

ABC Response to the ACMA's Perth FM Options Paper

June 2021



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1. Executive Summary

In its 2020 report on “The future delivery of radio”, the Australian Communications and Media Authority (ACMA) identified that AM broadcasting is a technology in decline and AM-to-FM conversion as a means of addressing that decline. The report noted that, unlike other metropolitan areas, frequencies for potential AM-to-FM conversions exist in Perth.

The Options Paper “FM broadcasting services band in the Perth RA1 licence area” (“Options Paper”) presents options for converting AM services to FM in that city.

The need for such conversions is particularly acute in Perth, which suffers from poor AM reception as a result of its geography. These reception issues are exacerbated by factors such as high-rise development, the electrification of Perth’s metropolitan commuter train network and additional electrical poles and wires in suburban areas.

As outlined in the Options Paper, five high-powered FM channels can be found in Perth RA1. This provides the opportunity to significantly improve the audio experience of listeners in the city by converting major AM services in the city to FM. These include three ABC radio services and two commercial services.

Accordingly, the Corporation supports Option 1 in the Options Paper, which would realise this opportunity and provide audiences in Perth with an improved listening experience.

The ABC notes that implementing Option 1 will require consequential changes to other broadcasting services in the Perth market. It is willing to assist broadcasters with navigating such changes and has commenced discussions with the Community Broadcasting Association of Australia (CBA) and some affected community broadcasters.

The Corporation does not believe that the other options considered in the Options Paper represent the most efficient and effective use of the spectrum available.

The ABC has recently undertaken fieldwork to assess coverage and reception in the Perth radio market. This work shows that a conversion of its Perth AM services to high-powered FM would, when considered with existing adjacent-area services, provide equivalent coverage. The Corporation has also developed options for further improving coverage.

2. Introduction

The ABC welcomes the opportunity to present a submission on the Options paper “FM broadcasting services band in the Perth RA1 licence area” released by the ACMA in April 2021.

The challenges facing broadcasters on AM in metropolitan radio markets are well documented, including in the ACMA’s March 2020 report to the Minister on “The future delivery of radio”. The ABC seeks the conversion of three national Perth AM licences: ABC Perth, Radio National and News Radio. These three licenses are currently broadcasting on various frequencies and power levels in the Perth market and the ABC supports conversion of all three to FM under Option 1 of the ACMA Perth options RA1 licence paper. Conversion of all three services to a common FM platform on equal power, as outlined, meets the public interest test in the *Broadcasting Services Act 1992* (“BSA”).

Since the switch-off of analog television services in Bunbury, the availability of scarce FM spectrum to serve the Perth market has improved. This unique opportunity has been known to the ABC since 2013. In preparation for any proposed ACMA licence-area plan (LAP) variation, the national broadcaster has commissioned two major field studies in the Southwest Western Australia region to determine reception of AM and FM services. This submission will present the findings of those studies, summarise Perth’s unique AM transmission coverage issues, and outline a strategy for FM conversion of the ABC’s existing AM services that passes the public interest test set out in the BSA.

3. The public interest in FM conversion

3.1. Planning decisions under the *Broadcasting Services Act 1992*

The ACMA’s licence-area planning functions are set out in Part 3 of the BSA. In performing those functions, the ACMA is required under section 23 to promote the objects of the BSA, including the economic and efficient use of the radiofrequency spectrum, and to have regard to a range of relevant factual matters.

Re-organising radio in Perth to exploit the opportunity created by the closure of analog TV services in Bunbury in 2013 would represent an economic and efficient use of valuable VHF Band II (FM) spectrum. The greatest public value would be derived from converting the largest possible number of AM services to FM. It would further the objects of the BSA, most notably by promoting “the availability to audiences throughout Australia of a diverse range of radio services offering entertainment, education and information” (s 3(1)(a)). In such a conversion, ABC services should receive a high priority commensurate with the Corporation’s role in the Australian broadcasting system and the diversity it brings to the mix of radio services available to Perth listeners.

Conversion of all high-power AM services in Perth would also promote the object of providing “a regulatory environment that will facilitate the development of a broadcasting industry in Australia that is efficient, competitive and responsive to audience need” (s 3(1)(b)).

The ABC also notes the regulatory policy of the BSA, which relevantly notes that Parliament intends that broadcasting services will be regulated in a manner that will readily accommodate technological change.

3.2. ACMA “Future delivery of radio” report

In March 2020, the ACMA released a report, “The future delivery of radio” (“Radio Report”), that directly addresses AM-to-FM conversion. The Report notes that broadcasters regard FM as a long-term stable technology and that greater use of FM “can address the decline in AM audiences in this transition phase until digital pathways become clearer”.¹ It identifies the ACMA’s first radio LAP planning priority as “converting commercial, community and national radio broadcasting services from AM to FM in areas where FM spectrum is readily available”.²

The ABC supports this approach and agrees that high priority should be accorded to AM-to-FM conversion where possible.

The Radio Report’s discussion of radio planning notes that:

There is limited utility in conducting further engineering investigations into finding additional FM frequencies for capital-city AM-to-FM conversions beyond areas where special circumstances apply.³

However, as a footnote clarifies, Perth is an example of such a special circumstance, as “analog television switchover in Bunbury has made additional frequencies available”.⁴ Consistent with this, the Radio Report states that the ACMA will:

Continue to progress to public consultation [its] work on the potential for replanning the Perth FM band to potentially enable conversion of all commercial and national radio broadcasting services to FM. This could overcome Perth’s unique geographic circumstances, which result in poor AM propagation.⁵

The ABC concurs with the ACMA’s view that conversion of high-power AM services to FM in Perth would promote the objects of the BSA, including the economic and efficient use of spectrum. In this context, the Radio Report states:

We consider providing FM frequencies to match AM coverage (within a licence area for licensed broadcasters) is generally an economic and efficient use of spectrum. Whether a specific proposed LAP variation would be an economic and efficient use of spectrum needs to be determined at the individual service planning stage.⁶

The Corporation also acknowledges the importance of ensuring that FM coverage as far as possible matches that of the converting AM service, including the need for or desirability of mitigation measures if there is any substantial audience loss. The Radio Report sets out the ACMA’s expectations as follows:

Where an FM conversion and any associated FM infill repeaters are not able to match AM coverage, we will generally expect the service to be simulcast in both AM and FM. We do not consider this coverage duplication to be wasteful of spectrum, noting that

¹ ACMA. “The future delivery of radio: Final report”, March 2020, p.31.

² ACMA. “The future delivery of radio”, p.32.

³ ACMA. “The future delivery of radio”, p.32.

⁴ ACMA. “The future delivery of radio”, p.32.

⁵ ACMA. “The future delivery of radio”, p.33.

⁶ ACMA. “The future delivery of radio”, p.33.

the AM band currently has little value in alternative use, and the desire of the industry to move to alternative delivery platforms.⁷

4. Relevant issues

4.1. General

As the ACMA's March 2020 report on the future of radio recognised, "AM audiences are in a slow, long-term decline, due to changes in audience preferences and the limitations in AM's audio fidelity and interference susceptibility".⁸ AM broadcasting is 100-year-old technology that imposes high infrastructure costs, requires high power consumption and is highly susceptible to interference from electrical noise. Further details of AM transmission issues are summarised in Appendix 3.

These problems are particularly pronounced in the Perth basin where vast areas of sandy soil with poor conductivity present an environment that is not conducive for optimal AM radio transmission. As a result, Perth has always suffered from poor AM coverage when compared to other markets. Moreover, increasing high-rise development, "noise making" household appliances, the electrification of Perth's metropolitan commuter train network and additional electrical poles and wires in suburban Perth all contribute to, and compound, the poor reception of AM radio in Perth.

