# TIC-Report-Impact-Update-Climate-Files-on-NatHERS-2022-Star-Bands

## Development of star bands and implications for changes to star ratings

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# 1 Executive Summary

In 2018 a Preliminary Impact Study was undertaken to determine the impact on energy ratings of updated weather data to see whether new star bands would be needed (Floyd et al, 2018). This project showed that the change in energy demands predicted by Chenath for the updated weather data were so significant that new star bands were recommended to minimise disruption to the industry.

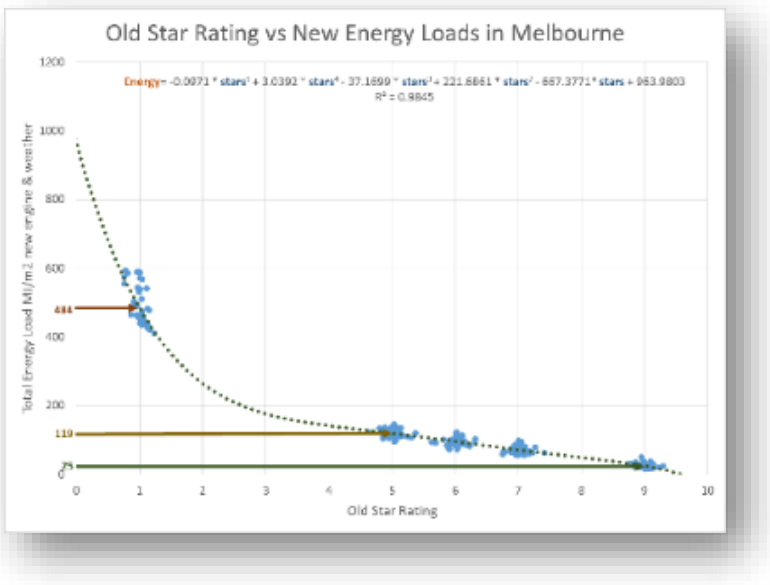
This project develops new star bands for each climate zone using a methodology initially developed in a previous project (Floyd, Isaacs and Marker, 2014). This methodology has been further refined for this project. The methodology is designed to:

- Be easily repeatable: the rating files and analysis spreadsheets for this project allow any future updates to be assessed with far fewer resources than this initial setup,
- Minimise disruption to the building industry by ensuring that the extent of change to star ratings for dwellings is as small as possible: the methodological basis of the process ensures that the net impact on ratings is minimal, and
- Provide concrete examples of the implications of the change to ratings that can be used for industry education or regulatory assessment: eighteen dwellings in each climate zone have been optimised to 5, 6 and 7 stars to provide real world examples of the impacts on a broad range of projects.

The basic methodology of the project is to develop a sample of dwelling designs at 1, 5, 6, 7 and 9 stars in the current version of AccuRate, simulate these dwellings in the new version of AccuRate with the new weather data, and derive a correlation between the old star rating and the new energy loads[1]. Section 2 provides a full explanation of the methodology used.

The old star rating and the new energy loads (blue dots) are plotted on a graph in Excel and a curve of best fit is obtained (dotted green line). The equation of this curve is used to develop the new star bands. An example of this is shown for the Melbourne climate zone in Figure 1 below.

**Figure 1 Graph showing correlation of existing star rating with new energy loads for Climate 21 Melbourne RO**




Source: Floyd et al, 2014

[1] Floyd et al, 2014 showed that with only the 1, 5, 6, 7 and 9 star MJ/m$^2$ thresholds all star bands from 0 to 10 could be predicted with minimal error.

## 1.1 Star Band Scenarios

The inevitable consequence of updating weather data is that for many dwellings the rating will change after the introduction of the updated weather data. This will add an initial adjustment cost to industry as they update ratings for standard plans. To minimise this disruption two star band scenarios have been developed for consideration:

a) To limit the reduction of ratings with the updated weather data to a maximum of 0.2 stars for the dwellings assessed. This ensures that there will be more dwellings which increase their rating than reduce their rating. The net impact on stringency varies across climate zones, but in 90% of climate zones there is an increase to the average rating of dwellings between 0.1 and 0.3 stars i.e. on average it will be require less costly improvements to achieve the same rating level.

b) To limit the star ratings with the updated weather data to an average of zero change across the tested cohort of modelled dwellings at the 6 star point (and 5 stars, as applicable). Individual dwellings still go up and down, but the average change for all dwellings will equal zero (or as close as possible to zero) at the regulatory point. In some circumstances the highest impact on an individual design would be a decrease in the rating greater than 0.2 stars. Under this scenario, a future stringency increase from BAU to 7 stars would have higher costs, but higher benefits.

In section 4 the implications of the new star rating bands are explained in depth for 13 climate zones including all capital cities. Section 3 lists all the current and updated star bands as well as the average change to the rating of the dwellings assessed in this project.

## 1.2 Modifying 10 star rating levels for all Climate Zones

In addition, this project also developed new 10-star rating levels for all climate zones. The current 10-star rating is set to a theoretical concept: that a 10-star dwelling should have no requirement for heating or sensible cooling (other than to reduce humidity). This has proved to be problematic in a more severe climate zones. Feedback from NatHERS Assessor Accrediting Organisations suggested that in many climate zones, no matter how good the design or the specification of building materials 10-stars was impossible to achieve. Further, 10-star requires much lower energy demands than other exemplar schemes such as Passive House.

To redefine the 10-star level in each climate the passive solar designed ‘Design for Place’ house was modified to achieve the lowest energy demand for heating and cooling that could be achieved using the highest performing building products available today, as appropriate to the climate zone e.g. double glazing was not required for hot climates with no heating demand. Further, the CSIRO data portals were examined to determine the highest ratings which have been achieved in the field to make sure that the 10-star house met or exceeded the highest performance levels ever achieved.

The new 10-star rating levels are all set to a higher number of MJ/m$^2$ than is currently used in NatHERS. In hot humid climates like Darwin, the new 10-star level represents around 8.6 stars – a level that has never been reach in Darwin so far. In cool climates like Melbourne the new 10-star level represents around 9.5 stars. This rating level has only been exceeded by a handful of houses. In milder climates like Brisbane or Sydney, the new 10-star level represents closer to 9.8 stars in the current system. The new 10-star levels are a ‘stretch goal’, but they are achievable. Making 10-stars more achievable will encourage more designers to attempt to achieve it.

Redefining the 10-star level to lower the performance required to achieve it has implications for lower star rating bands. The six-star level was kept fixed at the level achieved through the correlation process above, and the 7- to 9-star bands adjusted to provide a smooth progression to the 10-star level. This will have the impact of slightly lowering the performance required at 7 stars. This is an important consideration in light of the proposed regulatory developments for 2022.

## 1.3 Updating Climate Files

The development of hourly weather data files for use with simulation tools has had a difficult history. In the past, there have been many problems with the quality of these files e.g. solarimeters losing calibration, applying solar data from one site to another or using interpolations of three hourly data. Updating weather data files is needed to ensure that the best possible data is used. As the quality of climate data, improves, the design will become more and more climatically appropriate. Further, we live in a world where the climate is changing. Regular updates to climate data will therefore be needed more frequently in future.

This project has developed an easily repeatable methodology for updating climate data to assist government to respond to the needs of the future in a warming world. The new star bands it has developed are designed to minimise the disruption to the building industry that updating climate data will cause. The new 10-star level is set to a very high but achievable level of performance that will encourage more designers to attempt to reach this and other star rating levels above minimum regulatory compliance.

**Observations regarding the development of star bands which produce a 0-average change at 6 stars.**

Additional sections have been added at the request of the NatHERS Administrator showing the impact on ratings if star bands were developed to provide a zero-average change at 6 stars in each climate. The impacts on the 13 base climates are described in detail in Section 4. To see a summary of the impacts for all climates see Section 9 "Appendix 3: Impact of rating change sorted into categories for all 69 climates with average rating change at 6 stars held to 0". Note that the largest changes e.g. rating changes in excess of -0.5 stars, occur outside the 13 base climates.

In Adelaide, Canberra and Hobart the rating changes for star bands developed to limit rating reductions and to keep rating changes at 6 stars at an average 0 are virtually identical. In a number of other climates, the extent of difference in minimal. Section 3.3 shows the star bands developed with both methods and the average change to the rating at 6 stars for each. This shows there are many climates where the extent of the average rating change at 6 stars is not large using the rating reduction limit method.

In general, the climates where containing the extent of rating change was most difficult were those climates which are relatively mild like Brisbane, Mascot or Carnarvon. In such climates small changes to weather data can lead a few MJ/$m^2$ change to energy load predictions which represents a significant star impact because the star bands width is small compared to other climates. In addition, where the existing climate data may not be of high quality, the extent of rating change is difficult to contain because the old weather data may simply not be the best representation of the climate e.g. Willis Island.

There were some climates where the balance of heating and cooling changes significantly. Section 10 "Appendix 4 Change to heating and cooling loads at 5, 6 and 7 stars" shows changes to heating and cooling loads. These climates also present issues with containing the extent of rating change because the relative importance of heating and cooling changes. There were only around 7 of the 69 climates where this presented a significant issue.

**Additional Information regarding the methodology**

In many climates (but not all) Class 2 dwellings show a relative reduction in their rating compared to Class 1. On balance the consultant team felt that this did not warrant separate star bands for Class 2 dwellings. Firstly, the extent of the difference was less than 0.3 stars. Secondly, in a number of climates it was clear that there was significant scope to redesign to meet the new rating using methods which would lower construction costs e.g. using smaller window areas in those climates where window areas in Class 2 dwellings are able to be very much higher than Class 1. Evaluation of cost impacts is beyond the scope of this project.

The basic methodology of this project is to derive the new star bands by correlating old ratings with energy loads predicted using the updated weather data, regardless which star band derivation method is used. To an extent this is based on a presumption that the rating of dwellings should, on average, remain the same

with the updated weather data. Preserving ratings as much as possible minimises the disruption to the regulatory application of the NatHERS. It can be argued that, in fact, the current market response to achieving compliance should change in the light of a more accurate description of climate conditions. Maintaining current rating levels is not necessarily at odds with maintaining current ratings. If the change to weather data favours more climatically appropriate design, then adopting these strategies will lower construction costs and the market will adapt to this over time.

**Further information on the development of the rating reduction limited star bands**

The work for this project showed that very few ratings will be maintained at exactly the same level with the updated weather data. This will cause some initial disruption to the assessor and building industry as they work out how NatHERS rewards different design strategies with the new climate data. This will take some time, and, in the first instance, it is possible that sub-optimal decisions will be made.

The consultant team developed the initial approach of limiting rating reductions because we felt this would minimise industry disruption during the transition to the new weather data. It is easier to select those design changes which will slightly lower performance than find those that improve performance. The rating reduction limited star bands will see more ratings increase than decrease and this will make it easier for industry to adapt. This approach would also make it easier to transition to higher stringency levels proposed for NCC 2022.

Limiting rating reduction to a maximum of -0.2 stars may be seen as effectively lowering standards across the board through the introduction of new weather data. This is not the case. This methodology affects the average rating at 6 stars by less than 0.2 stars in 53 of the 69 climates. These climates represent over 80% of the Class 1 ratings in the CSIRO NatHERS dashboards. In 44 climates (76% of Class 1 construction) the average change at 6 stars is less than 0.1 stars. The table below provides more information on the extent of the average change to ratings at 6 stars using the rating reduction limited methodology.

The rating reduction limited methodology was developed for those climates where the updated weather data caused significant changes to ratings in an attempt to minimise disruption to industry. Significant changes to ratings may happen because the original weather data was of low quality. Significant changes to ratings can also occur in climates with low energy loads as discussed above. Brisbane (0.34 stars average change at 6 stars) and Mascot (0.23) are two examples of mild climates which experience larger rating changes. While the change in ratings is larger in these climates, the actual change to the energy loads is small compared to more severe climates.

| Average Rating Change at 6 stars | No Climates | Percent of Class 1 construction since May 2016 |
|---|---|---|
| **Between -0.1 and 0.0** | 26 | 29.9% |
| **Between 0.0 and 0.1** | 18 | 46.3% |
| **Between 0.1 and 0.2** | 9 | 3.6% |
| **Between 0.2 and 0.3** | 7 | 9.3% |
| **Between 0.3 and 0.4** | 8 | 10.8% |
| **Between 0.7 and 0.8*** | 1 | 0.0% |

* There have been significant known problems with the climate data at Willis Island. In this climate, using the rating reduction limited methodology, the average rating at 6 stars increases by 0.7 stars. Only 60 dwellings have been rated in this climate since May 2016.

# 2 Methodology

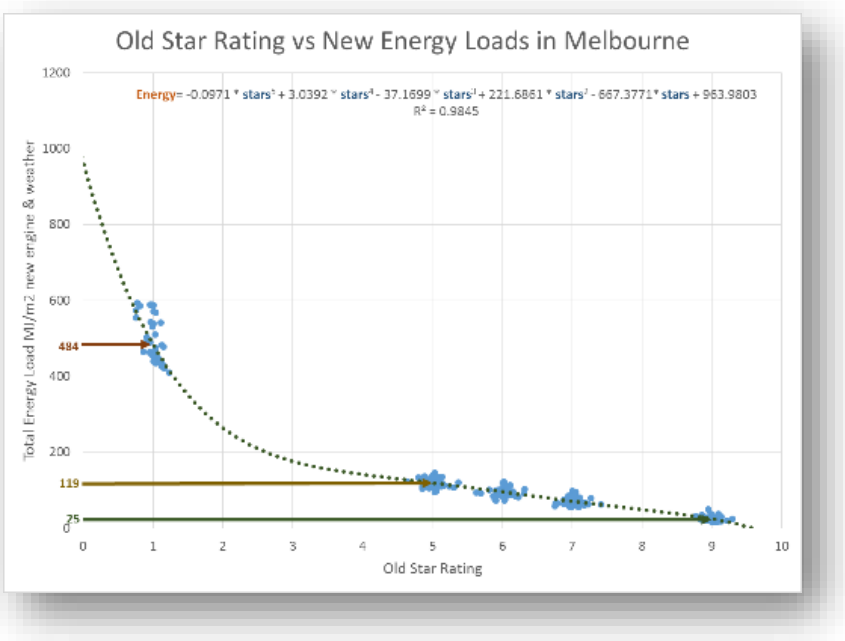
Updated weather data has been developed for the 69 NatHERS climate zones. When weather data changes the energy demand for heating and cooling predicted by simulation tools will also change. As a result, the star band thresholds i.e. the MJ/m2 figures that represent each star rating level will need to be adjusted so that changes to ratings are kept to a reasonable minimum. A Preliminary Impact Study was conducted in 2018 (Floyd et al 2018). This project showed that the use of new weather data would lead to an unacceptable change to the star rating of dwellings without the development of new star band thresholds. Further, this project found that even small changes to weather data can lead to significant changes to predicted energy demand. This project develops re-calibrated star band thresholds for the updated weather data.

## 2.1 Overview: Adjusting star bands for updated climate data

The basic approach to developing star bands is to develop a sample of dwelling designs at 1, 5, 6, 7 and 9 stars in the current version of AccuRate, simulate these dwellings in the new version of AccuRate with the new weather data, and derive a correlation between the old star rating and the new energy loads[2].

The old star rating and the new energy loads (blue dots) are plotted on a graph in Excel and a curve of best fit is obtained (dotted green line). The equation of this curve is used to develop the new star bands. An example of this is shown for the Melbourne climate zone in Figure 2 below.

**Figure 2 Graph showing correlation of existing star rating with new energy loads for Climate 21 Melbourne RO**




Source: Isaacs et al, 2015

The advantage of the correlation approach is that it ensures that the average difference in star ratings across the house sample will be zero and therefore minimises the impact of the change to weather data on changes to ratings and cost of compliance.

[2] Isaacs et al, 2015 showed that with only the 1, 5, 6, 7 and 9 star MJ/m$^2$ thresholds all star bands from 0 to 10 could be predicted with minimal error.

Eighteen dwellings are simulated in each climate zone. The dwellings represent a broad range of designs e.g. volume builder Class 1 dwellings at less than ideal orientation, passive solar and well-ventilated dwellings at optimum orientation, semi-detached dwellings and apartments at a variety of orientations and levels. In developing versions of each dwelling at the various rating levels, particular care was taken to ensure that cost-effective methods are used to upgrade star rating from 5 to 6 to 7 stars. Plans for these dwelling are shown in Section 7 Appendix 1: Dwelling Plans used for this project. A slightly different sample of dwellings was used in each climate zone based on the availability of AccuRate file from previous projects. The dwelling used in each climate zone are described in Section 2.5.

The following sections describe the methodology for adjusting the star band thresholds. It explains the:

2.2 Fine tuning of the star bands,

2.3 Methodology for adjusting 10 stars,

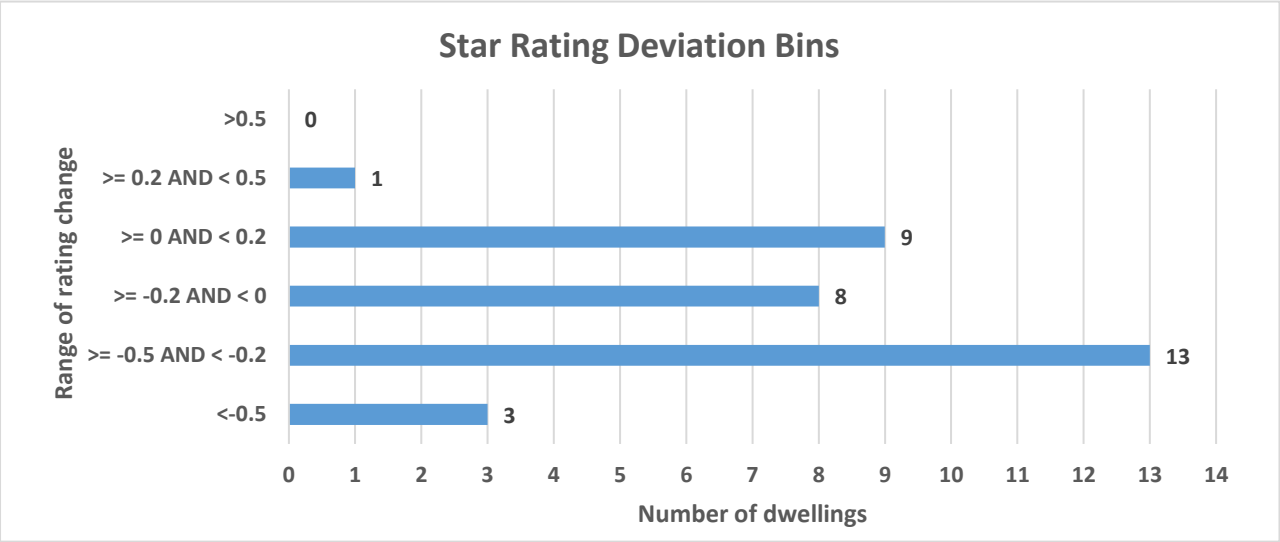
2.4 How changes to ratings at current regulatory minimums are reported,

2.5 Techniques used to minimise resources required to develop star bands through using dwellings developed for base climates where the rating in these climates correlates well with ratings in other climates, and

2.6 The sample of dwellings used in each climate.

## 2.2 Fine tuning star bands

While the correlation approach guarantees that the average change in star rating will be zero, the changes to individual houses can exceed 0.5 stars. For example, Longreach star bands derived solely from the correlation between current star rating and energy demands predicted using updated weather data shows the following changes to energy ratings:




The average change to ratings in Longreach is zero, however, 16 of the dwellings had a reduced rating by more than 0.2 stars and only 1 dwelling increased its rating by over 0.2 stars. In other climates, the reverse was true i.e. there were many more dwellings which increased their rating by more than 0.2 stars than reduced their rating by the same amount even though the average rating change was zero. It was clear from this analysis that changing weather data would require some effort from volume builders to fine tune ratings of standard plans to the new 6 stars, and for NatHERS assessors to understand how the updated weather data influenced the value of various energy efficient design features.

In addition to the change to weather data it was also decided to modify the 10-star level. The rationale for this is explained in Section 2.2. This change generally increased the number of MJ/m$^2$ needed to achieve 10

stars i.e. it became easier. In some cases, the new 10-star level represented a dwelling which was closer to the old 9-star level than to 10 stars. This change necessitated adjustments to the star bands below 10 stars in order to maintain a smooth transition from one star rating to the next. The point at which star bands are adjusted to take account of the higher ten star threshold will also affect the change in rating at regulatory levels e.g. if star bands are modified from 1 star onwards the 5 and 6 star rating threshold will increase making the rating easier to achieve.

The analysis spreadsheet developed by EES[3] was constructed to allow star bands to be fine-tuned to address these issues:

- the variability of rating results was addressed by reporting the change changes to ratings and allowing various curve fit algorithms to be evaluated and included the ability to scale star bands up or down to minimise rating variability, and
- providing the ability to start the transition to the new 10-star level from a variety of rating levels.

The consultant team analysed literally dozens of different approaches to fine tuning the star bands before deciding on a preferred approach in consultation with the NatHERS Administrator. This final approach to fine tuning the star bands was selected to minimise disruption the building and assessor industries, while at the same time ensuring that the rating of dwellings designed to achieve current minimum compliance would change by as little as possible.

The final fine tuning of the star bands which is shown in this report makes two further adjustments to the star bands over and above the initial correlation between current star rating and energy demand with updated weather data:

- To minimise disruption to the building industry star bands are developed which limit the maximum reduction in rating to 0.2 stars. This has the effect of slightly reducing stringency making it cheaper, on average, to achieve regulatory minimum ratings. This provides compensation for the initial expense of changing standard plans and for the time NatHERS assessors will need to put in to better understand how different design strategies affect the energy rating, and
- The increase to the 10-star rating MJ/m2 only affects the star band thresholds from 7 to 9 stars. This means that current regulatory levels (5 and 6 stars) are not impacted by the increase to the 10 star threshold. It also minimises the change to the 7 star threshold which is under consideration as a minimum regulation in 2022, but does make it slightly easier to achieve, on average, that is the case in the current software.

In general, average changes to ratings are within the range of a 0.1 to 0.3 star increase. The larger increases are found in milder climates with low heating and cooling energy demand where a change of only a few MJ/m2 can have a proportionately higher change to star ratings, or in climate zones where the extent of change to weather data was greater.

This report provides two scenarios where star bands are fine tuned to:

a) limit the maximum reduction in rating to 0.2 stars and
b) the star bands could be re-calibrated to an average change of zero stars, as in the Longreach example, above. The disadvantage of such an approach would, as explained, mean that in most cases, the largest impact on individual dwellings will exceed 0.2 stars. The advantage would be that the relatively large increases in star ratings observed in some climate zones will be moderated. For example, see Figures 15 and 16 for the relatively large star rating increases observed in Longreach due to limiting the decreases to 0.2 stars, compared to the net zero change outlined above.

Ultimately policy will determine the scenario decision.

[3] See Section 8 Appendix 2: Star bands analysis spreadsheet

## 2.3 Reviewing the 10-star level with updated Climate Files

***Current 10-star performance levels have been problematic, and industry has found that obtaining 10-stars in a variety of climates is simply not achievable or can only be achieved by rating the dwelling without following NatHERS Technical Note 1 data entry rules for zoning.*** To ensure that 10-stars is achievable, but still a stretch goal, the Design for Place house is improved to achieve the highest level of performance that is possible with current energy efficient product technology:

- Insulation levels are set to R4.0 in walls and R8.0 in ceilings/roofs. This is the highest level that can be installed in conventional framed construction without increasing framing member size.
- A high level of internal mass is used. Floors are assumed to concrete slab on ground with ether polished or ceramic tile finish. Internal walls are assumed to be either concrete block or brick as appropriate to the construction practice in the climate. Wall insulation is placed on the outer side of the thermal mass in the external wall. Note that in the Design for Place house some of the external walls are assumed to be light weight framed construction, so not all external walls are assumed to have high thermal mass.
- Windows are assumed to have the highest performance level appropriate to the climate. In cool climates the highest performance double glazing in a thermally broken aluminium frame available is used. This translates to a maximum U value of 2.0 and a minimum SHGC of 0.5. In mild and hot climates e.g. from Sydney to Darwin, a window with single low e glazing is used. In mild climates a thermally broken/low U value aluminium or timber frame is used, while in hot climates a timber framed window is used. In climate zones with higher cooling loads a low SHGC glazing product is used. To ensure adequate natural lighting a minimum SHGC of 0.3 is applied.
- Windows are assumed to be highly openable in mild and hot climates to maximise the benefit of internal air movement in reducing cooling loads e.g. bi-fold or stacker doors, louvre or casement windows. In addition ceiling fans are used in all habitable rooms in the house to provide comfort through air movement when external windspeeds are low. The number and size of ceiling fans are optimised to the size of the room and the climate. In some milder climates the energy demand of providing more than one ceiling fan can exceed the cooling energy demand reductions.
- Window area in the base version of the Design for Place house is quite high: 64.4 m2 in a house with a Net Conditioned Floor Area (NCFA) of 147.1m2 i.e. a window to floor area ratio of 44%. This is almost double the size of windows at 6 stars found in the CSIRO data portal. Despite this high window area, because the house has well oriented windows, the house can achieve current minimum regulatory levels. Window sizes are reduced in the 6 and 7 star level to mirror findings from the CSIRO data portal. Some further reduction in window area is applied at 10-star as appropriate to the climate e.g. in cool climates with high performance double glazing changes to window area have a minimal impact on the rating so smaller reductions in window area are made in these climates. In hot climates further reductions to window area continue to lower cooling loads so some additional modest window area reductions are applied. Window area reductions at the 10-star level still maintain the aesthetic of the house and are not set to provide the minimum cooling loads in hot climates. In these climates, setting window size to the NCC minimum and providing additional air movement through large insulated openings would provide the lowest cooling demand.
- The house is oriented to minimise heating and cooling loads. In hot climates this will mean facing living area south while in cool climates living areas face north. In some climates, in order to make best use of natural ventilation, an orientation of due south may not adequately capture prevailing wind directions, for example, in Darwin the best orientation for this house was to orient living room windows to 210o.

If the 10-star level is set at a higher MJ/$m^2$ level than currently applies, this will also increase the thresholds for lower rating levels. When this occurs, the rating threshold for 6 stars is fixed to the value which correlates with the current 6 stars level i.e. the minimum requirement of the NCC, and star band thresholds from 7 to 9 stars are increased.

## 2.4 Adjusting the star bands – 'limiting the impact'

Once the correlation between current rating and new energy demand has been developed to derive adjusted star bands, the impact of the new weather data on the star rating at the regulatory level appropriate to the climate zone is analysed into 3 groups:

a) Less than or equal to 0.2 star change,
b) Between 0.2 and 0.5 star change, and
c) Greater than 0.5 star change.

After this initial analysis the star bands are further fine tuned to minimise the **reduction** in ratings of dwellings to a maximum of 0.2 stars. While this makes star rating levels slightly easier to achieve with the updated weather data and adjusted star bands, limiting the rating change in this way minimises the extent of work industry will need to do to implement the change.

Note that the final step of evaluating the extent of changes to current designs needed to restore the dwellings to their current rating level is not part of this project. This will be needed if these dwellings were used for regulatory evaluation.

The dwelling sample described in section 2.5 below, contains a broad variety of dwelling types including volume builder and passive solar houses, semi-detached houses and apartments. The impact on star ratings is analysed for all these types and reported.

### 2.4.1 Differences between Class 1 and Class 2 dwelling rating changes

In a previous project which developed star bands for an earlier set of changes to weather data[4], increases to wind speed in the revised weather data showed that, in some climates, this had the effect of lowering ratings in apartments and increasing the rating of houses. This was due to the greater opportunity to reduce cooling demand provided by cross ventilation in houses which have openings on all 4 sides. This was particularly pronounced in CZ17 Sydney Regional Office. This climate zone only applies to a small area of inner Sydney where virtually all new dwellings are Class 2 (4638 Class 2 compared to 351 Class 1 since May 2016 in the CSIRO dashboards).

This issue can be addressed by limiting the extent of change to ratings to a maximum of a 0.2-star reduction. This ensures that in CZ17, adopting the updated weather data does not adversely affect the rating of the predominant dwelling class. However, if this issue is found in climate zones where Class 2 dwellings do not predominate the increase in the rating of Class 1 dwellings may not be acceptable. In this case it may be preferable to develop separate star bands for each Class of dwelling. In Section 4 the impacts of the updated weather data on all dwellings simulated in the climate zone are shown. Where the change to the rating of the two Classes of dwellings are significantly different, this is highlighted. In general terms the extent of change between the two dwelling classes was not sufficient to warrant the development of separate star bands for each class while the issue in CZ17 Sydney RO has been adequately dealt with by limiting rating reductions to a maximum of 0.2 stars.

While this report focuses on the 13 base climates described below, Section 9 Appendix 3 shows average change to star ratings across all dwellings and reports changes to the rating for Class 1 and 2 separately in all climate zones.

[4] Isaacs et al 2015

## 2.5 Sample dwellings

All of the dwellings required to derive the new star bands have been entered into AccuRate. There are 18 dwellings in each climate zone. These dwellings represent a range of sizes and typologies as well as designs which should be well suited to specific types of climates e.g. passive solar or tropical well-ventilated designs. All Rating files have been subject to Quality Assurance checking.

**Table 1 Class 1 dwellings used in each climate zone**

| File Code | Description | Floor | 1 Darwin | 3 Longreach | 4 Carnarvon | 6 Alice Springs | 8 Moree | 10 Brisbane | 13 Perth | 16 Adelaide | 21 Melbourne | 24 Canberra | 26 Hobart | 32 Cairns | 56 Mascot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SBH01_SLA | Large detached 2 Story | CSOG | ■ | | ■ | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| SBH01_TIM | | Timb. | ■ | ■ | | ■ | | ■ | ■ | ■ | ■ | ■ | ■ | | ■ |
| SBH02_SLA | Medium detached 1 Story | CSOG | | ■ | | ■ | | ■ | | ■ | ■ | ■ | ■ | | |
| SBH02_TIM | | Timb. | | | ■ | | | | | | | | | ■ | |
| SBH03_SLA | Medium detached 2 Storey, Passive Solar | CSOG | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| SBH03_TIM | | Timb. | | | | | | | | | | | | | |
| SBH04_SLA | Medium detached 1 Storey | CSOG | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| SBH04_TIM | | Timb. | | | | | | | | | | | ■ | ■ | ■ |
| SBH05_SLA | Small detached A, 1 storey | CSOG | ■ | | ■ | | ■ | | ■ | ■ | ■ | ■ | | ■ | ■ |
| SBH05_TIM | | Timb. | | ■ | | ■ | | ■ | | ■ | ■ | ■ | ■ | | |
| SBH06_SLA | Small Detached B, 1 storey | CSOG | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| SBH06_TIM | | Timb. | ■ | | ■ | | ■ | | ■ | | | | | | |
| SBH07_TIM | Well Ventilated House, Medium | Timb. | | | | | | | | | | | | ■ | |
| SBH08_TIM | Well Ventilated House, Small | Timb. | ■ | | ■ | | | | | | | | | | |
| SBH09_SLA | Hybrid well ventilated house, Medium | CSOG | | ■ | | ■ | ■ | ■ | ■ | | | | | | ■ |
| SBH11_SLA | Passive Solar, Medium | CSOG | | | | | | | | ■ | ■ | ■ | ■ | | |
| SBH15_SLA | Medium Semi Detached, best orientation | CSOG | ■ | | ■ | | ■ | | ■ | | | | | ■ | ■ |
| SBH16_SLA | Medium Semi Detached, worst orientation | CSOG | | ■ | | ■ | | | | | | | | | |
| SBH17_SLA | Small Semi Detached, best orientation | CSOG | | ■ | | ■ | | ■ | | | | | | | |
| SBH18_SLA | Small Semi Detached, worst orientation | CSOG | | | | | ■ | | | | | | | | |
| SBH19 | Passive Solar, Small (DfP) | CSOG | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |

**Table2 Class 2 apartments used in each climate zone**

| File Code | Description | Floor | 1 Darwin | 3 Longreach | 4 Carnarvon | 6 Alice Springs | 8 Moree | 10 Brisbane | 13 Perth | 16 Adelaide | 21 Melbourne | 24 Canberra | 26 Hobart | 32 Cairns | 56 Mascot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SBH20 | Apartment, Middle Unit, Ground Floor, South | Slab | | | | | | | | | | | | | |
| SBH21 | Apartment, Middle Unit, Ground Floor, West | Slab | | | | | | | | | | | | | |
| SBH22 | Apartment, Middle Unit, Middle Floor, North | Slab | | | | | | | | | | | | | |
| SBH23 | Apartment, Middle Unit, Middle Floor, East | Slab | | | | | | | | | | | | | |
| SBH24 | Apartment, Corner Unit, Middle Floor, North | Slab | | | | | | | | | | | | | |
| SBH25 | Apartment, Corner Unit, Middle Floor, West | Slab | | | | | | | | | | | | | |
| SBH26 | Apartment, Corner Unit, Upper Floor, East | Slab | | | | | | | | | | | | | |
| SBH27 | Apartment, Corner Unit, Upper Floor, South | Slab | | | | | | | | | | | | | |

Wall types used are the predominant wall type used in the location as shown in the CSIRO dashboards based on data extracted from NatHERS portals since May 2016 e.g. Concrete Block in Darwin, Brick Veneer in Sydney, Brick Cavity in Perth and precast concrete panels in Apartments.

The plans of the houses used in this project are shown in Appendix 1.

Volume builder detached houses (SBH01, 02, 04, 05, 06) are simulated with the street elevation facing north i.e. less favourable orientation, while Passive solar and well ventilated houses (SBH03, 07, 08, 09, 11 and 19) are simulated with north (in mild or cool climates) or south orientation (in hot climates). This ensures that the dwellings simulated cover a broad range of design solutions to achieving each star rating level. This has been done to ensure that impacts on the rating reported in this project cover a wide range of expected outcomes.

Class 2 apartments (SBH20-27) are simulated at a range of orientations and levels (above a car park, with other dwellings above and below and at roof level). Again, this has been done to ensure that impacts on the rating reported in this project cover a wide range of expected outcomes.

## 2.6 Reducing the resources required to calculate star bands

There are 69 climates and 18 houses at 5 rating levels to be developed for each climate i.e. potentially over 6,000 dwellings to be updated, optimised to specific star ratings, simulated and then record the results. Once these files have been run in the current software with the current weather data, they must be opened in the new software using the new weather data, simulated and the results recorded. To limit the resources required to calculate star bands two strategies were used:

1. Limit the number of climates where 1, 5, 6, 7 and 9 star versions of each dwelling are generated.

   For the correlation between current star rating and new energy demand to work the range of ratings simply needs to extend across the range of 1 to 9 stars and be relatively evenly distributed across this range. It is not necessary for ratings to be exactly 1, 5, 6, 7 and 9 stars to generate the new star bands. By analysing the correlation of ratings for the same dwellings between climates, a subset of climates can be defined where the ratings are broadly similar e.g. Moorabbin ratings correlate well with Melbourne ratings and Mascot ratings correlate well with Coffs Harbour ratings[5].

   This analysis showed that an appropriate range of ratings in each climate zone can be generated using just 13 of the 69 climates. These 13 climates are called *base climates*. The base climate rating files are run in all the climates where the rating in that climate correlates well the base climate. Those climates where the star rating correlates well a base climate are part of the *family of climates* associated with the base climate[6].

   Because the ratings at 5, 6 and 7 stars will be of particular interest to industry and are a potential source of information to assist with the evaluation of regulatory impacts the initial selection of base climates focussed on capital cities where building activity is greatest.

2. The AccuBatch utility was used to run multiple files in multiple climate zones rather than running AccuRate manually for each rating file in each climate.

   The AccuBatch utility uses the scratch file which is created to provide data to the Chenath engine, rather than the data file generated by AccuRate itself. This means that the scratch file must be saved and renamed each time a file is created. The AccuBatch utility outputs energy loads and star ratings to a csv (comma separated variable) file which can be easily opened in a spreadsheet for analysis.

The reduction in the number of climates reduces the extent of rating file generation by over 80%, while AccuBatch reduces the time taken to generate the energy demand in each climate by around 40-90%, depending on the number of climates in each climate family. Overall, these two techniques reduce the resources required to generate star bands by around 95%.

[5] Floyd, Isaacs and Marker, 2014 analysed the correlation between star ratings in different climate zones for a set of 60 houses with a broad range of rating levels. For details see this earlier report which is available from the NatHERS Administrator on request.

[6] House files developed for one climate can be re-run in another climate and have a sufficient range of rating outcomes to allow star bands to be predicted. Using this method substantially reduces the work required to recalculate star bands. To examine which climates could use the house rating files developed for others to successfully calculate star bands a database of ratings including 20 houses in three specifications in all climate zones developed by Floyd Energy for the NatHERS administrator was examined. Capital cities in seven of the eight NCC climate zones used in the RIS were taken as a starting point. Rating files were not developed for Alpine climates because these show a strong correlation with ratings in Hobart, and the number of new houses in these climates zones is small. The key factor is that the extent of correlation produces a sufficient range of ratings for three zones of the curve (low end ratings, transition ratings and high end ratings) p. 29*, NatHERS Star Bands for Proposed 2015 version of Chenath including new weather data, Detailed Report*, Tony Isaacs Consulting, Floyd Energy, Pitt & Sherry 2014

### 2.6.1 Base Climates and Climate Families

Table3 below shows the base climates and their associated family of climates. Ratings generated in the based climates are used to develop star bands in each of their associated climate families.

**Table3 Base climates for development of star bands and the climates allocated to these base climates which use the rating files from the base climate**

| Base Climate | NatHERS zone | Other climates in this Family i.e.<br>files generated in the base climate can be used to generate star bands in these climates |
|---|---|---|
| **Adelaide** | 16 | 27, 28, 47, 48, 49, 53 |
| **Alice Springs** | 6 | 19, 40, 41, 42, 43 |
| **Brisbane** | 10 | 9 |
| **Cairns** | 32 | 5, 7, 31, 35, 36 |
| **Canberra** | 24 | 14, 20, 57, 65, 66 |
| **Carnarvon** | 4 | |
| **Darwin** | 1 | 2, 29, 30, 33 |
| **Hobart** | 26 | 23, 25, 59, 67, 68, 69 |
| **Longreach** | 3 | 34, 37, 38, 39 |
| **Melbourne** | 21 | 18, 22, 55, 58, 60, 61, 62, 63, 64 |
| **Moree** | 8 | 45, 46 |
| **Perth** | 13 | 12, 44, 50, 51, 54 |
| **Sydney (Mascot)** | 56 | 11, 15, 17, 52 |

With only 18 files at 5 rating levels produced in each base climate there may be insufficient dwellings available to achieve an acceptable correlation, particularly in non-base climates. To overcome this potential limitation the rating files from other climates are run in addition to the base climate files as shown in Table 4.

**Table4 Additional rating files developed for other climates run in all climates allocated to each base climate**

| **Base Climate Group**<br>**Based on NatHERS Climate Zone** | Rating files developed for these climates also modelled in in addition to base climate files | |
|---|---|---|
| **1 Darwin** | 32 | 10 |
| **3 Longreach** | 8 | 6 |
| **4 Carnarvon** | 6 | 10 |
| **6 Alice Springs** | 3 | 8 |
| **8 Moree** | 6 | 3 |
| **10 Brisbane** | 4 | 56 |
| **13 Perth** | 16 | 56 |
| **16 Adelaide** | 56 | 21 |
| **21 Melbourne** | 24 | 26 |
| **24 Canberra** | 21 | 26 |
| **26 Hobart** | 21 | 24 |
| **32 Cairns** | 10 | 1 |
| **56 Sydney (Mascot)** | 13 | 16 |

# 3 New Star bands

## 3.1 Star bands with -0.2 star floor to rating change

The tables below compare the current star band thresholds for the current weather data (Cur), and the adjusted star bands based on updated weather data (Adj) in all 69 NatHERS climates from 1 to 10-stars. Star bands were calculated from 0 to 10 stars in 0.1-star jumps. The 1-star jumps are shown below for brevity.

In the table below, the average change to the rating for all dwellings simulated at the 6-star level with the updated weather and adjusted star bands is shown in the last column to provide an indication of the net impact on stringency. Note that the extent of change to the average rating depends on the extent to which the current and updated weather data matches. The closer the match, the less the change in the rating. Section 4 explains the impacts on star ratings in greater detail for all the base climate zones as described in Section 2.6.1 above.

Section 3.2 shows the star bands if the average change to star ratings with the updated weather data is kept to 0 at 6 stars. Note that keeping the change to exactly zero requires many iterations. To contain the work required within the time, for the purposes of this report a 0-change means that the average change is less than 0.05 stars.

**Table 5 Star band thresholds from 1 to 10 stars: Current and Adjusted with no rating change less than -0.2 stars**

| CZ No | Climate | Current/Adjusted | Star Rating | | | | | | | | | | Average rating change @ 6 stars |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| **1** | Darwin | Cur | 773 | 648 | 555 | 480 | 413 | 349 | 285 | 222 | 164 | 119 | |
| | | Adj | 757 | 641 | 547 | 438 | 407 | 346 | 303 | 260 | 221 | 190 | 0.16 |
| **2** | Port Hedland | Cur | 569 | 455 | 373 | 310 | 260 | 215 | 172 | 131 | 93 | 62 | |
| | | Adj | 619 | 517 | 431 | 327 | 298 | 245 | 206 | 168 | 133 | 105 | 0.36 |
| **3** | Longreach | Cur | 550 | 396 | 294 | 226 | 178 | 141 | 107 | 74 | 43 | 18 | |
| | | Adj | 517 | 395 | 292 | 188 | 165 | 133 | 105 | 77 | 50 | 29 | 0.39 |
| **4** | Carnarvon | Cur | 181 | 137 | 105 | 82 | 66 | 53 | 41 | 31 | 22 | 14 | |
| | | Adj | 195 | 149 | 116 | 81 | 72 | 56 | 46 | 37 | 29 | 22 | 0.16 |
| **5** | Townsville | Cur | 309 | 259 | 218 | 183 | 153 | 127 | 103 | 81 | 61 | 44 | |
| | | Adj | 332 | 285 | 242 | 188 | 172 | 143 | 122 | 103 | 85 | 70 | 0.26 |
| **6** | Alice Springs | Cur | 562 | 385 | 269 | 196 | 148 | 113 | 84 | 56 | 29 | 7 | |
| | | Adj | 580 | 409 | 277 | 161 | 139 | 108 | 83 | 58 | 35 | 16 | 0.19 |
| **7** | Rockhampton | Cur | 295 | 222 | 171 | 136 | 110 | 90 | 71 | 54 | 38 | 24 | |
| | | Adj | 345 | 269 | 211 | 151 | 136 | 111 | 87 | 66 | 46 | 28 | 0.18 |
| **8** | Moree | Cur | 481 | 315 | 214 | 155 | 119 | 94 | 71 | 47 | 24 | 7 | |
| | | Adj | 555 | 337 | 216 | 135 | 121 | 98 | 78 | 57 | 36 | 21 | 0.18 |
| **9** | Amberley | Cur | 334 | 226 | 157 | 113 | 85 | 67 | 52 | 38 | 24 | 12 | |
| | | Adj | 340 | 253 | 178 | 103 | 88 | 68 | 53 | 39 | 26 | 14 | 0.02 |
| **10** | Brisbane | Cur | 203 | 139 | 97 | 71 | 55 | 43 | 34 | 25 | 17 | 10 | |
| | | Adj | 233 | 177 | 129 | 81 | 71 | 57 | 47 | 37 | 28 | 20 | 0.34 |
| **11** | Coffs Harbour | Cur | 232 | 153 | 103 | 73 | 55 | 44 | 34 | 24 | 15 | 7 | |
| | | Adj | 240 | 149 | 101 | 65 | 57 | 46 | 36 | 26 | 17 | 9 | 0.22 |
| **12** | Geraldton | Cur | 285 | 191 | 132 | 96 | 73 | 57 | 43 | 29 | 16 | 5 | |
| | | Adj | 271 | 175 | 118 | 74 | 65 | 51 | 39 | 27 | 16 | 6 | -0.05 |
| **13** | Perth | Cur | 387 | 251 | 167 | 118 | 89 | 70 | 52 | 34 | 17 | 4 | |
| | | Adj | 434 | 301 | 208 | 123 | 106 | 82 | 63 | 44 | 27 | 13 | 0.17 |

| CZ No | Climate | Current/Adjusted | Star Rating 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Average rating change @ 6 stars |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **14** | Armidale | Cur | 661 | 451 | 314 | 227 | 169 | 128 | 93 | 60 | 27 | 1 | |
| | | Adj | 821 | 594 | 425 | 258 | 220 | 162 | 123 | 86 | 49 | 20 | 0.06 |
| **15** | Williamtown | Cur | 349 | 232 | 159 | 114 | 86 | 67 | 50 | 34 | 19 | 6 | |
| | | Adj | 357 | 209 | 134 | 90 | 83 | 68 | 53 | 39 | 25 | 13 | 0.06 |
| **16** | Adelaide | Cur | 480 | 325 | 227 | 165 | 125 | 96 | 70 | 46 | 22 | 3 | |
| | | Adj | 450 | 320 | 219 | 128 | 110 | 84 | 64 | 46 | 27 | 13 | -0.01 |
| **17** | Sydney RO | Cur | 230 | 148 | 98 | 68 | 50 | 39 | 30 | 22 | 13 | 6 | |
| | | Adj | 271 | 149 | 91 | 58 | 52 | 41 | 32 | 23 | 14 | 7 | 0.33 |
| **18** | Nowra | Cur | 423 | 284 | 195 | 140 | 105 | 81 | 60 | 40 | 20 | 5 | |
| | | Adj | 429 | 284 | 195 | 121 | 106 | 81 | 62 | 43 | 24 | 10 | 0.01 |
| **19** | Charleville | Cur | 434 | 284 | 195 | 140 | 105 | 81 | 60 | 40 | 20 | 5 | |
| | | Adj | 443 | 305 | 213 | 133 | 116 | 89 | 69 | 50 | 31 | 16 | -0.02 |
| **20** | Wagga | Cur | 663 | 455 | 321 | 235 | 178 | 137 | 100 | 64 | 30 | 3 | |
| | | Adj | 695 | 513 | 365 | 213 | 179 | 131 | 99 | 67 | 38 | 14 | 0.04 |
| **21** | Melbourne | Cur | 559 | 384 | 271 | 198 | 149 | 114 | 83 | 54 | 25 | 2 | |
| | | Adj | 451 | 302 | 207 | 128 | 111 | 85 | 64 | 45 | 26 | 11 | 0.13 |
| **22** | East Sale | Cur | 653 | 449 | 317 | 231 | 175 | 133 | 98 | 63 | 30 | 2 | |
| | | Adj | 677 | 470 | 330 | 204 | 176 | 133 | 101 | 70 | 40 | 15 | 0.02 |
| **23** | Launceston | Cur | 740 | 513 | 366 | 272 | 208 | 160 | 117 | 74 | 33 | 1 | |
| | | Adj | 692 | 486 | 345 | 219 | 191 | 145 | 111 | 77 | 44 | 19 | -0.03 |
| **24** | Canberra | Cur | 792 | 547 | 387 | 284 | 216 | 165 | 120 | 77 | 35 | 2 | |
| | | Adj | 820 | 608 | 444 | 270 | 227 | 160 | 121 | 83 | 47 | 18 | -0.05 |
| **25** | Cabramurra | Cur | 1404 | 1012 | 753 | 580 | 454 | 352 | 255 | 160 | 71 | 1 | |
| | | Adj | 1431 | 1013 | 759 | 527 | 468 | 361 | 294 | 228 | 167 | 119 | -0.07 |
| **26** | Hobart | Cur | 723 | 498 | 354 | 262 | 202 | 155 | 113 | 71 | 31 | 0 | |
| | | Adj | 720 | 482 | 339 | 221 | 196 | 152 | 117 | 81 | 47 | 21 | -0.05 |
| **27** | Mildura | Cur | 541 | 367 | 256 | 187 | 143 | 110 | 81 | 53 | 25 | 3 | |
| | | Adj | 530 | 377 | 262 | 158 | 136 | 103 | 79 | 55 | 32 | 14 | 0.00 |
| **28** | Richmond | Cur | 450 | 298 | 203 | 146 | 112 | 87 | 66 | 44 | 23 | 7 | |
| | | Adj | 443 | 323 | 231 | 137 | 115 | 81 | 62 | 42 | 23 | 9 | 0.04 |
| **29** | Weipa | Cur | 743 | 611 | 517 | 445 | 384 | 326 | 266 | 207 | 153 | 111 | |
| | | Adj | 606 | 490 | 407 | 323 | 300 | 255 | 211 | 168 | 129 | 98 | 0.13 |
| **30** | Wyndham | Cur | 1071 | 839 | 685 | 576 | 488 | 406 | 321 | 234 | 154 | 95 | |
| | | Adj | 1005 | 839 | 699 | 528 | 479 | 391 | 341 | 289 | 241 | 206 | 0.23 |
| **31** | Willis Island | Cur | 391 | 330 | 282 | 242 | 207 | 176 | 146 | 118 | 93 | 71 | |
| | | Adj | 501 | 457 | 409 | 329 | 300 | 243 | 207 | 173 | 143 | 117 | 0.71 |
| **32** | Cairns | Cur | 302 | 253 | 214 | 181 | 153 | 128 | 105 | 84 | 64 | 48 | |
| | | Adj | 343 | 288 | 244 | 206 | 174 | 145 | 119 | 96 | 74 | 56 | 0.31 |
| **33** | Broome | Cur | 652 | 531 | 448 | 387 | 335 | 285 | 234 | 182 | 134 | 99 | |
| | | Adj | 644 | 524 | 442 | 356 | 331 | 283 | 252 | 220 | 191 | 170 | 0.10 |
| **34** | Learmonth | Cur | 439 | 330 | 256 | 204 | 166 | 134 | 104 | 74 | 47 | 25 | |
| | | Adj | 459 | 339 | 258 | 183 | 165 | 133 | 107 | 82 | 59 | 40 | -0.06 |
| **35** | Mackay | Cur | 248 | 202 | 165 | 136 | 112 | 92 | 75 | 60 | 47 | 34 | |
| | | Adj | 243 | 198 | 162 | 121 | 111 | 92 | 77 | 64 | 53 | 41 | 0.05 |
| **36** | Gladstone | Cur | 191 | 146 | 114 | 90 | 73 | 59 | 48 | 37 | 28 | 19 | |
| | | Adj | 247 | 190 | 147 | 105 | 97 | 84 | 69 | 54 | 41 | 29 | 0.18 |
| **37** | Halls Creek | Cur | 649 | 492 | 387 | 315 | 259 | 211 | 162 | 114 | 69 | 34 | |
| | | Adj | 656 | 502 | 387 | 276 | 249 | 202 | 166 | 130 | 97 | 71 | 0.16 |

| CZ No | Climate | Current/Adjusted | Star Rating | | | | | | | | | | Average rating change @ 6 stars |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| **38** | Tennant Ck | Cur | 545 | 414 | 325 | 262 | 213 | 170 | 129 | 89 | 52 | 22 | |
| | | Adj | 562 | 431 | 333 | 236 | 212 | 171 | 143 | 116 | 90 | 70 | -0.01 |
| **39** | Mt Isa | Cur | 560 | 417 | 320 | 253 | 205 | 164 | 126 | 90 | 55 | 28 | |
| | | Adj | 531 | 394 | 302 | 213 | 192 | 154 | 124 | 95 | 67 | 45 | 0.08 |
| **40** | Newman | Cur | 527 | 373 | 273 | 207 | 162 | 127 | 95 | 64 | 35 | 11 | |
| | | Adj | 532 | 415 | 314 | 193 | 161 | 108 | 86 | 64 | 44 | 28 | 0.00 |
| **41** | Giles | Cur | 429 | 298 | 215 | 161 | 126 | 98 | 73 | 49 | 25 | 7 | |
| | | Adj | 397 | 273 | 195 | 130 | 115 | 91 | 72 | 53 | 35 | 21 | -0.05 |
| **42** | Meekatharra | Cur | 358 | 241 | 167 | 120 | 91 | 70 | 52 | 34 | 17 | 4 | |
| | | Adj | 440 | 292 | 202 | 130 | 115 | 90 | 70 | 51 | 32 | 18 | -0.05 |
| **43** | Oodnadatta | Cur | 495 | 344 | 244 | 179 | 135 | 103 | 77 | 51 | 27 | 7 | |
| | | Adj | 478 | 325 | 221 | 134 | 117 | 95 | 76 | 57 | 40 | 25 | 0.07 |
| **44** | Kalgoorlie | Cur | 396 | 259 | 173 | 122 | 91 | 70 | 52 | 34 | 17 | 3 | |
| | | Adj | 440 | 288 | 195 | 122 | 108 | 86 | 67 | 48 | 31 | 16 | 0.15 |
| **45** | Woomera | Cur | 446 | 295 | 203 | 148 | 115 | 90 | 67 | 43 | 20 | 3 | |
| | | Adj | 435 | 264 | 182 | 122 | 107 | 81 | 65 | 48 | 32 | 20 | -0.01 |
| **46** | Cobar | Cur | 469 | 308 | 210 | 151 | 115 | 89 | 67 | 44 | 21 | 4 | |
| | | Adj | 552 | 311 | 204 | 137 | 123 | 95 | 76 | 56 | 36 | 21 | 0.12 |
| **47** | Bickley | Cur | 485 | 325 | 224 | 161 | 122 | 94 | 70 | 46 | 22 | 4 | |
| | | Adj | 490 | 309 | 211 | 139 | 124 | 97 | 76 | 54 | 33 | 17 | 0.06 |
| **48** | Dubbo | Cur | 513 | 347 | 241 | 176 | 134 | 103 | 76 | 49 | 23 | 3 | |
| | | Adj | 532 | 362 | 250 | 156 | 137 | 106 | 81 | 56 | 32 | 14 | 0.05 |
| **49** | Katanning | Cur | 537 | 354 | 241 | 172 | 130 | 100 | 74 | 48 | 22 | 2 | |
| | | Adj | 563 | 411 | 298 | 185 | 159 | 119 | 91 | 63 | 36 | 14 | 0.30 |
| **50** | Oakey | Cur | 391 | 256 | 174 | 126 | 98 | 78 | 60 | 41 | 22 | 8 | |
| | | Adj | 469 | 339 | 224 | 122 | 105 | 84 | 65 | 44 | 23 | 14 | 0.28 |
| **51** | Forrest | Cur | 401 | 262 | 175 | 124 | 93 | 72 | 53 | 35 | 16 | 2 | |
| | | Adj | 424 | 267 | 181 | 119 | 106 | 84 | 65 | 46 | 26 | 12 | 0.01 |
| **52** | Swanbourne | Cur | 231 | 152 | 102 | 71 | 51 | 39 | 29 | 20 | 11 | 3 | |
| | | Adj | 297 | 196 | 133 | 84 | 74 | 60 | 46 | 34 | 22 | 11 | 0.34 |
| **53** | Ceduna | Cur | 406 | 271 | 186 | 134 | 101 | 78 | 58 | 37 | 17 | 2 | |
| | | Adj | 391 | 252 | 173 | 111 | 98 | 76 | 58 | 39 | 21 | 8 | -0.06 |
| **54** | Mandurah | Cur | 332 | 218 | 148 | 107 | 82 | 65 | 49 | 33 | 17 | 5 | |
| | | Adj | 270 | 162 | 106 | 71 | 65 | 54 | 40 | 25 | 13 | 8 | 0.27 |
| **55** | Esperance | Cur | 351 | 233 | 158 | 111 | 82 | 62 | 46 | 30 | 14 | 1 | |
| | | Adj | 322 | 192 | 128 | 82 | 72 | 54 | 41 | 28 | 15 | 4 | -0.08 |
| **56** | Mascot | Cur | 284 | 186 | 125 | 88 | 66 | 51 | 39 | 26 | 14 | 5 | |
| | | Adj | 229 | 126 | 84 | 59 | 53 | 40 | 31 | 22 | 13 | 6 | 0.23 |
| **57** | Manjimup | Cur | 565 | 384 | 266 | 191 | 143 | 108 | 79 | 51 | 24 | 2 | |
| | | Adj | 523 | 346 | 241 | 153 | 133 | 100 | 75 | 51 | 28 | 9 | -0.01 |
| **58** | Albany | Cur | 457 | 307 | 210 | 149 | 110 | 83 | 60 | 39 | 19 | 1 | |
| | | Adj | 430 | 248 | 164 | 110 | 97 | 74 | 54 | 37 | 19 | 4 | -0.04 |
| **59** | Mt Lofty | Cur | 987 | 706 | 518 | 391 | 301 | 230 | 166 | 105 | 48 | 1 | |
| | | Adj | 957 | 685 | 499 | 330 | 290 | 223 | 177 | 132 | 91 | 57 | -0.04 |
| **60** | Tullamarine | Cur | 663 | 462 | 328 | 241 | 182 | 138 | 100 | 64 | 30 | 2 | |
| | | Adj | 632 | 394 | 276 | 190 | 169 | 129 | 98 | 68 | 40 | 17 | -0.01 |
| **61** | Mt Gambier | Cur | 702 | 484 | 341 | 250 | 189 | 144 | 105 | 67 | 31 | 1 | |
| | | Adj | 692 | 453 | 315 | 204 | 179 | 138 | 104 | 72 | 41 | 15 | -0.06 |

| CZ No | Climate | Current/Adjusted | Star Rating 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Average rating change @ 6 stars |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **62** | Moorabbin | Cur | 615 | 426 | 301 | 220 | 165 | 125 | 91 | 58 | 27 | 1 | |
| | | Adj | 544 | 367 | 256 | 164 | 145 | 112 | 85 | 58 | 34 | 13 | 0.00 |
| **63** | Warrnambool | Cur | 716 | 493 | 349 | 258 | 197 | 151 | 110 | 70 | 32 | 2 | |
| | | Adj | 692 | 422 | 296 | 208 | 187 | 145 | 110 | 76 | 44 | 19 | -0.05 |
| **64** | Cape Otway | Cur | 593 | 418 | 301 | 222 | 168 | 127 | 92 | 59 | 28 | 2 | |
| | | Adj | 570 | 401 | 285 | 179 | 155 | 116 | 88 | 62 | 37 | 16 | -0.05 |
| **65** | Orange | Cur | 964 | 679 | 492 | 369 | 285 | 219 | 159 | 101 | 46 | 2 | |
| | | Adj | 865 | 625 | 456 | 295 | 258 | 197 | 153 | 111 | 71 | 39 | -0.06 |
| **66** | Ballarat | Cur | 874 | 618 | 448 | 335 | 257 | 197 | 143 | 91 | 42 | 2 | |
| | | Adj | 936 | 636 | 455 | 305 | 271 | 211 | 164 | 119 | 76 | 41 | 0.06 |
| **67** | Low Head | Cur | 554 | 384 | 273 | 201 | 153 | 116 | 85 | 54 | 24 | 0 | |
| | | Adj | 660 | 453 | 324 | 212 | 186 | 143 | 110 | 77 | 45 | 19 | -0.02 |
| **68** | Launceston Air | Cur | 867 | 600 | 428 | 318 | 245 | 188 | 137 | 86 | 38 | 0 | |
| | | Adj | 908 | 619 | 441 | 293 | 261 | 205 | 158 | 112 | 68 | 33 | 0.06 |
| **69** | Thredbo | Cur | 1238 | 888 | 655 | 499 | 387 | 298 | 216 | 136 | 61 | 1 | |
| | | Adj | 1394 | 1031 | 765 | 501 | 438 | 337 | 275 | 216 | 160 | 115 | -0.03 |

## 3.2 Star bands with 0 average change at 6 stars

Table 6 shows the star bands with a zero average change to the rating at 6 stars and the current star bands. Note that Table 7 in the next section compares the two sets of adjusted star bands.

**Table 6 Star band thresholds from 1 to 10 stars: Current and Adjusted with average rating change at 6 = 0**

| CZ No | Climate | Current/Adjusted | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Star change @ 6 stars |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | Darwin | Cur | 773 | 648 | 555 | 480 | 413 | 349 | 285 | 222 | 164 | 119 | |
| | | Adj | 741 | 626 | 535 | 430 | 399 | 340 | 298 | 257 | 219 | 190 | 0.03 |
| **2** | Port Hedland | Cur | 569 | 455 | 373 | 310 | 260 | 215 | 172 | 131 | 93 | 62 | |
| | | Adj | 579 | 484 | 405 | 309 | 281 | 233 | 197 | 163 | 131 | 105 | -0.02 |
| **3** | Longreach | Cur | 550 | 396 | 294 | 226 | 178 | 141 | 107 | 74 | 43 | 18 | |
| | | Adj | 469 | 358 | 265 | 171 | 149 | 122 | 96 | 71 | 48 | 29 | 0.00 |
| **4** | Carnarvon | Cur | 181 | 137 | 105 | 82 | 66 | 53 | 41 | 31 | 22 | 14 | |
| | | Adj | 189 | 145 | 113 | 79 | 70 | 55 | 45 | 36 | 29 | 22 | 0.01 |
| **5** | Townsville | Cur | 309 | 259 | 218 | 183 | 153 | 127 | 103 | 81 | 61 | 44 | |
| | | Adj | 314 | 269 | 230 | 179 | 164 | 136 | 117 | 100 | 84 | 70 | -0.04 |
| **6** | Alice Springs | Cur | 562 | 385 | 269 | 196 | 148 | 113 | 84 | 56 | 29 | 7 | |
| | | Adj | 532 | 379 | 260 | 151 | 130 | 101 | 78 | 55 | 34 | 16 | -0.04 |
| **7** | Rockhampton | Cur | 295 | 222 | 171 | 136 | 110 | 90 | 71 | 54 | 38 | 24 | |
| | | Adj | 335 | 260 | 204 | 146 | 132 | 108 | 85 | 64 | 45 | 28 | -0.04 |
| **8** | Moree | Cur | 481 | 315 | 214 | 155 | 119 | 94 | 71 | 47 | 24 | 7 | |
| | | Adj | 515 | 312 | 203 | 130 | 117 | 95 | 75 | 55 | 35 | 21 | 0.00 |
| **9** | Amberley | Cur | 334 | 226 | 157 | 113 | 85 | 67 | 52 | 38 | 24 | 12 | |
| | | Adj | 331 | 242 | 171 | 102 | 87 | 67 | 53 | 39 | 26 | 14 | -0.04 |
| **10** | Brisbane | Cur | 203 | 139 | 97 | 71 | 55 | 43 | 34 | 25 | 17 | 10 | |
| | | Adj | 215 | 166 | 121 | 75 | 66 | 53 | 44 | 35 | 27 | 20 | -0.02 |
| **11** | Coffs Harbour | Cur | 232 | 153 | 103 | 73 | 55 | 44 | 34 | 24 | 15 | 7 | |
| | | Adj | 224 | 142 | 96 | 61 | 53 | 43 | 34 | 24 | 16 | 9 | -0.02 |
| **12** | Geraldton | Cur | 285 | 191 | 132 | 96 | 73 | 57 | 43 | 29 | 16 | 5 | |
| | | Adj | 273 | 177 | 120 | 75 | 66 | 51 | 38 | 24 | 12 | 6 | -0.03 |
| **13** | Perth | Cur | 387 | 251 | 167 | 118 | 89 | 70 | 52 | 34 | 17 | 4 | |
| | | Adj | 412 | 304 | 204 | 113 | 97 | 79 | 61 | 43 | 26 | 13 | -0.03 |
| **14** | Armidale | Cur | 661 | 451 | 314 | 227 | 169 | 128 | 93 | 60 | 27 | 1 | |
| | | Adj | 791 | 559 | 399 | 246 | 211 | 158 | 120 | 84 | 48 | 20 | -0.02 |
| **15** | Williamtown | Cur | 349 | 232 | 159 | 114 | 86 | 67 | 50 | 34 | 19 | 6 | |
| | | Adj | 349 | 196 | 132 | 94 | 85 | 66 | 51 | 37 | 24 | 13 | -0.05 |
| **16** | Adelaide | Cur | 480 | 325 | 227 | 165 | 125 | 96 | 70 | 46 | 22 | 3 | |
| | | Adj | 450 | 319 | 219 | 128 | 110 | 84 | 64 | 46 | 27 | 13 | -0.01 |
| **17** | Sydney RO | Cur | 230 | 148 | 98 | 68 | 50 | 39 | 30 | 22 | 13 | 6 | |
| | | Adj | 251 | 136 | 84 | 55 | 50 | 39 | 30 | 22 | 14 | 7 | -0.02 |
| **18** | Nowra | Cur | 423 | 284 | 195 | 140 | 105 | 81 | 60 | 40 | 20 | 5 | |
| | | Adj | 424 | 284 | 195 | 120 | 105 | 81 | 61 | 42 | 24 | 10 | -0.04 |
| **19** | Charleville | Cur | 434 | 284 | 195 | 140 | 105 | 81 | 60 | 40 | 20 | 5 | |
| | | Adj | 443 | 305 | 213 | 133 | 116 | 89 | 69 | 50 | 31 | 16 | -0.05 |
| **20** | Wagga | Cur | 663 | 455 | 321 | 235 | 178 | 137 | 100 | 64 | 30 | 3 | |
| | | Adj | 672 | 469 | 331 | 202 | 172 | 127 | 96 | 65 | 37 | 14 | -0.03 |
| **21** | Melbourne | Cur | 559 | 384 | 271 | 198 | 149 | 114 | 83 | 54 | 25 | 2 | |
| | | Adj | 430 | 290 | 199 | 123 | 107 | 81 | 62 | 44 | 25 | 11 | -0.01 |
| **22** | East Sale | Cur | 653 | 449 | 317 | 231 | 175 | 133 | 98 | 63 | 30 | 2 | |

| CZ No | Climate | Current/Adjusted | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Star change @ 6 stars |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Adj | 655 | 441 | 310 | 198 | 172 | 131 | 100 | 69 | 40 | 15 | -0.04 |
| **23** | Launceston | Cur | 740 | 513 | 366 | 272 | 208 | 160 | 117 | 74 | 33 | 1 | |
| | | Adj | 691 | 492 | 350 | 219 | 191 | 145 | 111 | 77 | 44 | 19 | -0.02 |
| **24** | Canberra | Cur | 792 | 547 | 387 | 284 | 216 | 165 | 120 | 77 | 35 | 2 | |
| | | Adj | 822 | 600 | 432 | 262 | 223 | 161 | 122 | 84 | 47 | 18 | -0.01 |
| **25** | Cabramurra | Cur | 1404 | 1012 | 753 | 580 | 454 | 352 | 255 | 160 | 71 | 1 | |
| | | Adj | 1452 | 1028 | 770 | 535 | 475 | 366 | 298 | 231 | 168 | 119 | 0.00 |
| **26** | Hobart | Cur | 723 | 498 | 354 | 262 | 202 | 155 | 113 | 71 | 31 | 0 | |
| | | Adj | 720 | 482 | 339 | 221 | 196 | 152 | 117 | 81 | 47 | 21 | -0.05 |
| **27** | Mildura | Cur | 541 | 367 | 256 | 187 | 143 | 110 | 81 | 53 | 25 | 3 | |
| | | Adj | 530 | 379 | 263 | 158 | 136 | 103 | 79 | 55 | 32 | 14 | 0.00 |
| **28** | Richmond | Cur | 450 | 298 | 203 | 146 | 112 | 87 | 66 | 44 | 23 | 7 | |
| | | Adj | 446 | 342 | 246 | 138 | 113 | 79 | 60 | 41 | 23 | 9 | -0.04 |
| **29** | Weipa | Cur | 743 | 611 | 517 | 445 | 384 | 326 | 266 | 207 | 153 | 111 | |
| | | Adj | 587 | 475 | 395 | 314 | 291 | 248 | 206 | 165 | 127 | 98 | -0.03 |
| **30** | Wyndham | Cur | 1071 | 839 | 685 | 576 | 488 | 406 | 321 | 234 | 154 | 95 | |
| | | Adj | 973 | 823 | 677 | 499 | 453 | 377 | 330 | 283 | 239 | 206 | 0.03 |
| **31** | Willis Island | Cur | 391 | 330 | 282 | 242 | 207 | 176 | 146 | 118 | 93 | 71 | |
| | | Adj | 435 | 401 | 360 | 289 | 263 | 213 | 185 | 160 | 137 | 117 | 0.01 |
| **32** | Cairns | Cur | 302 | 253 | 214 | 181 | 153 | 128 | 105 | 84 | 64 | 48 | |
| | | Adj | 324 | 275 | 233 | 180 | 164 | 136 | 113 | 92 | 72 | 56 | -0.03 |
| **33** | Broome | Cur | 652 | 531 | 448 | 387 | 335 | 285 | 234 | 182 | 134 | 99 | |
| | | Adj | 636 | 519 | 438 | 352 | 328 | 280 | 250 | 219 | 191 | 170 | 0.04 |
| **34** | Learmonth | Cur | 439 | 330 | 256 | 204 | 166 | 134 | 104 | 74 | 47 | 25 | |
| | | Adj | 461 | 339 | 259 | 184 | 166 | 133 | 108 | 82 | 59 | 40 | -0.03 |
| **35** | Mackay | Cur | 248 | 202 | 165 | 136 | 112 | 92 | 75 | 60 | 47 | 34 | |
| | | Adj | 238 | 194 | 159 | 119 | 108 | 90 | 76 | 63 | 52 | 41 | -0.03 |
| **36** | Gladstone | Cur | 191 | 146 | 114 | 90 | 73 | 59 | 48 | 37 | 28 | 19 | |
| | | Adj | 241 | 183 | 142 | 103 | 95 | 81 | 67 | 52 | 41 | 29 | 0.02 |
| **37** | Halls Creek | Cur | 649 | 492 | 387 | 315 | 259 | 211 | 162 | 114 | 69 | 34 | |
| | | Adj | 640 | 487 | 380 | 273 | 245 | 197 | 150 | 103 | 53 | 71 | 0.01 |
| **38** | Tennant Creek | Cur | 545 | 414 | 325 | 262 | 213 | 170 | 129 | 89 | 52 | 22 | |
| | | Adj | 558 | 427 | 332 | 236 | 213 | 171 | 143 | 116 | 90 | 70 | 0.00 |
| **39** | Mt Isa | Cur | 560 | 417 | 320 | 253 | 205 | 164 | 126 | 90 | 55 | 28 | |
| | | Adj | 522 | 388 | 298 | 211 | 190 | 153 | 123 | 94 | 66 | 45 | 0.04 |
| **40** | Newman | Cur | 527 | 373 | 273 | 207 | 162 | 127 | 95 | 64 | 35 | 11 | |
| | | Adj | 504 | 387 | 291 | 180 | 151 | 105 | 84 | 63 | 44 | 28 | -0.03 |
| **41** | Giles | Cur | 429 | 298 | 215 | 161 | 126 | 98 | 73 | 49 | 25 | 7 | |
| | | Adj | 405 | 279 | 200 | 133 | 118 | 93 | 73 | 54 | 35 | 21 | -0.03 |
| **42** | Meekatharra | Cur | 358 | 241 | 167 | 120 | 91 | 70 | 52 | 34 | 17 | 4 | |
| | | Adj | 439 | 293 | 203 | 130 | 115 | 90 | 70 | 51 | 32 | 18 | -0.04 |
| **43** | Oodnadatta | Cur | 495 | 344 | 244 | 179 | 135 | 103 | 77 | 51 | 27 | 7 | |
| | | Adj | 471 | 324 | 222 | 135 | 118 | 95 | 76 | 57 | 40 | 25 | 0.00 |
| **44** | Kalgoorlie | Cur | 396 | 259 | 173 | 122 | 91 | 70 | 52 | 34 | 17 | 3 | |
| | | Adj | 447 | 309 | 212 | 125 | 108 | 84 | 66 | 47 | 30 | 16 | -0.03 |
| **45** | Woomera | Cur | 446 | 295 | 203 | 148 | 115 | 90 | 67 | 43 | 20 | 3 | |
| | | Adj | 419 | 263 | 177 | 116 | 104 | 82 | 65 | 48 | 32 | 20 | 0.03 |
| **46** | Cobar | Cur | 469 | 308 | 210 | 151 | 115 | 89 | 67 | 44 | 21 | 4 | |

| CZ No | Climate | Current/Adjusted | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Star change @ 6 stars |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Adj | 511 | 295 | 187 | 125 | 115 | 94 | 75 | 55 | 36 | 21 | 0.01 |
| **47** | Bickley | Cur | 485 | 325 | 224 | 161 | 122 | 94 | 70 | 46 | 22 | 4 | |
| | | Adj | 481 | 306 | 205 | 134 | 120 | 96 | 75 | 54 | 32 | 17 | 0.02 |
| **48** | Dubbo | Cur | 513 | 347 | 241 | 176 | 134 | 103 | 76 | 49 | 23 | 3 | |
| | | Adj | 520 | 350 | 243 | 153 | 134 | 104 | 79 | 55 | 32 | 14 | -0.01 |
| **49** | Katanning | Cur | 537 | 354 | 241 | 172 | 130 | 100 | 74 | 48 | 22 | 2 | |
| | | Adj | 522 | 381 | 276 | 171 | 147 | 111 | 85 | 59 | 34 | 14 | 0.02 |
| **50** | Oakey | Cur | 391 | 256 | 174 | 126 | 98 | 78 | 60 | 41 | 22 | 8 | |
| | | Adj | 425 | 290 | 198 | 117 | 100 | 76 | 60 | 43 | 27 | 14 | 0.01 |
| **51** | Forrest | Cur | 401 | 262 | 175 | 124 | 93 | 72 | 53 | 35 | 16 | 2 | |
| | | Adj | 460 | 321 | 221 | 130 | 111 | 84 | 65 | 46 | 26 | 12 | -0.01 |
| **52** | Swanbourne | Cur | 231 | 152 | 102 | 71 | 51 | 39 | 29 | 20 | 11 | 3 | |
| | | Adj | 273 | 180 | 122 | 77 | 68 | 55 | 43 | 32 | 21 | 11 | -0.01 |
| **53** | Ceduna | Cur | 406 | 271 | 186 | 134 | 101 | 78 | 58 | 37 | 17 | 2 | |
| | | Adj | 396 | 256 | 173 | 111 | 99 | 77 | 59 | 40 | 22 | 8 | 0.01 |
| **54** | Mandurah | Cur | 332 | 218 | 148 | 107 | 82 | 65 | 49 | 33 | 17 | 5 | |
| | | Adj | 248 | 151 | 99 | 67 | 61 | 50 | 39 | 28 | 16 | 8 | -0.01 |
| **55** | Esperance | Cur | 351 | 233 | 158 | 111 | 82 | 62 | 46 | 30 | 14 | 1 | |
| | | Adj | 322 | 197 | 128 | 80 | 71 | 55 | 42 | 28 | 15 | 4 | 0.00 |
| **56** | Mascot | Cur | 284 | 186 | 125 | 88 | 66 | 51 | 39 | 26 | 14 | 5 | |
| | | Adj | 218 | 120 | 80 | 57 | 51 | 38 | 30 | 21 | 12 | 6 | 0.04 |
| **57** | Manjimup | Cur | 565 | 384 | 266 | 191 | 143 | 108 | 79 | 51 | 24 | 2 | |
| | | Adj | 522 | 349 | 243 | 154 | 133 | 100 | 75 | 51 | 28 | 9 | -0.03 |
| **58** | Albany | Cur | 457 | 307 | 210 | 149 | 110 | 83 | 60 | 39 | 19 | 1 | |
| | | Adj | 426 | 261 | 170 | 107 | 96 | 75 | 55 | 37 | 20 | 4 | 0.01 |
| **59** | Mt Lofty | Cur | 987 | 706 | 518 | 391 | 301 | 230 | 166 | 105 | 48 | 1 | |
| | | Adj | 976 | 699 | 512 | 337 | 296 | 227 | 179 | 134 | 92 | 57 | 0.03 |
| **60** | Tullamarine | Cur | 663 | 462 | 328 | 241 | 182 | 138 | 100 | 64 | 30 | 2 | |
| | | Adj | 628 | 405 | 279 | 186 | 167 | 131 | 99 | 69 | 41 | 17 | -0.01 |
| **61** | Mt Gambier | Cur | 702 | 484 | 341 | 250 | 189 | 144 | 105 | 67 | 31 | 1 | |
| | | Adj | 695 | 461 | 319 | 205 | 180 | 140 | 106 | 73 | 41 | 15 | -0.01 |
| **62** | Moorabbin | Cur | 615 | 426 | 301 | 220 | 165 | 125 | 91 | 58 | 27 | 1 | |
| | | Adj | 548 | 373 | 262 | 167 | 146 | 112 | 85 | 59 | 34 | 13 | 0.01 |
| **63** | Warrnambool | Cur | 716 | 493 | 349 | 258 | 197 | 151 | 110 | 70 | 32 | 2 | |
| | | Adj | 688 | 433 | 296 | 203 | 184 | 147 | 112 | 78 | 45 | 19 | 0.00 |
| **64** | Cape Otway | Cur | 593 | 418 | 301 | 222 | 168 | 127 | 92 | 59 | 28 | 2 | |
| | | Adj | 570 | 401 | 285 | 179 | 155 | 116 | 88 | 62 | 37 | 16 | 0.00 |
| **65** | Orange | Cur | 964 | 679 | 492 | 369 | 285 | 219 | 159 | 101 | 46 | 2 | |
| | | Adj | 877 | 634 | 463 | 299 | 261 | 200 | 156 | 112 | 72 | 39 | -0.03 |
| **66** | Ballarat | Cur | 874 | 618 | 448 | 335 | 257 | 197 | 143 | 91 | 42 | 2 | |
| | | Adj | 909 | 622 | 446 | 299 | 266 | 207 | 161 | 117 | 75 | 41 | -0.02 |
| **67** | Low Head | Cur | 554 | 384 | 273 | 201 | 153 | 116 | 85 | 54 | 24 | 0 | |
| | | Adj | 660 | 453 | 324 | 212 | 186 | 143 | 110 | 77 | 45 | 19 | -0.04 |
| **68** | Launceston Air | Cur | 867 | 600 | 428 | 318 | 245 | 188 | 137 | 86 | 38 | 0 | |
| | | Adj | 891 | 606 | 431 | 287 | 256 | 201 | 155 | 110 | 67 | 33 | -0.01 |
| **69** | Thredbo | Cur | 1238 | 888 | 655 | 499 | 387 | 298 | 216 | 136 | 61 | 1 | |
| | | Adj | 1380 | 1125 | 860 | 535 | 455 | 339 | 277 | 217 | 160 | 115 | -0.03 |

