



Submission in response to
ACMA Options paper

Wireless Broadband in the 26 GHz band

Public Version

November 2018

CONTENTS

Section 1.	Executive Summary	3
Section 2.	Background	4
Appendix A:	Urban Site Density	9
Appendix B:	Regional Mobile Infrastructure Density	12

Section 1. Executive Summary

- 1.1 Optus welcomes the opportunity to provide a response to the Australian Communications and Media Authority (ACMA) Options Paper, Wireless Broadband in the 26 GHz band (Options Paper).
- 1.2 The purpose of the Options Paper is to determine the quantity of spectrum to be allocated in the 26 GHz band and appropriate licensing arrangements to meet forecast demand via defined use cases.
- 1.3 Optus' views are provided from the perspective of both a mobile and satellite network operator. That is, Optus has an interest in seeking future allocations in the 26 GHz band for 5G use and seeking future allocations in the 27.0 to 27.5 GHz band for satellite uplinks from Optus' Gateway Earth Stations and Teleports.
- 1.4 Optus considers that the 'three-type model' constitutes an appropriate high-level representation of potential future use of the 26 GHz band and should be referenced to assess demand.
- 1.5 Optus considers that the proposed Option 2d is the only viable option.
- 1.6 Class licencing should not be considered as a licensing type in the 26 GHz band until 5G systems have been deployed. Class licencing creates challenges for interference monitoring, management and enforcement.
- 1.7 Optus supports a 700 MHz guard band for outdoor deployments at the bottom of the band (to protect Earth Exploration Satellite Services (EESS)) rather than the current 1.5GHz guard band due to Australia's lower population and forecast network density and improvements in filters with IMT-2020 evolution.
- 1.8 Optus supports the lower boundary at 24.7GHz and the upper boundary at 27.5GHz for outdoor deployments. Optus considers low power indoor deployments could be made in 24.25 to 24.7 GHz with suitable licence conditions determined via TLG consultation.
- 1.9 An allocation of 2.8 GHz of bandwidth in the 26GHz band (24.7 – 27.5GHz) following the CEPT recommendation of 200 MHz lots should enable up to 800 MHz per licence and support allocations for three to four licensees.
- 1.10 Optus agrees with the ACMA's view that 27 to 27.5 GHz at the top of the band can co-exist with IMT-2020 systems and that this spectrum be included in the allocation to avoid fragmenting the band and disconnecting it from 28 GHz.
- 1.11 Optus supports the ACMA accelerating the initial investigation and preliminary planning phases. However, once quantity and proposed licensing arrangements are settled, we support a delay in allocation and the issue of scientific licences for a set period to test use cases. The inclusion of this additional step will provide critical and currently unknown input to the development of the technical framework to apply to licences issued in the 26 GHz band. This will ensure 26GHz allocations are viable for 5G investment while co-existing with EESS below 24 GHz.
- 1.12 Optus suggest the ACMA also foreshadow how 26 GHz allocations would be deployed and/or transitioned under a new Radiocommunications Act.
- 1.13 Optus supports the submission made by the Australian Mobile Telecommunications Association (AMTA).

Section 2. Background

Question One: Does the three-type model constitute an appropriate high-level representation of potential usage of the 26 GHz band? If not, are there any use cases that should be included, excluded or omitted?

- 2.1 Optus considers that the three-type model (*type one: wide area mobile networks; type two: fixed wireless access; type three: private deployments/private premises*) constitutes an appropriate high-level representation of potential use of the 26 GHz band.
- 2.2 Optus suggests that these use categories be referenced to assess demand for 26 GHz, noting that there is no current evidence of demand for type three use.
- 2.3 Optus notes that:
 - (a) the three-type model needs to acknowledge that mobile network operators will concurrently deploy both type one and type two networks in the 26 GHz band.
 - (b) use types aren't 'set and forget' and should be tested over time as 5G use cases in the 26 GHz band evolve.

Question Two: What are the implications for 26 GHz wireless broadband in Australia of the Electronic Communication Committee of CEPT (ECC) decision on emission limits to protect passive EESS?

