CHAPTER 3 CONTENTS

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3 DESCRIPTION OF THE RECEIVING ENVIRONMENT

3.1 Biophysical Environment

3.1.1 Climate

The study area falls within the warm fully humid frost-free climate of the subtropical Indian Ocean Coastal belt isotherm for which temperature and precipitation seasonality is low and held relatively constant by the warm Mozambique current. Due to the site's proximity to the ocean temperatures do not fluctuate drastically, with average monthly maximum and minimum temperatures of 28 ºC and 13 ºC respectively. The estimated annual evaporation is ≤ 1400mm annually. The hottest times of the year occur from January to April. The coldest periods are experienced from June to September with a monthly minimum of 13 ºC. This is also usually the driest time of the year with an average monthly rainfall ranging from 9mm to 38mm. The wettest times of the year take place from October to April (summer) with a mean annual rainfall of 1148mm taken from March 2013 – February 2014 (www.accuweather.com).

3.1.2 Soils

An Agricultural Potential Assessment was undertaken by Mzansi Agriculture for the proposed conversion of land use from a sugar cane farming activity to an industrial park (Appendix D3). This assessment was carried out in order to determine whether the agronomic or agribusiness potential of this land parcel precludes or permits a change of land use from zoning as agricultural land to zoning for industrial land usage. Key findings from this study are described below.

Due to difficult terrain and shallow soils this farm would be marginal arable agricultural land if it were commercially owned. However due to the capital costs and operating structure of the sugar milling industry a poor yielding farm owned by a miller is still viable as volume throughput is critical to the profitability of a sugar mill. Poor or negative farming margins are offset by enhanced milling profits.

The site lies within the Coastal Sands and the Coastal Lowlands Soil System. Table 3-1 below provides a descriptive summary of the main features of the Soil Forms encountered at the site.

Table 3-1: Description of soil families on site

Soil Family	Features
Bonheim	Bonheim soils are characterised by a black blocky clay (Melenic A-horizon) topsoil over a yellow-brown or red blocky clay with variegated colours (Pedocutanic B-Horizon). These soils are usually found on the lower slopes and footslopes.
Dundee	The Dundee soil form is found on flood plains. It is created by recent alluvial deposits. Where the topsoil is stratified, deep ploughing or ripping is required in order to mix the strata for uniform rooting. Preference in these areas should be given to high yield, high-value crops.
Fernwood	Fernwood is named after the farm Fernwood between Mtubatuba and Hluhluwe. It is fine unstructured sand that was deposited along parts of the South African coastline as sediment from the Great Flood which took place some 10,000 years ago. It is first found a narrow strip in the southern KZN and then gradually widens as it moves

Soil Family	Features
	northwards, reaching a width of 30-40 km on the Maputaland coast. This soil does little more than hold the plant upright.
Glenrosa	Glenrosa soils are widespread throughout the KZN South Coast Lowlands Soil System. Topsoil, comprising of grey loamy sand to clay is typically 200mm to 400mm deep. However, tongues of soil do penetrate into a substrate of weathering rock, thus permitting some root, moisture and nutrient penetration to a deeper level. They carry a high erosion hazard.
Katspruit	This soil is typically found in or near wetlands, seepage areas, foot slopes and valley bottoms where there is a high water table. A loamy sand to sandy loam occurs at a depth seldom exceeding 300 to 400 mm over deep mottled clay with a water table. This land is technically not arable but is often planted to sugarcane by dropping the water table through the digging of drainage ditches or the now illegal use of cambered beds.
Kroonstad	Kroonstad soils are usually found in valley bottoms and wetlands fringes where there is a gentle slope which has resulted in the latching of nutrients and organic matter, typically at a depth of 500-700mm. This is evidenced by a bleached grey or white strata technically referred to as an E-Horizon. Below this, there is a wet, glayed mottled technically as a G-Horizon.
Mispah	Mispah soils are also highly erodible with exceptionally good surface water management required. Topsoil depth is often less than 200 mm, covering a stratum of densely bedded shale or solid rock. Often found in proximity to Glenrosa soils or merging into them, depending on highly localised weathering, Mispah soils also carry a high erosion hazard.
Oakleaf	At this particular site, the Oakleaf soil form is a light sandy soil derived from alluvium. The texture at this site is such that it is borderline between the Sezela soil series (0-6 % Clay) and the Levubu soil form (6-15 % Clay). Further inland clay contents become higher. It is an easy soil to work with.
Swartland	This Soil Form is characterised by a grey to dark grey-brown sandy loam over blocky clay with variegated colours. The third stratum consists of soft decomposing rock. Although Swartland topsoil depths are typically 400 mm to 600 mm, in this instance the topsoil depth reached 1 200 mm.

The land capability class (LCC) for the majority of the site is non-arable agricultural land (LCCVI class). Small portions of the site are marginal arable agricultural land (LCCIV class). Only soils complying with Land Capability Classes I to III (LCCI to LCCIII) are readily acceptable for arable crop cultivation: LCC IV soils may be cultivated under certain stringent and well-managed conditions. Refer to the land capability of the site in Figure 3-1.

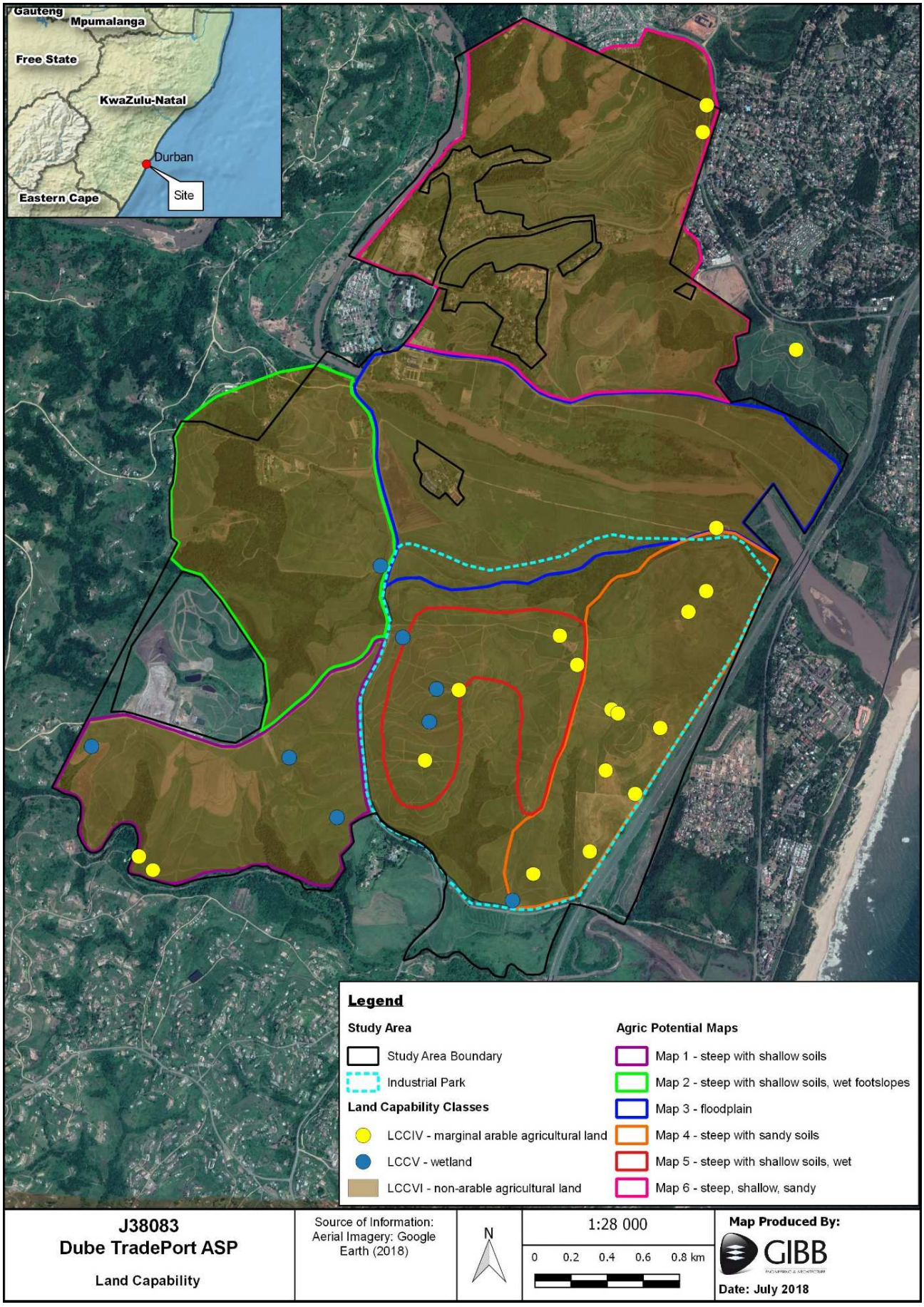


Figure 3-1: Land capability of the site

3.1.3 Geology

(a) Proposed KZN ASP site

A Geotechnical Assessment was undertaken by Syncline Geotechnical Engineers for the KZN ASP site (refer to Appendix D4). The eastern portion of the study area is characterised by Quaternary age Aeolian (wind-blown) sands of the Berea Formation. The Berea sands generally extend to depths in excess of 3.0 metres below Existing Ground Level (EGL).

The central and western portions of the study area are underlain by shale bedrock of the Ecca Group – Pietermaritzburg Formation. This sedimentary unit has been intruded by Karoo-age dolerite in the form of sills and dykes (refer to Figure 3-2 which shows inferred geological boundaries).

Berea Formation Sand

The subsoils encountered in the areas underlain by Quaternary age aeolian (windblown) sands are described as follows:

- Slightly moist to moist, moderate brown to dark brown, loose to medium dense/soft to firm, shattered, moderately clayey, fine-grained, silty SAND to slightly sandy silty CLAY – COLLUVIUM; and
- Slightly moist to moist, orange-brown to reddish-brown with depth, loose to medium dense, slightly to moderately clayey, fine-grained, silty SAND – BEREA FORMATION. This layer extends to depths in excess of 3.0 metres below EGL.

Pietermaritzburg Formation Shale

The subsoils encountered in the areas underlain by Pietermaritzburg Formation Shale are described as follows:

- Slightly moist to moist, moderate brown to dark brown, loose to medium dense/soft to firm, shattered, moderately clayey, fine-grained, silty SAND to slightly sandy silty CLAY – COLLUVIUM;
- Slightly moist, dark greyish brown to olive-grey and yellowish-brown, soft to firm, intact, slightly gravelly, SANDY SILTY CLAY to slightly sandy silty CLAY – RESIDUAL SHALE; and
- Olive grey to dark grey, stained yellow, orange and reddish-brown, completely to highly weathered (becoming progressively moderately weathered with depth), fine-grained, intensely laminated, very highly to highly fractured, very soft to soft rock – SHALE BEDROCK.

Shale bedrock occurs at depths typically in the range 0.7 to 2.5 metres below EGL, and greater than 2.5 metres near drainage courses/valley lines.

These soils of the Pietermaritzburg Formation have been intruded, in the form of sills and dykes, by Karoo-age dolerite. These areas of intrusion have colluvial, residual dolerite and dolerite bedrock subsoils.

Qb/C2 – Inferred area underlain by Quaternary-age sandy soils of the Berea Formation (potentially compressible and collapsible as per NHBRC)

Pp/H1-H2 – Inferred area underlain by Pietermaritzburg Formation Shale bedrock, (potentially low to medium expansive clay as per NHBRC)

Jd/H1-H2 – Inferred area underlain by Karoo-age Dolerite bedrock, (potentially low to medium expansive clay as per NHBRC)

Figure 3-2: Inferred geology and National Home Builders Registration Council (NHRBC)

Karoo Age Dolerite

The subsoils encountered in the areas underlain by Karoo age Dolerite are described as follows:

- Slightly moist to moist, moderate brown to dark brown, loose to medium dense/soft to firm, shattered, moderately clayey, fine-grained, silty SAND to slightly sandy silty CLAY – COLLUVIUM;
- Slightly moist, reddish-brown, stained orange and yellow, soft to firm, intact, SANDY SILTY CLAY to silty sandy CLAY (containing dolerite gravel and corestones) – RESIDUAL DOLERITE; and
- Olive grey, speckled white, stained yellow and orange, highly to moderately weathered, fine to medium-grained, highly to very highly fractured, soft rock – DOLERITE BEDROCK.

(b) Proposed sewer line route

A geotechnical investigation was carried out by Syncline Geotechnical Engineering (Pty) Ltd for the proposed new sewer rising main (Appendix D5). The findings of the study are described below (please refer to Figure 3.3).

The northern portion of the pipeline route (IP1 – IP6) is underlain by sandy/clayey fill and colluvial soils, residual silty soils and tillite bedrock of the Dwyka Group. Weathered bedrock occurs at depths generally in the range 0.7 to 3.5 metres below EGL. In addition, a small section of the northern portion (IP7 – IP8) is characterised by sandy soils of the Berea Formation.

The central and southern portions of the pipeline route (IP9 – IP20) are underlain by sandy/clayey fill and colluvial soils, clayey residual soils and shale bedrock of the Pietermaritzburg Formation. Weathered bedrock occurs at depths generally in the range 1.3 to 3.5 metres below EGL.

Dwyka Group Tillite

- Slightly moist to moist, moderate brown to greyish brown, loose to medium dense, slightly clayey, fine-grained, silty SAND (containing builders' rubble and domestic waste) – FILL;
- Slightly moist to moist, moderate brown to greyish brown, loose to medium dense/soft to firm, intact, moderately clayey, fine-grained, silty SAND to very sandy CLAY – COLLUVIUM;
- Slightly moist to moist, yellowish-brown to orange-brown, soft to firm, intact, moderately clayey, SANDY SILT– RESIDUAL TILLITE; and
- Pale yellow, stained orange and grey, completely to highly weathered, fine-grained, very highly to highly fractured, extremely soft to very soft rock –TILLITE BEDROCK.

NORTH

Test Position	Latitude (S)	Longitude (E)
IP1/DCP1	S30° 04' 32.5"	E30° 51' 20.6"
IP2/DCP2	S30° 04' 30.0"	E30° 51' 14.1"
IP3/DCP3	S30° 04' 27.1"	E30° 51' 04.7"
IP4/DCP4	S30° 04' 35.4"	E30° 50' 55.0"
IP5/DCP5	S30° 04' 44.3"	E30° 50' 49.6"
IP6/DCP6	S30° 04' 47.4"	E30° 50' 37.6"
IP7/DCP7	S30° 05' 01.4"	E30° 50' 34.4"
IP8/DCP8	S30° 05' 15.2"	E30° 50' 32.2"
IP9/DCP9	S30° 05' 25.6"	E30° 50' 20.4"
IP10/DCP10	S30° 05' 23.7"	E30° 50' 06.0"
IP11/DCP11	S30° 05' 27.0"	E30° 49' 48.6"
IP12/DCP12	S30° 05' 38.7"	E30° 49' 35.9"
IP13/DCP13	S30° 05' 47.6"	E30° 49' 25.0"
IP14/DCP14	S30° 06' 03.3"	E30° 49' 24.9"
IP15/DCP15	S30° 06' 23.0"	E30° 49' 28.8"
IP16/DCP16	S30° 06' 38.6"	E30° 49' 27.1"
IP17/DCP17	S30° 06' 54.5"	E30° 49' 21.6"
IP18/DCP18	S30° 07' 07.6"	E30° 49' 23.4"
IP19/DCP19	S30° 07' 25.5"	E30° 49' 37.8"
IP20/DCP20	S30° 07' 27.0"	E30° 49' 53.7"

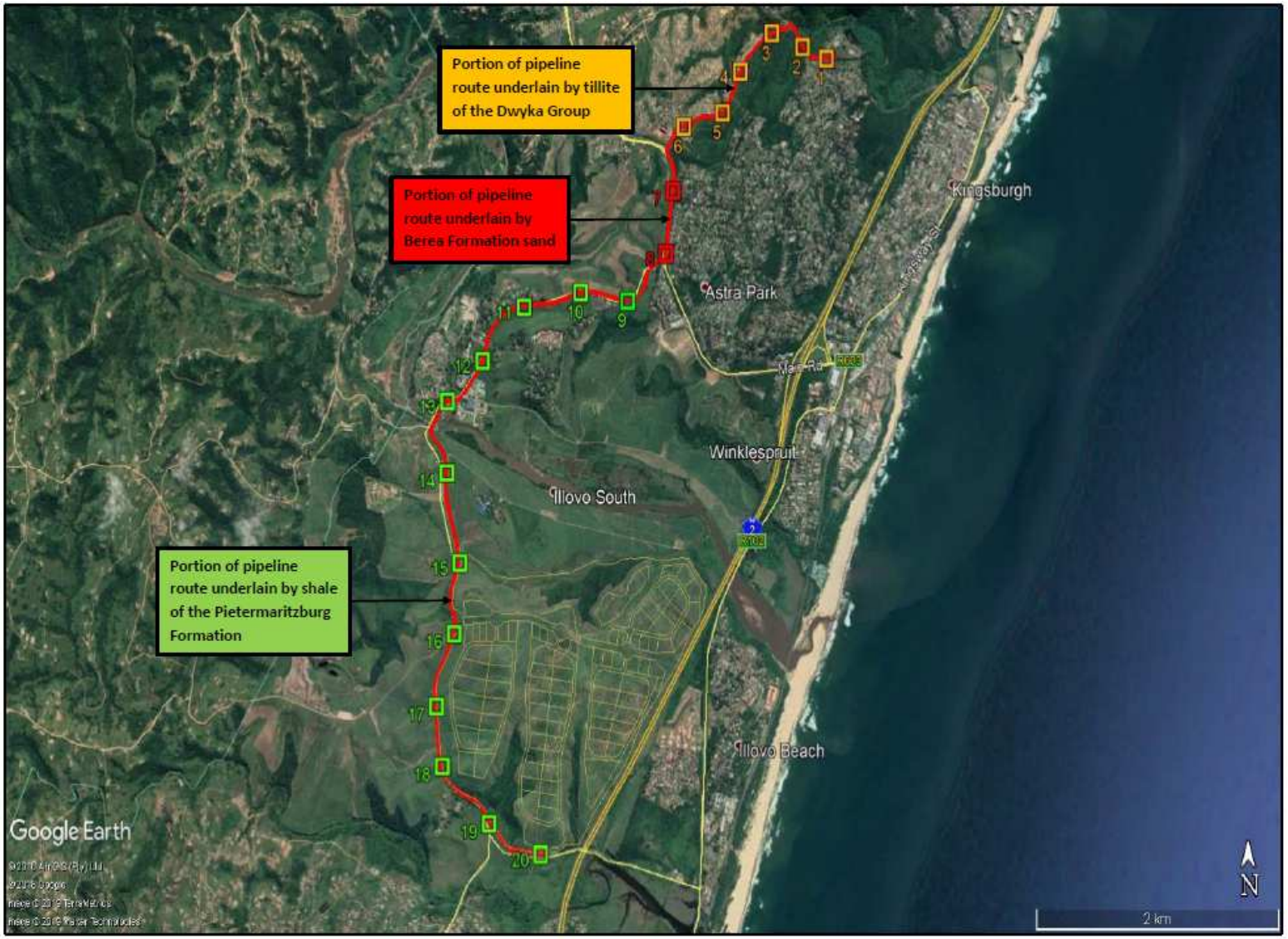


Figure 3-3: Geology map for the proposed sewer line route

Berea Formation

- Slightly moist to moist, moderate brown to greyish brown, loose to medium dense/soft to firm, intact, moderately clayey, fine-grained, silty SAND to very sandy CLAY – COLLUVIUM; and
- Slightly moist to moist, dark red to reddish-brown, loose to medium dense (becoming dense with depth), moderately clayey, fine-grained SAND (with boulders) – BEREA FORMATION.

Pietermaritzburg Formation Shale

- Slightly moist to moist, moderate brown to greyish brown, loose to medium dense, slightly clayey, fine-grained, silty SAND (containing builders' rubble and domestic waste) – FILL;
- Slightly moist to moist, moderate brown to greyish brown, loose to medium dense/soft to firm, intact, moderately clayey, fine-grained, silty SAND to very sandy CLAY – COLLUVIUM;
- Slightly moist to moist, dark olive, mottled orange, yellow and grey, soft to firm, intact, silty sandy CLAY – RESIDUAL SHALE; and
- Dark olive, stained orange/red and grey, completely to highly weathered, very fine-grained, intensely laminated, very highly to highly fractured, extremely soft to very soft rock – SHALE BEDROCK.

The permanent groundwater table was not encountered during the course of the field investigation and is anticipated to occur at a depth in excess of 10.0 metres below EGL. However, a perched groundwater table was encountered in few of the inspection pits. In instances where a perched water table is encountered, the trench should be kept dry by pumping out any water which accumulates.

No signs of inherent ground instability such as slip scars, tension cracks or sloughing of the subsoils were encountered during the investigation and thus the site is rendered stable and suitable for development.

The estimated soft material excavatability was 60%, that of the intermediate material 30%, whilst that of hard material was 10% (as per SANS 1200DA).

The use of a tractor loading backhoe (TLB) or equivalent excavator should enable removal with relative ease of materials classified as SOFT in terms of SANS 1200DA. Plant with greater hydraulic power e.g. CAT 220, Hitachi EX 220 should be considered where materials resembling INTERMEDIATE are anticipated (generally where weathered bedrock is encountered). Approximately 10% of HARD ripping is anticipated along the pipeline route. Allowance should be made for using pneumatic rock hammers or a 'Woodpecker' excavator where HARD materials are anticipated.

(c) Proposed powerline route

Syncline Geotechnical Engineering(Pty) Ltd undertook the Geotechnical Assessment of the proposed 132kV electrical powerline from the existing Kingsburgh substation to the proposed new substation at the KZN ASP site (refer to Appendix D6). Key findings from this study are described below.

The study area is underlain by sandy fill and colluvial soils, clayey residual soils, and shale bedrock of the Ecca Group – Pietermaritzburg Formation. Refer to the geology map in Figure 3-4. Bedrock occurs at depths typically in the range 0.5 to 2.0 metres below EGL but may extend deeper in localised portions along the powerline route. The shale bedrock is intruded in some areas by Karoo age dolerite in the form of sills and dykes. The sandy residual soils which overlie the dolerite bedrock are generally in excess of 2.5 metres thickness.

Subsoil horizons encountered along the powerline route included the following:

- Slightly moist to moist, orange-brown to reddish-brown, very loose to loose, slightly clayey, fine-grained, silty SAND (containing occasional builders rubble) – FILL;
- Slightly moist, grey/greyish brown to moderate brown, loose to medium dense, slightly to moderately clayey, fine-grained, silty SAND – COLLUVIUM;
- Slightly moist, yellowish-brown, mottled orange and grey, soft to firm, intact, gravelly, SANDY SILTY CLAY to silty sandy CLAY (containing shale fragments) – RESIDUAL SHALE;
- Pale yellow to olive-yellow, stained orange, red and grey, completely to highly weathered, very fine-grained, intensely laminated, very highly to highly fractured, very soft to soft rock – SHALE BEDROCK; and
- Dark grey, stained orange, highly to moderately weathered, very fine-grained, intensely laminated, highly fractured, medium-hard to hard rock – SHALE BEDROCK.

The permanent groundwater table was not encountered during the course of the field investigation and is anticipated to occur at a depth in excess of 10.0 metres below EGL.

(i) Stability

- The bedding planes in the shale bedrock dip at angles of 5 to 15 degrees towards the east/southeast i.e. the bedrock will likely daylight out of slope in east/southeast facing cut embankments, and may be prone to sliding if not formally retained/supported;
- Furthermore, the intrusion of dolerite into the shale would have likely upset the natural orientation of the beds, opened up the discontinuities to allow for the latter ingress of water and the development of clay gouge along joints and bedding planes; and
- The combination of clay gouge filled joints/bedding planes and high hydrostatic forces induced by rainwater could give rise to slope stability problems even on relatively flat bedding dips of between 2 and 10 degrees.

(ii) Excavatibility

- Subsoils at 0.0 to 2.0 metres (soft) depth will be easily excavatible;

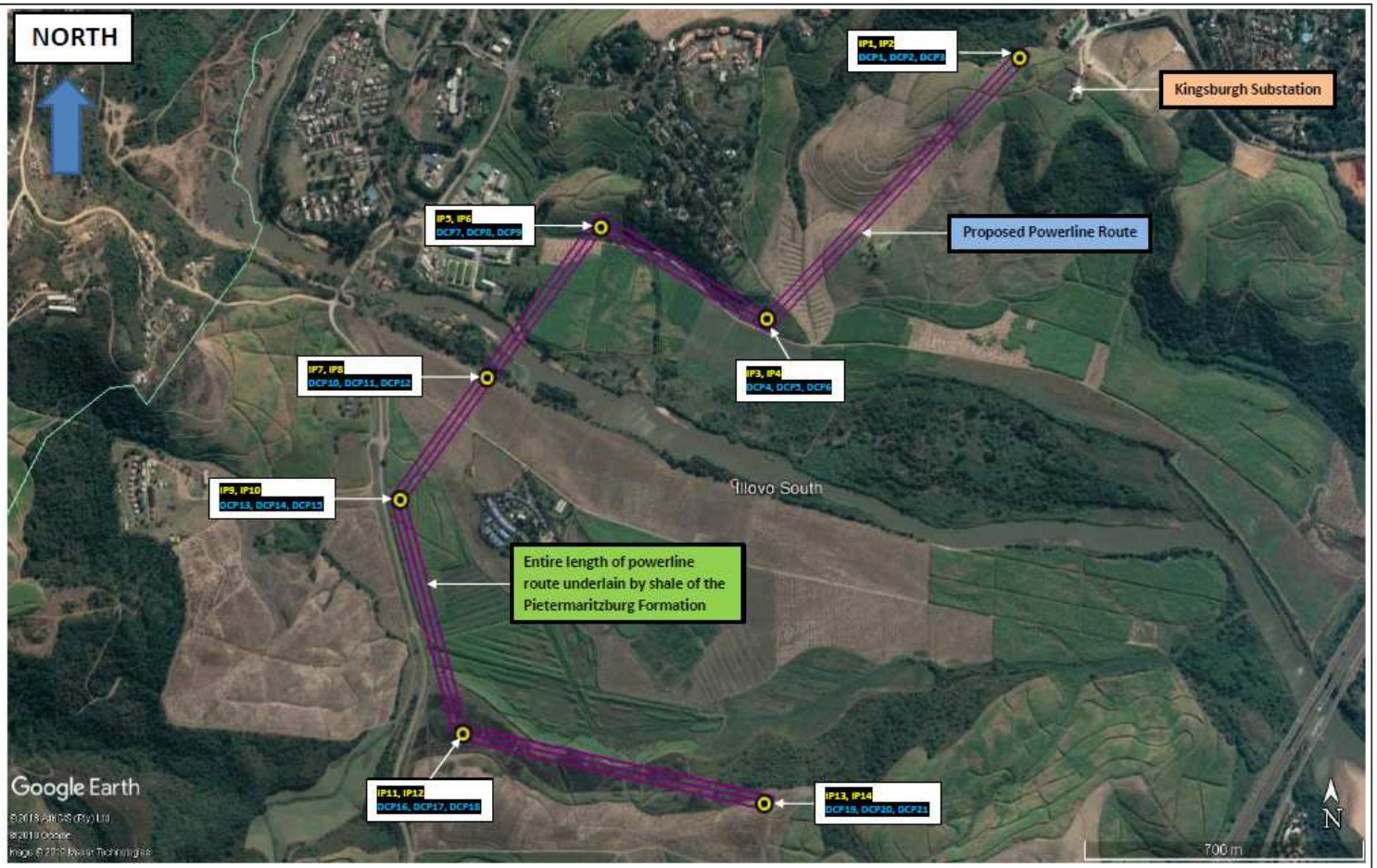
- Subsoils at 2.0 to 4.0 metres (intermediate) depth will require a bulldozer; and
- Excavations below 4.0 metres (hard) will require the use of pneumatic tools and possibly blasting.

Also, according to the guidelines provided by the NHBRC, it is considered that the site generally classifies as H1/H2 i.e. potentially low to medium expansive clayey soils.

Taking into account the subsoil geology of the study area, it is considered that all piles will need to be designed to act in end-bearing[1], founded in the underlying competent, medium-hard, shale bedrock. It is considered that pressure grouted Continuous Flight Auger (CFA) piles are suitable for use on the site.

[1] There are 2 types of piles, namely friction piles and end bearing piles. In this case, foundation loads should be carried/supported on the bedrock at depth, at the end of the pile, and not in friction (along the pile sides).

Test Position	Latitude (S)	Longitude (E)
IP1	S30° 05' 33.8"	E30° 50' 24.4"
IP2	S30° 05' 34.7"	E30° 50' 25.0"
IP3	S30° 05' 55.3"	E30° 50' 00.9"
IP4	S30° 05' 54.5"	E30° 50' 00.0"
IP5	S30° 05' 48.0"	E30° 49' 45.3"
IP6	S30° 05' 47.3"	E30° 49' 59.5"
IP7	S30° 05' 59.5"	E30° 49' 35.5"
IP8	S30° 05' 59.5"	E30° 49' 33.4"
IP9	S30° 06' 08.5"	E30° 49' 26.4"
IP10	S30° 06' 08.4"	E30° 49' 25.5"
IP11	S30° 06' 26.2"	E30° 49' 32.2"
IP12	S30° 06' 26.3"	E30° 49' 32.0"
IP13	S30° 06' 31.7"	E30° 50' 00.8"
IP14	S30° 06' 32.9"	E30° 50' 01.0"
DCP1	S30° 05' 33.8"	E30° 50' 24.4"
DCP2	S30° 05' 34.7"	E30° 50' 25.0"
DCP3	S30° 05' 34.2"	E30° 50' 24.9"
DCP4	S30° 05' 55.3"	E30° 50' 00.9"
DCP5	S30° 05' 54.5"	E30° 50' 00.0"
DCP6	S30° 05' 55.0"	E30° 50' 00.6"
DCP7	S30° 05' 48.0"	E30° 49' 45.3"
DCP8	S30° 05' 47.3"	E30° 49' 45.4"
DCP9	S30° 05' 47.6"	E30° 49' 45.4"
DCP10	S30° 05' 59.5"	E30° 49' 35.5"
DCP11	S30° 05' 59.5"	E30° 49' 33.4"
DCP12	S30° 05' 59.5"	E30° 49' 33.7"
DCP13	S30° 06' 08.5"	E30° 49' 26.4"
DCP14	S30° 06' 08.4"	E30° 49' 25.5"
DCP15	S30° 06' 08.6"	E30° 49' 25.8"
DCP16	S30° 06' 26.2"	E30° 49' 32.2"
DCP17	S30° 06' 26.3"	E30° 49' 32.0"
DCP18	S30° 06' 26.6"	E30° 49' 31.9"
DCP19	S30° 06' 31.7"	E30° 50' 00.8"
DCP20	S30° 06' 32.9"	E30° 50' 01.0"
DCP21	S30° 06' 32.4"	E30° 50' 00.9"



IP1 – Position of Inspection Pit

DCP1 – Position of CBR Dynamic Cone Penetrometer (DCP) Test

Image sourced from Google Earth 2019

Latitude: S30° 05' 33.8"

Longitude: E30° 50' 24.4"

Scale: As shown on image

Syncline
GEOTECHNICAL ENGINEERING (PTY) LTD
Helping You Found On Solid Ground
Geologists and Geotechnical Engineering Consultants

PROJECT: 132kV Electrical Powerline - KZN ASP	
CLIENT: Gibb (Pty) Ltd	
DATE: 17 September 2019	PROJECT REFERENCE NUMBER: SGE-192-2019
DRAWN BY: K. Govender	FIGURE NUMBER: 2 – Site Plan
CHECKED BY: S. Pather	REVISION: 0

Figure 3-4: Geology map for the proposed powerline route

3.1.4 Groundwater

(a) Proposed KZN ASP site

A Geohydrological Assessment was undertaken by GCS Consulting for the proposed KZN ASP development (refer to Appendix D7). The findings of this study described below.

(i) Desktop Findings

Based on available data, groundwater is typically encountered in:

- Contacts between lithologies or unconformities;
- Fractures and bedrock contacts which are recharged through overlaying saturated sands;
- Dolerite dyke contacts with competent rock type such as crystalline rock, sandstone and diamictite (King et al., 1998); and

The regional geological map indicates that dolerite dyke and sill structures occur in the region (DMEA, 1998). Intrusive dolerite is generally associated with the Pietermaritzburg sediments. Depending on the degree of fracturing and weathering associated with the sills, the dolerite may inhibit or promote seepage and groundwater flow. However, this can only be determined by drilling into the rock.

The geotechnical investigation[2] undertaken by Syncline Geotechnical Engineering (Pty) Ltd (2018) indicated that dolerite occurs towards the north, south and west of the study area.

Available literature and site observation data further suggests that three (3) aquifers exists in the area:

- A shallow unconfined aquifer system associated with alluvium deposits, specifically in the floodplain areas of the iLovu and uMsimbazi Rivers;
- A shallower semi-confined aquifer system associated with weathered to partly consolidated sedimentary rock as well as moderately to partially weathered dolerite rock (underlying the ASP site); and
- A deeper confined fractured aquifer network associated with sediments of the Ecca and Dwyka Groups (underlying the above mentioned aquifers).

The aquifers can be referred to as being fractured with intergranular aquifer zone occurrences (King *et al*., 1998[3]):

- The aquifer host rock comprises alluvium (area near the iLovu River), shale and siltstone (arenaceous rock of the Ecca group) and mafic intrusive rocks (dolerite);

[2] Geotechnical Investigation for Proposed Dube Tradeport KZN Automotive Supplier Park Township Establishment on the Remainder of the Farm Nogi No. 17469 in Illovo South, eThekwini Municipality.

[3] King, G. Maritz, E. and Jonck, F. 1998. 2829 Durban - 1:500 000 Hydrogeological map series of the Republic of South Africa.

- The aquifer has a low to medium hydraulic conductivity (K-value) and porosity (n-value); and
- The aquifer is mainly of secondary nature.

The aquifer in the study area is classified as a minor aquifer system (Parsons, 1995[4]) and is poorly exploited.

- This aquifer underlying the site has maximum reported yields ranging from 0.1 to 0.5l/s; and
- Yields may increase to a range > 2 l/s for successful boreholes drilled into geological contacts or deeper fractured aquifer zones (Ecca Group).

Recharge to the underlying aquifer is estimated to be in the order of 7.6 to 10 % (average 83 mm/yr) of the MAP (900 - 1000 mm) which falls within quaternary catchment U70E (DWAF, 2006[5]). A review of the GRIP (2016[6]) and NGA (2018[7]) databases indicated that there are several groundwater boreholes within a 5km radius of the Site. However, water level and chemistry data for the boreholes are limited:

- Only ten (10) boreholes have data available. No field level groundwater boreholes could be located during the field hydrocensus. Hence, only desktop database boreholes were available for this assessment.

(ii) Field Investigation

The field investigation took place on the 29th of November 2018. The following summarises the findings and work completed:

- A hydrocensus was completed in the area. However, no field-level groundwater boreholes could be located. Correspondence with several residents indicated that municipal water is readily used in the area;
- All non-perennial drainage lines which fall in the ASP development area were dry during the site walk-over assessment. Hence, no surface water samples could be obtained. The only flowing water bodies were the iLovu and uMsimbazi Rivers; and
- A geophysical investigation, with the use of magnetic methods, was completed in the area. The survey aimed to trace dolerite sill contact areas or intrusive dolerite dyke structures. These structures are known to either inhibit or promote groundwater flow depending on their degree of fracturing, dip and strike direction.

[4] Parsons, R. 1995. A South African Aquifer System Management Classification. Water Research Commission Report No. KV 7795.

[5] DWAF. 2006. Groundwater Resource Assessment II (GRA2) - Task 3aE Recharge. Access Site: https://www.dwaf.gov.za/Geohydrology/gra2/3aEFinalReportA.pdf.

[6] GRIP. 2016. Groundwater Resource Information Project data.

[7] NGA. 2018. National Groundwater Archive.

Based on the geophysical survey data obtained:

- Intrusive dolerite occurs in the northern, southern and western areas of the ASP project area; and
- Depending on the degree of fracturing and weathering associated with the sills, the dolerite may inhibit or promote seepage and groundwater flow. However, this can only be determined by drilling into the rock.

Based on the numerical flow model and available groundwater level data:

- According to available data, the groundwater levels within the region are expected to range from 2 to 120 (on average 19.3) metres below ground level (mbgl). However, a shallow perched groundwater table is likely to occur in close proximity to drainage courses and rivers, at depths typically in the range of 0.5 to 3.5 mbgl. According to the Geotechnical Assessment by Syncline (2018) no groundwater seepage was encountered during the excavation of several test pits in the study area (pits ranged from 1 to 3 mbgl);
- Available data suggest that the groundwater table mimics the topography; and
- The flow model indicates groundwater flow velocities ranging from 0.01 (minimum) to 0.06 (max) m/day. Those above suggest very slow-moving groundwater in the study area.

(iii) Hydrochemistry

Limited groundwater quality data is available for the study area. However, available literature (King *et. al.*, 1998) suggest that the electrical conductivity (EC) for the underlying aquifer generally range between 0 – 300 mS/m and the pH ranges from 6 to 8. In context, this means that groundwater can generally be used for domestic, irrigation and recreational use.

(b) Proposed sewer line and powerline

GCS Water and Environment (Pty) Ltd conducted a geohydrological investigation to assess any existing and likely future groundwater-related impacts by the proposed ASP power and sewer lines development (Appendix D8). The findings of the study are described below.

The aquifers underlying the ASP sewer and power lines has maximum reported yields ranging from 0.1 to 0.5 l/sec – Class D2 Aquifer[8].

Groundwater typically exhibit neutral pH conditions (range from 7 to 8) and electrical conductivity (EC) ranges between 58.7 to 153.1 mS/m indicating fresh to brackish groundwater is present in the area (at depths estimated to be from 2-30mbgl).

[8] Class D aquifers generally have yields ranging from 0.1 to 0.5 l/sec and are associated with intergranular and fractured rock / material. These aquifers are rarely targeted for groundwater production due to the low yields.

Higher permeability coefficients are associated with Berea Formation sands ranging from 2.15 to 6.31 m/day. Residual shale/clayey soil has slow permeability coefficients ranging from 0.28 to 0.96 m/day. Similar characteristics are likely to be applicable to material of similar nature along the sewer and power lines.

Groundwater flow through a saturated medium and aquifer hydraulic conductivity ranged from 1×10^{-1} to 1×10^{-3} m/day for the aquifer rock in the study area and therefore the pollution migration velocities are estimated to range from 1 x 10—4 to 0.03 m/day.

The impacts on groundwater dewatering and reduced baseflow at the site are anticipated to be zero as no groundwater abstraction was proposed.

An overlay and index method, known as the DRASTIC Index, was used to classify the geohydrological vulnerability and the aquifer susceptibility to pollution. Please refer to Appendix A and B of the Geohydrological Assessment in Apppendix D8, for the DRASTIC Index methodology and evaluation of the study area.

DRASTIC is an acronym for the hydrogeological factors that are assessed, namely the following:

- D: Depth to Groundwater: The depth from the groundwater surface to the water table in an unconfined aquifer and to the bottom of the confining layer in a confined aquifer;
- R: (Net) Recharge: The total quantity of water which is applied to the ground surface and infiltrated to reach the aquifer;
- A: Aquifer Media: Consolidated or unconsolidated rock which serves as an aquifer;
- S: Soil Media: The uppermost portion of the vadose zone (unsaturated zone) characterized by significant biological activity;
- T: General Topography or Slope: The slope and slope variability of the land surface.
- I: Impact of the Vadose Zone Media: The zone above the water table which is unsaturated or discontinuously saturated; and
- C: Conductivity (Hydraulic) of the Aquifer: The ability of the aquifer material to transmit water (measure of ease by which groundwater moves through the aquifer).

The DRASTIC index ranges from 66 to 170. The range was sub-dived into 5 levels of relative vulnerability based on the calculated range. The anticipated aquifer vulnerability for the iLovu River area is high to very high, and the remaining area is very low to moderate.

3.1.5 Hydrology (Flood lines)

(a) Proposed KZN ASP site

A Hydrological Assessment to determine the 1:100 year pre- and post-development planning flood lines for the proposed KZN ASP were conducted by SRK Consulting Engineers (Appendix D9).

The pre-development land-use is mostly agriculture (sugar cane) and open spaces (watercourses and grasslands), whereas for post-development the land-use was based on the proposed Automotive Supplier Park Development layout.

The Hydrological Assessment further determined the pre- and post-development peak flows for sub-catchments within the development as well as the 1:100 year pre- and post-development planning flood lines. Key findings from the study are described below reports that resultant flood lines did not intersect with the proposed sites of the development, apart from those at the source of the stream tributaries. Investigations could be carried out for these sites as to whether they could be developed, and a portion of these streams backfilled, however, environmental investigations are recommended.

(b) Proposed sewer line and powerline

A Hydrological Assessment was undertaken by GroundTruth Water, Wetlands and Environmental Engineering in order to delineate the 1:100 year flood line for the sections of the iLovu River that the proposed sewer and power lines crosses (Appendic D10). The findings of the study are described herein.

(i) Hydrological Modelling:

- There are 12 (twelve) catchments contributing to the iLovu River flow, varying from 0.174 km2 to 945.14 km2 in area sizes;
- The design rainfall depths for the 1:100 year return period at various durations range from 70.1 to 129.9 mm; and
- The estimated Peak Discharges for each catchment for the 1:100 year return period ranged from 5.47 m3/s for the smallest catchment to 1156 m3/s for the largest catchment.

(ii) Hydraulic Modelling:

- A HEC-RAS[9] two-dimensional model (*Hydrologic Engineering Centre of the US Army Corps of Engineers) RAS (River Analysis Software*) was set up for all rivers and tributaries that cross, or are in close proximity to the proposed powerline and sewer line; and
- The stability of the model was checked using the courant number and it was concluded that the model was stable.

There are instances where the alignments of the sewer and powerline routes fall within the modelled 1:100 year flooded extents (refer to Figure 3-5).

[9] A HEC-RAS two-dimensional model was set up using dimensions surveyed from a site visit to the iLovu River as well as existing minor road culverts along the proposed routes.

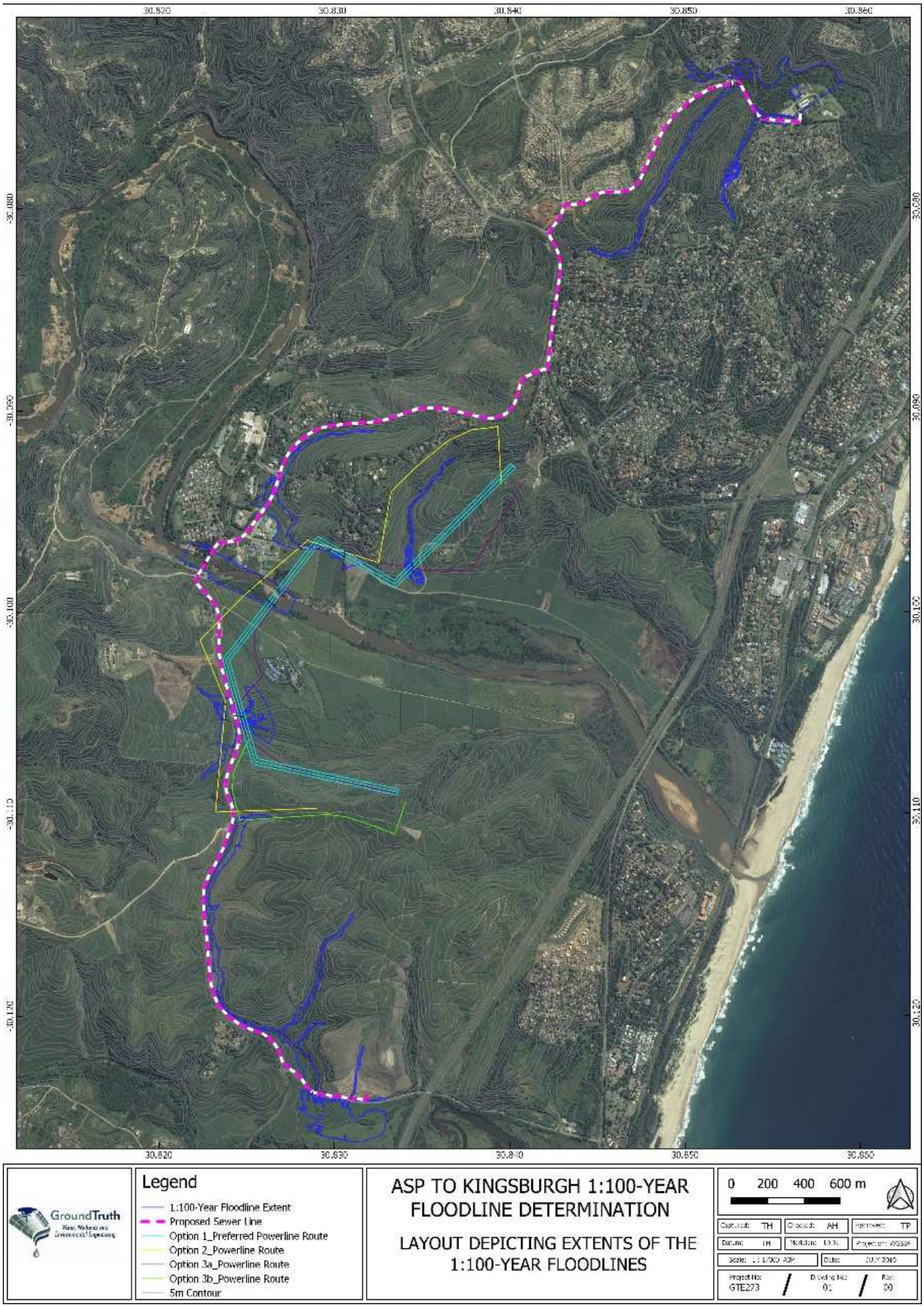


Figure 3-5: 1:100 year flood lines for the proposed sewer line and powerline route alignments

3.1.6 Aquatic Environment

(a) Proposed KZN ASP

An Aquatic Assessment was undertaken for the proposed ASP development by GCS (Pty) Ltd (GCS) (refer to Appendix D11). The study area spans two quaternary catchments, U70D and U70E of the Pongola-Mtamvuna Management Area (WMA 4). The major river systems draining the area are the iLovu River and estuary, located north of the site and the uMsimbazi River and estuary, south of the site.

The Atlas of Freshwater Ecosystem Priority Areas (FEPAs) in South Africa (Nel *et al*., 2011[10]) provides a series of maps detailing strategic spatial priorities for conserving South Africa's freshwater ecosystems and supporting the sustainable use of water resources. The FEPAs were identified through a systematic biodiversity planning approach that incorporated a range of biodiversity aspects such as ecoregion, the current condition of habitat, presence of threatened vegetation, fish, frogs and birds, and importance in terms of maintaining downstream habitat. River FEPAs achieve biodiversity targets for river ecosystems and threatened/near threatened fish species, and were identified for rivers that are currently in a good condition (A or B ecological category). The FEPA status indicates that they should remain in good condition in order to contribute to national biodiversity goals and support sustainable use of water resources.

According to the Atlas (Nel *et al*., 2011), the Present Ecological State (PES), or health, of the iLovu River and its estuary is considered moderately modified (Category C), and the uMsimbazi River and its estuary are considered largely natural with few modifications (Category B).

(i) Assessment Findings

Sampling Sites

The quality of the instream and riparian habitat has a direct influence on the aquatic community. Evaluating the structure and functioning of an aquatic ecosystem must, therefore, take into account the physical habitat to assess the ecological integrity.

Eight sites within the boundaries of the proposed development area were investigated for suitable conditions and habitat to conduct the SASS5 protocol and area described in Section 5.1 of Appendix D11. Due to the absence of flowing water on site, the in situ Water Quality, Integrated Habitat Assessment Index and SASS5 results could not be obtained.

The IHI assessment was performed at each site to provide an indication of the impacts on the riparian and the instream habitats, which would affect the residing macro-invertebrate communities should they be present. The provisional PES of the sites was thus determined on the basis of habitat integrity only, keeping in mind that the above suite of methods and tools, which could not be implemented due to the absence of water flow, provide a complimentary

[10] Nel, J.L., Driver, A., Strydom, W.F., Maherry, A., Petersen, C., Hill, L., Roux, D.J., Nienaber, S., van Deventer, H., Swartz, E. and L.B. Smith-Adao (2011) Atlas of Freshwater Ecosystem Priority areas in South Africa: Maps to support sustainable development of water resources. WRC Report No. TT 500/11.

assessment of river health, centred on the status of macro-invertebrate communities. The baseline survey undertaken in November 2018 can, therefore, be regarded as inconclusive.

It must be noted that the rivers and streams on site are ephemeral in nature resulting in intermittent flow throughout the year. Therefore, these rivers will not be able to support the natural habitats that are required for the establishment of diverse and large aquatic invertebrate communities. Thus, the absence of river flow is a natural limiting factor and the absence of the SASS5 score is inevitable.

Habitat Characterisation - Index of Habitat Integrity

The Index of Habitat Integrity (IHI) differs from the Integrated Habitat Assessment System (IHAS) in that it provides an assessment of the perceived impacts and modifications to the stretch of the river under investigation. This index considers impacts to the riparian zone as well as the instream aquatic habitat. The results of the IHI assessment for each site are provided in Table 3-2.

All the monitoring sites (Site ASP 01 to ASP 08) (refer to Figure 3-6) were found to be moderately modified and were categorised as Class C, indicating a loss of natural habitat but basic ecosystem functions are potentially still unchanged.

The instream modifications that rated the highest across all sites were the lack of flowing water and the presence of exotic/invasive flora species. Stagnant pools of water were present at all the sites with the exception of Site ASP 01, where no water was observed. Where water is present, it appeared to be a muddy brown colour with plant debris floating on the surface providing an indication that there is no water movement.

The absence of water flow impacts greatly on the water quality as extremely low levels of oxygen and elevated concentrations of pollutants may be generated due to the lack of flushing, which will result in inhabitable conditions. The absence of flowing water will be the greatest limiting factor for aquatic macro-invertebrate communities.

The highest-rated modifications to the riparian zone across all sites were exotic vegetation encroachment followed by the removal of indigenous vegetation. The monitoring sites investigated are all within an area of intensive sugarcane cultivation, facilitated by the historical removal of indigenous vegetation. Various alien invasive plant species such as grasses (*Typha* spp) and Morning Glory (*Ipomoea indica*) were present within the wider riparian area. The riparian vegetation at Site ASP 01 consisted almost solely of a singular invasive reed species, *Arundo donax*.

Solid waste (litter) was also observed in the riparian areas of ASP 04, ASP 05, ASP 06, which is most likely due to these sites being close to roads such as the N2 and the sugarcane service road.

