Future use of the 3.6 GHz band—

Decisions and preliminary views

October 2017

Canberra

Red Building   
Benjamin Offices  
Chan Street   
Belconnen ACT

PO Box 78  
Belconnen ACT 2616

T +61 2 6219 5555  
F +61 2 6219 5353

Melbourne

Level 32   
Melbourne Central Tower  
360 Elizabeth Street   
Melbourne VIC

PO Box 13112  
Law Courts   
Melbourne VIC 8010

T +61 3 9963 6800  
F +61 3 9963 6899

Sydney

Level 5   
The Bay Centre  
65 Pirrama Road   
Pyrmont NSW

PO Box Q500  
Queen Victoria Building   
NSW 1230

T +61 2 9334 7700 or 1800 226 667  
F +61 2 9334 7799

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Written enquiries may be sent to:

Manager, Editorial and Design  
PO Box 13112  
Law Courts  
Melbourne VIC 8010  
Tel: 03 9963 6968  
Email: [candinfo@acma.gov.au](mailto:candinfo@acma.gov.au)

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# Executive summary

This paper presents the Australian Communications and Media Authority’s (the ACMA’s) decisions and preliminary views on the way forward, with associated reasoning, on the future use of 3575–3700 MHz (the 3.6 GHz band) in Australia. The decisions and preliminary views on the way forward in this paper conclude the review process commenced in October 2016 with the release of the discussion paper [*Future use of the 1.5 GHz and 3.6 GHz bands*](http://www.acma.gov.au/sitecore/content/Home/theACMA/future-use-of-the-1_5-ghz-and-3_6-ghz-bands)*,* followed by the *Future use of the 3.6 GHz band* consultation package (the 3.6 GHz consultation paper)in June 2017. The 3.6 GHz band consultation consisted of the following three papers:

* *Future use of the 3.6 GHz band—Options paper* (the Options paper)
* *Future use of the 3.6 GHz band—Highest value use assessment: Quantitative analysis* (the HVU paper)
* *Future use of the 3.6 GHz band—Summary of and response to 3.6 GHz submissions*.

Completing the review of the 3.6 GHz band has been a priority for the ACMA, given the urgent need to provide clarity on a way forward to all stakeholders in the band. While undertaking this review as a priority, the ACMA has remained committed to making any decisions and identifying a proposed way forward in the band in an open, transparent and evidence-informed manner.

The ACMA believes that the outcomes detailed in this paper—essentially to commence the process by which the minister may make spectrum in metropolitan and regional Australia (as defined in Annex C) available for spectrum licensing—will provide important opportunities for Australians in both regional and urban Australia to take early advantage of new broadband services, including 5G, in this band. In recommending this decision, the ACMA recognises the impact this will have on some incumbents. In response, the ACMA proposes to implement a range of mitigation strategies, in some cases unprecedented, to assist incumbents with the transition.

## Stakeholder feedback to the 3.6 GHz band consultation

The 3.6 GHz band consultation sought industry views on a comprehensive assessment of the highest value use of the band and a series of replanning options, including an ACMA preferred option. The extensive feedback received to the consultation (35 responses) reaffirms the importance of the 3.6 GHz band to many stakeholders and the sensitivity associated with any potential regulatory changes in the band.

Stakeholder views on the future of the 3.6 GHz band were once again strong and highly polarised. The views expressed by incumbents and prospective spectrum users were largely consistent with those communicated throughout the review process.

Broadly speaking, incumbents such as point-to-multipoint users (in particular Wireless Internet Service Providers (WISPs)) and some earth station licensees remain deeply concerned with any changes that would affect their continued access to the band. The primary development learnt from feedback to 3.6 GHz band consultation was the reduced level of apprehension from some existing licensed earth station operators (such as Telstra Corporation Limited (Telstra) and Singtel Optus Pty Limited (Optus)) regarding possible changes. This is because they are able to retune operations at their current earth stations in Sydney and Perth above 3700 MHz. However, Inmarsat Australia Proprietary Limited (Inmarsat), which operates an earth station at Landsdale in Perth, remains of the view that it should be permitted to continue its current operations on a protected basis.

Feedback from potential new users of the 3.6 GHz band for wide-area broadband services (the major mobile carriers and NBN Co Limited (NBN Co)) reaffirmed their strong interest in gaining access to the band in metropolitan and regional areas, either for fixed or mobile services. Submissions also confirmed the 3.6 GHz band as suitable for use by early 5G deployments.

## Summary of ACMA considerations and conclusions

### HVU and the case for action

As part of its mobile broadband (MBB) strategy, the ACMA committed to undertaking a comprehensive assessment of the highest value use (HVU) of a band during the preliminary replanning phase of the process for consideration of additional spectrum for MBB services. Following on from the preliminary HVU included in the October 2016 discussion paper, and using feedback obtained from stakeholders as part of that process and further engagement, the ACMA completed a comprehensive HVU of the 3.6 GHz band, which was contained in the HVU paper released in June 2017. The analysis indicated that the HVU of the band has (or will soon) move to wide-area broadband deployments (notably MBB) in metropolitan and regional areas.

In response to submissions to the HVU paper, the ACMA has reviewed the HVU framework and data assumptions. In relation to the framework, WISPs and fixed satellite service (FSS) earth receive licensees were concerned that the framework did not include potential spectrum sharing arrangements. The ACMA notes that while spectrum sharing could increase economic welfare under a best-case scenario, there is no consensus on whether spectrum sharing in a situation where demand exceeds supply is a viable option (discussed further below). Therefore, the ACMA did not analyse the HVU of an option that, based on available information, is unlikely to be practically feasible.

Having reviewed and updated its HVU analysis following feedback received to the Options paper, the ACMA remains of the view that there is strong evidence that re-farming for wide-area broadband purposes is net beneficial in metropolitan and surrounding areas (Area 1 and Area 2[[1]](#footnote-2)).

The ACMA also believes the potential re-farming benefits exceed the potential incremental costs in Area 3, despite the potential for some unquantifiable costs (primarily consumer detriment) if incumbent point-to-multipoint licensees are displaced. The ACMA notes that the extended re-allocation periods, the availability of alternative spectrum in the 5.6 GHz and possibly the 28 GHz bands, and the potential ability to continue accessing the band via third-party authorisation arrangements, will provide some incumbents with opportunities to continue providing services. The ACMA considers that these mitigation strategies are likely to limit the materiality of the unquantifiable costs of the re-farming of the 3.6 GHz band. The ACMA also notes that there are unquantified benefits of re-farming the band for 5G services that are particularly relevant in Area 3, such as providing easier access to medical professionals in regional areas. Having regard for the quantified and unquantified costs and benefits, the ACMA is confident that re-farming will also be net beneficial in Area 3.

The ACMA remains of the view that current regulatory arrangements are not optimised for the expected HVU of the band and hence the case for review and modification of existing arrangements continues to be warranted.

### Bandwidth and geographic area considerations

In the Options paper, the ACMA identified a range of possible replanning options to facilitate the band moving to its expected highest value use. These options were based on different spectrum bandwidths and geographic areas (as well as different licensing regimes).

The HVU assessment in the Options paper indicated that the public benefit derived from the 3.6 GHz band is maximised by re-allocating the entire 3.6 GHz band in metropolitan and regional areas for the issue of spectrum licences rather than a hybrid approach where a segment is retained for site-based apparatus licensing. It also indicated that greater benefit will be derived through minimising fragmentation in spectrum arrangements across frequency ranges and different geographic areas.

Based on this, the ACMA remains of the view that it should establish arrangements optimised for wide-area broadband deployments (mobile and fixed) over the entire 125 MHz of the 3.6 GHz band in metropolitan and regional areas. The expected licensing regime under this approach would be spectrum licences allocated via auction.

The ACMA recognises that WISPs (and other point-to-multipoint interests) and Inmarsat suggest that a better option would be to either develop sharing arrangements (discussed later) or only re-farm part of the 3.6 GHz band and/or to do so only in metropolitan areas. Inmarsat in particular indicated that its satellite operations only occupy about half the 3.6 GHz band in Perth, so restrictions on wide-area broadband deployments would largely be limited to that spectrum. While the ACMA has considered this argument carefully, it is not persuaded that the resultant impact on wide-area broadband deployments would be warranted. The continued protection of the Inmarsat earth receive facility would mean that most of Perth would be limited to ‘small cell’ deployments rather than ‘macro’ deployments, with a corresponding impact on the ability of the spectrum to be provided to its highest value use. In other words, the opportunity cost (of limiting any mobile broadband use in affected areas to small cell deployment) would be expected to outweigh the benefit in terms of the reduction in costs to the incumbent.

### Mitigations for incumbents

A key element of the ACMA-preferred replanning option was the implementation of various mitigation strategies for incumbents. These mitigations were:

* the use of extended re-allocation periods for incumbents
* the identification of alternative spectrum options for apparatus licensed point-to-multipoint uses
* the ability of affected apparatus licensees to negotiate ongoing access to the band via third-party arrangements with spectrum licensees in the area

the identification of earth station protection zones in regional Australia to allow the geographic relocation of metropolitan earth stations that require protected access to the 3.6 GHz band.

Extended re-allocation periods

Incumbents provide a range of existing services using either relatively recently installed infrastructure of modest cost (for example, point-to-multipoint services) or expensive long standing infrastructure that requires extended periods to relocate (for example, earth stations). In both cases, in order to facilitate the continued delivery of these services and/or allow a reasonable opportunity to recoup investments, extended re-allocation periods have been considered in most areas.

The exact duration of such an extended re-allocation period is a matter of judgement. The proposed periods seek a balance between rapid access in areas likely to have early wide-area broadband deployments (metropolitan areas), while providing longer re-allocation periods in areas where broadband deployments are likely to take longer to occur (regional areas).

Based on information received to the Options paper, the ACMA has revisited its initial proposals for a uniform seven year re-allocation period in both metropolitan and regional Australia (as described in Annex C). Instead, the ACMA is proposing re-allocation periods of two years in metropolitan areas (Area 1A), except for Perth (Area 1B) where five years is proposed, and seven years in ‘metro plus’ (Area 2) and regional areas of Australia (Area 3). While spectrum licences would commence before the end of this period, existing apparatus licensed users could, at their discretion, continue to operate (and be protected) throughout this period, though new assignment would be restricted by section 153P of the *Radiocommunications Act 1992* (the Act). It is important to note that the setting of an appropriate re-allocation period or periods will be a matter for the minister to decide if and when he makes a re-allocation declaration for the 3.6 GHz band under section 153B of the Act.

The statutory minimum two-year re-allocation period in metropolitan areas (other than Perth) maximises the early opportunity for new services in these areas. It will have a low impact on incumbents due to the small number of pre-existing licensed users of the band in these areas and the ability of incumbent earth station licensees to migrate services out of the 3.6 GHz band. The five-year (rather than two-year) period in Perth is proposed to provide time for one incumbent earth station operator that cannot migrate services out of the 3.6 GHz band, to plan and implement alternative arrangements. Five years was chosen as a balance of sufficient time for relocation, while minimising the impact protection of this facility would have on availability of new services in Perth. The continued operation and protection of the facility beyond this time would severely affect the availability of wide-area broadband services in this spectrum in the Perth area.

The extended re-allocation period of seven years in regional areas will allow market mechanisms to be used if new 3.6 GHz band spectrum licence holders seek to use spectrum in an area occupied by an incumbent apparatus-licensed spectrum user prior to the end of the re-allocation period. Similarly, market mechanisms could be used for incumbent spectrum users to support continued operation in the band (for example, an incumbent apparatus licensee could negotiate with a ‘new’ spectrum licensee to continue services beyond the re-allocation period if mutually agreed).

Alternative spectrum options for apparatus licensed point-to-multipoint

The identification, where possible, of alternative site-based, coordinated apparatus licensing arrangements for point-to-multipoint services was a further mitigation strategy proposed by the ACMA in the Options paper. A key consideration was ensuring, as far as possible, that any such arrangements will endure for a reasonable period. This is a challenge, because bands of interest to site-based apparatus point-to-multipoint uses are often of interest to wide-area broadband services (be they fixed or mobile) and therefore, likely to come under review as potential candidates for re-allocation as wide area spectrum licences in the future.

In the Options paper, the ACMA proposed that a 40 MHz portion of the 5600–5650 MHz (5.6 GHz) band be made available under a coordinated apparatus-licensed regime for site-based point-to-multipoint uses. The intention was to provide a long-term alternative for site-based point-to-multipoint users that provide services that are not conducive to a spectrum-licensed regime. The use of coordinated apparatus licenses was also proposed to facilitate protection of incumbent Bureau of Meteorology (BoM) radars in the band.

The ACMA acknowledges feedback from a range of sources querying apparatus licensing in the 5.6 GHz band. This feedback included concerns over the protection of BoM radars, queries over the utility of the band for point-to-multipoint services being compromised by illegal use of the band and limited bandwidth, and interest in proceeding with a class-licensing approach for the band to allow for broader use of the band.

After considering this feedback, the ACMA remains of the view that establishment of site-based, coordinated apparatus-licensing arrangements for point-to-multipoint services in the 5.6 GHz band is appropriate and useful. Allowing access by coordinated apparatus licences can, if designed properly, be fully consistent with protection of BoM radar use. Where available, the band is also well-suited to WISP and other point-to-multipoint use, with concerns about any existing illegal use able, if borne out, to be addressed through compliance and enforcement work. The ACMA adopting a policy position to not vary these arrangements prior to the end of 2028 can also be given to encourage investor confidence. The ACMA will develop the necessary planning and coordination rules as part of the implementation of the overall planning decision for the 3.6 GHz band detailed in this paper.

It will be ACMA policy that existing 3.6 GHz point-to-multipoint licensees (issued before the embargo was expanded) will, as far as possible, be given preference when assessing applications for apparatus licences in the 5.6 GHz band.

The ACMA acknowledges that this mitigation does not and cannot completely address all current and potential future demand for site-based, coordinated point-to-multipoint apparatus licences.

During the consultation period, the ACMA was also approached regarding the possibility of facilitating access to part of the 27.5–29.5 GHz (28 GHz) band for apparatus-licensed point-to-multipoint arrangements in regional Australia. The ACMA has considered this and, while not having made formed any firm view, agrees it is worthy of further investigation. The ACMA therefore will investigate the possibility of implementing apparatus-licensed point-to-multipoint arrangements in part of the 28 GHz band in regional Australia to provide further options for new and displaced 3.6 GHz licensees.

Again, while this band potentially offers opportunities for some operators, the nature of propagation characteristics in the band means that it could not be a solution in all cases. In addition, due to NBN Co using the band for the uplink component of its satellite broadband service, coexistence will need to be carefully managed. However, limiting use to part of the 28 GHz band in regional Australia through development of a coordinated apparatus-licence regime would assist in ensuring coexistence.

Earth station protection zone(s)

The ACMA proposed the establishment of an east coast earth station protection zone to provide an alternative for satellite operators to continue to provide the services currently delivered by earth stations in metropolitan areas. This acknowledges that while satellite services in this band are currently operated from metropolitan areas for reasons of history and convenience, there is no overwhelming argument as to why they must remain in these areas long term. Feedback to the concept was broadly supportive, though one licensed earth station operator did not agree that relocation from metropolitan areas was appropriate.

Following consideration of feedback, the ACMA remains of the view that establishment of one or more east coast earth station protection zones is an appropriate mitigation strategy. While having received some input from industry and undertaken some independent analysis on possible sites, at this point it is still uncertain which (if any) will be suitable as earth station protection zones. Due to the uncertainties associated with which site (or sites) will be viable, it is proposed to identify several of the most promising options now, and consider them further as part of the consultation on making a recommendation to the minister under section 153G of the Act. This will provide more time for the ACMA and industry to investigate the suitability of these sites. Identifying multiple sites will also increase the likelihood that at least one of them will be a suitable location. The proposed locations for further exploration are the three areas around Quirindi, Moree and Roma defined in Annex D, along the eastern side of the continent.

Should it become apparent that one or more of these zones is not viable, the ACMA could investigate mechanisms to make the area available for wide-area broadband services. If this was to occur before the ACMA makes a re-allocation recommendation to the minister, the area would be removed from consideration. Alternatively, if after the minister makes a decision, it subsequently became clear that an area was not suitable, the ACMA could investigate implementing temporary apparatus-licensing arrangements for broadband services in these areas, while working towards options to spectrum license the area at a later date.

Once the band has been spectrum licensed, the ACMA would not create a new zone in spectrum and areas subject to spectrum licensing if it became clear an alternative site was preferable as a protection zone. This would not preclude a commercial arrangement being put in place with the spectrum licensee, but would prevent practical ACMA regulatory intervention in the areas made available for spectrum licensing. However, alternative sites outside those frequencies and areas subject to spectrum licensing could continue to be considered.

Dynamic spectrum access/sharing concepts

The ACMA has also given thought to the possibility of using some form of dynamic spectrum access-based sharing in the band. WISPs have suggested various sharing arrangements as a potential way to allow wide-area fixed and mobile broadband deployments in the 3.6 GHz band, while simultaneously allowing incumbent site-based point-to-multipoint users to continue to operate and new users to gain access to the band. Advocates have put forward a proposal for an extensive trial to be undertaken to develop potential sharing models using these concepts with the help of government funding.

The ACMA has carefully considered whether practical sharing models could be implemented that would meet the requirements of both aspirant wide-area broadband network users and incumbent (and aspirant) point-to-multipoint users alike. It does not believe practical sharing models will provide the required certainty of long-term access to wide-area broadband users while simultaneously offering the desired certainty to current and new point-to-multipoint users that they state is required. This is because, in practice, the sharing models contemplated are based on hierarchical access rights—with lower tiers of users having to ‘give way’ to higher-tier users, in the event of conflict of uses. Determining which users are to be given ‘top tier’ rights, through their licence conditions, would be something the ACMA would need to resolve and would likely be contentious as it is likely that both incumbents and prospective wide-area broadband users would seek to be considered as the top-tier user.

Under the tiered sharing model proposed by the USA, an auction of rights over a large number of geographically small areas has been determined to be the most transparent and practical way to resolve competitive contention in this circumstance. However, there are reports that a number of stakeholders continue to express reservations with this approach, claiming that it will impede 5G use of the band in the US.[[2]](#footnote-3) As a result, at its meeting on 24 October 2017, the Federal Communication Commission (FCC) decided to release a notice of proposed rulemaking in the 3550–3700 MHz band for comment.[[3]](#footnote-4) Some of the changes being considered include longer licence terms with the possibility of renewal and larger geographical lots for auction. The ACMA notes that, with the current exception of the US, many other countries have chosen not to adopt a shared/tiered approach in this band between site-based and wide-area wireless broadband deployments.

The ACMA believes the approach it has proposed, that is, auctioning wide-area spectrum licences while providing an extended re-allocation period for incumbents (thereby conferring ‘primary rights’ on incumbents, but for a fixed period), along with the identification (where possible) of alternative spectrum for future deployments, is likely to be the better approach. This approach, in essence, puts in place a form of tiered-access sharing arrangement for the duration of the re-allocation period (seven years). Ongoing access or ‘neutral host’ arrangements could also be negotiated with spectrum licensees in the area, albeit at their discretion, beyond the end of the extended reallocation period.

### ACMA decisions and preliminary views

Based on input to the Options paper and the resulting ACMA analysis, the ACMA has decided to progress the 3.6 GHz band to the re-farming stage of its [process for considering additional spectrum for mobile broadband services](http://www.acma.gov.au/Industry/Spectrum/Spectrum-projects/Mobile-broadband/mobile-broadband-strategy-and-work-plan). The approach is largely consistent with the preferred option outlined by the ACMA in the Options paper, but with some modest changes to reflect information gained during consultation and further consideration by the ACMA.

The ACMA will:

1. Consult on a recommendation to the minister[[4]](#footnote-5) (the re-allocation consultation), that, in accordance with section 153B of the Act, he make a re-allocation declaration for the issue of spectrum licences for the entire 3.6 GHz band in metropolitan and regional areas (that is, areas 1A, 1B, 2 and 3 as defined in Annex C) and apply the following re-allocation periods:

* two years in Adelaide, Brisbane, Canberra, Melbourne and Sydney (Area 1A)
* five years in Perth (Area 1B)
* seven years in ‘metro plus’ areas (Area 2)
* seven years in the rest of regional Australia (Area 3).

The re-allocation periods proposed in Area 1B, Area 2 and Area 3 are longer than have generally been used in the past (typically periods in the range of two to four years have been defined). They are intended as part of the mitigation strategy for incumbents.

1. As part of the re-allocation consultation, flag the option of excising areas around Moree, Quirindi and Roma as defined in Annex D, from being re-allocated. It is proposed that these areas be investigated as locations for potential east coast earth station protection zones in the 3.6 GHz band (and other commercial satellite bands). It is should be noted that commitment to these locations in regional Australia does not preclude investigation of possible locations outside those areas being recommended for re-allocation (for example, Bourke). If one or more of these areas are excised from the final recommendation to the minister, and pending a decision from the minister, suitable protection arrangements for the zones would be developed as part of any Technical Liaison Group (TLG) process for the 3.6 GHz band. In the event that one or more of these sites are found to be unsuitable, any protection criteria could be removed and options to make the areas available initially for the apparatus licensing of wide-area broadband services and possible eventual spectrum licensing, subject to a further re-allocation decision, could be investigated.[[5]](#footnote-6)
2. As part of the re-allocation consultation, flag the option of excising the area immediately surrounding the earth station facility at Uralla, New South Wales (represented by the Hierarchical Cell Identification Scheme (HCIS) identifier NU7K4 and displayed in Annex D) from being re-allocated. This would enable the earth station facility operated by Lockheed Martin Australia Pty Ltd (Lockheed Martin) to continue operating under apparatus-licenced arrangements. If this area is excised from the final recommendation to the minister, and pending a decision form the Minister, suitable protection criteria for the facility would be developed as part of any TLG process for the 3.6 GHz. Note, the long-term viability of this site may be reviewed in the future, given increasing international interest in the 3700–4200 MHz band for use by wide-area broadband services.
3. If the minister makes a re-allocation declaration in accordance with the proposed recommendation, proceed with the necessary steps to undertake a price-based allocation of spectrum licences in metropolitan and regional areas (that is, areas 1A, 1B, 2 and 3).
4. Establish site-based apparatus-licensed point-to-multipoint arrangements in the 5.6 GHz band in regional and remote Australia as part of the mitigation strategy to assist WISPs and other prospective site-based wireless broadband operators. The ACMA will adopt a policy position that the 5.6 GHz band should be made available for such licensing at least until the end of 2028. In addition to this, it will be ACMA policy that existing 3.6 GHz point-to-multipoint licensees in Area 2 and Area 3, be encouraged to apply for licences in the 5.6 GHz band and will be given preference in the ACMA’s consideration of such applications. The ACMA will work with industry to develop a process to guide its decision-making when there is contention for these licences in areas where there are multiple licensees vying for access to the band.
5. Investigate the possibility of apparatus-licensed point-to-multipoint arrangements in part of the 28 GHz band in regional Australia as another possible option to assist WISPs and other prospective site-based wireless broadband operators.

## Next steps

To give effect to the decisions and preliminary views outlined above, the ACMA will perform the work outlined below:

1. Concurrently with the release of this paper, the ACMA has commenced consultation on a draft recommendation to the minster in accordance with section 153G of the Act. Following this consultation, and subject to any additional information obtained, the ACMA is currently minded to make a recommendation to the minister in accordance with section 153F of the Act.
2. Subject to a re-allocation declaration being made by the minister, the ACMA will commence work to progress allocation of spectrum licences in those areas subject to re-allocation. This will include establishing a TLG for the development of the technical framework for 3.6 GHz spectrum licences. A spectrum licence technical framework is the set of technical rules made by the ACMA for operation within a specific band. Under the Act, the framework consists of three regulatory elements—conditions on the licence (including [licence core conditions](https://www.acma.gov.au/Industry/Spectrum/Radiocomms-licensing/Spectrum-licences/spectrum_24)), a determination of unacceptable interference for the purpose of [device registration](https://www.acma.gov.au/Industry/Spectrum/Radiocomms-licensing/Spectrum-licences/spectrum_22-1), and radiocommunications advisory guidelines. Additional technical planning and coordination rules may also be developed through a TLG to manage interference to and from spectrum licences.
3. Develop and consult on frequency assignment rules for coordinated apparatus-licensed point-to-multipoint use of the 5.6 GHz band outside of metropolitan areas (that is, areas 2 and 3). In parallel, develop and consult on mechanisms to facilitate existing 3.6 GHz point-to-multipoint licensees being given preference when assessing applications for licences in the 5.6 GHz band.
4. Investigate and consult on the possible development of coordinated apparatus-licensed point-to-multipoint use of some or all of the 28 GHz band outside of metropolitan areas.
5. Develop and consult on planning arrangements for east coast earth station zones. This will include the development of appropriate coordination arrangements as part of any TLG process for the 3.6 GHz band, with additional planning and frequency assignment rules developed as necessary.

# 1. Introduction

The ACMA released a consultation package on the [*Future use of the 3.6 GHz band*](http://www.acma.gov.au/theACMA/future-approach-to-the-3_6-ghz-band) on 23 June 2017 (the June 2017 consultation package). The consultation package followed on from the discussion paper, [*Future use of the 1.5 GHz and 3.6 GHz bands*](http://www.acma.gov.au/theACMA/future-use-of-the-1_5-ghz-and-3_6-ghz-bands), released by the ACMA in October 2016 (the October 2016 discussion paper).

The June 2017 consultation package consisted of the following three documents:

* *Future use of the 1.5 GHz and 3.6 GHz bands—Summary of and response to 3.6 GHz band related submissions* (the Summary of submissions paper)
* *Future use of the 3.6 GHz band—Highest value use assessment—Quantitative Analysis* (the HVU paper)
* *Future use of the 3.6 GHz band—Options paper* (the Options paper).

