. Therefore, it is possible that the survey significantly under-recorded this species. The species was not recorded by ANCR within the Nyabarongo wetlands in 2003.

White-winged Swamp-warbler

White-winged Warbler is a shy and unobtrusive species, however it responded well to the sound of playback calls. It was recorded at 30 out of the 84 survey locations (36%) (Figure 11-19). The species was recorded in many of the areas of papyrus dominated swamp. It was absent from much of the areas of *Typha* dominated swamp, but did occur in the wetland adjacent to the Expressway when papyrus exceeded approximately 15 % of the vegetation cover. In eight of the survey locations, a pair of White-winged Warblers were recorded. The behaviour observed suggests that the birds were holding breeding territories. The species was recorded by ANCR within the Nyabarongo wetlands in 2003.

Black-lored Babbler

Black-lored Babbler was recorded in 19 (23%) widely distributed locations (Figure 11-20). Interestingly, the species was rarely recorded within large dense areas of papyrus swamp, but was often recorded in the surrounding farmland, close to the wetland edge. However, unlike Arrow-marked Babbler *Turdoides jardineii*, the species was not recorded far from wetlands. On one occasion, a bird was observed carrying nesting material into the swamp, possibly suggesting this is its preferred nesting habitat. Babblers are noisy and gregarious species and where present, Black-lored Babbler responded quickly to the sound of the playback. Both pairs and small family groups of birds were recorded, with a maximum of eight in one location. The species was not recorded by ANCR within the Nyabarongo wetlands in 2003, although it is likely to have been present at the time.

Northern Brown-throated Weaver

This species was only recorded in three locations, two of which were within the large papyrus dominated swamp located between Lake Kidogo and Lake Gashanga (Figure 11-21). With so few sightings, it is hard to interpret much into the results. The species did not show strong responses to the sound of the playback and therefore it is possible that the survey under-recorded it. The species was recorded by ANCR within the Nyabarongo wetlands in 2003.

Papyrus Canary

Only a single pair of Papyrus Canary was recorded during the October/November 2017 survey and was not recorded in May/June 2017 (Figure 11-22). The two birds did not appear to be holding territory and quickly moved away to the north. This result suggests that the species is rare within the area. The species was not recorded by ANCR within the Nyabarongo wetlands in 2003.

Red-Chested Sunbird

Whilst not a trigger species for the Nyabarongo Wetlands IBA, this species is included as a trigger species for two other wetland IBAs within Rwanda. Red-Chested Sunbird was recorded widely at 22 locations (26%) surveyed in October and November 2017 (Figure 11-23). This may represent a slight under-estimate as this only relates largely to males, with the females being very similar in appearance to other sunbird species. The species also did not respond strongly to the sound of the playback. Most of the individuals observed were highly mobile, moving rapidly between flowering plants on which they feed. However, some of the males appeared to show territorial behaviour, calling and displaying from the top of taller vegetation. Given the abundance of this biome-restricted species within the Nyabarongo Wetlands IBA, it is treated as a trigger species in the remainder of this chapter. The species was recorded by ANCR within the Nyabarongo wetlands in 2003.

Summary

Seven out of the eight trigger species of the Nyabarongo Wetlands IBA were recorded within the area subject to surveys. Four of the species are widespread within the areas of remaining wetland, although three of the species (Papyrus Gonolek, White-winged Warbler and Carruther's Warbler) are strongly associated with papyrus dominated swamps. Black-lored Babbler and Red-chested Sunbird appear to utilise both the wetlands and the nearby farmland habitats. Three of the species (Papyrus Yellow Warbler, Northern Brown-throated Weaver and Papyrus Canary) were all recorded as present, although rarely encountered. The delineation of the IBA boundary by Birdlife Boundary is currently not precise, partly reflecting lack of data previously available to the organisation. The results of the October/November 2017, provide a very robust dataset by which to update the IBA boundary with a high level of precision. In summary, all of the papyrus and *Typha* dominated swamps within the AOI are treated as qualifying as part of the Nyabarongo Wetlands IBA.

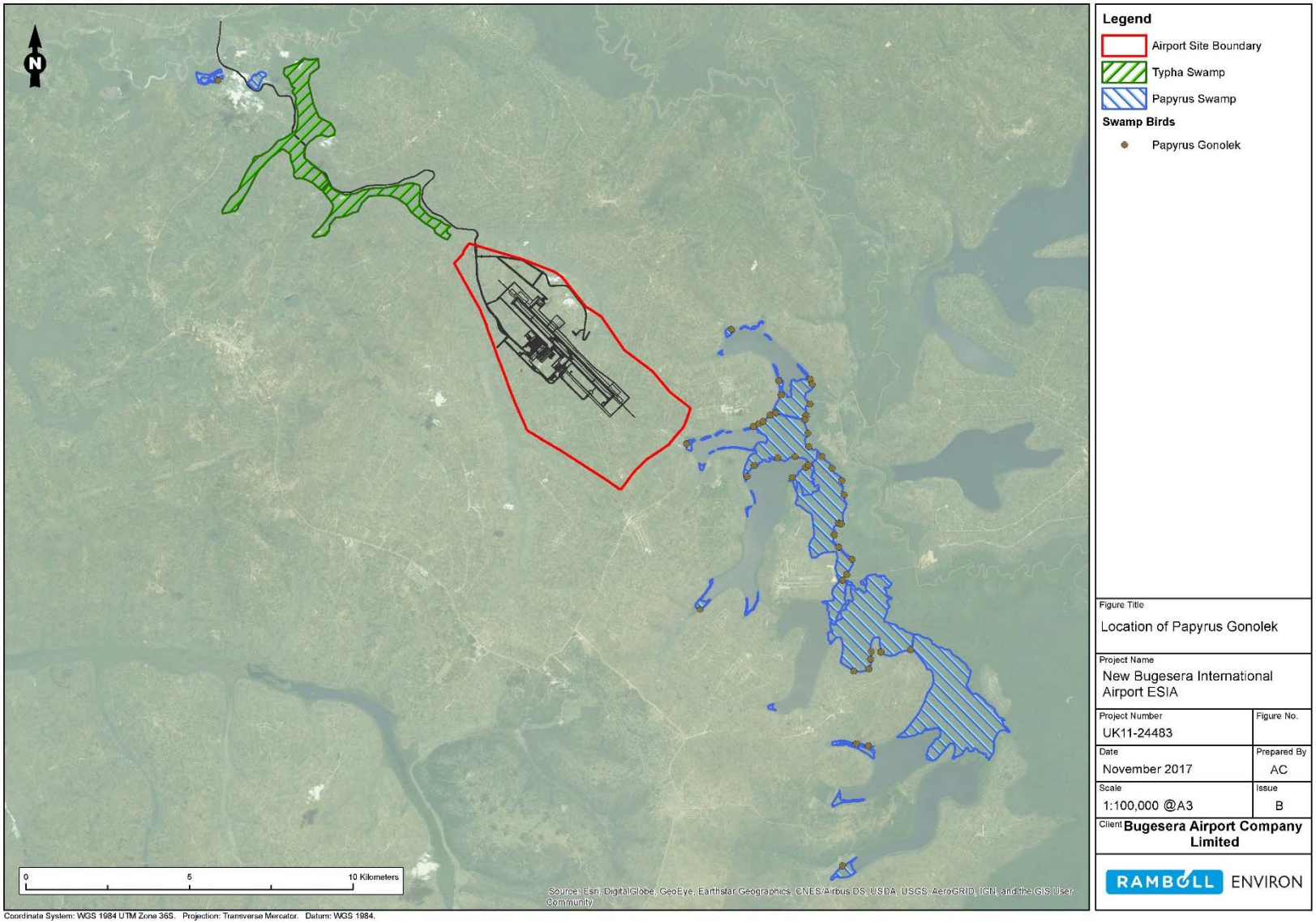

Figure 11-16: Distribution of Papyrus Gonolek Recorded October / November 2017

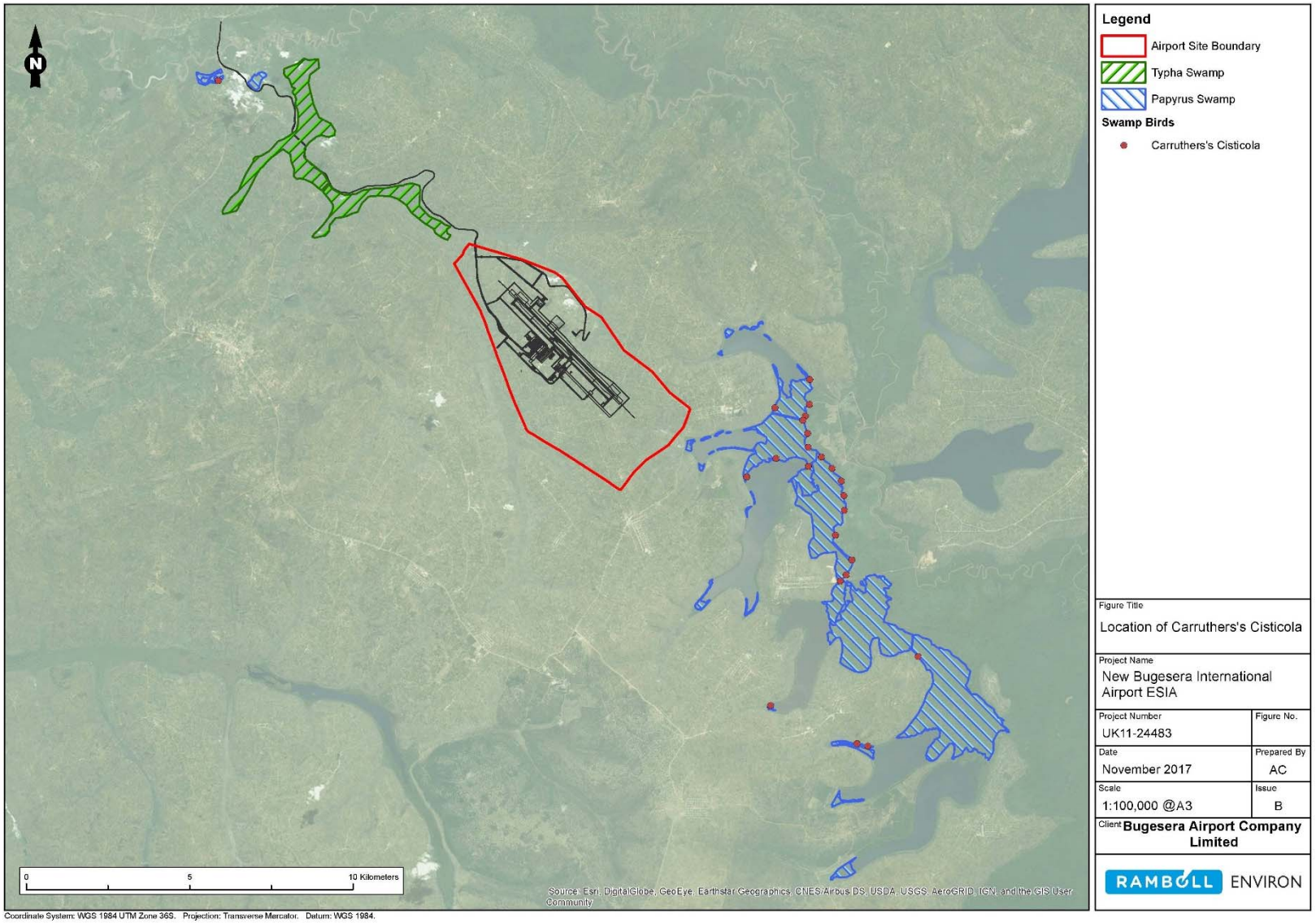

Figure 11-17: Distribution of Carruther's Cisticola Recorded October / November 2017

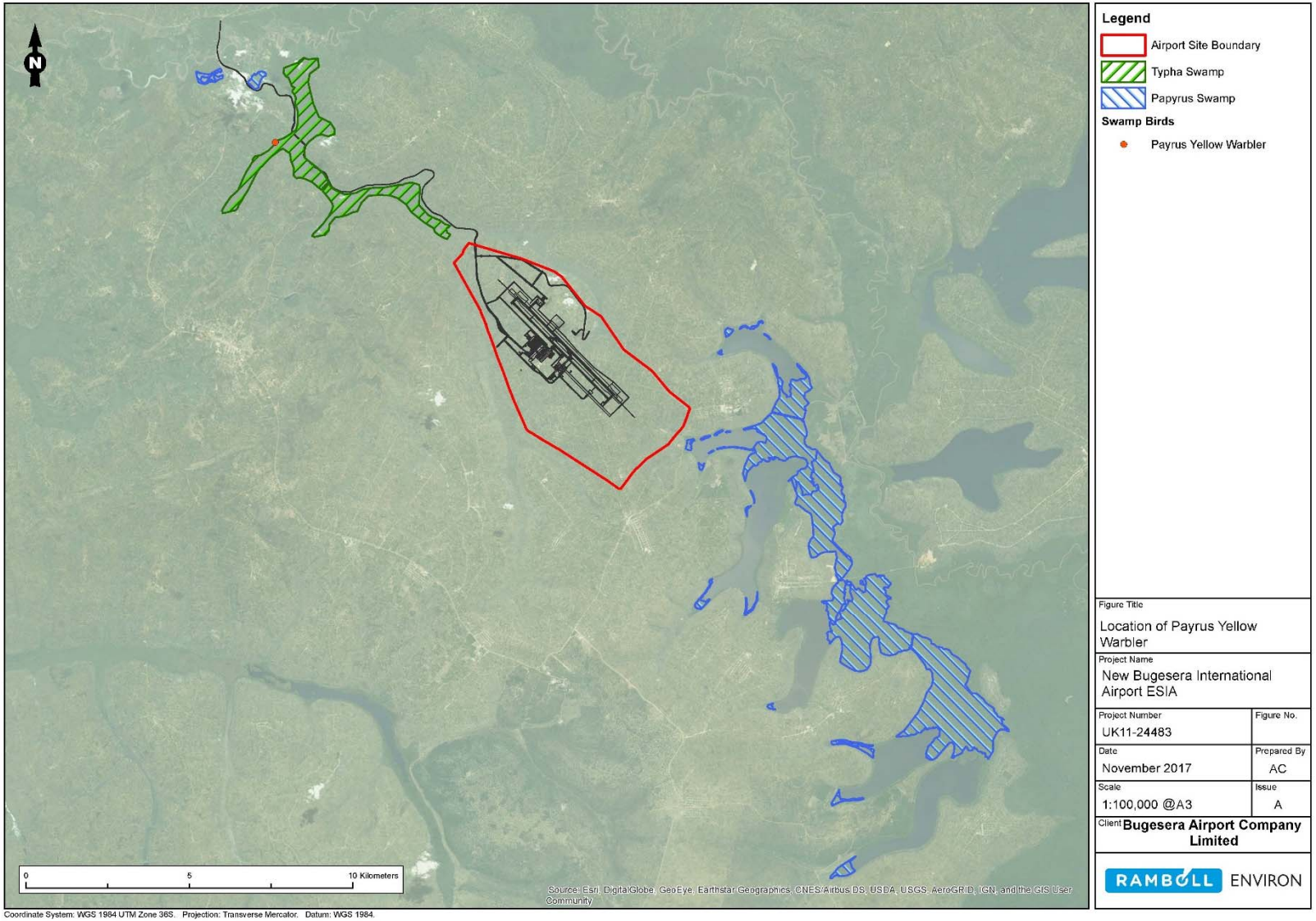

Figure 11-18: Distribution of Papyrus Yellow Warbler Recorded October / November 2017