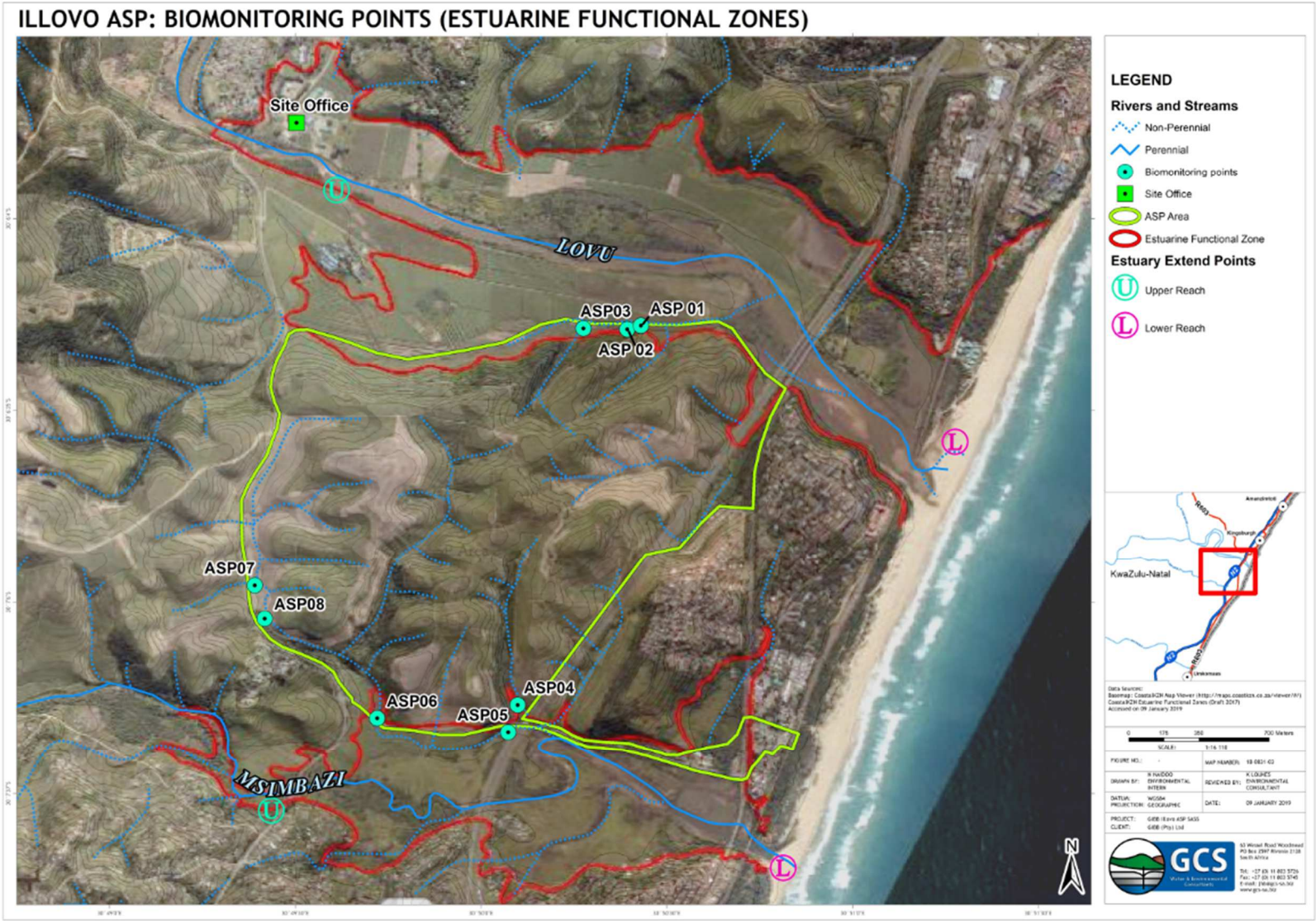


Figure 3-6: Aquatic monitoring sites for the proposed ASP development

Table 3-2: IHI results for each site of the ASP development

	Weight	ASP 01	ASP 02	ASP 03	ASP 04	ASP 05	ASP 06	ASP 07	ASP 08
Instream Criteria									
Water abstraction	14	0	0	0	0	0	0	0	0
Inundation	10	0	0	0	0	0	0	0	0
Water quality	14	11	15	15	15	15	11	15	15
Flow modifications	13	11	9	9	11	10	9	9	8
Bed modifications	13	10	8	8	7	8	8	7	7
Channel modifications	13	16	10	10	8	8	10	10	6
Presence of exotic macrophytes	9	16	12	8	8	12	12	8	5
Presence of exotic fauna	8	0	0	0	0	0	0	0	0
Solid waste disposal	6	0	0	0	12	12	8	0	0
Total (100)	100	31.2	26.8	25.3	27.7	29.1	26.4	24.8	21.1
	Instream Habitat Integrity (%)	69	73	75	72	71	74	75	79
	Instream Habitat Integrity Class	C	C	C	C	C	C	C	C
Riparian Zone Criteria									
Water abstraction	13	0	0	0	0	0	0	0	0
Indundation	11	0	0	0	0	0	0	0	0
Water quality	13	15	15	15	15	15	15	15	15
Flow modifications	12	13	13	13	13	13	13	13	13
Channel modifications	12	6	6	6	8	12	12	12	5
Removal of indigenous vegetation	13	17	17	17	17	17	17	17	17
Exotic vegetation encroachment	12	18	15	10	12	15	12	10	5
Bank erosion	14	0	0	0	0	0	0	0	0
Total (100)	100	34.4	33.0	30.6	32.5	35.8	34.4	33.4	27.7
	Riparian Habitat Integrity (%)	66	67	69	68	64	66	67	72
	Riparian Habitat Integrity Class	C	C	C	C	C	C	C	C
	Total Integrity Score	67	70	72	70	68	70	71	76
	Total Integrity Class	C	C	C	C	C	C	C	C

(b) Proposed sewer line and powerline

An Aquatic Assessment was undertaken for the proposed sewer and power infrastructure required KZN ASP Township development by GCS (Pty) Ltd (GCS) (refer to Appendix D12). The proposed sewer pipeline traverses quaternary catchments U70E, U70D and U70F of the Pongola-Mtamvuna Management Area (WMA 4) and the powerline span quaternary catchments U70E and U70D. The major river systems draining the area are the iLovu River and estuary, which is traversed by the proposed sewer and powerline, and the uMsimbazi River and estuary, south of the proposed sewer and powerline.

(i) Assessment Findings

Sampling Sites

The quality of the instream and riparian habitat has a direct influence on the aquatic community. Evaluating the structure and functioning of an aquatic ecosystem must, therefore, take into account the physical habitat to assess the ecological integrity.

Five sites were assessed of which two sites (ASP 06 and ASP 08) (Refer to Figure 3-7) were previously surveyed in November 2018. Three additional sites, namely ASP 09, ASP 11, ASP 12 were investigated to determine their suitability for the application of the SASS protocol. The environment surrounding each sample site was observed, recorded and has been described in Section 5.1 of Appendix D12. Due to the absence of flow at some of the sample sites, the in situ Water Quality, IHAS and SASS5 results could not be obtained.

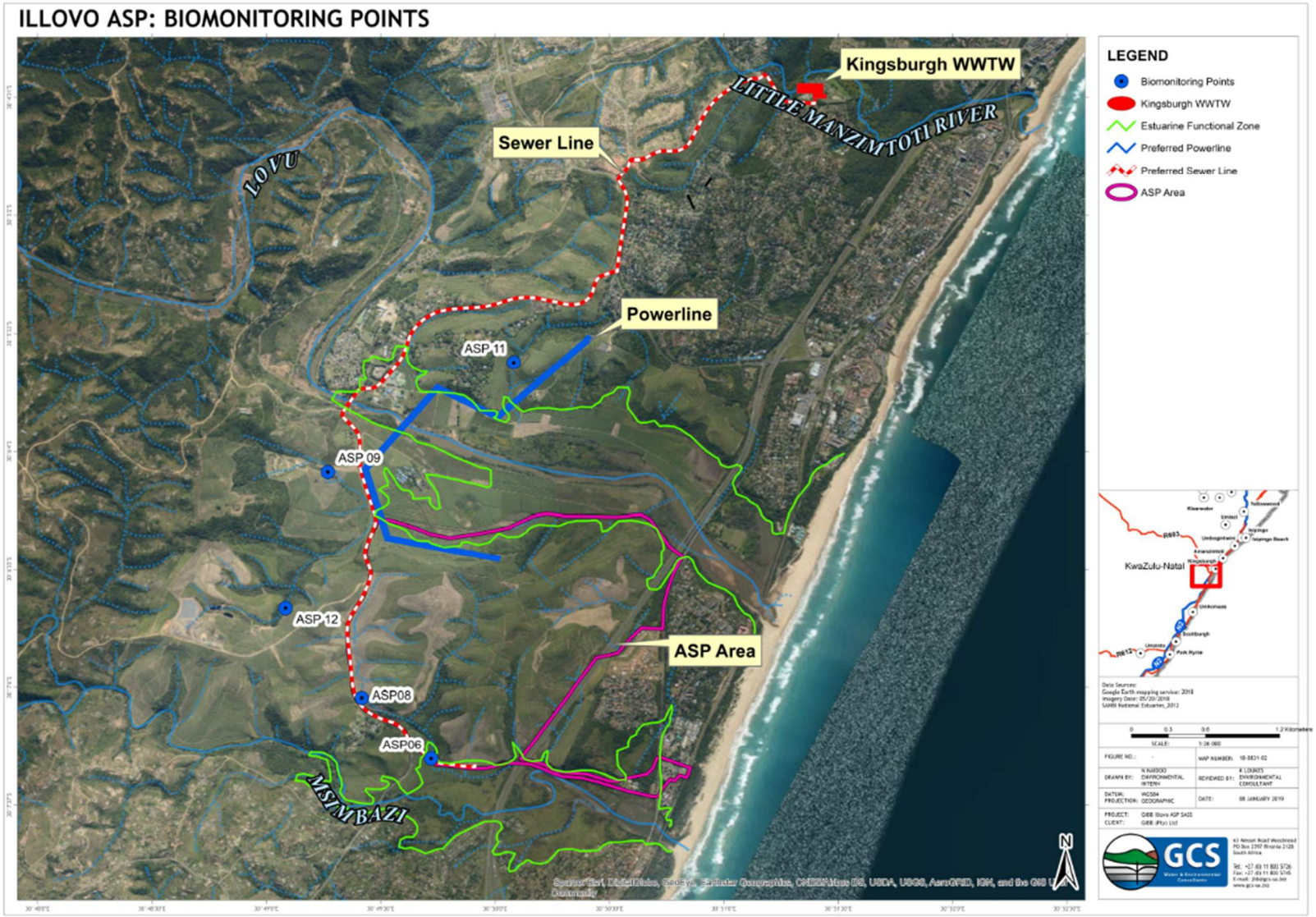


Figure 3-7: Aquatic monitoring sites for the proposed KZN ASP sewer line and powerline development

The IHI assessment was performed at each site to provide an indication of the impacts on the riparian and the instream habitats, which would affect the residing macro-invertebrate communities should they be present. The provisional PES of the sites was thus determined on the basis of habitat integrity only, keeping in mind that the above suite of methods and tools, which could not be implemented due to the absence of water flow, provide a complimentary assessment of river health, centred on the status of macro-invertebrate communities.

It must be noted that the rivers and streams on site are ephemeral in nature resulting in intermittent flow throughout the year. Therefore, these rivers will not be able to support the natural habitats that are required for the establishment of diverse and large aquatic invertebrate communities. Thus, the absence of river flow is a natural limiting factor and the absence of the SASS5 score is inevitable.

(ii) Water Quality

The *in situ* water quality measurements collected during the survey for all the sites are presented in Table 3-3 below.

pH

- Most fresh waters are usually more or less neutral, with a pH ranging from 6.5 to 8.5 (Davies and Day, 1998[11]);
- The pH values recorded for these sites were within the SAWQG guidelines for freshwater ecosystems (DWAF, 1996b[12]); and
- Therefore, pH was not considered to be a limiting factor to aquatic biota.

Temperature

- Temperature varies with the seasons and the life cycles of many aquatic macro-invertebrates are cued to temperature (DWAF, 2005).
- The temperatures recorded were expected for the time of day and season during which sampling took place (winter).
- Temperature was not considered to be a limiting factor to aquatic biota.

[11] Davies, B. and Day, J. (1998) Vanishing Waters. Cape Town, South Africa: University of Cape Town Press.

[12] Department of Water Affairs and Forestry (1996b) The South African Water Quality Guidelines (SAWQG) for Aquatic Ecosystems, Vol. 7 Aquatic Ecosystems.

Table 3-3: In situ water quality measurements for ASP sewer and powerline sites

Parameter	pH	Temp (°C)	TDS (mg/l)	EC (mS/m)	DO (mg/l)	DO Sat
DWAF Aquatic Ecosystem TWQG	Not to vary by more than 0.5 pH units or by more than 5% from normal range.	Not to vary by more than 2˚C or 10% from normal background temp for time of day and season	Not to vary by more than 15% from normal cycles of the water body under un-impacted conditions at any time of the year	Not to change by more than 15% from normal	5 mg/l	80 - 120 % Sat.
ASP 06	7	21.2	590	139	6.1	93
ASP 08	6.9	19.1	720	145	4.5	65
ASP 09	7	19.5	290	58	3.4	49
ASP 11	6.7	18.4	550	111	6	87
ASP 12	6.7	19.6	940	187	4	63

Total Dissolved Solids TDS) & Electrical Conductivity (EC)

- Most of the macro-invertebrate taxa that occur in streams and rivers are sensitive to salinity, with toxic effects likely to occur in sensitive species at salinities > 1000 mg/ℓ (DWAF 1996b). According to the SAWQG for Aquatic Ecosystems (DWAF 1996b), TDS concentrations in South African inland waters should not vary by more 15% from the normal cycles of the water body under un-impacted conditions at any time of the year;
- The TDS and EC levels recorded will be regarded as the winter baseline values for the surrounding area of the proposed development;
- Thus, the guidelines provided by the SAWQG for Aquatic Ecosystems (DWAF 1996b) for TDS and EC will be applied to the baseline values measured of the pre-development activities when follow-up surveys are undertaken.; and
- It must be noted that the impacts of agricultural activities such as tillage and application of fertilisers can elevate TDS/EC values above normal/natural conditions. Thus despite not a having a baseline for TDS/EC values, they are very likely to be affected by current agricultural practices.

Dissolved Oxygen (DO)

- The DO concentrations were within acceptable limits for sites ASP 06 and ASP 11. However very low DO levels were recorded at the remaining sites. Low DO levels will be present when water flow is slow or absent and will improve with faster flowing water because of turbulence created within the instream environment; and

- The DO levels were considered to be a limiting factor to aquatic biota at the sites KZN ASP 08, ASP 09 and ASP 12.

(iii) Index of Habitat Integrity

The Index of Habitat Integrity (IHI) differs from the IHAS in that it provides an assessment of the perceived impacts and modifications to the stretch of the river under investigation. This index considers impacts to the riparian zone as well as the instream aquatic habitat. The results of the IHI assessment for each site are provided in Table 3-4.

Site ASP 12 was found to be unmodified and was categorised as Class A, indicating a natural habitat with intact ecosystem functions. Site ASP 08 was categorised as Class B, largely natural with few modifications. At this site, it was observed that there were small changes in the natural habitat, but ecosystem functions remained unchanged. The remaining sites ASP 06, ASP 09 and ASP 11 were all rated as moderately modified (Class C), displaying a loss and change of natural habitat and biota with lower community diversity. However, basic ecosystem functions were still predominantly unchanged. The main instream and riparian zone impacts are discussed in further detail below.

Instream Impacts

The instream impacts that scored the highest across all sites were bed and channel modification, followed by water quality.

Overall site ASP 09 scored the highest in regard to instream modifications due to channel modifications, poor water quality and a thick layer of black anoxic debris covering the stream bed. The stream is traversed by a service road to the Illovo offices and a culvert is present to allow for continued water flow underneath the road. The water colour observed at this site appeared to be a grey to black colour where water was stagnant and more transparent where water was flowing.

Based on observations of the surrounding environment, it was deduced that the grey to black colour could potentially be attributed to constituents of burnt sugar cane, which has runoff from the adjacent embankments into the stream channel. It is suspected that the burnt sugar cane constituents covered the stream bed, giving the water the grey to black colouration. The lack of water flow at the time of the survey impacted greatly on water quality as extremely low levels of oxygen was present and elevated concentrations of likely agriculturally-derived pollutants used on the surrounding sugar cane fields may be generated due to the lack of flushing. This will result in inhabitable conditions in aquatic invertebrate communities.

Instream bed modification was also observed at Site ASP 06 due to dead sugar cane and other plant debris deposited in the stream channel, which ultimately will impede water flow and modify bottom/ river bed habitat. The stream channel is also modified due to the presence of a culvert and gabion baskets on the downstream side of the culvert.

Stagnant pools of water were present at three of the five sites (ASP 08, ASP 11 and ASP 06) and the water appeared to be a light brown muddy colour with some floating plant debris,

which provided some indication that there was little to no water flow. It was concluded that the lack of flowing water is the greatest limiting factor for aquatic macro-invertebrate communities.

Riparian zone impacts

The highest scoring modifications to the riparian zone across all sites was exotic vegetation encroachment and the removal of indigenous vegetation. The investigated monitoring sites are all within an area of intensive sugarcane cultivation, facilitated by the historical removal of indigenous vegetation. Various alien invasive plant species such as Brazilian Pepper Tree (*S terebenthifolious),* Bugweed (*S mauritianum*), Common Lantana (*L. camara*), Indian Shot (*C. indica*), Triffid Weed (*C. odorata*) and Syringa (*M. azedarach*).

Water quality within the riparian zone was rated as severe for site ASP 09 due to the burnt sugar cane debris washing down from the sugarcane fields into the stream and impacting on the water quality.

Channel modification within the riparian zone was also rated as a large impact mainly due to the presence of culverts at the monitoring points.

Solid waste (litter) was also observed in the riparian areas of Site ASP 06 and lesser extent at Site ASP 08, which is most likely due to these sites being in close proximity to the roads accessible to general public.

Table 3-4: IHI results for each site of the sewer and powerline infrastructure for the ASP development

	Weight	ASP 06	ASP 08	ASP 09	ASP 11	ASP 012
Instream Criteria						
Water abstraction	14	0	0	0	0	0
Inundation	10	0	0	0	0	0
Water quality	14	8	10	15	8	15
Flow modifications	13	12	6	6	10	8
Bed modifications	13	12	6	18	3	0
Channel modifications	13	15	4	15	10	0
Presence of exotic macrophytes	9	5	5	5	10	0
Presence of exotic fauna	8	0	0	0	0	0
Solid waste disposal	6	10	6	3	3	1
Total (100)	100	29.0	17.2	31.2	20.8	12.8
	Instream Habitat Integrity (%)	71	83	69	79	87
	Instream Habitat Integrity Class	C	B	C	B	B
Riparian Zone Criteria						
Water abstraction	13	0	0	0	0	0
Indundation	11	0	0	0	0	0
Water quality	13	0	0	18	0	0
Flow modifications	12	13	5	5	10	0
Channel modifications	12	15	0	15	15	0
Removal of indigenous vegetation	13	15	12	12	15	0
Exotic vegetation encroachment	12	12	15	8	15	5
Bank erosion	14	0	5	0	0	5
Total (100)	100	27.0	18.6	29.0	27.0	5.2
	Riparian Habitat Integrity (%)	73	81	71	73	95
	Riparian Habitat Integrity Class	C	B	C	C	A
	Total Integrity Score	72	82	70	76	91
	Total Integrity Class	C	B	C	C	A

(iv) Invertebrate Habitat Assessment

The integrity of the instream and riparian habitat has a direct influence on the integrity of the aquatic macroinvertebrate community. Evaluating the structure and functioning of an aquatic ecosystem must, therefore, take the integrity of the physical habitat of the system into account. An IHAS assessment could only be undertaken at sites ASP 09 and ASP 12, which had flowing water and the sampling of aquatic invertebrates could take place.

The results of the IHAS assessment conducted at Site ASP 09 and ASP 12 are provided in Table 3-5.

Table 3-5: IHAS results for each site

IHAS Biotopes Assessed	ASP 09	ASP 12
Stones in Current (SIC)	8	11
Vegetation (VEG)	5	5
Gravel, Sand & Mud (GSM)	5	12
Physical Stream Conditions	23	28
Biotope Score (%)	**7**	**22**
Total Habitat Score	**33**	**51**
Total IHAS	**41**	**56**
IHAS Class	**C**	**C**

The results from the IHAS indicated that Site ASP 09 and Site ASP 12 were both classified "inadequate" (Class C).

The water level and flow at both sites were very low, thus white water/riffle habitat was completely absent, resulting in a decreased SIC habitat score. Vegetation was also limited at both sites and consisted of roots at ASP 12 and a single species of grass at ASP 09.

The GSM biotype at ASP 09 was not accessible due to a thick layer of sludge that covered the stream bed and therefore provided a poor score for this biotype. At site ASP 12, the GSM biotype was dominated by mud and sand where gravel was absent.

The physical stream condition for both sites was scored relatively low because of the low water level and flow and impacts caused by surrounding agricultural practices of sugarcane.

Overall, the IHAS results indicated that there were severe limitations in the various biotopes for each site. Impacts on the prevalence and composition of the aquatic communities were therefore expected.

(v) Aquatic Macro-invertebrates

The sampling of aquatic macro-invertebrates was only undertaken at sites ASP 09 and ASP 12, due to the absence of flowing water at the other sites. The SASS5 and ASPT scores derived from the macro-invertebrate data are illustrated in Table 3-6.

Both sites were characterised by a low diversity of pollution tolerant species that have low sensitivity ratings. Only nine (9) different taxa were collected at site ASP 09 and 12 taxa at ASP 12.

The SASS5 results for both Sites ASP 09 and ASP 12 indicated that they are in a seriously modified ecological condition (Category E/F). These results are supported by the high number of perceived impacts from the IHI assessment, together with the outcomes of IHAS which indicated that there was inadequate habitat available for a thriving aquatic macro-invertebrate community. This is indicative of a loss of basic ecosystem function most likely due impacts from the surrounding agricultural practises and poor water quality (low flow and soot input from burnt sugar cane).

Table 3-6: SASS5 results for each site for sewer and powerline infrastructure

Taxon	Sensitivity	ASP 09	ASP 12
ANNELIDA			
Oligochaeta (Earthworms)	1	x	
CRUSTACEA			
Potamonautidae* (Crabs)	3	x	
EPHEMEROPTERA (Mayflies)			
Baetidae 1sp	4		x
ODONATA (Dragonflies & Damselflies)			
Synlestidae (Sylphs)	8		x
Coenagrionidae (Sprites and blues)	4	x	x
Gomphidae (Clubtails)	6	x	
Libellulidae (Darters/Skimmers)	4		x
HEMIPTERA (Bugs)			
Gerridae* (Pond skaters/Water striders)	5		x
TRICHOPTERA (Caddisflies)			
Hydropsychidae 1 sp	4		x
Leptoceridae	6	x	
COLEOPTERA (Beetles)			
Dytiscidae/Noteridae* (Diving beetles)	5		x
Gyrinidae* (Whirligig beetles)	5		x
DIPTERA (Flies)			
Ceratopogonidae (Biting midges)	5	x	x
Chironomidae (Midges)	2		x
Culicidae* (Mosquitoes)	1	x	x
Muscidae (House flies, Stable flies)	1	x	
Simuliidae (Blackflies)	5		x
Syrphidae (Rat-tailed maggots)	1	x	
	SASS	28	52
	Number of Taxa	9	12
	ASPT	3.1	4.3
	Class	E/F	E/F

3.1.7 Freshwater Environment

GIBB (Pty) Ltd undertook the Wetland/Riparian Delineation and Functional Assessment for the KZN ASP development, the proposed sewer line route and the proposed powerline routes. Refer to these studies in Appendix D13, D14 and D15 respectively. The study site is situated in

Illovo which places it in tertiary catchment U70 and quaternary catchments U70D which has an annual runoff of 11.9 million m^3 and comprises of an area of 208 km^2, and U70E, covering an area of 87 km^2, which forms a part of the uMsimbazi River and iLovu River Catchments. Freshwater wetlands were present on the site connected to the local drainage network leading to the Illovo and uMsimbazi estuaries.

As per the findings by Umgeni Water, the uMsimbazi and iLovu Rivers suffer from a turbidity problem as a result of improper farming practices and overgrazing occurring within the catchment, which has given rise to soil erosion. Additional problems affecting the catchment includes; high *E. Coli* levels within watercourses due to inadequate infrastructure of the surrounding informal settlements, as well as high phosphate levels which are attributed to over fertilisation of the agricultural lands.

A number of wetlands within 500m of the study site were not assessed due to there being no hydrological link to the development site. The systems have been transformed by extensive sugar cane cultivation and encroachment of alien invasive species.

(a) Proposed KZN ASP site

A wetland delineation (Figures 3-8 to 3-13) identified numerous wetlands within and 500m of the proposed site of the ASP and access options. Multiple Hydrogeomorphic (HGM) units were identified within the proposed site of development. HGM units are classified according to the National Wetland Classification System developed by SANBI (Ollis et al., 2013[13]). The HGM classification system uses the hydrological and geomorphological features of the delineated wetland unit to determine its classification.

Wetlands found on site included the numerous seeps, three channelled valley bottoms, an unchannelled valley bottom and two riparian areas. The total area of all wetlands encompassing the site of the proposed development is approximately 117.4ha. Due to the extensive number of wetlands identified within the site, HGM units were grouped into process units for assessment purposes. These process units were separated according to HGM unit classification, the soil type (clay or sandy), the slope (gentle or steep) and the extent of drainage within the wetland. **Error! Reference source not found.** below is a list of all wetlands identified within the KZN ASP site and their process unit classification.

Table 3-7: Process unit classification of the Proposed ASP development

HGM UNIT ID	PROCESS UNIT	HGM CLASSIFICATION	GPS LOCATION	AREA (ha)
U70E-C1-RZ1	RZ	Riparian	30° 7'19.95"S 30°50'15.51"E	0.160
U70E-C1-RZ2	RZ		30° 7'8.86"S 30°50'23.44"E	0.030
U70E-C2-RZ1	RZ		30° 7'24.60"S 30°50'6.20"E	0.020
U70E-C2-RZ3a	RZ		30° 7'3.53"S 30°50'4.25"E	0.510
U70E-C2-RZ3b	RZ		30° 7'0.45"S 30°50'5.09"E	0.050

[13] Ollis, D., Snaddon, K., Job. N. and Mbona. N. 2013. Classification system for wetland and other aquatic ecosystems in South Africa. User manual: inland systems. SANBI biodiversity series 22. SANBI Pretoria.

HGM UNIT ID	PROCESS UNIT	HGM CLASSIFICATION	GPS LOCATION	AREA (ha)
U70D-C3-RZ1	RZ		30° 6'26.92"S 30°50'12.14"E	0.090
U70D-C3-RZ2a	RZ		30° 6'35.67"S 30°50'9.14"E	0.020
U70D-C3-RZ2b	RZ		30° 6'35.09"S 30°50'7.22"E	0.010
U70E-C4-RZ1a	RZ		30° 7'12.49"S 30°49'50.02"E	0.100
U70E-C4-RZ1b	RZ		30° 7'14.61"S 30°49'42.52"E	0.090
U70E-C4-RZ1c	RZ		30° 7'5.97"S 30°49'52.09"E	0.150
U70E-C5-RZ1	RZ		30° 7'7.82"S 30°49'24.12"E	0.380
U70D-C1-UCVB1	UCVB	UCVB	30° 6'44.47"S 30°50'40.44"E	2.770
U70E-C1-UCVB1	UCVB		30° 7'13.46"S 30°50'19.68"E	0.500
U70E-C4-UCVB1	UCVB		30° 6'56.38"S 30°49'49.90"E	0.380
U70E-C4-UCVB2	UCVB		30° 6'50.44"S 30°49'53.14"E	0.290
U70D-C4-UCVB	UCVB		30° 6'21.78"S 30°49'53.92"E	56.600
U70E-C6-UCVB	UCVB		30° 7'29.90"S 30°49'47.74"E	21.100
U70E-C1-CVB1b	CVB1	CVB	30° 7'18.79"S 30°50'16.54"E	0.050
U70E-C5-CVB1	CVB4		30° 7'21.17"S 30°49'42.42"E	1.620
U70E-C1-CVB1a	CVB1		30° 7'17.76"S 30°50'16.62"E	0.260
U70E-C2-CVB1	CVB1		30° 7'22.77"S 30°50'5.94"E	0.110
U70E-C5-CVB2	CVB2		30° 7'16.20"S 30°49'37.73"E	0.170
U70D-C3-CVB2	CVB3		30° 6'24.86"S 30°50'13.32"E	0.250
U70E-C2-CVB3	CVB3		30° 7'19.15"S 30°50'4.10"E	0.200
U70D-C3-CVB3	CVB2		30° 6'34.08"S 30°50'8.14"E	0.090
U70E-C4-CVB5a	CVB5		30° 7'5.42"S 30°49'44.70"E	0.970
U70E-C4-CVB5b	CVB5		30° 6'40.82"S 30°49'53.42"E	1.270
U70E-C5-CVB7a	CVB7		30° 7'5.66"S 30°49'24.11"E	0.240
U70E-C5-CVB7b	CVB7		30° 6'59.83"S 30°49'23.35"E	0.310
U70E-C5-CVB7c	CVB7		30° 6'53.86"S 30°49'22.47"E	0.120
U70E-C5-CVB7d	CVB7		30° 6'44.61"S 30°49'25.37"E	0.580
U70E-C4-CVB8	CVB8		30° 6'45.58"S 30°49'54.93"E	0.140
U70D-C3-S1a	S1	SEEP	30° 6'37.01"S 30°50'4.49"E	0.140
U70D-C2-S1	S1		30° 6'29.86"S 30°50'24.92"E	1.880
U70D-C3-S1b	S1		30° 6'37.80"S 30°50'11.05"E	0.030
U70E-C1_S2	S2		30° 7'21.29"S 30°50'14.82"E	0.030
U70E-C1-S3a	S3		30° 7'16.62"S 30°50'11.48"E	0.110
U70D-C1-S3a	S3		30° 6'53.56"S 30°50'27.88"E	0.200
U70E-C1-S3b	S3		30° 7'11.71"S 30°50'14.12"E	0.640
U70D-C1-S3b	S3		30° 6'41.57"S 30°50'35.74"E	0.210
U70E-C1-S3c	S3		30° 7'4.96"S 30°50'19.36"E	0.760
U70D-C1-S3c	S3		30° 6'30.76"S 30°50'43.38"E	0.160
U70E-C1-S3d	S3		30° 7'15.18"S 30°50'17.47"E	0.040
U70E-C1-S3e	S3		30° 7'18.17"S 30°50'15.18"E	0.010
U70E-C1-S3f	S3		30° 7'24.84"S 30°50'11.77"E	0.230

HGM UNIT ID	PROCESS UNIT	HGM CLASSIFICATION	GPS LOCATION	AREA (ha)
U70E-C1-S3g	S3		30° 7'24.51"S 30°50'13.35"E	0.160
U70E-C2-S3a	S3		30° 7'5.77"S 30°50'0.43"E	0.280
U70E-C2-S3b	S3		30° 7'3.61"S 30°50'2.46"E	0.110
U70E-C2-S3c	S3		30° 6'59.33"S 30°50'4.25"E	0.220
U70E-C2-S4	S4		30° 6'56.62"S 30°50'7.47"E	1.600
U70D-C1-S4a	S4		30° 6'46.55"S 30°50'19.28"E	5.390
U70D-C1-S4b	S4		30° 6'36.01"S 30°50'36.61"E	1.380
U70E-C4-S5b	S5		30° 6'57.74"S 30°49'47.64"E	0.001
U70E-C4-S5c	S5		30° 6'56.84"S 30°49'48.93"E	0.010
U70E-C4-S5a	S5		30° 6'58.12"S 30°49'46.14"E	0.030
U70E-C4-S7f	S7		30° 6'38.95"S 30°49'56.61"E	0.210
U70E-C5-S7i	S7		30° 6'41.90"S 30°49'28.02"E	0.700
U70E-C5-S7h	S7		30° 6'40.76"S 30°49'26.99"E	0.300
U70E-C5-S7d	S7		30° 6'59.33"S 30°49'23.00"E	0.220
U70E-C5-S7g	S7		30° 6'51.55"S 30°49'21.64"E	0.010
U70E-C5-S7e	S7		30° 6'53.94"S 30°49'22.05"E	0.150
U70E-C5-S7a	S7		30° 7'5.45"S 30°49'23.92"E	0.220
U70E-C3-S7	S7		30° 7'19.31"S 30°49'53.33"E	1.640
U70E-C5-S7b	S7		30° 7'4.89"S 30°49'27.08"E	0.330
U70E-C5-S7c	S7		30° 7'0.24"S 30°49'30.60"E	1.370
U70E-C5-S7f	S7		30° 6'51.56"S 30°49'31.48"E	3.790
U70E-C4-S7a	S7		30° 6'59.77"S 30°49'53.21"E	0.480
U70E-C4-S7d	S7		30° 6'48.33"S 30°49'58.16"E	0.810
U70E-C4-S7c	S7		30° 6'49.30"S 30°49'49.80"E	1.170
U70E-C4-S7b	S7		30° 6'53.80"S 30°49'56.13"E	0.520
U70E-C4-S7e	S7		30° 6'42.57"S 30°49'59.97"E	0.540
U70E-C5-S7j	S7		30° 6'37.04"S 30°49'35.38"E	1.690

- RZ – Riparian zone.
- UCVB – Valley bottom without a channel.
- CVB1 – Valley bottom with a channel, steep slopes, sandy soils and partial drainage.
- CVB2 - Valley bottom with a channel, steep slopes, sandy soils and extensive drainage.
- CVB3 - Valley bottom with a channel, moderate slopes, sandy soils and partial drainage.
- CVB5 - Valley bottom with a channel, steep slopes, clay soils and partial drainage.
- CVB7 - Valley bottom with a channel, moderate slopes, clay soils and partial drainage.
- CVB8 - Valley bottom with a channel, moderate slopes, clay soils and extensive drainage.
- S1 – seep, steep slopes, sandy soils and partial drainage.
- S2 - seep, steep slopes, sandy soils and extensive drainage.
- S3 - seep, moderate slopes, sandy soils and partial drainage.
- S4 - seep, moderate slopes, sandy soils and extensive drainage.
- S5 - seep, steep slopes, clay soils and partial drainage.
- S7 – seep, moderate slopes, clay soils and partial drainage.

Hundred and seventeen point four hectares (117.4ha) of wetland area was found to be at risk within the site which was made up of seeps, valley bottoms and riparian systems. The overall health of all the units with the exception of UCVB 1 and CVB 5 were determined to be largely modified. UCVB 1 and CVB 3 were evaluated to be moderately modified where a moderate change in the ecosystem processes and the loss of natural habitats has taken place but the natural habitat remains predominantly intact. Below is a summary of the assessment findings (
Table 3-8).

Table 3-8: Summary of wetland process unit functionality for the proposed ASP Development

PROCESS UNIT	PES	EIS	PRIMARY ECOSERVICE	RMO
S1	E – Very Largely Modified	Low	Cultivated foods	Maintain
S2	E – Very Largely Modified	Low	Cultivated foods	Maintain
S3	E – Very Largely Modified	Low	Cultivated foods	Maintain
S4	E – Very Largely Modified	Low	Cultivated foods	Maintain
S5	D – Largely Modified	Low	Cultivated foods	Maintain
S7	E – Very Largely Modified	Low	Cultivated foods	Maintain
CVB 1	E – Very Largely Modified	Moderate	Cultivated foods	Maintain
CVB 2	C – Moderately Modified	Moderate	Cultivated foods	Maintain
CVB 3	D – Largely Modified	Moderate	Stream flow regulation	Maintain
CVB 5	C – Moderately Modified	Moderate	Cultivated foods	Maintain
CVB 7	C – Moderately Modified	Moderate	Cultivated foods	Maintain
CVB 8	D – Largely Modified	Moderate	Cultivated foods	Maintain
UCVB 1	C – Moderately Modified	Moderate	Stream flow regulation	Maintain
Riparian	E – Very Largely Modified	Low	N/A	Maintain

Refer to the delineation of the wetlands on the KZN ASP site, access Option 1, 1c, 1d and 3b in Figures 3-8 to 3-13.

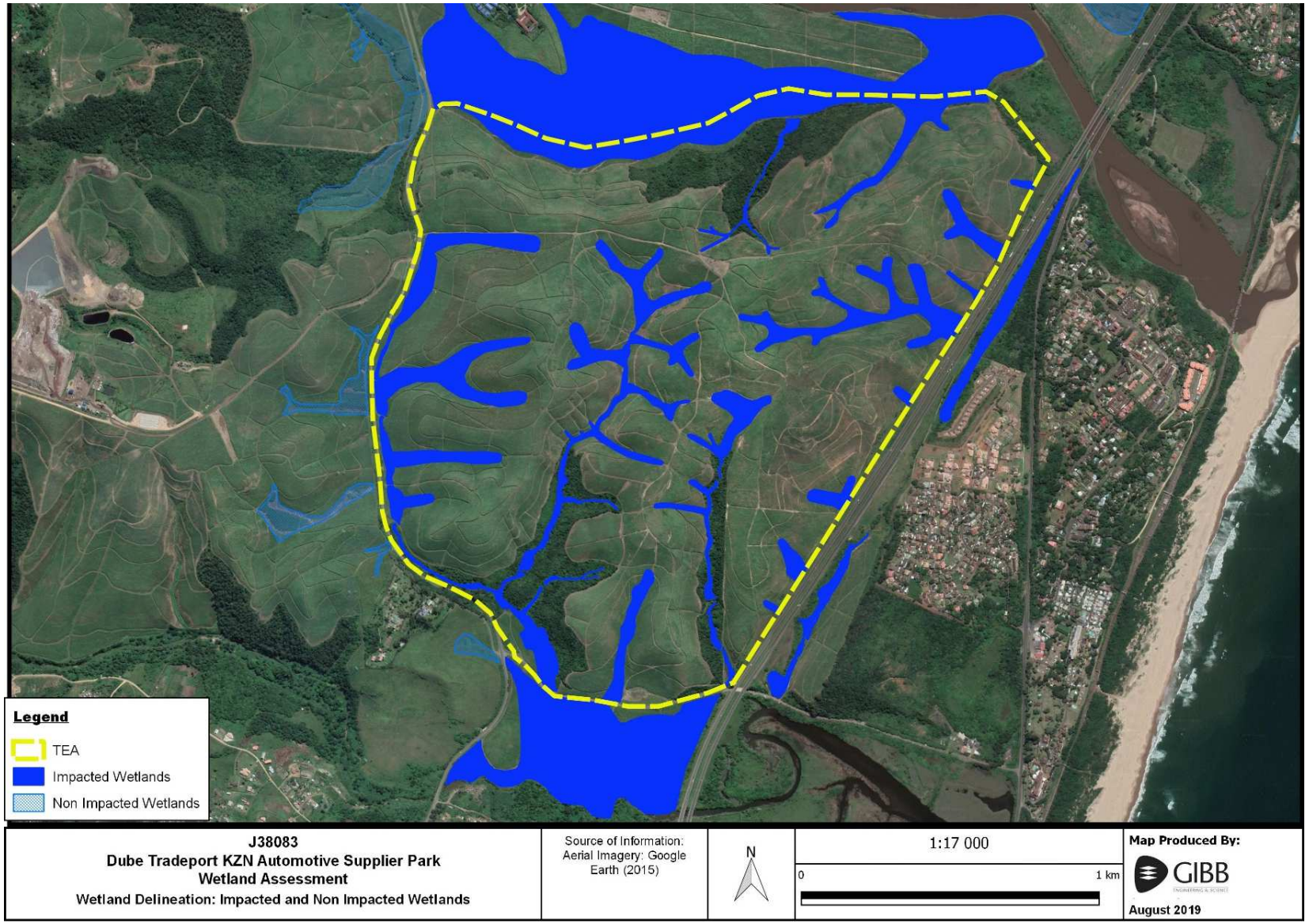


Figure 3-8: KZN ASP wetland delineation

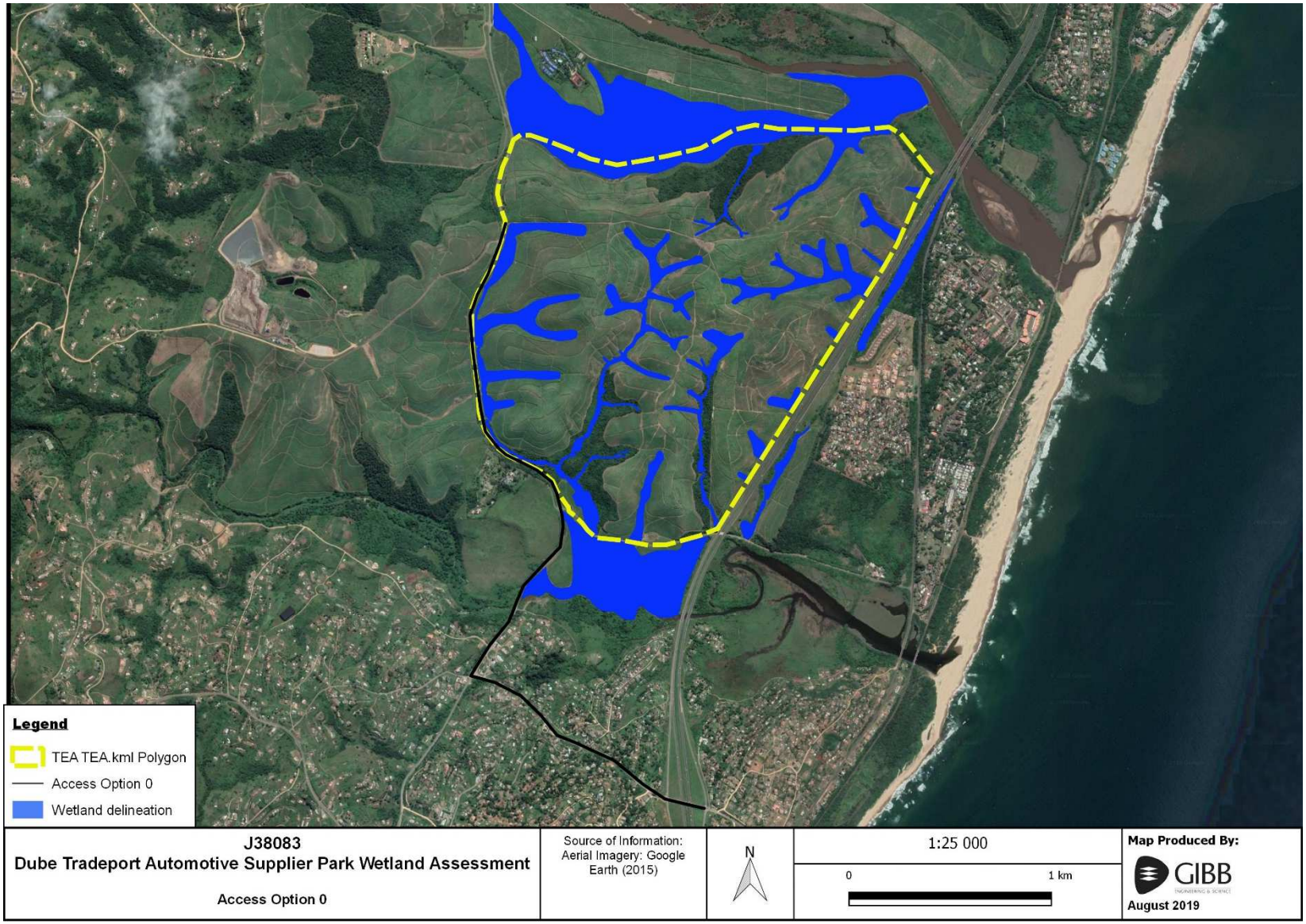


Figure 3-9: Wetland delineation with Access Option 0

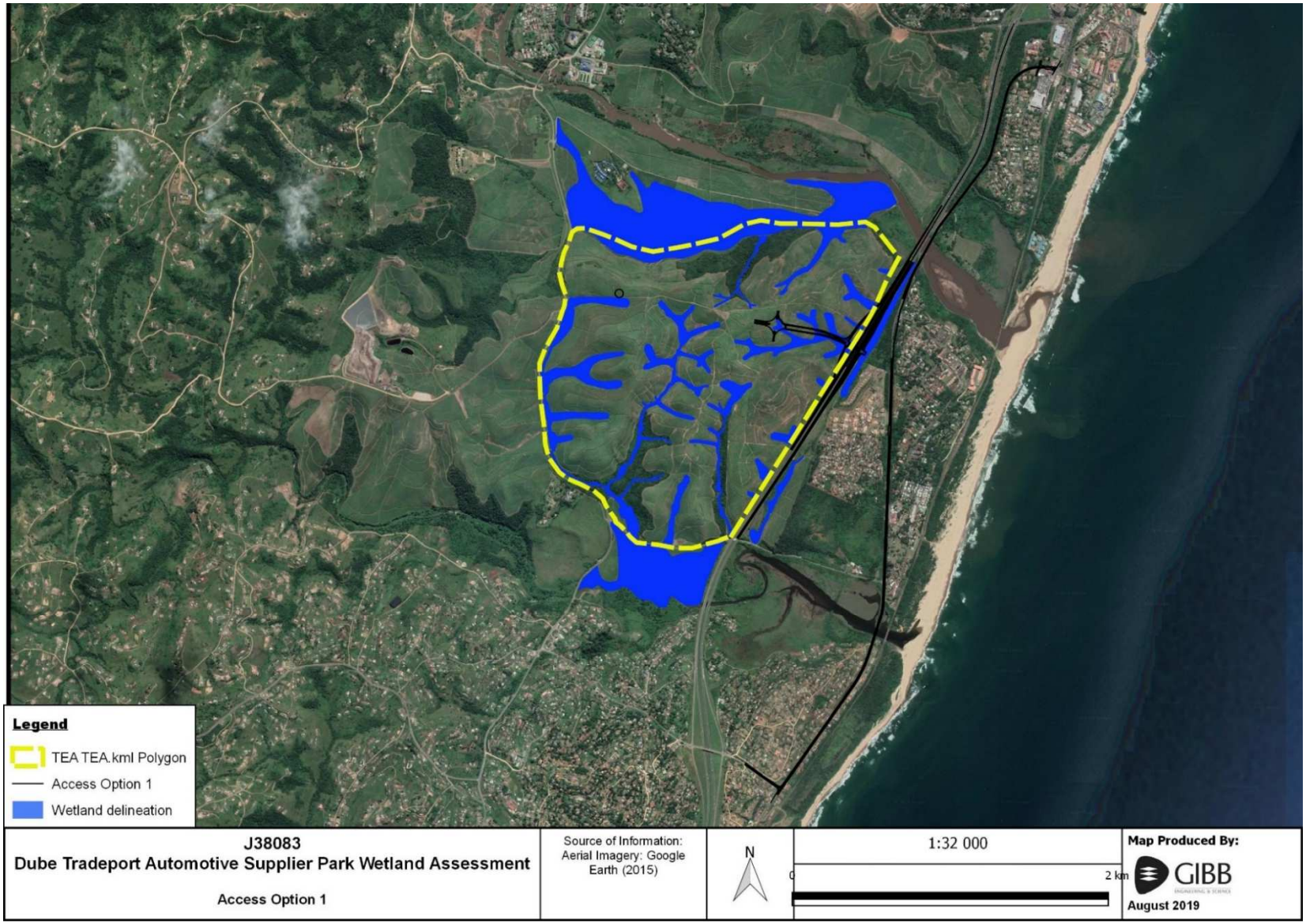


Figure 3-10: Wetland delineation with Access Option 1

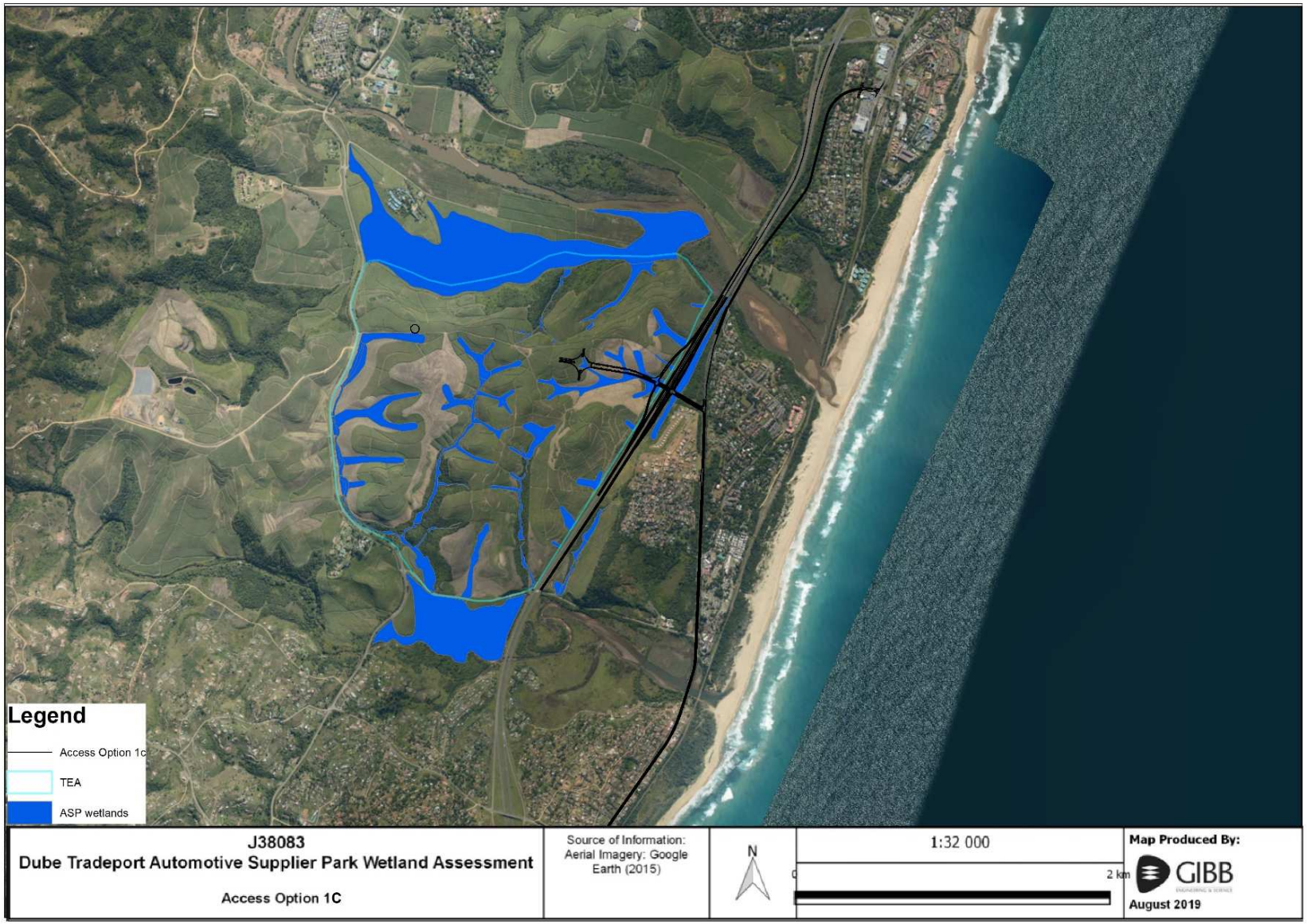


Figure 3-11: Wetland delineation with Access Option 1c

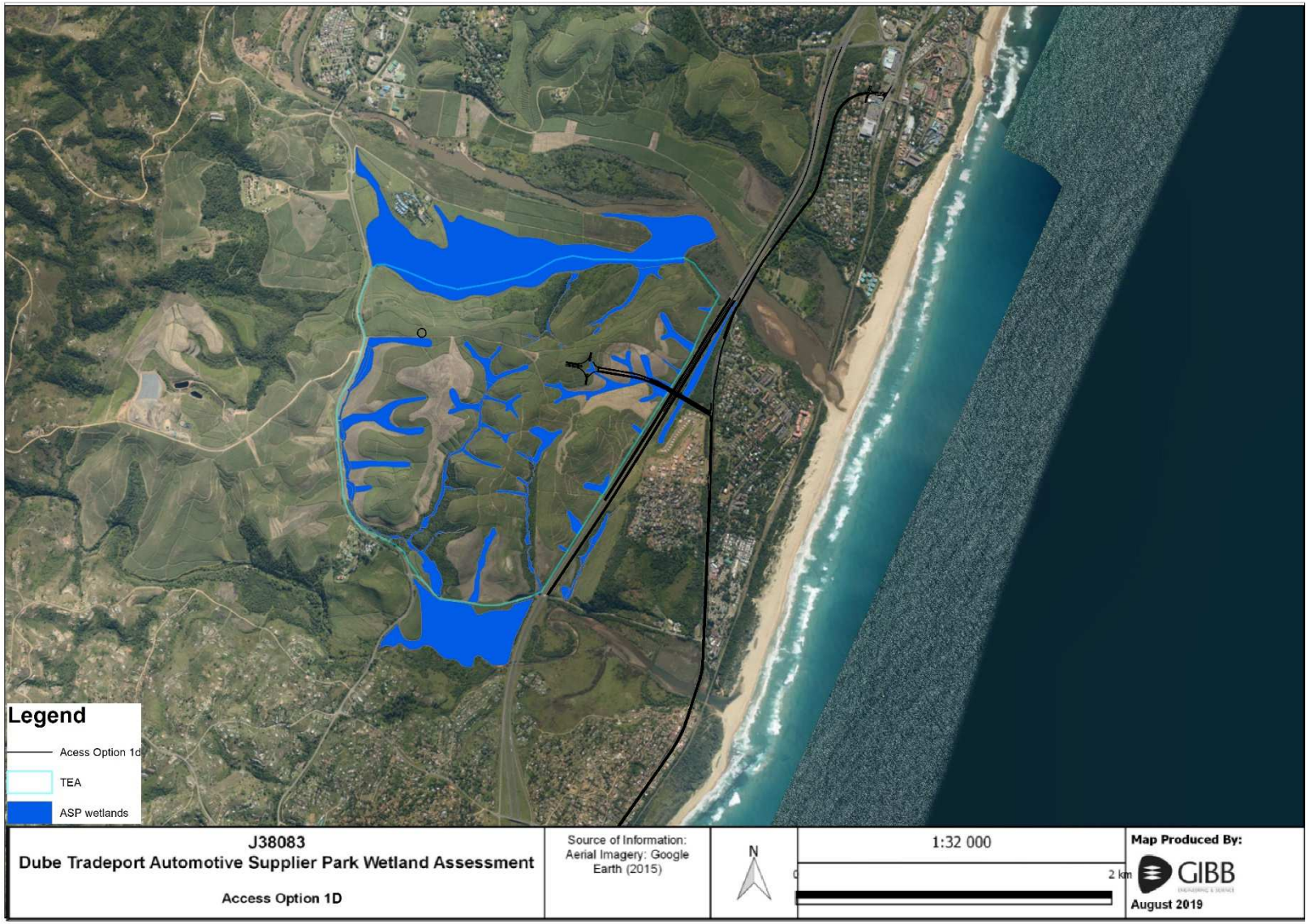


Figure 3-12: Wetland delineation with Access Option 1d

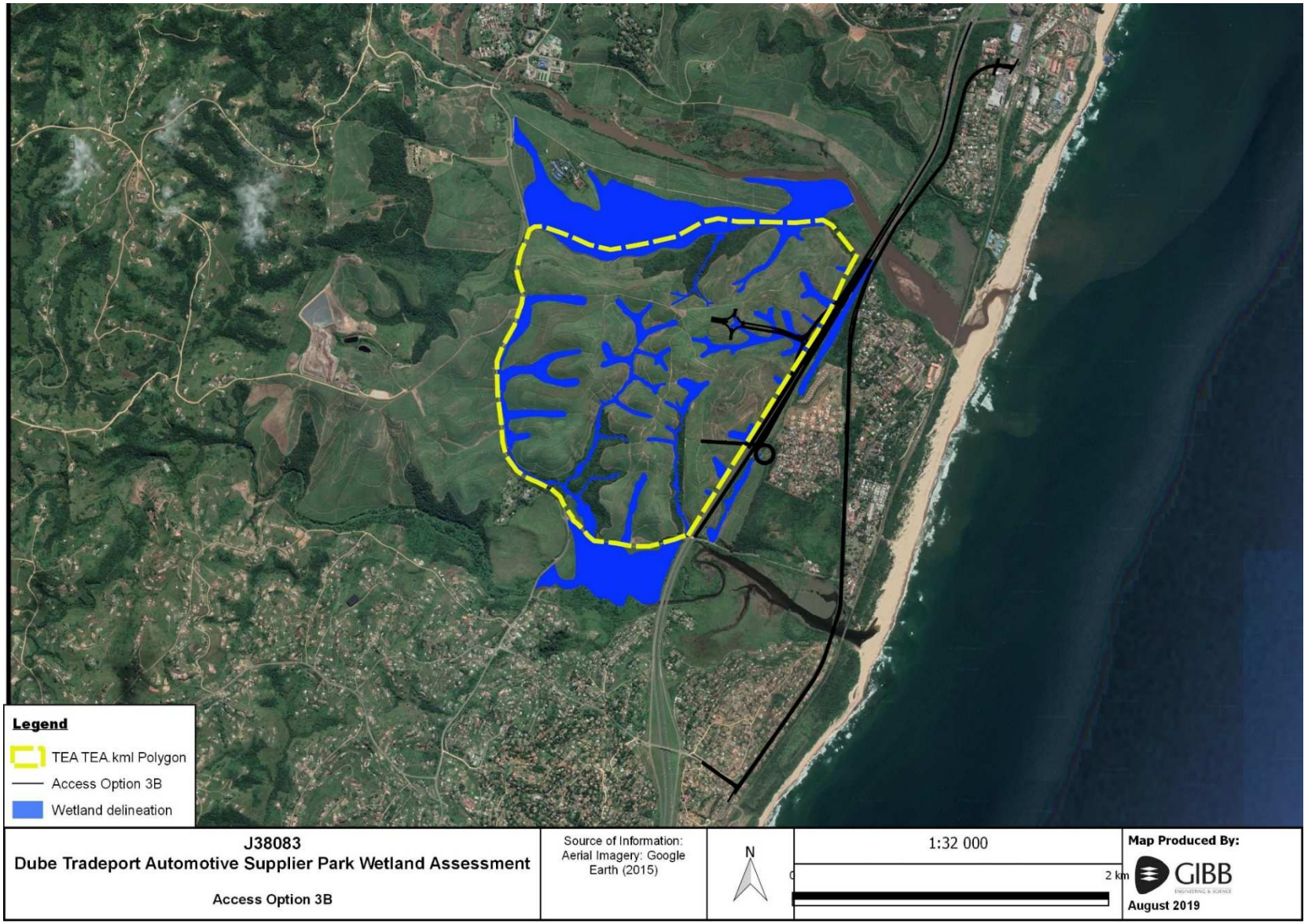


Figure 3-13: Wetland delineation with Access Option 3b

(b) Proposed sewer line

A final wetland delineation (Figure 3-14) identified numerous wetlands within and 500m of the proposed site of the ASP sewer line. Wetlands found on site included the numerous seeps, three channelled valley bottoms, and unchannelled valley bottoms. The total area of all wetlands encompassing the site of the proposed development is approximately 98.40ha (Table 3-9).