Summary

- 2.4 It is Optus' view that emission limits currently selected by CEPT(ECC) will make the 26 GHz band unviable for 5G in Australia. It is critical that sufficient usable bandwidth is available to unlock the full potential for 5G services. These bandwidths are only available in the mmWave bands.
- 2.5 26 GHz is a particularly important as:
 - (a) it is the pioneer mmWave band;
 - (b) it is located at the bottom of the range of mmWave frequencies being considered globally; and
 - (c) has existing low utilisation.
- 2.6 Optus suggests the emission limits for the 26 GHz band should be scaled based on Australia's low population and infrastructure density, compared to Europe.
- 2.7 Optus agrees with the ACMA's view that 27 to 27.5 GHz at the top of the band can co-exist with IMT-2020 systems and this spectrum should be included in the allocation to avoid fragmenting the band and disconnecting it from 28 GHz.
- 2.8 The ACMA must allocate sufficient 26 GHz spectrum for a suitable mmWave ecosystem to be developed and sufficient investment to occur.
- 2.9 Optus proposes that the 26 GHz band be added to the Earth Station Protection Zone (ESPZ) areas and that Satellite licences can be added to existing Teleports with proper coordination.

Lower Boundary

- 2.10 In terms of EESS protection, applying CEPT(ECC) limits at the bottom of the band could make the band unusable for 5G as 1.5GHz guard band leaves 1GHz, between 26.5-27.5 GHz available. It is expected that 5G will use 800 MHz per operator in order to realise the full benefits of the technology.
- 2.11 From vendor responses, Optus can advise that recommended protection values for EESS protection are in the range:
- (a) BS: -32 to -37 dBW/200 MHz
 - (b) UE: -28 to -30 dBW/200 MHz
- 2.12 Optus considers the following values are appropriate for Australia: BS: -32 dBW/200MHz and UE: -30 dBW/200MHz.
- 2.13 Optus notes the size of the guard band also depends on device density and filter performance as well as protection value.
- 2.14 **Appendix A** provides an example of city density scaling. It is based on an extensive study in TG5-1 in Greater London that could be adapted for use in Greater Sydney if adjusted for lower population and infrastructure density. For an IMT-2020 network, the infrastructure density would follow the population density in urban areas.
- 2.15 When Australian population and site density analysis is taken into account, the guard band could be between 500MHz and 1GHz depending on equipment filters. These filters will improve as and when mmWave for 5G ecosystem develop.
- 2.16 Optus supports the AMTA proposal for a 700 MHz guard band at the bottom the band (to protect EESS satellites) rather than the CEPT(ECC)1.5 GHz guard band to accommodate Australia's lower site and population density and expected improvements in filters with IMT-2020 evolution.

Upper Boundary

- 2.17 For the upper boundary of the 26 GHz band (27 to 27.5GHz), Optus agrees that detailed co-existence measures can be addressed via the Technical Liaison Group (TLG) processes. For example, coordination zones for Satellite (including Optus satellite). This will include consideration of international work in 27-27.5 GHz co-existence arrangements.
- 2.18 Local regulations and coordination should be used to manage the low number of fixed incumbents in the 26 GHz band.
- 2.19 The WRC-19 agenda item 1.13 ITU-R 5/1 studies referred to in the Options Paper at Appendix 1 are robust and show a high level of protection margin for Fixed Satellite Services (FSS) in 27 to 27.5 GHz. Even if changes to the assumptions lowered the protection margin by 20dB or more, the conclusion of the studies is that co-existence is possible and would still be valid.
- 2.20 It is Optus' view that 27 to 27.5 GHz should not be separated out as coexistence with incumbents is possible. 27 to 27.5 GHz should be included in the 26 GHz band allocation to avoid fragmenting the band and disconnecting it from 28GHz.
- 2.21 Optus does not support the use of class licences in the 26 GHz band as it removes visibility of device use. This is critical for both other licensees and the ACMA when

attempting to monitor, manage and enforce interference. Class licence conditions are effectively unenforceable.

- 2.22 As an alternate, in the frequency range 24.25 to 24.7 GHz, Optus proposes the use of low powered spectrum licences for indoor use.

Question Three: Are the proposed defined geographic areas for wide-area licensing appropriate?

