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Report on the floristic and ecological assessment of the proposed construction of a bulk water transfer pipeline from the Maselspoort Dam and purification plant to the New Northern Waste Water Treatment Works (WWTW) and Bloemfontein WWTW, Bloemfontein, Free State Province.

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Vegetation and ecological assessment.

1. Introduction

1.1 Background

Natural vegetation is an important component of ecosystems. Some of the vegetation units in a region can be more sensitive than others, usually as a result of a variety of environmental factors and species composition. These units are often associated with water bodies, water transferring bodies or moisture sinks. These systems are always connected to each other through a complex pattern. Degradation of a link in this larger system, e.g. tributary, pan, wetland, usually leads to the degradation of the larger system. Therefore, degradation of such a water related system should be prevented.

Though vegetation may seem to be uniform and low in diversity it may still contain species that are rare and endangered. The occurrence of such a species may render the development unviable. Should such a species be encountered the development should be moved to another location or cease altogether.

South Africa has a large amount of endemic species and in terms of biological diversity ranks third in the world. This has the result that many of the species are rare, highly localised and consequently endangered. It is our duty to protect our diverse natural resources.

South Africa's water resources have become a major concern in recent times. As a water scarce country we need to manage our water resources sustainably in order to maintain a viable resource for the community as well as to preserve the biodiversity of the system. Thus, it should be clear that we need to protect our water resources so that we may be able to utilise this renewable resource sustainably. Areas that are regarded as crucial to maintain healthy water resources include wetlands, streams as well as the overall catchment of a river system.

Water is essential and crucial to the survival of all living organisms as well as ecosystem processes. This also applies to the survival of humans as we need daily intake of water. We, as humans, also utilise water for a range of other daily tasks and it is considered an essential component of our daily lives. It is therefore necessary for a community to have easy access to a potable water supply. The provision of water to a community must therefore take priority.

The proposed pipeline will be constructed from the Maselspoort Dam and the associated purification plant to the New Northern Waste Water Treatment Works (WWTW) and Bloemfontein WWTW (Map 1). The function of the pipeline will be to transport treated waste water to the purification plant at the Maselspoort Dam and from there back to Bloemfontein for re-use. Several streams and rivers will be crossed by the pipeline.

A site visit was conducted on 13 January 2015. The route of the pipeline was surveyed by means of sample transects.

For the above reasons it is necessary to conduct a vegetation and ecological assessment of an area proposed for development.

The report together with its recommendations and mitigation measures should be used to minimise the impact of the proposed development.

1.2 The value of biodiversity

The diversity of life forms and their interaction with each other and the environment has made Earth a uniquely habitable place for humans. Biodiversity sustains human livelihoods and life itself. Although our dependence on biodiversity has become less tangible and apparent, it remains critically important.

The balancing of atmospheric gases through photosynthesis and carbon sequestration is reliant on biodiversity, while an estimated 40% of the global economy is based on biological products and processes.

Biodiversity is the basis of innumerable environmental services that keep us and the natural environment alive. These services range from the provision of clean water and watershed services to the recycling of nutrients and pollution. These ecosystem services include:

- Soil formation and maintenance of soil fertility.
- Primary production through photosynthesis as the supportive foundation for all life.
- Provision of food, fuel and fibre.
- Provision of shelter and building materials.
- Regulation of water flows and the maintenance of water quality.
- Regulation and purification of atmospheric gases.
- Moderation of climate and weather.
- Detoxification and decomposition of wastes.
- Pollination of plants, including many crops.
- Control of pests and diseases.
- Maintenance of genetic resources.

2. Scope and limitations

- To evaluate the present state of the vegetation and ecological functioning of the area proposed for the pipeline development.
- To identify possible negative impacts that could be caused by the proposed construction of a pipeline.

2.1 Vegetation

Aspects of the vegetation that will be assessed include:

- The vegetation types of the region with their relevance to the proposed site.
- The overall status of the vegetation on site.
- Species composition with the emphasis on dominant-, rare- and endangered species.

The amount of disturbance present on the site assessed according to:

- The amount of grazing impacts.
- Disturbance caused by human impacts.
- Other disturbances.

2.2 Fauna

Aspects of the fauna that will be assessed include:

- A basic survey of the fauna occurring in the region using visual observations of species as well as evidence of their occurrence in the region (burrows, excavations, animal tracks, etc.).
- The overall condition of the habitat.
- A list of species that may occur in the region (desktop study).

2.3 Limitations

Several bulbous and herbaceous species may have finished flowering and may have been overlooked or not identifiable.

Due to time constraints the entire pipeline route could not be surveyed and only likely sensitive areas were surveyed. It is therefore possible that sensitive species may have been overlooked. Some animal species may not have been observed as a result of their nocturnal and/or shy habits.

3. Methodology

3.1 Several literature works were used for additional information.

Vegetation:

Red Data List (Raymondo *et al.* 2009)

Vegetation types (Mucina & Rutherford 2006)

Field guides used for species identification (Bromilow 1995, 2010, Coates-Palgrave 2002, Manning 2009, Moffett 1997, Van Oudtshoorn 2004, Van Wyk & Malan 1998, Van Wyk & Van Wyk 1997, Venter & Joubert 1985).

