Plan Change 14

Sunlight Access Qualifying Matter

Christchurch City Council

Technical Report – Residential Recession Planes in Christchurch

Author: David Hattam

Peer reviewed: Ceciel DelaRue

DISCLAIMER:

Christchurch City Council has taken every care to ensure the correctness of all the information contained in this report. All information has been obtained by what are considered to be reliable sources, and Christchurch City Council has no reason to doubt its accuracy. It is however the responsibility of all parties acting on information contained in this report to make their own enquiries to verify correctness.

Contents

1 Introduction and Overview

Due to the difference in latitude between the Upper North Island and Christchurch, recession planes in the Medium Density Residential Standards (MDRS) would have a more significant impact on solar access in Christchurch than in other tier 1 cities.

Steeper MDRS recession plane angles mean that housing built in medium density areas may be shaded for longer periods of the day in winter. Our modelling has determined that for some sites there will be no solar access at certain times of the year.

The following analysis informs recommendations for a recession plane that could be applied in Christchurch as an alternative to the 4m and 60 degree recession plane used in the MDRS.

The recommendations are based on two pieces of work. The first of these is a study which compares the level of solar access in Christchurch with that in Auckland for various site orientations at different times of the year (Section 2). The second is a study which considers the impact of alternative recession planes on site capacity (Section 3).

In summary, the first study finds that there is a significantly lower amount of solar access in Christchurch (as measured by the length of time a ground floor window would receive direct sunlight onto its surface). The testing shows that in winter:

- For sites oriented roughly north-south, the majority of units in Christchurch receive between 20% and 30% less winter solar hours than Auckland. Depending on orientation, the difference is around 20 minutes of sun per day, at a time of year when the duration of sunshine is usually less than two hours.
- For sites oriented east-west, Auckland sites would have no ground floor solar access for a third of the year, whereas in Christchurch the equivalent is almost half the year.

The impact of this loss of solar access may also be more significant in Christchurch than other tier 1 cities due to low sun angles, colder ambient temperatures and less powerful diffuse radiation (indirect solar energy).

For Christchurch to receive a similar level of solar access to cities in the upper North Island, an alternative recession plane of 50 degrees at a starting height of 3m is recommended. To allow additional flexibility, a variable recession plane would achieve a similar level of sunlight access to other tier 1 cities.

The second piece of work considers the impact of alternative recession places on site capacity. A number of potential recession planes were identified and tested, based on existing practice in Christchurch, along with recession planes derived from the first study and variations of the MDRS recession planes.

The study found that there was little variation in capacity in most of the scenarios. The reason for this is that the MDRS recession planes are generous and do not constrain capacity, when standard 3 storey development types are designed on typical sites. This indicates that there is scope to amend the recession planes without significantly affecting capacity. The recommended variable recession plane would provide 95% of the theoretical capacity of an MDRS development.

Between them, the two studies indicate that there would be significant benefits in amending the MDRS recession planes in Christchurch. The significantly lower levels of winter solar access in Christchurch could be addressed through adopting revised recession planes, which would have a low impact on site capacity.

2 Solar Access Study

2.1 Overview

The following sections summarise work that has been carried out to test:

- The impact of MDRS recession planes in Christchurch compared to cities in the upper north island (as demonstrated by Auckland).
- The impact of proposed new recession planes in Christchurch (compared to the MDRS).

In assessing the revised recession planes, Auckland has been used as a reference. The majority of areas where MDRS applies are in the upper North Island. There are some 7 degrees of latitude difference between Auckland and Christchurch and so the impact of reduced sun access is considerably higher in Canterbury than in most other MDRS areas. A sample of sun altitude angles is shown below for various cities on key dates. For most dates there (in the winter at least) there is a difference of 6.7 degrees in sun altitude angle between Christchurch and Auckland and approximately 6 degrees between Christchurch and Hamilton.

City	Sun Angle (altitude at 12pm in degrees)			
	21 Jun	6 August	21 Sept	21 Dec
Auckland	29.3	35.8	52.0	68.2
Hamilton	28.6	35.1	51.2	68.1
Tauranga	28.8	35.3	51.4	68.7
Wellington	25.1	31.6	47.7	65.6
Christchurch	22.7	29.1	45.3	63.0

The testing described in this paper has been carried out using Sketchup models geolocated to Christchurch to show the path of the sun across the facades of buildings on various days of the year.

2.2 Defining a Recession Plane

It can be readily demonstrated that the MDRS recession plane has a much greater impact in Christchurch than in Auckland. The next step is to consider the most appropriate recession plane for Christchurch.

Options that could be considered include the existing recession planes used in Residential Medium Density and Residential Central City zones. The latter has allowed for a considerable amount of 3 storey development to date.

An alternative approach is to use a recession plane which is similar to the MDRS. The aim was to allow for a similar level of solar access in Christchurch to the upper north island, where the majority of MDRS zoned land is located.

A variable recession plane has been proposed for Christchurch (similar to those used in the Operative District Plan) and this was found to be appropriate through the testing process. The proposed variations are shown below:

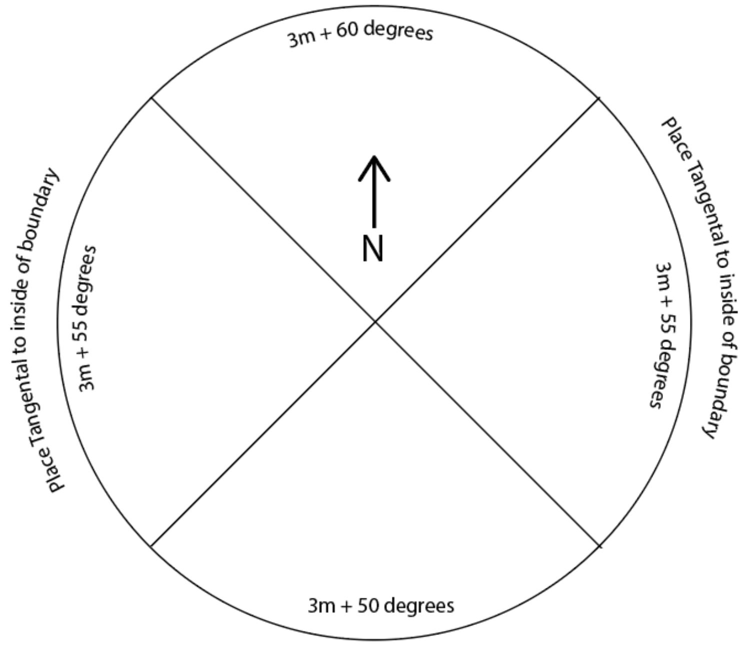
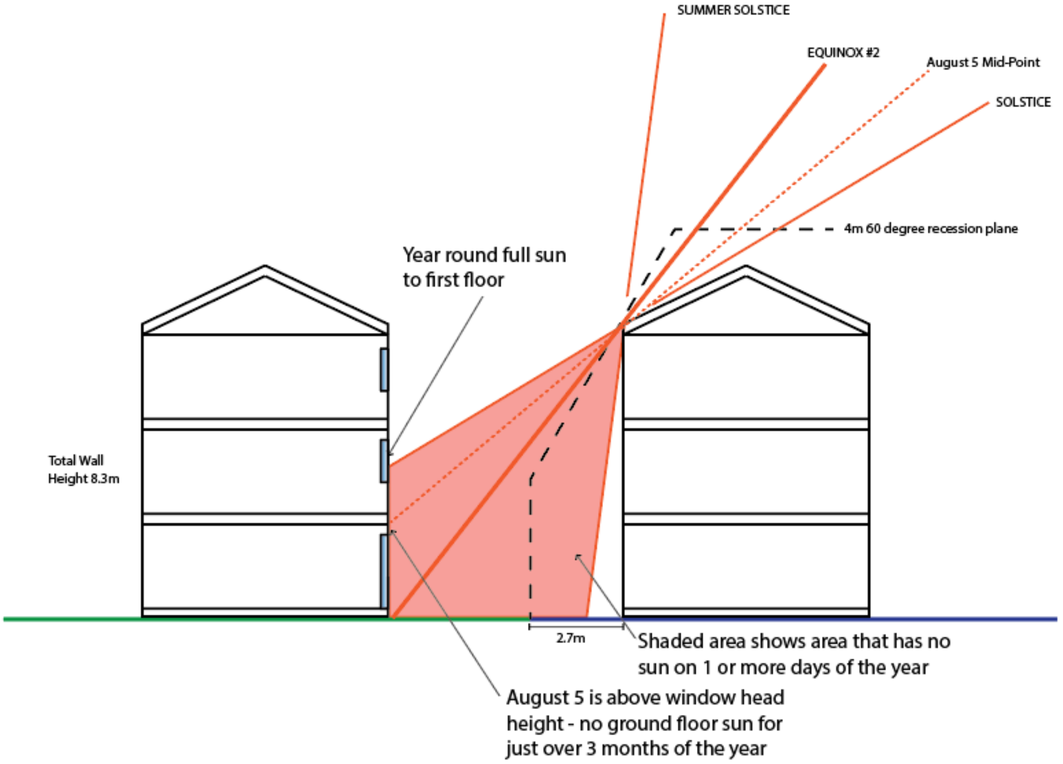


Figure1: Proposed Recession Planes

Summer and winter apex sun angles are shown on the diagrams below. In these diagrams, the orange or green lines indicate the apex sun angle on key dates through the year. On any of the dates indicated, the area below the line is shaded for the whole day and the shaded area in each diagram shows the area that is subject to all day shade at some point during the year.



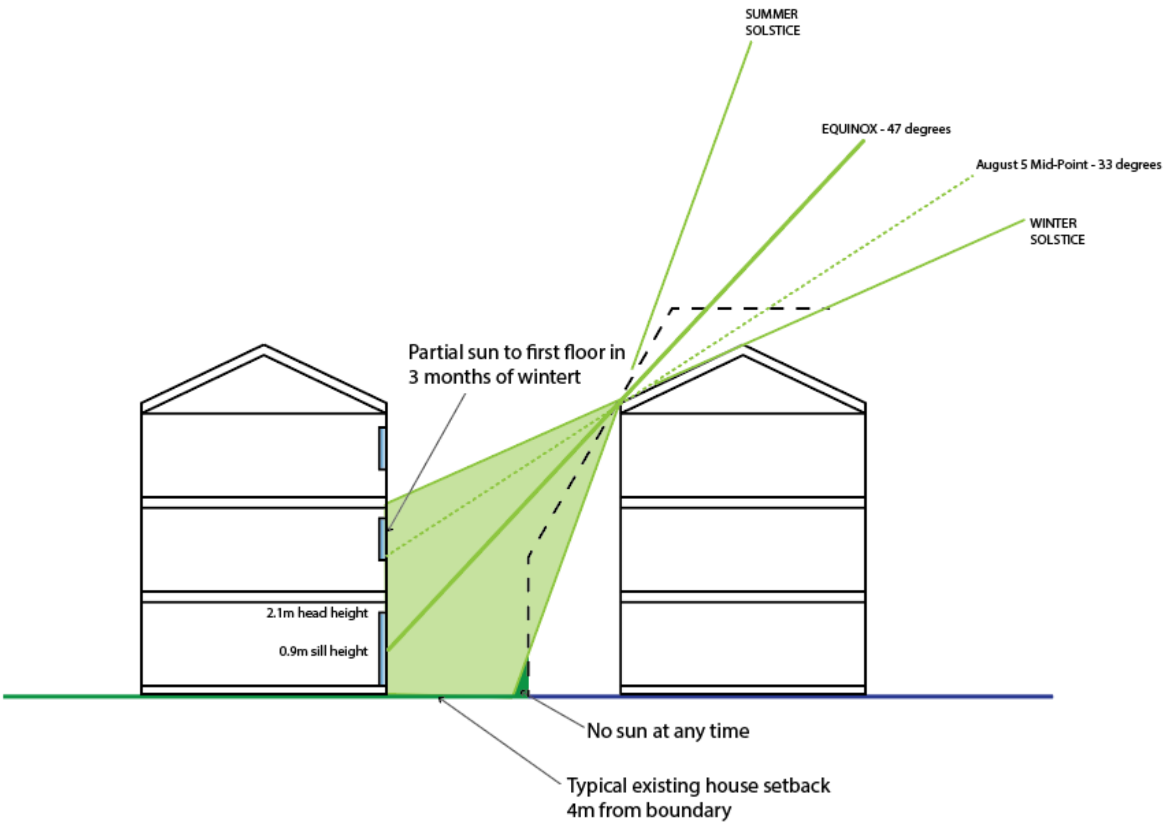


Figure 2: Sun Angles on key dates in Auckland (top) and Christchurch

In order for a 3 storey unit in Christchurch to affect its neighbour to the same extent as in Auckland, it would need to be moved a further 2m from the boundary (if it was to the north of the subject site):

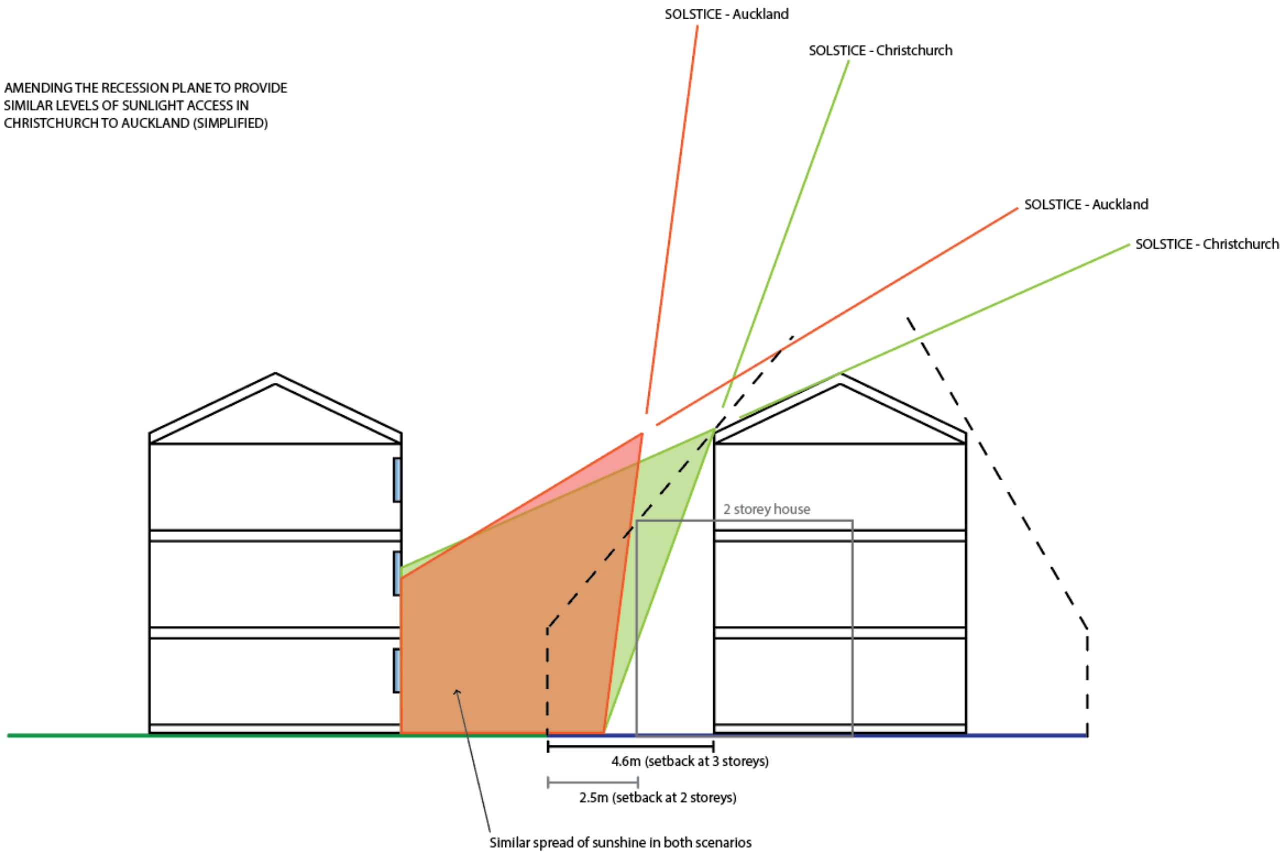


Figure 3: Comparison of available sun, showing where a three storey house may be located to provide similar solar access in Christchurch compared to Auckland.

