				Degree to which the impact can be mitigated	High	High	
				Cumulative impacts	Not expected to result in cumulative impacts		
Sediment control using gravel bags	Clogging of gravel bags resulting in poor water quality, gravel bags changing water flow regime, bursting of gravel bags	Water quality, flow regime, aquatic fauna and flora habitat disturbance	Rehabilitation	Severity	Low	Low	The gravel bags need to be inspected prior to forecast rain, during extended rain events, after rain events and weekly during the rainy season. If the gravel bags are exposed to sunlight for a prolonged period, they will need to be replaced every three months due to the degradation of the bags by the sun; the bags will need to be reshaped and replaced as needed; sediment that will accumulate in the bags must be removed periodically in order to maintain the effectiveness of the bags. Inspection and maintenance must be
				Duration	Short term	Short term	
				Extent	Medium	Low	
				Consequence	Low	Low	
				Probability	Medium	Low	
				Significance	Low	Low	
				Status	Negative	Positive	
				Confidence	Medium	Medium	

				Reversibility	Fully reversible	Fully reversible	carried out throughout the lifespan of the process.
				Loss of resource	Low	Low	
				Degree to which impact can be mitigated	High	High	
				Cumulative impacts	Not expected to result in cumulative impacts		
Treating footpaths using organic mulch	Disturbance of flow regime (water flow along path to be rehabilitated must be stopped); trampling of vegetation and habitat; water pollution	Water quality and flow; riparian and surrounding vegetation	Rehabilitation	Severity	Low	Low	This method of rehabilitation is only suitable for flat surfaces and moderate slopes; rooted plants on the paths to be rehabilitated should not be removed; path-forming animals must be removed or reduced; area being treated should also be demarcated so that people do not continuously trample on it.
				Duration	Short term	Short term	
				Extent	Local	Local	
				Consequence	Low	Low	
				Probability	Low	Low	
				Significance	Low	Low	
				Status	Negative	Positive	

				Confidence	Medium	Medium	
				Reversibility	Fully reversible	Fully reversible	
				Loss of resource	Low	Low	
				Degree to which impact can be mitigated	High	High	
				Cumulative impacts	Not expected to result in cumulative impacts		
Preventing overgrazing of wetland vegetation and animal footpaths (rotational grazing)	Reduced grazing time; more time for vegetation to grow and recover; less waterlogged soils	Vegetation, soil, water quality	Rehabilitation	Severity	Low	Low	Rotational grazing will ensure that the wetland capacity for grazing is not exceeded and that animal trampling will be maintained at low levels as animals will not be grazing on the wetlands all the time. This also ensures that when soils are waterlogged, they cannot be worsened by trampling as animals will only graze when conditions are favourable.
				Duration	Short term	Short term	
				Extent	Localised	Localised	
				Consequence	Low	Low	
				Probability	Low	Low	
				Significance	Low	Low	
				Status	Positive	Positive	
				Confidence	High	High	

				Reversibility	Fully reversible	Fully reversible	
				Loss of resource	Low	Low	
				Degree to which impact can be mitigated	High	High	
				Cumulative impacts	Not expected to result in cumulative impacts		
Invasive alien species control	Soil disturbance; soil and water contamination from petrol or oil (if using mechanised method and herbicides); death of aquatic life due to water contamination; riparian zone disturbance; death of non-target species	Water quality; soil; aquatic fauna and flora; human and animals health can be affected due to herbicides;	Rehabilitation	Severity	Medium	Low	Only herbicides registered for use on a specific species must be used; herbicides must only be sprayed during active growing of plants; plants need to be sprayed before the seeds are produced (namely between flowering and fruit set); herbicides must not be applied during the wet seas (before or after rain) as they will wash away into rivers and watercourses and contaminate them; manual removal using mechanised tools is effective in removal of dense stands of aliens; manual removal of alien invasive species is only
				Duration	Medium	Low	
				Extent	Medium	Medium	
				Consequence	Medium	Medium	

				Probability	Medium	Medium	effective in areas with low infestations; biocontrol agents that may threaten commercial populations of target species that exist nearby.
				Significance	Medium	Medium	
				Status	Negative	Negative	
				Confidence	Medium	Medium	
				Reversibility	Fully reversible	Fully reversible	
				Loss of resource	Medium	Low	
				Degree to which impact can be mitigated	Medium	Medium	
				Cumulative impacts	Not expected to result in cumulative impacts		
Bank stabilisation using Soil bioengineering techniques (establishing a dense cover od soil protecting plants)	Digging on banks and surrounding landscape when preparing soil for planting; trampling;	Soil; riparian and surrounding vegetation	Rehabilitation	Severity	Low	Low	Transplanting of small seedlings from an area where they are abundant is advisable as small seedlings are likely to transplant more successfully than large ones; plants with vigorous rooting growth are preferential and must be used as they accelerate natural plant succession; all
				Duration	Short term	Short term	
				Extent	Localised	Localised	

				Consequence	Low	Low	planting will need to be followed by some form of micro-habitat treatment such as mulching with local plant material or using surface geotextile or moisture capturing hollows. It is also advisable to plant when the wet season has begun in order to eliminate the need for watering plants; monitoring is vital to ensure that the a thick layer of vegetation is successfully created with minimal environmental impact; a qualified botanist must be consulted on the type of plants suitable for different types of soils etc.
				Probability	Medium	Medium	
				Significance	Medium	Medium	
				Status	Negative	Negative	
				Confidence	Medium	Medium	
				Reversibility	Fully reversible	Fully reversible	
				Loss of resource	Low	Low	
				Degree to which impact can be mitigated	High	High	
				Cumulative impacts	Not expected to result in cumulative impacts		
Addressing illegal dumping through river clean ups (clearing of debris in water, clearing of blocked culverts and more)	Trampling; temporary disturbance of fauna during the process	Soil, invertebrates, vertebrates and mammals	Rehabilitation	Severity	Low	Low	Environmental education and presentations need to be carried out for participants of the watercourse clean ups; after the clean ups, there must be monitoring to ensure that no litter or any other pollutants are
				Duration	Short term	Short term	

				Extent	Localised	Localised	dumped in the watercourses; debris hindering water flow needs to be removed for watercourses; watercourse clean ups need to be more frequent; environmental education for residents is also a necessity.
				Consequence	Low	Low	
				Probability	Medium	Low	
				Significance	Low	Low	
				Status	Negative	Negative	
				Confidence	High	High	
				Reversibility	Fully reversible	Fully reversible	
				Loss of resource	Low	Low	
				Degree to which impact can be mitigated	High	High	
				Cumulative impacts	Not expected to result in cumulative impacts		
Preventing unsustainable reed harvesting	Wetland will be able to perform important functions such as flood attenuation, sediment control, water purification, provision of habitat for fauna and avifauna.	Soil; water quality; fauna; water flow	Rehabilitation	Severity	Low	Low	Harvesting seasons need to be implemented and enforced, harvesting should only be allowed at certain times during certain conditions; reasonable yields should also be set; fines should be set for illegal harvesting.

				Duration	Short term	Short term	
				Extent	Localised	Localised	
				Consequence	Low	Low	
				Probability	Low	Low	
				Significance	Low	Low	
				Status	Positive	Positive	
				Confidence	High	High	
				Reversibility	Fully reversible	Fully reversible	
				Loss of resource	Low	Low	
				Degree to which impact can be mitigated	High	High	

Table 19: impacts to be mitigated and their respective phases

ACTIVITIES	PHASE	SIZE AND SCALE OF DISTURBANCE	MITIGATION MEASURES	COMPLIANCE WITH STANDARDS	TIME PERIOD FOR IMPLEMENTATION
Mulching of slopes and banks (Stabilisation of slopes using geotextile; seeding slopes to get them ready for mulching; Harvesting of trees for mulching, Layering slopes with mulch)	Rehabilitation	100m-200m	Use of organic mulches only (based on wood products); careful harvesting of trees for mulch; mulch from trees is to be applied when dry so as to eliminate chemical impact on soil; when harvesting for mulch, every third or fourth tree or large shrub will be cut at 30 mm above ground so as not to change the habitat too drastically; cutting down of trees (especially indigenous trees) is temporary loss as the trees will resprout with time. Monitoring of alien invasion or weed encroachment after mulching process.	National Water Act, No. 36 of 1998, section 39, a general authorization has been granted for certain activities listed under NWA as long as these activities are undertaken for wetland rehabilitation. These activities include, "impeding or diverting the flow of a watercourse", and "altering the bed, banks, course or characteristics of a watercourse" where they are specifically undertaken for the purpose of rehabilitating a wetland for conservation purposes.	Upon cessation of the individual activity
Installation of erosion control fences	Rehabilitation	100m	Fences will be used with mulch for effective water control and microclimate creation; when placing mulched fences, the work will be done around existing vegetation; trampled sections will quickly regrow.	National Water Act, No. 36 of 1998, section 39, a general authorization has been granted for certain activities listed under NWA as long as these activities are undertaken for wetland rehabilitation. These activities include, "impeding	Upon cessation of the individual activity

				or diverting the flow of a watercourse", and "altering the bed, banks, course or characteristics of a watercourse" where they are specifically undertaken for the purpose of rehabilitating a wetland for conservation purposes.	
Stone Gabions construction and installation	Rehabilitation	100m-200m	Gabions preferably used with geotextiles to reduce water velocities and to recapture river bed sediment; during construction of gabion structures, the correct height, shape and foundation will be relevant to site being rehabilitated; qualified engineers will be consulted on appropriate gabion structures and installations; microscopic organisms and invertebrates will obtain new habitat under rocks within habitat; once gabions are installed properly, vegetation will regrow and sedimentation and erosion will cease.	National Water Act, No. 36 of 1998, section 39, a general authorization has been granted for certain activities listed under NWA as long as these activities are undertaken for wetland rehabilitation. These activities include, "impeding or diverting the flow of a watercourse", and "altering the bed, banks, course or characteristics of a watercourse" where they are specifically undertaken for the purpose of rehabilitating a wetland for conservation purposes.	Upon cessation of the individual activity
Installation of River mattress	Rehabilitation	100-200m	River Mattresses preferably used with geotextiles to reduce water velocities and to recapture river bed sediment; during construction of river mattress structures, the correct height, shape	National Water Act, No. 36 of 1998, section 39, a general authorization has been granted for certain activities listed under NWA as long as	Upon cessation of the individual activity

			and foundation will be relevant to site being rehabilitated; qualified engineers will be consulted on appropriate river mattress structures and installations; once river mattresses are installed properly, vegetation will regrow and sedimentation and erosion will cease.	these activities are undertaken for wetland rehabilitation. These activities include, "impeding or diverting the flow of a watercourse", and "altering the bed, banks, course or characteristics of a watercourse" where they are specifically undertaken for the purpose of rehabilitating a wetland for conservation purposes.	
Sediment control using silt fence	Rehabilitation	100-200m	When installing the fence tree roots are present then installation needs to be done around the roots so that they are not cut down; slope gradient will be considered; soil type must also be considered; inspection and monitoring required after installation.	National Water Act, No. 36 of 1998, section 39, a general authorization has been granted for certain activities listed under NWA as long as these activities are undertaken for wetland rehabilitation. These activities include, "impeding or diverting the flow of a watercourse", and "altering the bed, banks, course or characteristics of a watercourse" where they are specifically undertaken for the purpose of rehabilitating a wetland for conservation purposes.	Upon cessation of the individual activity

Sediment control using gravel bags	Rehabilitation	100-200m	The gravel bags need to be inspected prior to forecast rain, during extended rain events, after rain events and weekly during the rainy season. If the gravel bags are exposed to sunlight for a prolonged period, they will need to be replaced every three months due to the degradation of the bags by the sun; the bags will need to be reshaped and replaced as needed; sediment that will accumulate in the bags must be removed periodically in order to maintain the effectiveness of the bags. Inspection and maintenance must be carried out throughout the lifespan of the process.	National Water Act, No. 36 of 1998, section 39, a general authorization has been granted for certain activities listed under NWA as long as these activities are undertaken for wetland rehabilitation. These activities include, "impeding or diverting the flow of a watercourse", and "altering the bed, banks, course or characteristics of a watercourse" where they are specifically undertaken for the purpose of rehabilitating a wetland for conservation purposes.	Upon cessation of the individual activity
Treating footpaths using organic mulch	Rehabilitation	100m	This method of rehabilitation is only suitable for flat surfaces and moderate slopes; rooted plants on the paths to be rehabilitated should not be removed; path-forming animals must be removed or reduced; area being treated should also be demarcated so that people do not continuously trample on it.	National Water Act, No. 36 of 1998, section 39, a general authorization has been granted for certain activities listed under NWA as long as these activities are undertaken for wetland rehabilitation. These activities include, "impeding or diverting the flow of a watercourse", and "altering the bed, banks, course or characteristics of a watercourse" where they are specifically undertaken for	Upon cessation of the individual activity

				the purpose of rehabilitating a wetland for conservation purposes.	
Preventing overgrazing of wetland vegetation and animal footpaths (rotational grazing)	Rehabilitation	100m	Rotational grazing will ensure that the wetland capacity for grazing is not exceeded and that animal trampling will be maintained at low levels as animals will not be grazing on the wetlands all the time. This also ensures that when soils are waterlogged, they cannot be worsened by trampling as animals will only graze when conditions are favourable.	National Water Act, No. 36 of 1998, section 39, a general authorization has been granted for certain activities listed under NWA as long as these activities are undertaken for wetland rehabilitation. These activities include, "impeding or diverting the flow of a watercourse", and "altering the bed, banks, course or characteristics of a watercourse" where they are specifically undertaken for the purpose of rehabilitating a wetland for conservation purposes.	Upon cessation of the individual activity
Invasive alien species control	Rehabilitation	400m	Only herbicides registered for use on a specific species must be used; herbicides must only be sprayed during active growing of plants; plants need to be sprayed before the seeds are produced (namely between flowering and fruit set); herbicides must not be applied during the wet seas (before or after rain) as they will wash away into rivers and watercourses and contaminate them;	National Water Act, No. 36 of 1998, section 39, a general authorization has been granted for certain activities listed under NWA as long as these activities are undertaken for wetland rehabilitation. These activities include, "impeding or diverting the flow of a watercourse", and "altering	Upon cessation of the individual activity

			manual removal using mechanised tools is effective in removal of dense stands of aliens; manual removal of alien invasive species is only effective in areas with low infestations; biocontrol agents that may threaten commercial populations of target species that exist nearby.	the bed, banks, course or characteristics of a watercourse" where they are specifically undertaken for the purpose of rehabilitating a wetland for conservation purposes.	
Bank stabilisation using Soil bioengineering techniques (establishing a dense cover od soil protecting plants)	Rehabilitation	300m	Transplanting of small seedlings from an area where they are abundant is advisable as small seedlings are likely to transplant more successfully than large ones; plants with vigorous rooting growth are preferential and must be used as they accelerate natural plant succession; all planting will need to be followed by some form of micro-habitat treatment such as mulching with local plant material or using surface geotextile or moisture capturing hollows. It is also advisable to plant when the wet season has begun in order to eliminate the need for watering plants; monitoring is vital to ensure that the a thick layer of vegetation is successfully created with minimal environmental impact; a qualified botanist must be consulted on the type of plants suitable for different types of soils etc.	National Water Act, No. 36 of 1998, section 39, a general authorization has been granted for certain activities listed under NWA as long as these activities are undertaken for wetland rehabilitation. These activities include, "impeding or diverting the flow of a watercourse", and "altering the bed, banks, course or characteristics of a watercourse" where they are specifically undertaken for the purpose of rehabilitating a wetland for conservation purposes.	Upon cessation of the individual activity

Addressing illegal dumping through river clean ups (clearing of debris in water, clearing of blocked culverts and more)	Rehabilitation	1-2km	Environmental education and presentations need to be carried out for participants of the watercourse clean ups; after the clean ups, there must be monitoring to ensure that no litter or any other pollutants are dumped in the watercourses; debris hindering water flow needs to be removed for watercourses; watercourse clean ups need to be more frequent; environmental education for residents is also a necessity.	National Water Act, No. 36 of 1998, section 39, a general authorization has been granted for certain activities listed under NWA as long as these activities are undertaken for wetland rehabilitation. These activities include, "impeding or diverting the flow of a watercourse", and "altering the bed, banks, course or characteristics of a watercourse" where they are specifically undertaken for the purpose of rehabilitating a wetland for conservation purposes.	Upon cessation of the individual activity
Preventing unsustainable reed harvesting	Rehabilitation	100m	Harvesting seasons need to be implemented and enforced, harvesting should only be allowed at certain times during certain conditions; reasonable yields should also be set; fines should be set for illegal harvesting.	National Water Act, No. 36 of 1998, section 39, a general authorization has been granted for certain activities listed under NWA as long as these activities are undertaken for wetland rehabilitation. These activities include, "impeding or diverting the flow of a watercourse", and "altering the bed, banks, course or characteristics of a watercourse" where they are specifically undertaken for	Upon cessation of the individual activity

				the purpose of rehabilitating a wetland for conservation purposes.	

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APPENDIX 1: Vegetation observed on site

Herb species observed on site

The herb species identified included, *Bidens pilosa, Asclepias, Conyza bonariensis, Agave Sisalana, Ipomoea purpurea, Berkheya radula, Helianthus annuus, Zinnia peruviana, Tagetes minuta, Vernonia oligocephala, Datura ferox, Rumex obtusifolius, Amaranthus hybridus, Indigofera hilaris, Nidorella hottentotica, Ipomoea carnea, Argemone ochroleuca, Canna indica L., Cirsium vulgare, Datura stramonium, Ziziphus zeyheriana, Verbena bonariensis, Conyza canadensis, Conyza podocephala, Alternanthera pungens, Acalypha caperonioides, Schkuhria pinnata and Gomphrena celosioides*. Table 1 below illustrates some of the herbs observed on site.

Table 1: Herbs observed on site

	*Amaranthus hybridus* (smooth pigweed) Permanent and seasonal zones
	*Tagetes minuta* (naturalised) (tall khaki weed)

	*Ipomoea purpurea* (common morning glory) Permanent zone
	*Bidens pilosa* (blackjack) (naturalised) Temporary zone
	*Indigofera hilaris* (gay indigofera) Temporary zone

	*Nidorella hottentotta* Temporary zone
	*Ipomoea carnea* (bush morning glory) Seasonal and temporary zone
	*Argemone ochroleuca* (Mexican poppy) Seasonal zone

	*Canna indica* (canna lily) Seasonal and temporary zone
	*Canna indica* (canna lily) Permanent zone
	*Cirsium vulgare* (bull thistle) Temporary zone

	*Vernonia oligocephala* (bicoloured leaf vernonia) Seasonal zone
	*Rumex obtusifolius* (broad-leaved dock) Seasonal zone
	*Berkheya radula* (sun daisy) Seasona zone

	*Helianthus annuus* (common sunflower) Seasonal zone

Reeds observed on site

The following reed species were observed on site; *Phragmites australis, Typha capensis* and the alien invasive *Arundo donax*. The following table (Table 2) depicts some of the reeds observed on site.

