Watercourse Investigation for the Nondweni Landfill Site (LFS), KwaZulu-Natal Province

Specialist Report

Prepared For: SE Solutions

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Wetlands • Ecology • Responsibility

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Approach and Disclaimer

This report provides a brief description of watercourses, as defined by the National Water Act (NWA), Act No. 36 of 1998, that are present within the study area, including wetlands present within a 500m radius of the study area. The latter is undertaken at a secondary level of detail through a mainly desktop approach with limited site surveying. The study area is known as the Nondweni landfill site (LFS), an operational LFS, located approximately 250m southwest of Nondweni in the Nqutu Local Municipality, in north-central KwaZulu-Natal. The investigation furthermore provides a description of selected aspects of the study area and identifies potential project related impacts, recommended mitigation measures and an impact assessment table.

This study does not provide detailed descriptions of the local geology, agricultural potential, climatic conditions, hydrology of the aquatic environments(including volumes and flow patterns), surface and ground water quality, aquatic and terrestrial flora and fauna, or a detailed review of the legal constraints associated with potential project related impacts on the environment. It has been assumed for the purposes of this report that these aspects have been the subject of separate specialist studies should they be required as part of the environmental authorisation process. The following refers to general limitations that affect the accuracy of information represented within this report:

- A soil specific wetland delineation approach had to be adopted as hydrophyte indicators were not readily available, due to the survey period (October 2015), overlapping with the non-growing season when plant identification to the species level is constrained by the general absence of reproductive structures. In addition, plant identification was further hindered by excavation and stockpile disturbances associated with the operation of a landfill site within the study area, while a high grazing pressure was present in the surrounding 500m study area buffer.
- Hydrophyte wetland indicators were therefore of limited use during the field surveys and a soil specific wetland delineation approach had to be adopted. Soil indicators were, however, also partially obscured within the study area by soil stockpiles located in between excavated areas.

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1. Introduction

1.1. Background and Terms of Reference

SE Solutions appointed Imperata Consulting to conduct a watercourse specialist investigation for the existing and operational Nondweni landfill Site (LFS), located in the Nqutu Local Municipality in the KwaZulu-Natal Province. The study was undertaken by Mr. L.E.R Grobler from Imperata Consulting who compiled the report on the findings of the commissioned watercourse assessment, which included a desktop component as well as a fieldwork survey component. The terms of reference for the specialist study include the following:

- The delineation and assessment of wetlands and other watercourses present within the study area, including the delineation of wetlands within a 500m radius around the property (henceforth referred to as the 500m study area buffer or 500m buffer). The delineation of wetlands within the 500m buffer will be undertaken at a secondary level of detail through a mainly desktop approach with limited site surveying.
- Watercourses identification will be based on definitions specified in the National Water Act (Act No. 36 of 1998) (NWA). Watercourse definitions used as part of the investigation include the following:
    - A river or spring.
    - A natural channel in which water flows regularly or intermittently.
    - A wetland, lake or dam into which, or from which, water flows.
- The description and classification of delineated wetlands into corresponding hydro-geomorphic (HGM) units according to Ollis *et al.* (2013).
- Present Ecological State (PES) assessment of identified wetlands within the LFS study area. PES assessments for wetlands and other watercourses located outside of the study area, but inside the 500m buffer, are excluded from this study.
- Ecological Importance and Sensitivity (EIS) assessment of identified wetlands present within the study area. EIS assessments for wetlands and other watercourses located outside of the study area, but inside the 500m buffer, are excluded from this study.
- The identification of potential project-related impacts along with an impact assessment and the recommendation of appropriate mitigation measures.

1.2. Experience of the author

Mr. Grobler has undergraduate majors in Botany (UP) and Soil Science (UP), an honours degree in Botany from the University of Pretoria (cum laude), and a MSc (cum laude) from the Department

of Plant Sciences (UP) with a focus on peatland wetland systems. He is a registered Pr. Sci. Nat professional natural scientist in the fields of Botanical Science and Ecological Science (Reg. no. 400097/09). He has been working as a consultant based in Pretoria, with work experience in Gauteng, Mpumalanga, North-West, Eastern Cape, Northern Cape, Free State, Limpopo and KwaZulu-Natal Provinces over the last eight years. Areas of specialisation include wetland, riparian and headwater drainage line assessments, with a special interest in peat wetlands.

1.4. General assumptions

- This study assumes that the project proponents will always strive to *avoid, mitigate* or *offset* potentially negative project related impacts on the environment, with impact avoidance being considered the most successful approach, followed by mitigation and offset. It further assumes that the project proponents will seek to enhance potential positive impacts on the environment.
- Spatial GIS shapefiles received from the client were used to demarcate the landfill site boundaries are deemed accurate.
- The project proponents will commission an additional study to assess the impact(s) if there is a change in the size and/or extent of the study area or proposed infrastructure that is likely to have a potentially significant and/ or unavoidable impact on watercourses (e.g. wetlands).

1.5. Overview of wetlands and riparian habitat

1.5.1. What are wetlands?

In terms of the Ramsar Convention on Wetlands (Iran 1971), to which South Africa is a contracting party, "… wetlands include a wide variety of habitats such as marshes, peatlands, floodplains, rivers and lakes, and coastal areas such as salt marshes, mangroves, and sea grass beds, but also coral reefs and other marine areas no deeper than six meters at low tide, as well as human-made wetlands such as waste-water treatment ponds and reservoirs" (Ramsar Convention Secretariat 2007).

In South Africa, wetlands are defined as "…land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil" (National Water Act, 1998 (Act No. 36 of 1998)). Wetlands are also included in the definition of a watercourse within the NWA, which implies that whatever legislation refers to the aforementioned will also be applicable to wetlands.

In addition, the NWA stipulates that "…reference to a watercourse includes, where relevant, its bed and banks…". This has important implications for the management of watercourses and encroachment on their boundaries, as discussed further on in this document.

