An apparent drainage depression was observed immediately north of the Kynoch site (**Figure 22**) and this feature has undergone the same alteration as the one to the south in the form of Allandale Road and its associated storm water infrastructure.

Figure 22 Google Earth images from 2003 (top) and 2015 (bottom) indicating the drainage feature

7.2.3 Site 3

The concave area that forms the headwaters for the depression on Site 3 has been developed in its entirety (**Figure 23**) with a subsequent highly altered hydrological regime and storm water runoff.

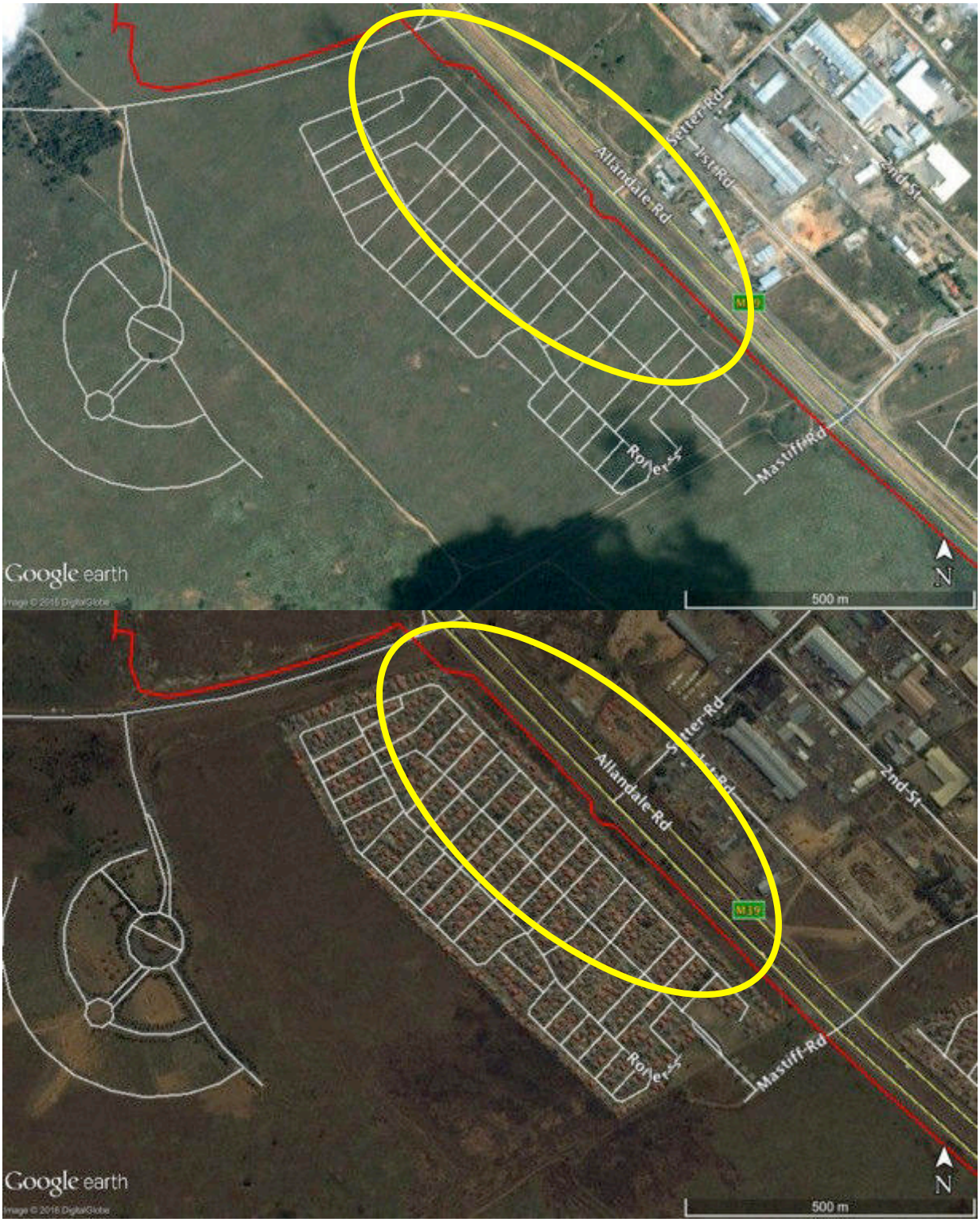

Figure 23 Google Earth images from 2003 (top) and 2016 (bottom) indicating the drainage feature

7.2.4 Site 4

The headwaters of the wetland and watercourse identified on Site 4 exhibited wattle trees during 2003 and has experienced a drastic change by 2015 in the form of the establishment of the Waterfall Cemetery (**Figure 24**). The pipeline alignment runs along the existing and planned future road layout on the site.

Figure 24 Google Earth images from 2002 (top) and 2016 (bottom) indicating the drainage feature

7.4 SOIL FORM AND SOIL WETNESS INDICATORS

The investigation on the site revealed that the soils along the pipeline corridor conform to the description of the soils of the HHGD. Most of the soils along the corridor however have been altered significantly through the impacts associated with the construction of road infrastructure. In this sense the natural soils have been altered significantly and even changed into soils of the Witbank (orthic A horizon / man-made soil deposit) in many places.

7.4.1 Site 1

This site has been impacted significantly and no intact soil profiles were observed (**Figures 25** to **27**). The roadbed is wide and grades into an area downslope that has been subjected to the construction of a road, excavation and construction of storm water trenches and the impoundment of water further downslope.

7.4.2 Site 2

Site 2 is characterised by a large concave area that constitutes a typical headwater area with associated seepage zone of the HHGD. The soils associated with this type of area have been elucidated in sections 5.7 and 5.8. Allandale Road forms a distinct interception of the wetland and watercourse associated with the feature as does the access road to the old Kynoch facilities. The road interception and continual construction activities associated with this feature are indicated in **Figures 28** to **36**.

Figure 25 View of Site 1 towards the east

Figure 26 View of Site 1 towards the south

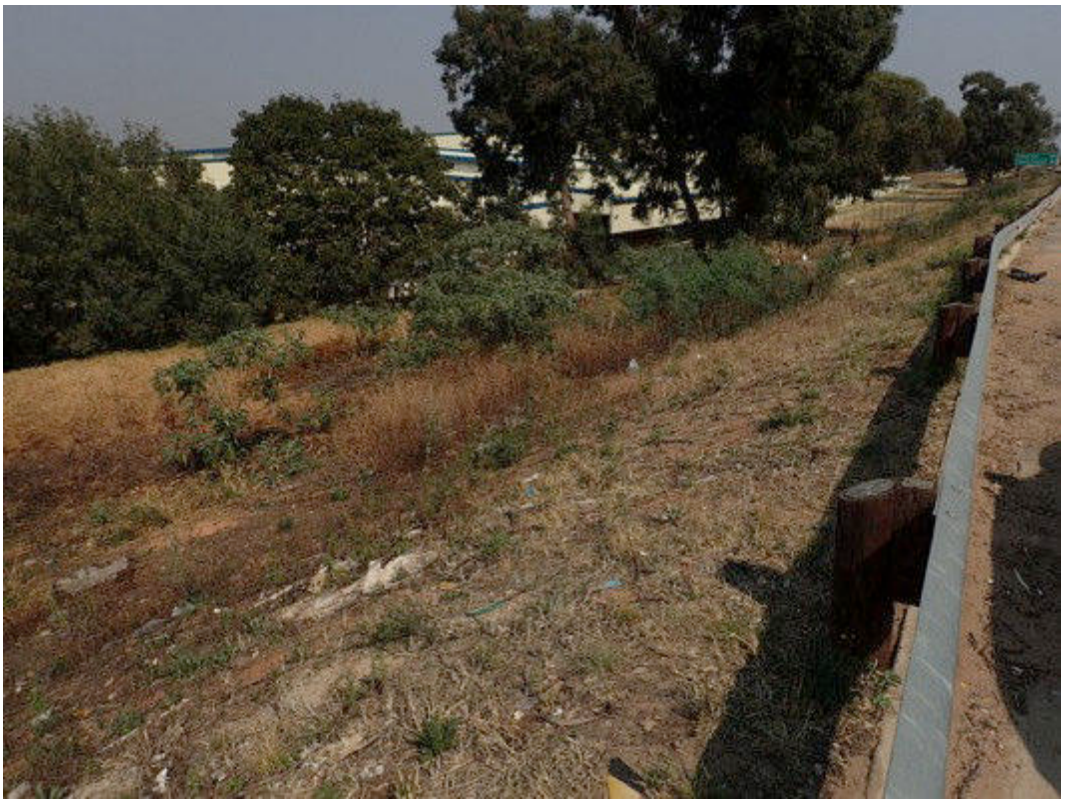

Figure 27 View of Site 1 towards the west

Figure 28 View of Site 2 towards the northwest with additional road infrastructure and storm water structures under construction

Figure 29 View of Site 2 towards the northwest with a storm water inlet between the two lanes

Figure 30 View of Site 2 towards the south upslope from Allandale Road with exotic vegetation indicative of a wetter part of the landscape

Figure 31 Darkened A horizon soil material on Site 2 that indicates an original seepage wetland zone

Figure 32 View of Site 2 towards the north west with Allandale Road and its storm water infrastructure evident

Figure 33 View of Site 2 towards the south with a seepage zone immediately above Allandale Road that has been intercepted and cut off by the associated storm water infrastructure

Figure 34 Current road works and trenching on Site 2

Figure 35 Current road works and trenching on Site 2

Figure 36 Current road works and trenching on Site 2

The soils of the site have been impacted in the infrastructure development area and the hydrological pathways have been intercepted. Within the road reserve as well as immediately on the edge of the roadways the soils have been altered to that of the Witbank soil form and extensive areas have been compacted. It is also evident on the upslope side of Allandale Road (**Figures 30** to **33**) that the lateral seepage of water has been intercepted by storm water infrastructure and that this water is forced to the surface with a subsequent flow into the storm water channel.

The drainage feature further to the north west on Allandale Road on Site 2 exhibits a similar pattern in terms of the severing of the lateral flow paths from the upslope areas. The vegetation is dominated extensive kikuyu grass growth and it appears that there are swales or surface soil disturbances evident immediately upslope of the road (**Figure 37** to **40**). This area on the road is characterised by a storm water inlet upslope from Allandale Road that appears blocked (**Figure 41**), a storm water inlet between the two roadways (**Figure 42**) and a storm water outlet between houses towards the drainage feature to the north (**Figure 43**).

In all these cases that hydrological functioning of the landscape has been altered through the establishment of the road infrastructure.

Figure 37 Kikuyu grass on Site 2 above Allandale Road (view to the southeast)

Figure 38 Kikuyu grass on Site 2 above Allandale Road (view to the south)

Figure 39 Kikuyu grass on Site 2 above Allandale Road (view to the west)

Figure 40 Kikuyu grass and swales on the western section of Site 2 above Allandale Road (view to the west)

Figure 41 Blocked storm water inlet on Allandale Road on Site 2

Figure 42 Storm water inlet on Allandale Road on Site 2 between the roadways

Figure 43 Storm water outlet on Site 2 towards the north of Allandale Road

7.4.3 Site 3

Site 3 has been impacted in its entirety through urban developments and the soils have therefore been sealed through paving, roads and houses. The discussion in sections 5.10 and 5.11 therefore applies.

7.4.4 Site 4

The wetland and watercourse area on Site 4 has been impacted through the construction of the Alsation Road that provides access to the Gautrain infrastructure as well as to the Waterfall Cemetery. The main impacts on the wetland feature relate to the alteration of the hydrological functioning and water quality characteristics through infrastructure, grave digging and burial within its headwaters. The soils found on the site are in agreement with the discussion provided in sections 5.7 and 5.8 and will therefore not be repeated here.

The access road to the Waterfall Cemetery has storm water infrastructure associated with it (**Figures 44** to **46**) and there is a distinct storm water channel that runs down the upslope side of Alsatian Road (**Figure 47**). The area for the proposed extension of the access road and pipeline alignment is characterised by soils of the Wasbank and Dresden forms and as such have no wetland characteristics.

Figure 44 Storm water outlet under the access road to the Waterfall Cemetery

Figure 45 Storm water outlet under the access road to the Waterfall Cemetery

Figure 46 Storm water inlet under the access road to the Waterfall Cemetery

Figure 47 Storm water channel (unlined) running parallel to Alsatian Road above the access road to the Waterfall Cemetery

7.5 ARTIFICIAL MODIFIERS AND ALTERED HYDROLOGICAL DRIVERS

The common thread of the artificial modifiers on the site is the historical establishment of road infrastructure along the currently planned pipeline corridor. The establishment of roads alters the hydrological functioning of a landscape completely as it 1) intercepts later flowing water up to the depth of the road bed construction and 2) it catches, accumulates and channels storm water runoff. Additional impacts include the establishment of urban developments were surface sealing occurs as described in section 5.10 with the implications described in section 5.11.

8. WETLAND AND RISK ASSESSMENT

8.1 SITE 1

8.1.1 Proposed Delineation

The delineation of the wetland on Site 1 is provided in **Figure 48**. The delineation was conducted on the historical images available for the site and excludes the area that has been transformed for the construction of what appears to be storm water structures.

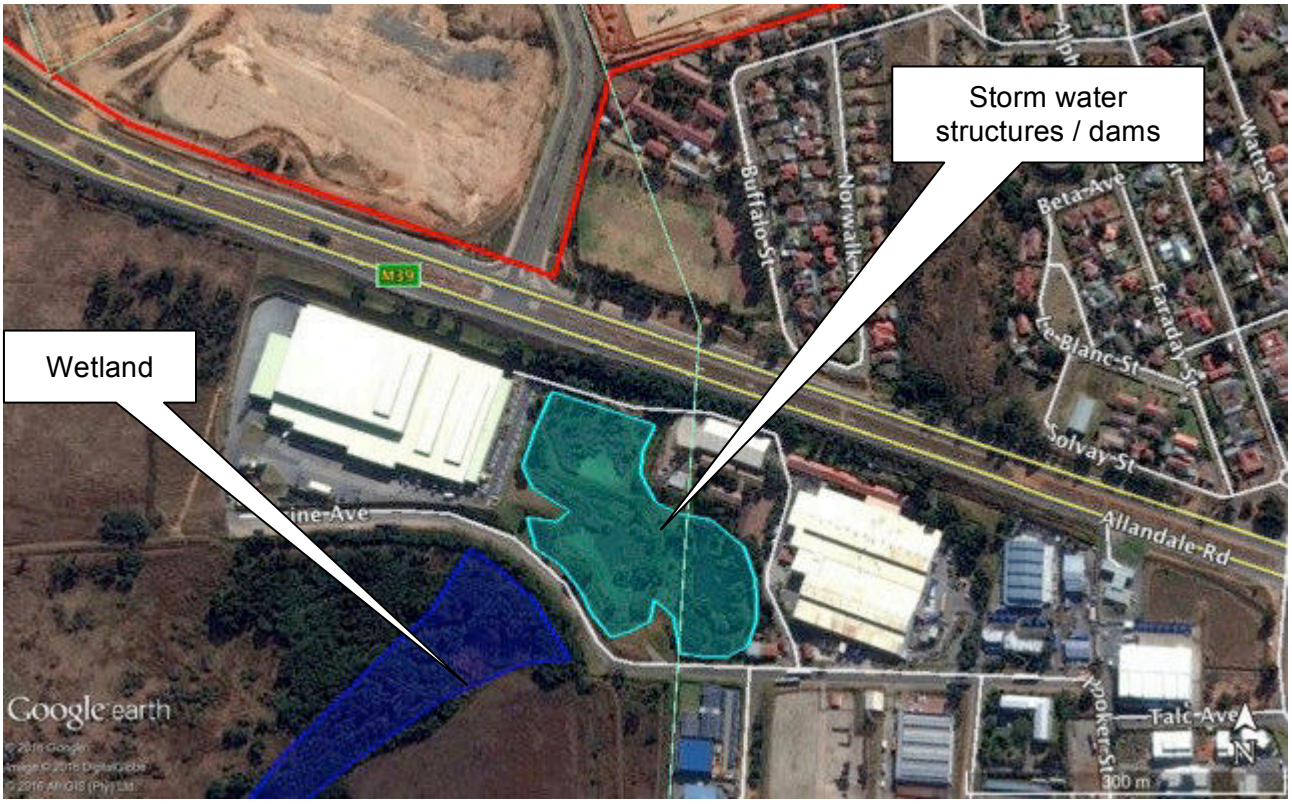

Figure 48 Proposed delineation and identification of storm water structures on Site 1

8.1.2 Present Ecological Status (PES) Determination

As is evident form **Figure 48** the wetland and watercourse area has been impacted significantly through 1) the construction of Allandale Road historically over the drainage feature with a subsequent alteration of the hydrology through increase and concentrated storm water runoff, 2) the construction of several dams or storm water containment structures within the watercourse and 3) the presence of wattle trees within the original watercourse downslope of the man-made structures. Due to the drastic alteration of the watercourse, the storm water signatures, the ecology of the wetland and the hydrological drivers the wetland / watercourse is assigned a PES value of F.

8.1.3 Water Quality Analysis

Due to the lack of surface water within the wetland area a water quality analysis exercise was not conducted.

8.1.4 Identification of Impacts of Proposed Upgrade on Wetlands

8.1.4.1 Impact on Flow Regime

On the specific site there will be no impact on the current flow regime of the wetland nor will there be an impact on any wetland within the 500 m regulatory zone.

8.1.4.2 Impact on Water Quality

The current water quality of the wetland may be impacted temporarily through an increased sediment load if a large amount of sediment is washed from the construction site. With mitigation this impact can be managed satisfactorily (refer to mitigation measures).

8.1.4.3 Impact on Habitat

The pipeline corridor traverses the road reserve and as such there will be a negligible impact on wetland habitat.

8.1.4.4 Impact on Biota

The pipeline corridor traverses the road reserve and as such there will be a negligible impact on wetland biota.

8.1.5 Mitigation Measures and Rehabilitation Strategy

The important mitigation measures for the upgrading and installation of the pipeline on Site 1 include the following:

1. Sediment generation should be prevented through adequate housekeeping during construction. The specific mitigation measures should be generated by the project engineer and implemented by the site manager. These measure include:
    a. The establishment of earth bunds on the downslope area to trap sediment.
    b. Timing of the excavation (if possible) to coincide with the dry season.
    c. Compaction of fill material on the surface to increase hardness and resistance to erosion.
    d. Identification of preferential flow areas of water on the surface (as a function of local topography) and the establishment of stabilised vegetated or concreted preferential flow areas into the storm water infrastructure.
2. Post development the exposed surface area of the pipeline corridor should be stabilised against erosion on slopes.
3. Lateral seepage water that accumulates upslope of the compacted fill area of the pipeline trench should be mitigated and managed to allow for flowing over the in-filled trench area without causing erosion. This can be done through the establishment of stabilised overflow areas and vegetation of the soil covering.
4. The hydrological impact of the trenching and compaction of the fill material cannot be mitigated but is negligible in the presence of a roadbed that runs along the pipeline corridor. In this regard the hydrological attenuation should be conducted along with the approved and established storm water management infrastructure associated with the Allandale Road.

8.1.6 Monitoring Protocol

The surface stability and sediment generation of the corridor should be inspected and addressed on the following basis;

1. Inspect corridor and compacted surface area as soon as possible after the first three large rainfall events. In the event that sediment generation and erosion is evident corrective measures should be taken in the context of the mitigation and rehabilitation measures provided above.
2. Inspect the corridor yearly after the end of the rainy season for a period of two years to confirm stability of the earth works.

8.2 SITE 2

8.2.1 Proposed Delineation

The high-level delineation of the wetlands on Site 2 is provided in **Figures 49** to **51**. The delineation was conducted on the historical images available for the site and excludes the areas that have been impacted by road construction and associated storm water structures.