Terrestrial fauna:

Field guides for species identification (Smithers 1986a).

3.2 Survey

The site was assessed by means of transects and sample plots.

Noted species include rare and dominant species.

The broad vegetation types present on the site were determined.

The state of the environment was assessed in terms of condition, grazing impacts, disturbance by humans, erosion and presence of invader and exotic species.

Animal species were also noted as well as the probability of other species occurring on or near the site according to their distribution areas and habitat requirements.

The state of the habitat was also assessed.

3.3 Criteria used to assess sites

Several criteria were used to assess the site and determine the overall status of the environment.

Vegetation characteristics

Characteristics of the vegetation in its current state. The diversity of species, sensitivity of habitats and importance of the ecology as a whole.

Habitat diversity and species richness: normally a function of locality, habitat diversity and climatic conditions.

Scoring: Wide variety of species occupying a variety of niches – 1, Variety of species occupying a single niche – 2, Single species dominance over a large area containing a low diversity of species – 3.

Presence of rare and endangered species: The actual occurrence or potential occurrence of rare or endangered species on a proposed site plays a large role on the feasibility of a development. Depending on the status and provincial conservation policy, presence of a Red Data species can potentially be a fatal flaw.

Scoring: Occurrence actual or highly likely – 1, Occurrence possible – 2, Occurrence highly unlikely – 3.

Ecological function: All plant communities play a role in the ecosystem. The ecological importance of all areas though, can vary significantly e.g. wetlands, drainage lines, ecotones, etc.

Scoring: Ecological function critical for greater system – 1, Ecological function of medium importance – 2, No special ecological function (system will not fail if absent) – 3.

Degree of rarity/conservation value:

Scoring: Very rare and/or in pristine condition – 1, Fair to good condition and/or relatively rare – 2, Not rare, degraded and/or poorly conserved – 3.

Vegetation condition

The sites are compared to a benchmark site in a good to excellent condition. Vegetation management practises (e.g. grazing regime, fire, management, etc.) can have a marked impact on the condition of the vegetation.

Percentage ground cover: Ground cover is under normal and natural conditions a function of climate and biophysical characteristics. Under poor grazing management, ground cover is one of the first signs of vegetation degradation.

Scoring: Good to excellent – 1, Fair – 2, Poor – 3.

Vegetation structure: This is the ratio between tree, shrub, sub-shrubs and grass layers. The ratio could be affected by grazing and browsing by animals.

Scoring: All layers still intact and showing specimens of all age classes – 1, Sub-shrubs and/or grass layers highly grazed while tree layer still fairly intact (bush partly opened up) – 2, Mono-layered structure often dominated by a few unpalatable species (presence of barren patches notable) – 3.

Infestation with exotic weeds and invader plants or encroachers:

Scoring: No or very slight infestation levels by weeds and invaders – 1, Medium infestation by one or more species – 2, Several weed and invader species present and high occurrence of one or more species – 3.

Degree of grazing/browsing impact:

Scoring: No or very slight notable signs of browsing and/or grazing – 1, Some browse lines evident, shrubs shows signs of browsing, grass layer grazed though still intact – 2, Clear browse line on trees, shrubs heavily pruned and grass layer almost absent – 3.

Signs of erosion: The formation of erosion scars can often give an indication of the severity and/or duration of vegetation degradation.

Scoring: No or very little signs of soil erosion – 1, Small erosion gullies present and/or evidence of slight sheet erosion – 2, Gully erosion well developed (medium to large dongas) and/or sheet erosion removed the topsoil over large areas – 3.

Faunal characteristics

Presence of rare and endangered species: The actual occurrence or potential occurrence of rare or endangered species on a proposed site plays a large role on the feasibility of a development. Depending on the status and provincial conservation policy, presence of a Red Data species or very unique and sensitive habitats can potentially be a fatal flaw.

Scoring: Occurrence actual or highly likely – 1, Occurrence possible – 2, Occurrence highly unlikely.

3.4 Biodiversity sensitivity rating (BSR)

The total scores for the criteria above were used to determine the biodiversity sensitivity ranking for the sites. On a scale of 0 – 30, six different classes are described to assess the suitability of the sites to be developed. The different classes are described in the table below:

Table 1: Biodiversity sensitivity ranking

BSR	BSR general floral description	Floral score equating to BSR class
Ideal (5)	Vegetation is totally transformed or in a highly degraded state, generally has a low level of species diversity, no species of concern and/or has a high level of invasive plants. The area has lost its inherent ecological function. The area has no conservation value and potential for successful rehabilitation is very low. The site is ideal for the proposed development.	29 – 30
Preferred (4)	Vegetation is in an advanced state of degradation, has a low level of species diversity, no species of concern and/or has a high level of invasive plants. The area's ecological function is seriously hampered, has a very low conservation value and the potential for successful rehabilitation is low. The area is preferred for the proposed development.	26 – 28
Acceptable (3)	Vegetation is notably degraded, has a medium level of species diversity although no species of concern are present. Invasive plants are present but are still controllable. The area's ecological function is still intact but may be hampered by the current levels of degradation. Successful rehabilitation of the area is possible. The conservation value is regarded as low. The area is acceptable for the proposed development.	21 – 25
Not preferred (2)	The area is in a good condition although signs of disturbance are present. Species diversity is high and species of concern may be present. The ecological function is intact and very little rehabilitation is needed. The area is of medium conservation importance. The area is not preferred for the proposed development.	11 – 20
Sensitive (1)	The vegetation is in a pristine or near pristine condition. Very little signs of disturbance other than those needed for successful management are present. The species diversity is very high with several species of concern known to be present. Ecological functioning is intact and the conservation importance is high. The area is regarded as sensitive and not suitable for the proposed development.	0 - 10

