

Terrestrial Digital Television Coverage and Reception in the Shortland Electorate

Report for the Department of Infrastructure,
Transport, Regional Development,
Communications and the Arts

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Contents

Executive summary	1
Background	1
Findings	2
Observations	3
Introduction	5
Shortland electorate	5
Methodology	7
Coverage and reception	7
Desktop coverage analysis	10
Monitoring analysis	12
Findings	13
Summary	17
Measurement analysis	18
Findings	18
MP survey locations- measurements	21
Summary	28
Antenna survey analysis	29
Findings	29
MP survey locations- Antenna survey	32
Summary	33
Overall observations	34
In-fill transmitters	35
Appendix A: Measurement results at MP survey locations	36

Executive summary

The ACMA undertook an investigation into terrestrial television coverage and reception in the Shortland electorate from December 2022 to June 2023. This work was funded by the Shortland Terrestrial Television Transmission initiative.

This work included:

- > a desktop analysis of predicted coverage in the area.
- > the establishment of 3 monitoring sites within the Shortland electorate to measure the broadcast television signal strength and quality over time.
- > a field measurement regime where the broadcast television signals at 99 separate locations across the Shortland electorate were measured and analysed.
- > a visual survey of household antenna installations across the Shortland electorate.

This report summarises the findings from this work and provides observations on the findings.

Background

There is a history of complaints regarding television reception in and around the Shortland electorate area (referred to in short in this report as the Shortland area) since the digital switchover in 2013. In 2017, the ACMA released a [fact sheet](#) on TV reception issues in the Greater Newcastle region which includes the Shortland electorate.

Shortland is a complex and challenging environment for television coverage and reception due to:

- > the number of television transmission sites with overlapping coverage, deployed to address television reception issues in areas with hilly terrain blocking the signal. There are 3 television transmitters within the Shortland electorate and an additional 3 that provide coverage to Shortland but are located outside the boundary of the electorate.
- > the use of Single Frequency Networks (SFN), or networks of transmitters which re-use the same TV channels at two or more television transmission sites due to very limited number of television channels (frequencies) available. There are 3 separate SFNs in the area, 2 SFNs have 3 transmitters and the other has 2 transmitters.
- > provision of both metropolitan and regional commercial services in the Central Coast overlap area between the Sydney Metro and Regional Northern NSW TV licence areas.
- > the potential for interference to broadcast transmissions, and therefore viewers, due to atmospheric ducting.

Broadcast television coverage and reception are closely related factors that influence the viewing experience for television audiences.

Coverage principally relates to the broad geographic extent a television signal is available to a predetermined 'usable' level. The extent of the coverage is governed by the characteristics of the transmitter (such as site location, height and power) and the geography of the area including localised obstructions such as the built environment, trees/forests, and local terrain which influences propagation of the signal. Target coverage area is therefore principally a matter for the broadcaster in deciding the transmission parameters and where to locate transmitters.

Reception relates to the ability of an individual viewer to receive a television signal where coverage is present. This is in large part determined by the viewer having an appropriate television receive system in place. This includes a suitable external antenna pointing at the correct site along with their television being tuned to the correct channel for the transmitter their antenna is pointing to. Importantly, while a viewer may have adequate coverage, they may not have acceptable reception if they do not have a suitable receive system.

When considering the viewer experience both coverage and reception factors must be considered.

Findings

The ACMA has conducted a multi-faceted analysis of coverage and reception of digital television in the Shortland area. This includes:

- > monitoring analysis
- > measurement analysis and
- > antenna survey analysis.

Monitoring analysis results indicate that parts of the Shortland area experience intermittent drops in signal quality which could result in poor television reception. These drops may have been caused by atmospheric ducting. However, they are only for very small percentages of time:

- > 1.2% of time for the monitoring site at Catherine Hill Bay- The TV signal parameters were measured around 148,265 times during the monitoring period and the modulation error ratio (MER)¹ dropped below the threshold level a maximum of 1843 times.
- > 0.12% of time for the monitoring site at Mt Hutton- The TV signal parameters were measured around 106,398 times during the monitoring period and the MER dropped below the threshold level a maximum of 127 times.
- > 0.01% of time for the monitoring site at Belmont- The TV signal parameters were measured around 50,809 times during the monitoring period and the MER dropped below the threshold level a maximum of 9 times.

Measurement analysis results indicate that the poor television viewing reportedly experienced by some households in the Shortland area is primarily due to reception issues with some localised coverage issues arising due to vegetation and localised nearby terrains obstructions. Of the 99 sites measured, 15 sites indicated either variable or poor television reception. These locations are in Caves Beach, Belmont, Eleebana, Mount Hutton and Dudley. The areas where localised coverage issues were evident (by either an inadequate signal level, an inadequate MER, or both) are not widespread and are limited to a small number of streets in each location.

¹ Modulation error ratio (MER) is a measure of the signal quality taking into account the sum of all interference effects occurring on the transmission channel.

Antenna survey analysis results indicate that reception issues (in areas where our measurement analysis showed coverage is considered adequate) is more widespread. Around 74 per cent of the households surveyed experience reception issues which are largely attributable to antenna system issues. These issues include insufficient antenna height, antenna pointing not optimised to the best-serving transmitter or otherwise installed incorrectly, or household level obstruction of the antenna by trees, buildings or terrain.

In summary, based on our observations, while some coverage deficiencies were evident from the analysis, it is likely that the main source contributing to poor viewer television experience in the Shortland area was identified as occurring from inadequate household antenna systems.

Observations

In considering the results of the analysis, the ACMA makes a number of observations about methods to address the identified coverage and reception issues.

Terrestrial television coverage issues can only be addressed by the installation of additional 'in-fill' transmitter sites (where possible) or changing the technical parameters (where possible) of the existing sites, including increasing power. Installing in-fill transmitters incurs costs and any coverage improvements must be analysed to determine if doing so provides an overall benefit. For new sites, costs include the capital and operational costs of installing and maintaining the additional site, the availability of suitable spectrum and the potential to complicate the TV coverage/reception environment for viewers. Benefits include providing coverage to viewers who had none before and potentially providing a better signal² to those who already had coverage from another site.

A careful cost/benefit analysis would assist in scoping the case or otherwise for proceeding with investigating additional transmitters. The ACMA notes that, historically, coverage deficient areas of this small scale have generally not been addressed by broadcasters installing additional transmitters. It should also be noted that every transmitter in Australia is likely to have black spot areas within its targeted coverage area where adequate coverage cannot be achieved due to terrain, local vegetation or obstructions. This issue is not unique to the Shortland area.

Depending on the requirements for any new in-fill transmitters, finding suitable frequencies for additional transmission sites in the Greater Newcastle region may be challenging. If a decision was made to proceed with additional transmission sites, the ACMA considers these would need operate as an SFN with existing sites or amongst the new sites because of limited spectrum availability in the area and the risk of increasing interference, and degradation to existing services, in nearby areas. This would likely make the area even more complex for television reception and may have knock-on effects to television coverage in other areas, both within and outside the Shortland area. This would place additional importance on viewers having a correct antenna and receiver installation (antenna pointing and television tuning) to receive the best television signal for their location.

It should be noted that the ACMA does not have a role in mandating the deployment of broadcast infrastructure to provide coverage. The establishment of new transmission infrastructure is a matter for broadcasters. In scenarios where a broadcaster is

² The benefit of a better coverage to those who already have coverage could mean greater robustness to coverage in the event of interference events caused by ducting or other affects impacting normal signal coverage, for example.

contemplating installing a new site, the ACMA will assist by, where possible, finding a suitable set of channels for the new site.

Depending on specific implementation approaches adopted for any new broadcast sites, broadcasters would also need to consider implications for programming content feeds to these new sites.

Given the widespread reception issues observed in the area, it may be beneficial to viewers for broadcasters and/or the government to implement an additional localised public information program to assist viewers to adjust their antennas and scan their television receivers to optimise their reception of existing television services. Access to commercial professional antenna installer services may also assist some viewers to ensure that their household antenna system is appropriately setup for their environment.

Other methods to improve television reception could include access to Viewer Access Satellite Television (VAST) services to assist affected viewers to improve their television reception.

Introduction

In 2017, the Federal Member for Shortland Pat Conroy MP conducted a survey of the Shortland electorate on digital television reception to collect feedback on the state of digital television in response to ongoing complaints of poor reception since the digital switchover in 2013.

Respondents were asked to rate their satisfaction with their digital television reception from 1 to 10, with 1 indicating low satisfaction and 10 indicating high satisfaction. 227 responses were received to the survey with 54 percent of respondents scoring satisfaction of 6 out of 10 or higher. The suburb with the highest number of dissatisfied responders was Belmont at 16, followed by Belmont North with 10, Caves Beach with 7, Charlestown with 6, Dudley with 5 and Eleebana and Mount Hutton with 4.

In a 2022 election commitment, and subsequently as part of the October 2022 budget process, the Government announced the Shortland Terrestrial Television Transmission initiative. The initiative is intended to improve viewer access to free-to-air television services in the Shortland electorate.

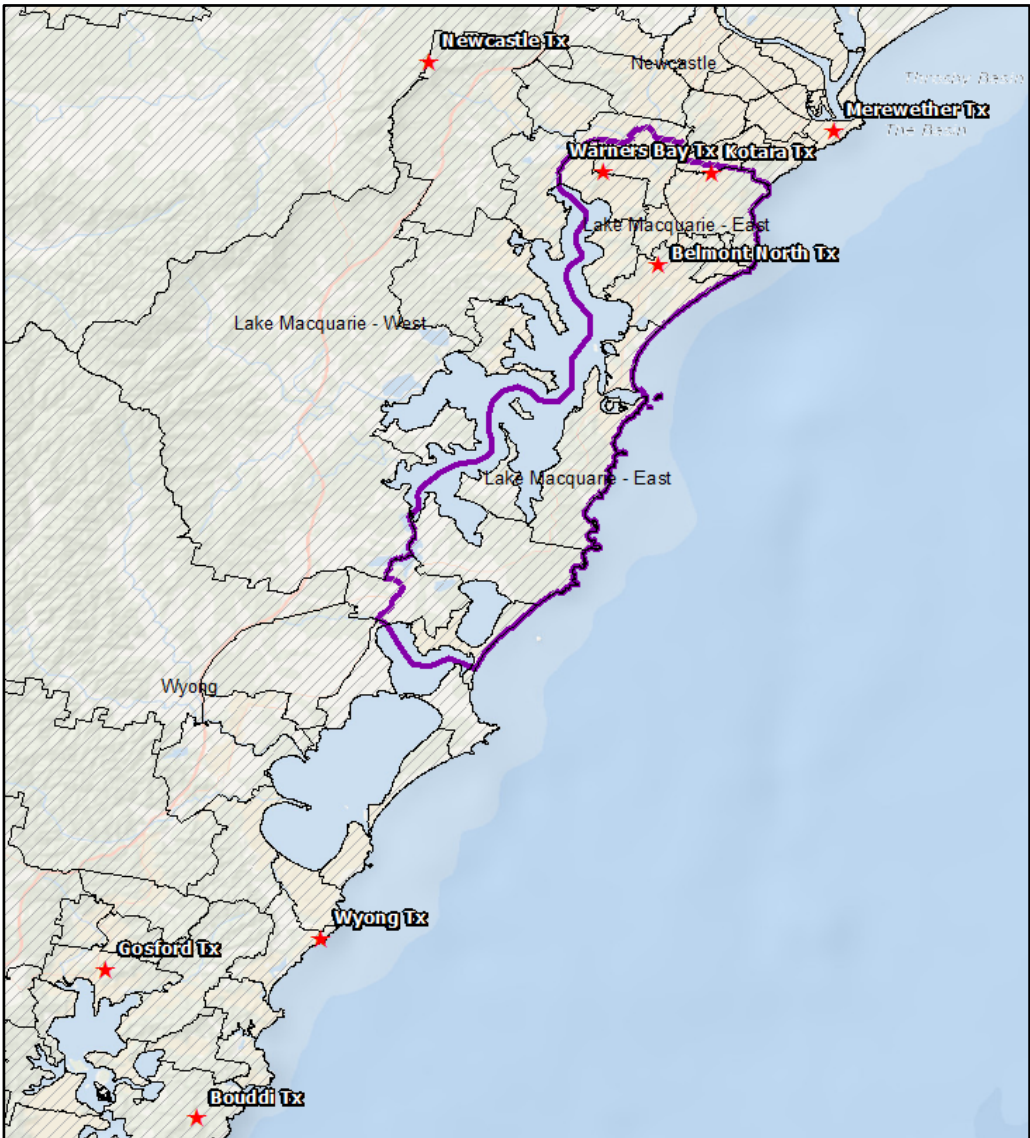
As part of this initiative, the ACMA was tasked to undertake a field reception study to identify the cause of reception difficulties and to recommend possible solutions. Funding will be provided by way of a grant to establish the necessary new or upgraded television transmission infrastructure identified by the ACMA. Funding of \$2.5 million is allocated across three years 2022-23 to 2024-25³.

