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154 Pages

Planning Department <planning@edcgov.us>

CHALLENGE Conditional Use Permit S17-0016/AT7T CAF4 - Attachments 2

1 message

Sierra Person <sierradperson@yahoo.com> Thu, Feb 1, 2018 at 11:08 AM
To: planning@edcgov.us

Dear County of El Dorado Planning Commission,

I am writing to ask for your understanding and support. AT&T (Epic Wireless) has proposed to build a 160 foot monopine wireless communications tower on Clouds Rest Rd. I do not oppose the construction of a new or upgraded monopine tower but do take issue with the chosen location. Placing it in close proximity to several homes and infringing on the views of many others. I am not opposed to cell towers, however they need to be in safe locations where they will not destroy wildlife habitats, historical sites and ecological preserves. Demand AT&T to responsibly place their towers in better locations that will not hurt the people of our county or our environment.

While I am aware of the telecommunications Act of 1996, that effectively silenced the American people, i still feel it pertinent to bring up some of the health risks. The research i have attached has me greatly concerned for the safety of my children. I have a two month old daughter and a 3 1/2 year old son. Would you be willing to put a cell tower next to your home within the vicinity of your children or grandchildren? Give homeowners within a quarter mile radius of the proposed tower the choice to make this decision that could potentially affect our health and well being. We have lived in our house for 35 years and would hate to have to move due to the building of this tower. I have also attached information pertaining to cell tower fires. In the event of a fire we would have no escape route. Please protect our home and children.

We have great service provided by Verizon Wireless. Has AT&T made their best effort to expand their coverage by co-owning on an existing tower? There are many towers already in the area just a few miles away.

I ask that you deny the requested use permit. Please protect the residents, uphold the county codes and ensure that future construction of wireless infrastructure be completed intelligently and responsibly where the needs of the residents, not the telecommunication companies, come first. Thank you for your time and understanding in this matter.

Sincerely,

Sierra Pearson
4221 Clouds Rest Rd
Placerville, CA 95667
530-409-3128

Environmental Impact

Decrease in Property Value

Cell Tower Safety/Crime

Other Counties

17 attachments

- **Environmental Health Trust Bees, Butterflies and Wildlife: Research on Electromagnetic Fields and th.pdf**
  196K
- **The Effects of Chronic Exposure to Very Low Intensity Microwave Radiation on Domestic Fowl: Journal .pdf**
  177K
- **Cellphone Towers EMR Damaging Birds, Insects, Humans | Natural Society.pdf**
  1564K
- **A Pushback Against Cell Towers - The New York Times.pdf**
  86K
- **Appraiser: Cell Tower Will Affect Property Values | Bridgewater, NJ Patch.pdf**
  273K
- **Cell Towers, Antennas Problematic for Buyers | Realtor Magazine.pdf**
  170K
- **DECREASED REAL ESTATE VALUE - Burbank ACTION (Against Cell Towers In Our Neighborhood).pdf**
  983K
- **Impact-of-Cell-Towers-on-House-Prices.pdf**
  2710K
- **Property Values Declining Near Cell Towers | Protect Your Family from EMF Pollution.pdf**
  409K
- **Richard Cristdahl: Cellular phone towers impact property values | TheUnion.com.pdf**
  51K
- **Take Back Your Power » Real Estate Survey: Do Cell:Grid Towers Impact a Property's Desirability?.pdf**
  689K
- **In Race For Better Cell Service, Men Who Climb Towers Pay — ProPublica.pdf**
  377K
- **Mahwah Police investigating theft of cell tower batteries.pdf**
  199K
- **Cell tower catches fire behind Heritage High School in Newport News - Daily Press.pdf**
  513K
- **Arcadia Denies Verizon Proposal for Cell Tower in Residential Zone - Arcadia Weekly.pdf**
  822K
- **Supervisors Vote Down Controversial Cell Tower | Local News | ledger.news.pdf**
  92K
- **Use Permit, Epic Wireless - Nevada City, CA.pdf**
  469K

Bees, Butterflies And Wildlife: Research On Electromagnetic Fields And The Environment

Electromagnetic fields from powerlines, cell phones, cell towers and wireless impacts the birds, bees, wildlife and our environment. Below is just a small example of the critical research that has been done on this issue.

"The electromagnetic radiation standards used by the Federal Communications Commission (FCC) continue to be based on thermal heating, a criterion now nearly 30 years out of date and inapplicable today."

-The Department of Interior in a 2014 letter on the impact of cell towers (http://nebula.wsimg.com/e498f8f484d32b310fa2cccec4eb7d28?AccessKeyId=FF4B01FD5B2965093C55&disposition=0&alloworigin=1) on migratory birds.

Balmori, Alfonso. "Anthropogenic radiofrequency electromagnetic fields as an emerging threat to wildlife orientation." (http://www.sciencedirect.com/science/article/pii/S0048969715002296) *Science of The Total Environment*, vol. 518–519, 2015, pp. 58–60

- The growth of wireless telecommunication technologies causes increased electrosmog. Radio frequency fields in the MHz range disrupt insect and bird orientation.
- Radio frequency noise interferes with the primary process of magnetoreception. Existing guidelines do not adequately protect wildlife. Further research in this area is urgent.

Cucurachi, C., et al. "A review of the ecological effects of radiofrequency electromagnetic fields (RF-EMF)." (http://www.sciencedirect.com/science/article/pii/S0160412012002334) *Environment International*, vol. 51, 2013, pp. 116–40.

- A Review of 113 studies from original peer-reviewed publications. RF-EMF had a significant effect on birds, insects, other vertebrates, other organisms and plants in 70% of the studies. Development and reproduction of birds and insects are the most strongly affected endpoints.

Balmori, A. "Electrosmog and species conservation." (http://www.ncbi.nlm.nih.gov/pubmed/25089692?dopt=Abstract) *Science of the Total Environment,* vol. 496, 2014, pp. 314-6.

- "Conclusion: At the present time, there are reasonable grounds for believing that microwave radiation constitutes an environmental and health hazard....Concerning the exposure to electromagnetic fields, the precautionary principle is needed and should be applied to protect

species from environmental non-thermal effects (Zinelis, 2010). Controls must be introduced and technology rendered safe to the environment, since this new ubiquitous and invisible pollutant could deplete the efforts devoted to species conservation."

Manville, Albert M. "A BRIEFING MEMORANDUM: What We Know, Can Infer, and Don't Yet Know about Impacts from Thermal and Non-thermal Non-ionizing Radiation to Birds and Other Wildlife." (https://ecfsapi.fcc.gov/file/12270470130362/Manville%207-14-%202016%20Radiation%20Briefing%20Memo-Public.pdf) *Wildlife and Habitat Conservation Solutions*, 2014.

- "In summary, we need to better understand ... how to address these growing and poorly understood radiation impacts to migratory birds, bees, bats, and myriad other wildlife. At present, given industry and agency intransigence ... massive amounts of money being spent to prevent addressing impacts from non-thermal radiation — not unlike the battles over tobacco and smoking — and a lack of significant, dedicated and reliable funding to advance independent field studies, ... we are left with few options. Currently, other than to proceed using the precautionary approach and keep emissions as low as reasonably achievable, we are at loggerheads in advancing meaningful guidelines, policies and regulations that address non-thermal effects...."

Bees And Butterflies

"Cryptochromes are very badly affected by weak oscillating electromagnetic fields that are orders of magnitude weaker than the Earth's steady magnetic field. This can disrupt both solar and magnetic navigation, which can account for colony collapse disorder in bees."

—Dr. Andrew Goldsworthy

Research clearly shows that Bees and Butterflies are sensitive to electromagnetic fields.

Cammaerts, Marie-Claire. "Is electromagnetism one of the causes of the CCD? A work plan for testing this hypothesis." (https://www.jscimedcentral.com/Behavior/behavior-2-1006.php) *Journal of Behavior*, vol. 2, no. 1, 2017, pp. 1006.

- The decline of domestic bees all over the world is an important problem still not well understood by scientists and beekeepers, and far from being solved. Its reasons are numerous: among others, the use of pesticides and insecticides, the decrease of plant diversity, and bee's parasites. Besides these threats, there is a potential adverse factor little considered: manmade electromagnetism.
- The present paper suggests two simple experimental protocols for bringing to the fore the potential adverse effect of electromagnetism on bees and to act consequently. The first one is the observation of bees' avoidance of a wireless apparatus; the second one is the assessment of colonies' strength and of the intensity of the electromagnetism field (EMF) surrounding them. If bees avoid a wireless apparatus, if hives in bad health are located in EMF of a rather high intensity, it can be presumed that bees are affected by manmade electromagnetism. This should enable searching for palliative measures.

Goldsworthy, Andrew. "The Birds, the Bees and Electromagnetic Pollution: How electromagnetic fields can disrupt both solar and magnetic bee navigation and reduce immunity to disease all in one go." (https://ecfsapi.fcc.gov/file/7520958012.pdf) 2009.

- Many of our birds are disappearing mysteriously from the urban environment and our bees are now under serious threat. There is increasing evidence that at least some of this is due to electromagnetic pollution such as that from cell towers, cell phones, DECT cordless phones and Wifi. It appears capable of interfering with their navigation systems and also their circadian rhythms, which in turn reduces their resistance to disease. The most probable reason is that these animals use a group of magnetically-sensitive substances called cryptochromes for magnetic and solar navigation and also to control the activity of their immune systems.

Guerra, Patrick A., Robert J. Gegear, and Steven M. Reppert. "A magnetic compass aids monarch butterfly migration." (http://www.nature.com/articles/ncomms5164) Nature Communications, vol. 5, no. 4164, 2014.

- "Here we use flight simulator studies to show that migrants indeed possess an inclination magnetic compass to help direct their flight equator ward in the fall. Another vulnerability to now consider is the potential disruption of the magnetic compass in monarchs by human-induced electromagnetic noise, which can apparently disrupt geomagnetic orientation in a migratory bird."

Kumar, Neelima R., Sonika Sangwan, and Pooja Badotra. "Exposure to cell phone radiations produces biochemical changes in worker honey bees." (http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3052591/) Toxicol Int., 18, no. 1, 2011, pp. 70–2.

- The present study was carried out to find the effect of cell phone radiations on various biomolecules in the adult workers of Apis mellifera L.

The results of the treated adults were analyzed and compared with the control. Radiation from the cell phone influences honey bees' behavior and physiology. There was reduced motor activity of the worker bees on the comb initially, followed by en masse migration and movement toward "talk mode" cell phone. The initial quiet period was characterized by rise in concentration of biomolecules including proteins, carbohydrates and lipids, perhaps due to stimulation of body mechanism to fight the stressful condition created by the radiations. At later stages of exposure, there was a slight decline in the concentration of biomolecules probably because the body had adapted to the stimulus.

Favre, Daniel. "Mobile phone induced honeybee worker piping." (http://link.springer.com/article/10.1007%2Fs13592-011-0016-x#page-1) Apidologie, vol. 42, 2011, pp. 270-9.

- Electromagnetic waves originating from mobile phones had a dramatic impact on the behavior of the bees, namely by inducing the worker piping signal. In natural conditions, worker piping either announces the swarming process of the bee colony or is a signal of a disturbed bee colony.

Warnke, Ulrich. "Birds, Bees and Mankind: Destroying Nature by 'Electrosmog'." (https://ecfsapi.fcc.gov/file/7521097894.pdf) *Competence Initiative for the Protection of Humanity, Environment and Democracy*, Brochure 1, 2009.

- Bees pollinate approximately 1/3 of all crops and they are disappearing by the millions. Warnke raises the concern that the dense, energetic mesh of electromagnetic fields from wireless technologies may be the cause.

Sharma, V.P. and N.K. Kumar. "Changes in honeybee behaviour and biology under the influence of cellphone radiations." (http://beekeepingtimes.com/index2.php?option=com_content&task=view&id=272&pop=1&page=0&Itemid=1) *Current Science*, vol. 98, no 10, 2010, pp. 1376-8.

- We have compared the performance of honeybees in cell phone radiation exposed and unexposed colonies. A significant ($p < 0.05$) decline in colony strength and in the egg laying rate of the queen was observed. The behaviour of exposed foragers was negatively influenced by the exposure, there was neither honey nor pollen in the colony at the end of the experiment."

"Briefing Paper on the Need for Research into the Cumulative Impacts of Communication Towers on Migratory Birds and Other Wildlife in the United States." (http://electromagnetichealth.org/pdf/CommTowerResearchNeedsPublicBriefing-2-409.pdf) *Division of Migratory Bird Management (DMBM)*, U.S. Fish & Wildlife Service, 2009.

- Of concern to DMBM are the potential impacts of radiation on bird populations.For example, preliminary research on wild birds at cellular phone tower sites in Spain showed strong negative correlations between levels of tower-emitted microwave radiation and bird breeding, nesting, and roosting in the vicinity of the electromagnetic fields.

Harst, Wolfgang Harst, Jochen Kuhn and Hermann Stever. "Can Electromagnetic Exposure Cause a Change in Behaviour? Studying Possible Non-thermal Influences on Honey Bees – An Approach Within the Framework of Educational Informatics." (http://www.next-up.org/pdf/ICRW_Kuhn_Landau_study.pdf) *Acta Systemica-IIAS International Journal*, vol 6, no. 1, 2006, pp. 1-6.

- A pilot study on honeybees testing the effects of non-thermal, high frequency electromagnetic radiation on beehive weight and flight return behavior. In exposed hives, bees constructed 21% fewer cells in the hive frames after 9 days than those unexposed.

Sainudeen, Sahib.S. "Electromagnetic Radiation (EMR) Clashes with Honey Bees." (http://ipublishing.co.in/jesvol1no12010/EIJES2044.pdf) *International Journal of Environmental Sciences*, vol. 1, no. 5, 2011.

- Recently a sharp decline in population of honey bees has been observed in Kerala. Although the bees are susceptible to diseases and attacked by natural enemies like wasps, ants and wax moth, constant vigilance on the part of the bee keepers can over come these adverse conditions. The present plunge in population (< 0.01) was not due to these reasons. It was caused by man due to unscientific proliferation of towers and mobile phones."
- Six colonies of honeybees (Apis mellifera) were selected. Three colonies were selected as test colonies (T1,T2&T3) and the rest were as control (C1,C2&C3). The test colonies were provided with mobile phones in working conditions with frequency of 900 MHz for 10 minutes for a short period of ten days. After ten days the worker bees never returned hives in the test colonies. The massive amount of radiation produced by mobile phones and towers is actually frying the navigational skills of the honey bees and preventing them from returning back to their hives.
- The study concludes, "More must also be done to compensate individuals and communities put at risk. Insurance covering diseases related to towers, such as cancer, should be provided for free to people living in 1 km radius around the tower. Independent monitoring of radiation levels and overall health of the community and nature surrounding towers is necessary to identify hazards early. Communities need to be given the opportunity to reject cell towers and national governments need to consider ways of growing their cellular networks without constantly exposing people to radiation."

"The potential dangers of electromagnetic fields and their effect on the environment." (http://assembly.coe.int/nw/xml/XRef/Xref-XML2HTML-en.asp?fileid=17994&) *Council of Europe Parliamentary Assembly*, resolution 1815, 2011.

- The potential health effects of the very low frequency of electromagnetic fields surrounding power lines and electrical devices are the subject of ongoing research and a significant amount of public debate. While electrical and electromagnetic fields in certain frequency bands have fully beneficial effects which are applied in medicine, other non-ionising frequencies, be they sourced from extremely low frequencies, power lines or certain high frequency waves used in the fields of radar, telecommunications and mobile telephony, appear to have more or less potentially harmful, non-thermal, biological effects on plants, insects and animals, as well as the human body when exposed to levels that are below the official threshold values. One must respect the precautionary principle and revise the current threshold values; waiting for high levels of scientific and clinical proof can lead to very high health and economic costs, as was the case in the past with asbestos, leaded petrol and tobacco
- As regards standards or threshold values for emissions of electromagnetic fields of all types and frequencies, the Assembly strongly recommends that the ALARA (as low as reasonably achievable) principle is applied, covering both the so-called thermal effects and the athermic or biological effects of electromagnetic emissions or radiation. Moreover, the precautionary principle should be applied when scientific evaluation does not allow the risk to be determined with sufficient certainty.

Kimmel, Stefan, et al. "Electromagnetic radiation: influences on honeybees (Apis mellifera). (http://www.partecipiamo.it/cultura/renzo_barbattini/api_e_frequenze_elettromagnetiche_002.pdf)" *IIAS-InterSymp Conference*, 2007.

- 39.7% of the non-irradiated bees had returned to their hives while only 7.3% of the irradiated bees had.

Clarke, Dominic, et al. "Detection and Learning of Floral Electric Fields by Bumblebees." (http://www.sciencemag.org/content/340/6128/66) *Science*, vol. 340, no. 6128, 2013, pp. 66-9. 5

- "We report a formerly unappreciated sensory modality in bumblebees (Bombus terrestris), detection of floral electric fields. Because floral electric fields can change within seconds, this sensory modality may facilitate rapid and dynamic communication between flowers and their pollinators."

Gegear, Robert J. et al. "Animal Cryptochromes Mediate Magnetoreception by an Unconventional Photochemical Mechanism." (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2820607/) *Nature*, vol. 463, no. 7282, 2010, pp. 804.

- "A team of neurobiologists that has investigated the mysteries of monarch migration for many years now reports that photoreceptor proteins found in monarch butterflies are linked to animal navigation. Their research finds that two types of photoreceptor proteins not only allow the butterflies to see UV light (light that is less than 420nm long, and thus, is invisible to humans), but also allows them to sense the Earth's geomagnetic field. These photoreceptor proteins are known as cryptochromes."

Oschman, James and Nora Oschman. "Electromagnetic communication and olfaction in insects." (https://www.thefreelibrary.com/Electromagnetic+communication+and+olfaction+in+insects.-a0163395921) Frontier Perspectives, 2004.

"Report on Possible Impacts of Communication Towers on Wildlife Including Birds and Bees." (http://www.moef.nic.in/downloads/public-information/final_mobile_towers_report.pdf) *Ministry of Environment and Forest*, Government of India, 2010.

- This report details the on impacts of communication towers on wildlife including birds and bees submitted to MoEF. It warns of harmful radiation and recommends special laws to protect urban flora & fauna from threats radiation emerging from mobile towers.

Sivani, S., and D. Sudarsanam. "Impacts of radio-frequency electromagnetic field (RF-EMF) from cell phone towers and wireless devices on biosystem and ecosystem – A Review." (http://www.biolmedonline.com/Articles/Vol4_4_2012/Vol4_4_202-216_BM-8.pdf) *Biology and Medicine*, vol. 4, no. 4, 2012, pp. 202–16.

- There is an urgent need for further research and "of the 919 research papers collected on birds, bees, plants, other animals, and humans, 593 showed impacts, 180 showed no impacts, and 196 were inconclusive studies".
- "One can take the precautionary principle approach and reduce RF-EMF radiation effects of cell phone towers by relocating towers away from densely populated areas, increasing height of towers or changing the direction of the antenna."

Birds

Schwarze, S.,, et al. "Weak Broadband Electromagnetic Fields are More Disruptive to Magnetic Compass Orientation in a Night-Migratory Songbird (Erithacus rubecula) than Strong Narrow-Band Fields." (http://bit.ly/1YfgUXy) *Front Behav Neurosci.*, vol. 10, no. 55, 2016.

- Magnetic compass orientation in night-migratory songbirds is embedded in the visual system and seems to be based on a light-dependent radical pair mechanism. Recent findings suggest that both broadband electromagnetic fields ranging from ~2 kHz to ~9 MHz and narrow-band fields at the so-called Larmor frequency for a free electron in the Earth's magnetic field can disrupt this mechanism. However, due to

local magnetic fields generated by nuclear spins, effects specific to the Larmor frequency are difficult to understand considering that the primary sensory molecule should be organic and probably a protein. We therefore constructed a purpose-built laboratory and tested the orientation capabilities of European robins in an electromagnetically silent environment, under the specific influence of four different oscillating narrow-band electromagnetic fields, at the Larmor frequency, double the Larmor frequency, 1.315 MHz or 50 Hz, and in the presence of broadband electromagnetic noise covering the range from ~2 kHz to ~9 MHz. Our results indicated that the magnetic compass orientation of European robins could not be disrupted by any of the relatively strong narrow-band electromagnetic fields employed here, but that the weak broadband field very efficiently disrupted their orientation.

Engels, S. et al. "Anthropogenic electromagnetic noise disrupts magnetic compass orientation in a migratory bird." (http://www.ncbi.nlm.nih.gov/pubmed/24805233?dopt=Abstract&holding=npg) Nature, vol. 509, 2014, pp. 353–6.

- Scientists found that migrating robins became disorientated when exposed to electromagnetic fields at levels far lower than the safety threshold for humans. "Here we show that migratory birds are unable to use their magnetic compass in the presence of urban electromagnetic noise...These fully double-blinded tests document a reproducible effect of anthropogenic electromagnetic noise on the behavior of an intact vertebrate."

Balmori A. "Possible Effects of Electromagnetic Fields from Phone Masts on a Population of White Stork (Ciconia ciconia)." (http://www.emf-portal.org/viewer.php?aid=13468&l=e) *Electromagn Biol Med*, vol. 24, no. 2, 2005, pp. 109-19.

- Interesting behavioral observations of the white stork nesting sites located within 100m of one or several cell site antennas were carried out. These results are compatible with the possibility that microwaves are interfering with the reproduction of white storks and would corroborate the results of laboratory research by other authors In far away areas, where the radiation decreases progressively, the chronic exposure can also have long term effects. Effects from antennas on the habitat of birds are difficult to quantify, but they can cause a serious deterioration, generating silent areas without male singers or reproductive couples.

Kavokin, K., et al. "Magnetic orientation of garden warblers (Sylvia borin) under 1.4 MHz radiofrequency magnetic field." (http://www.ncbi.nlm.nih.gov/pubmed/24942848?dopt=Abstract) Journal of the Royal Society, Interface, vol. 11, no. 97, 2014.

- "Birds in experimental cages, deprived of visual information, showed the seasonally appropriate direction of intended flight with respect to the magnetic meridian. Weak radiofrequency (RF) magnetic field (190 nT at 1.4 MHz) disrupted this orientation ability."
- "These results may be considered as an independent replication of earlier experiments, performed by the group of R. and W. Wiltschko with European robins (Erithacus rubecula). Confirmed outstanding sensitivity of the birds' magnetic compass to RF fields in the lower megahertz range demands for a revision of one of the mainstream theories of magnetoreception, the radical-pair model of birds' magnetic compass."
- "As discussed above, the high sensitivity of the birds' magnetic compass to RF fields, found in [21,22,24] and now confirmed by us, is difficult to explain within the existing radical-pair theory ...."

Cammaerts, M.C. and Johansson, O. "Ants can be used as bio-indicators to reveal biological effects of electromagnetic waves from some wireless apparatus." (http://www.ncbi.nlm.nih.gov/pubmed/23977878) *Electromagnetic Biology and Medicine*, vol. 33, no. 4, 2014, pp. 282-8.

- "the linear and angular speed of ants are immediately altered by the presence of EMF/RF fields. Based on these results, the authors advise users to deactivate the WiFi function of their PC/laptop."

Margaritis, L.H., et al. "Drosophila oogenesis as a biomarker responding to EMF sources." (https://www.ncbi.nlm.nih.gov/pubmed/23915130) *Electromagnetic Biology and Medicine*, vol. 33, no. 3, 2014, pp. 165-89.

- A total of 280 different experiments were performed. Exposure to wireless devices such as WiFi, baby monitors, and phones created statistically significant effects regarding reproduction and cell death apoptosis induction, even at very low intensity levels (0.3 V/m bluetooth radiation), well below ICNIRP's guidelines.

Balmori, A. "Mobile phone mast effects on common frog (Rana temporaria) tadpoles." (http://europepmc.org/abstract/MED/20560769/reload=0;jsessionid=jv2SP5fEaIu2vDSfoszx.24) *Electromagnetic Biology and Medicine*, vol. 29, no. 1-2, 2010, pp. 31-5.

- Eggs and tadpoles of the common frog were exposed to electromagnetic radiation from cell phone antennas for two months, from the egg phase until an advanced phase of tadpole prior to metamorphosis. Results indicate that radiation emitted by phone masts in a real situation may affect the frogs development and may cause an increase in mortality of exposed tadpoles. "This research may have huge implications for the natural world, which is now exposed to high microwave radiation levels from a multitude of phone masts."

Plants And Trees

Halgamuge, M.N. "Weak radiofrequency radiation exposure from mobile phone radiation on plants." (http://www.ncbi.nlm.nih.gov/pubmed/27650031?dopt=Abstract) Electromagnetic Biology and Medicine, vol. 36, no. 2, 2017, pp. 213-235.

- "Our analysis demonstrates that the data from a substantial amount of the studies on RF-EMFs from mobile phones show physiological and/or morphological effects (89.9%, $p < 0.001$). Additionally, our analysis of the results from these reported studies demonstrates that the maize, roselle, pea, fenugreek, duckweeds, tomato, onions and mungbean plants seem to be very sensitive to RF-EMFs. Our findings also suggest that plants seem to be more responsive to certain frequencies..."

Waldmann-Selsam, C., et al. "Radiofrequency radiation injures trees around mobile phone base stations." (https://www.ncbi.nlm.nih.gov/pubmed/27552133?dopt=Abstract) Science of the Total Environment, vol. 572, 2016, pp. 554-69.

Gustavino, B., et al. "Exposure to 915 MHz radiation induces micronuclei in Vicia faba root tips." (http://1.usa.gov/1OQ4P8N) *Mutagenesis*, vol. 31, no. 2, 2016, pp. 187-92.

- The increasing use of mobile phones and wireless networks raised a great debate about the real carcinogenic potential of radiofrequency-electromagnetic field (RF-EMF) exposure associated with these devices. Conflicting results are reported by the great majority of in vivo and in vitro studies on the capability of RF-EMF exposure to induce DNA damage and mutations in mammalian systems. Aimed at understanding whether less ambiguous responses to RF-EMF exposure might be evidenced in plant systems with respect to mammalian ones, in the present work the mutagenic effect of RF-EMF has been studied through the micronucleus (MN) test in secondary roots of Vicia faba seedlings exposed to mobile phone transmission in controlled conditions, inside a transverse electro magnetic (TEM) cell.
- Exposure of roots was carried out for 72h using a continuous wave (CW) of 915 MHz radiation at three values of equivalent plane wave power densities (23, 35 and 46W/m2). The specific absorption rate (SAR) was measured with a calorimetric method and the corresponding values were found to fall in the range of 0.4-1.5W/kg.
- Results of three independent experiments show the induction of a significant increase of MN frequency after exposure, ranging from a 2.3-fold increase above the sham value, at the lowest SAR level, up to a 7-fold increase at the highest SAR. These findings are in agreement with the limited number of data on cytogenetic effects detected in other plant systems exposed to mobile phone RF-EMF frequencies and clearly show the capability of radiofrequency exposure to induce DNA damage in this eukaryotic cell system.
- It is worth noticing that this range of SAR values is well below the international limits for localised exposure (head, trunk), according to the ICNIRP guidelines (35) and IEEE std C95.1 (38), which are 10 (8.0) W/kg for occupational exposure and 2.0 (1.6) W/kg for general public exposure respectively.

Halgamuge, Malka N., See Kye Yak and Jacob L. Eberhardt. "Reduced growth of soybean seedlings after exposure to weak microwave radiation from GSM 900 mobile phone and base station." (http://onlinelibrary.wiley.com/doi/10.1002/BEM.21890/abstract) *Bioelectromagnetics*, vol. 36, no. 2, 2015, pp. 87-95.

- The aim of this work was to study possible effects of environmental radiation pollution on plants. The association between cellular telephone (short duration, higher amplitude) and base station (long duration, very low amplitude) radiation exposure and the growth rate of soybean (Glycine max) seedlings was investigated.
- The exposure to higher amplitude (41 V m−1) GSM radiation resulted in diminished outgrowth of the epicotyl. The exposure to lower amplitude (5.7 V m−1) GSM radiation did not influence outgrowth of epicotyl, hypocotyls, or roots. The exposure to higher amplitude CW radiation resulted in reduced outgrowth of the roots whereas lower CW exposure resulted in a reduced outgrowth of the hypocotyl. Soybean seedlings were also exposed for 5 days to an extremely low level of radiation (GSM 900 MHz, 0.56 V m−1) and outgrowth was studied 2 days later. Growth of epicotyl and hypocotyl was found to be reduced, whereas the outgrowth of roots was stimulated.
- Our findings indicate that the observed effects were significantly dependent on field strength as well as amplitude modulation of the applied field.

Senavirathna, M.D., et al. "Nanometer-scale elongation rate fluctuations in the Myriophyllum aquaticum (Parrot feather) stem were altered by radio-frequency electromagnetic radiation." (http://www.ncbi.nlm.nih.gov/pubmed/24670369) *Plant Signal Behav*, vol. 9, no. 3, 2014.

- Statistically significant changes to this plant from a non thermal effect.

Soran, M.L., et al. "Influence of microwave frequency electromagnetic radiation on terpene emission and content in aromatic plants." (https://www.ncbi.nlm.nih.gov/pubmed/25050479) *Journal of Plant Physiology*, vol. 171, no. 15, 2014, pp. 1436-43.

- Microwave irradiation resulted in thinner cell walls, smaller chloroplasts and mitochondria, and enhanced emissions of volatile compounds, in particular, monoterpenes and green leaf volatiles (GLV). These data collectively demonstrate that human-generated microwave pollution can potentially constitute a stress to the plants.
- The above is only a small sampling of the research showing biological effects at non thermal levels on living organisms.

Haggerty, Katie. "Adverse Influence of Radio Frequency Background on Trembling Aspen Seedlings." (https://www.hindawi.com/journals/ijfr/2010/836278/) International Journal of Forestry Research, vol 2010, no. 836278, 2010.

- "This study suggests that the RF background may have strong adverse effects on growth rate and fall anthocyanin production in aspen, and

may be an underlying factor in aspen decline."

Additional References:

Effects of EMFs on other animals:

Ernst D.A. and K.J. Lohmann. "Effect of magnetic pulses on Caribbean spiny lobsters: implications for magnetoreception." (http://www.ncbi.nlm.nih.gov/pubmed/27045095?dopt=Abstract). Journal of Experimental Biology, vol. 219, pt. 12, pp. 1827-32. 2016

- The Caribbean spiny lobster,Panulirus argus, is a migratory crustacean that uses Earth's magnetic field as a navigational cue, but how lobsters detect magnetic fields is not known. Magnetic material thought to be magnetite has previously been detected in spiny lobsters, but its role in magnetoreception, if any, remains unclear. As a first step toward investigating whether lobsters might have magnetite-based magnetoreceptors, we subjected lobsters to strong, pulsed magnetic fields capable of reversing the magnetic dipole moment of biogenic magnetite crystals. Lobsters were subjected to a single pulse directed from posterior to anterior and either: (1) parallel to the horizontal component of the geomagnetic field (i.e., toward magnetic north); or (2) antiparallel to the horizontal field (i.e., toward magnetic south). An additional control group was handled but not subjected to a magnetic pulse. After treatment, each lobster was tethered in a water-filled arena located within 200 m of the capture location and allowed to walk in any direction. Control lobsters walked in seemingly random directions and were not significantly oriented as a group. In contrast, the two groups exposed to pulsed fields were significantly oriented in approximately opposite directions. Lobsters subjected to a magnetic pulse applied parallel to the geomagnetic horizontal component walked westward; those subjected to a pulse directed antiparallel to the geomagnetic horizontal component oriented approximately northeast. The finding that a magnetic pulse alters subsequent orientation behavior is consistent with the hypothesis that magnetoreception in spiny lobsters is based at least partly on magnetite-based magnetoreceptors.

Harkless, Ryan, Muntather Al-Quraishi and Mary C. Vagula. "Radiation hazards of radio frequency waves on the early embryonic development of Zebrafish." (http://spie.org/Publications/Proceedings/Paper/10.1117/12.2053469) *SPIE Proceedings*, vol. 9112, 2014.

- With the growing use of wireless devices in almost all day-to-day activities, exposure to radio-frequency radiation has become an immediate health concern. It is imperative that the effects of such radiation not only on humans, but also on other organisms be well understood. In particular, it is critical to understand if RF radiation has any bearing on the gene expression during embryonic development, as this is a crucial and delicate phase for any organism. Owing to possible effects that RF radiation may have on gene expression, it is essential to explore the carcinogenic or teratogenic properties that it may show. This study observed the effects of RF radiation emitted from a cellular telephone on the embryonic development of zebrafish.
- This study observed the effects of RF radiation emitted from a cellular telephone on the embryonic development of zebra fish. The expression of the gene shha plays a key role in the early development of the fish. This gene has homologs in humans as well as in other model organisms. Additionally, several biomarkers indicative of cell stress were examined: including lactate dehydrogenase (LDH), superoxide dismutase (SOD), and lipid peroxidation (LPO).
- Results show a significant decrease in the expression of shha, a significant decrease in LDH activity. There was no significant increase in SOD and LPO activity.

Li, Ying, et al. "Extremely Low-Frequency Magnetic Fields Induce Developmental Toxicity and Apoptosis in Zebrafish (Danio rerio) Embryos." (https://link.springer.com/article/10.1007/s12011-014-0130-5) Biological Trace Element Research, vol. 162, no. 1, 2014, pp. 324-32.

- In conclusion, the overall results demonstrated that ELF-MF exposure has detrimental effects on the embryonic development of zebrafish by affecting the hatching, decreasing the heart rate, and inducing apoptosis, although such effects were not mortal threat. The results also indicate that zebrafish embryos can serve as a reliable model to investigate the biological effect of ELF-MF.

Takebe, Arika, et al. "Zebrafish respond to the geomagnetic field by bimodal and group-dependent orientation." (http://www.nature.com/srep/2012/121011/srep00727/full/srep00727.html), *Scientific Reports*, vol 2, no. 727, 2012.

- In this study, we found that zebrafish, a model organism suitable for genetic manipulation, responded to a magnetic field as weak as the geomagnetic field.

Magneto-reception in cows and other mammals:

Baker, R.R., J.G. Mather and J.H. Kennaugh. "Magnetic bones in human sinuses." (https://www.ncbi.nlm.nih.gov/pubmed/6823284) *Nature*, vol. 301, no. 5895, 1983, pp. 79-80.

- Evidence continues to accumulate that a wide range of organisms, from bacteria to vertebrates, can detect and orient to ambient magnetic fields (for examples see refs 2-4). Since the discovery that magnetic orientation by bacteria was due to the presence within the organism of magnetic particles of the ferric/ferrous oxide, magnetite, the search has begun for other biogenic deposits of inorganic magnetic material and ways in which the possession of such material might confer on the organism the ability to orient to ambient magnetic fields. Such

magnetic material, often identified as magnetite, has been discovered in bees, homing pigeons, dolphins and various other organisms, including man. A variety of hypotheses for the use of magnetite in magnetic field detection have been proposed. We report here that bones from the region of the sphenoid/ethmoid sinus complex of humans are magnetic and contain deposits of ferric iron. The possible derivations and functions of these deposits are discussed.

Malkemper, E.P., et al. "Magnetoreception in the wood mouse (Apodemus sylvaticus): influence of weak frequency-modulated radio frequency fields." (http://bit.ly/1zh1J91) *Scientific Reports*, vol. 4, no. 9917, 2015.

- Wood mice exposed to a 0.9 to 5 MHz frequency sweep changed their preference from north-south to east-west. In contrast to birds, however, a constant frequency field tuned to the Larmor frequency (1.33 MHz) had no effect on mouse orientation. In sum, we demonstrated magnetoreception in wood mice and provide first evidence for a radical-pair mechanism in a mammal.Open Access Paper: http://bit.ly/1zh1J91
- In sum, we show that wood mice possess a magnetic sense that they use to position their nests along the NNE-SSW axis relative to the magnetic field. The NNE-SSW preference was not altered by RF fields delivered at the Larmor frequency, but was shifted by approximately 90° by a RF frequency sweep (0.9–5 MHz repeated at 1 kHz) at an intensity of only ~5% that of the Larmor frequency stimulus.
- The results point to the involvement of a radical pair mechanism, the first such evidence for a mammal, although further research is needed to provide a more thorough characterization of the underlying mechanism.
- The RF magnetic fields applied here have peak intensities below the ICNIRP guidelines for general public exposure (63, i.e., Brms = 0.92 μT/f [MHz], or Bpeak = 1.30 μT/f [MHz]) considered as harmless for human health. Yet, we show that they are sufficient to affect behaviour in a mammal.

Fedrowitz, Maren. "Cows: A big model for EMF research, somewhere between Vet-Journals and "Nature"." (https://www.bems.org/node/14835) *The Bioelectromagnetics Society*, 2014.

- Effects of electromagnetic fields (EMF) on cows have been frequently discussed in public media as well as in specialist journals and meetings with agricultural, veterinary or dairy backgrounds. Indeed, in view of the available literature, it does seem that cows show EMF susceptibilities and respond to environmental exposures of a broad range of frequencies and properties:
- Cows are sensitive to the Earth´s magnetic field. Bovine magnetoreception can be influenced by external EMF, e.g. powerlines.
- Several physiological alterations in dairy cows exposed to extremely low frequency (ELF) EMF were reported without major indications for adverse health effects. Notably, the observed effects seem to be dependent on the magnetic field component or on combined electric and magnetic fields rather than on electric field exposure alone.
- Cows are sensitive to earth currents (stray voltage) associated with transients in particular harmonics. Milk production, health, and behavior seem to be negatively affected.
- Bovine responses to radiofrequency (RF) exposure include avoidance behavior, reduced ruminating time, and alterations in oxidative stress. These findings indicate possible adverse health effects. However, most of the studies have critical points (one-herd-case report, logistic problems in study design, lack of appropriate exposure assessment) that confirmation of the observed RF effects is clearly needed, though studies in such big animals are time-, place-, and money-consuming, and exposure assessment and dosimetry are challenging issues.
- Overall, cattle seem to be affected by environmental EMF exposure. Cows align to geomagnetic field lines and are influenced by ELF EMF

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Cressey, D. "Magnetic cows are visible from space." (http://www.nature.com/news/2008/080825/full/news.2008.1059.html) *Nature News*, 2008

Begall, S., et al. "Magnetic alignment in grazing and resting cattle and deer." (http://www.pnas.org/content/105/36/13451.abstract) *PNAS*, vol. 105, 2008, pp. 13451-5.

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Original Article

The Effects of Chronic Exposure to Very Low Intensity Microwave Radiation on Domestic Fowl

J. A. Tanner & C. Romero-Sierra

Pages 195-205 | Published online: 07 Jul 2009

Pages 195-205 | Published online: 07 Jul 2009

 https://doi.org/10.3109/15368378209040336

Abstract

Continuous exposure of birds to very low intensity microwave radiation was investigated from the point of view of health and external appearance. Subjects were two colonies of 56 domestic fowl (white leghorns) from the same brood and at the beginning of their second laying period. Above one colony was a 4-ft. diameter parabolic dish coupled to a 7.06 GHz CW microwave transmitter. Field intensity in each cage (without birds) ranged from 0.19 $\mu W/cm^2$ in the outer cages to 360 $\mu W/cm^2$ in the cages roximal to the line of sight of the dish. Daily account was kept of the number and weight of eggs produced per cage and of the environmental parameters for a period of 248 days. Egg production of the irradiated colony was greater (13.7%) than that of the control colony but was accompanied by double the mortality rate. Postmortem histological examinations revealed two major groups of diseases. The irradiated birds that survived showed a profound deterioration in health.

