



Report

Visual impact assessment for the proposed 960 MW coal fired power plant in Lamu County, Kenya



Document prepared by:
Aurecon South Africa Pty (Ltd)
Reg no. 1977/03711/07
PO Box 494
Cape Town
8000

Comments should be directed to:

Paul Buchholz

T +27 079 881 4447
E paul.buchholz@aurecongroup.com
W www.aurecongroup.com

A person using Aurecon documents or data accepts the risk of:

- a. Using the documents or data in electronic form without requesting and checking them for accuracy against the original hard copy version.
- b. Using the documents or data for any purpose not agreed to in writing by Aurecon.

Copyright Notice

Copyright © 2015 by Aurecon South Africa (Pty) Ltd except where expressly transferred by written agreement to the Client. Any unauthorised reproduction, adaptation, alteration, translation, publication, distribution or dissemination (including, but not limited to, performances in public, broadcasting and causing the work to be transmitted in a diffusion service) of the whole or any part of this Document in any manner, form or medium (including, but not limited to, electronic, oral, aural, visual and tactile media) whatsoever will constitute an act of copyright infringement in terms of the Copyright Act 98 of 1978 and will make the Doer/Transgressor liable to civil action and may in certain circumstances make the Doer/Transgressor liable to criminal prosecution.

All trademarks and registered trademarks mentioned in this document are the property of their respective owners. Nothing contained in this Document should be construed as granting any license or right to use any trademarks without the prior written permission of Aurecon South Africa (Pty) Ltd.

Disclaimer

The contents of this Document are based upon the information made available to Aurecon South Africa (Pty) Ltd at the date of this Document and on current local and international standards, codes, and technology as at the date of this Document. Every effort has been made to produce an accurate assessment and make realistic and practical recommendations. This Document, and information or advice, which it contains, is provided by Aurecon South Africa (Pty) Ltd solely for internal use and reliance by its Client in performance of Aurecon South Africa (Pty) Ltd duties and liabilities under its contract with the Client. Regard should be had to those terms and conditions when considering and/or placing any reliance on this Document.

Aurecon South Africa (Pty) Ltd cannot be held liable for any errors and/or omissions in this Document nor for any damages, consequential or otherwise, which the client may sustain from the use or reliance upon this Document and all information contained herein.

Confidentiality Statement

This document contains confidential information belonging to Aurecon South Africa (Pty) Ltd and may not be used for any purpose other than that for which the information was provided. When disclosure to employees or agents of the Recipient is necessary, the Recipient shall ensure that the employees or agents shall be bound by equivalent duties of confidentiality and non-use. The Recipient shall take all reasonable care to ensure that this document is securely kept; and shall return, destroy or otherwise deal with it, as directed by the Provider. Furthermore, this document, its contents and intellectual property, may not be disclosed to any third part without the written consent of Aurecon South Africa (Pty) Ltd.



CONTENTS

Chapter 1: Executive summary	1	Chapter 6: Application of the methodology	15
Chapter 2: Introduction	3	Chapter 7: Legislative context	16
Objectives of the visual assessment	3	Chapter 8: Description of the effected environment	17
Existing operations	4	Chapter 9: Project description	18
Description of the project surrounds	4	Construction phase	19
General methodology	4	Operational phase	21
Chapter 3: Landscape character and sense of place	5	Decommissioning phase	21
Chapter 4: Methodology	6	Chapter 10: Impact assessment	22
Key viewing locations	7	Chapter 11: Visual mitigation and management	27
Visual sensitivity	8	Visual mitigation principles	27
Visual modification	10	Mitigation measures	27
Data	12	Chapter 12: References	30
Chapter 5: Gaps and limitations	13		
Data	13		
Viewshed analysis	13		
Visualisation	14		

Tables:

Table 1: Visual impact matrix	15
Table 2: Location of key viewing locations	22
Table 3: Key categories of development	23
Table 4: EIA Study risk matrix	26

Map Plates:

Plate 1: Project layout A
Plate 2: Project layout B
Plate 3: Project layout C
Plate 4: Key viewing locations A
Plate 5: Key viewing locations B
Plate 6: Key viewing locations C
Plate 7: Key viewing locations D
Plate 8: Key viewing locations E
Plate 9: Land cover and land use
Plate 10: Topography
Plate 11: Viewshed analysis
Plate 12: LAPSSET area

Glossary

Aesthetics	Relates to the pleasurable characteristics of a physical environment as perceived through the five senses of sight, sound, smell, taste, and touch.
Adverse visual impact	Any modification in land forms, water bodies, vegetation or any introduction of structures which negatively impacts the visual character of the landscape and disrupts the harmony of the basic elements (i.e. form, line, colour and texture).
Basic elements	The four design elements (form, line, colour and texture) which determine how the character of a landscape is perceived.
Contrast	Opposition or unlikeness of different forms, lines, colours or textures in a landscape and therefore the degree to which project components visually differs from its landscape setting.
Colour	The property of reflecting light of a particular intensity and wavelength (or mixture of wavelengths) to which the eye is sensitive. It is the major visual property of surfaces.
Form	The mass or shape of an object(s), which appears unified, such as a vegetative opening in a forest, a cliff formation or a water tank.
Integration	The degree to which a development component can be blended into the existing landscape without necessarily being screened from view.
Interfluve	The area of higher ground which separates 2 rivers / watercourses which flow into the same drainage system
Key viewing locations	One or more points on a travel route, use area or a potential use area, where the view of a management activity would be most revealing.
Landscape character	The arrangement of a particular landscape as formed by the variety and intensity of the landscape features and the four basic elements of form, line, colour and texture. These factors give the area a distinctive quality, which distinguishes it from its immediate surroundings.
Landscape features	Land and water form, vegetation and structures, which compose the characteristic landscape.
Line	The path (real or imagined) that the eye follows when perceiving abrupt differences in form, colour or texture. Within landscapes, lines may be found as ridges, skylines, structures, changes in vegetative types or individual trees and branches.
Micro-topography	Small scale variations in the height and roughness of the ground surface; in the context of this report the definition includes structures such as buildings and larger-sized vegetation that can restrict views
Mitigation measures	Methods or procedures designed to reduce or lessen the adverse impacts caused by management activities.
Rehabilitation	A management alternative and/or practice which restores landscapes to a desired scenic quality.
Scale	The proportionate size relationship between an object and the surroundings in which the object is placed.
Sense of place	The unique quality or character of a place, whether natural, rural or urban and relates to uniqueness, distinctiveness or strong identity. It is also sometimes referred to as genius loci meaning 'spirit of the place.
Texture	The visual manifestations of the interplay of light and shadow created by the variations in the surface of an object or landscape.
Visual modification	A measure of the visual interaction between a development and the landscape setting within which it is located.
View-shed	The creation of a computer generated probable view-shed to define the extent to which the planned infrastructure is visible from key viewing locations.
Visual Sensitivity	The degree to which a change to the landscape will be perceived in an adverse way.
Visual Impact	A measure of joint consideration of both visual sensitivity and visual modification



CHAPTER ONE

EXECUTIVE SUMMARY

Table 3 classifies the project as a Category 5 development in an area of medium scenic and cultural significance. A high visual impact is therefore expected with a potential intrusion on the existing landscape creating a noticeable change in the visual character of the area.

The degree of contrast created by a project depends on how dissimilar the introduced forms are to those continuing to exist in the landscape. The large shape and mass of the various power station structures will create contrast within the existing landscape because they are very dissimilar to the natural shape and forms existing in the landscape. The project infrastructure will introduce new lines, colours and textures into the existing landscape that will create contrast and increase the level of visual modification.

The project landscape has a very low visual absorption capacity largely due to the flat topography of the area and the lack of micro-topographical features such as natural vegetation that can screen views of the project and the project will therefore be highly visible. The viewshed analysis and photomontages show that the project will be very visible and the line of sight analysis indicates that the 210m chimney will be visible from areas located more than 10km away from the project and draw people's attention to the project.

The project will also be located outside any defined urban edge or industrial area and will therefore create an initial change to the fabric and character of the landscape. The inter-relationship with land uses in adjacent lands can affect the visual sensitivity of an area. A project located within the view-shed of a tourist resort may for example be very sensitive, whereas an area surrounded by commercially developed lands may not be visually sensitive. As the Lamu Port South Sudan Ethiopia (LAPSSET) transport corridor is implemented the visual character of the area surrounding the project site will change to a commercially developed zone. The project's impact on the visual character of the area will therefore decrease over time as the area surrounding the power station changes to a commercial zone.

During the construction phase of the project the visual sensitivity and modification levels will be high due to construction activities involved during the day and night. Construction activities will be very visible due to the low visual absorption capacity of the landscape and mitigation measures will not be able to reduce the impact. During the operational phase of the project concrete chimney will create a high visual impact due to its height and mitigation measures will not be able to reduce the impact. The successful implementation and maintenance of mitigation measures will reduce the visual impact of the power plant area, coal ash yard, jetty and worker housing development. During the decommissioning phase of the project the visual impact would be low and it is envisaged that most of the infrastructure will be integrated into the LAPSSET project area.

Value can be placed in a landscape in terms of its aesthetic quality, or in terms of its sense of identity or sense of place with which it is associated. If no such values are held with respect to a landscape, there is less likely to be a perception of visual impact if the landscape becomes subject to visual alteration. Development within a landscape may not be perceived negatively at all if the development is associated with progress or up-liftment of the human condition. It is therefore important to note that the communities in the surrounding areas might see the project as a positive contribution to the local economy by improving electricity supply and creating new business opportunities.

Once the construction phase of the project has been completed it is critical that mitigation measures implemented during and after the construction phase are monitored and maintained where required. This would include the regular monitoring and maintenance of re-vegetated areas especially at disturbed sites and on constructed slope areas until they have established successfully.



CHAPTER TWO

INTRODUCTION

Visual, scenic and cultural components of the environment can be seen as a resource and, similar to any other resource (which has a value to individuals), can add significant value to both the society and economy of a region. In addition, this resource may have a scarcity value, be easily degraded and is often irreplaceable.

The manner in which the built environment is developed has an immense impact on the intrinsic and systemic value of that environment. Thus developmental integrity is determined by the level of sensitivity practiced in integrating development into the environment in which it is to be located.

An iterative design approach enables the site planning and detailed design of a development project to be informed by and respond to the on-going environmental impact assessment, as the environmental constraints and opportunities are taken into consideration at each stage of decision making. Visual impact assessments are an important part of an iterative design process, because it can help to avoid or minimise potential negative effects of a development and, where appropriate, can also help in seeking opportunities for landscape enhancement.

The following specific concepts should be considered during visual input into the Environmental and Social Impact Assessment (ESIA) process:

- An awareness that 'visual' implies the full range of visual, aesthetic, cultural and spiritual aspects of the environment that contribute to the area's sense of place.
- The consideration of both the natural and the cultural landscape, and their inter-relatedness.
- The identification of all scenic resources, protected areas and sites of special interest, together with their relative importance in the region.
- An understanding of the landscape processes, including geological, vegetation and settlement patterns, which give the landscape its particular character or scenic attributes.
- The need to include both quantitative criteria, such as 'visibility', and qualitative criteria, such as aesthetic value or sense of place.
- The need to include visual input as an integral part of the project planning and design process, so that the findings and recommended mitigation measures can inform the final design, and hopefully the quality of the project.

Objectives of the visual assessment

The objective of this study is to assess the potential visual impacts of the proposed 981.5MW coal fired power plant on the existing landscape and values of the area. The project will be located in Kwasasi area, Hindi division, Lamu County (Plate 13).

The following components have been included as part of the visual assessment:

- A site inspection to identify the view-shed for the planned activities and potentially sensitive viewing locations within the vicinity.
- Characterisation of the existing visual landscape in terms of topography, existing land use and vegetation.
- Assessment of the potential visual impacts of the planned activities on sensitive receptors.
- Development of mitigation and management measures.

Existing Operations

Currently no other power plants or developments exist in the project area.

Description of the project surrounds

The coal fired power plant project will be located approximately 20km north of Lamu town along the shoreline in a predominantly cultivated area with small remaining patches of indigenous vegetation (Plate 12).

General methodology

The methodology to determine the level of visual impact of the planned infrastructure involves, in the first instance, a consideration of the existing visual environment. This includes a consideration of existing landscape setting and how the planned infrastructure is seen from various viewing locations. In this way the visual character of the landscape, as well as visual sensitivity of the various viewing locations can be determined.

Secondly, the visual modification of the planned infrastructure is determined by considering the visual characteristics of the planned infrastructure in the context of the landscape within which it is seen. The planned infrastructure will have certain visual characteristics associated with it. These elements will express themselves in terms of form, shape, line, colour, and to a lesser extent, texture. An understanding of this visual character will provide an appreciation of how various infrastructure elements will be seen in the landscape.

A combined consideration of both visual sensitivity and visual modification determines impact and gives some direction on mitigation strategies.

The key factors considered during the assessment included:

- Sensitive land uses (e.g. residential areas, public roads and natural/recreation areas); and
- The visual form, scale and colour of the development.

The methodology that will be employed during the preparation of this visual assessment will include the following components:

- Characterisation of the existing landscape and visual setting;
- Identification of points with potential views of the planned infrastructure;
- Examination of the main components and activities of the planned infrastructure;
- The illustration of potential landscape or visual impacts using photographs and maps
- Qualitative assessment of impacts, including:
 - Visual modification at key viewpoints – How does the proposed development contrast with the landscape character of the surrounding setting?
 - Visual sensitivity at key viewpoints – How sensitive will viewers be to the proposed development?
 - Development of mitigation and management measures.

The methodology employed by this visual assessment is based on the following methodologies:

- The United States Department of Agriculture: Forestry Service - Landscape Aesthetics;
- The United States Bureau of Land Management Visual Resources Management;
- The Landscape Institute and the Institute of Environmental Management & Assessment - Guidelines for Landscape and Visual Impact Assessment; and
- The Provincial Government of the Western Cape's Guideline for involving visual and aesthetic specialists in EIA processes and the Guidelines for Landscape.



CHAPTER THREE

LANDSCAPE CHARACTER AND SENSE OF PLACE

Landscape character is defined as the distinct, recognizable, and consistently occurring pattern of elements in a particular type of landscape as created by particular combinations of geology, landform, soils, vegetation, land use, field patterns, and human settlement. Character is what makes landscapes distinctive and creates a particular sense of place in a locality (Transport Research Board, 2013).

Landscapes that warrant a very high level of protection are intact landscapes where existing landscape character and sense of place is beautifully expressed. The scale of unnatural intrusions also does not dominate the scene and for which the introduced forms, lines, colours, textures and patterns mimic the native environment so effectively that they are unobtrusive.

The European Landscape Convention (2000) defines landscape as:

“An area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors. The term ‘landscape’ is thus defined as a zone or area as perceived by local people or visitors, whose visual features and character are the result of the action of natural and/or cultural (that is, human) factors. This definition reflects the idea that landscapes evolved through time, as a result of being acted upon by natural forces and human beings. It also underlines that landscape forms a whole, whose natural and cultural components are taken together not separately”.

The scientific literature on landscape perception concludes that human perception of the landscape, including visual quality and visual impacts, is a transactional process. Perceived visual quality is therefore the result of the interaction between the landscape and people. Understanding both the affected landscape and the affected population of viewers is necessary for determining visual quality and visual impacts.

It is therefore essential that the people in the landscape are involved in identifying the character of the existing landscape, particularly what is visually valuable, and in determining visual impacts and the appropriate level of mitigation.

Social science and design literature extending over more than 40 years empirically demonstrates the relationship between visual experience and aesthetic pleasure (appreciation of beauty). Each of these studies underscores the strong association between human visual experience and aesthetic pleasure. Some of the studies also point out the aesthetic effects of other senses (smell, sound, touch), but they conclude that sight is the dominant sensual basis for aesthetic experience of landscapes.

Several studies also indicate that movement (driving, walking, cycling, rowing etc.) through the landscape is a complex experience that is crucial for scenic perception and user satisfaction. (Transport Research Board, 2013).



CHAPTER FOUR

METHODOLOGY

Visual impact assessments should not be seen as an obstacle in the approval process. Visual input, especially at the early concept stage of the project, can play an important role in helping to formulate design alternatives, as well as minimising impacts, and possibly even costs, of the project.

It is in the nature of visual and scenic resources to include abstract qualities and connotations that are by their nature difficult to assess or quantify as they often have cultural or symbolic meaning. It is necessary therefore to include both quantitative criteria (such as viewing distances), and qualitative criteria (such as sense of place), in visual impact assessments.

