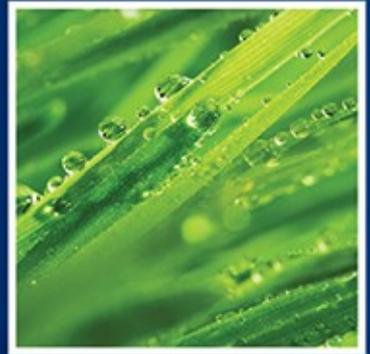




LEADERS IN ENVIRONMENTAL MONITORING



LAFARGE INDUSTRIES

MONTHLY WATER QUALITY ASSESSMENT REPORT

AUGUST 2022

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Lafarge Industries

**Monthly Water Quality
Assessment Report**

August 2022

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Lafarge Industries
Monthly Water Quality Assessment Report,
August 2022

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**LAFARGE INDUSTRIES
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INDUSTRIAL SITE
LICHTENBURG
2740**

ATTENTION: UNEYSA TALJARD

AUGUST 2022

**WATER QUALITY ASSESSMENT REPORT
LAFARGE INDUSTRIES
AUGUST 2022**

1. INTRODUCTION

Aquatico was commissioned by Lafarge Industries to sample, analyse and evaluate the physical, chemical and bacteriological quality of drinking (monthly), surface (monthly) and groundwater (bi-annual) localities.

Drinking water quality will be compared against the SANS 241:2015 drinking water standards (SABS, 2015) and the Quality of Domestic water supplies (WRC, 1998) in Table 1. The highest exceedance in each locality will determine the class of that locality.

The water is classed according to the following colour codes:

- Water testing within the **Blue** or **Green** colour class may be used without reservation and is considered safe for all users.
- Water testing within the **Yellow** colour class is generally regarded as safe, however sensitive users should be identified and warned to take personal consumption precautions.
- Water testing within the **Red** colour class can be used as a short-term emergency supply, approximately seven days only, when other sources are unavailable.
- When water tests within the **Purple** colour class the public must be warned not to use the water, or to use emergency home treatment where possible. If this is not possible, alternative water supplies must be considered and made available.

Table 1: Structure of the classification system describing the effects of the different classes of water on the various domestic uses of water (Quality of Domestic Water Supplies, Vol. 1: Assessment Guide).

CLASS / COLOUR	DESCRIPTION	EFFECTS
Class 0 (Blue)	Ideal water quality	Drinking health: No effects, suitable for many generations
		Drinking aesthetic: Water is pleasing
		Food preparation: No effects
		Bathing: No effects
		Laundry: No effects
Class 1 (Green)	Good water quality	Drinking health: Suitable for lifetime use. Rare instances of sub-clinical effects
		Drinking aesthetic: Some aesthetic effects may be present
		Food preparation: Suitable for lifetime use
		Bathing: Minor effects on bathing or on bath fixtures
		Laundry: Minor effects on laundry or on fixtures
Class 2 (Yellow)	Marginal water quality	Drinking health: May be used without health effects by majority of individuals of all ages, but may cause effects in some individuals in sensitive groups. Some effects possible after lifetime use.
		Drinking aesthetic: Poor taste and appearance are noticeable
		Food preparation: May be used without health or aesthetic effects by the majority of individuals.
		Bathing: Slight effects on bathing or on bath fixtures
		Laundry: Slight effects on laundry or on fixtures
Class 3 (Red)	Poor water quality	Drinking health: Poses a risk of chronic health effects, especially in babies, children and the elderly
		Drinking aesthetic: Bad taste and appearance may lead to rejection of water
		Food preparation: Poses a risk of chronic health effects, especially in babies, children and the elderly
		Bathing: Significant effects on bathing or on bath fixtures
		Laundry: Significant effects on laundry or on fixtures
Class 4 (Purple)	Unacceptable water quality	Drinking health: Severe acute health effects, even with short-term use
		Drinking aesthetic: Taste and appearance will lead to rejection of water
		Food preparation: Severe acute health effects, even with short-term use
		Bathing: Serious effects on bathing or on bath fixtures
		Laundry: Serious effects on laundry or on fixtures

Groundwater will be compared against the SANS 241:2015 drinking water standards (SABS, 2015) and for comparative purposes against the Department of Water Affairs and Forestry, 1996, South African Water Quality Guidelines (SAWQG) (second edition). Volume 4: Agricultural Use: Irrigation.

Waste water will be compared against the Department of Water Affairs General Authorisations in terms of Section 39 of the National Water Act, 1998 (Act NO. 36 of 1998) for disposing of waste water in a manner which may detrimentally impact a water source.

Process water will be compared against the Department of Water Affairs and Forestry (DWAF), 1996. South African Water Quality Guidelines (SAWQG) (second edition), Volume 3: Industrial Use and the Department of Water Affairs General Authorisation Limits.

Monitoring localities that form part of this study are listed in Table 2 to Table 5, which also indicates sampling frequency, locality abbreviations and parameters analysed.

Table 2: Groundwater Monitoring.

Locality	Description	Latitude	Longitude	Sampling Frequency
Borehole				
Borehole P1	Monitoring Borehole	S26.12980	E26.18588	Bi-Annual
Borehole P2	Monitoring Borehole	S26.13011	E26.18887	Bi-Annual
Borehole P3	Monitoring Borehole	S26.12984	E26.18585	Bi-Annual
Borehole T1	Monitoring Borehole	S26.11841	E26.16777	Bi-Annual
Borehole T2	Monitoring Borehole	S26.11772	E26.16737	Bi-Annual
Borehole T3	Monitoring Borehole	S26.11892	E26.18443	Bi-Annual
Borehole LBH3	Monitoring Borehole	S26.12982	E26.18585	Bi-Annual
Borehole LQBH4	Monitoring Borehole	S26.07275	E25.80018	Bi-Annual
Borehole LQBH5	Monitoring Borehole	S26.07964	E25.80196	Bi-Annual
Borehole LQBH8	Monitoring Borehole	S26.07662	E25.78401	Bi-Annual
Borehole LQBH9	Monitoring Borehole	S26.07434	E25.79851	Bi-Annual
Parameters				
pH, EC, Ca, Mg, Na, K, Total Alkalinity, F, Cl, NH ₄ (N), NO ₃ (N), PO ₄ , SO ₄ , Al, Fe, Mn, Groundwater level depth				Bi-Annual
Ba, As, Co, Cr, Ni, Pb, Se, Sr, V, Zn, Mn, Cu, Ga, Ge, Rb, Y, Zr, Sn, W, Bi, Th, U, Hg				Annually

Table 3: Potable Water Monitoring.

