ZERO CARBON CHARGE

CIVIL ENGINEERING SERVICES REPORT
FOR THE PROPOSED DEVELOPMENT LOCATED
AT AKKERBOOM FARMSTALL, NORTHERN CAPE

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Revision History

Date	Rev No	Description	Revised By
31 Jan ‘24	A	Internal Review	D. de Ruiter
14 Feb ‘24	B	Client Review	D. de Ruiter
16 Feb ‘24	0	Issued for Use	D. de Ruiter

1. Introduction

1.1 Terms Of Reference

Bauwen Consulting (Pty) Ltd. has been appointed by Zero Carbon Charge (Pty) Ltd as consulting civil engineers for the proposed charging station, battery storage and tourist facility development located on portion 19 & 47 of the farm Frier's Dale No. 466, Gordonia Division, Northern Cape.

This appointment inter alia includes the preparation of a civil services report for the civil engineering services for the proposed development. The following matters are dealt with during the preliminary design stage of the project and are addressed in the civil services report:

i) Design standards and specifications applicable to the scope of works.
ii) Preliminary design calculations of the harvesting and treatment of raw water on site.
iii) Preliminary design calculations of the required potable water on site.
iv) Preliminary design calculations of the generation and handling of black and grey water on site.
v) Detailed stormwater management will not form part of this report and will be dealt with in a separate stormwater management report.
vi) Traffic management and investigations will not form part of this report and will be dealt with in a separate traffic impact assessment report.

1.2 Local Authority

The proposed development falls within the Kai! Garib Local Municipality located in the Northern Cape. All external civil engineering services for the proposed development will be constructed to the required standards of the local municipality and Northern Cape Standards.

1.3 Locality and Extent

The proposed development is located along the N14, situated between Upington in the Northeast and Kakamas in the West in the Northern Cape province of South Africa. The proposed development is situated approximately 58 km Southwest of Upington and 33 km east of Kakamas. The N14 highway runs past the proposed development and is a national route between Johannesburg and the N7 highway. The property is accessed directly from the N14. The locality of the development is shown in Figure 2-1.