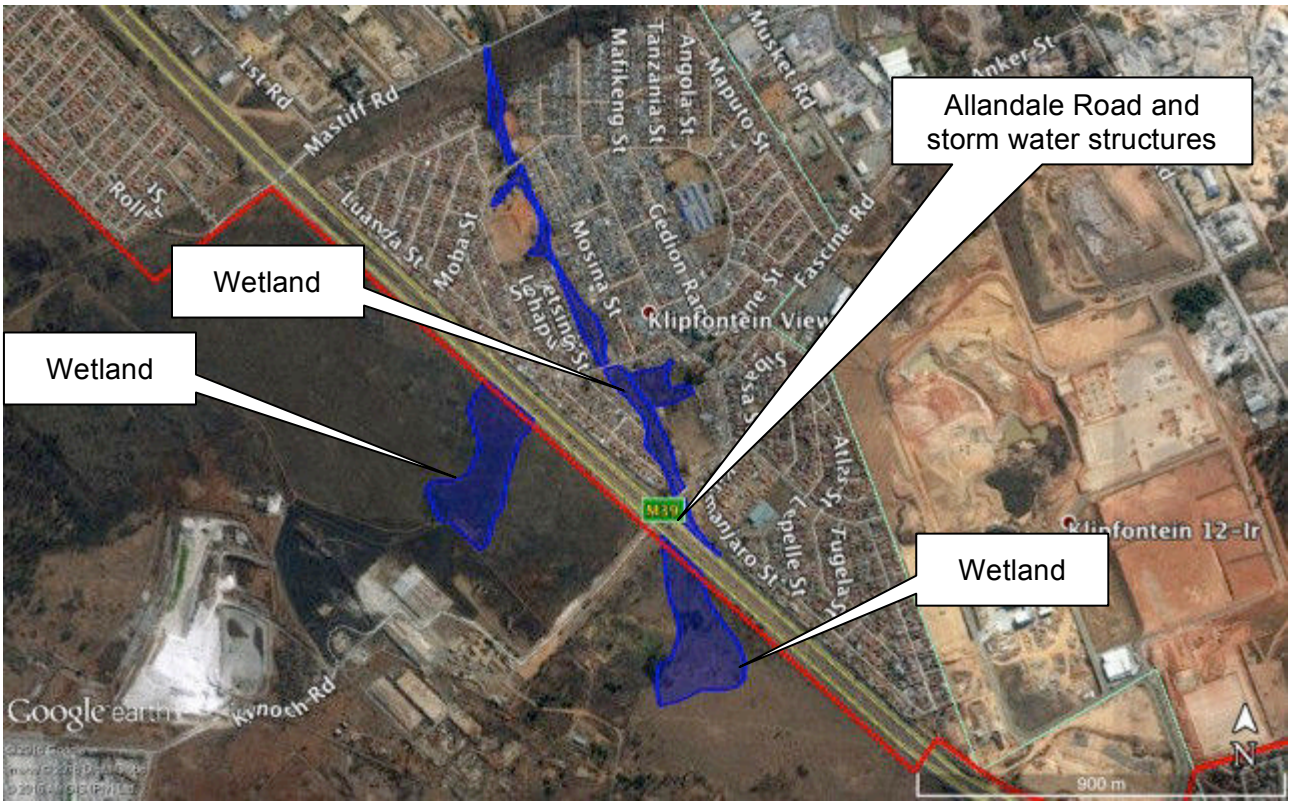

Figure 49 Proposed high-level delineation and identification of urban impacts on Site 2

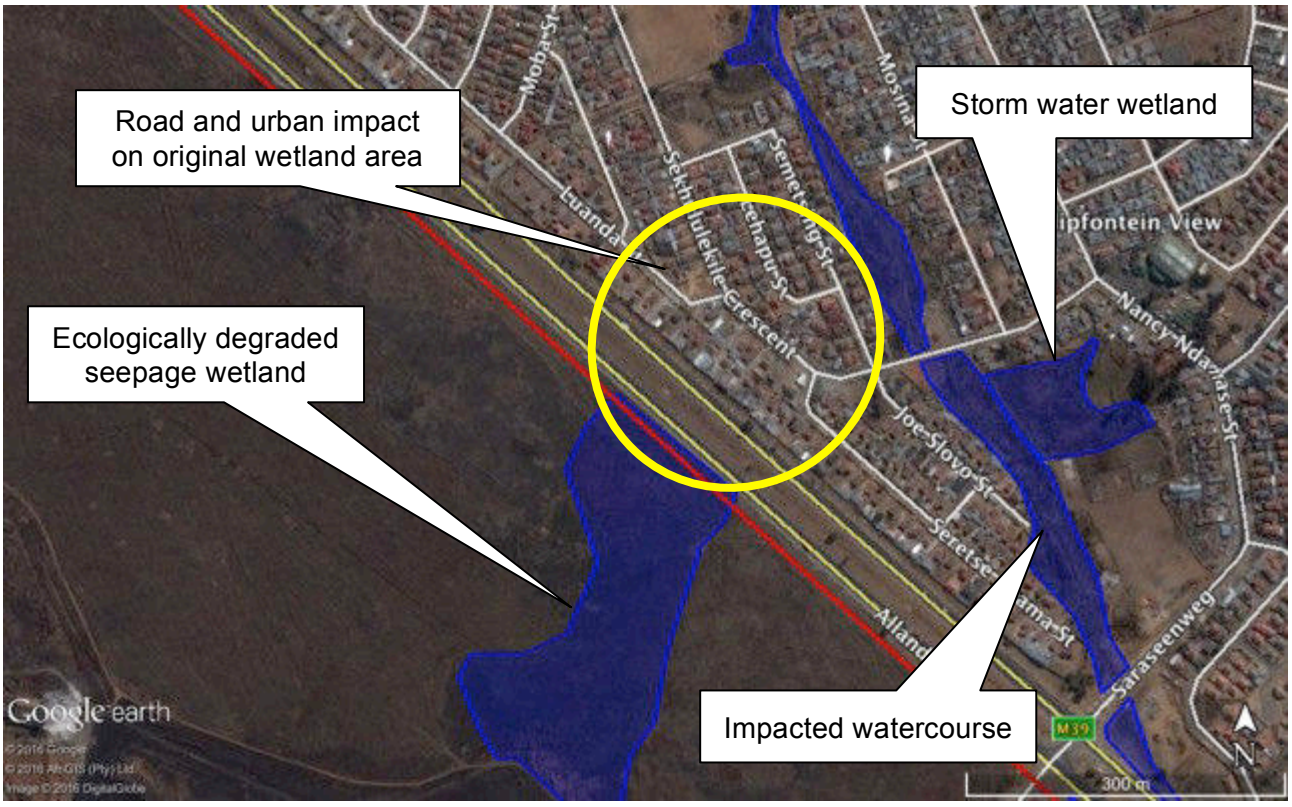

Figure 50 Proposed delineation and identification of urban impacts on Site 2

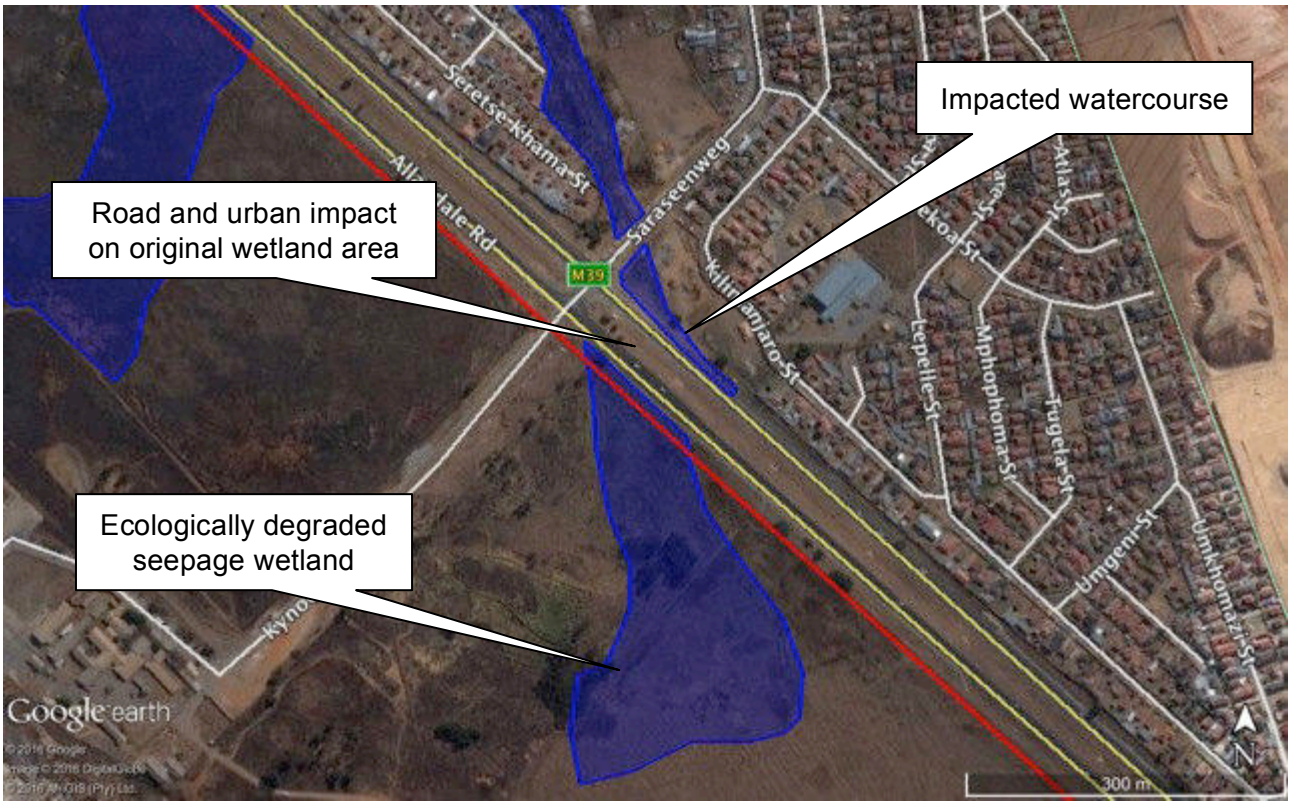

Figure 51 Proposed delineation and identification of urban impacts on Site 2

8.2.2 Present Ecological Status (PES) Determination

As is evident form **Figures 49** to **51** the wetlands and watercourses have been impacted significantly through 1) the construction of Allandale Road historically over the drainage feature with a subsequent alteration of the hydrology through increase and concentrated storm water runoff, 2) the impacts of Allandale Road and the urban developments of Klipfontein View that has severed the northern seepage wetland form the watercourse, 3) the encroachment of Klipfontein View development on the watercourse emanating from the site and 4) the historical land use activities on the AECI site that has lead to the drastic alteration of the vegetation within the seepage wetland areas. Due to the drastic alteration of the watercourse and its associated seepage wetlands through urban infrastructure developments, storm water runoff structures and long-term historical land use changes the impacted wetland / watercourse areas are assigned a PES value of F.

8.2.3 Water Quality Analysis

Due to the lack of surface water within the wetland area a water quality analysis exercise was not conducted.

8.2.4 Identification of Impacts of Proposed Upgrade on Various Wetlands

8.2.4.1 Impact on Flow Regime

On the specific site there will be no impact on the current flow regime of the wetland nor will there be an impact on any wetland within the 500 m regulatory zone as the current road and its associated storm water infrastructure exerts an overriding influence of the site and wetland / watercourse flow regime.

8.2.4.2 Impact on Water Quality

The current water quality of the wetland may be impacted temporarily through an increased sediment load if a large amount of sediment is washed from the construction site. With mitigation this impact can be managed satisfactorily (refer to mitigation measures).

8.2.4.3 Impact on Habitat

The pipeline corridor traverses the road reserve and as such there will be a negligible impact on wetland habitat as the wetland habitat within the road reserve has already been degraded significantly.

8.2.4.4 Impact on Biota

The pipeline corridor traverses the road reserve and as such there will be a negligible impact on wetland biota as there is no wetland biota associated with the already disturbed area.

8.2.5 Mitigation Measures and Rehabilitation Strategy

The important mitigation measures for the upgrading and installation of the pipeline on Site 1 include the following:

1. Sediment generation should be prevented through adequate housekeeping during construction. The specific mitigation measures should be generated by the project engineer and implemented by the site manager. These measure include:
    a. The establishment of earth bunds on the downslope area to trap sediment.
    b. Timing of the excavation (if possible) to coincide with the dry season.
    c. Compaction of fill material on the surface to increase hardness and resistance to erosion.
    d. Identification of preferential flow areas of water on the surface (as a function of local topography) and the establishment of stabilised vegetated or concreted preferential flow areas into the storm water infrastructure.
2. Post development the exposed surface area of the pipeline corridor should be stabilised against erosion on slopes.

3. Lateral seepage water that accumulates upslope of the compacted fill area of the pipeline trench should be mitigated and managed to allow for flowing over the in-filled trench area without causing erosion. This can be done through the establishment of stabilised overflow areas and vegetation of the soil covering.
4. The hydrological impact of the trenching and compaction of the fill material cannot be mitigated but is negligible in the presence of a roadbed that runs along the pipeline corridor. In this regard the hydrological attenuation should be conducted along with the approved and established storm water management infrastructure associated with the Allandale Road.

8.2.6 Monitoring Protocol

The surface stability and sediment generation of the corridor should be inspected and addressed on the following basis;

1. Inspect corridor and compacted surface area as soon as possible after the first three large rainfall events. In the event that sediment generation and erosion is evident corrective measures should be taken in the context of the mitigation and rehabilitation measures provided above.
2. Inspect the corridor yearly after the end of the rainy season for a period of two years to confirm stability of the earth works.

8.3 SITE 3

The anticipated seepage area on Site 3 has been developed in its entirety and will therefore not be discussed in any further detail in this report.

8.4 SITE 4

8.4.1 Proposed Delineation

The high-level delineation of the wetland on Site 4 is provided in **Figure 52**. The delineation was conducted on the historical images available for the site as well as previous on site wetland delineation soil surveys.

8.4.2 Present Ecological Status (PES) Determination

Form **Figure 52** it is evident that the wetland extends from the Waterfall Cemetery near the crest of the landscape to a stream that flows into the Jukskei River in the north. The wetland and watercourse has experience impacts in the form of extensive urban infrastructure developments associated with the cemetery, unknown water quality impacts from the burial activities within the headwaters and seepage area of the wetland on the cemetery site and historical agricultural activities immediately surrounding the seepage and watercourse wetlands. Along the pipeline corridor along the roads and on the side of the cemetery (Section 1 – **Figure 53**) the wetland has a

PES rating of an E and on the proposed development site (Section 2 – **Figure 53**) it has a localised rating of a C. The latter will change to an F once the site has been developed in terms of residential and road infrastructure.

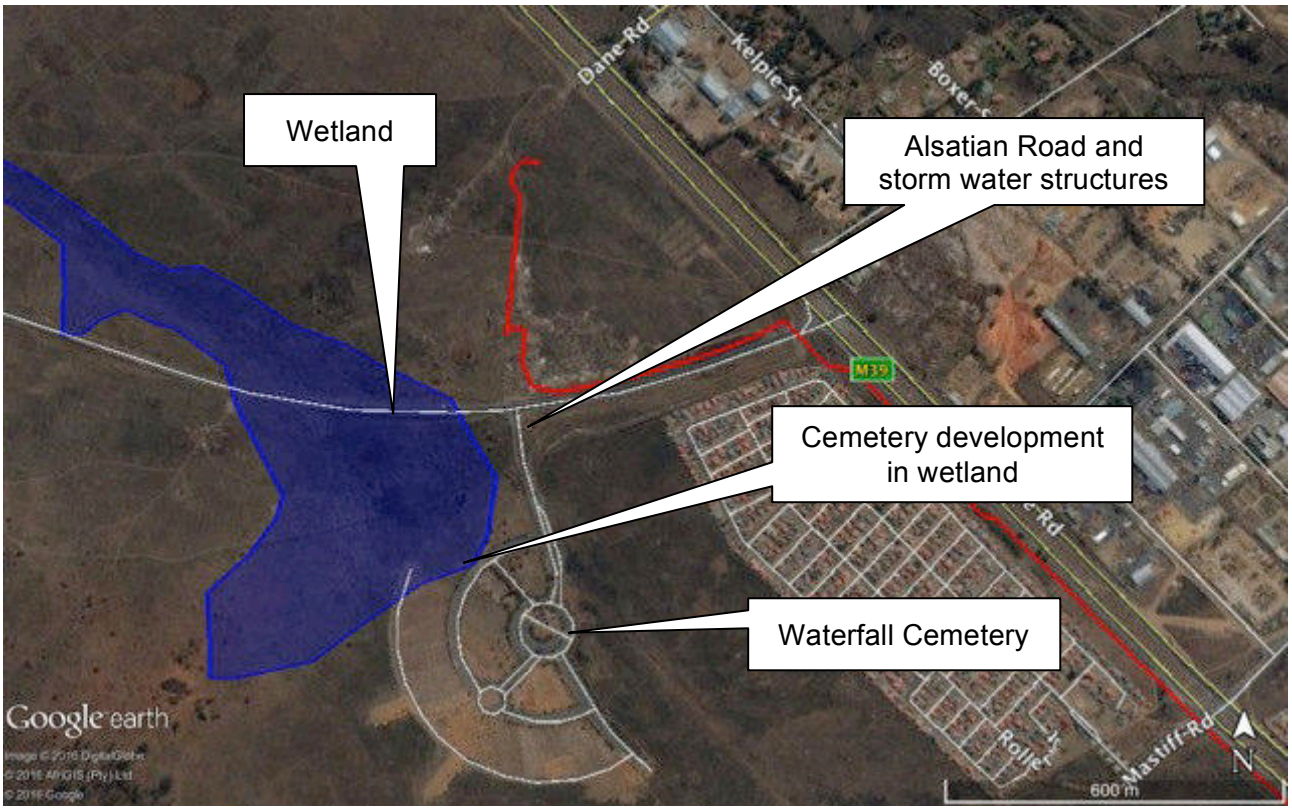

Figure 52 Proposed delineation and identification of urban impacts on Site 4

8.4.3 Water Quality Analysis

Due to the lack of surface water within the wetland area a water quality analysis exercise was not conducted.

8.4.4 Identification of Impacts of Proposed Upgrade on Various Wetlands

8.4.4.1 Impact on Flow Regime

Current and Future State in Area With Existing Road and Storm Water Developments (Section 1 Figure 53): On this part of the site there will be no impact on the current flow regime of the wetland nor will there be an impact on any wetland within the 500 m regulatory zone as the current road and its associated storm water infrastructure exerts an overriding influence of the site and wetland / watercourse flow regime.

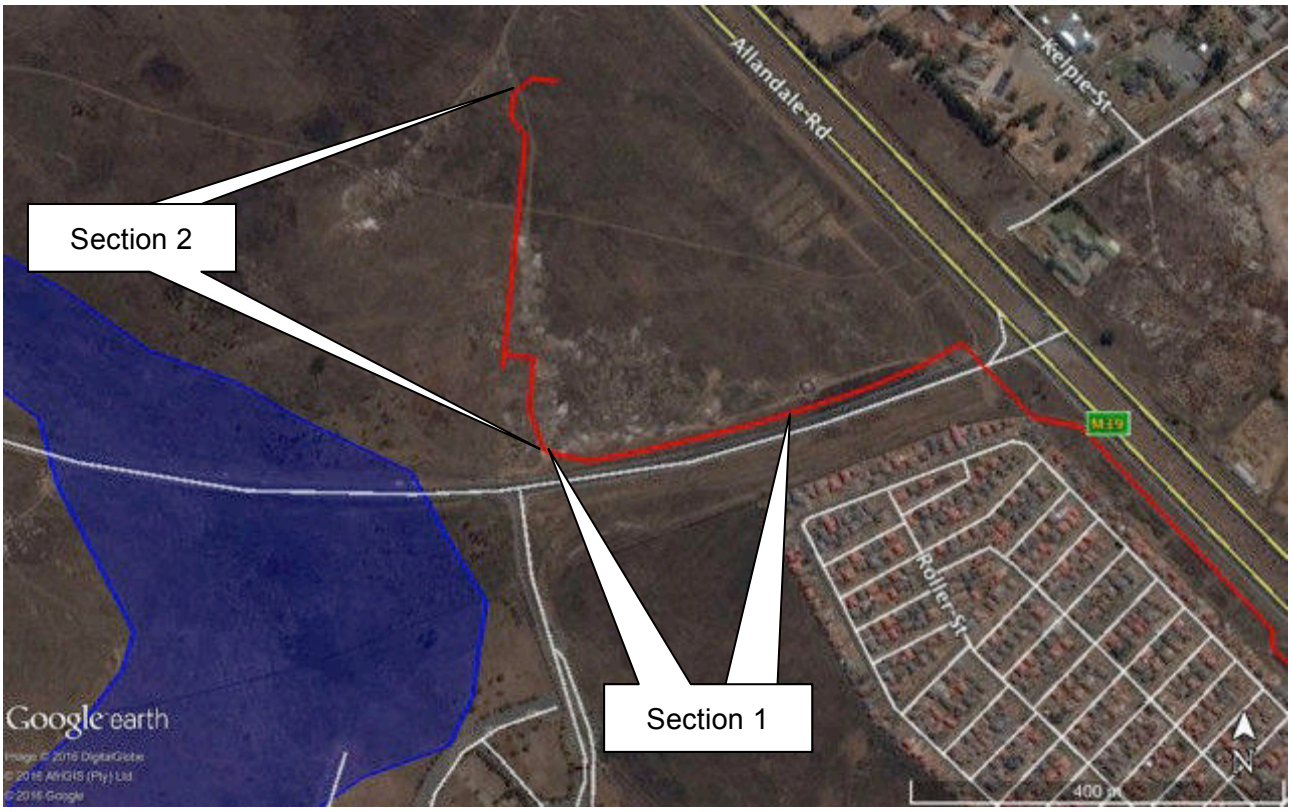

Figure 53 Pipeline development discussion sections on the site

Current State in Area Without Road Development Currently (Section 2 Figure 53): Under the current state of the wetland (before any road or urban developments) the construction of the pipeline will have a permanently detrimental effect on the flow regime of the landscape in that the pipeline will intercept laterally flowing water. This is in line with the discussion provided in section 5.13.2 under point 3 and visually explained in **Figures 16** to **18**. On the specific site the flow regime will be altered in that the water will pond upslope of the in-filled and compacted trench material. This water will seep out of the soil and flow over the in-filled material if the levels allow. The overall impact on the identified wetland will be negligible as the impact area forms but a small part of the entire wetland hydrological feeding area.

Future State in Area Without Road Development Currently (Section 2 Figure 53): The future state of the site will be in line with the discussion provided for Section 1 (**Figure 53**) and will be significantly and permanently altered through the construction of the access roads (along which the pipeline corridor runs) and urban developments (paving and sealing of land surface – refer to sections 5.10, 5.11 and 5.13).

8.4.4.2 Impact on Water Quality

Current and Future State in Area With Existing Road and Storm Water Developments (Section 1 Figure 53): The current water quality of the wetland may be impacted temporarily through an increased sediment load if a large amount of sediment is washed from the construction site. With mitigation this impact can be managed satisfactorily (refer to mitigation measures).

Current State in Area Without Road Development Currently (Section 2 Figure 53): The water quality will be affected within the lateral seepage area in that the water that accumulates (ponds) upslope of the in-fill material and trench will be forced to the surface and will experience oxidised conditions after development as opposed to more anoxic conditions in the natural state. This is in line with the discussion in section 5.13.2, Point 4. Although this change will have a small, and not necessarily detrimental impact on the water quality, the impact will be permanent. This impact will be negligible however as there are much larger water quality determinants within the catchment of the wetland in the form of the leaching of water through the burial area. Important: In this area the current status of the water quality is not known as it is impacted by fluctuating water levels in the graves with variable oxidizing and reducing conditions leading to variable casket and cadaver decomposition rates.

Future State in Area Without Road Development Currently (Section 2 Figure 53): The future state of the water quality will be determined by the extensive urban development activities and water will therefore flow on the surface and fast as opposed to subsurface laterally and slow. This could have a marked effect on the water quality in the form of urban footprints. These activities have no correlation with the pipeline construction activities and will therefore not be discussed further in this report.

8.4.4.3 Impact on Habitat

Current and Future State in Area With Existing Road and Storm Water Developments (Section 1 Figure 53): The pipeline corridor traverses the road reserve and as such there will be a negligible impact on wetland habitat as there is no wetland habitat associated with the already disturbed area.

Current State in Area Without Road Development Currently (Section 2 Figure 53): The current state of this area is characterised by historical agricultural activities with a subsequent alteration of the ecological characteristics of the site. The downslope site of the pipeline corridor is also characterised by historical rubble dumping and as such has been impacted significantly already. The impact of the pipeline will be limited to the corridor itself in terms of physical impacts. The water quality and flow regime impacts (as described above) will lead to a change in the ecological characteristics of the immediately upslope and downslope areas.

Future State in Area Without Road Development Currently (Section 2 Figure 53): The future state of the habitat will be significantly different to the reference state as the upslope areas are to be developed for urban infrastructure and residential properties. The habitat in the upslope area will therefore be destroyed completely and the downslope area will be altered through the change in hydrological regime.

8.4.4.4 Impact on Biota

Refer to point 8.4.4.3 as the impacts are generic for habitat and biota. The larger wetland has already been impacted by activities that include 1) impacts of the cemetery, 2) impacts of the roads in the headwaters, 3) impacts of a sewer line constructed along the alignment of the watercourse and 4) the historical agricultural activities.

8.4.5 Mitigation Measures and Rehabilitation Strategy

IMPORTANT NOTE: The mitigation and rehabilitation measures for the pipeline cannot be separated from the impacts expected for the development for which the pipeline is earmarked. The mitigation measures and rehabilitation strategy will therefore be discussed in the context of the future developments as well as the current state of the site.