Table 3-9: Process unit classification of the Proposed Sewer line development

HGM UNIT ID	PROCESS UNIT	HGM CLASSIFICATION	GPS LOCATION	AREA (ha)
U70E-C5-CVB2	CVB2	CVB	30° 7'16.15"S 30°49'37.97"E	0.170
U70D-C4-CVB5	CVB5		30° 6'14.00"S 30°49'19.07"E	2.990
U70E-C5-CVB1	CVB1		30° 7'21.11"S 30°49'42.49"E	1.620
U70D-C4-CVB7	CVB7		30° 6'29.80"S 30°49'21.02"E	4.090
U70E-C5-CVB7d			30° 6'41.74"S 30°49'27.33"E	0.580
U70E-C5-CVB7b			30° 6'59.42"S 30°49'23.48"E	0.310
U70D-C5-S4	S4	SEEP	30° 5'55.12"S 30°49'22.03"E	0.340
U70D-C9-S5a	S5		30° 5'20.64"S 30°49'56.75"E	0.300
U70D-C9-S5b			30° 5'4.84"S 30°50'26.83"E	0.140
U70D-C9-S7a	S7		30° 5'20.45"S 30°50'13.99"E	0.760
U70D-C9-S7b			30° 5'12.20"S 30°50'22.17"E	0.680
U70E-C3-S7			30° 7'20.19"S 30°49'53.27"E	1.640
U70E-C5-S7a			30° 7'5.23"S 30°49'23.91"E	0.220
U70E-C5-S7e			30° 6'54.44"S 30°49'22.31"E	0.150
U70E-C5-S7d			30° 6'59.52"S 30°49'22.78"E	0.220
U70D-C9-UCVB1a	C9-UCVB1a	UCVB	30° 5'18.45"S 30°49'45.91"E	0.680
U70D-C9-UCVB1b	C9-UCVB1b		30° 5'11.10"S 30°50'16.39"E	1.380
U70E-C6-UCVB	C6-UCVB1		30° 7'29.90"S 30°49'47.74"E	21.100
U70D-C4-UCVB	C4-UCVB1		30° 6'21.78"S 30°49'53.92"E	56.600
U70D-C6-UCVB1a	C6-UCVB1a		30° 5'43.32"S 30°49'37.43"E	1.950
U70D-C6-UCVB1c	C6-UCVB1b		30° 5'37.34"S 30°49'36.70"E	0.180
U70D-C6-UCVB1c	C6-UCVB1c		30° 5'28.32"S 30°49'49.59"E	1.240
U70D-C9-UCVB1a	C9-UCVB1a		30° 5'17.53"S 30°49'51.08"E	0.680

- CVB1 – valley bottom with a channel, sandy/ sandy loam soils, steep slope and partial drainage.
- CVB5 – valley bottom with a channel, clay soils, steep slope and partial drainage.
- CVB7 – valley bottom with a channel, clay soils, moderate slope and partial drainage.
- S4 – seep, sandy/ sandy loam soils, moderate slope and extensive drainage.
- S5 – seep, clay soils, steep slope and partial drainage.
- S7 – seep, clay soils, moderate slope and partial drainage.
- UCVB – valley bottom with no channel.

Most wetlands associated with the study area were considered to be in a Poor (D category) to Seriously Modified (E category) in terms of PES. Only two wetlands were considered to be in a Moderate/Fair condition (C category PES). The major impact affecting these wetlands included the practice of sugar cane farming which has led to the transformation of these systems. The state and functionality of these wetlands are summarised in Table 3-10 below.

Table 3-10: Summary of wetland process unit functionality for the proposed sewer line Development

PROCESS UNIT	PES	EIS	PRIMARY ECOSERVICE	RMO
U70E-C5-CVB2	C – Moderate	Moderate	Cultivated foods	Maintain
U70D-C4-CVB5	D – Large	Low	Cultivated foods	Maintain
U70D-C4-CVB7	D – Large	Low	Cultivated foods	Maintain
U70E-C5-CVB7	C – Moderate	Moderate	Cultivated foods	Maintain
U70D-C5-S4	E – Very large	Low	Cultivated foods	Maintain
U70D-C9-S5a	D – Large	Low	Cultivated foods Food for livestock	Maintain
U70D-C9-S5b	E – Very large	Low	Cultivated foods Food for livestock	Maintain
U70D-C9-S7a	C – Moderate	Low	Erosion control Carbon Storage	Maintain
U70D-C9-S7b	C – Moderate	Low	Erosion control Carbon Storage	Maintain
U70E-S7	E – Very large	Low	Cultivated foods	Maintain
U70D-C4-UCVB1	E – Very large	Moderate	Cultivated foods	Maintain
U70E-C6-UCVB1	D – Large	Moderate	Cultivated foods Food for livestock	Maintain
U70D-C6-UCVB1a	D – Large	Low	Streamflow regulation	Maintain
U70D-C6-UCVB1c	D – Large	Low	Cultivated foods	Maintain
U70D-C9-UCVB1	E – Very large	Low	Cultivated foods Carbon Storage	Maintain

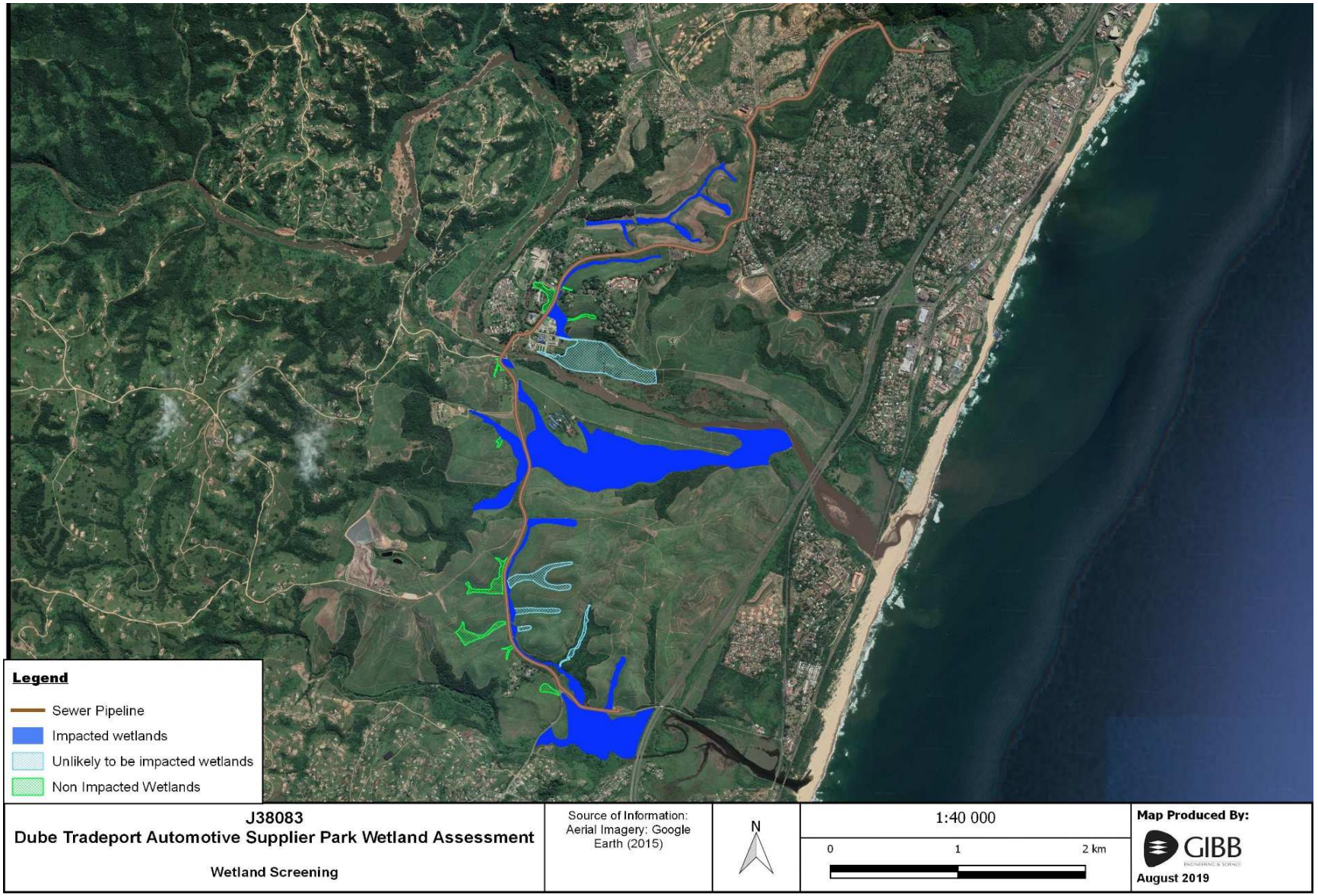


Figure 3-14: Wetland delineation of the proposed sewer line development

(c) Proposed powerline

A final wetland delineation (Figure 3-15) identified numerous wetlands within and 500m of the proposed site of the ASP powerline line. Multiple HGM units were identified within the proposed site of development. Wetlands found on site included the numerous seeps, three channelled valley bottoms, and unchannelled valley bottoms. The total area of all wetlands encompassing the site of the proposed development is approximately 83.58ha (Table 3-11).

Table 3-11: Process unit classification of the Proposed Powerline development

HGM UNIT ID	PROCESS UNIT	HGM CLASSIFICATION	GPS LOCATION	AREA (ha)
U70E-C4-CVB5b	CVB5	CVB	30° 6'40.65"S 30°49'53.84"E	1.270
U70D-C4-CVB5	CVB5		30° 6'14.47"S 30°49'22.25"E	2.990
U70D-C4-CVB7	CVB7		30° 6'30.80"S 30°49'19.60"E	4.090
U70D-C4-UCVB	C4-UCVB1	UCVB	30° 6'21.78"S 30°49'53.92"E	56.600
U70D-C6-UCVB1b	C6-UCVB1b		30° 5'55.17"S 30°49'47.06"E	14.100
U70D-C7-UCVB1	C7-UCVB1		30° 5'52.00"S 30°50'3.79"E	2.360
U70D-C8-S1	S1	SEEP	30° 5'49.92"S 30°50'20.73"E	0.270
U70E-C5-S7j	S7		30° 6'36.53"S 30°49'34.84"E	1.690
U70E-C4-S7f	S7		30° 6'39.08"S 30°49'56.57"E	0.210

- CVB5 – valley bottom with a channel, clay soils, steep slope and partial drainage.
- CVB7 – valley bottom with a channel, clay soils, moderate slope and partial drainage.
- S1 – seep, sandy soils, steep, partial drainage
- S7 – seep, clay soils, moderate slope and partial drainage.
- UCVB – valley bottom with no channel.

Most wetlands associated with the study area were considered to be in a Seriously Modified (E category) in terms of PES. Only two wetlands were considered to be in a Largely Modified state (D PES) and one Moderate/Fair condition system (C category PES). The major impact affecting these wetlands included the practice of sugar cane farming which has led to the transformation of these systems. The state and functionality of these wetlands are summarised in Table 3-12.

Table 3-12: Summary of wetland process unit functionality for the proposed Powerline Development

PROCESS UNIT	PES	EIS	PRIMARY ECOSERVICE	RMO
U70D-C4-CVB5	D- Large	Low	Cultivated foods	Maintain
U70E-C4-CVB5	C - Moderate	Moderate	Cultivated foods	Maintain
U70D-C4-CVB7	D- Large	Low	Cultivated foods	Maintain
U70D-C8-S1	D – Large	Low	Cultivated foods Food for livestock	Maintain
U70E-C5-S7	E – Very large	Low	Cultivated foods	Maintain
U70D-C4-UCVB1	E – Very large	Moderate	Cultivated foods	Maintain
U70D-C6-UCVB1b	E – Very large	Low	Cultivated foods Food for livestock	Maintain
U70D-C7-UCVB1	C - Moderate	Low	Erosion control Carbon Storage	Maintain

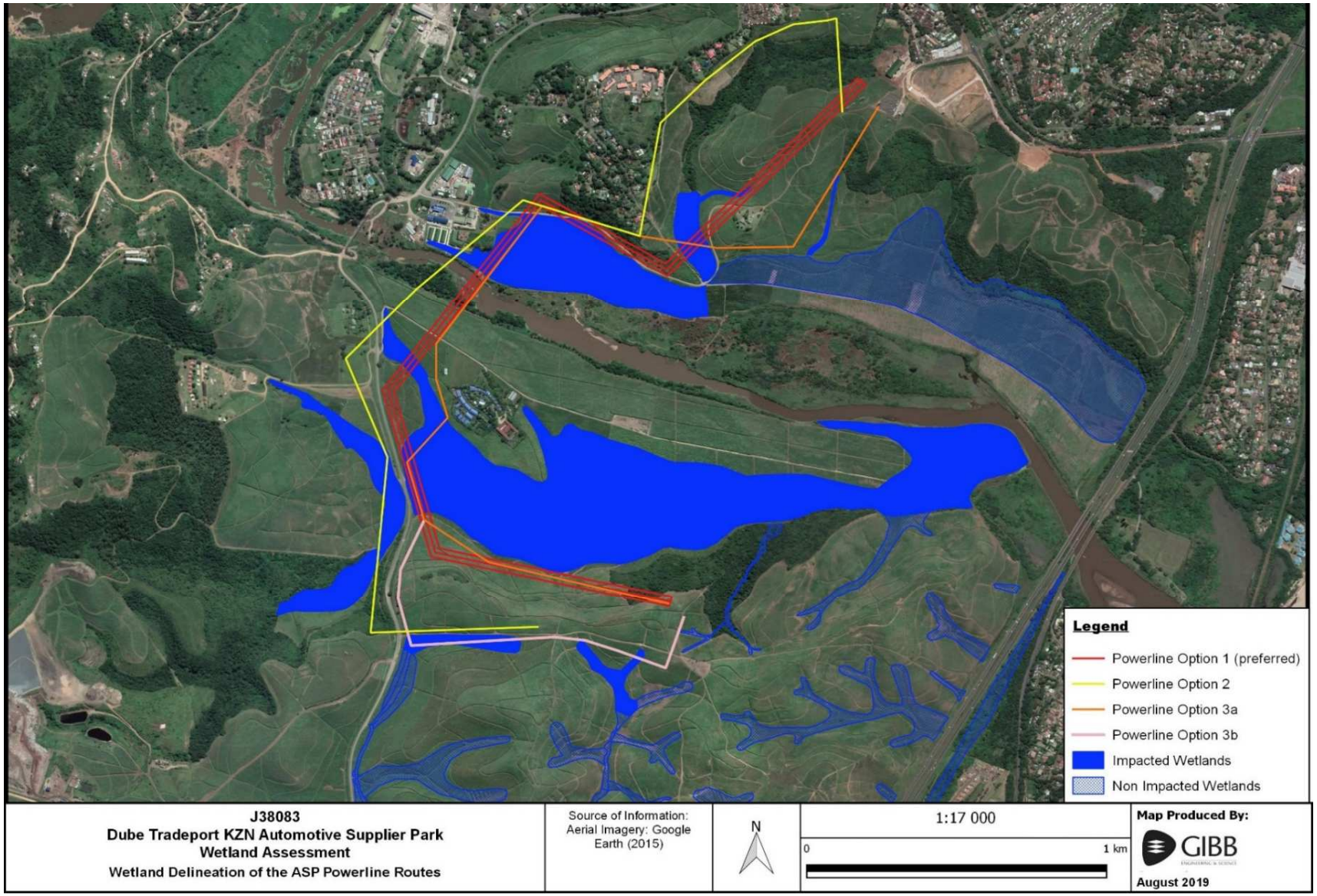


Figure 3-15: Wetland delineation of the proposed powerline development

3.1.8 Estuarine Environment

An Estuarine Assesssment was undertaken by MER for the proposed KZN ASP development as this site is bordered by the iLovu Estuary at the North and the uMsimbazi Estuary in the South (refer to Appendix D16). This study was conducted so as to establish the current stutus/condition of the estuaries, current disturbances (if any) and also any risks/impacts that may be associated with the proposed development whilst proposing possible mitigations and recommendations significant for restoration. The study was conducted at a detailed desktop level and no biological sampling nor site visits were conducted.

The Subtropical region has been determined in the recent NBA to have the second highest number of estuaries in a degraded state, mainly due to pollution, very high fishing pressure (illegal gillnetting), direct habitat loss, sand mining, and intensive sugar cane farming in the catchments and estuary functional zone (SANBI 2019). This makes the regional importance, of the iLovu and the uMsimbazi, as two well-functioning and healthy estuaries extremely high. This section details the features and characteristics of both estuaries which are a result of the analysis of the estuaries and which are pertinent to the impact assessment.

(a) Current Status of the iLovu and uMsimbazi Estuaries

KZN has a relatively straight, northeast trending coastline, divided into gentle bays by short, low headlands or rocky outcrops. The warm waters of the Indian Ocean, with the strong Agulhas Current flowing in a south-westerly direction, transporting warm water along the KZN coast influencing climate and biodiversity. In this context the estuaries are important sheltered environments on the KZN coast providing habitat not easily replicated along the open coastline. Estuaries are “super” ecosystems. Although they comprise less than 2% of South Africa’s territory, these highly productive ecosystems contribute R4.2 billion per annum to the South African economy (NBA 2018). The estuaries along the KZN coast number 75 and have been heavily impacted by agricultural and urban activities. These habitats are significantly degraded through freshwater reduction, habitat destruction, nutrient pollution and overexploitation of living resources, which affects related ecosystem services (e.g. nursery function). This reduces the capacity of estuaries to buffer the effects of change, albeit natural or anthropogenic.

The iLovu and uMsimbazi estuaries are both classified as Intermittently Open Estuaries. This is the most numerous category of estuaries in KwaZulu-Natal. However, although numerous, the estuaries in this category vary greatly in size, character and function. The iLovu and uMsimbazi are no exception with the iLovu tending to be a predominantly open system while the uMsimbazi is more predominantly closed. This has significant effects on the nature and characteristics of these two systems making them distinct and different from one another.

(i) Present Ecological State, Threat Status and Recommended Ecological Category for both estuaries

At a local level within the eThekwini municipality the present ecological state (PES) of these estuaries elevates their importance as they sit in sequence of estuaries in a degraded state. The health of individual estuaries matters as it contributes to the overall resilience of the network of estuaries along a section of coast. Aggregating estuary condition in 100 km sections of the coast provides a measure of how connectivity between estuaries is declining as it visually represents sections of the coast where estuarine abiotic and biotic processes are suboptimal for coast-wise

connectivity, e.g. recruitment, flood recovery, and genetic exchange. This is significant as the latest National Biodiversity Assessment (SANBI 2019) has assessed that a 300 km functional gap in the network of estuaries in the Subtropical region exists, as a result of the poor state of health of estuaries along this stretch of coastline. In many cases, the gaps seem to be driven by the ongoing degradation of small estuaries which are perceived by resource managers to be insignificant and of low value. Therefore any estuaries within this section of the coast with a reasonable health score become significant even at a regional level.

(i).1 Present Ecological State (PES)

The PES of the iLovu estuary is a C/D indicating that this estuary is on a trajectory from a C category estuary which is 'Moderately modified' to a D category or 'Heavily modified' estuary. The PES of the uMsimbazi is a B/C indicating that this important estuary is also on a negative trajectory from a B categorisation of 'Natural' to 'Near Natural' ecological condition to a C or 'Moderately Modified' estuary.

(i).2 Threat Status

An ecosystem that has been classified as Critically Endangered, Endangered or Vulnerable, based on an analysis of ecosystem threat status is one which has lost, or is losing, vital aspects of its structure, function or composition. The degrading nature of these two estuaries in an area of the coast where many of the adjacent estuaries have a PES in a D to E and even F category, reinforces their threat status as a Vulnerable (uMsimbazi) and Endangered (iLovu) system. This means that these estuaries are now at a point where there is a high risk of collapse with further pressures, impacts or degradation.

This threat status underpins both the analysis and recommendations of this assessment. This is important as Vulnerable ecosystem is one that has the majority of their original extent (measured as area, length or volume) left in natural or near-natural condition but have experienced some loss of habitat or deterioration in condition. These ecosystem types are likely to have lost some of their structure and functioning and will be further compromised if they continue to lose natural habitat or deteriorate in condition. Identified biodiversity priority areas should guide planning, resource management and decision making in these ecosystems types

(i).3 Recommended Escological Category and Target Ecological Catgory

The recommended ecological category (REC) for the iLovu and uMsimbazi estuaries based on their estuarine functional importance, PES and threat status is a C and B, respectively (SANBI 2019). The Target Ecological Category (TEC) has also recently been gazetted as part of the uMvoti to uMsimkulu WMA Study making it an requirement to ensure that not only are impacting activities prevented from causing degradation of the estuary from the TEC but in fact there is an imperative to restore function

(ii) Delineation and buffer recommendations for both estuaries

In South Africa, the Estuarine Functional Zone (EFZ) is the tool used to delineate the dynamic estuary space. Thus it is an area that not only includes the main estuary channel, but also the areas which at times are shallow margins to the estuary and support physical and biological processes and habitats necessary for estuarine function and health. It includes all dynamic areas influenced by long-term estuarine sedimentary processes, i.e. sediment stored or eroded during

floods, changes in channel configuration, aeolian transport processes, and changes due to coastal storms (van Niekerk 2019). Spatial delineation of the EFZ is standardised and captures the natural, historical estuary and should not be confused with setback/management lines that often exclude developed areas. The EFZ purpose is to identify the 'space' in which estuarine physical and biological functions take place over long timescales (>decades). Development within the EFZ is captured as an aspect of habitat degradation or decline in overall estuary condition (SANBI 2019).

The delineation of both estuaries has very recently been updated (SANBI 2019) and these layers have been used to inform this study. This delineation includes a protective buffer to the estuary as this more recent delineation has been expanded to include estuarine habitats omitted from the previous NBA. Using this new delineation not only delineates the estuary but provides a buffer which has the following advantages:

- It brings the most dynamic areas influenced by long-term estuarine sedimentary processes into the estuary boundary i.e. sediment stored or eroded during floods, mouth dynamics, changes in channel configuration, aeolian transport processes, and changes due to coastal storms.
- It allows space for the natural variability that is part of these ecosystems on longer time scales providing space for key physical processes that influence biodiversity.
- Both these estuaries fall into the intermittently open estuary category which means that the estuary inlet closes to the sea. This results in water levels increasing in the estuary and backflooding can occur up to the 4.5m amsl topographic contour.
- This extended EFZ allows for the inclusion of the important habitat ecotone that is the transition between terrestrial, wetland and estuary
- The extended EFZ also represents 'climate change accommodation space' as it allows for estuaries to retreat under sea level rise scenarios of between +0.5 and +2.0m projected for South Africa in the short to medium term;

The delineation of the iLovu Estuary (Figure 3-1 of Appendix D16) shows its position and proximity relative to the northern boundary of the proposed development. It is the larger of the two estuaries in this study with an area of approximately 340 ha and a shoreline length of 27 km. The EFZ stretches to a point 6 km upstream which is the current head of the estuary. The lateral boundaries of the estuary are demarcated by the 5m amsl contour which is a much more refined line than the SANBI (2012) desktop delineation. The estuary mouth is the downstream boundary of an estuary. However, to allow for the highly dynamic nature of estuary inlets on the eastern seaboard an area known as the 'Estuarine Shore' has been introduced in the NBA 2019 to reflect the dynamic nature of the interface between estuaries and the coast (Harris et al. 2019).

The uMsimbazi Estuary delineation (Figure 3-2 of Appendix D16) indicates its position and proximity relative to the southern boundary of the proposed development. It has an area of approximately 150 ha and a shoreline length of 15 km. The EFZ stretches to a point 4 km upstream which is the currently determined head of the estuary. The lateral boundaries of the estuary are demarcated by the 5m amsl contour which is a much more refined line than the SANBI (2012) desktop delineation.

Common to both the downstream boundary of an estuary is the inlet or estuary mouth. A recent change to the delineation method for estuaries, to allow for the highly dynamic nature of estuaries particularly on the eastern seaboard, is the addition of an area known as the 'Estuarine Shore' in the NBA 2019 to reflect the dynamic nature of the interface between estuaries and the coast (Harris et al. 2019).

(iii) Estuary Importance and Sensitivity

National legislation makes provision for identifying Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs) with accompanying land-use guidelines that are compiled into Biodiversity Sector Plans. Critical Biodiversity Areas (CBAs) are areas required to meet biodiversity targets for ecosystems, species and ecological processes, as identified in a systematic biodiversity plan. Ecological Support Areas (ESAs) play a vital role in supporting the ecological functioning of Critical Biodiversity Areas and Protected Areas and/or in delivering ecosystem services. Both these estuaries are identified as CBAs which are irreplaceable in the conservation planning matrix at both a local and provincial level. The accompanying coastal forests and wetland complex are considered to be important ecological support areas and are critical to the health status of the estuaries.

(iv) Climate Change and Estuary Adaptations

The delineation of the estuaries as already mentioned takes climate change adaptation into account by allowing as it does for the predicted sea level rise scenarios of +0.5 to +2.0 m. In addition, the iterative planning which has occurred prior to the proposed plan has taken into account increased flows from urban development to the estuary.

(b) Hydrology

The mean annual precipitation for this area is 1 000 mm and the mean annual runoff of freshwater received by both estuaries is related to this combined with the size of their catchments (Figure 3-3 of Appendix D16).

Figure 3-16: Delineated boundary or EFZ of the uMsimbazi estuary relative to the proposed development site.

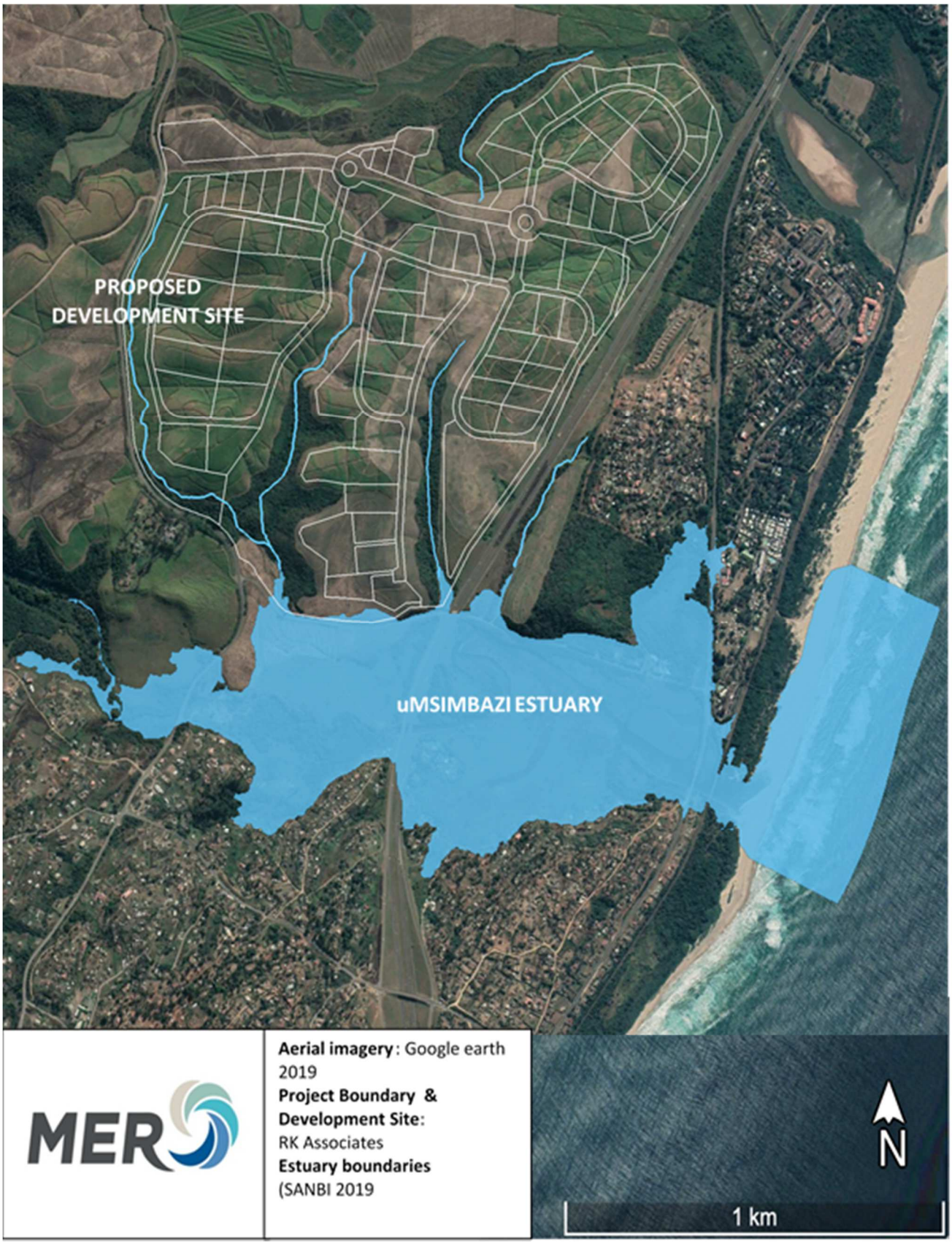


Figure 3-17: Delineated boundary or EFZ of the uMsimbazi estuary relative to the proposed development site.

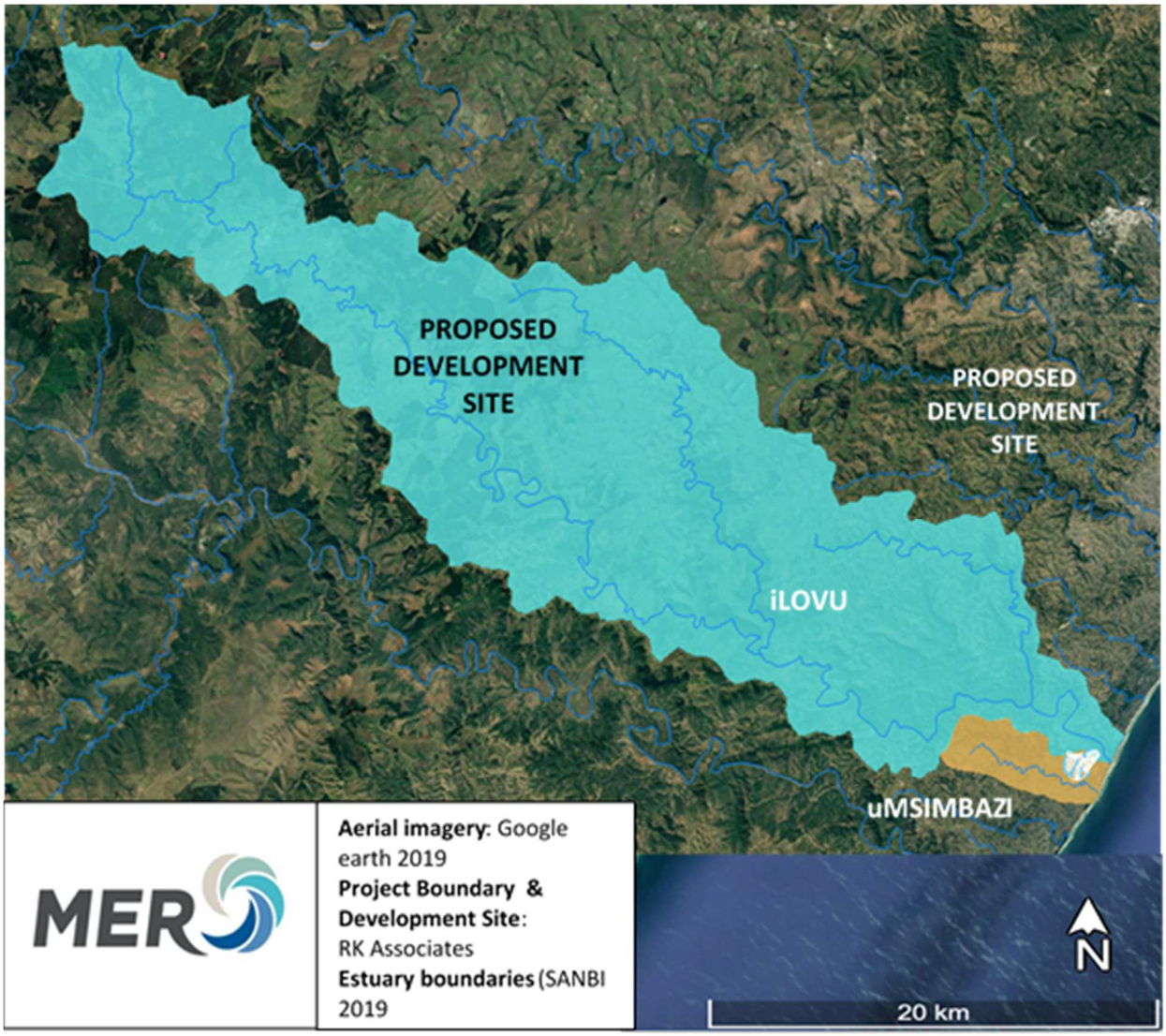


Figure 3-18: Catchmets of tehiLovu and uMsimbathi Rivers

The iLovu River drains quaternary catchments U70A, U70B, U70C and U70D with a total area of 950km^2. Its linear length is about 135 km and the catchment geometry is long and narrow with a slope of 0.088. Land-use is la largely rural with only 5% impervious area and most of the floodplain remains intact. The remainder of the catchment and floodplain comprise rural settlement and sugarcane plantations. Two impoundments, i) Beaulieu dam is situated in quaternary catchment U70A and ii) Nungwane Dam in quaternary catchment U70D.

The mean annual runoff (MAR) for the iLovu catchment under natural conditions is 119. 6Mm^3/year while, the MAR estimated for present conditions is 89.6 Mm^3/year. The natural monthly flows were extracted from the WR2012 database for the ILovu catchment and used to simulate present day flows. This modelling took into account two dams, three abstractions accounting for 0.42Ml/month and discharges and return flows of 0.05 Ml/month. These simulated flows suggest that there has been an average reduction of 25% in inflows from natural to present-day conditions over the simulation period.

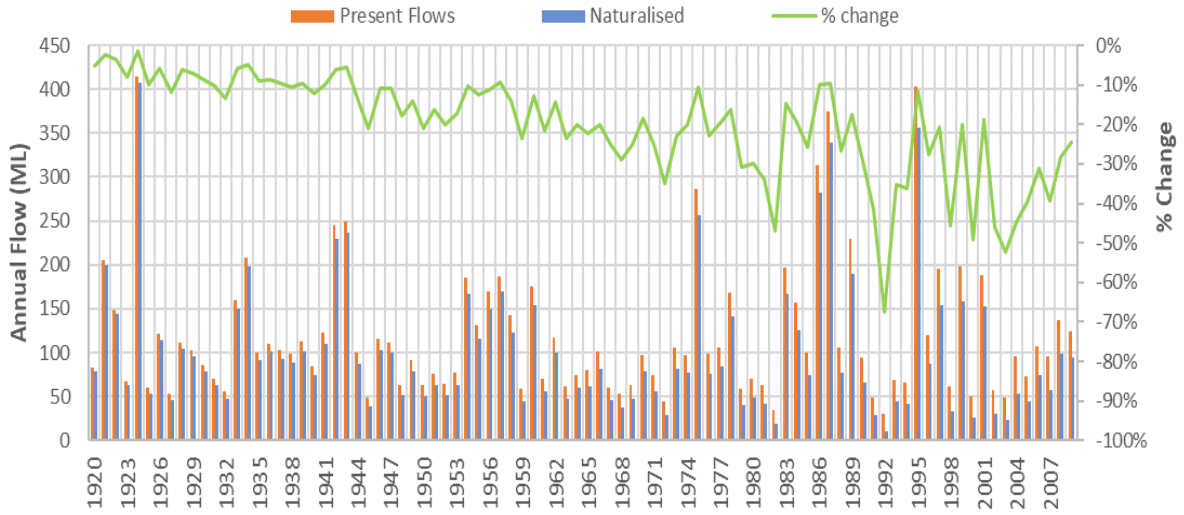


Figure 3-19: WR2012 flows for the Lovu catchment under present and natural conditions. The percentage change for each year is also included and indicated on the secondary Y-axis.

The uMsimbazi river catchment has a very coastal catchment of approximately 35 km2 (e.g. Jezewski, 1984; Forbes and Demetriades, 2008) of quartenary catchment U70E. The estimated length of the uMsimbazi River is about 15 km with a slope of 0.011. The uMsimbazi catchment is largely rural with 25% of the catchment made up of impervious area. The remainder of the catchment and floodplain comprise rural settlement and sugarcane plantations.

The estimated MAR of the uMsimbazi catchment was scaled from the estimated MAR of the full U70E quaternary catchment. The simulated MAR for quaternary catchment U70E, provided by WR2012, suggest negligible change in the inflows between natural-day (6.33Mm3/year) and present-day (6.32Mm3/year) conditions

Figure 3-19 shows the annual runoff from 1920 until 2009 and the percentage change for the simulated period. Both of the estuaries had these flows calibrated to estimated daily streamflows using the methods described by Slaughter et al. (2015). This is necessary because of the low gauge densities and inadequate data which characterise South Africa's water resources. Simulated monthly flow volumes for relevant quaternary catchments were accessed from WR2012 (in July 2019).

Measured daily rainfall data were obtained from the eThekwini Municipality, Umkomaas Depot (-30.200036°, 30.754047°). The simulated flows were volume corrected to ensure that they were consistent with the simulated monthly flow volumes. These data were used to model water quantity changes and assess impact to the estuary with the mouth and bathymetric data available

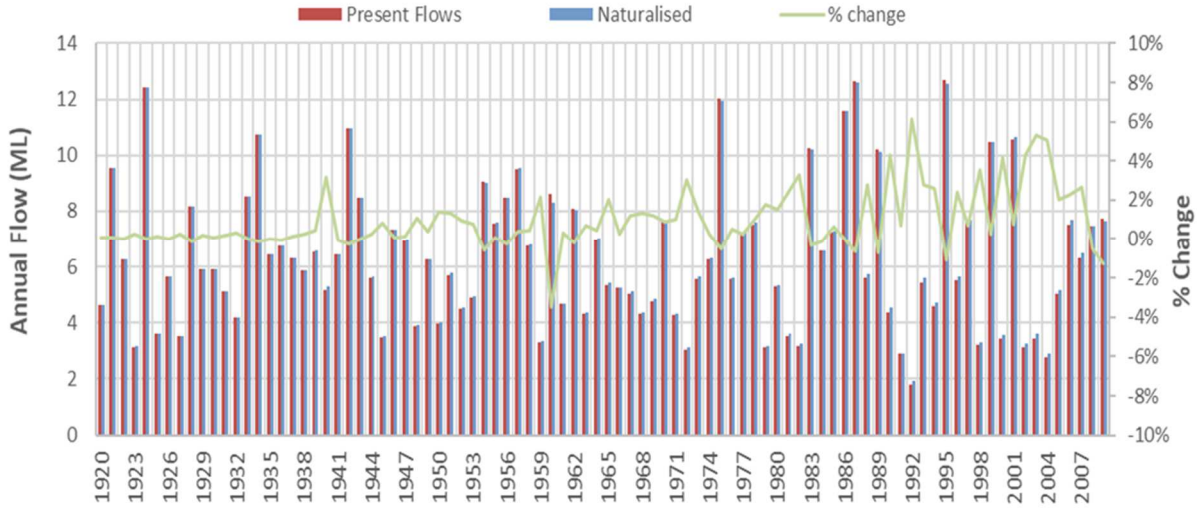


Figure 3-20: WR2012 flows for the uMsimbazi catchment under present and natural conditions. The percentage change for each year is also included and indicated on the secondary Y-axis

(c) Estuary Inlet/ Mouth Dynamics

Changes in run-off can have direct effects on the physical condition of an estuary, which can indirectly affect other environmental components. The most important physical aspect of the estuary to be aware of when variations in water quantity may be an issue are related to the state of the mouth. A reduction in runoff could increase closed-mouth conditions while increases in volumes and velocities could increase open mouth conditions. Changes in inlet/mouth dynamics can have dire consequences for physical (e.g. no flushing of sediments) and ecological (e.g. spawning of juvenile fish, benefits of influx of fresh sea water) functioning. Resource utilisation and recreational use of an estuary can also be affected through, for example, loss of habitat availability, biodiversity as well as aesthetics problems (bad smells as algae builds up). Estuaries are extensively used as nurseries for juvenile fish and other organisms, particularly during spring/summer, thus, it is critical to ensure at that estuary mouth dynamics of the region are considered.

An investigation was therefore undertaken on the dynamics of the estuary mouth, based on available information. Fortunately, an excellent dataset exists with daily mouth state records for both estuaries for a period of forty years available for analysis by MER. The understanding that was acquired was used to predict conditions under the different runoff scenarios that were part of this analysis. The dataset was used to understand the nature (predominantly open or predominantly closed) and characteristics (frequency and seasonality) of inlet or mouth dynamics.

The two systems, although both in the same estuary classification category of Intermittently Open, have very different overall mouth dynamics (Figure 3-6). The iLovu is predominantly open with an incidence of over 70% open mouth conditions recorded while the uMsimbazi is closed for over 80% of the time over the same period. This is clearly indicated in the data aggregated over forty years which provides a rough indication of mouth state. Both estuaries have very low incidences of artificial breaching or interference with the estuary mouth. This relates strongly to catchment size (Figure 3-3) with the iLovu catchment being 30x larger than the uMsimbazi with relative sizes of 95 000 ha versus 3 300 ha, respectively.

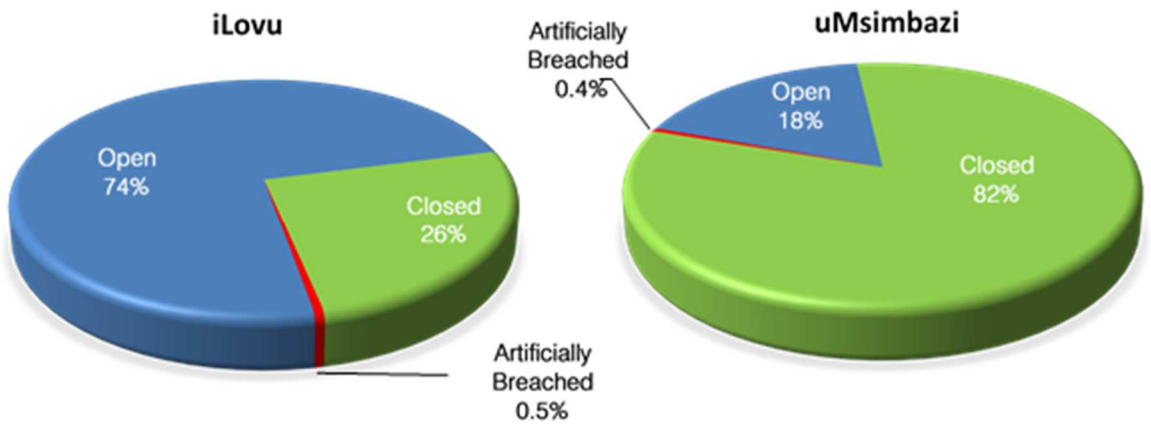


Figure 3-21: Mouth conditions (open/closed or artificially breached) of the iLovu and uMsimbazi estuaries between 1980 and 2019.

The time sequence analysis of the annual mouth state clearly indicates the variability (Figure 3-7). This pattern is tied to the catchment rainfall and freshwater inputs received by the estuary. The overall pattern remains the same as the overall picture in Figure 3-6, with the iLovu estuary having a higher proportion of open phases each year and the uMsimbazi having a higher proportion of closed phases. Understanding this variability is important to the assessment of impacts as any change to this pattern is considered a negative change in estuary health score. The iLovu estuary is noted with some years having longer durations of closure (>250 days open) and other years having only as little as 2 days of closure. The uMsimbazi is slightly less variable with closure varying between 200 - 352 days per annum. The cyclical nature of the rainfall patterns on longer (decadal) cycles are clearly seen in this analysis.

To provide some resolution to this the seasonality of mouth closure has been analysed using the dataset to show the monthly breaching patterns by aggregating the monthly data from this long term dataset.. This monthly pattern along with the bigger picture of annual variability clearly illustrates why mouth state cannot be too easily simplified into statements like '4 mouth openings per year etc.'

The iLovu and uMsimbazi estuaries both have a seasonal mouth dynamic with an increased likelihood of open mouth conditions during the spring and summer rainfall season with an greater than 70% occurrence of open mouth conditions during the spring to late summer. This seasonal effect is more marked in the iLovu estuary, however both estuaries show open phases are possible during the low flow winter period with a 50% occurrence for the iLovu but less than 10% occurrence in the uMsimbazi.

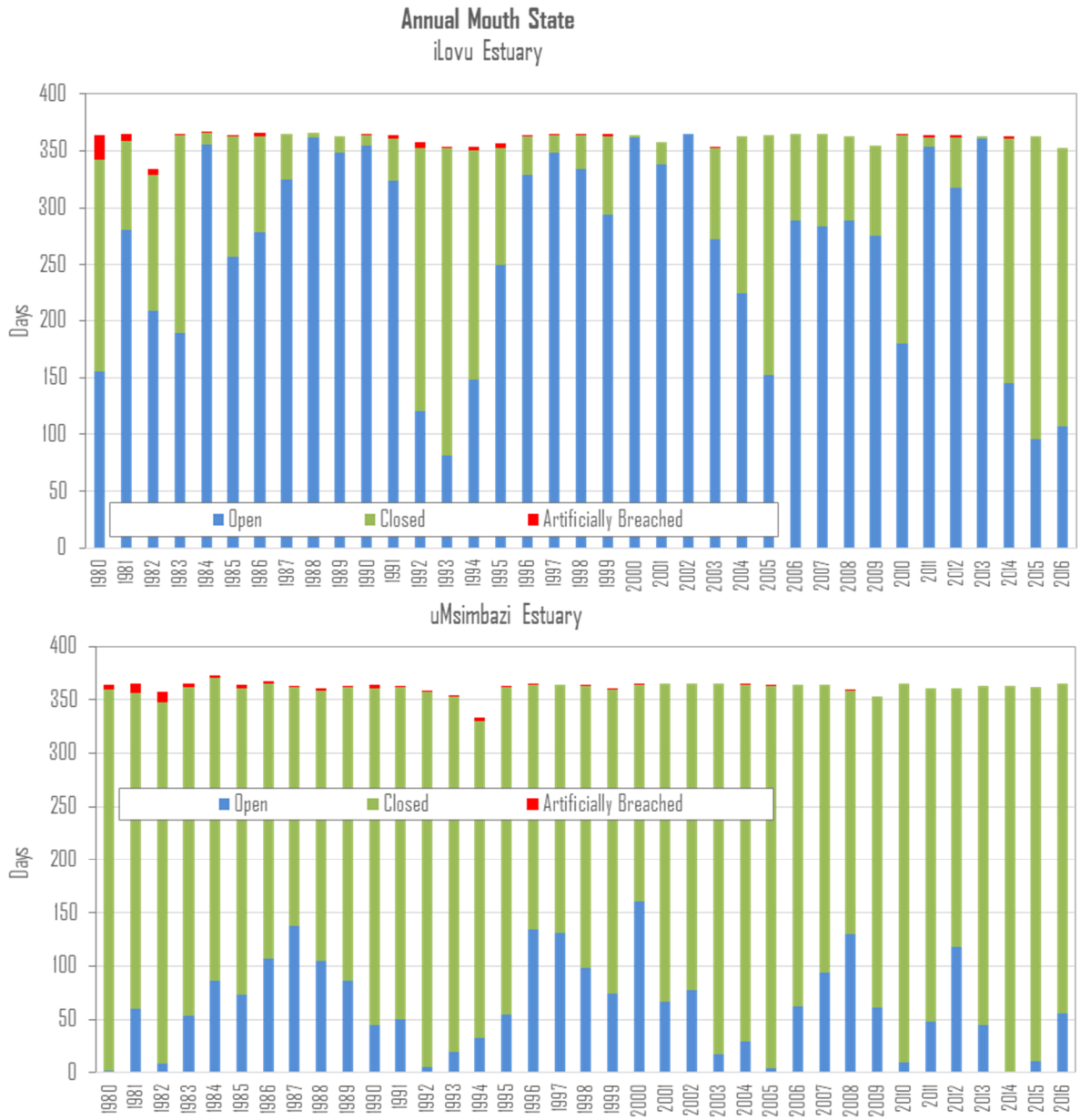


Figure 3-22: Monthly mouth state (open/closed or artificially breached) of the iLovu and uMsimbazi estuaries aggregated from 1980 and 2019.

(d) Water Quality

Water quality in the estuary is very good with physico-chemical parameters being in line with an estuary showing low levels of response / impact from surrounding land uses. Solid waste is becoming a more serious problem with significant dumping along the cane haulage road on the north bank and directly into the estuary. For example, a number (>8) of cattle carcases including decomposing heads were observed below the road bridge in the upper estuary on one of the earlier sampling trips.

(e) Biodiversity

The uMsimbazi Estuary is a relatively shallow, sinuous and slightly perched system that is situated in a mature floodplain. Its upper reaches consist of a narrow meandering channel which

widens and straightens in the middle and lower estuary on route to the sea. The mouth is often closed and its position and morphology is influenced by littoral drift.

The hydrology of the estuary is largely intact with the hydrological model simulations showing that the flow distribution and volume of the freshwater inputs to the estuary are at 99.9% of the reference condition. This means that water driven habitats such as the intertidal, subtidal and supratidal habitats are receiving the same volume and timing of flows without significant modification and other adjacent habitats and associated estuarine support areas provide a strong platform and diversity of habitat for floral and fauna biodiversity.

(i) Plants

Vegetation within the mapped estuary areas has been substantially transformed and much no longer corresponds with what naturally occurred. Although some is due to alien plant invasion, this transformation has been greatly spurred by agricultural conversion of land adjacent to and within the EFZ. The floodplain of iLovu has been severely impacted. Bank alteration and encroachment of sugar cane cultivation onto the floodplain is evident in even the earliest available (1937) aerial photographs. A stand of *Hibiscus tiliaceus* occurs along the south bank of the lower estuary but its distribution is limited by the steep rise in terrain on the landward side. Upstream a fringe of riverine vegetation occurs along the banks of the river and the coastal vegetation surrounding this on both the north and south sides are disturbed and alien infested. Dune thicket occurs along the coast on either side of the estuary. Further upstream the area is characterized by agricultural development.