The NWA defines riparian areas as "…the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterized by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas…" Note that this does not imply that the plant species within a riparian zone must be aquatic, only that the species composition of plant assemblages must be different within the riparian area and adjacent uplands.

In terms of the wetland delineation document available from the Department of Water Affairs and Forestry (DWAF), now known as the Department of Water and Sanitation (DWS), "wetlands must have one or more of the following attributes" (DWAF 2005):

- **Wetland (hydromorphic) soils** that display characteristics resulting from prolonged saturation.
- The presence, at least occasionally, of **water loving plants (hydrophytes)**.
- A **high water table** that results in saturation at or near the surface, leading to anaerobic conditions developing in the top 50 cm of the soil.

It follows that the level of confidence associated with a specific area being considered as a wetland is proportionate to the number of confirmed indicators that positively correlate with wetland habitat. Not all indicators are always present within a specific biophysical and land use setting, while not all indicators are always reliable and/or useful under all conditions. The use of additional wetness indicators from different disciplines that are internationally applied therefore adds value and confidence in the identification and delineation of wetland habitats, especially in challenging environments. These types of environments include urban settings where disturbances to the natural soil and vegetation are common.

2. Methods

2.1.General

The following methods and approaches were applied as part of the wetland investigation:

- Existing spatial datasets that indicate potential watercourses an ecologically important areas were used as part of an initial desktop approach:
    - The 1:50 000 river and drainage line data of the study area and its surroundings was used, as illustrated on the relevant topographic map (2830BB Nondweni).
    - The recently completed National Freshwater Ecosystem Priority Areas (NFEPA) spatial database was used to identify potential wetland areas within the study area and its immediate surroundings. This wetland layer has been formed by combing information from the National Land Cover 2000 data set (NLC 2000), 1:50 000 topographic maps and sub national data (Van Deventer *et al.* 2010).
    - The National Spatial Biodiversity Assessment (NSBA) spatial dataset, which is based on the DWA 1:500 000 rivers GIS layer (Driver *et al.* 2004). The GIS layer was obtained via the BGIS website hosted by the South African National Biodiversity Institute (SANBI).
    - The KZN Freshwater Systematic Conservation Plan 2007 and the KZN Terrestrial Systematic Conservation Plan 2010.
- A Topographic Wetness Index model was performed with SAGA GIS software to help indicate the potential occurrence of wetlands and other watercourses within the study area and its surrounding 500m buffer (also referred to as the 500 m study area buffer). Sample points were targeted in areas with expected increased wetness, as indicated on the modeled map, which were regarded as more likely to contain wetlands.
- A wetland site survey was undertaken on 28October 2015 by Mr. LER Grobler.
- Watercourses were identified and delineated through the procedure described by the Department of Water and Sanitation (DWS; previously also known as DWAF and DWA) in their document entitled: “A Practical field procedure for the identification and delineation of wetlands and riparian areas” (DWAF 2005).
- Available wetland indicators that were investigated included hydromorphic (wetland soil) features, the presence of wetland plant species (e.g. hydrophytes), riparian species and vegetation features, alluvial soil features, and terrain unitindicators.
- A strong emphasis was placed on the identification of hydromorphic features to identify and delineated wetland areas. Investigated hydromorphic features typically included the

presence of mottling, gleying, localised iron depletion, low chroma matrix colours, and organic enrichment in the A horizon (DWAF, 2005 & Nobel *et al*.2005).

- Sample points were generally arranged along transects perpendicular and parallel to areas with convergent contour lines where drainage lines or flow paths were expected, in order to record gradients of change between terrestrial and watercourse habitats.
- The field surveys primarily focussed on the delineation of watercourses within the study area, while selected areas were investigated for the presence of wetland habitat within a 500 m radius of the site. Any wetland habitat located within the 500m study area buffer was primarily delineated and classified through a desktop approach with limited site surveying.
- Identified wetland areas and other watercourses were delineated into GIS polygon shapefiles, which were used for map creation.
- All natural wetlands identified within the study area and 500 m buffer were classified according to the recently completed 'Classification System for Wetlands and other Aquatic Ecosystems in South Africa' up to the hydrogeomorphic (HGM) unit level (Ollis *et al*. 2013).
- The HGM classification system is based on three key parameters pertaining to the wetland: the geomorphic setting of the wetland, the source of water inputs into the wetland, and its hydrodynamics (how does water move through the wetland), (Brinson 1993; Kotze *et al.* 2008).
- The Present Ecological State (PES) of any wetland that may occur within the study area was to be assessed according to the method developed by Kleynhans (DWAF 1999) or the Wetland IHI method developed by DWA (2007).
- The PES method compares the current condition of a wetland, or other watercourse type, to its perceived reference condition, in order to determine the extent to which the watercourse had been modified from its pristine (reference) condition.
- Results from the PES assessments are rated into one of six categories ranging from unmodified/ pristine wetlands (Class A) to critically/ totally modified HGM wetland units (Class F).
- An Ecological Importance and Sensitivity (EIS) assessment of any identified wetlands that may occur within the study area were undertaken to provide an indication of the conservation value and sensitivity of these watercourses. The applied EIS wetland assessment was based on the following criteria derived from the method proposed by Rountree & Malan (2010):
    - Habitat uniqueness

- Species of conservation concern
- Habitat fragmentation with regards to ecological corridors
- Prominent ecosystem services

2.2.Limitations

The following refers to general limitations that affect the applicability of information represented within this report (also refer to the Approach and Disclaimer section):

- Wetland assessments are based on a selection of available techniques that have been developed through the Department of Water and Sanitation (DWS), as well as the Water Research Council (WRC) based on site conditions and applicability. These techniques are, however, largely qualitative in nature with associated limitations due to the range of interdisciplinary aspects that have to be taken into consideration.
- Wetland areas within transformed landscapes, such as urban, agricultural settings, or other areas with existing disturbances, such as landfill sites, are often affected by disturbances that restrict the use of available wetland indicators, such as hydrophytic vegetation or soil indicators (e.g. as a result of the dominance of alien vegetation, cultivation, hard surfaces, and dumping and infilling). Hence, a wide range of available indicators are considered, to help determine wetland boundaries more accurately.
- A soil specific wetland delineation approach had to be adopted as hydrophyte indicators were not readily available due to the survey period overlapping with the non-growing season (dry season)when plant identification is constrained by the general absence of reproductive structures. In addition, plant identification was further hindered by excavation and stockpiling activities within the study area.