## 3.3 Comparison of alternative adjusted star bands

**Table 7 Star band thresholds from 1 to 10 stars showing Alternative Adjusted bands with average change at 6 stars = 0 and no rating change less than -0.2 stars**

| CZ No | Climate | Alt | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Star change @ 6 stars |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | Darwin | 0 @ 6 | 741 | 626 | 535 | 430 | 399 | 340 | 298 | 257 | 219 | 190 | 0.03 |
| | | >= -0.2 | 757 | 641 | 547 | 438 | 407 | 346 | 303 | 260 | 221 | 190 | 0.15 |
| **2** | Port Hedland | 0 @ 6 | 579 | 484 | 405 | 309 | 281 | 233 | 197 | 163 | 131 | 105 | -0.02 |
| | | >= -0.2 | 619 | 517 | 431 | 327 | 298 | 245 | 206 | 168 | 133 | 105 | 0.36 |
| **3** | Longreach | 0 @ 6 | 469 | 358 | 265 | 171 | 149 | 122 | 96 | 71 | 48 | 29 | 0.00 |
| | | >= -0.2 | 517 | 395 | 292 | 188 | 165 | 133 | 105 | 77 | 50 | 29 | 0.39 |
| **4** | Carnarvon | 0 @ 6 | 189 | 145 | 113 | 79 | 70 | 55 | 45 | 36 | 29 | 22 | 0.01 |
| | | >= -0.2 | 195 | 149 | 116 | 81 | 72 | 56 | 46 | 37 | 29 | 22 | 0.16 |
| **5** | Townsville | 0 @ 6 | 314 | 269 | 230 | 179 | 164 | 136 | 117 | 100 | 84 | 70 | -0.04 |
| | | >= -0.2 | 332 | 285 | 242 | 188 | 172 | 143 | 122 | 103 | 85 | 70 | 0.26 |
| **6** | Alice Springs | 0 @ 6 | 532 | 379 | 260 | 151 | 130 | 101 | 78 | 55 | 34 | 16 | -0.04 |
| | | >= -0.2 | 580 | 409 | 277 | 161 | 139 | 108 | 83 | 58 | 35 | 16 | 0.27 |
| **7** | Rockhampton | 0 @ 6 | 335 | 260 | 204 | 146 | 132 | 108 | 85 | 64 | 45 | 28 | -0.04 |
| | | >= -0.2 | 345 | 269 | 211 | 151 | 136 | 111 | 87 | 66 | 46 | 28 | 0.09 |
| **8** | Moree | 0 @ 6 | 515 | 312 | 203 | 130 | 117 | 95 | 75 | 55 | 35 | 21 | 0.00 |
| | | >= -0.2 | 555 | 337 | 216 | 135 | 121 | 98 | 78 | 57 | 36 | 21 | 0.18 |
| **9** | Amberley | 0 @ 6 | 331 | 242 | 171 | 102 | 87 | 67 | 53 | 39 | 26 | 14 | -0.04 |
| | | >= -0.2 | 340 | 253 | 178 | 103 | 88 | 68 | 53 | 39 | 26 | 14 | 0.02 |
| **10** | Brisbane | 0 @ 6 | 215 | 166 | 121 | 75 | 66 | 53 | 44 | 35 | 27 | 20 | -0.02 |
| | | >= -0.2 | 233 | 177 | 129 | 81 | 71 | 57 | 47 | 37 | 28 | 20 | 0.34 |
| **11** | Coffs Harbour | 0 @ 6 | 224 | 142 | 96 | 61 | 53 | 43 | 34 | 24 | 16 | 9 | -0.02 |
| | | >= -0.2 | 240 | 149 | 101 | 65 | 57 | 46 | 36 | 26 | 17 | 9 | 0.22 |
| **12** | Geraldton | 0 @ 6 | 273 | 177 | 120 | 75 | 66 | 51 | 38 | 24 | 12 | 6 | -0.03 |
| | | >= -0.2 | 273 | 177 | 120 | 75 | 66 | 51 | 38 | 24 | 12 | 6 | -0.03 |
| **13** | Perth | 0 @ 6 | 412 | 304 | 204 | 113 | 97 | 79 | 61 | 43 | 26 | 13 | -0.03 |
| | | >= -0.2 | 434 | 301 | 208 | 123 | 106 | 82 | 63 | 44 | 27 | 13 | 0.17 |
| **14** | Armidale | 0 @ 6 | 791 | 559 | 399 | 246 | 211 | 158 | 120 | 84 | 48 | 20 | -0.02 |
| | | >= -0.2 | 821 | 594 | 425 | 258 | 220 | 162 | 123 | 86 | 49 | 20 | 0.06 |
| **15** | Williamtown | 0 @ 6 | 349 | 196 | 132 | 94 | 85 | 66 | 51 | 37 | 24 | 13 | -0.05 |
| | | >= -0.2 | 357 | 209 | 134 | 90 | 83 | 68 | 53 | 39 | 25 | 13 | 0.06 |
| **16** | Adelaide | 0 @ 6 | 450 | 319 | 219 | 128 | 110 | 84 | 64 | 46 | 27 | 13 | -0.01 |
| | | >= -0.2 | 450 | 320 | 219 | 128 | 110 | 84 | 64 | 46 | 27 | 13 | -0.01 |
| **17** | Sydney RO | 0 @ 6 | 251 | 136 | 84 | 55 | 50 | 39 | 30 | 22 | 14 | 7 | -0.02 |
| | | >= -0.2 | 271 | 149 | 91 | 58 | 52 | 41 | 32 | 23 | 14 | 7 | 0.33 |
| **18** | Nowra | 0 @ 6 | 424 | 284 | 195 | 120 | 105 | 81 | 61 | 42 | 24 | 10 | -0.04 |
| | | >= -0.2 | 429 | 284 | 195 | 121 | 106 | 81 | 62 | 43 | 24 | 10 | 0.01 |
| **19** | Charleville | 0 @ 6 | 443 | 305 | 213 | 133 | 116 | 89 | 69 | 50 | 31 | 16 | -0.05 |
| | | >= -0.2 | 443 | 305 | 213 | 133 | 116 | 89 | 69 | 50 | 31 | 16 | -0.02 |
| **20** | Wagga | 0 @ 6 | 672 | 469 | 331 | 202 | 172 | 127 | 96 | 65 | 37 | 14 | -0.03 |
| | | >= -0.2 | 695 | 513 | 365 | 213 | 179 | 131 | 99 | 67 | 38 | 14 | 0.04 |
| **21** | Melbourne | 0 @ 6 | 430 | 290 | 199 | 123 | 107 | 81 | 62 | 44 | 25 | 11 | -0.01 |
| | | >= -0.2 | 451 | 302 | 207 | 128 | 111 | 85 | 64 | 45 | 26 | 11 | 0.13 |
| **22** | East Sale | 0 @ 6 | 655 | 441 | 310 | 198 | 172 | 131 | 100 | 69 | 40 | 15 | -0.04 |
| | | >= -0.2 | 677 | 470 | 330 | 204 | 176 | 133 | 101 | 70 | 40 | 15 | 0.02 |

| CZ No | Climate | Alt | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Star change @ 6 stars |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **23** | Launceston | 0 @ 6 | 691 | 492 | 350 | 219 | 191 | 145 | 111 | 77 | 44 | 19 | -0.02 |
| | | >= -0.2 | 692 | 486 | 345 | 219 | 191 | 145 | 111 | 77 | 44 | 19 | -0.03 |
| **24** | Canberra | 0 @ 6 | 822 | 600 | 432 | 262 | 223 | 161 | 122 | 84 | 47 | 18 | -0.01 |
| | | >= -0.2 | 820 | 608 | 444 | 270 | 227 | 160 | 121 | 83 | 47 | 18 | -0.05 |
| **25** | Cabramurra | 0 @ 6 | 1452 | 1028 | 770 | 535 | 475 | 366 | 298 | 231 | 168 | 119 | 0.00 |
| | | >= -0.2 | 1431 | 1013 | 759 | 527 | 468 | 361 | 294 | 228 | 167 | 119 | -0.07 |
| **26** | Hobart | 0 @ 6 | 720 | 482 | 339 | 221 | 196 | 152 | 117 | 81 | 47 | 21 | -0.05 |
| | | >= -0.2 | 720 | 482 | 339 | 221 | 196 | 152 | 117 | 81 | 47 | 21 | -0.05 |
| **27** | Mildura | 0 @ 6 | 530 | 379 | 263 | 158 | 136 | 103 | 79 | 55 | 32 | 14 | 0.00 |
| | | >= -0.2 | 530 | 377 | 262 | 158 | 136 | 103 | 79 | 55 | 32 | 14 | 0.00 |
| **28** | Richmond | 0 @ 6 | 446 | 342 | 246 | 138 | 113 | 79 | 60 | 41 | 23 | 9 | -0.04 |
| | | >= -0.2 | 443 | 323 | 231 | 137 | 115 | 81 | 62 | 42 | 23 | 9 | 0.04 |
| **29** | Weipa | 0 @ 6 | 587 | 475 | 395 | 314 | 291 | 248 | 206 | 165 | 127 | 98 | -0.03 |
| | | >= -0.2 | 606 | 490 | 407 | 323 | 300 | 255 | 211 | 168 | 129 | 98 | 0.13 |
| **30** | Wyndham | 0 @ 6 | 973 | 823 | 677 | 499 | 453 | 377 | 330 | 283 | 239 | 206 | 0.03 |
| | | >= -0.2 | 1005 | 839 | 699 | 528 | 479 | 391 | 341 | 289 | 241 | 206 | 0.23 |
| **31** | Willis Island | 0 @ 6 | 435 | 401 | 360 | 289 | 263 | 213 | 185 | 160 | 137 | 117 | 0.01 |
| | | >= -0.2 | 501 | 457 | 409 | 329 | 300 | 243 | 207 | 173 | 143 | 117 | 0.71 |
| **32** | Cairns | 0 @ 6 | 324 | 275 | 233 | 180 | 164 | 136 | 113 | 92 | 72 | 56 | -0.03 |
| | | >= -0.2 | 343 | 288 | 244 | 190 | 174 | 145 | 119 | 96 | 74 | 56 | 0.31 |
| **33** | Broome | 0 @ 6 | 636 | 519 | 438 | 352 | 328 | 280 | 250 | 219 | 191 | 170 | 0.04 |
| | | >= -0.2 | 644 | 524 | 442 | 356 | 331 | 283 | 252 | 220 | 191 | 170 | 0.10 |
| **34** | Learmonth | 0 @ 6 | 461 | 339 | 259 | 184 | 166 | 133 | 108 | 82 | 59 | 40 | -0.03 |
| | | >= -0.2 | 459 | 339 | 258 | 183 | 165 | 133 | 107 | 82 | 59 | 40 | -0.06 |
| **35** | Mackay | 0 @ 6 | 238 | 194 | 159 | 119 | 108 | 90 | 76 | 63 | 52 | 41 | -0.03 |
| | | >= -0.2 | 243 | 198 | 162 | 121 | 110 | 92 | 77 | 64 | 52 | 41 | 0.06 |
| **36** | Gladstone | 0 @ 6 | 241 | 183 | 142 | 103 | 95 | 81 | 67 | 52 | 41 | 29 | 0.02 |
| | | >= -0.2 | 249 | 192 | 148 | 106 | 97 | 84 | 69 | 54 | 41 | 29 | 0.30 |
| **37** | Halls Creek | 0 @ 6 | 640 | 487 | 380 | 273 | 245 | 197 | 150 | 103 | 53 | 71 | 0.01 |
| | | >= -0.2 | 656 | 502 | 387 | 276 | 249 | 202 | 166 | 130 | 97 | 71 | 0.16 |
| **38** | Tennant Creek | 0 @ 6 | 558 | 427 | 332 | 236 | 213 | 171 | 143 | 116 | 90 | 70 | 0.00 |
| | | >= -0.2 | 562 | 431 | 333 | 236 | 212 | 171 | 143 | 116 | 90 | 70 | -0.01 |
| **39** | Mt Isa | 0 @ 6 | 522 | 388 | 298 | 211 | 190 | 153 | 123 | 94 | 66 | 45 | 0.04 |
| | | >= -0.2 | 531 | 394 | 302 | 213 | 192 | 154 | 124 | 95 | 67 | 45 | 0.08 |
| **40** | Newman | 0 @ 6 | 504 | 387 | 291 | 180 | 151 | 105 | 84 | 63 | 44 | 28 | -0.03 |
| | | >= -0.2 | 532 | 415 | 314 | 193 | 161 | 108 | 86 | 64 | 44 | 28 | 0.00 |
| **41** | Giles | 0 @ 6 | 405 | 279 | 200 | 133 | 118 | 93 | 73 | 54 | 35 | 21 | -0.03 |
| | | >= -0.2 | 397 | 273 | 195 | 130 | 115 | 91 | 72 | 53 | 35 | 21 | -0.05 |
| **42** | Meekatharra | 0 @ 6 | 439 | 293 | 203 | 130 | 115 | 90 | 70 | 51 | 32 | 18 | -0.04 |
| | | >= -0.2 | 440 | 292 | 202 | 130 | 115 | 90 | 70 | 51 | 32 | 18 | -0.05 |
| **43** | Oodnadatta | 0 @ 6 | 471 | 324 | 222 | 135 | 118 | 95 | 76 | 57 | 40 | 25 | 0.00 |
| | | >= -0.2 | 478 | 325 | 221 | 134 | 117 | 95 | 76 | 57 | 40 | 25 | 0.07 |
| **44** | Kalgoorlie | 0 @ 6 | 447 | 309 | 212 | 125 | 108 | 84 | 66 | 47 | 30 | 16 | -0.03 |
| | | >= -0.2 | 440 | 288 | 195 | 122 | 108 | 86 | 67 | 48 | 31 | 16 | 0.15 |
| **45** | Woomera | 0 @ 6 | 419 | 263 | 177 | 116 | 104 | 82 | 65 | 48 | 32 | 20 | 0.03 |
| | | >= -0.2 | 435 | 264 | 182 | 122 | 107 | 81 | 65 | 48 | 32 | 20 | -0.01 |
| **46** | Cobar | 0 @ 6 | 511 | 295 | 187 | 125 | 115 | 94 | 75 | 55 | 36 | 21 | 0.01 |
| | | >= -0.2 | 552 | 311 | 204 | 137 | 123 | 95 | 76 | 56 | 36 | 21 | 0.12 |

| CZ No | Climate | Alt | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Star change @ 6 stars |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **47** | Bickley | 0 @ 6 | 481 | 306 | 205 | 134 | 120 | 96 | 75 | 54 | 32 | 17 | 0.02 |
| | | >= -0.2 | 490 | 309 | 211 | 139 | 124 | 97 | 76 | 54 | 33 | 17 | 0.06 |
| **48** | Dubbo | 0 @ 6 | 520 | 350 | 243 | 153 | 134 | 104 | 79 | 55 | 32 | 14 | -0.01 |
| | | >= -0.2 | 532 | 362 | 250 | 156 | 137 | 106 | 81 | 56 | 32 | 14 | 0.05 |
| **49** | Katanning | 0 @ 6 | 522 | 381 | 276 | 171 | 147 | 111 | 85 | 59 | 34 | 14 | 0.02 |
| | | >= -0.2 | 563 | 411 | 298 | 185 | 159 | 119 | 91 | 63 | 36 | 14 | 0.30 |
| **50** | Oakey | 0 @ 6 | 425 | 290 | 198 | 117 | 100 | 76 | 60 | 43 | 27 | 14 | 0.01 |
| | | >= -0.2 | 469 | 339 | 224 | 122 | 105 | 84 | 65 | 44 | 23 | 14 | 0.28 |
| **51** | Forrest | 0 @ 6 | 460 | 321 | 221 | 130 | 111 | 84 | 65 | 46 | 26 | 12 | -0.01 |
| | | >= -0.2 | 424 | 267 | 181 | 119 | 106 | 84 | 65 | 46 | 26 | 12 | 0.01 |
| **52** | Swanbourne | 0 @ 6 | 273 | 180 | 122 | 77 | 68 | 55 | 43 | 32 | 21 | 11 | -0.01 |
| | | >= -0.2 | 300 | 198 | 135 | 84 | 75 | 60 | 46 | 34 | 22 | 11 | 0.40 |
| **53** | Ceduna | 0 @ 6 | 396 | 256 | 173 | 111 | 99 | 77 | 59 | 40 | 22 | 8 | 0.01 |
| | | >= -0.2 | 391 | 252 | 173 | 111 | 98 | 76 | 58 | 39 | 21 | 8 | -0.06 |
| **54** | Mandurah | 0 @ 6 | 248 | 151 | 99 | 67 | 61 | 50 | 39 | 28 | 16 | 8 | -0.01 |
| | | >= -0.2 | 267 | 163 | 107 | 72 | 66 | 54 | 42 | 29 | 17 | 8 | 0.33 |
| **55** | Esperance | 0 @ 6 | 322 | 197 | 128 | 80 | 71 | 55 | 42 | 28 | 15 | 4 | 0.00 |
| | | >= -0.2 | 322 | 192 | 128 | 82 | 72 | 54 | 41 | 28 | 15 | 4 | -0.08 |
| **56** | Mascot | 0 @ 6 | 218 | 120 | 80 | 57 | 51 | 38 | 30 | 21 | 12 | 6 | 0.04 |
| | | >= -0.2 | 229 | 126 | 84 | 59 | 53 | 40 | 31 | 22 | 13 | 6 | 0.23 |
| **57** | Manjimup | 0 @ 6 | 522 | 349 | 243 | 154 | 133 | 100 | 75 | 51 | 28 | 9 | -0.03 |
| | | >= -0.2 | 523 | 346 | 241 | 153 | 133 | 100 | 75 | 51 | 28 | 9 | -0.01 |
| **58** | Albany | 0 @ 6 | 426 | 261 | 170 | 107 | 96 | 75 | 55 | 37 | 20 | 4 | 0.01 |
| | | >= -0.2 | 430 | 248 | 164 | 110 | 97 | 74 | 54 | 37 | 19 | 4 | -0.04 |
| **59** | Mt Lofty | 0 @ 6 | 976 | 699 | 512 | 337 | 296 | 227 | 179 | 134 | 92 | 57 | 0.03 |
| | | >= -0.2 | 957 | 685 | 499 | 330 | 290 | 223 | 177 | 132 | 91 | 57 | -0.04 |
| **60** | Tullamarine | 0 @ 6 | 628 | 405 | 279 | 186 | 167 | 131 | 99 | 69 | 41 | 17 | -0.01 |
| | | >= -0.2 | 632 | 394 | 276 | 190 | 169 | 129 | 98 | 68 | 40 | 17 | -0.01 |
| **61** | Mt Gambier | 0 @ 6 | 695 | 461 | 319 | 205 | 180 | 140 | 106 | 73 | 41 | 15 | -0.01 |
| | | >= -0.2 | 692 | 453 | 315 | 204 | 179 | 138 | 104 | 72 | 41 | 15 | -0.06 |
| **62** | Moorabbin | 0 @ 6 | 548 | 373 | 262 | 167 | 146 | 112 | 85 | 59 | 34 | 13 | 0.01 |
| | | >= -0.2 | 544 | 367 | 256 | 164 | 145 | 112 | 85 | 58 | 34 | 13 | 0.00 |
| **63** | Warrnambool | 0 @ 6 | 688 | 433 | 296 | 203 | 184 | 147 | 112 | 78 | 45 | 19 | 0.00 |
| | | >= -0.2 | 692 | 422 | 296 | 208 | 187 | 145 | 110 | 76 | 44 | 19 | -0.05 |
| **64** | Cape Otway | 0 @ 6 | 570 | 401 | 285 | 179 | 155 | 116 | 88 | 62 | 37 | 16 | 0.00 |
| | | >= -0.2 | 570 | 401 | 285 | 179 | 155 | 116 | 88 | 62 | 37 | 16 | -0.05 |
| **65** | Orange | 0 @ 6 | 877 | 634 | 463 | 299 | 261 | 200 | 156 | 112 | 72 | 39 | -0.03 |
| | | >= -0.2 | 865 | 625 | 456 | 295 | 258 | 197 | 153 | 111 | 71 | 39 | -0.06 |
| **66** | Ballarat | 0 @ 6 | 909 | 622 | 446 | 299 | 266 | 207 | 161 | 117 | 75 | 41 | -0.02 |
| | | >= -0.2 | 936 | 636 | 455 | 305 | 271 | 211 | 164 | 119 | 76 | 41 | 0.06 |
| **67** | Low Head | 0 @ 6 | 660 | 453 | 324 | 212 | 186 | 143 | 110 | 77 | 45 | 19 | -0.04 |
| | | >= -0.2 | 660 | 453 | 324 | 212 | 186 | 143 | 110 | 77 | 45 | 19 | -0.02 |
| **68** | Launceston Air | 0 @ 6 | 891 | 606 | 431 | 287 | 256 | 201 | 155 | 110 | 67 | 33 | -0.01 |
| | | >= -0.2 | 908 | 619 | 441 | 293 | 261 | 205 | 158 | 112 | 68 | 33 | 0.06 |
| **69** | Thredbo | 0 @ 6 | 1380 | 1125 | 860 | 535 | 455 | 339 | 277 | 217 | 160 | 115 | -0.03 |
| | | >= -0.2 | 1394 | 1031 | 765 | 501 | 438 | 337 | 275 | 216 | 160 | 115 | -0.03 |

# 4 Impacts on star ratings

The sections below show the star bands for updated weather data and the impact on the current star rating in the 13 base climates[7]. Initial adjusted star bands were generated using the curve fit between current star rating and new energy demand as described in the methodology (Section 2).

After inspecting the impact on minimum regulatory ratings two adjustments were made:

d) The 10-star level was often adjusted by increasing the allowable energy demand to ensure that 10-stars, while still a 'stretch goal', was still demonstrably achievable[8]. This increase in the 10-star energy demand threshold has some impact on the lower star band thresholds from 7 to 9 stars i.e. above the current required regulatory minimum. In some climates, where the new 10-star threshold is close to the current 9-star level this impact is particularly pronounced.

e) Star bands were the adjusted to ensure that the maximum reduction in rating in all cases did not exceed 0.2 stars. In general, this slightly relaxes stringency at the current regulatory minimum. The change to weather data will require a significant effort by industry to re-work standard solutions and adjust documentation to suit. This initial cost can be offset if the impact of the change in effect allows a small reduction in stringency.

The impacts of the adjusted star bands are shown for two conditions:

f) adjusting the star bands with the initial correlation and the adjustment to 10 stars while keeping the average rating change at 6 stars to 0, and

g) adjusting the star bands the initial correlation and the adjustment to 10 stars while keeping the average rating change at 6 stars to -0.2

Note that the changes to ratings sorted into rating change categories are shown for all 69 climates in Section 9 Appendix 3.

[7] Impacts on star ratings at minimum regulatory levels were evaluated for all climate zones and not just the 13 base climates. However, because dwellings were only optimised to achieve 5, 6 and 7 stars in the base climates, these results may not be as reliable as those shown in the base climates. Note that due to the scale of the work required regulatory impacts statements justifying rating changes do not look at impacts outside capital cities and major regional centres. This project looks at a greater range of climates than is usually the case for a RIS.

[8] Feedback from AAO's, particularly the BDAV (now Design Matters), suggested that it was virtually impossible to achieve 10-stars in many climates without allowing assessors to abandon some of the zoning requirements of Tech Note 1 such as tuning off conditioning in circulation spaces. In many cases, raising the 10-star threshold by a few MJ/$m^2$ would still only allow exceptional dwellings to achieve 10-stars, but would make this level achievable and therefore something designers and assessors could aspire to achieve. To ensure that the required regulatory rating procedures could be used at 10-stars and still provide exceptional performance the 10-star level was adjusted in virtually all climates. See section 5

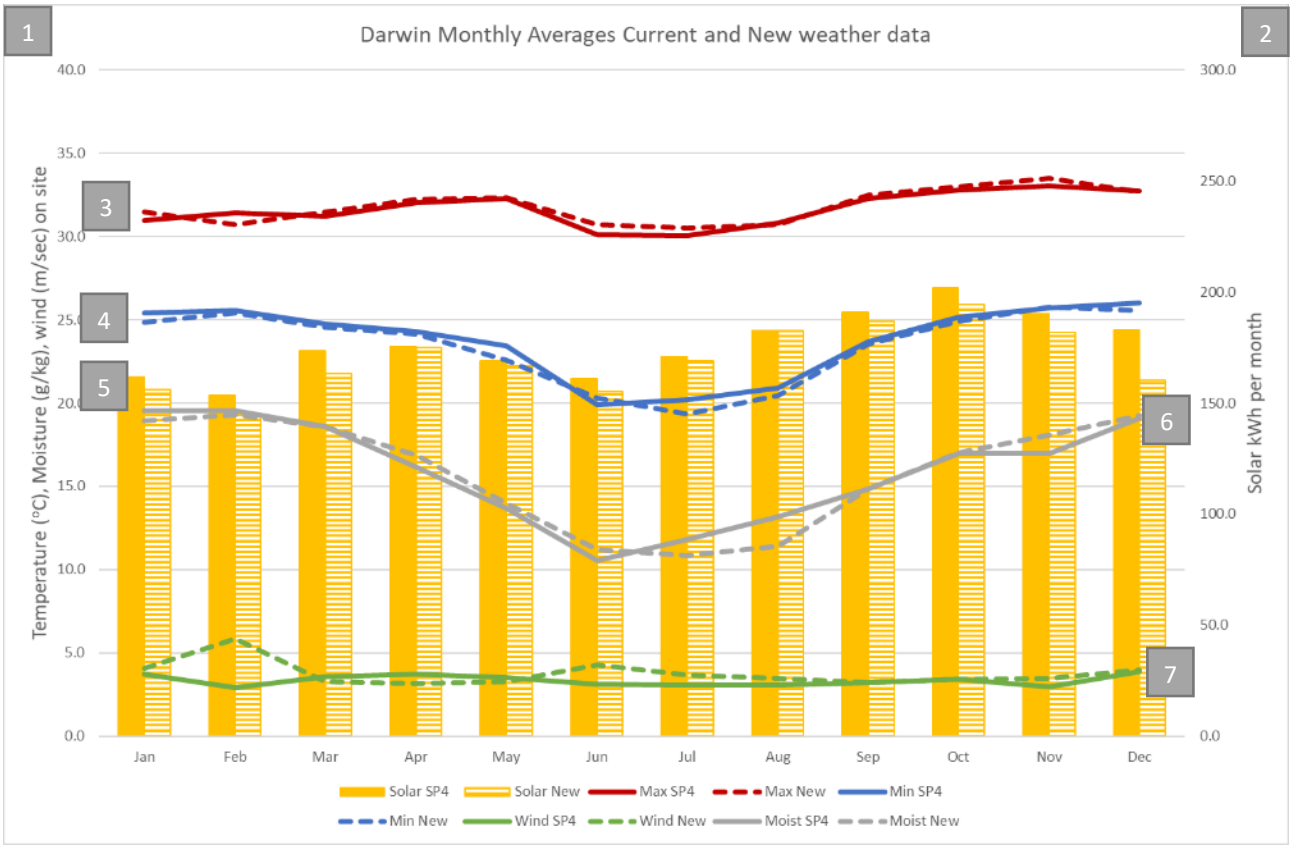
## 4.1 Reporting rating changes

The sections below report the new star bands for each of the 13 base climates and presents the change to ratings of the sample of dwellings. While this process is only reported for the 13 base climates, a similar level of analysis was conducted for each of the 69 NatHERS climates. This section uses a number of graphs to report this information. To save repetition the features of these graphs are explained below.

### 4.1.1 Comparison between current and updated climate data

Figure 3shows the average monthly values for 5 key climate parameters for the current and updated weather data files. In the graph the current data is labelled SP4 for the current AccuRate service pack number which uses the climate files, and the updated weather data is simply labelled New. Current data is shown with solid lines, updated data is shown with dashed lines. This data is provided so that the broad extent of change to the weather data can be better understood.

**Figure 3 Example of the change to monthly average climate parameters**

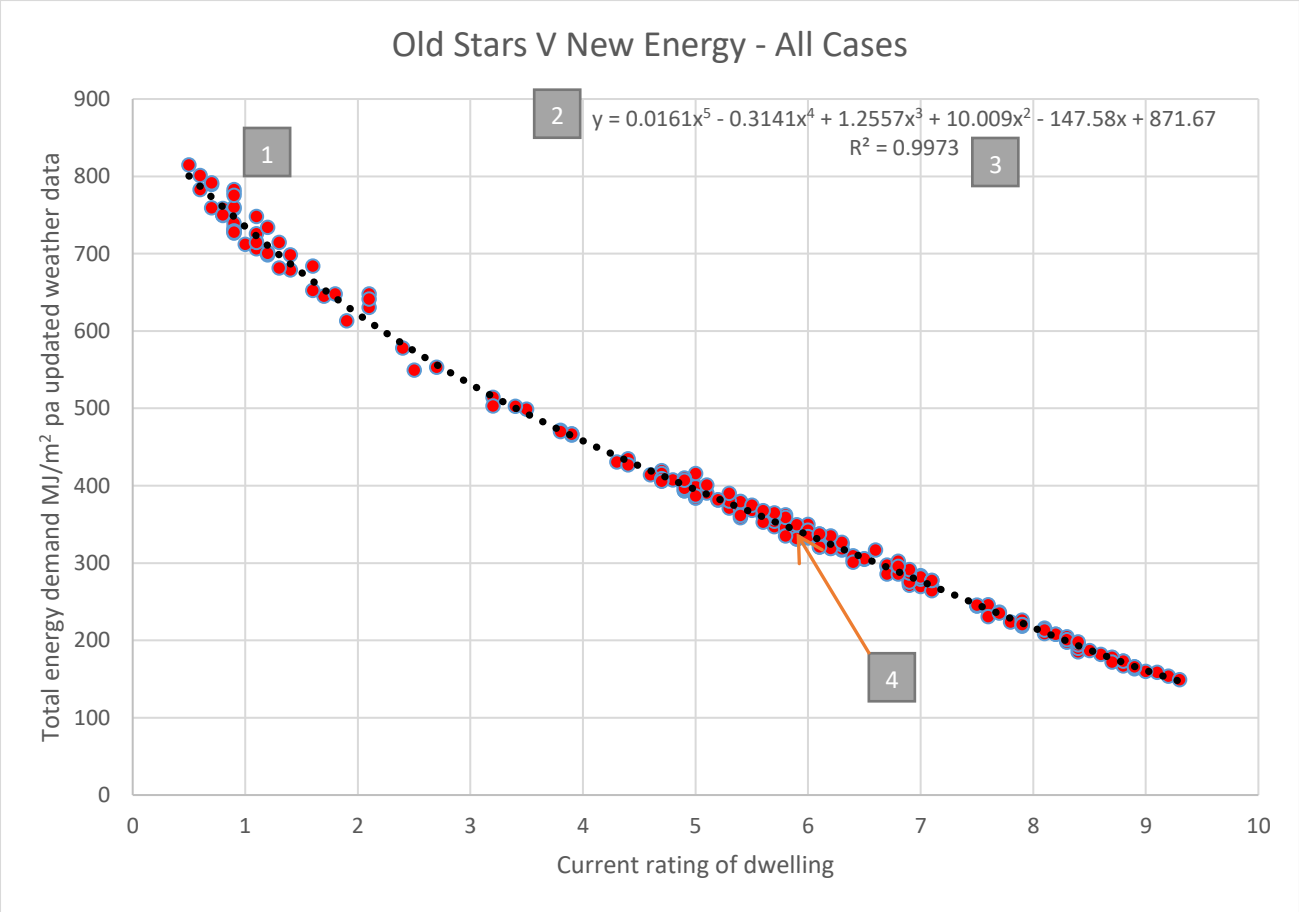



| Feature no. | Description |
|---|---|
| **1** | Left Axis. Used for temperature, wind speed and moisture content |
| **2** | Right Axis. Used for solar radiation |
| **3** | Average Monthly Temperature |
| **4** | Average Minimum Temperature |
| **5** | Average Monthly total solar radiation on a horizontal surface including both direct and diffuse radiation |
| **6** | Average Monthly Moisture content of air |
| **7** | Average monthly wind speed, adjusted for wind speed for 1 storey houses in a suburban environment |

### 4.1.2 Initial correlation between current rating and energy demand using updated weather files

Star bands are developed by correlating the current rating with energy demands predicted with updated weather data. This correlation produces a curve of best fit between the current rating and energy demands using the updated weather data. This curve of best fit is used to calculate new star bands. The star bands are then adjusted to limit rating reduction to a maximum of 0.2 stars and redefine 10 stars as outlined in the methodology (Section 2.2). The design and specifications of the 10-star dwelling is explained in Section 5. In each section a graph of the raw correlation is shown at the beginning. This shows the degree to which the current rating and new energy demands correlate. Figure 4 shows an example of this graph.

**Figure 4 Example of the correlation between current star rating and energy demand predicted with updated weather data**

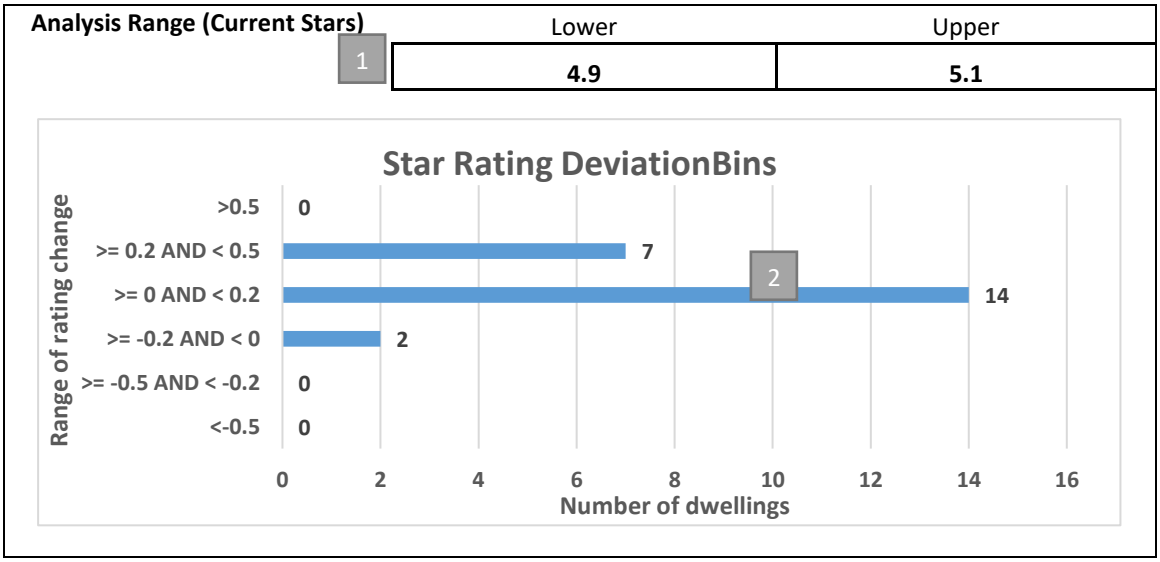



| Feature no. | Description |
|---|---|
| **1** | Dots show each of the 270 cases used to develop correlation between current rating and energy demand using updated energy demand |
| **2** | Correlation equation which can be used to predict new energy demand that represents each star value |
| **3** | $R^2$ of R squared value of correlation. The closer to 1, the closer the perfect correlation between current star and new energy demand. Values in excess of 0.99 show excellent correlation |
| **4** | The range of energy demands for dwellings which currently achieve ratings at the current regulatory minimum at 6 stars (or other rating levels) can be seen by observing the range of energy demands. This shows that not all dwellings which currently achieve 6 stars will achieve 6 stars with the updated weather data. gives an indication of the extent of change to ratings that will occur. This is explained in more detail with other graphs. |

### 4.1.3 Change to ratings sorted into categories

After the initial correlation and adjustments, the extent of change to ratings is reported in 5 categories and shown in a graph like Figure 5 below. This analysis is presented for dwellings which achieve the minimum regulatory rating currently in force in the jurisdiction e.g. in Darwin the minimum requirement for Class 1 is 5 stars and not the 6 stars of the NCC. Note that in Darwin the minimum rating for Class 2 is 3.5 stars, but there are insufficient data points at this rating level to show impacts for Class 2 separately

**Figure 5 Sample of graph showing change to ratings**




| Feature no. | Description |
|---|---|
| **1** | This shows the upper and lower rating levels of dwellings which are included in the graph. Because ratings were only optimised to within 0.1 stars of the each rating level (or 2MJ/m2, which can represent 0.2 stars in mild climates) a range is needed to identify rating changes at the minimum regulatory level. |
| **2** | The number of dwellings at each category of rating change. Note that while 18 dwellings are optimised to specific ratings in the Base climate zones, houses rated in two other climates are run to provide an adequate spread of ratings to ensure that the correlation works properly. Some of these ratings developed for other climate zones will be within the rating range so the number of dwellings shown will often exceed 18. |

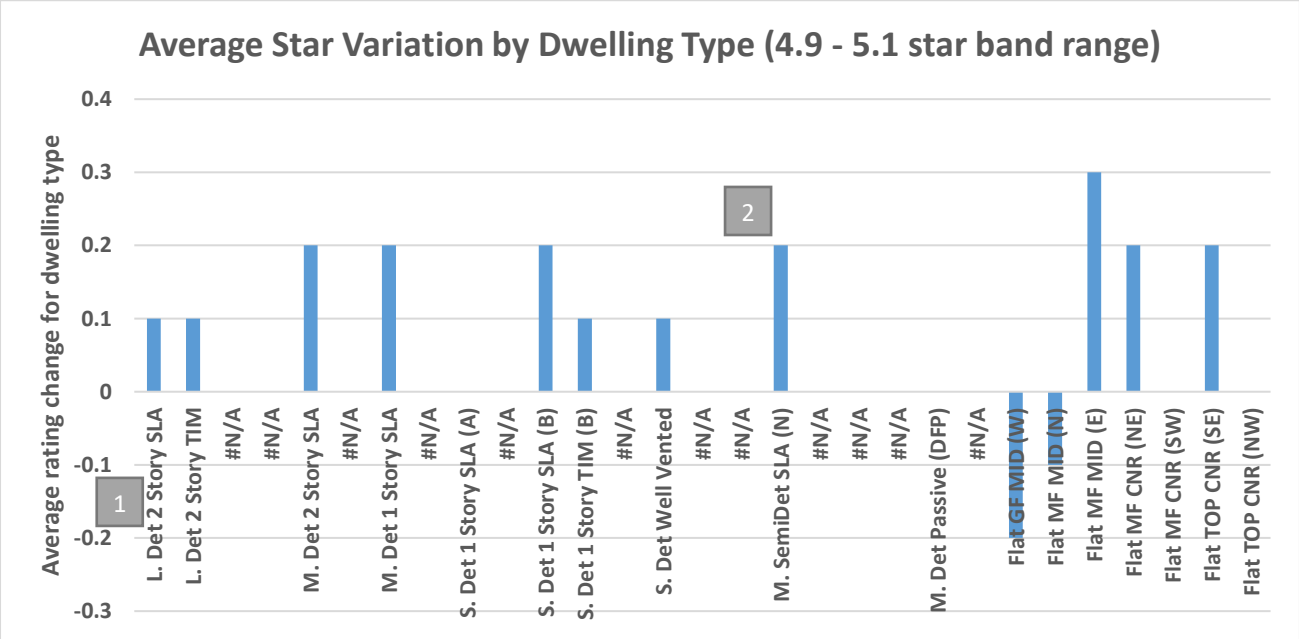
### 4.1.4 Change to ratings by dwelling

In addition to the change in rating by category the average rating change for each dwelling is shown to provide an indication of how the updated weather and adjusted star bands affect different types of dwellings. To develop the star bands ratings developed for 3 of the base climates are run to ensure that there is a good spread of rating outcomes to develop the correlation (See Section 2.6.1). This means that there may be more than the 18 dwellings developed for the base climate zone which achieve the minimum required star rating. The extent of change for each dwelling is therefore the average change for each dwelling.

Figure 6 shows an example of the rating change by dwelling type graph.

Note that while there were 29 dwelling types available, only 18 are simulated in each climate zone (See Section 2.5). If a particular dwelling type is not simulated in the climate zone the label on the horizontal axis shows #N/A. In addition, some of the apartments with favourable orientation could not be made to achieve lower rating levels, so these apartments are not included in the graph and are also denoted with a #N/A.

**Figure 6 Example of rating change by dwelling type**




| Feature no. | Description |
|---|---|
| **1** | Dwelling description. This shows a description of the dwelling type to assist in identifying the type of dwellings. To minimise space some shorthand descriptions were used. These are shown in Table 8below. |
| **2** | Average change to rating for the dwelling type. If there is no bar shown above a dwelling type the average change was 0. |

**Table 8 Abbreviations used in dwelling descriptions**

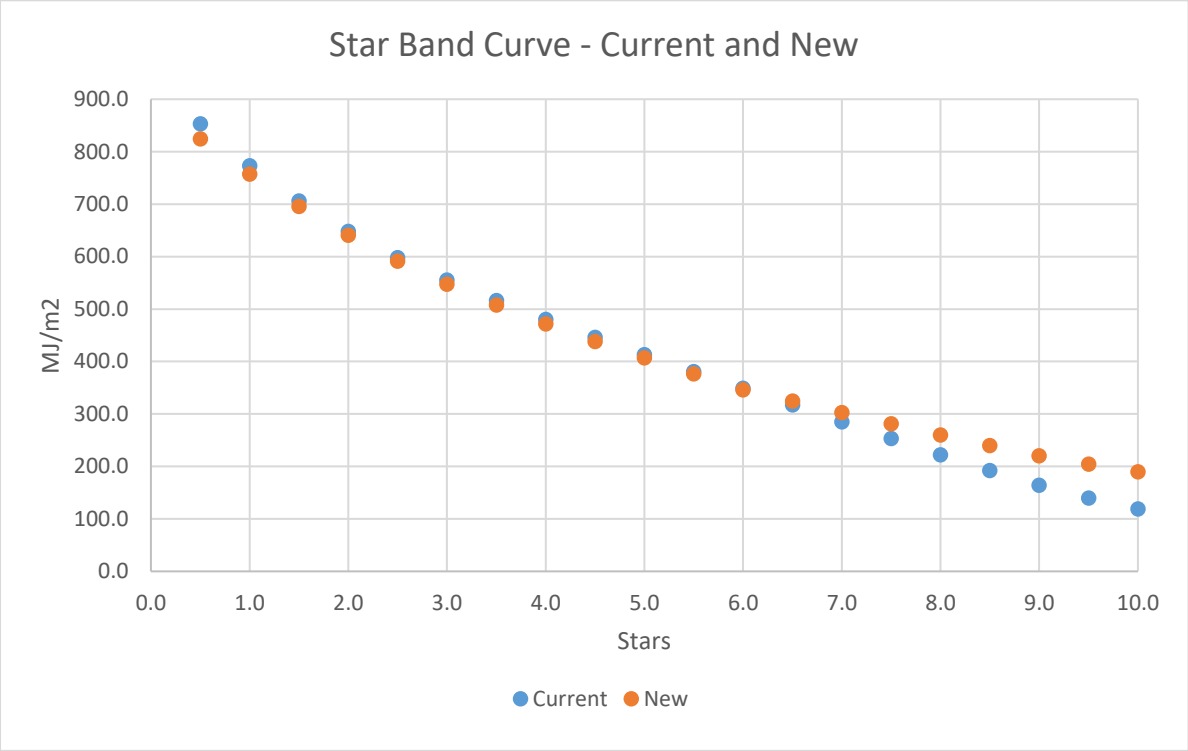
| **Class 1 dwellings** | |
|---|---|
| **L, M or S** | Indicates a Large Medium of Small Class 1 house. |
| **Det or SemiDet** | Indicates a Detached or Semi-detached house. |
| **SLA or TIM** | Indicates the ground floor is a concrete slab or timber suspended floor over an enclosed subfloor. |
| **1 Storey 2 storey** | Indicates the number of storeys in the Class 1 house |
| **Class 2 dwellings are indicated as Flat.<br>There are a number of other descriptions associated with these dwelling types** | |
| **GF/MF/TOP** | Indicates the dwelling is located on the ground floor, middle floor or top floor. |
| **MID/CNR** | Indicates that the dwelling a located in the middle i.e. external walls have only one orientation, or on a corner i.e. has external walls with two orientations. |
| **In brackets** | S, W, N, E, NE, SW, SE or NW. This shows the orientations of the external walls. Where there is only one letter, this indicates the middle unit has a south, west, north or east orientation. |
| **Where there are two letters this indicates the orientations of each external wall i.e. North and East, South and West, South and East, or North and West.** | |

### 4.1.5 Comparison of current and adjusted star bands for base climate zone

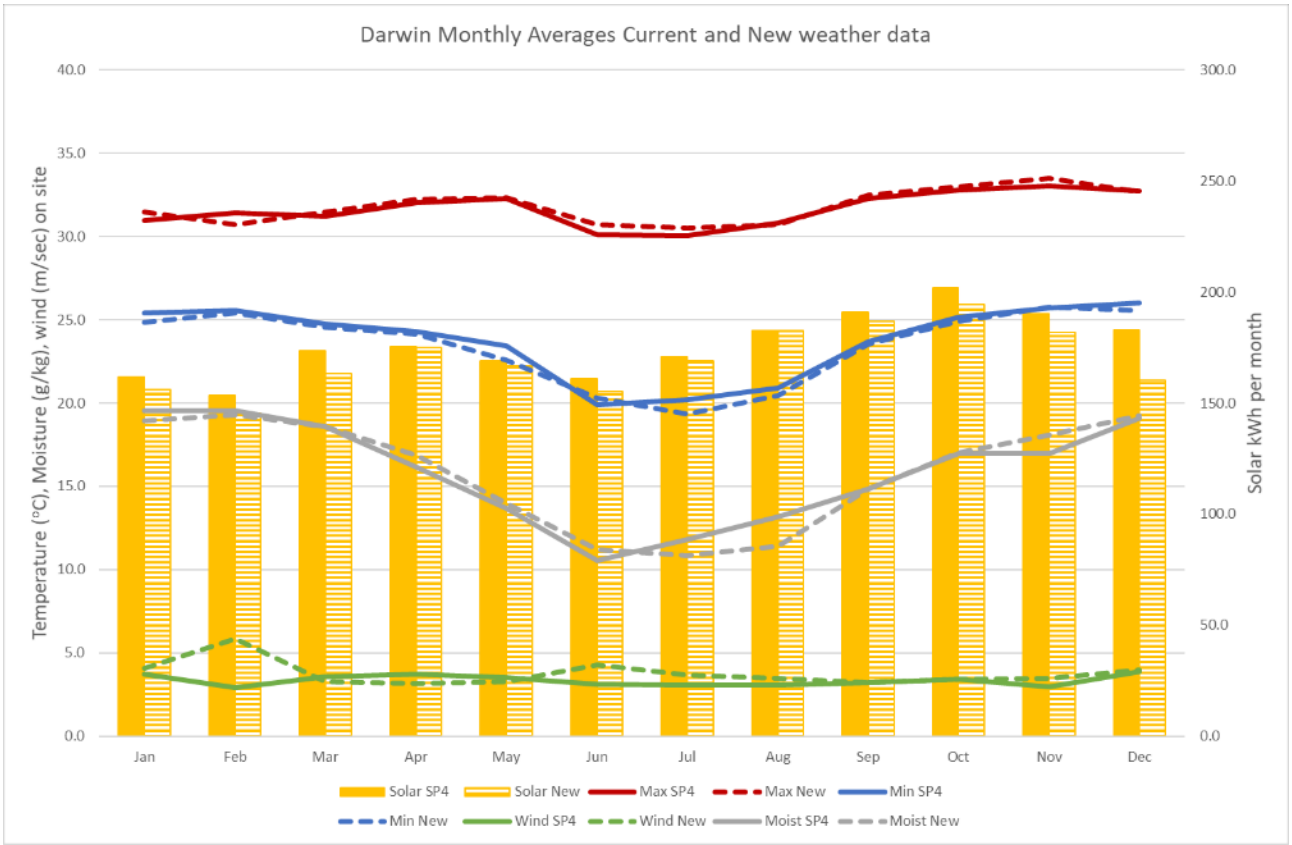
Finally, the current star band thresholds in 0.5-star jumps are shown on a graph with the adjusted star band thresholds (labelled New) developed for the updated weather data. The adjusted star band thresholds are shown with orange dots, the current thresholds are shown with blue dots.

The difference between current and adjusted star band thresholds from 0.5 to 6.0 stars indicates the extent of change to total heating and cooling loads which occur due to the updated weather data. The star band thresholds from 6.5 to 10 stars indicate the changes due to the redefinition of the 10-star level.

**Figure 7 Example of current star band and adjusted star band MJ/m2 thresholds**



## 4.2 Darwin

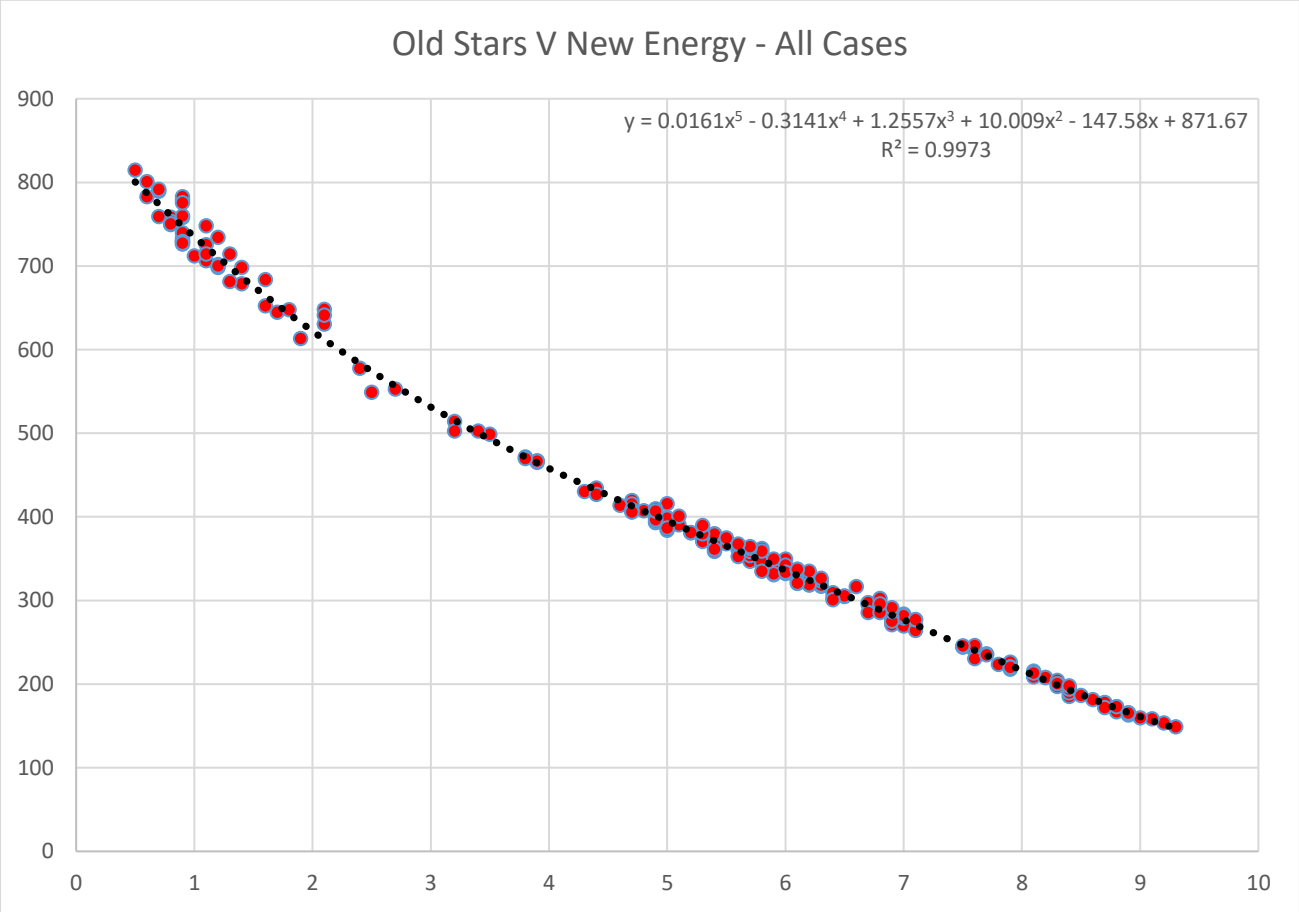



The difference between the monthly average climate data sets is minimal. There are some reductions in solar radiation in some months. This suggests that the prediction of cooling loads in Darwin may be slightly lower with the new weather data.

### 4.2.1 Initial Correlation

Figure 8 shows the initial correlation between current star rating and the energy demand predicted using the new weather data. The correlation is strong ($R^2$ value of 0.997) which indicates that the extent of the variation to the star ratings should be minimal.

**Figure 8 Correlation between existing energy rating and energy demand with new weather data in Darwin**



### 4.2.2 Adjusted star bands with limited rating reduction and new 10-star level

While the NCC requires a minimum rating of 6 stars, in the NT the current minimum rating for Class 1 dwellings is 5 stars and 3.5 stars for Class 2 dwellings. The initial analysis focusses on the minimum rating level in use in the jurisdiction and therefore focusses on both 5 and 6 stars in this section.

The initial correlation between current rating and energy demand with updated weather shown in Table 9 is modified to limit reductions in rating to 0.2 stars and add the new 10 star level. Note that the higher 10-star limit also affects star band thresholds from **7 to 9 stars**.

Table 9 shows the adjusted star bands using the two alternative methods and the current star bands.

**Table 9 Current and adjusted star band thresholds in Darwin**

| Star | Current | Adjusted star bands no change <= -0.2 stars | Adjusted star bands with 0 average change at 6 stars |
|---|---|---|---|
| **1.0** | 773 | 757 | 741 |
| **2.0** | 648 | 641 | 626 |
| **3.0** | 555 | 547 | 535 |
| **4.0** | 480 | 472 | 462 |
| **5.0** | 413 | 407 | 399 |
| **6.0** | 349 | 346 | 340 |
| **7.0** | 285 | 303 | 298 |
| **8.0** | 222 | 260 | 257 |
| **9.0** | 164 | 221 | 219 |
| **10.0** | 119 | 190 | 190 |

The differences between the star bands for the two alternative methods of adjusting star bands are not large in Darwin. As is shown in the graphs below the impact on ratings of the two methods on individual dwellings is not large.

Figure 9 shows the range of rating changes for dwellings with rating levels between 4.9 and 5.1 stars. This is shown because the minimum regulatory rating level currently implemented in Darwin is 5 stars for Class 1 dwellings.

**Figure 9 Changes to ratings at 5 stars in Darwin rating change limited to >= -0.2**

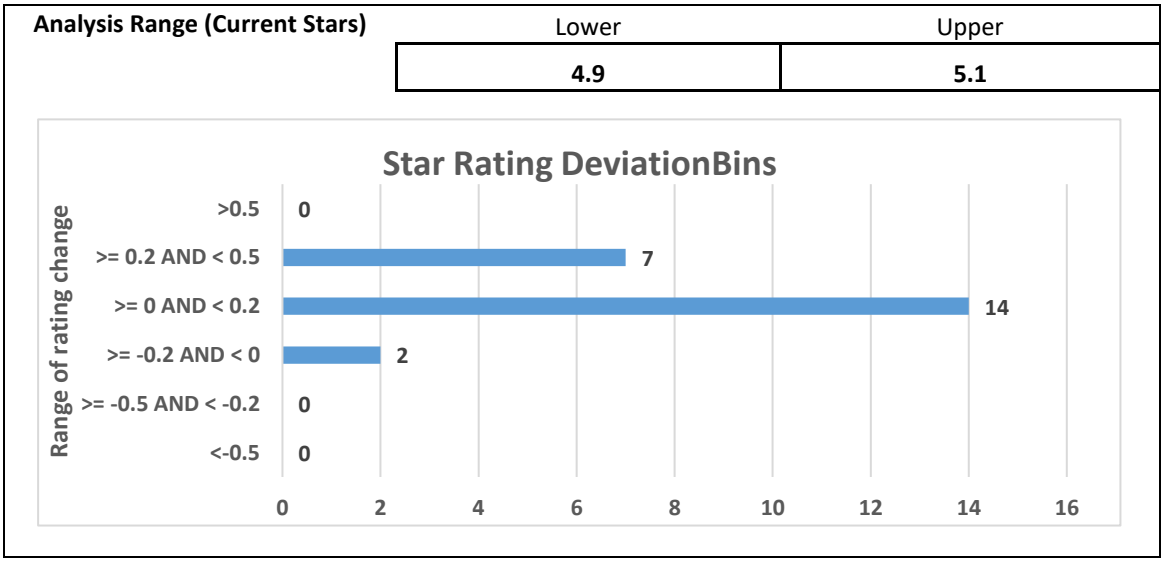
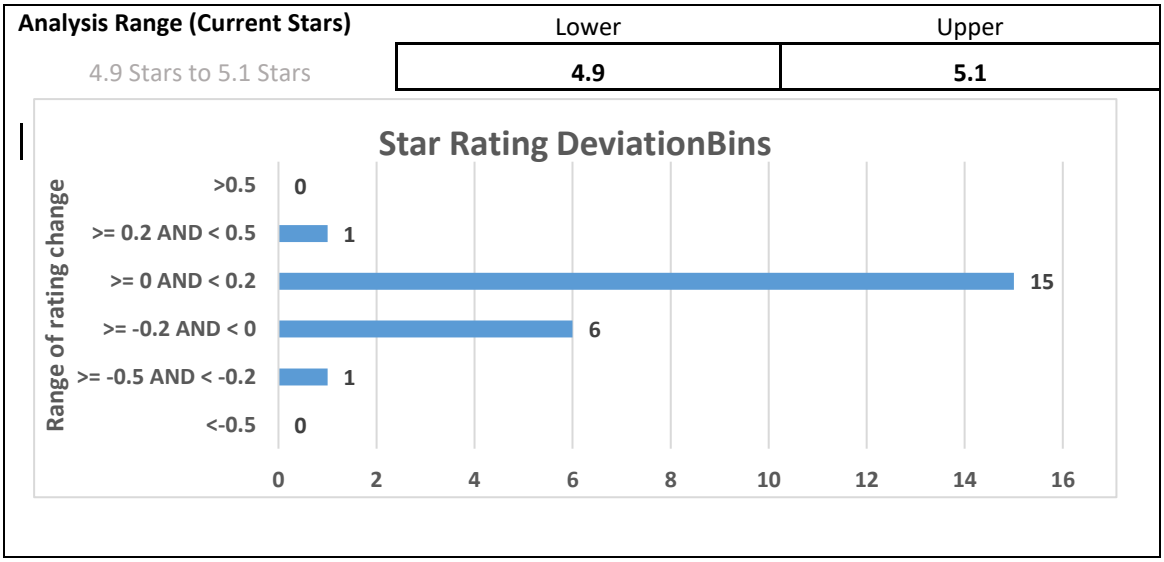
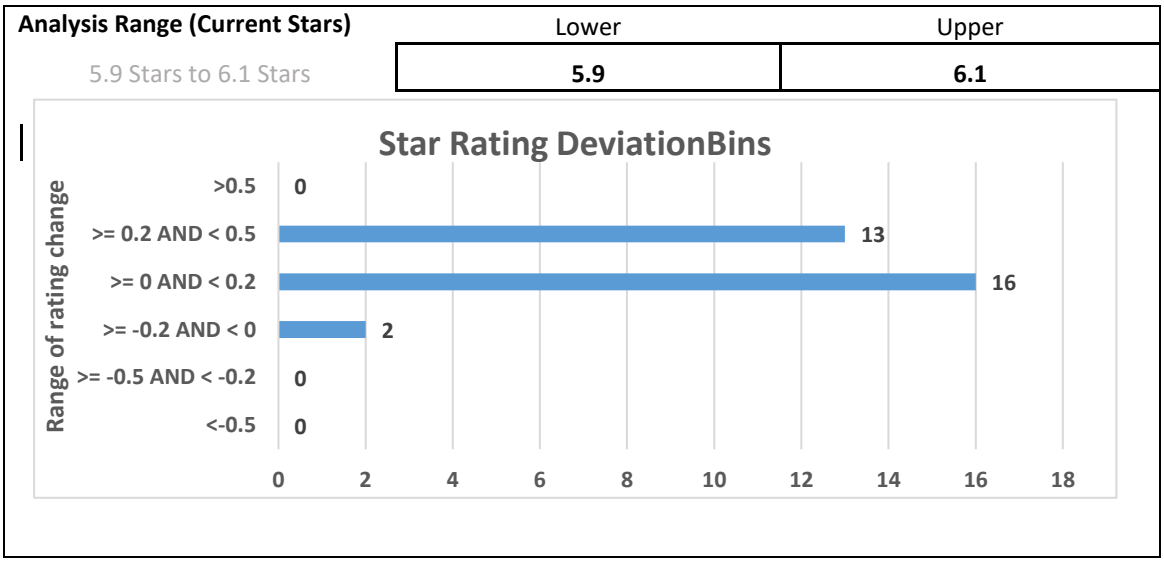


**Figure 10 Changes to ratings at 5 stars in Darwin rating change 0 at 6 stars**



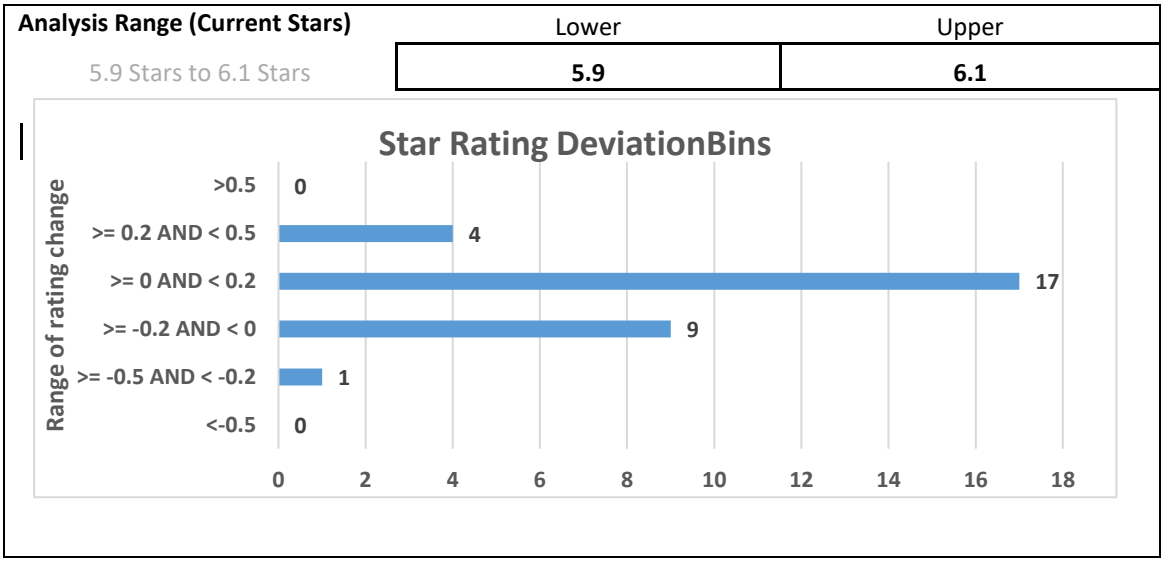

Because the NCC specifies a minimum of 6 stars in this climate, the impact on ratings at 6 stars is also shown in Figure 11 below.

**Figure 11 Changes to ratings at 6 stars rating change limited to -0.2**




The revised star bands have eliminated all cases where the reduction in rating exceeds 0.2 stars. The average rating of houses which currently obtain a rating of 5 stars increases by 0.09 stars, while the rating of houses which currently achieve 6 stars increases slightly by 0.16 stars.

**Figure 12 Changes to ratings at 6 stars rating change 0 at 6 stars**




The graphs above show that the rating of only one dwelling at 5 and at 6 stars is affected by putting a floor on the maximum drop in rating of 0.2 stars.

### 4.2.3 Change to rating for different types of dwellings

Figure 13 shows the changes to the rating of the dwellings simulated in Darwin at 5 stars.

**Figure 13 Change to rating of individual dwellings in Darwin at 5 stars rating change limited to -0.2**

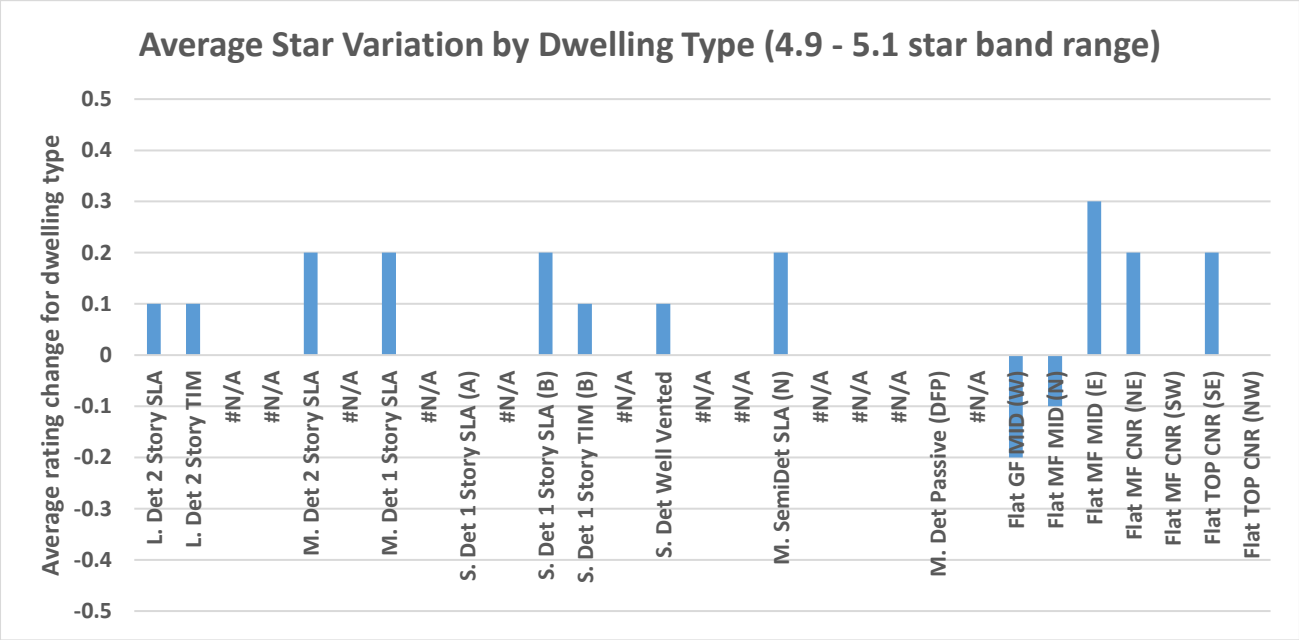
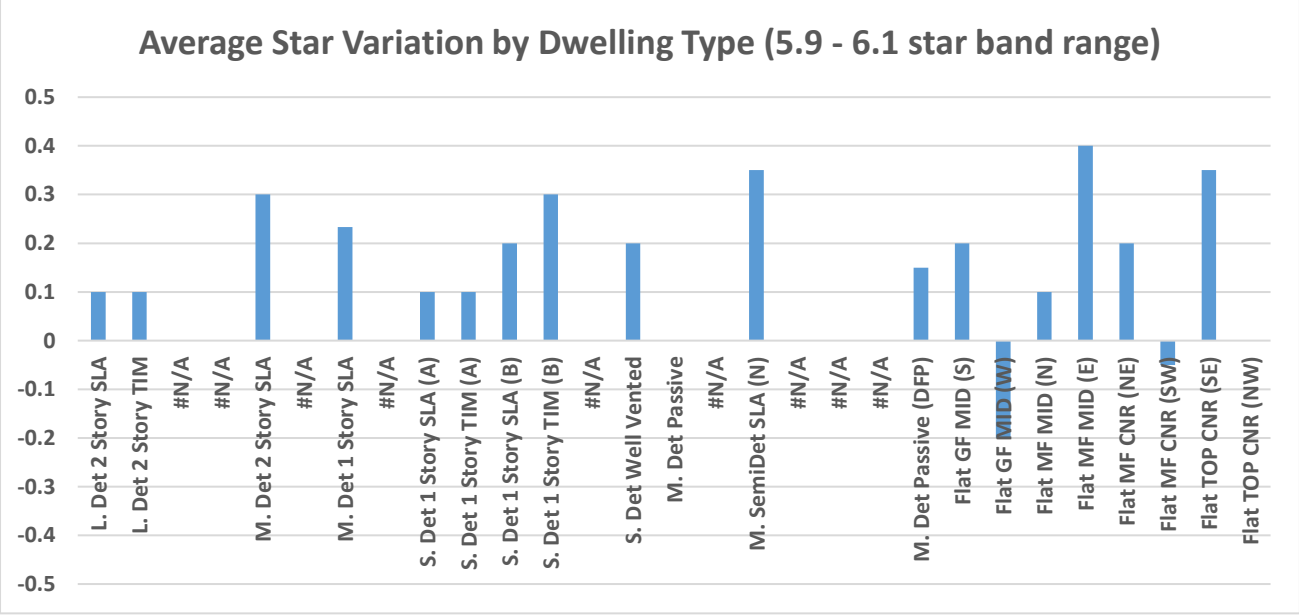



Figure 13 shows that east facing apartments and two storey houses have the largest improvement in their rating while western facing apartments show have the largest rating reduction.

Figure 14 shows the changes to the rating of the dwellings simulated in Darwin at 6 stars

**Figure 14 Change to rating of individual dwellings in Darwin at 6 stars rating change limited to -0.2**




Changes to ratings at both star levels are similar.

The figures below show the changes to ratings using star bands which fix the average rating change at 6 stars to 0. They show that the main difference in the two methods of deriving the star bands is that the West facing apartment on the ground floor has a significant drop in rating using the updated weather data at both 5 and 6 stars. The rating of this unit drops by 0.4 stars and the 5 star level and 0.3 stars at 6.

**Figure 15 Change to rating of individual dwellings in Darwin at 5 stars rating change at 6 stars is 0**

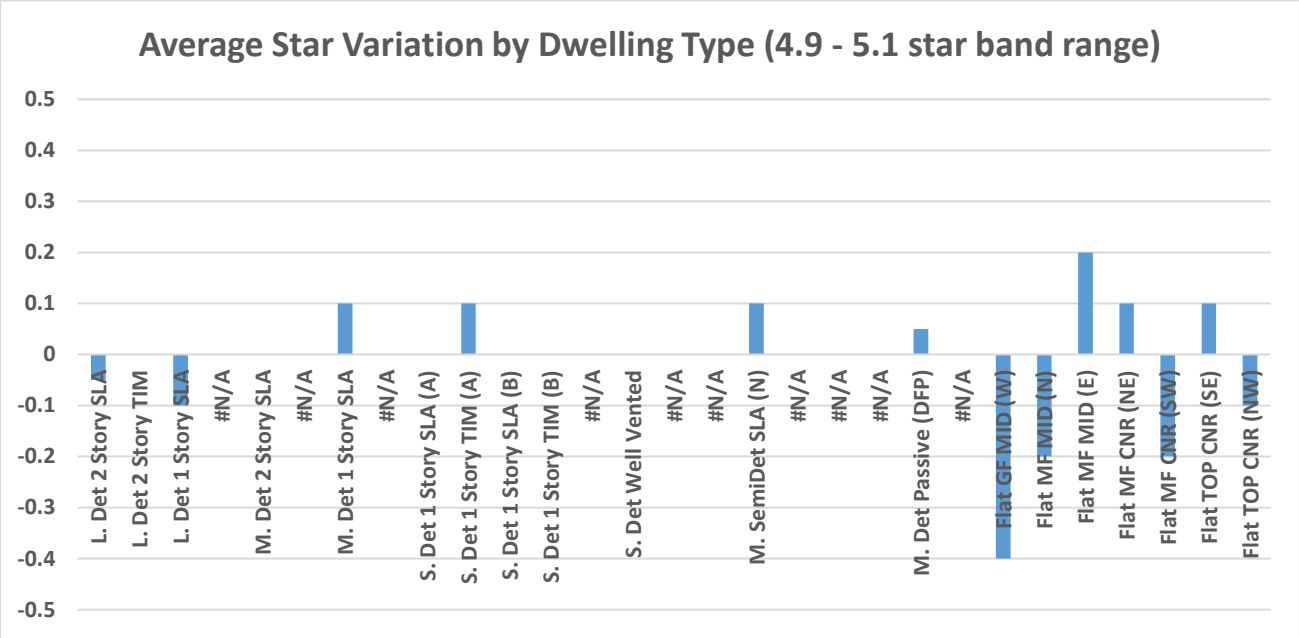
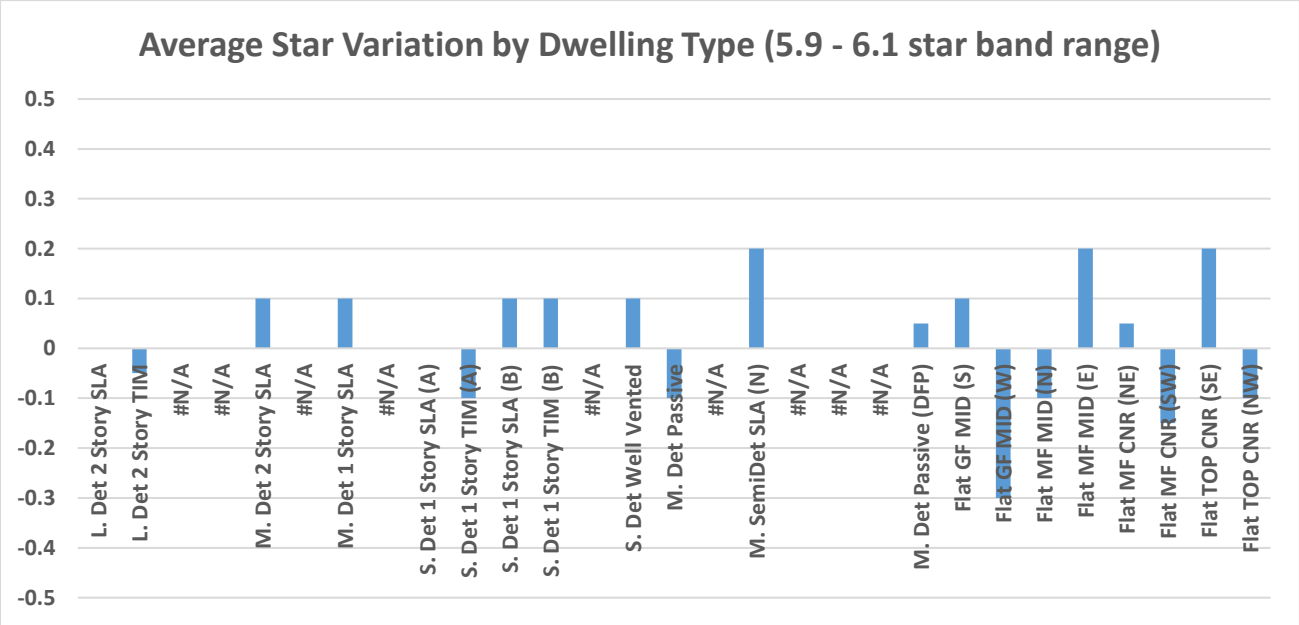



**Figure 16 Change to rating of individual dwellings in Darwin at 6 stars rating change at 6 star is 0**



### 4.2.4 Comparison of current and adjusted star bands for Darwin

The new weather data results in a slight decrease (3.5%) to the energy demand at 6 stars.

Figure 17 below shows the current and adjusted star band thresholds for Darwin. Note that the new thresholds at 6 and below are slightly lower than the current star bands consistent with the slight reduction in total energy demand while the thresholds for 6.5 stars and above are higher as a result of the recalibration of 10-stars.

**Figure 17 Comparison of current and adjusted star bands for Darwin rating change limited to -0.2**

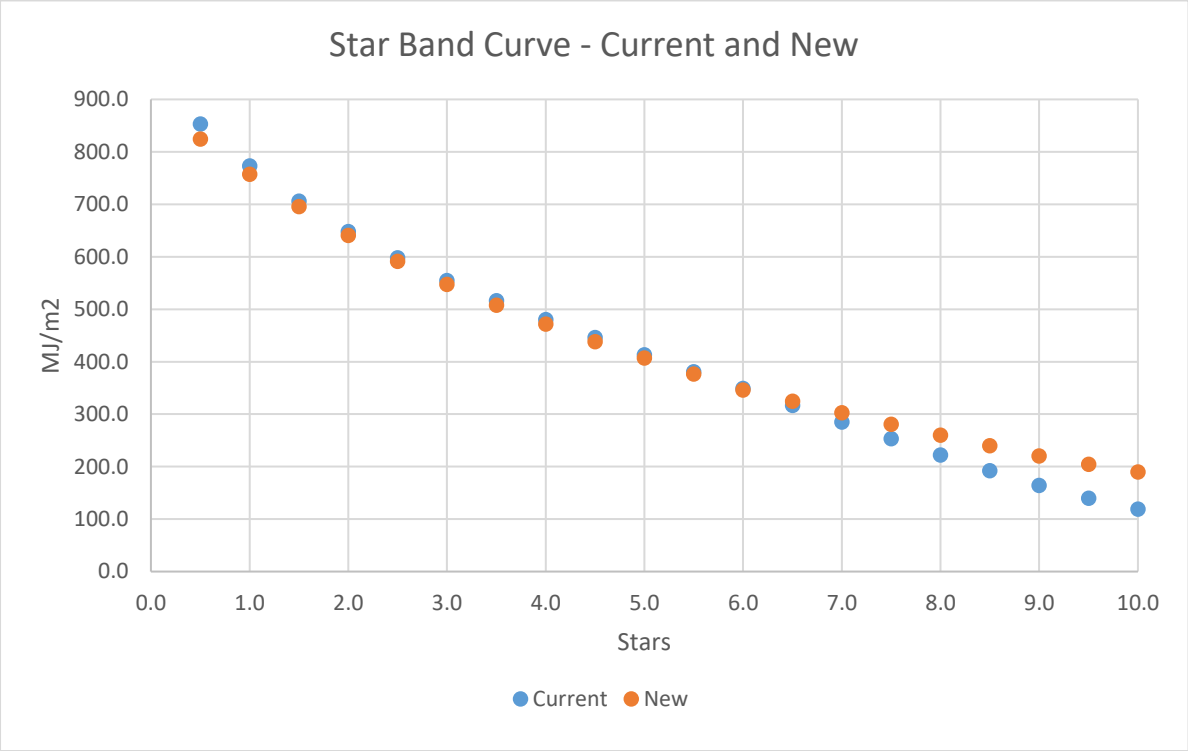
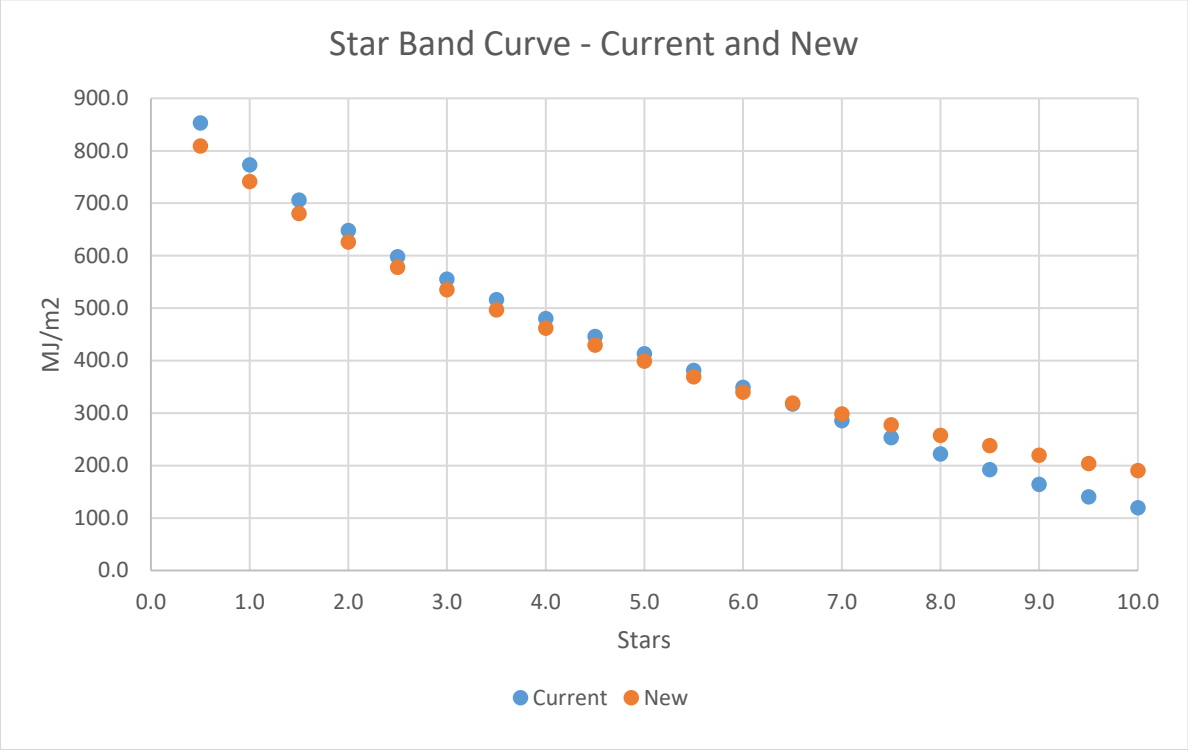
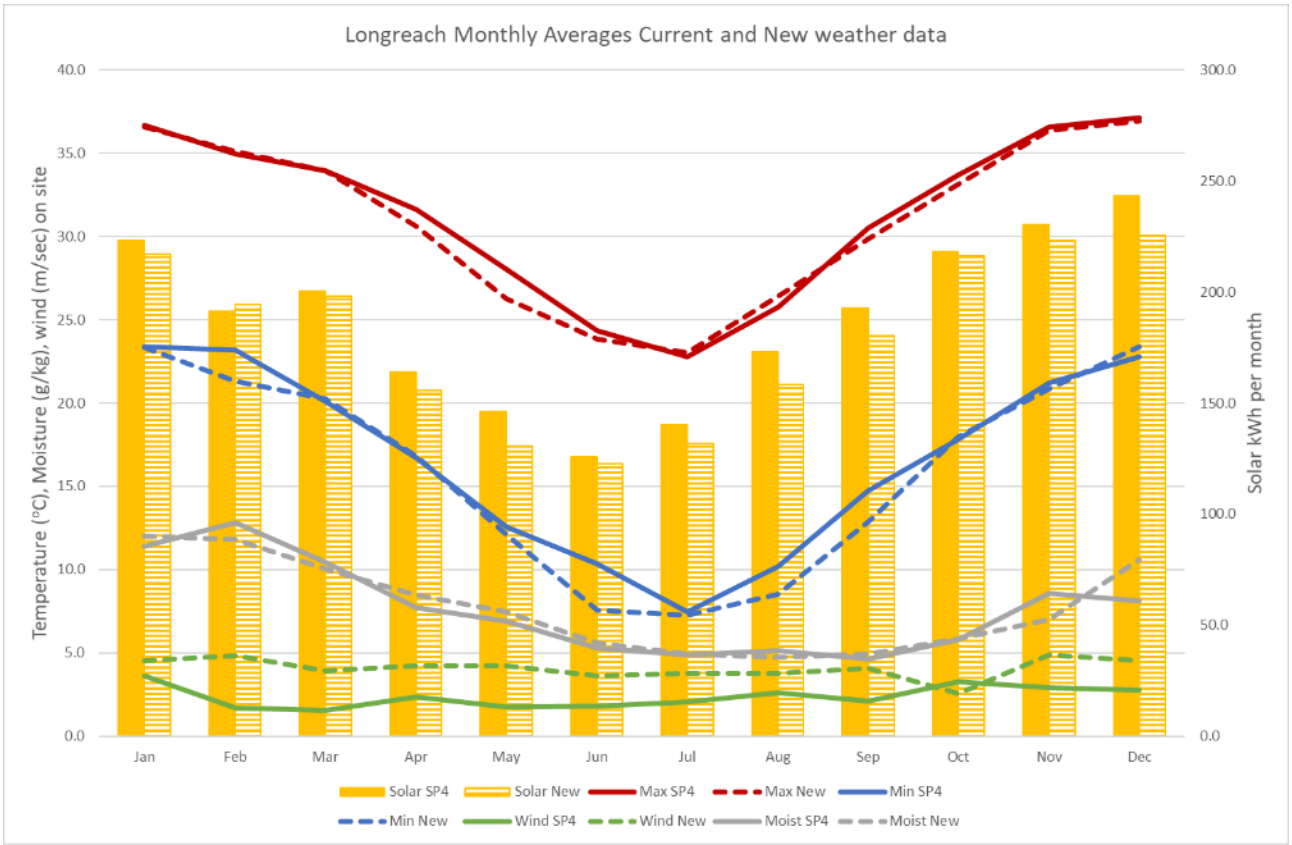


**Figure 18 Comparison of current and adjusted star bands for Darwin rating change at 6 stars is 0**



## 4.3 Longreach

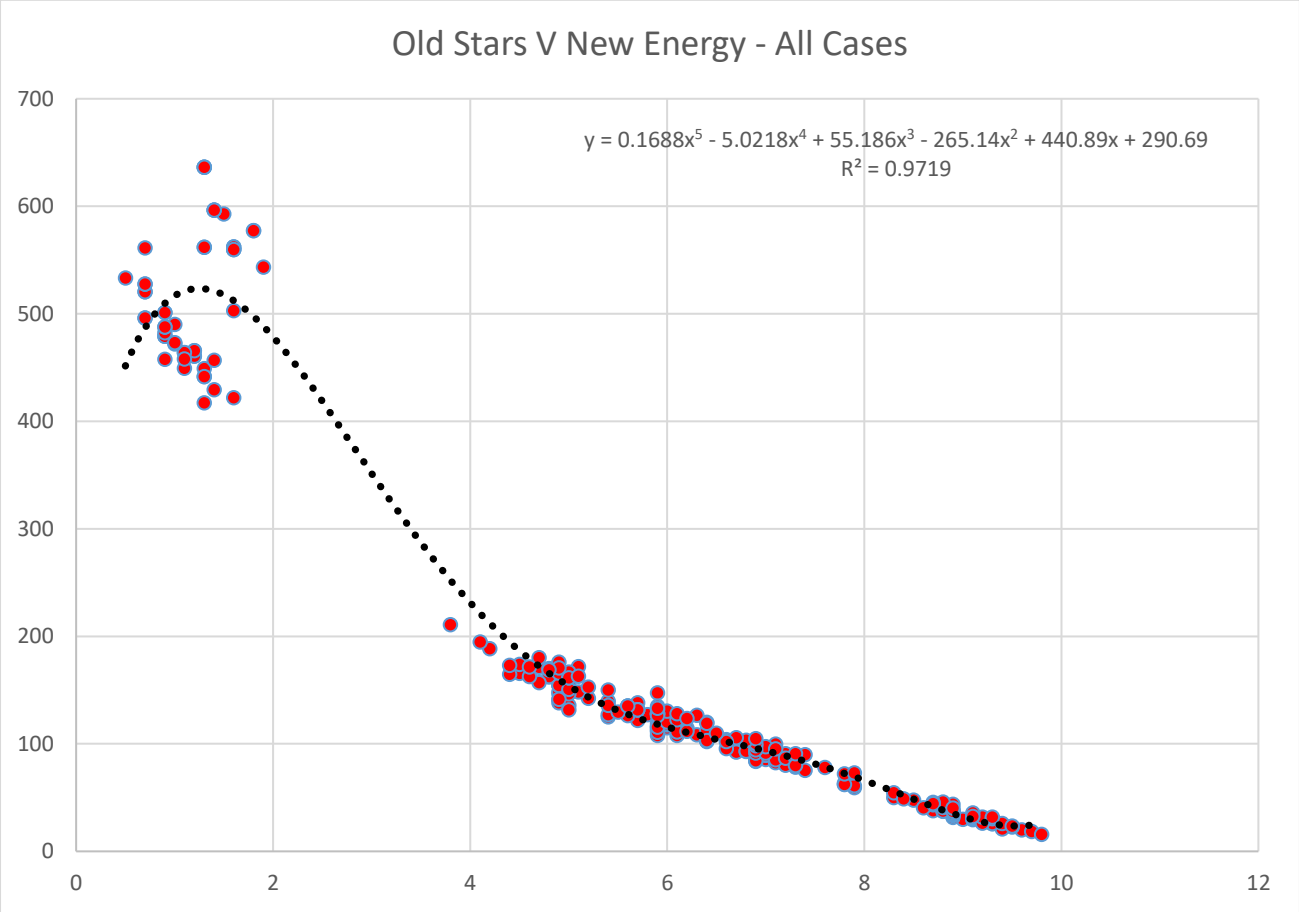



The new Longreach weather data has significantly lower solar radiation levels than the current weather data as well as some lower maximum and minimum temperatures in some months. Wind speeds are significantly higher in the new weather data. The combined effects of these changes to weather data should see lower cooling demand predicted by NatHERS simulations, but the climate should still be cooling dominated.

