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*Annexure 2*

**1. CLIMATE CHANGE ISSUES**

Climate change is one of the biggest issues facing the world today and it is attributed directly or indirectly to human activity that alters the composition of the global atmosphere resulting in an unnaturally high variability in climate. Most scientists and governments recognize that, while uncertainties exist, there is a strong evidence to suggest that human activities emit greenhouse gasses that change the earth's climate and that further change is inevitable. South Africa is still developing its economy; our dependence on coal-driven energy sources and the energy intensity nature of our economy have resulted in an extremely high carbon emission level compared to the rest of the world.

South Africa is located in the region that is most susceptible and vulnerable to climate change, and it appears already that we are experiencing the early effects of global warming and climate variability. Average land and sea surface temperatures have increased and rainfall patterns have changed, and the frequency of extreme weather events has increased. Climate changes in South Africa over the next coming years indicate that some parts of the country will become dryer, experience shorter rainfall seasons and that air temperature will rise particularly in the interior. Other potential changes include increased incidence of floods and droughts and more severe temperature inversions which will exacerbate air pollution problems. Such changes in climate will significantly affect all components of the natural environment various sectors of the economy such as agriculture, fishing and tourism, human health and the well-being of all South Africans. Changes in terrestrial ecosystems and species distributions are already being correlated with climatic changes over the sub-continent, and the pace of these changes is expected to accelerate.

Alfred Nzo is one of the seven districts of the Eastern Cape Province of South Africa, and it is the smallest and one of the poorest districts in the province. The Alfred Nzo district has a small formal economy compared to the rest of the province. Agriculture is the principal private sector and provides 12% of formal employment. Forestry is the best formal agricultural sector with wide-spread plantations around Maluti. There is also livestock farming, which includes cattle, sheep and goats. Rural households tend to rely heavily on climate-sensitive resources such as local water supplies and agricultural land; climate sensitive activities such as arable farming and livestock husbandry and natural resources such as fuel wood. Climate change can reduce the availability of these local natural resources, limiting the options for rural households that depend on natural resources for consumption or trade. Land may become less fertile may be. Shifts in climate will bring changes in Alfred Nzo region; some areas may see greater natural resources because of increased rainfall, for example. But on balance, the poorest regions are most likely to suffer because they are least able to adjust to new conditions.

**2. WHAT CAUSES CLIMATE CHANGE**

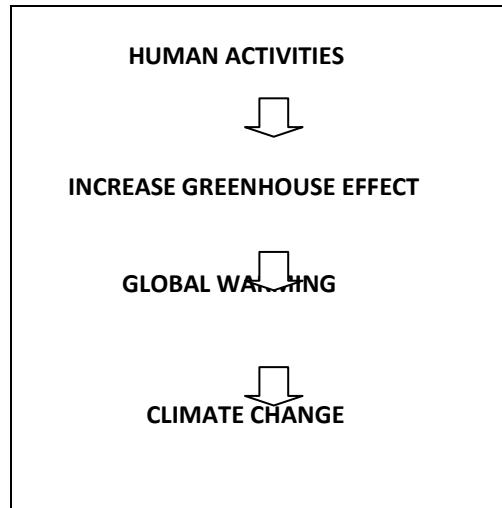
Climate change is the result of changes in weather patterns due to increase in the Earth's average temperature. It is certain that increased greenhouse gas emissions from the burning of fossil fuels and from land use change lead to a warming of the Earth, and it is very likely that these greenhouse gases are the dominant cause of the global warming that has been taking place over the last years.

Global warming is the increased heat trapped in the earth's atmosphere resulting from excess greenhouse gases such as Carbon Dioxide (CO<sub>2</sub>), Methane (CH<sub>4</sub>) and Nitrous Oxide (N<sub>2</sub>O) that form a layer in the atmosphere reflecting the sun's rays back to the earth surface. These gases are exacerbated in the atmosphere by fossil fuel use for energy (i.e. coal and oil) and the alteration to our natural landscape. This has an unnatural warming effect on our fragile environment. This increase in greenhouse gases mostly

comes from human activities such as burning fossil fuels, land clearing and intensive agriculture. Climate change is also often referred to as global warming but it is not, global warming cause's climate to change.

