BLUE NORTH

THINKING. FUTURE

Packhouse Action Group Water and Energy Project

2021 Water Benchmark Results

February 2023

Table of Contents

Table of Figures

List of Tables

1 Introduction

In 2017, Blue North Sustainability was contracted by the Packhouse Action Group (PAG) to conduct a study on the water risks faced by pome fruit packhouse and cold storage operations and provide water consumption benchmarks for these facilities. Since 2017, Blue North has concluded three more rounds of benchmarking (Phase 2, 3 & 4).

This report concludes the fifth phase of this project and includes data from **January to December 2021**. The objectives of the fifth phase were to:

- replicate the water use benchmark study undertaken in Phase 1, Phase 2, Phase 3 and Phase 4;
- increase packhouse participation;
- provide a year-on-year comparison of water use in the packhouse and cold storage operations;
- collect more detailed data around drenching;
- collect data for hybrid pack lines;
- collect more data on water recycling practices.

This report presents the results from Phase 5 (2021 data) and draws a comparison between the results of Phase 1 (2017 data), Phase 2 (2018 data), Phase 3 (2019 data) and Phase 4 (2020 data) in terms of water benchmarks. Lastly, the report summarises the different water management and recycling methodologies applied at the packhouses. Electricity benchmark results were compiled in a separate report.

2 Methodology

Outreach was made to previous participants and potential new participants via phone call or email. Packhouses new to the project were offered the details of the project and a virtual onboarding session if they showed interest in participating. Packhouses that participated in the previous phases of the project were offered a training session in the latest version of the data collection tool if they deemed it necessary.

2.1 Development of the Data Collection Tool

Data was collected via the data collection tool and sense checked by the project team. Data anomalies were discussed with participants and, where applicable, rectified or reasons for the anomalies recorded.

Phase 5 followed a similar approach to the previous phases, but included the following updates and changes to the data collection tool:

- additional data capture fields for the number of bins drenched;
- additional data capture fields for hybrid pack line water use and;
- additional data capture field for wastewater treatment method.

2.2 Scope of the Data Collection

The following five areas in pome fruit packhouses were benchmarked in terms of water consumption:

- **Drenching** – This includes water consumption for the drenching of fruit or bins.
- **Dedicated pre-sort** – This includes all dedicated pre-sort line water consumption.
- **Packing lines** – This includes all packing line water consumption, of which flume water use makes up the majority.
- **Hybrid line** – This includes the water consumption of all packing lines where pre-sort and packing occur simultaneously.
- **Cold storage** – This includes the water consumption of Regular Atmosphere (RA) and Controlled Atmosphere (CA) facilities. Cooling tower water consumption made up the majority of cold storage water consumption.
- **Ablutions, canteen & offices** – This benchmark includes staff water consumption.

2.3 Participation

Twenty-three packhouses were invited to participate, of which nine packhouses provided data.

- Four of the packhouses have participated since the start of the project, three since phase 3 and two since phase 4.
- Unfortunately, none of the prospective packhouses (new to the project) contacted could participate in this round of the project.
- The primary reasons for packhouses not participating are:
    - Limited capacity for data collection.

    - Data quality concerns due to lack of metering or allocation issues.
- Two more packhouses did not provide data for Phase 5, but showed interest in participating in future data collection rounds.

2.4 Notes on the Data

- All datasets for Phase 5 correspond to the 2021 calendar year (January to December).
- Packhouses are anonymised in the report (named A to M). Packhouse K could only provide data on the total water consumption.
- Caveats apply to some data points and where applicable, they are acknowledged in this report under "Notes".
- Regarding the figures displayed in sections 3.1 to 3.5, blue bars always indicate accurate/metered data, whereas yellow bars indicate calculated or estimated data.

3 Water Benchmarks

3.1 Drenching Benchmarks

3.1.1 Calculation: Drenching per tonne

The benchmark for drenching per tonne is calculated as follows:

Drenching water consumption (m^3) x 1000 / Tonnes of pome fruit drenched

The benchmark's unit of measure is Litres per Tonne of pome fruit drenched.

3.1.2 Calculation: Drenching per bin

The benchmark for drenching per bin is calculated as follows:

Drenching water consumption (m^3) x 1000 / Number of pome fruit bins drenched

The benchmark's unit of measure is Litres per bin of pome fruit drenched.

3.1.3 Results

Only the results of packhouses that provided drenching data are shown in the figures below.