4. Ecological overview of the site

4.1 Overview of ecology and vegetation types (Mucina & Rutherford 2006)

According to Mucina & Rutherford (2006) the area consists of Highveld Alluvial Vegetation (AZa 5) and Bloemfontein Dry Grassland (Gh 5). Of these vegetation types the Highveld Alluvial Vegetation is considered to be of Least Concern but the Bloemfontein Dry Grassland is listed as a Threatened Ecosystem with a status of Vulnerable (VU) (National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004)) (Map 2). Large portions of this grassland has been transformed by dryland crop cultivation and urbanisation.

The topography of the pipeline route consists of undulating plains with isolated hills in the north of the route. These hills consist of dolerite capped mesas but will not be affected by the pipeline as it will remain in the bottomlands away from these hills. Treated waste water will be transported via the pipeline from the New Northern WWTW and Bloemfontein WWTW to the Maselspoort Dam and treatment works where the water will be purified and then transported via the pipeline back to Bloemfontein for human consumption. The pipeline route will be from the oxidation ponds of the Bloemfontein WWTW from where it will cross the Bloemspruit and will be located south of the new racecourse development. The pipeline will cross the N8 National Road and will be installed alongside the Maselspoort Road. A short stretch of pipeline will connect to the main pipeline from the New Northern WWTW. From here the pipeline will cross the Renosterspruit and continue along the Maselspoort Road through the Roodewal Small Holdings up to the Phillip Saunders turnoff and from this turnoff the pipeline will follow the road to the Maselspoort Dam. From the Renosterspruit crossing up to the Maselspoort Dam the pipeline will cross four other small streams. The landscape from the Maselspoort Dam to the beginning of the small holdings are largely natural and is utilised as natural grazing. From the small holdings to the WWTW the natural landscape has been transformed to varying degrees.

The majority of the pipeline route will follow the tarred road (Map 1). The areas adjacent to this road has also been degraded by the impact of the road, firebreaks along the fence and dirt tracks. However, the pipeline still crosses several sensitive areas consisting of natural streams (Map 1 & 2).

The vegetation structure along the pipeline route is dominated by a uniform grass layer. However, near the Maselspoort Dam and consisting of a large area consists of thicket associated with the Modder River. The Modder River near the Maselspoort Dam also contains a dense riparian thicket with sedge and reed beds. The seasonal streams along the route consist of sedge and reed layers. The Bloemspruit and Renosterspruit also contain dense thicket and reed beds.

No rare or endangered species could be identified along the pipeline route except for one species (Appendix B). This species, *Crinum bulbispermum* (Orange River Lily) occurs along the Modder River and the two seasonal streams being crossed by the pipeline near Maselspoort. This species is currently listed in the National Red List as being a Declining species. The species is widespread but can be considered as somewhat rare and rapidly declining. It must be regarded as having a significant conservation value. Due to the small footprint of the pipeline only a small portion of the population will be affected. It is recommended that all specimens which will be affected by the pipeline construction should be removed and transplanting adjacent to the pipeline in an area of suitable and similar habitat. Permits must be obtained for those specimens to be transplanted.

The vegetation along the majority of the pipeline route consists of Bloemfontein Dry Grassland which is considered a Threatened Ecosystem and listed as being Vulnerable (VU) (Map 2). A large portion of the pipeline route from the Roodewal Small Holdings to the crossing of the N8 National Road is in varying degrees of degradation and transformation and is consequently no longer considered to be representative of this vegetation type. The footprint of the pipeline will be small and not a large portion of the vegetation will be transformed. The pipeline will follow the Maselspoort road and will be installed adjacent to the road just outside of the road reserve inside the farm fence. The survey has indicated that this area has been degraded to varying degrees. The area has been utilised as a firebreak and dirt tracks and the vegetation has therefore been degraded to varying degrees. The installation of the pipeline should be confined to this disturbed portion outside the road reserve. The footprint of the construction and installation of the pipeline should be kept to a minimum. Strict mitigation should be implemented especially regarding the handling of topsoil including removal and replacement thereof to ensure that as natural as possible vegetation re-establishes on the site.

The pipeline will cross two perennial rivers and four smaller seasonal streams (Map 1 & 2).