3. Study Area Description

3.1. Location and existing land use

- The Nondweni landfill site (LFS), henceforth referred as the study area or site, is located within the Nqutu Local Municipality in KwaZulu-Natal Province(coordinates 30°48 25.418"S and 28°12 10.144"S).
- The study area has an area size of 7 ha is located approximately 1.5 km south of a secondary road that joins the Provincial Road (R68).
- The study area is located on irregular undulating lowlands with hills and degraded unimproved natural grassland patches as classified according to the 2005 KZN land cover spatial dataset.
- The area occupied by the study area and 500 m buffer overlaps with water reservoirs, cultivated land, temporary farm subsistence, dryland cultivation areas and residential areas.
- The study area is surrounded by Nkunyane, Nondweni A, Othaka, Muntuyedwe and Mbilane Rural dwellings.

3.2. Study Area catchment and surface hydrology

- The study area is located within the Usuthu To Mhlathuze Water Management Area (WMA) and falls within Quaternary Catchment W21E.
- Quaternary Catchment W21Ehas a Moderate conservation status and in a Largely Natural condition (Class B) Present Ecological State (PES) as determined by Middleton and Bailey (2008).
- Multiple drainage lines (non-perennial) are indicated within the 500 m study area buffer and flow from west to east, before they drain into the Nondweni River (perennial).
- QuaternaryCatchmentW21E is largely unmodified and undeveloped with multiple land use, infrastructures and industrial threat to the hydrological integrity of the study area catchment

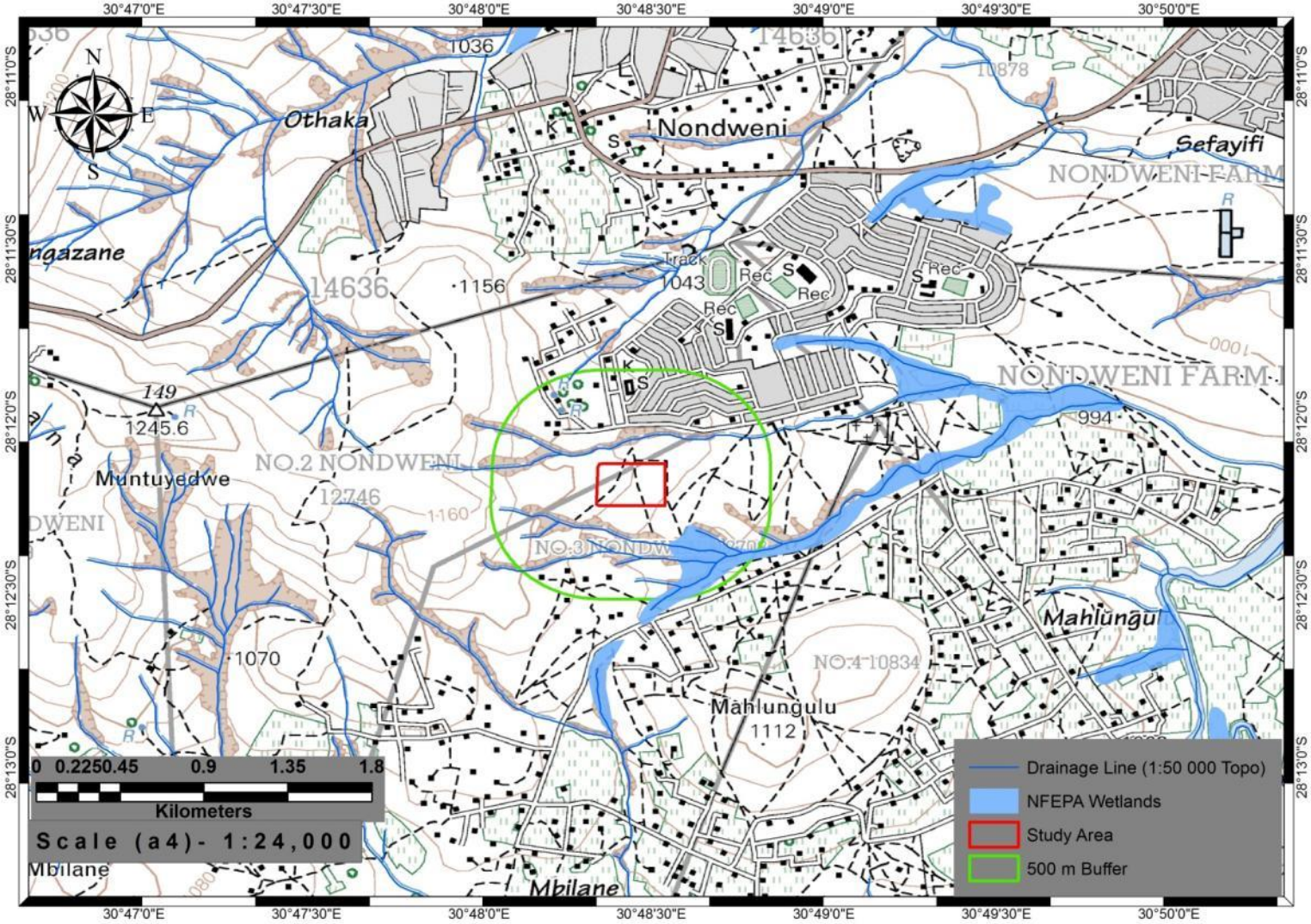

Figure 1: Locality map of the study area illustrating the study area boundary, 500 m study area buffer, wetlands indicated on the NFEPA dataset, and drainage lines from the 1:50 000 topographical map (2830BB).

