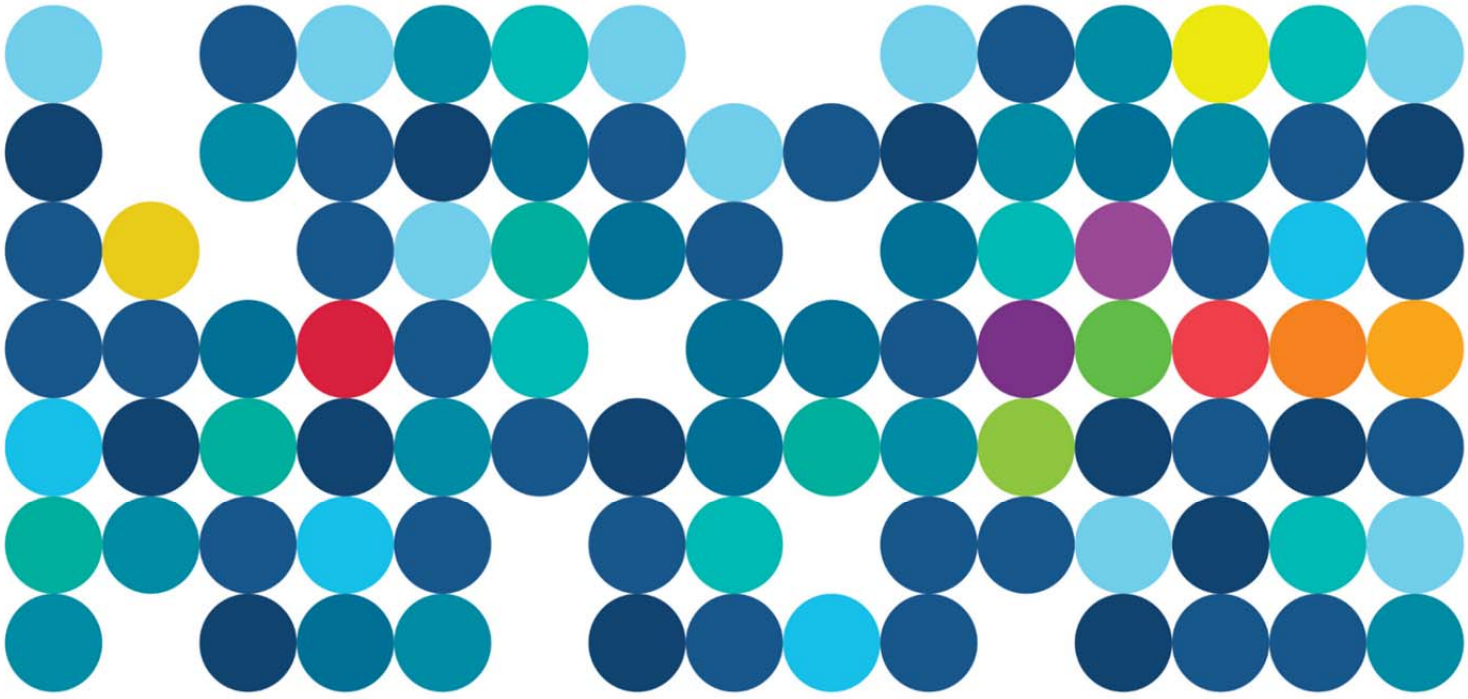
Water Efficiency Benchmarks

Commercial Buildings - Perth & West Perth CBD
Western Australia

Prepared by HFM Asset Management for the Water Corporation

1 June 2017



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Version Control

Version	Date	Comment	Responsible Party
0.1		Data Analysis	I Draganjac / P Rice
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1.1	11/05/2017	Amendments	P Rice
1.2	28/07/2017	Correct Performance Category Descriptions	P Rice

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1 Introduction

By request of the Water Corporation and the City of Perth, HFM Asset Management Pty Ltd performed an update of the commercial office efficiency benchmark database, consisting of commercial buildings located within Perth and the West Perth CBD.

The project utilises data derived from the 2010/11 to 2015/16 financial years. The exercise was designed to provide water efficiency benchmark guidance to the owners and operators of commercial office buildings within Perth, Western Australia. Outcomes form the basis of the Water Corporation Waterwise Office Program, with the intent of the present exercise to assess and account for trends over the past five years.

Contributions on this project in data, time and cost were born by the project participants as outlined below:

Project Participants:

- Water Corporation – Provision of annual water consumption data, project sponsor, project co-ordination and the project brief.
- Property Council of Australia (WA Branch) - Provision of commercial office Nett Lettable Area (NLA) data greater than 5000 m^2, participation in stakeholder consultation.
- City of Perth – Project sponsor and project coordinator.
- HFM Asset Management Pty Ltd. - Data processing, collation, interpretation, analysis, criteria development, outcome presentation and report writing.

