CLIENT
City of Cape Town

MAIN ENVIRONMENTAL CONSULTANT
JG Afrika

PROPOSED DEVELOPMENT OF A SOLAR PHOTOVOLTAIC FACILITY AT PAARDEVLEI, SOMERSET WEST (CAPE TOWN)

SPECIALIST AQUATIC ECOSYSTEMS IMPACT ASSESSMENT

FINAL

OCTOBER 2024

PREPARED BY
Liz Day (PhD; Pr Nat Sci.)
[redacted]

LIZ DAY CONSULTING
Specialist River and Wetland Consultant

LIZ DAY CONSULTING Specialist River and Wetland Consultant

1 December 2023

DECLARATION OF SPECIALIST INDEPENDENCE

I, Elizabeth (Liz) Day as a specialist river and wetland consultant (aquatic ecologist), and Director of Liz Day Consulting (Pty) Ltd (LDC), hereby confirm my independence as a specialist and declare that I do not have any interest, be it business, financial, personal or other, in any proposed activity, application or appeal in respect of which LDC was appointed by JG Afrika to provide a specialist aquatic ecosystems Impact Assessment Report for the proposed development of a solar photovoltaic facility and battery energy storage system on the City of Cape Town-owned Paardevlei site, Somerset West, other than fair remuneration for work performed.

[redacted]

Title / Position: Director

Qualification(s): BA, BSc, BSc Hons, PhD

Experience: > 28 years working on freshwater ecosystems.

Work experience: Liz has worked as a freshwater ecologist / aquatic ecosystems specialist for over 28 years, primarily in the Western Cape, and has produced over 900 technical and Environmental Impact Assessment reports, requiring the assessment and/or recommendations for the management and monitoring of rivers and/or wetlands.

Regarding the current project, Liz has worked extensively on the Paardevlei (previously AECI and then Heartlands) site since 2007. She compiled the freshwater ecosystems component of the Stormwater Masterplan for the overall site and its accompanying Water Use License Application; compiled the Paardevlei rehabilitation plan; the Paardevlei watercourse Operational Management Plan; and the (updated) 2018 Paardevlei Baseline Report; and was the aquatic specialist on various projects and precinct development applications for the overarching site, including Precinct 2; the (now constructed) substation; and the Paardevlei Outfall.

Liz has undertaken numerous DWS Risk Assessments and is familiar with the principles of wetland delineation and watercourse assessment methodologies.

Registrations: Member of IAIA; Member of WISA; Member of SAWS; Member of SER; Registered Professional Natural Scientist with SACNASP (Reg No 400270/08) for fields of Biological Science, Ecological Science, Aquatic Science and Zoological Science.

CV provided in Appendix A

TABLE OF CONTENTS

1 INTRODUCTION

1.1 Background

The City of Cape Town is currently proposing the development of a Solar Photovoltaic (PV) Facility & Battery Energy Storage System (BESS) on City-owned vacant land within Somerset West. The broader site is known as Paardevlei, and the PV/ BESS site ("the site") lies within this greater area. Preparation of the Paardevlei Solar PV Facility & BESS project ("the project") has been funded by the C40 Cities Finance Facility (CFF)[1], as an initiative to mobilise financial resources for transformative actions by cities on a worldwide basis, with the intention of significantly reducing their Green House Gas emissions, and building climate resilience. CFF funding is intended to take projects to funding-ready status.

The proposed project would comprise a 30 to 60 MW facility on City-owned land with a total extent of **152 ha,** connected directly to an existing 132 kV switching station located near to the site (see Figure 1.1). If authorized, construction of the project would be planned to start in the 1st quarter of 2026.

JG Afrika has been appointed through the CFF to oversee the necessary environmental and water use authorization application processes required for the project. Since the site includes numerous wetlands, JG Afrika in turn appointed Liz Day Consulting (Pty) Ltd ("LDC") to provide specialist aquatic ecosystem input into the project Basic Assessment Report (BAR) from an aquatic ecosystems perspective. Specifically, LDC was appointed to compile the present specialist aquatic ecosystem assessment report.

This report is the final specialist aquatic ecosystems report. It includes more detailed mitigation measures regarding wetland rehabilitation, planting and the inclusion of an additional ecological corridor. These are outlined in Section 4.2.1 and 4.2.2.

1.2 Terms of reference

This specialist report was informed primarily by the need to comply with the DFFE's "*Protocol for the specialist assessment and minimum report contents for environmental impacts on aquatic ecosystems*" (Government Notice 320 of 20 March 2020).

As part of this, the specialist report is required to include:

- A description of aquatic ecosystems potentially affected by the proposed project; including:
  - An assessment of their condition / Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS);
  - Their conservation importance (including context in regional biodiversity spatial planning layers);
  - Their extent;
- A description of the proposed development / interventions from an aquatic ecosystems perspective;
- A formal assessment of the implications of the proposed interventions for (freshwater / inland) aquatic ecosystems and recommendations for mitigation against negative impacts;
- Overall recommendations as to the acceptability of the proposed project from an aquatic ecosystems perspective.

1.3 Activities informing this input

This report was informed by:

- Consideration of previous watercourse planning, mapping and assessment in the Paardevlei site as a whole (in particular Day 2013; Day 2018 and Day 2020);

- Consideration of regional and national conservation and management data relating to watercourses on the Paardevlei site (e.g. the National Biodiversity Assessment of aquatic ecosystems (Van Deventer et al 2018); the Western Cape Biodiversity Spatial Plan (Pool-Stanvliet et al 2017); the City of Cape Town's (2017) biodiversity network); and the gazetted Berg River Catchment Resource Quality Objectives (DWS 2020);
- A focused site visit in November 2023, to assess changes since previous watercourse mapping in this area (Day 2018 and Day 2020) – this site visit was carried out in early summer when all wetlands on the site were dry. However, the specialist has visited the site on numerous occasions during the wet season over the past 15 years, and this is not considered a major limitation. Watercourses were readily apparent at the time of the site visit;
- Consideration of the development proposal and its implications for aquatic ecosystems in particular.

1.4 Site location

The site is located in Somerset West, in the Cape Town Metropolitan Area, in the Western Cape Province of South Africa (see **Figure 1.1**). It is located within the broader Paardevlei site, and is accessed via a number of old roads, once associated with the (former) AECI development on the site. These are accessed off WR Quinan Road, from Beach Road in Somerset West / Strand.

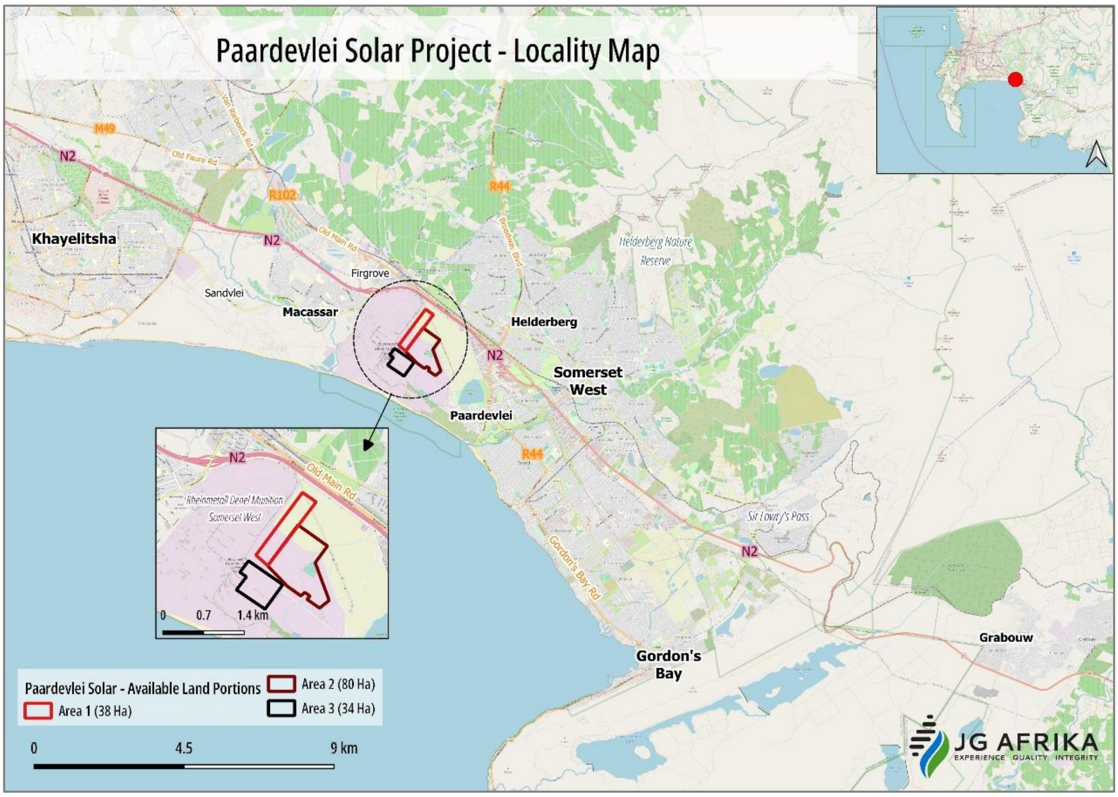


Figure 1.1
Location of the proposed solar PV facility and BESS on the greater Paardevlei site, Cape Town. Figure courtesy JG Afrika

1.5 Assessment Methodologies

1.5.1 Wetland presence

The presence of wetland conditions in particular areas was confirmed by one or more of the following indicators, as recommended by DWAF (2005 & 2008):

- The presence of plant species indicative of wetland conditions;
- The presence of standing water, a water table within 50cm of the soil surface for at least part of the year, or saturated soil conditions over prolonged periods in undeveloped areas;
- Indicators of hydromorphic soils (e.g. mottles and/or gleying).

1.5.2 Wetland classification

Wetlands were classified in terms of the South African National Wetland Classification system of Ollis et al (2013) (see Appendix B6 for details).

1.5.3 Wetland extent

Wetland extent was estimated on the basis of aerial photography, interpreted from ground-truthing on site and spot location readings, taken with a hand-held GPS.

1.5.4 Wetland condition

Present Ecological Status (PES) is a means of describing changes in the current (present) condition of a wetland system, with reference to its natural or reference condition. The procedure for determining PES for the wetlands on the present study area is based on a refinement of that appearing in Appendix W4 of the DWAF Resource Directed Measures for Water Resources: Wetland Ecosystems (DWAF 1999) (see Appendix B1).

1.5.5 Wetland importance and sensitivity

The method used by the Department of Water and Sanitation (DWS) to assess **ecological importance and sensitivity (EIS)** of wetlands in this study is a refinement of the DWAF Resource Directed Measures for Water Resources: Wetland Ecosystems method (DWAF 1999). It includes an assessment of ecological (e.g. presence of rare and endangered fauna / flora), functional (e.g. groundwater storage / recharge) and socio-economic criteria (e.g. human use of the wetland). The methodology has been adapted to allow for broad-scale EIS assessments of wetlands other than the specific floodplain wetlands for which the methodology was originally developed. The protocol for these assessments are summarised in Appendix B4.

1.6 Assumptions, limitations and uncertainties

- The Stormwater Masterplan for the greater Paardevlei site (including the present site) (see Bau-Afrika 2014 for details), was initially approved by the Department of Environmental Affairs and Development Planning (DEADP) on 27 Nov 2015, and subsequently amended to change the name of the applicant on 03 June 2016. In addition, a Water Use License (WUL) was granted by the Department of Water and Sanitation (DWS) on 27 November 2016 for the Section 21c and Section 21i water uses associated with the stormwater masterplan, as defined in the National Water Act (NWA) (Act 36 of 1998) (*Water Use License No 20/G22H/CI/4890 for The Paardevlei Storm Water Master Plan, as issued to the City of Cape Town (24/10/2016) File No 27/2/1/G522/137/1*). The latter was amended in 2021 to allow for changes in the design of one of two stormwater outfalls to the sea (Day 2020).

  An important assumption in the present assessment is that the WUL conditions / requirements of the approved Stormwater Master Plan, which included requirements for the creation of ecological corridors through the overall site and requirements for the conservation of certain watercourses in particular, in a development context, will be implemented as development of the site progresses. Mitigation recommendations made in this assessment have been formulated to support the development of the required ecological corridors. They do however also take cognisance of recommended changes in corridor alignment as a result of the re-establishment of wetland in parts of the site that had been remediated (see Day 2018).

- It is however noted too that the hydrological model that underpinned the 2014 stormwater masterplan (Bau-afrika) did not take into account the City of Cape Town's revised Rainfall Grid which allows for an increase in rainfall intensity as a result of climate change / global warming. Day (2020) commented that the model had been re-run by Bau-afrika in 2019, who found that the increase in runoff had a significant effect on infrastructure requirements, requiring updates to the design of the Lourens River outfall as well as the Main Drain. <u>This notwithstanding, it is assumed that the major routing of stormwater flows through and past the present site would be as outlined in Bau-Africa (2014);</u>
- At the time of this report, there was no detailed design for the management of stormwater on the site, other than as dictated in the broad principles and macro-scale layout of the stormwater master plan. This report has thus taken the approach of providing principles that should be met in detailed stormwater design for the developments within Precinct 2, that would allow concerns around water quality, aquatic biodiversity and other ecological concerns to be addressed, without setting specific fixes on engineering design that might not be feasible at detailed design phase;
- This assessment was carried out under dry season conditions and although the specialist is familiar with the broader Paardevlei development site, no detailed assessment of aquatic biota (algae, invertebrates and plants) was carried out on the wetlands actually impacted on the present site. Since the wetlands have relatively poor topographical and plant cover diversity (being formed on excavated and scraped remediation areas), they are not considered likely to support threatened invertebrate communities. They have however conservatively been assumed to provide habitat to aquatic communities that support more complex food webs (birds, amphibians), which are assessed in the faunal report (i.e. Molepo 2023);
- Water quality assessments were not carried out in the affected wetlands (due also to the dry season assessment) and the degree to which past activities on the site have affected water quality in extant wetlands is not known;
- Another uncertainty flagged in this report is the impact of large-scale eucalyptus clearing on groundwater levels, and the potential for contaminated groundwater to impact on surface water. This should be considered by the geohydrological specialist.
- This assessment has not considered differences in technology options for the site, other than as far as they affect the development footprint.

1.7 Definitions

All references to watercourses in this document are based on the following definitions, as stipulated in the National Water Act (NWA) (Act 36 of 1998), where:

"**watercourse**'' means -

(a) a river or spring;
(b) a natural channel in which water flows regularly or intermittently;
(c) a wetland, lake or dam into which, or from which, water flows; and
(d) any collection of water which the Minister may, by notice in the Gazette, declare to be watercourse, and a reference to a watercourse includes, where relevant, its bed and banks;

"**wetland**" means -

land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil.

"**Extent of a watercourse**" (as defined in General Notice (GN) 509 of August 2016) means:

(a) The outer edge of the 1 in 100 year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam; and

(b) Wetlands and pans: the delineated boundary (outer temporary zone) of any wetland or pan.

1.8 Content of the report in terms of addressing EIA regulations for specialist reporting

In 2020, the National Department of Forestry, Fisheries and the Environment (DFFE) issued *inter alia* the "*Protocol for the specialist assessment and minimum report contents for environmental impacts on aquatic ecosystems*" (Government Notice 320 of 20 March 2020).

Table 1.1 summarises the reporting requirements listed in the above protocol, and indicates where they are addressed in this report.

Table 1.1
Required Specialist Report contents and locations of items covered in the present document (as per the DFFE's "Protocol for the specialist assessment and minimum report contents for environmental impacts on aquatic ecosystems" (Government Notice 320 of 20 March 2020).

