

Software Requirements Specification

SANBI

Biodiversity for Life

South African National Biodiversity Institute



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1. Introduction

1.1 Purpose

The purpose for this Global Environment Facility (GEF)-funded project, is to develop a coordinated system of wildlife trade monitoring with centralised/shared information to be developed for priority species (rhino, lion, leopard, cheetah, and elephant). The system should eventually be able to house information for other species as well, and the design of the system should be such that extra modules could be added for additional species.

Currently, permits for legal trade, information about illegal trade seizures and other law enforcement processes, and provincial-level monitoring data for key species (e.g., population counts and population information such as births, deaths, translocations, etc.) are captured at a provincial and sometimes national level. In addition, private wildlife owners maintain their own information systems about wildlife on their land, and some non-governmental organisations maintain their own information systems for specific species.

The proposed central monitoring system is expected to provide valuable data and information on a national level about the impacts of legal and illegal trade in the species and the current status of the distribution and abundance of the species. The data will then be interrogated and analysed by users of the system to inform national and international permitting and listing or reporting processes (e.g., the Threatened or Protected Species list under NEMBA, the CITES listings, hunting quotas, etc.).

The purpose of this document is to develop clear specifications for the development of the new centralised monitoring system.

1.2 Audience and Reading Suggestions

This document is mainly intended for the developers who will be responsible for the actual build or development of the solution and for any prospective vendors that may be subcontracted and working under SANBI's direction during the development of the system.

Lastly, this document will assist the project manager(s) that will be overseeing the project and managing the deliverables of the project against the system development project plan.

The document is broken-down into five sections which can be read in a sequential order. These sections are as follows:

- **High-Level Requirements** – This section shows the major components of the overall system, subsystem interconnections, and external interfaces.
- **Conceptual System Design** – Solution Components
- **Detailed Functional Requirements** – Use Cases
- **System Integration requirements**

- **Non-functional System Requirements** – Refers to describe how the system must behave and establish constraints of its functionality. This type of requirements is also known as the system's quality attributes.
- **Other requirements**

1.3 Background

SANBI is the body mandated by the National Environmental Management Biodiversity Act of 2004 (No. 10 of 2004) to champion the exploration, conservation, sustainable use, appreciation, and enjoyment of South Africa's exceptionally rich biodiversity for all South Africans. This includes giving effect to international agreements, and cooperative governance arrangements directed at ensuring the country's rich and varied biodiversity is conserved for future generations. SANBI also manages the technical unit for the Scientific Authority of South Africa (SAoSA).

The SANBI technical unit, which provides advice and analysis on various species, recognises that it consumes a significant amount of its time and effort trying to obtain data from a variety of sector stakeholders – which could be better spent on more strategic, value-adding activities, and that it would be more efficient if they could access the required data from a central location.

This has led SANBI to initiate a project to develop a national digital platform for population-level monitoring of traded wildlife as part of its responsibility for Component 1 of the Global Environmental Facility-funded project titled 'Strengthening institutions, information management and monitoring to reduce the rate of illegal wildlife trade in South Africa'

The focus of the project was therefore on monitoring population levels for the charismatic species such as the lion, elephant, leopard, and rhino. The system is designed with scalability in mind such that alter iterations will be able to cater for data pertaining to other fauna and flora species as and when these become required.

1.4 Scope

The aim is to develop a centralised system for population-level monitoring of traded wildlife where information from provinces and private landowners is made available to key users (primarily to the Scientific Authority and other relevant decision makers) under strict access and security controls. The scope is divided into three deliverables as indicated below:

1. Technical Specifications Document

Formulate the technical specifications required to develop the proposed system

2. Implementation Guidance

Provide an implementation guide for system rollout

2. High-Level Requirements

2.1 Current Context

Currently SANBI gets and subscribes to data from many different sources. A lot of the data is informally gathered by species SME's and by partner organisations. The gathered data is mostly recorded in simple spreadsheets or in CSV files or simple databases.

Much of the current monitoring and data capturing about wildlife populations takes place within the provinces' scientific services and by private wildlife managers, however this monitoring and data capturing is not coordinated. There is no standard across these files in terms of how the data is aggregated and although security and governance apply to a lot of this data, the data sources are individually managed, with no formal standards, guidelines, and approaches in this regard.

The GEF-funded project proposes to develop consistent and agreed monitoring protocols, coordinate inputs, and to develop a system for uploading, sharing, and analysing monitoring data for threatened species.

The centralised system will curate important data into a shared database, allowing for national-level decision-making. The centralised system will need to have agreed protocols and recording systems together with semi-automated analyses that could be performed by different tiers of users.

2.2 High-Level System Requirements

The high-level system requirements are indicated in the figure below with detailed descriptions per pillar. An in-depth explanation if required can be viewed in the attached reference document i.e., "Business and System Discovery Report" (to be shared with the successful tenderer).

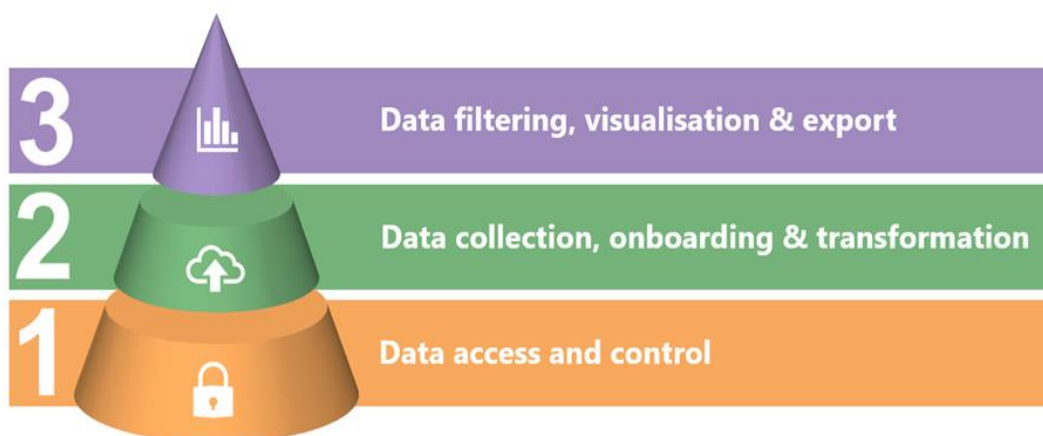


Figure 1: Use Case Pillars

Description of pillars

- **Pillar 1** - Data access and control: this pillar encapsulates the use cases involved in ensuring the system's remains data secure and makes provision for assigning permissions via access control.
- **Pillar 2** - Data collection, onboarding, and transformation: this pillar encapsulates the use cases that address how collected data is going to be entered into the system (i.e., either manually or via direct system integration), how data quality is going to be maintained and how data received from differing sources in differing formats is going to be stored and structured in a consistent manner.
- **Pillar 3** - Data filtering, visualisations, and export: this pillar encapsulates the use cases concerned with ensuring users can manipulate and present the data in the manner required. It also includes user requirements in terms of options for exporting the data (i.e., in what format, for printing, sharing, or storage, etc.)

Note: These pillars constitute the model by which the use cases are organised and are not intended to be viewed as a sequential process.

2.3 High-Level Functional Requirements i.e., Use Cases

The below table indicates a summarised view of all the System Use Cases defined per user cases per pillar.

Table 1: System Use Cases

Pillar 1: Data Access & Control	Pillar 2 Data Collection, onboarding & transformation	Pillar 3: Data filtering, visualisation & export
Add new user account	Create new account	Filter by fauna species name
Configure roles and permissions	Add profile information (species and property)	Filter by time period (annual)
Assign role to account	Add, or update species population and/or activity data	View species population data, as totals, per area
Add spatial layers	Upload species population and/or activity data	View species population data, as density, per area (leopard)
Add and configure system species	View own species data	View number of properties per population category
Data security	Edit account information	View number of populations per population category
	Edit profile information	View number of populations per population category, per area
	Configure reminder notifications	View species population density per property
	Log in	View species population data, as trends
	Pull data from other systems or online databases	View species population data, as a map
	Species habitat and biology information	View all species population data, as a table
	Provincial habitat information view	View species activity data, as totals, by method
		View species activity data, as totals, by method, by area
		View activity data, as % of total population
		View species activity data, as trends
		View all species activity data, as a table
		View species population data, as a map
		Extract data as CSV
		Extract data as report
		Save extracted data

2.4 System Context Diagram

The future system SANBI monitoring system will leverage all valuable sources of species information, gathered by SME's and by partner organisations, and extract this information into a system database, after formatting the data into the required database format, and after checking the quality and integrity of this data.

Proper security and governance will be applied to the data. Strict role-based access to this data will also be implemented to protect this information from being exploited.

The centralised system will curate important data into a shared database, allowing for national-level decision-making. The centralised system will need to have agreed protocols and recording systems, together with semi-automated analyses, that could be performed by different tiers of users.

Consistent and agreed monitoring protocols will be enforced, coordinate inputs will be input, and the system will allow for the uploading, downloading, and sharing of information, and enable proper analysis and monitoring of threatened species.

The future intention of the system is to get SME's and partner organisations, who currently gather information in Excel Spreadsheets and CSV files, to rather capture this information directly into the system, and to offer them the benefit of analysing all the data about the species they are interested in, inside the system. The system must be developed in such a way so that it can be rolled out to monitor and analyse further endangered species in the future.

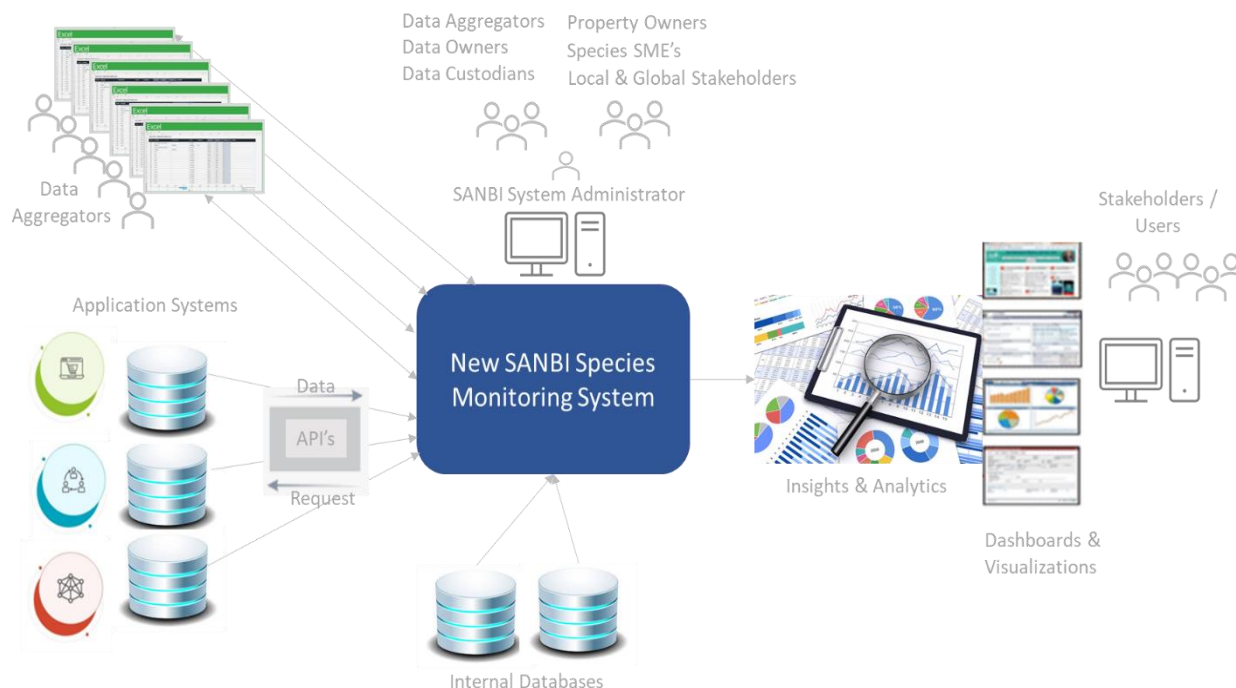


Figure 2: New Species Monitoring System context

2.5 System Data Requirements

2.5.1 Data Modelling

Data management resides at the core of this solution. The solution needs to have the following characteristics to fulfil initial and future requirements:

- **Configurability.** The data model supported by the solution needs to be configurable through an UI accessible to a power-user or admin user. All system components need to be metadata driven based on the defined data model. A configurable forms builder should use data definitions to drive functionality of the data capture forms, including required validations associated with specific data entities/types.
- **Extendibility.** The system shall be easy to extend to cater for additional species, properties, activities, etc. The core data model supported by the system needs to be generic enough to allow for the required level of extendibility. Alignment to best practice and standards will also support this characteristic.
- **Alignment to standards.** The data model used by the solution needs to be based on existing standards and taxonomies, e.g., Darwin Core and Access to Biological Collections Data (ABCD). This will help with future proofing the model and provide the ability to extend it beyond initial requirements without major rework. This will also simplify integration with other external systems such as GBIF, etc.
- **Data integrity.** The solution shall ensure data integrity based on the defined data model. Data integrity constraints and validations shall be applied to data entered via data capture, via interfaces as well as data ingested from other systems (integrated).

The conceptual data model proposed below is divided into the following core subject areas:

- **Species / Organism** – All data related to definition of management organisms. Initially it will include fauna species in scope. In the future it will also include flora items.
- **Property** – data about property against which activity or population information is captured
- **Spatial** – spatial data, i.e., property/site spatial information, areal, etc.
- **Activity** – all data related to activities which need to be managed in the system
- **Event** – all data related to events (managed and unmanaged) that need to be managed in the system
- **Stakeholder** – all stakeholders (Organisations or natural persons) that need to be managed/referenced in the system
- **Occurrence / Observation** – data related to observations of particular species
- **Population Data** – population information managed in the system for different species per property
- **Regulatory Permits** – information about permits associated with regulated activities

The data subject areas figure is visualised below.