More of the EFZ remains intact on the uMsimbazi with the uMsimbazi the increase in settlements moving beyond the 5m contour or into the EFZ on the southern bank as well as the increasing introduction of cattle and over-burning is also

As a result, the species composition of most of the open vegetation bears little resemblance to what should occur under natural conditions, while a large amount of the woody vegetation within the estuary, estimated at more than 50%, comprises alien species. This has either replaced formerly open indigenous vegetation, or replaced indigenous woody vegetation.

In spite of this, if these negative impacts were relieved the vegetation would recover over time, particularly if alien plants were also controlled. The diverse aquatic estuarine community on the northern edge of the estuary, comprised of *Typha capensis*, and a number of large and small sedge species, and herbs, comprises a still significant reservoir from which this could occur. The vegetation is also valuable as open space and faunal habitat, including for some red listed faunal species such as Grey Crowned Crane (*Balearica regulorum*), which has previously been seen within the area used as a pasture.

(ii) Animals

Surveys of Durban's estuaries between the uThongati in the north and iMhahlongwa in the south have shown that the uMsimbazi and to a lesser extent the iLovu supported a greater diversity of habitats and species than other comparable estuaries in the area (Forbes & Demetriades 2010).

This contrast has been emphasized by the more recent survey of the uMsimbazi estuary which showed that the benthic macroinvertebrate diversity was even more diverse and abundant (MER 2016) than previously indicated (MER 2010). Even more significantly the importance of the closed phase of these estuaries was clearly illustrated by the development of the faunal community through the closed phase. The total individual densities, i.e. the combined counts of all taxa recorded per square metre, further emphasized the contrast referred to above in that these densities were higher than those recorded in physically similar estuaries in the greater Durban area. The marked increases in total densities provide a strong indication of the significance of a closed mouth period to the functioning of these estuarine systems.

Although during this survey the diversity and abundance of fish and bird resources appeared to be low, it is important to remember that as more mobile components of an estuary these groups are more difficult to sample and are also more variable.

The historical literature and other systems similar to both the iLovu and uMsimbasi provides important context that intermittently open estuaries cycle in their role and value for different components/taxon groups which make up an estuary's trophic structure. Changes in salinity, mouth state and submerged macrophytes can bring about completely different conditions from those experienced during this survey and then illustrate the value of the increased invertebrate food resources by hosting a diverse fish and bird fauna.

During closed phases with relatively high water levels these estuaries support a completely different community of fish and birds from the open phases with shallow margins and tidal conditions.

(iii) Alien Invasive Species

Unfortunately, the invasive alien snail Tarebia granifera has managed to spread into both estuary systems. This snail has continued to expand in KZN coastal lakes, rivers and estuaries and the two estuaries are no exception although as yet, no data exist to suggest that this has had an effect on the indigenous diversity. It has however been considered as a biological control mechanism against bilharzia vector snails in other parts of the world so there is a presumption that it is able to displace or outcompete other snail species. This has however not yet been conclusively shown to be the case in South Africa.

3.1.9 Terrestrial Ecology

An Ecological Assessment was undertaken by GIBB (Pty) Ltd for the KZN ASP development (refer to Appendix D17), sewer line (Appendix D18) and powerline (Appendix D19). The field surveys were undertaken on 13 and 14 December 2018, 15 February 2019, 5 and 6 March 2019, 4 June 2019, and 1 August 2019.

(a) Proposed KZN ASP Site

(i) Regional Vegetation

The study site is located within the Indian Ocean Coastal Belt biome, which covers the seaboard of the KwaZulu-Natal Province (Mucina and Rutherford, 2006[14]). The tropical appearance of the vegetation associated with the Indian Ocean Coastal Belt is the result of a mixture of growth forms such as trees, lianas, and epiphytes, while grass plays a subordinate role in this biome (Mucina and Rutherford, 2006). The land use in this biome is primarily sugarcane and subsistence farming, which has resulted in the loss of vast areas containing natural vegetation. Therefore, grass being "subordinate" may be attributable to the fact that vast areas were planted to cane. Historically, forest was rare to non-existent and grassland would dominate where the topography was undulating, due to natural processes such as fire (Finch and Hill, 2008[15]). The biomes within South Africa are divided into smaller units known as vegetation types. Both Mucina and Rutherford (2018[16]) on a national scale, and Scott-Shaw and Escott (2011[17]) in KwaZulu-Natal differentiate four vegetation types that occur within the boundary of the study area. These are KwaZulu-Natal Coastal Belt Grassland, Subtropical Alluvial Vegetation, Coastal Forest, and Scarp Forest. Of the terrestrial vegetation types, the KwaZulu-Natal Coastal Belt Grassland and Coastal Forest are likely to be affected by the proposed development directly.

KwaZulu-Natal Coastal Belt Grassland

The majority of the proposed development infrastructure is positioned within the original extent of this vegetation type. This vegetation type was once primary grassland dominated by *Themeda triandra* but due to extensive sugarcane cultivation, timber plantations and coastal holiday resorts, it has now been transformed into patches of secondary grassland and coastal thickets interspersed along the KwaZulu-Natal coast.

Alien plant species are widespread and include *Chromolaena odorata*, *Lantana camara, Melia azedarach*, and *Solanum mauritianum*. According to Mucina and Rutherford (2006), KwaZulu-Natal Coastal Belt Grassland is classified as Endangered with more than 50% transformed for cultivation, urban developments, and road infrastructure. Extensive invasions by alien plant species affect the remaining natural areas. The percentage of land transformed is likely much higher today. Table 3-13 summarises the dominant and important species that are characteristic of the KwaZulu-Natal Coastal Belt vegetation type.

Table 3-13: Important floral species characteristic of the KwaZulu-Natal Coastal Belt Grassland vegetation type (after Mucina and Rutherford, 2006)

Important Taxa	
Graminoids	*Aristida junciformis* subsp. *galpinii, Digitaria eriantha, Panicum maximum, Themeda triandra, Alloteropsis semialata* subsp. *eckloniana, Cymbopogon caesius, C. nardus, Eragrostis curvula, Hyparrhenia filipendula,* and *Melinis repens*

[14] Mucina, L. and Rutherford, M.C. (2006): The vegetation of South Africa, Lesotho and Swaziland, Strelitzia 19, Pretoria: South African National Biodiversity Institute.

[15] Finch, J.M., and Hill, T.R. (2008): A late Quaternary pollen sequence from Mfabeni Peatland, South Africa: reconstructing forest history in Maputaland, Quaternary Research 70: 442-450.

[16] Mucina, L. and Rutherford, M.C. (2018): Vegetation Map of South Africa, Lesotho and Swaziland [vector geospatial dataset], Pretoria: South African National Biodiversity Institute.

[17] Scott-Shaw, C.R. and Escott, B.J. (eds) (2011): KwaZulu-Natal Provincial Pre-transformation vegetation type map, GIS coverage [kznveg05v2_011_wll.zip], Biodiversity Conservation Planning Division, Ezemvelo KZN Wildlife.

Herbs	*Berkheya speciosa* subsp. *speciosa, Cyanotis speciosa, Senecio glaberrimus, Alepidea longifolia, Centella glabrata, Chamaecrista mimosoides, Conostomium natalense, Crotalaria lanceolata, Dissotis canescens, Eriosema squarrosum, Gerbera ambigua, Hebenstretia comosa, Helichrysum cymosum, Stachys aethiopica, Bulbine asphodeloides, Disa polygonoides, Hypoxis filiformis, Ledebouria floribunda, Pachycarpus asperifolius,* and *Tritonia disticha*
Low shrubs	*Clutia pulchella, Gnidia kraussiana, Phyllanthus glaucophyllus,* and *Tephrosia polystachya*
Woody climbers	*Abrus laevigatus, Asparagus racemosus,* and *Smilax anceps*
Trees and tall shrubs	*Bridelia micrantha, Phoenix reclinata, Syzygium cordatum, Acacia natalitia, Albizia adianthifolia,* and *Antidesma venosum*
Biogeographically Important Species	
Graminoids	*Cyperus natalensis, Eragrostis lappula*
Herbs	*Helichrysum longifolium, Selago tarachodes, Senecio dregeanus, Sphenostylis angustifolia*
Geophytic herbs	*Kniphofia gracilis, K. littoralis, K. cooperi, Pachystigma venosum, Zeuxine africana*
Low shrubs	*Helichrysum kraussii, Agathisanthemum bojeri, Desmodium dregeanum, Strelitzia nicolai*
Small trees/shrubs	*Anastrabe integerrima, Acacia nilotica* subsp. *kraussiana*
Endemic Species	
Herbs	*Vernonia africana* (extinct), *Kniphofia pauciflora*
Low shrubs	*Barleria natalensis* (extinct)

Coastal Forest

This vegetation is located in the north-eastern corner of the study area, adjacent to the main site. It occurs on a northwest facing slope between the N2 highway and the R102. Mucina and Rutherford (2018) classified this vegetation as Northern Coastal Forest whilst Scott-Shaw and Escott (2011) defined it as KwaZulu-Natal Coastal Forests: Southern Mesic Coastal Lowlands Forest. Patches of coastal forest extend along the Indian Ocean seaboard from KwaZulu-Natal to the Eastern Cape Province at low altitudes from 10 to 150m. These usually occur on rolling coastal plains or stabilised coastal dunes. The dominating tree species include *Albizia adianthifolia, Drypetes natalensis* and *Englerophytum natalense*, whilst tropical shrubs dominate the species rich understorey (Table 3-14). Mucina and Rutherford (2006) classified Northern Coastal Forest as Least Threatened with about 68% statutorily conserved, however, it is under threat in KwaZulu-Natal and classified as Critically Endangered.

Table 3-14: Important floral species characteristic of the Coastal Forest vegetation type (after Mucina and Rutherford, 2006)

Important Taxa	
Herbs	*Asystasia gangetica, Isoglossa woodii, Microsorum scolopendria, Zamioculcas zamiifolia, Cyperus albostriatus, Oplismenus hirtellus*
Understorey Trees and Shrubs	*Brachylaena discolor, Chrysanthemoides monilifera, Carissa bispinosa, Euclea natalensis, Eugenia capensis, Gymnosporia nemorosa, Kraussia floribunda, Peddiea africana, Strelitzia nicolai, Dracaena aletriformis, Dalbergia armata*
Tall Trees	*Acacia kosiensis, Albizia adianthifolia, Drypetes natalensis, Englerophytum natalense, Mimusops caffra, Sideroxylon inerme, Trichilia emetica,*
Graminoids	*Cyperus albostriatus, Oplismenus hirtellus*

Biogeographically Important Species	
Tall Trees	*Celtis gomphophylla*, *Chrysophyllum viridifolium*, *Diospyros inhacaensis*, *Drypetes natalensis*, *Cola natalensis*, *Inhambanella henriquesii*, *Manilkara concolor*
Small Trees	*Coffea racemosa*, *Dovyalis longispina*, *Artabotrys monteiroae*, *Encephalartos ferox*, *Erythrococca berberidea*, *Pancovia golungensis*
Tall Shrubs	*Haplocoelum foliolosum* subsp. *mombasense*, *Landolphia kirkii*
Endemic Species	
Small Tree	*Acacia kosiensis*

Scarp Forest

This vegetation is located in the south-eastern corner of the study area, and will not be affected by the proposed development. The small remnant occurs on a south-facing slope, east of the N2 highway, overlooking the uMsimbazi Estuary. Mucina and Rutherford (2018) classified this vegetation as Scarp Forest whilst Scott-Shaw and Escott (2011) defined it as Eastern Scarp Forests: Southern Coastal Scarp Forest. Dominant tree species include *Buxus macowanii*, *Drypetes gerrardii*, *Englerophytum natalense*, *Harpephyllum caffrum*, and *Millettia grandis* (Table 3-15). Mucina and Rutherford (2006) classified Scarp Forest as Least Threatened with about 20% statutorily conserved, and a target of 40%.

Table 3-15: Important floral species characteristic of the Scarp Forest vegetation type (after Mucina and Rutherford, 2006)

Important Taxa	
Herbs	*Stangeria eriopus, Piper capense, Begonia dregei, B. homonyma, Streptocarpus grandis, S. johannis, Clivia miniata*
Understorey	*Buxus macowanii, Rinorea angustifolia, Dombeya cymosa, Encephalartos natalensis, E. villosus, Ochna natalitia, Strychnos henningsii, S. mitis, Flagellaria guineensis, Thunbergia alata, Memecylon natalense, Eugenia natalitia*
Trees	*Millettia grandis, Buxus natalensis, Drypetes gerrardii, Englerophytum natalense, Harpephyllum caffrum, Heywoodia lucens, Rothmannia globosa, Commiphora harveyi, C. woodii, Drypetes arguta, Nectaropetalum capense, Nuxia congesta, Olinia emarginata, Ptaeroxylon obliquum, Pterocelastrus tricuspidatus, Vitellariopsis marginata*

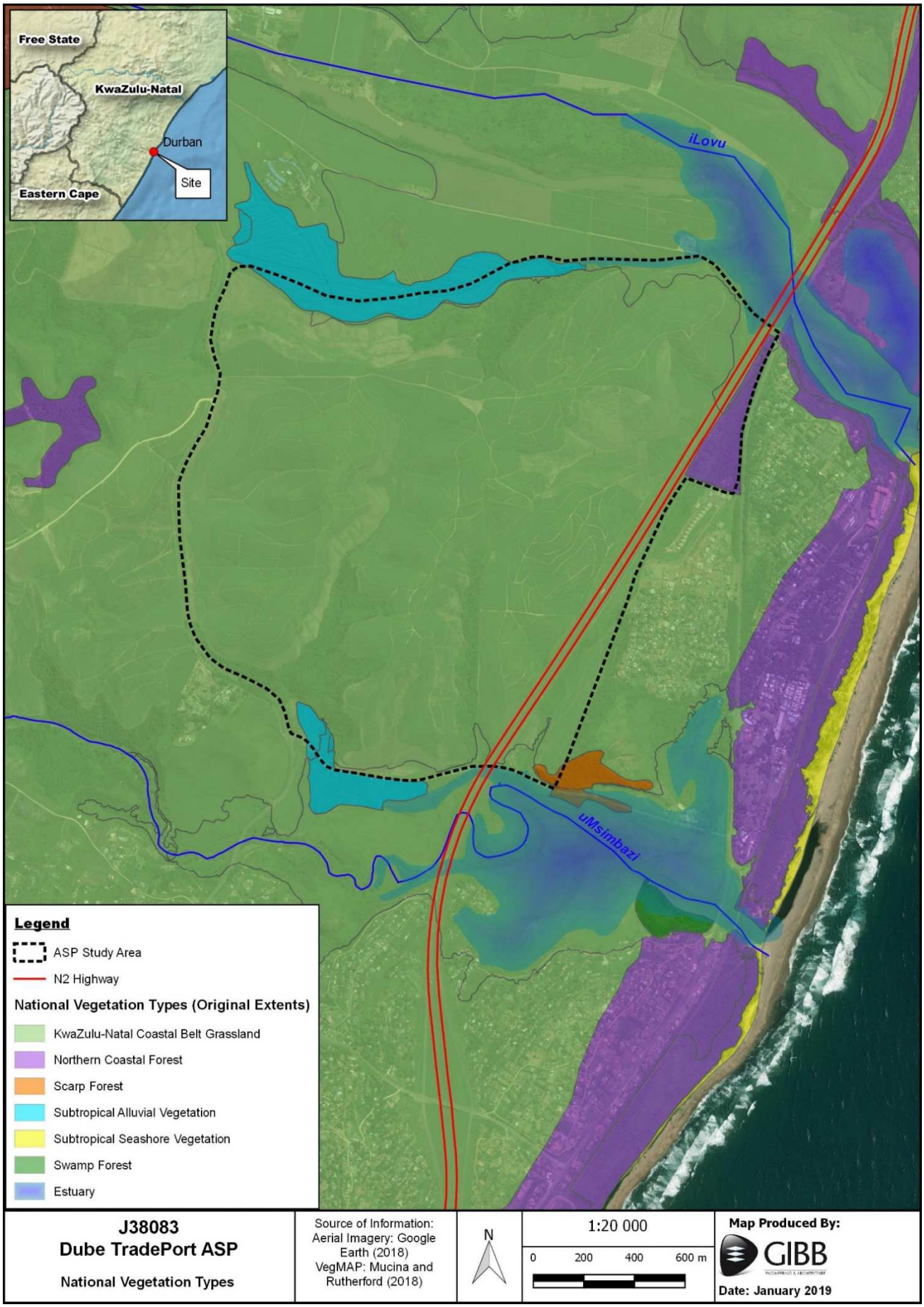


Figure 3-23: The study area in relation to national vegetation types

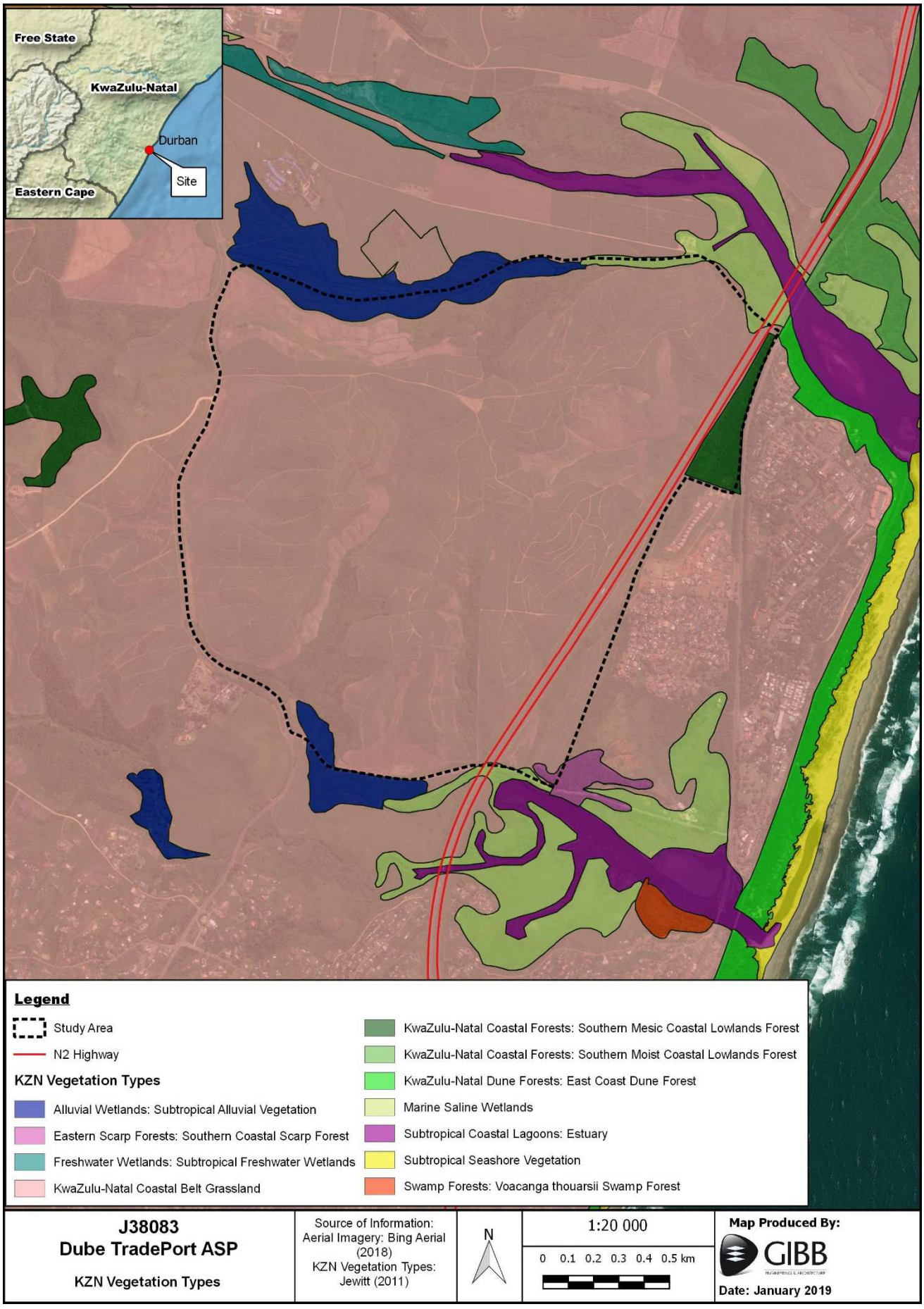


Figure 3-24: The study area in relation to KZN vegetation types

(ii) Conservation Targets and Status for Vegetation Types in KwaZulu-Natal

The provincial conservation agency (Ezemvelo KwaZulu-Natal Wildlife [EKZNW]) calculated the conservation status of vegetation types in KwaZulu-Natal by using the latest provincial vegetation maps, accumulated transformation maps, and biodiversity conservation targets. The vegetation types were used as coarse filter surrogates for many species that do not have explicit species targets in conservation planning (Jewitt, 2011[18]). The conservation status of vegetation types in KwaZulu-Natal was determined by comparing the amount of natural habitat remaining for a vegetation type in the province with the biodiversity conservation target of the vegetation type. Table 3-16 shows the thresholds used by EKZNW to derive the conservation status of vegetation types.

The province supports one hundred and one (101) vegetation types of which nineteen (19) are Critically Endangered, sixteen (16) are Endangered, sixteen (16) are Vulnerable and fifty (50) are Least Threatened (Jewitt, 2011). The study area falls within the **KwaZulu-Natal Coastal Belt Grassland**, which is currently listed as **Critically Endangered** in KwaZulu-Natal. According to EKZNW (Jewitt, 2011), approximately 89% of KwaZulu-Natal Coastal Belt Grassland was transformed (as at 2008), which is almost double the percentage estimated by Mucina and Rutherford (2006). The conservation target of this vegetation type is 25% and less than 1% receives formal protection.

The **KwaZulu-Natal Coastal Forests: Southern Mesic Coastal Lowlands Forest** situated in the north-eastern corner is also listed as **Critically Endangered** in KwaZulu-Natal with 44% transformed (as at 2008; Jewitt, 2011). The conservation target of this vegetation type is 72% and only 13% receives formal protection.

Table 3-16: Conservation status thresholds for KZN (Jewitt, 2011)

Threshold	Conservation Status
Remaining natural habitat <= the biodiversity target	**Critically Endangered**
Remaining natural habitat <= biodiversity target +15%	**Endangered**
Remaining natural habitat <= 60% of the original area of ecosystem	**Vulnerable**
Remaining natural habitat > 60% of the original area of ecosystem	**Least Threatened**

(iii) Listed Terrestrial Ecosystems

The National Environmental Management: Biodiversity Act (NEMBA, Act 10 of 2004) provides for listing threatened or protected ecosystems, in one of four categories: Critically Endangered (CR), Endangered (EN), Vulnerable (VU) or Protected (Pr) (DEA, 2011[19]). The main purpose of listing threatened ecosystems is to reduce the rate of the ecosystem and species extinction and includes

[18] Jewitt, D. (2011): Conservation Targets and Status for Vegetation Types in KZN, Pietermaritzburg: Ezemvelo KZN Wildlife.

[19] DEA (Department of Environmental Affairs) (2011): National Environmental Management: Biodiversity Act, 2004: National list of ecosystems that are threatened and in need of protection, *Government Gazette Number 34809*, Notice 1002, 9 December 2011, Pretoria: DEA.

the prevention of further degradation and loss of structure, function and composition of threatened ecosystems. Threatened terrestrial ecosystems identified in the NEMBA were delineated using the following:

- The South African Vegetation Map (Mucina and Rutherford, 2006; 2018 [beta update]);
- National forest types (Von Maltitz et al., 2003[20]);
- Priority areas identified in a provincial systematic biodiversity plan (in this particular case the KwaZulu-Natal Biodiversity Sector Plan (Escott et al., 2016[21])); and
- High irreplaceability forest patches and clusters identified by the Department of Agriculture, Forestry and Fisheries (DAFF) (Berliner, 2005[22]).

Extensive stakeholder engagement and the best available science formed the basis of the criteria used to identify threatened terrestrial ecosystems listed in NEMBA. The criteria for thresholds for Critically Endangered, Endangered and Vulnerable ecosystems are summarised in Table 3-17.

Table 3-17: Criteria used to identify threatened terrestrial ecosystems (DEA, 2011)

Criterion	Critically Endangered	Endangered	Vulnerable
A1: Irreversible loss of natural habitat	Remaining natural habitat < biodiversity target	Remaining natural habitat < biodiversity target + 15%	Remaining natural habitat < 60% of the original area
A2: Ecosystem degradation and loss of integrity	> 60% of ecosystem significantly degraded	> 40% of ecosystem significantly degraded	> 20% of ecosystem significantly degraded
C: Limited extent and imminent threat	-	Ecosystem extent <3000ha and imminent threat	Ecosystem extent <6000ha and imminent threat
D1: Threatened plant species associations	> 80 threatened Red List plant species	> 60 threatened Red List plant species	> 40 threatened Red List plant species
F: Priority areas for meeting explicit biodiversity targets as defined in a systematic biodiversity plan	Very high irreplaceability and high threat	Very high irreplaceability and medium threat	Very high biodiversity and low threat

The implication for land management is that any development situated within listed ecosystems will require the following:

- Planning: linked to the requirement in the NEMBA for listed ecosystems to be taken into account in municipal Integrated Development Plans (IDPs) and Spatial Development Frameworks (SDFs);
- Environmental Authorisation (EA): in terms of the Environmental Impact Assessment (EIA)

[20] Von Maltitz, G., Mucina, L., Geldenhuys, C., Lawes, M., Eeley, H., Adie, H., Vink, D., Flemming, G. and Bailey, C. (2003): Classification system for South African Indigenous Forests. An objective classification for the Department of Water Affairs and Forestry, *Environmentek Report ENV-P-C 2003-017*, Pretoria: CSIR.

[21] Escott, B.J., Elliott, F. and Livingstone, T-C. (eds)(2016): KwaZulu-Natal Biodiversity Spatial Planning Terms and Processes, Version 3.3, Unpublished Report, Biodiversity Spatial Planning and Information Division, Ezemvelo KZN Wildlife.

[22] Berliner, D. (2005): Systematic Conservation Planning for the forest biome of South Africa, Department of Water Affairs and Forestry, South Africa.

Regulations of 2014 promulgated under the National Environmental Management Act (NEMA; Act 107 of 1998) as amended in 2017;
- Proactive management: in terms of the NEMBA; and
- Monitoring and reporting: in terms of the NEMBA.

The EIA Regulations include three lists of activities that require EA:

- Listing Notice 1: activities that require a Basic Assessment (BA) (R983 of 2014 as amended 7 April 2017);
- Listing Notice 2: activities that require Scoping and Environmental Impact Report (EIR) (R984 of 2014 as amended 7 April 2017); and
- Listing Notice 3: activities that require a BA in specific identified geographical areas only (R985 of 2014 as amended 7 April 2017).

Activity 12 in Listing Notice 3 relates to the clearance of 300 square metres (0.03ha) or more of vegetation, which will trigger a BA within any Critically Endangered or Endangered ecosystem listed in terms of Section 52 of NEMBA. This means any development that involves loss of natural habitat in a listed Critically Endangered or Endangered ecosystem is likely to require at least a BA in terms of the EIA regulations. It is important to note that while the original extent of each listed ecosystem has been mapped, a Basic Assessment Report (BAR) in terms of the EIA regulations is triggered only when remaining natural habitat within each ecosystem is threatened. A BAR is not required where natural habitat has already been irreversibly lost in listed ecosystems.

As indicated in Section 2.11.1 – Table 2-25, the proposed alternative access road options 1, 1c, 1d and 3b, as well as the proposed sewer line route alignment, will entail the clearance of more than 300m^2 of indigenous vegetation.

Activity 27 in listing Notice 1 relates to clearance of an area of 1 hectares or more, but less than 20 hectares of indigenous vegetation. In context of the proposed development, there may be areas of indigenous vegetation that will need to be cleared to make way for the proposed development activities, but it will not exceed 20ha in extent. As majority of the site is currently used for sugar cane cultivation, these areas are therefore transformed. The areas of high ecological significance within the proposed KZN ASP site are steep and unsuitable for development. The indigenous vegetation on the KZN ASP site will therefore not be impacted. Cumulatively, there will be clearance of more than 1ha of indigenous vegetation (but under 20ha) for the construction of the sewer line and various road access options. Refer to Table 2-25 in Section 2.11.1.

The proposed development does not trigger any listed activities in Listing Notice 2, as the clearance of indigenous vegetation is less than 20ha.
The proposed development site is located within two ecosystems that are listed in terms of Section 52 of NEMBA (DEA, 2011[23]). The Interior South Coast Grasslands ecosystem (KZN7), and the Southern Coastal Grasslands ecosystem (KZN18) were both listed as **Critically Endangered**, under Criterion F since they are part of the priority areas needed for meeting explicit biodiversity

[23] DEA (Department of Environmental Affairs) (2011): National Environmental Management: Biodiversity Act, 2004: National list of ecosystems that are threatened and in need of protection, *Government Gazette Number 34809*, Notice 1002, 9 December 2011, Pretoria: DEA.

targets as defined in a systematic biodiversity plan. These areas are considered to have undergone severe degradation of ecological structure, function or composition as a result of human intervention and are subject to high risk of irreversible transformation.

The original extent of the Interior South Coast Grasslands ecosystem was 148 000ha of which only 9% remains in a natural state and around 2% of this is protected. This ecosystem is known to support 24 threatened or endemic plant and animal species. Key biodiversity features include three millipede species including *Centrobolus angulatus*, *Doratogonus infragilis* and *Doratogonus montanus*; seventeen plant species including *Begonia rudatisii, Crassula streyi, Craterostigma nanum* var. *nanum, Diaphananthe millarii, Eugenia simii, Helichrysum woodii, Huernia hystrix parvula, Kniphofia pauciflora, Kniphofia rooperi, Phylica natalensis, Plectranthus ernstii, Rhynchocalyx lawsonioides, Streptocarpus primulifolius, Watsonia confusa,* and *Watsonia inclinata*; four reptile species including *Bradypodion angustiarum, Bradypodion caeruleogula, Bradypodion melanocephalum* and *Bradypodion wezae*; and six vegetation types including KwaZulu-Natal Coastal Forest, KwaZulu-Natal Sandstone Sourveld, Ngongoni Veld, KwaZulu-Natal Coastal Belt, Pondoland Scarp Forest, and Pondoland-Ugu Sandstone Coastal Sourveld (Goodman, 2007).

The original extent of the Southern Coastal Grasslands ecosystem was 23 000ha of which only 6% remains in a natural state and less than 1% of this is protected. This ecosystem is known to support nine threatened or endemic plant and animal species. Key biodiversity features include one amphibian, *Hyperolius pickersgilli*; two millipede species including *Centrobolus anulatus* and *Doratogonus infragilis*; three plant species including *Kniphofia rooperi* and *Phylica natalensis*; three reptile species including *Bradypodion caeruleogula*, *Bradypodion melanocephalum* and *Bradypodion wezae*; and five vegetation types including KwaZulu-Natal Coastal Forest, KwaZulu-Natal Dune Forest, Pondoland Scarp Forest, Pondoland-Ugu Sandstone Coastal Sourveld, and KwaZulu-Natal Coastal Belt (Goodman, 2007[24]).

[24] Goodman, P.S. (2007): *KwaZulu-Natal Terrestrial Conservation Plan (C-Plan),* Version 4, Biodiversity Conservation Planning Division, Ezemvelo KZN Wildlife.

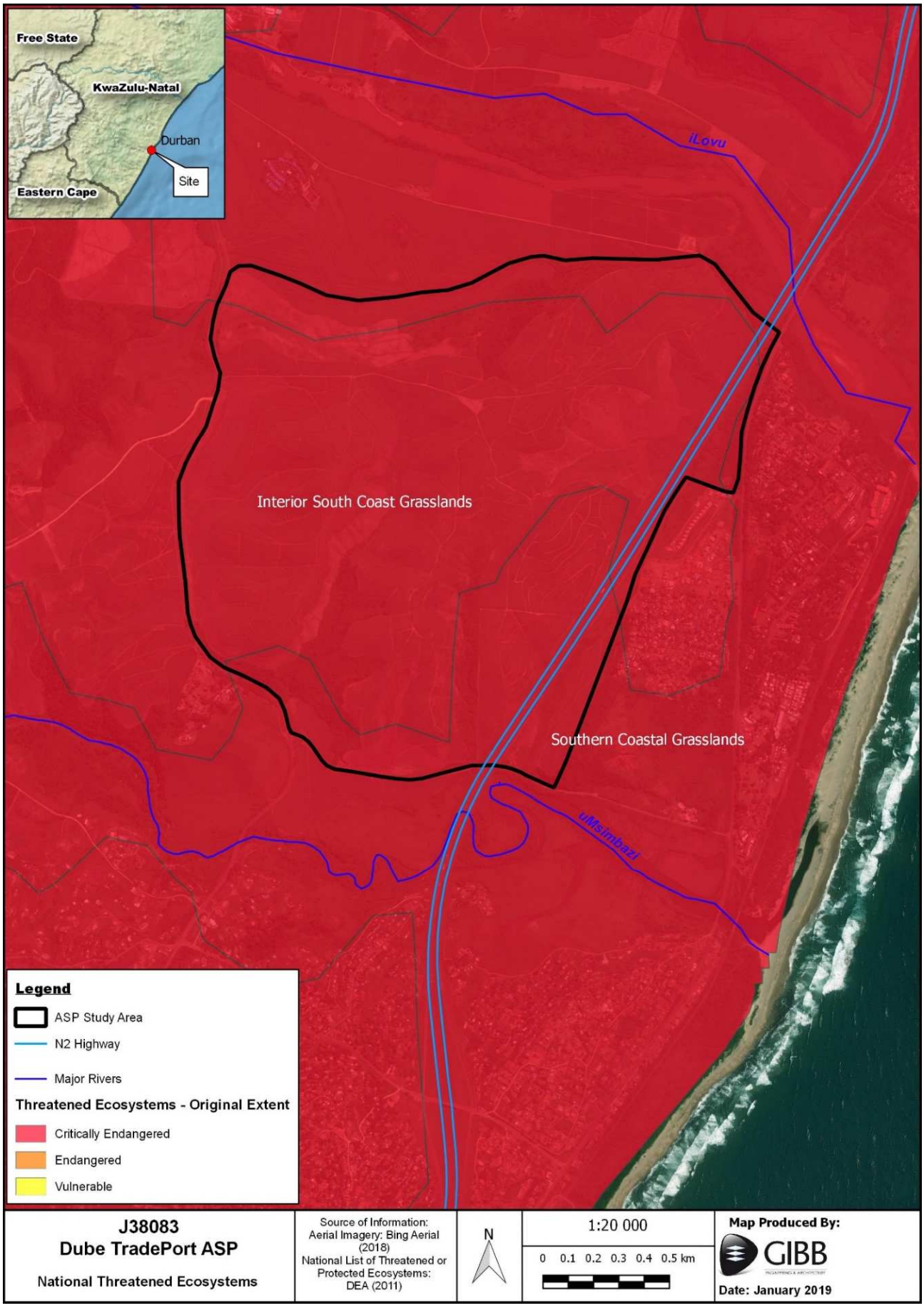


Figure 3-25: The study area in relation to national threatened ecosystems

(iv) KwaZulu-Natal Systematic Conservation Planning

A Provincial Conservation Plan aims to build on national plans at the provincial level. It is intended to be used by all who are involved in land-use and development planning, most particularly those specialists who need a comprehensive source of biodiversity information. EKZNW developed the KwaZulu-Natal Systematic Conservation Plan (KZNSCP; Jewitt, 2011[25]), which has subsequently been replaced by the KwaZulu-Natal Biodiversity Sector Plan (KZNBSP) to guide the long–term conservation of biodiversity in the province (Escott et al., 2016).

The GIS layer lists land areas containing high biodiversity using irreplaceability measures. An irreplaceability measure quantifies the contribution of a particular site to achieve representation biodiversity targets (Ferrier et al., 2000[26]).

The KZNBSP provides a spatial representation of land and coastal marine area required to ensure the persistence and conservation of biodiversity within KZN, reflected as Critical Biodiversity Areas (CBA) and Ecological Support Areas (ESA). The Plan has been produced as a tool for (i) guiding protected area expansion priority areas and identification of stewardship sites and (ii) informing all other economic sector' strategic spatial planning processes with the intention of ensuring more sustainable development in KZN. It also informs other internal EKZNW strategic processes such as alien clearing programme prioritisation, informs District Conservation Officer priorities, and informs the decisions and nature of response to development applications by EKZNW's Integrated Environmental Management Unit. The categories included in the KZNBSP map are as follows (Escott et al. 2016[27]):

- **Formal Protected Areas (PAs):** Area's identified for formal protection under the National Environmental Management: Protected Areas Act, 2003 (Act 57 of 2003, NEMPAA);
- **CBA Irreplaceable:** Planning units (PU) that represent the only localities for which the conservation targets for one or more of the biodiversity features contained within can be achieved i.e. there are no alternative sites available. The distribution of the biodiversity features is not always applicable to the entire extent of the PU but is often confined to a specific niche habitat e.g. a forest or wetland reflected as a portion of the PU in question. In such cases, development could be considered within the PU if special mitigation measures are put in place to safeguard the feature(s) and if the nature of the development is sympathetic to the conservation objectives. However, this is site and case dependant;
- **CBA Optimal:** Indicates the presence of one (or more) features with a very high irreplaceability score. In practical terms, this means that there are alternate sites within which the targets can be met, but there are not many. The site represents the most optimal area for choice in the systematic planning process, meeting both the target goals for the features concerned, as well as a number of other guiding criteria such as high agricultural potential area avoidance, or falls within a macro-ecological corridor. Again, development could be considered within the PU if special mitigation measures are put in place to

[25] Jewitt, D. (2011): Conservation Targets and Status for Vegetation Types in KZN, Pietermaritzburg: Ezemvelo KZN Wildlife.

[26] Ferrier, S., Pressey, R.L. and Barrett, T.W. (2000): A new predictor of the irreplaceability of areas for achieving a conservation goal, its application to real-world planning, and a research agenda for further refinement, *Biological Conservation* 93: 303-325.

[27] Escott, B.J., Elliott, F. and Livingstone, T-C. (eds)(2016): KwaZulu-Natal Biodiversity Spatial Planning Terms and Processes, Version 3.3, Unpublished Report, Biodiversity Spatial Planning and Information Division, Ezemvelo KZN Wildlife.

safeguard the feature(s) and if the nature of the development is sympathetic to the conservation objectives. This is also site and case dependant;

- **ESA:** Areas that are required to support and sustain the ecological functioning of Critical Biodiversity Areas (CBAs). For terrestrial and aquatic environments, these areas are functional but are not necessarily pristine natural areas. They are however required to ensure the persistence and maintenance of biodiversity patterns and ecological processes within the CBAs, and which also contributes significantly to the maintenance of Ecological Infrastructure (EI). ESAs are further split into ESA: Species Specific, ESA: Protected Area Buffers, and ESA: Corridors; and
- **Natural Biodiversity Area:** Areas identified as Natural Biodiversity Areas (NBAs) represent the natural and/or near natural environmental areas (i.e. NOT 100% modified either by tillage or construction) not identified within the optimisation software output. It is important to note that whilst these areas are not highlighted in MINSET and MARXAN analysis, this lack of selection should not be misinterpreted as reflecting areas of no biodiversity value. Whilst it is preferred that development be focussed within these areas, development still has to be conducted in an informed and sustainable manner. Important species and Ecosystem Services can still be associated with these Planning Units (PUs) and should be accounted for in the Environmental Impact Assessment (EIA) process.

According to the KZNBSP, portions of the study area fall within areas classified as CBA: Irreplaceable. Such areas of the site include remnants of natural bush with the study area, coastal forest vegetation located in the north-eastern corner of the study area, as well as natural areas within the iLovu and uMsimbazi Estuaries and floodplains.

(v) The Durban Metropolitan Open Space System

The Durban Metropolitan Open Space System (D'MOSS) is a system of open spaces comprising approximately 74 600ha of land and water that incorporates areas of high biodiversity value linked together in a viable network of open spaces. D'MOSS is mapped by the Biodiversity Planning Branch of the Environmental Planning and Climate Protection Department (EPCPD) of eThekwini Municipality, in consultation with relevant experts. Examples of areas included in D'MOSS are nature reserves, rural landscapes in the upper catchments, riverine and coastal corridors and some areas of privately-owned land. From a natural resource perspective, D'MOSS includes ecologically important features such as dams, estuaries, mangrove and swamp forests, dune, coastal and scarp forests, wetlands, floodplains, reedbeds, grassland, dry valley thicket, and woodland, including wooded grasslands. D'MOSS, therefore, provides a unique opportunity to conserve several of South Africa's threatened ecosystems and species. If protected and managed, D'MOSS will assist the province and the country in meeting biodiversity conservation targets.

Figure 3-27 shows the extent of natural areas defined as D'MOSS that fall within the region of the study area. These include all remaining patches of natural bush with the study area, coastal forest and wetland vegetation located in the north-eastern corner of the study area, as well as the iLovu and uMsimbazi estuaries and floodplains.

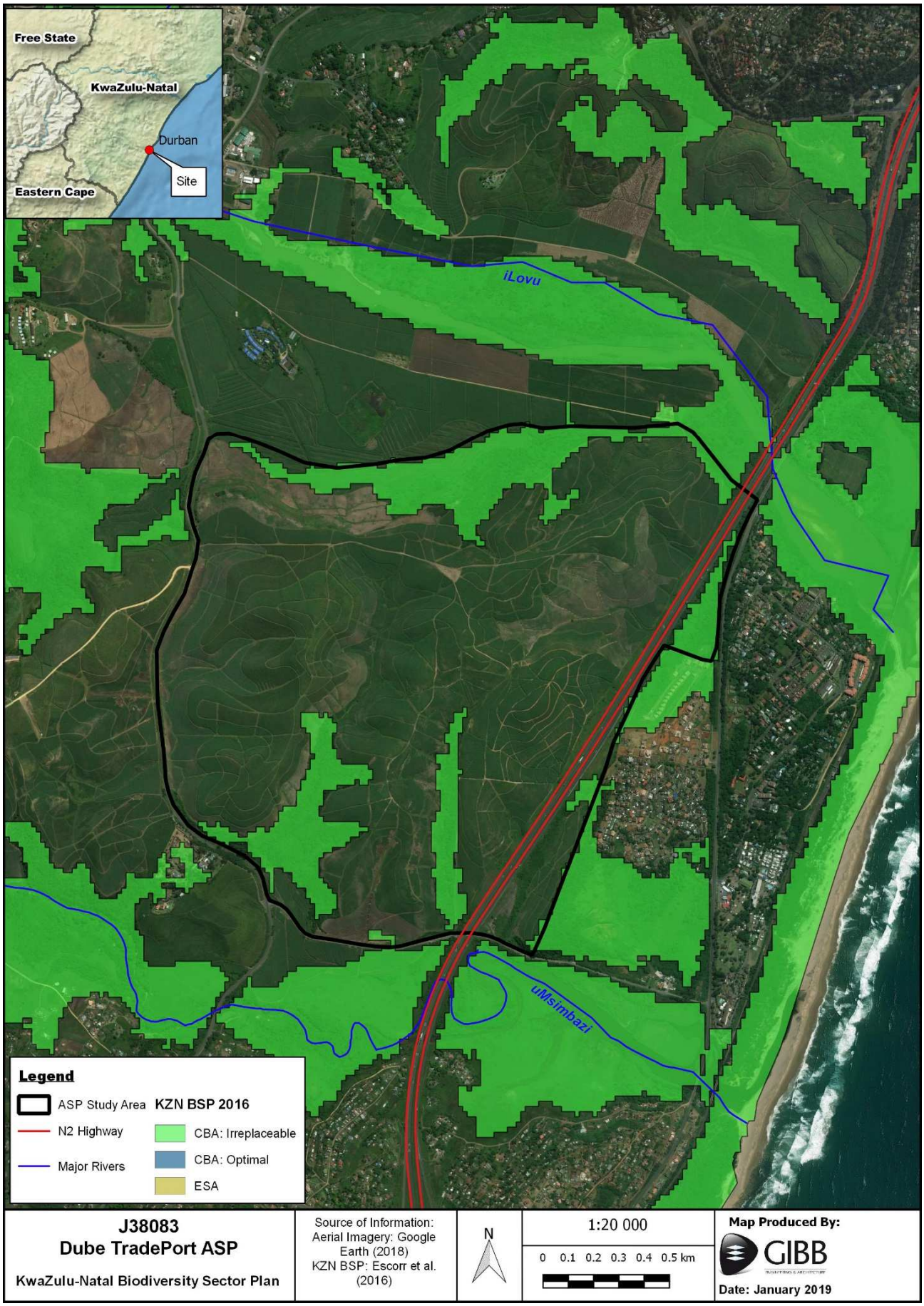


Figure 3-26: The study area in relation to terrestrial CBAs according to the KZN BSP

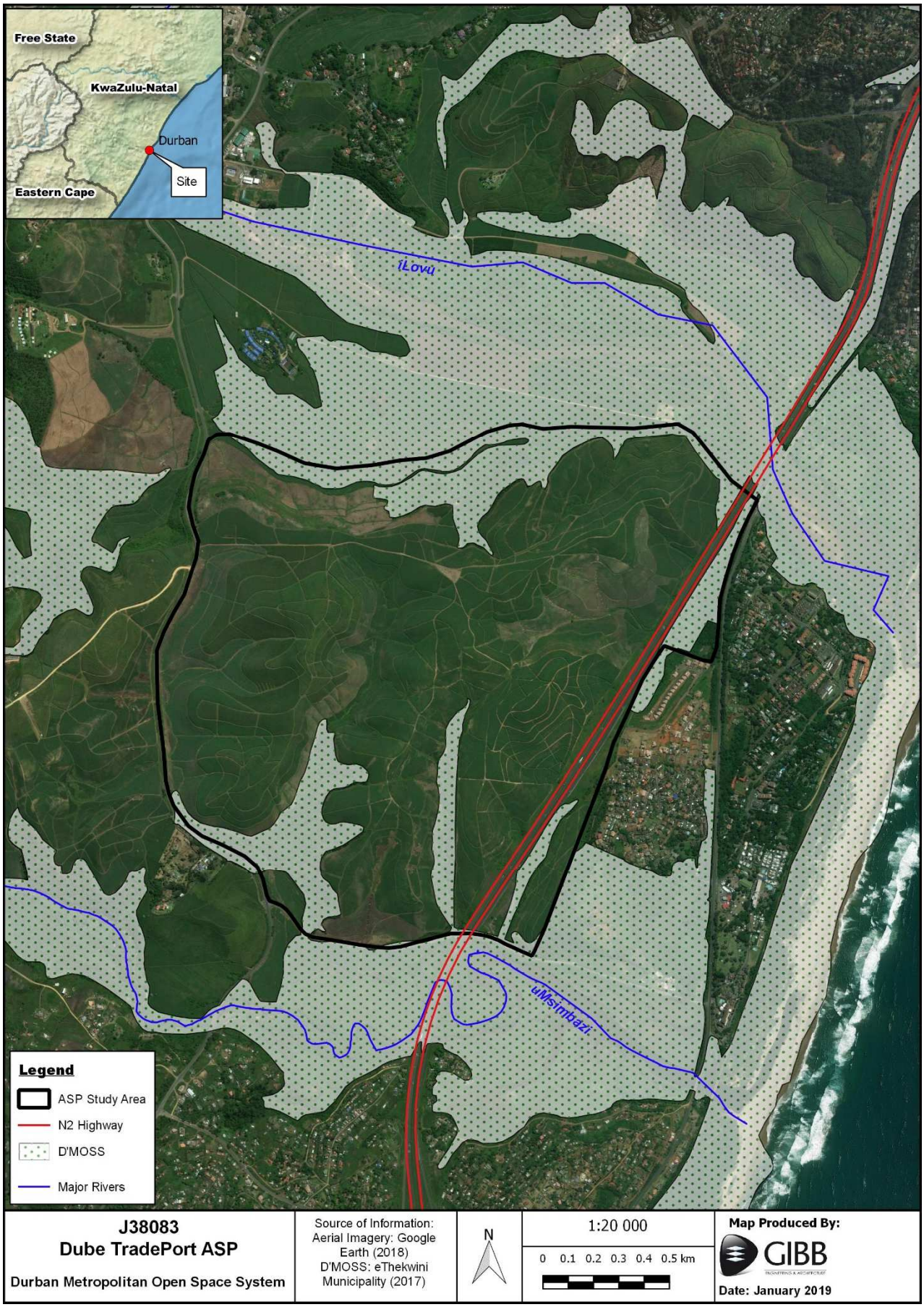


Figure 3-27: The study area in relation to D'MOSS

(vi) Results: Flora

Vegetation Overview

The study area was largely transformed (irreversibly modified) with the majority of the proposed development site for the KZN ASP occurring in sugar cane fields (Figure 3-29). Most areas of the study site and surroundings, which occurred within the original extent of KwaZulu-Natal Coastal Belt Grassland were modified or highly disturbed by agricultural activities. Remaining natural vegetation in the study area from this vegetation type was classified as Coastal Thicket/Scrub and was confined to steep valleys where farming activities were restricted.

The eastern side of the study area supported two small pockets of secondary indigenous forest. The extreme south-eastern corner of the study area incorporated a small portion of Scarp Forest, confined to a small cliff on the northern bank of the uMsimbazi Estuary. According to the development layout at the time of writing, this vegetation would not be affected by the proposed development and was therefore not sampled in detail. The north-eastern corner of the study area between the N2 highway and the R102 regional road supported a small patch of secondary Coastal Forest, as well as wetland habitat. This vegetation will be affected by the proposed development and was further investigated.

Other remaining natural vegetation in the study area included riparian and wetland associated vegetation such as reedbeds, which occurred in drainage lines and wetlands on site, or were associated with the iLovu and uMsimbazi Estuaries. Please refer to the wetland report for the delineation of wetland areas.

Figure 3-28: Character of the study area

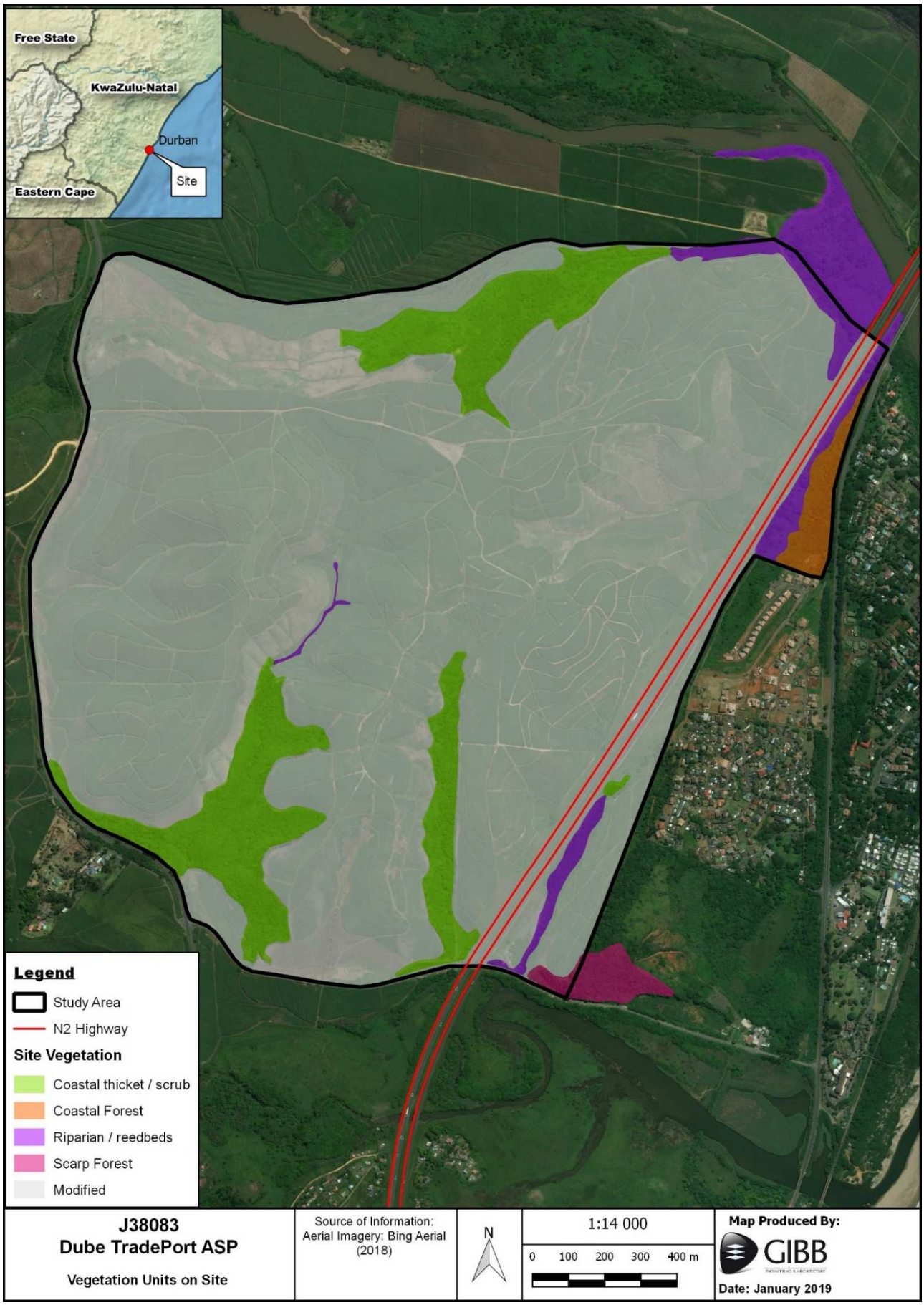


Figure 3-29: Vegetation categories described within the study area

Modified areas

By definition modified areas are those places where anthropogenic activity has substantially altered the primary ecological function and natural species composition of an area. Modified areas on the study site included sugar cane fields, gravel roads and black top roads. Such areas were devoid of natural vegetation.