To achieve this outcome on medium and high density sites, (i.e. ensuring that units are located further away from the boundary) the preferred option is a variable recession plane with a starting height of 3m and an angle of between 50 and 60 degrees. This is effective because it manages the impact on neighbours so that adjoining sites will receive a similar level of sunlight hours as those in the upper North Island. It also manages the shading from a two storey house in the winter months to the same extent as a 3 storey house:

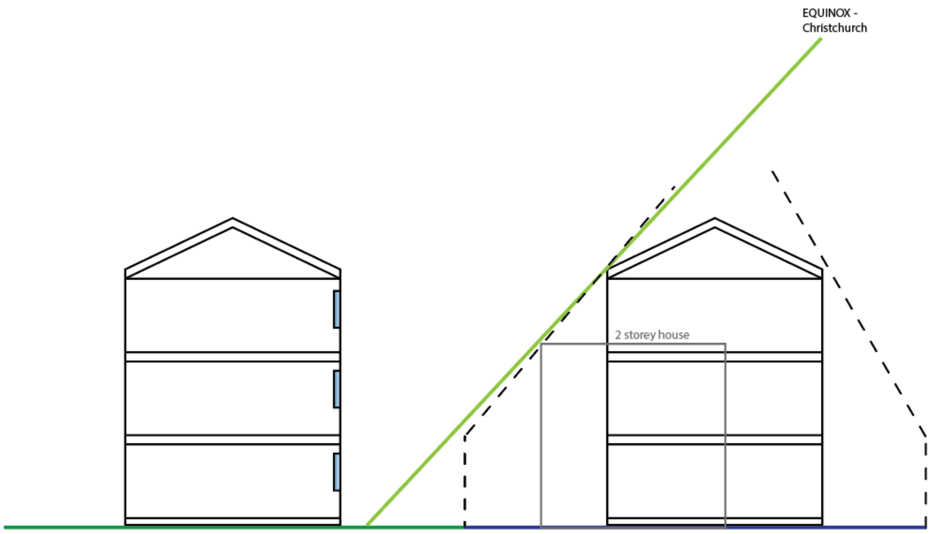


Figure 4: Using a 3m and 50 degree recession plane, the shading from a two- and three-storey house is similar at the equinox.

Consideration was given to whether a fixed or variable recession plan is more appropriate. A fixed recession plane can be simpler to understand, whilst variable recession planes can allow for more capacity whilst focussing the restrictions where they are most needed.

The view has been taken, for the purposes of this study, capacity is more important than simplicity. This is partly because variable recession planes have been operative in Christchurch for many years and are well understood, although the proposed framework is simplified compared to current recession planes.

For these reasons, a variable recession plane was defined for testing purposes, based around a 3m and 50 degree recession plane to the south, and 3m and 55 degrees for east and west (with 3m and 60 for the north).

2.3 Creating the Models for Testing

Under current zoning, three storey residential development occurs in Christchurch generally in more central areas which have better access to facilities.

Typical units used in the study were based on 3 storey typologies that may be facilitated by the MDRS, to take advantage of the recession planes. These units would fit onto a typical site and have a ground floor garage along with a wide driveway (to provide for reversing), with upper floor living accommodation. The absence of ground floor living in such units means that they may be located close to site boundaries. A cross section of this typology is shown below:

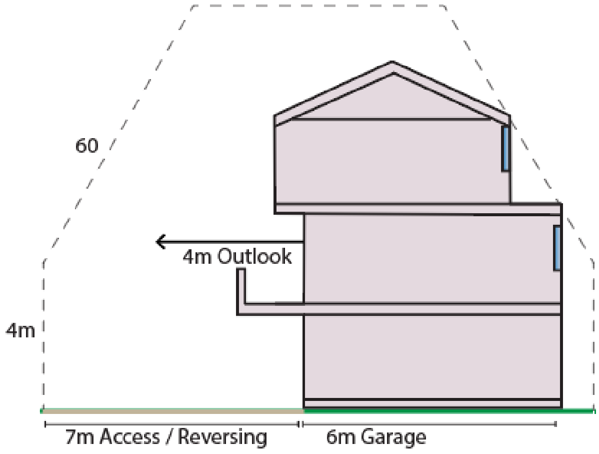


Figure 5: Cross section of potential MDRS house used for testing purposes

A typical height for a 3 storey unit is 8.3m (at the eaves) and 10m at the ridge. This is sufficient to achieve full height ceilings on each floor to comply with the building act. Some examples of this format are shown in the Section 77 evaluation report (in appendix 1).

A model using complying minimum height ceilings is considered a realistic scenario in most situations. It is uncommon for units to have higher ceilings than required by the building act. It is also common for units to use design features such as coved ceilings to reduce wall height and allow buildings closer to boundaries.

The site layout used to create the model is shown below:

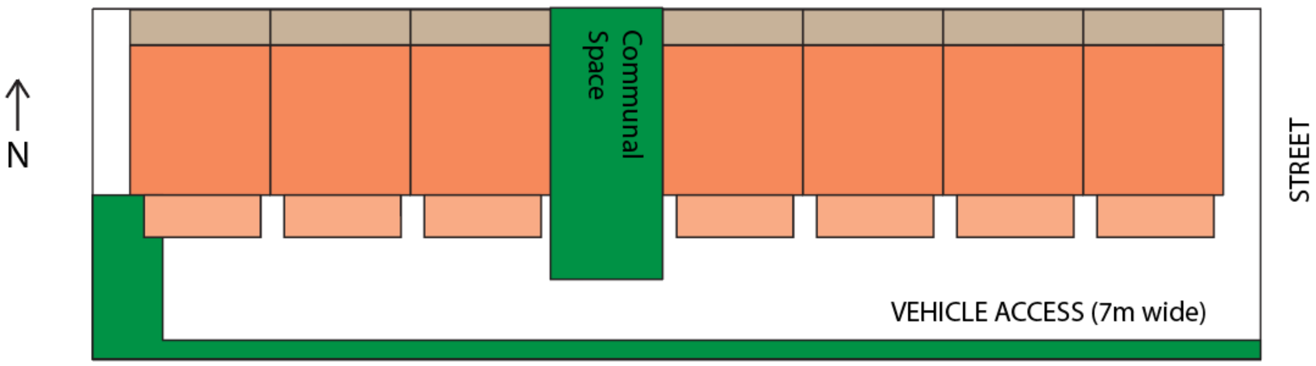


Figure 6: Potential site layout

This translates into a Sketchup model as shown below:

Figure 7: Sketchup model used for testing purposes (MDRS development)

In creating this model, a typical 15m wide site was used (with a length of 50m). Narrow sites can be more restrictive because there is less space under the recession plane, meaning it can be hard to achieve 3 storeys. Wider sites are conversely more flexible.

15m is a common site width in Christchurch and was a standard site used in subdivision until around 1970, when development patterns changed (and shorter and wider sites based around cul-de-sacs came into vogue). It is the dominant site in the inner suburbs and around older centres such as Papanui, Riccarton and Spreydon. It is regarded as being important that the rules allow for 3 storey developments on these sites and if they do, it can be assumed that development will be possible elsewhere on the generally wider sites. Whilst there are some narrow sites around, these are a minority. Ensuring 15m wide sites can be developed will ensure that most sites in the city are suitable for 3 storey units.

The analysis was designed to simulate the level of solar access provided to a typical medium density house, that may be built in inner Christchurch now, or in future under MDRS, if a 3 storey MDRS compliant development was to be constructed next to it. What is being measured is the impact of the above model on its neighbour.

The key metric used in the analysis is the amount of time that a typical 1m^2 window on such a unit would receive full sunlight, looking at both a ground floor window and a first floor window. Of these windows, the sunlight available to the ground floor is considered most important, because this is typically the location of living areas, where people spend most time.

The diagram below shows the units used in the model:

Figure 8: 3 storey MDRS development casting shadow on adjacent two storey model

The impact of shallower recession planes was simulated by moving the models away from the boundary by the distance required to fit under the revised recession plane.

The intention was to model the impact of this building on a "typical" townhouse development next door. The reasons for using this form are:

- This is the predominant recent form of high density development in all zones, with many examples expected to be in place for at least the next 50 years.
- This is also expected to be the predominant form in the lifetime of the next plan. For a variety of reasons, there is limited appetite amongst developers to build apartments.

The recipient building was setback 4m (which is a practical setback to accommodate a 20m outdoor living space for a typical 5m-6m wide unit, and also a common setback at present).

The impact on the two windows was modelled at 5 key dates throughout the year:

- Winter Solstice – 21 June
- Mid-point – 5 August
- Equinox – 21 September
- Mid-point – 6 November
- Summer Solstice – 21 December

Although not conventionally modelled, the mid-point is useful because it gives an indication of solar seasonal access for a 3 month period (eg is there solar access for 9 months of the year even if not at the solstice).

The diagram below shows the point at which the window is considered to have solar access:

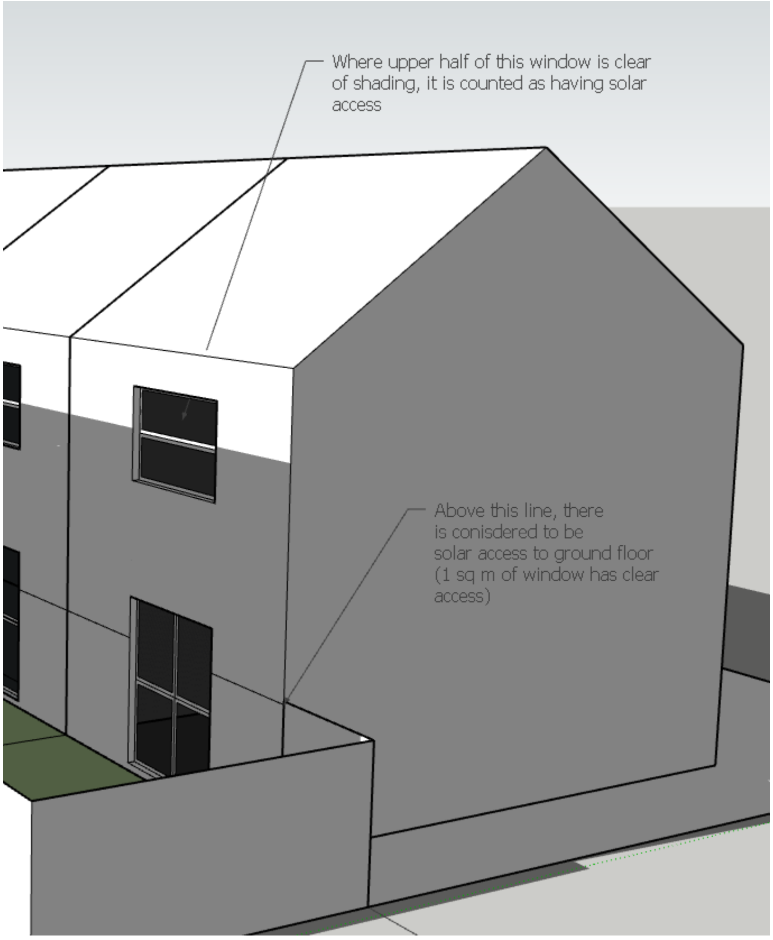


Figure 9: modelled solar access on ground and first floors

The units modelled are those internal to the site because although front units may benefit from some oblique sun, this is not guaranteed by recession planes and will only apply to some of the units.

The models were rotated in 30 degree increments to provide an indicated of solar access at different orientations, to investigate the impact of different recession planes. This provides evidence of the efficacy of variable and fixed recession planes in Christchurch. The angles modelled are indicated below:

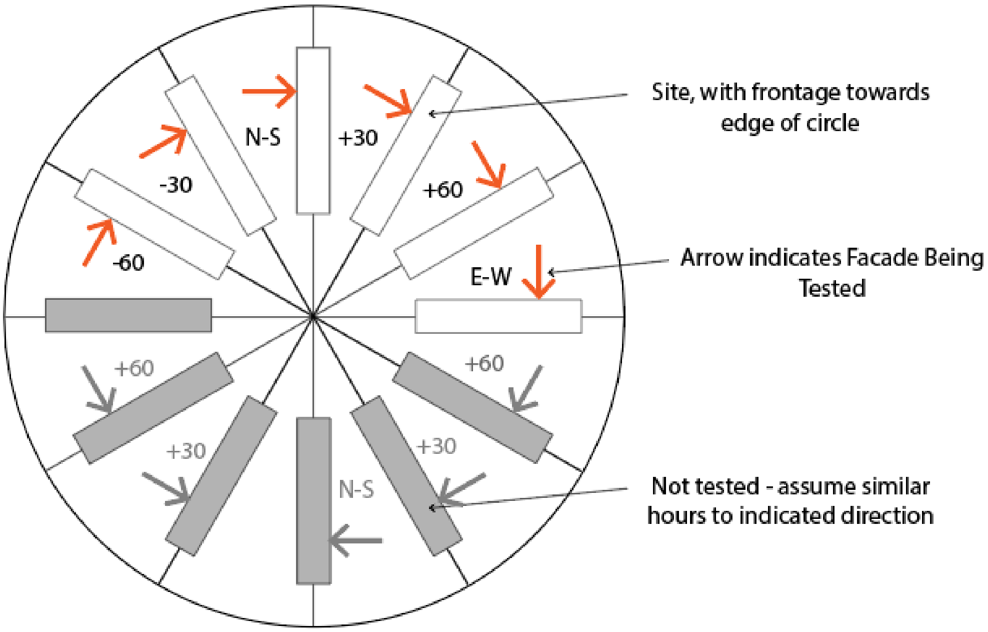


Figure 10: Site orientation (as shown by orange arrows). These orientations provide an indication for all site orientations because east and west can be mirrored (there would be very similar periods of sun on mirrored sites, although the time of day and intensity may vary). This is shown by the grey sites, which have not been modelled, but which can use the times indicated.

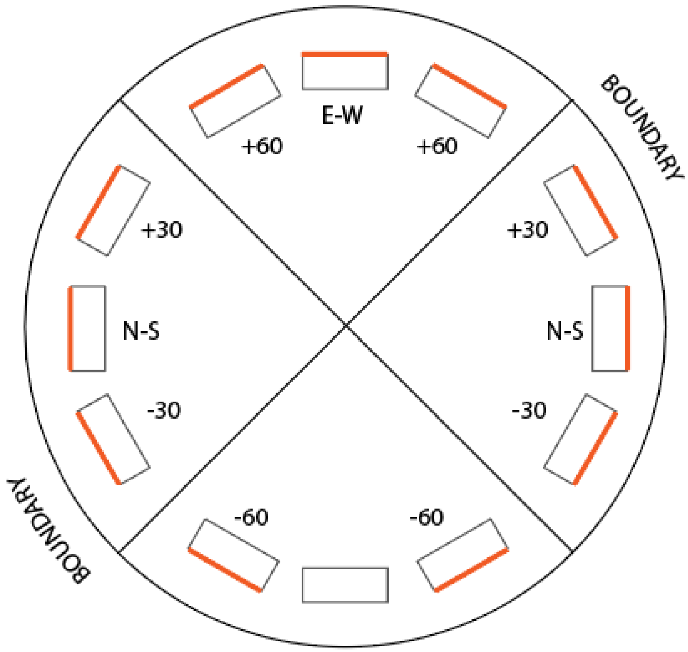


Figure 11: Site Orientation in relation to boundaries – angles relate to the most relevant scenario.

