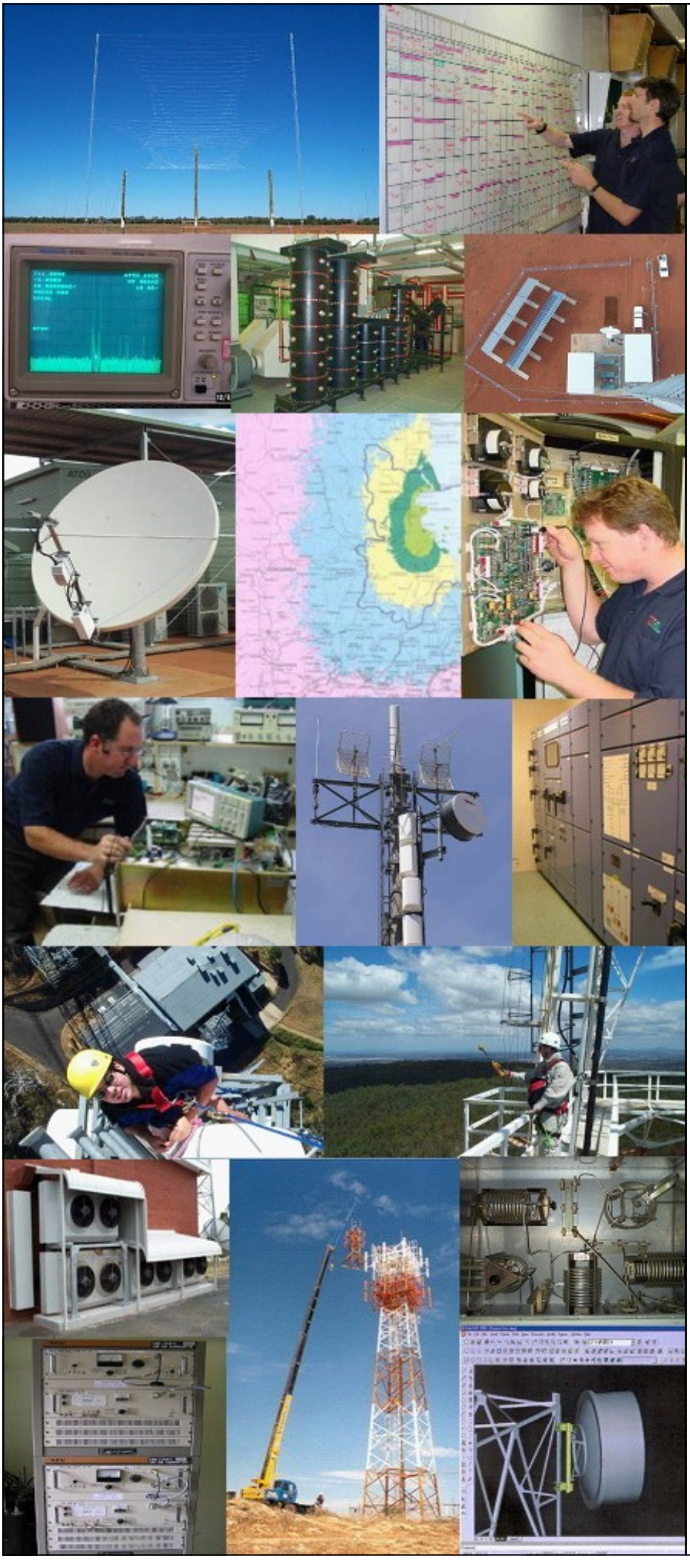

Royal North Shore Hospital Redevelopment

Gore Hill Transmission Site

29 June 2006

THL AUSTRALIA

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1 EXECUTIVE SUMMARY

NSW Health is proposing to lodge a Concept Plan with the Minister of Planning to guide the redevelopment of the Royal North Shore Hospital complex. This Plan foreshadows the development of new hospital buildings, the refurbishment of some existing buildings and the redevelopment of some hospital buildings for commercial and residential uses.

THL Australia has conducted a desktop analysis on the broadcast implications relating to the redevelopment of the Royal North Shore Hospital. Gore Hill tower, a major broadcasting and telecommunications site, sits a few hundred meters away from the proposed development. This potentially raises a number of issues regarding:

- RF EMR exposure from a health and safety point of view
- EMI for electrical devices within the new hospital developments
- Impact on existing microwave/LOS links on the tower
- Options for the redevelopment of the multi-storey carpark
- RF Ghosting as a result of signal reflection from the proposed new development

THL was supplied with an illustrative Master Plan (see appendices) together with elevations indicating the heights of the proposed buildings. Whilst this report considers and gives guidance for potential future development of the multi-storey car park (marked 9 and 10 on the illustrative Master Plan) it should be noted that the Concept Plan does not seek consent to any development north of Westbourne Street.

Results indicate the maximum EMR exposure level for the maximum transmitted power level (future use of the tower) is 9.5% of the *General Public Reference Level.* This exposure level is experienced at the height of 146 AHD on the rooftop of the existing Building 2 (otherwise known as the 'Big Brown Building' and marked 1c on the attached illustrative Master Plan). The buildings illustrated for other sites all have exposure levels of less than 9.5%. Current use of the tower yields a maximum EMR exposure level of 1.5% on the rooftop of the residential building proposed for site 7.

The maximum RF field of 9.5% at 146m AHD falls in between the two EMI standards of 3 V/m for general electrical equipment and 10 V/m for critical medical electrical equipment. This indicates the potential for EMI to be caused in poorly shielded general electrical equipment. If EMI does eventuate, it may be overcome by building materials with good reflective/absorptive properties.

The development proposed in the Concept Plan is not expected to interfere with the existing microwave link from Gore Hill Tower to North Head broadcast station. The link travels over the northernmost portions of those sites marked 10 and 11 on the illustrative Master Plan, well to the north of the developments proposed in the Concept Plan which are all to the south of Westbourne Street. However, no further development of the northern portion of the carpark can occur unless the existing microwave link is moved higher up the tower. If the link is moved to a practical maximum height of 60m (152m AHD) above ground level on the tower, the multi-storey carpark could be redeveloped to a height of approximately 135m AHD and is unlikely to breach the *General Public Reference Level*.

LOS restrictions for future microwave links towards East Sydney due to the RNSH redevelopments may be overcome by increasing the height of the links on the tower

The area of potential multipath/ghosting includes subscribers close to the transmission site and within the RNSH development envelop. Due to the short radio path length experience in

this area, it is anticipated that ghosting should not be an issue. However, a number of mitigation techniques can overcome ghosting/multipath if it occurs.

Due to the low EMR level of exposure, it is anticipated that during the construction phase, the exposure of construction crane operators/construction workers will still be well below the *General Public Reference Level.* Generally the electronic shielding of construction cranes and construction equipment is of higher quality than the standard electrical device and therefore EMI should not be an issue.

2 BACKGROUND

NSW Health is wishing to upgrade and redevelop Royal North Shore Hospital, St. Leonards. Burns Bridge has been appointed to manage the first stages of this project and Cox Richardson is the appointed urban designers and planners.

From an urban design point of view and market driven point of view there is a desire to gain some height at the northern most area of the site fronting Westbourne Street. The highest point of the site is the junction of Westbourne Street and Reserve Road. In addition NSW Health wish to explore the possibility of the future redevelopment of the multistory car park identified as Buildings 9 and 10.

THL Australia has been commissioned by Burns Bridge to undertake this study. The results of which can be found in the latter sections of this report.