Reference in Protocol	Description	Section in this report where addressed
Section 2	**Site Sensitivity Verification:** Prior to commencing with a specialist assessment, the current use of the land and the environmental sensitivity of the site under consideration identified by the Screening Tool must be confirmed by undertaking a Site Sensitivity Verification. Confirmation or rejection of Site Screening Tool findings	Section 2.9
Table 1: Section 1.1	An applicant intending to undertake an activity identified in the scope of this protocol on a site identified on the screening tool as being of: 1.1.1. "very high sensitivity" for aquatic biodiversity, must submit an Aquatic Biodiversity Specialist Assessment; or 1.1.2. "low sensitivity for aquatic biodiversity, must submit an Aquatic Biodiversity Compliance Statement.	Section 2.9 (and Section 2 as a whole) N/A
Table 1: Sections 2.1-2.4	**2. Aquatic Biodiversity Specialist Assessment:** Requirements for Aquatic Biodiversity Specialist Assessment where there is a confirmed VERY HIGH SENSITIVITY RATING for aquatic biodiversity features: 2.1 The assessment must be prepared by a specialist registered with the South African Council for Natural Scientific Professionals (SACNASP), with expertise in the field of aquatic sciences. 2.2. The assessment must be undertaken on the preferred site and within the proposed development footprint. 2.3. The assessment must provide a baseline description of the site which includes, as a minimum, the following aspects: 2.3.1. a description of the aquatic biodiversity and ecosystems on the site, including: (a) aquatic ecosystem types; and (b) presence of	Page i and Appendix A Section 2 and 1.3 Section 2 Section 2:

	aquatic species, and composition of aquatic species communities, their habitat, distribution and movement patterns; 2.3.2. the threat status of the ecosystem and species as identified by the screening; 2.3.3. an indication of the national and provincial priority status of the aquatic ecosystem, including a description of the criteria for the given status (i.e. if the site includes a wetland or a river freshwater ecosystem priority area or subcatchment, a strategic water source area, a priority estuary, whether or not they are free -flowing rivers, wetland clusters, a critical biodiversity or ecologically sensitivity area); and 2.3.4. a description of the ecological importance and sensitivity of the aquatic ecosystem including:(a) the description (spatially, if possible) of the ecosystem processes that operate in relation to the aquatic ecosystems on and immediately adjacent to the site (e.g. movement of surface and subsurface water, recharge, discharge, sediment transport, etc.); and (b) the historic ecological condition (reference) as well as present ecological state of rivers (in- stream, riparian and floodplain habitat), wetlands and/or estuaries in terms of possible changes to the channel and flow regime (surface and groundwater). 2.4. The assessment must identify alternative development footprints within the preferred site which would be of a "low" sensitivity as identified by the screening tool and verified through the site sensitivity verification and which were not considered appropriate.	Sections 2.1-2.4 and 2.5 (and 1.6) Section 2.5.2 Section 2.6 and Section 2.5 Section 2
Table 1: Sections 2.5-2.6	2.5 Related to impacts, a detailed assessment of the potential impacts of the proposed development on the following aspects must be undertaken to answer the following questions: 2.5.1 Is the proposed development consistent with maintaining the priority aquatic ecosystem in its current state and according to the stated goal? 2.5.2. is the proposed development consistent with maintaining the resource quality objectives for the aquatic ecosystems present? 2.5.3. how will the proposed development impact on fixed and dynamic ecological processes that operate within or across the site? This must include: (a) impacts on hydrological functioning at a landscape level and across the site which can arise from changes to flood regimes (e.g. suppression of floods, loss of flood attenuation capacity, unseasonal flooding or destruction of floodplain processes); (b) will the proposed development change the sediment regime of the aquatic ecosystem and its sub -catchment (e.g. sand movement, meandering river mouth or estuary, flooding or sedimentation patterns); (c) what will the extent of the modification in relation to the overall aquatic ecosystem be (e.g. at the source, upstream or downstream portion, in the temporary I seasonal I permanent zone of a wetland, in the riparian zone or within the channel of a watercourse, etc.); and (d) to what extent will the risks associated with water uses and related activities change; 2.5.4. how will the proposed development impact on the functioning of the aquatic feature? This must include: (a) base flows (e.g. too little or too much water in terms of characteristics and requirements of the system); (b) quantity of water including change in the hydrological regime or hydroperiod of the aquatic ecosystem (e.g. seasonal to temporary or permanent; impact of over -abstraction or instream or off stream impoundment of a wetland or river); (c) change in the hydrogeomorphic typing of the aquatic ecosystem (e.g.	Sections 3 and 4 Section 4 and Table 4.2 Table 4.2 Table 4.2 Table 4.2

	change from an unchanneled valley- bottom wetland to a channeled valley -bottom wetland); (d) quality of water (e.g. due to increased sediment load, contamination by chemical and/or organic effluent, and/or eutrophication); (e) fragmentation (e.g. road or pipeline crossing a wetland) and loss of ecological connectivity (lateral and longitudinal); and (f) the loss or degradation of all or part of any unique or important features associated with or within the aquatic ecosystem (e.g. waterfalls, springs, oxbow lakes, meandering or braided channels, peat soils, etc.); 2.5.5. how will the proposed development impact on key ecosystems regulating and supporting services especially: (a) flood attenuation; (b) streamflow regulation; (c) sediment trapping; (d) phosphate assimilation; (e) nitrate assimilation; (f) toxicant assimilation; (g) erosion control; and (h) carbon storage? 2.5.6. how will the proposed development impact community composition (numbers and density of species) and integrity (condition, viability, predator - prey ratios, dispersal rates, etc.) of the faunal and vegetation communities inhabiting the site? 2.6. In addition to the above, where applicable, impacts to the frequency of estuary mouth, closure should be considered, in relation to: (a) size of the estuary; (b) availability of sediment; (c) wave action in the mouth; (d) protection of the mouth; (e) beach slope; (f) volume of mean annual runoff; and (g) extent of saline intrusion (especially relevant to permanently open systems).	Table 4.2 Table 4.2 N/A
Table 1: Sections 2.7	The findings of the specialist assessment must be written up in an Aquatic Biodiversity Specialist Assessment Report that contains, as a minimum, the following information: 2.7.1. Contact details of the specialist, their SACNASP registration number, their field of expertise and a curriculum vitae; 2.7.2. A signed statement of independence by the specialist; 2.7.3. A statement on the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment; 2.7.4. The methodology used to undertake the site inspection and the specialist assessment, including equipment and modelling used, where relevant; 2.7.5. A description of the assumptions made, any uncertainties or gaps in knowledge or data; 2.7.6. The location of areas not suitable for development, which are to be avoided during construction and operation, where relevant; 2.7.7. Additional environmental impacts expected from the proposed development; 2.7.8. Any direct, indirect and cumulative impacts of the proposed development on site; 2.7.9. The degree to which impacts and risks can be mitigated; 2.7.10. The degree to which the impacts and risks can be reversed; 2.7.11. The degree to which the impacts and risks can cause loss of irreplaceable resources; 2.7.12. A suitable construction and operational buffer for the aquatic ecosystem, using the accepted methodologies;	Page i and Appendix A Page i Sections 1.3 and 1.6 Section 1.5 Section 1.6 Section 4 Section 4 Section 4 Section 4 and Table 4.1 Section 4 Section 4

	2.7.13. Proposed impact management actions and impact management outcomes for inclusion in the Environmental Management Programme (EMPr); 2.7.14. A motivation must be provided if there were development footprints [...] that were identified as having a "low" aquatic biodiversity sensitivity and that were not considered appropriate; 2 .7.15. A substantiated statement, based on the findings of the specialist assessment, regarding the acceptability or not of the proposed development and if the proposed development should receive approval or not; and 2.7.16. Any conditions to which this statement is subjected.	Section 4 Table 4.2 Section 6 Section 4 (mitigation) and Section 5

2 DESCRIPTION OF AFFECTED AQUATIC ECOSYSTEMS

2.1 Site overview and history of development

The site lies within the greater Paardevlei site. This area, shown in **Figure 2.1**, covers some 729 ha of natural, disturbed and partly developed land, including extensive areas that have been identified as wetlands (e.g. Snaddon 2007, City of Cape Town 2013, Day 2012, 2014 and (updated) 2018). The Paardevlei site has a long history of disturbance. In the 1800s, the land was used for farming, but was acquired in 1899 by De Beers Consolidated Mines (Ltd) for the purpose of establishing a munitions factory, later being owned and operated by AECI (Brown and Magoba 2009). During this time, large areas (including the Paardevlei wetland itself) were contaminated by chemicals associated with the plant, and stands of eucalyptus trees were grown, as noise screens and buffers against shock waves generated during explosives testing. In 1996, the munitions works ceased and parts of the property were sold for development, while remediation work to address areas of contamination commenced. The present study area was included in remediation activities, with contaminated soils being stripped off the surface in places. These works had only recently been completed at the time of the original wetland baseline study of the overall site (Day 2012), which noted that large areas of alluvial wetland occurred on the site, but that these had been almost completely transformed and, with a few exceptions, did not warrant conservation. Aquatic and biodiversity corridors were instead designed to provide ecological connectivity across the site and nodes of terrestrial and aquatic habitat diversity within the site (these are described and indicated in Appendix D). In 2015, the City of Cape Town (CCT) purchased the overall site, and in 2018, the aquatic ecosystems baseline report was revisited (see Day 2018). This report noted that the site as a whole had undergone concentrated localized development since Day (2012)'s assessment, including the development of a sports club and soccer fields towards the western site boundary (i.e. in the present proposed solar site) and the installation of an east-west aligned sewer to the Macassar Waste Water Treatment Works (WWTW) (including through the present site), from west of Paardevlei, on an alignment just north of the Langvlei. In addition, areas that were only recently remediated in 2011/2012, including large areas in the present study area from which volumes of contaminated surface soils had been stripped, had since stabilized to a new ecological (and hydrological) regime, including extensive wetland areas. Day (2014) predicted that these areas had high capacity to form perched wetlands that might detract from their future developmental potential.

The present site includes the sports club and soccer fields referred to above, as well as large areas of disturbed, vegetated open fields, grazed by springbok and (it is assumed) cattle; stands of eucalypts from the AECI munitions testing areas; stormwater drainage channels through the site; and gravel access roads through and within the site. These are discussed in more detail in subsequent parts of this section of the report, which focuses on the proposed solar development site only.

2.2 Catchment context

The site lies in the Department of Water and Sanitation (DWS)'s quaternary catchment G22J. This quaternary catchment forms part of the DWS's Berg-Olifants Water Management Area. Like all catchments within Cape Town's boundaries, the G22J quaternary is included in the DWS's Berg River Catchment Classification. Resource Quality Objectives (RQOs) have been gazetted for rivers, estuaries, dams and groundwater resources in this area (Government Notice (GN) 1179 of 2020). However, no RQOs have been formulated to date for wetlands in this area. The current site includes only wetlands, and no estuaries or dams.

At a topographical catchment level, CCT data shown in **Figure 2.1** suggest that the site in fact straddles two catchments – the Lourens River catchment to the east and the Eerste / Kuils catchment to the west. However, in fact the site is very flat and low-lying, and its drainage has been manipulated historically by the creation of a network of drainage channels, which drain surface water towards the Lourens River estuary, via the so-called "Main Drain" (an artificial west-east flowing drainage channel through the Paardevlei site, south of the present site. Thus in practice, the site forms part of the Lourens River catchment only. In a full development context, as planned for in Bau-afrika (2014) and encapsulated in the Paardevlei site WULA, the site would drain both towards the Lourens River estuary and would also discharge into the sea further west via an artificially constructed outfall, not yet in place (see Bau-afrika 2014 and Day 2014).

2.3 Hydrology (greater Paardevlei site)

In addition to local precipitation, the greater Paardevlei site receives runoff from five external water sources, comprising the **Triomf** and **Heldervue Drains**, which convey stormwater runoff from areas to the north east of the site, towards the Langvlei; the **Somchem Drain**, which drains a portion of the adjacent Denel / Somchem property to the west of the site, and also discharges into the Langvlei, being joined by discharges from the **Magazine** and **Marshall Yard Drains**; the **Farm Bypass Drain**; the **Heldervue** and **Triomf Drains**; the **Crescent Bypass**, which receives runoff from the area north east of the Paardevlei and discharges this into the eastern edge of Paardevlei; and the **Melksloot Canal** – an artificial channel that historically conveyed water from the Lourens River into Paardevlei by means of an adjustable sluice gate, set in a weir across the upper reaches of the channel (see **Figure 2.1**). The combined Main Drain / Crescent Bypass channel passes into the Lourens River at its estuary, via a recently (2020/2021) configured outlet structure, designed to convey flood flows in a full development context of the greater Paardevlei site, as envisaged in the authorised stormwater master plan.

A number of other wetlands have also been identified on the Paardevlei site – those relevant to the present assessment are described in the following sections of this report.

Note that the Marshall Yard Drain passes through the present site.

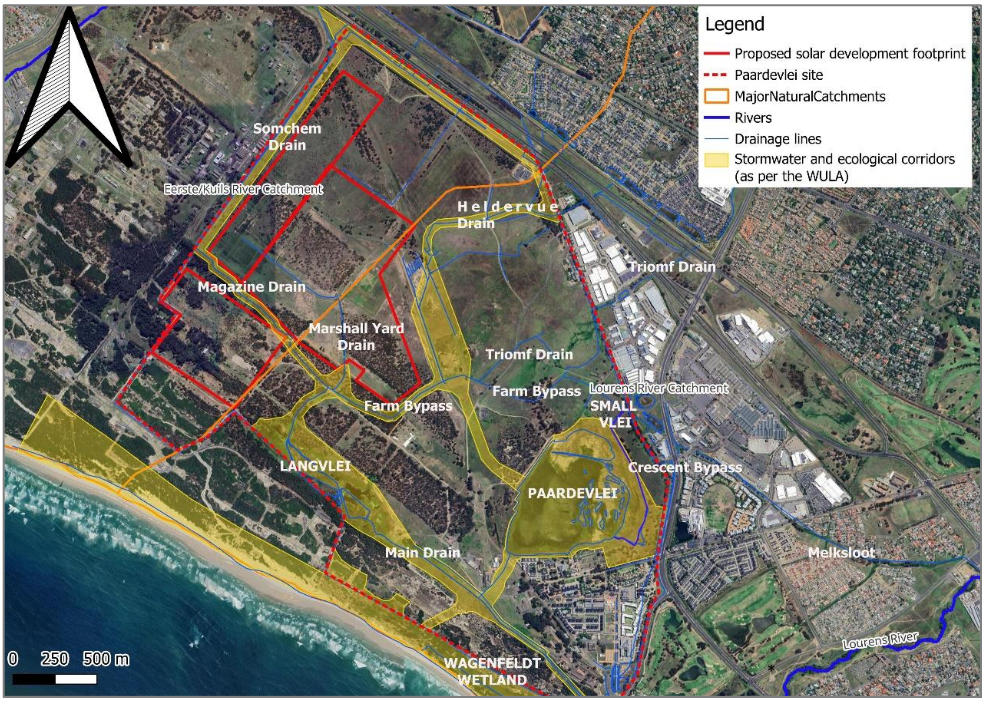


Figure 2.1
Catchment context of the proposed solar facility site, showing the greater Paardevlei site and locations of major wetlands, rivers and stormwater channels – the latter named as per the stormwater masterplan (Bau-afrika 2014)

2.4 Assumed reference condition for watercourses on the broader Paardevlei site

The wetlands that occur today on the Paardevlei site are largely remnants of the (probably) numerous wetlands that, prior to the impacts of development and industrial activity within the broader Helderberg area, would have been a feature of the coastal plain of the Helderberg Basin. McStay (2006) describes the coastal plain as an extensive alluvial fan formed over the wavecut platform of shaley rocks of the Malmesbury Group. This author notes that recent dune sands that have been deposited over older calcretised dune deposits have resulted in a south to north transition from sandy soils near the coast, to clay soils further inland. The flat gradient and low lying nature of much of the area, coupled with the presence of relatively impermeable calcrete, clay and shale beneath a shallow transported soil cover, gave rise to poor surface drainage and the formation of extensive areas of wetlands, most of which today comprise seasonally wet grasslands, that have established on the thin layer of sand over the Malmesbury shale-derived clays (Snaddon 2007). Under natural conditions, the site (and much of the broader Paardevlei site). Perched depressional wetlands (including Paardevlei wetland itself) formed in some low-lying areas, and were largely reliant on direct precipitation and localised runoff.

2.5 Wetlands on and in the near vicinity of the site

2.5.1 Overview

Figure 2.2 shows wetland extent on and near the present site, as mapped in Day (2018). This figure shows:

- Extensive, largely transformed "alluvial wetland" areas, extending across much of the greater Paardevlei site;
- Areas of wetland in better condition within this wetland mosaic, where recovery post-remediation has occurred and/or where wetlands have re-established following removal of surface soils during remediation, resulting in impervious clays at or near the surface, on which rainwater can pond ("best condition wetland areas" and "Recovering seasonal wetland mosaic"), all in well-grazed areas in the northern north-eastern portions of the site;
- Artificial drainage channels / trenches through the site connecting to the Magazine Drain, which runs between the southern and northern portions of the development, and connects to Langvlei and the Main Drain further south, within the greater Paardevlei property.

Figure 2.3 presents a more detailed view of the current site, based on ground-truthing in 2023 to supplement 2018 mapping data. The figure indicates the following:

- Extensive alluvial wetland (or **wetland flats** as per Ollis et al 2013's classification) characterise much of the site, forming a mosaic of disturbed terrestrial areas interspersed with low lying pans and shallow depressions. These were variously vegetated with grasses and indigenous vegetation typical of seasonal wetland conditions, namely stands of *Juncus kraussii* sedge, *Pennisetum macrourum* grass, and (in wetter areas), *Bolboschoenus maritimus* and *Eleocharis limosa*. These areas have not been highlighted for blanket conservation within the site (see Day 2014; Day 2018) but do contain areas where the wetlands are in better condition, usually as a result of recovery from disturbance or because of remediation interventions that have contributed to their formation. <u>These wetlands are considered watercourses in terms of the definitions included in the NWA and NEMA (see Section 1.7 of this report).</u>
- A mosaic of seasonally saturated-to-shallowly-inundated wetland pans (still classified as wetland flats in terms of Ollis et al 2013), which were mapped out where they

occurred within or immediately abutting the study area (i.e. east and north of the soccer fields). These pans were characterized by *Sarcocornia cf. perenne,* a plant commonly associated with salt marsh conditions, and indicative here of high rates of evapoconcentration, resulting in saline to brackish conditions on the surface during the dry season. These wetlands are considered watercourses in terms of the definitions included in the NWA and NEMA (see Section 1.7 of this report).