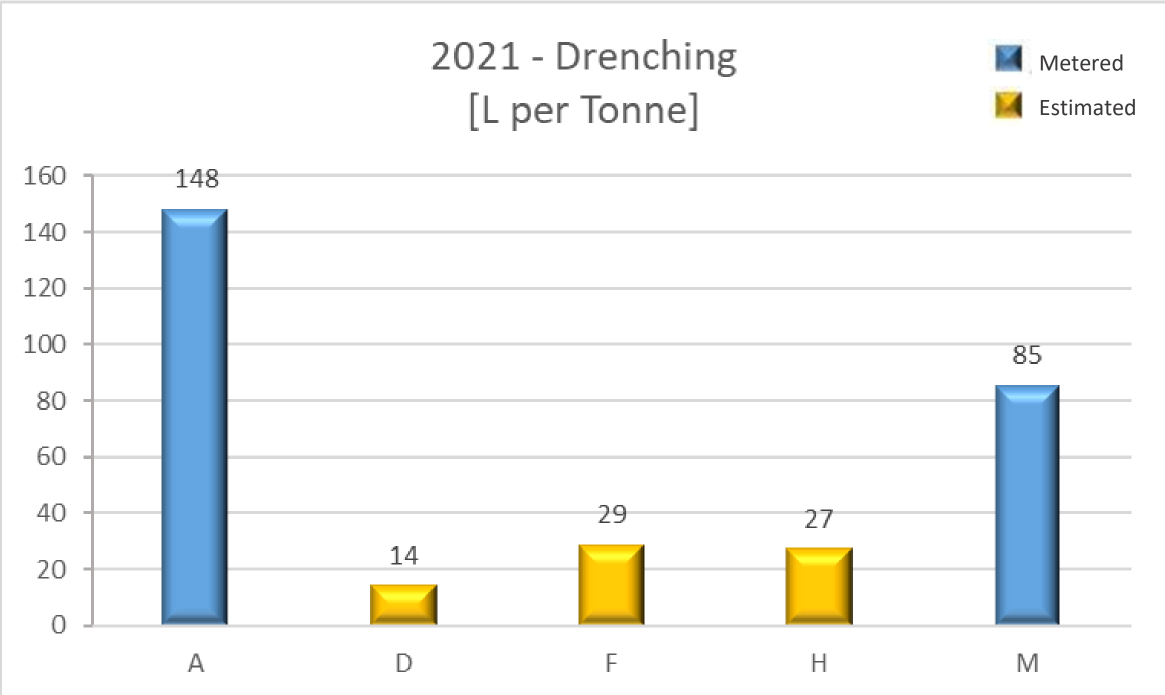

Figure 1: Drenching per tonne of fruit benchmarks

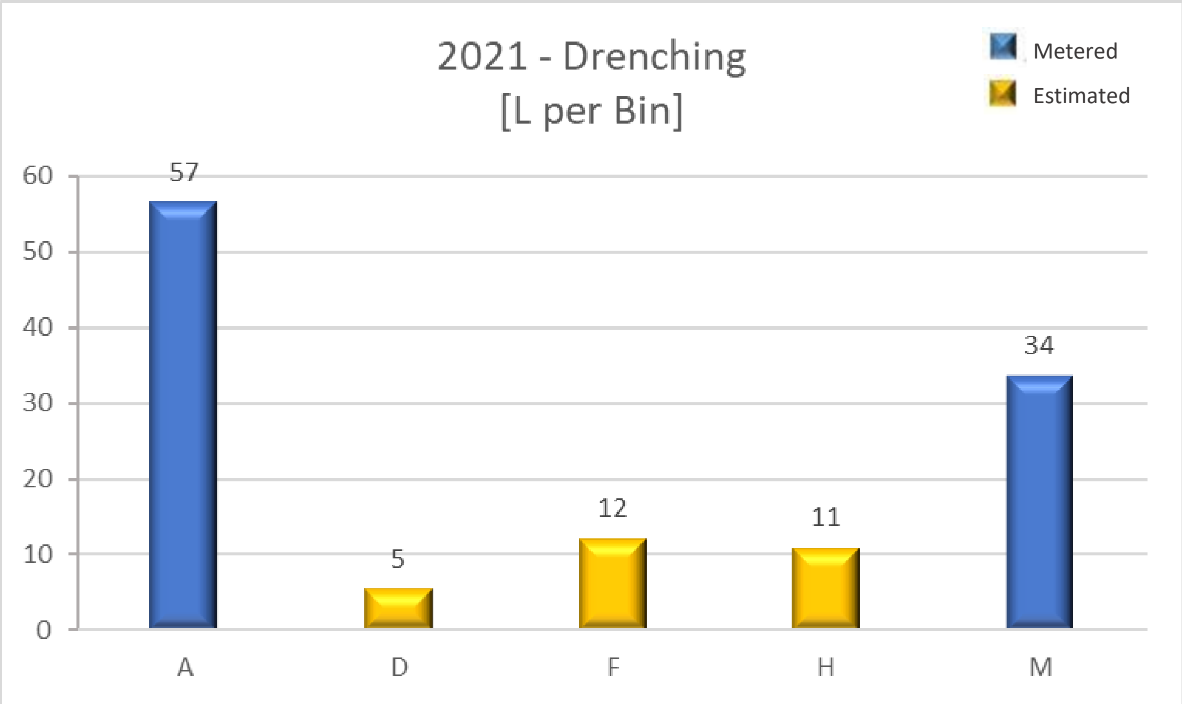

Figure 2: Drenching per bin benchmarks

Figure 1 and Figure 2 notes:
Water consumption of Packhouses D, F and H were estimated due to insufficient metering.

Packhouse B & K – The two packhouses drenches pome fruit, but the water used for drenching is not recorded and could not be estimated.

Packhouse D – This benchmark is very low. Both the tonnes of fruit drenched and the water consumption for drenching was estimated for this packhouse. It is possible that these figures may have been underestimated, hence the resulting low benchmark.

Packhouse F – This packhouse only drenches a very small amount of its fruit.

Packhouse H – This packhouse only drenches a very small amount of fruit and it drenches three bins at a time.

When comparing only good quality (metered) data (blue bars in the figures), Packhouse A nearly used twice the amount of drenching water per tonne of fruit than that of Packhouse M.

The variation in the drenching benchmarks could be attributed not only to lack of metering or accurate record keeping, but also to different drenching protocols applied by the packhouses (e.g., tonnes of fruit drenched, number of times fruit gets drenched etc.). It is recommended that more information on the drenching protocols used by each packhouse be collected in order to better understand the reason for variation in the benchmarks.

3.2 Dedicated Pre-sorter Benchmark

3.2.1 Calculation

The benchmark for a dedicated pre-sort line is calculated as follows:

Pre-sort water consumption (m^3) x 1000 / Tonnes of pome fruit for dedicated pre-sort line

The benchmark's unit of measure is Litres per Tonne of pome fruit for a dedicated pre-sort line.

3.2.2 Results

Only the results of packhouses with a dedicated pre-sort line are shown in the figures below.

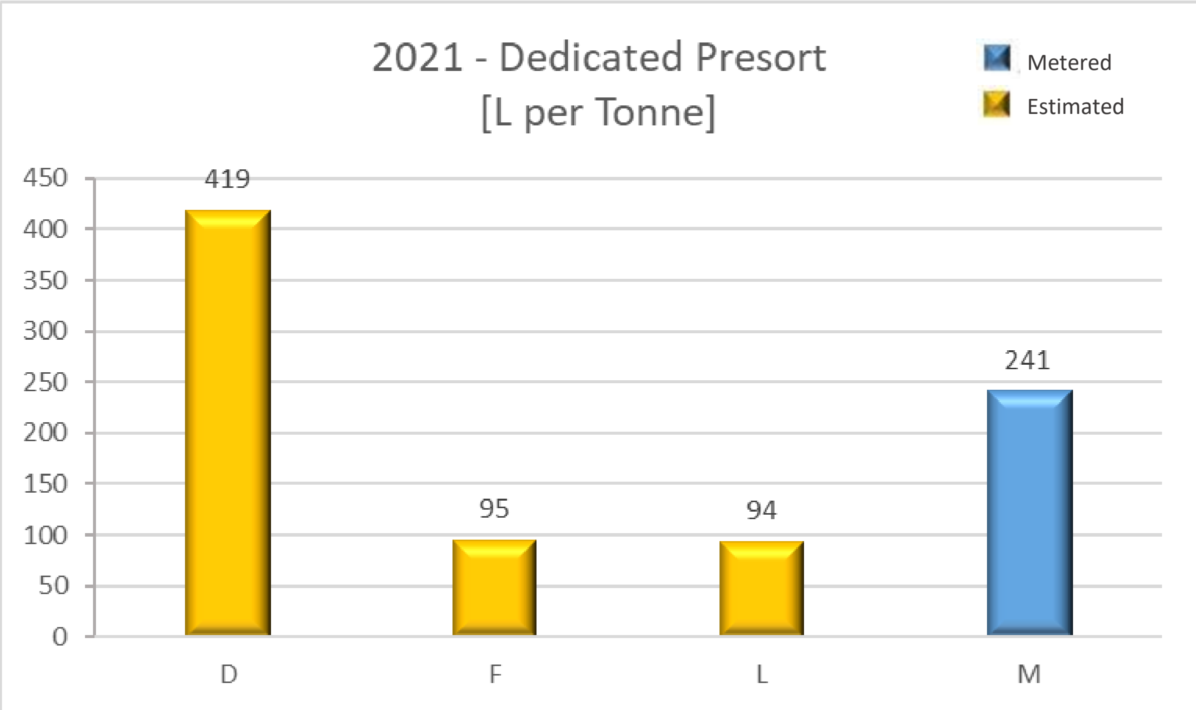

Figure 3: Dedicated pre-sort line benchmarks

<u>Figure 3 notes:</u>

Only packhouse M could provide metered water use data for the pre-sort line. The benchmarks for the other packhouses are estimates due to a lack of metering.

Packhouse K – This packhouse pre-sorts its pome fruit, but the water used for pre-sort is not recorded and could not be estimated.

Packhouse L – Pre-sort flumes are filled only once per season if no breakages occur.

Packhouse M – This packhouse replaces the water in its pre-sort plants every four weeks after filling them.

3.3 Dedicated Packing Line Benchmark

3.3.1 Calculation

The benchmark for a dedicated packing line is calculated as follows:

Flume & pack floor water consumption (m^3) x 1000 / Tonnes of pome fruit packed

The benchmark's unit of measure is Litres per Tonne of pome fruit packed.