An investigation into the effects of the Royal North Shore Hospital expansion based on the drawings supplied by Cox Richardson on behalf of Burns Bridge as well as a detailed discussion with Broadcast Australia has been conducted. The investigation and report has been divided into the following sections:

- RF Field Calculation – EMR Analysis
- EMI Analysis
- Existing Microwave Link Analysis
- Building 9 & 10 Development Options
- Ghosting / Multipath Effects

3 ACKNOWLEDGEMENT

Acknowledgement of Broadcast Australia's assistance in providing data on the Gore Hill transmission tower.

4 DATA SOURCES AND ACCURACY

Proposed Royal North Shore Hospital redevelopment drawings - being an illustrative Master Plan and elevations) were supplied by Cox Richardson who are the urban designers and planners.

Gore Hill antenna and transmitter details have been supplied by Broadcast Australia based on revised data from previous reports done on the Gore Hill tower. Height tolerances are in the range of ±2m.

Building and ground height tolerances are approximately ±5m as discrepancies have been found in differences in ground and building heights. For example, Gore Hill Transmitter site ground level is known as 92m AHD and is indicated to be in the upper 80m AHD mark in the drawings provided by Cox Richardson.

RF EME and EMI uncertainty is calculated to be approximately 3dB.

5 RF FIELD CALCULATION – EMR ANALYSIS

5.1 Concern

High powered broadcast sites such as the Gore Hill site can have high EMR zones that could easily extend 100s of meters from the towers at different antenna heights on the towers. If a new building is of sufficient height or at a small distance from the broadcast site, there is the potential that *General Public Reference Levels* may be exceeded. These reference levels are defined by the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA).

5.2 Results

The Gore Hill broadcast site has been modelled using three different scenarios, namely:

- Current\Contracted Services (Normal Operation)
- Current\Contracted Services (Standby Operation)
- Maximum\Future Services

All three scenarios need to be modelled as they require different antennas operating at different power levels. The maximum services scenario is the highest transmit power scenario. Refer to Appendix 2 for the different antenna and transmitter power configuration scenarios.

Results as per drawings 23704-10, 23704-11, 23704-12 and 23704-13 in Appendix 1:

Locations of highest RF exposure fields		
Location	**% of General Public Exposure Level**	**Height (m)**
Current\Contracted Services (Normal Operation)		
Building 7 (proposed building)	1.5%	167m AHD
Current\Contracted Services (Standby Operation)		
Building 1C (existing building)	3.5%	146m AHD
Maximum\Future Services		
Building 1C (existing building)	**9.5%**	**146m AHD**

In all configuration scenarios the maximum exposure level is 9.5% of the *General Public Reference Level.* It should also be noted that this level of exposure will be experienced at the maximum height of 146m AHD on the rooftop of the existing Building 1C.

Due to the low level of exposure, it is anticipated that during the construction phase, the exposure of construction crane operators will still be well below the *General Public Reference Level.*

6 EMI ANALYSIS

6.1 Concern

The presence of high RF fields can cause general electrical equipment and more importantly medical equipment to perform with steady, momentary, or intermittent disruption. This is becoming of increasing concern as more electrical devices move to microprocessor designs.

There are a number of EMI standards around. The most appropriate for medical devices being the IEC's standards. IEC 660601-1-2, "Medical electrical equipment - Part 1-2: General requirements for safety". This standard calls for a 3 V/m immunity requirement for general electrical and general medical equipment. However, devices used in more sensitive locations have a 10 V/m immunity requirement.

6.2 Results

Based on the RF Calculation results performed in the previous section and with reference to the drawings located in Appendix 1, the highest RF field experienced is 9.5% of the *General Public Reference Level*.

The IEC Immunity standard recommends an immunity of:

Immunity Standards		
Electrical Equipment	**IEC Immunity Standard**	**Equivalent % of *General Public Reference Level****
General	3 V/m	1.2%
Critical Medical	10 V/m	13.3%

* Based on frequencies in the range of 10MHz to 400MHz

The worst case field of 9.5% at 146m AHD falls in between the above 2 standards indicating that the potential for general electrical equipment EMI is much higher than that of the critical medical equipment.

However, other factors affecting RF level attenuation (ie losses through walls and windows) and to a lesser extent reflection (i.e. building shielding and reflection) have not been included in this analysis.

Due to the number of variables that can affect EMI, it is recommended that EMI measurements be taken at key locations within the hospital or residential buildings to determine the likely effect of EMI occurring.

During the construction phase, it is anticipated that EMI causing the electronics in the construction cranes should not be an issue as the electronics in these devices are usually well shielded.

7 EXISTING MICROWAVE LINK ANALYSIS

7.1 Concern

Any new developments of the Royal North Shore Hospital could potentially block existing line of sight microwave links.

7.2 Result

Only one existing microwave link exists in the direction of the RNSH expansion zone. This link is located at 30m on the eastern leg of the Gore Hill tower at an azimuth of 82.5ºTN. This link is approximately 11km long and ends at the broadcast site at North Head.

The Concept Plan does not seek to change the buildings to the north of Westbourne Street, therefore the existing link should not be interfered with

At Building 10 (350m from the Gore Hill tower), the fresnel zone radius is 2.4m. To avoid attenuation of the microwave link, a minimum fresnel zone clearance of 57.7% is needed. As is indicated in 23704-14 in Appendix 1 the current clearance is approximately 10m which gives 100% fresnel zone clearance plus an additional 7.6m.

LOS restrictions for future microwave links towards East Sydney may be overcome by putting link dishes higher on the broadcasting tower. In order to overcome the height of the tallest proposed building (Building 7) a dish would need to be mounted at approximately 75m on the Gore Hill Tower. The implications on the tower wind loadings and other factors would need to be considered before the dish could be relocated higher.

LOS existing and new restrictions can be seen in drawing 23704-15 in Appendix 1.

The use of a construction crane on or near the multi-storey carpark would need to be aware of the existing link. This is discussed in more detail in the following section.

8 BUILDING 9 & 10 DEVELOPMENT OPTIONS

Burns Bridge would like to know what options are available for the redevelopment of the multi-storey carpark (Buildings 9 & 10). Currently, an existing link to north head passes directly over the northern most part of the carpark. This can be seen in drawing 23704-15 in Appendix 1.

8.1 Result

Only Building 10 (as per drawing 23704-12 in Appendix 1) is restricted in height due to the existing North Head Microwave link.

No further development of the carpark can occur unless the existing microwave link is moved higher up the tower without performing some onsite measurements to confirm accuracy of heights in the drawings. Currently the link clearance is approximately 7.6m. If the link is moved higher up the tower (approximately 60m AGL max) the multi-storey carpark could be redeveloped up to a height of about 135m AHD without adversely affecting the link. This can be inferred from drawing 23704-12 in Appendix 1.

Even though analysis states there is currently a clearance of 7.6m between the carpark and the fresnel zone of the link, due to height tolerances mentioned in previous sections of this report it is recommended that no development takes place without moving the link higher up the tower. However, further, more detailed field analysis with the use of a theodelite could be performed.

The RF fields experienced at 135m AHD would be equivalent to the fields experienced at Building 1C in the maximum transmit power scenario mentioned in the EMR Analysis Section. The results can be summarised in the following below:

Multi-storey Carpark Height	
Link Height on Tower m AHD (m AGL)	**Carpark Height m AHD**
Current height of 122m (30m) on Tower	112m (Existing)
Highest practical height of 142m (60m) on Tower	135m*

*To match the anticipated highest EMR reading experienced at the top of Building 1C, the maximum height of Building 10 (and Building 9) is limited to 135m AHD.

9 GHOSTING / MULTIPATH EFFECTS

9.1 Concern

A new structure in the area - for example, the RNSH expansion plans, can cause the problem of ghosting to occur after years of trouble-free television and FM radio reception.

