6. WASTEWATER

6.1 Overview

Umgeni Water owns and operates the Darvill and Ixopo Wastewater Works (WWW), but manages a number of other WWW on behalf of Municipalities. Management contracts are in place for the operation and maintenance of the Howick, Cool Air, Mpofana, Appelsbosch, Camperdown, and Richmond WWW for the uMgungundlovu District Municipality and Lynnfield Park WWW for the Msunduzi Municipality. Additionally, the Albert Falls North and South WWWs form part of the management of Albert Falls Dam. All the operations use aeration basins for biological nutrient removal and clarifiers for the separation process.

6.2 Umgeni Water Owned Wastewater Works

6.2.1 Darvill Wastewater Works

The Darvill WWW (with current upgrades shown in Figure 6.1) serves the Msunduzi Municipality. This WWW has a current biological treatment capacity of 65 Mℓ/day. The average daily inflow (November 2014 to October 2015) was approximately 80 Mℓ/day (Figure 6.2) which is more than the plant’s capacity. The graph also indicates the spike in flow in the summer seasons when there is ingress of storm water into the sewer system.

The WWW plant comprises the following unit processes:

- Storm water overflow and storage facility
- Excess storm water chlorination facility and storm water return pump installation
- Inlet works complete with mechanical screening, grit removal and flow measurement
- Primary sedimentation tanks
- Bio-filters (now offline)
- Activated sludge process (anaerobic, anoxic, and aeration zones)
- Aluminum sulfate addition to assist phosphate removal
- Secondary clarifiers for separation and return of activated sludge
- Chlorination of final effluent
- Pre-thickener for primary sludge

The existing inlet works consists of two inlet channels each equipped with hand racked coarse screens, four mechanical screens (installed in pairs), four vortex flow grit separators complete with submersible centrifugal grit pumps, grit classifier and belt conveyor with screenings compactor and flow measurement.

Primary treatment consists of three primary settling tanks (PST), two 30 m in diameter and a 40 m diameter tank. Primary sewage is fed from the PSTs to a balancing tank (10 Mℓ).

Primary settled sewage is transferred and lifted from the balancing tank by the main pump station to an elevated level at the activated sludge tanks inlet from where the sewage receives secondary treatment. The pump station consists of two receiving sumps with two large horizontal split casing centrifugal pumps servicing each sump. A central manifold connects the two pump sets to allow for interchangeable operation. The two pumps per sump operate in a full duty/standby configuration.
The activated sludge plant at Darvill consists of a number of pre anoxic / anoxic / anaerobic zones followed by the aeration basin. The aeration basin is equipped with 15 x 75 kW vertical shaft surface aerators and 9 no. low speed mixers in the anoxic / anaerobic / aerobic zones. The biological reactor has a retention time of 9.2 hours for a flow of 60 Mℓ/day which is adequate for a conventional activated sludge process; therefore hydraulically the biological reactor is adequately sized. At a COD and TKN concentration of 650 mg/ℓ and 56 mg/ℓ respectively, the aeration system has the capacity to effectively treat approximately 40 Mℓ/day.

Secondary treatment consists of five clarifiers with a RAS pump station fitted with centrifugal pumps operating on variable speed drives. The effluent from the clarifiers is disinfected using a high concentration chlorine solution which is discharged into the effluent upstream of the chlorine contact tank.

The chlorine disinfection unit process is followed by a series of maturation rivers / lagoons. In total there are three rivers / lagoons with a combined volume of 20 428 m³ giving a total retention time of 8.2 hours for the design flow of 60 Mℓ/day.

The sludge treatment system currently has two sources of sludge produced and subsequently processed. Primary sludge withdrawn from the underflow of the primary sedimentation tanks is forwarded to a gravity sludge thickening stage before passing through a pre-fermentation process and then onto anaerobic digestion. The pre-fermentation process produces a supernatant high in volatile fatty acids (VFA’s) which is returned to the liquid treatment phase and aids in denitrification ahead of the aeration basis.