Shortland electorate

The Shortland electorate is located South of the city of Newcastle in New South Wales. Figure 1 shows a map of the Shortland electorate including the locations of terrestrial television transmitters in and around the area.

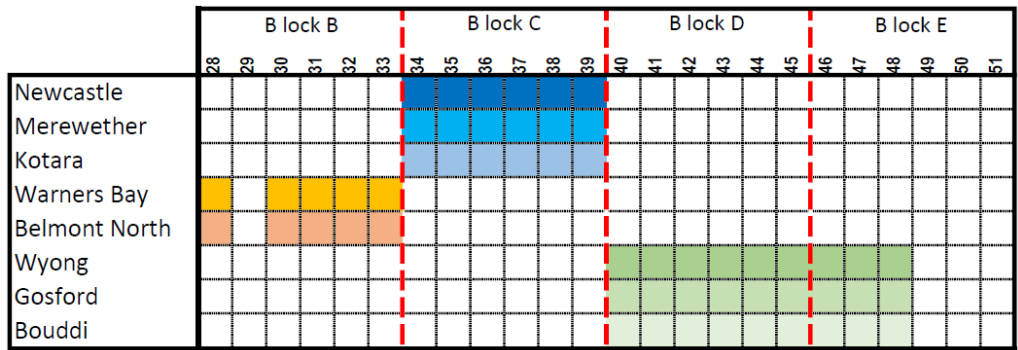
³ [Regional Ministerial Budget Statement 2022-23](#), October 2022.

Figure 1: Map of the Shortland electorate including the locations of terrestrial television transmitters



The Shortland electorate is within the Northern New South Wales TV1 licence area. Parts of the Shortland electorate below Catherine Hills Bay are also included in the Sydney TV1 licence area. Figure 2 shows the television channels used at each broadcast site in and around the area.

Figure 2: Channel plan for transmitters in and around the Shortland electorate



The Greater Newcastle region, including the Shortland area, is a complex and challenging environment for TV reception, due to:

- > the number of TV transmission sites with overlapping coverage, deployed to address television coverage deficiencies in areas with hilly terrain blocking the signal. There are 3 television transmitters within the Shortland electorate and an additional 3 that provide coverage to Shortland but are located outside the boundary of the electorate (shown in Figure 1).
- > the very limited number of television channels (frequencies) available, requiring the use of Single Frequency Networks (SFN), or networks of transmitters which re-use the same TV channels at two or more TV transmission sites. There are 3 separate SFNs in the area (indicated by the transmitters utilising the same channels in Figure 2), 2 SFNs have 3 transmitters and the other with 2 transmitters.
- > the provision of both metropolitan and regional commercial services in the Central Coast overlap area of the Sydney Metro and Regional Northern NSW TV licence areas; and
- > the potential for interference from the high-powered co-channelled Illawarra transmitter due to atmospheric ducting.

There is a history of complaints regarding television reception in and around the Shortland area since the digital switchover in 2013. In 2017, the ACMA released a [fact sheet](#) on TV reception issues in the Greater Newcastle region which includes the Shortland area.

Methodology

To address the request to undertake a field reception study to identify the cause of reception difficulties and to recommend possible solutions, the ACMA has conducted extensive analysis of terrestrial television coverage in the Shortland area which is detailed in this report. The analysis consists of four components:

1. A desktop analysis of predicted terrestrial television coverage identifying areas of potential coverage deficiency.
2. Fixed monitoring of terrestrial television signals in the area to investigate signal variations over time.
3. Field survey to measure the strength and quality of signals at specific locations; and
4. Field survey of household antennas across the Shortland area.

The analysis conducted as part of each of these four components is detailed in the proceeding sections of this report. The results have been analysed to develop observations regarding terrestrial television coverage in the Shortland area which are detailed at the end of this report.

Coverage and reception

Coverage principally relates to the broad geographic extent a television signal is available to a predetermined 'usable' level. It is determined by the characteristics of the transmitter (such as site location, height, power and antenna) and the geography of the area which influences propagation of the signal. Target coverage area is therefore a matter for the broadcaster in deciding the transmission parameters and where to locate transmitters.

There are different levels of coverage in a coverage area. Coverage areas are predicted based on computer modelling undertaken by the ACMA. Predicted coverage

may differ from actual coverage or the actual reception of the transmitted signal in an area.

Coverage is a predicted level of digital TV signal strength, while reception is the quality of the signal that your television actually receives. For example, if your television is not connected to an antenna, it may not be able to receive the television signal, even if you are in a good coverage area.

Coverage can be also affected by localised obstructions such as the built environment, trees/forests and local terrain. The detailed, localised impacts of the built environment and trees/forests are not (and cannot be) generally captured in coverage predictions. However, some degree of margin is inherent in coverage predictions which accounts for some of these affects. In some cases, local terrain can be considered when modelling coverage, but often cannot be due to the limitations of accounting for small terrain features in computer models.

Reception relates to the ability of an individual viewer to receive a television signal where coverage is present. This is in large part determined by the viewer having an appropriate television receive system in place. This includes a suitable external antenna pointing at the correct site along with their television being tuned to the correct channel. Importantly, while a viewer may have adequate coverage, they may not have reception if they do not have a suitable receive system.

When considering the viewer experience both coverage and reception factors must be considered.

The quality of the coverage provided by a terrestrial broadcast transmitter can be measured in terms of signal level, to measure the strength of the signal, and modulation error ratio (MER), to measure of the signal quality taking into account the sum of all interference effects occurring on the transmission channel. MER is closely related to the carrier-to-noise ratio (C/N).

Usable field strength is the level of field strength needed to provide adequate reliable reception. The television transmitters providing coverage to the Shortland area transmit in band 4 and 5. The Digital Terrestrial Television Broadcasting Planning Handbook (DTTB Planning Handbook) provides technical information relating to digital television planning. Table 4.1 of the DTTB Planning Handbook states that the minimum median field strength required for digital television services is 50 dB μ V/m in band 4 and 54 dB μ V/m in band 5.

Digital television planning is based on planning assumptions regarding the notional receiving system which are outlined in the DTTB Planning Handbook. This includes the use of outdoor receive antennas placed 10 metres above ground level. That is, in threshold coverage areas to receive the predicted level of coverage, viewers may have to install their antennas up to 10 metres above ground level which in some cases is higher than residential roof height. Other technical characteristics required for receivers are outlined in Appendix D of the DTTB Planning Handbook.

Appendix D of the DTTB Planning Handbook states that for a DTTB notional receiving system a minimum receiver input voltage of 30 dB μ V and C/N (MER) of 20 dB is required for a band 4 service and 31 dB μ V and a C/N (MER) of 20 dB is required for a band 5 service.

ACMA staff have conducted extensive field measurements of digital terrestrial television signals across the country over the past decade. Based on this work, experience suggests that a minimum signal level of around 45 dB μ V and a minimum

of around 25 dB of MER should provide an adequate stable television reception in the majority of cases.

In the analysis of measurements conducted as part of this project we have used a signal level of 45 dB μ V and a MER of 25 dB and above as the threshold, usable signal level and MER to classify a measurement indicating good quality reliable TV reception (Green).

If both the measured signal level and MER were below the threshold, then the measurement is classified as indicating poor-quality TV reception (Red).

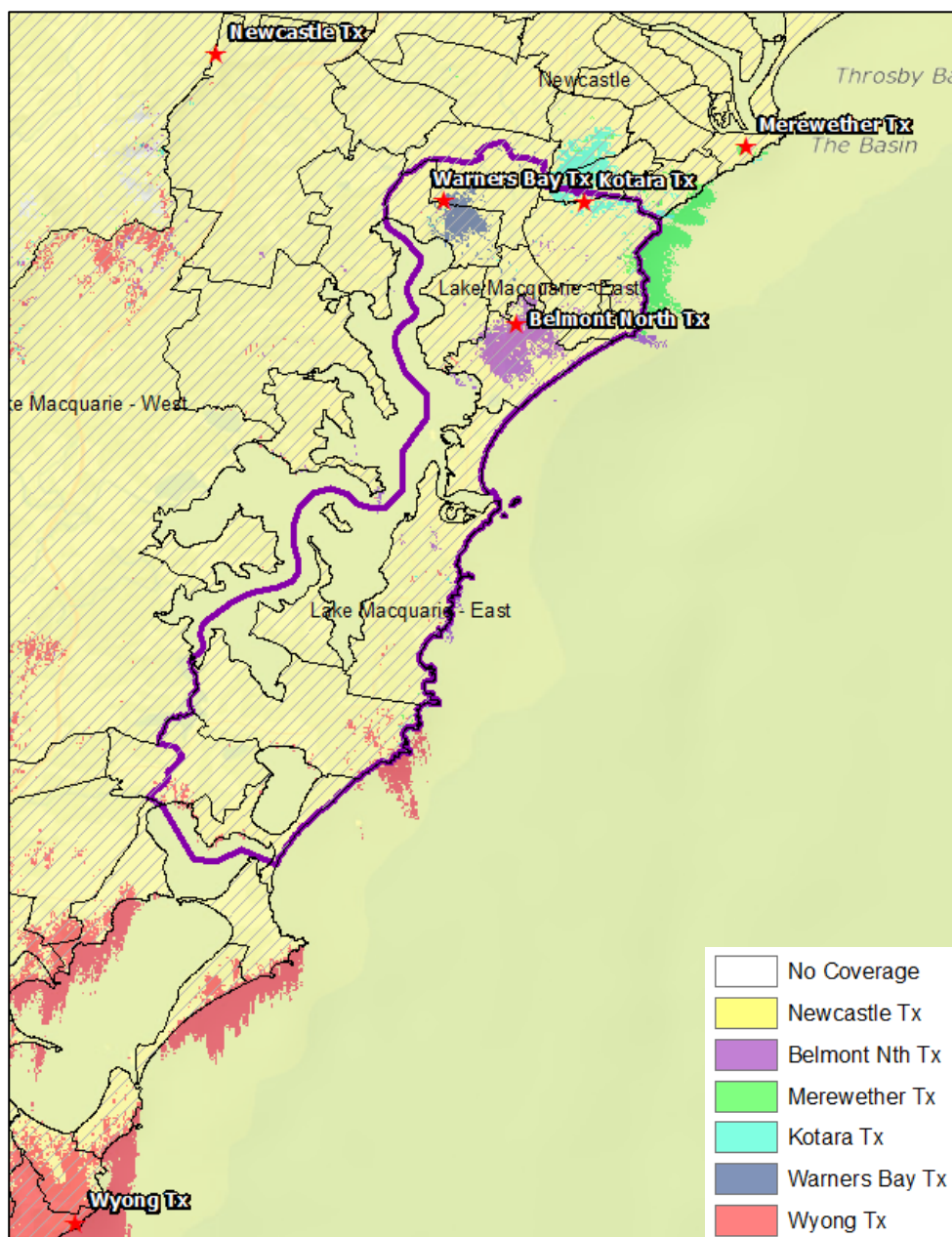
If one of either the measured signal level or the MER was below the threshold, then the measurement is classified as indicating variable quality TV reception (Yellow).

Note that even at the locations that were classified as receiving variable (Yellow) or poor (Red) quality TV reception, the measurement equipment was able to receive and decode television signals (i.e., a service was available to watch). But as the measurements were close to the usable signal and MER threshold levels, and the measurements were only a representation of the television reception at that instant in time, other external factors like signal fading, weather, atmospheric ducting etc. could influence the reception and these locations might not receive reliable reception.

Desktop coverage analysis

Figure 3 shows a map of terrestrial television coverage in the Shortland area as predicted using computer modelling and the 'best server' approach, that is, identifying which television transmitter provides the best coverage (in terms of signal strength) in a particular area. The different colours indicate which transmitter provides the highest signal level at a particular location. As can be seen from Figure 3, the Newcastle transmitter, shown in yellow, is the dominant transmitter in this area. A minimum field strength of 50 dBµV/m as stated in Table 4.1 of the DTTB Planning Handbook has been used for the coverage predictions in this report. That is, the areas where minimum field strength is predicted to be less than 50 dBµV/m are shown as "no coverage".

Figure 3: Map showing terrestrial television coverage in the Shortland area



It should be noted that every transmitter in Australia is likely to have black spot areas within its targeted coverage area where adequate coverage cannot be achieved due to terrain, local vegetation or obstructions. This issue is not unique to the Shortland area.