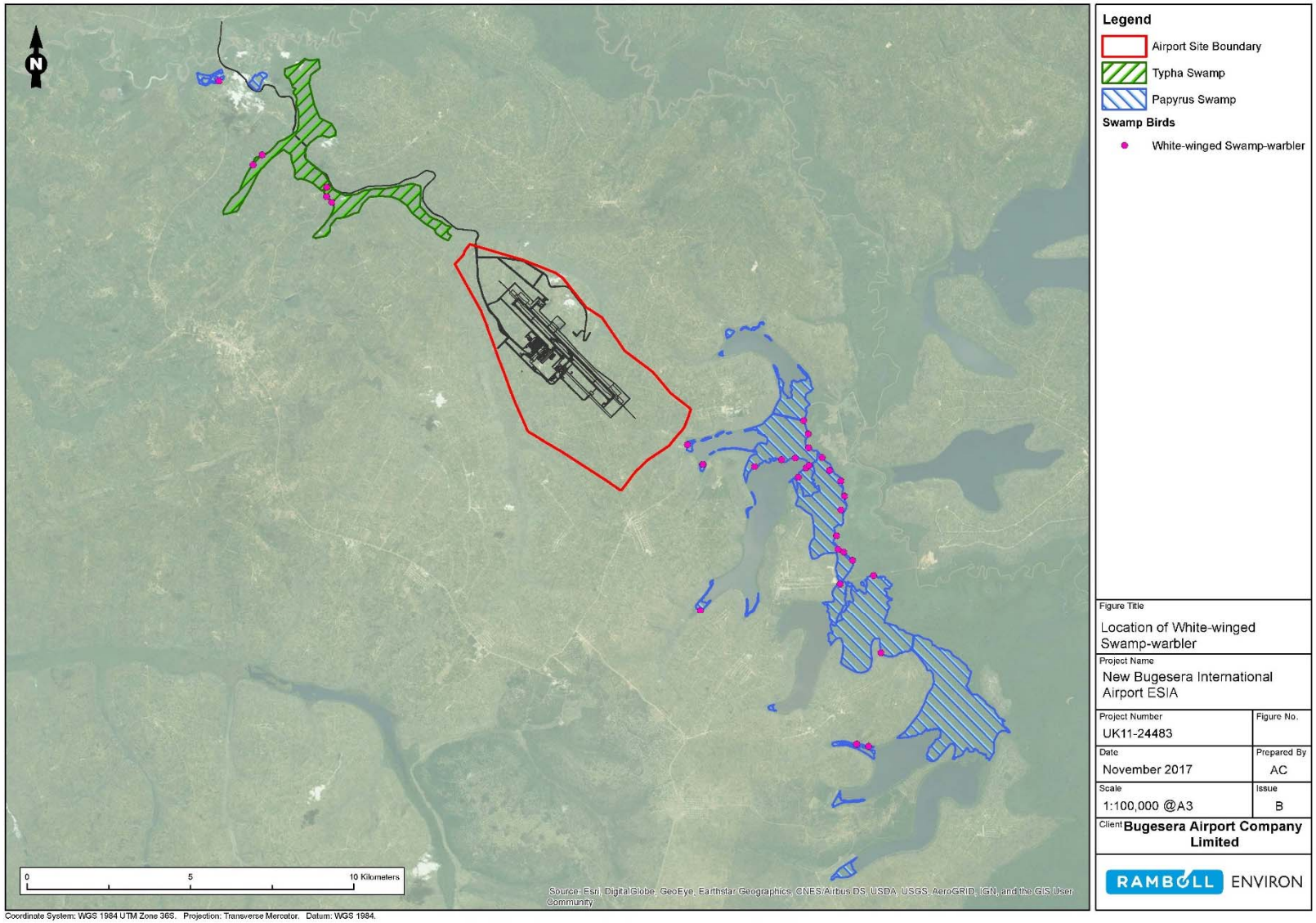

Figure 11-19: Distribution of White-winged Warbler Recorded October / November 2017

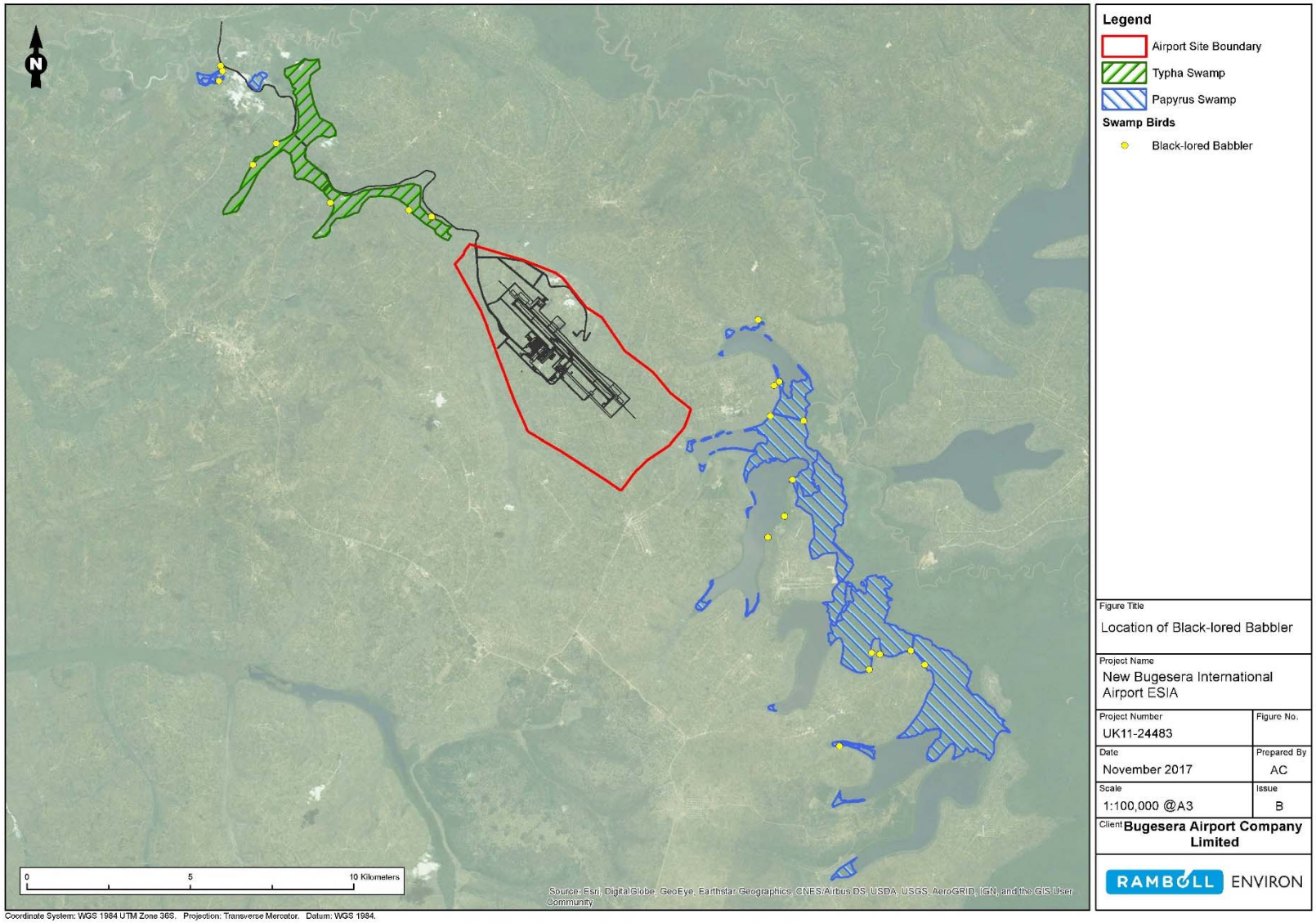

Figure 11-20: Distribution of Black-lored Babbler Recorded October / November 2017

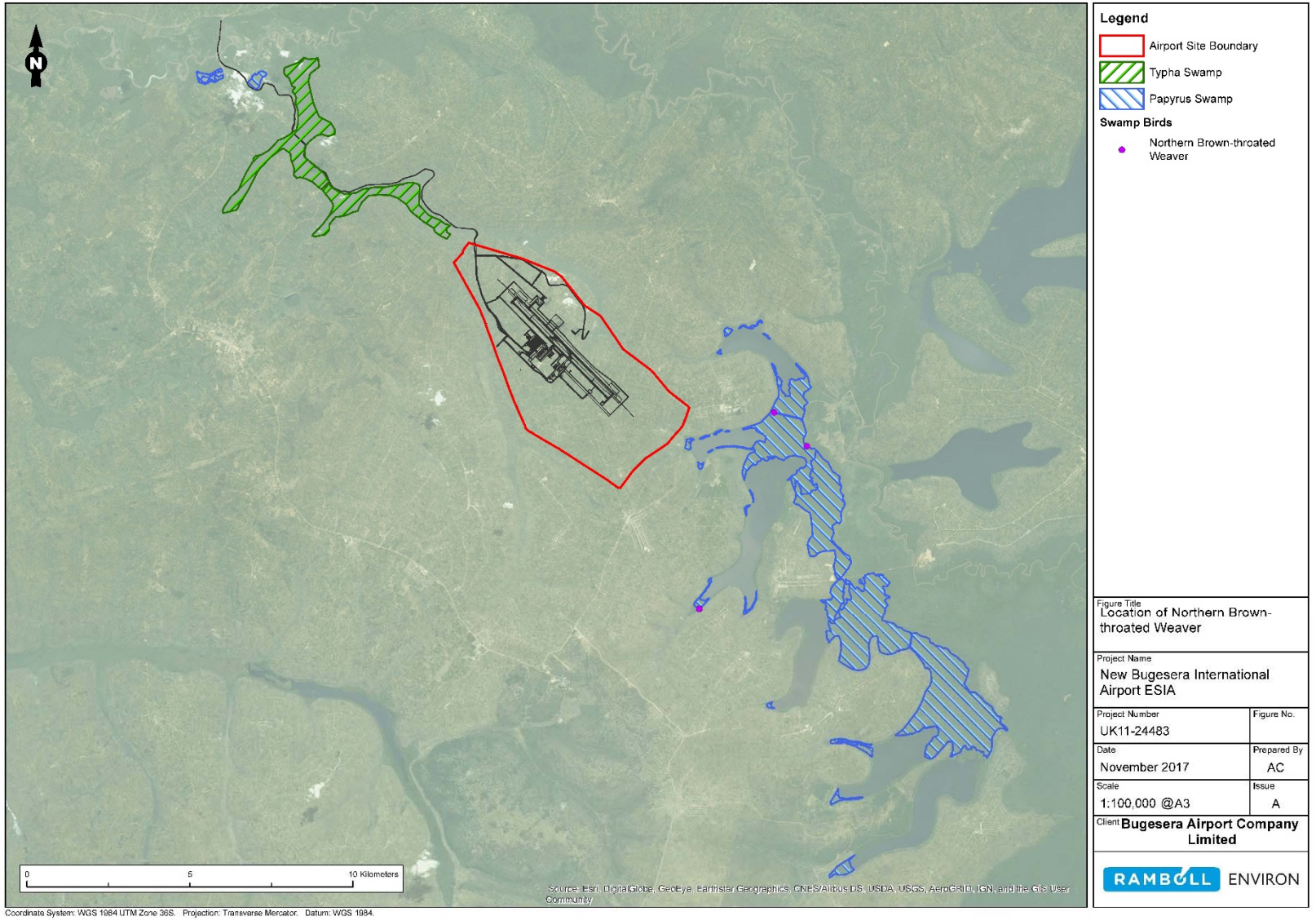

Figure 11-21: Distribution of Northern Brown-throated Weaver Recorded October / November 2017