3.3.2 Results

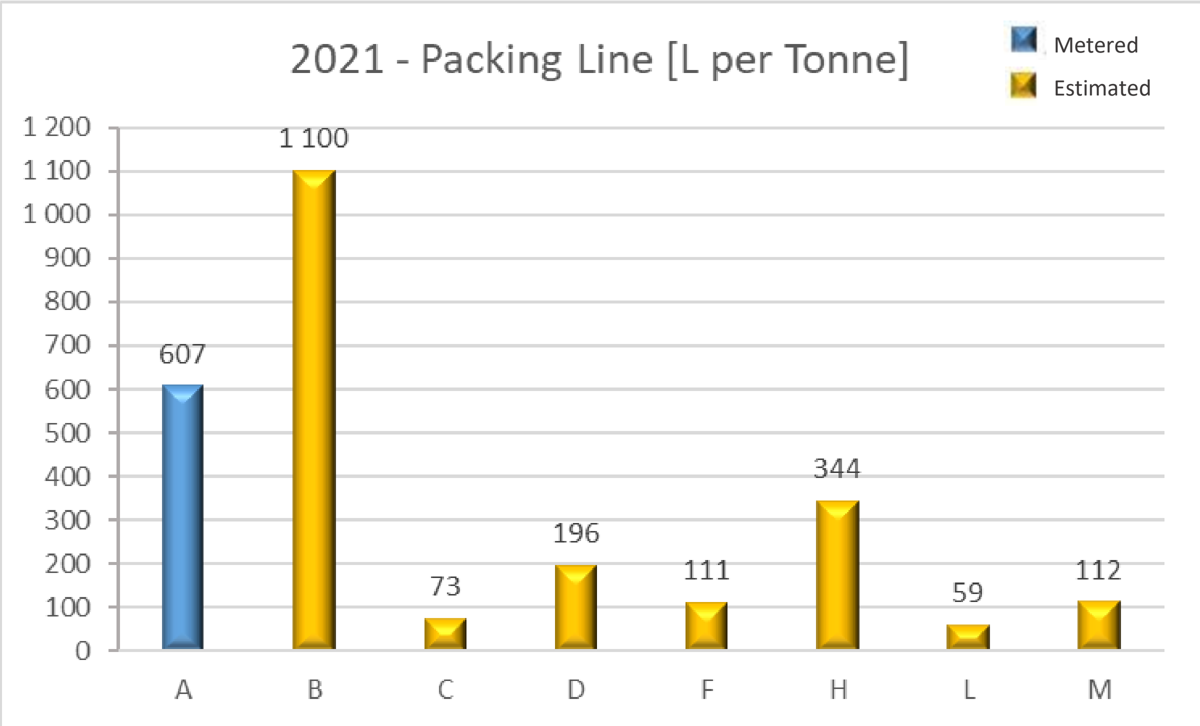

Figure 4: Packing line benchmarks

Figure 4 notes:

Water consumption of Packhouses B, C, D, F, H, L and M were estimated due to insufficient metering. Water consumption for Packhouses A and M also includes hybrid lines (simultaneous pre-sort and packing).

Packhouses A, C, D and H each have flume technologies older than 10 years, while the other packhouses have newer flume technology.

Packhouse B – The packing line water benchmark is very high because it includes water for other uses.

Packhouse C – The packing line benchmark is very low. This packhouse drains its flumes once every two weeks. The water consumption for each section of the packhouse was estimated (not metered). Thus, the low value could also be due to a water allocation issue.

Packhouse K – The packing line water use is not recorded and could not be estimated.

Packhouse L – The packing line benchmark is very low. This packhouse only fills its flumes once per season if no breakages occur. The flumes get topped up as needed with municipal water or treated borehole water. The flume water of this packhouse is treated via an Aquaking system. The packhouse could not provide details on the water treatment system beyond that a type of bromide chemical is used, and that silver and other components gets released into the flume water via an electrode. The total water consumption of the packhouse as a whole is metered, but water consumption for each area of activity is estimated (not metered). Thus, the low value could also be due to a water allocation issue.

The lack of metering at the packing lines is concerning in terms of data accuracy as this is a major area of water use in pome fruit packhouses. It is recommended that a meter campaign or standard be launched by the industry to help increase metering, recording and data integrity. Other key solutions would consist of raising awareness, offering training, and finding inexpensive recycling technology for the packing line.

3.4 Cold Storage Benchmark

3.4.1 Calculation

The cold storage benchmark includes all cold storage water consumption, of which cooling towers make up the majority.

The benchmark for cold storage is calculated as follows:

Cold storage water consumption (m^3) x 1000 / (CA & RA Tonne.Days)

The benchmark's unit of measure is Litres per Tonne.Day of fruit stored. Tonne.Days is not an intuitive unit of measure and is explained in more detail below.

The cold storage benchmark cannot only be based on the tonnes of fruit stored as cold storage protocols vary widely from one operation to the next. Some packhouses store pome fruit for short periods (days or weeks), while other packhouses store fruit for long periods (several months to almost a year). Tonne.Days neatly addresses this issue as it calculates the amount of water used to store one tonne of pome fruit for one day. An example is:

200 Tonnes stored for 1 day = 200 Tonne.Days
200 Tonnes stored for 3 days = 600 Tonne.Days

3.4.2 Results

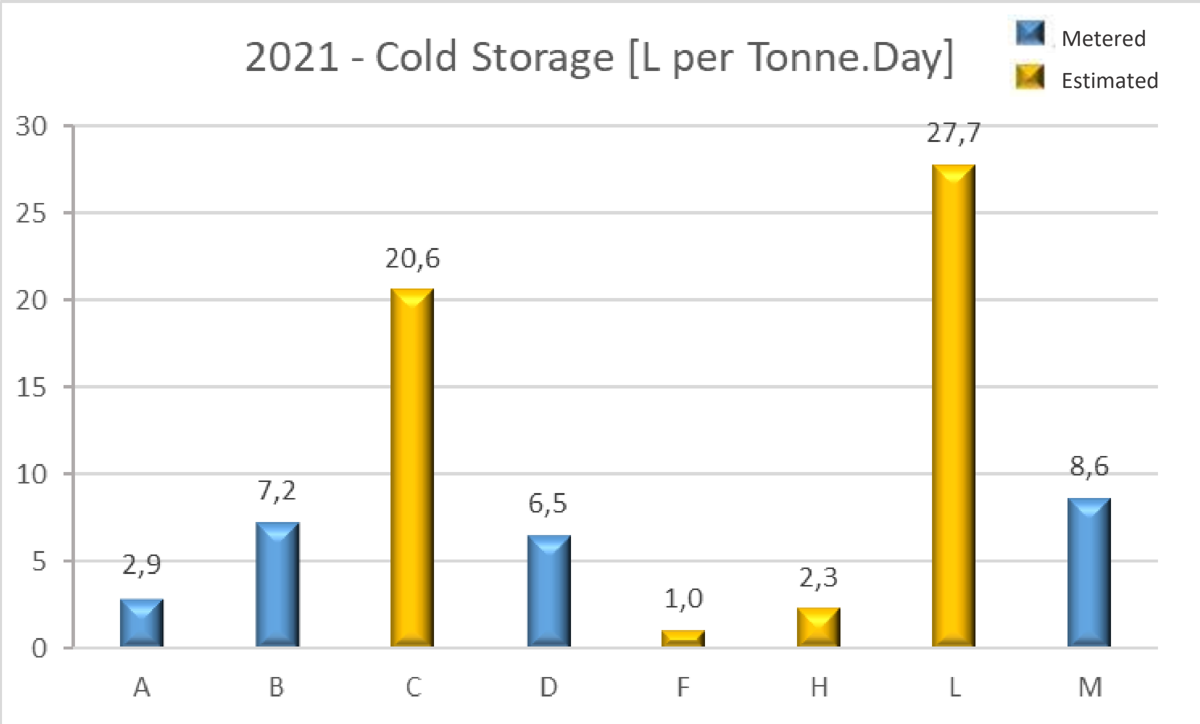

Figure 5: Cold storage benchmarks

<u>Figure 5 notes:</u>

Water consumption of Packhouses C, F, H, and L was estimated due to insufficient metering.

