

TORONTO STAFF REPORT

November 5, 1999

To: Board of Health

From: Dr. Sheela V. Basrur, Medical Officer of Health

Subject: Health Effects of Wireless Telephone Transmission Towers

Purpose:

This report responds to a request from the Urban Environment and Development Committee for a review and report on a Prudent Avoidance Policy for the siting of wireless (cellular) telephone transmission towers.

Financial Implications:

There are no financial implications for Public Health on this issue. The potential financial implications for the City as a whole should be considered by the Telecommunications Steering Committee in its development of a detailed siting protocol.

Recommendations:

It is recommended that:

- (1) The Board of Health endorse the adoption of a Prudent Avoidance Policy in the siting of base cellular telephone antennas in the City of Toronto;
- (2) The Board of Health forward this report to the Telecommunications Steering Committee for their information and any public consultation they deem appropriate;
- (3) The Board of Health request the Telecommunications Steering Committee to incorporate a Prudent Avoidance Policy in a protocol for the siting of base cellular telephone antennas in the City of Toronto which includes the following:
 - (a) applicants who wish to install new antennas or modified antennas must demonstrate that radio frequency (RF) exposures in those areas namely used by people other than telecommunications workers (e.g., roof-top gardens, balconies,

or grounds) will be at least 100 times lower than those currently recommended by Safety Code 6;

- (b) in situations where residents express concern over an existing base cellular telephone antenna, the owner and /or operator of the facility be requested to monitor levels of radio frequency (RF) fields around the antenna and provide this information to the affected community and the Telecommunications Steering Committee; and
 - (c) a mechanism for notifying residents of a proposed site for new telephone base antennas should be developed, which includes the advantages of using the proposed site, alternative sites considered, and the maximum expected exposure to RF due to installation in areas that the public or building occupants would normally use;
- (4) City Council request the federal Minister of Industry to ensure adherence to the City of Toronto's Prudent Avoidance Policy when granting approval for the siting of base cellular telephone antennas in the City of Toronto; and
- (5) The Medical Officer of Health forward this report for information purposes to the Federal Minister of Health, all other Boards of Health in Ontario, and to the Toronto District School Board and the Toronto Catholic District School Board.

Background :

On November 2, 1998, the Urban Environment and Development Committee considered a report from Councillor John Adams, Midtown, recommending that the Chief Planner, in consultation with the Medical Officer of Health, be directed to review and report on a policy for the appropriate siting of wireless (cellular) telephone transmission towers. It further recommended that the City of Toronto adopt a policy based on "prudent avoidance" and a rule preventing the siting of wireless telephone transmission towers in residential neighbourhoods and less than 200 metres from schools and day care centres.

Residents around the Leslie Street Water Tower in North York have raised concern about the potential health effects from the telephone transmitters installed on the tower. Clearnet and Microcell have signed agreements with the City which were negotiated with the former Municipality of Metropolitan Toronto and passed by the Metropolitan Council at its meetings of August 13 and 14, 1997. On July 12, 1999, the Economic Development and Parks Committee considered a motion from Councillor Minnan-Wong, Don Parkway, and resolved that the Chief Planner's report, in consultation with the Board of Health, include consideration of the health issues related to cellular transmission equipment. At its meeting of October 12, 1999, North York Community Council recommended that the City terminate the agreement with both Clearnet and Microcell.

At its meeting of October 25, 1999, the Telecommunications Steering Committee requested the Medical Officer of Health to consult with Health Canada or other appropriate health organizations to determine the potential health effects of exposure to radio frequencies.

In developing this report, Public Health staff consulted with Urban Planning and Development Services.

Comments:

(1) Wireless Communication Technology

The use of wireless communication technology is increasing rapidly. In particular, cellular telephones and their associated transmission towers are becoming more widespread. Cellular telephones allow for improved communication and are becoming an integral part of how we live and work. They can enhance work productivity, improve service capabilities, and provide for increased personal or family security. However, there are concerns related to the potential health effects that may be associated with exposure to the radio waves used with this technology.