The important mitigation measures for the upgrading and installation of the pipeline on Site 4 include the following:

1. Sediment generation should be prevented through adequate housekeeping during construction. The specific mitigation measures should be generated by the project engineer and implemented by the site manager. These measure include:
    a. The establishment of earth bunds on the downslope area to trap sediment.
    b. Timing of the excavation (if possible) to coincide with the dry season.
    c. Compaction of fill material on the surface to increase hardness and resistance to erosion.
    d. Identification of preferential flow areas of water on the surface (as a function of local topography) and the establishment of stabilised vegetated or concreted preferential flow areas into the storm water infrastructure.
2. Post development the exposed surface area of the pipeline corridor should be stabilised against erosion on slopes.
3. Lateral seepage water that accumulates upslope of the compacted fill area of the pipeline trench should be mitigated and managed to allow for flowing over the in-filled trench area without causing erosion. This can be done through the establishment of stabilised overflow areas and vegetation of the soil covering.
4. The hydrological impact of the trenching and compaction of the fill material cannot be mitigated but is negligible in the presence of a roadbed that runs along the pipeline corridor. In this regard the hydrological attenuation should be conducted along with the approved and established storm water management infrastructure associated with the Allandale Road.

8.2.6 Monitoring Protocol

The surface stability and sediment generation of the corridor should be inspected and addressed on the following basis;

1. Inspect corridor and compacted surface area as soon as possible after the first three large rainfall events. In the event that sediment generation and erosion is evident corrective measures should be taken in the context of the mitigation and rehabilitation measures provided above.
2. Inspect the corridor yearly after the end of the rainy season for a period of two years to confirm stability of the earth works.

9. RISK ASSESSMENT

A risk assessment was conducted for the pipeline construction activities for the four identified sites according to the risk assessment methodology stipulated by DWS (Section 21c and i water use Risk Assessment Protocol, 2015). **Tables 3** to **6** contain the risk assessment for Sites 1 to 4 respectively.

10. CONCLUSIONS AND RECOMMENDATIONS

The following conclusions are drawn from the investigation:

1. The proposed pipeline corridor traverses four areas that were indicated to be potential wetland or watercourses.
2. The proposed pipeline corridor runs alongside a number of roads with a historical impact on the hydrological functioning of the landscape in the form of interception of lateral seepage and surface water flows.
3. The impacts associated with the upgrading and construction of the pipeline are considered to be negligible compared to the impacts of the already established road infrastructure. In this regard the pipeline will not contribute to any additional impacts save for possible erosion of surface soils material that can and should be mitigated during construction.
4. Adequate erosion prevention measures should be implemented for the post-development site.
5. The small area of new road development in the north lies within a terrestrial area that is hydrologically linked with the wetland/watercourse. The road development will have a much greater effect on the hydrology than the pipeline construction and it is therefore proposed that the pipeline be installed at the same time as the road construction takes place in order to minimise the impacts. In this regard sediment generation and erosion mitigation measures should be put in place for both these development but these can dovetail if conducted simultaneously.
6. The risk assessment conducted for the sites indicate the following risk ratings:
    a. Site 1: Significance: 32; Risk Rating: L; Confidence Level: H
    b. Site 2: Significance: 32; Risk Rating: L; Confidence Level: H
    c. Site 3: Significance: 32; Risk Rating: L; Confidence Level: H
    d. Site 4 Current state: Significance: 48; Risk Rating: L; Confidence Level: H
    e. Site 4 Future state after approved developments: Significance: 32; Risk Rating: L; Confidence Level: H

Table 3 Site 1 pipeline construction risk assessment

Category	**Discussion / Comments**	**Rating**
Phase	Construction Phase	
Activity	Construction of pipeline next to Allandale Road	
Aspect		
Impact	Excavation and infilling of trench, laying of pipe and compaction of fill material	
Severity: Flow Regime	Flow regime drastically and permanently altered historically from reference state for construction of Allandale Road	**1**
Severity: Physico & Chemical (Water Quality)	Drastically altered historically	**1**
Severity: Habitat (Geomorphology + Vegetation	Drastically altered historically	**1**
Severity: Biota	Drastically altered historically for road construction and through historical land uses	**1**
Severity Rating	Insignificant in context of historical modifiers	**1**
Spatial Scale	Construction site only	**1**
Duration	Construction phase only	**2**
Consequence	Sum of above three	**4**
Frequency of activity	Activity takes place once	**1**
Frequency of Impact	Permanent impact	**5**
Legal Issues	Drastic historical modifier context leading to the categorisation of the drainage depression, in the vicinity of the road, as severely modified with none of the original drivers and characteristics	**1**
Detection		**1**
Likelihood	Sum of above 4	**8**
Significance		**32**
Risk Rating	Low	**L**
Confidence Level	High	**H**
Control Measures	Erosion control and sediment containment	
Borderline LOW MODERATE Rating Classes		
PES and EIS of Watercourse	At the point of the road impact and within road reserve	**F**

Table 4 Site 2 pipeline construction risk assessment

Category	**Discussion / Comments**	**Rating**
Phase	Construction Phase	
Activity	Construction of pipeline next to Allandale Road	
Aspect		
Impact	Excavation and infilling of trench, laying of pipe and compaction of fill material	
Severity: Flow Regime	Flow regime drastically and permanently altered historically from reference state for construction of Allandale Road	**1**
Severity: Physico & Chemical (Water Quality)	Drastically altered historically	**1**
Severity: Habitat (Geomorphology + Vegetation	Drastically altered historically	**1**
Severity: Biota	Drastically altered historically for road construction and through historical land uses	**1**
Severity Rating	Insignificant in context of historical modifiers	**1**
Spatial Scale	Construction site only	**1**
Duration	Construction phase only	**2**
Consequence	Sum of above three	**4**
Frequency of activity	Activity takes place once	**1**
Frequency of Impact	Permanent impact	**5**
Legal Issues	Drastic historical modifier context leading to the categorisation of the drainage depression, in the vicinity of the road, as severely modified with none of the original drivers and characteristics	**1**
Detection		**1**
Likelihood	Sum of above 4	**8**
Significance	Consequence X Likelihood	**32**
Risk Rating	Low	**L**
Confidence Level	High	**H**
Control Measures	Erosion control and sediment containment	
Borderline LOW MODERATE Rating Classes		
PES and EIS of Watercourse	At the point of the road impact and within road reserve	**F**

Table 5 Site 3 pipeline construction risk assessment

Category	**Discussion / Comments**	**Rating**
Phase	Construction Phase	
Activity	Construction of pipeline along urban development edge	
Aspect		
Impact	Excavation and infilling of trench, laying of pipe and compaction of fill material	
Severity: Flow Regime	Flow regime drastically and permanently altered historically from reference state through establishment of urban development	**1**
Severity: Physico & Chemical (Water Quality)	Completely altered historically	**1**
Severity: Habitat (Geomorphology + Vegetation	Completely altered historically	**1**
Severity: Biota	Completely altered historically for road construction and through historical land uses	**1**
Severity Rating	Insignificant in context of historical modifiers	**1**
Spatial Scale	Construction site only	**1**
Duration	Construction phase only	**2**
Consequence	Sum of above three	**4**
Frequency of activity	Activity takes place once	**1**
Frequency of Impact	Permanent impact	**5**
Legal Issues	Complete historical destruction and alteration through urban development leading to the categorisation of the downslope drainage depression, in the vicinity of the road and elsewhere, as severely modified with none of the original drivers and characteristics	**1**
Detection		**1**
Likelihood	Sum of above 4	**8**
Significance		**32**
Risk Rating	Low	**L**
Confidence Level	High	**H**
Control Measures	Erosion control and sediment containment	
Borderline LOW MODERATE Rating Classes		
PES and EIS of Watercourse	At the point of the road impact and within road reserve	**F**

Table 6 Site 4 pipeline construction risk assessment

Category	Discussion / Comments	Rating
Phase	Construction Phase	
Activity	Construction of pipeline next Alsatian Road and access road to new urban development	
Aspect		
Impact	Excavation and infilling of trench, laying of pipe and compaction of fill material	
Severity: Flow Regime	Flow regime currently relatively intact in the northernmost section (only altered through historical agricultural activities) and altered drastically along Alsatian Road. Future drastic alteration expected on entire alignment with construction of new access road and urban development.	**3 (1)***
Severity: Physico & Chemical (Water Quality)	Refer to discussion under "Flow Regime"	**3 (1)***
Severity: Habitat (Geomorphology + Vegetation	Refer to discussion under "Flow Regime"	**3 (1)***
Severity: Biota	Refer to discussion under "Flow Regime"	**3 (1)***
Severity Rating	Insignificant in context of historical modifiers	**3 (1)***
Spatial Scale	Construction site only	**1**
Duration	Construction phase only	**2**
Consequence	Sum of above three	**6 (4)***
Frequency of activity	Activity takes place once	**1**
Frequency of Impact	Permanent impact	**5**
Legal Issues	Drastic historical modifier context	**1 (1)***
Detection		**1**
Likelihood	Sum of above 4	**8 (8)***
Significance		**48 (32)**
Risk Rating	Low	**L (L)***
Confidence Level	High	**H (H)***
Control Measures	Erosion control and sediment containment	
Borderline LOW MODERATE Rating Classes		
PES and EIS of Watercourse	Impacts already in place in broader watercourse in the form of 1) a sewer pipeline and 2) the infrastructure and activities associated with the Waterfall Cemetery	**C (E)***

*** Denotes the rating after the impacts of the approved road and urban developments along the pipeline corridor on Site 4**

7. For all the sites the current state risk assessments indicate that a General Authorisation (GA) process should be adequate. However, for Site 4 it is strongly recommended that the impacts for the pipeline be managed in conjunction with the impacts of the associated urban development.

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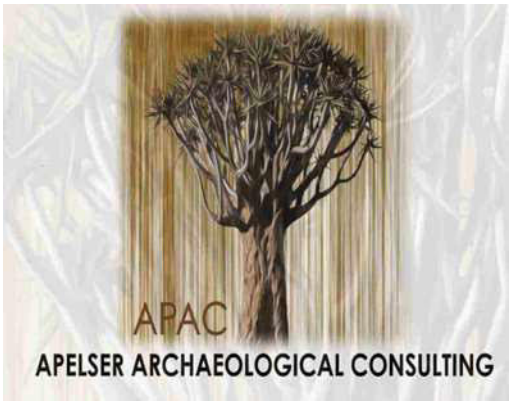
Appendix 3B: Heritage Impact Assessment Report



Comprehensive and Professional Solutions for all Heritage Related Matters

CK 2006/014630/23 **VAT NO.: 4360226270**

REPORT ON A PHASE 1 HIA FOR A PROPOSED TOWNSHIP DEVELOPMENT ON PORTION 1 OF THE FARM WATERVAL 5IR, NEAR MIDRAND GAUTENG PROVINCE

For:

Seaton Thompson & Associates
P.O.Box 936
IRENE
0067

REPORT: **APAC013/81**

by:

A.J. Pelser
Accredited member of ASAPA
Professional Member of SASCH

December 2013

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Member: AJ Pelser BA (UNISA), BA (Hons) (Archaeology), MA (Archaeology) [WITS]

DISCLAIMER:

Although all efforts are made to identify all sites of cultural heritage (archaeological and historical) significance during an assessment of study areas, the nature of archaeological and historical sites are as such that it is always possible that hidden or subterranean sites, features or objects could be overlooked during the study. APELSER Archaeological Consulting can't be held liable for such oversights or for costs incurred as a result thereof.

SUMMARY

A Pelser Archaeological Consulting (APAC) was appointed by Seaton Thompson & Associates to conduct a Phase 1 HIA for a proposed residential development on Portion 1 of the farm Waterval 5IR, in Midrand, Gauteng. The area has been extensively disturbed in the past through various developments, including agriculture. As a result any significant archaeological and/or historical sites or features that might have existed here in the past would have been extensively disturbed or destroyed.

This report discusses the results of the field assessment and background study on the archaeology & history of the area. Only two sites dating to the recent past were identified and recorded, although it is possible that more might exist. A number of recommendations in terms of mitigation measures are put forward at the end of this report.

Based on the assessment, from a Heritage perspective, the development should be allowed to continue, taking cognizance of the conclusions and recommendations put forward at the end of this report.

CONTENTS

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1. INTRODUCTION

A Pelser Archaeological Consulting (APAC) was appointed by Seaton Thompson & Associates to conduct a Phase 1 HIA for a proposed residential development on Portion 1 of the farm Waterval 5IR, in Midrand, Gauteng. The area has been extensively disturbed in the past through various developments, including agriculture. As a result any significant archaeological and/or historical sites or features that might have existed here in the past would have been extensively disturbed or destroyed.

Two sites dating to the recent past were identified and recorded, although it is possible that more might exist.

The client indicated the location and boundaries of the study area and the fieldwork focused on these.

2. TERMS OF REFERENCE

The Terms of Reference for the study is to:

1. Identify all possible objects, sites, occurrences and structures of an archaeological or historical nature (cultural heritage sites) located on the portions of land that will be impacted upon by the proposed development;

2. Assess the significance of the cultural resources in terms of their archaeological, historical, scientific, social, religious, aesthetic and tourism value;

3. Describe the possible impact of the proposed development on these cultural remains, according to a standard set of conventions;

4. Propose suitable mitigation measures to minimize possible negative impacts on the cultural resources;

5. Review applicable legislative requirements;

3. LEGISLATIVE REQUIREMENTS

Aspects concerning the conservation of cultural resources are dealt with mainly in two acts. These are the National Heritage Resources Act (Act 25 of 1999) and the National Environmental Management Act (Act 107 of 1998).

3.1 The National Heritage Resources Act

According to the above-mentioned act the following is protected as cultural heritage resources:

a. Archaeological artifacts, structures and sites older than 100 years
b. Ethnographic art objects (e.g. prehistoric rock art) and ethnography
c. Objects of decorative and visual arts
d. Military objects, structures and sites older than 75 years

e. Historical objects, structures and sites older than 60 years
f. Proclaimed heritage sites
g. Grave yards and graves older than 60 years
h. Meteorites and fossils
i. Objects, structures and sites of scientific or technological value.

The National Estate includes the following:

a. Places, buildings, structures and equipment of cultural significance
b. Places to which oral traditions are attached or which are associated with living heritage
c. Historical settlements and townscapes
d. Landscapes and features of cultural significance
e. Geological sites of scientific or cultural importance
f. Sites of Archaeological and palaeontological importance
g. Graves and burial grounds
h. Sites of significance relating to the history of slavery
i. Movable objects (e.g. archaeological, palaeontological, meteorites, geological specimens, military, ethnographic, books etc.)

A Heritage Impact Assessment (HIA) is the process to be followed in order to determine whether any heritage resources are located within the area to be developed as well as the possible impact of the proposed development thereon. An Archaeological Impact Assessment (AIA) only looks at archaeological resources. An HIA must be done under the following circumstances:

a. The construction of a linear development (road, wall, power line, canal etc.) exceeding 300m in length
b. The construction of a bridge or similar structure exceeding 50m in length
c. Any development or other activity that will change the character of a site and exceed 5 000m^2 or involve three or more existing erven or subdivisions thereof
d. Re-zoning of a site exceeding 10 000 m^2
e. Any other category provided for in the regulations of SAHRA or a provincial heritage authority

Structures

Section 34 (1) of the mentioned act states that no person may demolish any structure or part thereof which is older than 60 years without a permit issued by the relevant provincial heritage resources authority.

A structure means any building, works, device or other facility made by people and which is fixed to land, and includes any fixtures, fittings and equipment associated therewith.

Alter means any action affecting the structure, appearance or physical properties of a place or object, whether by way of structural or other works, by painting, plastering or the decoration or any other means.

Archaeology, palaeontology and meteorites

Section 35(4) of this act deals with archaeology, palaeontology and meteorites. The act states that no person may, without a permit issued by the responsible heritage resources authority (national or provincial):

a. destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;
b. destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite;
c. trade in, sell for private gain, export or attempt to export from the Republic any category of archaeological or palaeontological material or object, or any meteorite; or
d. bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment that assists in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites.
e. alter or demolish any structure or part of a structure which is older than 60 years as protected.

The above mentioned may only be disturbed or moved by an archaeologist, after receiving a permit from the South African Heritage Resources Agency (SAHRA). In order to demolish such a site or structure, a destruction permit from SAHRA will also be needed.

Human remains

Graves and burial grounds are divided into the following:

a. ancestral graves
b. royal graves and graves of traditional leaders
c. graves of victims of conflict
d. graves designated by the Minister
e. historical graves and cemeteries
f. human remains

In terms of Section 36(3) of the National Heritage Resources Act, no person may, without a permit issued by the relevant heritage resources authority:

a. destroy, damage, alter, exhume or remove from its original position of otherwise disturb the grave of a victim of conflict, or any burial ground or part thereof which contains such graves;
b. destroy, damage, alter, exhume or remove from its original position or otherwise disturb any grave or burial ground older than 60 years which is situated outside a formal cemetery administered by a local authority; or
c. bring onto or use at a burial ground or grave referred to in paragraph (a) or (b) any excavation, or any equipment which assists in the detection or recovery of metals.

Human remains that are less than 60 years old are subject to provisions of the Human Tissue Act (Act 65 of 1983) and to local regulations. Exhumation of graves must conform to the standards set out in the **Ordinance on Excavations** (**Ordinance no. 12 of 1980**) (replacing the old Transvaal Ordinance no. 7 of 1925).

Permission must also be gained from the descendants (where known), the National Department of Health, Provincial Department of Health, Premier of the Province and local police. Furthermore, permission must also be gained from the various landowners (i.e. where the graves are located and where they are to be relocated to) before exhumation can take place.

Human remains can only be handled by a registered undertaker or an institution declared under the **Human Tissues Act** (**Act 65 of 1983 as amended**).

Unidentified/unknown graves are also handled as older than 60 until proven otherwise.

3.2 The National Environmental Management Act

This act states that a survey and evaluation of cultural resources must be done in areas where development projects, that will change the face of the environment, will be undertaken. The impact of the development on these resources should be determined and proposals for the mitigation thereof are made.

Environmental management should also take the cultural and social needs of people into account. Any disturbance of landscapes and sites that constitute the nation's cultural heritage should be avoided as far as possible and where this is not possible the disturbance should be minimized and remedied.

4. METHODOLOGY

4.1 Survey of literature

A survey of available literature was undertaken in order to place the development area in an archaeological and historical context. The sources utilized in this regard are indicated in the bibliography.

4.2 Field survey

The field assessment section of the study was conducted according to generally accepted HIA practices and aimed at locating all possible objects, sites and features of archaeological significance in the area of the proposed development. The location/position of all sites, features and objects is determined by means of a Global Positioning System (GPS) where possible, while detail photographs are also taken where needed.

4.3 Oral histories

People from local communities are sometimes interviewed in order to obtain information relating to the surveyed area. It needs to be stated that this is not applicable under all

circumstances. When applicable, the information is included in the text and referred to in the bibliography.

4.4 Documentation

All sites, objects, features and structures identified are documented according to the general minimum standards accepted by the archaeological profession. Co-ordinates of individual localities are determined by means of the Global Positioning System (GPS). The information is added to the description in order to facilitate the identification of each locality.

5. DESCRIPTION OF THE AREA

The study area is located on Portion 1 of the farm Waterval 5IR, in Midrand, Gauteng Province. It is situated between Allandale Drive & Alsatian Road (east of Allandale & west of Alsatian). It is surrounded by residential and commercial developments and most of the adjacent areas have been extensively changed. The study area itself is characterized by rolling grassveld and the topography is relatively flat.

Agricultural activities in the recent past have affected the study area as well. The remains of these farming activities are present in the form of (possibly) farm laborer dwellings, while recent informal residential dumping has also impacted on sections of the area. There is very little tree cover, although some clumps of bluegum and other exotic trees are present in some portions.

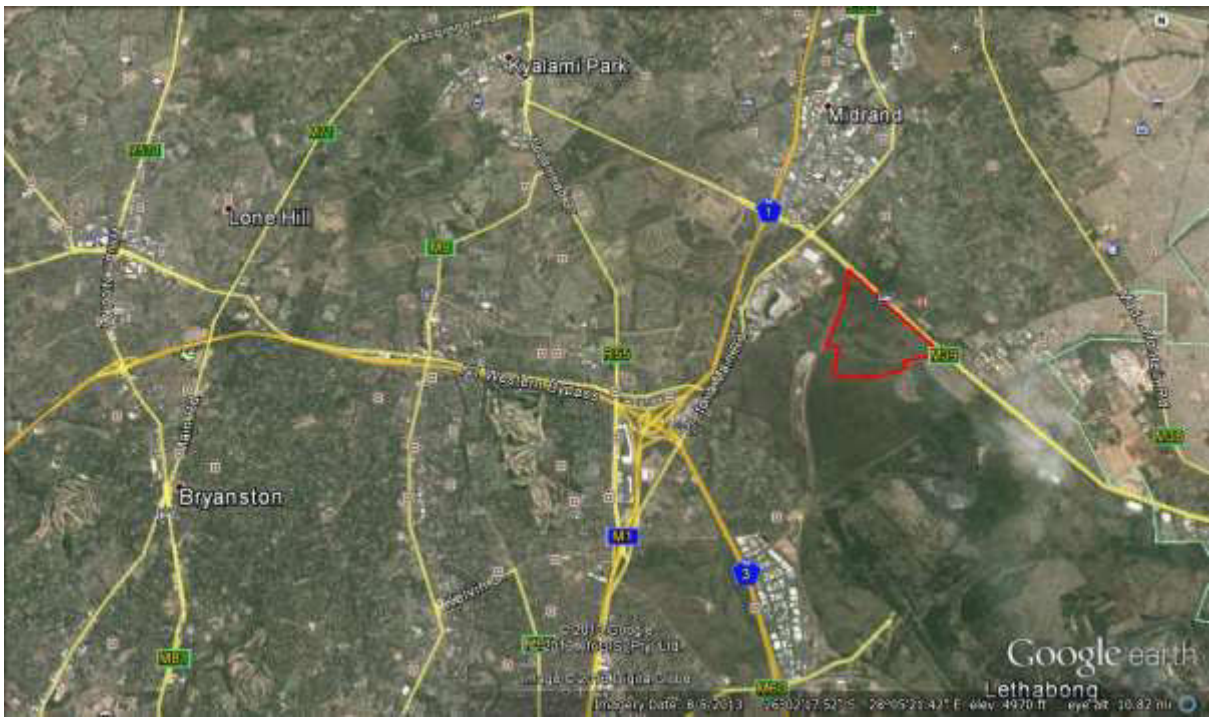

Figure 1: General location of study area (red polygon).
Google Earth 2013 – Image date 2013/08/05.

Figure 2: Closer view of study area (Google Earth 2013 – Image date 2013/08/05).

Figure 3: General view of study area. Note the rolling grass veld.

Figure 4: Another view of a section of the area showing surrounding developments.

Figure 5: Residential dumping occurs in certain sections.

Figure 6: Clumps of trees occur in sections.