The perennial rivers consist of the Bloemspruit and Renosterspruit. They are considered to have a PES of Category F: Critically/Extremely modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible. In spite of this seriously modified nature these streams still provide a vital ecosystem service as water conduits and must therefore still be considered sensitive. Several impacts on the streams have caused this modified condition. The streams are naturally only seasonal. However, due to canalisation and runoff from urban areas and industry they are now perennial systems. This has had a profound impact on riparian vegetation and the flood dynamics of these rivers. The streams flow through urban and industrial areas which contribute highly polluted runoff. This leads to high levels of pollution within the streams. A large portion of the Bloemspruit has been canalised. This has a large impact on the functioning of the stream in terms of flood dynamics and the ecosystem services rendered by an intact riparian community. The Bloemspruit flows past the Bloemfontein WWTW which does not have sufficient capacity and consequently untreated sewage overflows into the stream further leading to high levels of pollution and degradation of the stream. High levels of rubbish dumping takes place within the catchment and in stream and this further degrades these streams. The Bloemspruit feeds into the Renosterspruit and consequently the degraded condition both impact on each other.

North of the Renosterspruit crossing and within the Roodewal Small Holdings a small seasonal stream is crossed. This stream flows through the small holdings which are disturbed and transformed. As a consequence the stream is also degraded and disturbed. Despite this it must be regarded as sensitive and care must be taken when crossing this stream.

Approximately 2.3 km before the Maselspoort Dam turnoff the pipeline will cross a small seasonal stream. The stream has its origins within the surrounding natural grassland. A small weir has been constructed in the stream damming runoff and the stream is also crossed by the tarred road. These impacts have an influence on the stream but it is considered largely natural and in a good condition. The main channel of the stream is not well defined and it may be difficult to discern this stream. This stream must be regarded as being sensitive and utmost care must be taken when crossing this stream. Mitigation measures should include keeping the

footprint to a minimum, taking utmost care with topsoil, monitoring of weed establishment and no manholes within 32 meters of the stream.

From the Maselspoort Dam turnoff to the dam itself the pipeline crosses two seasonal streams which are 300 meters from each other. Both of these have their origins to the south of the road and within the natural surrounding grassland. Small weirs have been constructed in their flow channels but few other impacts are evident on these streams. As a result they are relatively unchanged, natural and in a good condition. Numerous specimens of the Red Listed and Declining *Crinum bulbispermum* (Orange River Lily) occur along the banks of these streams. This also increases the sensitivity of these streams. They must be considered as sensitive and utmost care must be taken when construction occurs near these streams. Mitigation measures should include keeping the footprint to a minimum, taking utmost care with topsoil, monitoring of weed establishment, transplanting of affected Red Listed species and no manholes within 32 meters of the stream.

The pipeline will turn south at the Modder River to the Maselspoort Dam. Though the pipeline will not cross the river it will be located in close proximity to it. The pipeline must preferably be kept more than 32 meters away from the river and care must be taken to keep impacts to a minimum.

Table 2: Summary of streams and position of pipeline crossing.

Stream	Position of crossing
Perennial river (Bloemspruit) - feeds into the Renosterspruit	S 29.121476° E 26.281671°
Perennial river (Renosterspruit) - feeds into Modder River	S 29.097219° E 26.331583°
Seasonal Stream 1 (unnamed) - flowing through small holdings, feeds into Renosterspruit	S 29.084682° E 26.358735°
Seasonal Stream 2 (unnamed) - flowing through natural area feeds into Modder River	S 29.059779° E 26.382869°
Seasonal Stream 3 (unnamed) - flowing through natural area feeds into Modder River	S 29.046532° E 26.410740°
Seasonal Stream 4 (unnamed) - flowing through natural area feeds into Modder River	S 29.047762° E 26.414023°

4.2 Overview of terrestrial mammals (actual & possible)

No mammal species could be identified on the pipeline route although it is clear by the amount of burrows and signs of animal life that the area contains a substantive and healthy mammal population. However, the proximity of the pipeline route to the tarred road will cause a decrease in the mammal population. The impact on mammal species is anticipated to be low as the pipeline will have a small footprint size and after construction the area will return to a natural condition.

The only factor that would have a high impact on the mammal population would be the hunting, capturing and trapping of mammal. This must be strictly prohibited.

List of some Red Data terrestrial mammals that could occur in the region:

South African Hedgehog	<i>Atelerix frontalis</i>
Aardwolf	<i>Proteles cristatus</i>
African Wild Cat	<i>Felis lybica</i>
Small-Spotted Cat	<i>Felis nigripes</i>
Bat-Eared Fox	<i>Otocyon megalotis</i>
Striped Weasel	<i>Poecilogale albinucha</i>

It is considered likely that some of these species may occur within the area but is unlikely that they would be directly affected by installation of the pipeline due to the small footprint as long as hunting, capturing and trapping of animals is prohibited.

5. Site specific results

Habitat diversity and species richness:

Habitat diversity along the pipeline route is moderate. The site consists predominately of grassland with thicket along the northern portion of the route. The perennial- and seasonal streams along the route also contribute to habitat diversity (Map 1). Despite the variety of habitats the species diversity is uniform and relatively low.