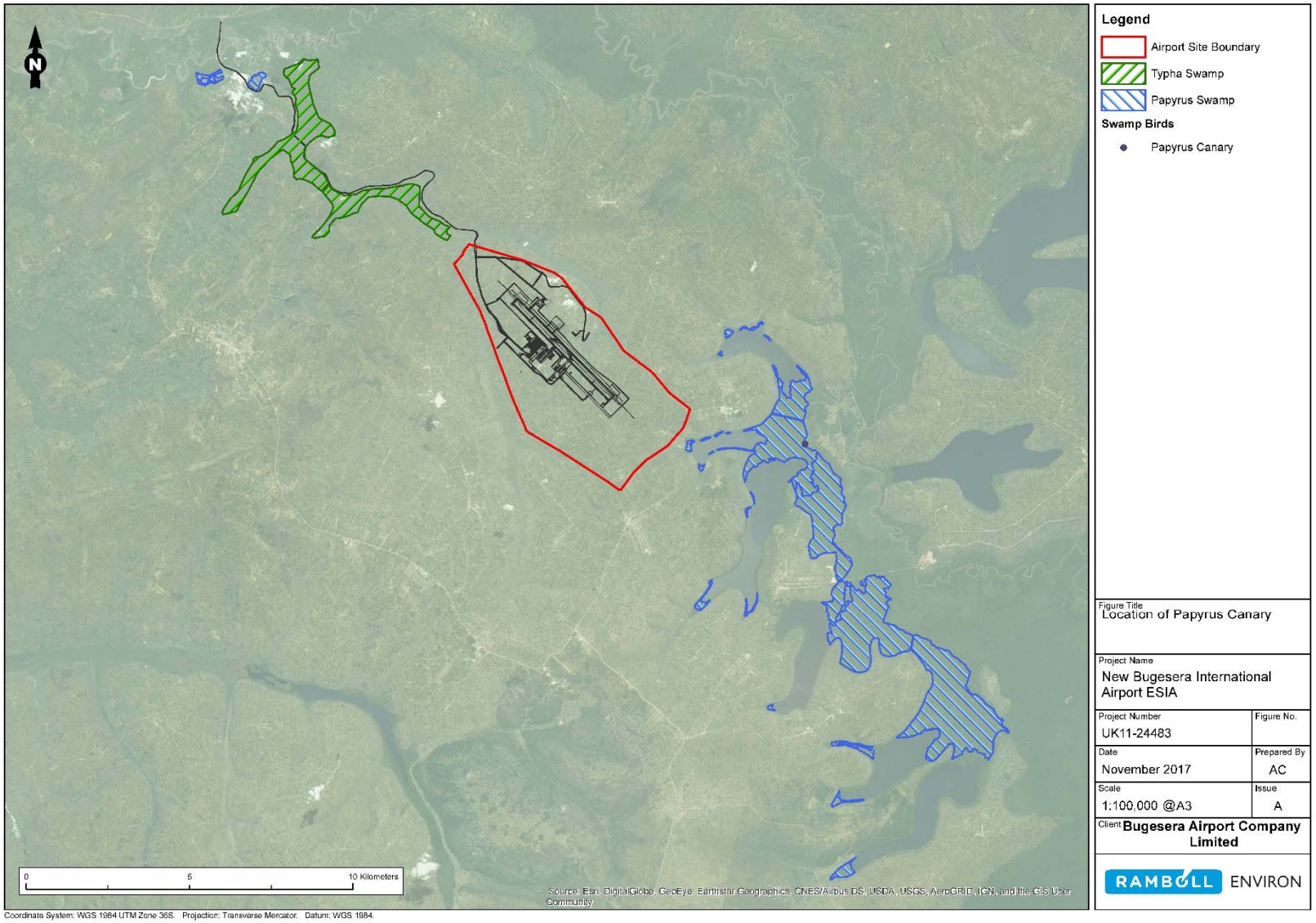

Figure 11-22: Distribution of Papyrus Canary Recorded October / November 2017

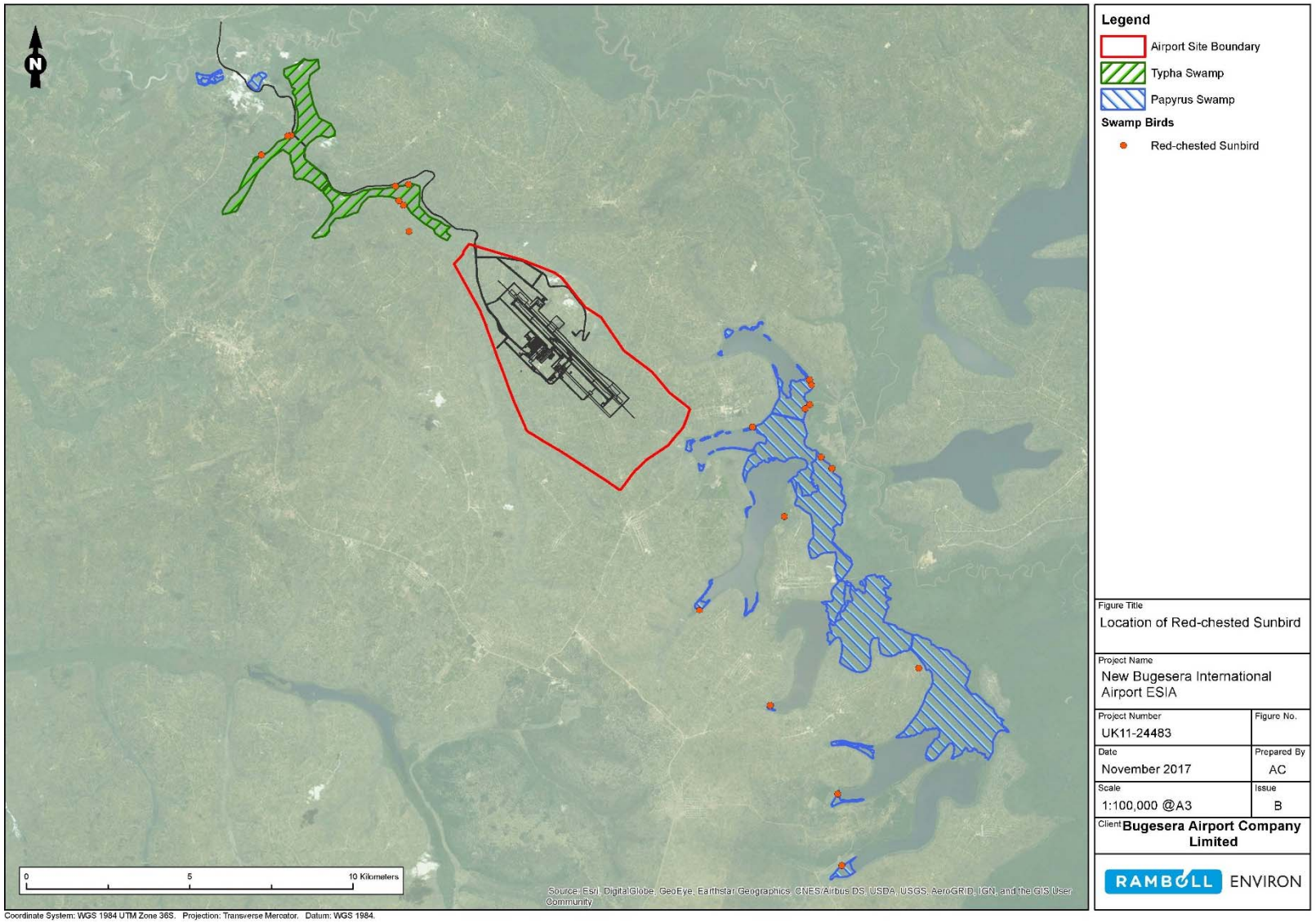

Figure 11-23: Distribution of Red-Chested Sunbird Recorded October / November 2017

Migratory Species

A total of 19 Palearctic migrants and ten intra-African migrants were recorded during the two surveys completed in 2017. The rest of the species recorded were local residents. No large concentrations or high densities of migrants were recorded. The farmland and bushland habitats within the Proposed Project Area are unlikely to support significant populations of migratory birds. The wetlands are more likely to support migratory species including water birds. However, the populations supported are unlikely to be of international importance. The migratory species recorded during 2017 are listed in Table 11-14.

Table 11-14: Migratory Species and their Abundancies

English Name	Scientific name	African (AM) / Palearctic Migrant (PM)	Number of individuals*	
			May / June 2017	October / November 2017
African Open-Billed Stork	*Anastomus lamelligerus*	AM	1	0
Abdim's Stork	*Ciconia abdimii*	AM	0	9
Osprey	*Pandion haliaetus*	PM	0	5
Pallid Harrier	*Circus macrourus*	PM	1	0
Montagu's Harrier	*Circus pygargus*	PM	x	1
Eurasian Marsh Harrier	*Circus aeruginosus*	PM	3	1
Lesser Spotted Eagle	*Aquila pomarina*	PM	1	1
Booted Eagle	*Hieraaetus pennatus*	PM	0	1
Steppe Buzard	*Buteo buteo*	PM	0	1
Marsh Sandpiper	*Tringa stagnatilis*	PM	0	1
Green Sandpiper	*Tringa ochropus*	PM	0	1
Common Sandpiper	*Actitis hypoleucos*	PM	0	6
Wood Sandpiper	*Tringa glareola*	PM	0	5
Lesser Moorhen	*Gallinula angulata*	AM	0	1
Levaillant's Cuckoo	*Oxylophus levaillantii*	AM	3	1
Black Cuckoo	*Cuculus clamosus*	AM	1	0
Red-chested Cuckoo	*Cuculus solitarius*	AM	0	7
European Bee-eater	*Merops apiaster*	PM	0	<50
African Palm Swift	*Cypsiurus parvus*	AM	x	0
Sand Martin	*Riparia riparia*	PM	x	x
Lesser Striped Swallow	*Hirundo abyssinica*	AM	104	x
Barn Swallow	*Hirundo rustica*	PM	0	x
Yellow Wagtail	*Motacilla flava*	PM	2	2
Red-capped Robin Chat	*Cossypha natalensis*	AM	0	2
Whinchat	*Saxicola rubetra*	PM	0	4

Table 11-14: Migratory Species and their Abundancies				
English Name	**Scientific name**	**African (AM) / Palearctic Migrant (PM)**	**Number of individuals***	
			May/June 2017	**October/ November 2017**
Blackcap	*Sylvia atricapilla*	PM	1	0
Spotted Flycatcher	*Muscicapa striata*	PM	0	4
Red-backed Shrike	*Lanius collurio*	PM	0	3
Cardinal Quelea	*Quelea cardinalis*	AM	4	0

Vultures

No threatened scavenging vulture species were recorded during the two surveys completed in 2017, nor were any recorded during the 2010 ESIA bird survey. Local people consulted informally during the bird surveys were not aware of the presence of these species. Vultures are large and conspicuous and typically local communities are familiar with them. The lack of awareness of vultures by local communities gives a strong indication of their absence in the area. Unlike many areas in Africa, towns and villages in Rwanda do not dispose of rubbish in the streets or on the edge of settlements. This is reflected in the absence of Hooded Vulture *Necrosyrtes monachus*, relatively low numbers of all scavenging bird species including Pied Crow *Corvus albus* and Black Kite *Milvus migrans*. The absence of other large species of vulture may reflect the highly cultivated nature of the landscape and relative scarcity of livestock and large wild mammals.

Threatened and Endemic Species

During an initial desk study, a number of threatened bird species were identified as potentially to be present within the Proposed Project Area based on their global distribution. Table 11-15 provides a list of Endangered and Critically Endangered species recorded in Rwanda along with an indication of whether they have the potential to be present. Of these species, only the Grey Crowned-crane was recorded during the baseline study. As already discussed, it is unlikely that threatened vulture species are present.

Table 11-15: Threatened Bird Species in Rwanda		
Species	**Status**	**Population/ Range**
Steppe Eagle *Aquila nipalensis*	Status: Endangered A2abcd+3bcd+4abcd ver 3.1 http://www.iucnredlist.org/details/22696038/0	Occurs within non-breeding range in Rwanda. Not recorded during 2017 surveys or during 2010 ESIA survey.
Madagascar Pond-heron *Ardeola idae*	Status: Endangered C2a(ii) ver 3.1 http://www.iucnredlist.org/details/22697143/0	This species breeds on Madagascar and has a very small global population estimated to be between 2,000-6,000 individuals[66] It has a large non-breeding range covering Central and East Africa including the Comoro Islands, Mozambique, Zimbabwe, Zambia, Malawi, Tanzania, Kenya, Uganda, Burundi, Rwanda and Democratic Republic of Congo.

[66] BirdLife International (2017) Species factsheet: Ardeola idae. Downloaded from http://www.birdlife.org on 28/11/2017.

Table 11-15: Threatened Bird Species in Rwanda		
		According to the Birdlife International website[33], the species has been recorded in the Nyabarongo Wetlands IBA. Although the species was not recorded in either of the two surveys completed in 2017, or the 2010 ESIA bird survey, it was recorded within the Nyabarongo Wetlands in 2003 by ACNR[67]. According to Nsabagasani *et al.* (undated)[68] Madagascar Pond Heron was recorded in the Northern of Akanyaru wetlands, near the junction to the Nyabarongo wetlands during surveys completed July to December 2008. Madagascar Pond Heron is assumed to be present and therefore included within the Critical Habitat Assessment (Technical Appendix 11.1).
Grey Crowned-crane *Balearica regulorum*	Status: Endangered A2acd+4acd ver 3.1 http://www.iucnredlist.org/details/22692046/0	Large range including Democratic Republic of the Congo, Rwanda, Uganda and Kenya south through Tanzania to Mozambique, and nominate race *B. r. regulorum* found from Mozambique south through Zimbabwe to South Africa and west in small numbers to Namibia and Angola. Recorded during field surveys.
Grauer's Swamp-warbler *Bradypterus graueri*	Status: Endangered B2ab(ii,iii,iv,v) ver 3.1 http://www.iucnredlist.org/details/22714468/0	Found in Rwanda, Burundi, eastern Democratic Republic of Congo (DRC) and south-western Uganda. In Rwanda, it occurs in Rugezi Swamp (Vande Weghe 1983[69]) (probably the largest subpopulation), in the marshes between the Virunga volcanos (Vande Weghe 1983), and in Nyungwe (Rugege) Forest (Vande Weghe 1983, Dowsett-Lemaire 1990[70]). Global distribution does not overlap with Proposed Project AoI and considered absent from the Proposed Project AoI.
White-backed Vulture *Gyps africanus*	Status: Critically Endangered A2bcd+3bcd ver 3.1 http://www.iucnredlist.org/details/22695189/0	This species is the most widespread and common vulture in Africa, although it is now undergoing rapid declines. It occurs from Senegal, Gambia and Mali in the west, throughout the Sahel region to Ethiopia and Somalia in the east, through East Africa into Mozambique, Zimbabwe, Botswana, Namibia and South Africa in the south. Considered absent from the Proposed Project AoI.
Rüppell's Vulture *Gyps rueppelli*	Status: Critically Endangered A2abcd+3bcd ver 3.1	This species occurs throughout the Sahel region of Africa from Senegal, Gambia and Mali in the west to Sudan, South Sudan and Ethiopia in the east.