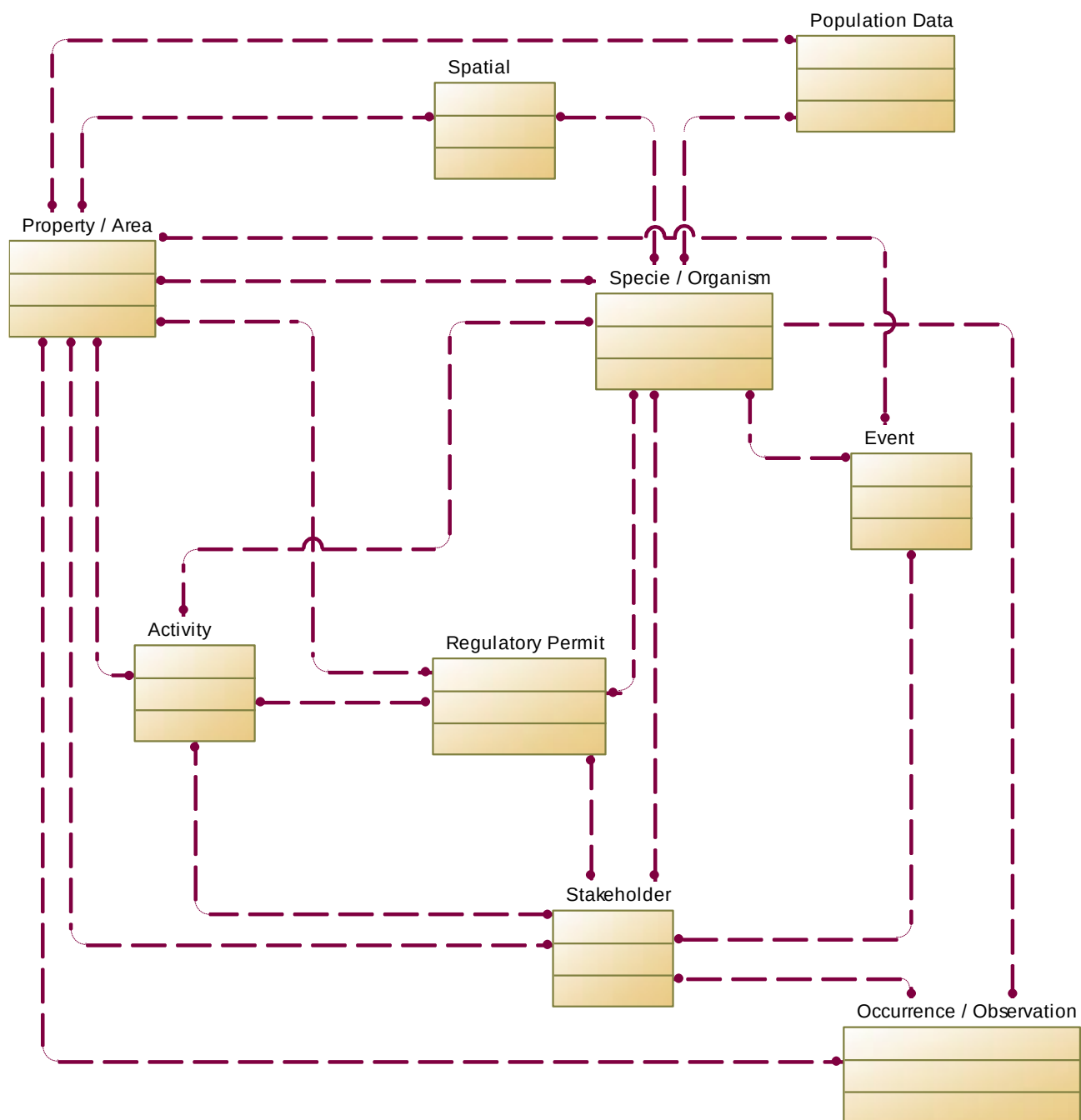


Figure 3: Data Subject Areas

In addition to the data subject areas, the subsequent diagram indicates a high-level conceptual data model for the system.

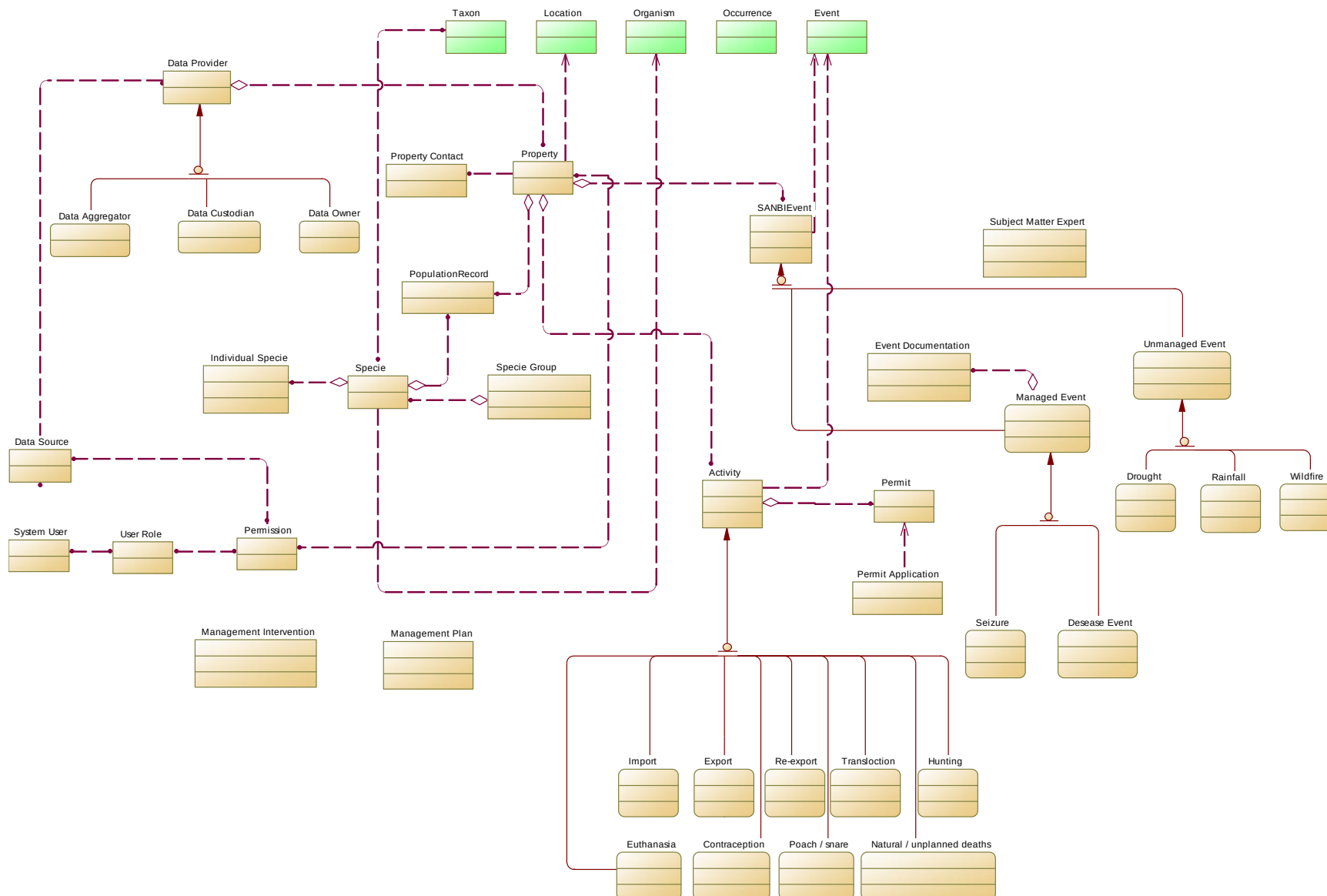


Figure 4: Conceptual Data Model

2.5.2 Standards & best practice

Below information about Darwin Core and ABCD is given for reference as these standards need to be considered during detailed design phase of the implementation project.

2.5.2.1 Darwin Core (DwC)

Darwin Core (often abbreviated to DwC) is an extension of Dublin Core for biodiversity informatics. It is meant to provide a stable standard reference for sharing information on biological diversity (biodiversity). The terms described in this standard are a part of a larger set of vocabularies and technical specifications under development and maintained by Biodiversity Information Standards (TDWG) (formerly the Taxonomic Databases Working Group).

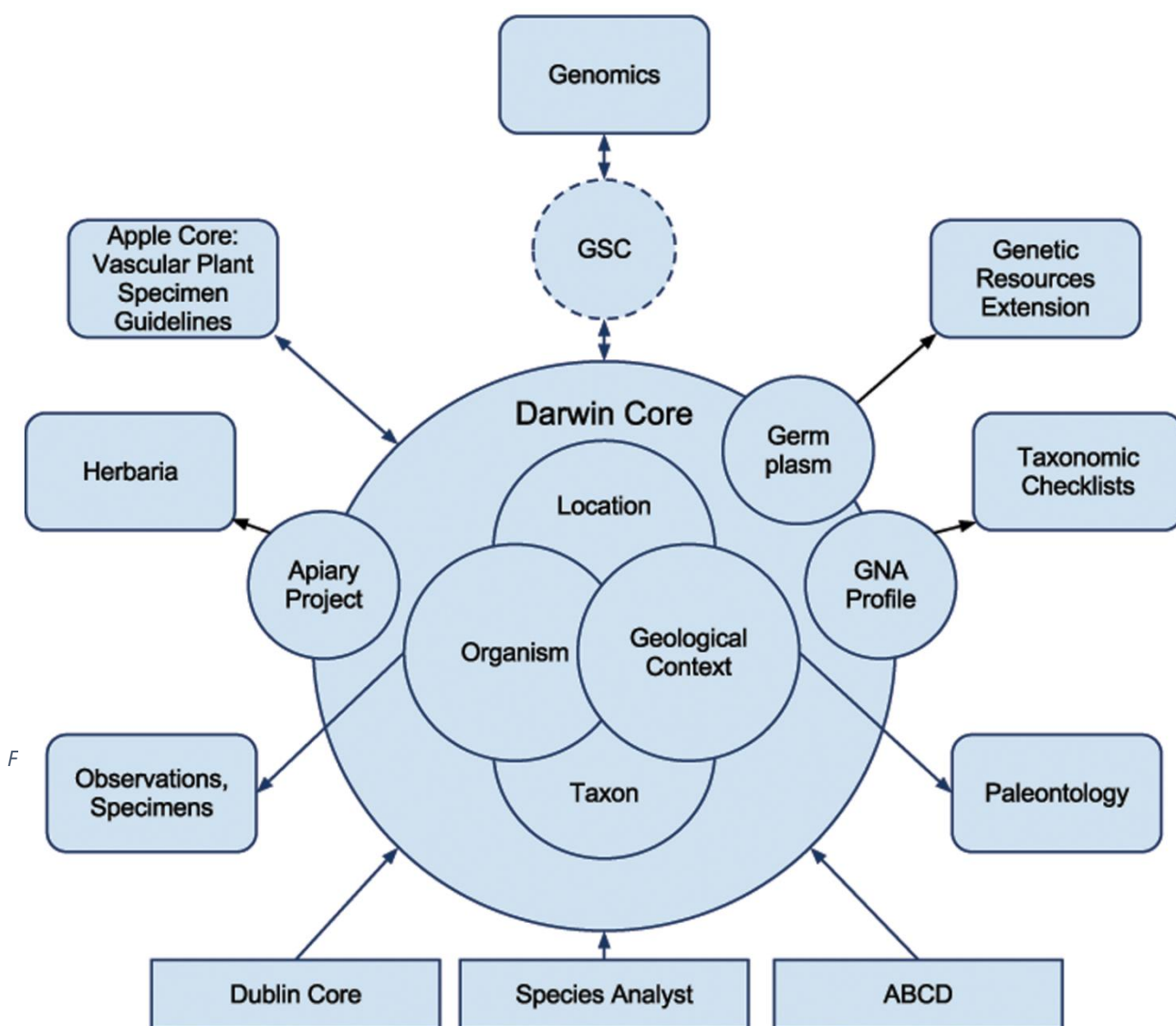


Figure 6: Scope of Darwin Core

The Standard, deriving from previous standards work (e.g., Dublin Core), describes core sets (e.g., organismal, taxonomic) of characteristics of biodiversity, which are applicable in many biological domains (e.g., Paleontology, Botany). The standard can be extended to cover details of specific sub-disciplines (e.g., Genetic Resources, Herbaria, Taxonomic Checklists).

Collaborations with other standards organisations (Genomics Standards Consortium (GSC) extend Darwin Core for new disciplines (Genomics, Metagenomics, Gene Marker Sequences).

Record-level Terms	Dublin Core terms, institutions, collections, nature of data record	Simple Darwin Core (flat)
Occurrence	evidence of species in nature, observers, behavior, associated media, references.	
Event	sampling protocols and methods, date, time, field notes	
Location	geography, locality descriptions, spatial data	
Identification	linkage between Taxon and Occurrence	
Taxon	scientific names, vernacular names, names usages, taxon concepts, and the relationships between them	
GeologicalContext	geologic time, chrono-stratigraphy, biostratigraphy, lithostratigraphy	
ResourceRelationship	explicit relationships between identified resources (e.g., one organism to another, taxon to location, etc.)	Generic Darwin Core (relational)
MeasurementOrFact	measurements, facts, characteristics, assertions, references	

Figure 7: Darwin Core Categories

Simple Darwin Core is comprised of seven categories of terms (green). This subset of Darwin Core terms represent descriptive data about organisms that can be represented in one file with one row per record and one column per term. Two additional categories (orange) expand Darwin Core with concepts that require a more complex data structure, such as multiple measurements from a single specimen, and cannot be represented easily in Simple Darwin Core.

Additional information can be found on: <https://dwc.tdwg.org/>

2.5.2.2 Access to Biological Collections Data (ABCD)

The Access to Biological Collections Data (ABCD) Schema is an evolving comprehensive standard for the access to and exchange of data about specimens and observations (a.k.a. primary biodiversity data). The ABCD Schema attempts to be comprehensive and highly structured, supporting data from a wide variety of

databases. It is compatible with several existing data standards. Parallel structures exist so that either (or both) atomised data and free text can be accommodated.

Sponsored by Biodiversity Information Standards TDWG - the Taxonomic Databases Working Group, the current specification was last modified in 2007.