FM reception does not suffer from the same transmission characteristics and is clearly preferred by consumers due to its superior audio quality and ubiquitous device availability.

The Options Paper explicitly recognises these problems and the solution offered by AM-to-FM conversion. It states, for example, that Option 1 is "intended to resolve the longstanding issues for existing services regarding poor AM reception in the Perth area due to its adverse environmental conditions for AM Electromagnetic Propagation (EM) and impulse noise from electric rail and powerlines".⁹

4.2. AM radio's declining audience

An analysis of listening trends over the past decade shows the increasing dominance of FM and digital listening in comparison to AM. The comparison also highlights the particular problems with AM listening in Perth, likely stemming from poorer coverage due to poor soil conductivity.

GfK radio survey data for Perth shows a slow decline in AM listening over time: since 2010, AM radio listening has decreased from 37% to 31% of people aged 10+. In comparison, listening to FM services, which exhibit better-quality audio and reception, has remained steady at 84% of the available 10+ audience. Moreover, AM audiences are aging; the average audience age is

⁷ ACMA, "The future delivery of radio", p.34.

⁸ ACMA, "The future delivery of radio", p.15

⁹ ACMA, "FM broadcasting services band in the Perth RA1 licence area", Options paper, April 2021, p.2.

now 54, compared with the FM average age of 41. This is consistent with the ACMA's broader finding in the Radio Report that younger audiences prefer FM.¹⁰

ABC radio services are an important part of the mix of radio services enjoyed by Perth listeners. However, the audience for AM radio is declining, with evidence younger, FM-habituated audiences are no longer tuning into AM listening in significant numbers as they get older. On the other hand, the evidence shows that FM radio continues to be enjoyed by all ages.

An AM-to-FM conversion would be a considerable boost to the diversity, quality and local relevance of services available to radio audiences in the Perth market. It would provide the large and growing group of younger and middle-aged listeners who do not—and will not—listen to AM radio with access to a broader range of services merely through transmission via a more suitable technology.

While DAB+ is another available technology in the Perth market offering greater sound quality than AM, in-car and household receivers have not reached a mass sufficient to provide a viable alternative to FM. The ABC regards DAB+ and the streaming of ABC radio content as important supplements, but not alternatives, to FM conversion.

Taken together, the demographic and sound-quality challenges of AM seriously compromise the Corporation's ability to deliver services that are as relevant to younger generations as to older ones. Providing content and services of relevance to all Australians, including those from different age groups and cultural and socioeconomic backgrounds, is an important element of the ABC's commitment to reflecting contemporary Australia as set out in its Five-Year Plan.¹¹

The continuing importance of ABC radio in the national listening "mix" suggests that permitting ABC to convert its Perth radio services to FM will yield considerable public benefits both for Perth listeners and for other Australians.

4.3. The high cost of AM transmission

AM radio transmission is disproportionately expensive compared to transmission via FM or DAB+. In the Perth and other metropolitan markets, AM transmission costs the ABC substantially more than comparable FM services. As AM radio transmitter sites require significant parcels of non-undulating land, the AM transmitters in major metropolitan markets are in locations close to urban development and are of significant value. This value is reflected in annual transmission fees. In contrast, FM broadcasts are transmitted from existing television towers with the resulting infrastructure already amortised. This ability to use shared infrastructure generally results in far lower incremental costs.

FM conversion in Perth will allow the ABC to release funds currently required for expensive AM transmission facilities and use them to expand FM and DAB+ broadcasting coverage in other locations and to invest more in Australian content. By significantly reducing the ABC's

¹⁰ ACMA, "The future delivery of radio", p.13.

¹¹ *ABC Five-Year Plan 2020–25* <https://about.abc.net.au/wp-content/uploads/2020/07/ABC-Five-Year-Plan-FINAL-Updated.pdf>.

radio transmission costs in Perth, conversion of radio services to FM will promote the objects of the BSA in other ways, and in other parts of the country, as well.

4.4. Impact on existing services

The Corporation is aware of the burden any planning and implementation of consequential changes arising from the conversion of five high-powered FM services, as proposed in Option 1, will have on existing broadcasters. The ABC is committed to providing them with aid and assistance. It will provide appropriate advice, support and resources to affected broadcasters making consequential changes, potentially including providing technical assistance, contributing to their on-air campaigns to communicate frequency changes to the public and assisting with relocation.

The ABC has previously provided project management and technical expertise for self-help radio and television installations to communities across the country. It will draw on that expertise to support the community sector with any consequential changes in Perth. The Corporation is committed to working with the ACMA and the community sector to successfully conclude the frequency reallocation, potentially including in relation to the provision of transmission equipment and/or site-sharing agreements. The ABC understands that the ACMA expects the parties to work together to achieve the proposed frequency allocations on a good-faith basis and looks forward to working with the affected parties on this basis.

As a preliminary step, the ABC has commenced discussions through the Community Broadcasting Association of Australia (CBAA), in particular, to facilitate planning of proposed changes under Options presented by the ACMA.

4.5. Effect of conversion on radio coverage

In June 2019 and January 2021, the ABC deployed its Field Test Vehicle to Perth to conduct substantial analysis of reception quality of its Perth AM, FM and DAB+ services.

The aim of the field studies was three-fold:

1. Verify existing Perth radio coverage.
2. Identify any coverage issues resulting from potential AM-to-FM conversion.
3. Identify and develop any migration strategies.

The field measurement methodology included a desktop exercise based on existing field-strength data, measurement of FM services as per ACMA planning guidelines and subjective assessment of audio quality from each Perth radio service. Some 71 locations were selected for the measurement of field-strength data of existing AM and FM radio services in Perth and the surrounding environs. A map of the selected locations is included in Appendix 2.

The field test equipment utilised included:

- A 10-metre mast for consistent DAB+ and FM measurements
- 360-degree rotation of the test antenna
- Vertical and horizontal polarity movement
- Rhode and Schwarz ETL kit for accurate signal-strength reading
- Potomac PI4100 kit for accurate AM signal-strength reading

- Use of calibrated domestic antennas to accurately reflect user experience.

When processing the field survey data:

- Results were cross-checked against predicted data
- Any anomalies were analysed and accounted for
- A composite map was generated combining multiple platforms across a particular radio service
- Coverage analysed assessing areas of poor audio quality against the ratings data for Perth to obtain final affected listeners.

The results of the field survey for the three ABC Perth AM services were as follows:

4.5.1. ABC Radio

The ABC Radio Perth AM signal reaches a population of 2,138,600 people. When considering ABC Radio Perth's weekly audience reach of 13.4% this translates to roughly 286,600 listeners.

ABC field test surveys have concluded that a new Perth FM 100 kW service would cover a population of 1,951,900 of these people, which would translate to around 261,600 listeners.

The remaining 25,000 listeners, including those in the Roleystone valley, would be encouraged to retune to similar ABC Radio content from:

- Dalwallinu AM or Northam AM, which carry ABC Radio Mid West and Wheat Belt;
- Wagin AM, which carries ABC Great Southern WA; or
- Bunbury (Busselton) AM, which carries ABC South West WA.

This detail is illustrated in Figure 1 of Appendix 1.

4.5.2. Radio National

The Radio National AM signal reaches a population of 1,983,900 people. When considering Radio National's weekly audience reach of 4.3% this translates to around 85,300 listeners.

ABC field test surveys have concluded that a new Perth FM 100 kW service would cover a population of 1,948,840 of these people, which would translate to around 83,800 listeners.

There is an area in the Roleystone valley where, due to the localised hilly terrain, the FM signal can be affected. Field tests concluded that in-car reception should continue to be available, but indoor reception could require the installation of an external antenna depending on the listener's location. There are 600 people residing in this area, which translates to perhaps 26 listeners affected.