[67] Association pour la Conservation de la Nature au Rwanda (2004) Conservation And Sustainable Use Of Wetlands in South-Eastern Of Rwanda
[68] Nsabagasani, C., Nsengimana, S. and Hakizimana, E. (undated) Biodiversity Survey In Akanyaru Wetlands, Unprotected Important Bird Areas In Rwanda
[69] Vande weghe, J. P. 1983. Sympatric occurrence of the White-winged Warbler Bradypterus carpalis and Grauer's Rush-warbler B. graueri in Rwanda. Scopus 7(3/4): 85-88
[70] Dowsett-Lemaire, F. 1990. Eco-ethology, distribution and status of Nyungwe Forest birds, Rwanda. In: Dowsett, R.J. (ed.), Enquête faunistique et floristique dans la Forêt de Nyungwe, Rwanda, pp. 31-85. Tauraco Press, Ely, U.K.

Table 11-15: Threatened Bird Species in Rwanda		
	http://www.iucnredlist.org/details/22695207/0	Also south through the savanna regions of East Africa in Kenya, Tanzania and Mozambique. Formerly abundant, the species has experienced extremely rapid declines in much of its range, particularly West Africa. Considered absent from the Proposed Project AoI.
Hooded Vulture *Necrosyrtes monachus*	Status: Critically Endangered A2acd+3cd+4acd ver 3.1 http://www.iucnredlist.org/details/22695185/0	Large range across Africa, but considered absent from the Proposed Project AoI.
Grey Parrot *Psittacus erithacus*	Status: Endangered A2bcd+3bcd ver 3.1 http://www.iucnredlist.org/details/22724813/0	Eastern edge of large range. *P. erithacus* has a distribution extending from south eastern Côte d'Ivoire east through the moist lowland forests of West Africa to Cameroon, and thence in the Congo forests to just east of the Albertine Rift (up to the shores of Lake Victoria). Not recorded during either 2010 or 2017 surveys and considered absent from the Proposed Project AoI.
Lappet-faced Vulture *Torgos tracheliotos*	Status: Endangered A2bcd+3bcd ver 3.1 http://www.iucnredlist.org/details/22695238/0	This species breeds in Egypt, Senegal, Niger, Mauritania, Mali, Burkina Faso, Chad, Sudan, Ethiopia, Somalia, Democratic Republic of Congo, Rwanda, Uganda, Kenya, Tanzania, Zambia, Malawi, Mozambique, Namibia, Botswana, Zimbabwe, South Africa, Swaziland, Saudi Arabia. Considered absent from the Proposed Project AoI.
White-headed Vulture *Trigonoceps occipitalis*	Status: Critically Endangered A2bcd+3bcd ver 3.1 http://www.iucnredlist.org/details/22695250/0	This species has an extremely large range in sub-Saharan Africa (from Senegal, Gambia and Guinea-Bissau disjunctly east to Eritrea, Ethiopia and Somalia, and south to easternmost South Africa and Swaziland. Considered absent from the Proposed Project AoI.

There were three species of conservation concern recorded during the avifauna survey, plus an additional species identified as likely to be present from secondary data, as listed in Table 11-16. No endemic or range-restricted species were identified as potentially present in the secondary data review, or recorded during the field surveys.

Table 11-16: Threatened Species Identified				
Family	**English Name**	**Scientific Name**	**IUCN status**	**Individuals Recorded During Surveys**
ARDEIDAE	Madagascar Pond Heron	*Ardeola idae*	EN	0
ACCIPITRIDAE	Pallid Harrier	*Circus macrourus*	NT	2

Table 11-16: Threatened Species Identified				
GRUIDAE	Grey Crowned-crane	*Balearica regulorum*	EN	4
MALACONOTIDAE	Papyrus Gonolek	*Laniarius mufumbiri*	NT	89
SYLVIIDAE	Papyrus Yellow Warbler	*Chloropeta gracilirostris*	VU	1

11.4.3.6 Mammals

According the REMA (2009), 151 mammal species have been recorded in Rwanda, of which 11 are threatened, but none are endemic. According to the IUCN Red List, only six species of mammal in Rwanda are assessed as either Critically Endangered or Endangered (Ugandan Shrew *Crocidura tarella*, Black Rhinoceros *Diceros bicornis*, Eastern Gorilla *Gorilla beringei*, African Wild Dog *Lycaon pictus*, Chimpanzee *Pan troglodytes* and Hill's Horseshoe Bat *Rhinolophus hilli*). None of these species occur within the Proposed Project AOI. During the mammal survey, a small number of animals were recorded and others were reported by the local communities. A total of eight families were reported as provided in Table 11-17 as likely occurrences. Figure 11-24 illustrates photos of a deceased Dwarf Mongoose *Helogale parvula* and dung of a Jackal (likely a Side-stripe Jackal *Canis adustus*) recorded across the Proposed Project Area. This was recorded towards west of the proposed runway location.

Monkeys were recorded during both the May/June 2017 surveys and during the October/November 2017 bird surveys. Based on secondary data, these are likely to be Blue Monkey *Cercopithecus mitis* (IUCN LC).[70] Although not reported during the survey or mentioned by local communities, according to literature Sitatunga *Tragelaphus spekii* (IUCN LC) is also present[71].

Generally, the Project Area comprises cultivated farmland with no high concentration of vegetation cover, resulting in low mammal diversity. Therefore, the wetlands provide an important habitat for mammals, including Hippopotamus *Hippopotamus amphibius* that were reported to occur in the Project Area (discussed in detail in subsection below). With the exception of Hippopotamus, which are categorised as IUCN Vulnerable, no other mammal species of conservation importance were recorded during the mammal survey or are expected to be present in the Area of Influence based on the results of a detailed literature search.

Dung suspected to be from jackal

Dwarf mongoose (*Helogale parvula*)

Figure 11-24: Dung of a Jackal and Deceased Dwarf Mongoose Recorded during the Baseline Assessment

Table 11-17: List of Mammal Families Recorded or Reported during the Baseline Surveys during May/June 2017

Area of Occurrence	Kinyarwanda Name	Families
X-0179220 Y-9760639	Enyeende	Monkeys (*Cercopithecidae*)
Reported by community	Enjobe	*Bovidae*
Reported by community	Ingurube	Bush-pig (*Suidae*)
Reported by community	Enkima	
X-0190413 Y-9760318	Isha	Duiker (*Bovidae*)
Reported by community	Engeragera	
Reported by community		Hares (*Leporidae*)
X-0191467 Y-9757580	Envubu	Hippopotamus (*Hippopotamidae*)
X-0179269 Y-9768022	Omubwembwe	Jackal (*Candae*)
X-0189197 Y-9760595	Embeba	Rodents (*Muridae*)
X-0174395 Y-9753138	Ebisimba	*Mustelidae*

Hippopotamus

The presence of Hippopotamus within the Proposed Project AOI was confirmed during the 2017 surveys (Figure 11-25). Local boatmen near Lake Kidogo reported that they occur during the wet season. Staff at the La Palisse Hotel, Gashora reported that they sometimes graze on the lawns of the hotel. During the May/June 2017 surveys, footprints that appeared to be of a Hippopotamus were seen around Lake Rumira. During the October/November bird surveys, Hippopotamus footprints were seen in two locations on the edge of the large papyrus swamp between Lake Miravi and Lake Kilimbi. The local community members confirmed that Hippopotamus were present the same morning in both locations. No signs of Hippopotamus were recorded within the wetland alongside the Expressway route. The wetland in this location does not provide suitable habitat for the species as there are no large waterbodies, the areas of very wet swamps are limited in extent and there are high levels of disturbance from local communities. Local community members surrounding the wetland were asked about the presence of Hippopotamus and all were unanimous in reporting that they are absent in this location.

Based on the locations of the sightings and the reports of local community members, it is likely that the wetland complex to the east of the Proposed Project, comprising a series of large lakes and papyrus swamp supports a permanent population of Hippopotamus. It is likely that the large area of papyrus provides a refuge for the species from disturbance from people, but that they move around the wetland complex, especially during the wet season. Local community members reported some potential people-wildlife conflict, with Hippopotamus causing some damage to crops along the wetland edge. Hippopotamus are categorised by IUCN as Vulnerable.

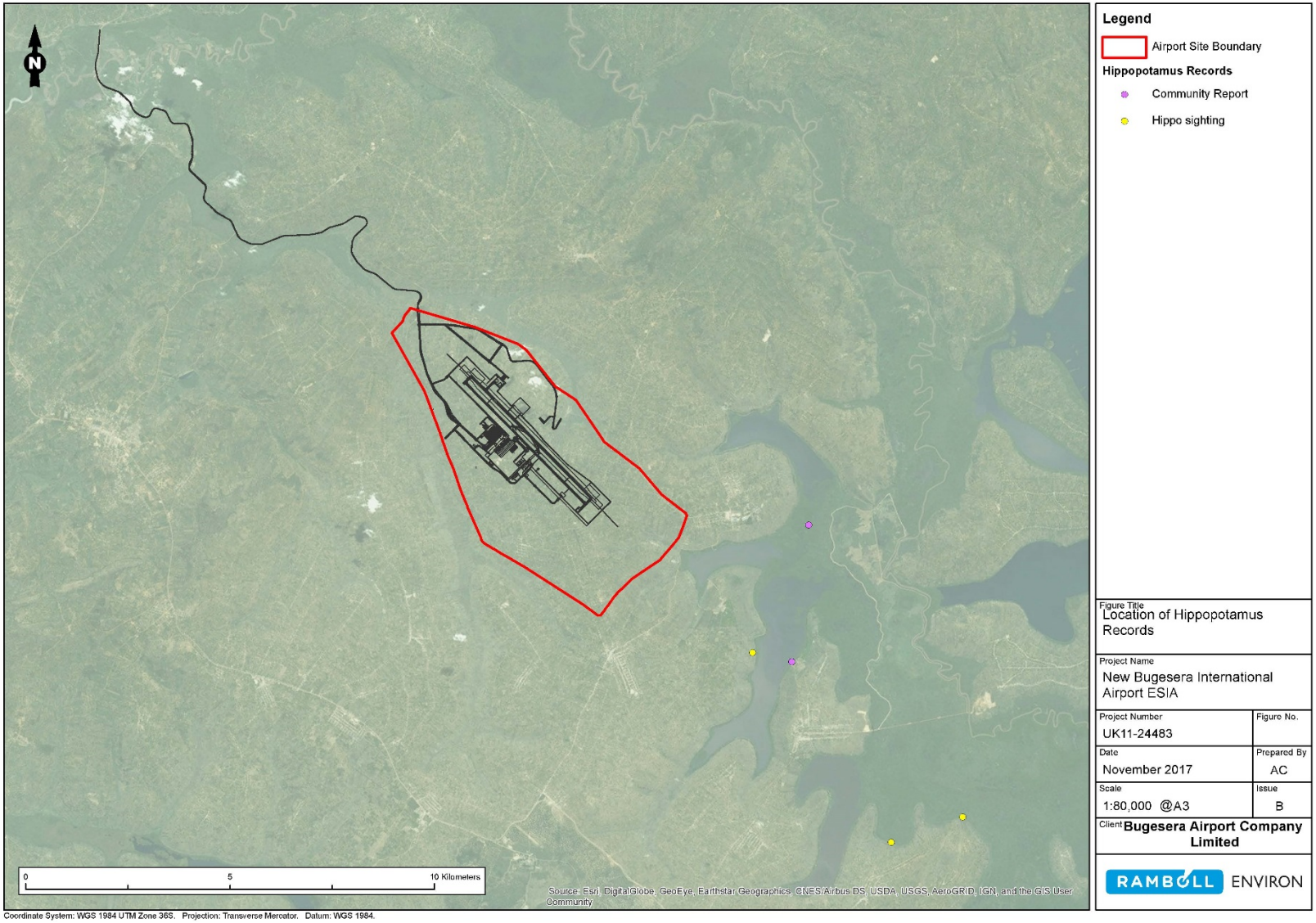

Figure 11-25: Location of Hippopotamus Records

11.4.4 Sensitivity

The sensitivity of the biodiversity receptors is assessed in the following section according to criteria described in Chapter 3: Impact Assessment Methodology and Section 11.2.3 of this chapter. The sensitivity of receptors has taken into account IFC PS6 criteria for natural and critical habitats. The detailed determination of features that confer critical habitat status is provided in Appendix 11.1. Table 11-18 provides a summary of the critical habitat relevant to this assessment.

Table 11-18: Critical Habitat Determination Summary

Feature	IFC PS6 Criteria	Rationale	Critical Habitat Tier
Madagascar Pond Heron	Criteria 1 and 3	Potential to support 1% of global population of IUCN Endangered species	Tier 2
Ningu *Labeo victorianus*	Criterion 1	Regular occurrence of IUCN Critically Endangered species	Tier 2
Nyabarongo Wetlands KBA and IBA	Criterion 6	Internationally and/or nationally recognised area	N/a

11.4.4.1 Internationally Recognised Areas

One internationally recognised area is present within part of the Proposed Project Area: Nyabarongo Wetlands IBA. This IBA meets the definition of critical habitat and is of high sensitivity.

11.4.4.2 Habitats

An appraisal of the sensitivity of habitats within the Proposed Project Area is provided in Table 11-19. No habitats qualify as critical habitat under IFC PS6 Criterion 4 Highly threatened and/or unique ecosystems. Although swamp and aquatic vegetation does not qualify as critical habitat under criterion 4, it does represent a key component of the Nyabarongo Wetlands IBA, which is designated for its biome-restricted wetland bird species. Therefore, the swamp and aquatic vegetation is assessed as high sensitivity.

Table 11-19: Habitat Sensitivity Appraisal

Habitat	Rationale	Sensitivity
Anthropic landscapes	Modified habitat that does not qualify as critical habitat	Low
Grassland	Modified habitat that does not qualify as critical habitat	Low
Wooded grassland	Modified habitat that does not qualify as critical habitat	Low
Bush land and thicket	Modified habitat that does not qualify as critical habitat	Low
Swamp and aquatic vegetation	Represents key component of internationally recognised Nyabarongo Wetlands IBA, supporting biome-restricted wetland bird species	High

11.4.4.3 Threatened and Red List Plant Species

No threatened or endemic species of plant were identified as potentially present in the desk study and no threatened or endemic species were recorded during the field surveys. Therefore, all of the plant species recorded are of negligible sensitivity and therefore not considered further in this assessment as individual species. However, the assemblages of plant species are assessed as components of the relevant habitat types (see Table 11-22).

