# City of Ekurhuleni Wetland and Watercourse Rehabilitation Planning within the Rietvlei Catchment

## Situation Assessment Report

*By:*

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# 1 INTRODUCTION

Wetland Consulting Services (WCS) was appointed by Environmental Impact Management Services (EIMS) on behalf of the City of Ekurhuleni (CoE) to design a planning regime for wetland rehabilitation, to be implemented within the Rietvlei catchment. This catchment was selected by CoE as a priority catchment to be focused on as part of this rehabilitation planning project.
The Rietvlei catchment is located within heavily developed areas consisting of township and urban developments and associated infrastructures, as well as subsistence agricultural areas. All these landuses can lead to typical water quality and quantity impacts. Impacts range from failing of sewer infrastructure and direct discharge of sewage into watercourses, increased stormwater flows off hardened surfaces resulting in erosion and deterioration of the natural watercourses and agricultural return flows containing a variety of pesticides and fertilisers which negatively affect water quality in the receiving watercourses. Wetland rehabilitation within this catchment provides a potential opportunity to address some of these, and other, impacts.

## 1.1 PURPOSE OF THE STUDY

The purpose of this project is to prioritise and undertake wetland rehabilitation planning, including associated required authorisations, in order to successfully implement identified rehabilitation projects within the Rietvlei Catchment area in the City of Ekurhuleni (CoE).
The specific objectives of the study include:

- Study inception;
- Information and data sourcing and analysis;
- Status quo assessment of the wetland areas within the catchment;
- Prioritisation of a maximum of five wetlands for rehabilitation within the catchment;
- Development of rehabilitation strategies; and
- Communication and liaison

## 1.2 PURPOSE OF THIS REPORT

The situation assessment report has been produced:

1. To indicate the proposed approach towards the assessment of wetlands within the catchment;
2. To prioritise wetlands for the purpose of rehabilitation within the catchment;
3. To highlight the impacts on wetlands and to assess the ecological state of wetlands within the catchment;
4. To provide baseline ecological information, including the health of the wetlands within the catchment; and
5. To develop a rehabilitation strategy as a precursor to the required rehabilitation plans based on the health of the wetlands.

## 1.3 STUDY AREA

The study area is the catchment of the Rietvlei River within the CoE boundary as indicated in Figure 2 below. The catchment falls within the Department of Water and Sanitation (DWS) quaternary catchment A21A. The extent of the specific catchment targeted for this CoE project is shown in the figure below. This catchment was delineated based on 5m contours with the outlet

point of the major river system placed on the edge of the CoE boundary. The extent of the study catchment area in relation to the quaternary catchments is detailed in Table 1 below.

**Table 1: The extent of the study catchment area in relation to the DWS Quaternary catchment.**

| Sub-catchment | Catchment Area ($km^2$) | Catchment Area ($km^2$) within COE | % Quaternary Catchments within COE |
|---|---|---|---|
| Rietvlei/Hennops (A21A) | 482 | 282 | 59 |

### 1.3.1 RIETVLEI CATCHMENT

The Rietvlei catchment is located in the Crocodile (West) Marico Water Management Area in quaternary catchment A21A within the Hennops Catchment. The river in the study area consists of the Rietvlei River and associated smaller, first order tributaries draining into the Hennops River. Figure 2 below indicates the location of the study catchment in relation to the CoE Boundary. The Rietvlei system starts in the small-holdings area of Kempton Park and flows northwards past O.R. Tambo International Airport to Rietvlei Dam. Rietvlei Dam is an important contributor of water supply in the Tshwane Metropolitan Municipality. The primary supply of this water originates from agricultural and industrial surface run-off and is also fed by a tributary - the Grootvlei River - which originates from the Bapsfontein area. Sewage works situated at Kempton Park are responsible for serious pollution. A series of wetlands between the sewage works and the dam are anticipated to play a role in filtering some of the pollution carried by the rivers. The Tshwane Metropolitan Municipality also operates an extensive filtering plant at the dam. The landuse within the catchment is urban development around the Kempton Park area and agricultural activities towards the lower reaches of the river.

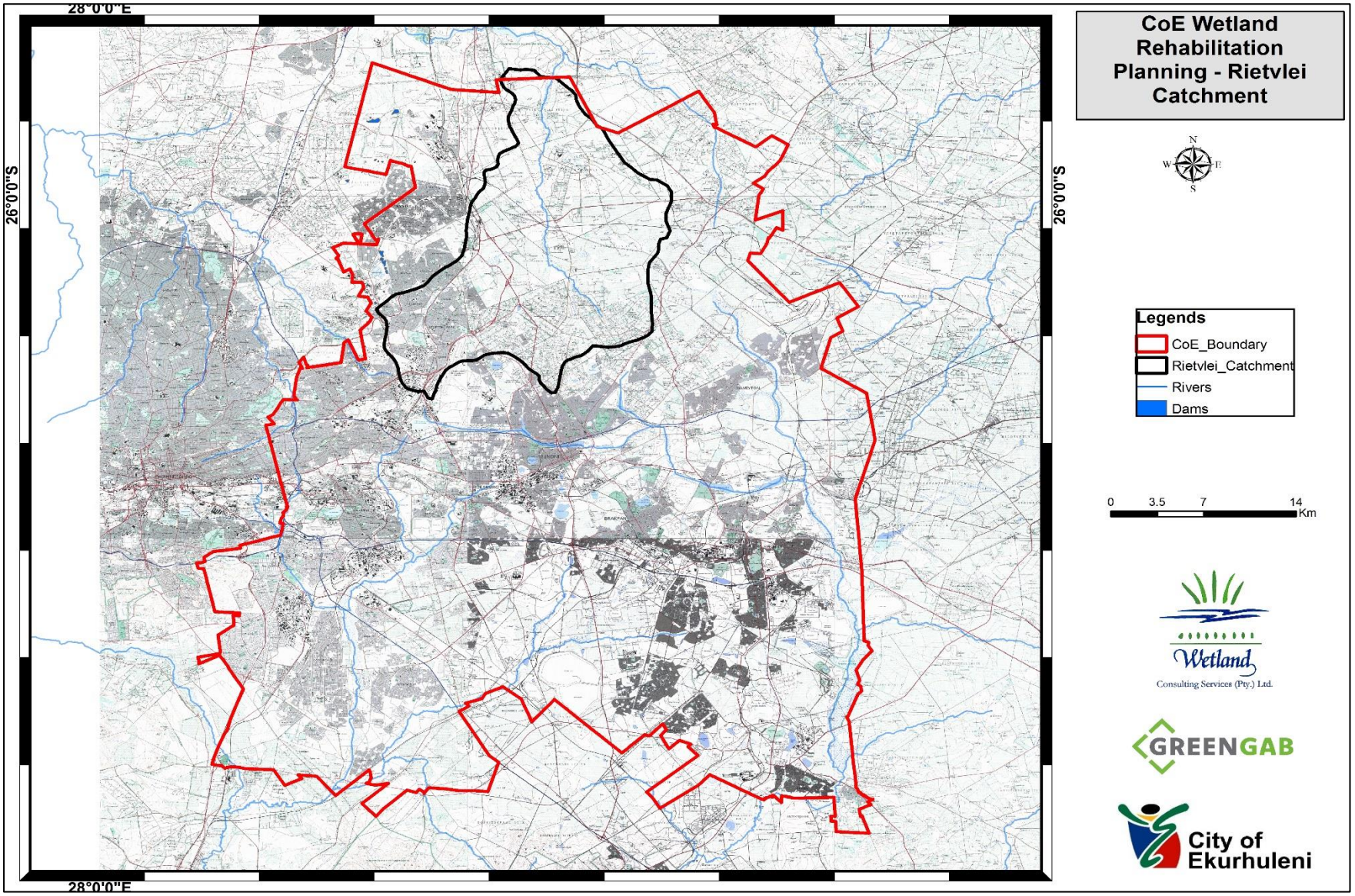



**Figure 1: Map showing the extent of the CoE boundary in relation to the Gauteng Provincial boundary.**

# 2 APPROACH

## 2.1 WETLAND DELINEATION AND CLASSIFICATION

Various wetland datasets of wetland coverages including National Wetland Inventory, National Freshwater Priority Areas, Regional Conservation Plans, Environmental Management Frameworks and CoE wetland inventory datasets were used to identify any gaps that will require additional data collection. An integration of all datasets to formulate a single wetland coverage dataset was undertaken. Additional delineations on high resolution aerial imagery was undertaken where gaps were identified using the methodology as proposed by (Thompson *et al*., 2002), followed by limited ground-truthing for verification, collection of ecological integrity data, verification of existence of wetland and landuse within and around wetlands. The complete wetland layer was classified in terms of HydroGeoMorphic (HGM) settings in accordance with the South African Wetland Classification as proposed in (SANB, 2009) and (Ollis *et al*., 2013).

## 2.2 ECOLOGICAL CATEGORISATION

### 2.2.1 PRESENT ECOLOGICAL STATE (PES) OF WETLANDS WITHIN THE CATCHMENT

A method to assess wetland ecological condition based on land-cover type, as detailed in the Water Research Commission Project K5/2350 (Kotze, 2016a and 2016b), was used to provide an overall ecological state of wetlands and watercourses onsite. This method utilizes calculations within wetland and surrounding wetland land-uses as a proxy to determine wetland impacts, and consequently wetland ecological state. The following table indicates the rating and intensity score for individual landuses within and surrounding the wetland and watercourses onsite used in the method.

**Table 2: Table indicating the categorisation and scoring of impacts/landuses within and around wetlands utilised for the catchment PES assessment.**

| Landuse Type National Land cover | Simplified Category | Buffer Landuse Integrity Score | Wetland Landuse Integrity Score |
|---|---|---|---|
| Woodland/Open bush | Alien vegetation sparse | 3 | 4 |
| Grasslands | Natural | 0.5 | 1.5 |
| Plantations / Woodlots | Alien vegetation dense | 4.5 | 5.4 |
| Thicket /Dense bush | Alien vegetation dense | 4.5 | 5.4 |
| Settlements | Urban | 6 | 8 |
| Cultivated commercial annual crops non-pivot | Cultivated dry | 4.5 | 4.5 |
| Wetlands | Natural | 0.5 | 1.5 |
| Low shrub land | Alien vegetation sparse | 3 | 4 |
| Bare Ground | Bare ground | 5 | 7 |
| Mines | Mines | 8 | 10 |
| Waterbodies | Dam | 4.5 | 6 |
| Cultivated commercial permanent orchards | Orchards | 5.5 | 4.2 |

| Landuse Type National Land cover | Simplified Category | Buffer Landuse Integrity Score | Wetland Landuse Integrity Score |
|---|---|---|---|
| Cultivated commercial annual crops pivot | Cultivated irrigation | 5.5 | 4.9 |
| Cultivated subsistence crops | Cultivated subsistence | 4 | 3.8 |
| Degraded | Degraded | 1.5 | 3.5 |
| Dam | Dam | 4.5 | 6 |
| Road | Road | 6 | 8.2 |
| Railway | Railway | 6 | 8.2 |
| Erosion | Erosion | 5 | 7 |

For the purpose of the catchment PES assessment for this catchment study, a buffer of 300m was decided on and delineated outside of the wetland areas. This buffer will act as the catchment for the wetlands in assessing the catchment-based impacts.

### 2.2.2 WETLAND IMPORTANCE AND SENSITIVITY (IS) OF WETLANDS AND WATERCOURSES WITHIN THE CATCHMENT

A wetland importance and sensitivity (IS) assessment was conducted for each wetland system (HGM) at a desktop level only, and this was done in order to provide an indication of the conservation value and sensitivity of the wetlands. For the purposes of this study, the Rountree *et al.* (2013) assessment tool was used as a basis for the IS assessments. The Importance and Sensitivity assessment is undertaken to rank water resources in terms of:

- **Ecological Importance** - biodiversity support and ecological value;
- **Hydrological Functions** - Provision of goods and service or valuable ecosystem functions which benefit people; and
- **Direct Human Benefits** - Reliance of subsistence users (especially basic human needs uses).

As this assessment was undertaken at a desktop level, a number of the criteria that inform the overall score for each wetland had to be informed by available desktop information and datasets. Table 3 below provides an overview of the information used to inform the various criteria.

Site visits were undertaken as part of the ecological data capture process in order to collect any relevant data on the use of representative wetland HGM units by people and/or surrounding communities and any other usage taking place to representative wetland HGM's within the catchment area. All the data collected was integrated to inform the wetland IS assessments. The results provide a low level IS categorisation of the wetland HGM units within the targeted catchment.