Table 2: Reeds observed on site

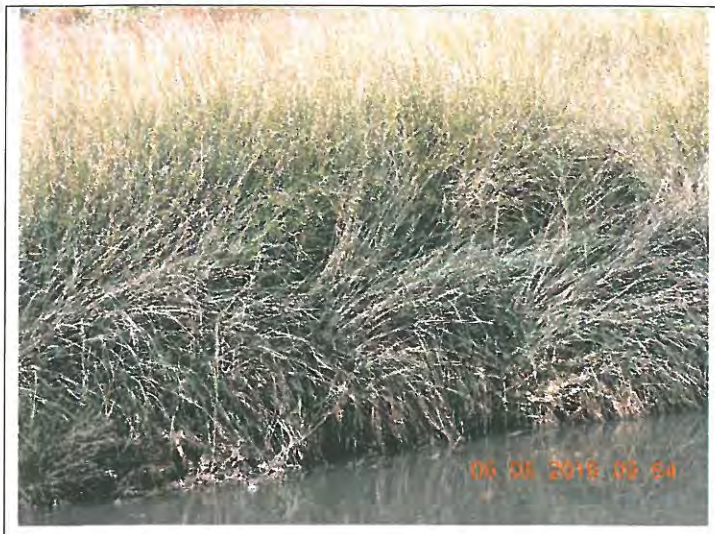
	*Phragmites australis* (common reed) Permanent zone

	*Typha capensis* (love reed) Permanent zone

Sedges observed on site

Table 3: sedges observed on site

	*Cyperus papyrus (Papyrus)* Permanent and seasonal zone

	*Carex commons* (frosted curls) Permanent zone

Trees observed on site

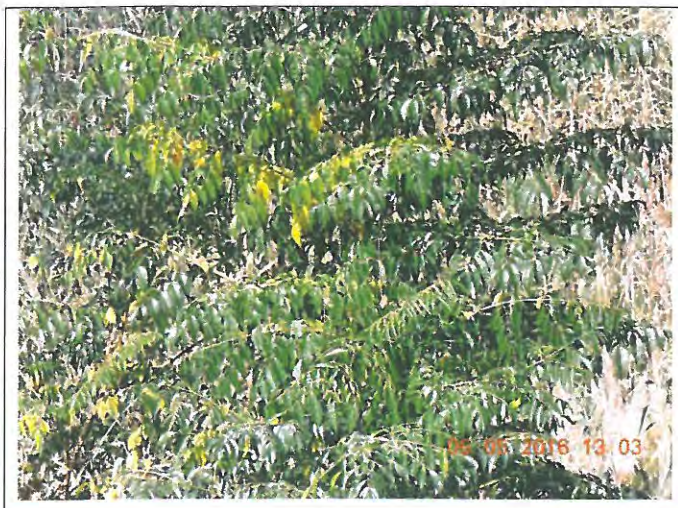
Tree species observed on site included, *Aloe marlothii, Osmathus fragrans, Acacia karroo, Eucalyptus camaldulensis, Solanum mauritianum, Solanum sisymbriifolium, Leonitis ocymifolia, Celtis Africana, Prunus persica, Agave sisalana, Acacia caffra, Salix alba, Salix babylonica, Seriphium plumosum, Melia azedarach, Pinus* sp., *Morus alba, Populus canescens.* Table 4 below depicts some of the tree species observed on site.

Table 4: Trees and shrubs observed on site

	*Aloe marlothii* (Aloe) Temporal zone

	*Osmathus fragrans* (tea olive shrub) Seasonal zone
	*Acacia karroo* (sweet thorn) Temporary zone
	*Eucalyptus camaldulensis* (gum tree) Temporary zone

	*Solanum mauritianum* (bugweed) Permanent zone
	*Solanum sisymbriifolium* (wild tomato) Temporary zone
	*Leonitis ocymifolia* (rock lionspaw) Seasonal zone

	*Celtis Africana* (white stinkwood) Seasonal zone
	*Prunus persica* (peach tree) Seasonal zone
	*Agave sisalana* (Sisal) Temporary zone

	*Acacia caffra* (common hook thorn) Temporary zone
	*Salix alba* (white willow) Permanent zone
	*Salix babylonica* (weeping willow) Permanent zone

	*Seriphium plumosum* (Slangbos) Temporary zone
	*Populus canescens* (Tower poplar) *Permanent zone*

Grasses observed on site

The grass species observed included *Hyparrhenia hirta, Eragrostis racemose, Eragrostis superba*, *Themeda triandra, Sporobulus Africana, Melinis repens, Aristida congesta* subsp. *congesta, Elionurus muticus, Pennisetum setaceum, Eragrostis chloromelas, Cortaderia selloana, Panicum maximum, Setaria sphacelata, Pennisetum clandestinum* and *Cynodon dactylon*. Table 5 below illustrates some of the mature grasses observed on site.

Table 5: Grasses observed on site

	*Themeda triandra* (red grass) Seasonal zone
	*Pennisetum setaceum* (fountain grass) Seasonal zone
	*Elionurus muticus* (wire grass) Permanent zone

	*Cortaderia selloana* (pampas grass) Temporary zone
	*Eragrostis chloromelas* (boer love grass) Seasonal zone
	*Hyperrhenia hirta* (common thatching grass) Seasonal zone

	*Pennisetum clandestinum* (kikuyu grass) *Temporary zone*
	*Cynodon dactylon* (couch grass) *Seasonal zone*

APPENDIX 2: List of threatened vegetation of the Gauteng Region

Vegetation	Status
1. Adromischus umbraticola subsp. umbraticola	Near Threatened
2. Alepidea attenuata	Near Threatened
3. Aloe peglerae	Endangered
4. Argyrolobium campicola	Near Threatened
5. Argyrolobium megarrhizum	Near Threatened
6. Blepharis uniflora	Rare
7. Bowiea volubilis subsp. volubilis	Vulnerable
8. Brachycorythis conica subsp. transvaalensis	Vulnerable
9. Brachystelma discoideum	Endangered
10. Ceropegia decidua subsp. pretoriensis	Vulnerable
11. Ceropegia turricula	Near Threatened
12. Cheilanthes deltoidea	Vulnerable
13. Cineraria austrotransvaalensis	Near Threatened
14. Cineraria longipes	Vulnerable
15. Cleome conrathii	Near Threatened
16. Cucumis humifructus	Vulnerable
17. Delosperma gautengense	Vulnerable
18. Delosperma leendertziae	Near Threatened
19. Delosperma macellum	Endangered
20. Delosperma purpureum	Endangered

21. Dioscorea sylvatica	Vulnerable
22. Encephalartos lanatus	Vulnerable
23. Encephalartos middelburgensis	Critically Endangered
24. Eulophia coddii	Vulnerable
25. Frithia humilis	Vulnerable
26. Frithia pulchra	Rare
27. Gladiolus pole-evansii	Rare
28. Gladiolus robertsoniae	Near Threatened
29. Gnaphalium nelsonii	Rare
30. Habenaria barbertoni	Near Threatened
31. Habenaria bicolor	Near Threatened
32. Habenaria kraenzliniana	Near Threatened
33. Habenaria mossii	Endangered
34. Holothrix micrantha	Endangered
35. Holothrix randii	Near Threatened
36. Khadia beswickii	Vulnerable
37. Kniphofia typhoides	Near Threatened
38. Lithops lesliei subsp. lesliei	Near Threatened
39. Lithops lesliei subsp. lesliei var. rubrobrunnea	Endangered
40. Melolobium subspicatum	Vulnerable
41. Nerine gracilis	Near Threatened
42. Prunus africana	Vulnerable
43. Searsia gracillima var. gracillima	Near Threatened

44. Stenostelma umbelluliferum	Near Threatened
45. Trachyandra erythrorrhiza	Near threatened

APPENDIX 3: GAUTENG threatened birds

Bird species	**Status**
1. Alcedo semitorquata Half-Collared Kingfisher	Near Threatened
2. Anthropoides paradiseus breeding area Blue Crane	Vulnerable
3. Anthropoides paradiseus overwinter area	Vulnerable
4. Circus ranivorus African Marsh-Harrier	Vulnerable
5. Eupodotis caerulescens Blue Korhaan	Near Threatened
6. Eupodotis senegalensis White-bellied Korhaan	Vulnerable
7. Gorsachius leuconotus	Vulnerable
8. Gyps coprotheres breeding area	Vulnerable
9. Mirafra cheniana Melodious Lark	Near Threatened
10. Podica senegalensis African Finfoot	Vulnerable
11. Sagittarius serpentarius Secretary bird	Near Threatened
12. Tyto capensis African Grass-Owl	Vulnerable

Consultant CV

Profile Summary

Nonkanyiso Zungu is a Professional Natural Scientist (Pr.Sci.Nat) with 10 years' experience in the environmental field. She has a Masters Degree in Environmental Management, and specializes on Water Resource Management.

Nonkanyiso has extensive experience in water resource management, waste management, and obtaining environmental authorisations (air, water, waste) across sectors that include: power generation, infrastructure (Construction), transportation (rail), waste disposal, water purification & sewage works. The projects she has undertaken include: Environmental Impact Assessments, Basic Assessments, Environmental Feasibility Studies, Environmental scoping studies, Environmental legal compliance audits, Waste management licences, Water use licences, and Baseline risk assessments.

Nonkanyiso Zungu is a Health & Safety and Environmental (SHE) auditor and is knowledgeable on internal integrated SHEQ auditing. She has experience on development and implementation of ISO 14001: 2004 management system and undertaking internal audits.

Nonkanyiso is also a wetland specialist with experience in wetland delineation, determination of present ecological status, ecological importance and sensitivity evaluations, and wetland rehabilitation planning using packages that include Wet-Health, Wet-EcoServices, and Wet-RehabEvaluate.

Education

Institution	Year	Degree Obtained
University of Pretoria	2011	MSc. Environmental Management
University of KwaZulu-Natal	2005	BSc. Honours, Ecology
University of KwaZulu-Natal	2003	BSc. Biological Sciences

Professional Registrations

- South African Council for Natural Scientific Professions (SACNASP, Pr. Nat. Sci. (Practice no. 400194/10): Ecological Science
- Member of the Gauteng Wetland Task Group
- Member of WISA (Gauteng Region)

Short Courses

- ISO 14001 IMPLEMENTATION AND INTERNAL AUDITING
- ISO 18001 IMPLEMENTATION AND INTERNAL AUDITING
- ISO 9001 IMPLEMENTATION AND INTERNAL AUDITING
- LEAD AUDITING (SAATCA)
- INCIDENT AND ACCIDENT INVESTIGATIONS
- QUALIFIED WETLAND ASSESSMENT PACTITIONER (WET-HEALTH; WET IHI, SPATSIM)
- ESRI GIS MAPPING, ARCMAP 10

Key Skills

- ISO 14001: 2004 internal auditing
- Legal compliance auditing
- Wetland delineation and assessment
- Environmental Impact Assessment
- Basic Assessments
- Feasibility Studies (Fatal flaw analysis)

Employment History

2014 – Current	SAZI Environmental Consulting cc
2011 - 2014	Sebata Group of Companies
2009 - 2011	Department of Water Affairs
2007 - 2009	Wetland Consulting Services
2005 - 2006	University of KwaZulu-Natal (Maluti Transfontier Conservation Program)
2004 – 2005	University of KwaZulu-Natal (Welgevonden Elephant Program)

Project Experience

PROJCET NAME	YEAR	RESPONSIBILITY	CONTACT DETAILS	REFERENCE NUMBER
ENVIRONMENTAL IMPACT ASSESSMENT/ EMP/ BA PROJECTS				
Basic Assessment for the construction of the Rand Water 210ML reservoir future planned 200ML reservoir in Vlakfontein	2015	Environmental Impact Assessment Practitioner.	Company: Rand Water Contact: Luzuko Kalimashe Tel: 078 6590462	
Basic Assessment for the proposed construction of Rand Water 200ML reservoir in Brakpan.	2015	Environmental Assessment Practitioner	Company: Rand Water Contact: Thokozani Masilela Tel: 072 495 0097	
Basic Assessment: Proposed construction of culvert upgrade works and sewer pipeline crossing through a watercourse, Eskom Holdings SOC Ltd. Ingula Pumped Storage Scheme	2014	• Environmental Assessment Practitioner • Project Management	Company: Eskom Ingula Pumped Storage Scheme Contact: Marcel Meso Tel: 036 342 3031	Ref: 14/12/16/3/3/1/ 1019
Waste Management Licence Application for the Eskom Witbank Clinker Ash Dump	2013-2014	• Environmental Assessment Practitioner	Company: Eskom SHE Management Division Contact: Gabriel Ngorima Tel: 076 9014006	
Eskom Academy of Learning Feasibility study for a Waste Treatment Plant	2013	• Project Management/EAP	Company: Eskom Real Estate Division Contact: Chinga Gwiza Tel: 083 7626030	
PKX Cableway Environmental Impact Assessment: Scoping study	2013	• Scoping report: environmental feasibility of the Cableway Development	Company: Arup Contact: Shupikai Chihuri	

			Tel: 011 2187600	
Eskom Witbank Clinker Ash Dump Pre-feasibility Study	2011 - 2012	• Project Management • Review of environmental specialist technical reports • Consolidation of technical reports and presenting feasibility of the project to the client.	Company: Eskom SHE Management Division Contact: Gabriel Ngorima Tel: 076 9014006	
Environmental Impact Assessment for proposed coal mining activities: Mining Environmental Management Plan	2012	• Environmental Assessment Practitioner • Project Management	Company: Silver Unicorn Trading Contact: Bonginkosi Curnick Njeke Tel: 082 464 6489	
WETLAND ASSESSMENTS				
City Of Johannesburg Wetland Rehabilitation Plan For The Braamfonteinspruit, Kyalami, And Natalspruit Management Units: Draft Report	2015-In Progress	• Wetland Assessment • PES and EIS description • Wetland classification	Company: Headwaters water and environmental consultant Contact Person: Lekau Hlabolwa Tel: 079 703 8487	
Blesboklaagte wetland delineation and assessment for the proposed Eyethu Coal mining activities, Middleburg, Mpumalanga	2015	• Wetland Assessment • PES and EIS description • Wetland classification	Company: Geovicon Environmental (Pty) Ltd Contact: Riana Tel: 082 4981847	
Watercourse Assessment Report For The Proposed Construction of a 15km 50kV Power Line From Eskom Helios Substation To The Proposed New Transnet Helios Traction Feeder Substation	2015	• Watercourse assessment	Company: Nsovo Environmental consulting Contact Person: Munyadziwa Rikhotso Tel: 071602 2369	
Nietgedacht Wetland Delineation And Assessment Report	2015	• Wetland Assessment • PES and EIS Description • Wetland Classification	Company: Phuka Tsa Nong Contact Person: Kele Tel: 0834785753	

Wetland Delineation And Assessment Report For The Proposed Development Of An Eskom Straatdrift Madikwe 22 Kv Powerline	2015	• Wetland Assessment • PES and EIS Description • Wetland Classification	Company: Baagi Environmental Consulting Contact person: Marita Oosthuizen Tel: 082 378 4903	
Wetland Assessment Report For The Bredell Wetland In Kempton Park, Gauteng Province	2015	• Wetland Assessment • PES and EIS description • Wetland classification	Company: Watercube Services: Molefe Morokane Contact Person: Tel: 076 806 4293	
Wetland Delineation And Assessment Report For The Proposed Development Of A Retirement Center And Bridge Construction Activities In Montana Tuine Ext 49 & 50 In Pretoria	2015	• Wetland Assessment • PES and EIS description • Wetland classification	Company: Central Development Contact Person: Pierre Reyneke Email: pierrer@centraldev.co.za	
Transhex Operations (Pty) Ltd wetland delineation and assessment report for the proposed diamond mining operations between Baken and Reuning, Northern Cape Province	2015	• Wetland Assessment • PES and EIS description • Wetland classification	Company: Envirobro Contact Person: Nndangi Musekene Tel: 072 748 0292	
Wetland delineation and assessment for Eyethu Coal mining activities, Middleburg, Mpumalanga	2015	• Wetland Assessment • PES and EIS description • Wetland classification	Company: Geovicon Environmental (Pty) Ltd Contact: Tshepo Shakwane Tel: 082 4981847	
Wetland Delineation and Assessment Report for the Proposed Eskom 400kv Transmission Line From Ariadne to Venus Substations in Kwazulu-Natal Province.	2014	• Wetland Assessment • PES and EIS description • Wetland classification • Water Use licence Application	Company: DIGES Contact Person: Brenda Makanza Tel: 082 075 6685	
Randwater M11 pipeline wetland delineation and assessment, Gauteng Province	2014	• Wetland Assessment • PES and EIS description	Company: Asande Projects	

		• Wetland classification	Contact Person: Grace Magaya Tel: 081 494 1611	
Wetland delineation and assessment for the proposed Dithakwaneng bridge construction, North-West Province	2014	• Wetland Assessment • PES and EIS description • Wetland classification	Company: Southern Hills Engineering (Pty) Ltd Contact Person: Johnson Matangi Tel: 084 663 8199	
Ongezien Wetland assessment, Witbank Mpumalanga Province	2013	• Wetland Assessment • PES and EIS description • Wetland classification	Company: Silver Unicorn Trading Contact Person: Bonginkosi Njeke Tel: on request	
Leeuwfontein wetland assessment	2013	• Wetland Assessment • PES and EIS description • Wetland classification	Company: Geovicon Environmental (Pty) Ltd Contact: Tshepo Shakwane Tel: 082 4981847	
Platreef-Borutho wetland assessment, Limpopo Province	2013	• Wetland Assessment • PES and EIS description • Wetland classification	Company: Nzumbululo Heritage Solutions Contact Person: Nonhlanhla Ncube Tel: on request	
Duvha-Minerva Transmission line wetland assessment and WULA	2013	Wetland assessment and water use licence application	Company: Nzumbululo Heritage Solutions Contact Person: Nonhlanhla Ncube Tel: on request	
Rockdale-Marble hall transmission line wetland assessment and WULA	2013	Wetland assessment and water use licence application	Company: Nzumbululo Heritage Solutions Contact Person: Nonhlanhla Ncube Tel: 015 291 3661	

Protea Glen wetland function assessment study.	2011	• Wetland assessment • PES and EIS description • Wetland classification	Company: Wetland Consulting Services Contact Person: Bhuti Dlamini Tel: on request	
Randwater Pipeline wetland assessment	2011	• Wetland assessment • PES and EIS description • Wetland classification	Company: Asande Projects Contact Person: Joshua Oluokun Tel: 073 4068051	
ECOLOGICAL ASSESSMENTS (FAUNA AND FLORA)				
Ecological Assessment Report For The Proposed Tweedracht 5.5km 88 Kv Power Line Development	2015	Flora and Fauna Assessments	Company: Nsovo environmental consultin Contact person: Munyadziwa Rikhotso Tel: 071602 2369	
Ecological Assessment Report For The Construction Of An Additional 200ml Rand Water Reservoir In Meredale	2015	Flora and Fauna Assessments	Company: Asande projects Contact person: Avhutetshelwi Mashau Tel: 011 315 6794	
Ecological Assessment Report For The Proposed Rand Water Additional 200ml Reservoir In Brakpan, East Rand, Gauteng Province	2015	Flora and Fauna Assessments	Company: Rand Water Contact Person: Thokozani Masilela Tel: 011 724 9140	
Ecological Assessment Report For The The Proposed Replacement Of Both The Existing A6 And A8 Pipelines With Two New Pipes (One Pipe At A Time) Running From Vereeniging Pumping Station To Zwartlopjes Pump Station With A Length Of 44 Km And A Diameter Of 1300	2015	Flora and Fauna Assessments	Company: Asande projects Contact person: Rolivhuwa Nemakonde Tel: 011 315 6794	

Ecological Assessment Report For The Construction Of The Rand Water Additional 210ml And Future Planned 200ml Reservoir On Vlakfontein Farm 69ir, Crystal Park, Ekurhuleni Metropolitan Municipality	2015	Flora and Fauna Assessment	Comapany: Rand Water Contact Person: Luzuko Kalimashe Tel: 083 4250 455	
Ecological Assessment For The Construction And Maintenance Of The Rand Water 17, 5km H43 Pipeline With An Internal Diameter Of 1200mm, And It's Associated Structure (Valve Chambers And Cathodic Protection) Between Graham Street, Centurion And Lyttelton, Gauteng Province	2015	Flora and Fauna Assessment	Company: Asande projects Contact person: Faith Chigwanhire Tel: 011 315 6794	
Randwater Brakpan Reservoir to Selcourt Reservoir M 11 Pipeline Fauna And Flora Assessment	2014	Flora and Fauna Assessments	Company: Asande Projects Contact Person: Freddy Milambo Tel: 074 181 8292	
COMPLIANCE AUDITS				
Universal Coal and Energy (Pty) Ltd: Kangala Coal Mine External Water Use Licence Audit	June 2015	Lead auditor	Company: Universal Coal and Energy (Pty) Ltd: Kangala Coal Mine Contact person: Lekau Hlabolwa Tel: 079 7038487	04/B20A/ABC GIJ/1506
THABA CRONIMET ANNUAL INTEGRATED WATER USE LICENCE AUDIT	June 2015	Lead Auditor	Company: Thaba Cronimet (Pty)Ltd Contact person: Lekau Hlabolwa Tel: 079 7038487	03/A24F/ACGI J
GLENCORE WONDERKOP SMELTER EXTERNAL WASTE MANAGEMENT LICENCE AUDIT	May 2015	Lead auditor	Company: Glencore Contact person: Bertha Mohapi Tel: 014 572 0393	No. 12/9/11/L510/7