Presence of rare and endangered species:

No rare or endangered species could be identified along the pipeline route except for one species (Appendix B). This species, *Crinum bulbispermum* (Orange River Lily) occurs along the Modder River and the two seasonal streams being crossed by the pipeline near Maselspoort. This species is currently listed in the National Red List as being a Declining species. The species is widespread but can be considered as somewhat rare and rapidly declining. It must be regarded as having a significant conservation value. Due to the small footprint of the pipeline only a small portion of the population will be affected. It is recommended that all specimens which will be affected by the pipeline construction should be removed and transplanting adjacent to the pipeline in an area of suitable and similar habitat. Permits must be obtained for those specimens to be transplanted.

Ecological function:

The ecological function along the pipeline is intact where it occurs in natural grassland. Where the pipeline route occurs along the small holdings to the south of the route the ecological has been transformed and degraded. The ecological function of the seasonal streams along the route is relatively intact except for the seasonal stream 1 which flows through the Roodewal Small Holdings. The ecological function of the Bloemspruit and Renosterspruit has been altered to a large degree. In spite of this all the watercourses remain sensitive and provide vital ecological functions. In these areas the impact of construction must be kept to a minimum.

Degree of rarity/conservation value:

The vegetation along the majority of the pipeline route consists of Bloemfontein Dry Grassland which is considered a Threatened Ecosystem and listed as being Vulnerable (VU) (Map 2). The footprint of the pipeline will be small and not a large portion of the vegetation will be transformed. The survey has indicated that the area adjacent the road reserve where the pipeline will be installed has been degraded to varying degrees. The conservation value is therefore only considered to be moderate.

The condition of the seasonal streams along the route is relatively natural and good except for the seasonal stream 1 which flows through the Roodewal Small Holdings. The condition of the Bloemspruit and Renosterspruit is poor, degraded and transformed to a large degree. In spite of this all the watercourses remain sensitive and have a significant conservation value.

Percentage ground cover:

The percentage ground cover is relatively high except in the south where the route occurs in the Roodewal Small Holdings.

Vegetation structure:

The vegetation structure consists predominately of grassland except in the north where it is dominated by thicket along the Modder River. This is considered natural except where the route occurs in the Roodewal Small Holdings and here it has been altered.

Infestation with exotic weeds and invader plants:

Infestation by exotic weeds are relatively low except along the Modder River itself, along the seasonal streams as well as along the portion within the Roodewal Small Holdings where exotics dominate in some areas (Appendix C).

Degree of grazing/browsing impact:

The majority of the area is being utilised as grazing for domestic stock. As a result the amount of overgrazing is moderate.

Signs of erosion:

Erosion along the pipeline route is relatively low but along the seasonal streams a limited amount of erosion is present.

Terrestrial animals:

It is considered likely that some species of conservational importance may occur within the area but is unlikely that they would be directly affected by installation of the pipeline due to the small footprint as long as hunting, capturing and trapping of animals is prohibited.

Table 3: Biodiversity Sensitivity Rating for the proposed pipeline.

	Low (3)	Medium (2)	High (1)
Vegetation characteristics			
Habitat diversity & Species richness		2	
Presence of rare and endangered species		2	
Ecological function		2	
Uniqueness/conservation value		2	
Vegetation condition			
Percentage ground cover		2	
Vegetation structure		2	
Infestation with exotic weeds and invader plants or encroachers	3		
Degree of grazing/browsing impact		2	
Signs of erosion		2	
Terrestrial animal characteristics			
Presence of rare and endangered species	3		
Sub total	6	16	
Total		22	

6. Biodiversity sensitivity rating (BSR) interpretation

Table 4: Interpretation of Biodiversity Sensitivity Rating.

Site	Score	Site Preference Rating	Value
Maselspoort pipeline	22	Acceptable	3

7. Discussion and conclusions

The pipeline route proposed for the construction of the Maselspoort pipeline from the Maselspoort Dam and purification plant to the New Northern Waste Water Treatment Works (WWTW) and Bloemfontein WWTW has been rated as being acceptable.

According to Mucina & Rutherford (2006) the area consists of Highveld Alluvial Vegetation (AZa 5) and Bloemfontein Dry Grassland (Gh 5). Of these vegetation types the Highveld Alluvial Vegetation is considered to be of Least Concern but the Bloemfontein Dry Grassland is listed as a Threatened Ecosystem with a status of Vulnerable (VU) (National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004)) (Map 2). Large portions of this grassland has been transformed by dryland crop cultivation and urbanisation.

No rare or endangered species could be identified along the pipeline route except for one species (Appendix B). This species, *Crinum bulbispermum* (Orange River Lily) occurs along the Modder River and the two seasonal streams being crossed by the pipeline near Maselspoort. This species is currently listed in the National Red List as being a Declining species. The species is widespread but can be considered as somewhat rare and rapidly declining. It must be regarded as having a significant conservation value. Due to the small footprint of the pipeline only a small portion of the population will be affected. It is recommended that all specimens which will be affected by the pipeline construction should be removed and transplanting adjacent to the pipeline in an area of suitable and similar habitat. Permits must be obtained for those specimens to be transplanted.