Also, for a viewer to receive the predicted level of coverage they would need to have their antennas installed 10 metres above ground level, which in some cases is higher than residential roof height.

Monitoring analysis

Atmospheric ducting is a phenomenon which causes radio signals to propagate greater distances. In the planning of broadcasting services, this can mean that signals from transmitters on the same frequency can carry to an area some distance away and cause interference.

Atmospheric ducting is considered in the planning of broadcasting services when determining the frequency reuse distance, that is, the distance required between transmitters using the same frequency for different services. In most cases, transmitters utilising the same frequency are separated by sufficient distances to avoid interference. However, there are small percentages of time where conditions are conducive to atmospheric ducting and interference may occur. This is an unavoidable reality of broadcast spectrum planning. Due to the nature of atmospheric ducting, the location and severity of this phenomenon is highly variable and unpredictable.

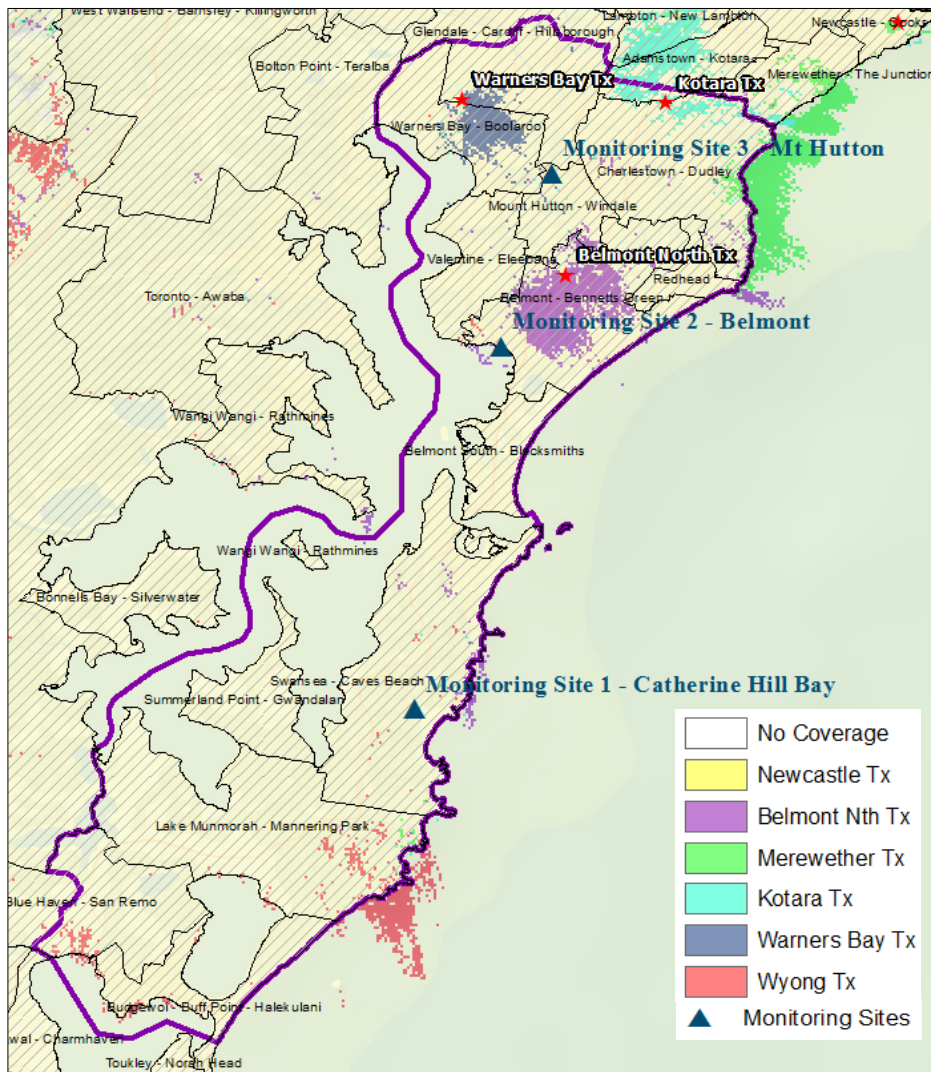
Interference due to atmospheric ducting presents as a drop in the MER of the transmitted signal.

Ducting is a known issue in this area. At certain times, distant TV signals from the Illawarra transmitter can travel much further than they normally would, which causes interference to the reception the main Newcastle transmissions in the Greater Newcastle region.

At the time of the digital switchover and television restack in 2013, planning decisions were made in partnership with the broadcasting industry regarding which transmitters would be planned on the same frequency blocks. As there are limited frequency blocks (5 available blocks of 6 frequencies) available for use across the entire country transmitters need to be planned on the same frequency blocks. Reuse of these 5 blocks of channels is necessary to be able to provide television services to the majority of the population, however there is a risk of interference from ducting. The transmitters for the Illawarra area and the main Newcastle region were planned on the same frequency block.

To assess the impact of ducting, fading or other issues on television reception in the Shortland area, Digital TV Monitoring Systems (DVMS) were installed at 3 chosen locations. The three locations are shown in the map in Figure 4.

Figure 4: Location of Digital TV Monitoring System (DVMS) in the Shortland electorate



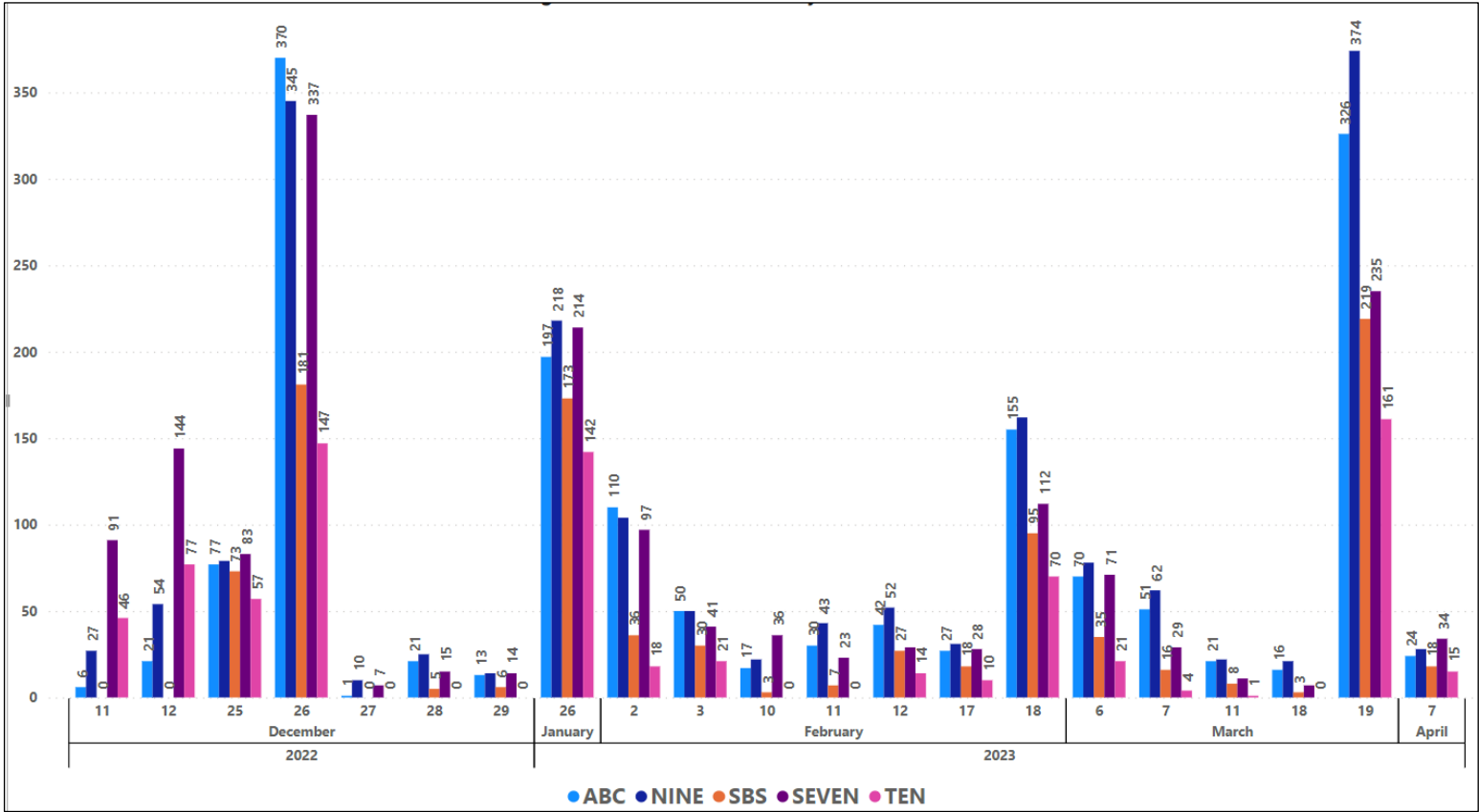
Findings

Monitoring of TV reception was conducted from 3 locations, the northern part of Catherine Hill Bay, Belmont and Mt Hutton. Both TV signal level and MER are important for receiving adequate TV reception. Figures 5, 6 and 7 show the number of times the MER of the TV signal dropped below 25 dB in the period monitored. This drop in MER could be due to one of, or a combination of, various factors. Some common factors for this drop in MER could be ducting, fading, input signal issues or site outage.

The MER dropped below 25 dB for the following percentage of measurements at each of the monitoring sites:

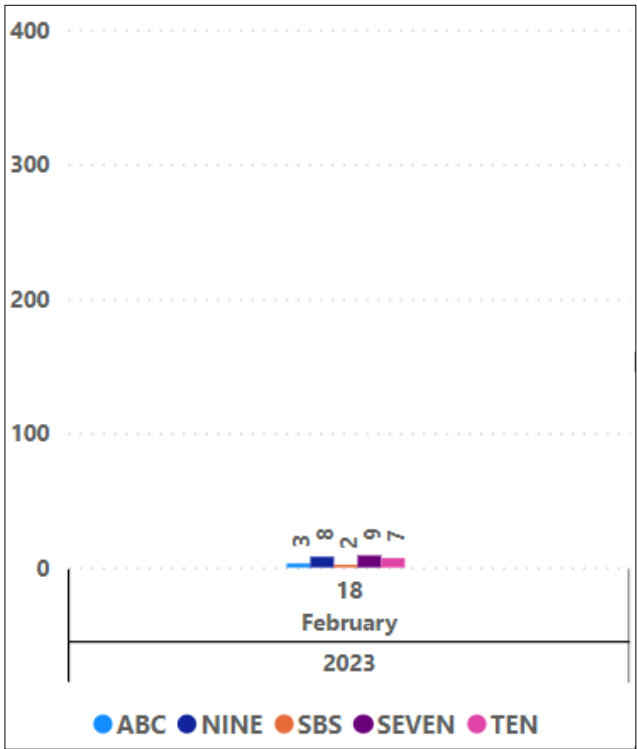
- > 1.2% at Catherine Hill Bay
- > 0.01% at Belmont
- > 0.12% at Mt Hutton