THABA CRONIMET ANNUAL INTEGRATED WATER USE LICENCE AUDIT	August 2014	Lead Auditor	Company: Thaba Cronimet (Pty)Ltd Contact person: Lekau Hlabolwa Tel: 079 7038487	03/A24F/ACGI J
Eskom Tutuka Power Station ISO14001:2004 Internal Audit	Decemb er 2014	Lead auditor	Company: Envirobro Contact person: Nndangi Musekene Tel: 072 748 0292	
Sebata Group ISO 14001: 2004 development and implementation	2013-2014	ISO 14001:2004 Implementation and internal auditing	SEBATA General manager: SHE Mr McDonald Mutsvangwa Contact: 0100600355	
Kusile water use licence quarterly audits	2013 – 2014 (quarterly for 12 months)	Lead auditor/wetland specialist	Company: Kusile Power station Contact person: Siphiwe Mahlangu Tel: 013 699 7097	No.: 04/B20F/CI/22 35
Transnet incident management	2013	Accident and Incident Management	Company Name: Isivuvu Technical Solutions Contact Person: Nhlanhla Maphalala Tel: 073 417 0438	
ZUFI Engineering safety systems audit	2013	OHSA 18001 audit	Company Name: ZUFI Engineering Contact Person: Sikholiwe Zungu Tel: 084 475 0509	
WATER USE LICENCE APPLICATIONS				
Construction of an Additional Rand Water 210ml Reservoir On Vlakfontein 69ir Farm In Crystal Park, Ekurhuleni Metropolitan Municipality, Gauteng Province	2015 – in progress	EAP and project manager	Company: Rand Water Contact Person: Thokozani Masilela Tel: 0720495 0097	14/12/16/3/3/1/ 1431

Construction of a Rand Water 200ml Reservoir In Brakpan, Ekurhuleni Metropolitan Municipality, Gauteng Province	2015 – in progress	EAP and project manager	Company: Rand Water Contact Person: Thokozani Masilela Tel: 0720495 0097	14/12/16/3/3/1/1423
Proposed Eskom 400kv Transmission Line From Ariadne to Venus Substations in Kwazulu-Natal Province: Water Use Licence Application	2014 – 2015	EAP and project manager	Company: DIGES Contact Person: Brenda Makanza Tel: 082 075 6685	12/12/20/1755
Duvha-Minerva 400kv Powerline deviation water use licence application	2013	EAP and project management	Company: Eskom Transmission Contact: Vuledzani Thanyane Tel: 011 800 5601 Ref: 16/2/7/B100/C983	16/2/7/B100/C983
Water Use Licence for the construction of the Rockdale to Wolwekraal 400kv powerline and associated secondary infrastructure, Mpumalanga and Limpopo Provinces	2013	EAP and project management	Company: Eskom Transmission Contact: Vuledzani Thanyane Tel: 011 800 5601 Ref: 16/2/7/B300/B03	12/12/20/1340

APPENDIX G.4 WETLAND ASSESSMENT SPECIALIST REPORT

Sazi
Environmental Consulting

WETLAND ASSESSMENT AND REHABILITATION REPORT FOR THE KLIP-MIDDDLE SOWETO CITY PARKS AND ZOO'S WITHIN THE CITY OF JOHANNESBURG MUNICIPALITY, GAUTENG PROVINCE:

May 2016

Title:	WETLAND ASSESSMENT AND REHABILITATION REPORT FOR THE KLIP MIDDLE SOWETO WITHIN THE CITY OF JOHANNESBURG MUNICIPALITY, GAUTENG.
Author:	Lufuno Nemakhavhani
Reviewed by:	Aphiwe-Zona Dotwana
Status of report:	FINAL
Document control	IN000046/2016
First Issue:	May 2016

Approved by:

.....

Nonkanyiso Zungu, Pr.Nat.Sci (Reg. No. 400194/10)

Specialist Ecologist/Wetland specialist

Date: 23 June 2016

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20/ or 12/9/11/L
NEAS Reference Number:	DEA/EIA
Date Received:	

Application for integrated environmental authorisation and waste management licence in terms of the-

(1) National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2014; and

(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 921, 2013

PROJECT TITLE

City Parks and Zoo's Environmental Studies that will be undertaken in Klip Middle Soweto and Upper Rietspruit, within the City of Johannesburg Municipality

Specialist:	Nonkanyiso Zungu		
Contact person:	Nonkanyiso Zungu		
Postal address:	PB Box, 201, Carlswald, Midrand		
Postal code:	1685	Cell:	084 8000 187
Telephone:	011 312 2806	Fax:	011 312 7208
E-mail:	nzungu@sazienvironmental.co.za		
Professional affiliation(s) (if any)	SACNASP (Registration No. 400194/10)		

Project Consultant:	Myezo Environmental Management Services		
Contact person:	Caspa Fulufhelo Neluheni		
Postal address:	Postnet Suite B165, Private Bag X18, Lynwood Ridge, Pretoria		
Postal code:	0040	Cell:	082 637 6081
Telephone:	012 998 7642	Fax:	012 998 7641
E-mail:	caspa@myezo.co.za		

4.2 The specialist appointed in terms of the Regulations_

I, Nonkanyiso Zungu , declare that –

General declaration:

I act as the independent specialist in this application;
I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
I declare that there are no circumstances that may compromise my objectivity in performing such work;
I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
I will comply with the Act, Regulations and all other applicable legislation;
I have no, and will not engage in, conflicting interests in the undertaking of the activity;
I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
all the particulars furnished by me in this form are true and correct; and
I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

SAZI Environmental Consulting CC

Name of company (if applicable):

16 June 2016

Date:

Indemnity

This report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken. 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 information available at the time of study. Therefore the author reserves 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.

Although the author exercised due care and diligence in rendering services and preparing documents, she accepts no liability, and the client, by receiving this document, indemnifies the author against all actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, directly or indirectly by the author and by the use of this document.

EXECUTUVE SUMMARY

1. Introduction

Lebone Engineering, on behalf of Johannesburg City Parks and Zoo has appointed SAZI Environmental Consulting cc to undertake a wetland specialist study, which will entail the assessment of the Klip-Middle Soweto Water Management Unit (WMU) and provide rehabilitation measures thereof.

The aim of this study was to assess the management of water catchments and sources, namely, conservation and preservation of the ecological reserve and the goal of reduced water pollution in Johannesburg Water Management Units within the city of Johannesburg Municipality. A two day site assessment was undertaken by in May 2016 with the purpose of site verification and wetland delineation.

This report is aimed at identifying wetland priority areas within the Klip-Middle Soweto to offer rehabilitation measures, in order to regain the health status of the Klip-Middle Soweto WMU.

2. Approach and Methodology

- Various data sources were utilised to obtain background information, including 1:50000 Maps, NFEPA maps, and MBCP maps.
- Wet-Health tool was used for the assessment of the present ecological status or health of the wetland.
- Eco-Services tool was used for the assessment of ecological importance and sensitivity of the wetland.
- Impact assessment was undertaken using the principles of the IWWMP operational guidelines developed by the Department of Water and Sanitation.

3. Wetland Assessment Results

a. Catchment description

The study area falls within C22A quaternary catchment of the Upper Vaal Water Management Area. The Klip River is the major river that runs in this area. The Klipspruit, a tributary to the Klip River is the main channel feeding the wetlands assessed in this WMU. The Rietspruit is another tributary to the Klip River. The Klip River and its tributaries, drain into the Vaal River. This catchment consists of a number of constructed dams, the Fleurhof and the Moroka dam are the two dams located within the study area.

b. Classification of wetlands

The Klipspruit River of the Klip-Middle Soweto WMU consisted of a channelled valley bottom wetland associated with the Klipspruit River itself. The Klipsruit wetland furthermore consisted of drainage lines that formed channelled valley bottom wetlands. The area assessed had a total number of four assessed wetlands all draining into the Klipspruit River.

The channelled valley bottom wetland type is mostly associated with a single stream or a river and its functions include soil erosion control as well as flood attenuation, respectively.

4. Wetland Health Assessment

Wetland ecological status was assessed by considering impacts to wetland hydrology, geomorphology and vegetation.

Based on the impact scores summarized below, it is evident that the wetland systems are modified and highly impacted.

HGM Unit	Hydrology Impact Score	Geomorphology Impact Score	Vegetation Impact Score	Overall Impact score	Health Category
Channelled valley bottom	9.0	4.9	9.6	8	F
Zone 1	9.0	3.1	7.9	7	E
Zone 2	2.0	2.3	9.0	4	D
Zone 3	9.0	3.4	8.6	7	E

5. Wetland Ecological Importance And Sensitivity

According to a study conducted by the Department of Water Affairs and Forestry (1999), Ecological Importance of a water resource is referred to as its ability to maintain ecological functioning on a local and global scale. Ecological Sensitivity refers to the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred (DWAF, 1999). Ecological Importance and Sensitivity of an area are considered pivotal because of their contribution to biodiversity importance.

The Klipspruit wetland which is a Channeled Valley Bottom wetland consists of some ecological functions which include biodiversity support due to the presence of the riparian habitat. However, no rare or red data species were identified in this area. The Klipspruit wetland is considered **critical** based on the ecological importance and sensitivity assessment.

6. Wetland Rehabilitation Plan

Due to the health of the Klipspruit River and its associated wetlands, extensive rehabilitation is expected and needed in order to improve the state of the wetland. In order to successfully implement the rehabilitation plan, focusing the rehabilitation strategy on individual HGM units (Zones of the Klipspruit wetland), will improve the health of the wetland since impacts to wetland zones vary with each HGM. It is important to know and understand the aim of the rehabilitation, as it helps in identifying rehabilitation materials and strategies. The successful rehabilitation of a wetland requires that the cause of damage or degradation is addressed, and that the natural flow patterns of the wetland system are re-established.

Based on the impacts identified, the rehabilitation plan for the Klip-Middle Soweto WMU will include but not limited to; removal of alien invasive species; re-vegetation of indigenous vegetation; erosion control measures (gabions, berms, weirs); reduction of illegal dumping into the wetland; implementation of correct management of runoff and stormwater management; stabilising sediment movement, etc.

7. Conclusion

The Klip-Middle Soweto WMU was highly impacted. The wetland units were polluted largely by littering. Littering in the Klip-Middle Soweto WMU is believed to be caused by over population in the area and housing settlements that are built within the wetlands. Some settlements in this area are regarded as squatter camps, and as such, services such as Pik-it-up recycling companies are not rendered in these areas, which is in turn resulting in dumping of domestic waste into the wetlands. The dumping of waste on a wetland also has an indirect impact on the odour of the wetland. This was another impact identified in the wetland units in this area. The wetland pungent smell is also believed to emanate from upstream activities.

Based on the study, the wetland units were largely impacted on hydrology, geomorphology and vegetation, consequently causing a high ecological and sensitivity status. This wetland unit is regarded critical based on the wetland health assessment undertaken. The rehabilitation of the Klip-Middle Soweto WMU is highly recommended.

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LIST OF TERMS AND ABBREVIATIONS

Delineation – the technique of establishing the boundary of an aquatic resource such as a wetland or riparian area.

Drain – In the context of wetlands, refers to a natural or artificial feature such as a ditch or trench created for the purpose of removing surface and sub-surface water from an area (commonly used in agriculture).

Ecological Importance – An expression of the importance of an environmental resource for the maintenance of biological diversity and ecological functioning on local and wider scales.

Ecological Sensitivity – A system's ability to resist disturbance and its capability to recover from disturbance once it has occurred.

EIS – Ecological Importance & Sensitivity.

GIS – Geographical Information Systems.

GPS – Global Positioning System.

Gulley (or erosion gulley) - A gully (commonly called a "donga") is an erosion landform or feature, created by running water eroding sharply into soil. Gullies generally resemble small ditches that can be several meters in depth and width. Gullying or gully erosion is the process by which gullies are formed.

HGM – Hydro-Geomorphic.

NFEPA – National Freshwater Ecosystem Priority Areas, identified to meet national freshwater conservation targets (CSIR, 2010).

PES – Present Ecological State, referring to the current state or condition of an environmental resource in terms of its characteristics and reflecting change from its reference condition.

1 INTRODUCTION

Lebone Engineering, on behalf of Johannesburg City Parks and Zoo, has appointed SAZI Environmental Consulting cc to undertake a wetland specialist study, which will entail the assessment of the Klip-Middle Soweto Water Management Unit (WMU) and provide rehabilitation measures thereof.

The aim of this study was to assess the management of water catchments and sources, namely conservation and preservation of the ecological reserve and the goal of reduced water pollution in Johannesburg Water Management Units within the City of Johannesburg Municipality. A two day site assessment was undertaken in May 2016 with the purpose of site verification and wetland delineation.

This report is aimed at identifying wetland priority areas within the Klip-Middle Soweto to offer rehabilitation measures, in order to regain the health status of the Klip-Middle Soweto WMU.

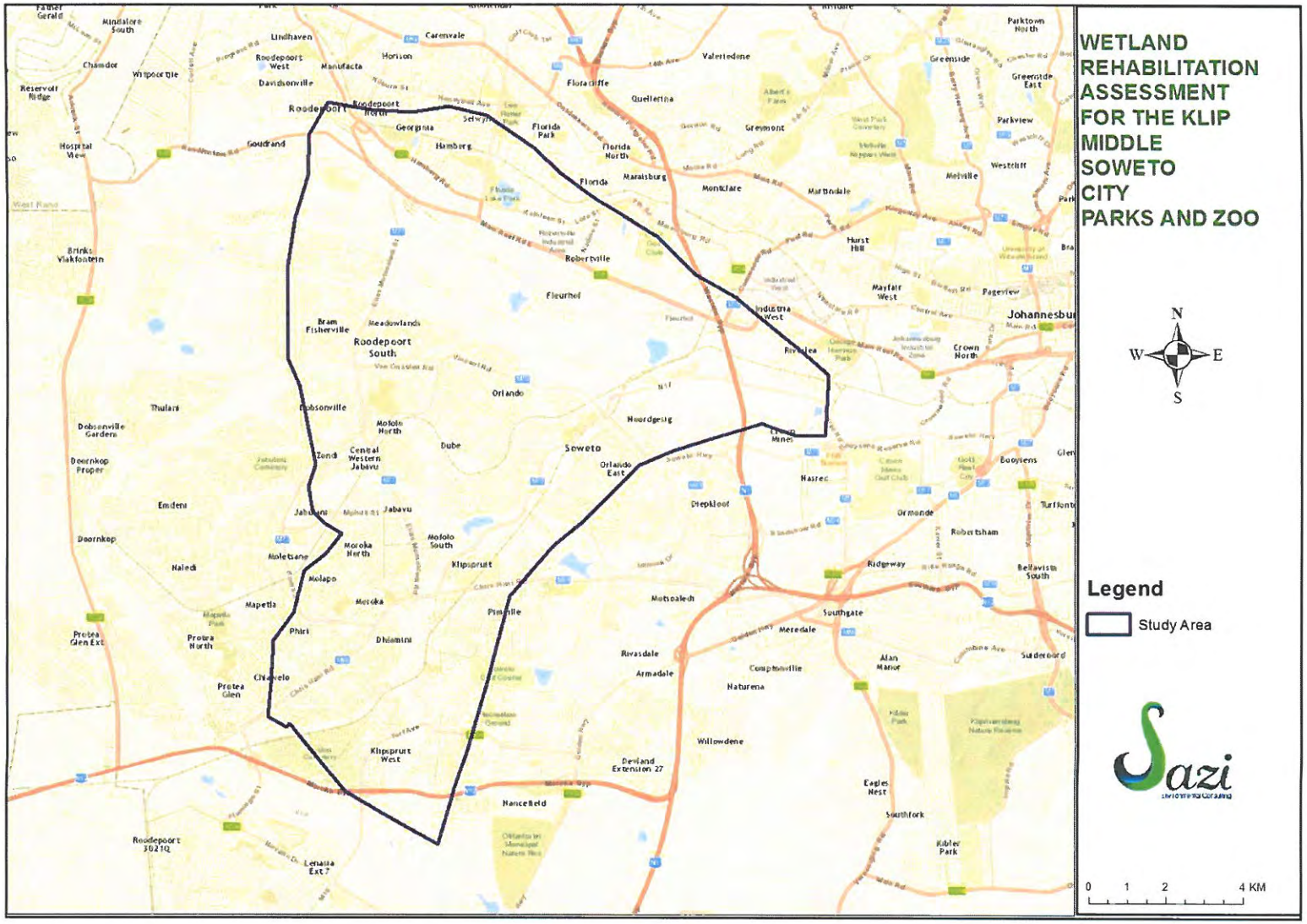

Figure 1: Location of the Klip- Middle Soweto Water Management Units

1.1 BACKGROUND

According to the South African River Health Programme (RHP), State of the Rivers Report, it is estimated that up to 50% of wetlands may have been lost country-wide. Of the more than 800 naturally-occurring freshwater wetlands in South Africa, 14% have full protection within a national park, provincial nature reserve or wildlife sanctuary and 4% are partly protected. South Africa currently has 16 wetlands designated as wetlands of international importance in accordance with the Ramsar Convention.

Loss and degradation of wetlands has been great and national policy and legislation provides clear direction and support for rehabilitation. Degradation is not necessarily permanent, a number of degraded wetlands recovered some of the health and values through rehabilitation. Good planning ensures a rational and structured approach towards rehabilitation as well as a clear understanding of the reasons for rehabilitation, the actions, and interventions required, and the benefits and beneficiaries.

In the context of rehabilitation planning, the assessment of the wetland health assists in the understanding of the condition of the wetland in order to determine whether it is beyond repair, whether it requires rehabilitation intervention, or whether, despite damage, it is perhaps healthy enough not to require intervention. It also helps to diagnose the cause of wetland degradation so that rehabilitators can design appropriate interventions that treat both the symptoms and causes of degradation.

This report is aimed at assessing the health status of selected priority wetlands within the Klip-Middle Soweto Management Unit. This information can be used to inform or redefine rehabilitation interventions.

1.2 ASSUMPTIONS AND LIMITATIONS

The following assumptions and limitations are applicable to this report:

- Due to the extent of the study area, use was made of aerial photographs, digital satellite imagery, as well as provincial and national wetland databases to identify areas of interest prior to the field survey. Any additional wetland areas or watercourses noted during the field survey were also assessed and added to the number of survey points. Although all possible measures were undertaken to ensure all wetland features and

riparian zones were assessed and delineated, some smaller ephemeral features may have been overlooked;

- The wetland delineations as presented in this report are regarded as a best estimate of the wetland boundaries based on the site conditions present at the time of assessment. It must be noted that due to the extent of the study area extensive use was made of digital Satellite imagery to delineate wetland boundaries and not all areas were delineated in detail;
- Global Positioning System (GPS) technology is inherently inaccurate and some inaccuracies, due to the use of handheld GPS instrumentation, may occur. If more accurate assessments are required, the wetlands will need to be surveyed and pegged according to surveying principles. The delineations are however deemed sufficiently accurate to ensure that the wetland resources are adequately protected if the management and mitigation measures of this report are adhered to and adequate buffers are implemented;
- In addition, significant transformation of the vegetation communities and soil profiles arising from historical and current agricultural practices as well as mining activities was apparent. As a result, identification of the outer boundary of temporary wetland zones and riparian zones proved difficult in some areas and in particular, in the areas where wetland conditions and riparian zones are marginal. Therefore, the wetland/riparian delineations as presented in this report are regarded as a best estimate of the wetland/riparian boundaries based on the site conditions present at the time of assessment;
- Wetlands and terrestrial zones create transitional areas where an ecotone is formed as vegetation species change from terrestrial to wetland species. Within this transition zone some variation of opinion on the wetland/riparian boundary may occur;
- Aquatic, wetland and riparian ecosystems are dynamic and complex. Some aspects of the ecology of these systems, some of which may be important, may have been overlooked.

1.3 DEFINITIONS AND LEGAL FRAMEWORK

In a South African legal context, the term watercourse is often used rather than the terms wetland, or river. The National Water Act, 1998 (Act No. 36 of 1998) (NWA) includes wetlands and rivers into the definition of the term watercourse (DWAF, 2008).

2 APPROACH AND METHODOLOGY FOLLOWED

2.1 DESKTOP ASSESSMENT

The main objective of the desktop assessment process was to ensure that wetland rehabilitation is undertaken at sites that are representative of the general condition of Management Unit (MU): Klip-Middle Soweto.