The flow chart below shows how human activities contribute to climate change:

Human activities add to greenhouse gasses that prevent the sunrays from going back to the atmosphere and are called the greenhouse effect, which lead to global warming that cause's climate change.



### **2.1 Human Activities**

Human activities, such as burning of coal, oil, and natural gas, as well as deforestation and various agricultural and industrial practices, are altering the composition of the atmosphere and contributing to climate change. These activities they produce the Greenhouse gasses such as carbon dioxide and methane, which they act as the barrier for sunlight.

- Carbon dioxide is produced when coal, oil, and natural gas (fossil fuels) are burned to produce energy used for transportation, manufacturing, heating, cooling, electricity generation, and other applications.
- Deforestation and land use changes, e.g., clearing land for logging, ranching, and agriculture, also lead to carbon dioxide emissions. Vegetation contains carbon that is released as carbon dioxide when the vegetation decays or burns.
- Desertification its immediate cause is the removal of vegetation. Unprotected, dry soil surfaces are blown away by winds or are washed away by floods, leaving infertile lower soil layers baked in the sun and become an unproductive hardpan. Overgrazing destroys valuable plant species, leaving mostly unpalatable ones. Losses of vegetation and biodiversity threaten habitat for other species. This is driven by a number of factors, alone or in combination, such as tillage for agriculture; too many livestock on too little land; removal of crop residues for feed/construction use; deforestation for fuel wood and construction materials; and inappropriate irrigation practices that lead to salinity.

The vegetation that is being removed plays a significant role in greenhouse emission and reducing carbon sink

- Methane (natural gas) is the second most important of the greenhouse gases resulting from human activities. It is produced by rice cultivation, cattle and sheep ranching, and by decaying material in landfills. Methane is also emitted during coal mining and oil drilling, and by leaky gas pipelines. Nitrous oxide is produced by various agricultural and industrial practices.
- Chlorofluorocarbons (CFCs) have been used in refrigeration, air conditioning and as solvents. However, the production of these gases is being eliminated under existing international agreements because they deplete the stratospheric ozone layer. Other fluorocarbons that are also greenhouse gases are being used as substitutes for CFCs in some applications, for example in refrigeration and air conditioning. Although currently very small, their contributions to climate change are expected to rise.
- Ozone in the troposphere, that is, in the lower part of the atmosphere, is another important greenhouse gas resulting from industrial activities. It is created naturally and also by reactions in the atmosphere involving gases resulting from human activities, including nitrogen oxides from motor vehicles and power plants.

### **2.1.1 Human Activities in Alfred Nzo District**

This is a global issue, but every human has a footprint and we are all responsible, e.g. using electricity here which is generated by burning coal in the Witwatersrand / Gauteng area. As much as Alfred Nzo District is not contributing that much in greenhouse gasses but it is going to experience climate change.

We make the following contributions, albeit small in the global picture:

- Industrial and commercial activities including scheduled processes and non-domestic fuel burning appliance operation by businesses, hospitals and schools
- Electricity generation by power stations for the national grid.
- Waste treatment and disposal waste incineration, landfills and waste water treatment works.
- Residential household combustion of coal, paraffin, dung and wood.
- Transport petrol and diesel driven vehicle tailpipe emissions, vehicle entrained road dust, brake and tyre wear fugitives and rail and aviation related emissions.
- Mining including fugitive dust releases and spontaneous combustion emissions.
- Agriculture including crop residue burning enteric fermentation and fertiliser, and pesticide application.
- Informal/miscellaneous including tyre burning, wild fires, dust from unmaintained gravel roads and fugitive dust from open areas.