### 4.3.1 Initial Correlation

Figure 19 shows the initial correlation between current star rating and the energy demand predicted using the new weather data. The correlation is strong ($R^2$ value of 0.972). Note the correlation is worst at star ratings at 2 stars or lower.

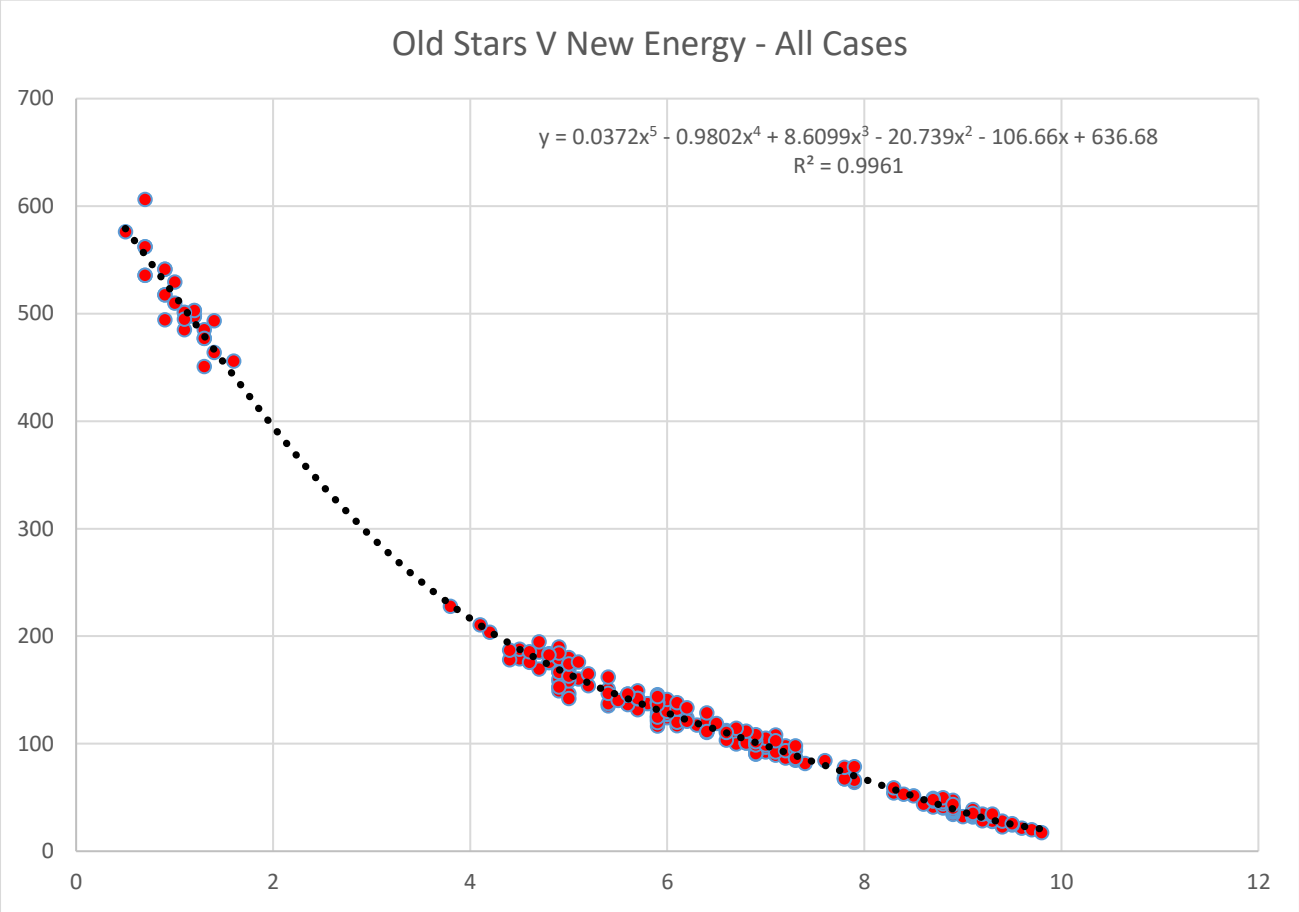
**Figure 19 Correlation between existing energy rating and energy demand with updated weather data in Longreach**




The poor correlation at the low star end was due to the large variation in energy loads in the one-star version of the Class 2 apartments. In these dwellings it was virtually impossible to make the apartments obtain a rating as low as 1 star in the current version of AccuRate even with full floor to ceiling windows with clear single glazing. To develop 1-star versions of apartments air leakage was substantially increased e.g. by installing chimneys with no damper. The significant change in temperatures in the updated weather data means that the impact of this additional high level of air leakage is now quite different with the updated weather data.

The poor correlation between current rating and energy demands with the updated weather data at the one-star end had significant implications for the development of star bands at 5 and 6 stars. If the reduction in rating at 6 stars was kept to a maximum of 0.2 stars, then the average rating for dwellings which currently achieve 5 stars increased by over 0.6 stars. This relaxation in stringency at 5 stars was deemed to be unacceptable. To address this issue the ratings of all one-star apartments were excluded. This produced a much better R squared value and contained the increase in the rating of dwellings at 5 stars. The graph below shows the improved correlation:

**Figure 20 Correlation between existing energy rating and energy demand with new weather data with 1-star apartment excluded in Longreach**



### 4.3.2 Adjusted star bands with limited rating reduction and new 10-star level

While the NCC requires a minimum rating of 6 stars, in Queensland the Queensland Development Code allows a minimum of 5 stars if an outdoor living area is provided which has an insulated ceiling and a ceiling fan. The analysis therefore reports on the impacts on ratings at both 5 and 6 stars.

The initial correlation between current rating and energy demand with updated weather shown in Figure 20 is modified to limit reductions in rating to 0.2 stars and add the new 10 star level. Note that the higher 10-star limit also affects star band thresholds from **7 to 9 stars**.

Table 6 shows both the adjusted star bands for the updated weather data and the current star bands.

**Table 6 Current and adjusted star band thresholds in Longreach**

| Star | Current | Adjusted star bands no change <= -0.2 stars | Adjusted star bands with 0 average change at 6 stars |
|---|---|---|---|
| **1.0** | 550 | 517 | 469 |
| **2.0** | 396 | 395 | 358 |
| **3.0** | 294 | 292 | 265 |
| **4.0** | 226 | 216 | 196 |
| **5.0** | 178 | 165 | 149 |
| **6.0** | 141 | 133 | 122 |
| **7.0** | 107 | 104 | 96 |
| **8.0** | 74 | 76 | 71 |
| **9.0** | 43 | 50 | 48 |
| **10.0** | 18 | 29 | 29 |

The figures below show the impact of the adjusted star bands on the rating of dwellings at 5 and 6 stars. Note that the number of houses in the 5-star range is different to 6 stars. To develop the star bands dwelling ratings developed for 3 climates were run in the Longreach climate. Because the number of dwellings which achieve these star rating levels which were developed for other climate zones varies the number of dwellings sown in the graphs below also varies.

**Figure 21 Changes to ratings at 5 stars in Longreach rating change limited to ->= -0.2**

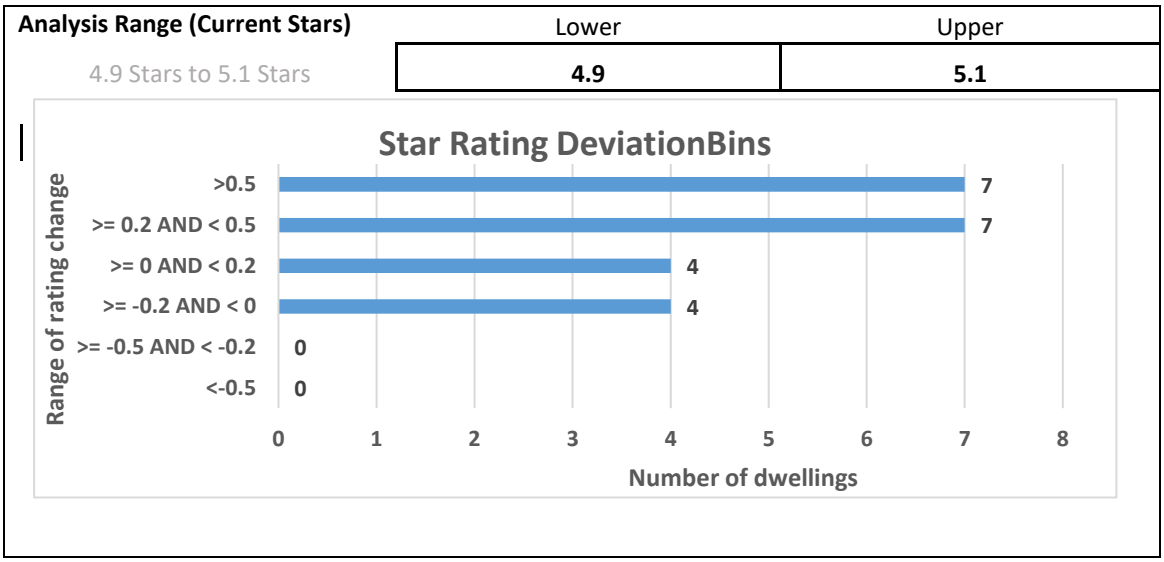
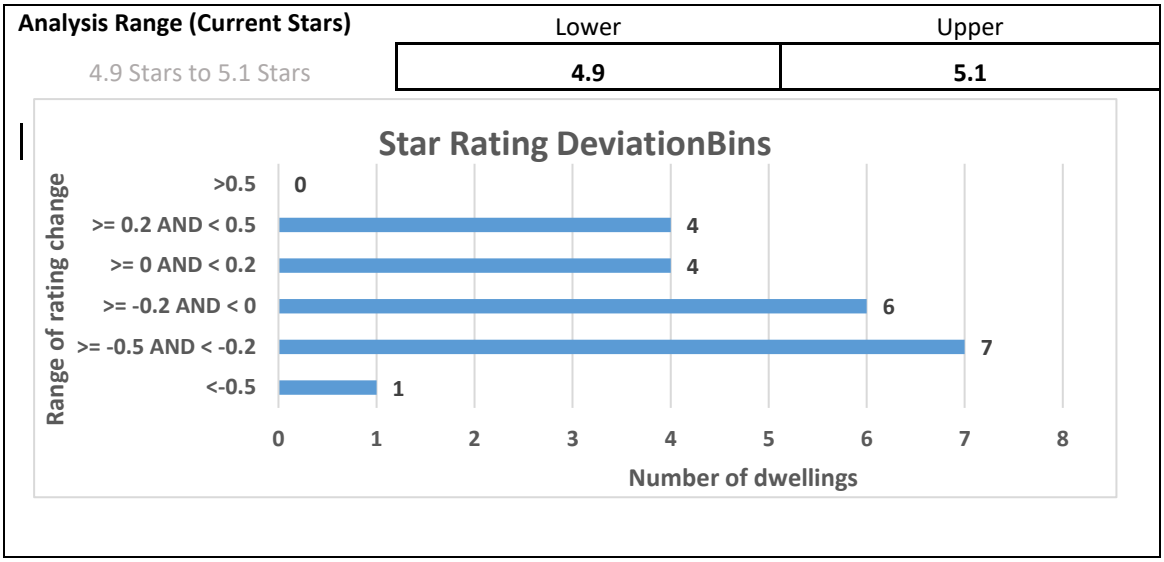


**Figure 22 Changes to ratings at 5 stars in Longreach average rating change at 6 stars is 0**




The figures above show that a significant proportion of houses which currently achieve 5 stars would experience a reduction in rating by more than 0.2 stars and one by more than 0.5 stars without putting a floor under the maximum drop in rating.

**Figure 23 Changes to ratings at 6 stars rating change limited to ->= -0.2**

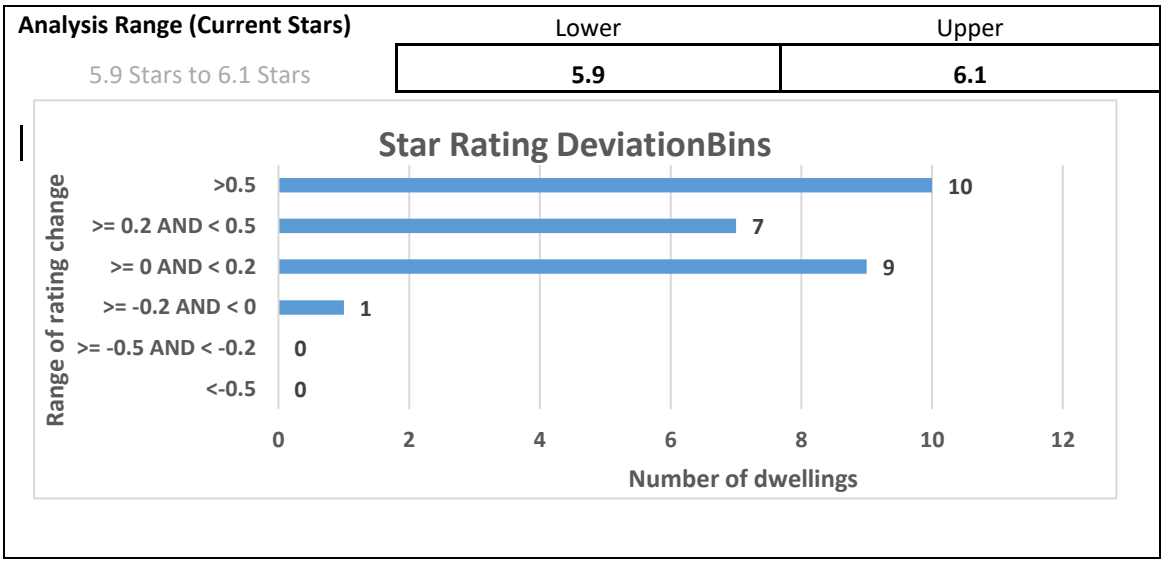
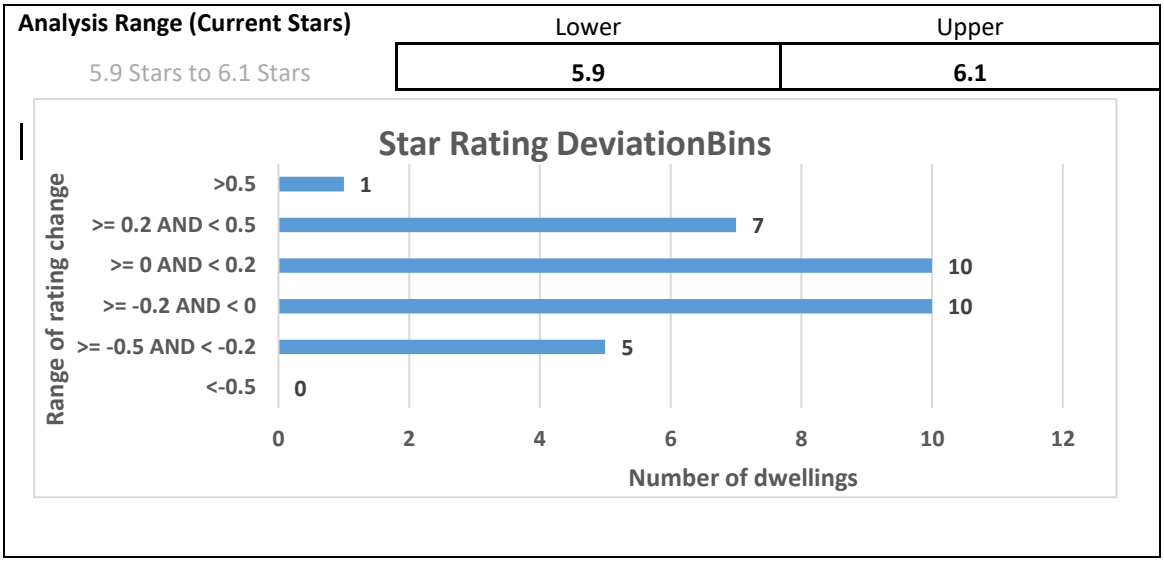


**Figure 24 Changes to ratings at 6 stars in Longreach average rating change at 6 stars is 0**




The rating reduction limited star bands ensure that the reduction in rating exceeds does not 0.2 stars at both 5 and 6 stars. This process has led to an average increase in the rating of dwellings at both star rating levels of around 0.3 stars with the updated weather and adjusted star bands.

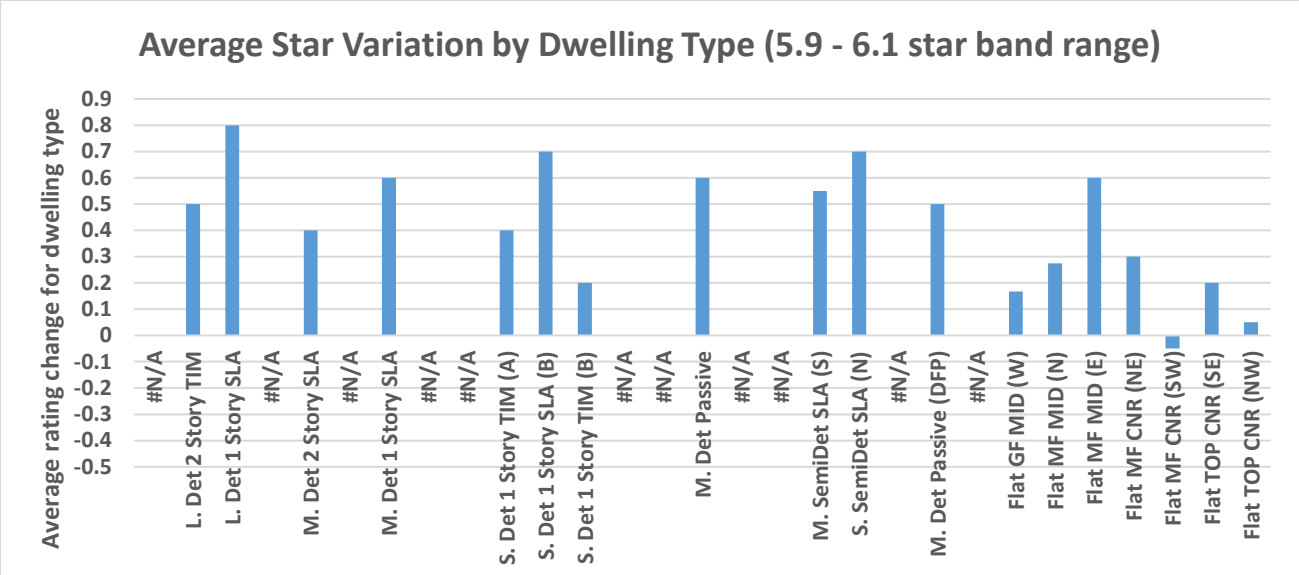
This change is due to the nature of the changes in the weather data and the small but significant difference in the ratings of Class 1 and 2 dwellings. With the updated weather data Class 2 ratings are around 0.2 stars lower than Class 1 dwellings. While this is too small to justify the development of separate star bands for both classes, eliminating all rating reductions of greater than 0.2 stars has the overall impact of increasing the average rating for Class 1 dwellings with the updated weather by more than was found in other climate zones.

Star bands which set the average rating change to 0 at 6 stars see a significant proportion of ratings drop by more than 0.2 stars including one case where the decrease in rating at 5 stars exceeds 0.5 stars.

### 4.3.3 Change to rating for different types of dwellings

Figure 25 shows the changes to the rating of the dwellings simulated in Longreach where the rating reduction is limited to 0.2 stars.

**Figure 25 Change to rating of individual dwellings in Longreach at 6 stars rating change limited to ->= -0.2**



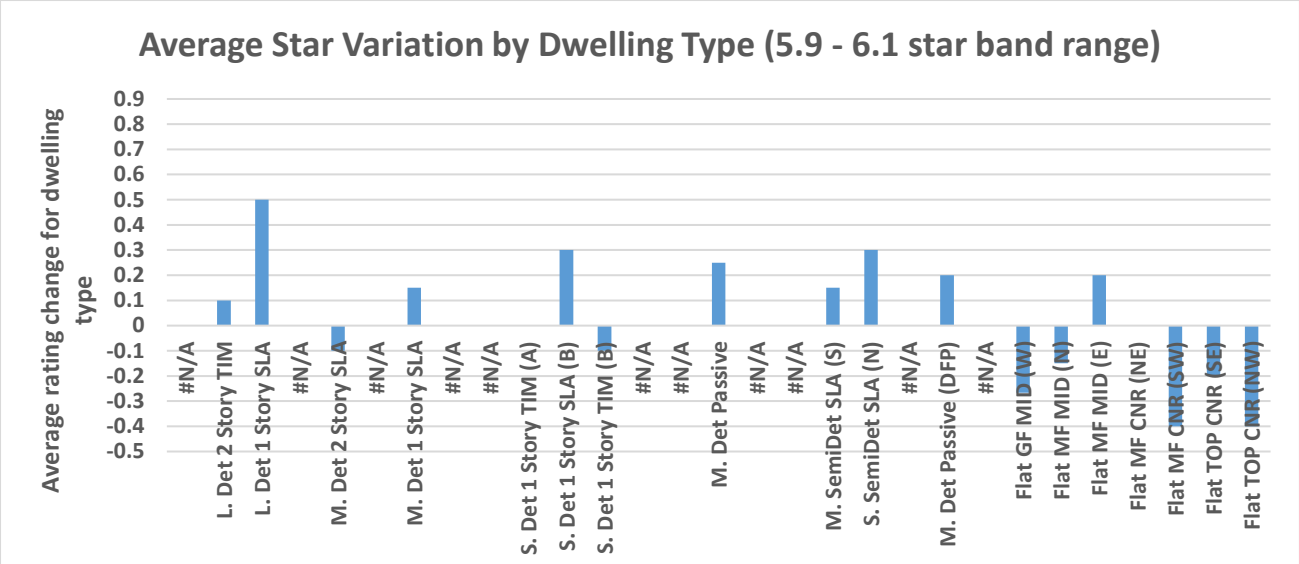

The rating of virtually all dwellings is increased in order to limit the change in rating to the apartments to a maximum reduction of 0.2 stars. If it is considered acceptable to allow this one unit to reduce its rating in excess of 0.2 stars, then the stringency at 5 stars could be increased to better match the current rating system.

There have been some significant changes in the weather data for Longreach from a thermal performance point of view. It is beyond the scope of this report to evaluate whether these changes are 'appropriate'. It is presumed that the quality of the new weather data is better than the original weather data. Lower cooling energy demand is predicted as a result of the updated weather data so the average 0.3-star reduction in stringency at 5 and 6 stars may be appropriate.

Longreach has very low construction volumes with only 78 Class 1 dwellings constructed since May 2016 and no Class 2 dwellings. From an overall policy perspective, the energy efficiency of dwellings in Longreach will have little impact on the energy used for space conditioning residences in Australia. The lack of Class 2 dwelling construction in this Climate Zone may suggest that it could be more appropriate to develop star bands based on Class 1 dwellings alone

Figure 26 shows the changes to the rating of the dwellings simulated in Longreach where the average change to the rating at 6 stars is 0.

**Figure 26 Change to rating of individual dwellings in Longreach at 6 stars average rating change at 6 stars is 0**




The largest rating reductions shown above are for apartments which either face west or are on the top floor.

The updated weather data shows that Class 2 dwellings are now considered to be slightly less efficient than they were previously. While it is beyond the scope of this project to quantify the costs of stringency changes it should be noted that the extent of change to the design and specification of Class 2 dwellings in moving from 5 to 6 stars was less restrictive in Class 2 than Class 1. Class 2 dwellings at 6 stars would often be able to comply with far greater window areas than shown on the original plan for the apartment building. The slight relative tightening of stringency for Class 2 dwellings as a result of the new weather data may not add significant compliance cost as improvements to the rating can be achieved by a modest reduction of window area. This can reduce construction costs.

### 4.3.4 Comparison of current and adjusted star bands for Longreach

The new weather data and star bands results in a moderate decrease (16%) to the energy demand for cooling at 6 stars. This reduction in energy savings predicted by the new weather data should be more than compensated for by the reduction in stringency at 5 and 6 stars reported above.

Figure 27 shows the current and adjusted star band thresholds for Longreach.

**Figure 27 Comparison of current and adjusted star bands for Longreach rating change limited to ->= -0.2**

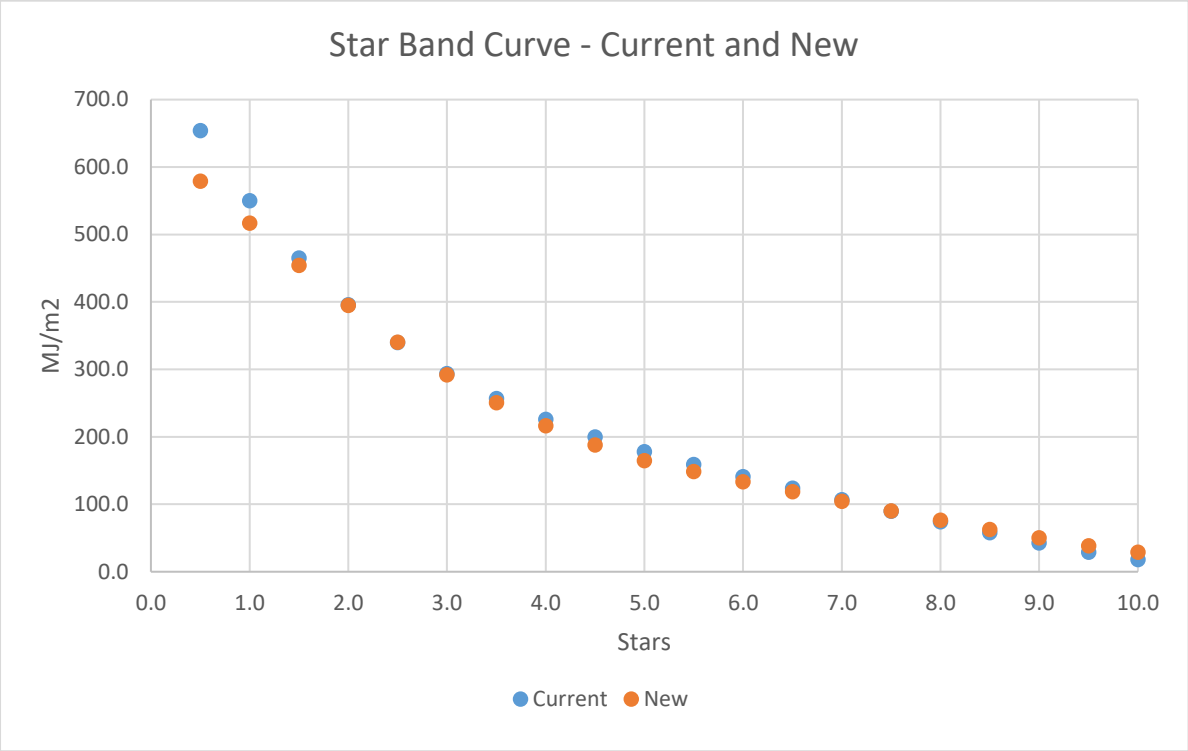
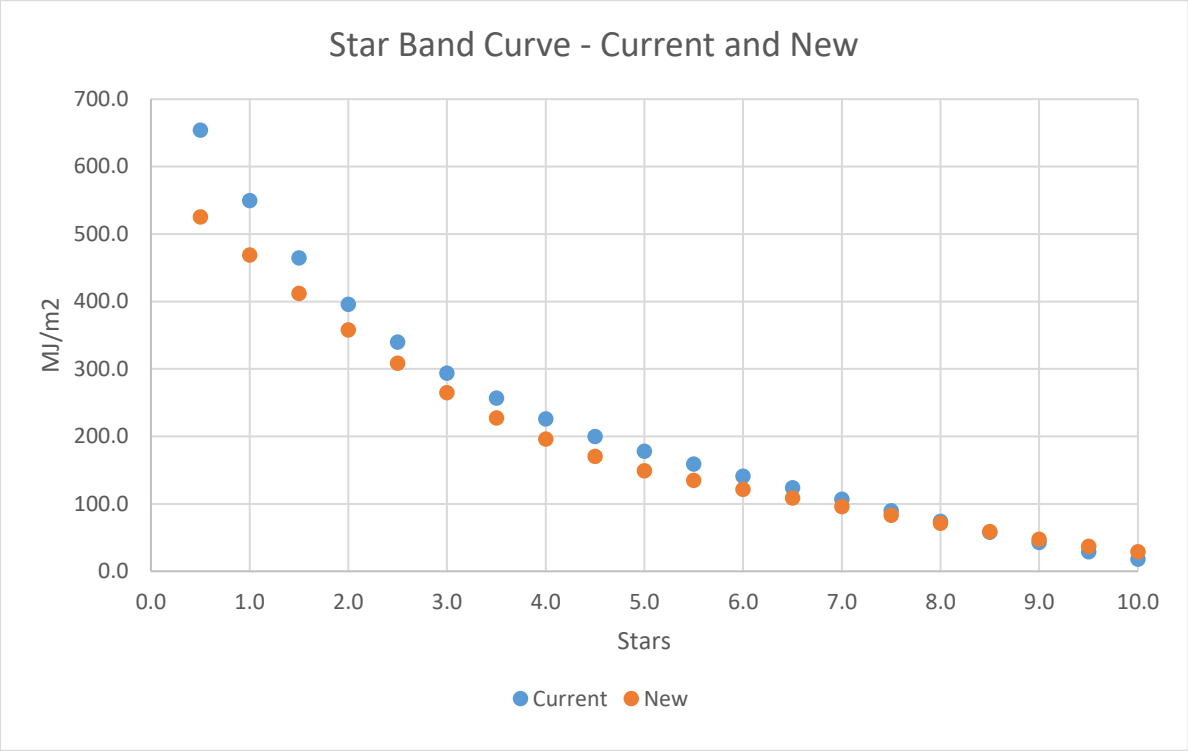
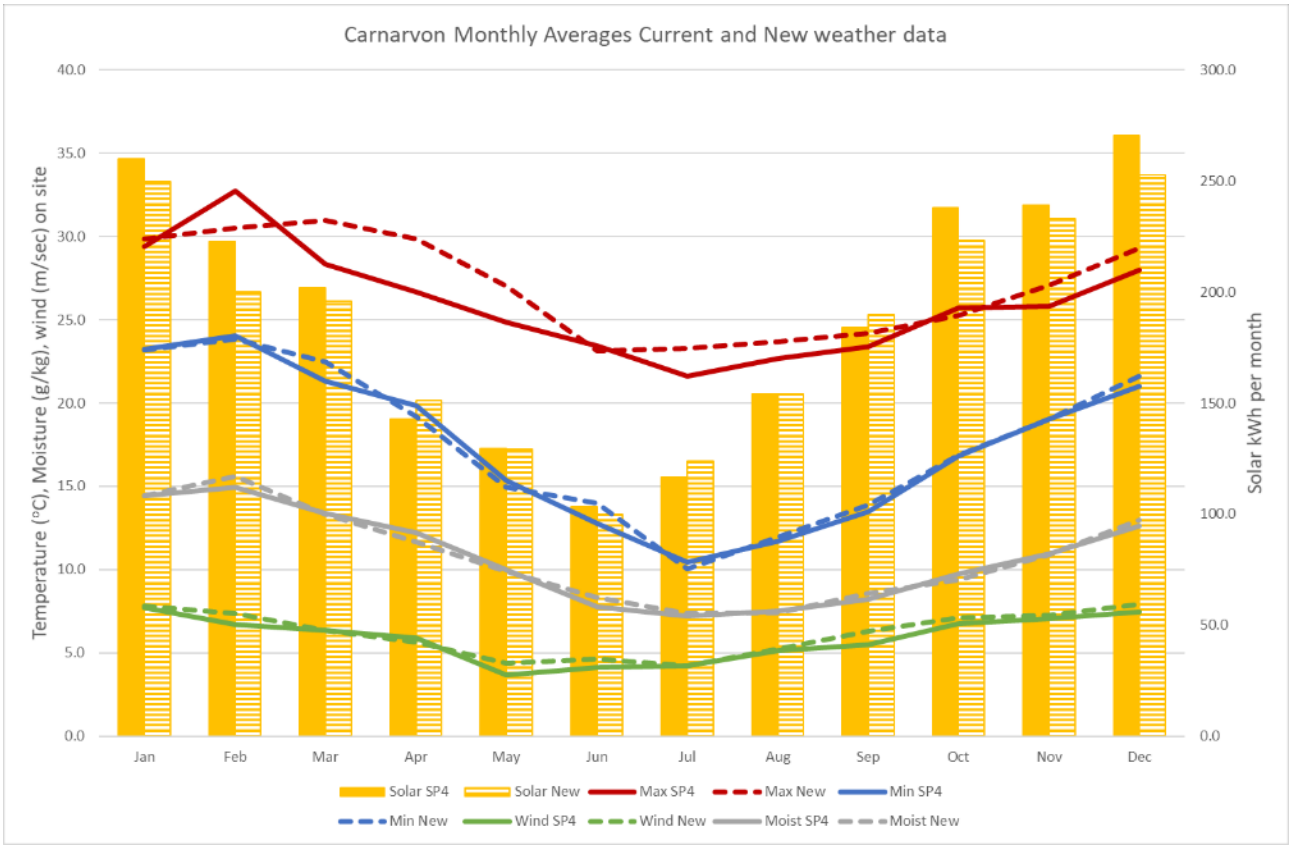


Figure 28 shows the new star bands where the average change to the rating at 6 stars is 0.

**Figure 28 Comparison of current and adjusted star bands for Longreach average rating change at 6 stars is 0**



## 4.4 Carnarvon



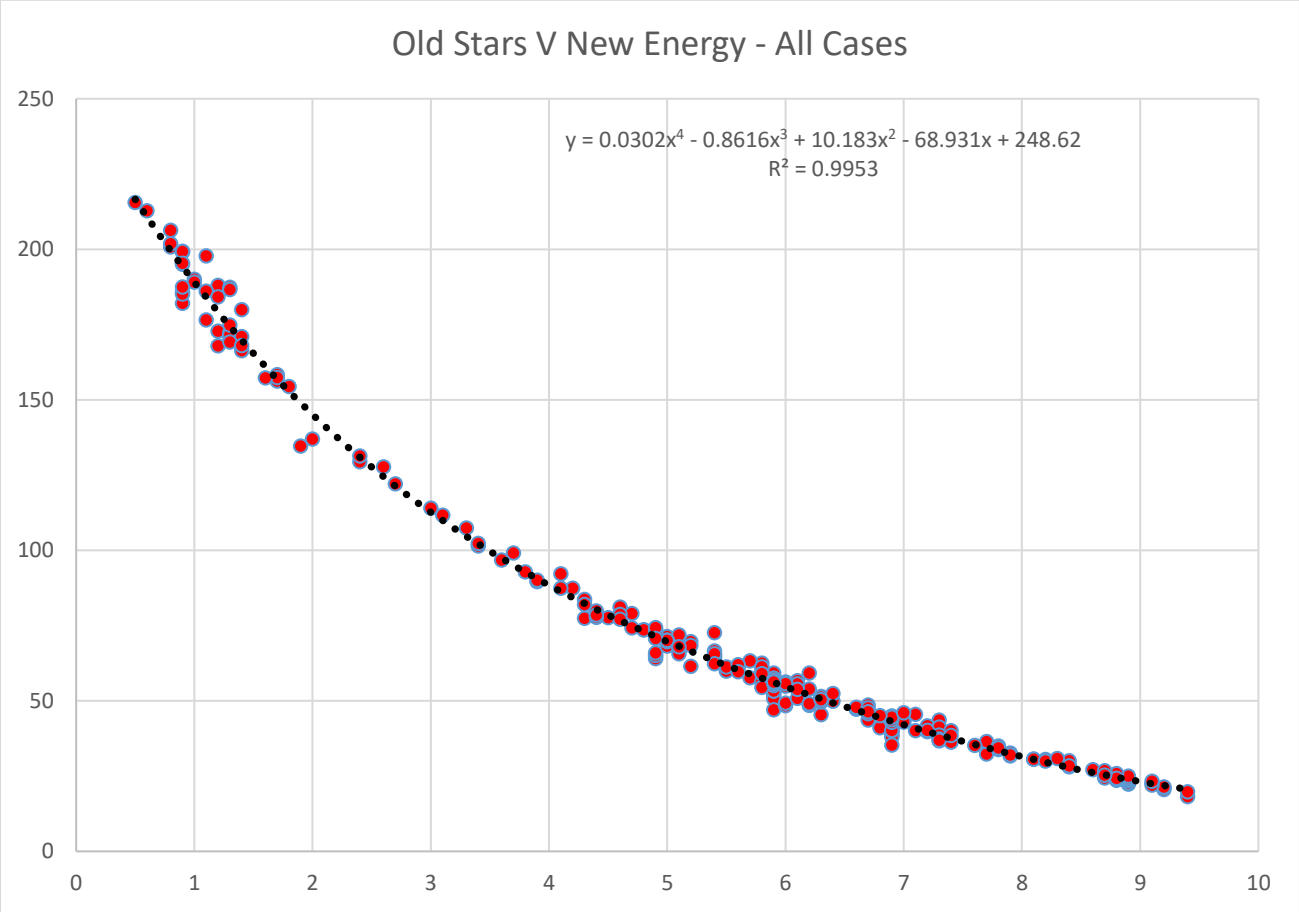

There are significant increases in maximum temperatures which should increase cooling demand, however, in some months, there are significant decreases in solar radiation which would act to reduce cooling demand.

Carnarvon is a unique climate in Australia. It is included as a base climate, not because of the volume of construction in this climate – the CSIRO dashboards report only 20 Class 1 dwellings since May 2016 – but because its energy demand for heating and cooling is unique and as a result the ratings of houses in Carnarvon do not correlate well with other climates (See Floyd, Isaacs and Marker, 2014).

### 4.4.1 Initial Correlation

Figure 29 shows the initial correlation between current star rating and the energy demand predicted using the new weather data. The correlation is very strong ($R^2$ value of 0.995). This indicates that the extent of the variation to the star ratings should not be excessive.

**Figure 29 Correlation between existing energy rating and energy demand with new weather data In Carnarvon**



### 4.4.2 Adjusted star bands with limited rating reduction and new 10-star level

The initial correlation between current rating and energy demand with updated weather shown in Figure 20 is modified to limit reductions in rating to 0.2 stars and add the new 10 star level. Note that the higher 10-star limit also affects star band thresholds from **7 to 9 stars**.

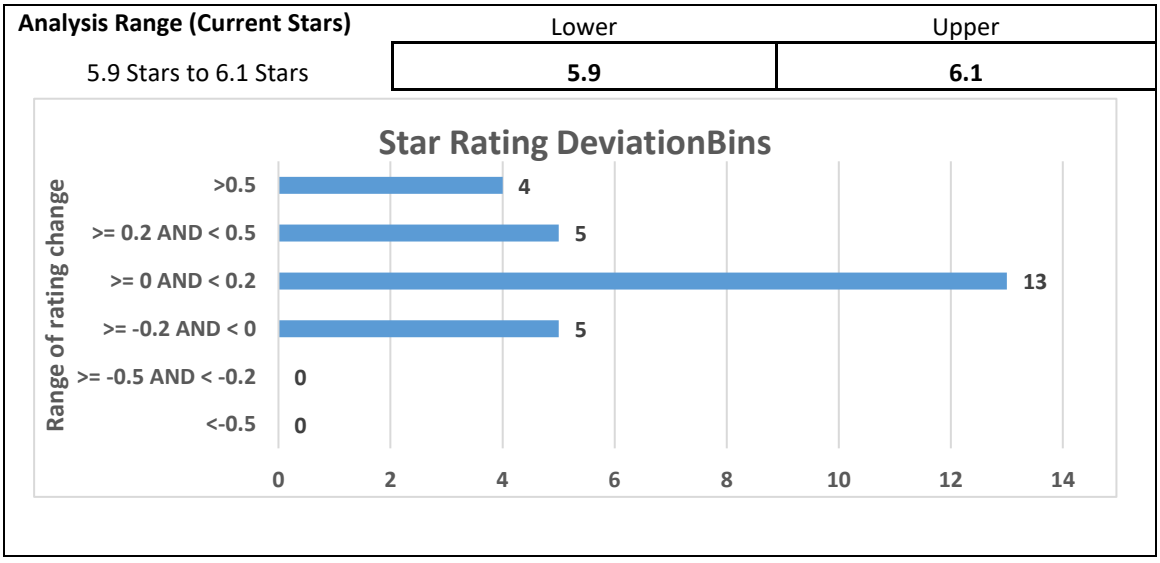
Table 10 shows the adjusted star bands using the two alternative methods and the current star bands.

**Table 10 Current and Adjusted star bands for updated weather data in Carnarvon**

| Star | Current | Adjusted star bands no change <= -0.2 stars | Adjusted star bands with 0 average change at 6 stars |
|---|---|---|---|
| **1.0** | 181 | 195 | 189 |
| **2.0** | 137 | 149 | 145 |
| **3.0** | 105 | 116 | 113 |
| **4.0** | 82 | 91 | 88 |
| **5.0** | 66 | 72 | 70 |
| **6.0** | 53 | 56 | 55 |
| **7.0** | 41 | 46 | 45 |
| **8.0** | 31 | 37 | 36 |
| **9.0** | 22 | 29 | 29 |
| **10.0** | 14 | 22 | 22 |

Figure 30 shows the range of rating changes for dwellings with rating levels between 5.9 and 6.1 stars where the rating reduction is limited to 0.2 stars.

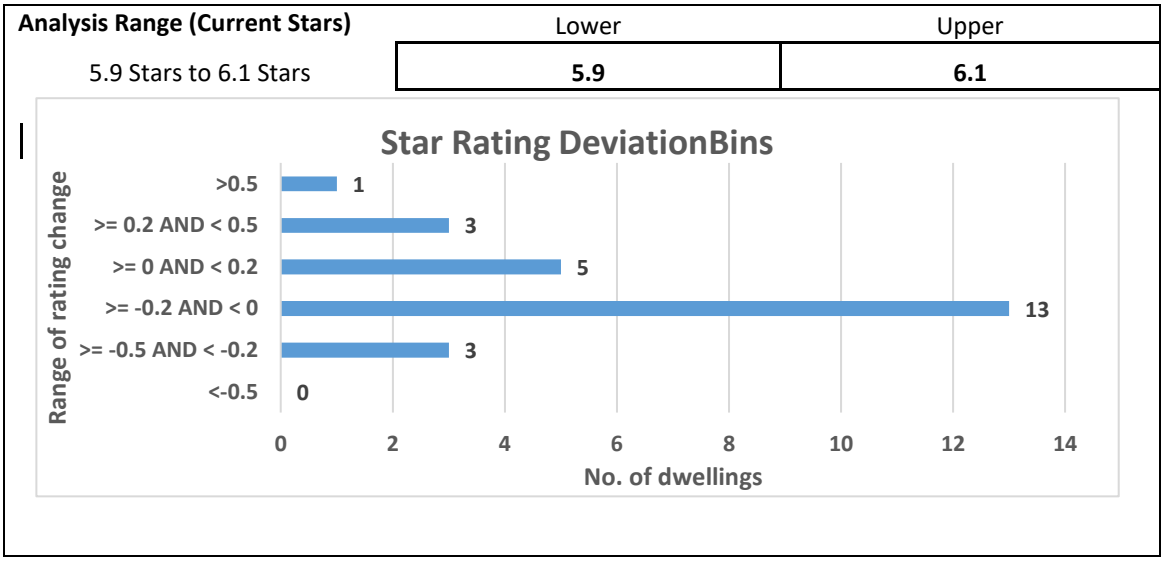
**Figure 30 Changes to ratings at 6 stars in Carnarvon rating change limited to ->= -0.2**




The revised star bands have eliminated all cases where the reduction in rating exceeds 0.2 stars. As a result, the average rating of houses which currently obtain a rating of 6 stars increases slightly by 0.16 stars.

Figure 31 shows the changes to the rating of the dwellings simulated in Carnarvon where the average change to the rating at 6 stars is 0.

**Figure 31 Changes to ratings at 6 stars in Carnarvon average rating change at 6 stars is 0**

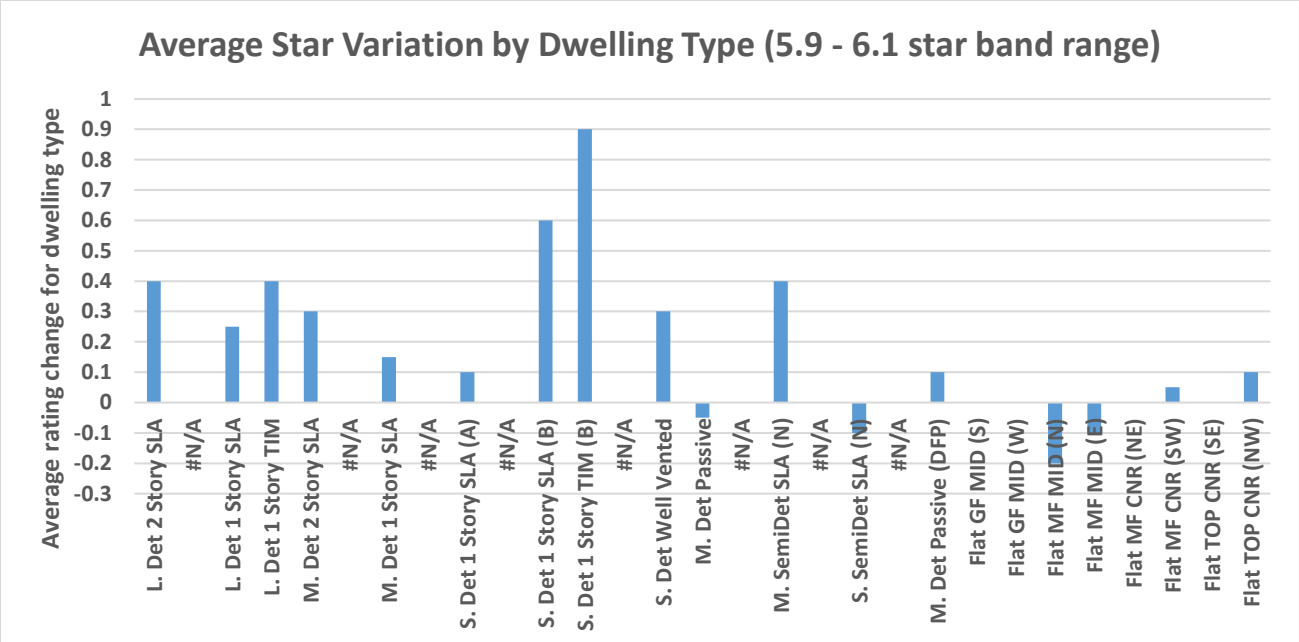



The figures above show that only a small number of dwellings would experience a change to their rating in excess of -0.2 stars where star bands are developed to achieve a 0-average change in the ratings of dwellings at 6 stars.

### 4.4.3 Change to rating for different types of dwellings

Figure 32 shows the changes to the rating of the dwellings simulated in Carnarvon where the rating reduction is limited to 0.2 stars

**Figure 32 Change to rating of individual dwellings in Carnarvon rating change limited to ->= -0.2**




The rating of virtually all dwellings is increased in order to limit the change in rating to the Middle Floor north facing Middle apartment to a reduction of 0.2 stars. While the rating change for Class 1 and Class 2 dwellings is different, the extent of this difference does not appear to warrant the development of separate star bands for Class 1 and Class 2 because the difference in ratings is less than 0.3 stars. Further, the CSIRO dashboards based on NatHERS portal data show that no Class 2 or 4 dwellings have been built in this climate zone.

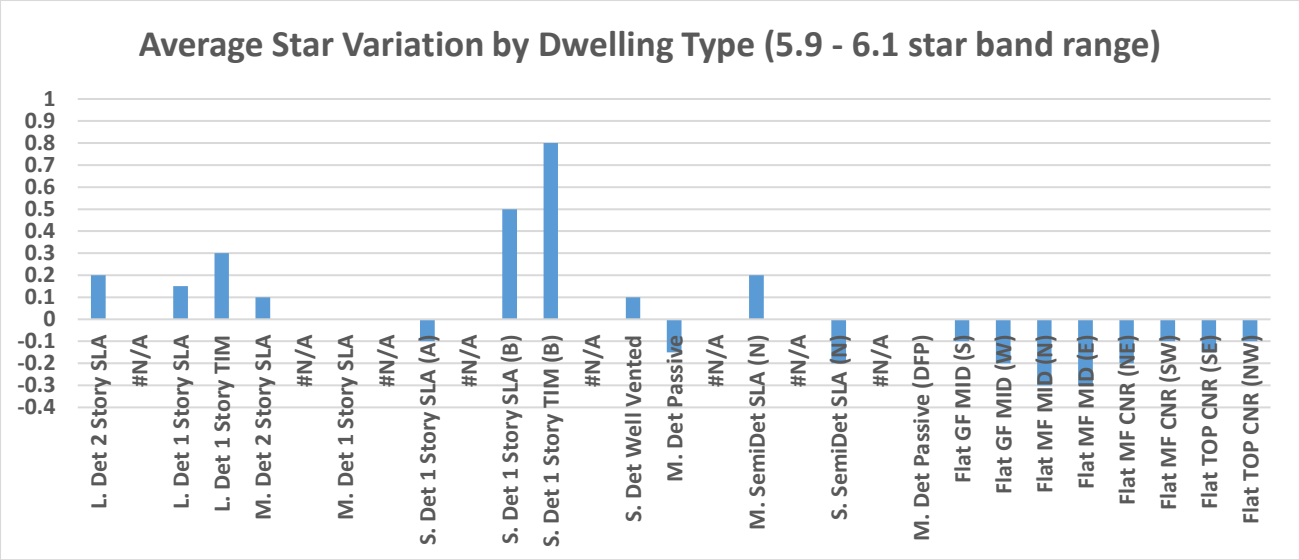
The updated weather data shows that Class 2 dwellings are now considered to be slightly less efficient than they were previously. While it is beyond the scope of this project to quantify the costs of stringency changes it should be noted that the extent of change to the design and specification of Class 2 dwellings in moving from 5 to 6 stars was less restrictive in Class 2 than Class 1. Class 2 dwellings at 6 stars would often be able to comply with far greater window areas than shown on the original plan for the apartment building. The slight relative tightening of stringency for Class 2 dwellings as a result of the new weather data may not add significant compliance cost as improvements to the rating can be achieved by a modest reduction of window area. This can reduce construction costs.

There is a large increase in the rating of the small semi-detached dwelling on its best orientation on both a timber floor and slab floor. The good orientation and lower external surface area of this dwelling give it inherent thermal performance advantages which suggests the new weather data amplifies these advantages. This is not an unreasonable outcome, but the extent of improvement is unexpected.

Star bands which limit rating reductions to 0.2 stars result in an average increase in the rating of dwellings which currently rate 6 stars of 0.16 stars. This is not excessive.

Figure 33 shows the changes to the rating of the dwellings simulated in Carnarvon where the average change to the rating at 6 stars is 0

**Figure 33 Change to rating of individual dwellings in Carnarvon average rating change at 6 stars is 0**




With star bands set to produce a 0 average change at 6 stars two of the apartments experience an average reduction in rating in excess of 0.2 stars.

### 4.4.4 Comparison of current and adjusted star bands for Carnarvon

The new weather data and star bands results in a moderate increase (7%) to the energy demand for cooling at 6 stars.

Figure 34 shows the current and adjusted star band thresholds for Carnarvon where the rating reduction is limited to 0.2 stars. The energy demand thresholds of the new star bands reflect the slightly higher cooling loads which are caused by the new weather data.

**Figure 34 Comparison of current and adjusted star bands for Carnarvon rating change limited to ->= -0.2**

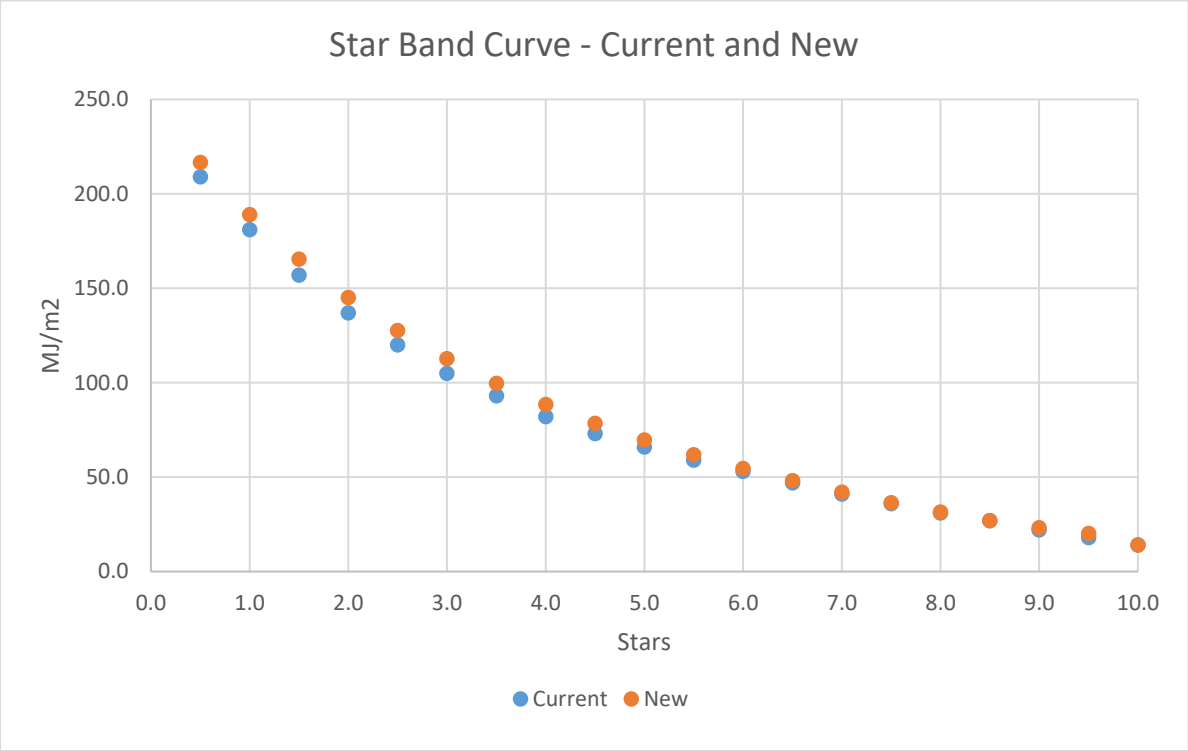
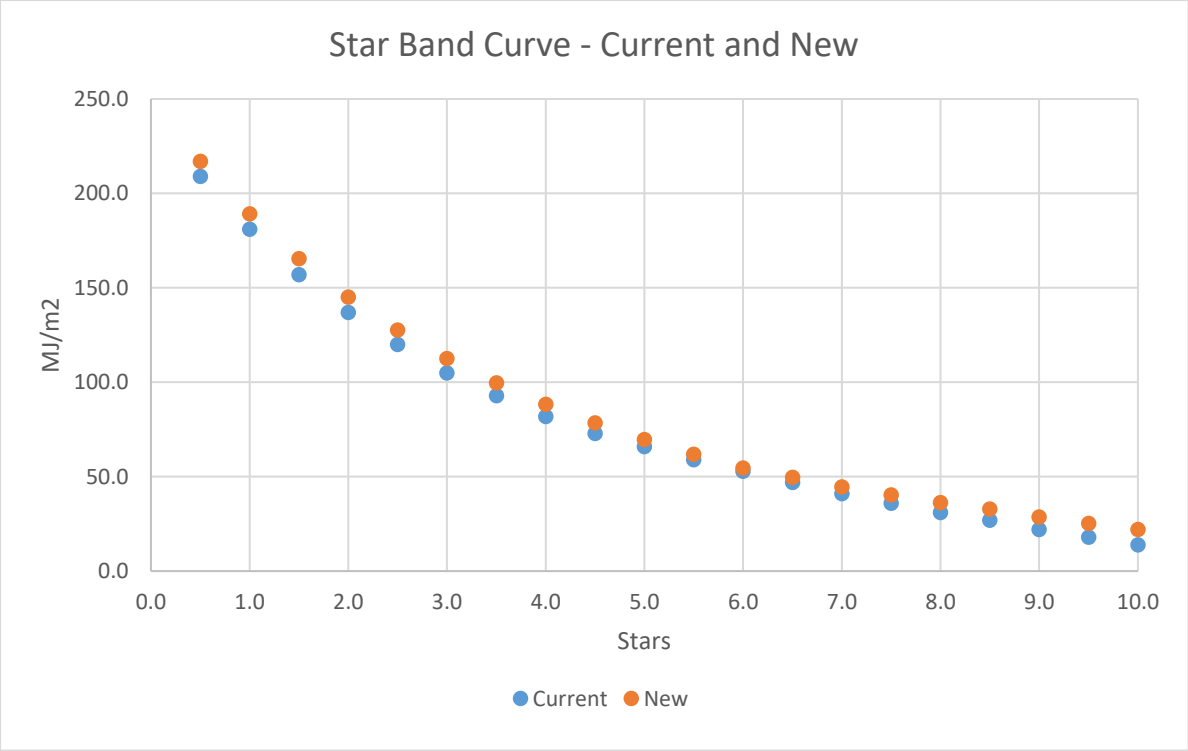
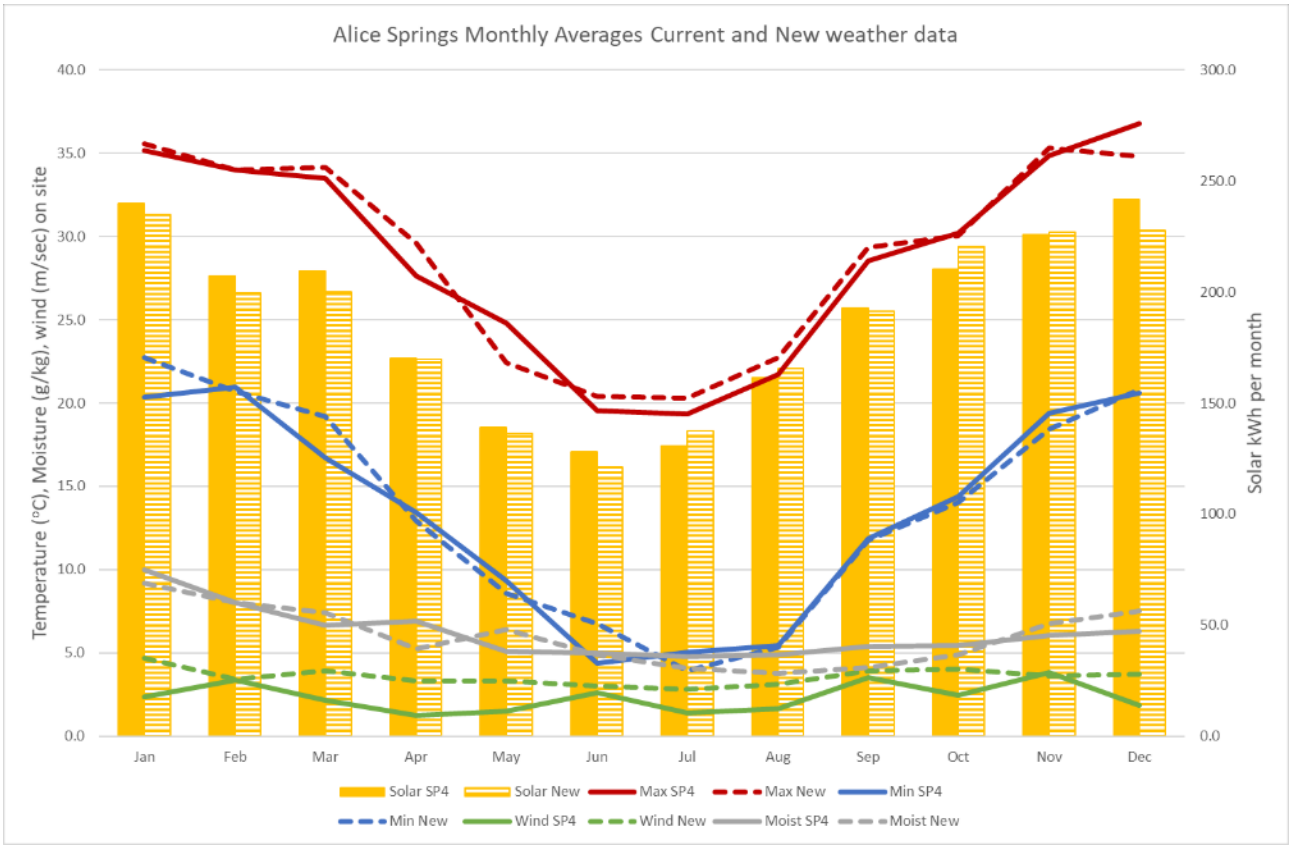


Figure 35 shows the current and adjusted star band thresholds for Carnarvon where the average change to the rating at 6 stars is 0.

**Figure 35 Comparison of current and adjusted star bands for Carnarvon average rating change at 6 stars is 0**



## 4.5 Alice Springs

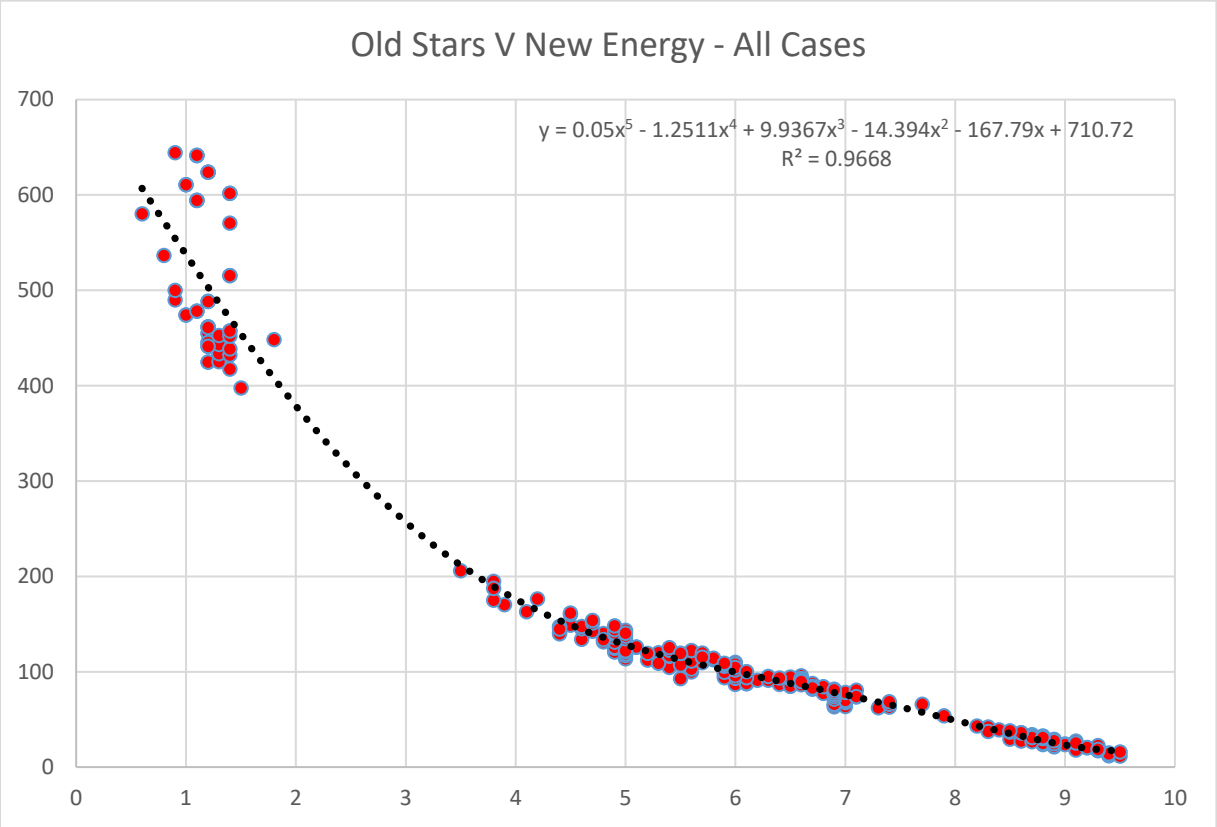



Solar radiation levels in all but three months are slightly lower in the updated weather data which should reduce cooling loads and increase heating energy demands. Maximums and some minimums in cooler months are higher which should reduce heating energy demands. Higher wind speeds may see relative improvements to the rating of Class 1 houses compared to Class 2 aartment. This is because Class 1 houses have inherrently better cross ventilation than Class 2 apartments.

### 4.5.1 Initial Correlation

Figure 36 shows the initial correlation between current star rating and the energy demand predicted using the new weather data. The correlation is strong ($R^2$ value of 0.967). Note the correlation is worst at star ratings at 2 stars or lower. At regulatory levels, correlation is much stronger which indicates that the extent of the variation to the star ratings at this level should not be excessive.

**Figure 36 Correlation between existing energy rating and energy demand with new weather data in Alice Springs**



### 4.5.2 Adjusted star bands with limited rating reduction and new 10-star level

While the NCC requires a minimum rating of 6 stars, in the NT the current minimum rating for Class 1 dwellings is 5 stars and 3.5 stars for Class 2 dwellings. The initial analysis focusses on the minimum rating level in use in the jurisdiction and therefore focusses on both 5 and 6 stars in this section.

The initial correlation between current rating and energy demand with updated weather shown in Table 11 is modified to limit reductions in rating to 0.2 stars and add the new 10 star level. Note that the higher 10-star limit also affects star band thresholds from **7 to 9 stars**.

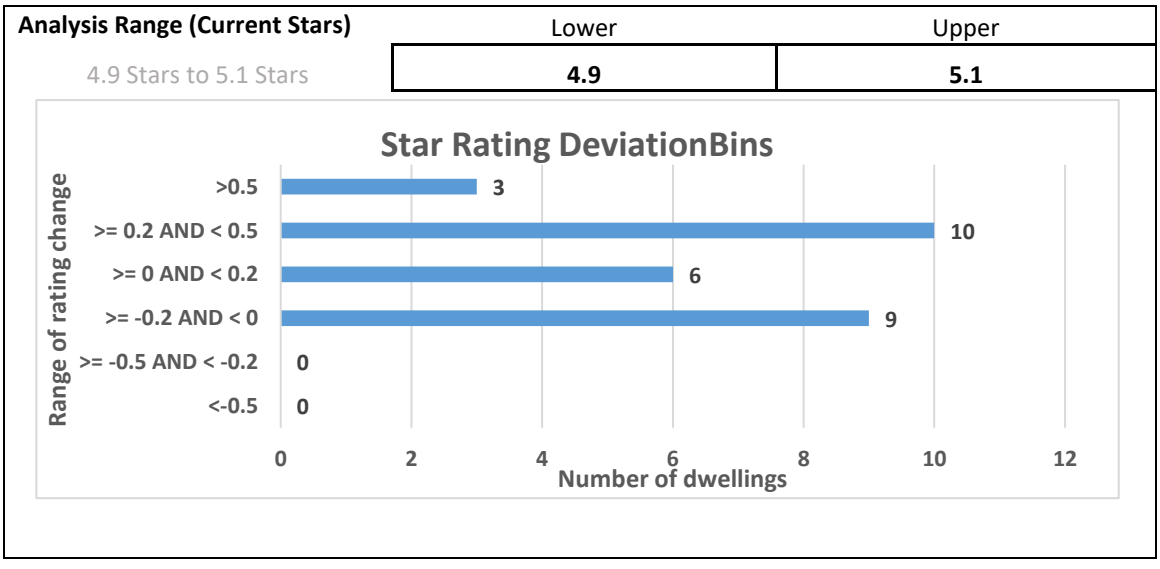
Table 11 shows the adjusted star bands using the two alternative methods and the current star bands.

**Table 11 Current and Adjusted star bands for updated weather data in Alice Springs**

| Star | Current | Adjusted star bands no change <= -0.2 stars | Adjusted star bands with 0 average change at 6 stars |
|---|---|---|---|
| **1.0** | 562 | 580 | 532 |
| **2.0** | 385 | 409 | 379 |
| **3.0** | 269 | 277 | 260 |
| **4.0** | 196 | 190 | 179 |
| **5.0** | 148 | 139 | 130 |
| **6.0** | 113 | 108 | 101 |
| **7.0** | 84 | 83 | 78 |
| **8.0** | 56 | 58 | 55 |
| **9.0** | 29 | 35 | 34 |
| **10.0** | 7 | 16 | 16 |

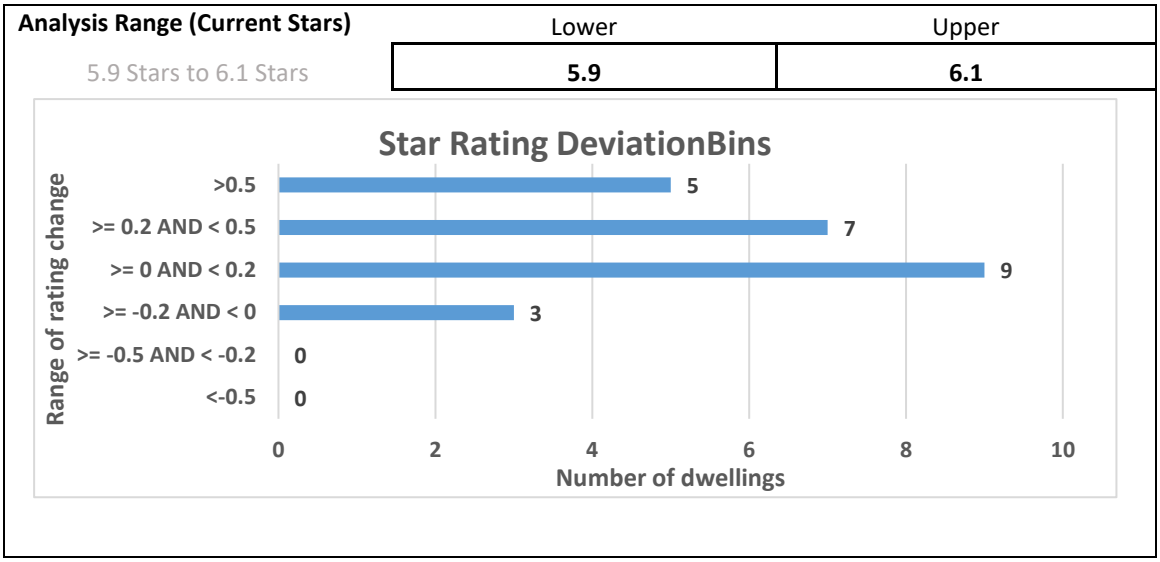
Figure 37 shows the range of rating changes for dwellings with rating levels between 4.9 and 5.1 stars. This is shown because the minimum regulatory rating level currently implemented in Alice Springs is 5 stars for Class 1 dwellings.

**Figure 37 Changes to ratings at 5 stars in Alice Springs rating change limited to ->= -0.2**




Because the NCC specifies a minimum of 6 stars in this climate, the impact on ratings at 6 stars is also shown below.

**Figure 38 Changes to ratings at 6 stars in Alice Springs rating change limited to ->= -0.2**

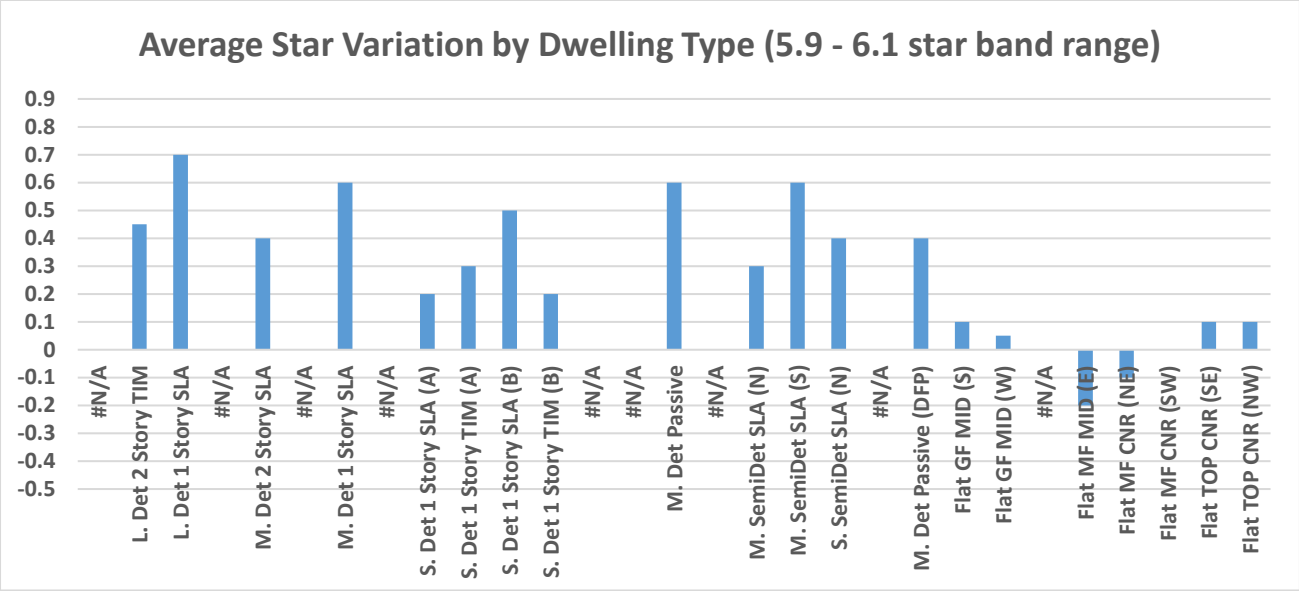



The revised star bands have eliminated all cases where the reduction in rating exceeds 0.2 stars. As a result, the average rating of houses which currently obtain a rating of 5 stars increases by 0.16 stars while 6-star dwellings increase their rating by an average of 0.27 stars.

### 4.5.3 Change to rating for different types of dwellings

Figure 39 shows the changes to the rating of the dwellings simulated in Alice Springs where the rating reduction is limited to 0.2 stars.

**Figure 39 Change to rating of individual dwellings in Alice Springs at 6 stars rating change limited to ->= -0.2**

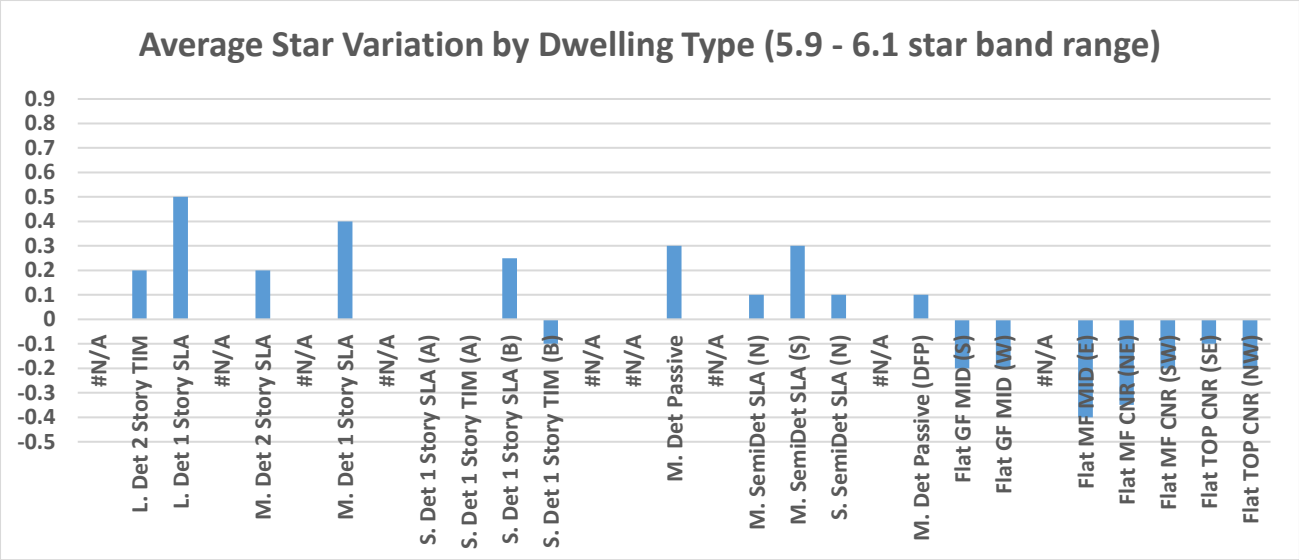



The rating of virtually all Class 1 dwellings is increased in order to limit the change in rating to the Middle Floor east facing Middle apartment to a reduction of 0.2 stars. If it is considered acceptable to allow this one unit to reduce its rating in excess of 0.2 stars, then the reduction in stringency at 5 and 6 stars could be reduced.

There is a large increase in the rating of the medium semi-detached dwelling on its best orientation on slab floor (0.5) and the Large 1 storey house on a slab (0.6). The rating of all apartments has slightly decreased.

Figure 40 shows the changes to the rating of the dwellings simulated in Alice Springs where the average change to the rating at 6 stars is 0.