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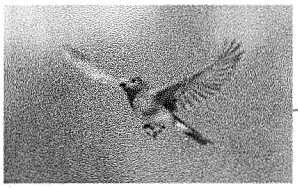
Cellphone Towers EMR Damaging Biological Systems Of Birds, Insects, Humans

BY ANTHONY GUCCIARDI (HTTP://NATURALSOCIETY.COM/AUTHOR/ANTHONY/)

POSTED ON OCTOBER 25, 2011



The electromagnetic radiation (EMR) emitted from mobile towers is so powerful that it affects the biological systems of birds, insects, and even humans. The study, released by the environment ministry, called for the protection of flora and fauna by law.

> "The review of existing literature shows that the EMRs are interfering with the biological systems in more ways than one and there had already been some warning bells sounded in the case on bees and birds, which probably heralds the seriousness of this issue and indicates the vulnerability of other species as well," the study found.

In September of 2010, the ministry established a 10-member committee under Bombay Natural History Society (BNHS) with director Asad Rahmani to study the impact of cellphone towers on birds and bees. The group of experts reviewed 919 studies performed in India and abroad regarding the **effects of cellphone towers on birds, insects, animals, wildlife, and humans**.

What the group found was quite startling.

Electromagnetic Radiation May Play A Role In The Decline Of Animal And Insect Populations

Of the 919 studies, a staggering **593 showed the negative impact of mobile towers on birds, bees, humans, wildlife and plants**. The experts even cited an international study that pinpointed cellphone towers as a potential cause in the decline of animal populations. They went on to say that there was an urgent need to focus more scientific attention on the subject before it was too late.

In addition to calling for a law protecting urban flora and fauna from emerging threats of electromagnetic radiation, the experts are also suggesting bold signs and messages on the dangers of cell phone tower and radiation to be posted near the position of cellphone towers.

> "To prevent overlapping high radiations fields, new towers should not be permitted within a radius of one kilometre of existing towers. If new towers must be built, construct them to be above 80 feet and below 199 feet ... to avoid the requirement for aviation safety lighting," it said.

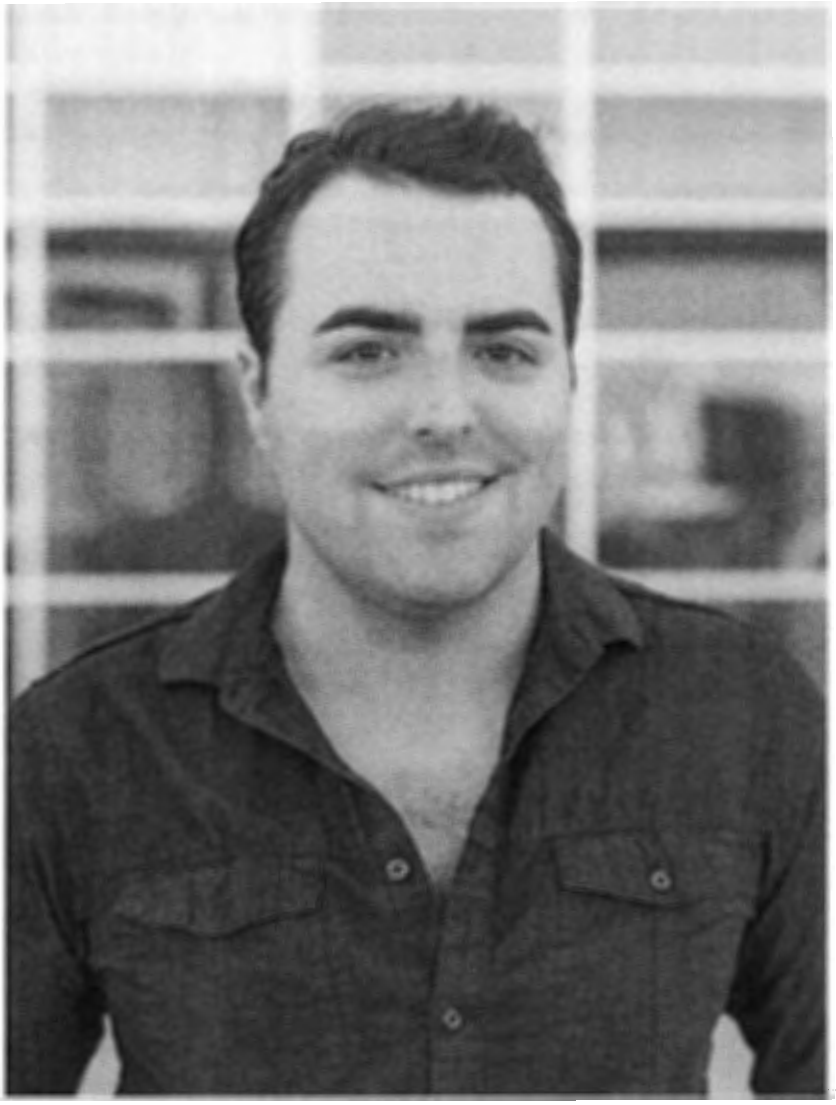
The negative effects of EMR on life is something that has been ignored by health officials and legislators for years. As cellphone subscriptions outnumber the total number of US citizens (http://naturalsociety.com/cellphone-subscriptions-outnumber-people-in-us-radiation-public-health/), more and more mobile phone towers are popping up around the globe. As the experts cautioned, it is extremely pertinent that further independent research is conducted to highlight the dangers of EMR.

Additional Sources:

IndianExpress (http://www.indianexpress.com/news/protect-wildlife-from-cellphone-towers-panel/859648)

Post written byAnthony Gucciardi:

Anthony is a natural health and human empowerment writer, speaker, and entrepreneur whose writings have appeared in #1 USA Today and Wall Street Journal Best-Selling books and top 100 websites. After overcoming Lyme Disease and nerve-related facial paralysis, Anthony's work now reaches several million readers per month through his highly prolific group of social media pages and websites. Focused on self-development techniques and living a healthy lifestyle, Anthony currently sits on the Advisory Board to Natural Society in addition to managing and directing several other companies dedicated to enhancing social good. Anthony's work routinely appears on both alternative and established websites and television programs alike, including Drudge Report, Thom Hartmann, Simple Reminders, RT, Infowars, Michael Savage, Gaiam TV, and many others.



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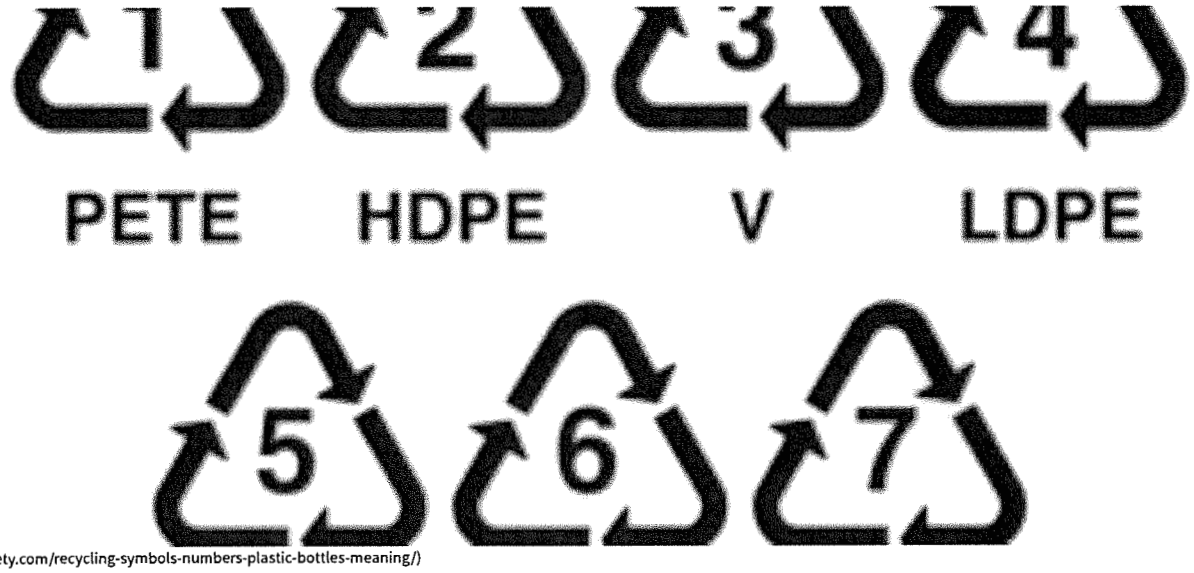

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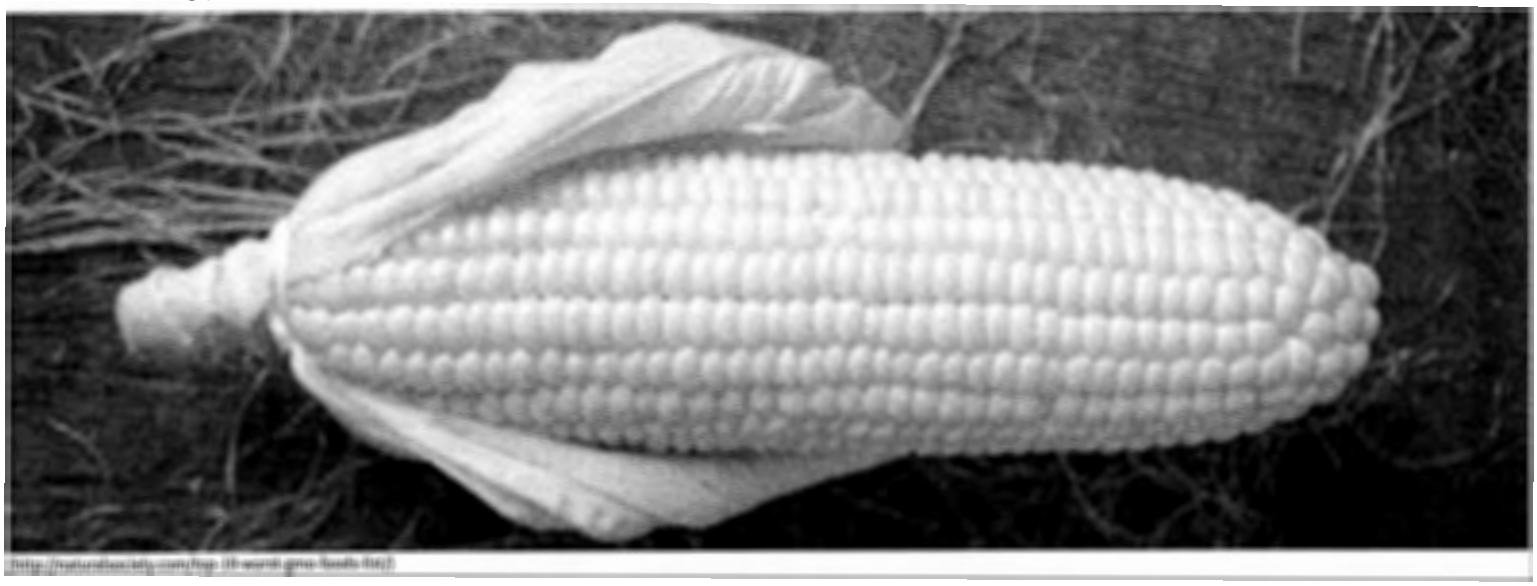

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A Pushback Against Cell Towers

By MARCELLE S. FISCHLER AUG. 27, 2010

Wantagh

TINA CANARIS, an associate broker and a co-owner of RE/MAX Hearthstone in Merrick, has a $999,000 listing for a high ranch on the water in South Merrick, one of a handful of homes on the block on the market. But her listing has what some consider a disadvantage: a cell antenna poking from the top of a telephone pole at the front of the 65-by-100-foot lot.

"Even houses where there are transformers in front" make "people shy away," Ms. Canaris said. "If they have the opportunity to buy another home, they do."

She said cell antennas and towers near homes affected property values, adding, "You can see a buyer's dismay over the sight of a cell tower near a home just by their expression, even if they don't say anything."

By blocking, or seeking to block, cell towers and antennas over the course of the last year, Island homeowners have given voice to concerns that proximity to a monopole or antenna may not be just aesthetically unpleasing but also harmful to property values. Many also perceive health risks in proximity to radio frequency radiation emissions, despite industry assertions and other evidence disputing that

such emissions pose a hazard.

Emotions are running so high in areas like Wantagh, where an application for six cell antennas on the Farmingdale Wantagh Jewish Center is pending, that the Town of Hempstead imposed a moratorium on applications until Sept. 21. That is the date for a public hearing on a new town ordinance stiffening requirements.

At a community meeting on Aug. 16 at Wantagh High School, Dave Denenberg, the Nassau county legislator for Bellmore, Wantagh and Merrick, told more than 200 residents that 160 cell antennas had been placed on telephone poles in the area in the last year by NextG, a wireless network provider.

"Everyone has a cellphone," Mr. Denenberg said, "but that doesn't mean you have to have cell installations right across the street from your house." Under the old town code, installations over 30 feet high required an exemption or a variance. But in New York, wireless providers have public utility status, like LIPA and Cablevision, and they can bypass zoning boards.

Earlier this month in South Huntington, T-Mobile was ordered to take down a new 100-foot monotower erected on property deemed environmentally sensitive (and thus requiring a variance). Andrew J. Campanelli, a civil rights lawyer in Garden City, said a group of residents had hired him to oppose the cellular company's application.

"They were worried about the property values," Mr. Campanelli said. "If your home is near a cell antenna, the value of your property is going down at least 4 percent. Depending on the size of the tower and the proximity, it is going down 10 percent."

In January, in an effort to dismantle 50 cell antennas on a water tower across from a school in the village of Bayville, Mr. Campanelli filed a federal lawsuit that cited health risks and private property rights.

In a statement, Dr. Anna F. Hunderfund, the Locust Valley superintendent, said that in February 2009 the district had engaged a firm to study the cellphone installations near the Bayville schools, finding that the tower "posed no significant health risks," and she noted that the emission levels fell well below amounts

deemed unsafe by the Federal Communications Commission.

In June 2009, Sharon Curry, a psychologist in Merrick, woke up to find a cell antenna abutting her backyard, level to her 8-year-old son's bedroom window.

Puzzled by its presence, particularly because she lives next to an elementary school, she did research to see if there was cause for concern. What she learned about possible health impacts, she said, led her to seek help from civic associations and to form a group, Moms of Merrick Speak Out, to keep new cell towers out. She said she was seeking the "responsible" placement of cell antennas, away from homes and schools.

The Federal Communications Act of 1996 says health concerns are not a valid reason for a municipality to deny zoning for a cell tower or antenna. Property values and aesthetics, however, do qualify, according to the act.

Frank Schilero, an associate broker with RE/MAX Innovations in Wantagh, has a listing on a $629,000 home down the street from the Farmingdale Wantagh Jewish Center, where the application is pending to put six cell antennas on the roof.

"People don't like living next to cell towers, for medical reasons or aesthetics," Mr. Schilero said. "Or they don't want that eyesore sticking up in their backyards." There is an offer on his listing, he added, but since the buyer heard about the possible cell antennas she has sought more information from the wireless companies about their size and impact.

Charles Kovit, the Hempstead deputy town attorney, said that under the proposed code change any new towers or antennas would have to be 1,500 feet from residences, schools, houses of worship and libraries.

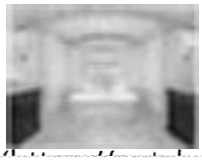
The town recently hired a consultant, Richard A. Comi of the Center for Municipal Solutions in Glenmont, to review antenna applications.

Under the new ordinance, applications for wireless facilities would require technical evidence that they had a "gap" in coverage necessitating a new tower.

"If not, they will get denied," Mr. Kovit said. The wireless companies would

also have to prove that the selected location had "the least negative impact on area character and property values." If another location farther away from homes can solve the gap problem, "they are going to have to move."

A version of this article appears in print on August 29, 2010, on Page RE9 of the New York edition with the headline: A Pushback Against Cell Towers.



Politics & Government (Https://Patch.com/New-Jersey/Bridgewater/Politics)

Appraiser: Cell Tower Will Affect Property Values

T-Mobile hearing to continue March 27.

By Audrey Levine, Patch Staff (https://patch.com/users/audrey-levine) | Feb 22, 2012 6:03 am ET | Updated Feb 22, 2012 11:52 am ET


r/sharer.php?

Real estate appraiser Robert Heffernan (http://bridgewater.patch.com/articles/resident-board-hasn-t-considered-property-values-in-application-for-t-mobile-cell-tower-at-green-knoll-volunteer-fire-company) presented his report to the zoning board of adjustment Tuesday concerning the impact of cell towers on property values—and announced that he believes a tower at 130 feet in the air will affect the homes nearby.

"I believe the tower will have an adverse impact to surrounding properties," he said. "I believe that is something that needs to be considered in terms of granting the application."

Heffernan was hired by resident Joseph Kirk as an expert witness concerning the T-Mobile application for a 130-foot tower at the Green Knoll Volunteer Fire Co (http://bridgewater.patch.com/listings/green-knoll-fire-company). Kirk had appealed to the zoning board (http://bridgewater.patch.com/articles/expert-to-report-on-tower-lowering-property-values) to allow the residents to bring in an expert concerning property values, citing that this is the one thing board members had yet to hear about.

The focus of Heffernan's study was on several towers around New Jersey, although T-Mobile attorney Greg Meese noted that none of these are exactly like the one being proposed for Bridgewater.

Meese noted that none of the examples Heffernan gave were stealth structures, meaning they were not flagpole or tree monopoles—the proposed structure will be a flapole without the actual flag.

"With all the cellular towers in New Jersey, you couldn't find one more comparable to what was proposd than a dual lattice tower that is 450 feet?" he asked. "What concerns me is that out of thousands of cell towers in New Jersey, you include one, and then studies of other towers that are not comparable."

But Heffernan noted that that is because there are none similar in the area.

"I was not able to find other cell towers established in this area," he said. "A review of testimony helped us understand that there are other towers in Bridgewater, but they all appear to be in conjunction with electrical power lines."

Heffernan said any similar structures in Bridgewater did not qualify for the study because of the need to look at houses sold in certain time frames.

"In most cases, the stealth towers that I have been acquainted with were not near residential properties to make for a valid study," he said. "Just because it is in a residential area doesn't mean it qualifies for the study. There has to be a sale of a property that is approximate to the tower."

"It is not just a matter of being within a close distance of the tower, it's being able to view the tower," he added.

Heffernan said he was able to study properties around the county that are similar to those in the Green Knoll area of Bridgewater, but with lattice towers, water tanks and other similar towers nearby.

This was based, Heffernan said, on the section of Bridgewater near the firehouse, with homes selling for between $325,000 and $725,000. The average sale price, he said, is $417,989, with 10 percent of the existing supply being marketed in any one period.

The one structure most similar to that which is being proposed, Heffernan said, is a lattice structure in Franklin. Heffernan discussed the different aspects of two properties near the structure to discuss their property values, and compared the value of the home in view of the tower to the one that is not.

The first, on Valley Wood Drive in Franklin, is a single family residence that sold in 2010 for $700,000, or $174.91 per square foot. The house, Heffernan said, sits on 0.517 acres, and is 4,002 square feet, with four bedrooms, three full baths, one half bath, one basement, a three-car garage, two fireplaces, a paver block driveway and more.

The house, Heffernan said, has a winter view of the monopole, which stands about 120 feet high, from the rear yard.

From there, Heffernan said, he also looked at a comparable property on Renoir Way, which has no view of that same cell tower, but is in the Woodlands community in Franklin with the Valley Wood Drive home.

The Renoir Way home sold in 2010 for $685,000, or $182.08 per square foot.

Heffernan accounted for several price differentials, including the fact that the Renoir Way home sold first, it is in an inferior location, it has vinyl siding instead of brick like the Valley Wood Drive home and other conditional information about the house.

Based on those adjustments, to make the Renoir Way home comparable in structure to the Valley Wood Drive home, Heffernan said, the former would actually sell for $774,800.

"The difference in price is $74,800, which reflects a difference of 10.7 percent," he said. "I can only attribute that to the fact that the Valley Wood Drive home has a clear view of the cellular tower."

All of this, Heffernan said, including many other examples, are based on a negative externality, which causes the house closest to the structure to be lower in value than the one farther away.

In addition, Heffernan said, his study determined that the structure being proposed for the firehouse is unlike anything in the neighborhood.

"I understand it is a flagpole at 130 feet, which is not typical of flagpoles," he said. "It is a 130-foot structure in a neighborhood that only allows 30-foot structures. It will obviously be notable from a large range in the area."

Heffernan said that, in his experience, people do not choose to live near similar structures.

"Or if they do choose to live there, they do so only when there is a reasonable price difference that makes it acceptable to live there," he said. "Properties that are approximately close to the tower will suffer substantial degradation to their value

based on the nature of the unusual feature in the residential neighborhood."

Heffernan, also a licensed real estate agent, said he would also feel obligated to mention to any potential buyer that there is a 130-foot cell tower proposed for the area.

In answer to a question from board member Donald Sweeney, Heffernan said he has never seen a case where a tower of some sort has not had some affect on nearby residential real estate, whether through lack of appreciation of value or sale price.

"These externalities clearly have negative impacts," Sweeney said.

"Location location location seems to be important in real estate," Heffernan said. "People look for the best location they can afford, and they have to balance that with size and style of the house. It starts with the neighborhood."

Board member Evans Humenick said the one other factor he is interested in is whether, in properties studied, the tower or the houses came first.

Heffernan said that, in most cases, the tower actually came first.

"I would think the tower would have an affect on the original buyer," Humenick said. "What is the relevance of the original sale?"

Heffernan said there is no real way to determine that.

"When you go back and find data, it is hard to establish what was the base of that home," he said. "The home may not be what it was when it was first built."

Humenick maintained that this was something to consider.

"People in the community deserve the best we can give them, and it is refreshing to find out that people did buy homes with towers already on the property," he said. "Our most important thing is to balance everything and protect the community."

Just before the meeting ended, Sweeney also questioned about a roaming agreement he had heard discussed after T-Mobile and AT&T discontinued its recent plans to merge the companies. He said he had heard that people with a lapse in service from one provider in an area could be picked up by another.

But Meese said he has been instructed to move forward with the application and that that possible agreement should have no bearing on it.

"I would say that is irrelevant," he said, citing the telecommunications act, which allows cellular communications companies to move forward with improving their coverage. "If the board took the postiion that roaming is there, they could never give you a place to build. T-Mobile wants to build a site there, they need a site there, and we believe we have the rights of the telecommunications act to build out regardless of roaming."

Although Heffernan had finished his own testimony by the end of the meeting, the hearing was continued for Meese to continue his questioning and bring his own expert in, in addition to comments from the public concerning property values.

The hearing will be continued to March 27, with another meeting already scheduled for April 3.

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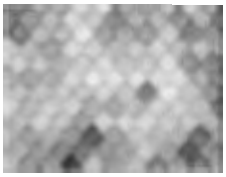

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REALTOR Mag

Cell Towers, Antennas Problematic for Buyers

DAILY REAL ESTATE NEWS | THURSDAY, JULY 24, 2014

An overwhelming 94 percent of home buyers and renters surveyed by the National Institute for Science, Law & Public Policy (NISLAPP) say they are less interested and would pay less for a property located near a cell tower or antenna.

What's more, of the 1,000 survey respondents, 79 percent said that under no circumstances would they ever purchase or rent a property within a few blocks of a cell tower or antennas, and almost 90 percent said they were concerned about the increasing number of cell towers and antennas in their residential neighborhood.

Trouble Spots for Buyers:

- Home Owners Object to Cell Tower Installations
- Field Guide to Cell Phone Towers
- 6 Ways a Home May Turn Off Buyers
- 6 Ways to Turn Off Buyers at Open Houses

The survey, "Neighborhood Cell Towers & Antennas—Do They Impact a Property's Desirability?" also found that properties where a cell tower or group of antennas are placed on top of or attached to a building (condominium high-rise, for instance) is problematic for buyers.

"A study of real estate sales prices would be beneficial at this time in the Unites States to determine what discounts home buyers are currently placing on properties near cell towers and antennas," says Jim Turner, chair of NISLAPP.

The NISLAPP survey echoes the findings of a study by Sandy Bond of the New Zealand Property Institute and past president of the Pacific Rim Real Estate Society (PRRES). "The Impact of Cell Phone Towers on House Prices in Residential Neighborhoods," which was published in The Appraisal Journal in 2006, found that buyers would pay as much as 20 percent less for a property near a cell tower or antenna.

Source: "Neighborhood Cell Towers & Antennas—Do They Impact a Property's Desirability?" National Institute for Science, Law & Public Policy (June 2014)

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Burbank ACTION (Against Cell Towers In Our Neighborhood)

DECREASED REAL ESTATE VALUE

Note: This page is best viewed using Mozilla Firefox internet browser.

For residents in other communities opposing proposed wireless facilities in your neighborhood: in addition to the real estate studies you send and share with your local officials, talk to your local real estate professionals and inform and educate them about the negative effects on local property values that cell towers have, and ask them to submit letters of support to city officials, or have them sign a petition that will be forwarded onto your city officials. See examples below. It's very important to have your local real estate professionals back up what the experts report in their studies to make your arguments real and relative to your

How would you like one of these ugly monsters installed on the sidewalk next to your home? This one was installed in a public right of way (PROW, aka sidewalk) on Via De La Paz in beautiful Pacific Palisades, because the City of Los Angeles currently lacks rigorous regulations concerning proposed PROW wireless installations. Why isn't the Los Angeles City Council and Attorney updating the city's ordinance like residents are asking? Photo courtesy Pacific Palisades Residents Association, http://pprainc.org/

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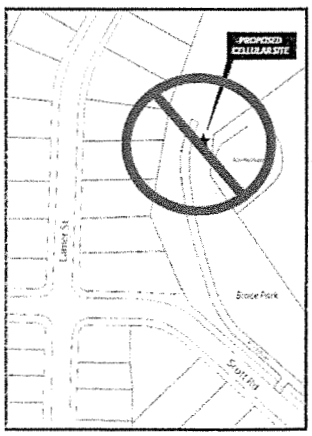
Calendar - upcoming events: http://burbankaction.wordp

Go to our "Smart Meter Concerns" Section: https://sites.google.com/site/smart-meter-concerns

Join our facebook page - network, share and post info that's going on in your community, inform and help other communities



Click below for more info:

specific community. You can also educate your local homeowners associations and neighborhood councils about the negative property value effects and have them submit letters and sign petitions, too. Check out the other pages on this website (click links in right column) for other helpful information.

Residents are justifiably concerned about proposed cell towers reducing the value of their homes and properties. Who would want to live right next to one, or under one? And imagine what it's like for people who purchase or build their dream home or neighborhood, only to later have an unwanted cell tower installed just outside their window?

This negative effect can also contribute to urban blight, and a deterioration of neighborhoods and school districts when residents want to move out or pull their children out because they don't want to live or have their children attend schools next to a cell tower.

People don't want to live next to one not just because of health concerns, but also due to aesthetics and public safety reasons, i.e., cell towers become eyesores, obstructing or tarnishing cherished views, and also can attract crime, are potential noise nuisances, and fire and fall hazards.

These points underscore why wireless facilities are commercial facilities that don't belong in residential areas, parks and schools, and find out why they should be placed in alternative, less obtrusive locations. In addition, your city officials have the power to regulate the placement and appearance of cell towers, as long as such discrimination is not unreasonable, and especially if you show them that you already have coverage in your area.

As mentioned on our Home Page, putting cell towers near residential properties is just bad business. For residential owners, it means decreased property values. For local businesses (realtors and brokers) representing and listing these properties, it will create decreased income. And for city governments, it results in decreased revenue (property taxes).

Read this New York Times news story, "A Pushback Against Cell Towers," published in the paper's Real Estate section, on August 27, 2010:

Burbank UPDATES:

- **June 3-17, 2011:** *City of Burbank Planning & Transportation Division issues its draft updated wireless facility ordinance -- it fails to protect our residential areas -- go here to read how you can help: https://sites.google.co 17-2011-resident-respons-comments-to-proposed-wtf-ordinance-update*
- *Read Burbank ACTION resident response to proposed Draft Update of our Wireless Telecommunications Facility Ordinance here.*
- *Please go here for our list of "Top 20" Resident Recommendations -- thanks to residents who have e-mailed these to our city officials. To read about the Dec. 1, 2010 Community Meeting, click the item under "Burbank UPDATES" in the column to your right.*
- Dec. 1, 2010: Community Meeting
- August 31, 2010: City Council Meeting - Interim Regulations Approved
- July 26, 2010: Planning Board Meeting - Interim Regulations Approved
- June 14, 2010 Study Session and Upcoming TBD

http://www.nytimes.com/2010/08/29/realestate/29Lizo.html?_r=1&ref=realestate.

A number of organizations and studies have documented the detrimental effects of cell towers on property values.

1. The Appraisal Institute, the largest global professional membership organization for appraisers with 91 chapters throughout the world, spotlighted the issue of cell towers and the fair market value of a home and educated its members that a cell tower should, in fact, cause a decrease in home value.

The definitive work on this subject was done by Dr. Sandy Bond, who concluded that "media attention to the potential health hazards of [cellular phone towers and antennas] has spread concerns among the public, resulting in increased resistance" to sites near those towers. Percentage decreases mentioned in the study range from 2 to 20% with the percentage moving toward the higher range the closer the property. These are a few of her studies:

a. "The effect of distance to cell phone towers on house prices" by Sandy Bond, Appraisal Journal, Fall 2007, see attached. Source, Appraisal Journal, found on the Entrepreneur website, http://www.entrepreneur.com/tradejournals/article/17 or http://www.prres.net/papers/Bond_Squires_Using_G

b. Sandy Bond, Ph.D., Ko-Kang Wang, "The Impact of Cell Phone Towers on House Prices in Residential Neighborhoods," The Appraisal Journal, Summer 2005; see attached. Source: Goliath business content website, http://goliath.ecnext.com/coms2/gi_0199-5011857/The-impact-of-cell-phone.html

c. Sandy Bond also co-authored, "Cellular Phone Towers: Perceived impact on residents and property values" University of Auckland, paper presented at the Ninth Pacific-Rim Real Estate Society Conference, Brisbane, Australia, January 19-22, 2003; see attached. Source: Pacific Rim Real Estate Society website, http://www.prres.net/Papers/Bond_The_Impact_Of_

Community Meeting

- Dec. 8, 2009 Study Session & City Hall Meetings
- Nov. 16, 2009 Planning Board and Nov. 17 City Hall Meetings
- November 12, 2009 Public Meeting

City of Burbank website: Wireless ordinance updates

Burbank Leader Newspaper Stories and Editorials

Tools: Reasons To Deny A Proposed Cell Tower and/or push for stronger regulations:

- Reasonable Discrimination Allowed
- Decrease In Property Value
- We Already Have Good Coverage: Significant Gap and 911
- Alternative Locations and Supplemental Application forms
- Aesthetics and Public Safety
- Public Right of

2. Industry Canada (Canadian government department promoting Canadian economy), "Report On the National Antenna Tower Policy Review, Section D — The Six Policy Questions, Question 6. What evidence exists that property values are impacted by the placement of antenna towers?"; see attached. Source: Industry Canada http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf08353.html website,

3. New Zealand Ministry for the Environment, "Appendix 5: The Impact of Cellphone Towers on Property Values"; see attached. Source: New Zealand Ministry for the Environment website, http://www.mfe.govt.nz/publications/rma/nes-telecommunications-section32-aug08/html/page12.html

On a local level, residents and real estate professionals have also informed city officials about the detrimental effects of cell towers on home property values.

1. **Glendale, CA**: During the January 7, 2009 Glendale City Council public hearing about a proposed T-mobile cell tower in a residential neighborhood, local real estate professional Addora Beall described how a Spanish home in the Verdugo Woodlands, listed for 1 million dollars, sold $25,000 less because of a power pole across the street. "Perception is everything," said Ms. Beall stated. "It the public perceives it to be a problem, then it is a problem. It really does affect property values." See Glendale City Council meeting, January 7, 2009, video of Addora Beall comments @ 2:35:24: http://glendale.granicus.com/MediaPlayer.php?view_id=12&clip_id=1227

2. **Windsor Hills/View Park, CA**: residents who were fighting off a T-Mobile antenna in their neighborhood received letters from real estate companies, homeowner associations and resident organizations in their community confirming that real estate values would decrease with a cell phone antenna in their neighborhood. To see copies of their letters to city officials, look at the . Report from Los Angeles County Regional Planning Commission regarding CUP Case No. 200700020-(2), from L.A. County Board of Supervisors September 16, 2009, Meeting documents, Los Angeles County website, here at:

Way Developments

- Noise and Nuisance and notes about Clearwire
- Health Effects: Science & Research
- Watch these videos - Glendale and other residents protest cell towers and ask for new ordinances - great examples: read, watch and learn how these residents and other local groups organized their effective presentations before their elected reps. What they did will inspire and may help you.

DVDs and Books: you can view and read

Take Action:

Read and Sign the Petition

Write and Call Our City Leaders

http://file.lacounty.gov/bos/supdocs/48444.pdf

a. See page 295, August 31, 2008 Letter from Donna Bohanna, President/Realtor of Solstice International Realty and resident of Baldwin Hills to Los Angeles Board of Supervisors explaining negative effect of cell tower on property values of surrounding properties. "As a realtor, I must disclose to potential buyers where there are any cell towers nearby. I have found in my own experience that there is a very real stigma and cellular facilities near homes are perceived as undesirable."

b. See page 296, March 26, 2008 Letter from real estate professional Beverly Clark, "Those who would otherwise purchase a home, now considered desirable, can be deterred by a facility like the one proposed and this significantly reduces sales prices and does so immediately...I believe a facility such as the one proposed will diminish the buyer pool, significantly reduce homes sales prices, alter the character of the surrounding area and impair the use of the residential properties for their primary uses."

c. See Page 298, The Appraiser Squad Comment Addendum, about the reduced value of a home of resident directly behind the proposed installation after the city had approved the CUP for a wireless facility there: "The property owner has listed the property...and has had a potential buyer back out of the deal once this particular information of the satellite communication center was announced....there has been a canceled potential sale therefore it is relevant and determined that this new planning decision can have some negative effect on the subject property."

d. See Page 301, PowerPower presentation by residents about real estate values: "The California Association of Realtors maintains that 'sellers and licensees must disclose material facts that affect the value or desirability of the property,' including 'known conditions outside of and surrounding' it. This includes 'nuisances' and zoning changes that allow for commercial uses."

e. See Pages 302-305 from the Baldwin Hills Estates Homeowners Association, the United Homeowners

Other Links:

- Actions Taken
- Other Communities Saying "No"
- Important Organizations
- Burbank Neighborhoods & Districts

Search for Antennae in Your Area

Website Contact Info

Home

Association, and the Windsor Hills Block Club, opposing the proposed cell tower and addressing the effects on homes there: "Many residents are prepared to sell in an already depressed market or, in the case of one new resident with little to no equity, simply walk away if these antennas are installed.

f. See Pages 362-363, September 17, 2008, Letter from resident Sally Hampton, of the Windsor Hills Homeowner's Assoc., Item K, addressing effects of the proposed facility on real estate values.

3. **Santa Cruz, CA**: Also attached is a story about how a preschool closed up because of a cell tower installed on its grounds; "Santa Cruz Preschool Closes Citing Cell Tower Radiation," Santa Cruz Sentinel, May 17, 2006; Source, EMFacts website: http://www.emfacts.com/weblog/?p=466.

4. **Merrick, NY:** For a graphic illustration of what we don't want happening here in Burbank, just look at Merrick, NY, where NextG wireless facilities are being installed, resulting in declining home real estate values. Look at this Best Buyers Brokers Realty website ad from this area, "Residents of Merrick, Seaford and Wantaugh Complain Over Perceived Declining Property Values: http://www.bestbuyerbroker.com/blog/?p=86.

5. **Burbank, CA**: As for Burbank, at a City Council public hearing on December 8, 2009, hillside resident and a California licensed real estate professional Alex Safarian informed city officials that local real estate professionals he spoke with agree about the adverse effects the proposed cell tower would have on property values:

> "I've done research on the subject and as well as spoken to many real estate professionals in the area, and they all agree that there's no doubt that cell towers negatively affect real estate values. Steve Hovakimian, a resident near Brace park, and a California real estate broker, and the publisher of "Home by Design" monthly real estate magazine, stated that he has seen properties near cell towers lose up to 10% of their value due to proximity of the cell tower...So even if they try to disguise them as tacky fake metal pine trees, as a real estate professional you're required by the California Association of Realtors: that

sellers and licensees must disclose material facts that affect the value or desirability of a property including conditions that are known outside and surrounding areas."

(See City of Burbank Website, Video, Alex Safarian comments @ 6:24:28, http://burbank.granicus.com/MediaPlayer.php?view_id=6&clip_id=848)

Indeed, 27 Burbank real estate professionals in December 2009, signed a petition/statement offering their professional opinion that the proposed T-Mobile cell tower at Brace Canyon Park would negatively impact the surrounding homes, stating:

"It is our professional opinion that cell towers decrease the value of homes in the area tremendously. Peer reviewed research also concurs that cell sites do indeed cause a decrease in home value. We encourage you to respect the wishes of the residents and deny the proposed T-Mobile lease at this location. We also request that you strengthen your zoning ordinance regarding wireless facilities like the neighboring city of Glendale has done, to create preferred and non preferred zones that will protect the welfare of our residents and their properties as well as Burbank's real estate business professionals and the City of Burbank. Higher property values mean more tax revenue for the city, which helps improve our city." (Submitted to City Council, Planning Board, City Manager, City Clerk and other city officials via e-mail on June 18, 2010. To see a copy of this, scroll down to bottom of page and click "Subpages" or go here: http://sites.google.com/site/nocelltowerinourneighborhood/real-estate-value/burbank-real-estate-professionals-statement)

Here is a list of additional articles on how cell towers negatively affect the property values of homes near them:

- The Observer (U.K.), "Phone masts blight house sales: Health fears are alarming buyers as masts spread across Britain to meet rising demand for mobiles," Sunday May 25, 2003 or go here: http://www.guardian.co.uk/money/2003/may/25/housepri
- "Cell Towers Are Sprouting in Unlikely Places," The New

York Times, January 9, 2000 (fears that property values could drop between 5 and 40 percent because of neighboring cell towers)

- "Quarrel over Phone Tower Now Court's Call," Chicago Tribune, January 18, 2000 (fear of lowered property values due to cell tower)
- "The Future is Here, and It's Ugly: a Spreading of Techno-blight of Wires, Cables and Towers Sparks a Revolt," New York Times, September 7, 2000
- "Tower Opponents Ring Up a Victory," by Phil Brozynski, in the *Barrington* [Illinois] *Courier-Review*, February 15, 1999, 5, reporting how the Cuba Township assessor reduced the value of twelve homes following the construction of a cell tower in Lake County, IL. See attached story: http://spot.colorado.edu/~maziara/appeal&attachments/N 43-LoweredPropertyValuation/
- In another case, a Houston jury awarded 1.2 million to a couple because a 100-foot-tall cell tower was determined to have lessened the value of their property and caused them mental anguish: Nissimov, R., "GTE Wireless Loses Lawsuit over Cell-Phone Tower," Houston Chronicle, February 23, 1999, Section A, page 11. (Property values depreciate by about 10 percent because of the tower.)

