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REPORT

ON

MASTER PLAN FOR THE MV (11kV) DISTRIBUTION NETWORK AT STRUISBAAI

REPORT NO: G/10264/E/R2A

Dated: 30 JUNE 2017

Prepared by:

Clinkscapes Maughan-Brown (South) (Pty) Ltd.
39 Victoria Street
GEORGE
6529
Contact: J.S. de Villiers
Tel. No. 044-8741511



CLINKSCALES MAUGHAN-BROWN

CONSULTING MECHANICAL
& ELECTRICAL ENGINEERS

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1.0 **INTRODUCTION**

This report has been compiled on the instruction of the Manager of the Electrical Department, Mr Steve Cooper, to prepare a master plan for the Medium Voltage (MV – 11kV) distribution network for Struisbaai.

The purpose of the master plan can be summarised as follows:

- 1.1 To identify the network components which need to be augmented to address immediate problems and to cater for long term load growth, i.e. 20 years, and new developments.
- 1.2 To serve as a basis for any new construction work so that it can be carried-out in a planned and phased manner, thus minimizing any abortive work due to a lack of insight into the future requirements.
- 1.3 To cost and programme the augmentation work to form part of a business plan for the implementation thereof.

The report contains sufficient information for forward planning to cater for full development of presently serviced areas and known new developments, which together, will generate a total load in the order of 4 MVA over the next ten (10) years.

It must be pointed out that load growth patterns will change and it is recommended that the window for the technical issues related to the master plan not be longer than two (2) years, but for financial planning it can be made up to five (5) years.

This report focusses more on the financial rather than the technical issues, which are depicted in detail on the master plan drawings and have previously been discussed and agreed with the Manager of the Electrical Department.

2.0 **BASIS OF REPORT**

The report is based on the following:

- (i) Information received from Mr Steve Cooper from the Municipality's Electrical Department and Mr Gerrit van Rooyen from Eskom during meetings and telephone conversations in 2017.
- (ii) Drawings of the existing municipal MV Network.
- (iii) Information received from the Municipality's Town Planning and Housing Departments regarding possible future developments in the area.

3.0 **DRAWINGS**

Reference should also be made to the following drawings, of which a copy of each is issued separately:

Existing Network

Drawing No. 10264/E2/01:	Struisbaai, Agulhas & Suiderstrand: Existing MV (11kV) Plan Layout No.1
Drawing No. 10264/E2/02:	Struisbaai, Agulhas & Suiderstrand: Existing MV (11kV) Plan Layout No.2
Drawing No. 10264/E2/03:	Struisbaai, Agulhas & Suiderstrand: Existing MV (11kV) Schematic Diagram

Master Plan Network

Drawing No. 10264/E2/04:	Struisbaai, Agulhas & Suiderstrand: Existing MV (11kV) Plan Layout No.1
Drawing No. 10264/E2/05:	Struisbaai, Agulhas & Suiderstrand: Existing MV (11kV) Plan Layout No.2
Drawing No. 10264/E2/06:	Struisbaai, Agulhas & Suiderstrand: Existing MV (11kV) Schematic Diagram

The master plan drawings show the existing network in blue and the upgrading and extension measures required in red. This method has been adopted to avoid having to refer to two sets of drawings.

4.0 **LOAD, DESIGN CRITERIA AND 20 YEAR GROWTH FORECAST**

The load figures, i.e Town's peak kVA demand and the connected kVA load of the existing network (diversity factors ranging from 35% to 65% were used), and future load depicted on the master plan have been used to assess the loading in the various areas as a basis to evaluate the present and future capacity of the existing network components and to determine the upgrading and extension measures required.

The maximum voltage regulation is taken at $\pm 2,5\%$ in the MV networks, $\pm 2,5\%$ across distribution substations and $\pm 7\%$ across the LV network.

The Town's peak kVA demands over the last eleven (11) years were obtained from Mr Steve Cooper, as measured at the Eskom Bulk Metering Point and included in Annexure A. This annexure also depicts the Town's load growth for the next twenty (20) years. Annexure B depicts a graph of a best fit exponential curve depicting the projected load growth.

