Client:
Lottershof Farm

Main Environmental Consultant:
PHS Consulting
Hermanus

PROPOSED EXPANSION OF THE LOTTERSHOF CHICKEN FARM, CALEDON, WESTERN CAPE

SPECIALIST WETLAND CONFIRMATION, RISK ASSESSMENT AND BASIC ASSESSMENT OF IMPLICATIONS FOR AQUATIC ECOSYSTEMS

JULY 2019

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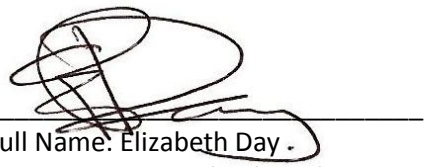
23 July 2019

DECLARATION OF SPECIALIST INDEPENDENCE

I, Elizabeth (Liz) Day as a specialist river and wetland consultant, and Director of Liz Day Consulting (Pty) Ltd, 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 PHS Consulting was appointed as the Environmental Assessment Practitioner (EAP) in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), other than fair remuneration for work performed, specifically in connection with specialist input into the Basic Assessment Process and Water Use Authorisation for the proposed expansion of the chicken farm on Lottershof Farm, Caledon.



Full Name: Elizabeth Day

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Title / Position: Dr (Director – LDC)

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

Experience: > 20 years working on freshwater ecosystems

Relevant work experience: Liz has worked as a freshwater ecologist / aquatic ecosystems specialist for the past +24 years, primarily in the Western Cape, and has produced over 600 technical and Environmental Impact Assessment reports, requiring the assessment of rivers and/or wetlands.

With regard to the current project, she has worked on ephemeral and seasonal wetlands in the Ashton/ Robertson area, and in the Klein River / Hermanus lagoon area downstream of the present study area.

Liz has also undertaken numerous Risk Assessments since the introduction of the DWS Risk Assessment Matrix and has experience in wetland delineation and wetland assessment and mapping.

Registration(s): Member of IAIA; Member of SAIEES; Registered Professional Natural Scientist by SACNASP (Reg No 400270/08) for fields of Biological Science, Ecological Science and Zoological Science.

TABLE OF CONTENTS

1 INTRODUCTION

1.1 Background

Lottershof Farm (Portion 5 of Farm 487 Caledon: Klein Steenboks River Farm) is an Elgin Chicken farm, hereafter referred to as "the site". Expansion of the farm is proposed, and PHS Consulting (PHS) was appointed by the developer to oversee the required applications for development authorisation in terms of *inter alia* the National Environmental Management Act (NEMA) (Act 107 of 1998). As part of this process, a Spatial Development Plan was drawn up by the development team, locating all of the proposed new development at least 100m from any watercourses, and 500m from wetlands identified by PHS on the site. The current farm includes a number of existing mortality pits, which would be used in the expanded development operations as well.

During a site visit by officials from the Breede Gouritz Catchment Management Agency (BGCMA), concerns were however raised as to whether a wetland occurred immediately downslope of the existing mortality pit locations. If this were the case, the wetland would potentially need to be included in the development application, both in terms of NEMA and in terms of the National Water Act (NWA) (Act 36 of 1998), which requires such consideration for any water use (as defined in Section 21 of the NWA)

In order to address this concern, Liz Day Consulting (Pty) Ltd (LDC) was appointed by PHS to undertake a specialist aquatic ecosystems assessment of the affected area.

1.2 Terms of Reference

LDC's terms of reference for this input required that the specialist:

1. Verify if the downslope of the existing mortality pits is a wetland and confirm these findings in writing;
2. In the event that it is confirmed as a wetland:
    a. Provide a basic assessment for the (ongoing) use of the mortality pits;
    b. Provide a risk matrix as per the DWS (2015) protocol;
    c. Provide mitigation measures/ recommendations to address any ecological concerns raised.

1.3 Activities informing this input

Input into this report was informed primarily by:

- A site visit in April 2019, accompanied by Mr F. Putter (Lottershof Farm), during which the area identified by BGCMA downslope of the existing mortality pits was assessed for wetland indicators, using the methodologies outlined in DWAF (2008) – note that the full slope to the valley bottom was assessed, and not just the area indicated by BGCMA:
- Existing conservation planning data for this area (i.e. the Western Cape Biodiversity Spatial Plan (WCBSP) (Stanvliet et al 2017)).

1.4 Site Location

Figure 1.1 illustrates the location of the site, which lies some 8km by road south east of Caledon in the Western Cape.