The multiple images seen in television reception are produced when part of the signal comes directly from the transmitter, while another part has been reflected from a hill, a building or some other large object in the locality.

The reflected signal travels a greater distance than the direct signal and so arrives slightly later in time, thus producing another image, or ghost, offset slightly from the main image.

FM radio reception may also be affected by multipath reception. A common symptom of this problem is a harsh edge to the sound, often accompanied by stereo light flashing. It may also cause symptoms similar to a flutter effect on a FM car radio receiver when the vehicle is moving.

9.2 Discussion

As indicated by drawing 23704-15 in Appendix 1, most of the multipath generated by the expansion of the hospital is relatively localised within and around the RNSH building envelop. In most cases the use of one of the mitigation techniques identified below will eliminate the issue.

As the area of potential multipath includes subscribers close to the transmission site and the length of the reflected ray is not much longer than direct ray, the limit of perceptibility of the ghost picture is very low.

However, if the ghosting is apparent, the following mitigation techniques can be used:

- Change alignment of current affected antenna
- Rotate affected antenna towards alternative site (e.g. Kings Cross or North Head)
- Switch to Digital Television
- Switch to cable television

Strong ghosting signals are usually a result of the interaction of the radio signal with high reflective building materials (e.g. glass, metals) whereas weaker ghosting is usually as a result of high absorptive building materials (e.g. concrete, brick).

10 REFERENCES

The following references have been used as a guide in this report:

1. ARPANSA RP3 “Radiation Protection Standard for Maximum Exposure Levels to Radiofrequency Fields – 3 kHz to 300 GHz (2002)”
2. ITU-R BS.412-8 “Planning Standards for FM Sound Broadcasting at VHF”
3. ITU-R BT.655-4 “Radio-Frequency Protection Ratios for AM Vestigial Sideband Terrestrial Television Systems”
4. ITU-R P.530-9 “Propagation data and Prediction Methods required for the Design of Terrestrial Line-Of-Sight Systems”
5. AS/NZS 3200.1.2:1995 “Part 1.2: General Requirements for Safety – Collateral Standard: Electromagnetic Compatibility – Requirements and Tests”
6. IEC 660601-1-2, “Medical electrical equipment - Part 1-2: General requirements for safety”

APPENDIX 1 – RF FIELD CALCULATION DRAWINGS

The RF field calculation drawings in this Appendix show areas on this site where *general public* and *occupational* RF exposures may exceed the allowable levels stipulated in the ARPANSA standard, or where other RF fields may be encountered.

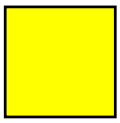
These areas are designated with different colour markings according to the level of access restriction:

1. **Above ARPANSA Occupational Reference Level**

   These are areas where RF exposures may exceed the ARPANSA *occupational* reference levels.

2. **Above ARPANSA General Public Reference Level**

   These are areas where RF exposures may exceed the ARPANSA *general public* reference levels, but not exceed the *occupational* reference levels.



3. **50% of ARPANSA General Public Reference Level**

   These contours indicate 50% of the ARPANSA *general public* reference levels.

4. **20% of ARPANSA General Public Reference Level**

   These contours indicate 20% of the ARPANSA *general public* reference levels.

5. **10% of ARPANSA General Public Reference Level**

   These contours indicate 10% of the ARPANSA *general public* reference levels.

6. **5% of ARPANSA General Public Reference Level**

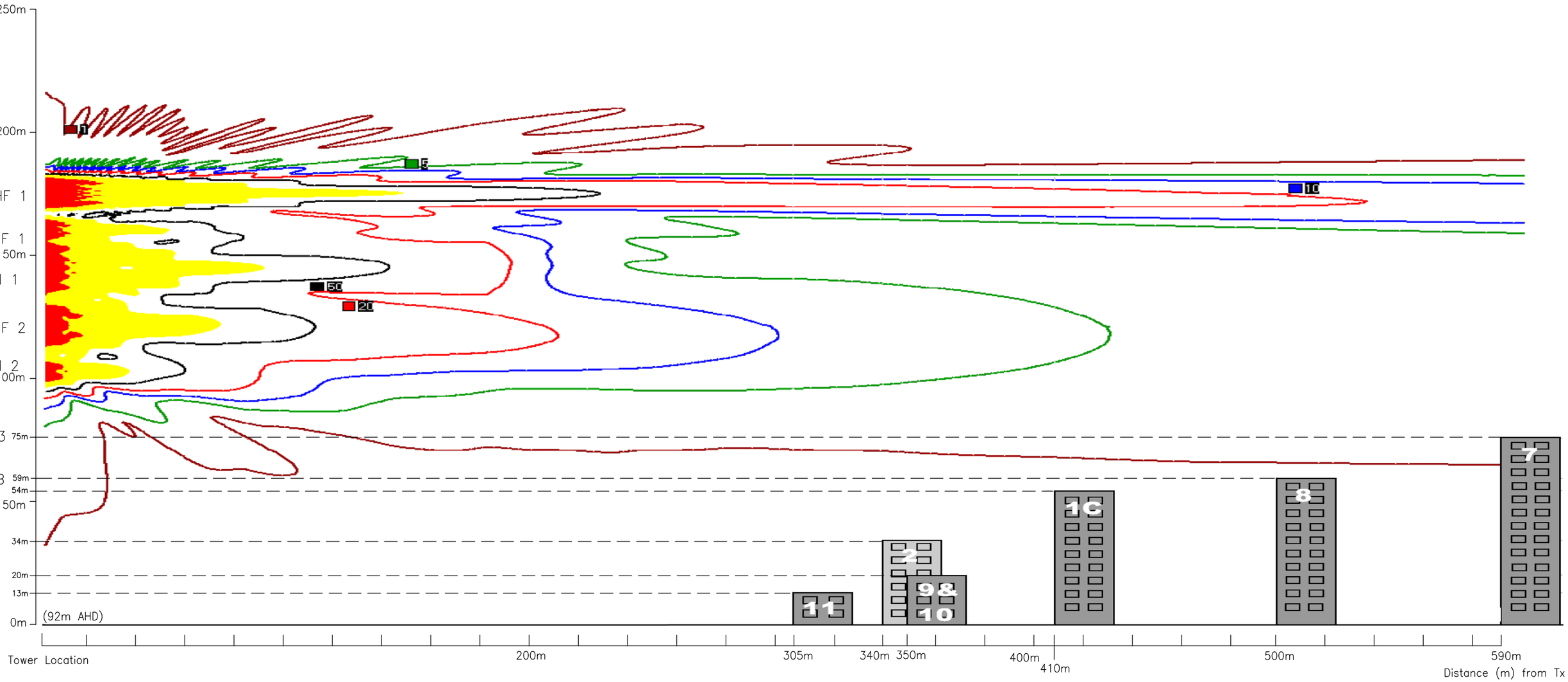
   These contours indicate 5% of the ARPANSA *general public* reference levels.

7. **1% of ARPANSA General Public Reference Level**

   These contours indicate 1% of the ARPANSA *general public* reference levels.

Persons viewing this document should ensure all drawings indicated here are present and viewed in full, rather than one in isolation.

