

Host Communities: siting and effects of facilities

A Sector Review of New Zealand's Mobile Phone Sites



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1 Introduction

1.1 Facility siting and effects research programme

This report contributes to social research being undertaken by Taylor Baines & Associates on the siting and effects (social impacts) of various facility types on their host communities. This facility research has been contracted by the Foundation for Research Science and Technology, and is being funded out of the Public Good Science Fund.

The need for research into the siting and social impacts of various facility types is highlighted by the varied and sometimes negative response from host communities to the siting of certain facilities. Examining siting issues and identifying the social impacts experienced by host communities will provide empirical information that is presently in short supply in New Zealand. This information can be used to:

- evaluate the current assessments of effects, and improve them if they are found to be deficient,
- encourage better-informed community participation in the siting process,
- support better-informed planning decisions,
- encourage the development of effective relationships between facility providers and host communities, and
- improve ongoing management of facilities.

This in turn will further develop the effects-based approach to resource management and planning embodied in the Resource Management Act 1991.

The concept of “effects” or “social impacts” which is used and explored in Taylor Baines facility siting research is in no way intended to refer only to negative effects or social impacts. Rather, the authors use the concept in an unbiased way, acknowledging that both positive and negative effects on host communities can result from siting a facility nearby. This approach is consistent with the definition of ‘effect’¹ in the Resource Management Act 1991 (see section 4.2 of this report).

1.2 Research on the siting and social impacts of mobile phone sites

This report is the first in a series that examine the siting and social impacts of mobile phone sites on their host communities. Mobile phone sites have been included in Taylor Baines facility siting research for two reasons. Firstly, the selection of a mobile phone site has in some situations provoked intense community objections and concern², and secondly, huge growth in the number of mobile phone³ users means that extensive mobile phone network development will need to occur in the near future to cope with increased demand. The aim of this research is therefore to

¹ Section 3 of the Resource Management Act 1991.

² Mobile phone service providers in New Zealand have however pointed out, that the majority of mobile phone sites are installed without any issues or concerns being expressed by host communities.

³ Also known as ‘cell phones’.

identify siting issues and patterns associated with mobile phone network development, and assess the social impacts that selected existing mobile phone sites in New Zealand have had on their host communities. This research will be presented in three stages. These three stages involve:

1) a **Sector Review**

- summarises mobile phone and mobile phone site technology,
- summarises mobile phone service providers, mobile phone technology and network development in New Zealand,
- summarises the policy and planning environment in New Zealand, and
- reviews literature and other sources of commentary on the potential and perceived social impacts of mobile phone sites,

2) an *Historical Analysis*

- examines the introduction of mobile phone services to a particular city or cities (including the timing sequence and rationale behind the network development),
- examines the characteristics of mobile phone sites, and the demographics of their host communities,
- examines the characteristics of mobile phone users within the host community as compared with the city's population as a whole, and
- examines the characteristics of alternative sites⁴, and the demographics of their host communities,

3) and *Case Studies*

- examine the social impacts of mobile phone sites on their host communities, and the experiences of the host communities as compared with the assertions as to potential impacts made before installation.

This report (**Sector Review**) summarises the nature of mobile phone and mobile phone site technology in Part 2, mobile phone service providers, mobile phone technology and network development in New Zealand in Part 3, and New Zealand's policy and planning environment in Part 4; and reviews literature and other sources of commentary on the potential and perceived social impacts of mobile phone sites on their host communities in Part 5.

In reading or using this report, it should be kept in mind that mobile phone technology is constantly changing and evolving and hence some circumstances or technologies described in this report will have changed.

The main objective of this **Sector Review** is to produce a working paper for use within Taylor Baines & Associates. In essence it is a 'scene setting' document. Its objective is not to critique policy or identify actual social impacts, rather it 'sets the scene' and assists with the development of stage two (*Historical Analysis*) and stage three (*Case Studies*) of this research. Although

⁴ 'Alternative sites' refers to mobile phone sites that were considered but not selected during site selection phases.

primarily for internal Taylor Baines use, this *Sector Review* (or portions of this *Sector Review*) may be made available for use by industry groups, researchers, and other interested groups.

In the course of preparing this report, the following were consulted:

Telecom Mobile Ltd

Vodafone New Zealand Ltd

National Radiation Laboratory

Environment Canterbury

Christchurch City Council

North Shore City Council

Wellington City Council

Neil Cherry.

Telecom Mobile Ltd, Vodafone New Zealand Ltd, and the National Radiation Laboratory have all had an opportunity to review and comment on this report during its preparation.

1.3 Terminology

The term 'host community' which is employed throughout this research is defined as:

the community resident in the geographic area most clearly associated with the mobile phone site. This geographic area may be defined by the visibility of the mobile phone site and/or by the area for which the mobile phone site provides coverage.

Note that this is a 'working definition', which may be re-evaluated and adjusted as this research proceeds and fieldwork in the host communities is carried out.

The term 'mobile phone sites' refers to strategically placed transceiver sites that enable mobile phones to function by sending and receiving radio signals between the sites and the phones. These can also be known as cell towers, base stations, and radiofrequency transmitters.

2 Mobile phone technology

This section provides a brief summary of the nature of mobile phone and mobile phone site technology.

2.1 Mobile phones

Mobile phones are telephones which can be used without being connected to a wire base. Mobile phones, unlike ordinary telephones, are linked to telephone exchanges by radio signals rather than by wire⁵.

There are two types of mobile phones:

- 1) handheld mobile phones (small phones with rechargeable batteries)
- 2) car mobile phones (more powerful than handheld mobile phones, with a greater range, and permanently installed in cars) (Telecom Mobile Ltd 2000).

Car phones were the first mobile phones to be introduced into the mass market. During the 1970s and 1980s there was a push to introduce mobile phones which did not have to be permanently installed in a car to operate. By the late 1980s handheld mobile phones were introduced. The popularity and functions of these mobile phones have increased since their introduction⁶.

Mobile phone technology is constantly changing and improving. There are two types of mobile phone technology, analogue and digital. Analogue phones are an older technology and are currently being phased out⁷. They are being replaced with digital phones which can provide extra services and features such as caller identification, text messaging, and internet access⁸.

2.2 Mobile phone sites

How mobile phones and mobile phone sites operate

Mobile phones operate by sending and receiving radio signals to and from mobile phone sites. These radio signals take the form of radio frequency waves which act as 'carriers' for voice messages or electronic data. Mobile phone sites continuously emit a signal, the strength of which changes depending on how many calls the site is carrying at any one time. When a mobile phone is first turned on it locks onto the strongest mobile phone site signal it can locate. The phone, if

⁵ They are however different from cordless or radio phones (cordless phones have a coverage of approximately 100 metres from a base which has to be plugged in, while radio phones are two way radios which provide wider coverage, to a taxi fleet for example).

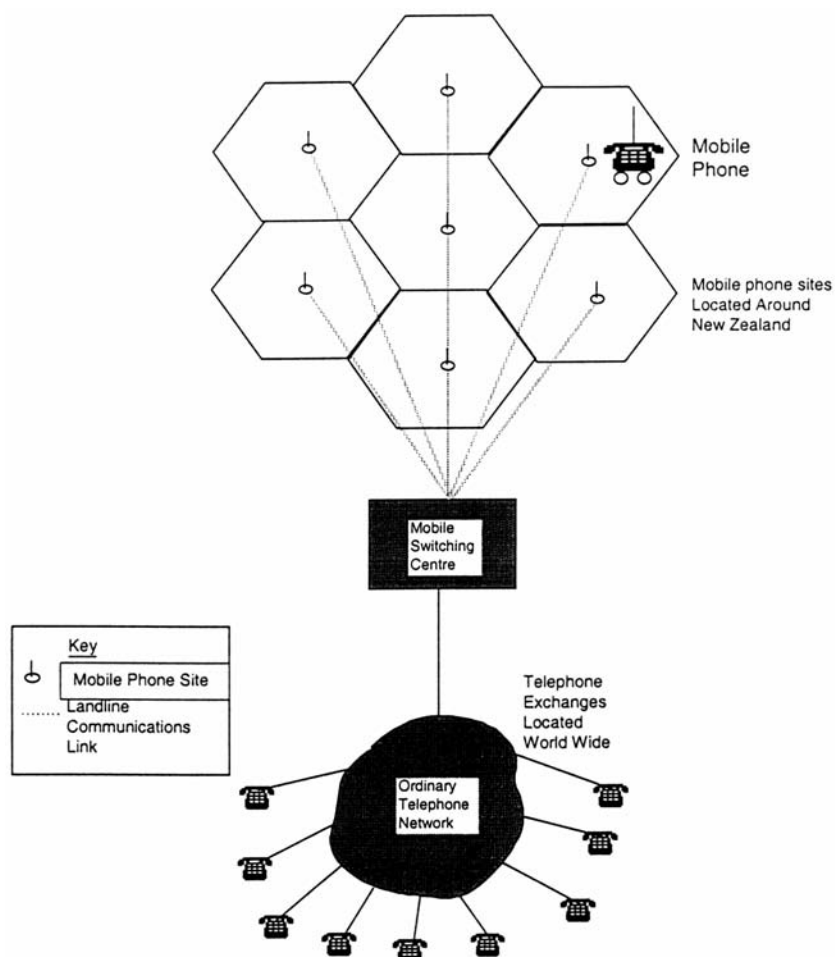
⁶ See Figure 10: Mobile Phone Connections by Service Provider in New Zealand 1990-2001.

⁷ Although analogue phones can no longer be purchased, customers with analogue or part analogue phones are currently still able to use them.

⁸ This digital technology also offers the greatest possibilities for increasing transmission capacity while minimising the power levels of mobile phone sites.

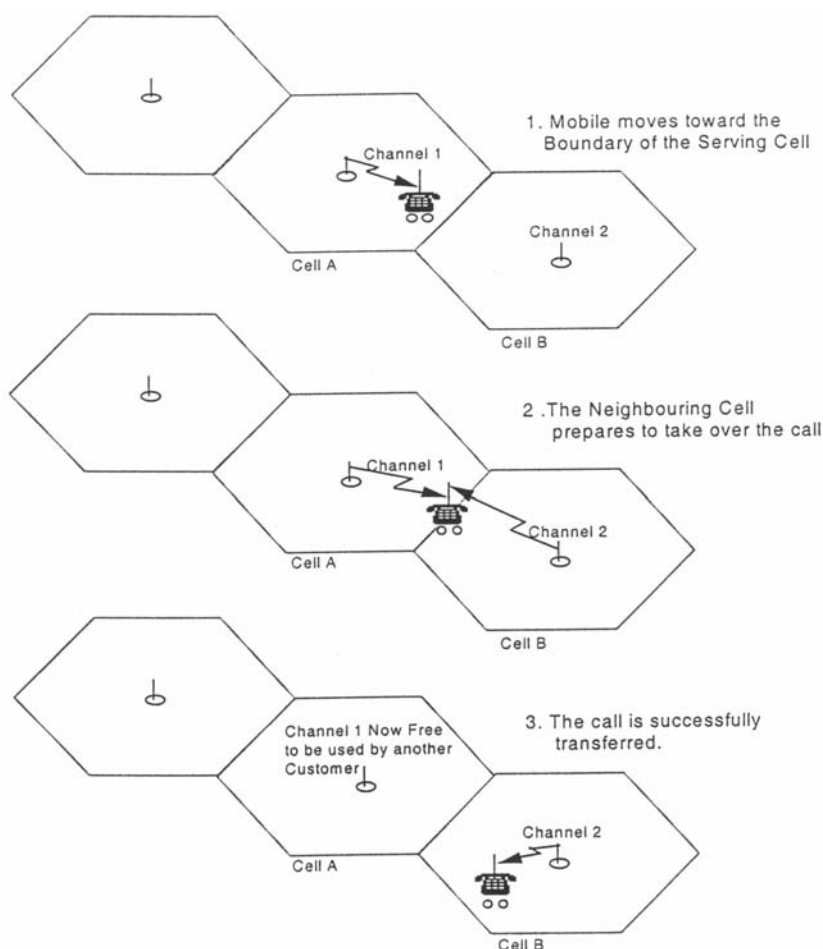
authorised, then registers on the system, and is ready to make and receive calls. When a mobile phone site receives a radio signal, this radio signal is then sent by landline or microwave link to a switching centre which transfers the call to another mobile phone via another mobile phone site or to a landline phone via the landline telephone network (Telecom New Zealand Ltd *Cellular 101*). It is important to note that radio frequency is used only in the last part of the communication link, which makes mobile technology one of the most efficient forms of radio communication.