The time recorded for each of the orientations on each of the sample days is the modelled length of time where the sample glazing was fully exposed to the sun, as described above.

These times were recorded for MDRS for Auckland and Christchurch. Further times were then recorded for Christchurch with the MDRS compliant units relocated to simulate the proposed recession planes at 50, 55 and 60 degrees.

Directions shown in the Tables use North-South as a zero reference, as shown in figure X above. "+30" refers to a change in site orientation of 30 degrees clockwise.

Key directions are considered to be form -30 degrees to +90 degrees (being East-West). Outside of this range, buildings are likely to be oriented with primary frontage on the other side of the building. Furthermore, low winter sun angles in this range mean that very large interventions would be required to make a difference.

In terms of interior solar access, the most important effects are regarded as being in winter, up to the equinox. In these months, the influence of solar heating is most important in raising internal temperatures. Summer also brings with it longer solar hours and better sun angles and so brings better all-round conditions than winter months.

2.4 Results

2.4.1 Comparisons between Christchurch and Auckland (MDRS Recession Planes)

The table below shows the hours of ground floor sun access for the scenario units:

Site Orientation	AUCKLAND				CHCH				Difference		
	Winter	6-Aug	Equinox		Winter	6-Aug	Equinox		Winter	6-Aug	Equinox
-60	0:00	0:00	1:40		0:00	0:00	1:00		0:00	0:00	0:40
-30	1:05	1:25	2:10		0:45	1:00	1:45		0:20	0:25	0:25
0 (N - S)	1:45	1:55	2:30		1:20	1:40	2:15		0:25	0:15	0:15
30	2:05	2:30	3:15		1:45	2:10	3:00		0:20	0:20	0:15
60	0:00	2:50	5:05		0:00	1:30	4:00		0:00	1:20	1:05
90 (E-W)	0:00	0:00	10:15		0:00	0:00	7:30		0:00	0:00	2:45

The key trends in this table are:

- Between -30 and + 30, there tends to be a 20 minute difference in sun access per day. In most cases the total sun hours are quite small (less than two hours) and so this represents a significant proportion of sunlight received (between 15 and 30%)

- At other angles, there are whole days where no sun is received (because the sun is behind the building envelope even at its apex). In these cases, Auckland receives more days of sunshine and this is examined further below.

- At +60 degrees, there is a significant difference in sun received. Similar to E-W units, there is no midwinter sun, although Auckland units would have good solar access by 6 August (and therefore for 9 months of the year). By the equinox, Christchurch units would also be receiving a good amount of sun hours (albeit less than if they were in Auckland).

Whilst the above results indicate that Christchurch units would receive less sun hours than those in Auckland, they do not show how latitude affects east-west oriented units. The table below shows how many days there is no solar access in each region:

EAST - WEST ORIENTED SITES: DAYS WITHOUT SOLAR ACCESS TO GROUND FLOOR

AUCKLAND:	131	(17 April - 26 August)
CHRISTCHURCH:	170	(30 March - 14 September)

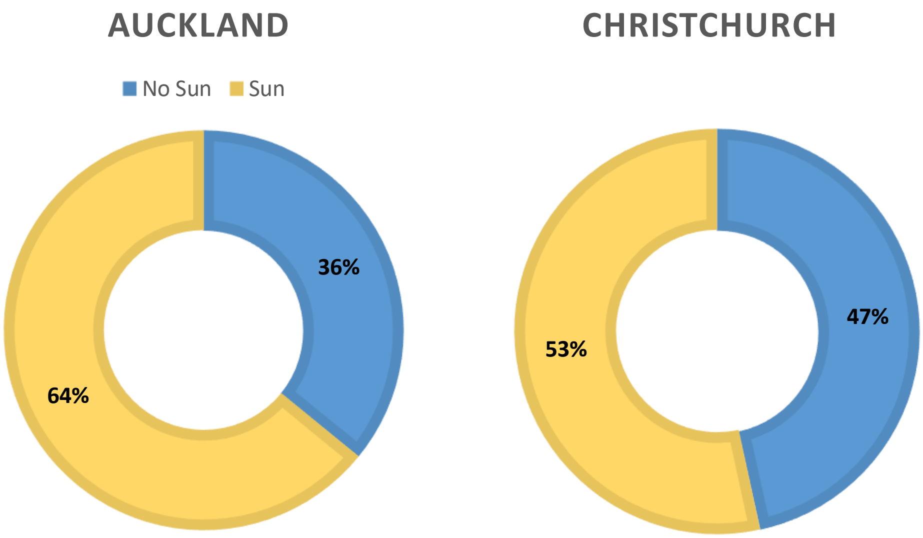


Figure 12: Proportion of days where units East-West oriented sites may receive no ground floor sun under MDRS

2.4.2 Results of Alternative Recession Planes in Christchurch

Alternative recession planes have been tested, with the aim of providing a similar level of solar access to Christchurch that may be experienced in the upper North Island. A variable recession plane was devised and tested, with results as shown below:

		CHRISTCHURCH MDRS			**CHRISTCHURCH PROPOSED**			**DIFFERENCE (CHCH PROPOSED/MDRS)**			**DIFFERENCE (PROPOSED/AUCKLAND)**		
R/plane Angle	Site Orientation	Winter	6-Aug	Equinox	Winter	6-Aug	Equinox	Winter	6-Aug	Equinox	Winter	6-Aug	Equinox
60	-60	0:00	0:00	1:00	0:00	0:00	1:10	0:00	0:00	0:10	0:00	0:00	0:30
55	-30	0:45	1:00	1:45	0:55	1:10	2:00	0:10	0:10	0:00	0:10	0:15	0:10
55	0 (N - S)	1:20	1:40	2:15	1:35	2:00	2:35	0:15	0:20	0:20	0:10	-0:05	-0:05
55	+30	1:45	2:10	3:00	2:05	2:30	3:25	0:20	0:20	0:25	0:00	0:00	-0:10
50	+60	0:00	1:30	4:00	0:00	3:05	5:20	0:00	1:35	1:20	0:00	-0:20	-0:15
50	90 (E-W)	0:00	0:00	7:30	0:00	0:00	10:30	0:00	0:00	3:00	0:00	0:00	-0:15

The table shows that the revised recession planes result in an increase in solar hours, as would be expected. The key trends in the above data are as follows:

- Between -30 and +30 degrees, there is generally an increase in solar exposure of around 20 minutes per site (although the +30 angle has a greater increase than -30). When compared to Auckland, the results are broadly similar, slightly worse at the solstice but slightly better at the equinox.
- At +60 and 90 degrees, the improvements appear quite dramatic (being measured in hours) but at these orientations the key metric is the number of days (see below) rather than hours per day. The results are quite similar to those of Auckland.

- At -60 the impact of the revised recession plane is more marginal (for an unfavourable orientation).

Regarding East-West oriented sites, the proposed recession planes would result in 125 days of sunlight as shown below. This is similar to the sunlight access provided in Auckland:

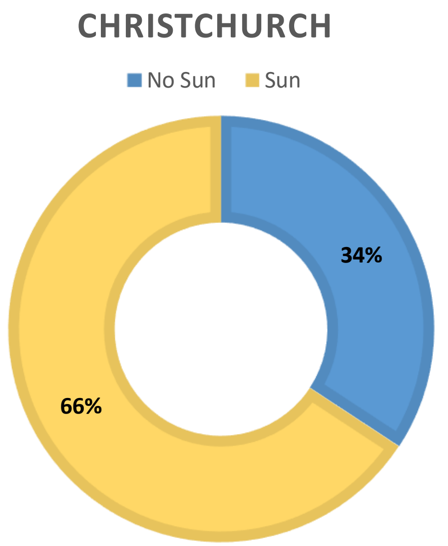
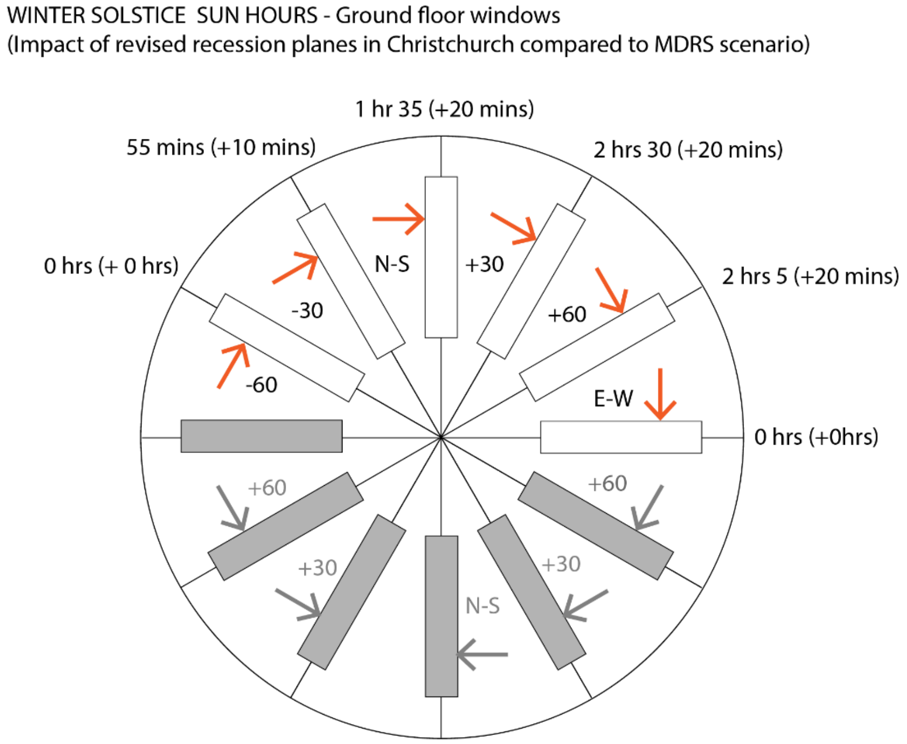
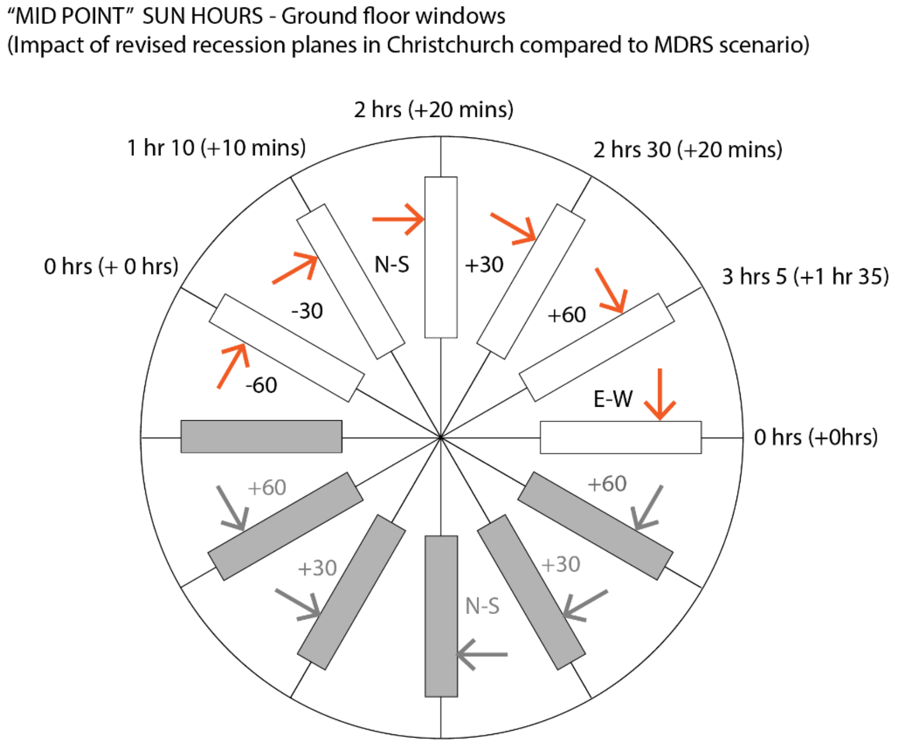


Figure 13: Proportion of days where units East-West oriented sites may receive no ground floor sun (Proposed Recession Planes)

The above data is represented in the diagrams below that show a comparison of the impact of the proposed recession planes on the key dates at different site orientations:



Christchurch City Council



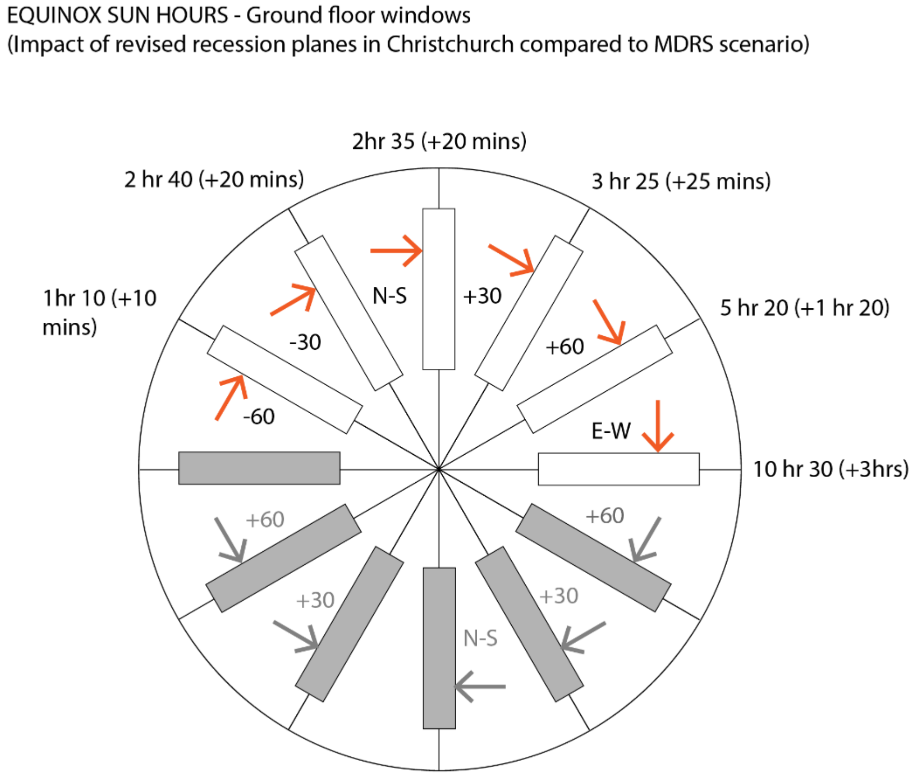


Figure 14: Modelled amount of Sunlight received per day in Christchurch using the proposed recession planes (compared to MDRS)

2.5 High Density Residential Zone

The high density residential zone uses the same recession planes as the MRZ up to a height of 12m. Above this, a setback is proposed of six to eight metres (depending on orientation), in effect a vertical recession plane. This creates a development envelope as illustrated in the cross sections below.