Radio waves are a form of radiant energy (which includes visible light) that makes up the electromagnetic spectrum. Wavelength and frequency are basic characteristics by which electromagnetic waves are described. Waves with shorter wavelength than visible light include ultraviolet light, x-rays, and gamma-rays. Waves with longer wave length than visible light include infrared light, microwaves, radio waves, and extremely low frequency (ELF) fields such as those produced by electrical power lines. Waves with sufficient energy to break chemical bonds are referred to as ionising radiation. These include x-rays and other higher frequency waves. Other waves are non-ionising. The frequencies currently, and anticipated to be, used for wireless communication in Canada are slightly higher frequencies than those used for radio and television, and are similar to the frequencies used for radar, remote sensing and microwave ovens.

In Canada, the regulation of telecommunication devices is a federal matter, which is administered by Industry Canada. Telecommunication devices must meet the requirements of Safety Code 6: "Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz". This Code, developed by Health Canada, includes guidelines for exposure to the public. Exposure levels recommended for the public, indicated in power densities of watts per square metres (W/m^2), vary from 2 to 10 W/m^2 depending on the frequency and range of the RF field.

(2) Exposures

The use of wireless telecommunication devices (e.g., radio, television and wireless telephones) has resulted in ubiquitous radio frequency (RF) fields in the environment. On the ground, maximum power fields are usually found 30 to 250 metres from base telephone towers. Results from monitoring studies typically show levels of RF well below current safety standards. For example, in Vancouver at a school with a roof-mounted antenna, the highest levels, which were measured on the roof, were 25 times less than those recommended by Safety Code 6. At ground

level around the school, the maximum RF levels were 230 times below those recommended by Safety Code 6, while indoor RF levels were even lower, about 4,900 times below the recommended limits.

In the City of Toronto, the public is exposed to radio frequency fields from a multitude of sources in addition to cellular telephone services. Radio, television, radio taxis, pager services, emergency communications (e.g. police, ambulance, radar) all depend on the use of radio waves. Levels of RF measured in cities are generally higher than background levels in rural areas. Given the density of the city, the presence of many high buildings close to each other, and the numerous RF sources, Toronto residents experience a much higher probability of exposure to multiple sources than other Canadians.

Available exposure data indicate that the public is exposed at very low levels, much lower than levels permitted under Safety Code 6. There are, however, some situations where levels could approach those of Safety Code 6. High exposures are not necessarily related to the visibility of the structure on which the antenna is mounted, such as on a self-standing tower. Since walls and ceilings act as a barrier, levels inside buildings are very much lower than outside. Areas where it would be anticipated that the public might be exposed to the highest levels of RF from base telephone transmitters are:

- (a) On roof-tops of apartment and office buildings where gardens, terraces, or other recreation activities are found. The limited data available suggests that, if base transmission towers were situated on such roof-tops, exposures to the people who use such roof-top facilities could approach the levels set in Safety Code 6;
- (b) On roof-tops or balconies of neighbouring buildings which are very close to each other. Levels inside high-rise buildings are attenuated by the outside wall and windows. However, there is little data on exposure levels on roof-tops and on the balconies on the top floors of apartment buildings. It would be expected that RF fields would be stronger at such levels compared to the ground. Additional caution might be required when antennas are placed on a building that is very close to another building of similar height, which has balconies or roof-top amenities.

(3) Health Concerns

When discussing health effects of RF fields, it is common to distinguish between thermal and non-thermal effects. The thermal effects of RF fields are generally well known. These are the health effects that result from the field's ability to increase the temperature of the body, and include changes in temperature regulation, endocrine function, cardiovascular function, immune response, nervous system activity and behaviour. Current standards are set to prevent these adverse health outcomes.

There is much more uncertainty related to the non-thermal health effects of the RF field. Adverse effects that have been observed in scientific studies in laboratory animals include tumour promotion, the ability to affect the blood-brain barrier; the potential to influence the body's pain control mechanisms, and the ability to affect sleep patterns. At the request of Health

Canada, the Royal Society of Canada recently reviewed the health effects of the RF field and noted that there is increasing evidence that biological effects occur at low levels which do not result in any thermal effects. The Royal Society concluded that there is insufficient evidence to determine whether these biological effects should be considered adverse health effects. However, it also concluded that there is not enough evidence to rule out the possibility of adverse health effects at low levels of exposure.