Figure 1: Components of the mobile telephone system



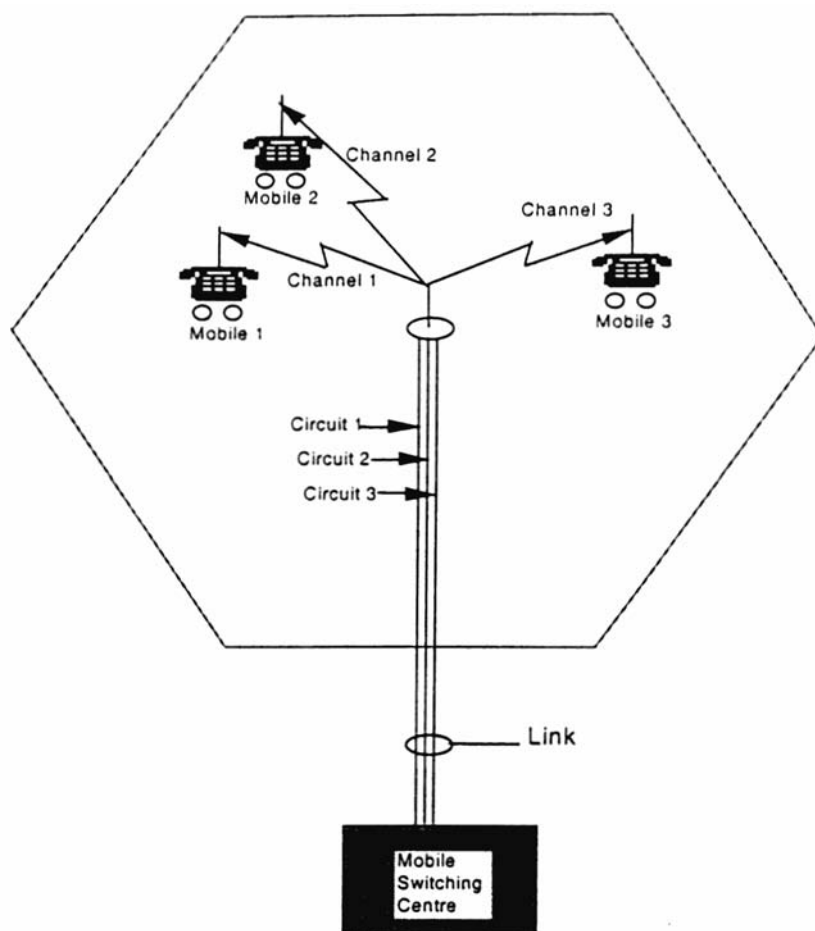
Source: Telecom Mobile Ltd 2000.

A mobile phone network contains a number of mobile phone sites which provide coverage to specific areas that are known as 'cells'. These cells typically provide coverage over a small geographic area. Collectively they provide coverage over a very large geographic area. As mobile phone users move about, calls are transferred from one cell to another ('handoff'). If there is no cell to transfer to, the telephone call will be discontinued ('dropped') (Telecom New Zealand Ltd *Cellular 101*; Telecom New Zealand Ltd *The Facts About Mobile Phone Sites*).

Figure 2: Call transfers between cells in the network

Source: Telecom Mobile Ltd 2000.

More than one telephone call can be handled by these mobile phone sites as each mobile phone site contains a number of circuits, each of which is connected to a radio channel. The number of channels a mobile phone service provider has available will differ. Digital networks have a greater capacity as each channel can handle a number of calls (compared with analogue networks which can handle only one call per channel). The radio signals used in mobile phone networks can be generated from a broad range of different frequencies. This range of frequencies is known as the radio spectrum. Within this spectrum, 'bands' of frequencies are allocated for specific uses, for example, public radio, mobile phones, and television. Mobile phone service providers purchase management rights to a 'band' of frequencies. Within this band a number of channels are available for use. Having a number of channels enables one person to talk on one channel without hearing the conversation of another person on another channel in the same cell. A call will be 'dropped' if there are no free channels when a call is 'handed off' to another cell (Telecom New Zealand Ltd *Cellular 101*; Telecom New Zealand Ltd *The Facts About Mobile Phone Sites*).

Figure 3: Each cell can support a number of simultaneous calls

Source: Telecom Mobile Ltd 2000.

Network development

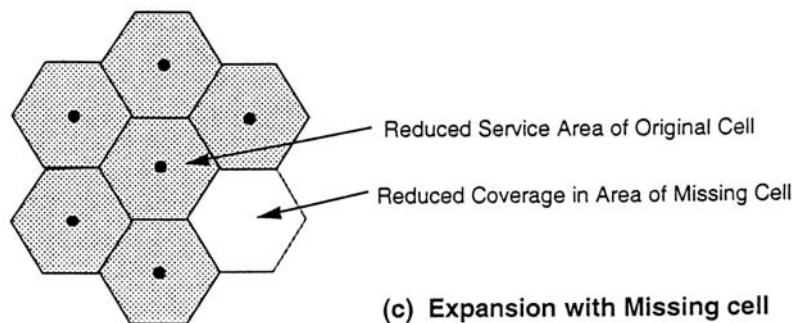
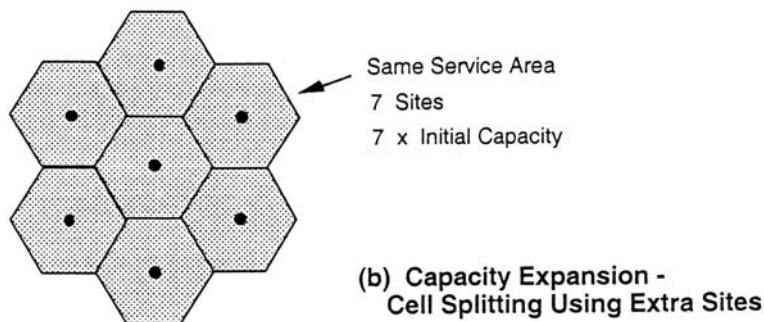
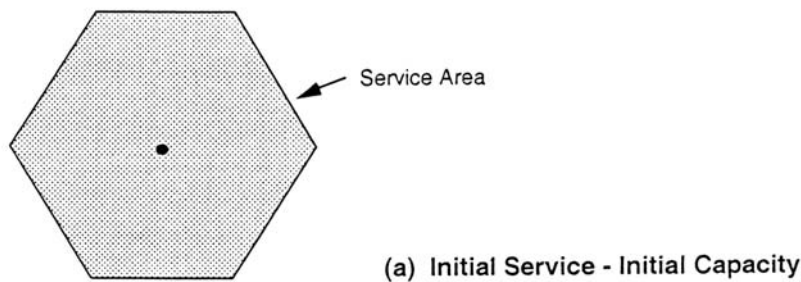
In order to meet mobile phone user demand, network development may occur through the establishment of new mobile phone sites in areas previously not covered, or through the establishment of new mobile phone sites in an area already covered in order to increase capacity. Network development may also need to occur for the network to function effectively, for example, in order to reduce interference (Telecom New Zealand Ltd *Cellular 101*).

Mobile phone sites have varying power levels. Because mobile phone networks are divided into cells, each mobile phone site can operate at much lower powers than other radiofrequency facilities such as television and radio transmitters which must provide coverage to much larger geographic areas. All mobile phone sites operate at low power levels ranging from outputs of approximately two to seventy five watts. Rural mobile phone sites have a slightly higher output than urban mobile phone sites as a wider coverage area is required.

When the mobile phone network in New Zealand was first developed, macro (higher powered) mobile phone sites were established (often on hill tops) as this provided a wide geographic area of coverage to a limited customer base. As the number of mobile phone users increase, more

channels are installed to increase capacity. Once the site has reached its maximum capacity it is necessary to reduce the higher powered site's coverage by introducing new lower powered mobile phone sites in order to increase capacity. This process is called 'cell splitting'. Coverage is reduced by lowering the power and altering the antenna arrangement or height of the original mobile phone sites. The original area of coverage is effectively split into a number of cells rather than one big cell. If any of these new cells do not have mobile phone sites established on them, then the original coverage area will be reduced (Telecom New Zealand Ltd *Cellular 101*; Telecom New Zealand Ltd *The Facts About Mobile Phone Sites*).

Figure 4: Capacity expansion using extra mobile phone sites

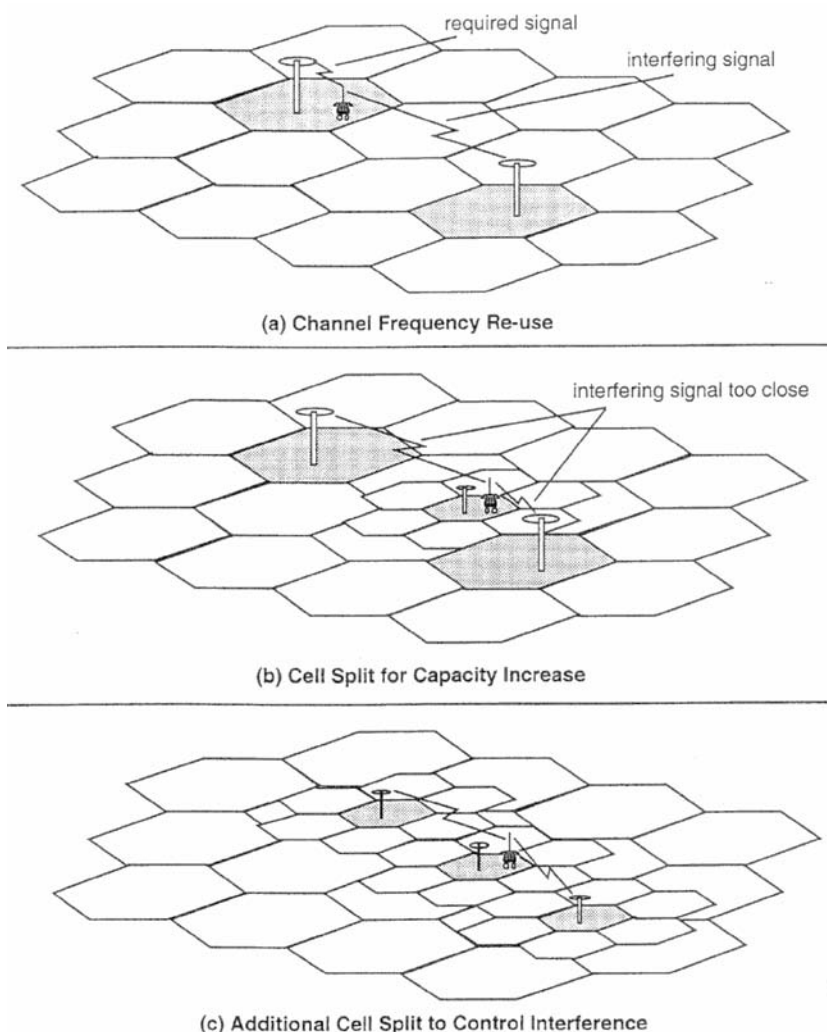


Source: Telecom Mobile Ltd 2000.