Packhouse K – The cold storage water use is not recorded and could not be estimated.

Considering only packhouses with good quality data, Packhouse B and D used nearly twice as much water for cold storage, and Packhouse M used three times more water for cold storage than Packhouse A. Packhouse A uses harvested rainwater and defrost water to supply water for their refrigeration plant (condensers).

3.5 Ablutions, Canteens & Offices Benchmark

3.5.1 Calculation

This benchmark includes the water consumption of ablutions, canteens & offices.

The benchmark for ablutions, canteens and offices is calculated as follows:

Ablutions, Canteens & Offices water consumption (m^3) x 1000 / (Staff man days)

The benchmark's unit of measure is Litres per person per day.

3.5.2 Results

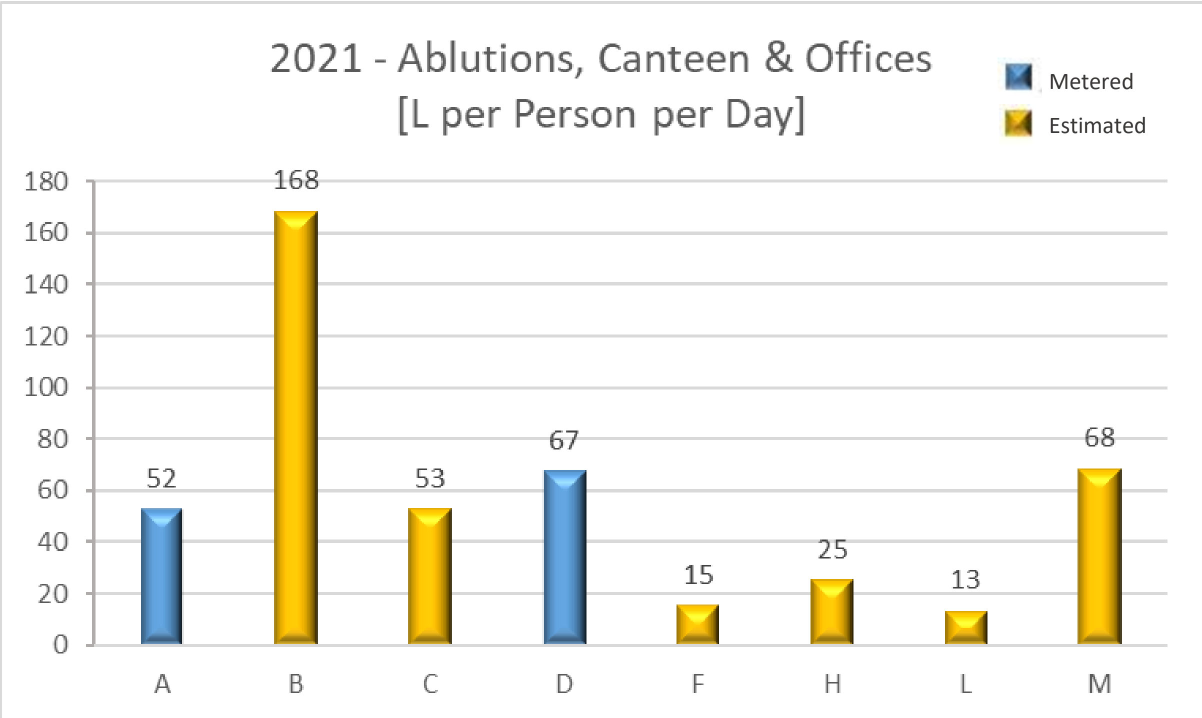

Figure 6: Ablutions, canteens & offices water use benchmarks

<u>Figure 6 notes:</u>

Water consumption of Packhouses B, C, F, H, L and M was estimated due to insufficient metering.

Packhouse K – The water use of ablutions, canteens and offices' is not recorded and could not be estimated.

When considering only the good quality data (Packhouse A and Packhouse D), the water consumption ranged from 52 to 67 litres per person per day. This is high considering the 50 litres per person per day allowance during the "Day Zero" drought of 2017 which included showering.

As noted in the previous report, there remains space for improving ablutions, office, and canteen water consumption. Key solutions would be raising awareness, offering training, and finding inexpensive recycling technology, especially for the ablutions section.

3.6 Overall Packhouse Benchmark

The overall benchmark for each packhouse incorporates water use for all sections of the packhouse, excluding water consumption allocated as "other". "Other" refers to water used for non-packhouse/cold storage activities. The unit of measure for this benchmark is m^3 of water per tonne of pome fruit packed. The benchmarks for January to December 2021 are presented in Figure 7 below.

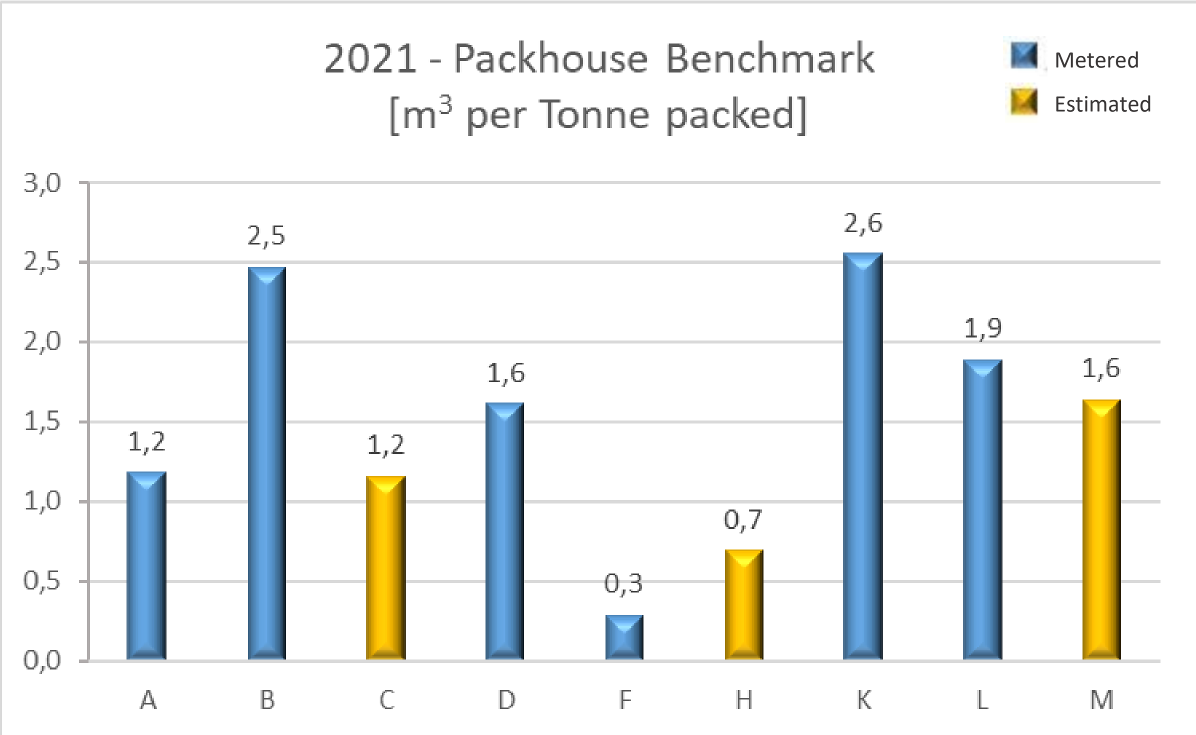

Figure 7: Overall pome fruit packhouse water use benchmarks for January to December 2021