As an initial process, extensive use was made of digital satellite imagery to identify possible wetland resources, and points to be ground-truthed in the field were carefully selected, ensuring that features displaying a diversity of digital signatures were identified in order to allow for field verification.

The following data sources were used to inform the desktop assessment:

- NFEPA wetland coverage, which shows locations of FEPA wetland sites;
- 1:50,000 imagery as well as latest Google Map Imagery for desktop assessment of the site;
- C-Plan vs 3 to get information on areas highlighted for terrestrial biodiversity conservation in the Gauteng Province;
- Biodiversity GIS (BGIS) to obtain conservation areas;
- Wet-Health tool for the assessment of the present ecological status or health of the wetland; and
- DWA Wetland Reserve tool for the assessment of ecological importance and sensitivity of the wetland.

After the initial ground-truthing of the pre-selected sites from the desktop study, desktop delineation of the wetland regions of the study area was undertaken based on biophysical attributes such as geological, geomorphological and vegetation characteristics, as well as the type and intensity of catchment land use which the systems in each MU was exposed to.

The following information sources were used to aid in the delineation of the wetland regions:

- The hydrogeomorphic wetland types across the study area;
- Groundwater and/or geological maps;
- Water quality data; and

2.3 CLASSIFICATION OF WETLANDS

This stage includes breaking the wetland units into Hydro-Geomorphic types (HGM); which are defined based on geomorphic setting (e.g. hillslope or valley bottom), water source (surface water dominated or sub-surface water dominated) and how water flows through the wetland unit (diffusely or channelled). Each wetland unit distinguished based on hydro-geomorphic type, were assessed individually. Figure 2 below indicates the wetland hydro-geomorphic setting of inland wetlands in South Africa as well as wetland classification applied on wetlands for assessment.

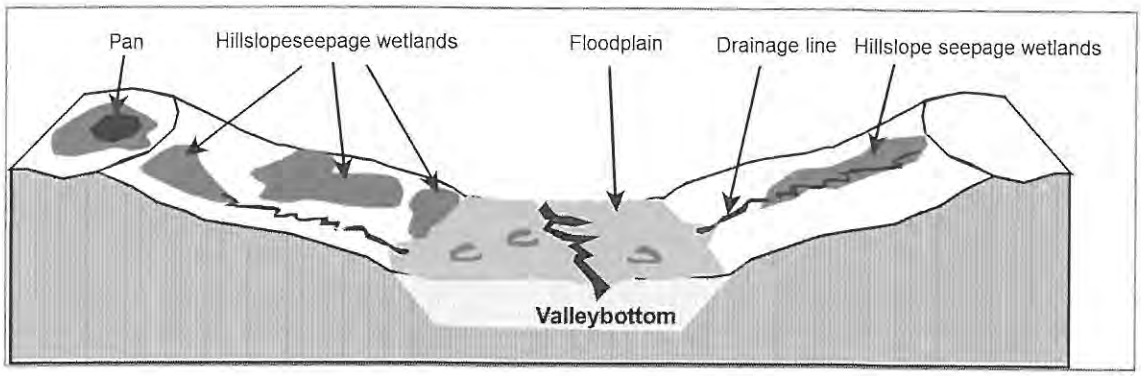

Figure 2: Wetland hydro-geomorphic setting

2.4 EXISTING IMPACTS AND CATCHMENT CONTEXT

Using available information, existing impacts to the wetlands and within the delineated micro-catchment were mapped and described.

2.5 WETLAND HEALTH ASSESSMENT

A level 2 Wet-Health method was used to determine the health of wetlands on site, thus describing their Present Ecological Status (PES) (Macfarlane, et al. 2008). This method utilises geomorphology, hydrology and vegetation to determine the health of a wetland. The hydrology module assesses the land use descriptors (irrigation, level of reduction or increase in flows, hydro-geomorphic setting of the wetland and extent of canalisation and gully

formations). The vegetation module assesses the level of vegetation transformation, which is indicated by level of alien species invasion, terrestrial species encroachment and encroachment by indigenous invasive species. The geomorphology module captures deviations in the sedimentary inputs and outputs to and from wetlands that are a consequence of human activities.

Values range from Class A (largely natural) to Class F (critically modified). Table 1 below describes the overall HGM health categories and their scores. **This is calculated as 10 - Impact scores to get the overall impact score.** Table 2 describes the hydrological categories whereas Table 3 indicates the vegetation description of categories and Table 4 shows the geomorphology categories and scores.

Table 1: Health categories used by WET-Health for describing the integrity of wetlands

HEALTH CATEGORY	DESCRIPTION	Min Score
A	Unmodified, natural.	0 – 0.9
B	Largely natural with few modifications. A slight change in ecosystem processes is discernable and a small loss of natural habitats and biota may have taken place.	1 – 1.9
C	Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact.	2 – 3.9
D	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4 – 5.9
E	The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	6 – 7.9
F	Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8 – 10

Table 2: Impact scores and health category associated with changes in hydrology

IMPACT CATEGORY	DESCRIPTION	SCORE	HYDROLOGICAL HEALTH CATEGORY
None	No discernible modification or the modification is such that it has no impact on hydrological integrity.	0 – 0.9	A
Small	Although identifiable, the impact of this modification on hydrological integrity is small.	1 – 1.9	B
Moderate	The impact of this modification on hydrological integrity is clearly identifiable, but limited.	2 – 3.9	C
Large	The modification has a clearly detrimental impact on hydrological integrity. Approximately 50% of hydrological integrity has been lost.	4 – 5.9	D
Serious	The modification has a clearly adverse effect on hydrological integrity. Well in excess of 50% of the hydrological integrity has been lost.	6 – 7.9	E
Critical	The modification is so great that the ecosystem processes of this component of hydrological health are drastically altered. 80% or more of the hydrological integrity has been lost.	8 – 10	F

Table 3: Summary of the Health scores associated with vegetation changes

DESCRIPTION	Score	HEALTH Category
Vegetation composition appears natural.	0 – 0.9	A
A very minor change to vegetation composition is evident at the site.	1 – 1.9	B
Compositional changes are evident but the site still contains mostly species expected in the reference state. Vegetation composition has been clearly altered but still contains a large proportion of natural species expected in the reference state.	2 – 3.9	C
Vegetation composition has been largely altered and introduced, alien and/or ruderal species are abundant but most characteristic wetland species are usually still present.	4 – 5.9	D

Vegetation composition has been substantially altered but some characteristic species remain, although the vegetation consists mainly of introduced, alien and/or ruderal species.	6 – 7.9	E
Vegetation composition has been totally or almost totally altered, and if any characteristic species still remain, their extent is very low.	8 – 10	F

Table 4: Impact scores associated with geomorphological changes

Threat Category	Description	Score	GEOMORPHOLOGY HEALTH CATEGORY
None	No discernible threat or the threat is such that no impact on wetland geomorphic integrity could be expected.	0 – 0.9	A
Small	Although identifiable, the threat posed could only be expected to have a small impact on wetland integrity.	1 – 1.9	B
Moderate	The threat posed could be expected to have an identifiable, but limited impact on wetland integrity.	2 – 3.9	C
Large	The threat posed could be expected to reduce wetland integrity by approximately 50%.	4 – 5.9	D
Serious	The threat posed could be expected to reduce wetland integrity in excess of 50%.	6 – 7.9	E
Critical	The threat posed could be expected to destroy ecosystem processes.	8 – 10	F

An overall wetland health score was calculated by weighting the scores obtained for each module and combining them to give an overall combined score using the following formula:

Overall health rating = [(Hydrology*3) + (Geomorphology*2) + (Vegetation*2)] / 7

This overall score assists in providing an indication of wetland health/condition which can in turn be used for recommending appropriate management measures.

2.6 WETLAND ECOLOGICAL IMPORTANCE AND SENSITIVITY (EIS)

An assessment of the importance and sensitivity of wetland systems using the Wetland EIS (Ecological Importance and Sensitivity) assessment tool was undertaken using the outcomes of the WET-Health assessment and other valuable information gathered in the field as well as available desktop information.

The maximum score for these components was taken as the importance rating for the wetland which is rated using Table 5, below.

Table 5: Ecological Importance and Sensitivity rating table

RATING	EXPLANATION
None, Rating = 0	Rarely sensitive to changes in water quality/hydrological regime.
Low, Rating =1	One or a few elements sensitive to changes in water quality/hydrological regime.
Moderate, Rating =2	Some elements sensitive to changes in water quality/hydrological regime.
High, Rating =3	Many elements sensitive to changes in water quality/ hydrological regime
Very high, Rating =4	Very many elements sensitive to changes in water quality/ hydrological regime

3 DESKTOP ASSESSMENT RESULTS

3.1 KLIP-MIDDLE SOWETO WATER MANAGEMENT UNIT GENERAL BACKGROUND

The Klip-Middle Soweto Water Management Unit is located in the C22A quaternary catchment of the Upper Vaal Water Management Area. The Klip River is the major river that runs in this management system, with the Klipspruit River as its main tributary. The Klipspruit River, a tributary to the Klip River, originates in the Greater Canada Area, just north of Orlando in Soweto. The Klipspruit joins the Klip River just beyond Lenansia where it flows into the Vaal River. The river's catchment covers most of Mzimhlophe, Orlando East and West, Dlamini and Kliptown.

The Klip-Middle Soweto WMU unit falls under the City of Johannesburg Municipality. The area is dominated by residential areas with a portion of commercial areas and mining areas.

Figure 3 below illustrates the quaternary catchments and main rivers that run through and adjacent the study area.

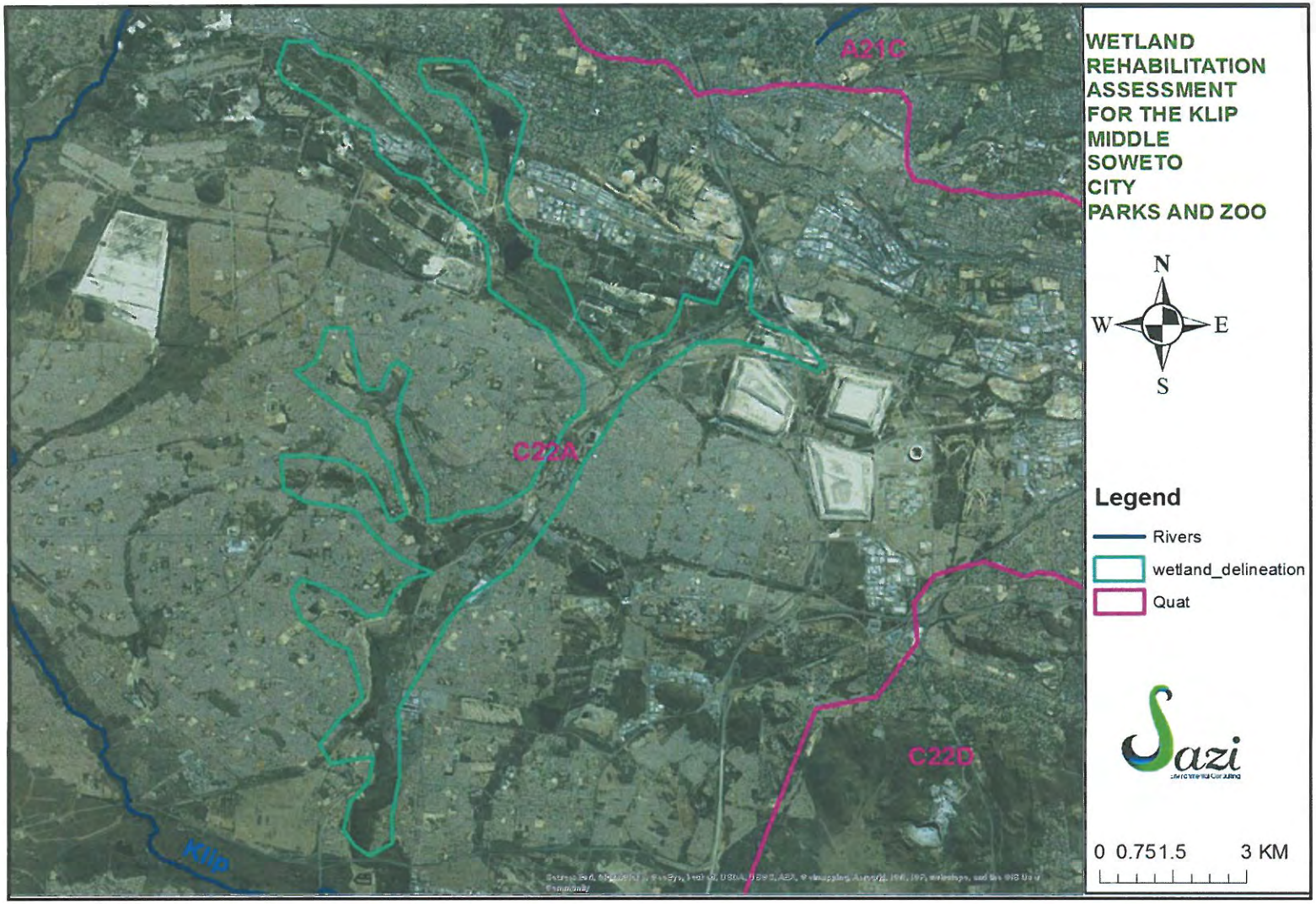

Figure 3: Catchments and main rivers within each management unit

3.2 ECOLOGICAL IMPORTANCE AND SENSITIVITY

In line with the Wetland Reserve methodology (DWA, 2013), and for the purposes of the current study, the wetlands ecological importance refers to its high biodiversity at a local and regional scale as well as presence of species of conservation concern. The wetland sensitivity refers to the wetlands ability to resist disturbance. The wetlands' ecological importance and sensitivity was assessed based on Ecological Importance (NFEPA, Conservation Status, Threatened Biodiversity Status); Hydrological Functions; and Direct Human Benefits. These characteristics are described in the sections below.

3.2.1 NFEPA

The Atlas of Freshwater Ecosystem Priority Areas in South Africa (Nel *et al*, 2011) which represents the culmination of the National Freshwater Ecosystem Priority Areas project, a partnership between SANBI, CSIR, WRC, DEA, DWA, WWF, SAIAB and SANParks, provides a series of maps detailing strategic spatial priorities for conserving South Africa's freshwater ecosystems and supporting sustainable use of water resources. Freshwater Ecosystem Priority Areas (FEPA's) were identified through a systematic biodiversity planning approach that incorporated a range of biodiversity aspects such as ecoregion, current condition of habitat, presence of threatened vegetation, fish, frogs and birds, and importance in terms of maintaining downstream habitat. High water yield areas and high groundwater recharge areas were also identified as part of the project.

The NFEPA uses the National Wetlands Classification System (NWCS) to categorise wetlands. This classification approach has integrated aspects of the HGM approach used in the WET-Health system as well as the widely accepted eco-classification approach used for rivers. The NWCS has a six tiered hierarchical structure, with four spatially nested primary levels of classification. The focus of this study was on **Level 3,** which classifies the HydroGeomorphic (HGM) units. The HGM units are defined as follows:

- Landform – shape and localised setting of wetland;
- Hydrological characteristics – nature of water movement into, through and out of the wetland; and
- Hydrodynamics – the direction and strength of flow through the wetland.

These factors characterise the geomorphological processes within the wetland, such as erosion and deposition, as well as the biogeochemical processes.

The NFEPA atlas was considered for the Klip-Middle Soweto WMUs wetland ecological assessment. The identification of wetland and aquatic NFEPA's takes place on a large scale and as a result, not all wetland units present on a site are always identified. Spatial layers (FEPA's) used include the wetland classification and ranking.

The NFEPA wetlands have been ranked in terms of importance in the conservation of biodiversity. Table 6 below indicates the criteria which were considered for the ranking of wetland areas.

Table 6: NFEPA ranking criteria

CRITERION	RANK
Wetlands that intersect with a Ramsar site	1
Wetlands within 500 m of a IUCN threatened frog point locality	2
Wetlands within 500 m of a threatened waterbird point locality	2
Wetlands (excluding dams) with the majority of its area within a sub-quaternary catchment that has sightings or breeding areas for threatened Wattled Cranes, Grey Crowned Cranes and Blue Cranes	2
Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing wetlands of exceptional biodiversity importance, with valid reasons documented	2
Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing wetlands that are good, intact examples from which to choose	2
Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing wetlands of biodiversity importance, but with no valid reasons documented	3
Wetlands (excluding dams) in A or B condition AND associated with more than three other wetlands (both riverine or non-riverine wetlands were assessed for this criterion)	4
Wetlands in C condition AND associated with more than three other wetlands (both riverine or non-riverine wetlands were assessed for this criterion)	4
Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing impacted Working for Wetland sites	5
Any other wetland (excluding dams)	6

According to the NFEPA atlas, the wetlands within the Klip-Middle Soweto WMU are within ranking 5. This infers that, in general, the wetlands in the WMU are not expected to contain red data species or contain species of exceptionally high conservation importance. According to NFEPA the Klip-Middle Soweto WMU consisted of three wetland types; a channelled valley bottom, a seep and an unchannelled valley bottom wetland (see figure 4).

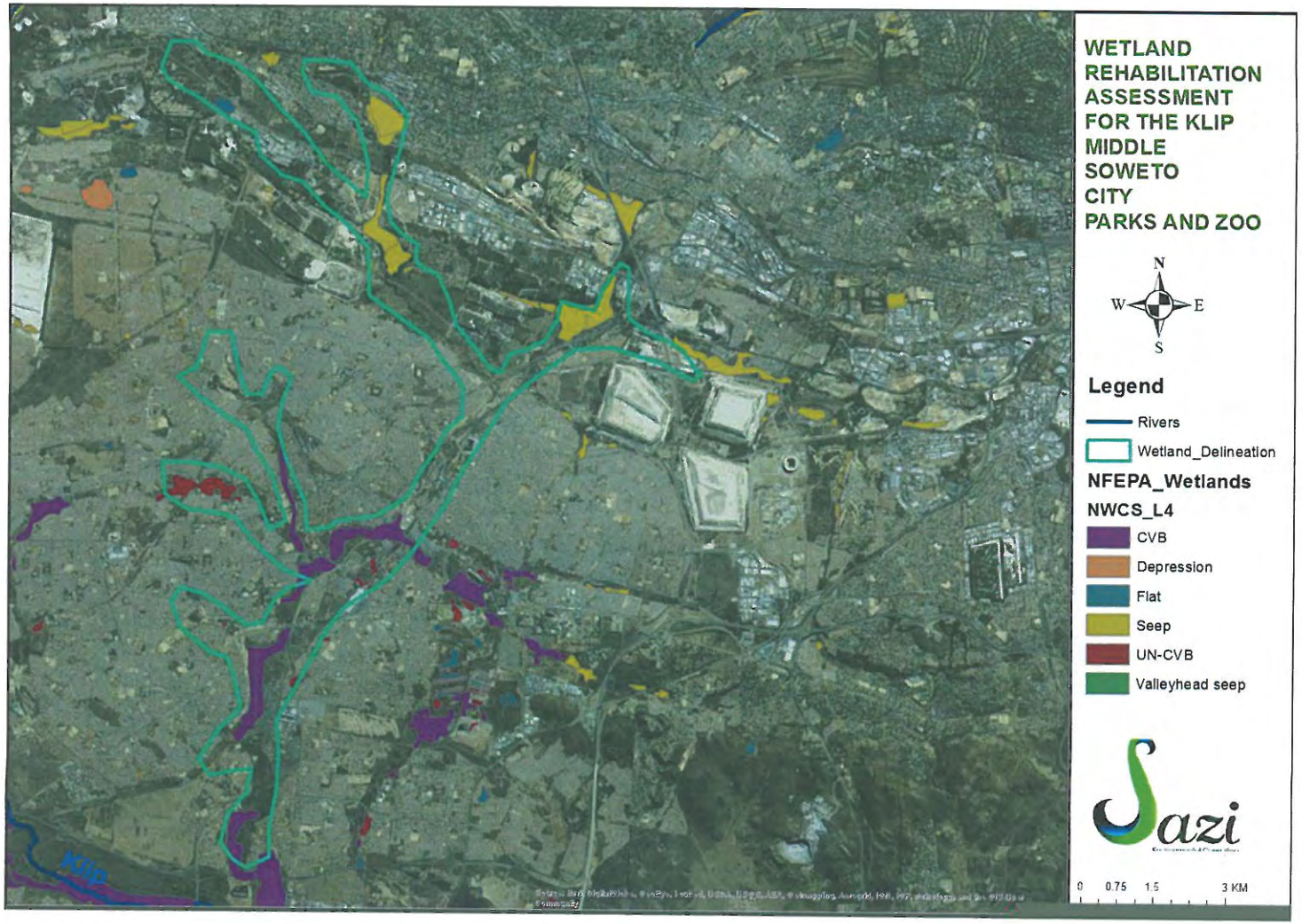

Figure 4: NFEPA ranking of wetlands within Klip-Middle Soweto Management Units

4 WETLAND ASSESSMENT RESULTS

4.1 WETLAND DESCRIPTION

The Klip-Middle Soweto Management Unit is known to have Channelled Valley Bottom (CVB) wetlands and Seep wetlands as seen in figure 4 above. A channelled valley bottom wetland was identified and assessed on site, which was associated with the Klipspruit River, a tributary to the Klip River. The CVB wetland was approximately 2 469ha in size. Three drainage lines were associated with this CVB and formed smaller CVB wetlands. These wetlands were also assessed together with the Klipspruit CVB. These wetlands were divided into smaller compartments due to the variety in wetland characteristics. These wetland systems were divided into 3 zones in addition to the main CVB and for the successful execution of this study, the systems will be referred to as "Zone 1, Zone 2, Zone 3 and Channelled Valley Bottom wetland" as seen in Figure 5 below.