- Wetland depressions within the open area south west of the sports club grounds, edged to the north and south by dense stands of eucalyptus forest. These depressions were vegetated by dense stands of *Eleocharis limosa*, and separated from each other by low berms. The depressions are clearly an artefact of past disturbance, probably linked to the excavation and disposal of contaminated soils. They form an expansive zone of wetland depressions across the site and are likely to provide wet season breeding habitat to frogs, aquatic insects and wading or swimming birds. That said, the extent to which their water quality still reflects past contamination is not known. Thus while they provide seemingly good quality physical habitat in the form of shallow, standing water pans in the wet season, the extent to which this is compromised by water quality impacts is not known. The pans were dry at the time of the site assessment. For the purposes of this study, it is assumed that they are not compromised by poor water quality, although a recommendation is that this aspect should be investigated. The depressions are drained by a network of channels and trenches that convey flow during high water periods, to the Marshall Yard Drain. These wetlands are considered watercourses in terms of the definitions included in the NWA and NEMA (see Section 1.7 of this report).
- A network of trenches and channels across the site, of which the main one comprises the Marshall Yard Drain, which runs west-east across the northern edge of the wetland depressions described above, then swings south, near the south-western corner of the sports club grounds. It is joined here by a channel conveying runoff from the wetland flats immediately north of the sports club boundary fence (mapped as mosaic wetland in **Figure 2.3**). The combined flows are also joined in this area by channels / trenches draining the wetland depression mosaic area to the west, and then pass under an internal gravel access road. The channel, densely invaded in places with bulrush (*Typha capensis*), passes south along the edge of another dense eucalyptus forest, to join the Magazine Drain – a channel that runs between proposed Development Areas 1 and 2, and Development Area 3, in the south. The Somchem Drain runs along the western site boundary, and passes into Langvlei and then the Main Drain along with the other main drainage channels. These are all artificial drainage systems, constructed to convey water out of the flat, low-lying wetland-dominated areas. During summer, the channels are usually dry. At the time of the site visit, the Marshall Yard Drain was flowing, from immediately downstream of the road crossing south of the sports club's south-western boundary fence. The trickle flows were found to derive from an overflowing sewer manhole near the culvert, which had clearly been flowing for some time, since the only channel where dense *Typha capensis* was established was the section downstream of the manhole. Typha capensis requires permanent saturation to inundation and thrives in nutrient-enriched, fresh (i.e. not brackish) environments (Hall 1990). The trenches described above are all artificial systems and unlike the wetlands, do not meet the legal criteria for watercourses (as defined in the NWA and NEMA (see Section 1.7).
- A few small wetlands (classified as wetland depressions) were noted in places along the margins of the eucalyptus forests, where channeled runoff from surrounding wetter areas passes into the forest areas. Eucalyptus trees have a high water uptake

however, and deeper within the forest areas, there were no signs of significant wetlands although in places indigenous terrestrial fynbos vegetation (e.g. *Metalasia* cf. *muricata*) still occurred as a sparse under-story. In the event that the eucalyptus forests were felled, much wetter conditions would be likely to prevail in these and other linked areas. These wetlands are considered watercourses in terms of the definitions included in the NWA and NEMA (see Section 1.7 of this report).

Table 2.1 provides photographic illustrations of some of the above features.

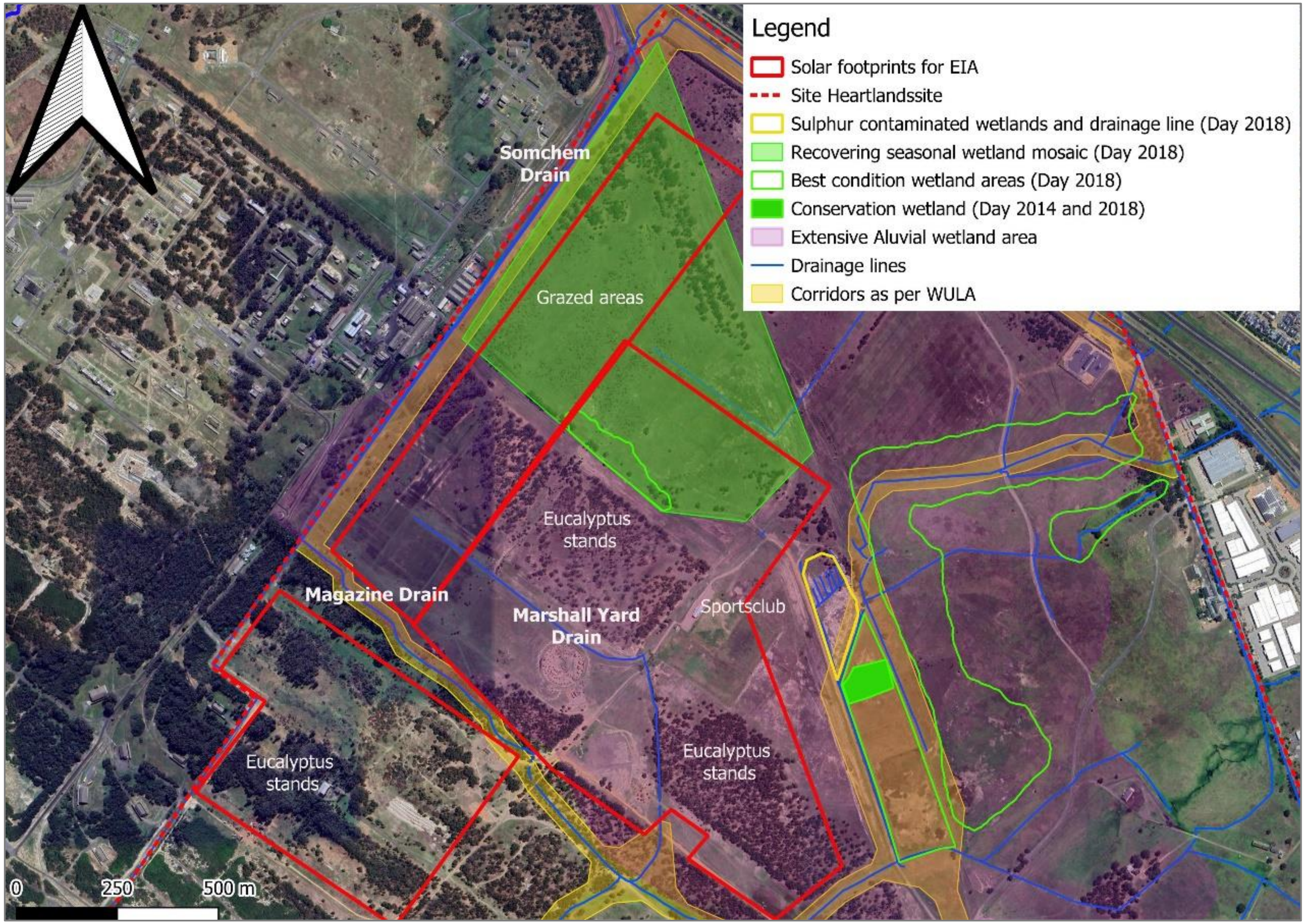


Figure 2.2
The current site in the context of <u>previously</u> mapped wetlands (Snaddon 2007, Day 2012, 2014 and (updated) 2018)

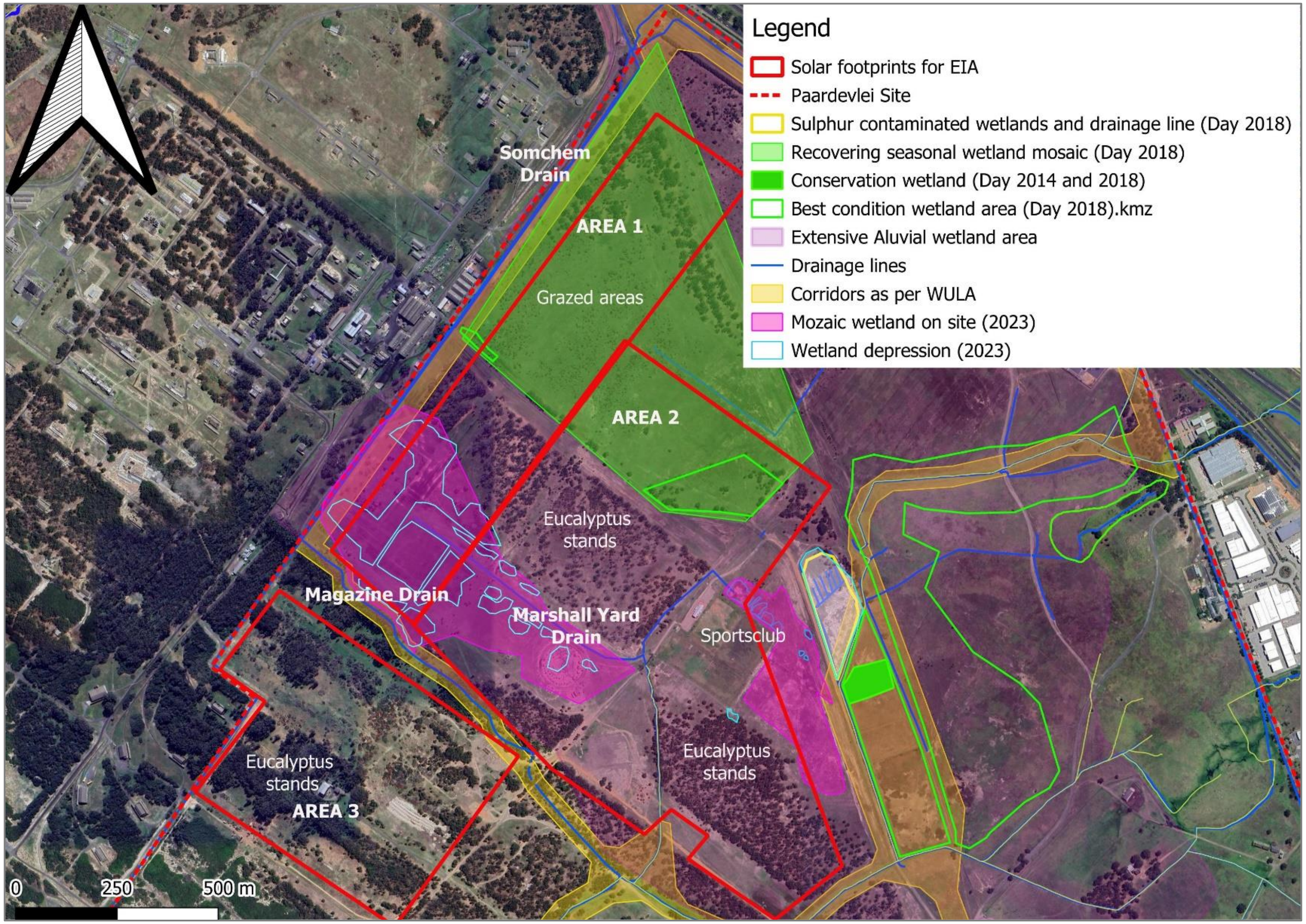


Figure 2.3
The current (Proposed Solar PV development) site showing present extent of wetlands within broadly mapped wetland mosaics

Table 2.1
Photographic illustrations of watercourses on the current site – photos as of Novemnber 2023

Photo A
Patchy wetlands establishing within the site just north of the sportsclub gate (mapped as alluvial wetland)

Photo B
Dry drainage channel along the northern boundary fence of the sportsclub – this links with the Marshall Yard Drain

Photo C
Seasonally inundated depression wetlands (*Eleocharis limosa* dominated) in development areas 1 and 2 (mapped as wetland depressions in mosaic wetland

Photo D
Seasonally inundated wetland depression (*Eleocharis limosa*) but showing contaminated adjacent soils, highlighting high levels of past disturbance and potential water quality contaminants

Photo E
Extensive *Eleocharis limosa depression wetlands in mapped wetland mosaic*

Photo F
Artificial berm separating wetland depressions Berms between depression wetlands indicate artificial nature of current wetland form in depression wetland mosaic

Photo G
Marshall Yard Drain downstream of the road crossing, with dense *Typha capensis* invasion of the channel, suggesting that sewage flows in summer are likely to have been sustained for some time

Photo H
Overflowing manhole into Marshall Yard Drain – green grass again suggests long-term flows

Photo I
Mosaic wetland flats in area north and east of sportsclub boundary fence

Photo J
Small wetland forming on edge of eucalyptus forest, as a result of channeled inflows from the adjacent sportsfields

Photo K
Wetland pans and some (excavated) depressions in land north of sportsclub's northern boundary fence

Photo L
Patches of wetland in better condiiton (from a plant species perspective) – mapped as "best condition wetland areas" in recovering wetland mosaic

2.5.2 Wetland freshwater bioregion and threat status

The National Biodiversity Assessment (NBA) for aquatic ecosystems (Van Deventer et al 2018) shows that all aquatic ecosystems on the site lie within the **Southwest Fynbos bioregion (Figure 2.4)**. The dataset shows the alluvial wetland flats wetland identified in this study as floodplain flats. Since the wetlands today lie outside of the 1:100 year floodplain of the Lourens River, they are rather classified in this report as wetland flats. Southwest Fynbos floodplain wetlands are considered Not Protected and have a threat status of Critically Endangered.

None of the other wetlands identified on the site are identified in the NBA 2018 dataset, although they would have the same status as the mapped floodplain flat wetland. However, Southwest Fynbos Depression wetlands have a threat status of Endangered. No Southwest Fynbos wetland flats are identified in the NBA – and the status of floodplain flats is thus assumed for all of the wetland areas identified on the site, noting however that they are highly degraded, permanently altered systems.

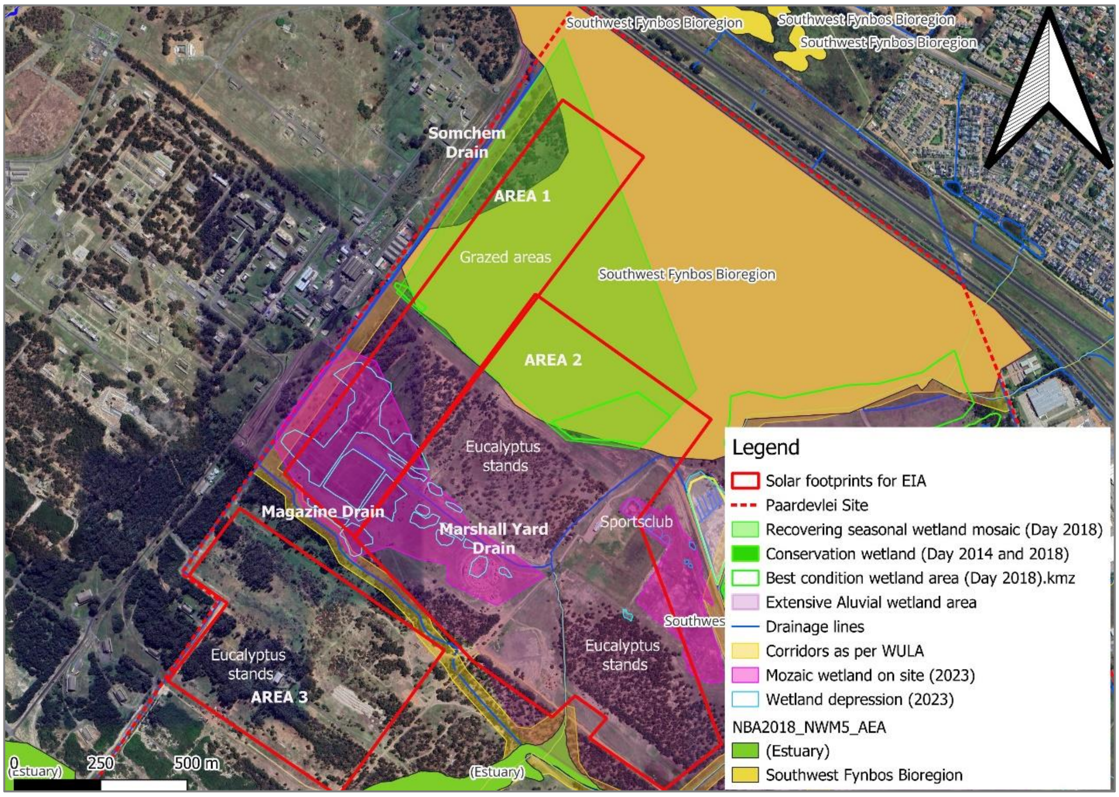


Figure 2.4
Site context in the 2018 National Biodiversity Assessment (NBA) (Van Deventer et al 2018).

2.6 Context in the Western Cape Biodiversity Spatial Plan

The Western Cape Biodiversity Spatial Plan (WCBSP) of Pool-Stanvliet et al (2017) (which includes the CCT's 2017 Bionet data for aquatic ecosystems) (see **Figure 2.5**) indicates that:

- Only the northern wetland flats area has been identified as wetland in this aquatic ecosystem biodiversity spatial plan;
- The identified wetland areas in the study area have been ranked as "Other Ecological Support Areas" (OESAs), signifying the lowest quartile of artificial or natural wetlands, which nevertheless may play a supporting role for downstream or adjacent connected ecosystems (Snaddon and Day 2009).