Locality	Description	Latitude	Longitude	Sampling Frequency
Drinking water				
Ants Hill	Drinking water: Ants Hill	S26.13272	E26.18432	Monthly
Tank	Drinking Water Tank	S26.13628	E26.18021	Monthly
Village Recreation Club	Drinking water: Village Recreation Club	S26.14033	E26.17870	Monthly
Tswana Quarry Kitchen Tap	Tswana Quarry Kitchen Tap	S26.07832	E25.80015	Monthly
Lovedale Quarry DW	Drinking water: Lovedale Quarry	S26.16075	E26.12803	Monthly (Added August 2021)
Parameters				
SANS 241-1:2015				Bi-Annual
pH, EC, Cl, Ca, SO ₄ , NH ₄ (N), NO ₃ (N), F, Ca, Mg, Na, K, Al, Fe, Mn, <i>E. coli</i> , Total coliforms, TVC, TDS, Total Alkalinity, PO ₄ , Cr, Cu, Ni, Zn, Co, Cd, Pb, Total Hardness				Monthly

Table 4: Monthly Surface and Process water Monitoring.

Locality	Description	Latitude	Longitude	Sampling Frequency
Effluent				
WWTW	Final Effluent	S26.14105	E26.18688	Monthly
WWTW Feed	Feed sample to the clarifier	S26.186649	E26.14125	Monthly
WWTW Raw	Raw Influent	S26.186649	E26.14125	Monthly
Parameters				
pH, EC, TDS, TSS, COD, Ca, Mg, Na, F, Cl, NH ₄ (N), NO ₃ (N), SO ₄ , Al, Fe, Mn, E. coli, Total coliform, Faecal coliform, Total viable count				Monthly
Dam				
Tswana Lime Pit	Tswana Lime Pit at mining site	S26.07827	E25.80047	Monthly
Zinc Dam	Plant Zinc Dam	S26.13038	E26.185995	Monthly
Parameters				
pH, EC, TDS, Ca, Mg, Na, Mn, F, Cl, SO ₄ , NH ₄ (N), NO ₃ (N), Al, Fe, TSS				Monthly

Table 4 continued: Monthly Surface and Process water Monitoring.

Locality	Description	Latitude	Longitude	Sampling Frequency
Service Water				
Tswana Quarry WSWB	Tswana Quarry Workshop wash bay	S26.07851	E25.79965	Monthly
Parameters				
Oil and grease (SOG), pH, TSS, TDS, EC				Monthly
Process water				
Process water		S26.13078	E26.18472	Monthly
Parameters				
pH, EC, Ca, Mg, Na, K, Total Alkalinity, F, Cl, NO(N), NH ₄ (N), NO ₃ (N), PO ₄ , SO ₄ , Al, Fe, Mn				Monthly

2. MATERIALS AND METHODS

All fieldwork is conducted based on the protocols and specifications, and code of practice contained in the SABS ISO 5667-1-15. These international standards address all aspects from the program design, sampling methods, as well as sample preservation and many other aspects.

Aquatico developed a custom-made data input system in accordance with SABS ISO guidelines 5667-1 to 5667-3, to assist the field scientist in recording the physical and environmental information of the sampling locality. This information is needed to interpret water quality, especially if the water quality results obtained by the laboratory indicate sudden changes at a specific locality.

The field data typically include the following information:

- Location and name of the sample site
- Details of the sampling point i.e., surface/underground/tap water
- Method of collection
- Time of collection
- Name of collector

- Flow status or dam level
- Co-ordinates
- Photographic evidence
- Water level of boreholes
- Other data gathered at this point

All of the above information is recorded on a handheld PDA device deployed to the field complete with GPS, bar-code scanner, camera and database-linked MONLIMS software. The water quality database is electronically updated with this information when the field technician returns from the field trip.

2.1. Laboratory Analysis

Aquatico maintains a state-of-the-art water laboratory in Pretoria and is a SANAS Accredited Testing Laboratory, No T0685. This analytical laboratory has been operational since July 2006 and takes part in the SABS Inter-laboratory Testing Scheme as required in the Scope of Work.

3. SITE BACKGROUND AND MONITORING AREA

Between Coligny and Mafikeng on the R503, Lichtenburg is situated approximately 230 km west of Johannesburg on the main route to Mmabatho.

Lichtenburg falls within the region that receives between 500mm to 650mm rainfall per annum. The geology of the area comprises dolomite and chert belonging to the Chuniespoort Group (Savannah Environmental, 2018). The site overlies Precambrian (Proterozoic) dolomites and associated marine sedimentary rocks that are assigned to the Malmani Subgroup (Chuniespoort Group) within the Transvaal Supergroup. The Malmani Subgroup consists of a series of formations stromatolitic and oolitic carbonates (limestones and dolomites), cherts and black carbonaceous shales.

The potable, surface and groundwater monitoring localities sampled during the sampling period has been listed in Table 2-4 with a map of the water monitoring localities in Figure 1.