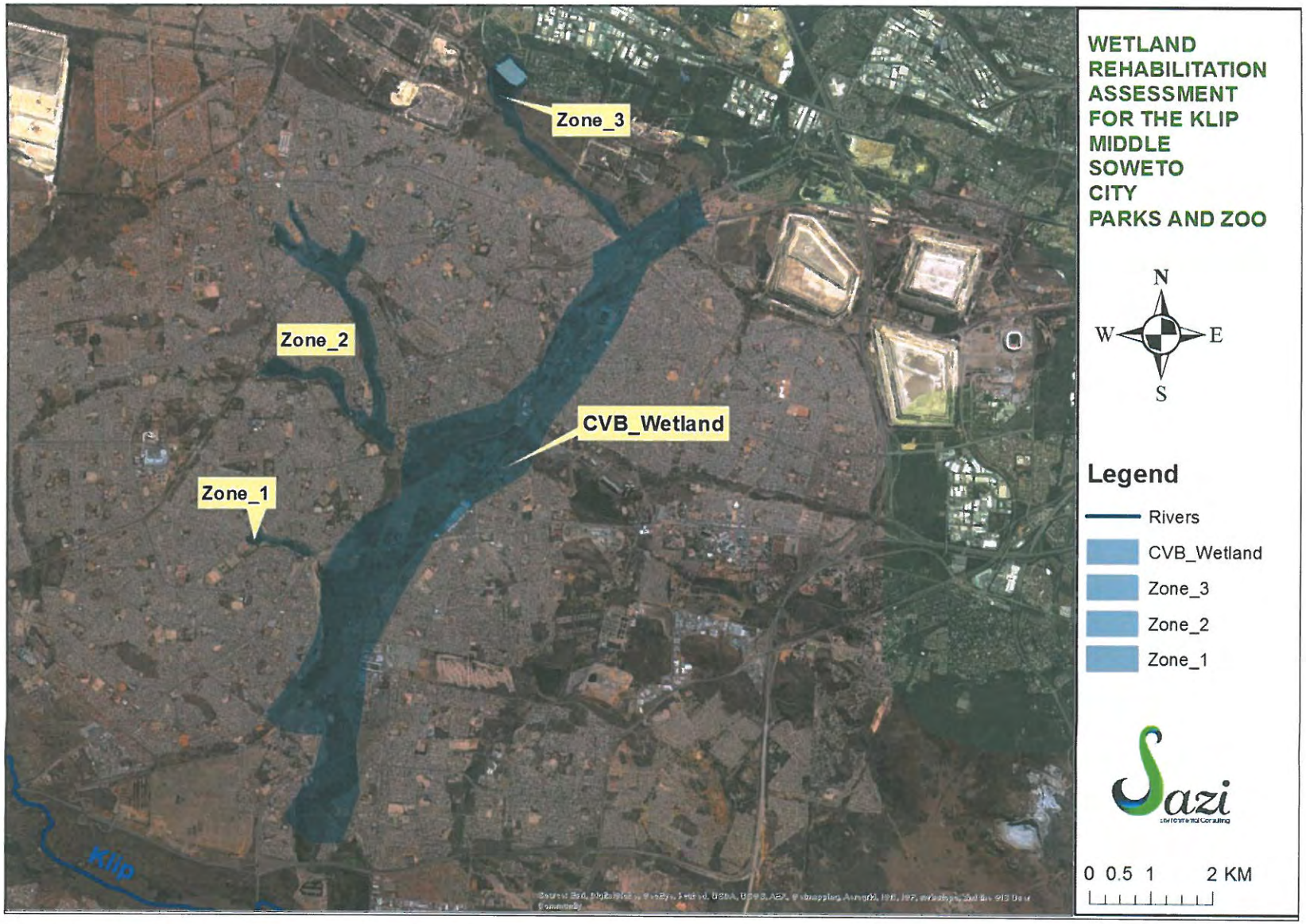

Figure 5: Wetland types assessed in the Klip-Middle Soweto WMU

4.1.1 Channelled Valley Bottom

Channelled valley bottom wetlands are wetland types that are associated with a single stream and are such that their valley floor is a depositional environment. These wetland types are known to ameliorate the impacts of floods by storing and slowly releasing floodwater to river channels. They are also good agents of flood attenuation and soil erosion control.

The portion of the Klip-Middle Soweto CVB wetland assessed was located from the Orlando West Township to Kliptown in the south of Soweto. The wetland starting point was at 26°13'52.32"S, 27°55'38.17"E coordinates. This wetland was located close to the Orlando West Park and opposite the Orlando stadium across the Klipspruit Valley main road.

The channelled valley bottom wetland assessed in the Klip-Middle Soweto Management area was located from Orlando west to Klip town. The CVB was located in an urban area as seen in figure 6 below.

Figure 6: Channelled Valley Bottom wetland assessed in the Klip-Middle Soweto WMU

4.1.2 Zone 1

Zone 1 is a drainage line that covers an area of 32ha in size and has since created a CVB wetland. The assessed area was located in Rockville and incorporated two prime attraction areas, the Moroka Dam and Thokoza Park. The drainage line identified on site was associated with a CVB of the Klipspruit wetland. The wetland area is bordered by the Chris Hani main road and it is located within an urban area. In this wetland, pathway crossings have been created throughout the study area. The wetland has people crossing at all times and children playing in the parks. Modification to the stream has occurred to this wetland. A river channel crossed through this area that furthermore connected to the Kilpspruit wetland.

Refer to figure 7 below for an illustration of the wetland location and extent.

Figure 7: Zone 1 CVB of the Klip-Middle Soweto WMU

4.1.3 Zone 2

Zone 2 was an area of approximately 22ha in size stretching from Orlando West to Jabavu. A channelled valley bottom wetland type was associated with this drainage line in Zone 2 (figure 8).

By the Orlando West portion of zone 2, the wetland was located within a residential area and consisted of a number of culverts. This wetland was used as a dumping site by local residents as domestic waste was constantly deposited in the wetland seasonal and permanent zones.

Jabavu area was also located within a residential area and a school. The wetland experienced foot paths within it, with creation of extra pathways within the wetland in addition to the existing pathways. The wetland in Jabavu had robust vegetation and marshes in some areas of the wetland. Illegal dumping continues to be an impact to the wetland units.

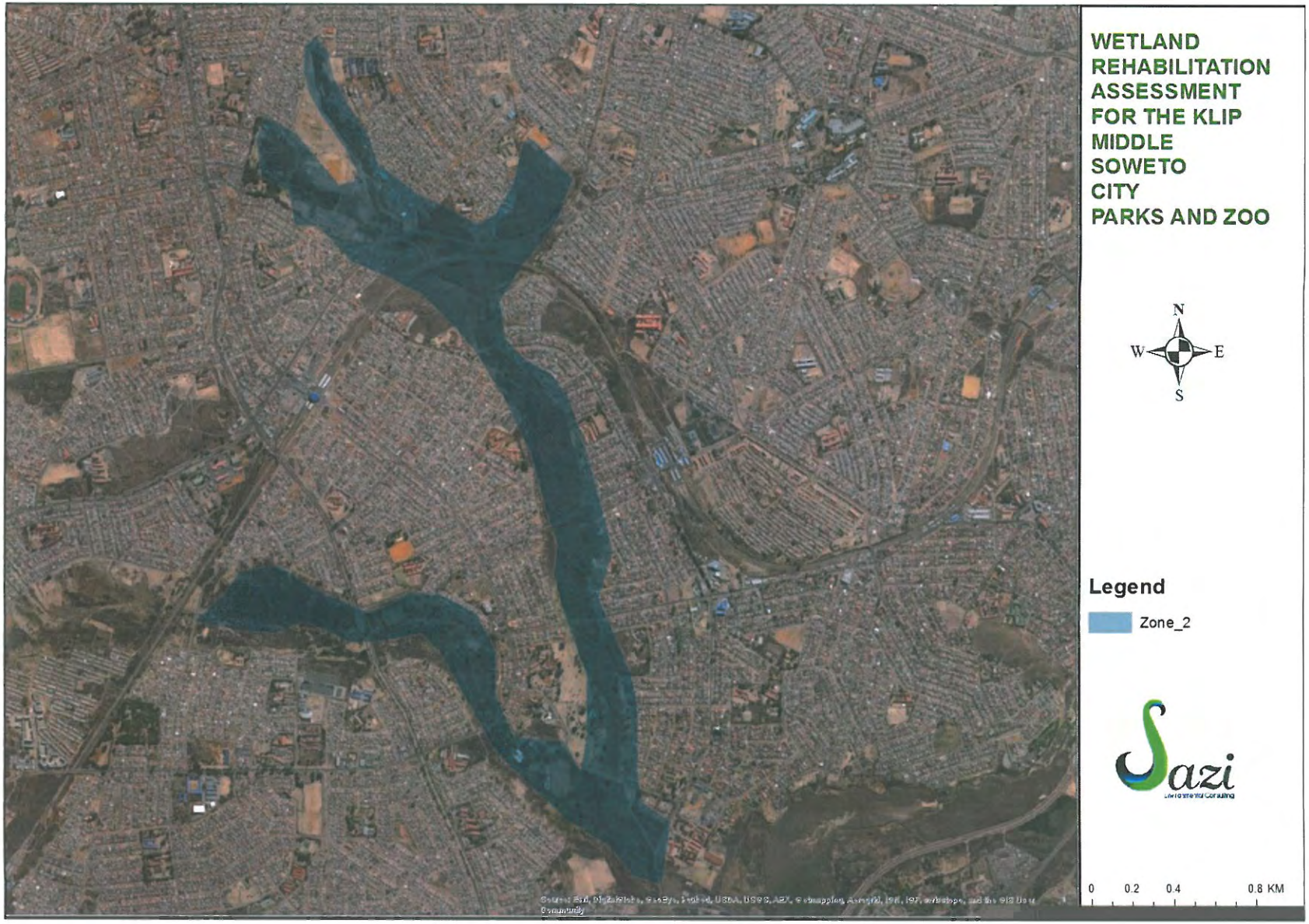

Figure 8: Zone 2 CVB of the Klip-Middle Soweto WMU

4.1.4 Zone 3

A channelled valley bottom wetland was also assessed in Zone 3. This wetland was located in Diepkloof Soweto (-26.218953S; 27.923655E). The Fleurhof dam also formed part of zone 3 at coordinates -26 12' 11.88"S, 27 54'29.91"E. Portions of zone 3 were located within a mining area, with evidence of mine dumps, slimes dams and tailing dams. This study area boarders Soweto and Florida in the west. The wetland was located across a main road crossing and was in an elevated area. The study area consisted of a river flowing through the wetland, qualifying the wetland as a channelled valley bottom wetland. Zone 3 wetland is depicted in figure 9 below.

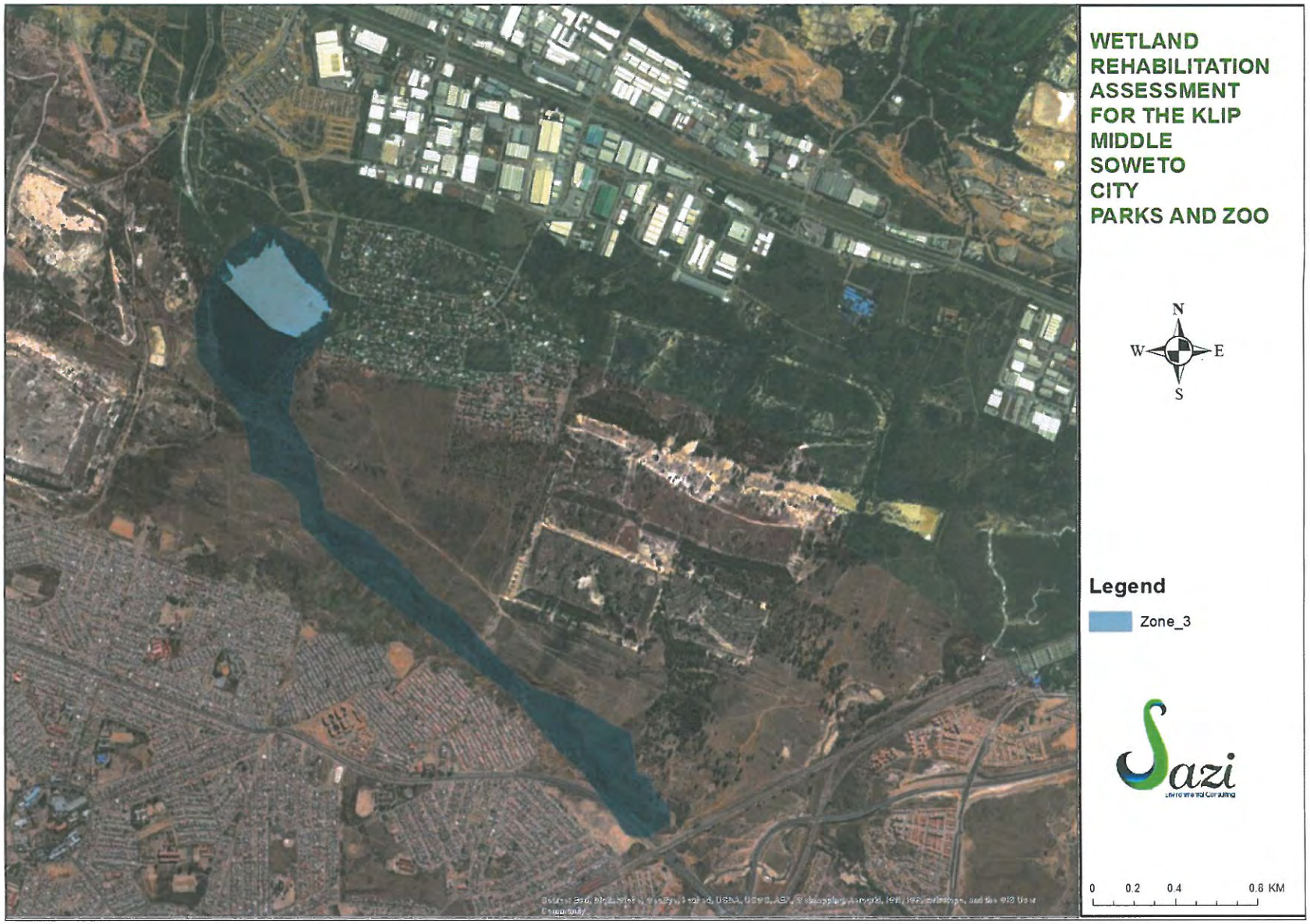

Figure 9: Zone 3 CVB of the Klip-Middle Soweto WMU

5 WETLAND HEALTH ASSESSMENT

Wetland health was assessed by considering impacts to wetland hydrology, geomorphology and vegetation. A summary of the findings is outlined in the following sections.

5.1 Hydrology

Wetland development and the maintenance of wetland habitat are largely dependent on water inputs from the catchment. Without this supply of water, wetlands could not be maintained within the landscape. Once water reaches a wetland, functioning is determined largely by on-site (within wetland) factors. One of the key factors in this regard is the way water is distributed and retained within the wetland system. A change in distribution generally results in altered wetness regimes which in turn affects vegetation patterns. Retention of water within a wetland is a pre-requisite for the creation of wetland habitat. Activities within wetlands may increase retention times or result in deep flooding resulting in an increase in water loving species or flooding of wetland habitat. Other activities are designed to dry out wetlands, so encouraging the encroachment of terrestrial species.

Activities that alter water distribution and retention patterns in wetlands generally include; direct abstraction of water, canalisation, impeding structures, and surface roughness. These hydrological attributes were assessed for the wetlands identified on site and the results are described in the section below per wetland.

5.1.1 Channelled valley bottom wetland

The channelled valley bottom wetland of the Klipspruit River was the major wetland assessed on site and thus had major hydrological impacts. The CVB wetland was faced with water quality as a major hydrological impact. The reduced water quality impact in this wetland in turn resulted in other hydrological impacts such as reduction of natural habitats for biota. Since the CVB was connected to many other drainage lines that further created wetlands, this wetland faced increased water input from dams upstream and stream diversion. Based on the level 1 wet health assessment conducted for this HGM unit, the hydrological impacts were considered critical with an impact score of 9.0. Table 7 below will further explain the impact score descriptions.

5.1.2 Zone 1

Zone 1 assessment area was a channelled valley bottom wetland and experienced major hydrological impacts, mainly due to the poor quality of the water in the wetland. Zone 1 was located in a recreational area and residential area which added threats to this wetland as littering was also a major impact in this area. About 60% of the assessed area was covered with litter and this was mainly in the permanent and seasonal zones of the wetland. Zone 1 was also impacted upon by damming. The Moroka dam in Soweto was located in this area and this is regarded as a major hydrological impact. Damming in wetlands trap sediments and creates barrier for fish life. Some section of the wetland was paved which increased surface water runoff, reducing surface water infiltration. Based on the level 1 wet-health conducted for this HGM unit, the wetland was also considered critical and ranked 9.0 impact score.

5.1.3 Zone 2

Zone 2 of the Klipspruit River was located in Jabavu and was considered of moderate hydrological health status. The wetland was ranked 2.0 impact score. This wetland was the least impacted on compared to the other assessed wetlands. The wetland still retained wetland characteristics such as marshes and abundant vegetation which made it easy to retain water and perform its flood attenuation purposes.

5.1.4 Zone 3

Major hydrological impacts identified in Zone 3 were due to damming upstream that had impacts on downstream habitat. Dams are considered hydrological impacts due to their threat to aquatic life. Zone 3 was considered Critical and ranked 9.0 impact score based on the level 1 wet-health assessment. Other impacts identified in this HGM unit included water quality impacts and increased water input into the wetland.

Table 7 summarizes all the HGM units assessed with their impacts scores. An explanation of these score ratings is explained in table 8 thereafter.

Table 7: Assessment of hydrological changes of the wetlands on the site

HGM Unit	Overall impact score	Health category
Channelled Valley Bottom	9.0	F
Zone 1	9.0	F
Zone 2	2.0	C
Zone 3	9.0	F

Table 8: Summary of impact scores and health category associated with changes in hydrology

IMPACT CATEGORY	DESCRIPTION	SCORE	HYDROLOGICAL HEALTH CATEGORY
None	No discernible modification or the modification is such that it has no impact on hydrological integrity.	0 – 0.9	A
Small	Although identifiable, the impact of this modification on hydrological integrity is small.	1 – 1.9	B
Moderate	The impact of this modification on hydrological integrity is clearly identifiable, but limited.	2 – 3.9	C
Large	The modification has a clearly detrimental impact on hydrological integrity. Approximately 50% of hydrological integrity has been lost.	4 – 5.9	D
Serious	The modification has a clearly adverse effect on hydrological integrity. Well in excess of 50% of the hydrological integrity has been lost.	6 – 7.9	E
Critical	The modification is so great that the ecosystem processes of this component of hydrological health are drastically altered. 80% or more of the hydrological integrity has been lost.	8 – 10	F

5.2 GEOMORPHOLOGY

This section evaluates the effects of changed sediment and erosion distribution and retention patterns on wetland geomorphology. This is in terms of sediment retention and erosion. Evidence of this would relate to accelerated erosion in the catchment and in the wetland. The geomorphological integrity of the four wetlands identified on site is described in the sections below.

