



URBAN TRANSITIONS AND TRANSFORMATION: ECOLOGY AND ENVIRONMENT

THE TEAM

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AGENDA

01

Introduction

02

Site location
and
regional
characteristics

03

Landform
and
Topography

04

Flora,
Fauna
and
Drainage

Source:
Author's
field survey



AGENDA

05

Climate and
Geology

06

Natural
Resources

07

Tourism

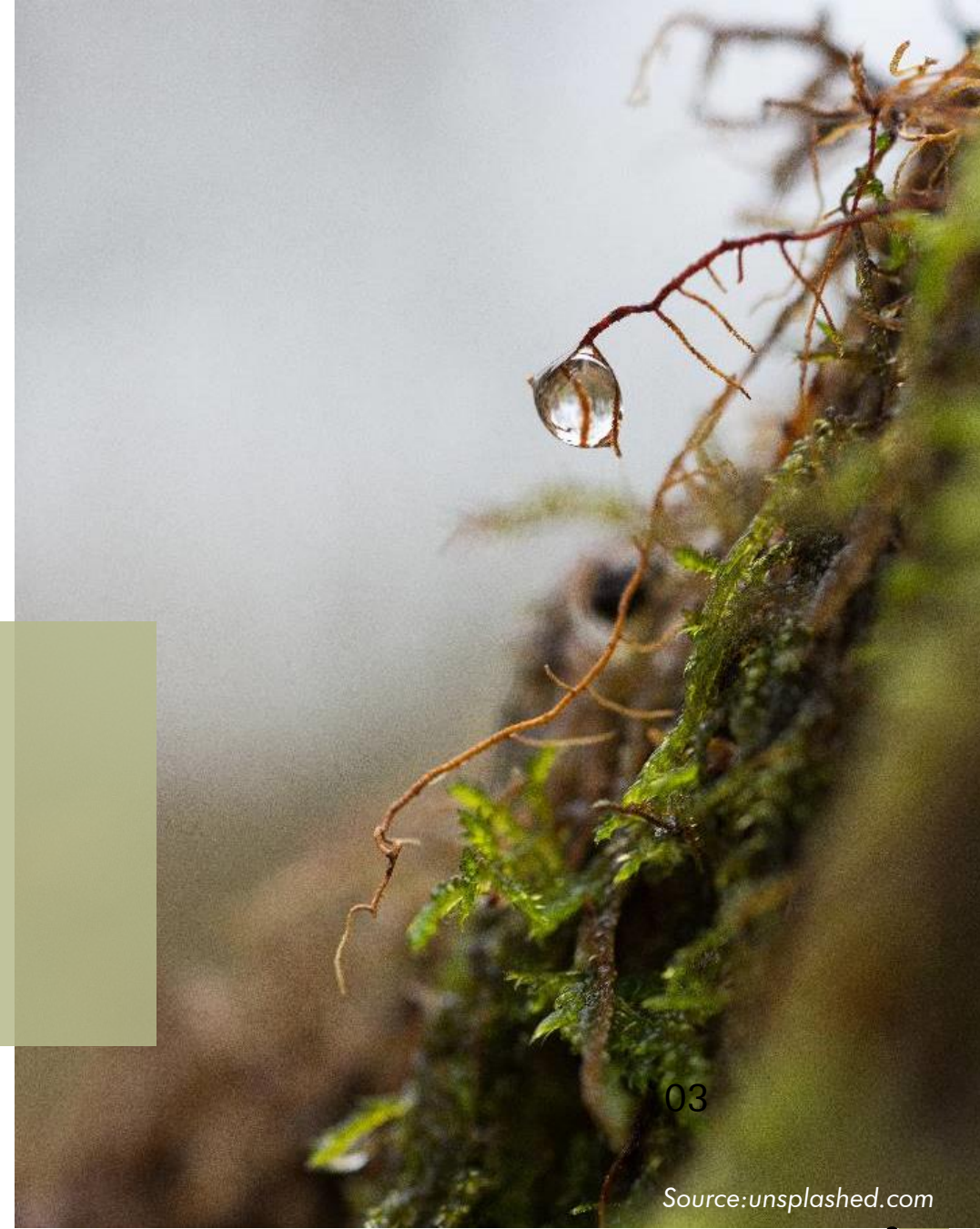
08

Ecological
problems

Source:
Author's
field survey



01 Introduction



03

Source:unsplashed.com





01

Introduction

Source: Author's field survey

URBAN ECOLOGY

- **Urban ecology** is the scientific study of the relation of living organisms with each other and their surroundings in the context of an urban environment(Niemela, 1999).
- **The purpose of urban ecology**
The goal of urban ecology is to achieve a balance between human culture and the natural environment.
- **About the survey**
Assessing and taking into consideration issues and problems of the environment that needs to be addressed in Manhyia, Asokore Mampong and Kumasi Metropolitan Assembly from an ecological standpoint.



02

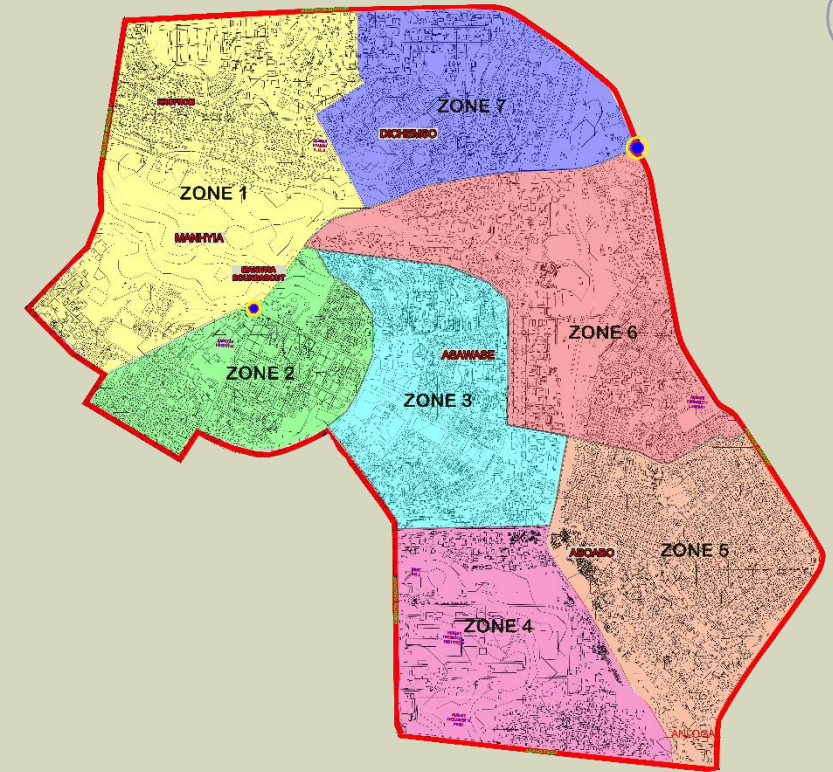
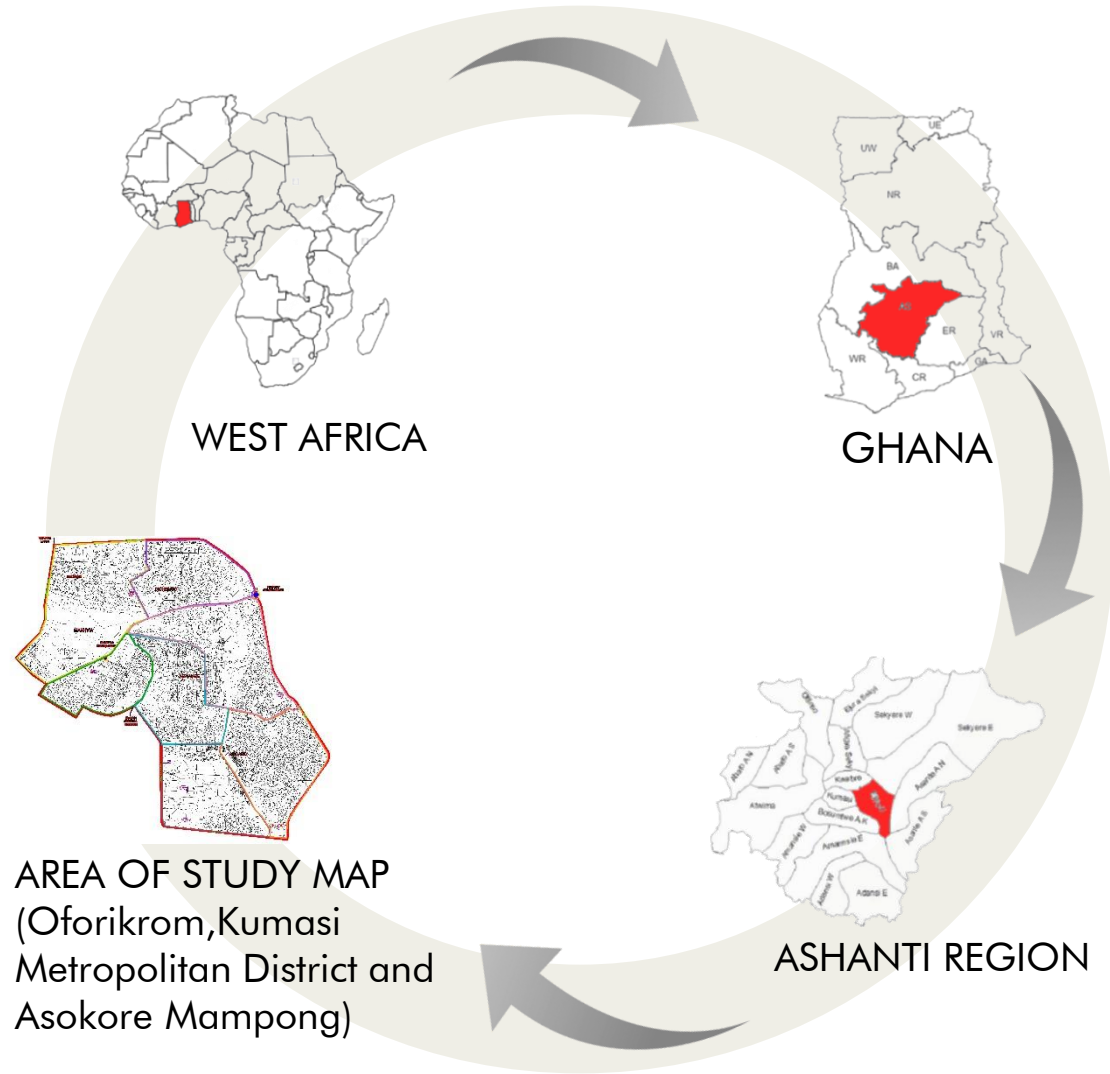
Site location and regional characteristics










Source: Author's field survey.



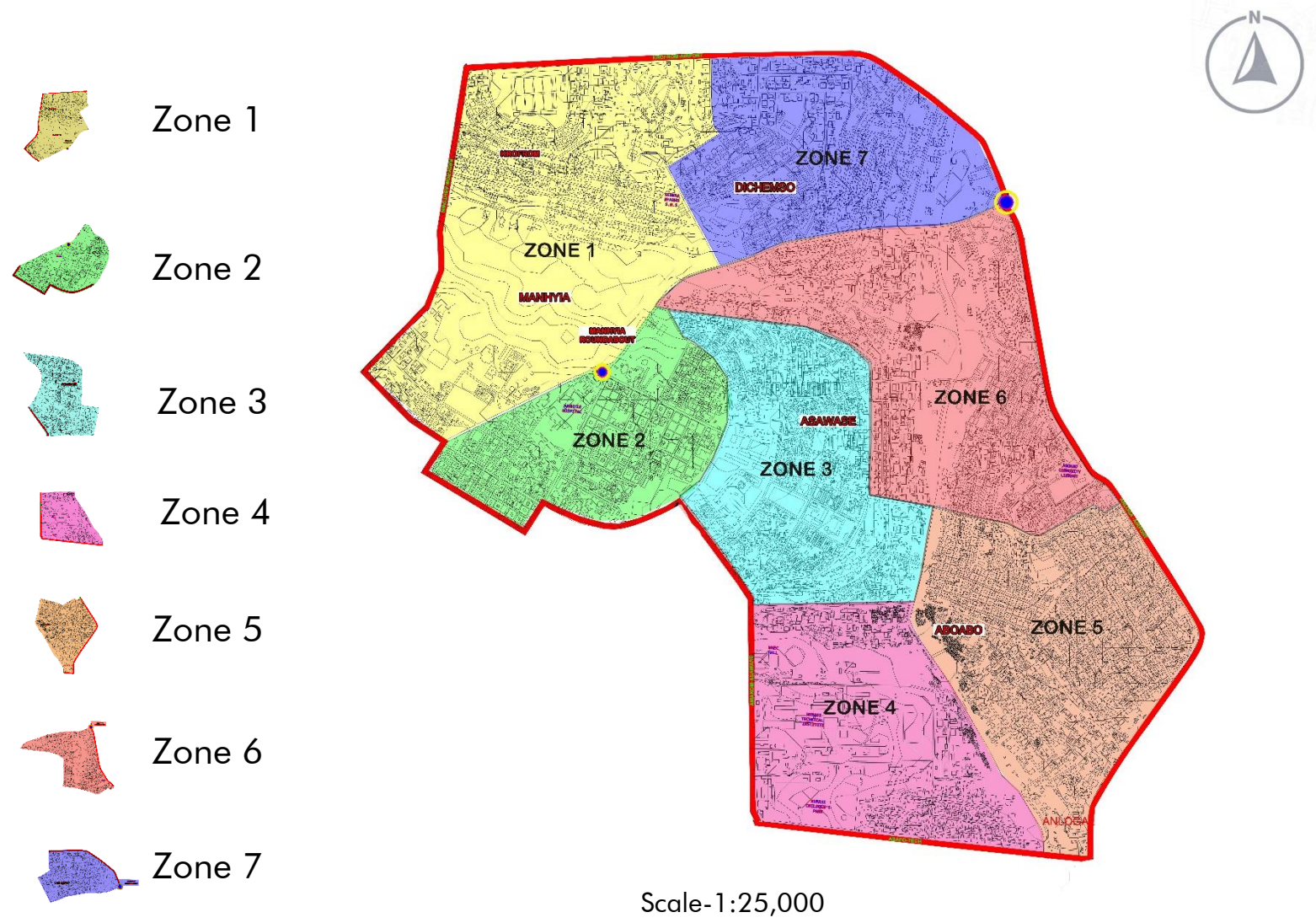
SITE LOCATION AND REGIONAL CHARACTERISTICS



- | | |
|--|--|
|  Zone 1 |  Zone 5 |
|  Zone 2 |  Zone 6 |
|  Zone 3 |  Zone 7 |
|  Zone 4 | |



ZONAL MAP OF THE TERRAIN



TOTAL AREA(in hectares)=499

Zone 1-105.0 ha.

Zone 2- 47.8 ha.

Zone 3- 60.7 ha.

Zone 4- 65.1 ha.

Zone 5 – 76.4 ha.

Zone 6- 84.8 ha.

Zone 7- 59.2 ha.



03 Landform and Topography



Source: Author's field survey



General definitions



LANDFORM

A landform is a feature on the Earth's surface that is part of the terrain. Mountains, hills, plateaus, and plains are the major types of landforms.

Source: unsplash.com



TOPOGRAPHY

The graphical representation of natural and man-made features of a place on maps to show their relative positions and elevations.



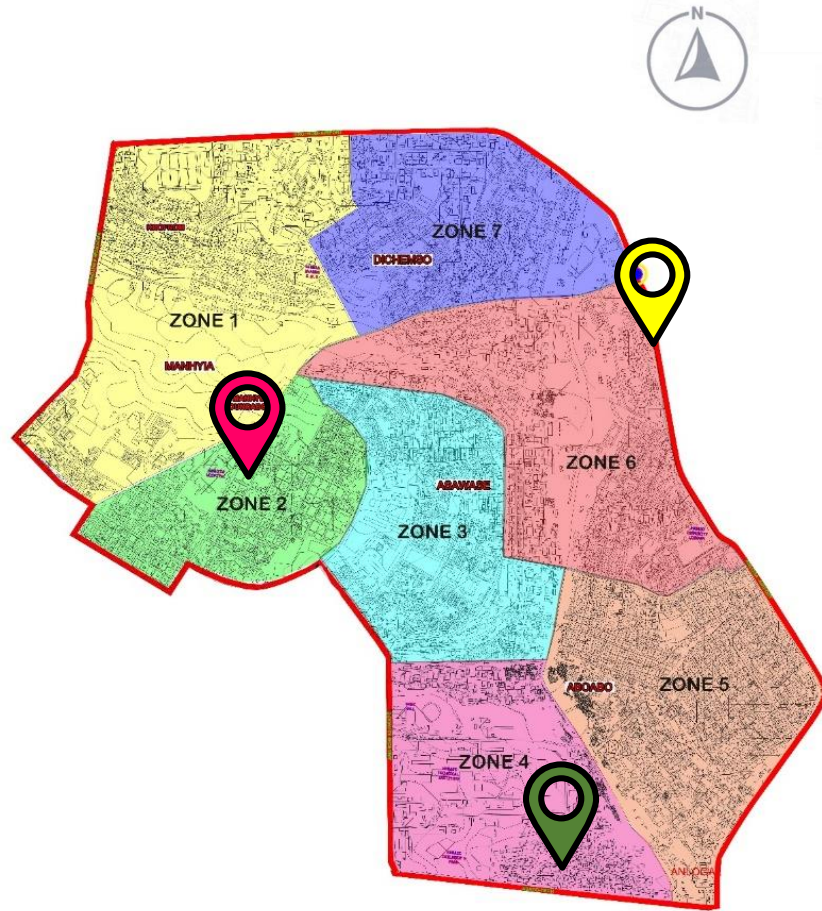
ECOLOGICAL AREAS

These are habitats which, either by themselves or in a network, contribute significantly to an ecosystem's productivity, biodiversity, and resilience.

Source: Author's field survey



GENERAL LAYOUT



Scale-1:25,000



Source: Author's field survey

M9RX+7GR, New Oxford St., Kumasi, Ghana.
Lat 6.691043° Long-1.601319°



Source: Author's field survey

PC42+MM2, Eastern By-Pass, Kumasi, Ghana.
Lat 6.70657° Long-1.598305°



Source: Author's field survey

LANDFORM

The general landform of the terrain consists of hills and valleys.

TOPOGRAPHY

The general topography of the terrain is undulating. However, Zone 2 has a relatively flat landform with gutters on both sides of the streets which aids in effective drainage.

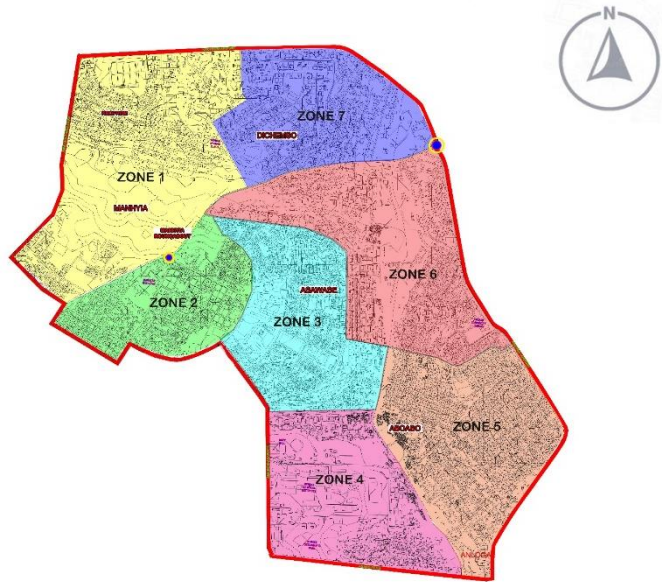
ECOLOGICAL AREAS

The study area falls within the moist semi-deciduous South-East Ecological Zone (tropical forest).

The study area also belongs to tropical wet and dry (savannah) climate



GENERAL LAYOUT



- The horizon line shows the different levels in height at the areas studied.
- The line separates or divides the area into highlands and lowlands
- This is evidence of the undulating nature of the terrain.



Source: Author's field survey



MAP SHOWING SOME HIGHLANDS IN THE TERRAIN



Source: Author's field survey

Dichemso Rd., Kumasi, Ghana.
Lat 6.709433° Long-1.610234°



Source: Author's field survey

Eastern By-Pass, Kumasi, Ghana.
Lat 6.70657° Long-1.598305°



Source: Author's field survey

New Oxford St., Kumasi, Ghana.
Lat 6.691043° Long-1.601319°

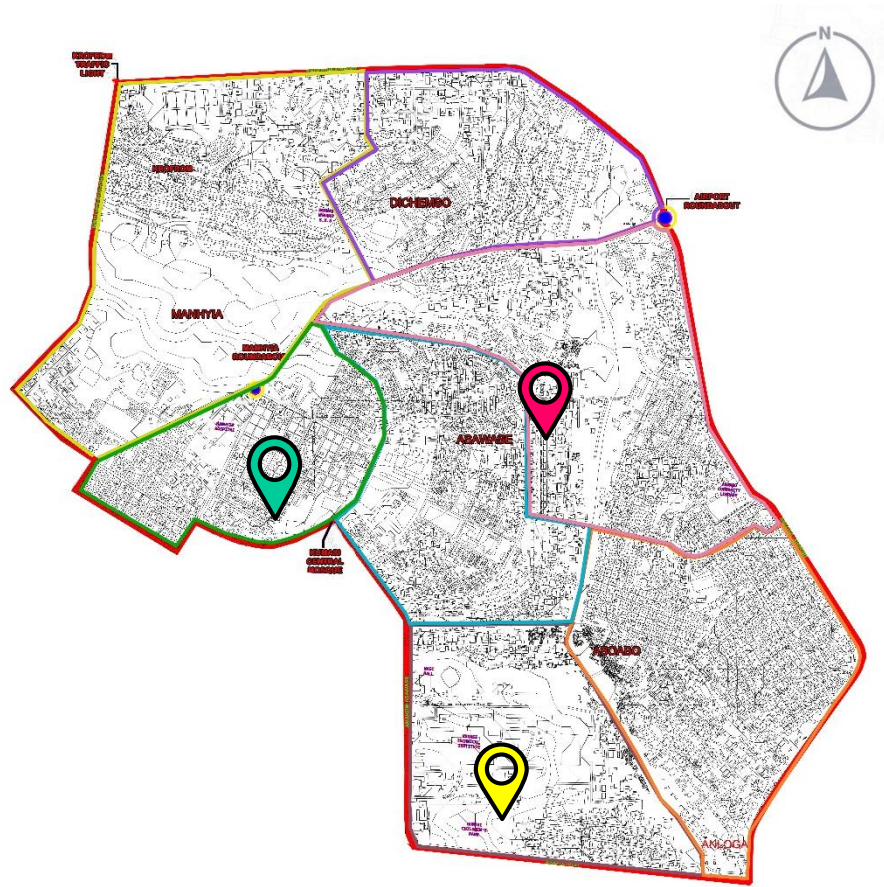


Source: Author's field survey

M9XX+VX4, Kumasi, Ghana.
Lat 6.69981° Long-1.601068°



MAP SHOWING SOME LOWLANDS IN THE TERRAIN



Scale-1:25,000



Source: Author's field survey



Source: Author's field survey

Keneanko Rd., Kumasi, Ghana.
Lat 6.704123° Long-1.602726°



Source: Author's field survey

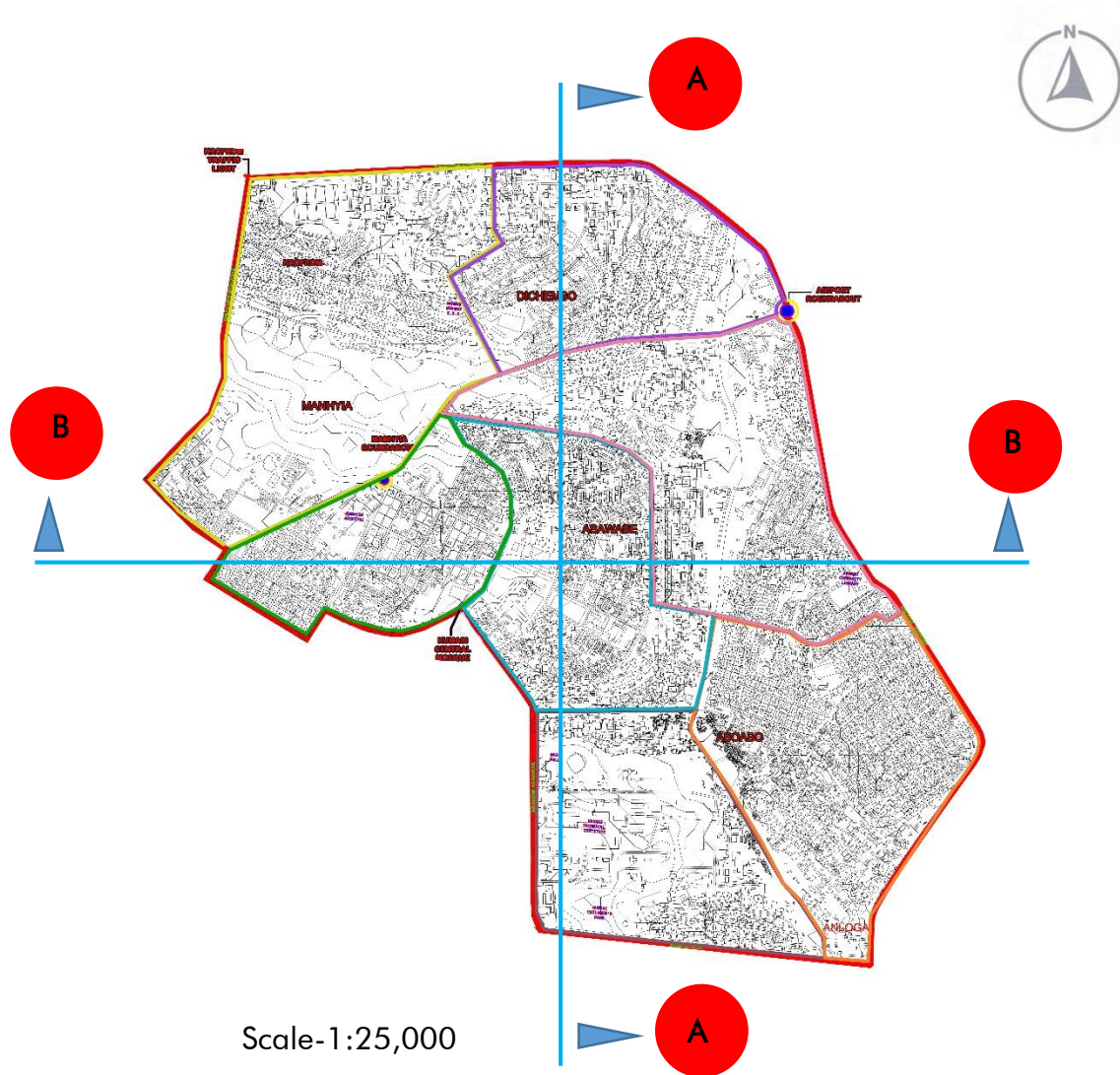


Source: Author's field survey

New Oxford St., Kumasi, Ghana.
Lat 6.691043° Long-1.601319°



SECTIONS OF TERRAIN



SECTION A-A



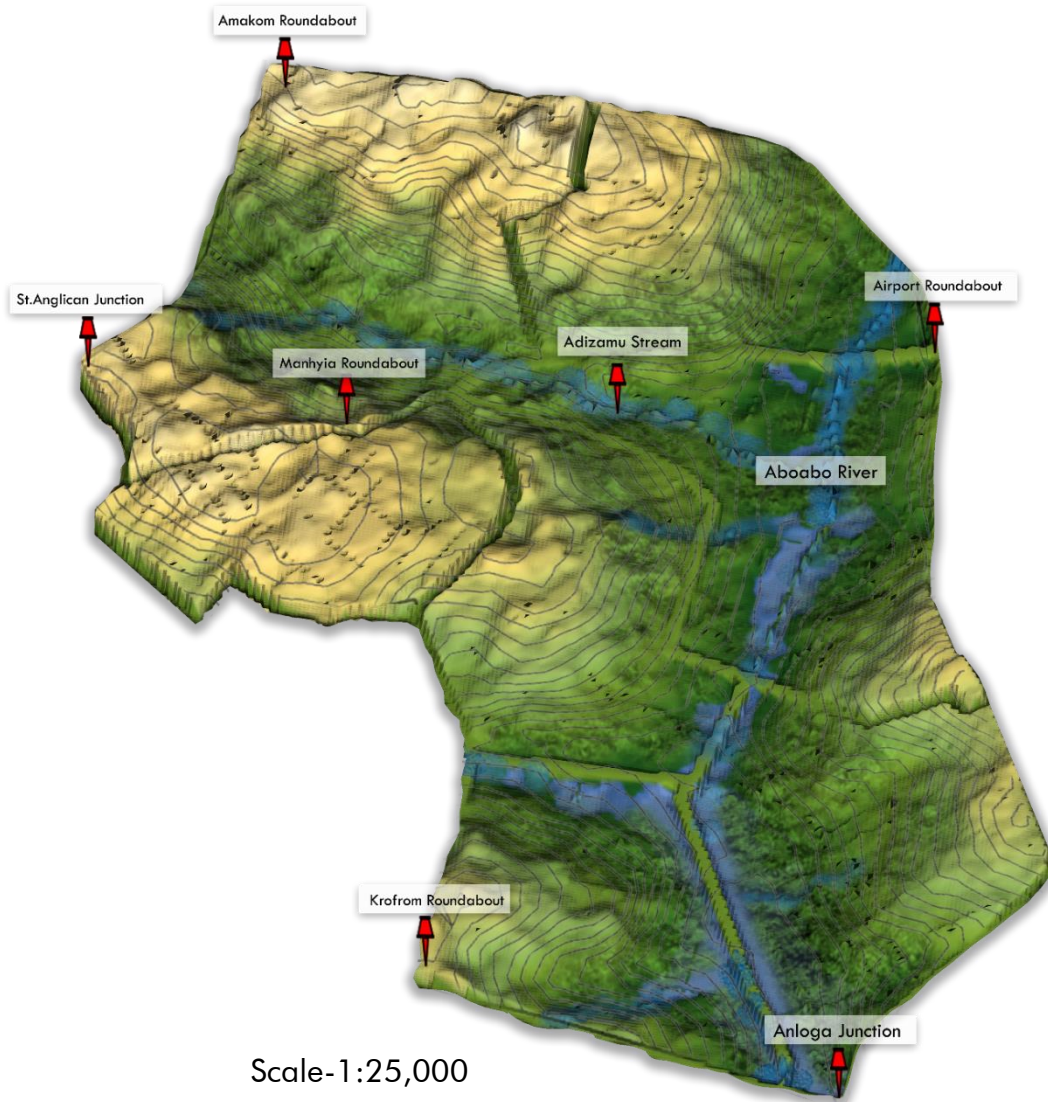
SECTION B-B

The average lowland elevation is 250m

The average highland elevation is 275m



HYDROLOGICAL MAP OF TERRAIN



Source: Author's field survey

Adizamu stream

Lat:6.709039° Long:-1.616698°



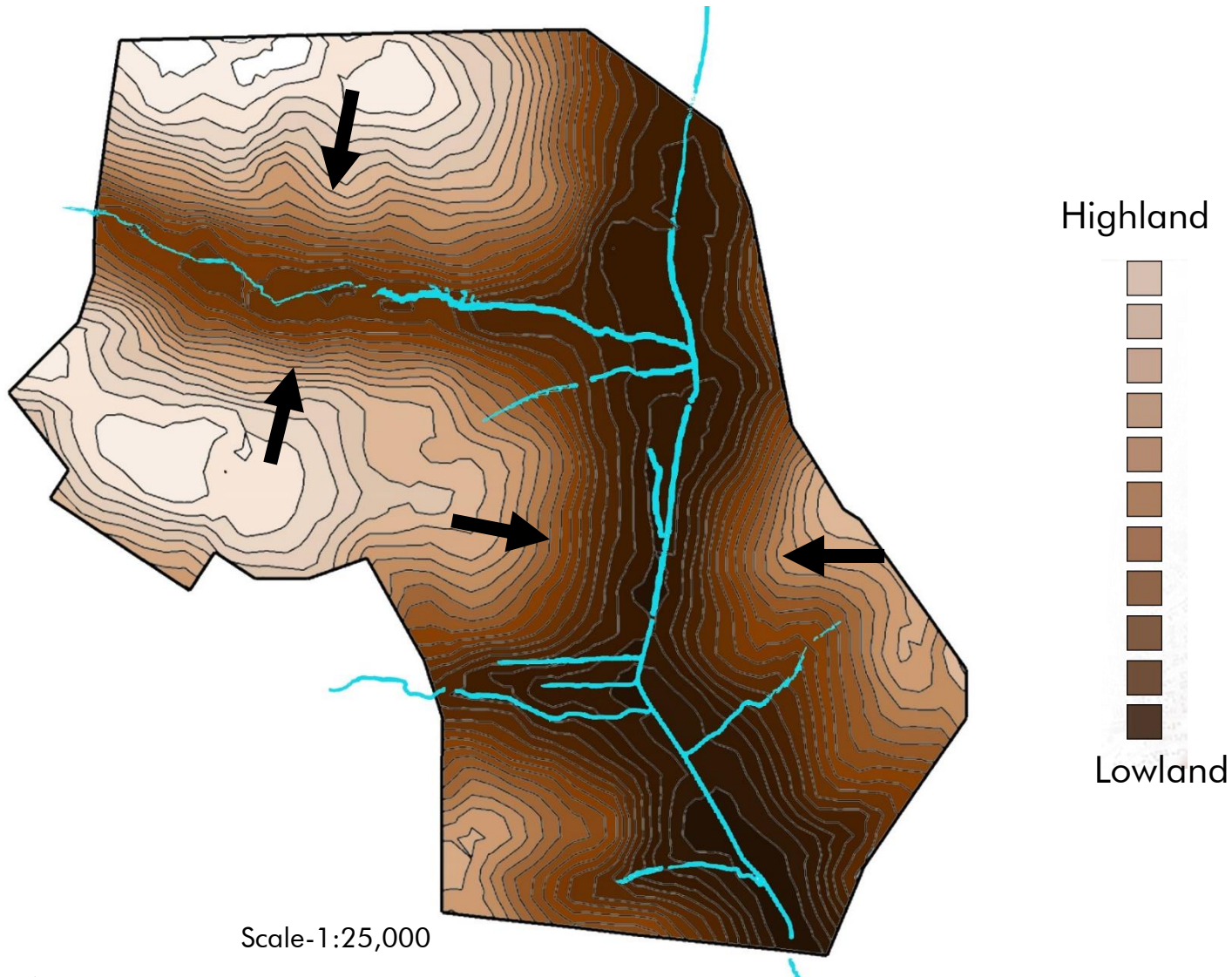
Source: Author's field survey

Aboabo river(Pelele stream)

Lat:6.697241° Long: -1.3601896°



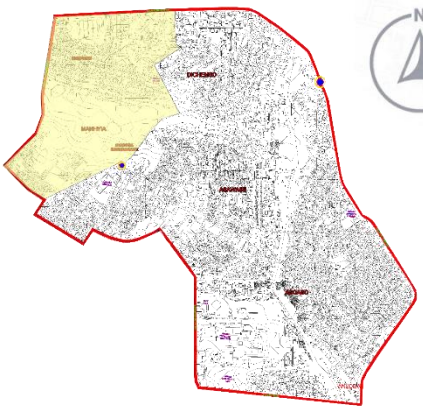
MAP SHOWING WATER FLOW PATTERN WITH CONTOURS



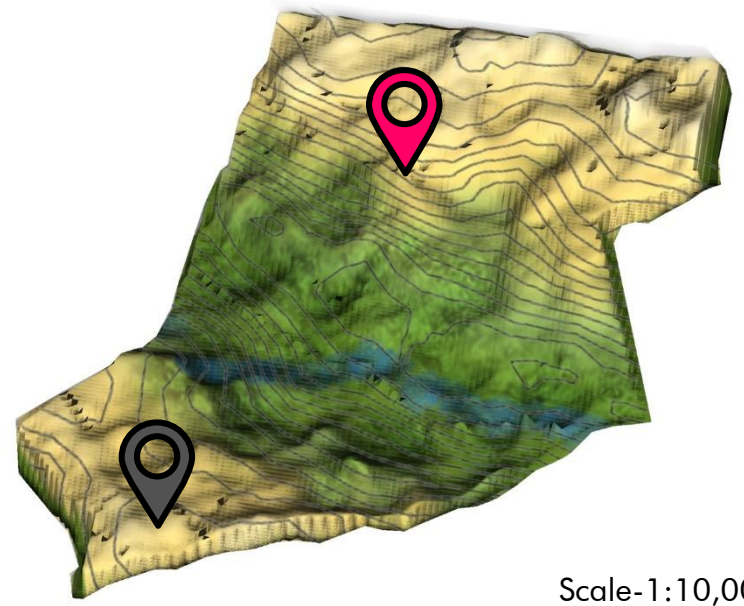
- The light coloured areas, representing the highlands slope towards the dark coloured areas which are the lowlands
- This forms the Adizamu stream which also flows into the Aboabo river, commonly known as “Pelele” which slopes South of the map.
- The landform influences the flow of the streams.