The Royal Society also considered whether radio frequency (RF) fields presents reproductive or cancer risks and concluded that the weight-of-evidence available today suggests that RF fields do not cause cancer or reproductive effects in humans. However, it also indicated that more research is needed to determine if RF fields can cause genetic damage or biological effects, which could result in cancer or reproductive disorders.

When there are uncertainties related to the level of exposure that could potentially harm human health, the precautionary principle demands the use of caution. The public health approach, which encourages prevention over cure, does not advocate waiting for confirmation of adverse effects from epidemiological studies before taking action. So far, human studies have not indicated a strong link between low level exposure to RF fields and adverse human health effects. This is reassuring. If there are health impacts associated with the low levels of exposure that are relatively common, they are likely to be small. However, due to a variety of methodological limitations, the available studies do not provide sufficient proof of either safety or harm.

(4) Exposure Standards and Protection Factors

When establishing environmental standards and guidelines to protect human health from chemical and physical agents, it is common practice among regulation setting authorities to determine the level at which no adverse health effects are expected, and then to apply “safety” or “protection” factors to compensate for the uncertainties in the science. When there are many layers of scientific uncertainty about the health effects, a greater number of protection factors must be applied to ensure the health of the public.

The exposure guidelines for the public recommended by Health Canada in Safety Code 6 are based on the thermal (i.e. due to heating) health effects associated with RF. They are based on studies that have demonstrated the power densities that can be tolerated at various radio frequencies before the body’s temperature is increased by 1 degree C with 30 minutes of exposure. A protection factor of 10 has been applied to these power densities to arrive at the doses recommended for occupational exposures. This protection factor is supposed to compensate for the variation in physical activity and conditions such as temperature and humidity. For the protection of the public, an additional safety factor of 5 has been applied (for a total of 50) to extrapolate from occupational to public exposure levels.

Health Canada has taken the position that there is insufficient evidence upon which to base exposure limits for non-thermal health effects, and that Safety Code 6 provides an adequate margin of safety to protect the public from all known health effects.

The exposure guidelines in Safety Code 6 have been designed to protect human health from thermal effects only. Safety Code 6 is based on the assumption that there are no non-thermal health effects even though a number of studies suggest that biological effects do occur at lower levels of exposure. Safety Code 6 is based on short-term health effects even though several long-term animal studies at lower levels of exposure have demonstrated adverse health effects such as behavioural changes and increased cancer rates. Safety Code 6 is based on a threshold for irreversible effects rather than on a “no adverse effect level” that is normally given preference when developing environmental health standards. When extrapolating from occupational to public exposure standards, Health Canada has applied a single protection factor of 5, when it is common practice to apply two factors, 4.2 and 10. The protection factor of 4.2 is applied to extrapolate from occupational to public exposure standards to account for the longer exposures that can be experienced by the public. The protection factor of 10 is applied to account for the fact that the general population has members such as children, pregnant women, and the aged, who may be more sensitive to the health effects associated with chemical and physical agents.

Given the scientific uncertainties surrounding the non-thermal health effects associated with RF, a protection factor of 1,000 to 10,000 is justified and prudent. Currently, the exposure guidelines for the public in Safety Code 6 incorporate a safety factor of 50. While this may be sufficient to ensure the health of the public from thermal health effects, it does not provide adequate assurance against the potential non-thermal health effects. Ensuring that levels of RF were kept 100 times below Safety Code 6 recommendations would be equivalent to using a safety factor of 5,000. This is within the range given above.

Several jurisdictions have already adopted exposure limits that are lower than Safety Code 6. The 1999 Swiss Ordinance on EMF (including RF) adopts a policy of prudent avoidance. New antennas or antennas that are moved or replaced must meet 10 percent of international standards (which are essentially the same as Safety Code 6 standards) for RF of sensitive use, such as where people live. This is a legally enforceable standard. Italy has adopted a chronic public exposure level of 15 percent of international standards. The Land of Salzburg (a province in Austria) has entered into a voluntary agreement with the industry requiring that exposures where people reside are kept below 1.5 percent of international standards.