There is a large variation in the overall water use benchmarks, which can be ascribed to different water management practices applied at the packhouses (e.g., flume drainage cycles, flume technology age, cold storage protocols, cold storage duration etc.). The majority of packhouses consumed 1 to 2 m^3 of water per tonne of fruit packed in 2021.

4 Water Usage Profiles

It is useful to compare the water use profiles of different packhouses. Figure 8 displays the percentage of water consumed by the different areas/activities in each of the participating packhouses, excluding water use allocated as "other". Packhouse K could only provide its total water use figure and thus its water use profile could not be determined.

4.1 Results

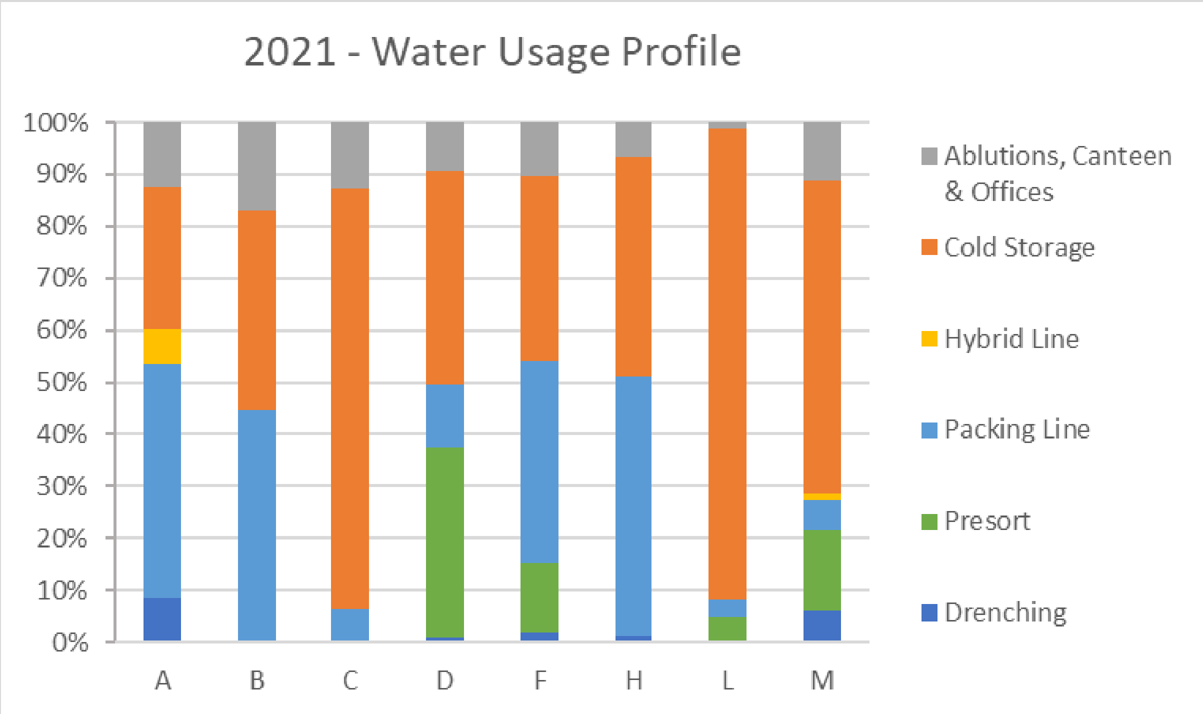

Figure 8: Water use profiles of the packhouses

Figure 8 notes:

Packhouse A – Provided accurate data and this profile can be used for comparison.

Packhouse K – Only measures total water consumption and thus water use for each specific area of the packhouse could not be determined.

Table 1 below summarizes the quality of the data received from each of the participating packhouses, for each area/activity.

Table 1: Summary of packhouse data quality for the different areas/activities

Packhouse	Drenching	Dedicated Pre-sort	Dedicated Packing line	Hybrid Line	Cold storage	Ablutions, canteens and offices
A	Metered	N/A	Metered	Metered	Metered	Metered
B	No data	N/A	Estimated	N/A	Metered	Estimated
C	N/A	N/A	Estimated	N/A	Estimated	Estimated
D	Estimated	Estimated	Estimated	N/A	Metered	Metered
E	Did not participate in Phase 5					
F	Estimated	Estimated	Estimated	N/A	Estimated	Estimated
G	Did not participate in Phase 5					
H	Estimated	N/A	Estimated	N/A	Estimated	Estimated
I	Did not participate in Phase 5					
J	Did not participate in Phase 5					
K	No data	No data	No data	N/A	No data	No data
L	N/A	Estimated	Estimated	N/A	Estimated	Estimated
M	Metered	Metered	Estimated	Estimated	Metered	Estimated
N	Did not participate in Phase 5					

4.2 Variation in Water Use Profiles

There is a large variation in the water use profiles of participating packhouses. This could be attributed to:

- A lack of metering (thus estimations).
- Water consumption that is metered, but that cannot be allocated to the specific areas of the packhouse ("crow's nest" of piping distributing water throughout the packhouse).
- Lack of water consumption records.
- Errors in water consumption records.
- The use of different types of flume technology.
- The application of different water recycling technologies.

5 Year-on-Year Comparison of Water Use Benchmarks

A benefit of undertaking water benchmarking is that it not only supports consumption target setting, but also allows for year-on-year comparisons. A year-on-year water benchmark comparison for Phase 1 (2017), Phase 2 (2018), Phase 3 (2019), Phase 4 (2020) and Phase 5 (2021) of this project is discussed below. Only packhouses who participated in phase 5 and at least another phase is shown in the figures below.

For the packing line (Figure 9) and the cold storage (Figure 10) comparison, it is best to use Packhouse A's data over all four years. For the ablutions, offices, and canteens comparison (Figure 11) it is best to use Packhouse A's results for 2018, 2019, 2020 and 2021 (2017's data was not allocated correctly).

