



**BIOREMEDIATION AND BIO-AUGMENTATION
MMABATHO WASTEWATER TREATMENT
WORKS (WWTW)**

FINAL REPORT

AUGUST 2019

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FINAL REPORT

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Compiled by BioPower Corporation

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1. INTRODUCTION

After Ngaka Modiri Molema District Municipality initially engaged with BioPower Corporation (Pty) Ltd regarding the Mmabatho Wastewater Treatment Works (WWTW), a detailed proposal on an action plan for the shock treatment and thereafter dosage with their unique, non-toxic product - BioSol SL36 - was submitted. After follow-up engagements, BioSol SL36 was procured and the company tasked to proceed with shock treatment and thereafter daily dosage of Mmabatho WWTW from **31 May 2019**.



Mmabatho WWTW

2. REFERENCES

- BioPower Corporation Progress Report 1 of site visit on 31 May 2019.
- BioPower Corporation Progress Report 2 of site visit on 13 June 2019.
- BioPower Corporation Progress Report 3 of site visit on 25 June 2019.
- BioPower Corporation Progress Report 4 of site visit on 09 July 2019.

BioPower Corporation acted strictly according to the agreed bioremediation programme for Mmabatho WWTW.

3. FINAL REPORT

3.1 Approach

Two (2) people were appointed and trained from the local community to apply and monitor the BioSol SL36. BioPower Corporation funded the above as part of a work-creation and social upliftment endeavour. A total of 4,000 litres were delivered for the bioremediation and bio-augmentation, which were applied as such:



Shock Dosage

Date	At inlet	Spray on BNR and clarifiers	Total Dosage
31 May 2019	200 litres	300 litres	500 litres
01 June 2019	200 litres	300 litres	500 litres
12 June 2019	100 litres		100 litres

Daily Dosage

Date	Morning Dosage	Afternoon Dosage	Total Dosage
02 June 2019	50 litres	50 litres	100 litres
03 June 2019	15 litres	10 litres	25 litres
04 June 2019	15 litres	10 litres	25 litres
05 June 2019 ONGOING	30 litres	20 litres	50 litres
TOTAL UP TO 28 JULY 2019		4 000 LITRES	

BioPower Corporation management conducted regular site inspections to ensure instructions are complied with. Mmabatho WWTW was visited on the following dates during the bioremediation programme:

- 31 May 2019
- 13 June 2019
- 25 June 2019
- 09 July 2019 and
- 30 July 2019



3.2 Effluent Samples



To ensure that optimal Quality Control can be maintained on the programme, BioPower Corporation continuously took effluent samples at the works – submitting them to the Environmental Laboratories at CSIR (SANAS lab T0007) for analysis.

BioPower Corporation funded these tests for quality purposes at no cost to the municipality.

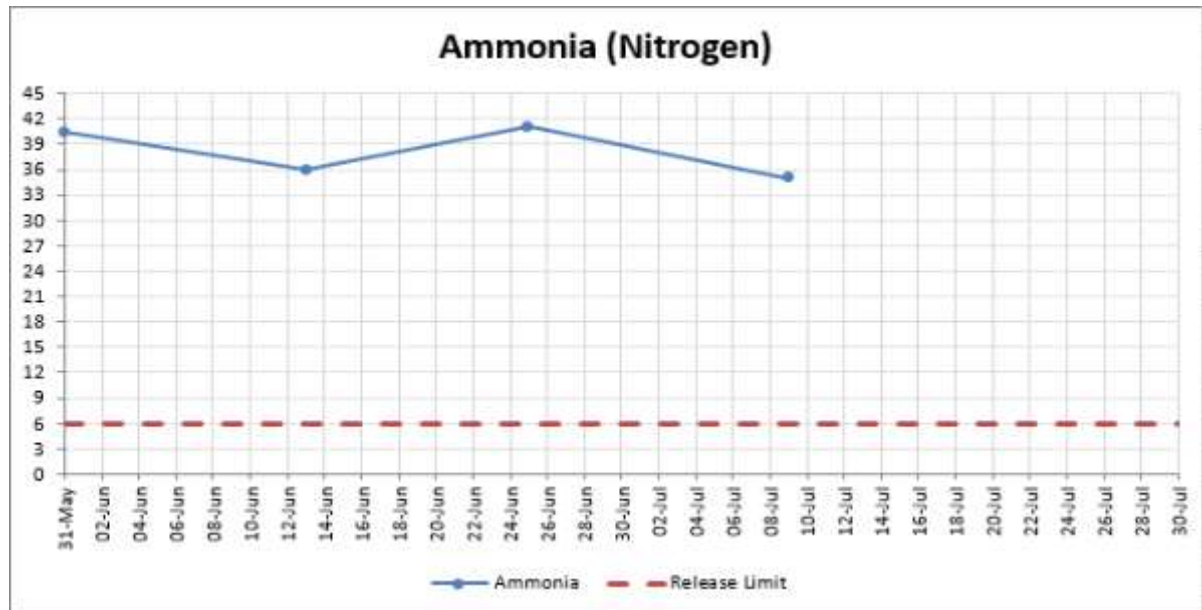
The following parameters were tested:

- Ammonia
- Chemical Oxygen Demand (COD)
- Total Suspended Solids (TSS)
- Electrical Conductivity (EC)
- pH
- Faecal Coliforms
- E.coli

Parameter	May 31, 2019	June 13, 2019	June 25, 2019	July 9, 2019	% Change
Ammonia	40.438	36	41	34.55	14.6%
COD	1 690	257	208	216	87.2%
TSS	113	100	88	70	38.1%
EC	142	131	124	126	11.3%
pH	7.35	7.27	8.01	7.89	N/A
Faecal Coliforms	205,000	270,000	61,500	61,500	70%
E.coli	174,000	205,500	58,600	55,350	68.2%

	Percentage Improvement
	Percentage Deterioration

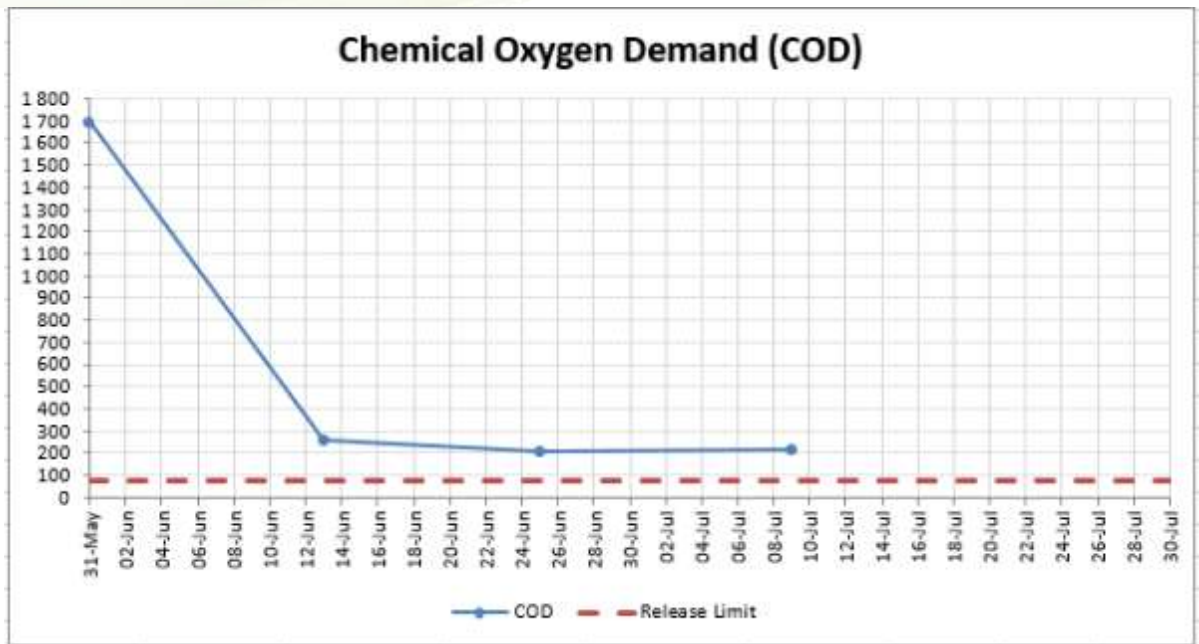




Ammonia (Nitrogen) levels showed a satisfactory drop over the period of the bioremediation programme, showing the effect of BioSol SL36. Vigorous aeration and mixing are needed for nitrification/denitrification processes. Non-operational mechanical equipment and excessive inflow of supposed blood through the inlet from the nearby abattoirs do play a deciding role in the counts to reach the desired standard.

