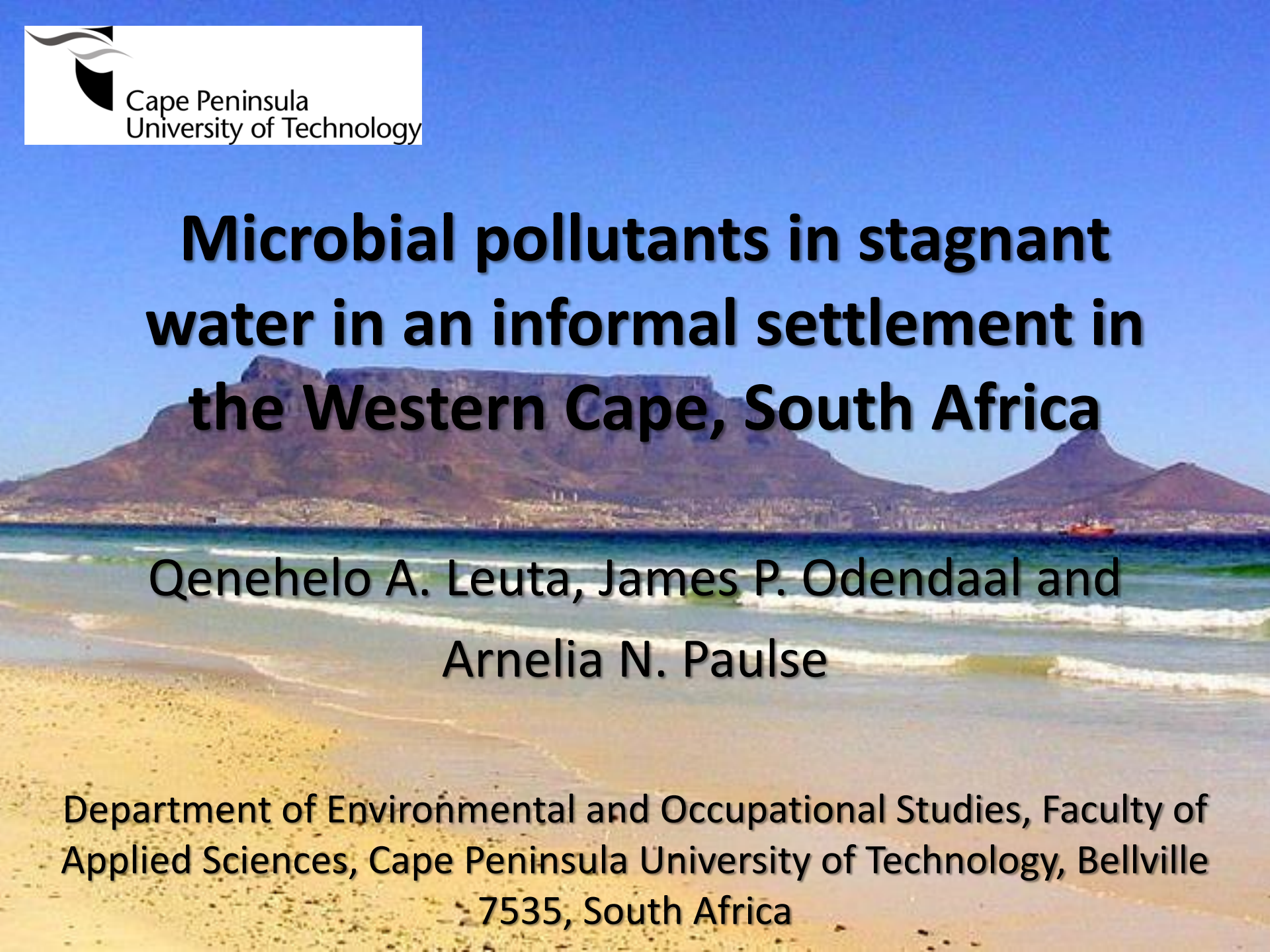

Cape Peninsula University of Technology

Microbial pollutants in stagnant water in an informal settlement in the Western Cape, South Africa