An implication of this is that impact ratings cannot simply be added together. Instead the assessment relies on the evaluation of a wide range of considerations, both objective and subjective, including the context of the proposed project within the surrounding area. The phrase “beauty is in the eye of the beholder” is often quoted to emphasize the subjectivity in undertaking a visual impact assessment

The analysis of the interaction between the existing visual environment (landscape character and sense of place) and the planned infrastructure provides the basis for determining visual impacts and mitigation strategies. This is completed by defining the visual effect of the planned infrastructure and visual sensitivity of viewing locations to determine impact.

The evaluation of the existing visual environment consists of the assessment of both the landscape setting, and key viewing locations within it. The landscape setting can be defined in terms topography, vegetation, hydrology and land use features. These elements define the existing visual character of the landscape with which the planned infrastructure interacts.

The use of the basic elements of form, line, colour and textures has become the standard in describing and evaluating landscapes. Modifications in a landscape which repeat the landscape's basic design elements are said to be in harmony with their surroundings. Modifications which do not harmonize, often look out of place and are said to contrast or stand out in unpleasing ways.

These basic design elements and concepts have been incorporated into the methodology to lend objectivity, integrity and consistency to the visual impact assessment process. By adjusting planned infrastructure designs so that the elements are repeated, visual impacts can be minimised.

The methodology is therefore a systematic process designed to separate the existing landscape and the planned infrastructure into their features and elements and to compare each part against the other to measure contrast in order to analyse potential visual impact of the proposed development and activities. An understanding of basic design principles and how they relate to the appearance of planned infrastructure is essential in order to minimize visual impacts.

It must be noted that the methodology is not intended to be the only means of resolving these impacts and should be used as a guide, tempered by common sense, to ensure that every attempt is made to minimize potential visual impacts.

Key viewing locations

Key viewing locations (views from communities, major roads, conservation areas etc.) are those areas where people are likely to obtain a view of the planned infrastructure. These viewing locations have different significance based on numerous factors, collectively evaluated through land use and viewing distance to the planned infrastructure.

The selection of the key viewing locations is based on their location within the defined view-shed where they would have a clear view of the planned infrastructure.

Factors that will be considered in selecting the key viewing locations are:

- **Angle of observation** - The apparent size of a project is directly related to the angle between the viewer's line-of-sight and the slope upon which the planned infrastructure is to take place. As this angle nears 90 degrees (vertical and horizontal), the maximum area is viewable.
- **Numbers of viewers** - Areas seen and used by large numbers of people are potentially more sensitive. Protection of visual values usually becomes more important as the number of viewers increase.
- **Length of time the project is in view** - If the viewer has only a brief glimpse of the planned infrastructure, the contrast may not be of great concern. If, however, the planned infrastructure is subject to view for a long period, as from an overlook, the contrast may be very significant.
- **Distance from the project** - The greater the viewing distances, the lower the visual sensitivity. The visual modification of a development is assumed to be the highest when the observer is very close to it and has a direct line of site. The visual modification then decreases with distance and is also known as distance decay (Hull & Bishop, 1988).
- **Field of vision** - The visual impact of a development can be quantified to the degree of influence on a person's field of vision both horizontally and vertically. The visual impact of a development will vary according to the proportion in which a development impacts on the central field of vision. Within the central field of vision images are sharp, depth perception occurs and colour discrimination is possible. Developments, which take up less than 5% of the central field of vision, are usually insignificant in most landscapes (Human Dimension and Design, 1979).

The horizontal central field of vision for most people covers an angle of between 50° and 60°. Within this angle, both eyes observe an object simultaneously. This creates a central field of greater magnitude than that possible by each eye separately. This central field of vision is termed the 'binocular field' and within this field images are sharp, depth perception occurs and colour discrimination is possible. Developments, which take up less than 5% of the central binocular field, are usually insignificant in most landscapes (5% of 50° = 2.5°).

The vertical central field of vision covers an angle of between 25° and 30° (limit of colour discrimination). The typical line of sight is considered to be horizontal or 0°. A person's natural or normal line of sight is normally a 10° cone of view below the horizontal and, if sitting, approximately 15°. Objects that take up 5% of this cone of view (5% of 10° = 0.5°) will only take up a small proportion of the vertical field of view, and are only visible when one focuses on them directly.

- **Visibility** - Viewed by the human eye 1.8 m from the ground across a "flat" surface such as the sea, the horizon will be of the order of 6 km distant, due to the curvature of the earth. Viewed at an elevation of 60 m, the horizon will be of the order of 32 km distant and from the top of a 1000 m mountain the horizon will be at a distance of approximately 113 km. A tall structure standing above the horizon would of course increase these distances significantly; for example, for an observer at 1.8 m who is viewing a man-made structure 50 m tall, the effective distance to the horizon is 34 km and for a 100 m structure the distance is 46 km (Miller & Morrice, no date).
- **Human perception** - Human perception is affected by the acuity of the human eye. In good visibility (visibility is meteorologically defined as the greatest distance at which an object in daylight can be seen and recognised), a pole of 100 mm diameter will become difficult to see at 1 km and a pole of 200 mm diameter will be difficult to see at 2 km. In addition, mist, haze or other atmospheric conditions may significantly affect visibility (Hill et al, 2001). Assuming this relationship is linear, and assuming absolute clarity of view, this suggests that the outer limit of human visibility in clear conditions of a pole 5000 mm (5 m) in diameter (a representative figure for a 60+ m high tower) will be of the order of 50 km; and the absolute limit of visibility imposed by the limit of the horizon viewed across a flat plane is similar at approximately 46 km.

Human perception is important in considerations of if and how planned infrastructure will be seen. People perceive size, shape, depth and distance by using many cues, so that context is critically important. When people see partial or incomplete objects, they may mentally “fill in” the missing information, so that partial views of infrastructure may have less effect than imagined. Although people may be able to physically “see” an object, unintentional “blindness” caused by sensory overload, or a lack of contrast or conspicuousness, can mean they fail to “perceive” the object. In a contrary way, large size, movement, brightness and contrast, as well as new, unusual or unexpected features, can draw attention to an object. In all these effects, issues such as experience, familiarity and memory may have an important role to play. Therefore, perception depends on experience, the visual field, attention, background, contrast and expectation, and may be enhanced or suppressed.

Value can be placed in a landscape in terms of its aesthetic quality, or in terms of its sense of identity or sense of place with which it is associated. If no such values are held with respect to a landscape, there is less likely to a perception of visual impact if the landscape becomes subject to visual alteration. Development within a landscape may not be perceived negatively at all if the development is associated with progress or upliftment of the human condition.

The perception of visual impacts is thus highly subjective and thus involves ‘value judgements’ on behalf of the receptor. The context of the landscape character, the scenic / aesthetic value of an area, and the types of land use practiced tend to affect the perception of whether landscape change (through development) would be considered to be an unwelcome intrusion. Sensitivity to visual impacts is typically most pronounced in areas set aside for the conservation of the natural environment (such as protected natural areas or conservancies), or in areas in which the natural character or scenic beauty of the area acts as a draw card for visitors (tourists) to visit an area, and accordingly where amenity and utilitarian ecological values are associated with the landscape.

When landscapes have a highly natural or scenic character, amenity values are typically associated with such a landscape. Structural features such as power lines and other electricity transmission developments and related infrastructure are not a feature of the natural environment, but are rather representative of human (anthropogenic) change to a landscape.

Thus when placed in a largely natural landscape, such structural features can be perceived to be highly incongruous in the context of the setting, especially if they affect or change the visual quality of a landscape. It is in this context of incongruity with a natural setting that new developments are often perceived to be a source of visual impact.

Visual sensitivity

Visual sensitivity is a measure of how critically a change to the existing landscape is viewed by people from different land use areas in the vicinity of a development.

The degree of visual sensitivity of an area is closely related to the aesthetic quality of the area, as well as to the value placed in the aesthetic quality of the landscape, but is also related to the area’s socio-economic profile. In this regard, residential, tourist and/or recreation areas generally have a higher visual sensitivity than other land use areas (e.g. industrial, agricultural or transport corridors), because they use the scenic amenity values of the surrounding landscape and may be used as part of a leisure experience and often over extended viewing periods.

It is important to note that the presence of natural / perceived natural and rural elements or areas within the landscape as viewed from the surrounds of the project area can engender perceptions of aesthetic quality or value to the landscape. Many studies of landscape conservation have highlighted the value placed by people in rural or natural landscapes. A rural landscape can be defined as an where an interaction between humans and nature over time has led to the development of a landscape that has its own characteristics, and which is a middle

ground between an urban landscape and wilderness, consisting of human activities that are related to the natural environment, such as agriculture and pastoral activities (Mazehan et al, 2013). A natural landscape, as defined in this report is close in appearance to how the landscape would appear without human alteration – i.e. mimicking or closely resembling that of a wilderness.

Placing value in a landscape is a psychological and cultural practice; values and meanings are not intrinsic to the landscape, but rather they are phenomena created by humans through their cultural practices (Pun, 2004). It is thus important to note that perceptions of landscape may not be universally shared and different individuals or groups of people may perceive or treat the same landscape differently, in turn ascribing different values and meanings to it (Pun, 2004). Values and meanings ascribed by local people may not be evident to an outsider.

There are different types of values that can be placed on a landscape; i.e. economic values (e.g. the relevancy of the landscape for business enterprises, or the market possibility of products from landscape), amenity values (values related to the non-material benefits associated with it) and security values (Pun, 2004). Amenity values can be subdivided into different sub-categories; “intrinsic” ecological value, scientific and educational value, aesthetical and recreational value, and orientational and identity value.

Landscapes and the viewing of landscapes has also been shown to have positive psychological and health benefits; Velarde et al (2007), have shown through an examination of various environmental psychology studies that visual exposure to natural landscapes (e.g. by means of viewing natural landscapes during a walk, or viewing from a window) generally has a beneficial impact on human health (e.g. reduced stress, facilitating recovery from illness, and behavioural changes that improve mood and general well-being).

Landscape as a source of beauty is prevalent within the arts and is strong draw card for recreational activities. In addition, landscape is an element in the ability of people to orient themselves, and is strongly related to people's cultural identity and sense of place. It is in this context that value is placed in natural or rural landscapes, and it follows that such value would be placed on views in an area such as the study area which is largely natural, and which has high aesthetic value by virtue of its scenic nature.

The above values can be interlinked, but can also be conflicting, e.g. amenity values associated with a landscape held by a certain group of people as described above may conflict with economic values associated with the market or development possibility of the landscape that are held by others. It is in this context that visual impact associated with a potential development often arises as an issue in environmental impact assessments.

The latter three sub-categories of amenity value described above – aesthetic, identity and psychological health value are typically involved in the perception of visual impact and constitute the elements of the ‘visual sensitivity’ associated with that landscape, as development within a landscape can change the landscape to the degree to which the amenity value associated with a landscape would be considered to be degraded or no longer present.

Landscapes are subdivided into three (3) distanced zones based on relative visibility from travel routes or observation points. The three zones are:

- Foreground-Middle ground Zone - This is the area that can be seen from each travel route for a distance of 0 to 10 kilometres where management activities might be viewed in detail. The outer boundary of this distance zone is defined as the point where the texture and form of individual plants are no longer apparent in the landscape. In some areas, atmospheric conditions can reduce visibility and shorten the distance normally covered by each zone.
- Background Zone - This is the remaining area which can be seen from each travel route to approximately 24 kilometres, but does not include areas in the background which are so far distant that the only thing discernible is the form or outline. In order to be included within this distance zone, vegetation should be visible at least as patterns of light and dark.

- Seldom-Seen Zone - These are areas that are not visible within the foreground-middle ground and background zones and areas beyond the background zones.

Land-use areas are generally characterised in terms of low, moderate or high visual sensitivity, as follows:

- Low visual sensitivity - industrial areas, local roads, mining and degraded areas.
- Moderate visual sensitivity - tourist roads, major roads, sporting or recreational areas and places of work.
- High visual sensitivity - rural residences, recreation areas, conservation areas, scenic routes or trails.

Visual sensitivity may range from high to low, depending on the following additional factors:

- **The visual absorption capacity** - The potential of the landscape to conceal the proposed project will reduce or increase visual sensitivity.
- **Viewing distance** – The greater the viewing distances, the lower the visual sensitivity. The visual modification of a development is assumed to be the highest when the observer is very close to it and has a direct line of site. The visual modification decreases with distance and is also known as distance decay (Hull & Bishop 1988).
- **Length of time the project is in view** - If the viewer has only a brief glimpse of the planned infrastructure, the contrast may not be of great concern and the visual sensitivity low. If, however, the planned infrastructure is subject to view for a long period, as from an overlook, the contrast may be very significant.
- **General orientation** - General orientation of residences to landscape areas affected by a project. Residential, tourist and/or recreation areas with strong visual orientation towards the planned infrastructure (i.e. those with areas such as living rooms and/or verandas orientated towards it), will have a higher visual sensitivity than those not orientated towards the planned infrastructure.
- **Relative planned infrastructure size** - The contrast created by the project is directly related to its size and scale as compared to the surroundings in which it is placed.
- **Type of users** - Visual sensitivity will vary with the type of users. Recreational sightseers may be highly sensitive to any changes in visual quality, whereas workers who pass through the area on a regular basis may not be as sensitive to change.
- **Numbers of viewers** - Areas seen and used by large numbers of people are potentially more sensitive. Protection of visual values usually becomes more important as the number of viewers increase.
- **Season of use** - Contrast ratings should consider the physical conditions that exist during the heaviest or most critical visitor use season, such as tree defoliation during the winter, leaf colour in the fall and lush vegetation and flowering in the spring.
- **Public interest** - The visual quality of an area may be of concern to local or national groups. Indicators of this concern are usually expressed in public meetings, letters, newspaper or magazine articles, newsletters, land-use plans, etc. Public controversy created in response to proposed activities that would change the landscape character should also be considered.
- **Adjacent land uses** - The inter-relationship with land uses in adjacent lands can affect the visual sensitivity of an area. For example, an area within the view-shed of a residential area may be very sensitive, whereas an area surrounded by commercially developed lands may not be visually sensitive.
- **Special areas** - Management objectives for special areas such as natural areas, wilderness areas, conservation areas, scenic areas, scenic roads or trails frequently require special consideration for the protection of the visual values. This does not necessarily mean that these areas are scenic, but rather that one of the management objectives may be to preserve the natural landscape setting. The management objectives for these areas may be used as a basis for assigning sensitivity levels.

Visual modification

Visual modification is a measure of the level of visual contrast and integration of the planned infrastructure with the existing landscape.

An existing landscape has certain visual characteristics expressed through the visual elements of form, shape, line colour and texture. A development that has different visual characteristics than the existing landscape will create

contrast with the existing landscape. If similar infrastructure already forms part of the existing landscape, the visual effects of the planned infrastructure will borrow visual character from these operations, reducing visual modification.

The degree to which the visual characteristics of the planned infrastructure contrast with the existing landscape will determine the level of visual modification. For example a newly created mine will have a high visual modification due to strong contrast. An extension of operations in an existing mine will have a lesser visual modification. A successfully rehabilitated mine area will also have a lower visual modification due to limited contrast with the existing landscape.

In a similar way, a project is said to be integrated with the existing landscape based on issues of scale, position in the landscape and contrast. High visual integration is achieved if a development is dominated by the existing landscape, is of small scale and/or limited contrast.

The level of visual modification generally decreases with distance and is categorised as follows:

- **Negligible (or very low) level of visual modification** – where the development is distant and/or relates to a small proportion of the overall view-shed.
- **Low level of visual modification** - where there is minimal visual contrast and a high level of integration of form, line, shape, pattern, colour or texture values between the development and the landscape. In this situation the development may be noticeable, but does not markedly contrast with the landscape.
- **Moderate level of visual modification** - where a component of the development is visible and contrasts with the landscape, while at the same time achieving a level of integration. This occurs where surrounding topography, vegetation or existing modified landscape provide some measure of visual integration or screening.
- **High level of visual modification** - where the major components of the development contrast strongly with the existing landscape and demand attention.