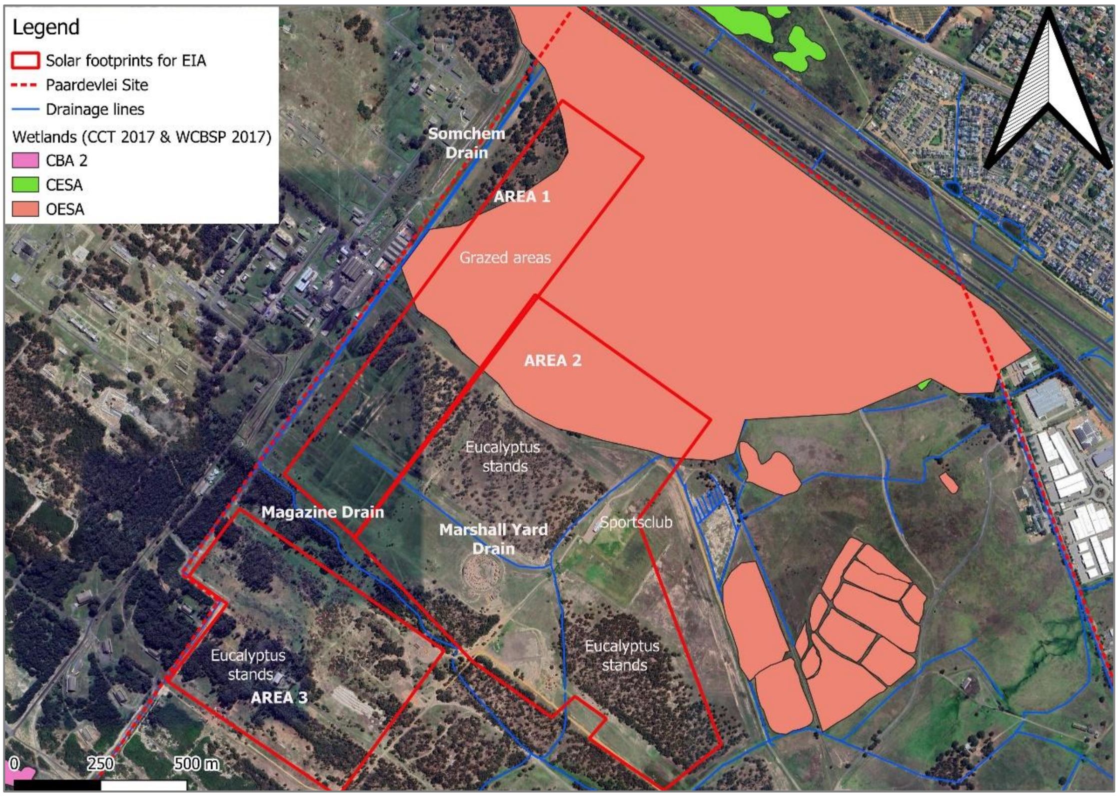


Figure 2.5
Site context in the WCBSP of Pool-Stanvliet et al (2017) and the CCT wetland biodiversity layer

2.7 Wetland condition, wetland ecosystem services, wetland Ecological Importance and Sensitivity and wetland Conservation Importance

Table 2.2 presents the results of assessment of the ground-truthed aquatic ecosystems described in Section 2.5.1. These assessments were carried out using the methodologies outlined in Appendix B, noting that wetland ecosystem services have been qualitatively described but were not assessed using the WET-Ecoservices assessment methodology of Kotze et al (2020). This is because the wetlands are artificial, small, and the direct result of soil remediation activities. They do provide ecosystems services – but the application of the detailed methodology was not considered appropriate in this context.

Table 2.2
Results of assessment of the ground-truthed aquatic ecosystems – methodologies and data as per Appendix B

Wetland type	Ecosystem services	PES	EIS	Conservation importance
Wetland flats ("alluvial wetlands")	Grazing; flood attenuation; sediment trapping; potential for water quality amelioration; No amenity or recreational value at present – but could be important in a development context. Very low biodiversity outside of identified nodes (included below) May play some role in buffering other systems	Category E (seriously modified from natural) as per Day 2014 and Day 2018)	Moderate	Low – mostly highly degraded

Wetland pans in wetland mosaic	Grazing; flood attenuation; No amenity or recreational value at present – but could be important in a development context. Low biodiversity importance; Provides limited ecological connectivity / links to downstream sites via drainage channels	Category E (seriously modified from natural) as per Day 2014 and Day 2018)	Low	Low to moderate – degraded but probably restorable and can act as buffers and stormwater attenuation areas
Wetland depressions in wetland mosaic	Grazing; flood attenuation; sediment trapping; No amenity or recreational value at present – but could be important in a development context. Low to moderate biodiversity importance, amplified in context of surrounding disturbance and degradation; Provides ecological connectivity (shelter, seasonally inundated aquatic habitat) through the site, linking to downstream systems (e.g. Langvlei wetland) via the drainage channels	Category E (seriously modified from natural) as per Day 2014 and Day 2018)	Moderate	Moderate – provides ecologically significant wetland habit types, albeit degraded and modified; provides connectivity between and within the site
Drainage channels	Wholly artificial but do provide longitudinal connectivity with up- and downstream aquatic ecosystems and many (including the Magazine Drain) are included among the key hydrological and ecological corridors through the site, in the greater Paardevlei stormwater master plan (Bau-afrika 2014 and Day 2014).	N/A (artificial)	Low / marginal	Moderate – important role as corridors through site; limited provision of aquatic habitat; important roles in conveyance, polishing and attenuation of stormwater flows

2.8 Context of the stormwater masterplan for the over-arching Paardevlei site

Figure 2.3 shows that stormwater corridors included in the stormwater masterplan for the Paardevlei Site include the Magazine Drain, between Development Areas 1 and 2 and Development Area 3. The lower reaches of the Marshall Yard Drain are also included in the masterplan hydrological and ecological corridor; and the Somchem Drain along the western edge of the current site is also recognised (see Day 2014) as an important corridor.

2.9 Site sensitivity verification

The site includes extensive areas of wetland habitat, and the development area would extend over portions of this habitat. The rating of the proposed development portions of the site as of High Sensitivity in the DFFE screening tool is thus concurred with.

3 DESCRIPTION OF THE PROPOSED PROJECT

This section provides an overview of the proposed development of a solar PV facility and its associated infrastructure in a portion of the Paardevlei site. These descriptions (taken from a Background Information Document provided to project specialists by JG Afrika (November 2023) form the basis against which potential impacts to aquatic ecosystems are identified and then assessed in Section 4.

The proposed project would entail:

- Development of a 30 to 60 MW facility on the current site, with three development portions having been identified as shown in **Figure 3.1** – <u>it is assumed for the purposes of this EIA that the proposed development application would be for full coverage of each of the three development areas</u>;
- Ground-mounting of the PV facility - photographic illustrations provided in JG Afrika (2023) (Figure 3 in that report) indicate that such a PV facility could allow for the development of low-growing vegetation beneath the solar panel arrangement. <u>However, since this has not been specified, the assessment in Section 4 assumes that site levelling and vegetation clearing would take place (worst case scenario)</u>;
- Inclusion of a Battery Energy Storage System (BESS);
- Associated infrastructure including the following:
    - Use of existing roads to access the PV plant
    - Additional internal roads to access the PV arrays
    - An underground powerline to connect the PV plant substation to the existing network 132 kV switching station;
    - A PV plant substation (to connect to the existing network 132 kV switching station).

Figure 3.1 provides an overview of the development footprint, in the context of mapped wetland and drainage channels, at the time of this assessment.

In addition to the development footprint itself, it is assumed too that, during the operational phase of the development, there will be a need for regular cleaning of the solar panels, using water and potentially detergent of some kind.

Note that this assessment considers only the implications of development within the footprint (three development areas) shown in Figure 3.1, and not the implications if any of roads, cables or pylons from the site to link with external infrastructure.

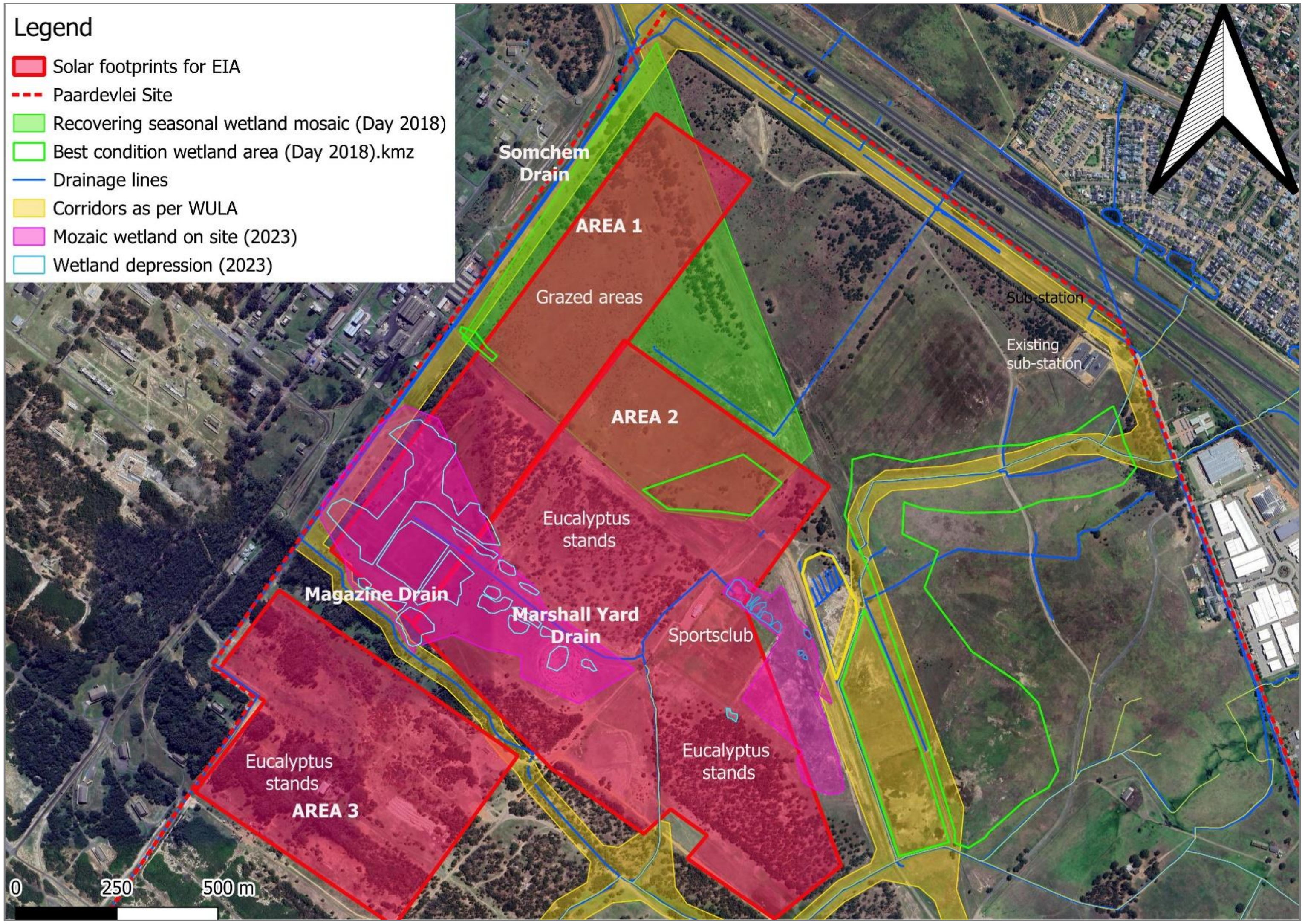


Figure 3.1
Overview of proposed development footprint, in the context of mapped wetland and drainage channels on site

4 IMPLICATIONS OF THE PROPOSED DEVELOPMENT FOR FRESHWATER ECOSYSTEMS

4.1 Overview

This section considers the impacts to aquatic ecosystems that would be associated with the proposed development and subsequent operational phase management of a solar PV facility and associated BESS on the portions of Paardevlei shown in Figure 3.1 and referred to in this report as the site. The identified impacts, based on the description of planned interventions outlined in Section 3, have been formally rated in **Table 4.1**, using the impact significance rating methodology included in **Appendix C**.

4.2 Impacts to aquatic ecosystems associated with planning and layout

The impacts identified in this section are those that would be associated with the placement and design of different aspects of the proposed project.

4.2.1 Impact 1: Loss of wetland habitat

Description of impact

Development of the project as shown in **Figure 3.1** and with the assumptions included in Section 3, would result in the effective loss of the mosaic of wetland depressions and pans within the broader wetland flats, as mapped in **Figure 2.3**. Wetland loss would be as a result of both (assumed) site levelling and, where site conditions still allowed pooling of water beneath solar arrays, loss of habitat quality. Habitat quality would be affected by shading (reducing or eliminating plant growth) and reduced access to water bodies by birds and other (macro) fauna, as a result of the over-lying solar panel arrays.

It is thus assumed that all of the mapped wetland depressions, pans and broader wetland flats mosaic within the proposed development area would be lost /impacted to a degree where their function as aquatic habitats becomes negligible.

These wetlands have however been impacted by a long history of development, and their current form is a degraded, artificially-created relic of their natural condition and type. They do however provide seasonal wetland habitat, which is an increasingly rare habitat in the City, and which will become increasingly scarce on the site as development continues. For this reason, this impact has been rated as of Medium to High significance in **Table 4.1**.

Recommended mitigation measures

Partial avoidance mitigation measures are included in Mitigation measures for Impact 2. These measures also provide for wetland creation within buffer areas – in essence, a form of on-site offset mitigation.

4.2.2 Impact 2: Interruption of required ecological connectivity in a full site development context

Description of impact

A requirement of the Water Use License for the Paardevlei Stormwater Masterplan is the establishment of broad (50 – 75m) ecological and hydrological corridors through the site, as indicated in Appendix D (after Day 2014 and Bau-afrika 2014). However, portions of Development Area 2 and 3 both encroach into the Magazine Drain corridor, interrupting is and effectively negating its role as an important connecting space in a development context.

Given the strategic importance of these corridors in the stormwater masterplan, this impact has been rated as of high significance in **Table 4.1** and avoidance mitigation is a requirement.

Recommended mitigation measures

The following measures, applicable to both Impact 1 and Impact 2, are considered essential:

i. The development edge must be pulled back so as to respect the 50m corridor along the Magazine Drain, as per the requirements of the stormwater master plan, as shown in Figure D1;

ii. An additional aquatic corridor must be created through the site, which allows conservation of a portion of the seasonal pools mapped within the central portion of Development Areas 1 and 2. **Figure 4.1** provides indicative routing of this corridor. Its exact position should be determined during the detailed design phase for of the project but the design principles must allow for the following:

   a. A minimum 50m wide corridor through the site, linking to the Somchem Drain corridor to the west and the Marshall Yard Drain to the east. The corridor should be widened towards the west to accommodate recovered wetlands of better quality (see **Figure 4.1**). In the event that such widening means that development cannot be accommodated between the new corridor and the Magazine Drain Corridor to the south, it is recommended that the two corridors should be consolidated in this area to form a single large wetland / open space area;

   b. The corridor must be designed to pass over the core depression wetlands mapped in **Figure 2.3;**

   c. Stormwater management must be designed so that the depression wetlands retain standing water through the wet season and into early summer and are not drained to provide additional attenuation space. If stormwater design requires ponds to drain between storms, then additional stormwater management areas should be created, by widening the corridors, and allowing a combination of standing-water perched wetlands (as at present), edged by wetlands that attenuate stormwater discharges and pass these downstream. Note that water generated from washing / cleaning of solar panels may not be passed into these wetlands, if detergents are used in this process;

   d. The corridor may not be infilled;

   e. The corridor may not be crossed by roads other than the existing road along its eastern edge;

   f. Measures to enhance the condition and biodiversity value of the depression wetlands should be put in place, including removal of existing berms; expansion of the depression wetlands within the overall corridor; and use of an excavator or other mechanical device to create a more natural shaping of the depressions. These activities should be planned and executed under the direct supervision of an aquatic ecologist, and would be intended to provide, *inter alia*, a better condition, informal on-site offset of the loss of excavated depression wetlands within the site;

   g. Planting of the corridors must also be allowed for, using locally indigenous, locally sourced (same catchment and preferably from the developed portion of the site) plant species, and managed so as to achieve 75% indigenous and diverse plant cover by two years after implementation – this may require short-term irrigation over at least two summers, as necessary;

   h. The wetland corridors must be maintained during the life-span of the development, with management measures including removal of invasive alien vegetation and solid waste, and attendance to localised erosion or impacts as a result of development stormwater flows;

i. Vegetation should be indigenous and may not include species likely to invade into adjacent natural areas. Thus alien kikuyu grass (*Pennisetum macrourum*) may not, for example, be utilised as a cover;

iii. An additional corridor of 30m width should be provided along the minor north-south running drainage channel to the Marshall Yard Drain, as shown in **Figure 4.1**. This corridor (which may be re-routed within the development layout if required) should:

a. Include the channel (or a re-aligned version of it) as an open, unlined channel. This channel would be suitable for use in stormwater conveyance, and would link into the channelised Marshall Yard Drain, at or downstream of the existing road crossing;

b. Be designed and landscaped to include shallow adjacent pans suitable for the establishment of *Sarcocornia perenne* as at present in the area immediately north and east of the sports club fence;

c. Planting of the corridors must also be allowed for, using locally indigenous, locally sourced (same catchment and preferably from the developed portion of the site) plant species, and managed so as to achieve 75% indigenous and diverse plant cover by two years after implementation – this may require short-term irrigation over at least two summers, as necessary;

iv. A 30 m wide corridor connecting to the recovering wetland shown in Area 2 shoud also be included (exact alignment of the corridor is flexible provided that it links to at least one other corridor through the site. The corridor should:

a. Be designed and landscaped to include shallow adjacent pans suitable for the establishment of *Sarcocornia perenne* as at present in the area immediately north and east of the sports club fence;

b. Planting of the corridors must also be allowed for, using locally indigenous, locally sourced (same catchment and preferably from the developed portion of the site) plant species, and managed so as to achieve 75% indigenous and diverse plant cover by two years after implementation – this may require short-term irrigation over at least two summers, as necessary;

v. The channelised Marshall Yard Drain, downstream of the bridge crossing, should be maintained in a 50m wide corridor, with seasonal *Sarcocornia* and /or depression wetlands created along the channel margins. The channel itself could be used for stormwater conveyance, and the corridor would lend itself to amenity uses such as walking, cycling, provided that these activities did not require hardening of the corridor, other than for limited pathways or bridges;

vi. If solar PV modules are required in the small triangle shown in **Figure 3.1** as extending into the *Sarcocornia* dominated mosaic wetland flats in the north eastern portion of Area 2, then infilling of this area would be a preferable approach to drainage through trenches or channels, as drainage would potentially impact on a wider area of extant wetlands than controlled infill. If infilling is undertaken:

a. Only clean fill should be utilised;

b. Vegetation should be ideally be indigenous and may not include species likely to invade into adjacent natural areas. Thus alien kikuyu grass (*Pennisetum* *macrourum*) may not, for example, be utilised as a cover;

vii. Buildings (e.g. BESS housing) should be located outside of the wetland mosaic areas shown in **Figure 2.3** and preferably on existing built platforms;

viii. Existing roads should be used as far as possible.