**Figure 40 Change to rating of individual dwellings in Alice Springs at 6 stars average rating change at 6 stars is 0**




This different change to ratings of Class 1 and 2 dwellings again raises the issue of whether a separate set of star bands should be developed for each Class in order to minimise changes to ratings with the introduction of the updated weather data. Once again, the average difference between the ratings of Class 1 and 2 dwellings does not exceed 0.3 stars and this is not believed to be enough to warrant a separate set of star bands.

The updated weather data shows that Class 2 dwellings are now considered to be slightly less efficient than they were previously. While it is beyond the scope of this project to quantify the costs of stringency changes it should be noted that the extent of change to the design and specification of Class 2 dwellings in moving from 5 to 6 stars was less restrictive in Class 2 than Class 1. Class 2 dwellings at 6 stars would often be able to comply with far greater window areas than shown on the original plan for the apartment building. The slight relative tightening of stringency for Class 2 dwellings as a result of the new weather data may not add significant compliance cost as improvements to the rating can be achieved by a modest reduction of window area. This can reduce construction costs.

Adopting star bands that that maintain the rating of current 6 star dwellings on average would only affect Class 2 dwellings. As discussed above, this may not add increase construction costs, but evaluation of such cost impacts is outside the scope of this project.

### 4.5.4 Comparison of current and adjusted star bands for Alice Springs

The new weather data and star bands where the rating reduction is limited to 0.2 stars results in a moderate decrease to both the energy demand for cooling (10%) and heating at 6 stars (17%).

Figure 41 shows the current and adjusted star band thresholds for Alice Springs where the rating reduction is limited to 0.2 stars. The energy demand thresholds of the new star bands reflect the slightly lower energy demand which are result from the use of the updated weather data. The 7 to 10-star levels are higher than current thresholds which reflect the increase in the 10-star threshold.

**Figure 41 Comparison of current and adjusted star bands for Alice Springs where the rating reduction is limited to 0.2 stars**

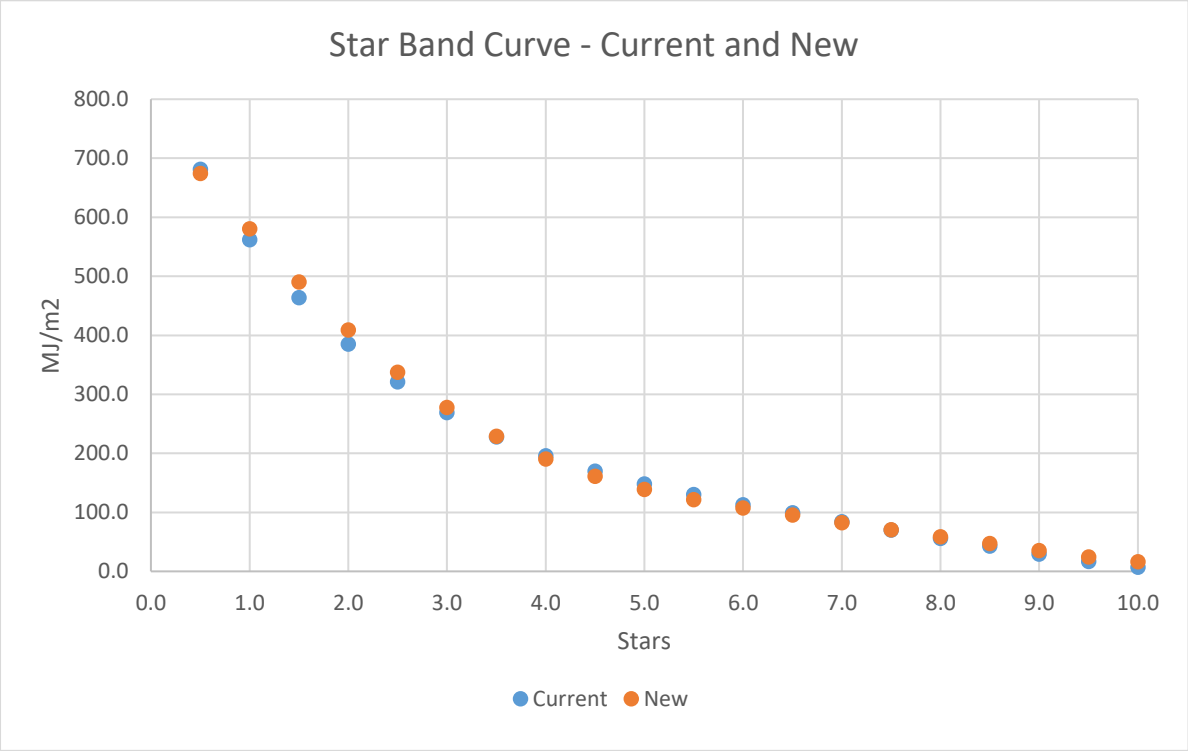
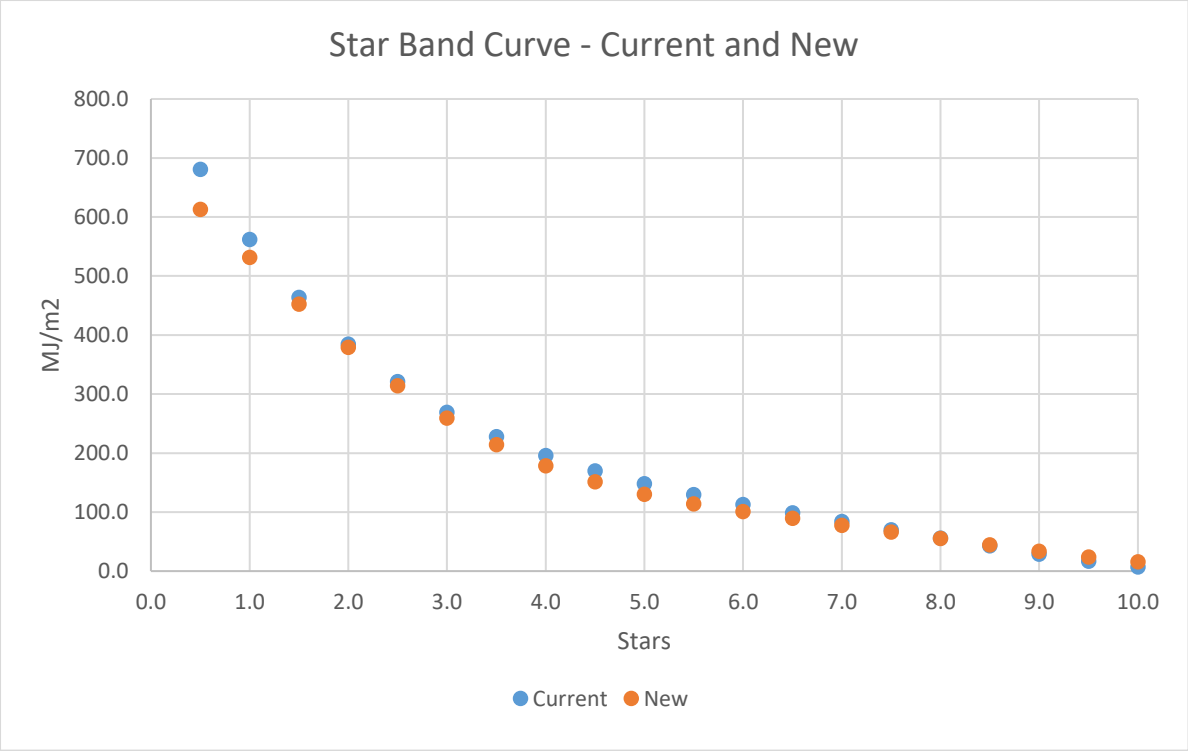
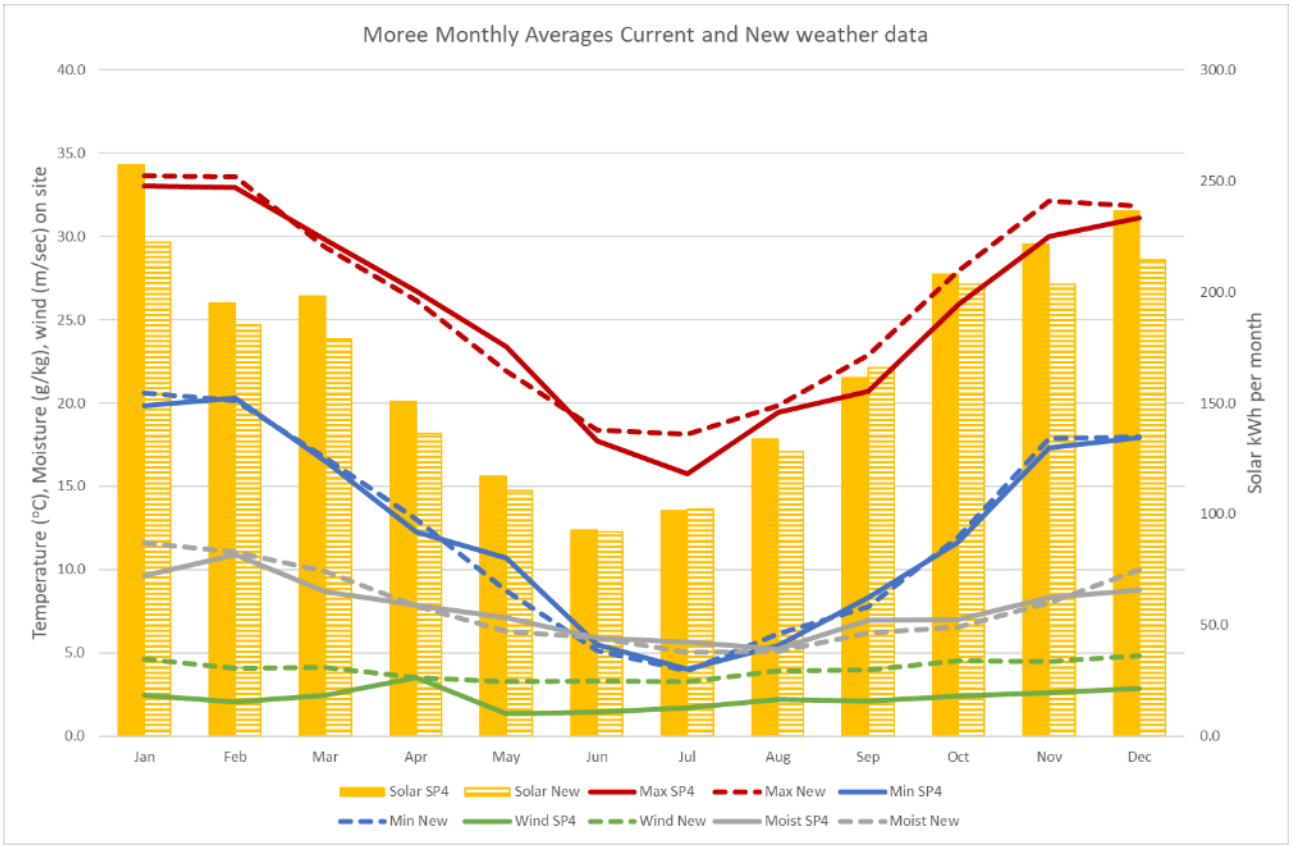


Figure 42 shows the changes to the rating of the dwellings simulated in Alice Springs where the average change to the rating at 6 stars is 0.

**Figure 42 Comparison of current and adjusted star bands for Alice Springs average rating change at 6 stars is 0**



## 4.6 Moree

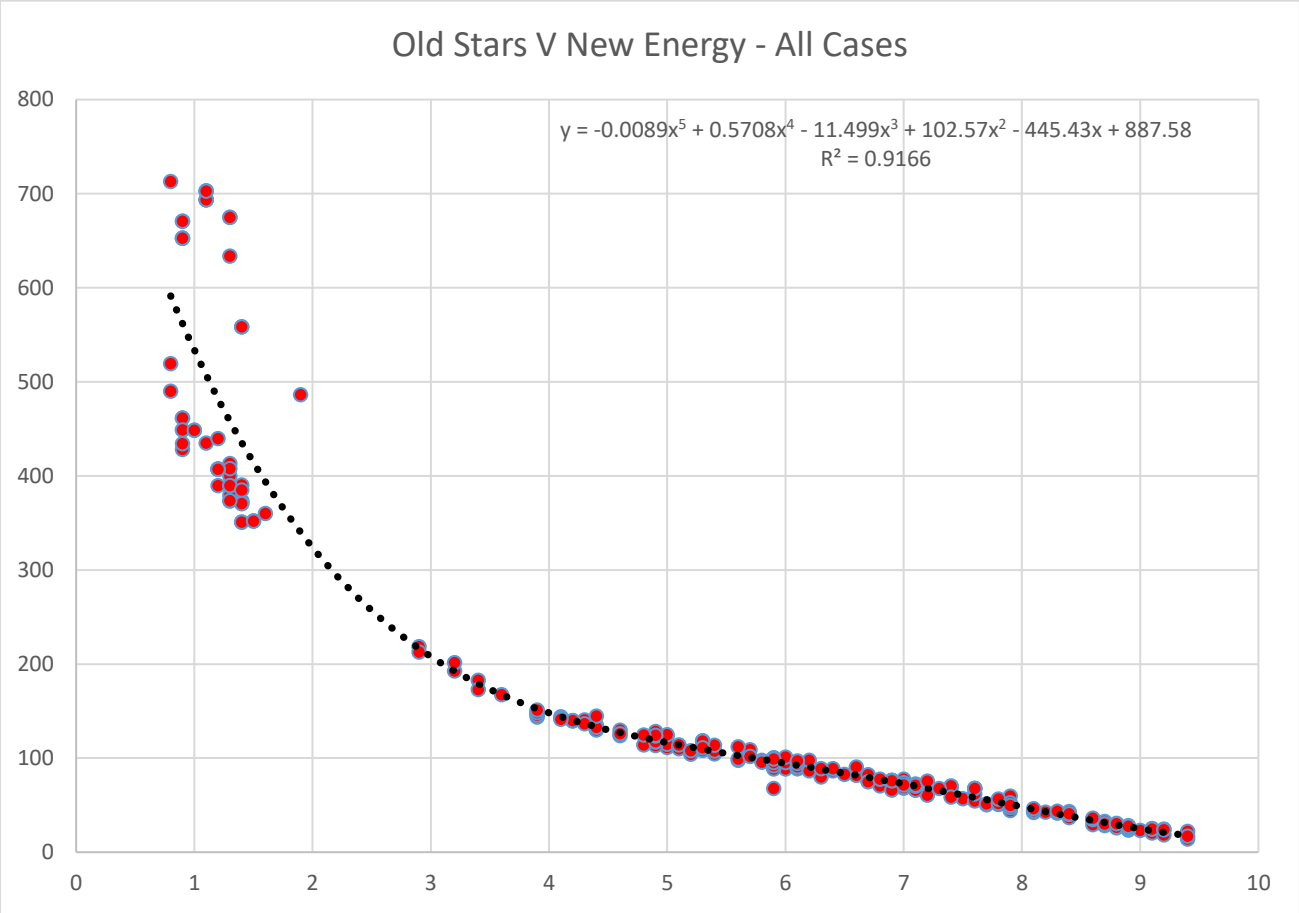



Higher maximum temperatures in most months will see an increase in cooling and reduction in heating loads. Significantly lower solar radiation in most months will have the reverse impact: lower cooling loads and higher heating loads. The higher windspeeds should also help to reduce cooling loads, particularly in Class 1 dwellings.

### 4.6.1 Initial Correlation

Figure 43 below shows the initial correlation between current star rating and the energy demand predicted using the new weather data. The correlation is reasonably strong ($R^2$ value of 0.917). Note the correlation is worst at star ratings at 2 stars or lower. At regulatory levels, correlation is much stronger which indicates that the extent of the variation to the star ratings at this level should not be excessive.

**Figure 43 Correlation between existing energy rating and energy demand with new weather data in Moree**



### 4.6.2 Adjusted star bands with limited rating reduction and new 10-star level

The initial correlation between current rating and energy demand with updated weather is modified to limit reductions in rating to 0.2 stars and add the new 10-star level. Note that the higher 10-star limit also affects star band thresholds from **7 to 9 stars**.

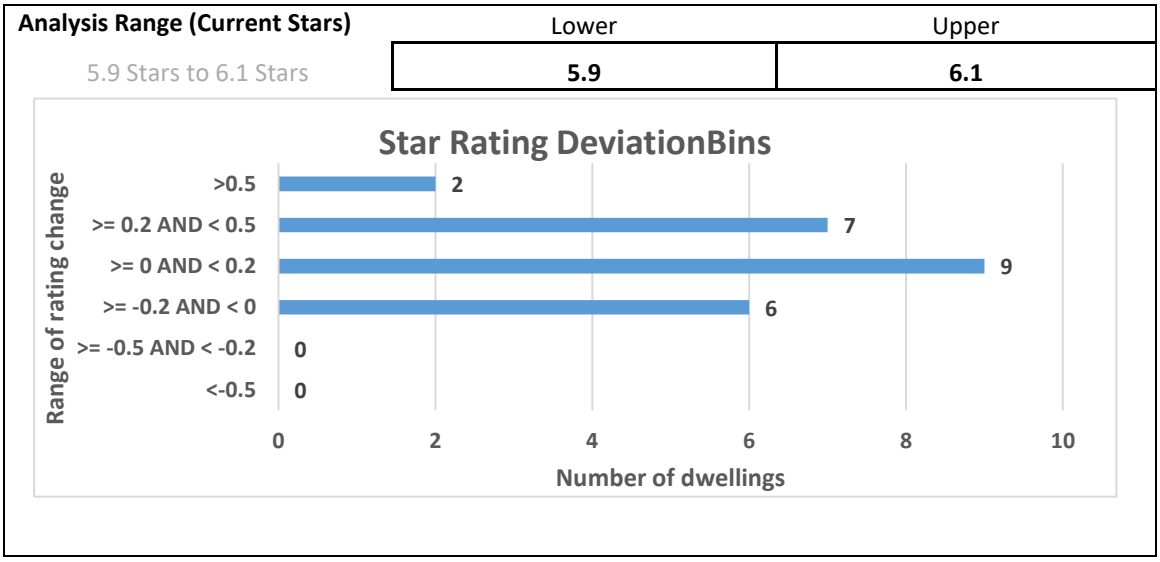
Table 12 shows the adjusted star bands using the two alternative methods and the current star bands.

**Table 12 Current and Adjusted star bands for updated weather data in Moree**

| Star | Current | Adjusted star bands no change <= -0.2 stars | Adjusted star bands with 0 average change at 6 stars |
|---|---|---|---|
| **1.0** | 481 | 555 | 515 |
| **2.0** | 315 | 337 | 312 |
| **3.0** | 214 | 216 | 203 |
| **4.0** | 155 | 154 | 147 |
| **5.0** | 119 | 121 | 117 |
| **6.0** | 94 | 98 | 95 |
| **7.0** | 71 | 78 | 75 |
| **8.0** | 47 | 57 | 55 |
| **9.0** | 24 | 36 | 35 |
| **10.0** | 7 | 21 | 21 |

Figure 44 shows the range of rating changes for dwellings with rating levels between 5.9 and 6.1 stars where the rating reduction is limited to 0.2 stars.

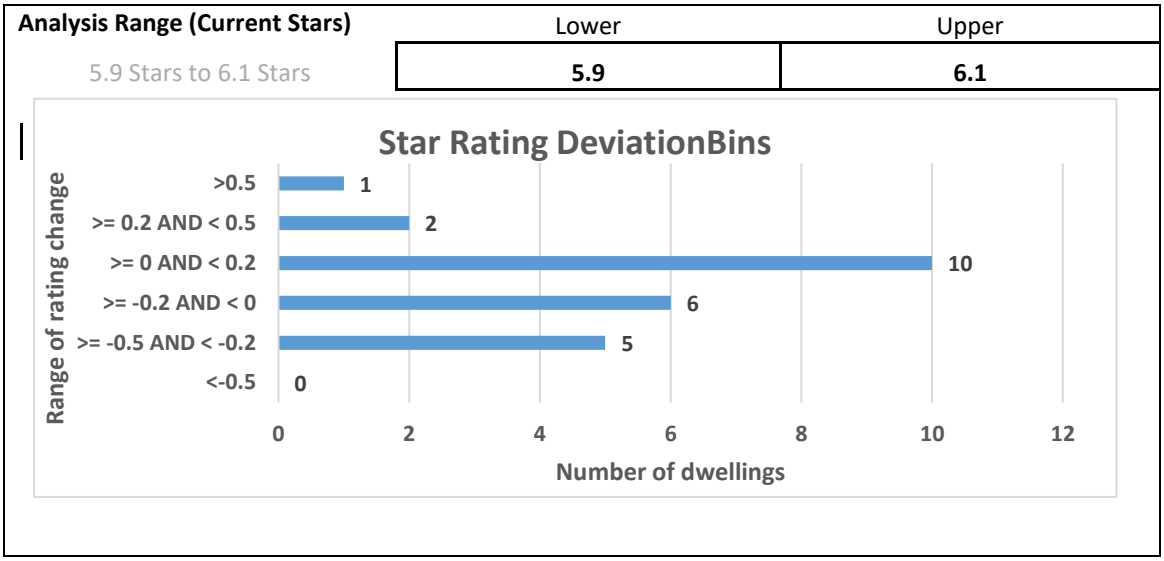
**Figure 44 Changes to ratings with rating reduction limit 6 stars in Moree rating change limited to ->= -0.2**




The revised star bands have eliminated all cases where the reduction in rating exceeds 0.2 stars. The average rating of houses which currently obtain a rating of 6 stars increases by 0.16 stars.

Figure 45 shows the range of rating changes for dwellings with rating levels between 5.9 and 6.1 stars where the average change to the rating at 6 stars is 0.

**Figure 45 Changes to ratings with rating reduction limit 6 stars in Moree average rating change at 6 stars is 0**

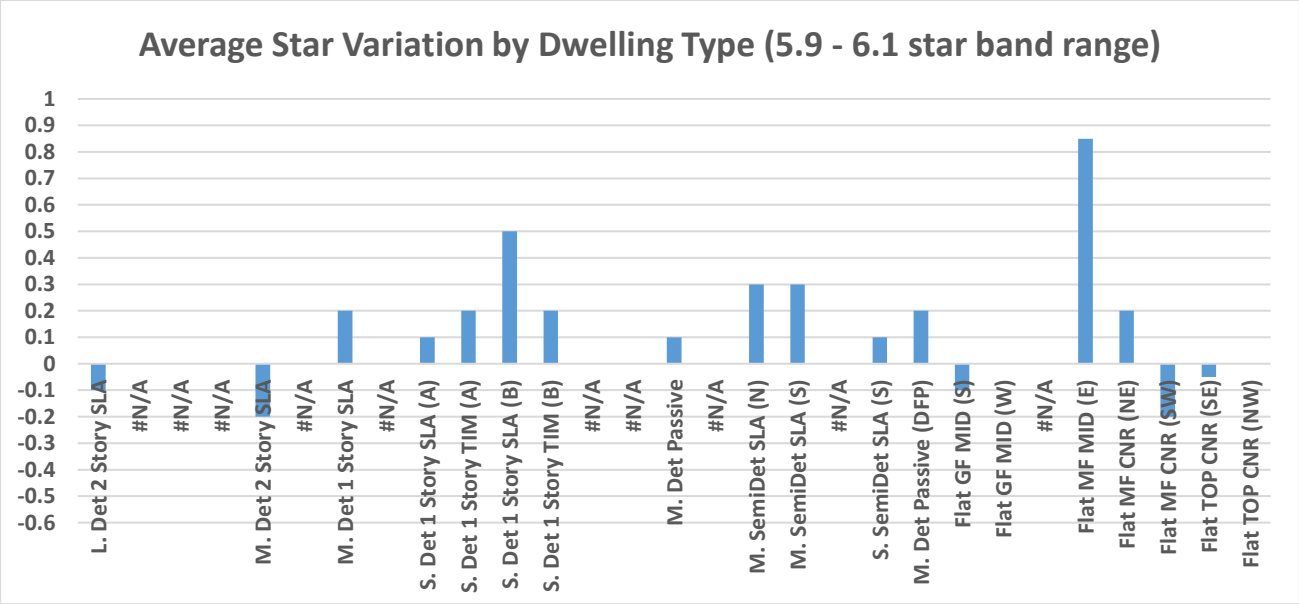



The figures above show that a small but significant proportion of dwellings would experience a reduction of rating in excess of 0.2 stars when the average change to the rating at 6 stars is 0.

### 4.6.3 Change to rating for different types of dwellings

Figure 46 shows the changes to the rating of the dwellings simulated in Moree where the rating reduction is limited to 0.2 stars.

**Figure 46 Change to rating of individual dwellings in Moree rating change limited to ->= -0.2**

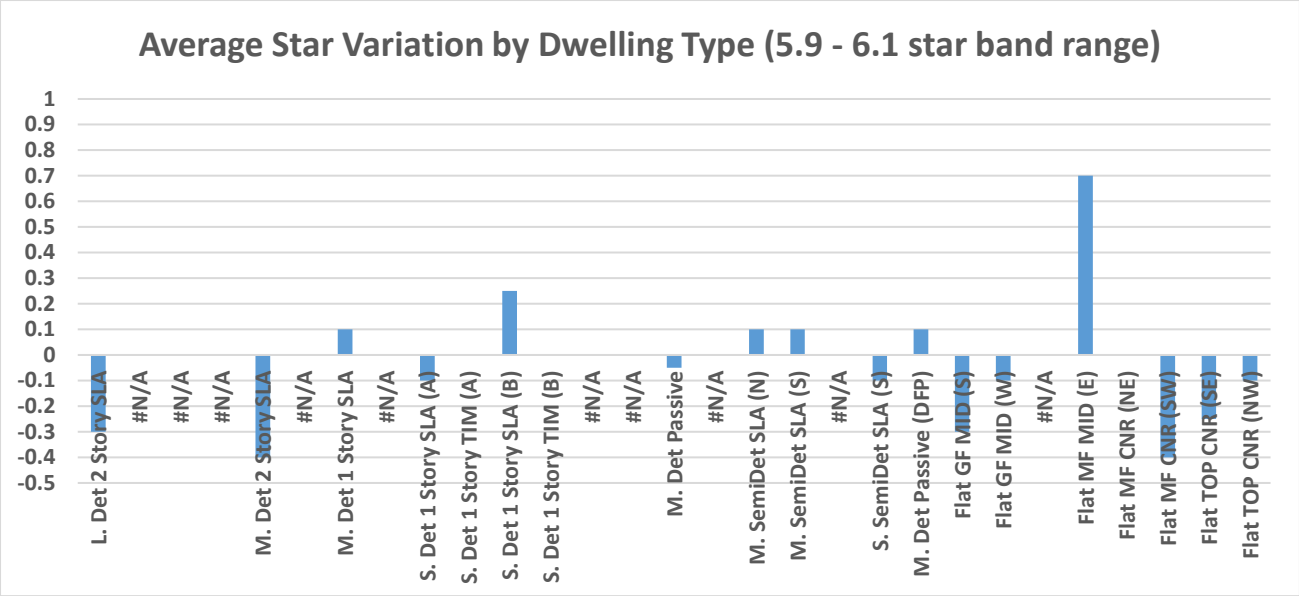



The rating of virtually all dwellings is slightly increased There is a large increase in the rating of the small semi-detached dwelling on its best orientation on both a timber floor and slab floor. The good orientation and reduced external surface area of this dwelling give it inherent thermal performance advantages which suggests the new weather data amplifies these advantages. The rating of the middle apartment on the middle floor facing east shows the greatest increase of just over 0.8 stars. Such apartments have shared building fabric on all but one side and therefore have inherent thermal performance advantages. This advantage combined with the significant reduction in solar radiation levels in summer in the updated weather data has led to a large increase in the rating of such apartments. In all cases the increase to ratings appear to be a reasonable outcome, but the extent of improvement is unexpected.

Star bands which limit rating reductions to 0.2 stars result in an average increase in the rating at 6 stars of 0.16 stars. This is not excessive, and the use of updated weather data and adjusted star bands should lead to minimal disruption.

Figure 47 shows the changes to the rating of the dwellings simulated in Moree where the average change to the rating at 6 stars is 0

**Figure 47 Change to rating of individual dwellings in Moree average rating change at 6 stars is 0**




Adopting star bands that that maintain the rating of current 6 star dwellings on average would only adversely affect Class 2 dwellings and Class 1 2 storey dwellings. As discussed above, this may not add increase construction costs for Class 2, but evaluation of such cost impacts is outside the scope of this project.

### 4.6.4 Comparison of current and adjusted star bands for Moree

The new weather data and star bands results in a moderate increase (7%) to the energy demand for cooling at 6 stars, so the benefits of energy efficiency will be slightly increased by the new weather data.

Figure 48 shows the current and adjusted star band thresholds for Moree where the rating reduction is limited to 0.2 stars. The energy demand thresholds of the new star bands reflect the slightly higher cooling loads which are caused by the new weather data and the increase to the 10-star threshold.

**Figure 48 Comparison of current and weather data adjusted star bands for Moree rating change limited to ->= -0.2**

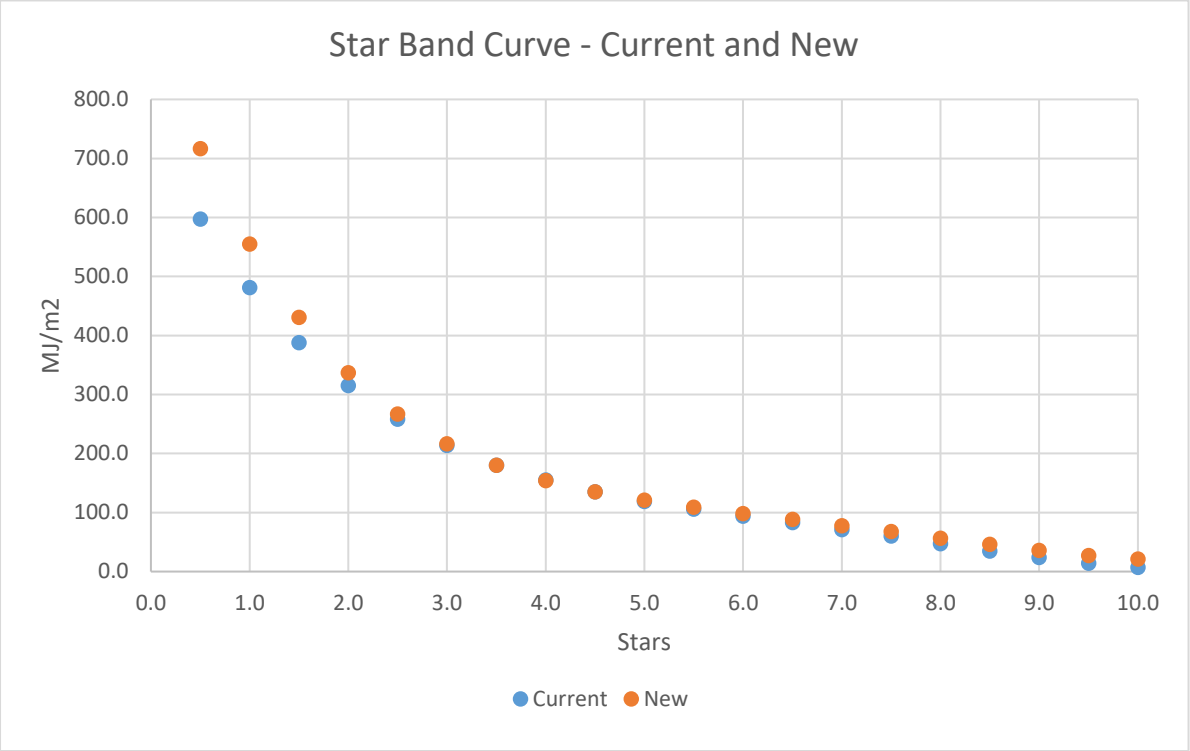
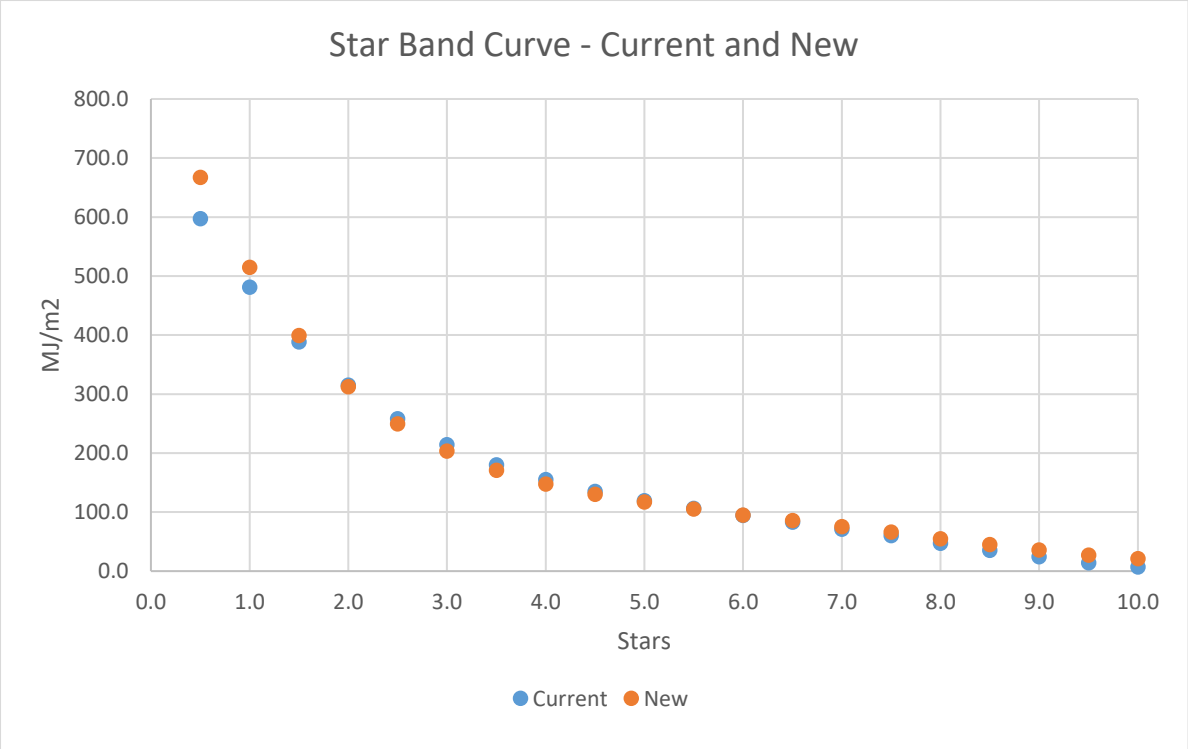
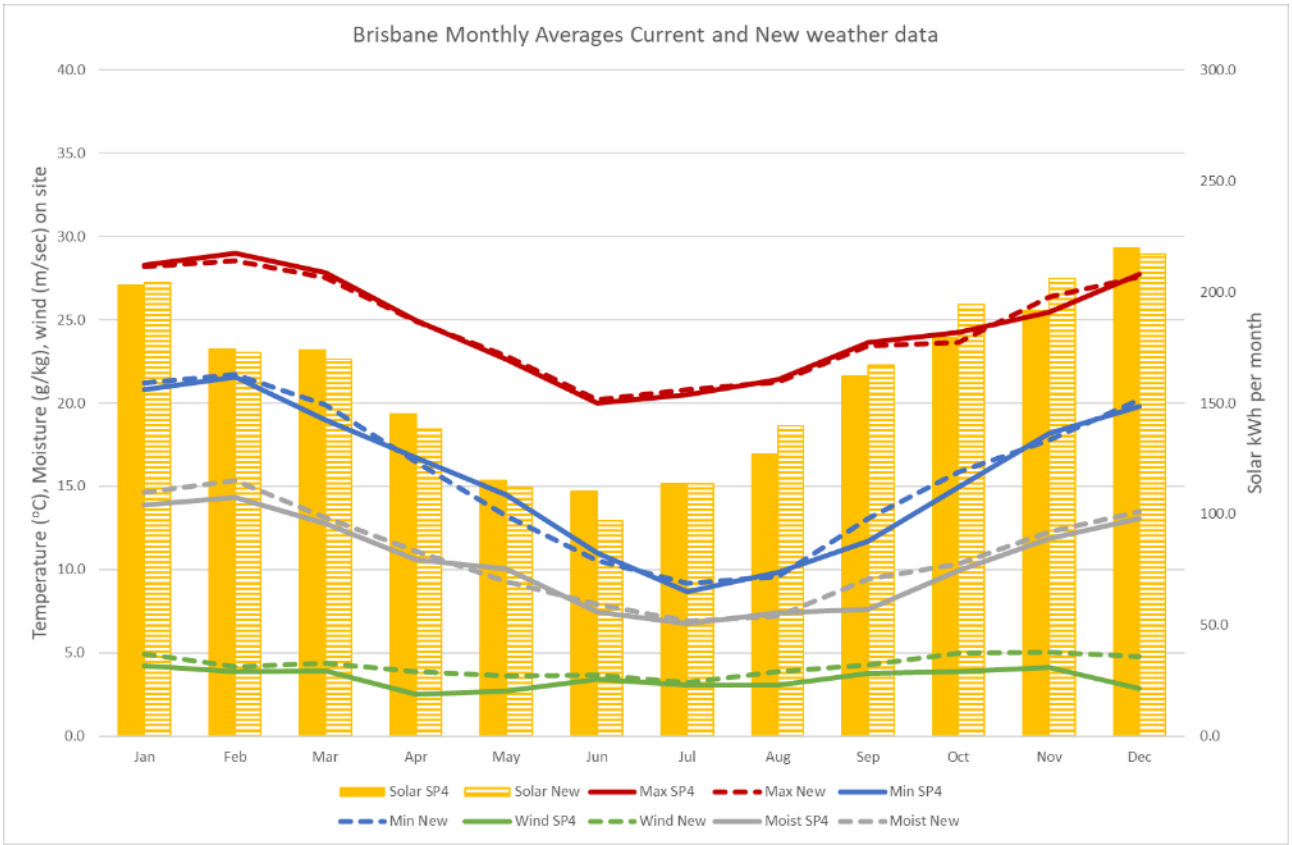


Figure 49 shows the current and adjusted star band thresholds for Moree where the average change to the rating at 6 stars is 0.

**Figure 49 Comparison of current and weather data adjusted star bands for Moree average rating change at 6 stars is 0**



## 4.7 Brisbane

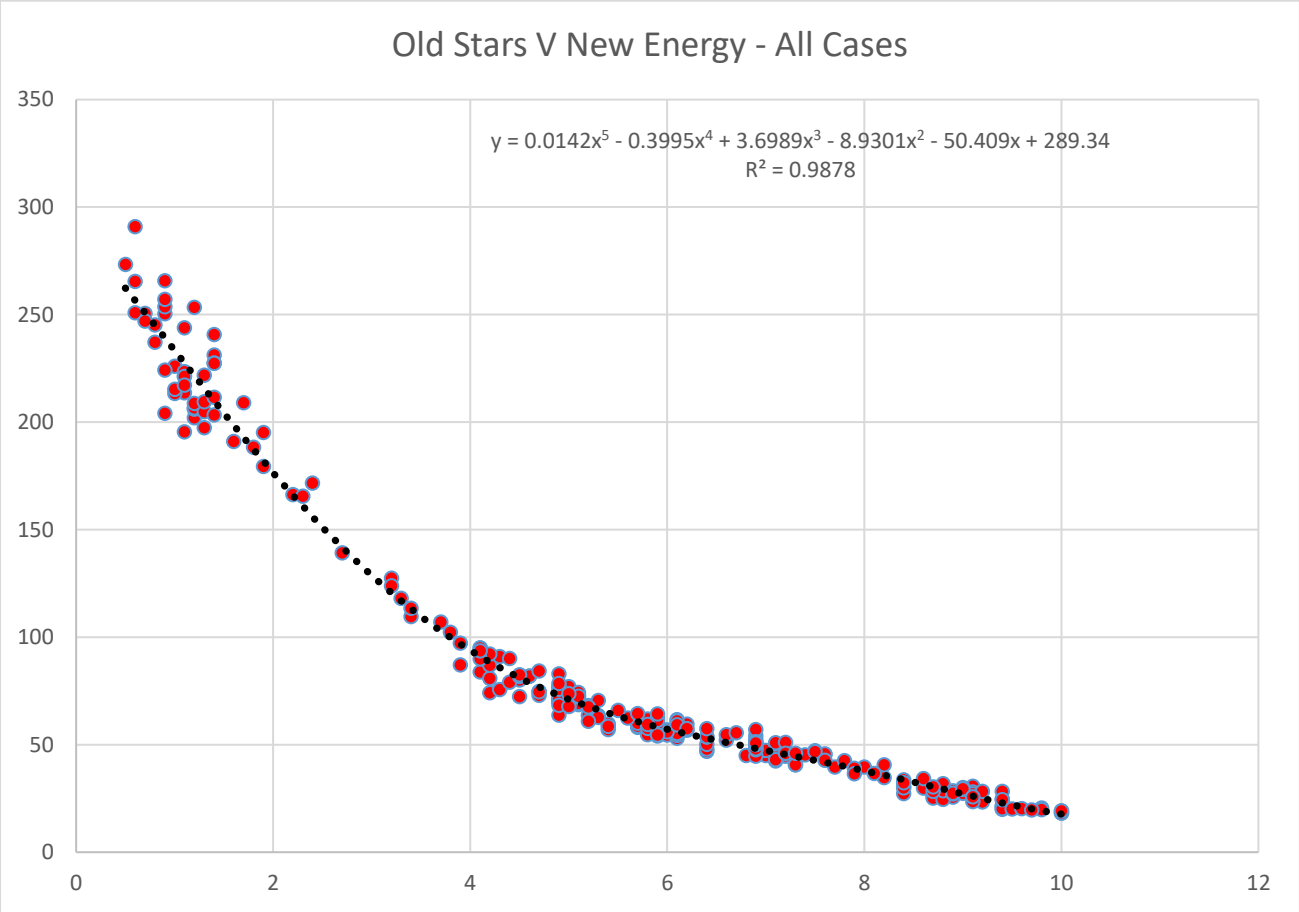



The adjusted weather data shows minimal differences with the current data except for solar radiation data. Solar radiation is significantly lower in June and significantly higher in August, October and November. It is expected that this would lead to slightly lower heating and slightly higher cooling. Because Brisbane is a climate zone with low MJ/m$^2$ star band thresholds this slight change may have a significant percentage impact on the predicted energy demand and star band thresholds.

### 4.7.1 Initial Correlation

Figure 50 shows the initial correlation between current star rating and the energy demand predicted using the new weather data. The correlation is quite strong ($R^2$ value of 0.988). Note the correlation is worst at star ratings at 2 stars or lower, so this should not affect the development of star bands at regulatory levels.

**Figure 50 Correlation between existing energy rating and energy demand with updated weather data in Brisbane**



### 4.7.2 Adjusted star bands with limited rating reduction and new 10-star level

While the NCC requires a minimum rating of 6 stars, in Queensland the Queensland Development Code (and NCC) allows a minimum of 5 stars if an outdoor living area is provided which has an insulated ceiling and a ceiling fan. The analysis below therefore reports on the impacts on ratings at both 5 and 6 stars.

In addition to limiting reductions in rating to 0.2 stars, the higher energy demand at 10-stars has a flow on effect to lower star levels. Note that the higher 10-star limit affects star band thresholds from **7 to 9 stars**.

Table 13 shows the adjusted star bands using the two alternative methods and the current star bands.

**Table 13 Current and Adjusted star bands for updated weather data Brisbane**

| Star | Current | Adjusted star bands no change <= -0.2 stars | Adjusted star bands with 0 average change at 6 stars |
|---|---|---|---|
| **1.0** | 203 | 233 | 215 |
| **2.0** | 139 | 177 | 166 |
| **3.0** | 97 | 129 | 121 |
| **4.0** | 71 | 94 | 88 |
| **5.0** | 55 | 71 | 66 |
| **6.0** | 43 | 57 | 53 |
| **7.0** | 34 | 47 | 44 |
| **8.0** | 25 | 37 | 35 |
| **9.0** | 17 | 28 | 27 |
| **10.0** | 10 | 20 | 20 |

The two methods of developing star bands yield results which are quite close indicating that the impact on ratings using each star band set will not be very different.

The figures below show the impact of the adjusted star bands on the rating of dwellings at 5 and 6 stars where the rating reduction is limited to 0.2 stars. Note that the number of houses in the 5-star range is different to 6 stars. To develop the star bands dwelling ratings developed for 3 climates were run in the Brisbane climate. Because the number of dwellings which achieve these star rating levels which were developed for other climate zones varies the number of dwellings sown in the graphs below also varies.

**Figure 51 Changes to ratings at 5 stars in Brisbane rating change limited to ->= -0.2**

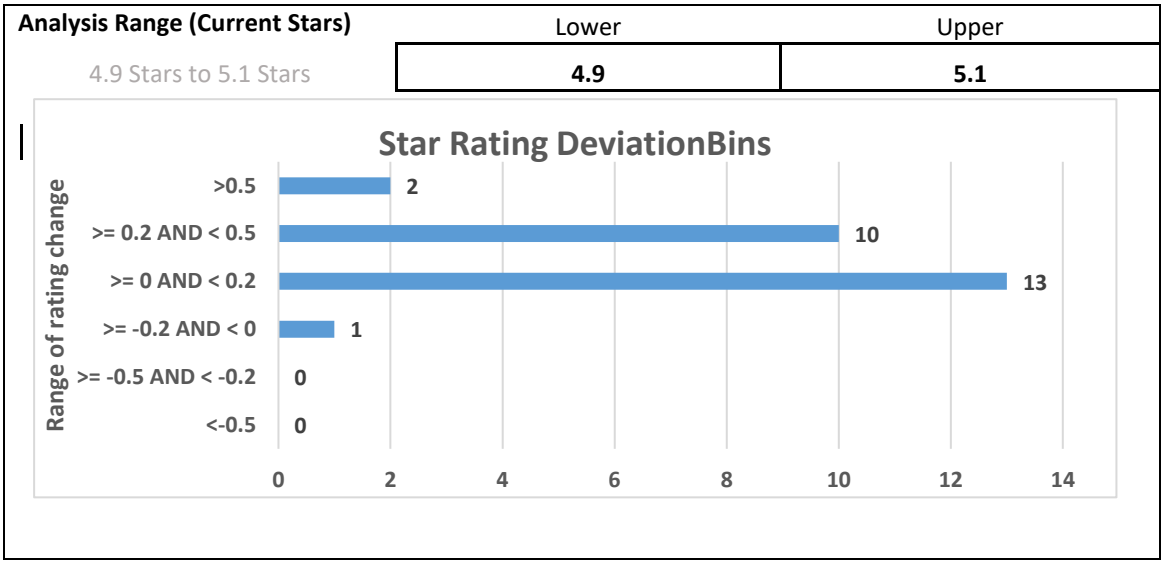
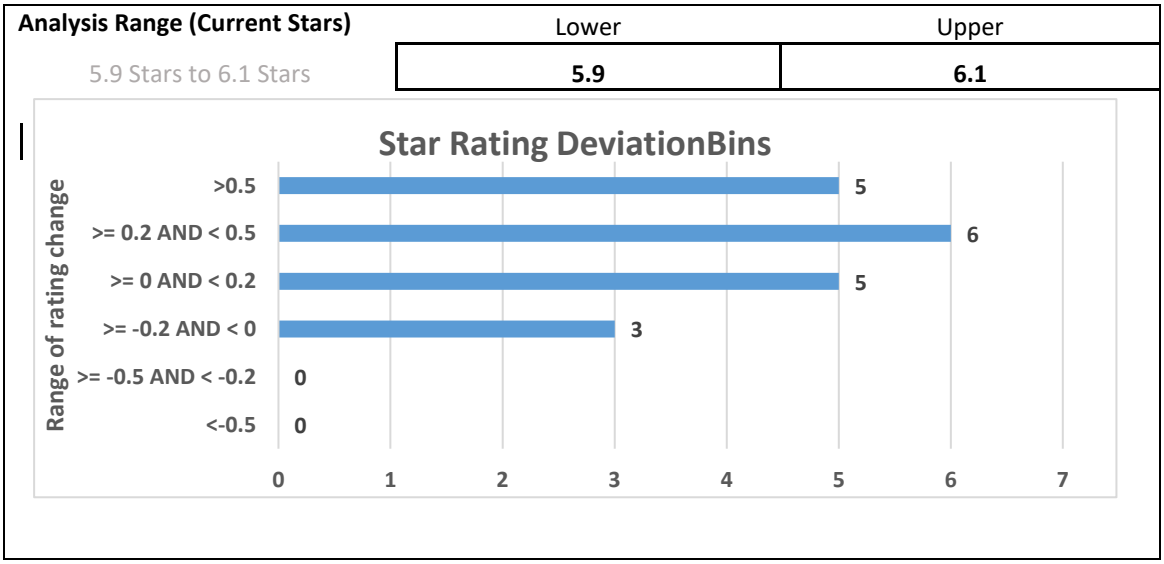



**Figure 52 Changes to ratings at 6 stars in Brisbane rating change limited to ->= -0.2**




The revised star bands have eliminated all cases where the reduction in rating exceeds 0.2 stars. As a result, the average rating of houses which currently obtain a rating of 5 stars increases by 0.25 stars while 6-star dwellings increase their rating by an average of 0.34 stars.

The figures below show the impact of the adjusted star bands on the rating of dwellings at 5 and 6 stars where the average change to the rating at 6 stars is 0.

**Figure 53 Changes to ratings at 5 stars in Brisbane rating average rating change at 6 stars is 0**

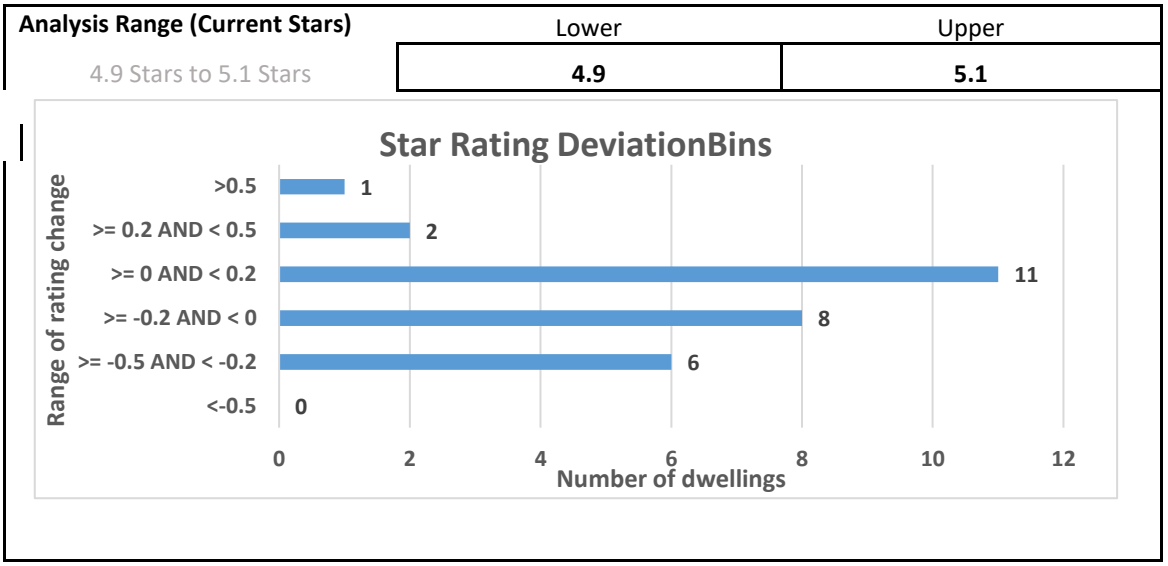
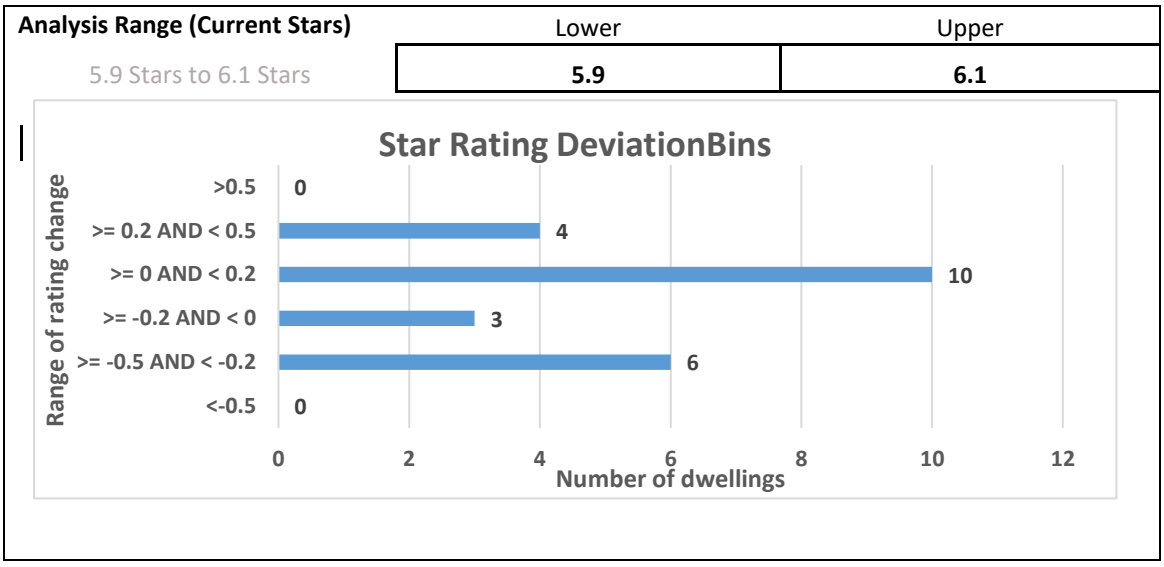



**Figure 54 Changes to ratings at 6 stars in Brisbane rating average rating change at 6 stars is 0**




The figures above show that a significant number of dwellings will experience a reduction in their rating in excess of 0.2 for both dwellings which currently rate 5 and 6 stars where the star bands are designed to achieve an average change to the rating at 6 stars of 0.

### 4.7.3 Change to rating for different types of dwellings

Figure 55 shows the changes to the rating of the dwellings at the current 5 stars in Brisbane where the rating reduction is limited to 0.2 stars.

**Figure 55 Change to rating of individual dwellings in Brisbane at 5 stars rating change limited to ->= -0.2**

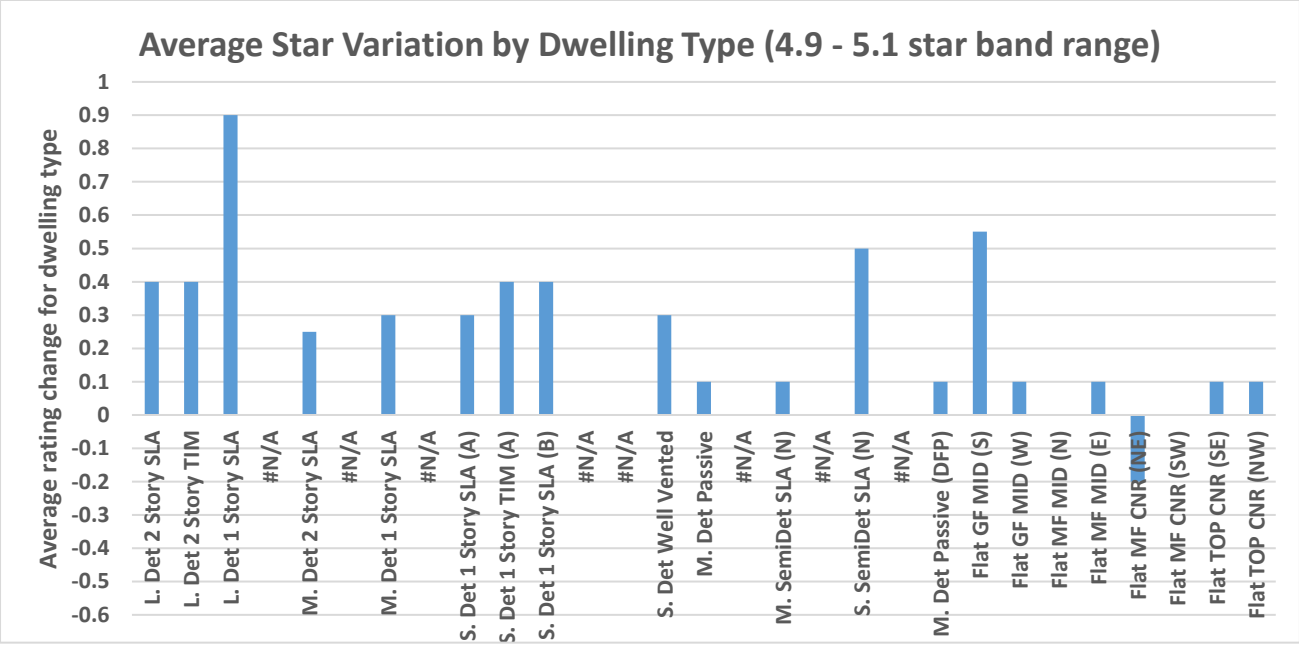
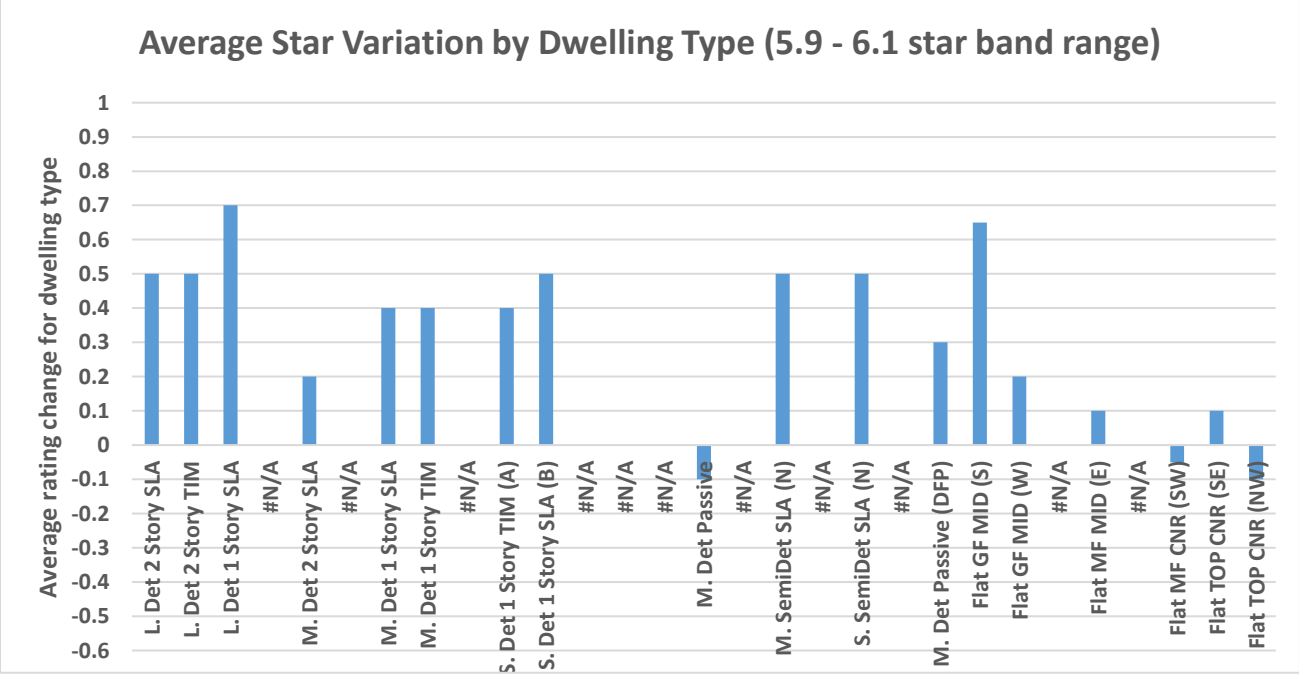



Figure 56 shows the changes to the rating of the dwellings at the current 6 stars in Brisbane where the rating reduction is limited to 0.2 stars.

**Figure 56 Change to rating of individual dwellings in Brisbane at 6 stars rating change limited to ->= -0.2**




Star bands which limit rating reductions to 0.2 stars at both 5 and 6 stars result in an average increase in the rating for houses which currently rate 5 and 6 stars of 0.23 stars at 5 stars and 0.34 stars at 6 stars. This is not excessive but is larger than found in other climates. The extent of change is brought about by the changes to solar radiation levels in the updated weather data which, while they produce small changes to

the predicted energy demand, have a disproportionate impact on ratings due to the low MJ/m2 star band thresholds in Brisbane compared to other climates.

Figure 57 shows the changes to the rating of the dwellings simulated in Brisbane at 5 stars where the average change to the rating at 6 stars is 0

**Figure 57 Change to rating of individual dwellings in Brisbane at 5 stars average rating change at 6 stars is 0**

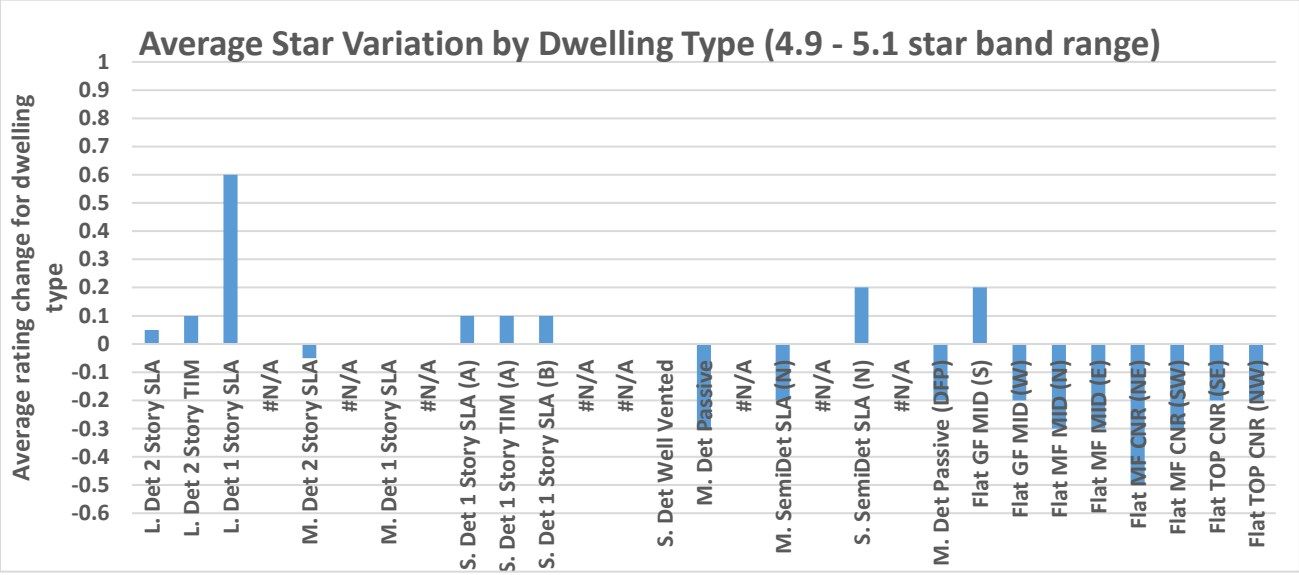
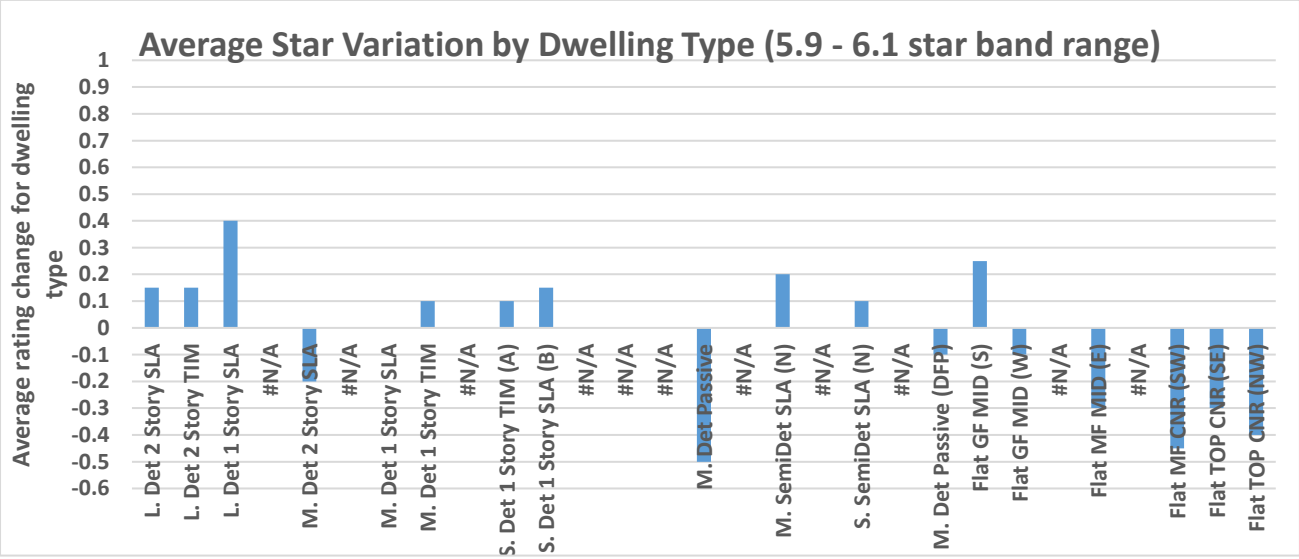



Figure 58 shows the changes to the rating of the dwellings simulated in Brisbane at 6 stars where the average change to the rating at 6 stars is 0

**Figure 58 Change to rating of individual dwellings in Brisbane at 6 stars average rating change at 6 stars is 0**




Note the following observations have been made subsequent to the more detailed evaluation of performance in Brisbane that establishing new load limits has required.

One of the primary differences in dwelling performance brought about by the updated weather data is an increase in cooling energy demand (+38% for dwellings currently rate 6 stars) and a decrease in heating energy demand (-23%). Because Brisbane has such small heating and cooling energy demands relative to other climate zones relatively small changes to weather data can lead to significant changes – in percentage terms – to the energy demands for heating and cooling.

This explains why the Design for Place House no longer rates as well as it used to. This house is optimised to reduce heating loads. As heating is lower and cooling higher the house design would need some adjustment for the climate e.g. reduce solar gain in summer though better shading, lower window areas or tinted windows and other strategies such as lighter colours and the use of ceiling fans. With these changes, the house would again show the performance advantage it had before the updated weather data was introduced.

This also explains why the apartment performance has almost uniformly reduced. Apartments were able to have quite large window areas at 5 and 6 stars using the old weather data. With adjustments to window area, shading or tinting it is likely that the rating level would be restored.

Brisbane is one of only 7 climates to show a significant change to the heating/cooling ratio brought about by the updated weather data. This makes the task of recalculating star bands a little more difficult because such changes to the heating/cooling ratio are also likely to change the way industry responds to the rating e.g. designers and NatHERS assessors will spend more time fine tuning cooling performance in summer than they did previously. This may be considered a good outcome by those who are specialists in designing dwellings in northern climates.

Because the change to weather may also induce a change to the market response, however, it means that predicting star bands solely on the basis of past performance of dwellings may be problematic. Predicting the extent of the design response itself may also prove to be difficult and this design response may change over time as designers and assessors both gain experience and develop innovative solutions. It is therefore suggested that an initial conservative approach be taken to developing adjusted star bands for the updated weather in Brisbane. Industry will need time to acclimatise to the new weather data so the approach of limiting the reduction in rating may be the best approach, particularly in light of increased stringency that may be introduced with NCC 2022.

Note that Section 10 Appendix 4 Change to heating and cooling loads at 5, 6 and 7 stars shows the change in the average heating and cooling demands for all 69 climates for dwellings which currently rate 5, 6 and 7 stars.

### 4.7.4 Comparison of current and adjusted star bands for Brisbane

The new weather data and star bands result in significant percentage changes to the prediction of heating demand (23% lower) and cooling demand (38% higher) for houses which currently rate 6 stars.

Figure 59 shows the current and adjusted star band thresholds for Brisbane where the rating reduction is limited to 0.2 stars. The energy demand thresholds of the new star bands reflect the higher total energy demand which has occurred as a result of the updated weather data.

**Figure 59 Comparison of current and adjusted star bands for Brisbane rating change limited to ->= -0.2**

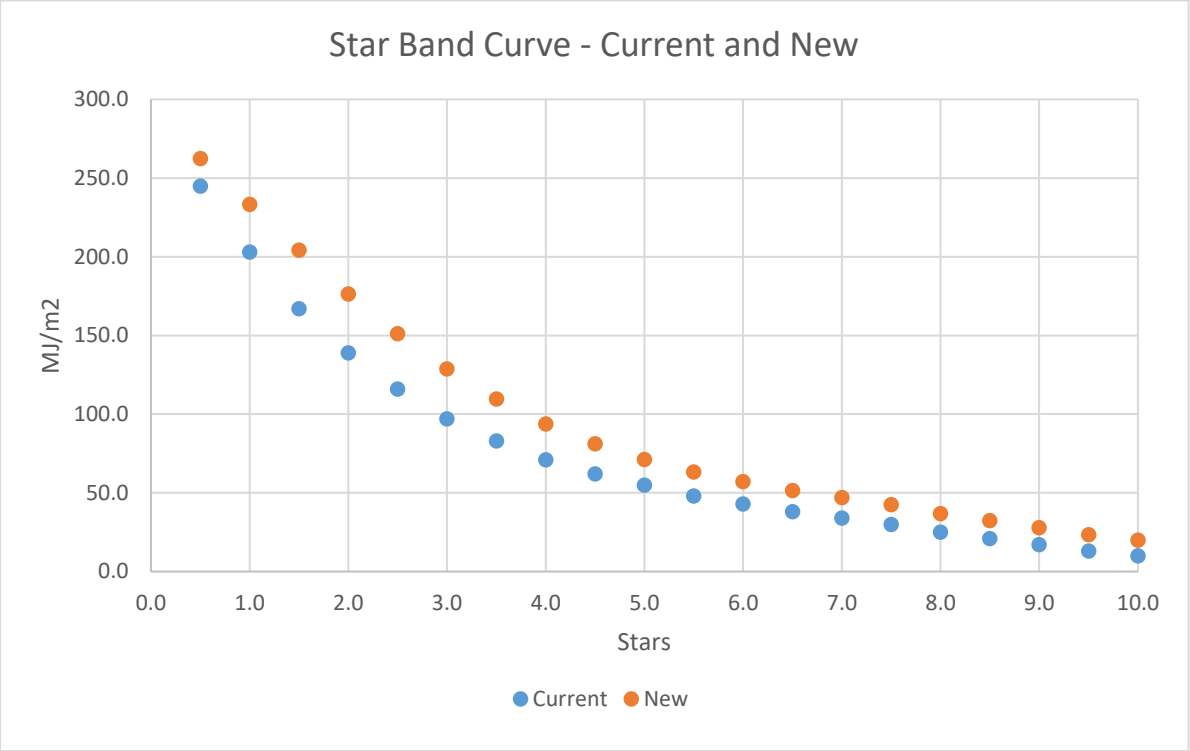
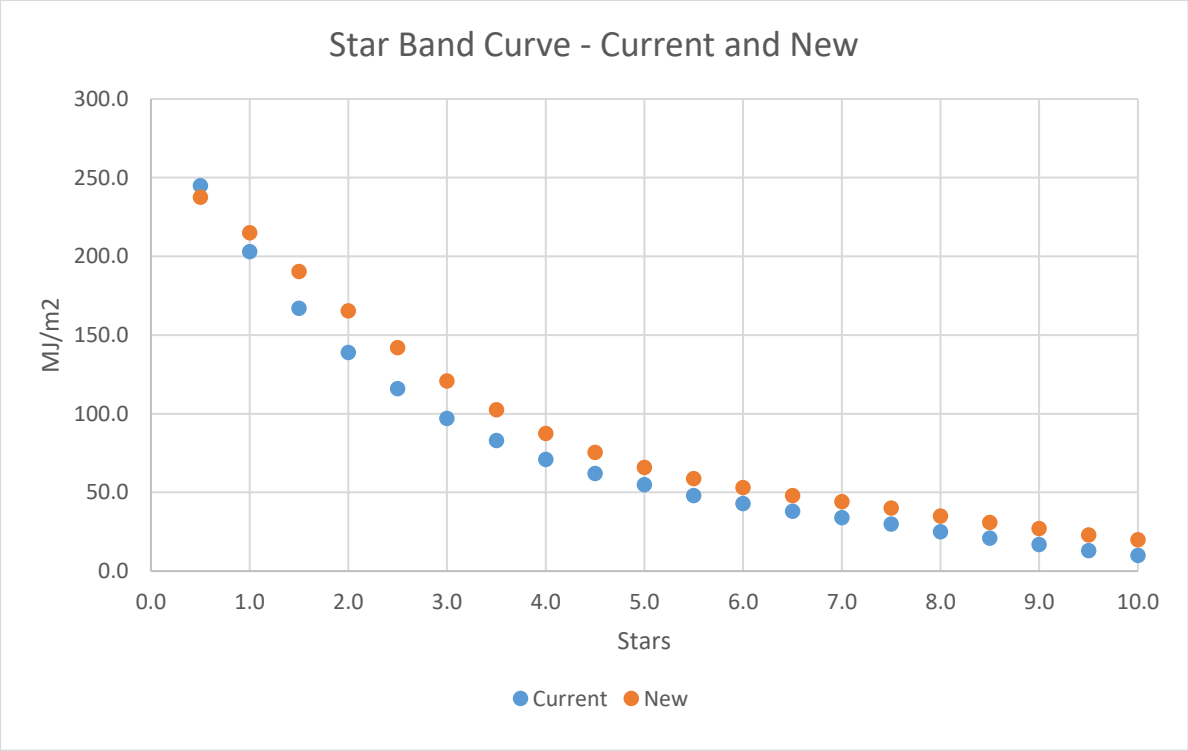
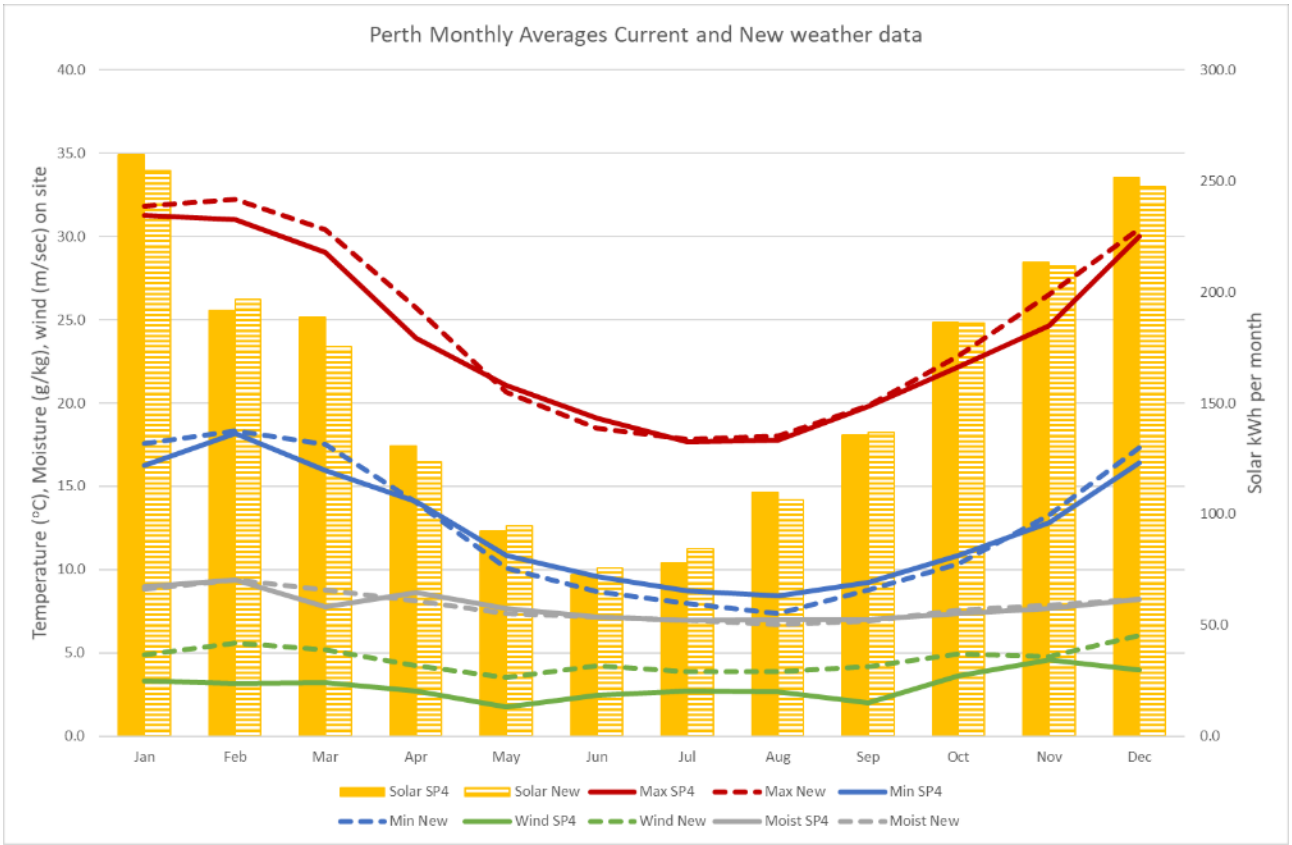


Figure 60 shows the current and adjusted star band thresholds for Brisbane where the average change to the rating at 6 stars is 0.

**Figure 60 Comparison of current and adjusted star bands for Brisbane average rating change at 6 stars is 0**



## 4.8 Perth

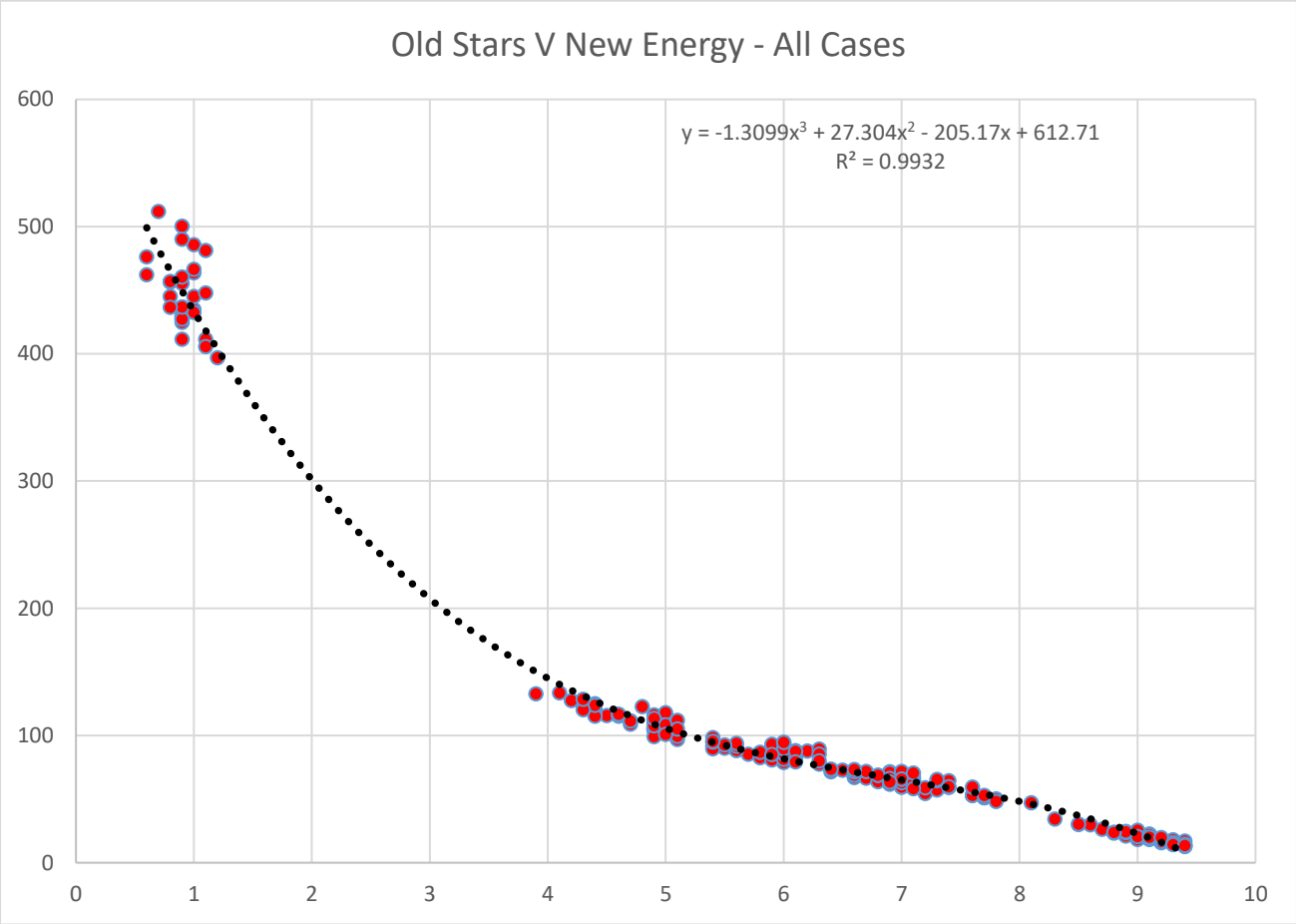



The difference between the climate data sets is small. Wind speeds are higher for all months which may lead to higher ratings for Class 1 dwellings than Class 2 due to the greater opportunity to provide cross ventilation. Solar radiation levels from May to July are slightly higher which will reduce heating energy demand. Slightly lower solar radiation levels from November to March except for February will probably lead to slightly lower cooling energy demand.