The following factors must be considered when applying visual modification categories:

- **Angle of observation** - The apparent size of a project is directly related to the angle between the viewer's line-of-sight and the slope upon which the project is to take place. As this angle nears 90 degrees (vertical and horizontal), the maximum area is viewable.
- **Length of time the project is in view** - If the viewer has only a brief glimpse of the project, the contrast may not be of great concern. If, however, the project is subject to view for a long period, as from a viewing location, the contrast may be very significant.
- **Relative size or scale** - The contrast created by the project is directly related to its size and scale as compared to the surroundings in which it is placed.
- **Season of use** - Contrast ratings should consider the physical conditions that exist during the heaviest or most critical visitor use season, such as tree defoliation during the winter, leaf colour in the fall and lush vegetation and flowering in the spring.
- **Light conditions** - The amount of contrast can be substantially affected by the light conditions. The direction and angle of lighting can affect colour intensity, reflection, shadow, form, texture and many other visual aspects of the landscape. Light conditions during heavy use periods must be a consideration in contrast ratings.
- **Recovery time** - The amount of time required for successful re-vegetation should be considered. Recovery usually takes several years and goes through several phases (e.g. bare ground to grasses, to shrubs, to trees, etc.). It may be necessary to conduct contrast ratings for each of the phases that extend over long time periods. Those conducting contrast ratings should verify the probability and timing of vegetative recovery.
- **Spatial relationships** - The spatial relationship within a landscape is a major factor in determining the degree of contrast.
- **Atmospheric conditions** - The visibility of planned infrastructure due to atmospheric conditions, such as air pollution or natural haze, should be considered.
- **Motion** - Movement such as waterfalls, vehicles or plumes draw attention to a project.
- **Form** - Contrast in form results from changes in the shape and mass of landforms or structures. The degree of change depends on how dissimilar the introduced forms are to those continuing to exist in the landscape.

- **Line** - Contrasts in line results from changes in edge types and interruption or introduction of edges, bands, and silhouette lines. New lines may differ in their sub-elements (boldness, complexity, and orientation) from existing lines.
- **Colour** - Changes in value and hue tend to create the greatest contrast. Other factors such as chroma, reflectivity and colour temperature, also increase the contrast.
- **Texture** - Noticeable contrast in texture usually stems from differences in the grain, density and internal contrast. Other factors such as irregularity and directional patterns of texture should also be considered.

Data

A visual impact assessment entails a process of data sourcing (collection of data during field work and various data custodians), spatial analysis, visualisation and interpretation. Geo-information technology is utilised which includes operations relating to Geographic Information Systems (GIS), Global Positioning System (GPS) and remote sensing technology. This report makes extensive use of maps created in a Geographic Information System and photographs taken during a field survey of the site. It is imperative that these should be read and interpreted together with the text.

The following data sets were used for this report:

- Lidar data and aerial photography provided by the client
- NASA Shuttle Topographic Mission digital elevation data



CHAPTER FIVE

GAPS AND LIMITATIONS

It should be noted that the 'experiencing' of visual impacts is subjective and largely based on the perception of the viewer or receptor. The presence of a receptor in an area potentially affected by the proposed power line does not thus necessarily mean that a visual impact would be experienced.

Value can be placed in a landscape in terms of its aesthetic quality, or in terms of its sense of identity or sense of place with which it is associated. If no such values are held with respect to a landscape, there is less likely to a perception of visual impact if the landscape becomes subject to visual alteration. Development within a landscape may not be perceived negatively at all if the development is associated with progress or up-liftment of the human condition.

The perception of visual impacts is thus highly subjective and thus involves 'value judgements' on behalf of the receptor. The context of the landscape character, the scenic / aesthetic value of an area, and the types of land use practiced tend to affect the perception of whether landscape change (through development) would be considered an unwelcome intrusion.

The abovementioned landscape values can be interlinked, but can also be conflicting, e.g. amenity values associated with a landscape held by a certain group of people as described above may conflict with economic values associated with the market or development possibility of the landscape that are held by others. It is in this context that visual impact associated with a potential development often arises as an issue in environmental impact assessments.

Data

The best currently and readily available datasets were utilized for the visual impact assessment. It is important to note that variations in the quality, format and scale of available datasets could limit the scientific confidence levels of the visual impact assessment outcomes.

Viewshed analysis

Slope and aspect are very important in the context of views, as described further on the impact assessment section of this report. Topography, expressed in the form of slope and aspect can perform an important role in limiting views or 'focussing' views in a certain direction. Viewers located low down within an enclosed valley would experience a limited visual envelope or viewshed, as the rising topography around them would prevent wider views of the surrounding terrain beyond the immediate valley.

Similarly an object placed lower down in such an enclosed valley would have a limited viewshed, being shielded or partly shielded by the terrain surrounding it. A viewer located on a hillslope with a certain aspect would only be able to view the surrounding terrain in the direction of the aspect of the slope. Conversely a viewer on a higher-lying interfluvium will be exposed to potentially wide-ranging views over the surrounding terrain, and large objects placed in these terrain settings could similarly be visible from a wide area.

The micro-topography within the landscape setting in which the viewer and object are located is also important; the presence of micro-topographical features and objects such as buildings or vegetation that would screen views from a receptor position to an object can remove any visual impact factor associated with it.

Fischer (1995) has analysed the effects of data errors on view-sheds calculated by Geographic Information Systems and has shown that the calculations are extremely sensitive to small errors in the data, and to the resolution of the data and the errors in viewer location and elevation. Other studies have also shown that a view-shed calculated using the same data but with eight different Geographic Information Systems can produce eight different results. Hankinson (1999) also states that view-shed are never accurate and they contain several sources of error and may not always be feasible to separate these errors or to estimate their size and potential effects. It is therefore better to describe a view-shed analysis as a probable view-shed that must be subjected to subsequent field testing and verification.

A probable view-shed can be based on topography only and shows areas that will be screened by intervening hills, mountains etc. A probable topographic view-shed does not take into account heterogeneous and complex natural and man-made elements in the surrounding landscape. Intervening vegetation, buildings or small variations in topography, such as road cuttings are therefore not considered.

Therefore it is a conservative assessment of those areas that may be visually impacted by the planned infrastructure. Increasing sophistication/accuracy of the probable view-shed by the addition of data on complex natural and man-made elements in the landscape is desirable but it will introduce further errors of detail and interpretation in the view-shed analysis.

Visualisation

It must be remembered that any visualisation (3D models, photomontages, photos and maps) of complex natural and man-made elements produce perceptions, interpretations and value judgements that are not always consistent with those that would be produced by actual encounters with the elements represented. Visualisations should therefore be considered an approximation of the three-dimensional visual experiences that an observer would receive in the field and must be subjected to subsequent field testing and verification.

A photomontage is the superimposition of an image onto a photograph for the purpose of creating a realistic representation of proposed or potential changes to any view. The overall aim of photography and photomontage is to represent the landscape context under consideration and the proposed development, both as accurately as is practical. It must be kept in mind that the human eye sees differently than a camera lens both optically and figuratively. The focusing mechanisms of human eyes and camera lenses are different; human eyes move, and the brain integrates a complex mental image; human vision is binocular and dynamic, compared to a camera that tends to flatten an image. It should therefore be noted that the 'experiencing' of visual impacts is subjective and largely based on the perception of the viewer or receptor. The presence of a receptor in an area potentially affected by the proposed development does not thus necessarily mean that a visual impact would be experienced.

CHAPTER SIX

APPLICATION OF THE METHODOLOGY

For a visual impact to be experienced, landscape alterations resulting from the project need to be visible. Visibility of the planned infrastructure from adjoining view locations will be determined by viewing into the planned infrastructure boundaries from a range of potential viewpoints.

There will be locations in the vicinity of the planned infrastructure that will be visually impacted to various levels. For the purposes of the visual impact assessment, a number of sites within key areas of the planned infrastructure boundaries will be selected as representative key viewing locations. The locations are selected with reference to field assessments and aerial photographs to determine the visibility of the planned infrastructure. Whilst there will be some variation in the impacts on specific viewing locations, an overall assessment of the visual impact on the selected locations will be representative for the majority of views experienced.

The visual sensitivity of various viewing areas will be determined by a review of aerial photography, plans of the planned infrastructure, and topographic plans of the surrounding areas. This will include land use, viewing distances and the general level of screening available from topography, buildings and vegetation. The assigned sensitivities will be also evaluated based on field data and other study data.

The visual modification of the planned infrastructure on external viewpoints will be determined by a review of the planned infrastructure, photomontages of the various infrastructure components, provided by the client.

The visual impact of the planned infrastructure will be determined by considering both visual modification and visual sensitivity which, when considered together, determine impact levels. The way in which the visual parameters of visual sensitivity and visual modification are cross referenced are illustrated in Table 1.

Visual impact mitigation strategies will developed for both on site and off site situations to ensure that visual modifications and/or visibility/visual sensitivity factors are decreased to achieve impact mitigation.

Table 1: Visual impact matrix

		Visual sensitivity		
		H HIGH	M MODERATE	L LOW
Visual modification	H HIGH	H	H	M
	M MODERATE	H	M	L
	L LOW	M	L	L
	VL VERY LOW	L	VL	VL



CHAPTER SEVEN

LEGISLATIVE CONTEXT

The IFC prescribes eight Performance Standards (PS) on environmental and social sustainability, the first of which is to identify and evaluate environmental and social risks and impacts of a project, as well as to avoid, minimize or compensate for any such impacts. This is the essence of all impact assessment fields, including visual.

One of the objectives of IFC Performance Standard 6 is to maintain the benefits from ecosystem services. Ecosystem services are organized into four types, with visual/aesthetic benefits falling into the category of cultural services, which are the nonmaterial benefits people obtain from ecosystems. This emotional enrichment that people experience is a non-material benefit that people obtain from cultural ecosystems services, as described by The Millennium Ecosystem Assessment, 2005. Ecosystems and Human Well-being: Synthesis report: "Cultural ecosystems services: the nonmaterial benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences."

One of the aims of visual impact assessments is to protect the integrity of the landscape character that a proposed project will impact on, in order to sustain visual resources for future benefit to, and utilization by, people. This resonates with IFC **Performance Standard 8** that recognizes the importance of cultural heritage for current and future generations. Its objective is to protect cultural heritage from adverse impacts of project activities and promote equitable sharing of benefits gained from the use thereof.

Performance Standard 3 recognizes that increased economic activity and urbanization often generate increased levels of pollution to air, water, and land, and consume finite resources in a manner that may threaten people and the environment at the local, regional, and global levels. The term "pollution" is refers to both hazardous and non-hazardous chemical pollutants in the solid, liquid, or gaseous phases, and includes other components such as pests, pathogens, thermal discharge to water, GHG emissions, nuisance odours, noise, vibration, radiation, electromagnetic energy, and the creation of potential visual impacts including light.

The visual impact assessment methodology of assessing potential impacts on the visual resources of the project area earmarked for the project, and recommending avoidance/mitigation/compensation measures, meets the four IFC Performance Standards applicable to the field of visual assessment, i.e. PS 1, PS 3, PS 6 and PS 8.

Furthermore, the Federal Environmental Protection Agency's (FEPA) Environmental Impact Assessment Sectoral Guidelines for Infrastructures identifies that roads and highways have the potential for impacts to environmental aesthetics especially deep land cuts, major fills and spoil deposits.

CHAPTER EIGHT

DESCRIPTION OF THE EFFECTED ENVIRONMENT

This section of the report establishes the visual character of the existing environment. This is needed to establish the change created by the planned infrastructure and provides a base line against which visual modification is measured.

The landscape setting can be defined in terms topography, vegetation, hydrology and land use features. These elements define the existing visual character of the landscape with which the planned infrastructure interacts.

The project will be located approximately 20km north of Lamu town along the shoreline in the Manda Bay area. Soil types located in the project area dictate the type of vegetation that occur. Silt and sand support scrub bush, scattered palms and swamp grass. In areas less susceptible to flooding, the silty clays support thick bush consisting of palms, indigenous trees and scrubs. Grassy open swampy areas dominate where there are drainage problems due to the low altitude (Plate 7: Figure 17). In general the project area is dominated by evergreen and semi-evergreen bushland and thicket interrupted by pockets of woodland and scrub woodland with scattered trees (Plate 9: Figure 30).

Mangroves strips occur along the shoreline of the project area and the intertidal environment of the creeks and basins supports significant area of mangrove forests (Plate 5: Figure 10). Mangroves in the Lamu area constitute 70% of mangrove forest cover in Kenya and is a major sources of wood for construction of houses, making charcoal and boats (Plate 10).

Coral reefs are found in the form of coral flats, lagoons, reef platforms and fringing reef. Sea grass zones occur between the Mangroves and coral reefs along the shoreline of the project area. Small sandy beaches are scattered in between the patches of mangrove forests.

Within the project area, the population consists of the Bajun, Mijikenda, Boni, Somali, Kikuyu and Sanye who practice farming, fishing, hunting/gathering and charcoal burning and the project area is therefore dominated by cultivated areas. Sesamum indicum is the dominant crop grown by the local farmers and vegetation clearance through slash and burn is evident everywhere in the project area (Plate 6: Figure 15). Small patches of indigenous vegetation remain in the project area. The main mode of transport for local residents is by boat among the islands and between the islands and the mainland (Plate 9: Figure 29).

Lamu stone town and was inscribed in 2000 by United Nations Educational and Scientific Cultural Organization in the list of world heritage sites due to its cultural heritage Outstanding Universal Value (Plate 9: Figure 28). No archaeological sites were found within the project area but some Iron Age sites, graves and mosque ruins were found within the surrounding areas.

The coastal belt of Kenya comprises of the following main topographical features which are closely related to the geological characteristics of the area: the Coastal Plain, the Foot Plateau, the Coastal Range and the Nyika. The altitude of the Coastal Plain is generally less than 45 m above sea level. Lamu District is generally flat and lies between zero and 50 metres above the sea level. The project area has very flat topography and is approximately 20 m above sea level. (Plate 11).



CHAPTER NINE

PROJECT DESCRIPTION

The visual effect of the planned infrastructure is determined by considering the visual characteristics of the planned infrastructure in the context of the landscape within which it is seen.

The project will be located in an area larger than the Kenya Ports Authority (KPA) is seeking to acquire for purposes of the Lamu Port South Sudan Ethiopia (LAPSSET) transport corridor project. The LAPSSET project is an international and regional transport corridor that will traverse the north-eastern part of Kenya and connect directly with Southern Sudan and Ethiopia. The larger area of land will be used for the construction of new port related industries and settlement schemes. (Plate 12).

The LAPSSET study identified a coal fired power plant as part of the transport corridor project. The proposed coal fired power plant project will generate a gross electrical output of 1050MW. The power plant will utilize 68.5MW for its own use and will export a total of 981.5MW to the national grid.

The project will consist of a power plant area, a coal ash yard, a worker housing development, a jetty and a berth. The power plant will consist out of the following individual components (Plates 2):

- Three pulverized coal-fired boilers that will be fuelled by coal.
- Steam turbine generators will be linked to each of the boilers.
- Condensers will be attached to each of the steam turbines.
- An electric switchyard that may include circuit breakers, disconnect switches, generator step-up transformers, auxiliary power transformers, steel structures and a control building.
- Water treatment facility will be constructed to treat raw water, feed water to the plant, condensate and once through cooling water. The water treatment facilities would include a desalination plant, water treatment building, water storage tanks, chemical storage tanks, clarifiers and demineralizers.
- Air pollution control equipment will be connected to each of the pulverized coal-fired boilers
- A pulverized coal-fired boiler stack will be connected to each boiler. The three stacks will be contained within a reinforced concrete chimney whose height will be approximately 210m tall.
- Coal will be the primary fuel for the station and would be delivered to the power plant site by barges that will travel from the entrance to Manda Bay up to the project site. When the power plant is at full operation about 10,000 metric tons of coal per day will be used.
- A new jetty and berth will be constructed for the power plant site (Plate 8: Figure 22, 24 & 25)
- The coal unloading jetty will have one to two off-loading cranes.
- The cranes will off-load coal from the barges and place it on a conveyor belt system with dust suppression systems to minimise dust emissions.
- The design of the power plant includes a provision for receiving coal using by rail in the future.
- Coal will be stored in 16 ha outdoor coal storage yards on the project site and a water spray system will suppress dust.
- A sewage treatment and coal settling pond will be constructed within the coal stock pile areas.
- Dust minimizing conveyor belts will transport the coal from the coal storage yards to the power plant.
- The coal stockpiles will be managed by using equipment such as stackers, re-claimers, bulldozers and front end loaders.
- Coal will pass through in door crushers and pulverisers before entering the power plant.