In the Waroona area south-east of Mandurah there is an area of reduced coverage, where around 3,460 people, or about 149 listeners, would experience poor audio quality from the available Radio National services. In addition, for roughly 560 people, or about 24 listeners, the FM signal can be affected in this area in a similar way to the Roleystone valley.

The ABC's assessment of potential mitigations in this region includes the installation of DAB+ at Mandurah, which would reduce the number of affected listeners with poor audio to roughly 28 and reduces the number of listeners who would experience an FM signal decrease to as

few as two. The remaining 1,300 listeners would be encouraged to retune to identical Radio National content from Dalwallinu AM or Bunbury (Busselton) AM services.

This detail is illustrated in Figures 2 and 3 of Appendix 1.

4.5.3. ABC News Radio

The ABC News Radio AM signal reaches a population of 1,974,100 people. When considering ABC News Radio's weekly audience reach of 4.5% this translates to around 88,800 listeners.

ABC field test surveys have concluded that a new Perth FM 100 kW service would cover a population of 1,953,200 of these people, which would translate to about 87,900 listeners.

There is an area in the Roleystone valley where, due to the localised hilly terrain the FM signal can be affected. Field tests concluded that in-car reception should continue to be available, but indoor reception may require the installation of an external antenna, although this is dependent on the listener's location. There are 600 people residing in this area, which translates to perhaps 27 listeners affected.

In the Chittering Valley area north-east of Perth there is an area of reduced coverage, where 3,600 people, or around 162 listeners, would experience poor audio quality from the available ABC News Radio services. In addition, for 1,900 people, or around 86 listeners, the FM signal can be affected in this area in a similar fashion to the Roleystone valley.

ABC assessment of the potential for mitigation in this region includes an installation of a synchronous FM network in the Chittering Valley, which would reduce the number of affected listeners with poor audio to about 29 and reduce the listeners who would experience an FM signal decrease to as few as three. The remaining 670 listeners would be encouraged to retune to identical ABC News Radio content from the Bunbury (Busselton) AM service.

This detail is illustrated in Figures 4 and 5 of Appendix 1.

4.5.4. Analysis of results

The field studies confirmed that all three ABC AM Perth services suffer from poor reception and audio quality in built-up areas and the North–South commuter railway corridor.

In contrast, existing Perth high-power FM services offer excellent city-wide coverage both in reception and audio quality. FM coverage across most of the existing footprint of Perth AM services is good, although the field study identified some FM coverage issues in the Roleystone, Chittering and Waroona area. As described above, the ABC has identified mitigation strategies for these small population areas, particularly for the ABC News Radio and Radio National services, which it will discuss with the ACMA during the Licence Area Planning (LAP) process.

Following analysis of the field studies, the ABC has confirmed that any conversion to FM at 100kW, as proposed in the Options Paper, will adequately service its audiences. The ABC is in the fortunate position to have high-powered radio services in the adjacent regions to Perth. These services provide audiences with alternate coverage from Northam, Bunbury (Busselton), Wagin and Dalwallinu. The maps provided in Appendix 1 reflect available services in regions adjacent to Perth.

An abridged version of the field survey report appears in Appendix 2. The full report is available to the ACMA.

4.6. Audience assistance

The ABC has successful experience in conversions of AM to FM radio services and the assistance that can be provided to listeners to ensure a smooth transition. The Corporation provides a dedicated Reception Advice Line (RAL) that provides guidance to audiences experiencing difficulties accessing ABC radio and television services. During the transition period, the Corporation would expand the staff of the RAL as required to support listeners who may need assistance in retuning their radios to the new FM frequencies. The ABC has previously adopted this approach during other high audience-impact technology changes.

The ABC would also employ a simulcast messaging strategy via broadcast across ABC platforms in Perth to advise ABC listeners to re-tune their radios to FM. It is anticipated that this simulcast period would be between six and eight weeks.

5. Analysis of the ACMA's proposed FM options for Perth

The Options Paper presents five options for responding to AM reception issues in Perth. As outlined in the Paper, the ACMA's planning has identified up to five new high-power FM frequencies that could be utilised for AM conversions in the Perth market. **Option 1** would make full use of those frequencies, allocating two for the conversion of existing commercial AM services (6IX and 6PR) to FM and three for the conversion of current national broadcaster AM services (the ABC's 6PB, 6WF and 6RN).

Option 2 would convert only the three national ABC AM services (6PB, 6WF and 6RN) to FM, but leave the two commercial stations as AM services. Conversely, **Option 3** would convert the two commercial AM services to FM and open the other three FM frequencies to new high-power services, leaving the three ABC stations as AM services.

Option 4 minimises changes by converting only a single national ABC AM service to FM, leaving the remaining ABC services and the commercial services on AM. Finally, **Option 5** would convert none of the existing AM services to FM, instead planning and allocating spectrum for three new high-power FM services.

5.1. Option 1

The ABC strongly supports Option 1 as the preferred outcome for the Perth radio market. This option will facilitate the goal of providing radio services in Perth with superior FM audio quality. It will resolve the historic poor reception issues faced by Perth AM broadcasters due to the local geography, poor ground conductivity and increasing man-made noise levels associated with rail and powerline infrastructure. It will make a wider range of popular services available to younger and middle-aged audiences, without any loss of the mix of services currently available to older listeners now listening to both AM and FM. Option 1 also aligns generally with the ABC's radio planning priorities.

The ACMA's planning has identified five new high-power FM frequencies and Option 1 employs all five of these, best utilising the available spectrum. Three of the potential five new

frequencies (102.5, 103.3 & 104.1 MHz) have been designated as national broadcaster allocations and planned for use at the Bickley transmission site as high-power (100 kW ERP) omni-directional services. This would enable the conversion of the Perth ABC AM services (Perth ABC Radio, Radio National and ABC News Radio) to FM, the three new FM services being collocated with the ABC's two existing FM services, utilising the same antenna and with all services operating with the same characteristics.

The ABC agrees with the planning approaches used to identify the new frequencies, including minimising interference to adjacent low-powered services by arranging the high-powered allocations in a single block.

The ABC acknowledges that Option 1 would also require a number of consequential changes to other services, as detailed in the Options Paper. These include the conversion to FM of two commercial AM services, for which two new FM frequencies have been identified, as well as a flow-on disruption to community broadcasters. These are discussed further below.

The Corporation also notes that infrastructure changes would be required at the Bickley site in order to host three additional high-power FM services.

To migrate the ABC News Radio service from AM to FM, the ABC will require an amendment to the *Parliamentary Proceedings Broadcasting Act 1946* to remove the legacy constraint that the channel be broadcast using medium-wave modulation. The Corporation has been in positive discussions with government about securing such an amendment. If the legislative amendment process is unable to be completed prior to activation of the new Perth FM frequencies, the ABC would anticipate simulcasting ABC News Radio until the legislation is passed.

5.2. Other options

Option 2 would meet the ABC's specific needs, but would not address the overarching problem of AM's decline in the Perth market or provide the best outcome for audiences suffering poor listening experiences in the city. Should the two commercial licensees be unwilling to adopt Option 1, the Corporation would support Option 2. However, its preference would be to convert the five high-powered AM services, as outlined in Option 1. This would ensure the goal as outlined in the ACMA Options paper is achieved. By maximising competition in the commercial radio market in Perth, conversion of the two commercial AM services (as well as the ABC's services) would appear to best promote the objective set out in section 3(1)(b) of the BSA.

The ABC does not support Options 3, 4 or 5.

As a principle, the ACMA should prioritise improving the reception of existing services with established audiences in the Perth market over introducing new FM services, as such an approach would condemn established services to decline.