### **2.2 Greenhouse Effect**

There are two meanings of the term "greenhouse effect". There is a "natural" greenhouse effect that keeps the Earth's climate warm and habitable. There is also the "man-made" greenhouse effect, which is the enhancement of Earth's natural greenhouse effect by the addition of greenhouse gases from the burning of fossil fuels and deforestation. In order to understand how the greenhouse effect operates, we need to first understand Infrared Radiation. Infrared (IR) radiation is just as important to the Earth's weather and climate as sunlight is. For every bit of sunlight that the Earth receives, an equal amount (on average) of IR radiation must travel from the Earth back to outer space. Everything emits infrared radiation but we usually don't notice it because it is weak, and you can't see it like you can sunlight. The radiant heat you feel from an oven or a fire is infrared radiation. Greenhouse gases trap some of the infrared radiation that escapes from the Earth, making the Earth warmer than it would otherwise be. You can think of greenhouse gases as sort of a "blanket" for infrared radiation it keeps the lower layers of the atmosphere warmer, and the upper layers colder, than if the greenhouse gases were not there. It is the carbon dioxide concentration that is increasing, due to the burning of fossil fuels as well as deforestation. The small concentration amount of methane in the atmosphere has also increased in recent decades. This is the man-made portion of the greenhouse effect, and it is believed by many scientists to be responsible for the global warming

### **2.3 Global Warming**

Scientists have determined that a number of human activities are contributing to global warming by adding excessive amount of greenhouse gases to the atmosphere. Greenhouse gases such as carbon dioxide, water vapour and methane accumulate in the atmosphere traps heat that normally would exit into outer space. While many greenhouse gases occur naturally and are needed to create the greenhouse effect that keeps the Earth warm enough to support life, human activities creates another layer of greenhouse gas that traps the sun rays from going back to space. Main source of excessive amount of

greenhouse gasses is by driving cars, using electricity from coal-fired power plants, or heating our homes with oil or natural gas, we release carbon dioxide and other heat-trapping gases into the atmosphere. Deforestation is another significant source of greenhouse gases, because fewer trees mean less carbon dioxide conversion to oxygen.

During the 150 years of the industrial age, the atmospheric concentration of carbon dioxide has increased by 31 percent. Over the same period, the level of atmospheric methane has risen by 151 percent, mostly from agricultural activities such as raising cattle and growing rice. As the concentration of greenhouse gases grows, more heat is trapped in the atmosphere and less escapes back into space. This increase in trapped heat changes the climate and alters weather patterns, which may hasten species extinction, influence the length of seasons, cause coastal flooding, and lead to more frequent and severe storms.

#### **2.4 Climate Change**

Climate includes patterns of temperature, precipitation, humidity, wind and seasons. Climate change affects more than just a change in the weather; it refers to seasonal changes over a long period of time. These climate patterns play a fundamental role in shaping natural ecosystems, and the human economies and cultures that depend on them.

Because so many systems are tied to climate, a change in climate can affect many related aspects of where and how people, plants and animals live, such as food production, availability and use of water, and health risks.

For example, a change in the usual timing of rains or temperatures can affect when plants bloom and set fruit, when insects hatch or when streams are their fullest. This can affect h pollination of crops, food for migrating birds, spawning of fish, water supplies for drinking and irrigation, forest health, and more.

Some short-term climate variation is normal, but longer-term trends now indicate a changing climate. A year or two of an extreme change in temperature or other condition doesn't mean a climate change trend has been "erased." Alfred Nzo District is an area that exceeds 1000m above sea level; rainfall is very high and can be very cold and snowy in winter season. Climate change is causing more severe and more frequent storms resulting in changes in timing and amount of rainfall that damage agricultural production. Agriculture is the mainstay in this district; because most people in the district are illiterate so they depend on agriculture. Understanding changes in agriculture already taking place, or likely to take place in the near future, in response to climate change is therefore of utmost importance. Added to other environmental degradation such as deforestation, erosion and desertification these changes have significant impacts on the health and livelihoods of people.