Ammonia removal is a strictly aerobic biological process, and the following is needed:

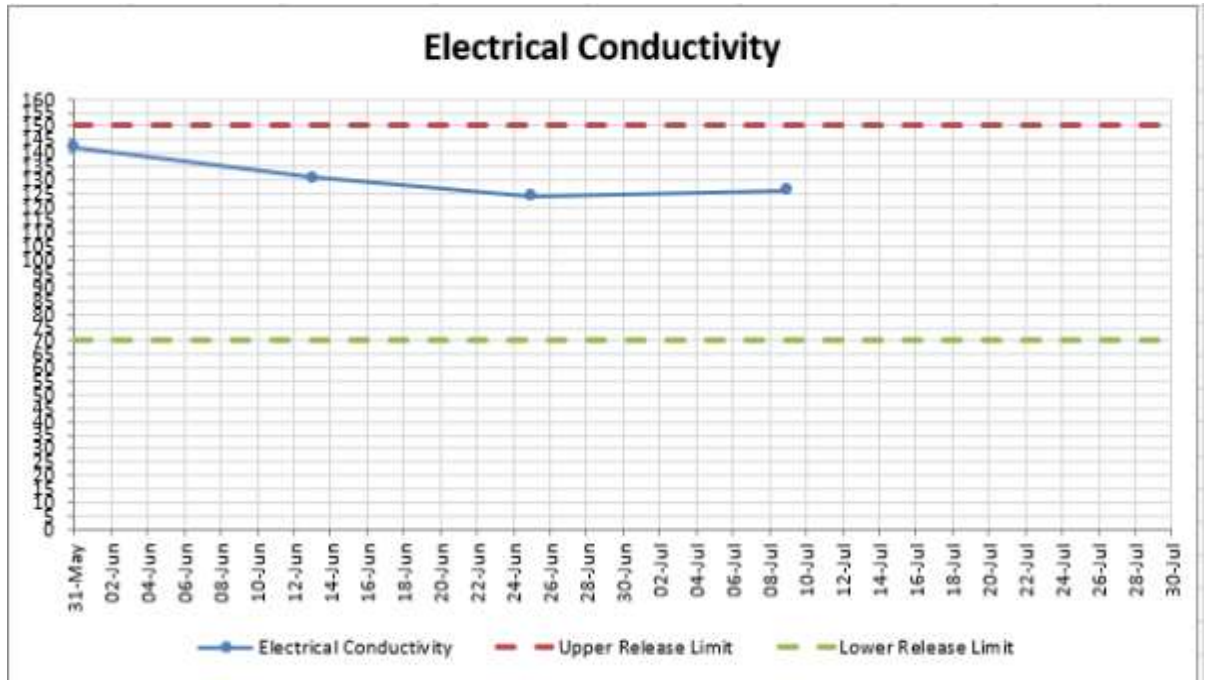
- Generally, nitrification occurs only under aerobic conditions at dissolved oxygen levels of more than 1.0 mg/L
- Nitrification requires a long retention time
- A low food to microorganism ratio (F:M)
- A high mean cell residence time (measured as MCRT or Sludge Age)
- Adequate pH buffering (alkalinity)