Figure 4.1 shows developable versus no-go areas on the site, as recommended in this section.

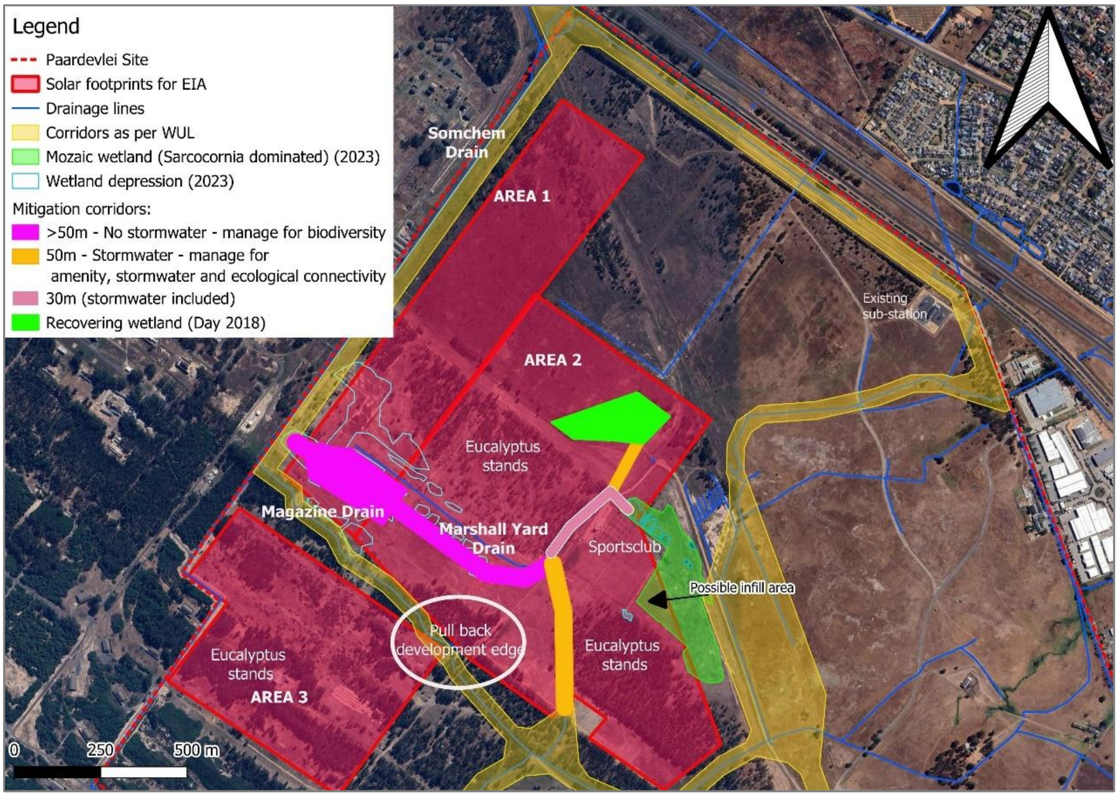


Figure 4.1
Development layout showing recommended new corridors and areas where the development should be pulled back from the WUL-required corridor. Note that wetlands outside of the site have not been shown; wetland mosaic areas within the site also not shown – this figure shows wetland areas and ecological corridors recommended for retention in a development context.

4.2.3 Impact 3: Wetland degradation as a result of eucalyptus clearing

Description of impact

Clearing of extensive areas currently occupied by eucalyptus stands is assumed, based on the current development layout. From a water resource conservation perspective, such measures are supported. However, where the site is being developed and not restored, their removal is likely to result in more water at the surface over the wet season, as well as a local increase in rainfall intensity, as the stands of trees dampen the intensity of rainfall passing through the canopy. If these changes are managed by conveyance off site into the existing or new drainage channels, there would potentially be a net increase in flow velocity and volume, particularly over the wet season, with potential for erosion and flooding in downstream areas where the stormwater system included in the masterplan has not yet been fully implemented.

It is also assumed that, following removal of stands of deep-rooted eucalyptus trees, groundwater levels would rise in parts of the site. JG Afrika (2023) notes that groundwater quality across the development area is considered to be poor with elevated concentrations of certain hydrochemical parameters of concern reported by SRK (2018) in the majority of the boreholes sampled. While most of the wetlands described in this report are perched rather than groundwater linked wetlands, if a raised water table intersects surface water areas (e.g. downstream in the Langvlei), then polluted water could enter these already impacted ecosystems, compromising their capacity for ecological recovery.

This impact has been identified with low confidence and requires input from the geohydrological specialists to confirm the actual risk entailed. Mitigation against this impact would be difficult, and mitigation recommendations revolve more around identification of the degree of risk posed.

Recommended mitigation measures

The following measures are required:

i. A stormwater management plan must be developed for the site that:
    a. Is in line with the stormwater master plan principles;
    b. Allows for the attenuation on site of increased flows generated both by surface hardening (roads, buildings, parking and solar modules);
    c. Accounts for potential increases in base and flood flows as a result of eucalyptus clearing.
ii. Specialist (geohydrological) input should inform decision-making around risk level and alleviation potential (e.g. borehole pumping and treatment of water);
iii. Monitoring of water quality in downstream stormwater channels and the Langvlei should be re-introduced before tree felling commences, and the contaminants of concern should be included in the monitoring programme, so that there is at least an understanding of water quality change and/or risk.

4.3 Impacts to aquatic ecosystems associated with the construction phase

The Construction Phase for this development is likely to include tree-felling and removal; demolition of parts or all of the existing buildings on the site; excavation of stormwater channels and attenuation ponds as required; laydown areas; excavation to allow for the shaping and rehabilitation of wetland depressions and pans in the wetland corridors (See Section 4.2.1); construction of roads and parking areas; buildings (including BESS containment structures); installation of solar PV modules; and installation of (assumed underground) cabling and other electrical infrastructure. The impacts associated with these activities are identified and described below, and formally assessed in **Table 4.1**.

4.3.1 Impact 4: Physical disturbance to remnant wetlands

Description of impact

During construction, both wetlands in the proposed corridors through the site and those that have not been ear-marked for conservation, would potentially be further disturbed by the passage of vehicles over them; their use as lay-down areas; damage during tree felling and haulage; and excavation for cabling and electrical infrastructure installations. Such disturbance would be exacerbated if undertaken in the wet season, when much of the site is saturated and /or inundated. Unmanaged construction could furthermore also impact on adjacent wetlands outside of the site (e.g. north and east of the sports club).

While it is recognized that wetlands on the site that are not included in the conservation areas would inevitably be disturbed by the proposed development, further physical degradation of the corridor wetlands and those outside of the site has been assessed as of medium to high significance and could have long-term impacts on their capacity to recover.

Recommended mitigation measures

The following measures are considered essential, namely:

i. The recommended corridors should be pegged out on site, and temporary mesh fencing installed at least 5 m beyond the pegged edge, before construction commences. These areas should be managed as no-go areas throughout construction, unless specifically targeted for rehabilitation mitigation (as per Section 4.2.1);

ii. Existing wetland mosaic areas north of the site (see Figure 2.3) should also be managed as no-go areas during construction and should not be used for laydown; site camps; storage areas – a wetland ecologist should provide input on site into the selection of suitable areas for such activities, if required off-site;

iii. Rehabilitation interventions in the wetland corridors (as per Section 4.2.2 (ii and iii) should:

    a. Take place before construction within 100m of the corridors commences, because they would be difficult to access once construction / installations have commenced in the surrounding area;

    b. Be overseen by a wetland ecologist;

    c. Be carried out outside of periods of inundation / saturation in these zones;

iv. Damage (e.g. excavation, flattening, infilling) of existing wetland mosaic areas outside of the conservation corridors should be minimized, so that these areas retain a level of function and provision of ecosystem services – it is recognized that disturbance will however definitely occur but:

    a. Construction in wetland mosaic areas that requires vehicle passage and/or excavation should at least be carried out when the surface is not saturated or inundated. This probably means that construction should be limited to the period between October and end of April each year, but surface hydrological conditions at the time should dictate this;

v. Where cables are excavated through wetland or wetland mosaic areas, care must be taken to re-shape the surface after they have been excavated, so as to achieve previous ground levels or better, rather than leaving a mound of infill. This means that excess soil may be generated;

vi. Trucks and other vehicles passing through the site should, as far as possible, keep to existing or created roads;

vii. All construction waste generated during construction must be removed from the site before the end of construction and disposed of at an appropriate legal waste disposal site;

viii. Litter should be cleared regularly from the site and disposed of appropriately;

ix. The above measures should be incorporated into a Construction Phase Environmental Management Plan.

4.3.2 Impact 5: Pollution of wetlands and channels

Description of impact

The passage of sediments, fuel, oil, or other waste into wetlands or stormwater channels would impact on aquatic habitat quality both on site and potentially in downstream receiving aquatic environments.

The nature of the proposed development means that sediment (mainly fine clays) is considered the greatest threat, particularly during the wet season. This impact has been rated as of low intensity and low significance.

Recommended mitigation measures

The following measures are recommended:

i. Refueling areas should be lined and bunded and be located at least 50m outside of any mapped wetland or wetland mosaic area;

ii. The construction site should be equipped with portable toilets located outside of any wetland mosaic area, and sufficient

iii. Where disturbed surfaces result in a flow of visibly sediment-enriched (turbid) water into any wetland or stormwater channel, measures must be put in place to retain such runoff in temporary sediment settlement ponds or to treat with other appropriate management devices, such that there is no significant change in the sediment load into downstream aquatic ecosystems (i.e. no more than a 5% increase);

iv. The above measures should also be incorporated into a Construction Phase Environmental Management Plan.

4.4 Operational Phase Impacts to aquatic ecosystems

The Operational Phase for this development would be associated with relatively few impacts other than maintenance interventions to repair or replace infrastructure; an increase in stormwater runoff, as a result of a substantial increase in surface hardening; and impacts associated with wash-down of solar panels.

The impacts associated with these activities are identified and described below, and formally assessed in **Table 4.1**.

4.4.1 Impact 6: Wetland and channel degradation as a result of changes in hydrology and water quality (from increased stormwater velocities and receipt of solar panel wash-off)

Description of impact

The development would result in a definite and substantial increase in peak flow velocity during storms, as a result of increased surface hardening, compounded by removal of eucalyptus forest. The latter has been assessed already in Section 4.2.3. Impacts of surface hardening to aquatic ecosystems would include an increased capacity for erosion in channels; and flushing of standing-water pools / depressions in the required wetland corridors, potentially reducing their value as standing water habitats.

Water quality impacts to downstream receiving wetlands including those in the wetland corridors could also be associated with the use of detergents in panel wash-down. This assessment conservatively assumes frequent wash-down and the use of detergents. If this water passed into the stormwater system, detergents could potentially impact on downstream receiving wetlands including those in the wetland corridors. Since such activities would not take place during storm events, water contaminants might be relatively concentrated, affecting wetlands with little or no water in them during summer. If washdown activities occurred frequently enough to result in permanent summer saturation or inundation in wetlands or channels, there would be a marked deterioration in these systems, with a shift from seasonal vegetation (e.g. *Eleocharis limosa*) to less ecologically desirable reedbed (*Typha capensis*).

These impacts have been assessed as of Medium negative significance in **Table 4.1**.

Recommended mitigation measures

Mitigation measures outlined in Section 4.2.3 (i) must be implemented to address the above issues.

In addition:

i. Ideally, detergents and other chemicals should not be used in wash water;

ii. Where the above is not practical, the system must be designed so that waste water generated during washdowns does not pass into the stormwater system but is collected and recycled; disposed of to the sewer; and/or used as irrigation water in areas that are not intended to support indigenous wetland habitats.

4.4.2 Impact 7: Physical disturbance to remnant wetlands as a result of maintenance / repairs

Description of impact

It is likely that all aspects of the development would require access over time for maintenance / repairs, resulting in similar but more localised impacts of lower intensity to those identified in the Construction Phase.

These impacts have been assessed as of Low significance, given that they are unlikely to be required at the same time.

Recommended mitigation measures

The mitigation measures outlined in Sections 4.3.1 and 4.3.2 must be implemented, as relevant to the activity being undertaken. The following additional measures / changes are however relevant:

i. Fencing off of wetland areas is not required, provided that the wetlands within the wetland corridors are treated as no-go areas;

ii. Where wetlands are disturbed during maintenance interventions, they should be rehabilitated to their condition prior to maintenance, or better. This might require earthworks.

4.5 Cumulative impacts

Development of the site as proposed would be a relatively small development at the scale of the Paardevlei site, and the main impacts associated with the site (fragmentation of assigned ecological and hydrological corridors and loss of degraded, partly artificial wetlands) appears insignificant at the level of the site. However, development of the whole site is anticipated in the stormwater masterplan, and in that context, the cumulative loss of wetlands across the site could be substantial, as would fragmentation of ecological corridors. Loss of even degraded but recovering seasonal wetlands also has greater significance in the context of the extent of development on the coastal flats in the broader Somerset West / Strand area, where very little remnants remain.

In a mitigated context, the cumulative impacts described above would however be adequately mitigated through the creation of strong ecological corridors within development sites on an individual basis, that support the required corridors included in the stormwater master plan for the overall Paardevlei development area.

Cumulative impacts in a mitigated context would thus be rated as of Low significance.

4.6 Impacts to aquatic ecosystems associated with a "No Development" outcome

The "no development" outcome would apply to the current site only, and it is assumed that the broader Paardevlei development would be undertaken as proposed in the stormwater masterplan, subject to development authorisation for different development portions.

In the absence of development on the present site, it is assumed that the area would remain a derelict area, potentially used for soccer in the future. The eucalyptus stands would remain and could spread further, but the wetlands that have established in excavated and remediation areas would remain and would be expected to show slow recovery in terms of both habitat and water quality over time. This would clearly be a preferred outcome to the development of the site as proposed. However, it is noted that development of a solar facility would not require the level of surface hardening that other development types could require, and would also be associated with relatively low impacts in terms of water quality impacts.

4.7 Results of formal assessment of impact significance

Table 4.1
Results of application of formal impact assessment protocols to identified impacts to aquatic ecosystems predicted as a consequence of development of a solar PV facility and associated infrastructure at Paardevlei. Assessment protocols as per Appendix C.
Assessments "with mitigation" assume implementation of all mitigation measures outlined in the above sections.