### 4.8.1 Initial Correlation

Figure 61 shows the initial correlation between current star rating and the energy demand predicted using the new weather data. The correlation is quite strong ($R^2$ value of 0.993). Note the correlation is worst at star ratings at 2 stars or lower, so this should not affect the development of star bands at regulatory levels.

**Figure 61 Correlation between existing energy rating and energy demand with updated weather data in Perth**



### 4.8.2 Star bands and rating impacts with limit to rating reduction

The initial correlation between current rating and energy demand with updated weather is modified to limit reductions in rating to 0.2 stars and add the new 10-star level. Note that the higher 10-star limit also affects star band thresholds from **7 to 9 stars**.

Table 14 shows the adjusted star bands using the two alternative methods and the current star bands.

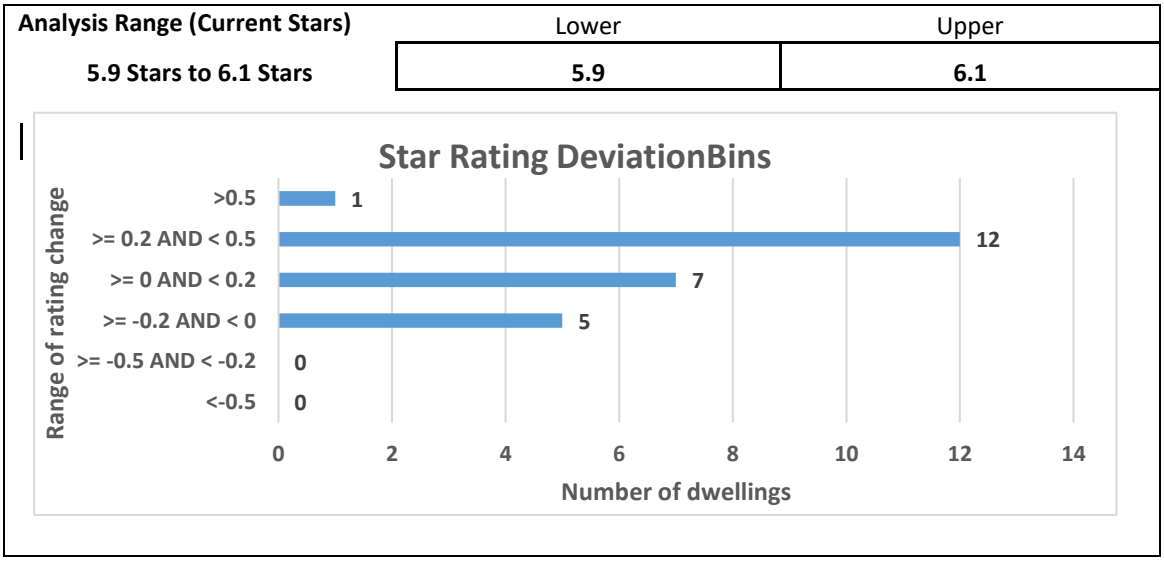
**Table 14 Current and Adjusted star bands for updated weather data in Perth**

| Star | Current | Adjusted star bands no change <= -0.2 stars | Adjusted star bands with 0 average change at 6 stars |
|---|---|---|---|
| **1.0** | 387 | 434 | 412 |
| **2.0** | 251 | 301 | 304 |
| **3.0** | 167 | 208 | 204 |
| **4.0** | 118 | 145 | 135 |
| **5.0** | 89 | 106 | 97 |
| **6.0** | 70 | 82 | 79 |
| **7.0** | 52 | 63 | 61 |
| **8.0** | 34 | 44 | 43 |
| **9.0** | 17 | 27 | 26 |
| **10.0** | 4 | 13 | 13 |

Star band thresholds developed through the two alternative methods are not very different.

Figure 62 shows the range of rating changes for dwellings with rating levels between 5.9 and 6.1 stars where the rating reduction is limited to 0.2 stars.

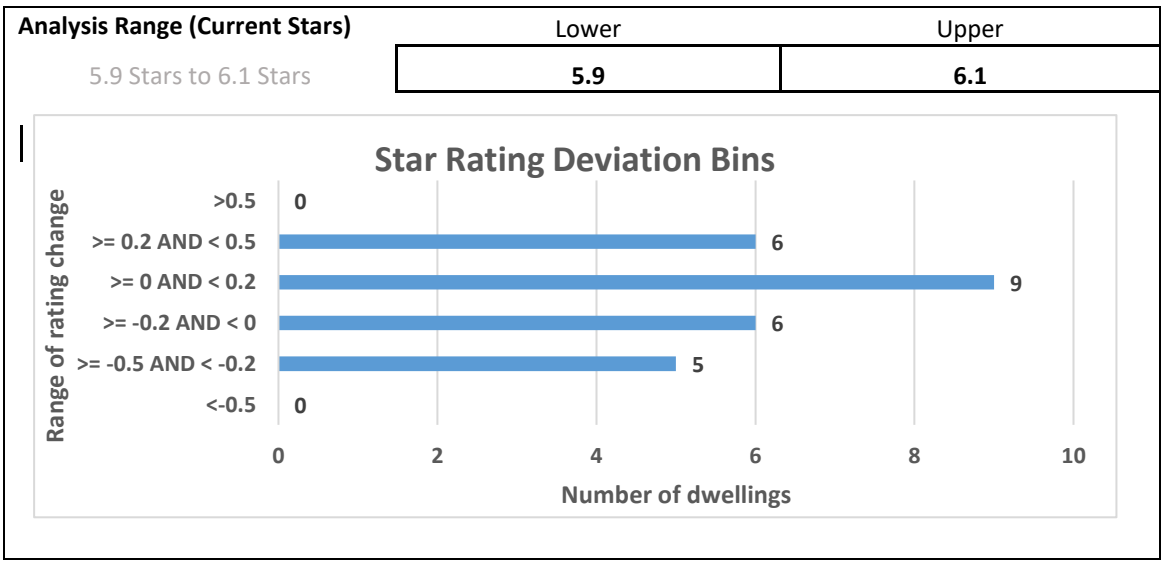
**Figure 62 Changes to ratings in Perth rating change limited to ->= -0.2**




The revised star bands have eliminated all cases where the reduction in rating exceeds 0.2 stars. The average rating of houses which currently obtain a rating of 6 stars increases by 0.17 stars.

Figure 63 shows the range of rating changes for dwellings with rating levels between 5.9 and 6.1 stars where the average change to the rating at 6 stars is 0.

**Figure 63 Changes to ratings in Perth average rating change at 6 stars is 0**

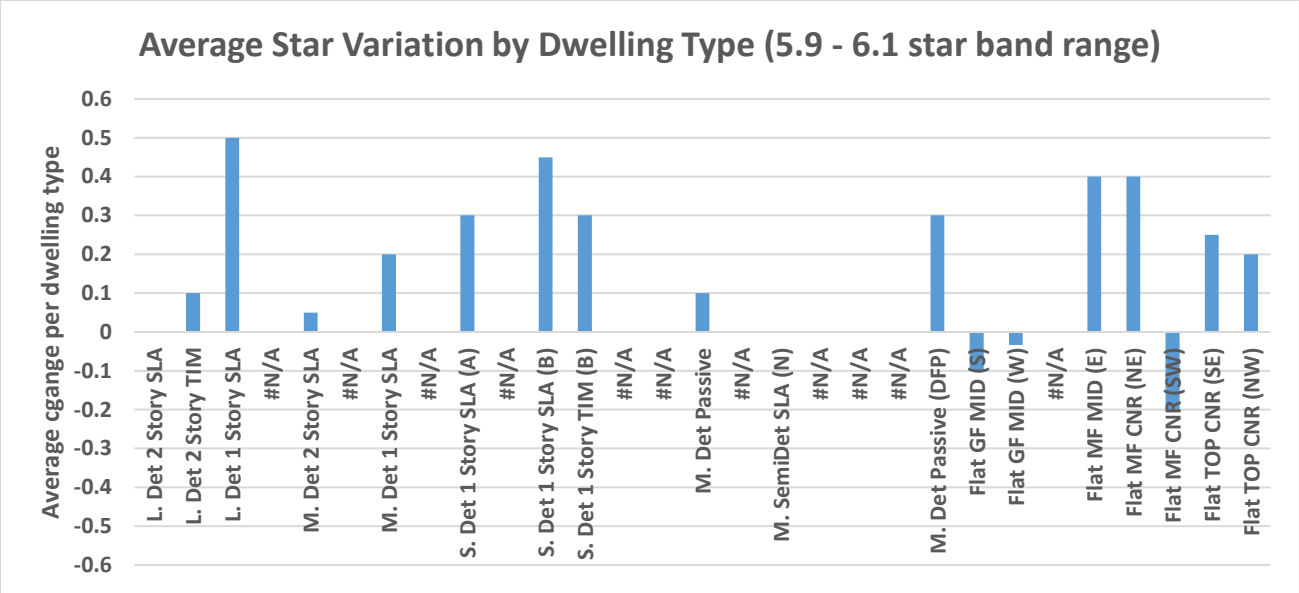



The star bands derived to achieve an average change of 0 at 6 stars results in a small but significant number of dwellings experiencing a reduction in rating of over 0.2 stars, however, no rating is reduced by more than 0.5 stars.

### 4.8.3 Change to rating for different types of dwellings

Figure 64 shows the changes to the rating of the dwellings at the current 6 stars in Perth where the rating reduction is limited to 0.2 stars.

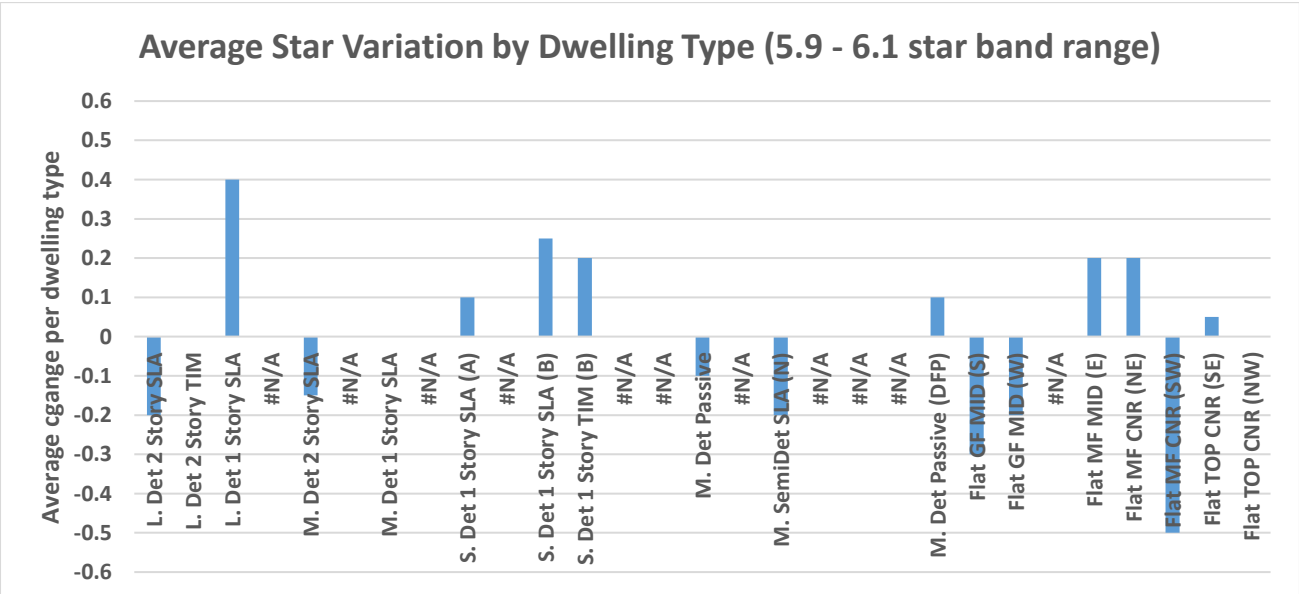
**Figure 64 Change to rating of individual dwellings in Perth at 6 stars rating change limited to ->= -0.2**




Ratings increase across the board with reductions in rating limited to Class 2 units at less favourable orientations (south and west). The need to limit rating reduction in these Class 2 dwellings at less favourable orientations to a maximum of 0.2 stars leads to some significant increases in the rating of other units, but this only increases the rating of dwellings which currently achieve 6 stars by 0.17 stars. This is not excessive. If it was acceptable to see a lowering of ratings in less favourably oriented Class 2 dwellings by more than 0.2 stars the increase in average ratings could be reduced.

Figure 65 shows the changes to the rating of the dwellings simulated in Perth where the average change to the rating at 6 stars is 0

**Figure 65 Change to rating of individual dwellings in Perth at 6 stars where the average change to the rating at 6 stars is 0**




The figures above show that the largest rating reductions in Perth for dwellings which currently rate 6 stars are for apartments with southern orientations. This reflects the slightly higher heating energy demands in

Perth which have occurred as a result of the updated weather data. The Design for Place house also receives a lower rating. This house has a high window area and is single glazed. It is likely that small adjustments to glazing area to lower heating loads or a reduction on shading would restore the rating of the house.

### 4.8.4 Comparison of current and adjusted star bands for Perth

The new weather data and star bands results in slight increase to the heating demand (20%) and cooling demand (2%) at 6 stars. While the increase in heating is large in percentage terms this is because Perth is a low energy demand climate. The magnitude of the increase is only 4 MJ/m$^2$.

Figure 66 shows the current and adjusted star band thresholds for Perth where the rating reduction is limited to 0.2 stars. The energy demand thresholds of the new star bands reflect the slightly higher energy loads which are caused by the new weather data and the slight increase in the 10-star threshold. Star bands at 4 stars and below show a more significant increase in the star band MJ/m$^2$ than higher rating levels. This is in part due to the higher energy demand and the fact that the correlation between current rating and new energy demand is not as good at 2 stars and below.

**Figure 66 Comparison of current and adjusted star bands for Perth rating change limited to ->= -0.2**

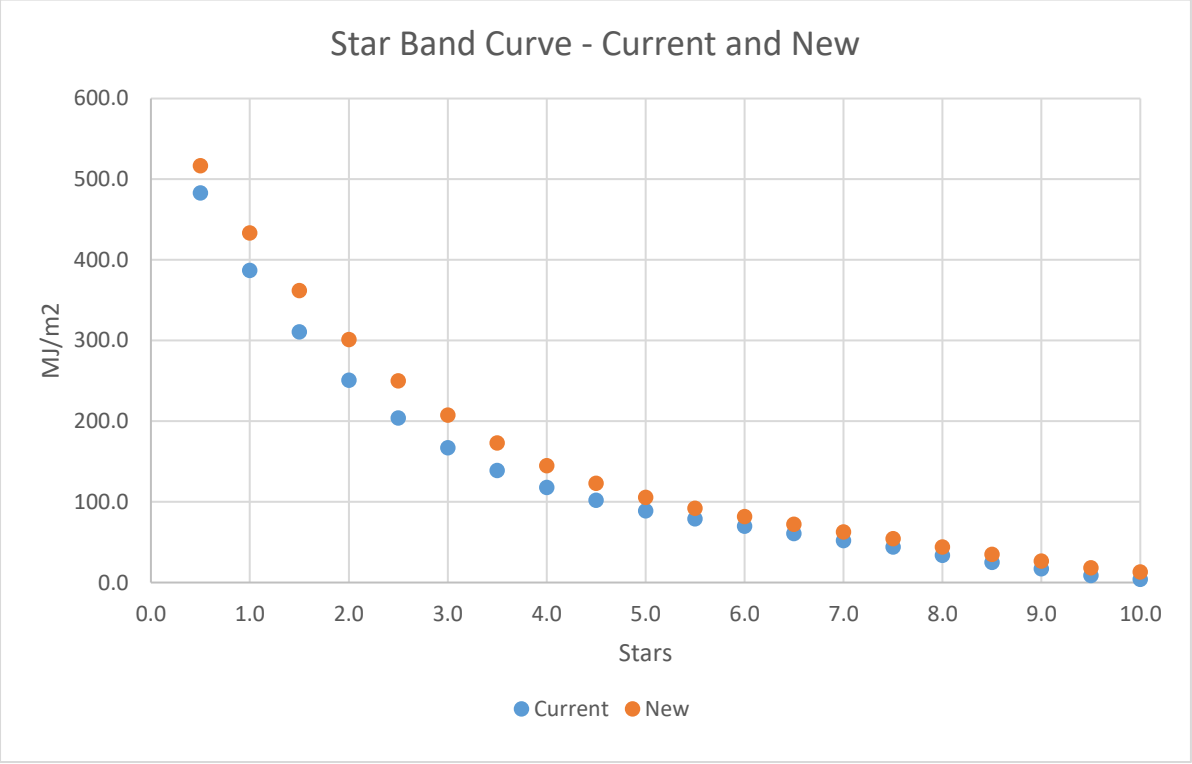
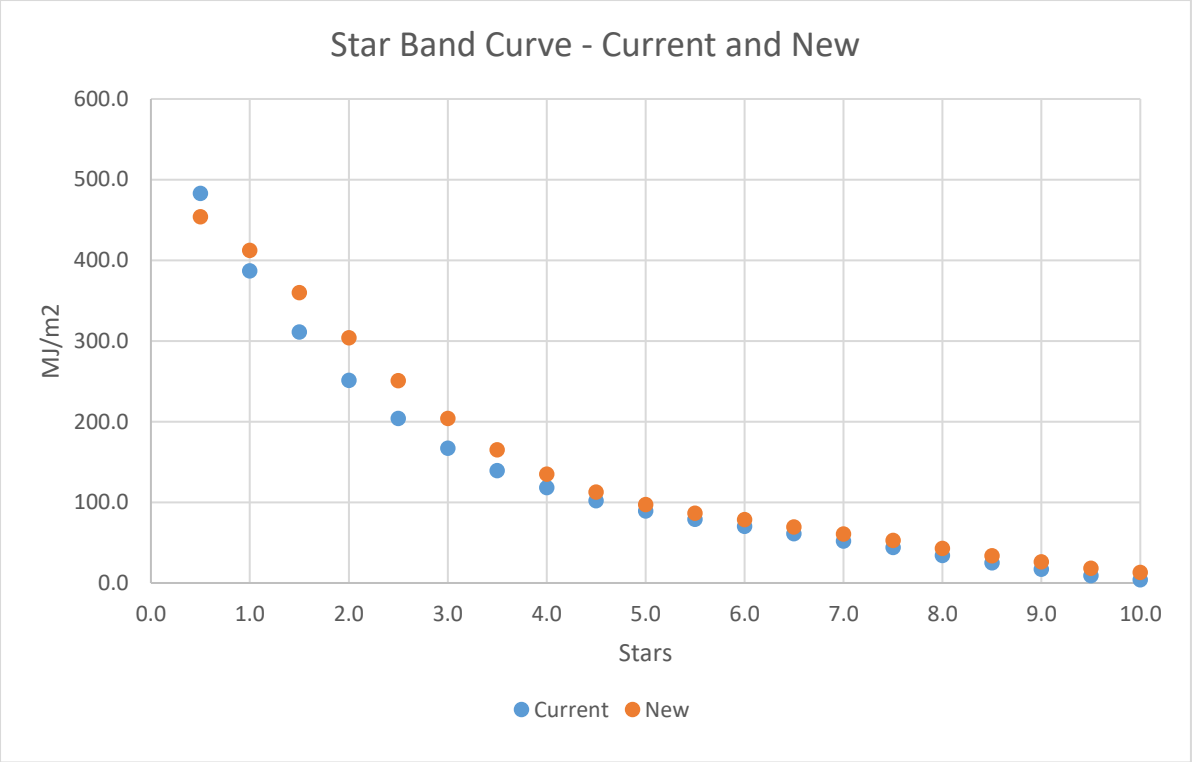
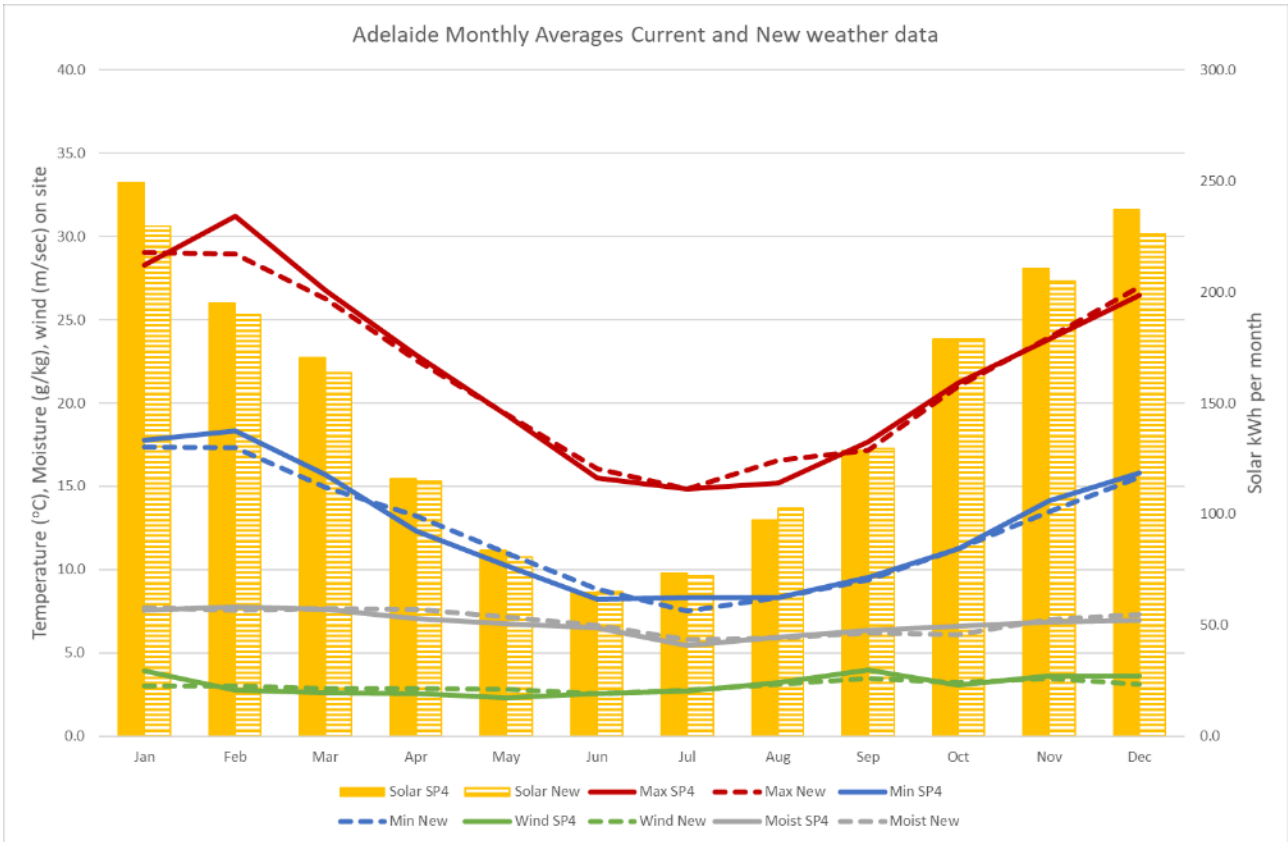


Figure 67 shows the current and adjusted star band thresholds for Perth where the average change to the rating at 6 stars is 0.

**Figure 67 Comparison of current and adjusted star bands for Perth average rating change at 6 stars is 0**



## 4.9 Adelaide

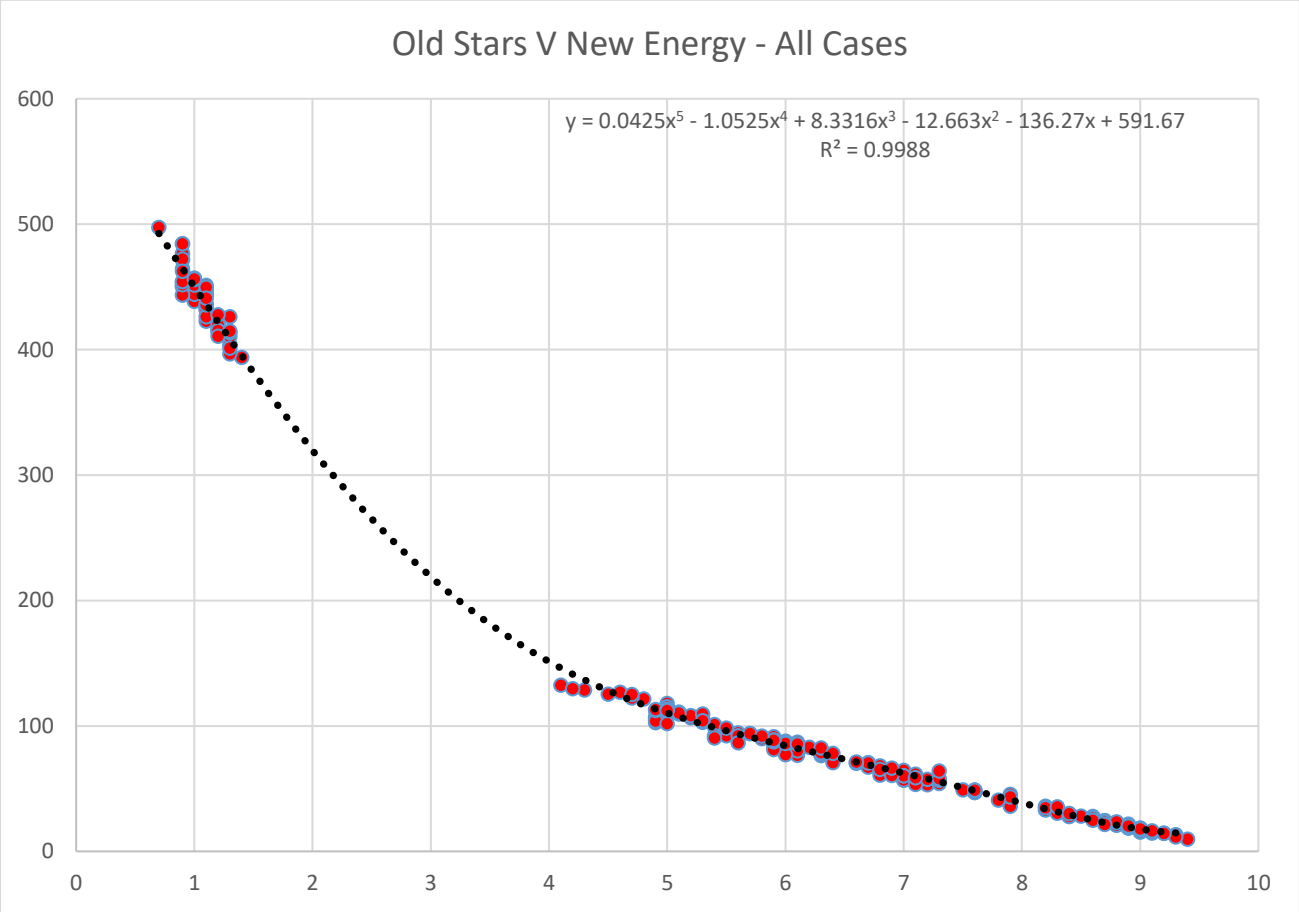



There is only minimal change to average climatic parameters between the current and updated weather data files. The lower solar radiation levels from November to March will lead to slightly reduced cooling energy demand.

### 4.9.1 Initial Correlation

Figure 68 shows the initial correlation between current star rating and the energy demand predicted using the new weather data. The correlation is very strong ($R^2$ value of 0.999) which indicates that changes to ratings should be minimal.

**Figure 68 Correlation between existing energy rating and energy demand with updated weather data in Adelaide**



### 4.9.2 Star bands and rating impacts with limit to rating reduction

The initial correlation between current rating and energy demand with updated weather is modified to limit reductions in rating to 0.2 stars and add the new 10-star level. Note that the higher 10-star limit also affects star band thresholds from **7 to 9 stars**.

Table 15 shows the adjusted star bands using the two alternative methods and the current star bands.

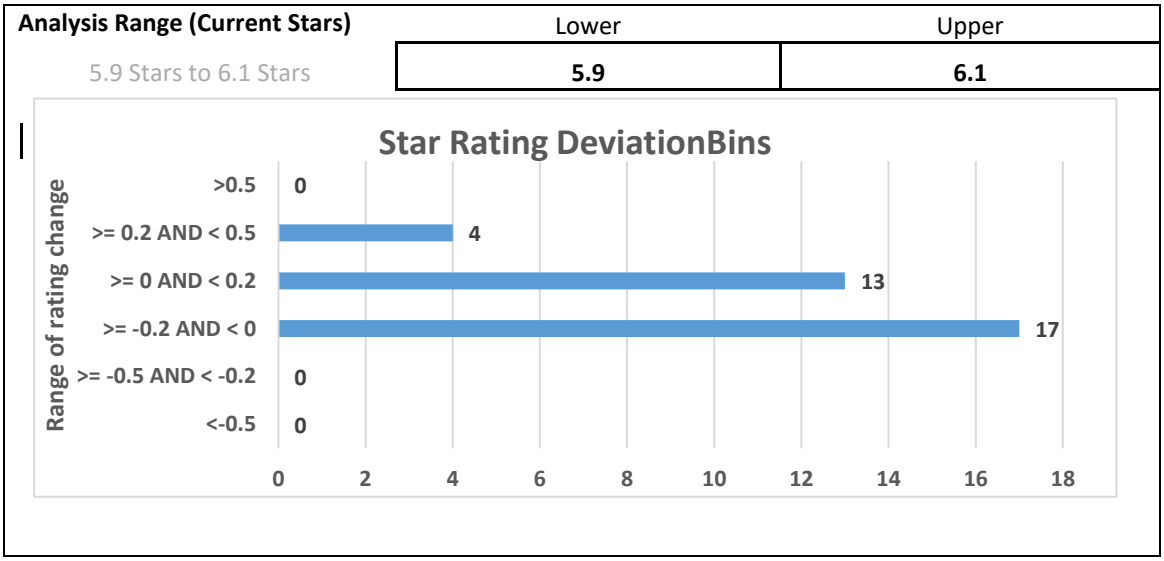
**Table 15 Current and Adjusted star bands for updated weather data Adelaide**

| Star | Current | Adjusted star bands no change <= -0.2 stars | Adjusted star bands with 0 average change at 6 stars |
|---|---|---|---|
| **1.0** | 480 | 450 | 450 |
| **2.0** | 325 | 320 | 319 |
| **3.0** | 227 | 219 | 219 |
| **4.0** | 165 | 151 | 151 |
| **5.0** | 125 | 110 | 110 |
| **6.0** | 96 | 84 | 84 |
| **7.0** | 70 | 62 | 64 |
| **8.0** | 46 | 41 | 46 |
| **9.0** | 22 | 20 | 27 |
| **10.0** | 3 | 13 | 13 |

There is very little difference between the star band thresholds derived suing each method because the average change at 6 stars in Adelaide was already below 0.1 stars even when the rating reduction is limited to 0.2 stars.

Figure 69 shows the range of rating changes for dwellings with rating levels between 5.9 and 6.1 stars where the rating reduction is limited to 0.2 stars.

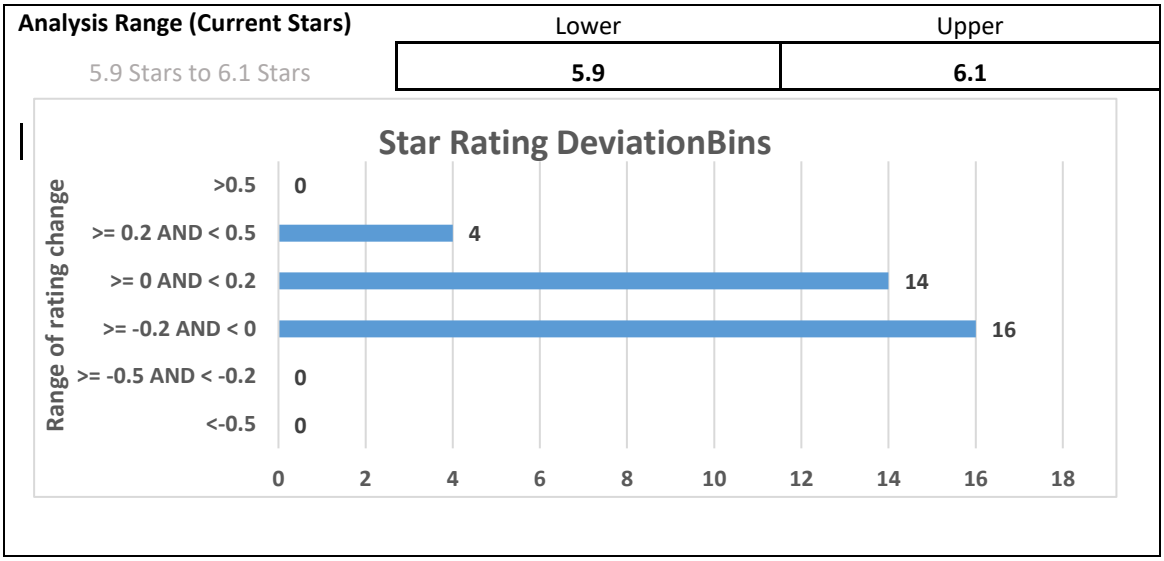
**Figure 69 Changes to ratings at 6 stars in Adelaide rating change limited to ->= -0.2**




The revised star bands have eliminated all cases where the reduction in rating exceeds 0.2 stars. The average rating of houses which currently obtain a rating of 6 stars is almost unaffected on average (-0.02 stars).

shows the range of rating changes for dwellings with rating levels between 5.9 and 6.1 stars where the average change to the rating at 6 stars is 0.

**Figure 70 Changes to ratings at 6 stars in Adelaide average rating change at 6 stars is 0**

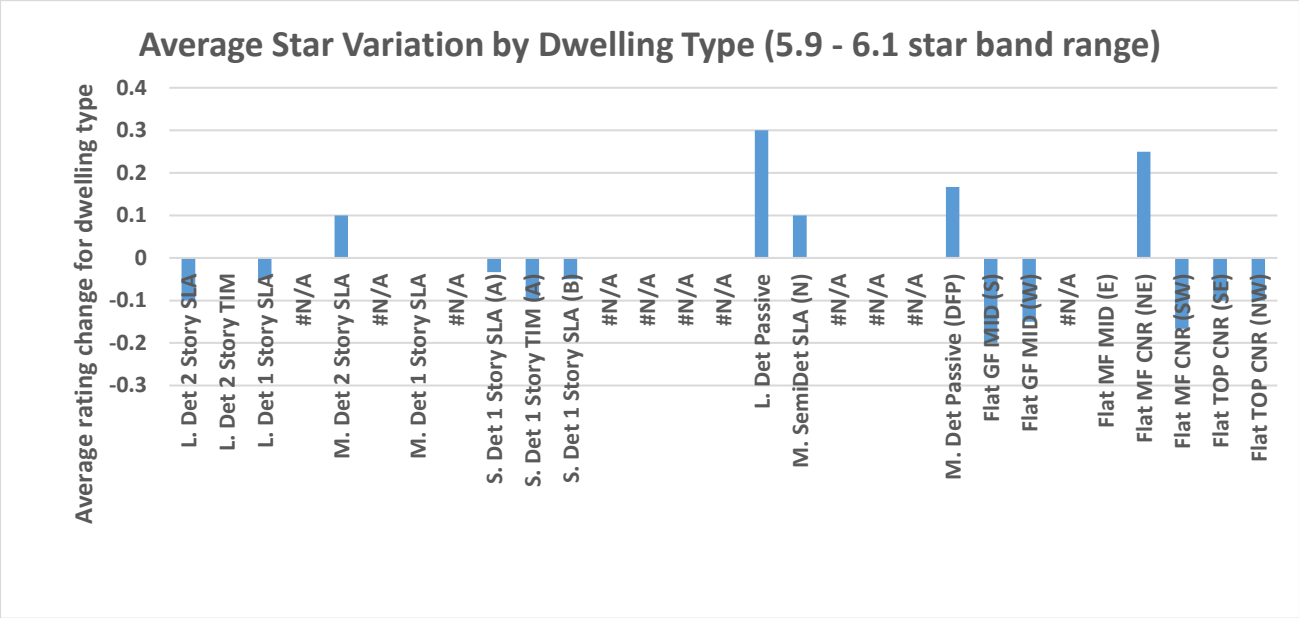



The figures above show that the two methods for deriving star bands in Adelaide produce virtually identical results. No further additional analysis will be presented below to highlight differences between the two methods.

### 4.9.3 Change to rating for different types of dwellings

Figure 71 shows the changes to the rating of the dwellings simulated in Adelaide.

**Figure 71 Change to rating of individual dwellings in Adelaide**




The Large and Medium detached passive solar dwellings show the greatest increase in rating. This indicates that the updated weather data will encourage slightly better passive solar design. On average Class 2 dwellings receive slightly lower ratings than Class 1 dwellings. The difference is small: less than 0.1 stars if passive solar Class 1 dwellings are excluded.

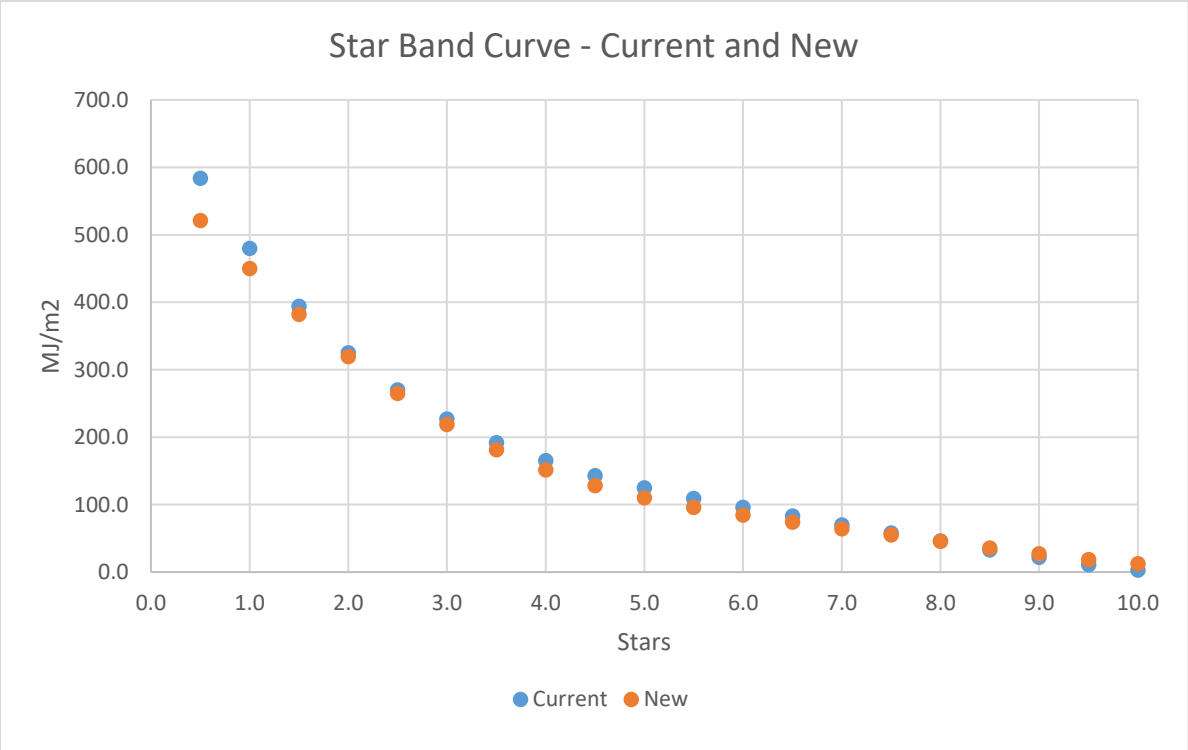
Changes to ratings are smaller in Adelaide than in many other climate zones with 67% of dwellings which currently rate 6 stars experiencing a rating change of 0.1 stars or less. The impact of the change on the building industry will therefore be minimal.

### 4.9.4 Comparison of current and adjusted star bands for Adelaide

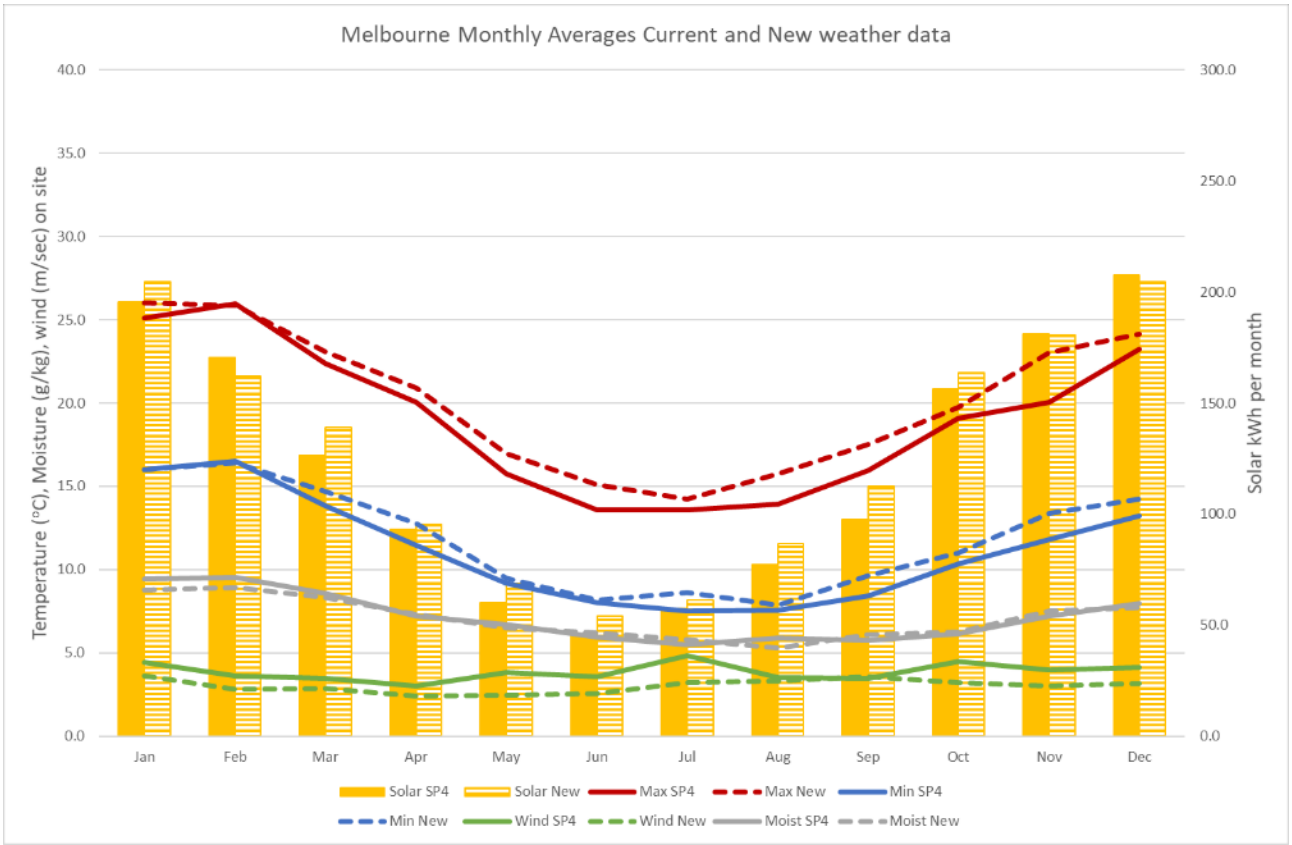
The new weather data and star bands results in slight decreases to the heating demand (8%) and cooling demand (18%) at 6 stars.

Figure 72 shows the current and adjusted star band thresholds for Adelaide. The energy demand thresholds of the new star bands reflect the slightly lower energy loads which are caused by the new weather data up to6 stars while the slight increase in the 10 star threshold results in a small increase to the energy loads required to achieve 7 to 10 stars compared to the current star bands.

**Figure 72 Comparison of current and weather data adjusted star bands for Adelaide**



## 4.10 Melbourne



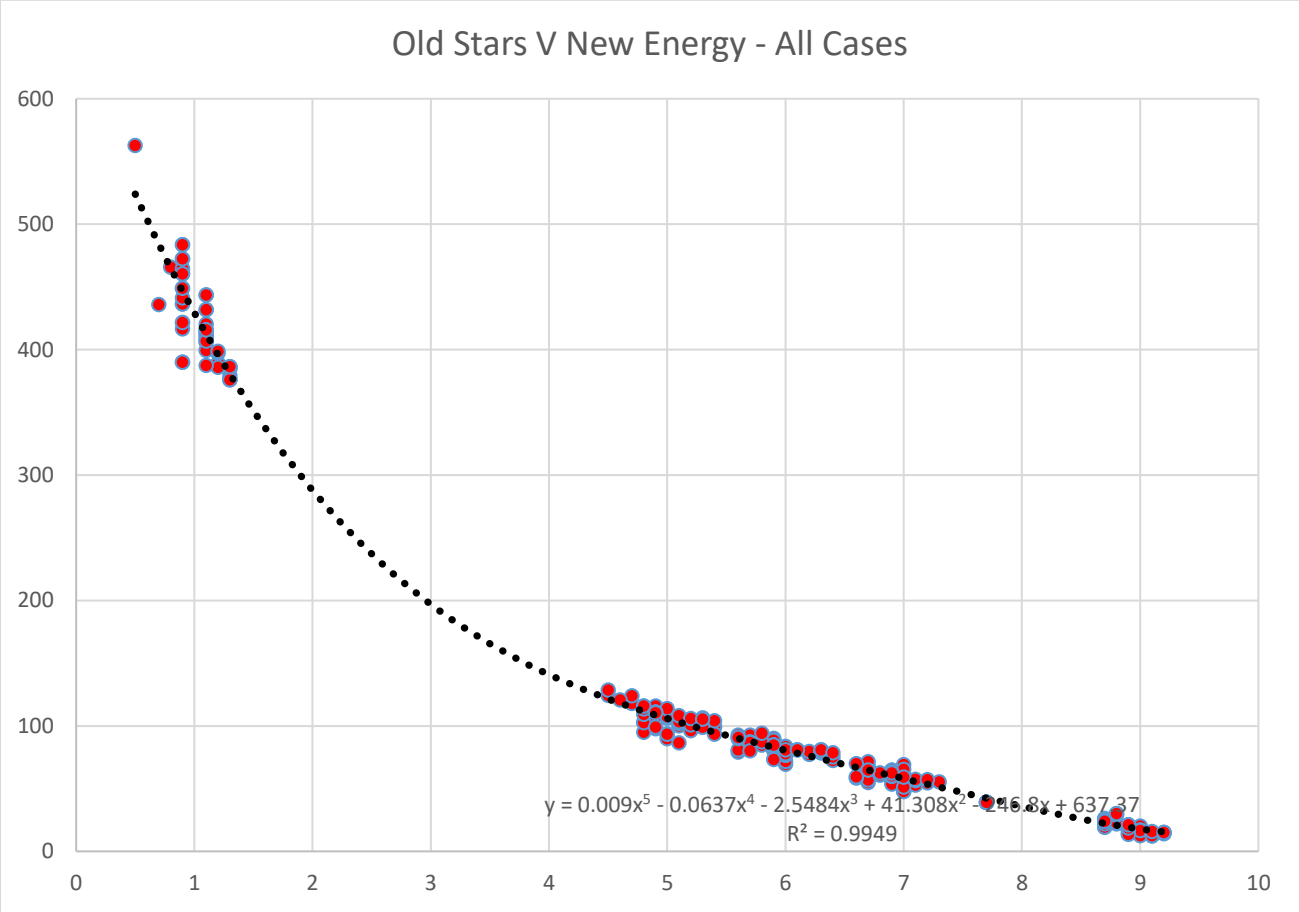

The new Melbourne weather data has a significantly higher level of solar radiation and higher maximum temperatures, particularly in cooler months. This will reduce the predicted energy demand for heating. Cooling energy demand in Melbourne is affected more by solar radiation data than temperatures due to the greater magnitude of heat gain through windows by radiation than conduction through roofs and walls. While solar radiation is significantly higher in January and March in the updated weather file, it is lower in February and December. It is not clear how cooling energy demand will be affected by the new weather data based without recourse to simulated energy results.

Note that the current weather data for Melbourne is made of from weather data taken from the period between 1970 to 1974. Since this time, it is conceivable that the urban heat island effect in central Melbourne has significantly increased temperatures. This may explain the increases to maximum and minimum temperatures.

### 4.10.1 Initial Correlation

Figure 73 shows the initial correlation between current star rating and the energy demand predicted using the new weather data. The correlation is very strong ($R^2$ value of 0.995). This indicates that the extent of the variation to the star ratings should not be excessive.

**Figure 73 Correlation between existing energy rating and energy demand with new weather data in Melbourne**



### 4.10.2 Star bands and rating impacts with limit to rating reduction

In addition to limiting reductions in rating to 0.2 stars, the higher energy demand at 10-stars has a flow on effect to lower star levels. Note that in the example below, the higher 10-star limit affects star band thresholds from **7 to 9 stars**.

Table16 shows both the Current and Adjusted star bands using the two alternative methods for deriving the new star bands.

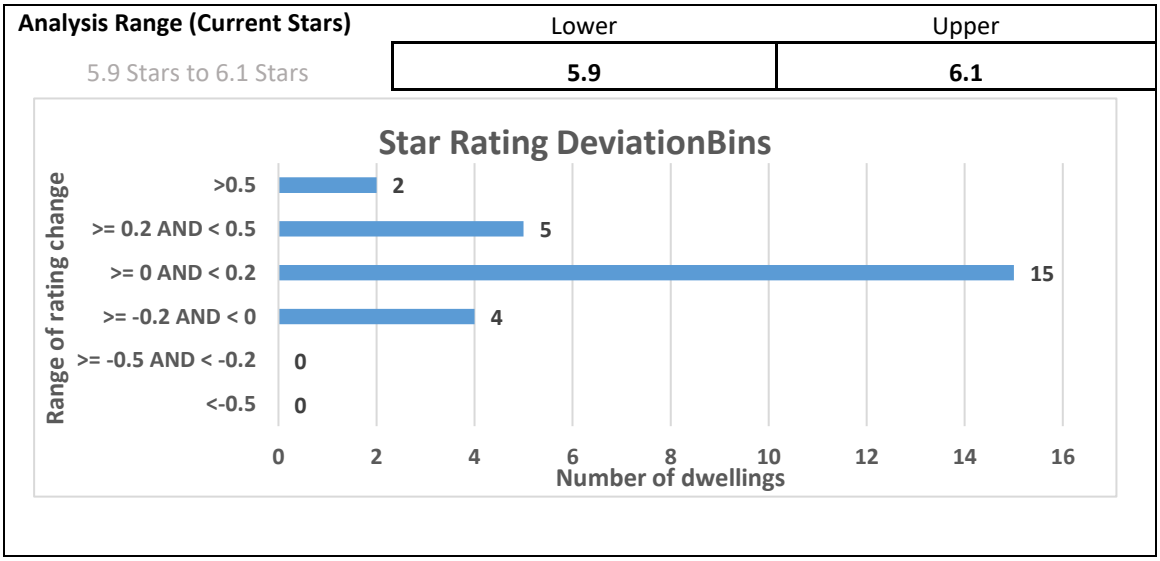
**Table16 Current and Adjusted star bands for updated weather data Melbourne**

| Star | Current | Adjusted star bands no change <= -0.2 stars | Adjusted star bands with 0 average change at 6 stars |
|---|---|---|---|
| **1.0** | 481 | 451 | 430 |
| **2.0** | 315 | 302 | 290 |
| **3.0** | 214 | 207 | 199 |
| **4.0** | 155 | 148 | 143 |
| **5.0** | 119 | 114 | 107 |
| **6.0** | 94 | 83 | 81 |
| **7.0** | 71 | 54 | 62 |
| **8.0** | 47 | 45 | 44 |
| **9.0** | 24 | 26 | 25 |
| **10.0** | 7 | 21 | 11 |

The table above shows that the difference between the star band thresholds developed using the two alternative method is minimal.

Figure 74 shows the range of rating changes for dwellings with rating levels between 5.9 and 6.1 stars where the rating reduction is limited to 0.2 stars.

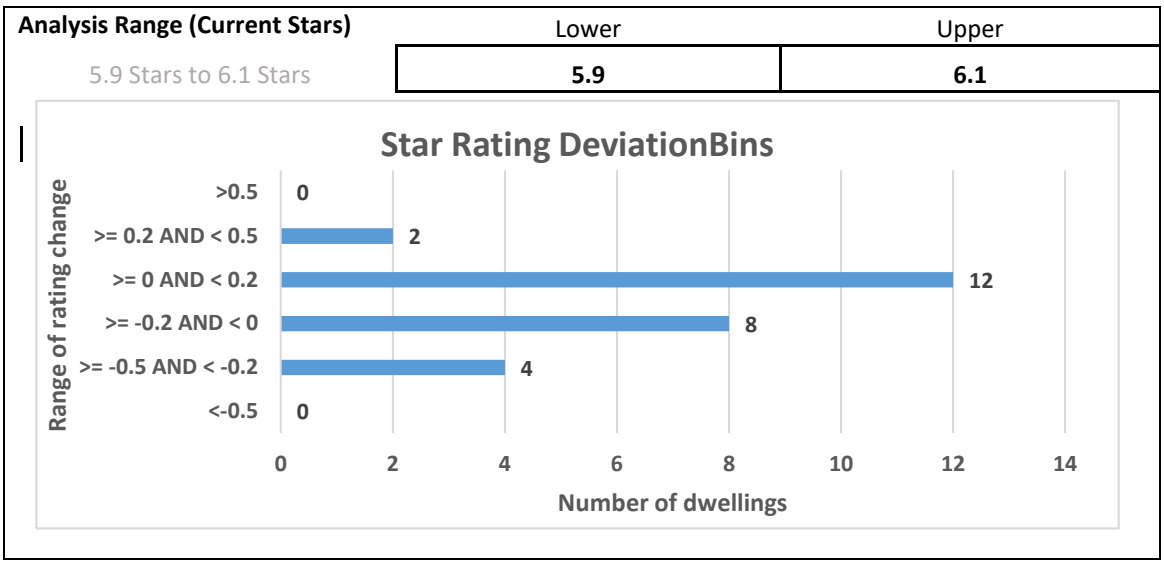
**Figure 74 Changes to ratings at 6 stars in Melbourne rating change limited to ->= -0.2**




The revised star bands have eliminated all cases where the reduction in rating exceeds 0.2 stars. As a result, the average rating of dwellings which currently obtain a rating of 6 stars increases by 0.18 stars.

Figure 75 shows the range of rating changes for dwellings with rating levels between 5.9 and 6.1 stars

**Figure 75 Changes to ratings at 6 stars in Melbourne average rating change at 6 stars is 0**

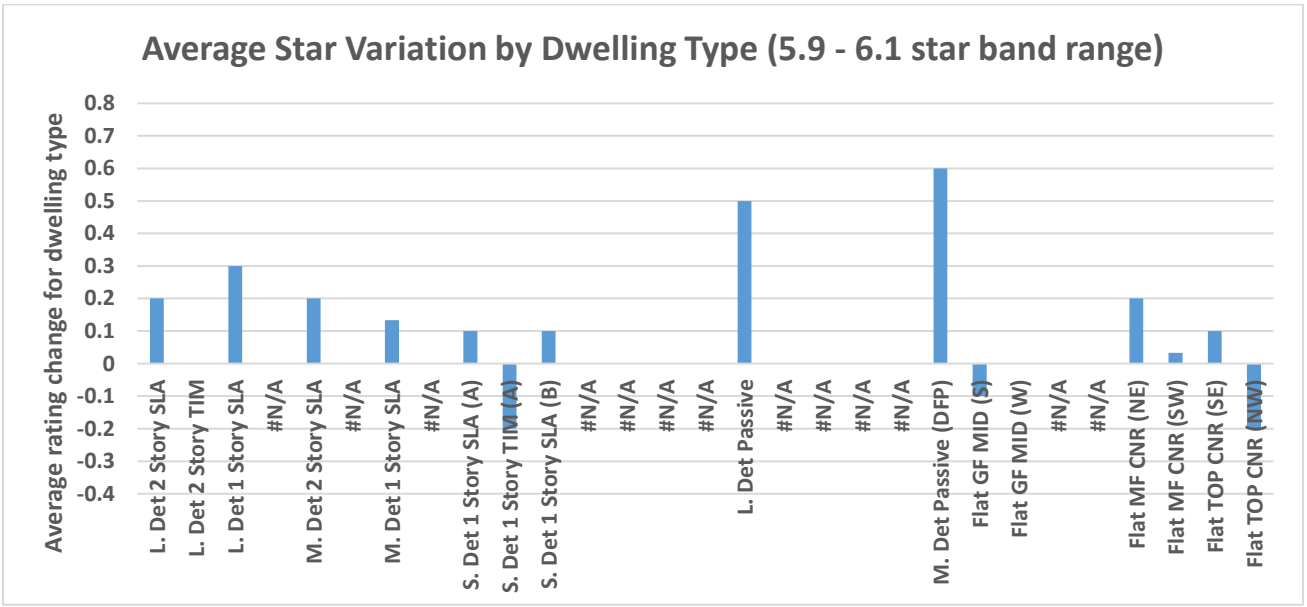



The figure above shows that if the extent of reduction in rating is not limited, a small but significant proportion of dwellings will experience a reduction in rating of over -0.2 stars.

### 4.10.3 Change to rating for different types of dwellings

Figure 76 shows the changes to the rating of the dwellings simulated in Melbourne where the rating reduction is limited to 0.2 stars.

**Figure 76 Change to rating of individual dwellings in Melbourne rating change limited to ->= -0.2**

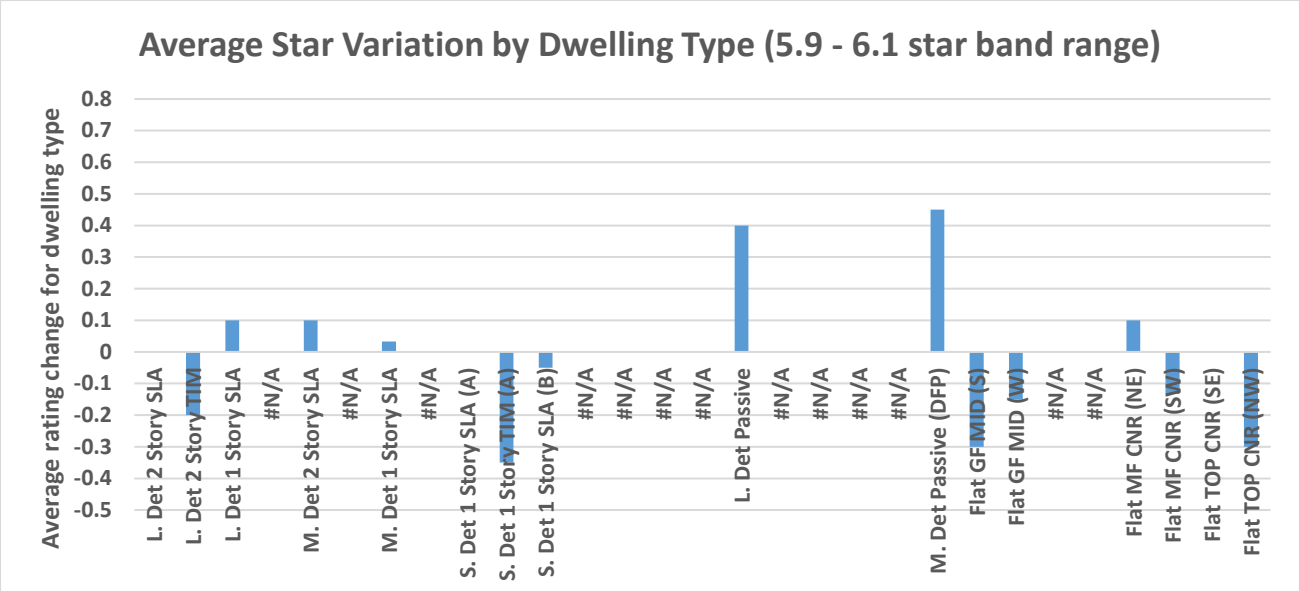



The updated weather data and adjusted bands result in significant increases to the rating of the two passive solar dwellings. This would appear to be due to the significant increase in winter solar radiation in the new weather data. Ratings of almost all dwellings have increased in order to limit the reduction in rating to two dwellings: the small detached house on a timber floor, and the middle apartment on the middle floor facing west.

Star bands which limit rating reductions to 0.2 stars result in an average increase in the rating at 6 stars of 0.18 stars. This is not excessive.

Figure 77 shows the changes to the rating of the dwellings simulated in Melbourne where the average change to the rating at 6 stars is 0.

**Figure 77 Change to rating of individual dwellings in Melbourne average rating change at 6 stars is 0**




The average change in rating for individual dwellings where the average change at 6 stars is fixed at 0 shows a similar trend to the rating reduction limited sample: Passive Solar Houses receive much higher ratings while Class 2 dwellings generally receive lower ratings. There is only a minimal change to volume builder detached designs with only one receiving a lower rating that exceeds 0.2 stars. While the reduction to energy heating demand in Melbourne is significant, the net change in rating with either approach is not large except for Passive Solar designs which significantly increase their rating. This is likely to be due to the higher solar radiation levels in winter in the updated weather file.

### 4.10.4 Comparison of current and adjusted star bands for Melbourne

The new weather data and star bands result in a decrease (39%) to the energy demand for heating and an increase in cooling (6%) at 6 stars.

Figure 78 shows the current and adjusted star band thresholds for Melbourne where the rating reduction is limited to 0.2 stars. The energy demand thresholds of the new star bands reflect the lower total energy demand which is caused by the new weather data.

**Figure 78 Comparison of current and adjusted star bands for Melbourne rating change limited to ->= -0.2**

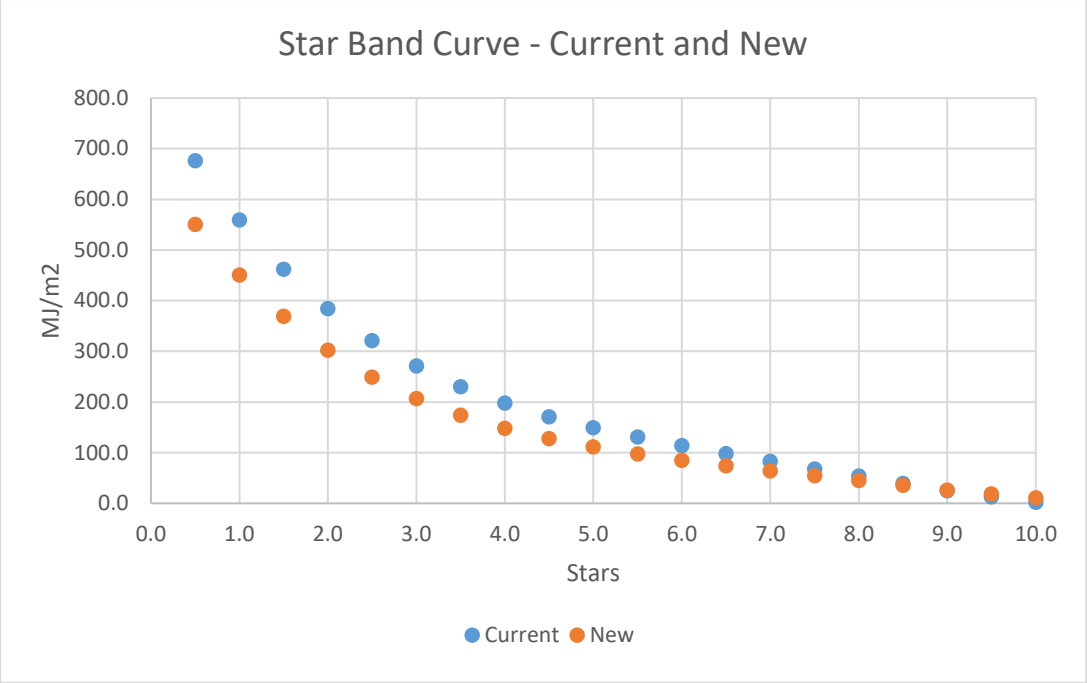
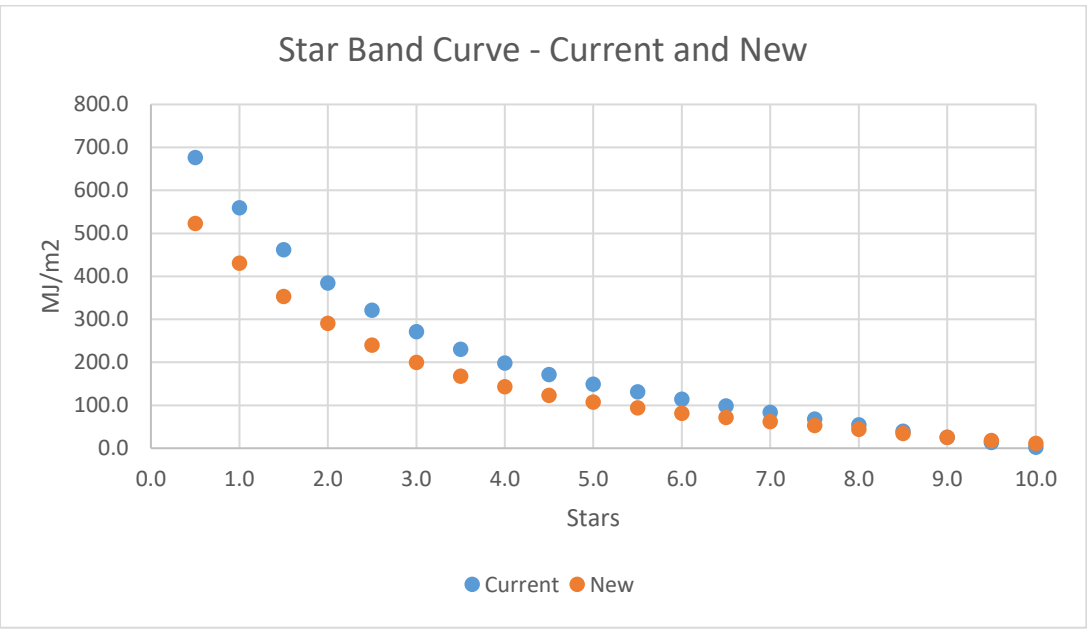
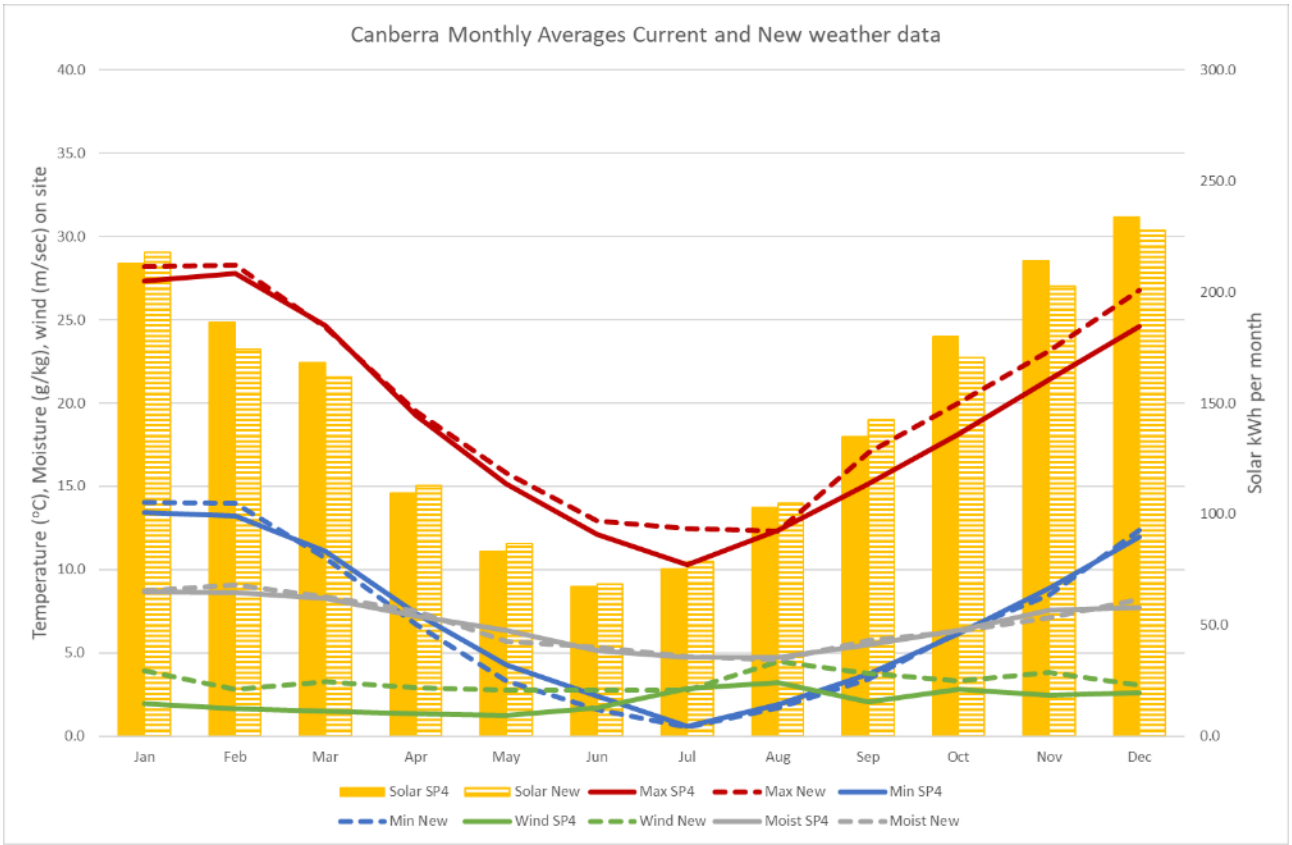



Figure 79 shows the current and adjusted star band thresholds for Melbourne where the average change to the rating at 6 stars is 0

**Figure 79 Comparison of current and adjusted star bands for Melbourne average rating change at 6 stars is 0**



## 4.11 Canberra

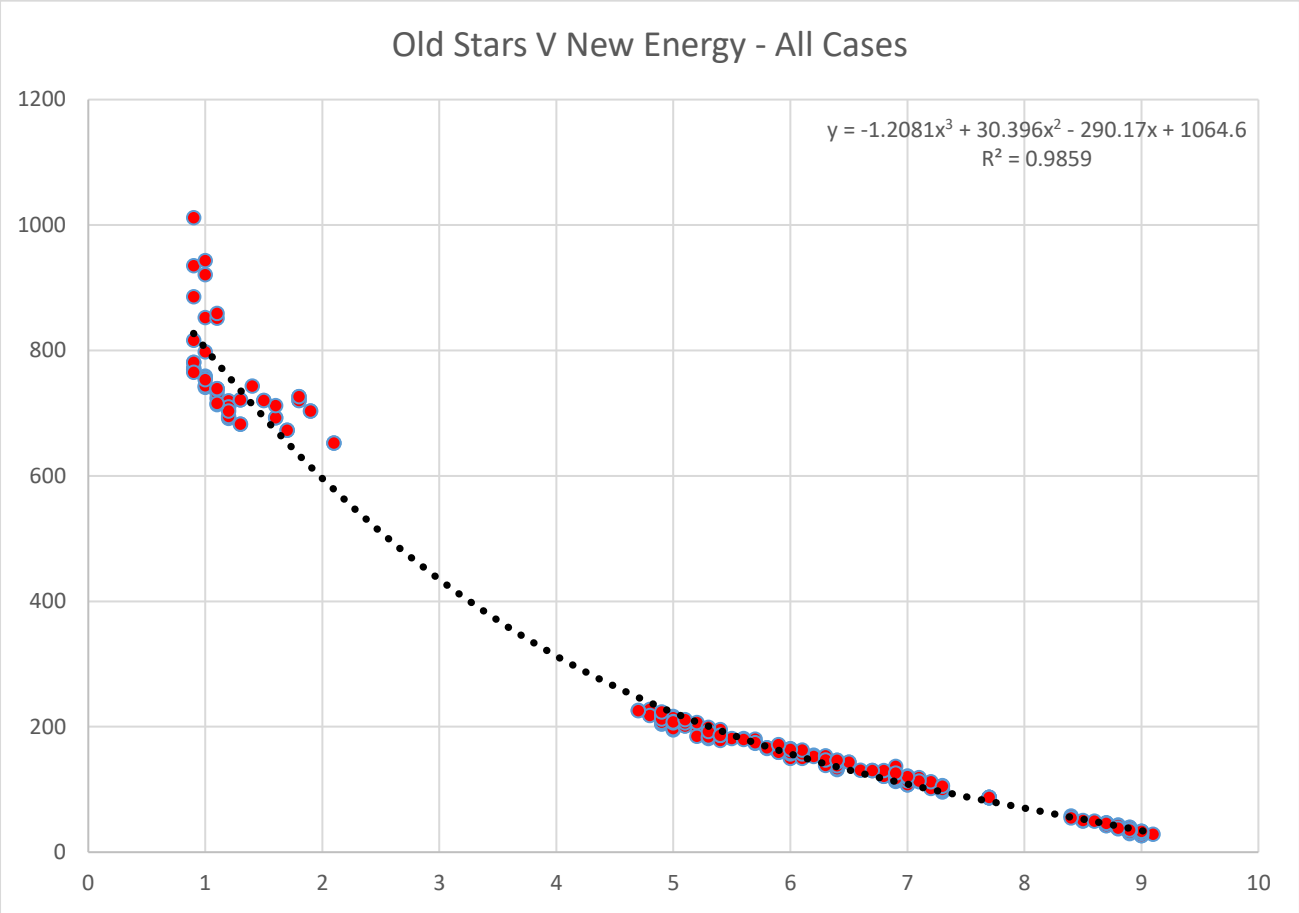



From October to March solar radiation levels have reduced significantly. This will lower cooling loads. Maximum temperatures from June to January have increased which will lower heating loads and increase cooling loads. Slightly higher wind speeds should also help to reduce cooling loads, particularly in Class 1 dwellings which have better cross ventilation than Class 2.

### 4.11.1 Initial Correlation

Figure 80 shows the initial correlation between current star rating and the energy demand predicted using the new weather data. The correlation is very strong ($R^2$ value of 0.986). This indicates that the extent of the variation to the star ratings should not be excessive. Note that the correlation is particularly strong at minimum regulatory levels and above.

**Figure 80 Correlation between existing energy rating and energy demand with new weather data in Canberra**



### 4.11.2 Star bands and rating impacts with limit to rating reduction

In addition to limiting reductions in rating to 0.2 stars, the higher energy demand at 10-stars has a flow on effect to lower star levels. Note that in the example below, the higher 10-star limit affects star band thresholds from **7 to 9 stars**.

Table 17 shows both the rating reduction limited and current star bands where the rating reduction is limited to 0.2 stars.

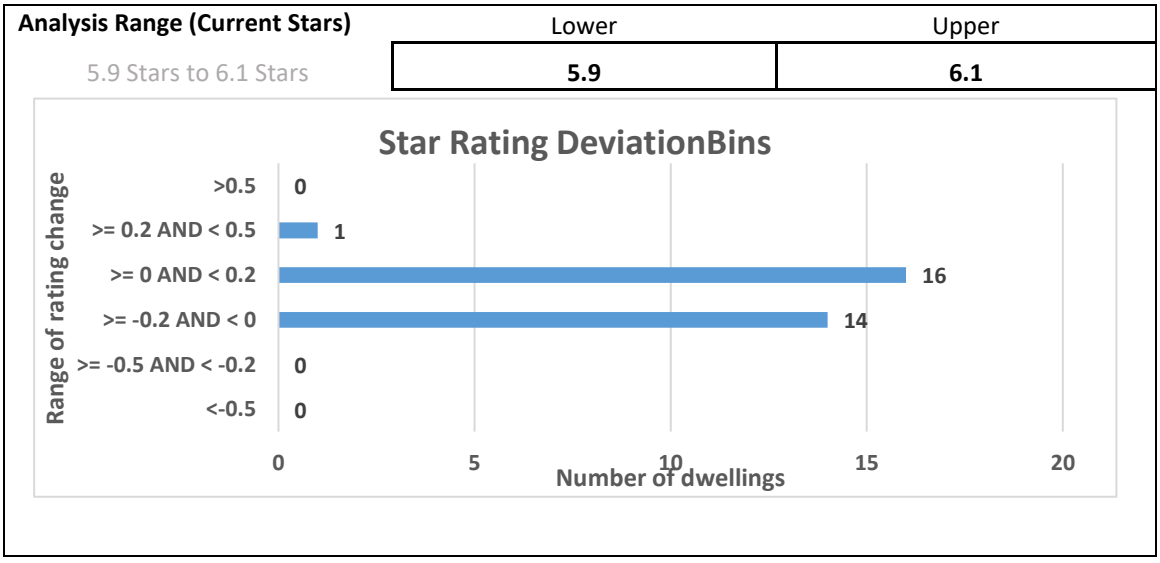
**Table 17 Current and Adjusted star bands for updated weather data in Canberra**

| Star | Current | Adjusted star bands no change <= -0.2 stars | Adjusted star bands with 0 average change at 6 stars |
|---|---|---|---|
| 1.0 | 792 | 820 | 822 |
| 2.0 | 547 | 608 | 600 |
| 3.0 | 387 | 444 | 432 |
| 4.0 | 284 | 319 | 310 |
| 5.0 | 216 | 227 | 223 |
| 6.0 | 165 | 160 | 161 |
| 7.0 | 120 | 121 | 122 |
| 8.0 | 77 | 83 | 84 |
| 9.0 | 35 | 47 | 47 |
| 10.0 | 2 | 18 | 18 |

The table above shows that star bands derived through each of the two methods are virtually identical.

Figure 81 shows the range of rating changes for dwellings with rating levels between 5.9 and 6.1 stars where the rating reduction is limited to 0.2 stars.

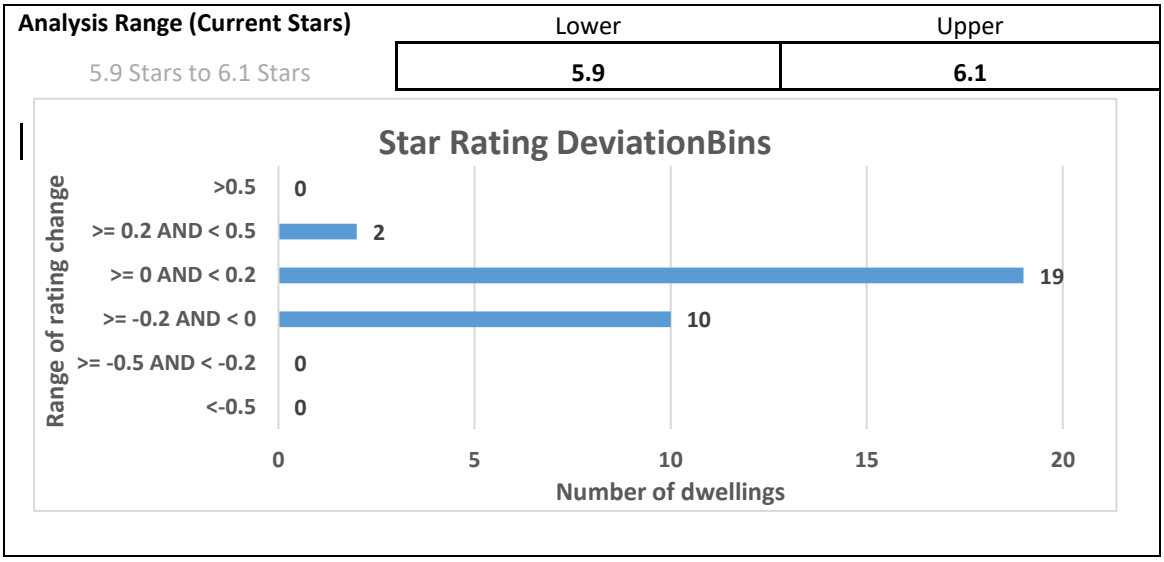
**Figure 81 Changes to ratings at 6 stars in Canberra where the rating reduction is limited to 0.2 stars**




The revised star bands have eliminated all cases where the reduction in rating exceeds 0.2 stars. As a result, the average rating of houses which currently obtain a rating of 6 stars slightly decreases by 0.05 stars.

Figure 82 shows the range of rating changes for dwellings with rating levels between 5.9 and 6.1 stars where the average change to the rating at 6 stars is 0.