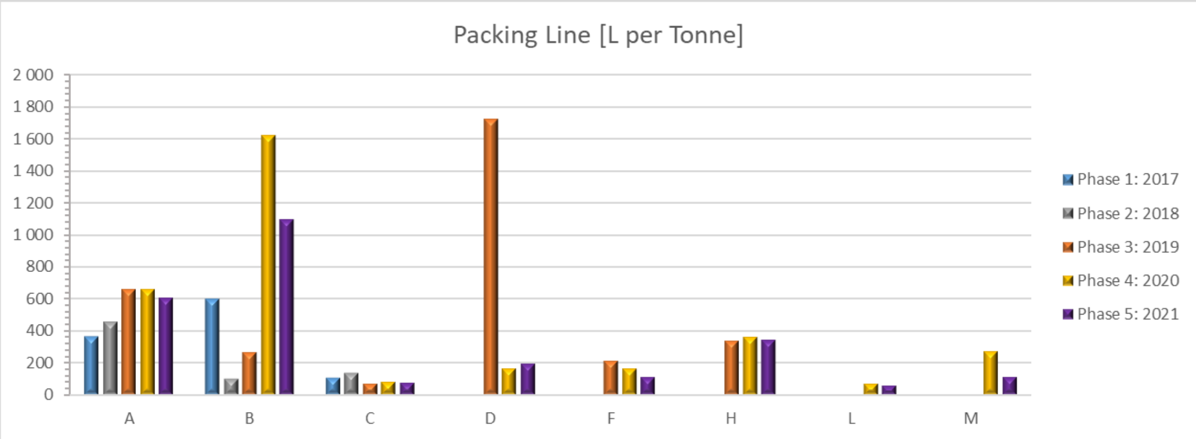

Figure 9: Year-on-year comparison of packing line benchmarks

Figure 9 notes:

Packhouse F's 2021 packing line benchmark improved due to more accurate tonnes packed data.

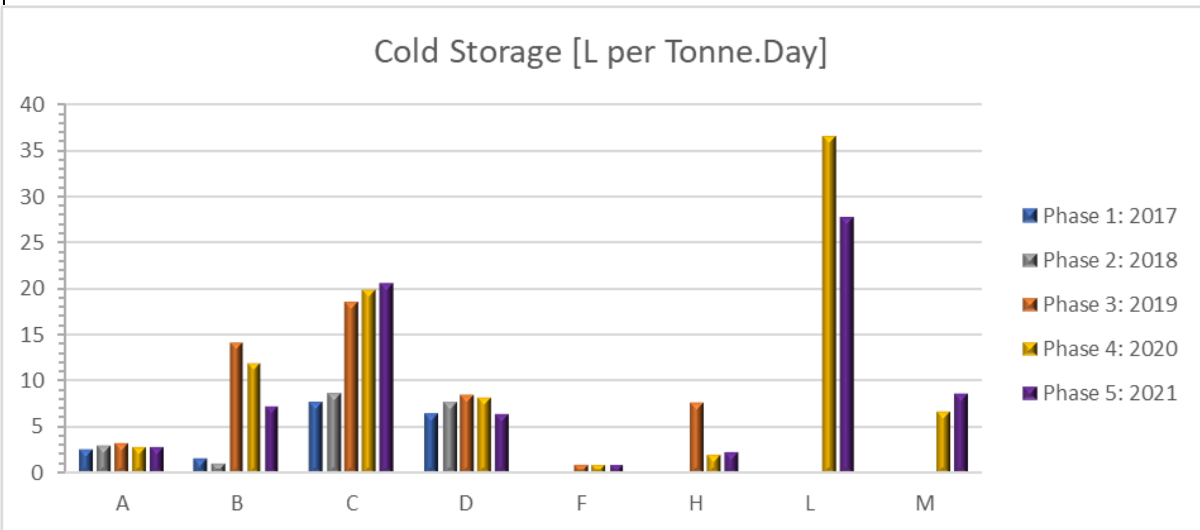

Figure 10: Year-on-year comparison of cold storage benchmarks

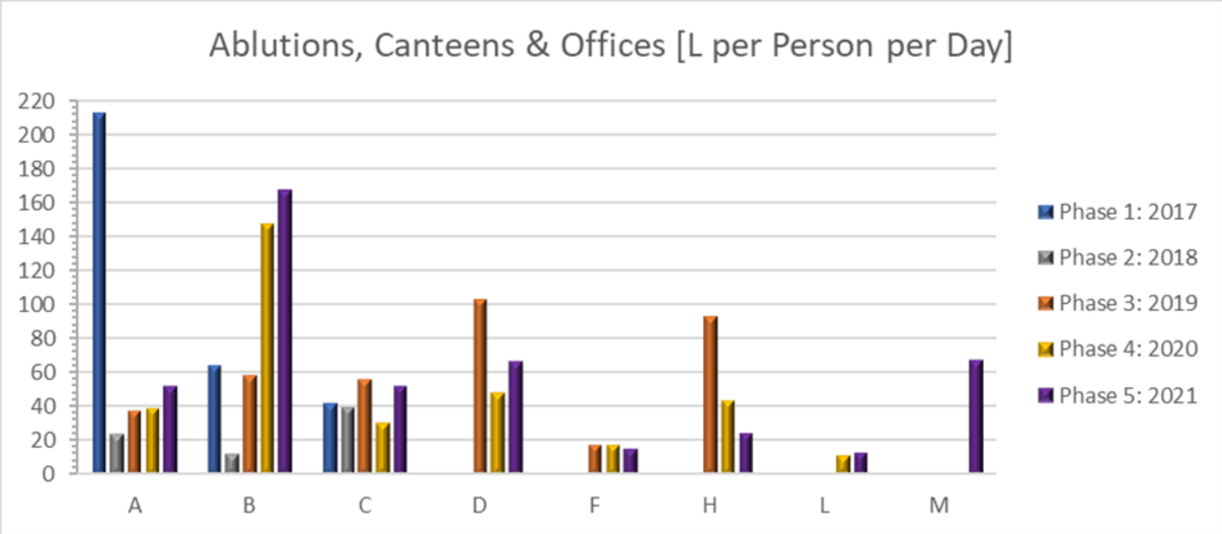

Figure 11: Year-on-year comparison of ablutions, canteen & offices benchmarks

The upward trend in water consumption seen from 2018-2019 could be attributed to the lifting of the Western Cape's "Day Zero" water restrictions.

The water consumption of 2021 for the packing line showed a decrease while the water consumption of the cold storage, ablutions, canteens and offices increased in comparison to that of 2020. The increase is especially apparent for the ablutions, canteens and offices and therefore improving water use efficiency in this area is recommended.

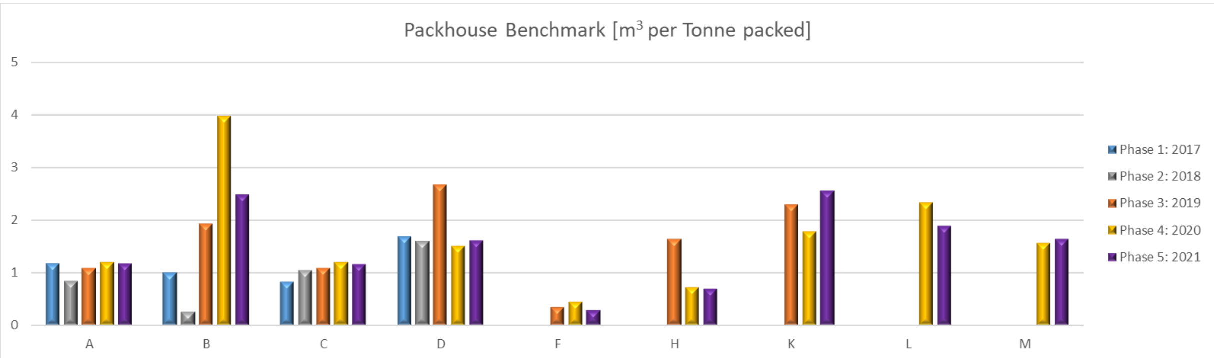

Figure 12: Year-on-year comparison of overall packhouse benchmarks

When looking at the overall packhouse benchmark results (Figure 12), the picture becomes very positive, with the majority of the packhouses showing a decrease in cubic metres of water (excluding "other" water use) consumed per ton of pome fruit packed since 2020.