3.4. Local climate, regional vegetation and soils

- Annual rainfall is approximately 730 mm and it mostly falls during the summer months(Middleton & Bailey 2008).
- A large portion of the precipitation comes in a form of thunderstorm, while the mean annual temperature (MAT) ranges between 15.6-19.0°C (overall average 16.5°C) with summer season to warm and hot and winters are cool (Mucina & Rutherford, 2006).
- The most recent vegetation map for South Africa, Lesotho and Swaziland (Mucina & Rutherford, 2006) indicate the entire study area is located in Grassland Biome and includes one bioregion (Sub-Escarpment Grassland Bioregion subgroup).The entire study area and its immediate surrounds are indicated as Kwazulu-Natal Highland Thornveld, a vegetation type included in the Sub-Escarpment Grassland Bioregion. This vegetation type is classified as Least Threatened due to moderate levels of transformation but is poorly protected. Almost 16% of the area has been transformed for cultivated land followed by urban sprawl as well as building of dams (Mucina & Rutherford, 2006).
- A recent revision of VEGMAP for KwaZulu-Natal by Scott-Shaw & Escott (2011) delineated a new vegetation unit within the 500 m study area buffer, namely Temperate Alluvial Vegetation, which is located southeast of the study area.
- The study area falls within Land Type Ea111, with diagnostic soil horizons that include Vertic, Melanic and Red-structured horizons. The surface geology mainly consist of dolerite with Tillite of the Dwyka Formation.
- The study area does not overlap with any listed Threatened Ecosystem areas according to the 2011 Schedule (Government Gazette of December 2011) of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA).
- The Ezemvelo Kwazulu-Natal Wildlife (EKZNW, 2010) Terrestrial Systematic Conservation Plan: Minimum Selection Surface (MINSET), was consulted to identify important aspects regarding the study area and its surroundings:
    - The study area and its entire 500m buffer do not overlap with any of the three Critical Biodiversity Area categories, but are both associated with the Biodiversity Area category (map legend 0CO).
    - Land that falls within the Biodiversity Area category is not open for wholesale development, as important species are still located within them and these should be accounted for in the EIA process.
    - The site and its buffer are associated with a Terrestrial Surface.
- According to (EKZNW, 2007) Freshwater Systematic Conservation Plan the following important aspects are defined for the study area and its surroundings:

- The study area and its entire 500 m buffer are located within an Available Planning Unit.

4. Watercourse Delineation and Assessment

4.1. Delineated and classified watercourses

- The study area does not overlap with wetland habitat indicated on the NFEPA wetland spatial dataset, but a portion of the 500 m buffer, located southeast of the site, does overlap with a channelled valley bottom wetland (Figure 1).
- No drainage lines, as indicated on the 1:50000 topographical map 2831BB, overlap with the study area, but are extensive within the 500 m buffer (Figure 1).
- A Topographical Wetness Index model was created to illustrate potential areas with increase soil moisture conditions within the site and its surroundings (Figure 2). This map was used to help target surveys during the site visit. Areas with expected increased wetness and therefore possible wetland conditions do not overlap with the study area, but are associated with the drainage lines from the topographical map in the 500 m study area buffer (Figure 2).
- The site survey confirmed the absence of wetland habitat within the study area as no hydromorphic features were identified, nor were any obligate hydrophytes recorded in the study area (Figure 3).
- Seep wetland and channelled valley bottom wetland habitat, as described by Ollis *et al.*(2013), were identified within the 500 m study area boundary, but not within close proximity to the landfill site (Figure 4& 5).
- Wetland habitat contained distinct mottling with gleying in the top 0.5 m of the soil profile (Figure 3).
- Gully or donga watercourses that represent deeply incised and entrenched channels with bare to poorly vegetated channel banks were identified north and south of the study area. Portions of gully watercourses previously existed as wetland habitat, e.g. channelled valley bottom and seep wetland habitat, which have become eroded over time (Figure 4&5). Wetland soil features were noticeable on exposed banks in some areas, while other portions contained none. The latter represent areas where the gully eroded into terrestrial habitat.
- Drainage lines that represent areas where waterflow is concentrated have also been delineated, but are only located outside of the study area (Figure 4&5).