After cell splitting has occurred, a further increase in capacity may be required as the number of mobile phone users increases. This is achieved by increasing the number of channels used by each mobile phone site and by 're-using' channels (channels are 're-used' when a number of mobile phone users use the same channel at the same time). Re-use of channels is necessary as there is only a limited number of channels available. To re-use channels mobile phone sites with the same

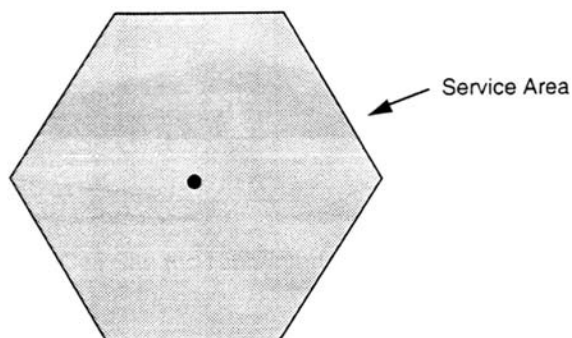
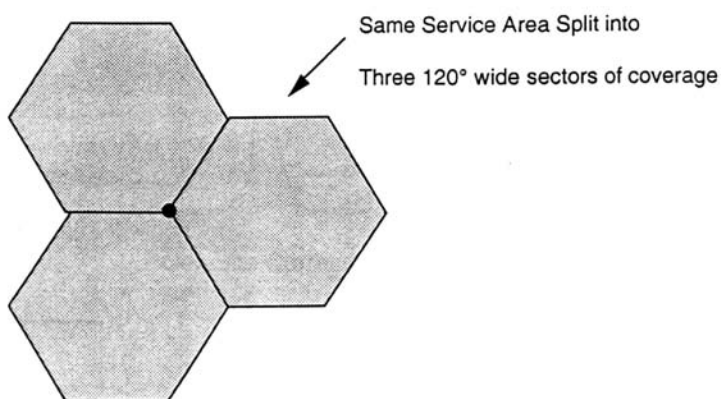
channels must be carefully sited (as far apart as possible) to ensure no interference occurs. However, as new mobile phone sites are added (additional cell splitting), the distance between mobile phone sites using the same channels is reduced. In order to further ensure that interference is minimised, the power level of these mobile phone sites have to be kept low, and antenna configurations and heights altered or additional mobile phone sites established to further increase the distance between mobile phone sites using the same channels (Telecom New Zealand Ltd *Cellular 101*).

Figure 5: Adding mobile phone sites to reduce interference



Source: Telecom Mobile Ltd 2000.

A further step may be undertaken in order to reduce interference in an expanding mobile phone network. This step is called 'sectorisation'. When a mobile phone network is established mobile phone sites are sometimes setup as omni-directional cells. Omni-directional cells provide coverage in all directions. As capacity needs increase these cells are sectorised by replacing omni-directional cells with directional cells. Effectively the mobile phone site is split into three 120° sectors. Each of these sectors operates independently and has its own channels.

Figure 6: Sectorising mobile phone sites to reduce interference**(a) Initial Service - Omni-directional Coverage from Site****(b) Sectorised Expansion - Three Sectors of Coverage from Site**

Source: Telecom Mobile Ltd 2000.

Mobile phone network development therefore occurs primarily to provide coverage, capacity and quality for increasing numbers of mobile phone users. The way in which networks develop is however constrained by a number of technological considerations such as channel re-use and the minimisation of interference.

Selecting mobile phone sites

The nature of mobile phone technology is such that it puts constraints on what sites can be selected to accommodate a new mobile phone site. The three main technical issues influencing site selection are: coverage needs, minimising interference, and the nature of the local terrain.

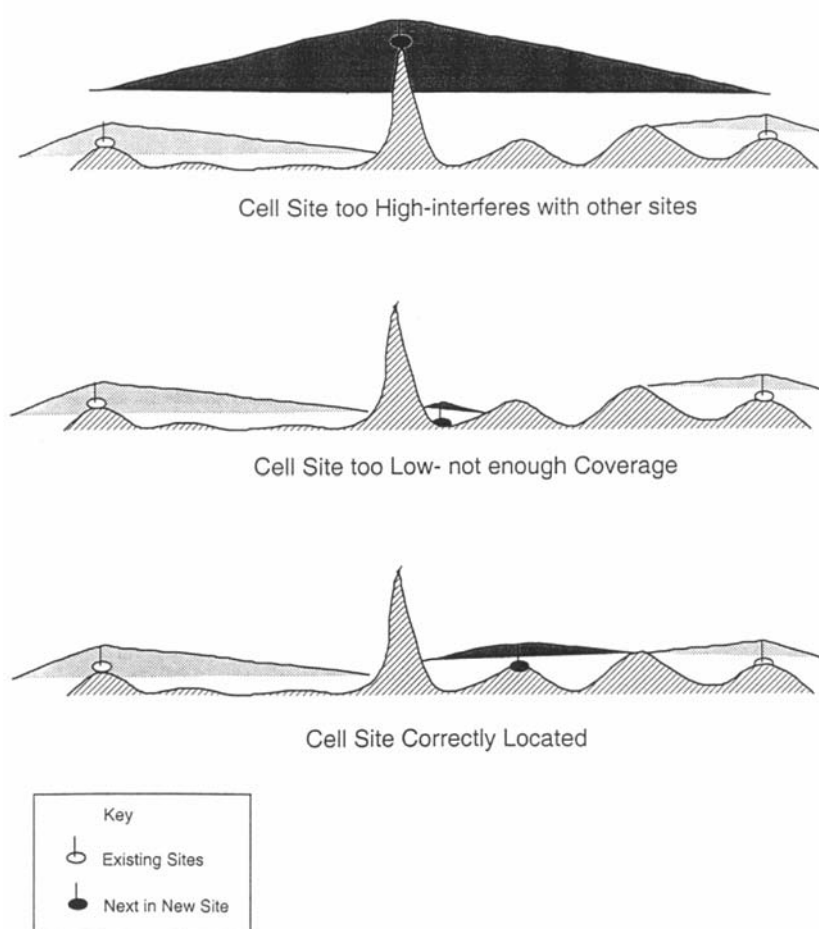
For a mobile phone network to function effectively, it needs to contain enough mobile phone sites to enable a mobile phone user to move about as they use their phone ('hand off' as explained above). These mobile phone sites need to overlap slightly to allow for 'hand off', but not so much

that one mobile phone site interferes with another mobile phone sites' functioning. Choice of location is therefore somewhat limited by this 'structure of cells'.

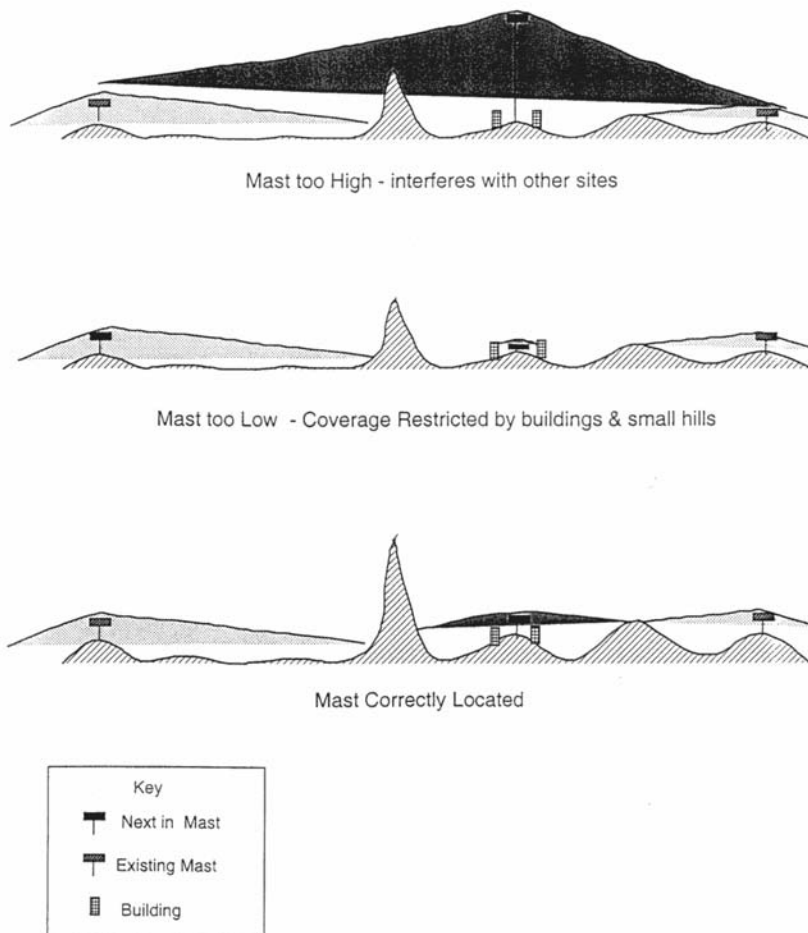
Even with correctly sited mobile phone sites, interference can still be an issue if there is a high re-use of channels. As explained above, when there is a high re-use of channels, mobile phone sites coverage needs to be controlled through careful siting and frequency planning.

Site selection is also constrained by the nature of local terrain. Mobile phone sites and masts for example, must be located at a suitable height determined partly by the local terrain (see Figure 7 and Figure 8).

Figure 7: Mobile phone sites must be located at a suitable height



Source: Telecom Mobile Ltd 2000.

Figure 8: Masts must be located at a suitable height

Source: Telecom Mobile Ltd 2000.

Site selection also has to take into account whether there are aspects of terrain or objects such as buildings or trees which may interfere with the mobile phone site's radio signal. Radio signals can pass through transparent media such as air and glass, and can reflect off hard surfaces, however they cannot pass through very solid structures such as solid concrete walls. They can also be absorbed (totally or partially) by 'softer' materials such as trees and rain drops⁹.

Mobile phone site components

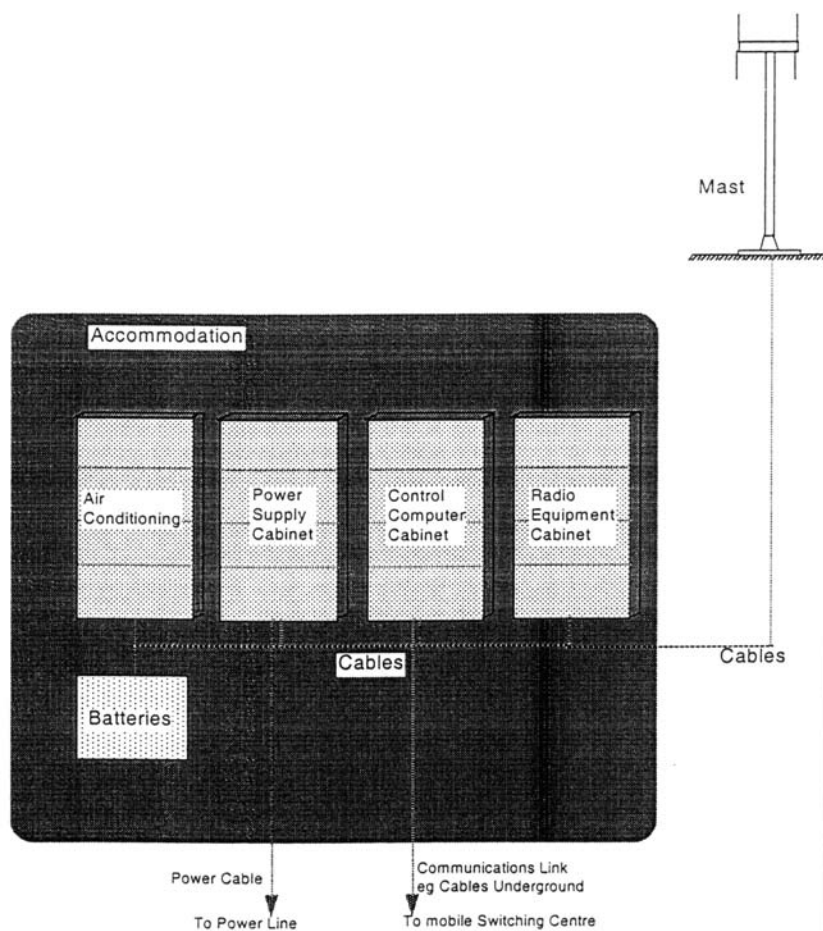
A mobile phone site consists of several components:

- 1) a mains power supply
- 2) emergency batteries
- 3) a control computer
- 4) radio equipment

⁹ The extent to which this happens depends on the spatial characteristics of the waves and whether the intercepting material has similar spatial characteristics. The degree of absorption can also be affected by the season or the material obstructing the signal.