### **3. IMPACTS OF CLIMATE CHANGE IN ALFRED NZO DISTRICT**

Climate change is the most alarming cause of environmental degradation. Changes in our climate may have significant effects on agriculture, fisheries and forest of Alfred Nzo District and the economy. Most rural household of Alfred Nzo District earn less than R1000 a month and others they depend on welfare grants therefore agriculture is the main source of livelihood for most of the rural people of this area. The South African study identified the following; health sector, maize production, plant and animal biodiversity, water resources and rangelands as areas most vulnerable to climate change. More recent climate change models may lead to modifications of the anticipated effects, but the summaries below offer the latest available information on the impacts of climate change

#### **3.1 Health Sector**

The potential impact of climate change on health of the South African population has been modeled as it has in other countries. Indirect health effects anticipated to occur locally include the following

- Mortality and increased incidence of infectious diseases and respiratory diseases due to increased surface temperature. The likely occurrence of epidemics of infectious diseases are related to changes in the distribution of diseases carriers and to reduce cellular immunity in humans as the result of ultraviolet
- Increased incidence of skin cancer , eye diseases due to exposure to higher ultraviolet radiation levels
- Water quality deterioration may cause water related diseases like cholera

Indirect effects of global climate change on human welfare are related to the potential impacts on biodiversity and ecosystems and on the availability of agricultural land and water for irrigation. The potential for crowding, malnutrition and starvation, allergic diseases, and suffering due to weather extremes has also been noted.

### **3.2 Water scarcity**

Water scarcity is a Countries problem not Alfred Nzo District only even without climate change it is predicted that within a few decades South Africa will be using up most of its surface water resources. The most significant impacts of climate change on water resources are the potential changes in the intensity and seasonality of rainfall. While some regions may receive more surface water flow, future problems are likely to include water scarcity, increased demand for water, and water quality deterioration. Climate change may also alter the magnitude, timing and distribution of storms that produce flood events. Arid and semi-arid regions which cover nearly half of South Africa are particularly sensitive to changes in precipitation and desertification which is already a problem in South Africa and could intensify.

### **3.3 Rangelands**

Previous climate change scenarios predicted that rangelands will generally become drier bringing both direct and indirect effects. With current predictions of wetting in the eastern parts of South Africa, rangelands here may not be affected directly. Nevertheless, lower rainfall and higher air temperatures will affect fodder production and affect the marginal costs of ranching. In addition, climate change could affect the frequency and spatial extent of livestock disease outbreaks, such as foot and mouth disease. Increased grass fuel load is predicted to increase fire intensities by about 20% by the coming years

### **3.4 Forestry**

The forestry industry is highly sensitive to climate change. Currently, only 1.5% of the South Africa including Alfred Nzo District is suitable for tree crops and the forestry sector is affected by factors such as land availability, water demand and socio-economic conditions. General aridification in some areas due to lower rainfall and higher air temperatures could affect the optimal areas for the country's major tree crop species and raise the marginal costs associated with planting in sub-optimal areas. Shifts in the optimum tree growing areas could affect the profitability of fixed capital investments such as sawmills and pulp mills. Lower production would also reduce the planting of trees which serve as carbon sinks. More temperature tolerant cultivars among the current tree species being planted could be selected for cultivation but it is probable that more lucrative uses for the land such as sub-tropical fruits will compete for the land currently taken up by tree plantations.

### **3.5 Biodiversity**

Biodiversity is important for South Africa because it maintains ecosystem functioning and has proven economic value for tourism and supports subsistence lifestyles. The combined effect of climate change, rising human population, and increasing per capita consumption will result in major changes to biodiversity. Climate change scenario modelling indicates that the area covered by the current biomes will decrease; of the 179 species of animals examined, 143 indicated range contractions and 4 are predicted to become extinct. A concern is the predicted expansion of insect pests, such as the brown locust, to areas that were previously cooler.