**Table 3: Details of the information and datasets used to inform the desktop wetland importance and sensitivity assessment of the wetlands within the catchment.**

| WETLAND IMPORTANCE AND SENSITIVITY COMPONENT | CRITERIA | RESOURCE/DATASET INFORMING SCORING OF CRITERIA |
|---|---|---|
| ECOLOGICAL IMPORTANCE & SENSITIVITY | **Biodiversity support** | |
| | ***Presence of Red Data species*** | Estimated based on the habitat requirements of wetland dependant Red Data List species and the types of habitats present in different wetland HGM types. |
| | ***Populations of unique species*** | Not directly assessed. The Gauteng Conservation Plan (C-Plan) V3.3, which identifies areas that are of varying levels of importance in meeting the provinces biodiversity conservation targets, was used to rank the wetlands in terms of their likelihood of supporting Red Data List and/or other important habitats or species. |
| | ***Migration/breeding/feeding sites*** | |
| | **Landscape scale** | |
| | ***Protection status of the wetland*** | Due to the broad scale of the assessment, all wetlands were conservatively assumed to lie on public land, i.e.: public or privately owned land under no formal protection. Where FEPA wetlands were present, the score was elevated slightly to account for an increased importance of the wetland. |
| | ***Protection status of the vegetation type*** | The protection status of the wetlands was informed by the Ecosystem Threat Statuses and Protection Levels for Wetland Vegetation Groups included within an assessment undertaken for the 2014 WRC project No K5/2281 - "Supporting better decision-making around coal mining in the Mpumalanga Highveld through the development of mapping tools and refinement of spatial data on wetlands." |
| | ***Regional context of the ecological integrity*** | The ecological integrity of the wetlands was informed by the results of the desktop level PES assessment for the wetlands within the catchment |
| | ***Size and rareity of the wetland type/s present*** | Based on the types of wetland HGM's present within the catchment and the relative frequency of occurrence of different wetland types |
| | ***Diversity of habitat types*** | Estimated based on the diversity of habitat types typcial of different wetland HGM units |
| | **Sensitivity of the wetland** | |
| | ***Sensitivity to changes in floods*** | floodplains at 4; valley bottoms 2 or 3; pans and seeps 0 or 1. |
| | ***Sensitivity to changes in low flows/dry season*** | Unchannelled VB's probably most sensitive |
| | ***Sensitivity to changes in water quality*** | Esp naturally low nutrient waters - lower nutients likely to be more sensitive |
| HYDRO-FUNCTIONAL IMPORTANCE | WET-Ecoservices Level 1 assessment applied to different wetland HGM types (Kotze DC, Marneweck GC, Batchelor AL, Lindley DS and Collins NB, 2007. WET-EcoServices: A technique for rapidly assessing ecosystem services supplied by wetlands. WRC Report No TT 339/08, Water Research Commission, Pretoria.) | |
| DIRECT HUMAN BENEFITS | Conservatively assumed that all wetlands are capable of providing at least one harvestable resource and/or cultivated food and have some capacity to contribute towards tourism, recreation, research and/or education | |

## 2.3 PRIORITISATION OF WETLANDS FOR REHABILITATION AND DEVELOPMENT OF A REHABILITATION STRATEGY

### 2.3.1 PROPOSED PRIORITISATION SELECTION CRITERIA

The review of existing information contributed towards identifying which level of prioritisation the proposed rehabilitation will fall into. Three levels of prioritisation were considered for this work. These can be summarised as follows:

- Wetlands where rehabilitation initiatives have been implemented. The purpose of this is to assess existing rehabilitation interventions, undertake a maintenance inventory and identify opportunities for improving their efficacy;
- Catchment of key waterbodies, as were determined by Re-Solve Consulting in 2015. The purpose of this is to integrate already identified key waterbodies into the current rehabilitation initiatives; and

- Consider wetlands that are of high risk or are threatened ecosystems; which provide habitat for endangered biota; and wetland systems that are likely to contribute in achieving enhanced biodiversity support, water quality improvement, sediment stabilisation or reinstating natural flooding regime. This assessment included rating and assessment of wetland that falls within freshwater priority ecosystem, regional conservation plans, ecosystem threat status of wetlands, condition of wetland which reflects its level of functioning and ownership of land which will necessitate implementation of management of proposed interventions within the wetland systems.

# 3 RESULTS

## 3.1 WETLAND DELINEATION AND CLASSIFICATION

The presence of wetlands in the landscape can be linked to the presence of both surface water and perched groundwater. Wetland types are differentiated based on their hydro-geomorphic (HGM) characteristics; i.e. on the position of the wetland in the landscape, as well as the way in which water moves into, through and out of the wetland systems. A schematic diagram of how these wetland systems are positioned in the landscape is given in Figure 2 and Table 4 below.

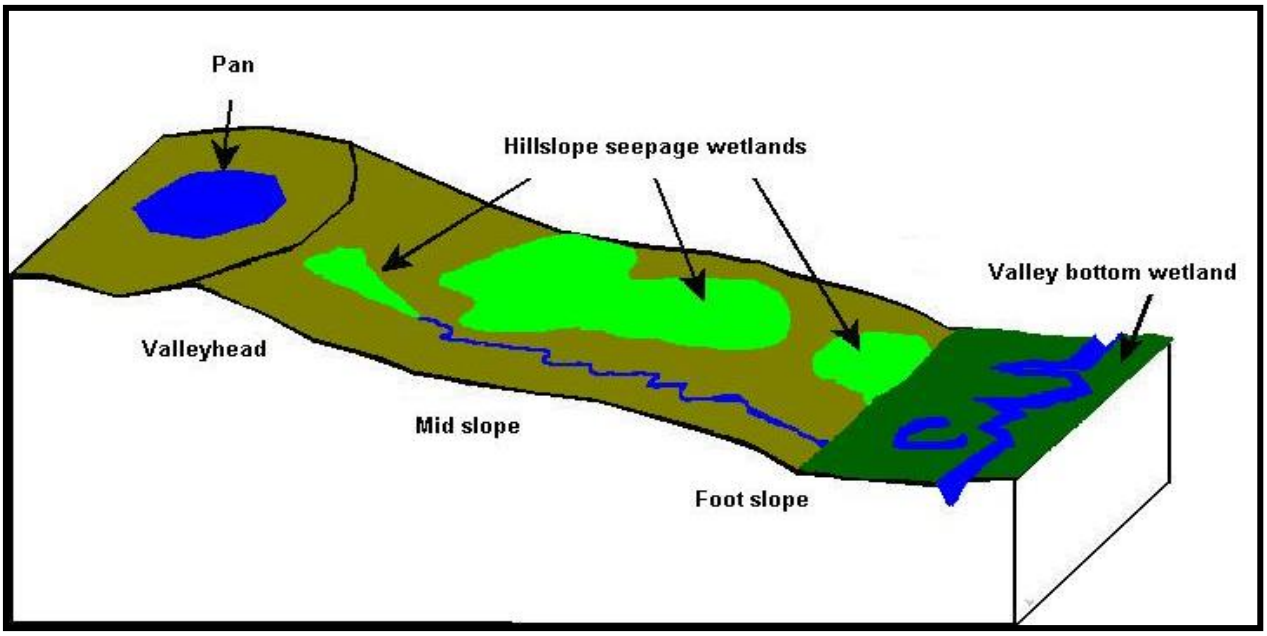



**Figure 2: Schematic diagram illustrating the position of the various wetland types within the landscape.**

The extent and distribution of wetland areas within the Rietvlei catchment area is indicated in Figure 3 below. Three types of natural wetland system, in terms of the hydro-geomorphic classification system in accordance with the South African Wetland Classification as proposed in (SANBI, 2009) and (Ollis *et al*., 2013), were recorded on site, namely:

- Depressions (Pans);
- Hillslope seepage wetlands; and
- Valley bottom wetlands (Channelled and Unchannelled).

**Table 4: The definition of the different wetland units recorded during the study in relation to type, topographic setting and hydrological components (Table and classification modified from Marneweck and Batchelor, 2002; Brinson, 1993).**

| LANDFORM SETTING | DEFINITION | HYDROLOGIC COMPONENTS | | |
|---|---|---|---|---|
| | | Inputs | Throughputs | Outputs |
| Hillslope seepage wetlands | Occur on concave or convex slopes immediately adjacent to or at the head of watercourses including other wetlands. Characterised by the colluvial (transported by gravity) movement of materials. Generally always associated with sandy soil forms. | Predominantly groundwater from perched aquifers and interflow. | Interflow & diffuse surface flows | Variable including interflow, diffuse surface flow and evapo-transpiration and stream flow. |
| Valley bottom with a channel | Occur in the shallow valleys that drain the slopes. Are gently or steep sloped and characterised by the alluvial transport and deposition of material by water. | Receive water inputs from adjacent slopes via runoff and interflow. May also receive inputs from a channelled system. Interflow may be from adjacent slopes, adjacent hillslope seepage wetlands if these are present, or may occur longitudinally along the valley bottom. | Surface flow and interflow. | Variable but predominantly stream flow. |
| Valley bottom without a channel | Valley bottom areas of low relief with no clearly defined stream and situated on alluvial fill. | Channel entering the wetland and adjacent hillslopes | Diffuse surface and subsurface flow | Channel outflow |

| LANDFORM SETTING | DEFINITION | HYDROLOGIC COMPONENTS | | |
|---|---|---|---|---|
| | | Inputs | Throughputs | Outputs |
| Pan (Depression) | A basin shaped area with a close elevation contour that is not connected via an outlet to the drainage network. | Variable but predominantly runoff and sub-surface seepage from adjacent slopes | Storage, Interflow & diffuse surface flow | Evapo-transpiration |

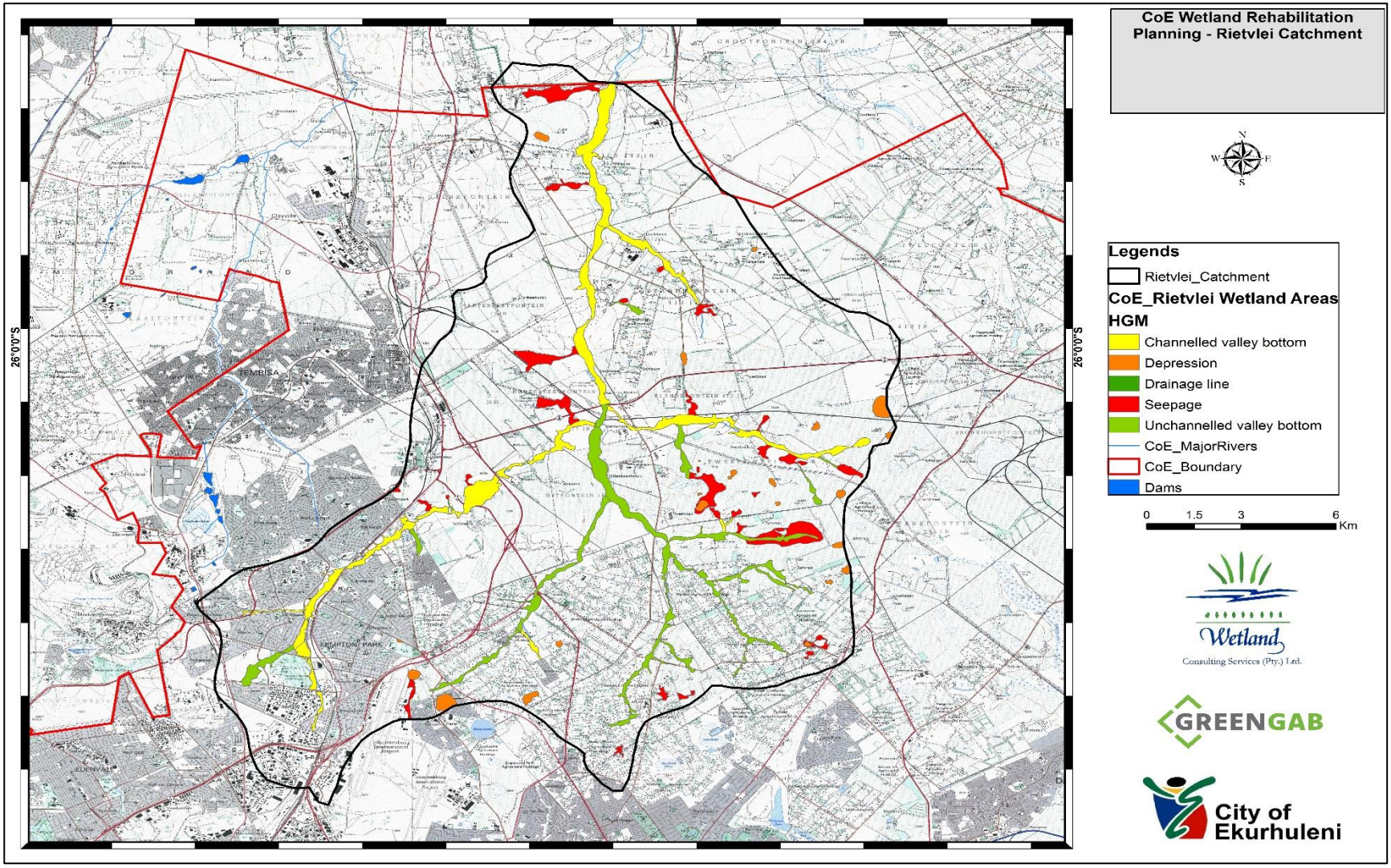



**Figure 3: Map showing the extent of wetlands and watercourses within the Rietvlei Catchment.**

## 3.2 ECOLOGICAL CATEGORISATION

### 3.2.1 PRESENT ECOLOGICAL STATE (PES)

Wetland areas have been subjected to numerous impacts associated with modification of the systems' hydrology, vegetation integrity and morphology. Increase in flow peaks caused by stormwater discharges and urbanization have resulted in channel incision, bank collapsing, erosion and sediment loss, as well as water quality deterioration. These changes have resulted in the desiccation of the adjacent wetland habitat, loss of riparian vegetation, loss of aquatic habitats and subsequently loss of biodiversity. Dumping, infilling, sand mining (excavation), the surcharging of outfall sewers and manholes, not to mention an influx of pollutants originating from the upslope residential areas, have also impacted on the quality of water, morphological structure and aesthetic appeal of the wetland areas within the catchment. Developmental activities on site as well as several road crossings, tracks and a bridge have all compromised both hydrology, geomorphology and the overall integrity of the entire wetland systems due to the extensive incision and subsequent erosion created by these features. The incision of the channels have resulted in further impacts on the systems. The vegetation within the wetland areas have been significantly altered with the desiccation of the system and the consequent encroachment of alien invasive plant species such as Kikuyu grasses and other terrestrial plant species. Without the implementation of rehabilitation interventions, it is likely that the integrity of the systems will deteriorate even further.

The main impacts at the site are:

- Cultivation and agricultural activities within and around wetlands;
- Sediment loss due to erosion associated with channel switching and incision caused by un-attenuated stormwater flows, resulting in loss of aquatic habitat, biodiversity and both riparian and wetland vegetation;
- Dumping of litter, building rubble and debris that has affected the morphological structure and aesthetic appeal of the wetland areas on site;
- Water quality deterioration associated with return flows from Kempton Park developed areas surrounding wetland areas on site; and
- The level of transformation within the wetland area has created a niche for invasive alien vegetation and weeds in the wetland.

Based on the recorded impacts in and around wetlands within the catchment, a catchment wide PES assessment was undertaken for all wetlands. The intensity scores, as discussed in the approach section, were used to area weight the impacts to wetlands and their catchments for the PES assessment. Figure 4 below indicates the results of the catchment PES assessment.