Stakeholder Workshop Participants

Water Corporation	- Erin Vis	Water Efficiency Programs Officer
	- Sara Ward	Water Efficiency Programs Officer
	- Anna Lichovidova	Relationship Manager
	- Adele Gismondi	Strategic Relationship Manager
HFM	- Peter Rice	Engineering Consultant
	- Bevan Tyler	General Manager

City of Perth

PCA (WA)

Acknowledgements:

HFM wish to thank the Water Corporation and the City of Perth for their diligence and commitment in developing this program, as well as the Property Council of Australia for their ongoing support. Thank you to Erin Vis for her support in compiling the required data.

2 Project Scope

The project scope was to develop and update benchmarking criteria for commercial office buildings based on data provided by the Water Corporation and PCA and supplemented by HFM's existing database.

Two categories of benchmarks have been developed; one for air cooled office buildings and one for water cooled office buildings. The industry recognised indicator is water consumption per net lettable area (kL/m^2/annum).

The target group of the sector was sites with a NLA larger than 5,000 m^2.

A range of benchmarks have been produced within each category that will determine the level of Waterwise recognition.

These recognition KPI's are based on benchmark outcomes for the previous calendar year and are reviewed at regular intervals with respect to the performance of the Perth office building population. It is envisaged that as the program evolves, an incremental improvement in office building performance will occur prompting continually improving consumption baselines and benchmarks. The recognition KPI's have remained the same for this period.

2.1 Project Objectives

- Update **industry benchmarks** which form the basis of the "Waterwise" program.
- Investigate and account for changing **industry benchmarks** with respect to time.
- Qualify the impact of **office occupancy** on building water consumption.
- The **"Waterwise" program** will be limited to office buildings that have a Net Lettable Area (NLA) of greater than 5000 m^2.

2.2 Programme Objectives

- To **motivate** sites with below average water use to improve water efficiency to a minimum standard.
- **Reward and recognise** those that are leading the industry.
- Drive **innovation** and continued **improvement** towards best practice.
- Office buildings that meet the minimum set of criteria will be endorsed and receive access to the **Waterwise branding** to promote their endorsement.

3 Data Source & Size

HFM was provided total annual water consumption data for financial years from 2011/12 to 2015/16 from the Water Corporation and PCA WA Net Lettable Area (NLA) data for buildings within the Perth, East Perth and West Perth CBD which were larger than 5000 m^2. The total analysed building stock has a combined NLA of 1,689,286 m^2.

The data was processed, collated and categorised in accordance with a data criteria developed specifically for this project.