6. DISCUSSION

The Stone Age is the period in human history when lithic (stone) material was mainly used to produce tools. In South Africa the Stone Age can be divided basically into three periods. It is however important to note that dates are relative and only provide a broad framework for interpretation. A basic sequence for the South African Stone Age (Lombard et.al 2012) is as follows:

Earlier Stone Age (ESA) up to 2 million – more than 200 000 years ago
Middle Stone Age (MSA) less than 300 000 – 20 000 years ago
Later Stone Age (LSA) 40 000 years ago – 2000 years ago

It should also be noted that these dates are not a neat fit because of variability and overlapping ages between sites (Lombard et.al 2012: 125).

There are no known Stone Age sites in the close geographical area, with the closest known ones those of Glenferness, Pietkloof, Zevenfontein, Aasvoelkop and Melvillekoppies. These sites date to MSA & LSA (Bergh 1999: 4). No Stone Age sites or material was identified during the assessment.

The Iron Age is the name given to the period of human history when metal was mainly used to produce artifacts. In South Africa it can be divided in two separate phases (Bergh 1999: 96-98), namely:

Early Iron Age (EIA) 200 – 1000 A.D.
Late Iron Age (LIA) 1000 – 1850 A.D.

Huffman (2007: xiii) indicates that a Middle Iron Age should be included. His dates, which are widely accepted in archaeological circles, are:

Early Iron Age (EIA) 250 – 900 A.D.
Middle Iron Age (MIA) 900 – 1300 A.D.
Late Iron Age (LIA) 1300 – 1840 A.D.

Once again there are no known Iron Age sites in the specific area and none were identified and recorded during the field work of 2013. The closest known LIA sites are those of Melvillekoppies and Bruma Lake (Bergh 1999: 6-7).

The earliest European groups to pass through or close to the area was those of Cornwallis Harris in 1836 (p.13), followed by the Voortrekkers soon afterwards (Bergh 1999: 13-14). In the 1890's a number of proclamations were made for the town of Waterval in the District of Pretoria. The 1890 proclamation of Waterval apparently refers to the town of Halfweghuis (todays' Midrand) on the farm Waterval halfway between Pretoria & Johannesburg. The oldest map that could be obtained from the database of the Chief Surveyor General (www.csg.dla.gov.za) is dated 1938 and indicates that at the time the farm was numbered as Waterval No.34 and that it was originally granted by deed of transfer in 1859 (CSG Document 10IK1T01). The grantee is not mentioned on this map. When farming was originally commenced with is not known, but it would have been soon after this date.

The only sites recorded in the area date to the recent historical period, and include the remains of homesteads (probably those of farm laborers) in the study area.

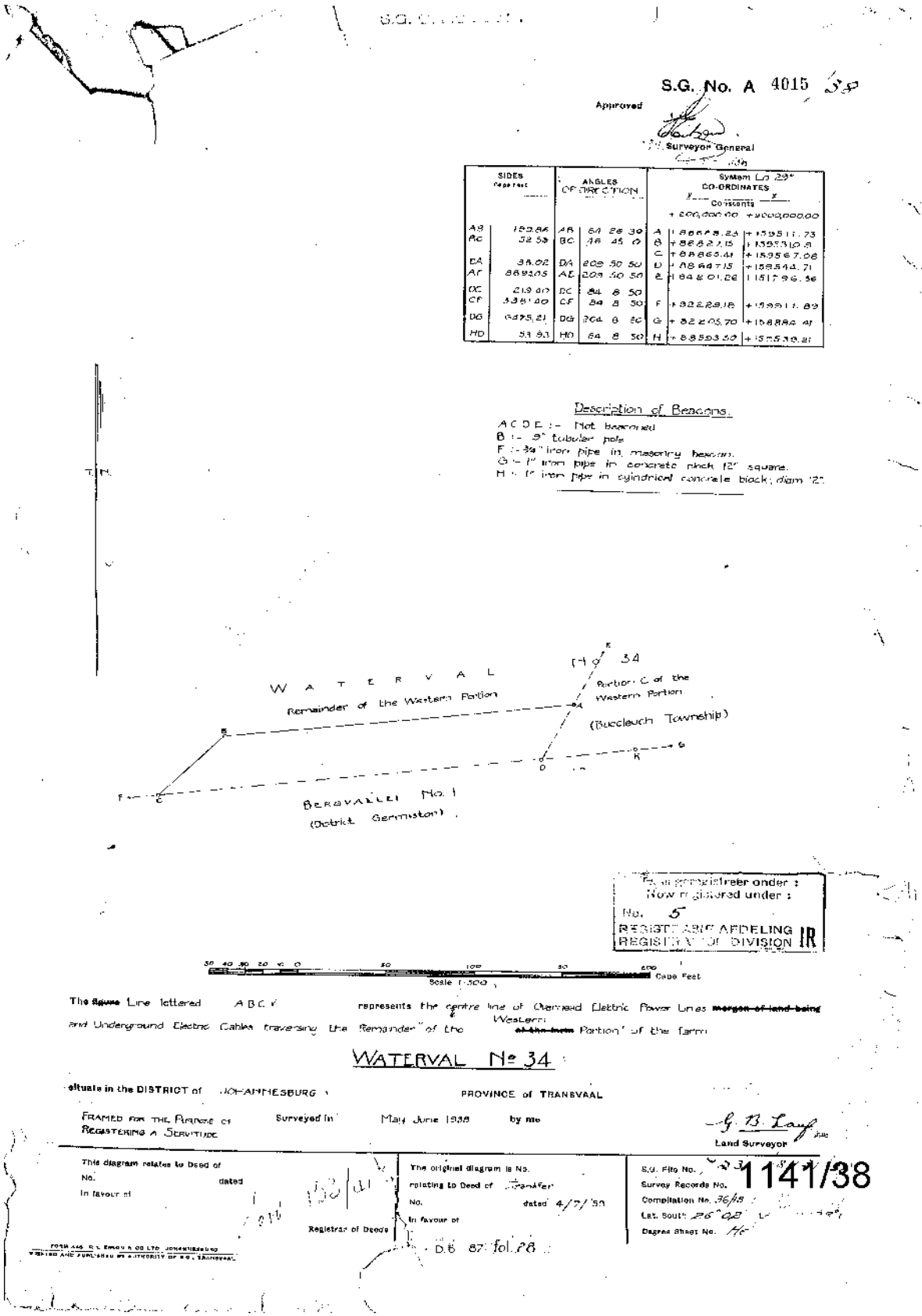

Figure 7: 1938 map of a section of the farm Waterval (www.csg.dla.gov.za).

Results of the Fieldwork

Only two sites were identified and recorded during the assessment and both consist of the remains of what could possibly be farm labour homesteads constructed of clay and plaster. No other sites or features were found. The age of these sites could not be determined.
No graves or cemeteries were located in the larger study area, although these could be present in close proximity to the homesteads. None were however noticed in these areas. The possible significance of these features are further diminished by the nearly total destruction and natural degradation of both.

GPS Locations
1. S26 02.111 E28 08.103
2. S26 02.052 E28 07.675

Cultural Significance: Low to medium
Heritage Significance: None
Field Ratings: General protection C (IV C): phase 1 is seen as sufficient recording and it may be demolished (low significance)
Mitigation: None required. Should any low stone packed or unmarked graves be found in close proximity these should be mitigated. Social consultation should be undertaken.

Figure 7: General view of the remains of a clay-built structure on Site 1.

Figure 8: View of Site 2 clay-built structural remains.

Figure 9: Location of sites recorded (Google Earth 2013 –Image date 2013/08/05).

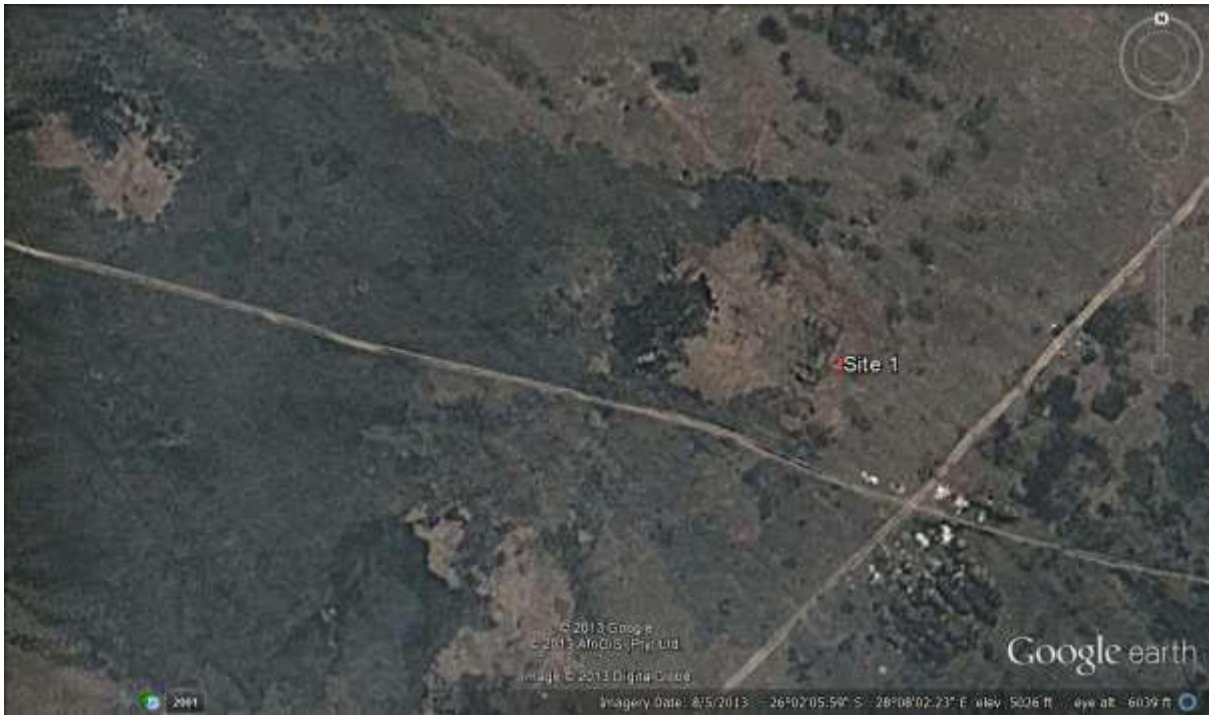

Figure 10: Closer view of Site 1 remains (Google Earth 2013 – Image date 2013/08/05).

7. CONCLUSIONS AND RECOMMENDATIONS

In conclusion it is possible to say that the Phase 1 HIA for the proposed residential development on Portion 1 of the farm Waterval 5IR, in Midrand, Gauteng, was conducted successfully. The area has been extensively changed and disturbed over the recent historical past through both agricultural activities and residential developments. If any archaeological or early historical sites or features did exist here in the past it would have been extensively disturbed or destroyed as a result. Only two sites were identified, and both consisted of the remains of clay-built homesteads possibly related to recent farming in the area and representing farm laborer dwellings. The sites are not significant.

Finally, from a cultural heritage point of view the development should be allowed to continue taking heed of the above. The subterranean presence of archaeological or historical sites, features or objects is always a possibility. This could include unknown and unmarked burial pits. Should any be uncovered during the development process and archaeologist or heritage specialist should be called in to investigate and recommend on the best way forward.

8. REFERENCES

Aerial views of study area location, boundaries and sites distribution: Google Earth 2013 – Imagery dates 2013/08/05.

Bergh, J.S. (red.). 1999. **Geskiedenisatlas van Suid-Afrika. Die vier noordelike provinsies**. Pretoria: J.L. van Schaik.

Huffman, T.N. 2007. Handbook to the Iron Age: **The Archaeology of Pre-Colonial Farming Societies in Southern Africa**. Scotsville: University of KwaZulu-Natal Press.

Knudson, S.J. 1978. **Culture in retrospect**. Chicago: Rand McNally College Publishing Company.

Chief Surveyor General Database (www.csg.dla.gov.za): Documents 10IK1T01.

APPENDIX A
DEFINITION OF TERMS:

Site: A large place with extensive structures and related cultural objects. It can also be a large assemblage of cultural artifacts, found on a single location.

Structure: A permanent building found in isolation or which forms a site in conjunction with other structures.

Feature: A coincidental find of movable cultural objects.

Object: Artifact (cultural object).

(Also see Knudson 1978: 20).

APPENDIX B
DEFINITION/ STATEMENT OF HERITAGE SIGNIFICANCE:

Historic value: Important in the community or pattern of history or has an association with the life or work of a person, group or organization of importance in history.

Aestetic value: Important in exhibiting particular aesthetic characteristics valued by a community or cultural group.

Scientific value: Potential to yield information that will contribute to an understanding of natural or cultural history or is important in demonstrating a high degree of creative or technical achievement of a particular period

Social value: Have a strong or special association with a particular community or cultural group for social, cultural or spiritual reasons.

Rarity: Does it possess uncommon, rare or endangered aspects of natural or cultural heritage.

Representivity: Important in demonstrating the principal characteristics of a particular class of natural or cultural places or object or a range of landscapes or environments characteristic of its class or of human activities (including way of life, philosophy, custom, process, land-use, function, design or technique) in the environment of the nation, province region or locality.

APPENDIX C
SIGNIFICANCE AND FIELD RATING:

Cultural significance:

- Low: A cultural object being found out of context, not being part of a site or without any related feature/structure in its surroundings.

- Medium: Any site, structure or feature being regarded less important due to a number of factors, such as date and frequency. Also any important object found out of context.

- High: Any site, structure or feature regarded as important because of its age or uniqueness. Graves are always categorized as of a high importance. Also any important object found within a specific context.

Heritage significance:

- Grade I: Heritage resources with exceptional qualities to the extent that they are of national significance

- Grade II: Heritage resources with qualities giving it provincial or regional importance although it may form part of the national estate

- Grade III: Other heritage resources of local importance and therefore worthy of conservation

Field ratings:

i. National Grade I significance: should be managed as part of the national estate

ii. Provincial Grade II significance: should be managed as part of the provincial estate

iii. Local Grade IIIA: should be included in the heritage register and not be mitigated (high significance)

iv. Local Grade IIIB: should be included in the heritage register and may be mitigated (high/ medium significance)

v. General protection A (IV A): site should be mitigated before destruction (high/medium significance)

vi. General protection B (IV B): site should be recorded before destruction (medium significance)

vii. General protection C (IV C): phase 1 is seen as sufficient recording and it may be demolished (low significance)

APPENDIX D
PROTECTION OF HERITAGE RESOURCES:

Formal protection:

National heritage sites and Provincial heritage sites – Grade I and II
Protected areas - An area surrounding a heritage site
Provisional protection – For a maximum period of two years
Heritage registers – Listing Grades II and III
Heritage areas – Areas with more than one heritage site included
Heritage objects – e.g. Archaeological, palaeontological, meteorites, geological specimens, visual art, military, numismatic, books, etc.

General protection:

Objects protected by the laws of foreign states
Structures – Older than 60 years
Archaeology, palaeontology and meteorites
Burial grounds and graves
Public monuments and memorials

APPENDIX E
HERITAGE IMPACT ASSESSMENT PHASES

1. Pre-assessment or Scoping Phase – Establishment of the scope of the project and terms of reference.

2. Baseline Assessment – Establishment of a broad framework of the potential heritage of an area.

3. Phase I Impact Assessment – Identifying sites, assess their significance, make comments on the impact of the development and makes recommendations for mitigation or conservation.

4. Letter of recommendation for exemption – If there is no likelihood that any sites will be impacted.

5. Phase II Mitigation or Rescue – Planning for the protection of significant sites or sampling through excavation or collection (after receiving a permit) of sites that may be lost.

6. Phase III Management Plan – For rare cases where sites are so important that development cannot be allowed.

Appendix 3C: Specialist Vegetation Report

Assessment of the vegetation and flora of Part of Remainder of Portion 1 of the Farm WATERVAL 5-IR, Midrand, Gauteng Province

Client:
Seaton Thomson Associates

PO Box 936,
Irene,
0062

Date:
9 December 2013

REPORT VERSION:
1st draft

Prepared by:
Dr David Hoare
(Ph.D., Pr.Sci.Nat.)

David Hoare Consulting cc
Biodiversity Assessments, Vegetation Description & Mapping, Species Surveys

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DETAILS OF SPECIALIST

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Appointment of specialist
David Hoare of David Hoare Consulting cc was commissioned by Seaton Thomson Associates to provide specialist consulting services for the Environmental Impact Assessment for a proposed development on Part of Remainder of Portion 1 of the Farm WATERVAL 5-IR in Midrand in Gauteng Province. The consulting services comprise an assessment of potential impacts on the flora and vegetation in the study area by the proposed project.

Summary of expertise
Dr David Hoare:

- Has majors in Botany and Zoology with distinction from Rhodes University, Grahamstown, an Honours Degree (with distinction) in Botany from Rhodes University, an MSc (cum laude) from the Department of Plant Science, University of Pretoria, and a PhD in Botany from the Nelson Mandela Metropolitan University, Port Elizabeth with a focus on species diversity.
- Registered professional member of The South African Council for Natural Scientific Professions (Ecological Science, Botanical Science), registration number 400221/05.
- Founded David Hoare Consulting cc, an independent consultancy, in 2001.
- Ecological consultant since 1995, with working experience in Gauteng, Mpumalanga, Limpopo, North West, Eastern Cape, Western Cape, Northern Cape and Free State Provinces, Tanzania, Kenya, Mozambique and Swaziland.
- Conducted, or co-conducted, over 330 specialist ecological surveys as an ecological consultant. Areas of specialization include general ecology, biodiversity assessments, vegetation description and mapping, plant species surveys and remote sensing of vegetation. Has undertaken work in grassland, thicket, forest, savannah, fynbos, coastal vegetation, wetlands and nama-karoo vegetation, but has a specific specialization in grasslands and wetland vegetation.
- Published six technical scientific reports, 15 scientific conference presentations, seven book chapters and eight refereed scientific papers.
- Attended 15 national and international congresses & 5 expert workshops, lectured vegetation science / ecology at 2 universities and referee for 2 international journals.

Independence:
David Hoare Consulting cc and its Directors have no connection with Seaton Thomson & Associates or with the landowner and development proponent. David Hoare Consulting cc is not a subsidiary, legally or financially, of the proponent, remuneration for services by the proponent in relation to this proposal is not linked to approval by decision-making authorities responsible for permitting this proposal and the consultancy has no interest in secondary or downstream developments as a result of the authorisation of this project.

Scope and purpose of report
The scope and purpose of the report are reflected in the "Terms of reference" section of this report

Indemnity and conditions relating to this report

The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information. David Hoare Consulting cc and its staff reserve the right to modify aspects of the report including the recommendations if and when new information may become available from ongoing research or further work in this field, or pertaining to this investigation.

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INTRODUCTION

On 26 September 2013 Seaton Thomson & Associates appointed David Hoare Consulting cc to undertake a vegetation assessment of the site. The location of the property is shown in Figure 1. The requirement of the study was to assess the sensitivity of the vegetation of the site and to assess the possibility of any threatened plant species occurring there. This report comprises the broad flora and vegetation assessment of the study site, based on a desktop and field assessment.

Terms of reference

The intention of the study was to provide an assessment of potentially sensitive vegetation or plant species features on site that may be negatively impacted by development of the site. The study was to include a site visit to assess the habitat on site with the view of making judgements on:

1. the condition of the vegetation on site;

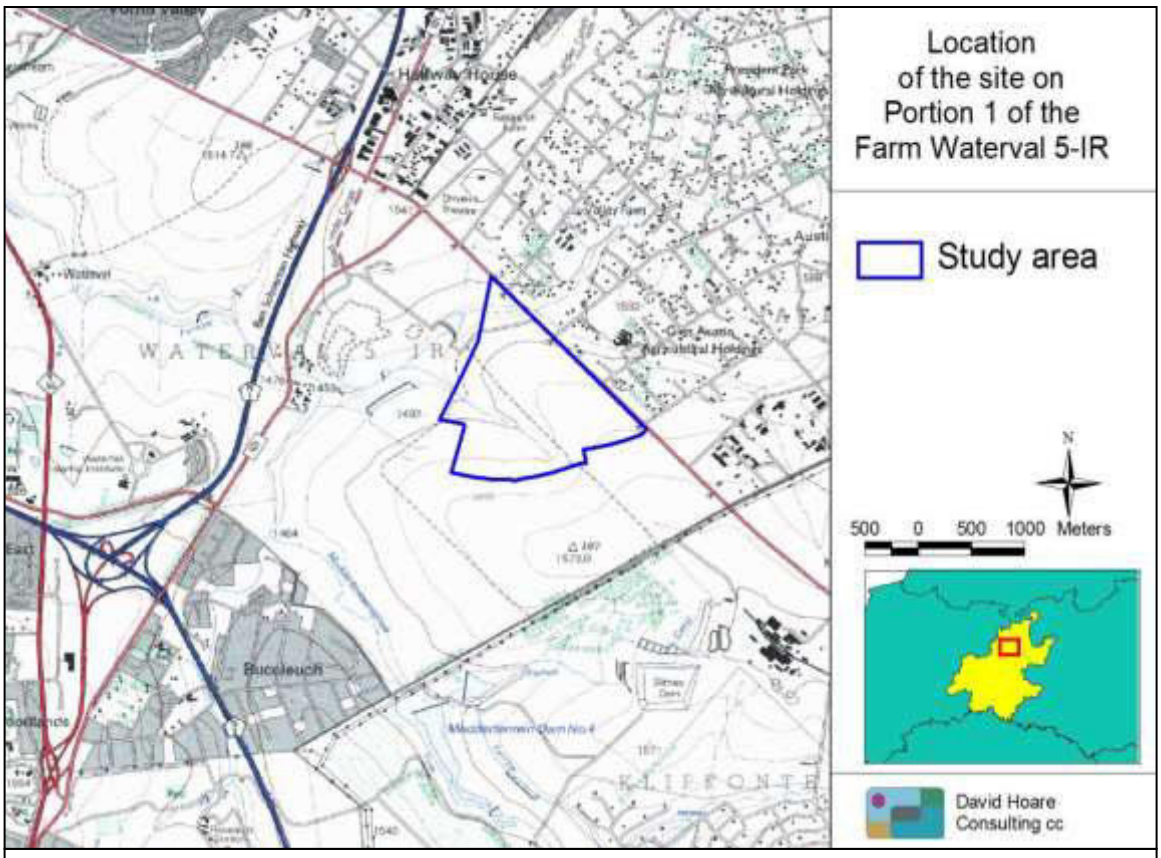

Figure 1: Location of site.

2. the sensitivity and conservation value of vegetation on site;
3. the suitability of habitat for threatened plant species.

The study was to cover the remaining areas of natural vegetation on the site. The following information was to be provided in the report:

- To provide a description of the broad vegetation types and/or habitats for the area, including any areas of potential conservation value. This will be based on published sources, including the vegetation map of South Africa (Mucina et al. 2006), the National Spatial Biodiversity Assessment and any Biodiversity Conservation Plans that exist for Gauteng Province.
- To provide the national conservation status of major vegetation types in which the study sites are located, as listed in The National List of Ecosystems that are Threatened and need of protection (GN1002 of 2011), published under the National Environmental Management: Biodiversity Act (Act No. 10, 2004).
- To provide an assessment of the Red Data (threatened) flora species within Gauteng Province and more specifically those that could occur in the project study area, including information on habitats in which they are most likely to be encountered.
- To investigate the potential presence of trees protected according to the National Forests Act and flora protected under the National Environmental Management: Biodiversity Act.
- To compile an assessment and map of the general status of vegetation on site in order to provide a description of which areas contain natural habitat versus those that are transformed and/or degraded.
- To list and describe potential impacts on biodiversity, sensitive habitats and ecosystem function.

