

ENVIRONMENTAL IMPACT ASSESSMENT REPORT

Establishment of a landfill site on the farm Northleigh 422/RE in the Viljoenskroon district, Free State

August 2017



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Moqhaka Local Municipality

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EXECUTIVE SUMMARY

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1 INTRODUCTION

1.1 The Applicant

Name: Moqhaka Local Municipality

Postal address: P.O. Box 302
Kroonstad
9500

Contact person: Mr. S. M. Mqwathi (Municipal Manager)

Tel.: 056 216 9911

1.2 Name and address of the surface owner

Detail the same as for the applicant

1.3 Name and address of the Environmental Assessment Practitioner

Name: Eko Environmental

Postal Address: Suite 158, Private Bag X01, BRANDHOF, 9324

Contact person: Louis De Villiers

Tel. No.: 051 444 4700

Fax: 0866976132

1.4 The property

Property description

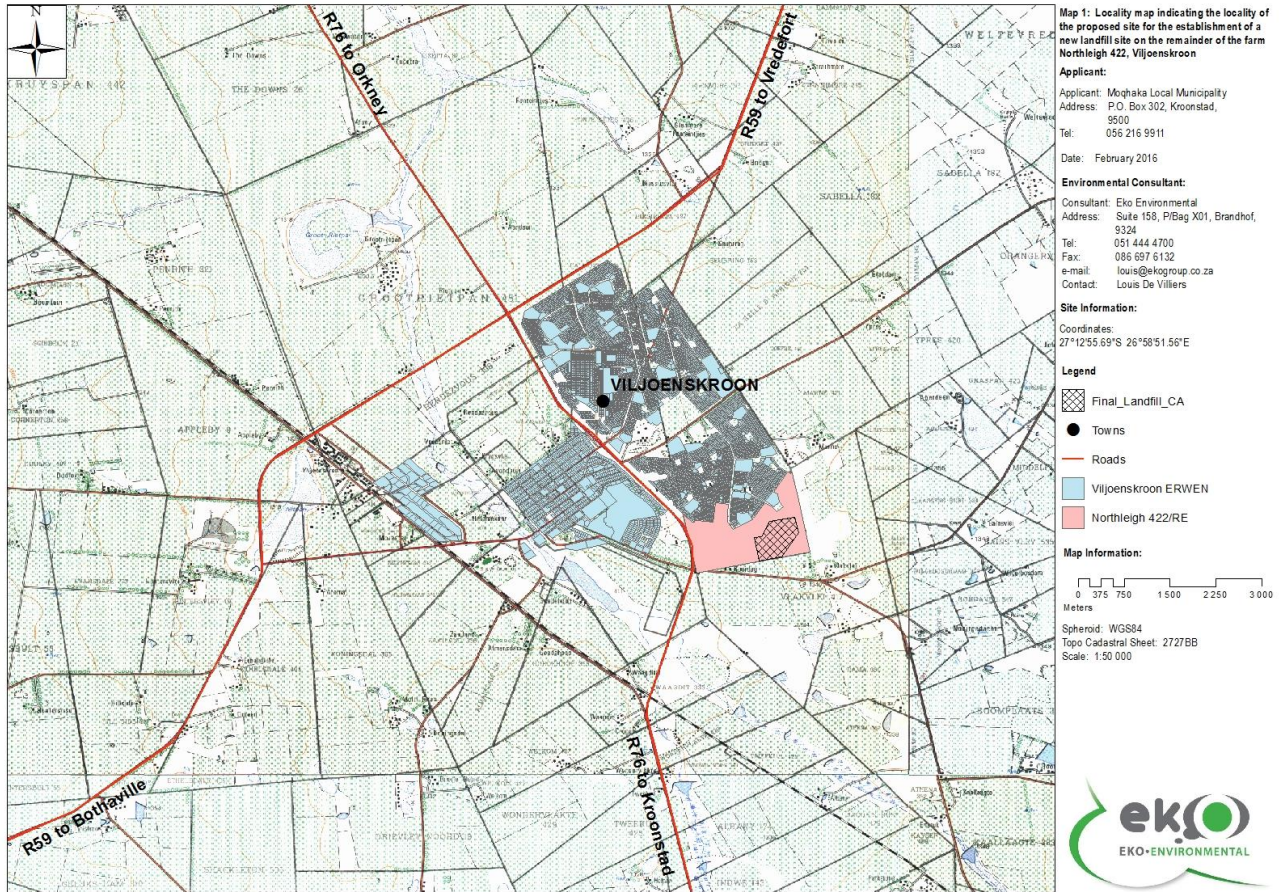
Table 1: Property description

Farm name and number	Farm portion	Area (ha)	Title deed
Northleigh 422	Remainder	400.5973	T6387/2006

Local Municipality: Moqhaka

District Municipality: Fezile Dabi

Figure 1: Regional setting of Northleigh 422/RE



1.4.1 Direction to the nearest towns

Viljoenskroon town is located approximately 2 km to the west of the proposed location of the landfill and Rammulotsi is situated about 1.3 km to the northwest of the proposed site (refer to **Figure 1**). It should be noted that future expansion of Rammulotsi will occur in the direction of the landfill. However, a buffer of 500 m will always be maintained.

1.4.2 Surface infrastructure

The proposed site was previously and is still currently used for agriculture (i.e. crop production and small grazing areas) and there is currently no infrastructure on the site.

1.4.3 Roads

Access to the proposed landfill will be obtained from Krige Street onto an existing road (Refer to Figure 1).

1.4.4 Water

The water table in the area surrounding Viljoenskroon is very shallow. Water will only be utilised for hygiene purposes (i.e. washing of hands and toilet facilities). The water will be obtained from the municipal supply for the town and sewage will also be connected to the town sewage line.

A specialist study undertaken by Mr. D. Van Rensburg indicated that 2 pans were identified which should be excluded from the proposed landfill area. This has been incorporated to minimise any potential impacts on surface water resources.

Appropriate measures will be implemented to reduce the risk of contamination of the water. A hydro census revealed that there are numerous boreholes on neighbouring farms which are used by the neighbouring farmers for various purposes (Refer to the Geo-hydrological report in **Annexure 4**).

1.4.5 Waste and Effluent

Due to the nature of the project, waste will be disposed of at the facility. The site will be used for the disposal of general waste. The volume of waste to be disposed of at the landfill site is between 1 500 - 2 500 m³/month (Refer to Section 6 in this report for further detail). Sewage will be disposed of at the sewage treatment plant of Viljoenskroon.

1.4.6 Presence of servitudes

No servitudes are present on the farm.

1.4.7 Land tenure and use of immediately adjacent land

The Remainder of the farm Northleigh 422 is the property of the Moqhaka Local Municipality. The land is leased by local farmers and is used for agriculture (i.e. grazing and crop production). It was proposed that the town will expand in the direction of the proposed landfill site. However, due to the need for a new landfill site it was decided that the town will no longer expand in this direction, but will rather expand towards the east of the current location of Rammulotsi.

The Free State Department of Agriculture, Forestry and Fisheries (**DAFF**) commented that they do not give consent for the establishment of the proposed landfill site on this land as it is located on high potential agricultural soil. The expanse of the landfill site will thus be lost for agriculture and food production. As indicated in paragraph 1 under Section 1.4.7 the proposed land was earmarked for township development and infrastructure has already been established close to this area before it was decided that the area will rather be used for landfill establishment. Due to the nature of the groundwater and the shallow water table thereof there are no other locations to establish the landfill site. It was suggested by the DAFF that a location be used inside the existing town boundaries. This is not feasible as other guidelines do not permit the establishment of a landfill site within

500 m from residential units. However, the town planner of the Moqhaka Local Municipality is in the process of including the proposed area into the town boundaries.

The farm is bordered by municipal grounds of Rammulotsi township to the north, north west with the town of Viljoenskroon located on land west of the site. The land use of the other immediately adjacent land is mainly residential (i.e. town) and agricultural (i.e. crop growing and livestock farming). The owners of the land adjacent to the farm are listed in indication of the properties:

Table 2 with an indication of the properties:

Table 2: Detail of landowners adjacent to Northleigh 422/RE

Owner	Farm name and number	Farm portion
Mr. Paul Marè	Vlakvlei 417.	RE, 1, 2, 3
	Marne 421	RE
Moqhaka Local Municipality	Viljoenskroon Townlands 11	RE
Moqhaka Local Municipality	Northleigh 422	7

2 DESCRIPTION OF THE EXISTING ENVIRONMENT

2.1 Geology and Soil

The study area is located within the Bd14 land type which has the following characteristics: It is underlain by Ecca sandstone, shale and mudstone with the occasional dolerite sills (ENPAT, 2001). During the geo-hydrological study, it was found that there are no dolerite structures underlying the study area. The proposed site is located on Aeolian sands next to an Andestic lava outcrop (Moolman. D, 2017).

The Viljoenskroon area is characterised by plinthic B horizons and soil forms mostly found in this land type is Avalon, Westleigh and Clovelly (Mucina & Rutherford, 2006 and ENPAT, 2001).

2.2 Climate

2.2.1 Regional climate

This region has an average Mean Annual Precipitation (**MAP**) of approximately 586 mm (Agricultural Research Council, 1955 - 2011), peaking in summer.

2.2.2 Mean monthly and annual rainfall

The mean monthly and annual rainfall: Table 3.

Table 3: Mean monthly rainfall for Viljoenskroon

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Mean monthly rainfall (mm)	99.73	77.75	68.33	55.57	16.74	8.15	4.97	7.92	15.20	64.25	71.41	95.68	585.72

Rainfall data received from the Agricultural Research Council for the years 1955 - 2011 for the Rietpan station.

2.2.3 Mean monthly evaporation

Table 4: Mean monthly evaporation

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Monthly evaporation (mm)	224.19	189.86	173.11	133.6	106.22	84.92	100.48	127.32	198.52	236.53	224.93	224.61	2024.28

Climate data was received from the Agricultural Research Council from a climate station at Rietpan between 1977 - 2003.

2.3 Land use

The land on the farm Northleigh 422/RE is used for agriculture on soil that has a high potential for crop production. However, the proposed site was bought by the Moqhaka Local Municipality and was earmarked for township development. The town planners are in the process of rezoning the portion where the landfill will be established.