The vegetation along the majority of the pipeline route consists of Bloemfontein Dry Grassland which is considered a Threatened Ecosystem and listed as being Vulnerable (VU) (Map 2). A large portion of the pipeline route from the Roodewal Small Holdings to the crossing of the N8 National Road is in varying degrees of degradation and transformation and is consequently no longer considered to be representative of this vegetation type. The footprint of the pipeline will be small and not a large portion of the vegetation will be transformed. The pipeline will follow the Maselspoort road and will be installed adjacent to the road just outside of the road reserve inside the farm fence. The survey has indicated that this area has been degraded to varying degrees. The area has been utilised as a firebreak and dirt tracks and the vegetation has therefore been degraded to varying degrees. The installation of the pipeline should be confined to this disturbed portion outside the road reserve. The footprint of the construction and installation of the pipeline should be kept to a minimum. Strict mitigation should be implemented especially regarding the handling of topsoil including removal and replacement thereof to ensure that as natural as possible vegetation re-establishes on the site.

It is considered likely that some mammal species of conservational importance may occur within the area but is unlikely that they would be directly affected by installation of the pipeline due to the small footprint as long as hunting, capturing and trapping of animals is prohibited.

The pipeline will cross two perennial rivers and four smaller seasonal streams as listed in Table 5 (Map 1). The condition of the seasonal streams along the route is relatively natural and good except for the seasonal stream 1 which flows through the Roodewal Small Holdings. The condition of the Bloemspruit and Renosterspruit is poor, degraded and transformed to a large degree. In spite of this all the watercourses remain sensitive and have a significant conservation value. Installation of the pipeline through these streams will lead to disturbance. To keep disturbance to a minimum several mitigation measures must be implemented. The

installation of the pipeline should preferably occur during periods of low or no flow. If there is still visible surface water in the stream during construction only half of the stream may be blocked off. Free flow of the stream should be able to take place at any time during construction. The construction footprint along the streams should be kept to a minimum. Topsoil should be carefully removed to a depth of 30 cm and stored. Once the pipeline is installed the topsoil should be replaced to virgin soil level and not elevated as this will act as a water barrier. Excess soil should be removed from the site. The construction area should be monitored for the establishment of weeds following construction. The two northern seasonal stream contain specimens of the Red Listed and Declining *Crinum bulbispermum* which must be transplanted to an adjacent area where they will not be affected by construction. No manholes should be constructed within 32 meters of these streams. The necessary authorisations must be acquired from Department of Water Affairs (DWA) as well as the Department of Environmental Affairs (DEA) for the crossing of these streams.

Table 5: Summary of streams and position of pipeline crossing.

Stream	Position of crossing
Perennial river (Bloemspruit) - feeds into the Renosterspruit	S 29.121476° E 26.281671°
Perennial river (Renosterspruit) - feeds into Modder River	S 29.097219° E 26.331583°
Seasonal Stream 1 (unnamed) - flowing through small holdings, feeds into Renosterspruit	S 29.084682° E 26.358735°
Seasonal Stream 2 (unnamed) - flowing through natural area feeds into Modder River	S 29.059779° E 26.382869°
Seasonal Stream 3 (unnamed) - flowing through natural area feeds into Modder River	S 29.046532° E 26.410740°
Seasonal Stream 4 (unnamed) - flowing through natural area feeds into Modder River	S 29.047762° E 26.414023°

8. Recommendations

- After construction of the pipeline the area must be rehabilitated. This includes removal of all construction material. Excavated rock may not be left in heaps and must be removed or distributed evenly over the terrain to represent a natural environment. Compacted areas must be ripped. Roads not being utilised afterwards must be rehabilitated.
- Problematic weeds must be eradicated where these establish on the constructed pipeline route (Appendix C). The stream crossings especially should be monitored for establishment of weeds.
- The route must be inspected for erosion due to construction. This is particularly relevant where streams or slopes are involved. Where erosion is evident this must be remedied.
- No littering must be allowed and all litter must be removed from the site.
- No hunting, harming, capturing or trapping must be allowed and this must be strictly prohibited.
- Monitoring of construction and compliance with recommended mitigation measures must take place.
- Where construction takes place within natural grassland the footprint should be kept to a minimum.
- The Red Listed and Declining bulb, *Crinum bulbispermum* (*Orange River Lily*), which occurs along the northern seasonal streams must be transplanted where it will not be affected by construction (Appendix B). The necessary permits must be obtained for transplanting the species.
- The necessary authorisations must be acquired from Department of Water Affairs (DWA) as well as the Department of Environmental Affairs (DEA) for the crossing of the streams along the route as listed in Table 5 (Map 1).
- The installation of the pipeline should preferably occur during periods of low or no flow. If there is still visible surface water in the stream during construction only half of the stream may be blocked off. Free flow of the stream should be able to take place at any time during construction.
- The construction footprint along the streams should be kept to a minimum.
- Topsoil should be carefully removed to a depth of 30 cm and stored. Once the pipeline is installed the topsoil should be replaced to virgin soil level and not elevated as this will act as a water barrier. Excess soil should be removed from the site.
- No manholes should be constructed within 32 meters of these streams.