Figure 3-30: Modified areas within the study area

Coastal Thicket/Scrub

Natural vegetation in the study area remnant of the KwaZulu-Natal Coastal Belt Grassland vegetation type was classified as Coastal Thicket/Scrub and was confined to steep valleys and drainage lines where farming activities were restricted. This vegetation on site was secondary in nature, and heavily infested with alien plants species, especially on the edges, however it comprised some species representative of coastal forest.

Within the KwaZulu-Natal Coastal Belt Grassland vegetation type, forest was rare to non-existent historically, and grassland would dominate where the topography was undulating due to natural processes such as fire (Finch and Hill, 2008). Today, however, with vast areas that were grassland now covered by sugar cane and settlement, grass has become the subordinate feature and woody vegetation has increased due the lack of fire in the landscape (Mucina and Rutherford, 2006; Finch and Hill, 2008). According to historical aerial imagery, all natural vegetation on the site was cleared for sugar cane circa 1937 and perhaps before (see Appendix A of Appendix D17).

Common indigenous species recorded in this vegetation unit included *Albizia adianthifolia, Brachylaena discolour, Bridelia micrantha, Celtis africana, Chrysanthemoides monilifera, Dalbergia obovata, Erythrina lysistemon,* and *Phoenix reclinata*. The most common alien species included *Chromolaena odorata, Ipomoea purpurea, Lantana camara, Melia azedarach, Schinus terebinthifolius, Solanum mauritianum,* and *Tithonia diversifolia*. Most of these species are invasive and require removal and control. Table 6 of Appendix D17 lists some of the species recorded in the vegetation unit.

Figure 3-31: Coastal thicket/scrub within the study area

Coastal Forest

A parcel of land in the north-eastern corner of the study area, between the N2 highway and the R102, supported a small patch of secondary Coastal Forest occurring on a steep, northwest-facing slope, above an Unchannelled Valley Bottom (UCVB) wetland supporting typical wetland habitat (Figure 3-29). This forest vegetation was also secondary in nature (see historical aerial imagery in Appendix A of Appendix D17) and infested with alien plants species, especially on the edges. This vegetation did however comprised species representative of Coastal Forest. A few of the alternatives for access to the development site includes an interchange on the N2 at this point (Option 1 and 1c) as well as a proposed bridge from the site over the N2 to the R102 in the east (Options 1c and 1d). As these layouts impact directly on this parcel of land, the vegetation was categorised further (Figure 3-32).

Dense infestations of alien plant species such as *Albizia lebbeck, Litsea glutinosa* and *Schinus terebinthifolius* dominated the edges of the wetland habitat on the flat, lower-lying portion immediately adjacent to the N2, and the forest vegetation further up the slope towards the R102 (Figure 3-33 and Figure 3-34). Much of the vegetation on the slope was characterised as forest edge habitat (±2.2ha) and comprised coastal scrub species such as *Brachylaena discolour, Chrysanthemoides monilifera*, and *Vachellia karroo* (Figure 3-35). The vegetation became more structured with a more intact canopy and differentiated sub-strata, with species more representative of forest, towards the southern part of the parcel of land (±1.3ha; Figure 3-32, Figure 3-34 and Figure 3-36), near the Larnaco housing development. Species recorded in this area included trees such as *Albizia adianthifolia, Celtis africana, Drypetes natalensis,*

Euclea natalensis, Strelitzia nicolai, Trema orientalis, and *Trichilia dregeana*, and climbers such as *Dalbergia armata, Rhoicissus tomentosa, and Smilax anceps.* Small trees and shrubs included *Diospyros natalensis, Euclea crispa*, *Grewia occidentalis*, and *Gymnosporia nemorosa*, while understorey species included *Chlorophytum comosum, Cyperus albostriatus, Dracaena aletriformis, Isoglossa woodii, Oplismenus hirtellus, and Scadoxus puniceus.* Table 7 of Appendix D17 lists more of the species recorded in the vegetation unit. While the forest is secondary in nature and currently considered highly disturbed, the potential for rehabilitation is present.

In terms of the National Forests Act (1998), trees in all indigenous forests are protected, and Chapter 3, Part 1, Section 7 prohibits the destruction of indigenous trees in any natural forest without a licence.

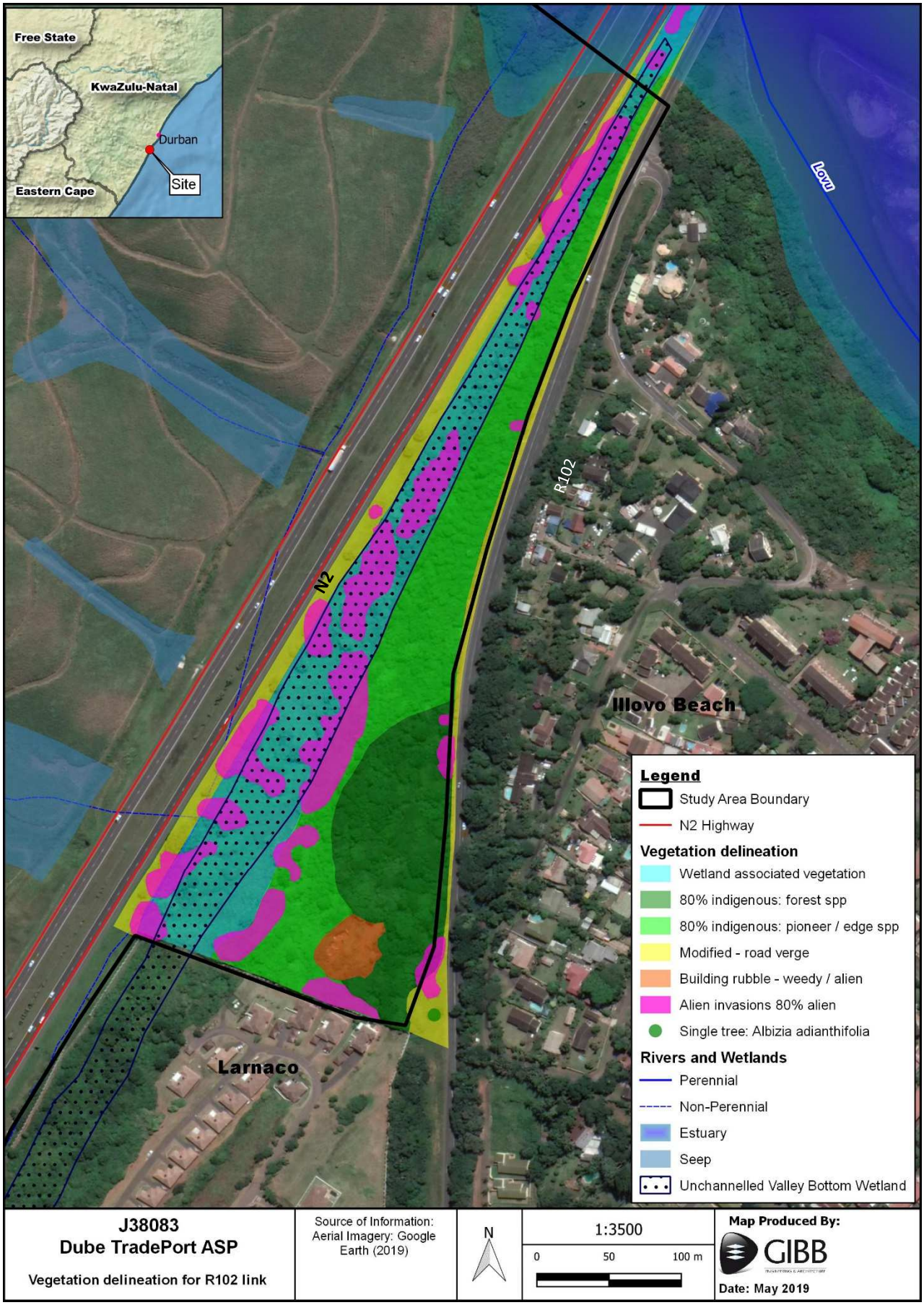


Figure 3-32: Vegetation delineation of the north-eastern corner of the study area

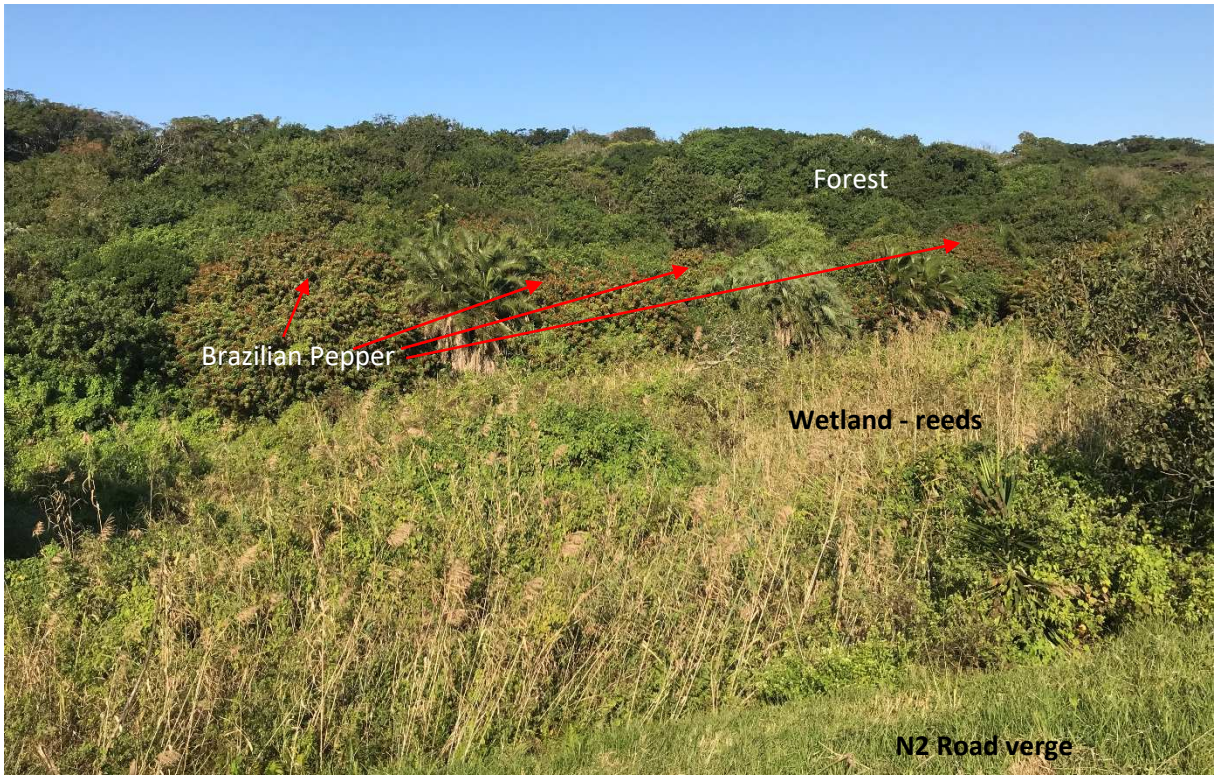


Figure 3-33: Unchannelled Valley Bottom wetland with dense *Schinus terebinthifolius* (Brazilian Pepper) infestations (foreground), with coastal forest vegetation occurring in the background further up the slope

Figure 3-34: Coastal forest occurring on the north-west facing slope near the Larnaco housing development

Figure 3-35: Forest edge / coastal thicket consisting of pioneer species occurring in the northern section towards the iLovu Estuary

Figure 3-36: Coastal forest internal structure

Plants of Conservation Concern

Plants of conservation concern are plants that are important for South Africa's conservation decision-making processes. A plant taxon is of conservation concern when it is considered to be threatened, or close to becoming threatened with extinction and therefore classified as Critically Endangered, Endangered, Vulnerable, or Near Threatened. These plants are nationally protected by NEMBA. Within the context of this report, plants that are Declining, Rare, and Data Deficient (Taxonomic and Distribution) are also referenced under this heading. Removal or trimming of individuals of these species will require a permit that should be accompanied by a rehabilitation plan specifying either re-establishment or rescue and relocation to a suitable site.

According to the Plants of Southern Africa (POSA) website, a minimum of 10 plant species of conservation concern could occur within the study area (Raimondo et al., 2009[28]; SANBI, 2016[29]). These species are listed by SANBI as species occurring in the Quarter Degree Grid Cell (QDGC) 3030BB. Species include *Aloe cooperi, Boophone disticha, Haemanthus deformis* and *Kniphofia glacialis*, none of which were recorded in the study area during the field surveys.

[28] Raimondo, D., Von Staden, L., Foden, W., Victor, J.E., Helme, N.A., Turner, R.C. Kamundi, D.A. and Manyama, P.A. (Eds) (2009): Red list of South African plants 2009, *Strelitzia* 25:1-668.

[29] SANBI Plants of Southern Africa (POSA) (2016): http://posa.sanbi.org/searchspp.php

These species, as well as their habitat requirements and likelihood of occurrence in the study area, are listed in Table 3-18.

Table 3-18: Species of conservation concern and likelihood of occurring in the study area

Species	Conservation Status	Habitat Requirements	Likelihood of occurring in the Study Area
Aloe cooperi	Declining	Moist habitats and dry rocky areas	Low
Boophone disticha	Declining	Coastal or semi-arid areas	Low
Brachystelma sandersonii	Vulnerable	Coastal areas	Medium
Clivia gardenii	Vulnerable	Forest	Medium
Clivia miniata	Vulnerable	Forest	Medium
Crinum moorei	Vulnerable	Coastal forests	Medium
Gasteria croucheri	Vulnerable	Rocky areas	Low
Haemanthus deformis	Vulnerable	Moist shaded slopes	Medium
Hypoxis hemerocallidea	**Declining**	**Wide range of habitats, including sandy hills, forest margins, open rocky grassland, mountain slopes**	**Confirmed**
Kniphofia glacialis	Critical	Coastal grasslands	Low

Provincially Protected Plants

Schedules 7 and 8 of the KwaZulu-Natal Environmental, Biodiversity and Protected Areas Management Bill, 2014 (Gen N4, PG1314, 25 February 2015), protects plant species of conservation concern in KwaZulu-Natal. A number of these species protected under this Bill were recorded within the study area, in most natural bush patches and remnant coastal forest found on site. These are listed in Table 3-19 along with their locality in the study area.

Table 3-19: Provincially protected species occurring in the study area

Taxonomic Name	Common Name	Occurrence in Study Area
Albizia adianthifolia	Flatcrown	Coastal Thicket; Coastal Forest; Modified areas
Dietes iridioides	Wild Iris	Coastal Forest
Dracaena aletriformis	Large-leaf Dragon-tree	Coastal Forest
Harpephyllum caffrum	Wild Plum	Coastal Thicket; Coastal Forest
Hypoxis hemerocallidea	African Potato	Edge of Coastal Thicket
Podocarpus latifolius	Real Yellowwood	Coastal Forest
Protorhus longifolia	Red Beech	Coastal Forest
Strelitzia nicolai	Natal Wild Banana	Coastal Thicket; Coastal Forest
Trichilia dregeana	Forest Natal Mahogany	Coastal Thicket; Coastal Forest
Vepris lanceolata	White Ironwood	Coastal Forest

Nationally Protected Trees

The National Forests Act, 1998 (Act No. 84 of 1998) enforces the protection of a number of indigenous tree species by affording them "Protected" status. As such, the removal, cutting, thinning or relocation of protected trees will require a permit from the Department of Agriculture, Forestry and Fisheries (DAFF). One such species recorded in the Coastal Forest in the study area is *Podocarpus latifolius* (Real Yellowwood). Other Nationally Protected tree species that have a possibility of occurring in the study area include *Pittosporum viridiflorum* (Cheesewood) and *Sideroxylon inerme* subsp. *inerme* (White Milkwood).

Alien and Invasive Plants

Numerous alien species were recorded throughout the study area and included *Albizia lebbeck, Cestrum laevigatum, Chromolaena odorata, Lantana camara, Litsea glutinosa, Melia azedarach, Schinus terebinthifolius,* and *Solanum mauritianum*. Appendix D of Appendix D17 summarises the alien species recorded in the study area as well as their NEMBA categories.

(vii) Results: Fauna

Faunal Habitat

The study area was largely transformed with sugar cane covering most areas of the site proposed for the development of the KZN ASP. Important faunal habitat in the study area included wooded areas provided by the coastal thicket and coastal forest, wetland habitat and drainage lines supporting reeds and other riparian habitat, as well as the riparian and estuarine habitat associated with the two major river systems bordering the site to the north and to the south. During the field surveys, high faunal activity (especially avifauna) was observed in and around these habitats.

The wooded drainage lines and coastal forest, combined with riparian and wetland habitat, provided high habitat heterogeneity for fauna in the study area by providing ample shelter, feeding, and breeding habitat for birds, mammals, amphibians, reptiles and invertebrates. Wooded habitat has a multi-layered vegetation structure dominated by evergreen or semi-deciduous trees and shrubs, with an herbaceous understorey (Lawes, 2002[30]; Mucina and Rutherford, 2006). This complexity of strata provides multiple habitats and niches for fauna to occupy and as such, wooded areas are generally high in biodiversity.

Watercourses and wetlands are usually areas of high faunal diversity as the riparian environment and dense vegetation provides abundant cover, feeding and breeding habitat for many species of invertebrates, birds, mammals, reptiles, amphibians and fish. When it is available, surface water provides drinking water for many faunal species while the soft substrate provides perfect burrowing environments for fossorial animals. The increase in prey and vegetation attracts a high diversity of birds as well as terrestrial mammals and reptiles (including predators).
Please note that in the context of this report, wetland habitat refers to the physical habitat features associated with moist areas that are utilised by fauna for shelter, foraging or

[30] Lawes, M.J. (2002): The Forest Ecoregion, In: *The Biodiversity of South Africa 2002. Indicators, Trends and Human Impacts*, Cape Town: Struik.

breeding, and does not denote the extent of any wetland. Please refer to the wetland delineation report for details pertaining to the extent of wetlands within the area of study.

Figure 3-37: Examples of faunal habitat in the study area including large reedbeds associated with the estuaries (top), wooded habitats (middle), and wetland and riparian habitat associated with the drainage lines (bottom)

Faunal Species Occurrence

Following is an account of the faunal species associated with the study area and those confirmed or likely to occur on the site. Refer to the appendices for detailed lists of the species discussed below. Species of conservation concern are those with a Red List status (national and global) higher than Least Concern and includes Protected species (provincial and national).

Avifauna

The region is high in avifaunal diversity with approximately four hundred and tewrnty-five (425) bird species occurring within QDGC 3030BB. Of this total, approximately thirty-five (35) species (8%) are marine pelagic, occurring mainly on the open ocean, and are unlikely to occur on or near the site. Of the remaining three hundred and ninety (390) terrestrial species, approximately three hundred and thirthy-three (332) species (85%) are associated with wooded habitats and inland water systems. This highlights the importance of these habitats in the study area and at a regional level.

During the field surveys, 85 bird species were observed in and around the study area. These are listed in Table 10 of Appendix D17 along with their provincial protection status (KZN, 1974[31]) and national (Taylor *et al.,* 2015[32]) and global (IUCN [World Conservation Union] Red List of Threatened Species, 2019[33]) conservation status. Bird species observed on site consisted of generalist species, riverine/wetland species, waterfowl, and those generally associated with wooded habitats.

A lower level of endemism exists in the eastern regions of South Africa, compared to the central and western sections of the country, with only thirthy-one (31) species endemic to southern Africa occurring in QDGC 3030BB. Conversely, due to the higher avifaunal diversity present as well as the level of habitat destruction in the biome, a larger proportion of species are of conservation concern compared to the central and western regions of the country. Fifty-six (56) bird species occurring in the QDGC are of conservation concern either provincially (KZN, 1974), nationally (Taylor *et al*., 2015) or globally (IUCN, 2019) (Appendix E of Appendix D17). This includes twenty-two (22) species that are marine pelagic and are unlikely to occur on or near the site.

Five bird species endemic to southern Africa were confirmed to occur in the study area during the field surveys, namely *Pternistis natalensis* (Natal Spurfowl), *Laniarius ferrugineus* (Southern Boubou), *Batis capensis* (Cape Batis), *Zosterops capensis* (Cape White-eye), and *Passer melanurus* (Cape Sparrow). One bird species of conservation concern, *Balearica regulorum* (Grey Crowned Crane), currently listed as Endangered at a national and global level, was recorded in the study area. A small group (around 5 individuals) was observed flying towards the uMsimbazi Estuary. An additional five bird species of conservation concern were given a high likelihood of occurring on or near the site due to the presence of suitable habitat, mainly provided by the two estuaries.

Eleven bird species that are protected by provincial legislation under the KwaZulu-Natal Environmental, Biodiversity and Protected Areas Management Bill, 2014 (General Notice 4, February 2015) were recorded in the study area during the field surveys (Table 10 of Appendix D17).

[31] KZN (KwaZulu-Natal) (1974): *Natal Nature Conservation Ordinance No. 15 of 1974*, KZN Provincial Ordinance.

[32] Taylor, M.R., Peacock, F. and Wanless, R.M. (eds.) (2015): Eskom Red Data Book of Birds of South Africa Lesotho and Swaziland, Johannesburg: BirdLife South Africa.

[33] IUCN (2019): IUCN Red List of Threatened Species, Version 2019-2: http://www.iucnredlist.org

Mammals

The region includes a relatively high diversity of mammals with approximately 90 terrestrial species expected to occur within the study area. These species are listed in Appendix F of Appendix D17 along with the likelihood of each species occurring in the study area as well as their provincial protection status (KZN, 1974) and national (Child *et al*., 2016[34]; DEA, 2015[35]) and global (IUCN, 2019) conservation status.

During the field surveys, six mammal species were recorded in the study area (Table 10 of Appendix D17). These were confirmed via droppings, spoor, mounds or sighting, all within the natural wooded habitat on site. A further twenty (20) mammal species were given a high likelihood of occurring in the study area and include species that inhabit wooded areas as well as generalist species that are tolerant of disturbed habitat. This includes four mammal species of conservation concern, namely *Otomops martiensseni* (Large-eared Free-tailed Bat), *Dendrohyrax arboreus* (Tree Hyrax), and *Philantomba monticola* (Blue Duiker) currently listed as Vulnerable, and *Hypsugo anchietae* (Anchieta's Pipistrelle) currently listed as Near Threatened. Appropriate habitat in and around Durban is known as important foraging habitat for *Otomops martiensseni*, a species with a known range-restricted to the coast between Ballito and Port Shepstone.

Herpetofauna

Amphibians

According to FrogMAP (Minter *et al*., 2004[36]; ADU, 2019[37]), the continuation of the Southern African Frog Atlas Project (SAFAP), 36 amphibian species are likely to occur within QDGC 3030BB. These are listed in Appendix G of Appendix D17 along with their national (Measey, 2011[38]) and global (IUCN, 2017) conservation status.

Six amphibian species were recorded in the study area during the daytime and nocturnal field surveys (Table 10 of Appendix D17). This includes two species endemic to southern Africa, *Arthroleptis wahlbergii* (Bush Squeaker), and *Leptopelis natalensis* (Natal Tree Frog), both of which are also range-limited species. Amphibians were recorded mostly in the wooded drainage lines and reedbeds associated with the uMsimbazi Estuary. An additional seven species were given a high likelihood of occurring in the study area due to the presence of suitable habitat (Appendix G of Appendix D17). This includes one species of conservation concern, *Afrixalus spinifrons* (Natal Leaf-folding Frog), a provincially protected species

[34] Child, M.F., Raimondo, D., Do Linh San, E., Roxburgh, L., Davies-Mostert, H. (2016): *The Red List of Mammals of South Africa, Swaziland and Lesotho*, South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa.

[35] DEA (Department of Environmental Affairs) (2015): NEMBA 2004 (Act 10 of 2004): Threatened or Protected Species Regulations, Government Gazette No. 38600, 31 March 2015, Pretoria: DEA.

[36] Minter, L.R., Burger, M., Harrison, J.A., Braack, H.H., Bishop, P.J. and Kloepfer, D. (eds) (2004): Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland, SI/MAB Series no. 9, Washington, D.C.: Smithsonian Institution.

[37] Animal Demography Unit: FrogMAP – South African Frog Atlas Project (SAFAP) (2019): http://vmus.adu.org.za

[38] Measey, G.J. (ed.) (2011): Ensuring a future for South Africa's frogs: a strategy for conservation research, SANBI Biodiversity Series 19, Pretoria: South African National Biodiversity Institute.

currently listed as Near Threatened, and one endemic species, *Breviceps verrucosus* (Plaintive Rain Frog).

The Critically Endangered and Protected *Hyperolius pickersgilli* (Pickersgill's Reed Frog) was given a medium likelihood of occurring in the study area. While this rare and localised species was not detected during the field surveys, it does not rule out the possibility of it occurring in the study area. According to Jeanne Tarrant of the Endangered Wildlife Trust (EWT), Manager of the Threatened Amphibian Programme, the proposed site for the ASP falls well within the range of *Hyperolius pickersgilli*, however there have been no records within the study area with the closest located 5km to the north and 10km to the south (pers. comm., January 2019). Most of the proposed layout does not impact on intact wetland habitat suitable for this species. However, it is recommended that a follow-up survey be conducted by a suitably qualified herpetologist following good spring rains, prior to construction commencing, to confirm the absence/presence of the species.

Reptiles

According to ReptileMAP (Bates *et al*., 2014[39]; ADU, 2019[40]), fifty-two (52) terrestrial reptile species have been confirmed to occur within QDGC 3030BB. These are listed in Appendix H of Appendix D17 along with their provincial protection status (KZN, 1974) and national (Bates *et al.,* 2014) and global (IUCN, 2019) conservation status. While no reptiles were encountered during the field surveys, twenty-one (21) species were given a high likelihood of occurring in the study area due to the presence of suitable habitat (Appendix H of Appendix D17). This includes eight species endemic to southern Africa, one species protected by provincial legislation, *Varanus niloticus* (Water Monitor), and two species of conservation concern, namely *Bradypodion melanocephalum* (KwaZulu Dwarf Chameleon), currently listed as Vulnerable, and *Macrelaps microlepidotus* (Natal Black Snake) currently listed as Near Threatened.

Bradypodion melanocephalum (KwaZulu Dwarf Chameleon) is found predominantly in coastal regions of KwaZulu-Natal and extends inland for about 100km. The species appears to inhabit a number of vegetation types within grassland, savanna, coastal bush, and forest, and individuals are known to inhabit seemingly disturbed areas, such as at roadsides. Adults often inhabit small patches of structured habitat including alien vegetation (Bates et al., 2014). Endemic to the eastern regions of South Africa, *Macrelaps microlepidotus* (Natal Black Snake) is found in forests and coastal bush in moist leaf litter or humic soils, and usually associated with damp localities near water (Bates *et al*., 2014). Habitat for both these species exists in the study area.

As part of the development layout (proposed N2 interchange and bridge to the R102) affects the forest habitat in the north-eastern corner of the study area, and the proposed platforms will be constructed in close proximity to the edges of the coastal thicket habitat on the site, it

[39] Bates, M.F., Branch, W.R., Bauer, A.M., Burger, M., Marais, J., Alexander, G.J. and de Villiers, M.S. (Eds) (2014): Atlas and Red List of the Reptiles of South Africa, Lesotho and Swaziland, Suricata 1, Pretoria: SANBI.

[40] Animal Demography Unit: ReptileMAP – South African Reptile Conservation Assessment (SARCA) (2019): http://sarca.adu.org.za

is recommended that a site specific Species Management Plan including Search and Rescue Plan for *Bradypodion melanocephalum* be written by a suitably qualified herpetologist and implemented prior to construction.

Terrestrial Macro-Invertebrates

Invertebrate species of conservation importance that occur in KwaZulu-Natal are listed in Table 11 of Appendix D17, along with their likelihood of occurrence on the study site.

(viii) Habitat Assessment and Sensitivity Analysis

Sensitivity Analysis and Criteria

The study area was assessed in terms of its ecological importance, which took both **ecological function** and **conservation value** from a floral and faunal perspective into account. Importance, and therefore sensitivity to development, was classified as follows:

- High – Areas that contain predominantly natural habitat and are important in maintaining biodiversity in the region. These areas have both high ecological function and conservation importance. Destruction of this habitat may result in a regional loss of biodiversity;

  Note: According to the vegetation sensitivity mapping rules of the Guidelines for Biodiversity Impact Assessment in KwaZulu-Natal (EKZNW, 2013[41]), all indigenous forest regardless of condition must be designated as sensitive. Furthermore, any vegetation that falls within a Critically Endangered vegetation type must be designated as sensitive.

- Medium – Habitat recorded on site that has medium ecological importance. These areas contain secondary vegetation / semi-natural habitat or modified habitat utilised by fauna (may include alien vegetation). These areas either have the potential for conservation (if rehabilitated for example) and moderate ecosystem function or may have high ecological function and low conservation importance. Destruction of this habitat will not result in significant loss of biodiversity from a regional perspective; and

- Low – Habitat recorded within the study area that has low ecological importance. These areas have little or no ecological function and conservation importance due to the high level of transformation and/or degradation.

Please note that areas may be classified by a combination of the above categories, e.g. medium-high, if for example an area is disturbed and has moderate ecosystem function but if rehabilitated may provide habitat for species of conservation concern and/or biodiversity features identified by the KZN BSP for CBA: Irreplaceable, and the site could contribute to reaching conservation targets for these features. Alternatively, an area may have high ecological function but is fragmented and too small to offer high conservation value.

[41] EKZNW (Ezemvelo KwaZulu-Natal Wildlife) (2013): Guideline for Biodiversity Impact Assessment in KwaZulu-Natal, Version 2, EKZNW Scientific Services, Pietermaritzburg.

Definitions:

Ecological Function: Ecological function describes the intactness of the structure and function of the vegetation communities which in turn support faunal communities. It also refers to the degree of ecological connectivity between the identified vegetation association and/or habitats and other systems within the landscape. Therefore, systems with a high degree of landscape connectivity among each other are perceived to be more sensitive.

- High – Natural areas with no or low evidence of human impact are considered to have intact ecosystem function and are considered important for the maintenance of ecosystem integrity. Most of these habitats are represented by vegetation communities in late succession and ecosystems with connectivity to other important ecological systems or are specialised habitats for fauna. These areas also offer valuable ecosystem services;
- Medium – Habitat that occurs at disturbances of medium intensity and is representative of vegetation communities in secondary succession stages with some degree of connectivity with other ecological systems. These areas, although often disturbed, are usually utilised by fauna; and
- Low – Degraded and highly disturbed habitat or modified vegetation with little or no ecological function.

Conservation Importance: The conservation importance of the site gives an indication of the necessity to conserve areas based on factors such as the importance of the site on a regional, provincial or national scale and on the ecological state of the area (level of degradation/disturbance). This is determined by the number of species, presence of rare, threatened, protected or endemic species, threatened ecosystems and areas that are protected by legislation.

- High – Ecosystems or habitats with high species richness and usually provide suitable habitat for species of conservation concern, or habitats representative of a threatened ecosystem. These areas should be maintained for the persistence of biodiversity;
- Medium – Habitats with intermediate levels of species richness without any species of conservation concern; and
- Low – Areas with little or no conservation potential and are usually species-poor or contain transformed and/or degraded habitat (majority of species are usually alien).

<u>Ecological Sensitivity within the Study Area</u>

Based on the findings of the ecological assessment and the above criteria, importance of habitats pertaining to flora and fauna, and thus sensitivity to the proposed development, was mapped (Figure 3-38 and Figure 3-39).

Highly Sensitive Habitats

All natural vegetation associated with the iLovu and uMsimbazi Estuaries was classified as highly sensitive (Figure 3-38). Estuaries are extremely important in maintaining biodiversity

at a regional level and have both high ecological function and conservation importance. Destruction of this habitat, especially the uMsimbazi Estuary, will result in a regional loss of biodiversity. The uMsimbazi Estuary falls within the Ecological Category B+ (MER, 2019[42]) and is gazetted as such, which means that its catchment must be managed to remain in this category.

The UCVB wetland that occurs adjacent to the N2 in the north-eastern corner of the study area, and flows in a northerly direction into the iLovu Estuary, was designated as highly sensitive (Figures 3-38 and Figure 3-39). Although this wetland has been severely impacted on by the construction of the N2 and invasive alien plant species such as *Albizia lebbeck* and *Schinus terebinthifolius*, it provides essential ecosystem services and serves as an ecological corridor between the portion of the wetland occurring immediately to the south (within the Larnaco housing development boundary) and the iLovu Estuary to the north (Figures 3-38 and Figure 3-39). The portion of the wetland within the Larnaco boundary was designated a conservation servitude and wetland offset for the housing development and is, therefore, a formally protected area (Figure 3-39). It is therefore important to maintain the ecological integrity of the wetland connecting it to the estuary.

The Guideline for Biodiversity Impact Assessment in KZN (EKZNW, 2013) requires all indigenous forest, regardless of condition, to be designated as sensitive. All indigenous forest in the study area, including the Coastal Forest in the north-eastern corner and the Scarp Forest in the south-eastern corner, was therefore classified as highly sensitive. This forest vegetation was confirmed to be secondary (see historical aerial imagery, Appendix A of D21) and disturbed, however, rehabilitation will be possible. According to the buffer determination guidelines for Biodiversity Impact Assessment in KZN (EKZNW, 2013), secondary forest requires a minimum buffer of 20m from the ecotone.

As the coastal forest is directly impacted by one of the proposed alternatives for access to the site (N2 Interchange Option 1c and Bridge to the R102 Option 1d), the forest sensitivity was further delineated (Figure 3-39). (See Section 6 Impact Assessment of Appendix D17) for further details regarding impacts). The area considered to be most representative of coastal forest and containing predominantly indigenous species (±1.3ha) was designated highly sensitive. The surrounding edge community consisting of mostly pioneer species (similar to coastal thicket) was designated as medium-high sensitivity (±2.2ha). All alien infestations and modified areas such as the road verge was designated as not sensitive. A small area within the forest near the Larnaco boundary was recently disturbed (*circa* 2011) by building activity, and then abandoned. This area consisted of building rubble and covered mostly with weedy and alien plant species. This portion was designated as not sensitive (Figure 3-39).

[42] MER (Marine and Estuarine Research) (2019): Preliminary Estuarine Report for the KZN Automotive Supplier Park Project, MER Draft Report.

Medium-high Sensitivity

The patches of coastal thicket within the study area were considered to be of medium-high ecological sensitivity. While these areas were confirmed to be secondary in nature (see historical aerial imagery, Appendix A of Appendix D17), the habitat is considered important because of the diversity of vegetation and fauna it supported, including species that are threatened or protected. These habitats represented natural vegetation remnant of KwaZulu-Natal Coastal Belt Grassland in the study area, and serve important functions as ecological corridors and habitat filtration mechanisms as wooded drainage lines upstream of the uMsimbazi and iLovu estuaries. These habitats have high potential for rehabilitation.

Medium Sensitivity

Areas of medium ecological sensitivity included wetlands and drainage lines in the study area that were highly modified by agricultural activities and invasive alien plant infestations. These areas still performed important ecological functions, and have high potential for rehabilitation. Once rehabilitated these areas along with the wooded drainage lines could provide important biodiversity value to the landscape by creating ecological corridors and connectivity between the estuaries.

Low Sensitivity

All areas covered with sugar cane as well as roads, road verges, and settlement were considered to be of low ecological importance and sensitivity.

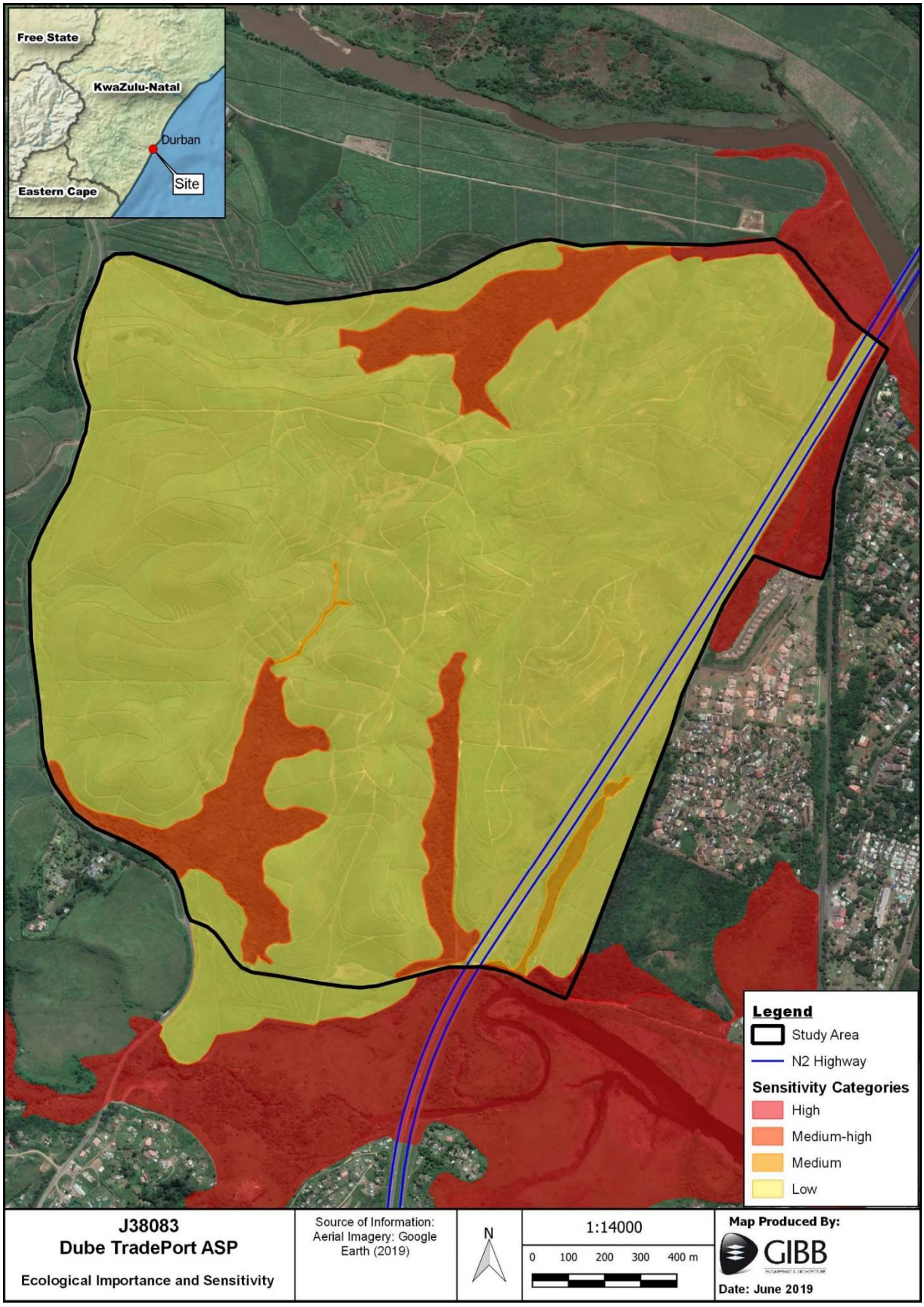


Figure 3-38: Areas of ecological importance and sensitivity in the study area

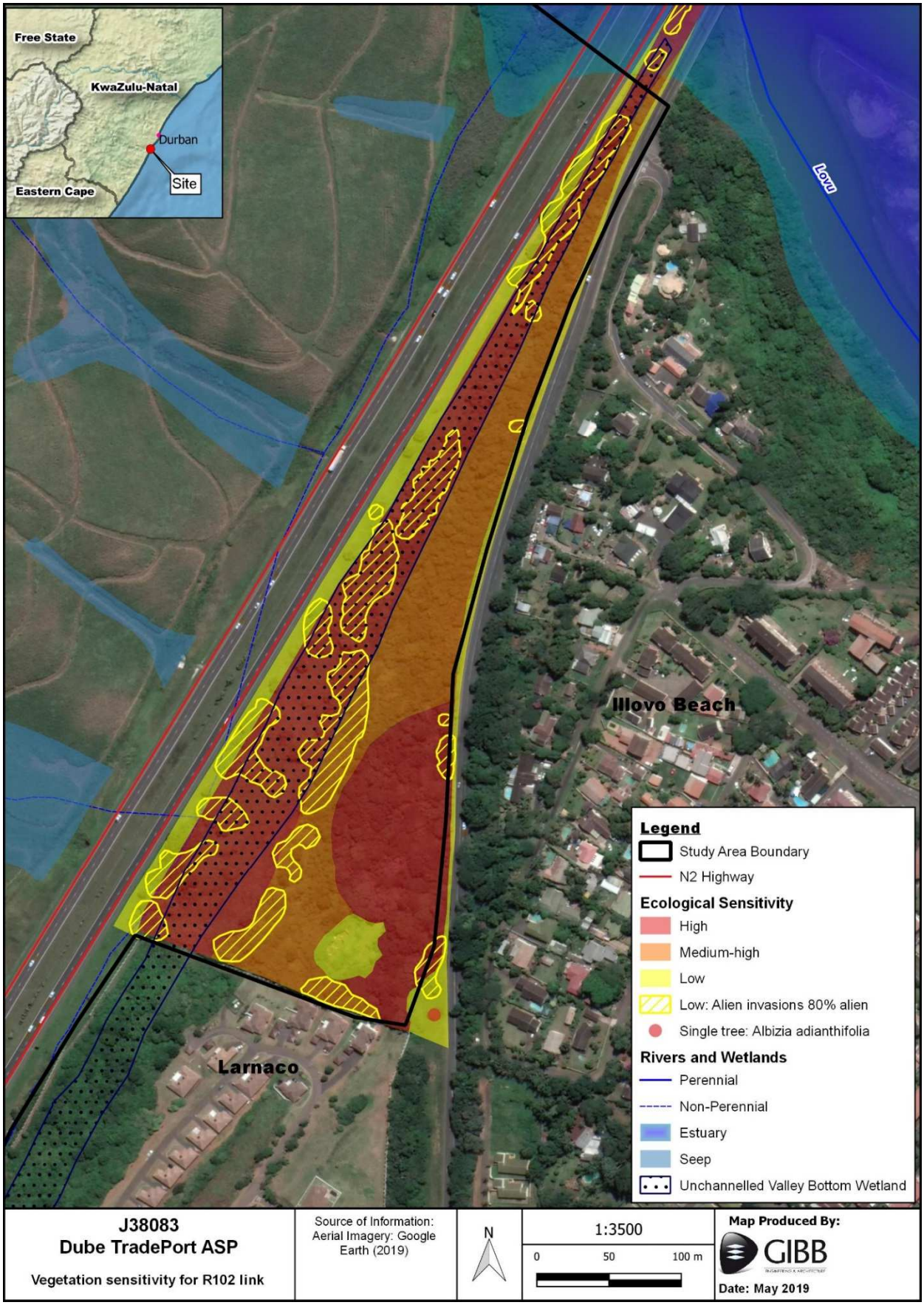


Figure 3-39: Ecological importance and sensitivity of the coastal forest and wetland in the north-eastern corner of the study area

(b) Proposed sewer line

An Ecological Assessment was undertaken by GIBB (Pty) Ltd for the proposed sewer rising main for the proposed KZN ASP development (Appendix D18).

(i) Regional Vegetation

According to Mucina and Rutherford (2018) on a national scale, two terrestrial vegetation types occur in vicinity of the proposed sewer line route, namely KwaZulu-Natal Coastal Belt Grassland, and Subtropical Alluvial Vegetation. According to Scott-Shaw and Escott (2011) in KwaZulu-Natal, four vegetation types occur in the vicinity, namely KwaZulu-Natal Coastal Belt Grassland, Subtropical Alluvial Vegetation, Marine Saline Wetlands, and KwaZulu-Natal Coastal Forests: Southern Moist Coastal Lowlands Forest. Of the terrestrial vegetation types, only the **KwaZulu-Natal Coastal Belt Grassland** is likely to be affected by the proposed development directly.

(ii) Conservation Targets and Status for Vegetation Types in KwaZulu-Natal

The study area falls within the KwaZulu-Natal Coastal Belt Grassland, which is currently listed as Critically Endangered in KwaZulu-Natal. According to EKZNW (Jewitt, 2011), approximately 89% of KwaZulu-Natal Coastal Belt Grassland was transformed (as at 2008), which is almost double the percentage estimated by Mucina and Rutherford (2006). The conservation target of this vegetation type is 25% and less than 1% receives formal protection.

(iii) Listed Terrestrial Ecosystems

The proposed sewer line traverses two ecosystems that are listed in terms of Section 52 of NEMBA (DEA, 2011). The Interior South Coast Grasslands ecosystem (KZN7), and the Southern Coastal Grasslands ecosystem (KZN18) were both listed as Critically Endangered, under Criterion F since they are part of the priority areas needed for meeting explicit biodiversity targets as defined in a systematic biodiversity plan. These areas are considered to have undergone severe degradation of ecological structure, function or composition as a result of human intervention and are subject to high risk of irreversible transformation.

(iv) KwaZulu-Natal Systematic Conservation Planning

According to the KZN BSP, portions of the sewer line route fall in close proximity to or span areas classified as **CBA: Irreplaceable**. Such areas of the site include remnants of natural bush with the study area, such as wooded drainage lines, and natural areas associated with the iLovu and Little Amanzimtoti Rivers. Most of these areas will be avoided due to position of the pipeline proposed to be routed within the road reserve along the entire route.

(v) The Durban Metropolitan Open Space System

Figure 3-44 shows the extent of natural areas defined as D'MOSS that fall within the region of the study area. These include all remaining patches of natural bush with the study area, such as wooded drainage lines, and natural areas associated with the iLovu and Little Amanzimtoti Rivers. Most of these areas will be avoided due to position of the pipeline proposed to be routed within the road reserve along the entire route.

