# AN INDEPENDENT INVESTIGATION AND ADVISORY ON THE ROLE OF WATER, SANITATION AND HYGIENE IN THE 2023 CHOLERA OUTBREAK IN HAMMANSKRAAL, SOUTH AFRICA

# WORK PACKAGE 4: WATER AND SANITATION SAFETY ASSESSMENT AND ENVIRONMENTAL MONITORING

Part 4: Assessment and Monitoring of Solid Waste and Sewer Overflows

# Final Report to the Water Research Commission

by

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WRC Report No. 3167/4/24 ISBN 978-0-6392-0665-3

October 2024



### Obtainable from

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## **EXECUTIVE SUMMARY**

#### **BACKGROUND**

This report is "Report number IV – Assessment and monitoring of solid waste and sewer overflows" and form part of "Work Package Four – Water and Sanitation Safety Assessment and Environmental Monitoring. The potential of illegal dumping of municipal solid waste as well as dysfunctional sewer systems on the potential spread of cholera is investigated.

#### **AIMS**

The main the aims of the project are shown below:

- 1. To identify potential sources of contamination caused by untreated sewerage or municipal solid waste dumped illegally.
- 2. Determine which of the identified areas poses a potential risk and obtain samples where sewerage and or waste comes into contact with water sources.

#### **METHODOLOGY**

Google earth was used to identify it as an illegal dump site as well as an uncontrolled sewer discharge. Each Source (S) was evaluated to determine if there is a Partway (P) to a Receptor (R), i.e. river, stream, pond or dam.

### **RESULTS AND DISCUSSION**

### Identification of sources

One hundred potential sources of contamination were identified with 16 targeted due to being identified as a risk level 4. The 16 high risk potential sources were linked to receptors such as rivers, streams, ponds or dams.

A team discussion determined the risk level for each site or area based on the table below.

Risk Level						
None Low Medium High						
1	2	3	4			

### Site sampling

The sites and areas identified as a high-risk level was targeted for sampling of pathways and/or receptors. Where possible, water samples were collected from these pathways or receptors and analysed in terms of microbiological and chemical constituents.

### **CONCLUSIONS**

The microbiological and chemical analysis did not yield any positive results for cholera although several sites showed definite contamination from sewerage, including targeted pathogens. The illegal dump sites also have the potential to spread *V. cholerae* should it be present due to soiled nappies being disposed here.

### **RECOMMENDATIONS**

The sewer system needs to be repaired and maintained and illegal dumps cleared whilst an adequate waste collection system should be implemented to curb illegal dumping.

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## **ACRONYMS & ABBREVIATIONS**

Abbreviation	Meaning
Р	Pathway
R	Receptor
S	Source

# **ACKNOWLEDGEMENTS**

The project team thanks the following people for their contributions to the project.

Name	Affiliation
Cholera Advisory Panel	Various Institutions
Dr Eunice Ubomba-Jaswa (Research Manager)	Water Research Commission
Community Members	Hammanskraal

## **GLOSSARY**

**Illegal dump**. An area where a community disposes of waste in a non-environmentally sound manner.

**Pathway**. A non-perennial stream of erosion gully that allows water to flow from a source to a receptor.

**Receptor**. Waterbody such as a dam or pond or a large perennial stream.

**Source**. For the purposes of this report the source is defined as an illegal dump site or sewer manhole overflowing.

## **CHAPTER 1: BACKGROUND**

### 1.1 INTRODUCTION

This report investigates the potential of illegal dumping of domestic solid waste as well as dysfunctional sewer systems that may aid in the spread of cholera, or other similar diseases.

### 1.2 PROJECT AIM

Assess the functionality of waste management systems (including but not limited to solid waste and sewerage) within the designated outbreak areas.

### 1.3 SCOPE LIMITATIONS AND METHODOLOGY

The scope for the "Assessment and monitoring of waste and sewer overflows" was left to the project team to determine how best to achieve the desired outcome.

Due to the area that had to be covered, "Google Earth" was used to identify uncontrolled sewer discharge as well as illegal dump sites. Each Source (S) was evaluated to determine if there is a Partway (P) to a Receptor (R), i.e. river, stream, pond or dam.

Where sources were connected to receptors, the potential for contamination was assessed based on allocated risk levels. Sites were identified where samples were taken for analysis.