3D MAP SHOWING CONTOURS & LANDFORM OF ZONE 1



Key Map

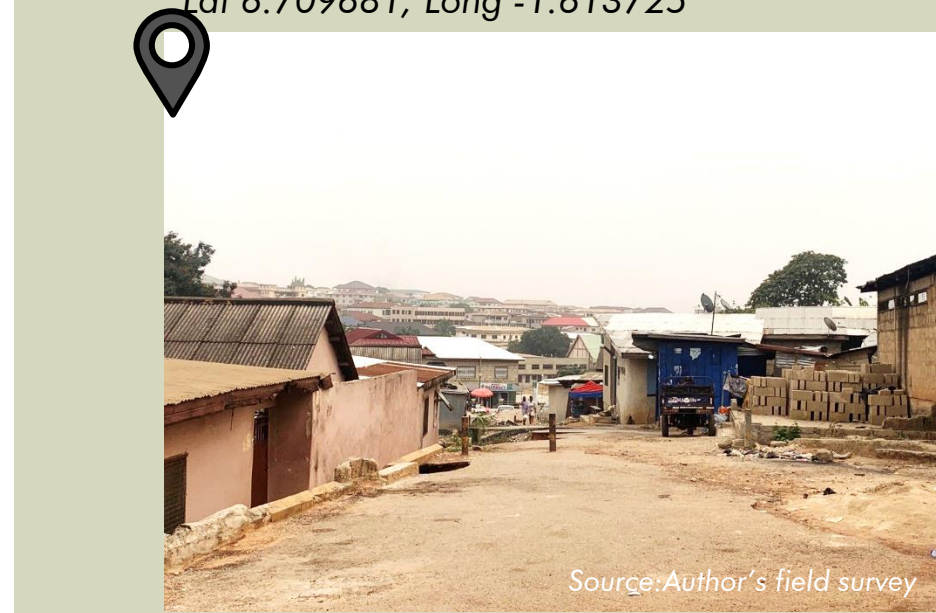


Scale-1:10,000



Source: Author's field survey

Lat 6.709681, Long -1.613725

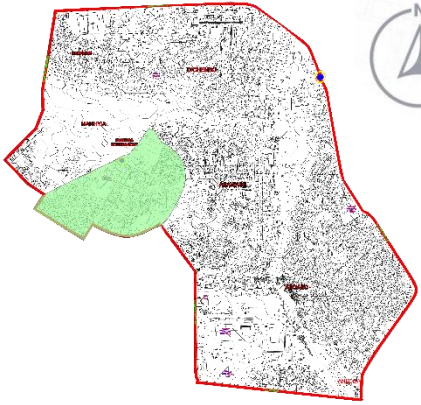


Source: Author's field survey

Lat 6.7112382, Long -1.612104



3D MAP SHOWING CONTOURS & LANDFORM OF ZONE 2



Key Map



Scale-1:10,000



Source: Author's field survey

Lat 6.702701, Lat -1.609824

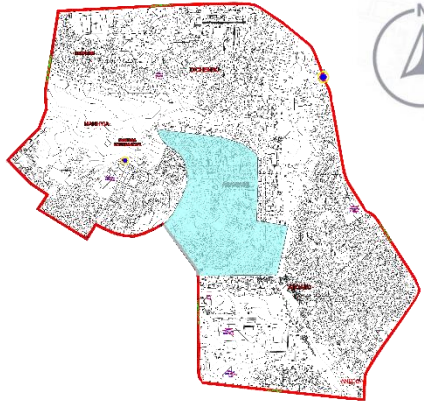


Source: Author's field survey

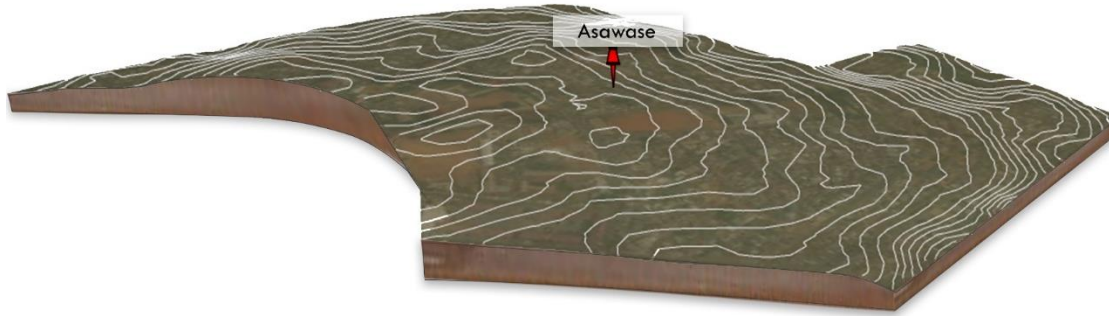
Lat 6.704054, Long -1.611524



3D MAP SHOWING CONTOURS & LANDFORM OF ZONE 3



Key Map



Scale-1:10,000



Source: Author's field survey

Lat 6.415450, Long-1.361392

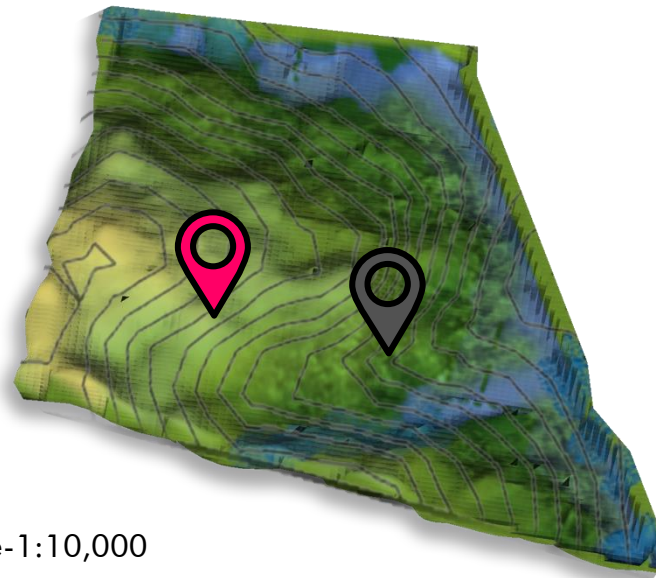
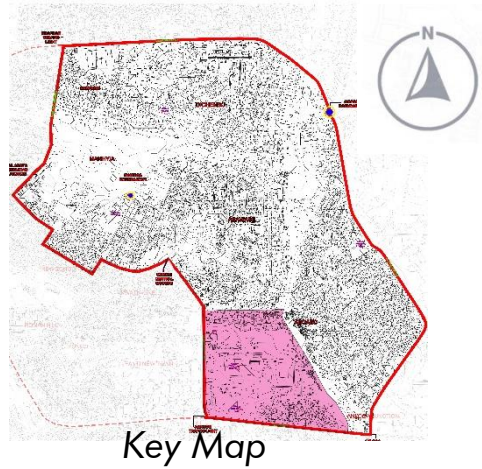


Source: Author's field survey

Lat 6.415445, Long -1.361166



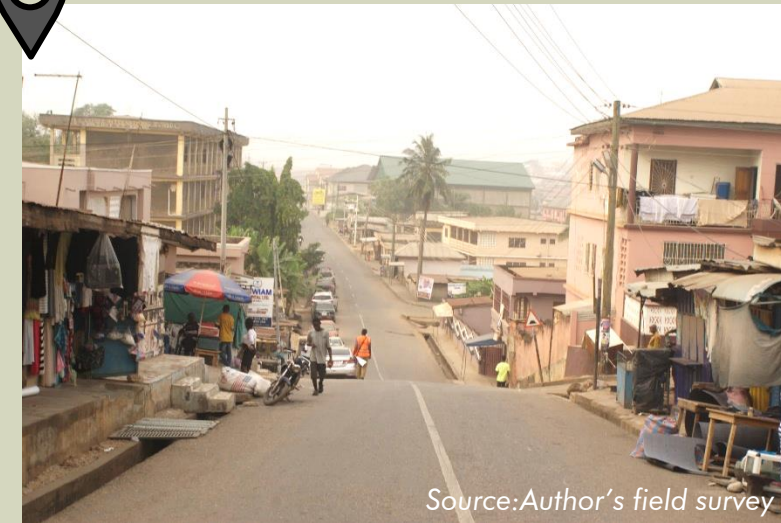
3D MAP SHOWING CONTOURS & LANDFORM OF ZONE 4



Scale-1:10,000



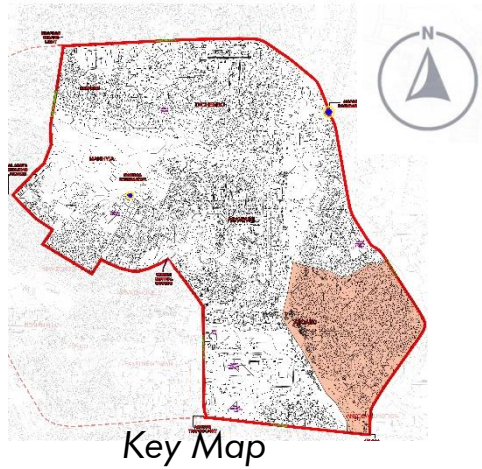
Lat 6.691720, Long -1.601307



Lat 6.691083, Long -1.600841



3D MAP SHOWING CONTOURS & LANDFORM OF ZONE 5

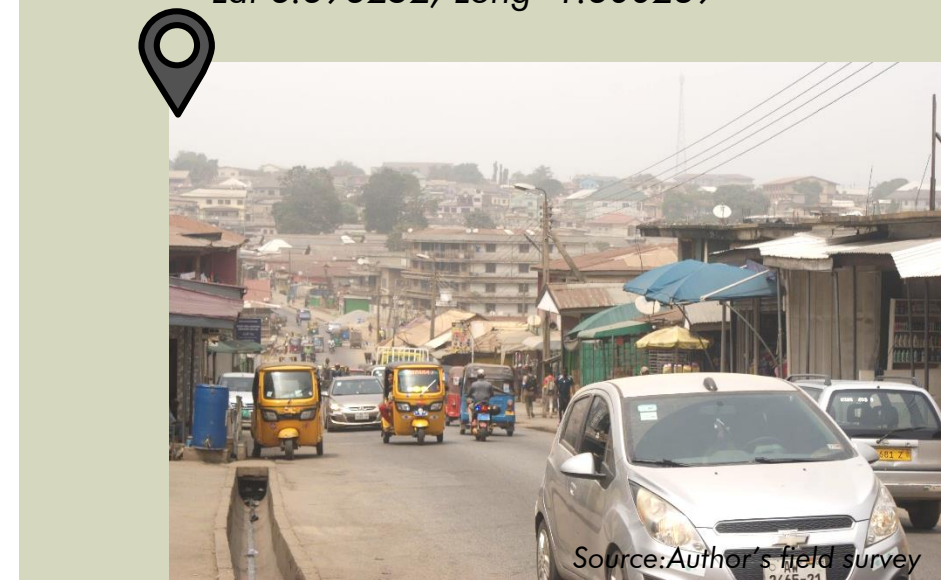


Scale-1:10,000



Source: Author's field survey

Lat 6.696252, Long -1.600289

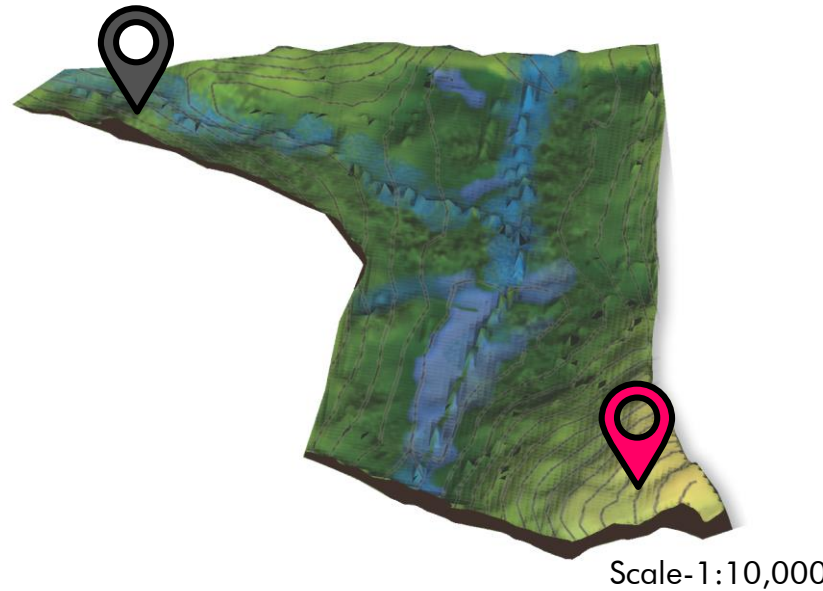
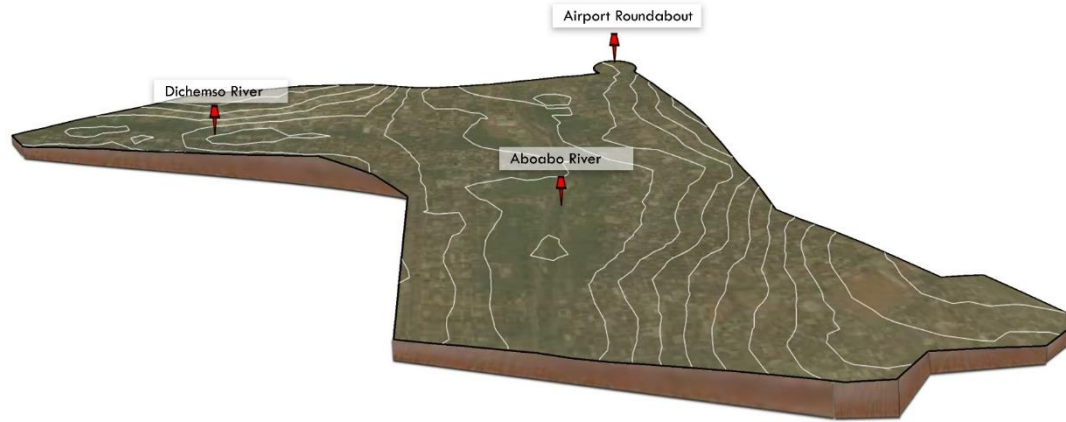
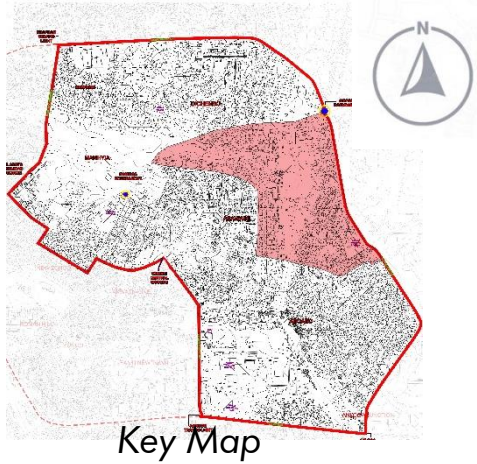


Source: Author's field survey

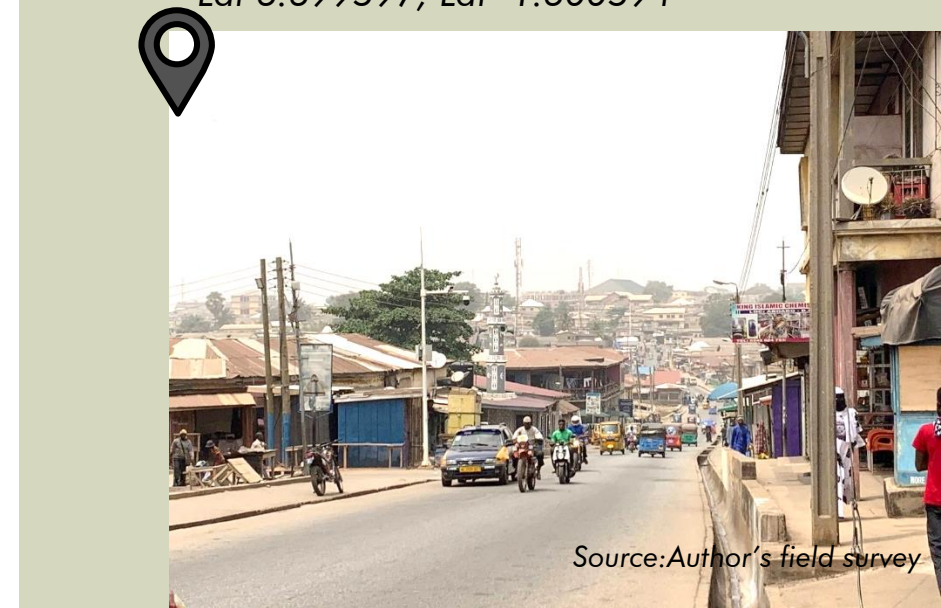
Lat 6.698809, Long -1.597907



3D MAP SHOWING CONTOURS & LANDFORM OF ZONE 6



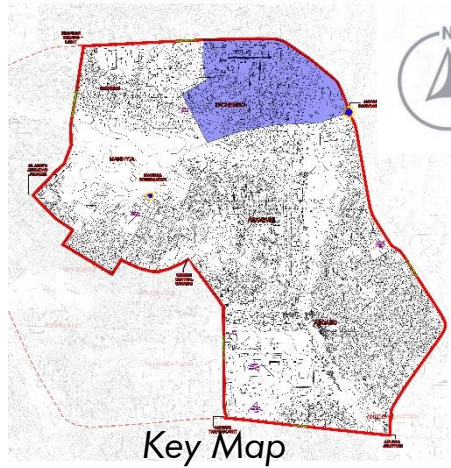
Lat 6.699597, Lat -1.600594



Lat 6.699637, Long -1.598813



3D MAP SHOWING CONTOURS & LANDFORM OF ZONE 7



Scale-1:10,000



Lat 6.710162, Long -1.608396



Lat 6.709439, Lat -1.602739



ECOLOGICAL ZONES

Most green zones identified are potential ecological zones mostly located along the existing water courses and in the valleys.



Aboabo river



Dichemso river



Antoa road



Adizamu stream



ECOLOGICAL ZONES

Most green zones identified are potential ecological zones mostly located along the existing water courses and in the valleys.



Source: Author's field survey

Manhyia forest reserve



Source: Author's field survey

Kumasi Veterinary Clinic



Scale-1:25,000



Source: Author's field survey

Kumasi children's park



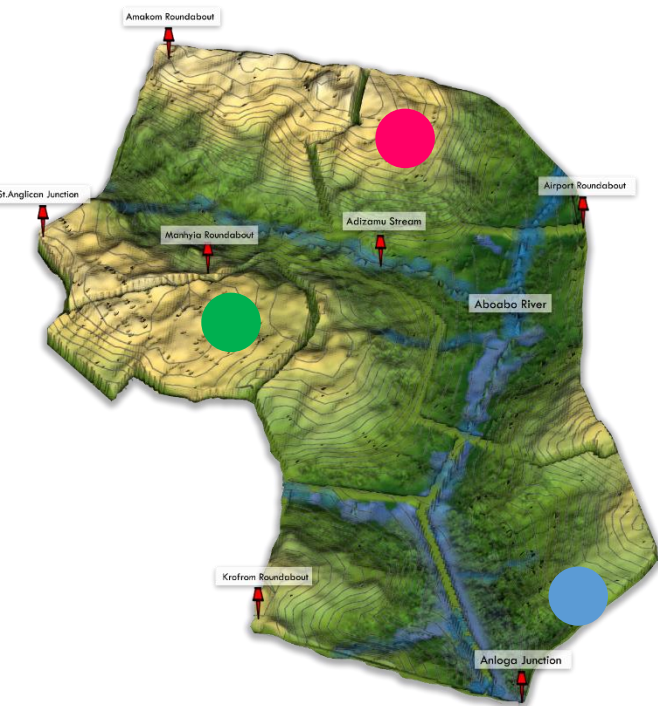
Source: Author's field survey

Manhyia Melcom



EFFECTS OF THE LANDFORM AND TOPOGRAPHY ON:

- Roads
- Buildings
- Drainage



Scale-1:10,000



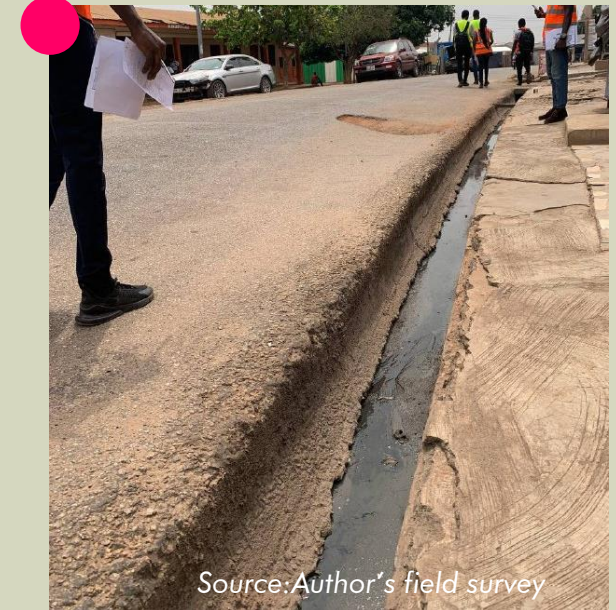
Due to the undulating landform, speed ramps are hardly on the roads. The form of the roads naturally controls speed of cars.



Most buildings have stepped up or down layout due to the undulating nature of the landform.



The undulating nature of the land naturally allows for an effective drainage system.



EFFECTS OF THE LANDFORM AND TOPOGRAPHY ON:

- Landform
- Buildings
- Roads



Landform

Eroded lands and the creation of gullies.



Source: Author's field survey



Buildings

Most buildings have stepped layout due to the undulating nature of their landforms



Source: Author's field survey

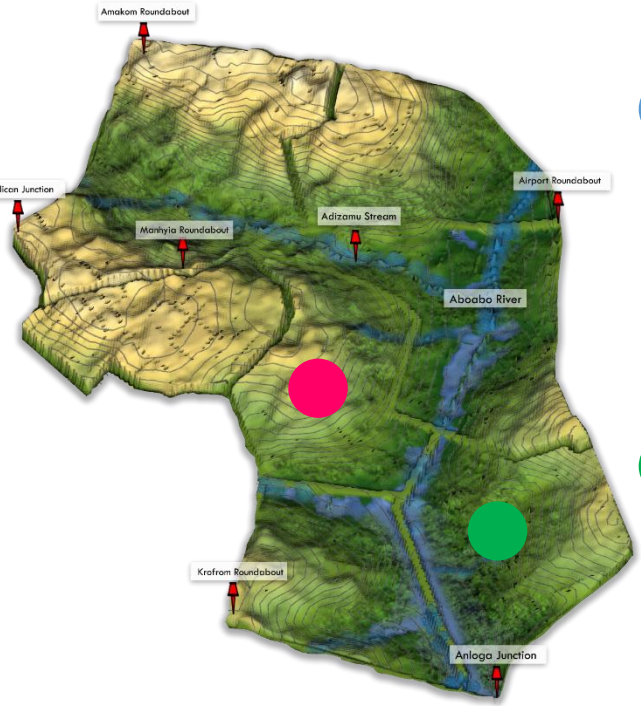


Source: Author's field survey



Road

Due to the undulating landform, speed ramps are hardly on the roads The form of the roads naturally controls speed of cars.



Scale-1:10,000



04

Flora, Fauna and Drainage



Source: Author's field survey





- **Flora**



FLORA

- Flora is all the life present in a particular region or time, generally the naturally occurring native plants (merriam-webster).
- The study area falls within the moist semi-deciduous South-East Ecological Zone (tropical forest).
- The most predominant species of plants found in the areas of study are plantain, avocado, palm, Siar kalayaan, and mango trees.
- The flora of the area of study is diverse and composed of different species of both economic and ornamental tree species with varying heights and characteristics.



Source: Author's field survey





Source: Author's field survey

IMPORTANCE OF VEGETATION IN THE ENVIRONMENT

- Trees contribute directly to the environment by providing oxygen, improving air quality, ameliorating harsh climate, conserving water, preserving soil, and supporting wildlife. During the process of photosynthesis, trees take in carbon dioxide and produce the oxygen we breathe (Naidu, 2021).
- Trees and bushes along roads can improve aesthetics, increase property values, reduce heat island effects, control surface water runoff, and limit noise pollution if dense and thick (Baldauf 2017).
- For example, the siar kalayaan trees found along the Antoa road, provide shade for pedestrians and vehicles as well as enhance the appearance in front of the road (author's field survey, 2023).



01

Culinary purposes
(food)

02

Ornamental purposes
(beauty, shade, wind
breaks)

03

Air purification

IMPORTANCE OF THE SPECIES IDENTIFIED IN THE AREAS OF STUDY

04

Medicinal purposes

05

Habitat for birds



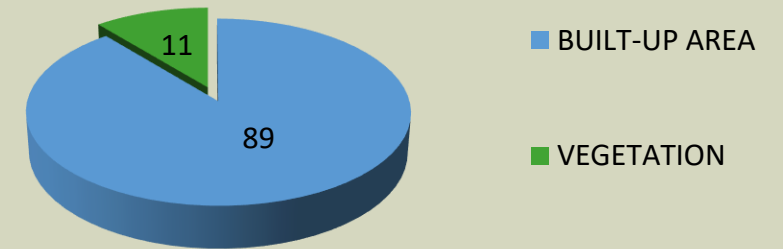
VEGETATIVE MAP OF TERRAIN



Scale-1:25,000

TOTAL AREA OF TERRAIN=499 ha

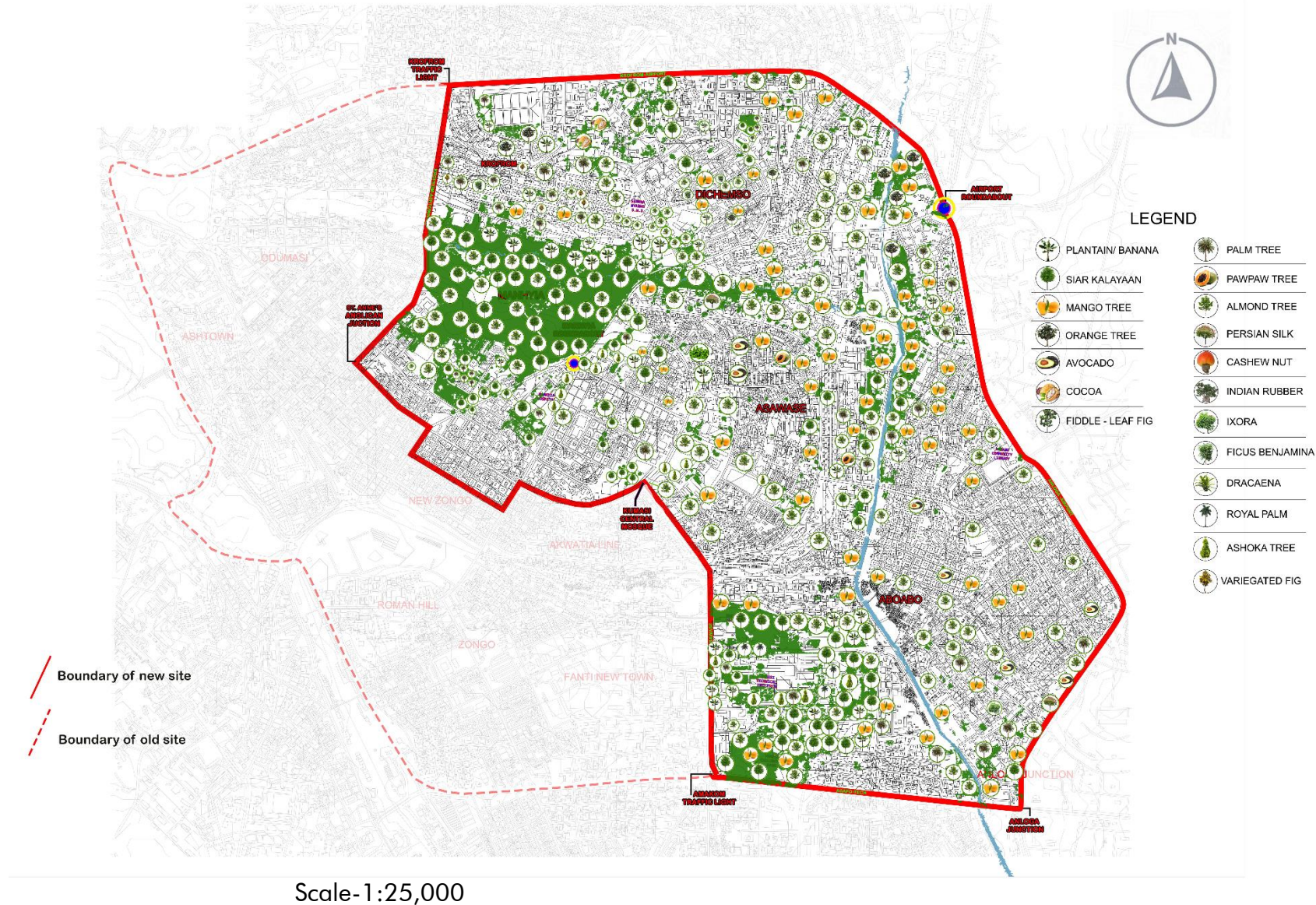
PERCENTAGE OF GREEN AREAS TO BUILT UP AREAS IN THE TERRAIN



BUILT-UP AREA =442.74 ha (89%)
VEGETATION=56.26 ha (11%)



MAP SHOWING FLORA IN THE STUDY AREAS



EXISTING FLORA IN THE STUDY AREAS



(source: author's field survey, 2023)

Common name: Plantain
Botanical name: *Musa Paradisiaca*

Location:

- Residences
- Green areas

Importance:

- Culinary purposes (food)



(source: author's field survey, 2023)

Common name: Palm tree
Botanical name: *Arecaceae*

Location:

- Residences
- Along the streets

Importance:

- Culinary purposes (food)
- Ornamental purposes (decorative, shade)



(source: author's field survey, 2023)

Common name: Tropical Almond tree
Botanical name: *Terminalia catappa*

Location:

- Schools
- Residences

Importance:

- Culinary purposes (food)
- Ornamental purposes (shade)



EXISTING FLORA IN THE STUDY AREAS



(source: author's field survey,2023).

Common name: **Arrowhead vine**
Botanical name: **Syngonium podophyllum**

Location:

- Residences
- Health facilities

Importance:

- Culinary purposes (food)



(source: author's field survey,2023).

Common name: **Queen's crape-myrtle**
Botanical name: **Lagerstroemia speciosa**

Location:

- Residences
- Along the streets

Importance:

- Culinary purposes (food)
- Ornamental purposes (decorative, shade)



(source: author's field survey,2023).

Common name: **Fiddle-leaf fig**
Botanical name: **Ficus lyrata**

Location:

- Along the streets and in the neighbourhood

Importance:

- Ornamental purposes(shade)
- Air purification



EXISTING FLORA IN THE STUDY AREAS



(source: author's field survey,2023).

Common name: **Golden trumpet**
Botanical name: **Allamanda**

Location:

- Residences

Importance:

- Ornamental purposes(decorative)



(source: author's field survey,2023).

Common name: **Siar kalayaan tree**
Botanical name: **Peltophorum pterocarpum**

Location:

- Along the streets

Importance:

- Ornamental purposes (shade, decorative)



(source: author's field survey,2023).

Common name: **Pawpaw tree**
Botanical name: **Asimina triloba**

Location:

- Residences
- Around the neighbourhood

Importance:

- Culinary purposes(food)



EXISTING FLORA IN THE STUDY AREAS



Common name: **Oleander**

Botanical name: **Nerium**

Location:

- Along the streets
- Residences

Importance:

- Ornamental purposes (decorative)



Common name: **Chinese ixora**

Botanical name: **Ixora chinensis**

Location:

- Manhya palace
- Along the streets

Importance:

- Ornamental purposes (decorative)



Common name: **Avocado tree**

Botanical name: **Persea Americana**

Location:

- Along the streets
- Residences

Importance:

- Ornamental purposes (shade)
- Culinary purposes (food)



EXISTING FLORA IN THE STUDY AREAS



(source: author's field survey,2023).