Figure 5: Monitoring Site 1 – Catherine Hill Bay – Count of MER < 25 dB



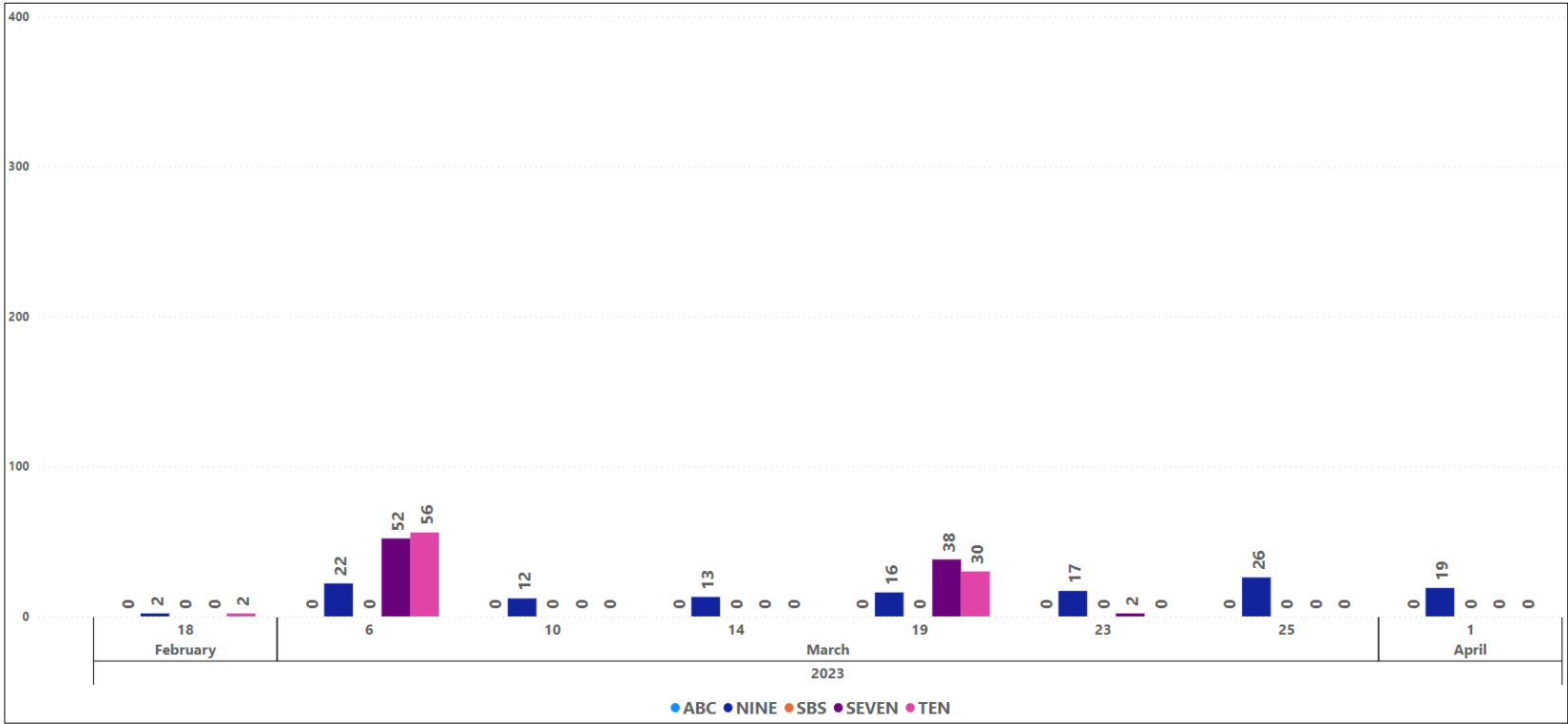
At Catherine Hill Bay site monitoring was conducted between 8 Dec 2022 and 16 Apr 2023. The TV signal parameters were measured around 148,265 times during the monitoring period. The above picture shows the number of times the MER dropped below 25 dB. Of the 148,265 measurements the signal MER dropped below 25 dB for a maximum of 1843 times which equates to 1.2% of times.

Figure 6: Monitoring Site 2 – Belmont – Count of MER < 25 dB



At Belmont site monitoring was conducted between 5 Jan 2023 and 16 Mar 2023. The TV signal parameters were measured around 50,809 times during the monitoring period (note measurements were not conducted on all days during the monitoring period). The above picture shows the number of times the MER dropped below 25 dB. Of the 50,809 measurements the signal MER dropped below 25 dB for a maximum of 9 times which equates to 0.01% of times.

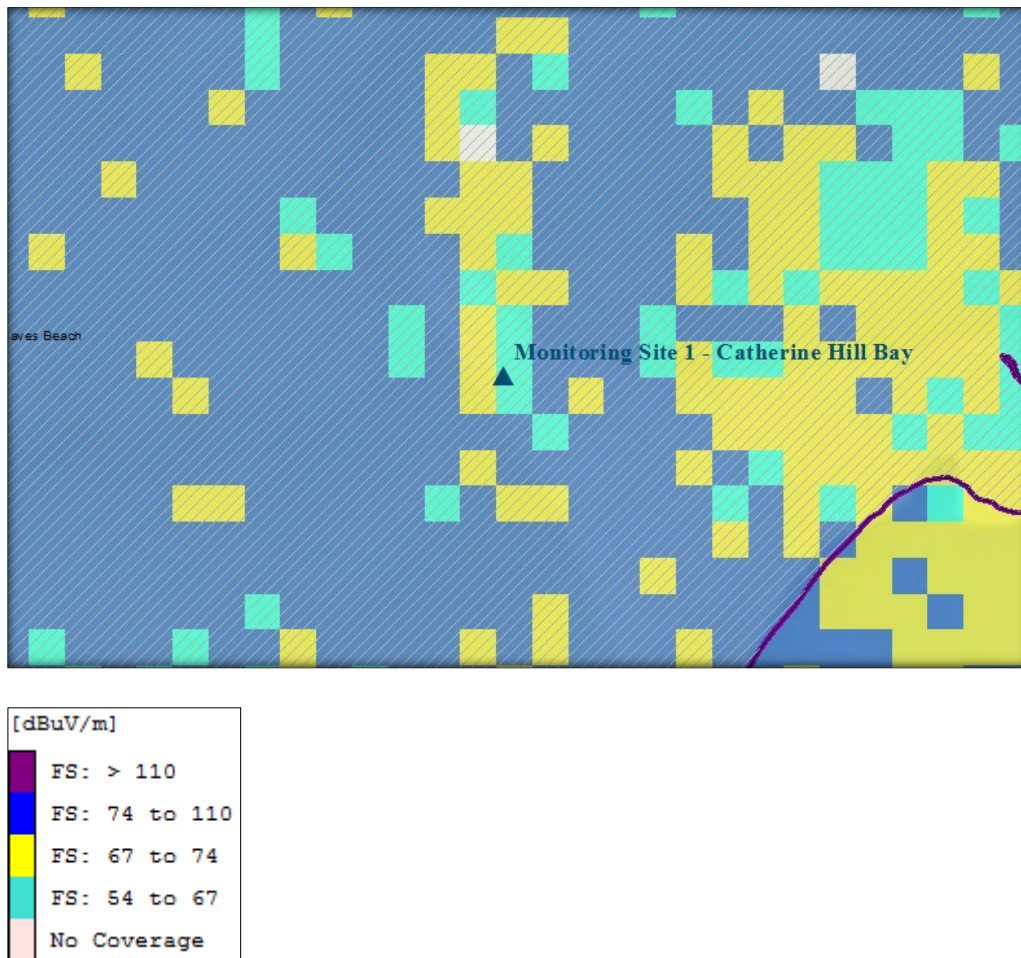
Figure 7: Monitoring Site 3 – Mt Hutton – Count of MER < 25 dB



At Mt Hutton site monitoring was conducted between 3 Feb 2023 and 13 Apr 2023. The TV signal parameters were measured around 106,398 times during the monitoring period. The above picture shows the number of times the MER dropped below 25 dB. Of the 106,398 measurements the signal MER dropped below 25 dB for a maximum of 127 times which equates to 0.12% of times.

Of the three monitoring sites, Catherine Hill Bay experienced the most instances of MER dropping below the threshold of 25 dB during the period monitored. This site is the farthest of the three monitoring sites from the Newcastle transmitter. As shown in Figure 8, the location was predicted to receive TV signal field strength between 54 and 67 dB μ V/m which is closer to the threshold levels than the other sites. The other two monitoring sites are predicted to receive TV signal field strengths of greater than or equal to 74 dB μ V/m.

Figure 8: Predicted coverage at the Catherine Hill Bay monitoring site



Summary

Overall, the results indicate that parts of the Shortland area experience intermittent drops in signal quality which could result in poor television reception. These drops may have been caused by atmospheric ducting. However, they are only for very small percentages of time.

Interference due to atmospheric ducting is difficult to remedy given there is already limited spectrum available for television broadcasting services in this area and there are multiple transmission sites making it a complex area for broadcast spectrum planning. Interference could be prevented by changing the operating frequency of either the Newcastle or Illawarra transmitters. However, this would likely simply shift interference due to atmospheric ducting to a different location.

Measurement analysis

In order to assess the strength and quality of terrestrial television broadcast signals in the Shortland area, two rounds of field measurements were conducted. Field measurements are where a signal is measured at a particular point in time in contrast to the monitoring analysis detailed in the previous section where signals were monitored over an extended period of time.

The first round of measurements was conducted between 20 February and 24 March 2023. The measurement locations were selected by analysing the predicted coverage for the Shortland area and identifying locations that were predicted to experience a range of signal levels covering a broad sample of the Shortland area.

The second round of measurements was conducted between 19 and 30 June 2023. The locations were selected based on data collected from the first round of measurements and locations of respondents to the survey conducted in 2017 by the Federal Member for Shortland Pat Conroy MP (the MP survey) that rated their coverage between 1 and 5 out of 10.

Measurements were conducted at 99 locations in total. Of the 99 locations measured 42 locations were either at or close to the addresses of respondents to the MP survey.

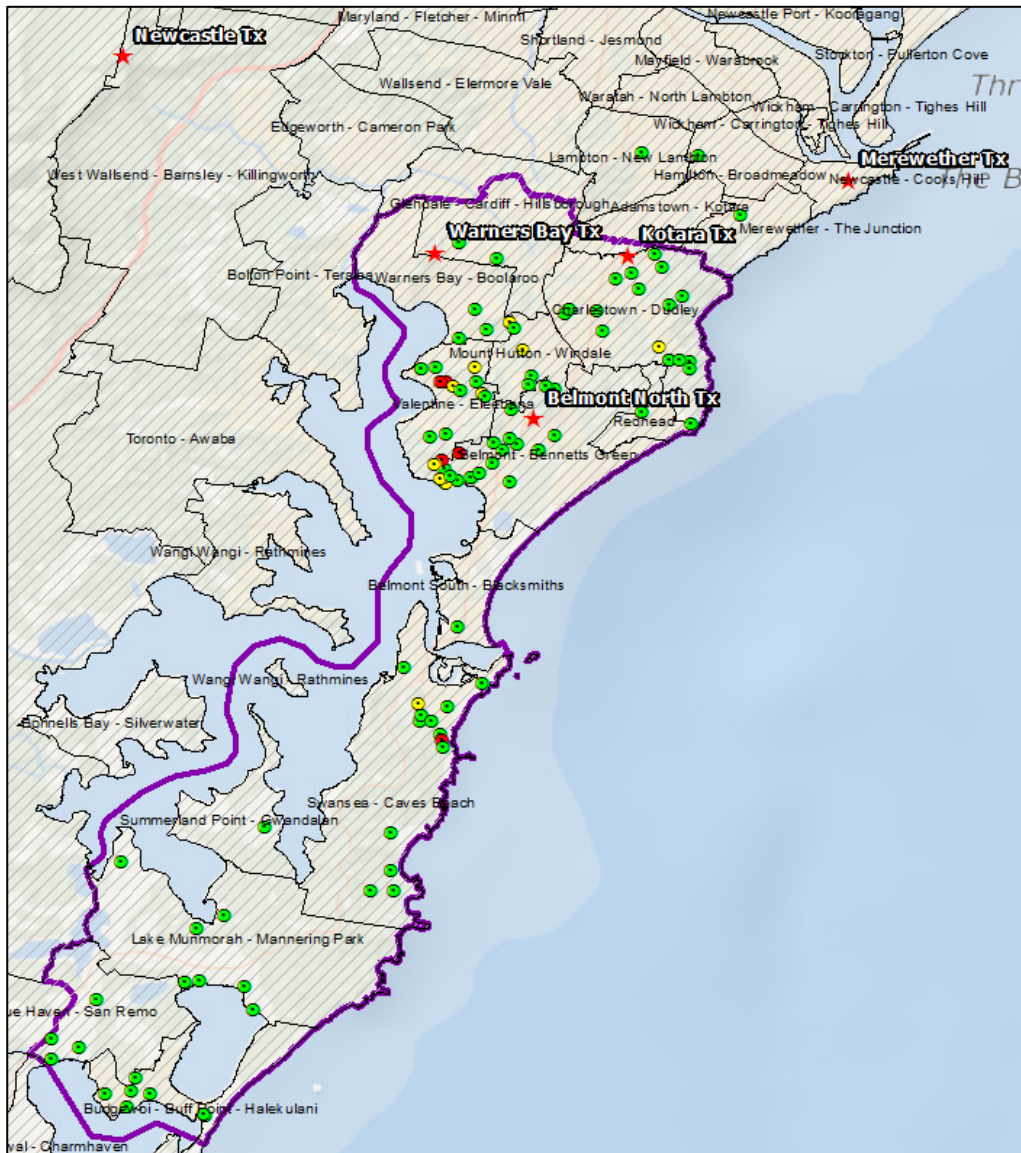
Measurements were conducted by ACMA staff using field measurement equipment with a receive antenna height of 10 metres.