2. Project Details

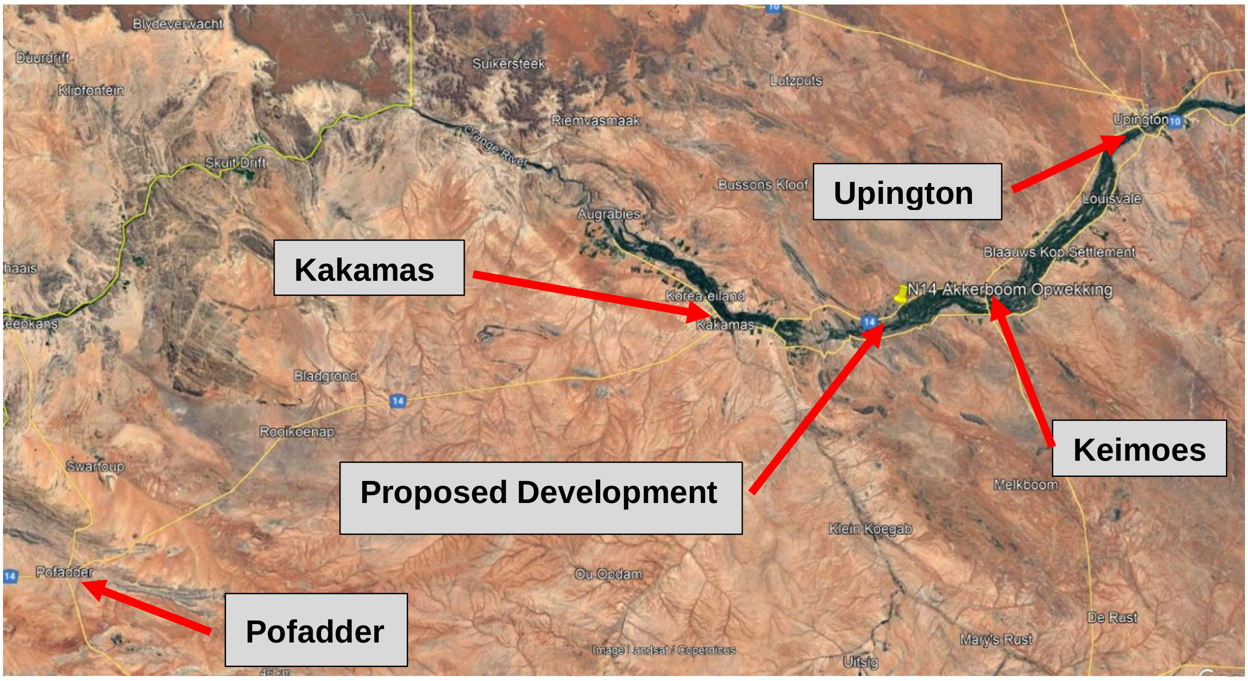

Figure 2-1: Locality of Akkerboom Farmstall Proposed Development

2.1 Developer

The developer for the proposed development is Zero Carbon Charge (Pty) Ltd. Their contact particulars are as follows:

Physical Address:	Groenhoek farm
	VREDENDAL
	8160
Telephone Number:	082 901 7859
E-mail address:	info@charge.co.za

The contact person for the developer is Juanita van der Merwe.

2.2 Consulting Engineer

The consulting civil engineers for the proposed development is Bauwen Consulting (Pty) Ltd. Contact particulars for the consulting engineers is as follows:

Physical Address:	Unit 21, Cambridge Business Park
	5 Bauhinia Street
	CENTURION

	0169
Mobile Number:	083 290 4167
E-mail address:	dirkie.deruiter@bauwen.co.za

The contact person for the consulting engineers is Mr. Dirkie de Ruiter.

2.3 Site Description

2.3.1 Topography

Due to the size of the development the topography of the site will vary over the area. However, the proposed area for the charging station and electrical equipment falls at an average slope of 3% to 5% to the South. The entire site slopes and drains towards the orange river located just south of the site.

2.3.2 Geology

A desktop study indicates that the site's consists of intrusive rock out of the Proterozoic eon, the Mokolian era and Namaquan time period. The specific rocks expected to be encountered on site is from the Namaqualand group and consists of Friersdale Charnockite that forms part of the Keimoes Suite.

The expected lithology on site may vary between dark grey to leucocratic, equigranular to porphyritic granite, granodiorite, charnockite, minor diorite and fine- to medium-grained leucocratic and pegmatitic, alaskitic granite.

2.3.3 Watercourses and Wetlands

There are no watercourses running through the proposed area of development. There are a flood drainage lines affecting the development, which will convey stormwater towards the Orange river, just south of the proposed site, in a case of a flood. No development will take place within the riparian area of these drainage lines.

3. Design Standards and Specifications

3.1 Design Standards

The following design standards and design guidelines will be applied during the design of the water and sewer network systems:

i) Guidelines for human settlement planning and design. Compiled under the patronage of the Department of housing and published by the CSIR Building and Construction Technology (2000 edition) (New Red Book).

3.2 Specifications

The SANS 1200 series of standard specifications for civil engineering construction will be applicable on this project.

4. Phased Development

The development consists of three main areas namely the charging area (dispensers), additions to the farmstall area and the electricity generation area (PV panels and electrical equipment). These areas will be developed in phases up to a total developed area of 71 397m^2 of which 68 900m^2 will be for electricity generation.

The phased development is broken up into 7 planned phases with the following breakdown:

i) Phase 1 consisting of 8 500m^2 of PV panels,
ii) Phase 2 to 5 will consist of 9 000 m^2 of PV panels each,
iii) Phase 6 will consist of 9 400 m^2 of PV panels and
iv) Phase 7 will consist of 15 000 m^2 of PV panels.

