UNIVERSITY OF JOHANNESBURG

FACULTY OF SCIENCE

DEPARTMENT OF GEOGRAPHY, ENVIRONMENTAL MANAGEMENT & ENERGY STUDIES

MODULE	**ENM9X04/ENM0418** ENVIRONMENTAL MANAGEMENT 2 (Environmental Analysis & Management Skills)
CAMPUS	**APK**
EXAM	**NOVEMBER 2014**

DATE: 2014.11.11 **SESSION 12:30 – 19:00**

ASSESSOR(S) **DR I.T. RAMPEDI**

EXTERNAL MODERATOR **PROF F.P. RETIEF (NWU)**

DURATION 7 HOURS **MARKS 150**

NUMBER OF PAGES: 12 PAGES

INSTRUCTIONS:

1. This examination paper has **THREE** compulsory sections.
2. The use of a calculator is permissible.
3. The assessment opportunity is an **OPEN-BOOK EXAMINATION**, allowing candidates to bring along relevant information.
4. However, the use of live internet sources is **NOT** permissible during the examination.
5. It is compulsory to cite relevant sources as you compile your answers and a complete **REFERENCE LIST** is imperative.
6. Every section must be written in a **SEPARATE SHEET**, which should be stapled together if more answering books are used.
7. A break of 30 minutes is allowed during the examination period.

SECTION A

QUESTION 1

CASE STUDY

THE PROPOSED LANDFILL GAS UTILISATION PLANT (LGUP) AT AN INDUSTRIAL AREA IN THE GAUTENG PROVINCE

INTRODUCTION

A Landfill Gas Utilisation Plant (LGUP), making use of the methane gas found in the mixture of gases characteristically occurring in landfill gas (LFG), is being proposed for generating electricity at the Kingston Landfill Site (KLS). The KLS disposal site is located at an industrial area in the Gauteng province. The specific company, Renewable Energy Mix Inc (REM), proposing the pilot venture into the exploitation of renewable energy sources is a subsidiary of Thabex Limited, a leading sub-Saharan gas exploration entity seeking to diversify its assets into the renewable energy sector in South Africa. Hence, an initial capital outlay of R 29 million has been set aside for the start-up phase of the proposed project. This announcement comes in the wake of a report in *The Citizen* newspaper that pressure for finding sustainable ways of dealing with municipal solid waste in the Gauteng province has been increasing in the last five years. According to this newspaper the municipalities are running out of land or space for establishing new landfill sites.

The process of capturing methane or "landfill" gas begins after organic waste dumped at the landfill is digested by anaerobic bacteria. The bacteria produces methane, which is recovered via a series of wells drilled into the landfill. The wells are connected by a network of pipes. A section of these pipes called the lateral system creates a vacuum and sucks the gas into a nearby central compression facility, as illustrated in Figure 1. Once the methane gas is at the facility, blowers continue to push it further so that it can be processed. During this treatment process, the trapped gas is allowed to cool meanwhile wastewater and solid waste are being removed. The gas then passes through a micron filter and is heated again. The process is completed by pumping it into combustion engines, which power several generators to make electricity or it may be upgraded to a pipeline-quality gas. The latter gas may be used directly or processed into an alternative vehicle fuel.