The June 2017 consultation package identified a range of possible replanning options for the 3575–3700 MHz (3.6 GHz) band, informed by detailed technical sharing studies and analysis of ongoing incumbent spectrum needs. This included a detailed explanation of, and reasoning for, the ACMA’s preferred approach for the 3.6 GHz band. A comprehensive assessment of the highest value use of the band was also provided.

The purpose of the June 2017 consultation package was to provide an opportunity for stakeholders to inform the ACMA’s thinking and comment on different options for future arrangements in the 3.6 GHz band, to ensure all relevant costs and benefits are accurately gauged and taken into consideration. The main outcome sought was to determine if the 3.6 GHz band should be progressed from the *preliminary replanning* stage to the *re-farming* stage of the ACMA’s [process for considering additional spectrum for mobile broadband services](http://www.acma.gov.au/Industry/Spectrum/Spectrum-projects/Mobile-broadband/mobile-broadband-strategy-and-work-plan), and, if so, what replanning option is most appropriate.

Thirty-five submissions were received to the June 2017 consultation package as listed in Annex A.

A summary and response to feedback received is contained in this paper. Based on consideration of the issues raised in the June 2017 consultation package, as well as the feedback received, this paper also contains the ACMA’s proposed way forward, and associated reasoning, for the 3.6 GHz band.

The structure of this paper is:

* Section 2 outlines comments received to the HVU paper and the ACMA’s response
* Section 3 outlines comments received to the Options paper and the ACMA’s response
* Section 4 contains the ACMA’s proposed way forward and associated reasoning on the way forward in the 3.6 GHz band

Section 5 details next steps.

This paper accompanies the release of another consultation paper, which commences the formal regulatory steps required to implement the outcomes of this paper for the 3.6 GHz band. Specifically, the paper is consulting on a proposed recommendation to the minister that he make a spectrum re-allocation declaration for specified areas in the 3.6 GHz band.

For simplicity in this paper, the term ‘mobile broadband’ (MBB) is used to refer to a variety of different technologies including terms such as 3G, 4G and 5G. The term should also be taken to include fixed wireless broadband systems.

Also, to provide clarity in the proceeding discussion, the definition of Area 1A, Area 1B, Area 2 and Area 3 referred to in this section are provided at Annex C.

## Legislative and policy environment

### Spectrum reform

The government is reforming the spectrum management framework within Australia. These reforms will simplify the regulatory framework and support new and innovative technologies and services. The reforms include implementing the recommendations of the government’s Spectrum Review report to:

1. Replace the current legislative arrangements with new legislation that removes prescriptive processes and streamlines licensing for a simpler and more flexible framework.
2. Better integrate the management of public sector and broadcasting spectrum to improve the consistency and integrity of the framework.
3. Review spectrum pricing to ensure consistent and transparent arrangements to support the efficient use of spectrum and secondary markets.

On 18 May 2017, the government released a [consultation package](https://www.communications.gov.au/have-your-say/consultation-new-spectrum-legislation%20) on reforms to modernise and simplify Australia’s spectrum management framework. The comprehensive consultation package included an Exposure Draft of the Radiocommunications Bill and related consultation papers, including approaches for broadcasting spectrum and transitional arrangements. Consultation papers on government spectrum holdings and spectrum pricing were also released. Consultation closed on 28 July 2017.

Currently, the Radiocommunications Bill and draft transitional and consequential legislation is being finalised before introduction into parliament. The Department of Communications and the Arts (DoCA) set out in the recent consultation package that transition to a new framework would take place over a number of years. In addition, the commencement of the new legislation would occur approximately 12 months after passage of the Bill through parliament.

Given the timeframes associated with the 3.6 GHz band review, the ACMA is proposing to develop new arrangements in this band on the basis that the existing regulatory regime will apply initially. It is acknowledged that any new arrangements for the 3.6 GHz band may need to be accommodated under the new legislative framework once it commences. The ACMA will take into account relevant opportunities offered by the implementation of the new legislative framework if, and when, applicable.

Further information on spectrum reform is available from DoCA at [spectrumreform@communications.gov.au](mailto:spectrumreform@communications.gov.au).

### Mobile broadband strategy and work program

The ACMA has developed a [set of strategies](http://www.acma.gov.au/Industry/Spectrum/Spectrum-projects/Mobile-broadband/mobile-broadband-strategy-and-work-plan) to address the growth in demand for MBB capacity. A key part of these strategies is a spectrum management process to release additional spectrum for MBB in bands where there is evidence of a change in highest value use.

The review of the 3.6 GHz band was flagged in the ACMA’s [*Five-year spectrum outlook 2016–20*](http://www.acma.gov.au/Industry/Spectrum/Spectrum-projects/Mobile-broadband/five-year-spectrum-outlook-2016-20)(FYSO), including in the *Mobile broadband work program—September 2016 update*, released in October 2016. It is intended that updates to this work program will be made in each subsequent edition of the FYSO.

The stages of the process for consideration of additional spectrum for MBB services are outlined in the ACMA’s [mobile broadband strategy](http://www.acma.gov.au/Industry/Spectrum/Spectrum-projects/Mobile-broadband/mobile-broadband-strategy-and-work-plan).

# 2. Summary and response to submissions—HVU analysis

The ACMA’s preliminary replanning activities for the 3.6 GHz band was the first time it had published a comprehensive assessment of highest value use. The paper *Future use of the 3.6 GHz band—Highest value use assessment: Quantitative analysis* (the ‘HVU paper’) represents a significant input to this assessment. The HVU paper was divided into separate sections that detailed economic re-farming benefits and incremental costs, then compared the results of the two sections. The ACMA sought stakeholder feedback for further detail regarding the economic benefits or costs that would result from re-farming the 3.6 GHz band and on the methodology used. It should be noted that while the ACMA’s ultimate HVU decision draws on the assessment performed in the HVU paper it also considered all other relevant inputs.

## Economic benefits of re-farming the 3.6 GHz band

The quantifiable re-farming benefits for the 3.6 GHz band were calculated as the potential valuations that would be placed on area-wide spectrum licences in the band. The range of $/MHz/pop valuations was wide, from $0.03/MHz/pop to $0.625/MHz/pop. Further unquantifiable consumer benefits and broader social net benefits were also considered as part of the analysis.

In the HVU paper, the following was asked:

1. **Are there any other spectrum valuations (for example, domestic or international auction prices or re-issue prices) that should be considered as a guide to the value of the 3.6 GHz band?**
2. **Is the range of $/MHz/pop values suitable for this analysis, or is there a case to narrow or broaden the range?**
3. **To what extent would 3.6 GHz band spectrum be less valuable if it was restricted to small cell use only?**
4. **What kind of differences in value would there be for 3.6 GHz band spectrum in regional or remote areas when compared with metropolitan areas?**

### Summary of submissions

Submissions from Airspan Spectrum Holdings Limited (Airspan) and Huawei referred to the 3.6 GHz band auction in Ireland, which was finalised in May 2017, as an indicator of potential spectrum valuations for the band in Australia. While the auction results in Ireland exceeded expectations in terms of valuations, the prices paid remain relatively low (approximately AU$0.07/MHz/pop) when compared with the range of valuations used in the HVU model. These submissions suggested that the top of the range (currently $0.03–0.625/MHz/pop) should be reduced, while submissions from current mobile network operators (MNOs) largely suggested that the range of valuations was appropriate. Vodafone and Airspan Networks indicated that the relatively low amount of bandwidth available (125 MHz) could lead to lower valuations of 3.6 GHz band spectrum than if optimal amounts (that is, 100 MHz per operator) were available to multiple operators.

Some respondents, particularly mobile industry representatives, pointed to the positive externalities that could result from the availability of 5G MBB services. These positive externalities largely related to potential technological innovations and particular unquantifiable social benefits. Examples of technological innovation included that with 5G providing low-latency connectivity, devices that could not afford a large lag in reaction time (for example, driverless cars) could become a realistic venture. The unquantifiable social benefits included access to health care through greater access to medical professionals via electronic means being beneficial for the economy.

Submissions from respondents that detailed potential positive externalities typically also outlined the potential economic value that MBB, and 5G in particular, would provide for the national and global economies. The value to the economy of such services largely related to the potential for 5G to drive productivity improvements, as well as the job creation that these services can support. The job creation aspect includes jobs within the telecommunications industry, along with jobs external to the industry, resulting from the economic growth potentially generated by 5G services.

Submissions from Telstra and Huawei addressed the potential reduction in value if 3.6 GHz band spectrum was restricted to small cell use only, when compared with unrestricted use. The ACMA sought feedback regarding the loss of value that would result from restricting spectrum to small cell use—which was proposed as a potential idea for areas that would need to share with FSS earth receive licence interference protection, and therefore unusable for MBB. These submissions referred to the substantial additional cost and complexity of network deployment that would result from such restrictions, which would make 3.6 GHz spectrum much less valuable.

### ACMA response to submissions

The ACMA has decided to retain the $/MHz/pop valuation range used for calculating potential re-farming benefits. While two of the potential bidders for the spectrum in a competitive allocation have indicated that the range is appropriate, there were parallels drawn between the 3.6 GHz band in Australia and the 3.6 GHz band auction in Ireland. While it should be noted that the Irish outcome was within the valuation range used by the ACMA, there are significant differences between the Irish case and the Australian case that should be acknowledged.

In the Irish 3.6 GHz auction, 350 MHz was available—significantly more bandwidth than what is available in the band in Australia. The majority of major MNOs in the Irish auction were able to obtain at or close to the commonly expressed optimal bandwidth amount (100 MHz) for 5G services. Spectrum auction outcomes are driven by the marginal valuations of bidders (that is, the incremental value a bidder places on an additional portion of spectrum). Beyond very small amounts of spectrum, bidders are expected to have diminishing marginal valuations, which means they place a declining value on each additional portion of spectrum. It follows that where there is a significant quantum of spectrum on offer (as in the Irish context), the incremental value bidders place on an additional portion of spectrum is lower than when there is a relatively smaller quantum of spectrum on offer.[[6]](#footnote-7) For this reason, the outcome of the Irish auction is not directly relevant for considering the potential values placed on spectrum in the Australian 3.6 GHz band (where only 125 MHz is available).

It is possible that the prices paid in this Irish auction understate the value of the 3.6 GHz band in Ireland, as these MNOs did not have to express a valuation that was too close to their willingness to pay for the spectrum. It is the maximum willingness to pay that is used as the valuation figure in the HVU model, rather than the eventual price paid, which means that the potential economic benefits from re-farming could be greater.

The ACMA notes that 5G is expected to provide a range of economic and social benefits, such as new technologies, improved productivity and job creation. It would be expected that many of these benefits would be reflected in a high willingness to pay for 5G network access by consumers and businesses, which in turn would be reflected in a high willingness to pay for 5G spectrum by MNOs. However, to the extent that these broader economic and social benefits of 5G are not fully captured in 5G network and spectrum prices, they would be considered in the HVU model as part of the additional consumer benefits and broader social net benefits. While some submissions provided expressions of the overall value of 5G to the global economy, these valuations have not been isolated to the spectrum available in the 3.6 GHz band. As such, these additional economic benefits have not been quantified.

The submissions detailing the reduction in the value of the 3.6 GHz band if it was restricted to small cell use have been noted. Under this option, arrangements would be made to support the ongoing use of the band (or a much longer re-allocation period) for FSS earth station licensees. To ensure the protection of FSS earth station licensees, wide-area MBB use would be limited to small cell use in most of Perth and large areas of Sydney. The ACMA’s analysis shows that making this spectrum available for macro-cell MBB deployments (as well as small cells) in major metropolitan areas would provide greater economic value than restricting it to small cell use. This was supported by Telstra and Huawei, who indicated that the loss of value from restricting the use of the band to small cells only, would be substantial. As such, there wouldn’t be much demand for the spectrum even if it was made usable.

New information provided by incumbent FSS earth receive licensees Telstra and Optus indicates that the re-farming benefits are now likely to considerably exceed incremental costs. This means that interference protection zones are likely to be unnecessary—whether there are small cell use restrictions or not—as the band is re-farmed in all metropolitan areas.

## Economic costs of re-farming the 3.6 GHz band

The incremental costs of re-farming were calculated as the economic cost of displacing incumbent services. This could be the cost of replacing or retuning equipment for incumbent providers to continue service, or the loss of economic value resulting from a material change in services for consumers (for example, if the incumbent provider had to discontinue services). The paper analysed multiple scenarios for the different incumbent licensed service types: point-to-multipoint, FSS earth receive and point-to-point.

In the HVU paper, the following was asked:

1. **Would there be a change in the quality of services that could be provided by WISPs with the 5.6 GHz band compared with the incumbent 3.6 GHz band services?**
2. **What alternative internet services could regional consumers access (excluding NBN Co’s Sky Muster services) if WISPs are unable to provide their fixed wireless broadband services?**
3. **How could the loss of point-to-multipoint licences in the 3.6 GHz band affect regular business operations for non-WISP licensees?**
4. **Are the applicable costs for equipment replacement and retuning for point-to-multipoint licences suitable? If not, what cost ranges should be applied?**
5. **Are there any additional costs (applicable under a Total Welfare Standard (TWS)) that have not been considered in this analysis?**
6. **If the 3.6 GHz band is re-farmed, what is the extent to which a longer re-allocation period would reduce incremental costs under a TWS?**
7. **Is the cost range for the relocation of all C-band licences from an FSS earth station facility suitable for this analysis?**
8. **Are the applicable costs for equipment replacement and retuning for point-to-point licences suitable? If not, what cost ranges should be applied?**

### Summary of submissions

Submissions from the majority of WISP respondents expressed doubts about the viability of the 5.6 GHz band for their services. The primary reasons for this were the lower amount of bandwidth available in the 5.6 GHz band (40 MHz) and the potential for interference from BoM radars or unlicensed users of the band. Submissions therefore indicated that there is some likelihood that several point-to-multipoint licensees will represent variable output cases as they do not migrate to the 5.6 GHz band, although an extended re-allocation period of seven years in Area 2 and Area 3 (refer to the *Length of re-allocation period* section) may mitigate some of these costs.

Several submissions referenced the potential loss of economic value that may result from WISPs representing variable output cases and being unable to continue service. Forgone economic benefits can be considered incremental costs in the HVU model, as they are a loss of consumer or broader social benefits resulting from incumbents being displaced. These submissions typically pointed to WISP services generating great improvements in connectivity and productivity in regional areas, which may be lost in the event of WISP customers having to migrate to a potentially inferior service—if one is available. There were no submissions that provided any form of quantification regarding this welfare loss, although one submission indicated that migrating WISP consumers to the National Broadband Network (NBN) would result in an increase in ongoing costs, which would ultimately be passed on to consumers.

Two metropolitan FSS earth receive licensees, Telstra and Optus, indicated that they could continue to provide services without use of the 3.6 GHz band. Telstra indicated that they would be able to retune their 3.6 GHz band services to above 3700 MHz, while Optus has already transitioned its services out of the 3.6 GHz band. A costly relocation of FSS earth station facilities would not have to occur to continue these services. In contrast, Inmarsat stated that the cost of relocating its facility may be considerably greater than the $25−30 million outlined in the HVU analysis.

Lockheed Martin, a regional FSS earth receive licensee, outlined some potential costs (or benefits forgone) that may result from displacing its service from the 3.6 GHz band. This submission presented multiple economic considerations that were not in the initial HVU analysis. The relevant regional FSS facility is stated to play an important role in global satellite networks, resulting in significant economic benefits forgone if displaced. The relocation of this facility is also stated to have to include all FSS earth receive licences, rather than just those in the C-band, leading to higher costs. The submission also stated that a protection zone would not have to be as wide-ranging as that outlined by the ACMA in order to protect these incumbents.

Digital Distribution Australia Pty Ltd (DDA) and Telstra provided information on incumbent point-to-point licences. DDA advocated for an extended re-allocation period to allow for a slower transition to a different band, as the cost of moving would be significant. Telstra indicated that, at least for some of its licences, the estimated incremental cost ranges provided by the ACMA (between $85,000 and $100,000) may be understating equipment replacement costs.

### ACMA response to submissions

The ACMA acknowledges point-to-multipoint licensees’ views on the 5.6 GHz band. However, it remains of the view that establishment of coordinated apparatus licence arrangements in the 5.6 GHz band will address some of the demand for long-term spectrum access by WISPs. It will also consider the use of the 28 GHz band to support point-to-multipoint licensees in regional areas. The extended re-allocation period, as well as the potential availability of negotiated access to the band via third-party authorisation arrangements, will also provide incumbents with opportunities to continue providing services. The ACMA considers that these mitigation strategies are likely to limit the materiality of the unquantifiable costs of the re-farming of the 3.6 GHz band.

The ability for some FSS earth receive licensees to transition their current operations out of the 3.6 GHz band is noted. The ACMA expects this to significantly reduce the incremental costs associated with displacing FSS earth receive licensees from the 3.6 GHz band. This not only makes a stronger case for re-farming in metropolitan areas in general, but also makes a stronger case for not providing either an extended re-allocation period in either of Area 1A or Area 1B or a perpetual interference protection zone. In the case of the regional FSS earth receive licensee, however, costs of geographic relocation have strengthened the case for an interference protection zone.

The ACMA notes Lockheed Martin’s views regarding the critical nature of its facility in Uralla to a global satellite network, and the high cost of relocating this facility ($20–50 million). The ACMA considers there is a good case for protecting this facility, due to potential incremental costs far exceeding potential re-farming benefits for the affected population. The ACMA, therefore, proposes to protect this facility with the additional caveats detailed in the Options paper.

The ACMA also notes the potential higher costs of equipment retuning or replacement for point-to-point fixed links. The initial HVU analysis indicated there are 47 licences in Area 3, leading to the upper bound of the incremental cost range being $4.7 million. However, given the low baseline of costs when compared with potential re-farming benefits, higher retuning or replacement costs do not significantly change the case for re-farming.

## HVU methodology

To determine the highest value use, the analysis detailed the potential economic benefits of moving to a new use (area-wide spectrum licensing, primarily for mobile broadband), and compared these benefits with the economic costs of displacing incumbents from the band. The new use would be considered to be the highest value use if re-allocation was considered net beneficial, with the economic benefits exceeding the incremental costs. The ACMA sought feedback on the validity of this methodology and whether there were any economic impacts or viewpoints that had not been included in the analysis.

In the HVU paper, the following was asked:

1. **Are there any general economic impacts that should be included but are not currently included in the method to determine highest value use?**

### Summary of submissions

The primary concern of some WISPs and FSS earth receive licensees was that the HVU model did not include potential spectrum sharing arrangements. These views outlined that the scope of the analysis was too narrow in only analysing what may be the highest value *use*, without analysing the potential for multiple highest value *uses*. The implication is that sharing could potentially result in higher economic welfare, as the full benefits of the new use would be supplemented with further economic benefits from coexisting uses. WISPs contended that this would enable them to provide services in particular regional locations where MNOs may end up holding wide-area spectrum licences, but may decide not to roll out 5G services.

All further considerations regarding the highest value use methodology are specific to the economic benefits or economic costs of re-farming, and are therefore outlined in those sections of this paper.

### ACMA response to submissions

The ACMA notes that there was no analysis of spectrum sharing (for example, dynamic spectrum licence management) in the HVU analysis. The purpose of the HVU analysis was to analyse whether existing arrangements in the band are conducive to the spectrum moving to its highest value use. Based on the analysis, the ACMA determined that it was likely that there had been a change in the highest value use of the band.

While spectrum sharing could increase economic welfare under a best-case scenario, there is no consensus on whether spectrum sharing is actually possible in the Australian market. Indeed, as outlined in the *Summary and response to submissions—Options paper* chapter, mobile industry respondents typically did not support the development of sharing arrangements outside of the re-allocation period.

The ACMA remains of the view that in areas where demand for 3.6 GHz spectrum is likely to exceed supply, practical sharing models will not provide the required certainty of long-term access to wide-area broadband users, while simultaneously offering the desired certainty to current and new point-to-multipoint users that they state is required. Given the ACMA has concluded that a sharing model is not feasible, the economic benefits of such a model have not been analysed (refer to the *Case for action and replanning options* section of this paper).

### **ACMA decision**

After considering the information provided in submissions, the ACMA has come to the following conclusions regarding the highest value use of the 3.6 GHz band:

* There is strong evidence of re-farming benefits exceeding incremental costs in Area 1. Potential re-farming benefits significantly exceed potential incremental costs in Area 1, particularly as costs have fallen due to the ability of two incumbent FSS earth receive licensees being able to re-tune equipment.
* The ACMA considers there is a strong case for re-farming extending to Area 2. Firstly, the quantified benefits exceed the quantified costs under most scenarios. It is only if mobile broadband providers’ valuation of the spectrum was relatively low (less than $0.08/MHz/pop) and few WISPs were able to negotiate continued access to the band through third-party authorisation arrangements, that quantified costs could exceed quantified benefits. Secondly, re-farming Area 2 would be net beneficial is because it enables the fully benefits of re-farming Area 1 to be realised. If Area 2 was not re-farmed, the licence boundaries separating it with Area 1 spectrum licences would create ‘dead zones’ in relatively populous areas. This could substantially reduce the re-farming benefits of spectrum licensing in Area 1.
* As such, the primary point of contention is whether re-farming is net beneficial when extended to Area 3. While there is some potential for unquantifiable costs (primarily consumer detriment) to be incurred due to the displacement of incumbent point-to-multipoint licensees in Area 3, the ACMA believes that the potential re-farming benefits exceed the potential incremental costs in this region. The ACMA notes that the extended re-allocation periods, the availability of alternative spectrum in the 5.6 GHz and possibly the 28 GHz band, and the potential ability to continue accessing the band via third-party authorisation arrangements, will provide incumbents with opportunities to continue providing services. The ACMA considers that these mitigation strategies are likely to limit the materiality of the unquantifiable costs of the re-farming of the 3.6 GHz band. The ACMA also notes that there are unquantified benefits of re-farming the band for 5G services in Area 3, such as easier access to medical professionals in regional areas. Having regard to the quantified and unquantified costs and benefits, the ACMA is confident that re-farming will also be net beneficial in Area 3.

It is therefore the view of the ACMA that progressing the 3.6 GHz band in areas 1, 2 and 3 to the *re-farming* stage of the ACMA’s process for considering additional spectrum for MBB services, will help facilitate the spectrum moving to its highest value use.

# 3. Summary and response to submissions—Options paper

The purpose of the Options paper was to determine if the 3.6 GHz band should be progressed from the *preliminary replanning* stage to the *re-farming* stage of the ACMA’s process for considering additional spectrum for MBB services and, if so, what replanning option would be best to implement. A number of issues for comment were provided in the paper to help inform the ACMA’s decision making on this.

This section summarises the issues raised in submissions, as well as providing the ACMA’s response, where appropriate.

## Case for action and replanning options

The Options paper outlined the case for action in replanning the 3.6 GHz band. This was informed by the comprehensive analysis of the HVU, along with an analysis whether existing arrangements in the band were conducive to the spectrum moving to its highest value use. The Options paper then identified a number of replanning options for the 3.6 GHz band intended to better allow the spectrum to move to its highest value use. It investigated the potential for replanning different geographic areas and different amounts of the 3.6 GHz band, as well as different licensing mechanisms.

The ACMA then outlined its preferred approach based on available information at the time. Specifically this was *Option 3c: Spectrum licence entire 3.6 GHz band in metropolitan and regional areas* (refer to the Options paper for further detail). Under this option, the 3.6 GHz band in areas 1A, 1B, 2 and 3 would be re-allocated for the issue of spectrum licences. Existing site-based point-to-multipoint apparatus-licensing arrangements would remain outside these areas.

The Options paper asked the following questions related to this issue:

1. **Should the 3.6 GHz band be progressed from the preliminary replanning stage to the re-farming stage in the ACMA’s process for considering additional spectrum for MBB services? Why/Why not?**
2. **Should any of the sharing arrangements discussed in this section be considered for implementation in the 3.6 GHz band? Why or why not?**
3. **Are there any other sharing arrangements that should be considered?**
4. **Are there any other replanning options that should be considered?**
5. **Which replanning option should be implemented in the band? Why?**
6. **If Option 4a is implemented, what frequencies and areas should be re-allocated for the issue of spectrum licences? How much spectrum should remain subject to site-based apparatus licensing arrangements? Should different amounts be considered in different areas?**
7. **If Option 4b is implemented, what frequencies and areas (that is, incumbent apparatus licence services) should remain subject to site-based apparatus licensing arrangements?**
8. **Comment is sought on the ACMA’s preferred option (Option 3c) for the 3.6 GHz band.**

### Summary of submissions

A range of responses were provided on this issue. While most respondents supported replanning and progressing the 3.6 GHz band to the *re-farming stage* in some form, there were differences in views on a preferred way forward.

Submissions from WISP interests

Respondents associated with WISP interests were generally not supportive of any changes that would affect their ability to provide and expand their services. Incumbent WISPs stated that they provide important services to government, businesses and communities, particularly in areas where there is little to no competition and other available services are inadequate. Requests were also made to remove the current embargo on the 3.6 GHz band in regional areas to support the growth of these services.

There was an acknowledgement from WISP interests that re-farming Area 1A and Area 1B may be an acceptable outcome (with some respondents also mildly supportive of Area 2), though an interest to deploy services in these areas was also flagged. The reason behind this acknowledgment was that Area 1A and Area 1B are where the highest demand for 5G is considered to be, and re-farming these areas would affect the least number of incumbents. WISP respondents also indicated that large carriers already have significant spectrum holdings in regional areas to draw on, much of which they suggest is not currently used.