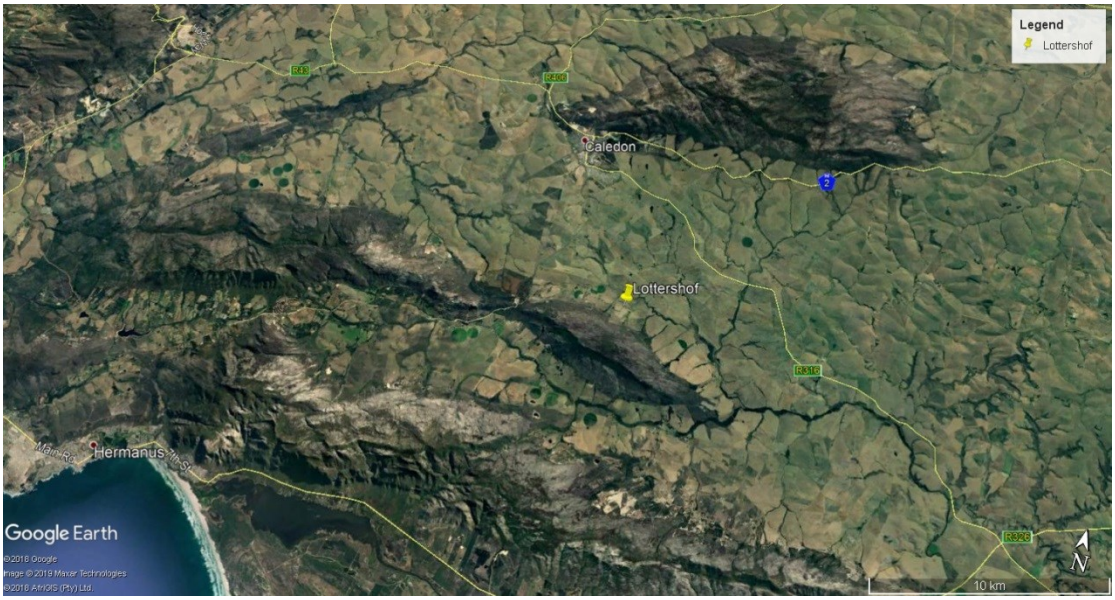

Figure 1.1
Location of the Lottershof Farm
Figure adapted from Cape Farm Mapper (https://gis.elsenburg.com/apps/cfm/#)

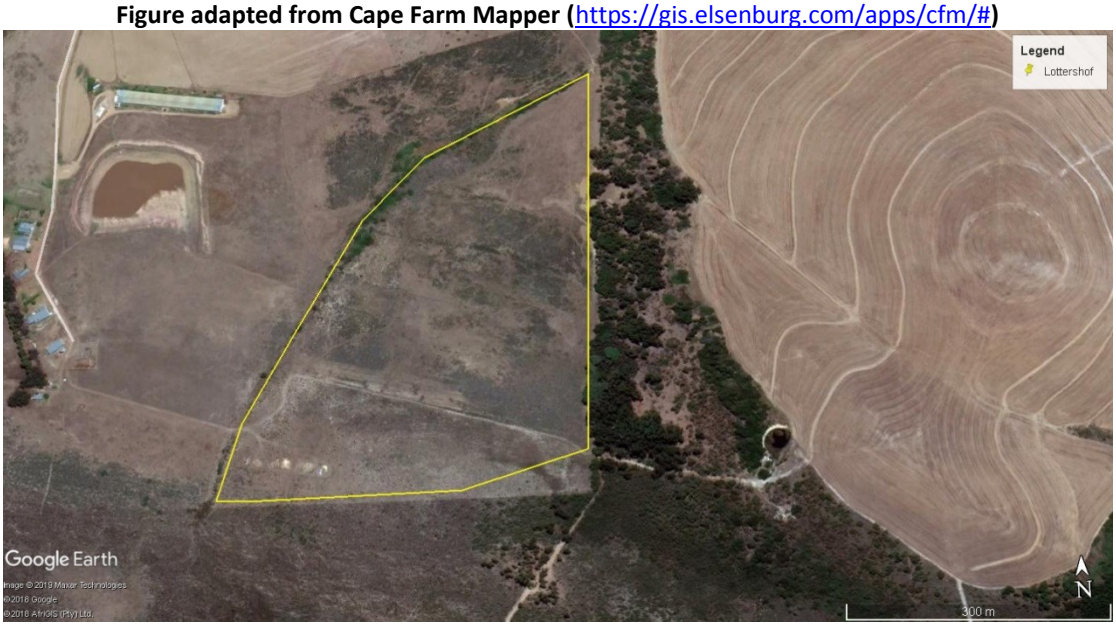

Figure 1.2
Portion of the site assessed in this study – assessment area outlined in yellow

1.5 Limitations and assumptions

- The findings outlined here were based on a dry season /late summer assessment of the site, when seasonal wet season plants would not necessarily be visible;
- The assessment focused on the portion of the overall farm shown in **Figure 1.2** only;
- Some of the affected area had been disturbed by road grading and/or ploughing as well as by disturbance including the passage of large vehicles and the movement of surface soils during recent fires.