This report provides details of the results of an assessment of the site. The findings of the study are based on a desktop assessment of the study area, including mapping from aerial imagery, and a site visit.

DESCRIPTION OF STUDY AREA

Study area

Location

The site is located to the south of Midrand and south-east of Tembisa (Figure 1). Allandale road forms the north-eastern boundary of the site, across the road of which is the Glen Austin Agricultural Holdings area. The study site falls within the quarter degree square 2628AA.

Topography

The site is gently sloping in an undulating landscape. There are two drainage valleys running through the site and the landscape slopes towards these drainage lines, but there is also a general slope towards the west. The site varies in elevation from approximately 1490m in the western parts to approximately 1548m on the eastern boundary.

Geology, soils and rainfall

The geology is Halfway House Granite, consisting primarily of gneiss, migmatite and granodiorite, although it is not known which of these rock types are found within the study area itself. Gneiss is a form of granite, but having the component materials, especially the mica, arranged in planes so that it breaks rather easily into coarse slabs or flags. Migmatite is a mixture of igneous and metamorphic rocks in which thin dikes and stringers of granitic material interfinger with metamorphic rocks. Granodiorite is an intrusive igneous rock similar to granite, but contains more plagioclase than potassium feldspar. It usually has a darker appearance than true granite and becomes crumbly as it erodes. The soils are course-grained sandy soils derived from these granites.

The land type of the site, which is an area with largely uniform soils, topography and climate, is the Bb land type (Land Type Survey Staff, 1987). Map units Ba - Bd refer to plinthic catenas in which upland duplex and margalitic soils are rare (MacVicar et al. 1974). The Bb landtype indicates land in which red and/or yellow apedal soils (Hutton, Bainsvlei, Avalon, Glencoe and Pinedene forms) that are dystrophic and/or

mesotrophic predominate over red and/or yellow apedal soils that are eutrophic, and in which red soils (mainly Hutton and Bainsvlei) occupy less than a third of the area.

The rainfall in the study area is approximately 650 mm per annum and occurs mainly in the summer (Dent et al. 1989).

Landuse and landcover

According to landcover maps for the area, the site is classified as mostly natural grassland (Fairbanks et al. 2000). Aerial imagery of the site shows that it is a combination of natural grassland, linear infrastructure (roads and railway line), disturbed areas and some small stands of alien trees (Figure 2). The 1:50 000 topocadastral maps for the site do not indicate any historical cultivation on site, but aerial imagery shows signs (parallel striations) that indicate that parts of the site may have been cultivated in the past. Google imagery from 2001, 2002 and 2007 shows significant parts of the site where vegetation is cleared due to cultivation.

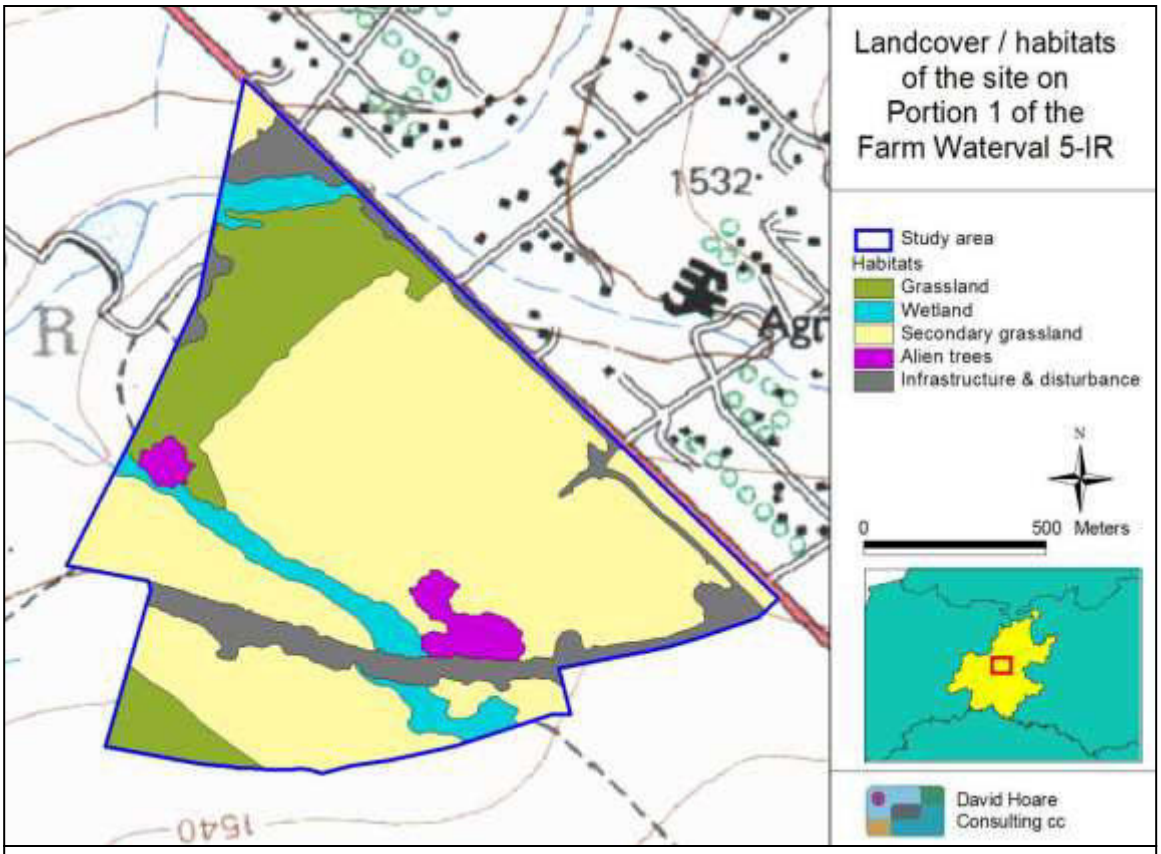

Figure 2: Landcover / habitats of the site

Historical Google imagery also shows parts of the sites under dense alien trees that are not currently invaded. The combined analysis of historical aerial imagery shows that the proportion of the site that has been subjected to some significant disturbance is relatively large – natural vegetation constitutes only 21.5% of the site (Table 1). Most of the vegetation on site is of a secondary nature in previously disturbed / cultivated areas. This was confirmed in the field on the basis of species composition.

Table 1: Proportion of site in different landcover classes.

Landcover	Area (ha)	Proportion of site (%)
Grassland	24.95	15.42
Wetland	9.90	6.12
Secondary grassland	105.17	65.02
Alien trees	4.52	2.79
Infrastructure & disturbance	17.23	10.65
	161.77	**100.00**

Figure 3: Secondary grassland on site.

Status of natural vegetation on site

The two natural vegetation types occurring on site are grassland and wetlands. Both have been heavily impacted and there is little remaining in good condition. The grasslands on site (Figure 3) are intact in places, but degraded in others. Degradation is due primarily to historical disturbance, as described in the section above ("Landuse and landcover").

Secondary grassland on site has a uniform species composition dominated overwhelmingly by weeping lovegrass, *Eragrostis curvula*. Local species richness is low, approximately 5 species per 100m^2, as is expected in a secondary grassland. Overall diversity is also relatively low, with only 41 species recorded throughout the entire site within secondary grasslands, of which 14 species are exotic weeds and/or declared invader species. Vegetation cover is good and there is limited recent disturbance.

Where the grassland is in an intact and natural state, the condition is moderate and

Figure 4: Natural grassland on site with mixed species composition.

has a relatively good species composition (Figure 4). A total of 70 plant species were recorded on site within these natural grassland areas, with local species richness being approximately 40 species per 100m^2. Most of these are indigenous species expected within natural grasslands with very few weeds. There is no dominance by any single species.

The wetlands on site are in moderate condition and, in the permanently wet areas, dominated by *Phragmites australis* and *Typha capensis* (Figure 5). It has been invaded in places along its margins by *Eucalyptus* trees and there are paths crossing it in various places as well as a road cutting through the top end of the one wetland system. From a vegetation point of view, the wetland is considered to be ecologically functional.

Vegetation, biogeography and conservation value

According to the most recent vegetation map of the country the study area falls within Egoli Granite Grassland. This vegetation type is found only in Gauteng on the

Figure 5: Wetland vegetation on the lower end of the site.

Johannesburg Dome extending from Lanseria Airport and Centurion to northern Johannesburg and from Tembisa to Muldersdrift (Mucina et al. 2006). It occurs on moderately undulating plains and low hills. The substrate is archaen granite and gneiss of the Halfway House Granite group, supporting leached, shallow, coarsely grained, sandy soil poor in nutrients.

According to Mucina et al. (2006), this is a grassland that is characterized by the presence of the species, *Themeda triandra*, *Tristachya leucothrix*, *Setaria sphacelata*, *Monocymbium ceresiiforme*, *Melinis repens*, *Hyparrhenia hirta*, *Heteropogon contortus*, *Eragrostis racemosa*, *Eragrostis curvula*, *Eragrostis chloromelas*, *Eragrostis capensis*, *Digitaria monodactyla*, *Cynodon dactylon*, *Aristida congesta*, *Aristida canescens*, *Acalypha angustata*, *Acalypha peduncularis*, *Becium obovatum*, *Crabbea hirsuta*, *Cyanotis speciosa*, *Dicoma anomala*, *Helichrysum rugulosum*, *Justicia anagalloides*, *Kohautia amatymbica*, *Nidorella hottentotica*, *Pentanisia prunellioides*, *Pseudognaphalium luteo-album*, *Senecio venosus* and *Cheilanthes hirta*.

Conservation status of vegetation

On the basis of a recently established approach used at national level by SANBI (Driver et al. 2005), vegetation types can be categorised according to their conservation status which is, in turn, assessed according to degree of transformation relative to the expected extent of each vegetation type. The status of a habitat or vegetation type is based on how much of its original area still remains intact relative to various thresholds. The original extent of a vegetation type is as presented in the recent national vegetation map (Mucina, Rutherford & Powrie 2005) and is the extent of the vegetation type in the absence of any historical human impact. There have, however, been various impacts on natural vegetation that have lead to portions of vegetation types being transformed by various factors. Landcover data for the country was used to determine the extent of transformation in different vegetation types relative to thresholds required for conserving representative samples of vegetation types. On a national scale the thresholds are as depicted in Table 2, as determined by best available scientific approaches (Driver et al. 2005). The level at which an ecosystem becomes Critically Endangered differs from one ecosystem to another and varies from 16% to 36% (Driver et al. 2005).

Table 2: Determining ecosystem status (from Driver et al. 2005). *BT = biodiversity target (minimum conservation requirement).

Habitat remaining (%)		
80–100	least threatened	LT
60–80	vulnerable	VU
*BT–60	endangered	EN
0–*BT	critically endangered	CR

The conservation status of Egoli Granite Grassland is Endangered (Driver et al., 2005 and Mucina et al., 2006), and whilst the conservation target is 24%, only a small extent is currently protected and 68% is considered to be transformed (Mucina & Rutherford, 2006). Current transformation threatens most of the remaining unconserved areas and many remaining areas are heavily utilised, degraded and poor in species typical of the vegetation type. Many parts considered to be primary grassland may in fact be secondary vegetation of old fields.

The National List of Ecosystems that are Threatened and need of protection (GN1002 of 2011), published under the National Environmental Management: Biodiversity Act (Act No. 10, 2004), lists national vegetation types that are afforded protection on the basis of rates of transformation. The thresholds for listing in this legislation are higher than in the scientific literature, which means there are fewer ecosystems listed in the National Ecosystem List versus in the scientific literature. Egoli Granite Grassland is listed in the National List of Ecosystems that are Threatened and need of protection (GN1002 of 2011) as Endangered.

Red Data plant species

Lists of historical occurrences of Threatened and Orange List plant species were obtained from GDARD for the quarter degree square 2628AA. These are listed in Appendix 1. The list contained 18 species assessed according to IUCN Ver. 3.1 (IUCN, 2001) criteria (Appendix 1).

According to GDARD records, one of the species listed in Appendix 1 (*Trachyandra erythrorrhiza*) has been previously recorded on site or on the farm upon which the site is located (1.1 km west of the current site). This species is usually found in marshy areas in black turf soil, conditions which are not found on site. No plants were found on site and it is considered unlikely that they occur there.

For all threatened plants that occur in the grid in which the site is found, a rating of the likelihood of it occurring on site is given as follows:

- LOW: no suitable habitats occur on site / habitats on site do not match habitat description for species;
- MEDIUM: habitats on site match general habitat description for species (e.g. grassland), but detailed microhabitat requirements (e.g. rocky grassland on shallow soils overlying dolomite) are absent on the site or are unknown from the descriptions given in the literature or from the authorities;
- HIGH: habitats found on site match very strongly the general and microhabitat description for the species (e.g. rocky grassland on shallow soils overlying dolomite);
- DEFINITE: species found on site.

On the basis of habitat preferences the species could be allocated to habitats within the study area where they are most likely to be found. On the basis of information

Figure 5: Plants of the Declining plant species, *Hypoxis hemerocallidea*, found on site.

provided by GDARD, two Near Threatened species and three Declining species were considered to have a medium chance of occurring in the study area. One Declining species was found on site (see below). The other species listed (Appendix 1) have a low chance of occurring in the study area.

A Declining plant species was recorded on site. This species (*Hypoxis hemerocallidea*) was recorded as a relatively large population scattered throughout the site within grasslands (Figure 5). It is estimated that a few hundred individuals occur on site. The species is not listed as a priority species in Gauteng for conservation purposes and the GDACE Red List Policy provides no guidelines for the retention or management of populations of Declining plant species. This is a relatively widespread species in South Africa, often found in moist grasslands on slopes overlooking drainage lines. It is declining due to harvesting for medicinal purposes. It is proposed that, should development of the site proceed, all individuals of this population are rescued by an approved organisation and housed at an appropriate nursery.

None of the other species listed in Appendix 1 were found on site, nor any similar or closely-related species. The field survey was undertaken at the correct time of the year to determine whether any, except two, of the species of concern could occur in the types of habitat found on site. It is therefore considered highly unlikely that any of these other species occur on site.

Sensitivity assessment

Sensitive features are those parts of the landscape identified in various Provincial policies and National Acts as being areas of ecological or conservation importance. For this study, sensitivity is derived from the guidelines provided in the "GDARD Requirements for Biodiversity Assessments" in combination with landcover mapping, wetlands and the potential presence of Red List organisms, areas with high habitat complexity or areas containing systems vital to sustaining ecological functions. Information from GDARD's C-Plan version 3 was used to provide additional information on the conservation value of the study area as well relevant legislation, policies and Provincial guidelines.

According to C-plan version 3 (Figure 6) most of the site is within an area mapped as "Important Area" and is therefore considered to have elevated conservation value.

According to GDARD Departmental policies and other environmental legislation the following applies:

1. The GDARD "Requirements for Biodiversity Assessments" stipulate that all untransformed grasslands have to be classified as having high sensitivity;

The study site is not close to any of the Centres of Plant Endemism (van Wyk & Smith 2001).

On the basis of current information and the requirements of guidelines, policies and Acts, parts of the site are classified as having High sensitivity (Figure 7). Significant parts of the site have been disturbed by various factors, but natural areas of grassland may still remain in parts of the site. A summary of the factors used to classify the site is given in Table 2.

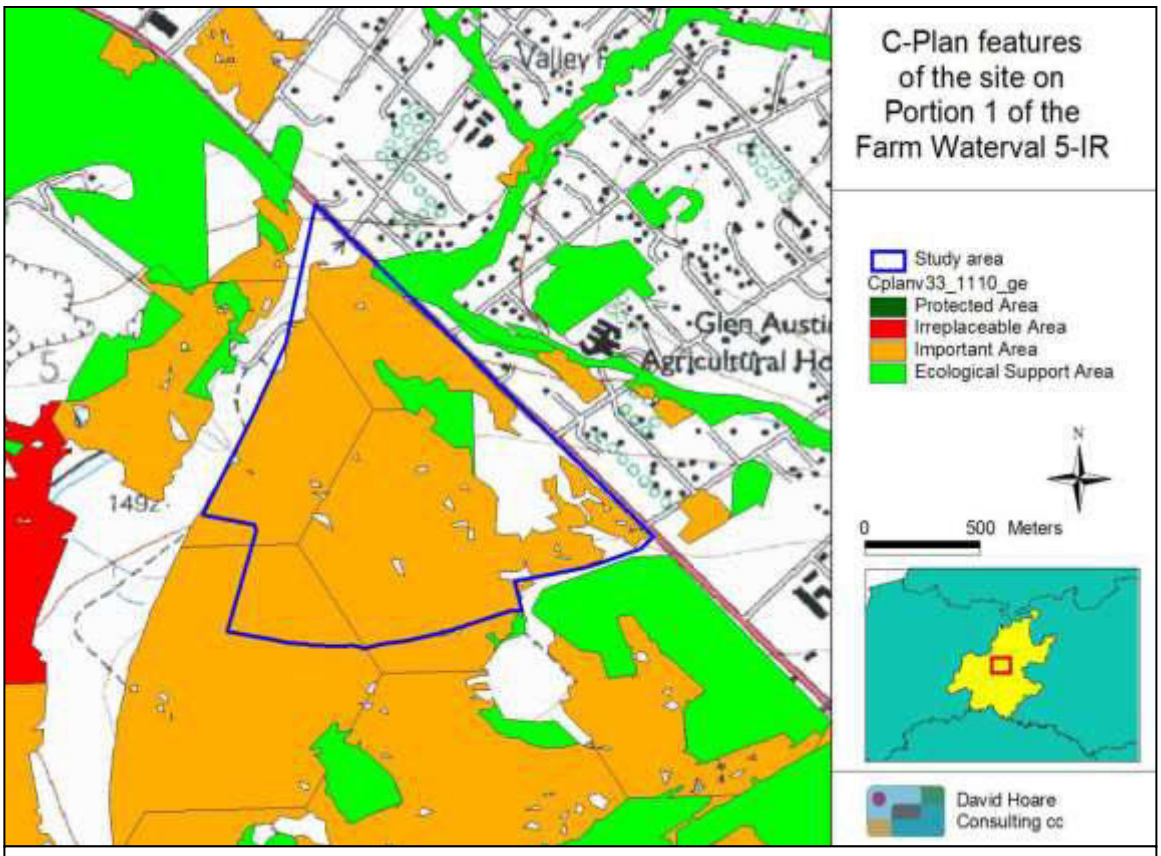

Figure 6: C-Plan 3 features on site.

Table 2: Factors contributing to sensitivity classification of habitats on site.

Vegetation/habitat type	Sensitivity	Reason
Grassland	High	• According to GDARD "Requirements for Biodiversity Assessments", all untransformed grasslands have to be classified as having high sensitivity. • Confirmed presence of a Declining plant species on site, *Hypoxis hemerocallidea*.
Wetlands	High	• wetlands in drainage line classified as seasonal wetlands (National Water Act)

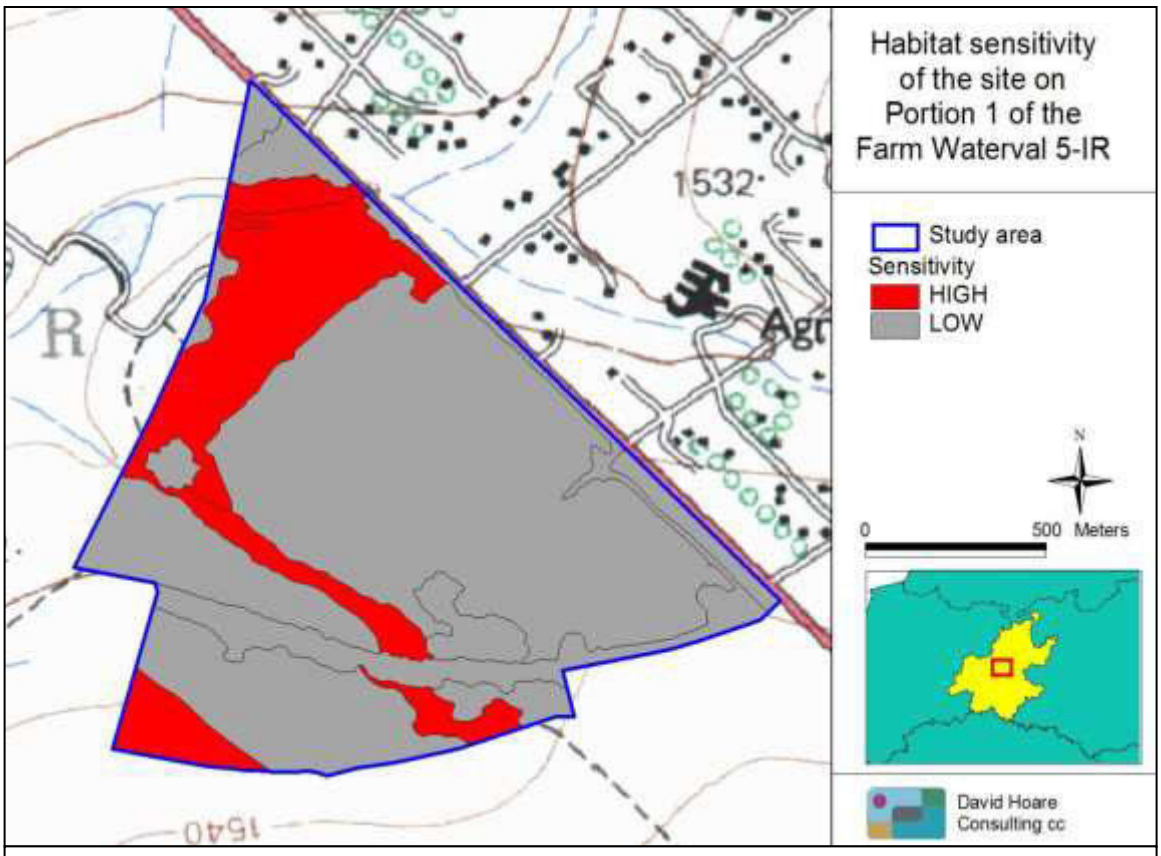

Figure 7: Habitat sensitivity on site.

CONCLUSIONS

On the basis of historical distribution records, the availability of habitat on site and the basic habitat descriptions for these species provided by GDARD, two Near Threatened and three Declining plant species were considered to have a medium chance of occurring in the types of habitats found on the site (see Appendix 1). One Declining plant species, *Hypoxis hemerocallidea*, was found on site as a relatively large scattered population. No other species of concern were found on site and, on the basis of the field investigation, it is considered unlikely that any occur on site. The plant species, *Hypoxis hemerocallidea*, is a relatively widespread species in South Africa and is declining due to harvesting for medicinal purposes, not due to habitat loss. Despite the large number of plants found on site, loss of these plants will not affect the conservation status of this species and, on a regional scale, would be a low impact. It is proposed that, should development of the site proceed, all individuals of this population are rescued by an approved organisation and housed at an appropriate nursery.