The design of the system is based on the system being able to supply the full load demand in an area, or areas, after the loss of any one feeder while the voltage regulation remains within reasonable limits at the furthest point of the network. It is not considered necessary to base planning on the loss of more than one feeder at the same time.

It is to be noted that the proposed network improvement is a concept design only and should not be considered as a final detailed planning. It provides a concept to guide actual detail planning and also acts as a guide to such planning to ensure general compliance with the spirit of the overall network master plan, without dictating rigid adherence to the order of priority given. The development within an area may occur earlier or later than is presently envisaged requiring a re-allocation of the order of the work.

5.0 **IMPACT OF RENEWABLES ON THE MASTER PLAN**

Renewable energy is energy that is generated from natural processes that are continuously replenished. This includes sunlight, geothermal heat, wind, tides, water, and various forms of biomass. This energy cannot be exhausted and is constantly renewed. Since it is, however, not be possible to exactly determine the extent of the afore-mentioned natural processes in the area it has been decided not to take the impact of any renewable technologies in consideration in the electricity master planning for the town.

6.0 **EXISTING NETWORK AND PROPOSED CHANGES**

The layout and schematic diagram of the existing MV network are shown on Drawing No.'s 10264/E2/01 & 02 and Drawing No. 10264/E2/03 respectively.

6.1 Eskom Supply:

The supply is provided from a 66/11kV Eskom substation via an 11kV overhead radial line (no firm supply) and underground cable with capacities of 6,8MVA and 6,096MVA respectively to the main intake substation, i.e. "SS Argonaut", situated on the northern side of Struisbaai.

The current notified maximum demand with Eskom is 5 000 kVA and the maximum actual kVA demand was measured in January 2011 at 4 058 kVA. From the graph under Annexure B it can be seen that the load requirement dropped from 2011 by approximately 500kVA and is slowly increasing from 2013 where the maximum was measured in January 2017 at 3,6 MVA.

The estimated maximum demand in the next 10 years is about 4 MVA, which means that the existing supply cable and overhead line will be sufficient to cater for the expected load requirements. No increase of the notified demand is expected.

To ensure a firm municipal supply of 4 MVA (expected load requirement towards 2027) to town, the Municipality needs to install an additional, 11kV overhead line and 185mm² Cu underground cable to the afore-mentioned substation.

6.2 MV Feeders:

The existing main MV reticulation network consists mostly of bare overhead lines, ABC overhead lines and underground cables feeding from "SS Argonaut". The lines and cables are connected to a various number of ground mounted transformer substations, miniature substations, switching stations and ring main units forming part of a ring system. The loads on the system conductors are well within the current capacities of the conductors, but additional underground feeder cables are required to ensure that all future erven are electrically supplied and existing transformer substations / miniature substations on a ring feed supply as further discussed below.

The municipal supply to "SS Argonaut" is provided via a single 11kV overhead radial line (no firm supply) and underground cable with capacities of 6,8MVA and 6,09MVA respectively. To ensure a firm supply to town the Municipality needs to install an additional MV overhead line between the Eskom Substation and "SS Argonaut". At this stage it is assumed that the Developer of the Langezandt Development will supply and install said line as per their Services Agreement with the Municipality. Should this work, however, not proceed the Municipality must make provision to install same.

It is advised that a third main ring feed be provided between "SS Argonaut" and "SS E" to better the switching possibilities and to ensure a firm supply to the end-user. This ring feed can be included in the future development planned in the centre of town.

CBD and Town Areas:

The CBD and Town Areas are presently fed by means of 35mm² ABC overhead lines and 25/35/50/70mm² Cu underground cables. We recommended that all radial feeds be connected to as shown on the drawings to ensure that all transformer substations and miniature substations are connected to a ring feed supply. It is further indicated on the drawings that all ABC overhead lines will be replaced with underground cables.

Township

The township is supplied from Eskom and therefore no master planning has been included for this area in this report.