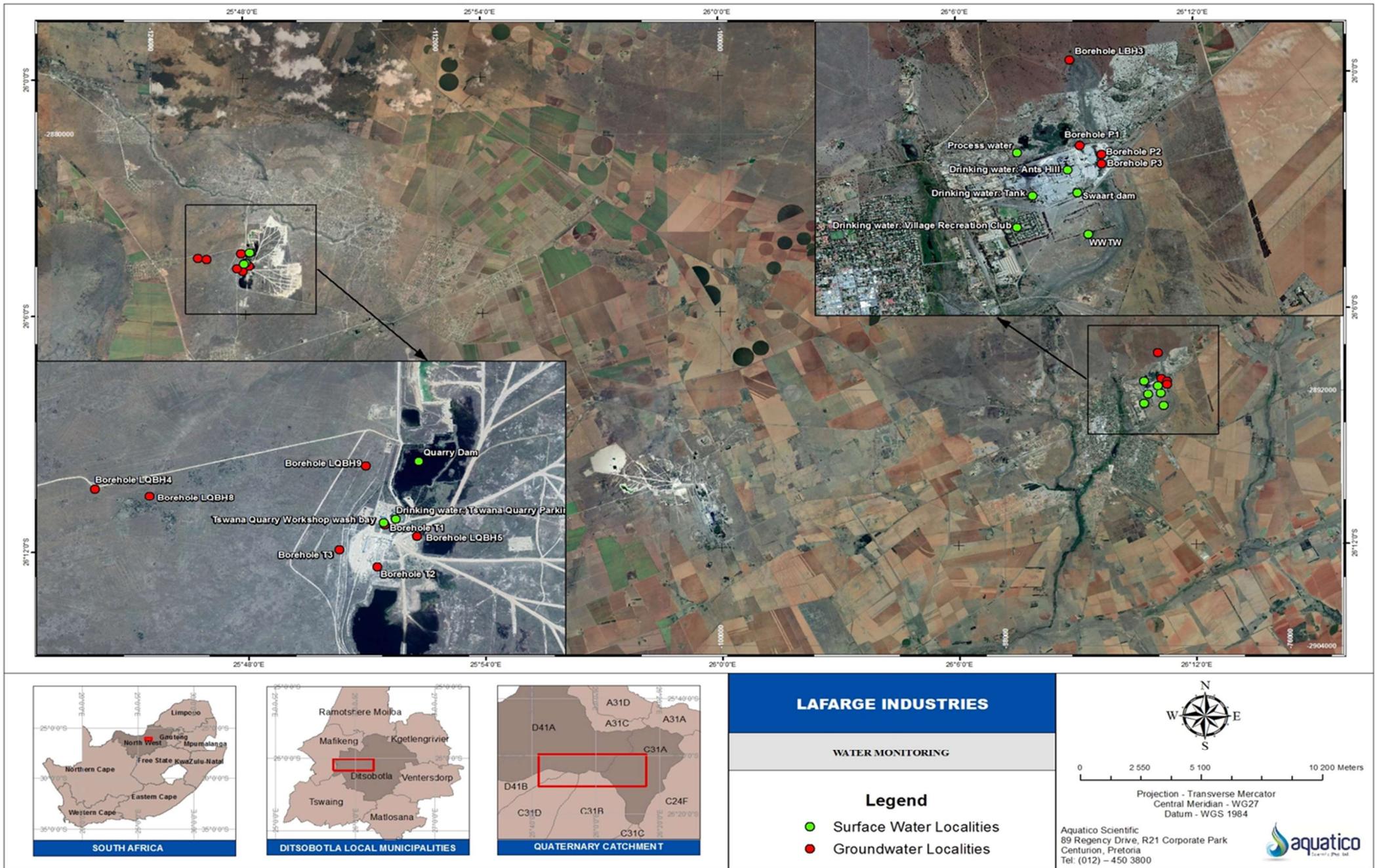


Figure 1: Map of the Water Monitoring localities at Lafarge Industries.

3.1. Water monitoring localities sampling register

A summary of the water samples collected during the monthly monitoring period is listed under Table 5. The sampling for August 2022 was conducted by Mr Sibusiso Simelane.

Table 5: Monthly Water Sampling Register for August 2022.

SAMPLING REGISTER: MONTHLY								
PROJECT NAME:				Lafarge Lichtenburg Plant				
MONTH:				August 2022				
SAMPLER NAME:				Sibusiso Simelane				
Lafarge Lichtenburg Plant								
Locality	Description	Coordinates		Sample Time	Status	Flow/Level	Remarks	Lab no
		Latitude	Longitude					
Drinking water								
Ants Hill	Drinking water: Ants Hill	S26.13287	E26.18402	2022-08-09 13:56	Yes	-	CLEAR	162038
Tank	Drinking Water Tank	S26.13629	E26.18023	2022-08-09 14:36	Yes	-	CLEAR	162041
Village Recreation Club	Drinking water: Village Recreation Club	S26.14013	E26.17856	2022-08-09 12:31	Yes	-	CLEAR	162045
Tswana Quarry Kitchen Tap	Drinking water: Tswana Quarry Kitchen Tap	S26.07840	E25.80024	2022-08-09 16:57	Yes	-	CLEAR	162044
Lovedale Quarry DW	Lovedale Quarry Drinking Water	S26.16072	E26.12812	2022-08-09 10:41	Yes	-	CLEAR	162039
Pit								
Tswana Lime Pit	Tswana Lime Pit at mining area	S26.07406	E25.80059	2022-08-09 18:00	Yes	Medium	CLEAR	162043
Townlands Pit		S26.12943	E26.18437	2022-08-09 14:55	Yes	Medium	SLIGHTLY TURBID	162042
Effluent								
WWTW Raw	Raw Influent	S26.14113	E26.18652	2022-08-09 12:55	Not sampled		PLANT OPERATING CLIENT ADVISED NOT TO SAMPLE	
WWTW Feed	Feed sample to the clarifier	S26.14112	E26.18650	2022-08-09 12:54				
WWTW Final	Final Effluent	S26.14115	E26.18652	2022-08-09 12:55				
Service water								
Tswana Quarry WSWB	Tswana Quarry Workshop wash bay	S26.07867	E25.79956	2022-08-09 17:01	Dry	-	DRY	
Process water								
Process water		S26.13074	E26.18454	2022-08-09 14:09	Yes	-	CLEAR	162040
Zinc Dam	Plant Zinc Dam	S26.13052	E26.18588	2022-08-09 14:06	Yes	Medium	TURBID	162046

4. WATER QUALITY RESULTS

4.1. Potable Water

Table 6: Potable water quality data for the monthly monitoring localities.

VARIABLE	UNITS	SANS 241-1:2015 Drinking Water Standard (SABS, 2015)	Quality of Domestic Water Supplies: Drinking Class 1	MONITORING LOCALITIES				
				Ants Hill	Tank	Village Recreation Club	Tswana Quarry Kitchen Tap	Lovedale Quarry DW
pH @ 25°C	pH	5.0/9.7	4.5/10.0	7.79	7.36	7.48	7.43	7.88
Electrical conductivity (EC) @ 25°C	mS/m	170	150	71.1	71.1	71.1	64.5	71.8
Total dissolved solids (TDS)	mg/l	1200	1000	440	433	439	358	422
Total alkalinity	mg CaCO ₃ /l	-	-	389	404	410	331	289
Total hardness	mg CaCO ₃ /l	-	300	412	402	406	314	384
Chloride (Cl)	mg/l	300	200	11.5	9.48	12	17.3	21
Sulphate (SO ₄)	mg/l	500	400	35.8	26.4	21.6	2.85	43.5
Nitrate (NO ₃) as N	mg/l	11	10	2.87	2.97	3.09	2.07	9.5
Ammonium (NH ₄) as N	mg/l	1.5	-	0.083	0.081	0.127	0.107	0.088
Orthophosphate (PO ₄) as P	mg/l	-	-	0.477	<0.005	0.042	<0.005	<0.005
Fluoride (F)	mg/l	1.5	1	<0.263	<0.263	<0.263	<0.263	<0.263
Calcium (Ca)	mg/l	-	150	85.8	83.4	89	80.6	89.6
Magnesium (Mg)	mg/l	-	100	48	47	44.6	27.5	38.9
Sodium (Na)	mg/l	200	200	7.14	5.9	6.82	17.8	10.1
Potassium (K)	mg/l	-	50	1.23	1.2	1.13	0.509	0.628
Aluminium (Al)	mg/l	0.3	-	<0.002	<0.002	<0.002	<0.002	<0.002
Iron (Fe)	mg/l	0.3	1	<0.004	<0.004	<0.004	<0.004	<0.004
Manganese (Mn)	mg/l	0.1	0.4	<0.001	<0.001	<0.001	<0.001	<0.001
Chromium (Cr)	mg/l	0.05	-	<0.003	<0.003	<0.003	<0.003	<0.003
Copper (Cu)	mg/l	2	1.3	0.017	<0.002	<0.002	<0.002	0.028
Nickel (Ni)	mg/l	0.07	-	<0.002	<0.002	<0.002	<0.002	<0.002
Zinc (Zn)	mg/l	5	5	0.014	<0.002	0.013	1.25	0.679
Cobalt (Co)	mg/l	-	-	<0.003	<0.003	<0.003	<0.003	<0.003
Cadmium (Cd)	mg/l	0.003	0.005	<0.002	<0.002	<0.002	<0.002	<0.002
Lead (Pb)	mg/l	0.01	-	<0.004	<0.004	<0.004	<0.004	<0.004
<i>E. coli</i>	CFU/100ml	0	1	0	0	0	0	0
Total coliform	CFU/100ml	10	10	0	0	0	0	0
Total Viable Count (TVC)	CFU/ml	1000	-	3	0	2	5128	5111