6 Water Management Practices

Packhouses were asked a series of quantitative and qualitative questions about packing lines and water reuse technologies and practices. A summary of these results is shown below.

6.1 Flume Technology Age

As can be seen in Figure 13, the flume technology age is almost evenly split between more than ten years old and less than ten years old.

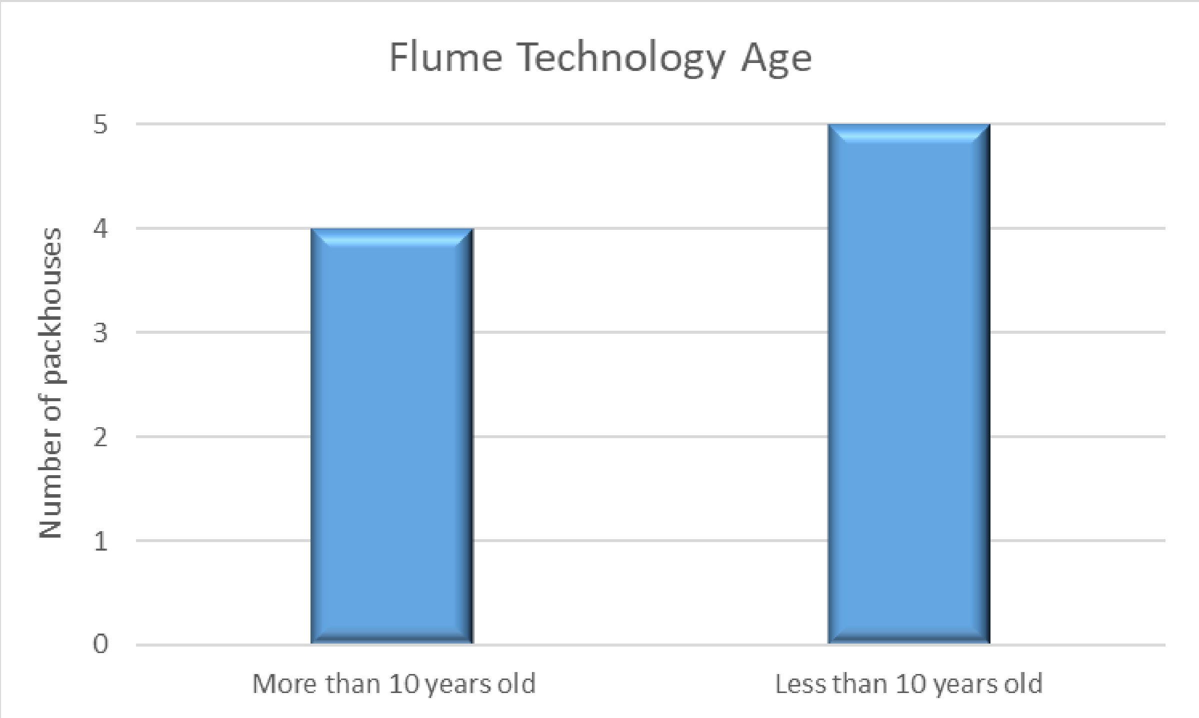

Figure 13: Flume technology age among the packhouses

6.2 Flume Water Management

All of the packhouses provided a detailed description of their flume water management processes.

6.2.1 Standard water management processes

6.2.1.1 PH management

- Four of the nine packhouses monitor their flume water pH levels at regular intervals throughout the day.
- Three packhouses don't have a pH management process in place.
- One packhouse does not manage its pH, but its Oxidation Reduction Potential (ORP) levels are managed by an external company.
- One packhouse measures its incoming borehole water pH once a year by taking borehole water samples.

Three packhouses reported their respective acceptable pH levels as:

- 7.0
- 7.0 – 7.5
- 6.5 – 7.8

6.2.1.2 Chlorine Management

- Seven of the nine packhouses indicated chlorine level monitoring at regular intervals throughout the day.
- Corrective actions are taken to restore chlorine concentration and pH to predetermined levels as necessary.
- One packhouse uses chlorine dioxide instead of chlorine in its flumes. Chlorine dioxide is an oxidising agent just like chlorine, but it can absorb five electrons instead of only two. This means that, mole for mole, ClO_2 is nearly three times more effective than chlorine.

Acceptable chlorine levels were reported by four of the packhouses and were indicated as:

- 20 ppm by one packhouse for the infeed flume of its pre-sort lines;
- 1-3 ppm by the above packhouse for its pre-sort flumes;
- 2-5 ppm by the above packhouse for its dedicated packing lines;
- 75 ppm by the above packhouse for its pear packing line;
- 50 ppm by one packhouse;
- 10 – 30 ppm by one packhouse; and
- 25 ppm by one packhouse;

6.2.2 Cumulative flume water holding capacity

All the packhouses reported their cumulative flume water holding capacity. This capacity ranged from 15 – 685 m^3. The average cumulative packhouse flume water holding capacity was 296 m^3.

6.2.3 Flume water drainage cycle

All packhouses reported their flume water drainage cycles. Five of the nine packhouses drain 100% of their flume water once a week.

Packhouse C drains their flumes once every two weeks. Packhouse L drains its flumes only two or three times per year, otherwise, the flumes are just topped up. Packhouse K only replaces its flume water on an indication of raised pathogen levels. Packhouse M drains its packing line flumes twice per week, its pear packing line flumes once per week and its pre-sort plant flumes every four weeks after filling them.

6.2.4 Flume Cleaning processes

All of the packhouses use the same method of cleaning their flumes which entails draining water from flumes, using brooms to remove leaves and other foreign matter and then washing/rinsing flumes with high-pressure water and soap. Thereafter flumes are rinsed/flushed and refilled with clean water.

Packhouse H and Packhouse K indicated that they add chlorine to their flumes after filling them with clean water.

6.3 Water Saving and Water Treatment Methods

Opportunities exist throughout packing operations to save or reuse water. Firstly, significant amounts of water can be saved by reducing flume drainage and refill frequency. Secondly, harvesting rainwater to supply operational water use can be an impactful way to use water from renewable sources rather than finite sources. At stages further along the processing chain, adjustments to sanitizing chemical dosages or the use of methods like UV treatment can be a cost-effective alternative to recycle or reuse water[1].

Another important aspect of water management is the treatment of wastewater. Wastewater associated with fruit processing and other agricultural products can be detrimental to the environment due to the large quantities of nutrients, organic compounds, suspended and dissolved solids it contains. It is therefore essential that wastewater from fruit packhouses be appropriately treated/filtered before being discharged to dams, rivers or groundwater to prevent environmental contamination.

Below follows a summary of water-saving and water treatment methods applied at the different areas of activity by the participating packhouses.

6.3.1 Flume water

- Four packhouses drain their flume water into a dam (or dams), after which it either runs into the river or is drained into groundwater.
- Two packhouses let their drained flume water filter naturally via reeds or a wetland system.
- Two packhouses dispose of their drained flume water via a storm drain water system.
- One packhouse sends its water to the municipality water treatment plant.

6.3.2 Rainwater

Only three out of the nine packhouses harvest rainwater.