Common name: **Crown-of-thorns**
Botanical name: **Euphorbia milii**

Location:

- Residences

Importance:

- Ornamental purposes (decorative)



(source: author's field survey,2023).

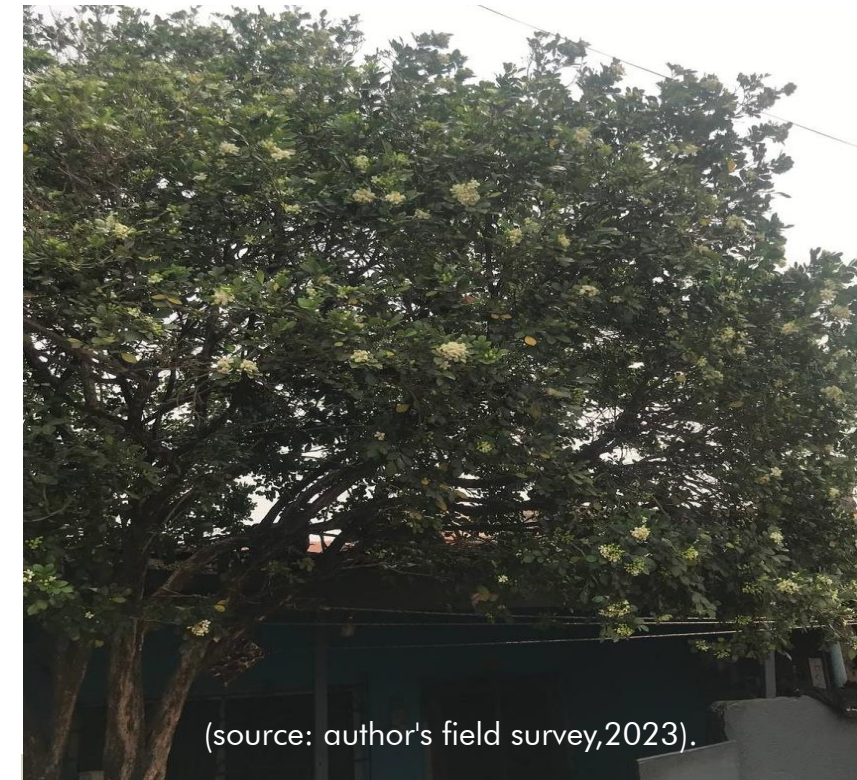
Common name: **Moses-in-the-cradle**
Botanical name: **Tradescantia spathacea**

Location:

- Residences

Importance:

- Ornamental purposes (decorative)



(source: author's field survey,2023).

Common name: **Lilac ivory silk**
Botanical name: **Syringa reticulata**

Location:

- Along the streets and in the neighbourhood
- Residences

Importance:

- Ornamental purposes(shade)



EXISTING FLORA IN THE STUDY AREAS



(source: author's field survey,2023).

Common name: **Indian rubber tree**
Botanical name: **Ficus elastica**

Location:

- Manhya palace

Importance:

- Ornamental purposes (decorative, shade)
- Air purification



(source: author's field survey,2023).

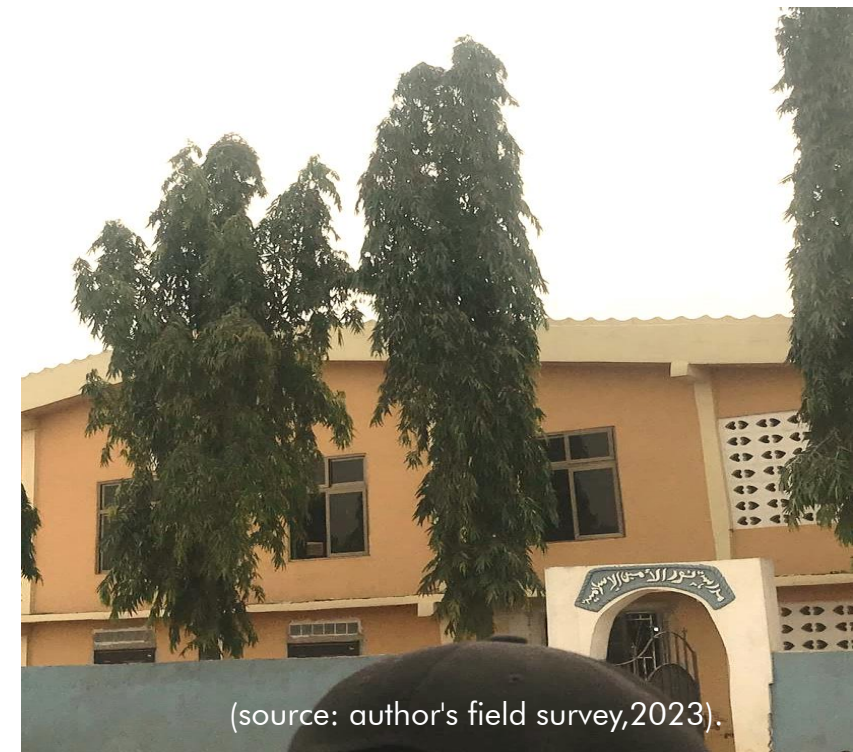
Common name: **Royal palm**
Botanical name: **Roystonea regia**

Location:

- Residences
- Along the streets
- Manhya hospital

Importance:

- Ornamental purposes (decorative, shade)



(source: author's field survey,2023).

Common name: **Ashoka tree**
Botanical name: **Saraca asoca**

Location:

- Residences
- Along the streets
- Schools

Importance:

- Ornamental purposes(decorative, shade)



EXISTING FLORA IN THE STUDY AREAS



(source: author's field survey,2023)

Common name: Turkey berry
Botanical name: *Solanum torvum*

Location:

- Residences

Importance:

- Culinary purposes (food)
- Medicinal



(source: author's field survey,2023)

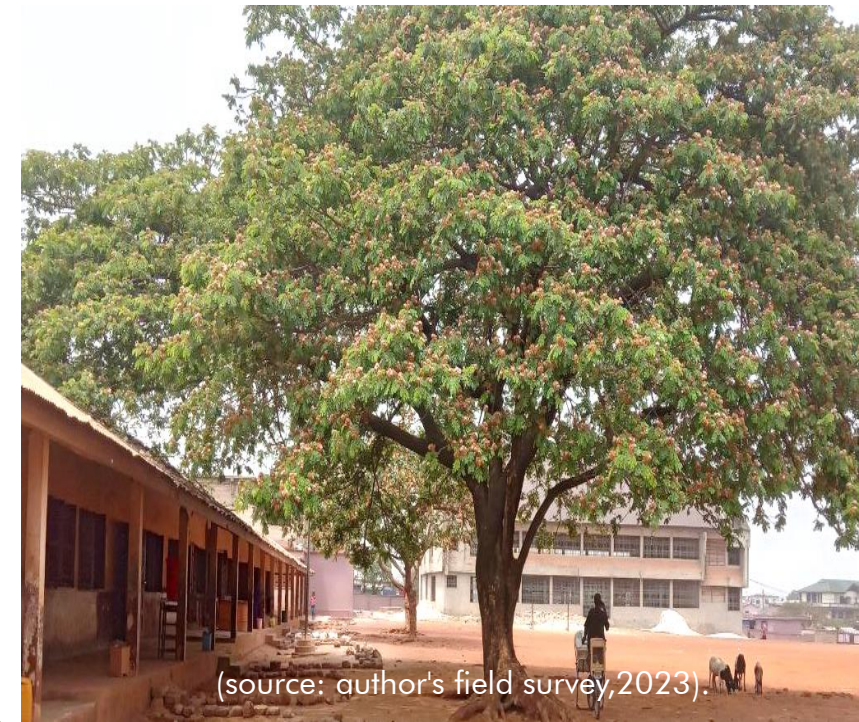
Common name: Orange tree
Botanical name: *Citrus × sinensis*

Location:

- Residences

Importance:

- Culinary purposes (food)
- Ornamental purposes (shade)



(source: author's field survey,2023)

Common name: Persian silk tree
Botanical name: *Albizia julibrissin*

Location:

- Schools
- Around the neighbourhood

Importance:

- Ornamental purposes (decorative, shade)



EXISTING FLORA IN THE STUDY AREAS



Common name: **Cast-iron plant**
Botanical name: **Aspidistra elatior**

Location:

- Manhya hospital

Importance:

- Ornamental purposes (decorative)
- Air purification



Common name: **Hibiscus plant**
Botanical name: **Hibiscus rosa-sinensis**

Location:

- Residences

Importance:

- Ornamental purposes (decorative)
- Medicinal purposes



Common name: **Bamboo plant**
Botanical name: **Bambusa vulgaris**

Location:

- Along the streets and in the neighbourhood
- Residences

Importance:

- Ornamental purposes(shade)



OVERVIEW OF VEGETATION IN ZONE 1



Source: Author's field survey

- Quite a good number of variety of plant species are found in Zone 1. Some of these species include the royal palm, Indian rubber, plantain, neem, and siar kalayaan tree.
- These plant species are located along the streets, in residences, and within the community.
- The siar kalayaan and neem trees are mostly found along the streets of the Antoa road.



OVERVIEW OF VEGETATION IN ZONE 1



- The dense vegetative area in Zone 1 is the Manhyia palace forest reserve, with a variety of species.
- Diverse plant species are also found in the Manhyia Palace and the Palace Museum. Some of these species are the royal palm, Indian rubber tree, plantain tree, and Spartan juniper tree.
- Within and around the residences, plantain trees, palm trees, orange trees, and mango trees were also identified.

Source: Author's field survey



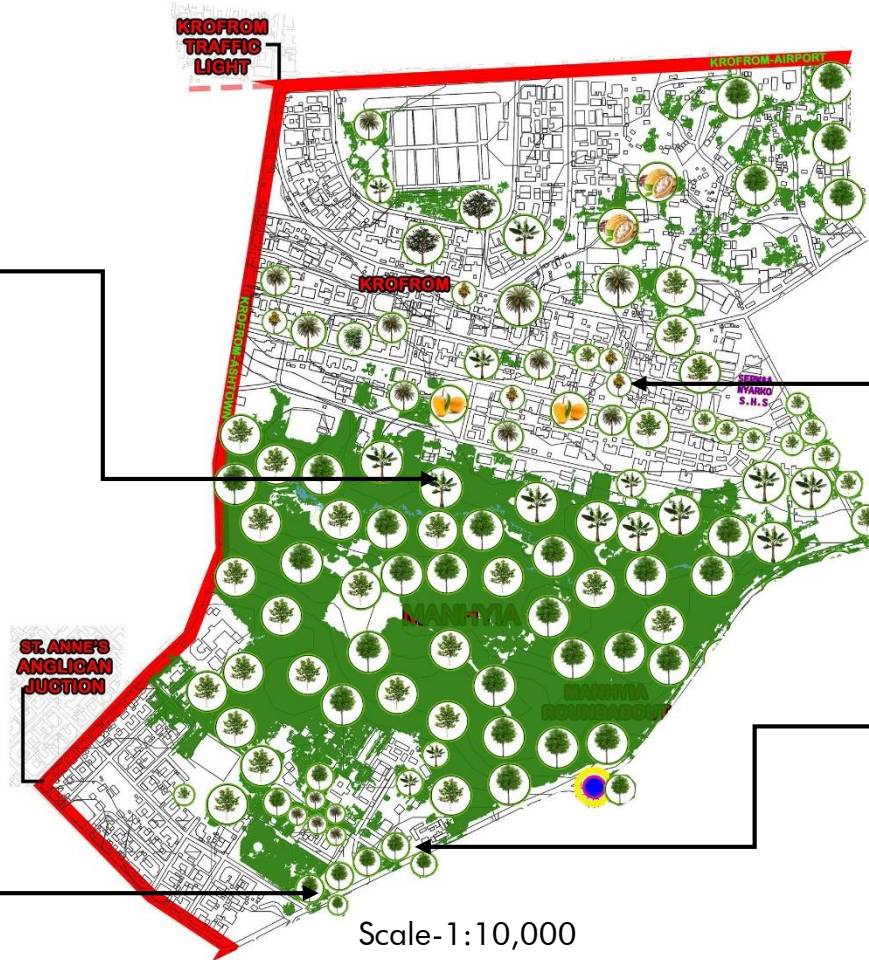
MAP SHOWING FLORA IN ZONE 1



Plantain tree
Lat 6.704097°, Long-1.613478°



Neem tree
Lat 6.70401°, Long-1.61571°



Percentage of flora in Zone 1 - **33%**



Variegated fig tree
Lat 6.70945°, Long-1.60966°



Siar kalayaan tree
Lat 6.70401°, Long-1.61571°



OVERVIEW OF VEGETATION IN ZONE 2



Source: Author's field survey

- The vegetation found in this zone is very few. There is hardly any greenery within the neighbourhood.
- The Manhya hospital is the dense vegetative area in the zone, with a variety of plant species.
- Some of these include royal palm, coconut trees, variegated fig, cast-iron plant, Ashoka trees, and burgundy rubber plant.



MAP SHOWING FLORA IN ZONE 2



Variegated fig tree
Lat 6.702585°, Long-1.613248°



Royal palm tree
Lat 6.702585°, Long-1.613248°



Scale-1:10,000

Percentage of flora in Zone 2- 4%



Ashoka tree
Lat 6.705132°, Long-1.610473°



Coconut tree
Lat 6. 69978°, Long-1.6101°



OVERVIEW OF VEGETATION IN ZONE 3

- Greenery in this zone is scarce.
- The plant species found are located along the roads and residences.
- Some of these include palm trees, turkey berry, siar kalayaan, Ashoka, Persian silk, and plantain trees.



Source: Author's field survey



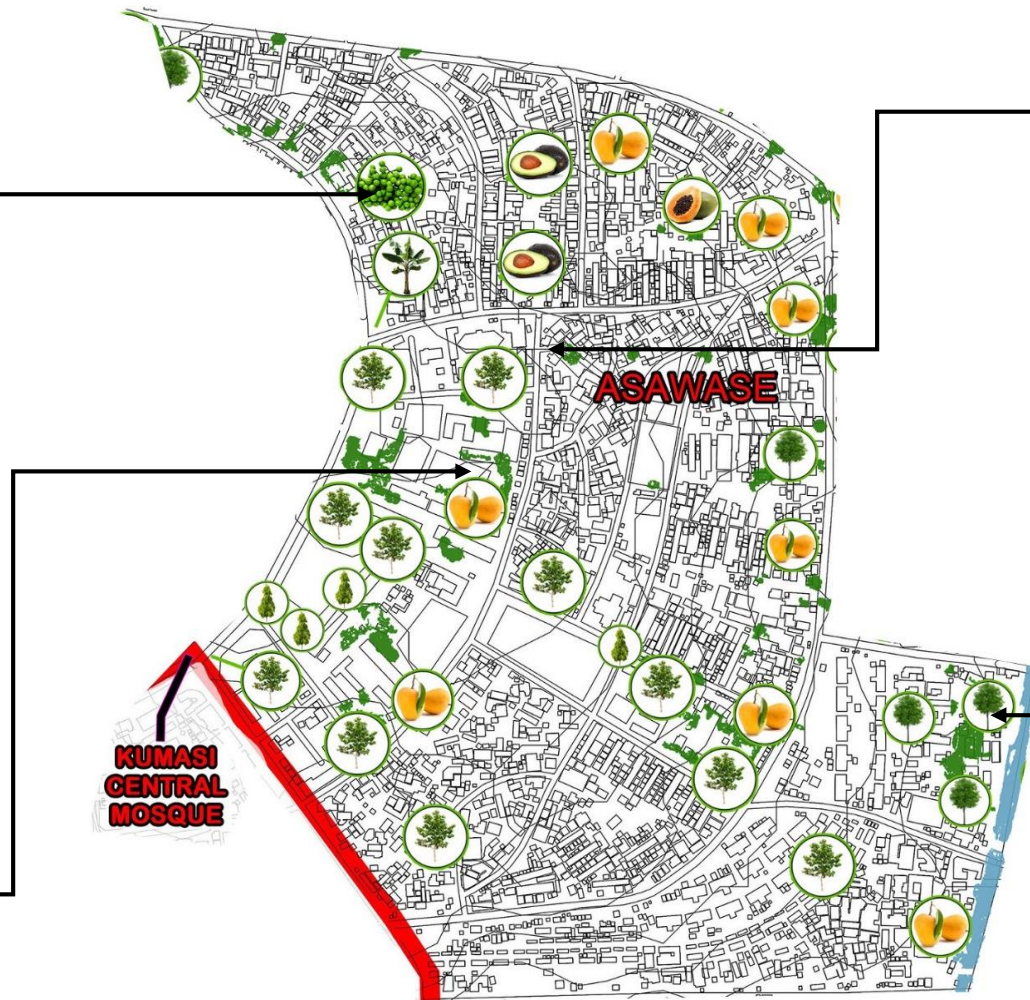
MAP SHOWING FLORA IN ZONE 3



Turkey berry plant
Lat 6.705331°, Long-1.61052°



Ashoka tree
Lat 6.70619°, Long-1.60806°



Scale-1:10,000

Percentage of flora in Zone 3- **2%**



Arrowhead vine
Lat 6.7025044°, Long-1.6060437°



Siar kalayaan tree
Lat 6.70068°, Long-1.60617°





Source: Author's field survey

OVERVIEW OF VEGETATION IN ZONE 4

- A good number of varying species are also found in Zone 4. Some of these species include the royal palm, plantain, pawpaw, almond, and Siar kalayaan trees.
- These plant species are located along the streets, in residences, institutions, open parks, and within the community.
- The Kumasi Children's park is the dense area in the zone, hosting diverse plant species.
- Mango tree, fiddle-leaf fig, and Siar kalayaan tree are some species identified in and around the park.



Source: Author's field survey

OVERVIEW OF VEGETATION IN ZONE 4

- The Kumasi Technical institute also falls within that zone where quite a number of different species can be found.
- Some species such as almond, mango, and plantain trees are also identified there.
- The University of Ghana, Legon, Kumasi campus has open spaces with a few plants scattered around it.

(source: author's field survey).



MAP SHOWING FLORA IN ZONE 4



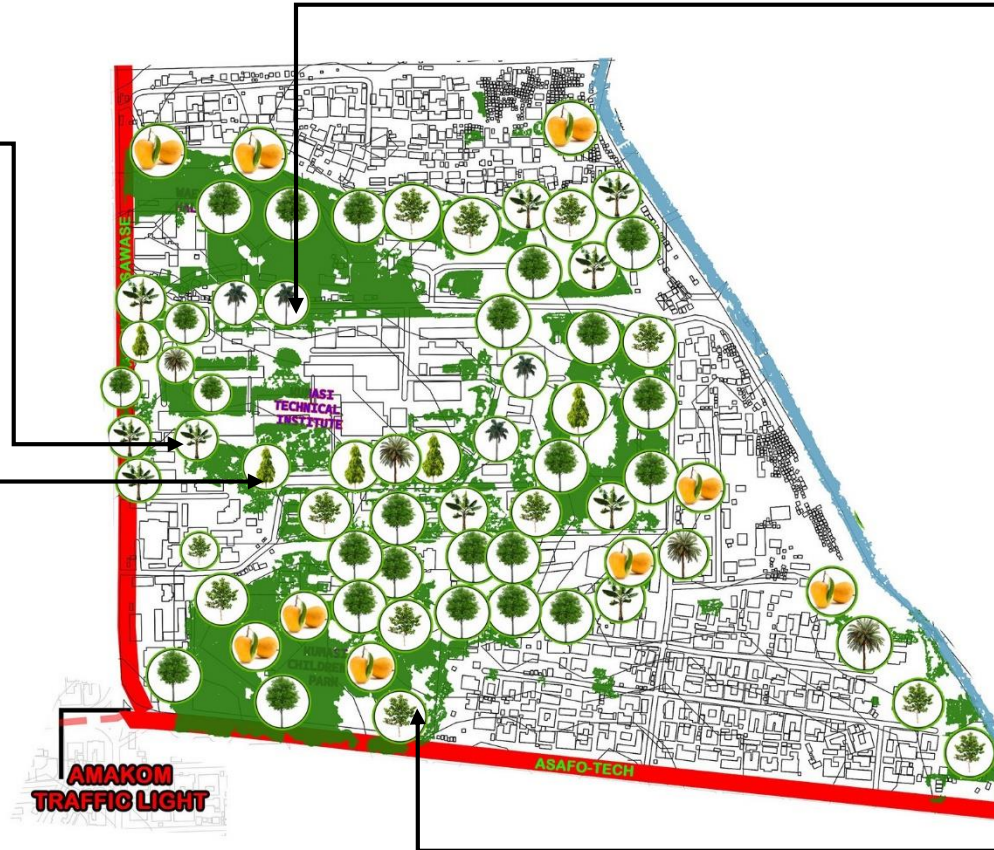
Source: Author's field survey

Plantain tree
Lat 6.69286°, Long-1.60416°



Source: Author's field survey

Ashoka tree
Lat 6.69286°, Long-1.60416°



Scale-1:10,000



Source: Author's field survey

Royal palm
Lat 6.69286°, Long-1.60416°



Source: Author's field survey

Siar kalayaan tree
Lat 6.68933°, Long-1.60341°

Percentage of flora in Zone 4- **27%**





Source: Author's field survey

OVERVIEW OF VEGETATION IN ZONE 5

- Variety of species are found in this zone but are also very few.
- Some of these species include the Chinese Ixora, coconut, plantain, orange tree, and palm trees.
- These plant species are located along the streets, in front of and in residences, and within the community.

(source: author's field survey).



MAP SHOWING FLORA IN ZONE 5



Mango tree
Lat 6.70356°, Long-1.59618°



Source: Author's field survey

Plantain tree
Lat 6.70356°, Long-1.59618°



Scale-1:10,000



Source: Author's field survey

Chinese Ixora
Lat 6.692244°, Long-1.597454°



Palm tree
Lat 6.68862°, Long-1.59653°

Percentage of flora in Zone 5- 2%





Source: Author's field survey

OVERVIEW OF VEGETATION IN ZONE 6

- Different species of greenery are found in this zone but are also few.
- Some of these species include bamboo, coconut, plantain, palm, orange, and mango trees.
- These plant species are located along the streets, the airport roundabout, in residences, in open spaces, along the waterbody, and within the community.

(source: author's field survey).



MAP SHOWING FLORA IN ZONE 6



Orange tree
Lat 6.707623°, Long-
1.604751°



Source: Author's field survey

Hibiscus plant
Lat 6.707013°, Long-
1.603918°



Scale-1:10,000

Percentage of flora in Zone 6- 9%



Mango tree
Lat 6.70853°, Long-1.59912°



Pawpaw tree
Lat 6.70934°, Long-1.60325°



OVERVIEW OF VEGETATION IN ZONE 7

- A variety of species are found in this zone are also scarce.
- Some of these species include the dandelion, plantain tree, Ashoka tree, almond tree, and coconut tree, with coconut tree being the predominant species.
- These plant species are located along the streets, in and in front of residences, in open spaces, and within the community.
- The coconut trees are located along the streets and in the compound of residences.

(source: author's field survey).

Source: Author's field survey



MAP SHOWING FLORA IN ZONE 7



Source: Author's field survey

Orange tree
Lat 6.71158°, Long-1.60652°



Source: Author's field survey

Spartan juniper tree
Lat 6.71158°, Long-1.60652°



Scale-1:10,000



Source: Author's field survey

Bamboo plant
Lat 6.71046°, Long-1.59957°



Source: Author's field survey

Coconut tree
Lat 6.70853°, Long-1.59912°

Percentage of flora in Zone 7- **3%**





IMPLICATIONS OF VEGETATION IN THE TERRAIN

- Areas with a good number of greenery such as zones 1 and 4, had spaces within the zones that were aesthetically pleasing. Hence enhancing the appearance of the space.
- Trees with large canopies were also planted along the road and in residences. These trees provided shade in the areas.
- Shade helps in reducing exposure to and harm from UV radiation (*Parisi and Turnbull, 2014*).
- Tree shade can directly lower surface temperature by reducing the storage and convection of heat of land surface by reducing the incident solar radiation at urban surfaces such as buildings and roads (*Akbari et al., 1997; Berry et al., 2013; Morakinyo et al., 2016*).

(source: author's field survey).



IMPLICATIONS OF VEGETATION IN THE TERRAIN

- Trees promote health and social well-being by removing air pollution (*Turner-Skoff, 2019*).
- Zones 2, 3, 5, 6, and 7 were areas with little greenery.
- These areas were not aesthetically pleasing as there were little to no trees found along the roads to enhance the appearance of the space.
- Also, the areas mentioned above are prone to harmful UV radiation.
- The loss of trees and other vegetation can cause climate change, desertification, soil erosion, flooding, and increased greenhouse gases in the atmosphere (*pachamama.org*).



(source: author's field survey).





Source: Author's field survey

- **Fauna**



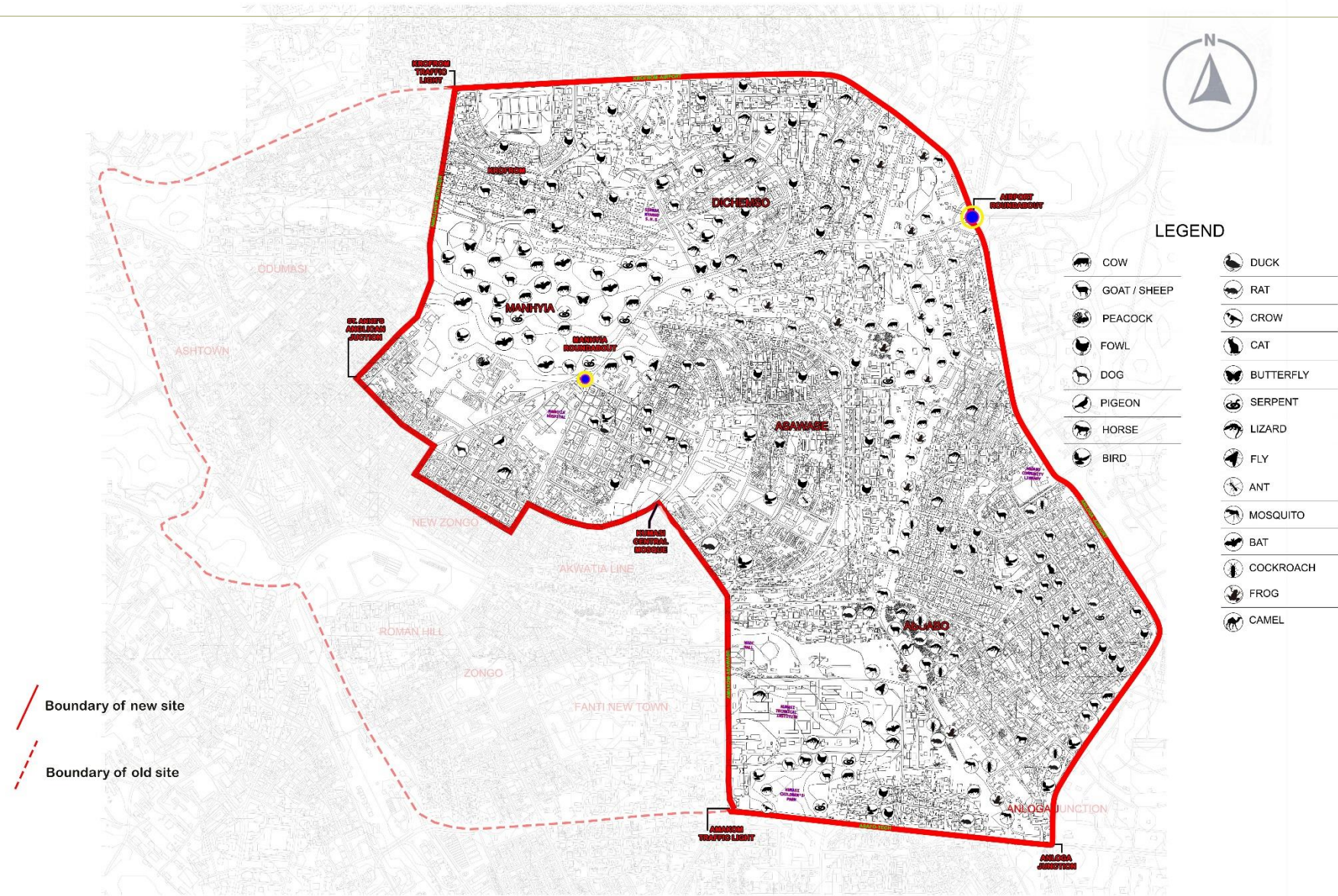
- **FAUNA** simply refers to all animals that live in a particular or area in the ecosystem(OxfordDictionary).
- This comprises herbivorous, omnivorous and carnivorous animals.
- The terrain has quite a number of animal species.
- These animal species are mostly domestically reared for food and commercial purposes and found in the inland.



Source: Author's field survey



MAP SHOWING FAUNA IN THE TERRAIN



Scale-1:25,000



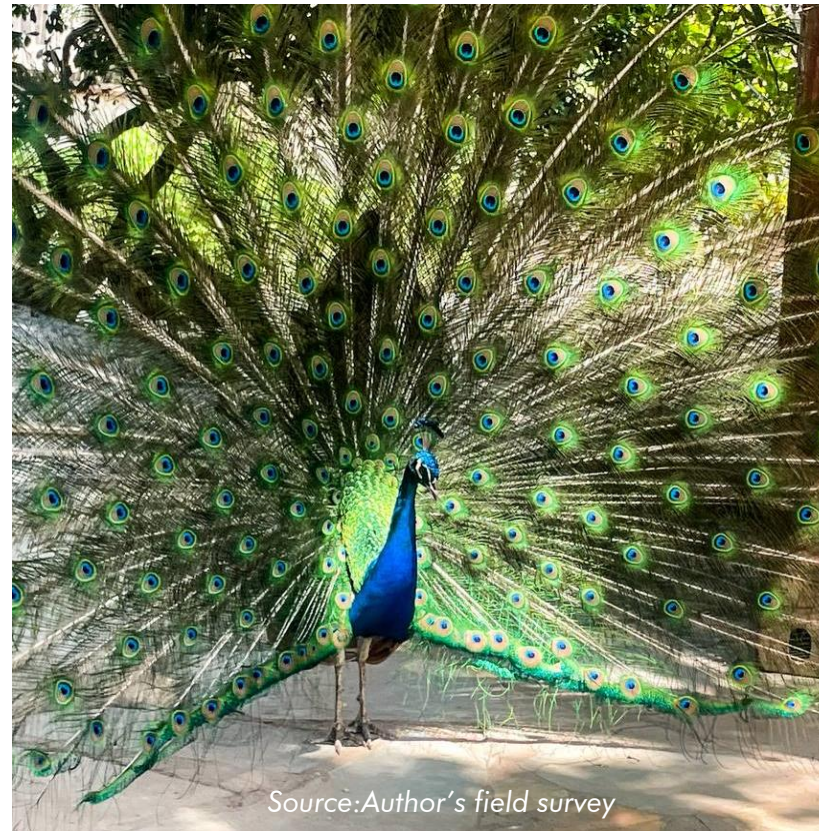
Common animal species in the study areas

Cattle (*Bos taurus*)

- They are herbivorous animals reared in the study area
- Used for both commercial and domestic purposes.



Source: Author's field survey



Source: Author's field survey

Peacock (*Pavo cristatus*)

- They are omnivorous animals found in the Manhya palace.
- Reared for its beauty.

Goat (*Capra aegagrus hircus*)

- They are herbivorous animals reared in the study area .
- Used for both commercial and domestic purposes.



Source: Author's field survey



Common animal species in the study areas

Dog (*Canis familiaris*)

- They are omnivorous animals in the study area.
- Often used for security purposes and kept as pets.



Sheep (*Ovis aries*)

- They are herbivorous animals reared in the study area
- Used for both commercial and domestic purposes.

Chicken

(*Gallus gallus domesticus*)

- They are reared at home for commercial purposes and for food.



Common animal species in the study areas

Horse (Equus caballus.)

- They are omnivorous animals in the study area.
- Used for commercial purposes



Egret (Ardea alba)

- They are omnivorous animals found in the study area.

Lizard (Lacertilia)

- They are omnivorous animals found in the study area.



Common animal species in the study areas

Snake (Serpentes.)

- Dangerous reptiles rarely seen in town.
- Usually spotted within green areas after rainfall
- Also spotted around some households



Source:google.com

Centipede(Chilopoda)

- Elongated metameric creatures with one pair of legs per body segment.
- They are found in the green areas

Termites (Isoptera)

- Insects which usually build hills and are very territorial.
- Also quite weary of unknowing by-passers.



Source:Author's field survey



Common animal species in the study areas

Mosquito(Culicidae)

- Mosquitoes are the most common insects in the terrain.
- This is mainly due to water and land pollution.
- This in turn results in malaria which is the commonest illness in the terrain.



Source:Author's field survey

Rat(Rattus)

- Omnivorous animals
- Commonly found in drains

Ant (Formicidae)

- Omnivorous insects
- Commonly found at random places in the terrain



Source:Author's field survey



Common animal species in the study areas

Housefly (*Musca domestica*)

- Very common insects in the terrain.
- This is mainly due to air, water and land pollution.



Cat (*Felis catus*)

- Omnivorous animals
- Often kept as pets

Moth (Lepidoptera)

- They are often around mainly due to air, water and land pollution.



Implications of Fauna in the study enclave

- Most of the communities are muslim communities, thus they rear cattle for commercial and other purposes.
- Cattle egrets are also seen because of the warm-temperate zone of the enclave and the presence of cattle. They forage the feet of grazing cattle.
- Houseflies and moths were also seen as a result of land and air pollution.



Source: Author's field survey

Aboabo

Lat 6.697606 ° Long -1.602060°

Implications of the study enclave On fauna

- There were a few areas with green pastures for the animals to feed on.
- Most of the areas were built up or covered with hard surfaces. Quite a number of the cattle found in the study area were lean.