*Value exceeds Assessment Set 1 / Value exceeds Assessment Set 2 and/or Assessment Set 1

4.1.1. Potable water quality results discussion

The potable water quality at Lafarge Industries can be described as neutral (pH: 6.0 – 8.5), non-saline (TDS: < 450 mg/l) and very hard (hardness: 300 - 600 mg CaCO₃/l), in terms of the recorded pH, TDS and Total Hardness values (Table 6).

- Of the sampled potable water localities, **Ants Hill, Tank and Village Recreation Club** complied with the SANS 241-1:2015 limits in terms of all the analysed variables in August 2022.
- Exceedances of the SANS 241-1:2015 limits were recorded in terms of **total viable counts (TVC)** at **Tswana Quarry Kitchen Tap and Lovedale Quarry DW**.
- No bacteriological content in terms of *E. coli* and total coliforms were detected at **any** of the sampled localities.
- Elevated **Total hardness**, exceeding the Quality of Domestic Water Supplies Good (Class 1) water quality was recorded at **all** of the potable water localities (Table 6).
- It should be noted that an elevated **nitrate (NO₃)** concentration still persists at **Lovedale Quarry DW**.

Ants Hill:

In terms of the classification system of the 'Quality of Domestic water supplies' (WRC, 1998) the quality is classified as follows:

Drinking:	Class 2 – Marginal	due to Total Hardness
Bathing:	Class 3 – Poor	due to Total Hardness
Washing:	Class 3 – Poor	due to Total Hardness
Food Preparation:	Class 3 – Poor	due to Total Hardness
Aesthetic:	Class 2 – Marginal	due to Total Hardness

Based on the assessment of variables analysed in comparison to 'SANS 241-1:2015 Drinking Water Standard (SABS, 2015)' and 'Quality of Domestic water supplies' (WRC, 1998), **Ants Hill** can be classified as **Marginal (Class 2)** water quality and is **Conditionally Fit** for use as potable water and domestic use due to **Total Hardness**.

Tank:

In terms of the classification system of the 'Quality of Domestic water supplies' (WRC, 1998) the quality is classified as follows:

Drinking:	Class 2 - Marginal	due to Total Hardness
Bathing:	Class 3 - Poor	due to Total Hardness
Washing:	Class 3 - Poor	due to Total Hardness
Food Preparation:	Class 3 - Poor	due to Total Hardness
Aesthetic:	Class 2 - Marginal	due to Total Hardness

Based on the assessment of variables analysed in comparison to 'SANS 241-1:2015 Drinking Water Standard (SABS, 2015)' and 'Quality of Domestic water supplies' (WRC,

1998), **Tank** can be classified as **Marginal (Class 2)** water quality and is **Conditionally Fit** for use as potable water and domestic use due to **Total Hardness**.

Village Recreational Club:

In terms of the classification system of the 'Quality of Domestic water supplies' (WRC, 1998) the quality is classified as follows:

Drinking:	Class 2 - Marginal	due to Total Hardness
Bathing:	Class 3 - Poor	due to Total Hardness
Washing:	Class 3 - Poor	due to Total Hardness
Food Preparation:	Class 3 - Poor	due to Total Hardness
Aesthetic:	Class 2 - Marginal	due to Total Hardness

Based on the assessment of variables analysed in comparison to 'SANS 241-1:2015 Drinking Water Standard (SABS, 2015)' and 'Quality of Domestic water supplies' (WRC, 1998), **Village Recreational Club** can be classified as **Marginal (Class 2)** water quality and is **Conditionally Fit** for use as potable water and domestic use due to **Total Hardness**.

Tswana Quarry Kitchen Tap:

In terms of the classification system of the 'Quality of Domestic water supplies' (WRC, 1998) the quality is classified as follows:

Drinking:	Class 2 - Marginal	due Total Hardness
Bathing:	Class 3 - Poor	due to Total Hardness
Washing:	Class 3 - Poor	due to Total Hardness
Food Preparation:	Class 3 - Poor	due to Total Hardness
Aesthetic:	Class 2 - Marginal	due to Total Hardness

Based on the assessment of variables analysed in comparison to 'SANS 241-1:2015 Drinking Water Standard (SABS, 2015)' and 'Quality of Domestic water supplies' (WRC, 1998), **Tswana Quarry Kitchen Tap** can be classified as **Marginal (Class 2)** water quality and is **Conditionally Fit** for use as potable water and domestic use due to **Total hardness** and **TVC**.

Lovedale Quarry DW:

In terms of the classification system of the 'Quality of Domestic water supplies' (WRC, 1998) the quality is classified as follows:

Drinking:	Class 3 – Poor	due to Nitrate
Bathing:	Class 3 - Poor	due to Total Hardness
Washing:	Class 3 - Poor	due to Total Hardness
Food Preparation:	Class 3 - Poor	due to Nitrate and Total Hardness
Aesthetic:	Class 2 - Poor	due to Total Hardness

Based on the assessment of variables analysed in comparison to 'SANS 241-1:2015 Drinking Water Standard (SABS, 2015)' and 'Quality of Domestic water supplies' (WRC, 1998), **Lovedale Quarry DW** can be classified as **Marginal (Class 2)** water quality and is

Conditionally Fit for use as potable water and domestic use due to **Total hardness** and **TVC**.

Exceeding Variables:

Total Hardness:

The hardness of the water can cause very severe scaling of kettles and can cause a severely increase impairment of lathering. The hardness of the water could also have a chronic health effect in sensitive groups (Individuals with a history of kidney or gall-bladder stone and infants under 1 year of age). The hardness can also have an effect on taste.

Total Viable Count (TVC):

Total viable counts are used to indicate the general microbial quality of water. They are used to assess the efficiency of water treatment and disinfection processes, to test the integrity of distribution systems for after-growth and to determine the quality of water used in industrial processes. High total viable counts in treated water indicate inadequate treatment of water, post-treatment contamination or bacterial after-growth in the distribution system. Therefore, pathogenic micro-organisms bacteria and viruses could possibly be present in water and pose a health risk when this water is used for domestic purposes.