5.2.1 Channelled Valley Bottom

The channelled valley bottom wetland being the main wetland in this study experienced large modification based on the level 1 wet-health assessment. The wetland experienced head cut erosion in most of its permanent zones. Other geomorphological impacts on this HGM unit included sedimentation, siltation and reduced roughness and gullies on the wetland. Sandy

soil dominated the CVB HGM unit, which is not a characteristic of the CVB wetland. This is due to the deposition from the Klip River into the Klipspruit River, a tributary to the Klip.

5.2.2 Zone 1

Zone 1 of the Klipspruit channelled valley bottom wetland was moderately modified. Major impacts observed in this wetland were canalisation and erosion gullies. The geomorphology of the wetland was also impacted by built up area and pavings in and around the HGM unit. The wetland unit also had collapsing gabions and river mattresses within the stream.

5.2.3 Zone2

Major impacts facing Zone 2 HGM unit are associated with head cut erosion and cut banks. The cut bank feature in streams is usually formed by erosion of the soil as the stream collides with the river bank. Meandering streams are usually the shape of such wetlands that have experienced cut banks. The wetland was moderately modified with collapsed gabions along the wetland stream and a railway line crossing within the wetland. Gullies and culverts were some of the impacts identified on site.

5.2.4 Zone3

Major geomorphological impacts identified in zone 3 HGM were associated with river bank erosion and sediment deposition. Another impact included damming upstream of the wetland. These impacts were considered to be moderate based on the Level 1 wet-health assessmentvconducted for this HGM unit.

A summary of the impact scores for each individual HGM unit is given in table 9 below. The explanation of the ranking of scores is given in table 10 thereafter.

Table 9: Assessment of geomorphology changes of the wetlands on the site

HGM Unit	Overall impact score	Health category
Channelled Valley Bottom	4.9	D
Zone 1	3.1	C
Zone 2	2.3	C
Zone 3	3.4	C

Table 10: Summary of the impact scores associated with geomorphological changes

Threat Category	Description	Score	GEOMORPHOLOGY HEALTH CATEGORY
None	No discernable threat or the threat is such that no impact on wetland geomorphic integrity could be expected.	0 – 0.9	A
Small	Although identifiable, the threat posed could only be expected to have a small impact on wetland integrity.	1 – 1.9	B
Moderate	The threat posed could be expected to have an identifiable, but limited impact on wetland integrity.	2 – 3.9	C
Large	The threat posed could be expected to reduce wetland integrity by approximately 50%.	4 – 5.9	D
Serious	The threat posed could be expected to reduce wetland integrity in excess of 50%.	6 – 7.9	E
Critical	The threat posed could be expected to destroy ecosystem processes.	8 – 10	F

5.3 VEGETATION

The vegetation in a wetland has an important contribution to the composition, structure and function of a wetland, and is also important in terms of the habitat. A robust vegetation cover assists in holding soil particles therefore minimising soil erosion intensity. This is also important for water retention, which aids in water quality improvement. Vegetation cover throughout the Klip-Middle Soweto WMU was similar, with only few portions comprising of distinct vegetation. The majority of the site was covered in grassland. Some areas in these wetland sites were disturbed with bare and rocky outcrops surrounded by built-up area.

5.3.1 Channelled valley bottom

The channelled valley bottom wetland on site consisted of a variety of wetland vegetation. This area was mostly dominated by grassland vegetation. Based on the PES for this HGM unit, vegetation was largely modified.

5.3.2 Zone 1

Zone 1 of the Klipspruit wetland was covered in grassland and consisted of *Salix* sp on the seasonal and permanent zones of the wetland. Vegetation in this HGM unit was compromised due to modifications in the HGM unit. Level 1 wet-health assessment conducted for this HGM unit ranked E health category.

5.3.3 Zone 2

Zone 2 wetland system was highly infested by alien invasive species such as; *Datura ferox*, *Bidens pilosa*, *Salix* sp. The whole wetland was however rich in vegetation cover that is able to retain water for longer durations of time. Vegetation in this area is impacted by illegal dumping and stream modifications.

5.3.4 Zone 3

A channelled valley bottom wetland was associated with zone 3. Portions of the zone 3 HGM unit were covered in rocky outcrops which caused an impact on the natural growth of wetland vegetation. Vegetation in this area was scattered with sections of the HGM unit consisting of bare soil. The Fleurhof dam section of the zone 3 HGM unit was impacted negatively due to modification of the wetland around the site that resulted from damming of the area.

The wetland was ranked F health category.

Table 12 gives an explanation of the impact scores summarised in table 11 below.

Table 11: Assessment of vegetation changes of the wetlands on the site

HGM Unit	Overall impact score	Health category
Channelled Valley Bottom	9.6	F
Zone 1	7.9	E
Zone 2	9.0	F
Zone 3	8.6	F

Table 12: Summary of the Health scores associated with vegetation changes

DESCRIPTION	Score	HEALTH Category
Vegetation composition appears natural.	0 – 0.9	A
A very minor change to vegetation composition is evident at the site.	1 – 1.9	B
Compositional changes are evident but the site still contains mostly species expected in the reference state. Vegetation composition has been clearly altered but still contains a large proportion of natural species expected in the reference state.	2 – 3.9	C
Vegetation composition has been largely altered and introduced, alien and/or ruderal species are abundant but most characteristic wetland species are usually still present.	4 – 5.9	D
Vegetation composition has been substantially altered but some characteristic species remain, although the vegetation consists mainly of introduced, alien and/or ruderal species.	6 – 7.9	E
Vegetation composition has been totally or almost totally altered, and if any characteristic species still remain, their extent is very low.	8 – 10	F

5.4 SUMMARY OF THE IMPACT SCORES

When the results of the three modules detailed above are combined, the PES results for the wetlands are obtained and are shown in Table 13. Table 14 explains the summary of the overall health impact score.

Based on the impact scores summarized below it is evident that the wetland systems are modified and highly impacted.

Table 13: Summary of the wetland PES assessment

HGM Unit	Hydrology Impact Score	Geomorphology Impact Score	Vegetation Impact Score	Overall Impact score	Health Category
Channelled valley bottom	9.0	4.9	9.6	8	F
Zone 1	9.0	3.1	7.9	7	E

Zone 2	2.0	2.3	9.0	4	D
Zone 3	9.0	3.4	8.6	7	E

Table 14: Summary of the Overall Health scores

DESCRIPTION	Score	HEALTH Category
Unmodified, natural.	0 – 0.9	A
Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1 – 1.9	B
Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact	2 – 3.9	C
Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4 – 5.9	D
The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	6 – 7.9	E
Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8 – 10	F

6 WETLAND ECOLOGICAL IMPORTANCE AND SENSITIVITY (EIS)

South Africa is a contracting party to the Ramsar Convention on Wetlands, signed in Ramsar, Iran, in 1971, and has thus committed itself to this intergovernmental treaty, which provides the framework for the national protection of wetlands and the resources they could provide. Wetland conservation is now driven by the South African National Biodiversity Institute, a requirement under the National Environmental Management: Biodiversity Act (No 10 of 2004).

Wetlands are among the most valuable and productive ecosystems on earth, providing important opportunities for sustainable development (Davies and Day, 1998). However wetlands in South Africa are still rapidly being lost or degraded through direct human induced pressures (Nel *et al.*, 2004).

According to Davies and Day, (1998), some of the wetland functions include the following:

- streamflow regulation;
- flood attenuation;
- groundwater recharge;
- water purification;
- sediment trapping;
- harvesting of natural resources;
- tourism and recreation;
- livestock, and crop farming.

According to Kotze, *et al,* (2008), wetlands perform certain functions based on their HGM unit type and the importance of a wetland unit is linked to its ecosystem services. Some of the functions in addition to Davies and Day (2008) include: provision of water for human use, cultural significance, erosion control, and biodiversity maintenance.

Conservation importance of the individual wetlands was based on the following criteria:

- Habitat uniqueness;
- Species of conservation concern;
- Habitat fragmentation with regard ecological corridors; and
- Ecosystem service (social and ecological).

Ecological Importance and Sensitivity is a concept introduced in the reserve methodology to evaluate a wetland in terms of:

- Ecological Importance;
- Hydrological Functions; and
- Direct Human Benefits.

6.1 ECOLOGICAL IMPORTANCE

The Klipspruit wetland which is a Channeled Valley Bottom wetland consists of some ecological functions which include biodiversity support due to the presence of the riparian habitat. However, no rare or red data species were identified in this area. The Klipspruit wetland is considered critical based on the ecological importance and sensitivity assessment.

6.2 HYDROLOGICAL FUNCTION

Channeled Valley Bottom wetland types are important for flood attenuation due to their vegetation cover. Also, they are generally important for their slow release of water during low rainfall periods, and this is important in areas where livestock grazing is a source of livelihood such as in the Klipspruit wetlands assessment.

6.3 DIRECT HUMAN BENEFITS

The Klipspruit wetland together with its drainage lines (referred to in this study as zones), is located in an urban settlement. This infers that the wetland will have human interactions at all times. The wetland is beneficial to humans as they use it for their livestock grazing. Another human benefit from this wetland included that of illegal dumping, the wetland and its associated stream was negatively impacted on by illegal dumping on the permanent zone and the river channel. Recreational purposes such as community parks were another human benefit. Orlando West Park, Thokoza Park and Dorothy Nyembe Park, were within a wetland buffer. The CVB wetland was observed to be also used for religious purposes, as water is abstracted from for stream in bottles for religious purposes. In addition, a religious holding was also observed in the CVB wetland and this is considered as a human benefit.

7 Current Impacts

Based on both the PES and EIS assessment conducted for each HGM unit, the Klipspruit River and its associated wetlands were highly impacted. Most of the impacts identified in one HGM was also experienced in the next. All the zones assessed for this wetland unit were all associated with one main river, the Klipspruit River, which explained the water quality of the stream throughout the wetland units. This section identifies all negative impacts observed on site in each assessed zone (HGM unit);

7.1.1 Channelled Valley Bottom

Table 15: Current impacts at the Channelled Valley Bottom wetland of the Klipspruit River

Impact	Description
	The water quality in this area was very thick and causing stagnation around the riparian zones of the river. This is a hydrological impact to the wetland that is emanating from upstream activities. The water quality in this HGM unit was accompanied by a pungent smell.

	Cut Bank caused by stream meandering in the channeled valley bottom causing additional erosion and sand deposition into the river. This is a serious geomorphological impact.
	Dumping of yard waste into the seasonal zone of a wetland.
	The wetland has experienced serious stream meandering, and sand deposition. This wetland has furthermore experienced riverbank erosion. Wetland vegetation has been lost in this wetland zone

	which has resulted in reduced roughness in the wetland zone.

7.1.2 Zone 1

Table 16: Current impacts at Zone 1 CVB wetland of the Klipspruit River

Impact	Description
	Concrete built up, bridge crossing and littering. This is a geomorphological and hydrological impact causing increased runoff and less surface infiltration. Littering causes pollution to water and further had aesthetic impact since this is located in a tourist attraction site.
	Alien invasive species (*Salix* sp) dominating the riparian zone of the wetland and littering along the stream.

	Littering directly in the stream of a wetland causes negative impacts on vegetation and the health of a river as it alters the health status of a wetland.
	Gully creation and littering on the wetland. Residential areas within 500m of a wetland and livestock grazing.
	Channelization of the stream causing increased erosion and sedimentation. The channelization of a stream using concrete has also impacted on riparian zone vegetation in

	this area. Houses built within wetland zones are also an impact to the wetland health status. This modification has also introduced alien invasion encroachment.
	Erosional gullies and littering.

	Stream canalization using concrete structures that have impacted on wetland vegetation.
	Stream channelization and algae bloom.

	Artificial dam (Moroka dam), a major hydrological impact to wetland.
	Water quality impacts, collapsed bridge crossing and walls.

	Littering within a wetland was a major impact in the Klipspruit wetland assessment.
	The river channel located within the Thokoza Park was canalized. The wetland experienced river bank erosion and alien invasive species encroachment.

	Vegetation undercutting and gabion deposition.
	Cutting down of trees for wood and storing them in a wetland is regarded as a negative vegetation impact.

	Riverbank erosion up until 2m.
	Culvert crossings and illegal dumping on the stream altering water flow and negatively impacting on river health.

	Illegal dumping on the stream channel impacting on the water quality of the wetland.

7.1.3 Zone 2

Table 17: Current impacts at Zone 2 CVB wetland of the Klipspruit River

Impact	Description
	Alien invasive species (*Datura ferox*) on the seasonal zone of a wetland and illegal dumping.

	Sedimentation and alien invasive species in the wetland zone.
	Alien invasive species encroachment, reduced roughness of wetland zones and drying out of stream channels. Littering was also observed in this wetland zone.

	Bridge crossing collapsed gabions deposit into the stream, water quality impacts and pungent smell in the wetland. Alien invasion and littering.
	River cut, caused by meandering and *Salix* sp (alien invasive species) on the river bank. Erosion and meandering of stream.

	Collapsed gabion mattress and gabion deposit in the wetland.
	Alien invasive species within canalized channel and littering.

	Railway line across a wetland regarded as an impeding structure.

7.1.4 Zone 3

Table 18: Current impacts at Zone 3 CVB wetland of the Klipspruit River

Impact	Description
	Heap of livestock Carcasses deposited and burnt on the wetland zones causing death to wetland vegetation and creating an unpleasant smell in the area.

	Pollution in the seasonal and temporal zones of a wetland caused by illegal dumping and burning of carcasses.
	Cow kraal located directly on the wetland. Littering and detritus deposit on wetland zones.

8 WETLAND REHABILITATION PLAN

Due to the health of the Klipspruit River and its associated wetlands, extensive rehabilitation is expected in order to improve the state of the wetland. In order to successfully implement the rehabilitation plan, focusing the rehabilitation strategy on individual HGM units (Zones of

the Klipspruit wetland), will improve the health of the wetland since impacts to wetland zones vary with each HGM. It is important to know and understand the aim of the rehabilitation, as it helps in identifying rehabilitation materials and strategies. The successful rehabilitation of a wetland requires that the cause of damage or degradation is addressed, and that the natural flow patterns of the wetland system are re-established.

Based on the impacts identified, the rehabilitation plan for the Klip-Middle Soweto WMU will include but not limited to; removal of alien invasive species; re-vegetation of indigenous vegetation; erosion control measures (gabions, berms, weirs); reduction of illegal dumping into the wetland; implementation of correct management of runoff and stormwater management; stabilising sediment movement, etc.

8.1 Alien invasive plan control

Alien species invasion is one of the most common major impacts facing wetlands in South Africa. These species are considered invasive for a couple of reasons, including their nature of competing with indigenous species for resources. In all zones of the wetland assessment, alien invasive species were observed. Eradication of these species can be achieved manually or mechanically. Some methods include the use of herbicides, grazers or pathogens, which require careful use as they can impact on the wetland health indirectly. Alien invasive species can also wither through manipulation of the hydrology, or by combination of methods.

Many introduced species spread prolifically in environments where predation and competition are limited, pushing out the native flora (Nel, 2016). Weed control can allow reestablishment of native plant communities. However, once introduced plant populations are well established, removal is a labour intensive, ongoing task (Lev, 2009).

8.2 Concrete weirs

"This type of structure is used to address headcut and/ or channel erosion by trapping sediment and raising the local water table to encourage overland flow (i.e. rewetting a wetland)" (Lev, 2009). All HGM units assessed experienced erosion to some extent. However, the CVCB and zone 1-2 experienced erosion extensively. There are many rehabilitation methods used in control of erosion. Gabion weirs were observed in some areas of Zone 1 and

2. However these gabion weirs were not in good condition and thus will require replacement during this rehabilitation process. Installation of Gabion weirs within a wetland promotes back-flooding and the re-establishment of a more natural wetness regime.

Selection of the rehabilitation method depends on the availability of appropriate foundation material and the volume of water moving through the wetland catchment (Lev, 2009).

8.3 Earth berms/plugs

Earth berms are structures used to divert or retain water. They are used to increase water levels in a wetland above historic levels to create open water. Berms are beneficial to residential areas as they protect the neighbouring properties from flooding. In this case berms are encouraged in all wetland assessment zones, more especially in zone 1.

8.4 Sediment Control (Sand bags)

The use of sandbags is a classic yet useful technique of sediment control and flooding control. This technique is simple and very effective in prevention or reduction of flood water damage. The channel valley bottom wetland and all its associated wetlands of the Klip-Middle Soweto WMU will require sandbags in their riparian zones as means of sediment control and flooding control. Sandbag construction does not guarantee a water-tight seal, but is satisfactory for use in most situations.

According to a study conducted by the US Army corps of engineers, the following sandbags techniques can be followed;

Remove any debris from the area where the bags are to be placed. Fold the open end of the unfilled portion of the bag to form a triangle. If tied bags are used, flatten or flare the tied end. Place the partially filled bags lengthwise and parallel to the direction of flow, with the open end facing against the water flow. Tuck the flaps under, keeping the unfilled portion under the weight of the sack. Place succeeding bags on top, offsetting by one-half (1/2) filled length of the previous bag, and stamp into place to eliminate voids, and form a tight seal. Stagger the joint connections when multiple layers are necessary.

Do not use garbage bags, as they are too slick to stack. Do not use feed sacks, as they are too large to handle. Use bags about 14-18" wide, and 30-36" deep.

8.5 Illegal dumping

The major impact to the Klipspruit wetland system is illegal dumping. Littering was encountered in all HGM units assessed for all zones. This impact has shown negative effects on the water quality, vegetation life, aquatic life and aesthetic impacts on parks and dams. Illegal dumping is believed to be caused by over pollution in the Klip-Middle Soweto WMU, and by lack of discipline in the area. The implementation of bins in the area has proven ineffective in the control of this impact. Therefore, regular removal of waste from the wetland should be implemented. Waste should be removed and the wetland zone rehabilitated to return them to a near natural state, in order to avoid any illegal dumping. Fencing off of wetland areas can also work in the reduction of illegal dumping.

8.6 Drains and gully control

In the context of wetlands, drains refer to a natural or artificial feature such as a ditch or trench created for the purpose of removing surface and sub-surface water from an area. Whereas, gullies are erosion landform or feature, created by running water eroding sharply into the soil. Gullies generally resemble small ditches that can be several meters in depth and width. Gullying or gully erosion is the process by which gullies are formed.

It is important to stabilise gully sides and also to stop the vertical erosion in the gully. This prevents the further lowering of the water table. Variety of materials: herbaceous or woody plants, hay bales, clay plugs, gabions filled with rock, a geo-textile lining, soil, or even just packing loose rock against head-cut faces can be applied in the controlling of gullies. Gullies control can be a manual activity that does not require extensive finances.

9 RISK ASSESSMENT

The section below (table 19) addresses the impacts involved in the rehabilitation activities of the Klip-Middle Soweto WMU. Appendix A is a risk assessment derived from the DWS Risk Assessment matrix (2015).

Table 19: Impact Assessment and Mitigation Measures

Activities	Impacts	Aspects affected	Phase	Significance rating			Typical mitigation measures
Removal of alien invasive species	**Soil roughness** Exposure of soil, increased erosion levels due to run-off of water. Little precipitation and evaporation, loss of habitat life, reduced water table levels	**Soil and indigenous species that depend on alien vegetation**	**Rehabilitation phase**		Without mitigation	With mitigation	Re-vegetation of indigenous species will be implemented as a mitigation measure
				Severity	Low	Low	
				Duration	low	low	
				Extent	Local	Local	
				Consequence	Medium	Low	
				Probability	Medium	Low	
				Significance	Low	Low	
				Status	Negative	Negative	
				Confidence	High	High	
				Reversibility			
				Loss of resource	Low	Low	
				Degree to which the impact can be mitigated	Low	Medium	
Sediment and erosion control	**Alteration of the river bank and impeding water flow,** Changing the water course. Siltation & sedimentation. Vegetation removal, Altering	**River bank, riparian zones, vegetation loss**	**Rehabilitation Phase**		Without mitigation	With mitigation	Re-vegetation of indigenous species will be implemented as a mitigation measure
				Severity	Medium	Low	

	the river bank and impeding structures				**Duration**	High	low	
					Extent	Medium	Local	
					Consequence	Medium	Low	
					Probability	Medium	Low	
					Significance	Low	Low	
					Status	Negative	Negative	
					Confidence	High	High	
					Reversibility			
					Loss of resource	Low	Low	
					Degree to which the impact can be mitigated	Low	Medium	

10 CONCLUSION

The Klip-Middle Soweto WMU was highly impacted. The wetland units were polluted largely by littering. Littering in the Klip-Middle Soweto WMU is believed to be caused by over population in the area and housing settlements that are built within the wetland systems. Some settlements in this area are regarded as squatter camps, and as such services such as Pik-it-up recycling companies are not rendered in these areas, which in turn results in dumping of domestic waste into the wetlands. The dumping of waste on wetlands also has an indirect impact on the odour of the wetland. This was one of the impacts identified in the wetland units in this area. The impacts to this wetland's pungent smell are also believed to emanate from upstream activities.