**Figure 82 Changes to ratings at 6 stars in Canberra where where the average change to the rating at 6 stars is 0**

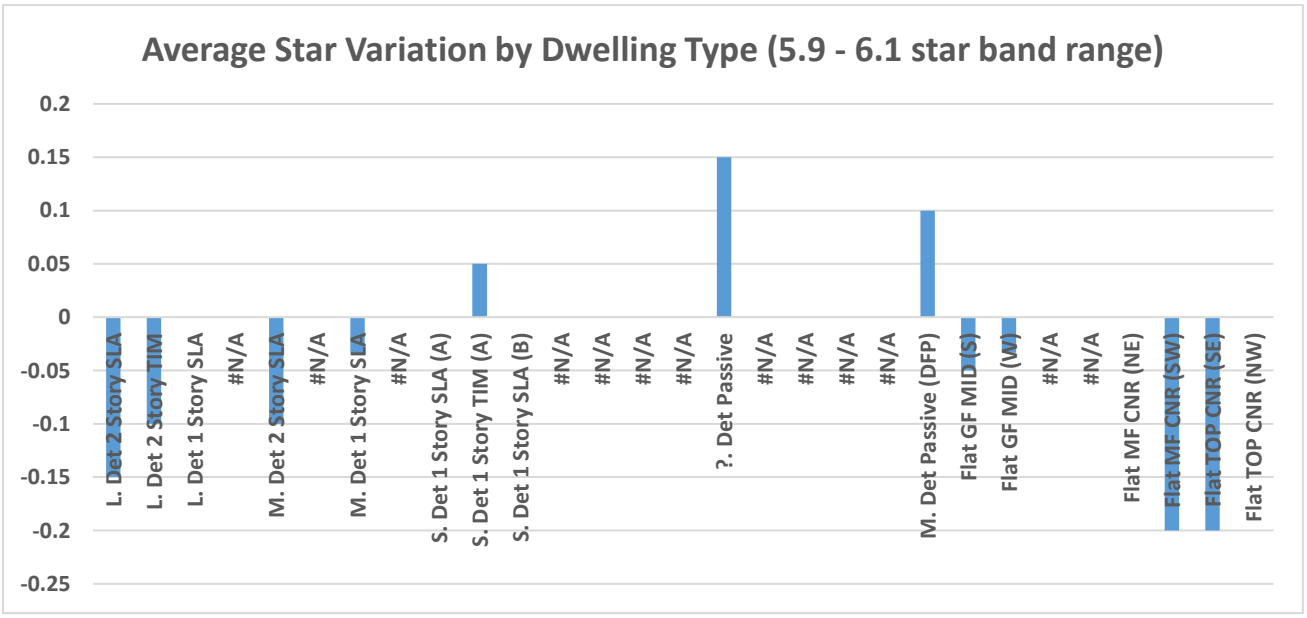



The figure above shows there is virtually no difference in the rating of dwellings with star bands derived through either the rating reduction limited or 0 change at 6-star methods. No further analysis of the differences between the two star band derivation methods will be shown below.

### 4.11.3 Change to rating for different types of dwellings

Figure 83 shows the changes to the rating of the dwellings simulated in Canberra.

**Figure 83 Change to rating of individual dwellings in Canberra**




The rating of virtually all dwellings is decreased with the new weather data except for passive solar designed houses. This change reflects the updated weather data which has higher solar radiation levels in cooler months and lower solar radiation levels in warmer months. Two storey houses and low solar gain corner apartments have the largest reduction in rating.

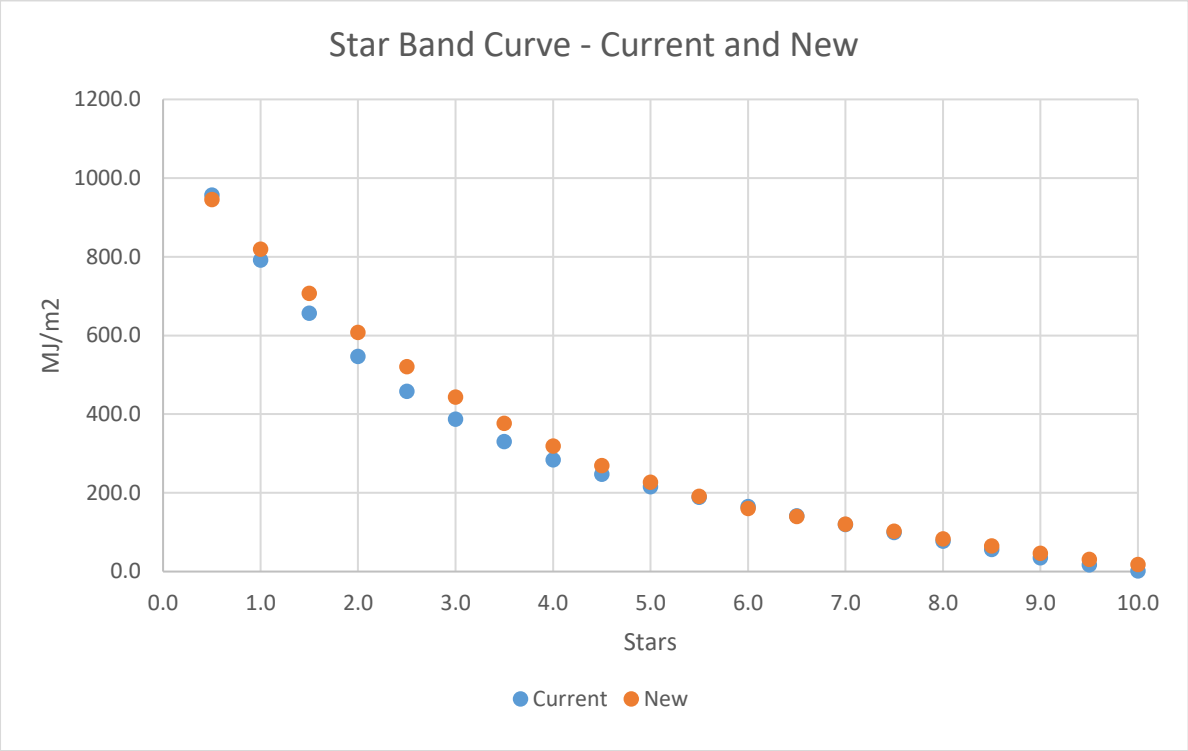
Star bands which limit rating reductions to 0.2 stars result in a small average decrease in the rating at 6 stars of 0.05 stars. This is not excessive.

### 4.11.4 Comparison of current and adjusted star bands for Canberra

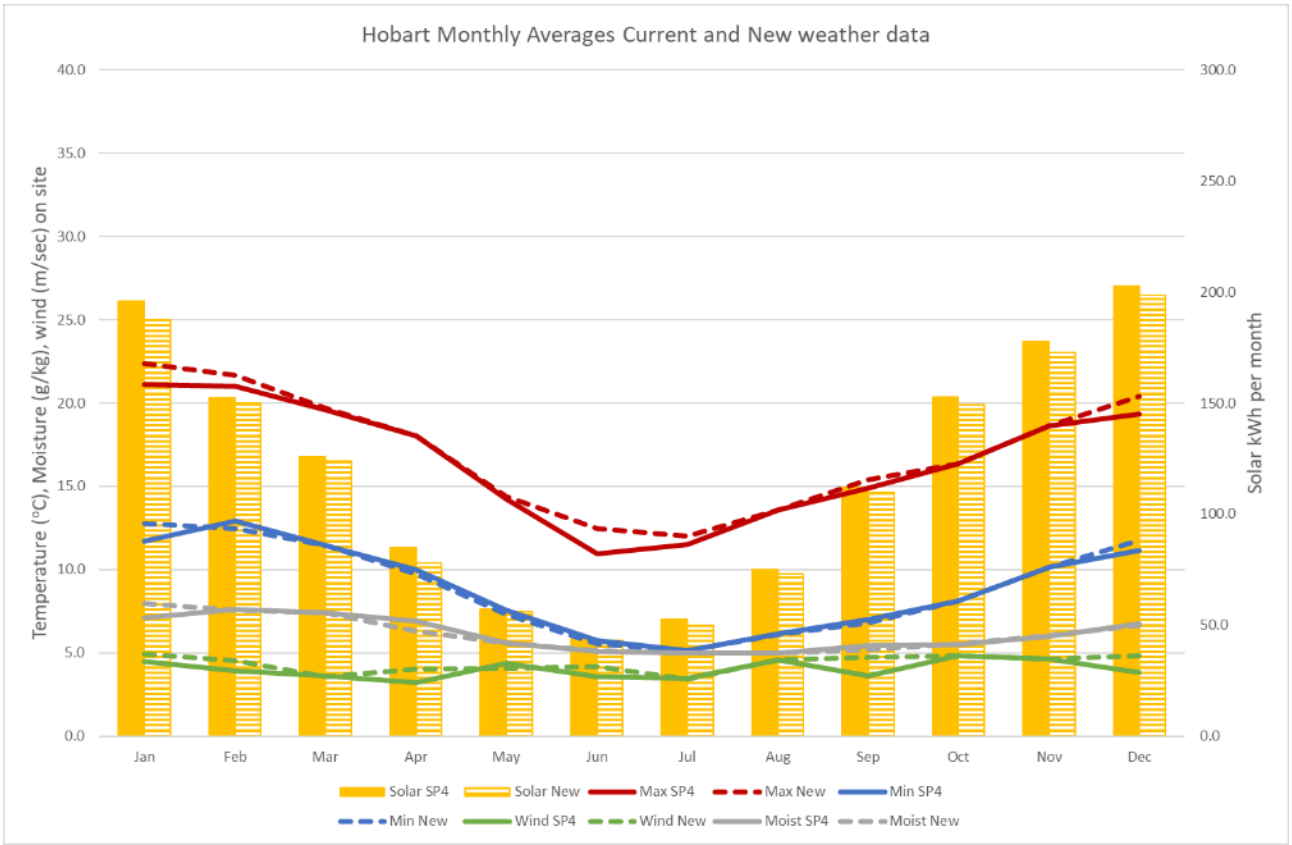
The new weather data and star bands results in a small change to the energy demand at 6 stars (heating decrease by 4%, cooling increase by 1%).

Figure 84 shows the current and adjusted star band thresholds for Canberra. The slightly higher energy demand thresholds of the updated star bands are a function of the poor correlation between current rating and updated energy demand as shown in Figure 80.

**Figure 84 Comparison of current and adjusted star bands for Canberra**



## 4.12 Hobart

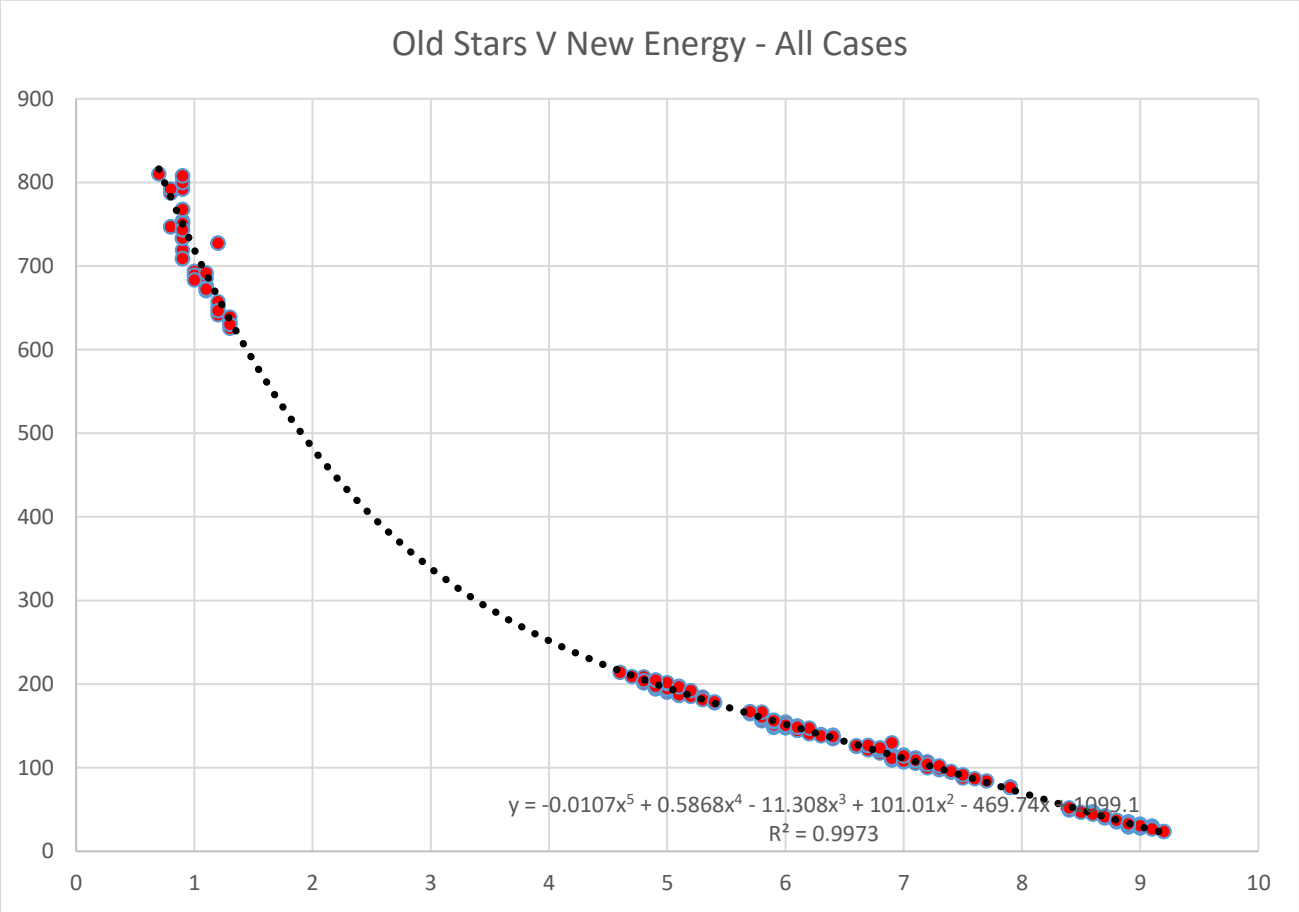



Slight increases to maximum from December to February will increase cooling energy demand in these months, however this may be balanced by the slight reduction to solar radiation. Maximum temperatures in the coldest months increase slightly and solar radiation levels are also lower. This will result in an increase to heating energy demand.

### 4.12.1 Initial Correlation

Figure 85 shows the initial correlation between current star rating and the energy demand predicted using the new weather data. The correlation is very strong ($R^2$ value of 0.997). This indicates that the extent of the variation to the star ratings should not be excessive.

**Figure 85 Correlation between existing energy rating and energy demand with new weather data in Hobart**



### 4.12.2 Star bands and rating impacts with limit to rating reduction

In addition to limiting reductions in rating to 0.2 stars, the higher energy demand at 10-stars has a flow on effect to lower star levels. Note that in the example below, the higher 10-star limit affects star band thresholds from **7 to 9 stars**.

Table 18 shows the adjusted star bands using the two alternative methods and the current star bands.

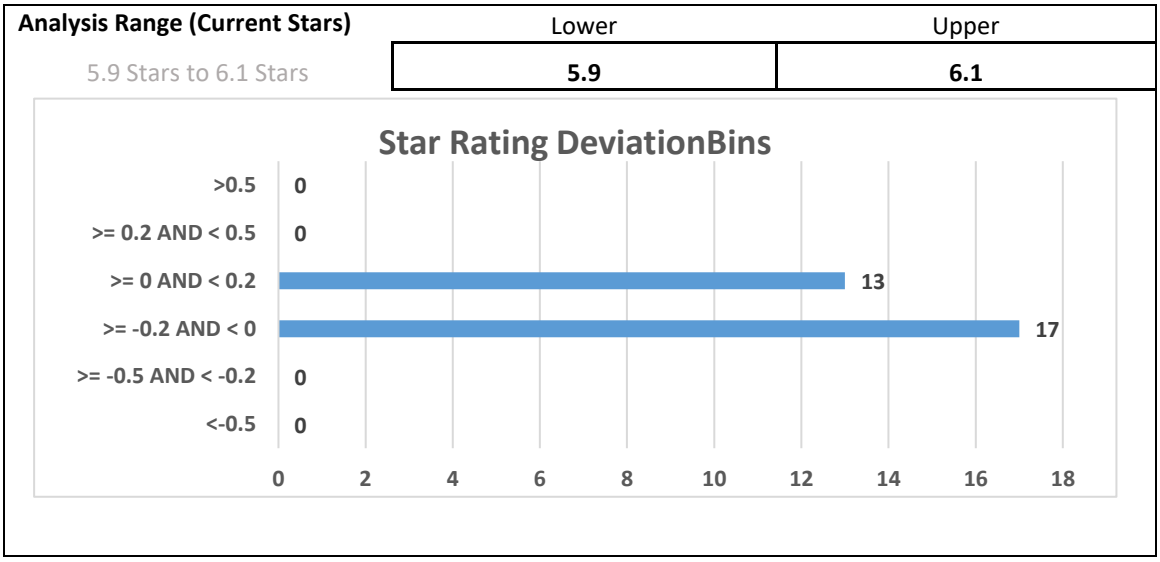
**Table 18 Current and adjusted star band thresholds for updated weather data in Hobart**

| Star | Current | Adjusted star bands no change <= -0.2 stars | Adjusted star bands with 0 average change at 6 stars |
|---|---|---|---|
| 1.0 | 723 | 720 | 720 |
| 2.0 | 498 | 482 | 482 |
| 3.0 | 354 | 339 | 339 |
| 4.0 | 262 | 252 | 252 |
| 5.0 | 202 | 196 | 196 |
| 6.0 | 155 | 152 | 152 |
| 7.0 | 113 | 117 | 117 |
| 8.0 | 71 | 81 | 81 |
| 9.0 | 31 | 47 | 47 |
| 10.0 | 0 | 21 | 21 |

The table above shows that star bands derived through each of the two methods are virtually identical.

Figure 86 shows the range of rating changes for dwellings with rating levels between 5.9 and 6.1 stars.

**Figure 86 Changes to ratings with rating reduction limit 6 stars in Hobart**

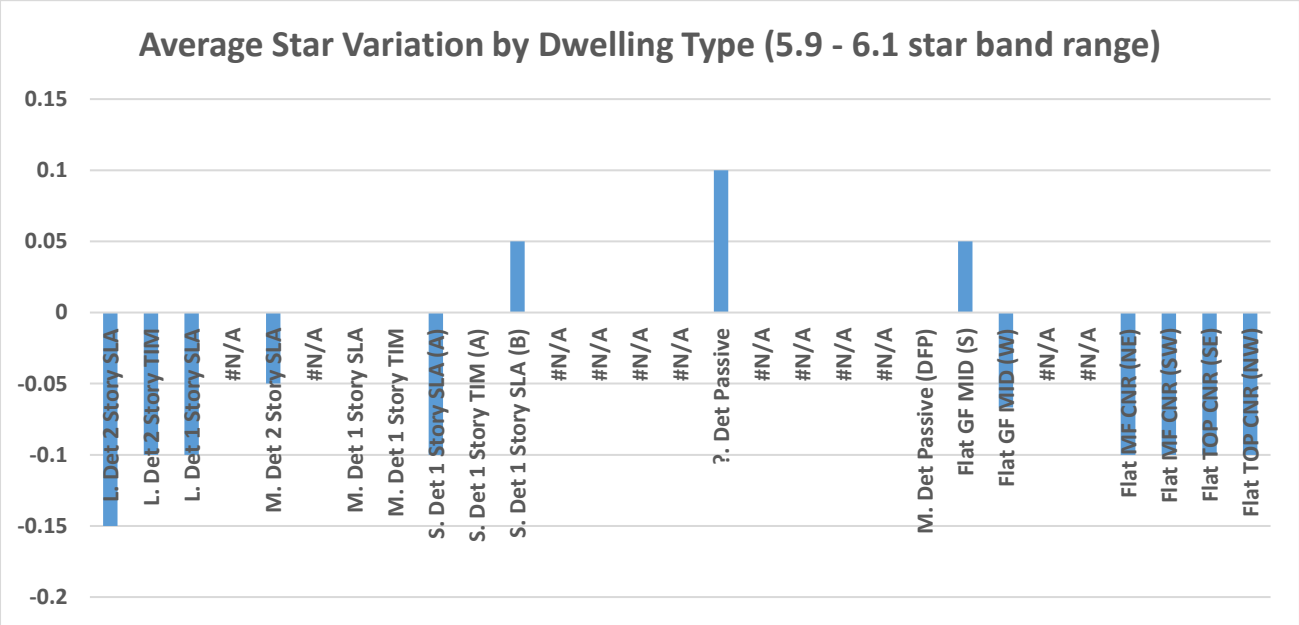



The revised star bands have adjusted star band levels above 6 stars to accommodate the new 10-star level. The average rating of houses which currently obtain a rating of 6 stars decreases by 0.05 stars. Because the rating reduction limited star bands produce virtually the same results as the 0 change at 6 star method, no further comparison between the two methods will be made.

### 4.12.3 Change to rating for different types of dwellings

Figure 87 shows the changes to the rating of the dwellings simulated in Hobart.

**Figure 87 Change to rating of individual dwellings in Hobart**




The extent of the change to rating is small. One of the Passive solar houses has the largest increase (0.1) while all corner apartments show a slight rating decrease (-0.1). The large two storey house has the biggest rating drop of 0.15 stars.

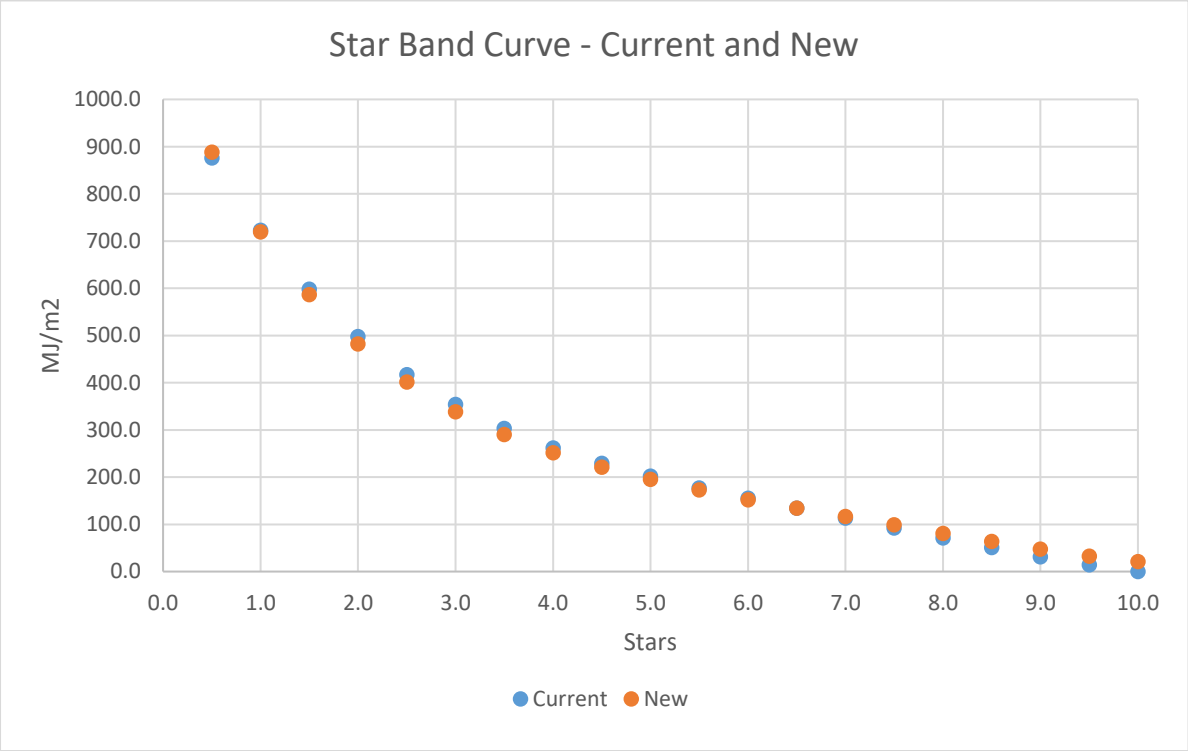
Star bands which limit rating reductions to 0.2 stars result in a small average decrease in the rating at 6 stars of 0.05 stars. This is not excessive.

### 4.12.4 Comparison of current and adjusted star bands for Hobart

The new weather data and star bands results in a slight increase in the energy demand for cooling (1%) and a slight drop in the energy demand for heating (4%) at 6 stars.

Figure 88 shows the current and adjusted star band thresholds for Hobart. The new star bands reflect the minimal impact on energy demand of the updated weather, but the new 10-star level slightly increases rating thresholds from 7 to 10-stars.

**Figure 88 Comparison of current and adjusted star bands for Hobart**



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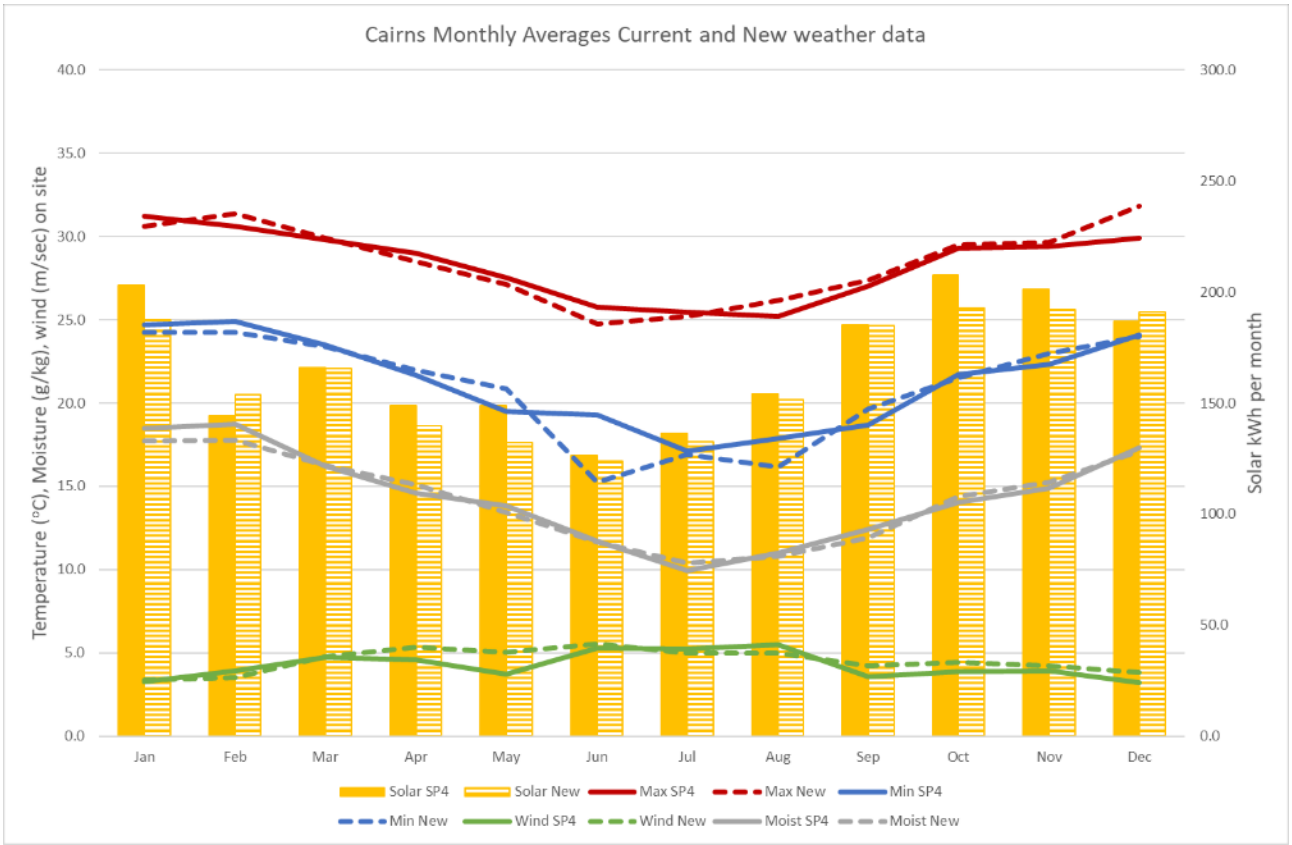
## 4.13 Cairns

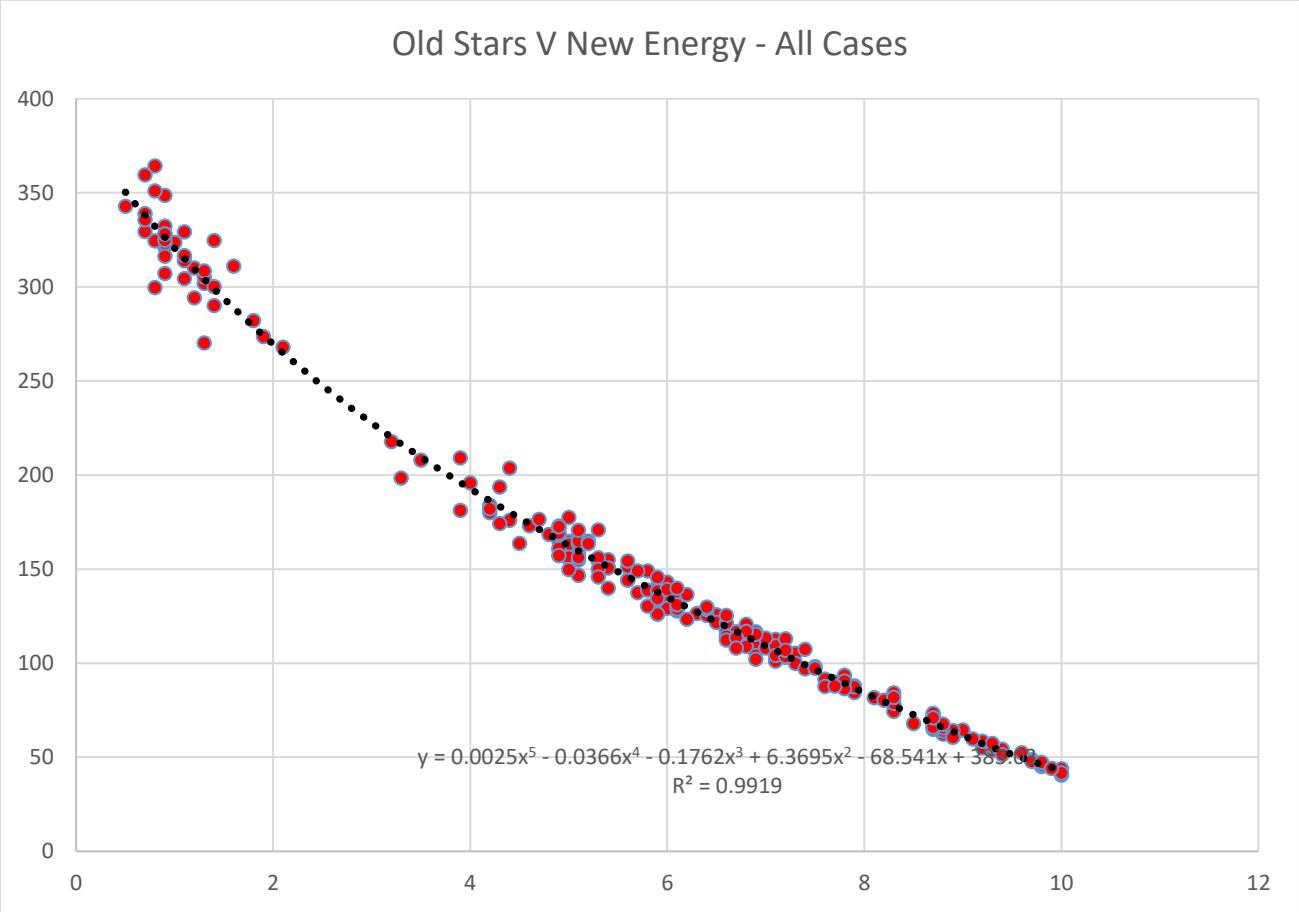



Radiation levels are significantly lower for most months, particularly the some of the hottest months like October November and January. This may lower the predicted cooling loads in Cairns. Increases in solar radiation in December and February may balance out the reduction in other months. Otherwise, while factors like average maximum and minimum temperature vary above and below the current the averages for the year are quite similar.

### 4.13.1 Initial Correlation

Figure 89 shows the initial correlation between current star rating and the energy demand predicted using the new weather data. The correlation is very strong ($R^2$ value of 0.992). This indicates that the extent of the variation to the star ratings should not be excessive.

**Figure 89 Correlation between existing energy rating and energy demand with new weather data in Cairns**



### 4.13.2 Star bands and rating impacts with limit to rating reduction

While the NCC requires a minimum rating of 6 stars, in Queensland the Queensland Development Code (and NCC) allows a minimum of 5 stars if an outdoor living area is provided which has an insulated ceiling and a ceiling fan. The analysis below therefore reports on the impacts on ratings at both 5 and 6 stars.

In addition to limiting reductions in rating to 0.2 stars, the higher energy demand at 10-stars has a flow on effect to lower star levels. Note that the higher 10-star limit affects star band thresholds from **7 to 9 stars**.

Table 19 shows the adjusted star bands using the two alternative methods and the current star bands.

**Table 19 Current and adjusted star band thresholds for updated weather data in Cairns**

| Star | Current | Adjusted star bands no change <= -0.2 stars | Adjusted star bands with 0 average change at 6 stars |
|---|---|---|---|
| 1.0 | 302 | 343 | 324 |
| 2.0 | 253 | 288 | 275 |
| 3.0 | 214 | 244 | 233 |
| 4.0 | 181 | 206 | 196 |
| 5.0 | 153 | 174 | 164 |
| 6.0 | 128 | 145 | 136 |
| 7.0 | 105 | 119 | 113 |
| 8.0 | 84 | 96 | 92 |
| 9.0 | 64 | 74 | 72 |
| 10.0 | 48 | 56 | 56 |

The table above shows some significant differences in star bands developed using the two methods.

The figures below show the impact of the adjusted star bands on the rating of dwellings at 5 and 6 stars where the rating reduction is limited to 0.2 stars.

**Figure 90 Changes to ratings at 5 stars in Cairns rating change limited to ->= -0.2**

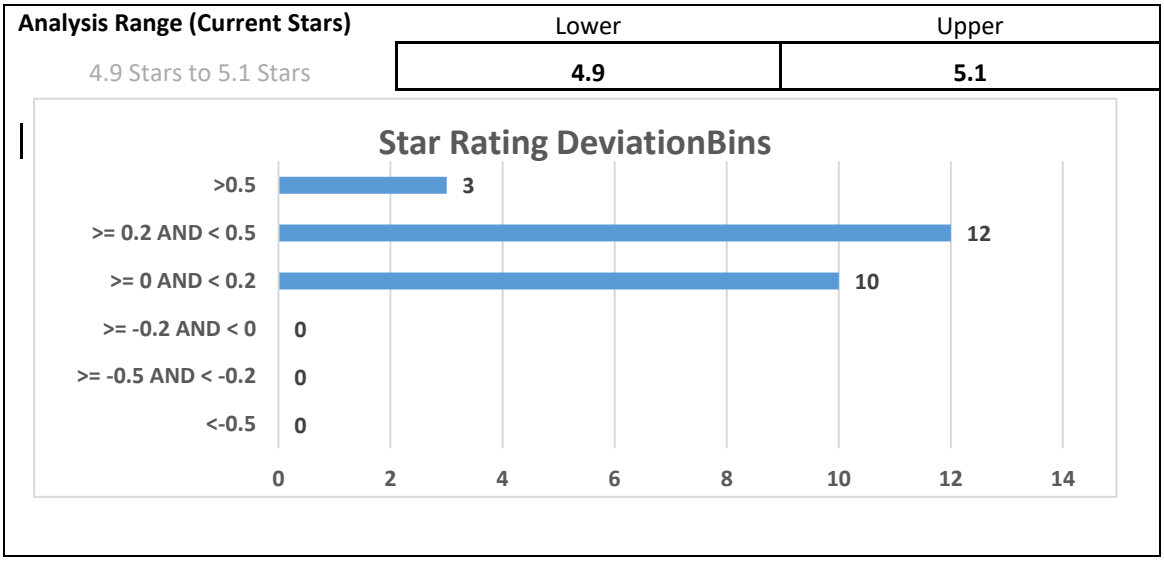
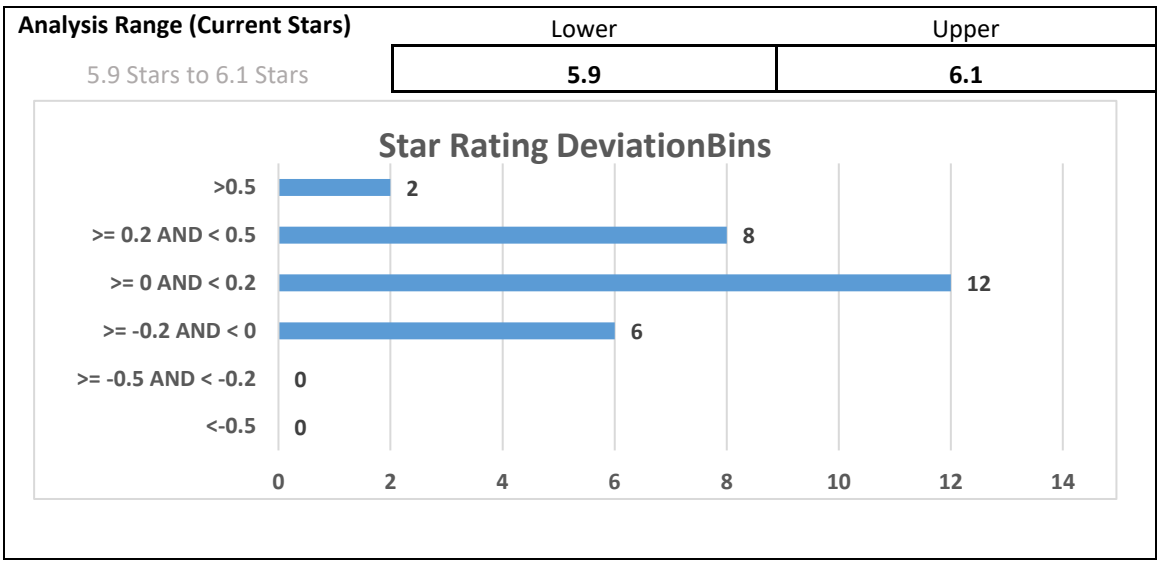



**Figure 91 Changes to ratings at 6 stars in Cairns rating change limited to ->= -0.2**




The revised star bands have eliminated all cases where the reduction in rating exceeds at both 5 and 6 stars 0.2 stars. As a result, the average rating of houses which currently obtain a rating of 6 stars increases by 0.31 stars and by 0.27 stars at 5 stars.

The figures below show the impact of the adjusted star bands on the rating of dwellings at 5 and 6 stars where the average change to the rating at 6 stars is 0.

**Figure 92 Changes to ratings at 5 stars in Cairns average rating change at 6 stars is 0**

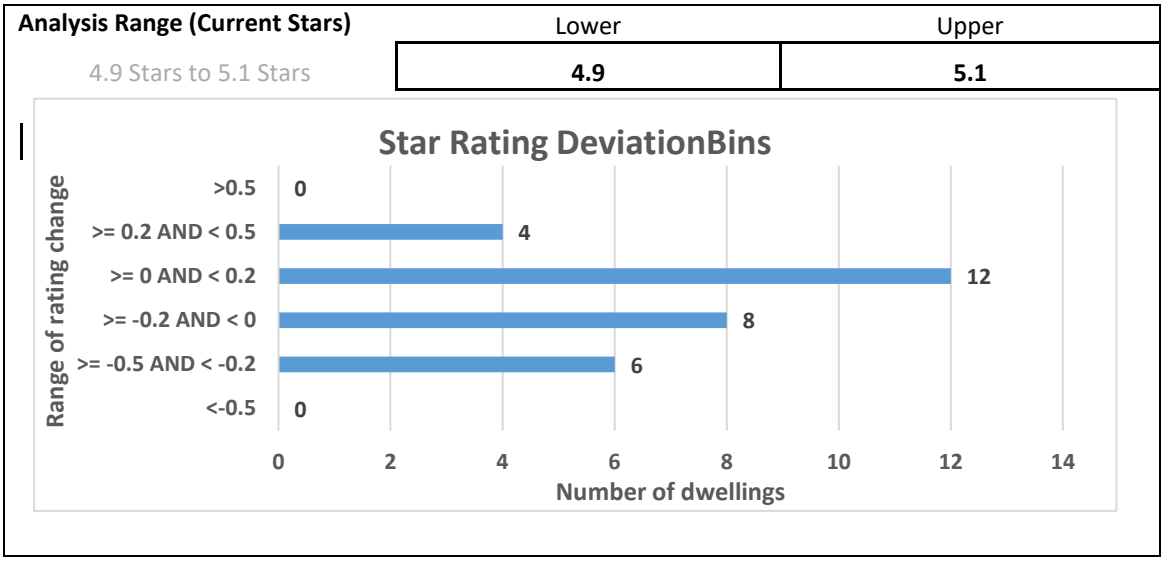
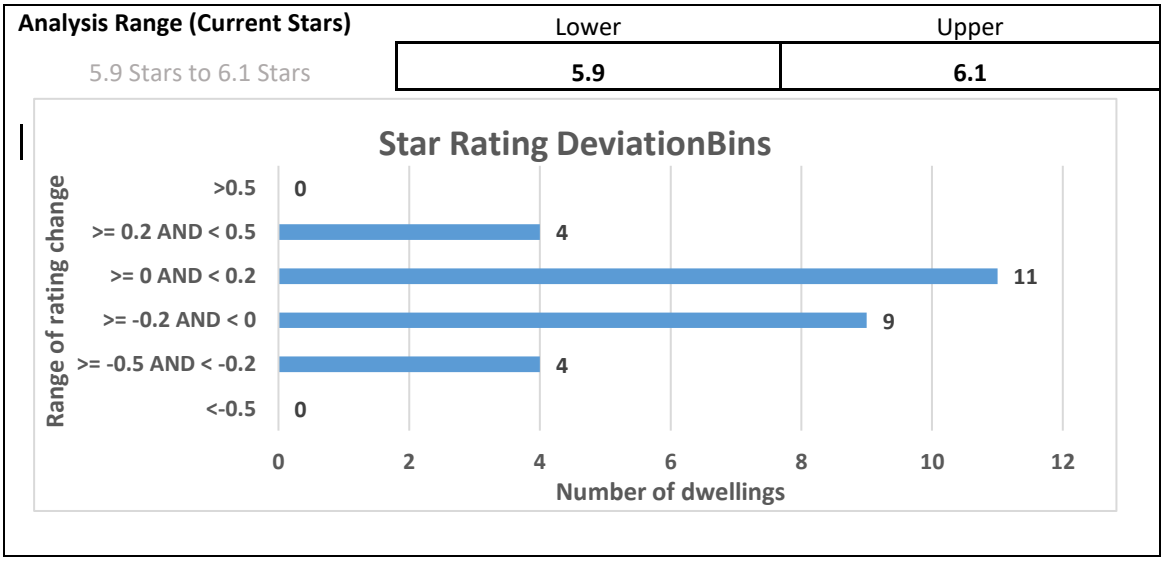



**Figure 93 Changes to ratings at 6 stars in Cairns average rating change at 6 stars is 0**

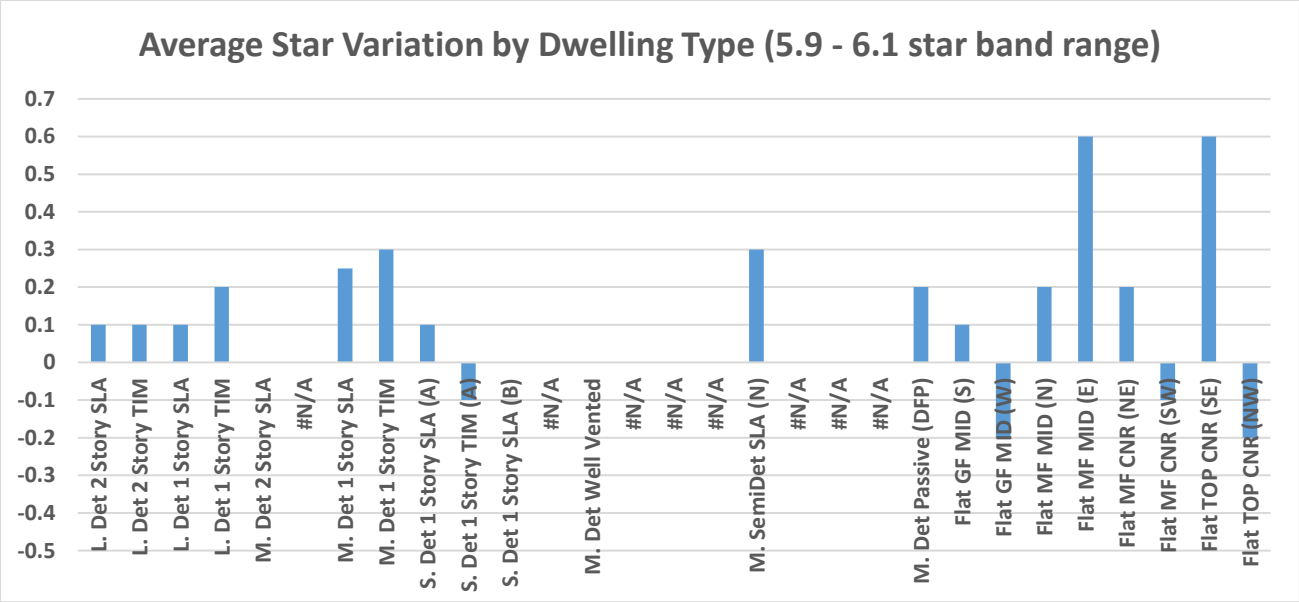



The figures above show a small but significant proportion of dwellings will have a reduction in rating of over 0.2 stars when star bands are developed to produce a 0 average rating change at 6 stars.

### 4.13.3 Change to rating for different types of dwellings

Figure 94 shows the changes to the rating of the dwellings simulated in Cairns at 6 stars where the rating reduction is limited to 0.2.

**Figure 94 Change to rating of individual dwellings in Cairns at 6 stars rating change limited to ->= -0.2**

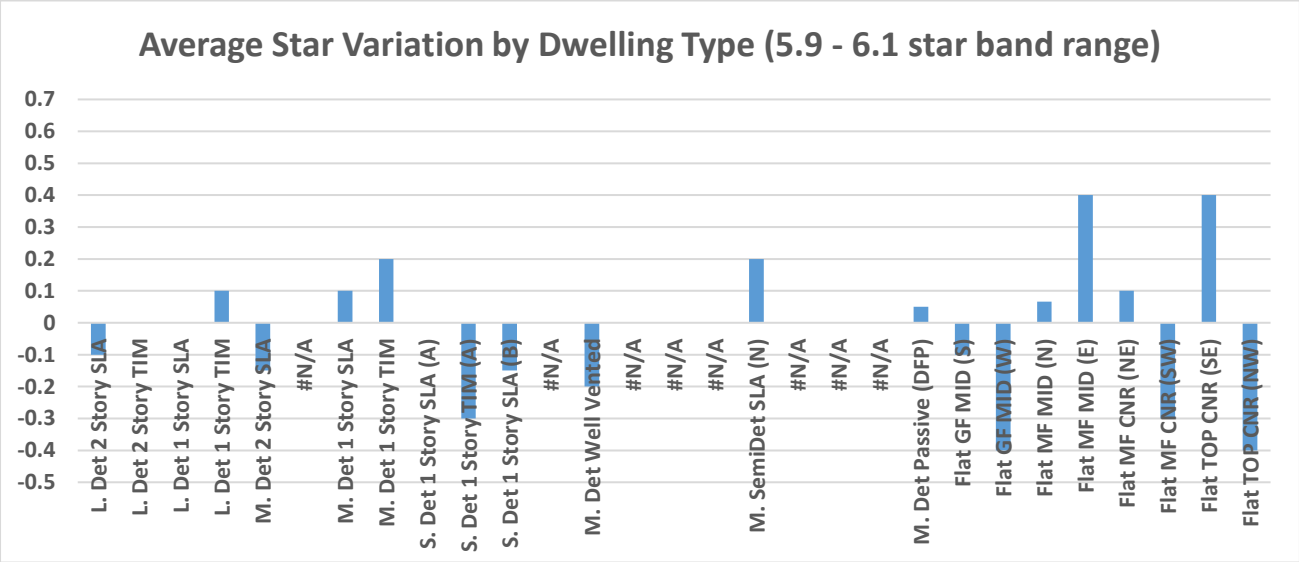



The rating of virtually all dwellings is increased in order to limit the change in rating to western facing apartments to a reduction of 0.2 stars. If it is considered acceptable to allow this one unit to reduce its rating in excess of 0.2 stars, then the reduction in stringency could be reduced.

Star bands which limit rating reductions to 0.2 stars result in a small average increase in the rating at 5 stars of 0.27 stars and 0.31 stars at 6 stars. This is not excessive.

Figure 95 shows the changes to the rating of the dwellings simulated in Cairns at 6 stars where the average change to the rating at 6 stars is 0.

**Figure 95 Change to rating of individual dwellings in Cairns at 6 stars average rating change at 6 stars is 0**



The figures above show that apartments with west facing windows will receive significantly worse ratings with the new weather data. Note that at both 5 and 6 stars in the current software these units were able to have significantly larger window areas than shown on the plans (see Section 7.13 for plans). With some reduction to the window area their original rating would be restored. This would imply that glazing on the west would need be treated differently in apartment buildings. This makes sense from a climatic design point of view, but may be unpopular with developers who prefer uniform facades.

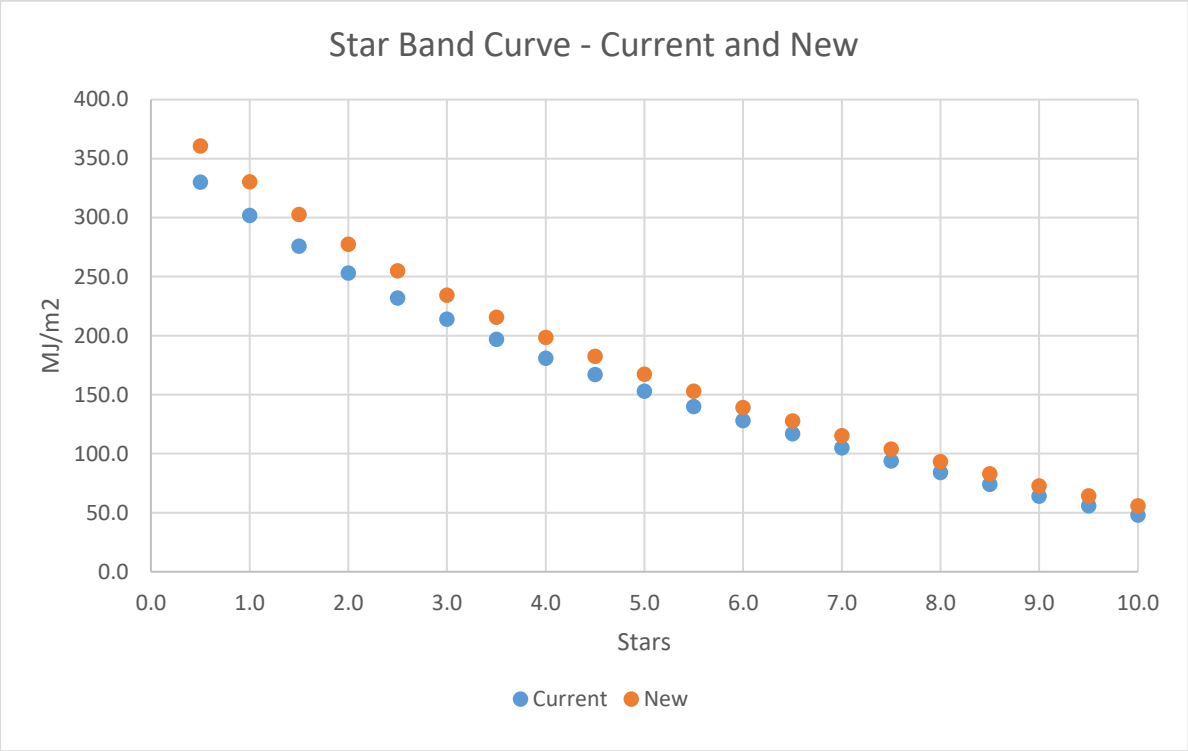
The 'Well ventilated detached house' also shows a slight reduction in rating. This is not because the new weather data suggests that this type of plan is less suited to the climate. Again, this is a dwelling with large windows and a modest reduction in window area would also allow its rating to be restored.

### 4.13.4 Comparison of current and adjusted star bands for Cairns

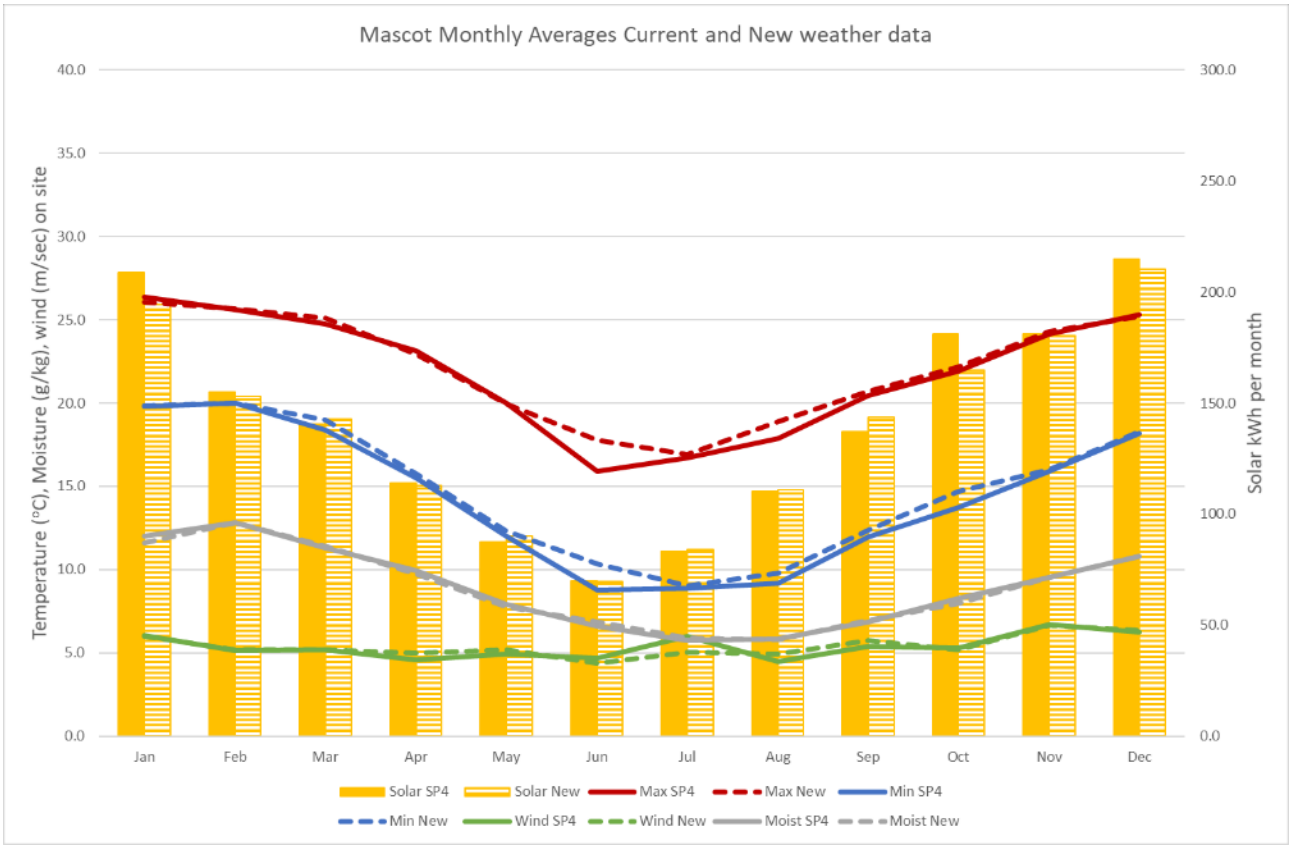
The new weather data and star bands results in a moderate increase (6%) to the energy demand for cooling at 6 stars.

Figure 96 shows the current and adjusted star band thresholds for Cairns. The energy demand thresholds of the new star bands reflect the slightly higher cooling loads which are caused by the new weather data.

**Figure 96 Comparison of current and adjusted star bands for Cairns**



## 4.14 Mascot

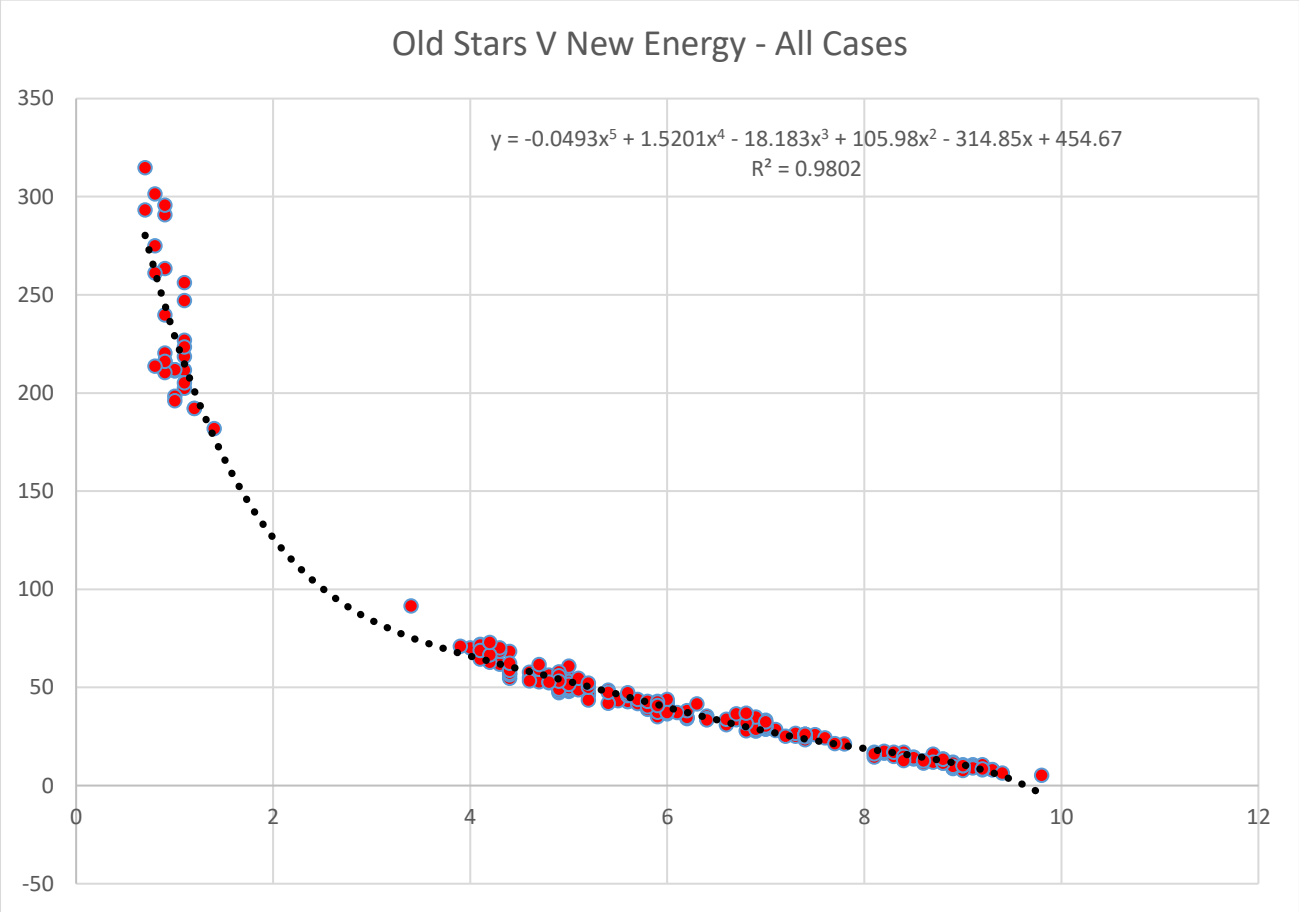



The difference between the climate data sets is small. Slightly lower solar radiation from October to February may lead to slightly lower cooling energy demand. Slightly higher Maximum and Minimum temperatures from May to August may lead to reduced heating energy demand.

### 4.14.1 Star bands and rating impacts with limit to rating reduction

Figure 97 shows the initial correlation between current star rating and the energy demand predicted using the new weather data. The correlation is strong ($R^2$ value of 0.980). This indicates that the extent of the variation to the star ratings should not be excessive. Note that R squared values over 0.99 are more difficult to achieve in climates where energy demands are lower as is the case in Mascot. Correlation is weaker at 2 stars and below, however, at regulatory levels above 5 stars the correlation is much better. This indicates that the change in ratings at regulatory levels should not be excessive.

**Figure 97 Correlation between existing energy rating and energy demand with updated weather data in Mascot**



### 4.14.2 Star bands and rating impacts with limit to rating reduction

In addition to limiting reductions in rating to 0.2 stars, the higher energy demand at 10-stars has a flow on effect to lower star levels. Note that in the example below, the higher 10-star limit affects star band thresholds from **7 to 9 stars**.

Table 20 shows the adjusted star bands using the two alternative methods and the current star bands.

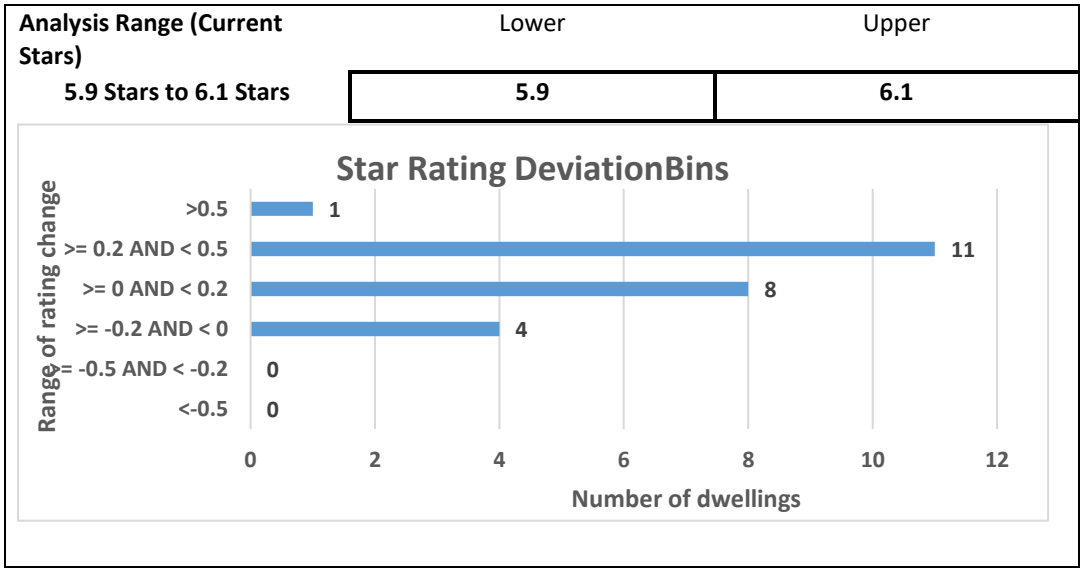
**Table 20 Current and Adjusted star bands for updated weather data in Mascot**

| Star | Current | Adjusted star bands no change <= -0.2 stars | Adjusted star bands with 0 average change at 6 stars |
|---|---|---|---|
| **1.0** | 284 | 229 | 218 |
| **2.0** | 186 | 126 | 120 |
| **3.0** | 125 | 84 | 80 |
| **4.0** | 88 | 66 | 63 |
| **5.0** | 66 | 53 | 51 |
| **6.0** | 51 | 40 | 38 |
| **7.0** | 39 | 31 | 30 |
| **8.0** | 26 | 22 | 21 |
| **9.0** | 14 | 13 | 12 |
| **10.0** | 5 | 6 | 6 |

The table above shows only minimal differences between the star bands derived using the two alternative methods. Mascot is a mild climate, so a small MJ change to the star bands will produce a higher star rating change than in other climates.

Figure 98 shows the range of rating changes for dwellings with rating levels between 5.9 and 6.1 stars where the rating reduction is limited to 0.2 stars.

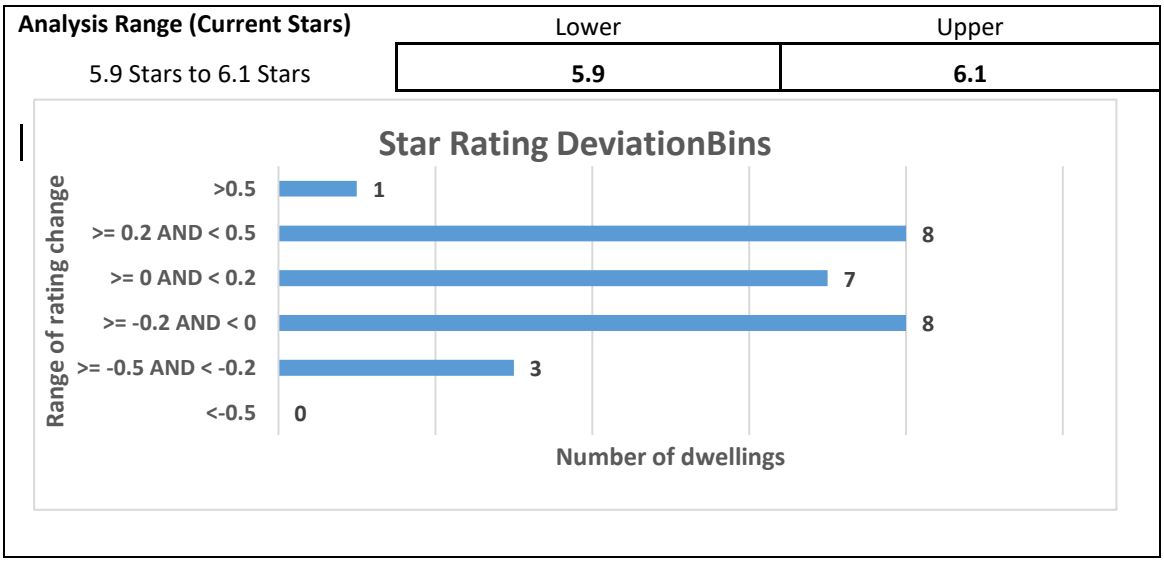
**Figure 98 Changes to ratings in Mascot rating change limited to ->= -0.2**




The revised star bands have adjusted star band levels above 6 stars to accommodate the new 10-star level. The average rating of houses which currently obtain a rating of 6 stars decreases by 0.23 stars.

Figure 99 shows the range of rating changes for dwellings with rating levels between 5.9 and 6.1 stars where the average change to the rating at 6 stars is 0.

**Figure 99 Changes to ratings in Mascot average rating change at 6 stars is 0**

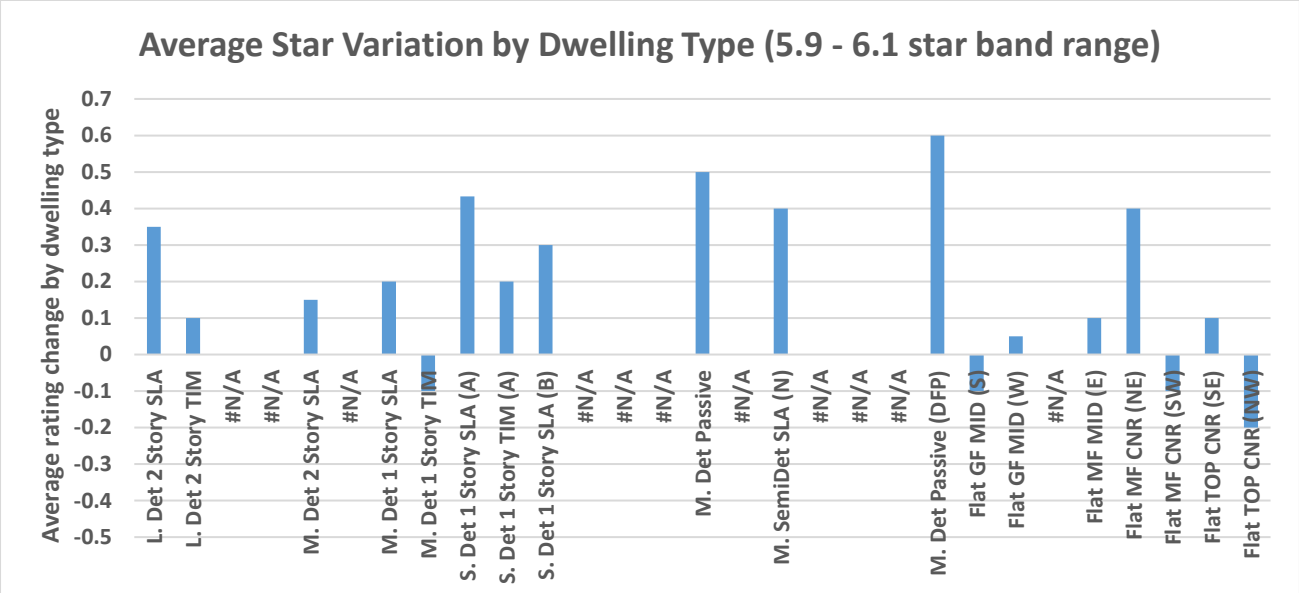



The figure above shows that a small number of dwellings will have a reduction in rating by more than 0.2 stars with the updated weather data and star bands derived to achieve a 0 average change at 6 stars.

### 4.14.3 Change to rating for different types of dwellings

Figure 100 shows the changes to the rating of the dwellings simulated in Mascot where the rating reduction is limited to 0.2 stars.

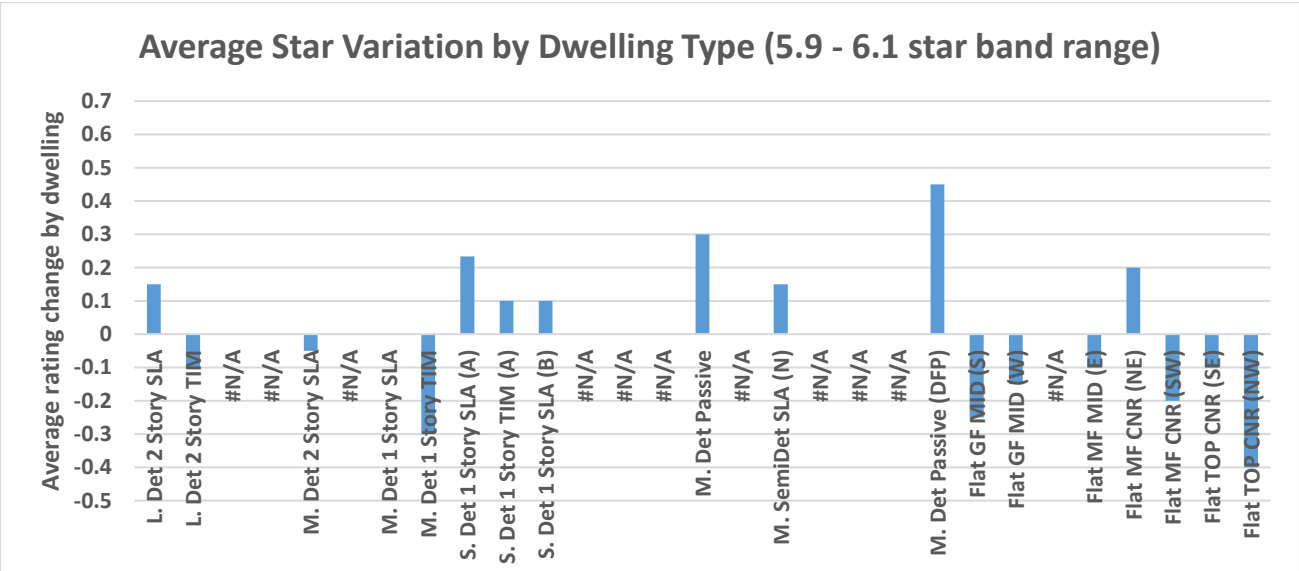
**Figure 100 Change to rating of individual dwellings in Mascot at 6 stars rating change limited to ->= -0.2**




Passive Solar houses show the largest increase to their rating. Note that the extent of the rating increase is exaggerated by the fact that the energy demands in Mascot are low and this increase represents only around 5 MJ/m$^2$. The updated weather data will encourage the adoption of more climatically appropriate design in this climate. Ratings increase across almost all Class 1 dwellings. Rating increases are not as high in Class 2, but the extent of difference between star bands calculated only on the basis of Class 2 dwellings and Class 1 dwellings is not great and would not justify the development of separate star bands for Class 2.

Figure 101 shows the changes to the rating of the dwellings simulated in Mascot where the average change to the rating at 6 stars is 0.

**Figure 101 Change to rating of individual dwellings in Mascot at 6 stars average rating change at 6 stars is 0**



The figures above show that the ratings of apartments which currently receive 6 stars will be lower than that of detached houses which currently achieve 6 stars with the new weather data regardless of the method used to derive the star bands. This is particularly true for apartments with west facing glass. This is in part due to the higher cooling energy demand predicted with the updated weather data. This doesn't necessarily mean that achieving minimum compliance with apartments will become more expensive than for houses. It will depend on the design response.

The rating of only one Class 1 dwelling reduces by more than 0.2 stars. This dwelling has a timber floor and this finding may indicate a more general trend to lower ratings for detached houses on timber floors.

### 4.14.4 Comparison of current and adjusted star bands for Mascot

The new weather data and star bands results in a decrease (22%) to the energy demand for heating and an increase in the energy demand for cooling (30%) at 6 stars. Note that while the percentage increases are large, this is because the energy demands themselves are low. The change will see a greater focus on reducing cooling to achieve compliance in this climate.

Figure 102 shows the current and adjusted star band thresholds for Mascot where the rating reduction is limited to 0.2 stars. The energy demand thresholds of the new star bands reflect the slightly higher cooling loads which are caused by the new weather data. The higher star band thresholds at 4 stars and below are in part due to the higher total energy demand and the lower level of correlation between current star rating and new energy demands at 2 stars and below.

**Figure 102 Comparison of current and adjusted star bands for Mascot rating change limited to ->= -0.2**

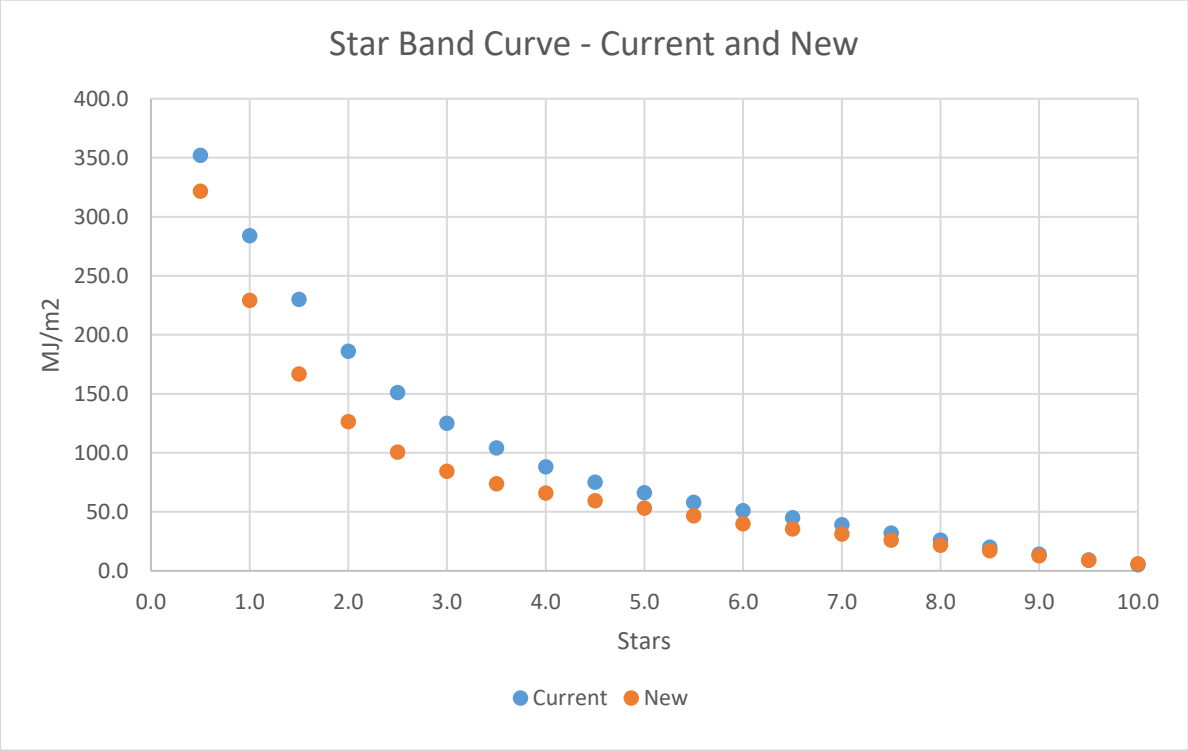
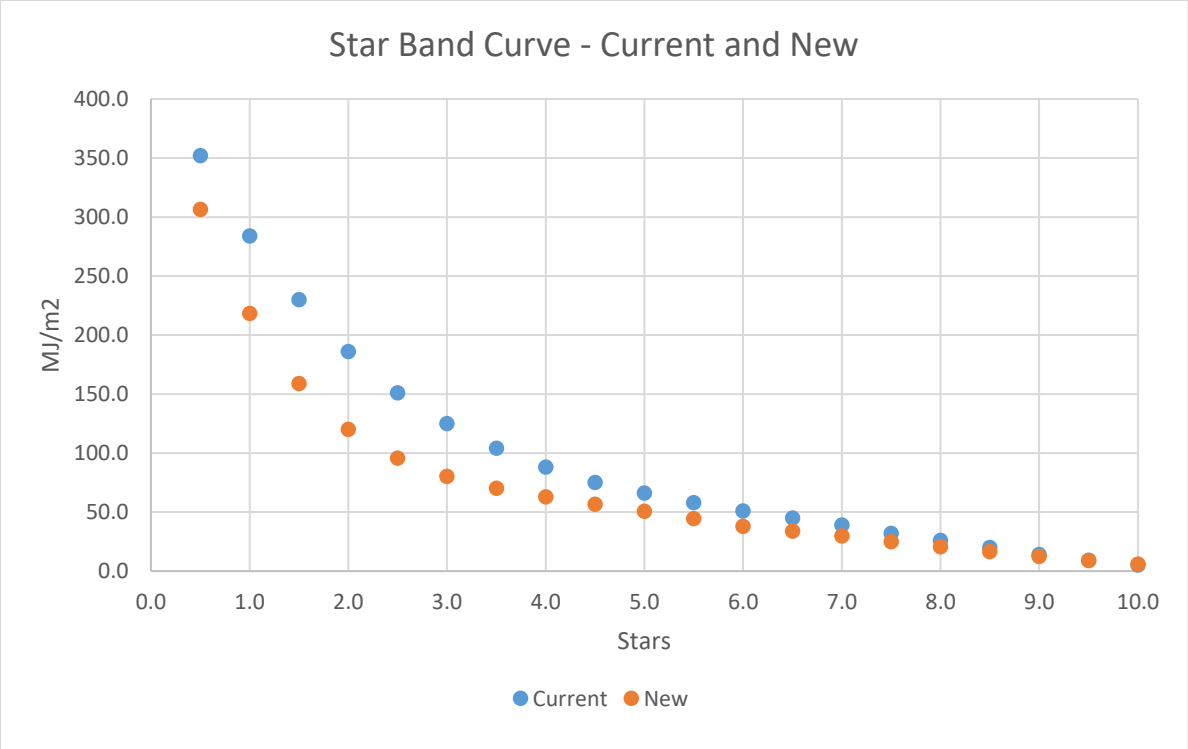


Figure 103 shows the current and adjusted star band thresholds for Mascot where the average change to the rating at 6 stars is 0.

**Figure 103 Comparison of current and adjusted star bands for Mascot average rating change at 6 stars is 0**



# 5 Development of the 10-star level

Since the introduction of second generation NatHERS tools the conceptualisation of the 10-star level has been simple: it should represent essentially no need for heating or cooling. The one exception to this was in more humid climates. In this case internal conditions can be uncomfortable simply due to the moisture content of the air. In such cases, cooling to dehumidify is unavoidable so the 10-star level was set to represent the amount of energy needed to dehumidify alone.

In the early days of second-generation tools, no attempts were made to design dwellings which achieved 10-stars, however, in recent years Design Matters (formerly BDAV) have run a 10-star challenge. This showed that 10-stars was virtually unachievable in many climate zones. To achieve 10-stars designers in this competition either selected climate zone where 10-stars was achievable, or, 'tweaked' NatHERS zoning guidelines by turning off heating and cooling in circulation spaces.

To provide some context to the criteria for 10-stars it is illustrative to compare this to other high-performance residential building standards. Passive House is an internationally accepted benchmark for high energy efficiency. On its website Passive House Australia explains that:

> "Passive House is a holistic construction certification standard, allowing Certified Passive House professionals flexibility to determine the most suitable building geometry based on usage and location. Passive buildings are thus comprised of a set of design principles used to attain a quantifiable and rigorous level of energy efficiency within a specific quantifiable comfort level under a "fabric first" design philosophy. [To that end,] a Passive House building is designed and built in accordance with five building-science principles:

h) Air-tightness (a completely sealed building envelope)

i) Thermal Insulation (high R values)

j) Mechanical Ventilation Heat recovery (all fresh air is introduced through a heat recovery system which, in cool conditions heats incoming air with exhaust air and vice versa in hot conditions),

k) High Performance Windows (low-emissivity double or triple glazing with thermally broken or non-metal frames. The size of the windows should be appropriate to each orientation, to allow solar radiation to penetrate during the winter months (free heating!) but not result in too much solar radiation during the summer), and

l) Thermal Bridge free construction (Otherwise your wonderfully insulated building will have a number of thermal highways that will cause increased energy consumption and increased condensation risk whilst impacting thermal comfort)."[9]

Passive House includes features which cannot be modelled by NatHERS like Heat Recovery Ventilation and high standards for air sealing and eliminating thermal bridges.