Six municipalities in Australia have adopted an initial siting guidance exposure limit of $0.1 \mu\text{W}/\text{cm}^2$ (or $1 \text{ mW}/\text{m}^2$) in a co-operative approach with carriers to find sites which the councils and the community would accept. This is about 10,000 times lower than current Safety Code 6 limits.

(5) Prudent Avoidance Policy

Given the degree of uncertainty as to whether exposure levels below those permitted by Safety Code 6 could result in adverse health effects, Toronto Public Health supports the implementation of a prudent avoidance policy. Such a policy encourages the adoption of individual or societal actions to avoid unnecessary exposures to radio frequencies that entail little or no cost.

In examining the need for a prudent avoidance policy, Toronto Public Health considered two factors:

- (a) Specific situations where high levels of exposure may occur; and
- (b) The weight-of-evidence that harm may occur at these levels of exposures.

There are a number of ways that a prudent avoidance policy could be implemented. In some jurisdictions, the siting of cellular transmission towers has been limited by the nature of land use (e.g., prohibited on schools); in others, on the basis of distance (e.g., 100 metres from residential properties). Because the strength and shape of the RF field surrounding a particular telephone transmission antenna is affected by the power of the installation, the direction of its transmission, and its height above ground, it would be difficult to establish distance- or facility-based policies that would be protective in all situations, without unnecessarily limiting service in many areas of the City. For this reason, Toronto Public Health is recommending an exposure-based policy in which public exposures are kept 100 times below those recommended in Safety Code 6. We believe that such a policy, based on accurate measurements of exposure rather than on an inaccurate surrogate such as distance, would provide a greater level of protection in a consistent way to all residents in Toronto.

(6) Implementation of Prudent Avoidance

In Canada, the final authority for the approval of the installation of base transmission towers lies with Industry Canada. The City of Toronto has little direct control over this matter. It is therefore recommended that the City work with the industry to develop a protocol for the siting of antennas in the City. A protocol incorporating a policy of prudent avoidance is in accordance with the recommended policy and procedures of Industry Canada. This protocol could be developed by the City's Telecommunications Steering Committee in conjunction with all the relevant parties. It should include the following elements:

- (a) A request that applicants who wish to install new, replacement or modified antennas demonstrate that radio frequency exposures in the areas used by people other than telecommunications workers (e.g., roof-top gardens, balconies or grounds) be at least 100 times lower than those currently recommended by Safety Code 6;
- (b) In situations where residents express concern over an existing base cellular telephone antenna, the owner and /or operator of the facility be requested to monitor RF field levels around the antenna and provide this information to the affected community and the Telecommunications Steering Committee; and
- (c) A mechanism for notifying residents of a proposed site for new telephone base antennas should be developed. This notification should include the advantages of using the proposed site, alternative sites considered, and the maximum expected exposure to RF due to the installation in areas that the public or building occupants would normally use.

Conclusions :

Exposure to radio frequency (RF) is ubiquitous and the use of wireless telecommunications is increasing. There is evidence of biological effects at levels below which thermal effects are known to occur. There is uncertainty as to whether or not these effects can cause adverse effects. Present exposure limits as set out in Safety Code 6 are based on protection from the thermal effects of RF. While this may be sufficient to ensure the health of the public from thermal health effects, it does not provide adequate assurance against potential non-thermal health effects. Since there are situations where residents of Toronto could be exposed to levels at which non-thermal health effects occur, it is recommended as an added margin of safety, that exposures to the public be kept at least 100 times below Safety Code 6 exposure limits. Although the regulation of telecommunications is a federal matter, it is recommended that the City develop a protocol for the siting of base telephone antennas which incorporates a policy of prudent avoidance, and that the City seek federal concurrence in applying this policy across Toronto.

The application of this prudent avoidance policy and protocol is expected to be feasible and readily achievable. It will also provide a rational basis with which to evaluate and respond to community concerns about both existing and future installations. The predicted exposures from single installations are very low, and thus in most cases, this policy is not expected to have an adverse impact on existing facilities. However, this policy provides an extra measure of protection as the number of installations increases in the city, and in the event that new research provides evidence that adverse effects do occur at levels lower than those currently known to do so.

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Attachment:

Technical Report "Health Concerns of Radio Frequency Fields Near Base Telephone Transmission Towers."