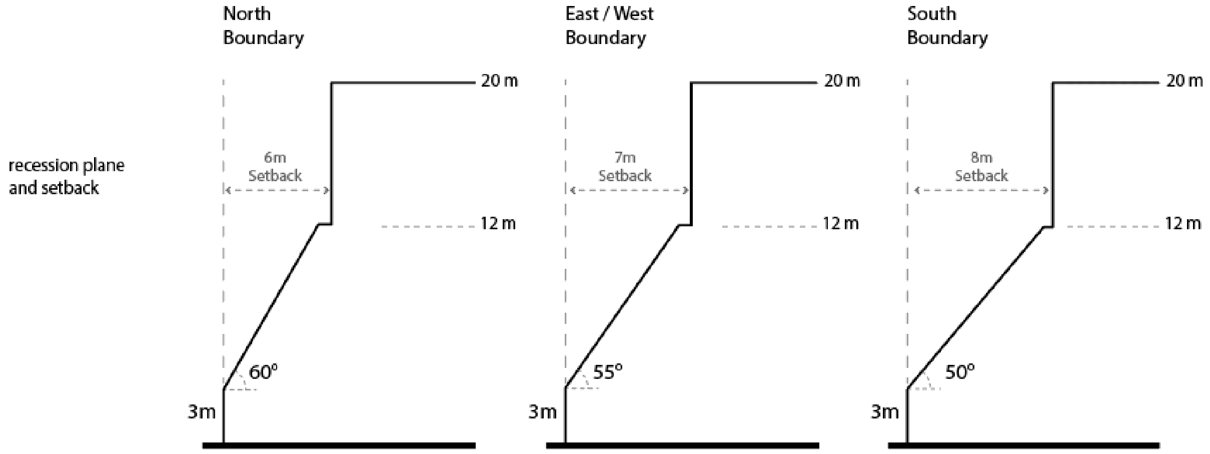


Figure 15: Proposed Recession Planes and upper floor setbacks

This approach is discussed in the Residential Urban Design Report[1]. It is based on an existing approach in the operative Residential Medium Density zone, where vertical recession planes are applied at a height of 11m in certain areas with higher height limits (rule 14.5.2.6b).

The use of the proposed variable recession planes affects the location of the upper floor setback. For a 3m and 60 degree recession plane, a 6m setback is viable as shown in figure 15 above (6m is regarded as being the minimum to allow for management of privacy and the sense of enclosure created by bulky buildings close to the boundary). However, a 50 degree recession plane results in an undercroft being created in the development envelope when a 6m setback is applied to the upper levels (refer to figure 16 below).

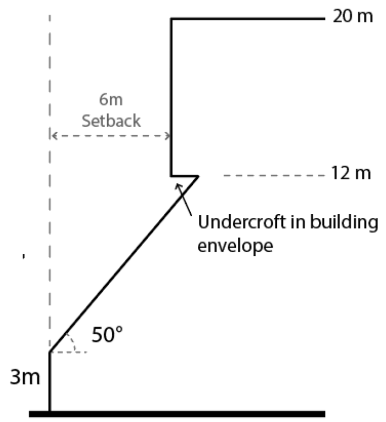


Figure 16: A 6m setback combined with a 3m+50 degree recession plane creates an undercroft in the envelope at 12m

[1] Residential Chapter - Technical Report – Urban Design (section 10.3.3)

The above situation would in effect mean that parts of the building 20m high could be closer to the boundary than parts of the building at a height of 10m. This would not achieve the intent of the urban design controls, which is that recession planes should become vertical at a height of 12m.

As a result, variable setbacks are recommended as illustrated in figure 15.

2.6 Conclusion

The above results demonstrate that applying a revised recession plane to Christchurch would provide for increased solar access.

The variable recession plane proposed would be sufficient to ensure a generally comparable level of solar access to Auckland (at least in terms of the number of hours of solar access).

The loss of solar access for almost 6 months of the year (for east-west oriented sites) is probably the most substantial negative impact of introducing the MDRS recession planes. The proposed recession planes would allow for east-west sites to have a comparable number of days of solar access to Auckland (closer to a third of the year).

An alternative proposal would be a fixed recession planes of 3m and 50 degrees. This would work in a similar fashion to MDRS (being simple, and providing a similar level of solar access). However, the variable recession plane would allow for a small increase in capacity and flexibility compared to a fixed recession plane and is regarded as providing a comparable level of solar access to that afforded in the upper North Island.

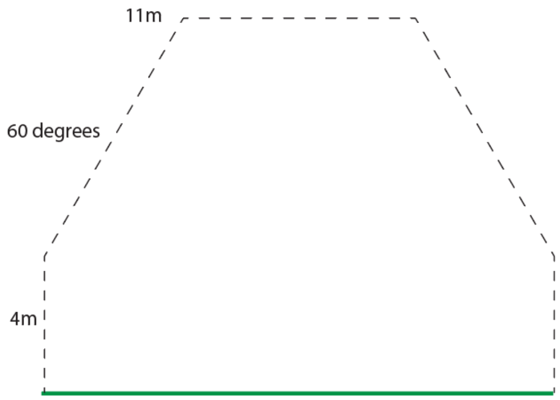
The MDRS does not provide a high level of solar access, even at higher latitudes. Even at favourable orientations in Auckland, it provides only 2 hours of sunlight per day at the solstice and the access afforded at the equinox is quite variable. This study is aimed at facilitating a comparable level of solar access to that expected in other parts of the country, rather than recommending a level of solar access on its merits.

On the basis of the study, it is recommended that a variable recession plane be introduced with a starting height of 3m and an incline of between 50 and 60 degrees.

3 Effects on Capacity of Various Development Envelopes

3.1 Introduction

The Medium Density Residential Standards will introduce a new development envelope, consisting of 60 degree recession planes and an 11m height limit, as shown below:



This is a significant liberalisation compared to the existing envelopes which have shallower planes starting at lower levels. The intention of the MDRS is to allow for more development on sites, in particular 3 storey development.

A particular concern is the impact of the steep recession planes in Christchurch as compared to other Tier 1 cities which are at more northerly latitude and have more favourable sun angles. The impact of this is explored elsewhere, where it has been found that a recession plane of 50 degrees at 3m allows similar levels of sun access in Christchurch to a 60 degree plane at 4m in Auckland or Hamilton. This is one of the options tested below.

This study shows that adopting tighter recession planes would not greatly affect capacity. The reason is that the MDRS planes are not a significant constraint on a typical site. This implies that there is scope to reduce the recession planes, to give more certainty to neighbours, without significantly reducing the scale of development achievable.

3.2 Method

Testing has been carried out of a number of potential development envelopes, using typical anticipated 3 storey townhouse developments.

In assessing the impact on development, a 2D diagram has been used to illustrate how the development may fit into the envelope for a typical Christchurch site, bearing in mind other constraints that exist in the zone. A typical site is long and narrow, and it was seen as important that a logical 3 storey development could be accommodated on the site, in the spirit of the MDRS.

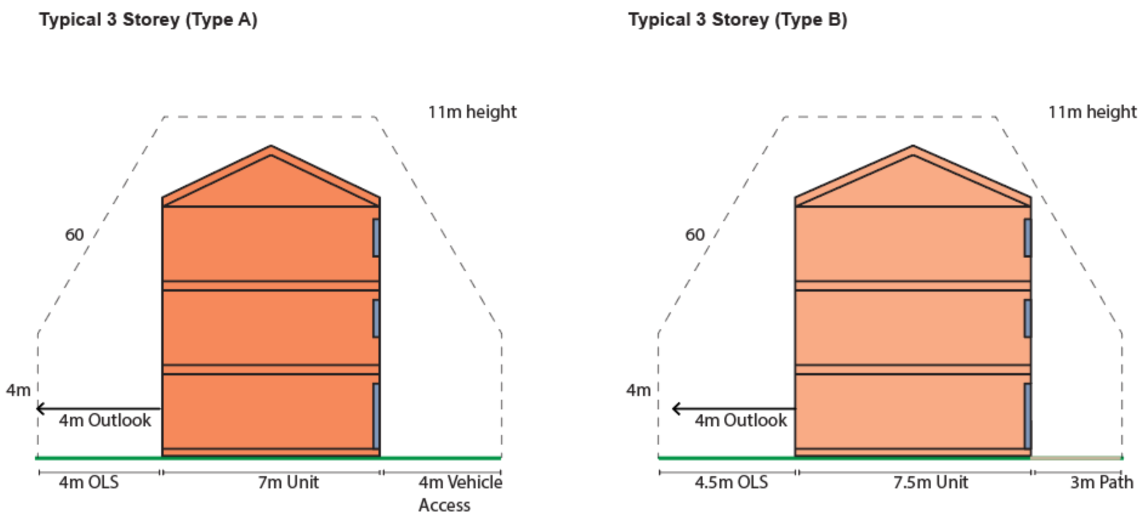
Only a relatively small proportion of the sites development envelope has been used, which reflects the ways sites' are developed. For instance, townhouse developments rarely reach the 50% site coverage limit. There are other limiting factors which include:

- Accommodating outdoor living spaces for each unit
- Providing for access
- Providing for bins and bike storage

Most sites will also provide parking, which will occupy a significant proportion of the site.

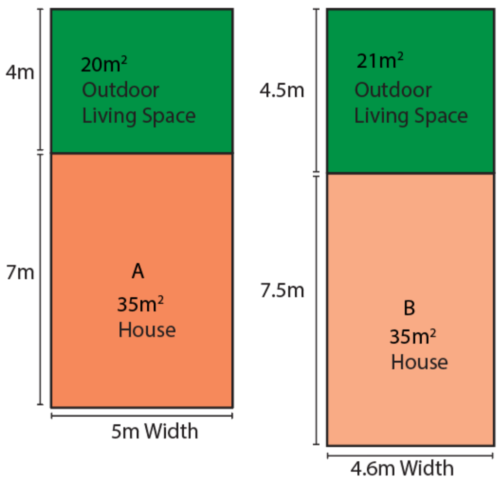
Testing of the new development envelope was carried out using established typologies built in Christchurch today.

A base case was established to show the expected level of development under the MDRS. This was a simple development designed to make the most of the envelope and is of a kind that would be expected. This is shown below:



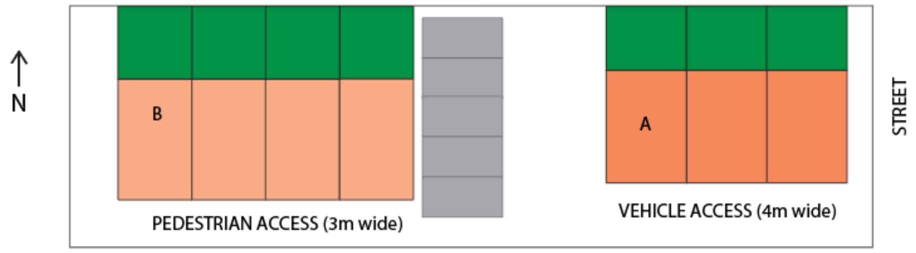
Cross section of MDRS development envelope showing how two types of unit would fit.

Achieving maximum yield of a site may require two different house types to take full advantage of the site (Type A and Type B, as shown below). It is regarded as making full use of the development potential of the site in a realistic fashion:



Above: Typical unit dimensions used in the analysis. Combinations of different shaped units can make more efficient use of a site

The ability to achieve the base case is demonstrated by the 2D cross-section diagrams (showing how the typologies can fit in the envelope) and a plan view, showing how the units would fit on the site. A site plan diagram is shown below (for the MDRS)



Where the envelope constrains development, a modified dwelling is first used, because this is a common solution. This would consist of:

- A coved roof (least impact on the development)
- A small 1m setback for the top floor
- A 1m setback and a coved roof
- A larger setback
- A complex building (for example with a lower floor overhang, coved roof and upper floor setback). Such a building may be less viable than the other examples and is the point at which the test is considered failed, and a two storey unit substituted.

The above represents a scale of compromises that would be made in order to fit the development on the site. In practice, these are common strategies and the impact of recession planes is first a loss of flexibility, and then a reduction in capacity. The first three of these are considered to have minimal impact on capacity. A coved roof, in particular, does not reduce the amount of development on the site and is a common strategy in the RMD zone at present.

Some testing was also carried out to show whether higher ceilings are possible (2.7m). However, a review of recent developments did not identify these as being common and higher ceilings were only used on the ground floor in one case. The need to accommodate higher ceilings has not been considered as a constraint as it is not a typical development form.

On the basis of this testing, a preferred alternative scenario was identified.

3.3 Results

The results are presented in a range of groupings and scenarios, with cross sections and plan views for each format, and noting the scale of compromise required to achieve the development if applicable.

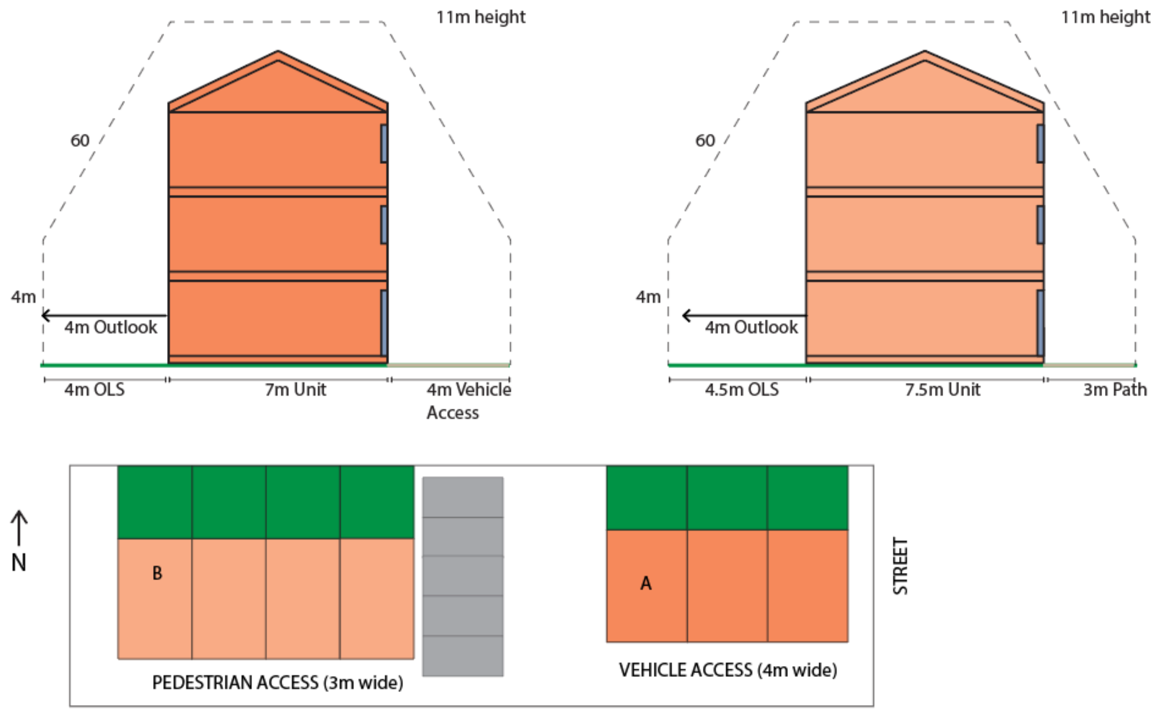
Overall there is very little difference in capacity between the examples. In most cases, the impact of the recession plane variations is that one three storey house needs to be replaced by a two storey house. This represents a loss in capacity of less than 5%.