6.3 Substations:

Provision has been made for a new main intake substation near the Eskom Supply point. This substation will increase the switching possibilities to town and will assist that the future load of the Langezandt Development can be shifted from the town's main supply. The building of this substation is, however, not urgent and can be done at a later stage when the load requirement of the Langezandt Development has increased significantly.

It is recommended that the ring main units inside "SS-Argonaut" be replaced with switchgear panels equipped with the appropriate protection relays.

A number of ground mounted transformer substations, which are fed from overhead lines via radial underground cables, must be replaced with miniature substations equipped with ring main units as depicted on the master plan drawings. Provision has been made for additional miniature substations within the urban edge where new developments are planned to cater for the future load and to ensure that the voltage regulation on the LV networks is within the allowable limits.

Provision has been made for ring main units on the main network as depicted on the drawings which will increase the switching possibilities of said network.

From our inspection it was noted that some of the ring main units were wrongly labeled. We propose that all switchgear and equipment be labeled according to the drawings.

6.4 Condition:

There is quite a number of switchgear at the aforementioned substations and pole mounted transformers which are very old, i.e. 30 years and older. Regular inspections and tests are needed to ensure that all components are working safely.

The following equipment was highlighted during the survey that needs attention: (Note that this equipment is not highlighted on the drawings)

- (a) Ring main unit: "RMU Marlyn"
- (b) Pole Mounted Transformer Substations (PMT's): "PMT Straatlig", "PMT Pomp No.2"
- (c) Ground Mounted Transformer Substation (GMT's): "GMT Skool Straat", "GMT Spookdraai 2", "GMT T6A", "GMT T10", "GMT T17",

7.0 **UPGRADING OF THE MV NETWORK**

In order to overcome the immediate and ten year load growth problems, the systematic strengthening of the internal reticulation system is recommended. An ongoing commitment to regular maintenance is also a pre-requisite to the provision of a quality supply to the town's consumers.

The immediate urgent elements which must be attended to:

- (a) Replace the ring main units inside "SS-Argonaut" with circuit breaker panels, equipped with the appropriate protection relays.
- (b) Ensure that all transformer substations and miniature substations are connected to a ring feed supply.
- (c) Commence / proceed with a maintenance programme.

The vision for the town in future is a ring main overhead / underground line / cable system which connects the new "SS Main Intake Substation" with all the existing & future miniature substations, including the replacement of all the ABC overhead lines with underground cables.

The proposed improvements and extensions have been divided into three phases. Phase 1 covers the most urgent work which should be carried out within the period from present (2018) to 2019, followed by Phase 2 and Phase 3 each of four year work periods, i.e. 2020 to 2023 and 2024 to 2027. Phase 3 encompasses some items of work for which it is not practical to set a time period, as certain items may be required at any time between 2020 to 2027, depending on the rate of development.

7.1 Phase 1 - (2018 to 2019):

- 7.1.1 SS-Argonaut: Replace the ring main units inside the building with switchgear panels, equipped with the appropriate protection relays.
- 7.1.2 General: Inspect and test equipment mentioned under Sub-Clause 6.4 of Clause 6.0 and replace with new or refurbish existing.

7.2 Phase 2 - 2020 to 2023:

- 7.2.1 GMT T12: Replace ground mounted transformer substation, "GMT T12", with a miniature substation, incl, ring main unit, and install 35mm² Cu underground cable between "MS T9" and new "MS T12", incl. "RMU 9".
- 7.2.2 GMT T19A: Replace ground mounted transformer substations, "GMT T19A" and "GMT T10", with miniature substations, incl, ring main units, and install 35mm² Cu underground cable between "MS T19A" and new "MS T10".
- 7.2.3 MS T22: Install 35mm² Cu underground cable between "MS T22" and "MS 16".
- 7.2.4 GMT T8A: Replace ground mounted transformer substation, "GMT T8A" with miniature substation, incl., ring main unit, and install ring main unit "RMU Main Road" and 25mm² Cu underground cable between new "MS T8A" and new "RMU Main Road".
- 7.2.5 General: Inspect and test equipment mentioned under item Sub-Clause 6.4 of Clause 6.0 and replace with new or refurbish existing.