While the above are noted, the findings of this assessment are nevertheless of high confidence.

1.6 Watercourse definitions

The National Water Act (Act No. 36 of 1998) (NWA) provides the only legislated definition of rivers and wetlands in South Africa, namely:

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

Rivers fall within the definition of **watercourses**, which are defined as follows:

"*(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 a watercourse."

Note that:

- Reference to a watercourse includes, where relevant, its bed and banks.
- The term "watercourse" excludes artificial channels and canals.
- "Extent of a watercourse" includes the watercourse up to the outer edge of the 1:100 year floodline, and/or the delineated riparian habitat, whichever is the greatest distance, as defined in GN509 of August 2017.

1.7 Identification of wetlands

The DWAF (2008) wetland delineation protocol is used in South Africa to determine the presence and extent of wetlands. This requires consideration of the following four wetland indicators:

- The terrain unit indicator, which identifies parts of the landscape where wetlands are more likely to occur;
- The soil form indicator, which identifies soil forms that are associated with prolonged and frequent saturation;
- The soil wetness indicator, which identifies morphological signatures of the soil, developed in the soil in response to prolonged and frequent saturation – these are referred to as redoxymorphic features;
- The vegetation indicator that identifies hydrophilic vegetation associated with frequently saturated soils.

Of the above, the soil wetness indicator is considered the most important, with the other indicators often being regarded as confirmatory rather than diagnostic (DWAF 2008).

However, vegetation indicators are also considered very useful in undisturbed sites and in "special case" areas, including sandy coastal aquifers (DWAF 2008).

2 DESCRIPTION OF THE PROPOSED DEVELOPMENT

There is an existing authorised free-range chicken rearing facility on the property, consisting of four (4) authorised double pens. This facility will be expanded to include eight new pens. The proposed development will thus entail the construction of eight (8) new rearing pens of 2025m^2 each (known as units 1 to 8 (see **Figure 2.1**) with a total footprint of approximately 16 200m^2; shaded free-range areas next to each pen (135 x15m); and the establishment of new internal roads (500 x 4m) to allow access between new and old pens.

Access will be obtained from an existing public gravel road on the farm, which intersects the R320. There is also a second public gravel road leading to the R326 that is in close proximity to the site.

The farm currently makes use of existing mortality pits located on the south-eastern portion of the property (see **Figure 2.2**). No new or additional mortality pits are currently required.

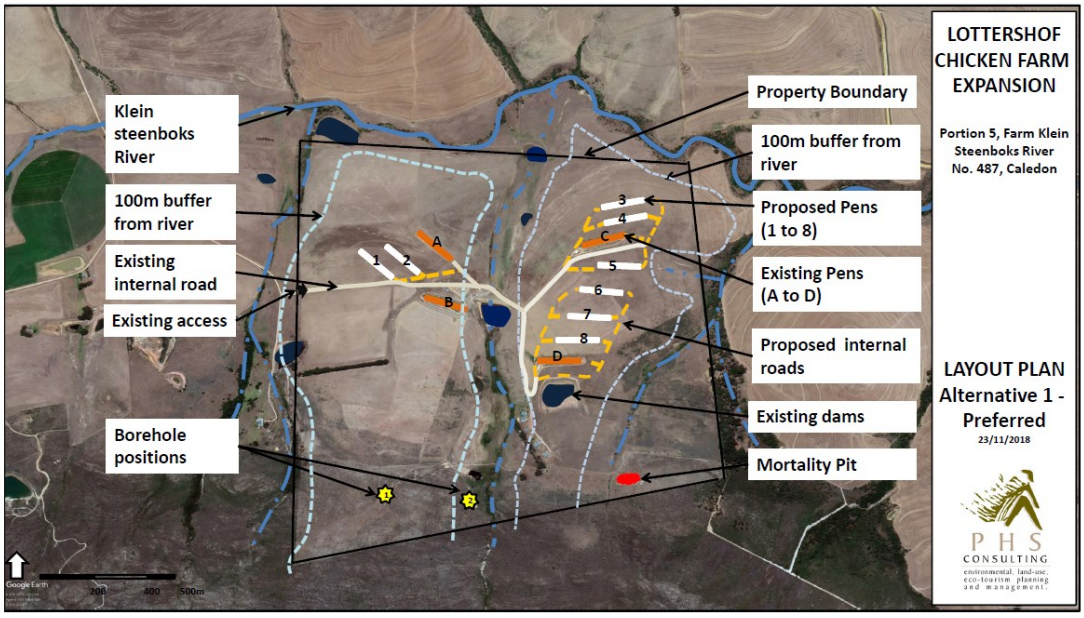

Figure 2.1
Proposed layout of the expanded development on Lottershof Chicken Farm, showing the existing mortality pits – figure supplied by PHS Consulting.