The site occurs within the Egoli Granite Grassland vegetation type. There are some patches of intact grassland on site, but most of the site consists of secondary grassland in previously cleared areas. The existence of some intact grassland on site has resulted in parts of the site being classified as having HIGH sensitivity. The overall diversity of indigenous species on site is moderately high (see Appendix 2). The overall impact of loss of this remaining natural grassland is assessed, at a regional level, as having moderate significance. Despite the high value attached to all natural grassland vegetation, there is little merit in conserving this relatively small patch of grassland (approximately 20 hectares). A minimum of 100 hectares is considered to be the minimum ecologically viable conservation unit for grassland. The secondary grassland on site is in good condition and has good vegetation cover with well-developed perennial growth. Although the natural composition has been lost, the secondary grassland is ecologically functional and provides natural linkages between different areas of indigenous vegetation on site.

There are two drainage lines on site that would be classified as wetlands according to the National Water Act. These wetland areas are in moderate condition and the wetland is ecologically functional. The species composition indicates a natural system

with intact ecological processes. According to GDARD guidelines, if the site is to be developed, buffer zones should be maintained around them to reduce development impacts. The wetland areas would, however, have to be properly delineated in order to accurately identify where they occur in the landscape.

On the basis of the field survey conducted on site it may be concluded that the proposed development may have negative impacts on an Orange Data plant species (*Hypoxis hemerocallidea*) and areas of grassland and wetland habitats. All three of these occur on site.

Recommendations:

Prior to any development of the site the following is recommended:

- Grassland areas on site that have been classified as having HIGH sensitivity should only be developed with permission from GDARD. They are listed according to the National List of Ecosystems that are Threatened and need of protection (GN1002 of 2011) and are shown as "Important Areas" in C-Plan.
- If any areas of grassland shown in Figure 5 as having HIGH sensitivity are to be developed, a comprehensive summer survey of these areas by a qualified botanist is required, in order to document species composition and richness within these areas.
- All individuals of *Hypoxis hemerocallidea* should be rescued from the footprint of the proposed development. Rescued plants should be kept in a nursery, according to instructions from conservation authorities.
- According to the Conservation of Agricultural Resources Act (Act No. 43 of 1983), all declared aliens that occur on the property must be effectively controlled. In terms of this Act 198 alien species were listed as declared weeds and invaders and ascribed to one of the following categories:
    - **Category 1**: Prohibited and must be controlled.
    - **Category 2** (commercially used plants): May be grown in demarcated areas provided that there is a permit and that steps are taken to prevent their spread.
    - **Category 3** (ornamentally used plants): May no longer be planted. Existing plants may be retained as long as all reasonable steps are

taken to prevent the spreading thereof, except within the flood line of watercourses and wetlands.

The declared aliens that occur on site are listed in Appendix 1.

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APPENDIX 1: Threatened, rare and declining plant species of the study area.

Sources: Threatened, rare and declining plant species: From the database of GDARD for the quarter degree grid 2628AA.
Conservation Status Category assessment according to IUCN Ver. 3.1 (IUCN, 2001).

CONFIDENTIAL: GDACE conditions for use of this data include that this list be treated as confidential and may not be attached to any document available for public perusal. Species names may not appear in the main document.

Taxon	Latest (IUCN version 3.1) Conservation Status**	Habitat	Flowering Time	Probability of occurrence*
Andromischus umbraticola subsp. *umbraticola*	Near Threatened (NT)	Rock crevices on rocky ridges, usually south-facing, or in shallow gravel on top of rocks, but often in shade of other vegetation.	September-January	LOW, habitat does not match
Boophone disticha	Declining	Dry grassland and rocky areas	October-January	**MEDIUM**, habitat partially matches
Bowiea volubilis subsp. volubilis	Near Threatened (NT)	Shady places, steep rocky slopes and in open woodland, under large boulders in bush or low forest.	September-April	LOW, habitat does not match
Callilepis leptophylla	Declining	Grassland or open woodland, often on rocky outcrops or rocky hillslopes.	August–January & May	**MEDIUM**, habitat partially matches (not found on site)
Cineraria austrotransvaalensis	Near Threatened (NT)	Amongst rocks on steep slopes of hills and ridges, as well as at the edge of thick bush or under trees; on all aspects and on a range of rock types: quartzite, dolomite and shale; 1400 – 1700 m.	March-June	LOW, habitat does not match
Cineraria longipes	Vulnerable (VU)	Grassland, on koppies, amongst rocks and along seepage lines, exclusively on basalt on south-facing slopes.	March-May	LOW, habitat does not match
Delosperma leendertziae	Near Threatened (NT)	Rocky ridges; on rather steep south facing slopes of quartzite in mountain	October-April	LOW, habitat does not match

		grassveld.		
Delosperma purpureum	Endangered (EN)	South facing slopes, grows in shallow soils among quartzitic rocks of crystalline or conglomerate type, in open or in broken shade, rarely in shade, in grassland with some trees.	November-April	LOW, habitat does not match
Eucomis autumnalis subsp. *clavata*	Declining	Open grassland, marshes.	November-April	**MEDIUM** habitat partially matches (not found on site)
Gunnera perpensa	Declining	In cold or cool, continually moist localities, mainly along upland streambanks.	October-January	LOW, no suitable permanent wetland habitat
Habenaria bicolor	Near Threatened (NT)	Well-drained grasslands at around 1600m.	January-April	**MEDIUM** habitat partially matches (not found on site)
Habenaria mossii	Endangered (EN)	Open grassland on dolomite or in black sandy soil.	March–April	LOW, habitat does not match
Holothrix micrantha	Endangered (EN)	Terrestrial on grassy cliffs, recorded from 1500 to 1800m.	October	LOW, habitat does not match
Holothrix randii	Near Threatened (NT)	Grassy slopes and rock ledges, usually southern aspects.	September-January	**MEDIUM** habitat partially matches (not found on site)
Hypoxis hemerocallidea	Declining	Grassland and mixed woodland.	January-March	**DEFINITE**, habitat matches, found on site
Khadia beswickii	Vulnerable (VU)	Open areas on shallow surfaces over rocks in grassland.	July-April	LOW, habitat does not match
Stenostelma umbelluliferum	Near Threatened (NT)	Deep black turf in open woodland mainly in the vicinity of drainage lines.	September-March	LOW, habitat does not match
Trachyandra erythrorrhiza	Near Threatened (NT)	Marshy areas, grassland, usually in black turf marshes.	September-November	LOW, habitat does not match

APPENDIX 2: Checklist of plant species recorded on site.

Abildgaardia ovata	
Acacia caffra	
Acalypha angusta	
*Agave americana	(Proposed declared invader)
Agrostis lachnantha	
Anthospermum rigidum	
Aristida junciformis	
Asclepias fruticosa	
Asparagus laricinus	
Aster harveyanus	
Berkheya radula	
Brachiaria serrata	
Bulbostylis burchellii	
*Campuloclinum macrocephalum	(Declared weed category 1)
Chaetacanthus setiger	
Chamaecrispa comosa	
Chlorophytum fasciculatum	
*Cirsium vulgare	(Declared weed category 1)
Commelina africana	
*Conyza canadensis	
Conyza podocephala	
Conyza sp.	
Crabbea acaulis	
Cynodon dactylon	
Cyperus denudatus	
*Cyperus esculentus	
Cyperus obtusiflorus var flavissimus	
Delosperma herbeum	
Digitaria erianthe	
Diospyros lycioides	
Elephantorrhiza elephantina	
Eragrostis capensis	
Eragrostis chloromelas	
Eragrostis curvula	
Eragrostis racemosa	
*Eucalyptus camaldulensis	(Declared invader category 2)
Felicia muricata	
Gazania krebsiana subsp. linearis	
Gymnosporia buxifolia	
Haplocarpha scaposa	
Helichrysum cf nudifolium	
Helichrysum nudifolium	
Helichrysum rugulosum	
Hemizygia pretoriae	
Hermannia grandistipula	
Heteropogon contortus	
Hypoxis hemerocallidea	(DECLINING)

Hypoxis iridifolia	
Hypoxis rigidula	
Hyparrhenia hirta	
Indigofera sp. cf. hedyantha	
Ipomoea crassipes	
Ipomoea obscura	
Ipomoea ommaneyi	
Justicia anagalloides	
Kohautia amatymbica	
Ledebouria revoluta	
Leersia hexandra	
Lotononis calycina	
Mariscus sp.	
*Melia azeradach	(Declared invader category 3)
Melinis nerviglumis	
Melinis repens	
Nidorella hottentotta	
Pearsonia cajanifolia	
Pelargonium luridum	
*Pennisetum clandestinum	(Proposed declared weed)
Pennisetum sphacelatum	
Pentanisia prunellioides	
Peucadanum magalismontanum	
Phragmites australis	
Pollichia campestris	
Polygala hottentotta	
*Polygonum lapathifolium	
Portulaca oleraca	
*Quercus robur	
Rhus pyroides	
Rhynchosia monophylla	
Rhynchosia totta	
Senecio erubescens subsp. crepidifolia	
Senecio pentactinus	
Senecio sp.	
Senecio venosus	
Seriphium plumosum	
*Solanum elaegnifolium	(Declared weed category 1)
*Solanum mauritianum	(Declared weed category 1)
Solanum panduriforme	
*Solanum sisymbriifolium	(Declared weed category 1)
Sphenostylis angustifolius	
Sutera pinnatifida	
*Tagetes minuta	
Tephrosia lupinifolia	
Themeda triandra	
Trifolium africanum	
Typha capensis	
*Verbena bonariensis	

Verbena tenuisecta
Vernonia oligocephala
Zornia milneana

Legal Status of weeds is as stipulated in 'Conservation of Agricultural Resources Act' (Act 43 of the Republic of South Africa 1983), as amended in 2001. In terms of this Act 198 alien species were listed as declared weeds and invaders and ascribed to one of the following categories:

- **Category 1:** Prohibited and must be controlled.
- **Category 2** (commercially used plants): May be grown in demarcated areas provided that there is a permit and that steps are taken to prevent their spread.
- **Category 3** (ornamentally used plants): May no longer be planted. Existing plants may be retained as long as all reasonable steps are taken to prevent the spreading thereof, except within the flood line of watercourses and wetlands.

Appendix 3D: Specialist Fauna Report

SPECIALIST FAUNAL SURVEY FOR PROPOSED DEVELOPMENT ON PART OF THE REMAINDER OF PORTION 1 OF THE FARM WATERVAL 5-IR; GAUTENG PROVINCE

Compiled for: SEATON THOMSON & ASSOCIATES BY:
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Zoological Consultant: Specialist Herpetological Consultant
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SUBMITTED: 29th NOVEMBER 2013

DETAILS OF SPECIALIST

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Appointment of specialist

Clayton Cook was commissioned by Seaton Thomson & Associates to provide specialist consulting services for the Environmental Impact Assessment for the proposed development of Part of the Remainder of Portion 1 of the Farm Waterval 5-IR. The consulting services comprise a description of faunal species on the site and an assessment of the potential for threatened faunal species likely to occur on site.

Summary of expertise

- Registered professional member of The South African Council for Natural Scientific Professions (Zoological Science), registration number 400084/04.
- Faunal and Specialist Herpetological consultant since 1997.
- Conducted over 150 preliminary faunal surveys and over 50 specialist surveys as a faunal consultant.
- Regional Organiser for Gauteng Province for the South African Frog Atlas Project 1999-2003.
- Published a scientific paper on *Pyxicephalus adspersus*, 8 scientific conference presentations, co-wrote the species accounts for the genus *Pyxicephalus* for the Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland South African as well as W.R.C Report No. 1258/1/06 on "A Biophysical framework for The Sustainable Management Of Wetlands In Limpopo Province With Nylsvley as a Reference Model". WRC PROJECT K5/1928: "Assessment of the Current Biodiversity Of The Wetland Amphibians Associated With Major River Systems Of The Kruger National Park (And The Physical And Chemical Factors Affecting Their Distribution)". VLOK, W[1], Fouche, P[2,] Cook, C.L.[3] and Pieterson, I[4].
- Attended 5 national and international herpetological congresses & 3 expert workshops, 6 Zoological Conferences as well as 4 South African Aquatic Sciences conferences lectured zoology and botanical science at University of Limpopo (2001-2004).
- Participant and author in the State of the Rivers project for the upper reaches of the Letaba River System

- Participant in the EWT Giant Bullfrog species survival programme as well as African Grass Owl Workshops.

Independence:

Clayton Cook have no connection with the proponent of the development and is not a subsidiary, legally or financially, of the proponent, remuneration for services by the proponent in relation to this proposal is not linked to approval by decision-making authorities responsible for permitting this proposal and the consultancy has no interest in secondary or downstream developments as a result of the authorisation of this project. The percentage work received directly or indirectly from the proponent in the last twelve months is approximately 0% of turnover.

Scope and purpose of report

The scope and purpose of the report are reflected in the "Terms of reference" section of this report below.

1. INTRODUCTION

1.1 Terms Of Reference

Clayton Cook was commissioned by Seaton Thomson & Associates to provide specialist consulting services for the Environmental Impact Assessment for the proposed development of Part of the Remainder of Portion 1 of the Farm Waterval 5-IR (henceforth called the Waterval site). In terms of the National Environmental Regulations of 2010, the applicant Waterfall Management Company are applying to the Gauteng Department of Agriculture and Rural Development (GDARD) for Environmental Authorization by undertaking a Scoping and Environmental Impact Assessment (EIA) for the proposed mixed use commercial activities on the 114 ha site. The site is situated southwest of Allandale Road (M36); east of the Gautrain Rapid Rail track and to the north of the Waterval Cemetery. Jukskei View Extensions 17 and 18 are situated on the south-eastern boundary (see Figure 1 locality map below). The consulting services comprise a description of faunal species on the site and an assessment of the potential for threatened faunal species with emphasis on threatened reptile (Striped Harlequin Snake), amphibian (Giant Bullfrog) and avifaunal/bird (African Grass Owl, Lesser Kestrel) species likely to occur on site.

The specialist faunal survey focused on the presence of mammals, birds, reptiles and amphibians within the Waterval site. The survey focused on the current status of threatened animal species occurring, or likely to occur within the proposed alignment, and describing the available and sensitive habitats on the proposed site as well as immediate adjacent areas. The vegetation unit on which the site is situated is **Egoli Granite Grassland (Gm 10)** in various stages of transformation and degradation. Situated within the lower-lying areas of the site are valley bottom wetlands with associated hillslope seepage wetlands. The faunal survey was conducted over three site visits conducted during the current summer rainfall period in late October and early November 2013 as well as heavily supplemented by personal species lists and previous surveys conducted on the site and Midrand area (1991-2013).

1.1 Objectives of the Specialist Faunal Survey

- To provide a description of the fauna occurring on the proposed Waterval site.
- To identify species (mammals, birds reptiles, amphibians) of conservation importance that could possibly occur on the proposed Waterval site.
- To determine potential impacts of the proposed development on the proposed Waterval site on the associated fauna.
- To provide management recommendations to mitigate negative and enhance positive impacts of the proposed Waterval development.

1.2 Scope of study

- A preliminary mammal, bird reptile and amphibian survey recording sightings and/or evidence of existing fauna occurring on the proposed Waterval site.
- An assessment of the ecological habitats, evaluating conservation importance and significance with special emphasis on the current status of threatened animal species (Red Data Species) occurring on the proposed Waterval site and immediate adjacent areas.
- Literature investigations, personal species lists with which to augment field data were necessary.
- Identification of potential ecological impacts on the proposed Waterval site and assess the significance of these, where possible.
- Investigate feasible and practical management recommendations that should be implemented to reduce or minimize the impacts, should the project be approved.
- Documentation of the findings of the study in a report.

1.3 Constraints or limitations of the current faunal survey included*:*

- The majority of threatened species are extremely secretive and difficult to observe even during intensive field surveys conducted over several years this is especially pertinent to the highly elusive and secretive Striped Harlequin Snake.
- Limitation of historic data and available databases for the majority of threatened species especially the Striped Harlequin Snake where only 80 records exist for Southern Africa, Swaziland and Lesotho (SARCA 2009).
- The presence of threatened species on site is assessed mainly on habitat availability and suitability as well as desk research (literature, personal records and previous surveys conducted on the site (1996-2013) and similar habitats within the Midrand-Kyalami area).

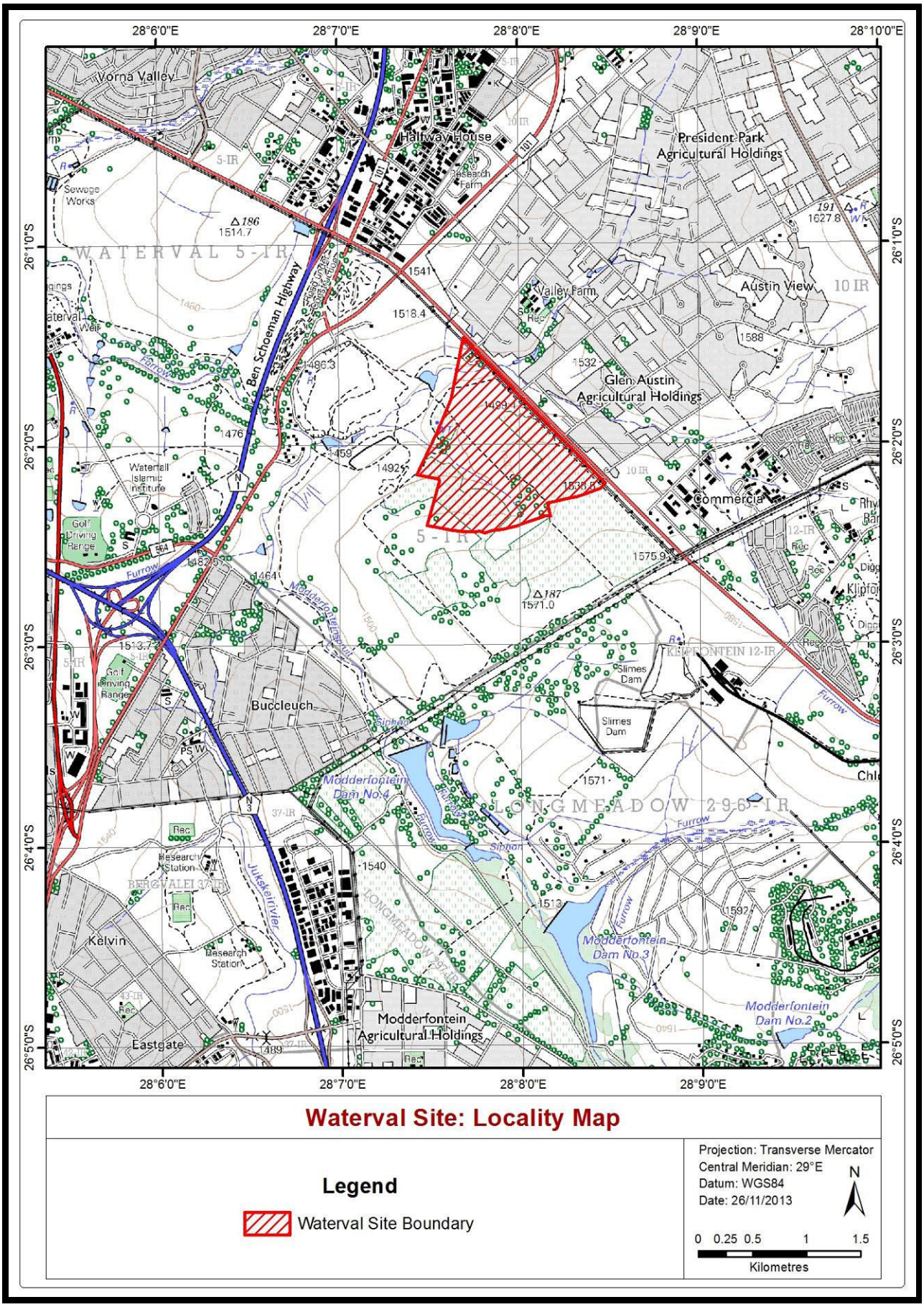

Figure1. Locality map of the proposed Waterval site.

2. METHODOLOGY

2.1 Predictive methods

A 1:50 000 map of the study area was provided showing existing infrastructure and the proposed Waterval site. This was used as far as possible in order to identify potential "hot-spots" or specialised habitats e.g. Patches of open grassland vegetation, rivers (Moddefonteinspruit and Jukskei River), palustrine wetlands (valley bottom and seepage wetlands) and dams. Satellite imagery of the area was obtained from Google Earth was studied in order to get a three dimensional impression of the topography and current land use. Aerial photographs were utilised for the sensitivity mapping using Arcview 9.2

2.2 Literature Survey

A detailed literature search was undertaken to assess the current status of threatened fauna that have been historically known to occur within the Waterfall (2628 AA) Quarter Degree Grid Cell (QDGC). The literature search was undertaken utilising *The Vegetation of South Africa, Lesotho and Swaziland* (Mucina & Rutherford 2006) for the vegetation description as well as *National Red List of Threatened Plants of South Africa* (Raimondo *et al,* 2009) as well as internet using POSA (http://posa.sanbi.org). *The Mammals of the Southern African Subregion* (Skinner & Chimimba 2005) and *The Red Data Book of the Mammals of South Africa: A Conservation Assessment* (Friedmann and Daly (editors) 2004) as well as ADU's MammalMAP (http://vmus.adu.org.za/vm_sp_list.php accessed on the 14th of November 2013) for mammals. Hockey, P.A.R., Dean, W.R.J., Ryan, P.G. (eds). 2005. *Roberts- Birds of Southern Africa VIIth ed*. And BARNES, K.N. (ed.) (2000) *The Escom Red Data Book of Birds of South Africa, Lesotho and Swaziland* for avifauna (birds) as well as internet SABAP2 (http://sabap2.adu.org.za accessed on the 14th of November 2013). *A Complete Guide to the Frogs of Southern Africa* (du Preez & Carruthers 2009) and *The Atlas and Red Data Book of the frogs of South Africa, Lesotho and Swaziland* (Minter *et al.* 2004) for amphibians as well as SAFAP FrogMAP (http://vmus.adu.org.za). The *Field Guide to the Snakes and other Reptiles of Southern Africa* (Branch 2001) and *South African Red Data Book-Reptiles and Amphibians* (Branch 1988) as well as SARCA (http://sarca.adu.org.za accessed on the 14th of November 2013 for reptiles.

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2.3 Site Investigation Methodology

A preliminary assessment of the status, spatial requirements and habitat preferences of all priority species likely to occur on the proposed Waterval site. For certain species, an estimate of the expected or historical distribution for the area could be extrapolated from published information and unpublished reports, while habitat and spatial requirements were generally derived from the literature. For other species such as the Striped Harlequin Snake, little of this information was readily available and conservation targets remain speculative. Species assessments will be updated when additional data becomes available and where appropriate, proposed conservation targets will be revised.