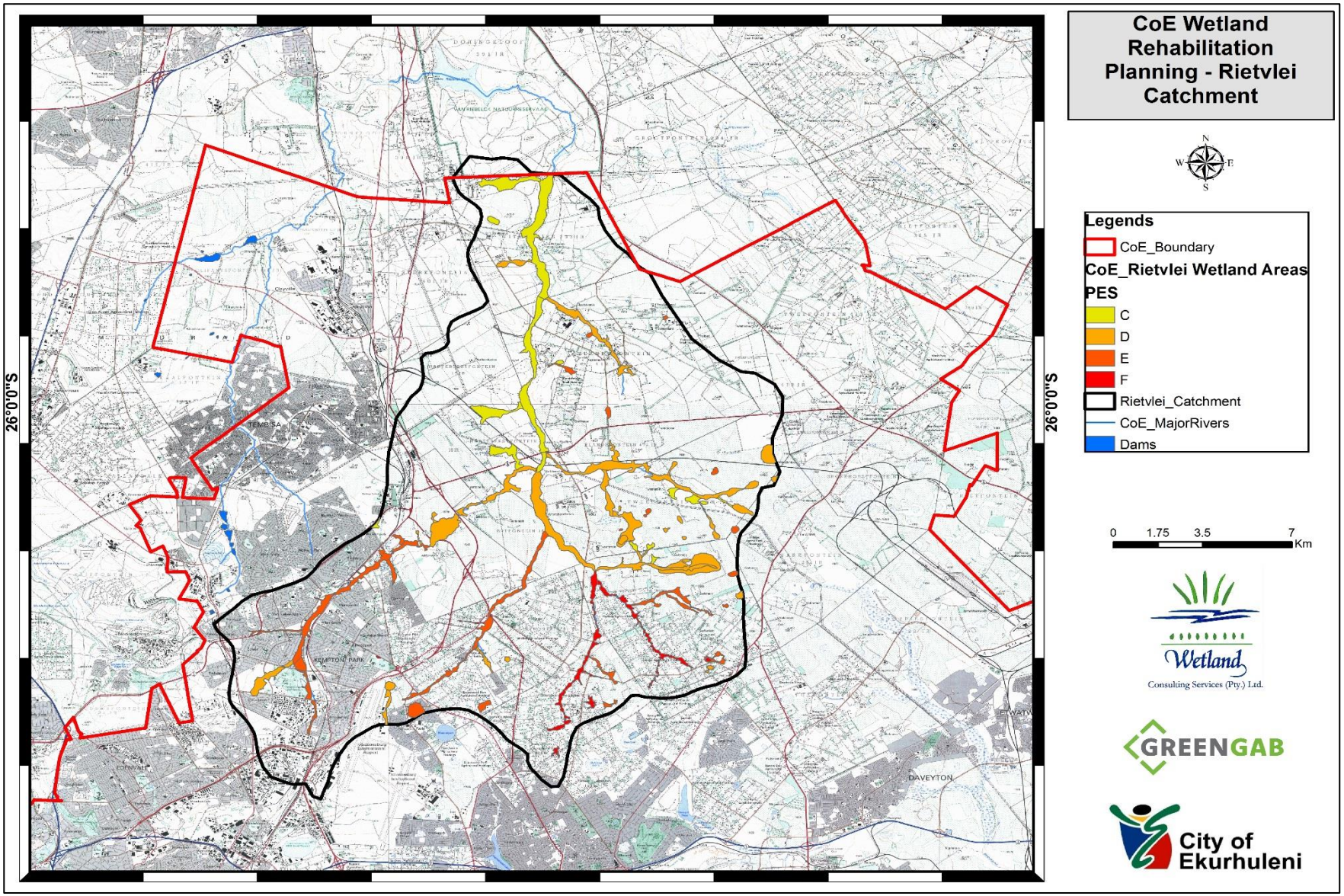



**Figure 4: Map showing PES assessment results for wetlands within the Rietvlei Catchment.**

### 3.2.2 **WETLAND IMPORTANCE AND SENSITIVITY (IS)**

"Importance" of a water resource is an expression of its importance to the maintenance of ecological diversity and functioning on local and wider scales. "Sensitivity" refers to the system's ability to resist disturbances and its capability to recover from disturbance once it has occurred.
The wetlands within the study area form part of the Crocodile West Marico Water Management Area, which is a heavily utilised and economically important catchment. Wetlands and rivers within the Rietvlei River catchment have been greatly impacted upon by various activities, which include urbanisation at the upper reaches and associated infrastructural activities, water abstraction and supply and extensive agricultural activities in the lower reaches upstream of the Rietvlei Dam, etc. As a result of these impacts, serious water quality and quantity concerns have been raised within the sub-catchment. Given this situation, and the fact that wetlands can support functions such as water purification and stream flow regulation, a high importance and conservation value is placed on all wetlands and rivers within the catchment that have as yet not been seriously modified. Within this context, a wetland IS assessment was conducted for every hydro-geomorphic wetland unit identified within the study area. Further considerations that informed the IS assessment include the following:

- The location of the study catchment area within the following vegetation types
    - Mesic Highveld Grassland in the upper reaches considered extensively transformed and threatened, having been classed as ***Endangered;***
    - Carletonville Dolomite Grasslands the middle section of the catchment which have been classed as ***Vulnerable***
- The wetland vegetation types extending across the catchment include Dry Highveld Grassland Group 5 and Mesic Highveld Grassland Groups 3 and 4, which are all considered Least Threatened, but which are poorly protected or not protected at all;
- According to the Gauteng Conservation Plan (C-Plan), the majority of the wetlands within the catchment form part of a network of Ecological Support Areas and areas that are Important for biodiversity conservation;
- The wetlands connect to the larger system/water resource that drains the entire area; and
- Several FEPA wetlands are present within the catchment.

It is these considerations that have, in part, informed the scoring of the systems in terms of their importance and sensitivity. Figure 5 below indicates the results of the wetland IS assessments.

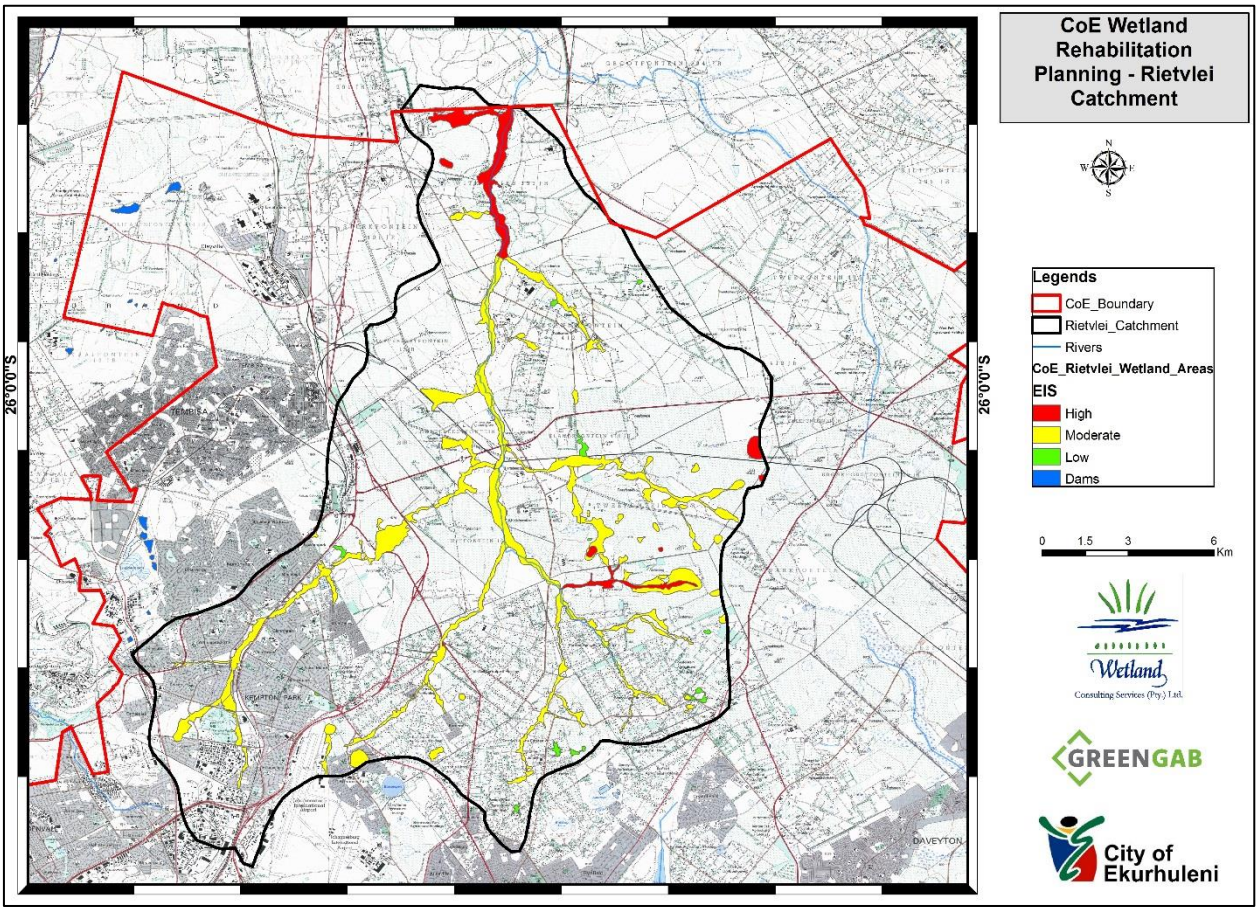



**Figure 5: Map showing wetland IS assessment results of wetlands within the Rietvlei Catchment.**

## 3.3 PRIORITY WETLANDS CONSIDERED FOR FURTHER ASSESSMENT AND REHABILITATION PLANNING.

The first order of prioritisation consists of integration of existing rehabilitation initiatives, alignment of objectives and proposed activities, particularly for the main Rietvlei River system as indicated in Figure 6 below. The aim of this is to evaluate and identify what has worked from existing initiatives and extend the approach to the entire Rietvlei system and associated tributaries.

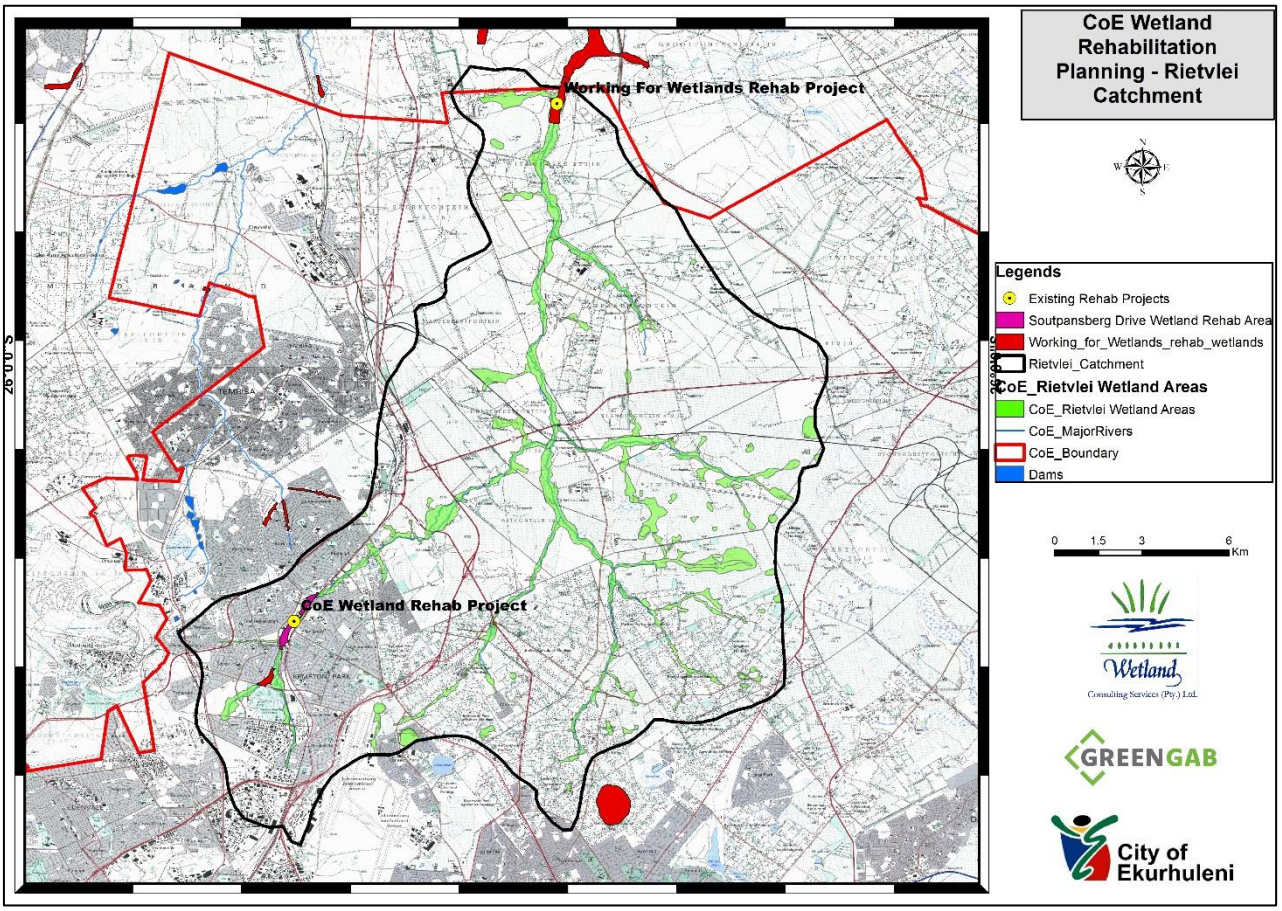



**Figure 6: Map showing existing rehabilitation initiatives within the Rietvlei Catchment.**

The second order of prioritisation consists of targeting local catchments of the key waterbodies already selected within the CoE. The key waterbodies within the Rietvlei catchment to be considered as part of this study include the main Rietvlei River. Figure 7 below indicates the location of the considered key waterbody within the catchment.