3.1 Data Source Roadmap

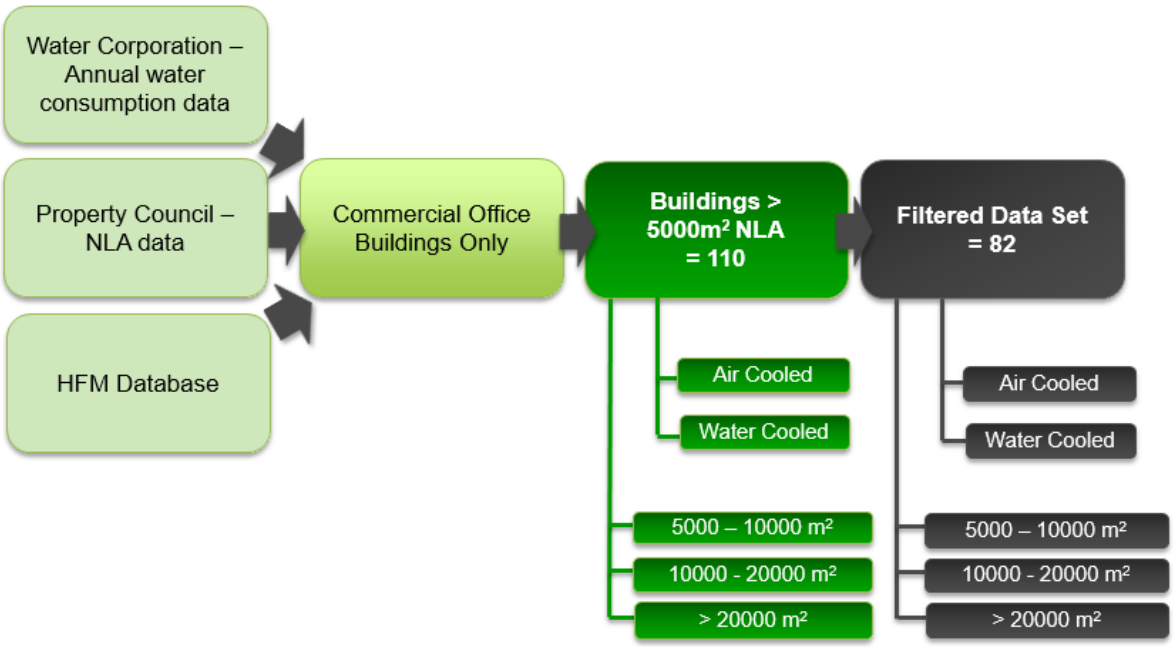

Figure 1: *Data Source Roadmap*

3.2 Summary of Sample Distribution

The data source sample distribution is summarised in Table 1. A total sample size of 110 buildings is filtered to a dataset containing 82 buildings by the methodology described in Section 4.

Table 1: *Summary of Sample Size.*

Data Sample Sizes by Category		Air Conditioning Plant		Net Lettable Area (m^2)		
		Air Cooled	Water Cooled	5,000 - 10,000	10,000 - 20,000	> 20,000
Complete Data Set	110	23	87	50	26	34
Filtered Data Set	82	16	66	36	20	26

4 Methodology

Commercial office buildings within the City of Perth with a Nett Lettable Area (NLA) greater than 5000 m^2 were matched with whole of building water consumption to develop the **water intensity index**, defined as water consumption (kL) per NLA (m^2); kL/m^2.

The data filter criteria was the same as the previous benchmark development exercise. The intent was to capture the largest possible data set with the information provided, while removing inaccuracies and exceptions that may potentially skew the outcomes.

Data processing, collation, interpretation and analysis was undertaken to filter data that did not meet the predetermined filter criteria.

Filter criteria:

1. 2017 PCA data available.
2. 2015/16 Water Corporation (WC) consumption data available.
3. A/C cooling method could be clearly determined (air or water cooled).
4. Only office buildings included (mixed use buildings were excluded).
5. Single WC supply accounts to precincts or lots with multiple buildings on the one lot were excluded unless separate meter was available.
6. Sites with water usage deemed to be outside of standard office building usages (i.e. high consumption – possibly due to retail tenancies, landscape irrigation etc., and low consumption – possible due to low occupancy) were excluded pending further meter separation and verification.
7. Excessively high consumers; with a water intensity index of > 50% of the mean, were excluded.
8. Excessively low consumers; with a water intensity index of < 50% of the mean, were excluded.

Concerning year to year comparison, the process above is applied independently to each annual data set. This was considered as both a simple and robust method to model the trend, ensuring that the building population is treated equally year to year.

As this process continues to evolve, the data quality will improve leading to an improvement in outcome reliability.

4.1 NABERS Water for offices

The NABERS water rating scale has been utilised for reference purposes to provide indicative rating comparisons only.

NABERS Water for office does not use benchmarking factors for the rating bands as per NABERS Energy for office. The figures in the table below shows the raw water consumption figures necessary to achieve a particular star rating in the major centres only, assuming a 55 hr/wk of hours of occupancy. These figures have been rounded, the actual thresholds are determined directly from the rating formula within the NABERS rating calculator rather than from this table. **This information is provided as a guide only.**

Table 2. *Calculated rating bands for major Australian cities. Whole of building kL / m2 (Source: New South Wales Office of Environment and Heritage).*

NABERS Rating	Sydney	Melbourne	Canberra	Adelaide	Brisbane	Perth
1 star	1.73	1.03	0.99	1.08	2.53	1.41
1.5 stars	1.56	0.94	0.91	099	2.26	1.28
2 stars	1.39	0.86	0.83	0.90	1.99	1.14
2.5 stars	1.21	0.77	0.75	0.80	1.72	1.01
3 stars	1.04	0.69	0.67	0.71	1.44	0.88
3.5 stars	0.87	0.60	0.59	0.62	1.17	0.75
4 stars	0.70	0.53	0.51	0.53	0.90	0.61
4.5 stars	0.52	0.43	0.43	0.44	0.62	0.48
5 stars	0.35	0.35	0.35	0.35	0.35	0.35
5.5 stars	0.26	0.26	0.26	0.26	0.26	0.26
6 stars	0.17	0.17	0.17	0.17	0.17	0.17

5 Outcomes

5.1 Water Use Baseline (Averages)

The outcomes of the study are presented in this section and subsequently developed to represent commercial office benchmarks for the existing building stock in the City of Perth business precincts.

For the unfiltered data set, the mean was calculated as 0.64 kL/m^2. The dataset was filtered for sites with greater than 50% variance from the mean (0.319 – 0.958 kL/m^2). The filtered data set, represented by the box below, has an average of 0.62 kL/m^2.