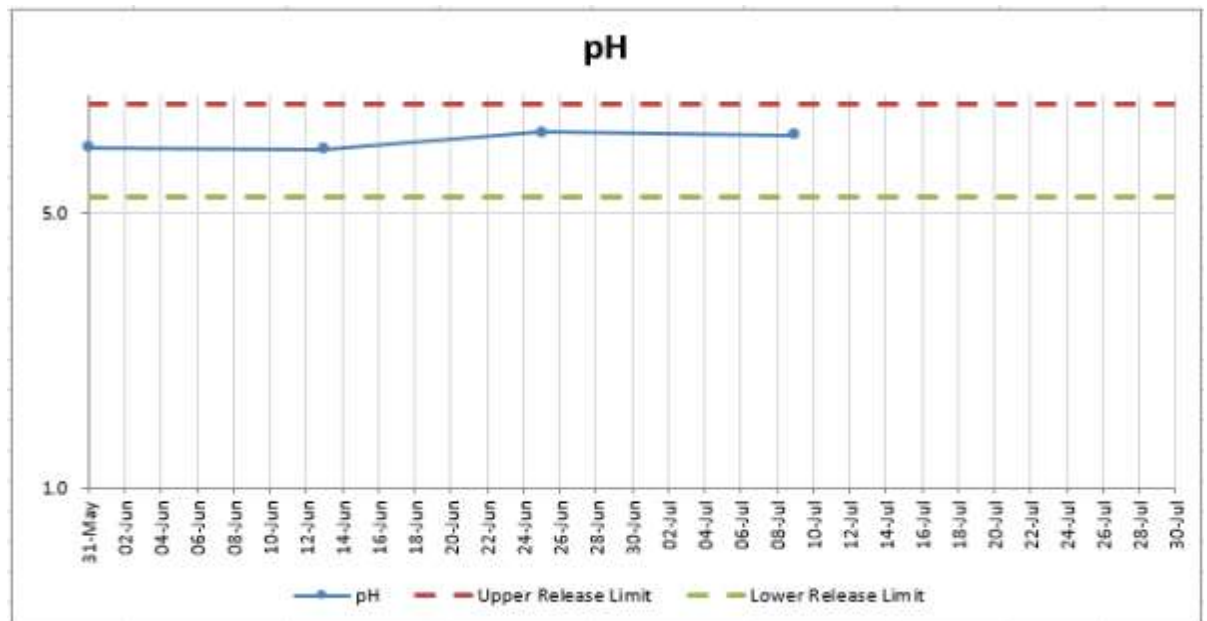
COD levels edging closer to compliance levels through the addition of BioSol SL36. With the continued use of BioSol SL36, COD levels will continue its shift towards the lawful standard.



TSS levels continue to drop and is closing in on compliance levels with the addition of BioSol SL36. Total Suspended Solids (TSS) are solids in water that can be trapped by a filter. TSS can include a wide variety of material, such as silt, decaying WWTW and animal matter, industrial wastes, and sewage. High concentrations of suspended solids can cause many problems for stream health and aquatic life.