The surrounding land is used for agriculture (to the north, east and south) and for residential use towards the northwest and west (i.e. Viljoenskroon and Rammulotsi).

2.4 Natural vegetation

Viljoenskroon is situated in the Vaal-Vet Sandy Grassland biome (Mucina and Rutherford, 2006).

According to Mucina and Rutherford (2006) more than 63% of land in the Vaal-Vet Sandy Grassland Biome is transformed for cultivation. It should be noted that the study area was extensively used for crop production and is therefore disturbed. The area with natural vegetation on the proposed site is minimal.

2.5 Surface water

Viljoenskroon is situated in the upper reaches of the Middle Vaal catchment in quaternary drainage region C70K.

There are two large pans to the west of Viljoenskroon, namely Grootrietpan in the north and Witpan in the south. The pan nearest to the site (i.e. Witpan) is located 6.5 km west of the site.

As described in the Wetland delineation of Mr. D. Van Rensburg there are 2 smaller pans located on the eastern and south eastern boundaries of the site which should not be disturbed. Buffers were made around these pans and excluded from the proposed site in order for them to be protected. There is also a larger pan towards the west of the proposed site. However, it is located far enough (approximately 610 m) from the proposed project not to be disturbed.

2.6 Groundwater

The Viljoenskroon area has a characteristically shallow water table. The wetland area (i.e. Olifants Vlei) that stretches from the southeast to the west of Viljoenskroon is evident of this shallow water table.

The plinthic catena in the Bd14 land type is shallow and is also an indication of the shallow water table.

Water will be used for sanitary and ablution purposes only. This will occur at the offices. Water will be obtained from the current municipal supply, therefore there should not be a significant additional impact on the quantity of groundwater to be used. As indicated by the size of the landfill it is clear that there will not be very deep excavation made for the burying of waste and the site will be lined to prevent contamination of groundwater.

2.7 Air quality and noise

Due to the fact that the Viljoenskroon area has very little major industrial facilities causing high atmospheric emissions, the overall air quality is good.

2.8 Sites of archaeological and cultural interest

The proposed site was previously disturbed by agricultural activities (i.e. crop production). It is therefore not foreseen that there will be any elements of heritage or archaeological value. This specific area is also not known for significant historical events. (Please refer to the archaeological and paleontological report from the specialist in **Annexure 4**).

2.9 Visual exposure / aesthetic impact

The area is generally used for agriculture. However, there is an industrial area to the south of Viljoenskroon. Based on the historic record of the management of the existing landfill, there is a strong assumption from the public that a landfill will have a major negative aesthetic impact on the surrounding environment, irrespective of the location thereof. It should be noted that this is the case with most landfills as they are associated with negative aesthetic impacts due to the nature of the project.

The proposed landfill is located approximately 1km to the east of the R76 (i.e. access from Kroonstad). Although this is far from the road the landfill will still be visible in the distance when travelling on the road. The landfill site will also be visible from the S83 (i.e. Krige street east of R76 crossing) passing to the south of the proposed landfill site. This is a gravel road used by landowners in the area.

The landfill will also be visible from certain parts of Rammulotsi, especially after the expansion of the town in the direction of the landfill. The residence on the farm of Mr. Mare is also located 500 m south east of the proposed landfill site. The site will therefore be visible from his farm.

2.10 Demographics and Regional socio-economic structure

The population of Viljoenskroon (2 094) and Rammulotsi (29 376) combined is 31 470 (based on 2001 - 2011 Statistics South Africa).

The population of Rammulotsi is 29 376 people with 13% of the population not earning an income and 9.4% has no schooling. However, the largest percentage (i.e. 37.9%) of people in Rammulotsi has some secondary education and 20.3% completed high school.

Viljoenskroon has a population of 2 094 people with 8.4% not earning an income with 2.5% of residents without schooling. The highest percentage of people (i.e. 41.3%) in Viljoenskroon has completed high school.

3 PUBLIC PARTICIPATION

Project initiation

A Public Participation process under Government Notice R.594 of 4 December 2014 in terms of NEMA, 1998 is undertaken as part of the Scoping Phase that included the following:

- Placement of site notices on various places which included site notices in public places (i.e. the library and local stores) in Viljoenskroon, the entrance to the proposed site and on the proposed site.
- Placement of an advertisement in the local newspaper (i.e. Kroonnuus) on 6 September 2016.
- A notification and Background Information Document (**BID**) regarding the proposed project was sent to all identified I&APs. This includes the adjacent landowners and relevant authorities.
- The Draft, Final and amended Final Scoping reports were sent to all registered I&AP for their review and comments were logged and addressed from the I&AP regarding the reports.
- The Draft EIA report was also sent to all registered I&AP for them to comment on.
- After the commenting period on the Draft EIA report, all comments were logged and addressed and included in the Final EIA report which was sent to all registered I&AP and submitted to DESTEA for processing

(Refer to **Annexure 3** for Public Consultation Process).

4 MOTIVATION FOR THE PROPOSED PROJECT

There is currently a growing need for improved services within the area and the Moqhaka Local Municipality.

The current landfill site poses a potentially significant threat to groundwater resources due to the relative low regional groundwater levels and the poor management of the site. None or very little covering is done with insufficient measures to manage runoff. No groundwater monitoring is done to determine the potential impact.

The site is also a health and safety risk in that it exists in an unacceptable close proximity to the nearest residential area which includes schools.

Because of the poor management (no covering), waste is almost constantly smouldering and generate thick smoke that is blown over the residential areas located down-wind of the prevailing wind direction (i.e. north-east).

Viljoenskroon and Rammulotsi are therefore in great need of a new well managed waste disposal facility to dispose of general waste in an environmentally sound manner. There is also a great need for more environmentally friendly ways of disposing of waste to landfill. This includes the recovery and recycling of certain items in the everyday waste stream. The current landfill site does not have a recycling and/or sorting station and very little recovery is done. The new landfill site has been designed with a sorting and recycling station where the sorting of waste will occur. This more effective sorting and recycling process will allow for a longer life of the landfill as less waste will be buried.

4.1 Who will benefit from this project

All the residents of Viljoenskroon and Rammulotsi will benefit from the establishment of a new landfill site. A new landfill site will entail the rehabilitation of the old landfill which will lower the impact of the old site on the environment and minimise the aesthetic impact it has on local residents. Furthermore, the rehabilitation of the old site will lower the health risks the existing site currently poses to residents.

However, comments have been received that adjacent landowners and communal farmers will be negatively affected by the landfill site in the following ways:

- Waste will be windblown and will pollute the neighbouring land. The landowner of the farm to the east of the proposed site (i.e. Mr. Mare) has a cattle stud with very expensive bulls. Plastic on his farm may cause death to his cattle resulting in significant financial loss and will also cause a negative aesthetic impact,
- The neighbouring landowner also commented that the landfill site at the proposed site may pollute the groundwater as a result of the low groundwater table,
- Comments were also received with regard to the current land-use of the site: it was indicated that communal farmers make use of the land for grazing for their animals after harvests. There is a concern that there will not be enough communal land left if this land is used for land filling,
- The DAFF also indicated that a very large portion of high potential agricultural land will be lost with the construction of the landfill site which will have negative impacts on the national food supply.
- Other comments received from residents in Rammulotsi were positive towards the establishment of a new landfill site in order to close the existing site as it poses a very large health and safety risk to them and their children.

4.2 An estimate of the expenditure required to undertake the project

It is estimated that the cost to establish the landfill site will amount to approximately R11 million. Thereafter there will be monthly costs to maintain equipment and the payment of salaries for employees at the landfill site.

5 CONSIDERATION OF ALTERNATIVES

An extensive site selection process was followed to locate the preferred site for the proposed landfill site. Five site alternatives were considered and weighed up against each other during the study which included the following:

5.1 Preferred alternative

- Establishment of a landfill site on the remainder of the farm Northleigh 422/RE for the disposal of domestic waste from the town of Viljoenskroon and Rammulotsi. The proposed landfill site will have a lifetime of 20 years and will cover an area of approximately 30 ha. The following aspects were considered:
 - According to data the wind direction in the area is from the north east. This limits the space for the establishment of the landfill site towards the northeast of the town as it may result in nuisance odours being blown from the landfill towards the town.
 - The proposed site is located more than 1 km from the R76 which will limit the negative aesthetic impact on passing motorists. Furthermore, there will not be a negative aesthetic impact from residents of Viljoenskroon if the site is managed appropriately.
 - The areas surrounding the town of Viljoenskroon have a very shallow water table which poses a high risk for the contamination of ground water. The water table on the largest area of the proposed site is deeper than on other areas around Viljoenskroon.
 - The proposed site is located on land owned by the applicant (i.e. Moqhaka Local Municipality) which lowers the cost of purchasing land to establish a landfill site.
 - The distance from the town to the landfill is short enough to not pose a major economic loss for the applicant.

The following alternatives in terms of site selection, technology and design alternatives were considered during the study:

5.2 Site alternatives:

5.2.1 Alternative 1:

Site Coordinates:

<u>Farm</u>	<u>Coordinates</u>	
<u>Penrith 321/2</u>	27.194083° S	26.906961° E

Site C is located on the farm Penrith 321/2 to the west of Viljoenskroon. Portion 2 of the farm Penrith is 168.786143 ha in size and is privately owned and will have to be purchased by the applicant if this site is decided on to be used for the landfill. This farm is bordered in the east and north east by the farm Grootrietpan 45 and Penrith 321/RE to the north. The southern, south eastern side of this site is bordered by the farm Appleby 579.

Positive attributes of the site for landfill establishment:

- The dominant wind direction for the area is a north-eastern wind. As the site is located to the west of the town and taking into consideration current and future development, any smoke and / or gasses related to the landfill site will generally be blown away from the residential areas and the CBD of the town but may impact on neighbouring farmsteads which is located on the downwind side of the predominant wind direction.
- The site is located approximately 2km west of the wetland (i.e. Olifantsvlei) and will thus not have a major impact on the wetland. Witpan is situated approximately 1km south of the site.
- The site is located at the intersection of the R59 from Bothaville and the S632. It may thus have a negative aesthetic impact on passing motorists. However, the view to the site is obstructed by the bridge over the S632.