1. Obtain samples where sewerage and or waste comes into contact with water sources to specify the risk.

# CHAPTER 2: IDENTIFICATION OF POSSIBLE CONTAMINATION SOURCES

### 2.1 INTRODUCTION

An extensive search was conducted on Google Earth to identify illegal dump sites and sewer overflows. This was done by searching the study area in a grid pattern, whereby illegal dumpsite can be easily identified since it is usually located on open areas within residential areas or on the outskirts of residential areas. Sewer overflows are easily identified when images taken during the winter month are viewed since overflows typically shows as green vegetation in an otherwise dry environment.

### 2.2 RESULTS FROM SEARCH

Figure 1 shows the 100 sites identified. Some of the sites are a combination of illegal dump site and sewer overflows and a number were marked as unknown for field verification.

### 2.3 CRITERIA FOR EVALUATION OF SITES IDENTIFIED

Once the potential Sources were identified, a team discussion determined the risk level for each site or area. Four risk levels ranging from none to high risk were considered for the evaluation of sites.

The following were considered for determining the risk level for each site:

- The likelihood of illegal waste dumps being infected with cholera is remote since these dumps contain
  very little organic matter that can act as a hibernating ground for the bacteria. These dumps mainly
  contain plastic; paper, metal cans, glass and cardboard and are mostly not conducive to the growth of
  bacteria. However, disposal of soiled nappies at these sites has the potential spreading disease.
- The possibility of such a dump being a place of growth medium for the pathogenic bacteria can increase during the rainy season but these dumps usually dry out quickly after a rain event. Hence, the most likely chance of spreading the bacteria is if an infected dump site has a pathway such as natural runoff ways, i.e. small non-perennial streams or erosion gullies down to a mainstream or river which flows to a dam or pond where water is being extracted.
- Other vectors that could contribute to the spread disease include inspects (typically flies), birds (often ibises) and rodents.
- Site where waste was dumped on street corners did mostly not have pathways.
- Some dumps are in old quarries that is filled with water during the rainy season which has the potential to spread the bacteria, should the waste dump be contaminated.
- Several illegal dumps are on the outskirts of residential areas and some of the sites are linked to a receptor stream or dam via a pathway erosion gully or non-perennial stream.
- A few street vendors have illegal dumps site at the back of their stalls and although these may be more
  conducive for bacterial growth due to potential increase of growth medium (spoiled food, offcuts etc.)
   These are potential high-risk areas, due to chances of transmission via unwashed hands or
  contaminated food. Due to the intrusive nature of sampling here, these sites were not considered.
- There are also several illegal dumps situated on or adjacent to school properties, these have also been classified as a medium risk.

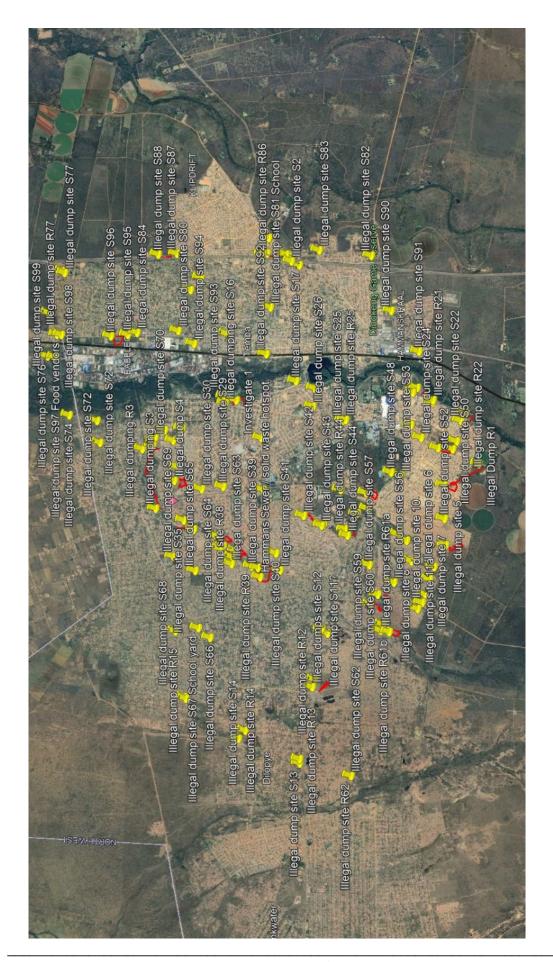


Figure 1: Map showing sewer overflows and illegal dump sites

## 2.4 SITE EVALUATION

The table below shows the sites that were identified for site investigation. A detailed table is shown in Appendix A of the report.