Source: Author's field survey

Aboabo

Lat 6.697606 ° Long -1.602060°





Source: Author's field survey

- **Drainage**





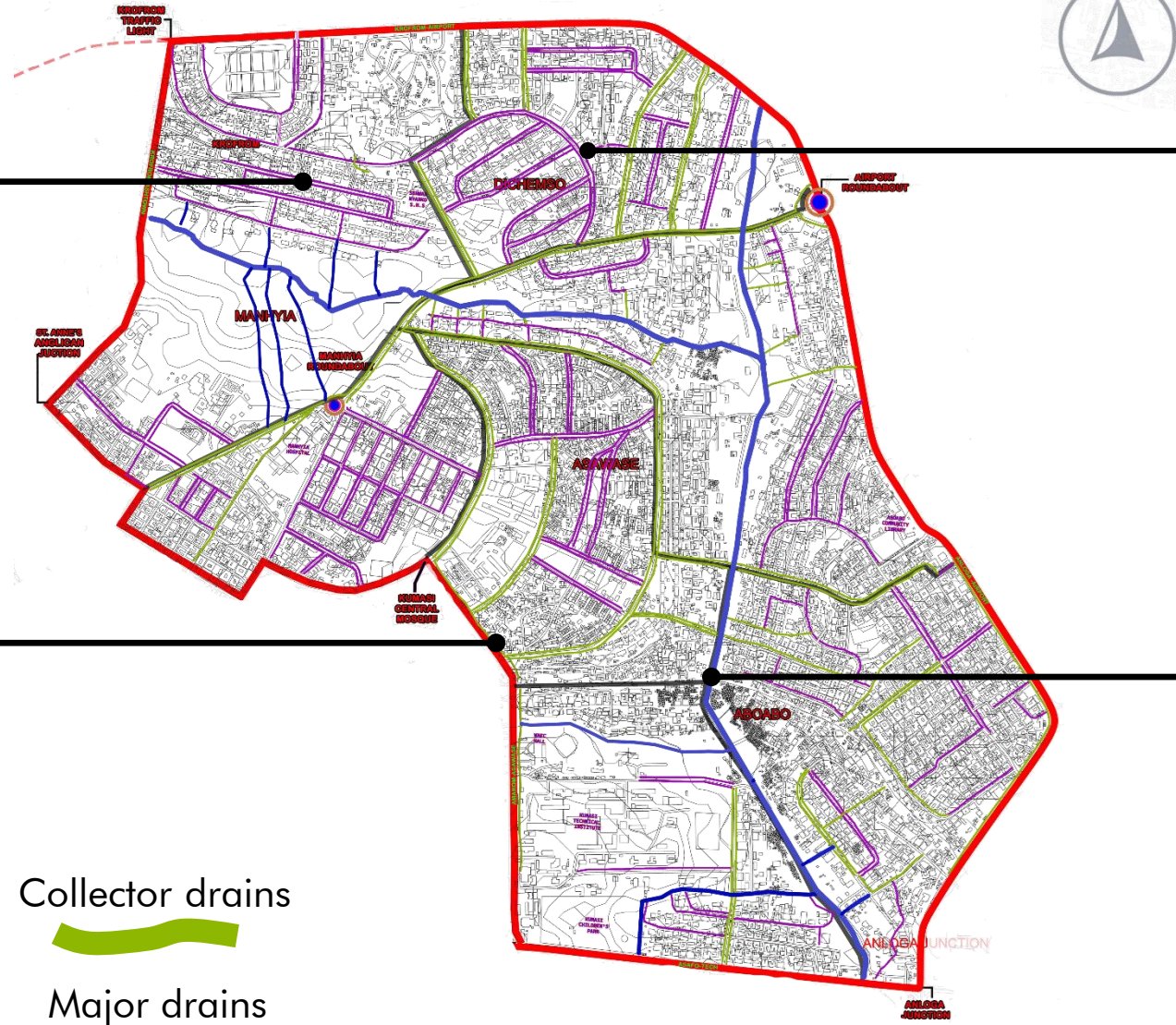
Drainage

Source: google.com

- Existing Drains
- Drainage Patterns
- Choked Gutters
- Flood Prone Areas
- Observations



Existing Drains



Source: Author's field survey

Minor Drains
 Lat: 6.709366
 Long: -1.612248






Source: Author's field survey

Collector Drains
 Lat: 6.710468
 Long: -1.608146



Source: Author's field survey

Collector Drains
 Lat: 6.698495
 Long: -1.606763

- Collector drains 
- Major drains 
- Minor drains 

Scale-1:25,000

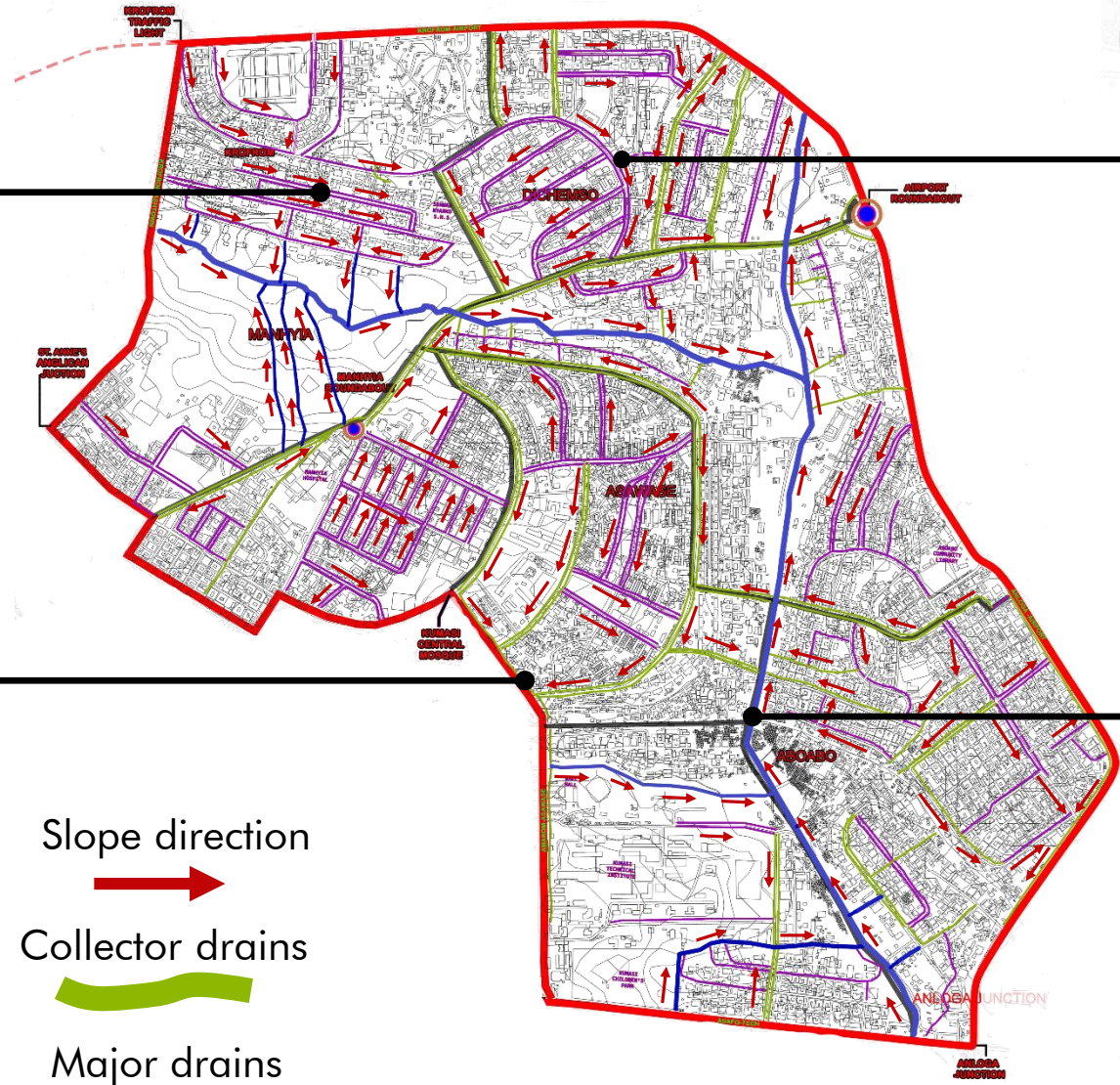


Source: Author's field survey

Major Drains
 Lat: 6.697241
 Long: -1.601896



Drainage Pattern



Source: Author's field survey

Minor Drains
 Lat: 6.709366
 Long: -1.612248



Source: Author's field survey

Collector Drains
 Lat: 6.710468
 Long: -1.608146



Source: Author's field survey

Collector Drains
 Lat: 6.698495
 Long: -1.606763



Source: Author's field survey

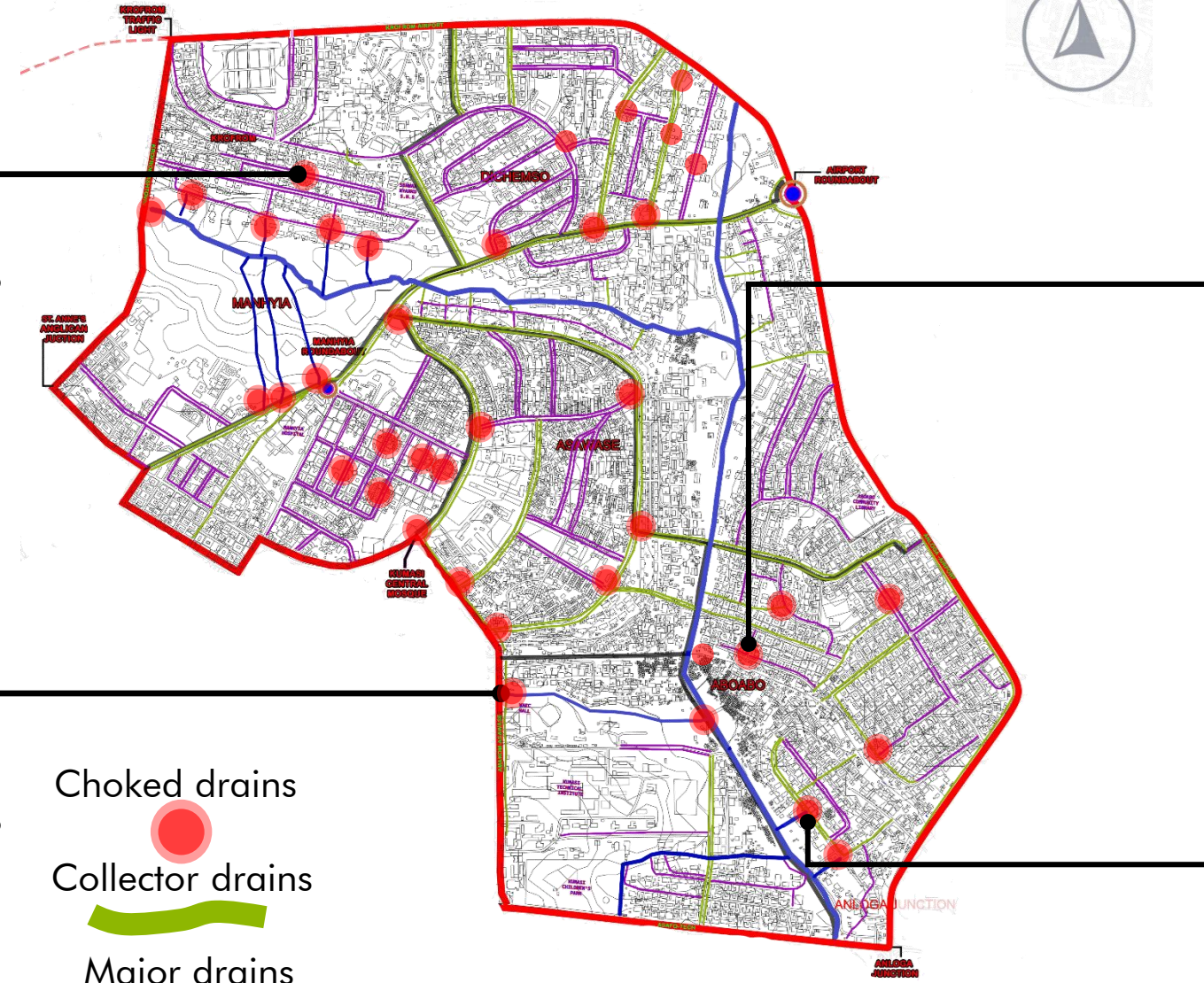
Major Drains
 Lat: 6.697241
 Long: -1.601896

- Slope direction
- Collector drains
- Major drains
- Minor drains

Scale-1:25,000



Choked Gutters



Source: Author's field survey
 Minor Drains
 Lat: 6.709366
 Long:-1.612248



Source: Author's field survey
 Collector Drains
 Lat: 6.695493
 Long:-1.601489



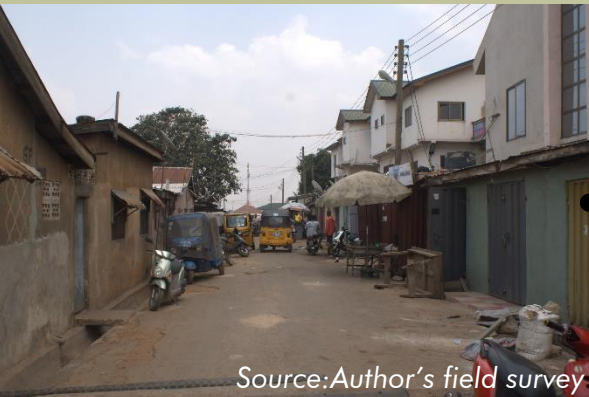
Source: Author's field survey
 Collector Drains
 Lat: 6.961966
 Long:-1.606955



Source: Author's field survey
 Major Drains
 Lat: 6.695246
 Long:- 1.601568



Flood Prone Areas



Source: Author's field survey

Minor Drains
 Lat: 6.709366
 Long: -1.612248



Source: Author's field survey

Collector Drains
 Lat: 6.712301
 Long: -1.602164





Source: Author's field survey

Collector Drains
 Lat: 6.961956
 Long: -1.606743



Source: Author's field survey

Major Drains
 Lat: 6.699095
 Long: -1.600698

- Flood Zones
-  Collector drains
 -  Major drains
 -  Minor drains
 -  Minor drains

Scale-1:25,000



Observations

- Most drains were not covered leading to silt infill.
- Some portions of the drains were choked with dust and plastic waste.
- Silt in the drains has created an environment for growth of weeds.
- The people live closer to the drains.
- Plastic waste and silt removed from the major drains during the drenching exercise has been deposited beside the drains.
- The covered drains were not disability friendly.
- Flood in these areas are caused by the waste found in drains choking the movement of liquid waste.
- The choked gutters were breeding mosquitoes, making malaria a dominant illness in the terrain.



05 Climate and Geology



Source: Author's field survey



Source: Author's field survey





Climate

- **Climate** is the long-term weather pattern in a region, typically averaged over 30 years. Some of the meteorological variables that are commonly measured are temperature, humidity, atmospheric pressure, wind, and precipitation. (Matthews, J.B. Robin; Möller, Vincent; van Diemen, Renée; Fuglestvedt, Jan S.; Masson-Delmotte, Valérie; Méndez, Carlos; Semenov, Sergey; Reisinger, Andy ,2021)
- Ashanti region has a Tropical wet and dry or Savanna climate. It is characterized by a wet season and dry season.
- The dry season lasts for most of the year.
- Generally, temperatures are high throughout the year Annual high temperature is 32.58 degrees Celsius and annual low temperature is 21.55 degrees Celsius.

Source: <https://tcktcktck.org/amp/ghana/ashanti>

Source: <https://sciencing.com/tropical-wet-dry-climates>



Source: Author's field survey

Human activities that cause Climate change

01

Combustion of fossil fuels for electricity, cars etc.



Source: Author's field survey

02

Changes in land use causing urban heat islands etc.



03

Deforestation



Source: Author's field survey



01

Extreme weather events. e.g. floods, heat, drought, wildfires etc.

02

A decrease in access to safe water

03

A decrease in air quality

IMPACT OF CLIMATE CHANGE ON THE ENVIRONMENT

04

A decrease in food security. Rain-fed crops can be reduced

05

An increase in climate-sensitive diseases. Malaria, pneumonia, etc.

Source: Author's field survey

Source: (WHO regional office of Africa, 2015)





Geology



01

The word geology means 'Study of the Earth'. Also known as geoscience or earth science.

(GeologyIn.com)

02

Geology comprises of:

- Earth formation
 - Composition
 - Processes
 - Impact
- (GeologyIn.com)

GEOLOGY

03

Geological impact

- Sustainability
- Climate Change
- Mineral Resources
- Water Management
- Mineral Resources

04

Soil types

- Sandy soil
 - Silt Soil
 - Clay Soil
 - Loamy Soil
- (byjus.com)

Source: Author's field survey

Source: Author's field survey



GEOLOGY OF GHANA

01

- The geology of Ghana is primarily very ancient crystalline basement rock, volcanic belts and sedimentary basins, affected by periods of igneous activity
- Ghana is characterized in general by low physical relief

ijser.org,2021

02

- Low plains stretch across the southern part of Ghana
- To their north lie three regions—the Ashanti Uplands, the Akwapim-Togo Ranges, and the Volta Basin.
- The high plains, occupies the northern and northwestern sector of Ghana

ijser.org,2021

Source:Author's field survey

Source:Author's field survey



SOIL

LATERITE

- Laterite, soil layer that is rich in iron oxide and derived from a wide variety of rocks weathering under strongly oxidizing and leaching conditions .
- Exposed surfaces are blackish-brown to reddish and commonly have a saggy, lavalike appearance
- Commonly lighter in colour (red, yellow and brown).

(Britannica.com)



Source: Author's field survey

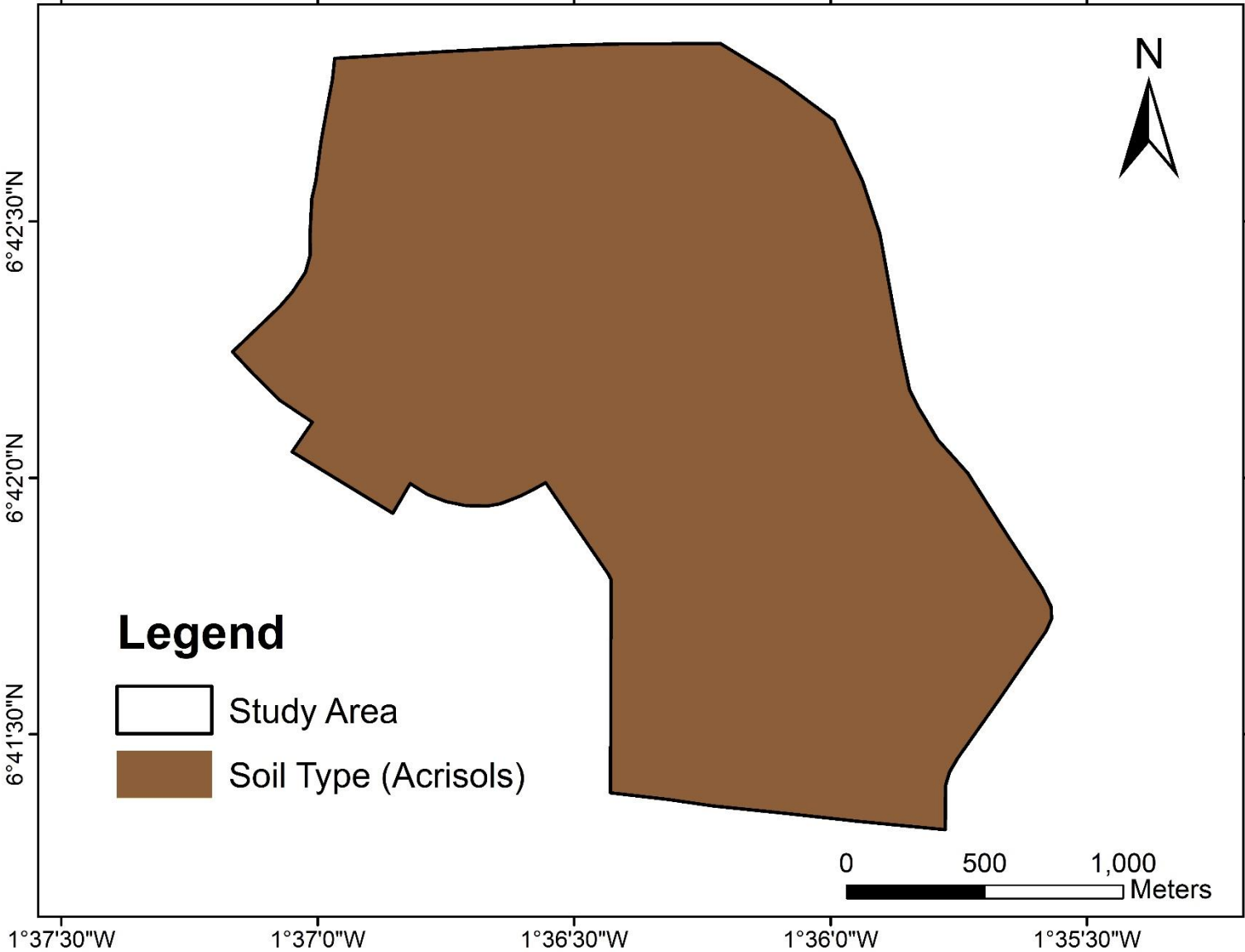
Laterite found at Manhyia



Laterite found at Asawase



GEOLOGICAL MAP OF STUDY ENCLAVE-SOIL TYPE



Source: Geological Dept., KNUST



MAP OF PREDOMINANT SOIL TYPE



Laterite found in various zones

All photos source: Author's field survey

Scale-1:25,000



ROCKS

01

A rock is a natural substance composed of solid crystals of different minerals that have been fused together into a solid lump.

TYPES OF ROCKS

- Sedimentary rocks
- Metamorphic rocks
- igneous rocks

02

ROCK TYPE DETERMINANTS

- Composition
- Grain size
- Texture
- Layering

PROCESS OF ROCK FORMATION

- Fragments(grains)
- Pressure and temperature
- Solidification

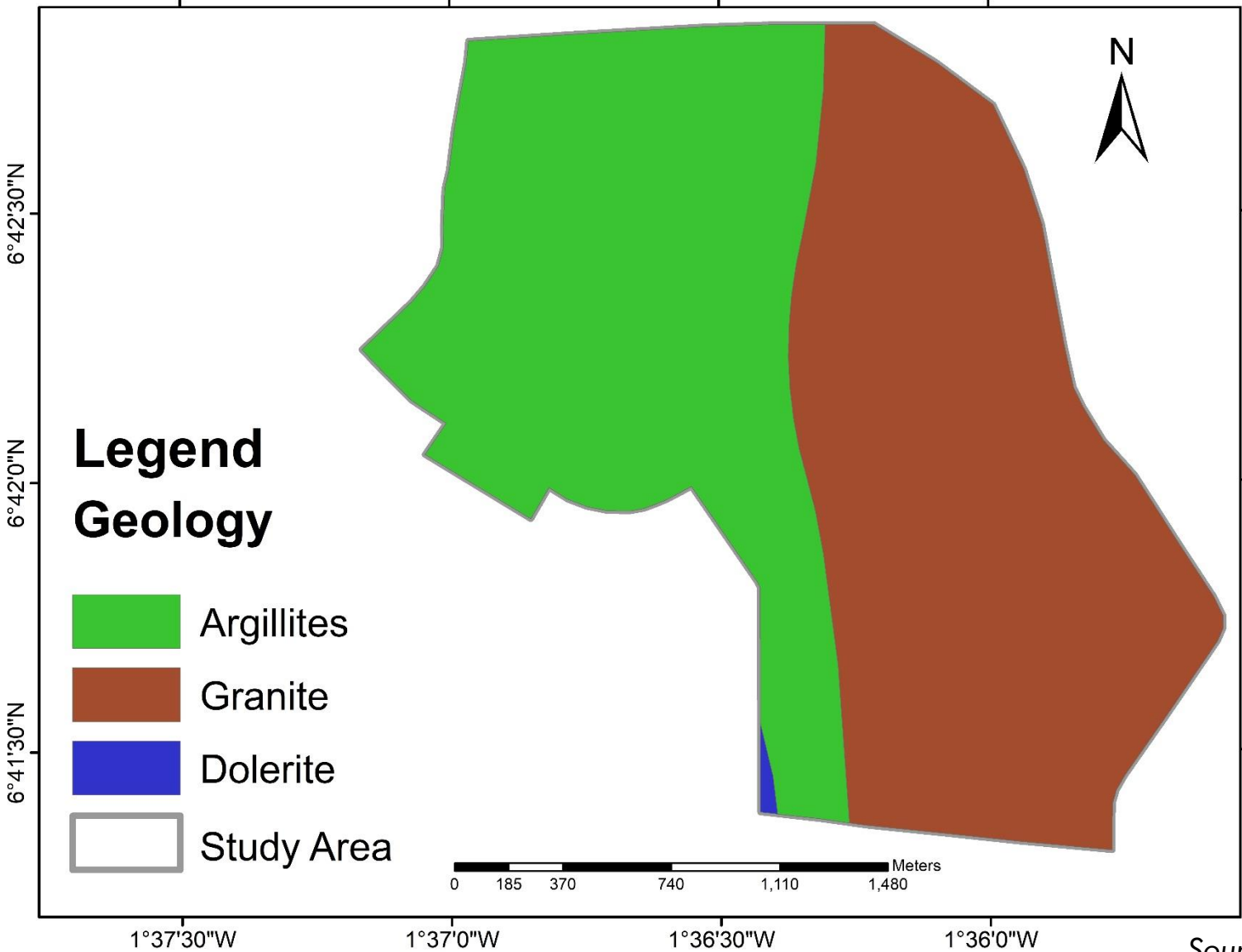
geologyscience.com

Source: Author's field survey

Source: Author's field survey



GEOLOGICAL MAP OF STUDY ENCLAVE-ROCK TYPES



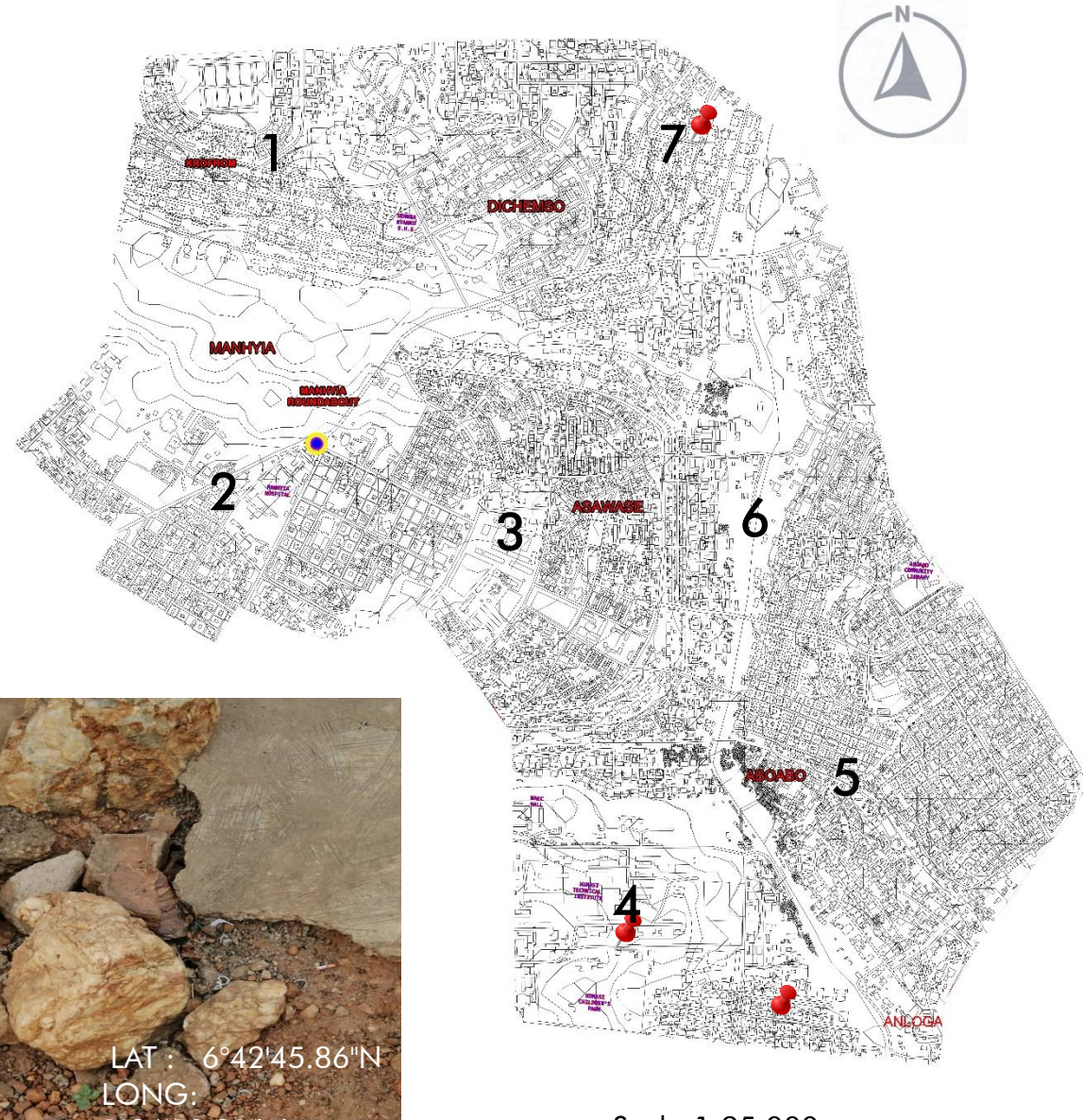
Source: Geological Dept., KNUST



ROCKS

Quartz stone

- It occurs in essentially all mineral environments, and is the crucial constituent of many rocks. It is likewise the maximum varied of all minerals, taking place in all distinct habits, and colorings.
- It is highly resistant to both mechanical and chemical weathering.
- It has a very high melting point and can withstand critically high temperatures.



Scale-1:25,000



LAT : 6°41'28.80"N
LONG: 1°36'21.24"W



LAT : 6°41'28.18"N
LONG: 1°36'4.88"W



LAT : 6°42'45.86"N
LONG:

Pictures of quartz stone discovered in various zones



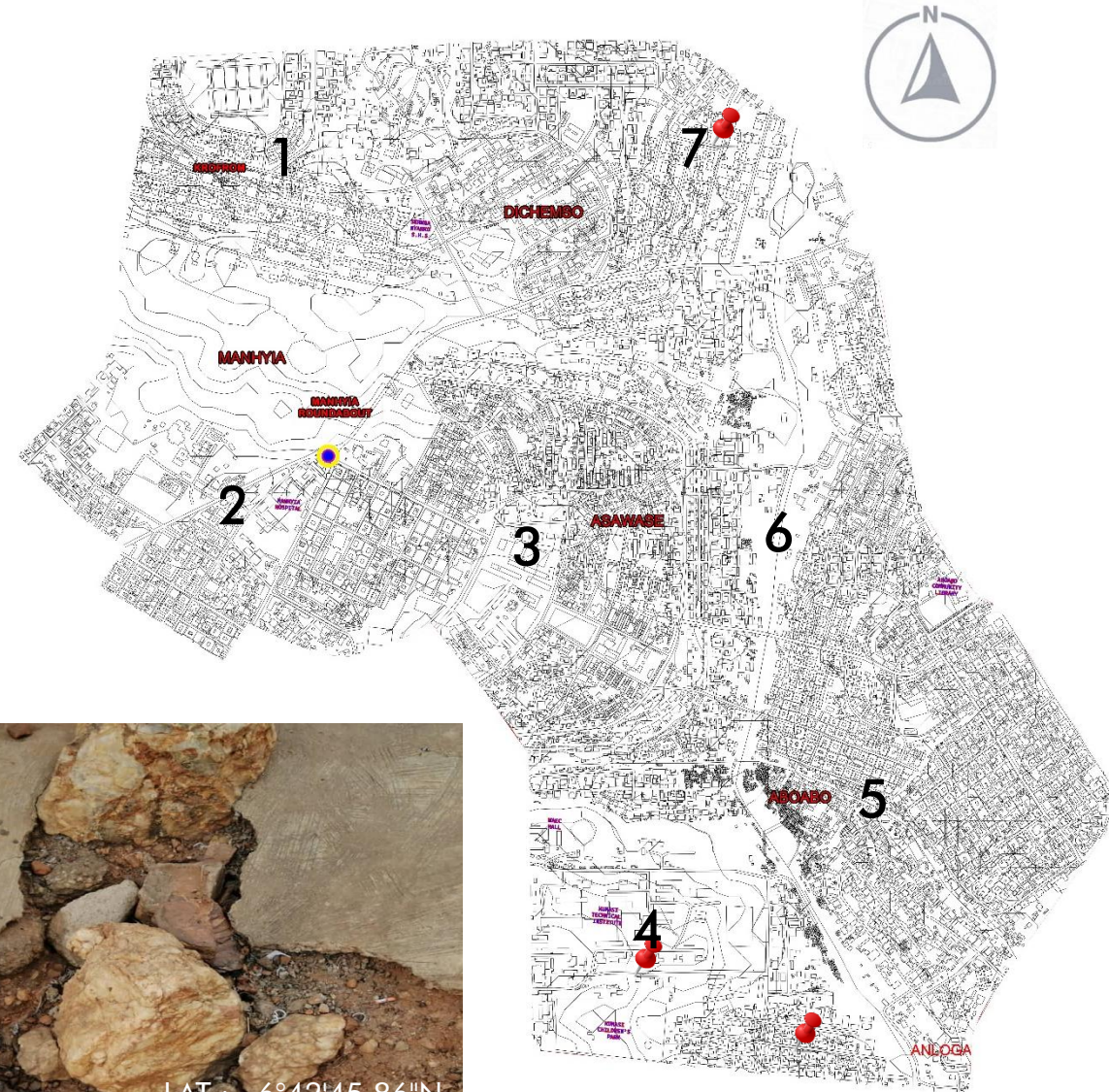
ROCKS

Quartz stone

USES

- Glassmaking
- Abrasives
- Production of refractory bricks
- Production of ceramic tiles
- Production of adhesives, putty, paint, and rubber.
- Production medical incision devices, cutting weapons, and sharpening cutting tools

(uniquecrystalminerals.com)



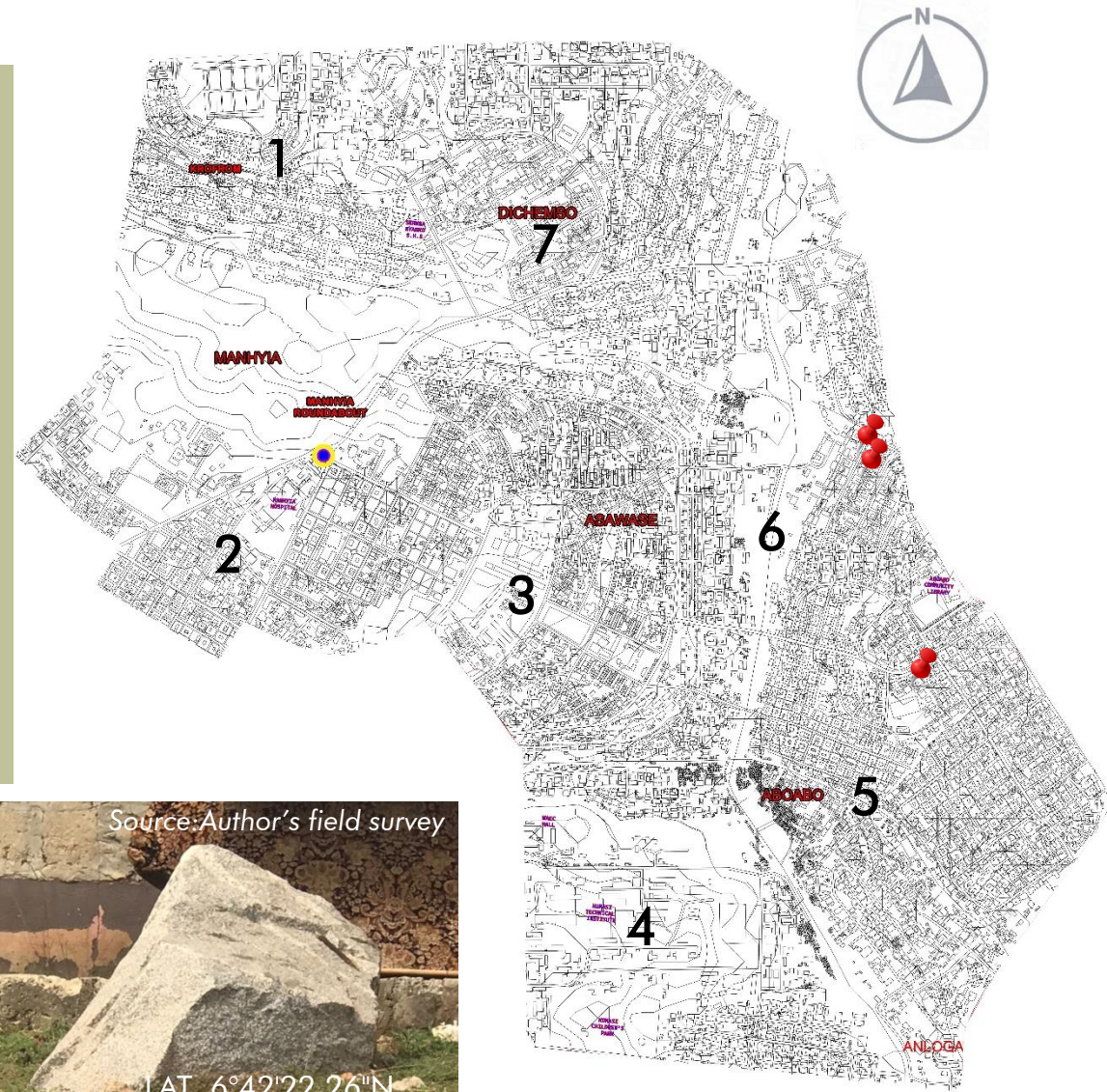
Scale-1:25,000

 Pictures of quartz stone discovered in various zones

ROCKS

Siltstone

- Texture: Clastic; Fine-grained (0.004 – 0.06 mm)
- Composition: Quartz, clay minerals
- Color: Reddish brown
- Miscellaneous: Massive; Feels slightly gritty
- Depositional Environment: Flood plain, Delta, or Mid-continental Shelf
- Grain size: Fine- grained



Scale-1:25,000

Pictures of siltstone discovered in various zones



ROCKS

Siltstone

- Siltstone is a clastic sedimentary rock that formed from grains whose sized between that of sandstone and mudstone.
- Siltstones may contain concretions, it is hard and durable and do not easily split into thin particles or layer
- The pore spaces of siltstone serve as good aquifer. It is rarely porous enough or extensive enough to serve as an oil or gas reservoir.