Additional information can be found at: <https://abcd.tdwg.org/>

2.6 User Documentation

In terms of documentation, a User System Manual and training should be developed during the implementation phase of this project. This includes an online tutorial and demo version of the system

Special focus should be given to sensitive data held in the system. Information security and risk best practice should be included in the system training.

2.7 Assumptions, Dependencies and Constraints

Assumptions

- *The Deeds Office database will be used as a source for property data. This access will require an annual subscription license (cost).*

Constraints

- *Rhino stakeholders do not trust government entities and therefore are quite resistant to provide relevant data.*
- *Little control exists over the format, quality, and integrity of historical data.*
- *Due to budget constraints, open-source technology components or packaged software components provided by the vendor (included in the solution), need to be used where possible.*

Dependencies

- *Developing a good relationship with Rhino stakeholders.*
- *Data sharing and ownership agreements and the legal aspects around this must be addressed with all parties who share information, load information and parties who extract information from the system.*

2.8 System Design Goals

The system must be:

- *Simple while secure data access and consumption*
- *POPIA compliant*
- *Human-error proof*
- *Flexible to add additional fauna and flora species to the system in the future*
- *Cater for species that are monitored with density metrics.*
- *Align to best practice and industry standards*
- *Use open-source components and solution building blocks where possible due to cost constraints*
- *Provide for decentralised and federated data ownership to accommodate the existing broad ecosystem of data providers and consumers*

- *Configurable (i.e., the system must preferably use a forms engine, that will allow for the extension and input of further configurable data fields where needed) – it must not require customised coding to be able to roll it out across further species*
- *The system should make use of a strong and configurable integration layer*
- *The system should have a strong configurable BI capability*
- *Off-the-shelf configurable products are preferred to custom building. Configuration is preferred to coding. The exact trade-off between buy vs customer vs build will need to be made as part of implementation phase*

2.9 System Development Approach

An agile, incremental development approach will be followed to develop the system. This approach *will* ensure *that* the development process is broken down into small, manageable portions known as increments. An agile, iterative approach ensures that the software development activities are systematically repeated in cycles known as iterations. This approach ensures:

- *Prioritised requirements are developed first.*
- *Initial product delivery is faster.*
- *Important functionality gets delivered early.*
- *Delivery cost is lower.*
- *Each release is a product increment, so that the customer will have a working product at hand all the time.*
- *Users can provide feedback to each product increment, thus avoiding surprises at the end of development.*
- *Requirements changes can be more easily accommodated.*

Agile and incremental development is easier to test and debug than other methods of software development, because relatively smaller changes are made during each iteration.

This approach is particularly relevant and effective to quickly deliver a limited functionality system

3. Conceptual System Design – Solution Components

The diagram below (Figure 8: Conceptual Solution Design) illustrates the conceptual system design for the population-level monitoring of traded wildlife system.

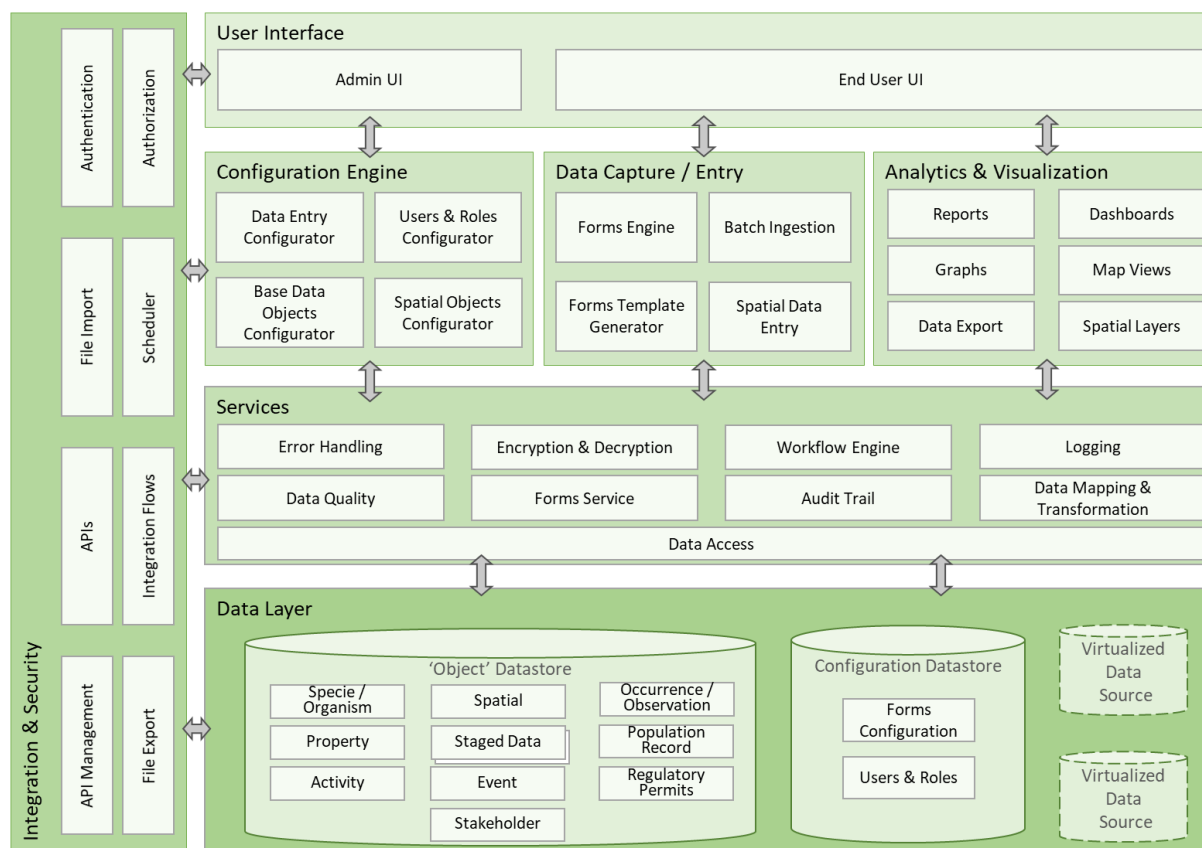


Figure 8: Conceptual Solution Design

Benefits of the above proposed layered architecture include modularity, simplicity, maintainability, flexibility, and scalability. It will allow the use of a combination of Off-The-Shelf tools/platforms and custom developed functional modules.

The approach to building a required solution is to use an integrated set of platforms/tools with most of the required functionality configured and some custom-built. The implementation vendor should provide the set of technologies/platforms that will:

- Enable further expansion of the solution with minimal coding and at a low cost (configure vs customise vs develop)
- Minimise support costs
- Ensure quick time to implement/configure new requirements

The following section describes the various elements of the solution design for the system as is evident in table 3 below.

Table 2: Solution Components Description

Layer	Functional Component	Description
User Interface		Layer responsible for rendering a user interface. This should be a responsive web-based interface. Separation from the layers below shall enable build of native mobile applications.
User Interface	Admin UI	User interface component used for configuring the system for data providers, aggregators, and consumers. This component will provide UI elements to perform tasks like management of user accounts, configuration of data model (species, properties, etc.). This component is separate from the ones in Configuration Engine layer to highlight separation of UI technology from underlying business logic/model.
	End User UI	User interface component used by end users, e.g., data providers, data aggregators and consumers
Configuration Engine	Data Entry Configurator	Component providing functionality related to configuration of various data sources and corresponding data entry methods (forms, file import, integration, etc.)
	Users & Roles Configurator	Functionality to manage users, roles, and permissions
	Base Data Objects Configurator	Configuration of Species and corresponding data entities/fields
	Spatial Objects Configurator	Configuration of spatial data
Data Capture / Entry	Forms Engine	Generation of forms based on the metadata and forms configuration
	Batch Ingestion	Ingestion of batch data (e.g., through integration or file import)
	Forms Template Generator	Generation of files-based templates for importing data
	Spatial Data Entry	Entry of spatial data
Analytics & Visualisation	Reports	Configurable reports builder and execution
	Graphs	Configurable graph visualisation configuration and execution
	Data Export	Configurable data export functionality
	Dashboards	Configurable dashboards
	Map Views	Map based views

	Spatial Layers	Spatial layers toggleable in the UI
Services	Error Handling	Consistent error handling
	Encryption & Decryption	Encryption and decryption services
	Workflow Engine	Configuration and execution of workflows
	Logging	Consistent logging mechanism
	Data Quality	Configurable data quality / data validation engine
	Forms Service	Services related to forms functionality. This should be metadata driven (from the configuration datastore)
	Audit Trail	Audit trail functionality
	Data Mapping & Transformation	Configurable data transformation and mapping
	Data Access	Unified data access layer. This layer will control access to the data stores managed withing this solution and together with relevant integration components enable data virtualisation design pattern
Data Layer	Object Datastore	Datastore for all non-configuration data
	Configuration Datastore	Datastore for configuration data
Integration & Security	API Management	API Management capabilities
	APIs	Defined APIs/Interfaces
	File Import	Configurable file import functionality
	File Export	Configurable file export functionality
	Integration Flows	Configurable integration flows
	Scheduler	Scheduling functionality
	Authentication	User authentication
	Authorisation	User authorisation

4. Detailed Functional Requirements – Use Cases

The following use cases are categorised by Pillar 1 of this project: **Data Access & Control** as indicated in section 2.3.

4.1 Use Case 1: Add new User Account

Name of Use Case	Add new user account	
Description and priority (H – high, L – Low)	In some instances, a system administrator would be required to register a new user/s onto the system	H
Actors and Interfaces	System Administrator Data providers	
Initial Status and Preconditions	The system should have the data model set up for new accounts to be created. The system needs to ask the provider relevant required fields, and follow an appropriate workflow to validate the information, and subsequently give the provider relevant access to the system. A default role with basic permissions is also assigned.	
Basic Flow		
Step 1: Log into the system Step 2: Select add new user Step 3: Select drop down list of standard roles and permissions Step 4: Add details of new user Step 5: Validation email sent and activate account		
Functional Requirements Reference(s)		
FREQ01	System shall support creating new user accounts	
FREQ02	System shall send out an email on user account creation to confirm account creation	
FREQ03	Validation of user email, account should not be activated before a user confirms validity of email address, thereafter, confirm login and password	
FREQ04	System should have a mechanism to validate cellphone number and email address	
FREQ05	System shall enforce strong passwords	
FREQ06	System shall support workflow for approvals of certain types of user accounts	
FREQ07	System shall support federation user accounts / authentication, e.g., google account for accessing the system for external users	
FREQ08	System shall have support for active directory integration (authentication) for internal users	
FREQ09	User needs to agree to T&C before first use of the system. This will be POPI consent for storing personal information in the system	
FREQ10	Ensure POPIA compliance for personal information of users (name, surname, email, cellphone + whatever else is required) * Ensure T&C reflect POPIA requirements * POPI processes to be define during implementation (e.g., process to remove user's data on request)	
FREQ11	Get the user's permission to store his/her personal data for appropriate use within the system, communicate conditions which they are agreeing to.	

FREQ12	User information to be stored securely in the system
FREQ13	Only admin users to have access to other user account details
FREQ14	If passwords are stored - they need to be stored in a secure manner, e.g., hashed password
FREQ15	Allow for user password reset mechanism - best practice. Via email / SMS code. Admins can reset a password
FREQ16	New users to be linked to Property as per business rules

4.2 Use Case 2: Configure roles and permissions

Name of Use Case	Configure roles and permissions	
Description and priority (H – high, L – Low)	In order to control which users have access to which functionality or data within the system, roles and permissions need to be configured.	H
Actors and Interfaces	System Administrator User with this specific assigned permission	
Initial Status and Preconditions	Pre-set and basic roles and permissions should be loaded on the system for the administrator to choose from. Additionally, the system should allow for the administrator to create more roles and permissions	
Basic Flow		
Step 1: Log into the system Step 2: Select manage roles and permissions Step 3: Select create new role and permissions Step 4: Define the specific role and permission		
Functional Requirements		
FREQ06	System shall support workflow for approvals of certain types of user accounts	
FREQ17	The system should support Role-Based Access Control (RBAC)	
FREQ18	Link property against data provider(s) per species data to be collected (Data providers cannot be unique per property as per use case)	
FREQ19	Identify system roles required by the system and the permissions associated with each role and the entry criteria that need to be met per role, ensure functionality to be able to configure this.	
FREQ20	Allow the system administrator only to create roles and link the associated permissions to that role	
FREQ21	When allocating roles, check that the above-mentioned entry criteria are met before allocating a role to a user account and allowing the associated permissions.	
FREQ22	Ensure all system functionality and data, across the whole system can be controlled on an access and permissions basis.	

4.3 Use Case 3: Assign roles & permissions to user accounts

Name of Use Case	Assign roles & permissions to user accounts	
Description and priority (H – high, L – Low)	In order to control which users have access to which functionality or data within the system, user accounts need to be assigned relevant roles (which have associated permissions).	H
Actors and Interfaces	System Administrator User with this specific assigned permission	
Initial Status and Preconditions	Roles and permissions should be added on the system and able to be assigned to user accounts. Basic roles or additional system administrator roles should be present in the system prior to selection	
Basic Flow		
Step 1: Log into the system Step 2: Select the specific user account Step 3: Select edit user account Step 4: Assign desired roles and permissions Step 5: Submit and execute request		
Functional Requirements		
FREQ06	System shall support workflow for approvals of certain types of user accounts	
FREQ17	The system should support Role-Based Access Control (RBAC)	
FREQ23	Allow users to request roles to be assigned to their user accounts once these have been created, also allow for changes in this regard. Allow authorisation of role allocation by other parties, through appropriate workflows if required.	
FREQ24	Allow system administrator link accounts created by user to specific roles, also allow for changes in this regard.	
FREQ25	Allow for changes to role definitions.	
FREQ26	Allow for sign-off of changes to roles and associated permissions through appropriate workflows.	