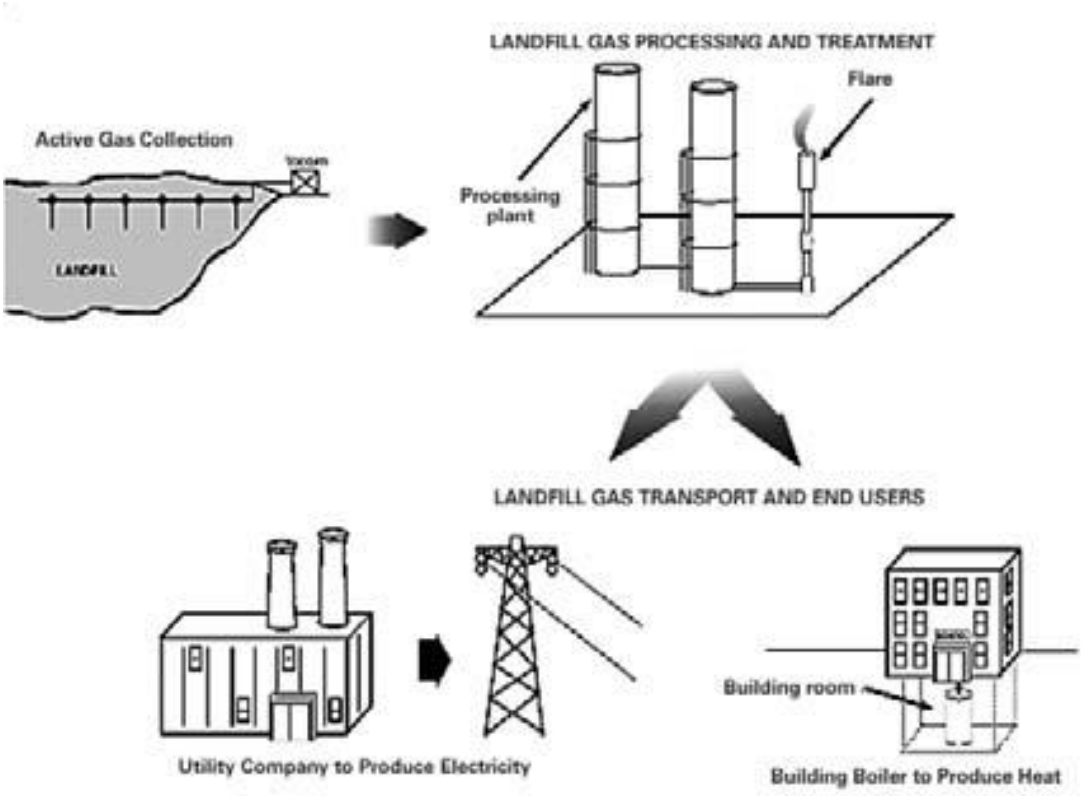

Figure 1.1: A gas collection system with a central processing facility, before being piped for end-uses.

Figure 1.2: The proposed initial start-up blower and a 1000 Nm3/h flare station.

At KLS, the proposed *waste-to-energy* generation project will be introduced in phases. Initially, the anticipated works will entail only the installation of 5 wells into the waste body, a blower and 1000 Nm3/h flare and six 1.6MW generators. Flares (as shown in **Figure 1.2**) are useful in all landfill gas systems as they can help control excess gas extraction spikes and maintenance down periods. For instance, when there is too much gas recovered, the excess gas recovered will be *'eliminated'* or "*flared*" by burning it in torches at nearly 1200^{o}C temperature. The aim of such flaring is to convert the methane in the landfill gas (LFG) into "less harmful" greenhouse gas such as carbon dioxide. The envisaged LGUP is estimated to provide gas to generate up to 9.6 Megawatts of electricity.

Background related to the location of the proposed Landfill Gas Utilisation Plant

The Kingston landfill site is located in an industrial area, near densely populated townships with about 2 million residents. The residents are housed in both formal and informal residential dwelling units. Downwind of the current landfill site is a heavily polluted wetland, due to the leachate visibly seeping out from the slopes of the landfill. Controlling the flow of this leachate is posing challenges to the local environmental control officers, especially if triggered by heavy summer rains. Some of the people reclaiming waste materials at this landfill site have mentioned that there are times when birds frequenting the wetland die in huge numbers, an indication of the toxic effect of this leachate. And at times, sporadic fires, releasing lots of smoke occur because of the spontaneous combustion of fugitive landfill gas.

In addition, there are some risks when building and running a Landfill Gas Utilisation Plant, as contemplated in this case study. For instance, waste-to energy processes of this nature are invariably accompanied by the release of environmentally harmful substances generally grouped as follows.

- combustion gases such as oxides of nitrogen, sulphur dioxide and hydrogen chloride,
- volatile organic compounds such as benzene, semi-volatile organic compounds such as dioxins and furans,
- non-methane organic compounds able to form smog,
- trace metals such as arsenic and nickel as well as
- wastewater and solid waste.

Other environmental risks include the potential for exposure to high concentrations of methane and unpleasant smells at the well heads during construction or for accidents related to the electricity generation process and malfunctioning of flaring equipments. It is on the face of these likely environmental risks that some of the local residents as well as environmental NGOs in the area are disgruntled and up in arms against the proposed development, claiming that the Kingston Landfill should rather be decommissioned and rehabilitated according to the initial registration certificate and permit provisions. However, with proper management procedures, these risks can be kept to a minimum and do not detract from the overall benefits.