Findings

Figure 9 shows the locations of the measurement sites. Of the 99 sites measured, 15 sites indicated either variable or poor television reception. The locations of these sites are shown in Figure 10 overlaid with the predicted coverage using computer modelling and the 'best server' approach, that is, identifying which television transmitter provides the best coverage (in terms of signal strength) in a particular area.

It should be noted that in some locations reception of multiple transmitters may be possible.

Figure 9: Location of total 99 measurement sites in the Shortland area



Green circles show locations with a measured signal level of over 45 dB μ V and a MER of over 25 dB indicating good quality TV reception.

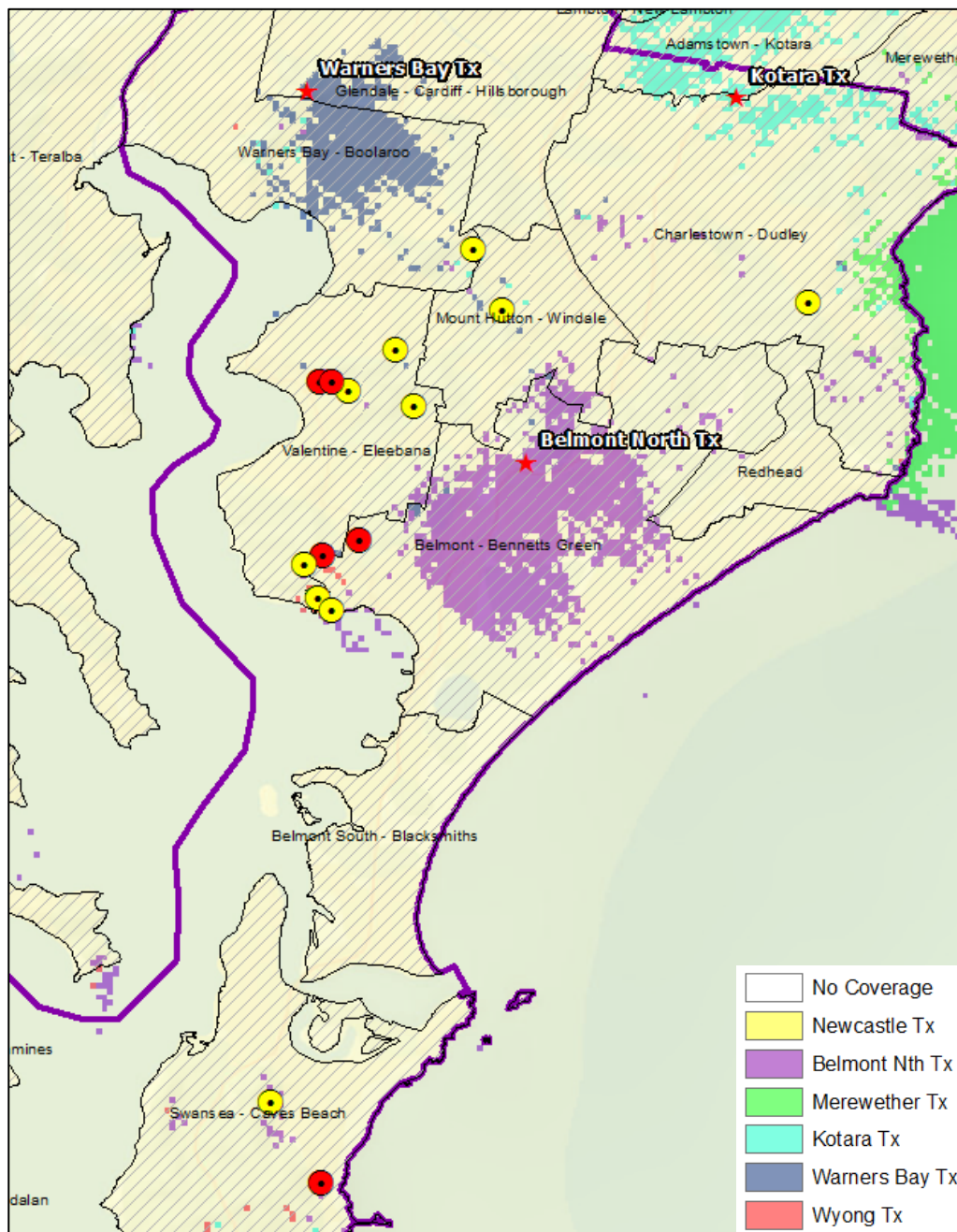
Yellow circles show locations where either the measured signal level was below 45 dB μ V or the MER below 25 dB indicating variable quality TV reception.

Red circles show locations with a measured signal level of below 45 dB μ V and a MER below 25 dB indicating poor quality TV reception.

Two locations within the Newcastle, Kotara and Merewether SFN outside of the Shortland electorate were used to take control measurements.

One location near New Lambton outside of the Shortland electorate was measured as it was listed in the MP survey.

Figure 10: Location of 15 measurement sites that indicated variable or poor television reception within the Shortland electorate



The measurement results indicate that in a majority of cases, signal level and MER is adequate to deliver good quality television reception. However, based upon a signal level of 45 dBuV and a MER of 25 dB, the measurements at some isolated locations in Caves Beach, Belmont, Eleebana, Mount Hutton and Dudley indicate either an inadequate signal level and/or inadequate MER for good quality television reception.

At all these locations it was observed that some level of terrain and vegetation is obstructing the line of sight to transmitters:

- > In Caves Beach, the areas where inadequate signal level and/or inadequate MER were measured are located at the foothill of a ridge at the West of Caves Beach. This shadows the signal from the Newcastle transmitter at Mount Sugarloaf to the North-West.

- > In Belmont, the areas where inadequate signal level and/or inadequate MER were measured are located at the foothill of two ridges. The first ridge at Green Point Foreshore Reserve shadows the signal from the Newcastle transmitter at Mount Sugarloaf to the North-West as well as the signal from the Warners Bay transmitter to the North. The second ridge at Laughlin Reserve shadows both the signals from the Belmont North transmitter to the North-East and the Warners Bay transmitter to the North.
- > In Eleebana, the locations where inadequate signal level and/or inadequate MER were measured are situated in valleys between local ridges such that there is no line-of-sight signal from the Belmont North transmitter to the East-Southeast. Similarly, some locations are tucked into the foothill of a ridge to the North of Woodside Drive in Eleebana which shadows both the signals from the Newcastle transmitter at Mount Sugarloaf to the North-West and the Warners Bay transmitter to the North.
- > In Mount Hutton, the locations where inadequate signal level and/or inadequate MER were measured are situated at the foothill of a ridge to the West-North-West of Deal Street Mount Hutton. This ridge shadows both the signals from the Newcastle transmitter at Mount Sugarloaf to the North-West and the Warners Bay transmitter to the North.
- > In Dudley, the location where inadequate signal level and/or inadequate MER were measured is situated at the foothill of a ridge around Banfield Lane, Twiston Street and Ashby Street Dudley. This ridge shadows the signals from the Newcastle transmitter at Mount Sugarloaf to the North-West, the Warners Bay transmitter to the North-West and the Kotara transmitter to the North. Similarly, local terrain shadows the signal from the Belmont North transmitter to the South-West.

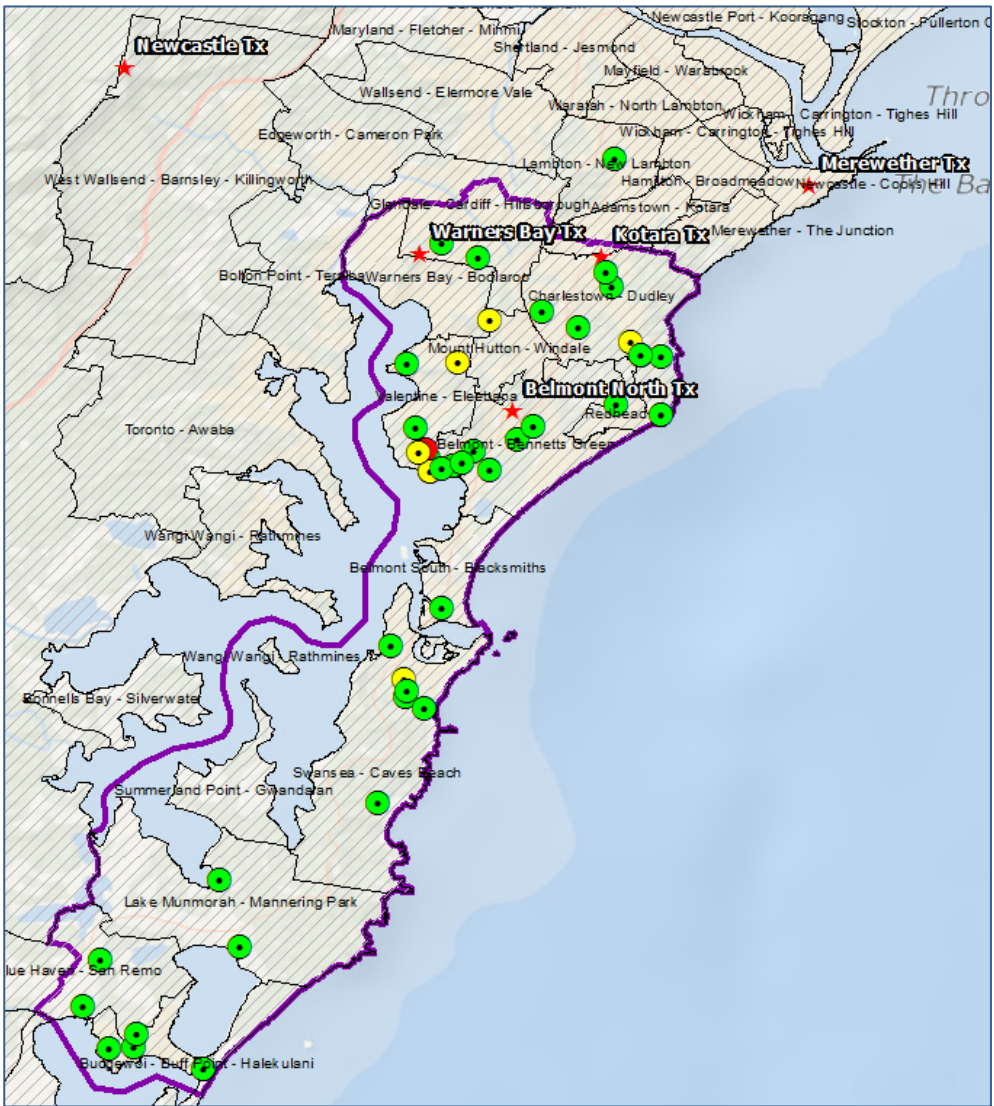
Importantly, at each location where inadequate signal level and/or inadequate MER was measured, there are nearby locations where adequate signal level and MER was measured, indicating that any possible deficiency in TV reception is very localised.

MP survey locations- measurements

42 of the 99 locations where measurements were undertaken were either located at or within very close proximity to the addresses of respondents to the MP survey that rated their television coverage between 1 and 5 (with 1 being the poorest coverage). The results are detailed in Appendix A. All the respondents who rated their television coverage between 1 and 3 and a sample of respondents who rated their television coverage between 4 and 5 were measured.

Figure 11 shows the location and results of measurements of these sites. Figures 12 to 15 show the measurement locations for respondents broken down by coverage rating. It should be noted that a number of the respondents to the survey were located in close proximity. Therefore 42 unique measurements covered the locations of 48 respondents to the MP survey of which 42 rated their coverage between 1 and 3 and 6 rated their coverage between 4 and 5.