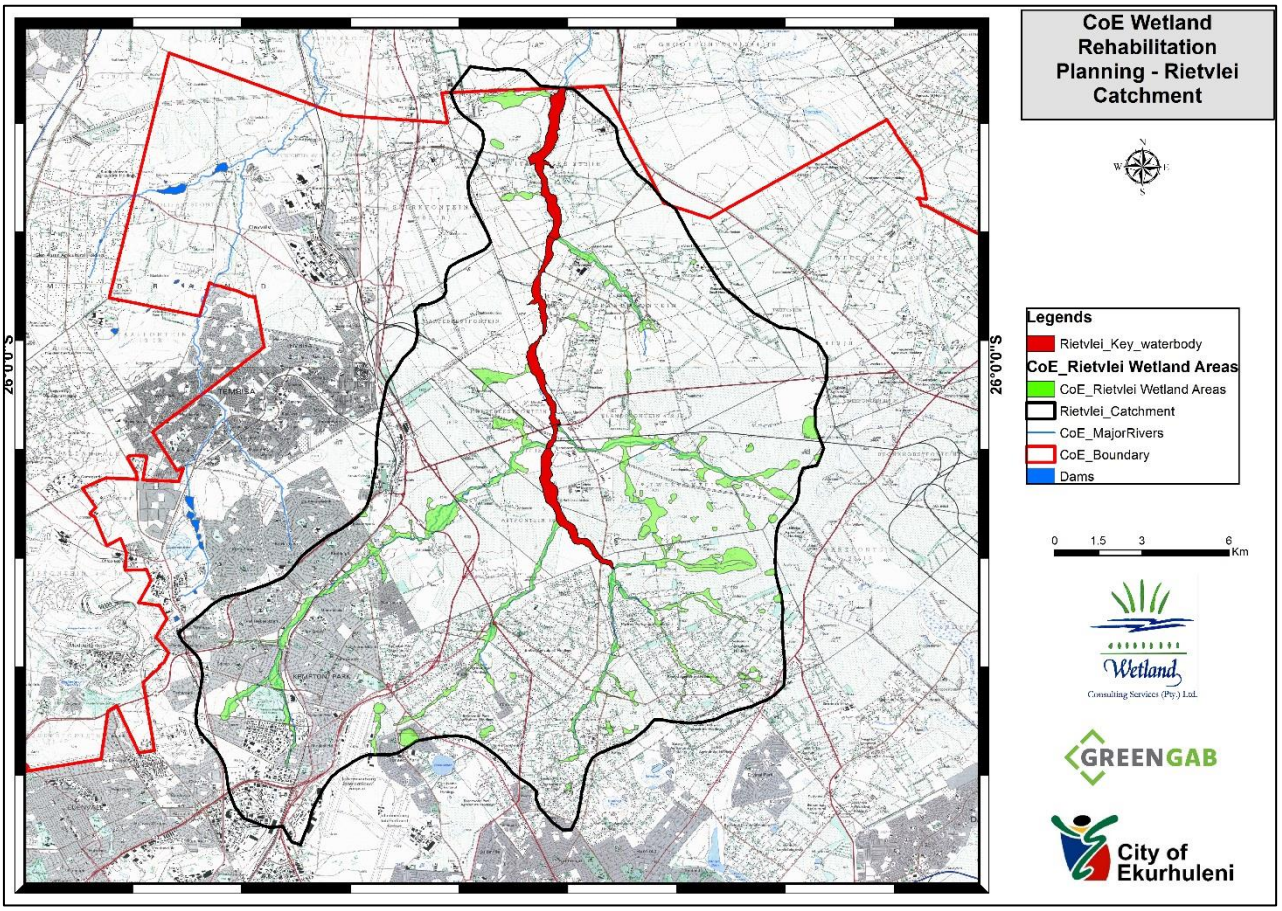



**Figure 7: Map showing considered key waterbodies identified within the Rietvlei catchment.**

The third order of prioritisation includes integration, assessment, scoring analysis of the following datasets:

- FEPA wetlands;
- Biodiversity support;
- Ecosystem threat status and protection level;
- COE landownership; and
- Wetland condition (PES).

Scoring used for the above selection criteria is as follows:

- 1 = Low
- 2 = Moderate
- 3 = High
- 4 = Very High

| Ecosystem Threat Status | Ecosystem Protection level | Biodiversity Support (C-Plan) | Score |
|---|---|---|---|
| Critical Endangered | Well protected | Irreplaceable | 4 |
| Endangered | Moderate Protected | Protected | 3 |
| Vulnerable | Poor Protected | Important | 2 |
| Least Threatened | Not Protected | Ecological Support Areas | 1 |

However, the NFEPA and CoE landowners were scored as follows:

| NFEPA | Land Ownership | Score |
|---|---|---|
| FEPA Wetlands | CoE Owned Land | 1 |
| Non FEPA Wetlands | Private land | 2 |

In order to combine all criteria into one prioritization ranking, all scores were added up and then rounded to the nearest integer. The highest combined score then represents the highest prioritization. The following categories were determined for the final prioritisation class of wetland areas.

| Priority List | Scoring Category Ranges |
|---|---|
| Very High | 13 - 16 |
| High | 9 - 12 |
| Moderate | 5 - 8 |
| Low | 1 - 4 |

Based on the above integration of scoring systems, Figure 8 below indicates the results of the prioritisation exercise.

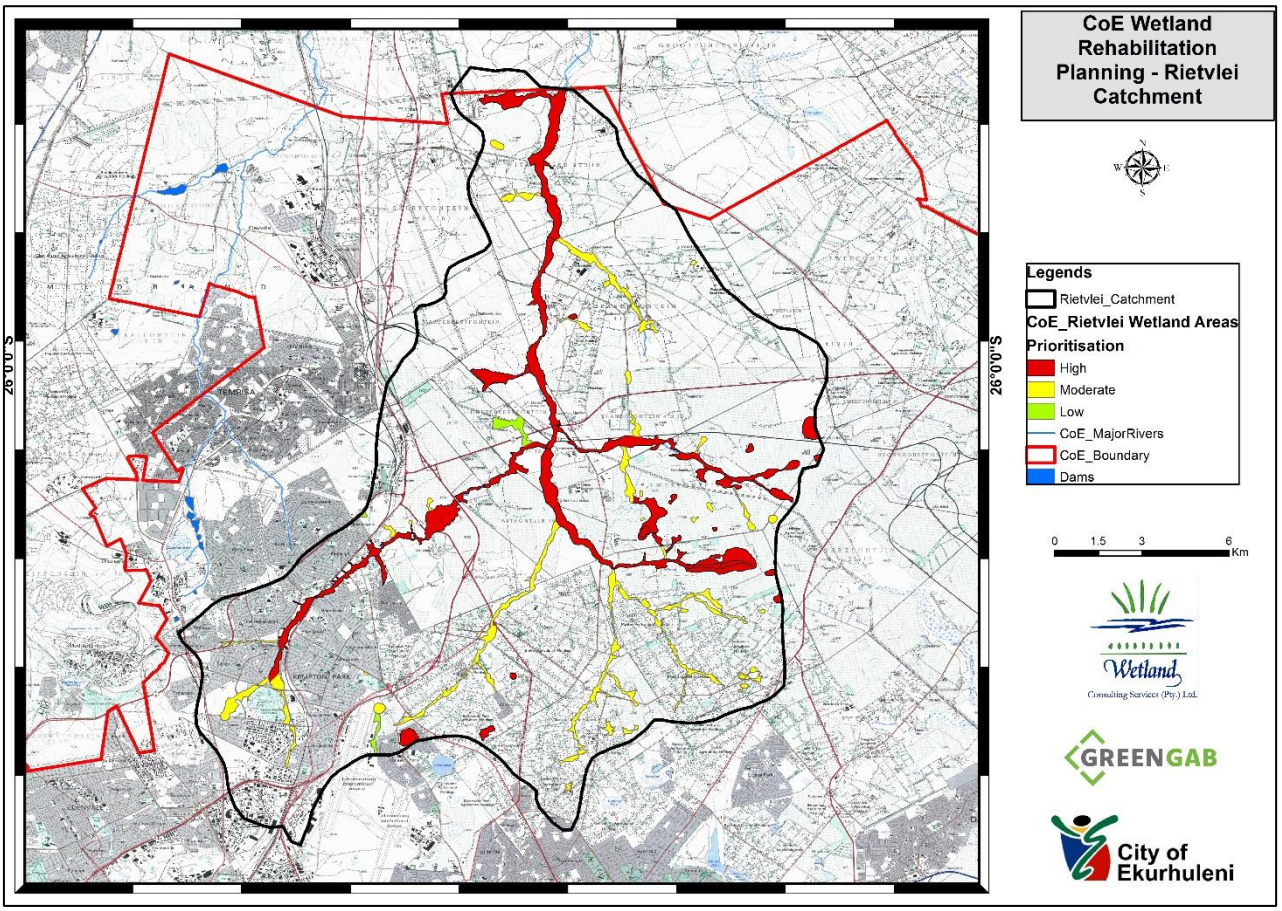



**Figure 8: Map showing the prioritisation of wetlands based on available data analysis as proposed onsite.**

Figure 9 below indicates the integration of all priority lists based on the above third order of prioritisation, while Table 5 indicate distribution of wetlands types prioritised for rehabilitation as part of this project. The wetlands indicated in Figure 9 include all the wetlands to be considered for wetland rehabilitation planning going forward for the project. Table 6 provided a distribution of wetland remaining within the Rietvlei Catchment to be considered and further assessed in terms of suitability for any future wetland rehabilitation work or projects. Table 6 further indicates that only 866.85 ha of wetland are targeted for rehabilitation for this current project within the 2103.5 ha of wetlands assessed for the entire Rietvlei Catchment and this further indicates that 1236.3 ha of wetlands are still available for further assessment in terms of suitability for rehabilitation for any future work the CoE may want to peruse after this project.

**Table 5: Distribution and total coverage of wetland types prioritised for rehabilitation as part of this project.**

| Catchment | CoE Wetland & Watercourses Types | Areas (Ha) | % Coverage |
|---|---|---|---|
| Rietvlei | Channelled Valley Bottom | 841.73 | 40.02% |
| Rietvlei | Depression (Pans) | 149.21 | 7.09% |
| Rietvlei | Drainage Line | 5.81 | 0.28% |
| Rietvlei | Seepage | 487.29 | 23.17% |
| Rietvlei | Unchannelled Valley Bottom | 619.10 | 29.44% |
| **TOTAL** | | **2103.15** | **100.00%** |

**Table 6: Distribution of remaining and total coverage of wetland types prioritised for rehabilitation as part of wetlands within the Rietvlei Catchment to be considered and further assessed in terms of their suitability for any future wetland rehabilitation work and/or projects.**

| Catchment | CoE Wetland & Watercourses Types | Areas (Ha) | % Coverage | Prioritised Wetlands for Rehabilitation | Remaining wetland for future work |
|---|---|---|---|---|---|
| Rietvlei | Channelled Valley Bottom | 841.73 | 40.02% | 724.21 | 117.52 |
| Rietvlei | Depression (Pans) | 149.21 | 7.09% | 29.88 | 119.33 |
| Rietvlei | Drainage Line | 5.81 | 0.28% | 0.00 | 5.81 |
| Rietvlei | Seepage | 487.29 | 23.17% | 0.00 | 487.29 |
| Rietvlei | Unchannelled Valley Bottom | 619.10 | 29.44% | 112.76 | 506.34 |
| **TOTAL** | | **2103.15** | **100.00%** | **866.85** | 1236.30 |

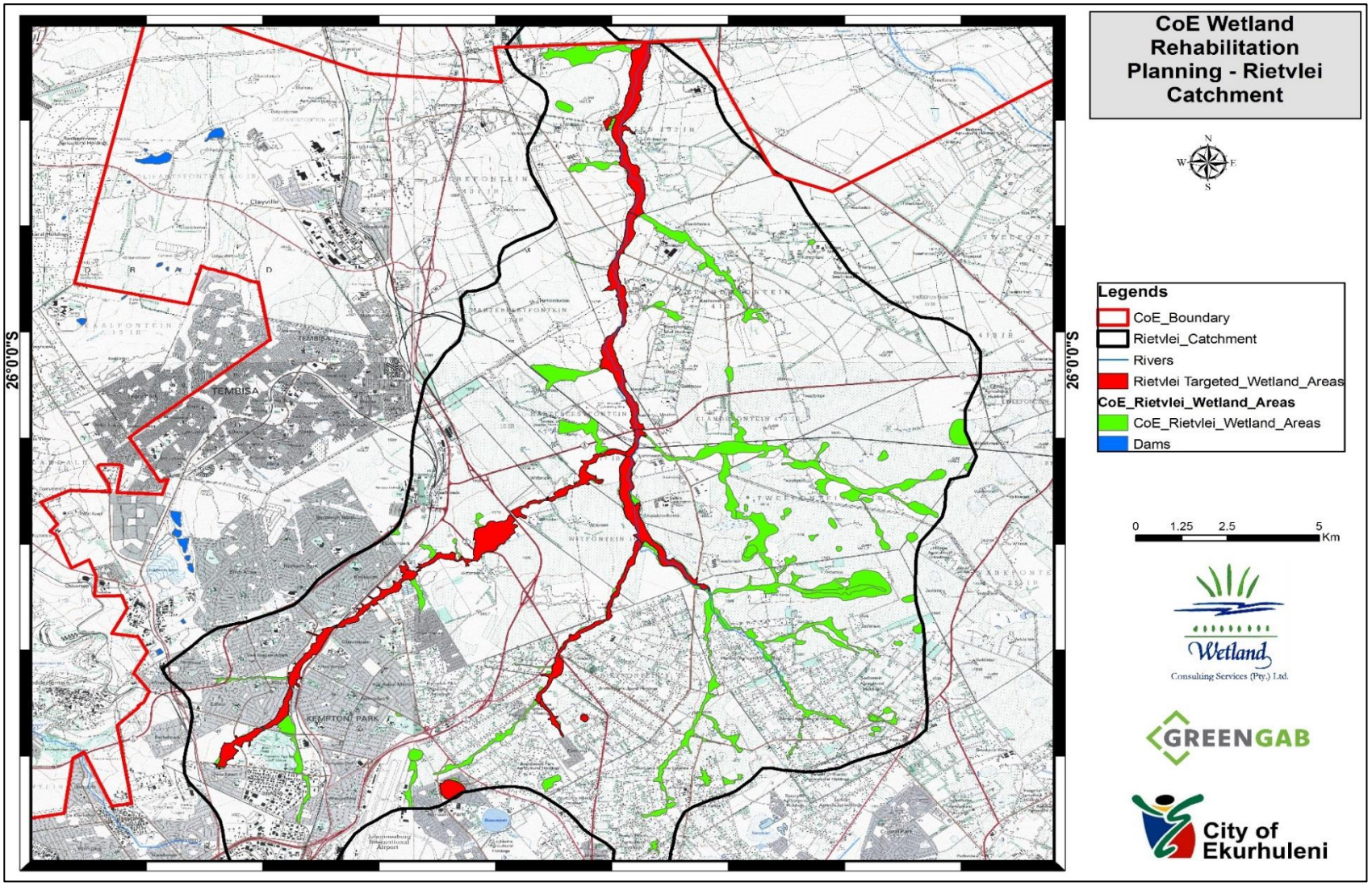



**Figure 9: Map showing the integrated prioritisation list and all wetlands to be considered for rehabilitation planning going forward.**

## 3.4 DELINEATION OF REHABILITATION ZONES

Due to the large extent of the wetland areas to be assessed on site, a simplified approach was adopted to assess these areas within the project area on site. The study catchment area was subdivided into **four Rietvlei rehabilitation zones.** Subdivision of the study area into a number of rehabilitation zones has the following benefit:

- Sharpening the focus on the environmental problems encountered in each of the six zones;
- Reducing the scale of the problems to be addressed, to those encountered within each zone;
- Ensuring community participation in the benefits of the rehabilitation process by addressing the rivers/wetlands problems within the geographic boundaries of each community;
- Ensuring as far as reasonably possible, that each community passes on water of acceptable quality to its downstream neighbours.