- 2.23 Optus supports the proposed defined regional geographic areas for wide-area spectrum licencing but considers these should be expanded into additional 'metro-like' regional areas with existing high levels of deployed infrastructure.
- 2.24 **Appendix B** provides suggestions and sample maps of regional areas with existing 'metro like' infrastructure density that should be considered for wide-area spectrum licensing. The density analysis is calculated from inter-site distances as this provides a more accurate infrastructure density measure than simply counting sites in arbitrarily sized areas.
- 2.25 The identified areas have attracted additional investment to meet demand and support both permanent and itinerant populations, for example, mining, regional universities and tourism. Optus suggestions for additional locations are:
- (a) Holiday areas of Nowra, Jervis Bay, Byron Bay/Ballina, Foster/Tuncurry, Albany WA, Margaret River;
 - (b) Major Regional Centres: Coffs Harbour, Port Macquarie, Bundaberg, Mackay, Cairns, Traralgon, Warrnambool, Victor Harbour, Bunbury;
 - (c) University Campuses: Bathurst, Armidale, Lismore, Wagga Wagga.

Question Four: What is the expected proliferation of—or demand for—services deployed under type 2 (apparatus-licensed) and/or 3 (class-licensed) models?

- 2.26 Optus expects demand for type 2 deployments e.g. fixed wireless will also come from type 1 operators.
- 2.27 Optus is not aware of any evidence of demand for type 3 users in the 26 GHz band and considers that limited allocations could be managed via apparatus licence with special conditions to protect the primary use of the band for 5G services. Specific licence conditions attached to such apparatus licences will need to be addressed as part of TLG consultations.

Question Five: Comment is sought on preferred option(s) for configuring and licensing the 26 GHz band.

- 2.28 It is Optus' view that Option 2d is the only viable option. That is, spectrum licensing of the whole available band in metro and major regional centres, with site and area based apparatus licences issued outside the spectrum licenced areas for wireless broadband and mobile broadband deployments.
- 2.29 Optus' support for Option 2d is on the basis that it delivers on key spectrum management principles. That is, highest value use and ensuring 26 GHz spectrum is efficiently allocated to support 5G deployments.

- 3.1 Optus does not support class licence allocations in the 26 GHz band. A voluntary registration scheme of class licenced devices is not practical since it is incomplete and cannot be enforced. It is critical that the licensing regime used for 26 GHz provides future mobile network licence holders and the ACMA with visibility of device deployments.
- 3.2 Optus supports a single licensee for each range of frequencies in an area.
- 3.3 An allocation of 2.8GHz bandwidth in the 26GHz band (24.7 – 27.5GHz) following the CEPT recommendation of 200 MHz lots should enable up to 800 MHz per licensee and support allocations for three to four licensees.
- 3.4 Optus agrees with the ACMA's view that 27 to 27.5 GHz at the top of the band can co-exist with IMT-2020 systems and this spectrum should be included in the allocation to avoid fragmenting the band and disconnecting it from the 28 GHz band.
- 3.5 Segmenting the band by frequency into spectrum and apparatus licences will create artificial boundaries. Optus suggests the band should be partitioned based on a geographic basis. That is, metropolitan and major regional areas.
- 3.6 Optus supports the proposed defined regional geographic areas for wide-area spectrum licencing but considers these should be expanded into additional 'metro-like' regional areas with existing high levels of deployed infrastructure. This includes mining, regional universities and regional holiday locations that experience seasonal peaks in network demand. Please see **Appendix A** for further details.
- 3.7 Optus disagrees with the ACMA's assumption that in-door areas will not need spectrum or apparatus licences on the basis that:
- (a) 80% of mobile network demand is and will continue to be in-door;
 - (b) Both mobile and fixed wireless technologies will be deployed in the 26GHz band, with significant investment in indoor cells and outdoor infrastructure; and
 - (c) Co-existence between outdoor and indoor devices and services within the band will need to be managed via spectrum or apparatus licences.

Question Six: If options 3 or 5 (all variants) are preferred, how much of the band should be available for spectrum licensing and apparatus licensing?

- 3.8 Optus does not support options 3 or 5.