Applying the riparian areas to these phases reduces the developable areas for the phases to the following:

i) Phase 1 consisting of 8 500m2 of PV panels,
ii) Phase 2 to 5 will consist of 8 500 m2 of PV panels each,
iii) Phase 6 will consist of 6 500 m2 of PV panels and
iv) Phase 7 will consist of 10 500 m2 of PV panels.

These adjusted phased areas will form the basis of our calculations.

5. Raw Water

5.1 Climate and Rainfall Data

The nearest weather data available is Keimoes, approximately 16km east of Akkerboom Farmstall. The area has minimal to non-existent precipitation throughout the course of a year. The average annual temperature is 21.7 °C with an annual rainfall for of 191 mm per year. The average rainy days per year is 23 days. This data was obtained from climate data website[1].

[1] Keimoes climate: Weather Keimoes & temperature by month (climate-data.org).

Figure 5-1 shows the rainfall distribution throughout the year.

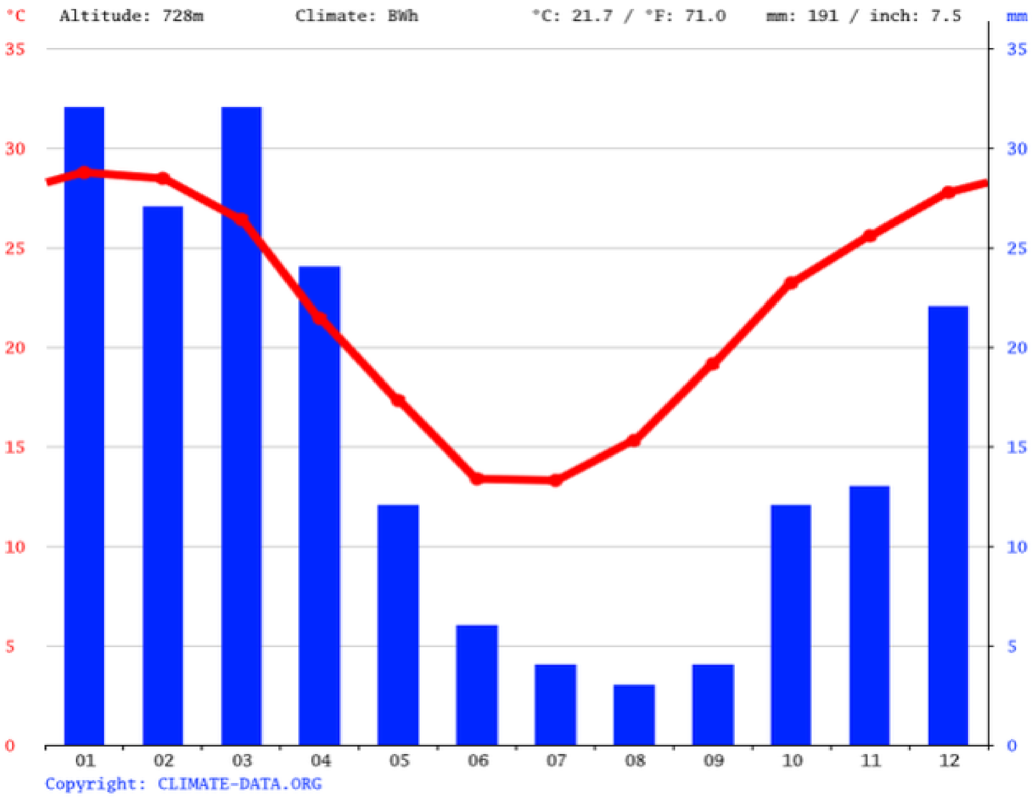

Figure 5-1: Monthly Rainfall Distribution

5.2 Raw Water Harvesting

The entire site development is considered a clean site, meaning there is no pollutants generated on the site that is not allowed to be directly discharged into the environment. Stormwater generated on the site will be harvested as far as possible for re-use, the remainder will be released into the environment in a controlled manner via overland flow.