	WITHOUT MITIGATION	**WITH MITIGATION**
DESIGN AND LAYOUT IMPACTS		
Impact 1:	**Loss of wetland habitat**	
Description:	See Section 4.2.1	
Nature of impact	Negative	Negative
Extent of impact	Immediate	Immediate
Duration of impact	Long-term	Long-term
Intensity of impact	Medium to high	Medium
Probability of occurrence	Definite	Definite
Significance rating of impact	Medium to high	Low
Reversibility	Essentially irreversible	
Proposed mitigation measures	See Section 4.2.2: Includes wetland rehabilitation, replacement and consolidation	
Impact 2:	***Interruption of required ecological connectivity in a full site development context***	
Description:	See Section 4.2.2	
Nature of impact	Negative	Negative
Extent of impact	Local	Immediate
Duration of impact	Long-term	Long-term
Intensity of impact	Medium to high	Low
Probability of occurrence	Definite	Low probability
Significance rating of impact	High	Low
Reversibility	Essentially irreversible	
Proposed mitigation measures	See Section 4.2.2: Includes wetland replacement, rehabilitation and consolidation	
Impact 3:	***Wetland degradation as a result of eucalyptus clearing: low confidence assessment***	
Description:	See Section 4.2.3	

	WITHOUT MITIGATION	**WITH MITIGATION**
Nature of impact	Negative	Negative
Extent of impact	Local	Immediate
Duration of impact	Long-term	Long-term
Intensity of impact	Low	Very Low
Probability of occurrence	Probable	Probable
Significance rating of impact	Low to Medium	Low
Reversibility	Reversible with difficulty	
Proposed mitigation measures	See Section 4.2.3	
CONSTRUCTION PHASE IMPACTS		
Impact 4:	***Physical disturbance to remnant wetlands***	
Description:	See Section 4.3.1	
Nature of impact	Negative	Negative
Extent of impact	Local	Immediate
Duration of impact	Medium-term	Short-term
Intensity of impact	Medium	Low-to-medium
Probability of occurrence	Highly probable	Probable
Significance rating of impact	Medium to high	Low
Reversibility	Partially reversible with time	
Proposed mitigation measures	See Section 4.3.1	
Impact 5:	***Pollution of wetlands and channels***	
Description:	See Section 4.3.2	
Nature of impact	Negative	Negative
Extent of impact	Local	Immediate
Duration of impact	Short-term	Short-term
Intensity of impact	Low	Low
Probability of occurrence	Highly probable	Probable
Significance rating of impact	Low	Very Low
Reversibility	Partially reversible	
Proposed mitigation measures	See Section 4.3.2	
OPERATIONAL PHASE IMPACTS		
Impact 6:	***Wetland and channel degradation as a result of changes in hydrology and water quality (from increased stormwater velocities and receipt of solar panel wash-off)***	
Description:	See Section 4.4.1	
Nature of impact	Negative	Negative
Extent of impact	Local	Immediate
Duration of impact	Long-term	Long-term
Intensity of impact	Medium	Low
Probability of occurrence	Probable	Low probability
Significance rating of impact	Low to Medium	Low

	WITHOUT MITIGATION	WITH MITIGATION
Reversibility	Partially reversible with time	
Proposed mitigation measures	See Section 4.4.1	
Impact 7:	***Physical disturbance to remnant wetlands as a result of maintenance / repairs***	
Description:	See Section 4.4.2	
Nature of impact	Negative	Negative
Extent of impact	Immediate	Immediate
Duration of impact	Medium-term	Short-term
Intensity of impact	Low	Low
Probability of occurrence	Probable	Probable
Significance rating of impact	Low	Very Low
Reversibility	Partially reversible with time	
Proposed mitigation measures	See Section 4.4.2	
IMPACTS OF NO DEVELOPMENT OPTION		
No development:	Slow and slight improvement in wetland habitat quality and diversity	
Description:	See Section 4.6	
Nature of impact	Positive	N/A
Extent of impact	Immediate	
Duration of impact	Long-term	
Intensity of impact	Low	
Probability of occurrence	Probable	
Significance rating of impact	Low (positive)	
Reversibility	N/A	
Proposed mitigation measures	N/A	

4.8 Response to specific requirements of the new NEMA impact assessment protocols

The National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998) assessment protocols, as amended, were promulgated in Gazette No. 42451, Government Notice No. 648 of 10 May 2019. These comprised procedures for the Assessment and Minimum Criteria for Reporting of Identified Environmental Themes in terms of Section 24(5)(a) and (h) of the NEMA, when applying for Environmental Authorisation.

Although these issues have been considered indirectly in Sections 2, 3 and Section 4.1-4.7, this section has been included to address each point raised in the amended assessment protocol specifically, as indicated in **Table 4.2**.

Table 4.2
Response to specific themes raised in the 2020 NEMA specialist reporting protocols (Government Notice No. 648 of 10 May 2019. Procedures for the Assessment and Minimum Criteria for Reporting of Identified Environmental Themes in terms of Section 24(5)(a) and (h) of the NEMA, when applying for Environmental Authorisation)

NEMA PROTOCOL ISSUE	RESPONSE Note that all responses assume that specified mitigation measures have been applied
Is the development consistent with maintaining the priority aquatic ecosystem in its current state and according to the stated goal?	Yes - with mitigation, the development would be in line with the authorized stormwater masterplan for the overall Paardevlei site
Is the development consistent with maintaining the Resource Quality Objectives for the aquatic ecosystems present?	No RQOs have been formulated for wetlands. However, mitigation measures that include the creation of wetland corridors would retain aquatic habitat connectivity and provide acceptable aquatic habitat – noting that the lost habitat comprises mainly artificial wetlands developing in excavated and degraded areas.
How will the development impact on fixed and dynamic ecological processes that operate within or across the site, including:	
• Impacts on hydrological functioning at a landscape level and across the site which can arise from changes to flood regimes (e.g. suppression of floods, loss of flood attenuation capacity, unseasonal flooding or destruction of floodplain processes); and	Stormwater mitigation measures would prevent downstream impacts and be in line with the authorized stormwater management plan for the greater site. Mitigation measures require retention of localised depression wetlands but also the creation of additional attenuation areas.
• Change in the sediment regime (e.g. sand movement, meandering river mouth/estuary, changing flooding or sedimentation patterns) of the aquatic ecosystem and its sub-catchment;	Sediment would be managed through stormwater ponding and by reducing site clearance (i.e. installation of solar PV modules on vegetated (artificial) wetland mosaic areas.
• The extent of the modification in relation to the overall aquatic ecosystem (i.e. at the source, upstream or downstream portion, in the temporary / seasonal / permanent zone of a wetland, in the riparian zone or within the channel of a watercourse, etc.)	The development would result in loss of and/or degradation of seasonal and temporary wetland. This wetland is however located in a highly transformed area and connected to downstream wetlands via artificial drainage trenches. Better quality wetland depressions that have developed in parts of the site would be retained. The retained wetlands have been artificially created by waste remediation activities on site – however, the natural pre-development condition of the area is likely to have been alluvial wetland flats.

• Assessment of the risks associated with water use/s and related activities.	The DWS risk assessment matrix shows Medium risk associated with the development. This is driven largely by the fact that wetlands, albeit degraded, would be impacted.
How will the development impact on the functionality of the aquatic feature, including: • Base flows (e.g. too little/too much water in terms of characteristics and requirements of system); • Quantity of water including change in the hydrological regime or hydroperiod of the aquatic ecosystem (e.g. seasonal to temporary or permanent; impact of over abstraction or instream or off-stream impoundment of a wetland or river) • Change in the hydrogeomorphic typing of the aquatic ecosystem (e.g. change from an unchanneled valley-bottom wetland to a channeled valley-bottom wetland). • Quality of water (e.g. due to increased sediment load, contamination by chemical and/or organic effluent, and/or eutrophication) • Fragmentation (e.g. road or pipeline crossing a wetland) and loss of ecological connectivity (lateral and Longitudinal) . • The loss or degradation of all or part of any unique or important features (e.g. waterfalls, springs, oxbow lakes, meandering or braided channels, peat soils, etc.) associated with or within the aquatic ecosystem.	Eucalyptus clearing will increase base flows (to potentially more natural levels) and controls on washdown waste water disposal would limit other baseflow impacts. Stormwater management should attenuate these flows; changes in hydroperiod would be mitigated by the above controls, although alien clearing would potentially increase hydroperiod. None – the HGM type has already largely changed from floodplain flats to wetland depressions and wetland flats. Changes associated with stormwater runoff from the development should be controlled by mitigation. This report flagged the need to consider water quality risks relating to changes in groundwater level as a result of eucalyptus clearing. Mitigation measures have addressed impacts of connectivity – hydrological and ecological connectivity would be retained within the site as well as along (artificial) channels included as corridors in the stormwater masterplan. None
How will the development impact on key ecosystem regulating and supporting services especially: • Flood attenuation; • Streamflow regulation; • Sediment trapping; • Phosphate assimilation;	Flood attenuation capacity arguably not reduced if development over wetland flats does not require site leveling and infill. However, demand for attenuation would increase as a result of catchment hardening – and this would need to be accommodated in an implemented stormwater management plan.

• Nitrate assimilation; • Toxicant assimilation; • Erosion control; and • Carbon storage.	Current sources of nutrients on the site are mainly from grazing cattle and springbok. Such sources would be eliminated in a solar development context. Sediment trapping and nutrient assimilation would be unchanged in the wetland corridor but potentially reduced in portions of wetland flats / pans if vegetation does not thrive under the solar panels. This would potentially be offset by reduced (to very low to negligible) nutrient sources. The site is flat and erosion is not a major concern. Stormwater attenuation measures would also address this risk. On-site carbon storage would be negatively impacted by the felling of extensive (but alien) eucalyptus forest. However, since the development would allow for solar energy generation, to supplement the City's current reliance largely on nuclear and thermal energy, the carbon storage loss would potentially be offset by future reduced consumption (and associated carbon dioxide releases). This has not been assessed in more detail in this report.
How will the development impact community composition (numbers and density of species) and integrity (condition, viability, predator-prey ratios, dispersal rates, etc.) of the faunal and vegetation communities inhabiting the site?	The wetlands that are likely to support the greatest diversity of wetland fauna and flora would be retained in the wetland corridors, and would have connectivity to up- and downstream habitats. Local plant species loss would be likely in the wetland flats that would be covered by solar panels – these are locally common plants that would moreover be accommodated (to a limited spatial extent) within the wetland corridors (e.g. *Sarcocornia perenne*).
In addition to the above, where applicable, impacts to the frequency of estuary mouth closure should be considered in relation to: • Size of the estuary; Availability of sediment; • Wave action in the mouth; • Protection of the mouth; • Beach slope; • Volume of mean annual runoff (MAR); • Extent of saline intrusion (especially relevant to permanently open systems).	 N/A N/A

A motivation must be provided if there were development footprints identified as having a "low'' biodiversity sensitivity and were not considered appropriate.	The "no development" option would not impact negatively on wetlands on site. The proposed development is however considered acceptable from an aquatic ecosystems perspective, and not associated with any impacts above Low-Medium significance with mitigation.

5 APPLICABILITY OF THE NATIONAL WATER ACT TO THE PROPOSED ACTIVITIES

The development activities proposed for the site include a number of water "uses", as defined in Section 21 of the National Water Act (NWA) (Act 36 of 1998). As such, they could be subject to requirements for authorisation and/or registration with the Department of Water and Sanitation (DWS).

The only watercourses on the site, in terms of the NWA definitions (see Section 1.7 of this report) comprise the wetland depressions, pans and mosaic wetland flats shown in **Figure 2.3**. The drainage trenches do not comply with the legally definition of a watercourse.

Section 21 water uses associated with the proposed development would comprise:

> *(c) impeding or diverting the flow of water in a watercourse* (installation of solar PV modules and cables within wetlands; construction of roads within wetlands; infilling portions of wetlands; re-shaping of wetlands for rehabilitation purposes; re-shaping of wetlands for development purposes; installation of stormwater management systems).
>
> *(i) altering the bed, banks. course or characteristics of a watercourse* (installation of solar PV modules and cables within wetlands; construction of roads within wetlands; infilling portions of wetlands; re-shaping of wetlands for rehabilitation purposes; and re-shaping of wetlands for development purposes).

If the above Section 21c and i water uses could be managed so as to minimise impacts, they would be Generally Authorised in terms of Government Notice (GN) 509 of August 2016, which allows for the General Authorisation of Section 21c and i activities that are assessed as of Low Risk.

Table 5.1 presents the results of the required Risk Assessment Matrix for Section 21c and 21i water use activities[1].

The table indicates that, as suggested by the findings of the Impact Assessment ratings in Table 4.1, that at least some impacts are of Medium rather than Low risk. **A Water Use License would thus be required**, to consider the proposed project application from a water resource perspective, in terms of the NWA.

[1] Note that the Risk Matrix in its current form does not easily (or defendably) apply to the Layout and Construction Phase activities assessed here, and ratings of Activity and Impact frequency have been adjusted to make more sense of the kind of impacts considered.

Table 5.1

Aspects and Impact Register/Risk Asssessment for Section 21c and 21i activities likely to be associated with the proposed development of a Solar PV Facility and BESS on the Paardevlei site. Assessment assumes fulll implementation of control measures listed (as per Section 5.4).
Risk Matrix completed by Liz Day -SACNASP Reg no. 400270/08

				Severity																
Phases	Activity	Aspect	Impact	Flow Regime	Physico & Chemical (Water Quality)	Habitat	Biota	Severity	Spatial scale	Duration	Conseq	Freq of activity	Freq of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Control Measures	Type of Watercourse
Layout and construction	Construction of a Solar PV facility with associated BESS and other infrastructure on the site	Installation of solar PV modules and cables and access roads within wetlands	Loss of wetland habitat (albeit wetland established in remediation and excavated areas, previously used in AECI activities but originally wetland floodplain flats)	1	1	3	2	1.8	1	4	6.8	1	5	5	1	12	81	MEDIUM	Section 4.2 of aquatic specialist EIA report	Wetland depressions and wetland flats
			Pollution of wetlands during construction (sediment; leaked fuels and other material)	1	2	2	2	1.8	1	2	4.8	1	3	5	2	11	52.3	LOW	Section 4.3 of aquatic specialist EIA report	
		Hardening of surface areas resulting in changes in surface water runoff quality and quantity into wetlands	Wetland degradation	2	2	2	1	1.8	1	2	4.8	2	4	5	2	13	61.8	MEDIUM	Section 4.3 of aquatic specialist EIA report	
		Clearing of Eucalyptus forest	Increased baseflows (Positive)	1	1	1	1	1	1	1	3	1	1	5	3	10	30	LOW	Section 4.2.3 of aquatic specialist EIA report	
			Potential water quality threats	2	3	2	2	2.3	2	3	7.3	3	4	5	4	16	116	MEDI		
		Re-shaping of wetlands for rehabilitation purposes	Improved wetland habitat quality where wetlands are incorporated into wetland corridors	1	1	1	1	1	1	1	3	1	1	5	1	8	24	LOW	Section 4.2.2 of aquatic specialist EIA report	
Operational	Management and maintenance of proposed solar PV facility and associated infrastructure	Routine maintenance or repairs to infrastructure	Wetland degradation	2	2	2	1	1.8	1	2	4.8	1	3	5	1	10	47.5	LOW	Section 4.4.2 of aquatic specialist EIA report	
		Stormwater flows from hardened surfaces	Wetland degradation	2	2	2	2	2	2	1	5	2	2	5	2	11	55	LOW	Section 4.4.1 of aquatic specialist EIA report	
		Washdown of solar panels	Wetland degradation	1	1	1	1	1	1	1	3	3	1	5	1	10	30	LOW		

6 CONCLUSIONS

This report has considered the likely impacts to aquatic ecosystems that would accrue from the proposed development of a solar PV facility at the Paardevlei site in Somerset West, Cape Town. The site currently comprises extensive wetland areas that have developed largely as a result of pollution remediation activities associated with its past use as a munitions factory and testing area. The area in which they have developed was however likely to have included extensive floodplain wetland flats under natural conditions. Past connection to the floodplain of the Lourens River has however long been lost. Nevertheless, wetland quality on the site is on an improving trajectory, although local wetland water quality is untested and may still be problematic from an aquatic ecosystems perspective.

If the proposed project were authorised, it would require development over large portions of wetland flats, most of which have developed in areas where soil remediation activities have required skimming of contaminated surface soils. Nevertheless, these wetlands are considered locally important representatives of seasonally inundated wetland habitat, and assuming that water quality has not been permanently impacted by past contamination, they have ecological value in a fast-developing landscape. At the same time, the stormwater masterplan for the greater Paardevlei site assumed development of this area, and allowed for substantial hydrological-ecological corridors through the site, to prevent ecological fragmentation and ensure sustainable stormwater management.

In this context, mitigation measures recommended in this report have focused on measures to:

- Allow for the re-creation, conservation and rehabilitation of the depression wetlands in the best condition on the site, and their inclusion in corridors that link to those required in terms of the stormwater master plan for the greater Paardevlei site;
- Address potential impacts to water quality and water quantity as a result of increased hardened surface areas on the site and possible sources of contaminated runoff;
- Reduce impacts to wetland areas that would underlie developed spaces.

The report has also flagged the potential for clearing of eucalyptus forests to result in unintended consequences such as a raised but contaminated water table that impacts on downstream aquatic ecosystems. This issue requires input from geohydrological specialists.

Assuming that the above issues can be addressed / informed, the proposed development is considered acceptable from a freshwater ecosystems perspective. It would however require a water use license, in terms of the NWA.

7 REFERENCES

Bau-afrika. 2014. Addendum X4. Draft Addendum to Stormwater Master Plan for the Development of the Paardevlei Macro Site. Design Concepts for the Stormwater Outfall System. Heartland. Somerset West. Report prepared for Heartland Properties (Pty) Ltd by Bau-afrika (Pty) Ltd.

Brown, C. and Magoba, R. 2009. Rivers and wetlands of Cape Town. WRC. TT 376/08. Pretoria.

City of Cape Town. 2009. Policy on minimising the impact of stormwater from urban development on receiving waters. Roads and Stormwater Department: Catchment, River and Stormwater Management Branch.