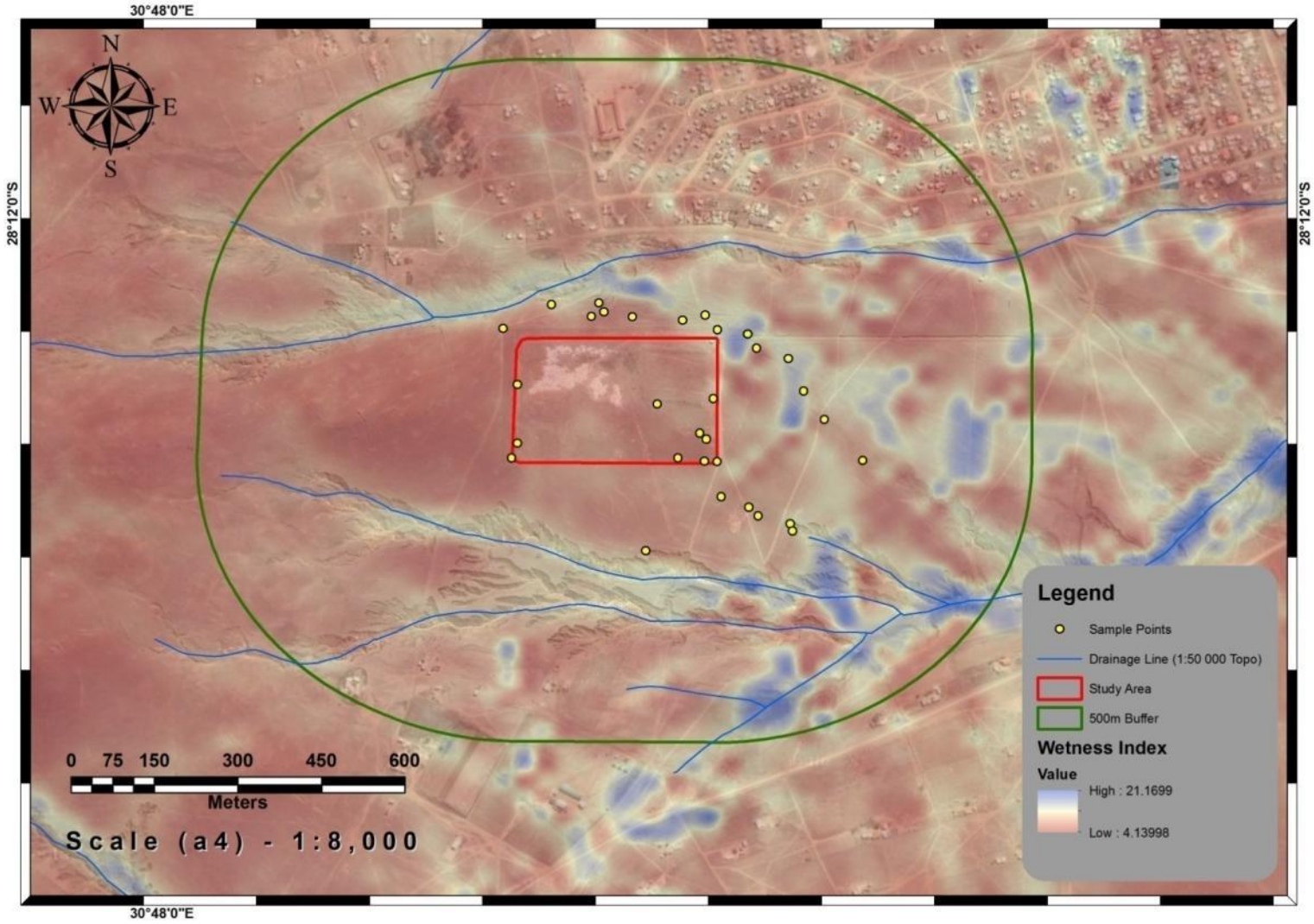

Figure 2: Illustrates landscape positions in the study are and its surroundings that are more likely to contain wetlands and other watercourses, as determined through a Topographical Wetness Index model created with the SAGA GIS program. Areas with increased wetness have only been modeled and may therefore differ from actual site conditions.

- These systems are regarded as watercourses, as defined in the NWA, as they contain swale-like channel features and can therefore be interpreted as 'natural channels with regular or intermittent flow'.
- Drainage lines lacked wetland soil indicators, while vegetation indicators were obscured by a high grazing pressure and the timing of the site visit during the end of the dry season. Channel features were generally poorly defined and discontinuous in nature with several headcuts in their upper reaches.

Figure 3: Illustrates soil profiles within the study area that lacked wetland features, such as mottling, gleying and spots of iron depletion (top row and bottom left), and distinct wetland features in the form of mottling within the top 0.5 m of the soil profile and gleying below that, as recorded on an exposed headcut profile that is eroding into a seep wetland, southeast of the landfill site (bottom right).