Negative attributes of the site for landfill establishment:

- The land is privately owned and will have to be purchased by the municipality if it proof to be the most appropriate site to establish the new landfill. It will thus increase the cost of establishing the landfill on this site drastically.
- The land use or zoning of this property is high potential agriculture and is currently used for crop production. So is the adjacent land. High potential agricultural soil will be lost if this proposed site is decided on.
- Access to the site can be gained from S632. However, a railway line running parallel to the S632 will have to be crossed to enter the site. Thus, a bridge will have to be constructed over the railway to enter the site. Entrance can also be gained from the R59. However, constructing an access road from the R59 will pose a safety risk for

motorists as the bridge over the S632 will impede the view and the access road to the site and motorists using it may not be noticed.





A photograph taken from the railroad towards the site.



An indication of the bridge over the railway and Krige Street.

5.2.2 Alternative 2:

Site Coordinates:

<u>Farm</u>	<u>Coordinates</u>	
<u>Koningsdal 395/2</u>	27.220251° S	26.913961° E

Site D is located on the farm Koningsdal 395/2 to the south west of Viljoenskroon. The proposed portion of this farm has an area of 170.6295ha and is privately owned. The farm is bordered in the east by Koningsdal 395/3, the north Koningsdal 395/1 and the south Koningsdal 395/RE. To the west of the site lies the farm Ethelsdale 405/RE. Witpan is situated about 530m North, North East of the site.

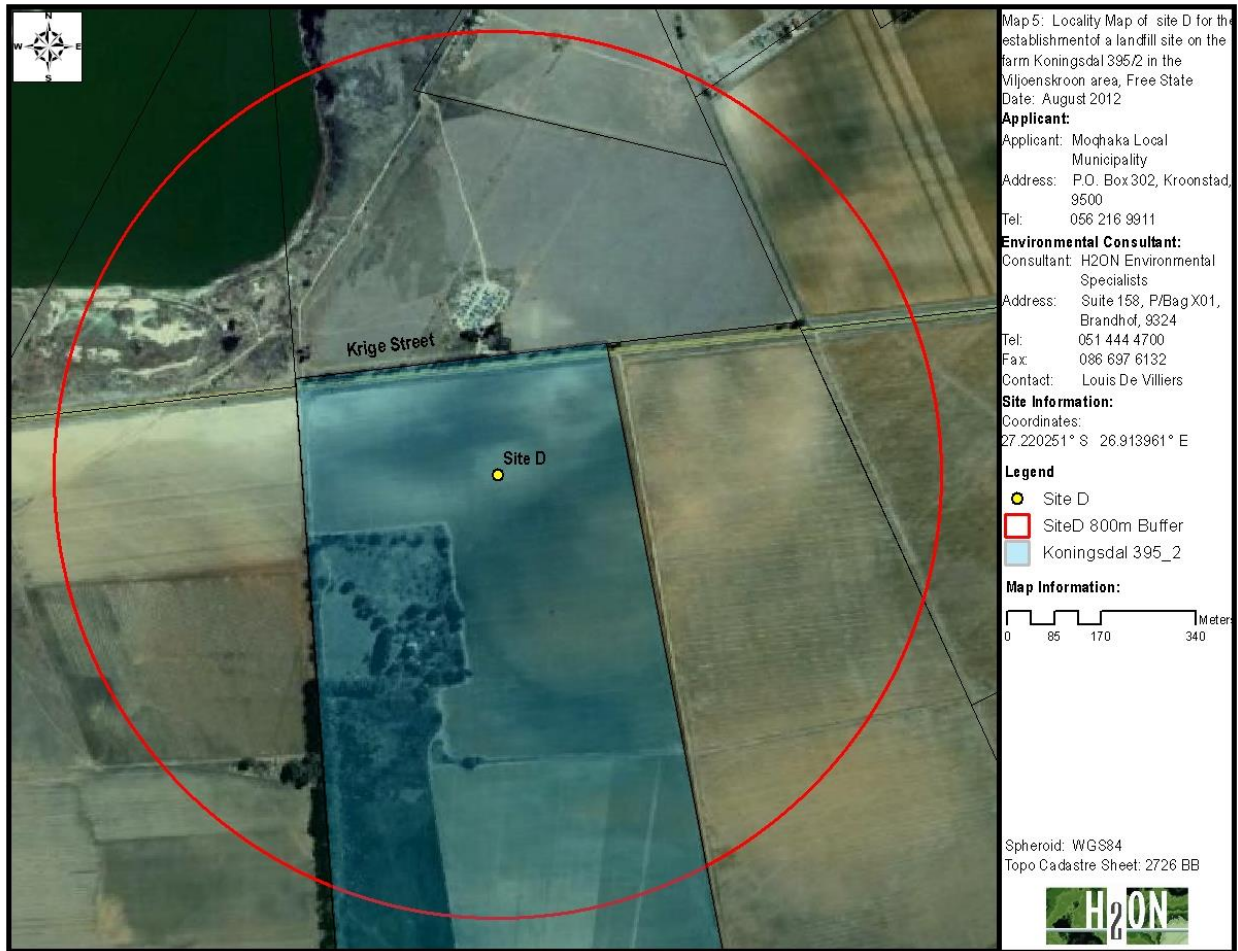
Positive attributes of the site for landfill establishment:

- The landfill site will be accessible from Reitz Street and will potentially be visible from the road as one enters the town from Bothaville and may have a negative aesthetic impact. However, depending on the location of the site a tree line may be utilized to partially conceal the landfill site.
- The site is located approximately 2.3km west of the wetland (i.e. Olifantsvlei) and will thus not have a major impact on the wetland. Witpan is situated approximately 530m to the north of the proposed site. Reitz Street will act as a buffer for any storm water from the landfill to enter it.
- There are no neighbouring houses located within 800m of the site.

- The dominant wind direction for the area is a north-easterly wind. As the site is located to the south west of the town and taking into consideration current and future development, any smoke and / or gasses related with the landfill site will generally be blown away from the residential areas and the CBD of the town.

Negative attributes of the site for landfill establishment:

- The property is privately owned by (to be confirmed) and will have to be purchased from the landowner in order to establish the landfill on this property. This will increase the cost and prolong the process of establishing a landfill site.
- The current land-use or zoning of the land is high potential agriculture and the land is currently used for crop production. If a landfill site is established on this proposed site, high potential agricultural soil will be lost.





A view from north of the site (Reitz Street) taken towards the site.



A view of the trees that may conceal the landfill site.

5.2.3 Alternative 3:

Site Coordinates:

<u>Farm</u>	<u>Coordinates</u>	
<u>Rammulotsi 590</u>	27.197997° S	26.973453° E

This site is located on the farm Rammulotsi 590 to the east of Viljoenskroon. The portion of this farm has an area of 137.81996 ha and is owned by the municipality. The farm is bordered by Rammulotsi neighbourhood to the north, north-west and Viljoenskroon to the west. Northleigh 422 is to the south of the site and Marne 421 to the east. The existing landfill site in Rammulotsi is situated approximately 850m from this proposed site.

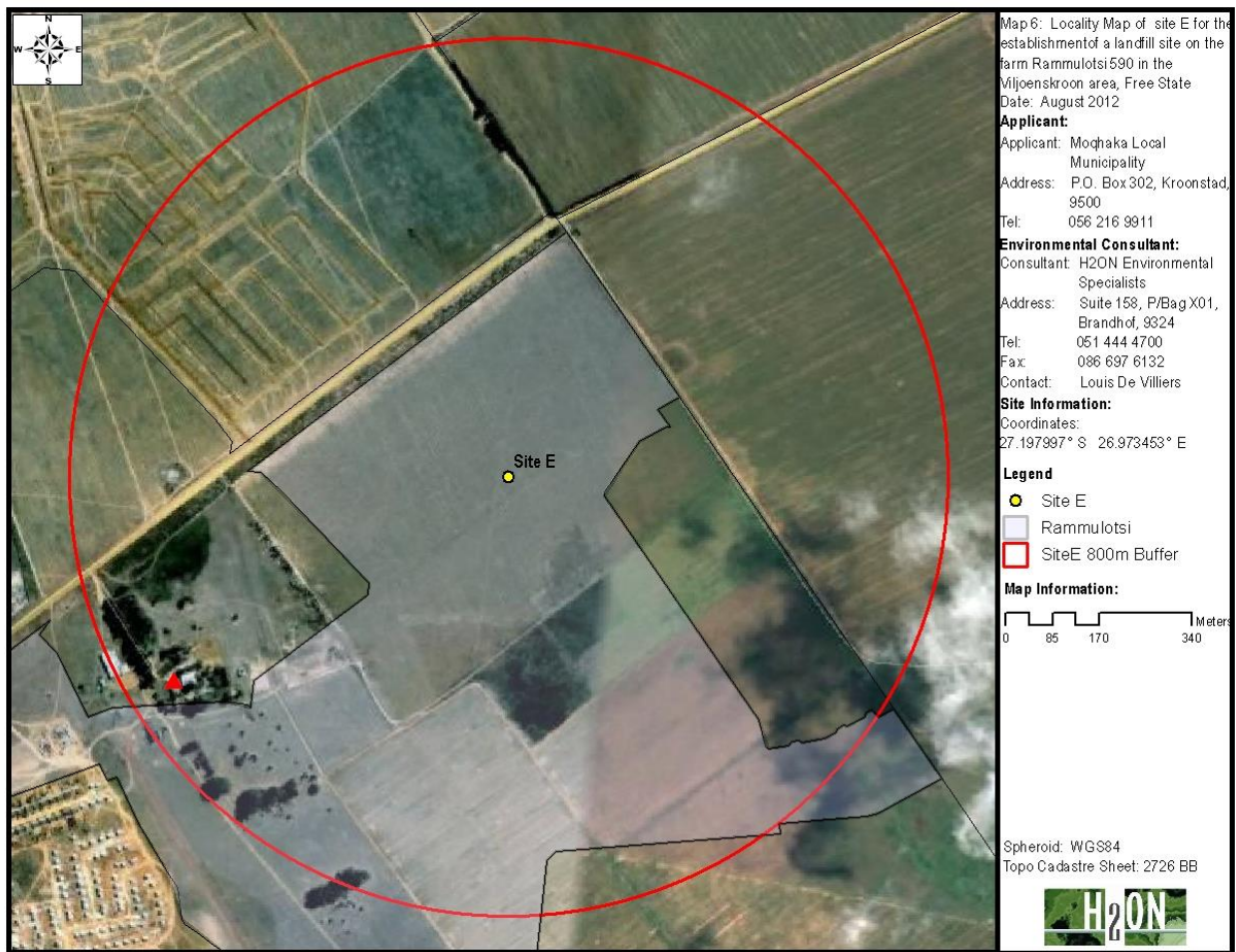
Positive attributes of the site for landfill establishment:

- The site is owned by Moqhaka Local Municipality and the land use or zoning of the land is high potential agriculture. However, the municipality will use the land for future town expansion or development. High potential agricultural soil will be lost when the land is used for town expansion and the establishment of a landfill site. Cost and time will be saved if it is decided that this proposed site will be used for the establishment of a landfill site as the applicant is the landowner.
- Entrance to the site will be gained from the S1230 in Rammulotsi. The proposed alternative site is not situated near town entrances and will thus not have a negative aesthetic impact on passing motorists.