Since the power generation processes involved at the proposed Landfill Gas Utilisation Plant are highly specialised, two external companies with the necessary technological capabilities have been selected after a tender process with all specifications for the proposed project. Clearly, the emissions of substances linked to landfill gas combustion will be increased if the proposed project is implemented. The Senior Management

Team spearheading the Landfill Gas Utilisation Plant (LGUP) project, realising that similar waste-to-energy projects have been negatively affected by costly delays emanating from the granting and withdrawals of environmental authorisations and public appeals, has recently approached a reputable close corporation specialising in environmental impact assessments and management for a formal consultation. On the basis of the context of this case study, answer the following questions.

QUESTION 1

Question 1.1

Making use of a customised **Input-Output Diagram** and a simplified **Leopold Matrix**, identify and predict the full range of impacts and their significance likely to result from the proposed LGUP project. Also, you must summarise the findings stemming from these analyses and interpretations.

(25)

Question 1.2

Provide professional advice to the proponents (REM Inc) on the types of **specialist studies** that are likely to be necessitated by the main environmental feasibility study (EIA) and provide an informed purpose, rationale and the terms of reference for such **specialist studies**.

(25)

SUB-TOTAL [50]

SECTION B

QUESTION 2

CASE STUDY

PROPOSED CONSTRUCTION OF A 100 MW SOLAR POWER PLANT ON PORTION 6 & 7 OF FARM BEZUIIDENHOUTSKRAAL 96 JR, WITHIN MORETELE LOCAL MUNICIPALITY OF THE BOJANALA PLATINUM DISTRICT MUNICIPALITY, NORTH WEST PROVINCE

INTRODUCTION

The Moretele Local Municipality is a rural municipality with insufficient electrical infrastructure resulting in the larger percentage of the population relying on fuel wood and fossil fuels for space heating and other needs. The Municipality's Integrated Development Plan (IDP) has identified electricity as a priority and intends to utilise renewable energy generation such as waste and solar radiation. This is intended to move towards sustainable living trends by reducing the amount of greenhouse gases produced. Solar energy has mostly been used in smaller projects or for domestic and individual requirements but recently the trend has shifted with solar energy also contributing to ESKOM's regional energy power mix. The Moretele Local Municipality, therefore, intends to construct and operate a **100 MW Solar Power Plant** on Portion 6 and 7 Bezuidenhoutskraal 96 JR **(Figure 1 & 2).** The plant will be equipped with Photovoltaic panel arrays and associated infrastructure to feed into ESKOM grid. The project will be carried out in two phases:

(i) PHASE 1: Construction of the solar plant; and

(ii) PHASE 2: Construction of 132kV power lines from the Solar Power Plant to Temba Substation.

PROJECT LOCATION

The project is located within the Moretele Local Municipality which falls under Bojanala Platinum District Municipality in the North West Province. The Moretele Local Municipality is located approximately 60 km north of Pretoria and is constituted by nearly 65 villages spread over 1369 km^2 area. It is boarded to the North East by the Thabazimbi Local Municipality, to the North by Bela-Bela Local Municipality, to the East by Nokeng-Tsa-Taemane, to the South by the City of Tshwane and to the West by Madibeng Local Municipality. The proposed farm is approximately 900 ha **(Figure 1)** in extent and there are two alternative sites, of which one will be selected. The entire site is near Mogogelo village, agricultural land and open veld, of which the latter is currently used as grazing area by the surrounding communities. However, for the initial start-up phase, the solar plant is envisaged to cover nearly 200 ha of land on portion 6 or 7 of the farm Bezuidenhoutskraal 96JR. Whereas **Site 1** is as flat as **Site 2**, it has a dry pan. On the other hand, Site 2 is crossed by a dry stream channel which only flows during the rainy season. Located very close to these sites towards the south is an area with riverine wetlands, which are permanent hydrological features developing along the course of the local tributary.