WISP respondents argued against any options that involved the use of spectrum licensing. They characterised it as an outdated concept that discriminates against smaller operators and is inherently anti-competitive. Instead, it was proposed that a dynamic spectrum sharing model should be investigated, citing global trends in this regard. An argument was made that incumbent WISP services should have the same status as incoming services, otherwise regional innovation in wireless communications could cease and current infrastructure become worthless. Many WISP respondents also believed sharing would be possible in many, if not most, areas and where this is not possible, other options could be considered. These options include making technical changes to systems, supporting neutral hosts[[7]](#footnote-8), or allowing a true market to function where a carrier determines buying out the WISPs access is the economically effective solution. It was stated that the ACMA’s lack of flexibility in its toolkit is not a good argument for not considering sharing models. Subsequently, a proposal for a pilot program to define and test a dynamic sharing licence model was also provided in the submission by the Wireless Internet Service Provider Association of Australia Inc (WISPAU).

WISP respondents also indicated that other countries are looking at millimetre wave (mmWave) bands for 5G and there is still a long lead-time before commercial equipment would be available and deployed. In addition to this, they stated indications are that initial deployments will be small area infill systems, which are unlikely to be deployed in regional areas and would only improve the ability to share the band with incumbents.

Submissions from satellite industry

Respondents representing the satellite industry were generally supportive of re-farming the 3.6 GHz band. Two incumbent earth station licensees indicated they have or are in the process of moving services outside of the 3.6 GHz band. However, the two other incumbents inside the proposed areas for re-allocation, Inmarsat and Lockheed Martin, indicated they could only support arrangements that would allow them to continue operating while being provided adequate protection. This was largely due to the high cost of relocating their facilities and other logistical reasons.

Inmarsat suggested sharing with MBB operators would be the most appropriate outcome, especially if the economic benefits forgone were in a range between $0.03/MHz/pop and $0.25/MHz/pop. Even higher estimates of $0.50/MHz/pop and $0.625/MHz/pop ($54–67 million) would just exceed the estimated relocation costs. Inmarsat pointed to arrangements developed by the European Conference of Postal and Telecommunications (CEPT) and the FCC that authorise use of C-band spectrum for MBB, while also protecting incumbents, including FSS earth stations.

Inmarsat acknowledged that sharing would only be possible if mobile operators are limited to small cell deployments in Perth and an additional 10–20 dB of clutter loss can be assumed. However, this limitation would mainly apply across their required operational frequency range of 3599–3650 MHz, and greater flexibility in deployments would apply for the rest of the band. In the event they are required to relocate their facility within a 20-year period, Inmarsat believes compensation is justified. The use of Option 4b to allow earth stations to continue operating in the band was supported by many satellite industry respondents.

Lockheed Martin also believes that sharing is possible, and a coordination zone smaller than 150 kilometres could be implemented to protect their earth station facility operating at Uralla. While not their first option, Lockheed Martin indicated they were prepared to accept the implementation of Option 4b (as defined in the Options paper) around their facility to support ongoing operations, provided there is long-term security in use of the site. They stated that for cost and logistical reasons, relocation of the Uralla facility is not considered practical and discontinuing operation is also not an option. Lockheed Martin argued that the facility is critical to support safe and orderly use of the entire geostationary orbital/spectrum resource and other satellite missions. The only other facility with similar longitudinal capabilities is in Korea.

Submissions from mobile industry

Respondents representing MBB industry views were supportive of Option 3(c), and generally requested it be made available as soon as possible, given global drivers. There was little support for options 4a or 4b (as defined in the Options paper). One respondent indicated that there was already an insufficient amount of spectrum on offer and, as such, it should not be reduced further. It was also argued that while options 4a and 4b would reduce incremental costs for incumbents, it would come with a corresponding reduction in re-farming benefits.

Mobile industry respondents typically did not support the development of sharing arrangements outside of the re-allocation period. There was no support for a sharing model that would give spectrum licensees rights in the band that were secondary to incumbents outside of the re-allocation period. A use-it-or-share it approach where spectrum licensees are primary users and other users secondary was also not considered a practical solution, due to the logistical problems it creates. It was further argued that the Citizens Broadband Radio Service (CBRS) and Licensed Shared Access (LSA) models have been designed for other regions and are not applicable to Australia. In particular, it was argued that the CBRS model is not appropriate as lower-tier users can be displaced at any time. It was further indicated that large operators in the US are raising concerns on this model.

Mobile industry respondents generally supported the use of commercial negotiations and third-party authorisations as a basis for sharing beyond any re-allocation period. One respondent suggested this should also be accompanied by the government paying compensation to affected parties. There was no support for ongoing sharing arrangements that would restrict operators to deploying only small cells in areas of significant population. It was argued that this would dramatically diminish the value of the spectrum, particularly given the planned use for the 3.6 GHz band is broad geographic coverage based on a macro-cell deployment model (likely with some small-cell infill).

Submissions from Airspan and Ruckus requested that either dedicated spectrum be set aside or coexistence arrangements, on a ‘no interference and no protection’ basis, be developed for small cell use in the 3.6 GHz band. It was argued that this would allow third parties to complement and help to improve one or more mobile network operator’s network coverage and capacity, rather than directly compete with them— something that may otherwise be cost prohibitive for mobile network operators to do. Under this arrangement, it was proposed that spectrum licensing should not extend beyond Area 2. Supporters of this approach stated that there are greater opportunities for small cells and incumbents to coexist and an ‘overlay model’ for sharing could be implemented and suitable protection criteria for other services defined. In the event contention occurs, commercial negotiation could resolve the issue. This approach is preferred to other options such as clearance of incumbents or 'carve outs' (option 4b). The ACMA also has the ability to raise apparatus licence fees in areas of high demand based on incentive pricing models.

### ACMA response to submissions

Since the release of the Options paper, there continue to be strong indications both domestically and internationally that the 3.6 GHz band will be a pioneer band for 5G. This is further evidenced by submissions to the Options paper from mobile industry interests, which indicated that the timeframe for equipment availability and deployment of commercial services could be as early as mid-2018 in some countries and will include both macro and small cell deployments. As a result, the ACMA considers comments regarding 5G only being in mmWave bands and only used for small cell deployments to be incorrect. It is therefore still appropriate to assess options for re-farming the 3.6 GHz band on the basis that potential services will be used to provide both macro and small cell coverage and services could be deployed as early as 2018.

From the responses provided and the current limited use of the 3.6 GHz band in many metropolitan areas, there appears—at a minimum—to be a strong case to change arrangements in Area 1A and Area 1B. However, while prospective new licensees in the band are interested in all of areas 1A, 1B, 2 to 3, there are concerns from incumbents about going beyond Area 1A or Area 1B unless some form of sharing arrangements are implemented. The ACMA has investigated various sharing models presented in submissions to the paper and developed elsewhere in the world. The idea behind these investigations was to determine if there is a way to support ongoing use of the band (and ideally expansion of services) by incumbents, while simultaneously allowing the deployment of wide-area fixed and mobile broadband networks over time.

The ACMA remains of the view that in areas where demand for 3.6 GHz spectrum is likely to exceed supply, practical sharing models will not provide the required certainty of long-term access to wide-area wireless broadband operators, while simultaneously offering the desired certainty to current and new site-based wireless broadband operators. This is because the sharing models contemplated are based on hierarchical access rights—with lower tiers of users having to ‘give way’ to higher-tier users (depending on the design of the model, this could be either incumbent or new licensees). The lack of certainty this creates is unlikely to support investment in infrastructure by lower-tier operators. As indicated previously, the ACMA believes the HVU of the band in areas of high demand for spectrum is for wide-area fixed/mobile wireless broadband services. On this basis, spectrum licensing is considered the best approach, as it provides long-term licensing arrangements allocated via market-based mechanisms to determine who values the spectrum the most. Discussion on the geographical area that this should apply to is provided in the *Geographical area options* section of this paper.

In order to reduce the impact on incumbents, the ACMA believes an appropriate re-allocation period should be recommended. This is discussed further in the *Length of re-allocation period* section of the paper. For affected incumbents operating under a point-to-multipoint apparatus licence, the ACMA will, as far as practical, work to identify and make available alternative spectrum for future deployments. For affected incumbent FSS earth station operators that are unable to migrate services out of the 3.6 GHz band, options to geographically relocate their facilities will be identified. In addition, incumbents would also be free to negotiate with any spectrum licensees in the area to continue operating their services after the end of the re-allocation period and could include setting up neutral host arrangements. This could be facilitated under third-party access arrangements and requires no intervention by the ACMA. Further discussion on options for different incumbent services is provided in later sections of this paper.

The ACMA acknowledges that incumbent earth station facilities operated by Telstra and Optus either plan to migrate their services out of the 3.6 GHz band or have already done so. This ensures there is no reason for them to consider relocating their facilities or cancelling services as a result of replanning activities in the 3.6 GHz band.

The ACMA also concurs with studies performed by Inmarsat that show sharing would be possible in Perth, provided fixed/mobile wireless broadband systems are limited to small cell deployments and an additional 10–20 dB of clutter loss can be assumed. However, while the band is likely to be used for small cell deployments in some cases, one of the main benefits that has driven the international and domestic focus on this band is its ability to leverage new technologies to provide broad geographic coverage based on a macro-cell deployment model. Furthermore, the ACMA believes that such a restriction would not be limited to the portions of the 3.6 GHz band that Inmarsat operates in. In order to manage interference, there would necessarily be restrictions on MBB deployments operating in adjacent spectrum—the smaller the offset, the greater the restrictions.

Consequently, the ACMA believes that enforcing such deployment restrictions on MBB use would severely undermine the utility and long-term benefits derived from the use of the spectrum and is not consistent with the ACMA’s HVU analysis. This outcome also applies to the concept of setting aside part of the 3.6 GHz band for dedicated small cell use, especially given the benefits in using this band for MBB macro cell deployments, coupled with the limited amount of spectrum available.

The ACMA acknowledges the concerns raised by some respondents with regard to Option 4b. In particular, the effect of using this approach to support a large number of incumbent services could become unwieldy and inefficient. As such, to date the ACMA has only used this option sparingly. With regards to the 3.6 GHz band, it is only proposed to use Option 4b to support ongoing use of the earth station facility operated by Lockheed Martin near Uralla (regional NSW). Since it is a single site and the size of the area carved out is small, it is not expected to have a significant effect on the overall usability of the larger spectrum licence area.

The ACMA also appreciates Lockheed Martin’s concerns regarding the long-term viability of the Uralla site as indicated in the Options paper. While the ACMA stands by the statement that the facility may be required to relocate to another location in the future, long-term viability of the site could be proven over time. Specifically, the main concern is the potential for spectrum denial or severe deployment restrictions for MBB services deployed in nearby towns (that is, Armidale and Tamworth). If it can be shown over time that MBB services can be deployed in major towns in the area without unreasonable restrictions, the ACMA would be willing to reconsider its position.

The ACMA understands that the current embargo on the 3.6 GHz band has been an ongoing source of frustration for incumbents wishing to expand their services. However, the embargo was considered an appropriate tool to minimise the effect any future re-farming decision may have on investments in new services and infrastructure. The ACMA will amend the embargo to reflect the outcomes of this paper. The ACMA’s decisions regarding other potential bands suitable for very long-term access for site-based point-to-multipoint services are intended to mitigate this concern, as well as assist in the relocation where possible of existing services, if desired.

### **ACMA decision**

After considering the information provided in submissions, the ACMA has come to the following conclusions regarding replanning options for the 3.6 GHz band:

* The 3.6 GHz bandshould be moved from the *preliminary replanning* stage to the *re-farming* stage of the ACMA’s process for considering additional spectrum for mobile broadband.
* Identified areas of high demand should be re-allocated for the issue of spectrum licensing (refer to *Geographical area options* for discussion on this), taking into account any areas proposed to be excised as part of a mitigation strategy for affected incumbents services (refer to the relevant *Options for incumbent services* section of this paper).
* Due to the limited amount of spectrum on offer (compared to the optimal 100 MHz per operator figure commonly quoted), the entire 3.6 GHz band should be made available for spectrum licensing in identified areas of high demand.

The embargo on the 3.6 GHz band will be modified to reflect the outcomes of this paper.

## Geographical area options

The Options paper proposed a number of different geographical area options that could be considered for re-farming. In developing area options, the ACMA considered what the most likely areas of high demand would be. This took into account the following:

* MBB operators have indicated that in order to realise the full benefits of 5G, each operator would ideally have in the order of 100 MHz of spectrum. Given there is 125 MHz of spectrum available in the 3.6 GHz band, this is likely to have a significant impact on the availability of spectrum in some areas and increase the potential for contention to occur.
* The extent of existing deployments in other bands (1800 MHz, 2 GHz, 2.3 GHz and 2.5 GHz bands) used to deploy wide-area fixed and mobile broadband services, taking into account that new technologies such as massive multiple-input and multiple-output (mMIMO) and beamforming, are expected to improve coverage and capacity of cells deployed in the 3.6 GHz band.[[8]](#footnote-9)
* It was identified that deployments by incumbent site-based 3.6 GHz wireless broadband operators and wide-area wireless broadband operators in other bands (1800 MHz, 2 GHz, 2.3 GHz and 2.5 GHz bands) in regional areas extensively overlap. While these deployments may not be at identical sites or cover the exact same areas, if the same band was used to accommodate both site-based and wide-area operators, there is likely to be an increase in demand and contention for spectrum in and around these areas.

There was also discussion on geographical boundary issues associated with area-wide licences. Based on this discussion, the ACMA asked for comment on the following guidelines when assessing potential areas for replanning in the 3.6 GHz band:

* To the extent possible, define geographical borders in areas of low demand.
* To the extent possible, define geographical areas that are large enough to minimise potential co-channel interference issues when deploying services in areas of high demand.
* Consider allocating spectrum licences simultaneously across the entire area in which spectrum licensing is considered the most appropriate longer-term outcome, even if the rollout of services is likely to commence in some areas first.

The Options paper asked the following questions related to this issue:

1. **Do the areas identified in this analysis cover the likely areas of high demand for access to the 3.6 GHz band? Would smaller or larger areas be more appropriate? Why?**
2. **Are these guidelines (when assessing potential areas for replanning) appropriate? Why?**
3. **Are there any other issues that affect the usability of an area-wide licence that should be taken into account when defining the licence area?**
4. **In the event an area-wide licensing option is implemented, in which of the defined areas (that is, Area 1[[9]](#footnote-10), 2, 3 and Australia-wide) should these arrangements be implemented? Are the current area definitions appropriate? If not, what area should be defined?**

### Summary of submissions

Submissions from WISP interests

As stated previously, respondents associated with WISP interests were generally not supportive of any changes that would affect their ability to provide and expand their services. In particular, they did not support the concept of area-wide licensing and stated that areas proposed were designed to suit the large carriers’ business models. Instead, sharing models or a more flexible spectrum-licensing model should be investigated. A few respondents believed sharing would be possible between WISPs and MNOs in most areas; saying this could be done via detailed coordination and planning for the most part, but where this is not possible, a market unencumbered by regulatory intervention could result in the best outcome. It was further stated that MNOs already have significant holdings in other bands they can draw on, much of which is currently unused in regional areas.

There appeared to be some acknowledgement from representatives of WISP interests that re-farming Area 1A and Area 1B (with some respondents also mildly supportive of also including Area 2) may be an acceptable outcome. This is where the demand for 5G is considered to be highest and re-farming these areas would affect the least number of incumbents. There was particular concern regarding the potential reduction in competition that could occur in re-farming areas that are too large.

A couple of submissions suggested looking at current deployments in the 2.5 GHz band to get an idea of areas where 5G deployments would be viable. They indicated that 5G is unlikely to rollout in other areas for at least another 15 years. It was also stated that dense wide-area network deployments come at cost, and there will be large parts of Australia in which it is not viable to deploy, as is evident from the black spot program. There was concern that spectrum licence arrangements prevent small operators from accessing spectrum in such areas. A more flexible regime would provide opportunities for small carriers or neutral hosts in areas uneconomical for large carriers.

Submissions from satellite industry

In general, respondents representing satellite service interests indicated support for any option that would allow incumbent FSS earth stations to continue operating unaffected (although this view was not held by incumbent FSS earth receive licensees, Telstra and Optus). As discussed in the *Case for action and replanning options* section of this paper, some respondents also proposed implementing sharing arrangements.

Submissions from mobile industry

Respondents representing mobile broadband industry views were generally supportive of re-farming areas 1A, 1B, 2 and 3, stating that it covers areas of high demand that include metropolitan and major regional population centres, as well as key interconnecting population corridors and road/rail links. These respondents also indicated that areas 1A, 1B, 2 and 3 combined are large enough to reduce the effect of ‘dead zones’ in or around population centres and support meaningful deployments. However, there was also a request to include other areas of high demand, such as Darwin, Geraldton and the Pilbara. One respondent also noted that a potential future restack of the broader 3400–3700 MHz would not necessarily be inhibited by differing licence boundaries, as was evidenced by the 2015 restack of 3.4 GHz band spectrum licences.

Some respondents representing MBB industry views also commented on potential future lot configurations. Here, there appeared to be two general views put forward. The first favoured the ability of operators to acquire lots in individual areas of geographical demand. The second view supported a single geographical lot covering areas 1A, 1B, 2 and 3 to avoid the creation of more ‘dead zones’.

There was little support for options 4a or 4b (as defined in the Options paper) from MBB industry respondents. As discussed in the *Case for action and replanning options* section of this paper, mobile industry respondents typically did not support the development of sharing arrangements outside of the re-allocation period. Instead, they supported the use of commercial negotiations and third-party authorisations as a basis for sharing beyond any re-allocation period. There was no support for ongoing sharing arrangements that would restrict operators to deploying only small cells in areas with significant population. It was argued that this would dramatically diminish the value of the spectrum, particularly given that planned use for the 3.6 GHz band is broad geographic coverage based on a macro-cell deployment model (with small-cell infill). One respondent stated they were working to obtain 3.6 GHz cell sizes similar to the 1800 MHz band—suggesting it is likely mobile operators will re-use the existing 1800 MHz sites. Another submitter supporting use of the band for small cell usage suggested the licence areas for such use should emulate those in the 1800 MHz and 2.1 GHz bands.

### ACMA response to submissions

As discussed in the *Case for action and replanning options* section, the ACMA believes spectrum licensing is the most appropriate licence type for areas of high demand. When originally identifying this as a preferred re-farming option, the ACMA took into account that it will take a number of years for an operator to roll-out services covering a large portion of regional areas. Consequently, an extended re-allocation period was proposed in regional areas—refer to the *Length of the re-allocation period* section of this paper for further discussion of this issue. In addition, under spectrum licence arrangements, incumbents may seek to negotiate ongoing access to the spectrum beyond the re-allocation period, as well as possible neutral host arrangements. Such an approach could be taken in areas that a spectrum licensee either hasn’t or has no plans to deploy services, with the licensee’s agreement.

The ACMA acknowledges there are a number of different bands already subject to spectrum licensing that can support wire-area MBB deployments in regional areas. However, comparisons of the current level of use of these bands need to take account of local circumstances. Some of these bands have been available in regional areas for fifteen or more years, including the 850 MHz, 900 MHz and 2.1 GHz bands. In these bands, licensees have had time to rollout services over a large geographical area and densify their network. As such, they already have significant deployments in regional areas. In other bands, which have only been made available in regional areas in the last one to three years, there are understandably fewer deployments. These bands include the 700 MHz, 1800 MHz and 2.5 GHz bands. However, based on device registrations on the ACMA licence database, the number of devices is changing rapidly in these bands, and is expected to continue growing over the coming years. Moreover, the rollout of services is anticipated to be faster than in the past. This is due to the increasing demand for data and the ability for licensees to re-use existing sites (noting the number of new sites is also expected to grow). Therefore, in assessing the likely level of use of a new band, it is considered appropriate to look at more mature bands, such as 850 MHz, 900 MHz and 2.1 GHz bands and, as far as possible, pick one that will have similar cell coverage capabilities. Newer bands could also be considered to compare current levels of use and determine the pace of new deployments.

When determining likely areas of high demand, the ACMA considered the extent of existing device registrations in the 1800 MHz, 2.1 GHz, 2.3 GHz and 2.5 GHz bands. This was on the basis that with the aid of new technologies, cell coverage in the 3.6 GHz band will be similar to existing deployments in these bands.[[10]](#footnote-11) This was supported in Huawei’s submission to the Options paper, which indicated the company was working to obtain 3.6 GHz cell sizes similar to the 1800 MHz band. The ACMA remains persuaded this is a reasonable approach to determining likely areas of high demand, and that areas 1A, 1B, 2 and 3 encompasses such areas. While the inclusion of Darwin and Geraldton areas was considered, they were, in the end, excluded. This is because there are additional coordination requirements within those locations that would restrict the ability of a licensee to deploy services. Consequently, it is recommended that existing site-based apparatus licensing arrangements remain in place at these locations. The ACMA also does not agree that the Pilbara should be included, given its remote location, low population density and distance from any major towns, highways or roads. On this basis, the ACMA remains of the view that apparatus license arrangements remains the most effective means for managing access to spectrum in that area.

The ACMA has also taken into account incumbent-licensed FSS earth stations in the 3.6 GHz band when defining and assessing areas of high demand and alternative options for them. For those facilities located in regional and remote areas, options to support their ongoing use are proposed. This includes further investigating Option 4b to support ongoing use of the 3.6 GHz band by the earth station facility located near Uralla in regional Australia. For those facilities located in major cities (areas where demand for MBB will be highest), other options need to be investigated, given sharing is not deemed a practical outcome. Potential options for one or more east coast earth station protection zones have also been considered. This is discussed further in the *Options for incumbent FSS earth station licensees* section of this paper.

### **ACMA** **decision**

After considering the information provided in submissions, the ACMA has come to the following conclusions regarding geographical area options for re-farming in the 3.6 GHz band:

* Areas 1A, 1B, 2 and 3 cover the most likely areas of high demand and should be included in the areas in the 3.6 GHz band that are recommended to the minister for re-allocation for the issue of spectrum licences.

Specific areas will be further considered to be excised from areas 2 and 3. These excised areas could be used to assist in the identification of one or more potential east coast earth station protection zone(s), and to support the ongoing use of the 3.6 GHz band by the FSS earth station facility near Uralla. Refer to *Options for incumbent FSS earth station licensees* section of this paper for details.

## Length of re-allocation period

The Options paper indicated that in the event a decision is made to re-allocate for spectrum licensing any part of the 3.6 GHz band, there would be a need to define an associated re-allocation period. Different issues for consideration when determining the length of the re-allocation period were also discussed. This took into account issues relevant to incumbents and prospective new licensees, as well as legislative requirements. Importantly, any period specified must be a minimum of two years and different periods can be defined for different areas (but not individual services). Importantly, this period does not commence until the minister actually makes a written re-allocation declaration or declarations for a band under section 153B of the Act.

Under the ACMA’s preliminary view detailed in the Options paper, a seven-year re-allocation period for all areas was proposed.

The Options paper asked the following questions related to this issue:

1. **If any part of the 3.6 GHz band is re-allocated for the issue of spectrum licences is seven years a suitable re-allocation period? If not, what period of time would be appropriate?**
2. **Should different re-allocation periods be considered for different areas? For example, should a longer period be considered for services outside Area 1?[[11]](#footnote-12)**

### Summary of submissions

Submissions from WISP interests

As stated previously, respondents associated with WISP interests were generally not supportive of implementing spectrum licence arrangements in the 3.6 GHz band, especially outside of areas 1A and 1B. Instead, they supported investigating sharing arrangements or a more flexible spectrum-licensing model. Some respondents believed sharing would be possible between WISPs and wide-area MBB deployments in most areas, and that market mechanisms could be used to resolve any conflicts that arise. Ultimately, these respondents felt there should be no limits on licence tenure and incumbents should be allowed to continue operating until they trade or cancel their licences.

In the event a re-allocation period does apply to incumbent apparatus licences in an area, WISP respondents supported a period of between 10–15 years, noting that Telstra had previously publically advocated a 10-year period. The main issue raised was whether viable alternative spectrum options would be made available for incumbent point-to-multipoint licensees to migrate into. If suitable spectrum is identified, some respondents suggested a seven-year re-allocation period might be suitable.

Digital Distributions, the major fixed link operator in the 3.6 GHz band, requested a 10-year re-allocation period, due to the cost of replacing equipment as well as acquiring and constructing new repeater sites. It also stated that during the re-allocation period, there should be no additional regulatory constraints placed on incumbents.

Submissions from satellite industry

Respondents associated with satellite interests were divided on this issue. Telstra and Optus indicated they have migrated their services out of the 3.6 GHz or will do so (it is noted these respondents are also potentially interested in deploying wide-area MBB services in the band). Consequently, they supported a shorter re-allocation period in Area 1, proposing two- and three-year periods respectively. Inmarsat and other satellite industry groups supported the development of long-term arrangements for FSS earth stations at their current locations. Specifically, Inmarsat requested ongoing protection for 20 years at their current location as this reflects the typical lifetime of a satellite. They argued any shorter period would justify compensation.

Submissions from mobile industry

Respondents associated with mobile industry interests also had a range of views on the length of any re-allocation periods. Most supported defining as short a re-allocation period as possible, suggesting case-by-case assessment for different services and areas. They argued that incumbent licensee considerations need to be tempered with restrictions on the use of spectrum for new services. Some respondents supported a longer re-allocation period in regional areas, given the initial focus would be on deploying wide-area MBB services in Area 1A and Area 1B. One respondent suggested the period could be reviewed as services are rolled out into regional areas. Of the major carriers, Telstra supported a two-year period in Area 1A and Area 1B, and a seven-year period in other areas. Vodafone supported a uniform two-year period in all areas, stating a longer period would create troubling competition and regulatory precedents and any revenue raised by the allocation could be used to offset incumbent transition costs. Optus proposed a uniform three-year period from 2019 in all areas, stating that committing to a firm date would provide greater certainty for incumbents and prospective licensee in investment decisions.