- The site is located more than 3km north of the wetland (i.e. Olifantsvlei) and will thus not have a major impact on the wetland.
- There are neighbouring houses located approximately 650m from the site and the site is reserved for future town expansion.

Negative attributes of the site for landfill establishment:

- The prevailing wind direction for the area is a north-easterly wind. As the site is located to the east of the town and taking into consideration current and future development, any smoke and / or gasses related with the landfill site will be blown towards the newly planned residential areas.



5.2.4 Alternative 4:

Site Coordinates:

<u>Farm</u>	<u>Coordinates</u>
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<u>Appleby 579/0</u>	27.200290°S	26.904825°E
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Site F is located on the farm Appleby 579/0 to the west of Viljoenskroon. The farm Appleby is 466.9769ha in size and is privately owned and will have to be purchased by the applicant if this site is decided upon to be used for the landfill. This farm is bordered in the east by the farm Panbit 578, north by the farm Penrith 321/2. The southern, south eastern side of this site is bordered by the farm Huntersvlei 401.

Positive attributes of the site for landfill establishment:

- The site is located approximately 2.2km west of the wetland (i.e. Olifantsvlei) and will thus not have a major impact on the wetland. Witpan is situated approximately 550m south of the site.
- The dominant wind direction for the area is a north-easterly wind. As the site is located to the west of the town and taking into consideration current and future development, any smoke and / or gasses related with the landfill site will generally be blown away from the residential areas and the CBD of the town.

Negative attributes of the site for landfill establishment:

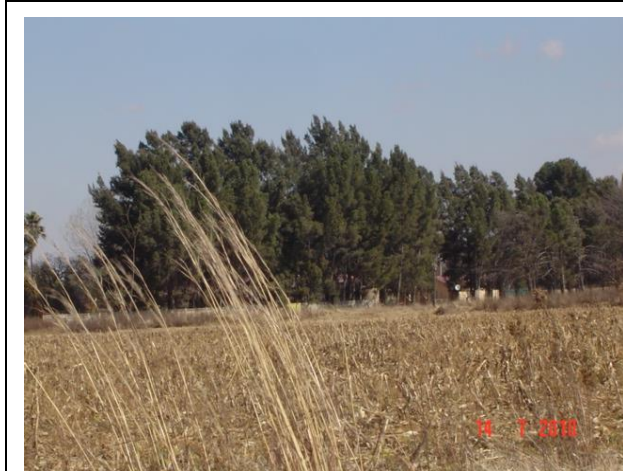
- The land is privately owned and will have to be purchased by the municipality to establish the landfill on this site. It will thus increase the cost of establishing the landfill on this site drastically.
- The land use or zoning of this property is high potential agriculture and is currently used for crop production. High potential agricultural soil will be lost if this proposed site is decided on.
- Access to the site can be gained from S632 and the R59. However, constructing an access road from the R59 will pose a safety risk for motorists as the bridge over the S632 will impede the view and the access road to the site and motorists using it may not be noticed.
- The site is located at the intersection of the R59 from Bothaville and the S632. It may thus have a negative impact on passing motorists.
- There are some neighbouring houses located in close proximity to the site which may pose to be problematic for the establishment of a landfill site on this property.



A view of the site taken from the north of the site at the railroad.



A view of the house in close proximity to the site.



Houses on the farm Appleby 579/0.



A photograph taken towards the west of the site.

Note:

A negative factor at all sites is that the water table of the area surrounding Viljoenskroon is very shallow and will thus have a very thin unsaturated zone between the landfill base and the saturated subsoil. A landfill site on any land surrounding Viljoenskroon will have to be managed appropriately.

5.3 Technological alternatives

5.3.1 Pyrolysis of plastic waste

The pyrolysis of waste includes the establishment of a pyrolysis plant which can thermo-chemically decompose organic and inorganic material to produce pyro-oil, pyro-gas and carbon which can be used or sold as an end product. The pyrolysis plant and its associated infrastructure will have to be established on the farm Northleigh 422/RE, or relocated to a larger landfill (i.e. Kroonstad).

Positive attributes of the site for landfill establishment:

- The pyrolysis plant will prolong the lifetime of the landfill,
- A smaller area will be required to establish a landfill,
- The plant will create more job opportunities of which numerous will be specialised. This will result in skills development in the local community,
- An income will be generated from waste collected.

Negative attributes of the site for landfill establishment:

- An area will still be transformed for the sorting of other waste (excluding plastic) and the burial (i.e. land filling) of some waste streams,
- Should the plant be established in another town, a transfer station will have to be established in Viljoenskroon. The Department of Small Business Economic Development, Tourism and Environmental Affairs (**DESTEA**) indicated that they will not consider a transfer station due to the high level of management that is required to operate such a site,
- A Public - Private Partnership will have to be established between the applicant and other shareholders to establish and manage all aspects of the plant,
- An atmospheric emissions license, among other, will need to be applied for before the plant can go into operation,
- The establishment and commencement with the pyrolysis plant will extend the timeframe of the establishment of a new landfill site which is a very urgent matter,
- The cost of purchasing, operating and maintaining the plant is very high.

5.4 Establishment of a transfer station

The establishment of a transfer station was considered as an alternative whereby waste from Viljoenskroon and Rammulotsi will be stored at a dedicated area in Viljoenskroon and transported to the Kroonstad landfill site on a weekly basis.

However, the Department of Economic Small Business Development, Tourism and Environmental Affairs (**DESTEA**) indicated that they will not consider this alternative due to the lack of management of the landfill sites within the Moqhaka Local Municipality. This alternative will not be assessed any further in this report due to this.

5.5 No-go alternative

If the no-go alternative is decided on, a new landfill will not be established and the current landfill will be used as presently. However, this will have a large negative impact on the health of the public and the environment. Refer to **Sections 1.1 and 1.3** in this report.

6 DETAILED DESCRIPTION OF THE PROJECT

Due to the state of the existing landfill site in Viljoenskroon, the municipality regards the establishment of a new landfill of very high priority.

The proposed landfill will be established over an area of approximately 30 ha and will have the following facilities available:

- 10 m X 4 m weighbridge,
- Recycling facility,
- 3 X 3 m x 4 m Drop-off zones, and
- An office with a guard house.

The establishment of the new proposed landfill will benefit society and especially the local residents in the following manner:

- The actual land-filling and/or building area will be located more than 500 m from any residence,
- It will have a recycling facility which will create jobs for local residents,
- The recycling facility will ensure that the lifetime of the landfill is prolonged and it will provide an income,
- A new landfill with proper management will result in a cleaner environment, and
- The establishment of the new landfill will create an opportunity for the municipality to close and rehabilitate the existing landfill site which poses a significant safety risk.

6.1 Landfill Classification:

Type of waste:

G: General Waste

Landfill size:

According to the Department of Water and Sanitation (**DWS**) "Minimum Requirements for Waste Disposal by Landfill", the classification of a landfill in terms of its size is according to its Maximum Rate of Deposition (**MRD**).

This is illustrated in the table below:

Landfill size classes:

Landfill sizes	Maximum Rate of Deposition (Tons per day)
Communal (C)	<25
Small (S)	>25 <150

Medium (M)	>150 <500
Large (L)	>500

The mass of general waste disposed of by one person with medium to low income is 0.5 kg/day while mass of waste generated by medium to high income person is 3.5 kg/day as indicated by the DWS (1998).

The population of Viljoenskroon (2094) and Rammulotsi (29376) combined is 31 470 (based on 2001 - 2011 Statistics South Africa). This data indicates an average growth rate of 1.48% per annum from 2001 and 2011. Data for population figures for Viljoenskroon and Rammulotsi between 2001 and 2011 are summarised in the table below:

Year	Viljoenskroon	Rammulotsi	Total
2001	2360	24 465	26 825
2011	2094	29 376	31 470
2001 – 2011 Growth rate %	-1.270	1.672	1.48

To ensure reliability and thoroughness for the landfill classification process the Initial Rate of Deposition (**IRD**) and MRD calculations will be done using a separate data set for each area that will be dependent on the new landfill. Thus the IRD's and MRD's for Viljoenskroon and Rammulotsi will be calculated separately and combined in order to ensure accurate calculations for this scoping report.

The existing waste stream was estimated by Moqhaka Local Municipality to be approximately 1500 – 2500m³ /month. If the waste has a mass of 0.6 tonnes/m³, the amount of waste would be roughly 14 400 tonnes per year. The existing waste stream IRD is approximately 39.4 tonnes/day.

Based on the population figures and an estimate of 0.5 kg waste disposed of per day per person in poor areas (the Rammulotsi population was used) and 3.5 kg waste disposed of per day per person in affluent areas (Viljoenskroon population was used), an estimate of 22.02 ton/day (14.6 ton/day for medium to low income) and (7.3 ton/day for affluent areas) was calculated which amounts to roughly 5724.42 ton/year (based on 260 day year). Based on this, the IRD is estimated at 22 tonnes/day refer to table below:

Area	Population	ton/day	ton/year (260 day)	Total ton/year	IRD ton/day
Viljoenskroon as affluent area (3.5kg per day)	2094	7.329	1905.54	5724.42	22.017
Rammulotsi as poor area (0.5kg per day)	29376	14.688	3818.88		

The design life of the proposed site is planned to be 20 years.

The MRD can be calculated by the following formula:

$MRD = IRD (1+d)^t$ where d is the expected population growth, and t is the design life. The MRD for the proposed landfill is 26.14 tonnes/day. The landfill size will thus be small (S) as the MRD will be between 25 - 150 tonnes/day.