A survey of the proposed development areas was carried out by driving around the entire area by car and closer inspection of the actual site carried out on foot during daylight as well as an evening survey on the 12th November 2013. Due to the close proximity of the site to Allandale Road and the N1 as well as historic agricultural activities on the site and surrounding open grasslands; the majority of natural vegetation (Egoli Granite Grassland Gm10) has already been transformed or become severely degraded due to large scale illegal dumping activities and invasion of anthropogenic grasses (kikuyu) as weedy plant and alien tree species (*Acacia mearnsii, Eucalyptus camaldulensis*). The majority of the site consists of old transformed agricultural lands with secondary succession *Hyparrhenia hirta* grasslands, cleared areas, kikuyu invaded rubble piles. Several formal and informal access roads bisect the entire site. Evidence of vagrants and illegal hunting and poaching activities were observed within the Eucalyptus wooded areas on the western boundary. The central valley bottom wetland has been heavily impacted on by the installation of a bulk sewer line as well as the K60 maintenance road for the Gautrain. Evidence of rill and surface erosion below stormwater discharge culverts and disturbed drainage areas as well as extensive alien and weedy plant and kikuyu invasion within the adjacent degraded seepage wetlands. Extremely poor water quality within the heavily reed invaded northern channelled valley bottom wetland as well as an existing Eskom substation within the temporary and seasonal wet zones.

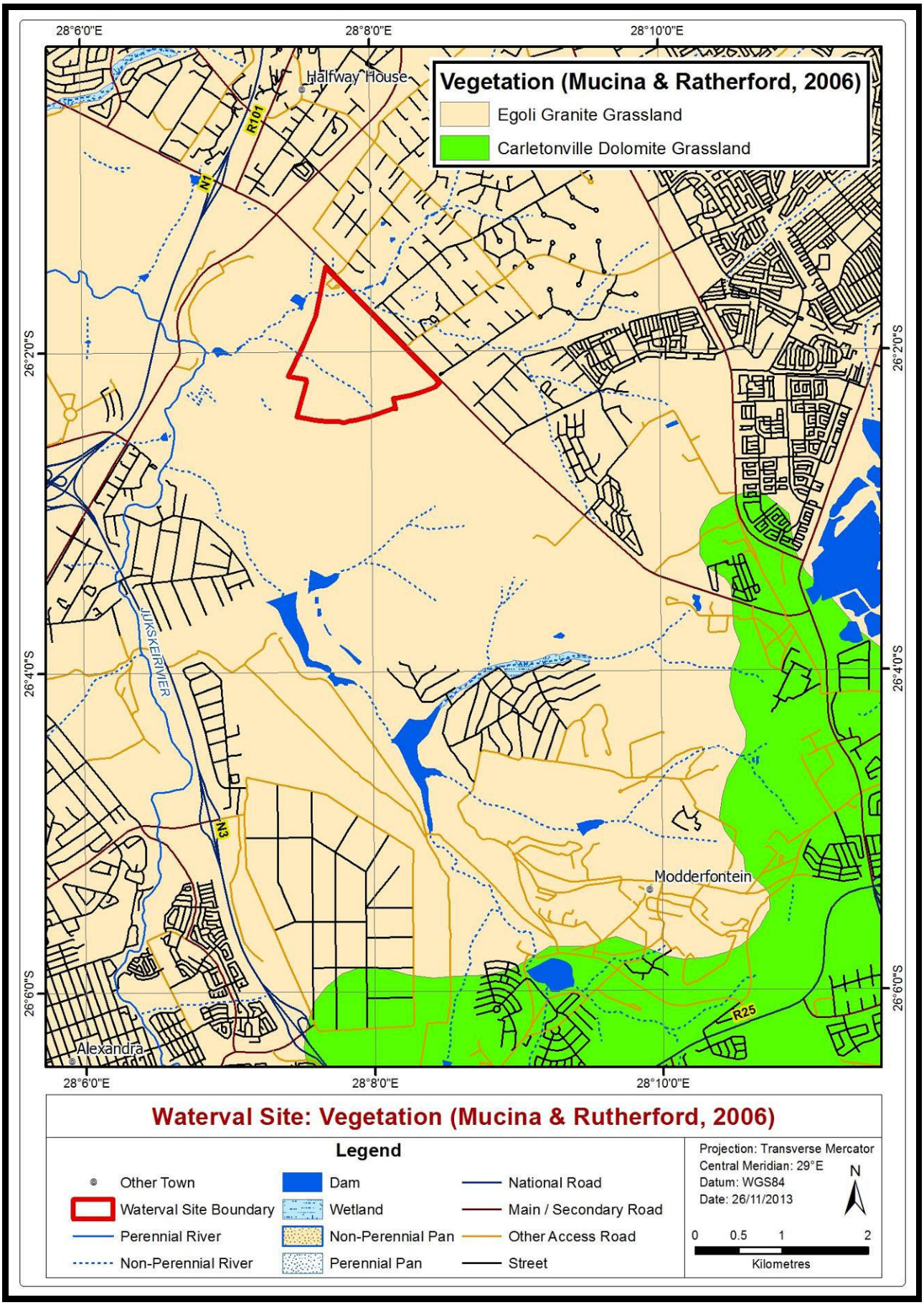

Figure2. Vegetation map for the proposed Waterval site (Mucina *et al.* 2006)

The study area falls within the **Grassland Biome** described by Mucina *et al*. (2006) where it is further divided into the **Egoli Granite Grasslands (Gm10)**. The grasslands have been historically impacted on by previous agricultural activities and degraded due to high levels of human disturbances including large scale illegal dumping activities on and surrounding the site. As the site is situated in a peri-urban environment the vegetation has been altered and transformed from its natural state and is dominated by the anthropogenic grass species *Aristida congesta*, *Eragrostis curvula, Hyparrhenia hirta* in the old agricultural lands (fallow lands) and are characterised by dense stands of weedy species (*Tagetes minuta, Bidens pilosa, Conyza albida, Verbena bonariensis*) as well as secondary succession grasses *Eragrostis curvula* and *Cynodon dactylon*.

Evidence of elevated moisture levels as well as seasonally inundated depressions and hillslope seepage areas were observed on the central portions of the site extending towards the poorly defined in certain areas; mainly un-channelled valley bottom wetland and in certain areas of the site are dominated by dense stands of the hygrophytic grass species *Arundinella nepalensis* and Cotton Wool Grass *Imperata cylindrica* as well as the bulbous herb Yellow Tulip (*Homeria pallida*), *Monopsis decipiens*, *Cyperus rupestris*. Other common species that occasionally become dominant or co-dominant in certain areas are *Eragrostis plana*, *Pennisetum setaceum*, *Setaria spacelata*, *Hemathria altissima*, *Scirpoides burkei*, *Aristida junciformis*, *Plantago lanceolata** and *Paspalum dillatum**. Kikuyu (*Pennisetum clandestinum**) has invaded the areas previously utilised for illegal dumping activities.

The geology of the site is archaen granite and gneiss of the Half-way House Granite at the core of the Johannesburg Dome. The shallow soils on the site are leached; coarsely grained and sandy and low in nutrients of the Glenrosa Form as well as Dresden Soil Form on the exposed ferricrete layer. The climate is strongly seasonal summer rainfall region, with dry winters. Incidence of frosts is frequent in the winter months. Mean annual precipitation (MAP) is between 620-800mm. The topography of the site is undulating with a gentle slope towards the poorly defined in certain areas central mainly un-channelled valley bottom wetland which flows into the Jukskei River to the north-west of the site. The Jukskei River is situated outside the northern boundary of the site. The Modderfontein Spruit, a tributary of the Jukskei, occurs to the southeast of the site; including the confluence with the Jukskei River.

The site is currently vacant and utilised for illegal dumping activities as well as several vagrants living within the old *Eucalyptus* woodlots. A bulk sewer line has been constructed within the temporary wet zone of the central valley bottom wetland. The site is bisected by the K60 or Gauteng Maintenance Depot access road which has disrupted the natural diffuse flow patterns of the adjacent seasonally inundated seepage wetlands.

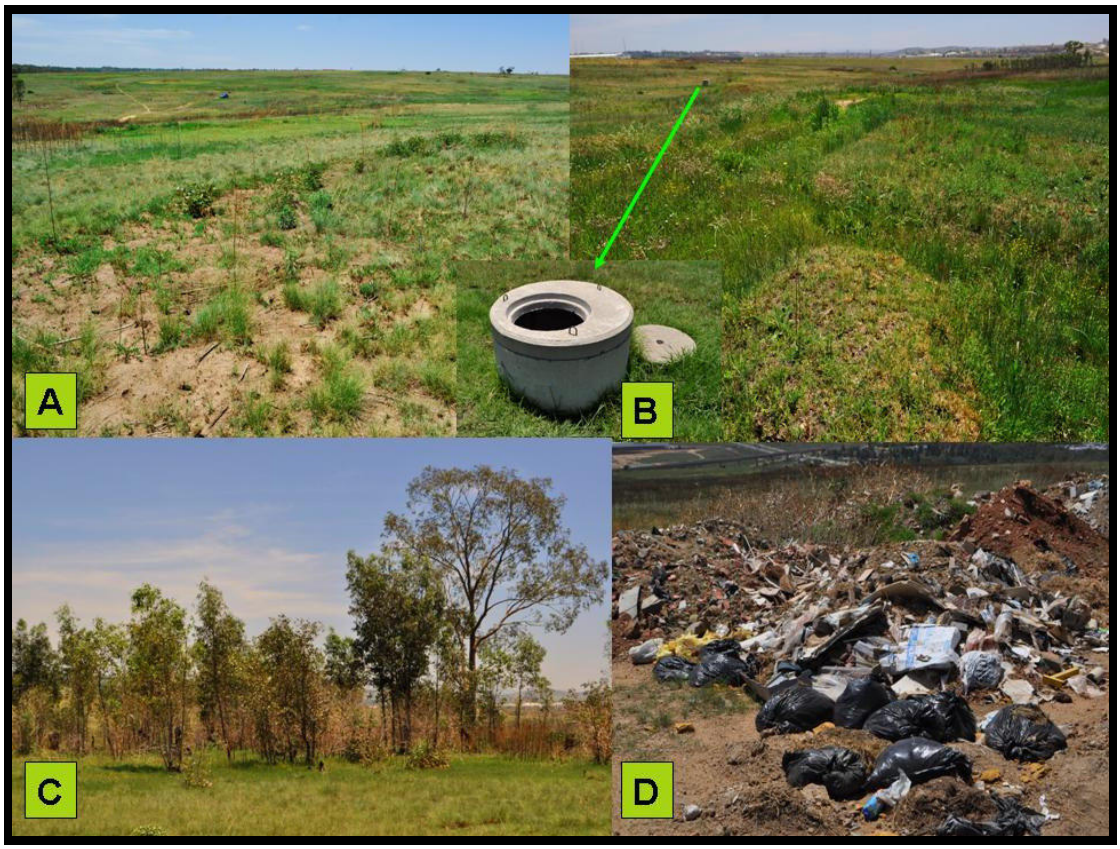

Figure3. The grasslands and palustrine wetlands on the site have been impacted on by previous as well as current agricultural activities as well as anthropogenic activities. A: The majority of the southern and south-eastern portions of the site consist of old transformed agricultural lands with secondary succession *Hyparrhenia hirta, Eragrostis curvula* grasslands. **B:** A bulk sewer line was constructed within the temporary wet zones of the mainly un-channelled valley bottom wetland. **C:** The site comprised previous woodlots or coppicing *Eucalyptus* plantations. Weedy invaded sections occur around the disturbed areas on the site especially around the large rubble piles **D:** Extensive illegal dumping of solid and organic waste material on the site. The organic material includes kikuyu lawn cuttings which have invaded the seepage wetlands as well as old rubble piles.

3. EXISTING IMPACTS ON THE VEGETATION AS WELL AS FAUNA ON THE WATERVAL SITE INCLUDE:

- Remaining open grasslands surrounding the proposed Waterval are mainly transformed old agricultural lands or heavily degraded and currently utilised for illegal dumping activities or are relic fragmented patches of grassland which are heavily impacted from surrounding human activities. The site is surrounded by existing residential plots to the east (Glen Austin Extension 3) Jukskei View Extensions 17 and 18 to the southeast, the Gautrain alignment and large scale commercial developments to the north. Frequent fires, grass and medicinal plant harvesting, illegal hunting and poaching, alien vegetation invasion, invasion of informal settlements, illegal dumping of rubble and waste products was observed on the proposed Waterval. site
- Several primary and secondary access roads occur around the site. Allandale Road (M39) forms the eastern boundary of the site and has high levels of vehicular traffic which results in increased road fatalities of migrating faunal species. The site is largely unfenced allowing free access into the remaining open areas.
- Several high security walls constructed around the perimeter of newly established high density residential developments, wire and electric fences around residential plots restrict the natural dispersal movements of several animal species (Giant Bullfrog).
- Limited indigenous riverine or riparian vegetation remains along the Modderfontein Spruit and Jukskei River. Large sections to the southwest have been completely transformed or heavily disturbed during the construction phase of the Gautrain
- An existing bulk sewer line runs parallel to the lower-lying central valley bottom wetland. The pipeline is situated within the seasonal and temporary wet zones of the seasonal seepage wetlands which feed into the valley bottom wetland. Severe headward erosion already occurs along certain sections of the seasonal drainage line, as well as surface erosion within the poorly vegetated areas along the bulk sewer line.
- A few scattered indigenous trees (*Acacia karroo, Searsia pyroides*) occur on the site. The majority of tree species are alien invasive species *(Eucalyptus sp., Acacia mearnsii*).
- A few low-lying most embedded granite rocky outcrops or extrusions occur adjacent to the valley bottom wetland.
- Illegal hunting and poaching activities were observed on the site. Several wire as well as nylon snares were observed along the wooded areas of the site as well as along Helmeted Gunieafowl pathways.
- Deterioration in water quality in the northern tributary of the Jukskeu River due to nutrient enrichment or eutrophication as well as possible leaking sewerage. The

small dam contains foul smelling water and are completely dominated by large green algal mats as well as smothered in macrophytes (*Phragmites australis*).

- The use of open fires for cooking and heating purposes results is a potential fire hazard and results in frequent burning of the site (degradation of any natural vegetation). Burning of dumped waste material results in frequent burning of the surrounding vegetation. Arson from vagrants in the area results in frequent fires as well as burning of stolen wire for copper collection.
- Frequent fires at the incorrect time of the year, illegal dumping and sand miningn has disturbed the limited underlying grass and forb vegetation layer with dense stands of Khaki Bush *Tagetes minuta*, Black-Jacks *Bidens pilosa* are found throughout the site
- Large scale illegal dumping of building rubble and waste material is found on the eastern and southern boundaries of the site.
- Severe alien vegetation invasion around the entire site including Common Thorn Apple (*Datura stramonium**), Blue Gum (*Eucalyptus* sp.), Bugweed (*Solanum mauritianum*), Lantana (*Lantana camara*), Giant Reed (*Arundo donax**), *Pinus spp.*, Sweet Prickly Pear (*Opuntia ficus-indica**) and Queen of the Night (*Cereus jamarcus**). Black Locust (*Robinia pseudoacacia**), Black Wattle (*Acacia mearnsi**i*), Cluster Pine (*Pinus patula**) Kikuyu (*Pennisetum clandestinum**).

4. RESULTS OF SPECIALIST FAUNAL SURVEY AND HABITAT ASSESSMENT

Three general habitat sensitivity scans were carried out on site on the 26th of October to the 12th November 2013. These site visits did not entail intensive surveying or utilisation of any sampling methods and can rather be viewed as being an opportunity to identify sensitive faunal habitats occurring on the proposed Waterval site. Emphasis was placed on the seasonal wetland habitats, low-lying granite outcrops and rocky sheets as well as open grassland areas in various stages of transformation and degradation. Due to the large size as well as dense weedy plant and grass species of the recently transformed grasslands areas little time was spent surveying these degraded habitats. All animals (mammals (larger), birds, reptiles and amphibians) seen or heard; were recorded. Use was also made of indirect evidence such as nests, feathers and animal tracks (footprints, droppings) to identify animals. A single night nocturnal survey was conducted on the 12th of November 2013. The majority of mammals were identified by visual observations as well as droppings and various burrow types. The majority of amphibians identified on the site were calling adults as well as incidentally observed adults (under rocks, logs, dumped material etc) and from dip netting for tadpoles with a small aquarium net. Reptiles were actively searched for under suitable refuges such as loosely embedded flat rocks, logs, stumps, dumped building rubble, tyres and carpets and identified by actual specimens observed.

4.1 Amphibians

Amphibians are an important component of South Africa's exceptional biodiversity (Siegfried 1989) and are such worthy of both research and conservation effort. This is made additionally relevant by international concern over globally declining amphibian populations, a phenomenon currently undergoing intensive investigation but as yet is poorly understood (Wyman 1990; Wake 1991). Amphibians have declined dramatically in many areas of the world. These declines seem to have worsened over the past 25 years and amphibians are now more threatened than either mammals or birds, though comparisons with other taxa are confounded by a shortage of reliable data.

Most frogs have a biphasic life cycle, where eggs laid in water develop into tadpoles and these live in the water until they metamorphose into juvenile fogs living on the land. This fact, coupled with being covered by a semi-permeable skin makes frogs particularly vulnerable to pollutants and other environmental stresses. Consequently frogs are useful environmental bio-monitors (bio-indicators) and may acts as an early warning system for the quality of the environment. The Giant Bullfrog (*Pyxicephalus adspersus*) has been chosen as a flagship species for the grassland eco-region (Cook in le Roux 2002)

Breeding in African frogs is strongly dependent on rain, especially in the drier parts of the country where surface water only remains for a short duration. The majority of frog species in the Gauteng Province can be classified as explosive breeders. Explosive breeding frogs utilise ephemeral pans or inundated grasslands for their short duration reproductive cycles.

During this survey; fieldwork was augmented with species lists compiled from personal records (1999-2010); data from the site collected for the South African Frog Atlas Project (SAFAP) (1999-2003) and published data, and the list provided in Table 1 below is therefore regarded as likely to be fairly comprehensive.

Table1. Frog species recorded by the consultant in the Glen Austin Agricultural Holdings and Waterval site during the period 1991 to 2013.

COMMON NAME	SCIENTIFIC NAME	BREEDING HABITAT
*Guttural Toad	*Amietophrynus gutturalis*	Seasonal pools within the central valley bottom wetland
Red Toad	*Schismaderma carens*	Reed invaded artificially created dams along the Jukskei tributary.
*Common Platanna	*Xenopus laevis*	Dams along the tributaries or seasonal drainage lines
*Boettger's or Common Caco	*Cacosternum boettgeri*	Seasonal pools within the central valley bottom wetland
*Bubbling Kassina	*Kassina senegalensis*	Seasonal pools within the central valley bottom wetland
*Tremelo Sand Frog	*Tomopterna cryptotis*	Seasonal pools within the central valley bottom wetland
Natal Sand Frog	*Tomopterna natalensis*	Seasonal pools within the central valley bottom wetland
Giant Bullfrog	*Pyxicephalus adspersus*	Seasonal pools within the central valley bottom wetland (historic records 2006)
*Common River Frog	*Amietia angolensis*	Permanent inundated pools within the central valley bottom wetland
Cape River Frog	*Amietia fuscigula*	Glen Austin Pan/Bird Sanctuary and adjacent Marsh Sylph Pan (historic records 1994-1998)
Striped Grass Frog	*Strongylopus fasciatus*	Glen Austin Pan/Bird Sanctuary
Snoring Puddle Frog	*Phrynobatrachus natalensis*	Glen Austin Pan/Bird Sanctuary
Raucous Toad	*Amietophrynus rangeri*	Historic records (1992)

* recorded during current survey (Nov 2013)

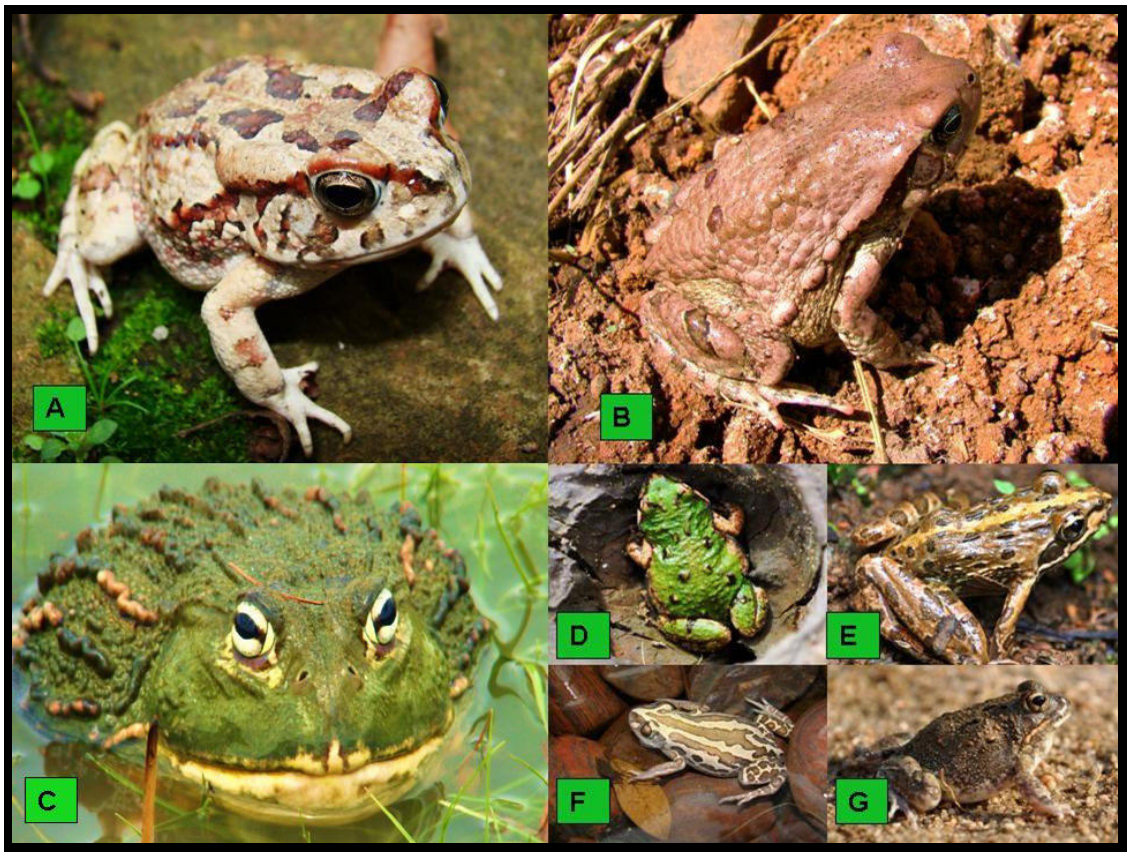

Figure4. **A conglomerate of photographs of the frog species likely to occur on the Waterval site. A:** Guttural Toad (*Amietophrynus gutturalis*); **B**: Red Toad (*Schismaderma carens*); **C:** Giant Bullfrog (*Pyxicephalus adspersus*); **D:** Boettger's Caco (*Cacosternum boettgeri*); **E:** Common River Frog (*Amietia angolensis*); **F:** Bubbling Kassina (*Kassina senegalensis*) and **G**: Tremelo Sand Frog (*Tomopterna cryptotis*).