It should be noted that the main geology mined in this area consists of Dolomite and Limestone, with Ca and Mg being the major chemical components. Thus, high concentrations of Total Hardness are expected within the surrounding groundwater localities as Total Hardness is a representative of bicarbonate, Ca and Mg, which is some of the main by-products mined within the Lafarge area.

4.2. Waste Water (Effluent)

Table 7: Waste water quality data for the monthly monitoring locality.

VARIABLE	UNITS	General Authorisation Limit, Section 21f and h, 2013	MONITORING LOCALITIES		
			WWTW Raw	WWTW Feed	WWTW Final
pH @ 25°C	pH	5.5/9.5	NOT PUMPING - PLANT NOT OPERATIONAL		
Electrical conductivity (EC) @ 25°C	mS/m	150			
Total Dissolved solids @ 180°C	mg/l	-			
Chloride (Cl)	mg/l	-			
Sulphate (SO ₄)	mg/l	-			
Nitrate (NO ₃) as N	mg/l	15			
Ammonium (NH ₄) as N	mg/l	6			
Fluoride (F)	mg/l	1			
Calcium (Ca)	mg/l	-			
Magnesium (Mg)	mg/l	-			
Sodium (Na)	mg/l	-			
Potassium (K)	mg/l	-			
Aluminium (Al)	mg/l	-			
Iron (Fe)	mg/l	0.3			
Manganese (Mn)	mg/l	0.1			
<i>E. coli</i>	CFU/100ml	1000			
Faecal coliform	CFU/100ml	1000			
Total coliform	CFU/100ml	-			
Total Viable Count (TVC)	CFU/ml	-			
Chemical oxygen demand (COD)	mg/l	75			
Total suspended solids (TSS)	mg/l	25			
Temperature	°C	-			
Total hardness	mg CaCO ₃ /l	-			

*Value exceeds Assessment Set 1

*N/R = Not requested

4.3. Process Water

Table 8: Process water quality data for the monthly monitoring locality.

VARIABLE	UNITS	DWAf (1996) SAWQG TWQGR for Industrial Use; Category 2 Processes	General Authorisation Limit, Section 21f and h, 2013	MONITORING LOCALITIES	
				Process water	Zinc Dam
pH @ 25°C	pH	6.5/8.0	5.5/9.5	8.15	8.74
Electrical conductivity (EC) @ 25°C	mS/m	30	150	79.3	891
Chloride (Cl)	mg/l	40	-	29.2	1914
Sulphate (SO ₄)	mg/l	80	-	43.9	874
Nitrate (NO ₃) as N	mg/l	-	15	0.49	0.197
Ammonium (NH ₄) as N	mg/l	-	6	0.128	0.255
Fluoride (F)	mg/l	-	1	<0.263	<0.263
Calcium (Ca)	mg/l	-	-	82.2	59.2
Magnesium (Mg)	mg/l	-	-	52.1	40.1
Sodium (Na)	mg/l	-	-	16.1	1739
Potassium (K)	mg/l	-	-	3.2	430
Aluminium (Al)	mg/l	-	-	<0.002	<0.002
Iron (Fe)	mg/l	0.2	0.3	<0.004	0.111
Manganese (Mn)	mg/l	0.1	0.1	<0.001	0.123

*Value exceeds Assessment Set 1 / Value exceeds Assessment Set 2 and/or Assessment Set 1

4.3.1. Process water quality results discussion

Nearby quarry water (locality **Process water**) is pumped throughout the process system and utilised for the cooling processes at Lafarge industries. The **Zinc Dam** is utilised as a water storage facility.

Alkaline pH values (pH > 8.5) were recorded at locality **Zinc Dam**, while a neutral pH (pH 6.0 - 8.5) prevailed at **Process Water** during August 2022 (Table 8).

Exceedances of the SAWQG for Industrial Use at locality **Process Water** were recorded in terms of **pH** and **electrical conductivity (EC)**, while **Zinc Dam** exceeded for the aforementioned variables as well as **chloride (Cl)**, **sulphate (SO₄)** and **manganese (Mn)** concentrations.

According to the DWAF, 1996 SAWQG for Industrial use; Category 2 Processes the following effects may be possible in terms of the variables (pH, EC/TDS, Cl and SO₄) detected:

1.	Damage to equipment and structures
2.	Interference with processes
3.	Product quality
4.	Complexity of waste handling

Locality Process Water

- The effects of the pH value at locality **Process Water** that falls in the quality range of 8.0 to 10.0 include:
 - minor to moderate damage due to scaling or deposits;
 - mild effect on alkaline and neutral processes and major pH adjustment for highly acidic processes;
 - potential for product impairment due to scaling of deposits mild to moderate; and
 - pH adjustment may be required before disposal of waste.
- The effects of the EC value at locality **Process Water** that falls in the quality range of 50 to 120 include:
 1. moderate damage to equipment and structures through corrosion and scaling and fouling possible;
 2. moderate to significant interference with processes possible;
 3. moderate impairment of product quality due to precipitation; and
 4. no problems except for disposal of highly saline effluents from moderate frequency regeneration of demineralisation plant.
- None of the analysed variables at locality **Process Water** exceeded the General Authorisation Limits during August 2022 (Table 8).

Locality Zinc Dam

- The effects of the pH value at locality **Zinc Dam** that falls in the quality range of 8.0 to 10.0 include:
 - minor to moderate damage due to scaling or deposits;
 - mild effect on alkaline and neutral processes and major pH adjustment for highly acidic processes;
 - potential for product impairment due to scaling of deposits mild to moderate; and
 - pH adjustment may be required before disposal of waste.
- The effects of the EC value at locality **Zinc Dam** that falls in the quality range of > 120 include:
 - significant to major damage to equipment and structures through corrosion and scaling and fouling;
 - significant to major interference with processes expected;

- significant to major impairment of product quality expected; and
 - major reduction in salt content required to comply with local or General Standards for discharges.
- The effects of the Cl concentration at locality **Zinc Dam** that exceeded the range of concentration > 200 include:
 - moderate to major damage due to corrosion particularly if pH is low and temperature elevated;
 - significant to major interference with processes expected;
 - moderate to major impairment of product quality expected; and
 - major reduction in chloride content may be required to comply with local or General Standards for discharges.
 - The effects of the SO₄ concentration at locality **Zinc Dam** that exceeded the range of concentration > 250 include:
 - moderate to major damage as a result of corrosion, scaling or concrete degradation;
 - moderate to major interference with processes expected;
 - significant to major impairment of product quality expected through precipitation; and
 - no problems, except for disposal of highly saline effluent from moderate to high frequency regeneration of demineralisation plant.
 - The effects of the Mn concentration at locality **Zinc Dam** that falls in the quality range of 0.1 – 0.5 include:
 - minor to moderate damage due to precipitation of manganese compound;
 - negligible to minor interference with processes expected;
 - negligible to moderate impairment of product quality; and
 - treatment may be required to reduce manganese concentrations to conform with local and General Standards for discharges.