Drawing No.	Drawing Issue	Drawing Title
23704-10	A	CURRENT POWER LEVEL ELEVATION VIEW (NORMAL OPERATION)
23704-11	A	CURRENT POWER LEVEL ELEVATION VIEW (STANDBY OPERATION)
23704-12	A	MAXIMUM POWER LEVEL ELEVATION VIEW
23704-13	A	MAXIMUM POWER LEVEL 146m AHD PLAN VIEW
23704-14	A	NORTH HEAD MICROWAVE LINK ANALYSIS
23704-15	A	RADIO SHADOW DUE TO RNSH EXPANSION
N/A	N/A	ILLUSTRATIVE RNSH CONCEPT MASTER PLAN



GORE HILL 2040
CURRENT POWER LEVEL
ELEVATION VIEW (NORMAL OPERATION)

MAXIMUM RF FIELD = 1.5%
OF THE ARPANSA REFERENCE LEVEL
(BUILDING 7)

ANTENNA / TRANSMITTER STATUS			
Antenna	Service	Frequency	Power
UHF 1 (Band 4/5)	BAND 4 UHF TV	526MHz–820MHz	64kW
VHF 1 (Band 3)	BAND 3 VHF TV	174MHz–230MHz	7.5kW
FM 1 (Main)	BAND 2 FM Radio	88MHz–108MHz	140kW
VHF 2 (Band 1)	BAND 1 VHF TV	45MHz–70MHz	40kW
FM 2 (Standby)	BAND 2 FM Radio	88MHz–108MHz	10kW
FM 3	BAND 2 FM Radio	88MHz–108MHz	0kW
DAB	BAND 2 Digital Radio	174MHz–230MHz	0kW

Note: Closest building edge used to indicate building distance to Gore Hill Transmitter site. Ground heights of the buildings are NOT shown.

- AREAS ABOVE OCCUPATIONAL REFERENCE LEVEL
- AREAS ABOVE GENERAL PUBLIC REFERENCE LEVEL
- 50.0% OF GENERAL PUBLIC REFERENCE LEVEL CONTOUR
- 20.0% OF GENERAL PUBLIC REFERENCE LEVEL CONTOUR
- 10.0% OF GENERAL PUBLIC REFERENCE LEVEL CONTOUR
- 5% OF GENERAL PUBLIC REFERENCE LEVEL CONTOUR
- 1% OF GENERAL PUBLIC REFERENCE LEVEL CONTOUR

The information on this drawing complies with:
ARPANSA Radiation Protection Standard (Maximum Exposure Levels to Radiofrequency Fields – 3kHz to 300GHz. May 2002)
AS 2772.2–1988 (Radiofrequency Radiation, Part 2: Principles and Methods of Measurement–300kHz to 100 GHz)

ISS	ORIGIN	BY	DATE	CHECKED	REVISION DETAILS

TITLE: CALCULATED RF FIELDS

SUB TITLE: GORE HILL 2040 CURRENT POWER LEVEL ELEVATION VIEW (NORMAL OPERATION)

SHEET 1 OF 6

ORIGIN: J>SCHREIBER
DRAWN: R.N.Anderson 14.6.06
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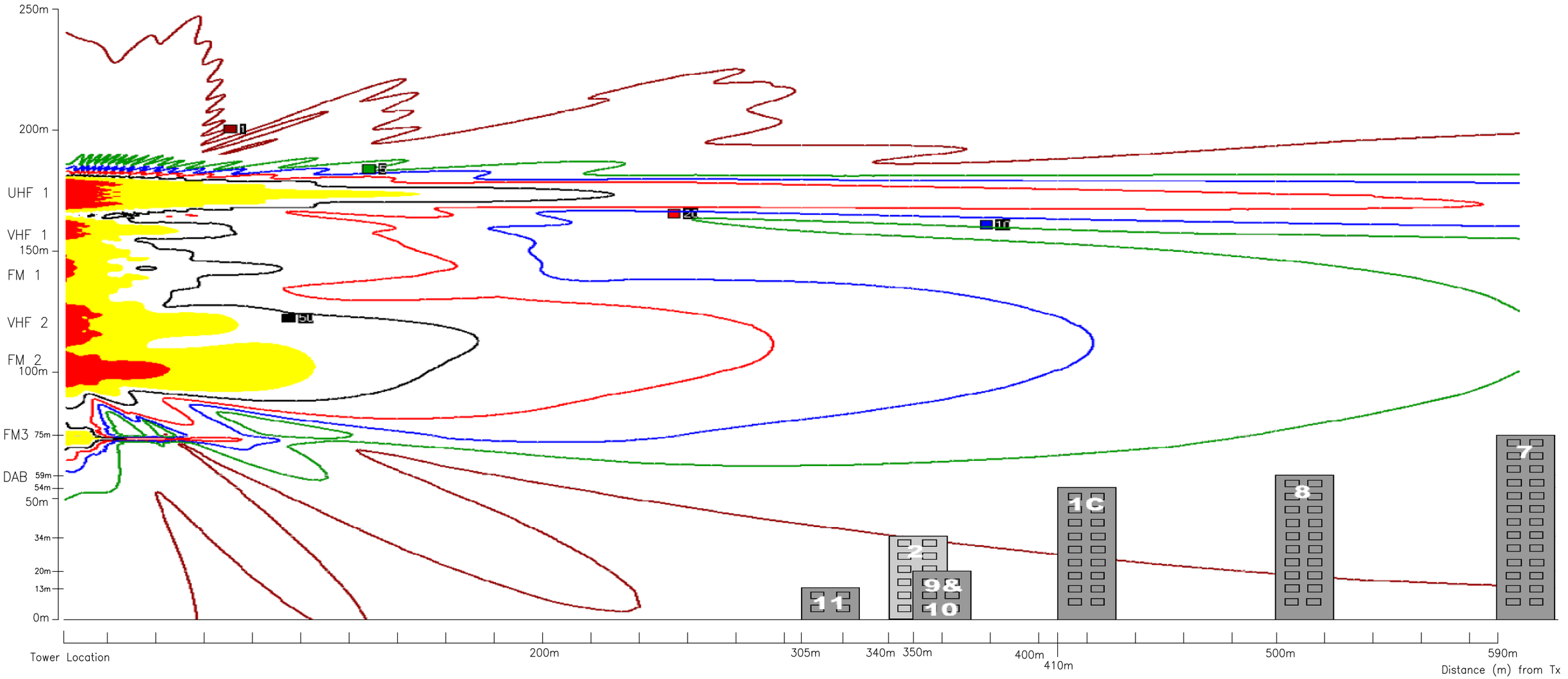
APPROVED FOR ISSUE:

THL AUSTRALIA

SIZE: A3
REG:
DRAWING No: 23704–10
ISSUE: A



GORE HILL 2040
CURRENT POWER LEVEL
ELEVATION VIEW (STANDBY OPERATION)

MAXIMUM RF FIELD = 3.5%
OF THE ARPANSA REFERENCE LEVEL
(BUILDING 1C)

ANTENNA / TRANSMITTER STATUS			
Antenna	Service	Frequency	Power
UHF 1 (Band 4/5)	BAND 4 UHF TV	526MHz–820MHz	64kW
VHF 1 (Band 3)	BAND 3 VHF TV	174MHz–230MHz	7.5kW
FM 1 (Main)	BAND 2 FM Radio	88MHz–108MHz	60kW
VHF 2 (Band 1)	BAND 1 VHF TV	45MHz–70MHz	40kW
FM 2 (Standby)	BAND 2 FM Radio	88MHz–108MHz	80kW
FM 3	BAND 2 FM Radio	88MHz–108MHz	10kW
DAB	BAND 2 Digital Radio	174MHz–230MHz	0kW

Note: Closest building edge used to indicate building distance to Gore Hill Transmitter site. Ground heights of the buildings are NOT shown.