This would be the case with Option 3, which would leave the ABC with three AM services in the Perth market while introducing three new high-powered FM services. Such a situation would place the national broadcaster in an extremely uncompetitive position in the Perth radio market, as the only three high-powered radio services remaining on the AM band.

Likewise, Option 5 would provide no opportunity for existing AM services—both national and commercial—to convert to FM while introducing new high-powered FM services. If the ACMA were to adopt this option, the Corporation would request three FM high-power national radio broadcasting services and continue simulcasting the existing ABC AM services. This simulcast option of simulcasting would come at a high cost to the ABC for no discernible public-interest benefit.

Finally, while Option 4 would allow for one ABC service to convert to FM, failure to fully exploit the opportunity arising from clearance of TV from VHF Band II in Bunbury would not represent the most “economic and efficient use” of scarce and valuable FM radio frequencies. The Corporation’s preference is for the greatest number of existing Perth AM services to convert to FM, maximising high-quality choices for Perth radio audiences.

6. ABC Recommendations

Since the cessation of analog television broadcasting in 2013, the ABC has explored alternative options for the use of the spectrum vacated by analog television services. One of the options considered has been the utilisation of FM frequency spectrum vacated by the national Bunbury and SW Western Australia analog television services. It is therefore opportune that the ACMA has presented options for the conversion of Perth AM services to FM.

The ABC strongly supports Option 1, as set out in the Options Paper, which would convert five existing high-power AM services to FM. It recommends that the ACMA adopt it to provide the radio listeners of Perth with better-quality reception of the existing high-powered AM radio stations in that city. Option 1 would provide listeners of all age groups with the opportunity to hear their favourite radio station(s) in superior FM audio quality.

The alternative options presented in the Options Paper do not fully grasp the opportunity to alleviate the unique challenges of AM broadcasting in Perth that is presented by the ACMA’s identification of five high-power FM frequencies. Moreover, several of the options would effectively condemn established services to inevitable decline.

The Corporation acknowledges the flow-on consequences of the introduction of Option 1 and, as described above, is committed to assisting affected broadcasters and listeners with navigating the changes.

ABC fieldwork to assess coverage and reception in the Perth radio market has shown that a conversion of its Perth AM services to high-powered FM would, when considered with existing adjacent-area services, provide equivalent coverage. The Corporation has also developed options for further improving coverage.