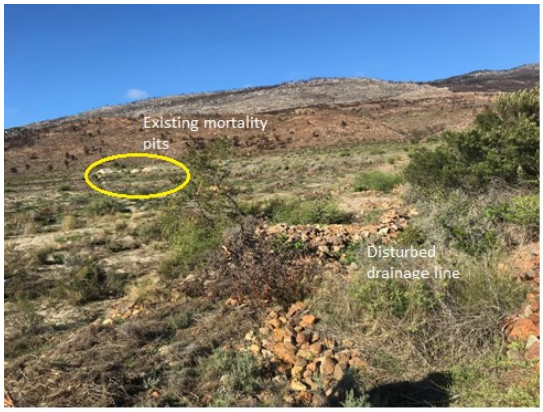

Figure 2.1
Location of existing mortality pits

3 DESCRIPTION OF THE AFFECTED WATERCOURSES

3.1 Catchment context

The site lies in Department of Water and Sanitation (DWS) Breede-Gouritz Water Management Area, and is located in DWS quaternary catchment G40K (**Figure 3.1**). This quaternary includes drainage from the Klein Steenboks Rivier, which flows just north of the site boundary. The Klein Steenboks River flows into the Hartbees Rivier and thence into the Klein Rivier, which enters the Klein Rivier Estuary / Hermanus Lagoon (also referred to in some maps as the Klein Rivier Dam). This estuary is an important habitat, both from a conservation and a recreational perspective, with an overall national importance rating of 97% and ranked in the top five estuaries in South Africa in terms of conservation importance (Turpie and Clark 2007).

Figure 3.1
Catchment context of the site (circled)
Figure adapted from Cape Farm Mapper (https://gis.elsenburg.com/apps/cfm/#)

3.2 Site climate

Cape Farm Mapper data (https://gis.elsenburg.com/apps/cfm/#) show that the site falls within an area with a Mean Annual Rainfall of 400-500mm and a Mean Annual Evaporation of 1100-1200 mm. Comparison of median monthly rainfall data with mean monthly evaporation data from the same dataset suggests that June and July are the only months where rainfall and evaporation rates are in a similar range (40-60 mm evaporation versus 50-60mm rainfall). Evaporation rates are double or more than double the rainfall rate in all other months, suggesting generally arid conditions.

3.3 Context of the site in regional (Western Cape Biodiversity Spatial Plan) and national (National Freshwater Ecosystem Priority Area) plans

Figure 3.2 shows the site in the context of the Western Cape Biodiversity Spatial Plan (WCBSP) (Stanvliet et al 2017). This figure shows that no aquatic Critical Biodiversity Areas (CBAs) occur on the portion of the site earmarked for expansion of mortality pits, although the steep hillslopes upslope (south) of the existing pits have been designated as a terrestrial CBA, and an area downslope of as well as east of the existing pits is mapped as a degraded (terrestrial) CBA. The upper section of the small watercourse just west of the pits and the terrestrial area along the same contour / alignment have however been assigned as Ecological Support Areas (ESAs) – these areas would be intended to serve as buffers for the CBAs and contribute to their sustainability by supporting ecological function and connectivity.

The remaining section of the watercourse has been mapped as a Restorable ESA – that is, a degraded system that could however be rehabilitated to serve as a more effective ESA.

National Freshwater Ecosystem Priority Area (NFEPA) data show no freshwater aquatic ecosystems on the site, other than a number of mapped artificial farm dams, the closest of which lies some 300m north west of the existing mortality pits, on the western side of the minor drainage channel (**Figure 3.2**).