- AREAS ABOVE OCCUPATIONAL REFERENCE LEVEL
- AREAS ABOVE GENERAL PUBLIC REFERENCE LEVEL
- 50.0% OF GENERAL PUBLIC REFERENCE LEVEL CONTOUR
- 20.0% OF GENERAL PUBLIC REFERENCE LEVEL CONTOUR
- 10.0% OF GENERAL PUBLIC REFERENCE LEVEL CONTOUR
- 5% OF GENERAL PUBLIC REFERENCE LEVEL CONTOUR
- 1% OF GENERAL PUBLIC REFERENCE LEVEL CONTOUR

The information on this drawing complies with:
ARPANSA Radiation Protection Standard (Maximum Exposure Levels to Radiofrequency Fields – 3kHz to 300GHz. May 2002)
AS 2772.2–1988 (Radiofrequency Radiation, Part 2: Principles and Methods of Measurement–300kHz to 100 GHz)

ISS	ORIGIN	BY	DATE	CHECKED	REVISION DETAILS

TITLE: CALCULATED RF FIELDS
SUB TITLE: GORE HILL 2040 CURRENT POWER LEVEL ELEVATION VIEW (STANDBY OPERATION)
SHEET 2 OF 6

ORIGIN: J.SCHREIBER
DRAWN: R.N.Anderson 15.6.06
CHECKED:
APPROVED FOR ISSUE:

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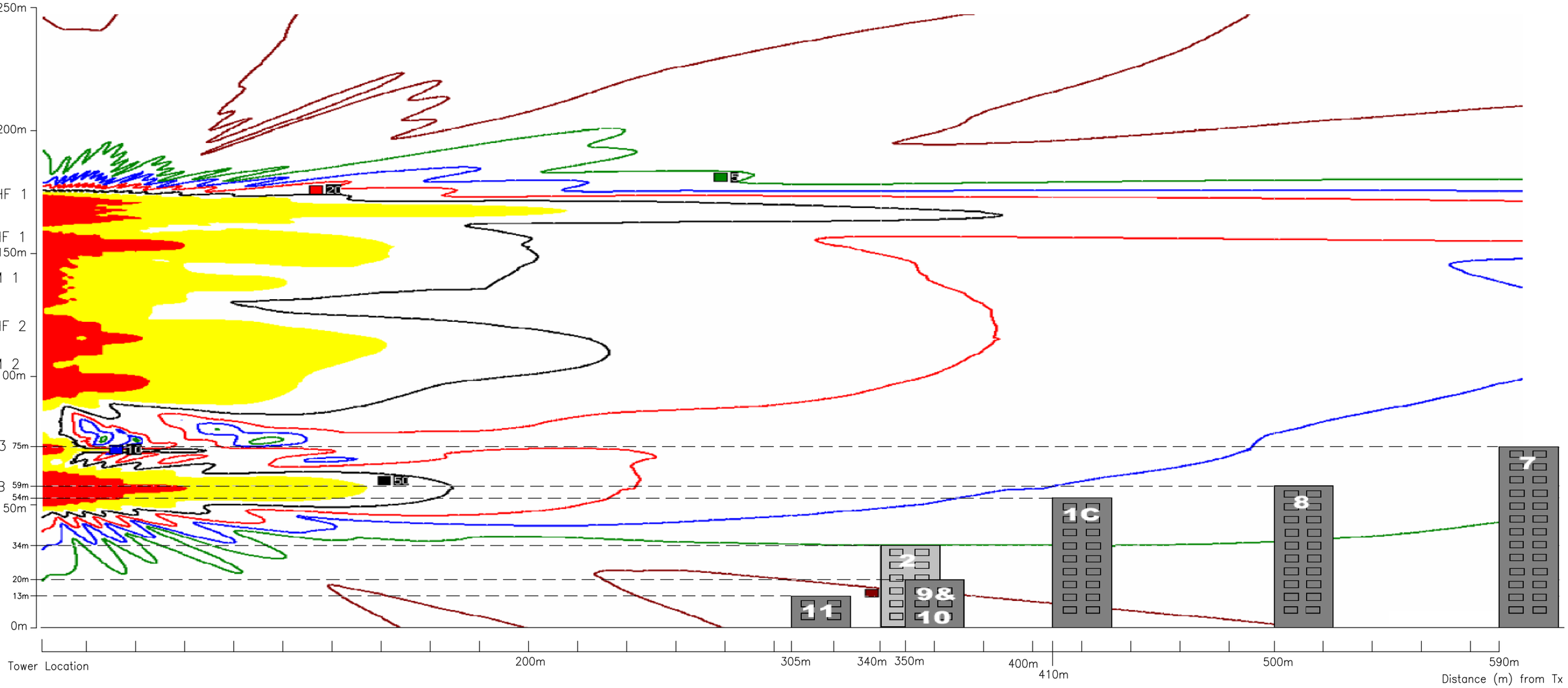
DRAWING No: 23704–11
ISSUE: A



GORE HILL 2040
MAXIMUM POWER LEVEL
ELEVATION VIEW

MAXIMUM RF FIELD = 9.5%
OF THE ARPANSA REFERENCE LEVEL
(BUILDING 1C)

ANTENNA / TRANSMITTER STATUS			
Antenna	Service	Frequency	Power
UHF 1 (Band 4/5)	BAND 4 UHF TV	526MHz–820MHz	81kW
VHF 1 (Band 3)	BAND 3 VHF TV	174MHz–230MHz	60kW
FM 1 (Main)	BAND 2 FM Radio	88MHz–108MHz	140kW
VHF 2 (Band 1)	BAND 1 VHF TV	45MHz–70MHz	60kW
FM 2 (Standby)	BAND 2 FM Radio	88MHz–108MHz	80kW
FM 3	BAND 2 FM Radio	88MHz–108MHz	30kW
DAB	BAND 2 Digital Radio	174MHz–230MHz	48kW

Note: Closest building edge used to indicate building distance to Gore Hill Transmitter site. Ground heights of the buildings are NOT shown.

- AREAS ABOVE OCCUPATIONAL REFERENCE LEVEL
- AREAS ABOVE GENERAL PUBLIC REFERENCE LEVEL
- 50.0% OF GENERAL PUBLIC REFERENCE LEVEL CONTOUR
- 20.0% OF GENERAL PUBLIC REFERENCE LEVEL CONTOUR
- 10.0% OF GENERAL PUBLIC REFERENCE LEVEL CONTOUR
- 5% OF GENERAL PUBLIC REFERENCE LEVEL CONTOUR
- 1% OF GENERAL PUBLIC REFERENCE LEVEL CONTOUR

The information on this drawing complies with:
ARPANSA Radiation Protection Standard (Maximum Exposure Levels to Radiofrequency Fields – 3kHz to 300GHz. May 2002)
AS 2772.2–1988 (Radiofrequency Radiation, Part 2: Principles and Methods of Measurement–300kHz to 100 GHz)

ISS	ORIGIN	BY	DATE	CHECKED	REVISION DETAILS

TITLE: CALCULATED RF FIELDS
SUB TITLE: GORE HILL 2040 MAXIMUM POWER LEVEL ELEVATION VIEW
SHEET 3 OF 6

ORIGIN: J.SCHREIBER
DRAWN: R.N.Anderson 15.6.06
CHECKED:
APPROVED FOR ISSUE:

THL AUSTRALIA
SIZE: A3
REG:
DRAWING No: 23704–12
ISSUE: A

GORE HILL 2040
MAXIMUM POWER LEVEL
146m AHD PLAN VIEW

MAXIMUM RF FIELD = 9.5%
OF THE ARPANSA REFERENCE LEVEL
(BUILDING 1C)

ANTENNA / TRANSMITTER STATUS			
Antenna	Service	Frequency	Power
UHF 1 (Band 4/5)	BAND 4 UHF TV	526MHz–820MHz	81kW
VHF 1 (Band 3)	BAND 3 VHF TV	174MHz–230MHz	60kW
FM 1 (Main)	BAND 2 FM Radio	88MHz–108MHz	140kW
VHF 2 (Band 1)	BAND 1 VHF TV	45MHz–70MHz	60kW
FM 2 (Standby)	BAND 2 FM Radio	88MHz–108MHz	80kW
FM 3	BAND 2 FM Radio	88MHz–108MHz	30kW
DAB	BAND 2 Digital Radio	174MHz–230MHz	48kW

Note: Closest building edge used to indicate building distance to Gore Hill Transmitter site. Ground heights of the buildings are NOT shown.