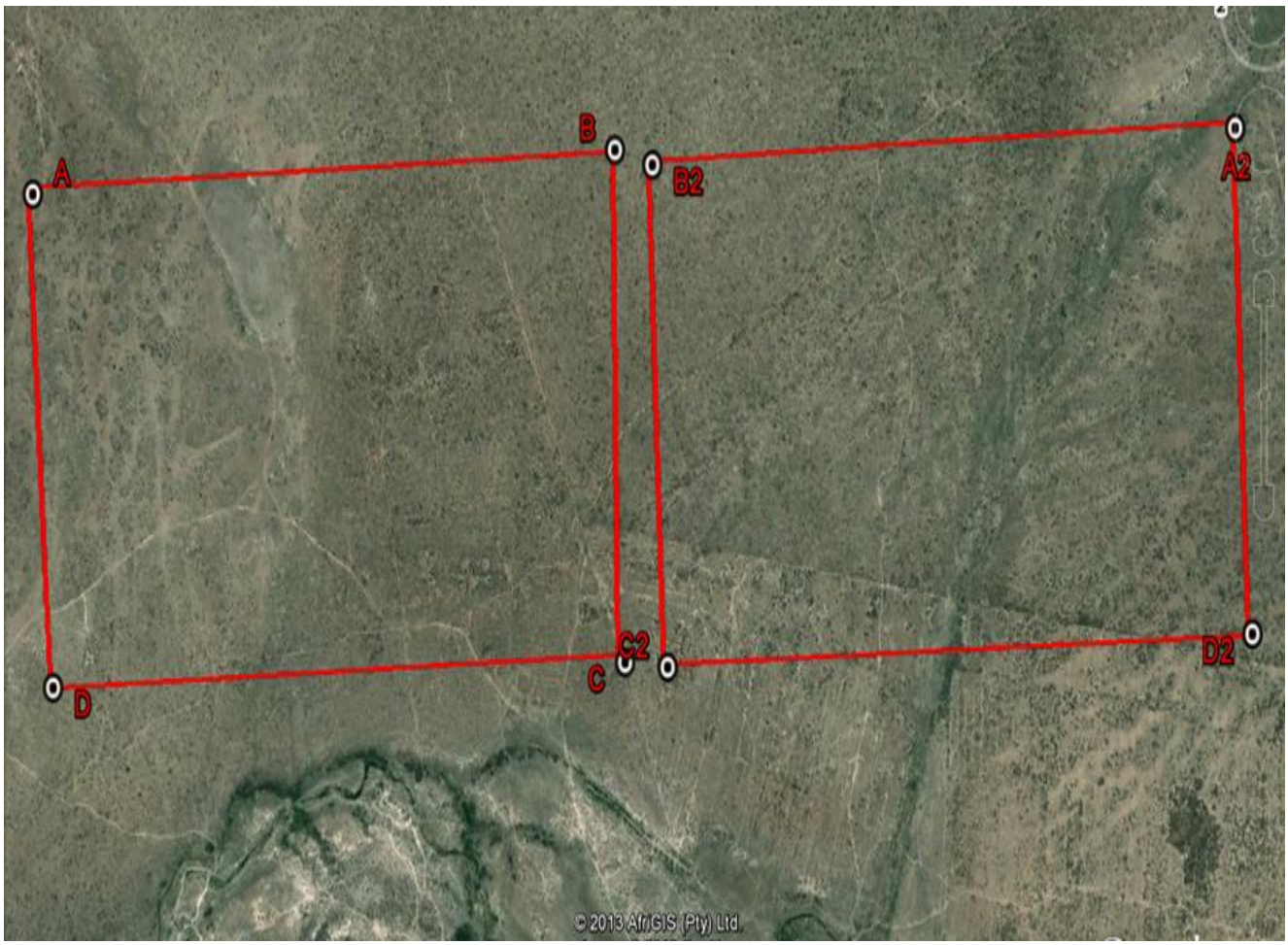

Figure 1: Proposed site maps, depicting the boundaries of Site 1 (ABCD) and Site 2 ($A_2B_2C_2D_2$).

PROJECT DESCRIPTION

The proposed project involves the construction and operation of a 100 MW solar plant that will be equipped with photovoltaic (PV) panel arrays and associated infrastructure. The conversion of sunlight to usable electrical energy is referred to as the *Photovoltaic Effect*. Solar panels collect solar radiation from the sun and actively convert that energy to electricity. Solar panels are comprised of several individual solar cells. These solar cells function similarly to large semiconductors and utilize a large-area p-n junction diode. When the solar cells are exposed to sunlight, the p-n junction diodes convert the energy from sunlight into usable electrical energy.