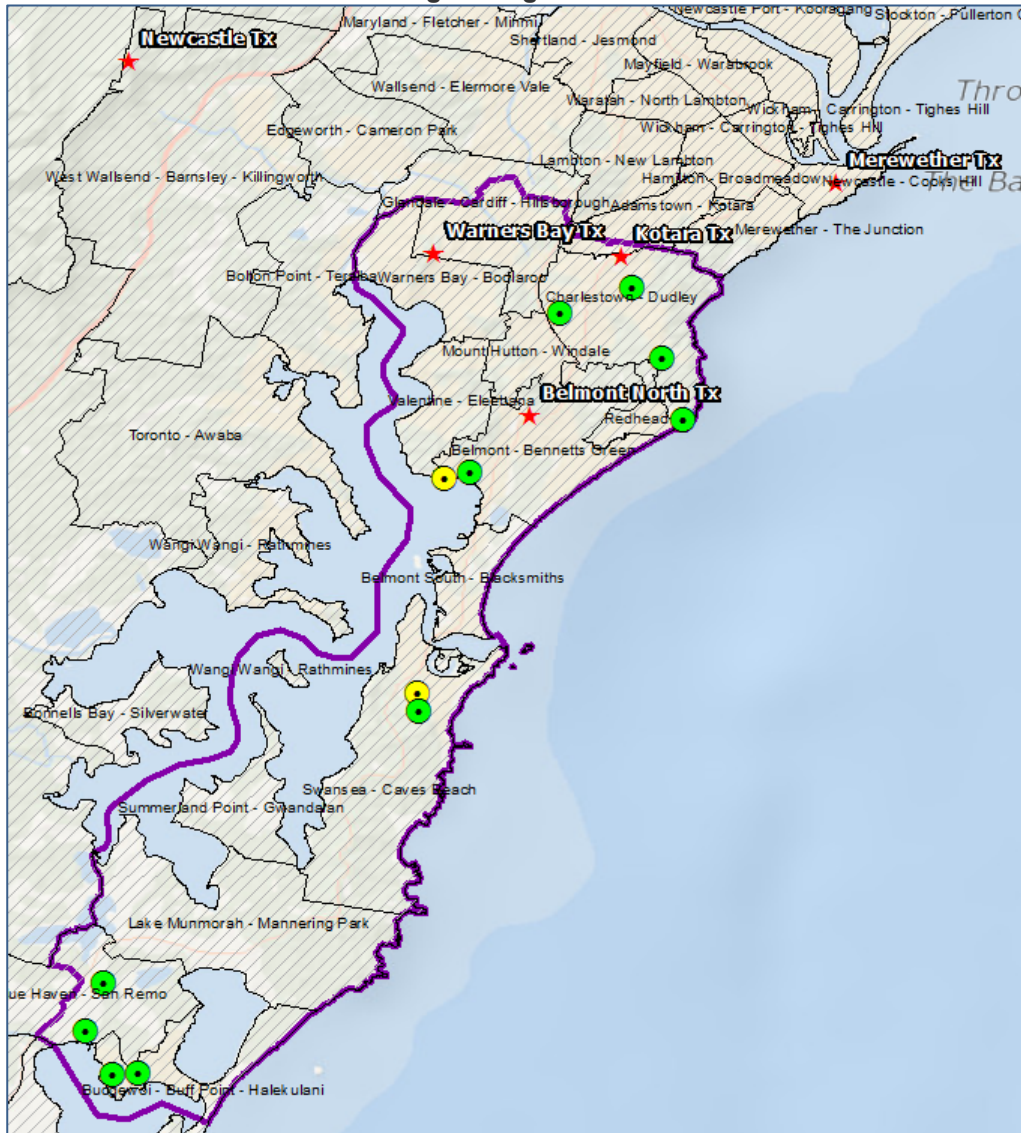
Figure 11: Measurement locations corresponding to MP survey respondent addresses within the Shortland area



New Lambton site location outside the Shortland electorate. Only 40 locations are visible within the Shortland electorate due to the scale of the picture and the locations of the measurement sites.

Figure 12 shows the location and results of measurements at sites where the respondent to the survey rated their coverage as 1 (poorest coverage).

Figure 12: Measurement locations corresponding to MP survey respondent addresses with coverage rating of 1 within the Shortland electorate



Only 12 locations are visible as in caves beach 3 respondents' addresses were close to each other so only one measurement was taken to represent the 3 addresses.

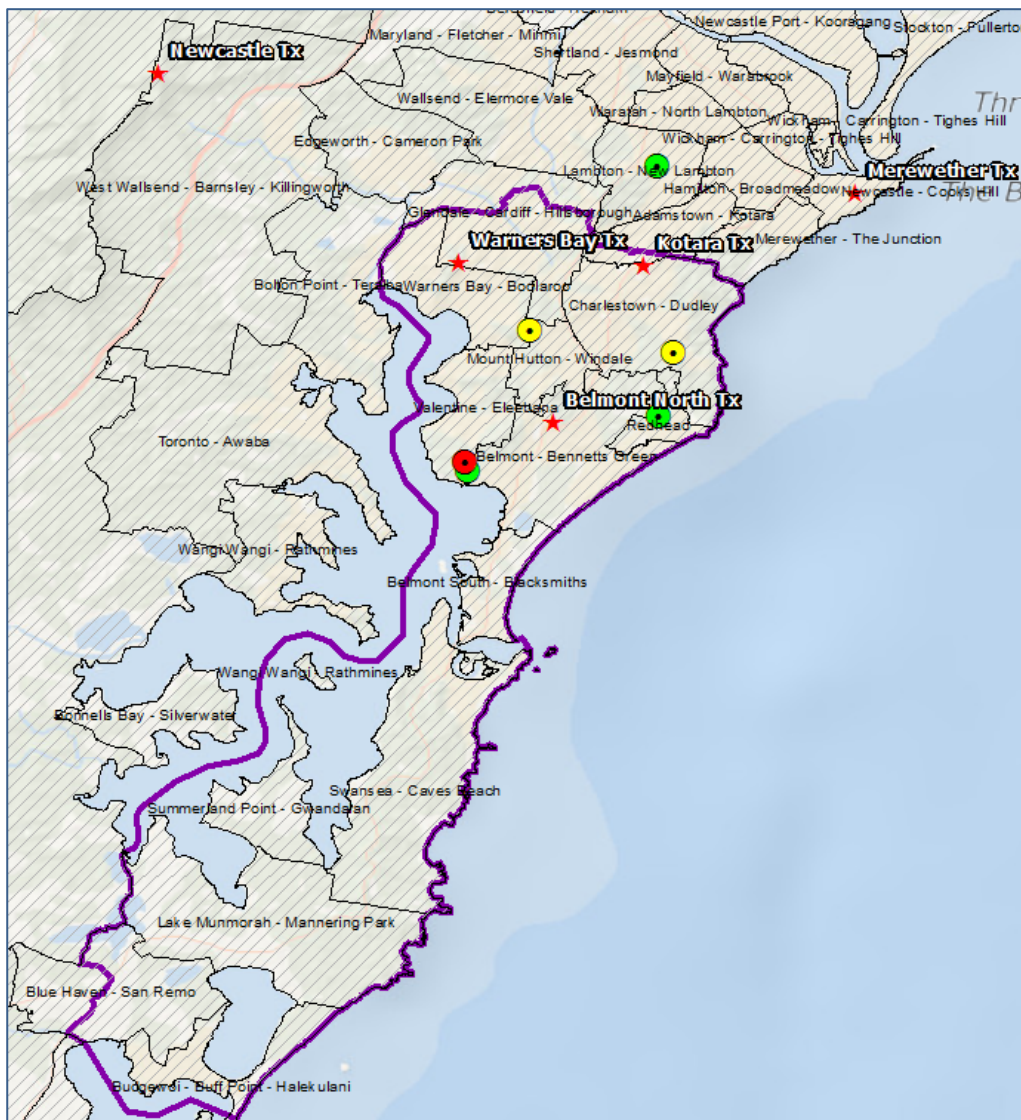
14 respondents to the MP survey rated their coverage as 1 (poorest). 12 unique measurements covered these 14 locations because in Caves Beach 3 respondents' addresses were close to each other so only one measurement was taken to represent the 3 addresses.

The measurement results indicate that in a majority of cases, television reception issues are not attributable to inadequate signal level or MER. Of the 14 locations where the respondent to the MP survey rated their coverage as 1 (poorest), only 4 locations showed variable quality TV reception and no measurements indicated poor quality TV reception. One of these locations was in Belmont and the other 3 locations were in Caves Beach. In each of these cases, the measured signal level was less than the threshold and the measured MER was above the threshold for good quality

television reception. It is worth noting that nearby locations show adequate signal level and MER and indicating that any possible deficiency in TV reception is very localised.

Figure 13 shows the location and results of measurements at sites where the respondent to the survey rated their coverage as 2.

Figure 13: Measurement locations corresponding to MP survey respondent addresses with coverage rating of 2 within the Shortland area

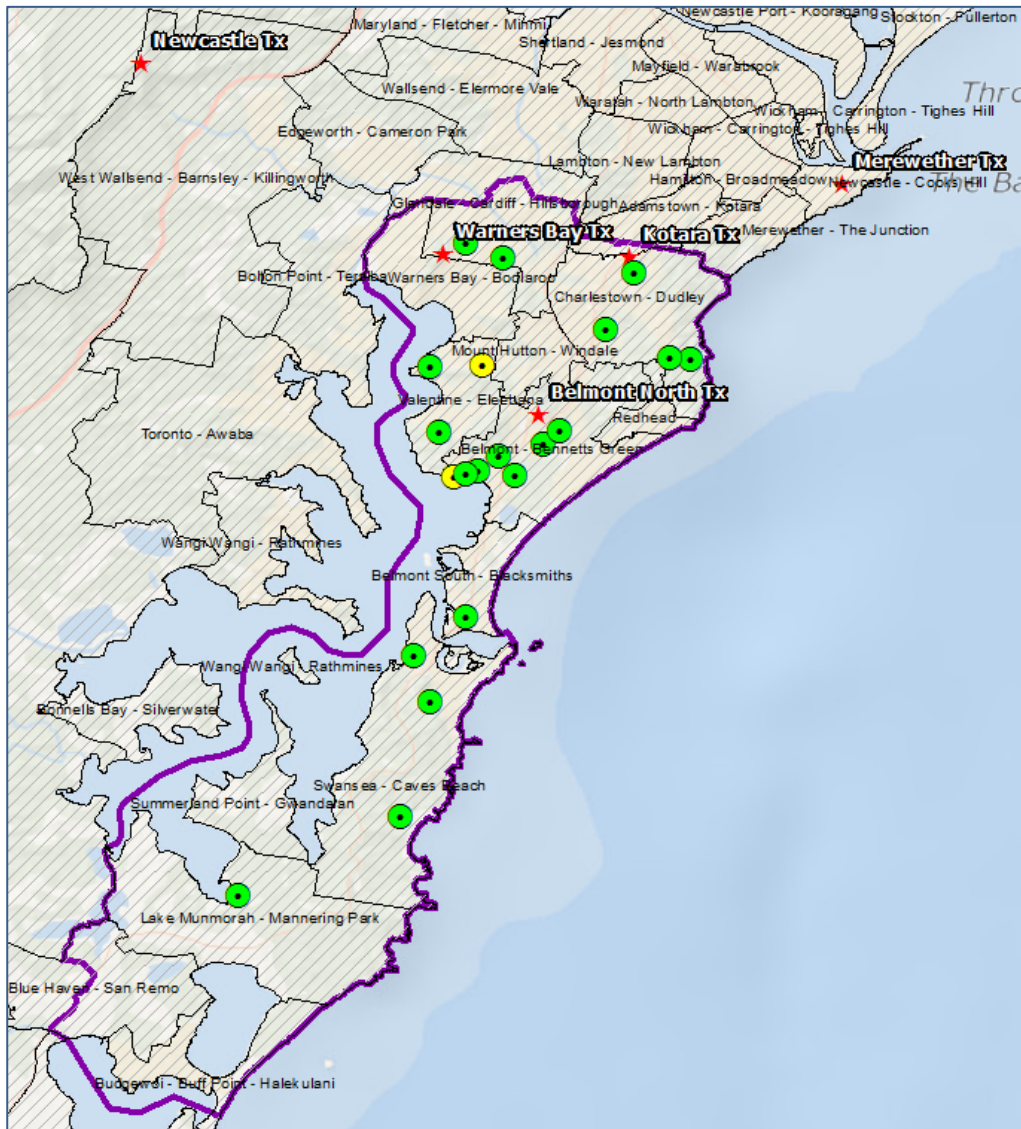


New Lambton site location outside the Shortland electorate.

6 respondents to the MP survey rated their coverage as 2. The measurement results indicate that in a majority of cases, television reception issues are not attributable to inadequate signal level or MER. Of the 6 locations where the respondent to the MP survey rated their coverage as 2, 3 locations showed variable or poor-quality TV reception. There was one location in Dudley (only MER below threshold) and one location in Mount Hutton (only signal level below threshold) where measurements indicated variable coverage. There was one location in Belmont where measurements indicated poor coverage (both signal level and MER below threshold). It is worth noting that nearby locations show adequate signal level and MER, indicating that any possible deficiency in TV reception is very localised.

Figure 14 shows the location and results of measurements at sites where the respondent to the survey rated their coverage as 3.