Area	IRD	d (expected population growth %)	d (expected population growth %) per annum	MRD = $IRD(1+d)^t$	Total MRD
Viljoenskroon	7,33	-12,70%	-1,27%	5,68	26,14
Rammulotsi	14,69	16,7%	1,67%	20,46	

The estimated depth of excavatable cover in Viljoenskroon will be limited to between 0.5 m and a maximum of 1m due to the depth of the water table below natural ground level. This may change after completion of the Geo-hydrological studies in the EIA phase of the project. Based on this, the area required for the landfill will vary between 19.6 ha and 39.5 ha. This area has been identified to accommodate for any future expansion of the town population. This will prevent the landfill from expanding to within 500 m from any residence in the future. Please note that the initial proposed area was 34 ha. After the report by Mr. D. Van Rensburg the area was reduced to approximately 30 ha to exclude the pans to the east and south east from the proposed area to prevent any impacts on them.

Significance to generate leachate: (B- or B+)

To determine the classification of the sites in Viljoenskroon and to determine if leachate management would have to be implemented at the sites, the climatic water balance was calculated from data acquired from the Agricultural

Resource Council (**ARC**). The data from the 10 wettest years was used to determine the climatic water balance using the formula $B_{\text{(climatic water balance)}} = R_{\text{(Rainfall)}} - E_{\text{(Evaporation)}}$. The following is the calculations of the climatic water balance:

Number	Year	Rainfall (R)	Evaporation (E) X 0.7	Total (R – E)
Wettest year	1987 – 1988	839	730.8	+ 107.92
2 nd wettest year	2000 – 2001	542.1	895.65	-353.55
3 rd wettest year	1995 – 1996	755.9	947.94	-192.04
4 th wettest year	1999 – 2000	607.8	816.76	-208.96
5 th wettest year	1988 – 1989	641.7	730.24	-88.54
6 th wettest year	1992 – 1993	422.4	687.68	-265.28
7 th wettest year	1980 – 1981	630.2	826.98	-196.78
8 th wettest year	1998 – 1999	542.7	909.79	-367.09
9 th wettest year	1982 – 1983	210.4	992.32	-781.92
10 th wettest year	2001 – 2002	537.9	660.59	-122.69

The rainfall and evaporation was determined by using the wettest 6 months in each of the years (e.g. Nov – Apr or May – Oct) (Please refer to **Annexure 5** for the rainfall data).

The calculations indicate that the sites identified for the establishment of a landfill site in Viljoenskroon will not require leachate management as it is classified as a **B-**. However, due to the shallow water table in the Viljoenskroon area and the potential risk of ground water contamination that will be assessed in the EIA phase, it might become necessary that, the landfill will be lined to prevent the contamination of groundwater.

The final classification of the proposed site: **GMB-**

7 ENVIRONMENTAL IMPACT ASSESSMENT

7.1 Assessment Methodology

The environmental significance assessment methodology is based on the following determination:

Environmental Significance = Overall Consequence x Overall Likelihood

7.1.1 Determination of Consequence

Consequence analysis is a mixture of quantitative and qualitative information and the outcome can be positive or negative. Several factors can be used to determine consequence. For the purpose of determining the environmental significance in terms of consequence, the following factors were chosen: **Severity/Intensity, Duration and Extent/Spatial Scale**. Each factor is assigned a rating of 1 to 5, as described below.

7.1.2 Determination of Severity

Severity relates to the nature of the event, aspect or impact to the environment and describes how severe the aspects impact on the biophysical and socio-economic environment.

Table 5: Rating of severity

Type of criteria	Rating				
	1	2	3	4	5
Quantitative	0-20%	21-40%	41-60%	61-80%	81-100%
Qualitative	Insignificant / Non-harmful	Small Potentially harmful /	Significant / Harmful	Great / Very harmful	Disastrous Extremely harmful
Social/ Community response	Acceptable / I&AP satisfied	Slightly tolerable / Possible objections	Intolerable/ Sporadic complaints	Unacceptable / Widespread complaints	Totally unacceptable / Possible legal action
Irreversibility	Very low cost to mitigate/ High potential to mitigate impacts to level of insignificance / Easily reversible	Low cost to mitigate	Substantial cost to mitigate / Potential to mitigate impacts / Potential to reverse impact	High cost to mitigate	Prohibitive cost to mitigate / Little or no mechanism to mitigate impact Irreversible

Type of criteria	Rating				
	1	2	3	4	5
Biophysical (Air quality, water quantity and quality, waste production, fauna and flora)	Insignificant change / deterioration or disturbance	Moderate change / deterioration or disturbance	Significant change / deterioration or disturbance	Very significant change / deterioration or disturbance	Disastrous change / deterioration or disturbance

7.1.3 Determination of Duration

Duration refers to the amount of time that the environment will be affected by the event, risk or impact, if no intervention e.g. remedial action takes place.

Table 6: Rating of Duration

Rating	Description
1: Low	One month
2: Low-Medium	Between 1 and 3 months (Quarter)
3: Medium	3 months to 1 year
4: Medium-High	1 to 10 years
5: High	More than 10 years

7.1.4 Determination of Extent/Spatial Scale

Extent refer to the spatial influence of an impact be local (extending only as far as the activity, or will be limited to the site and its immediate surroundings), regional (will have an impact on the region), national (will have an impact on a national scale) or international (impact across international borders).

Table 19: Example of calculating overall consequence

Rating	Description
1: Low	Immediate, fully contained area
2: Low-Medium	Surrounding area
3: Medium	Within Unit area of responsibility
4: Medium-High	Within farm area
5: High	Regional, National, International

7.1.5 Determination of Overall Consequence

Overall consequence is determined by adding the factors determined above and summarised below, and then dividing the sum by 4.

Table 7: Example of calculating overall consequence

Consequence	Rating
Severity	Example 4
Duration	Example 2
Extent	Example 4
SUBTOTAL	10
TOTAL CONSEQUENCE:(Subtotal divided by 3)	3.3

7.1.6 Likelihood

The determination of likelihood is a combination of Frequency and Probability. Each factor is assigned a rating of 1 to 5, as described below and in Table 8 and Table 9

7.1.7 Determination of Frequency

Frequency refers to how often the specific activity, related to the event, aspect or impact, is undertaken.

Table 8: Rating of frequency

Rating	Description
1: Low	Once a year or once/more during operation/LOM
2: Low-Medium	Once/more in 6 Months
3: Medium	Once/more a Month
4: Medium-High	Once/more a Week
5: High	Daily

7.1.8 Determination of Probability

Probability refers to how often the activity/event or aspect has an impact on the environment.

Table 9: Rating of probability

Rating	Description
1: Low	Almost never / almost impossible

2: Low-Medium	Very seldom / highly unlikely
3: Medium	Infrequent / unlikely / seldom
4: Medium-High	Often / regularly / likely / possible
5: High	Daily / highly likely / definitely

7.1.9 Overall Likelihood

Overall likelihood is calculated by adding the factors determined above and summarised below, and then dividing the sum by 2.

Table 10: Example of calculating the overall likelihood

Consequence	Rating
Frequency	Example 4
Probability	Example 2
SUBTOTAL	6
TOTAL LIKELIHOOD (Subtotal divided by 2)	3

7.1.10 Determination of Overall Environmental Significance

The multiplication of overall consequence with overall likelihood will provide the environmental significance, which is a number that will then fall into a range of LOW, LOW-MEDIUM, MEDIUM, MEDIUM, MEDIUM-HIGH or HIGH, as shown in the table below.

Table 11: Determination of overall environmental significance

Significance or Risk	Low	Low-Medium	Medium	Medium-High	High
Overall Consequence					
X	1 - 4.9	5 - 9.9	10 - 14.9	15 – 19.9	20 - 25
Overall Likelihood					

7.1.11 Qualitative description or magnitude of Environmental Significance

This description is qualitative and is an indication of the nature or magnitude of the Environmental Significance. It also guides the prioritisations and decision making process associated with this event, aspect or impact.

Table 12: Description of the environmental significance and the related action required.

Significance	Low	Low-Medium	Medium	Medium-High	High
Impact Magnitude	Impact is of very low order and therefore likely to have very little real effect.	Impact is of low order and therefore likely to have little real effect. Acceptable.	Impact is real, and potentially substantial in relation to other impacts. Can pose a risk to company	Impact is real and substantial in relation to other impacts. Pose a risk to the company. Unacceptable	Impact is of the highest order possible. Unacceptable. Fatal flaw.
Action Required	Maintain current management measures. Where possible improve.	Maintain current management measures. Implement monitoring and evaluate to determine potential increase in risk. Where possible improve	Implement monitoring. Investigate mitigation measures and improve management measures to reduce risk, where possible.	Improve management measures to reduce risk.	Implement significant mitigation measures or implement alternatives.

7.2 Environmental Impact assessment:

7.2.1 Geology and soil

Viljoenskroon and the immediate surrounding area is located in the Bd14 land type: The study area is underlain by the Ecca sandstone, mudstone and shale, with occasional dolerite sills. Aeolian sand overlies nearly all rocks. The Viljoenskroon area is characterised by plinthic B horizons and soil forms mostly found in this land type is Avalon, Westleigh and Clovelly (Mucina & Rutherford, 2006 and DEA, 2001).

In a geophysical survey done by GHT Consulting Scientists on the landfill and surrounding areas, through the assessment of a set of four magnetic traverse lines, no predominant anomalies were found (Refer to **Annexure 4**). The regional area surrounding the landfill consists predominantly of Aeolian sands with Andestic lava outcropping random areas. The proposed landfill site (according to the regional geology map Figure 9) will be located on Aeolian sands next to (and slightly overlapping) an outcrop of Andestic lava which makes it a suitable location for the landfill.