### ACMA response to submissions

As indicated previously, the ACMA believes spectrum licensing is the most appropriate licence option in areas of high demand. Under this approach, an associated re-allocation period for each area, subject to a re-allocation declaration, needs to be defined. When determining an appropriate length for this period, it is important to note that the Act does not allow for a different relocation period to be defined for different services within the same area. However, different periods can be defined for different areas.

The ACMA agrees that the length of any re-allocation is a trade-off between maximising the re-allocation period for incumbents and enabling access to spectrum for new licensees. Some respondents suggested a case-by-case consideration when defining a suitable period of time. Taking this into account, the most appropriate outcome may be to consider different re-allocation periods for different areas.

The ACMA understands if an area as large as Area 3 is identified for spectrum licensing, the initial focus will be on deploying services in Area 1A and Area 1B. It is then expected to take a number of years to rollout services that cover a majority of the remaining regional locations. This is supported by submissions made by mobile carriers. When we also consider the ongoing nature of many existing services in regional Australia, there is a case to consider different re-allocation periods for metropolitan and regional areas.

Based on submissions and, in particular, the limited number of incumbency issues, there appears to be a strong case to have a shorter re-allocation period in Area 1A and Area 1B than originally proposed. In particular, two of the three incumbent earth station operators have indicated the ability to migrate their services out of the band within a two-year period. This leaves a single incumbent licensee (Inmarsat) in Perth, which is unable to retune out of the 3.6 GHz band. Although a 20-year re-allocation has been requested, this is not a viable option. This is because sharing between FSS earth stations and MBB is not considered practical in the long term, as it would delay or prevent the provision of new services across much of Perth for the duration of any licences issued and then for some years afterward. Consequently, the ACMA believes the re-allocation period should be based on a period of time reasonably required to geographical relocate Inmarsat’s earth stations. Based on conversations with numerous incumbent earth station licensees, five years is considered a suitable timeframe to plan for and implement such a move.

The only other primary apparatus-licensed services in Area 1A and Area 1B are the two fixed links operating in Brisbane. Given the small number of links, the variety of alternative options available for them, and the location of the links in a highly populated area, a two-year re-allocation period appears justifiable. Similar periods of time have also been used for the re-allocation period in other bands where fixed links were the main incumbent service.

There are conflicting views from submitters on the appropriate length of a re-allocation period in regional areas. Of particular note is the request from the major fixed link licensee and WISPs in the band for a 10–15 year period; although some WISPs acknowledge a shorter period may be suitable, if viable alternative spectrum options were made available. Shorter re-allocation periods were proposed by mobile industry interests to avoid any possible delays or restrictions on the deployment of services.

When considering an appropriate length of time for a re-allocation period in this case, the ACMA has given particular consideration to the options available for incumbent point-to-multipoint licensees. These are discussed in the *Options for point-to-multipoint licensees* section of this paper. In summary, after the re-allocation period, the long-term options for point-to-multipoint licensees include acquiring access to the 5.6 GHz band or negotiating access to spectrum held by spectrum licensees in the area. In the event that neither of the long-term options is available, then at a minimum an appropriate period of time for incumbents to recover their investment is considered appropriate.

Based on submissions provided by incumbent point-to-multipoint licensees, the ACMA believes a seven-year re-allocation period would be suitable in both Area 2 and Area 3. During this period, spectrum licensees will be required to afford the same level of protection to incumbents as they currently receive. Since these licences are mostly located in regional and remote areas, and initial wide-area broadband deployments are expected in major metropolitan areas, the additional time to relocate may not have a significant effect on the ability of a spectrum licensee to rollout services in regional Australia. If earlier access is required in specific areas, however, spectrum licensees would be free to negotiate with incumbents to arrange it.

It is also important to note that the ACMA has no plans to place additional restrictions on incumbent licensees during the re-allocation period.

### **ACMA decision**

After considering the information provided in submissions, the ACMA has come to the following conclusions regarding the length of the re-allocation period for the 3.6 GHz band:

* Adelaide, Brisbane, Canberra, Melbourne and Sydney (Area 1A): two-year re-allocation period.
* Perth (Area 1B): five-year re-allocation period.
* Area 2: seven-year re-allocation period.

Area 3: seven-year re-allocation period.

## Options for incumbent point-to-multipoint licensees

The Options paper identified that there are a number of incumbent wireless broadband services operating under point-to-multipoint apparatus licences (point-to-multipoint licensees) in the 3.6 GHz band—the number affected ultimately depending on the type of replanning arrangements implemented.

In options involving spectrum licensing, any incumbent services that partially or completely overlap spectrum subject to a reallocation declaration could continue operating until the end of the relevant reallocation period, after which their licences will be automatically cancelled. This creates options for commercial negotiation—for example, for incumbents to elect to vacate early at a sufficient price, to seek to obtain ongoing access to the band beyond the end of the reallocation period as a third-party user authorised by the spectrum licensee, or to enter into other commercial arrangements with the spectrum licensee.

The Options paper also identified alternative options that may currently be available for incumbent point-to-multipoint licensees to continue providing services. This included alternative apparatus and class licensed bands, negotiating access to spectrum held by spectrum licensees in the area or migrating to fixed line options (if viable). However, given the limitations of some of these alternatives, the ACMA also investigated new spectrum options for point-to-multipoint licensees. While a number of bands were considered, the 5.6 GHz band appeared to be the best candidate.

It was acknowledged that any apparatus licence arrangements developed for the 5.6 GHz band may also come under review at some future point. This is because of the rate of change and innovation in global spectrum use generally, and the uncertainties inherent in predicting future changes in the highest value use of bands. But based on current knowledge, it was expected that the greatest certainty and longest timeframe before this occurred could be provided in the 5.6 GHz band as compared to other candidate bands.

The Options paper asked the following questions related to this issue:

1. **Is the 5.6 GHz band a viable option for wireless broadband systems?**
2. **Under what circumstances should apparatus and class-licensed arrangements be considered for the 5.6 GHz band?**
3. **If apparatus licensing arrangements are developed for wireless broadband systems in the 5.6 GHz band, are the notional arrangements proposed in Appendix 3 suitable?**
4. **If point-to-multipoint licences are affected by replanning activities in the 3.6 GHz band, are the alternative options identified suitable? Are there any alternative options that should be considered?**

### Summary of submissions

Submission from the Bureau of Meteorology (BoM)

BoM currently operates weather radars in the 5.6 GHz band. In their submission to the Options paper, they stated that use of the band should remain exclusively for their radars. They argued that any apparatus-licensed sharing arrangements would severely restrict use of the band for both point-to-multipoint and radar services. In particular, the arrangements would subject any new radars to harmful interference from Radio Local Area Network ((RLAN), for example, Wi-Fi) devices operating in both bands adjacent to the 5600–5610 MHz range.

BoM did not support allowing class licensed devices to operate in the 5.6 GHz band either. The Bureau stated that in Europe, there has been high levels of interference from RLANs into radars, clearly demonstrating that Dynamic Frequency Selection (DFS) does not work and that such interference is virtually impossible to locate and shut down.

Submissions from Wireless Internet Service Provider (WISP) interests

Respondents associated with WISP interests wanted to ensure suitable alternative spectrum is made available if the 3.6 GHz band is re-allocated for spectrum licensing. Some respondents indicated that current alternative options (that is,1800 MHz, 2.1 GHz and class licensed bands) were not adequate and commercial negotiations with spectrum licensees are out of the reach of small wireless service providers. A number of alternative bands were proposed instead, including 2400–2500 MHz, 4000–4200 MHz, 4940–4990 MHz, 5091–5150 MHz and 6000–6100 MHz. These bands were flagged due to the availability of equipment, amount of spectrum available and protection from illegal use. The ability to provide a carrier grade service was considered paramount to WISP respondents. One respondent suggested that, given the interest in the 3.6 GHz band for 5G, spectrum licensees in the adjacent 3.4 GHz band could migrate into the 3.6 GHz band. This would free up more spectrum for apparatus licensing, possibly even in metropolitan areas.

WISP respondents indicated serious doubts over the viability of the 5.6 GHz band as an alternative option to the 3.6 GHz band. While some respondents acknowledged that equipment could be configured to operate in the band, this would come at a cost (to operators and consumers) and there are a number of issues that would need to be addressed before proceeding:

* At most, there is only 40 MHz of spectrum available in the band, compared with 125 MHz in 3.6 GHz band. This is not enough spectrum for multiple operators and would limit further use of the band by BoM radars.
* The characteristics of BoM radars are unknown, so it is hard to determine the ability to coexist until this is provided. However, it is likely spectrum availability would be reduced further by the large coordination distance required to protect BoM radars.
* There are a large number of devices operating (illegally) in the band. Off-the-shelf consumer equipment can easily be configured to operate in this band. This would require ongoing policing by the ACMA in order to manage.
* A requirement to implement DFS would prevent the ability of operators to deploy carrier grade services.
* The ACMA needs to clarify if the 4W limit proposed relates to transmit power or EIRP. It was also noted that the 5.6 GHz band is already abused by operators operating at higher EIRPs.
* There are no guard bands to manage interference with adjacent band RLANs.
* The 5.6 GHz band has poorer propagation characteristics than the 3.6 GHz band.

Some respondents rejected the 5.6 GHz band option outright based on the issues outlined above. However, there were some reluctant support for the 5.6 GHz band, provided new and effective tools are used to manage access to it. In addition, a minimum of 10-years certainty of access to the spectrum would be required.

There was also support from some respondents to make the 5.6 GHz band available for RLANs on a class-licensed basis instead. There was no support from WISP interests for the simultaneous implementation of apparatus and class-licensing arrangements for wireless broadband in the 5.6 GHz band.

Submissions from mobile industry

Most of the respondents associated with mobile industry interests did not respond to issues associated with options for incumbent point-to-multipoint licensees. However, Telstra and Vodafone indicated incumbents could pursue commercial arrangements, with spectrum licensees to support ongoing access to the band. Telstra also indicated their support for developing apparatus licence arrangements in the 5.6 GHz band under the notional arrangements proposed. They also indicated support for use of the band by class licensed devices, as current bands are becoming congested in metropolitan areas, citing the risk of interference to regionally-based apparatus licence services would be low.

Telstra acknowledged that existing alternative bands for incumbent point-to-multipoint licensees (that is, 1800 MHz and 2.1 GHz) are likely to be inadequate due to current heavy use. Instead, they proposed that the ACMA review the possibility of making the 3300–3400 MHz and 4800–5000 MHz bands available for incumbent point-to-multipoint licensees.

Submissions from other stakeholders

Responses provided by other stakeholders were mainly focused on the ACMA’s proposal for the 5.6 GHz band. Most respondents proposed the band be made available for class-licensed use by RLANs, citing existing arrangements already in place in Europe and the US. The benefits of this would be access to more spectrum and wider bandwidth channels by RLANs. It was argued that coexistence with radars operating in the band is possible if DFS is mandated. Interference issues in the 5.6 GHz band internationally has resulted from non-compliant equipment.

There was concern from respondents that the development of apparatus licence arrangements would be counterproductive for RLAN use in the band. Though one submitter suggested apparatus-licensed arrangements could be applied in regional/remote areas, and class license arrangements in metropolitan areas.

### ACMA response to submissions

Use of the 5.6 GHz band

The ACMA acknowledges the concerns raised by BoM regarding the development of class or apparatus-licencing arrangements for wireless broadband in the 5.6 GHz band. However, as stated in numerous submissions, there is evidence to suggest that internationally, interference issues in the band are not due to the efficacy of DFS, but to non-compliant and uncoordinated use of RLANs. If this is the case, these negative experiences should not rule out the development of arrangements for a new service in a band, whether they be under a class or apparatus licence regime. The ACMA further observes that a coordinated apparatus-licensed regime in the band should go a step further in addressing BoM’s interference concerns, while also helping to identify interference sources if issues did arise.

It is acknowledged that the creation of apparatus licence arrangements for wireless broadband (as opposed to class license arrangements) could restrict the deployment of future radar services. This is why the ACMA proposed to leave a 10 MHz portion of the 5.6 GHz band for future radar-only use. In the Options paper, this was proposed to be the 5600–5610 MHz frequency range. Given most radar use is currently centred at 5625 MHz, the ACMA is also open to considering the 5620–5630 MHz frequency range instead. Agreement on the most appropriate way forward will form part of the future development and consultation of arrangements for the 5.6 GHz band.

The ACMA has also considered whether it would be practical to implement coordinated apparatus licence arrangements in regional/remote areas and class licensed arrangements (using DFS) in metropolitan areas. However, while the use of DFS and/or coordination procedures should protect BoM radars (notwithstanding BoM concerns on both approaches), there is currently no practical way to ensure class-licensed devices remain in metropolitan areas. This means that over time, under such arrangements, there would be an increased risk of interference to apparatus-licensed point-to-multipoint use in regional and remote areas.

After consideration of the issues, the ACMA believes a managed interference environment—that is, apparatus-licensed access to the band in accordance with ACMA-developed coordination rules—would be the most appropriate approach in the first instance. Not only would this provide greater control in access and protection for BoM radars, it will also provide options for new or existing wireless broadband operators to deploy carrier grade services. It also gives more time to further assess the efficacy of DFS in protecting radars internationally.

Alternative bands for apparatus licensed point-to-multipoint services

The ACMA appreciates the desire of many WISPs for more suitable alternative bands to be made available for site-based apparatus licensing. However, identifying alternative spectrum for site-based point-to-multipoint licensing is particularly challenging, as spectrum suitable for such use is also often of interest for wide-area broadband deployments (meaning access may not be guaranteed for the very long terms sought by WISPs) or is not suitable due existing arrangements and incumbency issues. The ACMA has considered other bands of interest to point-to-multipoint users, but believes that any apparatus-licensing arrangements developed for the 5.6 GHz band could be left in place for the longest period of time before coming under review. While other bands may be considered in the future, no assurances can be made at this point in time.

The alternative bands identified by respondents can be grouped into four categories:

* 2400–2500 MHz and 4940–4990 MHz: These bands are already subject to class-licensing arrangements and are either not suitable to provide a carrier grade service or are restricted for use by other uses or users such as Defence, national security and public safety agencies only.
* 5091–5150 MHz and 6000–6100 MHz: There are incumbency issues in these bands that make them unsuitable for use by wireless broadband services. Specifically, the 5091–5150 MHz band has been identified to support future Unmanned Aircraft Systems and currently is used by FSS earth stations (earth-to-space) domestically and internationally, and there are also no fixed or mobile service allocation in the band to support site-based point-to-multipoint operations. This is likely due to coexistence issues already mentioned (and would likely call into question the scale of equipment availability in the band). The 6000–6100 MHz band is used by fixed links and FSS earth stations (earth-to-space). There are in the order of 700 licences in the band, almost all of which are located in and around Perth and the east coast of Australia. This band was also considered under WRC-15 agenda item 1.1 as a candidate RLAN band. However, it was not identified as the restrictions on use were too severe (low power and indoor-only operations) to enable coexistence with FSS satellite systems.

3300–3400 MHz, 4000–4200 MHz and 4800–4940 GHz: These bands are also of interest internationally for wide-area network deployments. It cannot be guaranteed that these bands won’t come under review in the future. Therefore, long-term certainty of licence tenure cannot be provided at this time.

Move 3.4 GHz spectrum licences to the 3.6 GHz band, given interest in the band for 5G services: spectrum licences in the band will not expire until 2030 and cannot be varied without agreement from the licensees. Consequently, moving 3.4 GHz spectrum licensees is not considered a practical option. The ACMA also notes that internationally, the broader 3300–3800 MHz (and in future, potentially up to 4200 MHz) band is being targeted as a pioneer frequency range for the deployment of 5G services. Most sources also suggest that 100 MHz per operator is ideal to realise the full benefits of 5G. These developments suggest that current arrangements in 3.4 GHz are the right ones.

In response to the specific issues and concerns raised by WISP respondents:

* The ACMA acknowledges that the 5.6 GHz band apparatus-licensing arrangements would offer less spectrum than currently available for point-to-multipoint licensing in the 3.6 GHz band. This means it is unlikely to be possible to accommodate every user in the 3.6 GHz band who might seek reassignment into the 5.6 GHz band. To mitigate this to a degree, the ACMA is proposing a seven-year re-allocation period for incumbent point-to-multipoint licensees in Area 2 and Area 3. Since the re-allocation period proposed (seven years) is shorter than the proposed policy position of making the 5.6 GHz band available for such apparatus licencing for at least 10 years, it is acknowledged there may still be drivers for incumbent point-to-multipoint licensees to transition to the 5.6 GHz band. In these cases, it will be ACMA policy that existing 3.6 GHz point-to-multipoint licensees in Area 2 and Area 3, as far as possible, would be encourage to apply for ‘like for like’ licences in the band and given preference, to the extent possible, in the ACMA’s consideration of such applications. Depending on demand, the ACMA acknowledges that it may not be possible to accommodate all such requests. This may be due to incumbent radar services in the vicinity or the limited spectrum available if all 3.6 GHz band licensees in an area sought access to the 5.6 GHz band.
* The ACMA will work with stakeholders to develop appropriate access arrangements for the 5.6 GHz band. This will include specifying BoM radar characteristics to use for coordination. Preliminary analysis shows the band to be a viable option for new point-to-multipoint apparatus licences in many areas, notwithstanding the use of the band by BoM radar.
* The ACMA notes there may be wireless broadband devices already operating in the 5.6 GHz band, even though there are no formal arrangements to support this. The ACMA has already commenced survey work in regional areas to gauge the size of this issue. The results to date confirm there is illegal use within the band, but it does not appear to be widespread in the areas investigated. In order to make the spectrum suitable for use, the ACMA will work with licensees on an ongoing basis to identify those locations where illegal 5.6 GHz use is accruing and resolve the issue. It is important to note this issue is not unique to the 5.6 GHz band. There are multiple apparatus and spectrum-licensed bands where the use of illegal repeaters or other non-compliant devices causes problems for licensees. Compliance is an ongoing issue that the ACMA actively works with licensees to manage. As with these bands, the ACMA believes the issues identified in the 5.6 GHz band can be managed.
* Any arrangements developed for the 5.6 GHz band are proposed to require any prospective point-to-multipoint licensees to coordinate with incumbent radar services (and other apparatus-licensed wireless broadband services) before being issued a licence. This process will ensure interference is managed between the two services—as such, the use of DFS to manage interference is not considered necessary. Therefore, before deploying services, prospective licensees will be able to determine whether they have the ability to provide a carrier grade service. These services would then be provided protection from any subsequent apparatus-licensed radar and wireless broadband services deployed in the band.
* In the Options paper, the ACMA proposed implementing a maximum 4W EIRP limit for apparatus-licensed wireless broadband services in the 5.6 GHz band. However, in order to support larger coverage areas, where possible, the ACMA is willing to work with stakeholders to investigate setting a higher EIRP limit. The requirement to coordinate with other services in the band may restrict the level that can be used on a case-by-case basis. The ACMA also notes that a higher EIRP limit would likely result in larger separation distances being required between services to enable coexistence. This could decrease the overall number of services that could be deployed in the band.
* In the Options paper, the ACMA proposed making the 5610–5650 MHz frequency range available for point-to-multipoint apparatus licencing. This provides a de facto 10 MHz guard band from 5600–5610 MHz to RLANs operating below 5600 MHz, which is considered sufficient to manage any adjacent band interference. However, it is acknowledged there is no equivalent guard band to RLANs operating above 5650 MHz. In this case, interference is managed by the ability of licensees to transmit at higher EIRPs than adjacent band class-licensed devices, coupled with the apparatus licensees not having to implement techniques such as DFS or Carrier Sense Multiple Access (CSMA). In addition, in many regional areas it would be expected that the density of class-licensed use of RLANs immediately adjacent to the 5650 MHz boundary would be low, with a correspondingly low probability of interference to apparatus-licensed RLAN use. Similar arguments would also apply if the 5620–5630 MHz frequency range is restricted for BoM radar use and the 5600–5620 MHz and 5630–5650 MHz frequency ranges are used for point-to-multipoint apparatus licencing. It is noted that while the ACMA is still committed to reserving 10 MHz of the 5.6 GHz band for radar-only operation, the most appropriate approach to take will be discussed with stakeholders as part of the development of arrangements for the band.
* It is acknowledged that the propagation characteristics of the 5.6 GHz band are not the same as the 3.6 GHz band. However, in a line-of-sight environment (which many fixed wireless broadband services operate in), the difference will not be as significant. It can also be compensated for, to a degree, by using higher gain antennas.

The ACMA is aware of some interest in using the 28 GHz band (27.5–29.5 GHz) to deploy wireless broadband services. While there are existing arrangements in the band supporting point-to-point uses, there are no arrangements for point-to-multipoint (wireless broadband). Due to the propagation characteristics in the band, it is recognised that the 28 GHz band could not be considered a direct substitute for wireless broadband services in the 3.6 GHz band. However, there are deployment scenarios this band could be used for (as evidenced by operators who have expressed interest in the band). This band is at the early stages of consideration domestically and hence, no guarantees can be provided as to what, if any, arrangements could be implemented. However, the ACMA will investigate the possibility of site-based point-to-multipoint apparatus-licensed arrangements in part of 28 GHz band in regional Australia as another possible option to assist WISPs and other wireless broadband operators. In considering such use of the band, the ACMA is aware that other incumbent services will need to be considered, including point-to-point links and satellite uplinks, as well as potential future use of the band for earth stations in motion.

### **ACMA** **decision**

After considering the information provided in submissions, the ACMA has come to the following conclusions regarding options for incumbent point-to-multipoint licensees in the 3.6 GHz band. The ACMA will:

* provide a seven-year re-allocation period for incumbent point-to-multipoint licensees in the 3.6 GHz band in Area 2 and Area 3. Licensees may also seek to negotiate ongoing access (including neutral host arrangements) to spectrum held by spectrum licensees in the area.
* work with stakeholders to establish coordinated apparatus-licensing arrangements for point-to-multipoint services in the 5.6 GHz band. This will initially be in regional and remote areas, with future consideration for release in metropolitan areas.
* adopt a policy position that arrangements in the 5.6 GHz band will not be varied to the detriment of apparatus-licensed point-to-multipoint licensees prior to the end of 2028.
* adopt a policy position that existing 3.6 GHz point-to-multipoint licensees in Area 2 and Area 3, as far as possible, will be given preference in assessing applications for such licences. The ACMA will work with industry to develop a process to guide its decision making when there is contention for these licences in areas where there are multiple licensees vying for access to the band.
* work with prospective licensees on an ongoing basis to manage non-compliant use of the 5.6 GHz band.
* restrict access to a 10 MHz portion of the 5.6 GHz band for use by radar services only. The most appropriate location of this restricted portion will be discussed with stakeholders as part of the development of arrangements for the band.

investigate the possibility of apparatus-licensed point-multipoint arrangements in part of the 28 GHz band in regional Australia as another possible option to assist WISPs and other point-multipoint users.

## Options for incumbent FSS earth station licensees

The Options paper identified a number of incumbent FSS earth station licensees operating services in the 3.6 GHz band. The paper made particular note of the services located in the Belrose/Oxford Falls area in Sydney, as well as Landsdale and Lockridge in Perth. Facilities operating near Uralla in regional New South Wales and off the coast of Western Australia (remote Australia) were also mentioned.

In the event that any of these FSS earth stations are affected by replanning activities in the 3.6 GHz band, the Options paper identified the following two options for them:

* migrate services to frequencies outside of the 3.6 GHz band; or

geographically relocate services away from significant population centres.

For those FSS earth stations that choose to adopt the latter approach, it was further proposed that if they were located on the west coast of Australia, they could relocate to the earth station protection zone near Mingenew. This area is defined in [Embargo 49](http://www.acma.gov.au/~/media/Spectrum%20Engineering/Regulation/pdf/Embargo%20No%2049.pdf) and was created to provide long-term certainty for space and satellite operations, while minimising the probability of spectrum denial to terrestrial services in populated areas.

There is currently no equivalent earth station protection zone for FSS earth stations located along the east coast of Australia. The Options paper sought feedback from industry on this issue.

It asked the following questions:

1. **The ACMA seeks comment on the suitability of the current west coast earth station protection zone located near Mingenew, WA, for long-term satellite service use. Are the current regulatory arrangements effective?**
2. **In the event FSS earth stations are affected by replanning activities in the 3.6 GHz band, the ACMA seeks comment on:** 
   1. **Any issues surrounding the development and establishment of an east coast earth station protection zone; particularly on what factors would be necessary to make it an attractive option for earth station operations.**
   2. **Whether there are any views on potential candidate locations to consider.**
   3. **Whether there should there be more than one earth station protection zone on the east and west coasts of Australia.**
   4. **If the identification of a central Australia earth station zone should be considered.**

### Summary of submissions

Submissions from satellite industry

As discussed in the *Case for action and replanning options* section of this paper, many respondents associated with satellite interests supported ongoing access and protection of existing FSS earth station licences at their current locations, stating that sharing arrangements could be developed to support this. This outcome was supported by incumbent licensees Inmarsat and Lockheed Martin. Inmarsat requested a 20-year re-allocation period for their services, while Lockheed Martin indicated a need for ongoing operation at their current location. However, incumbent licensees Telstra and Optus indicated a preference (and ability) to migrate services out of the 3.6 GHz band, rather than physical relocation of facilities. Another respondent requested the ability to apply for new FSS earth receive licences in the 3.6 GHz band if they would be located near an existing FSS earth station.

Respondents were supportive of the existing earth station protection zone arrangements at Mingenew. There was also interest in identifying a second location in Western Australia. While there were no firm views on locations, Carnarvon and Kalgoorlie were suggested as possible sites.