The PV panels will be mounted on elevated structures where a gutter system will be mounted to collect the water runoff from the panels. The rainwater will then be collected through a reticulation network of tanks, pipes, and pumps. Placing PV panels on an area of 0.98ha it was calculated that the approximate PV panel area is 50% of the total area, it was assumed that only 75% of the rainfall on these areas will end up being harvested, due to losses in the system. These losses can typically be attributed to wind, splashing and moisture absorbed in the dust/dirt in the system. The potential rainfall that can then be harvested monthly and in total for each phase is indicated in Table 5-1.

Table 5-1: Potential Rainfall Harvesting Breakdown

Description	Actual Rainfall	Rainfall Harvested	Rainwater Harvesting per Phase (m^3)				Total (m^3)
			Phase 1	Phase 2-5*	Phase 6	Phase 7	
Total Area per Phase (m^2)	N/A	N/A	8 500	8 500	6 500	10 500	**59 500 m^2**
Harvesting Area per Phase (m^2)	N/A	N/A	4 250	4 250	3 250	5 250	**29 750 m^2**
January	32.0	24.0	102	102	78	126	**714**
February	27.0	20.3	86	86	66	106	**602**
March	32.0	24.0	102	102	78	126	**714**
April	24.0	18.0	77	77	59	95	**536**
May	12.0	9.0	38	38	29	47	**268**
June	6.0	4.5	19	19	15	24	**134**
July	4.0	3.0	13	13	10	16	**89**
August	3.0	2.3	10	10	7	12	**67**
September	4.0	3.0	13	13	10	16	**89**
October	12.0	9.0	38	38	29	47	**268**
November	13.0	9.8	41	41	32	51	**290**
December	22.0	16.5	70	70	54	87	**491**
TOTAL (m^3)	**191.0**	**143.3**	**609**	**609**	**466**	**752**	**4 262**

Per phase

The raw water storage size philosophy is that the storage capacity should be equal to the quantity of the month with the highest potential of rainwater harvesting respective to the phase of the development. For this area and development January and March yield the highest rainwater harvesting potential, and the initial raw water storage capacity should be approximately 100m3 for phase 1. It will then increase in increments of approximately 110m^3 per phase for phase 2 to 5, 80m^3 for phase 6 and approximately 130m^3 for phase 7. After full development of this proposed development the total storage capacity required for rainwater harvesting will be approximately 750m^3.

5.3 Raw Water Treatment

The treatment of the raw water harvested for potable use will involve a multi-step process to ensure the water meets the necessary quality standards. The first step will be pre-filtration, where debris such as leaves and twigs are removed to prevent contamination. Next, the water undergoes sedimentation to settle out finer particles. Filtration follows, employing various techniques such as sand, gravel, or membrane filtration to remove remaining impurities. Next the water will undergo disinfection, typically accomplished through chlorination, ultraviolet (UV) irradiation, or a reverse osmoses process to eliminate harmful microorganisms. Finally, the treated raw water can be stored as potable water in sterilised opaque tanks to inhibit bacterial growth. Regular monitoring and maintenance of the system are essential to ensure ongoing water quality and safety for potable use.

The raw treatment plant will be designed to be modular and will be upgraded as per the phased development and associated increase in potable water demand.

5.4 Stormwater Management

Stormwater management is a critical component in preventing erosion and protecting the integrity of soil and the natural landscape. When rainwater runs off without proper control, it can lead to soil erosion, carrying away sediments and causing damage to watercourses. A stormwater management plan will be developed for rainwater not harvested on the site. This plan will contain practices to help mitigate erosion by controlling the stormwater runoff velocities and volumes. Techniques such as retention basins, bio swales, and erosion control baskets and blankets to slow down and filter stormwater will be utilised in this stormwater management plan, which will allow sediment to settle before stormwater is released into the natural watercourses.