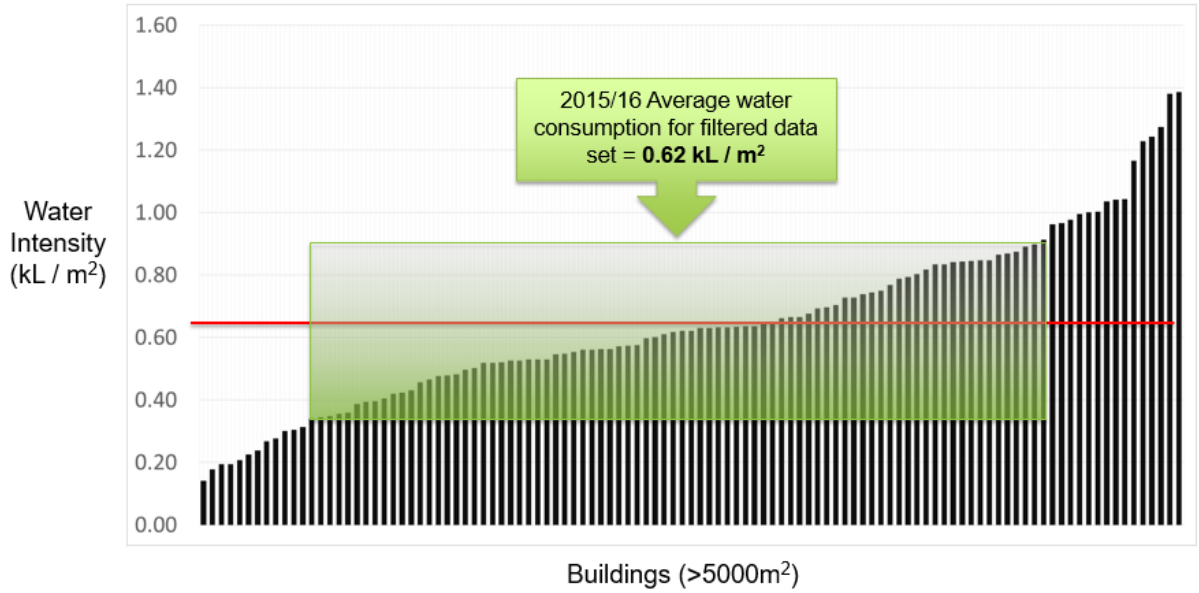

Figure 2: *2015/16 average water consumption.*

5.2 Water Cooled Versus Air Cooled Buildings

The buildings central plant has a fundamental effect on water consumption and the respective water intensity index. Water cooled buildings use water as a medium to reject heat and are typically more energy efficient than the equivalent air cooled arrangement. However, water cooled buildings use more water due to the requirement of a cooling tower.

On this basis, water efficiency calculations have been made based on the buildings central plant. The 2015/16 water intensity index averages for water cooled and air cooled buildings is 0.67 and 0.53 kL/m^2 respectively.

5.3 Annual Trends

The intent of the study was to investigate water efficiency trends in Perth with respect to time. The information below summarises the trends for the water cooled and air cooled datasets as well as the total population.

Table 3. *Water Efficiency figures for water cooled and air cooled buildings, per fiscal period.*

Water Intensity Index (kL / m^2)	Sample Size	2011/12	2012/13	2013/14	2014/15	2015/16	Normalised NABERS rating
Water Cooled	66	0.86	0.80	0.76	0.71	0.67	3.5 stars
Air Cooled	16	0.61	0.57	0.51	0.52	0.52	3.5 stars
Total	82	0.77	0.72	0.69	0.64	0.62	3.5 stars