7.3 Phase 3 - (2024 to 2027):

- 7.3.1 RMU SSF: Replace three way ring main unit, "RMU SSF" with a four way switch.
- 7.3.2 GMT T4: Replace ground mounted transformer substations, "GMT T4" and "GMT T5", with miniature substations, incl, ring main units, and install 25mm² Cu underground cable between new "MS T4" and new "MS T5".
- 7.3.3 GMT Tides: Install a 25mm² Cu underground cable between "GMT Tides" and "MS Kamp", incl. a ring main unit at each of the afore-mentioned substations.
- 7.3.4 MS Kamp: Replace ground mounted transformer substation, "GMT T6", with a miniature substation, incl, ring main unit, and install 25mm² Cu underground cable between new "MS T6" and "RMU Kamp".
- 7.3.5 SS Ocean View: Install 70mm² Cu underground cable between "SS Ocean View" and "SS Argonaut", incl. circuit breaker switch at "SS Argonaut".
- 7.3.6 General Item: Ground Mounted Transformer Substations: Replace ground mounted transformer substation with miniature substation, incl., ring main unit.
- 7.3.7 General Items: Replace 35 ABC overhead conductor with underground cable.
- 7.3.8 General: Inspect and test equipment mentioned under item Sub-Clause 6.4 of Clause 6.0 and replace with new or refurbish existing.

Note that the new infrastructure required for new developments, i.e. the Langezandt Development, the development in the centre of town, i.e. miniature substations "MS I", "MS J", "MS K" and "MS L" and the proposed low cost housing development on the north western side of town or any other smaller developments in town, have not been priced, since it has been assumed that said infrastructure will be financed by the respective developers.

8.0 **PROPOSED CHANGES TOGETHER WITH COST ESTIMATES**

The proposed upgrading and extensions to the MV network, together with the cost estimates & proposed order of priority, is given hereafter.

It is to be noted that the cost estimates exclude VAT, escalation and planning fees. Escalation can be added at approximately 1,25% per month. The cost estimates are order of magnitude values and must be refined the year before implementation after a more detailed design has been carried-out.

- 8.1 Phase 1 – (2018 to 2019):
- 8.1.1 SS-Argonaut: Replace the ring main units inside the building with switchgear panels, equipped with the appropriate protection relays. R1,085 mil
- 8.1.2 General: Inspect and test equipment mentioned under Sub-Clause 5.4 of Clause 5.0 and replace with new or refurbish existing. R 0,6 mil R1,685 mil
- 8.2 Phase 2 - 2020 to 2023:
- 8.2.1 GMT T12: Replace ground mounted transformer substation, “GMT T12”, with a miniature substation, incl, ring main unit, and install 35mm² Cu underground cable between “MS T9” and new “MS T12”. R1,698 mil
- 8.2.2 GMT T19A: Replace ground mounted transformer substations, “GMT T19A” and “GMT T10”, with miniature substations, incl, ring main units, and install 35mm² Cu underground cable between “MS T19A” and new “MS T10”. R1,630 mil
- 8.2.3 MS T22: Install 35mm² Cu underground cable between “MS T22” and “MS 16”. R 0,46 mil
- 8.2.4 GMT T8A: Replace ground mounted transformer substation, “GMT T8A” with miniature substation, incl., ring main unit, and install ring main unit “RMU Main Road” and 25mm² Cu underground cable between new “MS T8A” and new “RMU Main Road”. R 0,89 mil
- 8.2.5 General: Inspect and test equipment mentioned under item Sub-Clause 5.4 of Clause 5.0 and replace with new or refurbish existing. R 0,6 mil R5,278 mil
- 8.3 Phase 3 - (2024 to 2027):
- 8.3.1 RMU SSF: Replace three way ring main unit, “RMU SSF” with a four way switch. R 0,4 mil
- 8.3.2 GMT T4: Replace ground mounted transformer substations, “GMT T4” and “GMT T5”, with miniature substations, incl., ring main units, and install 25mm² Cu underground cable between new “MS T4” and new “MS T5”. R1,710 mil
- 8.3.3 GMT Tides: Install a 25mm² Cu underground cable between “GMT Tides” and “MS Kamp”, incl. a ring main unit at each of the aforementioned substations. R1,185 mil