Table 1: Site identified for field investigation

Risk Level					
None	Low	Medium	High		
1	2	3	4		
Site	Source	Pathway	Receptor	Comment	Investigate
3	X	Χ	Χ	All purple sites linked	X
13	X	Χ	Χ		X
16	X	Χ	Χ		X
17	Χ			Adjacent to larger receptor	Х
Inv	Χ			Adjacent to larger receptor	Χ
18	Χ			Adjacent to larger receptor	X
34	Χ	Χ	Х	All purple sites linked	X
35	Χ	Χ	Х	All purple sites linked	х
36	Х	Χ	Х	All purple sites linked	Х
37	Χ	Χ	Х	All purple sites linked	X
38	Χ	Χ	Х	All purple sites linked	X
39	Χ	Χ	Х	All purple sites linked	X
64	Χ	Χ	Х	All purple sites linked	Х
85	Χ	Χ	Х		Х
86	Х	Χ	Х		Х
100	X	X	X	Sewer overflow	Х

## **CHAPTER 3: SITE INVESTIGATION**

### 3.1 SITE INVESTIGATION AND SAMPLING

The sites and areas identified as a high risk as shown in Table 1 in the previous section, were targeted for sampling of pathways or receptors. Where possible, water samples were collected from these pathways or receptors.

### 3.2 RESULTS FROM INVESTIGATION

Set out below are photographs showing the sites where field investigations were conducted as well as the microbiology and chemical test results of the samples taken for each site.

## Site 13



Figure 2: Site 13 – Locality





Figure 3: Site 13 – Illegal dump site

Figure 4: Site 13 – Receptor

## Test results for the samples received

MICROBIOL	OGY TEST RESULT	S	CHEMISTRY TEST RESULTS				
DETERMINANT	ANT UoM R13		DETERMINANT	UoM	R13		
Total coliforms	MPN.100ml <sup>-1</sup>	488000	Chemical oxygen demand (COD)	mg.L <sup>-1</sup>	40.0		
Escherichia coli	MPN.100ml <sup>-1</sup>	17000	Electrical conductivity	mS.m <sup>-1</sup>	113.0		
Heterotrophic plate count	CFU.1ml <sup>-1</sup>	68000	Ammonia-nitrogen (NH <sub>3</sub> )	mg.L <sup>-1</sup>	0.4		
Salmonella enterica	Positive/Negative	Negative	рН		7.9		
Shigella species and/or EIEC	Positive/Negative	Negative	Comment: Results acceptable No cholera				
Toxigenic Vibrio cholerae (ctxAB+)	Positive/Negative	Negative					

## Site 16 and Site for investigation



Figure 5: Site 16 – Locality





Figure 6: Site 16

Figure 7: Site for investigation

## Test results for the samples received

MIC	ROBIOLOGY TEST	CHEMISTRY TEST RESULTS					
DETERMINANT	UoM	R16	INV1	DETERMINANT	UoM	R16	INV1
Total coliforms	MPN.100ml <sup>-1</sup>	>24 200	>2 420 000	Chemical oxygen demand (COD)	mg.L <sup>-0</sup>	26.0	44.0
Escherichia coli	MPN.100ml <sup>-1</sup>	24200	276000	Electrical conductivity	mS.m <sup>-0</sup>	118.0	86.0
Heterotrophic plate count	CFU.1ml <sup>-1</sup>	184000	2 350 000	Ammonia-nitrogen (NH <sub>3</sub> )	mg.L <sup>-0</sup>	0.5	10.9
Salmonella enterica	Positive/Negative	Positive	Negative	рН		8.4	7.3
Shigella species and/or EIEC	Positive/Negative	Negative	Positive	Comment: Both microbiology (Salmonella and Shigella) and Chemistry results (INV NH <sub>3</sub> ) are indicative of sewerage contamination. <i>V. cholerae</i> negative.			
Toxigenic Vibrio cholerae (ctxAB+)	Positive/Negative	Negative	Negative				