- Additional facilities such as buildings to house equipment and conduct administration, operations and maintenance activities; warehouses; electrical switchgear buildings; various pumps, motors and fans; fuel and chemical storage tanks/areas; lime/limestone, ammonia and mercury sorbent storage and handling equipment; fire protection, security and safety systems; storm water facilities; continuous emissions monitoring systems; and back-up electric generators may be constructed.
- During construction it is anticipated that there will be 2000–3000 workers at the project site. An onsite construction worker housing (colony) for a 1000 workers will be located within the power plant site. A modular, dormitory style community housing facilities would be used as the living quarters and each dormitory would be prefabricated and erected on a concrete slab. The primary infrastructure to support the construction worker housing would be potable water systems, sanitary wastewater treatment, and electric power and communication lines. The remaining workers will reside in offsite housing.
- During the operational phase approximately 500 workers will be based within the power plant. An area of about 7 ha within the project site has been set aside for housing the operational phase workers.
- Parking areas would be provided throughout the construction area and surfaced with crushed aggregate or gravels.
- An on-site solid waste disposal facility will be constructed and operated for the disposal of coal combustion by-products including fly ash, bottom ash, economizer ash, scrubber by-products and coal rejects.
- A water supply system will provide water for construction, process, cooling, potable, and fire protection purposes.
- One or more borrow areas would be established to provide earth and rock materials during site preparation and throughout the construction process. The location of the borrow areas will be determined during the detailed engineering design phase of the project.
- The location of the borrow pit(s) will be based on lab tests to determine the suitability of earth and rock for construction of the power plant. This will be determined during the detailed engineering design phase of the project

Construction phase

The construction phase of the project is expected to commence at the beginning of 2016 subject to receiving all regulatory approvals and securing financing. The main components that will be constructed during the construction phase of the project would include the power island, coal storage and handling, waste handling and disposal, water supply system and access roads.

The first unit should be commissioned in 36 months from the construction commencement date, followed by the second unit in 39 months and the third unit in 42 months from the construction start date respectively. Construction phase of the proposed project would include the following main stages:

- Pre-construction works;
- Surveying, site clearing, site preparation, and mobilization;
- Construction of foundations and below grade utilities;
- Building and equipment installation;
- Start-up, commissioning, and testing; and
- Site cleanup and project closeout.

Site clearing and preparation will involve the use of heavy, diesel powered equipment such as scrapers, bulldozers, dump trucks, bulldozers, and front-end loaders. Vegetation will be cleared and top soil will be stripped and stockpiled, back-filled and/or spread on site. The site preparation work would provide necessary grading for the plant facilities, establish access roads and parking areas for construction workers, and establish construction lay-down areas on the site.

Warehouses, mechanic shops, onsite housing facilities, and installation of construction utilities (water, power, sewer, communication) and security facilities (guardhouse, fencing) will be established on site. Earth and rock materials would be used during site preparation and throughout the construction process. The earth and rock materials would

be transported by trucks to the various construction areas via internal access roads (Plate 3: Figure 1).

Laydown areas will be established to accommodate materials required for the construction of various components of the power plant such as contractor's yards, buildings, camps, waste management area, fuel facility, etc.

The access road to the project site is a 2.5m wide dirt road that will not be adequate to transport heavy equipment to the project site. A road of about 12-15m wide and 14km long will be constructed over the existing road. The road will start at a point 4km north of Hindi-Bargoni road and go north-east to the south-western part of the project area.

A significant amount of equipment for the power plant will arrive via sea and will likely be off-loaded at a temporary landing area such as a jetty close to the project site. The exact location of the jetty will be only known during the detailed engineering design phase of the project.

Water will be required for construction activities including the need for potable water, sanitary facilities, fire protection, concrete production, and dust control. It is anticipated that two wells on site will provide an adequate water supply for the project via a water supply system that will be constructed.

The construction phase of the project will require an adequate and reliable source of electricity for various construction and support activities such as worker housing facilities, water supply system, construction trailers and start-up, testing and commissioning of the power plant.

Diesel powered generators will provide electricity for the various construction and support activities such as worker housing and water supply system. Cables from the diesel powered generators will be laid in conduits which in turn will be placed within trenches and taken to where the power is required.

There will be watch towers constructed at all corners of the power plant to be used during the construction and operational phases of the project.

Security infrastructure would consist of a security office to provide space and facilities for security personnel, a guardhouse for security personnel at the entrance to the power plant site, security fencing around the power plant site, watch towers at all corners of the power plant and security vehicles to patrol the site.

Reinforced concrete foundations will be constructed for most elements of the power plant. Foundations will be excavated mechanically and would involve heavy equipment such as excavators, dozers, loaders, concrete trucks, mixers, vibrators, pumps, trench digging equipment, and welding equipment. Concrete is proposed to be batched on-site for the foundations and ground slabs. Underground piping and electrical installation would begin in areas at or near foundations prior to the foundations being established. On completion of the foundation work multiple cranes will be used to erect steel and equipment. Equipment will be delivered by truck and ship.

The complete water supply system would be constructed prior to the start-up and commissioning of the project. The construction of the water supply system would involve the installation of a borehole complete with a submersible pump and, underground water pipeline within the project area. A desalination plant will be constructed for the operational phase of the project.

Waste generated during construction activities would be recycled as far as possible. Any non-recycled wastes would be collected and disposed of at the onsite solid waste disposal facility or transported to a NEMA or County approved disposal facility, as applicable. Portable toilets would be provided for onsite sewage handling during construction.

Once the major components of the power plant have been constructed the various subsystems would be tested,

started up, commissioned, and prepared for operations. Near the end of the construction phase, steam would be generated in the boiler and released to the atmosphere to clean the steam piping.

The final phase of power plant construction would include clean-up of the site, landscaping, completion of miscellaneous tasks, and teardown and removal of temporary construction facilities; the site will be rehabilitated where practical and reasonable. On full commissioning of the project, any access points to the site which are not required during the operational phase, will be closed and prepared for rehabilitation.

Operational phase

During the operational phase of the project over 350 full-time workers will ensure the operation of the equipment to produce electricity, handling of coal, disposal of coal combustion by-products, and routine maintenance of plant equipment. The workers will be housed in a housing estate on situated on project site. Water needs during operation would be supplied through sea water from the Manda bay which will be treated in an on-site desalination plant, demineralizer and disinfection system.

The power plant would be operated to serve base load electric needs, rather than intermediate or peaking electric needs, and would provide approximately 981.5MW of new base load coal-fired electric generation capacity (Plate 3: Figure 2).

Access to the power plant site would be from an existing dirt road that would be widened and paved. Access roads would be constructed as needed on the power plant site to serve the project's needs. Vehicle traffic during power plant operations would include employee vehicles traveling to the site, deliveries to the site, and onsite vehicles handling coal and coal combustion by-products.

Public access to the power plant site would be restricted through the use of fencing and security gates. The site would be equipped with industry recognized fire suppression systems. The power plant will include spill-containment dikes and collection systems around chemical storage areas and fuel tanks.

The power plant site would be fenced to restrict public access for safety and security reasons. Permanent signage is expected to include a sign along Mokowe – Bargoni Road indicating the name of the project and signage directing traffic on the power plant site.

Decommissioning phase

The project is anticipated to have a commercial life of 25 years or longer, dependent on proper maintenance. At the end of its commercial life, decisions would be made regarding continuing to use the power plant site for electric generation purposes or another industrial use.

The property will have a significant infrastructure in place (water supply system, electric transmission facilities) at the end of its commercial lifespan and would therefore be ideal for continued use as a site for an electric generation facility or for another industrial use.

Once the power plant permanently ceases operation of the power plant, the power plant footprint would be demolished with foundations left in place, and the power plant site restored to a condition suitable for future industrial use. Onsite electric transmission and water facilities would be left in place to support a future use of the property.

CHAPTER 10

IMPACT ASSESSMENT

This section defines the visual impact that is experienced from various view locations around the project areas. The visual impact will vary according to the visual modification of the planned infrastructure, its visibility and the visual sensitivity of areas from which it is seen. The potential sensitive viewing locations around the planned activities include rural residences, roads and conservation areas.

Table 2: Location of key viewing locations

Key viewing locations	Plate
A	1
B	1
C	1
D	1
E	1
F	1
G	1
H	1
I	1
J	1
K	1
L	1
M	1

According to Oberholzer (2005) a visual 'trigger' means a characteristic of either the receiving environment or the proposed project which indicates that visibility and aesthetics are likely to be key issues and may require a visual impact assessment.

In Table 3 (Oberholzer 2005) shows a possible range of environments, from the most visually sensitive to the least sensitive on the Y axis, and a range of development types from the least intensive to the most intensive on the X axis. The correlation of environment types with development types leads to varying levels of expected visual impact, on a scale from none to very high.

It must be noted that the table below should not be regarded as a comprehensive list of landscape/land use types and development categories, and does not replace the need for a comprehensive, systematic scoping process to identify the range of issues arising from a particular development.

Development category description:

- Category 1 development:
This would include nature reserves, nature-related recreation, camping, picnicking, trails and minimal visitor facilities.
- Category 2 development:
This would include low-key recreation / resort / residential type development, small-scale agriculture / nurseries, narrow roads and small-scale infrastructure.
- Category 3 development:
This would include low density resort / residential type development, golf or polo estates, low to medium-scale infrastructure.

- Category 4 development:
This would include medium density residential development, sports facilities, small-scale commercial facilities / office parks, one-stop petrol stations, light industry, medium-scale infrastructure.
- Category 5 development:
This would include high density township / residential development, retail and office complexes, industrial facilities, refineries, treatment plants, power stations, wind energy farms, power lines, freeways, toll roads, large scale infrastructure generally. Large-scale development of agricultural land and commercial tree plantations. Quarrying and mining activities with related processing plants.

Table 3: Key categories of development

Type of environment	Level of intensity				
	Category 1 development	Category 2 development	Category 3 development	Category 4 development	Category 5 development
Protected/wild areas of international, national, or regional significance	Moderate visual impact expected	High visual impact expected	High visual impact expected	Very high visual impact expected	Very high visual impact expected
Areas or routes of high scenic, cultural, historical significance	Minimal visual impact expected	Moderate visual impact expected	High visual impact expected	High visual impact expected	Very high visual impact expected
Areas or routes of medium scenic, cultural or historical significance	Little or no visual impact expected	Minimal visual impact expected	Moderate visual impact expected	High visual impact expected	High visual impact expected
Areas or routes of low scenic, cultural, historical significance / disturbed	Little or no visual impact expected. Possible benefits	Little or no visual impact expected	Minimal visual impact expected	Moderate visual impact expected	High visual impact expected
Disturbed or degraded sites / run-down urban areas / wasteland	Little or no visual impact expected. Possible benefits	Little or no visual impact expected. Possible benefits	Little or no visual impact expected	Minimal visual impact expected	Moderate visual impact expected

According to Table 3 the project is classified as a Category 5 development in an area of medium scenic and cultural significance. The contrast created by the project is directly related to its size and scale as compared to the surroundings in which it is placed and the project will therefore create a high level of contrast. A high visual impact is therefore expected with a potential intrusion on the existing landscape creating a noticeable change in the visual character of the area.

The greater the viewing distances, the lower the visual sensitivity. The visual modification of a development is assumed to be the highest when the observer is very close to it and has a direct line of site. Visibility reduces dramatically in the background and seldom seen zones that in turn decreases the visual modification created by the infrastructure due to the increased viewing distance.

The view shed analysis (based on topography alone) indicates that project components will be visible to people moving within the foreground-middle ground zone (the area that can be seen for a distance of 0 - 10 kilometres) around the project. The project will be highly visible within the 5km zone around the project and a low visibility is experienced beyond the 10km zone (**Plate 12**) except for the reinforced concrete chimney whose height will be approximately 210m tall and will be visible beyond the 10km zone.

The photomontage from observation point A (Plate 9: Figure 27) shows that the project will be visible from the edge of the 5km zone. The photomontage for observation points C, G1, G2 and I shows that the project will be highly visible to people travelling by boat and foot close to the project area (Plate 4, 5 & 6). The project will not be visible from observation point F due to the high vegetation screening the views of the project.

A line of sight analysis is a graphic line between two points on a surface that shows where along the line the view of a project is obstructed. Red lines indicate obstructed areas from the observer point and green lines are visible areas from the observer point. The line of sight analysis from observer point A and M indicates that the concrete chimney will be highly visible from these areas but very little will be seen from Observation point O (**Plate 11**).

The visual absorption capacity is defined as the potential of the landscape to conceal the proposed project that will in turn reduce or increase visual sensitivity. High vegetation, existing developments or a hilly terrain increases the visual absorption potential of the landscape. The project landscape has a very low visual absorption capacity largely due to the flat topography (**Plate 11**) of the area and the lack of micro-topographical features such as natural vegetation that can screen views of the project. The lack of screening vegetation is largely due to agricultural practices such as slash and burn that occurs throughout the project area and only small pockets of natural vegetation remains (**Plate 5: Figure 8 & 9**).

The project will be a high intensity and large-scale infrastructure project lying outside any defined urban edge or industrial area and will therefore create an initial change to the fabric and character of the landscape. The inter-relationship with land uses in adjacent lands can affect the visual sensitivity of an area. A project located within the view-shed of a tourist resort may for example be very sensitive, whereas an area surrounded by commercially developed lands may not be visually sensitive. As the Lamu Port South Sudan Ethiopia (LAPSSET) transport corridor is implemented the visual character of the area surrounding the project site will change to a commercially developed zone (**Plate 13**). The projects impact on the visual character of the area will therefore decrease over time as the area surrounding the power station is developed into a commercial area.

Protection of visual values usually becomes more important as the number of viewers increase. The project area in general is not used by large numbers of people and the visual sensitivity should therefore be less. If local people and tourists in the area have only a brief glimpse of the planned infrastructure, the visual modification may not be of great concern and the visual sensitivity low. Local people and tourist in the area are generally moving slowly through the area either by foot, boat or motorbike creating longer viewing periods of the project that increases the visual modification and sensitivity.

No formal residential, tourist and/or recreation areas with a strong visual orientation towards the project exist in close proximity to the project that will increase the visual sensitivity of the project. The current main users of the project area and surrounding areas is very much limited to local subsistence farmers with very few recreational sightseers. Recreational sightseers are more sensitive to any changes in visual quality, whereas the farmers in the area who pass through the area on a regular basis may not be as sensitive to the change created by the project.

No special areas such as wilderness areas or national parks that require special consideration for the protection of the visual values occur in close proximity to the project area. Lamu town occurs within the background zone so the project will not be visible except for the 210m high concrete chimney

Contrast in form results from changes in the shape and mass of landforms or structures. The degree of change depends on how dissimilar the introduced forms are to those continuing to exist in the landscape. The large shape and mass of the various project structures will create contrast within the existing landscape because they are very dissimilar to the natural shape and forms existing in the landscape. The project infrastructure will introduce new lines, colours and textures into the existing landscape that will create contrast and increase the level of visual modification (**Plate 3: Figure 2**).

Construction activities and an increased movement of construction vehicles and the associated increase in noise and dust levels will create high level of visual sensitivity and modification. Although the project is located in a largely transformed landscape the construction activities related to such a large construction project will create an expected high level of visual modification. A high level of visual sensitivity is expected due to the construction

activities and people being in close proximity with direct views of the project area. **(Plate 3: Figure 1)**.

Effective light management needs to be incorporated into the design of the lighting to ensure that the visual influence is limited to the power station. Currently no electrical lights are present in the project area due to a lack of electricity and light sources are limited to open fires and battery operated light sources. The project visual influence of the project lighting during the night will be significant during the construction and operational phase but will decrease over time as the LAPSSET project is implemented and the surrounding areas are developed **(Plate 3: Figure 3)**.

During the construction phase of the project the visual sensitivity and modification levels will be high due to construction activities involved during the day and night. Construction activities will be very visible due to the low visual absorption capacity of the landscape and mitigation measures will not be able to reduce the impact. During the operational phase of the project concrete chimney will create a high visual impact due to its height and mitigation measures will not be able to reduce the impact. The successful implementation and maintenance of mitigation measures will reduce the visual impact of the power plant area, coal ash yard, jetty and worker housing development. Some components of the LAPSSET project should be developed during the operational phase of the project and would change the surrounding landscape to commercial area and will therefore increase the visual absorption capacity of the landscape and the projects visual impact. During the decommissioning phase of the project the visual impact would be low and it is envisaged that most of the infrastructure will be integrated into the LAPSSET project area **(Table 4)**.