- 5) air conditioning equipment
- 6) cables
- 7) antenna

Figure 9: Components of a mobile phone site



Source: Telecom Mobile Ltd 2000.

The size and nature of these components differ depending on the type of mobile phone site required for the coverage area. Components 1) to 6) can need a floor space between one and ten square metres. They may be housed in an existing building or in a purpose built container. Antennas may be in the form of a rod or a panel. These rod and panel antennas may be incorporated into the structures of different objects, mounted on roofs or walls, or supported on masts. Attempts can also be made to disguise these antennas in order to minimise the visual impact.

The main determinant of what form the site will take, is the coverage area. There are basically three groups of mobile phone sites. Macro sites are usually the largest type of mobile phone site, often used when first establishing a network or in remote rural locations, and comprise rod or panel antennas on top of a stand-alone mast. Smaller micro sites that cover a smaller geographical area, comprise rod or panel antennas, located on either an existing building or structure, or on a stand-alone mast. The last type of site, a pico site, is the smallest type of mobile phone site. It comprises

a small box mounted inside a building to provide mobile phone coverage inside the building. As technology has improved, the nature of mobile phone sites has altered. For example, older masts which were traditionally larger, are now being replaced with slimline masts when possible. These new technologies are however still constrained by the technical issues discussed above, and therefore cannot always be used. Note that mobile phone site masts are much smaller than masts and towers used by broadcasting companies and other utility operators such as power companies' pylons.

Mobile phone site structures or locations may accommodate multiple utility operators, including radio, television, and mobile phone service providers. A mobile phone site is 'co-located' when its antennas are located on the same structure as another utility operator. Mobile phone sites which are co-located can minimise visual impact as there is only one mast/tower needed. However this mast/tower may need to be larger to cope with extra cables and weight, and any separation that may be needed between different technologies, therefore possibly increasing visibility¹⁰. A mobile phone site is 'co-sited' when it is located on the same area of land as another utility operator. Mobile phone sites which are 'co-sited' may increase the visibility of the site in the host community due to the presence of multiple utility operators and their structures, although as a result, fewer areas may need to be sought for sites, therefore limiting the number of host community sites needed.

¹⁰ And arguably taking a step backward from new technologies which are enabling the design of smaller and less visible transmitters.

3 Mobile phone service provision and network development in New Zealand

This section gives an overview of the different mobile phone service providers in New Zealand in June 2001, and summarises a number of issues relevant to the development of mobile phone networks in New Zealand.

3.1 Mobile phone service providers in New Zealand

At present, there are several mobile phone service providers in New Zealand (including: Telecom, Vodafone, TelstraSaturn, Clear Communications and The Warehouse). Of these mobile phone service providers, only Telecom and Vodafone have mobile phone networks. TelstraSaturn and Clear Communications have agreements to resell mobile phone services using Vodafone's mobile phone network, while The Warehouse resells mobile phone services using Telecom's mobile phone network. There are several mobile phone manufacturers that supply handsets in New Zealand. These include: Alcatel, Bosch, Ericsson, Kyocera, Motorola, Nokia, Philips, Samsung, Siemens.

Prior to 1989, Telecom had a state monopoly in the Telecommunications industry. In 1990 Telecom was privatised, and from 1991 telecommunications competitors entered the market. Telecom had begun to develop a mobile phone network in 1987. Despite deregulation Telecom remained New Zealand's only mobile phone service provider until July 1993 when BellSouth entered the market and began establishing a GSM digital network in Auckland to compete with Telecom's analogue network.

The United Kingdom based company Vodafone Group Plc, purchased Bell South New Zealand in November 1998 and continues to operate a Vodafone New Zealand Limited GSM digital network. In 2000 Clear Communications Limited entered into an agreement to resell mobile phone services on Vodafone's digital network. A similar deal was struck with TelstraSaturn in 2001.

As this research is concerned with the social impact of mobile phone sites on their host communities, this report focuses on Telecom and Vodafone, New Zealand's only mobile phone service providers with established mobile phone networks.

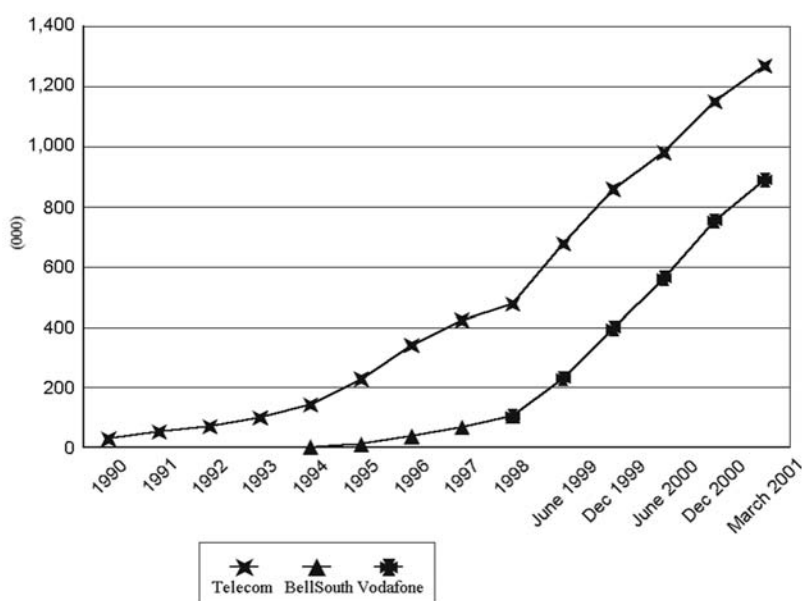
Telecom and Vodafone use different technologies. These technologies are incompatible within New Zealand (including the new digital technologies being introduced) which therefore prevents any 'roaming'. Roaming is a function which allows mobile phone users to use another compatible network's mobile phone site in areas where their own network does not have a mobile phone site available.

Currently Telecom uses an analogue AMPS (first generation - 1 G), digital AMPS (second generation - 2 G) network. It now also has a digital CDMA (code division multiple access - 2.5 G) network, which provides a higher quality service with greater capacity. Telecom operates within the 824-895 MHz frequency band.

Vodafone uses a digital GSM (Global Standard for Mobile Telephony - 2 G) network. It also has a GPRS (General Packet Radio Services - 2.5 G), digital network, that provides a higher quality service with greater capacity. Vodafone operates within the 890-960 MHz frequency band.

Since the introduction of mobile phone services in New Zealand, both Telecom and Vodafone (and Bell South prior to exiting the market) have had to cater for huge growth in the number of mobile phone users. At present, over 56% of New Zealand's population is connected to a mobile phone service and it is expected that over 70% of all New Zealanders will be connected to a mobile phone service by 2006 (Telecom Mobile Ltd 2001). The following graph highlights the huge increase in connections which has occurred since 1990:

Figure 10: Mobile phone connections by service provider in New Zealand 1990-2001



Source: Communications Policy Unit 2000; Vodafone New Zealand Limited
See Appendix for connection figures.

In order to meet the demand for mobile phone services resulting from this huge increase in mobile phone connections, mobile phone service providers, Telecom and Vodafone have had to develop their networks and increase the number of mobile phone sites. Currently, Telecom has approximately 750 mobile phone sites. Of these sites around 90% are sited on privately owned property, while approximately 33% are co-located or co-sited. A higher percentage of Telecom's mobile phone sites are sited on existing structures (such as buildings) as opposed to on towers or masts. Telecom's sites provide approximately 98% coverage (Telecom Mobile Limited 2001). Vodafone currently has 608 operating mobile phone sites. Of these sites, nearly 100% are sited on privately owned property. Approximately 80% are sited on existing structures (such as buildings), and around 15% are co-located or co-sited. These sites provide more than 98% coverage (Vodafone New Zealand Limited 2001).¹¹

¹¹ Note that these figures change rapidly and are likely to be out of date by the time of this report's publication. They do however provide an indication of scale.

3.2 Developing networks

Changing technologies and customer demand makes it essential for Telecom and Vodafone to continue to develop their mobile phone networks. Networks need upgrading as advancements in mobile phone technologies introduce and enable new services and features to be accessed by mobile phone users. Increasing numbers of mobile phone users requires the establishment of new mobile phone sites in areas which previously did not have any coverage, and in existing areas where capacity has been exceeded. The technical drivers and constraints associated with the development of a mobile phone network have been discussed in the previous section on 'Mobile phone technology' (Section 2). There are however a number of other drivers and constraints which influence the development of a network.

Mobile phone service providers¹² generally design their networks to cater for baseline levels of use. Network capacities are rarely designed to provide for the highest possible levels of peak use. If this were so, they would be under-utilised much of the time. The capacity of a network tends to be exceeded in two different circumstances. Firstly, as the level of subscribers in a particular area grows, the volume of mobile phone traffic increases progressively. Insufficient local capacity would be indicated by frequent experience of 'service unavailable'. This type of general demand increase for mobile phone services is what providers try to cater for in developing their permanent network. Secondly, extremely high levels of demand can be created for very short periods by certain events (for example, at the end of a sporting event there may be thousands of spectators present who try to make calls as soon as the game is over). Often most of these calls will not get through because the mobile phone site providing coverage to the area has insufficient capacity to carry the high volume of calls. Providers can cater for such circumstances in a temporary manner by installing a temporary transportable mobile phone site at the event. However, network providers do not generally try to make permanent capacity available to meet such short duration peaks in demand.

It is important to remember that mobile phone service providers are operating a business, and therefore have to calculate the commercial benefits and costs of their decisions to develop a network. It is very expensive to establish a mobile phone site. Although it would be ideal to provide 100% geographical coverage, this is presently commercially unviable. Generally, a mobile phone site would not be established unless there was going to be enough use to justify its cost. Rather than aiming for 100% geographical coverage, network providers therefore aim to provide 100% coverage for those with mobile phone connections. In other words, mobile phone sites are established where the subscribers "live, work, and play". This may mean that some mobile phone sites are established in remote areas (which have a small or non-existent permanent resident population), if mobile phone users occasionally or regularly need coverage in that particular area, for example, a busy road or a tramping track.

The discussion earlier on mobile phone technology (Section 2) highlighted several technical drivers and constraints underpinning the development of a mobile phone network, and a number of technical issues influencing the selection of mobile phone sites. The receptiveness of host communities to proposed mobile phone sites, and any possible visual impacts are also factors considered by mobile phone service providers during the site selection process. Linked to this

¹² Be they communications, transport systems, energy supply network service providers.

consideration of possible visual impacts is a duty to consider ‘environmental impacts’ under the Resource Management Act 1991 (RMA) during the planning and resource consent process (discussed in the following section).

Mobile phone site selection and design is also influenced by the New Zealand Standard on radiofrequency exposures (NZS 2772.1:1999). This Standard recommends that the limit for general public exposure to radiofrequency should be an absorption rate of 0.08 watts per kilogram. This is known as the basic restriction. Because absorption is very difficult to measure outside of the laboratory, the Standard specifies a reference level measured as power density. That level is 450 microwatts per square centimetre, at a frequency of 900 MHz. Compliance with the reference level ensures compliance with the basic restriction. In order to ensure that the public is not exposed to any radiofrequency radiation above the Standard, a test of ‘reasonable access’ is applied¹³. In all cases, the telecommunications providers operate well within the New Zealand Standard. This has been confirmed by numerous independent radiofrequency measurement reports conducted by the Ministry of Health’s National Radiation Laboratory, based in Christchurch.

¹³ ie: ensure that the Standard is not exceeded in any area which the public can reasonably access.

4 Public policy and planning environment

This section summarises the relevant national and regional/territorial public policy and planning environment in which the siting of mobile phone sites in New Zealand takes place.