## Site 85 and 86

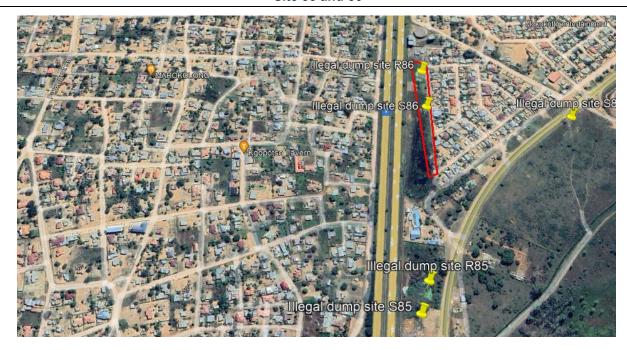


Figure 8: Site 85 & 86 - Locality





Figure 9: Site 85

Figure 10: Site 86

## Test results for the samples received

MIC	ROBIOLOGY TEST	RESULTS	CHEMISTRY TEST RESULTS				
DETERMINANT	UoM	R85	R86	DETERMINANT	UoM	R85	R86
Total coliforms	MPN.100ml <sup>-1</sup>	>2 420	10460	Chemical oxygen demand (COD)	mg.L <sup>-0</sup>	38.0	35.0
Escherichia coli	MPN.100ml <sup>-1</sup>	18	400	Electrical conductivity	mS.m <sup>-0</sup>	181.0	134.0
Heterotrophic plate count	CFU.1ml <sup>-1</sup>	40000	58000	Ammonia-nitrogen (NH <sub>3</sub> )	mg.L <sup>-0</sup>	0.5	4.1
Salmonella enterica	Positive/Negative	Negative	Negative	рН		8.2	8.3
Shigella species and/or EIEC	Positive/Negative	Negative	Negative	Comment: Chemistr potential sewerage of <i>V. cholerae</i> negative	contamination		icative of
Toxigenic Vibrio cholerae (ctxAB+)	Positive/Negative	Negative	Negative				

## Linked sites - 3, 34, 35, 36, 37, 38, 39, 64, 100 (Solid waste hot spot)



Figure 11: Site 85 & 86 - Locality





Figure 12: Site 3



Figure 13: Site 3

Comment: Illegal dump site S39 at the source of a natural stormwater stream links a number of other identified sites downstream to S3. Samples along this linkage was composited and analysed as for the other sites.

Figure 14: Site 36

MICROBIOL	OGY TEST RESULT	S	CHEMISTRY TEST RESULTS		
DETERMINANT	DETERMINANT UoM		DETERMINANT UoM		R7, S3 & R39
Total coliforms	MPN.100ml <sup>-1</sup>	21400	Chemical oxygen demand (COD)	mg.L <sup>-1</sup>	<10.0
Escherichia coli	MPN.100ml <sup>-1</sup>	5900	Electrical conductivity	mS.m <sup>-1</sup>	82.0
Heterotrophic plate count	CFU.1ml <sup>-1</sup>	105000	Ammonia-nitrogen (NH₃) mg.L <sup>-1</sup>		0.2
Salmonella enterica	Positive/Negative	Negative	рН		8.2
Shigella species and/or EIEC	Positive/Negative	Negative	Comment: Results acce V. cholerae negative.	ptable	
Toxigenic Vibrio cholerae (ctxAB+)	Positive/Negative	Negative			

## 3.3 GENERAL COMMENTS

The following should be noted regarding monitoring of Sites 17 and 18.

- Site 17 already monitored at receptor down stream of Dam
- Site 18 already monitored at receptor Sample taken before inflow into dam, the dam was also sampled.

## **CHAPTER 4: CONCLUSIONS & RECOMMENDATIONS**

### 4.1 CONCLUSIONS

The following can be concluded from the site investigation and sampling.

**Table 2: Conclusions** 

Site	Conclusion
Site 13	No evidence of microbial contamination or the presence of <i>V. cholerae</i> .
Site 16 and Site	Both microbiology (Salmonella and Shigella – Site 16 and INV) and chemistry results
for Investigation	(NH <sub>3</sub> – INV) are indicative of sewerage contamination. <i>V. cholerae</i> was not detected.
Site 85 & 86	Chemistry results of R86 relating to NH <sub>3</sub> is indicative of potential sewerage contamination. <i>V. cholerae</i> was not detected.
Linked sites	No evidence of microbial contamination or the presence of <i>V. cholerae</i> .