4.4 Use Case 4: Add Spatial Layers

Name of Use Case	Add Spatial layers	
Description and priority (H – high, L – Low)	The system is to contain geographical visualisations (maps) of data. To contextualise and make the data more useful, the system administrator needs to be able to add spatial layers data consumers can toggle on and off in map views.	H
Actors and Interfaces	System Administrator User with this specific assigned permission	
Initial Status and Preconditions	The spatial data should be included in the system already	

Basic Flow	
Step 1: Log into the system	
Step 2: Pull data required	
Step 3: Select map view	
Step 4: Toggle and un-toggle different spatial layers on the map view	
Functional Requirements	
FREQ27	Identify property parameters which will be monitored / or is being monitored for particular species
FREQ28	Assign spatial parameters per identified property, by allowing toggle on/ toggle off visual capabilities, in map views, using the selected GIS software application

4.5 Use Case 5: Add and configure system species

Name of Use Case	Add and configure system species	
Description and priority (H – high, L – Low)	The system is to contain population and trade data related to a specific fauna species. A unique identifier will link that species data to the property on which it occurs (see above).	H
Actors and Interfaces	System Administrator User with this specific assigned permission	
Initial Status and Preconditions	The system is to contain population and trade data related to a specific fauna species. A unique identifier will link that species data to the property on which it occurs. The general data fields should be on the system for the administrator to choose from.	
Basic Flow		
Step 1: Log into the system Step 2: Select add species Step 3: Add specie and location Step 4: Configure all data fields associated per specie		
Functional Requirements		
FREQ29	Allow for the configuration of hierarchical data about fauna and flora species, allow for the configuration of standard fields across all species and for specific fields per species. Allow for validation rules per field where necessary. These fields could relate to species properties, counts or specific events or entities etc.	
FREQ30	Allow for species data fields to be either optional or mandatory, enforce capture where mandatory.	
FREQ31	Configure specific events / entities and the lower-level data fields to be captured against that, with the applicable data and validation rules e.g., trades, hunting permits, deaths, seizures etc.	
FREQ32	Allow for the capturing of Fauna and Flora Species content and other data, as configured per species, against specific species data records	
FREQ33	Link loaded properties against specific species data.	

FREQ34	Load specific species event content against species categories and types, e.g., trades, seizures, deaths, culling etc.
FREQ35	Link and upload content data against specific species categories, types, entities, or events.
NFREQ01	Data model should be configurable through the UI with ability to define additional data entities and properties. The system data model should be configurable through the UI with the ability to define additional fields and properties and associated metadata. The configuration and population of the data model should be the first priority, in developing the system. The data model must be implemented through configurable forms and must ensure the integrity of the specified data model relationships, through validation rules. It should also allow for the further inclusion and configuration of additional fields, and validation rules, per data entity.
NFREQ02	The implemented data model should be aligned to available standards in the industry, e.g., Darwin Core, ABCD

4.6 Use Case 6: Data Security

Name of Use Case	Data Security	
Description and priority (H – high, L – Low)	Data in the system must kept secure.	H
Actors and Interfaces	Only system administrator	
Initial Status and Preconditions	Security of data in the system must be secure. System administrator should be able to confirm and edit security per role	
Basic Flow		
Step 1: Log into the system Step 2: View security fields Step 3: Edit security fields Step 4: Confirm changes to be made Step 5: Execute command		
Functional Requirements		
FREQ36	Ensure data security and privacy of data at all times especially e.g., with red list species, where this data could be compromised for poaching purposes.	
NFREQ06	System should ensure protection of data in transit and at rest for all sensitive information: * Files containing sensitive information to be encrypted or password protected * Database encryption to be considered * Full segregation of highly sensitive data (e.g., Rhino) should be considered, e.g., separate database with high security settings, encryption. * All connections to the system (UI, APIs, etc.) to be protected, no unprotected connections (e.g., http) to be allowed	
NFREQ07	Access to highly sensitive data (e.g., Rhinos) should only be allowed from on-premises or VPN - consider	
NFREQ08	Two factor authentication needs to be enforced for all privileged accounts	
NFREQ09	Sensitive data in file format should not be kept after being committed into the database	
NFREQ10	User education and training should be considered to minimise security risks (e.g., phishing)	
NFREQ11	The system should maintain audit trail of key system events and all operations with sensitive data (reads/write/modify/delete)	

NFREQ17	The integration layer shall support high security standards required for processing highly sensitive data
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The following use cases are categorised by Pillar 2: **Data collection, onboarding & transformation** as indicated in section 2.3.

4.7 Use Case 7: Create New Account

Name of Use Case	Create new account	
Description and priority (H – high, L – Low)	Data providers need to be able to register a new account in order to join the system and input their data.	H
Actors and Interfaces	System Administrator Data providers	
Initial Status and Preconditions	The system should have the data model set up for new accounts to be created. The system needs to ask the provider relevant required fields, and follow an appropriate workflow to validate the information, and subsequently give the provider relevant access to the system. A default role with basic permissions are also assigned.	
Basic Flow		
Step 1: Log into the system Step 2: Select create new account Step 3: Add details of new account Step 4: Validation email sent and activate account		
Functional Requirements		
FREQ01	System shall support creating new user accounts	
FREQ02	System shall send out an email on user account creation to confirm account creation	
FREQ03	Validation of user email, account should not be activated before a user confirms validity of email address, thereafter, confirm login and password	
FREQ04	System should have a mechanism to validate cellphone number and email address	
FREQ05	System shall enforce strong passwords	
FREQ07	System shall support federation user accounts / authentication, e.g., google account for accessing the system for external users	
FREQ08	System shall have support for active directory integration (authentication) for internal users	
FREQ09	User needs to agree to T&C before first use of the system. This will be POPI consent for storing personal information in the system	
FREQ11	Get the user's permission to store his/her personal data for appropriate use within the system, communicate conditions which they are agreeing to.	
FREQ12	User information to be stored securely in the system	
FREQ14	If passwords are stored - they need to be stored in a secure manner, e.g., hashed password	
FREQ37	Allow for the configuration of data input providers of type data owner, data aggregator or data custodian. Allow for onboarding of data input provider records linked to user accounts with the appropriate data permissions and access associated with data provider type.	

FREQ38	Allow for appropriate workflows to authorise the linking of user accounts to the role of data input provider.
FREQ39	Ensure the appropriate permissions are able to be assigned to the role of data input provider.
FREQ40	Ensure the data providers agree to the T's and C's associated with type of data provider.

4.8 Use Case 8: Add profile information (species and property)

Name of Use Case	Add profile information (species and property)	
Description and priority (H – high, L – Low)	Data providers need to be able to register a new account in order to join the system and input their data.	H
Actors and Interfaces	System Administrator Data providers	
Initial Status and Preconditions	• A drop down of species list should already be in the system. • To avoid duplications, a unique identifier is required to link species data to the property on which it occurs • Only one data provider can be linked to a unique property	
Basic Flow		
Step 1: Log into the system Step 2: Select property from a map of South Africa Step 3: System pulls relevant property identification (province, property area and unique ID) Step 4: Select the species present on that property		
Functional Requirements		
FREQ16	New users to be linked to Property as per business rules	
FREQ17	The system should support Role-Based Access Control (RBAC)	
FREQ41	Allow the linking of data providers to properties and specific species, to allow them to contribute to the species information and events.	
FREQ42	Allow data providers to contribute / add to property information, must be able to select many properties to contribute information to if their user profile is linked to those properties.	
FREQ43	The system shall allow selection of Property using an interactive map view	
FREQ44	The system shall allow definition of Property boundaries using a graphical map view	

4.9 Use Case 9: Add, or update Species population and/or activity data

Name of Use Case	Add, or update Species population and/or activity data	
Description and priority (H – high, L – Low)	Against the species and properties assigned to their profile, a data provider needs to be able to add population, and/or activity data.	H

	A data provider should be able to update this data (provide new / latest data) at any time.	
Actors and Interfaces	System Administrator Data providers	
Initial Status and Preconditions	A drop down of species list should already be in the system.	
Basic Flow		
Step 1: Log into the system Step 2: Select property Step 3: System pulls relevant property identification (province, property area and unique ID) Step 4: Select the species present on that property		
Functional Requirements		
FREQ17	The system should support Role-Based Access Control (RBAC)	
FREQ45	Allow data providers to contribute / add to species information linked to properties, must be able to select many species to contribute data to, if their user profiles are linked to those properties / species.	
FREQ46	Allow data providers to contribute / add to species information linked to properties, must be able to add event data for properties or species, if their user profiles are linked to those properties / species.	
FREQ47	Allow data providers to upload property and property event data for those properties to which their user profiles are linked.	
FREQ48	Allow data providers to upload species and species event data for those species to which their user profiles are linked.	
FREQ49	Allow data providers to download Excel templates, for property data or property event data in order to populate this data in the right format before requesting to upload this data into the system.	
FREQ50	Allow data providers to download Excel templates, for species data or species event data in order to populate this data in the right format before requesting to upload this data into the system.	
NFREQ05	The system shall support functionality to manually and automatically refine and clean ingested data before it is made available for reporting purposes	
NFREQ06	System should ensure protection of data in transit and at rest for all sensitive information: * Files containing sensitive information to be encrypted or password protected * Database encryption to be considered * Full segregation of highly sensitive data (e.g., Rhino) should be considered, e.g., separate database with high security settings, encryption. * All connections to the system (UI, APIs, etc.) to be protected, no unprotected connections (e.g., http) to be allowed	

4.10 Use Case 10: Upload Species population and/or activity data

Name of Use Case	Upload Species population and/or activity data	
Description and priority (H – high, L – Low)	A facility should be made for a data provider to upload a spreadsheet of their data rather than manually adding it.	H

Actors and Interfaces	System Administrator Data providers
Initial Status and Preconditions	Data template should be available for the data provider to complete offline
Basic Flow	
Step 1: Log into the system Step 2: Select property Step 3: System pulls relevant property identification (province, property area and unique ID) Step 4: Select the species present on that property Step 5: Download a template to update species population and/or activity data Step 6: Upload the updated spreadsheet back into the system	
Functional Requirements	
NFREQ06	System should ensure protection of data in transit and at rest for all sensitive information: * Files containing sensitive information to be encrypted or password protected * Database encryption to be considered * Full segregation of highly sensitive data (e.g., Rhino) should be considered, e.g., separate database with high security settings, encryption. * All connections to the system (UI, APIs, etc.) to be protected, no unprotected connections (e.g., http) to be allowed
NFREQ15	The integration layer shall be able to ingest external data via file imports (CSV, Excel, flat files), APIs, database access protocols

4.11 Use Case 11: View own species data

Name of Use Case	View own species data	
Description and priority (H – high, L – Low)	A data provider must be able to access and view data provided against their own property.	H
Actors and Interfaces	System Administrator Data providers	
Initial Status and Preconditions	New account has to be setup with all relevant detail of the property to view the species data. Species data linked to the property	
Basic Flow		
Step 1: Log into the system Step 2: Select property Step 3: Select view data Step 4: Choose specie/(s) and type of data to view		
Functional Requirements		
FREQ17	The system should support Role-Based Access Control (RBAC)	
FREQ53	Ensure data providers can view the property and species data linked to their user profiles	

4.12 Use Case 12: Edit Account Information

Name of Use Case	Edit Account Information	
Description and priority (H – high, L – Low)	Members of any role description should be able to change any/all personal information, including changing their password against the system email address.	H
Actors and Interfaces	System Administrator Data providers	
Initial Status and Preconditions	New account has to be setup with all relevant detail to be able to edit	
Basic Flow		
Step 1: Log into the system Step 2: Select account information Step 3: Select edit account Step 4: Change or edit account		
Functional Requirements		
FREQ04	System should have a mechanism to validate cellphone number and email address	
FREQ05	System shall enforce strong passwords	
FREQ12	User information to be stored securely in the system	
FREQ13	Only admin users to have access to other user account details	
FREQ14	If passwords are stored - they need to be stored in a secure manner, e.g., hashed password	
FREQ15	Allow for user password reset mechanism - best practice. Via email / SMS code. Admins can reset a password	
FREQ17	The system should support Role-Based Access Control (RBAC)	
FREQ54	Allow data providers to change any/all personal information, including their passwords against their system email address / user account.	
FREQ55	Allow data providers to make changes in data sharing agreements, but they must not be able to be change it retrospectively, changes must only reflect going forward, changes must alert the necessary people to consider legal implications.	

4.13 Use Case 13: Edit Profile Information

Name of Use Case	Edit Profile Information	
Description and priority (H – high, L – Low)	- Properties can be added at any point - Species can be added at any point - If a species' population is no longer on the property, the data provider can indicate the population quantity as '0' - If a data provider is no longer able to provide data on an assigned property, they should be able to indicate as such	H
Actors and Interfaces	System Administrator Data providers	

Initial Status and Preconditions	New account has to be setup with all relevant detail to be able to edit
Basic Flow	
Step 1: Log into the system Step 2: Select profile information Step 3: Select edit profile Step 4: Change or edit profile	
Functional Requirements	
FREQ17	The system should support Role-Based Access Control (RBAC)
FREQ56	Data providers must not be allowed to remove their profile from existing species or properties currently linked to it.
FREQ57	Data providers must be allowed to add their profile to further species or properties not currently linked to it.
FREQ58	If a species' population is no longer on the property, the data provider must be allowed to indicate the population quantity as '0'
FREQ59	Should a data provider not be recording or collected data on a property currently assigned to their profile, they should be able to indicate so.

4.14 Use Case 14: Configure Reminder Notifications

Name of Use Case	Configure Reminder Notifications	
Description and priority (H – high, L – Low)	STSU would like to remind data providers to provide updated species’ population and activity data periodically. Notifications should be sent to the system-stored email address.	H
Actors and Interfaces	System Administrator Data providers	
Initial Status and Preconditions	New account has to be setup with all relevant detail to be able to edit. Standard reminder notification has to be setup on the system	
Basic Flow		
Step 1: Log into the system Step 2: Select account information Step 3: Select edit account Step 4: Select specific specie Step 5: Select add reminder notification per specie Step 6: Select from dropdown list specific reminders for specie		
Functional Requirements		
FREQ60	Periodically create automated alerts, based on data collection frequency filed, indicated on data provider profile, to remind the data provider to provide updated species’ population and activity.	

FREQ61	System administrators must be able to configure triggered emails to remind system users to provide updated data at specified times.
FREQ62	Notifications should be sent to the data providers' email addresses stored as part of their system profile.