6. Potable Water Supply

6.1 Estimated Water Demand

The expected average cars per day is estimated to be 90 cars per day for each hectare of PV panels installed. Assuming on average 2.5 persons per vehicle equates to a total of 225 persons per day for each hectare of PV installed.

The average consumption of water per person per day volumes are in line with the “New Red Book” as mentioned under the design standards and specifications section of this report. The average water usage assumptions are as follows:

- Flushing of toilet (water saving toilet) – 9L
- Washing hands & drinking – 3L
- Cleaning water calculated per person – 3L
- Food preparation calculated per person – 1L
- Gardening – 2L
- Contingency – 2L

Total – 20L of water per person per day

Taking the above into consideration the average potable water demand per month as well as per phase was calculated and is indicated in Table 6-1.

Table 6-1: Estimated Potable Water Demand Breakdown

Description	Potable Water Demand per Phase (m³)				Total (m³)
	Phase 1	Phase 2-5*	Phase 6	Phase 7	
Daily Visitors	191	191	146	236	**1 339 People**
January (31 Days)	119	119	91	146	**830**
February (28 Days)	107	107	82	132	**750**
March (31 Days)	119	119	91	146	**830**
April (30 Days)	115	115	88	142	**803**
May (31 Days)	119	119	91	146	**830**
June (30 Days)	115	115	88	142	**803**
July (31 Days)	119	119	91	146	**830**
August (31 Days)	119	119	91	146	**830**
September (30 Days)	115	115	88	142	**803**
October (31 Days)	119	119	91	146	**830**
November (30 Days)	115	115	88	142	**803**
December (31 Days)	119	119	91	146	**830**
TOTAL	1 396	1 396	1 068	1 725	**9 773**

***Per phase**

6.2 Potable Water Storage Size

Potable water storage will be separate storage tanks than the raw water storage. These tanks will be allocated for potable water use only and will be filled by only treated raw water and any supplementary sourced potable water should it be required.

For the sizing of the potable water storage, it was recommended for sufficient potable water storage capacity to have a 5-day potable water backup for the demand of each phase. The approximate required potable water storage for each phase is shown in Table 6-2.

Table 6-2: Potable Storage Required per Phase

Phases	Daily Visitor	Daily Potable Water Demand (m³)	5-Day Backup Storage (m³)	Total Cumulative Storage Required (m³)
Phase 1	131	4	19	**19**
Phase 2	203	4	19	**38**
Phase 3	203	4	19	**57**

Phases	Daily Visitor	Daily Potable Water Demand (m³)	5-Day Backup Storage (m³)	Total Cumulative Storage Required (m³)
Phase 4	203	4	19	**77**
Phase 5	203	4	19	**96**
Phase 6	212	3	15	**110**
Phase 7	338	5	24	**134**

The concept potable storage layout is indicated on drawing number **B230601-CN014-08-200-290-001** attached hereto under **Drawings**.

6.3 Potable Water Shortfalls and Supplementing

The annual rainfall in the area is very little and rainwater harvesting will not be sufficient to supply the total development's potable water demands throughout the year. Table 6-3 show the shortfall that may occur for each month over the various phases of the development. The raw water quantities will have to be supplemented by alternative water sources. The preferred method will be by means of one or more boreholes, this however will be dependant on the availability of underground water sources. The borehole water will be pumped into and stored in the raw water tanks and will go through the same treatment than the rainwater harvested. Should no underwater source be found on site, the supplementing potable water will be bought and driven in from surrounding farming or municipal water sources.