The second sludge phase is the wasting of activated sludge. At Darvill WWW mixed liquor is wasted directly from the activated sludge reactor upstream of the final clarifiers. The waste mixed liquor is screened and thickened with a dissolved air flotation plant before being blended with the digested sludge and disposed of on the sludge lands adjacent to the WWW site.

![Figure 6.1 Darvill WWW Upgrade.](image)
Umgeni Water is currently in the process of upgrading Darvill WWW to cope with the increased inflows and predicted wastewater demands (Figure 6.3). The average dry weather flows (ADWF) within the Darvill WWW catchment are expected to grow to about 90 Mℓ/day by 2020 (Figure 6.3).

The plant is currently being upgraded by 35 Mℓ/day. The upgrade design makes allowance for expansion in the future to a maximum capacity of 120 Mℓ/day, which is forecast to occur in 2027. Some of the proposed infrastructure upgrades are illustrated in Figure 6.4.
Figure 6.4 Upgrade of Darvill WWW.
6.2.2 Ixopo Wastewater Works

Ixopo WWW (Figure 6.5 and Figure 6.6) serves the town of Ixopo in the Harry Gwala District Municipality. The WWW has a design capacity of 1.0 Mℓ/day and is designed to be doubled. Sludge is dried on beds and disposed of on a local farm that was previously owned by Umgeni Water, but was sold to the Harry Gwala District Municipality. The average daily inflow to the Ixopo WWW is shown in Figure 6.7.

Figure 6.5  Ixopo WWW.
Figure 6.6 Location of the Ixopo WWW.
Flows to the WWW have for a number of years been reduced as a result of blockages in the Ixopo sewer network. These blockages resulted in manholes within the sewer pipe network overflowing into the natural environment during 2013 and 2014, thereby reducing the inflows to the WWW as illustrated in Figure 6.7. In response, the Harry Gwala Municipality put in place measures to clear the sewer blockages and increase the return flows to the works. Umgeni Water assisted with this initiative by constructing a new sewer bulk pipeline. These collaborative efforts resulted in improved sewerage inflow to the WWW as evidenced in Figure 6.7 from October 2014 onwards.

Based on the improved inflows and demand projections the construction of an additional clarifier (3.25 Mℓ/day) was approved by Umgeni Water and is due for completion in April 2016. The increase in capacity at the WWW will also cater for planned new developments in Ixopo.

6.2.3 Albert Falls North and South Wastewater Works

The two Albert Falls WWWs (Figure 6.8) are transportable activated sludge units installed for the construction of the dam in the early 1970s. They were probably designed for approximately 100 m$^3$/day (0.1 Mℓ/ day). The bulk of the current feed to these WWWs is from conservancy tank contents delivered by tanker from the Albert Falls and Bon Accord resorts. Umgeni Water refurbished the WWW to a Sequencing Batch Reactor (SBR) configuration with a treatment capacity of 40 m$^3$/day to suit present demands.
Umgeni Water Operated Wastewater Works

In 2014 Umgeni Water entered into a management contract to manage all the wastewater works within the Umgungundlovu District Municipality (UMDM). Umgeni Water has, for a number of years, operated the Howick WWW, which also treats wastewater from the decommissioned Mpophomeni WWW, but now will operate the remaining five WWW’s within the Municipality (A list of the additional works and associated capacities are provided in Section 6.3.3).

The majority of the additional WWW are small and there is a lack of information currently available to report on them individually. Detail of these plants and their operation will be included in the 2017 Infrastructure Master Plan Document.

Howick and Mpophomeni Wastewater Works

Umgungundlovu District Municipality provides wastewater treatment services for the uMngeni Local Municipality at the Howick WWW. A large pump station at the Mpophomeni WWW site and a set of six smaller pump stations in Howick transfer wastewater for treatment at Howick WWW.