Based on the study, the wetland units were impacted largely on hydrology, geomorphology and vegetation. Consequently this caused a high ecological and sensitivity status. This wetland unit is regarded critical based on the wetland health assessment undertaken. The rehabilitation of the Klip-Middle Soweto WMU is highly recommended.

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Specialist CV

Profile Summary

Nonkanyiso Zungu is a Professional Natural Scientist (Pr.Sci.Nat) with 10 years' experience in the environmental field. She has a Masters Degree in Environmental Management, and specializes on Water Resource Management.

Nonkanyiso has extensive experience in water resource management, waste management, and obtaining environmental authorisations (air, water, waste) across sectors that include: power generation, infrastructure (Construction), transportation (rail), waste disposal, water purification & sewage works. The projects she has undertaken include: Environmental Impact Assessments, Basic Assessments, Environmental Feasibility Studies, Environmental scoping studies, Environmental legal compliance audits, Waste management licences, Water use licences, and Baseline risk assessments.

Nonkanyiso Zungu is a Health & Safety and Environmental (SHE) auditor and is knowledgeable on internal integrated SHEQ auditing. She has experience on development and implementation of ISO 14001: 2004 management system and undertaking internal audits.

Nonkanyiso is also a wetland specialist with experience in wetland delineation, determination of present ecological status, ecological importance and sensitivity evaluations, and wetland rehabilitation planning using packages that include Wet-Health, Wet-EcoServices, and Wet-RehabEvaluate.

Education

Institution	Year	Degree Obtained
University of Pretoria	2011	MSc. Environmental Management
University of KwaZulu-Natal	2005	BSc. Honours, Ecology
University of KwaZulu-Natal	2003	BSc. Biological Sciences

Professional Registrations

- South African Council for Natural Scientific Professions (SACNASP, Pr. Nat. Sci. (Practice no. 400194/10): Ecological Science
- Member of the Gauteng Wetland Task Group
- Member of WISA (Gauteng Region)

Short Courses

- ISO 14001 IMPLEMENTATION AND INTERNAL AUDITING

- ISO 18001 IMPLEMENTATION AND INTERNAL AUDITING
- ISO 9001 IMPLEMENTATION AND INTERNAL AUDITING
- LEAD AUDITING (SAATCA)
- INCIDENT AND ACCIDENT INVESTIGATIONS
- QUALIFIED WETLAND ASSESSMENT PACTITIONER (WET-HEALTH; WET IHI, SPATSIM)
- ESRI GIS MAPPING, ARCMAP 10

Key Skills

- ISO 14001: 2004 internal auditing
- Legal compliance auditing
- Wetland delineation and assessment
- Environmental Impact Assessment
- Basic Assessments
- Feasibility Studies (Fatal flaw analysis)

Employment History

2014 – Current	SAZI Environmental Consulting cc
2011 - 2014	Sebata Group of Companies
2009 - 2011	Department of Water Affairs
2007 - 2009	Wetland Consulting Services
2005 - 2006	University of KwaZulu-Natal (Maluti Transfontier Conservation Program)
2004 – 2005	University of KwaZulu-Natal (Welgevonden Elephant Program)

Project Experience

PROJCET NAME	YEAR	RESPONSIBILITY	CONTACT DETAILS	REFERENCE NUMBER
ENVIRONMENTAL IMPACT ASSESSMENT/ EMP/ BA PROJECTS				
Basic Assessment for the construction of the Rand Water 210ML reservoir future planned 200ML reservoir in Vlakfontein	2015	Environmental Impact Assessment Practitioner.	Company: Rand Water Contact: Luzuko Kalimashe Tel: 078 6590462	

Basic Assessment for the proposed construction of Rand Water 200ML reservoir in Brakpan.	2015	Environmental Assessment Practitioner	Company: Rand Water Contact: Thokozani Masilela Tel: 072 495 0097	
Basic Assessment: Proposed construction of culvert upgrade works and sewer pipeline crossing through a watercourse, Eskom Holdings SOC Ltd. Ingula Pumped Storage Scheme	2014	• Environmental Assessment Practitioner • Project Management	Company: Eskom Ingula Pumped Storage Scheme Contact: Marcel Meso Tel: 036 342 3031	Ref: 14/12/16/3/3/1/1019
Waste Management Licence Application for the Eskom Witbank Clinker Ash Dump	2013-2014	• Environmental Assessment Practitioner	Company: Eskom SHE Management Division Contact: Gabriel Ngorima Tel: 076 9014006	
Eskom Academy of Learning Feasibility study for a Waste Treatment Plant	2013	• Project Management/EAP	Company: Eskom Real Estate Division Contact: Chinga Gwiza Tel: 083 7626030	
PKX Cableway Environmental Impact Assessment: Scoping study	2013	• Scoping report: environmental feasibility of the Cableway Development	Company: Arup Contact: Shupikai Chihuri Tel: 011 2187600	
Eskom Witbank Clinker Ash Dump Pre-feasibility Study	2011 - 2012	• Project Management • Review of environmental specialist technical reports • Consolidation of technical reports and presenting feasibility of the project to the client.	Company: Eskom SHE Management Division Contact: Gabriel Ngorima Tel: 076 9014006	

Environmental Impact Assessment for proposed coal mining activities: Mining Environmental Management Plan	2012	• Environmental Assessment Practitioner • Project Management	Company: Silver Unicorn Trading Contact: Bonginkosi Curnick Njeke Tel: 082 464 6489	
WETLAND ASSESSMENTS				
City Of Johannesburg Wetland Rehabilitation Plan For The Braamfonteinspruit, Kyalami, And Natalspruit Management Units: Draft Report	2015-In Progress	• Wetland Assessment • PES and EIS description • Wetland classification	Company: Headwaters water and environmental consultant Contact Person: Lekau Hlabolwa Tel: 079 703 8487	
Blesboklaagte wetland delineation and assessment for the proposed Eyethu Coal mining activities, Middleburg, Mpumalanga	2015	• Wetland Assessment • PES and EIS description • Wetland classification	Company: Geovicon Environmental (Pty) Ltd Contact: Riana Tel: 082 4981847	
Watercourse Assessment Report For The Proposed Construction of a 15km 50kV Power Line From Eskom Helios Substation To The Proposed New Transnet Helios Traction Feeder Substation	2015	• Watercourse assessment	Company: Nsovo Environmental consulting Contact Person: Munyadziwa Rikhotso Tel: 071602 2369	
Nietgedacht Wetland Delineation And Assessment Report	2015	• Wetland Assessment • PES and EIS Description • Wetland Classification	Company: Phuka Tsa Nong Contact Person: Kele Tel: 0834785753	
Wetland Delineation And Assessment Report For The Proposed Development Of An Eskom Straatdrift Madikwe 22 Kv Powerline	2015	• Wetland Assessment • PES and EIS Description • Wetland Classification	Company: Baagi Environmental Consulting Contact person: Marita Oosthuizen Tel: 082 378 4903	

Wetland Assessment Report For The Bredell Wetland In Kempton Park, Gauteng Province	2015	• Wetland Assessment • PES and EIS description • Wetland classification	Company: Watercube Services: Molefe Morokane Contact Person: Tel: 076 806 4293	
Wetland Delineation And Assessment Report For The Proposed Development Of A Retirement Center And Bridge Construction Activities In Montana Tuine Ext 49 & 50 In Pretoria	2015	• Wetland Assessment • PES and EIS description • Wetland classification	Company: Central Development Contact Person: Pierre Reyneke Email: pierrer@centraldev.co.za	
Transhex Operations (Pty) Ltd wetland delineation and assessment report for the proposed diamond mining operations between Baken and Reuning, Northern Cape Province	2015	• Wetland Assessment • PES and EIS description • Wetland classification	Company: Envirobro Contact Person: Nndangi Musekene Tel: 072 748 0292	
Wetland delineation and assessment for Eyethu Coal mining activities, Middleburg, Mpumalanga	2015	• Wetland Assessment • PES and EIS description • Wetland classification	Company: Geovicon Environmental (Pty) Ltd Contact: Tshepo Shakwane Tel: 082 4981847	
Wetland Delineation and Assessment Report for the Proposed Eskom 400kv Transmission Line From Ariadne to Venus Substations in Kwazulu-Natal Province.	2014	• Wetland Assessment • PES and EIS description • Wetland classification • Water Use licence Application	Company: DIGES Contact Person: Brenda Makanza Tel: 082 075 6685	
Randwater M11 pipeline wetland delineation and assessment, Gauteng Province	2014	• Wetland Assessment • PES and EIS description • Wetland classification	Company: Asande Projects Contact Person: Grace Magaya Tel: 081 494 1611	
Wetland delineation and assessment for the proposed Dithakwaneng bridge construction, North-West Province	2014	• Wetland Assessment • PES and EIS description • Wetland classification	Company: Southern Hills Engineering (Pty) Ltd Contact Person: Johnson Matangi Tel: 084 663 8199	

Ongezien Wetland assessment, Witbank Mpumalanga Province	2013	• Wetland Assessment • PES and EIS description • Wetland classification	Company: Silver Unicorn Trading Contact Person: Bonginkosi Njeke Tel: on request	
Leeuwfontein wetland assessment	2013	• Wetland Assessment • PES and EIS description • Wetland classification	Company: Geovicon Environmental (Pty) Ltd Contact: Tshepo Shakwane Tel: 082 4981847	
Platreef-Borutho wetland assessment, Limpopo Province	2013	• Wetland Assessment • PES and EIS description • Wetland classification	Company: Nzumbululo Heritage Solutions Contact Person: Nonhlanhla Ncube Tel: on request	
Duvha-Minerva Transmission line wetland assessment and WULA	2013	Wetland assessment and water use licence application	Company: Nzumbululo Heritage Solutions Contact Person: Nonhlanhla Ncube Tel: on request	
Rockdale-Marble hall transmission line wetland assessment and WULA	2013	Wetland assessment and water use licence application	Company: Nzumbululo Heritage Solutions Contact Person: Nonhlanhla Ncube Tel: 015 291 3661	
Protea Glen wetland function assessment study.	2011	• Wetland assessment • PES and EIS description • Wetland classification	Company: Wetland Consulting Services Contact Person: Bhuti Dlamini Tel: on request	
Randwater Pipeline wetland assessment	2011	• Wetland assessment • PES and EIS description • Wetland classification	Company: Asande Projects Contact Person: Joshua Oluokun Tel: 073 4068051	

ECOLOGICAL ASSESSMENTS (FAUNA AND FLORA)				
Ecological Assessment Report For The Proposed Tweedracht 5.5km 88 Kv Power Line Development	2015	Flora and Fauna Assessments	Company: Nsovo environmental consultin Contact person: Munyadziwa Rikhotso Tel: 071602 2369	
Ecological Assessment Report For The Construction Of An Additional 200ml Rand Water Reservoir In Meredale	2015	Flora and Fauna Assessments	Company: Asande projects Contact person: Avhutetshelwi Mashau Tel: 011 315 6794	
Ecological Assessment Report For The Proposed Rand Water Additional 200ml Reservoir In Brakpan, East Rand, Gauteng Province	2015	Flora and Fauna Assessments	Company: Rand Water Contact Person: Thokozani Masilela Tel: 011 724 9140	
Ecological Assessment Report For The The Proposed Replacement Of Both The Existing A6 And A8 Pipelines With Two New Pipes (One Pipe At A Time) Running From Vereeniging Pumping Station To Zwartlopjes Pump Station With A Length Of 44 Km And A Diameter Of 1300	2015	Flora and Fauna Assessments	Company: Asande projects Contact person: Rolivhuwa Nemakonde Tel: 011 315 6794	
Ecological Assessment Report For The Construction Of The Rand Water Additional 210ml And Future Planned 200ml Reservoir On Vlakfontein Farm 69ir, Crystal Park, Ekurhuleni Metropolitan Municipality	2015	Flora and Fauna Assessment	Comapany: Rand Water Contact Person: Luzuko Kalimashe Tel: 083 4250 455	
Ecological Assessment For The Construction And Maintenance Of The Rand Water 17, 5km H43 Pipeline With An Internal Diameter Of 1200mm, And It's Associated Structure (Valve Chambers And Cathodic Protection)	2015	Flora and Fauna Assessment	Company: Asande projects Contact person: Faith Chigwanhire Tel: 011 315 6794	

Between Graham Street, Centurion And Lyttelton, Gauteng Province				
Randwater Brakpan Reservoir to Selcourt Reservoir M 11 Pipeline Fauna And Flora Assessment	2014	Flora and Fauna Assessments	Company: Asande Projects Contact Person: Freddy Milambo Tel: 074 181 8292	
COMPLIANCE AUDITS				
Universal Coal and Energy (Pty) Ltd: Kangala Coal Mine External Water Use Licence Audit	June 2015	Lead auditor	Company: Universal Coal and Energy (Pty) Ltd: Kangala Coal Mine Contact person: Lekau Hlabolwa Tel: 079 7038487	04/B20A/ABC GIJ/1506
THABA CRONIMET ANNUAL INTEGRATED WATER USE LICENCE AUDIT	June 2015	Lead Auditor	Company: Thaba Cronimet (Pty)Ltd Contact person: Lekau Hlabolwa Tel: 079 7038487	03/A24F/ACGI J
GLENCORE WONDERKOP SMELTER EXTERNAL WASTE MANAGEMENT LICENCE AUDIT	May 2015	Lead auditor	Company: Glencore Contact person: Bertha Mohapi Tel: 014 572 0393	No. 12/9/11/L510/7
THABA CRONIMET ANNUAL INTEGRATED WATER USE LICENCE AUDIT	August 2014	Lead Auditor	Company: Thaba Cronimet (Pty)Ltd Contact person: Lekau Hlabolwa Tel: 079 7038487	03/A24F/ACGI J
Eskom Tutuka Power Station ISO14001:2004 Internal Audit	Decemb er 2014	Lead auditor	Company: Envirobro Contact person: Nndangi Musekene Tel: 072 748 0292	
Sebata Group ISO 14001: 2004 development and implementation	2013-2014	ISO 14001:2004 Implementation and internal auditing	SEBATA General manager: SHE	

			Mr McDonald Mutsvangwa Contact: 0100600355	
Kusile water use licence quarterly audits	2013 – 2014 (quarterly for 12 months)	Lead auditor/wetland specialist	Company: Kusile Power station Contact person: Siphiwe Mahlangu Tel: 013 699 7097	No.: 04/B20F/CI/2235
Transnet incident management	2013	Accident and Incident Management	Company Name: Isivuvu Technical Solutions Contact Person: Nhlanhla Maphalala Tel: 073 417 0438	
ZUFI Engineering safety systems audit	2013	OHSA 18001 audit	Company Name: ZUFI Engineering Contact Person: Sikholiwe Zungu Tel: 084 475 0509	
WATER USE LICENCE APPLICATIONS				
Construction of an Additional Rand Water 210ml Reservoir On Vlakfontein 69ir Farm In Crystal Park, Ekurhuleni Metropolitan Municipality, Gauteng Province	2015 – in progress	EAP and project manager	Company: Rand Water Contact Person: Thokozani Masilela Tel: 0720495 0097	14/12/16/3/3/1/1431
Construction of a Rand Water 200ml Reservoir In Brakpan, Ekurhuleni Metropolitan Municipality, Gauteng Province	2015 – in progress	EAP and project manager	Company: Rand Water Contact Person: Thokozani Masilela Tel: 0720495 0097	14/12/16/3/3/1/1423
Proposed Eskom 400kv Transmission Line From Ariadne to Venus Substations in Kwazulu-Natal Province: Water Use Licence Application	2014 – 2015	EAP and project manager	Company: DIGES Contact Person: Brenda Makanza Tel: 082 075 6685	12/12/20/1755
Duvha-Minerva 400kv Powerline deviation water use licence application	2013	EAP and project management	Company: Eskom Transmission	16/2/7/B100/C983

			Contact: Vuledzani Thanyane Tel: 011 800 5601 Ref: 16/2/7/B100/C983	
Water Use Licence for the construction of the Rockdale to Wolwekraal 400kv powerline and associated secondary infrastructure, Mpumalanga and Limpopo Provinces	2013	EAP and project management	Company: Eskom Transmission Contact: Vuledzani Thanyane Tel: 011 800 5601 Ref: 16/2/7/B300/B03	12/12/20/1340

APPENDIX G.5 HERITAGE RESOURCES IMPACT ASSESSMENT SPECIALIST REPORT

PGS
HERITAGE

Heritage Impact Assessment for City Parks and Zoo's Enviromental Studies in Klip Middle Soweto within the City of Johannesburg Municipality, Gauteng Province

Heritage Impact Assessment

Issue Date:	7 June 2016
Revision No.:	1
Project Number:	186HIA

Declaration of Independence

The report has been compiled by PGS Heritage (Pty) Ltd, an appointed Heritage Specialist by Lebone Engineering on behalf of Johannesburg City Parks and Zoo. The views stipulated in this report are purely objective and no other interests are displayed during the decision making processes discussed in the Heritage Impact Assessment Process.

General declaration:

- *I act as the independent specialist in this application;*
- *I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;*
- *I declare that there are no circumstances that may compromise my objectivity in performing such work;*
- *I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;*
- *I will comply with the Act, Regulations and all other applicable legislation;*
- *I have no, and will not engage in, conflicting interests in the undertaking of the activity;*
- *I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;*
- *all the particulars furnished by me in this form are true and correct; and*
- *I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.*

HERITAGE CONSULTANT: PGS Heritage

CONTACT PERSON: Wouter Fourie
Tel: +27 (0) 12 332 5305
Email: wouter@pgsheritage.co.za

SIGNATURE:

Report Title	Heritage Impact Assessment for City Parks and Zoo's Enviromental Studies in Klip Middle Soweto within the City of Johannesburg Municipality, Gauteng Province		
Control	Name	Signature	Designation
Author	Wouter Fourie		Heritage Specialist /

As indicated in the table below, this Heritage Impact Assessment report was compiled in accordance with the National Environmental Management Act (NEMA) Environmental Impact Assessment (EIA) Regulations Appendix 6 requirements for specialist reports.

NEMA REGS (2014) - APPENDIX 6	RELEVANT PAGES AND SECTIONS
Details of the specialist who prepared the report.	Pages i, ii, iii and Appendix B p.31
The expertise of that person to compile a specialist report including a curriculum vitae.	Pages 1 (Section 1.2) and Appendix B
A declaration that the person is independent in a form as may be specified by the competent authority.	Page ii
An indication of the scope of, and the purpose for which, the report was prepared.	Section 2
The date and season of the site investigation and the relevance of the season to the outcome of the assessment.	Section 3.1
A description of the methodology adopted in preparing the report or carrying out the specialised process.	Section 3.1
The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure.	Sections 6
An identification of any areas to be avoided, including buffers.	Section 6
A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers.	Section 2
A description of any assumptions made and any uncertainties or gaps in knowledge.	Section 1.3
A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment.	Section 7. Please note that no development alternatives were assessed.
Any mitigation measures for inclusion in the EMPr.	Section 7
Any conditions for inclusion in the environmental authorization.	Sections 7
Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Sections 7
A reasoned opinion as to whether the proposed activity or portions thereof should be authorised and	Executive Summary and Section 8
If the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	
A description of any consultation process that was undertaken during the course of carrying out the study	Not applicable. A public consultation process was handled as part of the EIA and EMP process.
A summary and copies if any comments that were received during any consultation process	Not applicable. To date not comments regarding heritage resources that require input from a specialist have been raised.
Any other information requested by the competent authority.	Not applicable.