Table 6-3: Potable Water Shortfalls

Description	Potable Water Shortfall (m³)				Development Total (m³)
	Phase 1	Phase 2 – 5*	Phase 6	Phase 7	
January	17	17	13	20	**116**
February	21	21	16	26	**147**
March	17	17	13	20	**116**
April	38	38	29	47	**268**
May	80	80	61	99	**562**
June	96	96	73	118	**669**
July	106	106	81	131	**741**
August	109	109	83	135	**763**
September	102	102	78	126	**714**
October	80	80	61	99	**562**
November	73	73	56	91	**513**
December	48	48	37	60	**339**
TOTAL	**787**	**787**	**602**	**973**	**5 511**

Per phase

7. Grey/ Black Water

7.1 Estimated Grey/Black Water Generation

From the average daily used figures supplied under Section 6.1 in this report, it can be calculated that approximately 70% of this water will form the grey and black water generation. Table 7-1 shows the total daily grey and black water generated for the phases of development.

Table 7-1: Daily Grey/Black Water Generation

Phases	Daily Potable Water Demand (m^3)	Daily Grey/Black Water Generation (m^3)	Total Daily Grey/Black Water Generated (m^3)
Phase 1	4	3	**3**
Phase 2	4	3	**5**
Phase 3	4	3	**8**
Phase 4	4	3	**11**
Phase 5	4	3	**13**
Phase 6	3	2	**15**
Phase 7	5	3	**19**

The concept Black/grey water layout is indicated on drawing number **B230601-CN014-08-200-290-001** attached hereto under **Drawings**.

7.2 Proposed Grey/Black Water Treatment

As the development will be done in stages with a gradual increase in daily visitors resulting in gradual black and grey water generation increases. Therefore, there will not be a single solution to the treatment of this. Two solutions are proposed for the handling of black and grey water as the demand increases. These solutions are:

i) **Conservancy Tank System** - Initially the farmstall will make use of a chemical-resistant, conservancy tank to dispose of both black and grey water. The tank will serve as temporary storage only, requiring the waste to be pumped out whenever the tank is full. A licensed waste disposal company will collect the waste by means of a Honeysucker truck and dispose it at the Keimoes Wastewater Treatment Works (WWTW) located approximately 17km way in the town of Keimoes. The necessary agreements and permits will be obtained to dispose at Keimoes WWTW. It is foreseen that this system will be sufficient for the generation quantities of phase 1 and 2. For **Phase 1** a 30 000l conservancy tank system is recommended. This will be sufficient capacity for the full estimated number and generation of phase 1 on the basis that the tank gets pumped out on a weekly basis. For **Phase 2** an additional 30 000l conservancy tank system should be installed. This system will have sufficient capacity for the full estimated grey/black water generation for phase 1 and 2 on the basis that the tank gets pumped out on a weekly basis. This philosophy for Phase 1 and 2 described above will be dependant on the honey sucker truck sizes available in the area. A truck size of 14 000l were assumed, should the truck available be smaller the trips to empty the tank may increase or the timeframe between clean out can be shortened.

ii) **Modular Wastewater Package Plant System** - If the Black and Grey water generation increase to justify onsite wastewater package plants, which according to our expectations will be from Phase 3 onwards, a modular wastewater package plants will be used to replace the conservancy tank system. This modular system can then be upgrades as the grey/black water generation increases. The treated water can then be reused onsite for wash and irrigation water.

8. Solid Waste Management

Efficient solid waste management at this development is paramount for both environmental compliance and maintaining a positive public image. The management and handling of solid waste involves the implementation of comprehensive waste reduction, recycling, and disposal strategies. Established waste separation programs is recommended to encouraging visitors, workers and farmstall tenants to sort recyclables such as paper, cardboard, plastic, and glass from general waste. Centralized waste collection points equipped with clearly labeled bins facilitate easy disposal for both employees and visitors. Engaging with local waste management companies for regular pickups ensures that the collected waste is properly processed and recycled, reducing the overall environmental impact of the development. The necessary disposal licences and permits will be obtained prior to the disposal of any solid waste.

9. Construction Materials

Prior to construction the soil conditions on site will be investigated and the civil pavement and platform designs will be done in accordance with the soil conditions. The preference will be to rework the in-situ material to the desired platform levels and compaction specifications. However, should the in-situ material not be able to provide the bearing capacities required for the roads and structures, the required material will be sourced from a nearby commercial borrow pit.