Question Seven: If options 4 or 5 (all variants) are preferred, how much of the band should be available for class licensing?

- 3.9 Optus does not support options 4 or 5.
- 3.10 Class licencing should not be considered in the 26 GHz band until 5G systems have been deployed.
- 3.11 There is no evidence to demonstrate that special conditions applied to class licences can be properly monitored or enforced. Also, there are no studies that prove the benefits of device deployments including that co-existence is viable.
- 3.12 In response to consultation on the draft *Radiocommunications (Body Scanning – Aviation Security) Class Licence 2018* Optus and AMTA have foreshadowed significant concerns about the impact on interference management of the proposed change from apparatus to class licencing for body scanners at airports in the 26GHz band.

- 3.13 In summary, the proposed licensing change will restrict the ability for adjacent licenses to either know in advance the potential location of interference prior to deployment or effectively manage the cause of interference.

Question Eight: If options 4 or 5 (all variants) are preferred, what conditions should be applied to a class licence to protect co-frequency spectrum-licensed operations (in defined areas)? Would it be appropriate to define a means of making class-licensed use visible (for example, through a form of voluntary device registration)?

- 3.14 Optus does not support options 4 or 5.

Question Nine: Are there any other replanning options that should be considered?

- 3.15 Optus does not consider any other re-planning options should be considered.

Question Ten: Is there likely to be sufficient demand for type 1 services in regional centres outside metropolitan areas, and if so, what centres (either explicitly listed or by population threshold) should be included in the expanded licence areas?

- 3.16 Yes. Optus has indicated a number of 'metro like' regional areas with existing high levels of infrastructure are deployed. This includes regional holiday locations that experience seasonal peaks in demand as well as significant industry and educational institutions located in regional areas.

- 3.17 Optus expects to provide both type 1 and type 2 deployments in regional areas.

Additional Commentary: co-existence between new allocations in the 26GHz band and incumbent satellite use

- 3.18 Optus provides the following commentary and observations in relation to co-existence between new mobile broadband and fixed wireless access allocations in the 26GHz band and incumbent satellite use for the ACMA's consideration.
- 3.19 While Optus Satellite does not object to the 27.0 to 27.5 GHz band being used for IMT in Australia, it wants to retain access in the 27.0 to 27.5 GHz for satellite uplinks for the use of Gateway Earth Stations/Teleports which would be co-ordinated and licensed on a case by case basis. This access could relate to accessing existing or future non-Optus satellites or providing Gateways for future Optus Ka band satellites.
- 3.20 All Optus existing Teleports (*at Belrose and Oxford Falls NSW, Hume ACT, Regency Park SA and Lockridge WA*) are located within the area shown in Figure 4 of the Options Paper where the ACMA is considering designating in the 26 GHz band for IMT. The possibility of these teleports to be apparatus licensed for use in 27.0 to 27.5 GHz for satellite uplink services should be considered.
- 3.21 Optus considers further research is needed, both internationally and domestically, to determine the optimum sharing arrangements between IMT and satellite earth stations in the 27.0 to 27.5 GHz band.
- 3.22 Any sharing arrangements between satellite earth stations and terrestrial services in the 27.0 to 27.5 GHz band may need to also consider the possibility of operation with non-geo-stationary satellites.
- 3.23 Although the regions being considered for IMT in Options Paper does not cover any of the areas being considered for existing or possible future Earth Station Protection Zones (ESPZ), Optus believes that should the 26 GHz coverage area be extended, then the ESPZ areas should be excised from any IMT use.

Appendix A: Urban Site Density

Overview

- The diagrams below illustrate urban site density areas modelled by ITU-R in Greater London and Greater Sydney. They provide evidence that Australia has a significantly lower infrastructure and device density than used in the ITU-R studies.
- Based on this comparison, the interference to passive satellite services will be less than in the ITU-R studies and some scaling of the ITU-R study results should be applied for Australian spectrum considerations in the 26 GHz band.
- The methodology for such scaling should include both the differences in population and the difference in urban vs suburban mix.
- The ACMA's proposed 'Density Adjustment Factor' of 2.7dB does include both factors, however the scaling factor may be still on the low side when assessed against the data below comparing the two cities.