APPENDIX 1 – Perth Coverage Maps

Figure 1: ABC Radio

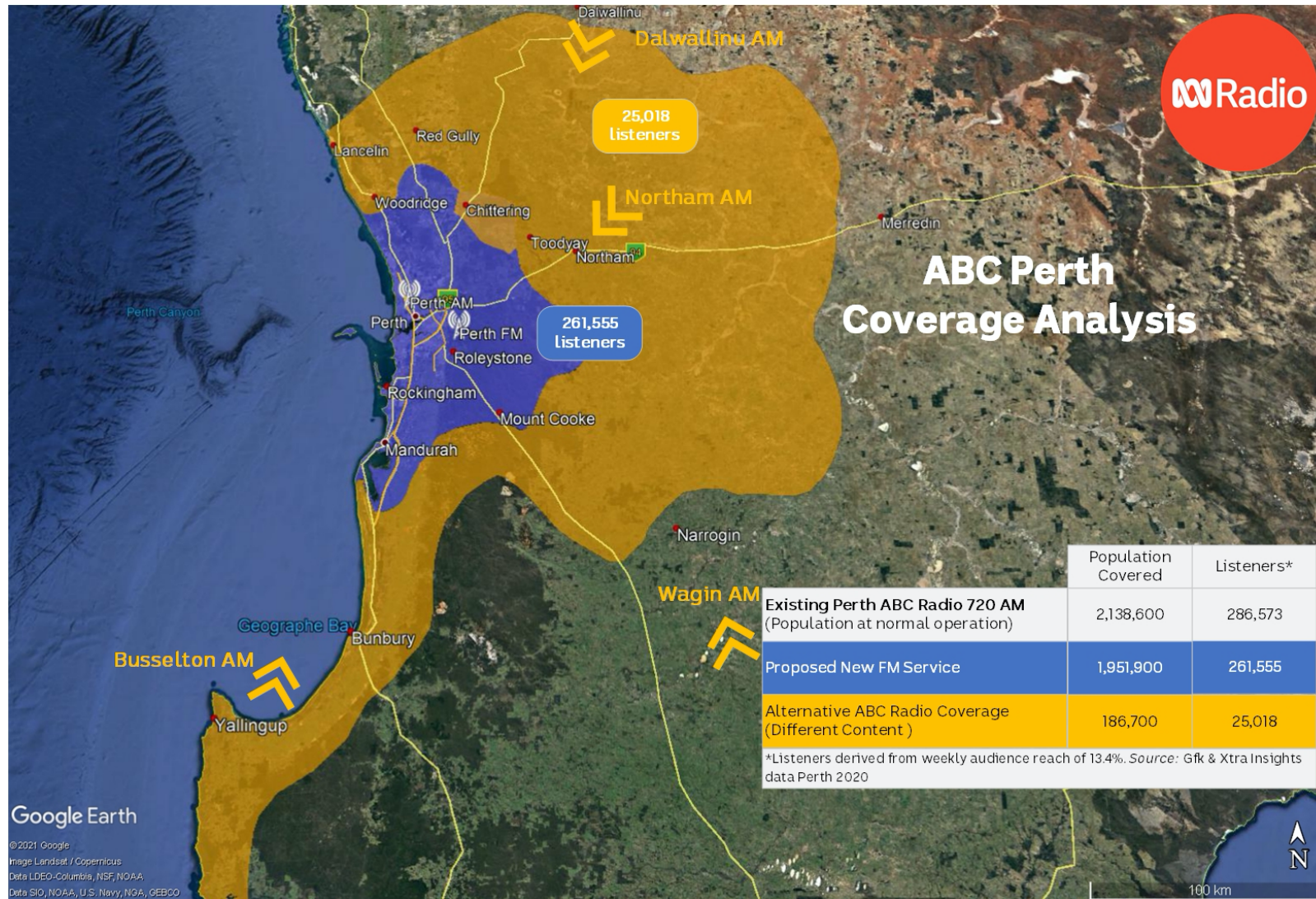


Figure 2: RN

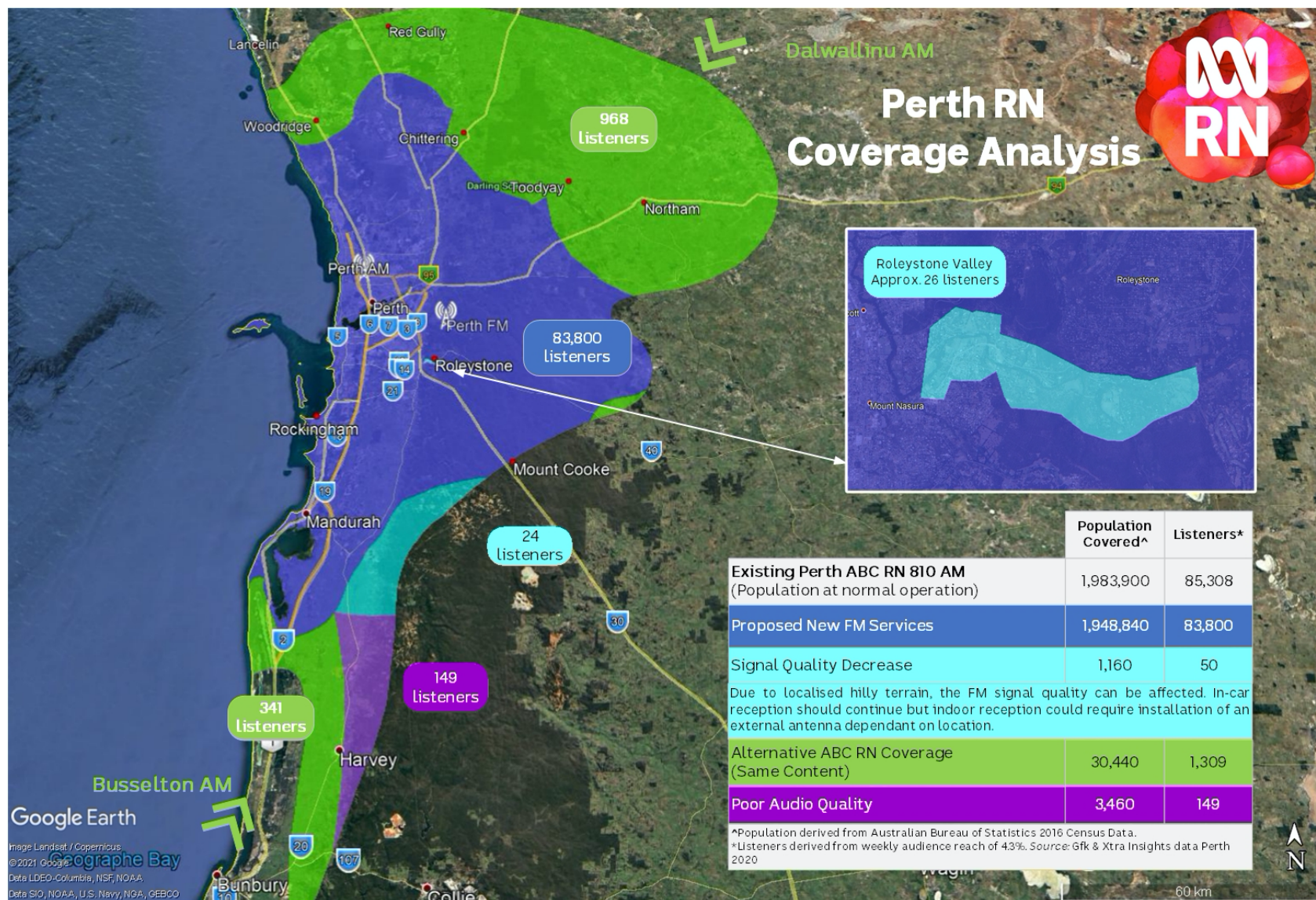


Figure 3: RN – possible mitigation options

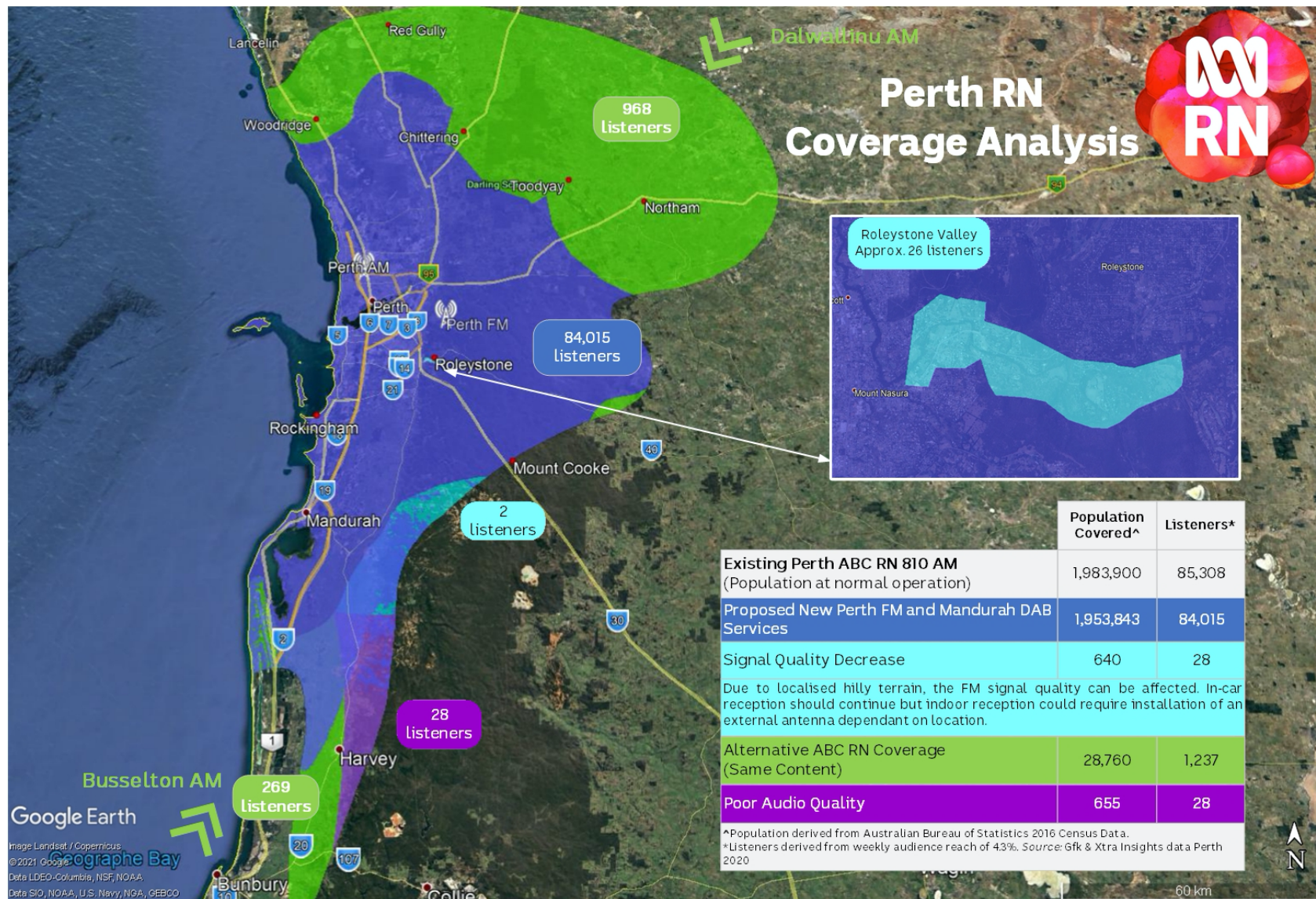


Figure 4: ABC NEWS Radio

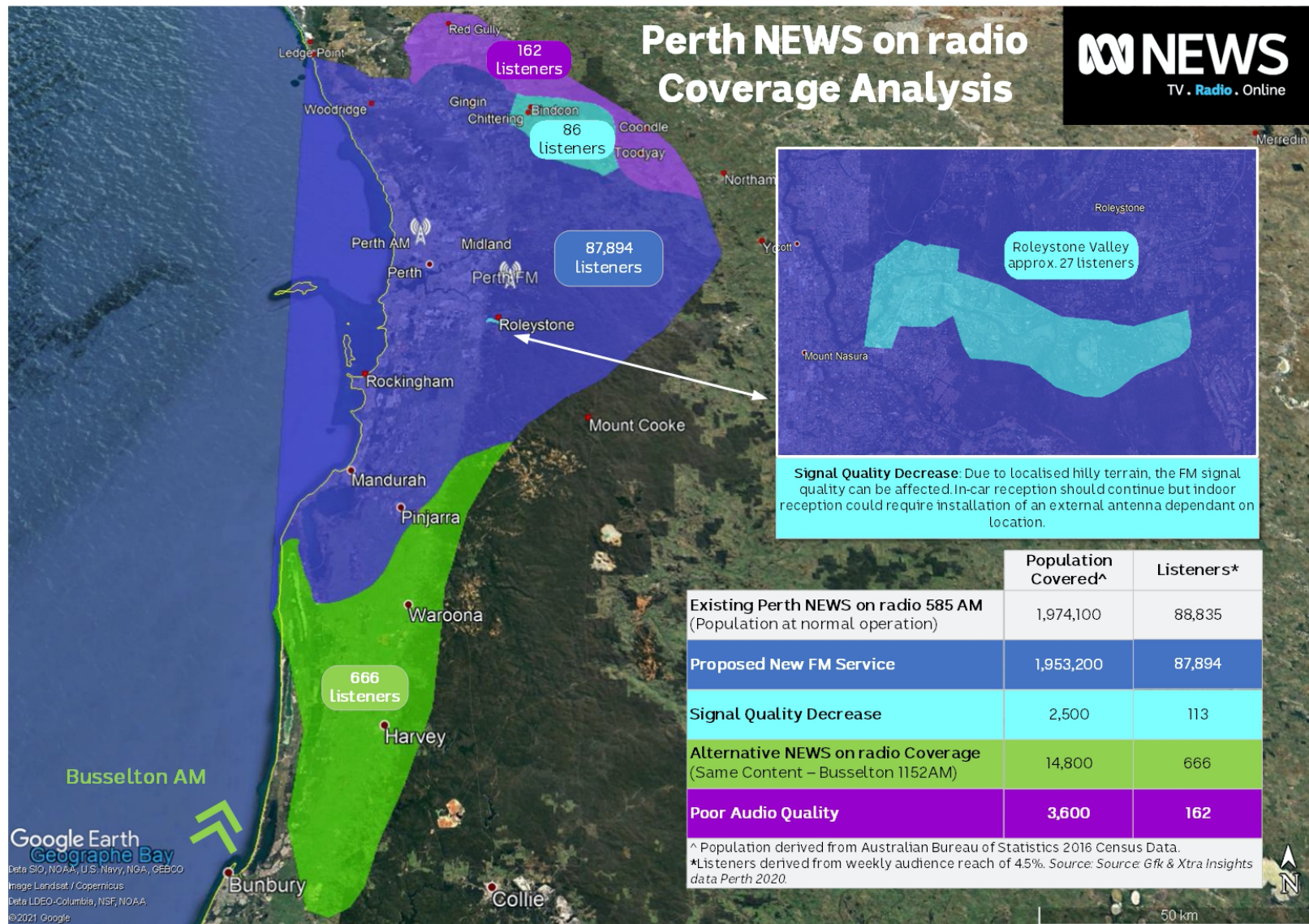
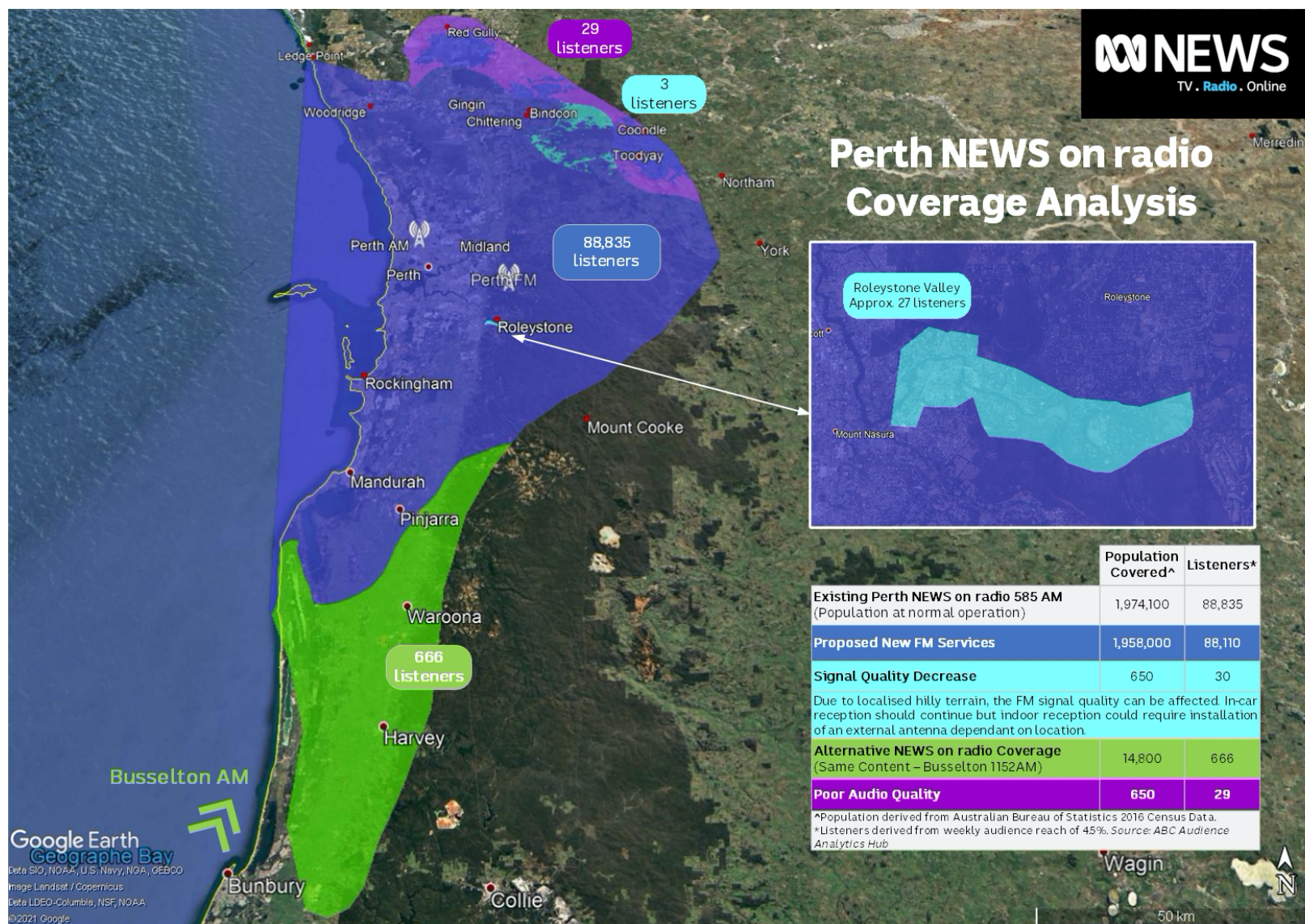


Figure 5: ABC NEWS Radio – possible mitigation options



APPENDIX 2 – WA Field Survey Summary Results – 71 locations

<i>Location</i>	<i>Name / Description</i>	<i>Latitude</i>	<i>Longitude</i>
1	Merredin	31°29'14.39"S	118°16'13.62"E
2	Baandee	31°34'51.77"S	117°58'47.24"E
3	Kellerberrin	31°38'15.95"S	117°42'59.73"E
4	Cunderdin	31°39'7.61"S	117°14'39.80"E
5	Northam	31°38'26.56"S	116°41'17.88"E
6	Nungarin	31°11'11.62"S	118° 6'15.11"E
7	Wedge Island	30°49'10.67"S	115°11'59.57"E
8	Lancelin	31° 1'29.26"S	115°19'55.93"E
9	Guilderton	31°20'36.43"S	115°30'12.63"E
10	Woodridge	31°19'49.67"S	115°36'22.72"E