Alternative	Severity	Duration	Extent	Consequence	Probability	Frequency	Likelihood	Significance
Preferred Alternative (Northleigh 422)	4	4	2	3.33	3	5	4	13.33
MITIGATED	1	2	1	1.33	2	5	3.5	4.7
Alternative 1 (Penrith)	4	4	2	3.33	3	5	4	13.33
MITIGATED	2	2	1	1.67	2	5	3.5	5.83
Alternative 2 (Koningsdal)	4	4	2	3.33	3	5	4	13.33
MITIGATED	2	2	1	1.67	2	5	3.5	5.83
Alternative 3 (Rammulotsi 590)	4	4	2	3.33	3	5	4	13.33
MITIGATED	2	2	1	1.67	2	5	3.5	5.83
Alternative 4 (Appleby)	4	4	2	3.33	3	5	4	13.33
MITIGATED	2	2	1	1.67	2	5	3.5	5.83
Alternative 5 (Pyrolysis)	3	4	2	3	3	5	4	12

MITIGATED	2	2	1	1.67	2	5	4	5.83
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Possible impacts on geology and soil:

It is not anticipated that the establishment of the landfill will have any impact on the geology in the area.

Soil may be contaminated due to mismanagement of waste which can occur as a result of incorrect disposal methods on the landfill site.

The sandy characteristic of the top layer of the soil forms that are present gives them a high water infiltration rate. It is therefore necessary to ensure that the landfill is used for general waste only to prohibit any contamination of surface and sub-surface groundwater. The impact that the landfill and everyday waste will have on the geology and soil before mitigation, will be low-medium. The cumulative impacts on the soil and geology will be low if the landfill is managed according to best practices.

Proposed Mitigation:

- There might also be a loss of topsoil as a result of the removal thereof. Topsoil must be removed before land filling or construction of any facilities and/or buildings.
- Topsoil will then be used during the rehabilitation of the landfill site.

Alternatives: It was proposed that a transfer station be established and the waste transported to other facilities (i.e. Kroonstad) in the area for disposal. However, DESTEA indicated that they will not consider this alternative as it requires very intensive management.

Another alternative as proposed by Mr. Marè (Vlakovlei Boerdery) was to establish a Pyrolysis Plant which can recycle plastic. The facility can also be developed and managed to recycle other items such as steel (i.e. cans), organic waste, paper, etc. However, a Public-Private Partnership must be established between the municipality and the public. Such a plant will also require land on which to operate and soil might also be lost and/or contaminated by hazardous substances. Furthermore, there will be a portion of waste which will not be recycled and which will have to be disposed of on a conventional landfill site. Although the significance of the impacts, especially on the soil has a lower rating it is also Medium before mitigation. The significance of the impacts after mitigation is also Low-Medium. It should be noted that the pyrolysis plant operation will entail many additional activities which may impact on the soil such as the production, storage, handling and transportation of petrochemical substances on the site. This may lead to spillages which will contaminate the soil. The Pyrolysis Plant may also result in loss of topsoil as it needs to be cleared before construction commences.

It should be noted that even if the significance ratings are lower for the transfer station and the Pyrolysis Plant, the management of these facilities to prevent impacts from occurring will be much higher than with a landfill site as they are much more technical.

7.2.2 Climate

None of the alternatives will have a direct impact on the climate of the area.

7.2.3 Land use

The land on the farm Northleigh 422/RE is currently being used for agriculture on soil that has a high potential for crop production. Should the landfill site be authorised the land will be lost for the use of agriculture. There will be a change of land use with the establishment of the landfill site. It should be noted that the proposed site was bought by the Moqhaka Local Municipality for town expansion. The DAFF indicated that they will not give consent for the establishment of the landfill due to the loss of the high potential agricultural land.

It should also be noted that the land is used for grazing of cattle of the communal farmers in the area after crops have been harvested. A large area of the grazing land of these farmers will be lost with the establishment of the landfill. There will be a definite loss of a maximum of 30 ha of agricultural land with the establishment of the landfill site. With the efficient management of recycling and land filling, the area can be smaller.

Alternative	Severity	Duration	Extent	Consequence	Probability	Frequency	Likelihood	Significance
Preferred Alternative (Northleigh 422)	2	5	2	3	3	5	4	12
MITIGATED	1	4	1	2	2	4	3	6
Alternative 1 (Penrith)	3	5	2	3.33	4	5	4.5	14.99
MITIGATED	2	4	1	2.33	3	4	3.5	8.16
Alternative 2 (Koningsdal)	4	4	2	3.33	3	5	4	13.33
MITIGATED	3	3	1	2.33	2	4	3	7
Alternative 3 (Rammulotsi 590)	4	4	2	3.33	3	5	4	13.33

MITIGATED	3	2	1	2	2	5	3.5	7
Alternative 4 (Appleby)	4	4	2	3.33	3	5	4	13.33
MITIGATED	3	2	1	2	2	5	3.5	7
Alternative 5 (Pyrolysis)	3	4	2	3	3	5	4	12
MITIGATED	2	2	1	1.67	2	5	4	6.67

Possible impacts on land use:

It can be anticipated that the establishment of the landfill will have an impact on the current land use of the area. The establishment of the landfill will lead to a loss of agriculture soil which can reduce the total value of the area. A loss of high potential agricultural land will result in less food being produced.

The impact that the landfill and everyday waste will have on the land use before mitigation is medium. The cumulative impacts on the land use will be low-medium if the landfill is managed according to best practices.

According to the report on the wetland delineation of the proposed new landfill site, by D van Rensburg (**Annexure 4**) there are two small pans located in the area of the new landfill location. It can be anticipated that these pans will reduce the agricultural value of the area. However, they have been excluded from the landfill site and the size of the site reduced from 34ha to approximately 30ha.

Alternative:

An alternative will be to establish the landfill site at an alternative location outside Viljoenskroon. However, it should be considered that the entire area surrounding Viljoenskroon is high potential agricultural land. The impact on agricultural land will therefore not be minimised.

Another alternative is to move the landfill site into an area inside the town boundary. There are no areas inside town where the landfill can be established further than 500m from any residential units.

Pyrolysis of plastics is also an alternative to landfilling. It should be noted that by implementing this alternative the land use will also be changed to industrial and high potential agricultural land will also be lost due to the construction of the facilities. Furthermore, there will be certain waste streams that cannot be recycled at the plant which will have to be disposed of at the landfill site.

Proposed mitigation:

- Another area will have to be identified by the municipality for provision of grazing land to communal farmers.
- Management and efficiency of on-site sorting and recycling must be of high priority in order to ensure that the landfill life is extended.

7.2.4 Plant and Animal life

Viljoenskroon is situated in the Vaal-Vet Sandy Grassland biome (Mucina and Rutherford, 2206).

According to Mucina and Rutherford (2006) more than 63% of land in the Vaal-Vet Sandy Grassland Biome is transformed for cultivation and this vegetation type is regarded as endangered. Although the majority of the proposed landfill site will be established on land where the indigenous vegetation has been removed for crop production there is still some very small areas comprising of the indigenous vegetation. These areas amount to approximately 2 ha.

The impact of the landfill means that approximately 2 ha of indigenous vegetation will be removed from the site as the other parts have been disturbed by tilling and crop production. The establishment of a landfill site will minimise available land for vegetation growth and may disturb habitats for certain species. Regardless of the findings, the proposed site has previously been disturbed by agricultural activities which mean that the biodiversity has been disturbed and minimized.

According to the report on the wetland delineation of the proposed new landfill site, by D van Rensburg (**Annexure 4**), the site does not contain any protected, rare or endangered species. It was also determined

that because of the transformed nature of the area it is considered highly unlikely that any endangered species will occur in the area. Due to agriculture i.e. ploughing, the site has been degraded and a decrease in the overall habitat has occurred. Because of the previous land disturbance, and the previous land use, the animal life has declined. Therefore, there will be no or very little potential impact on animal life.

If the landfill is maintained and if good housekeeping takes place, the overall impact of the landfill site on plant and animal life can be kept at a low. The overall impact after mitigation was calculated as low-medium.

Alternative	Severity	Duration	Extent	Consequence	Probability	Frequency	Likelihood	Significance
Preferred Alternative (Northleigh 422)	2	5	2	3	3	5	4	12
MITIGATED	1	1	1	1	2	5	3.5	3.5
Alternative 1 (Penrith)	2	5	2	3	3	5	4	12
MITIGATED	2	1	1	1.33	2	5	3.5	4.7
Alternative 2 (Koningsdal)	2	5	2	3	3	5	4	12
MITIGATED	2	1	1	1.33	2	5	3.5	4.7
Alternative 3 (Rammulotsi 590)	2	5	2	3	3	5	4	12
MITIGATED	2	1	1	1.33	2	5	3.5	4.7
Alternative 4 (Appleby)	2	5	2	3	3	5	4	12
MITIGATED	2	1	1	1.33	2	5	3.5	4.7
Alternative 5 (Pyrolysis)	2	5	2	3	3	5	4	12
MITIGATED	2	1	1	1.33	2	5	3.5	4.7

The cumulative impact of the landfill should be low as it is not foreseen that there will be a major increase in the population of Viljoenskroon.

Alternative: An alternative will be to establish the landfill site at an alternative location outside Viljoenskroon . However, it should be considered that the entire area surrounding Viljoenskroon is high potential agricultural

land. Another location might have indigenous vegetation that will have to be removed for the establishment of the landfill.

It should also be considered that the impact on the plant and animal species at all the alternatives will be the same as habitat will be demolished for either the establishment of the landfill or the construction of the pyrolysis and associated plants and activities.

Proposed mitigation:

- No animals will be harmed and/or killed on the site. If any animals are encountered they will be relocated from the site.
- Special care will be taken to prevent fires on the site which has the potential to destroy indigenous vegetation not only on the landfill, but in the surrounding environment. Open fires will not be allowed on the landfill site.
- Alien plant species will be removed from the site before re-seeding.
- Concurrent rehabilitation of the landfill will be implemented where areas where land filling is completed be rehabilitated as the opening of the next area commences.
- During rehabilitation the area will be reseeded with a mixture of indigenous seeds to ensure re-growth of natural vegetation.

7.2.5 Surface Water

Viljoenskroon is situated in the upper reaches of the Middle Vaal catchment in quaternary drainage region C70K. Pans occupy 1% of the Bd14 land type. There are two large pans to the west of Viljoenskroon, namely Grootrietpan in the north and Witpan in the south. The pans have a relative small catchment with very little impact on the water quality.

The landfill site is situated in the Free State, which consists of open, slightly rolling to very flat surfaces typical of the area. General sloping of the ground tends to be within the 1° to the 5° range.

The local water drainage occurs from the north, north east across the area in a western and south western direction.

A possible impact of the landfill will be that the surface water resources can get contaminated as a result of contaminated storm water. Therefore, a proper storm water management system should be implemented to divert clean water around the landfill and to contain storm water from the “dirty areas” on the site and not allow this water to drain into the surrounding environment.