4.15 Use Case 15: Log in

Name of Use Case	Log in	
Description and priority (H – high, L – Low)	Data providers need to be able to log into their account once it has been created. Facility must be made for members to set a new password if forgotten.	H
Actors and Interfaces	System Administrator Data providers	
Initial Status and Preconditions	Architectural system structure has to be in place	
Basic Flow		
Step 1: Log into the system		
Step 2: Enter username and password		
Step 3: Send OPT or additional verification code		
Step 4: Enter verification code and log in		
Functional Requirements		
FREQ63	Data providers need to be able to log into their account once it has been created	
FREQ64	The system should provide a secure method for changing their password	

4.16 Use Case 16: Pull data from other systems or online databases

Name of Use Case	Pull data from other systems or online databases	
Description and priority (H – high, L – Low)	Provision should be made to integrate with and pull relevant information from those systems. This data must be assimilated into the system and linked to relevant species data already on the system.	H
Actors and Interfaces	System Administrator User with specific assigned role	
Initial Status and Preconditions	All databases (both online and offline) must be linked prior to the system.	
Basic Flow		
Step 1: Log into the system		
Step 2: Search for the specific database of which the data is to be pulled into the system		
Step 3: Select pull in data		
Step 4: Define timeframe of data required		

Step 5: Select execute request	
Functional Requirements	
FREQ65	Because there are a number of systems identified that contain useful species information, functionality should be provided to integrate with, and pull relevant information from these systems. This data must be assimilated into the system and linked to relevant species data already on the system.
NFREQ03	The system shall have functionality to extract data in different formats and load it into an Object datastore
NFREQ04	The system shall support configurable data transformation and mapping into SANBI data model that will become the single version of the truth, from where insights and analytics will be provisioned.
NFREQ05	The system shall support functionality to manually and automatically refine and clean ingested data before it is made available for reporting purposes
NFREQ06	System should ensure protection of data in transit and at rest for all sensitive information: * Files containing sensitive information to be encrypted or password protected * Database encryption to be considered * Full segregation of highly sensitive data (e.g., Rhino) should be considered, e.g., separate database with high security settings, encryption. * All connections to the system (UI, APIs, etc.) to be protected, no unprotected connections (e.g., http) to be allowed
NFREQ12	The system shall include a capable and configurable integration layer
NFREQ13	Integration layer shall support Data Virtualisation design pattern
NFREQ14	The integration layer shall support scheduled as well as real-time use cases
NFREQ15	The integration layer shall be able to ingest external data via file imports (CSV, Excel, flat files), APIs, database access protocols
NFREQ16	The integration layer shall support API Management functionality
NFREQ17	The integration layer shall support high security standards required for processing highly sensitive data

4.17 Use Case 17: Species habitat and biology information

Name of Use Case	Species habitat and biology information	
Description and priority (H – high, L – Low)	When making recommendations on translocation permits, provincial scientists indicated it would be useful to have a central source for species habitat and biological information.	M
Actors and Interfaces	System Administrator User with specific assigned role	
Initial Status and Preconditions	All databases (both online and offline) must be linked prior to the system. Thus, all species habitat and biological information has to be uploaded and present on the system.	
Basic Flow		

Step 1: Log into the system Step 2: Select profile information Step 3: Select all properties Step 4: Select all regions and all fields Step 5: Pull all habitat and biology information	
Functional Requirements	
FREQ66	When making recommendations on translocation permits, provincial scientists indicated it would be useful to have a central source for species habitat and biological information - this relates to the more generic requirements around a central species data model which provides a single version of the truth.

4.18 Use Case 18: Provincial habitat information

Name of Use Case	Provincial habitat information	
Description and priority (H – high, L – Low)	When making recommendations on translocation permits, provincial scientists indicated it would be useful to have a view of habitats across the province (to ensure it is a match for the species being translocated)	M
Actors and Interfaces	System Administrator User with specific assigned role	
Initial Status and Preconditions	All databases (both online and offline) must be linked prior to the system. Thus, all species habitat and biological information has to be uploaded and present on the system.	
Basic Flow		
Step 1: Log into the system Step 2: Select profile information Step 3: Select all properties Step 4: Select province in question with relevant fields required Step 5: Pull habitat information		
Functional Requirements		
FREQ67	When making recommendations on translocation permits, provincial scientists indicated it would be useful to have a view of habitats across the province (to ensure it is a match for the species being translocated) - this again refers to having a central species data model which provides a single version of the truth of species, with the necessary links to region, province, country and linked to species events, e.g., trade, permits, diseases etc.	

The following use cases are categorised by Pillar 3: **Data filtering, visualisations, and exports** as indicated in section 2.3.

4.19 Use Case 19: Filter by fauna species name

Name of Use Case	Filter by fauna species name	
Description and priority (H – high, L – Low)	A data consumer needs to be able to filter available information via species, and in relevant cases, sub-species.	H
Actors and Interfaces	System Administrator User with specific assigned role Data consumers	
Initial Status and Preconditions	All databases (both online and offline) must be linked prior to the system. A dropdown list must be available to filter available information via species, and in relevant cases, sub-species. Both common and scientific names should be listed	
Basic Flow		
Step 1: Log into the system Step 2: Select property/s Step 3: Select specie name Step 4: Specify relevant information required per specie		
Functional Requirements		
FREQ68	The system shall include a configurable BI layer	
FREQ69	The BI component shall support configurable reports, dashboards, tabular views, map views	
FREQ70	BI views shall support filtering by different types of fields (including text, numeric, date)	
FREQ76	The system shall support data visualisation functionality with drill-down, graphical representations etc.	

4.20 Use Case 20: Filter by time period (annual)

Name of Use Case	Filter by time period (annual)	
Description and priority (H – high, L – Low)	For members of the wildlife trade ecosystem, it is useful to be able to understand whether a species’ population is increasing, decreasing or stable. A data consumer needs to be able to filter available information by year, or year range.	H
Actors and Interfaces	System Administrator User with specific assigned role Data consumers	
Initial Status and Preconditions	All databases (both online and offline) must be linked prior to the system. A filter for selecting time periods (both historic and current) data should be built into the system	
Basic Flow		
Step 1: Log into the system		

Step 2: Select property/s	
Step 3: Specify time period in question	
Step 4: Select remainder of the data required and execute request	
Functional Requirements	
FREQ68	The system shall include a configurable BI layer
FREQ69	The BI component shall support configurable reports, dashboards, tabular views, map views
FREQ70	BI views shall support filtering by different types of fields (including text, numeric, date)
FREQ76	The system shall support data visualisation functionality with drill-down, graphical representations etc.

4.21 Use Case 21: View species population data, as totals, per area

Name of Use Case	View species population data, as totals, per area	
Description and priority (H – high, L – Low)	A data consumer needs to be able to view population sizes categorised by the following area types: - National - Per province - Per land ownership type (State – national, provincial, municipal -, private, communal, custodianship, contractual – state/private, private/communal, state/community-, other) - Per property (where property is defined in use case 8)	H
Actors and Interfaces	System Administrator User with specific assigned role Data consumers	
Initial Status and Preconditions	All databases (both online and offline) must be linked prior to the system. All data fields have to be linked so that totals can be viewed	
Basic Flow		
Step 1: Log into the system Step 2: Select specie type Step 3: Select total population data Step 4: Select area		
Functional Requirements		
FREQ68	The system shall include a configurable BI layer	
FREQ69	The BI component shall support configurable reports, dashboards, tabular views, map views	
FREQ76	The system shall support data visualisation functionality with drill-down, graphical representations etc.	

4.22 Use Case 22: View species population data, as density, per area (leopard)

Name of Use Case	View species population data, as density, per area (leopard)	
Description and priority (H – high, L – Low)	A data consumer needs to be able to view Leopard density by the following area types: - Per Quaternary catchment	H
Actors and Interfaces	System Administrator User with specific assigned role Data consumers	
Initial Status and Preconditions	All databases (both online and offline) must be linked prior to the system. All Leopard data fields has to be linked so that totals can be viewed. Leopards unit of area has to be predefined as #/sq/km	
Basic Flow		
Step 1: Log into the system Step 2: Select Leopard as specie name Step 3: Select total population data Step 4: Select area		
Functional Requirements		
FREQ68	The system shall include a configurable BI layer	
FREQ69	The BI component shall support configurable reports, dashboards, tabular views, map views	
FREQ76	The system shall support data visualisation functionality with drill-down, graphical representations etc.	

4.23 Use Case 23: View number of properties per population category

Name of Use Case	View number of properties per population category	
Description and priority (H – high, L – Low)	A data consumer needs to be able to view the number of properties (where property is defined in use case 8) that have populations in each of the following categories: - 1 - 6 - 11 - 20 - 21 - 50 - 51 - 100 - 101 - 200 - >200	H
Actors and Interfaces	System Administrator User with specific assigned role Data consumers	

Initial Status and Preconditions	All databases (both online and offline) must be linked prior to the system. Number of properties per population data field must be setup in the system
Basic Flow	
Step 1: Log into the system Step 2: Select specie type Step 3: Select total population data Step 4: Select all properties	
Functional Requirements	
FREQ68 The system shall include a configurable BI layer FREQ69 The BI component shall support configurable reports, dashboards, tabular views, map views FREQ76 The system shall support data visualisation functionality with drill-down, graphical representations etc.	

4.24 Use Case 24: View number of populations per population category

Name of Use Case	View number of populations per population category	
Description and priority (H – high, L – Low)	A data consumer needs to be able to view the total number of populations within each of the following population size categories: - 1 - 6 - 11 - 20 - 21 - 50 - 51 - 100 - 101 - 200 - >200	H
Actors and Interfaces	System Administrator User with specific assigned role Data consumers	
Initial Status and Preconditions	All databases (both online and offline) must be linked prior to the system. Number of animal populations in the data field must be setup in the system	
Basic Flow		
Step 1: Log into the system Step 2: Select specie type Step 3: Select total population data Step 4: Select all properties		
Functional Requirements		
FREQ68	The system shall include a configurable BI layer	
FREQ69	The BI component shall support configurable reports, dashboards, tabular views, map views	
FREQ76	The system shall support data visualisation functionality with drill-down, graphical representations etc.	

4.25 Use Case 25: View number of populations per population category, per area

Name of Use Case	View number of populations per population category, per area	
Description and priority (H – high, L – Low)	A data consumer needs to be able to view the total number of populations within the above population size categories, in the following areas: - National - Per province - Per land ownership type (State – national, provincial, municipal -, private, communal, custodianship, contractual – state/private, private/communal, state/community-, other)	H
Actors and Interfaces	System Administrator User with specific assigned role Data consumers	
Initial Status and Preconditions	All databases (both online and offline) must be linked prior to the system.	
Basic Flow		
Step 1: Log into the system Step 2: Select specie type Step 3: Select total population data Step 4: Select all properties Step 5: Select all areas		
Functional Requirements		
FREQ68	The system shall include a configurable BI layer	
FREQ69	The BI component shall support configurable reports, dashboards, tabular views, map views	
FREQ76	The system shall support data visualisation functionality with drill-down, graphical representations etc.	

4.26 Use Case 26: View species population density per property

Name of Use Case	View species population density per property	
Description and priority (H – high, L – Low)	A data consumer needs to be able to view the density of a population on selected property, where density is calculated as the total amount of animals per hectare of land.	H
Actors and Interfaces	System Administrator User with specific assigned role Data consumers	

Initial Status and Preconditions	All databases (both online and offline) must be linked prior to the system. Data model to allow for density per individual property and combined
Basic Flow	
Step 1: Log into the system Step 2: Select specie type Step 3: Select population density Step 4: Select specific property	
Functional Requirements	
FREQ68	The system shall include a configurable BI layer
FREQ69	The BI component shall support configurable reports, dashboards, tabular views, map views
FREQ76	The system shall support data visualisation functionality with drill-down, graphical representations etc.

4.27 Use Case 27: View species population data, as trends

Name of Use Case	View species population data, as trends	
Description and priority (H – high, L – Low)	A data consumer needs to be able to view analyses captured in use cases 21 - 26 mapped over selected time period. Percentages and appropriate colours should be used to indicate the status of a species' population (increasing, stable or declining).	H
Actors and Interfaces	System Administrator User with specific assigned role Data consumers	
Initial Status and Preconditions	All databases (both online and offline) must be linked prior to the system. Data model to allow for population data to be viewed with all time periods selected	
Basic Flow		
Step 1: Log into the system Step 2: Select specie type Step 3: Select total population data Step 4: Select properties Step 5: Select all areas Step 6: Select start and end date Step 7: Visualise select data as a trend		
Functional Requirements		
FREQ68	The system shall include a configurable BI layer	
FREQ69	The BI component shall support configurable reports, dashboards, tabular views, map views	
FREQ76	The system shall support data visualisation functionality with drill-down, graphical representations etc.	

4.28 Use Case 28: View species population data, as a map

Name of Use Case	View species population data, as a map	
Description and priority (H – high, L – Low)	A data consumer needs to be able to view analyses captured in use cases 15, 16, 19 and 20 mapped geographically, with the ability zoom from a national to property level. A data consumer should be able to toggle on and off available spatial layers.	H
Actors and Interfaces	System Administrator User with specific assigned role Data consumers	
Initial Status and Preconditions	All databases (both online and offline) must be linked prior to the system. Data model to allow for population data to be viewed as a map with spatial data	
Basic Flow		
Step 1: Log into the system Step 2: Select specie type Step 3: Select total population data Step 4: Select properties Step 5: Select all areas Step 6: Select view spatially with map		
Functional Requirements		
FREQ68	The system shall include a configurable BI layer	
FREQ69	The BI component shall support configurable reports, dashboards, tabular views, map views	
FREQ76	The system shall support data visualisation functionality with drill-down, graphical representations etc.	

4.29 Use Case 29: View all species population data, as a table

Name of Use Case	View all species population data, as a table	
Description and priority (H – high, L – Low)	A data consumer needs to be able to view all the available species-related population data in the system as a table.	H
Actors and Interfaces	System Administrator User with specific assigned role Data consumers	
Initial Status and Preconditions	All databases (both online and offline) must be linked prior to the system. Data model to allow for population data to be viewed in table form	
Basic Flow		
Step 1: Log into the system Step 2: Select specie type		

Step 3: Select total population data	
Step 4: Select properties	
Step 5: Select all areas	
Step 6: Select view in tabular form	
Functional Requirements	
FREQ68	The system shall include a configurable BI layer
FREQ69	The BI component shall support configurable reports, dashboards, tabular views, map views
FREQ76	The system shall support data visualisation functionality with drill-down, graphical representations etc.