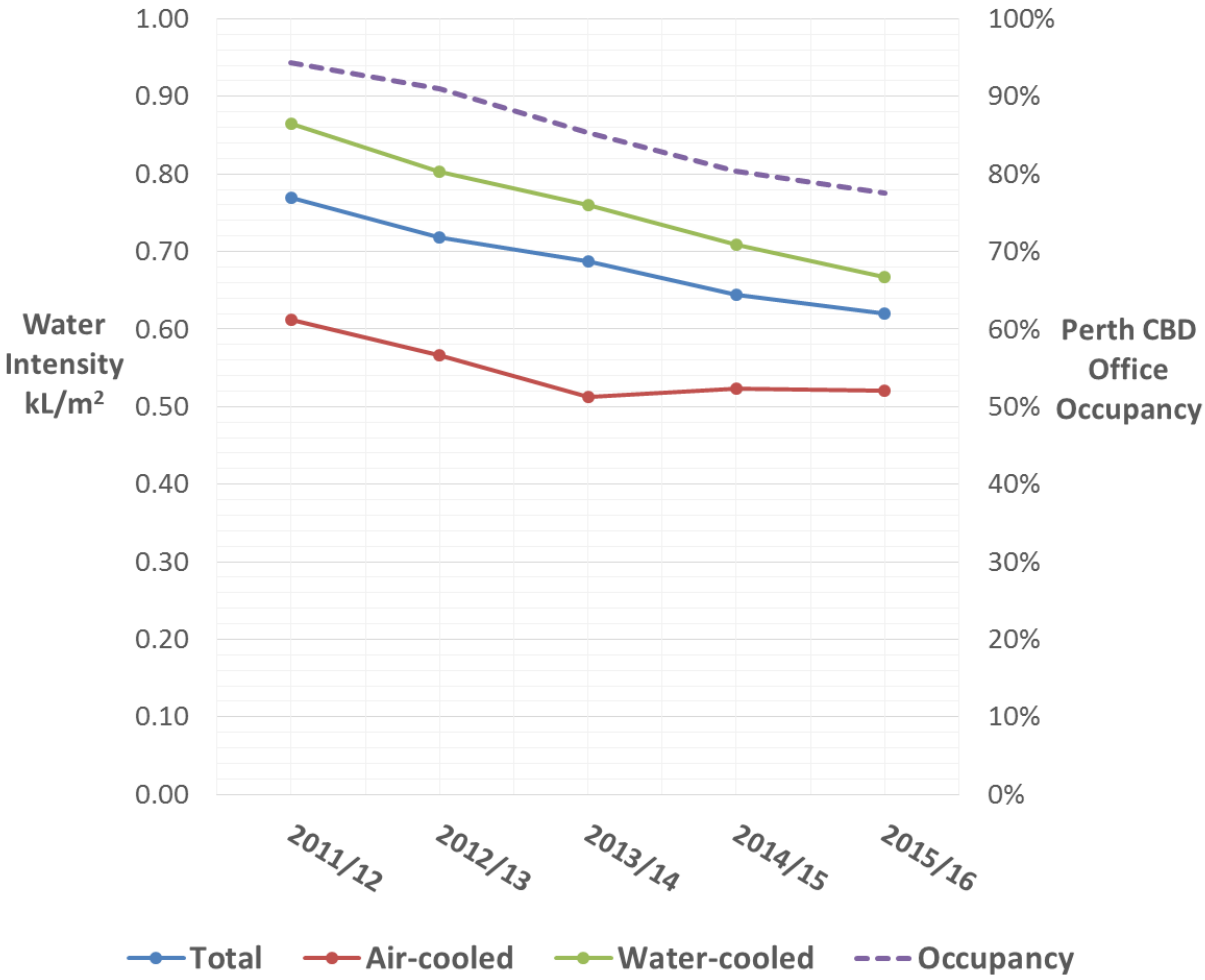

Figure 3. *Water Intensity Index (kL/m^2) for the past five fiscal periods.*

The outcome of the 2017 update identifies a clear and significant improvement in water efficiency over the past 5 years. From 2011/12 to 2015/16 the water intensity index for the average building population has decreased by 0.15 kL/m^2. This corresponds to a decrease in consumption of 254 gigalitres when extrapolated across the Perth building stock > 5000 m^2.

However, it is also evident that vacancy within the Perth office market is directly proportional to water consumption. HFM have subsequently investigated the proportionate impact of vacancy with respect to the improving water efficiency across the building stock. Figure 4 below highlights the strong correlation between occupancy and water consumption. As occupancy has decreased over the past five years, the average water intensity index has also decreased.