Development within a landscape may not be perceived negatively at all if the development is associated with progress or up-liftment of the human condition. It is therefore important to note that the communities in the surrounding areas might see the project as a positive contribution to the local economy by improving electricity supply and creating new business opportunities.

Once the construction phase of the project has been completed it is critical that mitigation measures implemented during and after the construction phase are monitored and maintained where required. This would include the regular monitoring and maintenance of re-vegetated areas especially at disturbed sites and on constructed slope areas until they have established successfully.

Table 4: EIA Study risk matrix

Planned infrastructure	Plate	Phase	Visual sensitivity	Visual modification level	Impact	Impact after mitigation	Extent	Magnitude	Duration	Probability	Environmental risk
Power plant	1-3	Construction	High	High	High	High	2	6	2	5	50
Coal ash yard	1-3	Construction	High	High	High	High	2	6	2	5	50
Concrete chimney (210m)	1-3	Construction	High	High	High	High	2	6	2	5	50
Jetty and berth	1-3	Construction	High	High	High	High	2	6	2	5	50
Worker housing development	1-3	Construction	High	High	High	High	2	6	2	5	50
Power plant area	3	Operational	Medium	High	High	Medium	2	4	4	4	40
Concrete chimney (210m)	3	Operational	High	High	High	High	2	4	4	4	40
Coal ash yard	3	Operational	Medium	High	High	Medium	2	4	4	4	40
Jetty and berth	3	Operational	Medium	Medium	Medium	Low	2	4	4	4	40
Worker housing development	3	Operational	Medium	Medium	Medium	Low	2	4	4	4	40
Power plant area	-	Decommissioning	Low	Medium	Low	Low	2	2	1	3	15
Concrete chimney (210m)	-	Decommissioning	Low	Medium	Low	Low	2	2	1	3	15
Coal ash yard	-	Decommissioning	Low	Medium	Low	Low	2	2	1	3	15
Jetty and berth	-	Decommissioning	Low	Medium	Low	Low	2	2	1	3	15
Worker housing development	-	Decommissioning	Low	Medium	Low	Low	2	2	1	3	15

CHAPTER ELEVEN

VISUAL MITIGATION AND MANAGEMENT

Visual mitigation principles

General visual mitigation principles to reduce visual impact can be categorised as:

- On site treatments to reduce visual effects; and
- Treatments at viewer locations to reduce visual sensitivity.

On site treatments involve rehabilitation of land forms and land cover, while viewer location treatments involve a range of treatments to screen views, filter views and/or re-orientate primary views.

On site treatments might include:

- Visual and ecological planting patterns of indigenous vegetation to achieve landscape patterns that emulate in part existing mixes of tree and grass cover in the surrounding landscape.
- Minimising exposure of work areas to sensitive receptors.
- Preparing an internal landscape plan for rehabilitation areas.

At viewer location treatments include:

- Landscape design and plantings for affected locations. This will require an appropriately qualified person to visit the affected locations and develop a landscape plan to screen or filter views to the project areas.

Design fundamentals are general design principles that can be used for all forms of activity or development, regardless of the resource value being addressed. Applying the following three fundamentals will assist with mitigation measures:

- Proper siting or location.
- Reducing unnecessary disturbance.
- Repeating the elements of form, line, colour and texture of the surrounding landscape.

Design strategies are more specific activities that can be applied to address visual design problems. The following strategies will not necessarily be applicable to every proposed activity or project:

- Colour selection
- Earthwork
- Vegetative manipulation
- Structures
- Reclamation/restoration
- Linear alignment design considerations

The fundamentals and strategies mentioned above are all interconnected, and when used together, can help resolve visual impacts from proposed activities or developments.

Mitigation measures

The following mitigation should be considered when constructing the proposed infrastructure for this project to reduce the visual impact. The following list provides more detail in relation to the principles described above and in relation to the mitigation measures proposed in Table 4.

Reducing unnecessary disturbance

As a general rule, reducing the amount of land disturbed during the construction of a project reduces the extent of visual impact. Measures relevant to the project include:

- Retain as much of the existing vegetation as possible and where practical to screen construction activities from key viewing locations. This is also referred to as vegetation manipulation.
- Establish limits of disturbance that reflect minimum area required for construction.
- Existing vegetation should be retained where possible through use of retaining walls.

Colour selection

The selection of the best colour for the planned project will have the greatest impact on the visual success or failure of the project. Strong contrasts in colour create easily recognizable visual conflicts in the landscape. Measures relevant to the project include:

- The selection of colours that blend with or are in harmony with the surrounding landscape will drastically reduce the visual impact of the project. Such colours would include tonal variations of existing colours in the surrounding landscape. Contrasting but discordant colours that stand out in the landscape should be avoided.
- Select colours for smooth structures that are two or three shades darker than the background colours to compensate for shadow patterns created by natural textures that make colours appear darker.
- Galvanized steel on structures should be darkened to prevent glare. Low lustre paints should be used wherever possible to reduce glare.

Reduce contrasts from earthworks

The scars left by excessive cut and fill activities during construction often leave long-lasting negative visual impacts. Once the dark surface soil layer is disturbed, exposing the much lighter colour of the subsurface soil, a strong contrast is created that may take many years to recover.

There are a number of ways to reduce the contrasts created by earthwork construction. Proper location and alignment are the most important factors. Fitting the proposed project infrastructure to the existing landforms in a manner that minimizes the size of cuts and fills will greatly reduce visual impacts from earthwork. Other earthwork design techniques, such as balancing cut and fill or constructing with all fill or all cut should be considered, where appropriate, as methods to reduce strong visual impacts. Measures relevant to the project include:

- The scars left by excessive cut and fill activities during construction often leave long-lasting negative visual impacts. Where possible fitting the proposed project infrastructure to the existing landforms in a manner that minimizes the size of cuts and fills will greatly reduce visual impacts from earthwork.
- The dumping of excess rock and earth on downhill slopes should be limited.

Restoration and reclamation

Strategies for restoration and reclamation are very much similar to the design strategies for earthwork, as well as the design fundamentals of repeating form, line, colour, and texture and reducing unnecessary disturbance. The objectives of restoration and reclamation include reducing long-term visual impacts by decreasing the amount of disturbed area and blending the disturbed area into the natural environment while still providing for project operations.

Though restoration and reclamation are a separate part of project design, they should not be forgotten or ignored. It is always a good idea to require a restoration/reclamation plan as part of the original design package. All areas of disturbance that are not needed for operation and maintenance should be restored as closely as possible to previous conditions. Measures relevant to the project include:

- The objective of restoration and reclamation efforts is to reduce the long-term visual impacts by decreasing the amount of disturbed area and blending the disturbed area into the natural environment while still providing for project operations.
- Topsoil should be stripped, saved, and replaced on earth surfaces disturbed by construction activities.

- Planting holes should be established on cut/fill slopes to retain water and seeds.
- Indigenous plant species should be selected to rehabilitate disturbed areas.
- Where possible rehabilitation efforts should emulate surrounding landscape patterns in terms of colour, texture and vegetation continuum's.
- Replacing soil, brush, rocks and forest debris over disturbed earth surfaces when appropriate, thus allowing for natural regeneration rather than introducing an unnatural looking grass cover.
- Re-vegetation of disturbed areas should occur as soon as practicable possible after the completion of various construction activities.

Lighting design

Effective light management needs to be incorporated into the design of the lighting to ensure that the visual influence is limited to the power station, without jeopardising operational safety and security.

A number of measures can be implemented to reduce light pollution and those relevant to the project are as follows:

- Where possible construction activities should be conducted behind noise/light barriers that could include vegetation screens.
- Low flux lamps and direction of fixed lights toward the ground should be implemented where practical. Choose "full-cut off shielded" fixtures that keep light from going uselessly up or sideways. Full-cut off fixtures produce minimum glare. They increase safety because you see illuminated people, cars, and terrain, not dazzling bulbs. If you can see the bright bulb from a distance, it's a bad light. With a good light, you see lit ground instead of the dazzling bulb. "Glare" is light that beams directly from a bulb into your eye.
- The design of night lighting should be kept to a minimum level required for operations and safety
- Utilisation of specific frequency LED lighting with a green hue on perimeter security fencing.
- Where feasible, put lights on timers to turn them off each night after they are no longer needed.

Once the construction phase of the project has been completed it is critical that mitigation measures implemented during and after the construction phase are monitored and maintained where required. This would include the regular monitoring and maintenance of re-vegetated areas especially at disturbed sites and on constructed slope areas until they have established successfully.

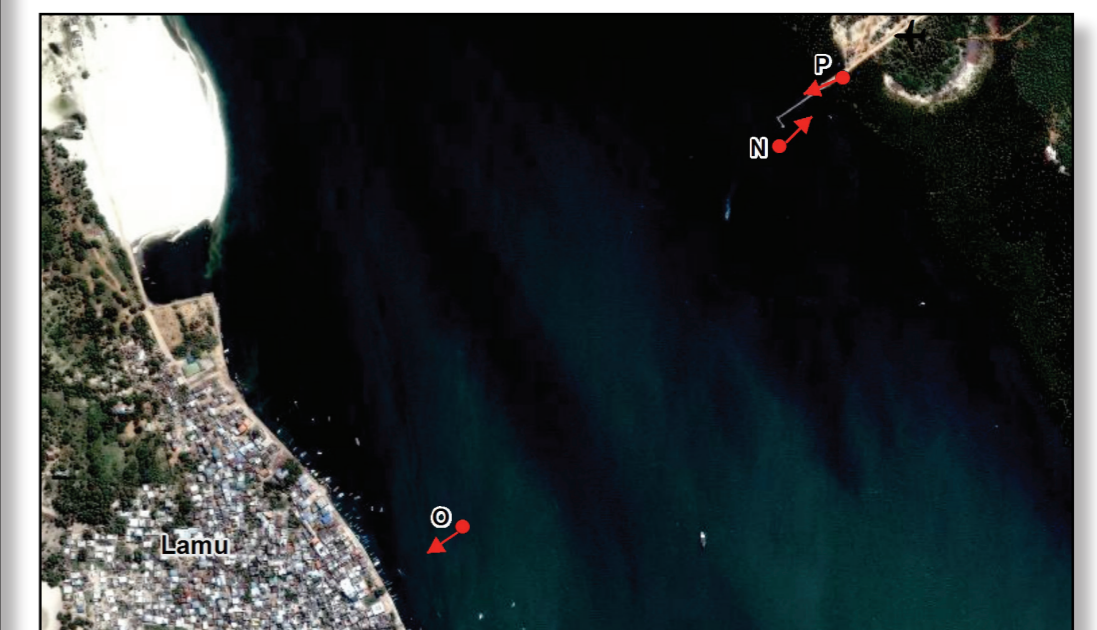
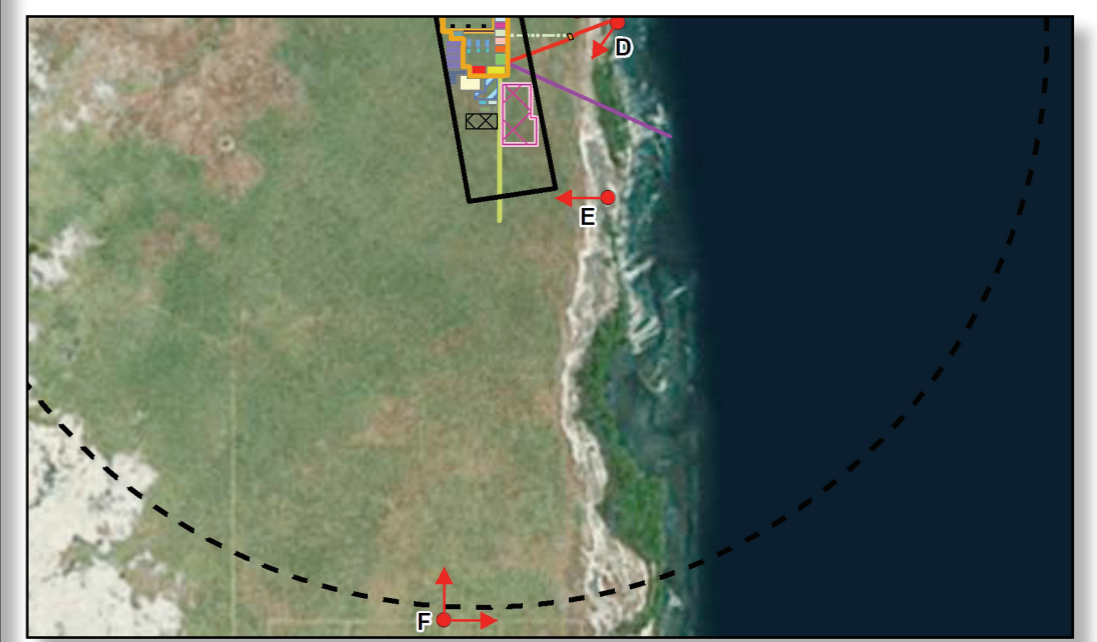
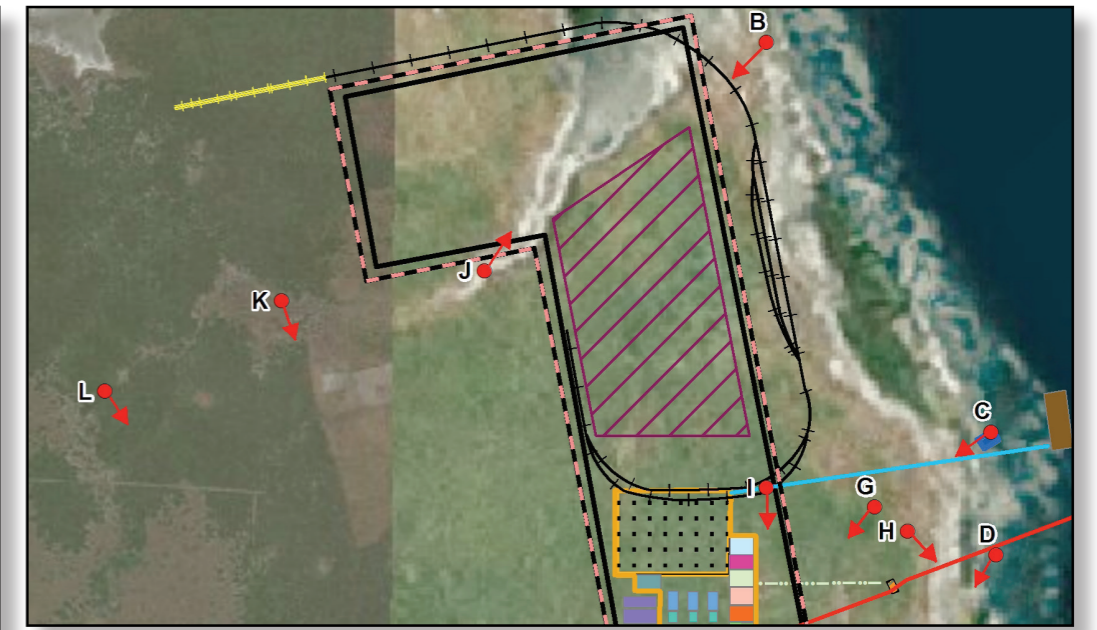