Howick WWW (Figure 6.9) has a design capacity of 6.8 Mℓ/day and is currently treating 5.3 Mℓ/day (Figure 6.10) based on a 12-month moving average. Mechanical dewatering equipment installed in 2013 has alleviated operational problems to a degree although the works still has capacity problems during peak periods. If additional treatment capacity is required, the WWW will have to be upgraded.
Mpopoheni WWW has been decommissioned, and is only used as a transfer station to Howick WWW. Plans are in place for the WWW to be re-commissioned as a treatment facility by Umgeni Water. Construction is envisaged to start towards the end of 2016. The upgrade of the WWW has been designed to treat 6 Mℓ/day with the possibility of increasing the WWW capacity to 12 Mℓ/day. The site has adequate land available for a WWW of at least 20 Mℓ/day.
6.3.2 Lynnfield Park Wastewater Works

The Lynnfield Park Wastewater Works (WWW) is a small (0.2 Mℓ/day) works that services part of the Ashburton area. Umgeni Water took over the operation of the works on behalf of the Msunduzi Local Municipality in April 2014. Inflow to the works is estimated at approximately 0.15 Mℓ/day. The WWW is currently being upgraded to 0.5 Mℓ/day with the addition of a new Sequential Batch Reactor (SBR). The extended aeration activated sludge reactors (Figure 6.11) will be decommissioned.

Figure 6.11 Lynnfield Park WWW Aeration Tanks.

The addition of a duplicate SBR (0.5 Mℓ/day) is planned and this would increase the capacity of the plant to 1 Mℓ/day. The upgrade to the works is being funded by a private developer and thus the increase in capacity is being timed to coincide with planned property developments in the area. Further upgrades to 2 and 4 Mℓ/day are planned based on expected future requirements.

6.3.3 Additional Wastewater Works

Five additional wastewater works have been added to Umgeni Water’s management contract with the Umgungundlovu District Municipality and these are listed in Table 6.1.
<table>
<thead>
<tr>
<th>Name</th>
<th>Class</th>
<th>Design Capacity (Mℓ/day)</th>
<th>Type</th>
<th>Process Adjustments Required</th>
<th>Capacity Upgrade Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Richmond</td>
<td>E</td>
<td>1</td>
<td>Aeration, Clarification</td>
<td>Under Aeration, DO monitoring &amp; control</td>
<td>Yes to 2 Mℓ/day. Add two additional aerobic basins. Upgrade storage dam</td>
</tr>
<tr>
<td>Camperdown</td>
<td>E</td>
<td>1</td>
<td>Aeration, Clarification</td>
<td>Over aeration, DO monitoring &amp; control</td>
<td>Yes to 2 Mℓ/day to facilitate growth in the area.</td>
</tr>
<tr>
<td>Mpofana</td>
<td>D</td>
<td>3.5</td>
<td>Aeration, Clarification, Ponds System</td>
<td>Clarifies carry-over, solids control required.</td>
<td>Yes to 7 Mℓ/day</td>
</tr>
<tr>
<td>Appelsbosch</td>
<td>E</td>
<td>0.5</td>
<td>Aeration, Clarification, Anaerobic ponds</td>
<td>DO monitoring &amp; control, solids control required, sludge treatment facility required.</td>
<td>No</td>
</tr>
<tr>
<td>Cool Air</td>
<td>C</td>
<td>1.5</td>
<td>Aeration, Clarification</td>
<td>Solids control required, no wasting taking place</td>
<td>No</td>
</tr>
</tbody>
</table>

Umgeni Water has conducted process audits at each of these plants and recommendations have been made to improve their operation and performance. In some instances rehabilitation and or upgrades to the existing plant infrastructure will be required.

Both the Mpofana and Richmond WWW will be increased in capacity to cope with demand. Design consultants are in the process of being appointed by Umgeni Water to undertake this task. The planned Camperdown WWW capacity upgrade has been put on hold until such time as the new sewer reticulation network has been completed by the Municipality.

A new 2 Mℓ/day WWW will be constructed at Trust feeds to cater for a planned housing development.

The Mphophomeni WWW will be recommissioned and upgraded to 6Mℓ/day.