Read about other "Tools" on our website that may help you and your fellow residents oppose a cell tower in your neighborhood in the column to the right. These include:

- Reasonable Discrimination Allowed
- We Already Have Good Coverage: Significant Gap and 911
- Alternative Locations and Supplemental Application forms
- Aesthetics and Safety
- Noise and Nuisance and notes about Clearwire
- Health Effects: Science & Research

Also print out this helpful article on court decisions from the communications law firm of Miller & Van Eaton (with offices in

D.C. and San Francisco) that you can pull and read to realize what rights you may or may not have in opposing a wireless facility in your neighborhood: http://www.millervaneaton.com/content.agent?page_name=HT%3A++IMLA+Article+Tower+Siting+Nov+2008 (click the link once you get to this page).

Other important decisions and actions taken by courts and local governments can be found in our Actions Taken page.

Watch how other resident groups organized effective presentations at their public hearings so you can pick up their techniques and methods.

You can read and find additional organizations and resident groups that have organized opposition efforts against cell towers and wireless facilities, on our Other Communities Saying "No" and Important Organizations pages.

Subpages (1): Burbank Real Estate Professionals Statement

Comments

You do not have permission to add comments.

features

The Impact of Cell Phone Towers on House Prices in Residential Neighborhoods

by Sandy Bond, PhD, and Ko-Kang Wang

abstract

This article examines whether proximity to cellular phone towers has an impact on residential property values and the extent of any impact. First, a survey approach is used to examine how residents perceive living near cellular phone base stations (CPBSs) and how residents evaluate the impacts of CPBSs. Next, a market study attempts to confirm the perceived value impacts reported in the survey by analyzing actual property sales data. A multiple regression analysis in a hedonic pricing framework is used to measure the price impact of proximity to CPBSs. Both the survey and market sales analysis find that CPBSs have a negative impact on the prices of houses in the study areas.

The introduction of cellular phone systems and the rapid increase in the number of users of cellular phones have increased exposure to electromagnetic fields (EMFs). Health consequences of long-term use of cellular phones are not known in detail, but available data indicates that development of nonspecific health symptoms is possible.[1] Conversely, it appears health effects from cellular phone equipment (antennas and base stations) pose few, if any, known health hazards.[2]

A concern associated with cellular phone usage is the siting of cellular phone transmitting antennas (CPTAs) and cellular phone base stations (CPBSs). In New Zealand, CPBS sites are increasingly in demand as the major cellular phone companies there, Telecom and Vodafone, upgrade and extend their network coverage. This demand could provide the owner of a well-located property a yearly income for the siting of a CPBS.[3] However, new technology that represents potential hazards to human health and safety may cause property values to diminish due to public perceptions of hazards. Media attention to the potential health hazards of CPBSs has spread concerns among the public, resulting in increased resistance to CPBS sites.

Some studies suggest a positive correlation between long-term exposure to the electromagnetic fields and certain types of cancer,[4] yet other studies report inconclusive results on health effects.[5] Notwithstanding the research results, media reports indicate that the extent of opposition from some property owners

1. Stanislaw Szmigielski and Elizbieta Sobiczewska, "Cellular Phone Systems and Human Health—Problems with Risk Perception and Communication," *Environmental Management and Health* 11, no. 4 (2000): 352–368.
2. Jerry R. Barnes, "Cellular Phones: Are They Safe?" *Professional Safety* 44, no. 12 (Dec. 1999): 20–23.
3. R. Williams, "Phone Zone—Renting Roof Space to Ma Bell," *The Property Business* 12 (April 2001): 6–7.
4. C. M. Krause et al., "Effects of Electromagnetic Field Emitted by Cellular Phones on the EEG During a Memory Task," *Neuroreport* 11, no. 4 (2000): 761–764.
5. Independent Expert Group on Mobile Phones, *Mobile Phones and Health* (Report to the United Kingdom Government, 2000), http://www.iegmp.org.uk.

affected by the siting of CPBSs remains strong.[6] However, the extent to which such attitudes are reflected in lower property values for homes located near CPBSs is not known.

Understanding the impact of CPBSs on property values is important to telecommunications companies both for planning the siting of CPBSs and for determining likely opposition from property owners. Similarly, property appraisers need to understand the valuation implications of CPBSs when valuing CPBS-affected property. The owners of affected property also want to understand the magnitude of any effects, particularly if compensation claims or an award for damages are to be made based on any negative effects on value.

The research here uses a case study approach to determine residents' perceptions towards living near CPBSs in Christchurch, New Zealand, and to quantify these effects in monetary terms according to an increasing or decreasing percentage of property value. The case study uses both an opinion survey and an econometric analysis of sales transaction data. A comparison of the results can be used to help appraisers value affected property as well as to resolve compensation issues and damage claims in a quantitative way. Further, the results provide a potential source of information for government agencies in assessing the necessity for increased information pertaining to CPBSs.

The following provides a brief review of the cellular phone technology and relevant literature. Then, the next section describes the research procedure used, including descriptions of the case study and control areas. The results are then discussed, and the final section provides a summary and conclusion.

Cellular Telephone Technology[7]

Cellular (mobile) telephones are sophisticated two-way radios that use ultrahigh frequency (UHF) radio waves to communicate information. The information is passed between a mobile phone and a network of low-powered transceivers, called mobile phone sites or cell sites. As mobile sites are very low powered they serve only a limited geographic area (or "cell"), varying from a few hundred meters to several kilometers; they can handle only a limited number of calls at one time. When a mobile phone user on the move leaves one cell and enters another, the next site automatically takes over the call, allowing contact to be maintained.

When a mobile phone call is initiated, the phone connects to the network by using radio signals to communicate with the nearest mobile phone site. The mobile phone sites in a network are interlinked by cable or microwave beam, enabling phone calls to be passed from one cell to another automatically. A mobile phone site is typically made up of a mast with antennas connected to equipment stored in a cabinet. Power is fed into the cabinet by underground cable. The antennas are designed to transmit most of the signal away horizontally, or just below horizontal, rather than at steep angles to the ground.

Mobile phone sites can only accommodate a limited number of calls at any one time. When this limit is reached, the mobile phone signal is transferred to the next nearest site. If this site is full or is too far away, the call will fail.

Cell site capacity is a major issue for telecommunication companies. As the number of people using mobile phones grows, more and more cell sites are required to meet customer demand for reliable coverage. At the end of March 2002, Telecom had more than 1.3 million mobile phone customers and more than 750 mobile phone sites throughout New Zealand. Vodafone had over 1.1 million mobile phone customers.[8] In areas, such as Auckland (the largest city in New Zealand, with close to a third of the NZ population), where almost complete coverage has been achieved, the main issue is ensuring that there is the capacity to handle the ever-increasing number of mobile phones and calls.

Locating Cellular Phone Sites

For cellular phone service providers, the main goals when locating cell sites are (1) finding a site that provides the best possible coverage in the area without causing interference with other cells, and (2) finding a site that causes the least amount of environmental impact on the surrounding area. Service providers usually attempt to locate cell sites on existing structures such as buildings, where antennas can be mounted on the roof to minimize the environmental impact. If this is not possible, a mast will need to be erected to support the antennas for the new cell site.

6. S. Fox, "Cell Phone Antenna Worries Family," *East & Bays Courier*, November 8, 2002, 1.
7. The information in this section was sourced from Telecom, http://www.telecom.co.nz; New Zealand Ministry for the Environment, http://www.mfe.govt.nz; and New Zealand Ministry of Health, http://www.moh.govt.nz.
8. Vodafone, "Cell Sites and the Environment," http://www.vodafone.co.nz/aboutus/vdfn_about_cellsites.pdf (accessed December 19, 2002) and "Mobile Phones and Health," http://www.vodafone.co.nz/aboutus/vdfn_about_health_and_safety.pdf (accessed December 19, 2002); and Telecom, "Mobile Phone Sites and Safety," http://www.telecom.co.nz/content/0,3900,27116-1536,00.html (accessed December 19, 2002).

Service providers prefer to locate cell sites in commercial or industrial areas due to the "resource consent" procedure required by the Resource Management Act 1991[9] for towers located in residential areas.

Despite the high level of demand for better cell phone coverage, the location of cell sites continues to be a contentious issue. The majority of people want better cell phone coverage where they live and work, but they do not want a site in their neighborhood. Thus, cell sites in or near residential areas are of particular concern. Concerns expressed usually relate to health, property values, and visual impact.[10]

In general, uncertainties in the assessment of health risks from base stations are presented and distributed in reports by organized groups of residents who protest against siting of base stations. When the media publishes these reports it amplifies the negative bias and raises public concerns. According to Covello, this leads to incorrect assessment of risks and threats by the public, with a tendency to overestimate risks from base stations and neglect risks from the use of cell phones.[11]

Assessment of Environmental Effects

Under the Resource Management Act 1991 (RMA), an assessment of environmental effects is required every time an application for resource consent is made. Information that must be provided includes "an assessment of any actual or potential effects that the activity may have on the environment, and the ways in which any adverse effects may be mitigated."[12] An assessment of the environmental effects of cell sites would take into consideration such things as health and safety effects; visual effects; effects on the neighborhood; and interference with radio and television reception.

Radio Frequency and Microwave Emissions from CPBSs

According to the Ministry for the Environment, the factors that affect exposure to radiation are as follows:

- Distance. Increasing the distance from the emitting source decreases the radiation's strength and decreases the exposure.
- Transmitter power. The stronger the transmitter, the higher the exposure.
- Directionality of the antenna. Increasing the amount of antennas pointing in a particular direction increases the transmitting power and increases the exposure.
- Height of the antenna above the ground. Increasing the height of an antenna increases the distance from the antenna and decreases the exposure.
- Local terrain. Increasing the intervening ridgelines decreases the exposure.[13]

The amount of radiofrequency power absorbed by the body (the dose) is measured in watts per kilogram, known as the specific absorption rate (SAR). The SAR depends on the power density in watts per square meter. The radio frequencies from cellular phone systems travel in a "line of sight." The antennas are designed to radiate energy horizontally so that only small amounts of radio frequencies are directed down to the ground. The greatest exposures are in front of the antenna so that near the base of these towers, exposure is minimal. Further, power density from the transmitter decreases rapidly as it moves away from the antenna. However, it should be noted that by initially walking away from the base, the exposure rises and then decreases again. The initial increase in exposure corresponds to the point where the lobe from the antenna beam intersects the ground.[14]

Health Effects

According to Szmigielski and Sobiczewska, the analogue phone system (using the 800–900 megahertz band) and digital phone system (using the 1850–1990 megahertz band) expose humans to electromagnetic field (EMF) emissions: radio frequency radiation (RF) and microwave radiation (MW), respectively. These two radiations are emitted from both cellular phones and CPBSs.[15]

For years cellular phone companies have assured the public that cell phones are safe. They state that the particular set of radiation parameters associated with cell phones is the same as any other ra-

9. The Resource Management Act 1991 is the core of the legislation intended to help achieve sustainability in New Zealand; see http://www.mfe.govt.nz/laws/rma.

10. Szmigielski and Sobiczewska; and Barnes.

11. Vincent T. Covello, "Risk Perception, Risk Communication, and EMF Exposure: Tools and Techniques for Communicating Risk Information," in *Risk Perception, Risk Communication and Its Application to EMF Exposure: Proceedings of the World Health Organization and ICNIRP Conference*, ed. R. Matthes, J. H. Bernhardt, M. H. Repucholi, 179–214 (Munich, Germany, May 1998).

12. Section 88(4), (b), Resource Management Act 1991.

13. Ministry for the Environment and Ministry of Health, *National Guidelines for Managing the Effects of Radiofrequency Transmitters*, available at http://www.mfe.govt.nz and http://www.moh.govt.nz (accessed May 21, 2002).

14. Ibid.; and Szmigielski and Sobiczewska.

15. Szmigielski and Sobiczewska.

dio signal. However, reported scientific evidence challenges this view and shows that cell phone radiation causes various effects, such as altered brain activity, memory loss, and fatigue.[16]

According to Cherry, there is also strong evidence to conclude that cell sites are risk factors for certain types of cancer, heart disease, neurological symptoms and other effects.[17] The main concerns related to EMF emissions from CPBSs are linked to the fact that radio frequency fields penetrate exposed tissues.

Public concern regarding both cell phones and CPBSs in many countries has led to establishment of independent expert groups to carry out detailed reviews of the research literature. Research on the health effects of exposures to RF are reviewed by, for instance, the NZ Radiation Laboratory, the World Health Organization, the International Commission on Non-Ionizing Radiation Protection (ICNIRP), the Royal Society of Canada, and the UK Independent Expert Group on Mobile Phones. The reviews conclude that there are no clearly established health effects for low levels of exposure. Such exposures typically occur in publicly accessible areas around radio frequency transmitters. However, there are questions over the delayed effects of exposure.

While present medical and epidemiological studies reveal weak association between health effects and low-level exposures of RF/MW fields, controversy remains among scientists, producers, and the general public. Negative media attention has fuelled the perception of uncertainty over the health effects from cell phone systems. Further scientific or technological information is needed to allay fears of the public about cell phone systems.

Radio Frequency Radiation Exposure Standards

International Standards. The reviews of research on the health effects of exposures to RF have helped establish exposure standards that limit RF exposures to a safe level. Most standards–including those set by the ICNIRP, the American National Standards Institute (ANSI), and New Zealand–are based on the most-adverse potential effects.

The 1998 ICNIRP guidelines have been accepted by the world's scientific and health communities; these guidelines are both consistent with other stated standards and published by a highly respected and independent scientific organization. The ICNIRP is responsible for providing guidance and advice on the health hazards of nonionizing radiation for the World Health Organization (WHO) and the International Labour Office.[18]

The New Zealand Standard. In New Zealand, when a mobile phone site is being planned, radio frequency engineers calculate the level of electromagnetic energy (EME) that will be emitted by the site. The level of EME is predicted by taking into account factors such as power output, cable loss, antenna gain, path loss, and height and distance from the antenna. These calculations allow engineers to determine the maximum possible emissions in a worst-case scenario, i.e., as if the site was operated at maximum power all the time. The aim is to ensure that EME levels are below international and NZ standards in areas where the general public has unrestricted access.

All mobile phone sites in New Zealand must comply in all respects with the NZ standard for radio frequency exposures.[19] This standard is the same as used in most European countries, and is more stringent than that used in the United States, Canada, and Japan. Some local communities in New Zealand have even lower exposure-level standards; however, in reality mobile phone sites only operate at a fraction of the level set by the NZ standard. The National Radiation Laboratory has measured exposures around many operating cell sites, and maximum exposures in publicly accessible areas around the great majority of sites are less than 1% of the exposure limit of the NZ standard. Exposures are rarely more than a few percent of the limit, and none have been above 10%.

Court Decisions

Two court cases in New Zealand have alleged adverse effects due to CPBSs: *McIntyre v. Christchurch City*

16. K. Mann and J. Röschke, "Effects of Pulsed High-Frequency Electromagnetic Fields on Human Sleep," *Neuropsychobiology* 33, no. 1 (1996): 41–47; Krause et al.; Alexander Borbely et al., "Pulsed High-Frequency Electromagnetic Field Affects Human Sleep and Sleep Electroencephalogram," *Neurosci Let*, 275, no. 3 (1999): 207–210; L. Kellenyi et al., "Effects of Mobile GSM Radiotelephone Exposure on the Auditory Brainstem Response (ABR)," *Neurobiology* 7, no. 1 (1999): 79–81; B. Hocking, "Preliminary Report: Symptoms Associated with Mobile Phone Use," *Occup Med* 48, no. 6 (Sept. 1998): 357–360; and others as reported in Neil Cherry, *Health Effects Associated with Mobil Base Stations in Communities: The Need for Health Studies*, Environmental Management and Design Division, Lincoln University (June 8, 2000); http://pages.britishlibrary.net/orange/cherryonbasestations.htm.

17. Cherry.

18. Ministry for the Environment and Ministry of Health.

19. NZS 2772.1:1999, "Radiofrequency Fields Part I: Maximum Exposure Levels – 3kHz to 300GHz." This standard was based largely on the 1998 ICNIRP recommendations for maximum human exposure levels to radio frequency. The standard also includes a requirement for minimizing radio frequency exposure. See National Radiation Laboratory, *Cell Sites* (March 2001), 7; available at http://www.nrl.moh.govt.nz/CellsiteBooklet.pdf.

Council[20] and *Shirley Primary School v. Telecom Mobile Communications Ltd.*[21] Very few cell site cases have actually proceeded to Environment Court hearings. In these two cases the plaintiffs claimed that there was a risk of adverse health effects from radio frequency radiation emitted from cell phone base stations and that the CPBSs had adverse visual effects.

In *McIntyre*, Bell South applied for resource consent to erect a CPBS. The activity was a noncomplying activity under the Transitional District Plan. Residents objected to the application. Their objections were related to the harmful health effects from radio frequency radiation. In particular, they argued it would be an error of law to decide, based on the present state of scientific knowledge, that there are no harmful health effects from low-level radio frequency exposure. It was also argued that the Resource Management Act contains a precautionary policy and also requires a consent authority to consider potential effects of low probability but high impact in reviewing an application.

The Planning Tribunal considered residents' objections and heard experts' opinions as to the potential health effects, and granted the consent, subject to conditions. It was found that there would be no adverse health effects from low levels of radiation from the proposed transmitter, not even effects of low probability but high potential impact.

In *Shirley Primary School*, Telecom applied to the Christchurch City Council for resource consent to establish, operate, and maintain a CPBS on land adjacent to the Shirley Primary School. This activity was a noncomplying activity under the Transitional District Plan. Again, the city council granted the consent subject to conditions. However, the school appealed the decision, alleging the following four adverse effects:

- Risk of adverse health effects from the radio frequency radiation emitted from the cell site
- Adverse psychological effects on pupils and teachers because of the perceived health risks
- Adverse visual effects
- Reduced financial viability of the school if pupils withdraw because of the perceived adverse health effects

The court concluded that the risk of the children or teachers at the school developing leukemia or other cancers from radio frequency radiation emitted by the cell site is extremely low, and the risk to the pupils of developing sleep disorders or learning disabilities because of exposure to radio frequency radiation is higher, but still very small. Accordingly, the Telecom proposal was allowed to proceed.

In summary, the Environmental Court ruled that there are no established adverse health effects from the emission of radio waves from CPBSs and no epidemiological evidence to show this. The court was persuaded by the ICNIRP guidelines that risk of health effects from low-level exposure is very low and that the cell phone frequency imposed by the NZ standard is safe, being almost two and one-half times lower than that of the ICNIRP.

The court did concede that while there are no proven health effects, there was evidence of property values being affected by both of the health allegations. The court suggested that such a reduction in property values should not be counted as a separate adverse effect from, for example, adverse visual or amenities effects. That is, a reduction in property values is not an environmental effect in itself; it is merely evidence, in monetary terms, of the other adverse effects noted.

In a third case, *Goldfinch v. Auckland City Council*,[22] the Planning Tribunal considered evidence on potential losses in value of the properties of objectors to a proposal for the siting of a CPBS. The court concluded that the valuer's monetary assessments support and reflect the adverse effects of the CPBS. Further, it concluded that the effects are more than just minor as the CPBS stood upon the immediately neighboring property.

Literature Review

While experimental and epidemiological studies have focused on the adverse health effects of radiation from the use of cell phones and CPBSs, few studies have been conducted to ascertain the impact of CPBSs on property values. Further, little evidence of property value effects has been provided by the courts. Thus, the extent to which opposition from property owners affected by the siting of CPBSs is reflected in lower property values is not well known in New Zealand.

Two studies have been conducted to ascertain the adverse health and visual effects of CPBSs on property values. Telecom commissioned Knight Frank (NZ) Ltd to undertake a study in Auckland in 1998/

20. NZRMA 289 (1996).
21. NZRMA 66 (1999).
22. NZRMA 97 (1996).

99 and commissioned Telfer Young (Canterbury) Ltd to undertake a similar study in Christchurch in 2001. Although the studies show that there is not a statistically significant effect on property prices where CPBSs are present,[23] the research in both cases involves only limited sales data analysis. Further, no surveys of residents' perceptions were undertaken, and the studies did not examine media attention to the sites and the impact this may have on saleability of properties in close proximity to CPBSs. Finally, as the sponsoring party to the research was a telecommunication company it is questionable whether the results are completely free from bias. Hence, the present study aims to help fill the research void on this contentious topic in an objective way.

CPBSs are very similar structures to high-voltage overhead transmission lines (HVOTLs); therefore it is worthwhile to review the body of literature on the property values effects of HVOTLs. The only recently published study in New Zealand on HVOTLs effects is by Bond and Hopkins.[24] Their research consists of both a regression analysis of residential property transaction data and an opinion survey to determine the attitudes and reactions of property owners in the study area toward living close to HVOTLs and pylons.

The results of the sales analysis indicate that having a pylon close to a particular property is statistically significant and has a negative effect of 20% at 10–15 meters from the pylon, decreasing to 5% at 50 meters. This effect diminishes to a negligible amount after 100 meters. However, the presence of a transmission line in the case study area has a minimal effect and is not a statistically significant factor in the sale prices.

The attitudinal study results indicate that nearly two-thirds of the respondents have negative feelings about the HVOTLs. Proximity to HVOTLs determines the degree of negativity: respondents living closer to the HVOTLs expressed more negative feelings towards them than those living farther away. It appears, however, from a comparison of the results, that the negative feelings expressed are often not reflected in the prices paid for such properties.

There have been a number of HVOTLs studies carried out in the United States and Canada. A major review and analysis of the literature by Kroll and Priestley indicates that in about half the studies, HVOTLs have not affected property values and in the rest of the studies there is a loss in property value between 2%–10%.[25] Kroll and Priestley are generally critical of most valuer-type studies because of the small number of properties included and the failure to use econometric techniques such as multiple regression analysis. They identify the Colwell study as one of the more careful and systematic analyses of residential impacts.[26] That study, carried out in Illinois, finds that the strongest effect of HVOTLs is within the first 15 meters, but the effect dissipates quickly with distance, disappearing beyond 60 meters.

A Canadian study by Des Rosiers, using a sample of 507 single-family house sales, finds that severe visual encumbrance due to a direct view of either a pylon or lines exerts a significant, negative impact on property values; however location adjacent to a transmission corridor may increase value.[27] This was particularly evident where the transmission corridor was on a well-wooded, 90-meter right-of-way. The proximity advantages include enlarged visual field and increased privacy. The decrease in value from the visual impact of the HVOTLs and pylons (on average between 5% and 10% of mean house value) tends to be cancelled out by the increase in value from proximity to the easement.

A study by Wolverton and Bottemiller[28] uses a paired-sale analysis of home sales in 1989–1992 to ascertain any difference in sale price between properties abutting rights-of-way of transmission lines (subjects) in Portland, Oregon; Vancouver, Washington; and Seattle, Washington; and those located in the same cities but not abutting transmission line rights-of-way (comparisons). Subjects sold during the study period were selected first; then a matching comparison was selected that was as similar to the subject as possible. The study results did not support a finding of a price effect from abutting an HVTL right-of-way. In their conclusion, the authors

23. Mark Dunbar, Telfer Young research valuer, personal communication with Bond, 2002. The results of these studies have not been made publicly known. The study by Knight Frank of Auckland was conducted by Robert Albrecht.

24. S. G. Bond and J. Hopkins, "The Impact of Transmission Lines on Residential Property Values: Results of a Case Study in a Suburb of Wellington, New Zealand," *Pacific Rim Property Research Journal* 6, no. 2 (2000): 52–60.

25. C. Kroll and T. Priestley, "The Effects of Overhead Transmission Lines on Property Values: A Review and Analysis of the Literature," Edison Electric Institute (July 1992).

26. Peter F. Colwell, "Power Lines and Land Value," *Journal of Real Estate Research* 5, no. 1 (Spring 1990): 117–127.

27. François Des Rosiers, "Power Lines, Visual Encumbrance and House Values: A Microspatial Approach to Impact Measurement," *Journal of Real Estate Research* 23, no. 3 (2002): 275–301.

28. Marvin L. Wolverton and Steven C. Bottemiller, "Further Analysis of Transmission Line Impact on Residential Property Values," *The Appraisal Journal* (July 2003): 244–252.

warn that the results cannot and should not be generalized outside of the data. They explain that

> limits on generalizations are a universal problem for real property sale data because analysis is constrained to properties that sell and sold properties are never a randomly drawn representative sample. Hence, generalizations must rely on the weight of evidence from numerous studies, samples, and locations.[29]

Thus, despite the varying results reported in the literature on property value effects from HVOTLs, each study adds to the growing body of evidence and knowledge on this (and similar) valuation issue(s). The study reported here is one such study.

Opinion Survey Research Objectives and Methodology

Research by Abelson;[30] Chalmers and Roehr;[31] Kinnard, Geckler and Dickey;[32] Bond;[33] and Flynn et al.,[34] recommend the use of market sales analysis in tandem with opinion survey studies to measure the impact of environmental hazards on residential property values. The use of more than one approach provides the opportunity to compare the results from each and to derive a more informed conclusion than obtained from relying solely on one approach. Thus, the methods selected for this study include a public opinion survey and a hedonic house price approach (as proposed by Freeman[35] and Rosen[36]). A comparison of the results from both of these techniques will reveal the extent to which the market reacts to cell phone towers.

Public Opinion Survey

An opinion survey was conducted to investigate the current perceptions of residents towards living near CPBSs and how this proximity might affect property values. Case study areas in the city of Christchurch were selected for this study. The study included residents in ten suburbs: five case study areas (within 300 meters of a cell phone tower) and five control areas (over 1 kilometer from the cell phone tower). The five case study suburbs were matched with five control suburbs that had similar living environments (in socioeconomic terms) except for the presence of a CPBS.

The number of respondents to be surveyed (800) and the nature of the data to be gathered (perceptions/personal feelings towards CPBSs) governed the choice of a self-administered questionnaire as the most appropriate collection technique. Questionnaires were mailed to residents living in the case study and control areas.

A self-administered survey helps to avoid interviewer bias and to increase the chances of an honest reply where the respondent is not influenced by the presence of an interviewer. Also, mail surveys provide the time for respondents to reflect on the questions and answer these at their leisure, without feeling pressured by the time constraints of an interview. In this way, there is a better chance of a thoughtful and accurate reply.

The greatest limitation of mail surveys is that a low response rate is typical. Various techniques were used to help overcome this limitation, including careful questionnaire design; inclusion of a free-post return envelope; an accompanying letter ensuring anonymity; and reminder letters. An overall response rate of 46% was achieved for this study.

The questionnaire contained 43 individual response items. The first question acted as an identifier to determine whether the respondent was a homeowner or tenant. While responses from both groups were of interest, the former was of greater importance, as they are the group of purchasers/sellers that primarily influence the value of property. However, it was considered relevant to survey both groups as both are affected by proximity to a CPBS to much the same extent from an occupiers' perspective, i.e., they both may perceive risks associated with a CPBS. It was hypothesized that tenants, being less-permanent residents, would perceive the effects in a similar way, but to a much lesser degree.

Other survey questions related to overall neighborhood environmental desirability; the timing of

29. Ibid., 252.

30. P. W. Abelson, "Property Prices and Amenity Values," *Journal of Environmental Economics and Management* 6 (1979): 11–28.

31. James A. Chalmers and Scott Roehr, "Issues in the Valuation of Contaminated Property," *The Appraisal Journal* (January 1993): 28–41.

32. W. N., Kinnard, M. B. Geckler, and S. A. Dickey, "Fear (as a Measure of Damages) Strikes Out: Two Case Studies Comparisons of Actual Market Behaviour with Opinion Survey Research" (paper presented at the Tenth Annual American Real Estate Society Conference, Santa Barbara, California, April 1994).

33. S. G. Bond, "Do Market Perceptions Affect Market Prices? A Case of a Remediated Contaminated Site," in *Real Estate Valuation Theory*, ed. K. Wang and M. L. Wolverton, 285–321 (Boston: Kluwer Academic Publishers, 2002).

34. James Flynn et al., "Survey Approach for Demonstrating Stigma Effects in Property Value Litigation," *The Appraisal Journal* (Winter 2004): 35–45.

35. A. Myrick Freeman, *The Benefits of Environmental Improvement: Theory and Practice* (Baltimore: John Hopkins Press, 1979).

36. Sherwin Rosen, "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition," *Journal of Political Economy* 82, no. 1 (Jan/Feb 1974): 34–55.

the CPBS's construction and its proximity in relation to the respondent's home; the importance placed on the CPBS as a factor in relocation decisions and on the price/rent the respondent was prepared to pay for the house; how a CPBS might affect the price the respondent would be willing to pay for the property; and the degree of concern regarding the effects of CPBSs on health, stigma, aesthetics, and property values. The surveys were coded to identify the property address of the respondent. This enabled each respondent's property to be located on a map and to show this in relation to the cell site.

Eighty questionnaires[37] were distributed to each of the ten suburbs (five case study and five control areas) in Christchurch. Respondents were instructed to complete the survey and return it in the free-post, self-addressed envelope provided. The initial response rate was 31%. A month later, a further 575 questionnaires with reminder letters were sent out to residents who had not yet responded. A total response rate of 46% was achieved. Response rates from each suburb ranged from 33% (Linwood) to 61% (Bishopdale).

The questionnaire responses were coded and entered into a computerized database.[38] The analysis of responses included the calculation of means and percentage of responses to each question to allow for an overview of the response patterns in each area.

Case Study and Control Areas

The suburbs of Beckenham, Papanui, Upper Riccarton, Bishopdale, and St Albans were selected for the case study because there is at least one CPBS within each of these communities. Census data, providing demographic and socioeconomic characteristics of geographic areas, was used to select the control suburbs of Spreydon, Linwood, Bromley, Avonhead, and Ilam.[39] The control areas are located further away (over 1 kilometer) from the CPBS in their matched case study area. As well as matching demographic and socioeconomic characteristics, each suburb was selected based on its similarity to its matched case study area in terms of living environment and housing stock, distance to the central business district, and geographic size; the only dissimilarity is that there are no CPBSs in the control areas. (See Appendix I for a location map.)

Demographic statistics show that Bromley and Ilam comprise a younger population (median age about 33), with Bishopdale and Upper Riccarton having an older population (median age about 40). The ethnic breakdown of each suburb indicates that Papanui and Spreydon have the highest proportion of Europeans (about 90%), Bromley has the highest proportion of both Maoris and Pacific Islanders (13.9% and 8.5% respectively), while Ilam, Avonhead, and Upper Riccarton have the highest proportion of Asians (16.1% to 18.5%).[40]

Median household and median family incomes (MHI and MFI) are highest in Ilam and Avonhead (MHI: $34,751NZ, $53,405NZ; MFI: $51,530NZ, $65,804NZ, respectively) and lowest in Linwood and Beckenham (MHI: $22,275NZ, $26,398NZ; MFI: $29,673NZ, $33,847NZ respectively).[41] Residents of St Albans West have the highest levels of education (21.7% have a degree or a higher degree) followed by Upper Riccarton (18.7%), Ilam (16.7%), and Avonhead (16.2%). These same suburbs have the highest proportion of professionals by occupational class (20.3% to 27.3%). Residents of Bromley have the lowest education (40% have no qualification) and the lowest proportion of professionals (5.5%).[42]

In summary, the socioeconomic data shows that Ilam is the more superior suburb, followed by Avonhead, Upper Riccarton, St Albans West, and Papanui. The lower socioeconomic areas are, in decreasing order, Spreydon, Bishopdale, Bromley, Beckenham, and Linwood.

Survey Results

A summary of the main findings from the survey is presented in Appendix II, and the survey results are discussed in the following.

Response Rates

Of the 800 questionnaires mailed to homeowners and tenants in the case study and control areas (400 to each group), 50% from the case study area and 41%

37. Approved by the University of Auckland Human Subjects Ethics Committee (reference 2002/185).

38. The computer program SPSS was selected as the appropriate analytical tool for processing the data.

39. The census is conducted in New Zealand every five years, and the data used to define the control areas is from the latest census conducted in 2001, see Christchurch City Area Unit Profile, 2001 at http://www.ccc.govt.nz/Census/ChristchurchCityAreaUnitProfile.xls.

40. Christchurch City Area Unit Profile statistics.

41. $1NZ = $0.65US, thus, $34,751NZ = $22,588US.

42. The median house price for Christchurch city in August 2003 was $185,000NZ/$120,000US (New Zealand national median house price at this time was $215,000NZ/$140,000US), http://www.reinz.co.nz/files/HousingFacts-Sample-Pg1-5.pdf (accessed March 17, 2004). Median house prices in each individual suburb could not be obtained as the median sales data from the Real Estate Institute of NZ (REINZ) contains more than one suburb in each location grouping.

from the control area were completed and returned. Over three-quarters (78.5%) of the case study respondents were homeowners compared to 94% in the control area.

Desirability of the Suburb as a Place to Live

More than half (58.3%) the case study respondents have lived in their suburb for more than five years (compared to 65% in the control group) and a quarter (25%) have lived in their suburb between 1 and 4 years (compared to 28% in the control group).

Around two-thirds (65% of the case study respondents and 68% of the control group respondents) rated their neighborhoods as either above average or superior as a place to live when compared with other similar named suburbs. The reasons given for this include close proximity to amenities (shops, library, medical facilities, public transport, and recreational facilities) and good schools.

Reasons given for rating the case study neighborhoods inferior to other similar neighborhoods include lower house prices, older homes, more student housing and lower-income residents. The reasons given by the control group respondents for an inferior rating include distance from the central business district (Avonhead); smell from the sewerage oxidation ponds and composting ponds (Bromley); and lower socioeconomic area and noise from the airport (Linwood).

Feelings About a CPBS as an Element of the Neighborhood

In the case study areas, a CPBS had already been constructed when only 39% of the respondents bought their houses or began renting in the neighborhood. Some responded that they were not notified that the CPBS was to be built, that they had no opportunity to object to it, and that they felt they should have been consulted about its construction. For the respondents who said that proximity to the tower was of concern to them, the most common reasons given for this were the impact of the CPBS on health, aesthetics, and property values. Nearly three-quarters (74%) of the respondents said they would have gone ahead with the purchase or rental of their property anyway if they had known that the CPBS was to be constructed.

In the control areas nearly three-quarters (72%) of the respondents indicated they would be opposed to construction of a CPBS nearby. The location of a CPBS would be taken into account by 83% of respondents if they were to consider moving. As with the case study respondents, the control group respondents who were concerned about proximity to a CPBS were most often concerned about the effects of CPBSs on health, aesthetics, and property values.

Impact on Decision to Purchase or Rent

In the case study areas, the tower was visible from the houses of 46% of the respondents, yet two-thirds (66%) of these said it was barely noticeable, and one-quarter said it mildly obstructed their view. When asked in what way the CPBS impacts the enjoyment of living in their home, 37% responded that its impact was related to health concerns, 21% said it impacted neighborhood aesthetics, 20% said it impacted property value, and 12% said it impacted the view from their property.

When asked about the impact that the CPBS had on the price/rent they were prepared to pay for their property, over half the case study respondents (53.1%) said that the tower was not constructed at the time of purchase/rental, and 51.4% of the respondents said the proximity to the CPBS did not affect the price they were prepared to pay for the property. Nearly 3% said they were prepared to pay a little less, 2% said they were prepared to pay a little more. For the control group respondents, 45% of the respondents would pay substantially less for a property if a CPBS were located nearby, over one-third (38%) were prepared to pay just a little less for such a property, and 17% responded that a CPBS would not influence the price they would pay.

Only 10% of the case study respondents gave an indication of the impact that the CPBS had on the price/rent they were prepared to pay for the property; one-third of these felt it would decrease price/rent by 1% to 9%. For the control group, over one-third (38%) of the respondents felt that a CPBS would decrease price/rent by more than 20%, and a similar number (36%) said they would be prepared to pay 10% to 19% less for property located near a CPBS. The responses are outlined in Table 1.

Table 1 Impact of a CPBS on Purchase/Rental Price Decision

Price/Rent Effect	Percent of Case Study Respondents (Control Group Responses)
20% more	5% (3%)
10–19% more	10% (2%)
1–9% more	14% (2%)
1–9% less	33% (19%)
10–19% less	24% (36%)
20% or greater reduction in price/rent	14% (38%)

Interestingly, it would seem that those living farther away from the CPBSs (the control group) are far more concerned about proximity to CPBSs than those living near CPBSs (the case study group); they indicated that a CPBS would have a greater price/rent effect. The possible explanations for this are discussed in the survey results section.

Concerns About Proximity to the CPBS

Most case study respondents were not worried about the effects of proximity to a CPBS related to health (50%), stigma (55%), future property value (61%), or aesthetics (63%). About one-quarter to one-third of these respondents were somewhat worried about the impact of proximity to a CPBS on health (38%), stigma (34%), future property value (25%), or aesthetics (25%). From the list of issues, respondents were most worried about future property value, but only 13.5% of the respondents responded this way.

Here again, control group respondents were much more concerned about the effects of proximity to a CPBS than their case study counterparts. Of the possible concerns about CPBSs on which respondents were asked to comment, control group respondents were most worried about the negative effects on future property values and aesthetics. Nearly half the respondents were worried a lot about these issues. Similar responses were recorded for the possibility of harmful health effects in the future from CPBSs (42% were worried a lot about this) and stigma associated with houses near CPBSs (34% were worried a lot). The responses regarding concerns about living near a CPBS are shown in Table 2.

In both the case study and control areas, the issue of greatest concern for respondents was the impact of proximity to CPBSs on future property values. The main concerns related to CPBSs were the unknown potential health effects, the possible socioeconomic implications of the siting of CPBSs, and how CPBSs affect property values. There also were concerns that the city council was not notifying the public about the possible construction of CPBSs.

Discussion of the Survey Results

The results were mixed, with responses from residents ranging from having no concerns to being very concerned about proximity to a CPBS. In general, those people living in areas farther from CPBSs were much more concerned about issues related to proximity to CPBSs than residents who lived near CPBSs.

Over 40% of the control group respondents were worried a lot about future health risks, aesthetics, and future property values compared with the case study areas, where only 13% of the respondents were worried a lot about these issues. However, in both the case study and control areas, the impact of proximity to CPBSs on future property values is the issue of greatest concern for respondents. If purchasing or renting a property near a CPBS, over a third (38%) of the control group respondents said a CPBS would reduce the price of their property by more than 20%. The perceptions of the case study respondents were again less negative, with a third saying they would reduce the price by only 1%–9%, and 24% saying they would reduce the price by 10%–19%.

The lack of concern shown by the case study respondents may be due to the CPBSs being either not visible or only barely visible from their homes. The CPBSs may be far enough away from respondents' properties (as was indicated by many respondents, particularly in St Albans West, Upper Riccarton, and Bishopdale) or hidden by trees and consequently not perceived as affecting the properties. The results may have been quite different had the CPBS being more visually prominent.