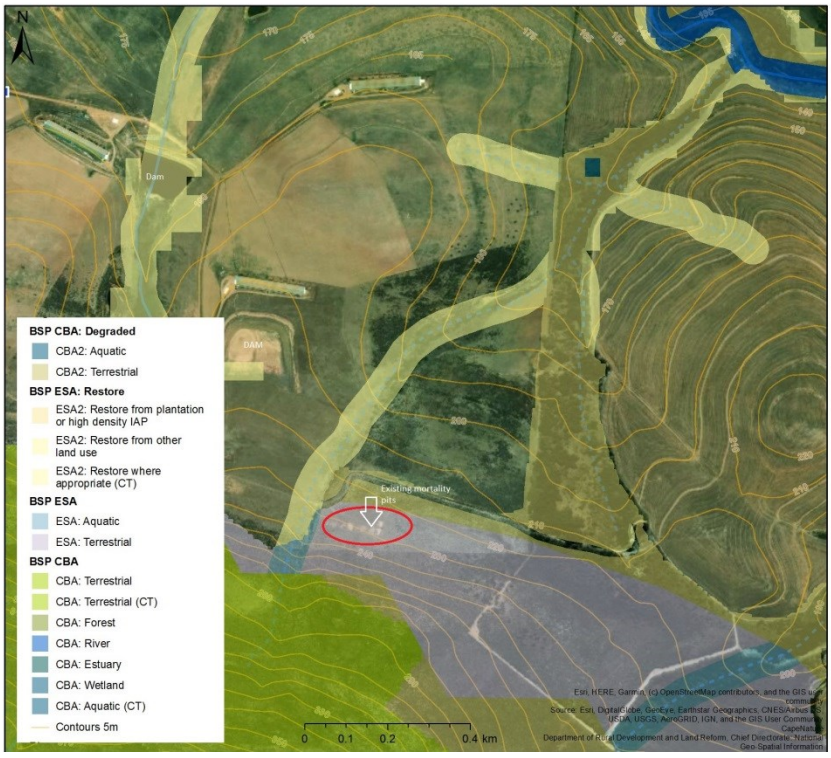

Figure 3.2
Area in the vicinity of existing mortality pits on Lottershof Farm in the context of the Western Cape Biodiversity Spatial Plan (Stanvliet et al 2017) and National Freshwater Ecosystem Priority Area (NFEPA) data (Driver et al 2011).
Figure adapted from Cape Farm Mapper (https://gis.elsenburg.com/apps/cfm/#)

3.4 Site description

The section of the site considered in this assessment comprises an extent of disturbed veld, parts of which had recently been burned and which included various farm tracks, a fire break and a few trenches / berms that ran with the contours and may have been created for erosion control purposes.

Existing mortality pits lie upslope (south) of the main access track, and at the foot of the steep slopes mapped in **Figure 3.2** as a terrestrial CBA. The area abutting and immediately downslope of the access track, extending some 15-20m downslope, had been disturbed by activities associated with the creation of a firebreak and the passage of vehicles engaged in putting out a recent fire in the area (Mr F. Putter, Lottershof Farm, pers. comm). Grasses and other vegetation were resprouting in the burned area (Photo B). Although this area was identified by BGCMA officials as possibly including wetland habitat, augering into the surface soils as per the DWAF (2008) wetland delineation methodology showed no signs of redoxymorphic features such as mottles, or any other wetland indicators (Photo E), notwithstanding the presence of an impervious layer within the top 20-40cm of the surface. The sloping terrain, low rainfall and high evaporation rates are assumed to combine to prevent soil saturation in these areas, which in a wetter climate might otherwise have allowed the development of wetland conditions.

The only wetland indicator noted in the immediate vicinity of the mortality pits was a single *Juncus kraussii* plant near the most westerly of the existing mortality pits, in a small (1-2m diameter), slightly depressed but disturbed area assumed to have been part of the natural alignment of the western drainage line, which passes down the steep slopes above the mortality pit area as a poorly defined drainage line, which has been artificially aligned from the access road downstream as a relatively straight, stony channel / trench. This passes along the western edge of the assessed area, within an area vegetated by *Seersia* sp. and edged by dense *Atriplex* sp. (salt bush) as well as stands of *Helichrysum* sp. No surface water was observed in the drainage line or anywhere else on the assessed portion of the site at the time of the site visit. The reaches of the watercourse down the hillslope are not considered to be a wetland, on the basis of the definitions in Section 1.6 – the steep slopes and arid climate with its low rainfall and high evaporation rates make sustained periods of saturated soils within the top 500mm of the surface unlikely, and there is no vegetation in the watercourse suggesting wetland conditions. Augering of the watercourse was not however possible as it is a stone-lined rocky system.

With distance downstream, the watercourse does however flatten out, and here there is evidence of a seasonally to temporarily valley bottom wetland, including stands of *Phragmites australis* and vegetation more typical of the outer margins of seasonal to temporary wetlands including stands of *Helychrysum* sp.

Soils in the small patch of wetland vegetation identified near the most westerly mortality pit (denoted by a single *J. kraussii* plant only) in the vicinity of the mortality pit showed slight mottling near the surface - deep augering was limited by the stony soil. Wetland conditions here are assumed to derive primarily from periodic overflow from the watercourse where the slope flattens out and the watercourse is diverted east. Seepage from the pit itself is also possible, but unlikely, given the depth of excavation compared to the surface level at which saturation would occur.