There was also support for the early identification of an east coast earth station protection zone. In order to make it an attractive option for future earth station operations, the following issues for consideration were provided:

* The area identified has to be large enough (several kilometres2 in size) to support a number of teleports operated by different operators.
* Access to high capacity fibre at a reasonable cost, preferably via diverse routes.
* Access to reliable and adequate mains power, with the possibility of diverse connections.
* All weather road access for vehicles with substantial and possibly out of gauge loads.
* Visibility down to 5° along the Geostationary arc.
* Support for non-geostationary orbit (NGSO) services done to 5° in relevant bands.
* Checking the rain micro-climate to avoid storm fronts (this is more an issue for higher frequency bands).
* No significant sources of radiofrequency interference in the vicinity.
* Local airport close by if it is located far from a major population centre.

Natural terrain protection for the area identified.

Respondents indicated they had not had the time to consider possible locations for an east coast earth station protection zone in detail. However, a few thoughts on the issue and potential options were identified as follows:

* Preferably located as close to Sydney as possible, possibly west of the Blue Mountains or on the Sydney-to-Canberra route (Goulburn/Southern Highlands). A second location could be considered in Victoria or Queensland.
* Dubbo is not considered suitable, due to proximity to a significant population centre.
* A site near Moree could be considered.
* Other possible locations include Broken Hill, Bourke or Roma, which are located near existing NBN Co earth station gateway locations.
* The zone may restrict utility of the 3.6 GHz band within a 75 kilometre radius.
* There was support in identifying two geographically distinct locations.

There was mild interest in identifying a central Australian earth station zone. Two respondents suggested a site located north of a latitude of 15° would be preferable. This could enable access to regional beams in southeast Asia not available in other parts of Australia.

Submissions from other stakeholders

A few submissions from other stakeholders commented on options for incumbent FSS earth station licensees. Generally, there was support for the concept of earth station protection zones and support for moving earth stations to areas of low demand for spectrum. The identification of an east coast protection zone was encouraged, though Telstra and Optus supported the option of retuning services were this was viable.

One respondent suggested considering locations west of the Great Dividing Range that are within 45 minutes of reasonably-sized population centres. This respondent also suggested any location should be away from major air corridors and ideally within a natural depression or valley. An area near Parkes may be suitable, given it is already a radio quiet area. Other respondents said that any location identified should not have an effect on any current or planned in-band and adjacent band wireless broadband deployments.

Another respondent suggested studies should be performed to determine the ability of small cells to coexist with earth stations.

Respondents indicated that interference to earth station protection zones should be managed via case-by-case coordination to specific protection levels, taking into account terrain and other engineering factors. Implementing exclusion zones is inefficient. One respondent contended that the claimed protection distances for FSS earth stations are likely overstated and better sharing would be possible if modern techniques and proper service modelling is performed. It was further suggested that the ACMA consider making satellite services secondary to wireless broadband services outside of defined earth station protection zones.

### ACMA response to submissions

The ACMA acknowledges that two incumbent FSS earth station licensees have signalled they have or will retune their services out of the 3.6 GHz band. This action is supported where it is a viable option. However, FSS earth station licensees in metropolitan areas should be aware that international developments within the 3700–4200 MHz band with regards to its potential use for MBB are being monitored. As such, this band may come under review at some future point.

The ACMA recognises that tuning services out of the 3.6 GHz band is not an option for Inmarsat’s facility located in Perth and Lockheed Martin’s facility near Uralla. For the former facility, as discussed in the *Case for action and replanning options* and *Length of re-allocation period* sections of this paper, coexistence between FSS earth stations and MBB services in Perth and a lengthy (for example, 20-year) re-allocation period are not considered appropriate solutions. To support the operation of this service in the long term, Inmarsat’s 3.6 GHz band operations in Perth will need to be geographically relocated. The most appropriate long-term solution in this case would be to move to a defined earth station protection zone.

Options for the earth station facility operated by Lockheed Martin near Uralla were previously discussed in the *Case for action and replanning options* and *Geographical area options* sections of this paper. In summary, the ACMA proposes that Option 4b be applied to this facility to enable it to continue operating. Specifically, it is recommended that the area represented by the HCIS identifier NU7K4 should not be included in the areas re-allocated for the issue of spectrum licences in the 3.6 GHz band. The ACMA stands by its statement in the Options paper that the facility may be required to relocate in the future. However, if it is shown that MBB service deployments in major towns in the area are not unreasonably restricted, the facility at Uralla will be able to continue its operation.

The ACMA appreciates the support from some submitters in defining an east coast earth station protection zone. The ACMA will work with stakeholders to identify one or more such zones, considering comments received on how to make them attractive for future earth station operations. Possible locations both inside and outside of the areas proposed for re-allocation will be considered. However, given the desire to progress with making spectrum in the 3.6 GHz band available for wide-area MBB networks, there is limited time available to undertake further assessment of locations before spectrum is re-allocated for the issue of spectrum licences.

Consequently, as part of the re-allocation consultation, the ACMA will flag the option of excising three prime candidate locations from the proposed areas to be re-allocated (as defined in Annex C). This reflects the ACMA’s current disposition to excise all three areas from any future recommendation made to the minister. It would then support their further consideration as east coast earth station protection zones (noting this would not prevent consideration of locations, such as Bourke, outside of those being considered for spectrum licensing). Pending a decision from the minister, and as part of the TLG process, the ACMA would then work with stakeholders to develop appropriate protection arrangements for these locations. Discussion in the TLG will include whether the implementation of exclusion zones or case-by-case coordination (or a combination of both) is appropriate.

This approach will give the ACMA and the satellite industry time to properly assess these locations and other locations outside of those being considered for spectrum licensing, to determine their suitability as earth station protection zones. In the event that one or more of these sites are found to be unsuitable, any protection criteria would be removed and options to make the areas available initially for the apparatus licensing of wide-area broadband services and then, potential future re-allocation for spectrum licensing, could be investigated.

The proposed areas to be excised are around Moree, Quirindi and Roma and are defined by the HCIS in Annex D. These areas were considered the most suitable for further consideration, due to a combination of factors such as:

* They are located far enough away from major population centres but still near a reasonably-sized population centre for staffing purposes.
* Natural terrain shielding (Quirindi).
* Low density of current use by other services in bands of interest to commercial satellite services (for example, C-band, Ku-band and Ka-band).
* Both Geosynchronous Orbit (GSO) and NGSO services can be supported at the sites.
* Large enough areas can be identified to support several teleports operated by different operators.
* The locations appear to be close to high-capacity fibre runs and reliable mains power.

The ACMA acknowledges the general support for the existing earth station protection zone arrangements at Mingenew. Options for a second location can also be considered, though any such location will need to be located outside of any areas that are re-allocated for the issue of spectrum licences. Based on comments received, the ACMA will also consider the potential for an earth station protection zone located north of a latitude of 15°. However, it is noted that the initial focus will be on identifying east coast protection zones and developing arrangements for the release of those areas in the 3.6 GHz band that will be re-allocated for the issue of spectrum licensing.

The ACMA will also, as part of the TLG process, define suitable ongoing protection arrangements for apparatus-licensed FSS earth stations operating in areas and frequencies adjacent to those re-allocated for spectrum licensing.

### **ACMA** **decision**

After considering the information provided in submissions, the ACMA has come to the following conclusions regarding options for incumbent FSS earth station licensees in the 3.6 GHz band:

* The ACMA supports retuning affected services out of the 3.6 GHz band where this is viable. However, FSS earth stations licensees in metropolitan areas should be aware that the ACMA is currently monitoring international developments in the 3700–4200 MHz band with regards to its use for MBB. As such, this band may come under review at some future point.
* Where retuning services out of the 3.6 GHz band is not a viable option, relocation (within the re-allocation period) to a designated earth station protection zone will be required for ongoing operation.
* The ACMA will work with stakeholders to determine appropriate locations for one or more east coast earth station protection zones. This will include consideration of locations both inside and outside of those areas being considered for spectrum licensing. It is recognised that there is limited time to assess suitable locations without impeding re-farming processes in the band. Consequently, as part of the re-allocation consultation, the ACMA will flag it is considering excising the areas around Moree, Quirindi and Roma defined in Annex D. The benefit of excising these areas is that if provides more time for them to be assessed as options for one or more east coast earth station protection zones (noting this would not prevent consideration of locations outside of the areas being considered for spectrum licensing, such as Bourke).
* If one or more of the areas around Moree, Quirindi and Roma are excised from the final recommendation to the minister, and pending a decision from the minister, suitable protection criteria for the facility would be developed as part of a TLG process for the 3.6 GHz band. In the event that one or more of these sites are subsequently found to be unsuitable, any protection criteria could be removed and options to make the areas available initially for the apparatus licensing of wide-area broadband services and then spectrum licensing could be investigated.
* As part of any TLG process, suitable ongoing protection arrangements will be developed for apparatus-licensed FSS earth stations operating in areas and frequencies adjacent to those re-allocated for spectrum licensing.
* The ACMA will work with stakeholders to determine an appropriate location and viability of a second Western Australian earth station protection zone. It is expected that any location considered will be outside of those areas being considered for spectrum licensing. The ACMA will also work with stakeholders to determine the viability off and potential location of an earth station protection zone located north of a latitude of 15°. However, work on identifying an east coast earth station protection zone and re-farming activities in the 3.6 GHz band will take priority.

As part of the re-allocation consultation, the ACMA will flag it is considering excising the area immediately surrounding the earth station facility at Uralla, New South Wales (represented by the HCIS identifier NU7K4). Excising this area would enable the facility to continue operating under existing apparatus-licence arrangements. If this area is excised from the final recommendation to the minister, and pending a decision from the minister, suitable protection criteria for the facility would be developed as part of a TLG process for the 3.6 GHz. Note, the long-term viability of this site may be reviewed in the future, given rising international interest in the 3700–4200 MHz band for use by wide-area mobile wireless broadband services and the proximity of the site to major regional population centres.

## Options for other incumbent services

In addition to services provided by incumbents operating point-to-multipoint and FSS earth station licences, the Options paper also identified the following allocations and uses of the 3.6 GHz band:

* fixed links (point-to-point licences)
* amateur services
* radiolocation services
* low interference potential devices operating under a class licence

television receive-only (TVRO) systems.

The Options paper discussed the alternative options available for each of these:

* For fixed links, a number of alternative options were identified. These included retuning to a different channel in the 3.8 GHz fixed-link band, relocating to another fixed-link band (as defined in [RALI FX3](http://www.acma.gov.au/Industry/Spectrum/Spectrum-planning/Space-systems-regulation/rali-fx3-appendix-1)), or investigating fixed-line options.
* For amateur services, it was noted they operate on a secondary basis in the 3.6 GHz band and based on the [*Australian Amateur Band Plan*](http://www.wia.org.au/members/bandplans/data/documents/Australian%20Band%20Plans%20160211.pdf), have alternative spectrum options in the 3300–3400 MHz band.
* For devices operating under a class licence, no protection is afforded. The Options paper indicated that the ACMA will continue to liaise with the Department of Defence on any future requirements in the 3575–3600 MHz band.
* For TVRO systems, unless they operate under an apparatus licence, they are not authorised to operate in Australia. No protection is afforded to unlicensed systems.
* Finally, while there is an allocation for the radiolocation service across the entire 3400–3600 MHz band, at present this services is only licensed to operate up to 3500 MHz.

The Options paper asked the following questions related to this issue:

1. **If point-to-point licences are affected by replanning activities in the 3.6 GHz band, are the options identified for point-to-point licences suitable? Are there any alternative options that should be considered?**
2. **Are the approaches for amateurs, radiolocation services, class licensed devices and TVRO systems suitable?**
3. **Are there any other options for incumbent services, not identified in this paper, which should be considered?**

### Summary of submissions

Submissions related to incumbent point-to-point licence options

Most respondents that commented on options for incumbent point-to-point licensees felt the alternative options available were suitable. This was due to a combination of the limited number of point-to-point licences in the band and the large number of suitable alternative bands available. Respondents representing the mobile industry also suggested that the ACMA should restrict use of the 3700–3800 MHz band for new point-to-point links and the retuning of existing ones out of the 3.6 GHz band. The reason given was that adjacent channel coordination requirements with point-to-point licenses could limit use of the 3.6 GHz band, and the 3700–3800 MHz band is also being looked at for MBB.

Some respondents supported alternative approaches to managing access to the 3.6 GHz band. These included investigating dynamic sharing models and allowing commercial negotiations to resolve situations where there is contention (refer to the *Case for action and replanning options* section of this paper for more detail). One respondent also suggested that the ACMA could raise apparatus licence fees, based on incentive pricing models, as a way to manage contention. They argued that this was a better model to provide incumbents with incentives to consider alternative bands and delivery mechanisms.

The major incumbent point-to-point licensee in the 3.6 GHz band (Digital Distribution Australia) requested a re-allocation period of 10 years to migrate their services to alternative bands. The reason for this was due to the cost of replacing equipment, as well as acquiring and constructing new repeater sites.

Submissions related to incumbent amateurs, radiolocation and class licensed devices and TVRO options

Some respondents indicated that incumbent amateurs, radiolocation services, class licensed devices and TVRO services should not be provided protection and should not cause interference to other services operating in the 3.6 GHz band. One respondent also stated that the current sharing arrangements in the band would remain suitable after any replanning activities in the band.

Some respondents suggested that if these incumbent services operated on a secondary basis, the development of sharing arrangements in the band would allow them to continue operating in areas where there is no contention for spectrum.

The Wireless Institute of Australia (WIA) indicated that the amount of spectrum in the 3300–3600 MHz band available for amateur use and the areas they can use it has decreased over time. Consequently, they requested that amateurs not be restricted from operating outside any areas in the 3.6 GHz band that are re-allocated for the issue of spectrum licences.

### ACMA response to submissions

Based on comments received, the ACMA believes the alternative arrangements identified for incumbent point-to-point licences affected by re-farming in the 3.6 GHz band are suitable. While options for sharing have been considered, as discussed in the *Case for action and replanning options* section, the ACMA believes spectrum licensing is the most appropriate way forward in areas of high demand. Under this approach, different re-allocation periods would apply to point-to-point licences in different areas, as discussed in the *Length* *of the re-allocation period* section of this paper. Specifically, of 47 point-to-point licences in the band, 45 are in areas where the proposed seven-year re-allocation period would apply. A two-year re-allocation period would apply to the remaining two licences, due to their location in Brisbane. Based on the ACMA’s most recent experience in re-allocating spectrum in regional Australia in the 1800 MHz band, a period of just over three years was identified by one incumbent point-to-point licensee as the minimum needed to migrate over 300 licences to alternative bands or delivery mechanisms. This suggests a seven-year re-allocation will be adequate for 45 point-to-point licences to be migrated to alternative bands or delivery mechanisms. A benefit of the spectrum-licensing approach is that it also permits the use of commercial negotiations, either to support ongoing use of the spectrum or facilitate an early vacation of the band by incumbent point-to-point links.

The ACMA supports requests to restrict use of the 3700-3800 MHz band for new point-to-point links and the retuning of existing links out of the 3.6 GHz band. This will improve utility of the 3.6 GHz band while also minimising any potential future disruption to point-to-point links in the event the 3700–3800 MHz band is reviewed in the future.

The ACMA recognises that different approaches could be used to manage incumbent secondary services, class licensed devices, unlicensed TVRO devices or potential future radiolocation services in the band. However, in this case the ACMA believes the arrangements proposed in the Options paper are suitable with the following changes based on submissions:

* Arrangements will be created to support ongoing amateur use of the 3.6 GHz band outside any areas and frequencies that are re-allocated for the issue of spectrum licenses.
* Acknowledging there are currently no radiolocation apparatus licences in the 3.6 GHz band, the ACMA will continue to liaise with the Department of Defence on its future requirements in the band. As part of the TLG process, the ACMA will work with stakeholders to define suitable interference management criteria for this case in the event radiolocations services are deployed. This may take a form similar to the arrangements currently in place for the adjacent band 3.4 GHz technical framework.

### **ACMA** **decision**

After considering the information provided in submissions, the ACMA has come to the following conclusions regarding options for other incumbent licensees in the 3.6 GHz band:

* The re-allocation periods proposed for different areas are considered suitable for incumbent amateur and point-to-point link licensees.
* Future use of the 3.8 GHz fixed link band plan will be limited to the 3800–4200 MHz frequency range. This will apply to new services, as well as any services retuned out of the 3.6 GHz band.
* Amateur services can continue operating on a ‘no interference and no protection’ basis until the end of the re-allocation period in any areas re-allocated for the issue of spectrum licences. There will be no restrictions placed on Amateur use outside of these areas as part of this process.
* There will be no changes to existing class licence arrangements in the 3.6 GHz band.
* TVRO and other unlicensed earth stations will not be afforded protection from interference.

Suitable interference management criteria will be developed in the event there is a need to operate radiolocation services in the 3.6 GHz band. These criteria will be developed as part of a TLG process.

## Other issues raised in submissions

Respondents raised various other issues that did not fall within the scope of the discussion in previous sections. These issues are summarised and responded to here.

### Adjacent band FSS

Some submissions from the satellite industry expressed concern regarding the management of interference from MBB services in the 3.6 GHz band into adjacent band FSS earth station licensees.

ACMA response

Adjacent band licensed FSS earth stations will be afforded protection from MBB services operating in the 3.6 GHz band. Relevant protection criteria will be developed as part of the TLG process to develop a technical framework for the 3.6 GHz band. Representatives of the mobile industry and incumbent FSS earth station licensees will be invited to participate in this process. Protection will be on a first-in-time licensed basis. The ACMA does not intend to provide protection to unlicensed services.

### Compensation

Several responses from incumbent licensees raised the issue of compensation in the event they are required to vacate the band.

ACMA response

Under the Act, the ACMA has no ability to provide financial compensation when regulatory arrangements change, licences are not renewed or are cancelled by operation of section 153H of the Act. However, to assist with transition to new arrangements, and mitigate some of the effects, the ACMA will put in place a number of mitigation measures for incumbent users, including extended re-allocation periods where appropriate on balance, and investigation of alternative spectrum options.

### Distinction between fixed and mobile broadband

Some respondents representing WISP interests requested that the ACMA better distinguish between fixed and mobile wireless broadband use in planning activities. They believe that the lack of distinction has resulted in incorrect assumptions and assessment of HVU for the 3.6 GHz band.

ACMA response

The ACMA acknowledges there is a distinction between fixed and mobile wireless broadband services and both are viable options for deployment in the 3.6 GHz band. The decision to group the two delivery modes together was made for the following reasons:

* The ACMA generally creates technology-flexible licensing arrangements. This means under current and any proposed future arrangements in the 3.6 GHz band, licenses will not be limited to deploying only fixed or mobile services. This is purely a commercial decision based on the requirements and business model of each licensee.
* There are multiple terms that relate to different mobile and fixed wireless broadband technologies and services. For simplicity, a single term was used to apply to all of these, since all uses will be feasible under future arrangements.

In the future, the ACMA will consider ways to better differentiate between fixed and mobile wireless broadband services when appropriate. However, the ACMA does not agree that this has affected its HVU analysis for the 3.6 GHz band. In this case, the main distinction in value identified was between site-based and wide-area deployments. Under both these deployment scenarios, the ACMA’s technology-flexible licensing arrangements allow licensees to deploy fixed, mobile, or both fixed and mobile technologies as they see fit.

### Optimisation of 3400–3700 MHz

Submissions from the mobile industry have continued to show their support, in this and previous consultations, for optimising arrangements across the broader 3400–3700 MHz band for TDD fixed/mobile broadband use. One respondent to the Options paper also expressed its disappointment that such a wider process had been delayed, given its importance to 5G investment.

ACMA response

The ACMA acknowledges there will be benefits in optimising arrangements across the 3400-3700 MHz band for TDD fixed/mobile broadband use. However, as outlined in the *Future use of the 1.5 GHz and 3.6 GHz bands—Summary of and response to 3.6 GHz submissions paper*, in order to facilitate timely consideration of the 3.6 GHz band, the ACMA has deferred any process for optimising the 3400–3700 MHz band until the outcomes of the review of the 3.6 GHz band are known. Any work would then be undertaken as a separate process and would consider the rights of existing spectrum licence holders. As far as possible the ACMA will also support mechanisms such as trading to rearrange and defragment spectrum holdings across the 3400–3700 MHz frequency range.

### Spectrum Review implementation

It was noted in one submission that the Radiocommunications Bill 2017 allows for perpetual licences as a general principle. The respondent questioned whether the review of the 3.6 GHz band had been accelerated, intentionally or otherwise, to forestall that outcome.

ACMA response

The reasons for the prioritisation of the 3.6 GHz review were outlined in the Options paper. The prioritisation recognised the significant investment uncertainty the Review has created for incumbent spectrum users, including the effect of the November 2016 spectrum embargo decision on point-to-multipoint users, including WISPs and their customers in regional Australia. Submissions and representations have expressed frustration at the lack of clear long-term licensing options for future point-to-multipoint deployments. The decision to prioritise the 3.6 GHz band also took into account submissions from several carriers supporting the urgent re-allocation of spectrum in the band for wide-area broadband deployments (fixed and mobile), including likely early 5G deployments. Prioritising the review of this band was intended to provide greater clarity and investment certainty for incumbents and potential new band entrants alike.

The government has indicated that the new legislation will not provide for perpetual licences. The exposure draft of the Bill provides for licences to be issued for up to 20 years[[12]](#footnote-13), it would also allow the ACMA to fix shorter periods.

### Assumptions regarding services provided by the NBN

Some submissions argued that there was an assumption in the HVU analysis that the NBN will address all regional broadband needs. These submissions noted that there are limitations to what the NBN can provide across different areas.

ACMA response

It was acknowledged in the HVU analysis that there is an unquantifiable cost in the cases where an incumbent licensees may discontinue service. The incremental costs will be the difference in economic welfare between the existing WISP service and the substitute internet service that customers use. However, in these cases, the incremental cost is not expected to have a material impact on the overall result of the HVU analysis.

# 4. ACMA decisions and preliminary views

Based on input to the Options paper and the resulting ACMA analysis, the ACMA has decided to progress the 3.6 GHz band to the re-farming stage of its [process for considering additional spectrum for mobile broadband services](http://www.acma.gov.au/Industry/Spectrum/Spectrum-projects/Mobile-broadband/mobile-broadband-strategy-and-work-plan). The approach is largely consistent with the preferred option outlined by the ACMA in the Options paper, but with some modest changes to reflect information gained during consultation and further consideration by the ACMA.

The ACMA will:

1. Consult on a recommendation to the minister[[13]](#footnote-14) (the re-allocation consultation), that, in accordance with section 153B of the Act, he make a re-allocation declaration for the issue of spectrum licences for the entire 3.6 GHz band in metropolitan and regional areas (that is, areas 1A, 1B, 2 and 3 as defined in Annex C) and apply the following re-allocation periods:

* two years in Adelaide, Brisbane, Canberra, Melbourne and Sydney (Area 1A)
* five years in Perth (Area 1B)
* seven years in ‘metro plus’ areas (Area 2)
* seven years in the rest of regional Australia (Area 3).

The re-allocation periods proposed in Area 1B, Area 2 and Area 3 are longer than have generally been used in the past (typically periods in the range of two to four years have been defined). They are intended as part of the mitigation strategy for incumbents.

1. As part of the re-allocation consultation, flag the option of excising areas around Moree, Quirindi and Roma as defined in Annex D, from being re-allocated. It is proposed that these areas be investigated as locations for potential east coast earth station protection zones in the 3.6 GHz band (and other commercial satellite bands). It is should be noted that commitment to these locations in regional Australia does not preclude investigation of possible locations outside those areas being recommended for re-allocation (for example, Bourke). If one or more of these areas are excised from the final recommendation to the minister, and pending a decision from the minister, suitable protection arrangements for the zones would be developed as part of any Technical Liaison Group (TLG) process for the 3.6 GHz band. In the event that one or more of these sites are found to be unsuitable, any protection criteria could be removed and options to make the areas available initially for the apparatus licensing of wide-area broadband services and possible eventual spectrum licensing, subject to a further re-allocation decision, could be investigated.[[14]](#footnote-15)
2. As part of the re-allocation consultation, flag the option of excising the area immediately surrounding the earth station facility at Uralla, New South Wales (represented by the Hierarchical Cell Identification Scheme (HCIS) identifier NU7K4 and displayed in Annex D) from being re-allocated. This would enable the earth station facility operated by Lockheed Martin to continue operating under apparatus-licenced arrangements. If this area is excised from the final recommendation to the minister, and pending a decision form the Minister, suitable protection criteria for the facility would be developed as part of any TLG process for the 3.6 GHz. Note, the long-term viability of this site may be reviewed in the future, given increasing international interest in the 3700–4200 MHz band for use by wide-area broadband services.
3. If the minister makes a re-allocation declaration in accordance with the proposed recommendation, proceed with the necessary steps to undertake a price-based allocation of spectrum licences in metropolitan and regional areas (that is, areas 1A, 1B, 2 and 3).
4. Establish site-based apparatus-licensed point-to-multipoint arrangements in the 5.6 GHz band in regional and remote Australia as part of the mitigation strategy to assist WISPs and other prospective site-based wireless broadband operators. The ACMA will adopt a policy position that the 5.6 GHz band should be made available for such licensing at least until the end of 2028. In addition to this, it will be ACMA policy that existing 3.6 GHz point-to-multipoint licensees in Area 2 and Area 3, be encouraged to apply for licences in the 5.6 GHz band and will be given preference in the ACMA’s consideration of such applications. The ACMA will work with industry to develop a process to guide its decision making when there is contention for these licences in areas where there are multiple licensees vying for access to the band.
5. Investigate the possibility of apparatus licensed point-to-multipoint arrangements in part of the 28 GHz band in regional Australia as another possible option to assist WISPs and other prospective site-based wireless broadband operators.