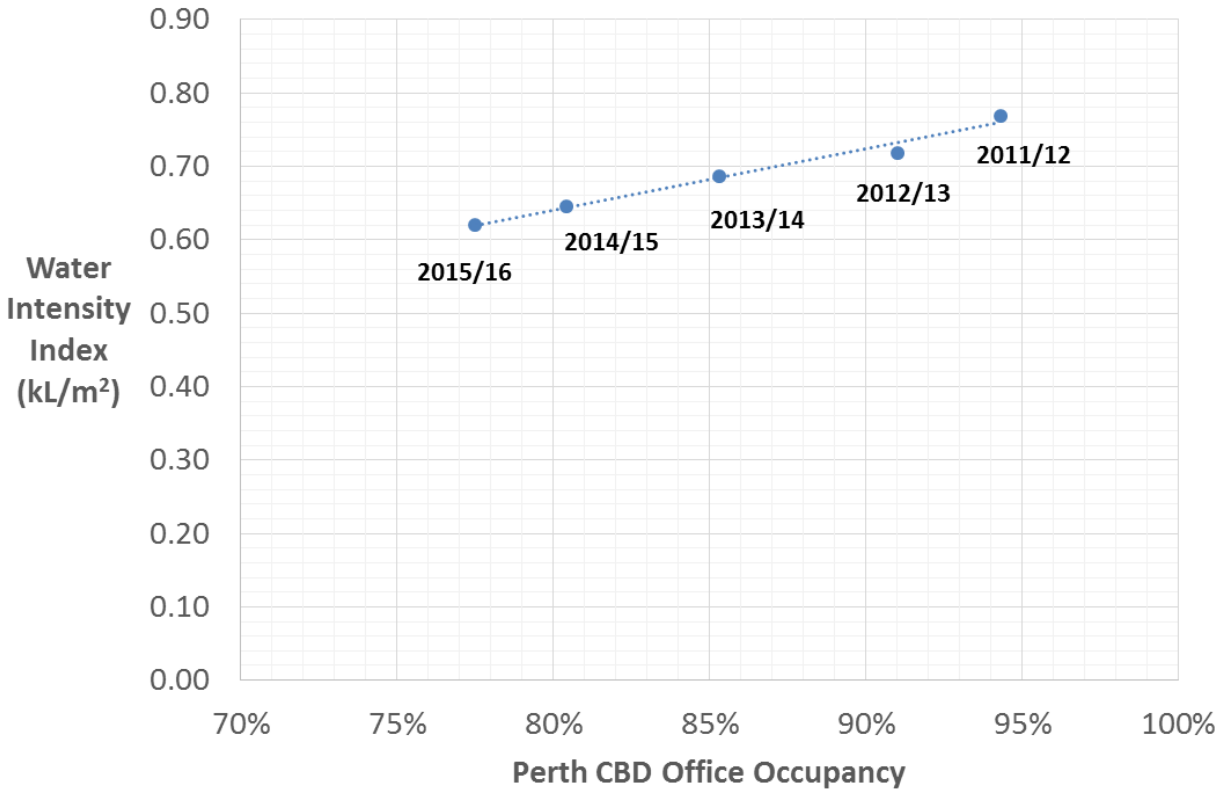

Figure 4. *Water Intensity Index (kL/m^2) with respect to occupancy for the past five fiscal periods.*

The proportion of total building water consumption related to occupancy has been derived from HFM's water audit database for commercial buildings:

- For a typical water cooled building, on average;
  - **65%** of water consumption is directly related to *occupancy* (amenities, domestic use and end-of-trip facilities)
  - **35%** of water consumption is related to *base building* consumption (mechanical plant, cleaning, base flow)

- For a typical air cooled building, on average;
  - **75%** of water consumption is directly related to *occupancy* (amenities, domestic use and end-of-trip facilities)
  - **25%** of water consumption is related to *base building* consumption (mechanical plant, cleaning, base flow)

Therefore, the fraction of whole of building water consumption impacted by occupancy is considered to be 70%. For example, if building occupancy decreases by 10%, we would expect a 7% decrease in building consumption. This premise enables quantification of water consumption trends within the commercial office market and the relative impact of occupancy and efficiency. Figure 5 illustrates the relationship graphically.