The impact on surface water will be low-medium if the correct management and mitigation measures are implemented.

As indicated in the wetland delineation by Mr. D. Van Rensburg (**Annexure 4**) there are 2 pans located to the east and south east of the proposed site. These pans will have to be protected from contamination from the landfill. It was therefore decided to decrease the area of the landfill in order to exclude these pans and their buffer areas as indicated by the specialist.

Alternative	Severity	Duration	Extent	Consequence	Probability	Frequency	Likelihood	Significance
Preferred Alternative (Northleigh 422)	3	5	3	3.67	4	5	4.5	16.5
MITIGATED	2	3	2	2.33	2	5	3.5	8.17
Alternative 1 (Penrith)	3	5	3	3.67	4	5	4.5	16.5
MITIGATED	2	3	2	2.33	2	5	3.5	8.17
Alternative 2 (Koningsdal)	3	5	3	3.67	4	5	4.5	16.5
MITIGATED	2	3	2	2.33	2	5	3.5	8.17
Alternative 3 (Rammulotsi 590)	3	5	3	3.67	4	5	4.5	16.5
MITIGATED	2	3	2	2.33	2	5	3.5	8.17
Alternative 4 (Appleby)	3	5	3	3.67	4	5	4.5	16.5
MITIGATED	2	3	2	2.33	2	5	3.5	8.17
Alternative 5 (Pyrolysis)	3	4	3	3.33	4	5	4.5	15
MITIGATED	2	3	2	2.33	2	5	3.5	8.17

Significance of the impacts without mitigation on the surface water resources will be Medium-High. It should be noted that there should not be an impact on the quantity of surface water as the activity will not use water. Impacts that can occur relates to contamination due to runoff. The significance of impacts that the activity might have on the surface water resources after mitigation is Low-Medium.

Alternatives: It is not expected that location alternatives will have more or less of an impact on surface water resources than the preferred alternative as all locations will be able to contaminate the wetland system surrounding Viljoenskroon if proper storm water management measures are not implemented.

A Pyrolysis plant will also have the potential to contaminate the surface water resources with hazardous substances if the correct and proper storm water measures are not implemented at the plant as it will store petrochemical and other hazardous substances and transport them on site. The significance of the impact of the Pyrolysis plant on surface water resources will also be Medium-High before mitigation and Low-Medium after mitigation.

Proposed mitigation:

- Storm water management measures will be maintained to ensure that clean and dirty water do not mix. Clean water will be diverted around the landfill site and will not be permitted to enter the site while dirty water will have to be contained on the landfill site and will not be allowed to drain into the surrounding environment.
- It is not expected that any hazardous substances will be stored on the site however, there will be a dedicated hazardous substances storage area on the site to prevent pollution of these substances.
- Any pollution incidents on surface water resources will be reported to the relevant authorities within 24 hours of the incident.
- The quality of the water in the close storm water resources will be monitored.

7.2.6 Groundwater

The Viljoenskroon area has a characteristically shallow water table. The Clovelly, Avalon and Westleigh soilforms can all be characterized by a sandy Orthic A top layer and a more clayey sub-surface layer. The wetland area (i.e. Olifants Vlei) that stretches from the southeast to the west of Viljoenskroon is evident of this shallow water table.

The plinthic catena in the Bd14 land type is shallow and is also an indication of the shallow water table. The high infiltration rate can cause water and contaminants to infiltrate into the water table.

Due to the nature of the activity the groundwater may be contaminated due to seepage and the shallow water table.

During a rainstorm the proposed landfill site can impact on the groundwater regime and the streams that is located down-gradient from the site. The recharge to the underlying rock formations will mainly occur along

preferential pathways in the form of vertical or sub-vertical fracture zones, thereby feeding the aquifers that occur in the area. In the geophysical survey done by GHT Consulting Scientists on the landfill and surrounding areas, through a set of four magnetic traverse lines, no predominant anomalies were found (Refer to **Annexure 4**). It was concluded after the geophysical survey, that there is not a dolerite dike underlying the investigated area and can therefore not act as a preferential pathway for pollutants.

The local water drainage occurs from the north, north east across the area in a western and south western direction

Alternative	Severity	Duration	Extent	Consequence	Probability	Frequency	Likelihood	Significance
Preferred Alternative (Northleigh 422)	4	5	4	4.33	5	5	5	21.7
MITIGATED	2	4	2	2.67	3	5	4	10.7
Alternative 1 (Penrith)	4	5	4	4.33	5	5	5	21.7
MITIGATED	2	4	2	2.67	3	5	4	10.7
Alternative 2 (Koningsdal)	4	5	4	4.33	5	5	5	21.7
MITIGATED	2	4	2	2.67	3	5	4	10.7
Alternative 3 (Rammulotsi 590)	4	5	4	4.33	5	5	5	21.7
MITIGATED	2	4	2	2.67	3	5	4	10.7
Alternative 4 (Appleby)	4	5	4	4.33	5	5	5	21.7
MITIGATED	2	4	2	2.67	3	5	4	10.7
Alternative 5 (Pyrolysis)	3	4	3	3.33	4	5	4.5	15
MITIGATED	2	3	2	2.33	2	5	3.5	8.17

It should be noted that the expected impacts on groundwater is the same for all location alternatives as the groundwater table is very shallow around the entire town of Viljoenskroon. However, there might be certain areas where the water table is shallower than other areas. The significance of the impacts before mitigation will be very high due to the nature of the activity and with mitigation the impacts will be Medium.

Possible mitigation: The impact will be low with proper engineering, management, lining of the facilities and placement of the facilities away from any recharge structures like dykes and fault zones. Areas where the water table is very shallow will be avoided.

It is not expected that there will be an impact on groundwater quantity as no groundwater will be used at the facility. Water to be used will be obtained from current municipal supply and will only be used for sanitary purposes and at the ablution facility at the offices.

Alternatives: Various farms were identified as alternative locations for the landfill. However, it should be noted that the water table around the entire Viljoenskroon is very shallow and the impact on groundwater might be the same on all these locations.

Pyrolysis of plastic was another alternative. The impact of such a plant on groundwater will be very low if the correct management measures are implemented for the storage and handling of potentially hazardous substances (i.e. petrochemical substances). It is expected that although most of the waste products will be recycled and reused, there will be certain waste streams that will not be recycled at this plant which will still be disposed of conventionally. The land filling of these waste streams will have an impact on the groundwater.

Proposed mitigation:

- Due to the shallow water table it is advised that the site be lined in the event that land filling and trenching be done. It is however proposed that a land-building method be followed where the waste is disposed of on the surface and not excavation and filling.
- The pollution control dam must be lined.
- No hazardous substances will be disposed of on the landfill site.
- Sorting and recycling will be done at the facility to ensure that less waste is disposed of on the landfill and to prolong the life of the facility. Any hazardous material which may contaminate groundwater will be removed.
- In the event that any potentially hazardous substances (i.e. diesel for machinery, etc.) be stored on-site it will be stored inside a bunded area on a concrete surface. This area will have the capacity to store 110% of the volume the substance.

With mitigation, the significance of the impacts on groundwater will be low.

7.2.7 Air quality and Noise

The Viljoenskroon area does not have major industrial facilities. The main land use in the area is agriculture and the air quality in the area is very good. It is generally assumed that a landfill site will have a negative impact on the air quality due to odours.

Alternative	Severity	Duration	Extent	Consequence	Probability	Frequency	Likelihood	Significance
Preferred Alternative (Northleigh 422)	4	4	4	4	4	5	4.5	18
MITIGATED	2	1	2	1.67	2	5	3.5	5.8
Alternative 1 (Penrith)	4	4	4	4	4	5	4.5	18
MITIGATED	2	1	2	1.67	2	5	3.5	5.8
Alternative 2 (Koningsdal)	4	4	4	4	4	5	4.5	18
MITIGATED	2	1	2	1.67	2	5	3.5	5.8
Alternative 3 (Rammulotsi 590)	4	4	4	4	4	5	4.5	18
MITIGATED	2	1	2	1.67	2	5	3.5	5.8
Alternative 4 (Appleby)	4	4	4	4	4	5	4.5	18
MITIGATED	2	1	2	1.67	2	5	3.5	5.8
Alternative 5 (Pyrolysis)	4	4	4	4	5	5	5	20
MITIGATED	2	3	2	2.33	4	5	4.5	10.5

It is expected that the landfill will have an effect on the air quality in the area as it will produce odours. The air quality may be negatively impacted upon by smouldering waste in the landfill site. The impact will be Medium – High without mitigation and Low – Medium with mitigation.

An increase in the quantity of waste to be disposed of at the landfill can influence the ambient air quality but if the proper management measures are implemented and maintained, the overall cumulative impacts can be kept at a low. It should also be noted that the landfill will be located in close proximity to Rammulotsi where

fuel (i.e. wood, coal, etc.) is burned for cooking. There will thus be a cumulative impact on the air quality of the area.

Noise in the area is associated with that of agriculture. The landfill might therefore have an impact on the ambient noise experienced in this area. However, the impact will only be noticed during normal working hours when the landfill and the machinery is in operation.

Alternative: The significance of the impacts that the Pyrolysis Plant will have on the air quality and ambient noise levels is High. If impacts are mitigated the significance will be Medium. This is due to the daily burning of plastic and all the other processes associated with it. There will be daily emissions to the atmosphere which will pollute it. Although there is a possibility that a landfill site may burn, it will not be a daily occurrence.

Proposed mitigation:

- Waste will be covered daily.
- No waste will be burned on the landfill site.
- Open fires will not be permitted at the landfill site.
- Hazardous and/or flammable waste will not be disposed of at the landfill site.
- Any smouldering areas on the landfill will be managed immediately by putting out the fire.

This impact can become low-medium with the correct mitigation measures.

7.2.8 Archaeological and Cultural Resources

The proposed site was previously disturbed by agricultural activities (i.e. crop production). It is therefore not foreseen that there will be any elements of archaeological value. The underlying geology of the area consist of volcanic material. It is therefore also unlikely that there will be any palaeontological artefacts in the area. There are no buildings and/or structures older than 60 years which will be demolished on the proposed site. This is also relevant to all other alternative locations (Please refer to the Heritage Impact Assessment by Dr. L. Rossouw in **Annexure 4**).