9. References

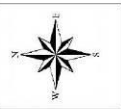
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Annexure A: Maps and Site photos



Locality map for the proposed construction of a bulk water transfer pipeline from the Maselspoort Dam and purification plant to the New Northern Waste Water Treatment Works (WWTW) and the Bloemfontein WWTW, Bloemfontein, Free State Province.



Map 1: Location of the proposed construction of a bulk water transfer pipeline from the Maselspoort dam and purification plant to the New Northern WWTW and Bloemfontein WWTW, Bloemfontein, Free State Province.



Prepared for:
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Legend:

-  Maselspoort Road
-  N8 National Road
-  Watercourses
-  Pipeline Route
-  Watercourse Crossings

Map Information

Spheroid: WGS 84

Scale:



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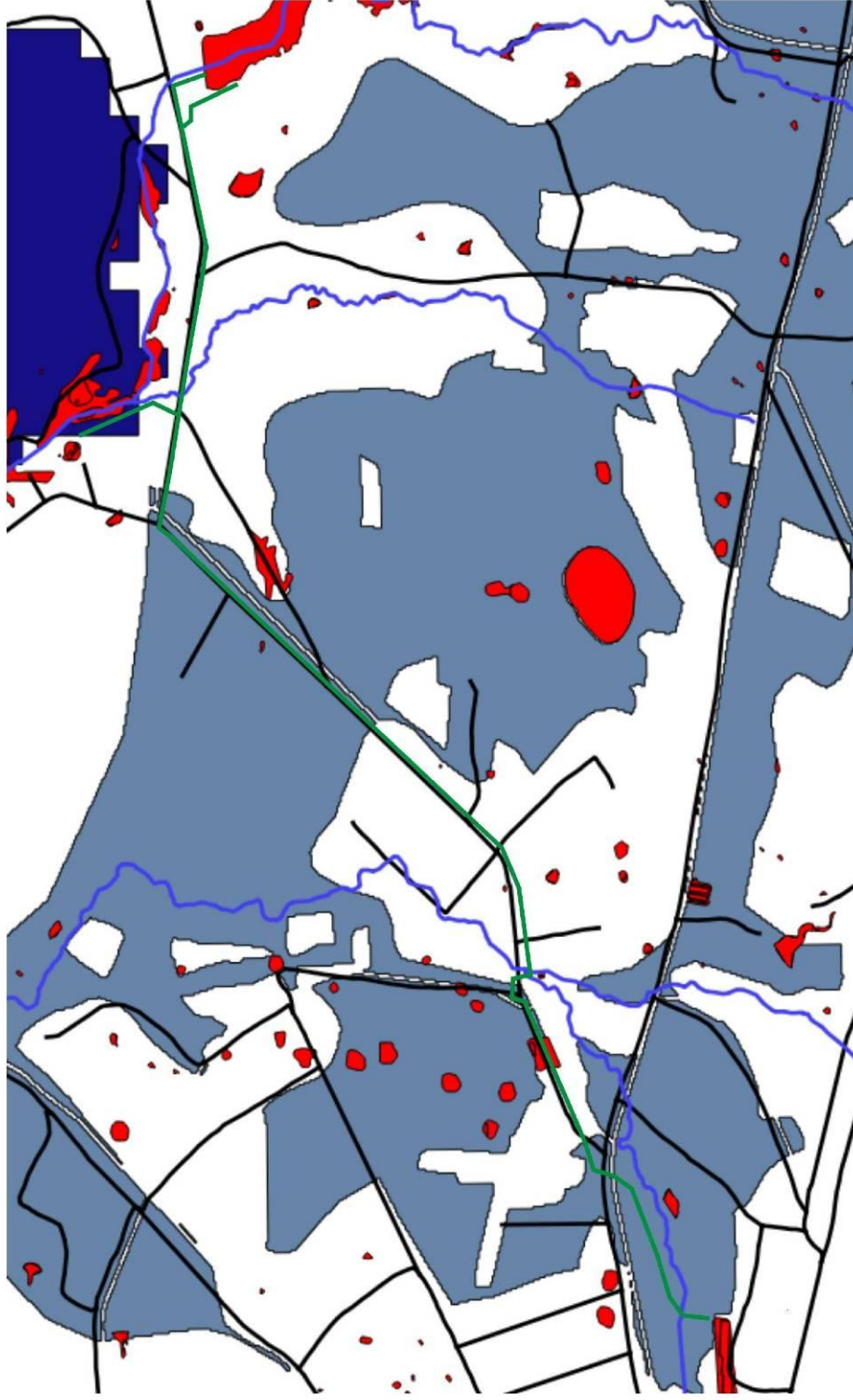
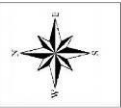
Suite 158, P/Bag X01, Brandhof, 9324

Tel: 051 4444 700

Fax: 086 6976 132



Sensitivity map for the proposed construction of a bulk water transfer pipeline from the Maselspoort Dam and purification plant to the New Northern Waste Water Treatment Works (WWTW) and the Bloemfontein WWTW, Bloemfontein, Free State Province.