Greater London vs Greater Sydney

- Greater London encompasses a total area of 1,583 square kilometres (611 sq miles), an area which had a population of 7,172,036 in 2001 and a population density of 4,542 inhabitants per square kilometre.



Figure 1: Population Density of Greater London

- Greater Sydney has a total area of 12,367.7 sq. km, the current population density of the area is 407 persons per sq. km which includes a number of surrounding national parks. The built urban area is estimated at 4,064 square kilometres which translates to a density of 1,237 persons per square kilometre.
- Sydney Inner Metro Area (1866 sq. km): yellow = major roads, mainly suburban.

Table 1: Inner Metro Sydney Analysis

Morphology		Metro Boundary	
Category	Surface (km ²)	Percentage	
sea (excluded*)	142.682	7.6	
inland water (excluded*)	47.3996	2.5	
wetland (excluded*)	0	0	
barren	125.2056	6.7	
grass-agriculture	237.4292	12.7	
rangeland	121.8124	6.5	
woodland	237.726	12.7	
forest	197.3988	10.6	
village	2.4324	0.1	
suburban	560.0588	30	
dense suburban	1.3064	0.1	
urban	15.7476	0.8	
dense urban	2.2456	0.1	
core urban	0.4936	0	
building blocks	7.0664	0.4	
industrial	97.192	5.2	
airport	0.614	0	
open in urban	69.0744	3.7	
Total Service area (km ²)*	1,675.80		
Dense Urban	2.2456	0.13%	
Urban	16.2412	0.97%	
Suburban	668.67	39.90%	
Suburban inCar	988.6464	59.00%	

Note:

* excludes areas not targeted for mobile coverage e.g. sea and water.

^^ Calculated for different radii around existing sites and tight Metro boundary.

% Clutter mapped to Morphology by using Bell Labs report and Optus mobile network site density.