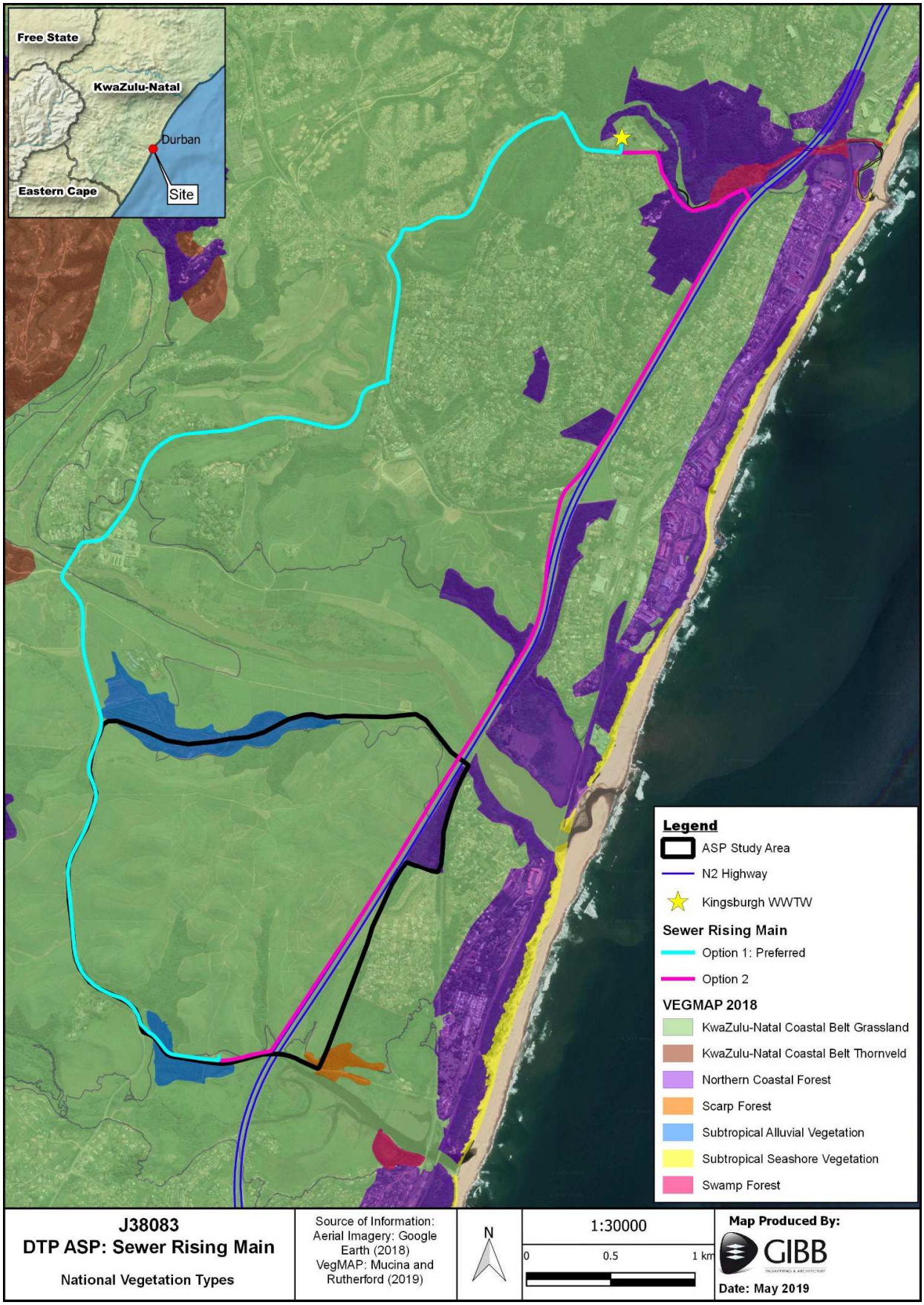


Figure 3-40: The proposed sewer line in relation to national vegetation types

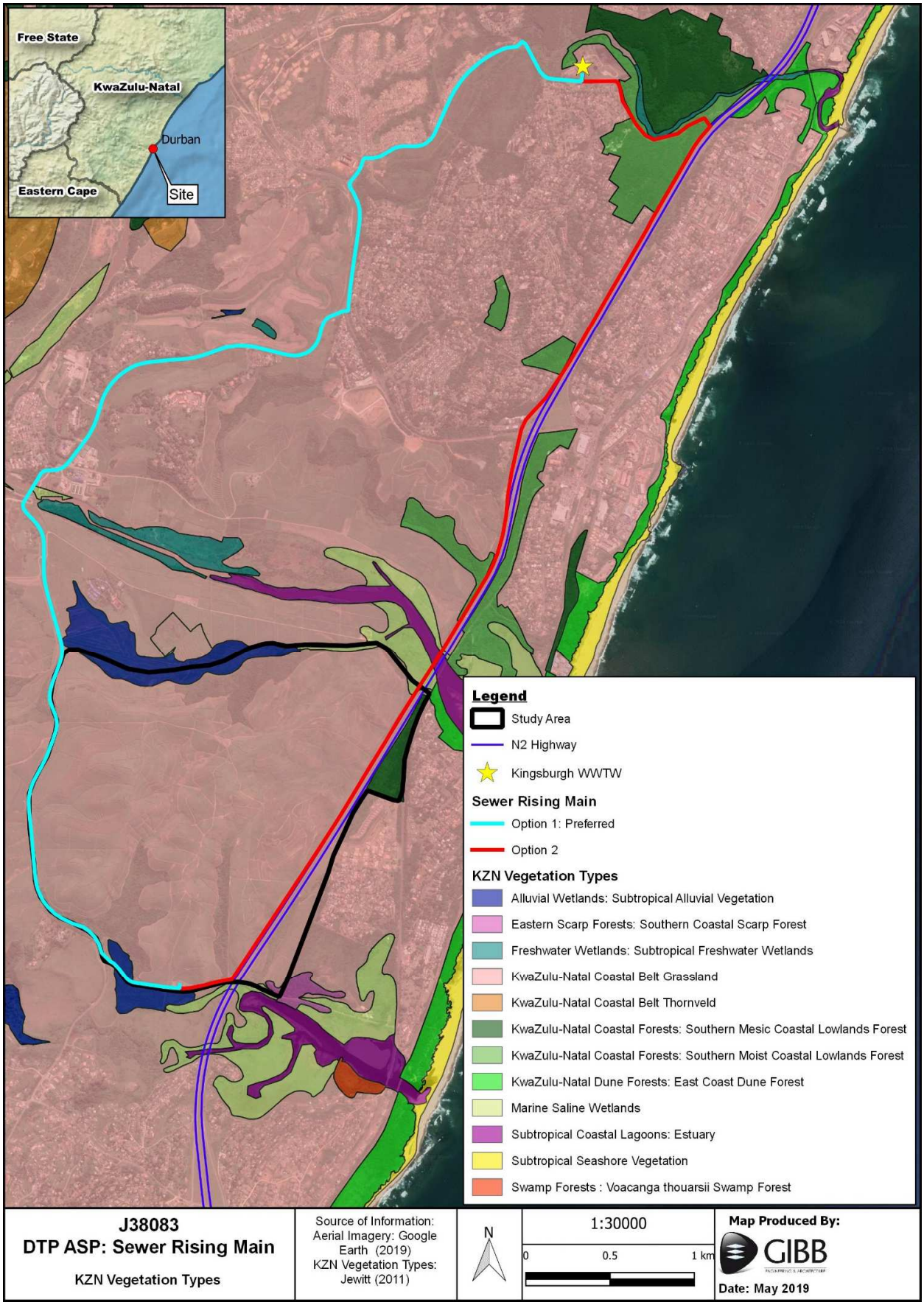


Figure 3-41: The proposed sewer line in relation to KZN vegetation types

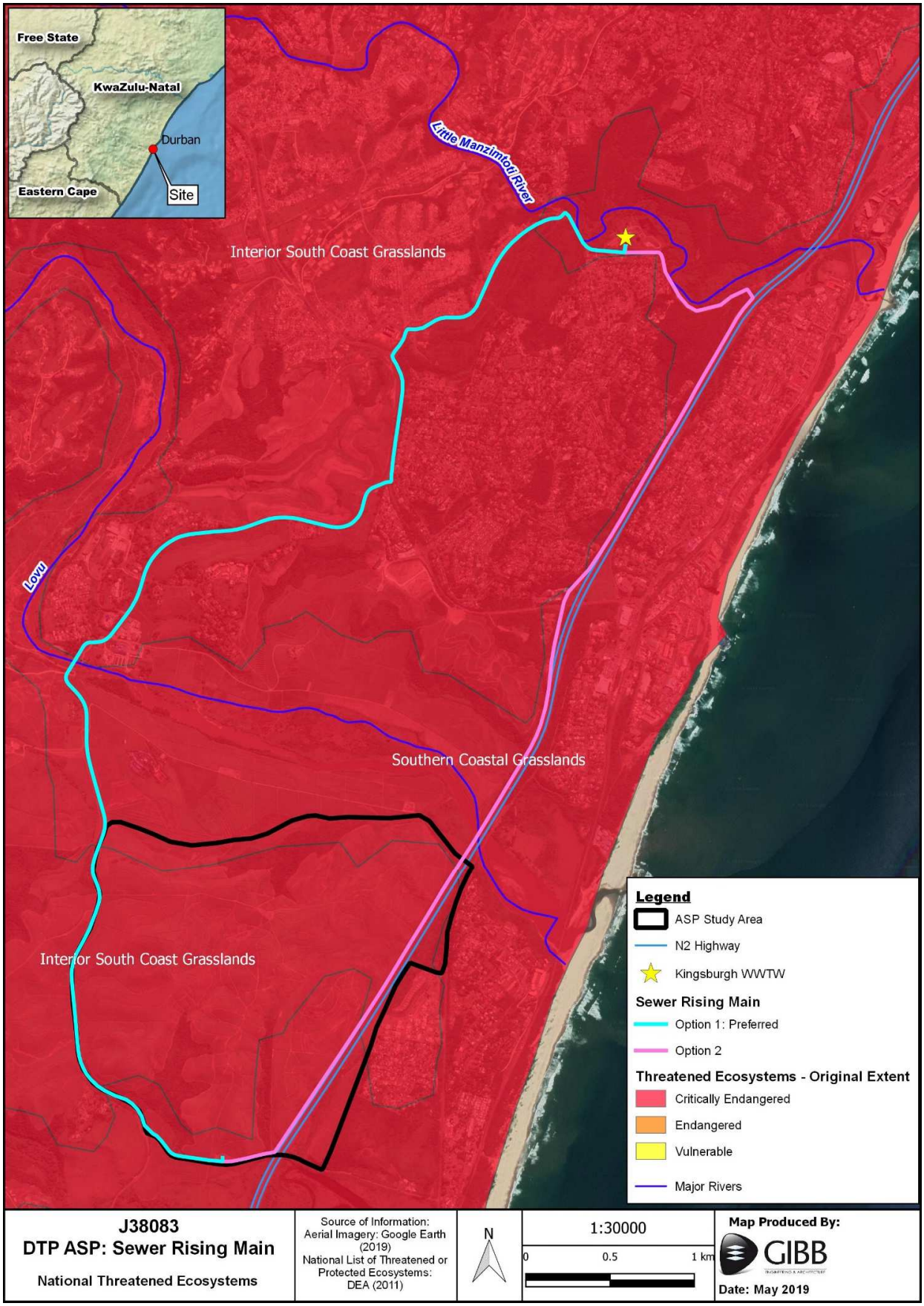


Figure 3-42: The proposed sewer line in relation to national threatened ecosystems

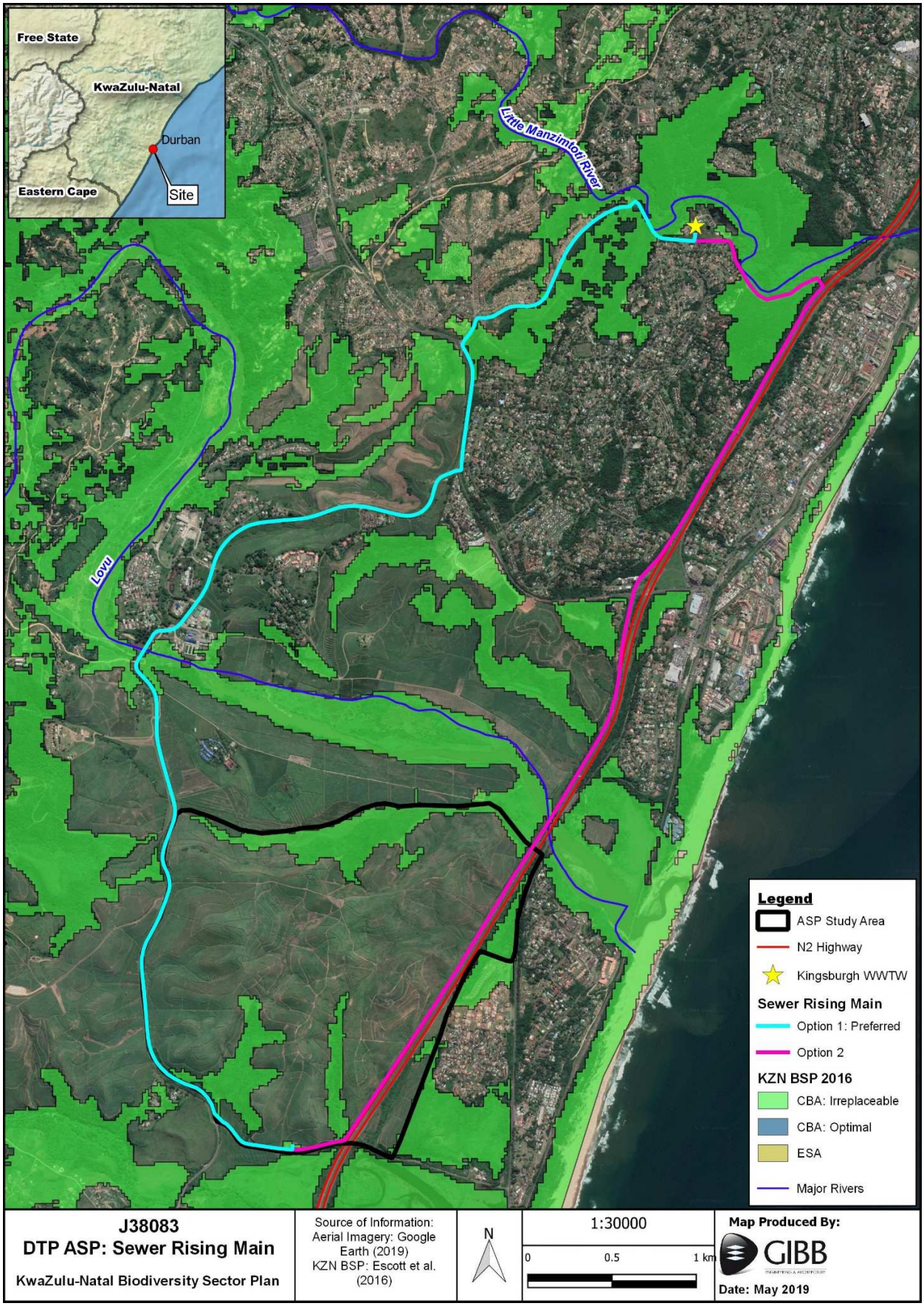


Figure 3-43: The proposed sewer line in relation to terrestrial CBAs according to the KZN BSP

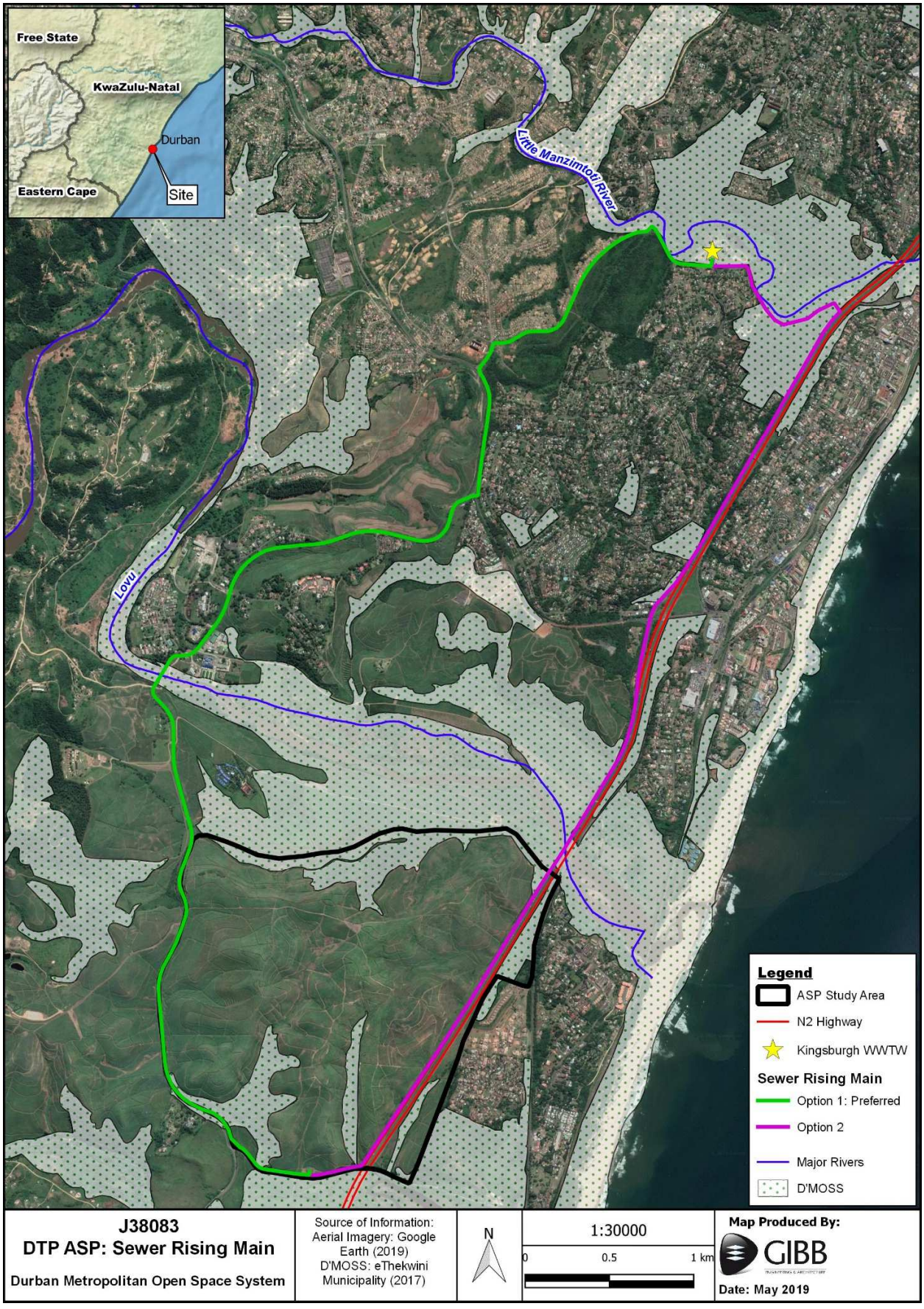


Figure 3-44: The proposed sewer line in relation to D'MOSS

(vi) Results: Flora

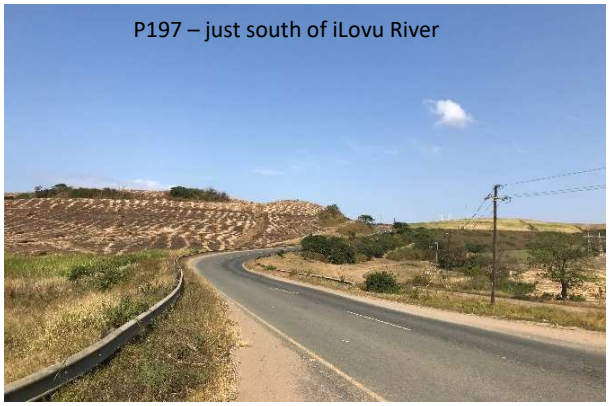
Vegetation Overview

Most of the study area and surroundings, which occurred within the original extent of KwaZulu-Natal Coastal Belt Grassland, were modified or highly disturbed by anthropogenic activities. The entire route of the sewer pipeline is proposed to be within the road reserve of various black-top roads until it reaches the existing Kingsburgh WWTW. The study area was largely transformed (irreversibly modified) with the majority consisting of sugar cane fields, residential settlement, and light industrial warehouses. Remaining natural vegetation in the study area from this vegetation type was classified as Coastal Thicket/Scrub and was confined to steep slopes and valleys where farming and development activities were restricted. Coastal Thicket associated with the Little Amanzimtoti also occurred in the northern end of the route. Other remaining natural vegetation in the study area included riparian vegetation associated with the iLovu River and Estuary.


P491 (Long Road) – south near start


P197 – southern reaches


P197 – southern reaches


P197 – just south of iLovu River


P197 – just north of iLovu River


P197 – heading north to R603

Figure 3-45: Character of the road reserve and study area along the pipeline route from the south on the P491 (top) to the north on Longacres Drive (bottom)

Modified Areas

By definition Modified areas are those places where anthropogenic activity has substantially altered the primary ecological function and natural species composition of an area. Modified areas along the pipeline route included black-top roads, road verges, sugar cane fields, and residential settlement. Such areas were devoid of ecologically important natural vegetation

Alien Scrub

A few patches of alien thicket/scrub occurred in the study area, mostly along road verges and along the P197. This vegetation consisted of alien shrubs and scattered trees. This vegetation appeared to be part of indigenous patches of coastal thicket previously, but since experiencing disturbance in the recent past, have become invaded by alien species

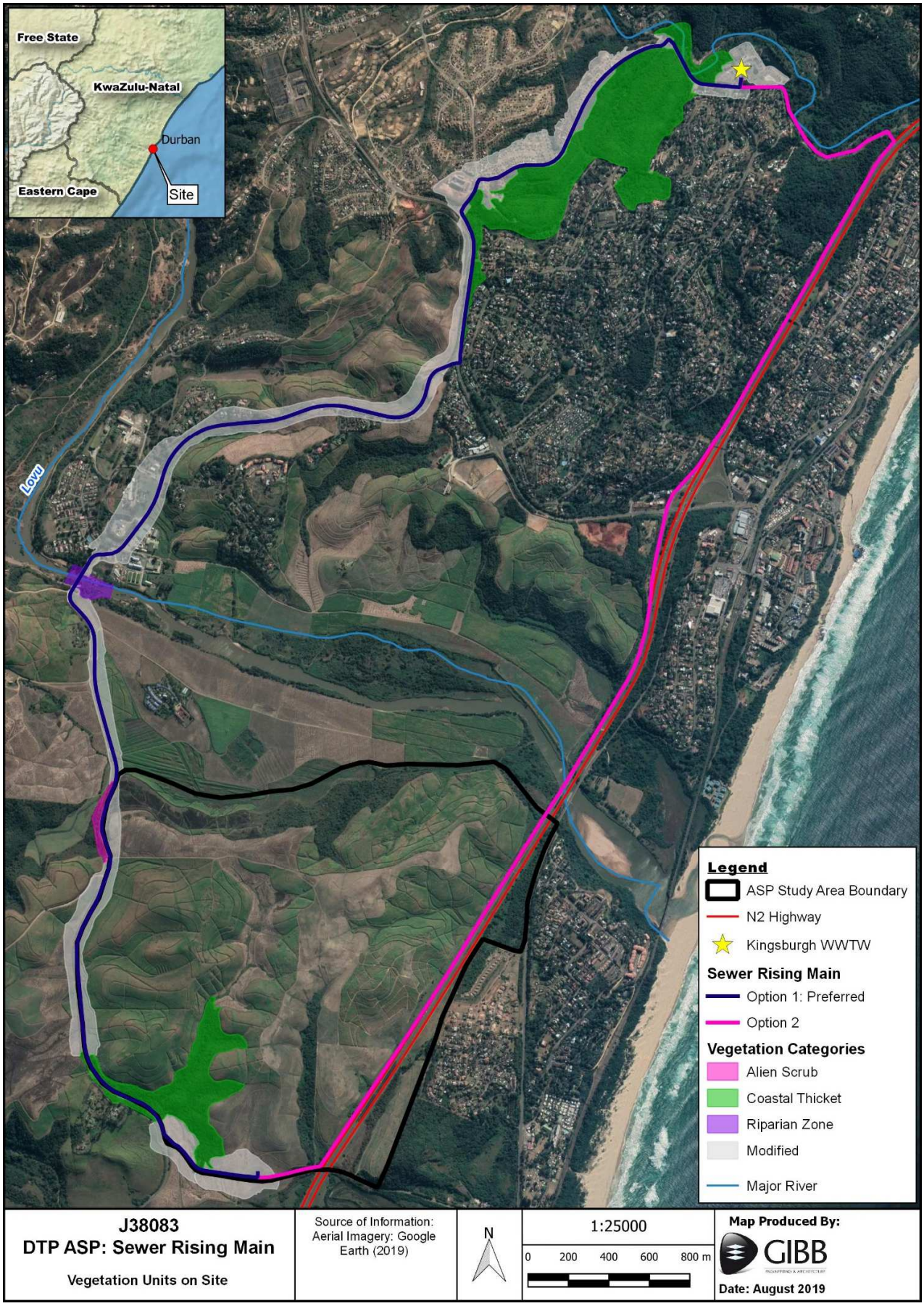


Figure 3-46: Vegetation categories described along the proposed sewer line route

Riparian Zone

The proposed sewer line route will need to cross the iLovu River to get to the existing Kingsburgh WWTW in the north. The pipeline is proposed to be fitted to the existing steel bridge on the P197, where an existing bulk water pipeline is attached. No trenching is proposed to be within the riparian zone. The banks of the river were found to be highly disturbed by anthropogenic activities (vehicles driving through river bed) and infested with alien plant species. The vegetation consisted predominantly of alien trees such as *Eucalyptus* sp. (Gum), *Schinus terebinthifolius* (Brazilian Pepper), *Leucaena leucocephala* (Leucaena), and *Melia azedarach* (Syringa), as well as riparian species such as the alien *Arundo donax* (Giant Reed), *Canna indica* (Indian Shot), and *Senna didymobotrya* (Peanut Butter Cassia)

Figure 3-47: Existing iLovu River steel bridge (left) with disturbed river banks and riparian vegetation (right)

Coastal Thicket/Scrub

Natural vegetation in the study area remnant of the KwaZulu-Natal Coastal Belt Grassland vegetation type was classified as Coastal Thicket/Scrub and was confined to steep slopes, valleys and drainage lines where farming and development activities were restricted. This vegetation was confined to two areas along the pipeline route, one in the south on the P197, and a larger patch in the north starting on the R603, in the valley east of 5101270 Street (Santo Alberto Street), and associated with the Little Amanzimtoti River near the Kingsburgh WWTW. This vegetation on site was secondary in nature, and heavily infested with alien plants species and very disturbed in places, especially on the edges. Within the KwaZulu-Natal Coastal Belt Grassland vegetation type, forest was rare to non-existent historically, and grassland would dominate where the topography was undulating due to natural processes such as fire (Finch and Hill, 2008). Today however, with vast areas that were grassland now covered by sugar cane and settlement, grass has become the subordinate feature and woody vegetation has increased due the lack of fire in the landscape (Mucina and Rutherford, 2006; Finch and Hill, 2008).

According to historical aerial imagery, all natural vegetation in the study area was cleared for sugar cane *circa* 1937 and perhaps before (see Appendix A in Appendix D18). Furthermore, according to historical Google Earth © imagery, the valley to the east of 5101270 Street (Santo Alberto Street) in the north of the study area was cleared of vegetation as recent as in 2011.

Common indigenous species recorded in this vegetation unit included *Albizia adianthifolia, Brachylaena discolour, Bridelia micrantha, Celtis africana, Chrysanthemoides monilifera, Dalbergia obovata, Erythrina lysistemon,* and *Phoenix reclinata*. The most common alien species included *Chromolaena odorata, Ipomoea purpurea, Lantana camara, Melia azedarach, Schinus terebinthifolius, Solanum mauritianum,* and *Tithonia diversifolia*. Most of these species are invasive and require removal and control. Table 4 of Appendix D18 lists some of the species recorded in the vegetation unit.

Figure 3-48: Coastal thicket/scrub within the study area, (a) next to the P197 in the south, (b) next to the R603, (c) east of 5101270 Street, and (d) near the Kingsburg WWTW

Plants of Conservation Concern

According to the Plants of Southern Africa (POSA) website, a minimum of 10 plant species of conservation concern could occur within the study area (Raimondo *et al*., 2009; SANBI, 2016). These species are listed by SANBI as species occurring in QDGC 3030BB. Species include *Aloe cooperi, Boophone disticha, Haemanthus deformis* and *Kniphofia glacialis*, none of which were recorded in the study area during the field surveys. These species as well as their habitat requirements and likelihood of occurrence in the study area are listed in Table 3-20.

Table 3-20: Species of conservation concern and likelihood of occurring in the study area

Species	Conservation Status	Habitat Requirements	Likelihood of occurring in the Study Area
Aloe cooperi	Declining	Moist habitats and dry rocky areas	Low
Boophone disticha	Declining	Coastal or semi-arid areas	Low
Brachystelma sandersonii	Vulnerable	Coastal areas	Medium
Clivia gardenii	Vulnerable	Forest	Medium
Clivia miniata	Vulnerable	Forest	Medium
Crinum moorei	Vulnerable	Coastal forests	Medium
Gasteria croucheri	Vulnerable	Rocky areas	Low
Haemanthus deformis	Vulnerable	Moist shaded slopes	Medium
Hypoxis hemerocallidea	**Declining**	**Wide range of habitats, including sandy hills, forest margins, open rocky grassland, mountain slopes**	**High**
Kniphofia glacialis	Critical	Coastal grasslands	Low

Provincially Protected Plants

Schedules 7 and 8 of the KwaZulu-Natal Environmental, Biodiversity and Protected Areas Management Bill, 2014 (Gen N4, PG1314, 25 February 2015), protects plant species of conservation concern in KwaZulu-Natal. A number of these species protected under this Bill were recorded within the study area, in most coastal bush patches in the study area, as well as along most road verges. For example, many *Albizia adianthifolia* trees occur within the road reserve of the P197. These species will require a permit from Ezemvelo KZN Wildlife (EKZNW) for cutting or removal and are listed in Table 3-21 along with their locality in the study area.

Table 3-21: Provincially protected species occurring in the study area

Taxonomic Name	Common Name	Occurrence in Study Area
Albizia adianthifolia	Flatcrown	Coastal Thicket; Modified areas
Dracaena aletriformis	Large-leaf Dragon-tree	Coastal Thicket
Harpephyllum caffrum	Wild Plum	Coastal Thicket; Modified areas
Protorhus longifolia	Red Beech	Coastal Thicket
Strelitzia nicolai	Natal Wild Banana	Coastal Thicket; Modified areas
Trichilia dregeana	Forest Natal Mahogany	Coastal Thicket; Modified areas

Nationally Protected Trees

Under the National Forests Act, 1998 (Act No. 84 of 1998), the removal, cutting, thinning or relocation of protected trees will require a permit from the Department of Agriculture, Forestry and Fisheries (DAFF). While no such species were recorded during the field surveys, Nationally Protected tree species that have a possibility of occurring in the study area include Pittosporum viridiflorum (Cheesewood) and *Sideroxylon inerme* subsp. *inerme* (White Milkwood). Such species are unlikely to occur within the road reserve and be affected by the proposed pipeline route.

Alien and Invasive Plants

Numerous alien species were recorded throughout the study area, and included *Canna indica*, *Chromolaena odorata, Lantana camara, Melia azedarach, Schinus terebinthifolius, Senna didymobotrya,* and *Solanum mauritianum*. Appendix C in Appendix D18 summarises the alien species recorded in the study area as well as their NEMBA categories.

(vii) Results: Fauna

Faunal Habitat

The entire route of the sewer pipeline is proposed to be trenched within the road reserve of various black-top roads until it reaches the existing Kingsburgh WWTW. Besides the roads and road verges, the study area surrounding the sewer line route was largely modified by sugar cane and settlement. Important faunal habitat in the study area included wooded areas provided by the coastal thicket, and the riparian and estuarine habitat associated with the iLovu River. During the field surveys, high avifaunal activity was observed in and around these habitats.

The wooded habitat provided high habitat heterogeneity for fauna in the study area by providing shelter, feeding, and breeding habitat for birds, mammals, amphibians, reptiles and invertebrates. Wooded habitat has a multi-layered vegetation structure dominated by evergreen or semi-deciduous trees and shrubs, with an herbaceous understorey (Lawes, 2002; Mucina and Rutherford, 2006). This complexity of strata provides multiple habitats and niches for fauna to occupy and as such, wooded areas are generally high in biodiversity.

Watercourses and wetlands are usually areas of high faunal diversity as the riparian environment and dense vegetation provides abundant cover, feeding and breeding habitat for many species of invertebrates, birds, mammals, reptiles, amphibians and fish. When it is available, surface water provides drinking water for many faunal species while the soft substrate provides perfect burrowing environments for fossorial animals. The increase in prey and vegetation attracts a high diversity of birds as well as terrestrial mammals and reptiles (including predators). Watercourses also tend to be ecological corridors for movement of both flora and fauna through the landscape.

Faunal Species Occurrence

Refer to the appendices in Appendix D18 for detailed lists of the species discussed below.

Avifauna

During the field surveys, 85 bird species were observed in and around the study area. These are listed in Table 10 in Appendix D18 along with their provincial protection status (KZN, 1974), national conservation status (Taylor *et al*., 2015) and global conservation status (IUCN [World Conservation Union] Red List of Threatened Species, 2019). Bird species observed on site consisted of generalist species, riverine/wetland species, and those generally associated with wooded habitats.

Five bird species endemic to southern Africa were confirmed to occur in the study area during the field surveys, namely *Pternistis natalensis* (Natal Spurfowl), *Laniarius ferrugineus* (Southern Boubou), *Batis capensis* (Cape Batis), *Zosterops capensis* (Cape White-eye), and *Passer melanurus* (Cape Sparrow). An additional six bird species of conservation concern were given a high likelihood of occurring on or near the site due to the presence of suitable habitat, mainly provided by the two estuaries. Eleven bird species that are protected by provincial legislation under the KwaZulu-Natal Environmental, Biodiversity and Protected Areas Management Bill, 2014 (General Notice 4, February 2015) were recorded in the study area during the field surveys (Table 10 in Appendix D18).

Mammals

During the field surveys, six mammal species were recorded in the study area (Table 10 in Appendix D18). These were confirmed via droppings, spoor, mounds or sighting, all within the wooded habitat on site. A further 20 mammal species were given a high likelihood of occurring in the study area and include species that inhabit wooded areas as well as generalist species that are tolerant of disturbed habitat. This includes four mammal species of conservation concern, namely *Otomops martiensseni* (Large-eared Free-tailed Bat), *Dendrohyrax arboreus* (Tree Hyrax), and *Philantomba monticola* (Blue Duiker) currently listed as Vulnerable, and *Hypsugo anchietae* (Anchieta's Pipistrelle) currently listed as Near Threatened. Appropriate habitat in and around Durban is known as important foraging habitat for *Otomops martiensseni*, a species with a known range restricted to the coast between Ballito and Port Shepstone. Habitat for this species is unlikely to be affected by the pipeline route.

Herpetofauna

Amphibians

Six amphibian species were recorded in the study area during the daytime and nocturnal field surveys (Table 7 in Appendix D18). This includes two species endemic to southern Africa, *Arthroleptis wahlbergii* (Bush Squeaker), and *Leptopelis natalensis* (Natal Tree Frog), both of which are also range limited species. Amphibians were recorded mostly in the wooded drainage lines and reedbeds associated with the uMsimbazi Estuary. An additional seven species were given a high likelihood of occurring in the study area due to the presence of suitable habitat (Appendix G in Appendix D18). This includes one species of conservation concern, *Afrixalus spinifrons* (Natal Leaf-folding Frog), a provincially protected species currently listed as Near Threatened, and one endemic species, *Breviceps verrucosus* (Plaintive Rain Frog). The Critically Endangered and Protected *Hyperolius pickersgilli* (Pickersgill's Reed Frog) was given a medium likelihood of occurring in the study area, however it is highly unlikely that the pipeline construction will affect any habitat that may be suitable for this species.

Reptiles

While no reptiles were encountered during the field surveys, 21 species were given a high likelihood of occurring in the study area due to the presence of suitable habitat (Appendix H in Appendix D18). This includes eight species endemic to southern Africa, one species protected by provincial legislation, *Varanus niloticus* (Water Monitor), and two species of

conservation concern, namely *Bradypodion melanocephalum* (KwaZulu Dwarf Chameleon), currently listed as Vulnerable, and *Macrelaps microlepidotus* (Natal Black Snake) currently listed as Near Threatened.

Bradypodion melanocephalum (KwaZulu Dwarf Chameleon) is found predominantly in coastal regions of KwaZulu-Natal and extends inland for about 100km. The species appears to inhabit a number of vegetation types within grassland, savanna, coastal bush, and forest, and individuals are known to inhabit seemingly disturbed areas, such as at road sides. Adults often inhabit small patches of structured habitat including alien vegetation (Bates *et al*., 2014). Endemic to the eastern regions of South Africa, *Macrelaps microlepidotus* (Natal Black Snake) is found in forests and coastal bush in moist leaf litter or humic soils, and usually associated with damp localities near water (Bates *et al*., 2014). Habitat for both these species exists in the study area.

As the entire pipeline route is proposed to be located within road reserve, it is recommended that a Search and Rescue Plan for *Bradypodion melanocephalum* be written by a suitably qualified herpetologist and implemented prior to construction beginning.

(viii) Habitat Assessment and Sensitivity Analysis

Ecological Sensitivity within the Study Area

Based on the findings of the ecological assessment, importance of habitats pertaining to flora and fauna, and thus sensitivity to the proposed development, was mapped (Figure 3-49).

Highly Sensitive Habitats

The riparian zone associated with the iLovu River and Estuary was classified as highly sensitive. Rivers and estuaries are extremely important in maintaining biodiversity at a regional level and have both high ecological function and conservation importance. Rivers also act as ecological corridors for movement through the landscape.

Medium-high Sensitivity

The patches of coastal thicket within the study area were considered to be of medium-high ecological sensitivity. While these areas were confirmed to be secondary in nature (see historical aerial imagery, Appendix A in Appendix D18), the habitat is considered important because of the diversity of vegetation and fauna it supported, including species that are threatened or protected. These habitats represented natural vegetation remnant of KwaZulu-Natal Coastal Belt Grassland in the study area, and serve important ecological functions and provide habitat heterogeneity to the landscape. These habitats have high potential for rehabilitation.

Low Sensitivity

All areas covered with sugar cane and alien dominated scrub, as well as roads and settlement were considered to be of low ecological importance and sensitivity.

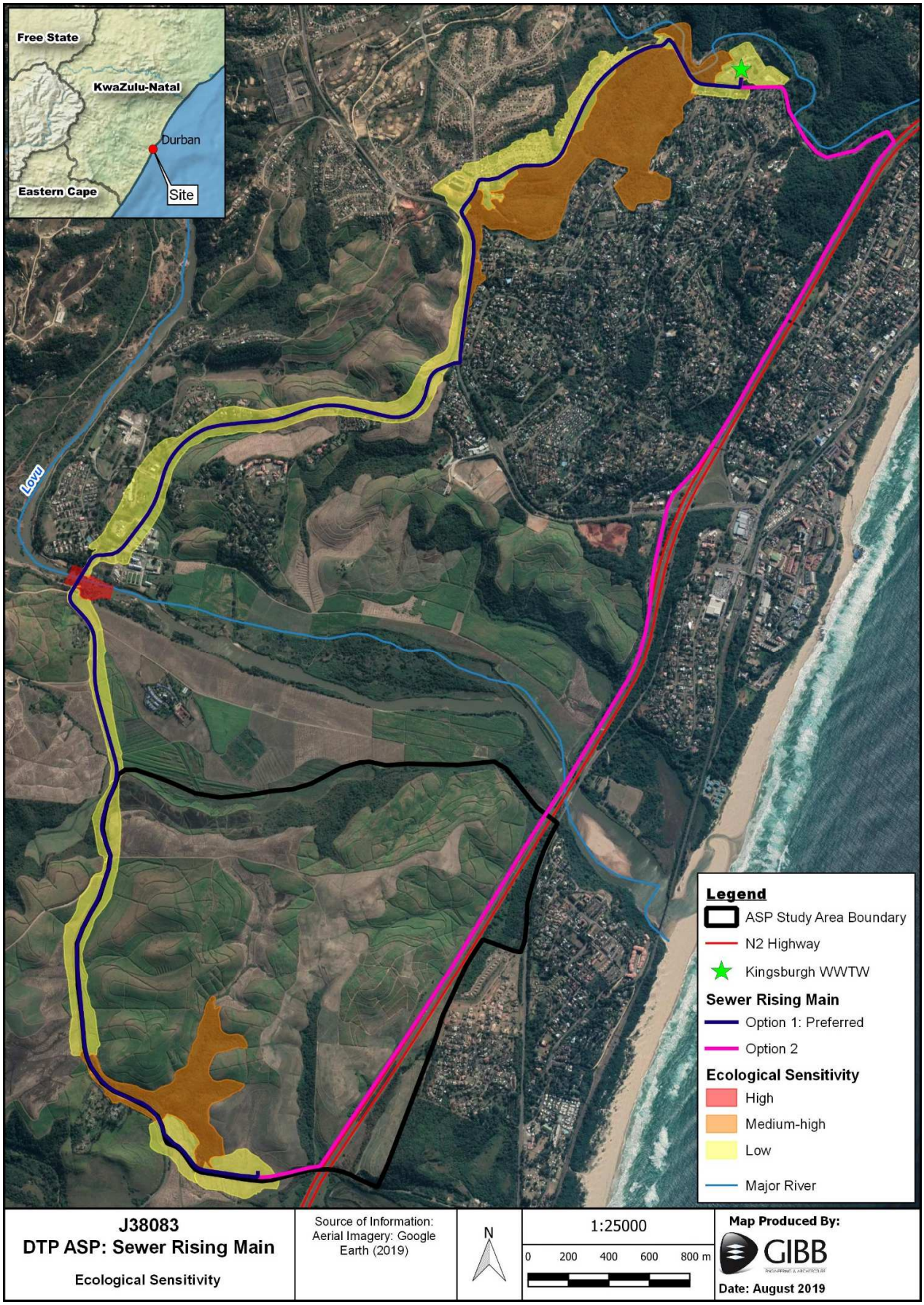


Figure 3-49: Areas of ecological importance and sensitivity along the sewer line route

(c) Proposed Powerline

An Ecological Assessment and Avifaunal Assessment was undertaken by GIBB (Pty) Ltd for the proposed 132kV powerline for the proposed KZN ASP development (Appendix D19).

(i) Regional Vegetation

According to Mucina and Rutherford (2018) on a national scale, two vegetation types occur in vicinity of the proposed powerline routes, namely KwaZulu-Natal Coastal Belt Grassland, and Subtropical Alluvial Vegetation. According to Scott-Shaw and Escott (2011) in KwaZulu-Natal, three vegetation types occur in the vicinity, namely KwaZulu-Natal Coastal Belt Grassland, Subtropical Freshwater Wetlands, and Subtropical Alluvial. Of the terrestrial vegetation types, only the KwaZulu-Natal Coastal Belt Grassland is likely to be affected by the proposed development directly.

(ii) Conservation Targets and Status for Vegetation Types in KwaZulu-Natal

The study area falls within the KwaZulu-Natal Coastal Belt Grassland, which is currently listed as Critically Endangered in KwaZulu-Natal. According to EKZNW (Jewitt, 2011), approximately 89% of KwaZulu-Natal Coastal Belt Grassland was transformed (as at 2008), which is almost double the percentage estimated by Mucina and Rutherford (2006). The conservation target of this vegetation type is 25% and less than 1% receives formal protection.

(iii) Listed Terrestrial Ecosystems

The powerline route alternatives are located within two ecosystems that are listed in terms of Section 52 of NEMBA (DEA, 2011). The Interior South Coast Grasslands ecosystem (KZN7), and the Southern Coastal Grasslands ecosystem (KZN18) are both listed as **Critically Endangered**, under Criterion F since they are part of the priority areas needed for meeting explicit biodiversity targets as defined in a systematic biodiversity plan. These areas are considered to have undergone severe degradation of ecological structure, function or composition as a result of human intervention and are subject to high risk of irreversible transformation.

(iv) KwaZulu-Natal Systematic Conservation Planning

According to the KZN BSP, portions of the powerline routes fall within or span areas classified as **CBA: Irreplaceable**. Such areas of the site include wooded drainage lines in the northern portion, natural areas associated with the iLovu River, and remnants of natural bush in the southern portion of the study area.

(v) The Durban Metropolitan Open Space System

Figure 3-54 shows the extent of natural areas defined as D'MOSS that fall within the region of the study area. These include all remaining patches of natural bush with the study area, such as wooded drainage lines, and wetland and riparian vegetation associated with the iLovu River and floodplain.

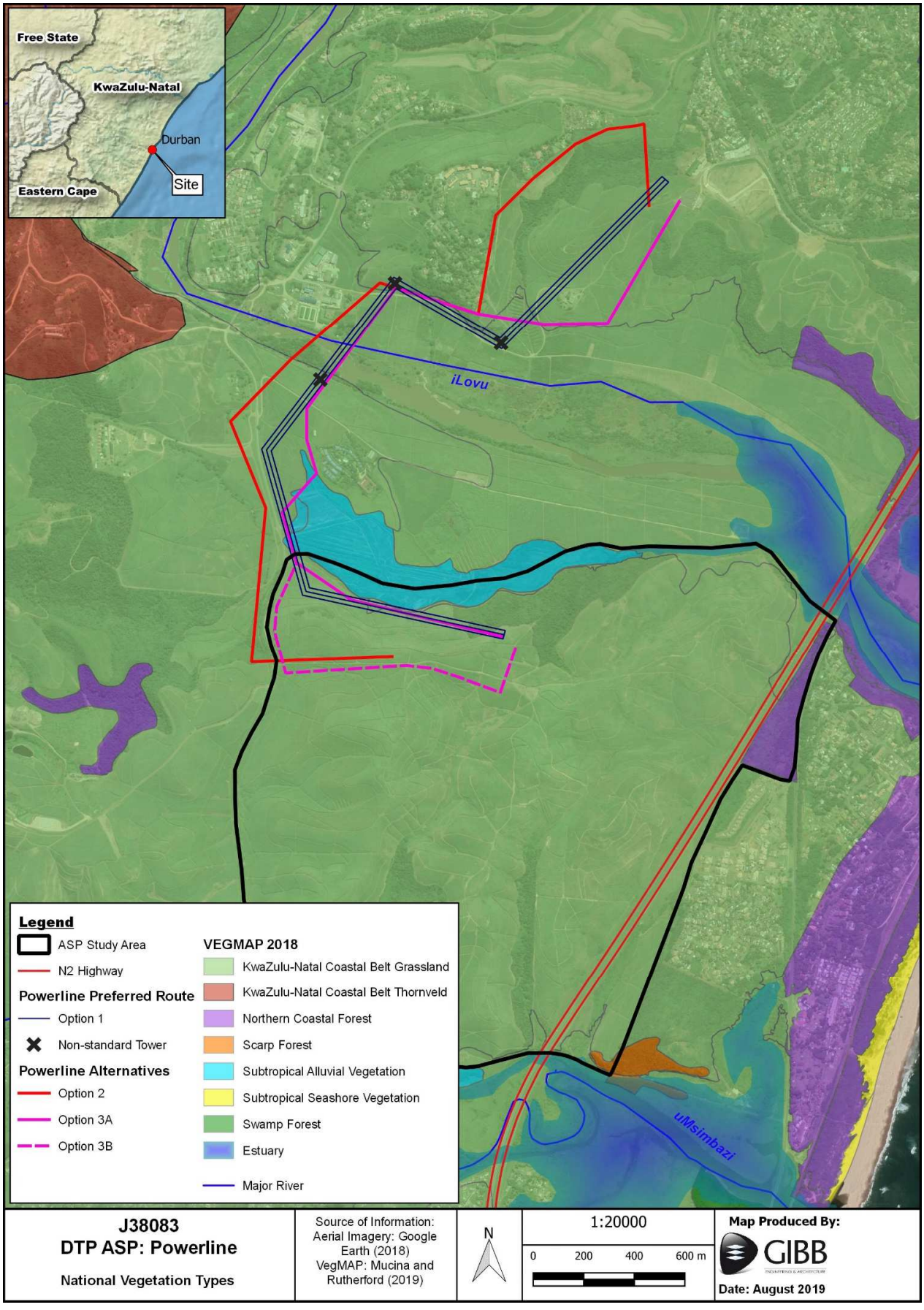


Figure 3-50: The proposed powerlines in relation to national vegetation types

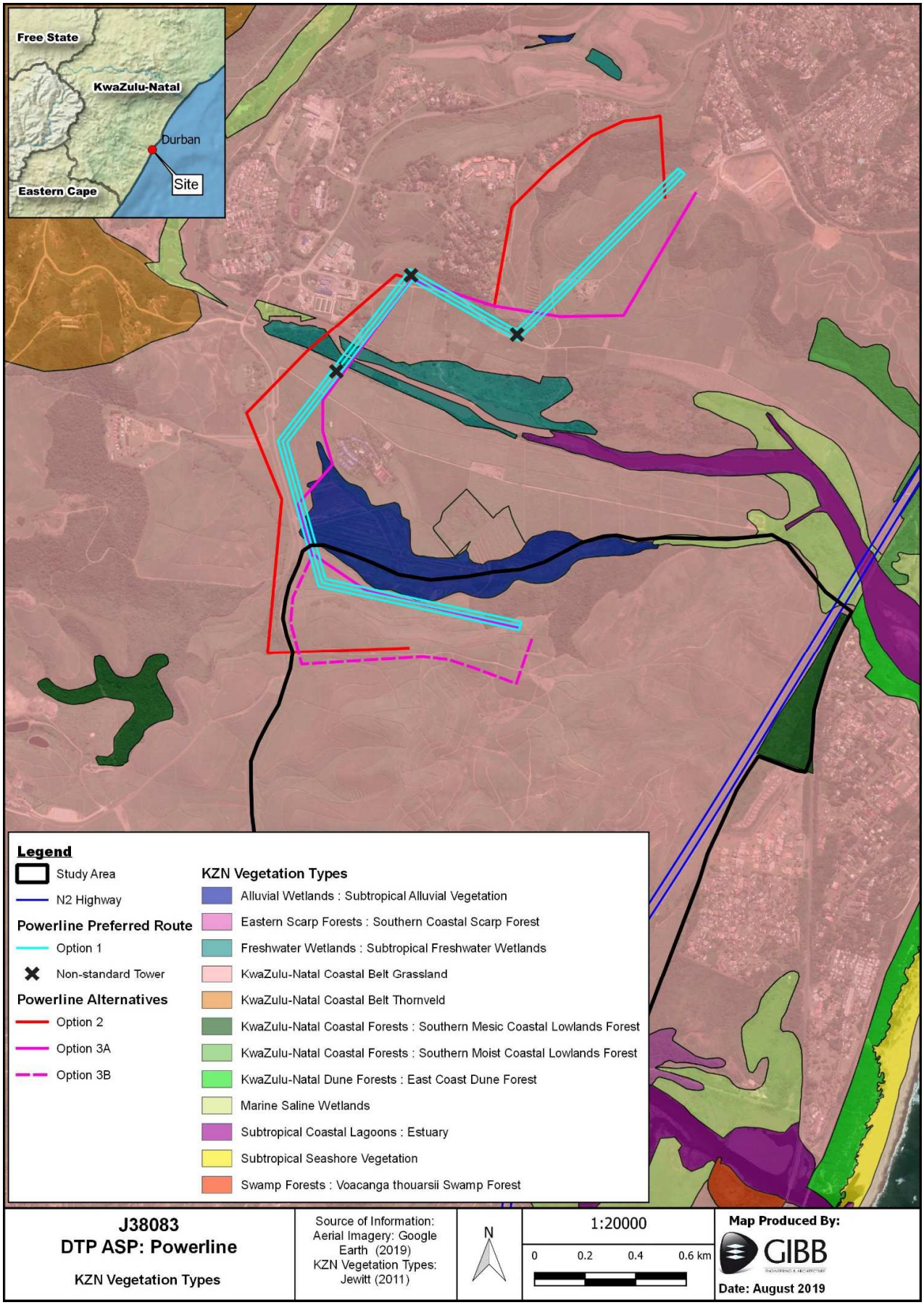


Figure 3-51: The proposed powerlines in relation to KZN vegetation types

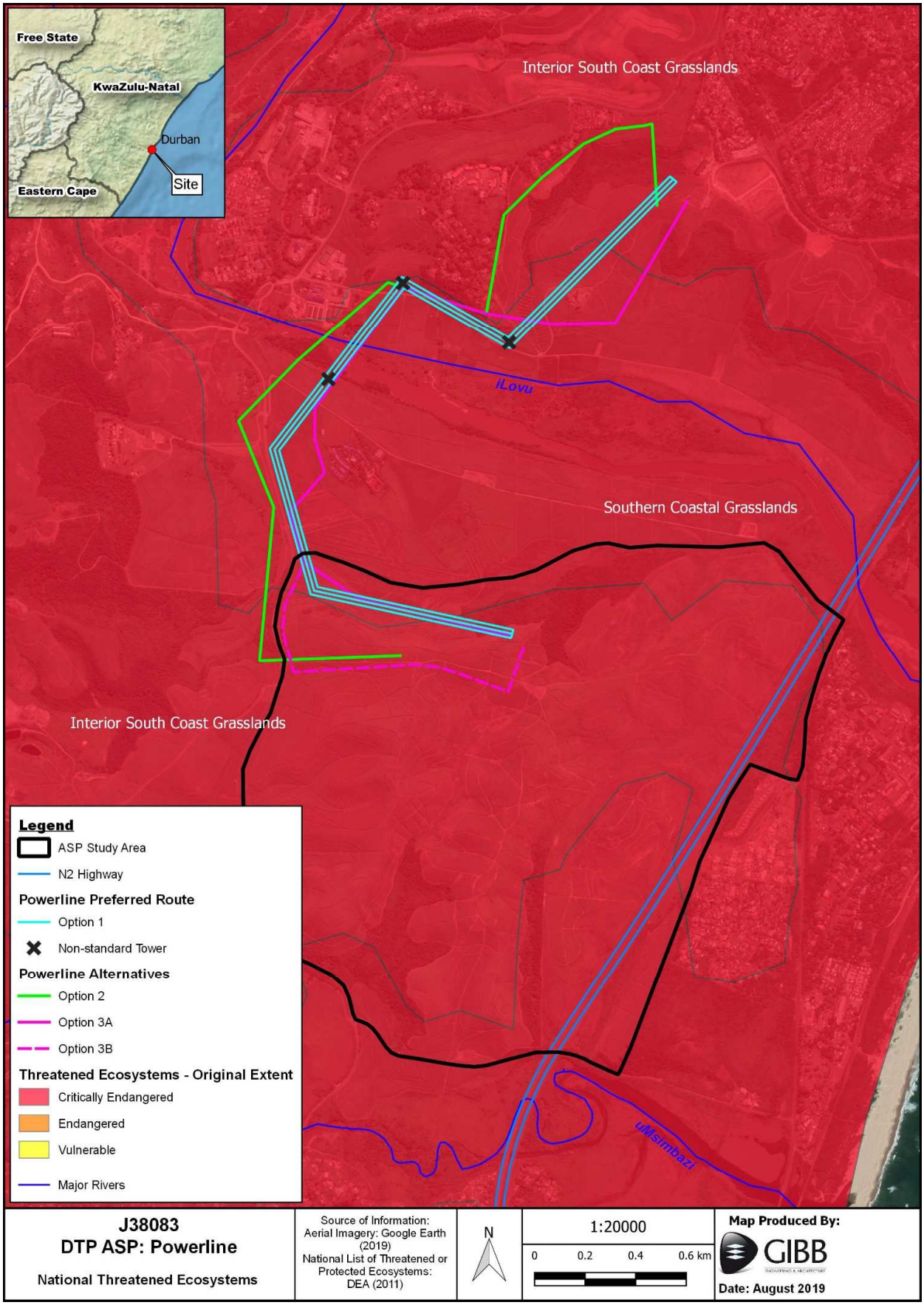


Figure 3-52: The proposed powerlines in relation to national threatened ecosystems

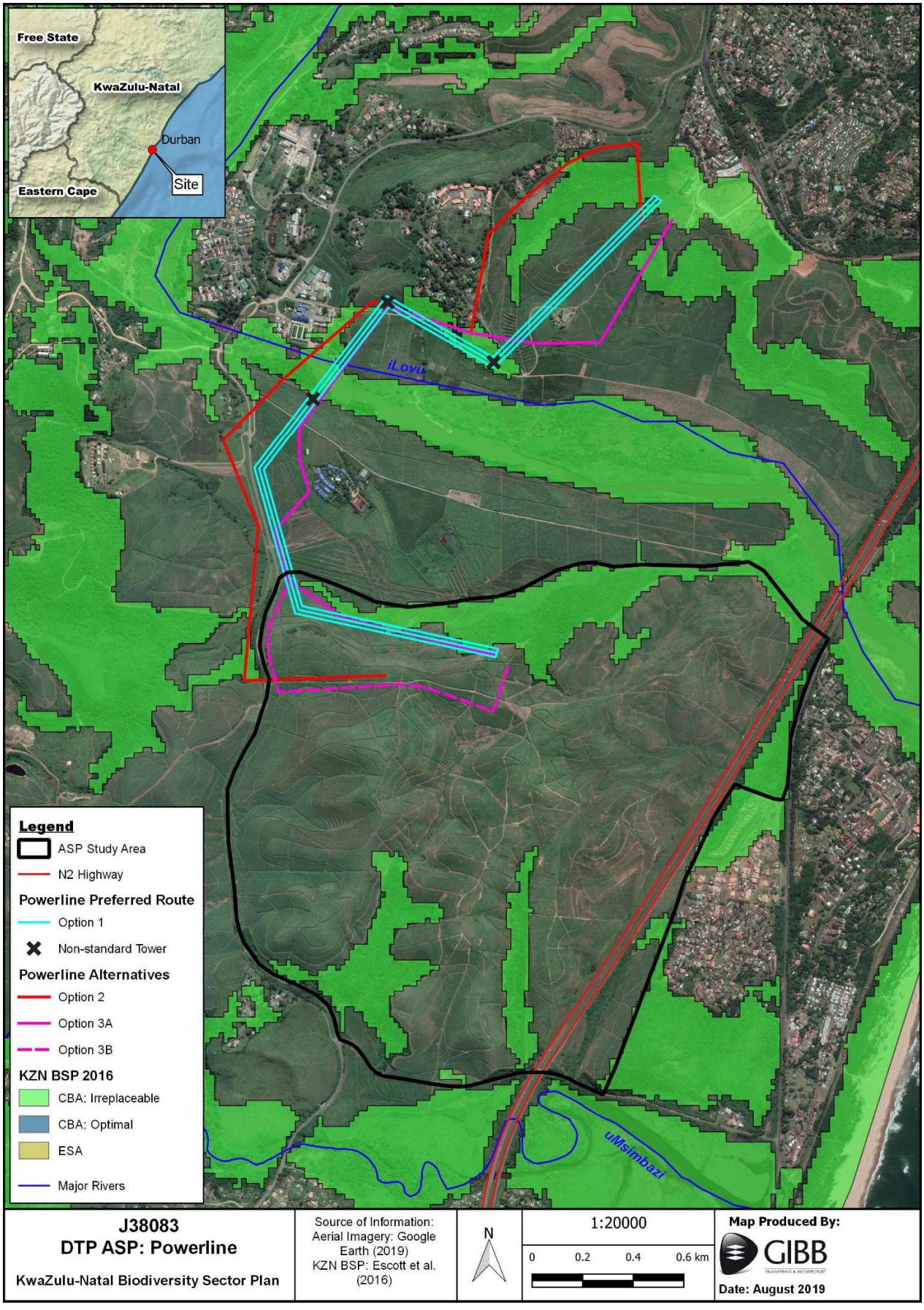


Figure 3-53: The proposed powerlines in relation to terrestrial CBAs according to the KZN BSP

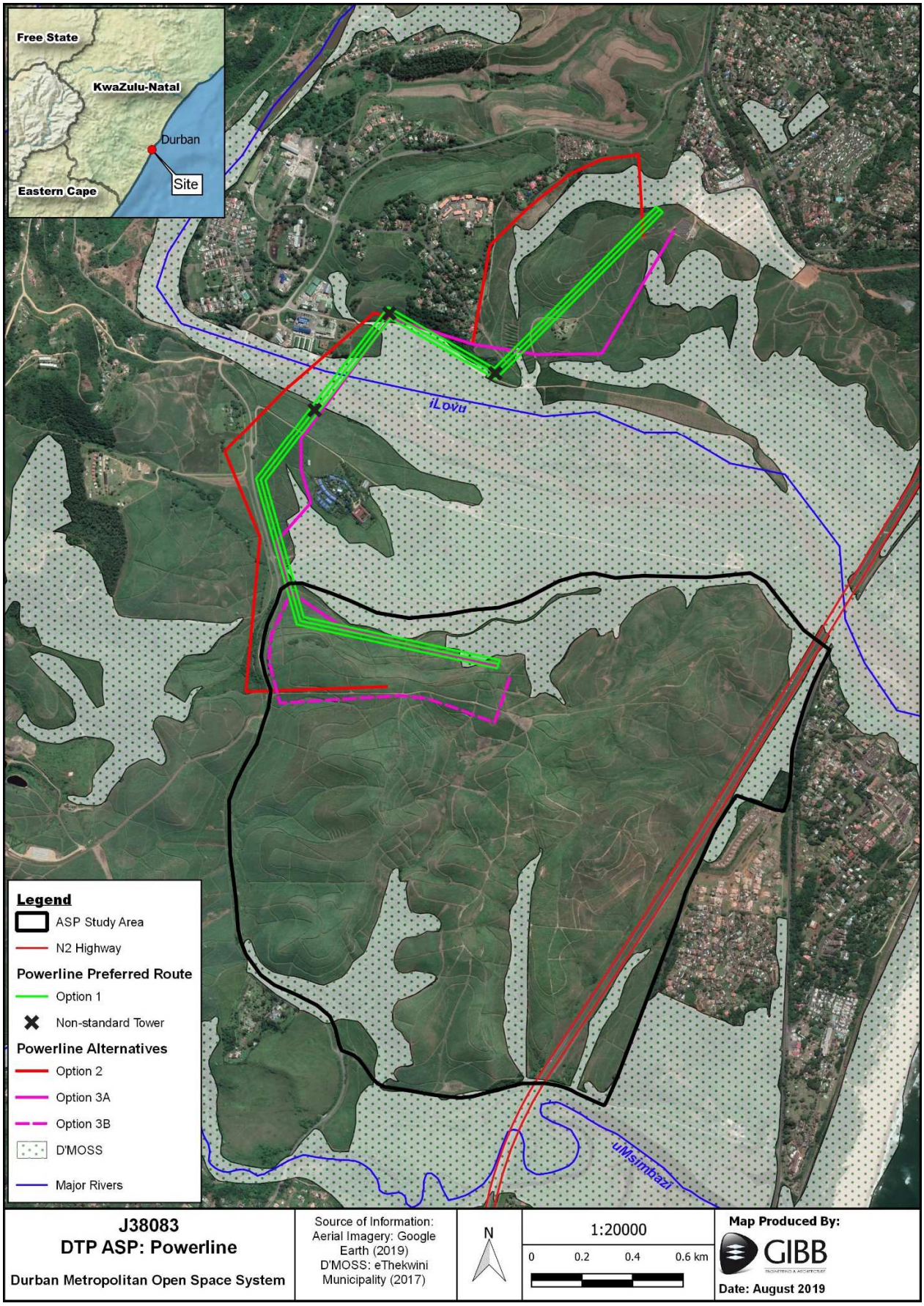


Figure 3-54: The proposed powerlines in relation to D'MOSS

(vi) Results: Flora

Vegetation Overview

The study area was largely transformed (irreversibly modified) with the majority of the study area of the powerline routes consisting of sugar cane fields, residential settlement and light industrial warehouses. Most of the study area and surroundings, which occurred within the original extent of KwaZulu-Natal Coastal Belt Grassland were modified or highly disturbed by anthropogenic activities. Remaining natural vegetation in the study area from this vegetation type was classified as Coastal Thicket/Scrub and was confined to steep slopes and valleys where farming and development activities were restricted. Other remaining natural vegetation in the study area included riparian vegetation associated with the iLovu River and Estuary. Please refer to the wetland report for the delineation of wetland areas.