Scale-1:25,000

Pictures of siltstone discovered in various zones



GEOLOGY

Observation

1. A predominant soil type (laterite)
2. No predominant rock type
3. Evidence of weathering of rocks by wind and water
4. Variation in rock type throughout the zones.



06

Natural Resources



03

Source: Author's field survey





Source: Author's field survey

NATURAL RESOURCES

- **Natural resources** are resources that are drawn from nature and used with few modifications.
- This includes the sources of valued characteristics such as commercial and industrial use, aesthetic value, scientific interest, and cultural value(Oxford dictionaries n.d).
- They are broadly classified into **renewable** resources and **non-renewable** resources or **biotic** and **abiotic** depending on their source of origin (Mitchell, 2002).
- Rapid rate of urbanization has led to the depletion of most of the natural resources found in the enclave.



TYPES OF RESOURCES



Renewable resources

Renewable resources found were;

- Waterbodies
- Subsurface water
- Vegetation
- Animals
- Solar energy

Source: Author's field survey



Non-renewable resources

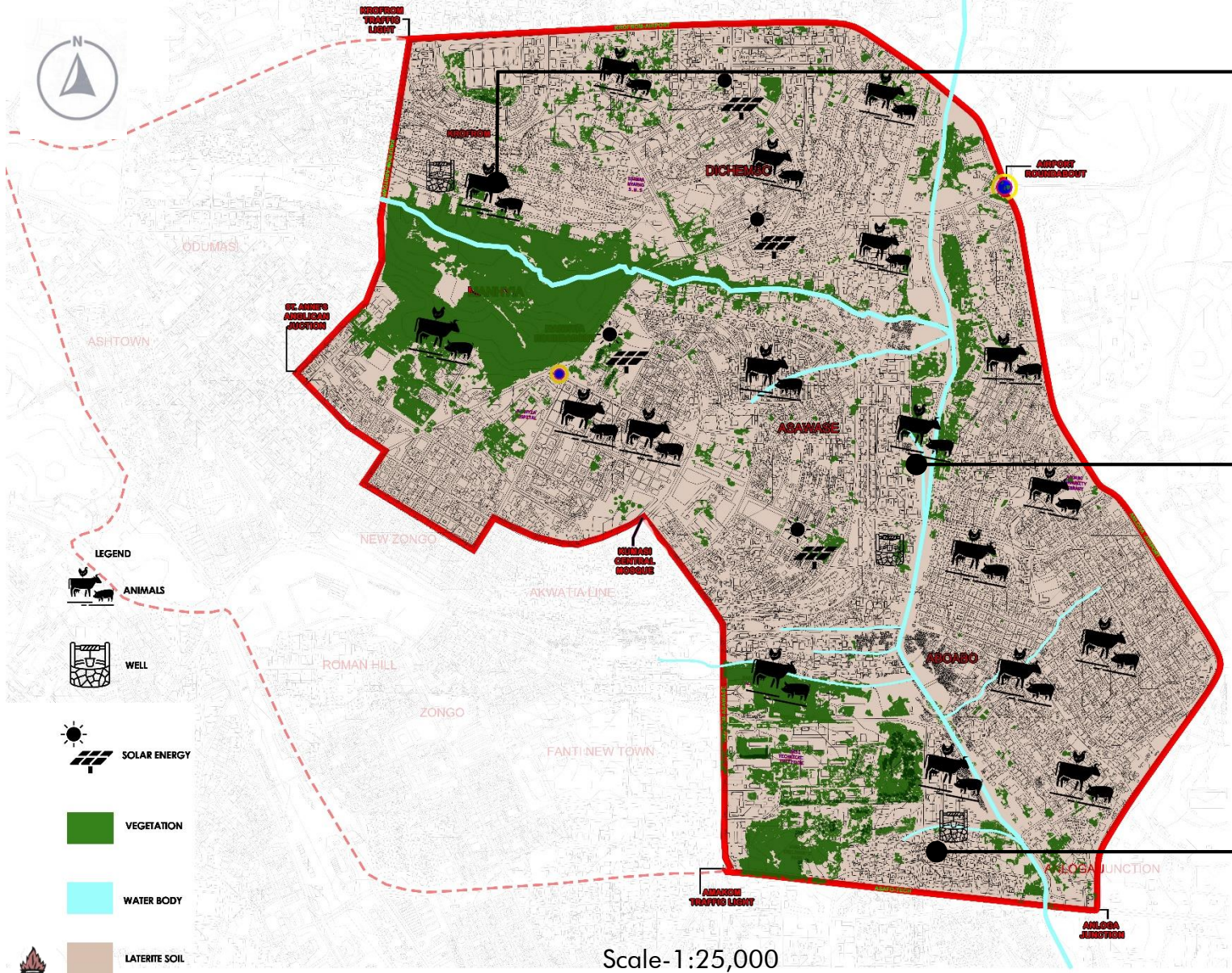
Non-renewable resources found were;

- Fertile land

Source: Author's field survey



MAP SHOWING NATURAL RESOURCES IN THE TERRAIN



Source: Author's field survey
Vegetation
Coordinates: 6.709572, -1.613411



Source: Author's field survey
Cattle
Coordinates: 6.697606, -1.602060



Source: Author's field survey
Groundwater
Coordinates: 6.697375, -1.602096



07 Tourism



Source: Author's field survey





**01
TOURIST
SITES**

CULTURAL TOURISM



**02
EFFECTS OF
TOURISM**

**ECONOMIC &
SOCIOCULTURAL**



**03
POTENTIAL
TOURISM**

ECO TOURISM



TOURISM



Source: Author's field survey

Manhya Palace Museum (cultural tourism)

Tourism is the movement of people to countries or places outside their usual environment for personal or business purposes (United Nations World Tourism, 2008).

Tourism can be classified into three (3); cultural, industrial and eco-tourism.

Cultural tourism is movements of persons for essentially cultural motivations such a study tours, performing arts and cultural tours, travel to cultural events, visits and to sites and monument (United Nations World Tourism, 2008).

Importance of tourism

- Helps in generating income opportunities for the local people.
- Boosts and diversifies the economy of the country.
- Also helps in improving the standard of the local people.
- Offers jobs to people such as tourist guides, agriculture, the food, art and hoteling industry, etc.



TOURISM

THE MANHYIA PALACE

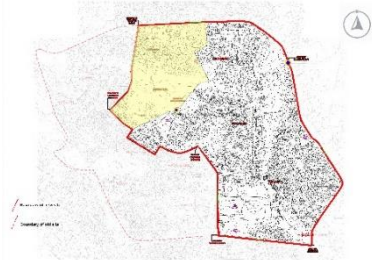
Location: Manhyia Palace, Manhyia, Kumasi

Area: about 7,500m²

The Manhyia Palace is the seat of the Asantehene and his official residence.

It was first built in 1995 by Otumfuo Opoku Ware II (15th King of the Asante Kingdom).

The Palace has residential spaces, open green spaces, parking lots, meeting areas and archives office.



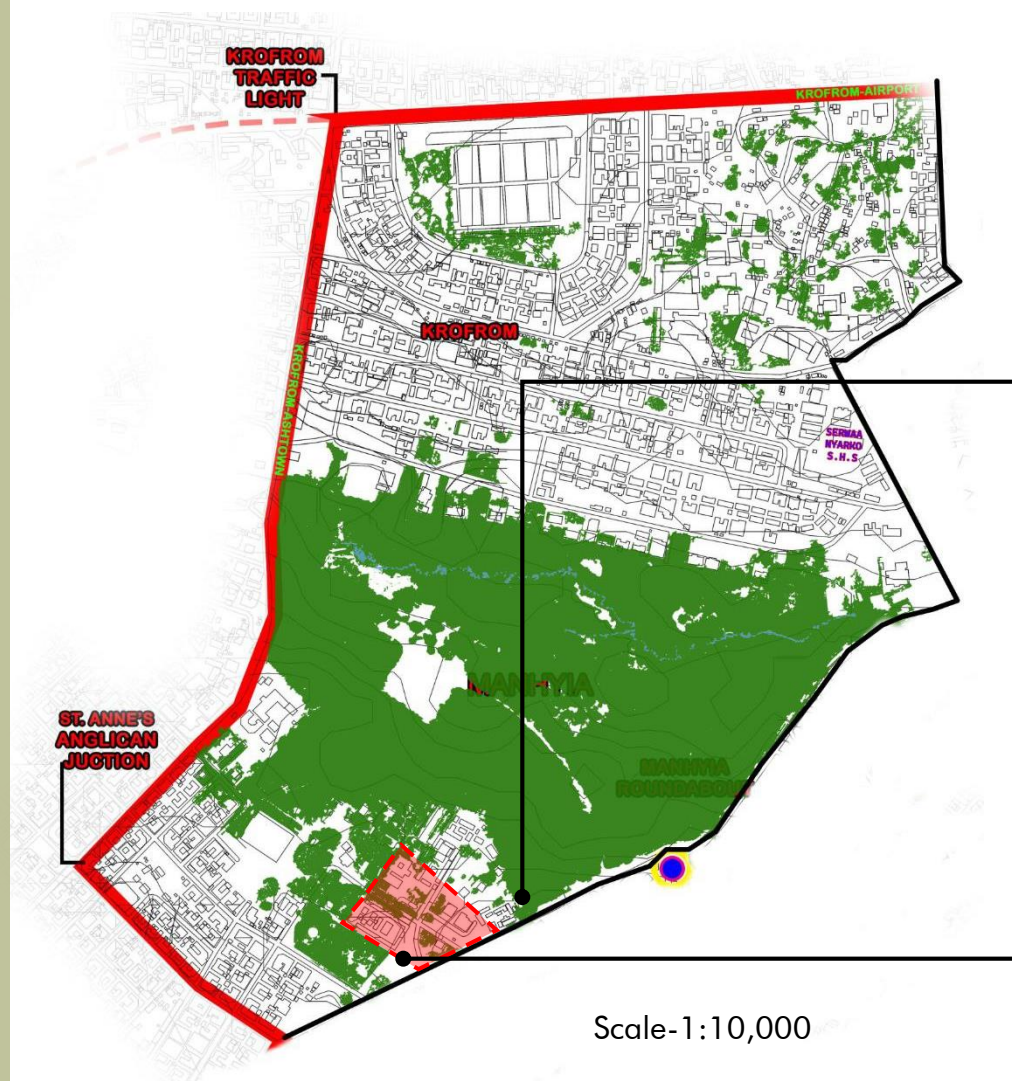
Key Map



Source: Author's field survey
Manhyia Archives,
Lat 6.709103 Long -1.613482



Source: Author's field survey
Manhyia Palace,
Lat 6.709103 Long -1.613482



MAP OF ZONE 1



TOURISM

MANHYIA PALACE MUSEUM

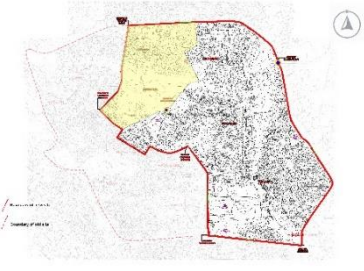
Location: Manhyia Palace Museum,
Manhyia

Area: about 13,275m²

The Manhyia Palace Museum was the former resident of past kings of the Ashanti Kingdom.

It was built in 1925 and converted to a museum by the current king, Otumfuo Osei Tutu II.

The museum is loaded with rich history and culture of the Asante Kingdom and information of key players in the history of the kingdom



Key Map



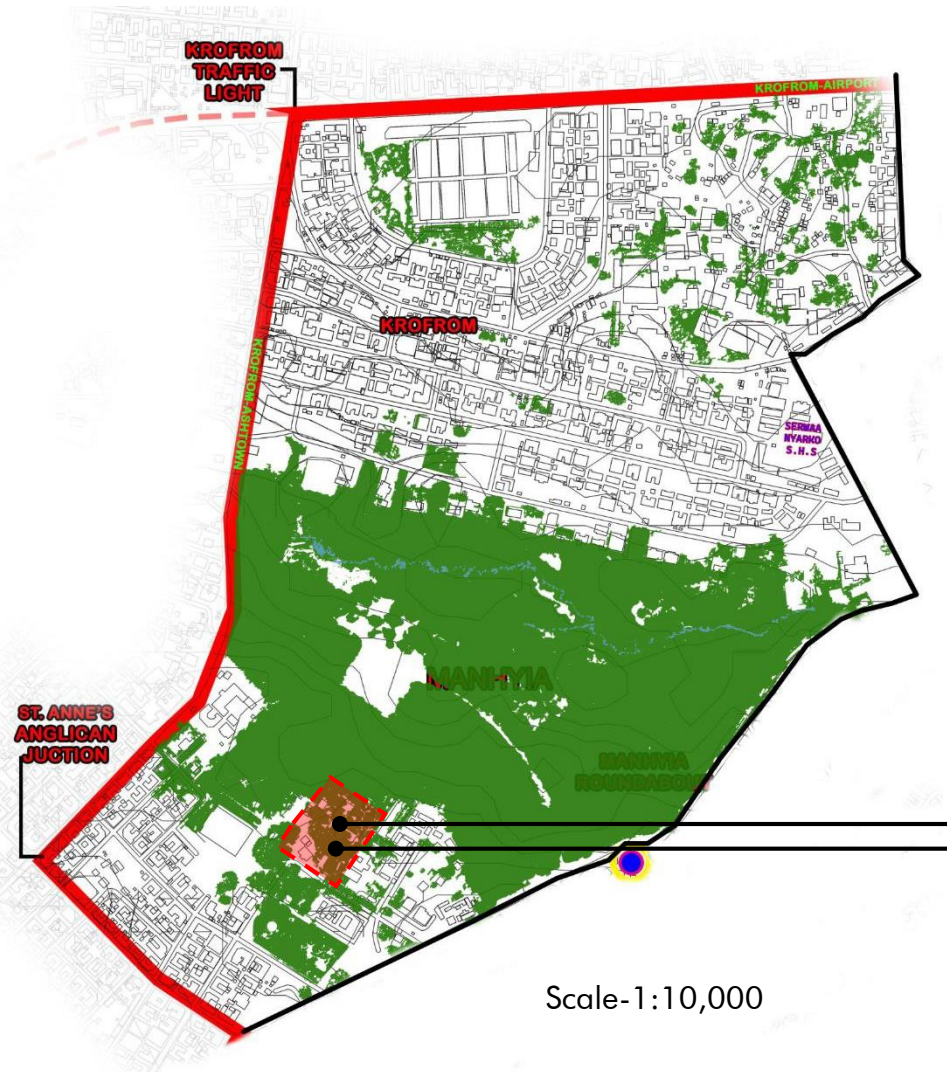
Source: Author's field survey

Manhyia Palace Museum
Lat 6.7041413, Long -1.615 8827



Source: Author's field survey

Open Green Space,
Lat 6.7041413, Long -1.615 8827



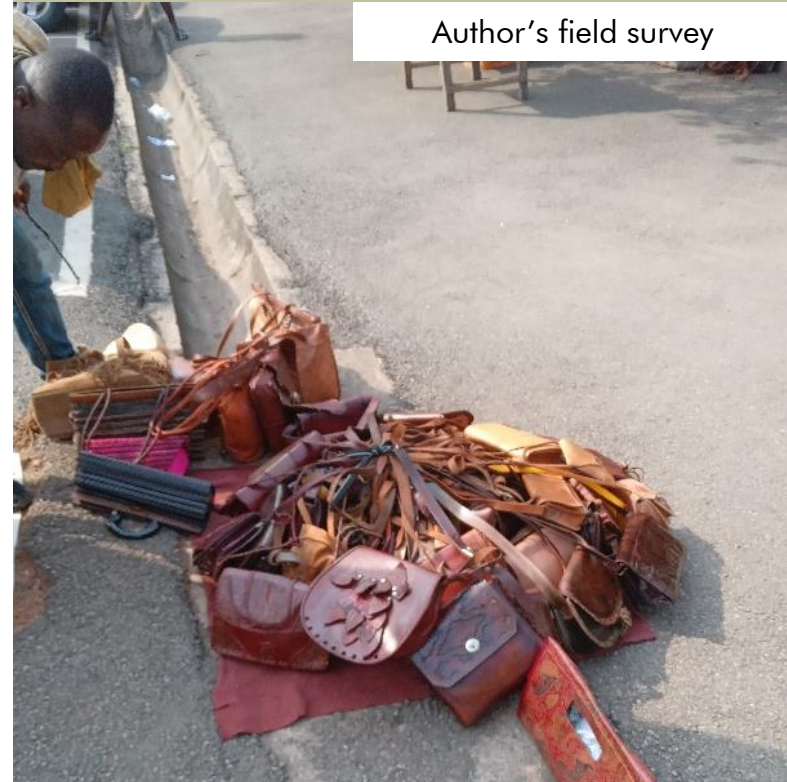
MAP OF ZONE 1

ECONOMIC EFFECTS

Author's field survey



- Provides jobs for people such as tourist guides, food, hostel/guest house industry, artists, security personnel, etc.



Author's field survey

- Boosts and diversifies the economy of the country.
- Encourages rebuilding and restoring historic sites and revitalization of culture.

- Helps improve the standard of living of the local people.
- Provides incentives to preserve heritage sites and customs.

Author's field survey



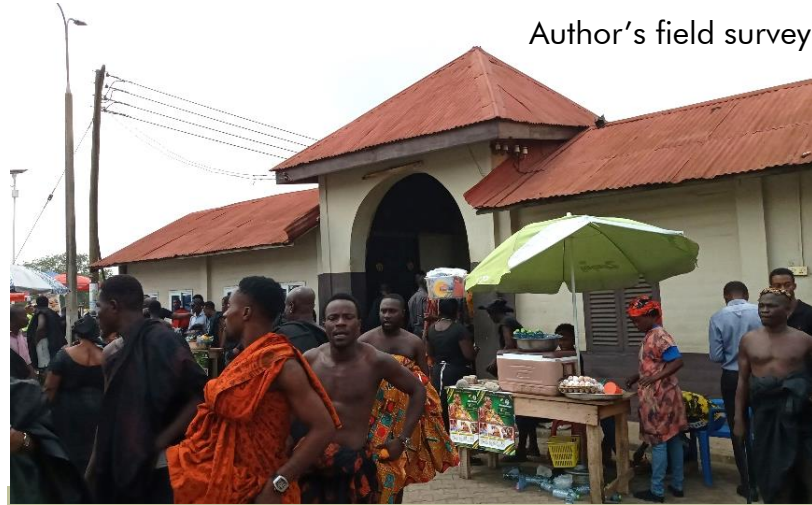
SOCIOCULTURAL EFFECTS

- It stimulates interest of locals' crafts, traditional activities and oral history. It creates opportunities for local businesses.

Author's field survey



Author's field survey



- It opens up the community to a wider world, new ideas and new experiences.
- Differences in social and moral values of locals & tourists can cause friction.

- Allows for more opportunities to socialize and engage with people from other places and each other.

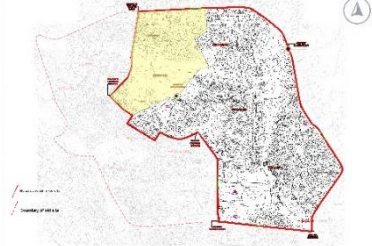
Author's field survey



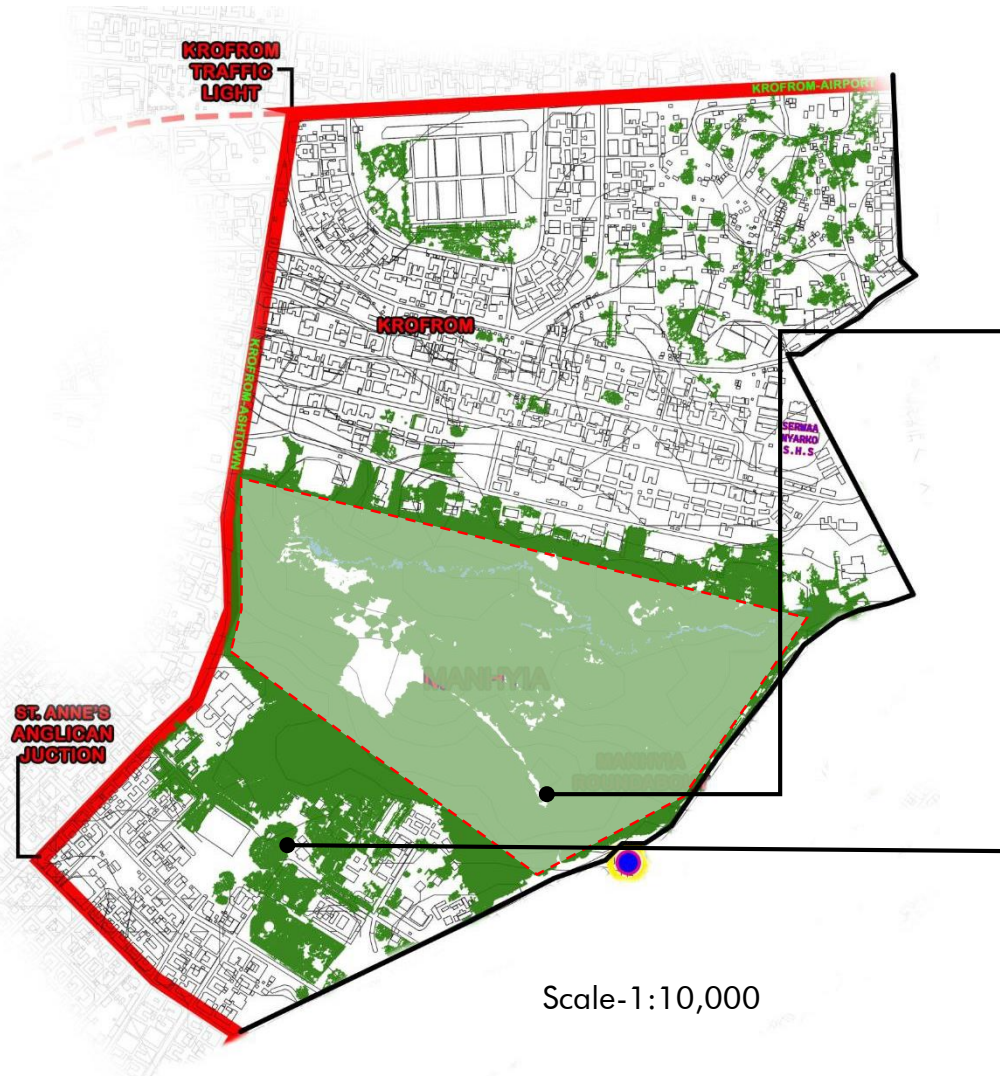
ECO-TOURISM POTENTIAL

- Eco-tourism is a nature-based tourism in which the main motivation of the tourists is the observation and appreciation of nature as well as the traditional cultures in natural areas (World Tourism Organization, 2022).
- Manhyaia has potential to develop an eco-tourism.

TOURISM



Key Map



MAP OF ZONE 1



Source: Author's field survey
Manhyaia forest reserve
cor. 6.7041816, -1.6126071



Source: Author's field survey
Species of animals
cor. 6.7042252, -1.6162432

FACTORS TO DETERMINE ECO-TOURISM

- Availability of natural forest.
- Area with historical or cultural importance.
- Various species of animals and trees.



07 Green Infrastructure



Source: Author's field survey



CONCEPT OF GREEN INFRASTRUCTURE

Green infrastructure is “a conceptual framework for understanding the valuable services nature provides the human environment.

At the regional or national levels, interconnected networks of **parks** systems, **forest** and **wildlife** corridors preserve ecological function, **manage water**, provide wildlife habitat and create a balance between built and natural environments”.

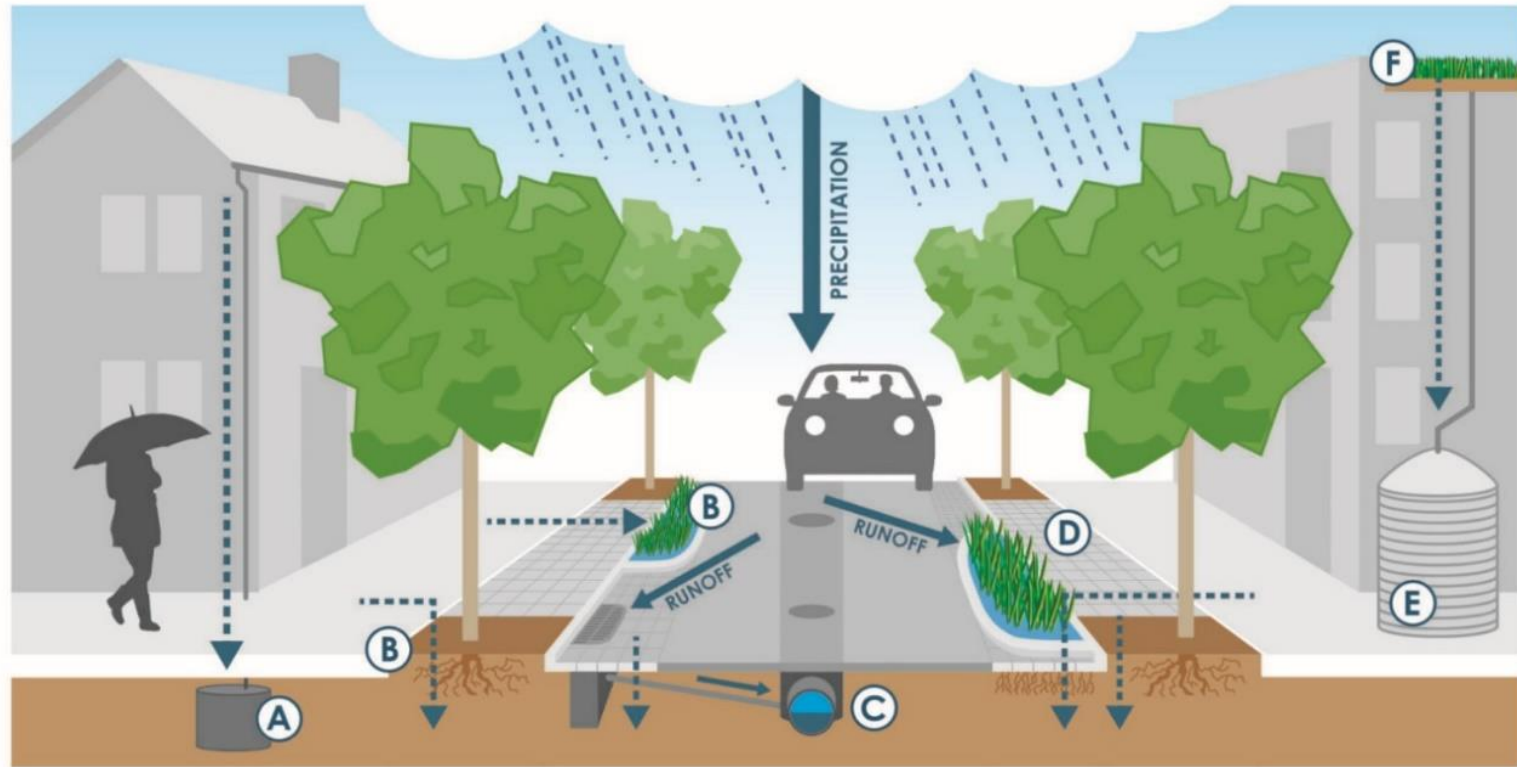
(American Society of Landscape Architects, 2023)



GREEN INFRASTRUCTURE

When green infrastructure systems are installed, they can provide cleaner air and water as well as significant value for the community with flood protection, diverse habitat, and beautiful green spaces.