Passive House Australia criteria set an upper limit to heating and cooling of 15kWh/$m^2$ per year[10] each i.e. equivalent to 108 MJ/$m^2$ in NatHERS terms. Only 2 of the 69 NatHERS climate zones have a 10-star energy demand threshold which is higher than the Passive House criteria. To be fair, Passive House high level criteria for heat recovery ventilation, windows, insulation and thermal bridging would result in NatHERS predicted heating and cooling load well under the upper limit in most NatHERS climate zones.

[9] Taken from:
https://passivehouseaustralia.org/APHA/What_is_Passive_House/Principles/APHA/What_is_Passive_House/Principles.aspx?hkey=10500711-3621-4dd4-9fa5-dc41d664f9a1

[10] See:
https://passivehouseaustralia.org/APHA/What_is_Passive_House/Criteria/APHA/What_is_Passive_House/Criteria.aspx?hkey=34f3fc0e-f4a0-4a0e-a8e2-12486461aa48

Experience with attempting to design to the 10-star level, and reference to other high efficiency residential building energy efficiency programs show that 10-stars needs some new conceptualisation. It is set at an unachievable level that far exceeds other benchmarks for high energy efficiency in many climates. It is important that 10-stars should be achievable so that designers are encouraged to attempt to reach such high-performance levels. Further, it is also important that 10-stars should not simply be a concept but should have real examples of how it can be achieved in every climate zone.

The Australian Government have published plans for a highly energy efficient house that are free for the public to download and build. This house, called the Design for Place house[11], is an exemplar energy efficient design which combines elements of both passive solar principles and well-ventilated design. This house is used to develop the 10-star energy demand in the 13 base climates. This example is then used to develop a 10-star energy demand in each of the climates within the climate family for each base climate.

The Design for Place house is improved to achieve the highest level of performance that is currently possible with current energy efficient product technology in each of the base climates to provide a real example of how the 10-star level can be achieved:

m) Insulation levels are set to R4.0 in walls and R8.0 in ceilings/roofs. This is the highest level that can be installed in conventional framed construction without increasing framing member size.

n) A high level of internal mass is used. Floors are assumed to concrete slab on ground with ether polished or ceramic tile finish. Internal walls are assumed to be either concrete block or brick as appropriate to the construction practice in the climate. Wall insulation is placed on the outer side of the thermal mass in the external wall. Note that in the Design for Place house some of the external walls are assumed to be light weight framed construction, so not all external walls are assumed to have high thermal mass.

o) Windows are assumed to have the highest performance level appropriate to the climate. In cool climates the highest performance double glazing in a thermally broken aluminium frame is used. This translates to a maximum U value of 2.0 and a minimum SHGC of 0.5 in cool climates. In mild and hot climates e.g. from Sydney to Darwin, a window with single low e glazing is used. In mild climates a thermally broken/low U value aluminium frame is used, while in hot climates a timber framed window is used. In climate zones with higher cooling loads a low SHGC glazing product is used. To ensure adequate natural lighting a minimum SHGC of 0.3 is applied.

p) Windows are assumed to be highly openable in mild and hot climates to maximise the benefit of internal air movement in reducing cooling loads e.g. bi-fold or stacker doors, louvre or casement windows.

q) Window area in the base version of the Design for Place house is quite high: 64.4 $m^2$ in a house with a Net Conditioned Floor Area (NCFA) of 147.1$m^2$ i.e. a window to floor area ratio of 44%. This is almost double the size of windows at 6 stars found in the CSIRO data portal. Despite this high window area, because the house has well oriented windows, the house can achieve current minimum regulatory levels. Window sizes are reduced in the 6- and 7-star level to mirror findings from the CSIRO data portal. Some further, reduction in window area is applied at 10-star as appropriate to the climate e.g. in cool climates with high-performance double-glazing changes to window area have a minimal impact on the rating so reductions in window area in these climates are only minimal. In hot climates minimum cooling loads would occur with NCC minimum window sizes and additional large opaque insulated openings. This approach has not been used in order to maintain a 10 star threshold which has some aesthetic appeal. Some additional window area reductions are applied, but the house still has reasonably large window areas compared to typical volume builder houses.

r) The house is oriented to minimise heating and cooling loads. In hot climates this will mean facing living area south while in cool climates living areas face north. In some climates, in order to make

[11] See Appendix 1, Section 7 for plans and elevations

best use of natural ventilation, the orientation selected may not be due south, for example, in Darwin the best orientation for this house was to orient living room windows to 210°.

In almost all cases this reconceptualising of 10-stars raises the 10-star threshold and in some cases, 10-stars now has a higher energy demand than the current 9 star threshold. This means that the star band energy demand thresholds between the current minimum regulatory requirement and 10-stars also need to be adjusted. This modification to star band thresholds has been undertaken in the following manner:

s) Establish the difference between the current 6- and 10-star levels in MJ/$m^2$,

t) Calculate the reduction in energy demand at each half star level as a percentage of the current gap between 6 and 10-stars,

u) Establish the new energy demand at 6 stars through correlation between the current star rating and new energy load,

v) Calculate the new energy load for 10-stars by the Design for Place house as described above,

w) Set the new star band thresholds by using the percentage reduction in energy demand at each star band threshold in the current star bands and applying this to the difference between the newly calculated 6- and 10-star levels for the new weather data e.g.

x) If the new 6 and 10-stars are 110 and 35 MJ/$m^2$, then 8 stars is set to 6 stars minus 56% of the difference between 6 and 10-stars i.e. 110 – 56% x (110-35) = 110 – 42 = 68 MJ/$m^2$.

**IMPORTANT NOTE**: Re calculating the 10-star threshold as explained above will effectively slightly reduce the stringency of 7 to 9 stars when the next version of NatHERS tools are released with new weather data. This will have some implications for the currently planned stringency increase to 7 stars in 2022.

The following sections show the following information in each of the base climate zones:

y) The current proportion of Class 1 ratings at high ratings to provide context for the new 10-star threshold,

z) the modifications required to the Design for Place house in order to achieve 10-stars,

aa) the new weather data energy load which represents 10-stars, and

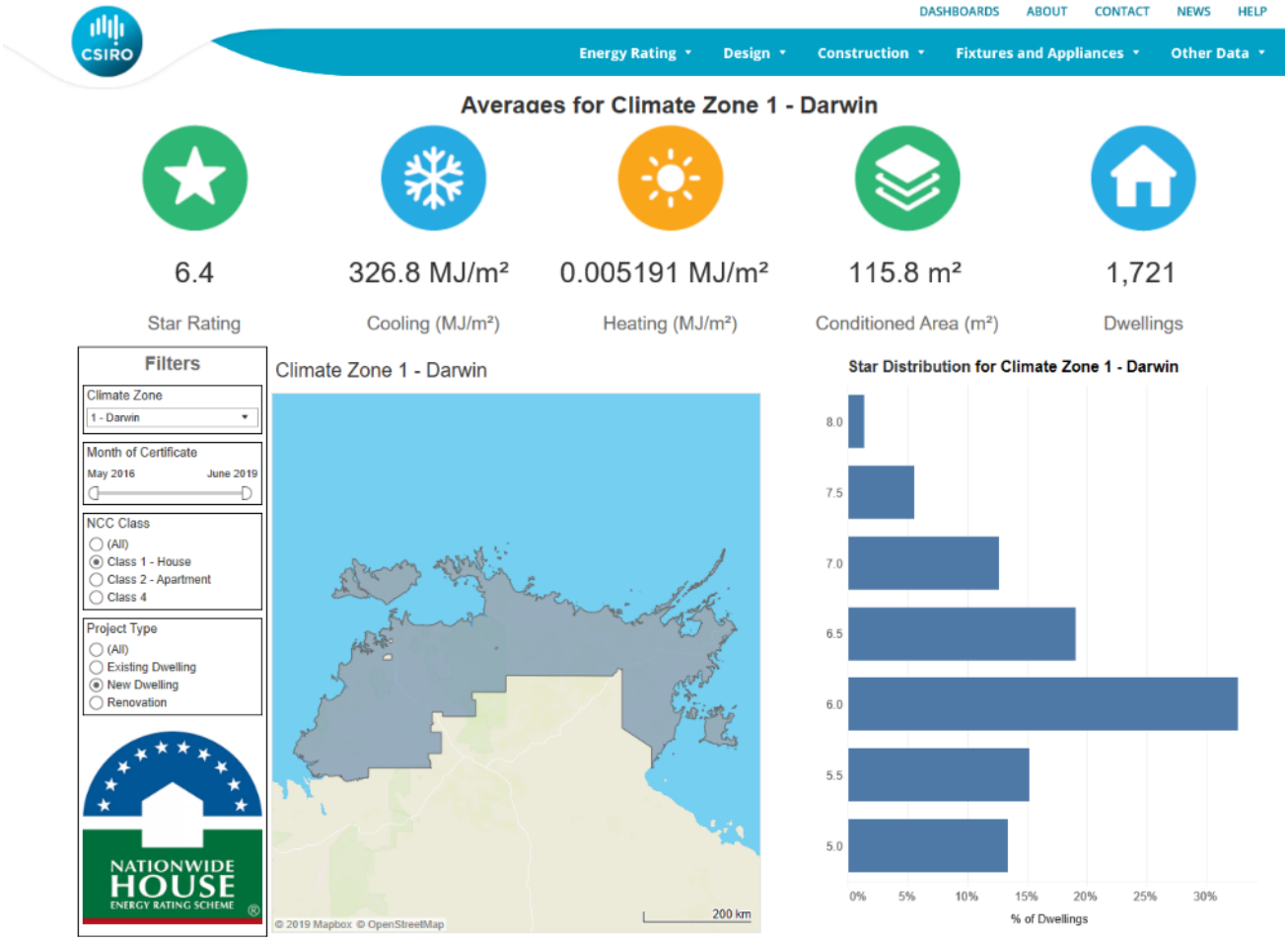
bb) what rating each of the 10-star houses would obtain in NatHERS using the current weather data and star bands.

## 5.1 Darwin

### 5.1.1 Distribution of current ratings

The data show below is extracted from the CSIRO Australian Housing Data Dashboards (https://ahd.csiro.au/dashboards/) which contain all data from Universal Certificates generated for regulatory compliance since May 2016 for Class 1 dwellings. It shows the distribution of ratings at various star rating levels. This provides important context for the proposed new 10-star rating level.

**Figure 104 Distribution of ratings in Darwin for Class 1 dwellings**




Highest rating level achieved in this climate zone: 1.4% of houses constructed between 8 and 8.4 stars.

### 5.1.2 Building Modifications needed to achieve the proposed 10-star threshold

The following modifications were made to the Design for Place house to set the 10-star level for this climate:

- 1400 ceiling fans to each habitable room, 3 in living
- R4.0 external insulation to conc block walls, R4.0 + foil to external framed walls
- R8.0 to ceilings, R1.25 anti-con under roof
- Stegbar cedar windows with single comfort plus glazing
- All internal walls concrete block
- All floors either bare slab or covered with ceramic tiles
- Best orientation is current north face rotated to face 210$^{o}$ (better orientation to prevailing winds)
- Non north/south windows (30/120 orient) shaded with canvass awning vented blinds
- All highlight windows shaded with blinds
- Openability of all windows is 90% e.g. stacker doors, casement or louvre
- Roof and windows white colour (solar absorptance = 0.22)
- Light coloured external walls (solar absorptance = 0.3)
- No added extra veranda around house to shade walls as are already light coloured and well insulated
- Wall to garage and bulkheads insulated with R4.0
- Reduced glazing area includes deleting one of the three sets of sliding door and highlight window to living area, reduce width of living windows to 2700 (from 3600), reduce width of Bed 1 windows from 3600 to 2400, reduce width of Bed 2 and 3 windows (from 2700 to 2400), reduce height of sliding doors from 2400 to 2100 in living and bed 1. Glazing area reduced from 64.4 $m^2$ to 41.3 $m^2$.

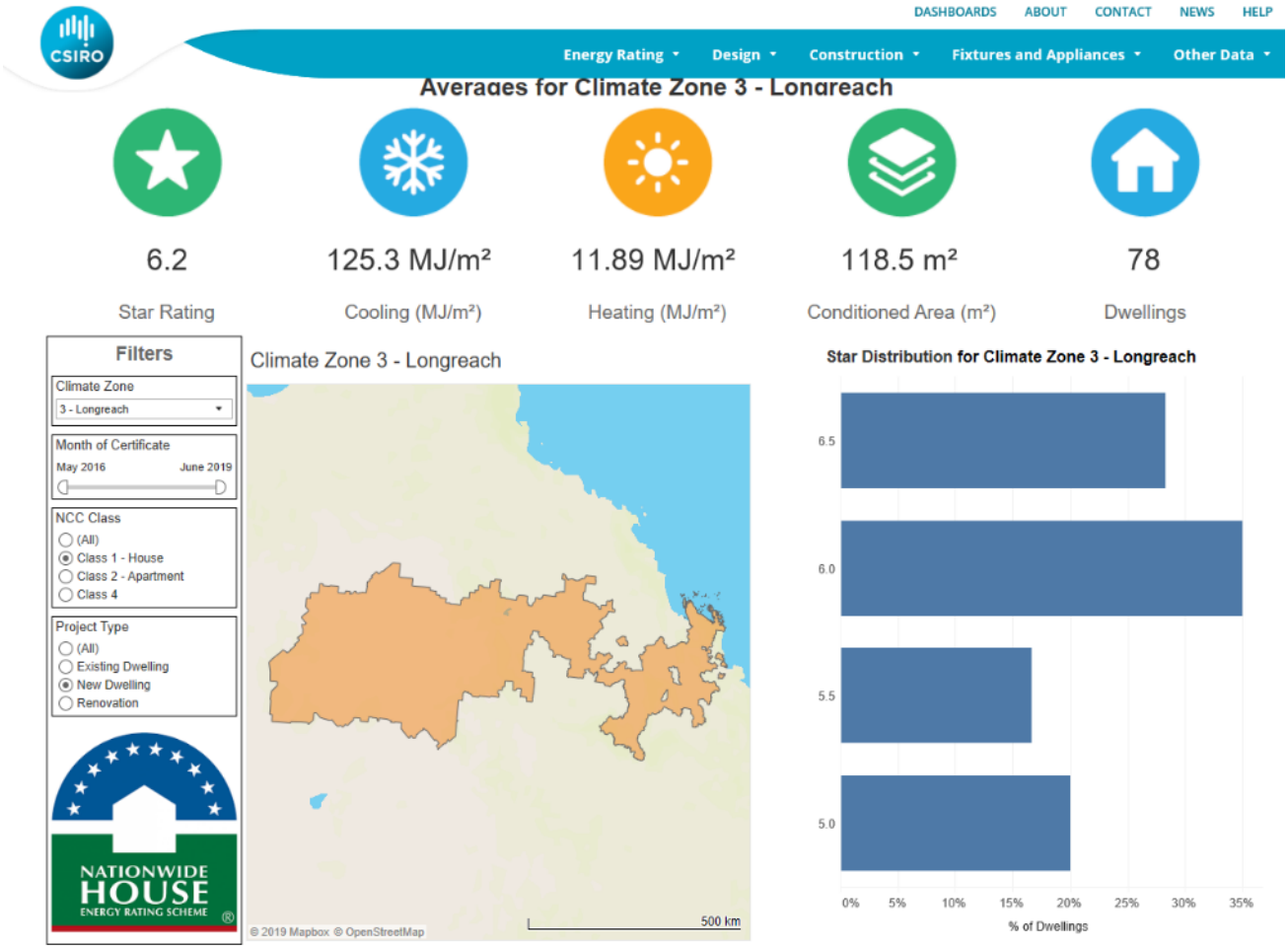
As specified, this house would obtain 8.4 stars in the current NatHERS scheme. The dashboard data shows that only 1.4% of houses built in Darwin have exceeded over 8 stars. Consequently, even though the proposed 10-star threshold would represent a rating level well below the current 10-star level, it is still very much a stretch goal.

## 5.2 Longreach

### 5.2.1 Distribution of current ratings

The data show below is extracted from the CSIRO Australian Housing Data Dashboards (https://ahd.csiro.au/dashboards/) which contain all data from Universal Certificates generated for regulatory compliance since May 2016 for Class 1 dwellings. It shows the distribution of ratings at various star rating levels. This provides important context for the proposed new 10-star rating level.

**Figure 105 Distribution of ratings in Longreach for Class 1 dwellings**




Highest rating level achieved in this climate zone: 28.3% of houses constructed since May 2016 between 6.5 and 6.9 stars.

### 5.2.2 Building Modifications needed to achieve the proposed 10-star threshold

The following modifications were made to the Design for Place house to set the 10-star level for this climate:

- 1400 ceiling fans to each habitable room, 3 in living
- R4.0 external insulation to conc block walls, R4.0 + foil to framed external walls
- R8.0 to ceilings, R1.25 anti-con under roof
- Stegbar cedar windows with single comfort plus glass
- All internal walls concrete block
- All floors either bare slab or covered with ceramic tiles
- N/E/W windows shaded with canvass awning vented blinds
- Openability of all windows is 90% e.g. stacker/bifold doors, casement or louvre
- Windows white (solar absorptance = 0.22)
- Light coloured external walls and roofs (solar absorptance = 0.3)
- No added extra veranda around house to shade walls as are already light and well insulated
- Wall to garage insulated with R2.0, bulkheads R4.0
- Reduced glazing area: reduce width of Living room windows to 2700 (from 3600), reduce width of Bed 1 windows from 3600 to 2700, reduce height of sliding doors from 2400 to 2100 in Living and Bed 1. Glazing area reduced from 64.4 $m^2$ to 50.1 $m^2$.

As specified, this house would obtain 9.2 stars in the current NatHERS scheme. Construction volumes in Longreach are low but show that no house has ever rated above 6.9 stars. While the stringency of 10-star level has been reduced it still represents outstanding performance in this climate zone.

## 5.3 Carnarvon

### 5.3.1 Distribution of current ratings

Only 20 dwellings constructed since May 2106. Average rating 5.5 stars. Dashboard rating distribution not available.

### 5.3.2 Building Modifications needed to achieve the proposed 10-star threshold

The following modifications were made to the Design for Place house to set the 10-star level for this climate:

- 1400 ceiling fans to each habitable room, 3 in Living
- R4.0 external insulation to conc block walls, R4.0 + foil to Linea FC sheet weatherboards
- R8.0 to ceilings, R1.25 anti-con under roof
- Stegbar cedar windows with single comfort plus glass
- All internal walls concrete block
- All floors either bare slab or covered with ceramic tiles
- N/E/W windows shaded with canvass awning vented blinds
- Openability of all windows is 90% e.g. stacker/bifold doors, casement or louvre
- Windows white (solar absorptance = 0.22)
- Light coloured external walls and roofs (solar absorptance = 0.3)
- No added extra veranda around house to shade walls as are already light and well insulated
- Wall to garage insulated with R2.0, bulkheads R4.0
- Reduced glazing area: reduce width of Living windows to 2700 (from 3600), reduce width of Bed 1 windows from 3600 to 2700, reduce height of sliding doors from 2400 to 2100 in Living and Bed 1. Glazing area reduced from 64.4 $m^2$ to 50.1 $m^2$.

As specified, this house would obtain 9.1 stars in the current NatHERS scheme. Again, while the 10-star level has been reduced it still represents outstanding performance compared to the general level of efficiency of houses built in Longreach.

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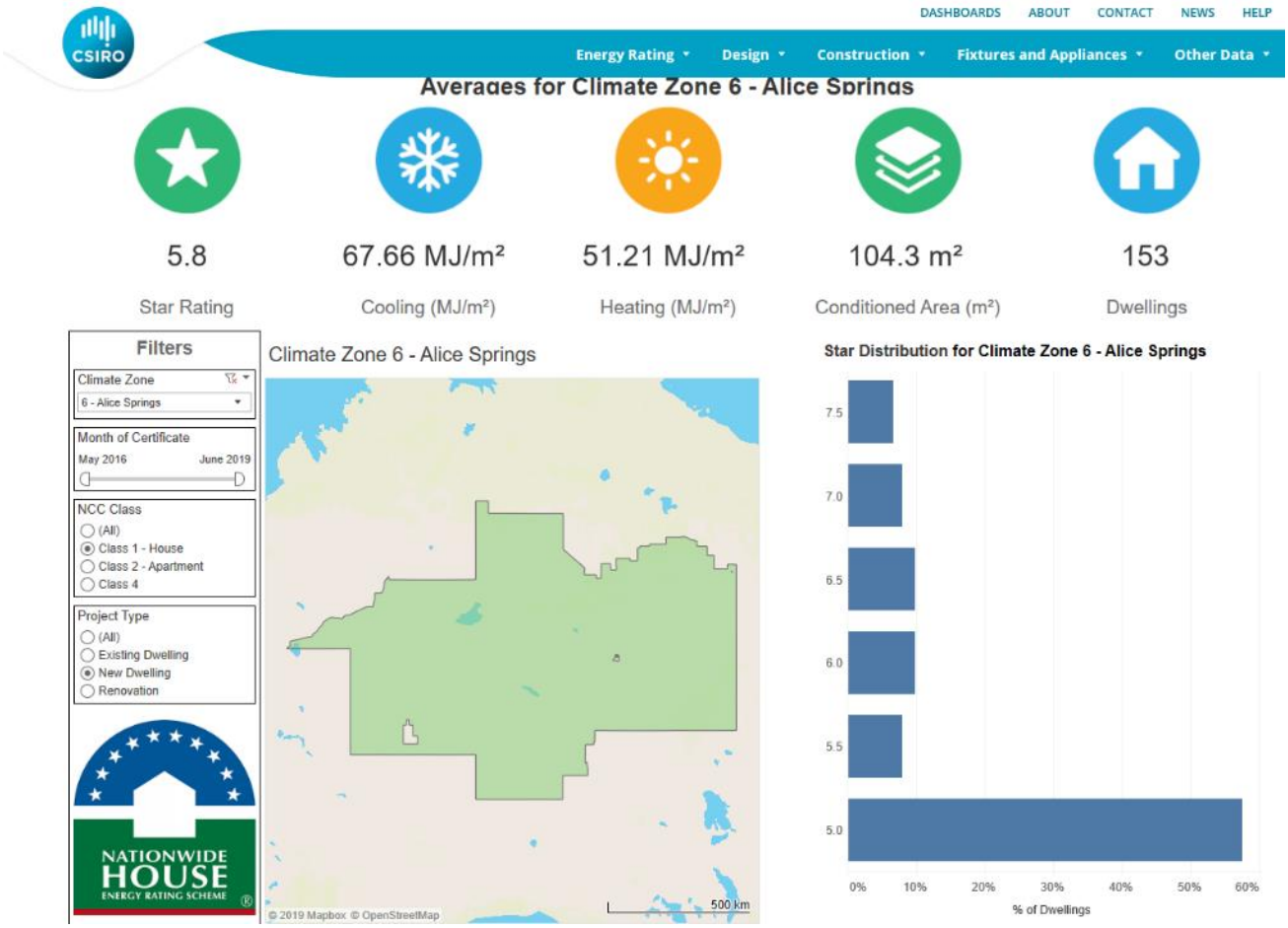
## 5.4 Alice Springs

### 5.4.1 Distribution of current ratings

The data show below is extracted from the CSIRO Australian Housing Data Dashboards (https://ahd.csiro.au/dashboards/) which contain all data from Universal Certificates generated for regulatory compliance since May 2016 for Class 1 dwellings. It shows the distribution of ratings at various star rating levels. This provides important context for the proposed new 10-star rating level.

**Figure 106 Distribution of ratings in Alice Springs for Class 1 dwellings**




Highest rating level achieved in this climate zone: 6.6% of houses constructed since May 2016 between 7.5 and 7.9 stars.

### 5.4.2 Building Modifications needed to achieve the proposed 10-star threshold

The following modifications were made to the Design for Place house to set the 10-star level for this climate:

- 1400 ceiling fans to each habitable room, 3 in Living
- R4.0 external insulation to conc block walls, R4.0 + foil to external framed walls
- R8.0 to ceilings, R1.25 anti-con under roof
- Stegbar cedar windows with single comfort plus glass
- All internal walls concrete block
- All floors either bare slab or covered with ceramic tiles
- N/E/W windows shaded with canvass awning vented blinds
- Openability of all windows is 90% e.g. stacker/bifold doors, casement or louvre
- Windows white (solar absorptance = 0.22)
- Light coloured external walls and roofs (solar absorptance = 0.3)
- No added extra veranda around house to shade walls as are already light and well insulated
- Wall to garage insulated with R2.0, bulkheads R4.0
- Reduced glazing area: incl reduce width of Living windows to 2700 (from 3600), reduce width of Bed 1 windows from 3600 to 2700, reduce height of sliding doors from 2400 to 2100 in Living and Bed 1. Glazing area reduced from 64.4 $m^2$ to 50.1 $m^2$.

As specified, this house would obtain 9.4 stars in the current NatHERS scheme. While this represents some reduction in the stringency of 10-stars it is still outstanding performance and much more efficient than any houses which have been built in Alice Springs to date.

## 5.5 Moree

### 5.5.1 Distribution of current ratings

150 dwellings constructed since May 2016, all ratings between 5 and 5.4 stars. Dashboard rating distribution not available.

### 5.5.2 Building Modifications needed to achieve the proposed 10-star threshold

The following modifications were made to the Design for Place house to set the 10-star level for this climate:

- 1400 ceiling fans to each habitable room, 3 in living
- R4.0 external insulation to reverse brick veneer walls, R4.0 + foil to external framed walls
- R8.0 to ceilings, R1.25 anti-con under roof
- Stegbar cedar windows with single comfort plus glass
- All internal walls brick
- All floors either bare slab or covered with ceramic tiles
- Best orientation is current north face rotated to face 210 (better orientation to prevailing winds)
- N/E/W windows shaded with canvass awning vented blinds
- Openability of all windows is 90% e.g. stacker/bifold doors, casement or louvre
- Windows white (solar absorptance = 0.22)
- Light coloured external walls and roofs (solar absorptance = 0.3)
- No added extra veranda around house to shade walls as are already light and well insulated
- Wall to garage insulated with R2.0, bulkheads R4.0
- Reduced glazing area: reduce width of living windows to 2700 (from 3600), reduce width of B1 windows from 3600 to 2700, reduce height of sliding doors from 2400 to 2100 in Living and Bed 1. Glazing area reduced from 64.4 $m^2$ to 50.1 $m^2$.

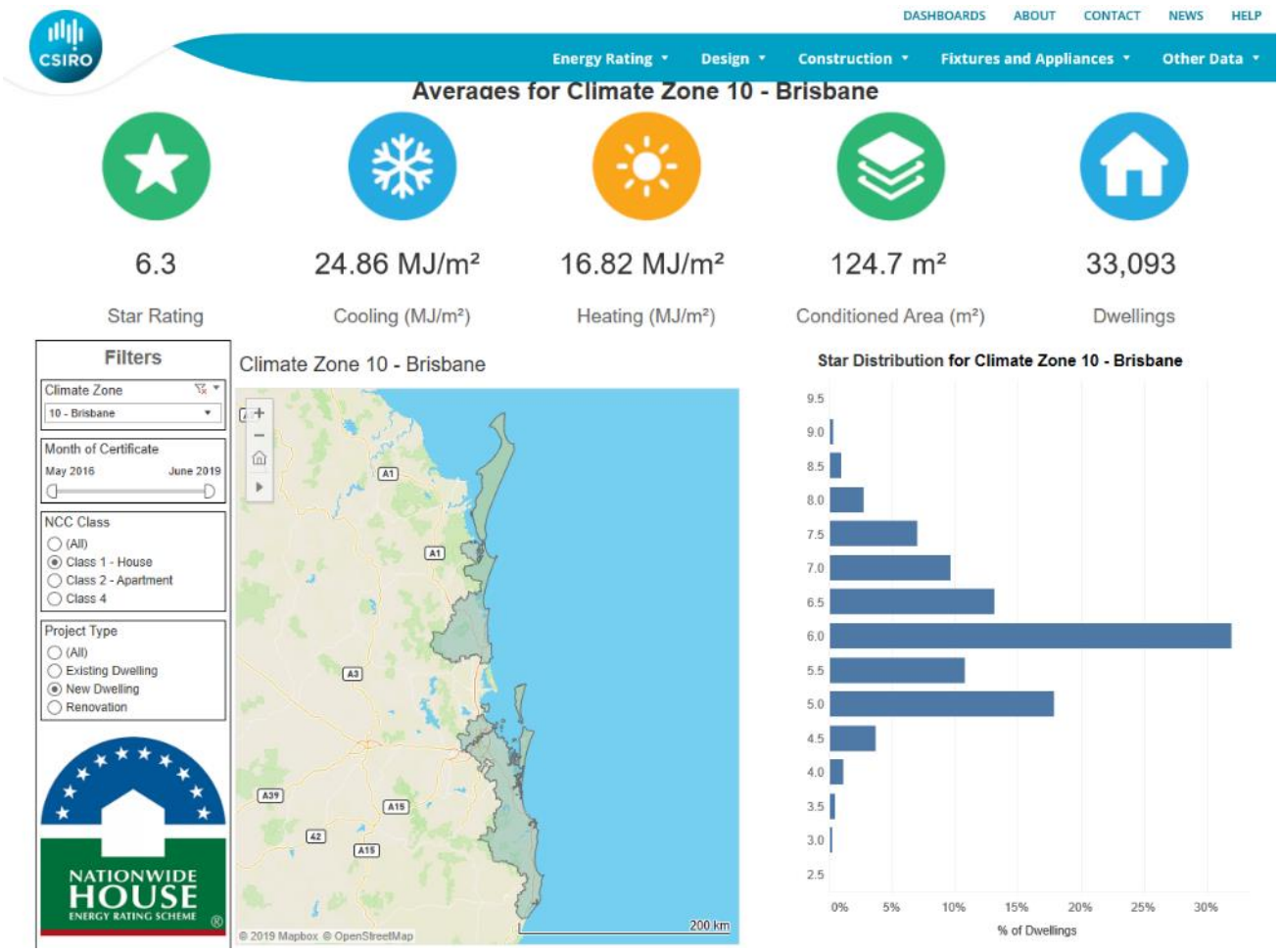
As specified, this house would obtain 9.1 stars in the current NatHERS scheme. While this represents some reduction in the stringency of 10-stars it is still outstanding performance and much more efficient than any houses which have been built in Moree to date.

## 5.6 Brisbane

### 5.6.1 Distribution of current ratings

The data show below is extracted from the CSIRO Australian Housing Data Dashboards (https://ahd.csiro.au/dashboards/) which contain all data from Universal Certificates generated for regulatory compliance since May 2016 for Class 1 dwellings. It shows the distribution of ratings at various star rating levels. This provides important context for the proposed new 10-star rating level.

**Figure 107 Distribution of ratings in Brisbane for Class 1 dwellings**




Highest rating level achieved in this climate zone: 0.34% of houses constructed since May 2016 between 9.0 and 9.9 stars.

### 5.6.2 Building Modifications needed to achieve the proposed 10-star threshold

The following modifications were made to the Design for Place house to set the 10-star level for this climate:

- 1400 ceiling fans to each habitable room, 3 in living
- R4.0 external insulation to reverse brick veneer walls, R4.0 + foil to external framed walls
- R8.0 to ceilings, R1.25 anti-con under roof
- Stegbar cedar windows with single comfort plus glass
- All internal walls brick
- All floors either bare slab or covered with ceramic tiles
- Best orientation is north
- N/E/W windows shaded with canvass awning vented blinds
- Openability of all windows is 90% e.g. stacker/bifold doors, casement or louvre
- Windows white (solar absorptance = 0.22)
- Light coloured external walls and roofs (solar absorptance = 0.3)
- No added extra veranda around house to shade walls as are already light and well insulated
- Wall to garage insulated with R2.0, bulkheads R4.0
- Reduced glazing area: reduce height of sliding doors from 2400 to 2100 in living and bed 1. Glazing area reduced from 64.4 $^{m2}$ to 60.6 $m^2$.

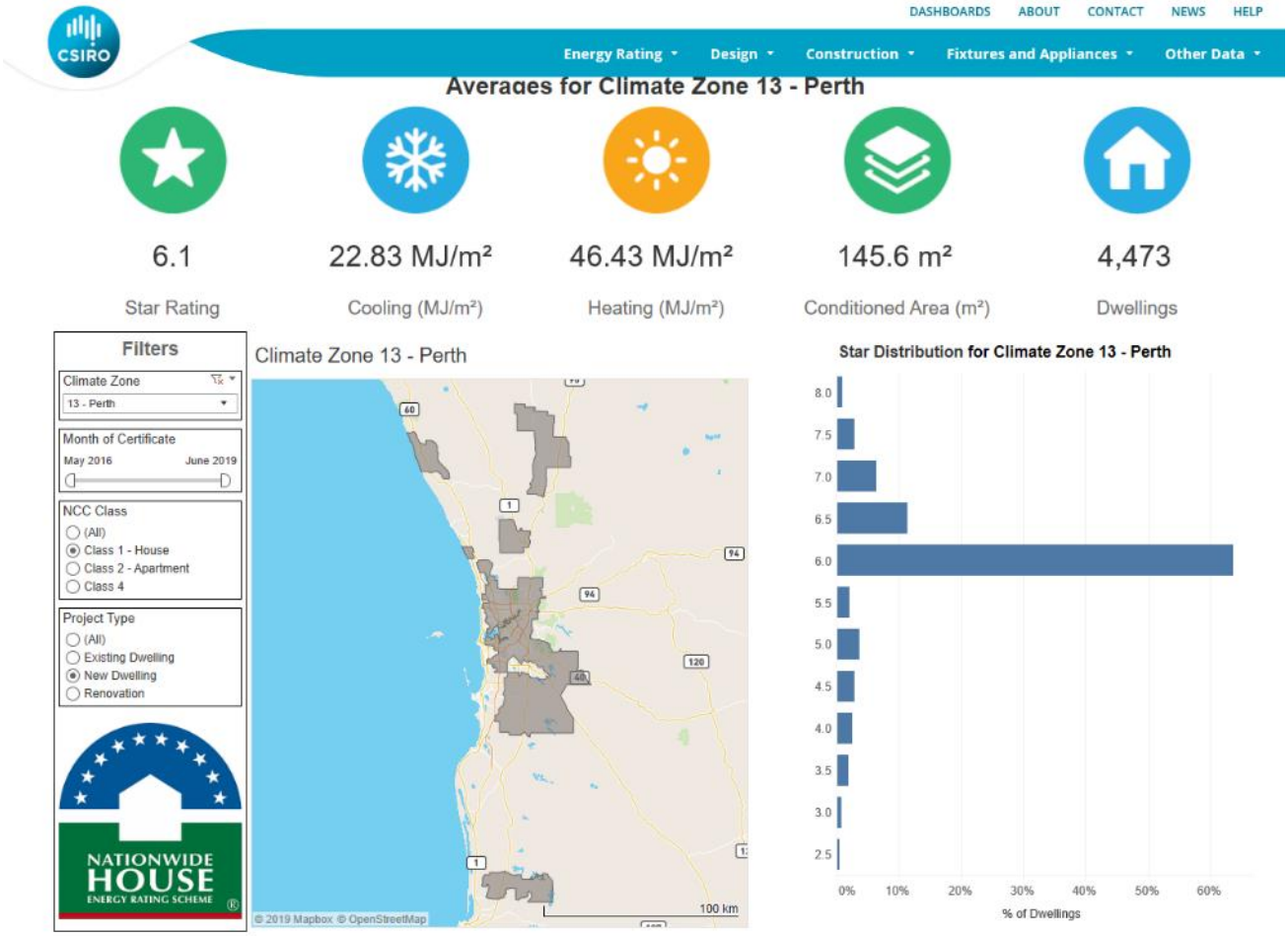
As specified, this house would obtain 9.8 stars in the current NatHERS scheme. This represents only a small reduction in the stringency of 10-stars. A small number of houses constructed in Brisbane may have achieved this revised 10-star level.

## 5.7 Perth

### 5.7.1 Distribution of current ratings

The data show below is extracted from the CSIRO Australian Housing Data Dashboards (https://ahd.csiro.au/dashboards/) which contain all data from Universal Certificates generated for regulatory compliance since May 2016 for Class 1 dwellings. It shows the distribution of ratings at various star rating levels. This provides important context for the proposed new 10-star rating level.

**Figure 108 Distribution of ratings in Perth for Class 1 dwellings**




Highest rating level achieved in this climate zone: 0.97% of houses constructed since May 2016 between 8.0 and 8.4 stars.

### 5.7.2 Building Modifications needed to achieve the proposed 10-star threshold

The following modifications were made to the Design for Place house to set the 10-star level for this climate:

- 1400 ceiling fans to 2x in living.
- R1.9 with reflective surface to brick cavity walls, R4.0 + foil to Reverse Brick Veneer lined externally with Linea FC sheet weatherboards
- R8.0 to ceilings, R1.25 anti-con under roof
- Timber framed low e single glazing, U=3.0, SHGC = 0.46 (typically) to all rooms
- Internal brick walls,
- All floors either bare slab or covered with ceramic tiles
- Openability of sliding doors increase to 60%, highlight windows are louvre 90% openable
- Windows medium frame colour
- Medium coloured external walls and roofs
- Wall to garage walls to Garage insulated with R2.0 and lined with plasterboard, bulkheads to attic R4.0
- Reduced glazing area incl reduce width of living windows to 3000 (from 3600), reduce width of B1 windows from 3600 to 3000 and reduce height from 2400 to 2100, Glazing area reduced from 64.4 m2 to 52.3 m2.

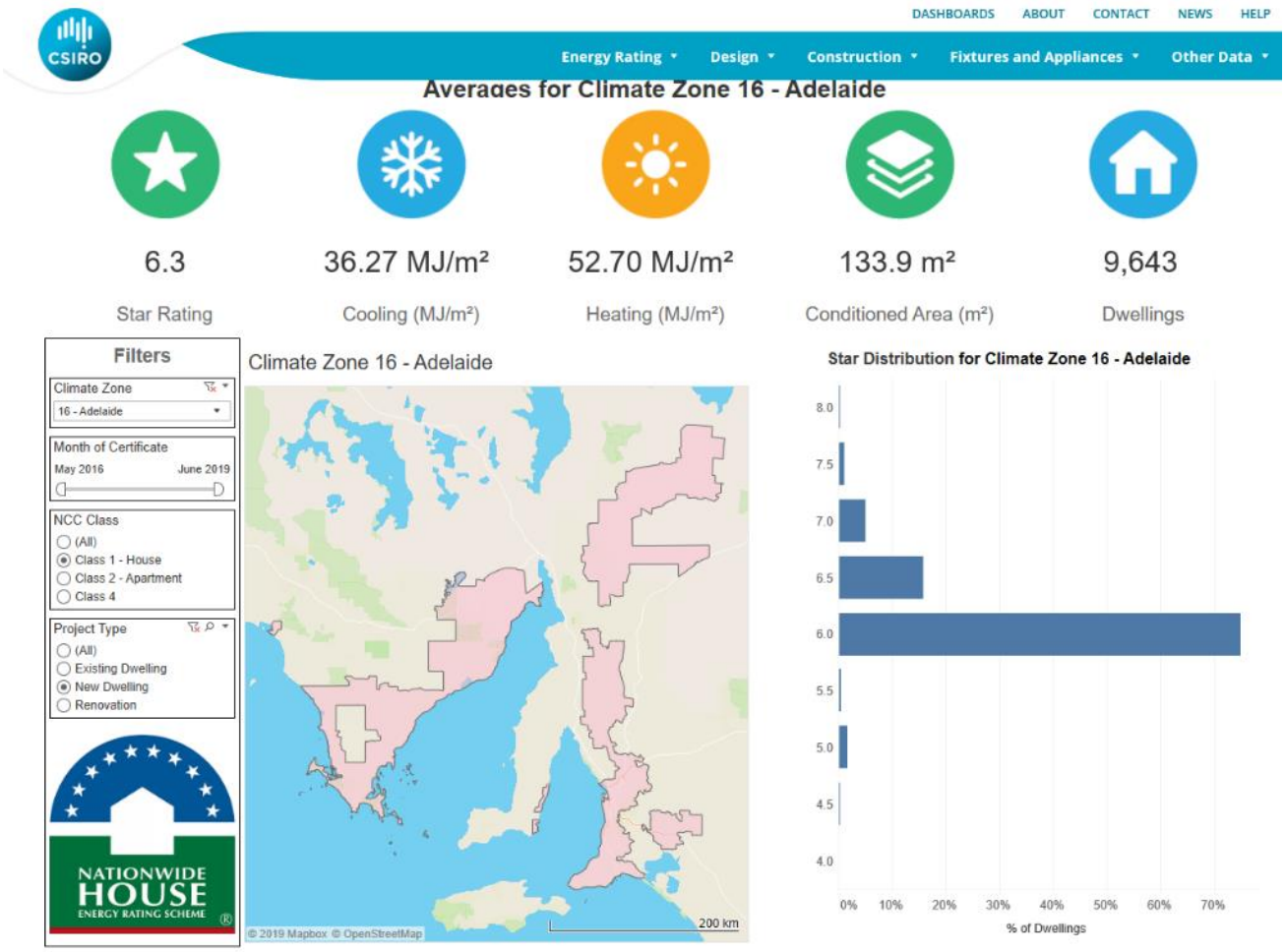
As specified, this house would obtain 9.4 stars in the current NatHERS scheme.

## 5.8 Adelaide

### 5.8.1 Distribution of current ratings

The data show below is extracted from the CSIRO Australian Housing Data Dashboards (https://ahd.csiro.au/dashboards/) which contain all data from Universal Certificates generated for regulatory compliance since May 2016 for Class 1 dwellings. It shows the distribution of ratings at various star rating levels. This provides important context for the proposed new 10-star rating level.

**Figure 109 Distribution of ratings in Adelaide for Class 1 dwellings**




Highest rating level achieved in this climate zone: 0.37% of houses constructed since May 2016 between 8.0 and 8.4 stars.

### 5.8.2 Building Modifications needed to achieve the proposed 10-star threshold

The following modifications were made to the Design for Place house to set the 10-star level for this climate:

- 1400 ceiling fans to 3x in living, 1x1200 in Study. 1x1400 in beds
- R4.0 external insulation to reverse brick veneer walls, R4.0 + foil to Linea FC sheet weatherboards
- R8.0 to ceilings, R1.25 anti-con under roof
- Double argon filled light bridge low e glazing in Aluminium frame U= 3.2 SHGC = 0.42 (typically) to all rooms except living, timber sliding doors to living and bed 1 double low e argon filled EA U=1.8, SHGC = 0.54
- Internal walls: plasterboard R2.7 to unconditioned, uninsulated brick feature walls on north side
- All floors either bare slab or covered with ceramic tiles
- Openability of sliding doors increase to 60%, casement windows to bedrooms, awnings to highlights all 88% openable
- Windows medium frame colour
- Medium coloured external walls and roofs
- Wall to garage insulated with R2.7, bulkheads R4.0
- Reduced glazing area incl reduce width of living windows to 2700 (from 3600), reduce width of B1 windows from 3600 to 2700 and reduce height of all full height windows from 2400 to 2100, Glazing area reduced from 64.4 m2 to 49.6 m2

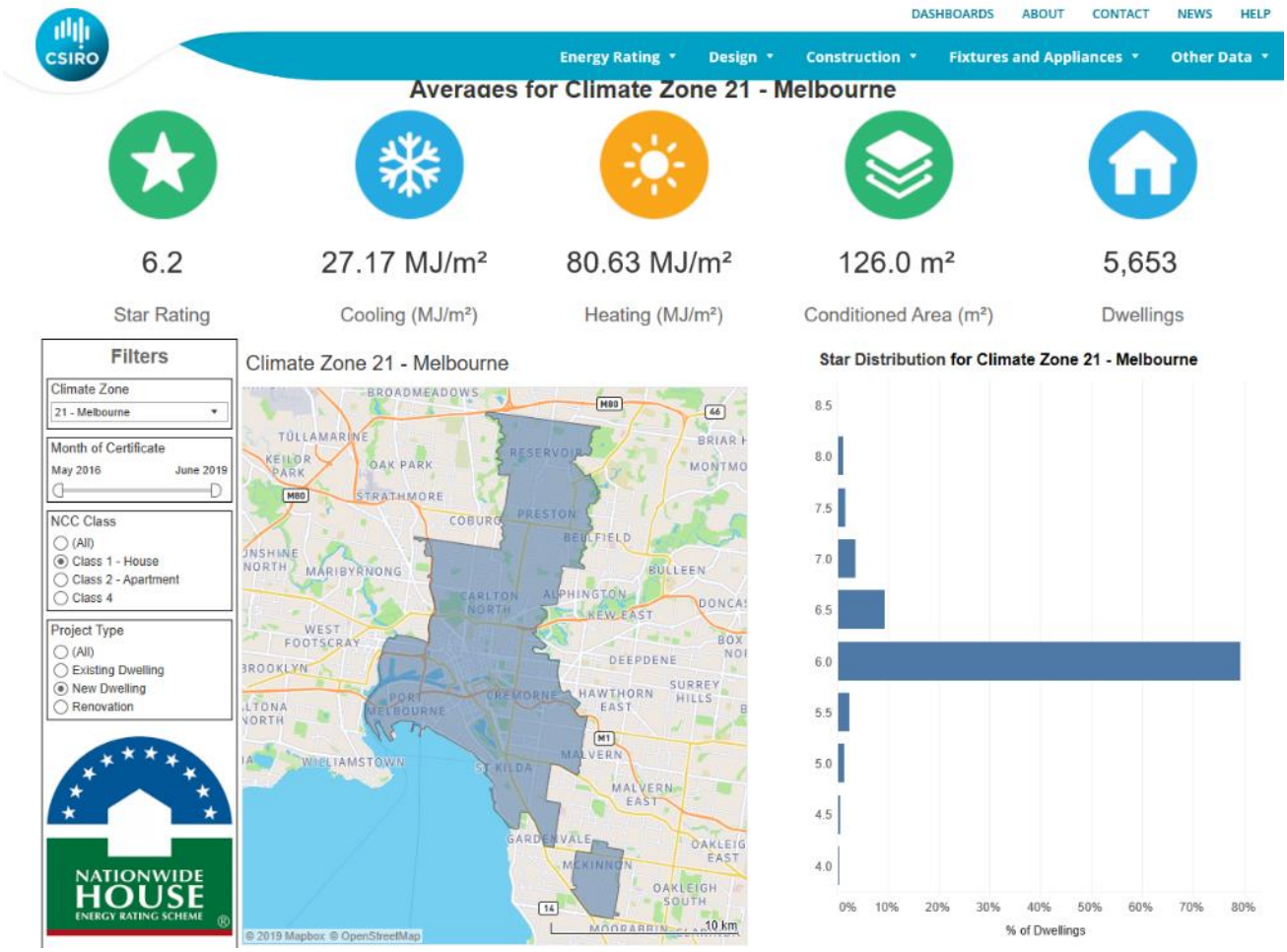
As specified, this house would obtain 9.5 stars in the current NatHERS scheme.

## 5.9 Melbourne

### 5.9.1 Distribution of current ratings

The data show below is extracted from the CSIRO Australian Housing Data Dashboards (https://ahd.csiro.au/dashboards/) which contain all data from Universal Certificates generated for regulatory compliance since May 2016 for Class 1 dwellings. It shows the distribution of ratings at various star rating levels. This provides important context for the proposed new 10-star rating level.

**Figure 110 Distribution of ratings in Melbourne for Class 1 dwellings**




Highest rating level achieved in this climate zone: 1.55% of houses constructed since May 2016 between 8.0 and 8.9 stars.

### 5.9.2 Building Modifications needed to achieve the proposed 10-star threshold

The following modifications were made to the Design for Place house to set the 10-star level for this climate:

- R4.0 external insulation + foil with an outward facing emissivity of 0.1 to reverse brick veneer walls, R4.0 + foil to external framed walls
- R8.0 to ceilings, R1.8 anti-con under roof
- UPVC double glazed with low e coating and argon fill windows
- All internal walls brick except to garage and unconditioned rooms which use R2.5 insulated plasterboard on studs
- All floors either bare slab or covered with ceramic tiles, insulated with R4.0
- Best orientation is north
- N/E/W windows shaded with canvass awning vented blinds
- Openability of windows is increased e.g. stacker/bifold doors, casement or louvre
- Windows medium colour (solar absorptance = 0.5)
- Dark coloured external walls and roofs (solar absorptance = 0.85)
- Wall to garage insulated with R2.5, bulkheads R4.0
- Reduced glazing area: reduce width of sliding doors and highlight windows from 3000 to 2700 in Living and Bed 1. Glazing area reduced from 64.4 m2 to 49.6 $m^2$.

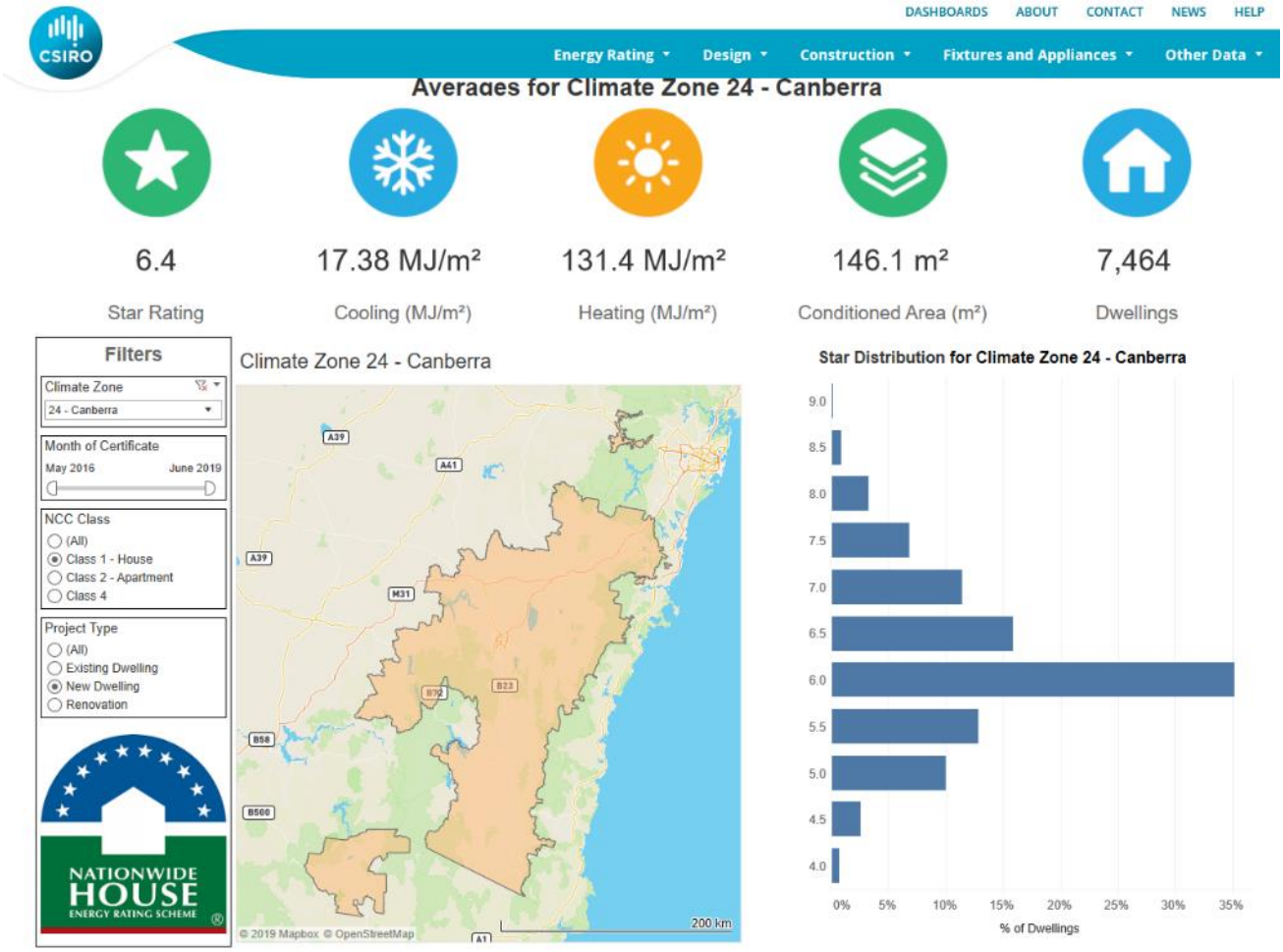
As specified, this house would obtain 9.4 stars in the current NatHERS scheme. This represents a modest reduction in stringency at 10-stars, however, no house in Melbourne has ever been built to this level of energy efficiency, so 10-stars still represents a stretch goal which is nevertheless achievable.

## 5.10 Canberra

### 5.10.1 Distribution of current ratings

The data show below is extracted from the CSIRO Australian Housing Data Dashboards (https://ahd.csiro.au/dashboards/) which contain all data from Universal Certificates generated for regulatory compliance since May 2016 for Class 1 dwellings. It shows the distribution of ratings at various star rating levels. This provides important context for the proposed new 10-star rating level.

**Figure 111 Distribution of ratings in Canberra for Class 1 dwellings**




Highest rating level achieved in this climate zone: 1.1% of houses constructed since May 2016 between 8.5 and 9.4 stars.

### 5.10.2 Building Modifications needed to achieve the proposed 10-star threshold

The following modifications were made to the Design for Place house to set the 10-star level for this climate:

- R4.0 external insulation + foil with an outward facing emissivity of 0.1 to reverse brick veneer walls, R4.0 + foil to external framed walls
- R8.0 to ceilings, R1.8 anti-con under roof
- UPVC double glazed with low e coating and argon fill windows
- All internal walls brick except to garage and unconditioned rooms which use R2.5 insulated plasterboard on studs
- All floors either bare slab or covered with ceramic tiles, insulated with R4.0
- Best orientation is north
- N/E/W windows shaded with canvass awning vented blinds
- Openability of windows is increased e.g. stacker/bifold doors, casement or louvre
- Windows medium colour (solar absorptance = 0.5)
- Dark coloured external walls and roofs (solar absorptance = 0.85)
- Wall to garage insulated with R2.5, bulkheads R4.0
- Reduced glazing area: reduce width of sliding doors and highlight windows from 3000 to 2700 in Living and Bed 1. Glazing area reduced from 64.4 m2 to 49.6 $m^2$.

Note that these specifications are the same as used for Melbourne.

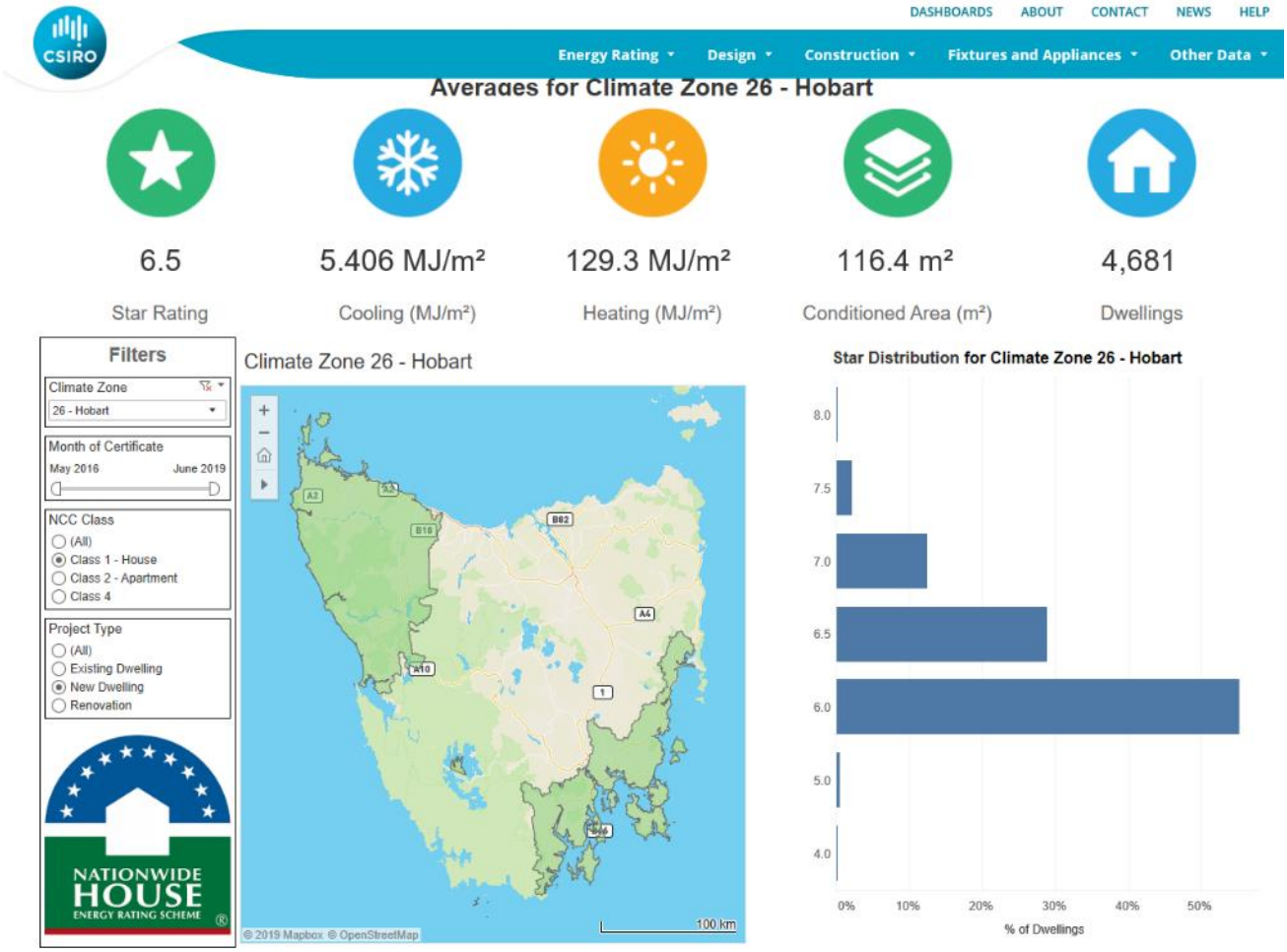
As specified, this house would obtain 9.4 stars in the current NatHERS scheme. This represents a modest reduction in stringency at 10-stars, however, no house in Canberra has ever been built to this level of energy efficiency, so 10-stars still represents a stretch goal which is nevertheless achievable.

## 5.11 Hobart

### 5.11.1 Distribution of current ratings

The data show below is extracted from the CSIRO Australian Housing Data Dashboards (https://ahd.csiro.au/dashboards/) which contain all data from Universal Certificates generated for regulatory compliance since May 2016 for Class 1 dwellings. It shows the distribution of ratings at various star rating levels. This provides important context for the proposed new 10-star rating level.

**Figure 112 Distribution of ratings in Hobart for Class 1 dwellings**




Highest rating level achieved in this climate zone: 2.46% of houses constructed since May 2016 between 7.5 and 8.4 stars.

### 5.11.2 Building Modifications needed to achieve the proposed 10-star threshold

The following modifications were made to the Design for Place house to set the 10-star level for this climate:

- R4.0 external insulation + foil with an outward facing emissivity of 0.1 to reverse brick veneer walls, R4.0 + foil to external framed walls
- R8.0 to ceilings, R1.8 anti-con under roof
- UPVC double glazed with low e coating and argon fill windows
- All internal walls brick except to garage and unconditioned rooms which use R2.5 insulated plasterboard on studs
- All floors either bare slab or covered with ceramic tiles, insulated with R4.0
- Best orientation is north
- N/E/W windows shaded with canvass awning vented blinds
- Openability of windows is increased e.g. stacker/bifold doors, casement or louvre
- Windows medium colour (solar absorptance = 0.5)
- Dark coloured external walls and roofs (solar absorptance = 0.85)
- Wall to garage insulated with R2.5, bulkheads R4.0
- Reduced glazing area: reduce width of sliding doors and highlight windows from 3000 to 2700 in Living and Bed 1. Glazing area reduced from 64.4 m2 to 49.6 $m^2$.

Note that these specifications are the same as used for Melbourne.

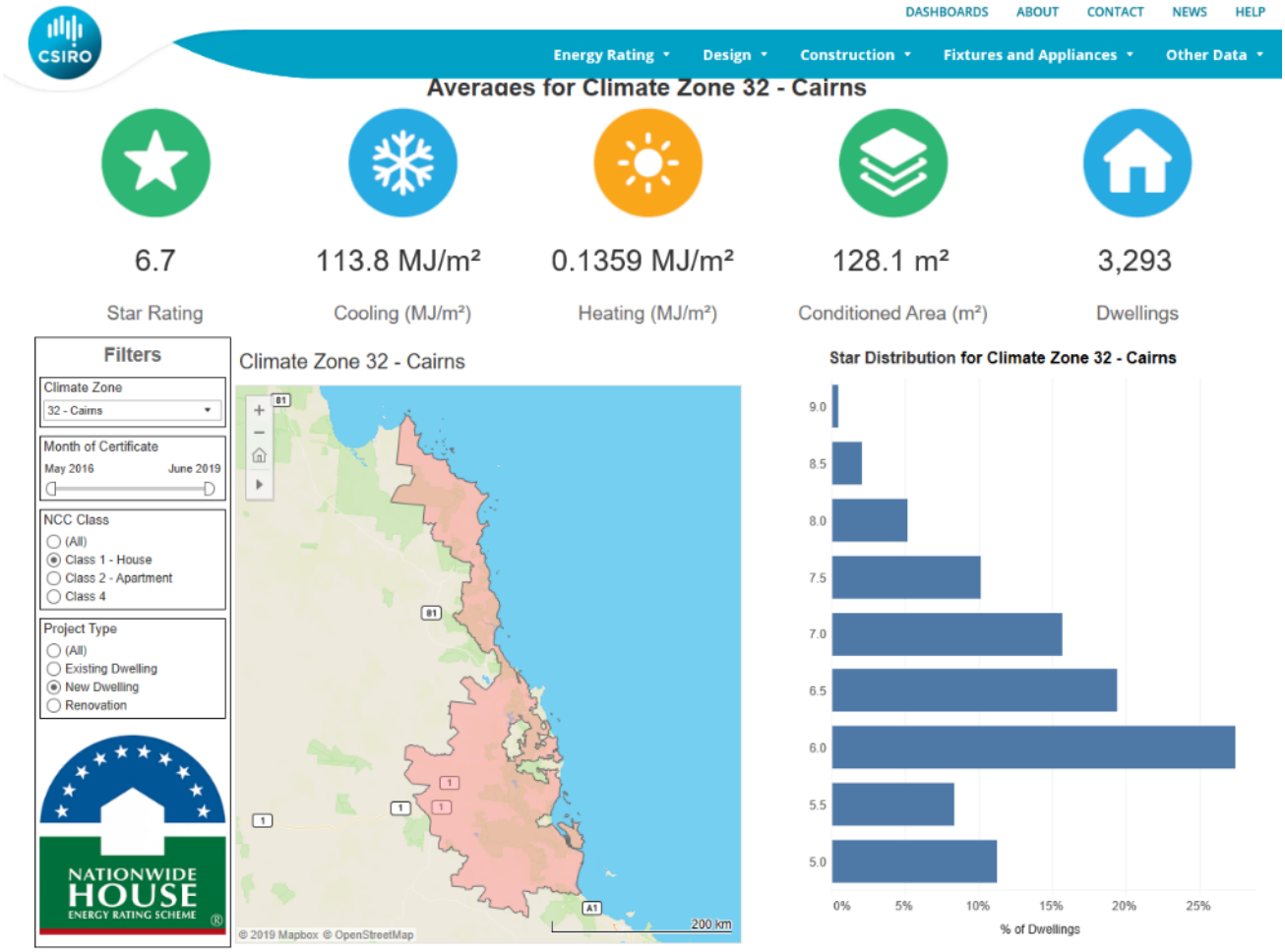
As specified, this house would obtain 9.2 stars in the current NatHERS scheme. While this represents a reduction in stringency at 10-stars, no house in Hobart has ever been built to a level of energy efficiency higher than 8.4 stars, so 10-stars still represents a stretch goal which is nevertheless achievable.

## 5.12 Cairns

### 5.12.1 Distribution of current ratings

The data show below is extracted from the CSIRO Australian Housing Data Dashboards (https://ahd.csiro.au/dashboards/) which contain all data from Universal Certificates generated for regulatory compliance since May 2016 for Class 1 dwellings. It shows the distribution of ratings at various star rating levels. This provides important context for the proposed new 10-star rating level.

**Figure 113 Distribution of ratings in Cairns for Class 1 dwellings**




Highest rating level achieved in this climate zone: 0.46% of houses constructed since May 2016 between 9.0 and 9.4 stars.

### 5.12.2 Building Modifications needed to achieve the proposed 10-star threshold

The following modifications were made to the Design for Place house to set the 10-star level for this climate:

- 1400 ceiling fans to each habitable room, 3x in living
- R4.0 external insulation to conc block walls, R4.0 + foil to external framed walls
- R8.0 to ceilings, R1.25 anti-con under roof
- Stegbar cedar windows with single comfort plus glass
- All internal walls concrete block
- All floors either bare slab or covered with ceramic tiles
- Best orientation is current north face rotated to face 180$^{o}$
- N/E/W windows shaded with canvass awning vented blinds
- Openability of all windows is 90% e.g. stacker/bifold doors, casement or louvre
- Windows white (solar absorptance = 0.22)
- Light coloured external walls and roofs (solar absorptance = 0.3)
- No added extra veranda around house to shade walls as are already light and well insulated
- Wall to garage insulated with R2.0, bulkheads R4.0
- Reduced glazing area: reduce width of Living windows to 2400 (from 3600), reduce width of Bed 1 windows from 3600 to 2400, reduce width of Bed 2 and 3 windows from 2700 to 2400, reduce height of sliding doors from 2400 to 2100 in Living and Bed 1. Glazing area reduced from 64.4 m2 to 46.6 m2.

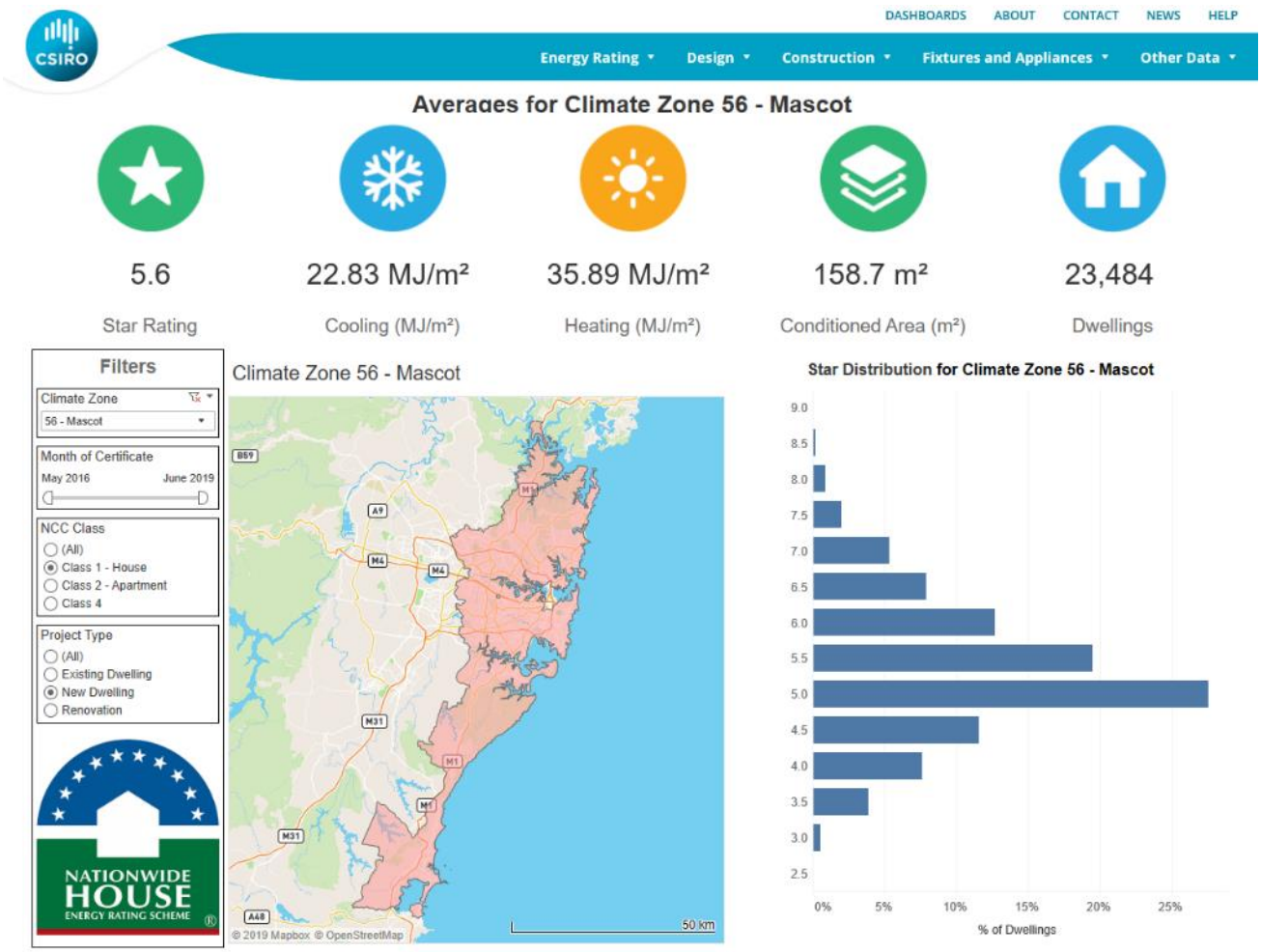
As specified, this house would obtain 9.3 stars in the current NatHERS scheme. This represents a modest reduction in stringency at 10-stars. A very small number of houses in Cairns may have already been built to this standard in Cairns. The proposed 10-star level still represents a stretch goal which is nevertheless achievable.

# 5.13 Mascot

## 5.13.1 Distribution of current ratings

The data show below is extracted from the CSIRO Australian Housing Data Dashboards (https://ahd.csiro.au/dashboards/) which contain all data from Universal Certificates generated for regulatory compliance since May 2016 for Class 1 dwellings. It shows the distribution of ratings at various star rating levels. This provides important context for the proposed new 10-star rating level.

**Figure 114 Distribution of ratings in Mascot for Class 1 dwellings**




Highest rating level achieved in this climate zone: 0.28% of houses constructed since May 2016 between 8.5 and 9.4 stars.

### 5.13.2 Building Modifications needed to achieve the proposed 10-star threshold

The following modifications were made to the Design for Place house to set the 10-star level for this climate:

- 1400 ceiling fans to 3x in living. 1x1200 in beds
- R4.0 external insulation to reverse brick veneer walls, R4.0 + foil to Linea FC sheet weatherboards
- R8.0 to ceilings, R1.25 anti-con under roof
- Single EA glazing in Aluminium frame U= 4.3 SHGC = 0.48 (typically) to all rooms except living, timber sliding doors to living and bed 1 single EA U=3.2, SHGC = 0.55
- Internal walls plasterboard R2.5 to unconditioned, brick feature walls on north side
- All floors either bare slab or covered with ceramic tiles
- Openability of sliding doors increase to 60%, louvre windows to highlights 90%
- Windows medium frame colour
- Medium coloured external walls and roofs
- Wall to garage insulated with R2.5, bulkheads R2.5
- Reduced glazing area incl reduce width of living windows to 3000 (from 3600), reduce width of B1 windows from 3600 to 3000 and reduce height from 2400 to 2100, Glazing area reduced from 64.4 m2 to 52.3 m2.

As specified, this house would obtain 9.7 stars in the current NatHERS scheme.

# 6 References

Isaacs et al (2014), *NatHERS Star bands for proposed 2015 version of Chenath including new weather data: Summary Report*, prepared by Tony Isaacs Consulting, Floyd Energy and Pitt and Sherry for NatHERS Administrator, 2015 Canberra

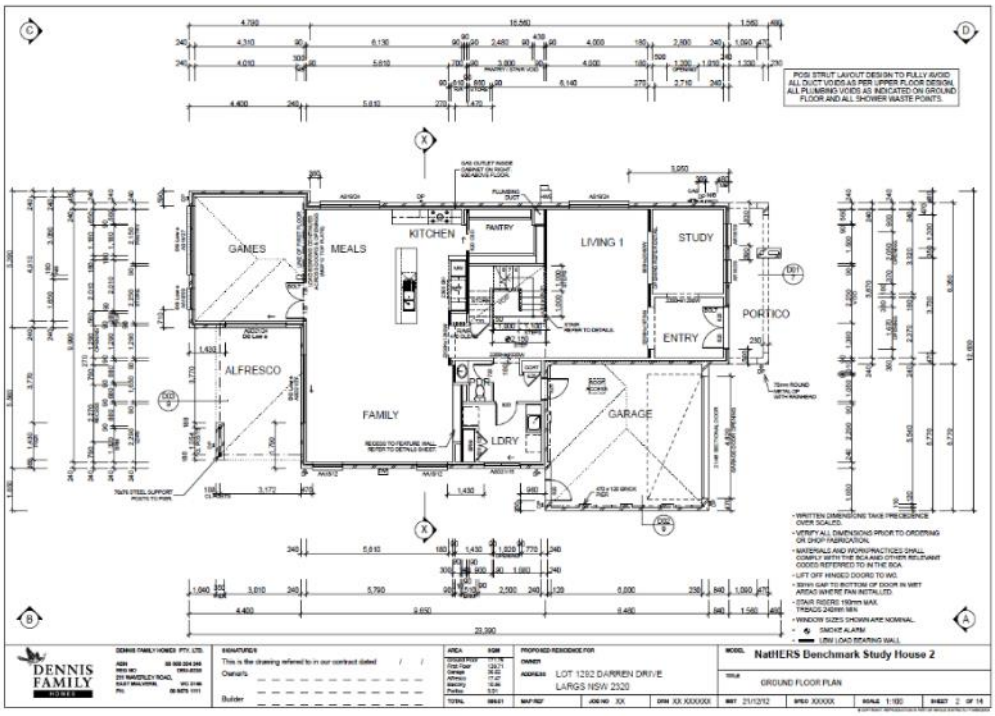
Floyd Energy (2018). *Preliminary impact assessment for Chenath engine changes,* prepared for the Australian Government Department of the Environment and Energy, Canberra.