11	Gingin	31°20'33.65"S	115°54'40.91"E
12	Wyalkatchem	31°10'57.14"S	117°22'40.92"E
13	Yanchep	31°32'57.74"S	115°37'39.49"E
14	Merriwa	31°40'14.177 S	115°42.856 E
15	Bullsbrook	31°39'46.77"S	116° 2'0.18"E
16	Wangara	31°47'24.75"S	115°48'46.88"E
17	Bickley	32° 0'40.61"S	116° 5'28.88"E
18	Freemantle	32° 3'21.65"S	115°45'30.73"E
19	Rockingham	32°16.690 S	115°44.681 E
20	Singleton	32°26'24.07"S	115°45'37.19"E
21	Mandurah	32°32'44.55"S	115°44'12.58"E
22	Goomalling	31°17'48.20"S	116°50'0.76"E
23	Brand Highway	31° 9'20.70"S	115°47'46.11"E
24	Muchea	31°34'45.04"S	115°58'35.08"E
25	Glen Forrest	31°54'34.80"S	116° 6'14.53"E
26	Stoneville	31°52'16.46"S	116°10'44.22"E
27	Chidlow	31°51'48.35"S	116°16'6.64"E
28	Roleystone	32° 6'55.92"S	116° 4'19.31"E
29	Bedforddale	32°10'47.32"S	116° 3'3.31"E
30	Jarrahdale	32°20'14.26"S	116° 3'44.71"E
31	Boddington	32°47'54.79"S	116°28'37.51"E
32	Welshpool	31°58'52.61"S	115°55'38.85"E