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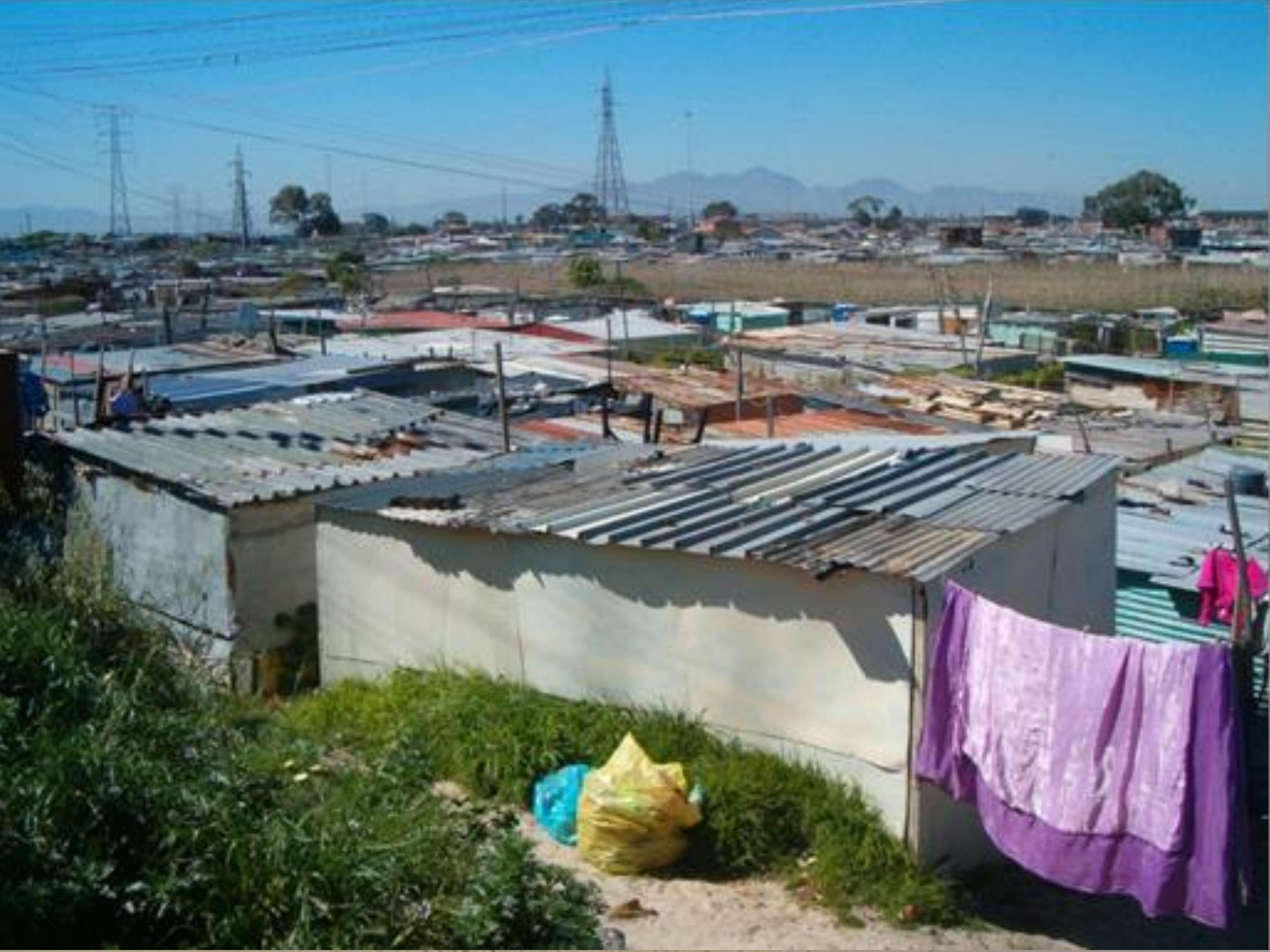
Introduction

- In developing country – South Africa, migration of people from rural to urbanised areas occurs on daily basis;
- Due to urbanisation informal housing schemes or informal settlements are constantly increasing and expanding as in most cases these houses are built with any material possibly found;
- This lead to overcrowding; no or low access to an adequate freshwater supply for daily use, as well as lack of sanitary facilities;
- Unfortunately, these problems are not monitored intensively by municipalities, or even sometimes ignored;
- Ms. Leuta collaborated with Social Justice Coalition who evaluates the moral, social, psychological issues of communities in such areas;



- High population density and fact that municipalities cannot accommodate high numbers → leads to the allocation of one tap for every 25 households within a distance of 200m and one toilet for every five households; Inadequate sanitation and poor drainage thereby puts water systems under major stress;
- Raw sewage from night pots and damaged sanitary facilities due to poor infrastructure and poor maintenance, mix with surface runoff → causes possible pathogens spreading throughout the community;