# 7 Appendix 1: Dwelling Plans used for this project

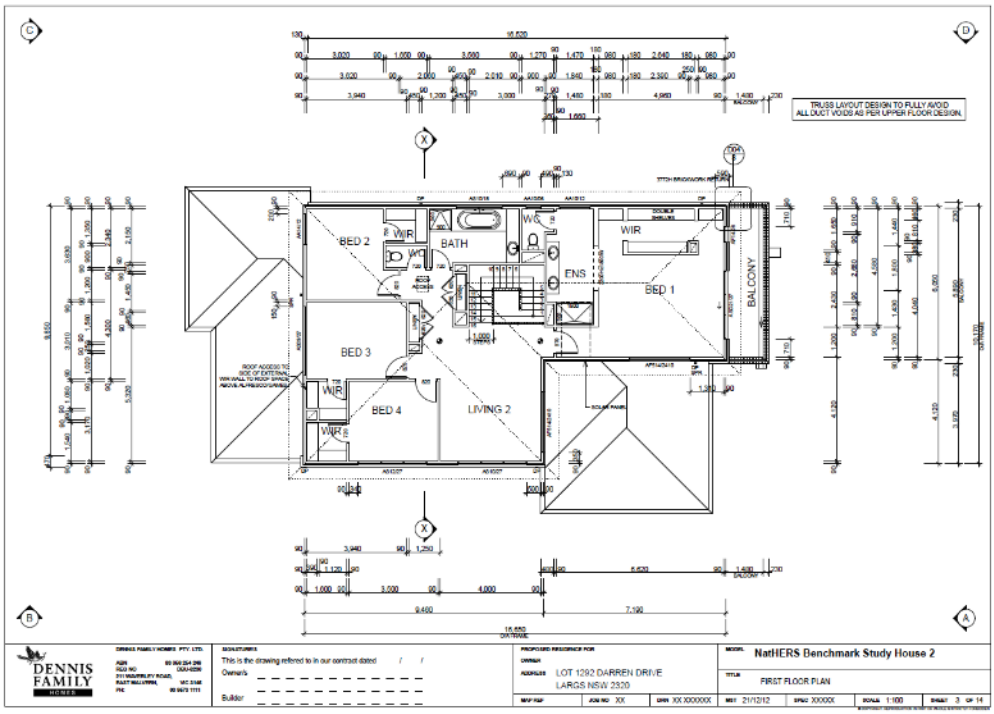
## 7.1 SBH01 Large detached 2 storey, NatHERS Benchmark study House No. 2

Dennis Family Homes

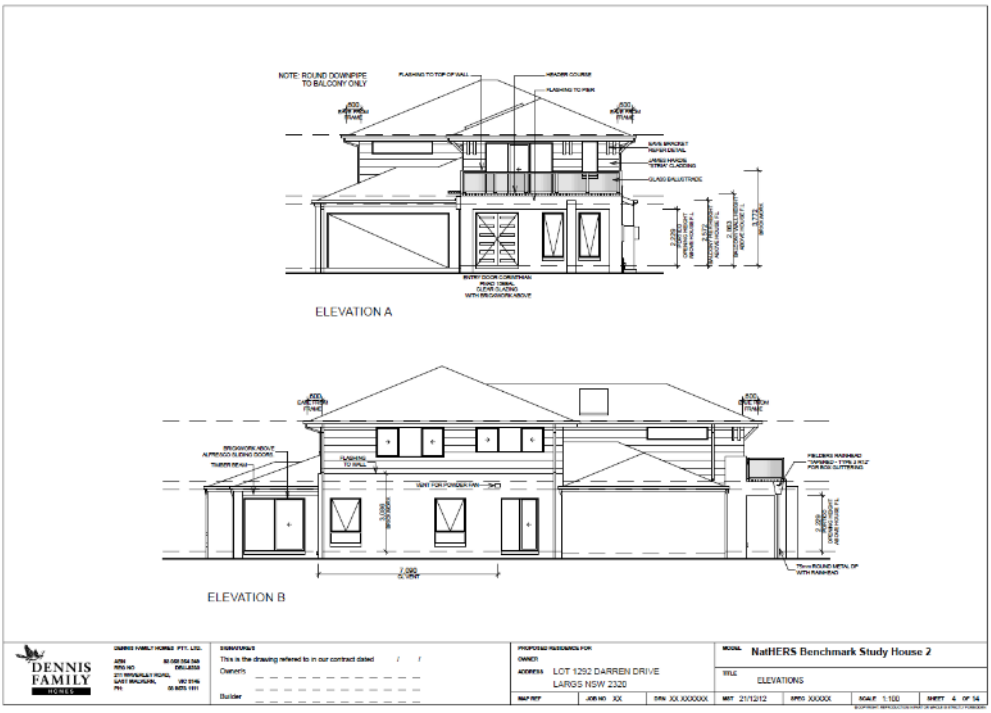
***Ground Floor***

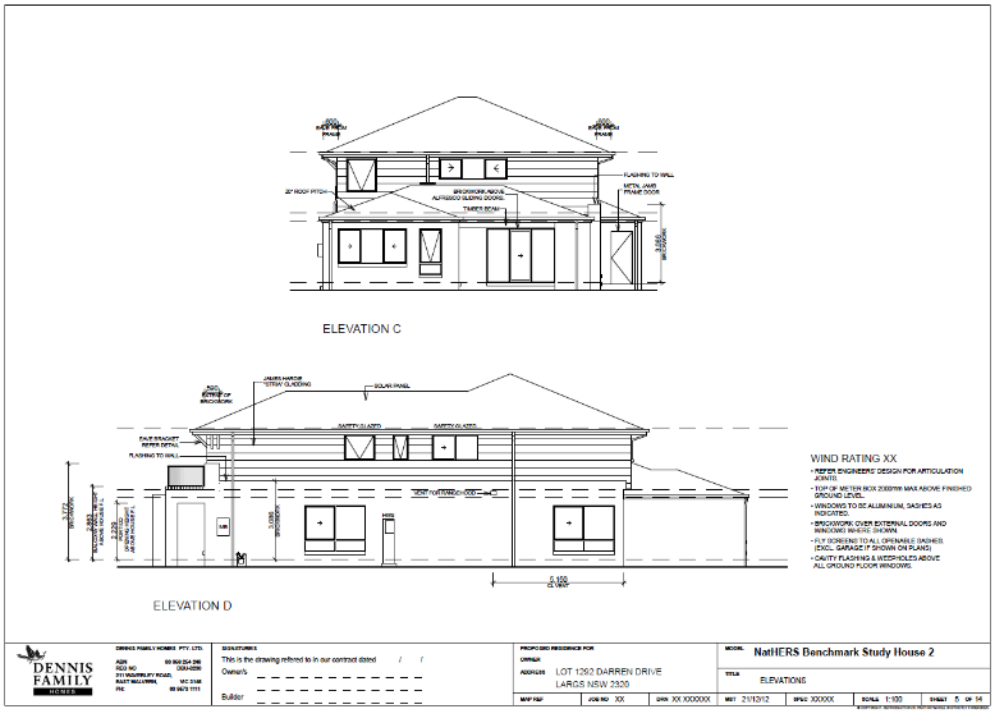


# Upper floor




# Elevations




ELEVATION C
ELEVATION D
WIND RATING XX
• REFER ENGINEERS DESIGN FOR ARTICULATION JOINTS.
• TOP OF METER BOX 2000mm MAX ABOVE FINISHED GROUND LEVEL.
• WINDOWS TO BE ALUMINIUM, SASHES AS INDICATED.
• BRICKWORK OVER EXTERNAL DOORS AND WINDOWS WHERE SHOWN.
• FLY SCREENS TO ALL OPENABLE SASHES (EXCL. GARAGE IF SHOWN ON PLANS)
• CAVITY FLASHING & WEEPHOLES ABOVE ALL GROUND FLOOR WINDOWS.
DENNIS FAMILY HOMES
SIGNATURES
This is the drawing refered to in our contract dated
Owner/s
Builder
PROPOSED RESIDENCE FOR
OWNER
ADDRESS
LOT 1292 DARREN DRIVE
LARGS NSW 2320
MODEL
NatHERS Benchmark Study House 2
TITLE
ELEVATIONS
JOB NO XX
DRN XX XXXXXX
DATE 21/12/12
SCALE 1:100
SHEET 5 OF 14

## 7.2 SBH02 Large detached, 1 storey, Henley (Clendon Vale) Talise Q1

### View from Street

### Plan

## 7.3 SBH03 Medium Detached, 2 storey, Set of 20, House01: CSR Display

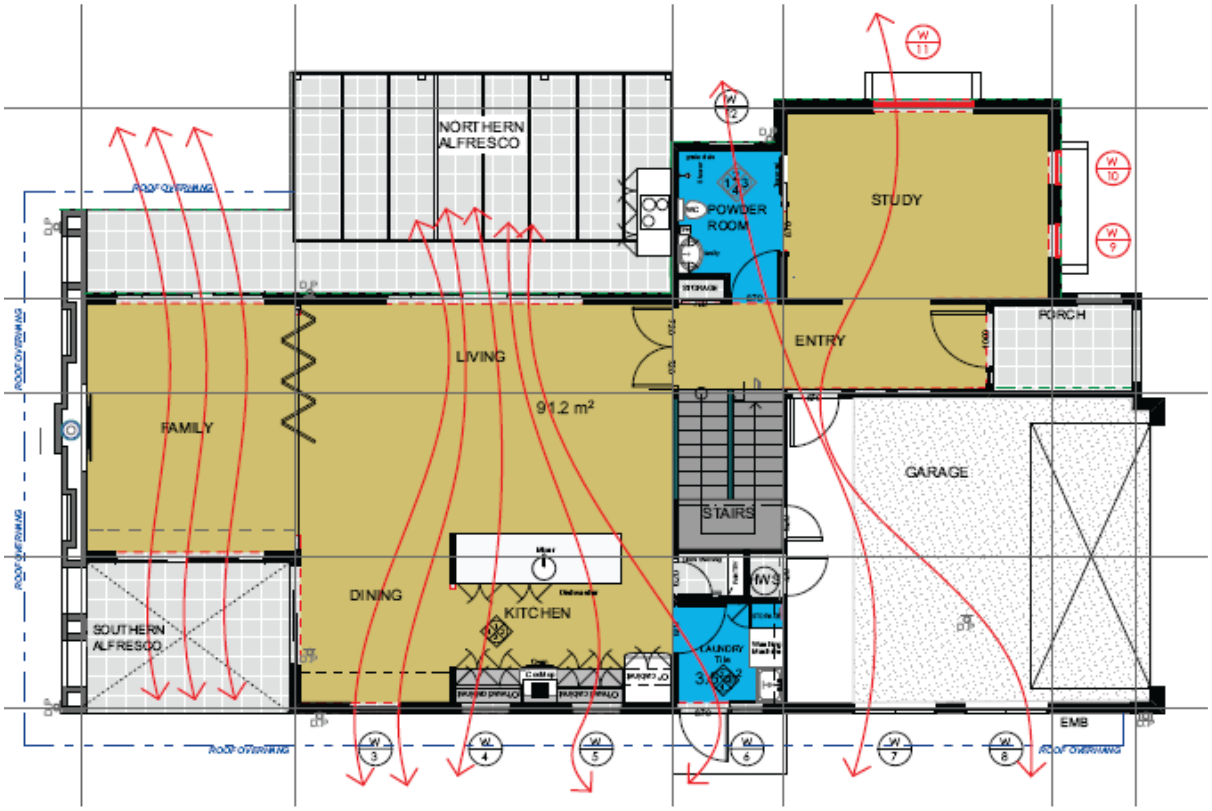
Ecologie Group architects. (CSR display and learning centre)

### View from street

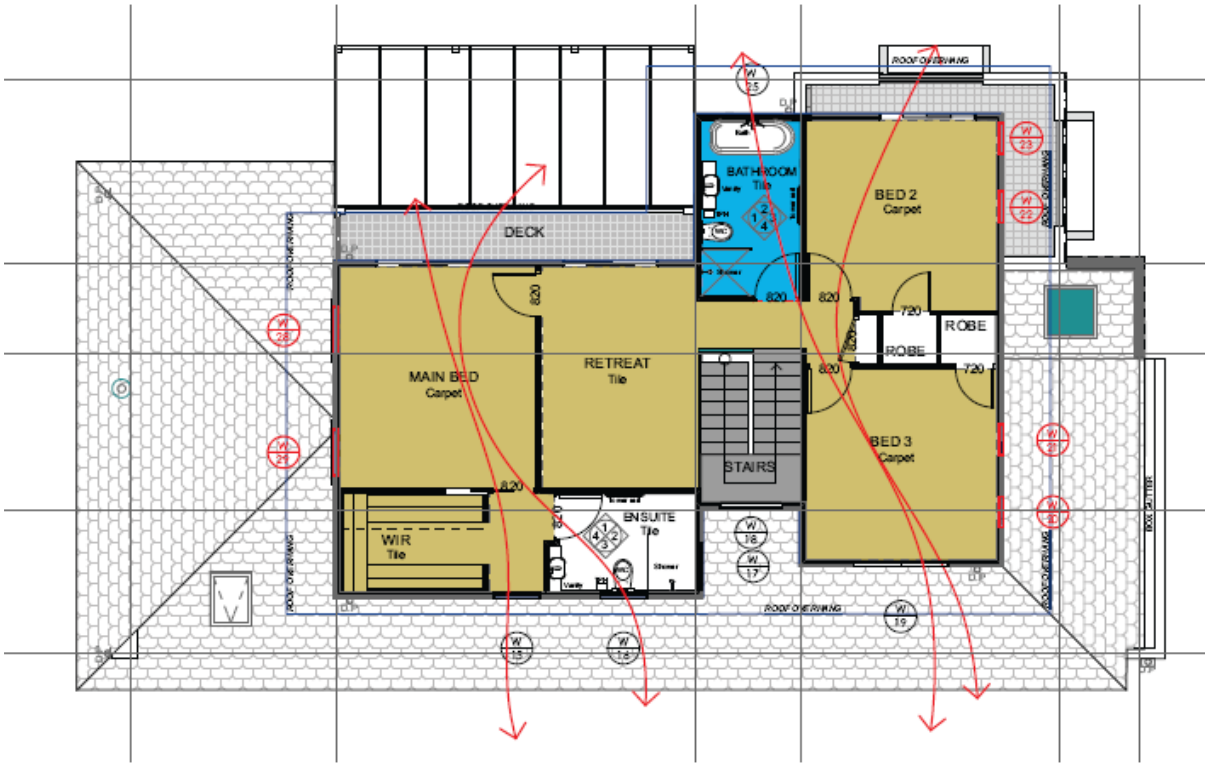
Double story design the lower level comprising double garage, entry hall, study, powder room, laundry open plan kitchen/living/dining and family room, upper level of parents retreat, master bedroom with an attached WIR and ensuite, bathroom and 2 bedrooms.

Total floor area of 241.2m$^2$. Net conditioned floor area 162.0 m$^2$

## Ground Floor




## Upper floor



## 7.4 SBH04 Medium Detached, 1 storey, Set of 20, House10: Henley Homes

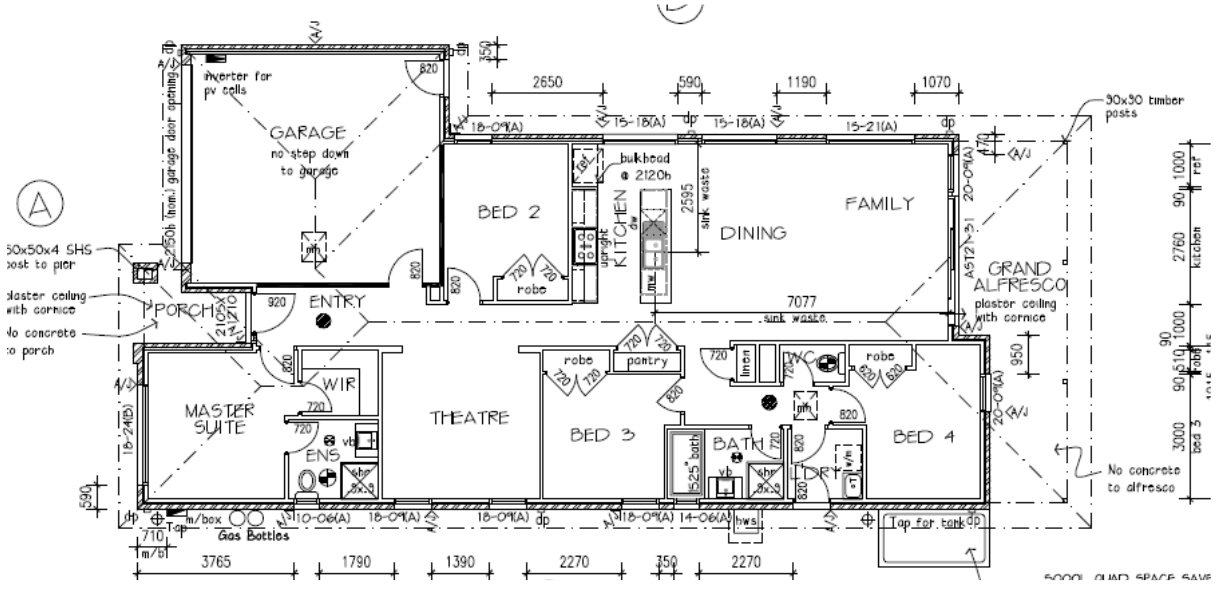
### View from Street

Single storey residence. Consisting of Master bedroom with ensuite and WIR, Bed 2, 3 and 4, Bath, laundry, WC, 2 circulation areas, Kitchen/living/family area, home theatre and double garage.

External alfresco area

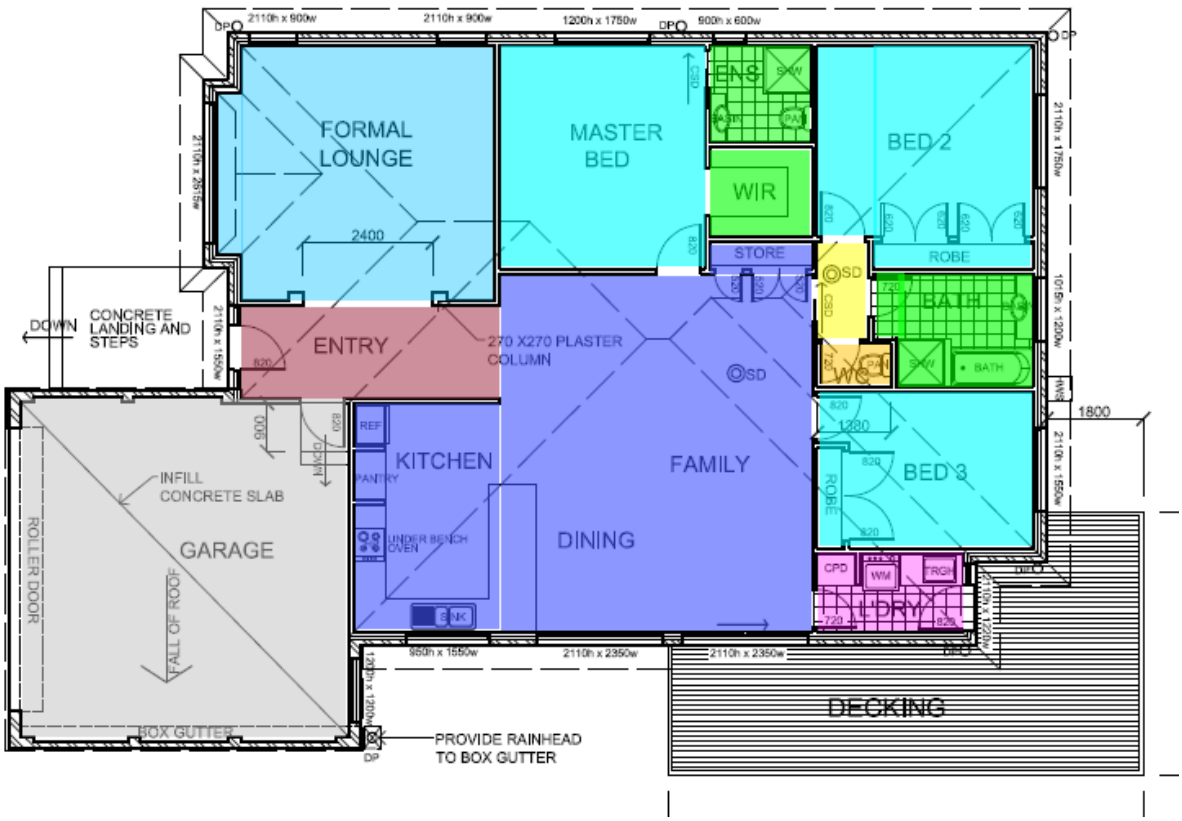
Floor area 188.40 $m^2$. Conditioned floor area of 122.9 $m^2$

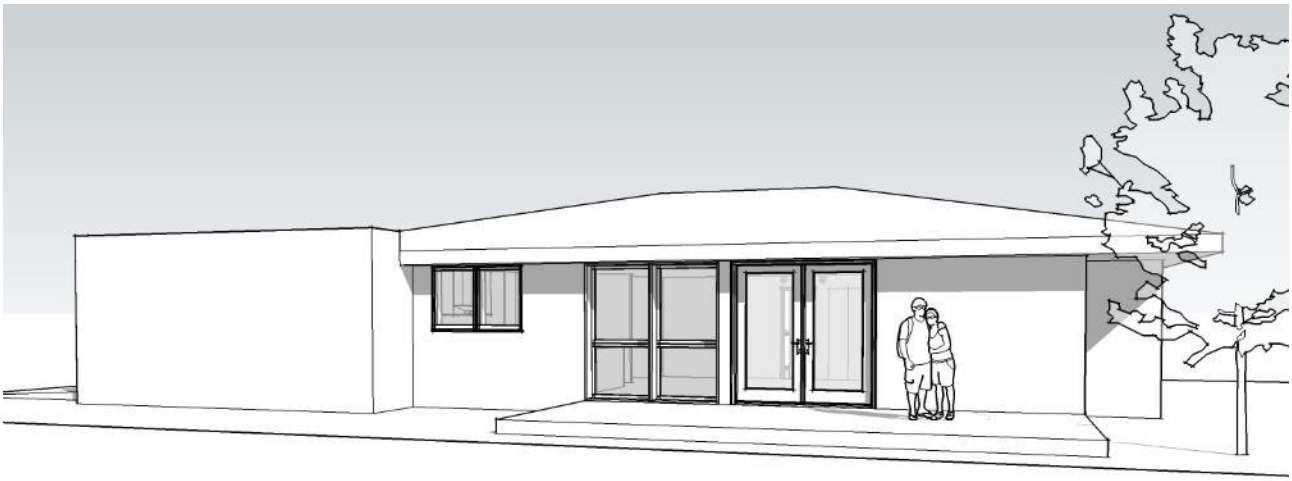
### Floor Plan



## 7.5 SBH05 Small Detached A, HIA small house

### Floor Plan

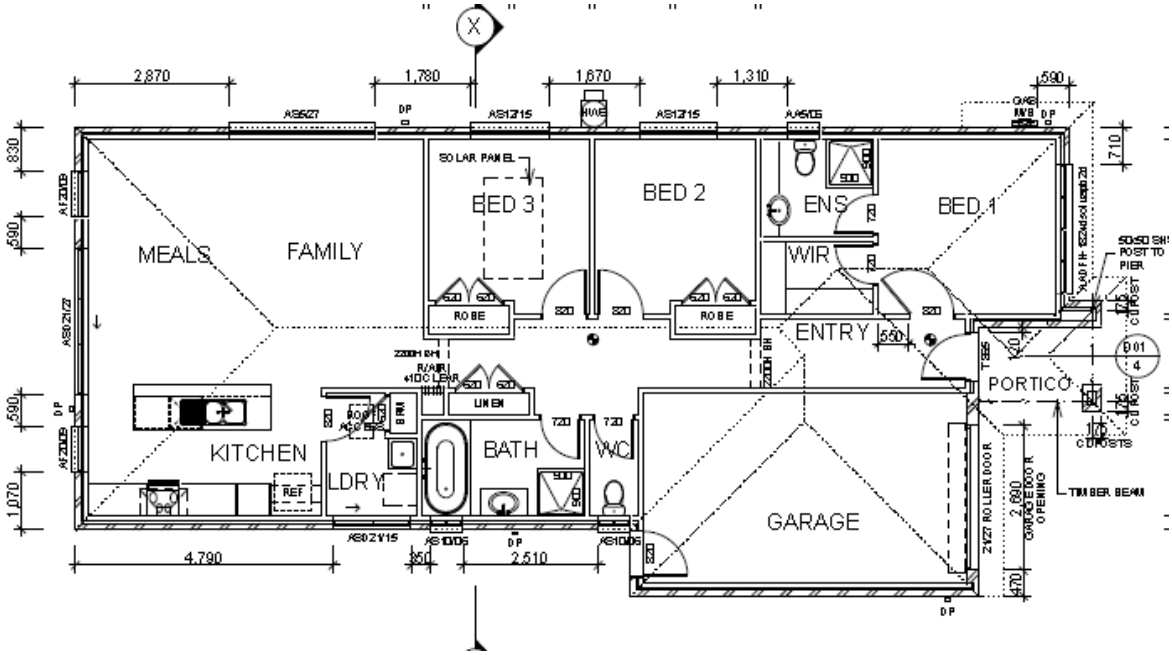


## 7.6 SBH06 Small Detached B, Dennis Family Homes Cambridge 151

### View from Street

### Floor Plan



## 7.7 SBH07 Medium elevated well-ventilated house, hot climate

Tony Isaacs

### Perspective

### Floor Plan

## 7.8 SBH08 Small elevated well-ventilated house, hot climate,

Simplified roof design, based on Troppo Architects

### Perspective

### Upper Floor

## 7.9 SBH09 Medium Hybrid Passive Solar/Ventilated & SBH 11 Passive Solar

Tony Isaacs

### Perspective

### Floor Plan

## 7.10 SBH15 & 16, Medium Semi-detached House, Set of 20, House09: AV Jennings

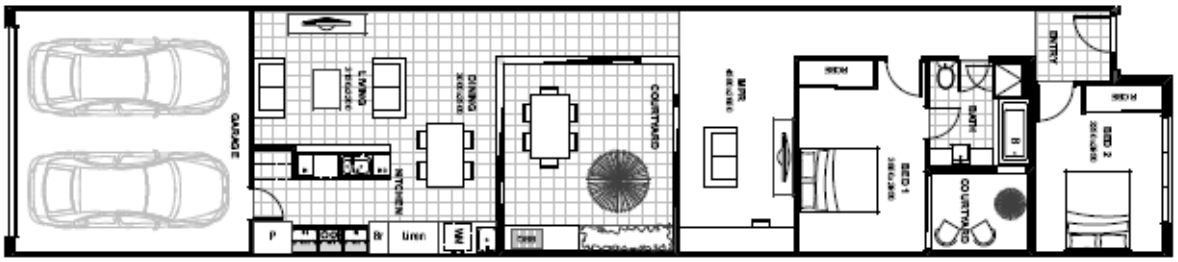
Configured so only 1 side with shared wall

### View from Street

Medium density single storey terrace house, with neighbours on either side. Solar access to front elevation and 2 internal courtyards. The design has 2 bedrooms, bathroom, 2 internal hallways, Multi-purpose room, open plan living/dining/kitchen/laundry, garage with rear access.

Floor area 141.20 $m^2$. Conditioned floor area of 93.6 $m^2$

### Floor Plan



## 7.11 SBH17 & 18 Small Semi Detached

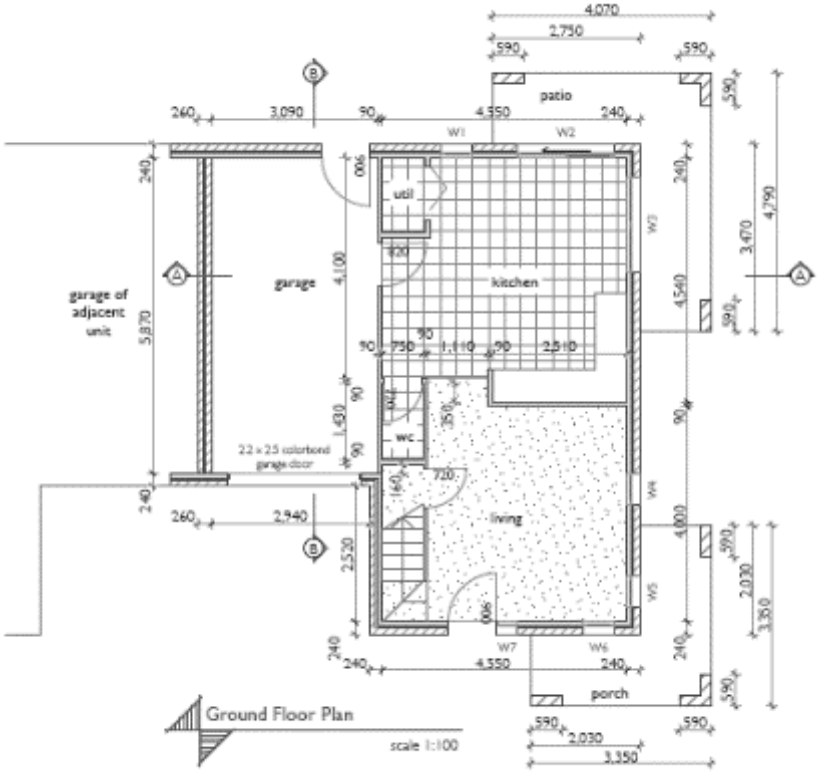
NatHERS software accreditation House 2

### View from Street

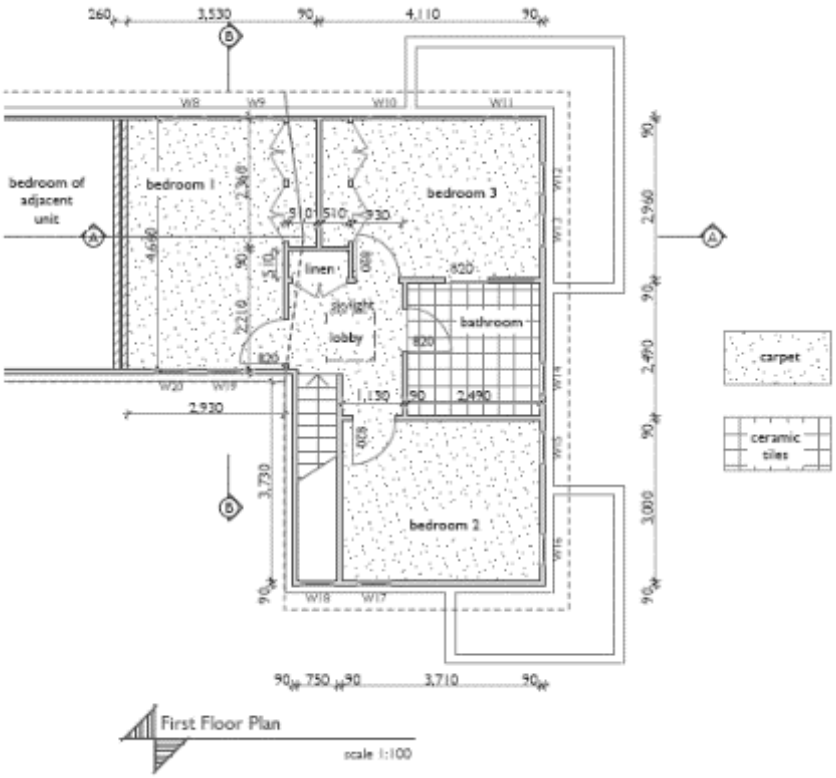
This design is NatHERS Software accreditation House 2. It is a double storey town house containing single garage, 3 bedrooms, living room, kitchen/ family, circulation area/hallway, separate WC, bath and laundry.

Total floor area of 95.5 $m^2$. Net conditioned floor area 81.1 $m^2$

### Ground Floor Plan

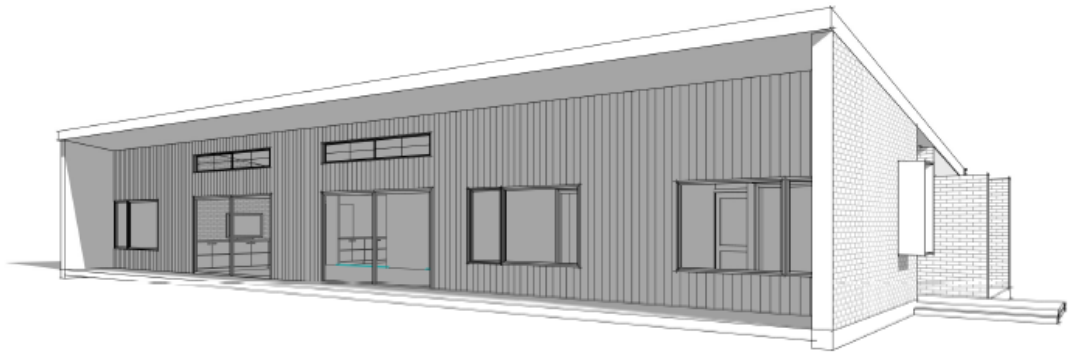


# Upper Floor Plan

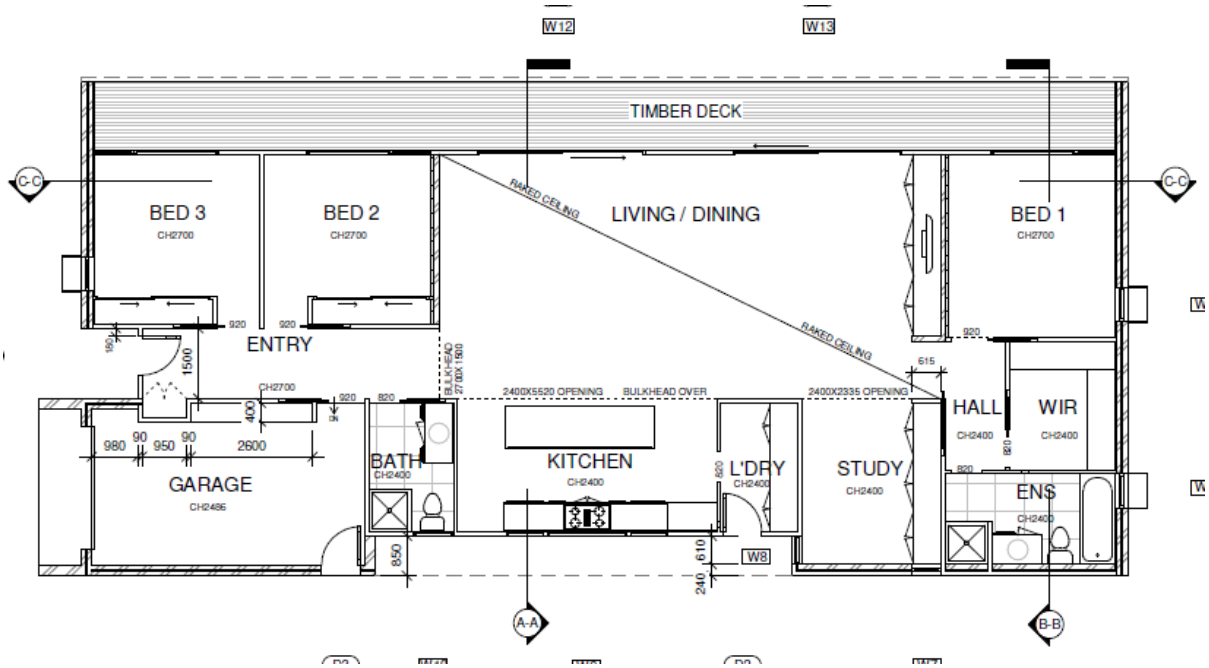


## 7.12 SBH19 Passive Solar, Design for Place

View from north



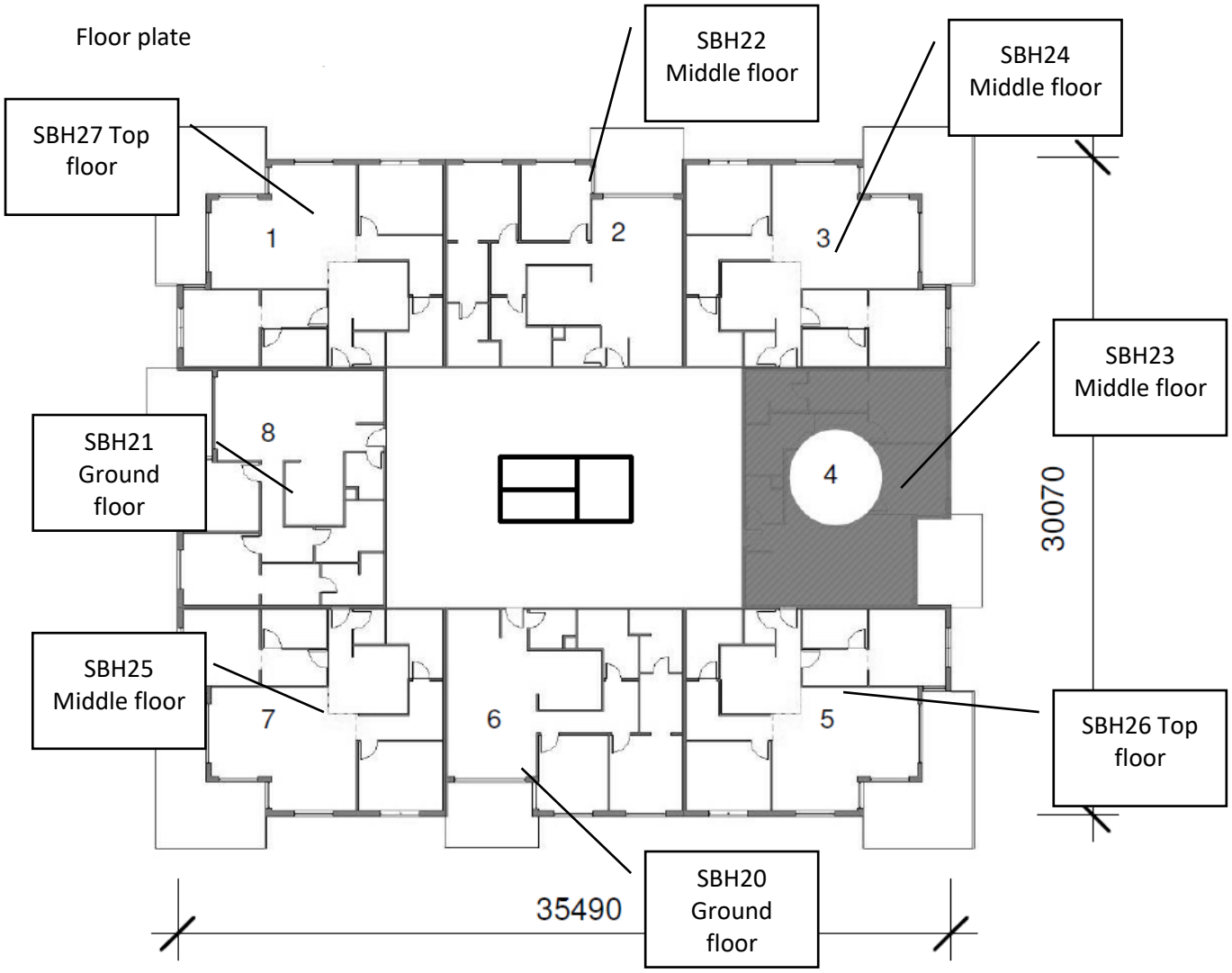
Plan



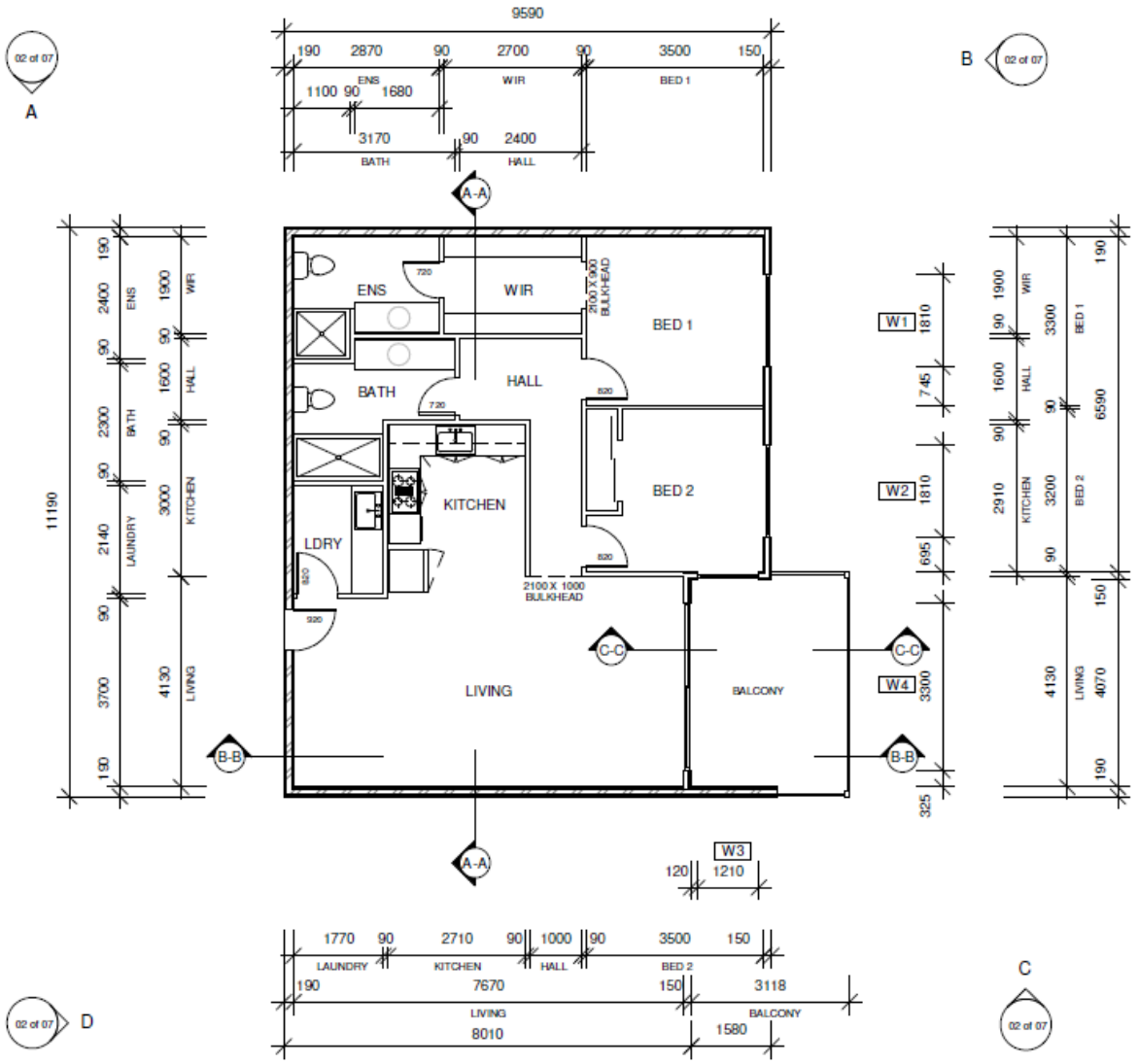
## 7.13 SBH20-27 Apartments

Perspective

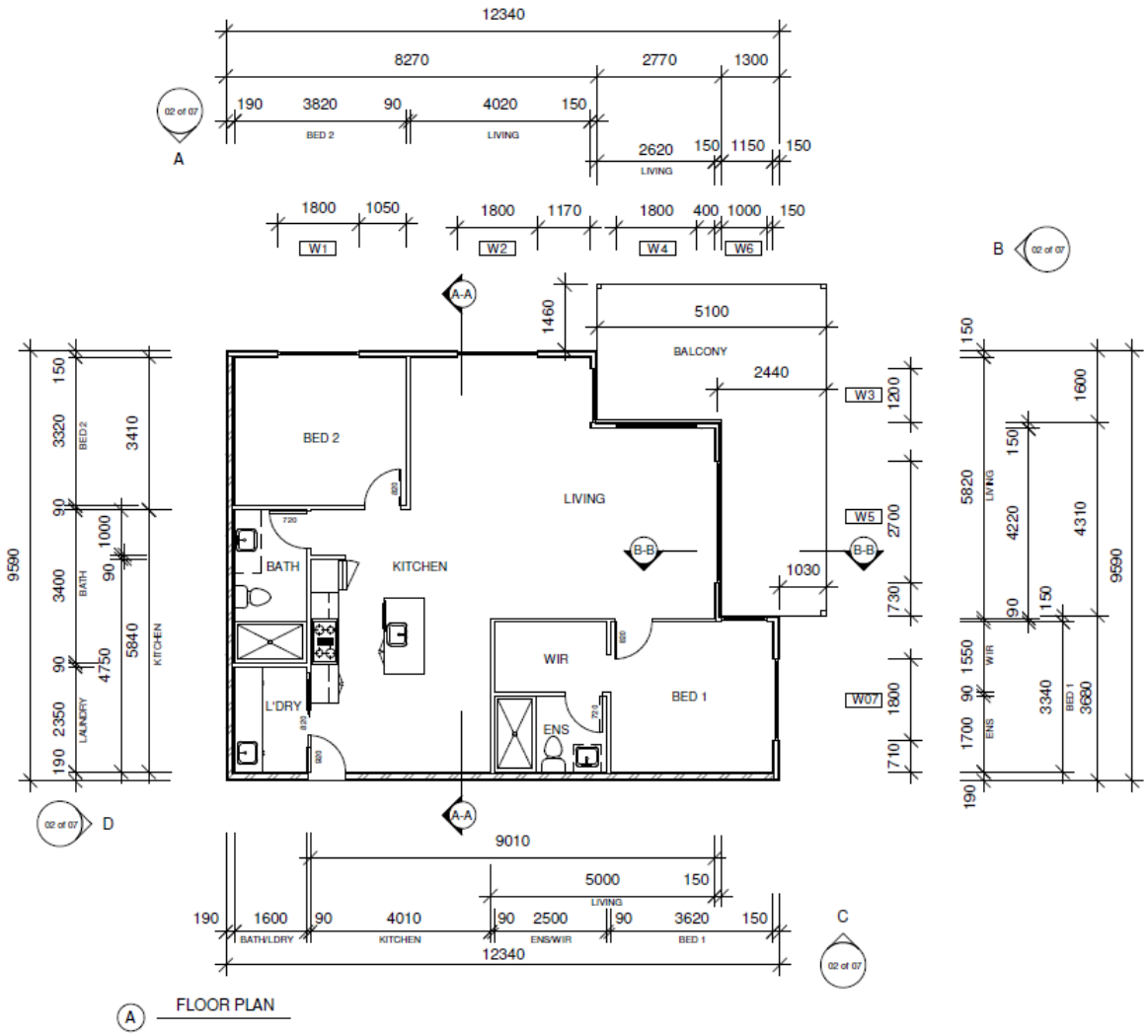
ɔM UNIT


Floor plate
SBH27 Top floor
SBH22 Middle floor
SBH24 Middle floor
SBH23 Middle floor
SBH21 Ground floor
SBH25 Middle floor
SBH26 Top floor
SBH20 Ground floor
1
2
3
4
5
6
7
8
30070
35490

Middle Unit Plan



Corner Unit Plan



# 8 Appendix 2: Star bands analysis spreadsheet

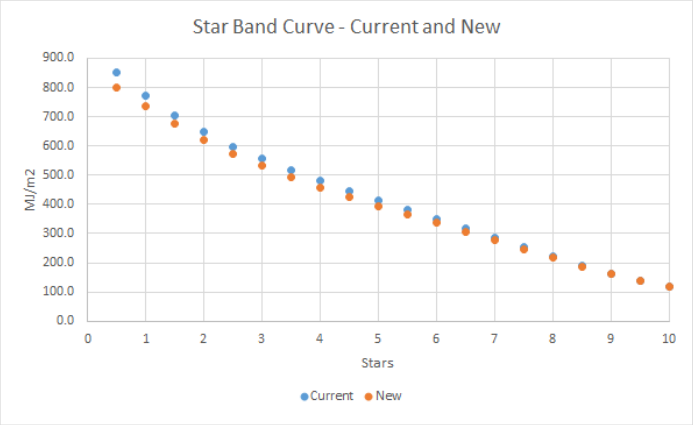
The following pages shows a screenshot of the anlaysis tab for the Spreadsheet. The full functionality of the analysis spreadsheet is shown in a separate document: “New Starband Calculator Description V01.docx” which is provided separately to this report.

# NCC 2022 - Starbands Analysis Sheet

Climate: 1 Darwin

Component Base Climates

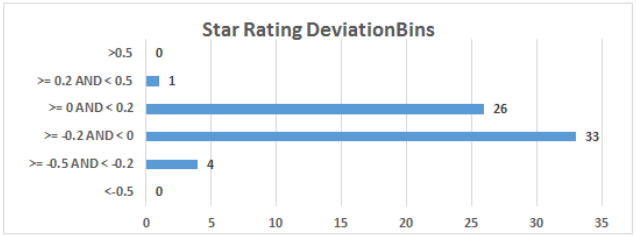
| 1 | 32 | 10 |
|---|---|---|




| Star | Current | New |
|---|---|---|
| 0.5 | 853.0 | 800.5 |
| 1 | 773.0 | 735.1 |
| 1.5 | 706.0 | 675.6 |
| 2 | 648.0 | 622.1 |
| 2.5 | 598.0 | 574.2 |
| 3 | 555.0 | 531.4 |
| 3.5 | 516.0 | 492.9 |
| 4 | 480.0 | 458.0 |
| 4.5 | 446.0 | 425.6 |
| 5 | 413.0 | 395.0 |
| 5.5 | 381.0 | 365.4 |
| 6 | 349.0 | 336.1 |
| 6.5 | 317.0 | 306.6 |
| 7 | 285.0 | 276.7 |
| 7.5 | 253.0 | 246.5 |
| 8 | 222.0 | 216.5 |
| 8.5 | 192.0 | 187.6 |
| 9 | 164.0 | 161.2 |
| 9.5 | 140.0 | 139.2 |
| 10 | 119.0 | 119.0 |

## Star Rating Deviation Profile Analysis

| Analysis Range (Current Stars) | Lower | Upper |
|---|---|---|
| | 5.5 | 6.5 |




| Range | Number | Percentage |
|---|---|---|
| <-0.5 | 0 | 0% |
| >= -0.5 AND < -0.2 | 4 | 6% |
| >= -0.2 AND < 0 | 33 | 52% |
| >= 0 AND < 0.2 | 26 | 41% |
| >= 0.2 AND < 0.5 | 1 | 2% |
| >0.5 | 0 | 0% |

**Curve fit Details**

5th level polynomial

| | |
|---|---|
| ^5 | 0.01612592138029700 |
| ^4 | -0.31407390787165300 |
| ^3 | 1.25570748692565000 |
| ^2 | 10.00920592273750000 |
| ^1 | -147.58412596034200000 |
| Scaling Factor Applied > | 100% |

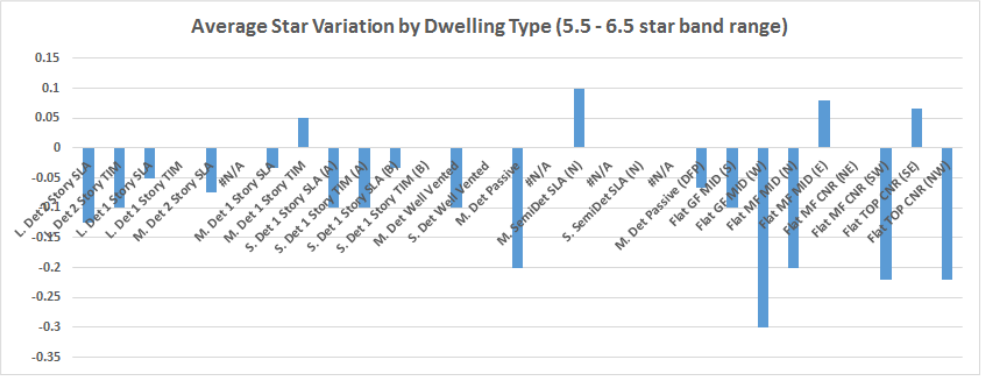
**Notes**

Curve fir ok

**Average star deviation-selected cohort**

- 0.08

| Class | Floor | Storeys | | Climates |
|---|---|---|---|---|
| All | All | All | | All |



# 9 Appendix 3: Impact of rating change sorted into categories for all 69 climates with average rating change at 6 stars held to 0

| CZ No. | Climate Zone | <-0.5 | >= -0.5 AND < -0.2 | >= -0.2 AND < 0 | >= 0 AND < 0.2 | >= 0.2 AND < 0.5 | >0.5 |
|---|---|---|---|---|---|---|---|
| 1 | Darwin | 0.0% | 3.2% | 29.0% | 54.8% | 12.9% | 0.0% |
| 2 | Port Hedland | 0.0% | 36.7% | 10.0% | 13.3% | 40.0% | 0.0% |
| 3 | Longreach | 0.0% | 15.2% | 30.3% | 30.3% | 21.2% | 3.0% |
| 4 | Carnarvon | 0.0% | 12.0% | 52.0% | 20.0% | 12.0% | 4.0% |
| 5 | Townsville | 0.0% | 26.9% | 15.4% | 42.3% | 15.4% | 0.0% |
| 6 | Alice Springs | 0.0% | 33.3% | 16.7% | 33.3% | 16.7% | 0.0% |
| 7 | Rockhampton | 0.0% | 9.1% | 36.4% | 50.0% | 4.5% | 0.0% |
| 8 | Moree | 0.0% | 20.8% | 25.0% | 41.7% | 8.3% | 4.2% |
| 9 | Amberley | 0.0% | 12.0% | 40.0% | 32.0% | 16.0% | 0.0% |
| 10 | Brisbane | 0.0% | 26.1% | 13.0% | 43.5% | 17.4% | 0.0% |
| 11 | Coffs Harbour | 0.0% | 22.7% | 18.2% | 45.5% | 9.1% | 4.5% |
| 12 | Geraldton | 0.0% | 0.0% | 55.6% | 38.9% | 5.6% | 0.0% |
| 13 | Perth | 0.0% | 19.2% | 23.1% | 34.6% | 23.1% | 0.0% |
| 14 | Armidale | 0.0% | 9.4% | 50.0% | 28.1% | 12.5% | 0.0% |
| 15 | Williamtown | 0.0% | 10.7% | 42.9% | 32.1% | 14.3% | 0.0% |
| 16 | Adelaide | 0.0% | 0.0% | 47.1% | 41.2% | 11.8% | 0.0% |
| 17 | Sydney RO | 0.0% | 28.6% | 28.6% | 28.6% | 0.0% | 14.3% |
| 18 | Nowra | 0.0% | 11.1% | 29.6% | 55.6% | 3.7% | 0.0% |
| 19 | Charleville | 0.0% | 0.0% | 51.9% | 44.4% | 3.7% | 0.0% |
| 20 | Wagga | 0.0% | 10.3% | 33.3% | 43.6% | 12.8% | 0.0% |
| 21 | Melbourne RO | 0.0% | 15.4% | 30.8% | 46.2% | 7.7% | 0.0% |
| 22 | East Sale | 0.0% | 5.3% | 47.4% | 47.4% | 0.0% | 0.0% |
| 23 | Launceston (Ti Tree Bend) | 0.0% | 0.0% | 50.0% | 41.7% | 8.3% | 0.0% |
| 24 | Canberra | 0.0% | 0.0% | 32.3% | 61.3% | 6.5% | 0.0% |
| 25 | Cabramurra (Alpine?) | 0.0% | 0.0% | 31.6% | 65.8% | 2.6% | 0.0% |
| 26 | Hobart | 0.0% | 0.0% | 56.7% | 43.3% | 0.0% | 0.0% |
| 27 | Mildura | 0.0% | 2.7% | 45.9% | 32.4% | 18.9% | 0.0% |
| 28 | Richmond | 0.0% | 3.4% | 48.3% | 37.9% | 10.3% | 0.0% |
| 29 | Weipa | 0.0% | 20.7% | 24.1% | 41.4% | 10.3% | 3.4% |
| 30 | Wyndham | 0.0% | 19.2% | 26.9% | 30.8% | 19.2% | 3.8% |
| 31 | Willis Island | 26.7% | 20.0% | 0.0% | 13.3% | 13.3% | 26.7% |
| 32 | Cairns | 0.0% | 14.3% | 32.1% | 39.3% | 14.3% | 0.0% |
| 33 | Broome | 0.0% | 0.0% | 23.7% | 65.8% | 10.5% | 0.0% |
| 34 | Learmonth | 0.0% | 0.0% | 42.9% | 52.4% | 4.8% | 0.0% |
| 35 | Mackay | 0.0% | 8.7% | 43.5% | 34.8% | 13.0% | 0.0% |
| 36 | Gladstone | 12.5% | 12.5% | 25.0% | 31.3% | 12.5% | 6.3% |
| 37 | Halls Creek | 0.0% | 11.5% | 26.9% | 46.2% | 15.4% | 0.0% |
| 38 | Tennant Creek | 0.0% | 4.8% | 33.3% | 61.9% | 0.0% | 0.0% |
| 39 | MT Isa | 0.0% | 6.7% | 20.0% | 63.3% | 10.0% | 0.0% |
| 40 | Newman | 0.0% | 33.3% | 29.2% | 20.8% | 12.5% | 4.2% |
| 41 | Giles | 0.0% | 10.7% | 32.1% | 50.0% | 7.1% | 0.0% |
| 42 | Meekathara | 0.0% | 0.0% | 60.7% | 28.6% | 10.7% | 0.0% |

| CZ No. | Climate Zone | <-0.5 | >= -0.5 AND < -0.2 | >= -0.2 AND < 0 | >= 0 AND < 0.2 | >= 0.2 AND < 0.5 | >0.5 |
|---|---|---|---|---|---|---|---|
| **43** | Oodnadatta | 0.0% | 3.8% | 26.9% | 61.5% | 7.7% | 0.0% |
| **44** | Kalgoorlie | **4.8%** | 19.0% | 14.3% | 42.9% | 14.3% | 4.8% |
| **45** | Woomera | 0.0% | 0.0% | 55.0% | 25.0% | 20.0% | 0.0% |
| **46** | Cobar | 0.0% | 16.7% | 37.5% | 25.0% | 16.7% | 4.2% |
| **47** | Bickley | 0.0% | 3.2% | 25.8% | 67.7% | 3.2% | 0.0% |
| **48** | Dubbo | 0.0% | 3.1% | 53.1% | 25.0% | 18.8% | 0.0% |
| **49** | Katanning | 0.0% | 24.0% | 8.0% | 44.0% | 12.0% | 12.0% |
| **50** | Oakey | **5.0%** | 10.0% | 45.0% | 25.0% | 5.0% | 10.0% |
| **51** | Forrest | 0.0% | 0.0% | 42.9% | 50.0% | 7.1% | 0.0% |
| **52** | Swanbourne | **12.0%** | 20.0% | 12.0% | 24.0% | 20.0% | 12.0% |
| **53** | Ceduna | 0.0% | 0.0% | 20.7% | 75.9% | 3.4% | 0.0% |
| **54** | Mandurah | **6.9%** | 27.6% | 6.9% | 20.7% | 34.5% | 3.4% |
| **55** | Esperance | 0.0% | 0.0% | 44.4% | 44.4% | 11.1% | 0.0% |
| **56** | Mascot (Airport) | 0.0% | 11.1% | 29.6% | 25.9% | 29.6% | 3.7% |
| **57** | Manjimup | 0.0% | 0.0% | 55.3% | 34.2% | 10.5% | 0.0% |
| **58** | Albany | 0.0% | 0.0% | 15.6% | 84.4% | 0.0% | 0.0% |
| **59** | Mt Lofty | 0.0% | 0.0% | 21.9% | 78.1% | 0.0% | 0.0% |
| **60** | Tullamarine (Airport) | 0.0% | 0.0% | 41.0% | 56.4% | 2.6% | 0.0% |
| **61** | Mt Gambier | 0.0% | 0.0% | 36.1% | 63.9% | 0.0% | 0.0% |
| **62** | Moorabbin (Airport?) | 0.0% | 0.0% | 45.7% | 45.7% | 8.6% | 0.0% |
| **63** | Warrnambool | 0.0% | 0.0% | 36.1% | 63.9% | 0.0% | 0.0% |
| **64** | Cape Otway | 0.0% | 0.0% | 35.5% | 51.6% | 12.9% | 0.0% |
| **65** | Orange | 0.0% | 0.0% | 41.7% | 58.3% | 0.0% | 0.0% |
| **66** | Ballarat | 0.0% | 7.7% | 23.1% | 61.5% | 7.7% | 0.0% |
| **67** | Low Head | 0.0% | 0.0% | 62.5% | 18.8% | 18.8% | 0.0% |
| **68** | Launceston (Airport) | 0.0% | 5.4% | 18.9% | 75.7% | 0.0% | 0.0% |
| **69** | Thredbo Village | 0.0% | 0.0% | 48.6% | 45.9% | 5.4% | 0.0% |

# 10 Appendix 4 Change to heating and cooling loads at 5, 6 and 7 stars

## 10.1 6 star average heating and cooling loads across sample

| | Current 06 stars | | New | | Change Heat | | Change Cool | |
|---|---|---|---|---|---|---|---|---|
| Location | Heating | Total Cool | Heating | Total Cool | Change | % | Change | % |
| Darwin | 0.0 | 362.8 | 0.0 | 350.3 | 0.0 | 0% | -12.6 | -3% |
| Port Hedland | 0.3 | 221.6 | 0.3 | 237.8 | 0.0 | 0% | 16.3 | 7% |
| Longreach | 5.1 | 134.4 | 7.5 | 112.5 | 2.5 | 49% | -22.0 | -16% |
| Carnarvon | 3.1 | 56.0 | 2.1 | 60.0 | -1.1 | -34% | 4.0 | 7% |
| Townsville | 0.3 | 136.2 | 0.1 | 146.2 | -0.2 | 0% | 10.0 | 7% |
| Alice Springs | 32.9 | 89.8 | 27.2 | 81.2 | -5.7 | -17% | -8.6 | -10% |
| Rockhampton | 3.5 | 82.0 | 4.4 | 97.4 | 0.9 | 0% | 15.4 | 19% |
| Moree | 55.1 | 46.5 | 53.3 | 47.9 | -1.8 | -3% | 1.4 | 3% |
| Amberley | 15.7 | 47.8 | 18.8 | 43.7 | 3.0 | 19% | -4.1 | -9% |
| Brisbane | 11.6 | 35.5 | 8.9 | 49.1 | -2.8 | -24% | 13.6 | 38% |
| Coffs Harbour | 13.8 | 40.5 | 15.1 | 36.2 | 1.3 | 10% | -4.3 | -11% |
| Geraldton | 11.8 | 51.8 | 9.9 | 46.7 | -1.9 | -16% | -5.1 | -10% |
| Perth | 24.1 | 44.7 | 28.8 | 45.8 | 4.7 | 20% | 1.1 | 3% |
| Armidale | 104.4 | 17.4 | 138.3 | 12.4 | 33.9 | 32% | -5.0 | -29% |
| Williamtown | 35.2 | 34.1 | 34.8 | 32.9 | -0.4 | 0% | -1.3 | -4% |
| Adelaide | 43.3 | 50.1 | 39.7 | 41.2 | -3.5 | -8% | -8.9 | -18% |
| Sydney RO | 13.8 | 34.5 | 22.3 | 22.8 | 8.4 | 61% | -11.7 | -34% |
| Nowra | 53.2 | 29.9 | 50.3 | 31.9 | -2.9 | -5% | 2.0 | 7% |
| Charleville | 30.8 | 66.9 | 32.3 | 66.8 | 1.4 | 5% | -0.1 | 0% |
| Wagga | 95.9 | 41.6 | 86.8 | 38.8 | -9.1 | -9% | -2.8 | -7% |
| Melbourne RO | 87.7 | 26.8 | 53.3 | 28.2 | -34.4 | -39% | 1.4 | 5% |
| East Sale | 106.6 | 21.7 | 111.2 | 13.7 | 4.6 | 4% | -8.0 | -37% |
| Launceston (Ti Tree Bend) | 140.8 | 11.3 | 124.6 | 11.2 | -16.2 | -12% | -0.1 | 0% |
| Canberra | 136.7 | 22.8 | 131.8 | 23.1 | -4.9 | -4% | 0.3 | 0% |
| Cabramurra (Alpine) | 349.7 | 6.5 | 362.9 | 3.5 | 13.1 | 4% | -3.0 | -46% |
| Hobart | 139.3 | 4.7 | 136.7 | 5.1 | -2.6 | -2% | 0.4 | 0% |
| Mildura | 56.8 | 51.3 | 56.3 | 42.6 | -0.5 | 0% | -8.7 | -17% |
| Richmond | 36.4 | 46.9 | 37.2 | 37.2 | 0.8 | 0% | -9.6 | -21% |
| Weipa | 0.0 | 323.9 | 0.0 | 241.0 | 0.0 | 0% | -82.9 | -26% |
| Wyndham | 0.0 | 438.8 | 0.0 | 402.4 | 0.0 | 0% | -36.4 | -8% |
| Willis Island | 0.0 | 201.7 | 0.0 | 250.0 | 0.0 | 0% | 48.3 | 24% |
| Cairns | 0.0 | 130.3 | 0.1 | 137.7 | 0.1 | 0% | 7.4 | 6% |
| Broome | 0.1 | 294.8 | 0.1 | 287.0 | 0.0 | 0% | -7.7 | -3% |
| Learmonth | 0.4 | 136.8 | 0.4 | 136.0 | 0.1 | 0% | -0.8 | 0% |
| Mackay | 0.9 | 101.1 | 1.4 | 97.4 | 0.5 | 0% | -3.7 | -4% |
| Gladstone | 1.3 | 59.1 | 1.0 | 80.0 | -0.4 | 0% | 20.9 | 35% |
| Halls Creek | 0.2 | 222.3 | 0.1 | 197.5 | -0.1 | 0% | -24.8 | -11% |
| Tennant Creek | 0.6 | 186.7 | 0.5 | 185.7 | -0.1 | 0% | -0.9 | 0% |
| MT Isa | 2.4 | 162.9 | 1.9 | 149.4 | -0.5 | 0% | -13.5 | -8% |
| Newman | 7.2 | 130.4 | 10.4 | 102.5 | 3.2 | 45% | -28.0 | -21% |
| Giles | 19.9 | 94.1 | 17.8 | 87.4 | -2.2 | -11% | -6.7 | -7% |
| Meekathara | 15.3 | 63.4 | 18.7 | 80.6 | 3.4 | 22% | 17.2 | 27% |

| Location | Current 06 stars Heating | Total Cool | New Heating | Total Cool | Change Heat Change | % | Change Cool Change | % |
|---|---|---|---|---|---|---|---|---|
| **Oodnadatta** | 23.1 | 98.9 | 23.7 | 85.1 | 0.7 | 0% | -13.7 | -14% |
| **Kalgoorlie** | 29.8 | 40.3 | 30.1 | 51.5 | 0.3 | 0% | 11.2 | 28% |
| **Woomera** | 51.5 | 52.2 | 57.3 | 35.6 | 5.8 | 11% | -16.6 | -32% |
| **Cobar** | 58.3 | 45.7 | 58.4 | 47.4 | 0.2 | 0% | 1.6 | 4% |
| **Bickley** | 52.7 | 35.5 | 51.6 | 37.2 | -1.2 | -2% | 1.7 | 5% |
| **Dubbo** | 65.7 | 31.6 | 60.0 | 37.1 | -5.7 | -9% | 5.5 | 17% |
| **Katanning** | 54.6 | 34.4 | 76.8 | 22.4 | 22.2 | 41% | -12.0 | -35% |
| **Oakey** | 29.3 | 48.8 | 38.9 | 35.5 | 9.6 | 33% | -13.3 | -27% |
| **Forrest** | 32.6 | 33.3 | 39.5 | 36.5 | 6.9 | 21% | 3.2 | 10% |
| **Swanbourne** | 18.2 | 25.6 | 16.6 | 41.9 | -1.6 | -9% | 16.3 | 64% |
| **Ceduna** | 39.5 | 35.0 | 37.8 | 34.1 | -1.7 | -4% | -0.9 | 0% |
| **Mandurah** | 25.2 | 39.2 | 15.9 | 32.4 | -9.4 | -37% | -6.8 | -17% |
| **Esperance** | 43.4 | 19.2 | 38.4 | 15.1 | -5.0 | -12% | -4.1 | -22% |
| **Mascot (Airport)** | 26.8 | 28.9 | 21.0 | 20.3 | -5.8 | -22% | -8.5 | -30% |
| **Manjimup** | 80.0 | 28.2 | 77.8 | 22.9 | -2.3 | -3% | -5.4 | -19% |
| **Albany** | 65.7 | 11.9 | 58.8 | 9.7 | -6.9 | -10% | -2.2 | -19% |
| **Mt Lofty** | 226.1 | 13.4 | 214.7 | 17.4 | -11.4 | -5% | 4.0 | 30% |
| **Tullamarine (Airport)** | 116.2 | 21.0 | 106.3 | 22.4 | -9.9 | -9% | 1.4 | 7% |
| **Mt Gambier** | 121.9 | 14.5 | 117.5 | 12.5 | -4.3 | -4% | -2.0 | -13% |
| **Moorabbin (Airport)** | 105.4 | 18.1 | 86.8 | 20.8 | -18.6 | -18% | 2.7 | 15% |
| **Warrnambool** | 127.4 | 16.9 | 126.1 | 11.3 | -1.3 | -1% | -5.7 | -34% |
| **Cape Otway** | 114.9 | 16.2 | 106.4 | 10.6 | -8.5 | -7% | -5.6 | -35% |
| **Orange** | 201.4 | 12.7 | 177.6 | 15.9 | -23.8 | -12% | 3.3 | 26% |
| **Ballarat** | 176.0 | 21.6 | 182.3 | 22.4 | 6.3 | 4% | 0.8 | 0% |
| **Low Head** | 108.9 | 4.9 | 136.7 | 3.4 | 27.8 | 26% | -1.5 | -30% |
| **Launceston (Airport)** | 172.1 | 3.1 | 180.4 | 5.6 | 8.3 | 5% | 2.5 | 82% |
| **Thredbo Village** | 279.0 | 11.3 | 327.5 | 4.2 | 48.6 | 17% | -7.1 | -63% |

## 10.2 5 star average heating and cooling loads across sample

| | Current 05 stars | | New | | Change Heat | | Change Cool | |
|---|---|---|---|---|---|---|---|---|
| Location | Heating | Total Cool | Heating | Total Cool | Change | % | Change | % |
| Darwin | 0.0 | 414.5 | 0.0 | 398.9 | 0.0 | 0% | -15.6 | -4% |
| Port Hedland | 0.4 | 260.3 | 0.4 | 276.4 | 0.0 | 0% | 16.1 | 6% |
| Longreach | 6.5 | 167.9 | 9.7 | 141.3 | 3.2 | 50% | -26.7 | -16% |
| Carnarvon | 4.3 | 66.8 | 2.9 | 72.6 | -1.4 | -33% | 5.8 | 9% |
| Townsville | 0.4 | 161.9 | 0.2 | 171.9 | -0.2 | 0% | 10.0 | 6% |
| Alice Springs | 38.8 | 116.4 | 32.7 | 105.1 | -6.1 | -16% | -11.3 | -10% |
| Rockhampton | 3.9 | 103.3 | 4.9 | 121.2 | 1.0 | 26% | 17.9 | 17% |
| Moree | 63.6 | 62.3 | 61.8 | 62.5 | -1.8 | -3% | 0.2 | 0% |
| Amberley | 18.3 | 62.9 | 21.8 | 58.4 | 3.5 | 19% | -4.5 | -7% |
| Brisbane | 13.6 | 45.5 | 10.6 | 60.7 | -3.0 | -22% | 15.1 | 33% |
| Coffs Harbour | 18.7 | 49.9 | 20.3 | 44.6 | 1.5 | 8% | -5.2 | -11% |
| Geraldton | 16.4 | 66.5 | 14.0 | 60.8 | -2.4 | -15% | -5.7 | -9% |
| Perth | 31.7 | 58.5 | 37.2 | 58.7 | 5.5 | 17% | 0.2 | 0% |
| Armidale | 137.2 | 19.1 | 177.4 | 13.6 | 40.3 | 29% | -5.5 | -29% |
| Williamtown | 44.7 | 43.3 | 44.0 | 41.7 | -0.6 | 0% | -1.7 | -4% |
| Adelaide | 57.4 | 60.8 | 52.9 | 50.3 | -4.5 | -8% | -10.4 | -17% |
| Sydney RO | 18.5 | 42.7 | 28.5 | 29.6 | 10.0 | 54% | -13.0 | -31% |
| Nowra | 70.9 | 32.6 | 67.1 | 35.3 | -3.8 | -5% | 2.8 | 9% |
| Charleville | 36.7 | 85.7 | 38.2 | 85.0 | 1.5 | 4% | -0.8 | 0% |
| Wagga | 124.2 | 46.4 | 112.3 | 43.2 | -11.9 | -10% | -3.3 | -7% |
| Melbourne RO | 114.3 | 29.0 | 71.2 | 30.5 | -43.1 | -38% | 1.5 | 5% |
| East Sale | 140.0 | 23.6 | 144.4 | 15.1 | 4.4 | 3% | -8.4 | -36% |
| Launceston (Ti Tree Bend) | 181.7 | 12.5 | 162.2 | 12.2 | -19.4 | -11% | -0.4 | 0% |
| Canberra | 177.2 | 24.9 | 169.9 | 25.5 | -7.3 | -4% | 0.6 | 0% |
| Cabramurra (Alpine) | 434.7 | 6.9 | 450.4 | 3.9 | 15.7 | 4% | -3.0 | -44% |
| Hobart | 180.9 | 5.3 | 176.9 | 5.6 | -4.0 | -2% | 0.2 | 0% |
| Mildura | 73.2 | 63.3 | 72.7 | 54.5 | -0.5 | 0% | -8.9 | -14% |
| Richmond | 49.0 | 58.0 | 49.6 | 47.3 | 0.6 | 0% | -10.7 | -18% |
| Weipa | 0.0 | 377.9 | 0.0 | 284.2 | 0.0 | 0% | -93.7 | -25% |
| Wyndham | 0.0 | 504.7 | 0.0 | 459.6 | 0.0 | 0% | -45.1 | -9% |
| Willis Island | 0.0 | 233.1 | 0.0 | 290.1 | 0.0 | 0% | 57.0 | 24% |
| Cairns | 0.0 | 154.6 | 0.2 | 164.5 | 0.1 | 0% | 9.9 | 6% |
| Broome | 0.2 | 335.1 | 0.1 | 326.5 | 0.0 | 0% | -8.7 | -3% |
| Learmonth | 0.5 | 167.3 | 0.6 | 166.8 | 0.1 | 0% | -0.4 | 0% |
| Mackay | 1.1 | 122.6 | 1.6 | 116.6 | 0.5 | 0% | -6.0 | -5% |
| Gladstone | 1.5 | 75.9 | 1.1 | 98.7 | -0.4 | 0% | 22.8 | 30% |
| Halls Creek | 0.3 | 264.6 | 0.1 | 237.5 | -0.1 | 0% | -27.1 | -10% |
| Tennant Creek | 0.9 | 225.8 | 0.8 | 223.9 | -0.1 | 0% | -1.9 | -1% |
| MT Isa | 3.3 | 198.6 | 2.5 | 181.4 | -0.8 | 0% | -17.2 | -9% |
| Newman | 9.2 | 161.6 | 13.1 | 127.9 | 4.0 | 43% | -33.7 | -21% |
| Giles | 23.9 | 119.1 | 21.2 | 109.8 | -2.7 | -11% | -9.2 | -8% |
| Meekathara | 18.6 | 81.3 | 22.6 | 102.8 | 4.0 | 21% | 21.5 | 26% |
| Oodnadatta | 27.8 | 124.2 | 28.6 | 106.9 | 0.8 | 0% | -17.3 | -14% |
| Kalgoorlie | 38.4 | 53.0 | 38.4 | 66.1 | 0.0 | 0% | 13.1 | 25% |
| Woomera | 59.8 | 68.3 | 66.2 | 48.6 | 6.4 | 11% | -19.8 | -29% |
| Cobar | 67.3 | 60.1 | 67.6 | 62.5 | 0.3 | 0% | 2.4 | 4% |
| Bickley | 69.5 | 46.0 | 67.9 | 47.1 | -1.6 | -2% | 1.0 | 2% |
| Dubbo | 84.1 | 41.4 | 77.4 | 47.2 | -6.7 | -8% | 5.8 | 14% |

| | Current 05 stars | | New | | Change Heat | | Change Cool | |
|---|---|---|---|---|---|---|---|---|
| **Location** | **Heating** | **Total Cool** | **Heating** | **Total Cool** | **Change** | **%** | **Change** | **%** |
| **Katanning** | 72.1 | 45.1 | 98.4 | 29.4 | 26.3 | 37% | -15.7 | -35% |
| **Oakey** | 37.5 | 62.6 | 49.1 | 47.6 | 11.5 | 31% | -15.0 | -24% |
| **Forrest** | 42.0 | 45.7 | 49.8 | 50.2 | 7.8 | 19% | 4.5 | 10% |
| **Swanbourne** | 24.2 | 33.7 | 22.3 | 52.7 | -1.9 | -8% | 19.0 | 56% |
| **Ceduna** | 52.7 | 44.4 | 50.3 | 43.7 | -2.4 | -4% | -0.7 | 0% |
| **Mandurah** | 32.7 | 51.4 | 21.2 | 41.3 | -11.5 | -35% | -10.1 | -20% |
| **Esperance** | 58.6 | 21.5 | 52.4 | 17.2 | -6.2 | -11% | -4.3 | -20% |
| **Mascot (Airport)** | 34.5 | 36.0 | 27.0 | 26.1 | -7.5 | -22% | -9.9 | -27% |
| **Manjimup** | 106.1 | 31.0 | 102.8 | 25.0 | -3.3 | -3% | -6.1 | -20% |
| **Albany** | 88.9 | 13.1 | 80.1 | 10.9 | -8.8 | -10% | -2.2 | -17% |
| **Mt Lofty** | 283.4 | 14.2 | 269.7 | 18.5 | -13.6 | -5% | 4.3 | 30% |
| **Tullamarine (Airport)** | 150.0 | 23.0 | 136.7 | 24.4 | -13.3 | -9% | 1.4 | 6% |
| **Mt Gambier** | 159.9 | 16.1 | 154.1 | 14.0 | -5.8 | -4% | -2.1 | -13% |
| **Moorabbin (Airport)** | 137.4 | 19.8 | 112.9 | 22.6 | -24.5 | -18% | 2.8 | 14% |
| **Warrnambool** | 166.1 | 18.3 | 163.3 | 12.4 | -2.8 | -2% | -5.9 | -32% |
| **Cape Otway** | 148.1 | 17.2 | 138.8 | 11.3 | -9.3 | -6% | -5.9 | -34% |
| **Orange** | 256.6 | 13.5 | 225.0 | 17.1 | -31.5 | -12% | 3.6 | 26% |
| **Ballarat** | 222.9 | 23.4 | 230.4 | 24.2 | 7.4 | 3% | 0.8 | 0% |

## 10.3 7 star average heating and cooling loads across sample

| | Current 07 stars | | New | | Change Heat | | Change Cool | |
|---|---|---|---|---|---|---|---|---|
| **Location** | Heating | Total Cool | Heating | Total Cool | Change | % | Change | % |
| **Darwin** | 0.0 | 309.6 | 0.0 | 299.8 | 0.0 | 0% | -9.8 | -3% |
| **Port Hedland** | 0.2 | 183.4 | 0.2 | 197.9 | 0.0 | 0% | 14.5 | 8% |
| **Longreach** | 3.5 | 103.9 | 5.3 | 85.9 | 1.8 | 51% | -18.0 | -17% |
| **Carnarvon** | 2.2 | 44.8 | 1.5 | 47.6 | -0.8 | 0% | 2.7 | 6% |
| **Townsville** | 0.3 | 110.2 | 0.1 | 120.4 | -0.2 | 0% | 10.1 | 9% |
| **Alice Springs** | 26.4 | 66.0 | 21.4 | 59.4 | -5.0 | -19% | -6.6 | -10% |
| **Rockhampton** | 3.5 | 62.2 | 4.3 | 74.7 | 0.9 | 0% | 12.5 | 20% |
| **Moree** | 45.4 | 33.1 | 44.0 | 35.0 | -1.4 | -3% | 1.9 | 6% |
| **Amberley** | 12.8 | 36.6 | 15.2 | 33.3 | 2.5 | 19% | -3.3 | -9% |
| **Brisbane** | 9.4 | 28.3 | 7.0 | 40.4 | -2.4 | -25% | 12.1 | 43% |
| **Coffs Harbour** | 9.5 | 32.4 | 10.4 | 29.4 | 1.0 | 0% | -3.1 | -9% |
| **Geraldton** | 7.8 | 40.2 | 6.5 | 35.6 | -1.3 | -17% | -4.6 | -11% |
| **Perth** | 17.1 | 34.0 | 21.1 | 35.6 | 4.0 | 23% | 1.6 | 5% |
| **Armidale** | 76.1 | 12.0 | 103.8 | 9.0 | 27.7 | 36% | -2.9 | -25% |
| **Williamtown** | 26.6 | 26.7 | 26.4 | 25.9 | -0.2 | 0% | -0.8 | 0% |
| **Adelaide** | 30.9 | 40.3 | 28.3 | 33.1 | -2.6 | -8% | -7.1 | -18% |
| **Sydney RO** | 9.5 | 27.6 | 16.3 | 17.5 | 6.9 | 72% | -10.1 | -37% |
| **Nowra** | 36.4 | 23.6 | 34.2 | 24.6 | -2.2 | -6% | 0.9 | 0% |
| **Charleville** | 24.6 | 50.1 | 25.9 | 49.9 | 1.3 | 5% | -0.2 | 0% |
| **Wagga** | 70.1 | 31.8 | 63.0 | 29.0 | -7.1 | -10% | -2.7 | -9% |
| **Melbourne RO** | 63.6 | 20.9 | 36.9 | 22.3 | -26.8 | -42% | 1.4 | 7% |
| **East Sale** | 77.6 | 16.8 | 81.7 | 10.2 | 4.0 | 5% | -6.6 | -39% |
| **Launceston (Ti Tree Bend)** | 105.2 | 8.1 | 92.4 | 8.3 | -12.8 | -12% | 0.2 | 0% |
| **Canberra** | 101.8 | 17.1 | 98.4 | 16.7 | -3.4 | -3% | -0.4 | 0% |
| **Cabramurra (Alpine)** | 275.8 | 5.0 | 287.2 | 2.4 | 11.3 | 4% | -2.6 | -52% |
| **Hobart** | 103.4 | 3.1 | 101.7 | 3.5 | -1.7 | -2% | 0.3 | 0% |
| **Mildura** | 42.1 | 40.9 | 42.0 | 32.6 | -0.1 | 0% | -8.3 | -20% |
| **Richmond** | 25.4 | 37.0 | 26.3 | 28.6 | 0.9 | 0% | -8.4 | -23% |
| **Weipa** | 0.0 | 270.1 | 0.0 | 198.2 | 0.0 | 0% | -71.9 | -27% |
| **Wyndham** | 0.0 | 375.2 | 0.0 | 344.7 | 0.0 | 0% | -30.5 | -8% |
| **Willis Island** | 0.0 | 168.0 | 0.0 | 200.8 | 0.0 | 0% | 32.8 | 20% |
| **Cairns** | 0.0 | 105.5 | 0.1 | 109.4 | 0.1 | 0% | 3.9 | 4% |
| **Broome** | 0.1 | 255.1 | 0.1 | 247.8 | 0.0 | 0% | -7.3 | -3% |
| **Learmonth** | 0.1 | 107.6 | 0.1 | 106.3 | 0.0 | 0% | -1.3 | -1% |
| **Mackay** | 1.0 | 79.5 | 1.4 | 77.7 | 0.4 | 0% | -1.9 | -2% |
| **Gladstone** | 1.4 | 43.5 | 1.0 | 61.8 | -0.4 | 0% | 18.4 | 42% |
| **Halls Creek** | 0.1 | 181.8 | 0.0 | 159.3 | 0.0 | 0% | -22.5 | -12% |
| **Tennant Creek** | 0.3 | 149.6 | 0.2 | 149.3 | -0.1 | 0% | -0.3 | 0% |
| **MT Isa** | 1.4 | 129.2 | 1.1 | 118.7 | -0.3 | 0% | -10.5 | -8% |
| **Newman** | 5.1 | 101.8 | 7.6 | 79.1 | 2.5 | 49% | -22.7 | -22% |
| **Giles** | 15.7 | 71.7 | 14.1 | 66.6 | -1.6 | -10% | -5.1 | -7% |
| **Meekathara** | 11.6 | 47.6 | 14.4 | 60.6 | 2.8 | 24% | 12.9 | 27% |
| **Oodnadatta** | 18.2 | 75.9 | 18.6 | 65.0 | 0.5 | 0% | -10.9 | -14% |
| **Kalgoorlie** | 21.8 | 30.6 | 22.5 | 40.4 | 0.7 | 0% | 9.8 | 32% |
| **Woomera** | 42.5 | 37.6 | 47.5 | 24.2 | 5.0 | 12% | -13.4 | -36% |
| **Cobar** | 47.9 | 33.2 | 48.0 | 33.9 | 0.1 | 0% | 0.7 | 0% |
| **Bickley** | 38.3 | 26.5 | 37.7 | 28.9 | -0.7 | 0% | 2.4 | 9% |
| **Dubbo** | 49.7 | 23.9 | 45.3 | 28.4 | -4.4 | -9% | 4.5 | 19% |

| | Current 07 stars | | New | | Change Heat | | Change Cool | |
|---|---|---|---|---|---|---|---|---|
| **Katanning** | 39.9 | 25.3 | 58.9 | 16.9 | 19.0 | 47% | -8.4 | -33% |
| **Oakey** | 22.0 | 37.6 | 29.9 | 26.5 | 7.9 | 36% | -11.2 | -30% |
| **Forrest** | 24.4 | 23.9 | 30.4 | 26.3 | 6.0 | 25% | 2.4 | 10% |
| **Swanbourne** | 12.8 | 19.3 | 11.6 | 33.7 | -1.2 | -9% | 14.4 | 74% |
| **Ceduna** | 28.0 | 27.0 | 26.9 | 26.2 | -1.1 | -4% | -0.8 | 0% |
| **Mandurah** | 18.5 | 30.0 | 11.0 | 25.5 | -7.5 | -41% | -4.4 | -15% |
| **Esperance** | 29.2 | 14.4 | 25.2 | 10.7 | -4.0 | -14% | -3.7 | -26% |
| **Mascot (Airport)** | 19.6 | 22.8 | 15.4 | 15.9 | -4.2 | -21% | -6.9 | -30% |
| **Manjimup** | 56.7 | 21.2 | 55.6 | 17.2 | -1.1 | -2% | -4.0 | -19% |
| **Albany** | 45.3 | 8.7 | 40.4 | 6.8 | -4.8 | -11% | -1.9 | -21% |
| **Mt Lofty** | 174.3 | 10.4 | 165.3 | 13.4 | -9.1 | -5% | 3.1 | 29% |
| **Tullamarine (Airport)** | 86.1 | 15.4 | 78.3 | 16.9 | -7.8 | -9% | 1.5 | 10% |
| **Mt Gambier** | 89.2 | 10.4 | 86.2 | 8.7 | -3.0 | -3% | -1.6 | -16% |
| **Moorabbin (Airport)** | 77.0 | 14.0 | 63.1 | 16.2 | -14.0 | -18% | 2.2 | 16% |
| **Warrnambool** | 94.3 | 12.8 | 93.9 | 8.2 | -0.4 | 0% | -4.6 | -36% |
| **Cape Otway** | 85.3 | 13.0 | 78.2 | 8.3 | -7.1 | -8% | -4.7 | -36% |
| **Orange** | 154.2 | 9.5 | 135.9 | 11.9 | -18.3 | -12% | 2.4 | 25% |
| **Ballarat** | 134.0 | 16.2 | 139.5 | 17.0 | 5.5 | 4% | 0.8 | 0% |
| **Low Head** | 80.2 | 3.8 | 102.5 | 2.7 | 22.3 | 28% | -1.1 | -29% |
| **Launceston (Airport)** | 129.4 | 2.0 | 136.9 | 4.0 | 7.5 | 6% | 1.9 | 94% |
| **Thredbo Village** | 217.7 | 8.6 | 258.8 | 2.8 | 41.0 | 19% | -5.8 | -67% |