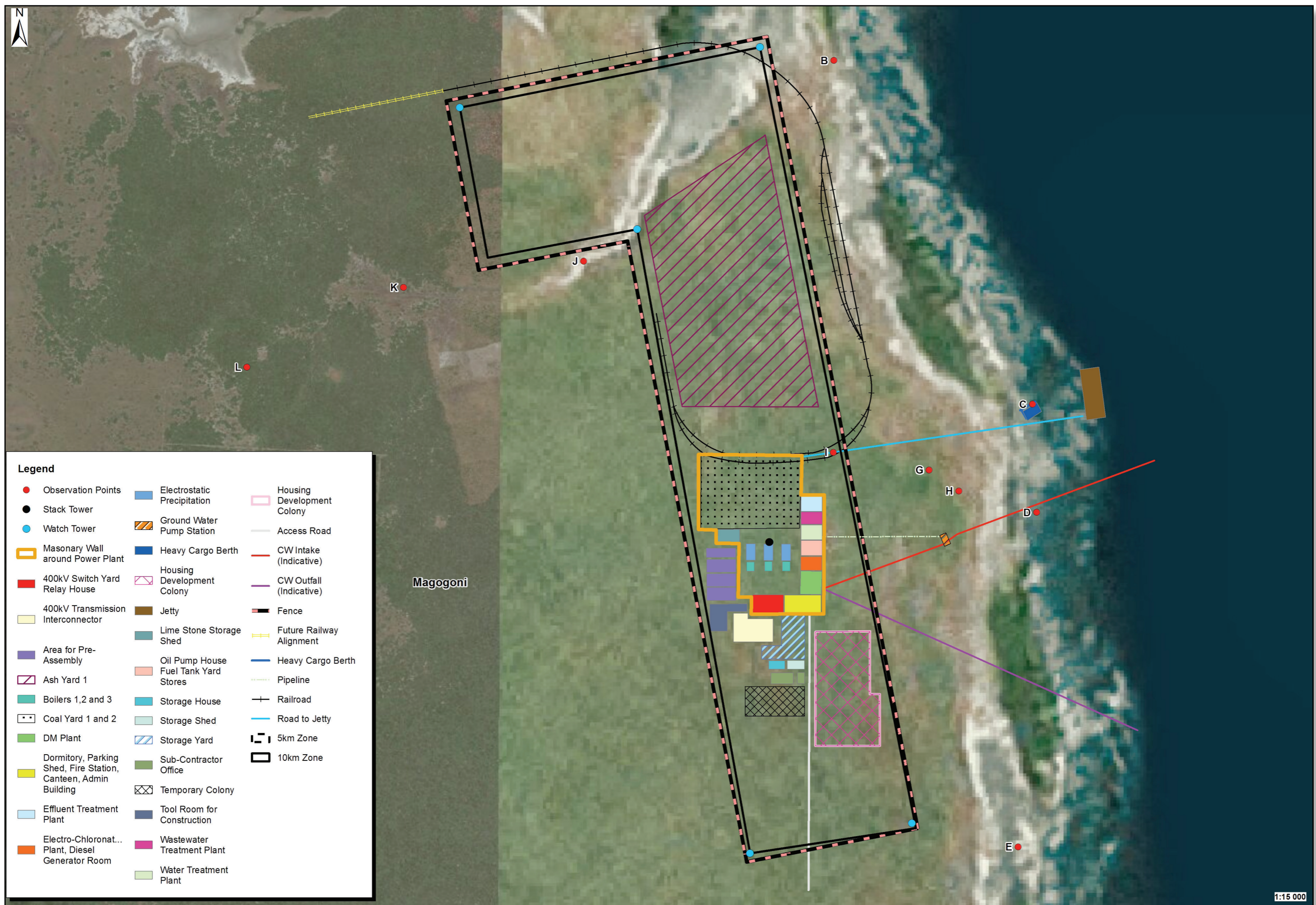
CHAPTER TWELVE

REFERENCES

- 1 AEA Technology plc (AEAT). (1998). Power Generation and the Environment - a UK Perspective, Volume 1. Report AEAT 3776. Culham, Oxfordshire.
- 2 Atkins Planning. (1986). First Report on the Visual Impact of Large Wind Turbines, Report ETSU-WN-1057/1.
- 3 Bergsjö, A., Nilsson, K., & Skarback, E. (1982). Wind Power in the Landscape. Fourth Symposium on Wind Energy Systems, 21-24 September 1982, (p. Paper N2). Stockholm, Sweden.
- 4 Bishop, I. D (no date). Determination of thresholds of visual impact: the case of wind turbines: Environment and Planning B: Planning and Design.
- 5 British Wind Energy Association (BWEA). (1994). Best Practice Guidelines for Wind Energy Development. London.
- 6 Council of Europe (2000). The European landscape convention. Strasbourg: Council of Europe.
- 7 Fisher, P F (1995). An exploration of probable view-sheds in landscape planning. Environment and Planning B: Planning and Design 22, 527-546.
- 8 Hankinson, Moira (1999). Landscape and Visual Impact Assessment. In Petts, Judith (Ed), Handbook of Environmental Impact Assessment. Volume 1. Blackwell Science, Oxford, pp347-373.
- 9 Hill, M, Briggs, J, Minto, P, Bagnall, D, Foley, K & Williams, A (2001). Guide to Best Practice in Seascape Assessment. Maritime Ireland/Wales INTERREG Report No 5. The Marine Institute, Dublin.
- 10 Mazehan, S.M., Shuib, B.K., and Hashim, H., 2013, Value of Rural Landscape from Public Perspectives, Proceedings of the International Conference on Social Science Research, ICSSR 2013 (e-ISBN 978-967- 11768-1-8). 4-5 June 2013, Penang, Malaysia
- 11 McKenna, G., 2009. Techniques for creating Mining Landforms with Natural appearance. Techniques for creating mining landforms with natural appearance, Proceedings of Tailings and Mine Waste Conference. Banff, Alberta. November 2009. The University of Alberta Geotechnical Centre, Edmonton.
- 12 Miller, David R & Morrice, Jane G (no date). A Geographical Analysis of the Intervisibility of the Coastal Areas of Wales. Unpublished report, Macaulay Land Use Research Institute, Aberdeen.
- 13 Panero, Julius and Zelnik, Martin (1979). Human Dimension & Interior Space — A Source Book of Design Reference Standards, The Architectural Press Ltd. London.
- 14 Hull, R. B. I., & Bishop, I. D. (1988). Scenic impacts of electricity transmission towers: the influence of landscape type and observer distance. Journal of Environmental Management, 27, 99-108.

- 15 Oberholzer, B. (2005). Guideline for involving visual & aesthetic specialists in EIA processes: Edition 1. CSIR Report No ENV-S-C 2005 053 F. Republic of South Africa, Provincial Government of the Western Cape, Department of Environmental Affairs & Development Planning, Cape Town.
- 16 Pun, D.P., 2004, Rural Landscape Change: Landscape Practices, Values and Meanings. The Case of Jagatpur VDC, Chitwan Nepal, Master of Philosophy in Social Change - Department of Geography, Norwegian University of Science and Technology (NTNU), Trondheim, Norway
- 17 Schor, H.J. and Gray, D.H., 2007. Landforming: an environmental approach to hillside development, mine reclamation and watershed restoration. John Wiley & Sons, Hoboken, NJ. 35
- 18 The Landscape Institute and the Institute of Environmental Management & Assessment - Guidelines for Landscape and Visual Impact Assessment (2005). Second Edition. Guidelines for Landscape and Visual Impact Assessment.
- 19 Transport Research Board, National cooperative highway research program, Report 741, Evaluation of Methodologies for Visual Impact Assessments. Washington, D.C. (2013).
- 20 United States Department of Interior, Bureau of Land Management (1984), Visual resource management: Washington, D.C., BLM Manual Handbook H-8400, Rel. 8-24.
- 21 United States Department of Agriculture - Forestry Service (1995). Landscape Aesthetics: A Handbook for Scenery Management. Handbook Number 701.
- 22 Velarde, M.D., Fry, G., and Tveit, B., 2007. Health effects of viewing landscapes – Landscape types in environmental psychology. *Urban Forestry & Urban Greening* 6 (2007) 199–212.





Legend

● Observation Points	■ Electrostatic Precipitation	□ Housing Development Colony
● Stack Tower	■ Ground Water Pump Station	— Access Road
● Watch Tower	■ Heavy Cargo Berth	— CW Intake (Indicative)
■ Masonary Wall around Power Plant	□ Housing Development Colony	— CW Outfall (Indicative)
■ 400kV Switch Yard Relay House	■ Jetty	— Fence
■ 400kV Transmission Interconnector	■ Lime Stone Storage Shed	— Future Railway Alignment
■ Area for Pre-Assembly	■ Oil Pump House Fuel Tank Yard Stores	— Heavy Cargo Berth
■ Ash Yard 1	■ Storage House	— Pipeline
■ Boilers 1,2 and 3	■ Storage Shed	— Railroad
■ Coal Yard 1 and 2	■ Storage Yard	— Road to Jetty
■ DM Plant	■ Sub-Contractor Office	— 5km Zone
■ Dormitory, Parking Shed, Fire Station, Canteen, Admin Building	■ Temporary Colony	— 10km Zone
■ Effluent Treatment Plant	■ Tool Room for Construction	
■ Electro-Chlorination Plant, Diesel Generator Room	■ Wastewater Treatment Plant	
	■ Water Treatment Plant	

Figure 1: Example of a coal power plant under construction



Figure 2: Example of a coal power plant in operation



Figure 3: Example of a power plant at night

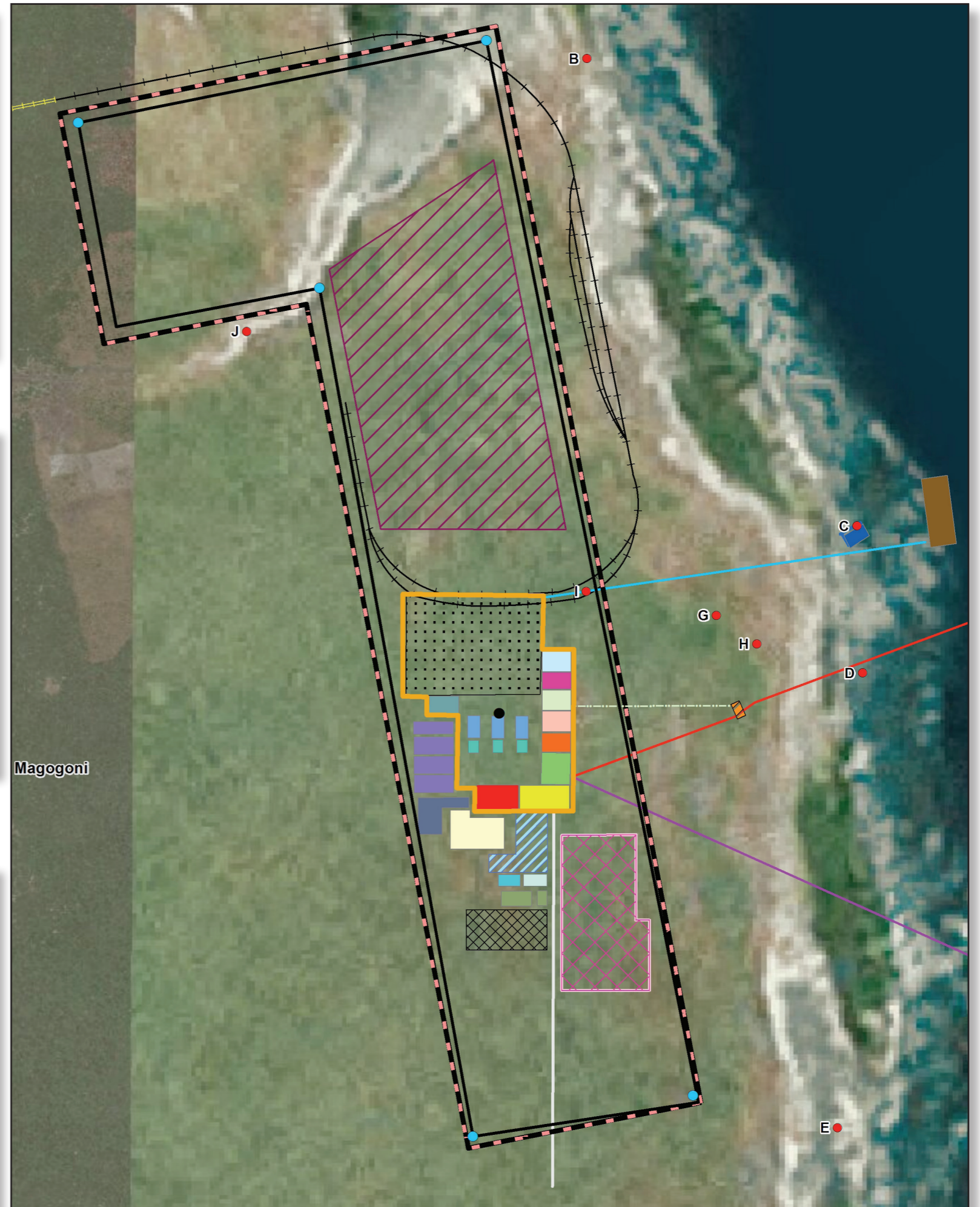


Figure 4: Project layout

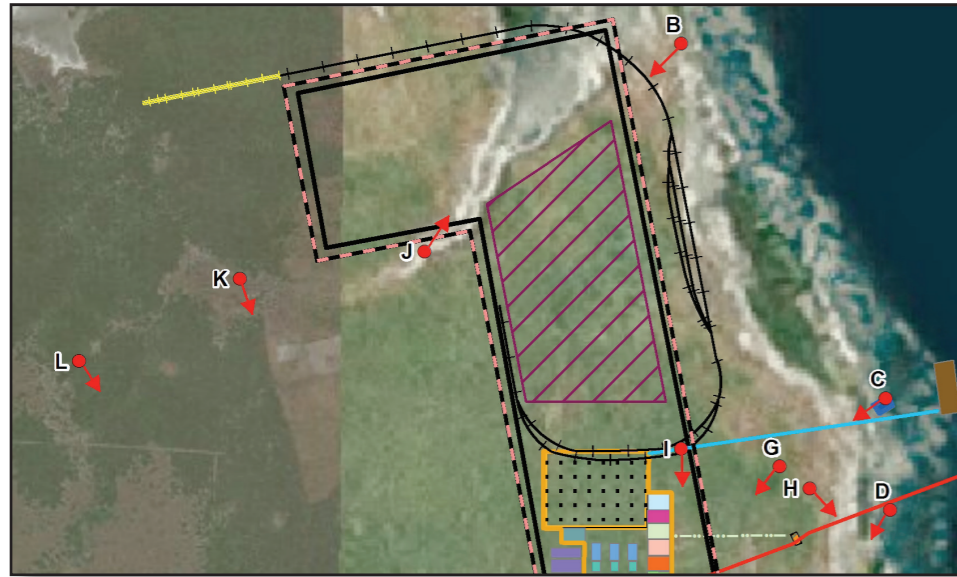


Figure 5: Photomontage from observation point B



Figure 6: Photomontage from observation point C



Figure 7: Project layout

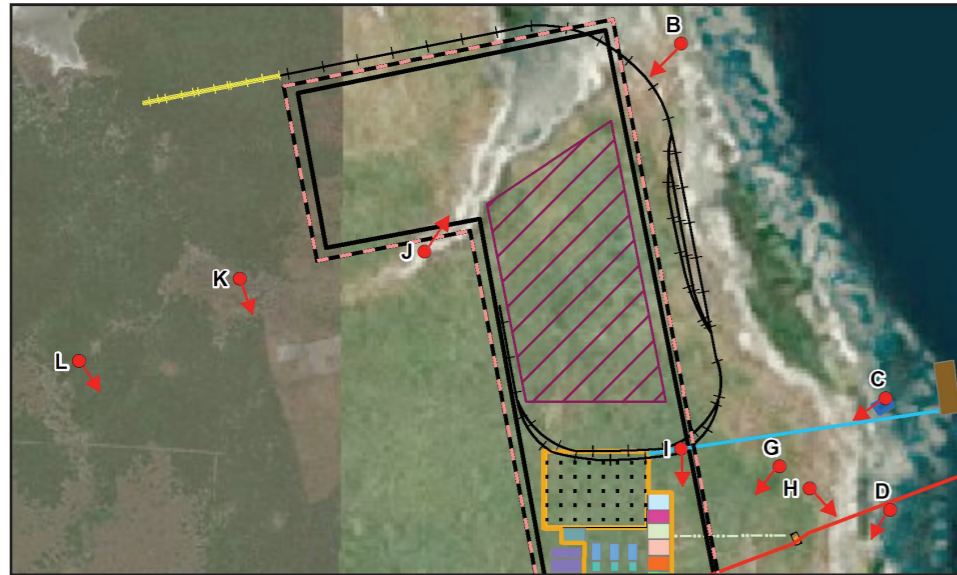
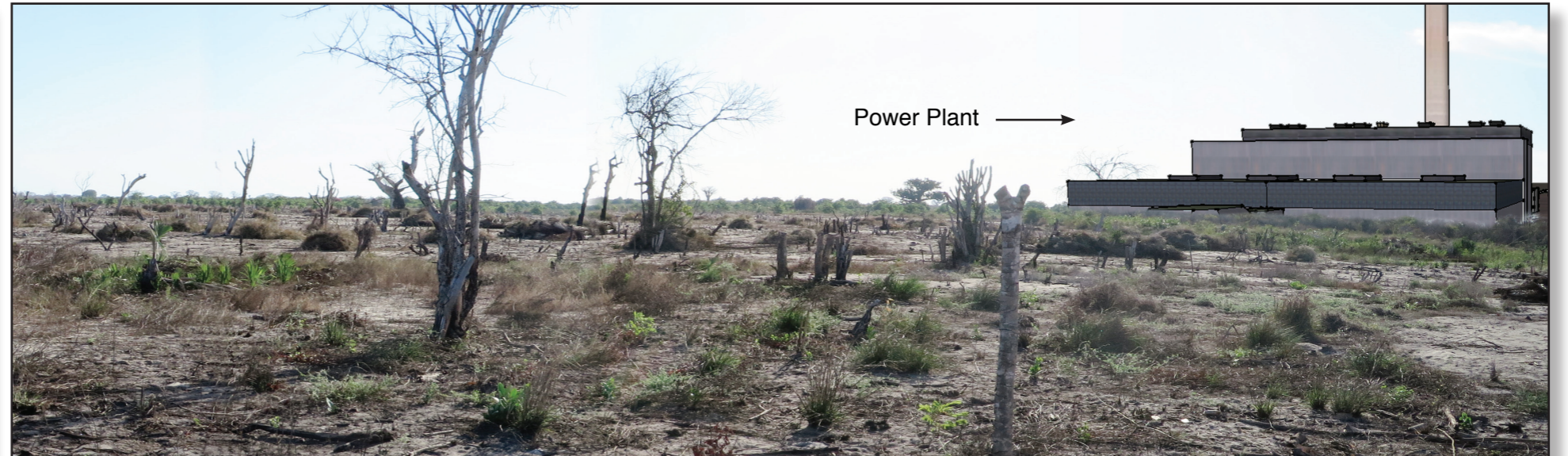