EXECUTIVE SUMMARY

PGS Heritage (Pty) Ltd was appointed by Lebone Engineering on behalf of Johannesburg City Parks and Zoo to undertake a Heritage Impact Assessment that forms part of the Environmental Impact Assessment and Environmental Management Programme for the for the management of water catchments and sources, namely, water conservation and preservation of the ecological reserve and the goal of reduced water pollution in Johannesburg's Water Management Units within the City of Johannesburg Municipality.

The fieldwork conducted did not identify any significant heritage reosurces in the accesable areas.

Based on the impact assessment criteria the impact by the proposed development on heritage resources is projected as low. To address the impacts on the chance find of heritage resource the following management measures are recommended:

- Archaeologist to check initial site clearance with construction crew for possible heritage resources.
- Stop construction if any heritage resources – such as graves, human remains or fossils are identified; and
- Where any significant resources are found the archaeologist must assess and make the appropriate mitigation requirements.

The overall impact of the development on heritage resources is seen as acceptably low and impacts can be mitigated to acceptable levels.

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List of Appendices

1 INTRODUCTION

PGS Heritage (Pty) Ltd was appointed by Lebone Engineering on behalf of Johannesburg City Parks and Zoo to undertake a Heritage Impact Assessment that forms part of the Environmental Impact Assessment and Environmental Management Programme for the for the management of water catchments and sources, namely, water conservation and preservation of the ecological reserve and the goal of reduced water pollution in Johannesburg's Water Management Units within the City of Johannesburg Municipality.

1.1 Scope of the Study

The aim of the study is to identify possible heritage sites and findings that may occur in the proposed development area. The HIA aims to inform the EIA in the development of a comprehensive EMPr to assist the developer in managing the identified heritage resources in a responsible manner, in order to protect, preserve, and develop them within the framework provided by the National Heritage Resources Act of 1999 (Act 25 of 1999) (NHRA).

1.2 Specialist Qualifications

This Heritage Impact Assessment was compiled by PGS Heritage (PGS).

The staff at PGS has a combined experience of nearly 70 years in the heritage consulting industry. PGS and its staff have extensive experience in managing HIA processes and will only undertake heritage assessment work where they have the relevant expertise and experience to undertake that work competently.

Wouter Fourie, Project manager for this project, is registered as a Professional Archaeologist with the Association of Southern African Professional Archaeologists (ASAPA) and has CRM accreditation within the said organisation, as well as being accredited as a Professional Heritage Practitioner with the Association of Professional Heritage Practitioners – Western Cape (APHP).

1.3 Assumptions and Limitations

The following assumptions and limitation apply to this study:

- Not detracting in any way from the comprehensiveness of the fieldwork undertaken, it is necessary to realise that the heritage resources located during the fieldwork do not necessarily represent all the possible heritage resources present within the area. Various factors account for this, including the subterranean nature of some archaeological sites and the current dense vegetation cover. As such, should any heritage features and/or objects not included in the present inventory be located or observed, a heritage specialist must immediately be contacted.
- Any such observed or located heritage features and/or objects found during construction/operation may not be disturbed or removed in any way until such time that the heritage specialist has been able to make an assessment as to the significance of the site (or material) in question. This applies to graves and cemeteries as well. In the event that any graves or burial places are located during the development, the procedures and requirements pertaining to graves and burials will apply as set out below.
- The fieldwork consisted of general site visists as detailed studies of each of the areas of direct impact was not possible due to wetland and dense vegetation and the general security issues associated with degraded urban environments in the Gauteng Province.

1.4 Legislative Context

The identification, evaluation and assessment of any cultural heritage site, artefact or find in the South African context is required and governed by the following legislation:

i. National Environmental Management Act (NEMA) Act 107 of 1998
ii. National Heritage Resources Act (NHRA) Act 25 of 1999
iii. Minerals and Petroleum Resources Development Act (MPRDA) Act 28 of 2002

The following sections in each Act refer directly to the identification, evaluation and assessment of cultural heritage resources.

i. GNR 982 (Government Gazette 38282, 14 December 2014) promulgated under the National Environmental Management Act (NEMA) Act 107 of 1998
    a. Basic Assessment Report (BAR) – Regulations 19 and 23
    b. Environmental Scoping Report (ESR) – Regulation 21

c. Environmental Impact Assessment (EIA) – Regulation 23

d. Environmental Management Programme (EMPr) – Regulations 19 and 23

ii. National Heritage Resources Act (NHRA) Act 25 of 1999

a. Protection of Heritage Resources – Sections 34 to 36; and

b. Heritage Resources Management – Section 38

iii. Minerals and Petroleum Resources Development Act (MPRDA) Act 28 of 2002

a. Section 39(3)

The NHRA stipulates that cultural heritage resources may not be disturbed without authorization from the relevant heritage authority. Section 34 (1) of the NHRA states that, "no person may alter or demolish any structure or part of a structure which is older than 60 years without a permit issued by the relevant provincial heritage resources authority". In addition, the NEMA (No 107 of 1998) and the GNR 982 (Government Gazette 38282, 14 December 2014) state that, "the objective of an environmental impact assessment process is to, identify the location of the development footprint within the preferred site, focussing on the geographical, physical, biological, social, economic, cultural and heritage aspects of the environment" (GNR 982, Appendix 3(2)(c), emphasis added). In accordance with legislative requirements and EIA rating criteria, the regulations of South African Heritage Resource Agency (SAHRA) and ASAPA have also been incorporated to ensure that a comprehensive legally compatible Archaeological Impact Assessment (AIA) report is compiled.

1.5 Terminology and Abbreviations

Archaeological resources

This includes:

i. material remains resulting from human activity which are in a state of disuse and are in or on land and which are older than 100 years including artefacts, human and hominid remains and artificial features and structures;

ii. rock art, being any form of painting, engraving or other graphic representation on a fixed rock surface or loose rock or stone, which was executed by human agency and which is older than 100 years, including any area within 10m of such representation;

iii. wrecks, being any vessel or aircraft, or any part thereof which was wrecked in South Africa, whether on land, in the internal waters, the territorial waters or in the maritime culture zone of the republic as defined in the Maritimes Zones Act, and any cargo, debris

or artefacts found or associated therewith, which is older than 60 years or which SAHRA considers to be worthy of conservation;

iv. features, structures and artefacts associated with military history which are older than 75 years and the site on which they are found.

Cultural significance

This means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance

Development

This means any physical intervention, excavation, or action, other than those caused by natural forces, which may in the opinion of the heritage authority in any way result in a change to the nature, appearance or physical nature of a place or influence its stability and future well-being, including:

i. construction, alteration, demolition, removal or change in use of a place or a structure at a place;
ii. carrying out any works on or over or under a place;
iii. subdivision or consolidation of land comprising a place, including the structures or airspace of a place;
iv. constructing or putting up for display signs or boards;
v. any change to the natural or existing condition or topography of land; and
vi. any removal or destruction of trees, or removal of vegetation or topsoil

Earlier Stone Age

The archaeology of the Stone Age, between 400 000 and 2500 000 years ago.

Fossil

Mineralised bones of animals, shellfish, plants and marine animals. A trace fossil is the track or footprint of a fossil animal that is preserved in stone or consolidated sediment.

Heritage

That which is inherited and forms part of the National Estate (Historical places, objects, fossils as defined by the NHRA).

Heritage resources

This means any place or object of cultural significance.

Holocene

The most recent geological time period which commenced 12 000 years ago.

Later Stone Age

The archaeology of the last 30 000 years, associated with fully modern people.

Late Iron Age (Early Farming Communities)

The archaeology of the last 1000 years up to the 1800s, associated with people who carried out iron working and farming activities such as herding and agriculture.

Middle Stone Age

The archaeology of the Stone Age between 30 000-300 000 years ago, associated with early modern humans.

Palaeontology

Any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains or trace.

Table 1: Abbreviations

Abbreviations	*Description*
AIA	Archaeological Impact Assessment
ASAPA	Association of South African Professional Archaeologists
CCS	Cryptocrystalline Silica
CRM	Cultural Resource Management
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
ESA	Early Stone Age

GPS	Global Positioning System
HIA	Heritage Impact Assessment
LIA	Late Iron Age
LSA	Later Stone Age
MSA	Middle Stone Age
NEMA	National Environmental Management Act
NHRA	National Heritage Resources Act
PGS	PGS Heritage
PHRA	Provincial Heritage Resources Authority
PSSA	Palaeontological Society of South Africa
SAHRA	South African Heritage Resources Agency
SAHRIS	South African Heritage Resources Information System
WMU	Water Management Unit

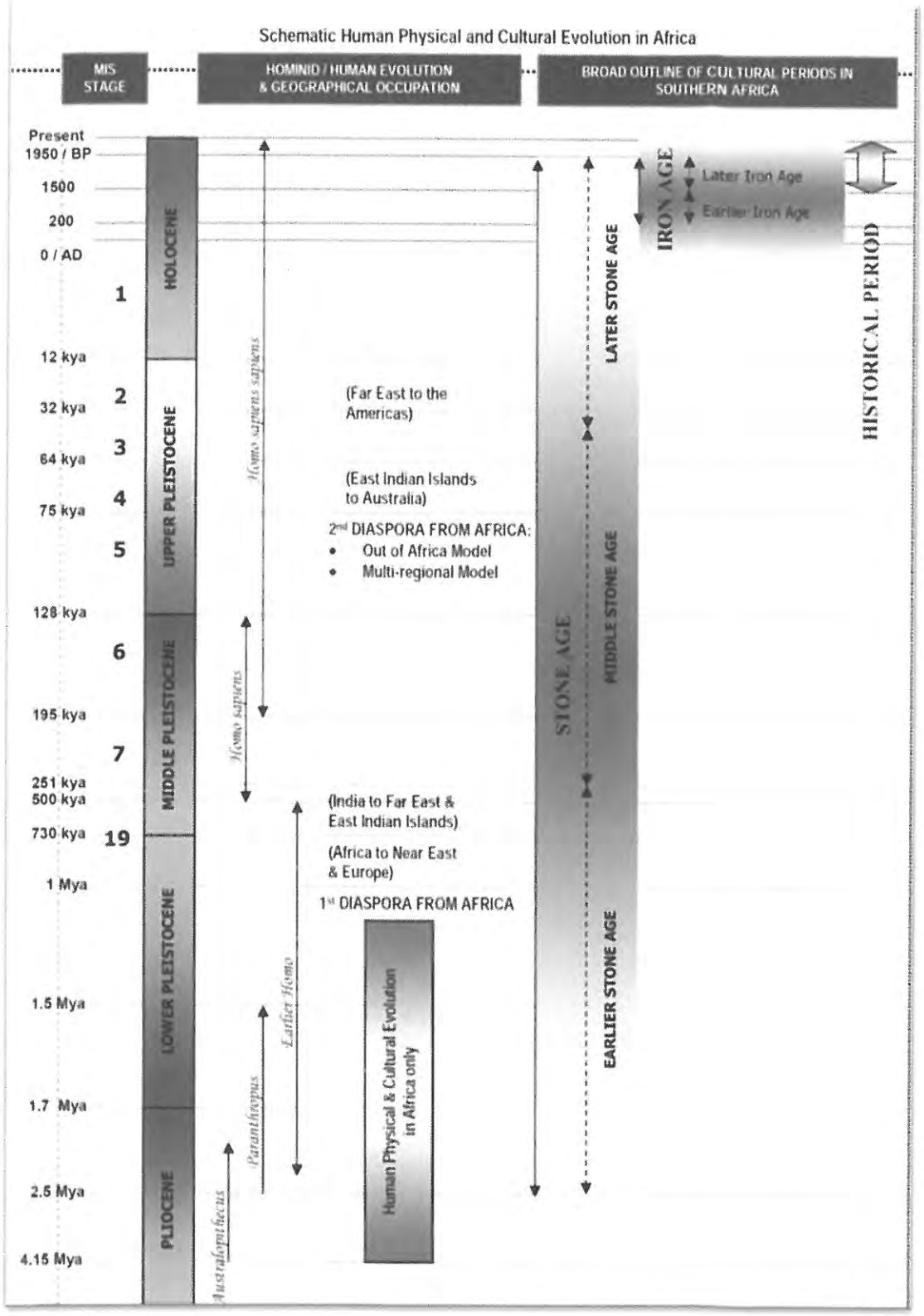

Figure 1 - Human and Cultural Time line in Africa (Morris, 2008)

2 TECHNICAL DETAILS OF THE PROJECT

2.1 Site Location

The study area is defined as the Klip-Middel Soweto study area. It streaches from Florida and Fleurhof in the north to Kliptown in Soweto in the south, Mpumalanga Province (**Figure 2**). The focus areas of the HIA is illustrated in **Figure 3**.

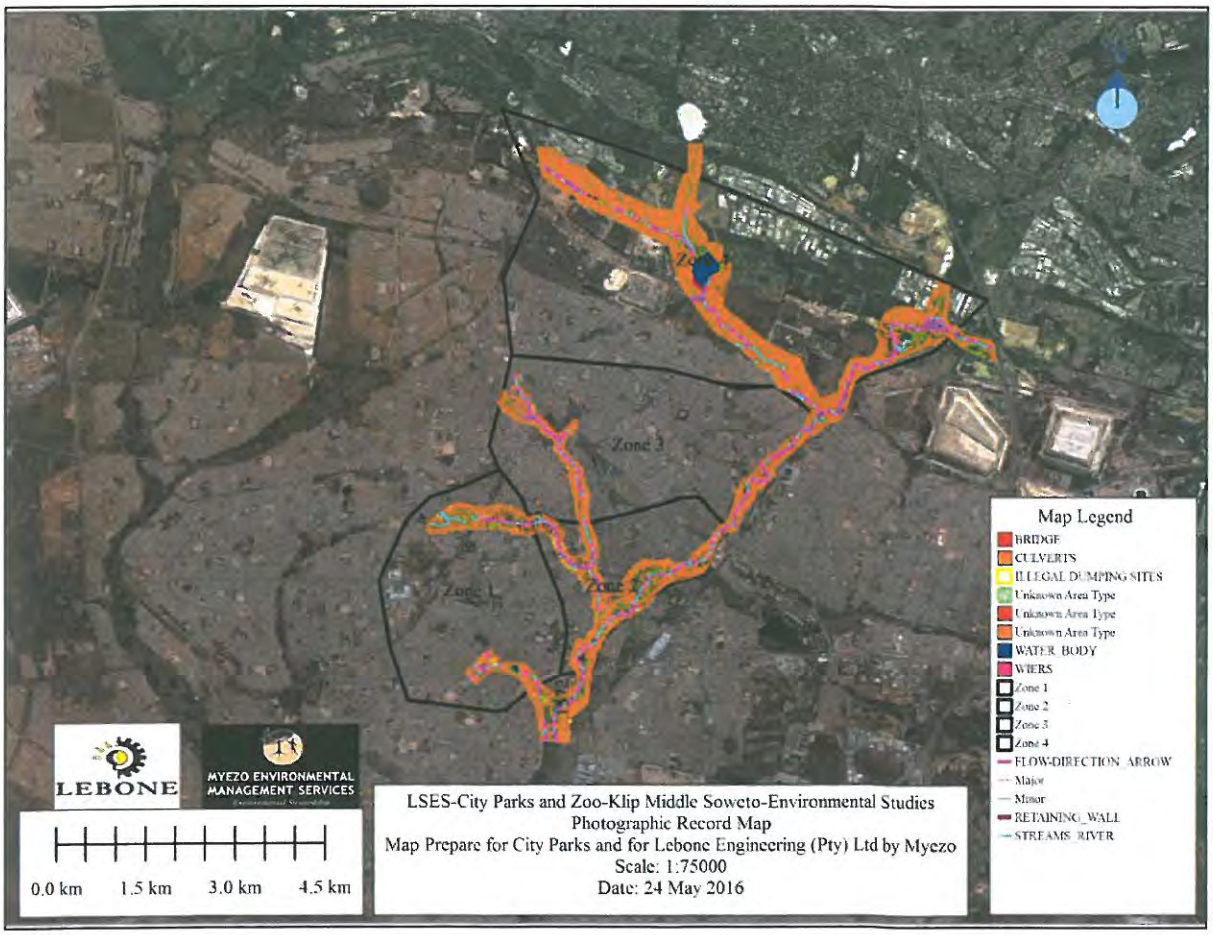

Figure 2 – Area of study (Myezo, 2016)

2.2 Project Description

2.1.1 Background

As the persistent drought conditions continue to affect South Africa, Water shortages have been reported across the country with Gauteng Province, Limpopo Province and KwaZulu Natal Province being the most affected. Rand Water which provides water to the municipalities of Gauteng including Johannesburg Water which distributes water to the areas within The City of Jonesburg Municipality

has given a warning of low levels of reservoirs in the province. To reduce the pressure imposed on water supply Rand Water has at the time of compiling this report placed the Gauteng Province under level 2 water restrictions, this entails that residents and business are to refrain from watering of gardens between 6am and 6pm, no filling of swimming pools and no using of hoses to wash cars or paved areas. This highlights the urgent need for the conservation of water resources to ensure access to a sustainable and reliable water resource for South Africa. With the City committing to the conservation of its sustainable resources in its Growth Development Strategy (GDS) will ensure that the City is doing its part to prevent further impact's on our water resources and preventing similar water shortage crises that we are currently experiencing

Figure 3 – HIA focus areas

In addition to this broader national challenge outlined above, the environmental aspects associated with the current high rate of development within the Jonesburg Metropolitan areas has contributed to the pollution of vulnerable Water Management Units (WMU) within the City of Johannesburg municipality and further put pressure on the already stressed water infrastructure. The expansion of urban development has resulted in a loss of valuable riverine environment, with diversions and illegal weirs, encroachments, channelization and the construction of roads, bridges and culverts across

rivers, resulting in their deterioration. In addition, the increased intensity of storm water runoff from urbanized catchments as well as increased pollutant loads is placing additional pressure on rivers which cannot always sustain such impacts. This leads to flooding, bacteriological pollution, chemical pollution, litter, exotic vegetation, bad visual impact, odour and sediment and obviously needs to be addressed.

This project will address some of these pressing issues, as part of its support to the GDS goals, which advocate for Management of Water Catchments and Sources, namely, water conservation and preservation of the ecological reserve and the goal of reduced water pollution. WMUs play a role in the management of storm water as they act as receiver of storm water diverted through the storm water drains from the city streets to the water units. The wetlands within the WMU serves as a natural filtration system. The Water Management Unit (WMU) to be covered in this particular report is the Middle Klipriver Water Management Unit.

2.2 Extent of proposed work

The rehabilitation and upgrade of thw WMU wil consist of the following activities in specific areas as identified by the Biodiversity Assessment Report. The activities relevant to ipmpact on heritage resources are:

- Mulching;
- Erosion control fences;
- Stone gabions and river mattresses;
- Sediment control;
- Treating footpaths; and
- Invasive alien species control.

3 ASSESSMENT METHODOLOGY

The section below outlines the assessment methodologies utilised in the study.

3.1 Methodology for Assessing Heritage Site Significance

This HIA report was compiled by PGS Heritage for the upgrade and water management of the Klip Middle Water Management Unit. The applicable maps, tables and figures are included, as stipulated in the NHRA (no 25 of 1999) and the NEMA (no 107 of 1998). The HIA process consisted of three steps:

Step I – Literature Review: The background information to the field survey relies greatly on the archival and historical cartographic material assessed as part of the study, as well as a study of the available literature.

Step II – Physical Survey: A physical survey was conducted through the proposed project area by a one heritage specialist. The study was completed on foot and by vehicle on 30-31 May 2016. Written descriptions, photographs and GPS coordinates were taken of all heritage sites identified during the survey.

Step III – The final step involved the recording and documentation of relevant archaeological and heritage resources, the assessment of resources in terms of the HIA criteria and report writing, as well as mapping and recommendations.

The significance of identified heritage sites was based on five main criteria:

- Site integrity (i.e. primary vs. secondary context),
- Amount of deposit, range of features (e.g., stonewalling, stone tools and enclosures),
- Density of scatter (dispersed scatter)
    - Low - <10/50m^2
    - Medium - 10-50/50m^2
    - High - >50/50m^2
- Uniqueness; and
- Potential to answer present research questions.

Management actions and recommended mitigation, which will result in a reduction in the impact on the sites, will be expressed as follows:

A - No further action necessary;
B - Mapping of the site and controlled sampling required;
C - No-go or relocate development activity position;
D - Preserve site, or extensive data collection and mapping of the site; and
E - Preserve site.