The subdivision is merely based on the point of confluence of tributaries in order to ensure manageable small catchments upstream. Figure 10 below indicates the proposed rehabilitation zones of the wetlands considered for further rehabilitation planning as shown in Figure 8 above.

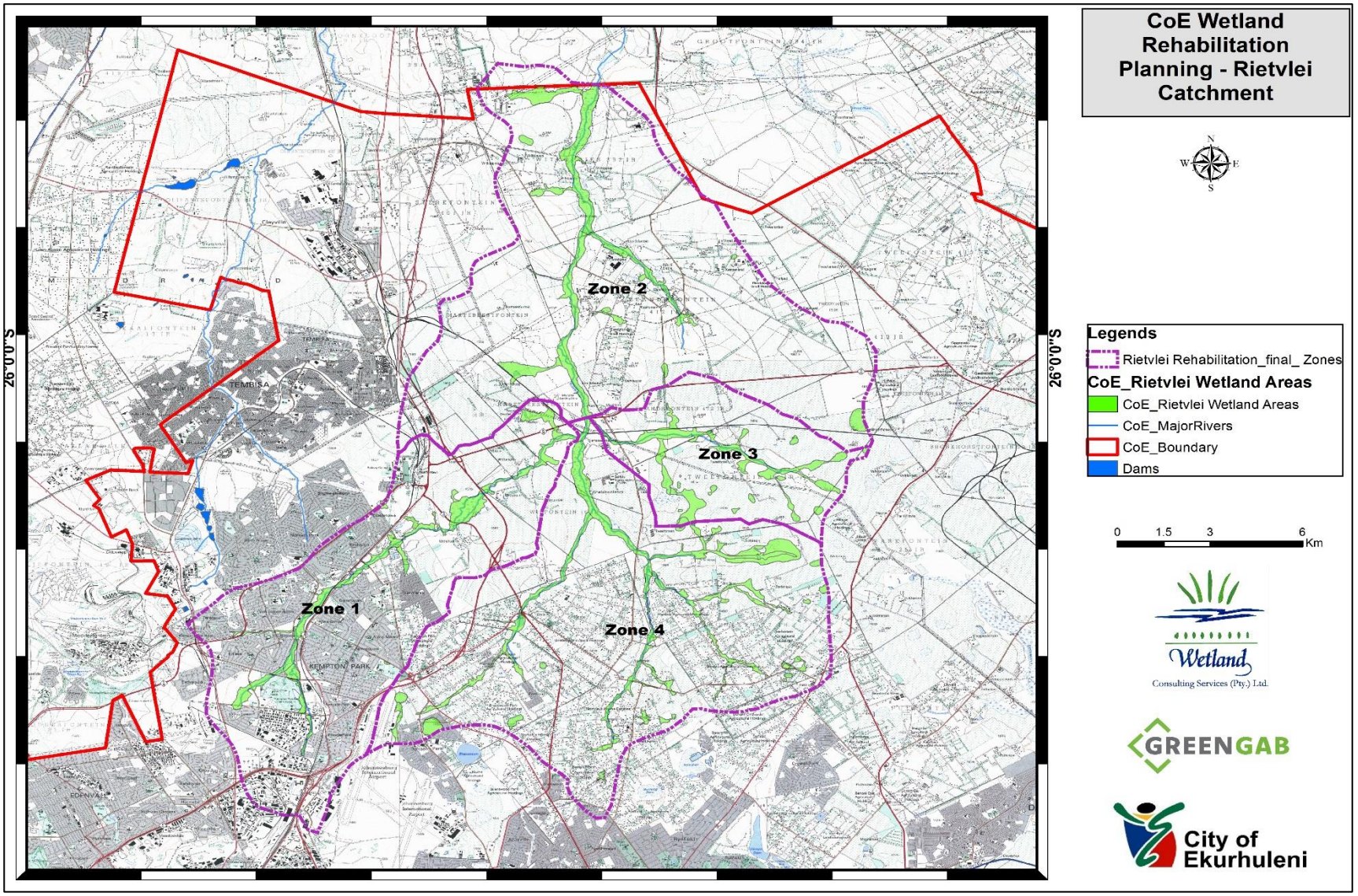



**Figure 10: Map showing the extent of rehabilitation zones for the wetlands to be considered for rehabilitation planning onsite.**

## 3.5 SITE ASSESSMENTS AND DEVELOPMENT OF A REHABILITATION STRATEGY FOR THE PRIORITISED WETLAND SYSTEMS

Planning a wetland rehabilitation strategy is a three-phase process involving:

1. The identification of the problems compromising wetland ecological integrity;
2. Setting rehabilitation objectives based on an analysis of the problems and the feasible extent of addressing them in order to make ecological improvements; and
3. Formulating solutions aimed at achieving the set objectives.

A range of problems undermining wetland ecological integrity were identified during the site visits. Addressing these impacts forms the underlying goal of the proposed wetland rehabilitation strategy. Rehabilitation inherently implies that there is a concession that it will not be possible to reinstate all of the driving ecological processes within the wetlands because:

- The hydrology of the catchment has been fundamentally altered; or
- The physical impact within the wetland will be too costly to reverse.

Only those processes that are realistically achievable were therefore considered and used to form the basis of the rehabilitation objectives. Under the current scenario, the goal of rehabilitating the wetlands to functional systems in some places is considered to be realistic.
This rehabilitation strategy provides an indication of rehabilitation interventions that can be considered during the design phase of the project. The feasibility of some of the proposed activities will further be assessed with an environmental engineer in terms of implementability and costing.

### 3.5.1 WETLAND REHABILITATION ZONE 1


**Figure 11: Map showing the extent of Rehabilitation Zone 1 with associated wetland areas.**

#### 3.5.1.1 HYDROGEOMORPHIC UNIT: CHANNELLED VALLEY BOTTOM (HGM 1.1) - GPS CO-ORDINATE: 26° 5'33.98"S; 28°13'4.94"E

**A. Impacts**

- Road culvert for storm-water;
- Dumping of building rubble and litter;
- Alien invasive vegetation:
  - *Bidens Formosa*
  - *Bidens pilosa*
  - *Populus alba*
  - *Arundo donax*
  - *Salix babylonica*
- Headcut erosion of channel; and
- Erosion of channel at side of gabion weir A21A-03-004.

**B. Rehabilitation objectives**

- Improve aesthetic appeal of the channel and surrounding open area for the community; and
- Improve habitat and attract local avifauna species.

**C. Rehabilitation activities**

- Removal of rubble and litter around the channel and in the open surrounding area and supply an alternative official dumping site;
- Removal of water pollutants;
- Remove alien invasive vegetation;
- Revegetate the channel using indigenous flora:
- Typical Species:
  - *Typha capensis*
  - *Juncus effuses*
  - *Kyllinga erecta*
  - *Schoenoplectus decipiens*
- Revegetate the open area using indigenous flora:
- Typical Species:
  - *Erythrina lysistemon trees*
  - *Celtis Africana trees*
  - *Melinis repens*
  - *Eragrostis racemosa*
- Create designated paths in the open surrounding area and bridges across the channel; and
- Create a recreational area for the community in the open surrounding by providing benches, park facilities and planting trees to provide shade.

## A. Photographs of impacts recorded in wetlands onsite

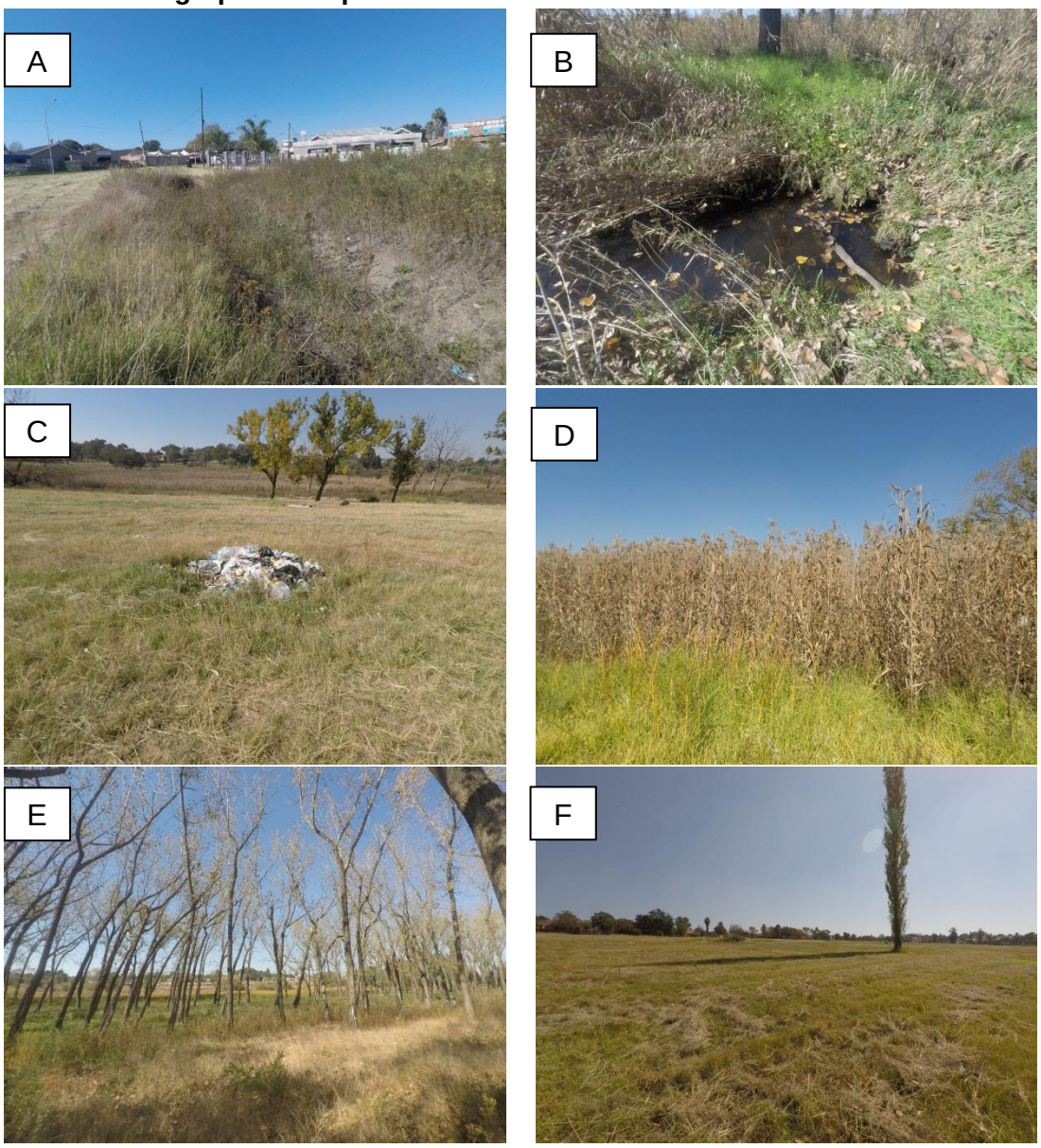



**Figure 12: A. Upstream of road culvert and alien invasive vegetation (26º5'33.48"S; 28º13'8.95E); B. Headcut erosion (26º4'41.01"S; 28º13'28.90E); C. Dumping of rubble and litter (26º4'32.30"S; 28º13'31.82E); D. Alien invasive vegetation, namely *Arundo donax* (26º4'38.95"S; 28º13'33.20E); E. Alien invasive vegetation, namely *Populus alba* (26º4'42.79"S; 28º13'25.84E); F. Open space adjacent to channel and suitable for recreational area (26º4'37.13"S; 28º13'29.97E). G. Gabion weir with concrete pipe (26º4'28.84"S; 28º13'33.13E); H. Concrete spillway: A21A-03-005 (26°4'48.00"S; 28º13'27.60"E); I. Concrete spillway: A21A-03-005 (26°4'48.00"S; 28º13'27.60"E).**

## B. Photographs of interventions present

A

B

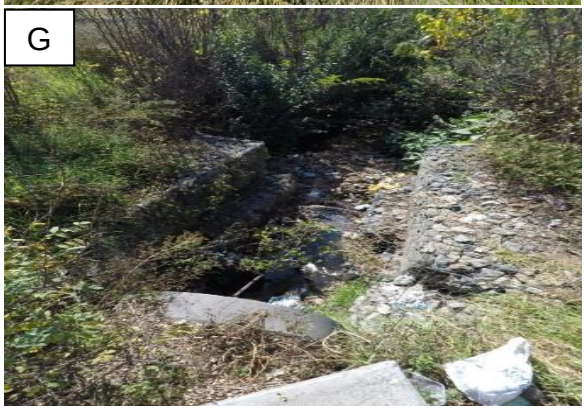
C

D

E

F

G



H


**Figure 13: A. Gabion weir: A21A-03-003 (26º4'38.15"S; 28º13'32.30E); B. Headcut erosion at far side of gabion weir: A21A-03-004 (26º4'40.15"S; 28º13'33.46E); C. Headcut erosion at far side of gabion weir: A21A-03-004 (26º4'40.15"S; 28º13'33.46E); D. Gabion weir: A21A-03-006 (26º4'46.61"S; 28º13'25.64E); E. Gabion weir (26º4'46.98"S; 28º13'26.44E); F. Gabion weir with concrete pipe (26º4'28.84"S; 28º13'33.13E).**