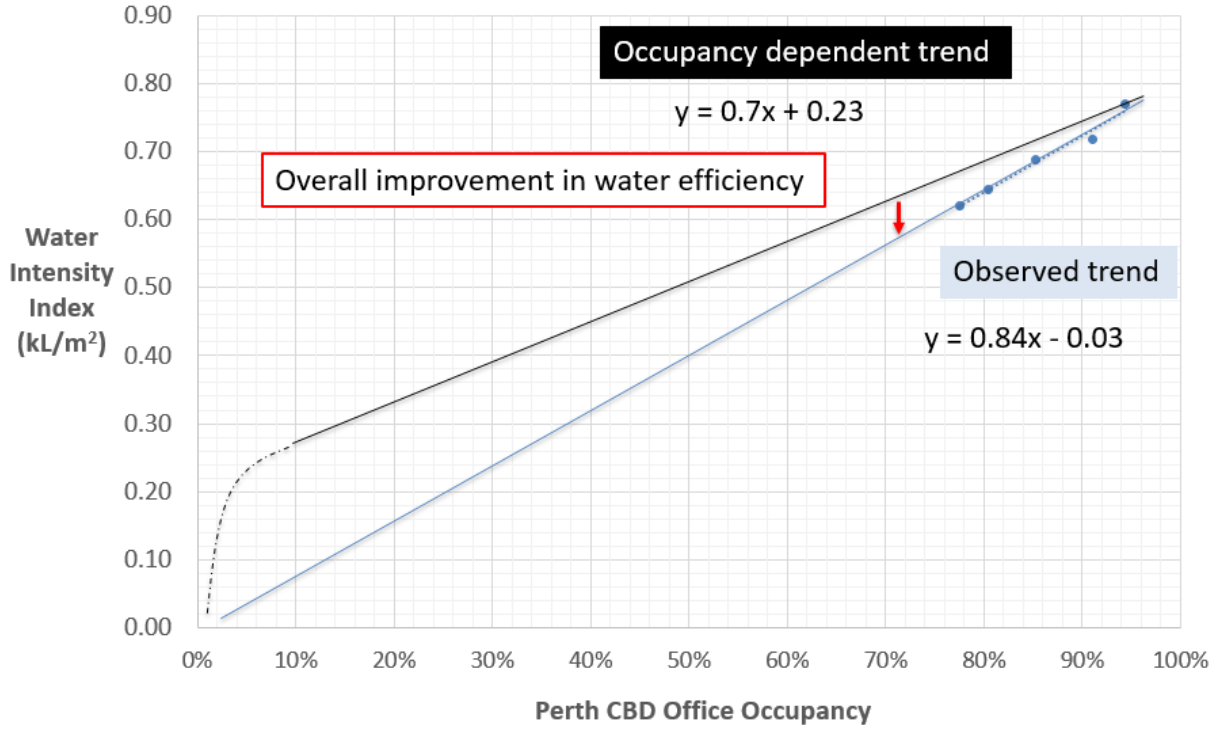

Figure 5. *Observed water consumption trend and vacancy dependent trend with respect to occupancy.*

It is observed that the water intensity index for the Perth building stock (> 5000 m^2) has improved at a greater rate than can be accounted for by vacancy trends alone.
For example;

- Between 2011/12 and 2015/16, occupancy has reduced by 17%.
- The associated vacancy dependent water consumption decrease is 17% x 70% = 12%, or 0.094 kL /m^2.
- The observed water reduction over the same period was 19%, or 0.15 kL/m^2.

It can be concluded that the water intensity index for the Perth building stock has improved at a rate which cannot simply be accounted for by the influence of office vacancy rates alone. This suggests that overall water efficiency continues to improve in the commercial office sector. This is likely driven by improvements related to refurbishment projects, as well as the improving behaviour and management practices by building operators.

Programs that drive awareness; such as the Waterwise Office Program, and NABERS Water ratings are considered to have made a significant contribution to this behavioural change.

5.4 Filtered Baseline Averages – Categorised by Area

More detailed KPI's have also been developed by HFM during this project. It is conceivable that these may be integrated into the Commercial Office Waterwise Program in the future. However at this stage, and as the program continues to make traction in the sector, the intent remains to keep it as simple as possible.

Additional to the project brief, we undertook a deeper level of analysis and categorised the water usage outcomes into the following building NLA categories:

- 5,000 to 10,000 m^2
- 10,000 to 20,000 m^2
- > 20,000 m^2.

Table 4: *Average water consumption by NLA category.*

Building Area	5,000 – 10,000 m^2	10,000 – 20,000 m^2	> 20,000 m^2
Sample Size	36	26	20
Water Cooled	0.637	0.619	0.639
Air Cooled	0.606	0.528	0.345

The outcomes provide an insight into the changing water usage patterns that exist between building sizes and prompts the requirement to better understand why these differences exist.

Our research identifies a number of reasons for the variance. Some major influences include management intensity and maintenance practices, which appear to vary with building size. In addition, plant types also vary extensively. These and other variables have an influence on water efficiency (For example: Office buildings over 20,000 m^2 tend to have additional supplementary condenser water systems to serve computer suites, and other forms of supplementary air conditioning plant.)

6 Waterwise Office Program

The performance categories listed below form the basis of the Waterwise Office Program for water cooled (Table 5) and air cooled (Table 6) buildings respectively. In each table the 2013/14 category distribution has been compared to what is calculated for 2015/16. There has been an increase in the number of buildings which are placed in the higher categories – this is due to the impact of vacancy as well as water efficiency overall.