4.1 National public policy and planning

Telecommunications deregulation

The telecommunications environment in which New Zealand's mobile phone network has developed, has experienced significant regulatory changes over the last fifteen years. At the time of the Labour Party's election to power in 1984, all of New Zealand's telecommunications services were provided by the New Zealand Post Office. A review¹⁴ of the Post Office's operations in 1985 highlighted inefficiencies, and prompted a series of reforms between 1987 and 1989. These reforms addressed the Post Office's statutory monopoly on public telecommunications in New Zealand, and introduced a number of measures aimed at deregulating the telecommunications market. The aim was to improve the industry's performance and increase consumer benefits by encouraging competitive open markets and enforcing general competition law.

As part of this process, the State Owned Enterprise Telecom Corporation of New Zealand was formed in 1987, after the separation of telecommunications services from postal and banking services in the Post Office, and the transfer of regulatory and policy advice sections and the management of the radiofrequency spectrum to the Department of Trade and Industry¹⁵. By mid 1989 all restrictions on the market had been removed, and Telecom had stated that it would provide interconnection to competitors on a fair and reasonable basis. This led the way for the privatisation of Telecom in 1990. From 1991 competition in the market was introduced with the first interconnection agreement occurring between Telecom and Clear¹⁶. Prior to these reforms, Telecom provided New Zealand's only mobile phone services¹⁷. These reforms enabled BellSouth, Telecom's first mobile phone network competitor, to enter the market in 1993¹⁸ (Communications Division 1997; Communications Policy Unit 2000).

¹⁴ The Mason/Morris Report (Communications Policy Unit 2000).

¹⁵ The Department of Trade and Industry later became the Ministry of Commerce, and since 2000 has become the Ministry of Economic Development

¹⁶ As Telecom still retained a position of dominance within the telecommunications market (through the retention of line ownership), the government introduced a Kiwi Share Obligation and rules relating to information disclosure. The Kiwi Share Obligation required Telecom to maintain free local calling for residential customers, restricted the rate of line rental increases, restricted rural line rentals, and required Telecom to make residential telephone services widely available.

¹⁷ Introduced in 1987.

¹⁸ BellSouth was sold to Vodafone in 1998.

In 1989, the government also introduced 'Network Operator Status'. This gave companies who qualify the right to apply for a court order to designate a site, enabling the installation of a telecommunication facility on public or private property (Communications Division 1997; Communications Policy Unit 2000).

The deregulation of the telecommunication market has therefore enabled a number of other telecommunications companies to enter the market and provide competition. This has increased the range and quality of services (including mobile phone services) being provided. The important implications of these deregulations for the purpose of this report, are that they have enabled other mobile phone service providers to enter the market and provide competition to Telecom's mobile phone services. The number of mobile phone sites being erected has therefore increased as an alternative mobile phone network (Vodafone) has developed alongside Telecom's (Communications Division 1997; Communications Policy Unit 2000).

An inquiry into the telecommunications market in 2000 has signaled that further changes to the market will occur (*Ministerial Inquiry into Telecommunications* 2000). Rather than further deregulation, this inquiry suggested that new regulatory measures should be implemented in order to ensure that effective competition is achieved and maintained in the telecommunications industry. The inquiry recommended three categories of regulated services be introduced: designation, deferred designation, and specification. Designated services would require operators to provide certain services according to established pricing principles, while deferred designation would give operators an opportunity to make agreements amongst themselves by a set deadline. Specified services would place an obligation on operators to provide a service but without there being any pricing principles in place. There are several recommendations in this inquiry that have implications for mobile phone service providers in New Zealand. The inquiry recommended that:

- existing mobile phone service providers wholesale their 2.5 G services prior to the launch of 3G services to enable new entrants in the market to build up a customer base¹⁹,
- 'roaming' should be specified. Roaming occurs when a mobile phone user accesses another service provider's network because their own service provider's network is not available. Although this occurs frequently overseas, it has not occurred in New Zealand because the two mobile phone service providers in New Zealand have had incompatible technologies. The spectrums (2.5 G, 3 G and GSM 900 MHz) that are currently being auctioned may however enable roaming to occur. Roaming should be specified to allow new entrants to provide a service and build up a customer base while they find sites, obtain resource consents, and establish a network of their own,
- 'co-location' should be specified. Co-location occurs when more than one radiofrequency facility is located on one site. In New Zealand some co-location has occurred between broadcasting operators, and between mobile phone service providers. The need for sites

¹⁹ At present Telecom uses a combination of 1 G (first generation mobile technology), 2 G (second generation mobile technology), and 2.5 G technologies, while Vodafone uses 2 G and 2.5 G technologies. Neither company has 3 G (third generation mobile technology) at this stage. To 'Wholesale' a service means that services are sold at discounted or wholesale prices between service providers who then resell them to customers.

is increasing as mobile phone use increases and networks need to be developed. The introduction of 3 G technologies will also require more sites than previous technologies. Co-location minimises the difficulties associated with finding new sites and facilitates the resource consent process. It should therefore be specified to assist new entrants in their attempts to enter the market. As co-location reduces the number of sites needed, it also has the potential to reduce the network's overall environmental impact (although it may increase the impact of an individual site²⁰). Specifying co-location would not prevent an operator from establishing their own network, but provides regulation that obliges dominant competitors to deal fairly with those seeking to enter the market. Once requested, co-location should be agreed on as long as there is enough space available, and no material interference would occur for existing users,

- a national policy statement (under the RMA) on emissions be released to address the concerns of some submitters to the inquiry that the development of mobile phone networks was being hindered by the inconsistent approach of territorial authorities around New Zealand, and
- s. 48A(6) of the Reserves Act 1977 be repealed so that mobile phone sites can be erected on reserves which are administered by territorial authorities, rather than only on reserves which are vested in territorial authorities under s. 26.

In response to the inquiry's recommendations the government has accepted the three new categories of regulated services (designation, deferred designation, and specification). The recommendations of the inquiry to specify the wholesaling of 2.5 G services, roaming, and co-location were not however adopted (*Government Response to the Telecommunications Inquiry* 2000).

New Zealand Standard

The Standards Act 1988 enables radiofrequency standards to be developed. A standard with a basic restriction level of 0.08 watts per kilogram (watts/kg) was adopted, together with a reference level of 200 micro watts per square centimetre ($\mu\text{W}/\text{cm}^2$) in 1990 based on a 1985 Australian standard (NZS 6609:1990 Part 1 *Radiofrequency Radiation - Maximum exposure levels 100 kHz - 300 GHz*). In 1991, the New Zealand and Australian Standards Committees amalgamated. In 1998, a revised interim standard was produced based on 1988 International Radiation Protection Association standards and the International Commission for Non-Ionising Radiation Protection (ICNIRP) guidelines in 1995 and 1998 (AS/NZS 2772.1 (Int):1998). As in 1990, the basic restriction level in the 1998 Interim Standard was 0.08 watts per kilogram with a reference level of 200 microwatts per square centimetre. After further review and consideration, a standard was finalised and adopted in 1999 (NZS 2772.1:1999 *Radiofrequency Fields Part 1: Maximum exposure levels 3 kHz - 300 GHz*). This standard recommends the same basic restriction of 0.08 watts/kg as the 1990 standard, but has a new reference level of $450 \mu\text{W}/\text{cm}^2$ for the general public. As well as setting this standard, it provides advice on how to implement the standard, and it also notes that where possible, exposures to radiofrequency fields should be minimised.

²⁰ Both the visual impact and the RF exposure levels.

It is important to note that the ICNIRP guidelines avoid the concept of ‘prudent avoidance’ or the ‘precautionary principle’ as it believes that standards should be based on scientifically established studies (Ministry for the Environment & the Ministry of Health & 2000). However, in effect the standard does incorporate the precautionary principle, as the guidelines are based on the premise that there are exposure thresholds before which no effects are expected to occur, and these are incorporated for the public safety factor of 50 below those thresholds.

Industry representatives note that it is very important that the proper definitions of “prudent avoidance” and the “precautionary principle” are fully understood. Neither concept refers to total avoidance of a technology until it is proven to be 100% safe, but rather refer to taking all practical steps to ensure risk is minimised. Both the Standards and the Industry recognise this. The Standards have an inherent safety factor of 50 and mobile phone sites operate at small percentages of the Standard. Clause 10 of the NZ Standard also incorporates its own precautionary principle requiring network operators to minimise RF to the lowest practicable level.

Ministry of Health and Ministry for the Environment - National Guidelines for Managing the Effects of Radiofrequency Transmitters

In 1998, the government directed the Ministry for the Environment in partnership with the Ministry of Health to produce national guidelines for managing the effects of radiofrequency transmitters (Ministry for the Environment & the Ministry of Health 2000)²¹. These guidelines are intended to assist territorial authorities, telecommunication service providers, and the public when dealing with radiofrequency transmitters and their effects. The guidelines were also constructed in an attempt to address the inconsistencies between territorial authority approaches to radiofrequency transmitter network development. Although these guidelines cover all radiofrequency transmitters including television and radio broadcasting facilities, they do pay particular attention to mobile phone sites because of the public attention that these facilities have received. The report covers: radiofrequency fields and technology, health effects and exposure standards, policy on exposures to radiofrequency fields, guidance on environmental effects, guidance for territorial authorities, guidance for the telecommunications industry, and guidance for the community.

The guidelines acknowledge that there is confusion in the community over the nature and extent of health effects from radiofrequency transmitters (p. 16). The guidelines state that it is not always possible to prove that new technologies (such as transmitters) are absolutely safe, and that it is therefore up to society to decide whether or not the exposures that do occur are acceptable (p. 16).

In producing the guidelines however, a number of studies that have been undertaken on this issue were assessed, attempts were made to resolve any discrepancies, and decisions were made as to

²¹ The guidelines are based on a two year consultation period, involving interested communities, the public, central and local government, and the radio communications industry. Eighty seven submissions from a range of organisations and the public were received in response to a discussion document which was released in 1999.

what weight was to be given to each study²². After reviewing these studies and health effects issues, the guidelines conclude that although there is some disagreement as to the nature and extent of health effects, there is no evidence of short or long term health effects from exposure to low radiofrequency fields (p. 25). The guidelines note that the Environment Court has also held that there are no adverse health effects, and that any potential adverse health effects are of low probability and small risk. It is noted that as the Resource Management Act 1991 is not a no-risk statute, therefore this small risk cannot prevent a mobile phone site from being erected (p. 3).

The guidelines recommend that measures such as risk communication should be undertaken (p. 47). Risk communication is a process in which territorial authorities and mobile phone service providers assist communities to increase their understanding of the issues and evidence relating to potential health risks²³.

The guidelines explain and review issues related to the New Zealand Standard and conclude that a strict application of the New Zealand Standard should be adhered to²⁴ (p. 26). It is conceded however, that where possible, attempts should be made to reduce exposures because of the lack of knowledge on possible health effects (as is embodied in Clause 10 of the Standard)²⁵ (p. 27).

The guidelines also review a number of effects other than potential health effects, including psychological, visual/landscape/amenity, property values, cultural, and positive effects. The guidelines agree with the decision in the *Shirley* case that psychological effects are based on fear, and that fear cannot be considered unless it is based on a real risk (p. 30). It is suggested in the guidelines that these fears be abated with public consultation and information sharing (p. 30).

In regards to visual/landscape/amenity effects, the guidelines acknowledge that adverse visual/landscape/amenity effects do occur and that they do have to be considered under the RMA²⁶, but

²² There are three types of studies identified by the guidelines:

- 1) 'In vitro' - laboratory experiments in a test tube - these are cheap and easy to carry out, but are limited in the range of effects that they can show as they are not carried out in the 'whole organism', therefore ignoring other possible interactions and influences.
- 2) 'In vivo' - laboratory experiments on animals - these are more expensive and complex to carry out, but the results are more appropriate for making predictions about the effects on humans.
- 3) 'Epidemiological' - systematic observation of the human population outside the laboratory - these studies examine the relationship between exposures and human health - although these studies should generally be given precedence over laboratory studies, caution has to be taken due to the fact that results may be influenced by selection bias, information bias, and the effect of chance.

²³ However, industry representatives note that the orthodox view which is held by all the independent and reputable scientific agencies is that there is no evidence of any actual risk to health as long as the Standard is adhered to.

²⁴ As was held in the Environment Court (Ministry for the Environment & the Ministry of Health 2000, p. 3).