Figure 8: Photomontage from observation point G (1)



For illustrative purposes only

Figure 9: Photomontage from observation point G (2)



For illustrative purposes only

Figure 10: Photograph taken from point H



Figure 11: Project layout

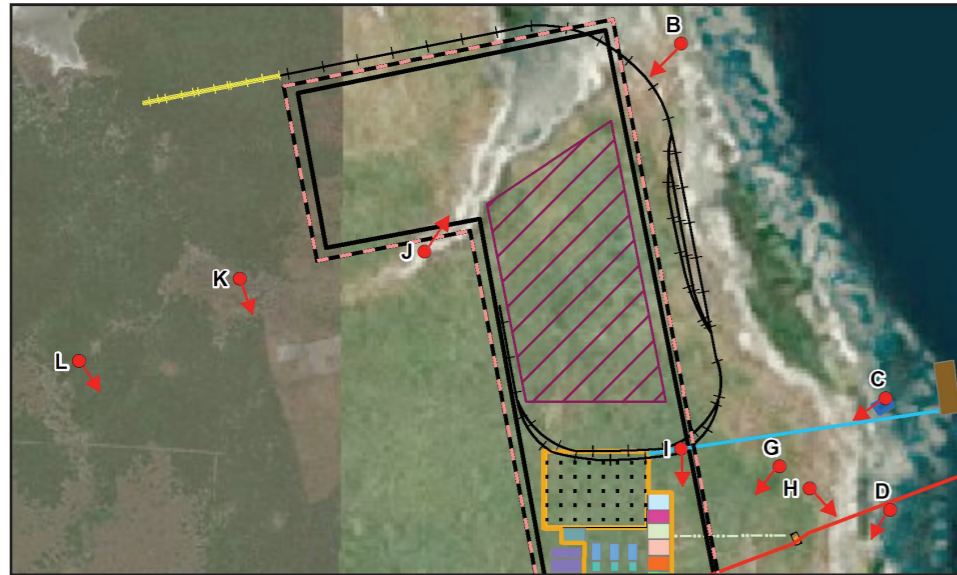


Figure 12: Photomontage from observation point I



For illustrative purposes only

Figure 13: Photograph taken from point J



Figure 14: Photograph taken from point K



Figure 15: Photograph taken from point L



Figure 16: project layout

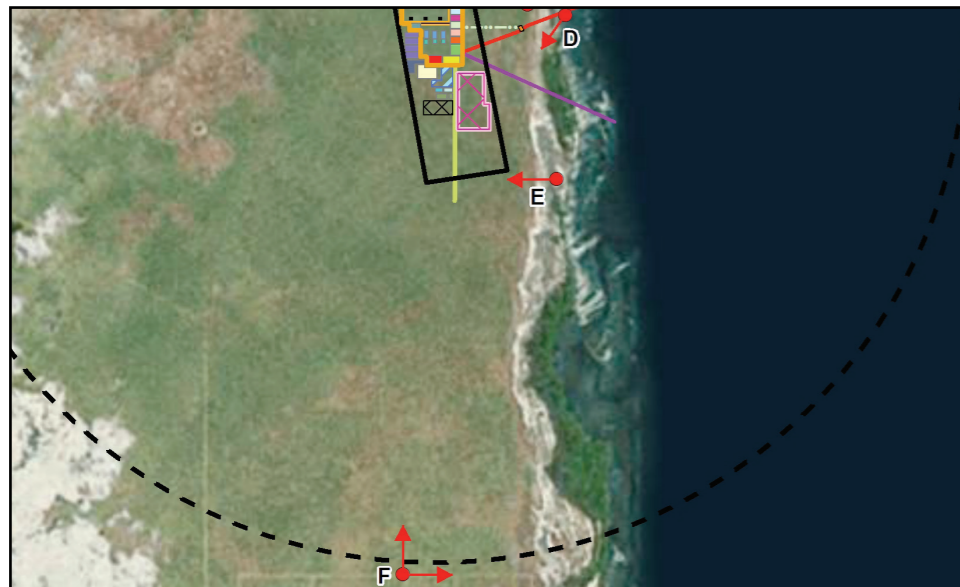


Figure 17: Photograph taken from point D



Figure 18: Photograph taken from point E

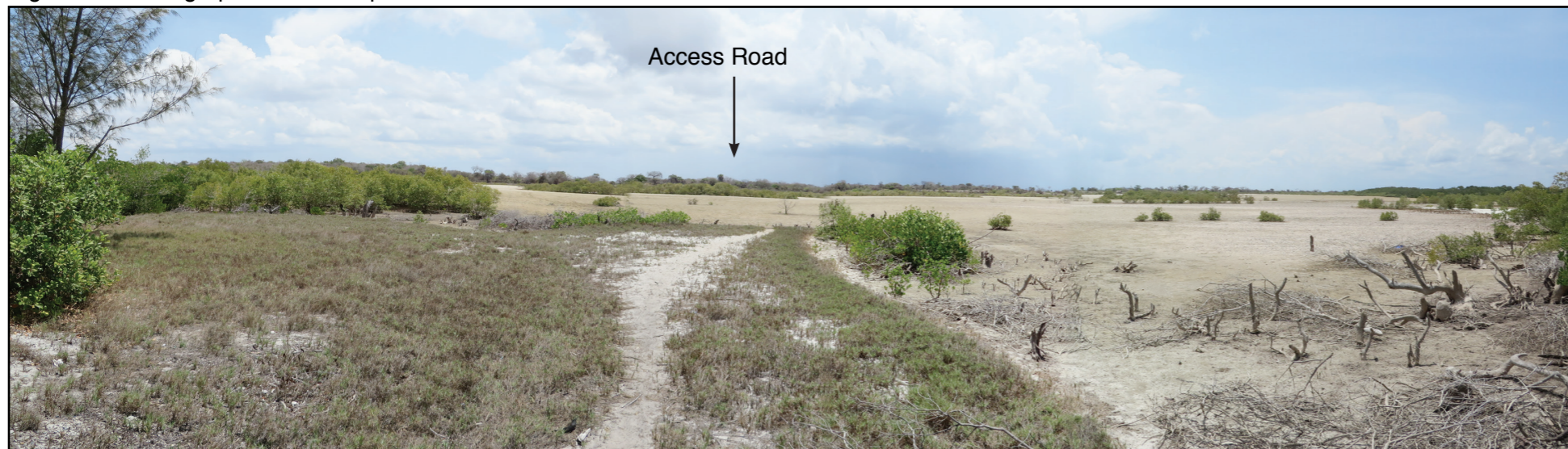


Figure 19: Photograph taken from point F (2)



Figure 20: Photograph taken from point F (1)



Figure 21: Lamu Town



Figure 22: Photograph taken from point N - jetty at airport



Figure 23: Photograph taken from point O - jetty at airport



Figure 24: Photograph taken from point P (1) - jetty at airport



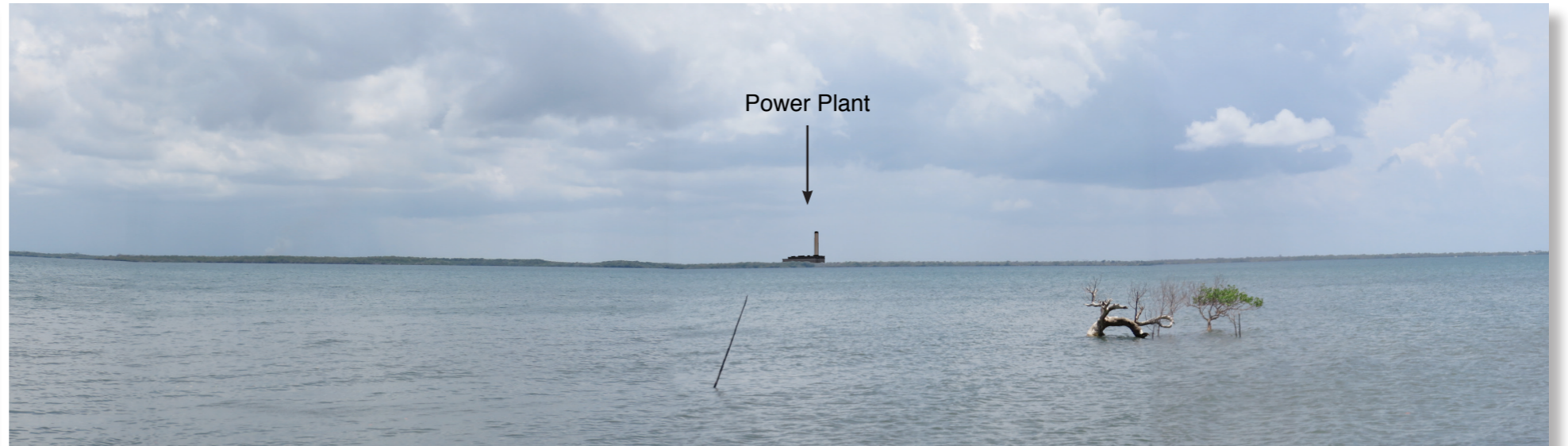
Figure 25: Photograph taken from point P (2) - jetty at airport