AREAS ABOVE OCCUPATIONAL REFERENCE LEVEL

AREAS ABOVE GENERAL PUBLIC REFERENCE LEVEL

50.0% OF GENERAL PUBLIC REFERENCE LEVEL CONTOUR

20.0% OF GENERAL PUBLIC REFERENCE LEVEL CONTOUR

10.0% OF GENERAL PUBLIC REFERENCE LEVEL CONTOUR

5% OF GENERAL PUBLIC REFERENCE LEVEL CONTOUR

1% OF GENERAL PUBLIC REFERENCE LEVEL CONTOUR

The information on this drawing complies with:
ARPANSA Radiation Protection Standard (Maximum Exposure Levels to Radiofrequency Fields – 3kHz to 300GHz. May 2002)
AS 2772.2–1988 (Radiofrequency Radiation, Part 2: Principles and Methods of Measurement–300kHz to 100 GHz)

ISS	ORIGIN	BY	DATE	CHECKED	REVISION DETAILS

TITLE: CALCULATED RF FIELDS

SUB TITLE: GORE HILL 2040 MAXIMUM POWER LEVEL 146m AHD PLAN VIEW

SHEET 4 OF 6

ORIGIN: J.SCHREIBER
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APPROVED FOR ISSUE:

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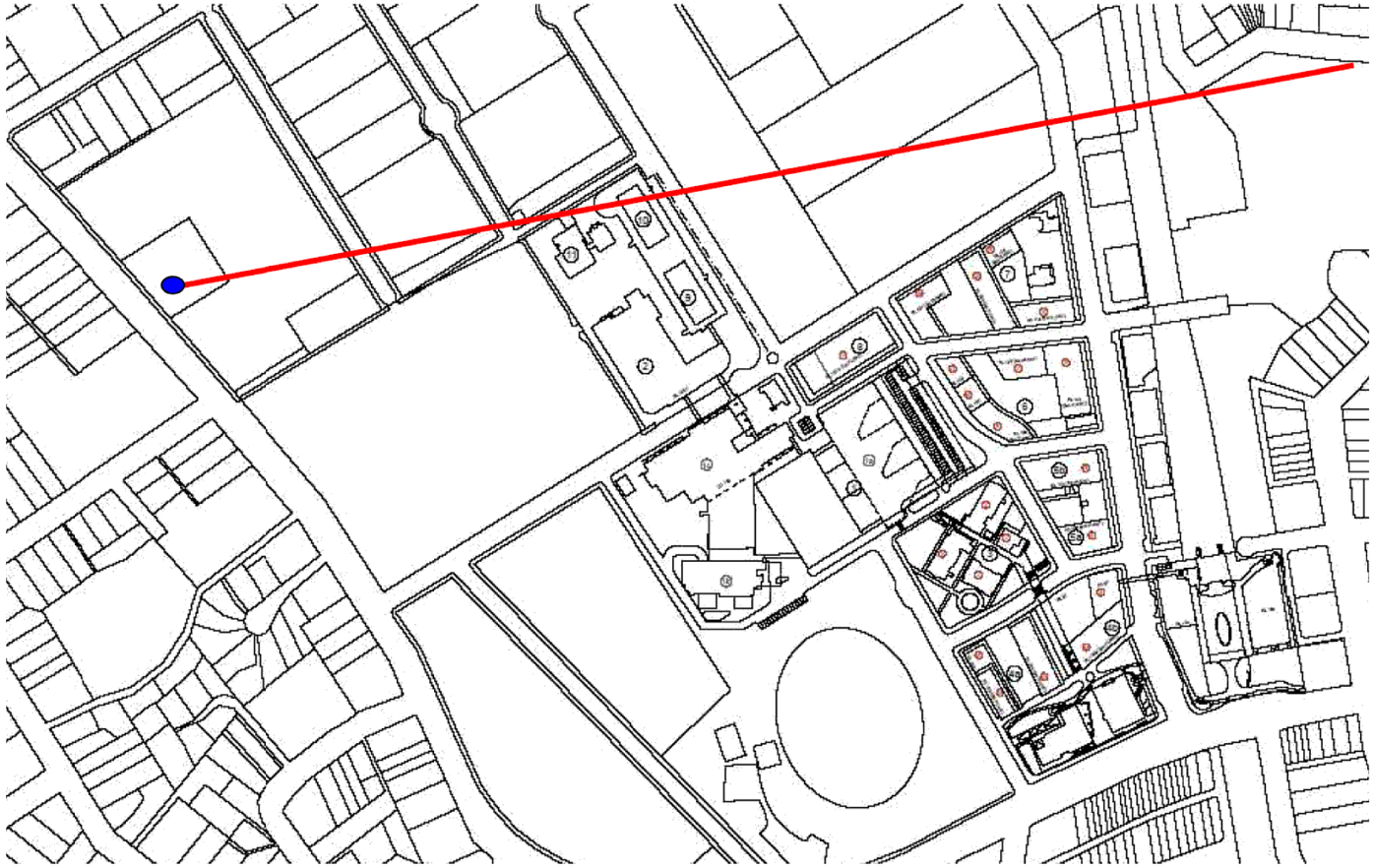
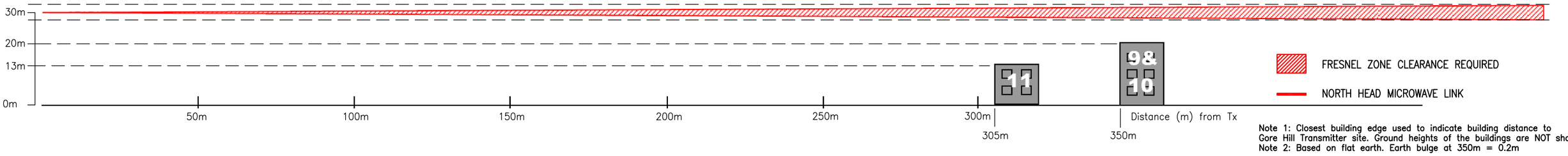
ISSUE: A



GORE HILL 2040 – NORTH HEAD
MICROWAVE LINK ANALYSIS

LINK DISTANCE = 11km
LINK ANGLE = 82.5° TN
LINK FREQUENCY = 18GHz
LINK HEIGHT = 30m

Fresnel Zone Radius @ 350m = 2.4m
Clearance to Building 10 @350m = 7.6m



Note 1: Closest building edge used to indicate building distance to Gore Hill Transmitter site. Ground heights of the buildings are NOT shown.
Note 2: Based on flat earth. Earth bulge at 350m = 0.2m

The information on this drawing complies with:
ARPANSA Radiation Protection Standard (Maximum Exposure Levels to Radiofrequency Fields – 3kHz to 300GHz. May 2002)
AS 2772.2–1988 (Radiofrequency Radiation, Part 2: Principles and Methods of Measurement–300kHz to 100 GHz)