Based on the sampling and analysis conducted, *V. cholerae* was not found at any of the respective monitoring points.

There is however evidence of chronic sewerage contamination caused by leaking sewerage lines or manholes. These could potentially serve as a pathway for cholera. Other pathogens that cause gastro-intestinal disease, including salmonella and shigella were in fact detected.

Nappies are disposed of at several of the illegal dump sites. If contaminated nappies are disposed of at these sites, it could lead to the spread of diseases when conditions are favourable.

### 4.2 RECOMMENDATIONS

A concerted effort should be made to maintain sewerage infrastructure to avoid a potential pathway for the spreading of diseases. A proper waste collection system should also be implemented to avoid illegal dumping of municipal solid waste.

# **APPENDIX 1: LIST OF SAMLING POINTS**

None	Risk Low	Level Medium	High			
1	2	3	4			
Site 1	Source ×	Pathway ×	Receptor ×	Linked	Comment	Investigate
3	×	×	×		All purple sites lipked	
4	×		×		All purple sites linked	
5	×					
7	×					
<u>8</u> 9	×					
10	×					
11a 11	×	×	×			
12	×	×	×			~
13 14	×	×	×			×
15 16	×	×	×			×
17	×				Adjacent to larger receptor	×
Inv 18	×				Adjacent to larger receptor Adjacent to larger receptor	×
19	×					
20 21	×	×	× ×			
22 23	×	×	×			
24	×					
25 26	×	×	×			-
27	×					
28 29	×					
30	×					
31 32	×					
33 34	×	×	×		All purple sites linked	
35	×	×	×		All purple sites linked	
36 37	×	×	×		All purple sites linked All purple sites linked	
38	×	×	×		All purple sites linked	
39 40	×	×	×		All purple sites linked	
41 42	×					
43	×		×			
44 45	×	×	×			
46	×					
47 48	×					
49	×					
50 51	×					
52 53	×					
54	×					
55 56	×					
57	×					
58 59	×					
60 61	×	×	×			
62	×	×	×			
63 64	×	×	×		All purple sites linked	
65	×					
66 67	×				In school yard	
68 69	×					-
70	×					
71 72	×				+	
73 74	×					
75	×					
76 77	×	×	×			
78	×					
79 80	×					
81	×				In school yard	
82 83	×					
84 85	×	×	×		Street vendor	
86	×	×	×			×
87 88	×					-
89	×					
90 91	×				+	1
92	×					
93 94	×					
95 96	×					
97	×				Street vendor	
98 99	×			· · · · · · · · · · · · · · · · · · ·		<del> </del>
100	×	×	×		Sewer overflow	×

## **APPENDIX 2: LABORATORY RESULTS**

Company: Virtual Comuniting Engineers
Addinate: ST George Stores Drive, Groenkloof
Pretoris
DI 81
Tot No.: (012) 482 0444

Project No: VIRTUAL\_CONSU-20220829

Date Sample Received: 2023/05/29 Cartiflants Date: 2023/07/06

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	Lah Numberi Description:					2384785 Weter	
		Street plants	Silbel plantic	900ml plants	Shipping Lo	SOOmi piterile	SOUND plants
ышр	e Cambineri	TelOs	hossie	hente	home	beele	berille
Determines at (make)	Method Straiber						
Ataziotain Nitreyen (rag/L N) Gleocked Oxygen Domest (rag/L O2) Conductivity (mS/m (§ 18°C) pH	. 61.268 EL 16 EL 1 EL4	0.4 40 113 7.9	0.5 26 118 8.4	0.5 38 193 8.2	4.J 35 134 8.5	21.6 60 127 7.9	LO.9 44 86 7.3

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Page 1 of 7

Companys Virtual Consulting Engineers Address: 57 George Starrar Drive, Groenkloot Prototia 0181