In the event that any artefacts of archaeological and/or palaeontological significance be unearthed during construction or operation the activities will be stopped and a specialist be appointed to investigate.

7.2.9 Visual exposure (Aesthetic impact)

The overall area is generally used for agriculture. However, there is an industrial area to the south of Viljoenskroon. Based on the historic record on the management of the existing landfill, there is a strong

feeling that a landfill will have a major negative aesthetic impact on the surrounding environment, irrespective of the location thereof.

Therefore, the proposed landfill site is located more than 1 km east of the R76 for the lowest aesthetic impact. It is visible from the R76 and may have a negative aesthetic impact.

Alternative	Severity	Duration	Extent	Consequence	Probability	Frequency	Likelihood	Significance
Preferred Alternative (Northleigh 422)	3	5	2	3.33	3	5	4	13.3
MITIGATED	2	1	1	1.33	3	5	4	5.3
Alternative 1 (Penrith)	3	5	2	3.33	3	5	4	13.3
MITIGATED	2	1	1	1.33	3	5	4	5.3
Alternative 2 (Koningsdal)	3	5	2	3.33	3	5	4	13.3
MITIGATED	2	1	1	1.33	3	5	4	5.3
Alternative 3 (Rammulotsi 590)	3	5	2	3.33	3	5	4	13.3
MITIGATED	2	1	1	1.33	3	5	4	5.3
Alternative 4 (Appleby)	3	5	2	3.33	3	5	4	13.3
MITIGATED	2	1	1	1.33	3	5	4	5.3
Alternative 5 (Pyrolysis)	3	4	1	2.67	3	5	4	10.7
MITIGATED	2	1	1	1.33	2	5	3.5	4.7

The aesthetic impact at the proposed site will be Low-Medium if the correct mitigation and management measures are implemented. The aesthetic impact of all the locations will be the same as they are located in the same distance range from roads and will be established in open lands.

The Pyrolysis plant will have a Low impact if mitigated. The plant will be constructed outside an industrial area and will thus have a negative aesthetic impact.

Proposed mitigation:

- The landfill should be fenced to contain activities inside and to obstruct visual access from outside.
- Vegetation (i.e. trees) can be used to make the site more visually acceptable to passing motorists by planting them on the border of the landfill.
- Daily covering of waste should be done to prevent waste being windblown from the landfill.
- If waste is windblown the area around the landfill will be cleaned.
- Recycling should be done to reduce waste products in the landfill.

7.2.10 Demographics and Regional socio-economic structure

The population of Viljoenskroon and Rammulotsi is estimated at approximately 31 468 people. The design, construction, operation and recycling initiatives on the site will generate new formal job opportunities for residents of the area.

The proposed landfill site will be located further than 500 m from any residential area and will therefore, if maintained well, have less of a health risk on residents. The currently used landfill site is located within 500m of residential units and a school which poses serious health risks to the people. The site is also not managed properly. The new landfill will therefore have a positive impact on residents of Viljoenskroon, especially the Rammulotsi area.

The above will be the same for all location alternatives.

The Pyrolysis alternative will have a larger positive impact on the demographics and socio-economic condition of the area as it will provide more jobs than a landfill site. Many of these jobs will be specialised and local residents will have to be trained to do such jobs. However, many of the jobs will be sorting and recycling. Furthermore, the Pyrolysis plant will contribute to the manufacturing of fuel and will generate additional income with much less waste in the community. A PPP will have to be established for the development of such a plant in the area.

8 CONCLUSION

A new landfill is urgently needed to prevent any further environmental degradation of the current site and to prevent any possible health hazards. The existing landfill site is located on Portion 1 of the farm Northleigh 422 in Rammulotsi, Viljoenskroon and covers an area of 6 ha and is within 500 m of the nearest residential houses. The site is poorly managed with no daily covering. There is no access control or on-site management which leads to uncontrolled scavenging and fires that smoulders which causes excessive smoke. The location and present state of the site poses a serious health risk to local residents and has a major pollution risk to groundwater.

The new landfill site will be located approximately 2 km to the east of Viljoenskroon town and 1.3 km southeast of Rammulotsi (Refer to Locality Map in **Annexure 2**). It is noted that future expansion of Rammulotsi will occur in the direction of the landfill whilst keeping in mind that a buffer of 500 m will always be maintained. The landfill will be a general waste site in accordance to the DWS, guidelines and standards.

The proposed site was and is still currently being used for agriculture (i.e. crop production and small grazing areas) however, the large need for a new and appropriate landfill site, dwarfs the value of agricultural use of the site.

By referring to the data obtained from the geophysical survey, it was found that there are no dolerite dikes underlying the investigated area that can act as a preferential pathway for pollutants (Geo-physical Report in **Annexure 4**). This data makes the site appropriate for the establishment of a landfill.

Furthermore, the report on the wetland delineation of the proposed new landfill site, by D van Rensburg (Wetland Report in **Annexure 4**), it was determined that there are two small pans located in the area of the new landfill location. It can be anticipated that these pans will reduce the agricultural value of the area. However, they have been excluded from the landfill site and the size of the site reduced from 34ha to approximately 30ha.

During the phase 1 Heritage Impact Assessment for the development of the proposed new landfill site, by Dr. L Rossouw (Heritage Report in **Annexure 4**), it was determined that the study area is underlain by the Hekpoort Formation (Transvaal Supergroup). The Hekpoort Formation is not considered to be palaeontologically sensitive. It was concluded that there is little to none chance of finding fossil material within the superficial overburden because of a lack of suitable Quaternary-aged alluvium at the site. There are also no artefacts of archaeological significant due to the disturbed nature of the site.

The above-mentioned findings from the specialist studies indicate that the location, geology and ecology of the proposed site, is suited for a new landfill. It was also taken into account that the applicant is the

landowner of the site which will have a significant impact on the economic aspect of the project as well as the time frames.

Most important is the positive impact that the closing and rehabilitation of the old landfill as well as the establishment of the new landfill site, will have on the socio-economic structure of the region, as it will minimise the cost to the environment. The new landfill will also minimise the footprint of the activity as it will be more environmentally friendly.

8.1 Summary of significance rating after mitigation

Impact	Preferred Site (Northleigh 422)	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Pyrolysis Plant
Geology and Soil	4.7	5.83	5.83	5.83	5.83	5.83
Climate	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact
Land Use	6	8.16	7	7	7	6.67
Plant & Animal Life	3.5	4.7	4.7	4.7	4.7	4.7
Surface Water	8.17	8.17	8.17	8.17	8.17	8.17
Groundwater	10.7	10.7	10.7	10.7	10.7	8.17
Air Quality and Noise	5.8	5.8	5.8	5.8	5.8	10.5
Archaeological and Cultural Resources	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact
Visual Exposure	5.3	5.3	5.3	5.3	5.3	4.7
Demographics and Regional structure	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact

8.2 Motivation for proposed site alternative

All possible alternatives were identified and assessed. The preferred site was decided on, based on certain factors:

- All variables like wind direction, geology, surface and groundwater, air quality and plant & animal life were taken into account during the assessment process.
- Lowest clearance of vegetation if possible.
- If the site is already the property of the municipality- Therefore the EIA and Construction process will be more time efficient and cost effective.
- The possibility of erecting a transfer station was considered- The option was denied by the DEA.

Possible alternative sites were taken into consideration for the proposed location of the landfill:

- The sites were individually assessed for pros and cons.
- The sites are privately owned which will increase the project cost.
- The current land zoning is of high agricultural value.
- The predominant wind direction makes some of the sites unsuitable for the project.

The alternative of constructing a Pyrolysis Plant that was proposed by Mr. Marè of farm Vlakvlei, was assessed and considered:

- The plant will have an additional set of external environmental impacts.
- Unlike a landfill, the Pyrolysis Plant will produce emissions daily into the atmosphere.
- A Public Private Partnership will have to be implemented between the landowners, the municipality and the community which will be very time consuming.
- The Construction and maintenance of a Pyrolysis Plant is a very expensive process.
- With the construction of such a plant, the land use of the site is still going to have to change.
- Special provision will have to be made for the storage for the hazardous substances on site.
- The Pyrolysis Plant will only be able to recycle and reduce waste to such an extent that at some point it will become necessary to use a landfill once more.

Therefore, the preferred site, farm Northleigh 422 was considered as the best suited site for the construction of a landfill with the lowest environmental impact being caused.

9 PROPOSED CONDITIONS OF APPROVAL

The following measures will have to be implemented and maintained throughout the lifetime of the landfill site:

- A waste license needs to be issued by the National Department of Environmental Affairs in terms of the National Environmental Management: Waste Act, 2008 (Act 59 of 2008);
- The maximum daily and overall capacity of the landfill should never be exceeded as this may cause pollution;

- No dumping of waste outside the fences of the landfill will be permitted;
- Waste will not be filled into areas where the groundwater is very shallow. The “land building” method will rather be implemented to prevent any contamination of groundwater;
- All conditions as indicated by the specialists will be implemented;
- Groundwater monitoring will be conducted annually by the applicant. An external service provider may be appointed to conduct such monitoring;
- Storm water management measures will be very important. Measures will be implemented during construction to divert clean storm water around the site and to contain dirty water on the landfill. The dirty water is not allowed to drain into the surrounding environment;
- No open fires will be allowed on the site;
- The access road to the landfill must always be used to gain access to the site;
- Trespassing onto adjacent properties will not be permitted;
- Sorting and rehabilitation of waste at the dedicated facility is very important and should be done throughout.

10 REFERENCES AND SUPPORTING DOCUMENTATION

- Dr. Rossouw, L. (2017). *Phase 1 Heritage Impact Assessment of a new Landfill Site at Viljoenskroon, FS Province*. Bloemfontein: National Museum.
- Mucina, L. & Rutherford, M.C. (eds). (2006). *The vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19*. Pretoria: South African National Biodiversity Institute.
- van Niekerk, L.J., Moolman, D. (2017). *Proposed New Landfill Geohydrological Report Viljoenskroon*. Bloemfontein: GHT CONSULTING.
- van Rensburg, D. (2017). *Report on the wetland delineation of the proposed new waste landfill site on the Remainder of the Farm Northleigh 422 near the town of Viljoenskroon, Free State Province*. Bloemfontein: D. van Rensburg.