Photovoltaic Solar Plant Components

Any solar plant is made up of the following components:

i. PV Modules that are generally connected together in series to produce strings of modules of a higher voltage. These strings may then be connected together in parallel to produce a higher current Direct Current (DC) input to the inverters.

ii. Module Mounting Systems that allow the PV modules to be securely attached to the ground at the desired angle to the sun.

iii. Power Center, custom figured for the system which will include low distortion inverter which are electronic devices that transform direct current (DC) generated by the PV modules into alternating current (AC); an interconnect with incoming ESKOM power; and a connection to the breaker panel;

iv. System Data Monitor which shows how much energy is flowing in from the energy sources and how much is flowing out to the loads; and

v. A Balance of System Hardware consisting of wiring, terminations, ground fault interrupter, surge protection, DC and AC disconnects.

All the parts used will require regular maintenance implying that hazardous waste will be produced for disposal, thereby requiring stringent management and minimisation. The associated infrastructure needing replacement and regular maintenance includes:

- Solar panels;
- Mounting structures and a field office covering 200 m^2;
- Inverters;
- Education/Training centre covering 100mx50m;
- Switching substation with 3x132kV feeder bays (50mx50m).
- Guard house and control rooms;
- Erection of lighting masts; and
- Erection of a fence.

In addition, the following will also be constructed and the applicant seeking environmental authorization will be responsible for the construction of the following services:

i. Access and Internal Roads

The entrance to the site will be from the existing gravel road, Mathibestad to Mogogelo. The access road from the existing road to the site will be approximately 1 km long and 10 m wide. Furthermore, the applicant will also be responsible for the construction of the internal access roads with widths ranging from 3m to 10m for the maintenance of the panels.

ii. Storm Water Drainage

Due to the relatively flat terrain in the area, storm water is generally a problem. Therefore, storm water may lead to localised flooding episodes.

iii. Bulk Water Supply

The construction of a 100 MW solar power plant needs approximately 180kL/month which will add up to 2160 kL for the entire construction period duration of 12 months. Portable water will also be needed during the operation period for cleaning the panels and for consumption by the workers. A mains water supply, stored water or access to a mobile water tank will be required. Some freshwater may be abstracted from the nearby stream channel.

iv. Sanitation

The current sanitation system in Mathibestad and Mogogelo is ventilated improved pit latrines. Chemical toilets will be provided for the workers during the construction phase and it is expected that the engineering services report will recommend the type of ablution facilities to be used during the operation phase.

v. Security

To ensure safety and reduce risk of unauthorized entry, the following shall be established;

- 11 permanent guarding posts in all four directions to provide for the level of security required;
- A fence surrounding the solar plant and substation which is at least 2m high; and
- Four lighting masts for illumination during the night.

vi. Electricity transmission lines

The project will also require the siting and construction of electricity power lines for a distance of 47 km because the solar energy generated must be fed to the Eskom grid at a Sub-Station at Temba, near Hammanskraal**.**

On the basis of this Case Study, you are required to respond to the questions (**Question 2.1 & 2.2**) provided below.