Furthermore, all other manufactured construction materials used on site will need to comply to the relevant material standard and have the necessary SANS approval and certification.

10. Maintenance of Services

Maintenance of the civil services as listed in this report will form an integral part of the successful operation of this development. Effective maintenance involves routine inspections, timely repairs, and strategic upgrades (as described in this report) to ensure the longevity and safety of these critical assets. Regular road maintenance will ensure smooth and safe transportation. Water supply and sewage systems require continuous monitoring and upkeep to prevent leaks, blockages or contamination. The pumps used in these systems should be serviced asper the intervals specified by the manufacturers.

The maintenance of civil services is not only about responding to immediate issues but also involves long-term planning to address the evolving needs of a growing visiting numbers and changing environmental conditions. Overall, a proactive and comprehensive approach to maintenance is crucial for sustaining the quality and functionality of civil services.

DRAWINGS

TYPICAL TANK DIMENSIONS

TANK CAPACITY	DIAMETER	HEIGHT
5 500 l	1.9 m	2.24 m
10 000 l	2.2 m	3.15 m
15 000 l	2.6 m	3.26 m
20 000 l	2.6 m	4.27 m

LEGEND

PHASE	SERVICE	TANK SIZE REQUIRED PER PHASE
PHASE 1	POTABLE WATER STORAGE	1 x 20 000l TANK
	BLACK/GREY WATER STORAGE	2 x 20 000l CONSERVANCY TANK
	RAW WATER STORAGE	5 x 20 000l TANK
PHASE 2	POTABLE WATER STORAGE	1 x 20 000l TANK
	BLACK/GREY WATER STORAGE	1 x 20 000l CONSERVANCY TANK
	RAW WATER STORAGE	6 x 20 000l TANK
PHASE 3	POTABLE WATER STORAGE	1 x 20 000l TANK
	BLACK/GREY WATER STORAGE	SWITCH TO PACKAGE PLANT (8kl/DAY)
	RAW WATER STORAGE	5 x 20 000l TANK
PHASE 4	POTABLE WATER STORAGE	1 x 20 000l TANK
	BLACK/GREY WATER STORAGE	UPGRADE PACKAGE PLANT (11kl/DAY)
	RAW WATER STORAGE	6 x 20 000l TANK
PHASE 5	POTABLE WATER STORAGE	1 x 20 000l TANK
	BLACK/GREY WATER STORAGE	UPGRADE PACKAGE PLANT (13kl/DAY)
	RAW WATER STORAGE	5 x 20 000l TANK
PHASE 6	POTABLE WATER STORAGE	1 x 20 000l TANK
	BLACK/GREY WATER STORAGE	UPGRADE PACKAGE PLANT (15l/DAY)
	RAW WATER STORAGE	6 x 20 000l TANK
PHASE 7	POTABLE WATER STORAGE	1 x 20 000l TANK
	BLACK/GREY WATER STORAGE	UPGRADE PACKAGE PLANT (19kl/DAY)
	RAW WATER STORAGE	5 x 20 000l TANK

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REV	DATE	BY	ISSUE REASON	CHECKED	APPR'D	REFERENCE DRAWING NUMBER	REFERENCE DRAWINGS
0	2024-02-16	DdR	REPORT DRAWING	DdR			

CLIENT: CHARGE ZERO CARBON CHARGE

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DATE:	2024-02-16	CLIENT:	ZERO CARBON CHARGE

CLIENT DRAWING No.: C-N014-08-620-320-001-0

Responsible Engineer:
Registration No.
Date:
Signature

CONSULTING TEAM: Bauwen

PROJECT: ZERO CARBON CHARGE

TITLE: AKKERBOOM FARMSTALL CONCEPT CIVIL SERVICES LAYOUT

SHEET: A1 | DRAWING No.: B230601-CN014-08-200-290-001 | REVISION: 0