The NABERS water rating scale has been used as the yardstick for the Waterwise Office Program reward criteria. This was recommended during the development of the Waterwise program in 2013 with consideration and consultation with the before mentioned stakeholders. It is recommended that category consumption benchmarks are maintained at the same values, to such a time that commercial office vacancy rates stabilise.
The water performance and Waterwise award criteria are as follows:

Table 5: *Water Cooled – Recommended Scale.*

Performance Category	2015/16 Consumption Benchmark kL /m^2	Waterwise Award Structure	Number of Buildings (2013/14)	Number of Buildings (2015/16)	NABERS Water Consumption Scale – Perth	NABERS Water Rating (stars)
Poor		Participant Certificate	15	7	> 1.01	< 2.5
Below Average			5	12	1.01 – 0.86	2.5 – 3.0
Baseline	0.86	Bronze	13	10	0.86 – 0.75	3.0 – 3.5
Average	0.75	Silver	17	19	0.75 – 0.61	3.5 – 4.0
Above Average	0.61	Gold	16	20	0.61 – 0.48	4.0 – 4.5
Best Practice	0.48	Platinum	12	18	0.48 – 0.35	4.5 – 5.0

Table 6: *Air Cooled – Recommended Scale.*

Performance Category	2015/16 Consumption Benchmark kL /m^2	Waterwise Award Structure	Number of Buildings (2013/14)	Number of Buildings (2015/16)	NABERS Water Consumption Scale – Perth	NABERS Water Rating (stars)
Poor		Participant Certificate	4	1	> 1.01	< 3.0
Below Average			2	1	0.86 – 0.75	3.0 – 3.5
Baseline	0.71	Bronze	1	5	0.75 – 0.61	3.5 – 4.0
Average	0.61	Silver	7	3	0.61 – 0.48	4.0 – 4.5
Above Average	0.48	Gold	4	5	0.48 – 0.35	4.5 – 5.0
Best Practice	0.35	Platinum	5	6	< 0.35	> 5.0

7 Future Directions

The fundamental future directions of this study are aligned with the intent of the Waterwise Office Program. That is to motivate the office market and drive innovation and continued improvement towards water efficiency best practice. The key to driving water efficiency in office buildings, or any facility for that matter, is in delivering a better understanding of the end uses and usage patterns within a facility.

Hence it is our recommendation in the future years of the Waterwise office program, to take steps to develop a more detailed performance criteria, utilising predetermined sub metering criteria for subsets of water end uses.

It is envisaged that this framework will continue to drive water efficiency practices in commercial office buildings and deliver step change water usage reductions.

A sample of what this may look like is outlined below:

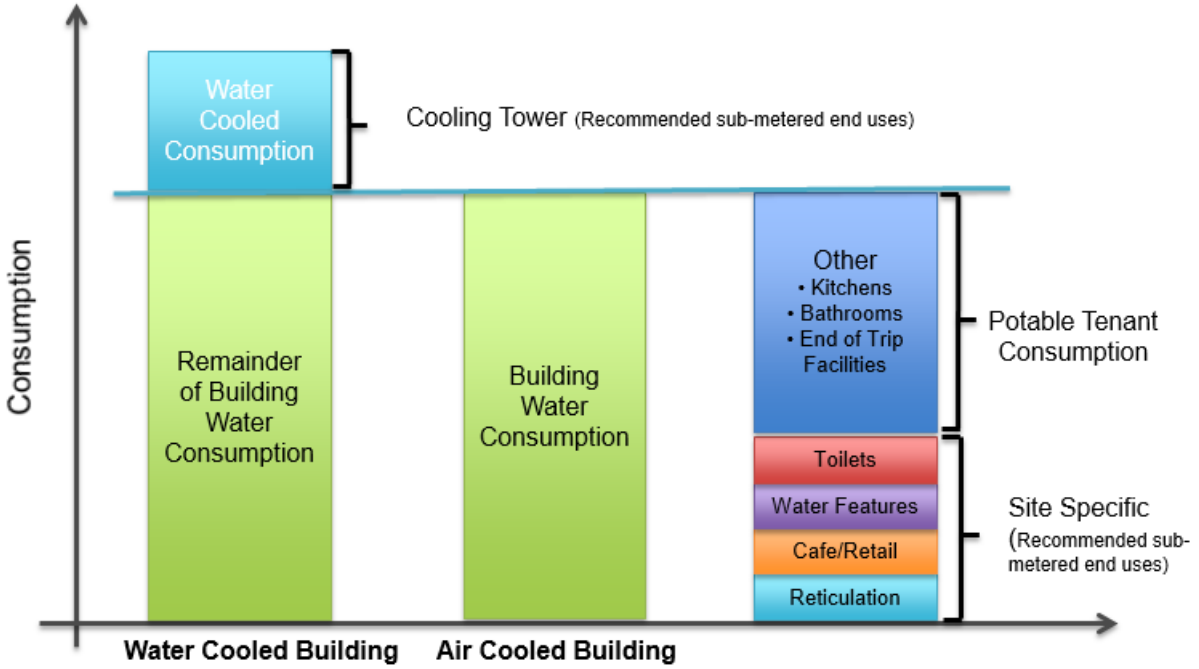

Figure 6: *Future Benchmarking Concept Model.*