Assuming conservatively that this patch is representative of natural wetland conditions, it has been assessed as in a Category F condition (Appendix A), with little to no connectivity to other systems and fragmented from its natural alignment. Its Conservation Importance, derived using the methodology of Ewart-Smith and Ractliffe (2002) (Appendix C), is considered Negligible, as it is too small to play any useful role in the landscape or to provide

habitat of any consequence. Its EIS (Appendix B) is considered marginal to low.

Figure 3.3 illustrates the locations of the areas described above within the assessed site, for clarity, while **Figure 3.4** shows the site with watercourses as depicted in NGI data obtained from Cape Farm Mapper (https://gis.elsenburg.com/apps/cfm/#). This figure indicates a second watercourse on the eastern side of the assessed area. Note however that no watercourse was visible along this alignment, and the 5m contours shown in the figure also do not indicate a clear watercourse there.

Photo A
View down degraded watercourse west and downslope of the existing mortality pits

Photo B
Recently burned area immediately downslope of the existing mortality pits

Photo C
***Helichrysum* sp. on slopes below mortality pits**

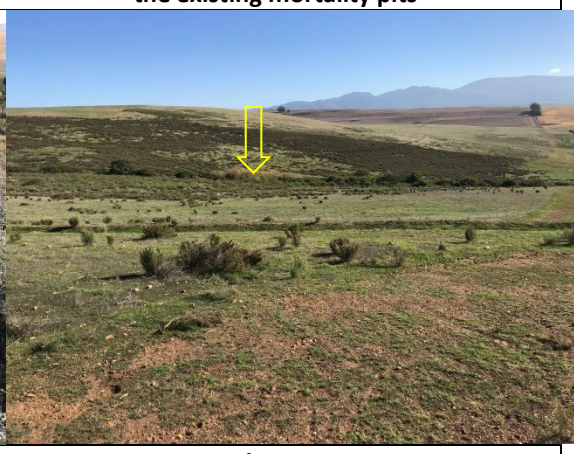

Photo D
View downslope towards valley bottom wetland (arrowed) – this is in the lower reaches of the watercourse shown in Photo A

Photo E
Example of augered soil showing high chroma soil, damp after rains, with no indicators of saturation

Figure 3.3
Assessed site showing features referred to in text.

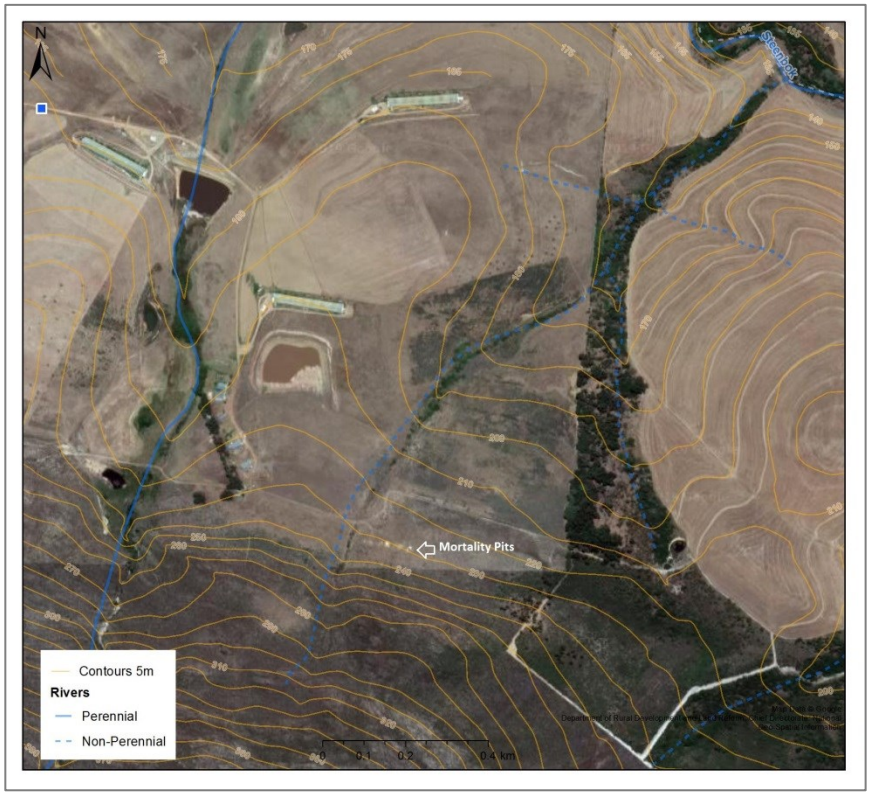

Figure 3.4
Assessed site with watercourse from NGI data
Cape Farm Mapper (https://gis.elsenburg.com/apps/cfm/#)

4 ASSESSMENT OF THE IMPACTS TO (FRESHWATER) AQUATIC ECOSYSTEMS AS A RESULT OF PROPOSED EXPANSION OF THE LOTTERSHOF CHICKEN FARM

4.1 Overview

The existing mortality pits lie outside of any identified watercourse, but within 500m of a number of dams, as well as the small *Juncus kraussii* patch and the seasonal watercourse described in Section 3.4 and shown in **Figure 3.3**.