# 5. Next steps

To give effect to the decisions and preliminary views outlined in this paper, the ACMA plans to perform the work outlined in Table 1. The key items of work are described below:

1. Concurrently with the release of this paper, the ACMA has commenced consultation on a recommendation to the minster in accordance with section 153B of the Act. Following this consultation, and subject to any additional information obtained, the ACMA is currently minded to make a recommendation to the minister in accordance with section 153F of the Act.
2. Subject to a decision being made by the minister, the ACMA will commence processes to allocate the 3.6 GHz band. This will include establishing a TLG for the development of the technical framework for 3.6 GHz spectrum licences. A spectrum licence technical framework is the set of technical rules made by the ACMA for operation within specific band. Under the Act, the framework consists of three regulatory elements: conditions on the licence (including [licence core conditions](https://www.acma.gov.au/Industry/Spectrum/Radiocomms-licensing/Spectrum-licences/spectrum_24)), a determination of unacceptable interference for the purpose of [device registration](https://www.acma.gov.au/Industry/Spectrum/Radiocomms-licensing/Spectrum-licences/spectrum_22-1), and radiocommunications advisory guidelines. Additional technical planning and coordination rules may also be developed through a TLG to manage interference to and from spectrum licences.
3. Develop and consult on frequency assignment rules for coordinated apparatus-licensed point-to-multipoint use of the 5.6 GHz band outside of metropolitan areas (that is, areas 2 and 3). In parallel, develop and consult on mechanisms to facilitate existing 3.6 GHz point-to-multipoint licensees being given the opportunity to apply for licences in the 5.6 GHz band, before it is made available for general over-the-counter licence applications.
4. Investigate and consult on the possible development of coordinated apparatus-licensed point-to-multipoint use of some, or all, of the 28 GHz band outside of metropolitan areas.
5. Develop and consult on planning arrangements for east coast earth station zones. This will include the development of appropriate coordination arrangements as part of any TLG process for the 3.6 GHz band, with additional planning and frequency assignment rules developed as necessary.
6. Indicative timetable

| Key steps | Anticipated timings |
| --- | --- |
| The ACMA announces the outcomes of the *Future use of the 3.6 GHz band* consultation process.  The ACMA releases for public comment the terms of the draft re-allocation recommendation. | October 2017 |
| The ACMA gives to the Minister for Communications a recommendation to make a spectrum re-allocation declaration (contingent on outcomes of draft re-allocation recommendation consultation).  Initial consultation with industry on alternative spectrum options for site-based point-to-multipoint apparatus licences in regional Australia. | December 2017 |
| The minister makes a spectrum re-allocation declaration (contingent on receipt of a re-allocation recommendation from the ACMA).  The ACMA commences the TLG process to develop the 3.6 GHz band spectrum licence technical framework (assumes a re-allocation declaration is made). This would include developing coordination criteria for the proposed earth station protection zones in the 3.6 GHz band. | February 2018[[15]](#footnote-16) |
| The ACMA releases for public comment the auction rules, marketing plan and other technical instruments (this and subsequent steps assume a re-allocation declaration is in force). | June 2018 |
| The ACMA calls for applications to participate in the auction, and releases the applicant information package. | August 2018 |
| Auction commences. | October 2018 |

# Glossary

| **Term** | **Definition** |
| --- | --- |
| 1800 MHz band | Refers to the 1710–1785/1805–1880 MHz frequency range |
| 2 GHz band | Refers to the 1920–1980/2110–2170 MHz frequency range |
| 2.3 GHz band | Refers to the 2302–2400 MHz frequency range |
| 2.5 GHz band | Refers to the 2500–2570/2620–2690 MHz frequency range |
| 3.4 GHz spectrum licence band | Refers to the 3425–3492.5 MHz and 3542.5–3575 MHz frequency ranges |
| 3.5 GHz band | Refers to the 3400–3425 MHz and 3492.5–3542.5 MHz frequency ranges |
| 3.6 GHz band | Refers to the 3575–3700 MHz frequency range |
| 5.6 GHz band | Refers to the 5600–5650 MHz frequency range |
| 28 GHz band | Refers to the 27.5–29.5 GHz frequency range |
| 3GPP | **3rd Generation Partnership Project**  An international body responsible for the standardisation of (cellular) mobile (including broadband) telecommunications, including the 2G, 3G, 4G and (soon) 5G technology standards |
| (Spectrum or Service) Allocation | For the purposes of radiofrequency spectrum planning, an allocation is a specific range of frequencies allocated to use by one or more radiocommunications services within a band plan or spectrum plan. |
| Apparatus licence | An apparatus licence authorises, under the *Radiocommunications Act 1992*, the use of a radiocommunications device under a particular service type, in a particular frequency range and at a particular geographic location for a period of up to five years |
| ASMG | **Australian Spectrum Map Grid**  Used to define geographical areas over which spectrum licences are issued. The HCIS is used to define the cells that make up the ASMG. The ASMG is described in detail in the document [*The Australian spectrum map grid 2012*](http://archive.acma.gov.au/webwr/_assets/main/lib410188/australian_spectrum_map_grid_28feb2012.docx)  *See also* HCIS |
| Cellular network | A network of radiocommunications services distributed over land areas called cells. Each cell is serviced by a base station, each of which is interconnected via a core network. User devices connected to cellular networks can be seamlessly passed between cells  2G, 3G and 4G mobile networks are examples of cellular networks |
| Coordination | The process of assessing the interference potential existing licensed services and a proposed new service will have on each other. Coordination is deemed to fail if the level of interference exceeds the specified protection criteria for the services involved |
| Dead zone | An area where an operator is restricted from deploying a service. This is usually a result of emission limits leaving or entering a specified adjacent area or the need to manage interference with other services  For spectrum licences, dead zones relate to the area near the geographical boundary of the licence where limits on emissions leaving the area can restrict the deployment of services |
| Embargo | A spectrum embargo is a policy notice of intent by the ACMA to restrict the allocation of new licences in a particular frequency range to support replanning of that frequency range |
| FDD | **Frequency Division Duplex**  A technique where downlink and uplink communications can operate at the same time but are separated by the allocation of different frequency blocks. The frequency separation between these blocks is known as the FDD ‘split’ (e.g. the FDD split between mobile services operating in the 803–960 MHz band is 45 MHz) |
| Guard band | A frequency band that is either deliberately vacant or has specific operating conditions to minimise intra-band interference between the two bands on either side (analogous to a ‘buffer’) |
| HCIS | **Hierarchical Cell Identification Scheme**  A naming convention developed by the ACMA that applies unique ‘names’ to each of the cells of the ASMG. Each five-minute of arc square cell in the ASMG is assigned a unique identifier, derived from the cell’s position in a hierarchically arranged grouping of cells. The hierarchy has four levels. A detailed description of the HCIS is available on the [ACMA website](http://www.acma.gov.au/Industry/Spectrum/Spectrum-planning/Current-APs-info-and-resources/3-4-ghz-auction-2000-applicant-information-package)  *See also* ASMG |
| HVU | **Highest value use**  When applied to spectrum, is the use for which spectrum can provide the greatest incremental value to economic welfare. The value provided to the economy by spectrum is typically due to reduced costs for spectrum users to provide services, or the ability to provide new services that would not be possible without the use of particular spectrum |
| International spectrum harmonisation | The generally desirable outcome where radiocommunications services operate throughout the world in similar spectrum bands. Among other benefits, harmonisation facilitates lower-cost equipment through economies of scale |
| International Telecommunication Union (ITU) | A specialised agency of the United Nations that is responsible for issues that concern information and communication technologies. The ITU coordinates the shared global use of radio spectrum and assists in the development of spectrum harmonisation arrangements |
| LTE | **Long Term Evolution**  A 4th Generation 3GPP technology standard for [wireless](http://en.wikipedia.org/wiki/Wireless) communications including high-speed data for mobile devices |
| Mobile broadband (MBB) | The variety of ways an internet service is delivered via a mobile network, typically comprising mobile wireless internet services provided via a dongle, USB modem or data card service, or mobile phone handset internet services |
| MBB strategy | The ACMA has developed a [set of strategies](http://www.acma.gov.au/Industry/Spectrum/Spectrum-projects/Mobile-broadband/mobile-broadband-strategy-and-work-plan) to address the growth in demand for mobile broadband capacity. A key part of these strategies is the articulation of a spectrum management process for the release of additional spectrum for MBB |
| Principles for Spectrum Management | Developed by the ACMA to guide its approach to spectrum management. The key theme of the Principles is that maximising the overall public benefit from use of the radiofrequency spectrum requires balanced application of both regulatory and market mechanisms. Details of the Principles are available on the [ACMA website](http://www.acma.gov.au/theACMA/About/The-ACMA-story/Facilitating/decisionmaking-process-fyso-25-1) |
| RALI | **Radiocommunications Assignment and Licensing Instruction**  A technical document made by the ACMA that outlines frequency assignment and information pertaining to coordination and interference management |
| Re-allocation of spectrum | Under section 153B of the *Radiocommunications Act 1992*, the minster can re-allocate specific frequencies and areas for the issue of spectrum (or apparatus) licences. A result of this process is the cancellation of incumbent apparatus licences in the identified areas at the end of a defined timeframe known as the re‑allocation period |
| Re-allocation period | The period of time before incumbent apparatus licenses that fall wholly or partially within the frequencies and areas to be re-allocated under section 153B of the *Radiocommunications Act 1992* will be cancelled. The re‑allocation period is required to be a minimum of two years |
| Spectrum licence | Issued under the *Radiocommunications Act 1992* and authorises the use of a particular frequency band within a particular geographic area for a period of up to 15 years. The geographic area can vary in size, up to and including the entire country |
| Spectrum licence technical framework | The ACMA develops a technical framework for each spectrum licensed band that sets the terms by which a device may be deployed and operated under a licence. It is designed to manage interference to and from other spectrum users and consists of three interlocking regulatory elements:   1. the conditions specified on the spectrum licence, in particular, the core conditions that define the spectrum space (both frequency and geographical area) and the level of emissions permitted inside and across the frequency boundaries of the licence 2. a determination of unacceptable interference for the purpose of device registration in each band 3. radiocommunications advisory guidelines that provide assistance and advice for coordination with stations in other services when and where required |
| TDD | **Time Division Duplex**  A technique where downlink and uplink communications use the same frequency but are separated by the allocation of different slots. This means uplink and downlink communications cannot occur at the same time |
| TLG | **Technical Liaison Group**  A TLG is a short-term advisory body convened by the ACMA as the forum for consultation between the ACMA, industry and other stakeholders with interest in the technical aspects relating to the technical framework for a particular spectrum licence band. The task of the TLG is to consider and provide advice to the ACMA on technical aspects required for the development or review of a spectrum licence technical framework |
| TVRO | **Television receive-only systems**  Used to obtain satellite television services. The antennas for these systems are usually attached to the walls or roofs of homes and businesses |
| WISP | Wireless Internet Service Provider |

# Annex A—Submissions received

## All submissions

|  |  |  |
| --- | --- | --- |
| Australian Communications Consumer Action Network (ACCAN) |  | Jettech |
| Airspan Spectrum Holdings Limited |  | Lockheed Martin Corporation |
| Australian Mobile Telecommunications Association (AMTA) |  | Microsoft |
| Australian Subscription Television and Radio Association (ASTRA) |  | National farmers federation |
| Bureau of Meteorology |  | NBN Co Limited |
| Cambium Networks |  | New Skies Satellites Australia |
| Communications Alliance - Satellite Services Working Group |  | Nokia |
| Countrytell |  | Optus |
| DB Telecommunications |  | Qualcomm |
| Department of Defence |  | Ruckus |
| Digital Distribution Australia |  | TasmaNet Pty Ltd |
| Ericsson |  | Telstra |
| Global mobile Suppliers Association (GSA) |  | Vodafone |
| Global VSAT Forum (GSV) |  | Wi-Fi Alliance |
| Huawai |  | Wireless Institute of Australia (WIA) |
| IEEE 802 LAN/MAN Standards Committee |  | WISPAU |
| Inmarsat |  | World Without Wireless |
| Intel |  |  |

# Annex B—Highest value use amendments

The ACMA sought stakeholder feedback to the paper *Highest value use assessment—Quantitative analysis* (the HVU paper), which was part of the *Future use of the 3.6 GHz band* package*.* The purpose of this section is to outline the changes made to the analysis since the release of the original paper. These changes are derived from a variety of sources, including information provided by respondents in submissions, new information coming to light, and greater specificity of re-farming options.

The amendments to the HVU paper relate to specific sections of the paper. As such, these amendments will be divided into those for *Re-farming benefits* and those for *Incremental costs*, then tied together under *Net benefit* to determine the ultimate outcomes.

## Re-farming benefits

The ACMA has not changed the valuation range for broadband (including potential 5G) spectrum used to estimate re-farming benefits. The valuation range remains between $0.03/MHz/pop and $0.625/MHz/pop, although the ACMA notes that some submissions indicated that the upper bound of the range was too high. The table of inferred re-farming benefits based on these valuations, therefore remains as follows:

1. Benefit for cumulative areas if the 3.6 GHz band is re-farmed

|  | **Area 1[[16]](#footnote-17)** | **Area 1+2** | **Area 1+2+3** | **Australia-wide** |
| --- | --- | --- | --- | --- |
| Population | 16.1 million | 19.1 million | 22.8 million | 23.3 million |
| $/MHz/pop value | | | | |
| $0.03 | $60 million | $72 million | $86 million | $87 million |
| $0.05 | $101 million | $119 million | $143 million | $146 million |
| $0.10 | $201 million | $239 million | $285 million | $291 million |
| $0.25 | $503 million | $597 million | $713 million | $728 million |
| $0.50 | $1.0 billion | $1.2 billion | $1.4 billion | $1.5 billion |
| $0.625 | $1.3 billion | $1.5 billion | $1.8 billion | $1.8 billion |

Table 3 includes the same data as the Table 2, but outlines the marginal increases in re-farming benefits for each geographic area option.

1. Marginal expected benefit for each area if the 3.6 GHz band is re-farmed

|  | **Area 1** | **Area 2** | **Area 3** | **Australia-wide** |
| --- | --- | --- | --- | --- |
| $/MHz/pop value | | | | |
| $0.03 | $60 million | $11 million | $14 million | $2 million |
| $0.05 | $101 million | $19 million | $23 million | $3 million |
| $0.10 | $201 million | $38 million | $46 million | $6 million |
| $0.25 | $503 million | $94 million | $116 million | $16 million |
| $0.50 | $1.0 billion | $188 million | $231 million | $31 million |
| $0.625 | $1.3 billion | $234 million | $289 million | $39 million |

There were several submissions that focused on the potential economic benefits of 5G services, such as productivity and innovation benefits. The ACMA considers that these benefits were already referenced in the HVU paper.

Some 5G benefits are captured in the quantifiable valuations. Customers are expected to place a higher value on MBB services if they receive the full benefits of 5G, such as low latency and high data throughput rates. The higher value placed on services means that they would be willing to pay more for MBB services. The logical progression follows that MNOs would place a higher value on the spectrum if they can generate higher revenues from providing new or improved services.

It is not expected that MNOs will capture the total benefits of higher consumer valuations through price rises—consumers are expected to retain some of the benefits of their higher valuations for MBB services. This means there will be some additional unquantifiable economic benefits to consumers above the valuations of MNOs, which were previously considered in the HVU paper.

There were also positive externalities (for example, productivity increases) that fall under the consideration of unquantifiable broader social net benefits in the HVU paper. While these benefits have been considered, they remain unable to be appropriately quantified when isolated specifically to the 125 MHz available in the 3.6 GHz band. As such, the ACMA considers that there are no further amendments required to the HVU paper regarding the potential value of 3.6 GHz band spectrum.

The HVU paper also contained the potential effect on re-farming benefits of the hybrid approaches of Option 4a or Option 4b. The outcomes related to these hybrid approaches are outlined in further detail in the *Net benefit* section of this annex.

## Incremental costs

Stakeholder feedback has necessitated amendments to incremental cost calculations for both point-to-multipoint and FSS earth receive licensed services. There are also considerable cost reductions related to FSS earth receive licensees.

### Point-to-multipoint licences

Point-to-multipoint licensed services were divided into those held by WISPs and those held by non-WISP licensees in the HVU paper, as the circumstances for these different categories of licensees were likely to be substantially different. However, the options for all point-to-multipoint licensees were largely the same. Point-to-multipoint licensees could represent constant output cases if they either continued to use a spectrum set-aside in the 3.6 GHz band, migrated to an alternative band (such as the 5.6 GHz band), continued to operate in the 3.6 GHz band under agreement with the spectrum licensees or found other ways to deliver their services.

The ACMA has decided not to proceed with Option 4a (setting aside 25 MHz in the 3.6 GHz band), so there will not be any opportunity for point-to-multipoint licensees to simply retune equipment. In some cases, there will be an opportunity to replace equipment, as the ACMA has decided to make the 5.6 GHz band available for point-to-multipoint apparatus licence use outside of Area 1. There is a policy commitment to keep the 5.6 GHz band available for point-to-multipoint use for 10 years, which is slightly longer than the proposed re-allocation period for incumbents in the 3.6 GHz band in areas 2 and 3 (which is seven years).

The options for displaced point-to-multipoint licensed services remain either representing a constant output case by migrating to the 5.6 GHz band or possibly the 28 GHz band, or continuing operation in the 3.6 GHz band via a third-party authorisation, or representing a variable output case and potentially discontinuing service. It is not possible to say definitively what number of services, if any, are likely to be unable to continue delivering services after the end of the re-allocation period. Due to the limited bandwidth available in the 5.6 GHz band, it is unlikely that all incumbent licensees will be able to migrate into the band, although the ACMA considers that the other mitigation strategies are likely to limit the risk of consumer detriment flowing from the 3.6 GHz re-farming.

Wireless Internet Service Providers (WISPs)

Constant output cases were initially expected to occur if either the 5.6 GHz band or a set-aside in the 3.6 GHz band were available to incumbent licensees. The 5.6 GHz band will be available to incumbent licensees, with migration to this band estimated to result in average equipment replacement costs of $270,000 per licence. This amount will continue to be used as the quantifiable costs associated with the displacement of WISPs from the 3.6 GHz band, although if this migration occurs, it is unlikely to happen until the end of the extended re-allocation periods. The potential retuning costs that would result from migrating to a set-aside ($838 per licence) can be disregarded.

Several submissions from WISPs indicated a reluctance to migrate to the 5.6 GHz band, primarily due to the lack of bandwidth that would be available and interference potential in the 5.6 GHz band. It is expected that some WISPs will attempt to secure third-party authorisations from prospective spectrum licensees. This will enable them to represent constant output cases, with the incremental costs being the price that WISPs have to pay for the third-party authorisation over and above what they currently pay for 3.6 GHz spectrum. These costs are unquantifiable at this stage. In addition, the ACMA notes it is also considering the use of the 28 GHz band (27.5–29.5 GHz) for apparatus-licensed point-to-multipoint arrangements in regional Australia.

The incremental costs associated with variable output cases (if they are to occur) are not quantifiable, but refer to the potential loss of producer surplus, consumer surplus and broader social net benefits in comparison with a service that acts as a substitute for fixed wireless internet (for example, satellite internet services). The producer surplus loss for WISPs if they discontinue service is likely to be largely offset by the producer surplus gain for the alternative internet provider, as the alternative provider gains customers. The primary economic welfare loss is therefore likely to be the loss of consumer surplus, along with negative broader social effects.

Put simply, the loss of consumer surplus is the reduction in value between what consumers place on the alternative service and what they placed on their incumbent service. This value reduction is then combined across all affected consumers. The ACMA assumes that consumers have made rational welfare-maximising choices in using their incumbent service, which means that there would be a loss of consumer surplus in migrating away from a welfare-maximising service.

The ACMA is unable to quantify the difference in value between what consumers would place on an alternative internet service and what they would place on their incumbent service. However, the concerns can still be considered qualitatively. For regional internet users, the loss of WISP services has the potential to result in slower data throughput rates, less reliable connectivity and greater latency in their internet services. If this was to occur, it is likely to result in a reduction in value for consumers that place relatively high importance on their internet service, although the value differentials are likely to be highly variable between different consumers. In addition to the reduction in consumer surplus resulting from the discontinuation of particular services, a loss of positive externalities may also occur.

Extended re-allocation periods for incumbent point-to-multipoint licensees and the availability of the 5.6 GHz band and potentially the 28 GHz band, have the potential to help mitigate some of these unquantifiable costs. During the re-allocation period, the opportunity to expand services in the 5.6 GHz band could prevent some costs associated with the economic benefits forgone from restricting the expansion of WISPs. Following the re-allocation period, incumbent licensees will have had longer to determine how to provide services to their customers without the 3.6 GHz band, and the alternative services that are available to consumers could also be significantly improved, leading to a smaller economic welfare loss.

Non-WISP licensees

Non-WISP licensees will encounter similar issues to WISPs. There will remain the option to migrate to the 5.6 GHz band during the 10 years for which a policy commitment has been made for the band’s availability. The 5.6 GHz band may also continue to be available beyond the 10-year commitment. Equipment replacement costs are estimated to average $112,500 for each non-WISP licensee. Incumbent licensees that choose not to migrate to the 5.6 GHz band will incur unquantifiable costs. They will either represent a constant output case if their end output remains relatively unchanged or if they secure third-party authorisations with spectrum licensees, or they will represent a variable output case if their end output is changed due to the discontinued use of spectrum.

Overall incremental costs for point-to-multipoint services

The primary change for point-to-multipoint licensed services compared with the initial HVU analysis is that a set-aside in the 3.6 GHz band is no longer an option. The incremental cost tables outlined in the HVU paper can now remove any potential for equipment retuning costs, but equipment replacement costs can remain. Feedback from WISPs indicated a reluctance to migrate to the 5.6 GHz band, although this migration would not need to occur until after the proposed re-allocation period.

Stakeholders provided little information on the extent to which consumers would suffer a loss in economic welfare through the loss of fixed wireless broadband services provided by point-to-multipoint licensees (if it is to occur). It is possible that many consumers would be able to switch to another provider without much noticeable deterioration in the quality of their internet services. On the other hand, some users may strongly prefer point-to-multipoint fixed wireless broadband, and a switch to a non-preferred internet provider (for example, satellite internet services) would result in a loss in economic welfare. It should be noted that re-farming does not necessarily exclude point-to-multipoint licensees from using spectrum in the 3.6 GHz band. Licensees may be able to secure a third-party authorisation from spectrum licensees, or could consider forming a consortium to bid for regional licences at auction.

1. Incremental costs of displacing point-to-multipoint licences from the 3.6 GHz band for cumulative areas

|  |  | **Area 1** | **Area 1+2** | **Area 1+2+3** | **Australia-wide** |
| --- | --- | --- | --- | --- | --- |
| Quantifiable costs | **WISPs** | $0 | $0–23 million | $0–45 million | $0–47 million |
| **Non-WISP licensees** | $0 | $0–4 million | $0–14 million | $0–27 million |
| **Total costs** | **$0** | **$0–27 million** | **$0–59 million** | **$0–74 million** |
| Unquantifiable costs  (includes WISPs and non-WISP licensees) | Licensees that choose not to move to a different spectrum band are likely to incur unquantifiable costs. These would be a substitute for the quantifiable costs that would be incurred if licensees are able to move to a different spectrum band.   * Where licensees can maintain the same level of end output, they will be considered constant output cases—the incremental costs incurred will be the reduction in producer surplus resulting from increased supply costs. * Where licensees are unable to maintain the same level of output, they will be considered variable output cases, which (if it occurs) results primarily in loss in consumer welfare.   There may be a difference in costs between equipment in an alternative band and 3.6 GHz band equipment if the replacement of equipment occurs as a regular business cost (i.e., part of a regular equipment replacement cycle). | | | | |

*Note:* *Lower bound costs of zero, while unlikely, would occur if incumbents were able to secure access to the 3.6 GHz band via third party authorisation, or if they were able to time moving to the 5.6 GHz band with their equipment replacement cycle, and not incur additional equipment costs.*

### FSS earth receive licences

FSS earth receive licensed services were divided in the HVU paper by the licensee that held each licence. Metropolitan licensees included Telstra, Optus and Inmarsat, while regional licensees included Lockheed Martin and Atwood Oceanics Pacific.

Optus has indicated that it is transitioning all of its C-band FSS earth receive licences above 3700 MHz, which means that it will no longer be in the 3.6 GHz band. This removes one facility in Perth and one facility in Sydney from the incremental cost calculations, reducing incremental costs by $20–50 million for each facility. Optus also outlined that this process has occurred separately to this re-farming process. As such, there are no incremental costs to be applied to Optus’ licences.

Telstra indicated in its submission to the Options paper that its 3.6 GHz band FSS earth receive licences would be able to be retuned above 3700 MHz, and that this would be a significantly less costly exercise than geographic relocation. Similar to Optus, this also removes one facility in Perth and one facility in Sydney from the incremental cost calculations, again reducing incremental costs by $20–50 million for each facility. There may be some costs associated with retuning, but these will be unquantifiable and likely to be substantially lower than the previous ranges applied.

Inmarsat indicated that its previously stated cost range of $25–30 million is still valid for its own licences, and that there may be additional costs due to having to relocate other licensees at their Landsdale facility—assumed to be Telstra and Optus, each of which has indicated it will migrate out of the 3.6 GHz band. Therefore, the ACMA has not changed the incremental cost range for Inmarsat’s facilities, but is proposing an extended five-year re-allocation period for Perth to help mitigate costs for Inmarsat.