### 3.5.2 WETLAND REHABILITATION ZONE 2

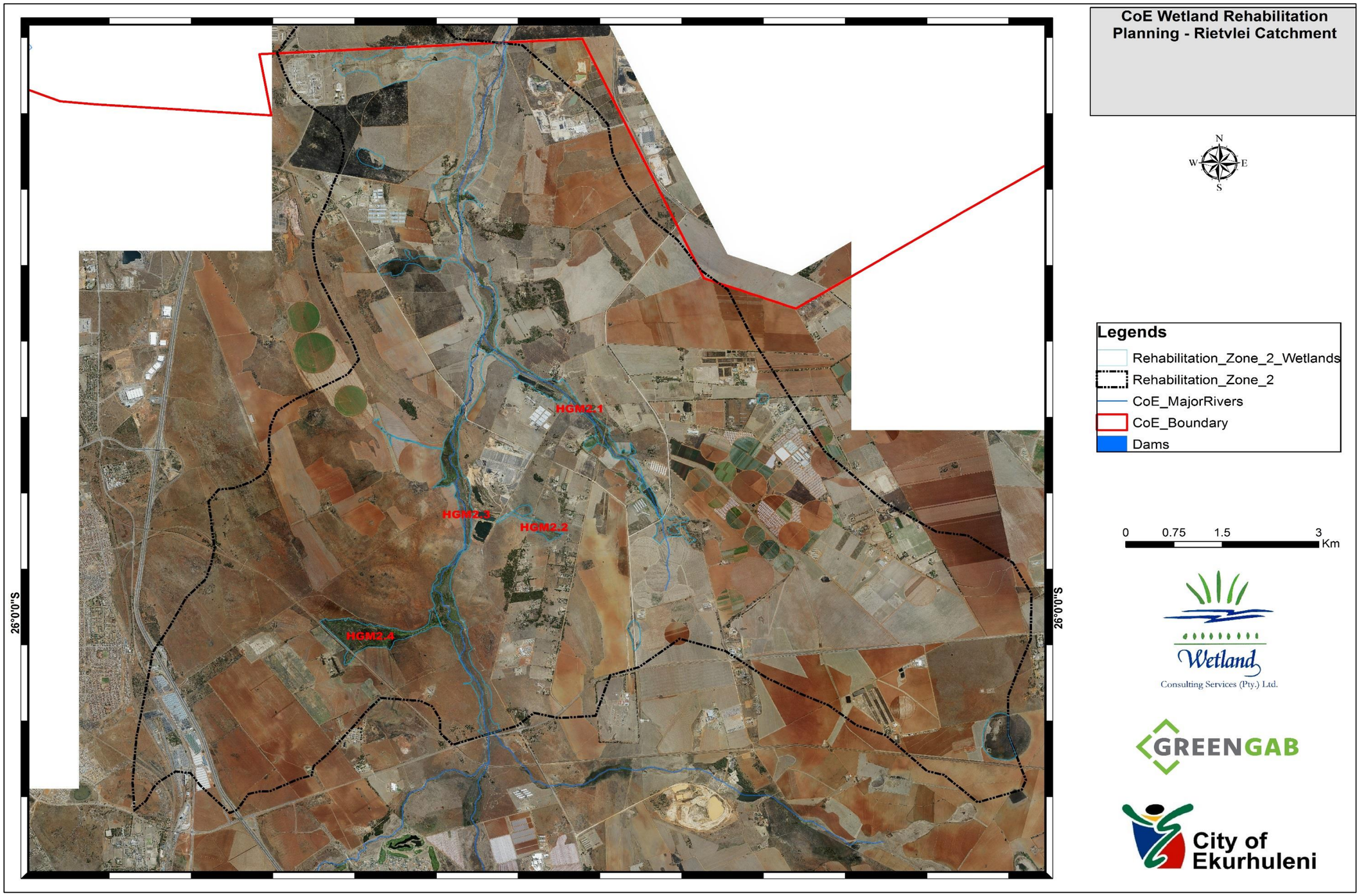



**Figure 14: Map showing the extent of Rehabilitation Zone 2 with associated wetland areas.**

#### 3.5.2.1 HYDROGEOMORPHIC UNIT: CHANNELLED VALLEY BOTTOM (HGM 2.1): GPS CO-ORDINATE: 25°59'8.21"S; 28°19'52.29"E

**A. Impacts**

- Cultivation within and around the edges of the wetland;
- Damming of water and flow impediments;
- Road crossing and culverts impeding the flow;
- Trenching and diversion of flows and water abstractions;
- Alien invasive vegetation; and
- Infilling and heap of soils.

**B. Rehabilitation objectives**

- Improve aesthetic appeal of the channel and surrounding open areas;
- Improve habitat and vegetation species composition; and
- Improve ecological integrity and functioning of the wetland system.

**C. Rehabilitation activities**

- Deactivate diversion channels, trenches and drains;
- Removal of alien vegetation invasive;
- Buffer agricultural activities away from the edge of the wetland; and
- Removal of redundant infrastructure and levelling of heap of soil within the wetland area.

**A. Photographs**


**Figure 15: View of the trench and dam (25º59'9.15"S; 28º19'53.69E).**

#### 3.5.2.2 HYDROGEOMORPHIC UNIT: UNCHANNELLED VALLEY BOTTOM (HGM 2.2): GPS CO-ORDINATE: 25°59'9.78"S; 28°18'39.74"E

**A. Impacts**

- Ruts on informal road;
- Presence of an old dam;
- Road crossing;
- Old farm dam;
- Trench or drain upstream of the road; and
- Excavations from brick mining above confluence with Rietvlei.

**B. Rehabilitation objectives**

- Improve ecological integrity of the wetland

**C. Rehabilitation activities**

- Construct proposer road crossing that enables diffuse and spreading of flow across the wetland;
- Deactivate tranches and drains upstream of the gravel road;
- Infill ruts and monitor informal roads;
- Remove dam water; and
- Design and implement channel through excavation area to maintain connectivity to the main river systems downstream.

**D. Photographs of impacts recorded**

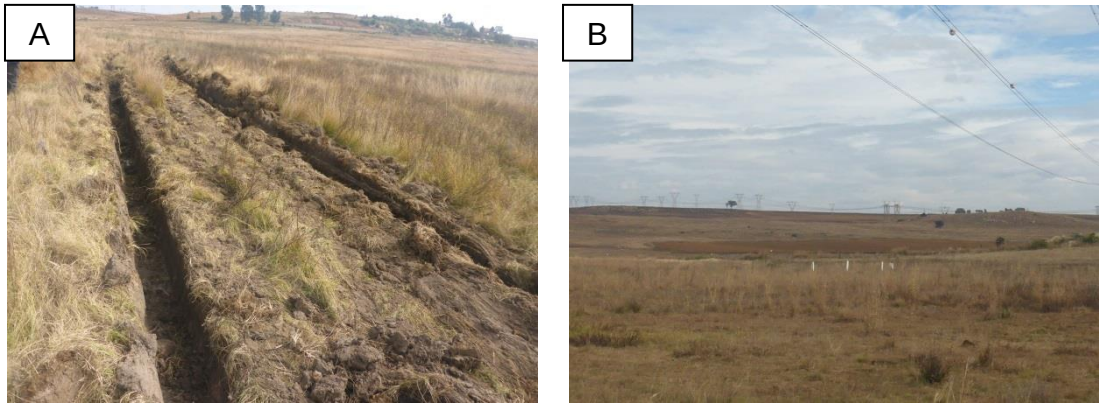



**Figure 16: Ruts on informal road (25°59'7.94"S; 28°18'36.97"E); B. presence of an old dam (25°59'10.02"S; 28°18'41.59"E).**

#### 3.5.2.3 HYDROGEOMORPHIC UNIT: CHANNELLED VALLEY BOTTOM (HGM 2.3): GPS CO-ORDINATE: 26°0'26.15"S; 28°17'59.44"E

**A. Impacts**

- Alien invasive vegetation, namely *Salix babylonica;*
- Headcut and gully erosion of channel;
- Channel incision and lateral erosion; and
- Road crossing and flow confinements.

**B. Rehabilitation objectives**

- Improve natural vegetation composition; and
- Improve ecological integrity of the wetland.

**C. Rehabilitation activities**

- Removal of alien invasive vegetation, namely Salix babylonica; and
- Potentially install structural intervention to halt head cut erosion of channel.

**D. Photographs of impacts recorded**

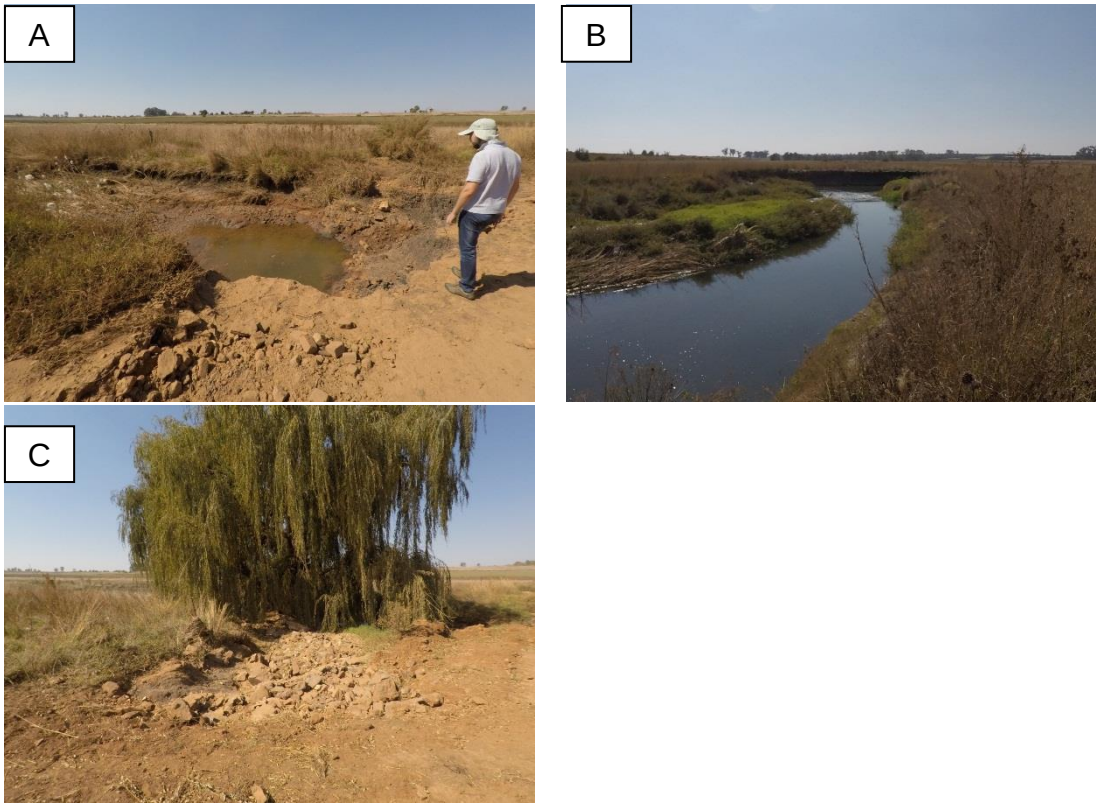



**Figure 17: A. Headcut erosion of channel (25º58'8.97"S; 28º18'3.99E); B. Headcut erosion of channel (25º58'7.48"S; 28º18'5.36E); C. Alien invasive vegetation, namely *Salix babylonica* (25º58'7.67"S; 28º18'3.36E).**

## E. Photographs of interventions present

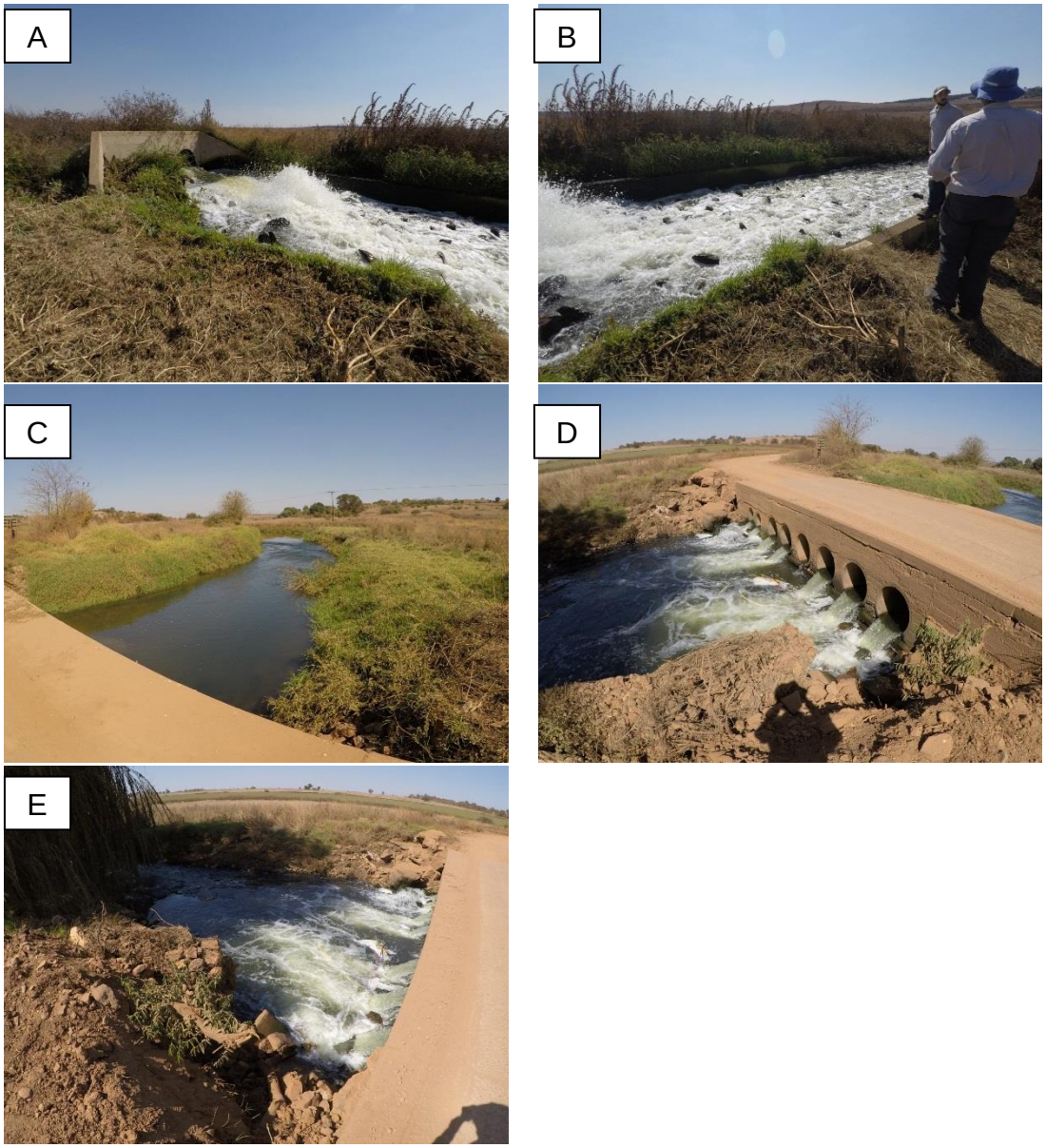



**Figure 18: A. Concrete water outlet and channel that flows into wetland (26º0'26.13"S; 28º17'59.22E); B. Concrete water outlet and channel that flows into wetland (26º0'26.13"S; 28º17'59.22E); C. Bridge and culverts to allow water flow (25º58'7.98"S; 28º18'3.55E); D. Bridge and culverts to allow water flow (25º58'7.98"S; 28º18'3.55E); E. Bridge and culverts to allow water flow (25º58'7.98"S; 28º18'3.55E).**

### 3.5.2.4 HYDROGEOMORPHIC UNIT: HILLSLOPE SEEPAGE (HGM 2.4): GPS CO-ORDINATE: 26°0'21.13"S; 28°16'57.86"E

**A. Impacts**

- Alien invasive vegetation:
  - *Eucalyptus grandis*
  - *Arundo donax*
  - *Salix babylonica*
  - *Acacia mearnsii*
  - *Poplus alba*

**B. Rehabilitation objectives**

- Improve natural vegetation species compositions; and
- Improve ecological integrity of the wetland.