ISS	ORIGIN	BY	DATE	CHECKED	REVISION DETAILS

TITLE: CALCULATED RF FIELDS
SUB TITLE: GORE HILL 2040 – NORTH HEAD MICROWAVE LINK ANALYSIS
SHEET 5 OF 6

ORIGIN: J.SCHREIBER
DRAWN: R.N.Anderson 21.6.06
CHECKED:
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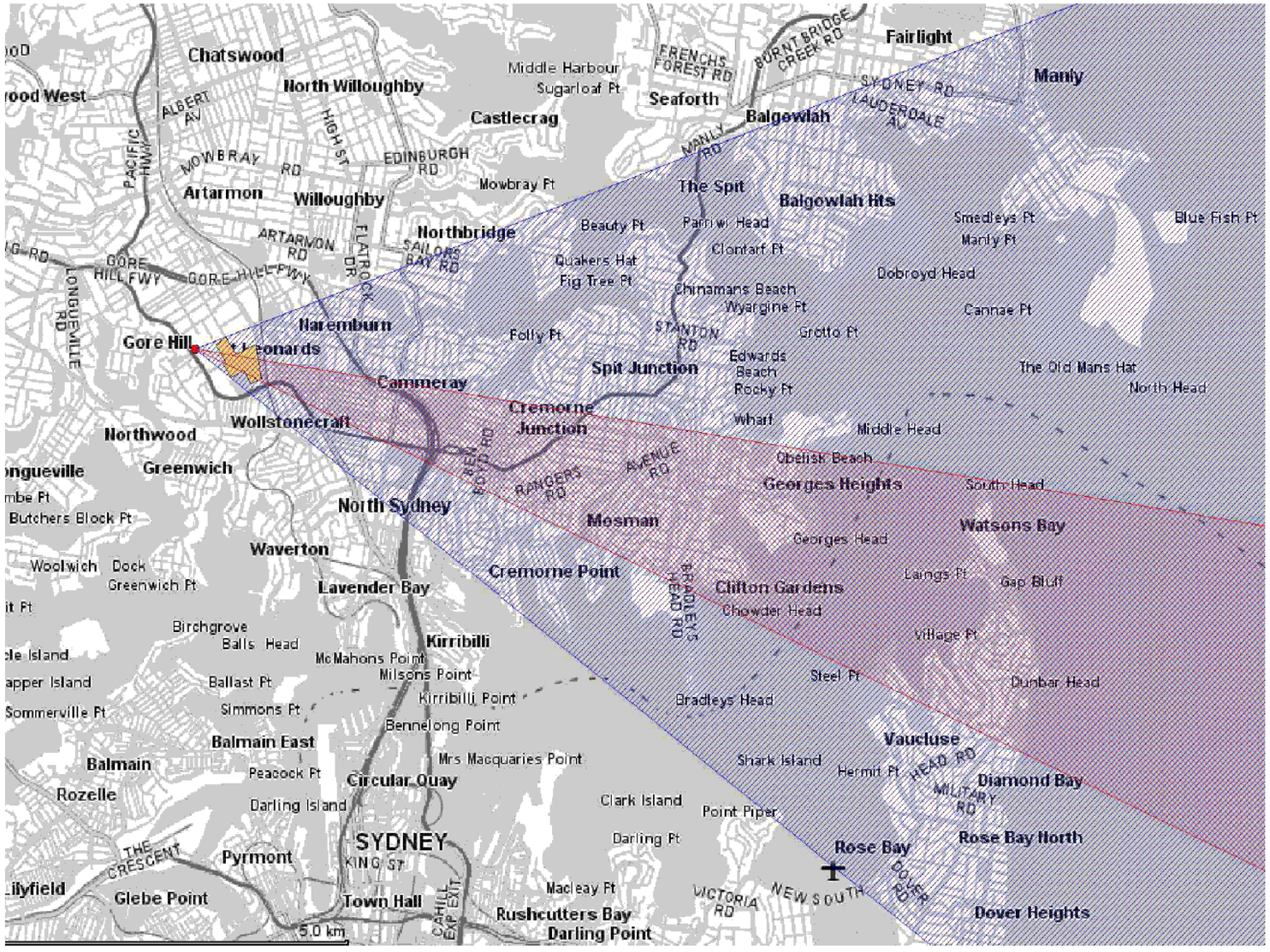
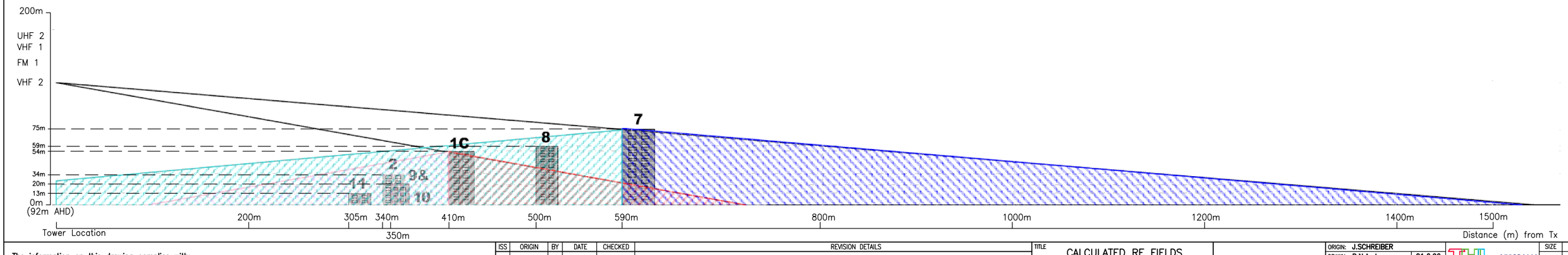


RADIO SHADOW DUE TO RNSH EXPANSION

- EXISTING RADIO SHADOW
- INCREASED RADIO SHADOW DUE TO RNSH EXPANSION (WORST CASE)
- RNSH BUILDING ENVELOPE
- EXISTING MULTIPATH AREA
- INCREASED MULTIPATH AREA DUE TO RNSH EXPANSION (WORST CASE)

Note: Potential LOS obstruction for all transmitters less than 167m AHD (height of Building 7). A worst case scenario of the entire RNSH building envelope being 167m AHD has been taken into account



The information on this drawing complies with:
ARPANSA Radiation Protection Standard (Maximum Exposure Levels to Radiofrequency Fields – 3kHz to 300GHz. May 2002)
AS 2772.2–1988 (Radiofrequency Radiation, Part 2: Principles and Methods of Measurement–300kHz to 100 GHz)

ISS	ORIGIN	BY	DATE	CHECKED	REVISION DETAILS

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SUB TITLE: RADIO SHADOW DUE TO RNSH EXPANSION
SHEET 6 OF 6

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@ SHORE

ILLUSTRATIVE CONCEPT MASTER PLAN

HASSELL · SILVER THOMAS HANLEY · COX · BURNS BRIDGE · NSW HEALTH Working as a Team

SCALE 1 : 2000 @ A3

DATE 11.04.2006

APPENDIX 2 - RF FIELD CALCULATION METHODOLOGY

Introduction

This site has been assessed by calculative methods as prescribed in the *Australian Standard* ***AS 2772.2 - 1988*** *(Radiofrequency radiation, Part 2: Principles and methods of measurement—300 kHz to 100 GHz)*.

This document only details RF fields emitted from this broadcast structure. It does not take into account other RF Fields emitted from nearby broadcast and/or telecommunication sites.

This document is not to be used for access onto the support structure. The appropriate *RF Hazard Control Document* should be consulted before any work is undertaken on site.