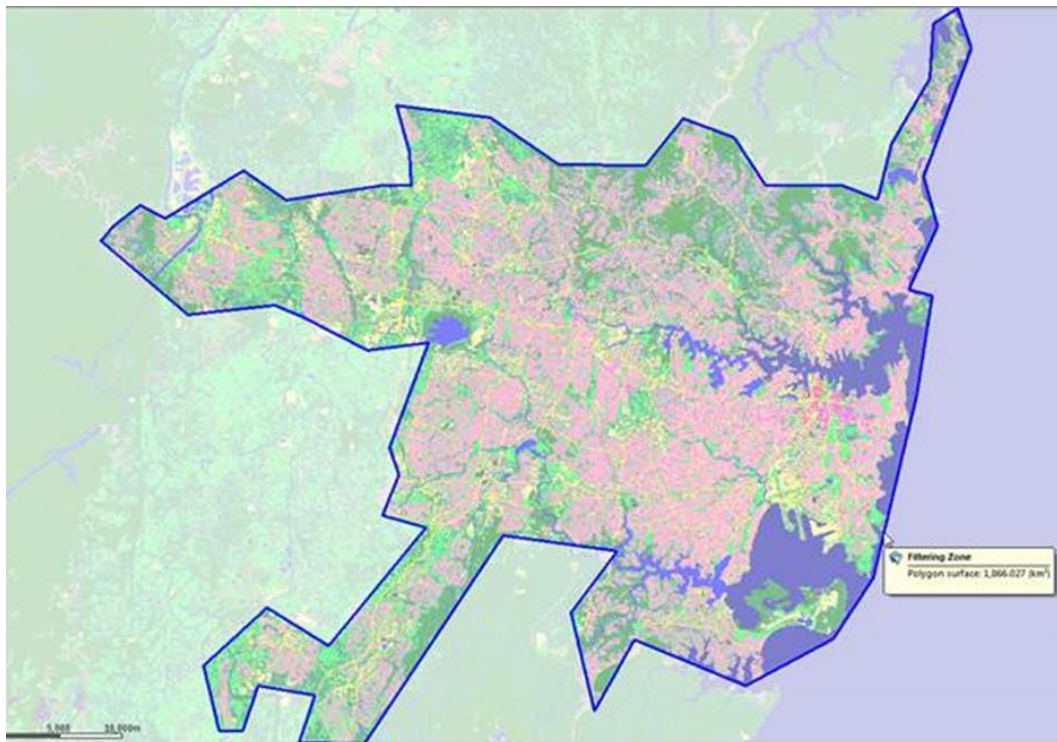


Figure 2: Morphology of Inner Metro Sydney

Appendix B: Regional Mobile Infrastructure Density

- This Appendix provides comparison of mobile infrastructure in selected regional and urban areas in Australia. It shows that some regional areas have similar mobile infrastructure density to metro areas to support Optus' view that the proposed defined major regional geographic areas for spectrum licensing in the 26GHz band should be expanded.
- The density analysis is calculated from inter-site distances as this provides a more accurate mobile infrastructure density measure than simply counting sites in arbitrarily sized areas.
- Key regional areas with existing metro like infrastructure that should be defined regional geographic areas for spectrum licensing in the 26GHz band are:
 - Holiday areas: Nowra, Jervis Bay, Byron Bay/Ballina, Foster/Tuncurry, Albany WA, Margaret River
 - Major Regional Centres: Coffs Harbour, Port Macquarie, Bundaberg, Mackay, Cairns, Traralgon, Warrnambool, Victor Harbour, Bunbury.
 - University Campuses: Bathurst, Armidale, Lismore, Wagga Wagga.
- Optus notes that:
 - not all regional areas with high population have been included in the ACMA's proposed regional areas in the Options Paper.
 - simple population distribution is not the only criteria that identifies areas of significant investment in regional mobile network infrastructure. The areas Optus has identified attracted additional investment not just because of permanent population, but also itinerant populations. For example, mining support towns, holiday and tourist locations and transport corridors.
- Optus suggests that the ACMA undertake further analysis of mobile infrastructure density across all regional areas and networks. It is likely that this analysis will likely reveal additional metro like areas that should be included as regional geographic areas for spectrum licensing in the 26GHz band.