Alternatively, the apparent lower sensitivity to CPBSs of case study residents compared to the control group residents may be due to cognitive dissonance reduction. In this case, respondents may be unwilling to admit, due to the large amounts of money already paid, that they may have made a poor purchase or rental decision in buying or renting property located near a CPBS. Similarly, the homeowners may be unwilling to admit there are concerns about CPBSs when the CPBSs were built

Table 2 Concerns about Living Near a CPBS*

Concern	Does not worry me	Worries me somewhat	Worries me a lot
Possibility of harmful health effects	50% (20%)	38% (38%)	12% (42%)
Stigma effect	55% (21%)	34% (45%)	12% (34%)
Effect on future property values	61% (15%)	25% (37%)	13% (47%)
Aesthetics	63% (18%)	25% (37%)	11% (45%)

* Percent of case study respondents having that concern (control group respondents). All numbers are rounded.

after they had purchased their homes, because to do so might have a negative impact on property values.

Regardless of the reasons for the difference in responses from the case study and control groups, the overall results show that residents perceive CPBSs negatively. In both the case study and control areas, the impact of proximity to CPBSs on future property values was the issue of greatest concern for respondents. Overall, respondents felt that proximity to a CPBS would reduce value by from 10% to over 20%. The second part of the study outlined below, involving an econometric analysis of Christchurch property sales transaction data, helps to confirm these results.

Respondents' comments added at the end of the survey indicate that residents have ongoing concerns about CPBSs. Although some people accepted the need for CPBSs, they said that they did not want them built in their back yard, or they preferred that they be disguised to blend better with their environment.

Market Study Research Objectives and Methodology

A market study was undertaken to test the hypothesis that in suburbs where there is a CPBS it will be possible to observe discounts to the selling price of homes located near these structures. Such discounts would be observed where buyers of proximate homes view the CPBSs in negative terms due to a perceived risk of adverse effects on health, aesthetics, and property value.

The literature dealing specifically with the measurement of the impact of environmental hazards on residential sale prices (including proximity to transmission lines, landfill sites, and ground water contamination) indicates the popularity of hedonic pricing models, as introduced by Court[43] and later Griliches,[44] and further developed by Freeman[45] and Rosen.[46] The more recent studies, including those by Dotzour;[47] Simons and Sementelli;[48] and Reichert,[49] focus on proximity to an environmental hazard and demonstrate that this reduces residential house prices by varying amounts depending on the distance from the hazard.[50] However, there are no known published studies that use hedonic housing models to measure the impact of proximity to a CPBS on residential property values.

As in the previous residential house price studies, the standard hedonic methodology was used here to quantify the impact of a CPBS on sale prices of homes located near a CPBS. The results from this study in tandem with the opinion survey results will help test the hypothesis that proximity to a CPBS has a negative impact on property value and will reveal the extent to which the market reacts to CPBSs.

Model Specification

A hedonic price model is constructed by treating the price of a property as a function of its utility-bearing attributes. Independent variables used in the model to account for the property attributes are limited to those available in the data set and known, based on other well-tested models reported in the literature and from valuation theory, to be related to property price. The basic model used to analyze the impact on sale price of a house located near a CPBS, is as follows:

$$P_i = f(X_{1,i}, X_{2,i} \ldots \ldots \ldots \ldots \ldots X_{n,i})$$

where:

P_i = property price at the i th location

$X_{1,i} \ldots X_{n,i}$ = individual characteristics of each sold property (e.g., land area, age of house, floor area, sale date, construction materials, house condition, CPBS construction date, etc.)

The more recent hedonic pricing studies that demonstrate the effects of proximity to an environmental hazard use different functional forms to represent the relationship between price and various property characteristics.[51] In hedonic housing models the linear and log-linear models are most popular. The linear model implies constant partial effects between house prices and housing characteristics, while the log-linear model allows for nonlinear price effects and is shown in the following equation:

43. A. T. Court, "Hedonic Price Indexes with Automotive Examples," in *The Dynamics of Automobile Demand* (New York: General Motors, 1939).

44. Zvi Griliches, ed. *Price Indexes and Quality Change* (Cambridge, Mass.: Harvard University Press, 1971).

45. Freeman.

46. Rosen.

47. Mark Dotzour, "Groundwater Contamination and Residential Property Values," *The Appraisal Journal* (July 1997): 279–285.

48. Robert A. Simons and Arthur Sementelli, "Liquidity Loss and Delayed Transactions with Leaking Underground Storage Tanks," *The Appraisal Journal* (July 1997): 255–260.

49. Alan K. Reichert, "Impact of a Toxic Waste Superfund Site on Property Values," *The Appraisal Journal* (October 1997): 381–392.

50. Only Dotzour found no significant impact of the discovery of contaminated groundwater on residential house prices. This was likely due to the nonhazardous nature of the contamination where the groundwater was not used for drinking purposes.

51. See for example L. Dale et al., "Do Property Values Rebound from Environmental Stigmas? Evidence from Dallas," *Land Economics* 75, no. 2 (May 1999): 311–326; Dotzour; Simons and Sementelli; and Reichert.

$$\ln P_i = b_0 + b_1 \times X_{1,i} + b_2 \times X_{2i} + b_3 \times X_{3i} \ldots \ldots \ldots + b_n \times X_{n+1} + a_o \times D_o + \ldots \ldots + a_m \times D_m + e_0$$

where:

$\ln P_i$ = the natural logarithm of sale price

b_0 = the intercept

$b_1 \ldots b_n$; $a_0 \ldots a_m$ = the model parameters to be estimated, i.e., the implicit unit prices for increments in the property characteristics

$X_1 \ldots X_n$ = the continuous characteristics, such as land area

$D_o \ldots D_m$ = the categorical (dummy) variables, such as whether the sale occurred before (0) or after (1) the CPBS was built

Sometimes the natural logarithm of land area and floor area is also used. The parameters are estimated by regressing property sales on the property characteristics and are interpreted as the households' implicit valuations of different property attributes. The null hypothesis states that the effect of being located near a CPBS does not explain any variation in property sale prices.

The Data

Part of the process for selecting appropriate case study areas was identifying areas where there had been a sufficient number of property sales to provide statistically reliable and valid results. Sales were required for the period before and after the CPBS had been built in order to study the impact of the CPBS on the surrounding properties' sale prices.

Further, due to the multitude of factors that combine to determine a neighborhood's character, such as proximity to the central business district, standard of schooling, recreational facilities provided, standard of housing, proximity to amenities, and the difficulty in allowing for these separately, sales located in areas with comparable neighborhood characteristics were preferred.

Four of the suburbs in the survey case study met the criteria for the market study: St Albans, Beckenham, Papanui, and Bishopdale. No sales data was available for Upper Riccarton after the CPBS was built in this suburb, hence this suburb was not included in the market analysis study. As each CPBS was built at a different date, the sales from each suburb were separately analyzed. The uniformity of locational and neighborhood characteristics in each of these suburbs allows the analysis to be simplified and to focus on the properties' physical attributes. The relative homogeneity of housing, locational, and neighborhood attributes was verified through field inspections.

The dependent variable is the property sale price. The data set includes 4283 property sales that occurred between 1986 and 2002 (approximately 1000 sales per suburb).[52]

The independent data set was limited to those variables that correspond to property attributes known and suspected to influence price. These variables are floor area (m^2); land area (ha); age of the house (the year the house was built); tower (a dummy variable indicating whether the sale occurred before or after the CPBS was built); sale date (month and year); time of sale based on the number of quarters before or after the CPBS was built (to help control for movements in house prices over time); category of residential property (stand-alone dwelling, dwelling converted into flats, ownership unit, etc); quality of the principal structure (as assessed by an appraiser); and roof and wall materials. The number of bedrooms was not available in the data set, but would not have been included as an independent variable since the number of bedrooms is highly correlated with floor area.

Since the GIS coordinates of properties for the initial analysis were not available, street name was included as an independent variable instead. To a limited extent, street name helped to control for the proximity effects of a CPBS. It was suspected that houses on a street close to a CPBS may, on average, sell for less than houses on a street farther away from the CPBS.

While views, particularly water views, have been shown in previous empirical studies to be an important attribute affecting sale price, in the present study the flat contour of the landscape where the homes are located, together with the suburban nature of the environment surrounding these, precluded any significant views. Thus, views were not included in the analysis. Further, due to the large number of sales included in the analysis, inspections of each individual property were not made to determine the view, if any, of a CPBS from each house. It was felt that it is not merely the view that may impact on price, but also proximity to a CPBS due to the potential effect this may have on health, cell phone coverage, and neighborhood aes-

52. These sales were obtained from Headway Systems Ltd, a data distribution and system development company. Headway is the major supplier of property market sales information to New Zealand's valuation profession; it is jointly owned by the NZ Institute of Valuers (NZIV) and PT Investments, a consortium of 28 shareholders from within the property industry.

thetics. Hence, view of a CPBS was not included as an independent variable. The variable descriptions are listed in Table 3. Variable codes are shown in Appendix III and basic descriptive statistics for selected quantitative variables are shown in Appendix IV.

Table 3 Variable Descriptions

Variable*	Definition
SLNETX	Sale price of the house (NZ$)
SITSTX	Street name
CATGYX2	Category of dwelling: D, E, etc.†
CATGYX4	Quality of the structure: A, B, C†
TIMESOLD.Q	Using the time the cell phone tower was built as a baseline quarter, the number of quarters before (–) and after (+) it was built
AGE	Year the house was built
LANDAX	Land area (ha)
MATFAX	Total floor area (m^2)
WALLCNX	Wall construction: W, B, C, etc. †
ROOFCNX	Roof construction: W, B, C, etc. †
TOWER	An indicator variable: 0 if before the cell phone tower was built, or 1 after it was built

* Sale price is the dependent variable.

† See Appendix III for explanation of variable codes.

Market Study Results

An econometric analysis of Christchurch property transaction data helped to confirm the opinion survey results. In the analysis of selected suburbs, the sales data from sales that occurred before a CPBS was built was compared to sales data from after a CPBS was built to determine any variance in price, after accounting for all the relevant independent variables.

Empirical Results

The model of choice is one that best represents the relationships between the variables and has a small variance and unbiased parameters. Various models were tested and the results are described in the next section. The following statistics were used to help select the most appropriate model: the adjusted coefficient of determination (adjusted R^2); the standard error of the regression equation; the AIC[53] and BIC[54] statistics; and *t*-test of significance of the coefficients and *F*-statistic.

Significance of Variables and the Equation: St Albans

As hedonic prices can vary significantly across different functional forms, various commonly used functional forms were examined to determine the model specification that best describes the relationship between price and the independent variables. Also, to test the belief that the relationship between *Price* and *Land Area* is not a linear function of *Price*, the variable *LANDAX* (land area) was transformed to reflect the correct relationship. Several transformations were tested including: linear of *SLNETX* (sale price) and log of *LANDAX*; log of *SLNETX* and linear of *LANDAX;* and log of *SLNETX* and log of *LANDAX*. All dummy variables remained in their linear form in each model.

It was found that the best result was obtained from using the log of *SLNETX* and log of *LANDAX*, and the linear form of all the dummy variables. Taking the log of an independent variable implies diminishing marginal benefits. For example, an extra 50 square meters of land area on a 550-square-meter site would be worth less than the previous 50 square meters. The log-log model shows the percent change in price for a one-percent change in the independent variable, while all other independent variables are held constant (as explained in Hill, Griffiths, and Judge).[55]

In the semilogarithmic equation the interpretation of the dummy variable coefficients involves the use of the formula: $100(e^{b_n} - 1)$, where b_n is the dummy variable coefficient.[56] This formula derives the percentage effect on price of the presence of the factor represented by the dummy variable and is advocated over the alternative, and commonly misused, formula of 100. (b_n). The resulting model included all the available variables as follows:

$$\begin{aligned}\log(SLNETX) = \alpha &+ \beta_1 \times TOWER + \beta_2 \times SITSTX \\ &+ \beta_3 \times CATGYX2 + \beta_4 \times CATGYX4 \\ &+ \beta_5 \times TIMESOLD \times Q + \beta_6 \times AGE \\ &+ \beta_7 \times \log(LANDAX) \\ &+ \beta_8 \times MATFAX \\ &+ \beta_9 \times WALLCNX \\ &+ \beta_{10} \times ROOFCNX\end{aligned}$$

53. AIC is the Akaike Information Criterion, and is a "goodness of fit" measure involving the standard error of the regression adjusted by a penalty factor. The model selected is the one that minimizes this criterion (Microsoft SPSSPC Online Guide, 1997).

54. The BIC is the Bayesian Information Criterion. Like the AIC, BIC takes into account both how well the model fits the observed data, and the number of parameters used in the model. The model selected is the one that adequately describes the series and has the minimum SBC. The SBC is based on Bayesian (maximum-likelihood) considerations. (Microsoft SPSSPC Online Guide, 1997).

55. R. Carter Hill, William E. Griffiths, and George G. Judge, *Undergraduate Econometrics* (New York: John Wiley & Sons, 1997).

56. See Robert Halvorsen and Raymond Palmquist, "The Interpretation of Dummy Variables in Semi-Logarithmic Equations," *American Economic Review* 70, no. 3 (1980): 474–475.

From the regression output, the variables *ROOFCNX* and *WALLCNX* were found to be insignificant so these were removed from the model and the regression was rerun. The table in Appendix V summarizes these results. The *F*-statistic (123) shows that the estimated relationship in the model is statistically significant at the 95% confidence level and that at least one of the coefficients of the independent variables within the model is not zero.

Table 4 summarizes the model selection test statistics. Based on the AIC and BIC, the regression that excludes the variables *ROOFCNX* and *WALLCNX* is superior to the regression that includes them (AIC and BIC are minimized). For this reason, the model excluding these variables was selected for analysis, and it is discussed next.

Table 4 Test Statistics — St Albans

	Adjusted R^2	AIC	BIC
Full Model	0.82	-118.38	36.55
Sub Model	0.82	-121.64	5.95

Tests for normality, heteroskedasticity, and multicollinearity generally indicated that the model was adequately specified and that the data were not severely ill conditioned (heteroskedasticity and multicollinearity were diminished when the data were transformed).

The coefficient of determination (R^2) indicates that approximately 82% of the variation in sale price is explained by the variation in the independent variable set. All variable coefficients had the expected signs,[57] except for *TOWER*, which was positive. The positive coefficient for *TOWER* shows that, when all the other variables are held constant, after the installation of a CPBS in St Albans, the price of a house would increase by $e^{0.1133} \approx 1.12$ (12%). A possible explanation is that cell phone technology was quite new at the time (1994), and as there had been little in the media about possible adverse health effects from CPBSs, people may have perceived it as a benefit as they were likely to get better cell phone coverage.

The most significant variables were *TIMESOLD.Q* (the quarter in which the sale occurred before or after the CPBS was built), *log(LANDAX)* (log of land area), and *MATFAX* (total floor area) and all have a positive influence on price. The positive *TIMESOLD.Q* indicates that the market was increasing over time since the CPBS was built (1994), but only to a limited extent (1.38%). The positive log of land area and total floor area shows that prices increase with increasing size.

The regression coefficient on *log(LANDAX)* is 0.3285, which indicates that, on average, a 10% increase in *LANDAX* will generate a 3.285% increase in price. The positive coefficient for *MATFAX* indicates that, when all the other variables are held constant, for each additional m^2 the price would increase by $e^{0.0022514} \approx 1.0022314$ (0.22% increase).

Significance of Variables and the Equation: Papanui

The same functional form used for St Albans was used for Papanui. From the regression output, the variable *CATGYX2* was found to be insignificant so it was removed from the model and the regression was rerun; Appendix VI summarizes the results. The *F*-statistic (152) shows that the estimated relationship in the model is statistically significant at the 95% confidence level and that at least one of the coefficients of the independent variables within the model is not zero.

Table 5 summarizes the model selection test statistics. Based on the AIC and BIC, the regression that excludes the variable *CATGYX2* is superior to the regression that includes it (AIC and BIC are minimized). For this reason, the model excluding this variable was selected for analysis, and is discussed next.

Table 5 Test Statistics — Papanui

	Adjusted R^2	AIC	BIC
Full Model	0.87	-509.91	-371.99
Sub Model	0.87	-510.57	-381.56

The coefficient of determination (R^2) indicates that approximately 87% of the variation in sale price is explained by the variation in the independent variable set. This would be considered high in comparison with the amount of explanation obtained in similar hedonic house studies reported in the literature.[58] All variable coefficients had the expected signs.

The most significant variables were *TIMESOLD.Q*, *MATFAX* (total floor area), and *TOWER*. The former two have a positive influence on price. The positive *TIMESOLD.Q* indicates that the

57. Note that the variable *AGE* is positive as this variable indicates the year the house was built; therefore, the higher the year, the younger the home. Newer houses have less wear and tear than older homes and sell, on average, for more than older homes.

58. For example, Reichert obtained an adjusted R^2 of 84%; Simons and Sementelli, 78%; Abelson, 68%; Dotzour, 56%–61%.

market was increasing over time since the CPBS was built (2000), but only by 1.4% per quarter. The positive coefficient for *MATFAX* indicates that, when all the other variables are held constant, the price would increase by $e^{0.0042576} \approx 1.00427$ (0.43%), with increasing size. The negative coefficient for *TOWER* shows that, when all the other variables are held constant, after the installation of a CPBS in Papanui, the price of a house would decrease by $e^{-0.2340} \approx 0.79$ (21% decrease).

Significance of Variables and the Equation: Beckenham

The same functional form used for Papanui and St Albans was used for Beckenham. From the regression output, the variable *ROOFCNX* was found to be insignificant so it was removed from the model and the regression was rerun; Appendix VII summarizes these results. The *F*-statistic (214) shows that the estimated relationship in the model is statistically significant at the 95% confidence level and that at least one of the coefficients of the independent variables within the model is not zero.

Table 6 summarizes the model selection test statistics. Based on the AIC and BIC, the regression that excludes the variable *ROOFCNX* is superior to the regression that includes it (AIC and BIC are minimized). For this reason, the model excluding this variable was selected for analysis.

Table 6 Test Statistics — Beckenham

	Adjusted R^2	AIC	BIC
Full Model	0.89	-819.00	-641.39
Sub Model	0.89	-818.66	-650.66

The coefficient of determination (R^2) indicates that approximately 89% of the variation in sale price is explained by the variation in the independent variable set. Again, as with the model for Papanui this amount of explanation would be considered high.

The most significant variables were *TIMESOLD.Q, MATFAX,* and *TOWER.* The former two have a positive influence on price. The positive *TIMESOLD.Q* indicates that the market was increasing over time since the CPBS was built in 2000, but only by 1.91% per quarter. The positive coefficient for *MATFAX* indicates that, when all the other variables are held constant, the price would increase by $e^{0.0042054} \approx 1.00421$ (0.42%), with increasing size. The negative coefficient for *TOWER* shows that, when all the other variables are held constant, after the installation of a CPBS in Beckenham, the price of a house would decrease by $e^{-0.25019} \approx 0.793$ (20.7% decrease).

Significance of Variables and the Equation: Bishopdale

The same functional form used for the other three suburbs was used for Bishopdale. From the regression output, the variables *ROOFCNX* and *CATGYX* were found to be insignificant so these were removed from the model and the regression was rerun; Appendix VIII summarizes these results. The *F*-statistic (122) shows that the estimated relationship in the model is statistically significant at the 95% confidence level and that at least one of the coefficients of the independent variables within the model is not zero.

Table 7 Test Statistics — Bishopdale

	Adjusted R^2	AIC	BIC
Full Model	0.79	-927.48	-775.71
Sub Model	0.79	-929.32	-796.52

Table 7 summarizes the model selection test statistics. Based on the AIC and BIC, the regression that excludes the variable *ROOFCNX* and *CATGYX* is superior to the regression that includes it (AIC and BIC are minimized). For this reason, the model excluding these variables was selected for analysis.

Again, the most significant variables were *TIMESOLD.Q* and *MATFAX*; the variable of interest, *TOWER*, was not a significant variable in the model so it is not discussed further. The former two variables have a positive influence on price. The positive *TIMESOLD.Q* indicates that the market was increasing over time since the CPBS was built in 1994, but only at 0.98% per quarter. The positive coefficient for *MATFAX* indicates that, when all the other variables are held constant, the price would increase by $e^{0.0039665} \approx 1.004$ (0.40%), with increasing size.

Summary of Results

The above analysis shows that the most significant variables and their impact on price were similar between suburbs. This indicates the relative stability of the coefficients between each model. Interestingly, the impact of *TOWER* on price (a decrease of between 20.7% and 21%) was very similar in the two suburbs where the towers were built in the year 2000. This may be due to the much greater media publicity given to CPBSs after the two legal cases in Christchurch (*McIntyre* and *Shirley Primary School*

in 1996 and 1999, respectively). The two suburbs where *TOWER* was either insignificant or increased prices by around 12%, were suburbs where towers had been built in 1994, prior to the media publicity.

Limitations of the Research

The main limitation affecting this survey was in the selection of the case study areas. Specifically, the areas selected had CPBSs that were not highly visible to residents. If more-visible CPBSs had been selected, the results may have been quite different. Thus, caution must be used in making generalizations from this study or applying the results directly to other similar studies or valuation assignments. Factors that could affect results are the distance of homes from the CPBS, the style and appearance of the CPBS, how visible the CPBS is to residents, the type of home (single family, multifamily, rental, etc.), and the socioeconomic make-up of the resident population.

To help address the proximity factor, a study is in progress examining the role of distance to the CPBSs and price effects; that study uses GIS analysis to determine the impact this has on residential property prices. It is expected that this will provide a more precise estimation of the impact of a CPBS on price.

It must be kept in mind that these results are the product of only one case study carried out in a specific area (Christchurch) at a specific time (2003). The above results indicate that value effects from CPBSs may vary over time as market participants' perceptions change. Perceptions toward CPBSs can change either positively or negatively over time. For example, as the World Health Organization's ten-year study of the health effects from CPBSs is completed and becomes available, consumers' attitudes may become more positive or negative depending on the outcome of that study. Consequently, studies of the price effects of CPBSs need to be conducted over time.

Areas for Further Study

This research has focused on residents' perceptions of negative effects from proximity to CPBSs and how these impact property values, rather than the scientific or technological estimates of these risks. The technologists' objective view of risk is that risk is measurable solely in terms of probabilities and severity of consequences, whereas the public, while taking experts' assessments into account, view risk more subjectively, based on other factors. Further, the results of scientific studies about the health effects of radio frequency and microwave radiation from CPBSs are not consistent. Residents' perceptions and assessments of risk vary according to a wide range of psychological, social, institutional, and cultural processes, and this may explain why their assessments differ from those of the experts.

Given the public concerns about the potential risks arising from being located nearby a CPBS, it is important for future studies to focus more attention on the kinds of risks the public associates with CPBSs and the level of risk perceived. How far away from the CPBS do people feel they have to be to be safe? What CPBS design, size, and surrounding landscape would help CPBSs to be more publicly acceptable? What social, economic, educational, and other demographic variables influence how people perceive the risks from CPBSs? Do residents that are heavy users of cell phones have a different perception of CPBSs than residents who make little use of this technology? Are these perceived risks reflected in property values and to what extent? Do these perceived risks vary over time and to what degree?

Answers to these questions, if shared among researchers and made public, could lead to the development of a global database to assist appraisers in determining the perceived level of risk associated with CPBSs and other similar structures.[59] Knowledge of the extent that these risks are incorporated into property prices and how they vary over time will lead to more accurate value assessments of properties in close proximity to CPBSs and other similar structures.

Summary and Conclusions

Focusing on four case study neighborhoods in Christchurch, New Zealand, this article presents the results from both an opinion survey and market sales analysis undertaken in 2003 to determine residents' perceptions towards living near a CPBS and how this may impact property prices. From the results, it appears that people who live close to CPBSs perceive the sites less negatively than those who live farther away.

The issue of greatest concern for survey respondents in both the case study and control areas is the impact of proximity to CPBSs on future property values. Overall, respondents would pay from 10%–19% less to over 20% less for a property if it were in close proximity to a CPBS.

The opinion survey results were generally confirmed by the market sales analysis using a hedonic house price approach. The results of the sales analysis show prices of properties were reduced by around 21% after a CPBS was built in the neighborhood. How-

59. For example, high-voltage overhead transmission lines.

ever, this result varies between neighborhoods, with a positive impact on price being recorded in one neighborhood, possibly due to the CPBS being built in that suburb before any adverse media publicity about CPBSs appeared in the local Christchurch press.

Research to date reports no clearly established health effects from radio frequency emissions of CPBSs operated at or below the current safety standards, yet recent media reports indicate that people still perceive that CPBSs have harmful effects. Thus, whether or not CPBSs are proven to be free from health risks is only relevant to the extent that buyers of properties near CPBSs perceive this to be true. Even buyers who believe that there are no adverse health effects from CPBSs, knowing that other potential buyers might think the reverse, will probably seek a price discount for a property located near a CPBS.

The comments of survey participants indicate the ongoing concerns that residents have about CPBSs. There is the need to increase the public's understanding of how radio frequency transmitting facilities operate and the strict exposure-limit standards imposed on the telecommunication industry. As more information is discovered that refutes concerns regarding adverse health effects from CPBSs, and as information about the NZ safety standards are made more publicly available, the perception of risk may gradually change, eliminating the discounts for neighboring properties.

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Additional Reading

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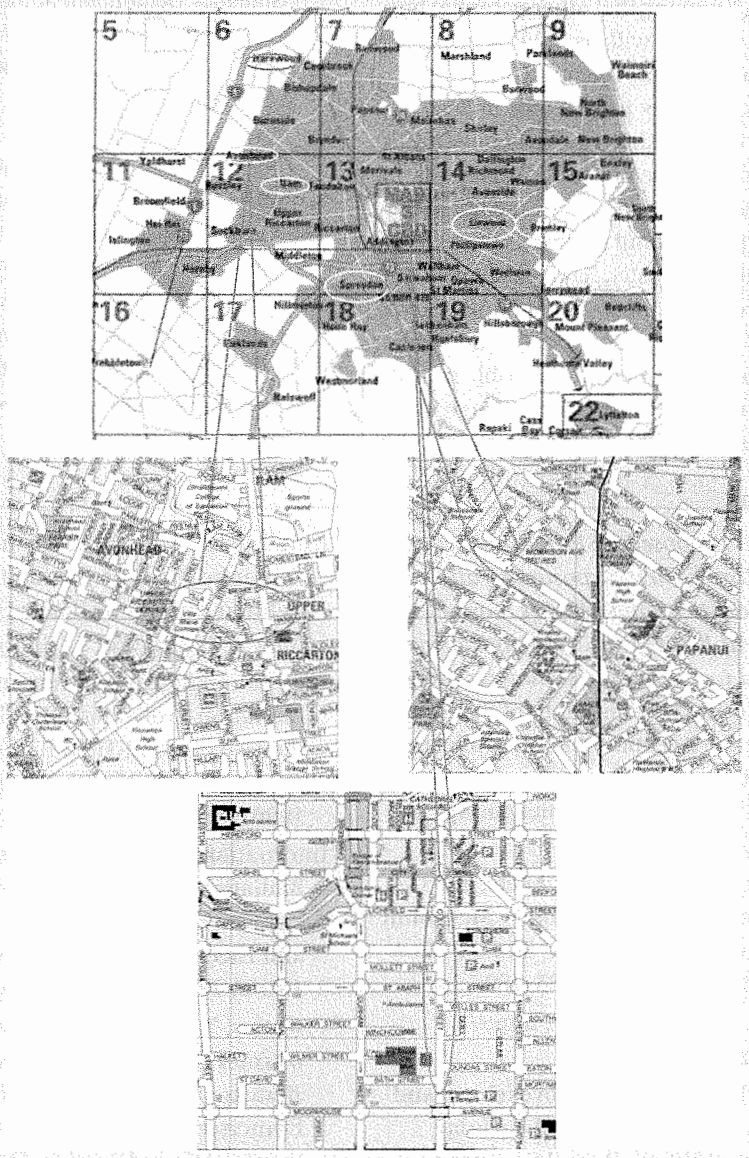
Appendix I Location Map



Areas circled in white at the top are without a cell phone tower, while areas circled in the bottom three maps have a cell phone tower.
Source: http://www.ccc.govt.nz/maps/Wises/

Appendix II Summary of the Survey Results

Variable	Responose	Valid Percent (%)	
		Case Study	Control
Occupancy	Homeowner	78.5	94.2
	Tenant	21.5	5.8
How long have you lived there?	Less than 6 months	8.0	2.6
	6 months–1 year	8.6	4.5
	1–4 years	25.1	27.7
	More than 5 years	58.3	65.2
How would you rate the desirability of your neighborhood?	Superior	27.4	30.9
	Above Average	37.4	36.8
	Average	28.5	27.0
	Below Average	5.6	4.6
	Inferior	1.1	0.7
Would you be opposed to construction of a cell phone tower nearby?	Yes		72.1
	No		27.9
When you purchased/began renting was the cell phone tower already constructed?	Yes	39.3	
	No	60.7	
Was the proximity of the cell phone tower a concern to you?	Yes	20.0	
	No	80.0	
Would you have gone ahead with rental/purchase if you had known a cell phone site was to be constructed?	Yes	73.9	
	No	26.1	
Is location of a cell phone tower a factor you would consider when moving?	Yes		83.4
	No		16.6
Is the cell phone tower visible from your house?	Yes	45.7	
	No	54.3	
If yes, how much does it impact on your view?	Very obstructive	9.6	
	Mildly obstructive	24.5	
	Barely noticeable	66.0	
In what way does it impact on the enjoyment of living in your house?	Views	11.8	
	Aesthetics	20.6	
	Health concerns	36.8	
	Change in property value	19.9	
	Other	11.0	
Effect a nearby cell phone tower would have on the price/rent you would pay for the property	Tower wasn't constructed	53.1	
	Pay substantially more	0.0	0.0
	Pay a little more	2.3	0.0
	Pay a little less	2.8	37.6
	Pay substantially less	0.6	45.4
	Not influence price	51.4	17.0
% Effect a nearby cell phone tower would have on the price/rent you would pay for the property	20% higher or more	5	3.2
	10–19% more	10	1.6
	1–9% more	14	2.4
	1–9% less	33	19.2
	10–19% less	24	36.0
	20% or a greater reduction	14	37.6
Concern about the possibility of harmful health effects in the future	Does not worry me	50.3	19.9
	Worries me somewhat	38.0	38.4
	Worries me a lot	11.7	41.7
Concern about the stigma associated with houses near the cell phone sites	Does not worry me	54.6	20.8
	Worries me somewhat	33.9	45.0
	Worries me a lot	11.5	34.2
Concern about the affect on your properties value in the future	Does not worry me	61.3	15.4
	Worries me somewhat	25.4	37.2
	Worries me a lot	13.3	47.4
Concern about the aesthetic problems caused by the tower	Does not worry me	63.3	18.2
	Worries me somewhat	25.4	37.0
	Worries me a lot	11.3	44.8

Appendix III Variable Codes

Category of Dwelling

Code	Definition
D	Dwelling houses are of a fully detached or semi-detached style situated on their own clearly defined piece of land.
E	Converted dwelling houses that are now used as rental flat.
F	Ownership home units which may be single storey or multi-storey and which do not have the appearance of dwelling houses.
H	Home and income. The dwelling is the predominant use, and there is an additional unit of use attached to or associated with the dwelling house that can be used to produce income.
R	Rental flats that have been purpose built.

Quality of the Principal Structure

Code	Definition
A	Superior design and quality of fixtures and fittings is first class.
B	The design is typical of its era and the quality of the fixtures and fittings is average to good.
C	The design is below the level generally expected for the era, or the level of fixtures and fittings is barely adequate and possibly of below average quality.

Building Materials: Walls and Roof

Code	Definition
W	Wood
B	Brick
C	Concrete
S	Stone
R	Roughcast
F	Fibrolite
M	Malthoid
P	Plastic
I	Iron
A	Aluminium
G	Glass
T	Tiles
X	*

Appendix IV Descriptive Statistics

Variable	Mean	Std. dev.	Median	Minimum	Maximum	Range
St Albans:						
Sale Price ($)	221,957	110,761	200,000	42,000	839,000	797,000
Land Area (ha)	0.0658	0.0331	0.0579	0.0261*	0.3794	0.3533
Floor Area (m^2)	161	70.40	150	50	450	400
Beckenham:						
Sale Price ($)	116,012	50,037	111,000	21,500	385,000	363,500
Land Area (ha)	0.0601	0.0234	0.0553	0.0164*	0.2140	0.1976
Floor Area (m^2)	115	32.50	110	40	340	300
Papanui:						
Sale Price ($)	127,661	51,114	119,000	43,000	375,000	332,000
Land Area (ha)	0.0685	0.0289	0.0675	0.0310	0.3169	0.2859
Floor Area (m^2)	122	34.60	110	56	290	234
Bishopdale:						
Sale Price ($)	136,786	41,390	134,500	56,000	342,000	286,000
Land Area (ha)	0.0679	0.0163	0.0653	0.0400	0.2028	0.1628
Floor Area (m^2)	125	31.20	118	64	290	226

* These small land areas are related to apartments or units in a block of apartments/units that have the land area apportioned on a pro rata basis.

Appendix V Regression Model: St Albans

log(*SLNETX*) = *TOWER* + *CATGYX2* + *CATGYX4* + *TIMESOLD.Q* + *AGE* + log(*LANDAX*) + *MATFAX* + *SITSTX*

Residuals:	**Min**	**1Q**	**Median**	**3Q**	**Max**
	-0.72855	-0.15032	0.01593	0.14263	0.72047

Coefficients:	**Estimate**	**Std. Error**	***t*-value**	**Pr(>|*t*|)**
(Intercept)	9.1781868	0.6769096	13.559	< 2e-16 ***
TOWER	**0.1133186**	0.0318188	**3.561**	0.000395 ***
CATGYX2D	0.1846417	0.0702520	2.628	0.008776 **
CATGYX2O	0.0334663	0.1008594	0.332	0.740134
CATGYX4B	-0.1551409	0.0245485	-6.320	4.75e-10 ***
CATGYX4C	-0.1483169	0.0722959	-2.052	0.040600 *
TIMESOLD.Q	**0.0136663**	**0.0008208**	**16.650**	< 2e-16 ***
AGE	0.0016408	0.0003521	4.660	3.81e-06 ***
log(LANDAX)	**0.3285367**	**0.0283610**	**11.584**	< 2e-16 ***
MATFAX	**0.0022314**	**0.0001962**	**11.373**	< 2e-16 ***
SITSTXAIKMANS RD	0.4029259	0.0533671	7.550	1.41e-13 ***
SITSTXBEVERLEY ST	0.2330787	0.0803137	2.902	0.003827 **
SITSTXBRISTOL ST	0.1706840	0.0521716	3.272	0.001124 **
SITSTXBROWNS RD	0.2492536	0.0720854	3.458	0.000579 ***
SITSTXCOX ST	0.3055798	0.0581672	5.253	2.00e-07 ***
SITSTXGORDON AVE	0.0823422	0.0679833	1.211	0.226236
SITSTXKNOWLES ST	0.1690979	0.0558911	3.025	0.002576 **
SITSTXMANSFIELD AVE	0.2954242	0.0652983	4.524	7.16e-06 ***
SITSTXMCDOUGALL AVE	0.3303105	0.0623720	5.296	1.60e-07 ***
SITSTXMURRAY PL	0.3613773	0.0629166	5.744	1.40e-08 ***
SITSTXOFFICE RD	0.3681146	0.0543368	6.775	2.71e-11 ***
SITSTX Other	0.0618491	0.0736629	0.840	0.401416
SITSTXPAPANUI RD	0.1940369	0.0560474	3.462	0.000570 ***
SITSTXRANFURLY ST	0.1701716	0.0617504	2.756	0.006012 **
SITSTXST ALBANS ST	0.1458665	0.0571172	2.554	0.010873 *
SITSTXWEBB ST	0.1895432	0.0725061	2.614	0.009143 **
SITSTXWESTON RD	0.2084419	0.0527555	3.951	8.60e-05 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Residual standard error: 0.2175 on 677 degrees of freedom
Multiple *R*-Squared: 0.8253, Adjusted *R*-squared: 0.8186
F-statistic: 123 on 26 and 677 DF, *p*-value: < 2.2e-16

Appendix VI Regression Model: Papanui

ln(formula = log(*SLNETX*) ~ *TOWER* + *SITSTX* + *TIMESOLD.Q* + *AGE* + log(*LANDAX*) + *MATFAX* + *WALLCNX* + *ROOFCNX* + *CATGYX4*, data = *Papanui.final*)

Residuals:	**Min**	**1Q**	**Median**	**3Q**	**Max**
	-0.484987	-0.098006	0.003859	0.106253	0.563126

Coefficients:	**Estimate**	**Std. Error**	***t*-value**	**Pr(>|*t*|)**
(Intercept)	5.9482316	0.6998186	8.500	< 2e-16 ***
TOWER	**-0.2339640**	0.0240908	**-9.712**	< 2e-16 ***
SITSTXHOANI ST	-0.1966982	0.0265429	-7.411	4.26e-13 ***
SITSTXLANGDONS RD	-0.1192547	0.0281242	-4.240	2.58e-05 ***
SITSTXLEANDER ST	0.0305555	0.0449437	0.680	0.496853
SITSTXMATSONS AVE	0.0949636	0.0292461	3.247	0.001231 **
SITSTXMORELAND AVE	-0.0892332	0.0397622	-2.244	0.025183 *
SITSTXMORRISON AVE	-0.1984492	0.0289772	-6.848	1.84e-11 ***
SITSTXOther	-0.1543194	0.0337436	-4.573	5.83e-06 ***
SITSTXSAILS ST	-0.0761412	0.0433455	-1.757	0.079490 .
SITSTXSAWTELL PL	0.1840793	0.0393904	4.673	3.66e-06 ***
SITSTXSAWYERS ARMS RD	0.0872393	0.0201388	4.332	1.73e-05 ***
SITSTXST JAMES AVE	0.2497688	0.0289940	8.615	< 2e-16 ***
TIMESOLD.Q	**0.0138914**	0.0004137	**33.575**	< 2e-16 ***
AGE	0.0029307	0.0003512	8.345	4.85e-16 ***
log(LANDAX)	0.0904764	0.0270812	3.341	0.000886 ***
MATFAX	**0.0042576**	0.0002410	**17.664**	< 2e-16 ***
WALLCNXC	0.0054100	0.0200666	0.270	0.787558
WALLCNXF	-0.0980851	0.0464442	-2.112	0.035106 *
WALLCNXO	-0.1158407	0.0468334	-2.473	0.013655 *
WALLCNXR	-0.0670051	0.0244382	-2.742	0.006291 **
WALLCNXW	-0.0679166	0.0192628	-3.526	0.000454 ***
WALLCNXX	-0.0571365	0.0358369	-1.594	0.111381
ROOFCNXI	0.1502973	0.1139845	1.319	0.187810
ROOFCNXO	0.0870092	0.1164152	0.747	0.455111
ROOFCNXT	0.0954874	0.1138506	0.839	0.401965
CATGYX4B	-0.0623758	0.0343487	-1.816	0.069872 .
CATGYX4C	-0.3669901	0.0905659	-4.052	5.74e-05 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Residual standard error: 0.1579 on 604 degrees of freedom
Multiple *R*-Squared: 0.8718, Adjusted *R*-squared: 0.8661
F-statistic: 152.2 on 27 and 604 DF, *p*-value: < 2.2e-16