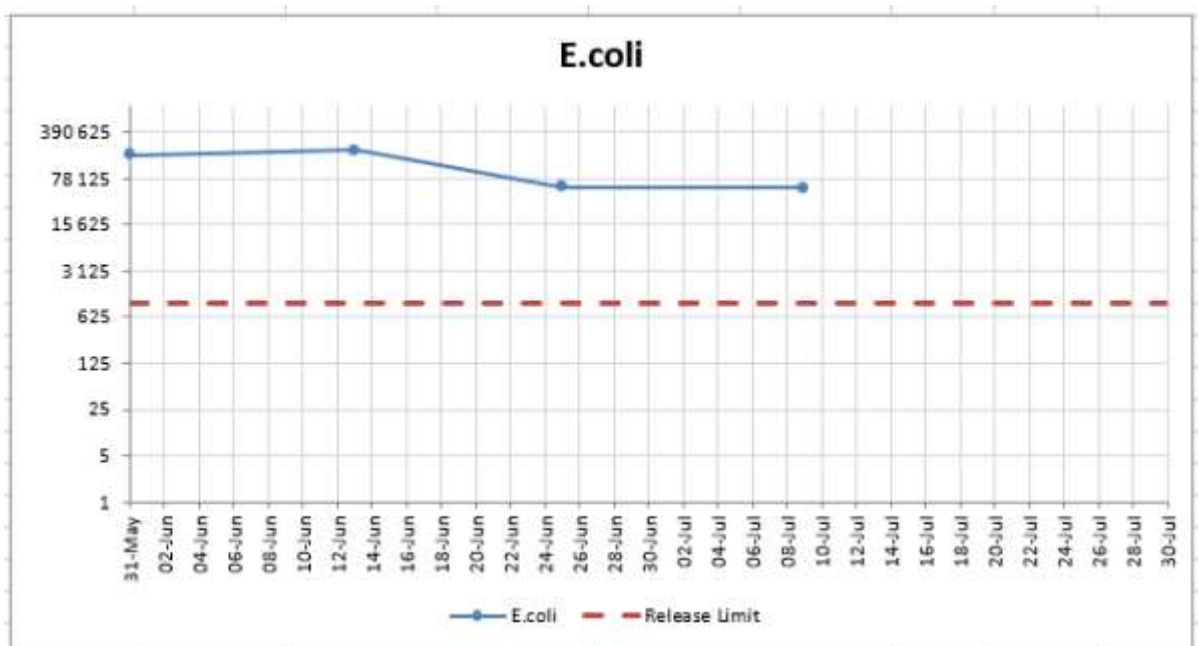
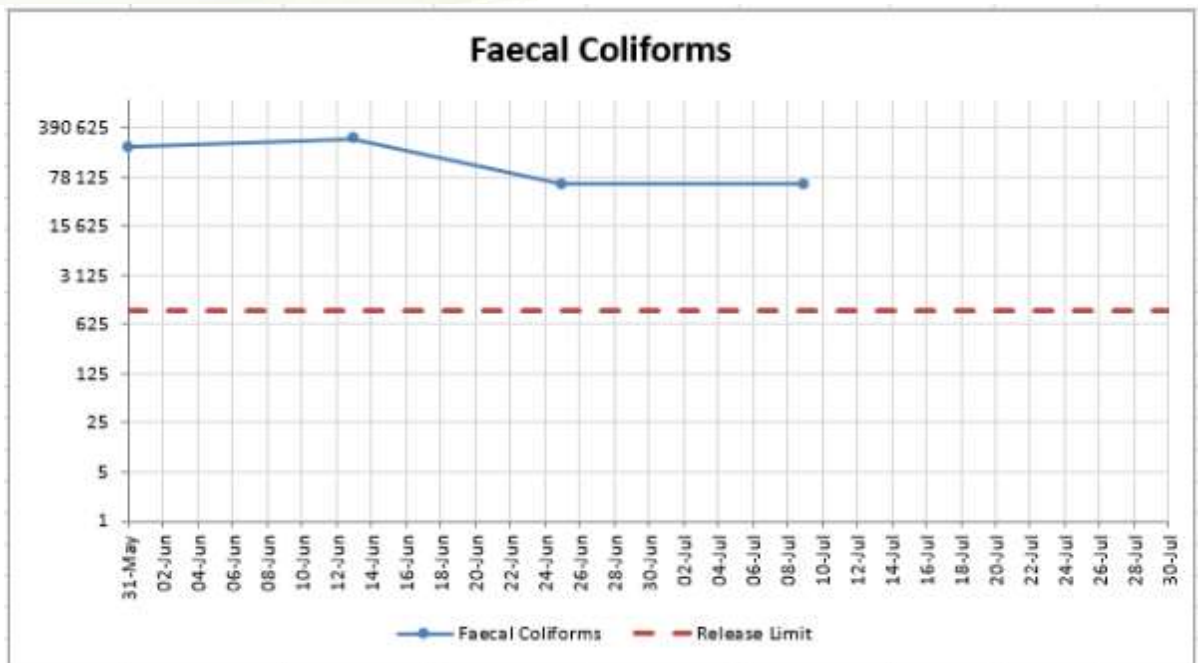


Notwithstanding the untoward salinity entering the WWTW, the EC remains within limits.



The pH remains in the middle between the upper- and lower limits. Inflow of foreign materials and supposed blood can be a contributor to the constant pH level.





The E.coli and Faecal Coliform results nearly mirror each other. The counts on 31 May and 13 June 2019 differs slightly, with latter counts being marginally higher. With the initial shock treatment of BioSol SL36, the F:M ratio of the WWTW changed, resulting in higher E.coli and Faecal Coliform count. With the continuous use of BioSol SL36 breaking up the settled sludge, the F:M ratio started to stabilise and as the suspended solids get processed by the bacteria the E.coli and Faecal Coliform counts have started to drop significantly and moving closer to acceptable releasing levels.



As can be attested to in the above table and graphics, the addition of BioSol SL36 in a bioremediation and bio-augmentation capacity has drastically improved the effluent quality from Mmabatho WWTW. This extends not only to the works but also to the downstream system into which the effluent flows.

The tested parameters all improved between 10% and 90% in the six (6) weeks since BioSol SL36 was first introduced.