Day, E. (Liz). 2009. Paardevlei. Re-assessment of options for the incorporation of Paardevlei into the proposed Heartlands Development at the former AECI site, Somerset West. Phase 1: Assessment of options and identification of opportunities and constraints in a development context. FCG Report to Heartland Properties (Pty) Ltd.

Day, E. (Liz). 2012. Heartland Site, Somerset West. Baseline Assessment of freshwater ecosystems on and associated with the site. FCG Report to Heartland Properties (Pty) Ltd.

Day, E. (Liz). 2013. Paardevlei. Operational Phase Environmental Management Plan. Revised Final Report. FCG Report to Heartland Properties (Pty) Ltd.

Day, E.(Liz). 2014. Basic Assessment Report on the proposed Stormwater Masterplan for the Paardevlei Site, Somerset West. Assessment of implications for freshwater ecosystems. Report for client Paardevlei Properties.

Day, E.(Liz). 2018. Paardevlei Site, Somerset West. Baseline assessment of freshwater ecosystems on and associated with the site: Report to TEP for the City of Cape Town.

Department of Water Affairs and Forestry. 1999. Resource Directed Measures for Protection of Water Resources. Volume 3: River Ecosystems Version 1.0, Pretoria. Resource Directed Measures for Protection of Water Resources, Pretoria, South Africa.

Department of Water Affairs and Forestry. 2005. A practical field procedure for identification and delineation of wetland riparian areas. Department of Water Affairs and Forestry, Pretoria, South Africa.

Driver, A, Nel, J.L., Snaddon, K., Murray, K., Roux, D., Hill, L., Swartz, E.R., Manuel, J. and Funke, N. 2011. Implementation Manual for Freshwater Ecosystem Priority Areas. WRC Report No. 1801/1/11. ISBN 978-1-4312-0147-1. Pretoria.

Molepo, M. 2023. Terrestrial Biodiversity Impact Assessment for the Proposed Paardevlei Solar Project in the Western Cape, South Africa. Report from MORA Ecological Services (Pty) Ltd to JG Afrika.

Nel, J.L., Murray, K.M., Maherry, A.M., Petersen, C.P., Roux, D.J., Driver, A., Hill, L., Van Deventer, H., Funke, N., Swartz, E.R., Smith-Adao, L.B., Mbona, N., Downsborough, L. and Nienaber, S. (2011). Technical Report for the National Freshwater Ecosystem Priority Areas project. WRC Report No. K5/1801.

Ollis, D.J., Snaddon, C.D., Job, N.M. & Mbona, N. 2013. *Classification System for Wetlands and other Aquatic Ecosystems in South Africa*. User Manual: Inland Systems. SANBI Biodiversity Series 22. South African National Biodiversity Institute, Pretoria.

Pool-Stanvliet, R., Duffell-Canham, A., Pence, G. and Smart, R. 2017. *The Western Cape Biodiversity Spatial Plan Handbook.* Cape Nature, Stellenbosch.

South African National Biodiversity Institute (SANBI) and Department of Water and Sanitation (DWS). 2016. *Wetland offsets: a best-practice guideline for South Africa.* WRC Report NO TT 660/16. Pretoria.

Van Deventer, H., Smith-Adao, L., Mbona, N., Petersen, C., Skowno, A., Collins, N.B., Grenfell, M., Job, N., Lötter, M., Ollis, D., Scherman, P., Sieben, E. & Snaddon, K. 2018. South African National Biodiversity Assessment 2018: Technical Report. Volume 2a: South African Inventory of Inland Aquatic Ecosystems (SAIIAE). Version 3, final released on 3 October 2019. Council for Scientific and Industrial Research (CSIR) and South African National Biodiversity Institute (SANBI): Pretoria, South Africa. Report Number: CSIR report number CSIR/NRE/ECOS/IR/2018/0001/A; SANBI report number. http://hdl.handle.net/20.500.12143/5847

APPENDIX A

SPECIALIST CURRICULUM VITAE

LIZ DAY'S CURRICULUM VITAE

SUMMARY DOCUMENT (2023)

Name	Dr Elizabeth (Liz) Day (née Reynolds)
Address	[redacted] South Africa
Cell number	[redacted]
Email	[redacted]
Date of birth	[redacted]
Place of birth	Zimbabwe
Nationality	South African
Current Position	Director: Liz Day Consulting (Pty) Ltd

Liz Day is a **Freshwater Ecologist** who provides specialist input into river and wetland ecosystems management and rehabilitation, water quality, baseline assessments, impact assessments, wetland offset determinations, strategic planning and review and other aspects of aquatic ecosystem consulting. She has particular experience in working in urban and agricultural areas, across a wide range of socio economic conditions.

KEY WORK EXPERIENCE

2019 -	Specialist consultant on freshwater ecosystems (rivers and wetlands) – Liz Day Consulting (Pty) Ltd
1999- 2019	Specialist consultant on freshwater ecosystems; co-founder of Freshwater Consulting (FCG)
1997 - 1999	Senior Consultant for Southern Waters Ecological Research and Consulting cc
1994 - 1996	Scientific Officer on Water Research Commission Project, Freshwater Research Unit, UCT.

SUMMARY OF RELEVANT EXPERIENCE

> 24 years' experience in aspects of aquatic ecology, specialising in:

- Water quality wetland, river, wetland and vlei water quality monitoring, data analysis and interpretation as well as urban stormwater quality assessments
- Urban river and wetland management and rehabilitation
- Urban stormwater design with respect to freshwater ecosystems and water quality amelioration
- Specialist input into environmental impact assessments; baseline and situation assessments
- DWS Risk Assessments;
- Wetland Offset calculations and agreements;
- Catchment and River Management Plans
- River corridor plans
- Inputs into Ecological Reserve Determinations
- River and wetland Maintenance and Management Plans
- River and wetland mapping and biodiversity planning
- Wetland delineation
- SASS5 bioassessments.

Liz has compiled over 900 specialist riverine ecology technical reports, 12 scientific papers (6 in international literature); 20 popular biological articles published in local environmental magazines, scripts for several environmental documentaries; *ad hoc* lecturer in freshwater ecology at UCT; co-author on 4 Water Research Commission reports; lead author on chapter in UNESCO Sustainable Management of Urban Aquatic Ecosystems handbook; lead author on chapter in Fynbos Ecosystem Management book; project leader and author of WRC Technical Manual for River Rehabilitation in South Africa (2016). She has also sat on the Reference Groups / Steering Committees of numerous Water Research projects, including those relating to wetland ecological infrastructure, wetland rehabilitation monitoring protocols, Sustainable Urban Drainage Systems (SUDS) and Water Sensitive Urban Design (WSUD) in the City of Cape Town and eThekwini Municipalities.

KEY QUALIFICATIONS

- Bachelor of Arts (English), University of Cape Town, 1989
- Bachelor of Science (Zoology and Environmental and Geographical Science); University of Cape Town; 1992
- Bachelor of Science (honours- Zoology, first class); University of Cape Town, 1993
- PhD (Zoology / Marine Biology); University of Cape Town, 1998

PROFESSIONAL AFFILIATIONS

- Member of WISA, IAIA-SA and Society for Ecological Restoration (SER) (African Chapter)
- Registered Professional Natural Scientist by SACNASP (Reg No 400270/08)
- Member of Western Cape Wetlands Forum and Wetland Society of South Africa
- Member of False Bay Nature Reserve Protected Area Advisory Committee
- Member – Mayoral Advisory Committee on Water Quality in Wetlands and Waterways.

APPENDIX B

Wetland assessment protocols

B1 Wetland condition

Wetland condition was assessed using the desk-top Present Ecological State (PES) methodology, adapted from DWAF (1999). The methodology is based on a comparison of current attributes of the wetland, which are scored against those of a desired baseline or reference condition, resulting in the assignment of a wetland to one of six PES categories, as defined in DWAF (1999) and described in Table B1. The methodology is applicable to natural wetlands only.

Table B1
Relationship between Present Ecological State (PES) and showing deviation from natural conditions, as defined in DWAF (2008) (Note: subcategories of DWAF 2008 have been excluded)

PES RATING/ VALUE	DEVIATION FROM REFERENCE CONDITIONS	SCORE (% SIMILARITY TO REFERENCE OR NATURAL CONDITION)	PES CATEGORY
0	No Change	≥92	A
1	Small Change	>82 to 92	B
2	Moderate Change	>62 to 82	C
3	Large Change	>42 to 62	D
4	Serious Change	> 22 to 42	E
5	Extreme Change	0 to 42	F

B2 Approach to the identification and delineation of wetlands

The presence of wetlands, and their extent (if any) was determined on the basis of DWAF (2005) and DWAF (2008). This was undertaken in2018 and reported on in Day (2018). In the current assessment, the Day (2018) findings were extrapolated to the present site, with ground-truthing and hand-held GPS marking out of wetlands on site, accompanied by desk-top mapping from aerial / satellite imagery.

B3 Wetland Conservation Importance

In order to provide a more specific guide to the relative conservation importance of individual wetland patches on the present site, a methodology developed by Ewart-Smith and Ractliffe (2002) was utilised. This methodology assigns low, medium and high conservation importance ratings to individual wetlands, on the basis of the following criteria (note that the highest category applicable to any wetland, based on any one criterion, is the one accorded the wetland as a whole):

- **Low conservation importance:**
  - does not provide ecologically or functionally significant wetland habitat, because of extremely small size or degree of degradation, and/or
  - of extremely limited importance as a corridor between systems that are themselves of low conservation importance.
- **Moderate conservation importance:**
  - provides ecologically significant wetland habitat (e.g. locally important wetland habitat types), and/or
  - fulfils some wetland functional roles within the catchment, and/or
  - acts as a corridor for fauna and/or flora between other wetlands or ecologically important habitat types, and/or

  - supports (or is likely to support) fauna or flora that are characteristic of the region and/or provides habitat to indigenous flora and fauna, and/or
  - is a degraded but threatened habitat type (e.g. seasonal wetlands), and/or
  - is degraded but has a high potential for rehabilitation, and/or
  - functions as a buffer area between terrestrial systems and more ecologically important wetland systems, and/or
  - is upstream of systems that are of high conservation importance.
- **High conservation importance:**
  - supports a high diversity of indigenous wetland species, and/or
  - supports, or is likely to support, red data species; supports relatively undisturbed wetland communities, and/or
  - forms an integral part of the habitat mosaic within a landscape, and/or
  - is representative of a regionally threatened / restricted habitat type, and/or
  - has a high functional importance (e.g. nutrient filtration; flood attenuation) in the catchment, and/or
  - is of a significant size (and therefore provide significant wetland habitat, albeit degraded or of low diversity).

B4 Ecological Importance and Sensitivity (EIS) protocol for wetlands

The method used to assess the EIS of wetlands is a refinement of the Resource Directed Measures for Water Resources: Wetland Ecosystems method (DWAF 1999). It includes an assessment of ecological (e.g. presence of rare and endangered fauna / flora), functional (e.g. groundwater storage / recharge) and socio-economic criteria (e.g. human use of the wetland).

Scoring of these criteria places the wetland in a Wetland Importance Class (A-D) (see Table B2).

Table B2
Wetland Importance Class integrating Ecological Importance and Sensitivity, and functional and socio-cultural importance modifiers

Importance class (one or more attributes may apply)	Range of Median	Wetland Importance Class
Very high Representative of wetlands that: • support key populations of rare or endangered species; • have a high level of habitat and species richness; • have a high degree of taxonomic uniqueness and/or intolerant taxa; • provide unique habitat (e.g. salt marsh or ephemeral pan; physiognomic features, spawning or nursery environments); • is a crucial avifaunal migratory node (e.g. RAMSAR wetlands); • may provide hydraulic buffering and sediment retention for large to major rivers that originate largely outside of urban conurbations; • have groundwater recharge/discharge comprising a major component of the hydrological regime of the wetland; • are highly sensitive to changes in hydrology, patterns of inundation, discharge rates, water quality and/or disturbance; and • are of extreme importance for conservation, research	>3 <=4	A

or education.		
High Representative of wetlands that: • support populations of rare or endangered species, or fragments of such populations that are present in other similar and geographically-adjacent wetlands; • contain areas of habitat and species richness; • contain elements of taxonomic uniqueness and/or intolerant taxa; • contain habitat suitable for specific species (e.g. physiognomic features); • provide unique habitat (e.g. salt marsh or ephemeral pan; spawning or nursery environments, heronries); • may provide hydraulic buffering and sediment retention for rivers that originate largely outside of urban conurbations, or within residential fringes of urban areas; • have groundwater recharge/discharge comprising a component of the hydrological regime of the wetland; • may be sensitive to changes in hydrology, patterns of inundation, discharge rates, water quality and/or human disturbance; and • are important for conservation, research, education or eco-tourism.	> 2 <= 3	B
Moderate Representative of wetlands that: • contain small areas of habitat and species richness; • provide limited elements of habitat that has become fragmented by development (e.g. salt marsh, ephemeral pan; roosting sites and heronries); • provide hydraulic buffering for rivers that originate in urban areas; • are moderately sensitive to changes in hydrology, patterns of inundation, discharge rates and/or human disturbance; • perform a moderate degree of water quality enhancement, but are insensitive to sustained eutrophication and/or pollution; and • are of importance for active and passive recreational activities.	>1 <= 2	C
Low/marginal Representative of wetlands that: • contain large areas of coarse (reeds) wetland vegetation with minimal floral and faunal diversity; • have a high urban watershed:wetland area ratio; • are important for active and passive recreation; • provide moderate to high levels of hydraulic buffering; • may be eutrophic and generally insensitive to further nutrient loading; • are generally insensitive to changes in hydrology, patterns of inundation, discharge rates and/or human disturbance; • have regulated water; and • contain large quantities of accumulated organic and inorganic sediments.	>0 <= 1	D

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

B6 Wetland classification

Wetlands were classified in terms of the South African National Wetland Classification system of Ollis et al (2013). This is a hierarchical system, which recognises three distinct wetland types – Inland, Estuarine and Coastal systems. The classification system for Inland wetlands, which comprised all of the wetlands on the site, is shown in **Table B4**.

Table B4

Structure of the National Wetland Classification Systems for Inland systems (rivers and wetlands excluding estuaries) showing main Hydrogeomorphic (HGM) Units at Level 4a and Subcategories at Levels 4b to 4c. Table after Ollis et al (2013)

LEVEL 4: HYDROGEOMORPHIC (HGM) UNIT		
HGM type	*Longitudinal zonation/Landform/ Outflow drainage*	*Landform/Inflow drainage*
A	**B**	**C**
River	Mountain headwater stream	Active channel
		Riparian zone
	Mountain stream	Active channel
		Riparian zone
	Transitional	Active channel
		Riparian zone
	Upper foothills	Active channel
		Riparian zone
	Lower foothills	Active channel
		Riparian zone
	Lowland river	Active channel
		Riparian zone
	Rejuvenated bedrock fall	Active channel
		Riparian zone
	Rejuvenated foothills	Active channel
		Riparian zone
	Upland floodplain	Active channel
		Riparian zone
Channelled valley-bottom wetland	[not applicable]	[not applicable]
	[not applicable]	[not applicable]
Unchannelled valley-bottom wetland	[not applicable]	[not applicable]
	[not applicable]	[not applicable]
Floodplain wetland	Floodplain depression	[not applicable]
	Floodplain flat	[not applicable]
Depression	Exorheic	With channelled inflow
		Without channelled inflow
	Endorheic	With channelled inflow
		Without channelled inflow
	Dammed	With channelled inflow
		Without channelled inflow
Seep	With channelled outflow	[not applicable]
	Without channelled outflow	[not applicable]
Wetland flat	[not applicable]	[not applicable]

APPENDIX C

Methodology for determining Impact Significance

C METHODOLOGY FOR DETERMINING IMPACT SIGNIFICANCE
Adapted by Liz Day Consulting

METHODOLOGY FOR ASSESSING IDENTIFIED IMPACTS	
Extent of impact being either	**Immediate** (the site and immediate surrounds);
	Local (a significant portion of the waterbody (wetland) or river reach);
	Regional (Affecting watercourses at a catchment scale);
	National (Affecting watercourses with national importance in terms of water supply or large systems with irreplaceable biodiversity);
	International (Affecting watercourses that traverse international boundaries; with international importance in terms of water supply or large systems with irreplaceable biodiversity);
Duration of impact being either:	**Short term** (0-5 years);
	Medium term (5-15 years);
	Long term (operational life of the development);
Intensity of impact being either:	**Low** (where natural, cultural and social functions and processes are not affected – affecting small watercourses of relatively low importance; or barely impacting on more important systems);
	Medium (where the affected environment is altered but natural, cultural and social functions and processes can continue – moderate impacts on important watercourses (e.g. Ramsar wetlands, IBAs); major impacts on insignificant watercourses);
	High (where the affected environment is altered but natural, cultural and social functions and processes are altered to the extent that it will temporarily or permanently cease – major impacts on important watercourses);
Probability of impact being either:	**Low probability** (possibility of impact occurring is low);
	Probable (where there is a distinct possibility that it will occur);
	Highly probable (where the impact is most likely to occur);
	Definite (where the impact will occur);
Significance of impact:	**Very Low** (where natural, cultural and social functions and processes are essentially unaffected or insignificantly affected)
	Low (where natural, cultural and social functions and processes are slightly affected);
	Low to Medium (where natural, cultural and social functions and processes are slightly affected causing a minor change in functions and processes but are still able to continue)
	Medium (where the affected environment is altered but natural, cultural and social functions and processes can continue);
	Medium to High (where natural, cultural and social functions and processes are altered and most likely the impact will not allow functions and processes to continue, but in some cases, the function or process may continue)

	High (where the affected environment is altered but natural, cultural and social functions and processes are altered to the extent that it will temporarily or permanently cease);
Reversibility Rating:	**Irreversible** (the activity will lead to an impact that is permanent);
	Partially reversible (The impact is reversible to a degree e.g. acceptable re-vegetation measures can be implemented but the pre-impact species composition and/or diversity may never be attained. Impacts may be partially reversible within a short (during construction), medium (during operation) or long term (following decommissioning) timeframe;
	Fully reversible (The impact is fully reversible, within a short, medium or long-term timeframe);

APPENDIX D

ECOLOGICAL CORRIDORS ON THE PAARDEVLEI SITE

AFTER DAY (2014)

Wetlands as ecological corridors on the Heartlands Site

This text has been extracted from Day (2014), and informed the water use license for the site

Overview

Day (2012) stressed the need for any future development framework on the Heartlands site to address the need for ecological connectivity at a site level. The study, which drew on collaborative work between the wetland ecologist and the faunal specialist (Mr James Harrison), in previous phases of the Heartland development, recommended that adequate corridors should be included in any future development layout, to allow for the movement of fauna between conservation nodes, and to allow for hydrological connectivity between key freshwater ecosystems. It was recommended that such corridors should also facilitate processes such as water quality amelioration, through filtration, and the management of runoff velocities, and moreover allow linkages between wetland habitats within the site, as well as with natural areas and existing corridors outside of the site (e.g. the Lourens River).