- One packhouse uses harvested rainwater for the condensers of their refrigeration plant.
- The harvested rainwater from another packhouse forms part of their production line and borehole water, and they also use it in their gardens.
- A third packhouse pumps its harvested rainwater into a natural filtration system before it is accumulated in its supply dam.

[1] Bailone, R.L., Borra, R.C., Fukushima, H.C.S. and Aguiar, L.K., 2022. Water reuse in the food industry. *Discover Food*, 2(1), pp.1-17.

6.3.3 Drenching

Three packhouses use technologies in their drenching process.

- One packhouse has a perforated grid with a mesh size of 3mm in its drenching line to separate particles from the water flow. These particles consist of leaves and other floating matter. The less particles in the water, the longer the chlorine will remain active.
- One packhouse has glass filters in its drenching line.
- One packhouse has a sand filter system in the borehole from where drenching water is sourced, to filter out iron. The water gets pumped from the borehole into a recipient tank (10 000L) where the iron is oxidated by air. The water is then pumped through a sand filter, where fine glass sand filters out the iron "sediment".

6.3.4 Pre-sort/packing line

Five out of the nine packhouses make use of technologies in their pre-sort line and/or packing line.

- One packhouse uses only glass filters.
- One packhouse has a sand filter through which its flume and process water is continuously cycled.
- One packhouse uses only sand filters and UV treatment.
- Two packhouses use sand filters, UV treatment and carbon filters.

6.3.5 Cold storage

Two out of the nine packhouses make use of recycling technologies in their cold storage.

- One packhouse directs its defrosted water to each refrigeration plant room's make-up tank.
- One packhouse collects condensate as part of the inflow to its settling dams.

6.3.6 Ablutions, canteens and offices

- One packhouse has a Biozone sewage treatment system.
- One packhouse has 4 x 10 000L separate rainwater capture tanks used exclusively to supply drinking water for their staff as the Municipal water is not always clean and drinkable.
-

6.3.7 Wastewater treatment method

Wastewater holds potential for reuse, and its environmental impact can be greatly reduced when properly treated to remove contaminants[1].
Four packhouses provided details of their wastewater treatment methods.

- One packhouse has its own sewage treatment plant. The clean and disinfected water from the treatment plant is drained into a dam, after which it runs into the river.
- One packhouse pumps its wastewater to a central municipal facility.
- One packhouse lets its wastewater filter naturally via a wetland system.

- One packhouse treats its wastewater with a silver bromide solution during the production process before it is released.

7 Conclusion

Nine of the packhouses that participated in Phase 4 returned to participate in Phase 5. This is encouraging as it indicates that the packhouses are getting value out of this process. If the number of participating packhouses increases in future rounds, the value of these benchmarks will increase even more.

While contacting packhouses during Phase 5, awareness was raised for the project and it was encouraging to see that two additional packhouses showed interest in participating in future rounds of data collection. The most common reason for non-participation was not having sufficient water metering, technologies, and procedures established in the packhouse or due to lack of capacity for data collection. These packhouses are encouraged to still participate as there is valuable learning for them in this regard and the project offers the perfect starting point in the journey towards more efficient water use.

The year-on-year comparisons build value and raise discussion points that participating packhouses can use to start internal discussions. In Phase 4 there were signs of decreased water consumption since the start of the project. It is positive to see that in Phase 5, the water consumption continues to show a decrease in some areas of the packhouse, particularly at the packing line. More accurate data from more packhouses is required to confirm these trends.

From a data collection point of view, the collection of hybrid packing line water use data and water recycling practices has proven valuable. Splitting the dedicated pre-sort, dedicated packing line and hybrid packing line (where pre-sort and packing occur simultaneously) water use has allowed for water consumption figures to be more accurately allocated by packhouses that make use of hybrid lines. To enable more accurate benchmark calculations from this data in future, the total tonnages must also be split between tonnes of fruit that go through dedicated pre-sort and packing lines, and that which goes through hybrid packing lines.

The reuse of water, use of alternative water sources and a reduction of water waste can reduce costs and add value to the final product in fruit packhouses. It is especially positive to see some of the packhouses putting more effort into harvesting rainwater by, for example, installing more rainwater capture tanks onsite and using harvested rainwater to supply certain areas of their operation. It is also very positive to find that some of the packhouses participating in this project are filtering or treating their wastewater and thus reducing their environmental impact.

The sharing of water recycling technologies through this project is valuable for knowledge exchange and learning to occur among pome fruit packhouses. Differences in water management practices and recycling technologies applied across packhouses could be used to explain some of the variances in the benchmarks. However, more accurate data is required to confirm the effect of these practices and technologies on water consumption. To encourage this, an initiative for the industry (a “water heroes” campaign for example) could be implemented to give acknowledgement for water use efficiency excellence. Packhouses could for example be scored in the project according to their water use efficiency journey.

The following points remain areas of concern:

- Not all packhouses meter specific areas and therefore do not have an accurate picture of how and where water is consumed.
- The lack of capacity for data collection makes it difficult to attract new participants to the project. An industry initiative that gives recognition for water use efficiency excellence (e.g., a “water heroes” campaign) could help increase participation in the project.
- In some cases, water meters are not read, nor are the readings being recorded. This results in poor water usage history and undermines the value of the data and any management decision based on the data.
- Renewable water sources such as harvested rainwater is only used by a few packhouses at this stage.

It is positive to find that more and more packhouses are indicating a shift towards installing meters for more accurate measurement of water use in the future, which will drastically improve the value of this report.

8 Recommendations

The following recommendations are made:

- It is key to understand the reasons for metering and data recording issues experienced by packhouses. This could be implemented in the next round of data collection.
- For future phases of the project, packhouses should be able to share information on current projects or plans being implemented to improve their water use efficiency (e.g., rainwater tanks being installed, installation of meters etc.)
- Fruit tonnages are to be split according to tonnes that go through dedicated pre-sort, dedicated packing and hybrid packing lines respectively.
- It is recommended to include questions on preventative maintenance (leak detection and repair) applied by packhouses in the next round of data collection.
- Details on drenching protocols should be collected in in the next round of data collection.
- A meter campaign or standard can be launched by the industry to help increase metering, recording and data integrity.
- To encourage participation in this project, the industry could launch initiatives to encourage water use efficiency excellence (e.g. a water heroes campaign).
- Participating packhouses could be asked for suggestions to improve the data collection tool and processes.
- Packhouses could consider implementing good water management practices to reduce water consumption, including:
    - Metering and consistently keeping a record of water consumption on a monthly/annual basis.
    - Ensuring that a formalised strategy/water policy is in place and implementing a water management plan.
    - Setting water reduction targets.
    - Training staff on water use efficiency and implementing water-wise behaviour.
    - Using alternative water supplies: rainwater, groundwater or surface water.
    - Reusing water in the packhouse where possible e.g., production water for floors, handwashing water for toilets; pump seal / defrosted / condenser water to the cooling tower make-up tank.
    - Treating wastewater and reusing it.
    - Maximising cooling tower cycles of concentration to six or more. Cycles of concentration refers to the number of times the concentration of total dissolved solids (TDS) in cooling tower water is multiplied relative to the TDS in the make-up water.
    - Longer retention of drenching and flume water.
    - Regular inspection and repair of leaks, regular repair and service of faulty equipment.

- Using efficient fittings and technologies (flow restrictors, tap aerators, autostop sensors, automatic shut-off valves, waterless urinals, hold flush/dual flush toilets etc.).