²⁵ Industry representatives note that this clause is strictly adhered to. This can be done by reducing transmitter power, selectively directing antennas, and by using alternative sites or alternative locations within sites.

²⁶ As held in the Environment Court, the guidelines also note that a claim of visual/landscape/amenity effects should not be a cloak for other objections.

chose not to consider them as they relate to the mobile phone site structures not the radiofrequency fields (p. 32).

The guidelines recognise that property values are often considered in the RMA during the consideration of amenity values, and that therefore they should not be considered separately from any considerations on amenity (p. 32).

The guidelines refer to case law in their discussion on cultural effects relating to Maori relationships with their ancestral lands (p. 33). This case law has held that consultation is crucial and that the uniqueness of the site for Maori should be considered (p. 33).

Positive effects are also considered in the guidelines (p. 34). The guidelines note that positive effects can be considered under the RMA and that several cases have recognised positive effects such as increased mobile phone coverage during their assessment of effects (p. 34). The guidelines do however state that they do not support a balancing approach in which the existence of positive effects could lead to unacceptable environmental change (p. 34).

The guidelines also give brief consideration to financial viability and the availability of alternative sites (p. 32-33). In relation to financial viability, the guidelines refer to the *Shirley case* which held that it was not an effect that could be considered but an effect of the schools own making. The guidelines note that no firm decision has been arrived at in relation to the availability of alternative sites in case law to date, but that there are provisions in the RMA that allow for the consideration of alternative sites. The guidelines recommend that telecommunication service providers voluntarily reduce exposures where possible (as is stated in Clause 10 of the New Zealand Standard).

There is some debate as to whether mobile phone site issues should be dealt with in district plans alone or in regional plans also. For such issues to be included in regional plans, radiofrequency fields would have to be defined as a contaminant (s. 2 RMA). This would then require telecommunication providers to apply for a discharge permit to discharge contaminants into the air. Section 2 of the RMA does not specifically refer to radiofrequency fields but does refer to any energy or heat which when discharged into air changes or is likely to change the physical, chemical, or biological condition of the air. The guidelines recognise that the absorption of radiofrequency waves will cause heating in the body but that this heating would be very small, difficult to measure, and would not cause any measurable change to the air. It was therefore concluded that radiofrequency waves were not a contaminant, and should only be considered in a district plan.

The guidelines provide detailed advice on how territorial authorities should manage the effects from radiofrequency transmitters (p. 36). The guidelines recognise that this guidance may have to be tailored to suit the format and style of each district's plan. The guidelines note that s.32 of the RMA requires territorial authorities to consider a range of methods before adopting any rule or method. In this case possible methods include: do nothing at all, implement rules in district plans, implement bylaws, public education, or advocacy²⁷. The guidelines state that territorial

²⁷ 'Advocacy' refers to an approach by territorial authorities that encourages industry to behave in a certain way through non-regulatory means (Ministry for the Environment & Ministry of Health 2000, p. 38).

authorities are justified in implementing rules in district plans as long as they comply with the New Zealand Standard, and acknowledge the associated benefits of rules such as the certainty they provide communities and the opportunity it provides for communities to participate in the planning and consent process. However, the guidelines note that implementing rules that have high cost implications are not justified when there are no established health effects²⁸.

The focus of the guidelines advice to the telecommunications industry is on abating community fears (p. 47-49). The guidelines recommend that the industry works with territorial authorities by providing them with effective information, by continuing to apply for certificates of compliance, by siting and designing transmitters in a way that avoids or reduces exposures, and by considering a joint monitoring venture. It also recommends that the industry works with the community by communicating information, using one honest, reliable, trustworthy contact person, by accommodating concerns where possible, by giving communities the chance to articulate their fears, by recognising the special skills needed to communicate effectively, and by publicising successful community communications.

Guidance for the community is also provided (p. 50- 52). Much of this guidance summarises the conclusions reached by the Ministry for the Environment and the Ministry of Health in the report. For example it is reiterated that there are no adverse health effects as long as the New Zealand Standard is complied with, that industry has been advised to keep exposures low, that territorial authorities can only interfere with the establishment of a transmitter to address environmental effects, that territorial authorities have to follow the precedent on potential health effects set in the *Shirley Case*, that the RMA is not a no-risk statute, and that each territorial authority will have its own rules as to visual/landscape/amenity effects. In order to help address community concerns, the guidelines recommend that more information on how transmitters work, how risk is evaluated, why there are different 'expert' opinions, how the standards committee makes decisions, and latest research be made accessible to communities. It also recommends that territorial authorities ensure that the New Zealand Standard is complied with, that information on the exposure levels of operational sites be provided in order to assure communities, and that industry groups communicate with communities.

4.2 Regional/territorial public policy and planning

Siting and social impact issues relating to mobile phone sites are managed at the regional/territorial level under the Resource Management Act 1991 (RMA). The management of these issues is influenced by the purpose of the RMA and its definition of 'effect' and 'environment':

5. Purpose-(1) The purpose of this Act is to promote the sustainable management of natural and physical resources.

(2) In this Act, "sustainable management" means managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural well being and for their health and safety while-

(a) Sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and

²⁸

High costs are involved with the resource consent process including experts and legal costs, and costs associated with delays in the process.

- (b) Safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and
- (c) Avoiding, remedying, or mitigating any adverse effects of activities on the environment.

3. Meaning of “effect”-In this Act, unless the context otherwise requires, the term “effect” ... includes-

- (a) Any positive or adverse effect; and
- (b) Any temporary or permanent effect; and
- (c) Any past, present, or future effect; and
- (d) Any cumulative effect which arises over time or in combination with other effects- regardless of the scale, intensity, duration, or frequency of the effect, and also includes-
- (e) Any effect of high probability; and
- (f) Any potential effect of low probability which has a high potential impact.

2. Interpretation-(1) In this Act, unless the context otherwise requires,-

....

“Environment” includes-

- (a) Ecosystems and their constituent parts, including people and communities; and
- (b) All natural and physical resources; and
- (c) Amenity values; and
- (d) The social, economic, aesthetic, and cultural conditions which affect the matters stated in paragraphs (a) to (c) of this definition or which are affected by those matters

These sections suggest that mobile phone sites should be managed in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural well being and for their health and safety while - avoiding, remedying, or mitigating any adverse effects from the mobile phone sites on people, communities, amenity values, and social, economic, and cultural conditions.

As was mentioned earlier during the discussion of the Ministry for the Environment and the Ministry of Health guidelines (2000), regional councils can only deal with the siting of mobile phone sites if RF is defined as a contaminant. The guidelines however have concluded that RF is not a contaminant and that the siting of mobile phone sites does not come under the jurisdiction of regional councils.

Siting and social impact issues are therefore dealt with solely by territorial authorities. Under the RMA, the functions of territorial authorities include:

31. Functions of territorial authorities under this Act-Every territorial authority shall have the following functions for the purpose of giving effect to this Act in its district:

- (a) The establishment, implementation, and review of objectives, policies, and methods to achieve integrated management of the effects of the use, development, or protection of land and associated natural and physical resources of the district:
- (b) The control of any actual or potential effects of the use, development, or protection of land, including for the purpose of the avoidance or mitigation of natural hazards and the prevention or mitigation of any adverse effects of the storage, use, disposal, or transportation of hazardous substances:

....

In order to carry out the purpose of the Act and their functions under it, territorial authorities must prepare a district plan and may include district rules within this plan²⁹. These rules may prohibit,

²⁹ s. 72, s. 76.

regulate, or allow activities³⁰. The management of mobile phone sites within different territories will therefore depend on whether or not they are considered to be significant territorial issues, and on the nature of the territorial rules relating to mobile phone sites included in district plans³¹.

The rules in a district plan may classify mobile phone sites as:

- Permitted activities³²
 - ▶ mobile phone sites can be established without applying for a resource consent.
- Controlled activities
 - ▶ mobile phone sites cannot be established without a resource consent
 - ▶ resource consents *shall* be granted, although conditions may be added³³
 - ▶ no public notification is needed if: the plan permits it without the written approval of affected persons, or the mobile phone service provider has the written approval of affected persons unless it is unreasonable to obtain approval of every such person³⁴.
- Discretionary activities
 - ▶ mobile phone sites cannot be established without a resource consent
 - ▶ resource consents *may* be granted or refused, and conditions may be added³⁵
 - ▶ no public notification is needed if: a consent authority has restricted its discretion and its plan permits it without the written approval of affected persons, or the effects are minor and the mobile phone service provider has the written approval of

³⁰ s. 68, s. 76.

³¹ Note that using rules in a district plan is not the only method to deal with mobile phone sites available to territorial authorities. Section 32 of the RMA actually requires territorial authorities to consider alternative methods before adopting any rule or other method. Such alternative methods may include: doing nothing (no resource consent needed, no cost, does not guarantee community that they can benefit from the site while providing for their health and safety), implementing bylaws (no resource consent needed if facility complies with bylaw, less public involvement in the bylaws adoption), public education (no costs for industry, long-term strategy, costs for territorial authority with no certainty that it will be effective), or advocacy (no certainty that public safety will be protected) (Ministry for the Environment & and Ministry of Health 2000, p. 39).

³² Note that the Ministry for the Environment & Ministry of Health guidelines (2000, p. 40) recommends that territorial authorities include mobile phone sites as a permitted activity in their district plans as long as three conditions are met. These conditions include: 1) exposures comply with the New Zealand Standard, 2) prior to commencing emissions the council is provided with written notice of the location/proposed location of the site; and a report by a radio engineer/technician or physical scientist predicting whether or not the Standard will be complied with, and 3) if the report to the council predicts that emissions will exceed 25% of the exposure limit in the Standard, then within three months of commencing emissions, a report from the National Radiation Laboratory certifying compliance with the Standard must be produced.

³³ s. 105.

³⁴ s. 94.

³⁵ s. 105.

affected persons unless unreasonable to obtain written approval from all such persons³⁶

- Non-complying activities
 - ▶ mobile phone sites cannot be established without a resource consent
 - ▶ a resource consent *shall not* be granted *unless*, any effects are minor and granting it would not be contrary to the objectives and policies of the district plan³⁷
 - ▶ no public notification is needed if: effects are minor and the mobile phone service provider has the written approval of affected persons unless unreasonable to obtain written approval from all such persons³⁸.
- Prohibited activities
 - ▶ mobile phone sites may not be established.

The RMA provides further guidance for territorial authorities which have defined mobile phone sites as those activities above which require resource consent. Matters to be considered when deciding whether or not to grant a resource consent include 'any actual and potential effects on the environment' (s.104 RMA).

As the RMA is not a no risk statute, any small health risk of low probability cannot prevent the establishment of a mobile phone site (Ministry for the Environment and the Ministry of Health 2000, p. 3).

Consideration should be given to cultural effects that a mobile phone site may have on its host community. Consultation with iwi will be needed³⁹ if the mobile phone site is to be located on or near sacred sites or sites of significance to local hapu. The overall cultural uniqueness of an area may be enough to warrant the refusal of a resource consent, even if damage to land is minimal and/or there are no archaeological remains (*TV3 Network Services Ltd v Waikato District Council* [1996] NZRMA 193).

Consideration of visual amenity values will usually be determined by a district plan's height and dimension rules, and is a site-specific issue.

Regional/territorial authority approaches

As mentioned above, regional and territorial authorities may take different approaches to the siting of mobile phone sites, due to the flexibility of approach embodied in the RMA. The approaches taken by Christchurch, North Shore, and Wellington City have been reviewed in this report in order to highlight the different approaches that have been taken in New Zealand to date.

³⁶ s. 94.

³⁷ s. 105.

³⁸ s. 94.

³⁹ In *Mason-Riseborough v Matamata-Piako District Council* [1997] A143/97 the court held that the applicant had failed to fulfil their obligations to consult by initiating consultation at such a late stage.

Mobile phone service providers have commented that the approach each regional and territorial authority has taken to the siting of mobile phone sites in New Zealand tends to have been determined by community responses to sitings (Vodafone New Zealand Limited 2001; Telecom Mobile Limited 2001). In their experience, Christchurch, in the Canterbury Region, stands out in terms of a strong community response, a fact they attribute largely to the level of community mistrust in the perceived health issue around mobile phone sites generated by one regional councillor in particular.