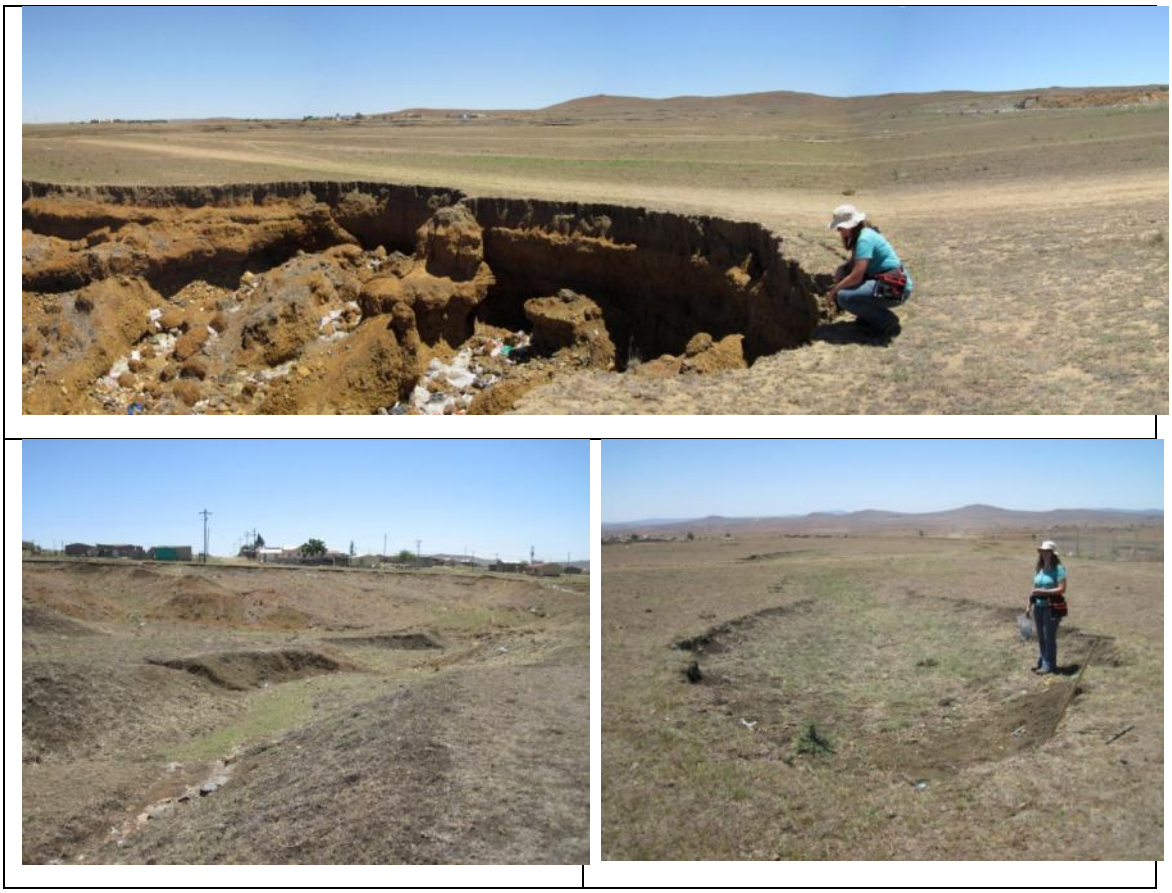

Figure 4: Illustrates a lateral headcut from a gully system that is actively eroding into a seep wetland (top), a section of a gully that lacks wetland features located north of the study area (bottom left), and the start of a drainage line located north of the study area.

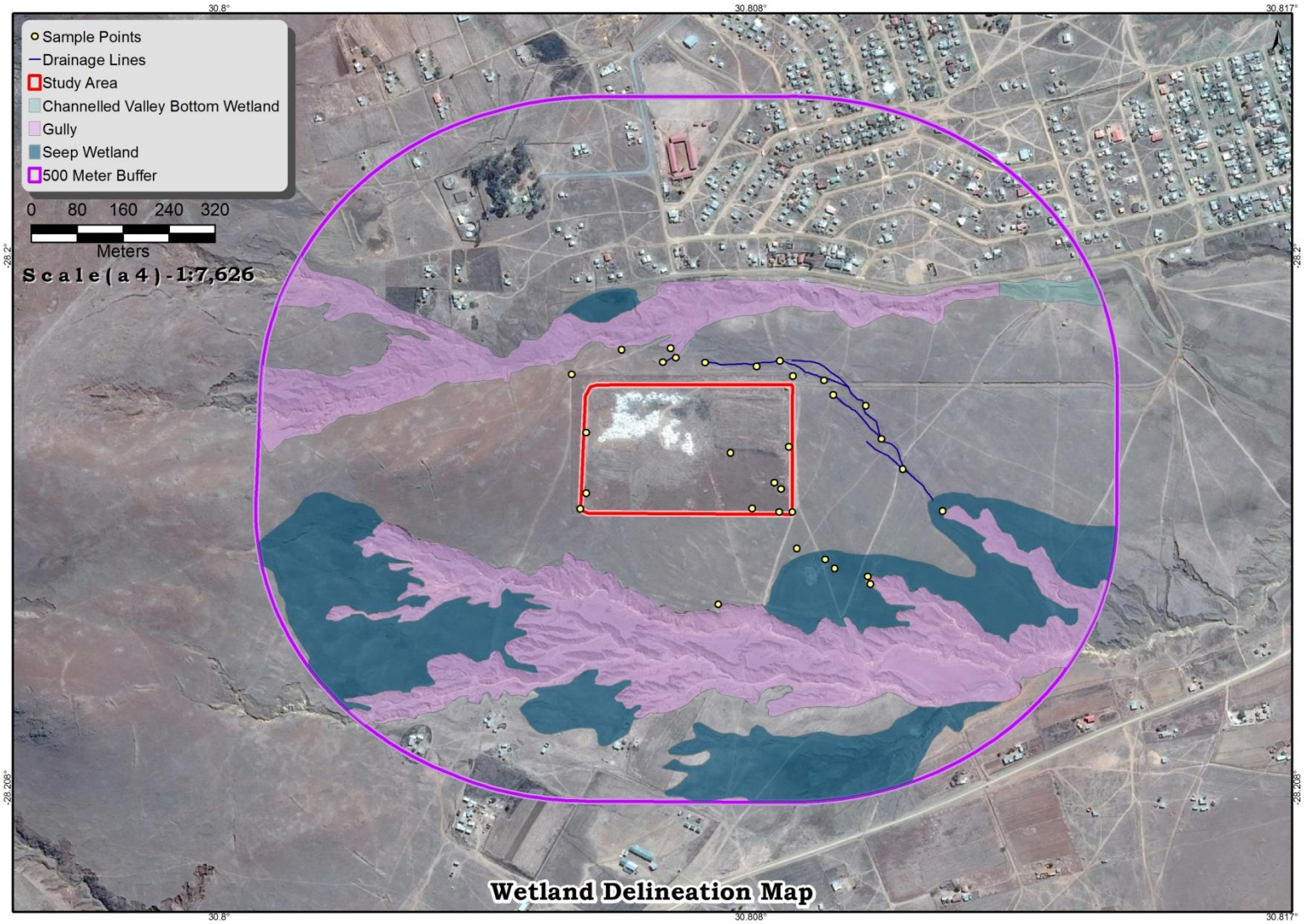

Figure 5: Illustrates delineated watercourses (wetlands, gullies and drainage lines) within the study area and its 500 m buffer.

4.2.Present Ecological State & Ecological Importance and Sensitivity Assessments

No Present Ecological State (PES) or Ecological Importance and Sensitivity (EIS) assessments were undertaken as no wetland or other types of watercourses were identified within the study area.