Figure 3-55: Character of the study area surrounding the proposed powerline routes

Modified Areas

By definition Modified areas are those places where anthropogenic activity has substantially altered the primary ecological function and natural species composition of an area. Modified areas in the study area included sugar cane fields, gravel roads and settlement. Such areas were devoid of natural vegetation.

Riparian Zone

All alternatives for the powerline route cross the iLovu River *en route* to the proposed substation on the ASP site, however no pylons are proposed to be constructed within the

riparian zone. The banks of the river were found to be disturbed by agricultural activities and infested with alien plant species. The vegetation consisted predominantly of alien trees such as *Eucalyptus* sp. (Gum), *Schinus terebinthifolius* (Brazilian Pepper), *Leucaena leucocephala* (Leucaena), and *Melia azedarach* (Syringa), as well as riparian species such as the alien *Arundo donax* (Giant Reed).

Figure 3-56: Modified south bank of the iLovu River with sugar cane and alien trees

Alien Scrub

A few patches of alien thicket/scrub occurred in the study area, mostly along the P197, and along road verges on the north bank of the iLovu River. This vegetation consisted of alien shrubs and scattered trees. This vegetation appeared to be part of indigenous patches of coastal thicket previously, but since experiencing disturbance in the recent past, have become invaded by alien species.

Figure 3-57: Alien thicket/scrub in the study area

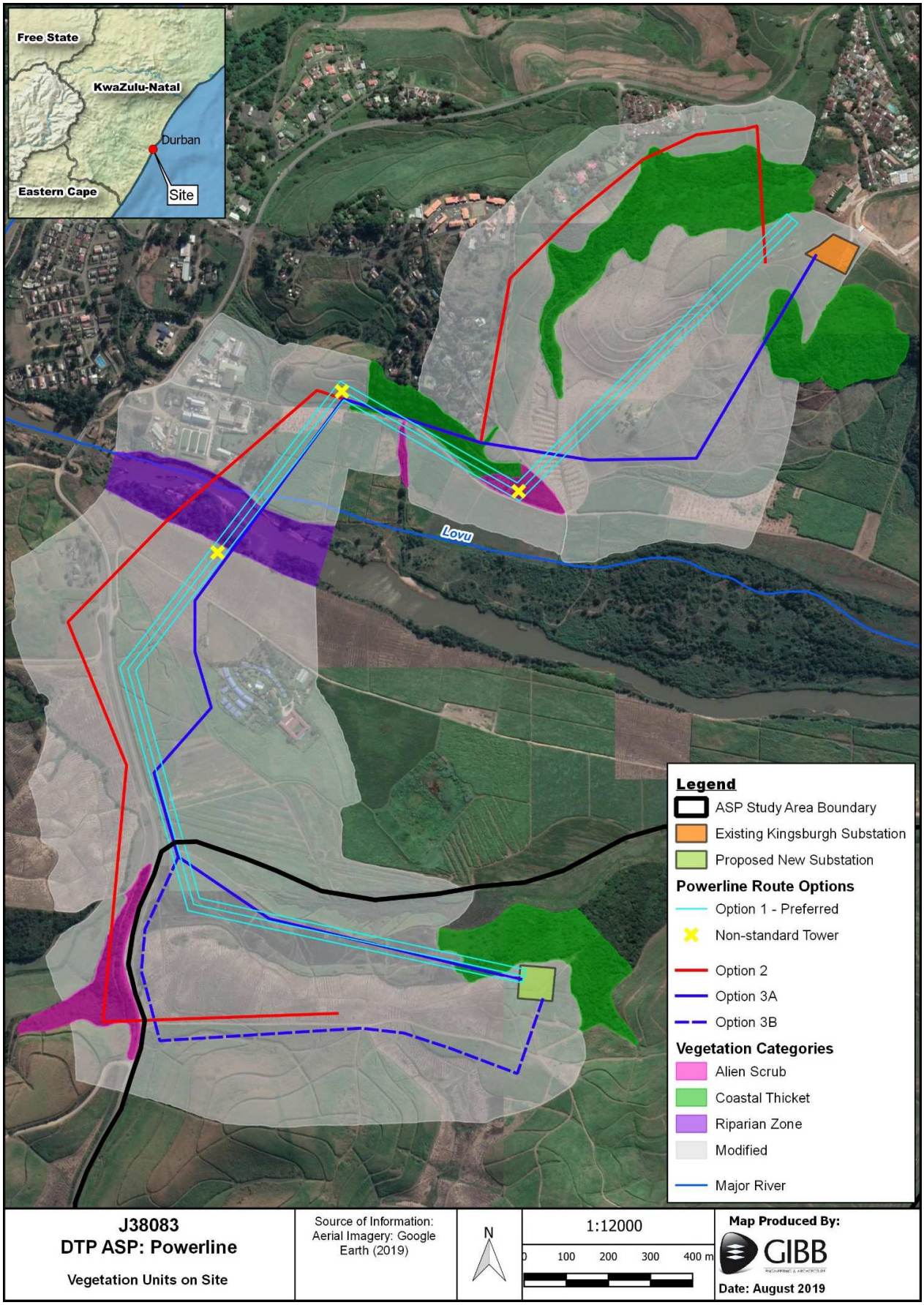


Figure 3-58: Vegetation categories described within the study area

Coastal Thicket/Scrub

Natural vegetation in the study area remnant of the KwaZulu-Natal Coastal Belt Grassland vegetation type was classified as Coastal Thicket/Scrub and was confined to steep slopes and valleys where farming and development activities were restricted. This vegetation on site was secondary in nature, and heavily infested with alien plants species, especially on the edges, however it comprised some species representative of coastal forest. Within the KwaZulu-Natal Coastal Belt Grassland vegetation type, forest was rare to non-existent historically, and grassland would dominate where the topography was undulating due to natural processes such as fire (Finch and Hill, 2008). Today however, with vast areas that were grassland now covered by sugar cane and settlement, grass has become the subordinate feature and woody vegetation has increased due the lack of fire in the landscape (Mucina and Rutherford, 2006; Finch and Hill, 2008). According to historical aerial imagery, all natural vegetation in the study area was cleared for sugar cane *circa* 1937 and perhaps before (see Appendix A in Appendix D23). Table 4 in Appendix D19 lists some of the species recorded in the vegetation unit.

Figure 3-59: Coastal thicket/scrub within the study area

Plants of Conservation Concern

According to the Plants of Southern Africa (POSA) website, a minimum of 10 plant species of conservation concern could occur within the study area (Raimondo *et al*., 2009; SANBI, 2016). These species are listed by SANBI as species occurring in QDGC 3030BB. Species include *Aloe cooperi, Boophone disticha, Haemanthus deformis* and *Kniphofia glacialis*, none of which were recorded in the study area during the field surveys. These species as well as their habitat requirements and likelihood of occurrence in the study area are listed in Table 3-22.

Table 3-22: Species of conservation concern and likelihood of occurring in the study area

Species	Conservation Status	Habitat Requirements	Likelihood of occurring in the Study Area
Aloe cooperi	Declining	Moist habitats and dry rocky areas	Low
Boophone disticha	Declining	Coastal or semi-arid areas	Low
Brachystelma sandersonii	Vulnerable	Coastal areas	Medium
Clivia gardenii	Vulnerable	Forest	Medium

Species	Conservation Status	Habitat Requirements	Likelihood of occurring in the Study Area
Clivia miniata	Vulnerable	Forest	Medium
Crinum moorei	Vulnerable	Coastal forests	Medium
Gasteria croucheri	Vulnerable	Rocky areas	Low
Haemanthus deformis	Vulnerable	Moist shaded slopes	Medium
Hypoxis hemerocallidea	**Declining**	**Wide range of habitats, including sandy hills, forest margins, open rocky grassland, mountain slopes**	**High**
Kniphofia glacialis	Critical	Coastal grasslands	Low

Provincially Protected Plants

Schedules 7 and 8 of the KwaZulu-Natal Environmental, Biodiversity and Protected Areas Management Bill, 2014 (Gen N4, PG1314, 25 February 2015), protects plant species of conservation concern in KwaZulu-Natal. A number of these species protected under this Bill were recorded within the study area, in most natural bush patches found in the study area. These are listed in Table 3-23 along with their locality in the study area.

Table 3-23: Provincially protected species occurring in the study area

Taxonomic Name	Common Name	Occurrence in Study Area
Albizia adianthifolia	Flatcrown	Coastal Thicket; Modified areas
Dracaena aletriformis	Large-leaf Dragon-tree	Coastal Thicket
Harpephyllum caffrum	Wild Plum	Coastal Thicket; Modified areas
Protorhus longifolia	Red Beech	Coastal Thicket; Modified areas
Strelitzia nicolai	Natal Wild Banana	Coastal Thicket; Modified areas
Trichilia dregeana	Forest Natal Mahogany	Coastal Thicket; Modified areas
Vepris lanceolata	White Ironwood	Coastal Thicket

Nationally Protected Trees

The National Forests Act, 1998 (Act No. 84 of 1998) enforces the protection of a number of indigenous tree species by affording them "Protected" status. As such, the removal, cutting, thinning or relocation of protected trees will require a permit from the Department of Agriculture, Forestry and Fisheries (DAFF). While no such species were recorded during the field surveys, Nationally Protected tree species that have a possibility of occurring in the study area include Pittosporum viridiflorum (Cheesewood) and *Sideroxylon inerme* subsp. *inerme* (White Milkwood).

Alien and Invasive Plants

Numerous alien species were recorded throughout the study area, and included *Cestrum laevigatum, Chromolaena odorata, Lantana camara, Litsea glutinosa, Melia azedarach, Schinus terebinthifolius,* and *Solanum mauritianum*. Appendix D in Appendix D19 summarises the alien species recorded in the study area as well as their NEMBA categories.

(vii) Results: Fauna

Faunal Habitat

The study area surrounding the powerline routes was largely modified by sugar cane and settlement. Important faunal habitat in the study area included wooded areas provided by the coastal thicket, and the riparian and estuarine habitat associated with the iLovu River. During the field surveys, high avifaunal activity was observed in and around these habitats.

Figure 3-60: Examples of faunal habitat in the study area including wooded habitats (left) and riparian and estuarine habitat associated with the iLovu River (right)

Faunal Species Occurrence

Following is an account of the faunal species associated with the study area and those confirmed or likely to occur on the site. Refer to the appendices in Appendix D19 for detailed lists of the species discussed below.

Avifauna

During the field surveys, 85 bird species were observed in and around the study area. These are listed in Table 7 in Appendix D19 along with their provincial protection status (KZN, 1974) and national (Taylor *et al.*, 2015) and global (IUCN [World Conservation Union] Red List of Threatened Species, 2019) conservation status. Bird species observed on site consisted of generalist species, riverine/wetland species, waterfowl, and those generally associated with wooded habitats.

Five bird species endemic to southern Africa were confirmed to occur in the study area during the field surveys, namely *Pternistis natalensis* (Natal Spurfowl), *Laniarius ferrugineus* (Southern Boubou), *Batis capensis* (Cape Batis), *Zosterops capensis* (Cape White-eye), and *Passer melanurus* (Cape Sparrow). One bird species of conservation concern, *Balearica regulorum* (Grey Crowned Crane), currently listed as Endangered at a national and global level, was recorded in the study area. A small group (around 5 individuals) was observed flying towards the uMsimbazi Estuary. An additional five bird species of conservation concern were given a high likelihood of occurring on or near the site due to the presence of suitable habitat, mainly provided by the two estuaries.

Eleven bird species that are protected by provincial legislation under the KwaZulu-Natal Environmental, Biodiversity and Protected Areas Management Bill, 2014 (General Notice 4, February 2015) were recorded in the study area during the field surveys (see Table 7 in Appendix D19).

Mammals

During the field surveys, six mammal species were recorded in the study area (see Table 7 in Appendix D19). These were confirmed via droppings, spoor, mounds or sighting, all within the wooded habitat on site. A further 20 mammal species were given a high likelihood of occurring in the study area and include species that inhabit wooded areas as well as generalist species that are tolerant of disturbed habitat. This includes four mammal species of conservation concern, namely *Otomops martiensseni* (Large-eared Free-tailed Bat), *Dendrohyrax arboreus* (Tree Hyrax), and *Philantomba monticola* (Blue Duiker) currently listed as Vulnerable, and *Hypsugo anchietae* (Anchieta's Pipistrelle) currently listed as Near Threatened. Appropriate habitat in and around Durban is known as important foraging habitat for *Otomops martiensseni*, a species with a known range restricted to the coast between Ballito and Port Shepstone. Habitat for this species is unlikely to be affected by the powerline route.

Herpetofauna

Amphibians

Six amphibian species were recorded in the study area during the daytime and nocturnal field surveys (see Table 7 in Appendix D19). This includes two species endemic to southern Africa, *Arthroleptis wahlbergii* (Bush Squeaker), and *Leptopelis natalensis* (Natal Tree Frog), both of which are also range limited species. Amphibians were recorded mostly in the wooded drainage lines and reedbeds associated with the uMsimbazi Estuary. An additional seven species were given a high likelihood of occurring in the study area due to the presence of suitable habitat (Appendix G in Appendix D19). This includes one species of conservation concern, *Afrixalus spinifrons* (Natal Leaf-folding Frog), a provincially protected species currently listed as Near Threatened, and one endemic species, *Breviceps verrucosus* (Plaintive Rain Frog).

The Critically Endangered and Protected *Hyperolius pickersgilli* (Pickersgill's Reed Frog) was given a medium likelihood of occurring in the study area, however it is highly unlikely that the powerline construction will affect any habitat that may be suitable for this species.

Reptiles

While no reptiles were encountered during the field surveys, 21 species were given a high likelihood of occurring in the study area due to the presence of suitable habitat (Appendix H in Appendix D19). This includes eight species endemic to southern Africa, one species protected by provincial legislation, *Varanus niloticus* (Water Monitor), and two species of conservation concern, namely *Bradypodion melanocephalum* (KwaZulu Dwarf Chameleon), currently listed as Vulnerable, and *Macrelaps microlepidotus* (Natal Black Snake) currently listed as Near Threatened.

Bradypodion melanocephalum (KwaZulu Dwarf Chameleon) is found predominantly in coastal regions of KwaZulu-Natal and extends inland for about 100km. The species appears to inhabit a number of vegetation types within grassland, savanna, coastal bush, and forest, and individuals are known to inhabit seemingly disturbed areas, such as at road sides. Adults often inhabit small patches of structured habitat including alien vegetation (Bates *et al.*, 2014). Endemic to the eastern regions of South Africa, *Macrelaps microlepidotus* (Natal Black Snake) is found in forests and coastal bush in moist leaf litter or humic soils, and usually associated with damp localities near water (Bates *et al.*, 2014). Habitat for both these species exists in the study area.

As some of the pylons are proposed to be located within alien scrub along a road side on the northern bank of the iLovu River, it is recommended that a Search and Rescue Plan for *Bradypodion melanocephalum* be written by a suitably qualified herpetologist and implemented prior to construction beginning.

(viii) Habitat Assessment and Sensitivity Analysis

Ecological Sensitivity within the Study Area

Based on the findings of the assessment, importance of habitats pertaining to flora and fauna, and thus sensitivity to the proposed development, was mapped (Figure 3-61).

Highly Sensitive Habitats

The riparian zone associated with the iLovu River and Estuary was classified as highly sensitive. Rivers and estuaries are extremely important in maintaining biodiversity at a regional level and have both high ecological function and conservation importance. Rivers also act as ecological corridors for movement through the landscape.

Medium-high Sensitivity

The patches of coastal thicket within the study area were considered to be of medium-high ecological sensitivity. While these areas were confirmed to be secondary in nature (see historical aerial imagery, Appendix A in Appendix D19), the habitat is considered important because of the diversity of vegetation and fauna it supported, including species that are threatened or protected. These habitats represented natural vegetation remnant of KwaZulu-Natal Coastal Belt Grassland in the study area, and serve important ecological functions and provide habitat heterogeneity to the landscape. These habitats have high potential for rehabilitation.

Low Sensitivity

All areas covered with sugar cane and alien dominated scrub, as well as roads and settlement were considered to be of low ecological importance and sensitivity.

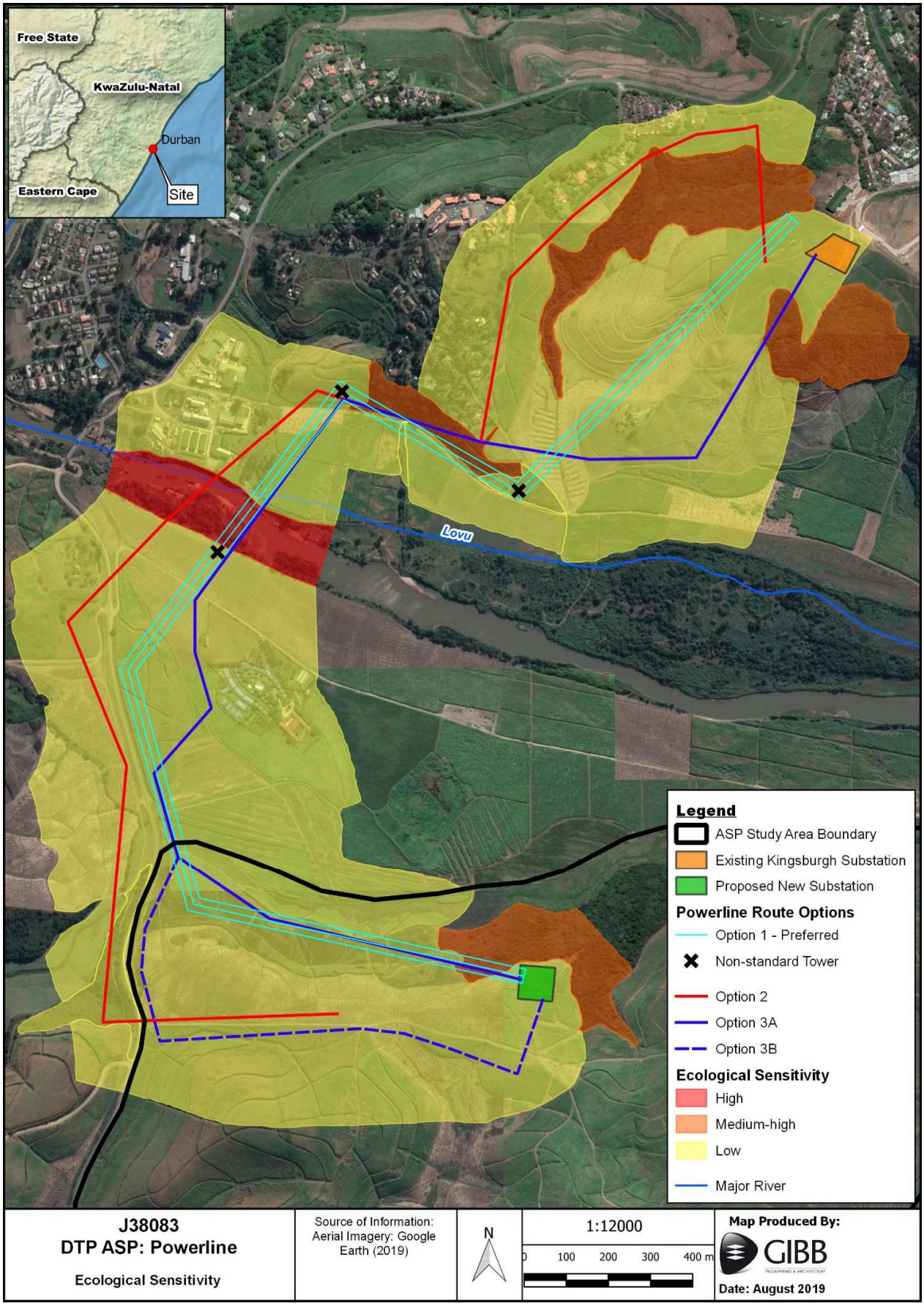


Figure 3-61: Areas of ecological importance and sensitivity in the study area

3.2 Social Environment

A Socio-Economic Impact Assessment was undertaken by Urban-Econ for the ASP development (refer to Appendix D20). The baseline data herein is taken from this study. The geographic area (referred hereafter as the Area of Influence - AOI) for which the socio-economic baseline is developed is based on the assumption that the communities immediately surrounding the study area likely to experience the greatest socio-economic impacts as a result of the construction and operation of the KZN ASP.

This area is defined in terms of the 2011 demarcations of the Municipal Demarcations board. This approach has been followed because the statistical information is available per these demarcations across two fixed time series, namely the 2001 Census and the 2011 Census. The AOI has been defined as follows in Table 3-24 and Figure 3-62.

Table 3-24: Area of Influence area

NO.	SUB-PLACE NAME	MUNICIPALITY NAME	AREA (KM^2)
1	KwaFakazi	Ugu District Municipality	3.82
2	Nkwali	Ugu District Municipality	13.04
3	Amagcino	eThekwini Municipality	0.64
4	Danganya	eThekwini Municipality	2.00
5	Ethekwini (Illovo South)	eThekwini Municipality	13.07
6	Illovo North	eThekwini Municipality	8.29
7	Kingsburgh	eThekwini Municipality	11.65
8	Umgababa South	eThekwini Municipality	6.23
9	Umnini	eThekwini Municipality	25.47
Total area			**84.21**

Source: (Statistics South Africa, 2012), (Urban-Econ, 2018)

3.2.1 Demographics

The demographic profile of the Area of Influence was extrapolated from Census data from two fixed time series, namely 2001 and 2011. For comparative purposes, the profile of the AOI is presented alongside the profile of KwaZulu-Natal Province and eThekwini Metropolitan Municipality.

(a) Population and Household Profile

- The AOI has an estimated population of 103 003 persons, with an average annual growth rate of 3.8% over a decade. This growth rate far exceeds the average annual growth in the population of KZN (0.7%) and eThekwini (1.1%) suggesting that it has experienced significant in-migration;
- There are currently an estimated 28 697 households in the area, with an estimated household density of 340.8 households per square kilometre (KZN = 30.2, eThekwini

= 474.5) and an average household size of 3.6 persons (KZN = 3.8, eThekwini = 3.4); and

- Over the period 2001 to 2011, the number of households and the household density experienced compound annual growth of 4.6% which far exceeds both the provincial growth rate (1.4%) and municipal growth rate (1.6%) over the same period. This is indicative of a significant influx of people and a sign of an urbanisation trend.

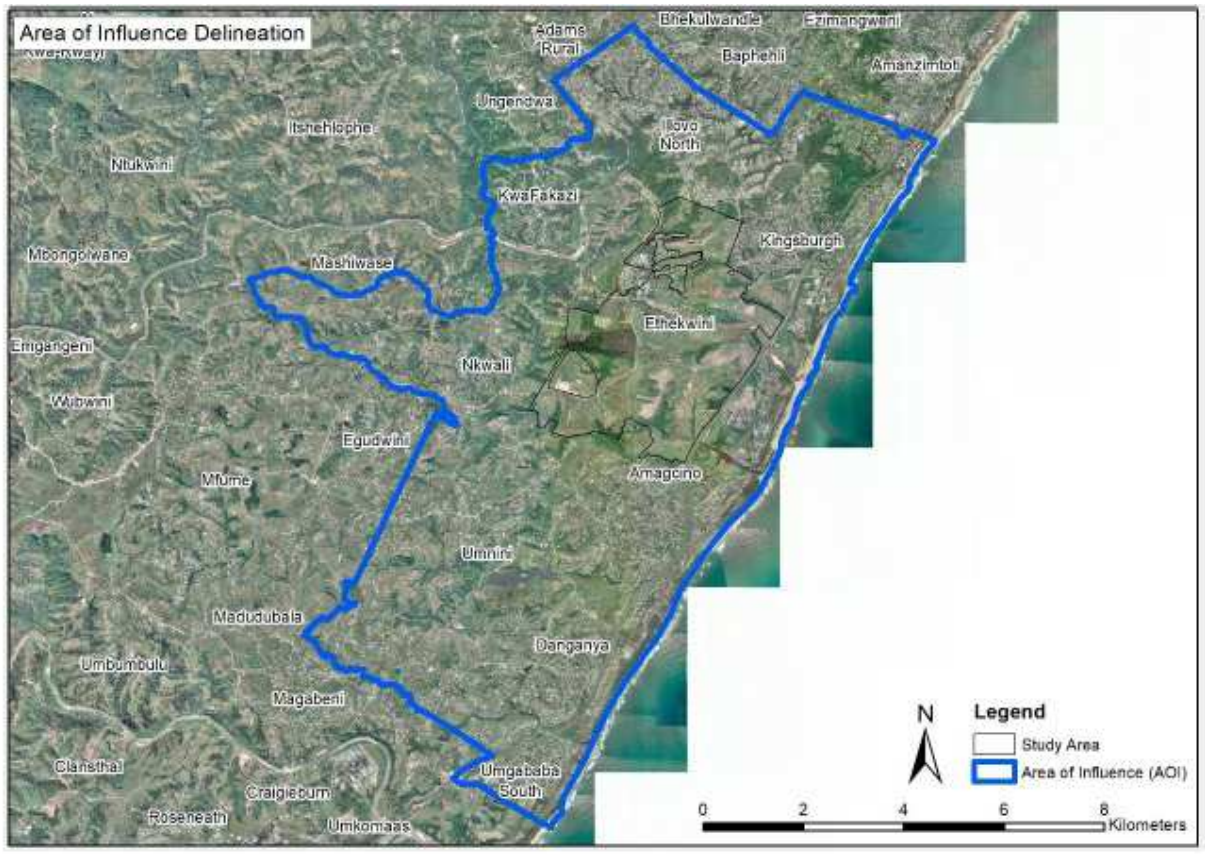


Figure 3-62: Delineation of the Area of Influence

(b) Age and Gender Profile

Extrapolating from the census 2001, 2011 and 2018 data sets with the population classified as youth (under the age of 15), as working age (16-64 years of age), and as elderly (over 65 years of age).

The trend exhibited by age profile across the different areas is broadly similar across the years. Loosely, the youth forms just about ±30% of the population, the working-age ±65% and the elderly accounting for approximately ±5% of the population across all three population scales.

From a gender perspective, the population in the AOI is broadly similar to the Provincial gender profile; approximately 48.3% of the population is male, with 51.7% being female. This differs slightly from the eThekwini gender profile, where the resident population is 49.4% male and 50.6% female. Refer to Figure 3-63.

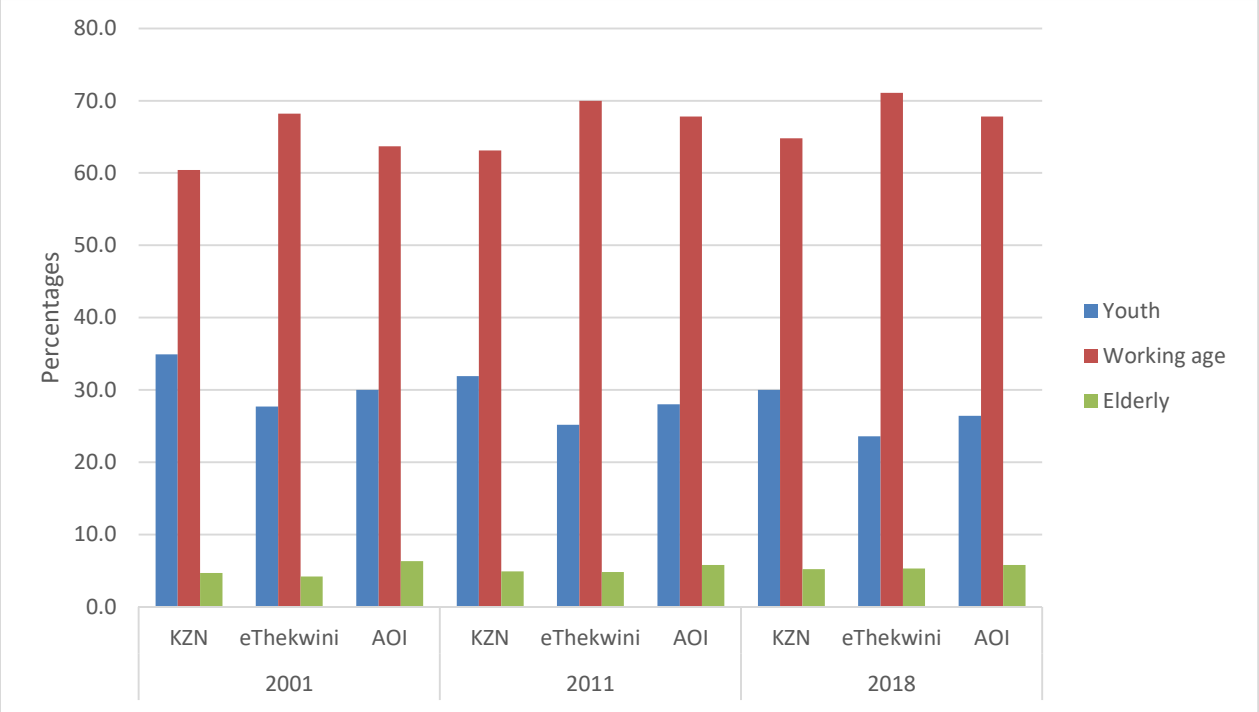


Figure 3-63: Change in age profile from 2001 to 2018

(c) Education Profile

An analysis of the educational profile of the AOI between 2001 and 2011 reveals that there has been a steady decline in the proportion of the population over 20 years of age with no formal schooling, with an average annual decline of 4.3%. Similarly, there is an associated gradual improvement in the proportion of the population that has matriculated or received a higher education qualification, with an average annual increase of 6.8% for grade 12 ad 7.2% for a higher education qualification. This compares favourably with both KZN and eThekwini, with the AOI actually having a larger proportion of the population falling within the top end of the education profile than both the KZN Province and eThekwini Municipality.

3.2.2 Socio-Economic Profile

Extrapolations based on historical trends suggest that a relatively high proportion of the population in the AOI is formally employed (89.4%), with correspondingly low unemployment rate (10.6%). This is far lower than the national unemployment rate which currently sits at around 27.2% (StatSA, 2018). Similarly, the unemployment rate in AOI is also below that of KZN (33.4%) and eThekwini (27.7%). Refer to Table 3-25 for a comparison of the soico-economic profile of the AOI.

Table 3-25: Summary and comparison of the socio-economic profile of the Area of Influence (AOI), 2018

Area Category	KZN	eThekwini	AOI	Unit
Employment Profile	66.6%	72.3%	89.4%	Employed
	20.3%	20.9%	8.5%	Unemployed

Area Category	KZN	eThekwini	AOI	Unit
	13.1%	6.8%	2.1%	Discouraged work-seeker
Household Income Profile	8.2%	12.1%	6.2%	No income
	48.6%	34.0%	16.0%	Low income
	21.3%	22.9%	17.8%	Low-Middle income
	18.0%	23.8%	57.6%	Middle-High income
	3.9%	7.3%	2.3%	High income
Weighted average monthly household income	R11 286.28	R16 163.12	R23 669.35	Per month

3.2.3 Employment Profile

Employment levels are an important indicator of socio-economic wellbeing as they provide insight into the proportion of the population with access to income and the ability to provide for basic needs, such as food and shelter, among others. Refer to Table 3-26 for comparisons of the employment profile of the AOI.

Table 3-26: Employment profile, 2018

Category	KZN	eThekwini	AOI
Employed	66.6%	72.3%	89.4%
Unemployed	33.4%	27.7%	10.6%
Labour force participation rate	48.6%	57.3%	60.9%
Labour absorption rate	32.4%	41.5%	54.4%

Extrapolations based on historical trends suggest that a relatively high proportion of the population in the AOI is formally employed (89.4%), with correspondingly low unemployment rate (10.6%). This is far lower than the national unemployment rate which currently sits at around 27.2% (StatSA, 2018). Similarly, the unemployment rate in AOI is also below that of KZN (33.4%) and eThekwini (27.7%).

It must be noted that there is a likelihood that the data has been weighted by the relatively higher populations of the urban nodes of Illovo North, Kingsburgh, and Umgababa South, which provide a greater number of employment opportunities to residents.

3.2.4 Cultural and Heritage

(a) Proposed KZN ASP

SATIVA (Pty) Ltd have undertaken a Phase 1: Archaeological and Heritage Impact Assessment and found no significant heritage resources within the proposed development site (including the various road access options. Refer to the study in Appendix D21.

Although the possibility of encountering previously unidentified burial sites is low, should such sites be exposed during subsurface construction work, they are still protected by applicable legislation and they should be protected.

(b) Proposed sewer line Route

SATIVA (Pty) Ltd undertook the Phase 1: Archaeological and Heritage Impact Assessment for the proposed construction of the sewer rising main from the KZN ASP site to the existing Kingsburgh WWTW (Appendix D22). No heritage resources were identified during the site survey.

Although the area is heavily altered, the potential of encountering heritage resources hidden beneath the surface still exist. In terms of the archaeology and heritage, with respect to the proposed sewer line route, there are no obvious 'Fatal Flaws' or 'No-Go' areas. No archaeological sites were recorded along all the proposed sewer line routes. The field survey established that the affected project area is degraded by agricultural activities and associated infrastructure. Although the area is degraded, there is still a possibility of encountering archaeological remains, especially during excavation for pipeline trenches. The Chance Finds Procedure (CFP) must be implemented should heritage resources be uncovered during construction. Based on the findings of this study, the proposed sewer line route is feasible from an archaeological perspective.

(c) Proposed Powerline Route

SATIVA (Pty) Ltd undertook the Phase 1: Archaeological and Heritage Impact Assessment for the Proposed 132KV transmission powerline from the existing Kingsburgh substation to the proposed substation on the KZN ASP site. Refer to Appendix D23. No heritage resources were identified at the proposed substation and along the Option 1, 3a and 3b powerline routes. An existing cemetery occurs along the Option 2 powerline route alignment. A historical house occurs 80m from the Option 2 route. A scatter of undecorated potsherds, although not in the direct footprint of the proposed substation, was recorded as having low heritage significance. There is a potential that archaeological remains may be uncovered during excavations for the proposed tower and substation foundations.

The Chance Finds Procedure (CFP) must be implemented should heritage resources be uncovered during construction. Based on the findings of this study, the proposed powerline route 1, 3a and 3b and the substation development is feasible from an archaeological perspective.

3.2.5 Aesthetic Environment

A Visual Impact Assessment was conducted by SVA International for the proposed KZN ASP site and the various access road options (Appendix D24). This study was aimed at ascertaining and remarking whilst assessing the potential visual impacts associated with the proposed development on the identified site and context. Key findings from this site are described below.

(a) Proposed KZN ASP

The study area focuses on the landscape within a 2km radius of the boundary of the proposed development. This surrounding area is made up of residential, farms and undeveloped areas. The topography of the study area is predominantly soft rolling hills and coastal plains, where the height above sea level ranges between 5 – 75m above sea level. The site for the proposed development is also fairly high in relation to the ground level of the surrounding areas and movement paths.

The visual quality of the region is moderate to moderately high. The landscape is made up of large tracts of vegetation, agriculture (subsistence and commercial), housing (both high and low income) and natural rivers, wetlands and coastal regions. There is no evidence of widespread erosion or natural degradation, and development, where this occurs, is domestic in scale.

The proposed development is expected to fade from view with increasing distance from the site. Visibility will decrease exponentially with the apparent decrease in the size of the development within the receptor's Field of View (FOV) and as contextual visual information increases within the receptor's FOV. The site is expected to be the most visible to receptors viewing from locations closer to the site (within approximately 1 – 2 km). The overall visibility of the site from the surrounding is largely dependent on the presence and positions of screening elements such as vegetation and urban development.

The project area is anticipated to be most visually apparent within a 1km distance from the boundary of the proposed development site. Due to the undulating landscape topography and existing infrastructure, buildings and vegetation, the proposed project is not anticipated to be highly visible from an area greater than 2km from the project area and will be most visible from areas within 1km.

Critical viewpoints from which the site could potentially be visible were determined based on the digital viewshed analysis. Thirteen potential viewpoints have been identified. The viewshed area that has been calculated for the site indicates that it will be visible from a distance of about 2 km. Although the proposed development covers a relatively large portion of land, it is hidden by the hilly terrain. It is therefore considered to have Moderate visibility in terms of the viewshed area.

(i) Viewpoints

A photographic survey was conducted on location by taking photographs of the site for the proposed development from various significant viewpoints. Refer to Figures 3-65 to 3-77. Critical viewpoints from which the site could potentially be visible were determined based on the digital viewshed analysis. Thirteen potential viewpoints have been identified (refer to Figure 3-64). Refer to Table 3-27 for the summary of visibility of each viewpoint.

(ii) Zone of Influence

The zone of visual influence is considerably smaller due to the screening effect of mature trees and vegetation in the surrounding areas. The area is not highly visible at increasing distance from the site and is only visible within a <1km radius. The zone of visual influence indicates that the site has moderate visibility. The proposed development would therefore have a moderate viewer incidence.

As viewer perception is largely based on subjectivity, user perception would vary between various viewers. Some would have both positive and negative viewing experiences of the proposed development, depending on viewing occurrences and outlook on development in the area.

(iii) Visual Exposure

The proposed development displays the greatest degree of visual exposure from viewpoints 02, 05, 07, 08, 09, 10 and 13, which is illustrated on Figure 3-78. These viewpoints are observed at close proximity, or from surrounding high lying areas and increase the prominence of the proposed development in the observers Field of View (FOV). Existing vegetation and the nature of the topography obscure the development in the observers FOV from viewpoints 03, 04 and 06. The development is partially visible from these points. While Figure 3-57 illustrates the critical viewpoints from which the site could potentially be visible based on the digital viewshed analysis, Figure 3-78 illustrates the areas with the greatest degree of visual expose from the viewpoints mentioned herein.

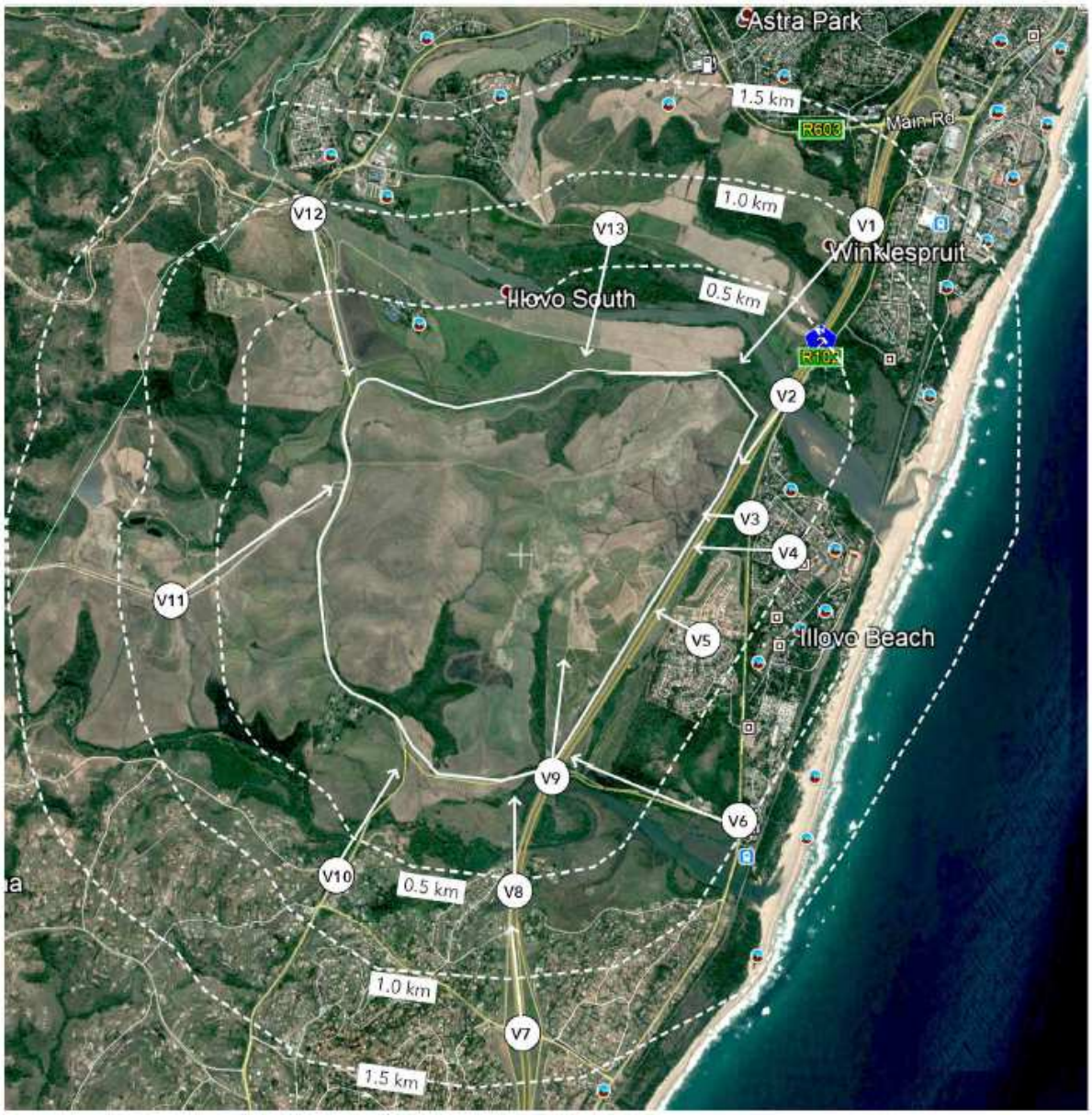


Figure 3-64: Diagram indicating potential viewpoints. (Google Earth, edited by SVA. 2019).

Figure 3-65: View Point 1 - Panoramic view from N2, near Winkelspruit, looking up and down the N2. The site is hidden from view by a hill and vegetation and is not visible from this point.

Figure 3-66: View Point 2 - View from N2, on the iLovu Bridge. The view is straight down the N2 in a south-west direction, with the site visible on the right-hand side. The site is highly visible from this point.

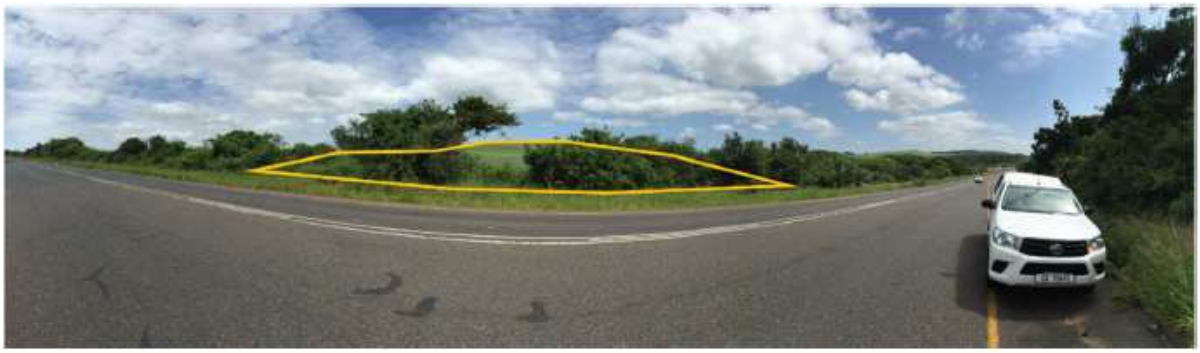


Figure 3-67: View Point 3 - Panoramic view from the N2 off-ramp for Illovo Beach, looking towards the east. The site is visible from this point.

Figure 3-68: View Point 4 - View from the Illovo Beach residential area. The site is obscured by vegetation but is still visible from this point.

Figure 3-69: View Point 5 - View from the Panorama Park residential area. The site is highly visible from this point.

Figure 3-70: View Point 6 - View from the Panorama Park residential area. The site is obscured by vegetation and the topography but is still visible from this point.

Figure 3-71: View Point 7 - View from the N2, looking north. The site is highly visible from this point.

Figure 3-72: View Point 8 - View from the N2, looking north. The site is highly visible from this point.

Figure 3-73: View Point 9 - View from the N2, above the uMsimbazi River, looking north. The site is highly visible from this point.

Figure 3-74: View Point 10 - View from the P197, looking north. The site is visible from this point.

Figure 3-75: View Point 11 - View from a high lying dirt road, looking east. The site is highly visible from this point.

Figure 3-76: View Point 12 - View from the steel bridge crossing the iLovu River. The site is not visible from this Point

Figure 3-77: View Point 13 - View from 'Old Main Road'. The site is visible from this point

Table 3-27: Summary of visibility from viewpoints

View Point (VP)	Visible
VP 1	NO
VP 2	YES
VP 3	YES
VP 4	YES
VP 5	YES
VP 6	YES
VP 7	YES
VP 8	YES
VP 9	YES
VP 10	YES
VP 11	YES
VP 12	NO
VP 13	YES

Figure 3-78: Diagram indicating potential viewpoints. (Google Earth, edited by SVA. 2019).

(iv) Visual Sensitivity

The site has medium to high visual sensitivity due to its undulating topography and large scale relative to surrounding developments. The surrounding land uses are mostly residential, which will increase the sensitivity to the proposed ASP industrial-type development

The residential areas around view point 5 and view point 13 will have the most sensitive views. At the moment these areas have a pleasant view of lush, green rolling hills. This will be replaced by large scale industrial type architecture. The duration of the viewing period would be fairly long.

These points, therefore, have high visual sensitivity. Although the site is also highly visible from viewpoints 2, 7, 8 and 9 – the duration of the viewing period is short, as the viewer is travelling along the N2 freeway and will be driving through similar kinds of developed area – around 3 minutes' travel time. These points, therefore, have low viewer sensitivity.

(v) Visual Absorption Capacity (VAC)

The site has medium visual absorption capacity due to the undulating landscape and topography and also due to the fact that many viewers would be transit travellers along the N2, with only a short time period of visual interaction with the proposed development (±3 minutes).

(vi) 'Genius Loci' (Sense of place)

This is the unique value that is allocated to a specific place or area through the cognitive experience of the user or viewer. In terms of the proposed developed it is suggested the sense of place would be altered to a degree but that would be within acceptable parameters.

(vii) Summary

Despite its location within the surrounding landscape the proposed development is not particularly well visible within its immediate and larger context from number of viewpoints. This is primarily due to the undulating nature of existing landscape within the site and immediate surrounding which offers visual concealment from a number of sides. However, from a limited number of viewpoints the development would be highly visible.

The proposed development is therefore considered to be moderately visually intrusive and will, despite its maximum height of 15 metres, blend-in to a degree with the existing setting and context.

(b) Proposed Road Access Options

In terms of visual impact Option 3b would have the greatest visual impact due to the additional loop and Option 1 the least. In addition, the difference between Option 1 and 1c in negligible in terms of visual impact on the landscape while Option 1d would increase heavy-duty traffic into the neighbouring residential settlement. All four road access options introduce a new

overpass infrastructure along the N2. Table 3-28 provides a description of the visual exposure of each road access option.

Table 3-28: Visual exposure of each road access option

Option	Viewer Sensitivity/ Viewers affected	Visual Exposure / View Points / Topography	Visual Absorption Capacity (VAC)
1	Residents of Larnaco as well as those travelling along the N2.	Due to the existing undulating topography, the narrow diamond is placed between two hills, helping to visually screen it from the neighbouring area. Therefore, it is deemed not as visually imposing as the other options.	High VAC due to existing similar structures along the N2 in the immediate vicinity.
1c	Larnaco Residents Affected as this R102 link is directly in their line of sight.	Existing undulating topography means the R102 link will be visible from surrounding high viewpoints and residents.	Medium VAC. Similar structures already exist along the N2 but would be more imposing on the existing landscape.
1d	Larnaco Residents Affected as this R102 link is directly in their line of sight. The narrow diamond structure is also visible.	Existing undulating topography means that the R102 link will be visible from surrounding high viewpoints and residents. The addition of the narrow diamond structure is a further visual imposition.	Medium VAC. Similar structures already exist along the N2, but somewhat more imposing on the existing landscape than option 1D, due to addition of narrow diamond.
3b	Panorama Park residents affected. As well as those travelling on the N2.	The proposed loop is a larger structure and is more visually imposing on the existing landscape.	Low VAC as there are no similar loop interchanges in the immediate vicinity. This creates a higher level of visual disturbance.

(c) Proposed Powerline

A Visual Impact Assessment was conducted by the Institute of Natural Resources (INR) for a 132kV electrical powerline from the existing Kingsburgh substation to the proposed substation at the ASP (Appendix D25). The assessment of visibility is based on a viewshed model which is developed based on the topography and on the specifications of the development. This identifies which areas of the region will potentially be affected visually by the proposed development. Key findings from the study are described below.

The diminishing of visual impact is compounded by the lattice makeup of the pylons which allows the background to be seen through the lattice, providing a degree of visual integration. This helps to further reduce the visual impact of a pylon. Refer to Figure 3-79.

Figure 3-79: Comparison between the visual impact of lattice pylon at 50 m (foreground) and 2000 m (red circle)

(i) Visual Absorption Capacity

The site's visual absorption capacity is low to moderate. The expanse of sugarcane is monochromatic and fragmented but there are a few topographic features in the valley that will allow the visual impact of the development to be partially dissipated or absorbed. The landscape is dominated by sugarcane which is fragmented by nature. Powerlines would introduce additional straight, fragmenting lines which are not out of place in such a landscape, particularly when below the horizon. However, when visible above the horizon, pylons are much more intrusive and visible.

(ii) Landscape exposure/enclosure

The proposed development site is the lower iLovu River valley which is somewhat enclosed and thus relatively secluded from the surrounding valleys. The landform of the site is characterized by a river valley bottom, surrounded by ridges to the north, south and west. The site is also partially enclosed to the east, where the valley narrows as the river approaches the coast. Because of this topographic seclusion, visual impacts are largely contained within the valley. The exception to this is the Nkwali North residents as they are situated at a higher altitude and therefore overlook the valley.

Line Option 1

The broader visual impact of option 1 is relatively contained when compared with other line options. There are several local areas of concern with Line option 1. These areas of concern are predominantly residential zones, along Draeger Crescent, where the powerlines pass in close proximity and where views of the majority of the pylons exist. South Illovo residents and businesses in the area of Draeger Crescent will have views that are significantly impacted by the Powerline Option 1. Refer to the viewshed analysis in Figure 3-80.