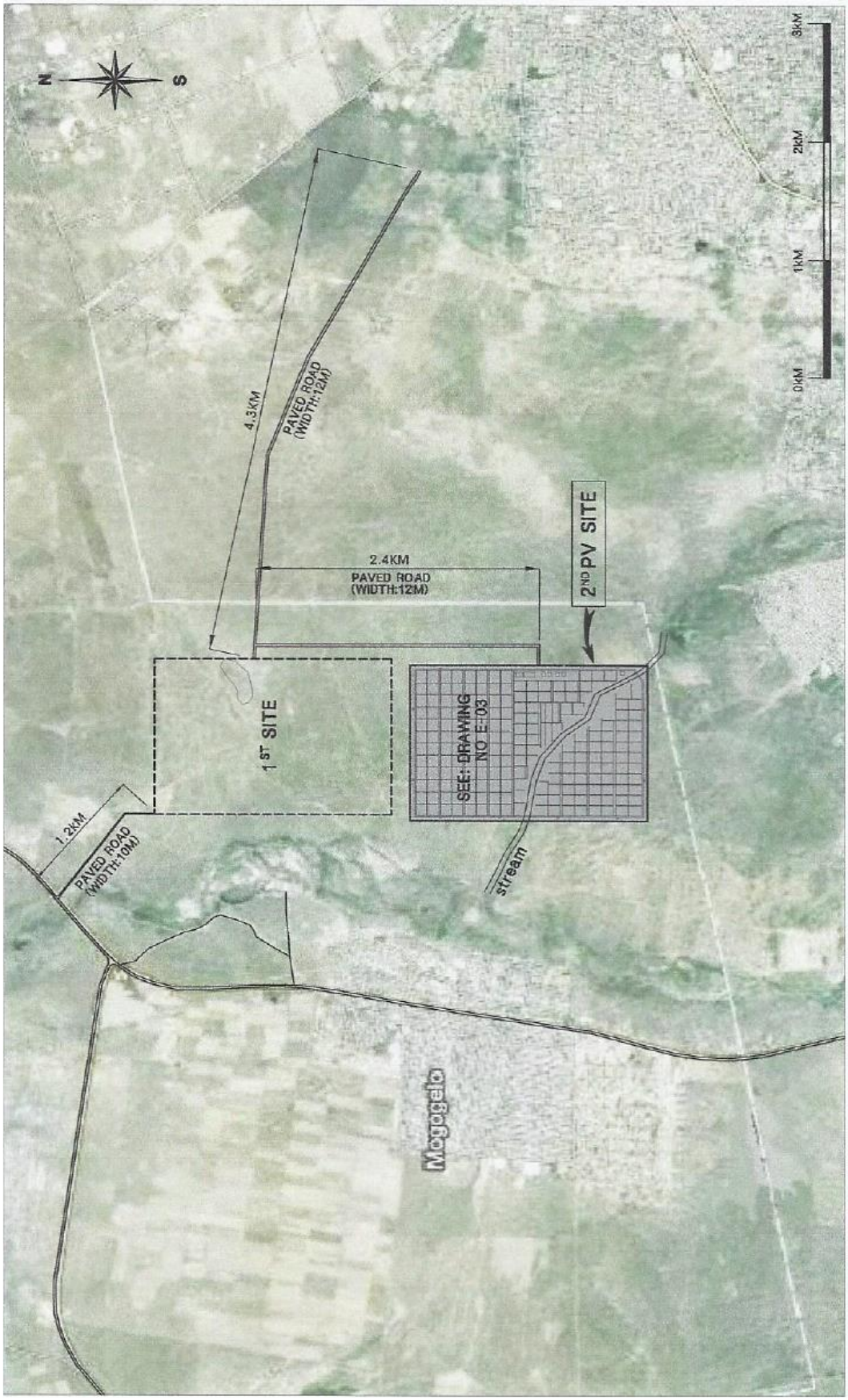

Figure 2: The proposed farm approximately 900 ha in extent (Figure 2), consisting of Mogogelo village, agricultural lands and veld which is currently used as grazing area by the surrounding communities.

QUESTION 2

Question 2.1

Project screening must provide enough information about a development and the receiving environment in which it will be situated, the prime goal being to provide a definite decision on the need and the type of environmental impact assessment (EIA) required. It is, thus, important that effective screening of actions takes place in an EIA system. Without it, unnecessarily large numbers of actions would be assessed and some actions with significant adverse impacts may be overlooked. The determination of whether or not an environmental assessment is to be prepared for a particular action depends upon the likely significance of its environmental impacts (Wood, 2000:72). On the basis of the case study summarised above, determine the need for and the scale of an environmental impact assessment (EIA) regarding the proposed activity. Your points of reference and motivation should be in line with the current South African environmental legislation, associated regulations and relevant literature.

(20)

Question 2.2

Identify and discuss the various environmental aspects that may require due consideration and a risk-adverse approach in the proposed solar energy project and explain how such aspects can be incorporated into an environmental management plan. In your answer, you must also indicate how such an environmental management plan can be applied and enforced.

(30)

SUB-TOTAL [50]

SECTION 3

QUESTION 3

Question 3.1

Give an informed perspective on the rapid evolution of **EIA-related Legislation** and **Regulations** in South Africa. In your answer, also provide a brief historical account on this phenomenon while clarifying the goal of such changes.