The implications of the pits for dams lying within a distance of up to 500m have already been addressed by the PHS water use license (WUL) specialists, and are not considered in this report.

The implications of the mortality pits for the small wetland and the seasonal watercourse form the basis of the impact assessment outlined in this section.

4.2 Construction phase impacts

No construction phase impacts to any watercourses identified in the assessment area in the vicinity of the existing mortality pits are envisaged. These watercourses lie well outside of any construction area associated with the proposed expansion of the chicken farm (see **Figure 2.2**).

4.3 Operational phase implications

No operational phase impacts are likely to accrue to the watercourses (including the small *Juncus kraussii* patch) identified in the current assessment area either, either as a result of the ongoing existing activities or as a result of expansion of the farm. In the context of farm expansion, it is likely that the mortality pits would be filled more quickly, but their distance to the section of the seasonal watercourse downslope of the pits is in excess of 300m, and given that their existing use has had no impact on the watercourses, it is extremely unlikely that continuation of such use would incur additional impacts. This reflects the low rates of seepage through fine, clayey soils, the high evaporation rates and low rainfall in the area and the high summer temperatures, all of which would contribute to localized decay within the pits and a very low to negligible likelihood that seepage would extend to the watercourse, assuming that no new pits are constructed or that any new pits are constructed along the same contour as the existing ones, and to the east rather than the west.

4.4 Recommended Best Practice measures

Although this assessment has not identified any impacts associated with the existing mortality pit use of any significance at all from an aquatic ecosystem perspective, it would nevertheless appear that design measures such as lining of any future new pits to prevent any seepage of organic materials or other residue into downstream watercourses, should be considered from the perspective of reducing the pollution footprint of the industry on water and other resources.

Given the negligible impact of the proposed development on the assessed watercourses, these recommendations are considered beneficial from a “best practice” perspective only, and cannot be enforced in terms of the present report, as essential mitigation.

5 RISK ASSESSMENT

5.1 Applicability of the National Water Act to the proposed expansion of Lottershof Chicken Farm

The terms of reference for this assessment included applying the DWS (2015) Risk Assessment Matrix to any Section 21c or i water uses associated with the ongoing use of mortality pits on Lottershof Farm, or future construction of additional pits within the same area. That is, activities involving impeding or diverting the flow of water in a watercourse (Section 21c) and/or altering the bed, banks, course or characteristics of a watercourse (Section 21i), where a watercourse is defined in the Act as (see also Section 1.6):

> (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 a watercourse.

The Act does not overtly distinguish between natural and artificial wetlands, and includes "wetlands" as a watercourse type.

In the present study, the very small *Juncus kraussii* wetland and the channelised watercourse (tributary of the Klein Steenboks Rivier) along the western and northern edge of the assessment area both fit the definition of a watercourse. However, there is no possibility that the proposed construction activities associated with the envisaged expansion of the farm, located outside of the catchment areas of these systems, could have any impact on watercourse function , characteristics, or any other aspect of these systems.

It is moreover also extremely unlikely that ongoing use of the existing or future additional mortality pits in the assessed area would have any impact on the identified watercourses including the very small *Juncus kraussii* wetland patch – certainly no such impacts were evident or even suggested during the site visit.

Note however that other watercourses (e.g. the seasonal drainage lines and some of the dams) on the broader Lottershof site do lie in closer proximity to the proposed pits and might be affected by their construction and use. These systems have however already been addressed in a Risk Assessment by PHS consultants and are specifically not considered in this document.

5.2 Application of the Risk Assessment Matrix

Despite the finding above, that the construction and operational phase expansion of the chicken farm including the ongoing use of the existing mortality pits would not in fact entail any Section 21c or I water use, the DWS (2015) Risk Assessment Matrix has nevertheless been completed for this study, to assess watercourse "Risk" in a structured manner.

The DWS Risk Matrix was developed by DWS with the intention of informing this authority as to either the need for authorisation of a Section 21c or i water use through a water use licence, requiring a Water Use Licence Application (WULA) and subsequent registration of use through the DWS, or whether the use might be considered Generally Authorised in terms of the stipulations of GN509, and require only Registration of Use. Section 21c and i water uses that are assessed as being of a Low Risk, using the Assessment Matrix, are considered Generally Authorised in terms of GN509, and require only Registration of Use, prior to implementation.

The results of the Risk Assessment Matrix are shown in **Table 5.1**.