Map 2: Sensitivity of the proposed construction of a bulk water transfer pipeline from the Maselspoort dam and purification plant to the New Northern WWTW and Bloemfontein WWTW, Bloemfontein, Free State Province. The extent of remaining Threatened Ecosystems is indicated as well as wetlands and National Freshwater Ecosystems Priority Areas (NFEPA) watercourses. Note that the pipeline will not form part of a National Protected Areas Expansion Strategy (NPAES) Focus Area.



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Legend:

- Road Network
- NFEPA Watercourses
- Pipeline Route
- Wetlands
- Threatened Ecosystems
- NPAES Focus Areas

Map Information

Spheroid: WGS 84

Scale: 1:60 000

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Figure 1: View of the Modder River the pipeline will be installed to the west of the river and will not cross it.



Figure 2: View west of the Modder River indicating the approximate location of the proposed pipeline (red line).



Figure 3: Position of the pipeline along the northern portion leading to the Maselspoort Dam (red line). Note the dense thicket occurring in this area.



Figure 4: View of the northern portion of the proposed pipeline (red line). Note grassland in relatively good condition but uniform species composition.



Figure 5: View of the seasonal stream 4 in the northern portion of the pipeline route. The stream will be crossed by the pipeline and is in a good condition, utmost care must be taken to keep the impact on the stream to a minimum.



Figure 6: View of the seasonal stream 3 in the northern portion of the pipeline route. The stream will be crossed by the pipeline and is in a good condition, utmost care must be taken to keep the impact on the stream to a minimum.



Figure 7: View of seasonal stream 3. Note also the Red Listed and Declining *Crinum bulbispermum* which will be affected by the pipeline construction (red circles). These are only a few of the specimens which are present at this stream.



Figure 8: A portion of the pipeline route within the northern natural area. Note that the area outside the road reserve is degraded due to being cleared as a firebreak.



Figure 9: A portion of the pipeline route within the northern natural area. Note that the area outside the road reserve is degraded due to being cleared as a firebreak.



Figure 10: View of the seasonal stream 2 (blue line). The main channel of the stream is indistinct but it is clear that the stream transports a high volume of water. It is in a good condition and utmost care must be taken to keep the impact on the stream to a minimum.



Figure 11: View of the seasonal stream 1. The stream flows through small holdings and consequently is degraded.



Figure 12: View of the Roodewal Small Holdings through which the pipeline will be installed (red line). This area is transformed.

Appendix B: Protected species on the site

Protected species on the site may not be limited to these species but these species have identified on and around the site. Additional sources should be consulted to confirm the presence of protected species.



Crinum bulbispermum

Orange River Lily/Oranjerivierlelie/Vleilelie

Protected in the Free State Province

National Red List Status: **Declining**

Method: **The species occurs along the seasonal stream 3 and 4. It is anticipated that due to the small footprint of the pipeline only a few will be affected. These must be transplanted to an area adjacent to the pipeline in suitable and similar habitat. Permits must be obtained for transplantation. Plants only flower for a short period after which they may be difficult to identify in which case an ecologist should be consulted.**

Appendix C: Likely invader weed species

Invader weed species in the pipeline route may not be limited to these species but these are considered to be the most likely and significant invaders to occur. Additional sources should be consulted to confirm invader weed species as well as the best method to eradicate them.

According to the Conservation of Agricultural Resources Act, No. 43 of 1983 any Category 1 declared plants must be controlled by the land user on whose land such plants are growing.



Cirsium vulgare
Scotch Thistle/Skotse Dissel

Type: Weed
Category: 1

Mechanical removal is effective to control this weed. Cutting should be done below soil level and no leaves should remain.



Xanthium spinosum
Spiny Cocklebur/Boetebos

Type: Weed
Category: 1

Mechanical removal by hand is effective to control this weed.

Several chemicals have also been registered for control: amitrole/simazine, bromoxynil, metribuzin, MCPA-K and 2,4-D(A).



Xanthium strumarium
Large cocklebur/Kankerroos

Type: Weed
Category: 1

Mechanical removal by hand is effective to control this weed. Cutting is not recommended as this leads to re-sprouting.

Several chemicals have also been registered for control: bromoxynil, metribuzin, cyanazine/atrazine, bendioxide, MCPB, MCPA-K and 2,4-D(A), (T), (I).



Argemone ochroleuca
Mexican Poppy

Type: Weed
Category: 1

Mechanical removal by hand is effective against this weed.

Several chemicals have also been registered for control: 2, 4-D, 2, 4-DB, dicamba, diuron, fluroxypyr, hexazinone, isoproturon, karbutilate, MCPA, picloram and terbutryn.



Solanum eleagnifolium
Silver-leaf Bitter Apple/Satansbos

Type: Wees
Category: 1

Chemical control is most effective for control of this weed. Garlon 4 (triclopyr) is the only registered herbicide for control.



Datura stramonium
Common Thorn Apple/Gewone stinkblaar

Type: Weed
Category: 1

Mechanical control is most effective. Pulling of plants and correct disposal of seed bearing plants is effective.

Chemical control is by means of a glyphosate spray



Datura ferox
Large thorn-apple/Grootstinkblaar

Type: weed

Category: 1

Mechanical removal by hand is effective for this weed.

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