There are 10 scenarios, which have been grouped for ease of reference, as follows:

1. Scenarios 1-3 use 60 degree recession planes with different starting heights.
2. Scenarios 4 and 5 use 50 degree recession planes
3. Scenarios 6-8 use a variable recession planes at different heights
4. Scenarios 9 and 10 are based on the existing zoning in the plan

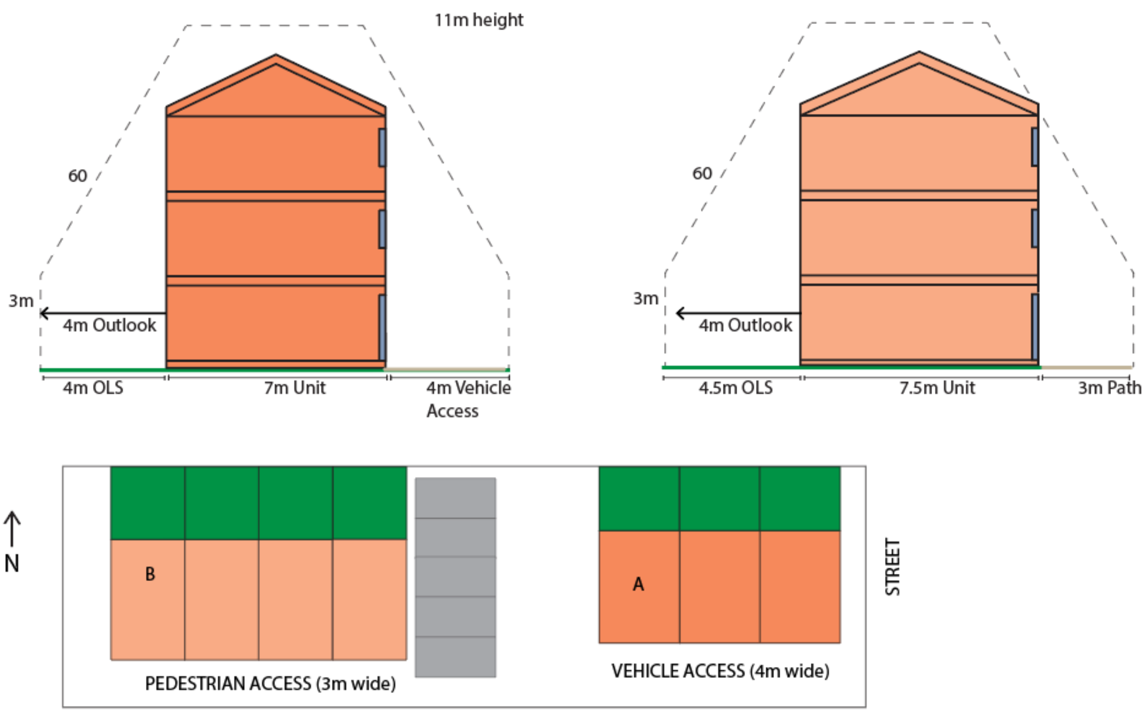
Group 1 - 60 degree recession planes

Scenario 1 – MDRS (4m and 60 degrees)



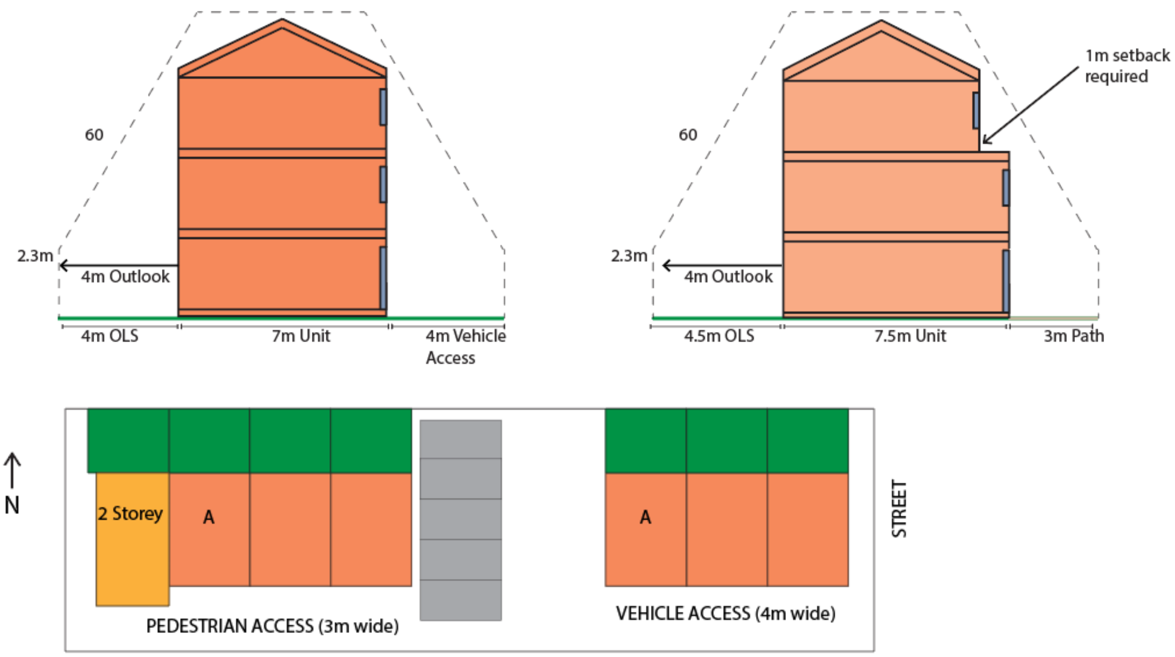
The highest yield is achieved by a combination of the unit types. Total capacity is 7 units (735m^2)

Scenario 2 – 3m and 60 degrees



The highest yield is achieved by a combination of the unit types. Total capacity is unchanged - 7 units (735m^2)

Scenario 3 – 2.3m and 60 degrees

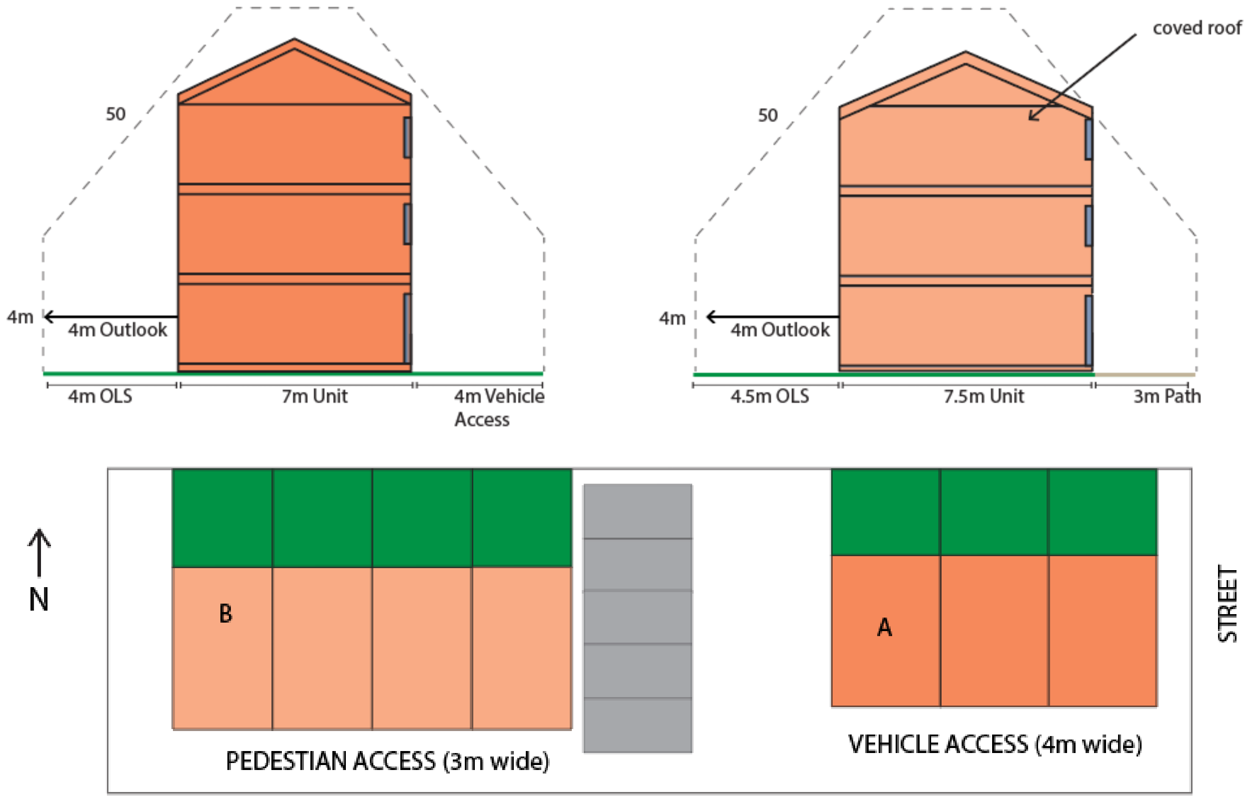


The highest capacity is achieved with the use of type A units, avoiding the need for a third floor setback. Total capacity is reduced by 5% to six 3 storey units and one 2 storey unit (700m^2).

Christchurch City Council

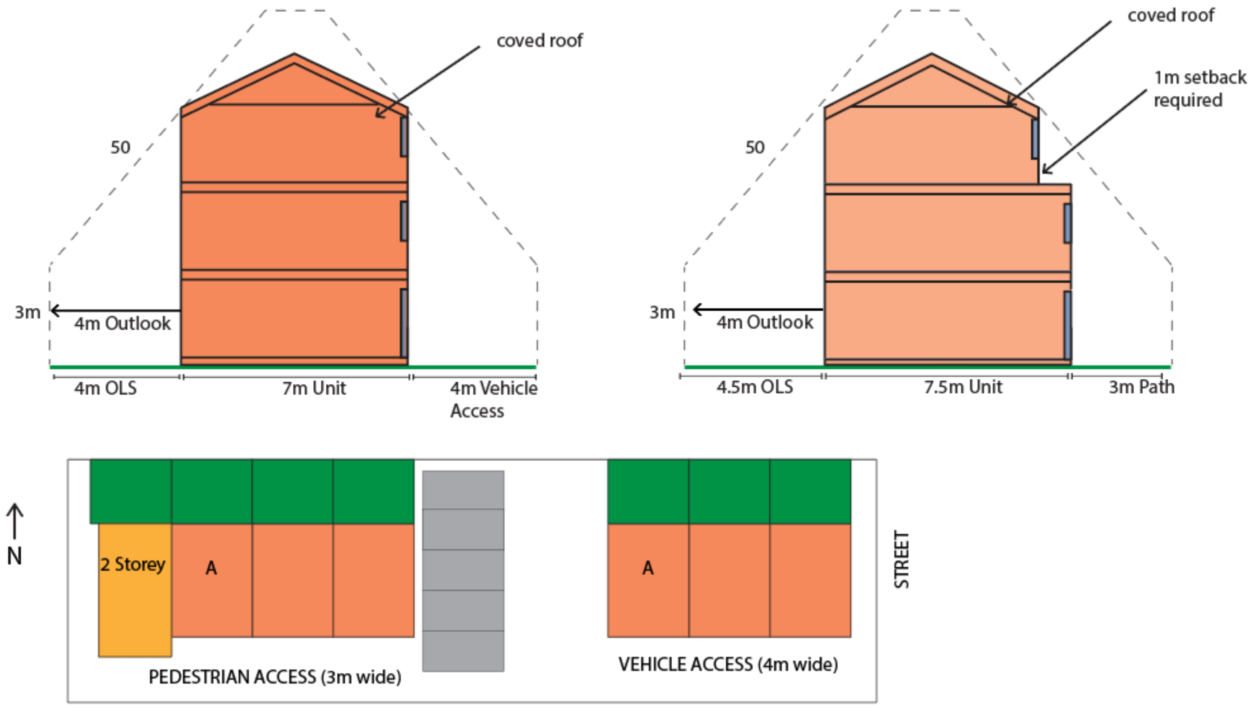
Group 2 - 50 degree recession planes

Scenario 4 – 4m and 50 degrees



Total capacity is unchanged - 7 units (735m^2). Some coving is needed for some units.

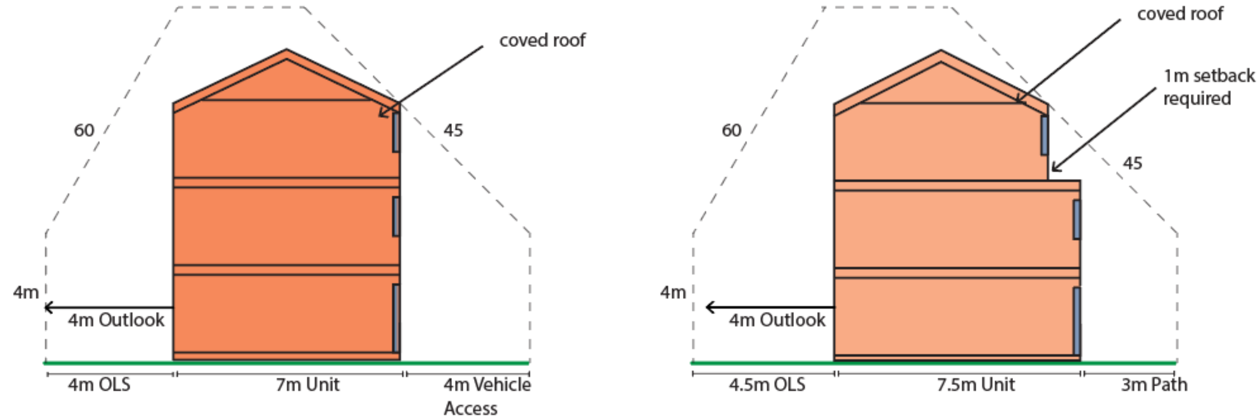
Scenario 5 – 3m and 50 degrees

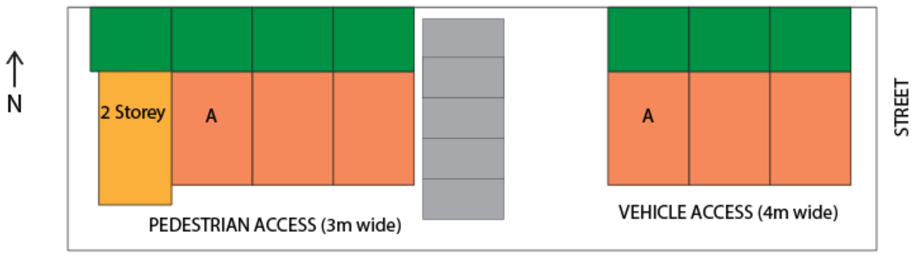


Total capacity is reduced by 5% to six 3 storey units and one 2 storey unit (700m^2).

Group 3 - Variable Recession Planes

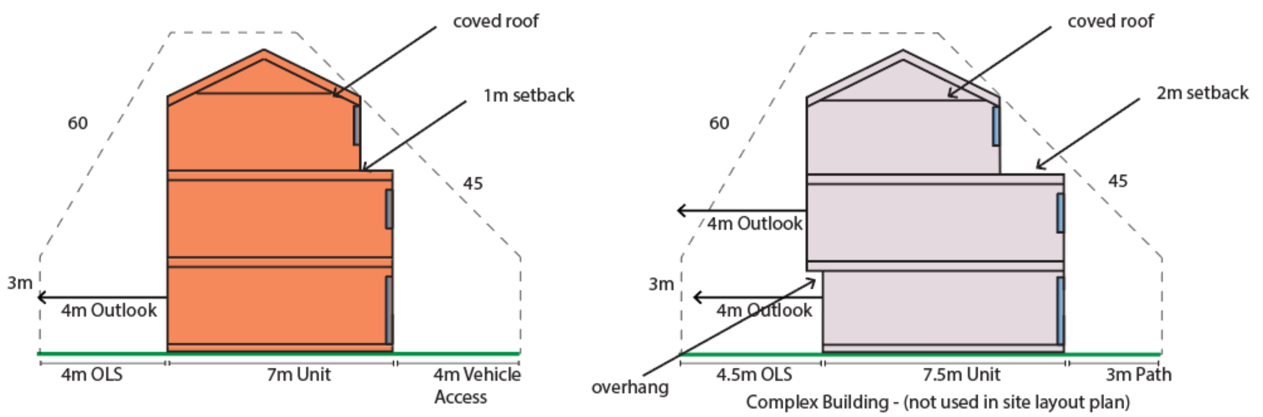
Scenario 6 – 4m Starting Height, 60 and 45 degree Angles

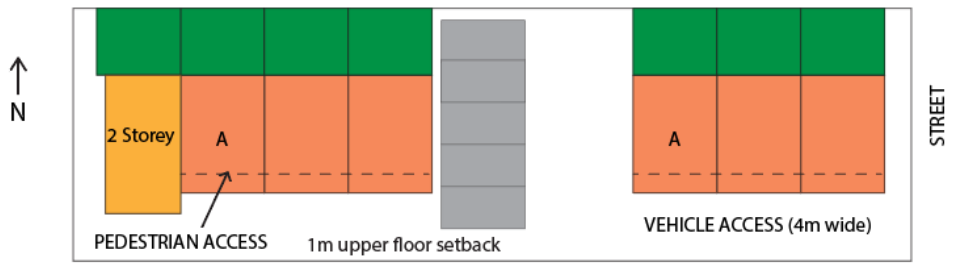




Total capacity is reduced by 5% to six 3 storey units and one 2 storey unit (700m^2).