EC and **Mn** of the analysed variables at locality **Zinc Dam** also exceeded the General Authorisation Limits during August 2022 (Table 8). It should be noted that significantly high **EC**, **Cl** and **SO₄** concentrations prevail at locality **Zinc Dam** and should not be released into the receiving environment. The possible reason for the high concentrations of the variables mentioned above is the concentration effect taking place in the dam due to evaporation.

4.4. Service water (Wash Bay)

Table 9: Service water quality data for the monthly monitoring locality.

VARIABLE	UNITS	General Authorisation Limit, Section 21f and h, 2013	MONITORING LOCALITIES
			Tswana Quarry WSWB
pH @ 25°C	pH	5.5/9.5	DRY
Electrical conductivity (EC) @ 25°C	mS/m	150	
Total Dissolved solids @ 180°C	mg/l	-	
Total suspended solids (TSS)	mg/l	25	
Oil and grease (SOG)	mg/l	2.5	

4.4.1. Wash bay water quality results discussion

The **Tswana Quarry WSWB** sample are collected at the Tswana Quarry truck wash bay (mechanical workshop) after the oil separator. Water from the truck wash bay is pumped through the oil separator for re-use or disposal.

No water sampled could be taken at **Tswana Quarry WSWB** during August 2022 due to dry conditions.

4.5. Surface water (Tswana Lime and Townlands Pit)

Table 10: Pit water quality data for the monthly monitoring locality.

VARIABLE	UNITS	General Authorisation Limit, Section 21f and h, 2013	SAWQG Volume 5, Agricultural Use, Livestock Watering, Cattle	MONITORING LOCALITIES	
				Tswana Lime Pit	Townlands Pit
pH @ 25°C	pH	5.5/9.5	-	8.49	8.18
Electrical conductivity (EC) @ 25°C	mS/m	150	-	49	82.8
Total Dissolved solids @ 180°C	mg/l	-	1000	302	506
Total hardness	mg CaCO ₃ /l	-	-	210	427
Chloride (Cl)	mg/l	-	1500	85.8	37
Sulphate (SO ₄)	mg/l	-	1000	4.59	39.8
Nitrate (NO ₃) as N	mg/l	15	22.6	0.283	0.411
Ammonium (NH ₄) as N	mg/l	6	-	0.117	0.137
Fluoride (F)	mg/l	1	2	<0.263	<0.263
Calcium (Ca)	mg/l	-	1000	43.6	83.3
Magnesium (Mg)	mg/l	-	500	24.7	53.2
Sodium (Na)	mg/l	-	2000	17.1	22.6
Potassium (K)	mg/l	-	-	1.85	4.82
Aluminium (Al)	mg/l	-	5	<0.002	<0.002
Iron (Fe)	mg/l	0.3	10	<0.004	<0.004
Manganese (Mn)	mg/l	0.1	10	0.008	<0.001
Chromium (Cr)	mg/l	-	-	<0.003	<0.003
Copper (Cu)	mg/l	0.01	0.5	<0.002	<0.002
Nickel (Ni)	mg/l	-	1	<0.002	<0.002
Zinc (Zn)	mg/l	0.1	20	<0.002	<0.002
Cobalt (Co)	mg/l	-	1	<0.003	<0.003
Cadmium (Cd)	mg/l	0.005	0.01	<0.002	<0.002
Lead (Pb)	mg/l	0.01	0.1	<0.004	<0.004
Total suspended solids (TSS)	mg/l	25	-	<4.5	13

*Value exceeds Assessment Set 1

4.5.1. Pit water quality results discussion

One additional pit locality (**Townlands Pit**) was added to the monitoring programme in February 2022. The water quality sampled at **Tswana Lime Pit** and **Townlands Pit** were compared against the General Authorisation limit and the SAWQG for Livestock Watering (Table 10).

The water at **Tswana Lime Pit** and **Townlands Pit** can be described as neutral, non-saline (**Tswana Lime Pit**) to saline and hard (**Tswana Lime Pit**) to very hard (Table 10). **All** of the analysed variables complied with the General Authorisation limit at Tswana Lime Pit and Townlands Pit during August 2022. The compliant (“unaffected”) water quality might be as a result of the influx of fresh rain water that causes a dilution effect.

No exceedances in terms of any analysed variables compared to the SAWQG for Livestock Watering limits.

5. CONCLUSION

A monitoring report specific for Lafarge industries was compiled by Aquatico to highlight and evaluate data according to applicable guidelines. Selected monitoring localities can be summarised as follows:

DRINKING WATER MONITORING

Physical, Chemical and Bacteriological Quality:

- In terms of physical quality, the representative drinking water localities can be described as neutral, non-saline and very hard.
- All of the analysed variables at localities Ants Hill, Tank and Village Recreation Club complied with the SANS 241-1:2015 limits in August 2022.
- TVC exceeded the SANS 241-1:2015 limit at Tswana Quarry Kitchen Tap and Lovedale Quarry DW.
- No *E. coli* and no total coliforms was detected at any of the sampled potable water localities.
- Localities Ants Hill, Tank, Village Recreation Club, Tswana Quarry Kitchen Tap and Lovedale Quarry DW can be classified as Marginal (Class 2) water quality, due to the Total Hardness. The water at these localities is Conditionally Fit for use as potable water and domestic use.
- Elevated total hardness is expected in the groundwater as the nature of the geology in this area mainly consist of dolomite and limestone, with Ca and Mg being the major chemical components.
- It should also be noted that an elevated NO₃ concentrations persist at Lovedale Quarry DW.

WASTE WATER MONITORING

- The waste water plant was not operational during sampling in August 2022.

PROCESS WATER MONITORING

- Exceedances observed in terms of pH and EC at locality Process water, while pH, EC, Cl, SO₄ and Mn exceeded at Zinc Dam when measured against the SAWQG for Industrial Use.
- Scaling, corrosion and salt depositions may occur from water at Process Water.
- Significant scaling, corrosion and salt depositions expected from water at Zinc Dam due to the extremely high EC, Cl and SO₄ recorded.
- EC and Mn exceeded the General Authorisation Limit at Zinc Dam

SURFACE (PIT) WATER MONITORING

- All of the analysed variables complied with the General Authorisation Limit at Townlands Pit and Tswana Lime Pit.
- The good water quality might be attributed to the influx of fresh rain water.