Appendix VII Regression Model: Beckenham

lm(formula = log(*SLNETX*) ~ TOWER + *SITSTX* + *CATGYX4* + *TIMESOLD.Q* + *AGE* + log(*LANDAX*) + *MATFAX* + *WALLCNX* + *CATGYX2*, data = *Beckenham.final*)

Residuals:	**Min**	**1Q**	**Median**	**3Q**	**Max**
	-0.64490	-0.09026	0.01142	0.10112	0.40993

Coefficients:	**Estimate**	**Std. Error**	***t*-value**	**Pr(>|*t*|)**
(Intercept)	9.2062865	0.4725194	19.483	< 2e-16 ***
TOWER1	**-0.2301918**	0.0182774	**-12.594**	< 2e-16 ***
SITSTXBECKENHAM ST	0.1648069	0.0515406	3.198	0.001436 **
SITSTXBOON ST	-0.0616738	0.0484966	-1.272	0.203817
SITSTXBRADFORD AVE	0.0923843	0.0494942	1.867	0.062300 .
SITSTXCOLOMBO ST	0.0623765	0.0467234	1.335	0.182223
SITSTXDEVON ST	-0.0959430	0.0457562	-2.097	0.036299 *
SITSTXDUNN ST	-0.0207886	0.0427676	-0.486	0.627031
SITSTXFISHER AVE	0.2271245	0.0400288	5.674	1.90e-08 ***
SITSTXLONGFELLOW ST	-0.0186953	0.0451597	-0.414	0.678990
SITSTXOTHER	-0.0222126	0.0467607	-0.475	0.634888
SITSTXPERCIVAL ST	-0.0347190	0.0517740	-0.671	0.502663
SITSTXROXBURGH ST	0.1029109	0.0466753	2.205	0.027729 *
SITSTXSOMERFIELD ST	0.0186495	0.0428968	0.435	0.663851
SITSTXSOUTHAMPTON ST	-0.0243265	0.0402926	-0.604	0.546171
SITSTXSOUTHEY ST	-0.0324513	0.0429880	-0.755	0.450520
SITSTXSTRICKLAND ST	-0.0819418	0.0407196	-2.012	0.044494 *
SITSTXTENNYSON ST	0.1165007	0.0393410	2.961	0.003147 **
SITSTXWEMBLEY ST	0.0648226	0.0458033	1.415	0.157359
CATGYX4B	0.0275481	0.0373405	0.738	0.460864
CATGYX4C	-0.1168640	0.0469787	-2.488	0.013049 *
TIMESOLD.Q	**0.0189904**	0.0003396	**55.928**	< 2e-16 ***
AGE	0.0010988	0.0002426	4.530	6.74e-06 ***
log(LANDAX)	0.1546535	0.0195655	7.904	8.19e-15 ***
MATFAX	**0.0042054**	0.0002138	**19.674**	< 2e-16 ***
WALLCNXC	-0.0208433	0.0378338	-0.551	0.581833
WALLCNXF	-0.1171637	0.0394091	-2.973	0.003031 **
WALLCNXO	-0.0445073	0.0399745	-1.113	0.265849
WALLCNXR	-0.1119164	0.0235736	-4.748	2.41e-06 ***
WALLCNXW	-0.0629968	0.0222366	-2.833	0.004718 **
WALLCNXX	-0.0992564	0.0398493	-2.491	0.012933 *
CATGYX2D	0.1445276	0.0399650	3.616	0.000316 ***
CATGYX2F	0.3069113	0.0744524	4.122	4.11e-05 ***
CATGYX2R	0.2927391	0.1222453	2.395	0.016847 *

Signif. codes:0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Residual standard error: 0.1515 on 864 degrees of freedom
Multiple *R*-Squared: 0.8911, Adjusted *R*-squared: 0.8869
F-statistic: 214.2 on 33 and 864 DF, *p*-value: < 2.2e-16

Appendix VIII Regression Model: Bishopdale

lm(formula = log(*SLNETX*) ~ *TOWER* + *TIMESOLD.Q* + *AGE* + log(*LANDAX*) + *MATFAX* + *WALLCNX* + *SITSTX*, data = *Bishopdale.final*)

Residuals:	**Min**	**1Q**	**Median**	**3Q**	**Max**
	-0.53633	-0.08893	0.01446	0.08850	0.49048

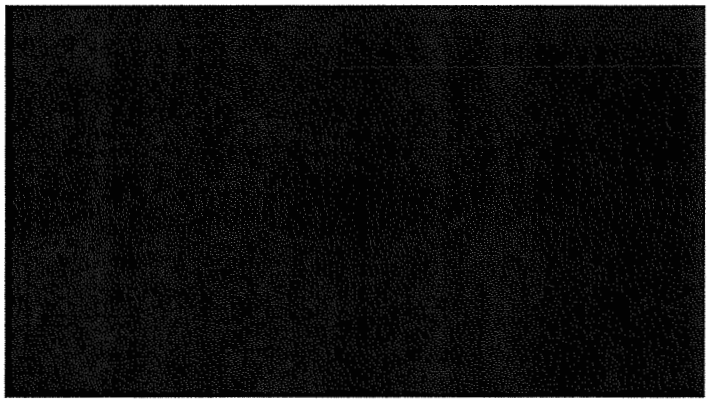
Coefficients:	**Estimate**	**Std. Error**	***t*-value**	**Pr(>|*t*|)**
(Intercept)	9.0005033	0.6988891	12.878	< 2e-16 ***
TOWER	0.0262575	0.0182796	1.436	0.151259
TIMESOLD.Q	**0.0097887**	0.0004834	**20.251**	< 2e-16 ***
AGE	0.0013236	0.0003598	3.679	0.000249 ***
log(LANDAX)	0.1357753	0.0333622	4.070	5.16e-05 ***
MATFAX	**0.0039665**	0.0001855	**21.389**	< 2e-16 ***
WALLCNXC	-0.0169935	0.0108641	-1.564	0.118160
WALLCNXO	0.0785660	0.0336688	2.333	0.019863 *
WALLCNXR	-0.0693225	0.0300511	-2.307	0.021313 *
WALLCNXW	-0.0815023	0.0230110	-3.542	0.000420 ***
SITSTXCARDOME ST	0.0610536	0.0314227	1.943	0.052360 .
SITSTXCHEDWORTH AVE	0.0330487	0.0317738	1.040	0.298589
SITSTXCLOTILDA PL	**0.2252988**	0.0420078	**5.363**	1.06e-07 ***
SITSTXCOLESBURY ST	0.0528749	0.0302668	1.747	0.081018 .
SITSTXCOTSWOLD AVE	0.0604953	0.0286474	2.112	0.035012 *
SITSTXEASTLING ST	0.0551537	0.0319833	1.724	0.085003 .
SITSTXFARRINGTON AVE	-0.0001768	0.0238544	-0.007	0.994087
SITSTXHAREWOOD RD	0.0204412	0.0252674	0.809	0.418753
SITSTXHIGHSTED RD	0.0391760	0.0253953	1.543	0.123302
SITSTXKILBURN ST	-0.0176756	0.0366951	-0.482	0.630155
SITSTXKINGROVE ST	-0.0052772	0.0375965	-0.140	0.888406
SITSTXLEACROFT ST	0.1058243	0.0333633	3.172	0.001571 **
SITSTXMURMONT ST	0.1825316	0.0365287	4.997	7.12e-07 ***
SITSTXNEWMARK ST	-0.0342136	0.0272490	-1.256	0.209621
SITSTXOTHER	0.0525437	0.0253634	2.072	0.038612 *
SITSTXRALEIGH ST	0.0470151	0.0314032	1.497	0.134740
SITSTXSTACKHOUSE AVE	0.0235719	0.0278844	-0.845	0.398165

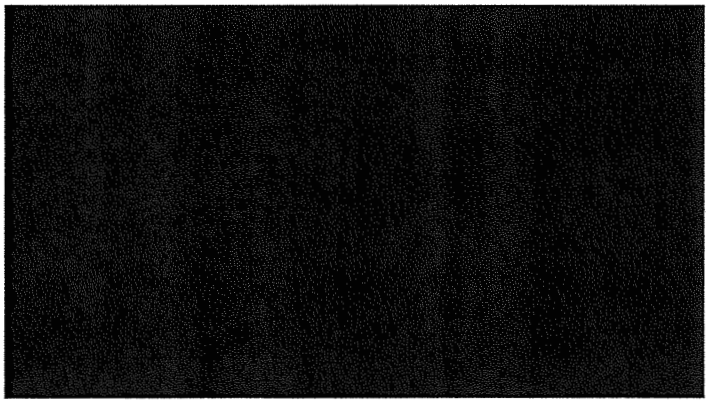
Signif. codes:0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Residual standard error: 0.137 on 821 degrees of freedom
Multiple *R*-Squared: 0.7946, Adjusted *R*-squared: 0.7881
F-statistic: 122.1 on 26 and 821 DF, *p*-value: < 2.2e-16

Property Values Declining Near Cell Towers

When it comes to cell phone towers, there is increasingly the perception that a family does not want to live next to one. There is good reason for this as the research on health effects shows.

The following articles, videos and studies relate to declining property values around cell tower installations. Start with this excellent, recent investigative piece by a San Francisco Bay Area journalist:





1.) 94% of people surveyed would not buy or rent a home next to a cell tower:

http://www.businesswire.com/news/home/20140703005726/en/Survey-National-Institute-Science-Law-Public-Policy

Here is my TEDx Talk: "Wireless Wake-up Call"

Get the 7 Most Important Steps to Protect Your Family

Name

E-Mail Address

SIGN UP

This is the resource I wish had been available to me when I first started

2.) Palo Alto community successfully stops a proposed AT&T cell tower at a Catholic church. They cite a 20% drop in property values in other communities. A very effective campaign for any neighborhood to model:

http://www.nocelltowerat1095channing.com/

As you can see in this recently NY Times article, Palo Alto residents really don't like having cell towers in their community (even though they are the cradle of wireless technology). What do these tech people know that the rest of the population doesn't?

This community in Berkeley recently did the same thing. They flooded the planning commission with 187 pages of emails against the tower and the application was denied.

3.) Here is an excellent study in *The Appraisal Journal* that shows cell tower installations negatively impact property values.

4.) NY Times article on how realtors have a hard time selling homes next to cell towers:

http://www.nytimes.com/2010/08/29/realestate/29Lizo.html

This community woke up one morning to find cell phone companies putting up towers right in their front yards.

5.) This is what the National Association of Realtors has to say on this issue:

http://www.realtor.org/field-guides/field-guide-to-cell-phone-towers

6.) Nolo Press article noting successful litigation against cell phone tower installations related to declining property values:

http://www.nolo.com/legal-encyclopedia/emf-radiofrequency-exposure-from-cell-32210-2.html

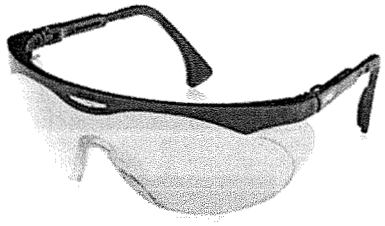
learning about the EMF topic. With this book, you will quickly learn how to find and create a home that is healthy for you and your family.

LEARN MORE

Learn What EMF Meters I Recommend

LEARN MORE

Here Are My Favorite EMF Reducing Products



7.) NASA scientist sells home of 25 years in Piedmont, CA (wealthy suburb of San Francisco) because city council approves a DAS cell tower near his home: http://sanfrancisco.cbslocal.com/2017/11/15/east-bay-homeowners-challenge-proposed-cellphone-towers/

8.) Excellent summary of various press articles from around the country related to declining property values around cell towers:

https://sites.google.com/site/nocelltowerinourneighborhood/home/decreased-real-estate-value

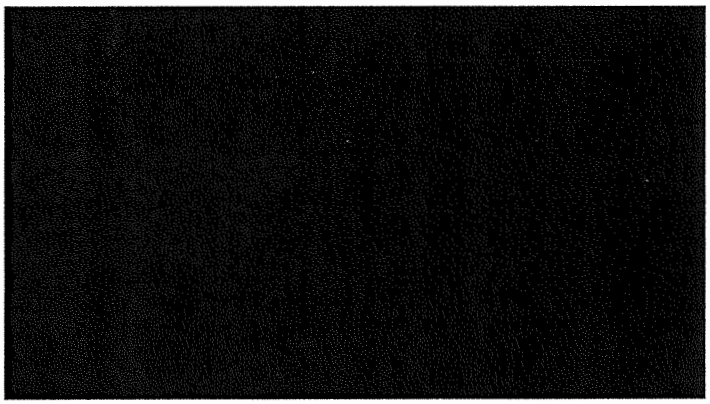
9.) Study using the mapping software GIS to show that property values were higher on average away from cell phone tower installations:

http://www.prres.net/papers/Bond_Squires_Using_GIS_to_Measure.pdf

10.) New Zealand study showing that property values decrease after cell phone tower installations:

New Zealand Study on Declining Property Values Around Cell Towers

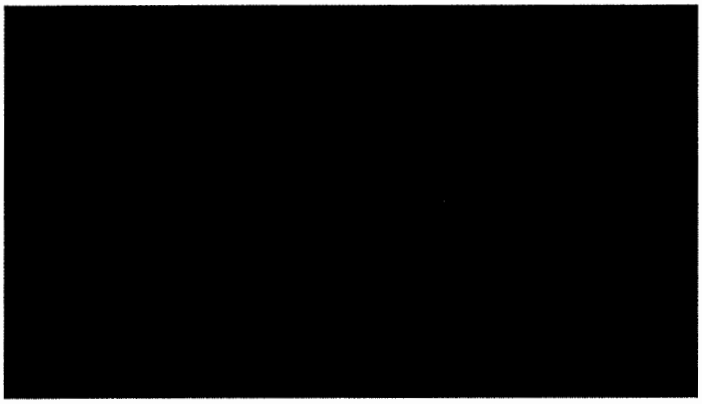
11.) Community stops new DAS cell tower system from being installed based on concerns of property values declining (December 15, 2015):



This is a Distributed Antenna System (DAS) cell tower antenna. Cities like San Francisco are placing multiple antennas like this on every block, right in front of people's homes. They may look innocent, but they are very powerful emitters of microwave radiation that can cause health effects for home owners.

Note: Communities all around the country are stopping cell towers in their tracks. I get emails every week about this. Here is one community in Colorado that

stopped a major tower. Also, this community in Berkeley recently stopped a tower from being built. It can be done if you get your entire community involved. The wealthy community of Hillsborough, CA recently stopped 16 cell towers from being installed after citizen outrage over not being included in the planning process:



Richard Cristdahl: Cellular phone towers impact property values

Other VoicesRichard Cristdahl

September 13, 2016

Last year it never occurred to me that a cell tower could reduce the value of my property. I believe this to be true for most people, and my guess is around 75 percent of us don't realize their property has been devalued up to 20 percent. This is changing rapidly as people are becoming aware.

The percentage of devaluation seems to rise proportionally to the higher awareness of this fact. The California Association of Realtors now requires you to disclose how far your home is to a cell antenna/tower when you list your property for sale. This action alone is speeding up the process.

The fight between Verizon, the planning commission and citizens of Nevada City, over installing eight antennas in the Historical District, has generated concern over these antennas lowering property values. The planning commission has been given documentation from numerous surveys that show property values dropping in a 1,500-foot radius around cell tower antenna sites. Even though the planning commission has been given all this information, they have ignored it and this issue as a means of denial of Verizon's application. The devaluation around 109 W. Pine Street could be over $10 million, a rough estimate I made using Zillow and some other online sources.

Looking at a tower all you see a structure, even if it's disguised as a tree or chimney. What you don't see is the microwave radiation that fills every cubic inch of air space for miles. If you don't know what microwave radiation is think of your microwave oven and what does, cook meat and veggies. The telecom industry has told you this radiation is much lower in power, therefore it's safe because of the FCC safety guidelines that they adhere to. Industry engineers compiled those guidelines back in the 1990s from scientific studies conducted in 1950 through 1990. There has been no study, not one, that shows microwave, cell phone, or cellular tower/antenna radiation is safe at any power level no matter how low it is. The industry states, that in its opinion, all scientific studies have alluded to or shown a high probability to cancer and that they didn't show an absolute 100 percent direct link, therefore there's no real proof. That sounds like the companies that make cigarettes, lead, DDT, sugar, mercury, GMOs and produce ionizing radiation who tried and are still trying to cover up the disastrous health effects of their products.

Cell tower cluster studies started around 2000 and the statistics revealed a 300 percent increase in cancer around these antenna sites. This didn't have an impact on me until I extrapolated further and discovered that 39.6 percent of men and women will be diagnosed with cancer during their lifetime and factoring in living near a cell tower almost guarantees that I will get cancer. Later in the 2000s, studies revealed other health effects of this radiation like headaches, insomnia, cognitive disruptions, DNA breakage, infertility, heart, lung, and kidney problems; these are just a few from a very long list. Microwave radiation can affect the blood with only 45 minutes of exposure to a 4G phone in standby mode carried in your backpack. This radiation polarizes a non-polar red blood cell causing them to be attracted to each other instead of bouncing off one another. It's called artificial rouleau, which I've nicknamed "Wi-Fi Blood", from the 100 percent results I got from testing school children that were exposed to Wi-Fi in their classroom. Physiologically this causes a problem with circulation that can be attributed to many health problems especially cardio vascular.

People educating themselves on the impact to our Historical District, the deleterious effects on health, and the devaluation of their property. The telecommunications industry has been lying to them like the cigarette and other industries before them with our government and their regulating agencies enabling them. They have ignored the mountain of research that has shown harm, hid warnings and safe usage, funded bogus studies, defamed good science and scientists. They have bought our legislators to fill and head our government agencies and commissions. They dispute the fact that your property is being devalued.

If you live in one of these areas you might consider taking action against the landowner, the tower owner, the carrier and the approving agency. Devaluing your property is like taking money out of your bank account. It's your money they're taking and a lot of it, like 2008 all over again for some people.

Richard Cristdahl OMD lives in Nevada City.

Real Estate Survey: Do Cell/Grid Towers Impact a Property's Desirability?

July 04, 2014 *by Take Back Your Power*
health, property value, real estate, smart grid, smart meters, towers *2 Comments*

by ElectromagneticHealth.org | see original news release

94% of respondents said a nearby cell tower or group of antennas would negatively impact value or interest in a property

The National Institute for Science, Law and Public Policy's survey "Neighborhood Cell Towers & Antennas—Do They Impact a Property's Desirability?" initiated June 2, 2014, has now been completed by 1,000 respondents as of June 28, 2014. The survey, which circulated online through email and social networking sites, in both the U.S. and abroad, sought to determine if nearby cell towers and antennas, or wireless antennas placed on top of or on the side of a building, would impact a home buyer's or renter's interest in a real estate property.

The overwhelming majority of respondents (94%) reported that cell towers and antennas in a neighborhood or on a building would impact interest in a property and the price they would be willing to pay for it. And 79% said under no circumstances would they ever purchase or rent a property within a few blocks of a cell tower or antenna.

- **94% said** a nearby cell tower or group of antennas **would negatively impact interest in a property or the price they would be willing to pay for it.**
- **94% said** a cell tower or group of antennas on top of, or attached to, an apartment building **would negatively impact interest in the apartment building or the price they would be willing to pay for it.**
- **95% said they** would opt to buy or rent a property that had zero antennas **on the building over a comparable property that had several antennas on the building.**
- **79% said** under no circumstances would they ever purchase or rent a property within a few blocks of a cell tower or antennas.
- **88% said that** under no circumstances would they ever purchase or rent a property with a cell tower or group of antennas on top of, or attached to, the apartment building.
- **89% said they were** generally concerned about the increasing number of cell towers and antennas **in their residential neighborhood.**

The National Institute for Science, Law and Public Policy (NISLAPP) was curious if respondents had previous experience with physical or cognitive effects of wireless radiation, or if their concern about neighborhood antennas was unrelated to personal experience with the radiation.

Of the 1,000 respondents, **57% had previously experienced cognitive effects from radiation emitted by a cell phone, wireless router, portable phone, utility smart meter, or neighborhood antenna or cell tower, and 43% had not experienced cognitive effects. 63% of respondents had previously experienced physical effects from these devices or neighborhood towers and antennas and 37% had not experienced physical effects.**

The majority of respondents provided contact information indicating they would like to receive the results of this survey or news related to the possible connection between neighborhood cell towers and antennas and real estate decisions.

Comments from real estate brokers who completed the NISLAPP survey:

> *"I am a real estate broker in NYC. I sold a townhouse that had a cell tower attached. Many potential buyers chose to avoid purchasing the property because of it. There was a long lease."*
>
> *"I own several properties in Santa Fe, NM and believe me, I have taken care not to buy near cell towers. Most of these are rental properties and I think I would have a harder time renting those units... were a cell tower or antenna nearby. Though I have not noticed any negative health effects myself, I know many people are affected. And in addition, these antennas and towers are often extremely ugly– despite the attempt in our town of hiding them as chimneys or fake trees."*
>
> *"We are home owners and real estate investors in Marin County and have been for the last 25 years. We own homes and apartment building here in Marin. We would not think of investing in real estate that would harm our tenants. All our properties are free of smart meters. Thank you for all of your work."*
>
> *"I'm a realtor. I've never had a single complaint about cell phone antennae. Electric poles, on the other hand, are a huge problem for buyers."*

Study: 21% reduction in property value if cell phone tower built

Concern was expressed in the comments section by respondents about potential property valuation declines near antennas and cell towers. While the NISLAPP survey did not evaluate property price declines, a study on this subject by Sandy Bond, PhD of the New Zealand Property Institute, and Past President of the Pacific Rim Real Estate Society (PRRES), The Impact of Cell Phone Towers on House Prices in Residential Neighborhoods, was published in *The Appraisal Journal* of the Appraisal Institute in 2006. The Appraisal Institute is the largest global professional organization for appraisers with 91 chapters.

The study indicated that **homebuyers would pay from 10%–19% less to over 20% less for a property if it were in close proximity to a cell phone base station.** The 'opinion' survey results were then confirmed by a market sales analysis. **The results of the sales analysis showed prices of properties were reduced by around 21% after a cell phone base station was built in the neighborhood."**

Additional comments

The Appraisal Journal study added,

> "Even buyers who believe that there are no adverse health effects from cell phone base stations, knowing that other potential buyers might think the reverse, will probably seek a price discount for a property located near a cell phone base station."

James S. Turner, Esq., Chairman of the National Institute for Science, Law & Public Policy and Partner, Swankin & Turner in Washington, D.C., says,

> "The recent NISLAPP survey suggests there is now a high level of awareness about potential risks from cell towers and antennas. In addition, the survey indicates respondents believe they have personally experienced cognitive (57%) or physical (63%) effects from radiofrequency radiation from towers, antennas or other radiating devices, such as cell phones, routers, smart meters and other consumer electronics. Almost 90% are concerned about the increasing number of cell towers and antennas generally. A study of real estate sales prices would be beneficial at this time in the Unites States to determine what discounts homebuyers are currently placing on properties near cell towers and antennas."

Betsy Lehrfeld, Esq., an attorney and Executive Director of NISLAPP, says,

> "The proliferation of this irradiating infrastructure throughout our country would never have occurred in the first place had Section 704 of the Telecommunications Act of 1996 not prohibited state and local governments from regulating the placement of wireless facilities on health or environmental grounds. The federal preemption leaves us in a situation today where Americans are clearly concerned about risks from antennas and towers, some face cognitive and physical health consequences, yet they and their families increasingly have no choice but to endure these exposures, while watching their real property valuations decline."

The National Institute for Science, Law, and Public Policy (NISLAPP) in Washington, D.C. was founded in 1978 to bridge the gap between scientific uncertainties and the need for laws protecting public health and safety. Its overriding objective is to bring practitioners of science and law together to develop intelligent policy that best serves all interested parties in a given controversy. Its focus is on the points at which these two disciplines converge.

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If you can support NISLAPP's work, please donate at the bottom of this page.

* * *

Commentary from ElectromagneticHealth.org:

Response to EMF real estate survey **conducted by The National Institute for Science, Law and Public Policy:**

ElectromagneticHealth.org suggests real estate agents and homebuyers be aware at this time that there are indeed perceived risks associated with real estate properties located in proximity to cell towers and antennas impacting both 1) interest in a given property and 2) a property's price.

Real estate agents are advised to:

1. Familiarize themselves with AntennaSearch.com to **be able to find antennas and hidden antennas** in a neighborhood,
2. Learn to work with an RF meter to **be able to competently assess a property and neighborhood** for RF electromagnetic fields from both external infrastructure sources and in-home devices,
3. Learn how real estate properties with high RF exposures can be physically remediated or mitigated (and when this is not practical),
4. Understand **at what distance from cell towers and antennas research is indicating biological and health effects**, including the increased incidence of cancer. (See cell tower studies in "Some Studies Showing Cell Tower Health Impacts")
5. Learn the potential health consequences of the **new radiating utility meters**, called 'smart meters', and be able to identify and evaluate them.
6. Understand the special **importance of low RF in bedrooms**, from all sources, and especially in the bedrooms of children.
7. Be able to advise clients on **improving home safety from internal and external electromagnetic fields.**

Given there are over 220,000 cell phone towers in the United States, over 50 million wireless networks and untold numbers of antennas on or even inside buildings, and new risks from utility meters and the

wireless networks that support them, real estate agents would best be conversant in the risks, and perceived risks, of electromagnetic fields. If ElectromagneticHealth.org can be of help to real estate agents, please do not hesitate to be in touch at info@ElectromagneticHealth.org.

Sources:
http://electromagnetichealth.org/electromagnetic-health-blog/survey-property-desirability/
http://electromagnetichealth.org/electromagnetic-health-blog/survey-commentary/

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2 Comments

Steve Kastner *May 19, 2015 at 8:40 am* Reply

It is a very argumentative topic as in real estate cell towers has it's own advantages & disadvantages. Considering the fact the only disadvantage that people think of living in areas with cell towers is the health issue. The percentage of radiation level that is dissipated by cell towers is less than 1% and it is being wrongly judged by people. The advantage of that area is that the cell phone reception, the signals would be excellent, secondly there are chances for landowners to earn money for providing their land for cell tower lease to other cell companies as well. Nowadays, cell tower lease rates are dependent on various factors and if the location is favorable, people can earn a decent amount for a considerable length of time because of agreement.

Jerry Flynn *September 1, 2015 at 8:28 am* Reply

Respectfully, you are misinformed, sir. See the BioInitiative Report which is the latest, most authoritative, independent science-based report. Authored by 29 scientists, including 21 PhDs and 10 Medical doctors from 10 countries, it should help clear up a few things for you. You may also want to visit the International Commission on Electro Magnetic Safety (ICEMS). Don't confuse ICEMS with ICES, which is a committee of the IEEE. ICES' key members are the U.S. Army, U.S. Air Force, Motorola, Nokia, Siemens, Alcatel-Lucent and Bell, so one would be wise to look elsewhere for the truth. ICEMS on the other hand is an entirely independent body of international scientists. Also view the Salzburg Resolution of 2000. Or the Seletun Statement 2010. One should note that no insurance company will insure against health-related claims attributed to any wireless techology! Within the U.S. Government, the EPA (on 3 occasions spanning many years) plus the FDA, Consumer Affairs Commission, NIOSH and OSHA, and NIEHS have all tried either to have the U.S.' egregiously high radiation Exposure Limits drastically reduced and/or have the USA (like Canada) admit that non-thermal radiation – the kind that is emitted by all of today's wireless devices – is harmful not just to people but to all forms of life. The USA, like Canada, the WHO and ICNIRP all recognize only THERMAL radiation! Sadly, as we learned with tobacco and asbestos, money corrupts even nice otherwise decent people! Regards, Jerry

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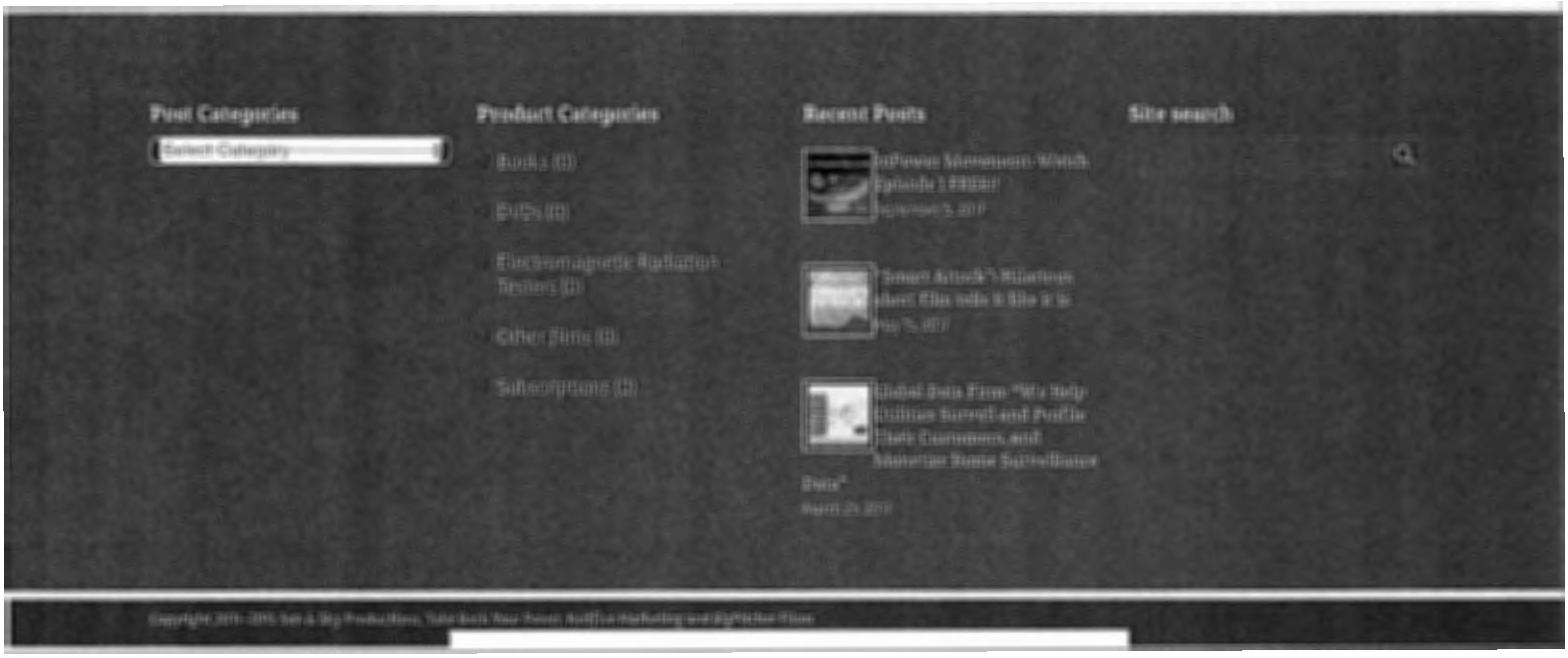

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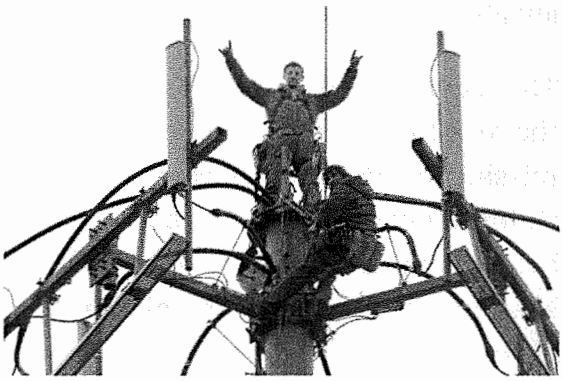
In Race For Better Cell Service, Men Who Climb Towers Pay With Their Lives

Corporate giants have outsourced the dangerous work of building and maintaining communications towers to tiny subcontracting companies. Over the last nine years, nearly 100 workers have died, 50 of them on cell sites.

by **Ryan Knutson** and **Liz Day**,
May 22, 2012, 9:52 a.m. EDT



This story was co-published with PBS Frontline, which will air a film version today. Check local listings.

In the spring of 2008, AT&T was racing to roll out a new cell phone network to deliver music, video and online games at faster speeds.

The network, known as 3G, was crucial to the company's fortunes. AT&T's cell service had been criticized by customers for its propensity to drop calls, a problem compounded when the company became the sole carrier for the

iPhone.

Jay Guilford was a tiny but vital cog in the carrier's plans.

On a clear evening in May, Guilford was dangling, 150 feet in the air, from a cell tower in southwest Indiana. He had been sent aloft to take pictures of AT&T antennas soon to be replaced by 3G equipment.

Work complete, Guilford sped his descent by rappelling on a rope. Safety standards required him to step down the metal pole, peg by peg, using a special line that would catch automatically if he fell. But tower climbing is a field in which such rules are routinely ignored.

"Bouncy, bouncy," Guilford, 25, called jovially to men on the ground.

Then, in an instant, the hook attaching the rope to the tower – broken and missing its safety latch – came loose. Guilford plummeted to the gravel below, landing feet first. The impact shattered his legs and burst his aorta. He bled to death in minutes.

Cell phones are our era's ubiquitous technology device. There are more active cell phones in the U.S. than people.

Communication Tower Deaths
Tower climbing, an obscure field with no more than 10,000 workers, has a death rate roughly 10 times that of construction. In the last nine years, nearly 100 tower climbers have been killed on the job. More than half of them were working on cell sites.

Other Towers *Includes: television, radio, Internet, microwave, and government communication towers*	43

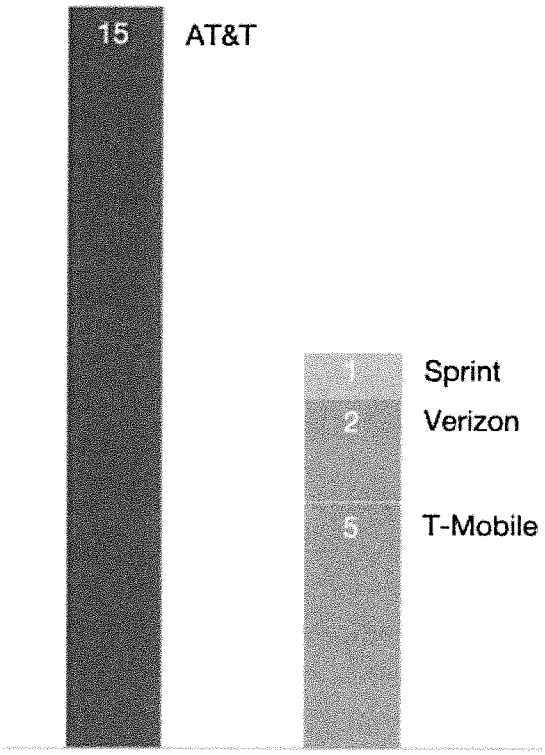
Fatalities on Cell Sites

Cell carriers generally outsource tower work, asserting that it isn't part of their core business.

Major carriers *AT&T, T-Mobile, Verizon, and Sprint*	23
Regional carriers *12 regional carriers*	17
Tower owners *Seven tower owners*	10

Among the major carriers

For the first time, our investigation has revealed the number of fatalities at subcontractors working on each carrier's networks.



Source: Occupational Safety and Health Administration investigations, ProPublica research

An investigation by ProPublica and PBS "Frontline" shows that the convenience of mobile phones has come at a hefty price: Between 2003 and 2011, 50 climbers died working on cell sites, more than half of the nearly 100 who were killed on communications towers.

Yet cell phone carriers' connection to tower climbing deaths has remained invisible. They outsource this dangerous work to subcontractors, a practice increasingly common in risky businesses from coal mining to trucking to nuclear waste removal. If you look up the major cell carriers in the Occupational Safety and Health Administration's database of workplace accident investigations, you will not find a single tower climber fatality listed.

Guilford didn't work for AT&T – he worked for a subcontracting outfit affiliated with a bigger subcontractor hired by a construction management firm working for AT&T.

For each tower-related fatality since 2003, ProPublica and PBS "Frontline" traced the contracting chain from bottom to top, reviewing thousands of pages of government records and interviewing climbers, industry executives and labor experts.

We found that in accident after accident, deadly missteps often resulted because climbers were shoddily equipped or received little training before being sent up hundreds of feet. To satisfy demands from carriers or large contractors, tower hands sometimes worked overnight or in dangerous conditions.

One carrier, AT&T, had more fatalities on its jobs than its three closest competitors combined, our reporting revealed. Fifteen climbers died on jobs for AT&T since 2003. Over the same period, five climbers died on T-Mobile jobs, two died on Verizon jobs and one died on a job for Sprint.

The death toll peaked between 2006 and 2008, as AT&T merged its network with Cingular's and scrambled to handle traffic generated by the iPhone. Eleven climbers died on AT&T jobs in those three years, including Guilford.

"I don't think there's any question that the pressure to build out the network has been a contributing factor to fatalities," said Steve Watts, who worked as a risk manager at AT&T until 2007.

Current AT&T officials would not comment on the Guilford case and declined requests to be interviewed for this story, as did officials at the other major cell carriers.

In a written statement, AT&T said it required its contractors to follow safety regulations and that cell tower fatalities had decreased in recent years even as carriers have continued to make expensive improvements to their wireless networks. There were no fatalities on AT&T jobs last year, the statement noted.

"Worker safety has always been a hallmark of AT&T," the statement said.

The carrier and its construction management firm, General Dynamics, had no employees on site when Guilford died – only subcontractors. Neither was sanctioned in OSHA's

investigation after the accident.

OSHA cited just one company for safety violations in the case: Nashville-based Phoenix of Tennessee, the parent company of All Around Towers, the subcontractor that had managed the climbing crew. Inspectors concluded that Phoenix of Tennessee had not removed broken equipment from the site or addressed unsafe work conditions in plain view. The company paid a fine of $2,500.

All Around Towers went out of business soon after the accident. Two of its owners, who started a new tower company called ETA Systems, declined to answer questions from ProPublica and PBS "Frontline."

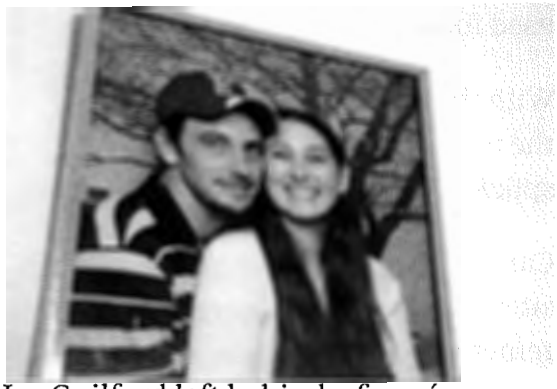
Kyle Waites, the owner of Phoenix of Tennessee and part-owner of All Around Towers, said he sent climbers for retraining and purchased new safety equipment after Guilford's fall.

"Do I feel responsible to a degree? I think everybody does that was involved with it," Waites said. "What caused Jay's death was a chain of events that all could have, and should have, been prevented."

But Waites said that those off site, like himself, could only do so much to ensure climbers' safety – it had been up to All Around Towers, and Guilford himself, to follow the rules.

"Once you leave men alone, the men have to police themselves," he said.

Guilford left behind a fiancée, Bridget Pierce, and two young children, Emily, now 7, and Aidan, now 5.