Scenario 7 – 3m Starting Height, 60 and 45 degree Angles

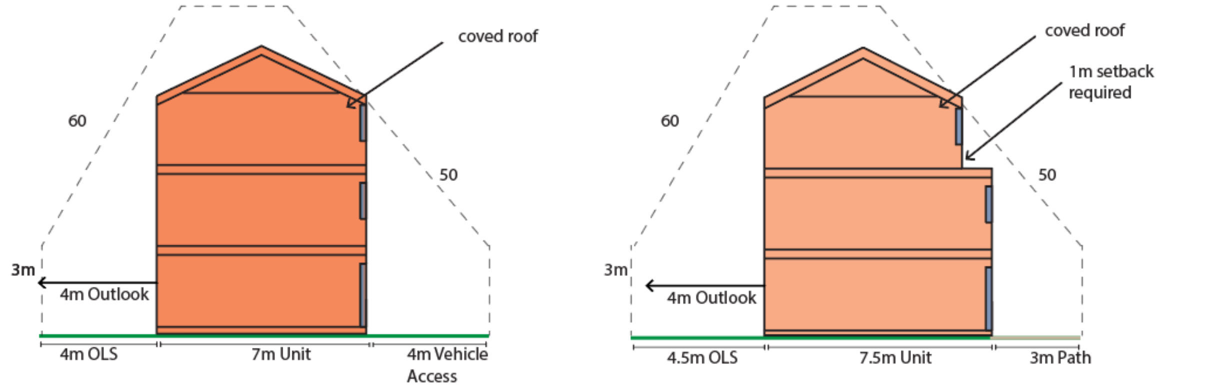




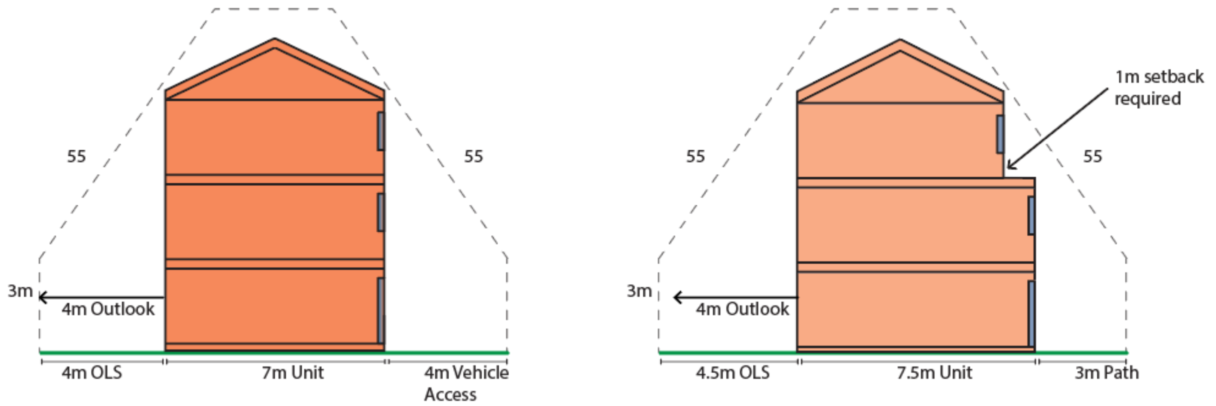
Total capacity is reduced by 9% to six 3 storey units (with upper floor setback) and one 2 storey unit (670m^2).

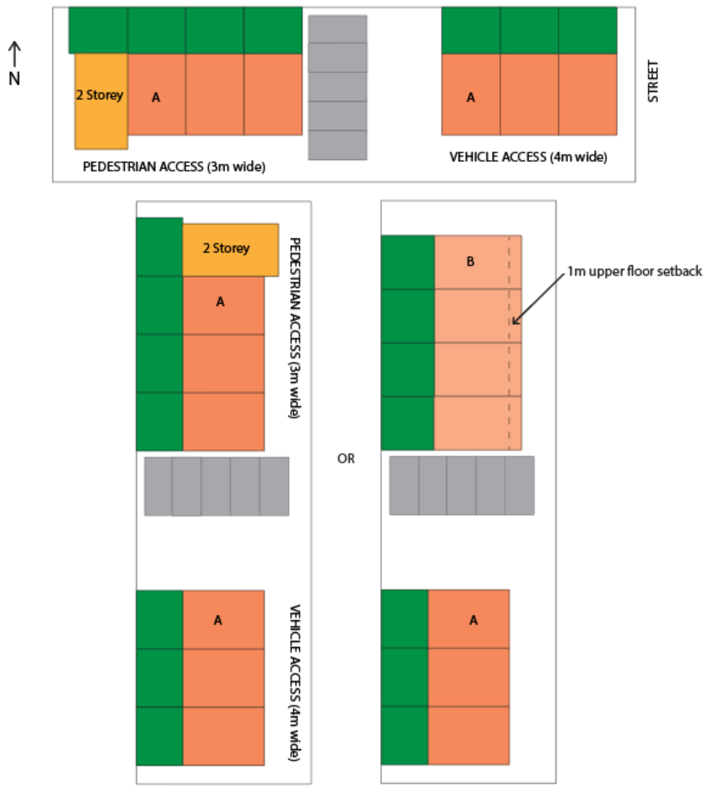
Scenario 8 - 3m Starting Height, 60 and 50 degree Angles

East West Oriented Site



North South Oriented Site



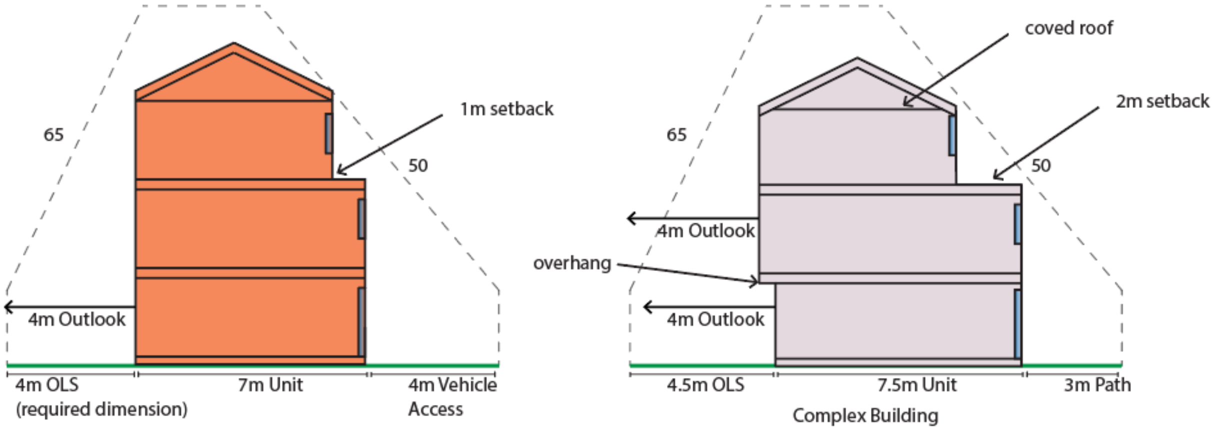


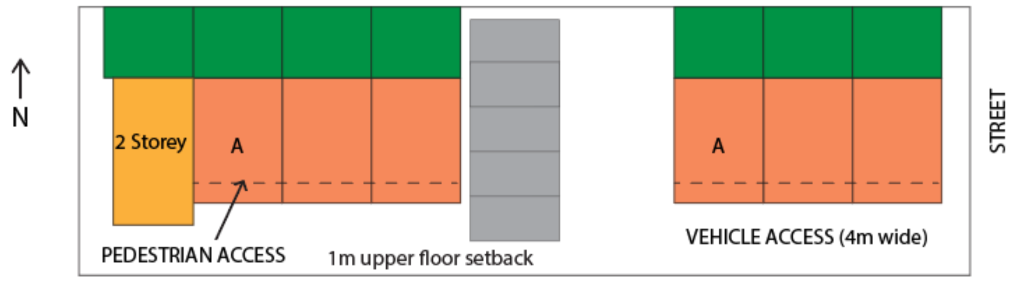
Variable recession planes have a minimum angle for boundaries at the south, a maximum at the north, and use an intermediate angle in between (55 degrees in this case). The best capacity and layout could change between orientations. In this scenario it makes little difference.

Total capacity is reduced by 5% to six 3 storey units and one 2 storey unit (700m^2).

Group 4 – Existing Recession Planes

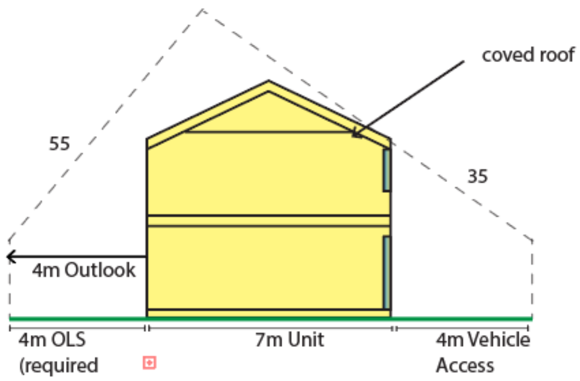
Scenario 9 – Residential Central City





Total capacity is reduced by 9% to six 3 storey units (with upper floor setback) and one 2 storey unit (670m^2).

Scenario 10 – Residential Medium Density



The shallow south recession plane means that the height limit is not reached and 3 storeys cannot be built on this narrow site.

Christchurch City Council

Total capacity is reduced by 48% to six 2 storey units (with upper floor setback) and one 1 storey unit (385m^2).

3.4 Discussion

There is limited variation in most of the scenarios, indicating that recession planes are not the main constraint on capacity until they are relatively shallow. This means that they can be reduced without significantly affecting the number of units that are likely to be built.

The analysis does show that the existing RMD zone is a constraint on capacity and that it does not enable 3 storey units to be built on typical sites.

The recession plane to be applied does depend on a combination of balancing the desire for flexibility and capacity against the tolerance for adverse impacts on neighbours. For this study, the main concern is shading rather than other adverse effects such as overlooking.

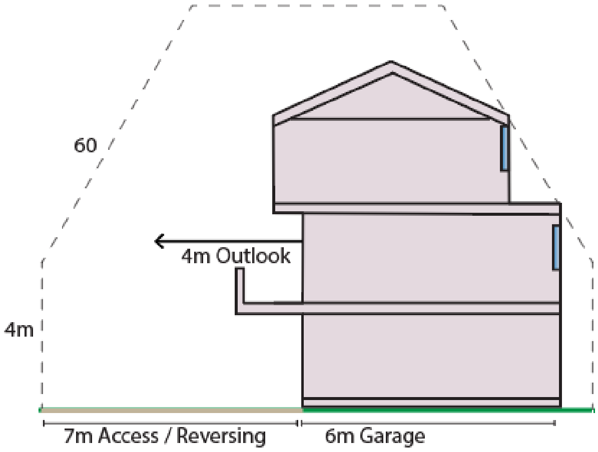
A variable recession plane has the advantage that it allows for maximising capacity where it has a reduced impact on the boundary. It therefore allows for more flexibility compared to a simple recession plane, but is a little bit more complicated to administer.

Variable recession planes have been in place in Christchurch for some time and seem to be well understood by the development community. As a result, it is not considered that complexity is a barrier to their use.

Many of the recession planes have similar impacts on capacity, and which one is most appropriate may therefore depend on other matters, including how effective they are. To inform this discussion, the table below summarises the results of this exercise:

Group	Scenario	Summary	Units	Floorspace	% of MDRS
1	1	MDRS - 4m+60	7	735	100
	2	4m+60	7	735	100
	3	4m+60	7 (inc. 1 2-storey)	700	95
2	4	4m+50	7	735	100
	5	3m+50	7 (inc. 1 2-storey)	700	95
3	6	Variable – 4m+ 60-45	7 (inc. 1 2-storey)	700	95
	7	Variable – 3m+ 60-45	7 (inc. 1 2-storey)	670	91
	8	Variable – 3m+ 60-50	7 (inc. 1 2-storey)	700	95
4	9	RCC – 2.3m+ 65-50	7 (inc. 1 2-storey)	670	91
	10	RMA – 2.3m+ 55-35	7 2-storey, 1 1-storey	385	52

The impact of tighter recession planes is likely to be that they reduce flexibility rather than capacity. There may be certain development forms that would be affected. An example is shown below, which places the bulk of the building against the recession plane in order to create space for reversing from garages.



Amending the recession planes would mean that this form was not possible on narrow sites. However, this is because it would have shading impacts on neighbours, and these would be greater than if the same building was to be constructed on a site in Auckland.

Using this development form allows for more flexibility (it allows houses with garages) but not necessarily more capacity (Those houses would have less living accommodation because of the space needed for garages). However, this comes at the cost of certainty for neighbours around the impacts of actual and potential development on surrounding sites.

Christchurch City Council

3.5 Conclusions

This study has tested the impact of different recession planes on capacity.

It demonstrates that for most of the recession plane scenarios there is only a small reduction in capacity, usually caused by the need to swap in a 2 storey unit at the rear of the site. The reason for this small impact is because recession planes are not the main constraint on development capacity in the MDRS.

As recession plane angles increase (or starting heights reduce) there is unsurprisingly an increase in the impact this has on the building envelope and capacity. However, with the exception of the RMD zone, none of the scenarios tested reduced capacity by more than 9% or prevented the construction of 3 storey units on the site. In particular, a variable recession plane with a 3m and 50 degree southern plane would reduce capacity by only 5%.

For shallower recession planes, such as used in the RMD zone, there will be a more severe impact on capacity, as these do not allow the development of 3 storeys on typical sites. It is likely that this would be considered an unacceptable constraint in the context of the MDRS and revisions to the RMA.

The main impact of introducing a shallower recession plane would be that it would reduce flexibility to use the site in different ways. However, setting a development envelope is often a trade-off between flexibility for a developer and certainty for neighbours, so this is a typical situation in plan-making.

Appendix 1 – NIWA Sun Diagrams

As part of this study, sun diagrams have been commissioned from the National Institute of Water and Atmospheric Research (NIWA). These diagrams illustrate the length of time direct sunlight can be received at a given point, along with the amount of solar energy received at that point.