Population Density Map Sample

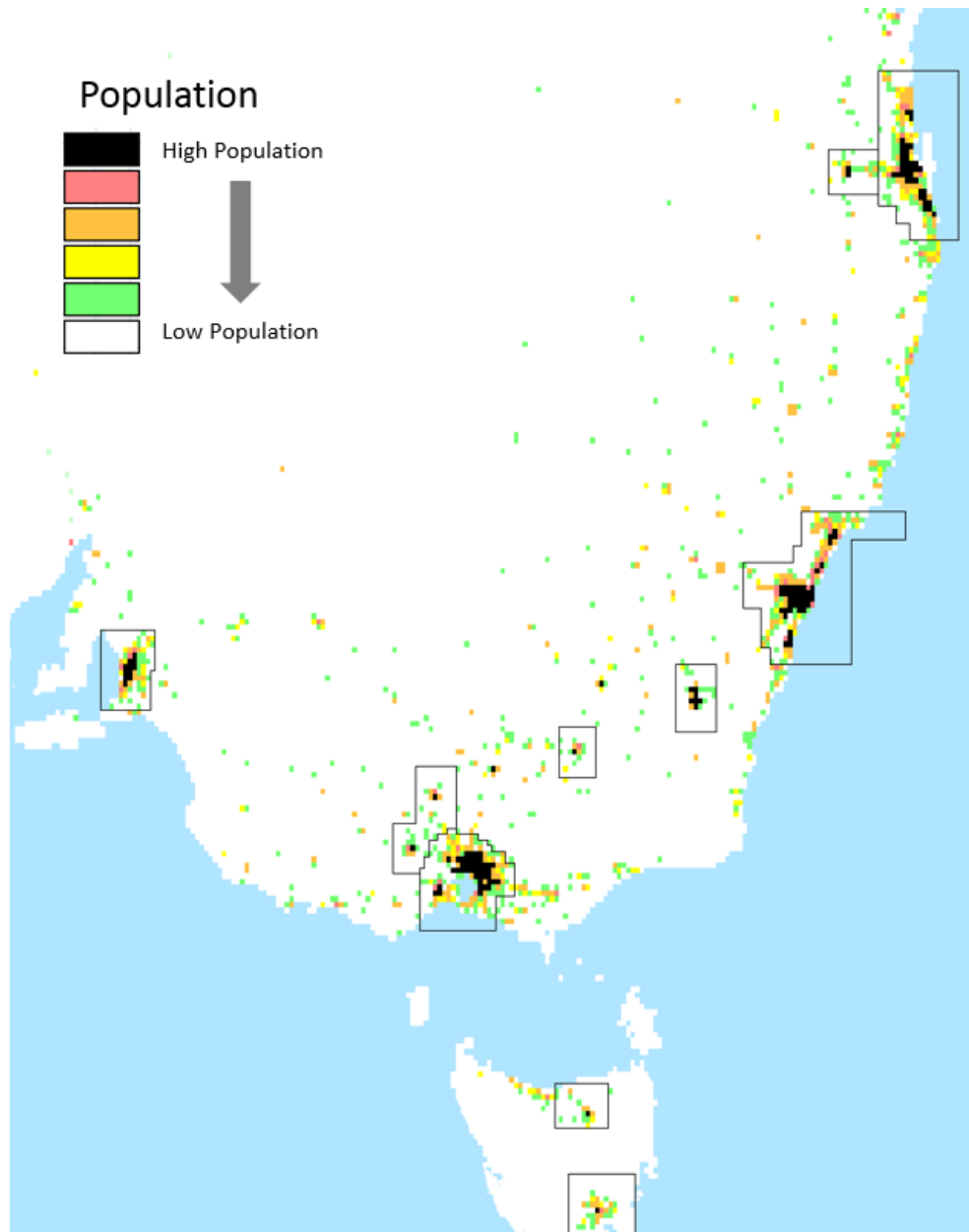


Figure 3: Map showing Population areas per HCIS Level1 areas and ACMA proposed 26GHz Spectrum Areas.