The conceptual approach to the establishment of ecological corridors on the site was revisited in July 2013, in discussions with the Heartland project planning team, as well as with Mr Harrison and Mr Schwaebler (stormwater engineer). These discussions resulted in consensus being reached regarding the need for, and treatment of, a number of key ecological corridors, from a general biodiversity perspective, taking into account terrestrial and aquatic faunal issues, as well as issues relating specifically to aquatic ecosystem conservation and rehabilitation, and the amelioration and management of the quality and quantity of stormwater runoff. The revised ecological corridors, as well as additional stormwater management areas, are shown in Figure D1, after Bau-Afrika. The main components of the revised approach can be summarised as follows:

- Paardevlei - Langvlei –Lourens River corridor: this set of corridors would include the Main Drain, and should allow hydrological and ecological linkages between these important systems – rehabilitation of the Main Drain such that it can contribute to this corridor function should be an important aspect of development design in this portion of the site;
- Lourens River – Eerste River catchment linkages – the existing undeveloped coastal area allows these linkages to take place already;
- North-south linkages between the Langvlei and its catchment area in the Heldervue – hydrological connectivity should be managed; ecological connectivity as far as the N2 should be established and aquatic ecosystem connectivity with areas upstream of the N2 should also be managed (the likely passage of undesirable alien fish from developments upstream of the Heartlands site is also an issue that requires consideration in the design and planning of these corridors);
- Links along the northern boundary of the development area are also considered important, linking extant wetlands in the Eskom servitude area along the N2, with nodes and corridors within the site;
- Paardevlei - Melck Sloot - Lourens River links – the Melck Sloot also provides at least aquatic ecosystem connectivity between the Heartlands site and the Lourens River – while maintenance of this particular corridor is not considered an essential element of ensuring ecological connectivity between aquatic ecosystems, if the corridor exists it will need to be considered at least in terms of management – for example, aquatic connectivity allows the passage of both desirable and undesirable flora and fauna into the Heartlands site (the likely passage of alien fish from the Lourens River into Paardevlei, for example, has been identified as an issue of concern (Day 2009).

Recommendations were also made in Day (2012) regarding the ecologically desirable treatment of the above corridors in a development context, if they are to achieve their objectives in terms of facilitating ecosystem connectivity between discrete habitat nodes. The three critical elements to consider in development planning comprised (after Day 2012):

- Provision of an adequate corridor width (see below);
- Ensuring that use of the corridor within the development is compatible with its primary function in ensuring managed hydrological and ecosystem connectivity;
- Ensuring that the nature of landuse abutting the corridor complements the role of the corridors.

Design criteria for ecological corridors

A number of specific design criteria for ecological corridors have also been developed, through the iterative design process with the Heartland project team, the stormwater engineer, the faunal specialist and the aquatic ecologist, as described in the previous section. These are outlined below, and have been updated from those presented in Day (2012). The extent to which the proposed development of Precinct 2 complies with these criteria is one of the issues specifically evaluated in this report.

- Major corridors between **Paardevlei** and the **Lourens River/Main Drain/Langvlei,** between **Langvlei** and the **Lourens River,** and between **Langvlei and Paardevlei** (incorporating the Paardevlei/ Main Drain link)**,** should be a minimum of 75m wide, and comprise flatly graded areas, landscaped so as to approximate natural heterogeneity and vegetated with appropriate terrestrial and wetland indigenous vegetation. These broad corridors would also play a role in stormwater management, and the passage of runoff along the corridors would need to be designed with ecosystem, hydraulic, water quality and aesthetic aspects in mind. It should be noted that in practice, and as shown in Figure D1, a section of the corridor between the Langvlei – Lourens River corridor, incorporating the upstream section of the Main Drain as far as the Paardevlei-Main Drain corridor intersection, would in fact comprise an area 100 m in width, in order to accommodate the required levels of flood attenuation in these reaches. By contrast, the reaches of the Main Drain downstream of the Paardevlei-Main Drain corridor intersection would be just 40m in width, narrowing to 20m over a short section. The narrower corridor along these reaches is accepted, on the grounds that terrestrial corridor requirements would be accommodated by the 50m wide terrestrial corridor from the Main Drain to the beach. Aquatic ecosystem corridor requirements could, for the reduced channel volumes expected in the Main Drain downstream of the (proposed) outlet to the Second Outfall, be adequately accommodated in a corridor of 40m width. The short section of width only 20m is unfortunately unavoidable, as a result of the close proximity of existing buildings and a cemetery, all of which have high Heritage value.
- Seasonal wetland and terrestrial corridors should be provided to link **Paardevlei** and the wetlands in the **north east of Paardevlei** to the **Langvlei / Lourens River** – this means that a continual band of at least 30m of mixed seasonal wetland and vegetated terrestrial area should run along at least one edge of the vlei.
- The north-eastern corridor that runs from the N2 in a south easterly direction to the Crescent Bypass wetlands is not considered a key corridor from a faunal perspective, and could be managed from the perspective of water quality amelioration only. A width of 25m has been assigned to this corridor.

- The southern edge of the Langvlei abutting the dunes should be managed in a development framework such that the system retains ecological connectivity to the inter-dune wetlands and other natural habitats along the coastal corridor.
- Key ecological corridors, which align with major (bulk) stormwater channels across the site, should be a minimum of 50m in width, including provision of vegetated wetland areas for the treatment of stormwater quality, and allowance for limited use of the corridors for amenity functions (e.g. walking and/or cycling areas). In addition, Day (2012) stipulates that:
    - the seasonal wetland demarcated as a CBA2 wetland in Figure 4 should be included in the ecological / drainage corridors and would moreover require a 20m buffer on either side of the wetland, to prevent its deterioration over time
    - portions of the disturbed, seasonal wetlands developing in the broader "alluvial wetland" area should be incorporated into the stormwater corridors, and managed as areas that received stormwater during flood flows only.
- Ideally, existing drainage lines should be retained for bulk stormwater conveyance on the site – where this is not feasible, new alignments should be designed and managed so as to comprise a series of vegetated channels that are effective in both the conveyance of stormwater and its amelioration in terms of water quality. This might mean that separate high- and low flow systems are required. Although unlined channels would be preferred from an ecological perspective, where lining is required, its design should be such that it facilitates the adequate establishment of appropriate vegetation.
- In the event that the Somchem Drain (or other drainage channel) is retained along the western edge of the development, this should also be managed as a major corridor, with a minimum width of 50m, and potentially wider if required from a terrestrial faunal perspective.
- In addition to establishing broad corridors between key wetland habitats, it is also noted that any future development plan should ensure that adequate ecological setbacks are provided between conserved wetlands, such that these do not deteriorate as a result of the proximity of urban development. Edging wetlands with roads rather than private gardens is recommended, as a means of improving surveillance of the open space areas from a security perspective and as a means of reducing impacts such as dumping and the encroachment of private gardens into natural areas of open space. The inclusion of pathways, boardwalks and other aspects that will increase the recreational / amenity value and use of ecological / stormwater corridors in a development context should also be encouraged, as this is often associated with improved maintenance effort, safety and security in these areas.

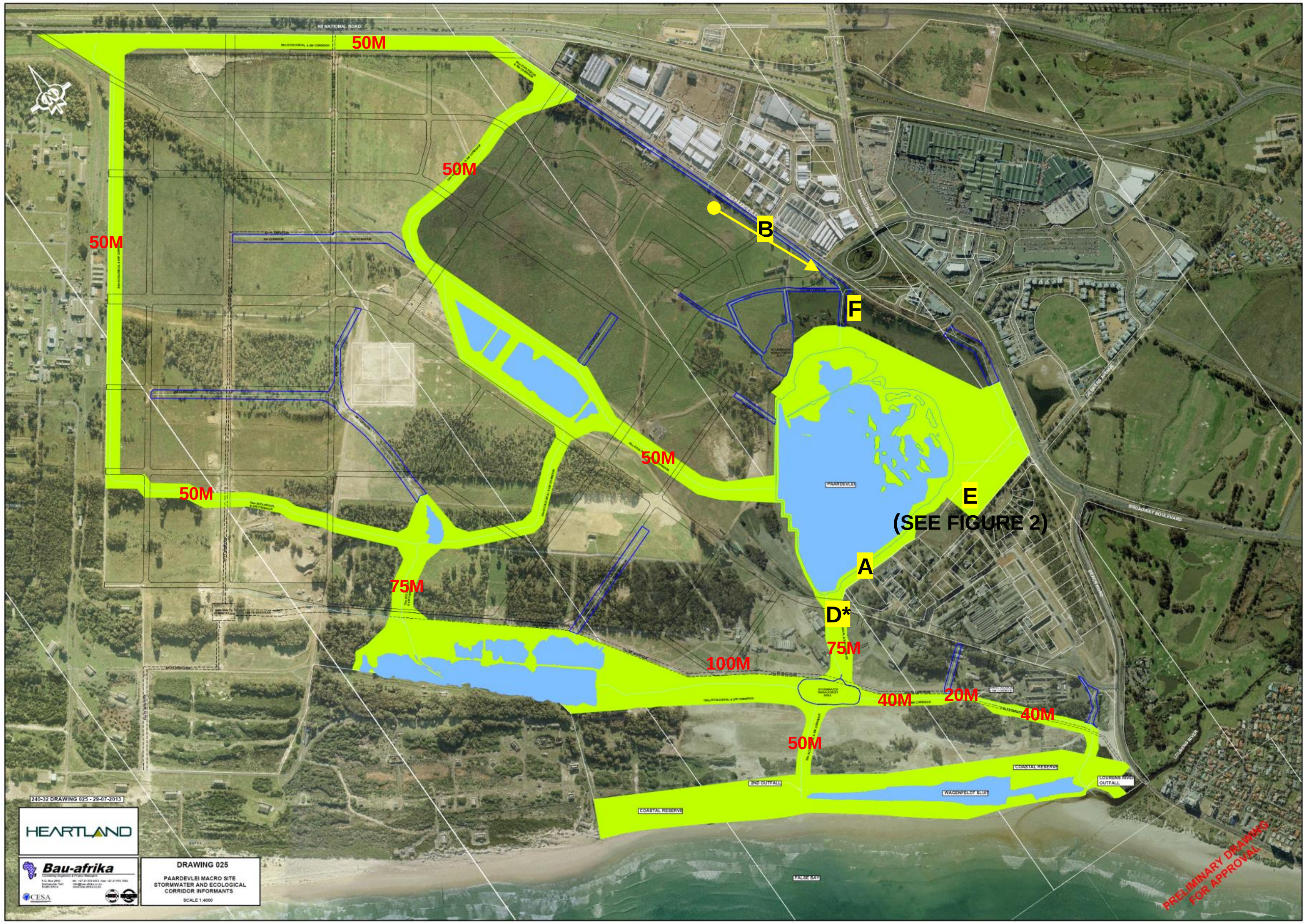
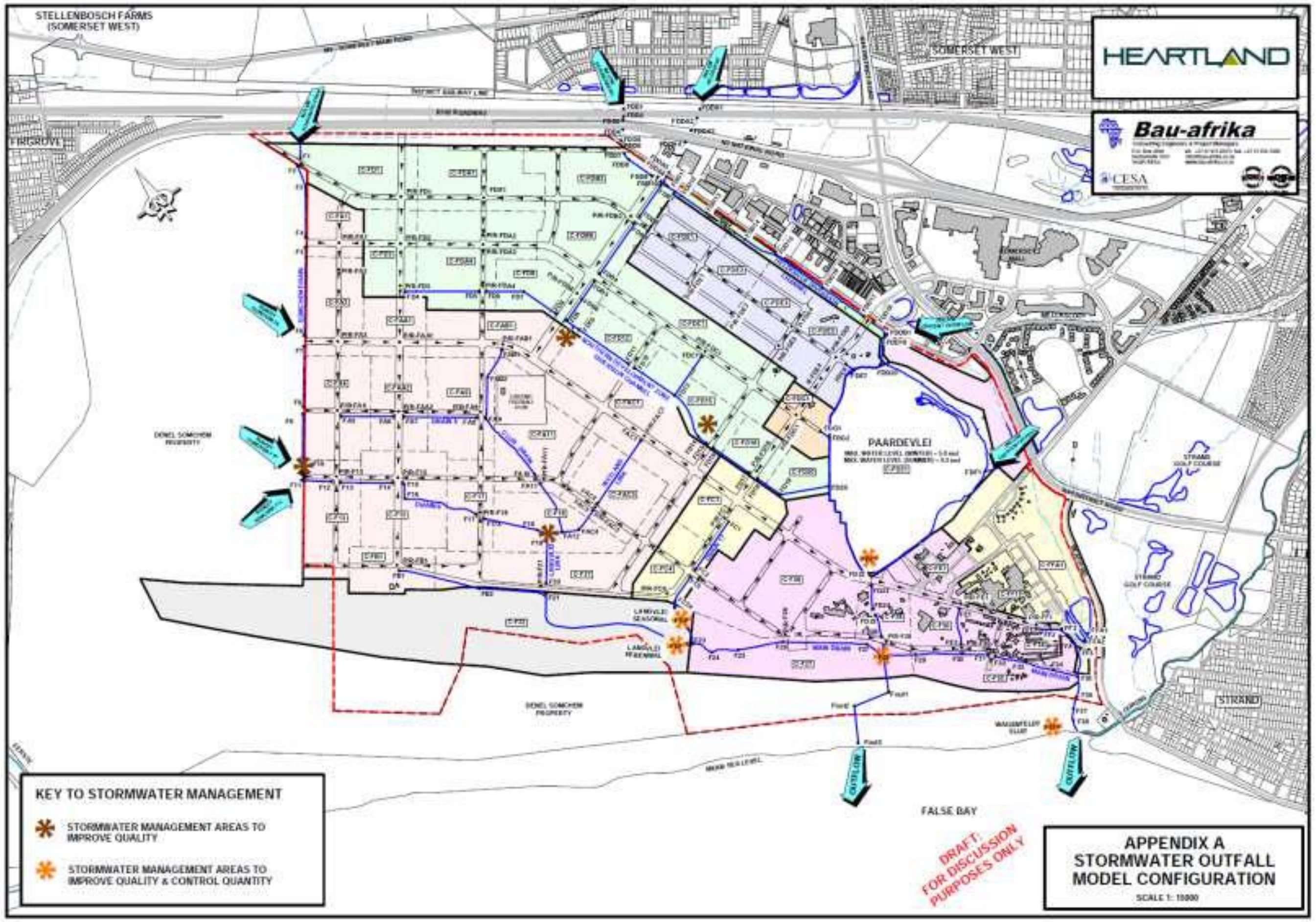


Figure D1

Conceptual ecological corridors proposed for the greater Heartland site, as revised in 2013 during iterative discussions between the stormwater engineer and the biophysical specialists. Figure compiled by Bau-afrika.


STELLENBOSCH FARMS (SOMERSET WEST)
HEARTLAND
Bau-afrika
SOMERSET WEST
FIRGROVE
PAARDEVLEI
DENEL SOMCHEM PROPERTY
DENEL SOMCHEM PROPERTY
STRAND
FALSE BAY
KEY TO STORMWATER MANAGEMENT
STORMWATER MANAGEMENT AREAS TO IMPROVE QUALITY
STORMWATER MANAGEMENT AREAS TO IMPROVE QUALITY & CONTROL QUANTITY
DRAFT: FOR DISCUSSION PURPOSES ONLY
APPENDIX A
STORMWATER OUTFALL MODEL CONFIGURATION