4.30 Use Case 30: View species activity data, as totals, by method

Name of Use Case	View species activity data, as totals, by method	
Description and priority (H – high, L – Low)	A data consumer needs to be able to view activity quantities, categorised by method. The above information should be available as an appropriate visualisation, or in tabular format.	H
Actors and Interfaces	System Administrator User with specific assigned role Data consumers	
Initial Status and Preconditions	All databases (both online and offline) must be linked prior to the system. Data model to allow for cross selection of activity data per method	
Basic Flow		
Step 1: Log into the system		
Step 2: Select specie type		
Step 3: Select activity data		
Step 4: Select activity method		
Step 5: Select all properties		
Functional Requirements		
FREQ68	The system shall include a configurable BI layer	
FREQ69	The BI component shall support configurable reports, dashboards, tabular views, map views	
FREQ71	The system shall be able to create trend views on data	
FREQ76	The system shall support data visualisation functionality with drill-down, graphical representations etc.	

4.31 Use Case 31: View species activity data, as totals, by method, by area

Name of Use Case	View species activity data, as totals, by method, by area	
Description and priority (H – high, L – Low)	A data consumer needs to be able to view activity quantities, categorised by method. The above information should be available as an appropriate visualisation, or in tabular format. Additionally, to user case 30, area must be included.	H
Actors and Interfaces	System Administrator User with specific assigned role Data consumers	
Initial Status and Preconditions	All databases (both online and offline) must be linked prior to the system. Data model to allow for cross selection of activity data per method and viewed spatially	
Basic Flow		
Step 1: Log into the system Step 2: Select specie type Step 3: Select activity data Step 4: Select activity method Step 5: Select properties Step 6: Select all areas		
Functional Requirements		
FREQ68	The system shall include a configurable BI layer	
FREQ69	The BI component shall support configurable reports, dashboards, tabular views, map views	
FREQ71	The system shall be able to create trend views on data	
FREQ76	The system shall support data visualisation functionality with drill-down, graphical representations etc.	

4.32 Use Case 32: View activity data, as % of total population

Name of Use Case	View activity data, as % of total population	
Description and priority (H – high, L – Low)	For members of the wildlife trade ecosystem, having a view of the impact of certain activities on populations is useful. A data consumer needs to be able to view the total species activities quantities as a % of the total population of that species, per the following areas: - National	H

	- Per province - Per land ownership type (State – national, provincial, municipal -, private, communal, custodianship, contractual – state/private, private/communal, state/community-, other) - Per property (where property is defined in use case 8)	
Actors and Interfaces	System Administrator User with specific assigned role Data consumers	
Initial Status and Preconditions	All databases (both online and offline) must be linked prior to the system. Data model to allow for cross selection of activity data and percentage of total population	
Basic Flow		
Step 1: Log into the system Step 2: Select specie type Step 3: Select all activity data Step 4: Select total population data Step 5: Select properties Step 6: Select all areas		
Functional Requirements		
FREQ68	The system shall include a configurable BI layer	
FREQ69	The BI component shall support configurable reports, dashboards, tabular views, map views	
FREQ71	The system shall be able to create trend views on data	
FREQ76	The system shall support data visualisation functionality with drill-down, graphical representations etc.	

4.33 Use Case 33: View species activity data, as trends

Name of Use Case	View species activity data, as trends	
Description and priority (H – high, L – Low)	A data consumer needs to be able to view analyses captured in use cases 30 - 32 mapped over selected time period. Percentages and appropriate colours should be used to indicate the status of a species' activity (increasing, constant or declining). The above information should be available as an appropriate visualisation, or in tabular format.	H
Actors and Interfaces	System Administrator User with specific assigned role Data consumers	
Initial Status and Preconditions	All databases (both online and offline) must be linked prior to the system. Data model to allow for cross selection of activity data per time period	

Basic Flow	
Step 1: Log into the system Step 2: Select specie type Step 3: Select activity data Step 4: Select activity method Step 5: Select start and end dates	
Functional Requirements	
FREQ68	The system shall include a configurable BI layer
FREQ69	The BI component shall support configurable reports, dashboards, tabular views, map views
FREQ71	The system shall be able to create trend views on data
FREQ76	The system shall support data visualisation functionality with drill-down, graphical representations etc.

4.34 Use Case 34: View all species activity data, as a table

Name of Use Case	View all species activity data, as a table	
Description and priority (H – high, L – Low)	A data consumer needs to be able to view all the available species-related activity data in the system as a table	H
Actors and Interfaces	System Administrator User with specific assigned role Data consumers	
Initial Status and Preconditions	All databases (both online and offline) must be linked prior to the system. Data model to allow for activity data to be viewed in table form	
Basic Flow		
Step 1: Log into the system Step 2: Select specie type Step 3: Select activity type Step 4: Select properties Step 5: Select all areas Step 6: Select view in tabular form		
Functional Requirements		
FREQ68	The system shall include a configurable BI layer	
FREQ69	The BI component shall support configurable reports, dashboards, tabular views, map views	
FREQ76	The system shall support data visualisation functionality with drill-down, graphical representations etc.	

4.35 Use Case 35: View species population data, as a map

Name of Use Case	View species population data, as a map	
Description and priority (H – high, L – Low)	A data consumer needs to be able to view analyses captured in use cases 31 and 32	H

	mapped geographically, with the ability zoom from a national to property level. A data consumer should be able to toggle on and off available spatial layers.	
Actors and Interfaces	System Administrator User with specific assigned role Data consumers	
Initial Status and Preconditions	All databases (both online and offline) must be linked prior to the system. Data model to allow for population data to be viewed as a map with spatial data	
Basic Flow		
Step 1: Log into the system Step 2: Select specie type Step 3: Select total population data Step 4: Select properties Step 5: Select all areas Step 6: Select view spatially with map		
Functional Requirements		
FREQ68 The system shall include a configurable BI layer FREQ69 The BI component shall support configurable reports, dashboards, tabular views, map views FREQ76 The system shall support data visualisation functionality with drill-down, graphical representations etc.		

4.36 Use Case 36: Extract data as CSV

Name of Use Case	Extract data as CSV	
Description and priority (H – high, L – Low)	A data provider needs to be able to select required species and species' data points, and have it exported as a .CSV file.	H
Actors and Interfaces	System Administrator User with specific assigned role Data consumers	
Initial Status and Preconditions	All databases (both online and offline) must be linked prior to the system. Data model to allow for cross selection of all options of data in system.	
Basic Flow		
Step 1: Log into the system Step 2: Select specie type Step 3: Select population or activity data Step 4: Select properties Step 5: Select all areas Step 6: Select extract as CSV		
Functional Requirements		
FREQ68 The system shall include a configurable BI layer		

FREQ74	The system shall support exporting of data as CSV or Excel files
FREQ75	The sensitive data shall only be exported as a password protected or (better) encrypted Excel file
NFREQ06	System should ensure protection of data in transit and at rest for all sensitive information: * Files containing sensitive information to be encrypted or password protected * Database encryption to be considered * Full segregation of highly sensitive data (e.g., Rhino) should be considered, e.g., separate database with high security settings, encryption. * All connections to the system (UI, APIs, etc.) to be protected, no unprotected connections (e.g., http) to be allowed

4.37 Use Case 37: Extract data as report

Name of Use Case	Extract data as report	
Description and priority (H – high, L – Low)	A data provider needs to be able to select required species and species' data points, and have it exported as a non-editable PDF.	H
Actors and Interfaces	System Administrator User with specific assigned role Data consumers	
Initial Status and Preconditions	All databases (both online and offline) must be linked prior to the system. Data model to allow for cross selection of all options of data in system.	
Basic Flow		
Step 1: Log into the system Step 2: Select specie type Step 3: Select population or activity data Step 4: Select properties Step 5: Select all areas Step 6: Select extract as report		
Functional Requirements		
FREQ68	The system shall include a configurable BI layer	
FREQ72	The system shall support exporting of reports as PDF files	
FREQ73	The system shall support password protecting generated PDF files	
NFREQ06	System should ensure protection of data in transit and at rest for all sensitive information: * Files containing sensitive information to be encrypted or password protected * Database encryption to be considered * Full segregation of highly sensitive data (e.g., Rhino) should be considered, e.g., separate database with high security settings, encryption. * All connections to the system (UI, APIs, etc.) to be protected, no unprotected connections (e.g., http) to be allowed	

4.38 Use Case 38: Save extracted data

Name of Use Case	Save extracted data	
Description and priority (H – high, L – Low)	It is useful for members of STSU to be able to save and have access to past data extracts as reference for future enquiries. A data provider needs to be able to save a particular CSV or report export, with the relevant species and species' data points applied. If any new data has been added, or edits made to the data in question since the export was first done, this should be noted as an addition to the original extract.	H
Actors and Interfaces	System Administrator User with specific assigned role Data consumers	
Initial Status and Preconditions	All databases (both online and offline) must be linked prior to the system. Data model to allow for cross selection of all options of data in system. Saving of data must have a timestamp for record purposes and comparing data at a later stage. Insert any filtering restrictions based on role	
Basic Flow		
Step 1: Log into the system Step 2: Select specie type Step 3: Select population or activity data Step 4: Select properties Step 5: Select all areas Step 6: Select save extract online as CSV/Excel/Report		
Functional Requirements		
FREQ68	The system shall include a configurable BI layer	
FREQ74	The system shall support exporting of data as CSV or Excel files	
FREQ75	The sensitive data shall only be exported as a password protected or (better) encrypted Excel file	
NFREQ06	System should ensure protection of data in transit and at rest for all sensitive information: * Files containing sensitive information to be encrypted or password protected * Database encryption to be considered * Full segregation of highly sensitive data (e.g., Rhino) should be considered, e.g., separate database with high security settings, encryption. * All connections to the system (UI, APIs, etc.) to be protected, no unprotected connections (e.g., http) to be allowed	

5. System Requirements

The table below indicates all system requirements from a core functional, security, data management, business intelligence, integration, and general system requirements perspective.

Table 3: System Requirements

Req #	Description
5.1 Core functional requirements	
FREQ01	The system shall support the creation of new user accounts
FREQ02	The system shall send out an email on user account creation to confirm account creation
FREQ03	Validation of user email, account should not be activated before a user confirms validity of email address, thereafter, confirm login and password
FREQ04	The system should have a mechanism to validate cellphone number and email address
FREQ05	The system shall enforce strong passwords
FREQ06	The system shall support workflow for approvals of certain types of user accounts
FREQ07	The system shall support federation user accounts / authentication, e.g., google account for accessing the system for external users
FREQ08	The system shall have support for active directory integration (authentication) for internal users
FREQ09	A user needs to agree to T&C's before first use of the system. This will be POPIA consent for storing personal information in the system
FREQ10	Ensure POPIA compliance for personal information of users (name, surname, email, cellphone + whatever else is required) * Ensure T&C's reflect POPIA requirements * POPIA processes to be define during implementation (e.g., process to remove user's data on request)
FREQ11	Get the user's permission to store his/her personal data for appropriate use within the system, communicate conditions which they are agreeing to.
FREQ12	User information to be stored securely in the system
FREQ13	Only admin users to have access to other user account details
FREQ14	If passwords are stored - they need to be stored in a secure manner, e.g., hashed password
FREQ15	Allow for user password reset mechanism - best practice. Via email / SMS code. Admins can reset a password
FREQ16	New users to be linked to Property as per business rules
FREQ17	The system should support Role-Based Access Control (RBAC)
FREQ18	Link property against data provider(s) per species data to be collected
FREQ19	Identify system roles required by the system and the permissions associated with each role and the entry criteria that need to be met per role, ensure functionality to be able to configure this.
FREQ20	Allow the system administrator to only create roles and link the associated permissions to that role
FREQ21	When allocating roles, check that the above-mentioned entry criteria are met before allocating a role to a user account and allowing the associated permissions.

FREQ22	Ensure all system functionality and data, across the whole system can be controlled on an access and permissions basis.
FREQ23	Allow users to request roles to be assigned to their user accounts once these have been created, also allow for changes in this regard. Allow authorisation of role allocation by other parties, through appropriate workflows if required.
FREQ24	Allow system administrator to link accounts created by users to specific roles, also allow for changes in this regard.
FREQ25	Allow for changes to role definitions.
FREQ26	Allow for sign-off of changes to roles and associated permissions through appropriate workflows.
FREQ27	Identify property parameters which will be monitored / or is being monitored for particular species
FREQ28	Assign spatial parameters per identified property, by allowing toggle on/ toggle off visual capabilities, in map views, using the selected GIS software application
FREQ29	Allow for the configuration of hierarchical data about fauna and flora species, allow for the configuration of standard fields across all species and for specific fields per species. Allow for validation rules per field where necessary. These fields could relate to species properties, counts or specific events or entities etc.
FREQ30	Allow for species data fields to be either optional or mandatory, enforce capture where mandatory.
FREQ31	Configure specific events / entities and the lower-level data fields to be captured against that, with the applicable data and validation rules e.g., trades, hunting permits, deaths, seizures etc.
FREQ32	Allow for the capturing of Fauna and Flora Species content and other data, as configured per species, against specific species data records
FREQ33	Link loaded properties against specific species data.
FREQ34	Load specific species event content against species categories and types, e.g., trades, seizures, deaths, culling etc.
FREQ35	Link and upload content data against specific species categories, types, entities, or events.
FREQ36	Always ensure data security and privacy of data especially e.g., with red list species, where this data could be compromised for poaching purposes.
FREQ37	Allow for the configuration of data input providers of type data owner, data aggregator or data custodian. Allow for onboarding of data input provider records linked to user accounts with the appropriate data permissions and access associated with data provider type.
FREQ38	Allow for appropriate workflows to authorise the linking of user accounts to the role of data input provider.
FREQ39	Ensure the appropriate permissions can be assigned to the role of data input provider.
FREQ40	Ensure the data providers agree to the T's and C's associated with type of data provider.
FREQ41	Allow the linking of data providers to properties and specific species, to allow them to contribute to the species information and events.
FREQ42	Allow data providers to contribute / add to property information, must be able to select many properties to contribute information to if their user profile is linked to those properties.
FREQ43	The system shall allow selection of Property using an interactive map view
FREQ44	The system shall allow definition of Property boundaries using a graphical map view
FREQ45	Allow data providers to contribute / add to species information linked to properties, must be able to select many species to contribute data to, if their user profiles are linked to those properties / species.