8.3.4	<u>MS Kamp</u> : Replace ground mounted transformer substation, "GMT T6", with a miniature substation, incl, ring main unit, and install 25mm ² Cu underground cable between new "MS T6" and "RMU Kamp".	R0,815 mil	
8.3.5	<u>SS Ocean View</u> : Install 70mm ² Cu underground cable between "SS Ocean View" and "SS Argonaut", incl. circuit breaker switch at "SS Argonaut", incl. circuit breaker switch at "SS Argonaut".	R1,625 mil	
8.3.6	<u>General Item: Ground Mounted Transformer Substations</u> : Replace ground mounted transformer substation with miniature substation, incl., ring main unit. (Replace two transformers, i.e. 2 x R 600 000-00/each)	R1,200 mil	
8.3.7	<u>General Item</u> : Replace 35 ABC overhead conductor with underground cable. (Replace 500m @ R 1 250-00/m = R 625 000-00)	R0,625 mil	
8.3.8	<u>General</u> : Inspect and test equipment mentioned under item Sub-Clause 6.4 of Clause 6.0 and replace with new or refurbish existing.	<u>R0,600 mil</u>	<u>R8,160 mil</u>
	Total, excl. VAT		R15,123 mil

9.0 FUNDING

It is only viable to implement the capital expenditure proposed under Clause 8.0 if suitable income sources can be found to fund such expenditure. These income sources can be as follows:

- (i) A portion of the income from the sales of electricity to fund External Loans.
- (ii) Contribution by developers in the form of:
 - (a) Augmentation Levies that will become Internal Funds.
 - (b) Direct payments for the supply and installation of external or main MV network components necessary to supply specific new developments.
- (iii) Grants from example the Department of Energy (DoE) for the electrification of sub-economy housing, schools, etc, and MIG funding from Provincial Government for mainly streetlighting projects.

It is recognised that in the case of External Loans, although it could be financially justified and increased year by year in relation to the increased income from electricity sales, there are other considerations in terms of the Municipality's overall budget, the availability of loans, etc, that finally determines the value thereof. The income from this source should therefore be determined by the Municipality's treasury department in consultation with the electrical department.

10.0 **CONCLUSION**

It is recommended that adequate financial provision be made in the budgets for ongoing upgrading to the network as set out above. We would recommend that at least R 1 250 000-00 to R 1 500 000-00 per year be budgeted for upgrading of the network.

It is believed that the terms of reference have been covered, but we hold ourselves available if clarification is required on any of the items or points raised within this report, and to possibly assist with the discussions with the treasury department to determine the allocation of the expenditure in terms of the Municipality's overall budget.

11.0 **ACKNOWLEDGEMENT**

The assistance of Mr Steve Cooper is gratefully acknowledged and we would like to thank the Municipality for entrusting this commission to us.

We present our report for your consideration and await your further instructions.