Stagnant water accumulating at bottom of a communal standpipe

- No drainage away from communal standpipes - result in greywater being stagnant at the base of communal taps;
- Becomes a possible breeding ground for various microorganisms - *Escherichia coli, Vibrio cholerae* and *Pseudomonas aeruginosa*;
- Becomes a health risk as children seen playing at or close to these standpipes;

Objectives

- To identify, select and sample six water points (stagnant water underneath standpipes) twice monthly for a period of five months;
- To determine the level of bacterial contamination in the stagnant pools by means of the Most Probable Number (MPN) techniques;
- To determine the total bacterial counts - HPC and FCM techniques using liquid counting beads and the LIVE/DEAD® Bac*Light*™ Probe;
- To isolate and identify Gram-negative bacteria - API 20E and the RapID™ ONE systems;
- To isolate and identify Gram-positive bacteria - BBL Crystal™ Gram Positive (GP) Identification system.

Materials and methods

Sample Collection: Water samples collected RR section in Khayelitsha on monthly basis from February 2012 to June 2012

↓

Enumeration of facecal coliforms and *E. coli* via MPN

↓

Total microbial counts via HPC and FCM

↓

Isolation and identification of Gram negative microorganisms via API 20E and RapID^{TM} ONE systems

↓

Isolation and identification of Gram positive microorganisms via BBL Crystal™ Gram Pos. (GP) Identification (ID) system

Results and Discussion

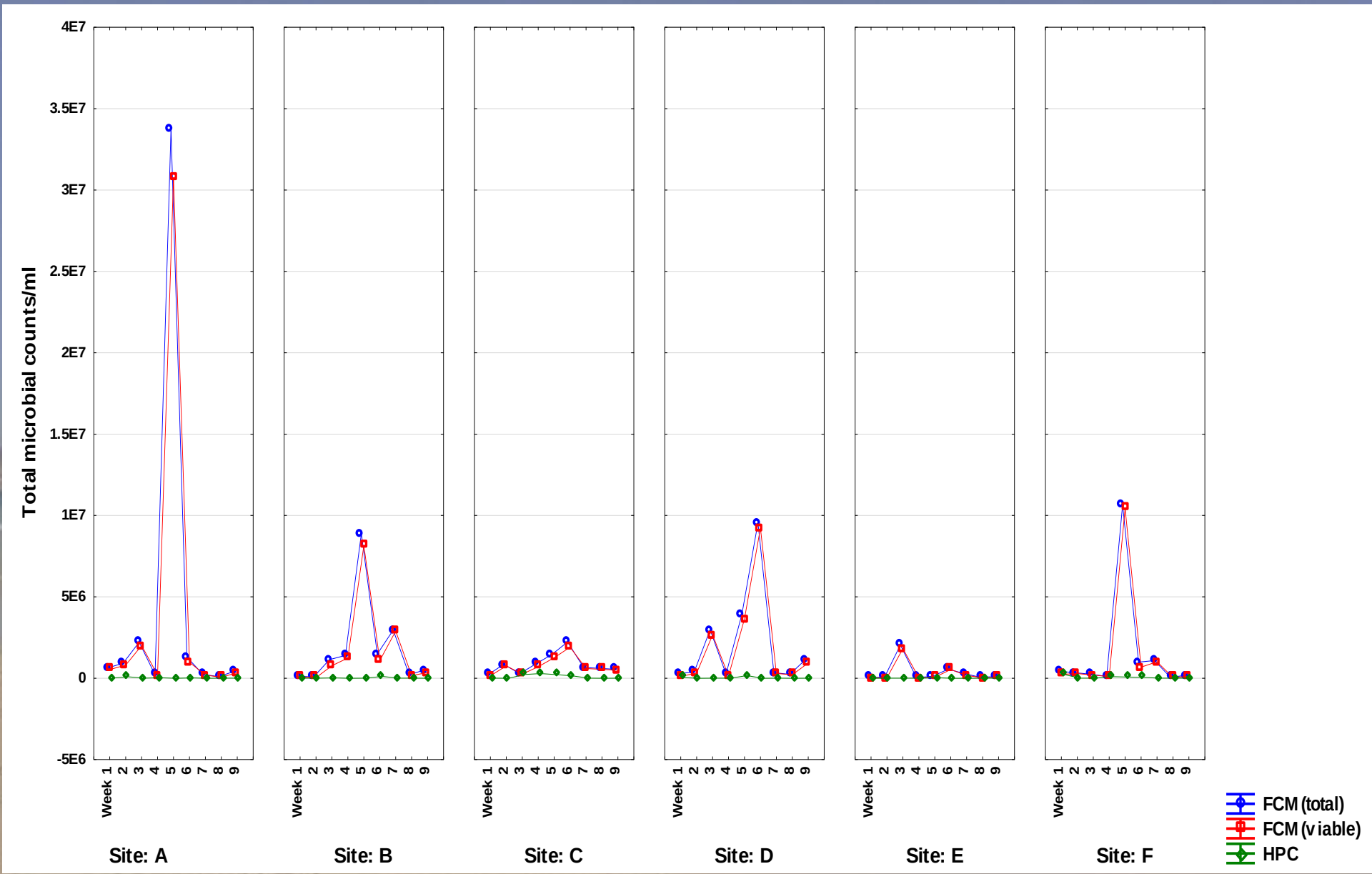
- **Enumeration (Statistical analysis):**