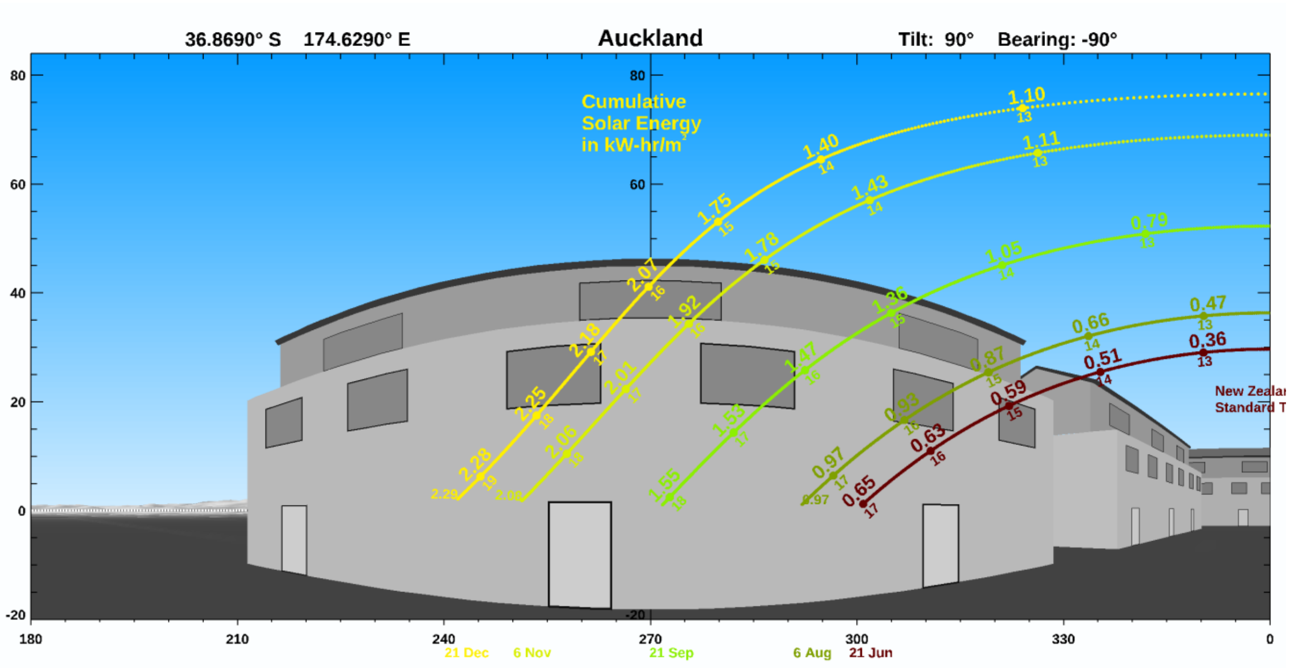
The diagrams are calibrated to simulate a medium density residential unit situated 4m from the internal boundary, with a 3 storey development being constructed on the adjacent site (the same scenario used in section 2 of this report). The model was located (and relocated) in accordance with various recession planes to simulate different scenarios.

The sunlight angles (and weather patterns) of Auckland and Christchurch were then applied to this model and outputs produced for different site orientations (rotating the model).

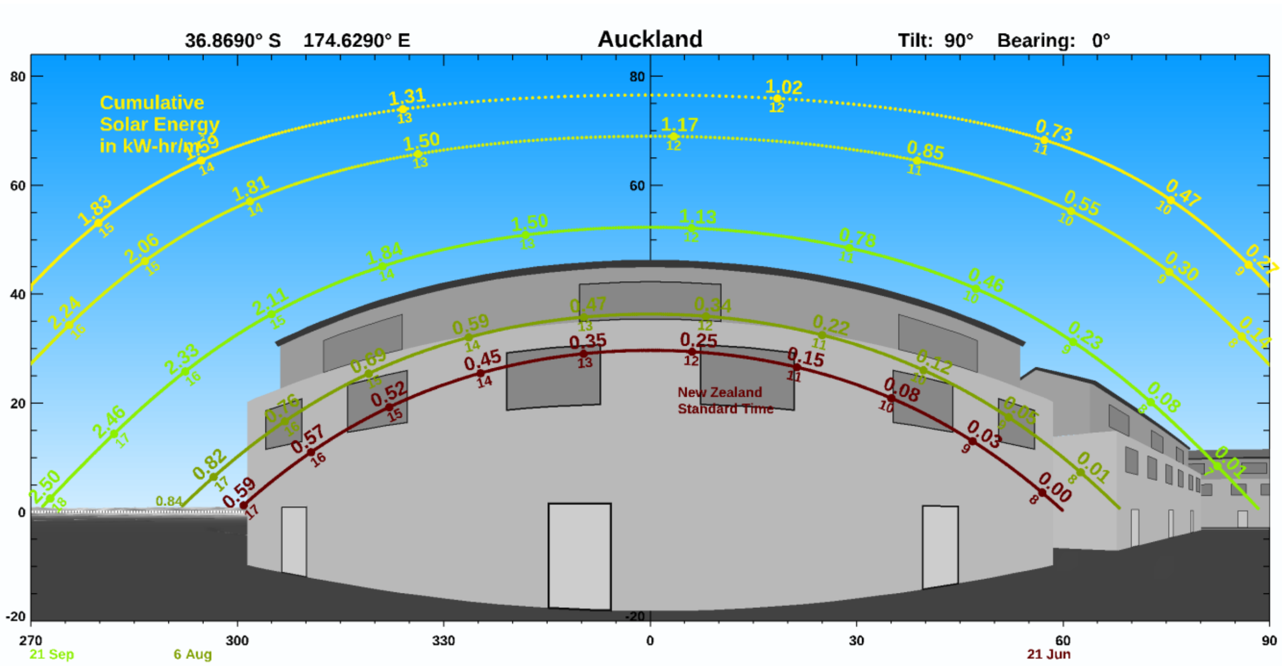
The diagrams show the path of the sun across the sky on key dates, noting the time (below the line) and the solar energy received (above the line). Solar energy includes that received directly, as well as ambient radiation.

A Auckland (Using MDRS recession planes)

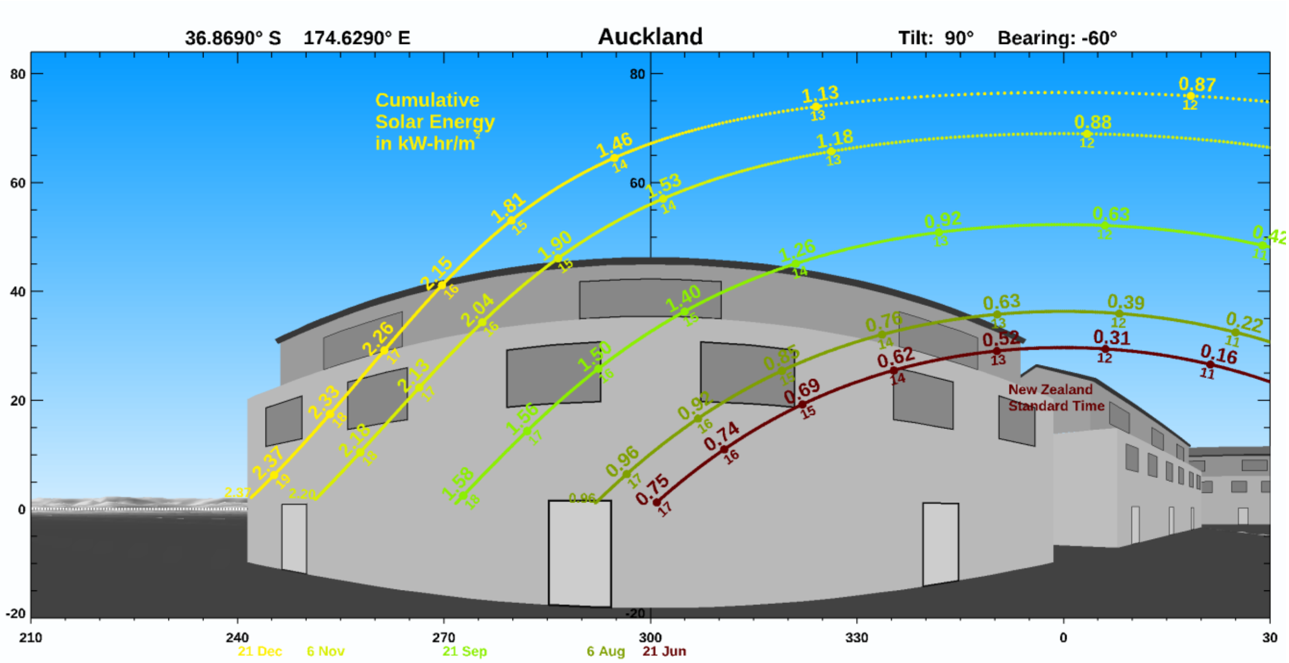
1 North – South Oriented Site



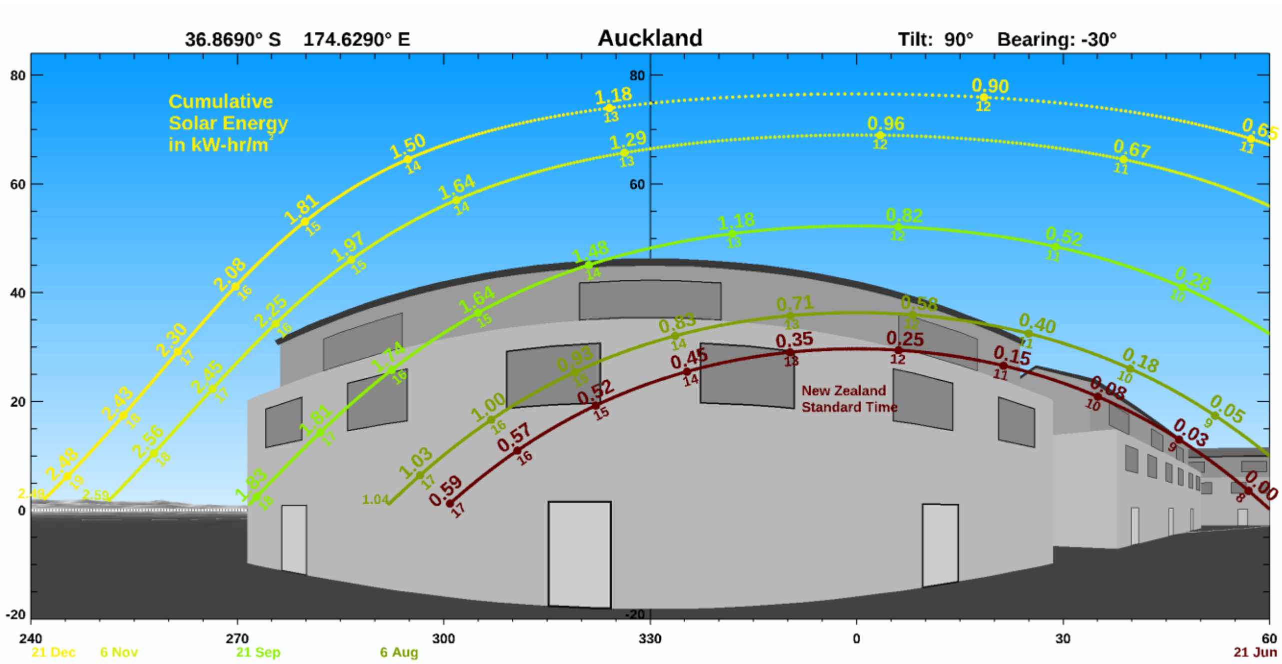
2 East – West Oriented Site



3 Site Orientation North–South + 30 degrees

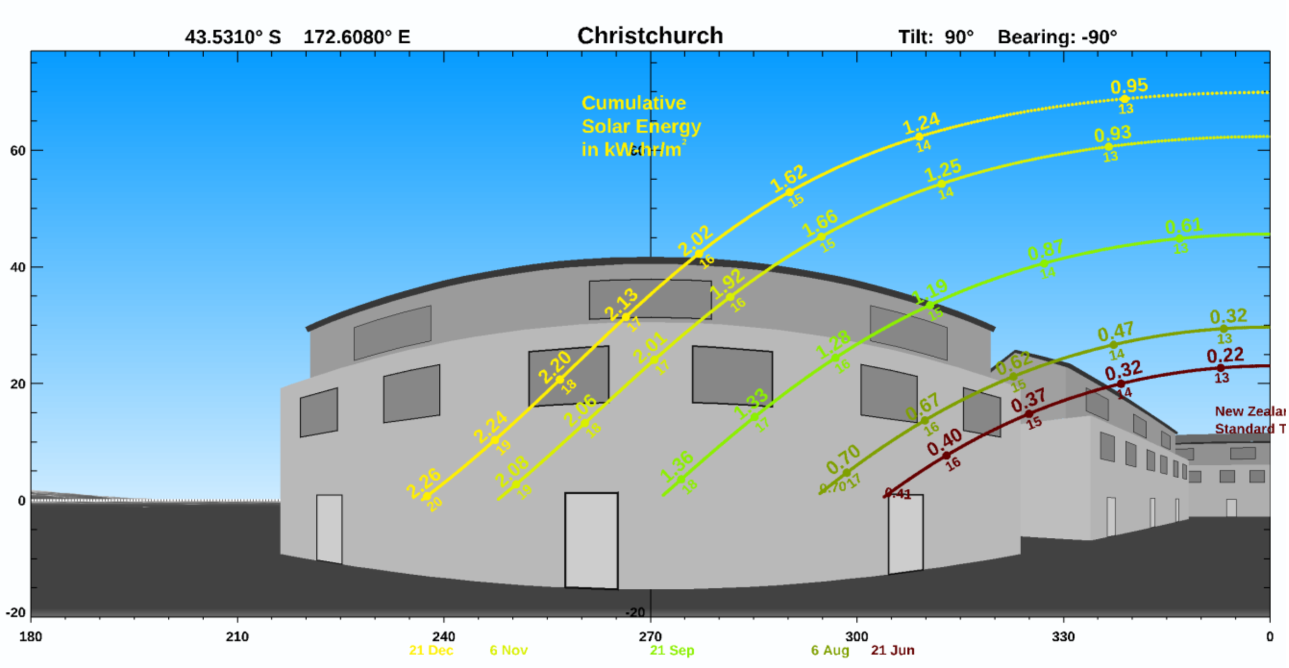


4 Site Orientation North–South + 30 degrees

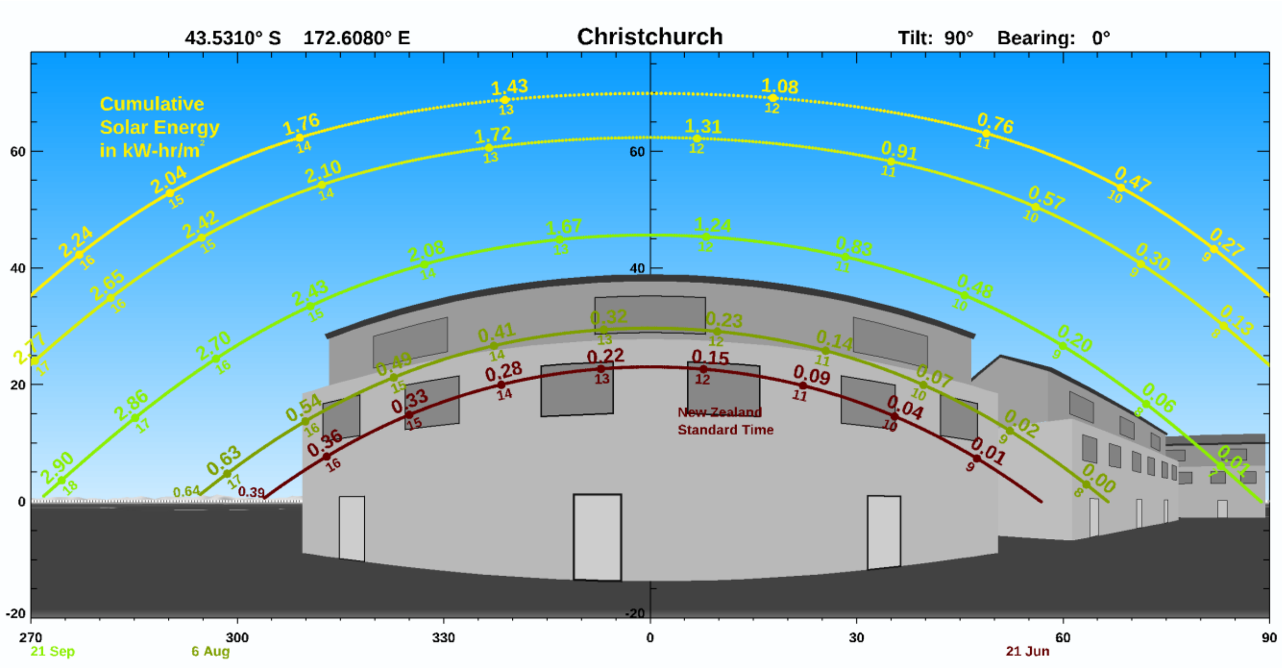


B Christchurch (Proposed Recession Planes)

