Supplementary Material

# Supplementary Tables

Table S1 Parabens and their characteristics

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| --- | --- | --- | --- |
| Analyte  | Molecular structure | Molecular weight | Log KOW |
| Methylparaben |  | 152.15 | 2.09 |
| Ethylparaben |  | 166.17 | 2.48 |
| Propylparaben |  | 180.08 | 2.81 |
| Butylparaben |  | 194.23 | 3.12 |

Table S2: Description of KwaZulu Natal sampling sites

|  |  |  |
| --- | --- | --- |
| **WWTPs sampling site** | **Activities at sampling site** | **Corresponding rivers** |
| Albert falls WWTP | It mostly treats domestic wastewater | UMgeni River downstream (Albert Falls WWTP) |
| Darvil WWTP | The Darvil WWTP mostly handles raw municipal wastewater, but it also accepts industrial wastewater. It releases the treated wastewater into the Msunduzi river.  | UMsunduzi River downstream (Darvil WWTP) |
| Dassenhoek WWTP | The plant handles approximately 95% household sewage and 5% industrial effluent. It contains a sludge lagoon where the effluent is stored following the aeration process. | UMlazi river (Dassenhoek WWTP) |
| Hammersdale WWTP | The WWTP processes domestic and industrial sewage from the Pietermaritzburg-Msunduzi Transitional Local Council territory. | UMlazi River upstream (Hammesdale WWTP) |
| Howick WWTP | Howick WWTPs exclusively process household wastewater. | UMgeni River upstream(Howick WWTP) |
| KwaNdengezi WWTP | Processes domestic and industrial wastewater | UMlazi River upstream (KwaNdengezi WWTP) |
| Verulam WWTP | It treats a significant portion of industrial and domestic wastewater from the surrounding areas | - |
| Umdloti WWTP | This plant serves both nearby residential and industrial factories.  | - |
| Northern WWTP | Processes residential and industrial wastewater from the nearby Durban city. | - |
| Southern WWTP | This plant processes raw sewage from Durban municipality as well as industrial wastewater | - |

Table S3: Description of Gauteng sampling sites

|  |  |  |
| --- | --- | --- |
| **WWTPs sampling site** | **Description/activities at sampling sites** | **Corresponding rivers** |
| Babelegi WWTP | It uses deactivated sludge process to treat wastewater. | Apies River (after Babelegi WWTP) |
| Roiwal WWTP | It employs activated sludge filters and bio-filtration to treat wastewater collected from Central Pretoria,in Gauteng Province.  | Apies River (below Rooiwal East WWTP) |
| Bavaainspoort WWTP | This plant uses activated sludge to treat wastewater and it provides services to nearby townships, Baviaanspoort WCW has a capacity of approximately 35 Ml/day. | Pienaars River (before Baviaanspoort WWTP) upstream |
| Zooegat WWTP | It mostly handles home wastewater, with some industrial wastewater.  | Pienaars River (Zooekgat WWTP) downstream |

Table S4: Concentrations (µg/L) of parabens in wastewater samples from selected KwaZulu Natal Province during 2nd wave of COVID-19

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Sample name | Symbols in Fig 1 | MePB | EtPB | PrPB | BuPB |
| Howick WWTP inlet | A | 71.3±3.3 | 24.8±1.5 | 51.4±2.4 | 3.79±0.12 |
| Howick WWTP outlet  | A | 5.43±0.17 | 5.63±0.15 | 0.49±0.07 | ND |
| Albert Falls WWTP inlet | B | 2.02±0.07 | 0.72±0.05 | 1.59±0.08 | ND |
| Albert Falls WWTP outlet | B | 0.99±0.06 | 0.16±0.04 | 0.48±0.04 | ND |
| Darvil-WWTP inlet  | C | 84.7±1.5 | 16.8±0.9 | 55.1±2.1 | 17.3±0.8 |
| Darvil-WWTP output | C | 3.77±0.15 | 1.41±0.06 | 2.93±0.06 | 4.12±0.11 |
| Dassenhoek-WWTP inlet | D | 10.3±0.6 | 3.03±0.08 | 13.7±2.1 | 9.61±0.21 |
| Dassenhoek WWTP outlet  | D | 5.33±0.18 | 3.64±0.21 | 6.89±0.18 | 5.32±0.13 |
| Kwangendezi -WWTP inlet | E | 9.15±0.24 | 1.44±0.07 | 13.5±0.8 | 4.09±0.06 |
| Kwangendezi-WWTP outlet | E | 3.22±0.12 | ND | 1.27±0.05 | ND |
| Mpumalanga-WWTP inlet | F | 10.3±0.5 | 3.54± | 3.84±0.04 | 2.10±0.07 |
| Mpumalanga WWTP outlet | F | 2.12±0.09 | 0.93±0.07 | ND | ND |
| Hammesdale-WWTP inlet | G | 2.63±0.11 | 9.01±0.22 | 7.71±0.11 | 1.52±0.8 |
| Hammesdale- WWTP outlet | G | 0.62±0.05 | 1.72±0.08 | 3.02±0.05 | 0.19±0.03 |
| Verulam WWTP inlet  | H | 5.38±0.17 | ND | 9.37±0.12 | 1.34±0.04 |
| Verulam WWTP outlet | H | 1.09±0.05 | ND | 0.95±0.05 | ND |
| Umdloti -WWTP inlet | I | 7.85±0.26 | 14.7±1.3 | 11.7±0.8 | 1.78±0.11 |
| Umdloti -WWTP outlet  | I | ND | 2.89±0.23 | 0.63±0.07 | ND |