<i>Location</i>	<i>Name / Description</i>	<i>Latitude</i>	<i>Longitude</i>
33	Regans Ford	30°58'35.96"S	115°42'4.01"E
34	Red Gully north	31° 0'2.34"S	115°52'19.50"E
35	Wannamal	31° 9'50.15"S	116° 3'24.62"E
36	Seabird	31°16'40.55"S	115°26'39.29"E
37	Breton Bay	31° 9'28.29"S	115°25'38.01"E
38	Ledge Point	31° 6'21.54"S	115°22'20.60"E
39	Whittaker South	32°33'47.51"S	115°59'56.04"E
40	Myara	32°29'36.34"S	116° 1'8.47"E
41	West Toodyay	31°31'50.66"S	116°25'9.82"E
42	Toodyay	31°33'4.44"S	116°28'2.72"E
43	Forrest Highway, turnoff to Old Bunbury Road	32°49'51.92"S	115°43'29.90"E
44	Forrest Highway, 8km west of Uduc Uduc	33° 1'45.00"S	115°44'3.23"E
45	Cemetery carpark, just south of Pinjarra	32°38'25.13"S	115°52'4.42"E
46	Waroona	32°51'48.53"S	115°55'43.57"E
47	North Brunswick	33°14'24.21"S	115°50'33.91"E
48	Clackline	31°41'34.52"S	116°34'48.97"E
49	St Ronans West	31°53'18.59"S	116°36'36.45"E
50	Cnr Brookton Highway & Running Brook Rd	32°13'29.60"S	116°23'21.66"E
51	Albany Highway, north of Herold Rd	32°21'17.96"S	116°13'50.06"E
52	Two Rocks	31°29'9.92"S	115°34'55.62"E
53	Two Rocks	31°30'4.98"S	115°36'24.00"E
54	Yanchep	31°33'46.87"S	115°38'9.99"E
55	Burns Beach	31°44'5.52"S	115°43'24.91"E
56	Mullaloo	31°46'20.12"S	115°44'20.06"E
57	Conica Park	31°48'46.70"S	31°48'46.70"S
58	Scarborough	31°53'18.62"S	115°45'59.15"E
59	Wembly Downs	31°54'16.13"S	115°46'13.60"E
60	City Beach	31°56'14.19"S	115°45'27.61"E
61	Terrace Road carpark, Perth	31°57'32.77"S	115°51'44.36"E
62	Roleystone	32° 7'36.14"S	116° 3'5.47"E
63	Mount Nasura	32° 7'20.53"S	116° 1'13.91"E
64	Armadale	32° 8'45.09"S	116° 1'3.91"E
65	Bakers Hill	31°43'43.58"S	116°27'4.99"E

<i>Location</i>	<i>Name / Description</i>	<i>Latitude</i>	<i>Longitude</i>
66	Dumbarton	31°35'38.65"S	116°26'55.21"E
67	Coondle	31°28'31.96"S	116°26'24.78"E
68	Mandurah	32°30'18.07"S	115°45'19.19"E
69	Mandurah	32°35'31.06"S	115°38'25.37"E
70	Mandurah	32°35'6.88"S	115°47'48.74"E
71	Toodyay North	31°32'23.54"S	116°27'33.77"E