Jay Guilford left behind a fiancée, Bridget Pierce, and two young children.

Under policies provided by Phoenix of Tennessee, Pierce received $200,000 in life insurance, but was denied worker's compensation because an autopsy showed Guilford had recently smoked marijuana. Lawyers advised Pierce not to sue because of the drugs.

In her house on the outskirts of Murfreesboro, Tenn., Pierce keeps a framed picture of Guilford posing atop a cell tower. He's smiling, his fists pumping in the air. After years of moving furniture and delivering pizza, he had loved his $10-an-hour climbing job, she said.

Still, Pierce cannot escape the sense that Guilford had been a disposable part to the companies that rely on men like him to go up cell towers.

"It's like he didn't exist," she said. "They just pass the ball off to the next person. Everybody in this process should be held accountable."

* * *

Until the 1990s, most tower work involved radio and television towers, which can be more than 1,000 feet high. Some phone companies employed staff climbers to work on microwave towers

used for long-distance calling.

With the proliferation of cell phones, the pace and volume of tower work spiked.

Carriers blanketed the country with cell sites to extend service to the most remote areas. There are now more than 280,000 sites nationwide, up from 5,000 in 1990. Many advances in service require switching out antennas and doing other upgrades.

The surge of cell work forever altered tower climbing, an obscure field of no more than 10,000 workers. It attracted newcomers, including outfits known within the business as "two guys and a rope." It also exacerbated the industry's transient, high-flying culture.

Climbers live out of motel rooms, installing antennas in Oklahoma one day, building a tower in Tennessee the next. The work attracts risk-takers and rebels. Of the 33 tower fatalities for which autopsy records were available, 10 showed climbers had drugs or alcohol in their systems.

"It's the wild, wild west of the technology industry," said Victor Guerrero, a construction project manager and former climber. "You've got to have a problem to hang 150 feet in the air on an 8-inch strap. You've got to be insane."

Since 2003, an analysis of OSHA records show, tower climbing has had a death rate roughly 10 times that of construction. In 2008, the agency's top administrator, Edwin Foulke, called tower climbing "the most dangerous job in America" at an industry conference.

"That's an alarming incidence of fatalities," said John Henshaw, who preceded Foulke as OSHA's administrator from 2001 to 2004. "It shouldn't be tolerated."

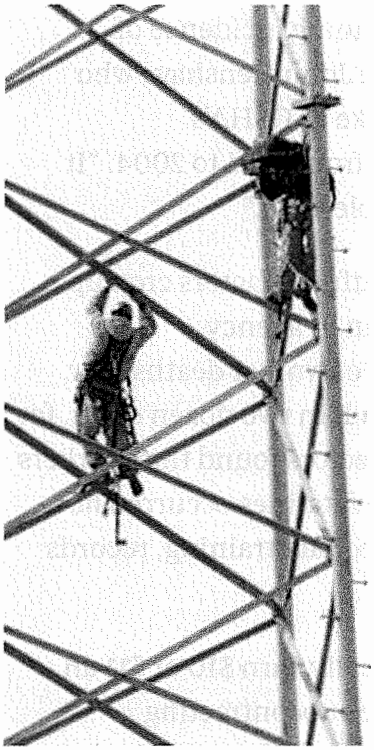
The same handful of factors crop up again and again in agency investigations of worker deaths, our reporting found. In two dozen cases, for example, inspectors found that workers on sites where fatalities occurred had received inadequate training, records show.

Climbers typically earn $10 or $11 an hour, yet some subcontracting companies demand they pay for their own safety gear, deducting money from their paychecks.

Faulty or misused equipment was identified in almost one-third of the tower-related deaths since 2003, OSHA records show. In April 2008, after 46-year-old William Bernard died in a 75-foot fall, an inspector found that his safety harness, rusty with wear, had a defective hook.

Carriers sometimes power down cell sites when climbers are on them, so subcontractors often work overnight, when fewer customers will notice disruptions. Jeremy Combs, 33, fell to his death just before midnight in September 2008, on a job where the crew wore headlamps and raced to meet an accelerated timetable, OSHA inspectors found.

Time pressure often leads tower hands to use a technique called free-climbing, in which workers don't connect their safety harnesses to the tower. This allows them to move up, down and



A tower worker (left) "free-climbs," neglecting to attach himself to the tower in order to save time. Wally Reardon, a veteran climber who quit in 2002, takes photos of free-climbing to raise awareness of the practice (Photo courtesy of Wally Reardon).

around more quickly, but leaves them without fall protection. In more than half of the tower fatalities we examined, workers were free-climbing, even though government safety regulations strictly prohibit it.

Wally Reardon, a veteran climber who quit in 2002, takes photos and video whenever he spots workers free-climbing to raise awareness about the practice. It often occurs within clear view of on-site supervisors and has their tacit approval, he said.

“Even the safest people I’ve worked with in the industry eventually will cave to it,” he said of the pressure to use such shortcuts.

After 32-year-old William Knorr died in

a 2004 fall, OSHA found that his supervisors had "completely disregarded" safety regulations to save "Time, Work, Money," an investigation report said. "Was there a motive? Faster and Easier."

No one knows better than Ray Hull how time pressure can lead to injuries.

In November 2003, Hull, then 35, was hired by a subcontractor to help build a 350-foot cell tower for Nextel in a cornfield near Fremont, Neb. The job needed to be done by midnight on Thanksgiving, just seven days away.

The project ran into a series of problems. The crane operator, deciding it was too windy to work, took his crane and left. Hull found replacement equipment, but it was in Texas, more than 15 hours away. Setting out to retrieve it, Hull and another tower hand, Frankie Ketchens, drove nonstop, taking turns behind the wheel.

When they arrived back at the site two days later, there was a Nextel truck near the tower's base. Hull assumed the carrier wanted to make sure the job was on time. He was mistaken – the driver was just a technician – but instead of returning to their motel to sleep, Hull and Ketchens immediately went to work.

When Hull had climbed 240 feet to add a section to the tower, Ketchens pulled the wrong lever on equipment hoisting a huge piece of steel. The equipment broke away from the tower and fell to the ground – with Hull attached. His safety harness broke his fall momentarily, then snapped.

Hull has no memory of falling or hitting

the ground. When he came to, he saw Ketchens above him. "I said, 'Frankie, I can't live through this ... You need to tell my family I love them," Hull recalled.

According to court records, Hull suffered massive internal injuries. He sued three companies involved with the project, and received a settlement from the subcontractor that hired his firm.

His case against Nextel was dismissed, however. In court documents, the carrier argued that its final project deadline was actually a month later and hadn't compelled the climbers to take undue risks.

The carrier also said it wasn't responsible for Hull, who, as a subcontractor, was "three entities removed from any relationship with a NEXTEL entity." (Nextel merged with Sprint in 2005. Sprint declined to comment on the case.)

Hull's injuries left him unable to climb towers. He started climbing at 14, following his father and grandfather into the business. Nearly nine years after the accident, he still misses it horribly. "There's probably not a human being alive that loved their job as much as I did," he said. "Everything that I could do was taken from me."

Watching an OSHA video of the accident scene for the first time late last year, his eyes welled with tears.

"It was a bad day. Or a good day depending on which way you look at it,' he said. "I walked away from it."

* * *

An OSHA investigation documents equipment from a fatal tower accident (Photo from OSHA investigation file).

Cell carriers give several reasons for why they outsource tower work: Building and maintaining towers, though crucial to cell service, isn't part of their core business. Contractors have greater expertise with construction. It's more economical to hire workers where and when needed, given the up-and-down volume of work.

"It makes good business sense for them to contract it out," Watts said.

But handling tower work this way also insulates companies atop the contracting chain from legal and regulatory consequences when there are accidents, industry insiders say.

OSHA has the authority to cite carriers if it can prove they had direct control over work or knew of safety violations. Yet, even though some carriers set prices and timetables for tower jobs – and many of their technical specifications, down to how to color code coaxial cables – their supervisors typically stay off-site and do not manage jobs directly.

The oversight system provides an incentive for them not to know too much about what's happening on work

sites, labor experts say.

"Information that there are unsafe practices makes you responsible for fixing those practices," said Thomas Kochan, a professor of management at MIT.

AT&T contracts spell out precisely what level of responsibility it wishes to have over each aspect of tower projects. In a table called the Division of Responsibilities Matrix, the carrier lists more than 100 tasks and, for each one, indicates if AT&T wants responsibility for it, to be consulted on it, or to be informed about it.

In three-year contracts issued in 2008 that were examined by ProPublica and PBS "Frontline," the matrices were blank for safety-related items, such as ensuring that OSHA standards were met. Contractors told us they understood this to mean the carrier wanted no involvement with them at all. AT&T declined to answer questions about the matrix.

In addition to outsourcing tower work, some cell phone companies funnel jobs through middlemen known as turf vendors. AT&T does this on almost all tower jobs; in 2010, Sprint moved toward a similar system.

Turf vendors – typically large construction management firms such as General Dynamics, Bechtel and Nsoro – oversee batches of tower projects, subcontracting out the climbing work to smaller companies.

Ed Reynolds, AT&T's president of network services until 2007, said middlemen lessened the administrative burden on carriers, giving them one big

contractor to deal with instead of dozens of little ones.

"You got one throat to choke," he said.

But subcontractors often contract out jobs to other subcontractors. As jobs are passed down from one company to the next, there's less ability to control who's actually doing the work, said Mark Hein, who has worked for several turf vendors as a construction manager.

When he was sent to check on cell sites last year, Hein discovered many subcontractors that hadn't been approved by the turf vendor.

"I'd show up on site and expect to find Company A and instead find Company Z," he said.

Many of the crews he came across weren't taking the most rudimentary safety precautions.

"They didn't have their hardhats, they didn't have safety glasses, they didn't have safety gear," he said. Many of the climbers lacked training certificates.

Hein did not have time to visit every site he was assigned to supervise – there were just too many, he said, a common lament among other construction managers for turf vendors.

Turf vendors also take a cut of what carriers pay for tower work – sometimes 40 percent or more – so subcontractors say they make less on these jobs.

In AT&T contracts examined by ProPublica and PBS "Frontline," the carrier requires turf vendors to reduce their prices 5 percent each year over the three-year term of the contract. These reductions are typically passed through

to subcontractors, industry insiders said.

"Guess who takes the hit? The next level [down]," said a construction manager for a turf vendor. "I'm not going to reduce the amount of money I take."

Chris Deckrow, who owns a small climbing company in Michigan, showed ProPublica and PBS "Frontline" the price sheet for AT&T jobs. For the task of installing a remote radio head, the price sheet said, the carrier would pay the turf vendor $187 and the turf vendor would pay the subcontractor $93.

Deckrow said his company – which often works as a subcontractor of a subcontractor – has been paid as little as $40 for installing remote radio heads. Overall, he said, he makes less than half the money working for a turf vendor that he would make working directly for a carrier.

Hein said the difference in pay dictates which companies take jobs involving turf vendors.

"Rather than paying this amount to this guy, who's really qualified and ... has a great reputation, they hire this person over here because he's available right now and he'll do it for what we want him to do it for," he said.

Verizon, which hires subcontractors directly, tends to work with the same select group of climbing companies over and over, paying them more, subcontractors say. David Coleman, an industry analyst at RBC Capital Markets, described becoming a Verizon subcontractor as the "golden ticket."

Several subcontractors complained that

they had to cut corners to turn a profit on turfing jobs, using three-man crews instead of four, putting in 18-hour days, hiring less experienced men and working through inclement weather.

Reynolds, who now works as an industry consultant,dismissed such gripes. "There's enough subcontractors out there willing to work," he said. Those that don't like the prices, he said, will "do something else."

Buckling on a harness before mounting a 300-foot tower last March to check out a broken light, Deckrow described how tight margins erode safety.

He said he's struggled to pay insurance premiums, cut back on training programs and delayed buying new safety gear for his men.

"This is stuff they have to wear every day in order to live through the day," he said. "We would love to replace it every year, every two years ... It's not in the budget."

Deckrow said earlier this month that he had decided to close his company rather than making further cuts.

"I want to be able to not worry about my guys not coming home," he said. Throughout the industry, companies are choosing between safety and staying in business, he added. "If we're not properly maintained or trained, then people will die. It's only a matter of time."

* * *

The worst years for cell site fatalities in the last decade were 2006 and 2008.

Most inside the industry agree that AT&T faced unique challenges and pressure to build out its network (PBS "Frontline").

There is no way to correlate these figures with workloads or to compare one carrier's tower work to another's because such information is proprietary. As of mid-2011, the four major carriers had varying numbers of cell sites: Verizon had 44,250, T-Mobile had 50,143, AT&T had 56,070 and Sprint had 67,500, according to data from US Wireless 411, a report by UBS.

Most inside the industry agree, however, that AT&T faced unique challenges and pressure to build out its network.

After Cingular merged with AT&T in 2004, the combined company (which later took the AT&T name) had to join its network systems, adjusting virtually every single cell site. Reynolds compared it to replacing the engines of a 747 in mid-flight.

In 2006, when the bulk of this work was done, 10 climbers died on cell site projects, including four on jobs for AT&T within two months.

William "Bubba" Cotton, 43, was the first, crushed to death on March 10 when a rope snapped, dropping a 50-

pound antenna on him. According to OSHA documents and court records, the accident occurred as two crews – one aloft and one on the ground – rushed to complete work on a tower in Talladega, Ala., before an upcoming NASCAR race. AT&T would not extend the deadline for the job despite a request from a crew leader, two workers testified in sworn depositions. (The company declined to comment on the case.)

The pressure ratcheted up again when AT&T became the exclusive carrier for the iPhone.

After the phone debuted in summer 2007, triggering a tsunami of data usage, customers began complaining about dropped calls and spotty service. According to a report in Wired, AT&T went to Apple, asking for help in limiting traffic to buy time for tower upgrades. Instead, Apple Chief Executive Steve Jobs explored switching to Verizon, the report said.

To prepare for the iPhone 3G's introduction in summer 2008, AT&T poured billions of dollars into wireless capital expenditures. The push meant work on an unprecedented scale for tower climbers.

"It was nuts," said Dan MacRae, a project manager who has worked on cell site projects for several turf vendors. "We were working in the field for 40 hours straight. They had crews in rain, sleet, snow."

The building boom was accompanied by a string of accidents.

After two climbers died on AT&T jobs within a five-day period in April 2008,

the carrier sent a letter to turf vendors calling for a construction stand down to discuss safety procedures and hold half-day courses to retrain workers.

But Guilford died just three and a half weeks after the work stoppage. Two more climbers died on AT&T jobs within the next four months.

AT&T would not answer questions about the stand down. In its statement, the carrier said that fatalities have decreased in the years since the stand down, aided by a safety initiative by OSHA and the tower industry.

Craig Lekutis – the founder of WirelessEstimator.com, a trade publication for the tower climbing industry – said the stand down turned out to be "more lip service" and not a long-term commitment.

Lekutis has tracked tower fatalities since 2004 and memorializes each lost climber on his website.

"Sadly, the major players know it's happening and know that they are contributors to it," he said, "but they don't do anything."

* * *

Tower-climbing fatalities have dropped considerably since the end of 2008.

Nine climbers died on cell site projects between 2009 and 2011, less than half as many as in the three previous years. There has been only one fatality on an AT&T job since 2009. Ethan "Little Britches" Hutchinson, 18, died in May 2010 after falling from a tower in Arkansas when his safety gear malfunctioned.

Ethan Hutchinson, 18, died in May 2010 after falling from a tower in Arkansas.

Some in the industry point to improved safety practices to explain the smaller death toll. Others say the recession cut into the volume of tower work and that, after finishing 3G upgrades, much of what carriers needed could be done on the ground.

With the next big push – building out 4G LTE networks – just getting underway in major markets, some veteran climbers worry that the fatality numbers will rise again.

"If not this year, another bad year is going to come," said Reardon, the tower industry veteran. "It's all about trying to do things faster and cheaper."

The subcontracting system remains much as it was during the worst years, climbers say.

There are also many young men like Jay Guilford, with few prospects and no experience, willing to climb towers if it means a steady paycheck.

Years later, the horror of Guilford's death remains fresh to Pierce, who was engaged to him at the time. She remembers receiving the phone call

from his father as she arrived home from shopping for an upcoming trip to Disney World.

"I freaked out and screamed and just screamed and screamed," she said.

Yet, about a year and a half later, when her current boyfriend was out of work, Pierce approached Phoenix of Tennessee to ask if he could apply to be a tower climber.

In retrospect, she regretted doing so, she said, but it was the only company she knew that had work. Ultimately, he found a job at Jack in the Box.

Guilford's stepbrother, Anthony Acker, also sometimes works as a tower climber. The family tried to talk him out of returning to it about a year ago.

"He said, 'Don't worry about me, old man, I'm being careful," said Gary Hart, Acker's father and Guilford's stepfather. "I just hope it all works out for him because I don't want to go through all this again."

Part 2: How OSHA has struggled to police this dangerous industry.

Travis Fox of PBS "Frontline," Robin Respaut and Kirsten Berg of ProPublica and Habiba Nosheen contributed to this report.

PBS "Frontline" aired a film version of this story. Check local listings.

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Mahwah Police investigating theft of cell tower batteries

Andrew Wyrich, Staff Writer @AndrewWyrich Published 8:59 a.m. ET April 21, 2017

(Photo: Jim Alcorn/Special to NorthJersey.com)

MAHWAH – Township police are investigating the theft of several large cell phone tower batteries that may have been stolen as part of a larger theft scheme, authorities said.

Mahwah police were notified of the batteries being stolen by an engineer from Verizon Wireless who spotted that they were missing during an inspection, Chief James Batelli said.

The batteries are stored in a cabinet adjacent to the tower, Batelli said, and are fenced in and secured with locks that had been removed. The alarm system for the cabinet also was disengaged, Batelli said.

Mahwah police then discovered that batteries were taken from another nearby cell tower, Batelli said.

On average, the batteries weigh approximately 40 pounds each and the cost to replace the batteries is approximately $10,000 at each site, Batelli said.

NEWS: Police search for Englewood bank robber (/story/news/bergen/englewood/2017/04/19/police-search-englewood-bank-robber/100654210/)

MAHWAH: Nanny stole $100,000 worth of jewelry from home, police say (/story/news/crime/2017/03/23/police-nanny-stole-100000-worth-jewelry-mahwah-home/99538064/)

CRIME: Cliffside Park woman arrested for setting apartment on fire (/story/news/bergen/cliffside-park/2017/04/20/cliffside-park-woman-arrested-setting-apartment-fire/100719042/)

The batteries are used to provide backup service to the towers in case of a power outage, Batelli said.

Similar incidents have been reported in Cedar Grove, Pennsylvania, Texas and California, Batelli said.

"It is believed the batteries are being stolen and resold at scrap yards for the value of the lead which is partially what they are made of," Batelli said.

Email: wyrich@northjersey.com Twitter: @AndrewWyrich (https://twitter.com/AndrewWyrich)

Read or Share this story: https://njersy.co/2p31Y79

Cell tower catches fire behind Heritage High School in Newport News

Newport News firefighter medics extinguished a cell phone tower fire behind Heritage High School

By **Sarah J. Ketchum**
Daily Press

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Cell tower catches fire behind Heritage High School in Newport News

JUNE 16, 2015, 1:22 PM | NEWPORT NEWS

Workers welding on a cell phone tower sparked a swiftly-moving fire behind Heritage High School in Newport News Tuesday, an official said.

Firefighters responded to the blaze at 5800 Marshall Avenue just before noon, according to fire department spokesman Battalion Chief Stephen Pincus.

The insulation on the lines caught fire, which spread rapidly through the inside and outside of the tower, he said. The Briarfield fire station is located right in front of the school, but by the time crews rounded the corner, flames had already moved up the entire length of the tower, he said.

Extra firefighters were called to the scene because of the heat and humidity, Pincus said. The temperature in Newport News reached above degrees, according to the National Weather Service. Pincus said it's important to rotate crews during hot weather so they don't suffer heat-related illnesses. Their thermal gear and air pack weighs about 80 pounds.

"I'm very highly concerned with personnel safety," he said

Students inside the school were moved to the front of the building, as a precaution, according to Pincus. Crews were concerned that the fire had compromised the structural integrity of the tower and that it might collapse, he said.

The fire was extinguished in about 25 minutes, according to Pincus. The tower did not collapse, and no injuries were reported.

The fire caused extensive damage to the tower and left it completely disabled, Pincus said. Virginia Dominion Power was called to disconnect all electricity to the tower, and crews from Sprint and Verizon are assessing the damage, he said.

This article is related to: Fires, National Weather Service

Arcadia Weekly

Tuesday, January 30, 2018 51°F ORANGEVALE

News

Arcadia Denies Verizon Proposal For Zone

Perhaps a tip-of-the-hat to Donald Trump's campaign cap slogar appeal want to 'Keep Arcadia Great' by not having a cell tower i by Terry Miller / Beacon Media News

By Malak Habbak

Arcadia City Council denied Verizon Wireless' proposed wireless tower facility in a resider the council that the facility had an immediate need and was the best alternative. The deci Arcadians Against Residential Towers in their battle with Verizon, nicknamed "David vs. G

Over 20 residents spoke against the tower during public comments, citing reasons for dei The group, young and old, dressed in green shirts for solidarity with yellow signs, flooded would open the gates to telecommunications carriers in residential zones, currently prohib

Under federal preemption, the city would be required to grant Verizon's request if it could least intrusive, given proper alternatives were analyzed.

"When it comes down to everything, you just have to go with your gut as to what the right t councilmembers Sho Tay, April Verlatto and Peter Amundson declared that Verizon did no

Beck was open to the alternative of 10 small cells, detailed in Verizon reports, but the idea consultant Douglas Dickinson (paid by Verizon) from CommVergent Technologies, who ar number of people" that would get covered by the 53-foot macro site. Dickinson further sta disguised as a bell tower at the Church of the Transfiguration, and that about 25-30 small

"Quite frankly, I think they made a good argument as much as they possibly could," said c opposition of the proposition. "We have a law to deal with and we're running on the edge.'

Verizon's gap in coverage claims were rooted in Long Term Evolution (LTE), a form of high

"We do not have 4G, AWS, LTE coverage in this area right now," said Albritton, referencing generation wireless services around the corner, Verizon would require more "close-knit fac

The Telecommunications Act of 1996, which ultimately supersedes municipal law, was use Gail Karish, who said the law protects multiple services in the mobile broadband.

Yet Verlatto found it hard to believe the federal act considers "my son's gaming" as a publ

"I don't think that's what the overall goal of these ordinances and the federal government v towers wherever they feel like they need to upgrade their services."

The decades old act also trumps any health-related concerns that were brought before cc commission denied the project twice, with the initial proposal to disguise the tower as a eu

Reverend Julie D. Bryant, the landlord of the proposed bell tower at the Church of the Trar would blend with the existing church. The tower would also fit with the organization's missi would help support the church's programs.

"The well-being, health and safety of our members, pre-school students, staff and neighbc said. After being contacted by Verizon for use of the property, she said the parish and the proceed "until we had been satisfied first."

She believed the tower would not be unique in that similar types of wireless facilities dwel Grove Elementary) and homes in Arcadia, an argument raised at city council and confirm Kasama.

Bryant even argued she had a "great interest" with its aesthetics of the bell tower, which v an aesthetic asset for a "Spanish revival."

Some neighbors of the church, including Marian Bachmeier, protested the aesthetics and Estates for legitimate reasons to base the denial. Ken Obst called the tower a "monstrosit post-war bedroom community identity.

"It's a very sensitive issue for my wife and I," said Obst, who lives across the street from th have a question for each of you: If Verizon were to build a tower across the street from wh

Beck also had a problem with the location and aesthetics. "It's going to stick out," he said there's a viable alternative to this bell tower and that Verizon should pursue that."

City council will complete a resolution on Feb. 21 with findings based on fact to deny the on federal preemption.

cell tower | City Council | verizon

February 8, 2017

ABOUT AUTHOR

Malak Habbak

Malak Habbak is a journalist and photographer covering local news across Southern Californi awarded Outstanding Graduating Student by her department. In the past four years, she cover and The Poly Post.

< Baseball Reliquary Presents 'Only the Ball Was White' Film

YOU MAY ALSO LIKE

Peter Amundson Elected Mayor, Sho Tay New Mayor Pro Tem

Arcadia, Verizon Match Deadlines for Legal A May

6 COMMENTS ON THIS POST TO "ARCADIA DENIES VERIZON PROI ZONE"

Frederic says:
February 8, 2017 at 9:22 pm

Sho Tay once again showed how he's confused on every subject. Can he PLEASE resign

+ REPLY

MSN says:
February 12, 2017 at 3:43 am

Sho Tay was GREAT! He knew exactly what was happening and communicated hi is subtly in what he communicated during the final City Council deliberation but when he is up for re-election...all 4 City Council members who voted to deny Ver The Council stopped MACRO-SITES = CELL TOWERS in all the R-1 zones not just have caused a proliferation in every R-1 neighborhood and would be impossible t

+ REPLY

MSN says:
February 9, 2017 at 1:02 am

The City Council made the right decision by denying the Verizon application for a 53′ ce ranch homes. We have few McMansions in our neighborhood. The cell tower would stuc to be allowed in ALL the R-1 zones. We are so grateful that the City Council protected o

+ REPLY

Eli Tsou says:
February 9, 2017 at 8:59 am

Council absolutely made the right decision. This siting was unneeded and unwanted by elementary school who had their kids within the 53′ of this tower can now feel better ab neighborhood can continue to enjoy their neighborhood.

Verizon coverage is already the best in Arcadia. With the hundreds of towers already in expansion of wireless coverage by upgrading the technology on current towers. They al: poles in our public right-of-way facilities.

With this specific application, they ignored a preferable collocation siting that is better profitable for them. However, it would've been easier for the city, and better for the resi for this more undesirable tower.

+ REPLY

Edward Mui says:
February 10, 2017 at 5:05 am

Thumbs up to the 4 Council members that strike down this tower. (When they are up fo they were able to see through all the smoke and screen and made a right decision. Ther

data submitted by Verizon was "engineered" to favor an approval. Also, how can Verizo tower is the least intrusive option? Really? That tower would destroy the aesthetic of tl to deliver data it should look into using "small cells" instead.

I am so happy the City Council was able to protect its citizens from a corporate bully. T The council also stopped a potential proliferation of towers by saying no to this 53-foo Arcadia should give the 4 Council members a big round of applause!

+ REPLY

MSN says:
March 2, 2017 at 10:44 pm

Verizon has sent the City of Arcadia their intention that they are going to sue the City. property owner of the Church of the Transfiguration, to STOP THE LAWSUIT.

+ REPLY

LEAVE A REPLY

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http://www.ledger.news/news/local_news/supervisors-vote-down-controversial-cell-tower/article_8f550e88-ba81-11e7-a075-3fd529dd3818.html

Supervisors Vote Down Controversial Cell Tower

Craig Baracco Oct 28, 2017

Board Chair Richard Forster (left) reads a proclamation honoring Lisa Schnepple (center) upon her retirement from the Amador County Probation Department. Next to Schnepple is Chief County Probation Officer Mark Bonini.

Craig Baracco

The Amador Board of Supervisors have voted down a permit that would have allowed a controversial cell phone tower on Willow Creek Road south of Highway 16. Meeting Tuesday morning, the Supervisors were hearing an appeal of a Planning Commission vote to deny the permit in September. As before, the Planning Commission, several neighbors testified against the proposed 136-foot tower. County Council Greg Gillott stated, at the start of the hearing, that under State law, the Board could not consider alleged health impacts of cell phone towers, so claims made at the Planning Commission that the tower would cause cancer in those who lived close-by were not repeated, but neighbors still objected to the appearance of the tower in a rural area. The supervisor's main objection to the project was a failure to co-located the project on a existing cell tower a half mile away. The tower project was funded as part of a federal program to bring high-speed internet service to rural areas that were underserved, and the project applicants, AT&T, insisted that they would not allow them to reach the required number of rural customers under the Federal program that funded the project. The Supervisor's were not impressed with the cell phone company's argument, with Supervisor Pat Crew saying "It seems to me you [AT&T] just haven't done

enough to try and co-locate this project. Several Supervisors noted the lack of public speakers who favored improved cell phone and internet service in the area affected. The permit was denied on a 5-0 vote.

In other business, the board gave an approval to a county-wide Tourism Promotion District. The new District would collect an additional fee of two percent on hotel stays throughout the county to fund Tourism promotion in the county. The new fee is expected to raise over $200,000 dollars, essentially doubling the budget of the Amador Council of Tourism.

Also approved was a $210,000 loan to the Jackson Valley Irrigation District to help pay for repairs on the Lake Amador Dam. JVID will use the loan to begin work immediately, and then repay the County once the irrigation district eventually receives state and federal emergency repair payments.

Finally the Board voted to release $20,000 from a Veterans Memorial fund to held pay for repairs at the public pool in Plymouth. The fund is specifically designated for projects that memorialize veterans. The Plymouth Veterans Memorial pool has been closed for the year. A total of $200,000 is being raised for the needed work, including both public funds and private donations.

[redacted]

Use Permit, Epic Wireless

Use Permit application by Epic Wireless Group on behalf of Verizon Wireless. The proposal is to erect eight (8) cellular antennas affixed to various points of the rooftop of 109 North Pine Street. Please review the staff reports below for a more complete project description.

CURRENT STATUS: The applicant has filed an appeal of the Planning Commission's decision to deny this Use Permit application. At their September 13, 2017 meeting, City Council denied the request by Epic Wireless to continue this item for a third time to allow them additional time to evaluate alternative antenna sites. Council directed staff to set the Public Hearing date for **September 27, 2017 at 6:30 p.m.** or as soon thereafter as the matter may be heard. The staff report can be found at the following link: http://www.nevadacityca.gov/agendalist.aspx?categoryid=9947

Preliminary Plans (updated 4/2016)
Application and Questionnaire
Coverage Map
Photo Simulations (updated 4/2016)
Radio Frequency Report (updated 5/2016)
Exhibits 1-11 Provided by applicant at June 16, 2016 meeting

NOTICE OF SCHEDULED PUBLIC HEARING for September 27, 2017 at 6:30 at City Hall Council Chambers
NOTICE OF SCHEDULED PUBLIC HEARING for September 15, 2016 at 2:00 at City Hall Council Chambers
NOTICE OF SCHEDULED PUBLIC HEARING for August 18, 1016 at 1:30 at City Hall Council Chambers
NOTICE OF SCHEDULED PUBLIC HEARING for June 16, 2016 at 1:30 P.M. at City Hall Council Chambers.
See below for staff reports.

NOTICE OF AVAILABLITY/NOTICE OF INTENT to file a Mitigated Negative Declaration for the Use Permit proposal. A copy of the draft

Initial Study/ Mitigated Negative Declaration is available for review. Comments on this study must be received no latter than June 15, 2016, by 5p.m.

STAFF REPORTS:

September 15, 2016 Planning Commission Staff Report (denied)

August 18, 2016 Planning Commission Staff Report (continued from June 16, 2016)

June 16, 2016 Planning Commission Staff Report (updated 6/9/2016) (Draft IS/MND included)

May 24, 2016 Advisory Review Committee (Draft Mitigated Negative Declaration included in packet)

January 21, 2016 (Architectural Review Only-Continued)

March 17, 2016 (Architectural Review Only-Approved)

PUBLIC COMMENT (not included in the staff reports):

David Adams email w/ Attachments (June 10, 2016)

David Adams - additional opposition letter (June 13, 2016)

David Adams - aesthetics opposition letter (June 13, 2016)

Marston Schultz - opposition letter w/Attachments (June 15, 2016)

David Adams - coverage gap opposition letter (June 15, 2016)

David Adams - IS/MND opposition letter (June 16, 2016)

Nevada County Historical Society, August 5, 2016

Graph: "Symptoms by People in the Vicinity of Cellular Phone Base Station," submitted by Marston Schultz

Email: *Re: Property Devaluation Near Cell Towers and Antennas*, submitted by Paula Orloff

Email: *Re: Decrease in Property Values for Properties near Cellular Antennas and Towers*, submitted by David Adams, Richard Cristdahl, Paula Orloff, Susan Pelican, and a Group of Concerned Citizens, Businesses, and Property Owners+

Email: *Re: Cell Tower Project Review August 18, 2016*, submitted by Jill Fuerst

Letter to EBI Consulting from Nevada County Landmark's Commission

Letter to Planning Commission from Laurie Oberholtzer

Petition Sheets - Submitted at June 21, 2016 meeting

Correspondence & Literature submitted at August 18, 2016 meeting

Email responses to Verizon text message

David Adams - Suggested Denial Findings

P. Orloff - Property Devaluation Information

Richard Cristdahl - ADA disability liability information, submitted 9/14/2016

R. Cristdahl : Science of total Environment- 11/30/2016

R-Cristdahl: NTP Preliminary Report-11/30/2016

P. Orloff: Governments and Orgs. that Ban or Warn Against Wireless Technology-11/30/2016

P. Orloff: FAQs About National Toxicology Program Radiofrequency Rodent Carcinogenicity Research Study-11/30/2016

M. Lipowitz: "Telecom Notices to Stockholders" and "Insurance Companies' Electromagnetic Field Exclusions"-11/30/2016

Video Links:

Cell Tower Community Meeting, Dr. Magda Havas (submitted by Marston Schultz July 26, 2016)

Health Risks of EMF, Dr. Martin Blank (submitted by Marston Schultz July 26, 2016)

"Wake Up Call" Olle Johannsson EMF Expert (submitted by Marston Schultz July 26, 2016)

RESONANCE Beings of Frequency (submitted by Marston Schultz July 26, 2016)

 PC 2-8-18 #3 72 Pages

Planning Department <planning@edcgov.us>

CHALLENGE Conditional Use Permit S17-0016/AT7T CAF4 - Attachments 3

1 message

Sierra Person <sierradperson@yahoo.com> Thu, Feb 1, 2018 at 11:16 AM
To: planning@edcgov.us

Sierra Pearson
4221 Clouds Rest Rd
Placerville, CA 95667
530-409-3128

Additional Health Impact

10 attachments

- **Blake_Levit_Henry_Lai_1_.pdf** 223K
- **Cell and Smart Phones - Electromagnetic Field (EMF) Safety from Safe Space Protection.pdf** 634K
- **Cell and Smart Phones - Electromagnetic Field (EMF) Safety from Safe Space Protection.pdf** 634K
- **day2Varna_Foster.pdf** 24K
- **Dr. Magda Havas, PhD » International Experts' Perspective on the Health Effects of Electromagnetic F.pdf** 554K
- **eger_naila_2004.pdf** 362K
- **Electromagnetic Fields: A Hazard to Your Health? - HealthyChildren.org.pdf** 96K
- **Environmental Health Trust » Blog Archive American Academy of Pediatrics Issues New Recommendations to "Reduce Exposure to Cell Phones" - Environmental Health Trust.pdf** 348K
- **Guidelines for Installation of the Mobile Towers.pdf** 437K
- **Harvard Study.pdf** 214K

Biological effects from exposure to electromagnetic radiation emitted by cell tower base stations and other antenna arrays

B. Blake Levitt and Henry Lai

Abstract: The siting of cellular phone base stations and other cellular infrastructure such as roof-mounted antenna arrays, especially in residential neighborhoods, is a contentious subject in land-use regulation. Local resistance from nearby residents and landowners is often based on fears of adverse health effects despite reassurances from telecommunications service providers that international exposure standards will be followed. Both anecdotal reports and some epidemiology studies have found headaches, skin rashes, sleep disturbances, depression, decreased libido, increased rates of suicide, concentration problems, dizziness, memory changes, increased risk of cancer, tremors, and other neurophysiological effects in populations near base stations. The objective of this paper is to review the existing studies of people living or working near cellular infrastructure and other pertinent studies that could apply to long-term, low-level radiofrequency radiation (RFR) exposures. While specific epidemiological research in this area is sparse and contradictory, and such exposures are difficult to quantify given the increasing background levels of RFR from myriad personal consumer products, some research does exist to warrant caution in infrastructure siting. Further epidemiology research that takes total ambient RFR exposures into consideration is warranted. Symptoms reported today may be classic microwave sickness, first described in 1978. Nonionizing electromagnetic fields are among the fastest growing forms of environmental pollution. Some extrapolations can be made from research other than epidemiology regarding biological effects from exposures at levels far below current exposure guidelines.

Key words: radiofrequency radiation (RFR), antenna arrays, cellular phone base stations, microwave sickness, nonionizing electromagnetic fields, environmental pollution.

Résumé : La localisation des stations de base pour téléphones cellulaires et autres infrastructures cellulaires, comme les installations d'antennes sur les toitures, surtout dans les quartiers résidentiels, constitue un sujet litigieux d'utilisation du territoire. La résistance locale de la part des résidents et propriétaires fonciers limitrophes repose souvent sur les craintes d'effets adverses pour la santé, en dépit des réassurances venant des fournisseurs de services de télécommunication, à l'effet qu'ils appliquent les standards internationaux d'exposition. En plus de rapports anecdotiques, certaines études épidémiologiques font état de maux de tête, d'éruption cutanée, de perturbation du sommeil, de dépression, de diminution de libido, d'augmentations du taux de suicide, de problèmes de concentration, de vertiges, d'altération de la mémoire, d'augmentation du risque de cancers, de trémulations et autres effets neurophysiologiques, dans les populations vivant au voisinage des stations de base. Les auteurs révisent ici les études existantes portant sur les gens, vivant ou travaillant près d'infrastructures cellulaires ou autres études pertinentes qui pourraient s'appliquer aux expositions à long terme à la radiation de radiofréquence de faible intensité « RFR ». Bien que la recherche épidémiologique spécifique dans ce domaine soit rare et contradictoire, et que de telles expositions soient difficiles à quantifier compte tenu des degrés croissants du bruit de fond des RFR provenant de produits de myriades de consommateurs personnels, il existe certaines recherches qui justifient la prudence dans l'installation des infrastructures. Les futures études épidémiologiques sont nécessaires afin de prendre en compte la totalité des expositions à la RFR ambiante. Les symptômes rapportés jusqu'ici pourraient correspondre à la maladie classique des micro-ondes, décrite pour la première fois en 1978. Les champs électromagnétiques non-ionisants constituent les formes de pollution environnementale croissant le plus rapidement. On peut effectuer certaines extrapolations à partir de recherches autres qu'épidémiologiques concernant les effets biologiques d'expositions à des degrés bien au-dessous des directives internationales.

Mots-clés : radiofréquence de faible intensité « RFR », les installations d'antennes, des stations de base pour téléphones cellulaires, la maladie classique des micro-ondes, les champs électromagnétiques non-ionisants, pollution environnementale.

[Traduit par la Rédaction]

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1. Introduction

Wireless technologies are ubiquitous today. According to the European Information Technology Observatory, an industry-funded organization in Germany, the threshold of 5.1 billion cell phone users worldwide will be reached by the end of 2010 — up from 3.3 billion in 2007. That number is expected to increase by another 10% to 5.6 billion in 2011, out of a total worldwide population of 6.5 billion.[2] In 2010, cell phone subscribers in the U.S. numbered 287 million, Russia 220 million, Germany 111 million, Italy 87 million, Great Britain 81 million, France 62 million, and Spain 57 million. Growth is strong throughout Asia and in South America but especially so in developing countries where landline systems were never fully established.