Figure 26: Project layout



Figure 27: Photomontage from observation point A



For illustrative purposes only

Figure 28: Lamu Town World Heritage Site

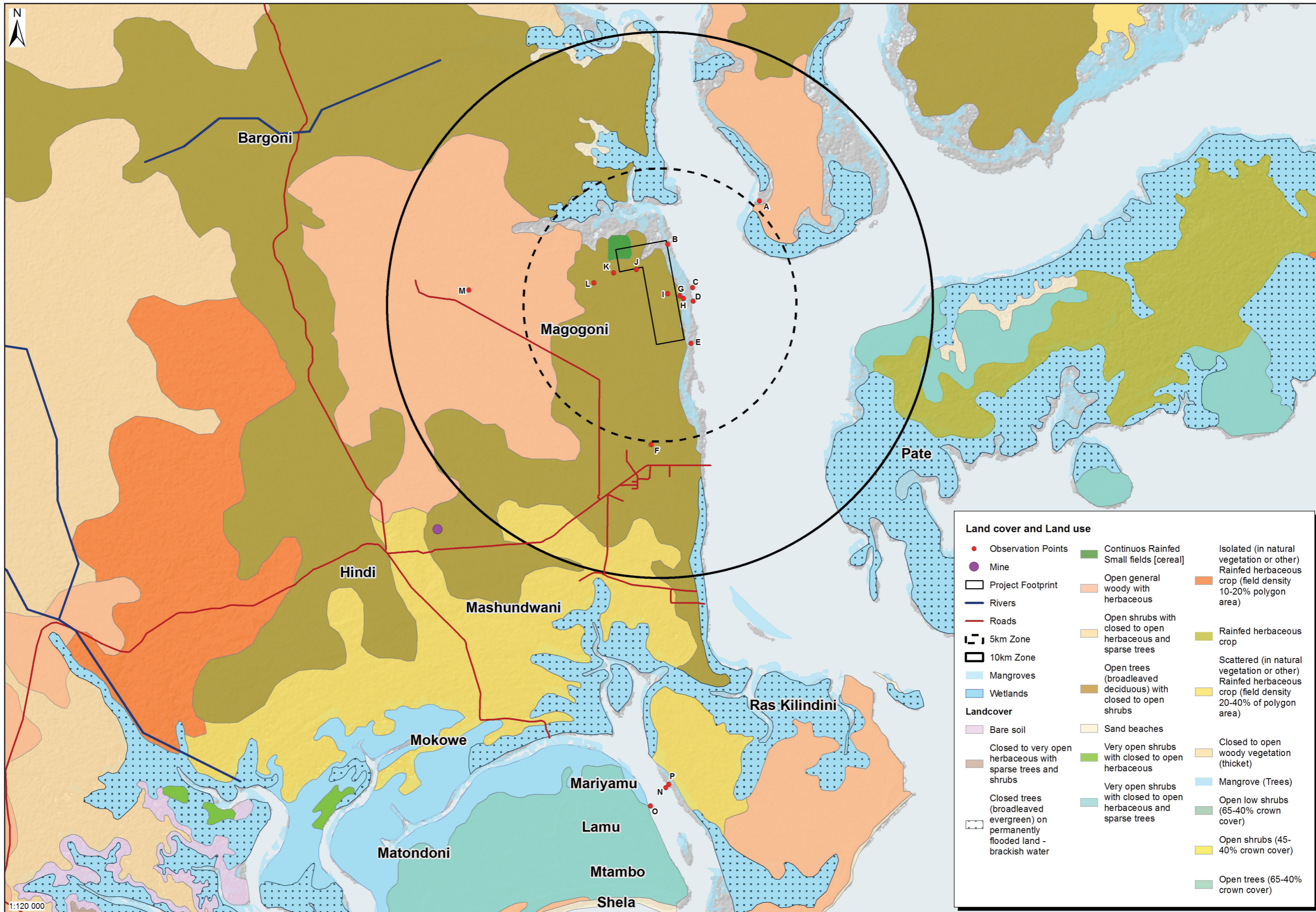


Figure 30: Indigenous vegetation

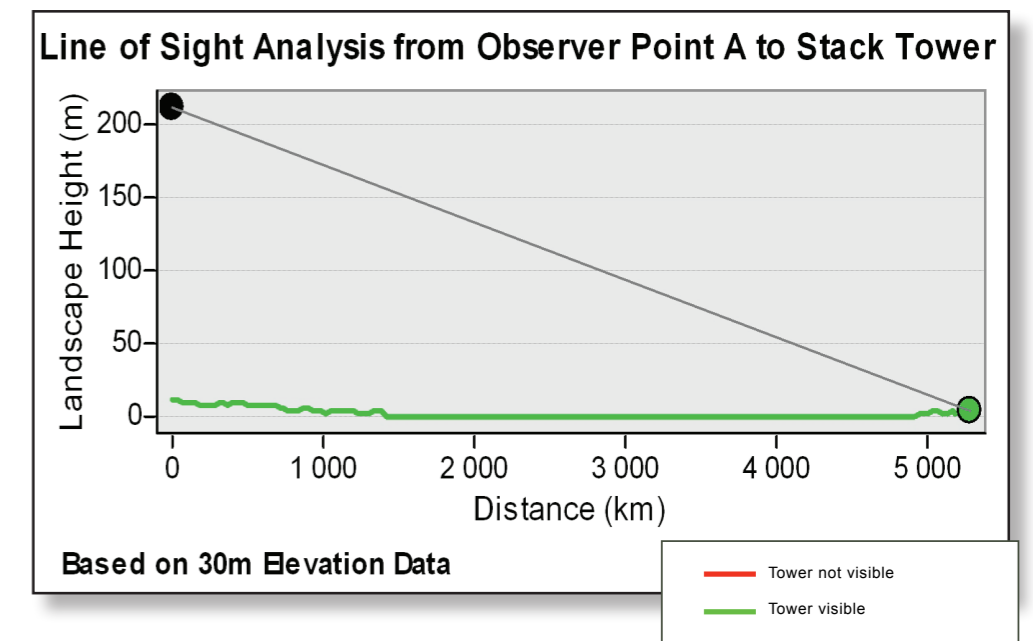
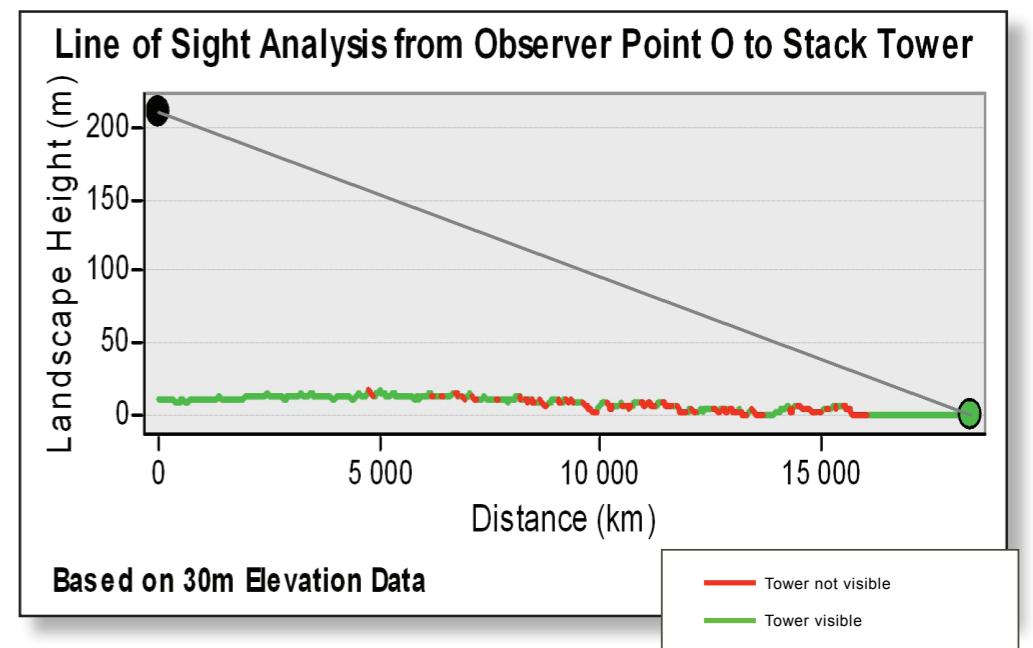
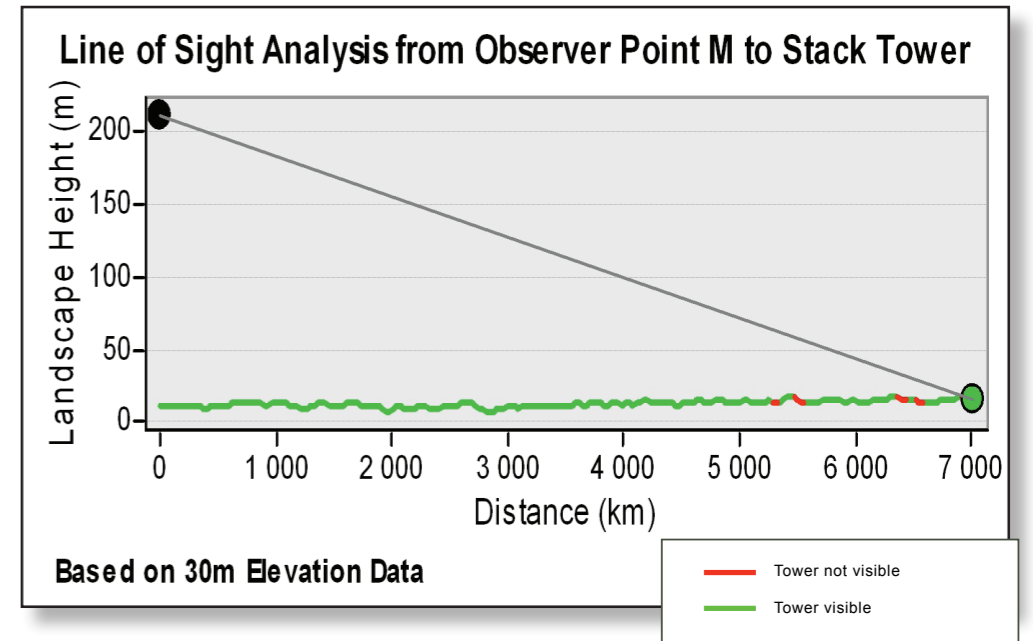
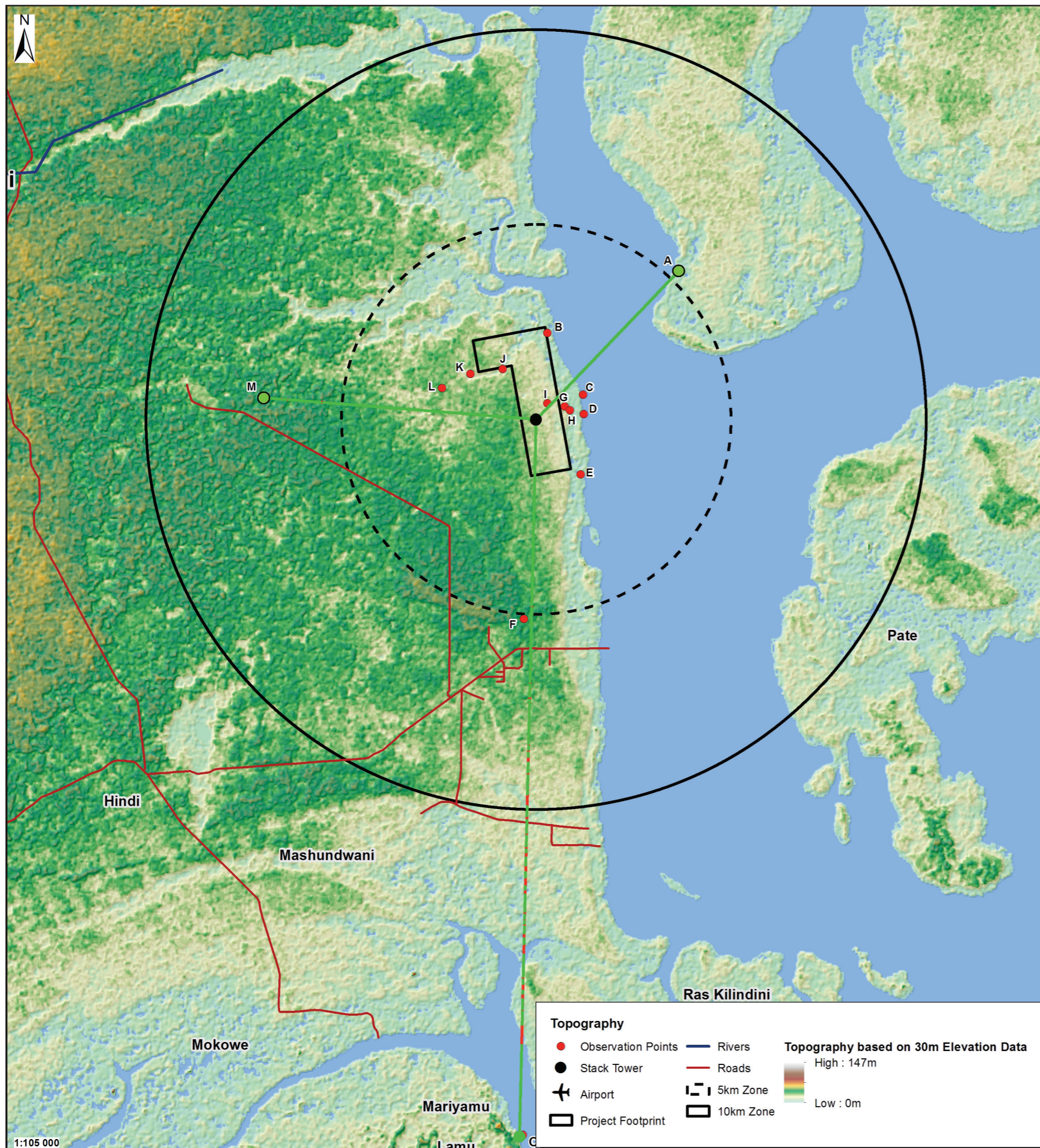


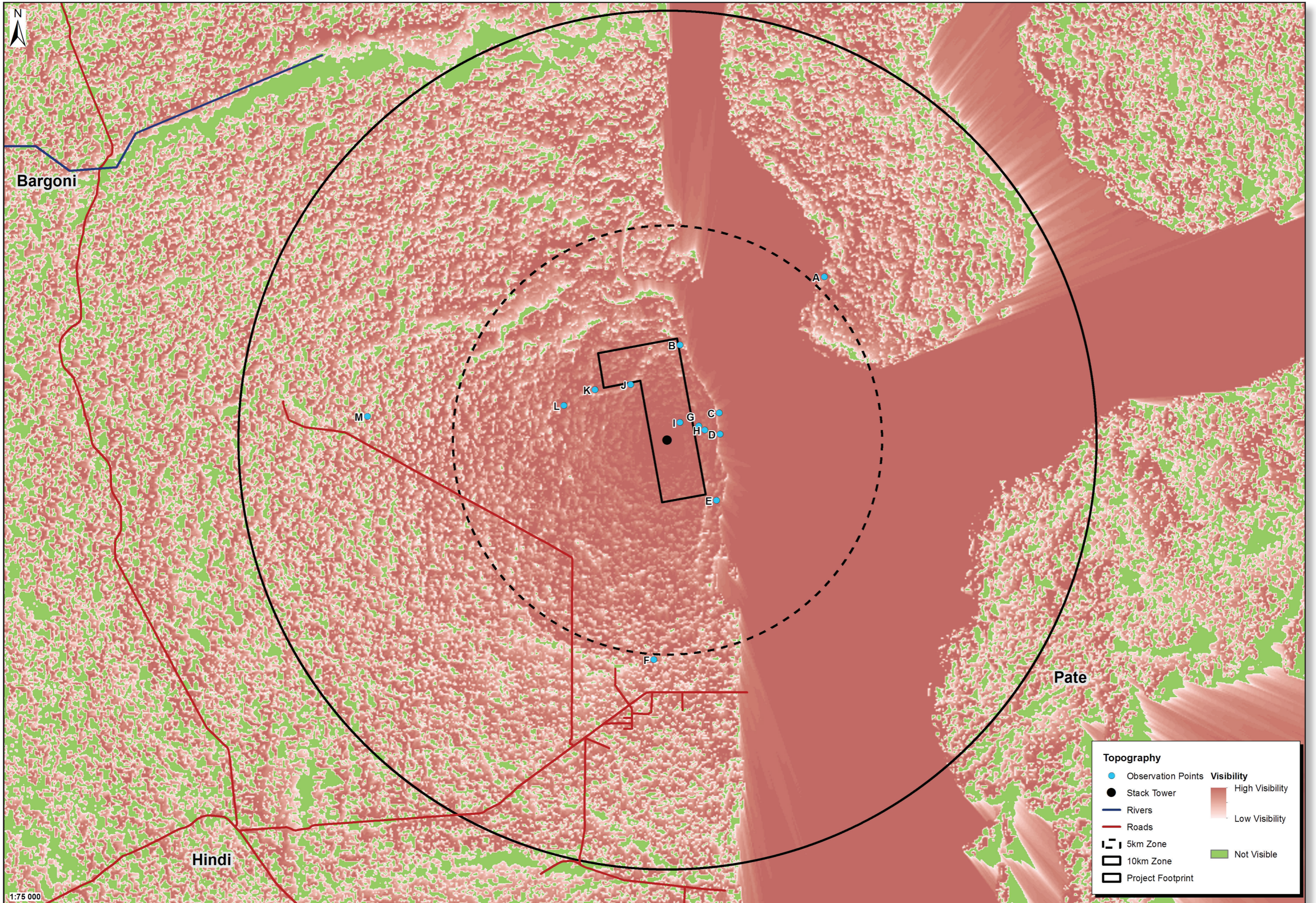
Figure 29: Lamu Harbour

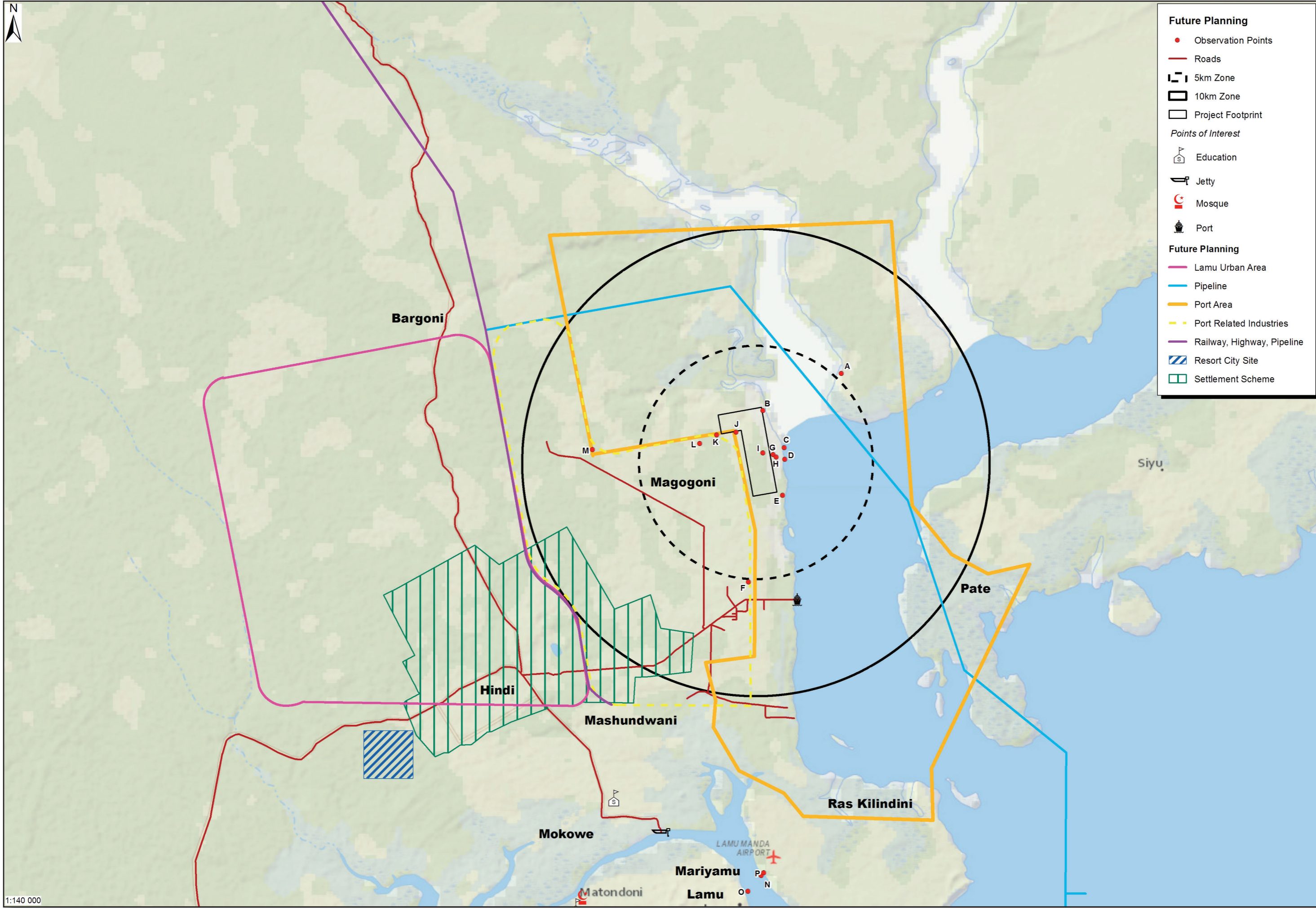




1:120 000







Future Planning

- Observation Points
- Roads
- ⊞ 5km Zone
- ⊞ 10km Zone
- ▭ Project Footprint

Points of Interest

- 🏫 Education
- ⚓ Jetty
- 🕌 Mosque
- 🚢 Port

Future Planning

- 🟡 Lamu Urban Area
- 🟢 Pipeline
- 🟠 Port Area
- 🟡-🟠 Port Related Industries
- 🟣 Railway, Highway, Pipeline
- ▨ Resort City Site
- ▨ Settlement Scheme

1:140 000

PLATE 13:
LAPSSET Area