6. RECOMMENDATIONS

- Monthly drinking water quality monitoring should continue as scheduled.
- It is advised to maintain a free chlorine (Cl₂) residual in the range of 0.2 mg/l to 0.5 mg/l to ensure disinfection in the distribution system.

7. REFERENCES

- DWA [Department of Water Affairs] (2013) Revision of General Authorizations in terms of Section 39 of the National Water Act, 1998 (Act No. 36 of 1998). *Government Gazette* 36820. 6 September (Government Notice no. 665).
- Department of Water Affairs and Forestry (1996). South African Water Quality Guidelines Volume 5 – Agricultural Use: Livestock Watering. 2nd Ed. Issue 1. Department of Water Affairs and Forestry. Pretoria.
- DWAF [Department of Water Affairs and Forestry] (1996). South African Water Quality Guidelines Volume 3 – Industrial Use. 2nd Ed. Issue 1. Department of Water Affairs and Forestry. Pretoria.
- WRC [Water Research Commission], DWAF [Department of Water Affairs and Forestry], and DOH [Department of Health] (1998). Quality of Domestic Water Supplies. Volume 1: Assessment Guide. (2nd Edition). WRC Report no. TT 101/98. Pretoria.
- Savannah Environmental (2018) Scoping Report for Lichtenburg 1, a PV facility and associated infrastructure, proposed on a site near Lichtenburg, in the North West Province.
- SABS [South African Bureau for Standards] SANS 241-1:2015 South African National Standard for Drinking Water Part 1: Microbiological, physical, aesthetic and chemical determinants. SABS Standards Division. Pretoria.

LAFARGE INDUSTRIES

APPENDIX A

PHOTOGRAPHIC MONITORING CATALOGUE



LAFARGE LICHTENBURG PLANT - PHOTOGRAPHIC MONITORING CATALOGUE

Locality	Ants Hill
Locality Coordinates	S26.13287 E26.18402
Sample Date	2022-08-09 13:56
Sample By	Sibusiso Simelane

Drinking water: Ants Hill



Locality	Tank
Locality Coordinates	S26.13629 E26.18023
Sample Date	2022-08-09 14:36
Sample By	Sibusiso Simelane

Drinking Water Tank



Locality	Tswana Quarry Kitchen Tap
Locality Coordinates	S26.07840 E25.80024
Sample Date	2022-08-09 16:57
Sample By	Sibusiso Simelane

Drinking water: Tswana Quarry Kitchen Tap



Locality	Village Recreation Club
Locality Coordinates	S26.14013 E26.17856
Sample Date	2022-08-09 12:31
Sample By	Sibusiso Simelane

Drinking water: Village Recreation Club



Locality	Lovedale Quarry DW
Locality Coordinates	S26.16072 E26.12812
Sample Date	2022-08-09 10:41
Sample By	Sibusiso Simelane

Lovedale Quarry Drinking Water



Locality	Townlands Pit
Locality Coordinates	S26.12943 E26.18437
Sample Date	2022-08-09 14:55
Sample By	Sibusiso Simelane



LAFARGE LICHTENBURG PLANT - PHOTOGRAPHIC MONITORING CATALOGUE

Locality	Tswana Lime Pit
Locality Coordinates	S26.07406 E25.80059
Sample Date	2022-08-09 18:00
Sample By	Sibusiso Simelane

Tswana Lime Pit at mining area



Locality	WWTW Raw
Locality Coordinates	S26.14113 E26.18652
Sample Date	2022-08-09 12:55
Sample By	Sibusiso Simelane

Raw Influent



Locality	WWTW Feed
Locality Coordinates	S26.14112 E26.18650
Sample Date	2022-08-09 12:54
Sample By	Sibusiso Simelane

Feed sample to the clarifier



Locality	WWTW Final
Locality Coordinates	S26.14115 E26.18652
Sample Date	2022-08-09 12:55
Sample By	Sibusiso Simelane

Final Effluent



Locality	Process water
Locality Coordinates	S26.13074 E26.18454
Sample Date	2022-08-09 14:09
Sample By	Sibusiso Simelane



Locality	Zinc Dam
Locality Coordinates	S26.13052 E26.18588
Sample Date	2022-08-09 14:06
Sample By	Sibusiso Simelane

Plant Zinc Dam



LAFARGE INDUSTRIES

APPENDIX B

TEST REPORT



Test Report

Page 1 of 4

Client: Lafarge Industries South Africa
Address: 1 Manana Road, Industrial Site, Lichtenburg, 2740
Report no: 132962
Project: Lafarge Lichtenburg Plant

Date of report: 18 August 2022
Date accepted: 11 August 2022
Date completed: 18 August 2022
Date received: 11 August 2022

Lab no:			162038	162039	162040	162041	162042	162043	162044
Date sampled:			09-Aug-22	09-Aug-22	09-Aug-22	09-Aug-22	09-Aug-22	09-Aug-22	09-Aug-22
Aquatico sampled:			Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sample type:			Water	Water	Water	Water	Water	Water	Water
Locality description:			Ants Hill	Lovedale Quarry DW	Process water	Tank	Townlands Pit	Tswana Lime Pit	Tswana Quarry Kitchen Tap
Analyses	Unit	Method							
A pH @ 25°C	pH	ALM 20	7.79	7.88	8.15	7.36	8.18	8.49	7.43
A Electrical conductivity (EC) @ 25°C	mS/m	ALM 20	71.1	71.8	79.3	71.1	82.8	49.0	64.5
A Total Dissolved solids @ 180°C	mg/l	ALM 24	NR	NR	NR	NR	506	302	NR
A Total alkalinity	mg CaCO3/l	ALM 01	389	289	406	404	NR	NR	331
A Chloride (Cl)	mg/l	ALM 02	11.5	21.0	29.2	9.48	37.0	85.8	17.3
A Sulphate (SO4)	mg/l	ALM 03	35.8	43.5	43.9	26.4	39.8	4.59	2.85
A Nitrate (NO3) as N	mg/l	ALM 06	2.87	9.50	0.490	2.97	0.411	0.283	2.07
A Nitrite (NO2) as N	mg/l	ALM 07	NR	NR	0.096	NR	NR	NR	NR
A Ammonium (NH4) as N	mg/l	ALM 05	0.083	0.088	0.128	0.081	0.137	0.117	0.107
A Orthophosphate (PO4) as P	mg/l	ALM 04	0.477	<0.005	<0.005	<0.005	NR	NR	<0.005
A Fluoride (F)	mg/l	ALM 08	<0.263	<0.263	<0.263	<0.263	<0.263	<0.263	<0.263
A Calcium (Ca)	mg/l	ALM 30	85.8	89.6	82.2	83.4	83.3	43.6	80.6
A Magnesium (Mg)	mg/l	ALM 30	48.0	38.9	52.1	47.0	53.2	24.7	27.5
A Sodium (Na)	mg/l	ALM 30	7.14	10.1	16.1	5.90	22.6	17.1	17.8
A Potassium (K)	mg/l	ALM 30	1.23	0.628	3.20	1.20	4.82	1.85	0.509
A Aluminium (Al)	mg/l	ALM 31	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
A Iron (Fe)	mg/l	ALM 31	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
A Manganese (Mn)	mg/l	ALM 31	<0.001	<0.001	<0.001	<0.001	<0.001	0.008	<0.001
A Chromium (Cr)	mg/l	ALM 31	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
A Copper (Cu)	mg/l	ALM 31	0.017	0.028	<0.002	<0.002	<0.002	<0.002	<0.002
A Nickel (Ni)	mg/l	ALM 31	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
A Zinc (Zn)	mg/l	ALM 31	0.014	0.679	<0.002	<0.002	<0.002	<0.002	1.25
A Cobalt (Co)	mg/l	ALM 31	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
A Cadmium (Cd)	mg/l	ALM 31	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
A Lead (Pb)	mg/l	ALM 31	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
A E.coli	CFU/100ml	ALM 40	<1	<1	NR	<1	NR	NR	<1
A Total coliform	CFU/100ml	ALM 40	<1	<1	NR	<1	NR	NR	<1
A TotalViableCount	CFU/ml	ALM 43	3	5111	NR	<1	NR	NR	5128