Table S5: Concentration (µg/L) of parabens n wastewater samples from selected KwaZulu Natal Province during 4th wave of COVID-19

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Sample name | Symbols in Fig. 2 | MePB | EtPB | PrPB | BuPB |
| Howick WWTP inlet | A | 53.8±2.4 | 21.0±1.9 | 9.13±0.44 | 0.97±0.04 |
| Howick WWTP outlet | A | 3.37±0.05 | 2.15±0.08 | 0.66±0.03 | ND |
| Darvil WWTP inlet | B | 15.3±0.8 | 14.6±0.9 | 23.7± | 3.44±0.07 |
| Darvil WWTP outlet | B | 1.96±0.07 | ND | 2.23±0.04 | ND |
| Mpumalanga WWTP inlet | C | 2.66±0.06 | 0.45±0.05 | 0.54±0.03 | ND |
| Mpumalanga WWTP outlet | C | 0.26±0.04 | ND | ND | ND |
| Hammersdale WWTP inlet | D | 56.7±3.3 | 15.6±0.09 | 28.9±2.3 | 6.68±0.11 |
| Hammersdale WWTP outlet | D | 2.45±0.06 | 3.59±0.04 | 1.22±0.04 | ND |
| Northern WWTP inlet | E | 39.8±2.6 | 12.6±0.06 | 22.4±1.3 | 5.33±0.15 |
| Northern WWTP outlet | E | 0.83±0.05 | 0.23±0.03 | 0.54±0.04 | ND |
| Southern WWTP domestic inlet | F | 26.5±1.3 | 8.95±0.07 | 33.9±1.1 | 1.23±0.04 |
| Southern WWTP industrial inlet | G | 56.1±2.3 | 12.3±0.6 | 61.8±2.3 | 3.56±0.05 |
| Southern WWTP outlet | F | 2.01±0.06 | 0.35±0.04 | 1.44±0.05 | ND |

Table S6: Levels of parabens in wastewater in Gauteng Province during the 3rd COVID-19 wave.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Sampling name | Symbols in Fig 4 | MePB | EtPB | PrPB | BuPB |
| Babelegi WWTP inlet | A | 5.66±0.07 | ND | 11.9±0.7 | ND |
| Babelegi WWTP outlet | A | 0.87±0.06 | ND | 2.16±0.07 | ND |
| Baviaanspoort WWTP inlet | B | 2.58±0.09 | 1.89±0.08 | 3.77±0.11 | ND |
| Baviaanspoort WWTP outlet | B | 0.24±0.03 | ND | 0.69±0.05 | ND |
| Refilwe WWTP outlet | A | 8.56±0.22 | ND | 9.19±0.16 | 6.79±0.05 |
| Rooiwal East WWTP (Composite samples) | C | 73.6±2.8 | 11.5±0.6 | 38.7±1.1 | 42.0±1.3 |
| Rooiwal East WWTP inlet | D | 123±5 | 18.3±0.9 | 67.9±1.4 | 85.8±2.5 |
| Rooiwal East WWTP (before chlorination) | D | 14.7±0.8 | ND | 8.79±0.21 | 3.82±0.11 |
| Rooiwal East WWTP outlet | E | 17.7±0.6 | ND | 11.8±0.4 | 4.72±0.17 |
| Themba WWTP inlet | E | 8.25±0.14 | ND | 12.3±0.3 | ND |
| Themba clarifier 2 WWTP inlet | F | 12.3±0.5 | ND | 17.5±0.6 | ND |
| Themba WWTP outlet | F | 2.79±0.03 | ND | 3.11±0.05 | ND |
| Zeekoegat WWTP inlet | G | 65.8±1.6 | 33.6±1.2 | 73.4±2.5 | 31.7±1.3 |
| Zeekoegat WWTP outlet | G | 15.5±0.8 | 4.88±0.07 | 12.5±0.5 | 4.67±0.12 |