Climate change and the resulting loss of biodiversity has the potential to harm the tourism sector which currently contributes R100 billion each year to our economy and it is estimated that if South Africans do not immediately act to adapt to the effects of climate change, it could cost the country about 1.5% of gross domestic product by 2050. Alfred Nzo District is mostly dependent on natural resources to increase the economy of this district for example tourism, it is very important protect the resources that we have.

### **3.6 Extreme weather events**

Recent climate modelling results indicate that extreme weather events may become more common. Rising average temperatures produce a more variable climate system. Localised events could include

- Windstorms and heavy winds
- Heat waves, droughts
- Storms with extreme rain or snow
- Severe thunderstorm and hail storm
- Extreme high and low temperatures

Drought conditions often provide too little water to support food crops, through either natural precipitation or irrigation using reserve water supplies. The same problem affects grass and grain used to feed livestock and poultry. When drought destroys food sources, people go hungry. Faced with other impacts of drought, many people will flee a drought-stricken area in search of a new home with a better supply of water, enough food, and without the disease. Drought often creates a lack of clean water for drinking, public sanitation and personal hygiene, which can lead to a wide range of life-threatening diseases. All living things must have water to survive; people can live for weeks without food, but only a few days without water. The low moisture and precipitation that often characterize droughts can quickly create hazardous conditions in forests and across rangeland, setting the stage for wildfires that may cause injuries or deaths as well as extensive damage to property and already shrinking food supplies. Extreme rain and snowstorm they will cause damage to buildings, flooding, washing away of roads, siltation in dams and damage to crop. Because of these heavy rains the ground water will not be able to recharge and this will result in shortage of water.



**3.6.1 Extreme weather events likely to happen in Alfred Nzo District their impacts and mitigation measures**

Events	Impacts	Mitigations
Possible increase in frequency, of severe tornadoes and heavy winds	Damage in houses, buildings, crops, soil erosion, inability to cultivate land due to water logging of soil	Identify areas prone to these natural disasters and limit further development
Possible increase in frequency of thunderstorm and hail	Flooding washing away of roads and bridges, siltation in dams and damage of crop	Wetlands must be protected and enhanced Roads and bridges are properly engineered
Possible increase in frequency of veld fires	Loss of grazing land, danger to human, livestock and buildings	Manage burning and range land management
Possible in frequency of snow and extreme temperature	Loss of life and livestock Damage to infrastructure	Proper disaster management Awareness about this we
Possible increased in land degradation	Current eroded areas will become worse	Proper disaster management Donga repair and clearing the wattle
Possible increased frequency of drought	Land degradation and soil erosion, lower yields from crop damage and failure, increase in livestock deaths and risk wildfire, loss of arable land. Loss of grassland, crops and scarcity of water	More protection for existing water resources (wetlands, dams, springs and rivers)
Possible frequency in floods	Reducing storage of dams and destroying wetlands. Damage of sewer systems	Quality of sewage systems for sewer lines in the floodplain, fasten and seal manhole covers to prevent floodwater infiltration Flood resistance, resilience measures specific to the potential for ground water flooding. Management surfaces run off. Maintenance, improvement of water courses, culvert, drains and sewerage network reduce associated flood risk

**3.7 A change in vegetation zone**

A change in climate would have an effect on the vegetation zones. We would see a change in the boundaries between grassland, forest and shrubland. This change in vegetation zones could cause famine in arid areas such as Africa that depends on a certain type of crop. The change in vegetation would cause

mass movement of people away from arid regions. The range of pests could also change if the vegetation changed. This could bring about an increase in disease levels. As we know that Alfred Nzo District depends on agricultural activities, their production will decrease. To meet the increasing food demand agriculture has to expand annually. If the climate becomes hotter and drier however maize production will decrease over the next years and speciality crops grown in specific environmentally favourable areas may be at risk. An increase in pests and diseases would also have a detrimental effect on the agricultural sector and invasive plants could become a greater problem, as it already started in this district.