Site Identification

Site Name:	Gore Hill
ACMA Site ID:	48711
BA Site ID:	2040
Address:	221 Pacific Highway, GORE HILL NSW
Latitude:	-33.8216
Longitude:	151.1838
Main Structure:	181m freestanding tower

Description of RF sources on this site

Current/Contracted Power Antenna Configuration (Normal Configuration)

Antenna and Transmitter Details					
Antenna name	**Antenna height**	**Service**	**Antenna Input Frequency**	**Antenna Input power‡**	**Combined EIRP**
UHF1 (Band IV/V)	166-180m	BAND IV/V UHF TV	526MHz to 820MHz	64 kW	3208 kW
VHF1 (Band III)	153-164m	BAND III VHF TV	174MHz to 230MHz	7.5 kW	95.3 kW
FM1 (Main)	134-152m	BAND II FM Radio	88MHz – 108MHz	160 kW	3511 kW
VHF2 (Band I)	109-131m	BAND I VHF TV	45MHz to 70MHz	40 kW	585 kW
FM2 (Standby)	96-107m	BAND II FM Radio	88MHz – 108MHz	10 kW	91 kW
FM3	69-79m	BAND II FM Radio	88MHz – 108MHz	0 kW	0 kW
DAB	48-66m	BAND III Digital Radio	174MHz – 240MHz	0 kW	0 kW

‡ Powers shown in this column are peak sync for PAL TV and average power for Digital TV and FM Radio. For PAL TV services a peak sync power to average power ratio of 70% has been used for calculations.

Current/Contracted Power Antenna Configuration (Standby Configuration)

Antenna and Transmitter Details					
Antenna name	**Antenna height**	**Service**	**Antenna Input Frequency**	**Antenna Input power‡**	**Combined EIRP**
UHF1 (Band IV/V)	166-180m	BAND IV/V UHF TV	526MHz to 820MHz	64 kW	3208 kW
VHF1 (Band III)	153-164m	BAND III VHF TV	174MHz to 230MHz	7.5 kW	95.3 kW
FM1 (Main)	134-152m	BAND II FM Radio	88MHz – 108MHz	60 kW	1317 kW
VHF2 (Band I)	109-131m	BAND I VHF TV	45MHz to 70MHz	40 kW	585 kW
FM2 (Standby)	96-107m	BAND II FM Radio	88MHz – 108MHz	80 kW	723 kW
FM3	69-79m	BAND II FM Radio	88MHz – 108MHz	10 kW	26 kW
DAB	48-66m	BAND III Digital Radio	174MHz – 240MHz	0 kW	0 kW

‡ Powers shown in this column are peak sync for PAL TV and average power for Digital TV and FM Radio. For PAL TV services a peak sync power to average power ratio of 70% has been used for calculations.

Maximum/Future Power Antenna Configuration

Antenna and Transmitter Details					
Antenna name	**Antenna height**	**Service**	**Antenna Input Frequency**	**Antenna Input power‡**	**Combined EIRP**
UHF1 (Band IV/V)	166-180m	BAND IV/V UHF TV	526MHz to 820MHz	80.6 kW	5537 kW
VHF1 (Band III)	153-164m	BAND III VHF TV	174MHz to 230MHz	60 kW	1005 kW
FM1 (Main)	134-152m	BAND II FM Radio	88MHz – 108MHz	160 kW	3511 kW
VHF2 (Band I)	109-131m	BAND I VHF TV	45MHz to 70MHz	60 kW	877 kW
FM2 (Standby)	96-107m	BAND II FM Radio	88MHz – 108MHz	80 kW	723 kW
FM3	69-79m	BAND II FM Radio	88MHz – 108MHz	30 kW	77 kW
DAB	48-66m	BAND III Digital Radio	174MHz – 240MHz	48 kW	825 kW

‡ Powers shown in this column are peak sync for PAL TV and average power for Digital TV and FM Radio. For PAL TV services a peak sync power to average power ratio of 70% has been used for calculations.

RF exposure regulations and standards applied at this site

This site has been assessed against the *general public* and *occupational* reference levels detailed in the *Radiation Protection Standard - Maximum Exposure Levels to Radiofrequency Fields – 3kHz to 300GHz, May 2002 (RPS3)* of the Australian Radiation Protection and Nuclear Safety Agency (**ARPANSA**). This Standard is downloadable from: www.arpansa.gov.au/rf_standard.htm

Compliance with the radiofrequency (RF) field exposure limits prescribed in the *Radiocommunications Licence Conditions (Apparatus Licence) Determination 2003* of the Australian Media and Communications Authority (**ACMA**) is automatically ensured by compliance with the ARPANSA E & H *general public* exposure reference levels. This Determination is downloadable from: www.acma.gov.au

The RF Field calculation assessment at this site was performed in accordance with *Australian Standard **AS 2772.2 - 1988** (Radiofrequency radiation, Part 2: Principles and methods of measurement—300 kHz to 100 GHz)*. This Standard is able to be purchased from: www.standards.com.au

ARPANSA (2002) reference levels applicable to this site

Reference levels for Electric and Magnetic Field Strengths (10MHz - 400MHz)			
Applicable Frequency (MHz)	**Reference level**	**General Public Level**	**Occupational Level**
10 – 400	E & H Field – Time Averaged	2 W/m^2	10 W/m^2
	E & H Field – Instantaneous	2,000 W/m^2	10,000 W/m^2

Transmitters operating between 400MHz and 2GHz at this site were surveyed according to the most stringent ARPANSA reference levels applicable. These levels are identified below.

Reference levels for Electric and Magnetic Field Strengths (400MHz - 2GHz)			
Applicable Frequency (MHz)	**Reference level**	**General Public Level**	**Occupational Level**
527	E & H field – Time Averaged	2.6 W/m²	13.2 W/m²
	E & H field – Instantaneous	2635 W/m²	13175 W/m²

Reference levels for Electric and Magnetic Field Strengths (> 2GHz)			
Applicable Frequency (MHz)	**Reference level**	**General Public Level**	**Occupational Level**
Above 2000	E & H Field – Time Averaged	10 W/m^2	50 W/m^2
	E & H Field – Instantaneous	10,000 W/m^2	50,000 W/m^2

Methodology used in assessment of RF levels

- Time averaged E and H field exposures at this site were assessed by calculations utilising RF Prediction software.
- The method utilised does not consider the effects of terrain. It has been assumed that all ground levels are the same as the base of the transmit structure. No account has been taken for reflections from the ground.
- The method utilised does not consider the effects of tower shielding, or re-radiation.
- The critical information required for each antenna array for the RF prediction software was:
  - -Horizontal and Vertical far field patterns;
  - -Horizontal and Vertical aperture and depth;
  - -Frequency of services;
  - -Average antenna input power and maximum antenna input power;
  - -Gain of antenna in dBi;
  - -Height above ground level;
  - -Offset from centre of tower (if any).
- The power rating of PAL TV transmitters is generally described as the “peak sync power”. The average power of a PAL TV transmitter depends on the picture content. The highest average transmitted power occurs when the picture content is black. In this report, the resulting average-to-sync power ratio used is 0.7. This value has been used to calculate the antenna input power and subsequent RF levels at the highest power scenario of a black picture content.
- The vertical and horizontal radiation patterns were generated using antenna array design software. Generated patterns were verified against the manufacturer handbooks. It was necessary to reproduce the vertical patterns for the full 360° as the manufacturer usually only provides the VRP between 0° and 20°.
- The RF prediction software reduces the system gain in the radiating near field of the antenna to account for the individual panels not adding in phase in this region. The gain reduction was calculated in accordance with ***AS 2772.2 - 1988*** *(Radiofrequency radiation, Part 2: Principles and methods of measurement—300 kHz to 100 GHz)*.

Site conditions during RF Field assessment

Two different site conditions have been assessed in this document. The first RF field calculation was conducted with all transmitter output power levels set to current/contracted conditions. The second RF field calculation was conducted with the power levels set to the maximum/future power rating of each antenna. Drawings for each site condition include a table indicating the power levels used for the assessment. These can be found in Appendix 1.

Level of uncertainty

Based on previous experience, the uncertainty in the reported RF field calculations used in this report is in the order of ± 3 dB.