The investment firm Bank of America Merril-Lynch estimated that the worldwide penetration of mobile phone customers is twice that of landline customers today and that America has the highest minutes of use per month per user.[3] Today, 94% of Americans live in counties with four or more wireless service providers, plus 99% of Americans live in counties where next generation, 3G (third generation), 4G (fourth generation), and broadband services are available. All of this capacity requires an extensive infrastructure that the industry continues to build in the U.S., despite a 93% wireless penetration of the total U.S. population.[4]

Next generation services are continuing to drive the build-out of both new infrastructure as well as adaptation of pre-existing sites. According to the industry, there are an estimated 251 618 cell sites in the U.S. today, up from 19 844 in 1995.[4] There is no comprehensive data for antennas hidden inside of buildings but one industry-maintained Web site (www.antennasearch.com), allows people to type in an address and all antennas within a 3 mile (1 mile = 1.6 km) area will come up. There are hundreds of thousands in the U.S. alone.

People are increasingly abandoning landline systems in favor of wireless communications. One estimate in 2006 found that 42% of all wireless subscribers used their wireless phone as their primary phone. According to the National Center for Health Statistics of the U.S. Centers for Disease Control (CDC), by the second half of 2008, one in every five American households had no landlines but did have at least one wireless phone (Department of Health and Human Services 2008). The figures reflected a 2.7% increase over the first half of 2008 — the largest jump since the CDC began tracking such data in 2003, and represented a total of 20.2% of the U.S. population — a figure that coincides with industry estimates of 24.50% of completely wireless households in 2010.[5] The CDC also found that approximately 18.7% of all children, nearly 14 million, lived in households with only wireless phones. The CDC further found that one in every seven American homes, 14.5% of the population, received all or almost all of their calls via wireless phones, even when there was a landline in the home. They called these "wireless-mostly households."

The trend away from landline phones is obviously increasing as wireless providers market their services specifically toward a mobile customer, particularly younger adults who readily embrace new technologies. One study (Silke et al. 2010) in Germany found that children from lower socioeconomic backgrounds not only owned more cell phones than children from higher economic groups, but also used their cell phones more often — as determined by the test groups' wearing of personal dosimetry devices. This was the first study to track such data and it found an interesting contradiction to the assumption that higher socioeconomic groups were the largest users of cell services. At one time, cell phones were the status symbol of the wealthy. Today, it is also a status symbol of lower socioeconomic groups. The CDC found in their survey discussed above that 65.3% of adults living in poverty or living near poverty were more likely than higher income adults to be living in households with wireless only telephones. There may be multiple reasons for these findings, including a shift away from cell phone dialogues to texting in younger adults in higher socioeconomic categories.

In some developing countries where landline systems have never been fully developed outside of urban centers, cell phones are the only means of communication. Cellular technology, especially the new 3G, 4G, and broadband services that allow wireless communications for real-time voice communication, text messaging, photos, Internet connections, music and video downloads, and TV viewing, is the fastest growing segment of many economies that are in otherwise sharp decline due to the global economic downturn.

There is some indication that although the cellular phone markets for many European countries are more mature than in the U.S., people there may be maintaining their landline use while augmenting with mobile phone capability. This may be a consequence of the more robust media coverage regarding health and safety issues of wireless technology in the European press, particularly in the UK, as well as recommendations by European governments like France and Germany[6] that citizens not abandon their landline phones or wired computer systems because of safety concerns. According to OfCom's 2008 *Communications Market Interim Report* (OfCom 2008), which provided information up to December 2007, approximately 86% of UK adults use cell phones. While four out of five households have both cell phones and landlines, only 11% use cell phones exclusively, a total down from 28% noted by this group in 2005. In addition, 44% of UK adults use text messaging on a daily basis. Fixed landline services fell by 9% in 2007 but OfCorn notes that landline services continue to be strong despite the fact that mobile services also continued to grow by 16%. This indicates that people are continuing to use both landlines and wireless technology rather than choosing one over the other in the UK. There were 51 300 UK base station sites in

[2] http://www.eito.com/pressinformation_20100811.htm. (Accessed October 2010.)
[3] http://www.ctia.org/advocacy/research/index.cfm/AID/10377. (Accessed October 2010.)
[4] http://www.ctia.org/advocacy/research/index.cfm/AID/10323. (Accessed October 2010.)
[5] http://www.ctia.org/advocacy/research/index.cfm/AID/10323. (Accessed October 2010.)
[6] http://www.icems.eu/docs/deutscher_bundestag.pdf and http://www.icems.eu/docs/resolutions/EP_EMF_resolution_2APR09.pdf. (Accessed October 2010.)

the beginning of 2009 (two-thirds installed on existing buildings or structures) with an estimated 52 900 needed to accommodate new 3G and 4G services by the end of 2009.

Clearly, this is an enormous global industry. Yet, no money has ever been appropriated by the industry in the U.S., or by any U.S. government agency, to study the potential health effects on people living near the infrastructure. The most recent research has all come from outside of the U.S. According to the CTIA – The Wireless Association, "If the wireless telecom industry were a country, its economy would be bigger than that of Egypt, and, if measured by GNP (gross national product), [it] would rank as the 46th largest country in the world." They further say, "It took more than 21 years for color televisions to reach 100 million consumers, more than 90 years for landline service to reach 100 million consumers, and less than 17 years for wireless to reach 100 million consumers."[7]

In lieu of building new cell towers, some municipalities are licensing public utility poles throughout urban areas for Wi-Fi antennas that allow wireless Internet access. These systems can require hundreds of antennas in close proximity to the population with some exposures at a lateral height where second- and third-storey windows face antennas. Most of these systems are categorically excluded from regulation by the U.S. Federal Communications Commission (FCC) or oversight by government agencies because they operate below a certain power density threshold. However, power density is not the only factor determining biological effects from radiofrequency radiation (RFR).

In addition, when the U.S. and other countries permanently changed from analog signals used for television transmission to newer digital formats, the old analog frequencies were reallocated for use by municipal services such as police, fire, and emergency medical dispatch, as well as to private telecommunications companies wanting to expand their networks and services. This creates another significant increase in ambient background exposures.

Wi-Max is another wireless service in the wings that will broaden wireless capabilities further and place additional towers and (or) transmitters in close proximity to the population in addition to what is already in existence. Wi-Max aims to make wireless Internet access universal without tying the user to a specific location or "hotspot." The rollout of Wi-Max in the U.S., which began in 2009, uses lower frequencies at high power densities than currently used by cellular phone transmission. Many in science and the activist communities are worried, especially those concerned about electromagnetic-hypersensitivity syndrome (EHS).

It remains to be seen what additional exposures "smart grid" or "smart meter" technology proposals to upgrade the electrical powerline transmission systems will entail regarding total ambient RFR increases, but it will add another ubiquitous low-level layer. Some of the largest corporations on earth, notably Siemens and General Electric, are involved. Smart grids are being built out in some areas of the U.S. and in Canada and throughout Europe. That technology plans to alter certain aspects of powerline utility metering from a wired system to a partially wireless one. The systems require a combination of wireless transmitters attached to homes and businesses that will send radio signals of approximately 1 W output in the 2.4000–2.4835 GHz range to local "access point" transceivers, which will then relay the signal to a further distant information center (Tell 2008). Access point antennas will require additional power density and will be capable of interfacing with frequencies between 900 MHz and 1.9 GHz. Most signals will be intermittent, operating between 2 to 33 seconds per hour. Access points will be mounted on utility poles as well as on free-standing towers. The systems will form wide area networks (WANs), capable of covering whole towns and counties through a combination of "mesh-like" networks from house to house. Some meters installed on private homes will also act as transmission relays, boosting signals from more distant buildings in a neighborhood. Eventually, WANs will be completely linked.

Smart grid technology also proposes to allow homeowners to attach additional RFR devices to existing indoor appliances, to track power use, with the intention of reducing usage during peak hours. Manufacturers like General Electric are already making appliances with transmitters embedded in them. Many new appliances will be incapable of having transmitters deactivated without disabling the appliance and the warranty. People will be able to access their home appliances remotely by cell phone. The WANs smart grids described earlier in the text differ significantly from the current upgrades that many utility companies have initiated within recent years that already use low-power RFR meters attached to homes and businesses. Those first generation RFR meters transmit to a mobile van that travels through an area and "collects" the information on a regular billing cycle. Smart grids do away with the van and the meter reader and work off of a centralized RFR antenna system capable of blanketing whole regions with RFR.

Another new technology in the wings is broadband over powerlines (BPL). It was approved by the U.S. FCC in 2007 and some systems have already been built out. Critics of the latter technology warned during the approval process that radiofrequency interference could occur in homes and businesses and those warnings have proven accurate. BPL technology couples radiofrequency bands with extremely low frequency (ELF) bands that travel over powerline infrastructure, thereby creating a multi-frequency field designed to extend some distance from the lines themselves. Such couplings follow the path of conductive material, including secondary distribution lines, into people's homes.

There is no doubt that wireless technologies are popular with consumers and businesses alike, but all of this requires an extensive infrastructure to function. Infrastructure typically consists of freestanding towers (either preexisting towers to which cell antennas can be mounted, or new towers specifically built for cellular service), and myriad methods of placing transceiving antennas near the service being called for by users. This includes attaching antenna panels to the sides of buildings as well as roof-mountings; antennas hidden inside church steeples, barn silos, elevator shafts, and any number of other "stealth sites." It also includes camouflaging towers to look like trees indigenous to areas where they are placed, e.g., pine trees in northern climates, cacti

[7] CTIA website: http://www.ctia.org/advocay/research/index.cfm/AID/10385. (Accessed 9 December 2008.)

in deserts, and palm trees in temperate zones, or as chimneys, flagpoles, silos, or other tall structures (Rinebold 2001). Often the rationale for stealth antenna placement or camouflaging of towers is based on the aesthetic concerns of host communities.

An aesthetic emphasis is often the only perceived control of a municipality, particularly in countries like America where there is an overriding federal preemption that precludes taking the "environmental effects" of RFR into consideration in cell tower siting as stipulated in Section 704 of *The Telecommunications Act of 1996* (USFCC 1996). Citizen resistance, however, is most often based on health concerns regarding the safety of RFR exposures to those who live near the infrastructure. Many citizens, especially those who claim to be hypersensitive to electromagnetic fields, state they would rather know where the antennas are and that hiding them greatly complicates society's ability to monitor for safety.[8]

Industry representatives try to reassure communities that facilities are many orders of magnitude below what is allowed for exposure by standards-setting boards and studies bear that out (Cooper et al. 2006; Henderson and Bangay 2006; Bornkessel et al. 2007). These include standards by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) used throughout Europe, Canada, and elsewhere (ICNIRP 1998). The standards currently adopted by the U.S. FCC, which uses a two-tiered system of recommendations put out by the National Council on Radiation Protection (NCRP) for civilian exposures (referred to as uncontrolled environments), and the International Electricians and Electronics Engineers (IEEE) for professional exposures (referred to as controlled environments) (U.S. FCC 1997). The U.S. may eventually adopt standards closer to ICNIRP. The current U.S. standards are more protective than ICNIRP's in some frequency ranges so any harmonization toward the ICNIRP standards will make the U.S. limits more lenient.

All of the standards currently in place are based on RFRs ability to heat tissue, called thermal effects. A longstanding criticism, going back to the 1950s (Levitt 1995), is that such acute heating effects do not take potentially more subtle non-thermal effects into consideration. And based on the number of citizens who have tried to stop cell towers from being installed in their neighborhoods, laypeople in many countries do not find adherence to exisitng standards valid in addressing health concerns. Therefore, infrastructure siting does not have the confidence of the public (Levitt 1998).

2. A changing industry

Cellular phone technology has changed significantly over the last two decades. The first wireless systems began in the mid-1980s and used analog signals in the 850–900 MHz range. Because those wavelengths were longer, infrastructure was needed on average every 8 to 10 miles apart. Then came the digital personal communications systems (PCS) in the late 1990s, which used higher frequencies, around 1900 GHz, and digitized signals. The PCS systems, using shorter wavelengths and with more stringent exposure guidelines, require infrastructure approximately every 1 to 3 miles apart. Digital signals work on a binary method, mimicking a wave that allows any frequency to be split in several ways, thereby carrying more information far beyond just voice messages.

Today's 3G network can send photos and download music and video directly onto a cell phone screen or iPod. The new 4G systems digitize and recycle some of the older frequencies in the 700 to 875 MHz bands to create another service for wireless Internet access. The 4G network does not require a customer who wants to log on wirelessly to locate a "hot spot" as is the case with private Wi-Fi systems. Today's Wi-Fi uses a network of small antennas, creating coverage of a small area of 100 ft ($\sim$30 m) or so at homes or businesses. Wi-fi can also create a small wireless computer system in a school where they are often called wireless local area networks (WLANs). Whole cities can make Wi-Fi available by mounting antennas to utility poles.

Large-scale Wi-Fi systems have come under increasing opposition from citizens concerned about health issues who have legally blocked such installations (Antenna Free Union[9]). Small-scale Wi-Fi has also come under more scrutiny as governments in France and throughout Europe have banned such installations in libraries and schools, based on precautionary principles (REFLEX Program 2004).

3. Cell towers in perspective: some definitions

Cell towers are considered low-power installations when compared to many other commercial uses of radiofrequency energy. Wireless transmission for radio, television (TV), satellite communications, police and military radar, federal homeland security systems, emergency response networks, and many other applications all emit RFR, sometimes at millions of watts of effective radiated power (ERP). Cellular facilities, by contrast, use a few hundred watts of ERP per channel, depending on the use being called for at any given time and the number of service providers co-located at any given tower.

No matter what the use, once emitted, RFR travels through space at the speed of light and oscillates during propagation. The number of times the wave oscillates in one second determines its frequency.

Radiofrequency radiation covers a large segment of the electromagnetic spectrum and falls within the nonionizing bands. Its frequency ranges between 10 kHz to 300 GHz; 1 Hz = 1 oscillation per second; 1 kHz = 1000 Hz; 1 MHz = 1 000 000 Hz; and 1 GHz = 1 000 000 000 Hz.

Different frequencies of RFR are used in different applications. Some examples include the frequency range of 540 to 1600 kHz used in AM radio transmission; and 76 to 108 MHz used for FM radio. Cell-phone technology uses frequencies between 800 MHz and 3 GHz. The RFR of 2450 MHz is used in some Wi-Fi applications and microwave cooking.

Any signal can be digitized. All of the new telecommunications technologies are digitized and in the U.S., all TV is

[8] See, for example, www.radiationresearch.org. (Accessed October 2010.)
[9] http://www.antennafreeunion.org/. (Accessed October 2010.)

broadcast in 100% digital formats — digital television (DTV) and high definition television (HDTV). The old analog TV signals, primarily in the 700 MHz ranges, will now be recycled and relicensed for other applications to additional users, creating additional layers of ambient exposures.

The intensity of RFR is generally measured and noted in scientific literature in watts per square meter (W/m^2); milliwatts per square centimetre (mW/cm^2), or microwatts per square centimetre ($\mu W/cm^2$). All are energy relationships that exist in space. However, biological effects depend on how much of the energy is absorbed in the body of a living organism, not just what exists in space.

4. Specific absorption rate (SAR)

Absorption of RFR depends on many factors including the transmission frequency and the power density, one's distance from the radiating source, and one's orientation toward the radiation of the system. Other factors include the size, shape, mineral and water content of an organism. Children absorb energy differently than adults because of differences in their anatomies and tissue composition. Children are not just "little adults". For this reason, and because their bodies are still developing, children may be more susceptible to damage from cell phone radiation. For instance, radiation from a cell phone penetrates deeper into the head of children (Gandhi et al. 1996; Wiart et al. 2008) and certain tissues of a child's head, e.g., the bone marrow and the eye, absorb significantly more energy than those in an adult head (Christ et al. 2010). The same can be presumed for proximity to towers, even though exposure will be lower from towers under most circumstances than from cell phones. This is because of the distance from the source. The transmitter is placed directly against the head during cell phone use whereas proximity to a cell tower will be an ambient exposure at a distance.

There is little difference between cell phones and the domestic cordless phones used today. Both use similar frequencies and involve a transmitter placed against the head. But the newer digitally enhanced cordless technology (DECT) cordless domestic phones transmit a constant signal even when the phone is not in use, unlike the older domestic cordless phones. But some DECT brands are available that stop transmission if the mobile units are placed in their docking station.

The term used to describe the absorption of RFR in the body is specific absorption rate (SAR), which is the rate of energy that is actually absorbed by a unit of tissue. Specific absorption rates (SARs) are generally expressed in watts per kilogram (W/kg) of tissue. The SAR measurements are averaged either over the whole body, or over a small volume of tissue, typically between 1 and 10 g of tissue. The SAR is used to quantify energy absorption to fields typically between 100 kHz and 10 GHz and encompasses RFR from devices such as cellular phones up through diagnostic MRI (magnetic resonance imaging).

Specific absorption rates are a more reliable determinant and index of RFR's biological effects than are power density, or the intensity of the field in space, because SARs reflect what is actually being absorbed rather than the energy in space. However, while SARs may be a more precise model, at least in theory, there were only a handful of animal studies that were used to determine the threshold values of SAR for the setting of human exposure guidelines (de Lorge and Ezell 1980; de Lorge 1984). (For further information see Section 8). Those values are still reflected in today's standards.

It is presumed that by controlling the field strength from the transmitting source that SARs will automatically be controlled too, but this may not be true in all cases, especially with far-field exposures such as near cell or broadcast towers. Actual measurement of SARs is very difficult in real life so measurements of electric and magnetic fields are used as surrogates because they are easier to assess. In fact, it is impossible to conduct SAR measurements in living organisms so all values are inferred from dead animal measurements (thermography, calorimetry, etc.), phantom models, or computer simulation (FDTD).

However, according to the Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR) *Health Effects of Exposure to EMF*, released in January of 2009:

> ... recent studies of whole body plane wave exposure of both adult and children phantoms demonstrated that when children and small persons are exposed to levels which are in compliance with reference levels, exceeding the basic restrictions cannot be excluded [Dimbylow and Bloch 2007; Wang et al. 2006; Kuhn et al., 2007; Hadjem et al., 2007]. While the whole frequency range has been investigated, such effects were found in the frequency bands around 100 MHz and also around 2 GHz. For a model of a 5-year-old child it has been shown that when the phantom is exposed to electromagnetic fields at reference levels, the basic restrictions were exceeded by 40% [Conil et al., 2008].... Moreover, a few studies demonstrated that multipath exposure can lead to higher exposure levels compared to plane wave exposure [Neubauer et al. 2006; Vermeeren et al. 2007]. It is important to realize that this issue refers to far field exposure only, for which the actual exposure levels are orders of magnitude below existing guidelines. (p. 34–35, SCENIHR 2009)

In addition to average SARs, there are indications that biological effects may also depend on how energy is actually deposited in the body. Different propagation characteristics such as modulation, or different wave-forms and shapes, may have different effects on living systems. For example, the same amount of energy can be delivered to tissue continuously or in short pulses. Different biological effects may result depending on the type and duration of the exposure.

5. Transmission facilities

The intensity of RFR decreases rapidly with the distance from the emitting source; therefore, exposure to RFR from transmission towers is often of low intensity depending on one's proximity. But intensity is not the only factor. Living near a facility will involve long-duration exposures, sometimes for years, at many hours per day. People working at home or the infirm can experience low-level 24 h exposures. Nighttimes alone will create 8 h continuous exposures. The current standards for both ICNIRP, IEEE and the NCRP (adopted by the U.S. FCC) are for whole-body exposures

averaged over a short duration (minutes) and are based on results from short-term exposure studies, not for long-term, low-level exposures such as those experienced by people living or working near transmitting facilities. For such populations, these can be involuntary exposures, unlike cell phones where user choice is involved.

There have been some recent attempts to quantify human SARs in proximity to cell towers but these are primarily for occupational exposures in close proximity to the sources and questions raised were dosimetry-based regarding the accuracy of antenna modeling (van Wyk et al. 2005). In one study by Martínez-Búrdalo et al. (2005) however, the researchers used high-resolution human body models placed at different distances to assess SARs in worst-case exposures to three different frequencies — 900, 1800, and 2170 MHz. Their focus was to compute whole-body averaged SARs at a maximum 10 g averaged SAR inside the exposed model. They concluded that for

> ... antenna–body distances in the near zone of the antenna, the fact that averaged field values are below reference levels, could, at certain frequencies, not guarantee guidelines compliance based on basic restrictions.
> (p. 4125, Martínez-Búrdalo et al. 2005)

This raises questions about the basic validity of predicting SARs in real-life exposure situations or compliance to guidelines according to standard modeling methods, at least when one is very close to an antenna.

Thus, the relevant questions for the general population living or working near transmitting facilities are: Do biological and (or) health effects occur after exposure to low-intensity RFR? Do effects accumulate over time, since the exposure is of a long duration and may be intermittent? What precisely is the definition of low-intensity RFR? What might its biological effects be and what does the science tell us about such exposures?

6. Government radiofrequency radiation (RFR) guidelines: how spatial energy translates to the body's absorption

The U.S. FCC has issued guidelines for both power density and SARs. For power density, the U.S. guidelines are between 0.2–1.0 mW/cm^2. For cell phones, SAR levels require hand-held devices to be at or below 1.6 W/kg measured over 1.0 g of tissue. For whole body exposures, the limit is 0.08 W/kg.

In most European countries, the SAR limit for hand-held devices is 2.0 W/kg averaged over 10 g of tissue. Whole body exposure limits are 0.08 W/kg.

At 100–200 ft (~30–60 m) from a cell phone base station, a person can be exposed to a power density of 0.001 mW/cm^2 (i.e., 1.0 μW/cm^2). The SAR at such a distance can be 0.001 W/kg (i.e., 1.0 mW/kg). The U.S. guidelines for SARs are between 0.08–0.40 W/kg.

For the purposes of this paper, we will define low-intensity exposure to RFR of power density of 0.001 mW/cm^2 or a SAR of 0.001 W/kg.

7. Biological effects at low intensities

Many biological effects have been documented at very low intensities comparable to what the population experiences within 200 to 500 ft (~60–150 m) of a cell tower, including effects that occurred in studies of cell cultures and animals after exposures to low-intensity RFR. Effects reported include: genetic, growth, and reproductive; increases in permeability of the blood–brain barrier; behavioral; molecular, cellular, and metabolic; and increases in cancer risk. Some examples are as follows:

- Dutta et al. (1989) reported an increase in calcium efflux in human neuroblastoma cells after exposure to RFR at 0.005 W/kg. Calcium is an important component in normal cellular functions.
- Fesenko et al. (1999) reported a change in immunological functions in mice after exposure to RFR at a power density of 0.001 mW/cm^2.
- Magras and Xenos (1997) reported a decrease in reproductive function in mice exposed to RFR at power densities of 0.000168–0.001053 mW/cm^2.
- Forgacs et al. (2006) reported an increase in serum testosterone levels in rats exposed to GSM (global system for mobile communication)-like RFR at SAR of 0.018–0.025 W/kg.
- Persson et al. (1997) reported an increase in the permeability of the blood–brain barrier in mice exposed to RFR at 0.0004–0.008 W/kg. The blood–brain barrier is a physiological mechanism that protects the brain from toxic substances, bacteria, and viruses.
- Phillips et al. (1998) reported DNA damage in cells exposed to RFR at SAR of 0.0024–0.024 W/kg.
- Kesari and Behari (2009) also reported an increase in DNA strand breaks in brain cells of rats after exposure to RFR at SAR of 0.0008 W/kg.
- Belyaev et al. (2009) reported changes in DNA repair mechanisms after RFR exposure at a SAR of 0.0037 W/kg. A list of publications reporting biological and (or) health effects of low-intensity RFR exposure is in Table 1.

Out of the 56 papers in the list, 37 provided the SAR of exposure. The average SAR of these studies at which biological effects occurred is 0.022 W/kg — a finding below the current standards.

Ten years ago, there were only about a dozen studies reporting such low-intensity effects; currently, there are more than 60. This body of work cannot be ignored. These are important findings with implications for anyone living or working near a transmitting facility. However, again, most of the studies in the list are on short-term (minutes to hours) exposure to low-intensity RFR. Long-term exposure studies are sparse. In addition, we do not know if all of these reported effects occur in humans exposed to low-intensity RFR, or whether the reported effects are health hazards. Biological effects do not automatically mean adverse health effects, plus many biological effects are reversible. However, it is clear that low-intensity RFR is not biologically inert. Clearly, more needs to be learned before a presumption of safety can continue to be made regarding placement of antenna arrays near the population, as is the case today.

Table 1. List of studies reporting biological effects at low intensities of radiofrequency radiation (RFR).

Reference	Frequency	Form of RFR	Exposure duration	SAR (W/kg)	Power density ($\mu W/cm^2$)	Effects reported
Balmori (2010) (in vivo) (eggs and tadpoles of frog)	88.5–1873.6 MHz	Cell phone base station emission	2 months		3.25	Retarded development
Belyaev et al. (2005) (in vitro)	915 MHz	GSM	24, 48 h	0.037		Genetic changes in human white blood cells
Belyaev et al. (2009) (in vitro)	915 MHz, 1947 MHz	GSM, UMTS	24, 72 h	0.037		DNA repair mechanism in human white blood cells
Blackman et al. (1980) (in vitro)	50 MHz	AM at 16 Hz		0.0014		Calcium in forebrain of chickens
Boscol et al. (2001) (in vivo) (human whole body)	500 KHz–3 GHz	TV broadcast			0.5	Immunological system in women
Campisi et al. (2010) (in vitro)	900 MHz	CW (CW– no effect observed) AM at 50 Hz	14 days, 5, 10, 20 min per day		26	DNA damage in human glial cells
Capri et al. (2004) (in vitro)	900 MHz	GSM	1 h/day, 3 days	0.07		A slight decrease in cell proliferation when human immune cells were stimulated with mitogen and a slight increase in the number of cells with altered distribution of phosphatidylserine across the membrane
Chiang et al. (1989) (in vivo) (human whole body)	Lived and worked close to AM radio and radar installations for more than 1 year				10	People lived and worked near AM radio antennas and radar installations showed deficits in psychological and short-term memory tests
de Pomerai et al. (2003) (in vitro)	1 GHz		24, 48 h	0.015		Protein damages
D'Inzeo et al. (1988) (in vitro)	10.75 GHz	CW	30–120 s	0.008		Operation of acetylcholine-related ion-channels in cells. These channels play important roles in physiological and behavioral functions
Dutta et al. (1984) (in vitro)	915 MHz	Sinusoidal AM at 16 Hz	30 min	0.05		Increase in calcium efflux in brain cancer cells
Dutta et al. (1989) (in vitro)	147 MHz	Sinusoidal AM at 16 Hz	30 min	0.005		Increase in calcium efflux in brain cancer cells
Fesenko et al. (1999) (in vivo) (mouse- wavelength in mm range)	From 8.15–18 GHz		5 h to 7 days direction of response depended on exposure duration		1	Change in immunological functions
Forgacs et al. (2006) (in vivo) (mouse whole body)	1800 MHz	GSM, 217 Hz pulses, 576 μs pulse width	2 h/day, 10 days	0.018		Increase in serum testosterone
Guler et al. (2010) (In vivo) (rabbit whole body)	1800 MHz	AM at 217 Hz	15 min/day, 7 days		52	Oxidative lipid and DNA damages in the brain of pregnant rabbits

Table 1 (*continued*).

Reference	Frequency	Form of RFR	Exposure duration	SAR (W/kg)	Power density ($\mu W/cm^2$)	Effects reported
Hjollund et al. (1997) (in vivo) (human partial or whole body)	Military radars				10	Sperm counts of Danish military personnel, who operated mobile ground-to-air missile units that use several RFR emitting radar systems, were significantly lower compared to references
Ivaschuk et al. (1997) (in vitro)	836.55 MHz	TDMA	20 min	0.026		A gene related to cancer
Jech et al. (2001) (in vivo) (human partial body exposure-narcoleptic patients)	900 MHz	GSM— 217 Hz pulses, 577 μs pulse width	45 min	0.06		Improved cognitive functions
Kesari and Behari (2009) (in vivo) (rat whole body)	50 GHz		2 h/day, 45 days	0.0008		Double strand DNA breaks observed in brain cells
Kesari and Behari (2010) (in vivo) (rat whole body)	50 GHz		2 h/day, 45 days	0.0008		Reproductive system of male rats
Kesari et al. (2010) (in vivo) (rat whole body)	2450 MHz	50 Hz modulation	2 h/day, 35 days	0.11		DNA double strand breaks in brain cells
Kwee et al. (2001) (in vitro)	960 MHz	GSM	20 min	0.0021		Increased stress protein in human epithelial amnion cells
Lebedeva et al. (2000) (in vivo) (human partial body)	902.4 MHz	GSM	20 min		60	Brain wave activation
Lerchl et al. (2008) (in vivo) (hamster whole body)	383 MHz 900 and 1800 MHz	TETRA GSM	24 h/day, 60 days	0.08		Metabolic changes
Magras and Xenos (1997) (in vivo) (mouse whole body)	"Antenna park"	TV and FM-radio	Exposure over several generations		0.168	Decrease in reproductive function
Mann et al. (1998) (in vivo) (human whole body)	900 MHz	GSM pulse-modulated at 217 Hz, 577 μs width	8 h		20	A transient increase in blood cortisol
Marinelli et al. (2004) (in vitro)	900 MHz	CW	2–48 h	0.0035		Cell's self-defense responses triggered by DNA damage
Markovà et al. (2005) (in vitro)	915 and 905 MHz	GSM	1 h	0.037		Chromatin conformation in human white blood cells
Navakatikian and Tomashevskaya (1994) (in vivo) (rat whole body)	2450 MHz 3000 MHz	CW (no effect observed) Pulse-modulated 2 μs pulses at 400 Hz	Single (0.5–12hr) or repeated (15–60 days, 7–12 h/day) exposure, CW–no effect	0.0027		Behavioral and endocrine changes, and decreases in blood concentrations of testosterone and insulin
Nittby et al. (2008) (in vivo) (rat whole body)	900 MHz,	GSM	2 h/week, 55 weeks	0.0006		Reduced memory functions
Novoselova et al. (1999) (in vivo) (mouse whole body – wavelength in mm range)	From 8.15–18 GHz		1 s sweep time – 16 ms reverse, 5 h		1	Functions of the immune system
Novoselova et al. (2004) (in vivo) (mouse whole body – wavelength in mm range)	From 8.15–18 GHz		1 s sweep time16 ms reverse, 1.5 h/day, 30 days		1	Decreased tumor growth rate and enhanced survival

Table 1 (*continued*).

Reference	Frequency	Form of RFR	Exposure duration	SAR (W/kg)	Power density ($\mu W/cm^2$)	Effects reported
Panagopoulos et al. (2010) (in vivo) (fly whole body)	900 and 1800 MHz	GSM	6 min/day, 5 days		1–10	Reproductive capacity and induced cell death
Panagopoulos and Margaritis (2010*a*) (in vivo) (fly whole body)	900 and 1800 MHz	GSM	6 min/day, 5 days		10	'Window' effect of GSM radiation on reproductive capacity and cell death
Panagopoulos and Margaritis (2010*b*) (in vivo) (fly whole body)	900 and 1800 MHz	GSM	1–21 min/day, 5 days		10	Reproductive capacity of the fly decreased linearly with increased duration of exposure
Pavicic and Trosic (2008) (in vitro)	864 and 935 MHz	CW	1–3 h	0.08		Growth affected in Chinese hamster V79 cells
Pérez-Castejón et al. (2009) (in vitro)	9.6 GHz	90% AM	24 h	0.0004		Increased proliferation rate in human astrocytoma cancer cells
Persson et al. (1997) (in vivo) (mouse whole body)	915 MHz	CW and pulse-modulated (217 Hz, 0.57 ms; 50 Hz, 6.6 ms)	2–960 min; CW more potent	0.0004		Increase in permeability of the blood–brain barrier
Phillips et al. (1998) (in vitro)	813.5625 MHz 836.55 MHz	iDEN TDMA	2, 21 h 2, 21 h	0.0024		DNA damage in human leukemia cells
Pologea-Moraru et al. (2002) (in vitro)	2.45 GHz		1 h		15	Change in membrane of cells in the retina
Pyrpasopoulou et al. (2004) (in vivo) (rat whole body)	9.4 GHz	GSM (50 Hz pulses, 20 μs pulse length)	1–7 days postcoitum	0.0005		Exposure during early gestation affected kidney development
Roux et al. (2008*a*) (in vivo) (tomato whole body)	900 MHz				7	Gene expression and energy metabolism
Roux et al. (2008*b*) (in vivo) (plant whole body)	900 MHz				7	Energy metabolism
Salford et al. (2003) (in vivo) (rat whole body)	915 MHz	GSM	2 h	0.02		Nerve cell damage in brain
Sarimov et al. (2004) (in vitro)	895–915 MHz	GSM	30 min	0.0054		Human lymphocyte chromatin affected similar to stress response
Schwartz et al. (1990) (in vitro)	240 MHz	CW and sinusoidal modulation at 0.5 and 16 Hz, effect only observed at 16 Hz modulation	30 min	0.00015		Calcium movement in the heart
Schwarz et al. (2008) (in vitro)	1950 MHz	UMTS	24 h	0.05		Genes in human fibroblasts
Somosy et al. (1991) (in vitro)	2.45 GHz	CW and 16 Hz square-modulation, modulated field more potent than CW		0.024		Molecular and structural changes in cells of mouse embryos

Table 1 (*concluded*).

Reference	Frequency	Form of RFR	Exposure duration	SAR (W/kg)	Power density ($\mu W/cm^2$)	Effects reported
Stagg et al. (1997) (in vitro)	836.55 MHz	TDMA duty cycle 33%	24 h	0.0059		Glioma cells showed significant increases in thymidine incorporation, which may be an indication of an increase in cell division
Stankiewicz et al. (2006) (in vitro)	900 MHz	GSM 217 Hz pulses, 577 ms width		0.024		Immune activities of human white blood cells
Tattersall et al. (2001) (in vitro)	700 MHz	CW	5–15 min	0.0016		Function of the hippocampus
Velizarov et al. (1999) (in vitro)	960 MHz	GSM 217 Hz square-pulse, duty cycle 12%	30 min	0.000021		Decrease in proliferation of human epithelial amnion cells
Veyret et al. (1991) (in vivo) (mouse whole body)	9.4 GHz	1 μs pulses at 1000 pps, also with or without sinusoidal AM between 14 and 41 MHz, response only with AM, direction of response depended on AM frequency		0.015		Functions of the immune system
Vian et al. (2006) (in vivo) plant	900 MHz				7	Stress gene expression
Wolke et al. (1996) (in vitro)	900, 1300, 1800 MHz 900 MHz	Square-wave modulated at 217 Hz CW, 16 Hz, 50 Hz, and 30 KHz modulations		0.001		Calcium concentration in heart muscle cells of guinea pig
Yurekli et al. (2006) (in vivo) (rat whole body)	945 MHz	GSM, 217 Hz pulse-modulation	7 h/day, 8 days	0.0113		Free radical chemistry

Note: These papers gave either specific absorption rate, SAR, (W/kg) or power density ($\mu W/cm^2$) of exposure. (Studies that did not contain these values were excluded). AM, amplitude-modulated or amplitude-modulation; CW, continuous wave; GSM, global system for mobile communication; iDEN, integrated digital enhanced network; TDMA, time division multiple access, TETRA, terrestrial trunked radio; UMTS, universal mobile telecommunications system.

8. Long-term exposures and cumulative effects

There are many important gaps in the RFR research. The majority of the studies on RFR have been conducted with short-term exposures, i.e., a few minutes to several hours. Little is known about the effects of long-term exposure such as would be experienced by people living near telecommunications installations, especially with exposures spanning months or years. The important questions then are: What are the effects of long-term exposure? Does long-term exposure produce different effects from short-term exposure? Do effects accumulate over time?

There is some evidence of cumulative effects. Phillips et al. (1998) reported DNA damage in cells after 24 h exposure to low-intensity RFR. DNA damage can lead to gene mutation that accumulates over time. Magras and Xenos (1997) reported that mice exposed to low-intensity RFR became less reproductive. After five generations of exposure the mice were not able to produce offspring. This shows that the effects of RFR can pass from one generation to another. Persson et al. (1997) reported an increase in permeability of the blood–brain barrier in mice when the energy deposited in the body exceeded 1.5 J/kg (joule per kilogram) — a measurement of the total amount of energy deposited. This suggests that a short-term, high-intensity exposure can produce the same effect as a long-term, low-intensity exposure, and is another indication that RFR effects can accumulate over time.

In addition, there is some indication that test animals become more sensitive to radiation after long-term exposure as seen in two of the critical experiments that contributed to the present SAR standards, called the "behavior–disruption experiments" carried out in the 1980s.

In the first experiment, de Lorge and Ezell (1980) trained rats on an auditory observing-response task. In the task, an animal was presented with two bars. Pressing the right bar would produce either a low-pitch or a high-pitch tone for half a second. The low-pitch tone signaled an unrewarded situation and the animal was expected to do nothing. However, when the high-pitch tone was on, pressing the left bar would produce a food reward. Thus, the task required continuous vigilance in which an animal had to coordinate its motor responses according to the stimulus presented to get a reward by choosing between a high-pitch or low-pitch tone. After learning the task, rats were then irradiated with 1280 MHz or 5620 MHz RFR during performance. Disruption of behavior (i.e., the rats could not perform very well) was observed within 30–60 min of exposure at a SAR of 3.75 W/kg for 1280 MHz, and 4.9 W/kg for 5620 MHz.

In another experiment, de Lorge (1984) trained monkeys on a similar auditory observing response task. Monkeys were exposed to RFR at 225, 1300, and 5800 MHz. Disruption of performance was observed at 8.1 mW/cm^2 (SAR 3.2 W/kg) for 225 MHz; at 57 mW/cm^2 (SAR 7.4 W/kg) for 1300 MHz; and at 140 mW/cm^2 (SAR 4.3 W/kg) for 5800 MHz. The disruption occurred when body temperature was increased by 1°C.

The conclusion from these experiments was that "... disruption of behavior occurred when an animal was exposed at an SAR of approximately 4 W/kg, and disruption occurred after 30–60 minutes of exposure and when body temperature increased by 1°C" (de Lorge 1984). Based on just these two experiments, 4 W/kg has been used in the setting of the present RFR exposure guidelines for humans. With theoretical safety margins added, the limit for occupational exposure was then set at 0.4 W/kg (i.e., 1/10 of the SAR where effects were observed) and for public exposure 0.08 W/kg for whole body exposures (i.e., 1/5 of that of occupational exposure).

But the relevant question for establishing a human SAR remains: Is this standard adequate, based on so little data, primarily extrapolated from a handful of animal studies from the same investigators? The de Lorge (1984) animal studies noted previously describe effects of short-term exposures, defined as less than one hour. But are they comparable to long-term exposures like what whole populations experience when living or working near transmitting facilities?