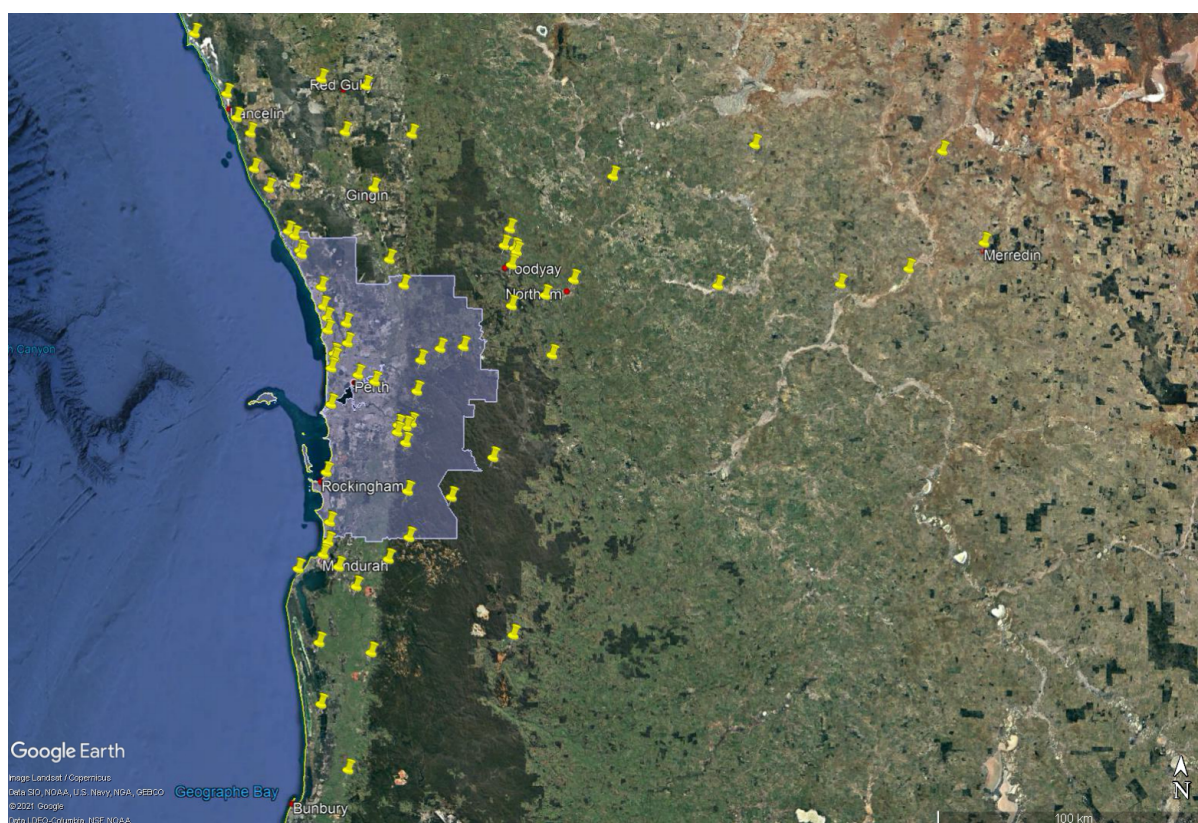


Figure 6: Map of field survey points and the Perth RA1 licence area



Figure 7: Commuter Train Station situated close to Freeway

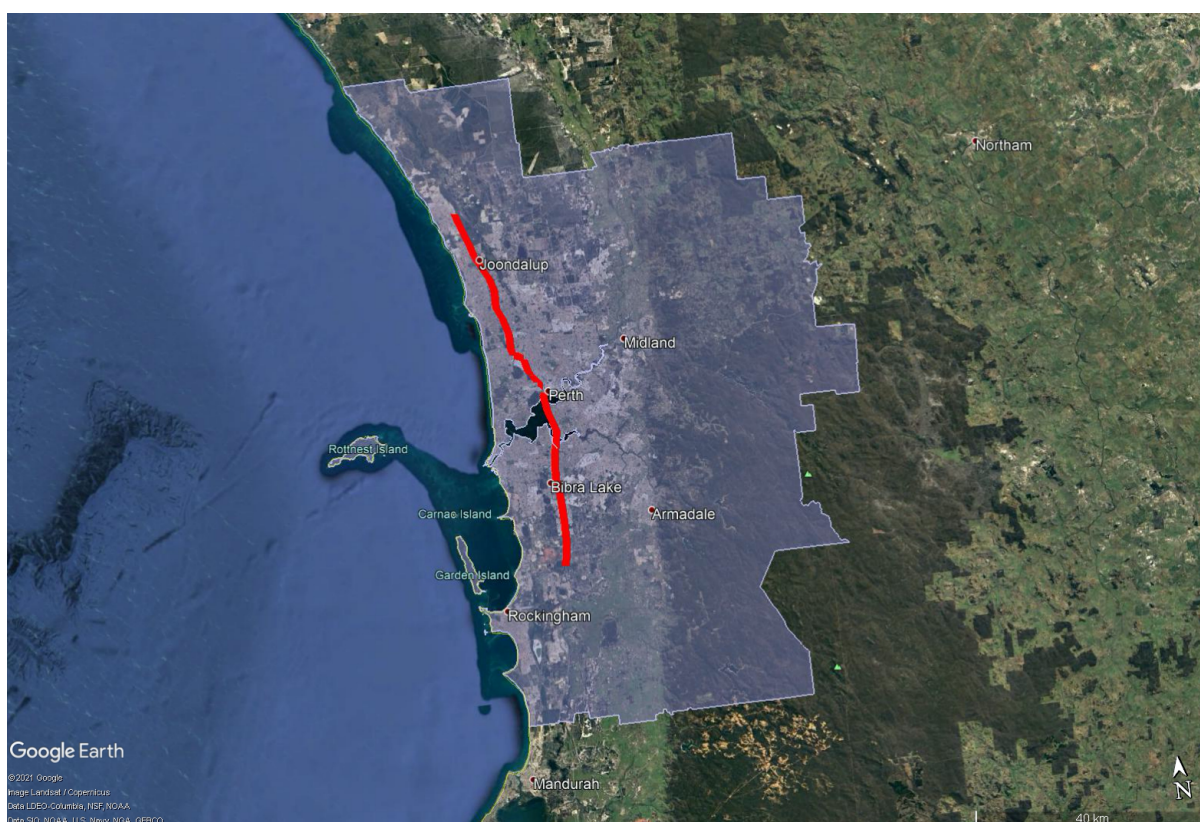


Figure 8: Red Line indicating increased AM interference from Perth commuter train line coincident with North-South Freeway

Appendix 3 – Explanations of AM transmission issues

6.1. Properties of Radio Waves

Radio waves are a form of electromagnetic wave and travel, or propagate, terrestrially in a number of ways. For example, they may travel along the surface of the earth (groundwave propagation), or by reflecting off layers in the upper atmosphere (skywave propagation) or in “line-of-site” paths through the atmosphere (tropospheric propagation).

Although the different types of propagation can and do often exist simultaneously, each type tends to be most effective at particular regions of the radiofrequency spectrum. For instance, Australia’s television signals are in the VHF and UHF (30 MHz to 3 GHz) portions of the spectrum and tend to propagate most effectively in straight paths through the atmosphere: very little energy at these frequencies will propagate as groundwaves or skywaves.

As we go lower in frequency to the High Frequency (HF) part of the spectrum, the most effective means of propagation is by skywave, and signals can travel very large distances around the planet by this means. These frequencies are ideal for long range and international “shortwave” communication.

Yet lower in frequency is the Medium Frequency (AM) area of the spectrum where groundwaves are the predominant mode of propagation. This is the area of spectrum where AM broadcasting lies and these AM signals travel well as ground waves. Vertical AM broadcast transmit antennas are designed to exploit the formation of groundwaves.

The groundwave travels along and penetrates the surface of the earth. Some of the energy is absorbed by the ground and this “loss” is largely responsible for the gradual weakening of the signal as it propagates away from the transmitter. At some distant point, the signal will have diminished to a level which no longer provides suitable reception. This is the extent of the signal’s coverage.

The amount of loss introduced by the ground is determined by its conductivity. Highly conductive ground will offer less loss to the signal, resulting in it traveling farther before diminishing below the reception threshold. Poor conductivity in the ground will result in greater signal loss, effectively reducing the coverage area of the signal. In fact, conductivity is the most important electrical characteristic affecting propagation of AM signals.

Ground losses are not equal, they affect higher frequencies more than lower frequencies and for this reason, lower frequencies in the AM broadcast band will travel further than higher frequencies, for a given power.

In general, we have no control over the conductivity of the ground within the required coverage area of an AM radio service. We can arrange for a transmitter site to be located in an area of good soil conductivity, for instance near to bodies of water or on swampy ground. This improves the efficiency of the transmitting antenna and ensures the maximum level of electromagnetic energy possible leaves the antenna, but beyond the boundary of the transmitter site, we must take what we are given in terms of ground conductivity. Incidentally, as water is very conductive, groundwaves propagate very well over ocean and other bodies of water.

In terms of ground characteristics, the Perth Metropolitan area is unlike any other Australian city, in that it rests on an extensive infertile sandy plain. The sand-plain soils typically have low water-holding capacity, resulting in comparatively low soil conductivity and hence poor groundwave propagation of the AM signal.

Another limiting factor for the utility of AM broadcasts is the impact of electrical noise on the signal. AM signals are very prone to interference from sources of electrical noise, either naturally occurring such as static from electrical storms or especially from man-made sources. Some industrial processes produce high levels of electrical noise, so too do electrical transmission and distribution infrastructure and electric rail infrastructure, as can be found in the Perth region. There is also an increasing level of noise being produced in the home from sources such as LED lighting, wireless battery chargers, TV receivers and computers, etc. FM transmissions are significantly less affected by electrical noise.

6.2. Electromagnetic propagation (EM) through soil

Electromagnetic propagation is the technical term used to define conductivity of AM radio transmission signals, which are highly susceptible to the salt content of soil. AM signals travel along the ground and transmit much better and have wider coverage from transmitter sites located where soil characteristics have moisture and where the signal is conducted through the soil more efficiently. Ideally the best transmitter sites for AM are in wetlands or marshes or where the soil retains moisture. The Perth basin is made-up sandy soil which does not retain moisture, so Perth is susceptible to poor AM radio reception. These propagation characteristics of AM in soil differ significantly from other media and do not affect FM or television transmissions, which are carried through the air, rather than along the ground.

The ACMA acknowledged in the March 2020 radio planning paper “AM audiences are in a slow, long-term decline, due to changes in audience preferences and the limitations in AM’s audio fidelity and interference susceptibility”. The ABC agrees with this ACMA position and also notes in the report observations that AM as 100-year-old technology is highly susceptible to interference from electrical noise, high infrastructure costs and high power consumption. The ABC also notes that the ACMA acknowledge the soil characteristics of the Perth basin affects the efficiency and poor reception of AM broadcasters in Perth.