Not surprisingly, the Risks to water resources as assessed in the Risk Matrix are all Low. In fact, they should have a zero rating (not permitted by the Matrix structure), as no risk to the assessed watercourses is likely to accrue as a result of the assessed activities.

This means that GN509 would be applicable to the development – although there is a good argument that there should be no need to register any water use for the watercourses identified in the assessment area considered in this study, as the proposed development would not affect them.

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Table 5.1
Results of (DWS) Risk Assessment of Section 21c and i activities potentially affecting watercourses in the designated assessment area of this study, on Lottershof Farm, Caledon, as a result of the proposed chicken farm expansion and the ongoing use of existing and potential new mortality pits.
Risk Matrix completed by Liz Day -SACNASP Reg no. 400270/08

Impact No	Phases	Activity	Aspect	Impact	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph+Vegetation)	Biota	Severity	Spatial scale	Duration	Conseq.	3	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Signif.	Risk Rating	Control Measures	Watercourse Type
4	Construction Phase	Construction of new roads, chicken houses etc as part of farm expansion	Proximity of wetlands and watercourses in the defined assessment area to construction activities making them vulnerable to disturbance	No impact envisaged	1	1	1	1	1	1	1	3		1	1	5	1	8	24	L	None recommended	Seasonal drainage line; valley bottom wetland and (very small) wetland depression
5	Operational Phase	Ongoing infilling of mortality pits with organic waste	Proximity of wetlands and watercourses in the defined assessment area making them vulnerable to impacts associated with seepage from organic waste	No impact envisaged	1	1	1	1	1	1	1	3		1	1	5	3	10	30	L	None recommended	

6 CONCLUSIONS

This study has considered an area of land, earmarked for more detailed assessment by BGCMA officials, who raised concerns that the area might include wetlands, which could potentially be affected by the proposed ongoing use of mortality pits on the Lottershof Farm.

The site assessment carried out by this specialist confirmed the presence of a minor wetland of negligible importance in the assessment area. It also noted the presence of a seasonal drainage line / watercourse, the downstream portions of which included wetland habitat.

However, the location of the mortality pits is such that impacts such as seepage of contaminated water from their contents are considered extremely unlikely to affect the wetlands / watercourses identified in the current assessment area.

As such, the watercourses in the assessed are not considered under any risk of impact as a result of the proposed development. Moreover, it is argued that there would in fact be no water use affecting these watercourses as a result of the propose development, and as such, no registration of water “use” should be required either, in terms of the NWA and/or GN509.

7 REFERENCES

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APPENDIX A

Wetland Condition assessment protocol – based on Habitat Integrity assessments

A Wetland condition

Habitat integrity is a measure of the degree of intactness of a system, and refers to the maintenance of the natural physico-chemical and habitat characteristics of a wetland (or river), both spatially and temporally. Habitat integrity is considered greatest where these characteristics are most comparable to natural aquatic ecosystem habitats of the region (Southern Waters 2001). It is based on a qualitative assessment of a number of pre-weighted criteria, with the final Habitat Integrity score being calculated as a percentage. These scores are grouped in broad bands or categories, as defined in Table A1, after Kleynhans (1996).

Several other assessments of wetland condition have been derived since the Habitat Integrity assessment protocol outlined here. These include methodologies developed as part of the WET Health assessment (Macfarlane et al 2008). In the present context however, where the affected wetlands are small and morphologically simple, and lacking multiple hydrogeomorphological units (as defined in Ollis et al 2013 and Macfarlane et al 2008), the simplified approach of the Habitat Integrity assessment was considered appropriate. This method requires consideration and rating of issues such as changes in hydroperiod, indigenous vegetation extent, alien vegetation invasion, changes in wetland extent, channelisation, infilling and other relevant criteria.

Table A1
Descriptions of Habitat Integrity categories (after Kleynhans 1996)
Note that Habitat Integrity categories equate to Present Ecolgical State (PES) categories

CATEGORY	DESCRIPTION	SCORE (similarity to natural conditions)
A	Unmodified, natural	90-100
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.	80-90
C	Moderately modified. A loss and change of natural habitat and biota have occurred but the basic ecosystem functions are still predominantly unchanged.	60-79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40-59
E	The loss of natural habitat, biota and basic ecosystem functions is extensive.	20-39
F	Modifications have reached a critical level and the lotic system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.	0

APPENDIX B

Methodology for determining the Environmental Importance and Sensitivity (EIS) of wetlands

B Environmental Importance and Sensitivity (EIS) protocol for wetlands

The method used to assess the EIS of wetlands is a refinement of the DWA 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 B1).

Table B1 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 or education.	>3 <=4	A
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,	> 2 <= 3	B

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.		
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

APPENDIX C

Methodology for determining the Conservation Importance of wetlands

C 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 criteria, 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