11.4.4.4 Fish

An appraisal of the sensitivity of freshwater species within the Proposed Project Area is provided in Table 11-20. According to secondary data, Ningu *Labeo victorianus* is present within the AOI and triggers critical habitat under IFC PS6 under Criterion 1 as it is Critically Endangered. Therefore its sensitivity is assessed as High. *Varicorhinus ruandae* is Near-threatened and has the potential to be present in the AOI as its global range overlaps with this area. Although rare and its global population size and trend are not known, as a precautionary measure it is considered to be locally important and of Low sensitivity. All other freshwater fish species are considered to be of negligible sensitivity as they are neither threatened nor endemic.

Table 11-20: Freshwater Fish Species Sensitivity Appraisal

Species	Rationale	Sensitivity
Ningu *Labeo victorianus*	Species populations that triggers critical habitat under IFC PS6 Criterion 1: Critically Endangered (CR).	High
Varicorhinus ruandae	Locally important populations of Near Threatened (NT) species with distribution which overlaps with AoI (assumed worst case to be locally important as precautionary measure).	Low
Other freshwater fish species	No other species assessed as threatened, Near-threatened, or endemic / range-restricted.	Negligible

11.4.4.5 Herptiles

None of the amphibian or reptile species recorded within the AOI triggers critical habitat. No threatened, endemic or range-restricted species of amphibian or reptile have been recorded and therefore all herptile species are of negligible sensitivity and not considered further in this assessment.

11.4.4.6 Birds

An appraisal of the sensitivity of bird species within the Proposed Project Area is provided in Table 11-21. Madagascar Pond Heron qualifies as Tier 2 critical habitat in accordance with IFC PS6 under criteria 1 and3. In addition, the assemblage of species recorded within the AOI that represents a key component of the Nyabarongo Wetlands IBA, which qualifies as critical habitat are of High sensitivity. As Madagascar Pond Heron and the IBA trigger species are all dependent on wetland habitats within the IBA, these species are assessed as a single group in the remainder chapter as a single IBA assemblage.

Table 11-21: Bird Species Sensitivity Appraisal

Species	Rationale	Sensitivity
Nyabarongo Wetlands IBA Species Assemblage: Papyrus Gonolek Carruthers's Cisticola	Represents a key component of the Nyabarongo Wetlands IBA	High

Table 11-21: Bird Species Sensitivity Appraisal		
Papyrus Yellow Warbler White-winged Swamp-warbler Black-lored Babbler Northern Brown-throated Weaver Papyrus Canary Red-chested Sunbird		
Madagascar Pond Heron	Species populations that potentially triggers critical habitat under IFC PS6 Criterion 1: Endangered species and Criterion 3: Migratory species	High
Pallid Harrier *Circus macrourus*	Locally important population of Near-threatened species	Low
Grey Crowned Crane *Balearica regulorum*	Locally important concentrations of Endangered (EN) species	Medium
Migratory Species Assemblage (excluding threatened species)	No populations of migratory species that represent a locally important population	Negligible
Other bird species	No other species assessed as Threatened, Near-threatened or endemic / range-restricted	Negligible

11.4.4.7 Mammals

An appraisal of the sensitivity of terrestrial mammal species within the Proposed Project Area is provided in Table 11-22. With the exception of Hippopotamus, terrestrial mammals are assessed as negligible sensitivity. The Proposed Project Area supports a small population of Hippopotamus, which are categorised as Vulnerable as per the IUCN Red List of Threatened species and is assessed as Low sensitivity.

Table 11-22: Terrestrial Mammal Species Sensitivity Appraisal		
Species	**Rationale**	**Sensitivity**
Hippopotamus *Hippopotamus amphibius*	Locally important population of Vulnerable species	Low
Other mammal species	No other species assessed as Threatened, Near-threatened or endemic / range-restricted	Negligible

11.5 Design Controls

11.5.1 Airport Area

A number of design controls will be implemented to reduce the impacts of the Proposed Project on receptors including biodiversity. These will include the following:

- Stormwater control measures in the form of retention basins or similar attenuation will designed and constructed to manage stormwater runoff and prevent erosion of the surrounding areas with the provision to reuse captured rainfall; and
- A permanent wastewater treatment plant will be constructed on the site as part of the construction phase.

11.5.2 Expressway Design

The Expressway will be designed according to good international practice GIIP) guidance on the protection of wildlife (e.g. Wildlife Crossing Structure Handbook: Design and Evaluation in North America (US Department of Transportation, 2011)[71], Wildlife and Traffic: A handbook for identifying conflicts and designing solutions (Iuell *et al.* 2003)[72]), including the following measures:

- The wetland crossing of the Nyabarongo River tributary valley will be designed with sufficient number and size of water passage features to ensure continued free flow of water between the wetlands either side of the road. These will be designed to ensure fish and other aquatic wildlife can continue to pass under the road. The efficacy of these measures will be monitored post-construction.
- The drainage channels installed alongside the road will be designed to ensure that small animals (mammals, amphibians etc.) cannot become trapped.
- Sediment settling ponds will be installed to reduce pollution and sediment entering the wetlands. These will be designed so that they are effective even in high rainfall events.
- Any street lighting installed on the Expressway will be designed to minimise the light spill onto surrounding vegetation, especially the wetlands. This will use design solutions such as direction beam lighting or cowls to shield adjacent habitats.

11.5.3 Abstraction Water Pipeline Design

- The temporary abstraction Water Pipeline design, where it enters the wetland surrounding Lake Kidogo will take into account the sensitive habitats present. The design will aim to minimise impacts to habitats during installation and decommissioning.
- The water pipe will have a fish excluder mesh installed where it enters the lake to ensure fish and other aquatic wildlife is not sucked into the pipe during water abstraction.
- Any degraded wetland habitats adjacent to the Water Pipeline where it enters Lake Kidogo will be restored following decommissioning at the end of the construction period.

11.6 Potential Impacts Prior to Mitigation

11.6.1 Construction Phase Impacts

The construction of the Project will involve a wide range of activities that have the potential to affect biodiversity. The relevant activities of the Project likely to give rise to impacts on receptors are summarised in Table 11-23, along with the likely pathway of the impacts. The largest direct impact of habitat loss will occur at the initial site clearance stage for both the Airport Area of 2,500 ha, and the Expressway covering approximately 64 ha. Smaller areas of habitat loss will be incurred from the widening of an existing road to the quarry and installation of the temporary Water Pipeline. Indirect impacts have also the potential to occur from disturbance, fragmentation, introduction or spread of invasive species, impacts to air quality, changes to hydrology and runoff of sediments and pollution into surrounding areas.

Detailed assessments have been completed in relation to air quality (Chapter 9), noise and vibration (Chapter 10) and water resources (Chapter 12), with findings relevant to impacts to biodiversity. Where relevant, these findings are summarised in this section. Indirect impacts to biodiversity can also result through increased pressure on ecosystem services. The creation of new roads can facilitate access to natural resources, both for use by local populations and

[71] US Department of Transportation (2011) Wildlife Crossing Structure Handbook: Design and Evaluation in North America. Publication No. FHWA-CFL/TD-11-003

[72] Iuell, B., Bekker, G.J., Cuperus, R., Dufek, J., Fry, G., Hicks, C., Hlavá˘c, V., Keller, V., B., Rosell, C., Sangwine, T., Tørsløv, N., Wandall, B. le Maire, (Eds.) (2003) Wildlife and Traffic: A European Handbook for Identifying Conflicts and Designing Solutions.

increasing the ease of export of goods (e.g. export of bushmeat, fuelwood and charcoal). The construction activities can lead to an influx of people, both construction workers and people seeking work. This in turn can increase the demand of natural resources such as meat, fish, wood, fibre and water. The removal of over 2,500 ha of farmland could also increase the pressure on remaining land resources, intensifying or displacing food production activities. Land within the Proposed Project AOI is already in short supply and there is already a high level of threat on the adjacent wetlands from agricultural conversion. This threat could be intensified as a result of the Proposed Project. Impacts to individual biodiversity receptors are detailed in the following sub-section 11.5.1.1.

Table 11-23: Project Activities and Likely Pathways of Potential Impact

Activity	Pathway of Potential Impact
Vegetation clearance and topsoil strip for Airport Area of 2,500 ha, Expressway covering approximately 64 hectares. Smaller areas of habitat loss will be incurred from the widening of an existing road to the quarry and installation of the temporary water pipeline.	Habitat loss. Direct mortality of plants and animals. Fragmentation. Disturbance to habitats and species from noise, artificial lighting and human activity. Introduction and spread of invasive species. Impacts to air quality. Runoff into surrounding habitats.
Water abstraction from Lake Kidogo.	Changes in hydrology causing habitat loss and degradation direct mortality (e.g. fish).
Earthworks, including changes to topography.	Disturbance. Impacts to air quality. Changes to hydrology. Runoff into surrounding water courses. Introduction and spread of invasive species.
Construction of airport facilities, Expressway, water pipeline and new quarry road.	Disturbance to habitats and species from noise, artificial lighting and human activity. Runoff into surrounding water courses habitats. Impacts to hydrology. Impacts to air quality. Introduction and spread of invasive species.
Induced access and population influx.	Increase in hunting and fishing. Increased use of natural resources such as fuelwood, fibre, and freshwater.
Removal of farmland.	Increased pressure on remaining wetlands for food and resources.

11.6.1.1 Internationally Recognised Areas

Nyabarongo Wetlands IBA

The Nyabarongo Wetlands IBA boundary has not been accurately delineated by Birdlife International within the vicinity of the Proposed Project. However, the results of the October/November 2017 bird survey and associated habitat mapping allows accurate delineation of the IBA values within the Proposed Project AOI. At least seven out of the eight IBA trigger species are present within wetland areas surrounding the Airport Area and alongside

the Expressway. These species are biome-restricted species to wetland habitats, particularly the swamp and aquatic vegetation natural habitats. Therefore, the following impact assessment does not solely focus on direct impacts to the trigger bird species, but also to the habitat on which they depend. Based on these results, all of the wetlands within the AOI should be treated as forming part of the IBA. According to the Birdlife International website, the IBA is already under serious pressure from agriculture. This assessment was verified within the Project AOI by observations made during the biodiversity baseline studies. Widespread cultivation is taking place along the edges of the wetland. The IBA does not benefit from any formal legal protection and is not subject to effective conservation management. These factors combine to reduce the resilience of the wetlands to further impacts.

None of the IBA wetlands occurs within the Airport Area and therefore will not be affected by direct habitat loss from this Project component. The majority of Expressway runs alongside but not within the wetland habitats. However, the Expressway will cross the IBA wetlands in one location before it joins the existing KK15 national road. This wetland crossing will lead to direct habitat loss including swamp and aquatic vegetation known to support IBA trigger species. The crossing will directly affect approximately 500 linear metres of a tributary valley to the Nyabarongo River. Assuming a road width of 44 metres, this equates to an area of 2.2 hectares (not taking into account a potentially larger working construction area). Depending on the final design of the road and in particular where it crosses the wetlands, the Expressway could potentially affect the hydrology of the wetland habitats, especially if it forms a barrier to water flow. This could significantly increase the area of wetland affected beyond that of direct habitat loss from construction activities. The Expressway will fragment wetland habitats where it crosses the Nyabarongo Wetlands IBA. This could affect those breeding bird territories in close proximity to the cleared area, but is unlikely to form a significant physical barrier to movement of birds from one side of the road to the other.

Due to the close proximity of the Expressway to wetland habitats along much of its length, it poses a risk of indirect impacts including disturbance, water pollution and surface water runoff, introduction of invasive species and impacts to air quality. Impacts to birds from disturbance during construction will be temporary, whereas disturbance impacts from the operational phase will be permanent. Therefore, impacts of disturbance from the road is discussed more fully in Section 11.5.2; however, Chapter 10: Noise and Vibration has calculated the distances from construction site boundaries that noise reduces to 70 dB (A) and 45 dB (A) as 45 m and 450 m respectively. A distance of 450 m from the Expressway includes a significant proportion of the adjacent wetland that would be potentially disturbed during construction. The wetlands alongside the Expressway are also highly vulnerable to runoff during the construction as it is situated in close proximity along much of its length. Also, the Expressway is situated on a moderately steep slope above the wetlands, meaning that significant cut and fill activities may be required. The risk of runoff will be highest during the wet season.

Chapter 9: Air Quality has modelled construction related impacts from the Expressway. There are no IFC / WHO air quality standards for the protection of biodiversity, but there are EU standards[73] for NO_x and SO_2 with annual means of 30 and 20 ($\mu g/m^3$) ascribed respectively. According to Tables 9-25 and 9-27 within Chapter 9 Air Quality, these levels will not be exceeded during construction at any of the modelled receptor locations, including two located close to the Expressway.

The construction of the water abstraction pipeline had been completed at the time of the October/November 2017 bird surveys. The pipeline had been installed in such a way as to avoid existing areas of Papyrus dominated swamp and did not cause direct habitat loss within wetland

[73] Directive on ambient air quality and cleaner air for Europe (CAFE). Directive 2008/50/EC

areas. Indirect impacts to hydrology could impact a much larger area. A total of 465 m^3 of water will be abstracted per day from Lake Kidogo during construction using the water pipeline. Water usage during construction will total 398,690 m^3. This represents approximately six percent of the total reserve of Lake Kidogo (7,051,520 m^3). This is a relatively small percentage of the water body volume and is likely to be an overestimate due to natural recharge of water, however if the abstraction is sufficient to lower water levels around the edge of the lake, this could impact the papyrus swamp and aquatic vegetation that fringes the lake. It could also make the wetland habitats more vulnerable to burning by local communities and conversion to agricultural uses. This poses a significant impact to the biome-restricted IBA trigger species that rely on this habitat.