Christchurch:

Dr Neil Cherry, a regional Councillor in Christchurch (Environment Canterbury), has argued that RF radiation is a contaminant which should be included in the regional air plan. Currently there is a Council resolution to advance this issue as a matter of urgency into the air plan. In order to do this, the Council believes that a declaration from the Environment Court should be sought to declare RF radiation as a contaminant. However, at this stage RF radiation has not been included in the air plan and no money has been currently set aside to follow through with this (Environment Canterbury 2001).

Rather than adopting the reference level in the current New Zealand Standard of $450\mu\text{W}/\text{cm}^2$, Christchurch's territorial authority, the Christchurch City Council has adopted (in 1999 after decisions from hearings were finalised) a reference level of $200\mu\text{W}/\text{cm}^2$ ⁴⁰. Note that when the City Plan was first notified in 1995⁴¹, a reference level of $50\mu\text{W}/\text{cm}^2$ was used. Prior to the City Plan's notification in 1995, no reference level was included (ie: in its transitional plan).

There was also no activity classification given to mobile phone sites in the transitional City Plan. Mobile phone sites were therefore classified as non-complying activities.

Under the Council's proposed City Plan, mobile phone sites are classified as either controlled or discretionary activities. Mobile phone sites which comply with the reference level of $200\mu\text{W}/\text{cm}^2$ are classified as controlled activities (resource consents *shall* be granted, although conditions may be added⁴²). However, if these sites do not comply with community or critical standards such as those relating to height and distance within various zones, then they are classified as discretionary activities (resource consents *may* be granted or refused, and conditions may be added⁴³). Council staff have commented that, generally, mobile phone service providers now design their sites to comply with the community/critical standards, therefore making the sites controlled activities (Christchurch City Council 2001).

⁴⁰ Based on the 1990 New Zealand Standard: NZS 6609:1990 Part 1 *Radiofrequency Radiation - Maximum exposure levels 100 kHz - 300 GHz*.

⁴¹ The Christchurch City Council's proposed City Plan was notified in 1995 but is not yet operative. All hearings have been held, however Environment Court proceedings have yet to be decided.

⁴² s. 105.

⁴³ s. 105.

Assessment criteria used by the Council when deciding on these resource consents include:

- matters contained in sections 104 and 105 of the RMA
- the visual impacts and their likely effects on residential or recreational use of land in the vicinity, ridge lines and view planes from public places, and design elements in relation to the locality with reference to the existing character of the locality and amenity values
- the screening and landscaping of the utility
- the practicality of screening and landscaping of the utility
- the siting of any structure in relation to existing dwellings and the effect on views of, or from such dwellings
- the visual appearance and design of the utility structures with regard to the surrounding environment, and the adequacy of landscaping, or screening treatment
- the cumulative visual effects with respect to existing facilities within an area
- the appropriateness of, and necessity for the scale and height of structures proposed, in terms of their intended function
- whether the best contemporary engineering practice has been adopted to reduce unnecessary public exposure to RF radiation, and the need for monitoring

North Shore:

Under the North Shore City Council's proposed District Plan⁴⁴, all mobile phone sites in the territory have to comply with the 1998 Interim New Zealand Standard (AS/NZS 2772.1 (Int): 1998 3 kHz - 300 GHz).

Mobile phone sites in business zones (except Local 1) which do not exceed a height of 20 metres and are not within 30 metres of residential land are classified as controlled activities (resource consents *shall* be granted, although conditions may be added⁴⁵).

The assessment criteria for controlled activities includes:

- design/external appearance and visual impact
- landscaping and screening
- height
- nuisance issues such as noise, vibration, glare, air emissions and vehicle movements.

Mobile phone sites in all zones except Recreation 1, 2, 3, and Residential 3, are classified as discretionary activities (resource consents *may* be granted or refused, and conditions may be added⁴⁶).

⁴⁴ The North Shore City Council's District Plan was notified in 1994. Although not operative yet, most content is now beyond challenge.

⁴⁵ s. 105.

⁴⁶ s. 105.

Without limiting its discretion, matters that may be considered by the Council when assessing whether or not to grant a resource consent for a discretionary activity include:

- design and external appearance and the visual impact in relation to the character of the locality and its amenity values
- landscaping and screening
- visual effect with respect to view lines from public places such as roads
- the number of public works and utilities in the area (co-location should be pursued in order to minimise the number of structures)
- the effect on amenities of an area caused by nuisance factors
- the levels of exposure to RF radiation
- the location of structures which have adverse effects on the safety of road users
- the operational efficiency and technical requirements of the public work or utility
- the provision and formation standard of onsite parking and manoeuvring areas.

Wellington:

Wellington City's District Plan was notified in 1994 and for the most part became operative in July 2000. The objectives and policies relating to the siting and operation of mobile phone sites concern providing for the efficient development and maintenance of utility networks, and the avoiding, remedying or mitigating of any adverse effects on the environment. In order to achieve these objectives and policies, mobile phone sites may be classified as permitted, controlled, or discretionary (restricted or unrestricted) activities under the plan.

Some of the circumstances where mobile phone sites are classified as permitted activities in the district plan include:

- when they are located on a building with measurements not exceeding 1.5 m² or 1.7 m in height,
- when they are located within a building,
- when they comprise a mast - which has no guy wires, is no closer than 3 m from a residential area, is no closer than 50 m to the nearest dwelling if 20 m or more in height and located in a rural area (note: this shall not apply if the mast is not visible from the dwelling), is no closer than 20 m to the nearest dwelling if less than 20 m in height and located in a rural area (note: this shall not apply if the mast is not visible from the dwelling), complies with relevant area height restrictions, and
- when they comply with the New Zealand Standard NZS 2772 : Part 1:1999 Radio frequency Fields Part 1 - Maximum Exposure Levels - 3 kHz to 300 Ghz.

Those mobile phone sites which do not meet the conditions and standards required as permitted activities are classified as either controlled, or discretionary (restricted or unrestricted) activities.

Case law: The Environment Court approach

A right of appeal to the Environment Court exists for those who want to challenge the actions and decisions of territorial authorities. A small number of mobile phone site cases have gone to the Environment Court (formerly the Planning Tribunal). The Environment Court approach has held that there are no established adverse health effects from exposure to RF emissions from mobile phone sites, and that therefore there is no reason to decline a resource consent to establish and

operate a mobile phone site on health grounds. It has further held that any risk that exists is negligible.

- *McIntyre Case, 1995/1996*

In this case, Vodafone's predecessor Bell South, was granted a resource consent to establish and operate a mobile phone site in Fendalton, Christchurch. Residents who were concerned about potential adverse health effects, appealed and argued: that a decision should not be made because of the incomplete state of present scientific knowledge on the effects of RF radiation, that the RMA contains a precautionary principle, and that s. 104 requires a consent authority to have regard to potential effects of low probability but high potential impact. The Planning Tribunal held that there would not be any adverse health impact and granted a resource consent subject to conditions (These conditions included a reference to the predicted exposures at the nearest residential boundary as described in the evidence of the company and the National Radiation Laboratory, and required Bell South to ensure that emissions were no more than $2 \mu\text{W}/\text{cm}^2$).

- *Beckenham Case, 1996*

In this case, Telecom appealed a decision by the Christchurch City Council to refuse a resource consent to establish and operate a mobile phone site in Beckenham, Christchurch because of adverse visual effects. Health effects were however also considered in this case. The Court held that there were no adverse health effects (if there were, they were no more than minor) and granted a resource consent subject to conditions.

- *Shirley Case, 1998:*

In this case, Telecom was granted a resource consent to establish and operate a mobile phone site in Shirley, Christchurch. A school close by, Shirley Primary School appealed. The school claimed that a number of adverse effects would occur including: an adverse effect on health, adverse psychological effects resulting from the school's perception of risk, adverse visual effects, and reduced financial viability of the school if pupils were withdrawn. Telecom also appealed against a condition set by the Council imposing a limit on the mobile phone site's power flux density. The Court held that the RMA was not a no-risk statute (we face risks everyday and cannot prohibit an activity because of a small risk), that there is no significant adverse health impact, and that the risks to Shirley Primary School were very low and acceptable. The Court endorsed a New Zealand Standard in line with the ICNIRP Standard of $450 \mu\text{W}/\text{cm}^2$.

5 Potential and perceived social impacts on host communities

5.1 Introduction

The scoping work for this research has encountered some highly polarised perspectives regarding the potential and perceived social impacts of introducing mobile phone sites into New Zealand. Mobile phone sites have the potential to lead to a range of both positive and negative social impacts. All the possibilities, no matter how uncertain, can be acknowledged here without implying any judgement as to the relative likelihood or consequence of any particular impact.

This section summarises the range of potential or perceived social impacts which may be experienced by individuals in the host communities of mobile phone sites or which may underlie community concerns when those communities are faced with the introduction of a local mobile phone site. Information in this review was sourced from case law, magazines, newspapers, key informant interviews, and mobile phone site service providers' documentation. A summary listing of the range of potential or perceived impacts, which will be described in more detail below, includes:

- increased access to user benefits (private use, use in personal emergencies, business use),
- revenues to the landowner for leasing land for a mobile phone site,
- aesthetic values and visual impacts,
- cultural values,
- risk of harm to wildlife, and
- perceived health effects for individuals and consequential impacts (stress and anxiety-related, resident migration and community change, financial viability, property values and house sales).

Science may be evidence-based, but the interpretation of scientific information can be influenced by situation and perspective. Indeed, the fundamental linkage between evidence and understanding is itself challenged at times. There are some who contend that the absence of evidence to the contrary confirms a particular conclusion, while others will argue the complete opposite.

Another concept in the science of impact assessment also needs to be considered. An effect does not have to be real and measurable to be capable of causing real consequences; perceived environmental effects can result in real social consequences; perceived risks can cause changes in some people's behaviours. It has been argued that the source of community information and the level of community participation in the siting process are important influences on the formation of a perceived risk. McLoughlin argues that communities in New Zealand are failing to take the initiative to approach a number of scientists who specialise in the area, but are instead choosing to be informed by the media and two high profile researchers in the area, therefore restricting their access to a range of information (1997/1998). The level of involvement of residents in the siting process may also affect the nature of their perceived risks. Significant involvement in the siting process may assist communities to obtain information which they may otherwise not have, and assist them to address questions and fears (*The Press* 2000a; *Shirley Primary School and Telecom*

Mobile Communications Ltd v Christchurch City Council [1999] NZRMA 66, 121). From a legal point of view it has been held that these perceived risks cannot be taken into account when deciding whether or not to grant a resource consent unless they are based on a real risk. The court also held that although these perceived risks or fears are not irrational, they are unreasonable (*Ibid.*)

The present situation is that there is little if any empirical information in New Zealand relating to any of the potential social impacts from mobile phone sites. Nevertheless, without pre-determining the outcome, it is legitimate to set out a possible map of the domain of enquiry to assist the future collection of empirical evidence should this occur, as is anticipated in this research programme.

5.2 Increased access to user benefits

The erection of a mobile phone site provides a benefit for those within and outside a host community who use mobile phones or wish to contact those who use mobile phones, by increasing coverage and capacity (*Shirley Primary School and Telecom Mobile Communications Ltd v Christchurch City Council* [1999] NZRMA 66, 121). A diverse group of private and business subscribers use mobile phones. Mobile phones are now used by people in all areas of business and are no longer considered the domain of sales representatives and others who work without an office base. To many, mobile phones are becoming essential and irreplaceable tools in business (*The Press* 2000a; Fletcher 2000; *Christchurch Star* 2000, p. 6). Customers are generally individuals who own a mobile phone for their own personal use. These customers may sign a contract or use a prepay system. There are numerous benefits associated with mobile phone use for these private customers, including having access to a phone for social purposes, travelling, and emergencies (Telecom New Zealand Ltd *The Facts About Mobile Phone Sites*). Over 18,000 emergency 111 calls are made each month from mobile phones. The use of mobile phones in an emergency may therefore extend the benefit of mobile phone use to people other than mobile phone owners⁴⁷.