**C. Rehabilitation activities**

- Removal of alien invasive vegetation except Salix babylonica as it is a very good shade plant; and
- Buffering of agricultural fields around the wetlands.

**D. Photographs of impacts recorded**

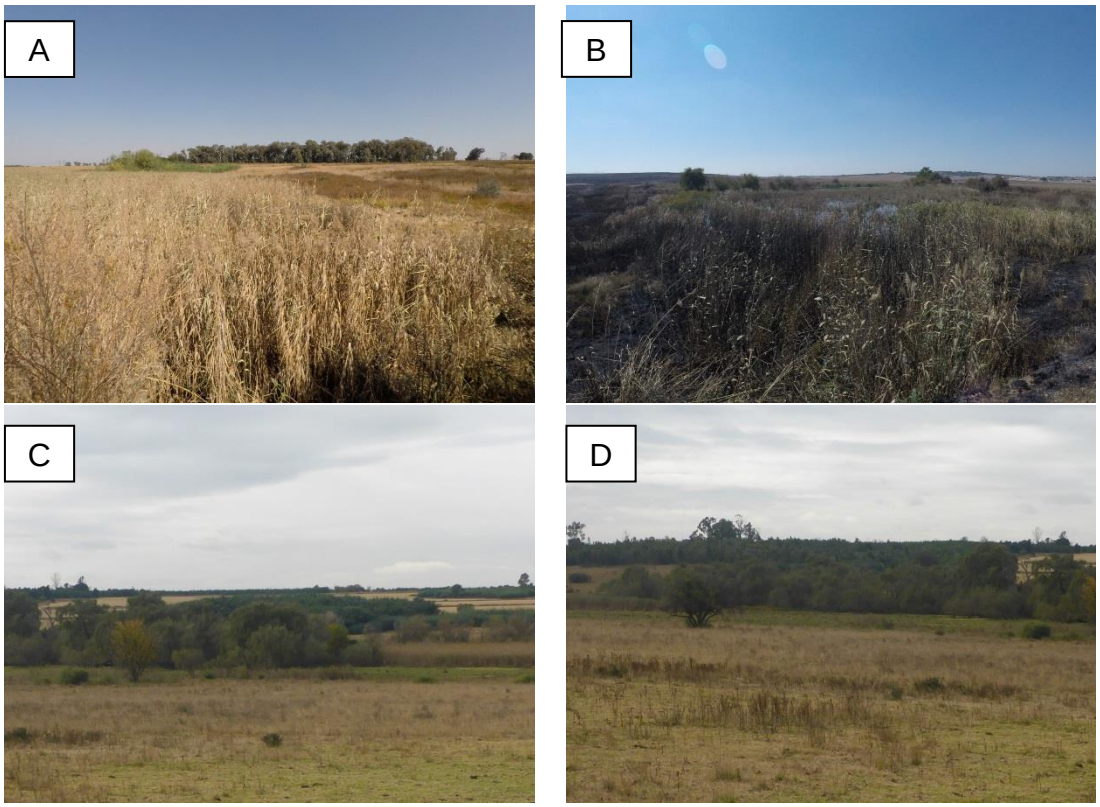



**Figure 19: A. Hillslope seepage wetland with alien invasive vegetation, namely *Eucalyptus grandis* and *Arunda donax* (26º0'21.28"S; 28º16'57.76E); B. Hillslope seepage wetland (26º0'21.28"S; 28º16'57.76E); C. Alien invasive vegetation (25°57'28.08"S; 28°18'6.33"E); D. Alien invasive vegetation (25°57'28.08"S; 28°18'6.33"E).**

### 3.5.3 WETLAND REHABILITATION ZONE 3

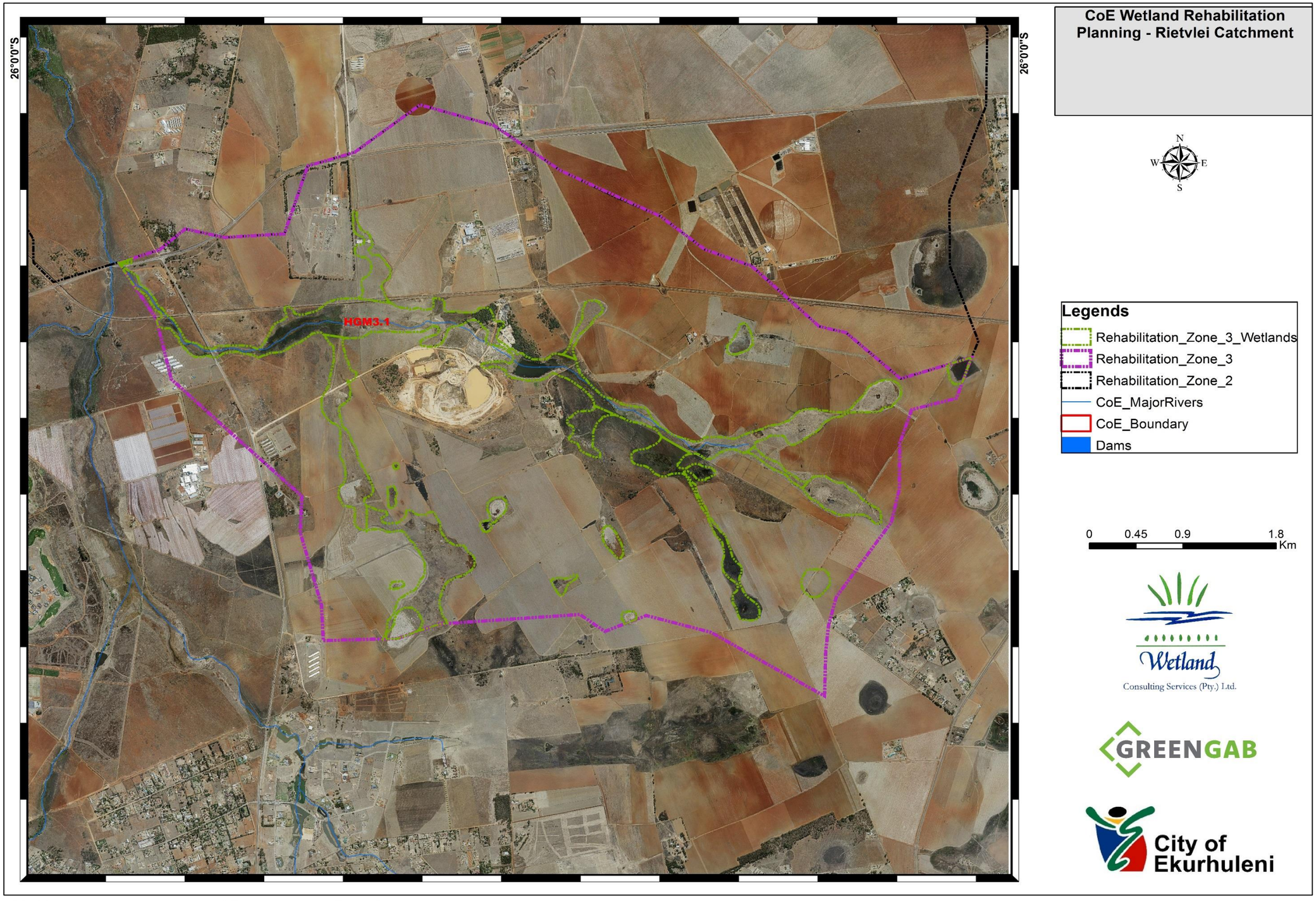



**Figure 20: Map showing the extent of Rehabilitation Zone 3 with associated wetland areas.**

#### 3.5.3.1 HYDROGEOMORPHIC UNIT: CHANNELLED VALLEY BOTTOM (HGM 3.1): GPS CO-ORDINATE: 26°1'23.43"S; 28°19'55.89"E

**A. Impacts**

- Excavation from sand mining activities happening in the valley bottom;
- Informal roads and disturbance;
- Presence of a dam;
- Alien invasive vegetation:
  - *Populus alba*
  - *Acacia mearnsii*
  - *Bidens Formosa*
  - *Ipomoea purpurea*
- Dumping of litter and building rubble; and
- Presence of power lines

**B. Rehabilitation objectives**

- Improve ecological integrity and functioning of the wetland system.

**C. Rehabilitation activities**

- Remove alien invasive vegetation.

**D. Photographs of impacts recorded**


**Figure 21: A. Excavation and sediment deposition from sand mining activities (26°1'34.87"S; 28°20'1.04"E); B. One of the informal roads within the valley bottom (26°1'41.74"S; 28°20'53.44"E); C. Alien invasive vegetation adjacent to a dam (26°1'35.09"S; 28°20'38.7"E); D. Power lines (26°1'34.88"S; 28°19'7.59"E).**

### 3.5.4 WETLAND REHABILITATION ZONE 4

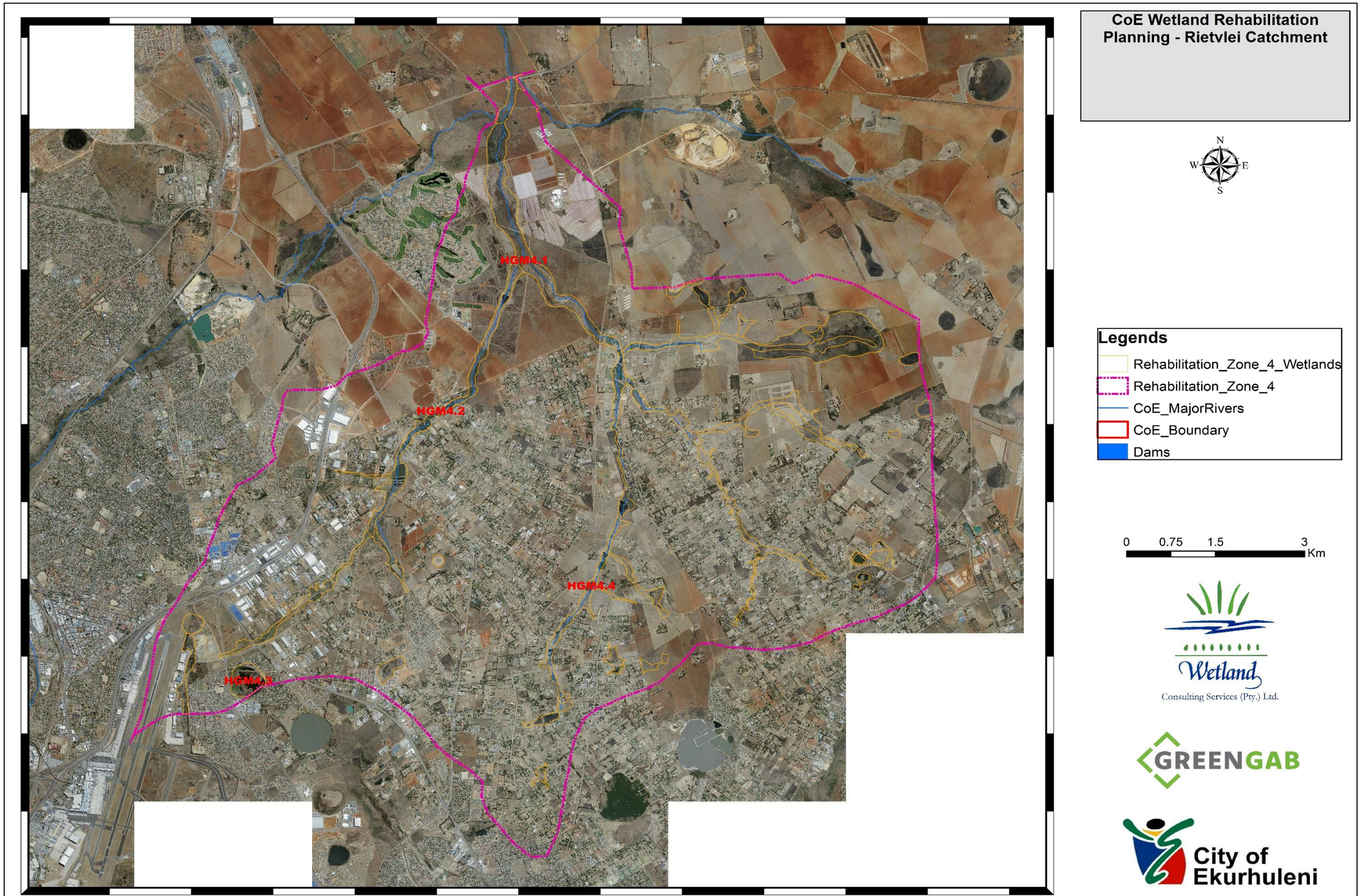



**Figure 22: Map showing the extent of Wetland Rehabilitation Zone 4 with associated wetland HGM units.**

### 3.5.4.1 HYDROGEOMORPHIC UNIT: CHANNELLED VALLEY BOTTOM (HGM 4.1)GPS CO-ORDINATE: 26°2'31.35"S; 28°18'13.71"E

**A. Impacts**

- Weakly channelled valley bottom wetland, i.e. channel is not continuous;
- Informal roads damaged from driving forming ruts and creating preferential flow paths;
- Presence of a water pipeline;
- Landscape in between secure estate (on opposite side of a formal road that cuts through the valley bottom wetland);
- Deeply incised channel;
- Dumping of litter; and
- Alien invasive vegetation
  - *Populus alba*
  - *Acacia mearnsii*
  - *Bidens Formosa*

**B. Rehabilitation objectives**

- Remove alien invasive vegetation;
- Prevent further erosion of the channel; and
- Improve and maintain aesthetic appeal of the channel and surrounding open area.