Project No: VIRTUAL\_CONSU-20230529

Date Sample Received: 2023/00/29 Cartificate Date: 2023/07/08

Page Annalyses: 222347709 - 2023/07/05  Bampia Frames: 7  Rampia Deta and Theas: 2123/06/29  Lab Mondrer: 2182789  Sample Centralner: 21 phasic betta  Descention Mirrore (ng/L N): 82.69  Chemical Crygen Demand (ng/L N): 82.69  Constantivity (m6/m @ 20°C): 91.1 92  ELA 9.3	x (012) 452 0444			
Rampia Name: 7  Rampia Name: Rampia Name: Rampia Name: Rampia Name: Rampia Debt and Time: 2023/05/29  Lath Nambur: 2385/89  Sample Description: Water  Sample Container: 21. phase betta  Detentioned (ordin) Mathod Number  Amenda Nitropea (mgT. N): E1.263 0.2  Chemical (hygra Demant (mgT. N): E1.28 < 10  Constantivity (m8/m @ 20°C): St. 1 82				EHRMICAL ANALYSIS
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Sample Name: R59  (combined)  Rample Determine: 2023/06/29  Lab Nambur: 2385/89  Sample Description: Water  Sample Container: 21 plants betta  Determined (unlik) Mathod Number  Amenda Nitrespo (mgL N): E1263 0.2  Chemical (hygra Demant (mgL N)): E1.18 <10  Contactivity (m8/m @ 20°C): S1.1 82			D2 83 and	
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Americal Nitrogen (mg/L R): E3.269 0.2 Chemical Chygen Demand (mg/L Q2): E3.18 <10 Conductivity (m8/m @ 25°C): E4.1 82				
Chemical Chygra Domand (mgl. Q2) EL 18 <10 Comfactivity (m8/m @ 20°C): SL 1 82	Detentional (adite)			
Constantivity (m8/m @ 20°C); SL 1 82	Americk Nitregeo (mg/L/R)	E126B	0.2	
	Chemical Chygen Demand (mg/L Q2)			
EL4 8.3	Conductivity (m6/m @ 25°C).			
	Big	ELA	6.3	

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Project Not VIRTUAL\_CONSU-2029/829

Date Semple Resolved: 2023/06/29 Certificate Date: 2023/07/06

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	ite Analysedir.				2023/07/12		
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В	ımple Numer	RIJ	RL6	R85	R\$6	518	DOVI
_	ta and Times] ab Number:;		2023/06/29 2383/19	2013/06/29 2338781	2023/06/29 ·	2023/06/29	2023/06/29 2318787
Statepile	Description:	Websc	Welce	Webs	Water	Want	Water
Ekstpi	= Container:	500ml plurtin Berrik	590mi glaniio lictila	500ati pikutin battis	90km) phath bottle	(O)col plantic holds	500mi plante beille
Determinant (units)	Stethod Number						
K-coti (MPSVL00mE)	EM 9	17000	24200	18	400	1046000	276000
metrogistic Place Count (effett mL)	EM 3	61000	184000	40000	18000	1846000 1880000	2330000
Tetal Colfigent (0473/140mL)	EM 9	498000	5-24200	>2420	10460	>2420000	>2420000

Test sciults marked with \* to this report are not included in the SANAS Scholule of Aconditation for ERWAT Laboratory. All results and retards indemnation will be obtained in conflictation became. The meaning what may be supplied to an estimated measurement of unswelling as 55% confidence level, where of which are swillable on request. This COA shall not be reportanced except in full with the approval alvas ERWAT Laboratory Management.

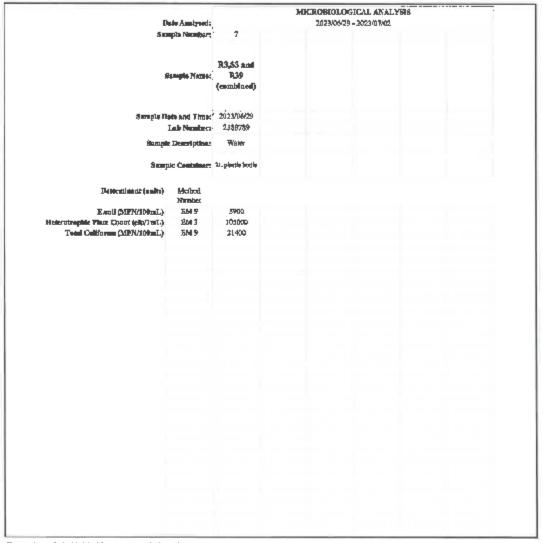
Page 8 kM

Company: Virtual Computing Engineers
Address: 57 George Storrer Drive, Groanidoof
Prations
0181