EXAMPLES OF GREEN INFRASTRUCTURE



A: Dry Well B: Stormwater Planter C: Storm Drain D: Permeable Paving E: Rainwater Harvesting Cistern F: Green Roof

American Society of Landscape Architects, 2023



01

- Natural Forest Reserves



GREEN INFRASTRUCTURE



02

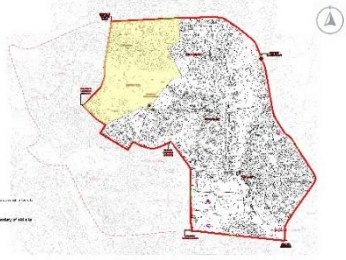
- Green Streets
- Rainwater Harvesting

03

- Urban Parks and Recreational Areas



GREEN INFRASTRUCTURE (Zone 1)



Key Map



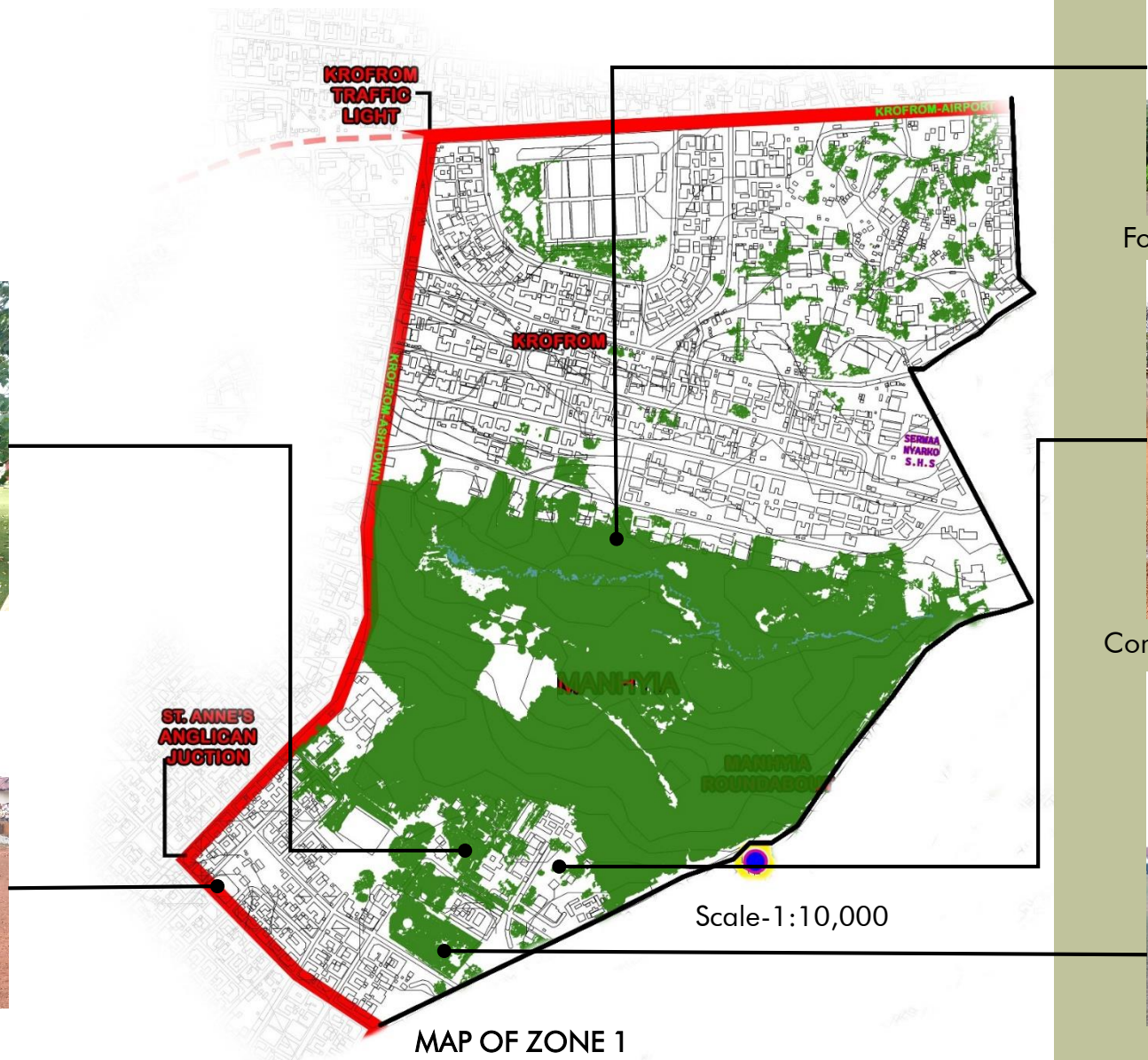
Source: Author's field survey

Open Green Space,
cor. 6.709103°, -1.613482°



Source: Author's field survey

Community Park,
cor. 6.709103°, -1.613482°



Source: Author's field survey

Forest reserve, cor. 6.708671°, -1.613723°



Source: Author's field survey

Community park, cor. 6.709103°, -1.613482°

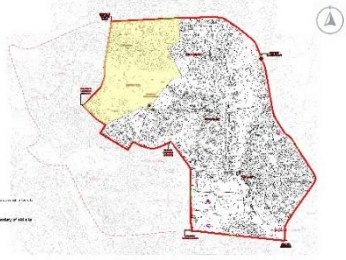


Source: Author's field survey

Durbar Grounds, cor. 6.709103°, -1.613482°



GREEN INFRASTRUCTURE (Zone 1)



Key Map



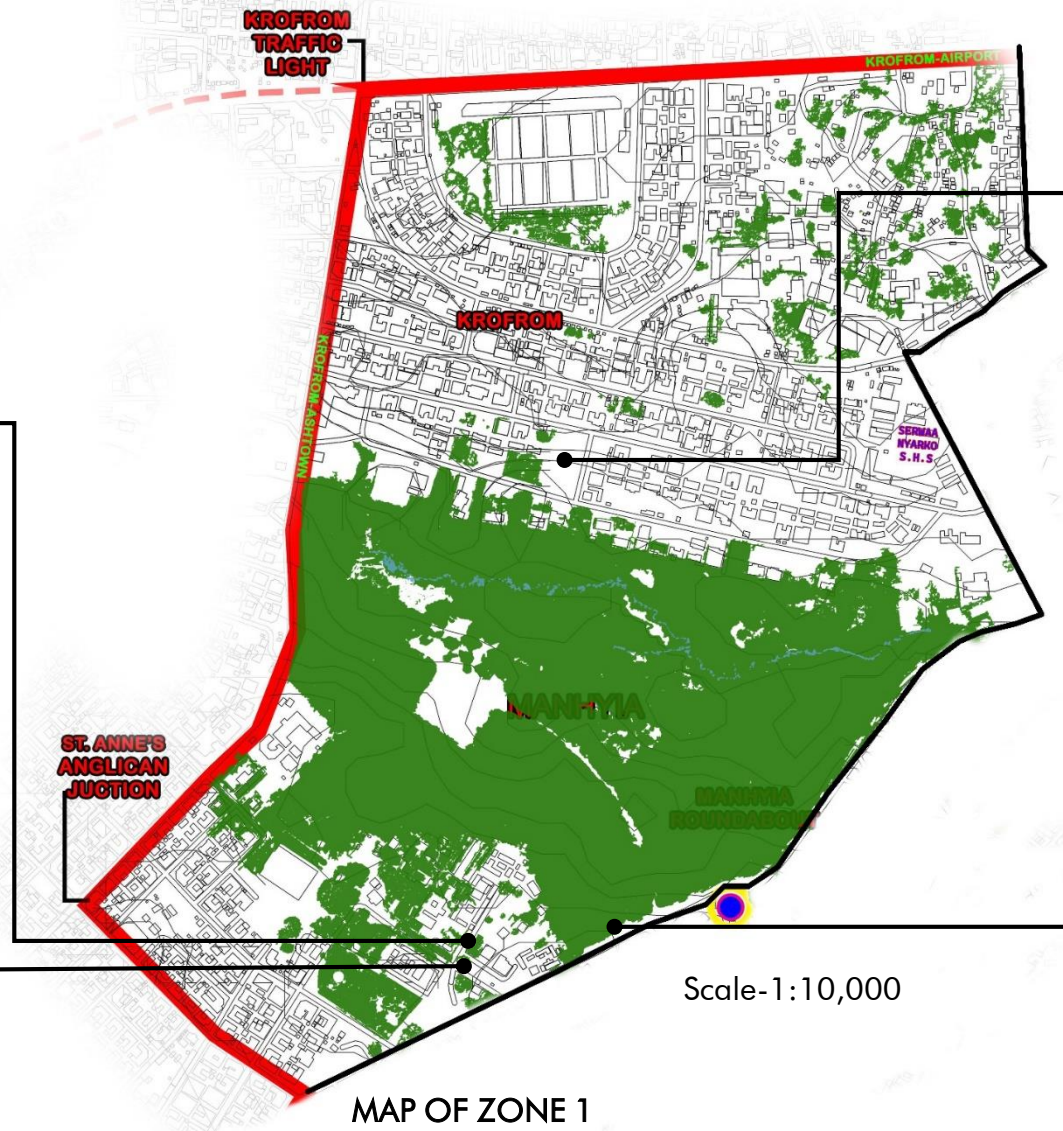
Source: Author's field survey

Green Street,
Lat 6.703724°, Long -1.614768°



Source: Author's field survey

Green Street,
Lat 6.703368°, Long -1.614886°



Source: Author's field survey

Community park, Lat 6.709280°, Long -1.613731°



Source: Author's field survey

Forest reserve, Lat 6.704138°, Long -1.61204°



GREEN INFRASTRUCTURE (Zone 2)



Key Map

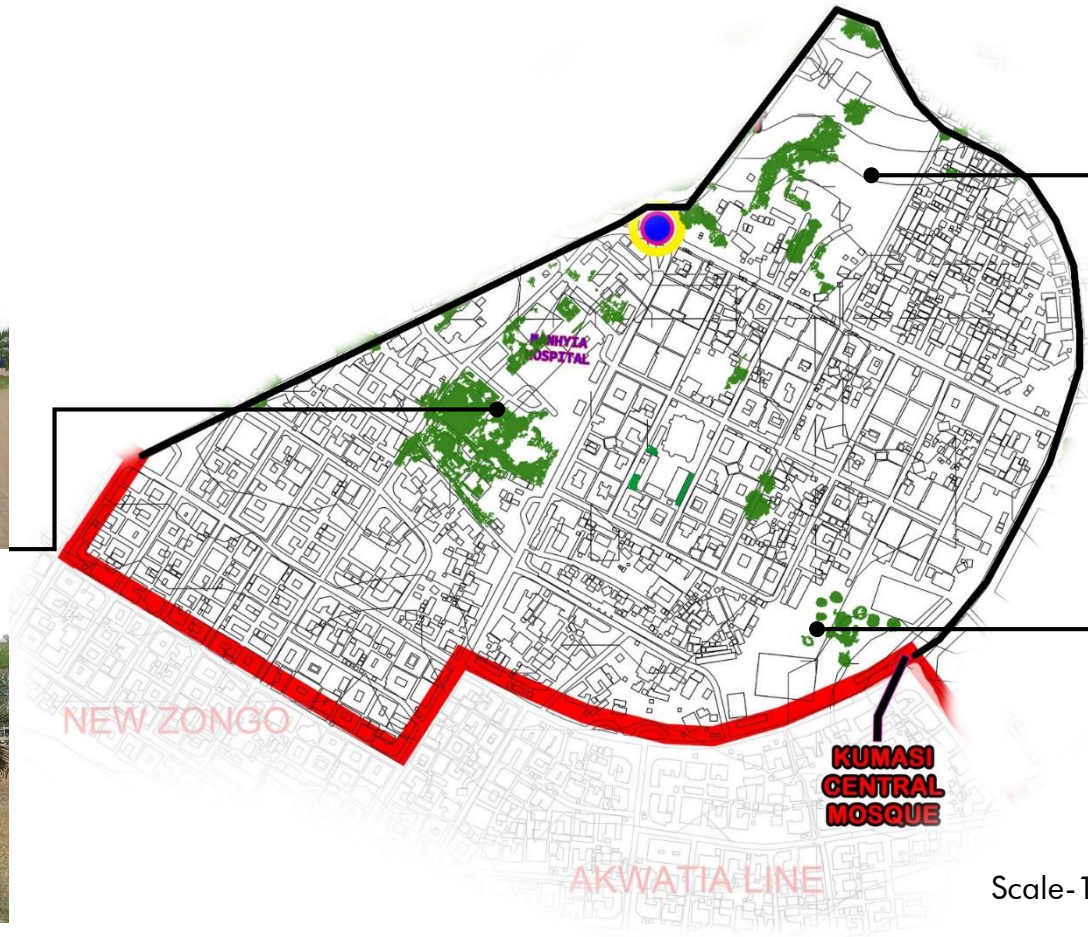


Source: Author's field survey



Source: Author's field survey

Open Green Space,
Lat 6.702686°, Long -1.613529°



MAP OF ZONE 2

Scale-1:10,000



Source: Author's field survey

Open Space, Lat 6.704801°, Long -1.609401°

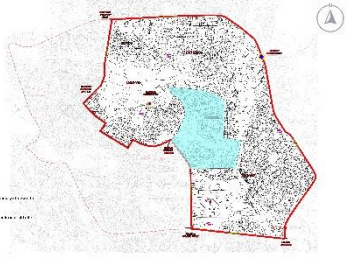


Source: Author's field survey

Community Park, Lat 6.700490°, Long -1.609513°



GREEN INFRASTRUCTURE (Zone 3)



Key Map



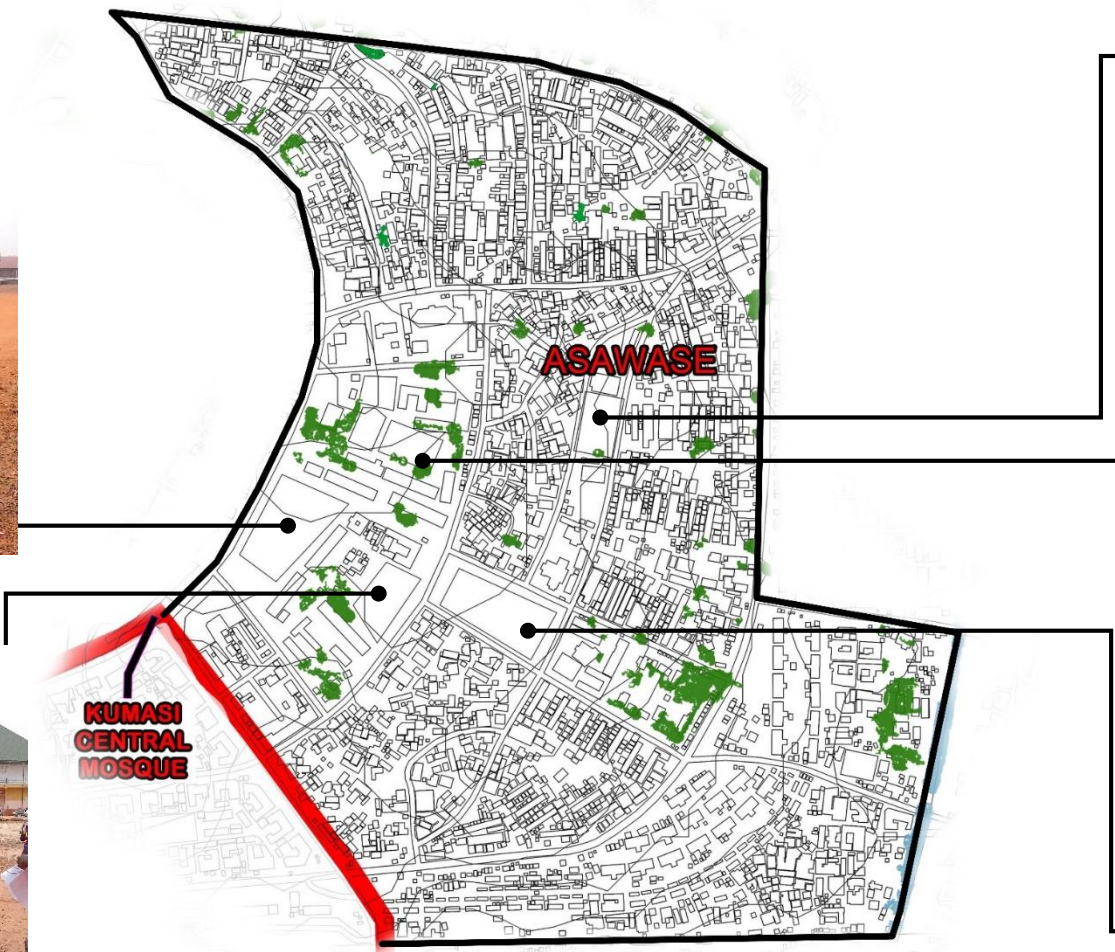
Source: Author's field survey

Community Park,
cor. 6.705331°, -1.61052°



Source: Author's field survey

Community School Park,
cor. 6.70136°, -1.608068°



MAP OF ZONE 3

Scale-1:10,000



Source: Author's field survey

Asawase Red Park,
cor. 6.701881°, -1.604888°



Source: Author's field survey

School Park, cor. 6.701568°, -1.606653°

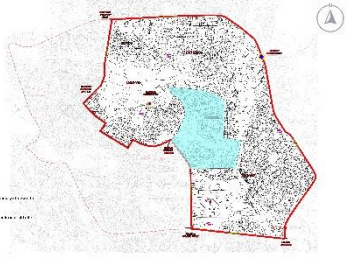


Source: Author's field survey

Dogo Moro Park,
cor. 6.699970°, -1.605915°



GREEN INFRASTRUCTURE (Zone 3)



Key Map



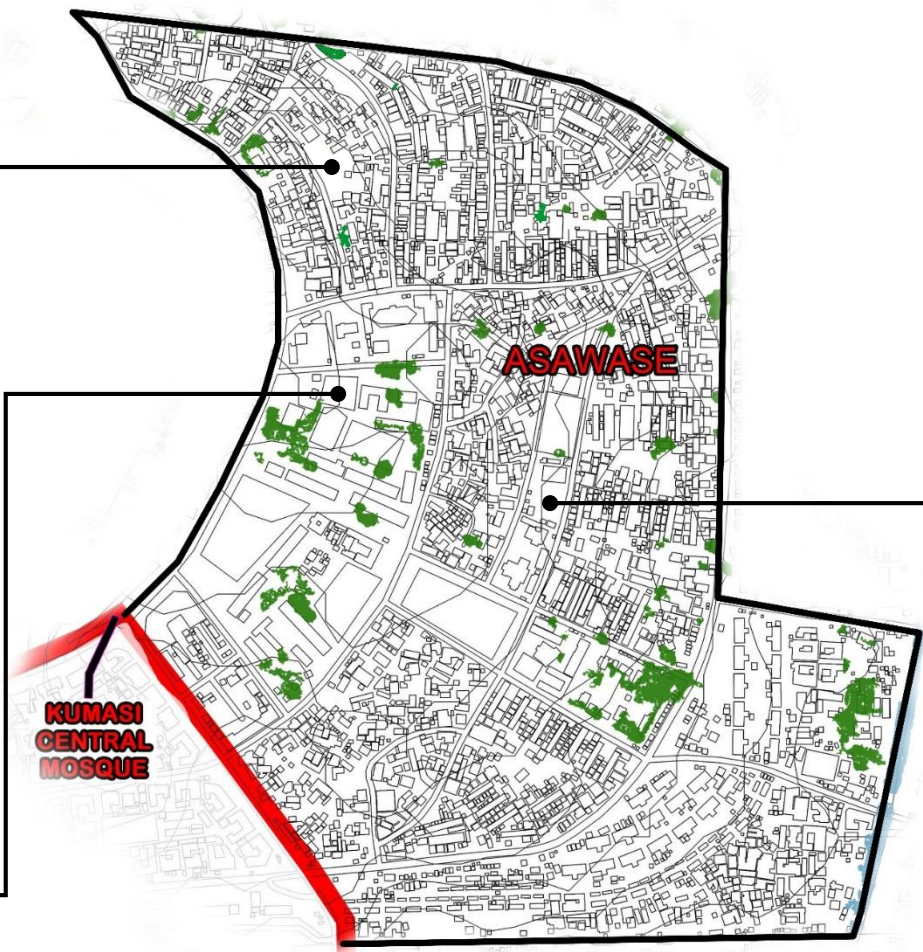
Source: Author's field survey

Open Space,
cor. 6.704355°, -1.607187°



Source: Author's field survey

Community School Park,
cor. 6.702123°, -1.607069°



Scale-1:10,000

MAP OF ZONE 3

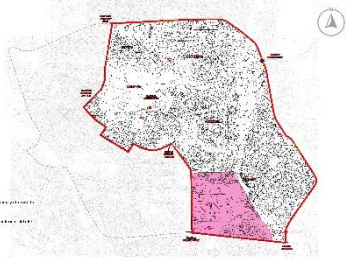


Source: Author's field survey

Open Space, cor. 6.701084°, -1.605109°



GREEN INFRASTRUCTURE (Zone 4)



Key Map



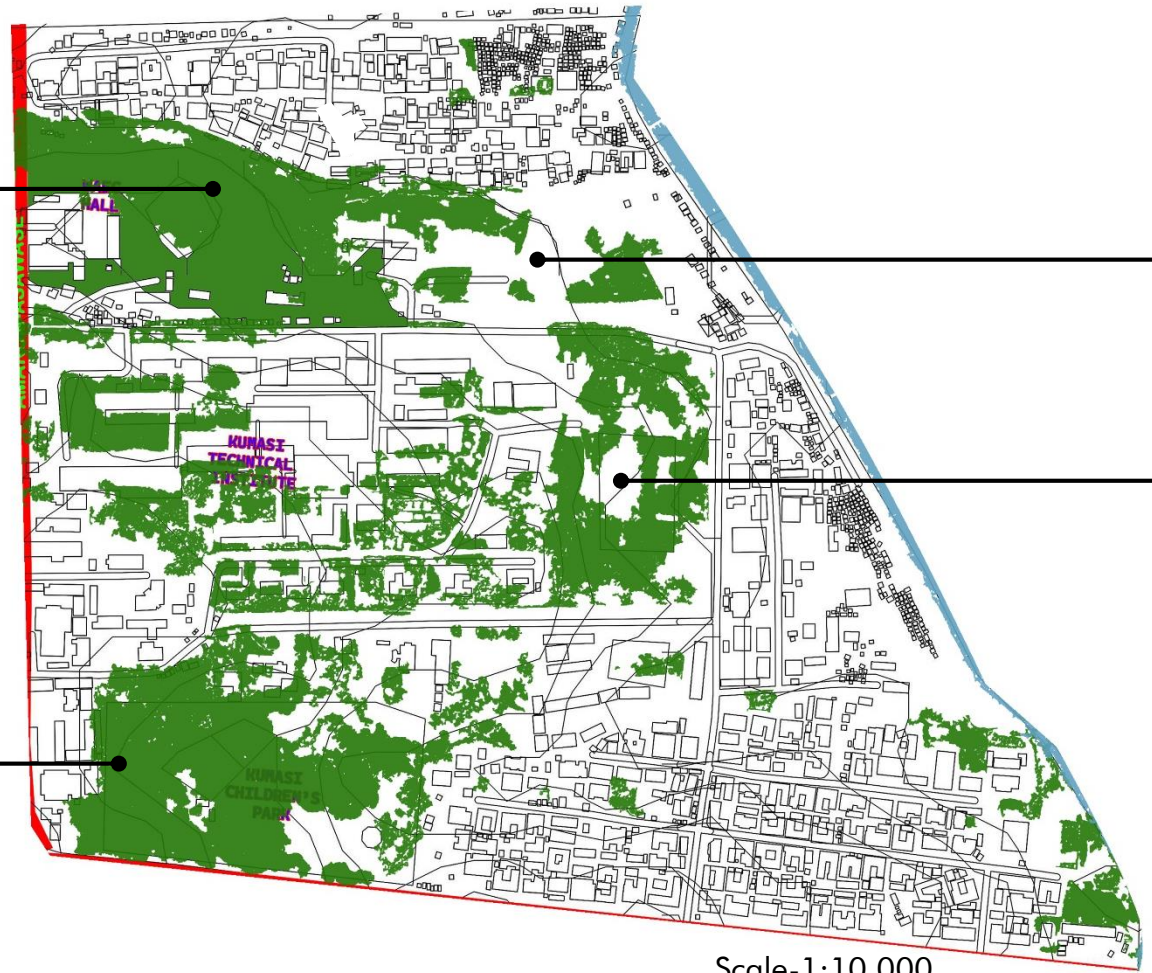
Source: Author's field survey

Green Reserve,
cor. 6.695251° -1.605704°



Source: Author's field survey

Community School Park,
cor. 6.690822° -1.604781°



Scale-1:10,000

MAP OF ZONE 4



Source: Author's field survey

Community Park,
cor. 6.694573° -1.602515°

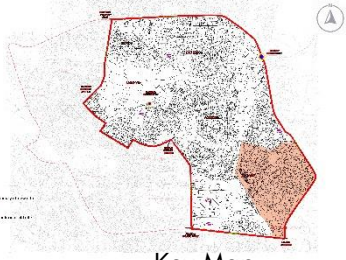


Source: Author's field survey

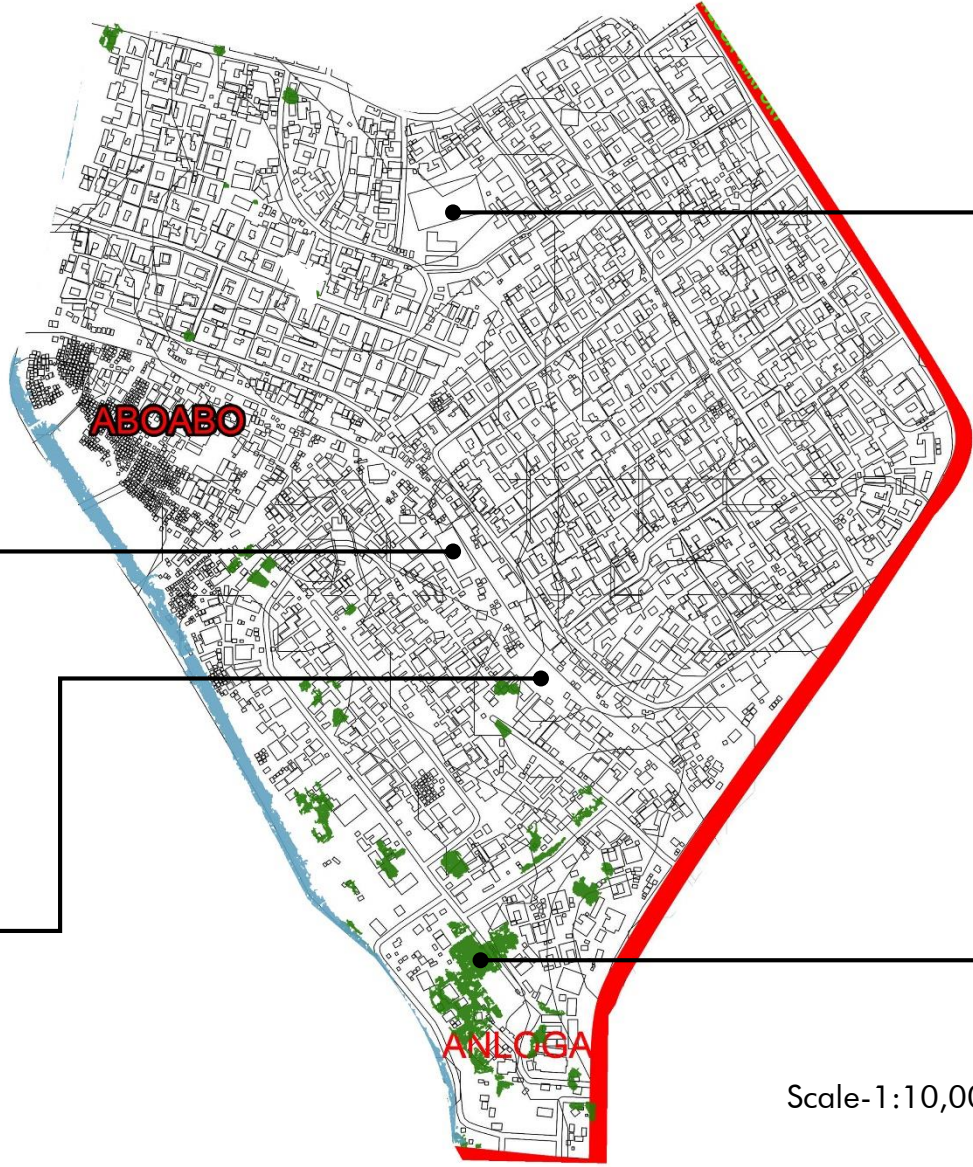
KTI School Park,
cor. 6.692802° -1.602004°



GREEN INFRASTRUCTURE (Zone 5)



Key Map



MAP OF ZONE 5

Scale-1:10,000



Source: Author's field survey

Community Park,
cor. 6.694558° -1.597674°



Source: Author's field survey

Open Space,
cor. 6.693308° -1.596867°



Source: Author's field survey

Middle B Park,
cor. 6.69782° -1.597749°

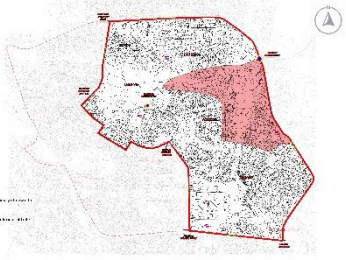


Source: Author's field survey

Community Park,
cor. 6.690584° -1.597535°



GREEN INFRASTRUCTURE (Zone 6)



Key Map



MAP OF ZONE 6

Scale-1:10,000



Source: Author's field survey

Green Reserve,
cor. 6.693308° -1.596867°



Source: Author's field survey

Green Buffer,
cor. 6.706631° -1.600682°

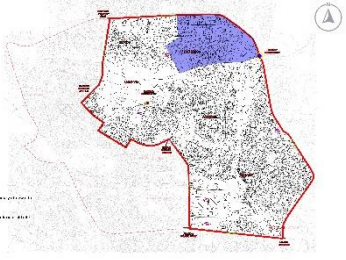


Source: Author's field survey

Open Space,
cor. 6.703423° -1.600166°



GREEN INFRASTRUCTURE (Zone 7)



Key Map



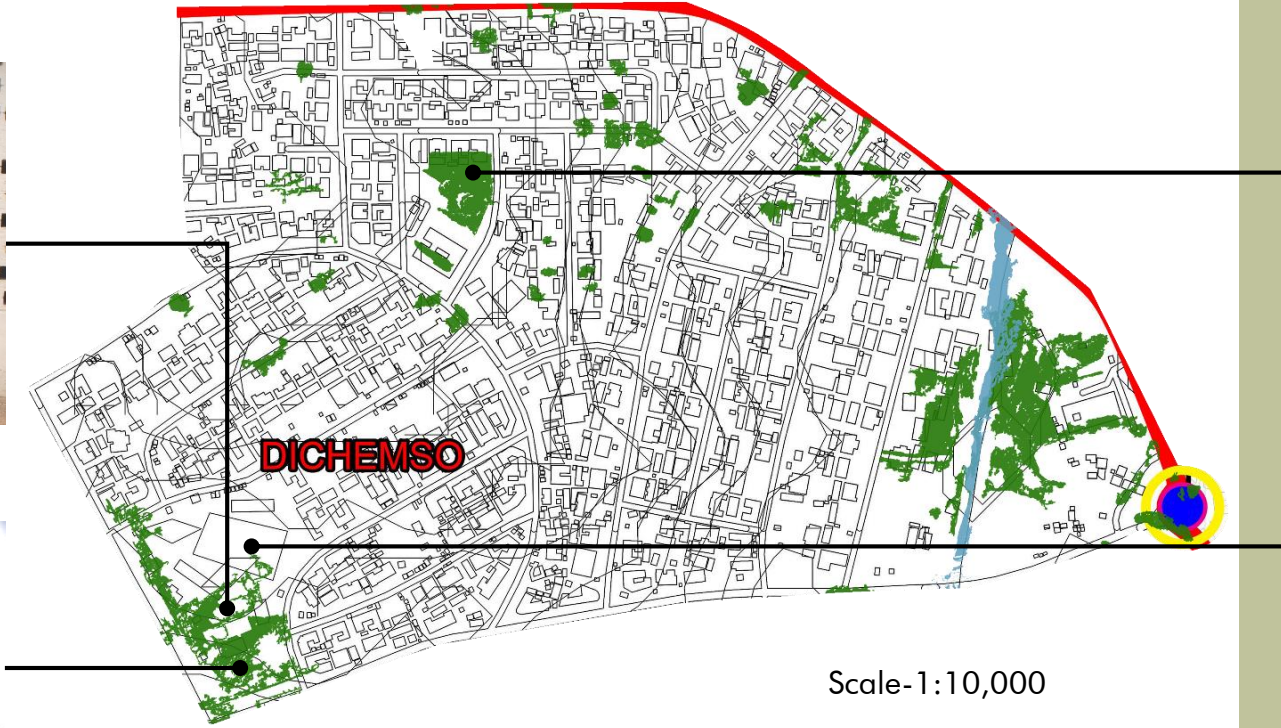
Source: Author's field survey

Rainwater Harvesting,
cor. 6.708037° -1.607877°



Source: Author's field survey

Open Space,
cor. 6.707900° -1.607700°



Scale-1:10,000

MAP OF ZONE 7



Source: Author's field survey

Church Park,
cor. 6.69782° -1.597749°



Source: Author's field survey

Otumfuo Park,
cor. 6.709053° -1.607752°



ZONE 1

- Manhya has a forest reserve of about 298,000m², which captures air pollutants and absorbs rainwater.
- The zone has open green parks and some community parks without greens.

Source: Author's field survey



OBSERVATIONS PER ZONE

Source: Author's field survey



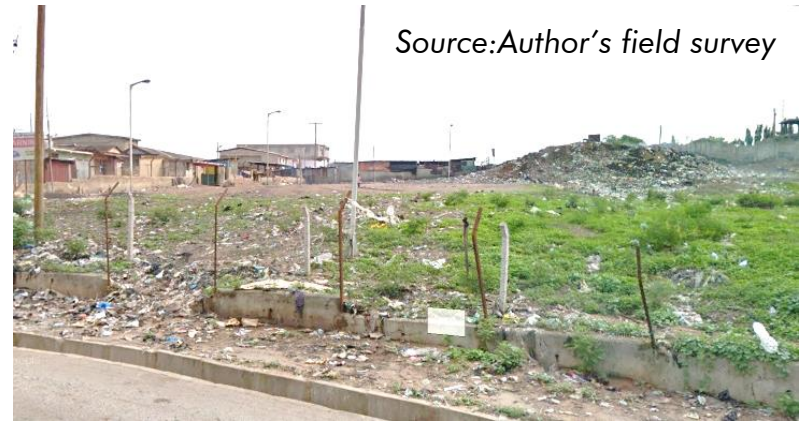
ZONE 1

- The Manhya city has few shaded streets with suitable pedestrian walkways.
- The zone had parking spaces but are not green.

ZONE 2

- Zone 2 is bordered by the forest reserve.
- It has a polluted open space.
- The Central Mosque has a large impermeable paved open space and parking lot.
- The zone has no green street.

Source: Author's field survey



ZONE 3

- Zone 3, that is, Asawase, has a number of community and school parks, but without greens.
- The area has few shaded streets with pedestrian walkways.

Source: Author's field survey



OBSERVATIONS PER ZONE



Source: Author's field survey



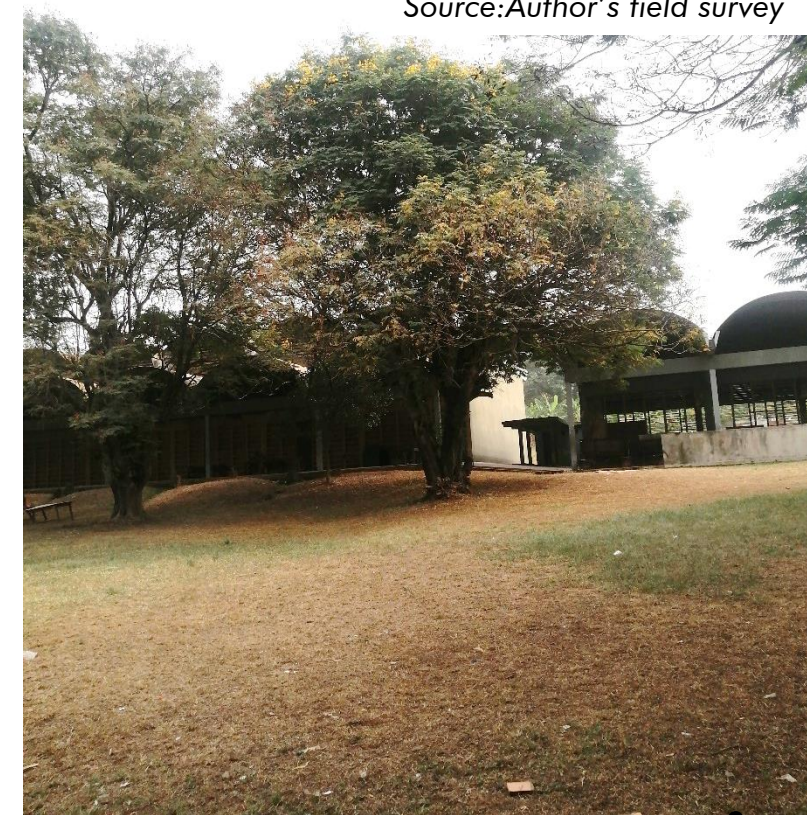
ZONE 4

- Much of the land in this zone is covered with greens.
- The area has a children's park and other open spaces including a school park.

ZONE 4

- Zone 4 has no green streets or shaded pedestrian walkways.
- It has about 22,000m² of forest reserve.

Source: Author's field survey



ZONE 5

- This area has little to no greens.
- Zone 5 has only one (1) community park and one (1) school park.
- The area has no green streets and parking.