A = Accredited N = Non accredited Out = Outsourced Sub = Sub-contracted NR = Not requested RTF = Results to follow NATD = Not able to determine ATR = Alternative test report ; Results relate only to the items sampled and tested ; Results reported against the limit of detection; Results marked 'Non SANAS Accredited' in this report are not included in the SANAS Schedule of Accreditation for this laboratory; Uncertainty of measurement available on request for all methods included in the SANAS Schedule of Accreditation; The report shall not be reproduced except in full without approval of the laboratory

Test Report

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Client: Lafarge Industries South Africa
Address: 1 Manana Road, Industrial Site, Lichtenburg, 2740
Report no: 132962
Project: Lafarge Lichtenburg Plant

Date of report: 18 August 2022
Date accepted: 11 August 2022
Date completed: 18 August 2022
Date received: 11 August 2022

Lab no:				162038	162039	162040	162041	162042	162043	162044
Date sampled:				09-Aug-22	09-Aug-22	09-Aug-22	09-Aug-22	09-Aug-22	09-Aug-22	09-Aug-22
Aquatico sampled:				Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sample type:				Water	Water	Water	Water	Water	Water	Water
Locality description:				Ants Hill	Lovedale Quarry DW	Process water	Tank	Townlands Pit	Tswana Lime Pit	Tswana Quarry Kitchen Tap
Analyses	Unit	Method								
A Total hardness	mg CaCO ₃ /l	ALM 26	412	384	420	402	427	210	314	
A Total suspended solids (TSS)	mg/l	ALM 25	NR	NR	NR	NR	13	<4.5	NR	
A Total oxidised nitrogen as N	mg/l	ALM 06	2.87	9.50	0.586	2.97	0.411	0.283	2.07	

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Test Report

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Client: Lafarge Industries South Africa
Address: 1 Manana Road, Industrial Site, Lichtenburg, 2740
Report no: 132962
Project: Lafarge Lichtenburg Plant

Date of report: 18 August 2022
Date accepted: 11 August 2022
Date completed: 18 August 2022
Date received: 11 August 2022

Lab no:	162045	162046		
Date sampled:	09-Aug-22	09-Aug-22		
Aquatico sampled:	Yes	Yes		
Sample type:	Water	Water		
Locality description:	Village Recreation Club	Zinc Dam		
Analyses				
	Unit	Method		
A pH @ 25°C	pH	ALM 20	7.48	8.74
A Electrical conductivity (EC) @ 25°C	mS/m	ALM 20	71.1	891
A Total Dissolved solids @ 180°C	mg/l	ALM 24	NR	NR
A Total alkalinity	mg CaCO3/l	ALM 01	410	1462
A Chloride (Cl)	mg/l	ALM 02	12.0	1914
A Sulphate (SO4)	mg/l	ALM 03	21.6	874
A Nitrate (NO3) as N	mg/l	ALM 06	3.09	0.197
A Nitrite (NO2) as N	mg/l	ALM 07	NR	0.077
A Ammonium (NH4) as N	mg/l	ALM 05	0.127	0.255
A Orthophosphate (PO4) as P	mg/l	ALM 04	0.042	<0.005
A Fluoride (F)	mg/l	ALM 08	<0.263	<0.263
A Calcium (Ca)	mg/l	ALM 30	89.0	59.2
A Magnesium (Mg)	mg/l	ALM 30	44.6	40.1
A Sodium (Na)	mg/l	ALM 30	6.82	1739
A Potassium (K)	mg/l	ALM 30	1.13	430
A Aluminium (Al)	mg/l	ALM 31	<0.002	<0.002
A Iron (Fe)	mg/l	ALM 31	<0.004	0.111
A Manganese (Mn)	mg/l	ALM 31	<0.001	0.123
A Chromium (Cr)	mg/l	ALM 31	<0.003	0.015
A Copper (Cu)	mg/l	ALM 31	<0.002	<0.002
A Nickel (Ni)	mg/l	ALM 31	<0.002	0.632
A Zinc (Zn)	mg/l	ALM 31	0.013	<0.002
A Cobalt (Co)	mg/l	ALM 31	<0.003	0.010
A Cadmium (Cd)	mg/l	ALM 31	<0.002	<0.002
A Lead (Pb)	mg/l	ALM 31	<0.004	<0.004
A E.coli	CFU/100ml	ALM 40	<1	NR
A Total coliform	CFU/100ml	ALM 40	<1	NR
A TotalViableCount	CFU/ml	ALM 43	2	NR

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Lab no:	162045	162046		
Date sampled:	09-Aug-22	09-Aug-22		
Aquatico sampled:	Yes	Yes		
Sample type:	Water	Water		
Locality description:	Village Recreation Club	Zinc Dam		
Analyses	Unit	Method		
A Total hardness	mg CaCO3/l	ALM 26	406	313
A Total suspended solids (TSS)	mg/l	ALM 25	NR	NR
A Total oxidised nitrogen as N	mg/l	ALM 06	3.09	0.274

A = Accredited N = Non accredited Out = Outsourced Sub = Sub-contracted NR = Not requested RTF = Results to follow NATD = Not able to determine ATR = Alternative test report ; Results relate only to the items sampled and tested ; Results reported against the limit of detection; Results marked 'Non SANAS Accredited' in this report are not included in the SANAS Schedule of Accreditation for this laboratory; Uncertainty of measurement available on request for all methods included in the SANAS Schedule of Accreditation; The report shall not be reproduced except in full without approval of the laboratory

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