Figure 14: Measurement locations corresponding to MP survey respondent addresses with coverage rating of 3 within the Shortland electorate

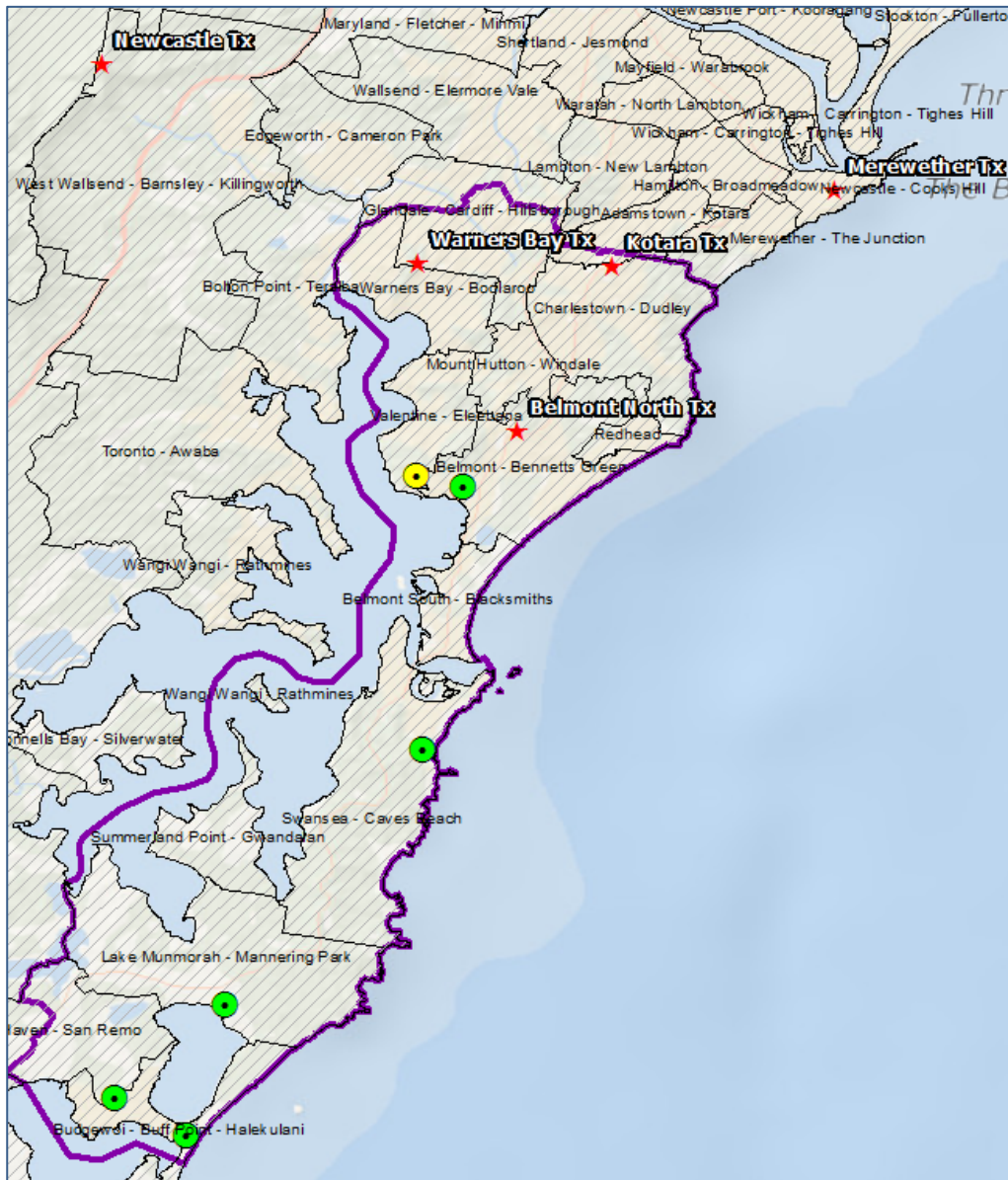


Only 21 locations are visible as in Belmont 2 respondents' addresses were close to each other so only one measurement was taken to represent the 2 addresses.

22 respondents to the MP survey rated their coverage as 3. The measurement results indicate that in a majority of cases, television reception issues are not attributable to inadequate signal level or MER. Of the 22 locations where the respondent to the MP survey rated their coverage as 3, 2 locations showed variable quality TV reception. There was one location in Eleebana (only MER below threshold) and one location in Belmont (only signal level below threshold) where measurements indicated variable coverage. It is worth noting that nearby locations show adequate signal level and MER, indicating that any possible deficiency in TV reception is very localised.

Figure 15 shows the location and results of measurements at sites where the respondent to the survey rated their coverage as 4 or 5.

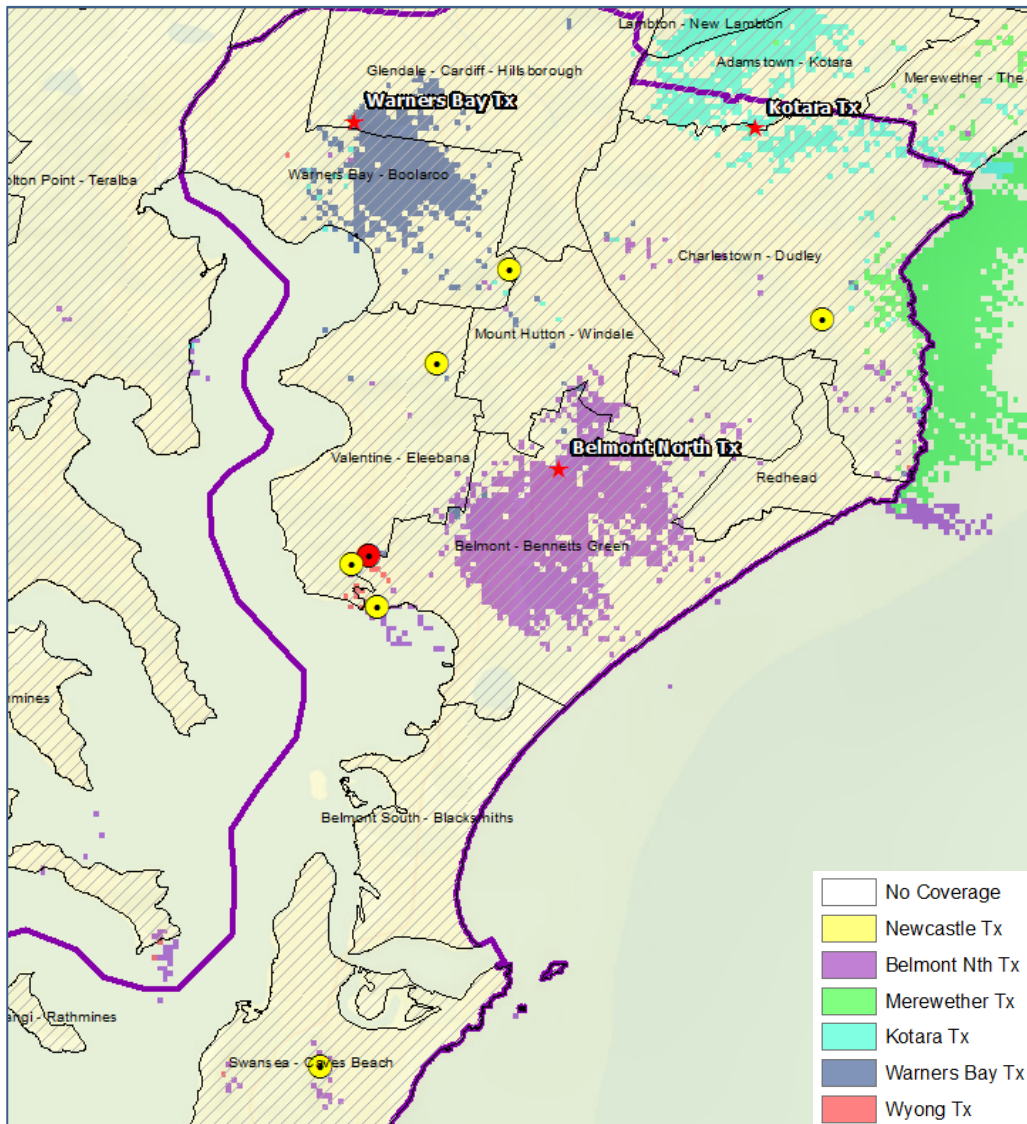
Figure 15: Measurement locations corresponding to MP survey respondent addresses with coverage rating of 4 or 5 within the Shortland electorate



6 respondents to the MP survey rated their coverage as 4 or 5. The measurement results indicate that in a majority of cases, television reception issues are not attributable to inadequate signal level or MER. Of the 6 locations where the respondent to the MP survey rated their coverage as 4 or 5, 1 location in Belmont (only MER below threshold) showed variable quality TV reception. It is worth noting that nearby locations show adequate signal level and MER, indicating that any possible deficiency in TV reception is very localised.

Figure 16 shows the locations of the 7 out of 42 measurement sites which correspond to MP respondent locations where results indicated variable or poor-quality TV reception. This is overlaid with the predicted coverage using computer modelling and the 'best server' approach, that is, identifying which television transmitter provides the best coverage (in terms of signal strength) in a particular area.

Figure 16: Measurement locations corresponding to MP survey respondent addresses where results indicated variable or poor-quality television reception within the Shortland electorate



Overall, the measurement results indicate that in a majority of cases, television reception issues are not attributable to inadequate signal level or MER. However, the signal level measured at some specific locations in Caves Beach, Belmont, Eleebana, Mount Hutton and Dudley indicate either an inadequate signal level or / and inadequate MER for good quality television reception.

Summary

The extensive field measurements conducted in the Shortland area indicate that, in the majority of locations, signal level and MER measured is adequate to deliver good quality television reception.

These field measurements generally reflect the coverage prediction modelling which indicates good television coverage to the entire Shortland area.

There are, however, some specific locations in Caves Beach, Belmont, Eleebana, Mount Hutton and Dudley that indicate either an inadequate signal level or inadequate MER or both (based upon a signal level of 45 dBuV and a MER of 25 dB) for good quality television reception. At all these locations it was observed that some level of terrain and vegetation is obstructing the line of sight to the transmitter.

At each of these locations, there are nearby measurement locations where both the signal level and MER was measured as sufficient for good quality television reception. This indicates that the areas of inadequate signal level and/or inadequate MER are isolated to a small number of residences or streets in each location.

Antenna survey analysis

The ACMA has conducted a survey of households' television (TV) antenna type, orientation and height in parts of the Shortland area. The aim of this survey was to collect evidence on the antenna pointing behaviour and other antenna characteristics which may influence the quality of television reception experienced in the Shortland area.

A number of factors related to the household television antenna will affect the quality of television reception received, including:

- > *Antenna type*- different types of antennas have different antenna gain characteristics. That is, some antennas better amplify the television broadcast signal than others.
- > *Antenna height*- antennas should be installed clear of all obstacles and in cases where the signals are variable, up to 10 metres high. Obstacles can include local terrain like hills or mountains and also vegetation like tall trees.
- > *Orientation and polarisation*- the effectiveness of an antenna is maximised if it is correctly polarised antenna pointing directly towards the television transmitter with the strongest signal level.
- > *Condition*- the general condition of an antenna will influence its effectiveness. For example, if an antenna has parts missing, is corroded, or the cabling is degraded, the quality of television reception may be reduced.

In some cases, a well-installed, good-quality antenna can assist in overcoming deficiencies in signal level in an area and facilitate good quality television reception.

Findings

Figure 17 shows the results of the antenna survey conducted around the Shortland area showing which broadcasting transmitter households have orientated their antennas towards. Figure 18 shows these results overlayed on a map of terrestrial television coverage in the Shortland area as predicted using computer modelling and the 'best server' approach, that is, identifying which television transmitter provides the best coverage (in terms of signal strength) in a particular area (previously shown in Figure 3).

Generally, for the best reception, a household should orientate their antenna toward the transmitter that delivers the strongest signal in their area. Within the Shortland area, the main transmitter is Newcastle transmitter. It can be seen from Figure 18 that the Newcastle transmitter provides the strongest signal across the majority of the Shortland area (as indicated by the yellow shading). This is reflected in the antenna survey results with overall the majority of surveyed households orientating their antenna toward the Newcastle transmitter.

The Shortland area is also served by a number of other transmitters including the Belmont North transmitter, the Warners Bay transmitter and the Kotara transmitter within the electorate and the Merewether transmitter and Wyong transmitter just outside the electorate boundary. The survey results indicate that some households are making use of these transmitters. However, there are a number of households that could potentially improve their reception by orientating their antennas toward these transmitters as the predictions indicate that they provide a greater signal level than the Newcastle transmitter.