5. Discussion and Impact Assessment

5.1. General discussion

- No wetlands or other watercourses are present within the study area, while a channelled valley bottom wetland and several seep wetlands were identified within the 500 m study area buffer, along with gullies, both north and south of the site, and several drainage lines flowing east and southeast of the site (Figure 5).
- The study area is therefore located on a catchment divide with watercourses located north, east and south thereof (Figures 2 & 5).
- Delineated drainage lines are regarded as watercourses as they contained channel features, although these channels were often poorly defined, swale-like in nature and discontinuous (Figures 5 & 6). Delineated drainage lines are regarded to be partially consistent with the watercourse definition of a 'natural channel with regular or intermittent flow', as defined in the NWA, and are therefore regarded as watercourses as part of a conservative approach.
- All delineated watercourses have been buffered by 32 m buffer as a general means of impact mitigation (Figure 6). The 32 m buffer also demarcates an area in which several 'listed activities', as defined by the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA), are identified as requiring legal authorization prior to commencement of activities within this buffer area.
- NEMA lists specific activities for which environmental authorization should be obtained when located within a watercourse, 32m of a watercourse or in some cases even within 100 m of a watercourse. Details pertaining to restrictions associated with different listed activities have been recently updated under sections 24(5) and 44 of the NEMA as set out in the Schedule under Government Gazette Notice 38282 date 4 December 2014.
- No watercourses overlap with the study area, while a very small portion of the 32 m buffer (associated with a drainage line), overlaps with the study area (Figure 6). The area of overlap is negligible and was calculated as 0.0001 ha (Table 1).

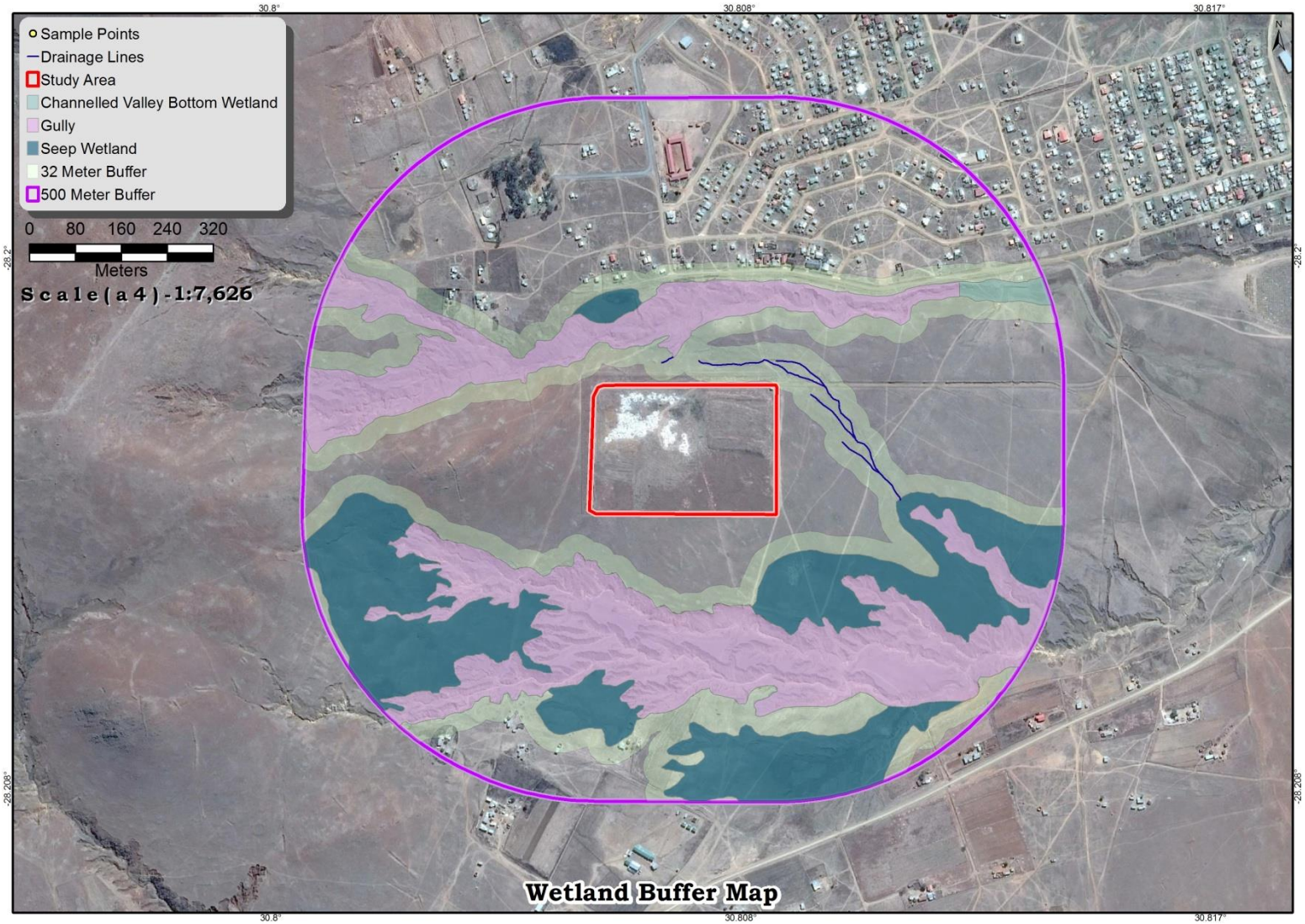

Figure 6: Illustrates a 32 m buffer around all delineated watercourses, which include wetlands, gullies and drainage lines.

- Based on the above, the impact of the landfill site on delineated watercourses is regarded as negligible (Figure 6; Table 1).

Table 1: Provides a summary of surface area sizes of delineated wetlands and gullies, as well as the length of delineated drainage lines (also refer to Figure 6).

Feature	Surface area size in hectares or length in meters
Study area	7.20 ha
500 m study area buffer	139.64 ha
Channelled valley bottom wetland	0.55 ha
Seep wetland located north of the study area	0.45 ha
Seep wetlands located south of the study area	19.91 ha
Gullies located north of the study area	9.10 ha
Gullies located south of the study area	18.32 ha
Combined length of drainage lines	804.43 m
Gullies and wetlands that overlap with the study area	0 ha
Drainage lines that overlap with the study area	0 m
32 m Buffer	73.53 ha
32 m buffer that overlap with the study area	0.0001 ha

5.2. Project-related impact identification

No new developments in the form of infrastructure construction are expected to be associated with the landfill site (LFS), as it is likely to continue in its current operational state for a number of years before it is closed. The current operation of the LFS does, however, require environmental authorisation. The environmental authorisation process is currently ongoing and this watercourse assessment study forms part thereof.