FREQ46	Allow data providers to contribute / add to species information linked to properties, must be able to add event data for properties or species, if their user profiles are linked to those properties / species.
FREQ47	Allow data providers to upload property and property event data for those properties to which their user profiles are linked.
FREQ48	Allow data providers to upload species and species event data for those species to which their user profiles are linked.
FREQ49	Allow data providers to download Excel templates, for property data or property event data in order to populate this data in the right format before requesting to upload this data into the system.
FREQ50	Allow data providers to download Excel templates, for species data or species event data in order to populate this data in the right format before requesting to upload this data into the system.
FREQ51	Provide a data upload facility for the data templates mentioned above, each record must be date stamped. This upload must allow for historical data to be imported into the system.
FREQ52	The system should ensure the applicable T's and C's for data providers are agreed to before uploading their Excel spreadsheets into the system would be possible.
FREQ53	Ensure data providers can view the property and species data linked to their user profiles
FREQ54	Allow data providers to change any/all personal information, including their passwords against their system email address / user account.
FREQ55	Allow data providers to make changes in data sharing agreements, but they must not be able to be change it retrospectively, changes must only reflect going forward, changes must alert the necessary people to consider legal implications.
FREQ56	Data providers must not be allowed to remove their profile from existing species or properties currently linked to it.
FREQ57	Data providers must be allowed to add their profile to further species or properties not currently linked to it.
FREQ58	If a species' population is no longer on the property, the data provider must be allowed to indicate the population quantity as '0'
FREQ59	Should a data provider not be recording or collected data on a property currently assigned to their profile, they should be able to indicate so.
FREQ60	Periodically create automated alerts, based on data collection frequency filed, indicated on data provider profile, to remind the data provider to provide updated species' population and activity.
FREQ61	System administrators must be able to configure triggered emails to remind system users to provide updated data at specified times.
FREQ62	Notifications should be sent to the data providers' email addresses stored as part of their system profile.
FREQ63	Data providers need to be able to log into their account once it has been created
FREQ64	The system should provide a secure method for changing their password
FREQ65	Because there are several systems identified that contain useful species information, functionality should be provided to integrate with, and pull relevant information from these systems. This data must be assimilated into the system and linked to relevant species data already on the system.
FREQ66	When making recommendations on translocation permits, provincial scientists indicated it would be useful to have a central source for species habitat and biological information - this relates to the more generic requirements around a central species data model which provides a single version of the truth.

FREQ67	When making recommendations on translocation permits, provincial scientists indicated it would be useful to have a view of habitats across the province (to ensure it is a match for the species being translocated) - this again refers to having a central species data model which provides a single version of the truth of species, with the necessary links to region, province, country and linked to species events, e.g., trade, permits, diseases etc.
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5.2 Business Intelligence Requirements

FREQ68	The system shall include a configurable BI layer
FREQ69	The BI component shall support configurable reports, dashboards, tabular views, map views
FREQ70	BI views shall support filtering by different types of fields (including text, numeric, date)
FREQ71	The system shall be able to create trend views on data
FREQ72	The system shall support exporting of reports as PDF files
FREQ73	The system shall support password protecting generated PDF files
FREQ74	The system shall support exporting of data as CSV or Excel files
FREQ75	The sensitive data shall only be exported as a password protected or (better) encrypted Excel file
FREQ76	The system shall support data visualisation functionality with drill-down, graphical representations etc.

5.3 Data Management Requirements

NFREQ01	Data model should be configurable through the UI with ability to define additional data entities and properties. The system data model should be configurable through the UI with the ability to define additional fields and properties and associated metadata. The configuration and population of the data model should be the first priority, in developing the system. The data model must be implemented through configurable forms and must ensure the integrity of the specified data model relationships, through validation rules. It should also allow for the further inclusion and configuration of additional fields, and validation rules, per data entity.
NFREQ02	The implemented data model should be aligned to available standards in the industry, e.g., Darwin Core, ABCD
NFREQ03	The system shall have functionality to extract data in different formats and load it into an Object datastore
NFREQ04	The system shall support configurable data transformation and mapping into SANBI data model that will become the single version of the truth, from where insights and analytics will be provisioned.
NFREQ05	The system shall support functionality to manually and automatically refine and clean ingested data before it is made available for reporting purposes

5.4 Security Requirements

NFREQ06	System should ensure protection of data in transit and at rest for all sensitive information: * Files containing sensitive information to be encrypted or password protected
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	* Database encryption to be considered * Full segregation of highly sensitive data (e.g., Rhino) should be considered, e.g., separate database with high security settings, encryption. * All connections to the system (UI, APIs, etc.) to be protected, no unprotected connections (e.g., http) to be allowed
NFREQ07	Access to highly sensitive data (e.g., Rhinos) should only be allowed from on-premises or VPN - consider
NFREQ08	Two factor authentication needs to be enforced for all privileged accounts
NFREQ09	Sensitive data in file format should not be kept after being committed into the database
NFREQ10	User education and training should be considered to minimise security risks (e.g., phishing)
NFREQ11	The system should maintain audit trail of key system events and all operations with sensitive data (reads/write/modify/delete)

5.5 Integration Layer Requirements

NFREQ12	The system shall include a capable and configurable integration layer
NFREQ13	Integration layer shall support Data Virtualisation design pattern
NFREQ14	The integration layer shall support scheduled as well as real-time use cases
NFREQ15	The integration layer shall be able to ingest external data via file imports (CSV, Excel, flat files), APIs, database access protocols
NFREQ16	The integration layer shall support API Management functionality
NFREQ17	The integration layer shall support high security standards required for processing highly sensitive data

5.6 General / Other Requirements

NFREQ18	Configure vs Custom Code – leverage low or no code platforms. Configuration rather than Custom Coding - The system should be developed utilising a low or no-code platform which allows for configurable forms to on-board the data associated with the data entities contained in the data model. This aspect will allow for ease of change, easy extension, and maintenance of the forms, to on-board the data required by the system.
NFREQ19	Platform based approach
NFREQ20	It should be possible to configure multiple isolated and self-sufficient environments of the system, e.g., for Development, QA, Production

5.7 Technology Requirements

NFREQ21	Preference should be given to the following Database technologies: Postgres, Microsoft SQL
NFREQ22	Preference should be given to the following server software: Microsoft IIS, Apache, Java
NFREQ23	Preference should be given to the following programming frameworks: Microsoft .NET, Python, ASP.NET, C#

5.9 Traceability of requirements to solution components

The table below illustrates the traceability of functional and non-functional requirements in relation to all solution components.

Table 5: Requirements to Solution Components Traceability

Requirement #	User Interface		Configuration Engine				Data Capture / Entry				Analytics & Visualisation				Services								Data Layer	Integration & Security											
	Admin UI	End User UI	Data Entry Configurator	Users & Roles Configurator	Base Data Objects Configurator	Spatial Objects Configurator	Forms Engine	Batch Ingestion	Forms Template Generator	Spatial Data Entry	Reports	Graphs	Data Export	Dashboards	Map Views	Spatial Layers	Error Handling	Encryption & Decryption	Workflow Engine	Logging	Data Quality	Forms Service	Audit Trail	Data Mapping & Transformation	Data Access	Object Datastore	Configuration Datastore	API Management	APIs	File Import	File Export	Integration Flows	Scheduler	Authentication	Authorisation
Core Functional Requirements																																			
FREQ01	X						X																												
FREQ02	X						X																												
FREQ03	X						X																												
FREQ04	X						X					X																							
FREQ05	X						X					X																							
FREQ06	X	X	X																																
FREQ07	X						X																												
FREQ08	X						X																												
FREQ09	X						X																												
FREQ10	X																																		
FREQ11	X						X																												

Requirement #	User Interface		Configuration Engine				Data Capture / Entry				Analytics & Visualisation				Services						Data Layer	Integration & Security													
	Admin UI	End User UI	Data Entry Configurator	Users & Roles Configurator	Base Data Objects Configurator	Spatial Objects Configurator	Forms Engine	Batch Ingestion	Forms Template Generator	Spatial Data Entry	Reports	Graphs	Data Export	Dashboards	Map Views	Spatial Layers	Error Handling	Encryption & Decryption	Workflow Engine	Logging	Data Quality	Forms Service	Audit Trail	Data Mapping & Transformation	Data Access	Object Datastore	Configuration Datastore	API Management	APIs	File Import	File Export	Integration Flows	Scheduler	Authentication	Authorisation
FREQ12	X						X					X																							
FREQ13	X											X																							
FREQ14	X						X					X																							
FREQ15	X											X																							
FREQ16	X							X																											
FREQ17		X	X		X		X	X	X	X	X	X	X																						
FREQ18		X																																	
FREQ19		X																																	
FREQ20		X																																	
FREQ21		X																																	
FREQ22		X																																	
FREQ23			X																																
FREQ24			X																																
FREQ25			X																																
FREQ26			X																																
FREQ27				X																															
FREQ28				X																															
FREQ29					X																														
FREQ30					X																														

Requirement #	User Interface		Configuration Engine				Data Capture / Entry				Analytics & Visualisation				Services							Data Layer		Integration & Security											
	Admin UI	End User UI	Data Entry Configurator	Users & Roles Configurator	Base Data Objects Configurator	Spatial Objects Configurator	Forms Engine	Batch Ingestion	Forms Template Generator	Spatial Data Entry	Reports	Graphs	Data Export	Dashboards	Map Views	Spatial Layers	Error Handling	Encryption & Decryption	Workflow Engine	Logging	Data Quality	Forms Service	Audit Trail	Data Mapping & Transformation	Data Access	Object Datastore	Configuration Datastore	API Management	APIs	File Import	File Export	Integration Flows	Scheduler	Authentication	Authorisation
FREQ31					X																														
FREQ32					X																														
FREQ33					X																														
FREQ34					X																														
FREQ35					X																														
FREQ36						X																													
FREQ37							X																												
FREQ38							X																												
FREQ39							X																												
FREQ40							X																												
FREQ41								X																											
FREQ42								X																											
FREQ43								X																											
FREQ44								X																											
FREQ45									X																										
FREQ46									X																										
FREQ47									X																										
FREQ48									X																										
FREQ49									X																										

Requirement #	User Interface		Configuration Engine				Data Capture / Entry			Analytics & Visualisation				Services						Data Layer	Integration & Security														
	Admin UI	End User UI	Data Entry Configurator	Users & Roles Configurator	Base Data Objects Configurator	Spatial Objects Configurator	Forms Engine	Batch Ingestion	Forms Template Generator	Spatial Data Entry	Reports	Graphs	Data Export	Dashboards	Map Views	Spatial Layers	Error Handling	Encryption & Decryption	Workflow Engine	Logging	Data Quality	Forms Service	Audit Trail	Data Mapping & Transformation	Data Access	Object Datastore	Configuration Datastore	API Management	APIs	File Import	File Export	Integration Flows	Scheduler	Authentication	Authorisation
FREQ50								X																											
FREQ51									X																										
FREQ52									X																										
FREQ53										X																									
FREQ54											X																								
FREQ55											X																								
FREQ56												X																							
FREQ57												X																							
FREQ58												X																							
FREQ59												X																							
FREQ60													X																						
FREQ61													X																						
FREQ62													X																						
FREQ63														X																					
FREQ64														X																					
FREQ65															X																				
FREQ66																X																			
FREQ67																	X																		

Requirement #	User Interface		Configuration Engine				Data Capture / Entry		Analytics & Visualisation				Services						Data Layer	Integration & Security																
	Admin UI	End User UI	Data Entry Configurator	Users & Roles Configurator	Base Data Objects Configurator	Spatial Objects Configurator	Forms Engine	Batch Ingestion	Forms Template Generator	Spatial Data Entry	Reports	Graphs	Data Export	Dashboards	Map Views	Spatial Layers	Error Handling	Encryption & Decryption	Workflow Engine	Logging	Data Quality	Forms Service	Audit Trail	Data Mapping & Transformation	Data Access	Object Datastore	Configuration Datastore	API Management	APIs	File Import	File Export	Integration Flows	Scheduler	Authentication	Authorisation	
Business Intelligence Requirements																																				
FREQ68																			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
FREQ69																			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
FREQ70																			X	X																
FREQ71																																	X			
FREQ72																																				
FREQ73																																				
FREQ74																																				
FREQ75																																				
FREQ76																			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Data Management Requirements																																				
NFREQ01					X																															
NFREQ02					X																															
NFREQ03																X																				
NFREQ04																X																				

Requirement #	User Interface		Configuration Engine				Data Capture / Entry		Analytics & Visualisation				Services						Data Layer	Integration & Security															
	Admin UI	End User UI	Data Entry Configurator	Users & Roles Configurator	Base Data Objects Configurator	Spatial Objects Configurator	Forms Engine	Batch Ingestion	Forms Template Generator	Spatial Data Entry	Reports	Graphs	Data Export	Dashboards	Map Views	Spatial Layers	Error Handling	Encryption & Decryption	Workflow Engine	Logging	Data Quality	Forms Service	Audit Trail	Data Mapping & Transformation	Data Access	Object Datastore	Configuration Datastore	API Management	APIs	File Import	File Export	Integration Flows	Scheduler	Authentication	Authorisation
NFREQ05								X	X							X																			
Security Requirements																																			
NFREQ06						X		X	X							X																			
NFREQ07						X																													
NFREQ08						X																													
NFREQ09						X																													
NFREQ10						X																													
NFREQ11						X																													
Integration Layer Requirements																																			
NFREQ12																X																			
NFREQ13																X																			
NFREQ14																X																			
NFREQ15									X							X																			
NFREQ16																X																			
NFREQ17					X											X																			

Requirement #	User Interface		Configuration Engine				Data Capture / Entry				Analytics & Visualisation				Services						Data Layer	Integration & Security														
	Admin UI	End User UI	Data Entry Configurator	Users & Roles Configurator	Base Data Objects Configurator	Spatial Objects Configurator	Forms Engine	Batch Ingestion	Forms Template Generator	Spatial Data Entry	Reports	Graphs	Data Export	Dashboards	Map Views	Spatial Layers	Error Handling	Encryption & Decryption	Workflow Engine	Logging	Data Quality	Forms Service	Audit Trail	Data Mapping & Transformation	Data Access	Object Datastore	Configuration Datastore	API Management	APIs	File Import	File Export	Integration Flows	Scheduler	Authentication	Authorisation	
General / Other Requirements																																				
NFREQ18																																				
NFREQ19																																				
NFREQ20																																				
Technology Requirements																																				
NFREQ21																																				
NFREQ22																																				
NFREQ23																																				

6. System Integration Requirements

6.1 User Interfaces

The system shall feature a web user interface. Two primary user interfaces functions will be provided by the user interface:

- **Admin UI.** This part of the user interface will provide functionality for admin users to configure the system, add/modify user profiles, create/modify system roles and associated permissions.
- **End-User UI.** This part of the user interface is what non-admin users will use. It will have functionality for regular users to edit their profile, capture additional data into the system, access basic reports. Power users will additionally have functionality to configure such elements of the system as data entities and fields managed by the system, forms configuration, build reports, dashboards, and other visualisations. Power users will have access to configure additional data sources and define transformation and data validation rules for new data sources.