**C. Rehabilitation activities**

- Monitor informal roads and ruts;
- Install multiple structures along the channel to help raise the water table. There is no risk of flooding because it is an open space;
- Removal of litter; and
- Remove alien invasive vegetation

**D. Photographs of impacts recorded**

A

B


**Figure 23: A. Damaged informal roads from driving forming ruts and creating preferential flow paths (26°3'19.20''S; 28°18'49.84''E); B. Damaged informal roads from driving forming ruts and creating preferential flow paths (26°3'19.20''S; 28°18'49.84''E). C. Presence of a water pipeline (26°3'37.01''S; 28°19'4.66''E); D. Private estates across the road but within the valley bottom wetland (26°3'38.65''S; 28°19'10.27''E), E. Litter dumping in and outside the channel (26°1'23.73''S; 28°18'12.06''E), F. Alien invasive vegetation (26°1'24.67''S; 28°18'12.73''E), G. Upstream of incised channel (26°1'27.73S; 28°18'0.01''E); H. Downstream of incised channel (26°1'27.73S; 28°18'0.01''E).**

#### 3.5.4.2 HYDROGEOMORPHIC UNIT: CHANNELLED VALLEY BOTTOM (HGM 4.2): GPS CO-ORDINATE: 26°4'50.17"S; 28°17'5.57"E

**A. Impacts**

- Water polluted (sewage discharge into dam);
- Alien invasive vegetation:
  - *Eucalyptus grandis*
  - *Arundo donax*
  - *Salix babylonica*
  - *Cortaderia selloana*
  - *Populus alba*
- Collapsed dam wall and bridge;
- Pathways; and
- Collapsed bridge wall.

**B. Rehabilitation objectives**

- Improve aesthetic appeal and surrounding areas;
- Improve habitat and attract local avifauna species;
- Create recreational spaces local communities;
- Remove alien invasive vegetation;
- Remove water pollutants; and
- Reinstate dam wall and bridge.

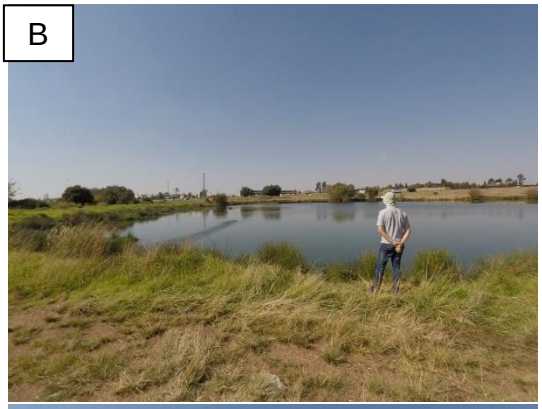
**C. Rehabilitation activities**

- Replace collapsed dam wall and bridge;
- Removal of water pollutants;
- Improve road by installing a low-lying gabion crossing that is cemented on top to allow diffuse flow;
- Removal of alien invasive vegetation;
- Revegetate the open area using indigenous flora:
- Typical Species:
  - *Erythrina lysistemon trees*
  - *Celtis Africana trees*
  - *Melinis repens*
  - *Eragrostis racemosa*
- Create designated paths in the open surrounding area and bridges at the dam wall; and
- Create a recreational area for the community in the open surrounding by providing benches, park facilities and planting trees to provide shade.

## D. Photographs of impacts recorded

A

B



C

D

E

F

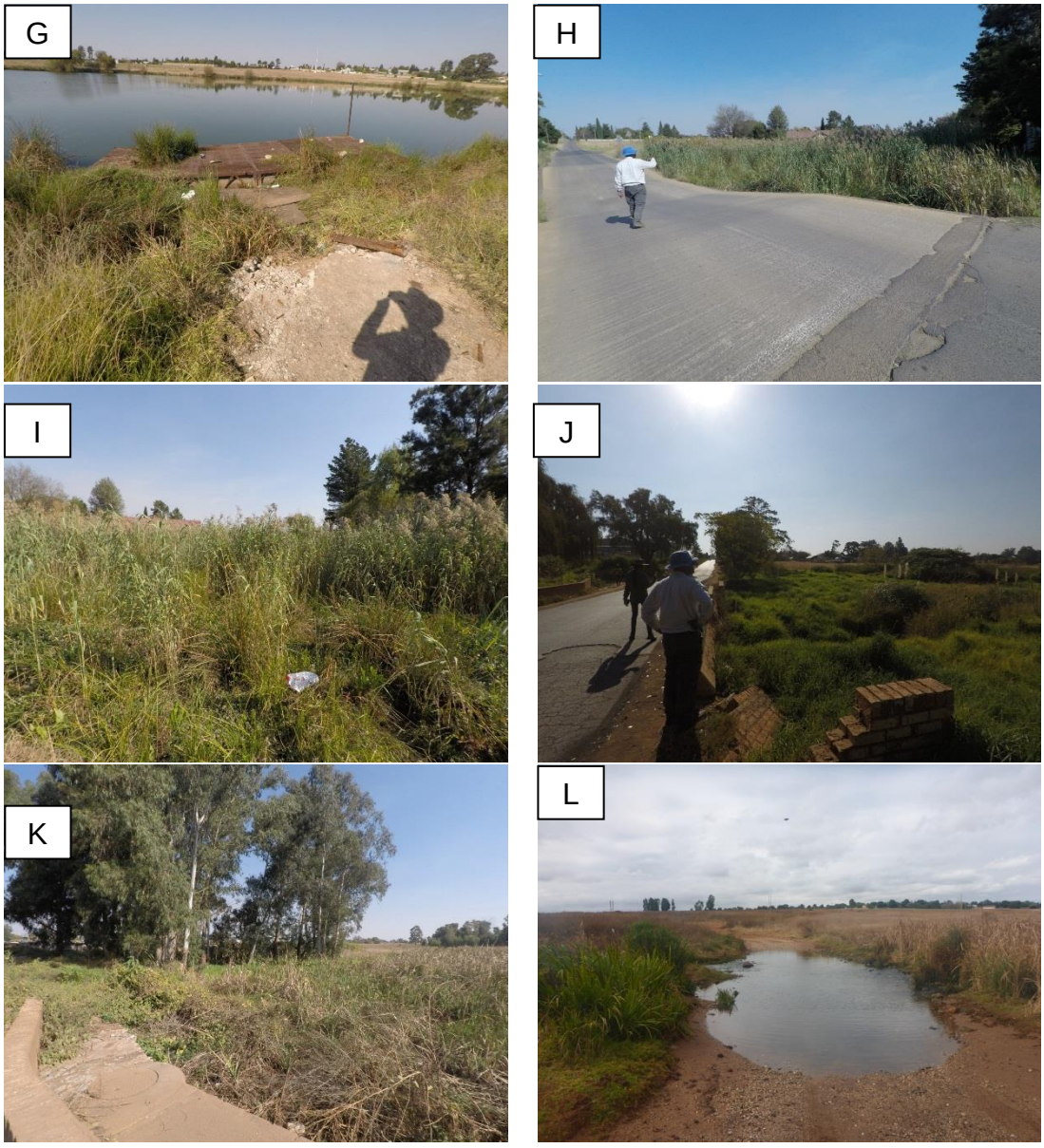



**Figure 24: A. Open space suitable for recreational area (26º4'52.56"S; 28º17'3.61E); B. Open space suitable for recreational area (26º4'52.56"S; 28º17'3.61E); C. Open space suitable for recreational area (26º4'52.56"S; 28º17'3.61E); D. Path (26º4'51.46"S; 28º17'4.09E); E. Collapsed dam wall and bridge (26º4'50.54"S; 28º17'7.34E); F. Headcut erosion of channel (26º4'50.54"S; 28º17'7.34E). G. Damaged dock (26º4'53.70"S; 28º17'3.62E); H. Alien invasive vegetation (26º5'38.91"S; 28º16'41.15E); I. Alien invasive vegetation, namely *Arunda donax* (26º5'39.38"S; 28º16'41.28E); J. Collapsed bridge wall and alien vegetation, namely *Cortaderia selloana* (26º6'16.92"S; 28º16'1.67E); K. Alien invasive vegetation, namely *Eucalyptus grandis* (26º6'16.97"S; 28º16'1.43E); L. Erosion of road where a channel cuts through and alien vegetation (26°3'43.68"S; 28°17'58.97"E).**

**E. Photographs of interventions present**

**Figure 25: A. Collapsed dam wall and bridge (26º4'50.54"S; 28º17'7.34E).**

### 3.5.4.3 HYDROGEOMORPHIC UNIT: PAN (HGM 4.3): GPS CO-ORDINATE: 26° 6'56.97"S; 28°15'24.49"E

**A. Impacts**

- Damaged fencing;
- Litter; and
- Alien invasive vegetation, namely *Eucalyptus grandis.*

**B. Rehabilitation objectives**

- Replace fencing;
- Remove litter; and
- Remove alien invasive vegetation.

**C. Rehabilitation activities**

- Replace fencing;
- Remove litter; and
- Remove alien invasive vegetation.

**D. Photographs of impacts recorded**



**Figure 26: A. Damaged fencing (26º6'57.31"S; 28º15'22.30E); B. Damaged fencing (26º6'57.31"S; 28º15'22.30E); C. Alien invasive vegetation, namely *Eucalyptus grandis* (26º6'57.31"S; 28º15'22.30E); D. Litter (26º6'57.31"S; 28º15'22.30E).**

#### 3.5.4.4 HYDROGEOMORPHIC UNIT: UNCHANNELLED VALLEY BOTTOM (HGM 4.4): GPS CO-ORDINATE: 26°5'37.04"S; 28°19'13.30"E

**A. Impacts**

- Litter; and
- Alien invasive vegetation:
  - *Populus alba*
  - *Salix babylonic*
  - *Eucalyptus grandis*

**B. Rehabilitation objectives**

- Removal of litter from channel; and
- Removal of alien invasive vegetation

**C. Rehabilitation activities**

- Remove of litter from channel; and
- Remove alien invasive vegetation.

**D. Photographs of impacts recorded**

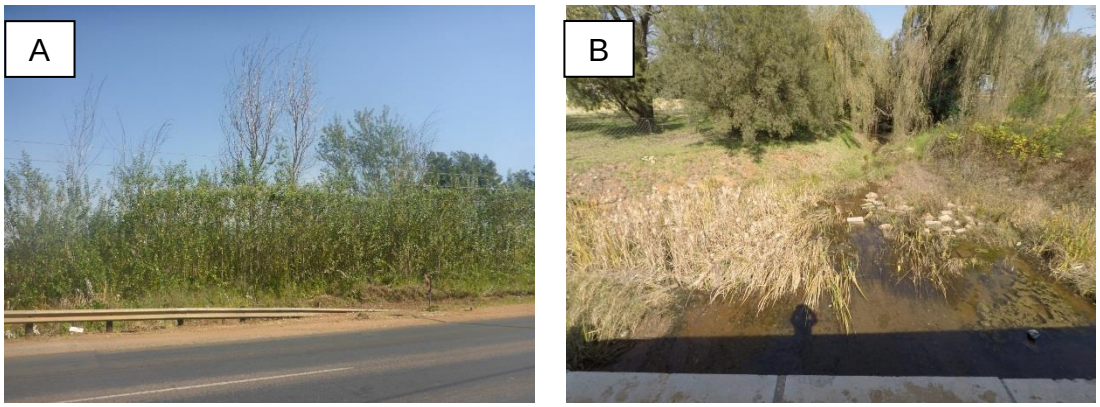



**Figure 27: A. Alien invasive vegetation, namely *Populus alba* (26º6'3.53"S; 28º19'2.21E); B. Upstream of bridge and alien invasive vegetation, namely *Salix babylonica* (26º4'43.25"S; 28º19'20.30E); C. Downstream of bridge and alien invasive vegetation, namely *Eucalyptus grandis* (26º4'43.25"S; 28º19'20.30E); D. Litter (26º4'43.25"S; 28º19'20.30E).**

Based on the impacts observed on wetland onsite as well as the proposed strategy per each zone as indicated in above sections, a master plan will be compile. The plan will include all the proposed rehabilitation activities proposed for wetlands onsite including their associated costing and amongst others the activities will include the following:

1. Rehabilitation Activities instream:
    a. Repair of existing rehabilitation structural activities instream (gabion and concrete structures) in order to improve their performances;
    b. Construction of new instream structural interventions (gabions or concrete structures) for stabilisation of channel or stream erosion;
    c. Construction of litter traps and silt traps;
    d. Walkway traversing wetland areas via pedestrian spanning crossings across the wetland area;
    e. Removal of litter and rubbles within the wetland/ watercourses;
    f. Removal of alien vegetation instream; and
    g. Landscaping and revegetation within the wetland areas to improve natural vegetation cover.
2. Rehabilitation Activities outside wetland areas within 500m Water Use Licence Application (WULA) trigger area
    a. Walkways outside delineated areas and along the watercourses;
    b. Physical removal of litter within and along the rivers through initiating various river clean projects;
    c. Formalisation and establishment of communal subsistence agricultural plots outside but along watercourses;
    d. Landscaping and revegetation of disturbed areas outside but along watercourses;
    e. Establishment of gym facilities outside but along watercourses;
    f. Removal of litter and rubbles outside but along wetland/ watercourses;
    g. Removal of alien vegetation outside but along watercourses;
    h. Establishment of rubbish collection facilities and bins at various point/areas outside but along the watercourses; and
    i. Establishment of glassed soccer fields at various places outside but along watercourses.

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