J.S. de Villiers Pr Tech Eng
CLINKSCALES MAUGHAN-BROWN

June 2017

ANNEXURE A

LOAD FIGURES

SCHEDULE A

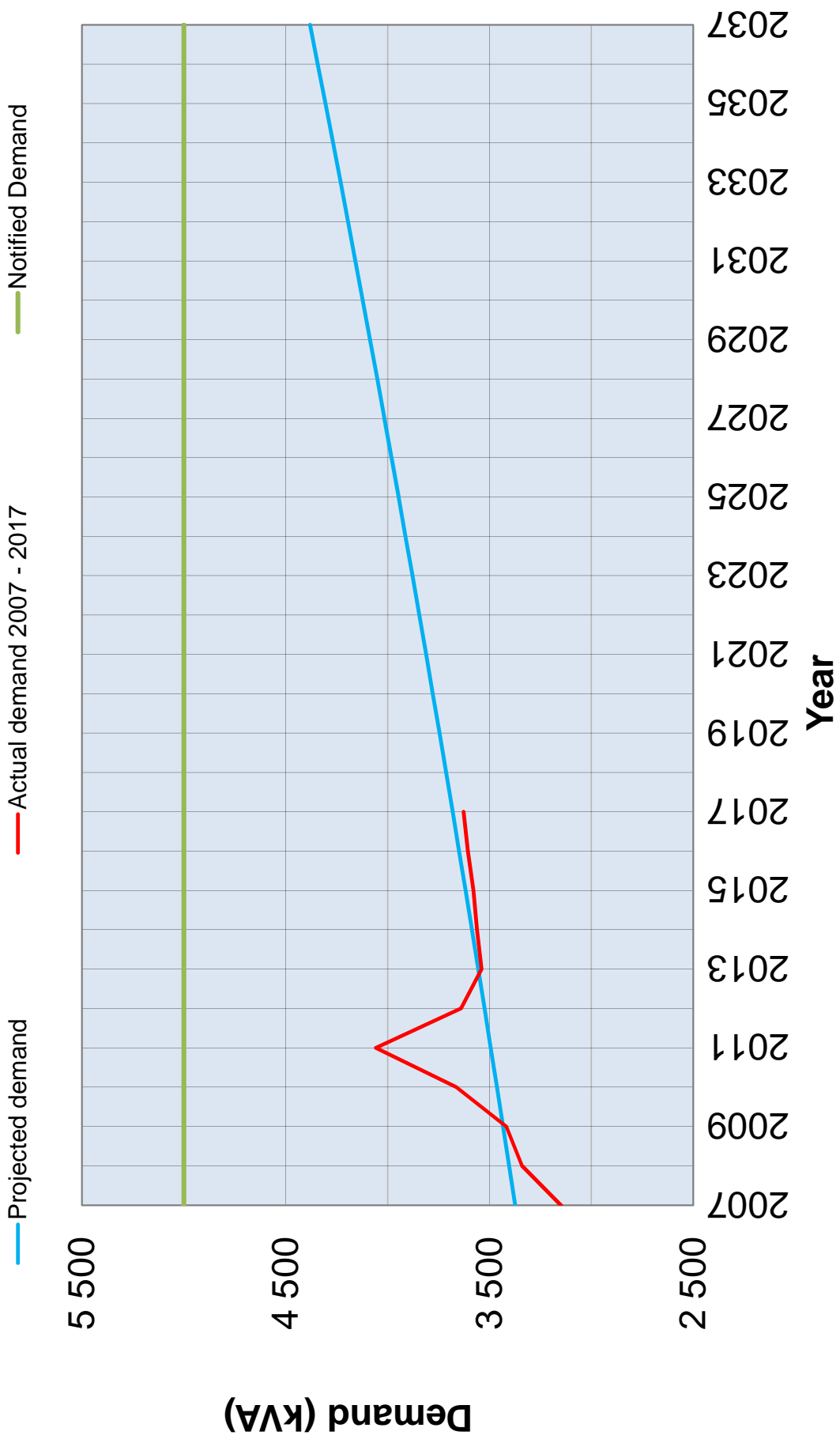
STRUISBAAI'S PEAK DEMAND (kVA) SINCE 2007 AND PROJECTED LOAD GROWTH FOR THE NEXT 20 YEARS

Year	Actual Peak kVA	Actual % Growth	Approx Projected Peak kVA
2007	3 149		
2008	3 341	6,10	
2009	3 417	2,27	
2010	3 663	7,20	
2011	4 058	10,78	
2012	3 640	-10,30	
2013	3 539	-2,77	
2014	3 561	0,62	
2015	3 579	0,51	
2016	3 606	0,75	
2017	3 627	0,58	
2018			3 713
2019			3 746
2020			3 778
2021			3 811
2022			3 845
2023			3 878
2024			3 912
2025			3 946
2026			3 981
2027			4 016
2028			4 051
2029			4 086
2030			4 122
2031			4 158
2032			4 194
2033			4 231
2034			4 268
2035			4 305
2036			4 343
2037			4 381

ANNEXURE B

PROJECTED GROWTH GRAPH

Struisbaai: Projected Load Growth



ANNEXURE C

DRAWINGS