1 North – South Oriented Site (Recession plane at 3m and 55 degrees)

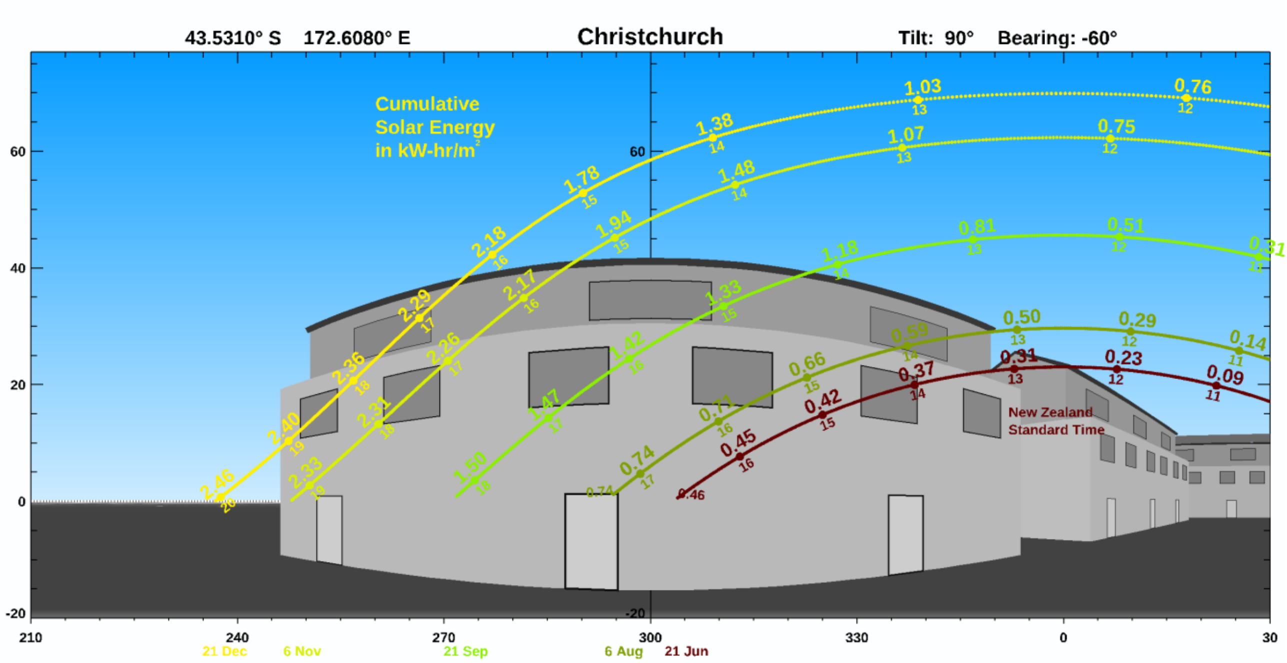


2 East – West Oriented Site (Recession plane at 3m and 50 degrees)

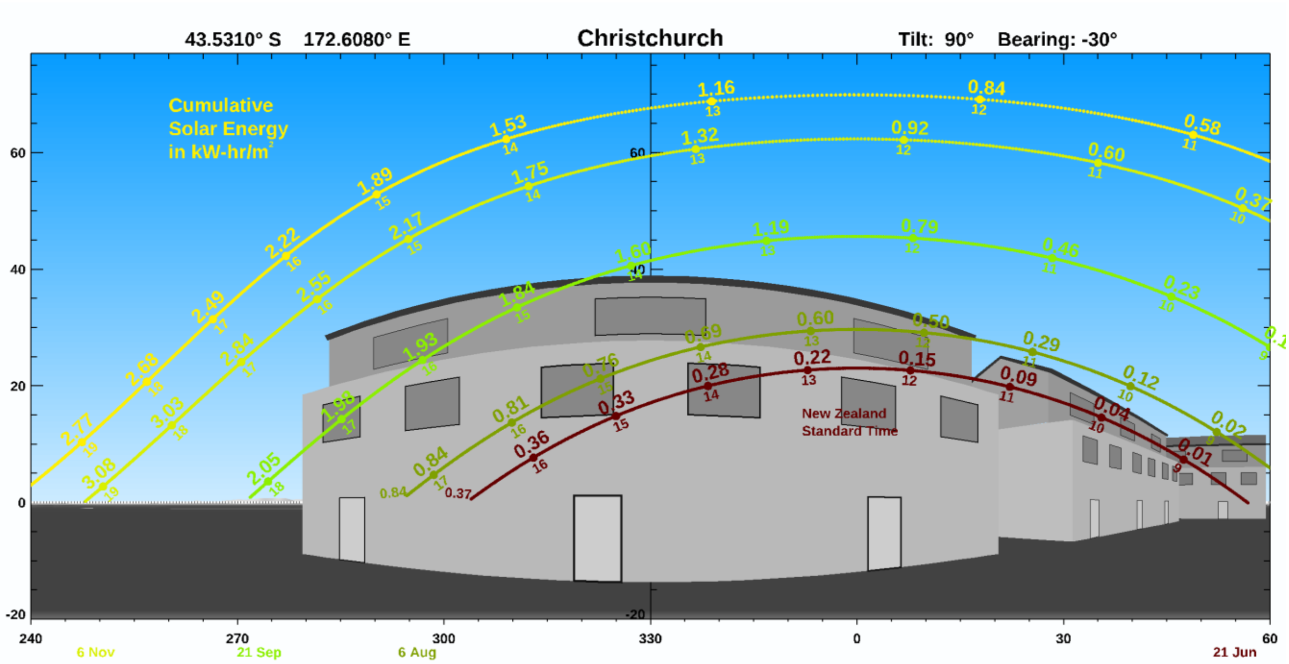


Christchurch City Council

3 Site Orientation North–South + 30 degrees (Recession plane at 3m and 55 degrees)



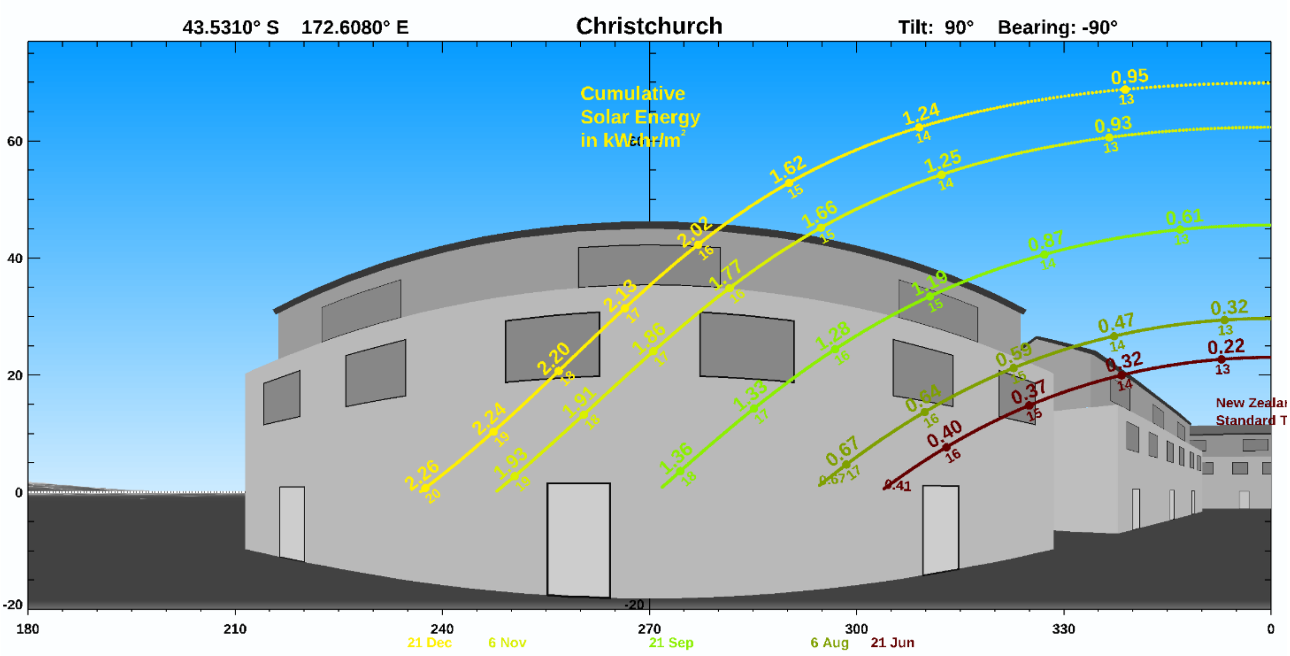
4 Site Orientation North–South + 30 degrees (Recession plane at 3m and 55 degrees)



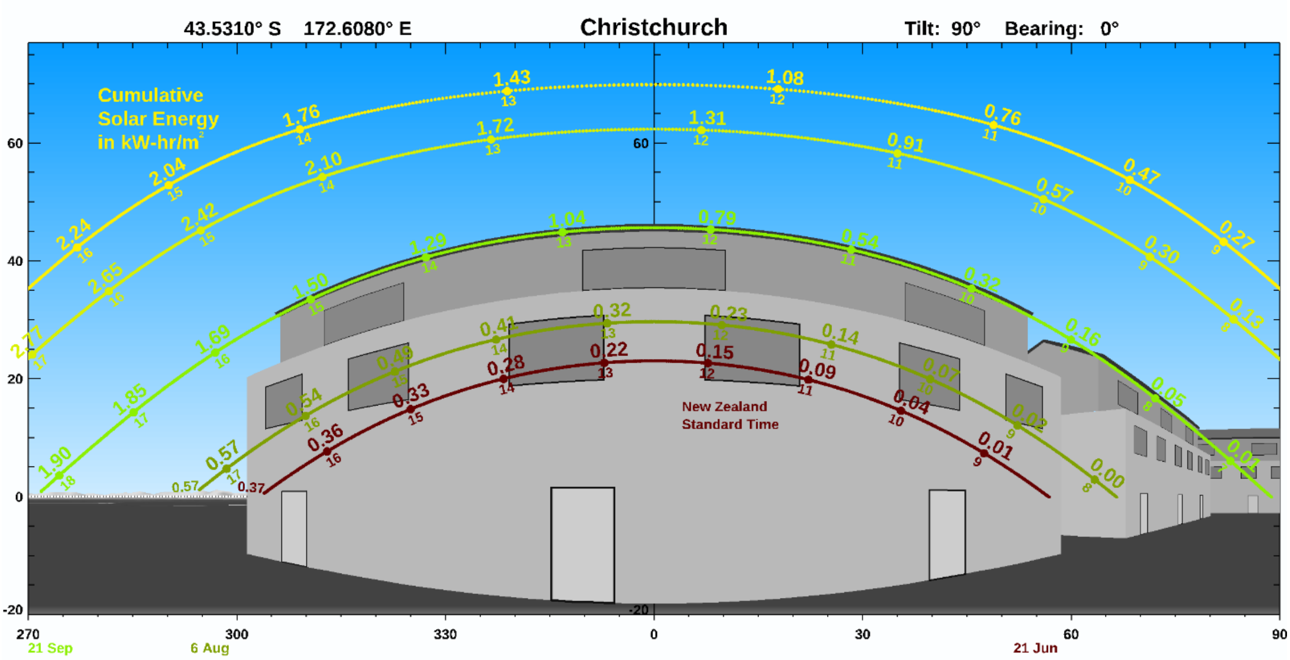
Christchurch City Council

C Christchurch (MDRS Recession Planes)

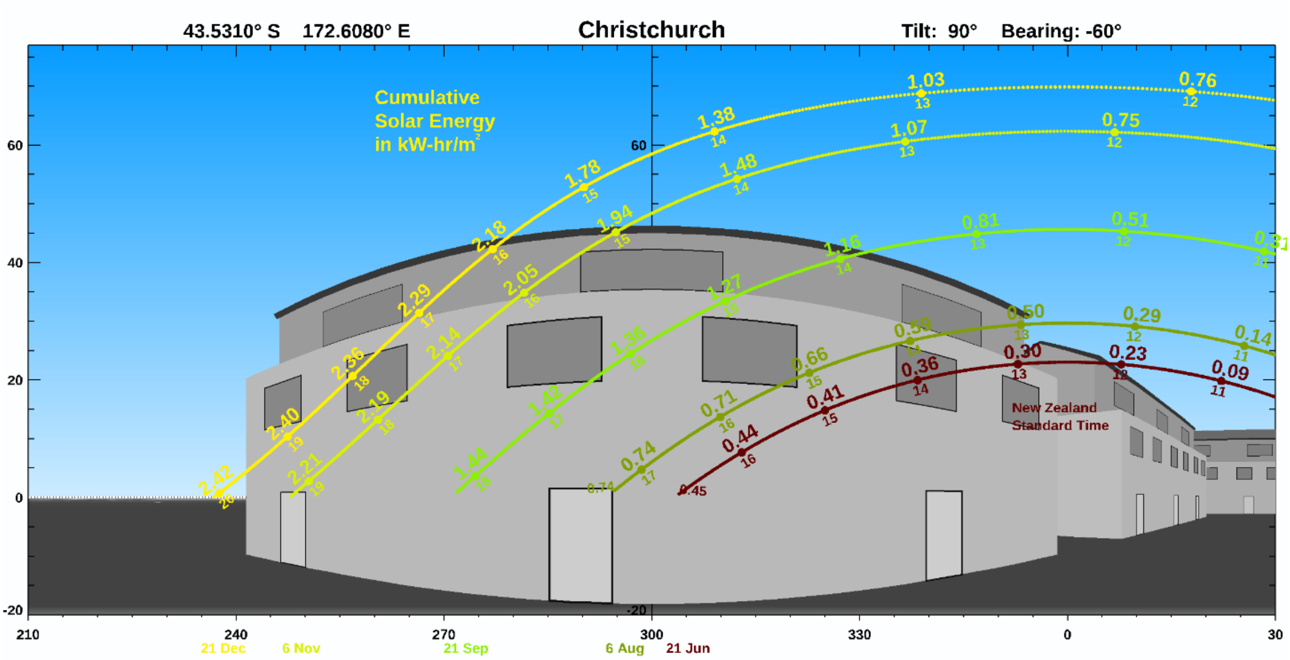
1 North – South Oriented Site



2 East – West Oriented Site



3 Site Orientation North–South + 30 degrees



4 Site Orientation North–South + 60 degrees