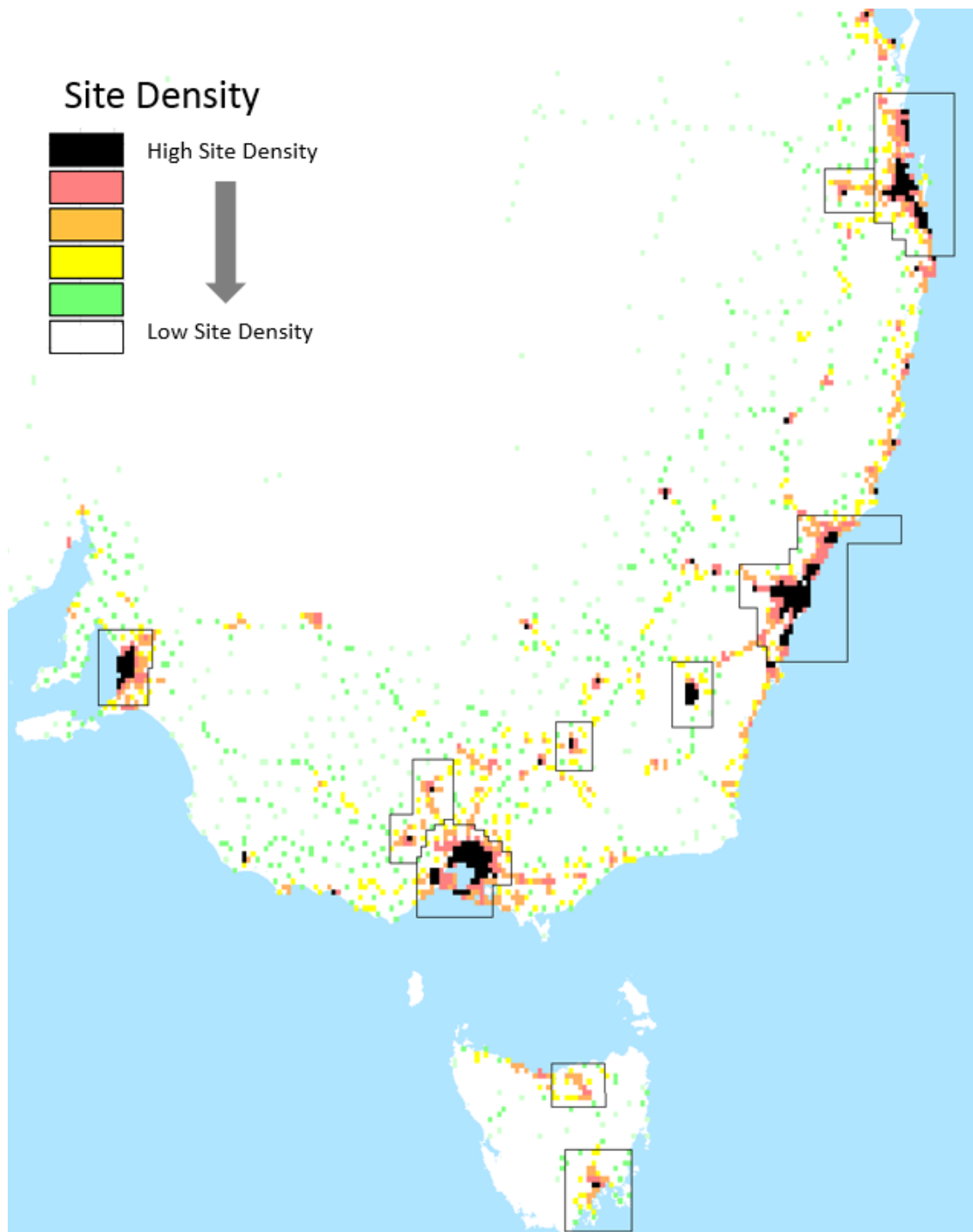


Figure 4: Map showing Optus Site Density per HCIS Level1 areas and ACMA proposed 26 GHz Spectrum Areas.

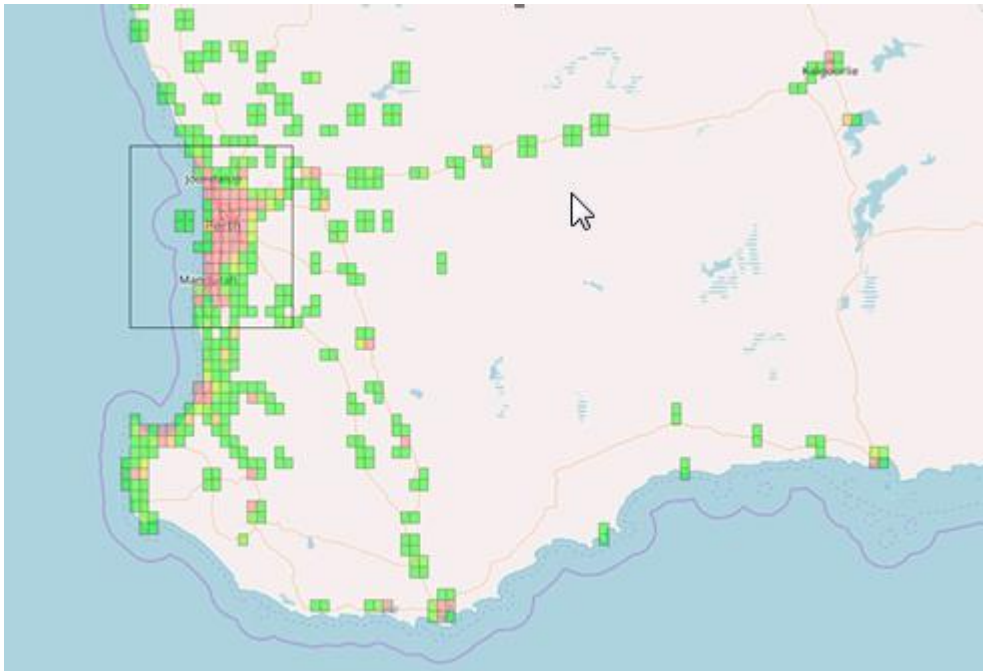


Figure 5: Map showing Optus Site Density per HCIS Level 1 areas near Perth and the ACMA proposed 26 GHz Spectrum Area.