Construction activity such as vehicle movements, vegetation removal, as well as the movement of soil and water has the potential to introduce and spread invasive species. A total of 13 non-native invasive plant species were recorded during the baseline surveys. These included two highly invasive aquatic plant species Common Water Hyacinth *Eichhornia crassipes* and Water Cabbage *Pistia stratiotes* that could impact the wetland ecosystems as a whole, although unlikely to significantly impact the IBA trigger bird species. However, Common Water Hyacinth appears to already occur in low densities within all of the wetland areas and therefore unlikely to spread any further as a result of construction activities.

The Proposed Project is likely to lead to a large population influx that will cause additional indirect impacts such as land-use conversion, increased pressure on natural resources such as freshwater, bush meat, fish and fuelwood. It could also increase the amount of waste entering wetlands. The removal of 2500 hectares of farmland in a country already dependent on food imports is likely to increase the pressure and intensification of remaining farmland and additional conversion of wetlands into farmland.

Table 11-24: Significance of Construction Impacts to Internationally Recognised Areas Prior to Mitigation

Impact	Receptor	Impact Magnitude	Receptor Sensitivity	Pre-Mitigation Impact Significance
Direct habitat loss, changes in hydrology, water abstraction, disturbance, water quality, invasive species and air quality. Impacts from induced access, loss of farmland and population influx.	Nyabarongo Wetlands KBA and IBA	**Impact Magnitude:** High **Nature:** Adverse **Type:** Direct and Indirect **Extent/Scale:** Local **Duration:** Long Term **Frequency:** Periodic **Reversibility:** Irreversible	High	**Major Adverse**

Habitats

The construction phase of the Proposed Project will require the removal of the existing vegetation within the Proposed Project Area. This includes 2500 ha from the Airfield Area and 64 ha along the route of the Expressway. Smaller areas would be lost as a result of the water pipeline and the new quarry road. The majority of the affected habitats are modified, including Anthropic landscapes, Grassland, Wooded grassland, Bush land and thicket.

A single natural habitat is present within the Proposed Project Area, swamp and aquatic vegetation. The impacts to this habitat are discussed in detail under the preceding sub-section as a key component of the Nyabarongo Wetlands IBA. In summary, a relatively small area of natural habitats will be directly affected from habitat loss. This is largely limited to the loss of swamp and aquatic vegetation where the Expressway crosses wetland habitats. However, as discussed indirect effects to hydrology from the Expressway, sediment runoff during construction and water abstraction could affect a much larger area of swamp and aquatic vegetation. In addition, induced access and loss of farmland due to the Proposed Project is likely to increase the already high level of pressure on the areas of remaining swamp and aquatic vegetation.

Indirect impact will likely be incurred to areas of modified habitats, especially those surrounding the Airfield Area. These indirect impacts will include the potential for sediment runoff, pollution spills, introduction and spread of invasive species, as well as impacts to air quality. Construction activity such as vehicle movements, vegetation removal, as well as the movement of soil and water has the potential to introduce and spread invasive species. A total of 13 non-native invasive plant species were recorded during the baseline surveys. The creation of large areas of bare soil during construction provide an opportunity for invasive species to colonise and spread into surrounding habitats. Most of the construction locations are immediately surrounded by modified habitat types, and these are likely to be most at risk from impacts from invasive species. However, as discussed in the preceding sub-section Common Water Hyacinth and Water Cabbage pose a risk to the natural wetlands.

Table 11-25: Significance of Construction Impacts to Habitats Prior to Mitigation

Impact	Receptor	Impact Magnitude	Receptor Sensitivity	Pre-Mitigation Impact Significance
Direct habitat loss, sediment runoff, invasive species and air quality.	Modified Habitats: Anthropic landscapes, Grassland, Wooded grassland, Bush land and thicket.	**Impact Magnitude:** High **Nature:** Adverse **Type:** Direct and Indirect **Extent / Scale:** Local **Duration:** Long-term **Frequency:** Constant **Reversibility:** Irreversible	Low	**Moderate Adverse**
Direct habitat loss, changes in hydrology, water abstraction, disturbance, invasive species, water quality and air quality. Impacts from loss of farmland, induced access and population influx.	Natural Habitats: Swamp and aquatic vegetation	**Impact Magnitude:** High **Nature:** Adverse **Type:** Direct and Indirect **Extent / Scale:** Local **Duration:** Permanent **Frequency:** Constant **Reversibility:** Irreversible	High	**Major Adverse**

Fish

The construction phase of the Proposed Project will remove a small area of wetland habitat where the Expressway crosses a 500 metre wide tributary valley of the Nyabarongo River. This wetland area comprises swamp and aquatic vegetation rather than open water and unlikely to support significant fish populations. The main waterbody to be impacted during construction will be Lake Kidogo that will be used for a source of water. Up to approximately 6% of the waterbody reserve will be used during construction, although this may be replenished from natural recharge. The majority of fish populations are likely to survive within the remaining lake area. The water abstraction pipeline will have a fish screen installed at its end to stop fish being sucked into the pipe.

Indirect adverse impacts such as runoff and resultant pollution (with the potential to introduce silt, nutrients and chemical contaminants, non-native species and disease into adjacent watercourses, impacting their fish communities), impacts to air quality and disturbance have the potential to significantly affect fish if not managed during construction.

Fish are an important food source and currently exploited by local human populations. This exploitation has the potential to increase during construction if the influx of workers and job-seekers increase the demand for fish. In addition, the creation of new roads can facilitate access and the ease by which fish can reach markets located further afield.

Table 11-26: Significance of Construction Impacts to Fish Prior to Mitigation

Impact	Receptor	Impact Magnitude	Receptor Sensitivity	Pre-Mitigation Impact Significance
Changes in hydrology, water abstraction, water quality. Impacts from induced access and population influx.	Ningu *Labeo victorianus*	**Impact Magnitude:** Medium **Nature:** Adverse **Type:** Direct and indirect **Extent/Scale: Local** **Duration:** Long-term **Frequency:** Constant **Reversibility:** Irreversible	High	**Major Adverse**
Changes in hydrology, water abstraction, water quality. Impacts from induced access and population influx.	*Varicorhinus ruandae*	**Impact Magnitude:** Medium **Nature:** Adverse **Type:** Direct and indirect **Extent/Scale: Local** **Duration:** Long-term **Frequency:** Constant **Reversibility:** Irreversible	Low	**Minor Adverse**

Birds

The construction phase of the Proposed Project will require the removal of over 2500 hectares of largely modified habitats. The baseline surveys show that the majority of bird species present within these modified habitats are common and widespread species that are not assessed in detail as part of the impact assessment. Eight biome-restricted species and IBA trigger species (Papyrus Gonolek, Carruthers's Cisticola, Papyrus Yellow Warbler, White-winged Swamp-warbler, Black-lored Babbler, Northern Brown-throated Weaver, Papyrus Canary and Red-chested Sunbird) were recorded extensively within the natural wetland habitat surrounding the Proposed Project Area. In addition, secondary data suggests that the wetlands support Madagascar Pond Heron which is IUCN Endangered. These species have been assessed as triggering critical habitat. Construction phase impacts to these species, as well as the swamp and aquatic habitats on which they depend, are discussed in detail above as component parts of the Nyabarongo IBA. Two additional threatened or Near-threatened species of birds were recorded during the baseline studies: Grey Crowned-crane *Balearica regulorum* (IUCN EN) and Pallid Harrier *Circus macrourus* (IUCN NT). Grey Crowned-crane is a resident African breeding species, whilst Pallid Harrier is a Palearctic migrant. A total of four Grey Crowned-crane and two Pallid Harriers were recorded during the baseline surveys. Although small numbers of individuals were recorded, this could represent permanent losses of locally important populations and therefore the impact magnitude is assessed as medium.

Table 11-27: Significance of Construction Impacts to Birds Prior to Mitigation

Impact	Receptor	Impact Magnitude	Receptor Sensitivity	Pre-Mitigation Impact Significance
Construction Phase impacts including site clearance and loss of habitat.	Grey Crowned-crane *Balearica regulorum*	**Impact Magnitude:** Medium **Nature:** Adverse **Type:** Direct and Indirect **Extent/Scale:** Local **Duration:** Long Term **Frequency:** Constant **Reversibility:** Irreversible	Medium	**Moderate Adverse**
Construction phase impacts including site clearance and loss of habitat.	Pallid Harrier *Circus macrourus*	**Impact Magnitude:** Medium **Nature:** Adverse **Type:** Direct and Indirect **Extent/Scale:** Local **Duration:** Long Term **Frequency:** Constant **Reversibility:** Irreversible	Low	**Minor Adverse**

Table 11-27: Significance of Construction Impacts to Birds Prior to Mitigation				
Direct habitat loss, changes in hydrology, water abstraction, disturbance, water quality, invasive species and air quality. Impacts from loss of farmland, induced access and population influx.	IBA bird species assemblage and Madagascar Pond Heron	**Impact Magnitude:** High **Nature:** Adverse **Type:** Direct and Indirect **Extent/Scale:** Local **Duration:** Long Term **Frequency:** Constant **Reversibility:** Irreversible	High	**Major Adverse**

Mammals

The majority of habitat losses affect modified habitats that support an assemblage of common and widespread mammal species. However, the baseline surveys recorded Hippopotamus (IUCN VU) in several of the wetland areas within the Proposed Project AOI. Hippopotamus were recorded at Lake Rumira and within the wetland area between Lake Miravi and Lake Kilimbi. Local communities also reported the species from Lake Kidogo. The majority of construction activity within the Airfield area are far enough away from these wetlands to make disturbance unlikely. The construction of the water abstraction pipeline unlikely to significantly affect Lake Kidogo from disturbance. However, the abstraction of water from Lake Kidogo could reduce water levels in this lake, if it is not replenished by natural recharge, thereby potentially reducing its suitability for Hippopotamus to some extent. Hippopotamus is unlikely to be affected by construction of the Expressway as they are not present in the adjacent wetland.

Table 11-28: Significance of Construction Impacts to Mammals Prior to Mitigation				
Impact	**Receptor**	**Impact Magnitude**	**Receptor Sensitivity**	**Pre-Mitigation Impact Significance**
Construction Phase impacts including site clearance and loss of habitat, disturbance and fragmentation.	Hippopotamus	**Impact Magnitude:** Low **Nature:** Adverse **Type:** Direct **Extent/Scale:** Local **Duration:** Short Term **Frequency:** Constant **Reversibility:** Irreversible	Low	**Minor Adverse**

11.6.1.2 Impact Assessment Prior to Mitigation

11.6.2 Operation Phase Impacts

The operation of the Project will involve a range of activities that have the potential to affect biodiversity. Detailed assessments have been completed in relation to air quality (Chapter 9), noise and vibration (Chapter 10) and water resources (Chapter 12), with findings relevant to impacts to biodiversity. Where relevant, these findings are summarised in this section.

The relevant activities of the Proposed Project likely to give rise to impacts on receptors are summarised in Table 11-32, along with the likely pathway of the impacts. Impacts to individual biodiversity receptors are detailed in the following sub-section 11.5.2.1.

Table 11-29: Proposed Project Activities and Likely Pathways of Potential Impact

Activity	Pathway of Potential Impact
Movement of aircraft.	Direct mortality (bird strike). Disturbance. Impacts to air quality.
Movement of people and ground vehicles.	Disturbance. Impacts to air quality.
Physical effects of infrastructure.	Disturbance. Changes to hydrology and drainage. Runoff of pollutants. Changes to micro-climates.
Increase in lighting.	Disturbance.
Bird control measures.	Habitat loss. Direct mortality. Disturbance.

11.6.2.1 Internationally Recognised Areas

Nyabarongo Wetlands IBA

The following impact assessment does not solely focus on direct impacts to the IBA trigger bird species, but also to the wetland habitat on which they depend.

One of the most significant operational impact to the Nyabarongo Wetlands IBA and its component trigger bird species is likely to result from disturbance, both from the airport and the Expressway. Many studies have shown that aircraft can cause disturbance to wildlife and especially birds[74]. The disturbance is caused both by the noise generated by the aircraft and visual cues, which are thought likely to stimulate an anti-predator response. Predicting the disturbance impact on birds from aircraft is very difficult as the level of disturbance is known to vary according to a wide range of factors including: bird species, flock size, type of aircraft, proximity, frequency of aircraft, the landscape setting, and interaction with other sources of disturbance.

There are no international guidelines on the noise disturbance thresholds for wildlife. However, many studies have recorded a range of behavioural and physiological effects in birds resulting from exposure to noise and disturbance. Whilst the evidence from studies into noise thresholds for effects on birds is complicated by the different units of measurement cited and different

[74] Drewitt, A., 1999. Disturbance effects of aircraft on birds. Birds Network: Information note. Natural England, Peterborough

species involved, it is considered that 65 dB represents an appropriate precautionary LA_{max} noise threshold below which significant noise disturbance impacts to birds is unlikely.

According to the Master Plan, the total number of flight operations per year will be as follows (one operation is a landing or a take-offs):

- 2020: 25,580 landings and take-offs; and
- 2045: 62,700 landings and take-offs.

This equates to approximately 70 operations per day in 2020, increasing to 172 operations per day by 2045. Chapter 10: Noise and Vibration provides noise contour plots that show that for both the 2020 and 2045 scenario, 65 dB_{max} is exceeded approximately 15 km to the southeast over the whole of Lake Kidogo, Lake Rumira, Lake Miravi and half of Lake Kilimbi. To the northwest 65 dB_{max} is exceeded across an approximately 4 km wide band of the Nyabarongo River valley. The maximum noise levels for 2020 and 2045 are identical as the same types of aircraft are involved. Whilst the dB_{max} noise footprint will not change between 2020 and 2045, the large increase in number of aircraft will increase the hourly and daily average levels within the wetlands.

Disturbance to the Nyabarongo Wetlands IBA will also result from the Expressway. Traffic on the Expressway is projected to increase from 4,661 per day in 2020 to 22,563 per day in 2045. Chapter 10: Noise and Vibration includes figures on the predicted distances from the road that will receive average noise levels exceeding 45 dB LA_{eq} (night) and 55 dB LA_{eq} (daytime). In 2020, these limits will be limited to 30 m and 40 m respectively and in 2045, these will extend to 55 m and 75 m respectively. These figures suggest a relatively limited area of impact from noise disturbance.