Figure 3-80: Viewshed analysis of Powerline Option 1

Line Option 2

The broader visual impact of option 2 is relatively widespread when compared with other alternatives but not as severe (fewer pylons are visible) in most areas. There are several local areas of concern with Option 2. These areas of concern are predominantly residential zones with views of the majority of the pylons. South Illovo residents and businesses in the areas of Nelson close, Poss Road and Draeger Crescent will have views that are significantly impacted by the Powerline Option 2. Refer to the viewshed analysis in Figure 3-81.

Line Option 3a

The broader visual impact caused by Option 3a is well contained to the iLovu River valley, with small parts being theoretically visible in areas beyond 2.5 km. Most of the visual impact is contained within 1 km, where most of the pylons are visible. The majority of the powerline is visible from just beyond 1km to high lying areas located in the north-west and east. The local areas of concern with Option3a are fewer than option 2, but with residents in Poss Road and Draeger Crescent still significantly impacted. Refer to the viewshed analysis in Figure 3-82.

Line Option 3b

The broader visual impact of line option 3b is more widespread when compared with option 3a but in the extended viewshed, not as severe (fewer pylons are visible). Local areas of concern with option 3b are the Nkwali North Residential area and the residential area around Draeger Crescent. These residential areas are highly impacted visually and can see the majority of the pylons. Refer to the viewshed analysis in Figure 3-83.

Figure 3-81: Viewshed analysis of Powerline Option 2

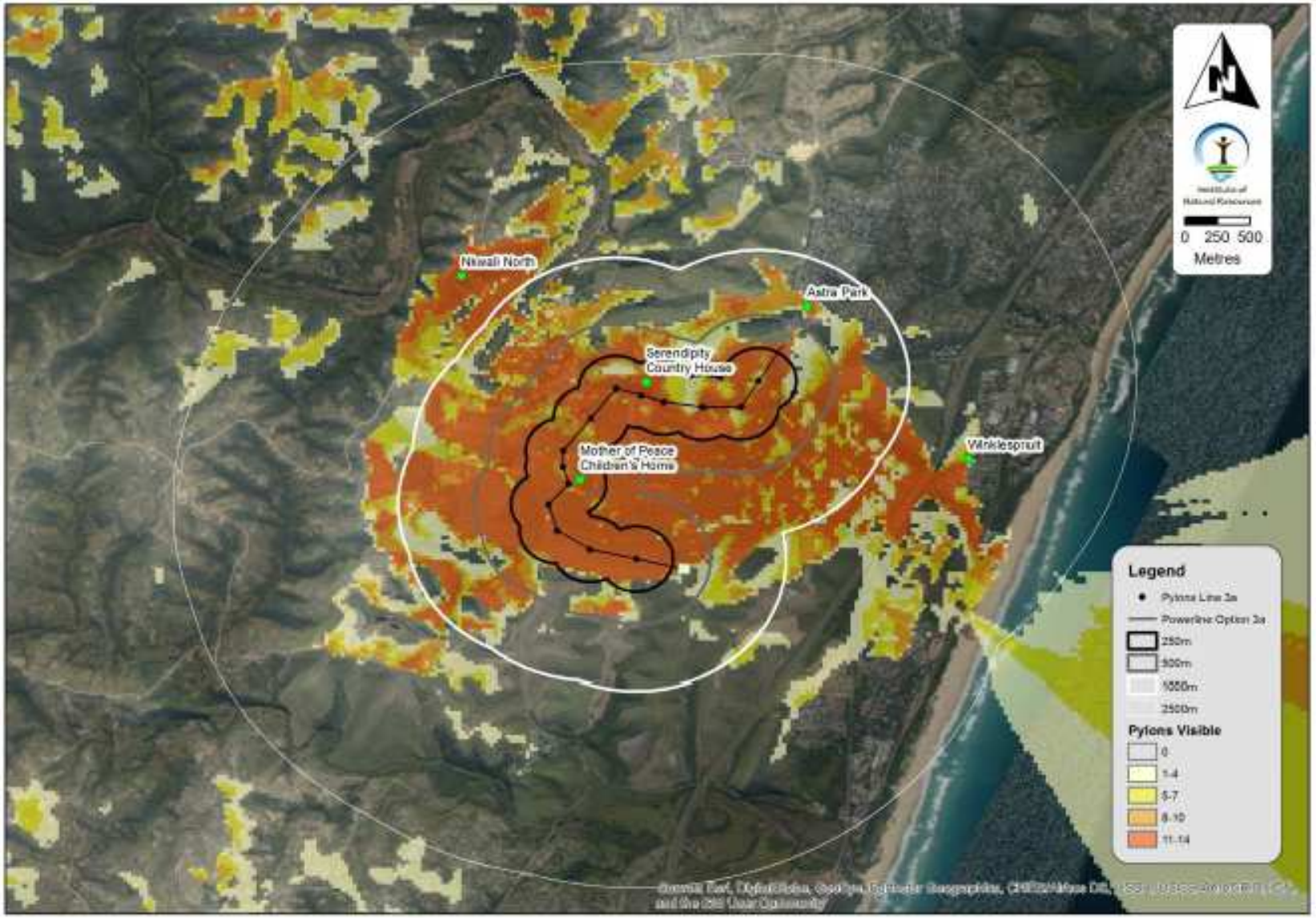


Figure 3-82: Viewshed for Line Option 3a

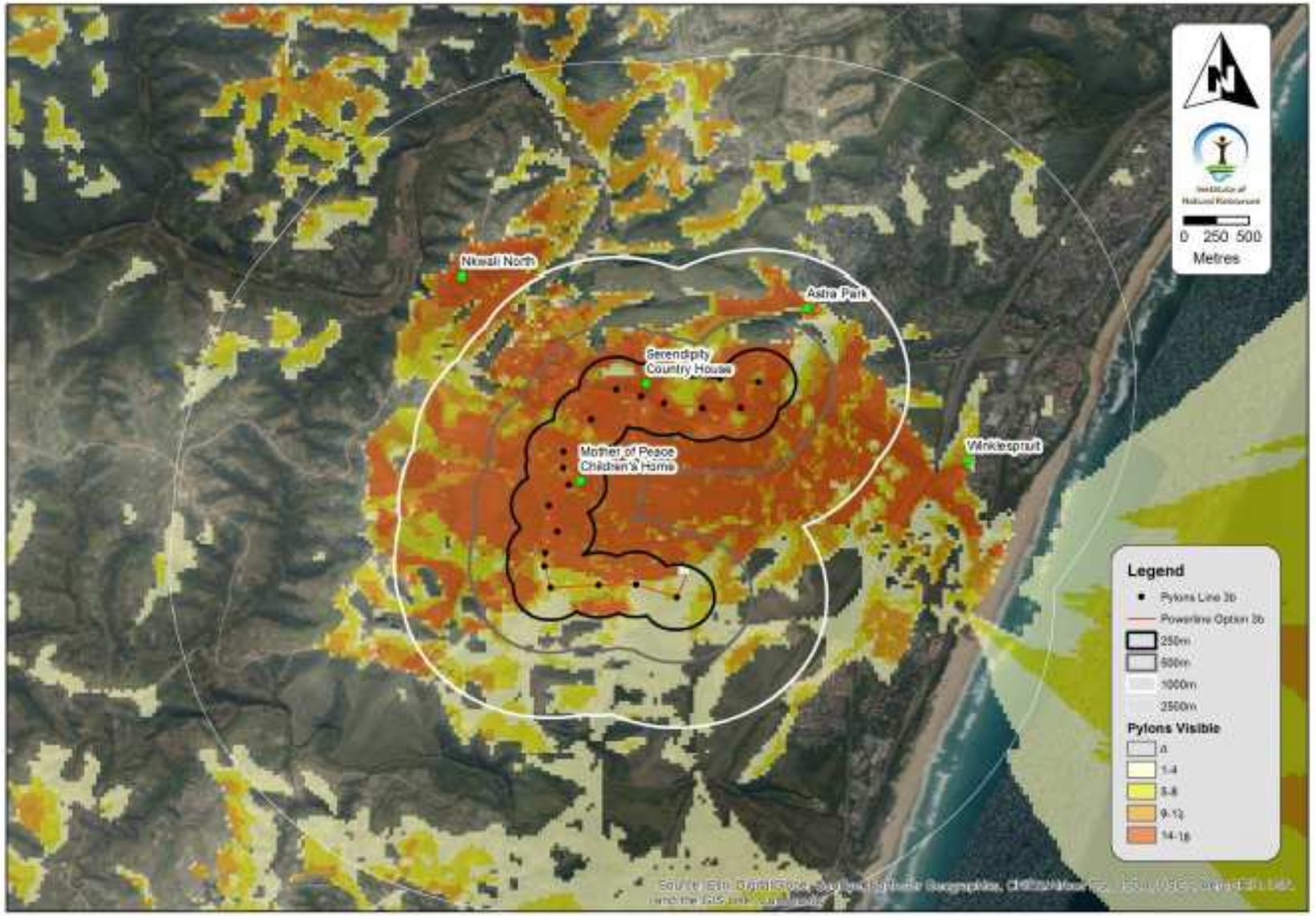


Figure 3-83: Viewshed analysis of Option 3b

(d) Proposed Substation

The proposed substation is situated on the southern ridge of the iLovu Valley, overlooking the iLovu River. The proposed dimensions of this structure are 100 x 100 m.

(i) Viewshed for Proposed Substation

The visual impact of the substation was assessed based on the typical 132Kv substation drawings and dimensions. In addition, the Kingsburgh substation has been used as an example of such a substation for visual impact assessment purposes. The proposed substation would be visible predominantly from the areas to the north, east and west of its proposed location, while areas to the south are largely shielded by the topography (Figure 3-84).

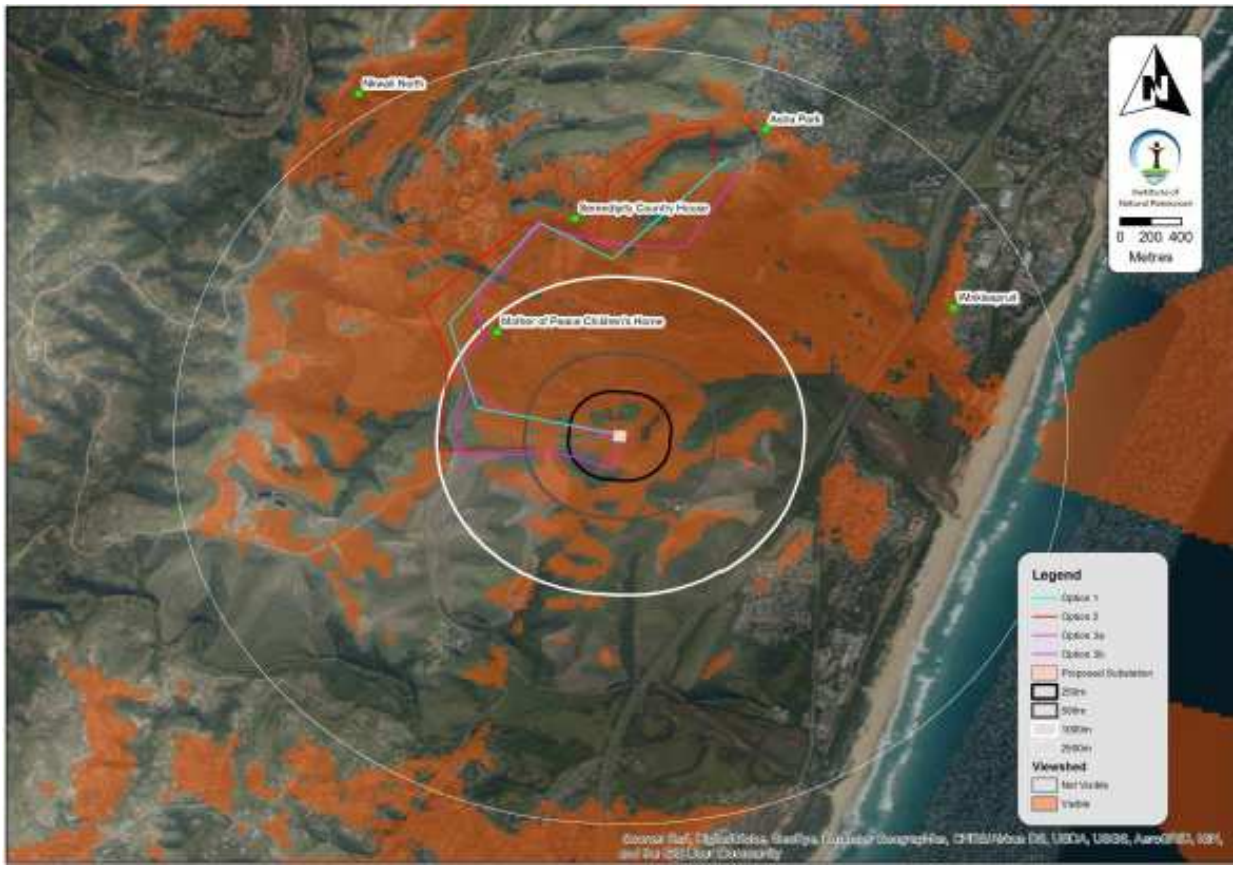


Figure 3-84: Viewshed analysis for the proposed substation

(ii) Sensitive Viewing Points

Potentially sensitive viewing points (SVPs) were identified using the viewshed analyses from the substation and each line option.

Nkwali North

Nkwali North is situated approximately 1km west of the proposed development, perched high on a ridge with easterly views across the valley (Figure 3-85). There are several free-standing houses and schools on the east-facing crest of the ridge. The sensitivity of the residents of Nkwali north is high as they are residents with affected views.

The powerlines are likely to break the skyline in certain areas but the impact of this will be diminished by the distance between the lines and the receiving environment. The visual impact of the proposed development would be further diminished as the area is already characterized by pylons and powerlines. Sand mining in the valley below has already detracted from any potentially sensitive natural views.

Astra Park

Views of the proposed development area from Astra Park (Figure 3-86) residential area are limited by the topography of the area. The most impacted residents of Astra Park will be those of the Coastline Crescent Shareblock which sits on the western extremity of Astra Park residential area. The surrounding vegetation in Coastline Crescent Shareblock will partly conceal the proposed development from view but not completely. However, the construction of pylons in the vicinity will not completely change the nature of the landscape for the receiving environment due to the presence of several existing large pylons in the area. Residents of Coastline Crescent Shareblock will be able to see at least half of the pylons in all of the powerline alternatives but residents from the rest of Astra Park will only be able to see a few pylons. Views from Astra Park are considered highly sensitive as they are residents with affected views.

Illovo South

Illovo South is a small community made up of residential areas, commercial zones and light industry (Figure 3-87). The light industry and commercial zones have a low sensitivity as they have views from urbanised areas, commercial buildings or industrial zones. However, the residents of this area have a high sensitivity. The addition of powerlines in the area would however not drastically change the character of the area as it is already relatively urbanized with a light industrial sense of place.

Line option 2 passes over parts of the industrial zone and within 200 m of the residential zone of Illovo South. Views from the industrial and commercial zones are immitigable due to the close proximity of the pylons. Views from the Illovo South residential area would be partly mitigable by use of vegetative screening to block the view of some of the pylons in line option 2. Line option 2 would create the greatest visual impact as it is the closest to Illovo South. Line options 1, 3 a & b are within 150 m of the industrial zone and within 250 m of the residential zone of Illovo South. Views from the industrial and commercial zones are not sensitive and only partly mitigable due to the close proximity of the pylons. Views from the Illovo South residential area would be partly mitigable by use of vegetative screening to block the view of some of the pylons.

Nelson Close Residents and Illovo Country Estate

Nelson Close is situated west of the existing Kingsburgh substation with views across the iLovu River valley. There are several free-standing houses, a country estate and one housing complex in this area, all overlooking the valley. Current views from Nelson Close are of agricultural fields with fragmented natural vegetation. The sensitivity of the residents of Nelson Close is high as they are residents with affected views. Illovo Country Estate and Clubhouse are located on the natural ridge, overlooking the proposed development site.

Line option 1 passes within 300 m of the Nelson Close residents, likely causing slight visual impacts on the residents. The pylons and powerlines are likely to be visible above the skyline for a portion of the view from the receiving environment before dropping below the horizon. Once the pylons are below the horizon, their visual impact is significantly reduced due to the mottled and fragmented backdrop. Similarly, Line 3 a & b pass within 400 m of the Nelson Close residents, likely causing slight visual impacts on the residents.

Line option 2 would cause further impact on a proposed residential development along Poss Road. Line option 2 runs directly over the proposed residential development. Refer to Figure 3-89 for the locality map illustrating the proximity of Nelson Close and Illovo Country Estate to the proposed powerline route options.

Draeger Crescent Residents

Draeger Crescent is situated south-west of Poss Road, with approximately 10 residences that overlook the iLovu River and part of the proposed route. In addition to the residences, there is a Bed and Breakfast (Serendipity Country House) which, to a large degree, relies on the view of the iLovu River valley and the rural sense of place for their business. The sensitivity of the residents of Draeger Crescent is high but the sensitivity of Serendipity Country House is high to exceptional as the business partly relies on the appreciation of the landscape for income.

The houses of Draeger Crescent are built on a ridge, approximately 15m-20m above the level of ground where the powerlines are proposed to be built. All proposed line options are located within 100 m of the residents of Draeger Crescent. It is likely that the residents of Draeger Crescent, including Serendipity Country House, will have their view of the iLovu River Valley broken by powerlines. The view of the valley will be broken by the powerlines and pylons which will traverse the view shown in Figure 25 of Appendix D25 mid-frame and in close proximity. Further away, the view of the horizon will be impacted by the proposed substation development.

The pylons of line option 1 are located at least 100 m from any of the residents on Draeger Crescent and Poss Road, reducing their visual impact slightly. However, the powerlines may still be visible across the horizon for some residents of Draeger Crescent and Poss Road. Refer to Figure 3-90 for the locality map illustrating the proximity of Draeger Crescent residential area to the proposed powerline route options.

Winkelspruit and Illovo Beach

Winkelspruit and Illovo Beach are mixed residential areas located to the east of the proposed development site. Several houses in Winkelspruit and Illovo Beach are west facing, with views over the river valley where the development is proposed to take place. Visual impacts on the receiving environment would be diminished by the distance from the proposed development. Impacts on view of the proposed development from these houses would be diminished by the distance and the sensitivity of the residents in these areas is high.

This viewpoint was selected to be representative of the views from both Illovo Beach and Winkelspruit. From Winkelspruit and Illovo Beach, the majority of the pylons in all proposed

line options will be visible but the impact will not be extensive due to the distance from the proposed development. Few of the pylons would be visible above the horizon and the residents are more than a kilometre away from the pylons thereby diminishing the impact. Similarly, the proposed substation will be visible from Winkelspruit and parts of Illovo Beach but the impact will be diminished by the distance between the proposed development and the receiving environment. Refer to Figure 3-91 for the locality map illustrating the proximity of Winkelspurit and Illovo Beach to the proposed powerline route options.

Main Farm House

The main farm house is situated south-west of the existing Kingsburgh substation on a small crest. Panoramic views across the river valley can be seen from the house while the existing substation can be seen north-east of the property. Line option 1 would be visible to the north and the west of the main farm house, approximately 80 m away. Mitigation is not possible due to the close proximity of the house to line option 1. However, the main farm house faces south-east, away from line option 1, which reduces the visual impact on the main farm house.

Line options 3 a & b both involve construction to the east and south of the main farm house with pylons being built as close as 150 m. The pylons would likely extend above the horizon with the powerlines draping across the field of view. The impact is significant given the orientation of the house and close proximity to pylons. Visual impact is only partly mitigable by vegetative screening. Refer to Figure 3-92 for the locality map illustrating the proximity of the main farm house to the proposed powerline route options.

Canoe Club and Eco Trail

The canoe club has views which are heavily exposed to all line options of the proposed development. The sensitivity of those using the canoe club for sports and recreational activities is moderate as their focus is not on the landscape but rather on the activity.

The Eco Trail starts from the canoe club and follows the iLovu River downstream. The views along the Eco Trail are focused on the landscape and will be impacted by the proposed development particularly in the portion of the Eco Trail closest to the Illovo Canoe Club (Figure 3-93). The sensitivity of those utilizing the Eco Trail is very high because their focus is on the appreciation of the landscape.

Line option 2 is approximately 50 m away from the canoe club and the start of the Eco Trail. The focus of the canoe club is predominantly south and east, away from the path of Line 2. Views are immitigable due to the close proximity of the receiving environment to line 2.

Part of lines 3 a & b are approximately 50 m away from the canoe club and pass directly over the Eco Trail. Views are immitigable due to the close proximity of the receiving environment to line options 1, 3 a & b. Refer to Figure 3-93 for the locality map illustrating the proximity of the canoe club and eco trail to the proposed powerline route options.

Figure 3-85: Sensitive Viewing Points that were identified, using the viewshed analyses, and then assessed during the site visit

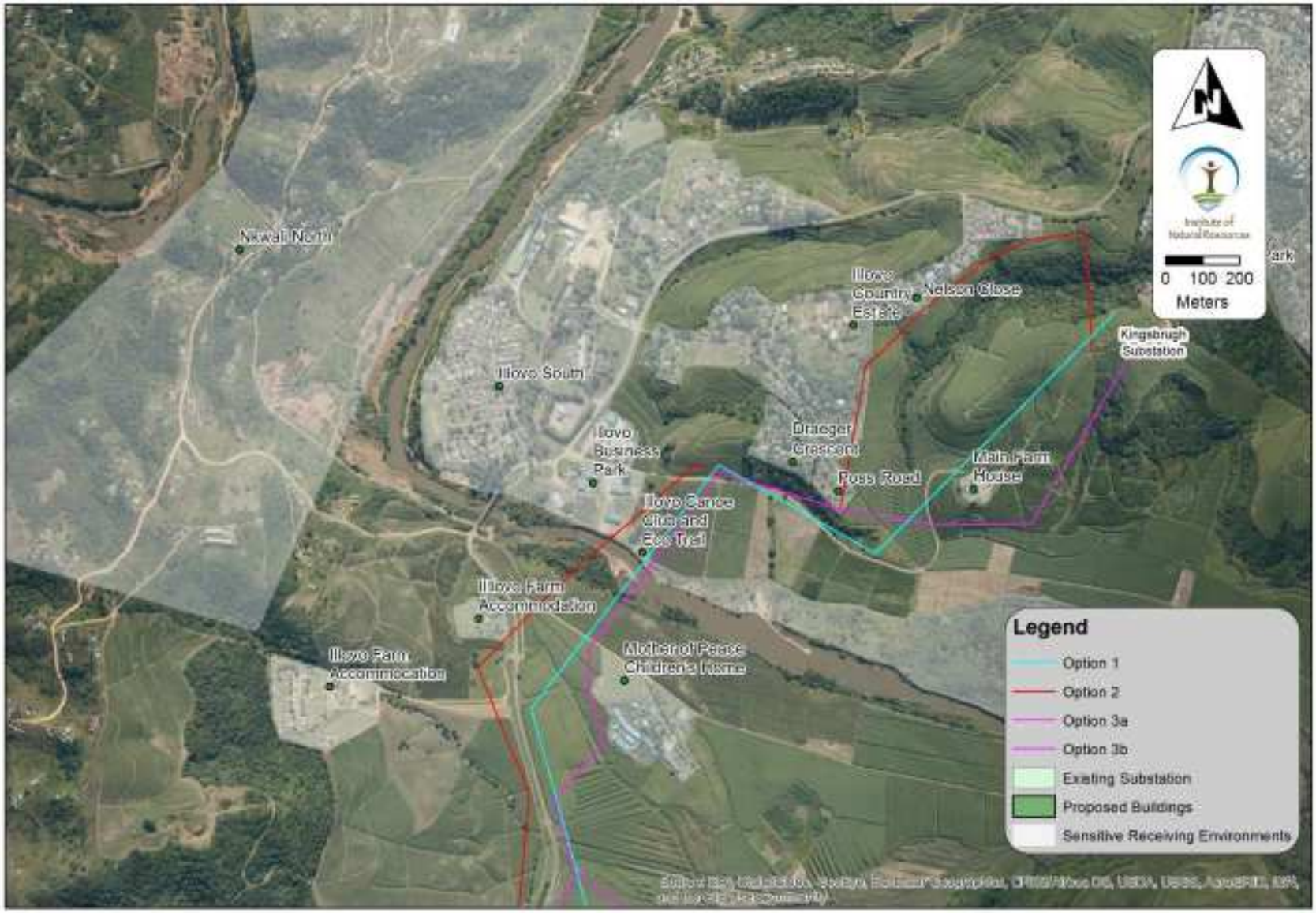


Figure 3-86: Locality map illustrating the proximity of Nkwali North residential area to the proposed powerline options

Figure 3-87: Locality map illustrating the proximity of Astra Park residential area to the proposed powerline options

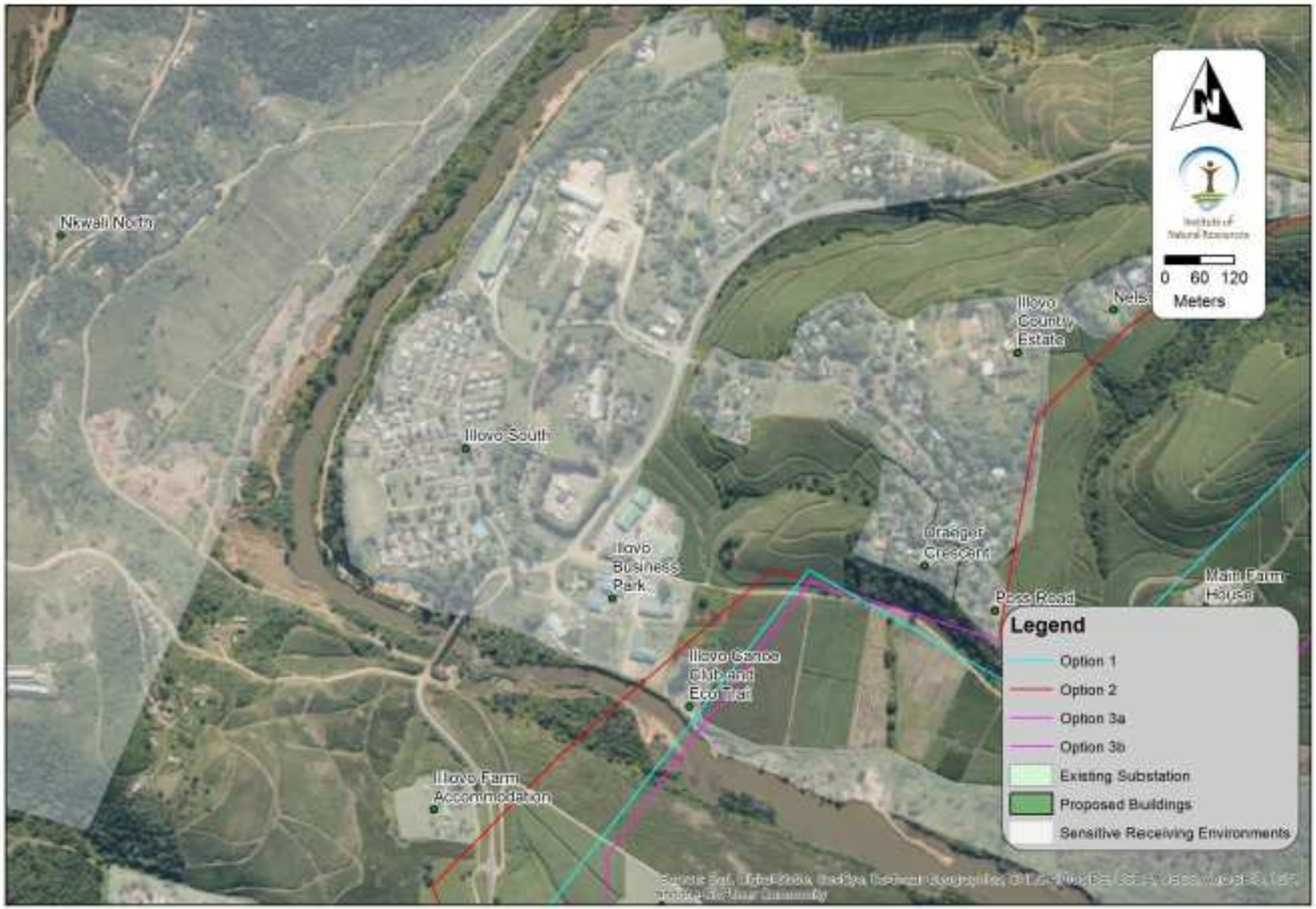


Figure 3-88: Locality map illustrating the proximity of Illovo South mixed-use area to the proposed powerline options

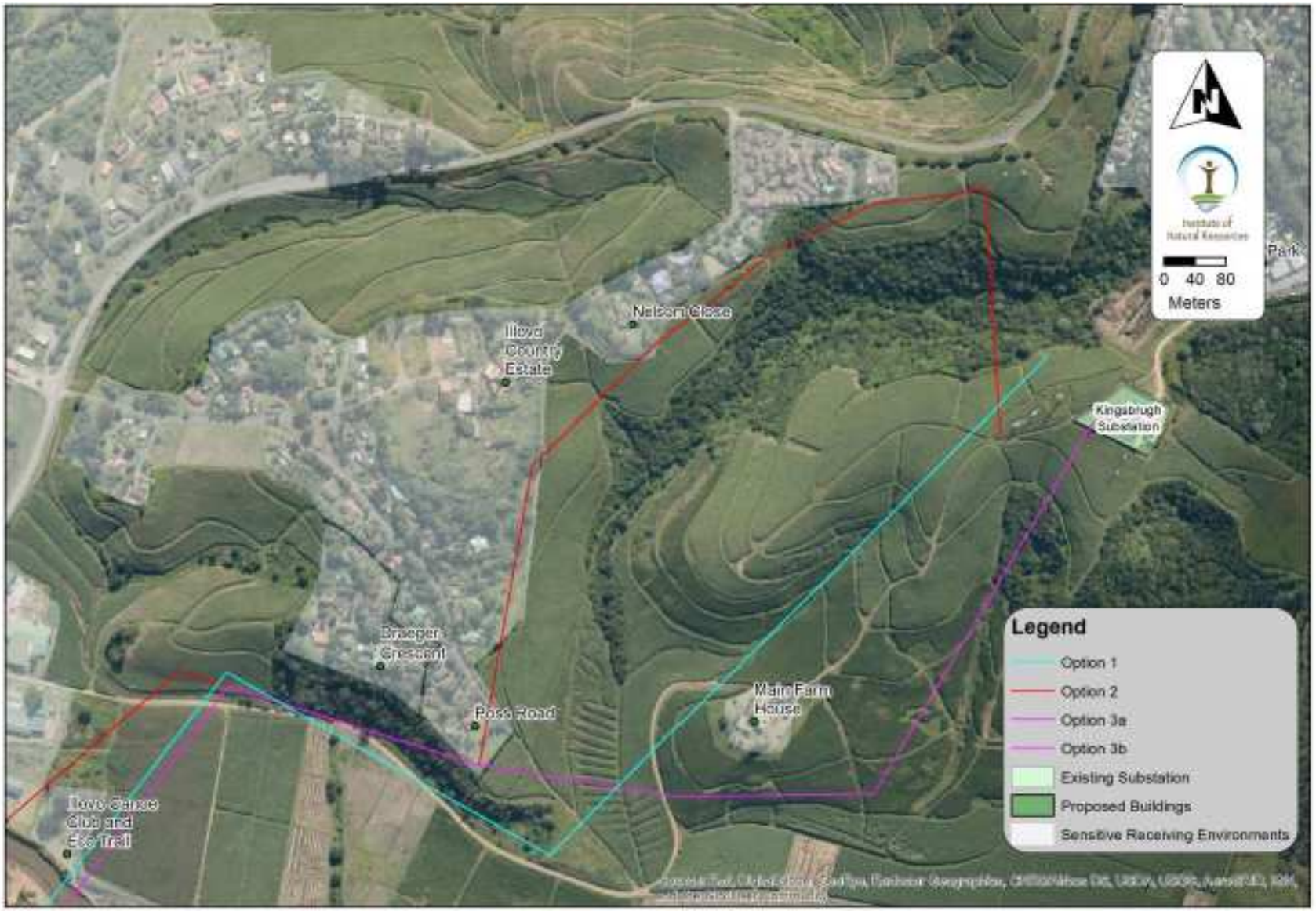


Figure 3-89: Locality map illustrating the proximity of Nelson Close and Illovo Country Estate to the proposed powerline options

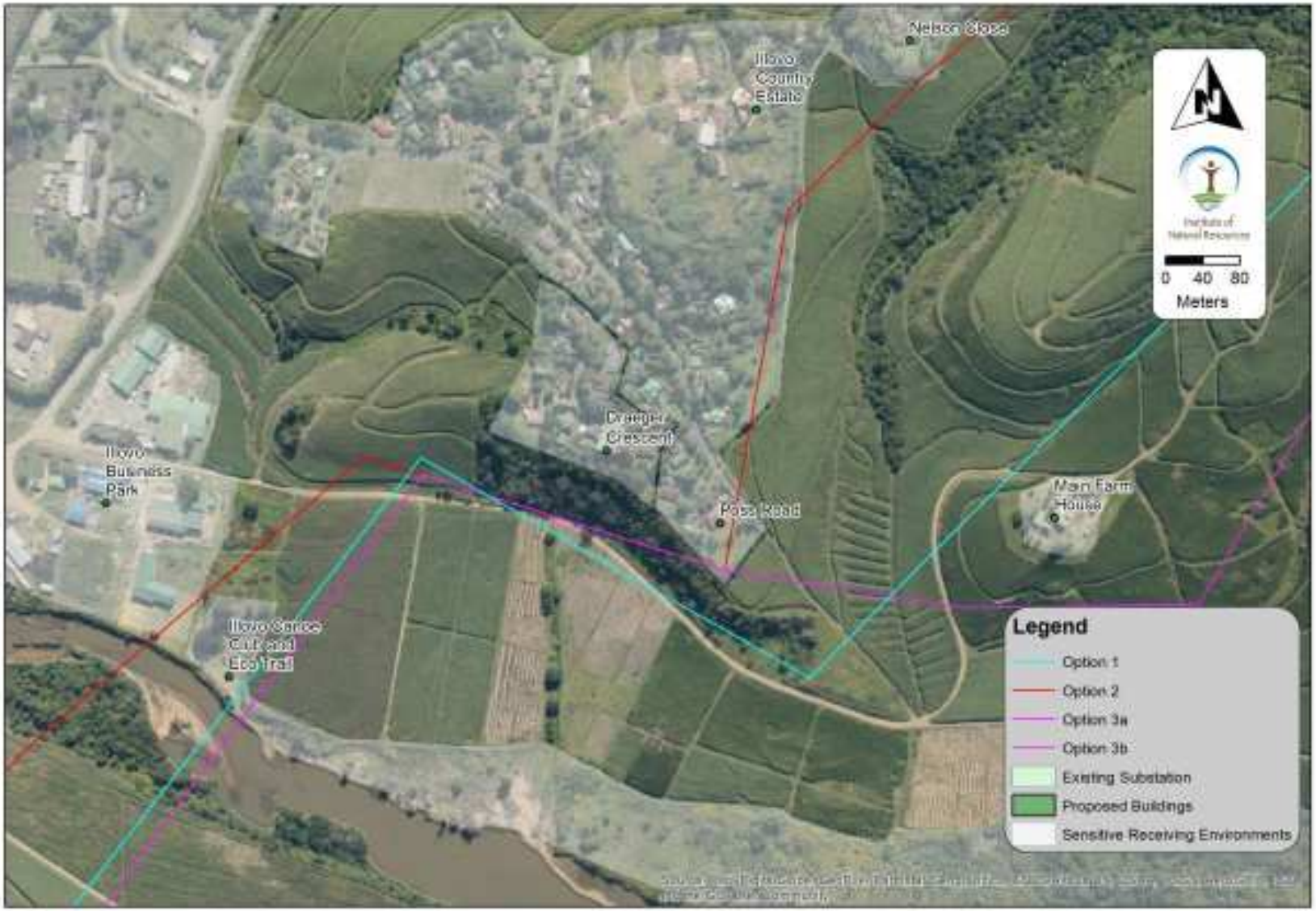


Figure 3-90: Locality map illustrating the proximity of Draeger Crescent residential area to the proposed powerline options

Figure 3-91: Locality map illustrating the proximity of Winkelspruit and Illovo Beach to the proposed powerline options

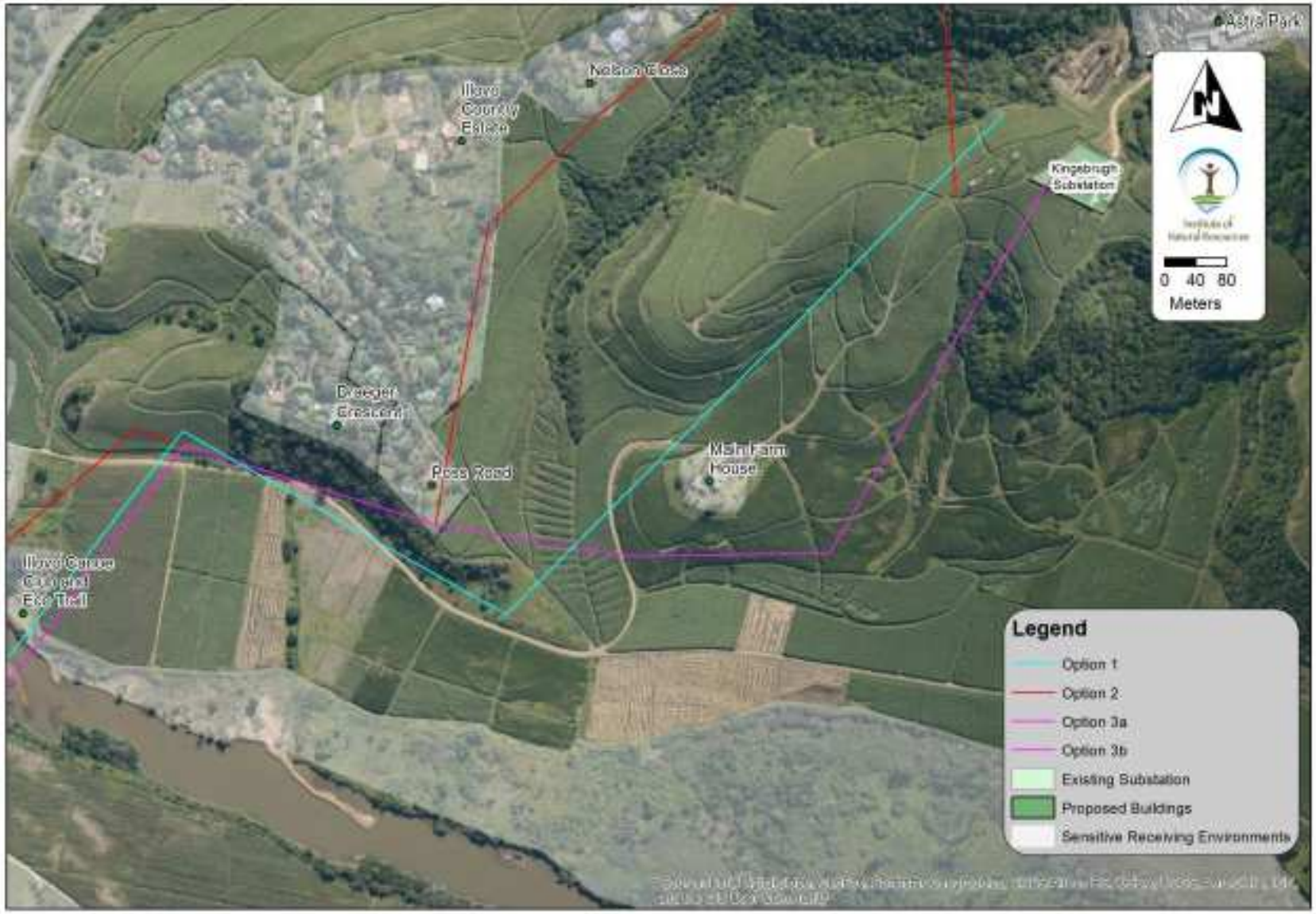


Figure 3-92: Locality map illustrating the proximity of the Main Farm House to the proposed powerline options

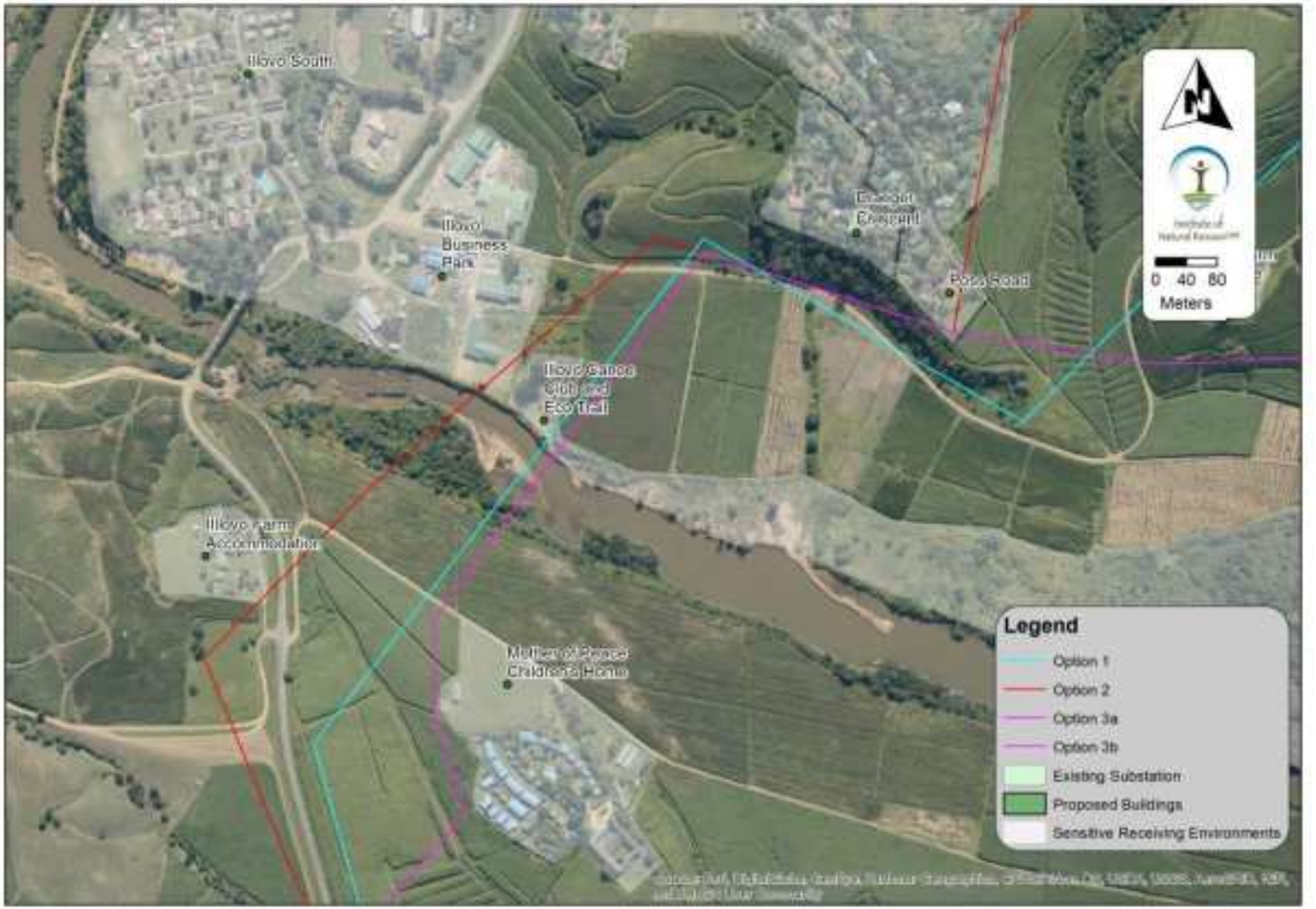


Figure 3-93: Locality map illustrating the proximity of the Illovo Canoe Club and Eco Trail to the proposed powerline options

Illovo Farm Accommodation

This viewpoint was selected to be representative of the views from both Illovo Farm Accommodation properties (Figure 3-94). The Illovo Farm Accommodation is situated west of the proposed development, with panoramic views of the valley. There are several residences and offices at the site, most of which would have views impacted by the proposed development.

The farm accommodation is perched slightly above the river valley with views from the existing substation to the site of the proposed substation. Options for mitigation of any of the proposed line options are limited by the topography of the land. The sensitivity of the residents at the Illovo Farm Accommodation is high as they are residents with affected views.

Lines options 1, 2 and 3 are approximately 500-700 m away from the residences at Illovo Farm Accommodation. The pylons and powerlines are likely going to break the skyline, further increasing the visual impact. However, the existing view of the landscape from the property is broken by several pylons and powerlines. The addition of any of the proposed line options would not significantly alter the character of the landscape from the perspective of Illovo Farm Accommodation. Refer to Figure 3-94 for the locality map illustrating the proximity of Illovo Farm Accomodation to the proposed powerline route options.

Mother of Peace Children's Home

All proposed line options pass within 300 m of the Mother of Peace Children's Home. The potential for mitigation of the visual impact at this site is limited due to the close proximity of the pylons.

Line 2 passes within 200 m of the boundary of Mother of Peace, potentially causing visual impacts on the residents. This visual impact is likely to be diminished south of this viewpoint as most of the pylons would not be obvious above the horizon. In addition, they would be located alongside existing pylons meaning the nature of the landscape would therefore not be significantly altered. Lines 3 a & b pass within 20 m of the boundary of Mother of Peace, potentially causing significant visual impacts on the residents.

The sensitivity of the residents at Mother of Peace Children's Home is regarded as high as they are residents with affected views, however, this property is well vegetated and constructed with an introspective layout. The perimeter, in particular, is hedged and tall trees are present which will help mitigate the visual impact of pylons. Refer to Figure 3-95 for the locality map illustrating the proximity of the Mother of Peace Childrens Home to the proposed powerline route options.

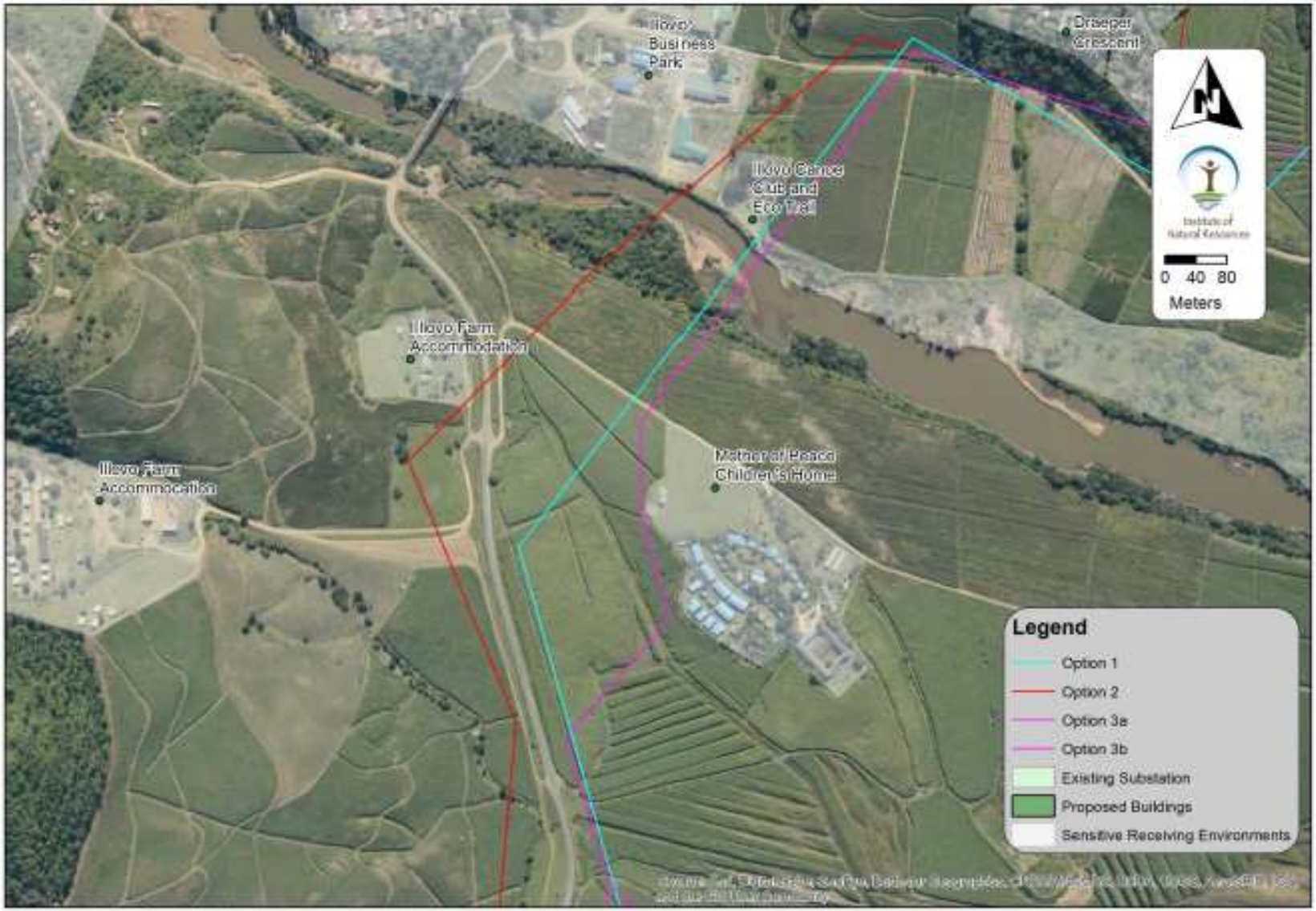


Figure 3-94: Locality map illustrating the proximity of Illovo Farm Accommodation to the proposed powerline options

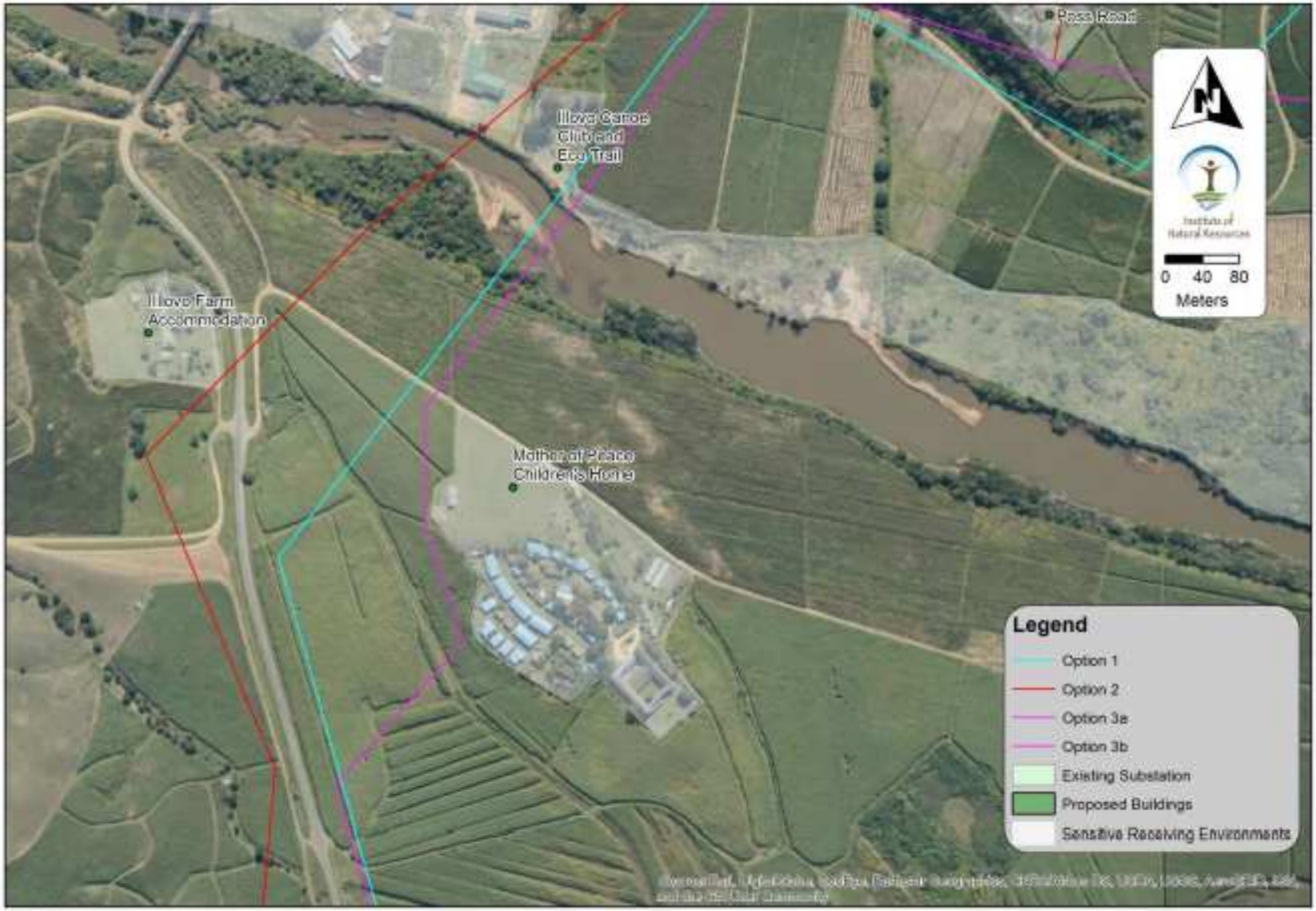


Figure 3-95: Locality map illustrating the proximity of Mother of Peace Children's Home to the proposed powerline options