Tel No: (012) 452 0444

Profesi No: VIRTUAL\_CONSU-20230629

Oate Sample Received: 2023/08/20 Certificate Date: 2023/07/06



Test results marked with \* in this report non metincluded in the SANAS Schneiden of Accomming the ERWAT Laboratory. All results and existed information with the "customers" required and are religion to an estimated measurement of uncertainty at 91% confidence level, values of which are available on respect. This COA shall not be reproduced except in Rid with the approval from ERWAT Laboratory Memogroups.

Company: Virtual Consulting Engineers
Address: 57 George Storrer Drive, Groenidoot
Pretoria
0181
Tel No: (012) 452 0444

Projent No: VIRTUAL\_CONEU-20220528

Date Garagie Received: 2023/08/29 Conflicate Date: 2023/07/08

Date Analyseds   2022/06/29 - 2023/06/29   Sample Nambers   1   2   3   4   5   6	Sample Number: 1 2 3 4 1 6  Rample Number: R13 R16 R85 R36 S36 CVVI  Bample Date and Time: 2022/08/29 2022/08/29 2023/08/						ALYSIS		
Rample Norms. RL3 RL6 R85 R86 S16 ENVI  Bample Date and Time 2023/04/29 2023/06/29 2023/	Rample Name. R13 R16 R85 R86 S18 ENVI  Rample Date and Time 2022/08/29 2023/0								
Bample Date and Time 2023/08/29 20223/08/29 2023/08/29 2023/08/29 2022/08/29 2022/08/29 2022/08/29	Remple Date and Them   2023/08/29   2023/0	Sam	pie Namberij	ı	2	3	4	1	6
Late (vancher: 2368777 2368779 2388783 2388783 2388785	Lain Number: 2389777 2389789 2388783 2389785 2389785 2386785  Sample Description: Water Wa	B	ingle Nama.	RL3	<b>R</b> 16	RBS	R86	815	ESVI
Sample Description: Water Street John Joseph Commission: 100ml plants bottle bo	Sample Description: Water Struct plants Scott plants bends bet bends ben			2023/04/29 2388977					
Determinant (contin)  Determinant (contin)  Method.  Nizzabee  Salamonella zamerien  PCR I Negative Positiva Nagative Negative Negative Negative Negative Positive Negative Negative Negative Positive Negative Ne	Determinant (cmin) Method.  Number  Salmon-lik emeries PCR   Negative Positive Negative Negative Negative Negative Positive Positive Negative Positive Positive Positive Negative Negative Positive Positive Negative Negative Negative Negative Positive Negative Negat								
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		Salmonilla enteries din specine au d'or Emrokrynsive E. celi-	Number PCR I PCR 3	Negative	Negativo	Negative	Negative	Positive	Postuvo

Test number with " in this reporture articelesiant in the SAMAS Schedule of Ascretization for ERVAT Laboratory. All regits and related information will be treated in a samples name. The could make may be semigrated to an extraordance with the "continuous of request and on subject to an estimated measurement of uncontainty of 55% could not be two, where of which are swellable on request. This COA shall not be repoduced except in full with the approval from ERWAT Laboratory Management.

Companys Virtual Condutting Engineers Addresse: 57 George Storner Drive, Grounkloof Prylodig 9181

Project No: VIRTUAL\_CONSU-20220828

Dale Bumple Received: 2023/09/29 Cartificate Date: 2023/07/06

Tel Noc (012) 452 0444 2022/06/29-2023/06/90 Sample Monther; R3,53 and Sample Name: 1939 (cambined) Sample Dute and Times. 2023/06/20 Lab Numbers 2388789 Sample Comittanes 21, plante bette Decembrant (anim) Mathod Number Rate gradin entertos: PCR L Negetive Stage Respective and/or Retrainment to E. call PCB 3 Negative Textiganie Vibrio chalcene PCR 2 Negative

Test results sugged with \* in this report are not included to the BANAS Schedule of Apprehitson for ERWAT Laboratory. All results and retard information will be breated in a confidencial manner. The requisit related we suggest to be supplied by the confidence in a confi

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