Lockheed Martin confirmed in its submission that the incremental costs associated with displacing their facility would exceed $20 million, but did not specify an alternative estimate. Therefore, the ACMA has retained the cost range for that facility.

Atwood Oceanics Pacific did not provide a submission. However, their offshore facility is located outside the preferred geographic area option of Area 3. As such, Atwood Oceanics’ access to the 3.6 GHz band will not be affected by the proposed re-farming option, and they will therefore incur no costs.

The results of stakeholder feedback have led to the following amended table of FSS earth receive incremental costs.

1. Incremental costs of displacing FSS earth receive licences from the 3.6 GHz band for cumulative areas

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | **Area 1** | **Area 1+2** | **Area 1+2+3** | **Australia-wide** |
| **Quantifiable costs** | **No. of licences** | 4 | 4 | 6 | 6 |
| **Incremental costs** | $25–30 million | $25–30 million | $45–80 million | $45–80 million |
| **Unquantifiable costs** | **No. of licences** | 11 | 11 | 11 | 13 |
| **Areas 1–3:** Telstra may incur some costs associated with retuning antennas to above 3700 MHz.  **Remote areas:** Atwood Oceanics Pacific is not expected to be able to relocate its offshore remote licences—the costs of discontinuing service for these FSS earth receive licences are unquantifiable. This unquantifiable cost is only relevant if the ACMA proceeds with Australia-wide spectrum licensing. If the ACMA only spectrum licences areas 1, 2 or 3, then Atwood Oceanics Pacific’s spectrum access is unaffected, and therefore they incur no costs. | | | | |

The marginal incremental costs in Table 6 below outlines the change in costs when the geographic area option is expanded. For instance, in Area 3 (excluding Area 2), the costs associated with Inmarsat’s facility in Area 1 are removed.

1. Marginal incremental costs of displacing FSS earth receive licences from the 3.6 GHz band for each area

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | **Area 1** | **Area 2** | **Area 3** | **Remote areas** |
| **Quantifiable costs** | **No. of licences** | 4 | 0 | 2 | 0 |
| **Incremental costs** | $25–30 million | $0 | $20–50 million | $0 |
| **Unquantifiable costs** | **No. of licences** | 11 | 0 | 0 | 2 |
| **Area 1:** Telstra may incur some costs associated with retuning above 3700 MHz.  **Remote areas:** Atwood Oceanics Pacific is not expected to be able to relocate its offshore remote licences—the costs of discontinuing service for these FSS earth receive licences are unquantifiable. This unquantifiable cost is only relevant if the ACMA proceeds with Australia-wide spectrum licensing. If the ACMA only spectrum licences areas 1, 2 or 3, then Atwood Oceanics Pacific’s spectrum access is unaffected, and therefore they incur no costs. | | | | |

### Point-to-point licences

There were two submissions that outlined that the increase in supply costs for point-to-point licensed services may be higher than the range indicated in the HVU paper. However, as no alternative estimates were provided, the cost range used in the HVU paper has been retained.

### Overall incremental costs

The changes to overall incremental costs can be summarised as follows:

* Option 4a (25 MHz set-aside for point-to-multipoint licensed services) has been removed from consideration, while the 5.6 GHz band has been made available for these services outside of Area 1 for at least 10 years, which is slightly longer than the re-allocation period for areas 2 and 3 (seven years). The ACMA is also considering the use of some of the 28 GHz band (27.5–29.5 GHz) for apparatus-licensed point-to-multipoint arrangements in regional Australia.
* Incremental costs for FSS earth receive licensees have fallen significantly due to Telstra and Optus indicating that they have the ability to retune equipment and migrate out of the 3.6 GHz band. The quantified costs for these two licensees are now zero with some additional unquantified costs.
* Optus indicated that they were transitioning their services out of the 3.6 GHz band irrespective of this re-allocation process.
* Telstra did not provide any cost estimates for retuning antennas.
* The only quantifiable costs associated with FSS earth receive licences are now for Inmarsat’s and Lockheed Martin’s facilities. It should be noted that the ACMA has decided to protect Lockheed Martin’s facility in Uralla, and therefore re-farming the 3.6 GHz band will not impose costs on this facility.

There is no change to incremental costs for point-to-point licensed services.

The result of these changes to incremental costs is the amended table below, which outlines a summary of all incremental costs.

1. Total incremental costs of displacing all incumbent licences from the 3.6 GHz band for cumulative areas

|  |  | **Area 1** | **Area 1+2** | **Area 1+2+3** | **Australia-wide** |
| --- | --- | --- | --- | --- | --- |
| Quantifiable costs | **Point-to-multipoint licences1** | $0 | $0–27 million | $0–59 million | $0–74 million |
| **FSS earth receive licences** | $25–30 million | $25–30 million | $45–80 million | $45–80 million |
| **Point-to-point licences** | $101,000–200,000 | $705,000–1 million | $2–5 million | $2–5 million |
| **Total** | $25–30 million | $26–59 million | $47–144 million | $47–159 million |
| Unquantifiable costs | **Point-to-multipoint licences** | If licensees are unable to relocate to a different spectrum band following the re-allocation period and output falls, then there will be an unquantified reduction in consumer surplus and a reduction in broader social net benefits. These unquantified costs would replace the quantifiable costs above. | | | |
| **FSS earth receive licences** | **Areas 1–3.** Telstra may incur some modest costs associated with retuning antennas to above 3700 MHz.  **Remote areas.** If the ACMA spectrum licences the band Australia-wide, thenAtwood Oceanics Pacific incurs an unquantifiable cost. However, if spectrum licensing only applies to area 1, 2 or 3, then Atwood Oceanics Pacific’s access to spectrum is unaffected, and they incur no costs as a result of re-farming. | | | |

1 *Lower bound costs of zero, while unlikely, would occur if incumbents were able to secure access to the 3.6 GHz band via third-party authorisation, or if they were able to time moving to the 5.6 GHz band with their equipment replacement cycle, and not incur additional equipment costs.*

The number of point-to-multipoint licences affected by re-farming is:

* 122 licences in Area 2, including 87 WISP and 35 non-WISP licences
* 171 licences in Area 3, including 80 WISP and 91 non-WISP licences

120 licences in remote areas, including seven WISP and 113 non-WISP licences.

Table 8 outlines the marginal increases in quantifiable incremental costs if the geographic area is expanded.

1. Marginal quantifiable incremental costs of displacing all incumbent licences from the 3.6 GHz band for each area

|  | **Area 1** | **Area 2** | **Area 3** | **Remote areas** |
| --- | --- | --- | --- | --- |
| Point-to-multipoint licences | $0 | $0–27 million | $0–32 million | $0–15 million |
| FSS earth receive licences | $25–30 million | $0 | $20–50 million | $0 |
| Point-to-point licences | $101,000–200,000 | $604,000–800,000 | $1,295,000–4 million | $0 |
| Total | $25–30 million | $1–29 million | $21–85 million | $0–15 million |

## Net benefit

The net benefit outlines the difference between re-farming benefits and incremental costs. Area-wide spectrum licensing will be considered the highest value use of the 3.6 GHz band if re-farming benefits are likely to exceed incremental costs, making the re-farming process net beneficial.

### Overall net benefit analysis

The original HVU paper outlined that area-wide spectrum licensing extended to Area 3 would be the highest value use. Stakeholder feedback has led to there being no change in the consideration of re-farming benefits, but some change in the consideration of incremental costs.

Incremental costs have primarily been reduced due to the feedback in submissions—this is particularly the case for FSS earth receive licensed services. The range of options for incumbent point-to-multipoint licensed services has expanded slightly to either migrating to the 5.6 GHz band and possibly the 28 GHz band, securing third-party authorisations or becoming a variable output case. The unquantifiable costs in variable output cases primarily relate to the loss of economic welfare that may occur if WISPs are unable to continue services.

Collating all re-farming benefits and incremental costs data points following the consultation process has led to the following amended summary table.

1. Summary of economic benefits and incremental costs of re-farming the 3.6 GHz band for cumulative areas

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | **Re-farming benefits**  **($0.03–$0.625/MHz/pop)** | **Incremental costs** |
| **Quantifiable** | **Area 1** | $60 million–1.3 billion | $25–30 million |
| **Area 1+2** | $72 million–1.5 billion | $26–59 million |
| **Area 1+2+3** | $86 million–1.8 billion | $47–144 million |
| **Australia-wide** | $87 million–1.8 billion | $47–159 million |
| **Unquantifiable** | **Addition to quantifiable** | Additional consumer and broader social net benefits are likely to result from the availability of 5G services via the 3.6 GHz band, which would increase economic welfare. | **FSS earth receive (Area 1).** Telstra may incur some modest costs associated with retuning services above 3700 MHz. |
| **Substitute to quantifiable** | N/A | **Point-to-multipoint.** If licensees are unable to relocate to a different spectrum band, then there may be a reduction in consumer surplus and in broader social net benefits.  **FSS earth receive (remote areas).** If the 3.6 GHz band is spectrum licensed Australia-wide, then Atwood Oceanics Pacific would lose access to spectrum, and these consequential costs have not been estimated. However, this cost does not apply if the band is spectrum licensed in area 1, 2 or 3. |

Note: The unquantifiable costs related to Atwood Oceanics Pacific, along with $20 −50 million of quantifiable costs for Lockheed Martin’s FSS earth receive licence in Area 3 and Australia-wide, can be disregarded when comparing benefits and costs. Both facilities will not be displaced from the 3.6 GHz band.

It should be noted that there are no licensed point-to-multipoint services located in Area 1. When determining whether re-farming would be net beneficial, the incremental costs associated with displacing point-to-multipoint services should therefore only be compared with the increase in re-farming benefits due to extending re-farming from Area 1 to areas 2–3. The change in quantified costs and benefits when expanding the geographic area are detailed in the table below.

1. Summary of marginal quantifiable economic benefits and incremental costs of re-farming the 3.6 GHz band for each area

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | **Re-farming benefits**  **($0.03–$0.625/MHz/pop)** | **Incremental costs** |
| **Quantifiable** | **Area 1** | $60 million–1.3 billion | $25–30 million |
| **Area 2** | $11–234 million | $604,000–29 million |
| **Area 3** | $14–289 million | $22–85 million |
| **Remote areas** | $2–39 million | $0–15 million |

As there is strong evidence of re-farming benefits exceeding incremental costs in Area 1, the primary point of contention is therefore whether re-farming should extend out to either Area 2 or Area 3. The incremental re-farming benefits from expanding re-allocation to these areas needs to exceed the incremental costs that would be incurred in these areas for there to be a case for re-farming. This primarily refers to incremental costs for point-to-multipoint licences, as Lockheed Martin’s FSS earth receive licence in Area 3 is going to be protected.

If Area 2 was retained for site-based apparatus licensing, the licence boundaries separating it with Area 1 spectrum licences would create ‘dead zones’ in relatively populous areas. This could substantially reduce the re-farming benefits of spectrum licensing in Area 1. The marginal increase when expanding spectrum licensing from Area 1 to Area 2 is therefore significantly greater than the figures outlined in Table 10, as the full benefits of re-allocating Area 1 could only be realised by also re-allocating Area 2. The ACMA therefore believes there is a strong case for re-farming extending to Area 2.

In considering the potential quantifiable re-farming benefits available when expanding the re-farming area to Area 3, the loss of economic welfare resulting from the 80 WISP licences potentially being displaced from the 3.6 GHz band would need to be substantial. While there is some potential for unquantifiable costs to be incurred due to the displacement of incumbent point-to-multipoint licensees, the ACMA expects that the potential re-farming benefits exceed the potential incremental costs in this region. The ACMA notes that the extended re-allocation period, the availability of alternative spectrum in the 5.6 GHz band and possibly the 28 GHz, and the potential ability to continue accessing the band via third-party authorisation arrangements will provide incumbents with opportunities to continue providing services. The ACMA considers that these mitigation strategies are likely to limit the materiality of the unquantifiable costs of the re-farming of the 3.6 GHz band. This provides the ACMA with confidence that re-farming would be net beneficial in Area 3.

Therefore the ACMA concludes that area-wide spectrum licensing is the highest value use of the 3.6 GHz band in areas 1, 2 and 3.

### Hybrid approaches

The analysis of hybrid approaches in the HVU paper attempted to determine whether there were methods by which economic welfare derived from the 3.6 GHz band could be maximised beyond simply re-farming for area-wide spectrum licensing.

Option 4a

Option 4a considered setting aside 25 MHz in the 3.6 GHz band for point-to-multipoint licensed services. Stakeholder feedback indicates that this is not enough bandwidth to allow for competitive WISP services, while a set-aside would also considerably reduce the value of the band for area-wide spectrum licensing. This option is no longer being considered and can be disregarded as part of the HVU analysis.

Option 4b

Option 4b considered protecting FSS earth receive services. These included metropolitan facilities in Perth and Sydney, along with a regional facility in Uralla and a remote offshore facility. Option 4b would be pursued if the reduction in incremental costs resulting from protecting these facilities exceeded the loss of re-farming benefits from area-wide spectrum licensing extending to a smaller portion of the population.

With regard to the metropolitan facilities, stakeholder feedback has indicated that Telstra and Optus’ facilities in Sydney and Perth would not have to be relocated, leading to a reduction in incremental costs of between $80 million and $200 million. The comparison table has therefore been amended as follows:

1. Analysis of re-farming benefits and incremental costs of protecting FSS earth receive licence locations in the 3.6 GHz band

|  |  | **Reduction in re-farming benefits** | | **Reduction in incremental costs** |
| --- | --- | --- | --- | --- |
|  |  | Macro-cell case | Small cell case |
| Quantifiable | **Sydney** | $8–168 million | $0.2–5 million | $0 |
| **Perth** | $8–161 million | $3–67 million | $25–30 million |
| **Total** | $16–329 million | $3–72 million | $25–30 million |
| Unquantifiable | **Total** | Additional consumer surplus and broader social net benefits would be forgone if the band is not re‑farmed. | Additional consumer surplus and broader social net benefits would be forgone if the band is not re-farmed.  There would be a substantial reduction in the value of the spectrum if it is restricted to small cell use only (rather than if it was unrestricted). | Inmarsat could retune its antennas or discontinue their FSS earth receive services. Retuning costs are unknown, while discontinuation costs would be the loss of economic welfare in moving to an alternative service. These costs would replace the quantifiable costs. |

Note 1: Quantifiable ranges refer to the reduction in re-farming benefits based on $/MHz/pop valuations between a lower bound of $0.03/MHz/pop and an upper bound of $0.625/MHz/pop for 15-year licences.

Note 2: The maximum reduction in re-farming benefits in the small cell case, including both quantifiable and unquantifiable costs, is equal to the maximum reduction in re-farming benefits in the macro-cell case.

Stakeholder feedback also indicated that there would be a substantial difference in the value of spectrum with use restricted to small cells versus that of the same spectrum with unrestricted use. This would make the reduction in re-farming benefits in the small cell case similar in magnitude to the macro-cell case. As such, the ACMA expects that the reduction in re-farming benefits is likely to exceed the reduction in incremental costs in both cities under this hybrid approach.

Lockheed Martin’s regional facility in Uralla will be protected from interference, as it is estimated that the incremental costs of displacing this facility from the 3.6 GHz band would exceed the benefits of re-faming in the areas surrounding the facility. Atwood Oceanics Pacific’s remote offshore facility will be unaffected, as re-farming is not proposed for remote areas.

# Annex C—Description of areas proposed for re-farming

The ACMA has defined four geographical area for replanning in the 3.6 GHz band. These areas are defined in Table 12 and displayed in Figure 1. It is noted that the ACMA is also considering excising four small areas from the definition of areas 2 and 3 in this Annex. These proposed excise areas are defined in Annex D. The areas defined in Table 12 with relevant areas from Annex D excised is displayed in Figure 2.

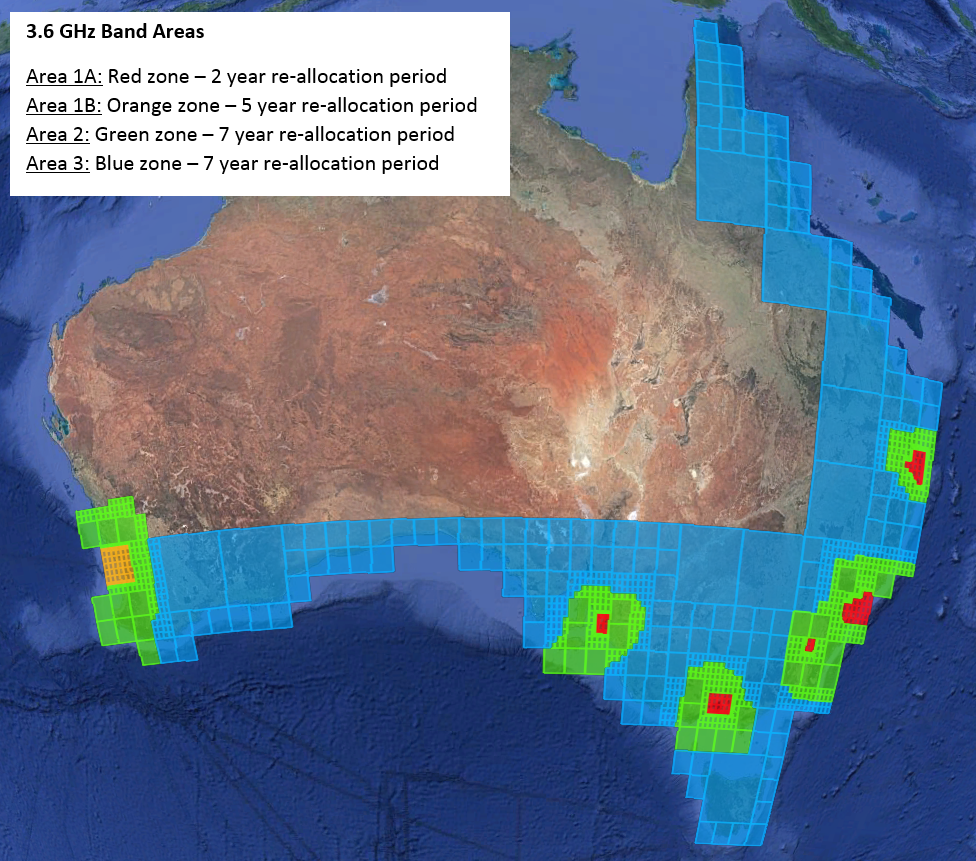
It is further noted that:

* in this paper, the combination of Area 1A and Area 1B is also referred to as Area 1

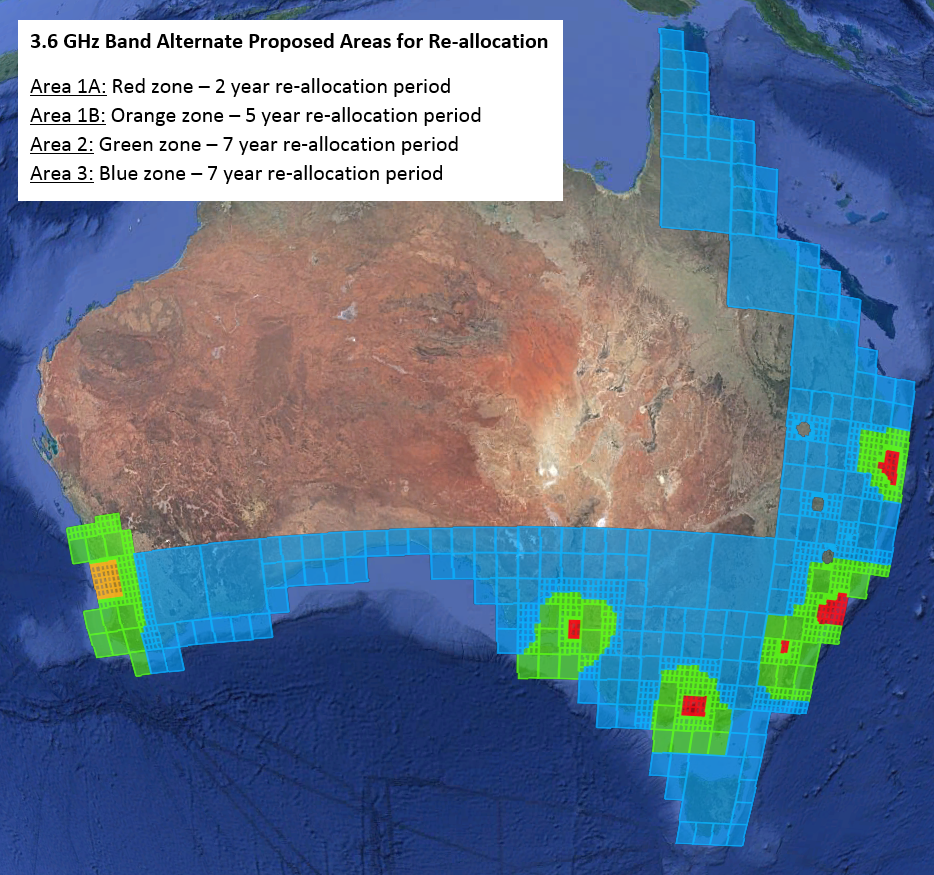
the Australian Spectrum Map Grid (ASMG) is used to define geographical areas over which spectrum licences are issued. The Hierarchical Cell Identification Scheme (HCIS) is a naming convention developed by the ACMA that applies unique ‘names’ to each of the cells that make up the ASMG. The ASMG and HCIS are described in detail in the document, [*The Australian spectrum map grid 2012*](http://www.acma.gov.au/Industry/Spectrum/Spectrum-planning/About-spectrum-planning/technical-framework-3_4-ghz).

The HCIS coordinates in Table 12 can be converted into a Placemark file (viewable in Google Earth) through a facility on the ACMA website: [www.acma.gov.au/theACMA/convert-hcis-area-description-to-a-placemark](http://www.acma.gov.au/theACMA/convert-hcis-area-description-to-a-placemark)