No proposed development impacts are therefore threatening watercourses adjacent to the study area, but existing watercourse-related impacts have to be identified, assessed and mitigated through appropriate recommendations. An impact assessment rating for each identified impact is provided in Table 2, while impact descriptions and mitigation measures are discussed below. The impact assessment method is based on the template received from SE Solutions and can be made available on request.

5.2.1. Loss of watercourse habitat and indigenous species

Natural habitat on the landfill site is largely transformed by active operations leading to a loss of indigenous species. No watercourses overlap with the landfill site, but an indistinct drainage line is present just within 32 m of the study area (Table 1). It is unlikely that wetland or other delineated watercourses will be affected through clearing or other activities related to the landfill site as long as activities are confined to the existing study area boundaries. The impact is considered to be Neutral and of Low significance (Tables 2 & 3).

Recommended mitigation:

- No landfill activities should occur outside of the existing study area boundaries.
- Any future expansion plans should consider delineated watercourses, drainage lines and their combined 32 m buffer as sensitive features (Figure 6), which should be further investigated and verified during environmental planning and authorisation phases.
- The fence around the study area should be repaired and maintained.
- Vehicle movement must be restricted to the study area and existing vehicle tracks outside of the study area.

Table 2: Pre-mitigation impact assessment table for the Nondweni LFS

Nature	Extent	Duration	Intensity	Probability	Status	Significance	Confidence	Reversibility	Replaceability
Loss of wetland habitat and indigenous species	Footprint	Short term	Low	Possible	Neutral	No impact	High	Partially reversible	Moderate - High
Water quality degradation in watercourses and drainage lines	Local	Long term	Medium-High	Highly likely	Negative	Medium - High	Medium	Partially reversible	Moderate - High
Erosion and Sedimentation	Local	Long term	Medium	Likely	Negative	Medium	Medium	Partially reversible	Low - Moderate

Table 3: Post-mitigation impact assessment table for the Nondweni LFS

Nature	Extent	Duration	Intensity	Probability	Status	Significance	Confidence	Reversibility	Replaceability
Loss of wetland habitat and indigenous species	Footprint	Short term	Low	Improbable	Neutral	No impact	High	Partially reversible	Moderate - High
Water quality degradation in watercourses and drainage lines	Local	Long term	Medium	Possible	Negative	Low	Medium	Partially reversible	Moderate - High
Erosion and Sedimentation	Local	Long term	Low-Medium	Possible	Negative	Low	Medium	Partially reversible	Low - Moderate

5.2.2. Water quality degradation in watercourses and drainage lines

The spread of litter can lead to surface pollution in delineated watercourses. Leachate from the landfill site is another source of potential pollution that may be transported as runoff or interflow into downstream wetlands. No drainage pipes or pipe outlets were observed downslope of the study area, between the site and the riparian habitat, and it remains unknown whether a drainage system is in place. No signs of a lining (sealing layer) was recorded within the LFS. The impact is considered to be Negative and of Medium-High significance (Table 2), but can be reduced to Low with mitigation (Table 3).

Additional information related to the risks, impacts and effective mitigation of water quality impacts, especially groundwater quality impacts, should be obtained from the groundwater study, which was not available at the time of report compilation.

Recommended mitigation:

- The fence around the landfill site should be maintained to contain solid waste.
- Dumping activities must be confined to the active operational area only.
- Vehicle movement must be restricted to the fenced area and the access roads leading to the landfill.
- The operational landfill site should not be expanded without relevant environmental authorisation/s.
- A lining or sealing layer should be applied to the excavated cavity in order to reduce the risk of leachate contaminating the groundwater table.
- Trenches and other stormwater management interventions as part of a stormwater management plan is recommended in order to restrict water accumulation in the waste body, as water ingress into the waste body can result in more leachate. Trenches and related stormwater control infrastructure should be located outside of buffered watercourses (Figure 6).
- Further details related to water quality mitigation should be obtained from the groundwater study.

5.2.3. Erosion and sedimentation

Earthmoving activities associated with landfill operations, such as digging, trenching and stockpile movement can lead to increased erosion and the alteration of sedimentation regime. Erosion disturbances were recorded within the delineated gullies, drainage lines and wetlands, specifically in the form of headcut development and channel incision. Sediment mobilisation within the study area, which is located on a catchment divide, can result in sediment influx into lower-lying watercourses. The impact is considered to be Negative and of Medium significance (Table 2), but can be reduced to Low with mitigation (Table 3).

Recommended mitigation:

- Earthmoving activities outside the footprint area within the study area and vehicle movement outside of existing access roads should be prohibited.
- Monitor all stockpiles for signs of erosion.
- Any areas where active erosion and sedimentation is observed must be rehabilitated and berms must be utilised to slow movement of water, where necessary.
- No new access road crossings to the study area across wetland or other watercourse features should be constructed without environmental authorisation/s, as they have the potential to concentrate surface flow and result in erosion.

5.3. Water Use License requirements

- Wetlands and other watercourses are protected water resources in terms of the NWA. Development or transformation of the watercourses is regarded as a *water use*, which can only be allowed through an approved Water Use License, irrespective of the condition of the affected watercourse.
- The implication is that authorization will have to be obtained from DWS before water use activities can be initiated in demarcated wetlands and other watercourses.
- Section 21 of the NWA defines different types of water use in a watercourse. Examples of water use activities that may be applicable to the artificial wetland in the study area include the following

  (c) impeding or diverting the flow of water in a watercourse.

  (i)altering the bed, banks, course or characteristics of a watercourse.
- A DWS stipulation published in Government Gazette No 32805 (December 2009) also require that a Water Use License should be applied for when any wetlands are present within a 500 m radius (buffer) of Section 21 *(c)* and/or Section 21 *(i)* water use activities.

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