However, research by Summers *et al.* (2011)[75] suggests that traffic noise is not the main cause of the negative relationship between bird species richness/ abundance and proximity to roads. Instead, traffic mortality may be the main mechanism causing this relationship. Whatever, the mechanism at play, the impacts of roads and other infrastructure on birds has been shown to extend up to 1 km (Benítez-López *et al.* 2010)[76]. An impact zone of 1 km would affect the majority of the tributary valley wetland alongside the Expressway, as well as part of the main Nyabarongo River valley. In addition to noise and mortality impacts, the Expressway will have street lighting installed, which can cause light disturbance into the surrounding habitats. However, the distances receiving light spill from the Expressway is likely to be relatively small especially if design controls such as cowls are installed.

Section 6.3.2.6 of the ESIA describes the lighting that will be installed in the Airport Area, including ground lighting for the runway, taxiway and apron. Whilst detailed light modelling is not currently possible, it is unlikely that light spill from the airfield will significantly impact areas of the Nyabarongo Wetlands IBA due to the distances involved. The nearest wetland to the runways is Lake Kidogo, which is approximately 2 km to the south east.

Chapter 9: Air Quality provides detailed modelling for NO_x and SO_2 for Phases 1 and 5 of the operational airfield. There are no IFC or WHO air quality standards for the protection of biodiversity, but there are EU standards for NO_x and SO_2 annual mean limits of 30 and 20 ($\mu g/m^3$) respectively. During Phase 1, the cumulative emissions will not exceed these standards. During Phase 5 the cumulative annual average of SO_2 will not exceed 1.19 $\mu g/m^3$ at any of the modelled receptor locations. However, during Phase 5 the cumulative annual average NO_2 levels

[75] Summers, P.D., Cunnington, G. M, and Fahrig L. (2011) Are the negative effects of roads on breeding birds caused by traffic noise? Journal of Applied Ecology 2011, 48, 1527–1534

[76] Benítez-López, A., Alkemade, R., and Verweij, P.A. (2010) The impacts of roads and other infrastructure on mammal and bird populations: A meta-analysis. Biological Conservation 143 (2010) 1307–1316

will represent up to 74% of the 30 µg/m^3. This includes >22 µg/m^3 at Expressway 1 & 2 and there is therefore the potential that the nearby part of the Nyabarongo Wetlands IBA could be moderately impacted.

The airport will create a relatively large impermeable surface area and a drainage network that will affect the local hydrology. There is a risk that these changes in hydrology may adversely affect the Nyabarongo Wetlands IBA catchment in the absence of an effective stormwater management system. In addition, there is a risk of water pollution entering wetland areas during operation of the Proposed Project and adversely affecting water quality. However, design controls have been committed that will address these impacts.

The Proposed Project is likely to lead to a large population influx that will cause additional indirect impacts such as land-use conversion, increased pressure on natural resources such as freshwater, bush meat, fish and fuelwood. It could also increase the amount of waste entering wetlands.

The airport is likely to implement a bird control system to reduce the risk of harm to aircraft from bird strike (Section 6.3.2.7). It will be the operator's responsibility to prepare a Wildlife Hazard Management Plan. This document will describe the procedures to manage wildlife hazards (such as bird strikes), including arrangements for assessing wildlife hazards, arrangements for implementing wildlife control programmes and persons responsible for dealing with wildlife hazards. Several measures exist against wildlife hazards, such as audio signal devices that beep to scare birds, removing empty nests in trees, implementing wildlife management measures to control and oversee the local habitat at the airport, netting or draining of streams, grass management, removing waste disposal sites, limiting other attraction to birds or bird monitoring systems. Some of these measures have the potential to negatively impact the Nyabarongo Wetlands IBA, especially if any habitat manipulation may be instigated in wetland areas.

Table 11-30: Significance of Operation Phase Impacts to Internationally Recognised Areas Prior to Mitigation

Impact	Receptor	Impact Magnitude	Receptor Sensitivity	Pre-Mitigation Impact Significance
Operational impacts of airport including noise disturbance, pollution, lighting and hydrology changes, and bird strike management. Impacts from induced access and population influx.	Nyabarongo Wetlands IBA	**Impact Magnitude:** High **Nature:** Adverse **Type:** Direct **Extent/Scale:** Regional **Duration:** Long Term **Frequency:** Constant **Reversibility:** Irreversible	High	**Major Adverse**

Habitats

Once construction has been completed, the operation phase of the airport is unlikely to cause any additional direct impacts from habitat loss. Impacts to natural swamp and aquatic vegetation habitat is discussed in detail in the preceding sub-section as a component part of the Nyabarongo Wetlands IBA. There is the potential for localised indirect impacts to the modified

habitats surrounding the Proposed Project Area from disturbance, changes in air quality, lighting and to the hydrology (i.e. increase runoff into adjacent wetlands and lakes) and the potential introduction of invasive species.

Table 11-31: Significance of Operation Phase Impacts to Habitats Prior to Mitigation

Impact	Receptor	Impact Magnitude	Receptor Sensitivity	Pre-Mitigation Impact Significance
Operational impacts of airport including disturbance, air quality, lighting and hydrology changes. Impacts from induced access and population influx.	Natural habitats: Swamp and aquatic vegetation	**Impact Magnitude:** Medium **Nature:** Adverse **Type:** Indirect **Extent/Scale:** Regional **Duration:** Long Term **Frequency:** Constant **Reversibility:** Irreversible	High	**Major Adverse**
Operational impacts of airport including disturbance, air quality, lighting and hydrology changes	Modified Habitats: Anthropic landscapes, Grassland, Wooded grassland, Bush land and thicket	**Impact Magnitude:** Medium **Nature:** Adverse **Type:** Direct and Indirect **Extent/Scale:** Local **Duration:** Long-term **Frequency:** Constant **Reversibility:** Irreversible	Low	**Minor Adverse**

Fish

Once construction has been completed, the operation phase of the airport is unlikely to cause any additional direct impacts to fish from habitat loss. Changes to hydrology in nearby watercourses could possibly impact their fish populations, though this is considered to be unlikely in light of the design controls. The same is the case for potential water pollution.

The Proposed Project is likely to lead to a large population influx that could significantly increase the demand for fresh fish. This could further impact fish populations that are reportedly over-fished at the current time. The impact to fish is assessed as being of **Major Adverse** significance prior to mitigation.

Birds

Once construction has been completed, the operation phase of the airport is unlikely to cause any additional direct impacts to birds from habitat loss. Indirect operational impacts to the IBA trigger species, Madagascar Pond Heron and the wetland habitats on which they depend, are discussed in detail above in the preceding sub-section as component parts of the Nyabarongo IBA and assessed to be **Major Adverse**. Following construction of the airfield and Expressway,

it is unlikely that Grey Crowned-crane will continue to occur in the remaining areas of habitat in the vicinity. However, Pallid Harrier is a Palearctic migrant that could continue to migrate through the Project Area and could in theory be at risk of bird strike. However, the bird management system would likely reduce risk of population level impacts to this species to **Negligible**.

Table 11-32: Significance of Operation Phase Impacts to Bird Species Prior to Mitigation

Impact	Receptor	Impact Magnitude	Receptor Sensitivity	Pre-Mitigation Impact Significance
Operation phase impacts including noise disturbance	Grey Crowned-crane *Balearica regulorum*	**Impact Magnitude:** Very Low **Nature:** Adverse **Type:** Indirect **Extent/Scale:** Local **Duration:** Long Term **Frequency:** Constant **Reversibility:** Reversible	Medium	**Negligible**
Operation phase impacts including noise disturbance	Pallid Harrier *Circus macrourus*	**Impact Magnitude:** Very Low **Nature:** Adverse **Type:** Direct **Extent/Scale:** Local **Duration:** Long Term **Frequency:** Constant **Reversibility:** Reversible	Low	**Negligible**
Operation phase impacts including noise disturbance	Nyabarongo IBA bird assemblage and Madagascar Pond Heron	**Impact Magnitude:** High **Nature:** Adverse **Type:** Direct and Indirect **Extent/Scale:** Local **Duration:** Long Term **Frequency:** Constant **Reversibility:** Irreversible	High	**Major Adverse**

Terrestrial Mammals

The operation of the airport and Expressway is unlikely to cause any additional direct impacts to mammals from habitat loss. Fragmentation effects of the Expressway are discussed as part of construction related impacts and would continue through the lifetime of the Project. Benítez-López *et al.* (2010) showed that the impacts of roads and other infrastructure on mammals has been shown to extend up to 5 km, although the precise response to disturbance is species-specific. The tolerance to noise of Hippopotamus is not well understood and no noise disturbance thresholds are available for this species. However, Chapter 10: Noise and Vibration provides noise contour plots that show that for both the 2020 and 2045 scenario, 65 dB_{max} is exceeded to the south east over the whole of Lake Kidogo, Lake Rumira, Lake Miravi and half of Lake Kilimbi. These areas are known to support Hippopotamus and aircraft noise could potentially impact the species. The potential impacts on Hippopotamus will be monitored through the Project BAP (Section 11.8). Increased threats to wetlands from agricultural conversion resulting from induced access and population influxes are likely to also cause a significant threat to Hippopotamus.

Table 11-33: Significance of Operation Phase Impacts to Terrestrial Mammals Species Prior to Mitigation

Impact	Receptor	Impact Magnitude	Receptor Sensitivity	Pre-Mitigation Impact Significance
Operation impacts of airport including disturbance. Impacts from induced access and population influx.	Hippopotamus	**Impact Magnitude:** High **Nature:** Adverse **Type:** Direct **Extent/Scale:** Local **Duration:** Long Term **Frequency:** Constant **Reversibility:** Reversible	Low	**Moderate Adverse**

11.7 Mitigation Measures

11.7.1 Construction Phase

A Biodiversity Management Plan (BMP) will be developed and included as an appendix to the overarching Developer Construction Environmental and Social Management Plan (C-ESMP). The EPC Contractor will then develop Construction Implementation Plans (CIPs), which will set out the detail of how their commitments will be met in alignment with the Developer C-ESMP, including the Developer BMP. . The Developer C-ESMP and Developer BMP will make specific reference to biodiversity fauna/flora protection measures. This will include the following:

- Employment of EHS Officers who will be responsible for implementation of the ESMP during construction including implementation of an environmental monitoring plan;
- The construction footprint will be carefully surveyed prior to start of construction and measures will be in place to ensure construction activities do not extend beyond the boundary;
- Only specified haul roads and designated construction tracks will be used by construction traffic;

- Careful positioning of lighting during construction to ensure light spoil does not occur on surrounding vegetation;
- Ensure water is not abstracted from any water bodies except for the designated source at Lake Kidogo, using the installed Water Pipeline;
- The water levels in Lake Kidogo will be monitored with the objective of defining a threshold point at which abstraction must be reduced or stopped. On the basis of current data, and until a more accurate numerical level can be established from lake level monitoring data, the maximum level threshold point should be defined as the base of the papyrus swamp vegetation in the lake to ensure that this habitat does not dry out.
- A walkover survey will be completed prior to vegetation clearance for the Expressway to identify the location of any protected plants and provisions will be put in place to arrange translocation to a safe receptor site.
- Remove organic top soil and store separately for use in restoration;
- Restore disturbed areas as soon as practicable to establish vegetation to protect from soil erosion. Use temporary soil protection if required (e.g. geojute). Wetland areas affected by the construction of the Expressway would be restored to pre-construction baseline conditions;
- Conduct weekly site inspections for signs of soil erosion or sediment runoff. This will particularly focus on areas that could affect adjacent wetlands. Implement remediating actions immediately if any erosion or sediment runoff is identified;
- Prohibit direct discharges into water bodies, or storage of waste materials outside of designated storage areas;
- Burning of waste will be prohibited.
- Hunting and fishing by construction workers will be prohibited, as will the purchasing of fish and bushmeat whilst at work. Alternative fuel sources will be supplied to construction workers that avoid wood or charcoal use on-site that has not been sustainably harvested; and
- The landscaping within the Airport Area will primarily use native species of plants. The airfield surrounding the runways will have grassland comprising only native plant species. The soft landscape design will also favour plants known to produce high density of nectar and pollen to mitigate impacts to pollinating insects including honey bees. A range of flowering plant species will be selected to provide a long season of flowering. This will require some additional research and engagement with local experts to specify the optimal plant composite, as well as long term management. This is necessary to maximise benefit to pollinators, without attractive large numbers of birds that could increase the risk of bird strike with aircraft. It is proposed that this is taken forward as part of the Project BAP.

11.7.2 Operation Phase

11.7.2.1 Biodiversity Management

EHS Officers will be employed by the Project to implement the long-term biodiversity monitoring strategy and the Project Biodiversity Action Plan (see sections 11.7 and 11.8).

11.7.2.2 Bird Management System

The bird management system will be reviewed by an ornithologist to ensure that it does not cause any negative impacts to threatened bird species or impact the Nyabarongo Wetlands IBA. Any instances of direct mortality from bird strikes with aircraft and airport infrastructure (e.g. collisions with control tower, aerials, power lines etc.) will be closely monitored through a robust reporting framework to include the facility maintenance staff, aircrews and aircraft maintenance

teams. This will be detailed in the BAP. The numbers of birds involved, their species and nature of incident will be recorded.

11.7.2.3 Fish

The Pollution Prevention Plan will detail measures to prevent runoff from the Proposed Project Area. In particular, measures will be employed to avoid silt, nutrients and chemical contaminants, non-native species and disease into adjacent watercourses. Water monitoring detailed for the Nyabarongo Wetland IBA will inform the need for further fish mitigation.

11.8 Monitoring

Separate monitoring strategies will be set out within the Contractor Implementation Plans (CIPs) and the Project BAP. The construction and operation phase CIPs will set out the monitoring strategies that will be adopted to accurately monitor both construction and operational impacts. The Project BAP biodiversity monitoring and evaluation strategy will focus on the following critical habitat features:

- Nyabarongo Wetlands IBA and the bird species that form component parts of the Internationally Recognised Area;
- Madagascar Pond Heron; and
- Ningu *Labeo victorianus.*

The biodiversity monitoring and evaluation strategy will also include Hippopotamus and papyrus swamp and aquatic vegetation. Although the Hippopotamus does not trigger critical habitat, it is IUCN VU and is a wide ranging, large and charismatic mammal species that could also be considered as a Keystone species within wetland ecosystems. Papyrus swamp and aquatic vegetation is a Natural Habitat of high sensitivity which supports the Nyabarongo IBA trigger species and Madagascar Pond Heron.