5.3 Leasing revenues to the site landowner

Although some mobile phone sites are located on land already owned by the service provider, many are placed on private land. The private landowners may benefit from the siting through rental payments (Telecom Mobile Limited; Vodafone New Zealand Limited; *New York Times* 2000b). Whether the benefits from lease payments translate into positive social benefits is, as yet, unknown.

5.4 Aesthetic values and visual impacts

The visual impact that a mobile phone site will have may also be an area of concern for host communities. The degree to which a mobile phone site may have an impact on a host community depends on the type of mobile phone site, and any measures taken to mitigate the potential effect.

⁴⁷ Assessment of the effect of mobile phones on the response times for emergency services may be investigated as part of Stages 2 and 3 of this research programme.

The size and nature of a mobile phone site is determined by a number of factors including its intended coverage and local terrain. As discussed in Part 2, a mobile phone site consists of a number of components which may be housed inside an existing building or in a special purpose-built container, and antenna/s which come in the form of rods or panels and may be incorporated into the structures of different objects, mounted on roofs or walls, or supported on masts.

Figure 11: Pictures of different mobile phone sites



Source: Telecom Mobile Ltd

Generally, attempts are made by mobile phone service providers to minimise the visual impact that a mobile phone site may have on its host community. The extent to which measures can be taken will be constrained by the intended purpose of the mobile phone site and local terrain. Often masts and antennas will be painted to blend in with the surroundings. Mobile phone sites have in the past been disguised as trees, chimneys, and clock towers. Although planting can be undertaken to provide visual screening or beautify the site, this is constrained by the fact that signals can be absorbed by trees. While some species are suitable, other species can obstruct the operation of the facility.

Figure 12: Mobile phone sites - attempts to minimise visual impact



Source: Telecom Mobile Ltd

The degree to which an impact may be experienced may also depend on the nature of the host community. Arguably less impact may be experienced in a commercial or industrial area. The impact may be considered to be greater however in a residential area, or an area which has strong historical links and features (*New York Times* 2000a, *New York Times* 2000b).

The issue of visual impact has been addressed in several legal cases in New Zealand. In the McIntyre case the proposed mobile phone site consisted of a number of panels placed on the top of an old two storey theatre now used for commercial purposes. Although near to residences the Court held that no significant visual impact would occur (*McIntyre v Christchurch City Council* [1996] NZRMA 289, 317). Although the proposed mobile phone sites in both the Shirley and Beckenham cases required tall masts to support the antennas, the court held that there would be an impact but not significant enough to refuse consent (*Shirley Primary School and Telecom Mobile Communications Ltd v Christchurch City Council* [1999] NZRMA 66, 121; *Telecom New Zealand Limited v Christchurch City Council* Environment Court Decision W165/96. 11). Factors that influenced these decisions included the colouring of the masts, the location of the masts at the rear of the sections, and fact that these masts were surrounded by commercial buildings.

5.5 Cultural values

Case law has held that consultation should be undertaken when a mobile phone site is to be located on or near sacred sites or sites of significance to local hapu, and that the uniqueness of the site for Maori should be considered (Ministry for the Environment & the Ministry of Health 2000, p. 33). A site may be unique because of the existence of archaeological remains or because of the occupation of the site by generations of Maori. As mentioned earlier, the overall cultural uniqueness of an area may be enough to warrant the refusal of a resource consent, even if damage to land is minimal and/or there are no archaeological remains⁴⁸.

5.6 Risk of harm to wildlife

The erection of radio transmitters in the United States has raised wildlife protection issues. Conservationists claim that over four million birds (including rare and endangered species) a year die from flying into television, radio, and mobile phone masts. This may be due to an attraction to mast lights and the placement of masts in migratory birds' flight path (*USA Today* 1999). The American Bird Conservancy claim that a poorly placed mobile phone mast can kill up to 10,000 birds a year (O'Connor 2000).

In discussions for this research, industry representatives were unaware of any such incidents happening in New Zealand, and pointed to differences in mast heights and lighting practices as possible explanations of this difference. Vodafone reported that its contractors had never seen any dead birds around any of its facilities, but had observed birds nesting in behind radiofrequency panel antennas on some sites. This issue has not yet been researched in New Zealand.

5.7 Perceived health effects

In most of the literature reviewed here, the central concern for communities and the focus of research has been on the impact that mobile phone sites may have on the health of individuals in the host community.

⁴⁸ *TV3 Network Services Ltd v Waikato District Council* [1996] NZRMA 193.

Mobile phone sites emit radiofrequency radiation (RF radiation). This RF radiation is measured in micro watts per square centimetre ($\mu\text{W}/\text{cm}^2$). As discussed earlier, the New Zealand standard presently recommends that the public should not be exposed to more than $450 \mu\text{W}/\text{cm}^2$ at a frequency of 900 MHz. The degree of exposure to these emissions varies according to the power level of the site, proximity to the site, the directionality of the antennas, the height of the antennas, local terrain (direct line of sight or reflections off surrounding features), and exposure patterns (length of time). For example, a higher powered mobile phone site may not produce the exposure levels expected as it may be mounted on a high mast, thereby reducing exposure, whereas a lower powered mobile phone site may produce a higher exposure rate because of its proximity to the user (Ministry of Health & Ministry for the Environment 2000; Cherry 2000). Industry sources noted that all mobile phone sites in New Zealand, irrespective of power rating and exposure level, comply with the recommended limit in the New Zealand Standard in all areas accessible to the general public. In fact, they asserted that most mobile phone sites “typically operate at about 1 per cent of the Standard”, and suggested that when compared with radio and television transmitters no sites would be described as “high powered”⁴⁹ or causing “high exposures”.

Industry and government agency representatives point to an “orthodox scientific view” on the question of potential health impacts⁵⁰ from mobile phone sites. This view appears to be represented in the conclusion that, under the prescribed standards, there have been no discernible health impacts to date from mobile phone sites. This “orthodox scientific view” has not often been challenged publicly. Within New Zealand, the most persistent challenge to this view has been articulated by Dr Neil Cherry, a Canterbury Regional Councillor, who was commissioned by the European Parliament to review the findings of relevant scientific studies’ into the health effects of mobile phone sites⁵¹. Dr Cherry concluded that over 50 studies have demonstrated a low but significant risk to human health. These studies show significant dose response rates for leukemia, brain tumours, miscarriages, and sleep disturbances. Dr Cherry claims that these epidemiological studies can be backed up with biological evidence as there is a reduction of melatonin associated with exposure to RF radiation (Cherry 2000). Extensive reviews and evaluations have also been carried out in the course of several legal cases in New Zealand. For some, the Shirley Primary School case in 1998 has resolved this debate as far as the legal issue is concerned (Hassan & Kryiak). In this case it was held that perceived risk could not be considered unless it was based on a real risk, and that evidence presented has demonstrated a risk too low to be significant.

It is important to state that future work under this research programme will not include any epidemiological studies of potential health effects. Such epidemiological studies are well beyond

⁴⁹ Industry representatives compared mobile phone site power levels - typically between 2 and 70 watts - with radio and television transmitter power levels - up to 1 million watts.

⁵⁰ Industry representatives described the following organisations as subscribing to such “orthodox scientific views” - the World Health Organisation (WHO), the International Commission on Non-Ionizing Radiation Protection (ICNIRP), the European Committee for Electro-technical Standardisation, the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), the UK National Radiological Protection Board, the US Federal Communications Commission, the American National Standards Institute, the NZ National Radiation Laboratory, Standards New Zealand, the NZ Ministry of Health.

⁵¹ It has been noted that the methodological, theoretical, and analytical approach adopted by Dr Neil Cherry has received some criticism, and raised the question as to how much weight should be given to his research (Bates 2000; Gledhill 2001).

the scope, time frame and expertise available for this research programme. The relevance of the foregoing discussion on perceived health effects for this research programme lies in the fact that even perceived effects might conceivably trigger other symptoms or impacts on social behaviours - such as stress and anxiety-related symptoms, resident migration and community change, or impacts on property values and house sales - some of which might be amenable to ex-post evaluation during specific case studies. It is for this reason that such potential subsequent social impacts (resulting from community perceptions) are discussed below.

5.8 Stress and anxiety-related impacts

The announcement and siting of a mobile phone site may have a social impact on host communities in the form of increased levels and incidence of stress and anxiety. Dr Staite, who gave evidence in the Shirley case⁵², claimed that residents in the Shirley community were stressed and anxious over the proposed location of the mobile phone site. Dr Staite argued that this stress and anxiety can affect people's functioning and affect social cohesiveness in the future (*Shirley Primary School and Telecom Mobile Communications Ltd v Christchurch City Council* [1999] NZRMA 66, 121). However, the Court stated that members of the school community had greatly exaggerated the risks (p. 123) and that if the community had generated "an atmosphere of fear and distrust among parents, teachers and pupils then it might have to live with that" (p. 121). It should also be noted that the court gave little weight to Dr Staite's evidence, finding it "methodologically unreliable, partially incomprehensible and inconsistent."

How such impacts, if they occurred, might be evaluated in an ex-post case study has yet to be determined.

5.9 Resident Migration and Community Change

A concern has been expressed that the erection of a mobile phone site will cause residents to leave the host community and thereby, in some cases, jeopardise school rolls and their financial viability (*New York Times* 2000). These changes are mostly motivated by the fear that the mobile phone site will have an adverse health effect, and would in essence change the nature of the community as it was prior to the siting. In the Shirley case, widespread fear was reported that the local school would become financially unviable as the school roll dropped. A survey carried out by a Statistics lecturer at the University of Canterbury prior to the installation of the mobile phone site, found that 83% of caregivers of children at the local school claimed that they would remove their children from the school if the mast was erected (*Shirley Primary School and Telecom Mobile Communications Ltd v Christchurch City Council* [1999] NZRMA 66, 121). In an article in *The Press* on 29 March 2000, the Principal of Shirley Primary School, was reported as stating that the school lost only 35 pupils at the end of 1998 when the Court's decision was issued. Such a potential consequential impact is clearly amenable to evaluation, and would be included in case study ex-post assessments, as is expected in Stage 3 of this research programme.

⁵² Called by Shirley Primary School.

5.10 Financial viability

In the *Shirley Case*, a neighbouring primary school appealed against a decision to grant a resource consent to establish a mobile phone site, arguing amongst other things that the school would suffer from reduced financial viability if its pupils were withdrawn. The Court held that such an effect would not be considered because it was an effect of its own making.

5.11 Property Values and House Sales

Some residents have expressed the fear that the presence of a mobile phone site in their community will have a negative impact on property values (*The Press* 2000a). Although there are a number of different types of mobile phone sites, it is important to note that communities generally associate mobile phone sites with masts (which may have a greater visual impact) as these sites tend to dominate any mobile phone site coverage in the media. This association may be a significant factor influencing this perception.

As part of the current research programme on the siting of facilities, Taylor Baines is examining a method for evaluating potential property value impacts over time.

A study carried out recently by Dunbar (2001) investigated the impact of ten Christchurch mobile phone sites on the residential property values in their surrounding neighbourhoods. Dunbar concluded that no material negative impact had been experienced. Property value studies in the United States have drawn similar conclusions (Thorne Consultants, INC 1996; The Stripling Shaw Stripling Group 1996; Pogel 1996).

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7 Appendix

7.1: Mobile Phone Connections by Service Provider in New Zealand 1990-2001

Source: Communications Policy Unit 2000; Vodafone New Zealand Limited

(In 000s)	1990	1991	1992	1993	1994	1995	1996	1997	1998	June 1999	Dec 1999	June 2000	Dec 2000	March 2001
Telecom	29	54	72	100	144	229	340	423	476	677	858	980	1150	1269
BellSouth	-	-	-	-	2.5	12	38	68	106	-	-	-	-	-
Vodafone	-	-	-	-	-	-	-	-	-	231	397	562	753	889

As at 31 March

BellSouth sold to Vodafone in 1998