A final effluent test was taken on the **29th of July 2019**, but after collaboration with all parties involved it was decided to discard the test as staff of Mmabatho WWTW, within the same period of effluent sample testing, started with a clean-up operation of the sludge blankets within the primary settlement tanks and, instead of removing the sludge *in toto*, Mmabatho WWTW staff dispose the excessive sludge straight into the effluent weir (overflow gutter) of the primary settlement tank, which has a negative influence on water quality as can be noted on the final analyses received.

3.3 Challenges Experienced

- Mechanical Dysfunction



The Mmabatho Wastewater Treatment Works has lost a lot of mechanical ability over the past few years which have rendered the works largely inoperable. This has caused a lot of sludge build-up over the decades, which has caused sub-standard effluent quality as well as malodours in the area around the facility.

Some of the failures include:

- Aerator failure in aerobic zones due to Microbially Induced Corrosion (MIC) and infrequent maintenance;
- Mixer failure in anaerobic zones due to MIC and infrequent maintenance;

- Various pumps and other equipment in-operational.

MIC is corrosion caused or promoted by microorganisms, usually chemoautotrophs. It can apply to both metals and non-metallic materials.



3.4 Abattoir Inflow



Waste from a nearby abattoir is found in the incoming wastewater on a daily basis, this includes blood, fatty residue as well as congealed fats hardened into heavy clumps. From what can be ascertained, the abattoir heats up the waste to make it run easier to the Mmabatho WWTW, after which the fats harden. The organic load from the abattoir causes high nitrite/nitrate and phosphate levels which contribute to the formation of foam.

Loss of mechanical ability and with the influx of wastewater from a nearby abattoir has also hampered the Dissolved Oxygen in the system - which in turn has slowed down aerobic biological processes. For this reason, the bioremediation and bio-augmentation are vitally important.

The product used is BioSol SL36, a biological product designed specifically for application in Wastewater Treatment Works.

This product:

- Is completely non-harmful and non-poisonous to people, animals and the environment in general – and enhances even the water sources where the effluent is released.



3.5 Health and Environmental Benefits

Apart from the obvious health- and environmental benefits, there has also been a drastic improvement in the odour pollution in the area. At arrival on the 31st of May, the odour rating was 3 out of a possible 5 on the aesthetic odour scale. On 1 June 2019 the odour rating had already improved to 2 out of 5 and by 05 June 2019 odour rating reached 0/5. Notwithstanding challenges during the programme the odour scale remain constant and by the end of the programme the odour scale was 0 out of 5.

4. SUMMARY OF ANNEXURES

- *Annexure A: Treatment Register*

5. CONCLUSION

A comprehensive Bioremediation and Bio-Augmentation Programme was conducted at Mmabatho WWTW as a measure to ensure healthy biomass and re-establish the biological ecosystem thereby addressing any possible sludge build-up at Mmabatho WWTW. The objective was also to counteract the initial loss of mechanical ability, incorrect rehabilitation methods, the loss of electricity and possible future mechanical failure. Furthermore, through the bioremediation of Mmabatho WWTW, the municipality show its dedication to the community and environment, and the reduction and maintenance of sludge at the WWTW, along with reduced odour which created a much healthier and safer environment for the community.

All indications show that BioSol SL36 has greatly improved the quality of the effluent released from the WWTW. This improvement will continue as the bioremediation and bio-augmentation continues in future. Progress made is also despite the loss of mechanical ability in the WWTW, and reparations thereof will enhance the effluent even more.

By continuing to optimally execute a Bioremediation and Augmentation Programme at Mmabatho WWTW will ensure that the WWTW is well on its way to operate inside the approved special guidelines of Department: Water & Sanitation while waiting for mechanical reparations and thereafter.

6. GALLERY

BEFORE



Clarifiers not working and excessive sludge formed a crust.

AFTER



With the addition of BioSol SL36 the crust started to disperse.

BEFORE



Water within the BNR covered with foam, possibly due to high inflow of phosphate.

AFTER



Water much clearer with the addition of BioSol SL36 and foam subsided.

BEFORE



BNR before BioSol SL36 added. The water had a dark colour and foam levels high.

AFTER



After adding BioSol SL36 colour of water changed to a lighter brown.