Source: Author's field survey



OBSERVATIONS PER ZONE

Source: Author's field survey



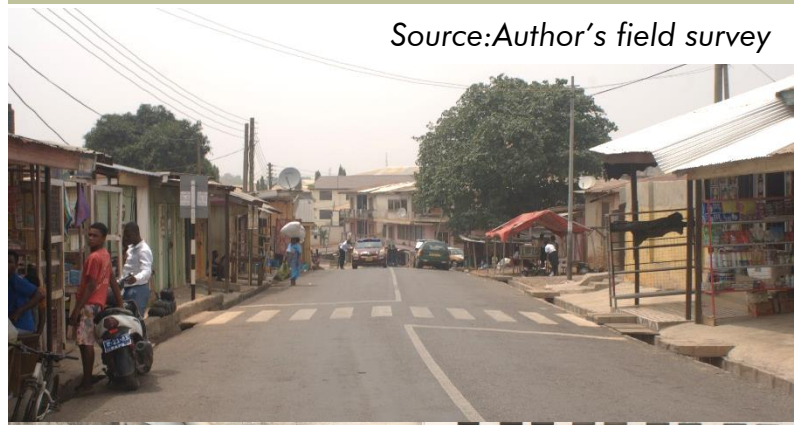
ZONE 6

- Has greenery along the river and drains.
- The zone has no urban parks and green parking spaces.

ZONE 7

- Zone 7 has greenery along the river and drains.
- It has a few open green spaces.
- The zone has no green streets.

Source: Author's field survey





08 Ecological Problems





- Water Pollution
- Land Pollution (Improper waste disposal)
- Noise Pollution
- Air Pollution
- Flood prone areas



01



Source: Author's field survey

Map coordinates : 6.69343, -1.60032

Water Pollution



Water Pollution

Water pollution is the release of substances into bodies of water that makes water unsafe for human use and disrupts aquatic ecosystems.

Water pollution can be caused by a plethora of different contaminants, including toxic waste and disease-causing microorganisms(Nathanson,2022).

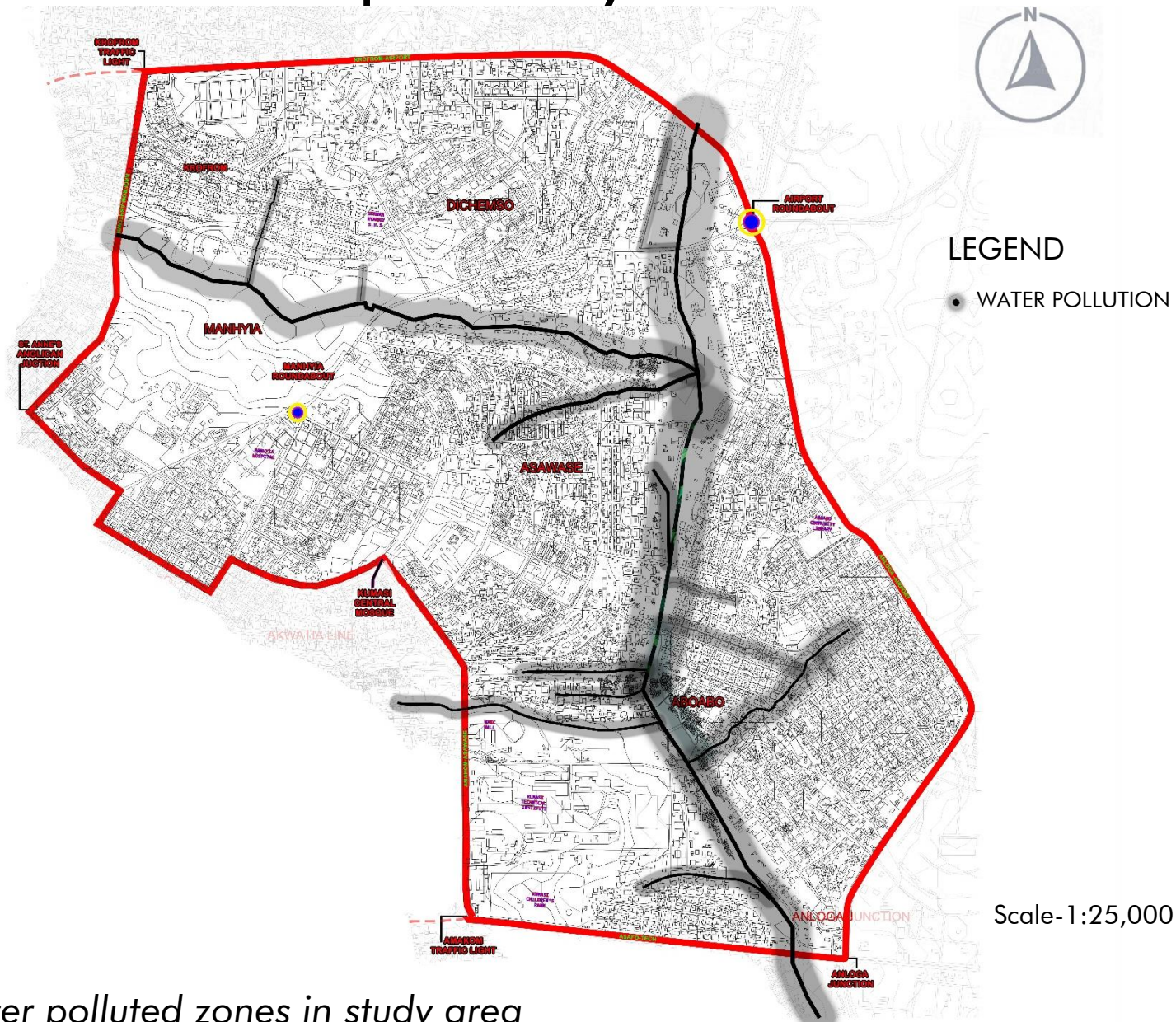


Source: Author's field survey

A polluted storm drain at Aboabo



Water Pollution Map of Study Enclave



Map showing water polluted zones in study area

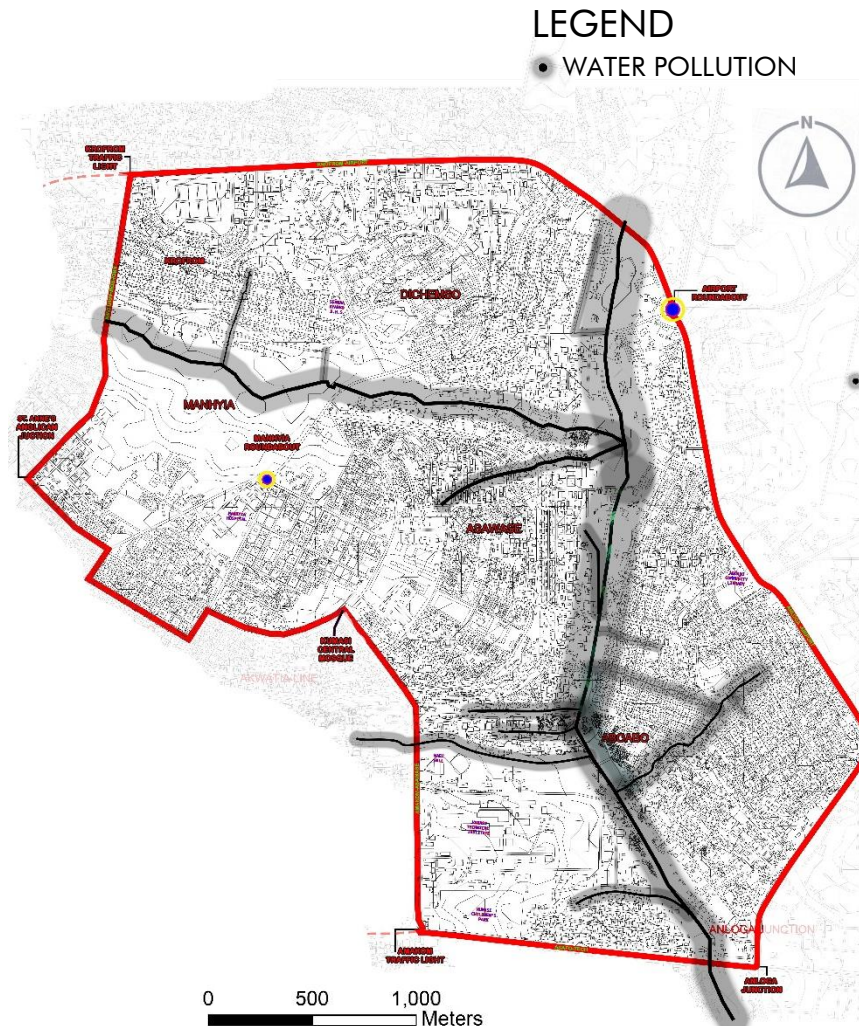


Water Pollution in the Study Enclave



Source: Author's field survey

Lat 6.691306° Long -1.601306°



Water pollution map of study area

Scale-1:25,000

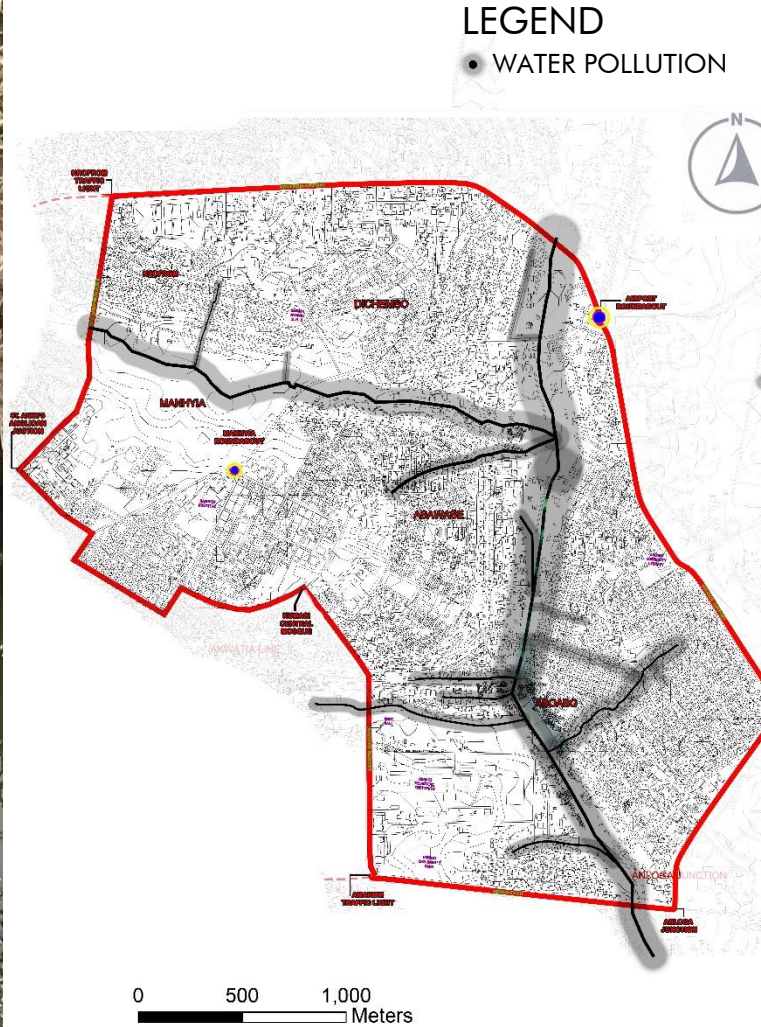


Source: Author's field survey

Lat 6.690688° Long -1.598765°



Water Pollution in Study Enclave



Water pollution map of study area

Scale-1:25,000



Lat 6.705492 °

Long -1.599417 °

Lat 6.699766 °

Long -1.601011 °



02



Source: Author's field survey

Land Pollution (Improper waste disposal)



Land Pollution

- Land pollution is the deposition of solid or liquid waste materials on land or underground in a manner that can contaminate the soil and groundwater, threaten public health, and cause unsightly conditions and nuisances.
- The prominent land pollution activity in the terrain studied is IMPROPER DISPOSAL OF WASTE.

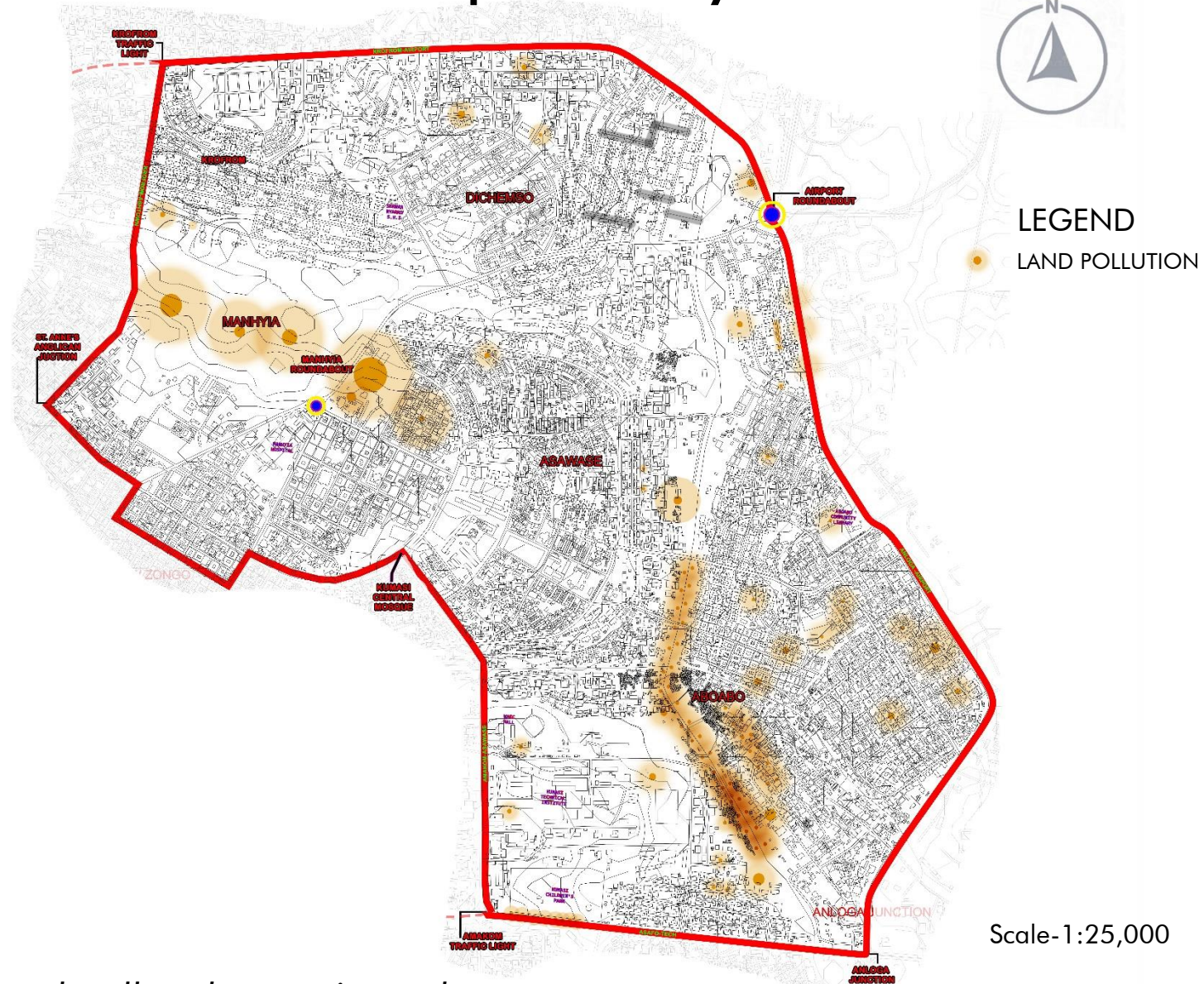


Source: Author's field survey

Indiscriminate disposal of waste



Land Pollution Map of Study Enclave



Map showing land polluted zones in study area



Land Pollution in the Study Enclave



Source: Author's field survey

Dumpsite at Manhya Roundabout

Lat 6.711787°

Long -1.60885°



Source: Author's field survey

Dumpsite behind Manhya Melcom

Lat 6.421733°

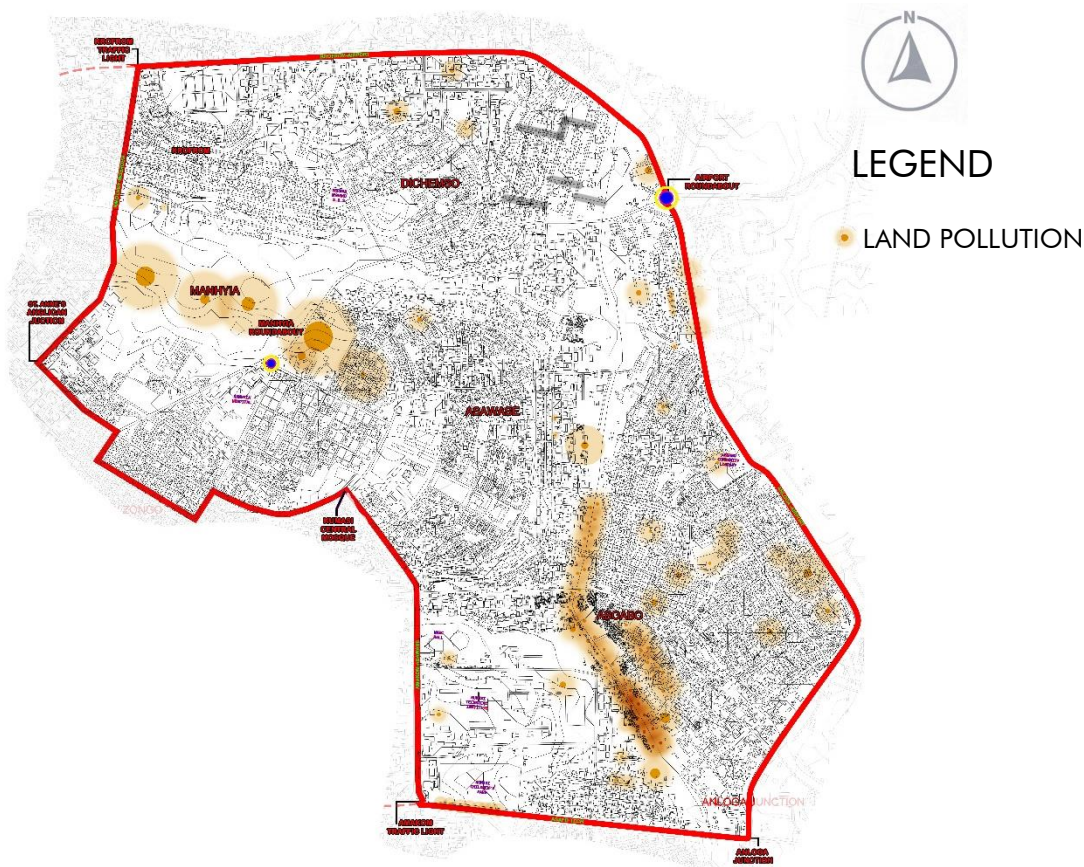
Long -1.363537°



Land Pollution in Study Enclave

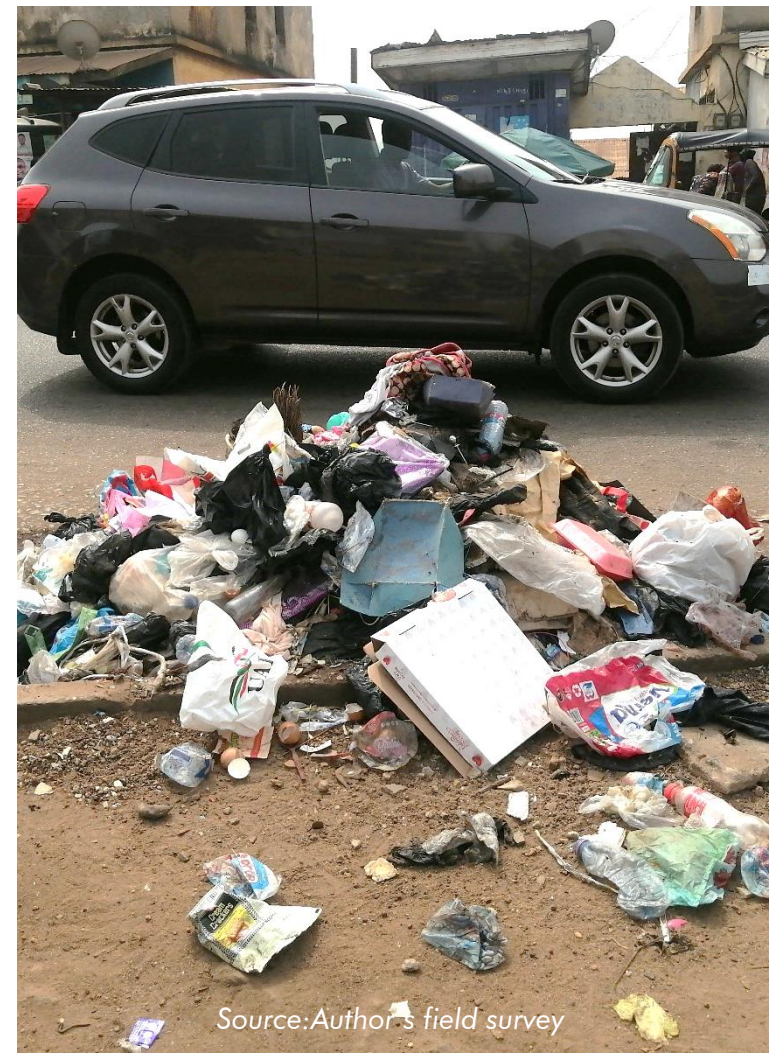


Lat 6.709532 °
Long -1.615998 °



Land pollution map of study area

Scale-1:25,000



Lat 6.698966°
Long -1.597619 °

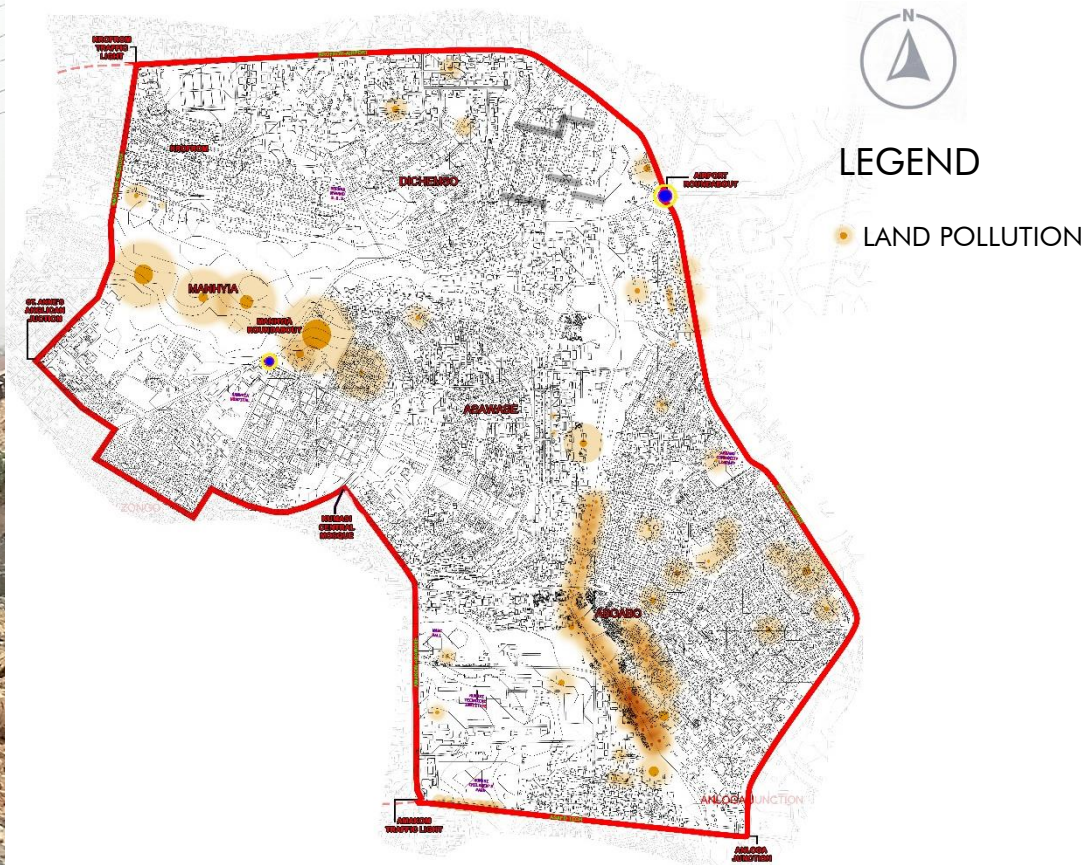


Land Pollution in Study Enclave



Source: Author's field survey

Lat 6.697445°
Long -1.602198 °



Land pollution map of study area

Scale-1:25,000



Source: Author's field survey

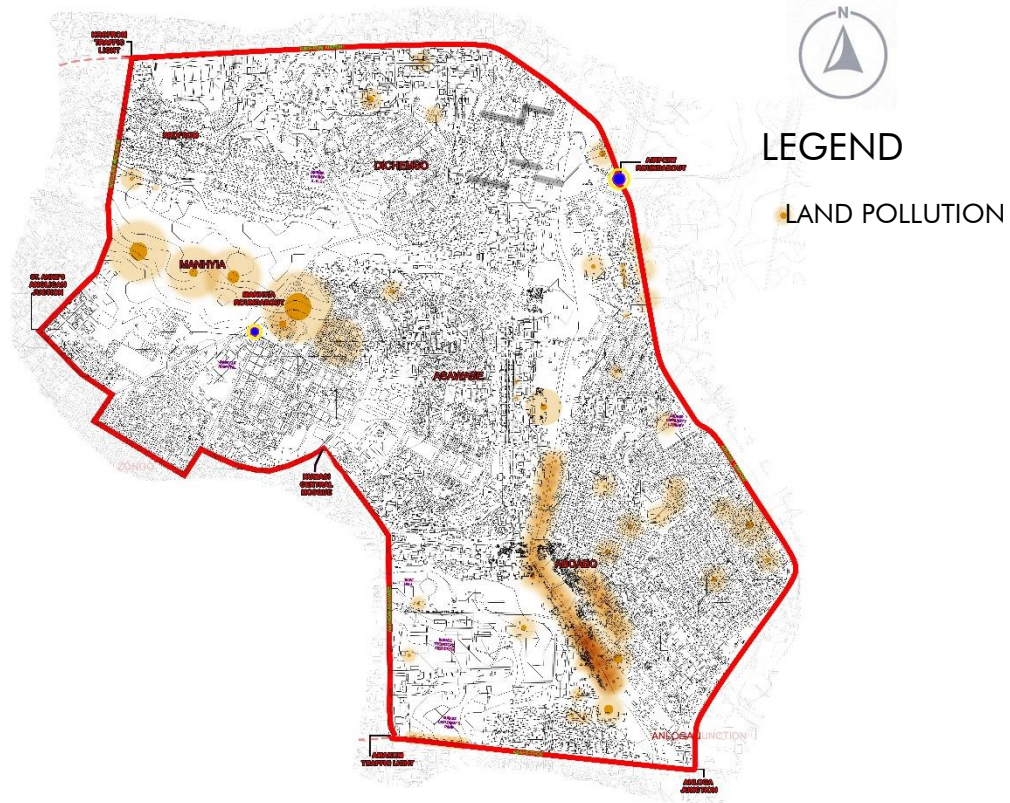
Lat 6.690658 °
Long -1.598706 °



Land Pollution in Study Enclave



Lat 6.703589°
Long -1.610495°



Land pollution map of study area



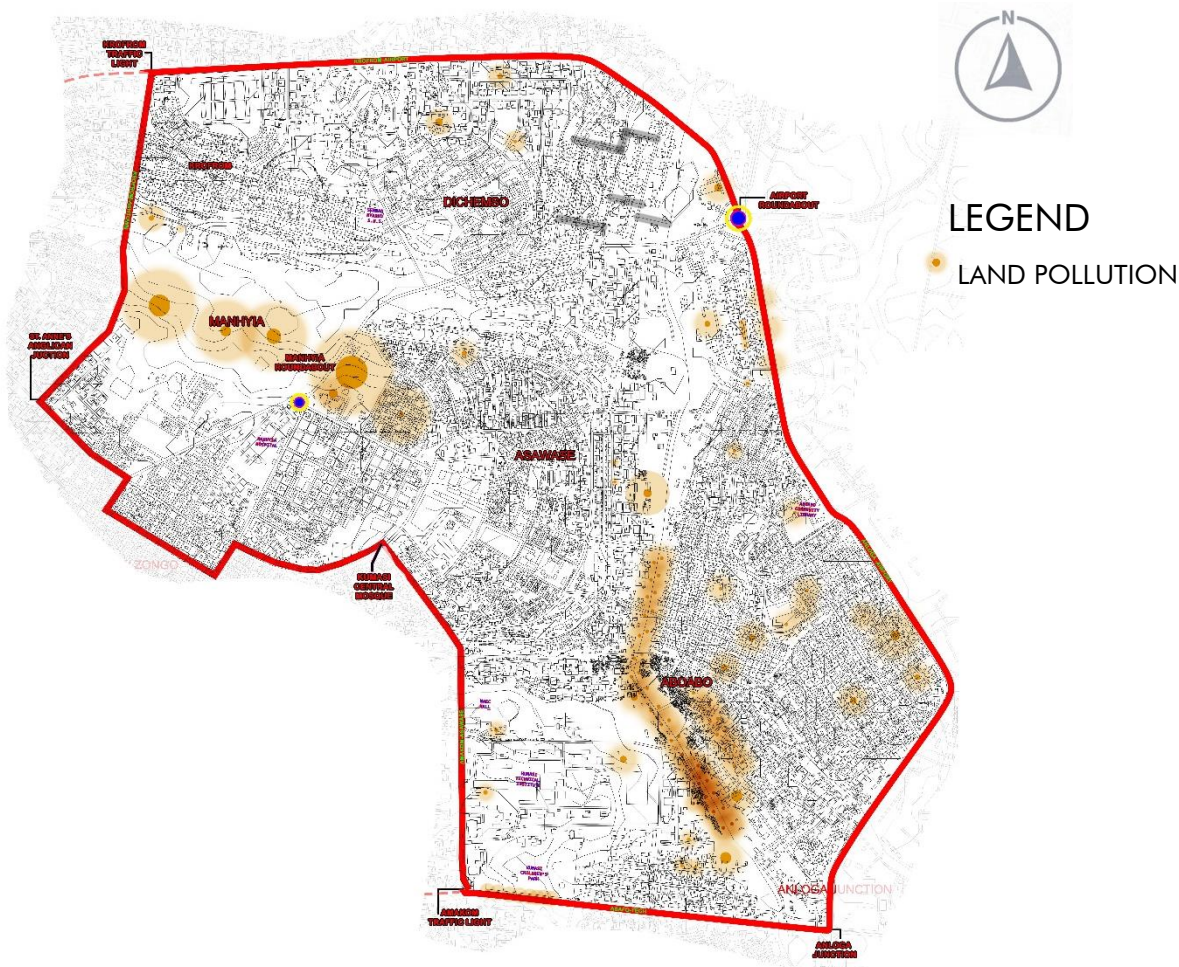
Lat 6.706926°
Long -1.609329°



Land Pollution in Study Enclave

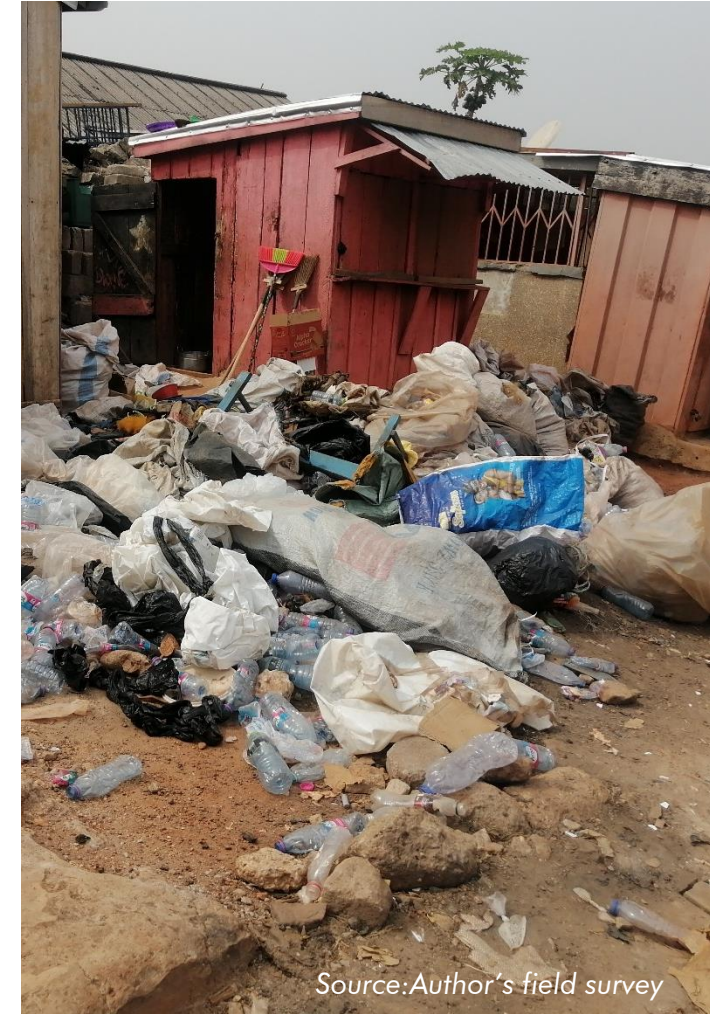


Source: Author's field survey



Land pollution map of study area

Scale-1:25,000



Source: Author's field survey

Latitude 6.690483
Longitude -1.598659

Latitude 6.690483
Longitude -1.598659



03



Source: Author's field survey

Noise Pollution



Noise Pollution

Unwanted or excessive sound that can have deleterious effects on human health, wildlife, and environmental quality.

Commonly generated inside

- industrial facilities
- workplaces,
- Traffic zones
- outdoor construction activities.