a) **MPN – highest MPN count obtained → 1.6 x 10^8 microorganisms/100mℓ; highest faecal coliform count → 4.7x10^6 microorganisms/100mℓ; highest *E. coli* count 1.8x10^6 microorganisms/100mℓ;**

b) **HPC – highest count obtained → 2.9 x 10^5 microorganisms/mℓ (Site C, week 4);**

c) **FCM – highest obtained → 3.4 x 10^7 microorganisms/mℓ (Site A, week 5);**

- **Most counts were significantly ($p < 0.05$) higher than the allowable limit as set out by DWAF (1996a) and the SABS (2011);**
- **FCM – most effective technique for enumeration purposes – yielded the best results;**
- **Counts alarming for communities in the area.**


Total microbial counts/ml
4E7
3.5E7
3E7
2.5E7
2E7
1.5E7
1E7
5E6
0
-5E6
Week 1 2 3 4 5 6 7 8 9
Site: A
Site: B
Site: C
Site: D
Site: E
Site: F
FCM (total)
FCM (viable)
HPC

Results and Discussion, cont.

- **Isolation and Identification:**

a) Gram-negatives:

The RapID ONE and the API 20E identification systems mostly identified *Escherichia coli*, Salmonella spp., *Klebsiella* spp., *Acinetobacter* spp. and *Enterobacter* spp.;

b) Gram-positives:

BBL Crystal™ Gram Positive (GP) Identification (ID) system mostly identified *Corynebacterium* species and *Bacillus cereus*.

Microbial organisms identified with the API 20E and RapID™ One Systems

API 20E	RapID™ ONE
Acinetobacter baumannii/calcoaceticus	*Acinetobacter calcoaceticus*
Enterobacter aerogenes	*Citrobacter freundii*
Enterobacter asburiae	*Enterobacter aerogenes*
Enterobacter cloacae	*Enterobacter asburiae (EG 17)*
Enterobacter sakazakii	*Enterobacter cloacae*
Escherichia coli 1	*Enterobacter sakazakii*
Klebsiella oxytoca	*Escherichia coli*
Klebsiella pneumonia ssp pneumoniae	*Klebsiella pneumonia*
Leclercia adecarboxylata	*Providencia alcalifaciens*
Pantoea spp *2*	*Salmonella 1 (Most)*
Raoultella terrrigena	*Salmonella gallinarum*
Salmonella ser. paratyphi A	*Salmonella paratyphi A*
Salmonella spp	*Serratia marcescens*
Serratia marcescens	

Microbial organisms identified with the BBL Crystal™ Gram-Positive (GP) Identification (ID) System

Aerococcus urinae	*Gemella morbillorum*
Bacillus cereus	*Kocuria kristinae*
Bacillus licheniformis	*Micrococcus luteus*
Brevibacillus brevis	*Staphylococcus equorum*
Corynebacterium bovis	*Staphylococcus sciuri*
Corynebacterium diphtheria	*Streptococcus intermedius*
Corynebacterium pseudodiphtheriticum	*Streptococcus porcinus*
Corynebacterium species	*Streptococcus anginosus*

Conclusion

- Many studies that assess greywater quality in informal settlements in South Africa concentrate on the chemical analysis;
- Microbial analysis usually focuses on indicator organisms such as total coliforms, faecal coliforms and *E. coli*;
- This study - given a basis for understanding pathogenic microorganisms present in greywater in informal settlements;

Conclusion, cont.

- Presence of pathogenic microorganisms, e.g. *Klebsiella pneumonia*, *Salmonella* spp., *Bacillus cereus* and *Micrococcus luteus* in the greywater at the base of the communal standpipes - health risk to the children playing in close proximity to the greywater, as well as adults using this water for daily use such as hand washing;

- **Alarming as this would probably always be a money issue instead of a health issue**

Acknowledgements

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