### ***3.8 Impacts on Women***

To understand the impact of climate change on women, you have to understand the situation of poor women in Alfred Nzo District face everyday. Their responsibilities are many and varied. Household tasks are extremely labor intensive and almost all of them fall to women and girls. They cook over wood and dung fires which they need to travel long distances in order for them to get, they go to the river to wash clothes and collect water for drinking and bathing. They also play a central role in agriculture. Alongside men, they plant and harvest crops and raises livestock. Most women must find ways to earn an income too. They work as domestic help and as vendors in the open air markets where the poor shop. Moreover, many women raise their children alone, with little or no support from a man depending only on child welfare. In general women lives are more intimately connected to the environment more than men and often men tend to be away in the cities while the women look after children and work on the land in rural areas. Women are particularly vulnerable to climate change because they are more prone to the adverse impacts of climate change.

## **5. HOW THE ALFRED NZO DISTRICT CAN MITIGATE AGAINST CLIMATE CHANGE ALFRED NZO DISTRICT**

Identification and selection of actions to mitigate the greenhouse gas emissions will be a great challenge because these emissions are strongly tied to human activities that support commercial systems. However, these activities cover a wide range from ones crucial to human well being. For Developing countries it will not be easy to solve this problem because the likely impact of the problem is global and no one country or group of countries can provide its remedy. However its solution lies on the co-ordination of national actions within regional and international frameworks. The solution will need to involve countries around the world because the impact of greenhouse gas emitted in one location may be felt in a completely different location. Hence, countries should develop a plan of action to cope with this problem. Such plan should be long-term in nature and be capable to respond to uncertainties and un-planned events and can be adjusted to suit new information as they become known. Further actions to reduce greenhouse gas emissions will have serious economic implications due to its link with human activities so involve restructuring of economic sectors.

### ***5.1 Reducing Greenhouse gases emission***

Carbon dioxide is the major gas causing greenhouse gas effect, it is necessary to check activities that produce these gases. Less energy use means less dependence on fossil fuel that creates greenhouse gases and contributes to global warming.

- Phasing out of CFCs
- Shift to low carbon fuels greater use of renewable energy sources, use of gas fired combined cycles, more use of natural gas as opposed to coal, greater use of biomass.
- Efficiency programs on energy supply and use
- Reduction of leaks from gas plants
- Controlling transport related emissions in the land use sector
- Improved forest management
- Improved livestock waste management, altered use and formulation of fertilisers, and other changes to agricultural land use, while maintaining food security.
- Reduction of emissions by change in agricultural systems
- Maintaining and expanding sinks by protecting forest and practising agro-forestry and other plantation exercises.
- Changing cattle feed to reduce methane emitted and utilising methane produced
- Proper construction and maintenance of gravel roads that would minimise dust

### ***5.2 Sustainable and Management***

The district has to make sustainable planning keeping water management relations to cope with the effects of climate change

- Adaptations options designed to ensure water supply and sanitation require integrated demand side as well as supply strategies
- Mitigation options needs to be conducted across multiple water dependant sectors, therefore integrated water resource management provides an important framework to achieve adaptation measures across those different sectors
- Changes in land use may result in net changes in carbon stocks and in different impact on water resources. Wetlands restoration one of the main mitigation practices in agriculture result in the improvement of water and air quality
- Improved agricultural management practices may increase productivity of the soil
- Forest will need better protection and management if their carbon dioxide emissions are to be reduced. Sustainable forest can generate forest biomass as renewable resource
- Waste solid and liquid management

Climate change is an emerging human security issue that threatens numerous communities. It is acknowledge that negative impacts of climate change affects women and children the most because they depend on natural resources and the environment for all their activities for basic needs. Worldwide, people are paying serious attention to climate change. We can help slow it down but we must take action now, the best way to mitigate a negative impact of disaster is to prepared for it.