Threatened species

The Giant Bullfrog (*Pyxicephalus adspersus*) is a protected frog species whose conservation status has been revised and was included as a Red Data Species under the category 'Lower Risk near threatened' (Minter *et al.* 2004). Giant Bullfrogs historically occurred throughout the Glen Austin Agricultural Holdings–Half Way House area. A major causal factor in the decline in Giant Bullfrog populations in this area is massive habitat destruction by previous agricultural activities (draining wetlands, ploughing of grasslands) and within the past twenty years by extensive residential and commercial developments. Major (N1, M39) and secondary road networks bisect suitable breeding and foraging areas resulting in mass road fatalities of migrating adult and juvenile bullfrogs. Fences and walls also prevent the natural migration of adult and juveniles from foraging areas and suitable breeding sites (habitat fragmentation).

Habitat deterioration due to changes in the seasonality of wetland sites (damming), deterioration of water quality due to surface water contamination with pesticides and pollutants and weed and reed invasion lead to the disappearance of bullfrog populations. Human predation of adult bullfrogs is another causal factor in population declines. This is especially prevalent in the rural parts of Southern Africa (Hammanskraal, Seshego) as well as around larger informal settlements such as Diepsloot (*pers.obs*. 2008, 2009). Bullfrogs are also caught illegally for the local and international pet industry. Removal of large adult males has a detrimental effect on the reproductive success of the small relic populations. The recent increase in the exotic pet trade; especially snakes; results in juvenile bullfrogs been captured for feeding captive snakes.

Bullfrog populations have declined dramatically over the past twenty years especially in the Midrand and Fourways area. Continual destruction and deterioration of suitable breeding and foraging areas have resulted in the disappearance of several smaller Giant Bullfrog populations. The majority of records (post 2000) of Giant bullfrogs from the Glen Austin Agricultural Holdings area are of migrating adult males usually found dead on the roads as well as a large breeding populations to the north-east of the site (Glen Austin population). Giant Bullfrogs have been previously recorded (1994 and 2004) by the consultant breeding within seasonally inundated hygrophilous sedge and grass dominated pools within the central valley bottom wetland.

Figure5. Giant Bullfrog breeding was previously recorded within seasonally inundated pools within the central valley bottom wetland. A single clutch and adult male was observed. High levels of predation resulted in a small school of tadpoles (<100).

The site currently offers limited foraging areas due to the degradation of the grasslands and restricted dispersal or migratory habitat due to the M39 as well as several electric and wire fences erected around the properties in Glen Austin Extension 3 and Jukskei View. The N1 and M36 are potential dispersal or migratory barriers as well as the raised Gautrain rapid rail alignment. Extremely limited open grassland habitat remains in the immediate area due to increased development pressures.

GDARD's Minimum Requirements for Biodiversity Studies: Amphibians

Under C-Plan version 3 (latest version i.e. version 3.3), no specialist studies for any species of amphibian are requested for consideration in the review of a development application. The Giant Bullfrog (*Pyxcicephalus adspersus*) has been removed following re-assessment of the species' status in South Africa. The species is not truly Near-Threatened in South Africa (no quantitative analysis of the Giant Bullfrog distribution against the IUCN criteria can consider them as such) and the most recent evaluation of the status of the Giant Bullfrog in December 2009 did not consider the species sufficiently threatened to be listed as Near Threatened (G. Masterson pers. comm. with Prof. Louis du Preez)*.

Given the current objectives of Gauteng's C-plan i.e. to be used to protect representative habitat and generate specialist studies for threatened faunal species, the Giant Bullfrog does not qualify for inclusion as a species-specific layer requiring specialist assessments. As per the C-Plan approach, the conservation of the Giant Bullfrog and of amphibians in general will be met by the protected area network as well as the designation of priority habitats i.e., pans or quaternary catchments, with associated restrictions on land use (refer to "Wetlands" section). The wetland and a protective buffer zone, beginning from the outer edge of the wetland temporary zone, must be designated as sensitive (GDARD Requirements for Biodiversity Assessments: Version 2; 2012). The current buffer zones around wetlands (30m for wetlands occurring inside urban areas and 50m for wetlands occurring outside urban areas) are totally in adequate to conserve core terrestrial habitat for the majority of frog species occurring in Gauteng Province; especially the Giant Bullfrog which requires large open areas to forage in.

* It is the opinion of the specialist consultant that dramatic population declines have occurred within Gauteng Province over the past 25 years and Giant Bullfrogs are worthy of conservation efforts.

4.2 REPTILES

Reptile lists require intensive surveys conducted for several years. Reptiles are extremely secretive and difficult to observe even during intensive field surveys conducted over several seasons. The majority reptile species are sensitive to severe habitat alteration and fragmentation. Due to previous agricultural activities in the area coupled with increased habitat destruction for urban and commercial expansion as well as Gautrain, degradation (alien plant invasion) and disturbances are all causal factors in the alteration of reptile species occurring in these areas. The indiscriminate killing of all snake species as well as the illegal collecting of certain species for private and the commercial pet industry reduces reptile populations especially snake populations drastically. The frequent burning of the site will have a high impact on remaining reptiles. Fires during the winter months will severely impact on the hibernating species, which are extremely sluggish. Fires during the early summer months destroy the emerging reptiles as well as refuge areas increasing predation risks.

The scattered low-lying granite outcrops and rocky sheets provide favourable refuges for certain rupiculous snake and lizard species. Reptile species recorded from under loosely embedded rocks on the site included Yellow-Throated Plated Lizard (*Gerrhosaurus flavigularis*), Montane Speckled Skink (*Trachylepis* (*Mabuya*) *punctatissima*), Variable Skink (*Trachylepis (Mabuya) varia*) Ground Agama (*Agama aculeata*) and Transvaal Thick-toed Gecko (*Pachydactylus affinis)*.

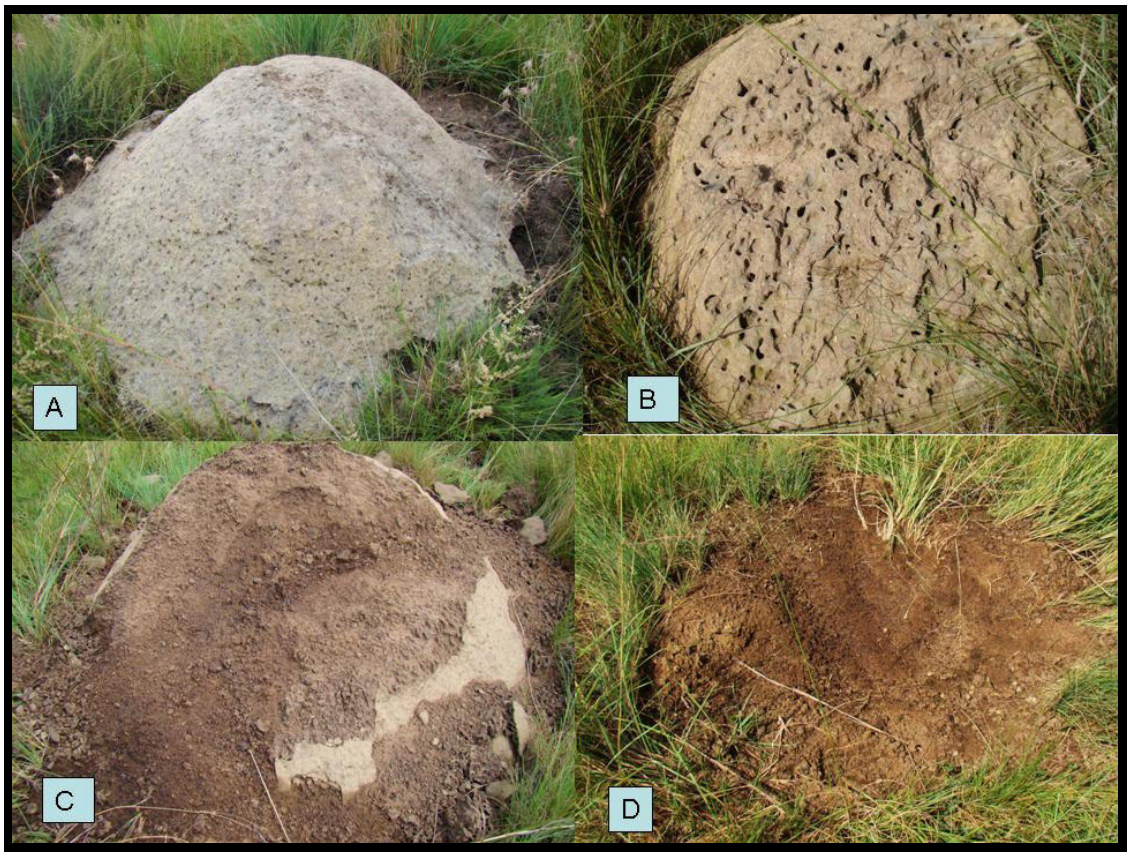

Figure6. Several large termite mounds *Trinervitermes spp.* were observed within the moist grassland adjacent to the tributary of the Jukskei River on the northern portions of the site. A: Large termite mounds (1m^2) were observed along the grasslands above the southern banks of the Jukskei Tributary. **B:** Moribund (old abandoned or dead mounds) termite mounds offer important refuges for numerous frog, lizard and snake species (Striped Harlequin Snake). Large number of species of mammal, birds, reptiles and amphibians feed on the emerging alates (winged termites). These mass emergences coincide with the first heavy summer rains and the emergence of the majority of herpetofauna. Termite mounds also provide nesting site for numerous snakes, lizards (varanids) and frogs. **C & D:** Several large termite mounds have recently been destroyed. Termite mounds are destroyed during illegal reptile collecting as well as for feeding aviary birds as well as exotic reptiles.

A few scattered large indigenous tree species such as Common Sweet Thorn (*Acacia karroo*), Common Wild Currant (*Searsia pyroides*) remain on the site. Trees including stumps, bark and holes are vital habitats for numerous arboreal reptiles (chameleons, snakes, agamas, geckos and monitors). Flap-necked Chameleons (*Chameleo dilepis*) have previously been recorded by the consultant on the site with an adult female collected from the informal dirt access road. The small reed invaded dams on the site and to the north of the site offer favourable habitat for Nile Monitors (*Varanus niloticus*), Marsh Terrapins (*Pelomedusa subrufa*) as well as Brown Water Snakes (*Lycodonomorphus rufulus*). The dumping of building rubble has created suitable habitat for certain reptile species such as Herald Snake (*Crotaphopeltis hotamboeia*), Variable Skink (*Trachylepis varia*), Brown House Snake (*Lamprophis fuliginosus*), and Spotted Skaapsteker (*Psammophylax rhombeatus*).

Table2. Reptile species recorded by the consultant during the current and previous surveys within the Glen Austin AH and Waterval site (1991-2013).

Common Name	**Scientific Name**
Marsh or Helmeted Terrapin	*Pelomedusa subrufa*
Cape Skink	*Trachylepis* (*Mabuya*) *capensis*
*Montane Speckled or Striped Skink	*Trachylepis* (*Mabuya*) *punctatissima*
Wahlberg's Snake-eyed Skink	*Panapsis wahlbergii*
Variable Skink	*Mabuya varia*
Common Rough-scaled Lizard	*Ichnotropis squamulosa*
Flap-neck Chamaeleon	*Chamaeleo dilepis*
*Transvaal Thick-toed gecko	*Pachydactylus affinis*
Cape Thick-toed Gecko	*Pachydactylus capensis*
*Cape Dwarf Gecko	*Lygodactylus capensis*
*Yellow-throated Plated Lizard	*Gerrhosaurus flavigularis*
Nile Monitor	*Varanus niloticus*

Ground Agama	*Agama aculeata distanti*
Southern Rock Agama	*Agama atra atra*
Herald or Red-lipped Snake	*Crotaphopeltis hotamboeia*
Rinkhals	*Haemachatus haemachatus*
Mole Snake	*Pseudapsis cana*
Common or Rhombic Night Adder	*Causus rhombeatus*
Puff Adder	*Bitis arietans*
Common or Rhombic Egg Eater	*Dasypeltis scabra*
Brown water Snake	*Lycodonomorphus rufulus*
Brown House Snake	*Lamprophis fuliginosus*
Aurora House Snake	*Lamprophis aurora*
Spotted or Rhombic Skaapsteker	*Psammophylax rhombeatus*
Striped Skaapsteker	*Psammophylax tritaeniatus*
Black-headed Centipede Eater	*Aparallactus capensis*
Green Water Snake	*Philothamnus hoplogaster*
Common Slug-eater	*Duberria lutrix*

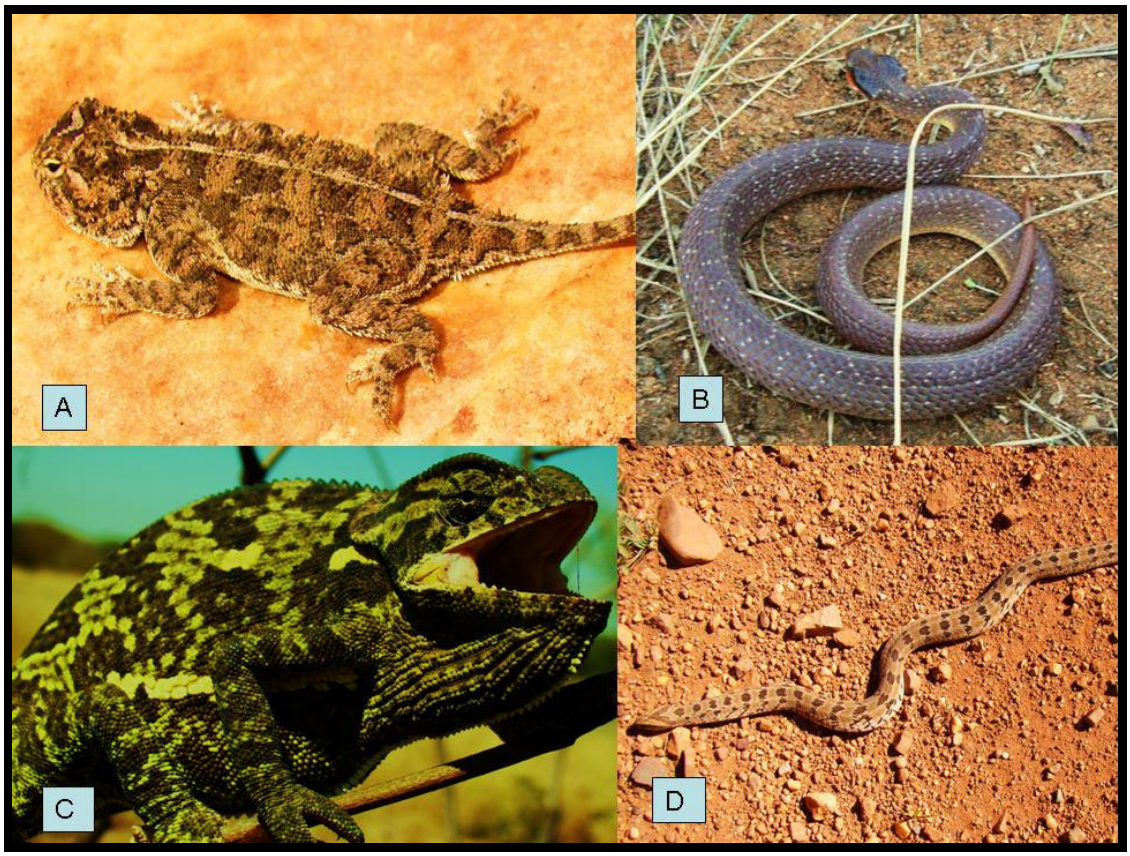

Figure7: Reptile species previously recorded from the Waterval site included: A: Distant's Ground Agama (*Agama aculeate distanti*); **B:** Herald Snake (*Crotaphopeltis hotamboeia*); **C:** Flap-necked Chameleon (*Chamaeleo dilepis*); **D:** Rhombic Night Adder (*Causus rhombeatus*). *

Threatened species

No threatened reptile species were recorded during this survey or previous surveys, but the Striped Harlequin Snake (*Homoroselaps dorsalis*), which is categorised as Rare in the out-dated Red Data List (Branch 1988) and is currently listed as Near-Threatened (NT) by the IUCN (World Conservation Monitoring Centre, 1996), though this assessment is also out-of-date. The conservation status of *H. dorsalis* will be reviewed in coming months by the South African Reptile Conservation Assessment (SARCA). Striped Harlequin Snakes have been recorded from the 2628AA QDGC and adjacent grid squares (2528CCand 2628AC) (SARCA virtual museum).

* Photographs are not of actual specimens recorded from the site

Prefers grassland and are endemic to the highveld of the Free State, Kwazulu-Natal, Swaziland, Limpopo and Gauteng. These snakes are very secretive and are only known from a few specimens. They burrow in loose soil and forage underground in tunnels and cracks, and are usually exposed in abandoned termitaria or under stones. They feed exclusively on thread snakes (*Leptotyphlops*) which they catch underground (Branch 1998). No thread snakes were observed under logs or loosely embedded rock material on the site.

Under C-Plan version 3.3, no specialist studies for any species of reptile are requested for consideration in the review of a development application within Gauteng Province (GDARD Requirements for Biodiversity Assessments: Version 2; 2012). It is highly unlikely that the degraded and transformed grassland habitats dominating the site forms critical habitat for any threatened reptile species. As a precautionary measure all termite mounds occurring within the proposed development areas should be excavated by hand and any reptile species encountered released in suitable habitat away from the development.

4.3 AVIFAUNA/BIRDS

Due to time constraints no comprehensive bird lists could be compiled. During brief site visitations (total of 20 hrs), 76 bird species were recorded (see Appendix, Table 8). Lists were supplemented from personal records collected from the Glen Austin AH (1991-2013). Over 230 bird species have been recorded within the 2600-2800 pentad in which the study site is situated. The majority of species recorded during field surveys are common, widespread and typical highveld species. Numbers of bird species in the Midrand area have declined mainly due to increased levels of human disturbances (quad and off-road bikes); extensive habitat transformation due to increased urban sprawl and agricultural activities; as well as severe habitat degradation of the wetlands as well as rivers (especially the Modderfonteinspruit and Jukskei). Human activity has transformed grasslands in South Africa to a point where few pristine examples exist (Low & Rebelo 1996; Barnes 1998). Factors such as agricultural intensification, increased pasture management (overgrazing), decrease in grassland management due to frequent fires and land-use alteration (urbanisation). Continuing pressure on sensitive wetland and surrounding open grassland habitat are largely responsible for the decline of the threatened avifaunal species.

Table3: Red List species recorded in Midrand area (Harrison et al. 1997; sabap2.adu.org.za).

Species	Conservation status (Barnes 2000)	Reporting rate SABAP1 %	Reporting rate SABAP2 %	Habitat requirements (Barnes 2000; Hockey et al 2005; Harrison et al 1997; personal observations)
Black Stork *Ciconia nigra*	Near threatened	0.3	-	Cliffs for roosting and breeding, and rivers and dams for foraging.
Yellow-billed Stork *Mycteria ibis*	Near threatened	0.2	-	Always associated with water – dams, wetlands, rivers, marshes, even small pools.
African Marsh-harrier *Circus ranivorus*	Vulnerable	0.3	-	Large permanent wetlands with dense reed beds. Sometimes forages over smaller wetlands and grassland.
Lanner Falcon *Falco biarmicus*	Near threatened	1.1	0.5	Generally prefers open habitat, but exploits a wide range of habitats. Will nest in wooded areas if suitable cliffs are present.
Peregrine Falcon *Falco peregrinus*	Near threatened	-	0.8	Wide range of habitat, but cliffs is a prerequisite for breeding.
Lesser Kestrel *Falco naumanni*	Vulnerable	0.8	1.3	Grasslands, old lands, cultivated lands.
Blue Crane *Anthropoides paradiseus*	Vulnerable	3.2	-	Grasslands, old lands, cultivated lands, wetlands,

				dams and pans for roosting.
African Grass-Owl *Tyto capensis*	Vulnerable	2.2	-	Normally associated with pristine, well managed grasslands usually in close proximity of water, but also in alien vegetation structurally resembling tall or rank grassland, and hydrophilic sedges.
Ayres Hawk-Eagle *Aquila ayresii*	Near threatened	0.5	-	Dense woodland and forest edges in hilly country. Sometimes enters suburban areas.
Half-collared Kingfisher *Alcedo semitorquata*		0.6	0.5	Fast-flowing streams with clear water and well-wooded banks. Occurs around dams (pers.obs.)
Cape Vulture *Gyps coprotheres*	Vulnerable	0.3	-	Large cliffs for breeding and roosting, open woodland and grassland. Roosts on transmission lines.
Martial Eagle *Alcedo semitorquata*	Vulnerable	0.3	-	Diverse habitats, from open grassland and scrub to woodland. Typically found in flat country.
White-Bellied Korhaan *Eupodotis senegalensis*	vulnerable	0.2	-	Relatively tall grassland, often in the interface between grassland and savanna. avoids

				severely grazed and recently burnt sites.
Grey Crowned Crane *Balearica regulorum*	Vulnerable	-	-	Breeds in marshes, pans and dam margins, and feeds in adjacent short to medium tall grassland and agricultural fields.
Melodious Lark *Mirafra cheniana*		0.3	-	Open climax Themeda grassland, pastures and fallow lands.

*Suitable habitat occurs on the site for species in bold

The small reed invaded high polluted dam constructed on the tributary of the Jukskei River on the northern portion of the site offers no suitable temporary foraging areas for Yellow-billed as well as Black Storks. No Black Storks have been recorded during the current SABAP2 project and extremely low reporting rates of Yellow-billed Storks for the Midrand area.

The grasslands on the site may be utilised by Lesser Kestrels for temporary foraging areas. In their African non-breeding quarters, Lesser Kestrels (*Falco naumanni*) are gregarious, occur commonly in open country and are attracted to abundances of swarming insects such as the alates of termites, locusts and grasshoppers, crickets, mole crickets and large beetles (McCann 1994). They roost communally in tall trees, mainly exotics such as *Eucalyptus*, in urban areas and disperse in the early morning to forage. Individuals will range over areas of 30km^2 to 178km^2 and the range of the roosting colony can exceed 1000km^2 (McCann 1994). Their feeding behaviour makes them susceptible to poisoning where locusts species (*Schitocera* and *Locusta*) and agricultural pests such as crickets are controlled with persistent agrochemicals. Lesser Kestrels prefer to forage in pristine grassland, but will also hunt in converted grasslands such as those found on the site.