1. 3.6 GHz band geographical areas proposed for re-farming without excised areas



1. 3.6 GHz band geographical areas proposed for re-farming with excised areas



1. HCIS description of proposed re-farming areas without excised areas

| Area | Sub-area name | HCIS |
| --- | --- | --- |
| Area 1A | Adelaide | IW3O, IW3P, IW6C, IW6D, IW3J5, IW3J6, IW3J8, IW3J9, IW3K4, IW3K5, IW3K6, IW3K7, IW3K8, IW3K9, IW3L4, IW3L5, IW3L6, IW3L7, IW3L8, IW3L9, IW3N2, IW3N3, IW3N5, IW3N6, IW3N8, IW3N9, IW6B2, IW6B3, IW6B5, IW6B6, IW6B8, IW6B9, IW6F2, IW6F3, IW6F5, IW6F6, IW6G1, IW6G2, IW6G3, IW6G4, IW6G5, IW6G6, IW6H1, IW6H2, IW6H3, IW6H4, IW6H5, IW6H6 |
| Brisbane | NT8K, NT8L, NT9A, NT9B, NT9E, NT9F, NT9I, NT9J, NT9M, NT9N, NU3B, NT5P8, NT5P9, NT6M7, NT6M8, NT6M9, NT6N7, NT6N8, NT6N9, NT6O7, NT6O8, NT8D2, NT8D3, NT8D5, NT8D6, NT8D8, NT8D9, NT8G7, NT8G8, NT8G9, NT8H2, NT8H3, NT8H5, NT8H6, NT8H7, NT8H8, NT8H9, NT8P1, NT8P2, NT8P3, NT8P4, NT8P5, NT8P6, NT9C1, NT9C2, NT9C4, NT9C5, NT9C7, NT9C8, NT9G1, NT9G2, NT9G4, NT9G5, NT9G7, NT9G8, NT9K1, NT9K2, NT9K4, NT9K5, NT9K7, NT9K8, NT9O1, NT9O2, NT9O4, NT9O5, NT9O7, NT9O8, NU3A2, NU3A3, NU3A5, NU3A6, NU3C1, NU3C2, NU3C4, NU3C5, NU3C7, NU3C8, NU3F1, NU3F2, NU3F3, NU3G1, NU3G2 |
| Canberra | MW4D3, MW4D6, MW4D9, MW4H3, MW4H6, MW4H9, MW4L3, MW5A, MW5B1, MW5B2, MW5B4, MW5B5, MW5B7, MW5B8, MW5E, MW5F1, MW5F2, MW5F4, MW5F5, MW5F7, MW5F8, MW5I1, MW5I2, MW5I3, MW5J1, MW5J2 |
| Melbourne | KX3J, KX3K, KX3L, KX3N, KX3O, KX3P, KX6B, KX6C, KX6D, LX1I, LX1J, LX1M, LX1N, LX4A, LX4B, KX6F1, KX6F2, KX6F3, KX6F4, KX6F5, KX6F6, KX6G1, KX6G2, KX6G3, KX6G4, KX6G5, KX6G6, KX6H1, KX6H2, KX6H3, KX6H4, KX6H5, KX6H6, LX1K1, LX1K4, LX1K7, LX1O1, LX1O4, LX1O7, LX4C1, LX4C4, LX4C7, LX4E1, LX4E2, LX4E3, LX4E4, LX4E5, LX4E6, LX4F1, LX4F2, LX4F3, LX4F4, LX4F5, LX4F6, LX4G1, LX4G4 |
| Sydney | MV9K, MV9L, MV9O, MV9P, MW3D, NV7C, NV7D, NV7E, NV7F, NV7G, NV7H, NV7I, NV7J, NV7K, NV7L, NV7M, NV7N, NV7O, NV7P, NW1A, NW1B, NW1C, NW1D, MV9D9, MV9G7, MV9G8, MV9G9, MV9H3, MV9H6, MV9H7, MV9H8, MV9H9, MW3C2, MW3C3, MW3C5, MW3C6, MW3C9, NV4N6, NV4N9, NV4O4, NV4O5, NV4O6, NV4O7, NV4O8, NV4O9, NV4P4, NV4P5, NV4P6, NV4P7, NV4P8, NV4P9, NV7A7, NV7A8, NV7A9, NV7B3, NV7B6, NV7B7, NV7B8, NV7B9 |
| Area 1B | Perth | BV1E, BV1F, BV1G, BV1H, BV1I, BV1J, BV1K, BV1L, BV1M, BV1N, BV1O, BV1P, BV2E, BV2F, BV2I, BV2J, BV2M, BV2N, BV4A, BV4B, BV4C, BV4D, BV4E, BV4F, BV4G, BV4H, BV5A, BV5B, BV5E, BV5F, BV1A4, BV1A5, BV1A6, BV1A7, BV1A8, BV1A9, BV1B4, BV1B5, BV1B6, BV1B7, BV1B8, BV1B9, BV1C4, BV1C5, BV1C6, BV1C7, BV1C8, BV1C9, BV1D4, BV1D5, BV1D6, BV1D7, BV1D8, BV1D9, BV2A4, BV2A5, BV2A6, BV2A7, BV2A8, BV2A9, BV2B4, BV2B5, BV2B6, BV2B7, BV2B8, BV2B9, BV4I1, BV4I2, BV4I3, BV4I4, BV4I5, BV4I6, BV4J1, BV4J2, BV4J3, BV4J4, BV4J5, BV4J6, BV4K1, BV4K2, BV4K3, BV4K4, BV4K5, BV4K6, BV4L1, BV4L2, BV4L3, BV4L4, BV4L5, BV4L6, BV5I1, BV5I2, BV5I3, BV5I4, BV5I5, BV5I6, BV5J1, BV5J2, BV5J3, BV5J4, BV5J5, BV5J6 |
| Area 2 | Adelaide metro plus | IW2, IW5, IW7, IW8, IW9, JW1, JW4, IV8K, IV8L, IV8N, IV8O, IV8P, IV9I, IV9J, IV9K, IV9L, IV9M, IV9N, IV9O, IV9P, IW1P, IW3A, IW3B, IW3C, IW3D, IW3E, IW3F, IW3G, IW3H, IW3I, IW3M, IW4D, IW4H, IW4K, IW4L, IW4N, IW4O, IW4P, IW6A, IW6E, IW6I, IW6J, IW6K, IW6L, IW6M, IW6N, IW6O, IW6P, JV7M, JV7N, JV7O, JV7P, JV8M, JW2A, JW2B, JW2E, JW2F, JW2G, JW2I, JW2J, JW2K, JW2M, JW2N, JW2O, JW5A, JW5B, JW5C, JW5E, JW5F, JW5I, JW5J, JW5M, JW7A, JW7B, JW7C, JW7D, JW7E, JW7F, JW7G, JW7I, IW3J1, IW3J2, IW3J3, IW3J4, IW3J7, IW3K1, IW3K2, IW3K3, IW3L1, IW3L2, IW3L3, IW3N1, IW3N4, IW3N7, IW6B1, IW6B4, IW6B7, IW6F1, IW6F4, IW6F7, IW6F8, IW6F9, IW6G7, IW6G8, IW6G9, IW6H7, IW6H8, IW6H9 |
| Brisbane metro plus | NT4G, NT4H, NT4K, NT4L, NT4O, NT4P, NT5D, NT5E, NT5F, NT5G, NT5H, NT5I, NT5J, NT5K, NT5L, NT5M, NT5N, NT5O, NT6A, NT6B, NT6C, NT6D, NT6E, NT6F, NT6G, NT6H, NT6I, NT6J, NT6K, NT6L, NT6P, NT7C, NT7D, NT7G, NT7H, NT7K, NT7L, NT7O, NT7P, NT8A, NT8B, NT8C, NT8E, NT8F, NT8I, NT8J, NT8M, NT8N, NT8O, NT9D, NT9H, NT9L, NT9P, NU2B, NU2C, NU2D, NU2F, NU2G, NU2H, NU2L, NU3D, NU3E, NU3H, NU3I, NU3J, NU3K, NU3L, NU3M, NU3N, NU3O, NU3P, NT5P1, NT5P2, NT5P3, NT5P4, NT5P5, NT5P6, NT5P7, NT6M1, NT6M2, NT6M3, NT6M4, NT6M5, NT6M6, NT6N1, NT6N2, NT6N3, NT6N4, NT6N5, NT6N6, NT6O1, NT6O2, NT6O3, NT6O4, NT6O5, NT6O6, NT6O9, NT8D1, NT8D4, NT8D7, NT8G1, NT8G2, NT8G3, NT8G4, NT8G5, NT8G6, NT8H1, NT8H4, NT8P7, NT8P8, NT8P9, NT9C3, NT9C6, NT9C9, NT9G3, NT9G6, NT9G9, NT9K3, NT9K6, NT9K9, NT9O3, NT9O6, NT9O9, NU3A1, NU3A4, NU3A7, NU3A8, NU3A9, NU3C3, NU3C6, NU3C9, NU3F4, NU3F5, NU3F6, NU3F7, NU3F8, NU3F9, NU3G3, NU3G4, NU3G5, NU3G6, NU3G7, NU3G8, NU3G9 |
| Canberra/ Sydney metro plus | MV6, MW1, MW2, MW6, MW7, MW8, MW9, NV5, MV2P, MV3L,, MV3M, MV3O, MV3P, MV3N, MV5D, MV5H, MV5L, MV5P, MV8D, MV8H, MV8J, MV8K, MV8L, MV8N, MV8O, MV8P, MV9A, MV9B, MV9C, MV9E, MV9F, MV9I, MV9J, MV9M, MV9N, MW3A, MW3B, MW3E, MW3F, MW3G, MW3H, MW3I, MW3J, MW3K, MW3L, MW3M, MW3N, MW3O, MW3P, MW4A, MW4B, MW4C, MW4E, MW4F, MW4G, MW4I, MW4J, MW4K, MW4M, MW4N, MW4O, MW4P, MW5C, MW5D, MW5G, MW5H, MW5K, MW5L, MW5M, MW5N, MW5O, MW5P, MX1C, MX1D, MX1H, MX2A, MX2B, MX2C, MX2D, MX2E, MX2F, MX2G, MX2H, MX3A, MX3B, MX3C, MX3D, MX3E, MX3F, MX3G, MX3H, NV1I, NV1J, NV1K, NV1L, NV1M, NV1N, NV1O, NV1P, NV2I, NV2J, NV2K, NV2L, NV2M, NV2N, NV2O, NV2P, NV3I, NV3J, NV3K, NV3L, NV3M, NV3N, NV3O, NV3P, NV4A, NV4B, NV4C, NV4D, NV4E, NV4F, NV4G, NV4H, NV4I, NV4J, NV4K, NV4L, NV4M, NW1E, NW1F, NW1G, NW1H, NW1I, NW1J, NW1K, NW1L, NW1M, NW1N, NW1O, NW1P, MV9D1, MV9D2, MV9D3, MV9D4, MV9D5, MV9D6, MV9D7, MV9D8, MV9G1, MV9G2, MV9G3, MV9G4, MV9G5, MV9G6, MV9H1, MV9H2, MV9H4, MV9H5, MW3C1, MW3C4, MW3C7, MW3C8, MW4D1, MW4D2, MW4D4, MW4D5, MW4D7, MW4D8, MW4H1, MW4H2, MW4H4, MW4H5, MW4H7, MW4H8, MW4L1, MW4L2, MW4L4, MW4L5, MW4L6, MW4L7, MW4L8, MW4L9, MW5B3, MW5B6, MW5B9, MW5F3, MW5F6, MW5F9, MW5I4, MW5I5, MW5I6, MW5I7, MW5I8, MW5I9, MW5J3, MW5J4, MW5J5, MW5J6, MW5J7, MW5J8, MW5J9, NV4N1, NV4N2, NV4N3, NV4N4, NV4N5, NV4N7, NV4N8, NV4O1, NV4O2, NV4O3, NV4P1, NV4P2, NV4P3, NV7A1, NV7A2, NV7A3, NV7A4, NV7A5, NV7A6, NV7B1, NV7B2, NV7B4, NV7B5 |
| Melbourne metro plus | KX2, KX5, KX8, KX9, LX5, LX7, LX8, KW8H, KW8I, KW8J, KW8K, KW8L, KW8M, KW8N, KW8O, KW8P, KW9E, KW9F, KW9G, KW9H, KW9I, KW9J, KW9K, KW9L, KW9M, KW9N, KW9O, KW9P, KX1P, KX3A, KX3B, KX3C, KX3D, KX3E, KX3F, KX3G, KX3H, KX3I, KX3M, KX4D, KX4H, KX4L, KX4P, KX6A, KX6E, KX6I, KX6J, KX6K, KX6L, KX6M, KX6N, KX6O, KX6P, LW7I, LW7J, LW7M, LW7N, LW7O, LW7P, LX1A, LX1B, LX1C, LX1D, LX1E, LX1F, LX1G, LX1H, LX1L, LX1P, LX2E, LX2I, LX2M, LX2N, LX2O, LX4D, LX4H, LX4I, LX4J, LX4K, LX4L, LX4M, LX4N, LX4O, LX4P, KX6F7, KX6F8, KX6F9, KX6G7, KX6G8, KX6G9, KX6H7, KX6H8, KX6H9, LX1K2, LX1K3, LX1K5, LX1K6, LX1K8, LX1K9, LX1O2, LX1O3, LX1O5, LX1O6, LX1O8, LX1O9, LX4C2, LX4C3, LX4C5, LX4C6, LX4C8, LX4C9, LX4E7, LX4E8, LX4E9, LX4F7, LX4F8, LX4F9, LX4G2, LX4G3, LX4G5, LX4G6, LX4G7, LX4G8, LX4G9 |
| Perth metro plus | AU9, AV9, AW3, BU7, BU8, BV7, BV8, BW1, BW2, BW5, AU6I, AU6J, AU6K, AU6L, AU6M, AU6N, AU6O, AU6P, BU4H, BU4I, BU4J, BU4K, BU4L, BU4M, BU4N, BU4O, BU4P, BU5E, BU5F, BU5G, BU5H, BU5I, BU5J, BU5K, BU5L, BU5M, BU5N, BU5O, BU5P, BU9A, BU9B, BU9E, BU9F, BU9I, BU9J, BU9M, BU9N, BV2C, BV2D, BV2G, BV2H, BV2K, BV2L, BV2O, BV2P, BV3A, BV3B, BV3E, BV3F, BV3I, BV3J, BV3M, BV3N, BV4M, BV4N, BV4O, BV4P, BV5C, BV5D, BV5G, BV5H, BV5K, BV5L, BV5M, BV5N, BV5O, BV5P, BV6A, BV6B, BV6E, BV6F, BV6I, BV6J, BV6M, BV6N, BV9A, BV9B, BV9E, BV9F, BV9I, BV9J, BV9M, BV9N, BW3A, BV1A1, BV1A2, BV1A3, BV1B1, BV1B2, BV1B3, BV1C1, BV1C2, BV1C3, BV1D1, BV1D2, BV1D3, BV2A1, BV2A2, BV2A3, BV2B1, BV2B2, BV2B3, BV4I7, BV4I8, BV4I9, BV4J7, BV4J8, BV4J9, BV4K7, BV4K8, BV4K9, BV4L7, BV4L8, BV4L9, BV5I7, BV5I8, BV5I9, BV5J7, BV5J8, BV5J9 |
| Area 3 | Regional Australia | CV, DV, KQ, KV, LR, LV, LY, MS, MT, MU, BW6, CW1, CW2, CW3, CW4, DW1, DW2, DW3, EV1, EV2, EV3, EV4, EV5, EV6, EV7, FV1, FV2, FV3, FV4, FV5, GV1, GV2, GV3, GV6, HV1, HV2, HV3, HV4, HV5, HV6, HV8, HV9, HW3, HW6, IV1, IV2, IV3, IV4, IV5, IV6, IV7, JV1, JV2, JV3, JV4, JV5, JV6, JV9, JW3, JW6, JW8, JW9, JX1, JX2, JX3, JX5, JX6, KO1, KO4, KO5, KO7, KO8, KP1, KP2, KP4, KP5, KP6, KP7, KP8, KP9, KW1, KW2, KW3, KW4, KW5, KW6, KW7, KY2, KY3, KY6, LP4, LP7, LQ1, LQ2, LQ4, LQ5, LQ7, LQ8, LW1, LW2, LW3, LW4, LW5, LW6, LW8, LW9, LX3, LX6, LX9, LZ1, LZ2, LZ3, MR1, MR4, MR5, MR7, MR8, MR9, MV1, MV4, MV7, MX4, MX7, MY1, MY4, MY7, MZ1, NS4, NS7, NS8, NS9, NT1, NT2, NT3, NU1, NU4, NU5, NU6, NU7, NU8, NU9, BV3C, BV3D, BV3G, BV3H, BV3K, BV3L, BV3O, BV3P, BV6C, BV6D, BV6G, BV6H, BV6K, BV6L, BV6O, BV6P, BV9C, BV9D, BV9G, BV9H, BV9K, BV9L, BV9O, BV9P, BW3B, BW3C, BW3D, BW3E, BW3F, BW3G, BW3H, BW3I, BW3J, BW3K, BW3L, BW3M, BW3N, BW3O, BW3P, IV8A, IV8B, IV8C, IV8D, IV8E, IV8F, IV8G, IV8H, IV8I, IV8J, IV8M, IV9A, IV9B, IV9C, IV9D, IV9E, IV9F, IV9G, IV9H, IW1A, IW1B, IW1C, IW1D, IW1E, IW1F, IW1G, IW1H, IW1I, IW1J, IW1K, IW1L, IW1M, IW1N, IW1O, IW4A, IW4B, IW4C, IW4E, IW4F, IW4G, IW4I, IW4J, IW4M, JV7A, JV7B, JV7C, JV7D, JV7E, JV7F, JV7G, JV7H, JV7I, JV7J, JV7K, JV7L, JV8A, JV8B, JV8C, JV8D, JV8E, JV8F, JV8G, JV8H, JV8I, JV8J, JV8K, JV8L, JV8N, JV8O, JV8P, JW2C, JW2D, JW2H, JW2L, JW2P, JW5D, JW5G, JW5H, JW5K, JW5L, JW5N, JW5O, JW5P, JW7H, JW7J, JW7K, JW7L, JW7M, JW7N, JW7O, JW7P, KW8A, KW8B, KW8C, KW8D, KW8E, KW8F, KW8G, KW9A, KW9B, KW9C, KW9D, KX1A, KX1B, KX1C, KX1D, KX1E, KX1F, KX1G, KX1H, KX1I, KX1J, KX1K, KX1L, KX1M, KX1N, KX1O, KX4A, KX4B, KX4C, KX4E, KX4F, KX4G, KX4I, KX4J, KX4K, KX4M, KX4N, KX4O, LW7A, LW7B, LW7C, LW7D, LW7E, LW7F, LW7G, LW7H, LW7K, LW7L, LX2A, LX2B, LX2C, LX2D, LX2F, LX2G, LX2H, LX2J, LX2K, LX2L, LX2P, MV2A, MV2B, MV2C, MV2D, MV2E, MV2F, MV2G, MV2H, MV2I, MV2J, MV2K, MV2L, MV2M, MV2N, MV2O, MV3A, MV3B, MV3C, MV3D, MV3E, MV3F, MV3G, MV3H, MV3I, MV3J, MV3K, MV5A, MV5B, MV5C, MV5E, MV5F, MV5G, MV5I, MV5J, MV5K, MV5M, MV5N, MV5O, MV8A, MV8B, MV8C, MV8E, MV8F, MV8G, MV8I, MV8M, MX1A, MX1B, MX1E, MX1F, MX1G, MX1I, MX1J, MX1K, MX1L, MX1M, MX1N, MX1O, MX1P, MX2I, MX2J, MX2K, MX2L, MX2M, MX2N, MX2O, MX2P, MX3I, MX3J, MX3K, MX3L, MX3M, MX3N, MX3O, MX3P, NT4A, NT4B, NT4C, NT4D, NT4E, NT4F, NT4I, NT4J, NT4M, NT4N, NT5A, NT5B, NT5C, NT7A, NT7B, NT7E, NT7F, NT7I, NT7J, NT7M, NT7N, NU2A, NU2E, NU2I, NU2J, NU2K, NU2M, NU2N, NU2O, NU2P, NV1A, NV1B, NV1C, NV1D, NV1E, NV1F, NV1G, NV1H, NV2A, NV2B, NV2C, NV2D, NV2E, NV2F, NV2G, NV2H, NV3A, NV3B, NV3C, NV3D, NV3E, NV3F, NV3G, NV3H |

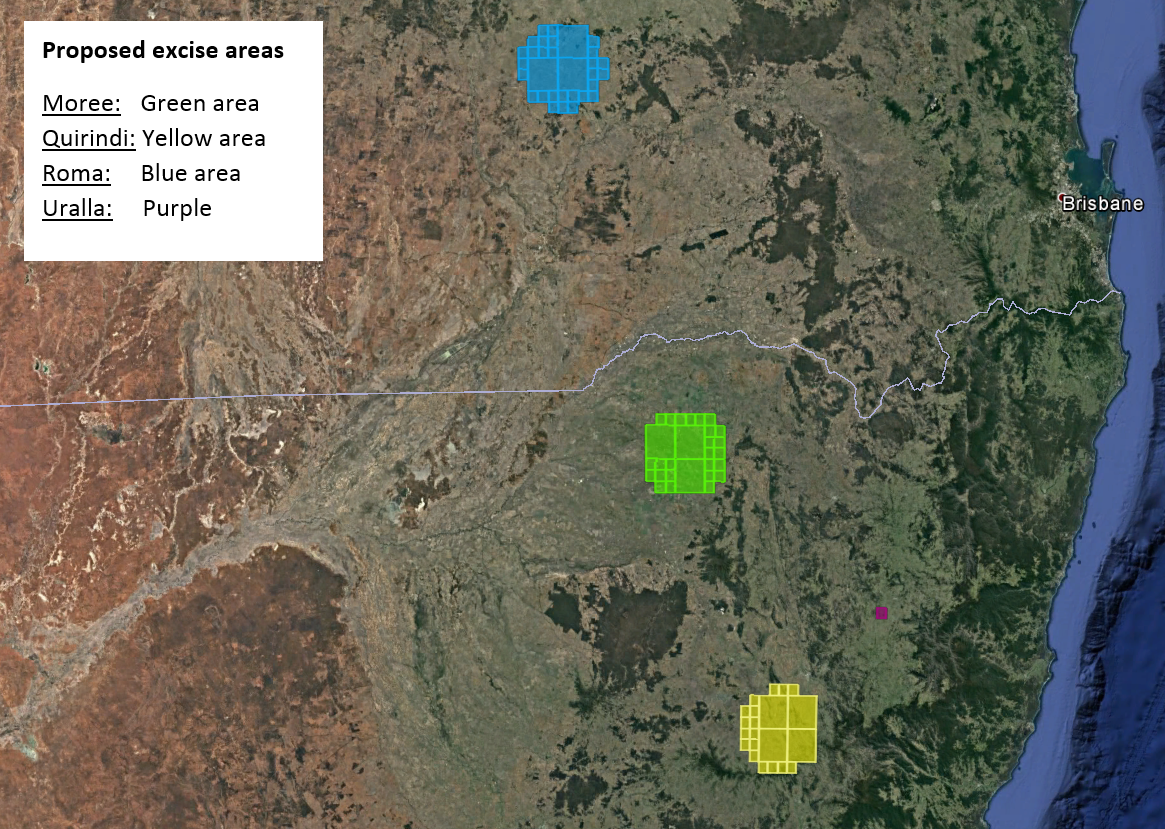
# Annex D—Proposed excise areas

The ACMA is also considering excising the areas defined in this annex from the areas proposed for re-farming in Annex C. These excised areas could be used to assist in the identification of one or more potential east coast earth station protection zone(s) and to support the ongoing use of the 3.6 GHz band by the FSS earth station facility near Uralla. The proposed areas are defined in Table 13 and displayed in Figure 3.

Note that the Australian Spectrum Map Grid (ASMG) is used to define geographical areas over which spectrum licences are issued. The Hierarchical Cell Identification Scheme (HCIS) is a naming convention developed by the ACMA that applies unique ‘names’ to each of the cells that make up the ASMG. The ASMG and HCIS are described in detail in the document [*The Australian spectrum map grid 2012*](http://www.acma.gov.au/Industry/Spectrum/Spectrum-planning/About-spectrum-planning/technical-framework-3_4-ghz).

The HCIS coordinates in Table 13 can be converted into a Placemark file (viewable in Google Earth) through a facility on the ACMA website: [www.acma.gov.au/theACMA/convert-hcis-area-description-to-a-placemark](http://www.acma.gov.au/theACMA/convert-hcis-area-description-to-a-placemark)

1. Proposed excise areas



1. HCIS description of proposed excise areas

| Area name | HCIS |
| --- | --- |
| Moree | MU5G, MU5H, MU5L, MU5C8, MU5C9, MU5D7, MU5D8, MU5D9, MU5K1, MU5K2, MU5K3, MU5K4, MU5K5, MU5K6, MU5K8, MU5K9, MU6A7, MU6E1, MU6E2, MU6E4, MU6E5, MU6E7, MU6E8, MU6I1, MU6I2, MU6I4, MU6I5, MU6I7 |
| Quirindi | MV3G, MV3H, MV3K, MV3L, MV3C8, MV3C9, MV3D7, MV3F3, MV3F5, MV3F6, MV3F8, MV3F9, MV3J2, MV3J3, MV3J5, MV3J6, MV3J9, MV3O1, MV3O2, MV3O3, MV3P1 |
| Roma | MT4H, MT4K, MT4L, MT4F9, MT4G2, MT4G3, MT4G4, MT4G5, MT4G6, MT4G7, MT4G8, MT4G9, MT4J3, MT4J6, MT4O1, MT4O2, MT4O3, MT4O6, MT4P1, MT4P2, MT4P3, MT4P4, MT4P5, MT5E4, MT5E7, MT5I1, MT5I2, MT5I4, MT5I5, MT5I7, MT5M1 |
| Uralla | NU7K4 |

1. A map and definitions of these areas is included at Annex C. [↑](#footnote-ref-2)
2. *US is ‘the outlier on 3.5 GHz’, according to Qualcomm technical standard boss*, Policy Tracker September 2017. [↑](#footnote-ref-3)
3. *FCC Moves to Promote Investment in the 3.5 GHz Band*, <https://www.fcc.gov/document/fcc-moves-promote-investment-35-ghz-band>. [↑](#footnote-ref-4)
4. As per section 153G of the Act, formal consultation with affected apparatus licensees is required before making a recommendation to the minister. The recommendation to the minister is made under section 153F of the Act. [↑](#footnote-ref-5)
5. It is noted a re-allocation process may not be required under the outcomes proposed in the Spectrum Review. [↑](#footnote-ref-6)
6. In the spectrum market, bidders exhibit increasing returns to scale across small portions of spectrum. For example, it is well understood that bidders value, say, 10 MHz of spectrum at more than double 5 MHz. [↑](#footnote-ref-7)
7. A Neutral Host is an entity that deploys and manages specific network systems (for example, base stations or distributed antenna systems) and then leases access to one or more other operators wishing to deploy services in a specific area, building or location. [↑](#footnote-ref-8)
8. Qualcomm, [*Making 5G NR a reality: Leading the technology inventions for a unified, more capable 5G air interface*](https://www.google.com.au/url?sa=t&rct=j&q=&esrc=s&source=web&cd=6&cad=rja&uact=8&ved=0ahUKEwjv-a_ZysHUAhXIGJQKHRWJCXMQFgg9MAU&url=https%3A%2F%2Fwww.qualcomm.com%2Fmedia%2Fdocuments%2Ffiles%2Fqualcomm-5g-vision-presentation.pdf&usg=AFQjCNEiUSNnoJOnJIaLb1qB454-TsDCjA), December 2016. [↑](#footnote-ref-9)
9. In this paper, Area 1 is represented by the combination of Area 1A and Area 1B, as defined in Annex C. [↑](#footnote-ref-10)
10. Qualcomm, [*Making 5G NR a reality: Leading the technology inventions for a unified, more capable 5G air interface*](https://www.google.com.au/url?sa=t&rct=j&q=&esrc=s&source=web&cd=6&cad=rja&uact=8&ved=0ahUKEwjv-a_ZysHUAhXIGJQKHRWJCXMQFgg9MAU&url=https%3A%2F%2Fwww.qualcomm.com%2Fmedia%2Fdocuments%2Ffiles%2Fqualcomm-5g-vision-presentation.pdf&usg=AFQjCNEiUSNnoJOnJIaLb1qB454-TsDCjA), December 2016. [↑](#footnote-ref-11)
11. In this paper, Area 1 is represented by the combination of Area 1A and Area 1B, as defined in Annex C. [↑](#footnote-ref-12)
12. Department of Communications and the Arts, [Radiocommunications Bill 2017: a platform for the future](https://www.communications.gov.au/file/26981/download?token=Ens8e53e), May 2017, page 15. [↑](#footnote-ref-13)
13. As per section 153G of the Act, formal consultation with affected apparatus licensees is required before making a recommendation to the minister. The recommendation to the minister is made under section 153F of the Act. [↑](#footnote-ref-14)
14. It is noted a re-allocation process may not be required under the outcomes proposed in the Spectrum Review. [↑](#footnote-ref-15)
15. Under section 153E of the Act, the minister has 180 days after receiving the ACMA’s recommendation to make a spectrum reallocation declaration. [↑](#footnote-ref-16)
16. In this paper, Area 1 is represented by the combination of Area 1A and Area 1B, as defined in Annex C. [↑](#footnote-ref-17)