The user interface should have responsive design.

Additionally, the following characteristics of the user interfaces are envisaged:

- User interface should be browser independent and can be accessed by latest versions of major web browsers
- User interface should support required security levels e.g.:
 - only accept secure connections
 - should be designed with security in mind
 - tested for common vulnerabilities like SQL-injections and Cross-site scripting
- Role based access to different parts of the user interface and system functionality
- Ease of use is key for system adoption

Our recommendation is to include a dedicated UX resource in the design of the user interface. This will ensure the intuitiveness and simplicity which are key success factors for the adoption of the system.

6.2 API Management Requirements

It is envisaged that in the future information hosted in the system will be made available to external parties / organisations via APIs. API Management layer is best practice for ensuring:

- APIs access is secure
- APIs are well-documented
- API usage is monitored including analytics
- API lifecycle management

It is recommended that the platform has support for or is extendable with API management layer to support future requirements.

6.3 Provided APIs/Interfaces

These will need to be determined in the future as the system builds up and matures and requirements for API access to the system become more defined.

6.4 Consumed Data Sources

After conducting a data sources workshop with primary user, Jeanetta, (as per the way forward steps outlined in Milestone 3's *Systems Evaluation Report*) a list of primary and backup data sources have been identified for inclusion in the SANBI system MVP. This list represents a best-effort level of completeness in terms of data requirement for the new SANBI system, given the data fragmentation and gaps present in the ecosystem.

The table below lists the final, primary sources identified for inclusion in the SANBI system MVP.

Table 6: Final Systems List

System		Population-level data		Activity data		Type	Species				Priority
No	Name	Historic	Ongoing	Historic	Ongoing		Rhino	Lion	Rhino	Leopard	
3	African Wildlife Poisoning Database			Y	Y	Online system		Y	Y	Y	4
4	Wildlife Seizure Database			Y	Y	Excel spreadsheet	Y	Y	Y	Y	3
5	CITES Trade Database			Y	Y	Online system	Y	Y	Y	Y	2
6	National E-Permitting System		Y		Y	Future integration. CSV export until then	Y	Y	Y	Y	2
7	SANParks Central Database (future)	Y	Y	Y	Y	Future system. Excel spreadsheet until then	Y	Y	Y		1
11-16	Provincial scientist / official		Y		Y	Excel spreadsheet	Y	Y	Y	Y	1
8-10	Provincial E-permitting system			Y	Y	North West/Cape Online. Can extract data from all			Y	Y	2
17	SA hunters database				Y	Future integration		Y	Y	Y	4
18	WRSAPortal		Y		Y	Online system	Y	Y	Y	Y	1
19	Cape Leopard Trust Database	Y	Y	Y	Y	Future system. Excel spreadsheet until then				Y	1
20	Panthera Leopard Monitoring Database	Y	Y			Online system				Y	1
21	Panthera Hunting Database (future)				Y	Future system. Excel spreadsheet until then				Y	4
23	Managed / Wild Lion Population Database (Jeanetta)	Y		Y		Excel spreadsheet		Y			1
24	Elephant Database (Mapss)	Y				Future system. Excel spreadsheet until then			Y		1

26	Elephant Population Database (Jeanetta)	Y				Excel spreadsheet			Y		1
27	SADC Rhino Management Group database	Y		Y		Excel spreadsheet	Y				1

The *Final Systems List* attachment includes additional detail on the above systems, including the data required of each system by the new SANBI system, any risks and considerations as well as possible data duplications with other systems to be kept in mind when onboarding data into the new SANBI system. The attachment also includes a wider view of the systems list - including the primary, backup and non-included data sources categorised by species.

Whilst the above list focuses on species data requirements, the below list of systems have been identified as having spatial data and functionality necessary for the new SANBI system and should be noted as primary sources.

- **(#29) SA Protected and Conservation Areas Database**
Spatial layer providing spatial data on protected areas in South Africa
- **(#18) WRSAPortal**
Interactive Map functionality providing spatial data on privately owned wildlife properties in South Africa.

6.5 Consumed APIs/Interfaces

Three systems were identified for API integration in the 1st phase:

- **Panthera & Leopard monitoring DB.** This system provides a generic AWS API for accessing the data. Details of this integration will need to be defined during system implementation.
- **African wildlife poisoning DB (AWPD).** No details on the available API are available at the time of preparing this document. Details of this integration will need to be defined during system implementation.
- **Cites trade database.** The database offers a Species+/CITES Checklist API which enables institutions to request data from the CITES Checklist and Species+ for use in websites and databases irrespective of the technology they use. The API provides information on CITES taxonomy (including scientific names and synonyms) and CITES Appendix listings as per the CITES Checklist. In addition, it provides information on distribution, references, common names, CITES export quotas and trade suspensions. Details of this integration will need to be defined during system implementation
- **WRSAPortal:** No details on the available API are available at the time of preparing this document. Details of this integration will need to be defined during system implementation.

7. Non-Functional Requirements

Non-functional requirements (NFR) specify the criteria used to judge the operation and performance of the system, whereas functional requirements define specific behaviour or functions of the system. Non-functional Requirements (NFRs) define system attributes such as the security, reliability, performance, maintainability, scalability, and usability of the system.

7.1 Usability

Usability defines how difficult it is for a new user to learn and operate the system. The following criteria are important to measure the usability of the system:

- **Ease of use:** the average time it takes to accomplish the goals of users of the system i.e., how many tasks a user can complete without any help, the number of transactions a user can complete without errors.
- **Intuitiveness and Simplicity:** how simple and intuitive is the system to navigate and use.
- **Workload and time to accomplish any task:** how many attempts users need to accomplish a particular task.

The usability of the SANBI system will be of utmost importance, to convince current data aggregators to rather use this system to on-board monitoring and population data, than to on-board this data in existing spreadsheets and CSV files. The ease of use in terms of obtaining reporting, insights, and visual representations of this data, will be very important to win people over to use the system instead of using their own siloed approaches to on-board data.

7.2 Security & Privacy

The security and privacy requirements of the SANBI system need to be managed very stringently in accordance with the following critical criteria:

- Password Authentication must be used to manage access to the system.
- User and role management will be used to manage access to sensitive and restricted data within the system.
- Personally Identifiable Information (PII): the information must be protected and encrypted.
- Audit logging and analysis
- Network and data security
- Data validation and sanitisation
- The system should ensure protection of data in transit and at rest, for all sensitive information:
 - Files containing sensitive information must be encrypted or password protected
 - Database encryption should be considered for sensitive data.
 - Full segregation of highly sensitive data (e.g., Rhino) should be considered, e.g., separate database with high security settings, encryption.
- All connections to the system (UI, APIs, etc.) to be protected, no unprotected connections (e.g., http) to be allowed
- Access to highly sensitive data (e.g., Rhinos) should only be allowed from on-premises datastores and through VPN
- Two factor authentication needs to be enforced for all privileged accounts
- Sensitive data in file format should not be kept after being committed into the database
- User education and training should be considered to minimise security risks (e.g., phishing)
- The system should maintain audit trail of key system events and all operations with sensitive data (reads/write/modify/delete)

7.3 Reliability and Performance

System reliability and performance are non-functional requirements that describe the responsiveness of the system to various user interactions. It is defined as the probability of a system or system element performing its intended function under stated conditions without failure for a given period of time (ASQ 2011).

Poor performance of the system will lead to negative user experience, which will undermine the ambition to make it easy to record and input species monitoring, events, and incident data. Specific performance requirements, per specific functional requirement, should be listed with that functional requirement, as part of the development and implementation of this system.

Software reliability must be ensured through improved and disciplined software development efforts and tests. (i.e., unit testing, formal user acceptance and production testing).

7.4 System Maintainability

System maintainability defines the probability that a system or system element can be repaired in a defined environment within a specified period of time. Increased maintainability implies shorter repair times as per (ASQ 2011).

The following parameters should guide acceptable levels of system maintainability.

- A. Response time for queries and updates
- B. System throughput
- C. Expected rate of user activity (for example, number of transactions per hour, day, or month, or cyclical periods)

7.5 Availability

Non-critical applications should have an availability of 99.9%, which equates to <9h of downtime per year. Required system availability must be taken into consideration in determining when maintenance may be performed on the system. System maintenance must be communicated to all system users well in advanced.

Backup requirements

User notifications (system outage alerts) must always be sent to all users of the system, as and when all or one of its parts become unavailable. Users must also be notified as to when the system will become available again.

7.6 Scalability

Scalability requirements describe how the system must grow without negative influence on system performance. This means serving more users, processing more data, and doing more transactions.

Scalability needs to address both hardware and software system implications. The scalability of the system needs to be born in mind in the architecture, development, and implementation of the system.

7.7 Data Retention

Due to the criticality of the data that will be loaded and captured into the system, data retention parameters i.e., the time that this data will be retained will be unlimited.

Species extinction is irreversible. The restoration of habitats, ecological processes, and ecosystem services is complex but possible, but the building blocks of higher levels of biological organisation cannot be restored once species go extinct. The minimisation of the species extinction rate is the target and the measure of success for this system, and therefore all data gathered, obtained, or on-boarded for this purpose will be held indefinitely.

Appendix A: Glossary

Business requirements

These include high-level statements of goals, objectives, and needs. Business requirements do not include any details or specific features. They state the problem and the business objective to be achieved such as

- Reducing species extinction,
- Monitoring species trade or movement,
- Controlling species disease etc.
- **Solution requirements** describe specific characteristics that a product must have to meet the needs of the stakeholders and the business itself. They fall into two large groups i.e., Functional Requirements and Non-Functional Requirements

Functional requirements are product features or functions that developers must implement to enable users to accomplish their tasks. Functional requirements describe system behaviour under specific conditions. For example: the system sends a confirmation email when a new user account is created. Functional requirements define what a product must do, what its features and functions are. Functional requirements can be classified according to different criteria. They can be grouped on the basis of the *functions* a given feature must perform in the end product e.g.

- Authentication
- Authorisation levels
- Compliance to laws or regulations
- External interfaces
- Transaction's processing
- Reporting
- Business rules, etc.

Non-Functional requirements describe the general properties of a system. They are also known as *quality attributes*. Non-functional requirements are not related to the system functionality, rather these requirements define how the system should perform. Some examples are:
The system should load in 3 seconds with the total number of simultaneous users < 5000.
The system should be able to handle 1000 users without performance deterioration.

User (stakeholder) requirements

The needs of discrete stakeholder groups are specified to define what they expect from a particular solution. This group serves as a bridge between the generalised business requirements and specific solution requirements.

Requirements are usually written in text, especially for agile-driven projects. However, they may also be visuals. Here are the most common formats and documents:

- Software requirements specification document
- Use cases
- User stories
- Functional decomposition
- Prototypes
- Models and diagrams

Use cases describe the interaction between the system and external users that leads to achieving particular goals. Each use case includes three main elements:

Actors. These are the external users that interact with the system.

System. The system is described by functional requirements that define an intended behaviour of the product.

Goals. The purposes of the interaction between the users and the system are outlined as goals.

There are two formats to represent use cases:

- Use case specification structured in textual format
- Use case diagram
-

Use case specification represents the sequence of events along with other information that relates to this use case. A typical use case specification template includes the following information:

- Description
- Pre- and Post- interaction condition
- Basic interaction path
- Alternative path
- Exception path
- User stories

User story is a documented description of a software feature seen from the end-user perspective. The user story describes what exactly the user wants the system to do. In agile projects, user stories are organised in a *backlog*, which is an ordered list of product functions. Currently, user stories are considered to be the best format for backlog items.

A typical user story is written like this: As a <type of user>, I want <some goal> so that <some reason>.

Example: As an admin, I want to add descriptions to products so that users can later view these descriptions and compare the products.

User stories must be accompanied by acceptance criteria. These are the conditions that the product must satisfy to be accepted by a user, stakeholders, or a product owner. Each user story must have at least one acceptance criterion. Effective acceptance criteria must be testable, concise, and completely understood by all team members and stakeholders. They can be written as checklists, plain text, or by using Given/When/Then format.

Finally, all user stories must fit the **INVEST quality model**:

- **I** – Independent
- **N** – Negotiable
- **V** – Valuable
- **E** – Estimable
- **S** – Small
- **T** – Testable
-

Independent. This means that you can schedule and implement each user story separately. This is very helpful if you implement continuous integration processes.

Negotiable. This means that all parties agree to prioritise negotiations over specification. This also means that details will be created constantly during development.

Valuable. A story must be valuable to the customer. You should ask yourself from the customer's perspective "why" you need to implement a given feature.

Estimable. A quality user story can be estimated. This will help a team schedule and prioritise the implementation. The bigger the story is, the harder it is to estimate it.

Small. Good user stories tend to be small enough to plan for short production releases. Small stories allow for more specific estimates.

Testable. If a story can be tested, it's clear enough and good enough. Tested stories mean that requirements are done and ready for use.