(20)

Question 3.2

CASE STUDY

SIRIKIN MINING OPERATION IN THE LIMPOPO PROVINCE

INTRODUCTION

A big mining company known as Sirikin (Pty Ltd) in the Limpopo province, with a staff complement of 600 operational staff is involved in opencast mining activities since 1991, in an area exceeding 15 000 hectares. Apart from these operations they have also pursued joint ventures particularly in East and West Africa during the last 16 years successfully. Regardless of their financial successes, water scarcity is a major

constraint in this area of the Limpopo province, apart from close proximity to remotely located and isolated rural communities who have to contend with poor ambient air quality, an unstable land surface as well as contaminated water bodies. Whereas the regulatory framework is not very restrictive in East and West Africa, in South Africa a new phase of environmental compliance and enforcement is fast setting in, and companies that are polluting the environment are being singled out for environmental prosecution and related legal processes.

According to the Department of Environmental Affairs and associated regulatory Departments, compliance means full implementation of all environmental requirements and zero-tolerance for any non-compliance. Compliance occurs when environmental management requirements are being met systematically and in a proactive manner.

The Sirikin Mine has approximately 80 million tons of mineral reserves and is currently 700 m deep with ultramafic pegmatoid intrusions, faults and dykes leading to losses in the exploitable ore. As a result, the mine has invested heavily in the state-of-the-art technology, automated devices and a range of heavy-duty machinery, the goal being to achieve company goals and production targets. However, environmental management and rehabilitation requirements have been severely compromised recently, leading to several fines amounting to millions of Rands. Consequently, the Mine is being pursued for the following environmental transgressions, of which a summary is provided below:

AIR POLLUTION

Over the years, opencast mining has led to vast quantities of dust comprised of various sizes which disperses suspended particulate matter and gaseous pollutants in to the atmosphere. More seriously, the resulting dust pollutants not only affect the health of mine workers but also impact nearby communities, agricultural crops and livestock, negatively. There is also poor visibility near sites where crushing of the ore occurs.

WATER POLLUTION

Mining activities at Sirikin are affecting both surface and groundwater resources and in this context, the local topography and drainage patterns are accentuating the severity of this pollution. There are several sources of environmental concern, namely, the de-watering of mine water; the mismanagement of used water (waste water) from dust suppressing systems as well as the leachate emanating from waste dumps and run-off resulting from pollution control dams.

Due to excessive soil and other structural erosion at the mine site, the runoff water has been found to contain high amounts of suspended solids. Such run-off actively reduces the penetration of light in receiving water bodies, thus adversely affecting the survival of aquatic living organisms and associated ecosystems. The leachate water is also toxic since it contains heavy metals, thus threatening to pollute surrounding ground water resources.

NOISE POLLUTION

With open cast mining, blasting operations are a common practice and this produces high intensity noise. Deafness is known to be caused by the slow but progressive degeneration of the neuro-sensorial cells of the inner ear. Moreover, a noisy working environment may lead to communication impairments, task interferences, sleep interferences, and changes in personal behaviour amongst the mine workers. In addition, noise produces other health effects which influence work productivity. Studies have repeatedly shown that fauna in the forests and other areas surrounding the mines are adversely impacted by noise. Also, wildlife tends to be more sensitive to noise and vibrations than people. The noise level is comparatively high in the mine site and an *adhoc* investigation carried out recently found it to be in the range of 92 to 130 dB, way above the above the limits of 75 dB prescribed by the World Health Organisation (WHO) for day time industrial areas.

LOSS OF BIODIVERSITY

One major environmental impact of the present Sirikin mine is the rapid loss of biodiversity. Over the years, large scale mining operations have contributed directly or indirectly to the loss of biological diversity. Natural vegetation is often cleared away at various places to help facilitate ore excavation, the development of mining infrastructure and the illegal dumping of overburdens. It has been observed that the removal of vegetative cover is often followed by massive soil erosion as well as the siltation of receiving rivers and reservoirs in the affected area. The direct impacts on the living organisms in these mining areas include deaths of plants and animals and the disturbance of wildlife habitats due to blasting and heavy machines.

Given these challenges, it is clear that environmental impact management is not conducted in a proactive and precautionery manner at Sirikin Mine and therefore a watershed or game changing approach is now critically imperative. Therefore, critically evaluate the role that an environmental management system (EMS) such **as ISO 14 001** can play in the **integrated accounting** of all environmental impacts associated with the business operations taking place at the Sirikin Mine in the Limpopo province. In your answer, also explain what steps in keeping with **ISO 14 001 system** need to be undertaken in order to help restore a pathway towards long term sustainability and environmental balance at this mine.

(30)

SUB-TOTAL [50]

TOTAL [150]

END OF THE ASSESSMENT PAPER