The monitoring and evaluation strategy will be designed as an integral part of the overall adaptive management programme to inform the regular review of the implantation of the Project Biodiversity Action Plan.

11.9 Biodiversity Action Plan

Following the implementation of mitigation, net residual impacts will still be incurred to both natural and critical habitats. Therefore, to achieve no net loss of natural habitats and a net gain of critical habitats, biodiversity offsets will be required.

According to paragraph 18 of PS6:

"In such cases where a client is able to meet the requirements defined in paragraph 17, the project's mitigation strategy will be described in a Biodiversity Action Plan and will be designed to achieve net gains of those biodiversity values for which the critical habitat was designated."

In line with PS6 and African Development Bank's Integrated Safeguards System, BAC will develop a detailed biodiversity offset strategy as part of a Project Biodiversity Action Plan (BAP). The offsets will be developed on a like-for-like basis, deliver enduring conservation outcomes, and demonstrate additionality for the protection of the relevant habitats and species (i.e. the IBA, the component IBA bird species and the wetland habitats on which they depend). The offsets will provide gains for the affected habitats and species above and beyond what would have happened without offsets and with the Project's impacts.

The BAP will include specific action plans for the following biodiversity features:

- Nyabarongo Wetlands IBA and the bird species that form component parts of the Internationally Recognised Area as well as Madagascar Pond Heron;

- Ningu *Labeo victorianus ;*
- Natural habitat: swamp and aquatic vegetation; and
- Hippopotamus.

The BAP will also include the liaison with landscape architects to develop the Airport Area soft landscape plan. The soft landscape design will be developed to favour plants known to produce high density of nectar and pollen to mitigate impacts to pollinating insects including honey bees. A range of flowering plant species will be selected to provide a long season of flowering. This will require some additional research and engagement with local experts to specify the optimal plant composite, as well as long term management. This is necessary to maximise benefit to pollinators, without attractive large numbers of birds that could increase the risk of bird strike with aircraft.

11.9.1 Biodiversity Action Plan Process

It is emphasised that a BAP is a live process and prescribed actions will be continually adapted in response to new information in order to achieve the desired objectives. In this way, a BAP is in alignment with the established business management process of "plan, do, check, and act" (as outlined in IFC PS1). This also follows the recommended process set out within British Standard (BS) 8583:2015 Biodiversity – Guidance for Businesses on managing the risks and opportunities. In effect the BAP provides an adaptive management strategy.

1. Plan: confirm the objectives and specify the action necessary to achieve those objectives and their associated targets.
2. Do: Implement the plan.
3. Check: Monitor implementation of the specified action through regular monitoring and analyse results against targets and requirements. Determine any causes of non-conformity and if required design corrective actions.
4. Act: carry out further actions as required and specified in step 3 (return to step 1).

11.9.2 Overarching Objectives of the BAP

A BAP is essentially a management tool that focuses the Project's mitigation and management strategy for key biodiversity values. The BAP would also manage the collection of additional baseline information where there are information gaps in a project's Environmental and Social Impact Assessment (ESIA).

The purpose of the BAP is to help protect, conserve and enhance key biodiversity values of the Project Area, with particular focus on natural habitats and features that confer critical habitat status. However, the management process provided by the BAP can be widened to include other actions that are more complex than those typically included in a standard Environmental and Social Management Plan (ESMP). The BAP would take into account the direct (primary) and indirect (secondary) impacts of the Project as identified in the ESIA and incorporate the commitments for mitigation and monitoring that have been made to address these impacts.

Biodiversity objectives for the Project are set at two levels: overall objectives of the BAP and specific objectives for each of the Action Plans.

The overall objectives of the BAP are to:

- promote and enhance the Nyabarongo Wetlands IBA, to deliver a net gain in its assemblage of bird species, including Madagascar Pond Heron;
- deliver a net gain for the fish species Ningu;
- achieve no net loss of natural habitats (i.e. swamp and aquatic vegetation);
- achieve no net loss in Hippopotamus;

- to achieve no net loss in ecosystem services in relation to honey bees kept by local beekeepers;
- Provide a framework for engaging stakeholders during the BAP process; and

11.10 Provide a robust, appropriately designed, and long-term biodiversity monitoring and evaluation programme that will inform adaptive management of the relevant biodiversity features and enhance knowledge underpinning their conservation programmes. Summary of Mitigation and Residual Impacts

A summary of the mitigation measures and residual impacts is presented in Table 11-34.

Table 11-34: Evaluation of Impact Significance: Biodiversity

Impact	Receptor	Phase	Impact Magnitude	Receptor Sensitivity	Pre-Mitigation Impact Significance	Design, Enhancement or Mitigation Measures	Management Plan	Residual Significance
Direct habitat loss, changes in hydrology, water abstraction, disturbance, water quality, invasive species and air quality Impacts from induced access, loss of farmland and population influx	Nyabarongo Wetlands IBA	Construction	**Impact Magnitude:** High **Nature:** Adverse **Type:** Direct and Indirect **Extent/Scale:** Local **Duration:** Long Term **Frequency:** Periodic **Reversibility:** Irreversible	High	**Major Adverse**	• Employment of EHS Officers; • Offsetting, to be detailed in BAP; and • Biodiversity Monitoring Strategy.	• C-ESMP • BMP • BAP	**Major Adverse** [1]
Direct habitat loss, sediment runoff, invasive species and air quality	Modified Habitats: Anthropic landscapes, Grassland, Wooded grassland, Bush land and thicket	Construction	**Impact Magnitude:** High **Nature:** Adverse **Type:** Direct and Indirect **Extent/Scale:** Local **Duration:** Long-term **Frequency:** Constant **Reversibility:** Irreversible	Low	**Moderate Adverse**	• Employment of EHS Officers; and • Landscaping using native plant species.	• C-ESMP • BMP	**Minor Adverse**

Table 11-34: Evaluation of Impact Significance: Biodiversity								
Direct habitat loss, changes in hydrology, water abstraction, disturbance, invasive species, water quality and air quality Impacts from induced access, loss of farmland and population influx	Natural Habitats: Swamp and aquatic vegetation	Construction	**Impact Magnitude:** High **Nature:** Adverse **Type:** Direct and Indirect **Extent/Scale:** Local **Duration:** Permanent **Frequency:** Constant **Reversibility:** Irreversible	High	**Major Adverse**	• Employment of EHS Officers; • Offsetting, to be detailed in BAP; and • Biodiversity Monitoring Strategy.	• C-ESMP • BMP • BAP	**Major Adverse** [1]
Changes in hydrology, water abstraction, water quality Impacts from induced access and population influx	Ningu *Labeo victorianus*	Construction	**Impact Magnitude:** Medium **Nature:** Adverse **Type:** Direct and indirect **Extent/Scale:** Local **Duration:** Long-term **Frequency:** Constant **Reversibility:** Irreversible	High	**Major Adverse**	• Offsetting, to be detailed in BAP if confirmed to be present; and • Biodiversity Monitoring Strategy.	• C-ESMP • BMP • Pollution Prevention Plan	**Major Adverse** [1]
Changes in hydrology, water	*Varicorhinus ruandae*	Construction	**Impact Magnitude:** Medium **Nature:** Adverse	Low	**Minor Adverse**		• C-ESMP • BMP	**Minor Adverse**

Table 11-34: Evaluation of Impact Significance: Biodiversity

abstraction, water quality			**Type:** Direct and indirect **Extent/Scale:** Local **Duration:** Long-term **Frequency:** Constant **Reversibility:** Irreversible				• Pollution Prevention Plan	
Construction Phase impacts including site clearance and loss of habitat	Grey Crowned-crane *Balearica regulorum*	Construction	**Impact Magnitude:** Medium **Nature:** Adverse **Type:** Direct and Indirect **Extent/Scale:** Local **Duration:** Long Term **Frequency:** Constant **Reversibility:** Irreversible	Medium	**Moderate Adverse**	• Employment of EHS Officers; and • Biodiversity Monitoring Strategy.	• C-ESMP • BMP • BAP	**Moderate Adverse**
Construction Phase impacts including site clearance and loss of habitat	Pallid Harrier *Circus macrourus*	Construction	**Impact Magnitude:** Medium **Nature:** Adverse **Type:** Direct and Indirect **Extent/Scale:** Local **Duration:** Long Term **Frequency:** Constant **Reversibility:** Irreversible	Low	**Minor Adverse**	• Employment of EHS Officers; and • Biodiversity Monitoring Strategy.	• C-ESMP • BMP • BAP	**Minor Adverse**
Direct habitat loss, changes	IBA trigger species	Construction	**Impact Magnitude:** High	High	**Major Adverse**	• Employment of EHS Officers;	• C-ESMP • BMP	**Major Adverse** [1]

Table 11-34: Evaluation of Impact Significance: Biodiversity								
in hydrology, water abstraction, disturbance, water quality, invasive species and air quality Impacts from induced access, loss of farmland and population influx.	assemblage and Madagascar Pond Heron		**Nature:** Adverse **Type:** Direct and Indirect **Extent/Scale:** Local **Duration:** Long Term **Frequency:** Constant **Reversibility:** Irreversible			• Offsetting, to be detailed in BAP; and • Biodiversity Monitoring Strategy.	• BAP	
Construction phase impacts mainly related to changes in hydrology.	Hippopotamus	Construction	**Impact Magnitude:** Low **Nature:** Adverse **Type:** Direct **Extent/Scale:** Local **Duration:** Short Term **Frequency:** Constant **Reversibility:** Irreversible	Low	**Minor Adverse**	• Employment of EHS Officers; • Offsetting, to be detailed in BAP; and • Biodiversity Monitoring Strategy.	• C-ESMP • BMP • BAP	**Negligible**
Operation impacts of airport including noise disturbance, pollution, lighting and	Nyabarongo Wetlands IBA	Operation	**Impact Magnitude:** High **Nature:** Adverse **Type:** Direct Extent/Scale: Regional	High	**Major Adverse**	• Employment of EHS Officers; • Bird management system;	• O-ESMP • BAP	**Major adverse** [1]

Table 11-34: Evaluation of Impact Significance: Biodiversity								
hydrology changes, and bird strike management. Impacts from induced access and population influx.			**Duration:** Long Term **Frequency:** Constant **Reversibility:** Irreversible			• Offsetting, to be detailed in BAP; and • Biodiversity Monitoring Strategy.		
Operation impacts of airport including disturbance, air quality, lighting and hydrology changes. Impacts from induced access and population influx.	Natural habitats Swamp and aquatic vegetation	Operation	**Impact Magnitude:** Medium **Nature:** Adverse **Type:** Indirect **Extent/Scale:** Regional **Duration:** Long Term **Frequency:** Constant **Reversibility:** Irreversible	High	**Major Adverse**	• Employment of EHS Officers; • Offsetting, to be detailed in BAP; and • Biodiversity Monitoring Strategy.	• O-ESMP • BAP	**Major Adverse** [1]
Operation impacts of airport including disturbance, air quality, lighting and	Modified Habitats: Anthropic landscapes, Grassland, Wooded grassland,	Operation	**Impact Magnitude:** Medium **Nature:** Adverse **Type:** Indirect **Extent/Scale:** Regional **Duration:** Long Term	Low	**Minor Adverse**	• Employment of EHS Officers.		**Negligible**

Table 11-34: Evaluation of Impact Significance: Biodiversity								
hydrology changes	Bush land and thicket		**Frequency:** Constant **Reversibility:** Irreversible					
Impacts from induced access and population influx	Ningu	Operation	**Impact Magnitude:** Medium **Nature:** Adverse **Type:** Indirect **Extent/Scale:** Regional **Duration:** Long Term **Frequency:** Constant **Reversibility:** Reversible	High	**Major Adverse**	• Employment of EHS Officers; • Offsetting, to be detailed in BAP; and • Biodiversity Monitoring Strategy.	• O-ESMP • BAP	**Major Adverse[1]**
Operation phase impacts including noise disturbance.	Grey Crowned-crane *Balearica regulorum*	Operation	**Impact Magnitude:** Very Low **Nature:** Adverse **Type:** Indirect **Extent/Scale:** Local **Duration:** Long Term **Frequency:** Constant **Reversibility:** Reversible	Medium	**Negligible**	• Employment of EHS Officers; and • Biodiversity Monitoring Strategy.	• O-ESMP • BAP	**Negligible**

Table 11-34: Evaluation of Impact Significance: Biodiversity								
Operation phase impacts including noise disturbance	Pallid Harrier *Circus macrourus*	Operation	**Impact Magnitude:** Very Low **Nature:** Adverse **Type:** Direct **Extent/Scale:** Local **Duration:** Long Term **Frequency:** Constant **Reversibility:** Reversible	Low	**Negligible**	• Employment of EHS Officers; • Bird management system; • Offsetting, to be detailed in BAP; and • Biodiversity Monitoring Strategy.	• O-ESMP • BAP	**Negligible**
Operation phase impacts including noise disturbance Impacts from induced access and population influx	IBA trigger species and Madagascar Pond Heron	Operation	**Impact Magnitude:** High **Nature:** Adverse **Type:** Direct and Indirect **Extent/Scale:** Local **Duration:** Long Term **Frequency:** Constant **Reversibility:** Irreversible	High	**Major Adverse**	• Employment of EHS Officers; • Bird management system; • Offsetting, to be detailed in BAP; and • Biodiversity Monitoring Strategy.	• O-ESMP • BAP	**Major Adverse** [1]

Table 11-34: Evaluation of Impact Significance: Biodiversity

Operation impacts of airport including disturbance Impacts from induced access and population influx	Hippopotamus	Operation	**Impact Magnitude:** High **Nature:** Adverse **Type:** Direct **Extent/Scale:** Local **Duration:** Long Term **Frequency:** Constant **Reversibility:** Reversible	Low	**Moderate Adverse**	• Offsetting, to be detailed in BAP; and • Biodiversity Monitoring Strategy.	• O-ESMP • BAP	**Minor Adverse**

[1] **Residual impact assessment excludes offsetting strategy that will compensate for losses and deliver a net gain as required.**