Figure 17: Antenna survey results- orientation

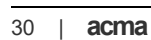
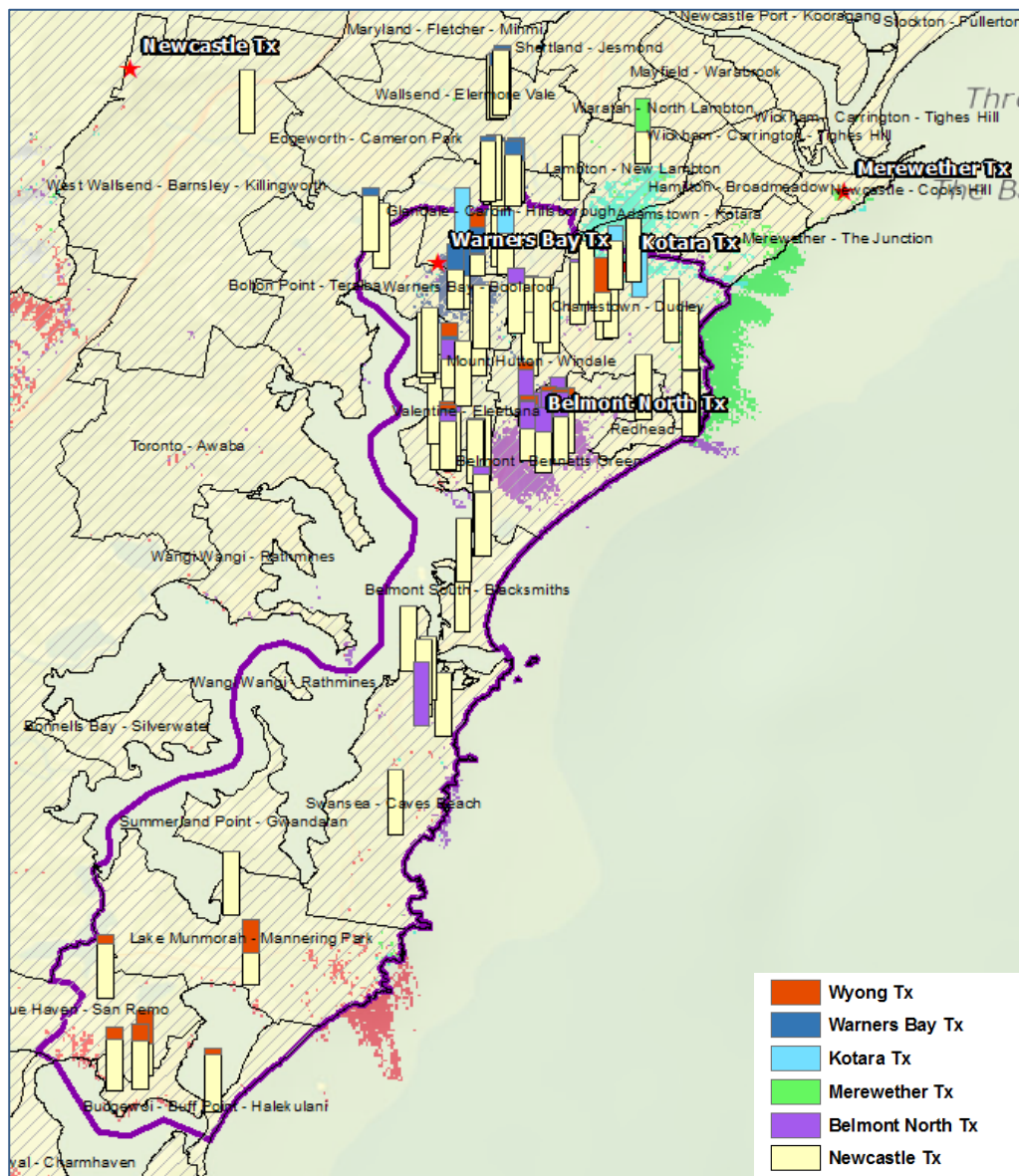


Figure 18: Antenna survey results- orientation overlayed on best server prediction



The antenna survey consisted of visual observations of household antenna arrangements which may or may not accurately reflect the actual implemented antenna receive system currently in place. Households were not contacted or visited as part of this survey. The visual field survey in the Shortland area indicates that majority of the antennas observed are pointing towards the Newcastle transmitter.

Surveyors observed that a majority of the older installations in the Shortland area were pointing towards the Newcastle transmitter, with some pointing toward the Wyong transmitter in the southern parts of the Shortland area.

The performance of antenna systems decreases as they age and degrade. Therefore, households with older antenna systems may experience an improvement in their television reception by replacing their antenna systems.

The newer installations closer to the Belmont North, Warners Bay and Kotara transmitters are pointing to these transmitters based on the location of the residence. Some older antenna installations near Belmont North, Warners Bay and Kotara

transmitters pointing to the Newcastle transmitter might receive better TV reception if they point to the local transmitter.

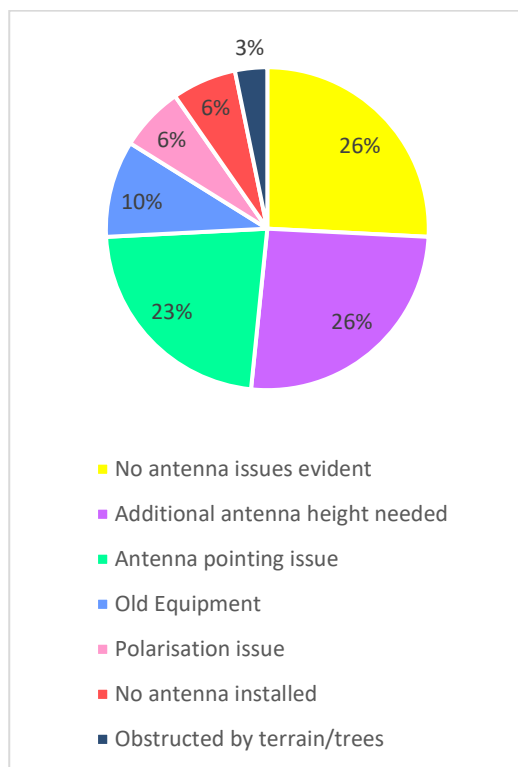
MP survey locations- Antenna survey

In addition to the antenna survey of a sample of locations around the Shortland area, ACMA staff conducted observations of the antenna characteristics at the addresses of respondents to the MP survey. The results are detailed in Appendix A.

From the analysis of the measurement survey, only 7 out of 42 measurement sites (16.7%) which correspond to MP respondent addresses indicated variable or poor-quality TV reception. Therefore, the reported reception issues for the other 83.3 per cent of locations are not able to be attributed to poor coverage.

To investigate the source of the reported reception issues for the remaining locations, the ACMA surveyed the antennas of respondents to the MP survey who rated their coverage between 1 to 5 out of 10 and where measurements indicated good quality TV reception. The results of this subset of the antenna survey are shown in Figure 19.

Figure 19: Antenna survey results- MP survey respondents that indicated poor reception where measurements showed good quality reception



Only 26 per cent of the households surveyed had no antenna installation issues evident which indicates that 74 per cent of the households surveyed could improve their television reception by adjusting their antenna installation. Surveyors identified 26 per cent of households where antenna height was relatively low. Antenna pointing was identified as an issue in 23 per cent of cases along with polarisation of the antenna⁴ identified as being incorrect in 6 per cent of cases. Old, degraded equipment and lack

⁴ For broadcast reception, household antennas are typically either horizontally polarised or vertically polarised. The polarisation depends on the transmitter which the household is using for television reception.

of antenna were also identified as potential issues affecting the quality of television reception in the households surveyed.

Summary

The results of the antenna survey indicate that the difficulties in the reception of television being experienced by viewers the Shortland area might be improved by the optimisation of antenna installations in a significant portion of areas. This is the case both generally in the Shortland area with some evidence that residents are not orientating their antenna toward the transmitter with the strongest signal, and also specifically when analysing the antenna set-ups of respondents to the MP survey which indicated poor television reception.

Overall observations

There are a number of factors which affect television coverage and television reception.

The quality of the coverage provided by a terrestrial broadcast transmitter can be measured in terms of signal level (a measure the strength of the signal), and modulation error ratio (MER) (a measure of the signal quality) taking into account the sum of all interference effects occurring on the transmission channel.

Television reception is determined not only by the quality of the coverage provided by a terrestrial broadcast transmitter but also by the equipment used to receive that coverage.

The results of this analysis indicate that poor television reception experienced by some households in the Shortland area is due to a combination of coverage and reception issues. While some coverage issues could be addressed by the installation of additional transmitters, this would be likely to further complicate an already complicated reception environment and would not rectify all issues.

The desktop coverage analysis, monitoring analysis and antenna survey analysis indicate that the quality of the coverage provided in the Shortland area is satisfactory, except in the following cases:

- > certain areas may experience interference from atmospheric ducting which results in a drop in MER and subsequent degradation in coverage.
 - > There are limited options available to improve coverage degradation due to atmospheric ducting should it occur. Additional in-fill transmitters may provide an alternative set of channels for viewers to watch provided they afford coverage to areas that are impacted by atmospheric ducting. However, they may introduce new areas of interference due to co-channel operation that could become a further reception issue. In any case, the monitoring analysis shows that signal is degraded below a suitable quality in the order of 1.2 per cent of the time of which some of this may be attributed to atmospheric ducting.
- > a small number of specific locations in Caves Beach, Belmont, Eleebana, Mount Hutton and Dudley where there is either an inadequate signal level or inadequate MER or both for good quality television reception.
 - > The specific locations which are experiencing inadequate signal level or inadequate MER or both for good quality television reception are not widespread and are limited to a few residences or streets in each location. These locations are spread across the Shortland area.

The antenna survey analysis showed that there is a reasonably high percentage of households where it was observed the receive antenna, or the installation and set-up of the antenna, may be adversely affecting the viewers reception of television.

This was the case in some areas identified as having inadequate signal. The television reception of these households may be improved by optimising their antenna systems.

Overall, given the small areas affected by inadequate signal level or inadequate MER (based upon a signal level of 45 dBuV/m and a MER of 25 dB) for good quality television reception, and that a reasonable percentage of reception issues being attributable to possible antenna system issues, a targeted information or assistance

campaign by broadcasters and/or the government to assist affected households may be beneficial. This could include information for viewers on adjusting their antennas and scanning their television receivers to optimise their reception of existing television services. Access to commercial professional antenna installer services may also assist some viewers to ensure that their household antenna system is appropriately setup for their environment.

Other methods to improve television reception could include access to Viewer Access Satellite Television (VAST) services to assist affected viewers to improve their television reception.

In-fill transmitters

Terrestrial television coverage issues can only be addressed by the installation of additional 'in-fill' transmitter sites (where possible) or increasing (where possible) the power of existing sites. Installing in-fill transmitters incurs costs and provides benefits that must be analysed to determine if doing so provides an overall beneficial. For new sites, costs include the capital and operational costs for installing and maintaining the additional site, the availability of suitable spectrum and the potential to complicate the TV coverage/reception environment for viewers. Benefits include providing coverage to viewers who had none before and potentially providing a better quality of signal⁵ to those who already have coverage from another site.

The results of this analysis indicate that poor television reception experienced by some households in the Shortland area is due to a combination of coverage and reception issues. While a small number of coverage issues could be addressed by the installation of additional transmitters, this would be likely to further complicate an already complicated reception environment and would not rectify all reception issues.

A careful cost/benefit analysis would assist in scoping the case or otherwise for proceeding with investigating additional transmitters. The ACMA notes that, historically, coverage deficient areas of this small scale have generally not been addressed by broadcasters installing additional transmitters. It should also be noted that every transmitter in Australia is likely to have black spot areas within its targeted coverage area where adequate coverage cannot be achieved due to terrain or local vegetation or obstructions. This issue is not unique to the Shortland area.

Depending on the requirements for any new in-fill transmitters, finding suitable frequencies for additional transmission sites in the Greater Newcastle region may be challenging. If a decision was made to proceed with additional transmission sites, the ACMA considers these would need operate as an SFN with existing sites or amongst the new sites because of limited spectrum availability in the area and the risk of increasing interference, and degradation to existing services, in nearby areas. This would likely make the area even more complex for television reception and may have knock-on effects to television coverage in other areas both within and outside the Shortland area. This would place additional importance on viewers having a correct antenna and receiver installation (antenna pointing and television tuning) to receive the best television signal for their location.

Depending on specific implementation approaches adopted for any new broadcast sites, broadcasters would also need to consider implications for programming content feeds to these new sites.

⁵ The benefit of a better coverage to those who already have coverage could mean greater robustness to coverage in the event of interference events caused by ducting or other affects impacting normal signal coverage, for example.

Appendix A: Measurement results at MP survey locations

This Appendix contains personal information and has been removed for privacy purposes.