Nathanson, J. and Berg, R.(2022)



Source: Author's field survey



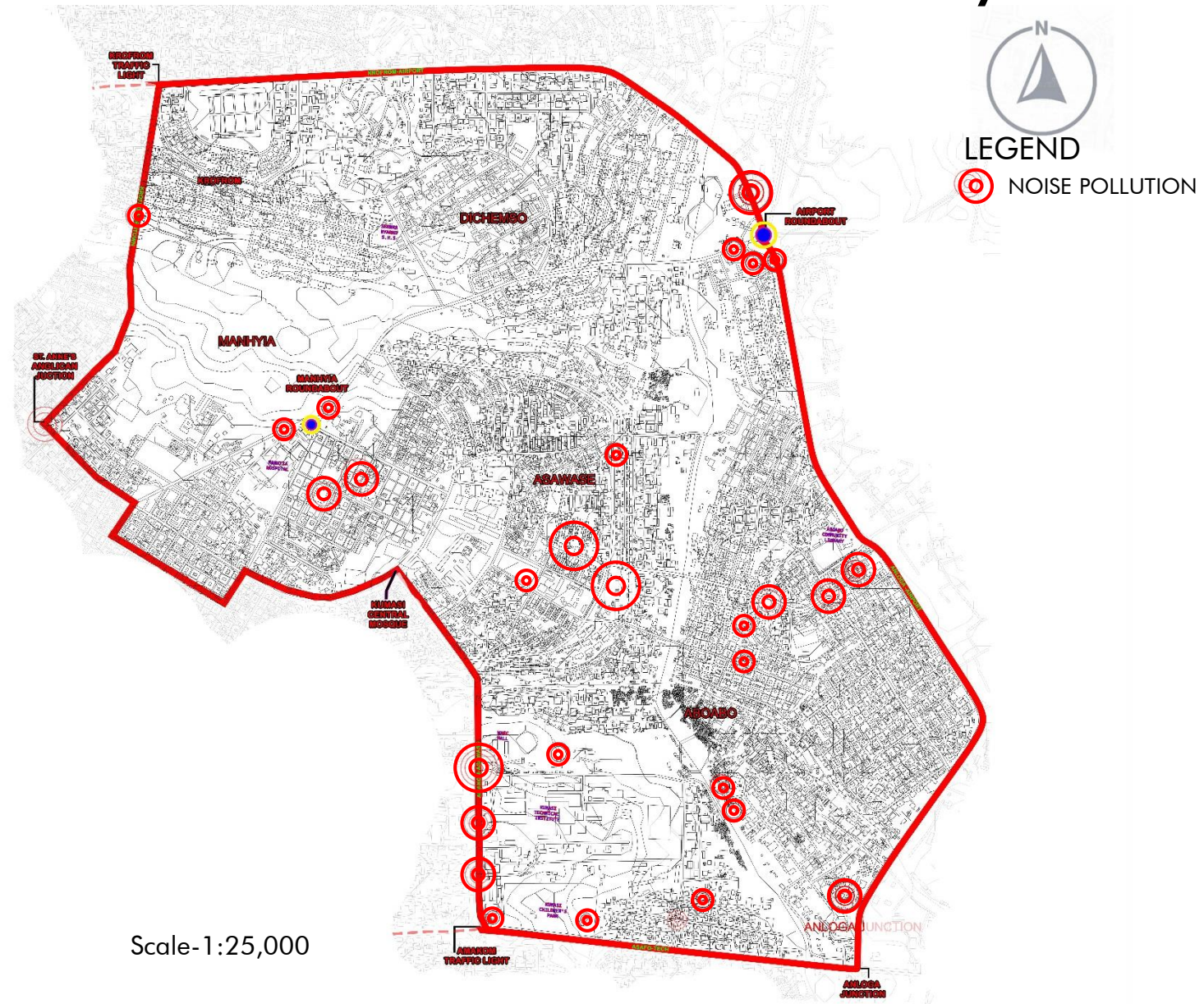
Noise Level Guidelines In Ghana

According to The Environmental Protection Agency Ghana,

- **Residential areas** permissible ambient noise levels of **55 dB** (decibels) during the day and **48dB** at night
- **Commercial areas**, according to the new guidelines, are allowed **70 dB** during the day and **65 dB** at night
- **Places of entertainment and public assembly** such as churches and mosques have a permissible noise level of 65 db noise levels during the day and 60 db during the night



Map Showing Recorded Noise level Locations in Study Enclave



Noise Sources in Study Enclave



Source: Author's field survey

Quarrying site in zone 1

Lat 6.7117° Long -1.60885°

Noise Levels: 65dB

Time Taken: 12:30am

Time Ended: 1:00pm



Source: Author's field survey

Blacksmithing site in zone 5

Latitude 6.696129 Longitude -1.599957

Noise Levels: 68dB

Time Taken: 10:30am

Time Ended: 10:45am



Noise Sources in Study Enclave



Source: Author's field survey



Source: Author's field survey



Source: Author's field survey

Cornmill in zone 5

Latitude 6.696845 Longitude -1.599650

Noise Levels: 65dB

Time Taken: 12:30am

Time Ended: 1:00pm

P.A. System in zone 6

Latitude 6.711787° Longitude -1.60885°

Noise Levels: 74dB

Time Taken: 1:30pm

Time Ended: 2:00pm

P.A. System in zone 6

Latitude 6.711787° Longitude -1.60885°

Noise Levels: 72 dB

Time Taken: 11:10 am

Time Ended: 11:30 am



Noise Sources in Study Enclave



Source: Author's field survey

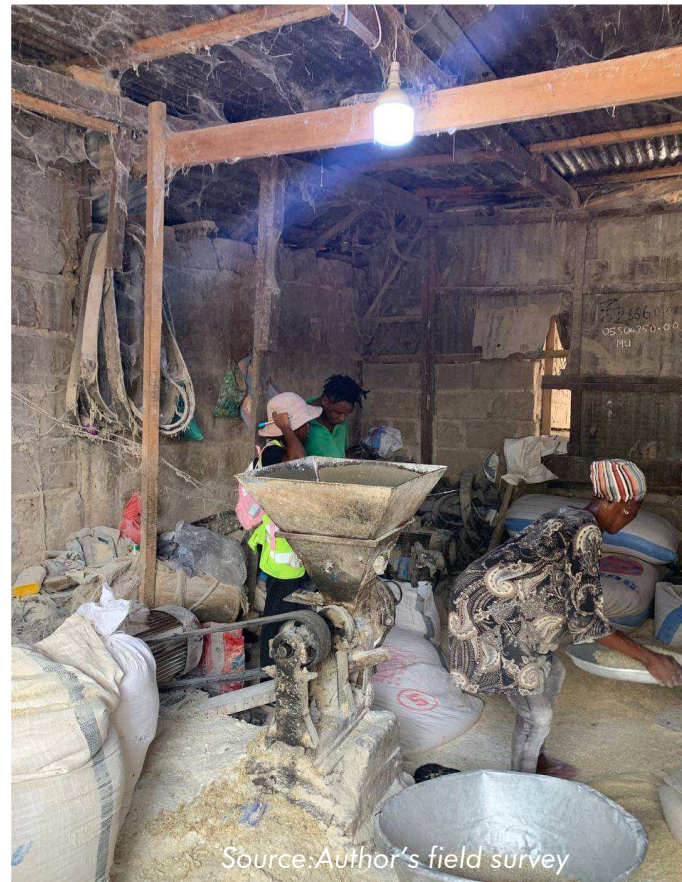
Anloga Junction

Latitude 6.411875° Longitude -1.355013°

Noise Levels: 70 dB

Time Taken: 3:30pm

Time Ended: 3:45 pm



Source: Author's field survey

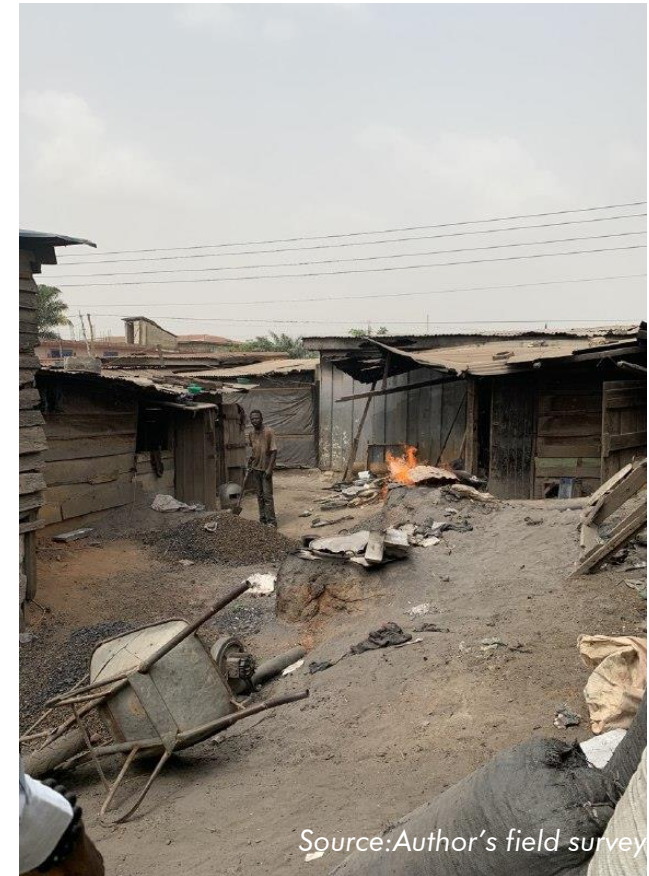
Anloga Junction

Latitude 6.411875° Longitude -1.355013°

Noise Levels: 68 dB

Time Taken: 4:30 pm

Time Ended: 4:45 pm



Source: Author's field survey

Blacksmith in zone 6

Latitude 6.705122° Longitude -1.599365°

Noise Levels: 62.8 dB

Time Taken: 12:40 am

Time Ended: 1:00 pm



Recorded Noise Levels of Certain Locations in Study Enclave

Location	Sound (dB)	Source	Time taken	Time ended
Manhyia Roundabout	64db	Traffic	10:10am	10:30am
Public address (P.A.) system around Manhyia roundabout	72db	P.A. system	11:10am	11:30am
Manhyia roundabout	62.8db	Traffic	12:40am	1:00pm
Public address (P.A.) system at Airport roundabout	74db	P.A. system	1:30pm	2:00pm
Anloga Junction	70db	Traffic	3:30pm	3:45pm
Amakom Traffic light	68db	Traffic	4:30pm	4:45pm



04



Air Pollution



AIR QUALITY INDEX(AQI)

An **air quality index (AQI)** is used by government agencies to communicate to the public,

- how polluted the air currently is
- how polluted it is forecast to become.

AQI information is obtained by averaging readings from an air quality sensor.



- The air quality index increases with increases in vehicle traffic, forest fires, or anything that can increase air pollution.

Pollutants tested include:

- Ozone
- Nitrogen dioxide
- Sulphur dioxide
- Particulate matter

Source: Author's field survey





Source: Author's field survey

Emissions from a vehicle's exhausts

Map Coordinates: 6.68988, -1.59824

Particulate matter

These are microscopic particles of solid or liquid matter suspended in the air that have an impact on climate and precipitation and adversely affects human health.

Sources

01

Dust

02

Vehicle emissions

03

Burning of fossil fuel

04

Construction site



AIR POLLUTION in the STUDY Enclave



Source: Author's field survey

Blacksmithing

Latitude 6.695762

Longitude -1.599021



Source: Author's field survey

Smoke from fish processing factory

Latitude 6.707062

Longitude -1.606962



Source: Author's field survey

Fumes from cars along the Ejisu Rd.

Latitude 6.68997

Longitude -1.606851



AIR POLLUTION in the STUDY AREA



Source: Author's field survey

Aboabo River

Latitude 6.70221° Longitude -1.600785°



Source: Author's field survey



Source: Author's field survey



Source: Author's field survey



AIR POLLUTION in the STUDY AREA



Source: Author's field survey

Quarrying site

Lat 6.711787°

Long -1.60885°



Source: Author's field survey

Saw mill

Lat 6.42285°

Long 1.364205°



AIR POLLUTION in the STUDY AREA



Dumpsite at Manhya Roundabout

Lat 6.711787°

Long -1.60885°



Dumpsite behind Manhya Melcom

Lat 6.421733°

Long -1.363537°



01 (b)



Climate analysis

Air quality





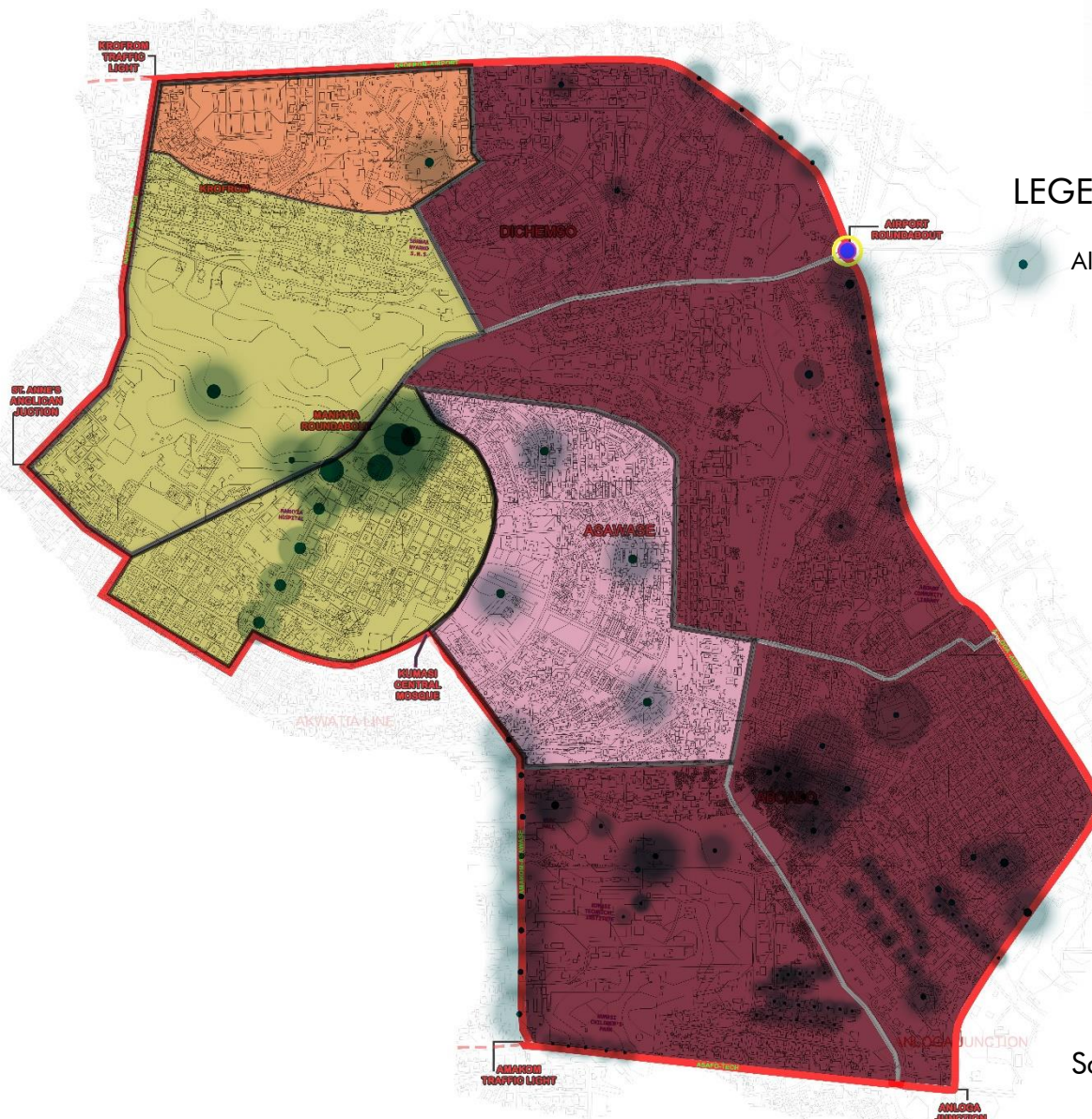
LEGEND

● AIR POLLUTION HOTSPOTS

Air Quality Index

AQI
400
300
200
150
100
50
0

- Harzadous
- Very unhealthy
- Unhealthy
- Moderate
- Unhealthy sensitive groups
- Good
- Very good



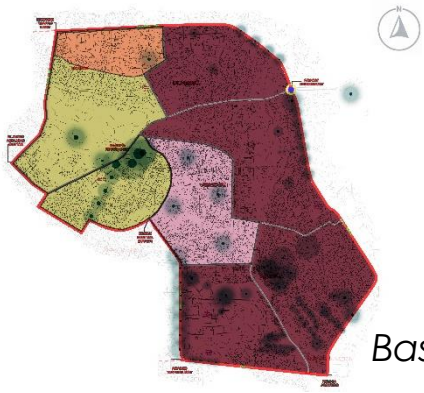
Source: Ventusky Climate Maps

Test period

During morning rush hours and evening work closing periods. This is when vehicle traffic is highest and vehicle emissions are concentrated in the atmosphere

Base Map showing the air quality index of the various zones with air pollution hotspots



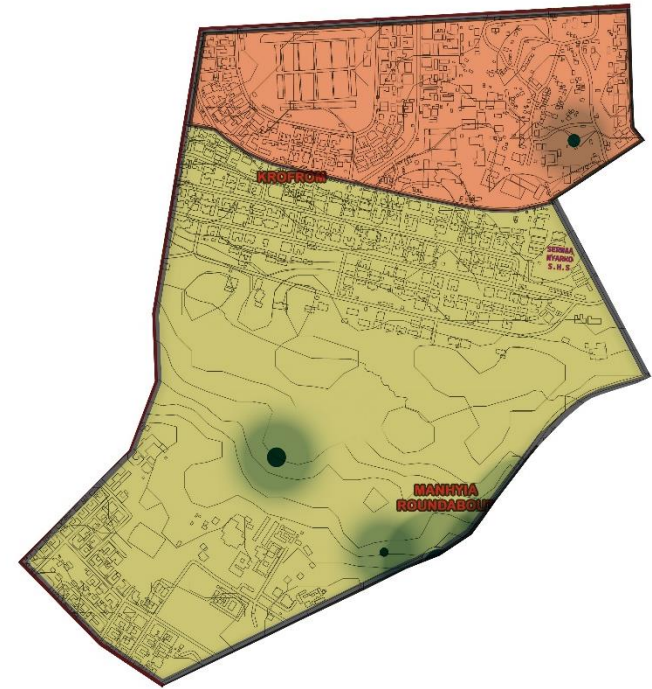


Base Map

Key Pollutants	Test Results	Impact on Area
Particulate matter 2.5	80 $\mu\text{g}/\text{m}^3$	Unhealthy
Particulate matter 10.0	170 $\mu\text{g}/\text{m}^3$	Unhealthy
Nitrogen dioxide	0 $\mu\text{g}/\text{m}^3$	Good
Sulfur dioxide	3 $\mu\text{g}/\text{m}^3$	Good
Ozone	60 $\mu\text{g}/\text{m}^3$	Moderate
Carbon monoxide	15 $\mu\text{g}/\text{m}^3$	Good

Source: Ventusky Climate Maps

ZONE 1



Zone 1 map showing the air pollution hotspots

Data recorded at midday on Wednesday February 15, 2023





Base Map

ZONE 2



Zone 2 map showing the air pollution hotspots

Data recorded at midday on Wednesday February 15, 2023

Key Pollutants	Test Results	Impact on area
Particulate matter 2.5	59 $\mu\text{g}/\text{m}^3$	Unhealthy
Particulate matter 10.0	120 $\mu\text{g}/\text{m}^3$	Unhealthy
Nitrogen dioxide	3 $\mu\text{g}/\text{m}^3$	Good
Sulfur dioxide	10 $\mu\text{g}/\text{m}^3$	Good
Ozone	40 $\mu\text{g}/\text{m}^3$	Unhealthy
Carbon monoxide	7 $\mu\text{g}/\text{m}^3$	Good

Source: Ventusky Climate Maps



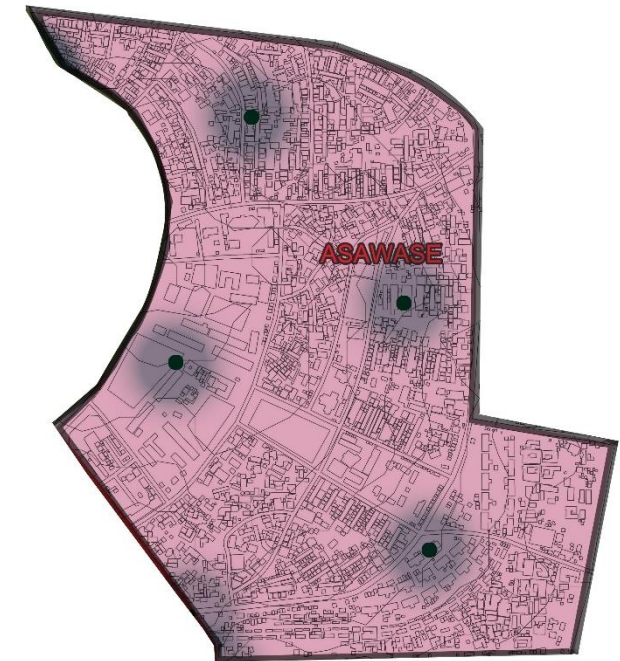


Base Map

Key Pollutants	Test Results	Impact on area
Particulate matter 2.5	92 $\mu\text{g}/\text{m}^3$	Very unhealthy
Particulate matter 10.0	473 $\mu\text{g}/\text{m}^3$	Very unhealthy
Nitrogen dioxide	1 $\mu\text{g}/\text{m}^3$	Good
Sulfur dioxide	2 $\mu\text{g}/\text{m}^3$	Good
Ozone	60 $\mu\text{g}/\text{m}^3$	Good
Dust	420 $\mu\text{g}/\text{m}^3$	Unhealthy

Source: Ventusky Climate Maps

ZONE 3



Zone 3 map showing the air pollution hotspots

Data recorded at midday on Wednesday February 15, 2023



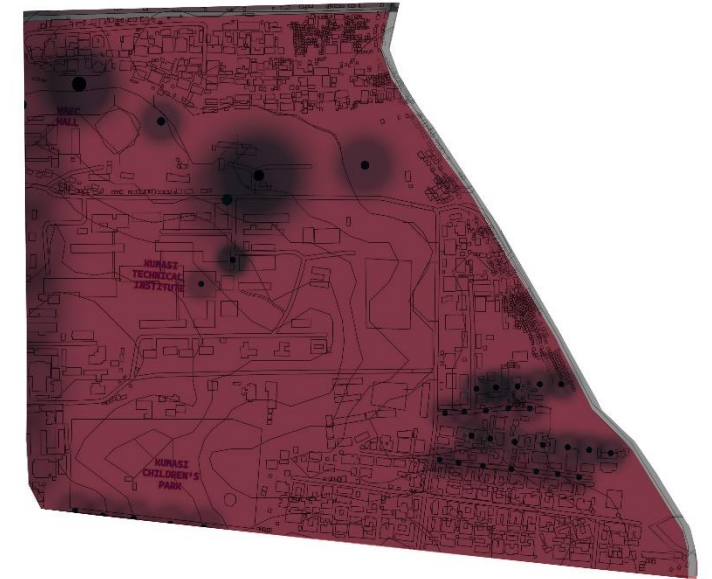


Base Map

Key Pollutants	Test Results	Impact on area
Particulate matter 2.5	26 $\mu\text{g}/\text{m}^3$	Moderate
Particulate matter 10.0	174 $\mu\text{g}/\text{m}^3$	Unhealthy
Nitrogen dioxide	1 $\mu\text{g}/\text{m}^3$	Good
Sulfur dioxide	3 $\mu\text{g}/\text{m}^3$	Good
Ozone	20 $\mu\text{g}/\text{m}^3$	Good
Dust	161 $\mu\text{g}/\text{m}^3$	Unhealthy

Source: Ventusky Climate Maps

ZONE 4



Zone 4 map showing the air pollution hotspots

Data recorded at midday on Wednesday February 15, 2023



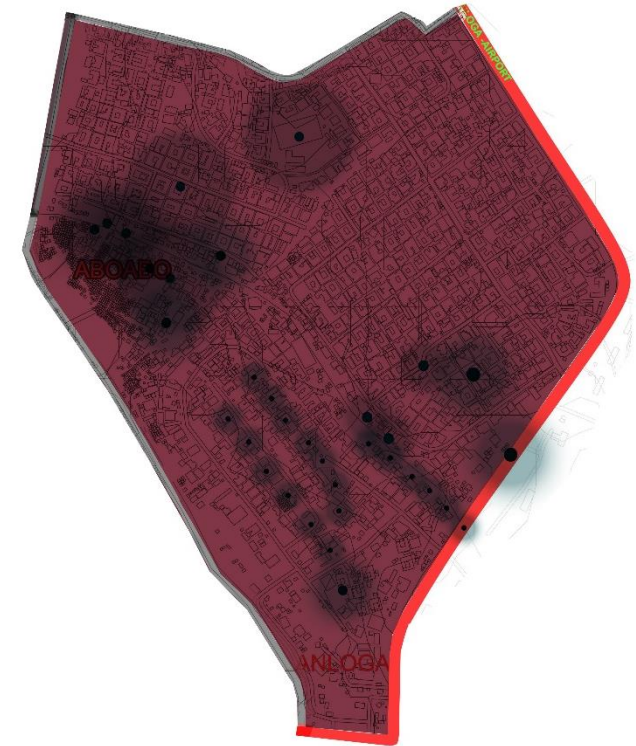


Base Map

Key Pollutants	Test Results	Impact on area
Particulate matter 2.5	78 $\mu\text{g}/\text{m}^3$	Moderate
Particulate matter 10.0	407 $\mu\text{g}/\text{m}^3$	Unhealthy
Nitrogen dioxide	1 $\mu\text{g}/\text{m}^3$	Good
Sulfur dioxide	4 $\mu\text{g}/\text{m}^3$	Good
Ozone	51 $\mu\text{g}/\text{m}^3$	Good
Dust	378 $\mu\text{g}/\text{m}^3$	Unhealthy

Source: Ventusky Climate Maps

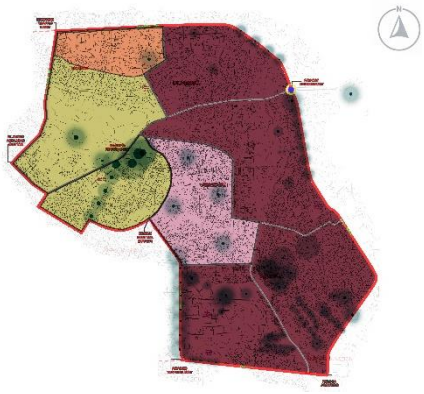
ZONE 5



Zone 5 map showing the air pollution hotspots

Data recorded at midday on Wednesday February 15, 2023





Base Map

ZONE 6



Zone 6 map showing the air pollution hotspots

Data recorded at midday on Wednesday February 15, 2023

Key Pollutants	Test Results	Impact on area
Particulate matter 2.5	26 $\mu\text{g}/\text{m}^3$	Moderate
Particulate matter 10.0	174 $\mu\text{g}/\text{m}^3$	Unhealthy
Nitrogen dioxide	1 $\mu\text{g}/\text{m}^3$	Good
Sulfur dioxide	3 $\mu\text{g}/\text{m}^3$	Good
Ozone	20 $\mu\text{g}/\text{m}^3$	Good
Dust	161 $\mu\text{g}/\text{m}^3$	Moderate

Source: Ventusky Climate Maps





Base Map

ZONE 7



Key Pollutants	Test Results	Impact on area
Particulate matter 2.5	26 $\mu\text{g}/\text{m}^3$	Moderate
Particulate matter 10.0	174 $\mu\text{g}/\text{m}^3$	Unhealthy
Nitrogen dioxide	1 $\mu\text{g}/\text{m}^3$	Good
Sulfur dioxide	3 $\mu\text{g}/\text{m}^3$	Good
Ozone	20 $\mu\text{g}/\text{m}^3$	Good
Dust	161 $\mu\text{g}/\text{m}^3$	Unhealthy

Zone 7 map showing the air pollution hotspots

Data recorded at midday on Wednesday February 15, 2023





Source: Author's field survey

Source: United Nations Economic Commission for Europe

01

Emissions of both Sulphur dioxide and nitrogen oxides causes acidification causing adverse effects on flora and fauna.

02

Air pollutants cause ground-level ozone depletion which causes damage to plant cell membranes and plant cover.

03

Ultimately human populations are also affected. Harmful concentrations of pollutants may directly enter our drinking water, notably through ground water seepage.



05

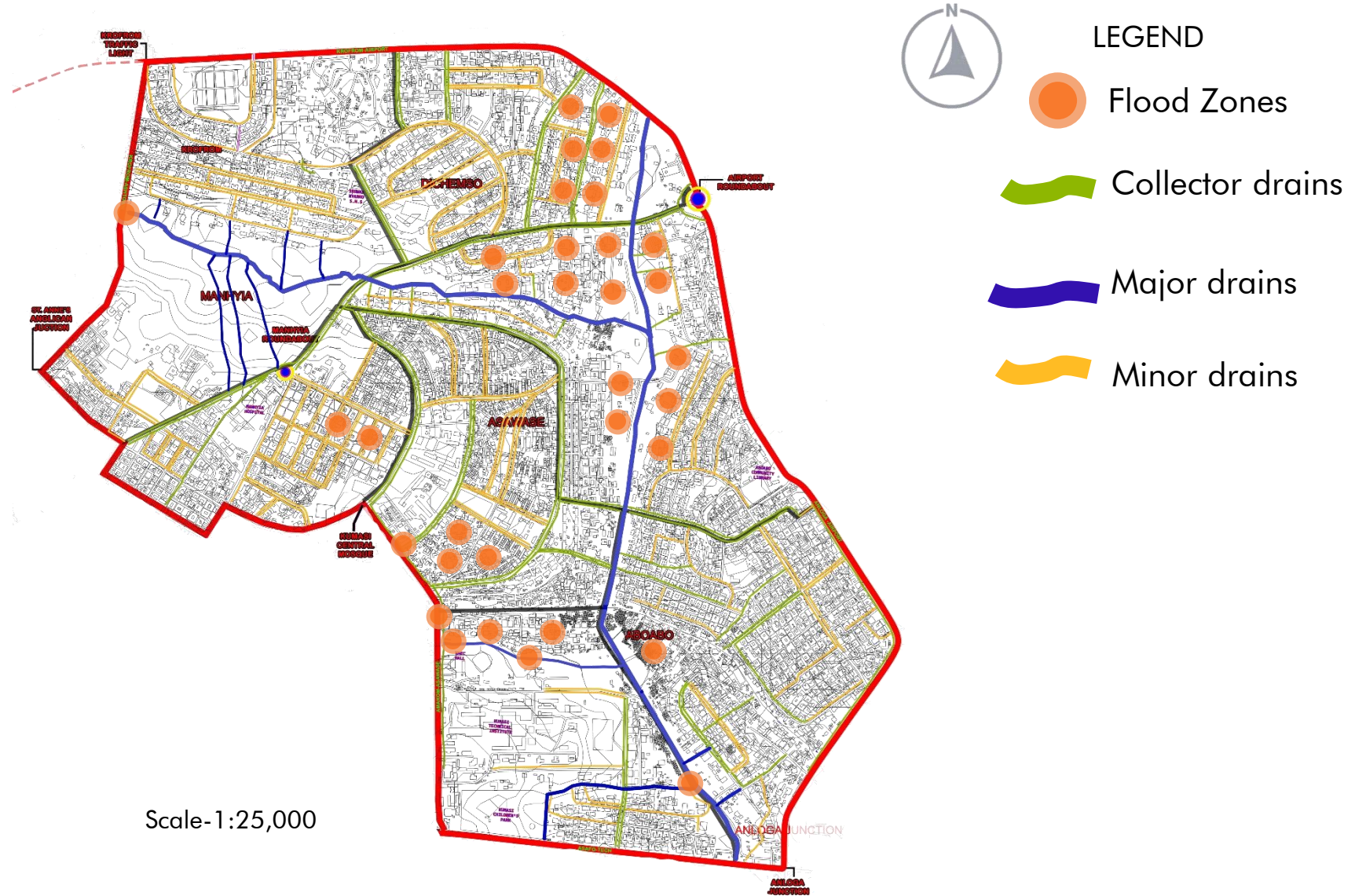


Source: Author's field survey

Flood prone areas



Map showing Flood Prone Areas in the terrain



Some flood prone zones in the terrain



Source: Author's field survey

Zone 6

Lat: 6.699095

Long:-1.600698



Source: Author's field survey

Zone 4

Lat:6.961956

Long:-1.606743



Some flood prone zones in the terrain



Dichemso Rd. (Zone 1)

Lat: 6.709433°

Long:-1.610234°



Zone 1

Lat:6.961956°

Long:-1.606743°



Map Schedule

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Map Showing Some Highlands In The	Pg.14
Map Showing Some lowlands In The	Pg.15
Sections Of Terrain	Pg.16
Hydrological Map Of Terrain	Pg.17

Name of map	Page Number
Map Showing Water Flow Pattern With Contours	Pg.18
3d Map Showing Contours & Landform Of Zone 1	Pg.19
3d Map Showing Contours & Landform Of Zone 2	Pg.20
3d Map Showing Contours & Landform Of Zone 3	Pg.21



Map Schedule

Name of map	Page Number
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Ecological Zones	Pg.26 &27
Vegetative map of Terrain	Pg.35
Map showing flora in the study areas	Pg.36
Map showing flora in zone 1	Pg.47



Map Schedule

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Map showing flora in zone 6	Pg.58
Map showing flora in zone 7	Pg.60
Map showing fauna in the terrain	Pg.65
Existing drains	Pg.76



Map Schedule

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Choked gutters	Pg.78
Flood prone zones	Pg.79
Map of predominant soil type	Pg.89

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Rocks(Quartz stone)	Pg.91&92
Rocks(Silt stone)	Pg.93&94
Map showing natural resources in the terrain	Pg.99
Tourism	Pg.103&104



Map Schedule

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Eco-tourism potential	Pg.107
Green Infrastructure(Zone 1)	Pg.112 & 113
Green Infrastructure(Zone 2)	Pg.114
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Green Infrastructure(Zone 5)	Pg.118
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Green Infrastructure(Zone 7)	Pg.120



Map Schedule

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Land pollution map of study enclave	Pg.134
Map showing recorded noise level locations in study enclave	Pg.143
Major sources of air pollution in study area	Pg.155

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Base map showing the air quality index of the various zone with air pollution hotspots	Pg.157
Zone 1 map showing the air pollution hotspots	Pg.158
Zone 2 map showing the air pollution hotspots	Pg.159
Zone 3 map showing the air pollution hotspots	Pg.160



Map Schedule

Name of map	Page Number
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Zone 5 map showing the air pollution hotspots	Pg.162
Zone 6 map showing the air pollution hotspots	Pg.163
Zone 7 map showing the air pollution hotspots	Pg.164
Map showing flood prone areas in the terrain	Pg.167





THANK YOU!

Source: Author's field survey