Two series of experiments were conducted in 1986 on the effects of long-term exposure. D'Andrea et al. (1986*a*) exposed rats to 2450 MHz RFR for 7 h a day, 7 days per week for 14 weeks. They reported a disruption of behavior at an SAR of 0.7 W/kg. And D'Andrea et al. (1986*b*) also exposed rats to 2450 MHz RFR for 7 h a day, 7 days per week, for 90 days at an SAR of 0.14 W/kg and found a small but significant disruption in behavior. The experimenters concluded, "... the threshold for behavioral and physiological effects of chronic (long-term) RFR exposure in the rat occurs between 0.5 mW/cm^2 (0.14 W/kg) and 2.5 mW/cm^2 (0.7 W/kg)" (p. 55, D'Andrea et al. 1986*b*).

The previously mentioned studies show that RFR can produce effects at much lower intensities after test animals are repeatedly exposed. This may have implications for people exposed to RFR from transmission towers for long periods of time.

Other biological outcomes have also been reported after long-term exposure to RFR. Effects were observed by Baranski (1972) and Takashima et al. (1979) after prolonged, repeated exposure but not after short-term exposure. Conversely, in other work by Johnson et al. (1983), and Lai et al. (1987, 1992) effects that were observed after short-term exposure disappeared after prolonged, repeated exposure, i.e., habituation occurred. Different effects were observed by Dumansky and Shandala (1974) and Lai et al. (1989) after different exposure durations. The conclusion from this body of work is that effects of long-term exposure can be quite different from those of short-term exposure.

Since most studies with RFR are short-term exposure studies, it is not valid to use their results to set guidelines for long-term exposures, such as in populations living or working near cell phone base stations.

9. Effects below 4 W/kg: thermal versus nonthermal

As described previously, current international RFR exposure standards are based mainly on the acute exposure experiments that showed disruption of behavior at 4 W/kg. However, such a basis is not scientifically valid. There are many studies that show biological effects at SARs less than 4 W/kg after short-term exposures to RFR. For example, since the 4 W/kg originated from psychological and (or) be-

havioral experiments, when one surveys the EMF literature on behavioral effects, one can find many reports on behavioral effects observed at SARs less than 4 W/kg, e.g., D'Andrea et al. (1986*a*) at 0.14 to 0.7 W/kg; DeWitt et al. (1987) at 0.14 W/kg; Gage (1979) at 3 W/kg ; King et al. (1971) at 2.4 W/kg; Kumlin et al. (2007) at 3 W/kg; Lai et al. (1989) at 0.6 W/kg; Mitchell et al. (1977) at 2.3 W/kg (1977); Navakatikian and Tomashevskaya (1994) at 0.027 W/kg; Nittby et al. (2008) at 0.06 W/kg; Schrot et al. (1980) at 0.7 W/kg; Thomas et al. (1975) at 1.5 to 2.7 W/kg; and Wang and Lai (2000) at 1.2 W/kg.

The obvious mechanism of effects of RFR is thermal (i.e., tissue heating). However, for decades, there have been questions about whether nonthermal (i.e., not dependent on a change in temperature) effects exist. This is a well-discussed area in the scientific literature and not the focus of this paper but we would like to mention it briefly because it has implications for public safety near transmission facilities.

Practically, we do not actually need to know whether RFR effects are thermal or nonthermal to set exposure guidelines. Most of the biological-effects studies of RFR that have been conducted since the 1980s were under nonthermal conditions. In studies using isolated cells, the ambient temperature during exposure was generally well controlled. In most animal studies, the RFR intensity used usually did not cause a significant increase in body temperature in the test animals. Most scientists consider nonthermal effects as established, even though the implications are not fully understood.

Scientifically, there are three rationales for the existence of nonthermal effects:

1. Effects can occur at low intensities when a significant increase in temperature is not likely.
2. Heating does not produce the same effects as RFR exposure.
3. RFR with different modulations and characteristics produce different effects even though they may produce the same pattern of SAR distribution and tissue heating.

Low-intensityeffects have been discussed previously (see Section 7.). There are reports that RFR triggers effects that are different from an increase in temperature, e.g., Wachtel et al. (1975); Seaman and Wachtel (1978); D'Inzeo et al. (1988). And studies showing that RFR of the same frequency and intensity, but with different modulations and waveforms, can produce different effects as seen in the work of Baranski (1972); Arber and Lin (1985); Campisi et al. (2010); d'Ambrosio et al. (2002); Frey et al. (1975); Oscar and Hawkins (1977); Sanders et al. (1985); Huber et al. (2002); Markkanen et al. (2004); Hung et al. (2007); and Luukkonen et al. (2009).

A counter-argument for point 1 is that RFR can cause micro-heating at a small location even though there is no measurement change in temperature over the whole sample. This implies that an effect observed at low intensities could be due to localized micro-heating, and, therefore, is still considered thermal. However, the micro-heating theory could not apply to test subjects that are not stationary, such as in the case of Magras and Xenos (1997) who reported that mice exposed to low-intensity RFR became less reproductive over several generations. "Hot spots" of heating move within the body when the subject moves in the field and, thus, cannot maintain sustained heating of certain tissue.

The counter argument for point 2 is that heating by other means does not produce the same pattern of energy distribution as RFR. Thus, different effects would result. Again, this counter argument does not work on moving objects. Thus, results supporting the third point are the most compelling.

10. Studies on exposure to cell tower transmissions

From the early genesis of cell phone technology in the early 1980s, cell towers were presumed safe when located near populated areas because they are low-power installations in comparison with broadcast towers. This thinking already depended on the assumption that broadcast towers were safe if kept below certain limits. Therefore, the reasoning went, cell towers would be safer still. The thinking also assumed that exposures between cell and broadcast towers were comparable. In certain cities, cell and broadcast tower transmissions both contributed significantly to the ambient levels of RFR (Sirav and Seyhan 2009; Joseph et al. 2010).

There are several fallacies in this thinking, including the fact that broadcast exposures have been found unsafe even at regulated thresholds. Adverse effects have been noted for significant increases for all cancers in both men and women living near broadcast towers (Henderson and Anderson 1986); childhood leukemia clusters (Maskarinec et al. 1994; Ha et al. 2003; Park et al. 2004); adult leukemia and lymphoma clusters, and elevated rates of mental illness (Hocking et al. 1996; Michelozzi et al. 2002; Ha et al. 2007); elevated brain tumor incidence (Dolk et al. 1997*a*, 1997*b*); sleep disorders, decreased concentration, anxiety, elevated blood pressure, headaches, memory impairment, increased white cell counts, and decreased lung function in children (Altpeter et al. 2000); motor, memory, and learning impairment in children (Kolodynski and Kolodynski 1996), nonlinear increases in brain tumor incidence (Colorado Department of Public Health 2004); increases in malignant melanoma (Hallberg and Johansson 2002); and nonlinear immune system changes in women (Boscol et al. 2001). (The term "nonlinear" is used in scientific literature to mean that an effect was not directly proportional to the intensity of exposure. In the case of the two studies mentioned previously, adverse effects were found at significant distances from the towers, not in closer proximity where the power density exposures were higher and therefore presumed to have a greater chance of causing effects. This is something that often comes up in low-level energy studies and adds credence to the argument that low-level exposures could cause qualitatively different effects than higher level exposures.)

There is also anecdotal evidence in Europe that some communities have experienced adverse physical reactions after the switch from analog TV broadcast signals to the new digital formats, which can be more biologically complex

Three doctors in Germany, Cornelia Waldmann-Selsam, MD, Christine Aschermann, MD, and Markus Kern, MD,

wrote (in a letter to the U.S. President, entitled *Warning — Adverse Health Effects From Digital Broadcast Television*)[10], that on 20 May 2006, two digital broadcast television stations went on the air in the Hessian Rhoen area. Prior to that time that area had low radiation levels, which included that from cell phone towers of which there were few. However, coinciding with the introduction of the digital signals, within a radius of more than 20 km, there was an abrupt onset of symptoms for constant headaches, pressure in the head, drowsiness, sleep problems, inability to think clearly, forgetfulness, nervousness, irritability, tightness in the chest, rapid heartbeat, shortness of breath, depression, apathy, loss of empathy, burning skin, sense of inner burning, leg weakness, pain in the limbs, stabbing pain in various organs, and weight gain. They also noted that birds fled the area. The same symptoms gradually appeared in other locations after digital signals were introduced. Some physicians accompanied affected people to areas where there was no TV reception from terrestrial sources, such as in valleys or behind mountain ranges, and observed that many people became symptom free after only a short time. The digital systems also require more transmitters than the older analog systems and, therefore, somewhat higher exposure levels to the general population are expected, according to the 2009 SCENIHR Report (SCENIHR 2009).

Whether digital or analog, the frequencies differ between broadcast and cell antennas and do not couple with the human anatomy in whole-body or organ-specific models in the same ways (NCRP 1986; ICNIRP 1998). This difference in how the body absorbs energy is the reason that all standards-setting organizations have the strictest limitations between 30–300 MHz — ranges that encompass FM broadcast where whole body resonance occurs (Cleveland 2001). Exposure allowances are more lenient for cell technology in frequency ranges between 300 MHz and 3 GHz, which encompass cellular phone technology. This is based on the assumption that the cell frequencies do not penetrate the body as deeply and no whole-body resonance can occur.

There are some studies on the health effects on people living near cell phone towers. Though cell technology has been in existence since the late 1980s, the first study of populations near cell tower base stations was only conducted by Santini et al. (2002). It was prompted in part by complaints of adverse effects experienced by residents living near cell base stations throughout the world and increased activism by citizens. As well, increasing concerns by physicians to understand those complaints was reflected in professional organizations like the ICEMS (International Committee on Electromagnetic Safety) Catania Resolution[11], the Irish Doctors Environmental Association (IDEA)[12], and the Freiburger Appeal[13].

Santini conducted a survey study of 530 people (270 men, 260 women) on 18 nonspecific health symptoms (NSHS) in relation to self-reported distance from towers of <10 m, 10 to 50 m, 50 to 100 m, 100 to 200 m, 200 to 300 m, and >300 m. The control group compared people living more than 300 m (approximately 1000 ft) or not exposed to base stations. They controlled for age, presence of electrical transformers (<10 m), high tension lines (<100 m), and radio/TV broadcast transmitters (<4 km), the frequency of cell phone use (>20 min per day), and computer use (>2 h per day). Questions also included residents' location in relation to antennas, taking into account orientations that were facing, beside, behind, or beneath antennas in cases of roof-mounted antenna arrays. Exposure conditions were defined by the length of time living in the neighborhood (<1 year through >5 years); the number of days per week and hours per day (<1 h to >16 h) that were spent in the residence.

Results indicated increased symptoms and complaints the closer a person lived to a tower. At <10 m, symptoms included nausea, loss of appetite, visual disruptions, and difficulty in moving. Significant differences were observed up through 100 m for irritability, depressive tendencies, concentration difficulties, memory loss, dizziness, and lower libido. Between 100 and 200 m, symptoms included headaches, sleep disruption, feelings of discomfort, and skin problems. Beyond 200 m, fatigue was significantly reported more often than in controls. Women significantly reported symptoms more often than men, except for libido loss. There was no increase in premature menopause in women in relation to distance from towers. The authors concluded that there were different sex-dependent sensitivities to electromagnetic fields. They also called for infrastructure not to be sited <300 m (~1000 ft) from populations for precautionary purposes, and noted that the information their survey captured might not apply to all circumstances since actual exposures depend on the volume of calls being generated from any particular tower, as well as on how radiowaves are reflected by environmental factors.

Similar results were found in Egypt by Abdel-Rassoul et al. (2007) looking to identify neurobehavioral deficits in people living near cell phone base stations. Researchers conducted a cross-sectional study of 85 subjects: 37 living inside a building where antennas were mounted on the rooftop and 48 agricultural directorate employees who worked in a building (~ 10 m) opposite the station. A control group of 80 who did not live near base stations were matched for age, sex, occupation, smoking, cell phone use, and educational level. All participants completed a questionnaire containing personal, educational, and medical histories; general and neurological examinations; a neurobehavioral test battery (NBTB) involving tests for visuomotor speed, problem solving, attention, and memory, in addition to a Eysenck personality questionnaire (EPQ).

Their results found a prevalence of neuropsychiatric complaints: headaches, memory changes, dizziness, tremors, depressive symptoms, and sleep disturbance were significantly higher among exposed inhabitants than controls. The NBTB indicated that the exposed inhabitants exhibited a significantly lower performance than controls in one of the tests of attention and short-term auditory memory (paced auditory

[10] http://www.notanotherconspiracy.com/2009/02/warning-adverse-health-effects-from.html. (Accessed October 2010.)
[11] http://www.icems.eu/resolution.htm
[12] http://www.ideeaireland.org/emr.htm
[13] http://www.laleva.cc/environment/freiburger_appeal.html

serial addition test (PASAT)). Also, the inhabitants opposite the station exhibited a lower performance in the problem-solving test (block design) than those who lived under the station. All inhabitants exhibited a better performance in the two tests of visuomotor speed (digit symbol and Trailmaking B) and one test of attention (Trailmaking A) than controls.

Environmental power-density data were taken from measurements of that building done by the National Telecommunications Institute in 2000. Measurements were collected from the rooftop where the antennas were positioned, the shelter that enclosed the electrical equipment and cables for the antennas, other sites on the roof, and within an apartment below one of the antennas. Power-density measurements ranged from 0.1–6.7 $\mu W/cm^2$. No measurements were taken in the building across the street. The researchers noted that the last available measurements of RFR in 2002 in that area were less than the allowable standards but also noted that exposures depended on the number of calls being made at any given time, and that the number of cell phone users had increased approximately four times within the 2 years just before the beginning of their study in 2003. They concluded that inhabitants living near mobile phone base stations are at risk for developing neuropsychiatric problems, as well as some changes in the performance of neurobehavioral functions, either by facilitation (over-stimulation) or inhibition (suppression). They recommended the standards be revised for public exposure to RFR, and called for using the NBTB for regular assessment and early detection of biological effects among inhabitants near base stations (Abdel-Rassoul et al. 2007).

Hutter et al. (2006) sought to determine cognitive changes, sleep quality, and overall well-being in 365 rural and urban inhabitants who had lived for more than a year near 10 selected cell phone base stations. Distance from antennas was 24 to 600 m in rural areas, and 20 to 250 m in the urban areas. Field strength measurements were taken in bedrooms and cognitive tests were performed. Exposure to high-frequency EMFs was lower than guidelines and ranged from 0.000002 to 0.14 $\mu W/cm^2$ for all frequencies between 80 MHz and 2 GHz with the greater exposure coming from mobile telecommunications facilities, which was between 0.000001 and 0.14 $\mu W/cm^2$. Maximum levels were between 0.000002 and 0.41 $\mu W/cm^2$ with an overall 5% of the estimated maximum above 0.1 $\mu W/cm^2$. Average levels were slightly higher in rural areas (0.005 $\mu W/cm^2$) than in urban areas (0.002 $\mu W/cm^2$). The researchers tried to ascertain if the subjective rating of negative health consequences from base stations acted as a covariable but found that most subjects expressed no strong concerns about adverse effects from the stations, with 65% and 61% in urban and rural areas, respectively, stating no concerns at all. But symptoms were generally higher for subjects who expressed health concerns regarding the towers. The researchers speculated that this was due to the subjects with health complaints seeking answers and consequently blaming the base station; or that subjects with concerns were more anxious in general and tended to give more negative appraisals of their body functions; and the fact that some people simply give very negative answers.

Hutter's results were similar to those of Santini et al. (2002) and Abdel-Rassoul et al. (2007). Hutter found a significant relationship between symptoms and power densities. Adverse effects were highest for headaches, cold hands and feet, cardiovascular symptoms, and concentration difficulties. Perceptual speed increased while accuracy decreased insignificantly with increasing exposure levels. Unlike the others, however, Hutter found no significant effects on sleep quality and attributed such problems more to fear of adverse effects than actual exposure. They concluded that effects on well-being and performance cannot be ruled out even as mechanisms of action remain unknown. They further recommended that antenna siting should be done to minimize exposure to the population.

Navarro et al. (2003) measured the broadband electric field (E-field) in the bedrooms of 97 participants in La Nora, Murcia, Spain and found a significantly higher symptom score in 9 out of 16 symptoms in the groups with an exposure of 0.65 V/m (0.1121 $\mu W/cm^2$) compared with the control group with an exposure below 0.2 V/m (0.01061 $\mu W/cm^2$), both as an average. The highest contributor to the exposure was GSM 900/1800 MHz signals from mobile telecommunications. The same researchers also reported significant correlation coefficients between the measured E-field and 14 out of 16 health-related symptoms with the five highest associations found for depressive tendencies, fatigue, sleeping disorders, concentration difficulties, and cardiovascular problems. In a follow up work, Oberfeld et al. (2004) conducted a health survey in Spain in the vicinity of two GSM 900/1800 MHz cell phone base stations, measuring the E-field in six bedrooms, and found similar results. They concluded that the symptoms are in line with "microwave syndrome" reported in the literature (Johnson-Liakouris 1998). They recommended that the sum total for ambient exposures should not be higher than 0.02 V/m — the equivalent of a power density of 0.00011 $\mu W/cm^2$, which is the indoor exposure value for GSM base stations proposed by the Public Health Office of the Government of Salzburg, Austria in 2002[14].

Eger et al. (2004) took up a challenge to medical professionals by Germany's radiation protection board to determine if there was an increased cancer incidence in populations living near cell towers. Their study evaluated data for approximately 1000 patients between the years of 1994 and 2004 who lived close to cell antennas. The results showed that the incidence of cancer was significantly higher among those patients who had lived for 5 to 10 years at a distance of up to 400 m from a cell installation that had been in operation since 1993, compared with those patients living further away, and that the patients fell ill on an average of 8 years earlier than would be expected. In the years between 1999 and 2004, after 5 years operation of the transmitting installation, the relative risk of getting cancer had tripled for residents in proximity of the installation compared with inhabitants outside of the area.

Wolf and Wolf (2004) investigated increased cancer incidence in populations living in a small area in Israel exposed

[14] http://www.salzburg.gv.at/umweltmedizin. (Accessed October 2010.)

to RFR from a cell tower. The antennas were mounted 10 m high, transmitting at 850 MHz and 1500 W at full-power output. People lived within a 350 m half circle of the antennas. An epidemiologic assessment was done to determine whether the incidence of cancer cases among individuals exposed to the base station in the south section of the city of Netanya called Irus (designated area A) differed from expected cancer rates throughout Israel, and in the town of Netanya in general, as compared with people who lived in a nearby area without a cell tower (designated area B). There were 622 participants in area A who had lived near the cell tower for 3 to 7 years and were patients at one health clinic. The exposure began 1 year before the start of the study when the station first came into service. A second cohort of individuals in area B, with 1222 participants who received medical services at a different clinic located nearby, was used as a control. Area B was closely matched for environment, workplace, and occupational characteristics. In exposure area A, eight cases of different types of cancer were diagnosed in a period of 1 year, including cancers of the ovary (1), breast (3), Hodgkins lymphoma (1), lung (1), osteoid osteoma (1), and hypernephroma (1). The RFR field measurements were also taken per house and matched to the cancer incidents. The rate of cancers in area A was compared with the annual rate of the general population (31 cases per 10 000) and to incidence for the entire town of Netanya. There were two cancers in area B, compared to eight in area A. They also examined the history of the exposed cohort (area A) for malignancies in the 5 years before exposure began and found only two cases in comparison to eight cases 1 year after the tower went into service. The researchers concluded that relative cancer rates for females were 10.5 for area A, 0.6 for area B, and 1.0 for the whole town of Netanya. Cancer incidence in women in area A was thus significantly higher (p <0.0001) compared with that of area B and the whole city. A comparison of the relative risk revealed that there were 4.15 times more cases in area A than in the entire population. The study indicated an association between increased incidence of cancer and living in proximity to a cell phone base station. The measured level of RFR, between 0.3 to 0.5 $\mu W/cm^2$, was far below the thermal guidelines.

11. Risk perception, electrohypersensitivity, and psychological factors

Others have followed up on what role risk perception might play in populations near cell base stations to see if it is associated with health complaints.

Blettner et al. (2008) conducted a cross-sectional, multiphase study in Germany. In the initial phase, 30 047 people out of a total of 51 444, who took part in a nationwide survey, were also asked about their health and attitudes towards mobile phone base stations. A list of 38 potential health complaints were used. With a response rate of 58.6%, 18.0% were concerned about adverse health effects from base stations, 10.3% directly attributed personal adverse effects to them. It was found that people living within 500 m, or those concerned about personal exposures, reported more health complaints than others. The authors concluded that even though a substantial proportion of the German population is concerned about such exposures, the observed higher health complaints cannot be attributed to those concerns alone.

Kristiansen et al. (2009) also explored the prevalence and nature of concerns about mobile phone radiation, especially since the introduction of new 3G–UMTS (universal mobile telecommunications system) networks that require many more towers and antennas have sparked debate throughout Europe. Some local governments have prohibited mobile antennas on public buildings due to concerns about cancer, especially brain cancer in children and impaired psychomotor functions. One aim of the researchers was risk assessment — to compare people's perceptions of risk from cell phones and masts to other fears, such as being struck by lightening. In Denmark, they used data from a 2006 telephone survey of 1004 people aged 15+ years. They found that 28% of the respondents were concerned about exposure to mobile phone radiation and 15% about radiation from masts. In contrast, 82% of respondents were concerned about other forms of environmental pollution. Nearly half of the respondents considered the mortality risk of 3G phones and masts to be of the same order of magnitude as being struck by lightning (0.1 fatalities per million people per year), while 7% thought it was equivalent to tobacco-induced lung cancer (approximately 500 fatalities per million per year). Among women, concerns about mobile phone radiation, perceived mobile phone mortality risk, and concerns about unknown consequences of new technologies, increased with educational levels. More than two thirds of the respondents felt that they had not received adequate public information about the 3G system. The results of the study indicated that the majority of the survey population had little concern about mobile phone radiation, while a minority is very concerned.

Augner et al. (2009) examined the effects of short-term GSM base station exposure on psychological symptoms including good mood, alertness, and calmness as measured by a standardized well-being questionnaire. Fifty-seven participants were randomly assigned to one of three different exposure scenarios. Each of those scenarios subjected participants to five 50 min exposure sessions, with only the first four relevant for the study of psychological symptoms. Three exposure levels were created by shielding devices, which could be installed or removed between sessions to create double-blinded conditions. The overall median power densities were 0.00052 $\mu W/cm^2$ during low exposures, 0.0154 $\mu W/cm^2$ during medium exposures, and 0.2127 $\mu W/cm^2$ during high-exposure sessions. Participants in high- and medium-exposure scenarios were significantly calmer during those sessions than participants in low-exposure scenarios throughout. However, no significant differences between exposure scenarios in the "good mood" or "alertness" factors were found. The researchers concluded that short-term exposure to GSM base station signals may have an impact on well-being by reducing psychological arousal.

Eltiti et al. (2007) looked into exposures to the GSM and UMTS exposures from base stations and the effects to 56 participants who were self-reported as sensitive to electromagnetic fields. Some call it electro-hypersensitivity (EHS) or just electrosensitivity. People with EHS report that they suffer negative health effects when exposed to electro-

magnetic fields from everyday objects such as cell phones, mobile phone base stations, and many other common things in modern societies. EHS is a recognized functional impairment in Sweden. This study used both open provocation and double-blind tests to determine if electrosensitive and control individuals experienced more negative health effects when exposed to base-station-like signals compared with sham exposures. Fifty-six electrosensitive and 120 control participants were tested first in an open provocation test. Of these, 12 electrosensitive and six controls withdrew after the first session. Some of the electrosensitive subjects later issued a statement saying that the initial exposures made them too uncomfortable to continue participating in the study. This means that the study may have lost its most vulnerable test subjects right at the beginning, possibly skewing later outcomes. The remainder completed a series of double-blind tests. Subjective measures of well-being and symptoms, as well as physiological measures of blood-volume pulse, heart rate, and skin conductance were obtained. They found that during the open provocation, electrosensitive individuals reported lower levels of well-being to both GSM and UMTS signals compared with sham exposure, whereas controls reported more symptoms during the UMTS exposure. During double-blind tests the GSM signal did not have any effect on either group. Electrosensitive participants did report elevated levels of arousal during the UMTS condition, but the number or severity of symptoms experienced did not increase. Physiological measures did not differ across the three exposure conditions for either group. The researchers concluded that short-term exposure to a typical GSM base-station-like signal did not affect well-being or physiological functions in electrosensitive or control individuals even though the electrosensitive individuals reported elevated levels of arousal when exposed to a UMTS signal. The researchers stated that this difference was likely due to the effect of the order of the exposures throughout the series rather than to the exposure itself. The researchers do not speculate about possible data bias when one quarter of the most sensitive test subjects dropped out at the beginning.

In follow-up work, Eltiti et al. (2009) attempted to clarify some of the inconsistencies in the research with people who report sensitivity to electromagnetic fields. Such individuals, they noted, often report cognitive impairments that they believe are due to exposure to mobile phone technology. They further said that previous research in this area has revealed mixed results, with the majority of research only testing control individuals. Their aim was to clarify whether short-term (50 min) exposure at 1 $\mu W/cm^2$ to typical GSM and UMTS base station signals affects attention, memory, and physiological endpoints in electrosensitive and control participants. Data from 44 electrosensitive and 44 matched-control participants who performed the digit symbol substitution task (DSST), digit span task (DS), and a mental arithmetic task (MA), while being exposed to GSM, UMTS, and sham signals under double-blind conditions were analyzed. Overall, the researchers concluded that cognitive functioning was not affected by short-term exposure to either GSM or UMTS signals. Nor did exposure affect the physiological measurements of blood-volume pulse, heart rate, and skin conductance that were taken while participants performed the cognitive tasks. The GSM signal was a combined signal of 900 and 1800 MHz frequencies, each with a power flux density of 0.5 $\mu W/cm^2$, which resulted in combined power flux density of 1 $\mu W/cm^2$ over the area where test subjects were seated. Previous measurements in 2002 by the National Radiological Protection Board in the UK, measuring power density from base stations at 17 sites and 118 locations (Mann et al. 2002), found that in general, the power flux density was between 0.001 $\mu W/cm^2$ to 0.1 $\mu W/cm^2$, with the highest power density being 0.83 $\mu W/cm^2$. The higher exposure used by the researchers in this study was deemed comparable by them to the maximum exposure a person would encounter in the real world. But many electrosensitive individuals report that they react to much lower exposures too. Overall, the electrosensitive participants had a significantly higher level of mean skin conductance than control subjects while performing cognitive tasks. The researchers noted that this was consistent with other studies that hypothesize sensitive individuals may have a general imbalance in autonomic nervous system regulation. Generally, cognitive functioning was not affected in either electrosensitives or controls. When Bonferroni corrections were applied to the data, the effects on mean skin conductance disappeared. A criticism is that this averaging of test results hides more subtle effects.

Wallace et al. (2010) also tried to determine if short-term exposure to RFR had an impact on well-being and what role, if any, psychological factors play. Their study focused on "Airwave", a new communication system being rolled out across the UK for police and emergency services. Some police officers have complained about skin rashes, nausea, headaches, and depression as a consequence of using Airwave two-way radio handsets. The researchers used a small group of self-reported electrosensitive people to determine if they reacted to the exposures, and to determine if exposures to specific signals affect a selection of the adult population who do not report sensitivity to electromagnetic fields. A randomized double-blind provocation study was conducted to establish whether short-term exposure to a terrestrial trunked radio (TETRA) base station signal has an impact on health and well-being in individuals with electrosensitivity and controls. Fifty-one individuals with electrosensitivity and 132 age- and gender-matched controls participated first in an open provocation test, while 48 electrosensitive and 132 control participants went on to complete double-blind tests in a fully screened semi-anechoic chamber. Heart rate, skin conductance, and blood pressure readings provided objective indices of short-term physiological response. Visual analogue scales and symptom scales provided subjective indices of well-being. Their results found no differences on any measure between TETRA and sham (no signal) under double-blind conditions for either control or electrosensitive participants and neither group could detect the presence of a TETRA signal above chance (50%). The researchers noted, however, that when conditions were not double-blinded, the electrosensitive individuals did report feeling worse and experienced more severe symptoms during TETRA compared with sham exposure. They concluded that the adverse symptoms experienced by electrosensitive individuals are caused by the belief of harm from TETRA base stations rather than because of the low-level EMF exposure itself.

It is interesting to note that the three previously men-

tioned studies were all conducted at the same Electromagnetics and Health Laboratory at the University of Essex, Essex, UK, by the same relative group of investigators. Those claiming to be electrosensitive are a small subgroup in the population, often in touch through Internet support groups. In the first test, many electrosensitives dropped out because they found the exposures used in the study too uncomfortable. The drop-out rate decreased with the subsequent studies, which raises the question of whether the electrosensitive participants in the latter studies were truly electrosensitive. There is a possibility that a true subgroup of electrosensitives cannot tolerate such study conditions, or that potential test subjects are networking in a way that preclude their participation in the first place. In fact, researchers were not able to recruit their target numbers for electrosensitive participants in any of the studies. The researchers also do not state if there were any of the same electrosensitive participants used in the three studies. Nor do they offer comment regarding the order of the test methods possibly skewing results.

Because of uncertainty regarding whether EMF exposures are actually causing the symptoms that electrosensitives report, and since many electrosensitives also report sensitivities to myriad chemicals and other environmental factors, it has been recommended (Hansson Mild et al. 2006) that a new term be used to describe such individuals — idiopathic environmental intolerance with attribution to electromagnetic fields (IEI-EMF).

Furubayashi et al. (2009) also tried to determine if people who reported symptoms to mobile phones are more susceptible than control subjects to the effect of EMF emitted from base stations. They conducted a double-blind, cross-over provocation study, sent questionnaires to 5000 women and obtained 2472 valid responses from possible candidates. From those, they were only able to recruit 11 subjects with mobile phone related symptoms (MPRS) and 43 controls. The assumption was that individuals with MPRS matched the description of electrosensitivity by the World Health Organization (WHO). There were four EMF exposure conditions, each of which lasted 30 min: (*i*) continuous, (*ii*) intermittent, (*iii*) sham exposure with noise, and (*iv*) sham exposure without noise. Subjects were exposed to EMF of 2.14 GHz, 10 V/m (26.53 $\mu W/cm^2$) wideband code division multiple access (W-CDMA), in a shielded room to simulate whole-body exposure to EMF from base stations, although the exposure strength they used was higher than that commonly received from base stations. The researchers measured several psychological and cognitive parameters immediately before and after exposure, and monitored autonomic functions. Subjects were asked to report on their perception of EMF and level of discomfort during the experiment. The MPRS group did not differ from the controls in their ability to detect exposure to EMF. They did, however, consistently experience more discomfort in general, regardless of whether or not they were actually exposed to EMF, and despite the lack of significant changes in their autonomic functions. The researchers noted that others had found electrosensitive subjects to be more susceptible to stress imposed by task performance, although they did not differ from normal controls in their personality traits. The researchers concluded that the two groups did not differ in their responses to real or sham EMF exposure according to any psychological, cognitive or autonomic assessment. They said they found no evidence of any causal link between hypersensitivity symptoms and exposure to EMF from base stations. However, this study, had few MPRS participants.

Regel et al. (2006) also investigated the effects of the influence of UMTS base-station-like signals on well-being and cognitive performance in subjects with and without self-reported sensitivity to RFR. The researchers performed a controlled exposure experiment in a randomized, double-blind crossover study, with 45 min at an electric field strength of 0 V/m, 1.0 V/m (0.2653 $\mu W/cm^2$), or 10.0 V/m (26.53 $\mu W/cm^2$), incident with a polarization of 45° from the left-rear side of the subject, at weekly intervals. A total of 117 healthy subjects that included 33 self-reported sensitive subjects and 84 nonsensitive subjects, participated in the study. The team assessed well-being, perceived field strength, and cognitive performance with questionnaires and cognitive tasks and conducted statistical analyses using linear mixed models. Organ-specific and brain-tissue-specific dosimetry, including uncertainty and variation analysis, was performed. Their results found that in both groups, well-being and perceived field strength were not associated with actual exposure levels. They observed no consistent condition-induced changes in cognitive performance except for two marginal effects. At 10 V/m (26.53 $\mu W/cm^2$) they observed a slight effect on speed in one of six tasks in the sensitive subjects and an effect on accuracy in another task in nonsensitive subjects. Both effects disappeared after multiple endpoint adjustments. They concluded that they could not confirm a short-term effect of UMTS base-station-like exposure on well-being. The reported effects on brain functioning were marginal, which they attributed to chance. Peak spatial absorption in brain tissue was considerably smaller than during use of a mobile phone. They concluded that no conclusions could be drawn regarding short-term effects of cell phone exposure or the effects of long-term base-station-like exposures on human health.

Siegrist et al. (2005) investigated risk perceptions associated with mobile phones, base stations, and other sources of EMFs through a telephone survey conducted in Switzerland. Participants assessed both risks and benefits associated with nine different sources of EMF. Trust in the authorities regulating these hazards was also assessed. Participants answered a set of questions related to attitudes toward EMF and toward mobile phone base stations. Their results were: high-voltage transmission lines are perceived as the most risky source of EMF; and mobile phones and base stations received lower risk ratings. Trust in authorities was positively associated with perceived benefits and negatively associated with perceived risks. Also, people who use their mobile phones frequently perceived lower risks and higher benefits than people who use their mobile phones infrequently. People who believed they lived close to a base station did not significantly differ in their perceived level of risks associated with mobile phone base stations from people who did not believe they lived close to a base station. A majority of participants favored limits to exposures based on worst-case scenarios. The researchers also correlated perceived risks with other beliefs and found that belief in paranormal phenomena is related to level of perceived risks associated with

EMF. In addition, people who believed that most chemical substances cause cancer also worried more about EMF than people who did not believe that chemical substances are harmful. This study found the obvious — that some people worry more about environmental factors than others across a range of concerns.

Wilen et al. (2006) investigated the effects of exposure to mobile phone RFR on people who experience subjective symptoms when using mobile phones. Twenty subjects with MPRS were matched with 20 controls without MPRS. Each subject participated in two experimental sessions, one with true exposure and one with sham exposure, in random order. In the true exposure condition, the test subjects were exposed for 30 min to an RFR field generating a maximum SAR (1 g) in the head of 1 W/kg through an indoor base station antenna attached to signals from a 900 MHz GSM mobile phone. Physiological and cognitive parameters were measured during the experiment for heart rate and heart rate variability (HRV), respiration, local blood flow, electrodermal activity, critical flicker fusion threshold (CFFT), short-term memory, and reaction time. No significant differences related to RFR exposure conditions and no differences in baseline data were found between subject groups with the exception for reaction time, which was significantly longer among the test subjects than among the controls the first time the test was performed. This difference disappeared when the test was repeated. However, the test subjects differed significantly from the controls with respect to HRV as measured in the frequency domain. The test subjects displayed a shift in the low/high frequency ratio towards a sympathetic dominance in the autonomous nervous system during the CFFT and memory tests, regardless of exposure condition. They interpreted this as a sign of differences in the autonomous nervous system regulation among persons with MPRS and persons with no such symptoms.

12. Assessing exposures

Quantifying, qualifying, and measuring radiofrequency (RF) energy both indoors and outdoors has frustrated scientists, researchers, regulators, and citizens alike. The questions involve how best to capture actual exposure data — through epidemiology, computer estimates, self-reporting, or actual dosimetry measurements. Determining how best to do this is more important than ever, given the increasing background levels of RFR. Distance from a generating source has traditionally been used as a surrogate for probable power density but that is imperfect at best, given how RF energy behaves once it is transmitted. Complicated factors and numerous variables come into play. The wearing of personal dosimetry devices appears to be a promising area for capturing cumulative exposure data.

Neubauer et al. (2007) asked the question if epidemiology studies are even possible now, given the increasing deployment of wireless technologies. They examined the methodological challenges and used experts in engineering, dosimetry, and epidemiology to critically evaluate dosimetric concepts and specific aspects of exposure assessment regarding epidemiological study outcomes. They concluded that, at least in theory, epidemiology studies near base stations are feasible but that all relevant RF sources have to be taken into account. They called for pilot studies to validate exposure assessments and recommended that short-to-medium term effects on health and well-being are best investigated by cohort studies. They also said that for long-term effects, groups with high exposures need to be identified first, and that for immediate effects, human laboratory studies are the preferred approach. In other words, multiple approaches are required. They did not make specific recommendations on how to quantify long-term, low-level effects on health and well-being.

Radon et al. (2006) compared personal RF dosimetry measurements against recall to ascertain the reliability of self-reporting near base stations. Their aim was to test the feasibility and reliability of personal dosimetry devices. They used a 24 h assessment on 42 children, 57 adolescents, and 64 adults who wore a Maschek dosimeter prototype, then compared the self-reported exposures with the measurements. They also compared the readings of Maschek prototype with those of the Antennessa DSP-090 in 40 test subjects. They found that self-reported exposures did not correlate with actual readings. The two dosimeters were in moderate agreement. Their conclusion was that personal dosimetry, or the wearing of measuring devices, was a feasible method in epidemiology studies.

A study by Frei et al. (2009) also used personal dosimetry devices to examine the total exposure levels of RFR in the Swiss urban population. What they found was startling — nearly a third of the test subjects' cumulative exposures were from cell base stations. Prior to this study, exposure from base stations was thought to be insignificant due to their low-power densities and to affect only those living or working in close proximity to the infrastructure. This study showed that the general population moves in and out of these particular fields with more regularity than previously expected. In a sample of 166 volunteers from Basel, Switzerland, who agreed to wear personal exposure meters (called exposimeters), the researchers found that nearly one third of total exposures came from base stations. Participants carried an exposimeter for 1 week (2 separate weeks in 32 participants) and also completed an activity diary. Mean values were calculated using the robust regression on order statistics (ROS) method. Results found a mean weekly exposure to all RFR and (or) EMF sources was 0.013 $\mu W/cm^2$ (range of individual means 0.0014–0.0881 $\mu W/cm^2$). Exposure was mainly from mobile phone base stations (32.0%), mobile phone handsets (29.1%), and digital enhanced cordless telecommunications (DECT) phones (22.7%). People owning a DECT phone (total mean 0.015 $\mu W/cm^2$) or mobile phone (0.014 $\mu W/cm^2$) were exposed more than those not owning a DECT or mobile phone (0.010 $\mu W/cm^2$). Mean values were highest in trains (0.116 $\mu W/cm^2$), airports (0.074 $\mu W/cm^2$), and tramways or buses (0.036 $\mu W/cm^2$) and were higher during daytime (0.016 $\mu W/cm^2$) than nighttime (0.008 $\mu W/cm^2$). The Spearman correlation coefficient between mean exposure in the first and second week was 0.61. Another surprising finding of this study contradicted Neubauer et al. (2008) who found that a rough dosimetric estimate of a 24 h exposure from a base station (1–2 V/m) (i.e., 0.2653–1.061 $\mu W/cm^2$) corresponded to approximately 30 min of mobile phone use. But Frei et al. (2009) found, using the exposimeter, that cell phone use was 200 times higher than the average base sta-

tion exposure contribution in self-selected volunteers (0.487 versus 0.002 $\mu W/cm^2$). This implied that at the belt, backpack, or in close vicinity to the body, the mean base station contribution corresponds to about 7 min of mobile phone use (24 h divided by 200), not 30 min. They concluded that exposure to RFR varied considerably between persons and locations but was fairly consistent for individuals. They noted that cell phones, base stations, and cordless phones were important sources of exposure in urban Switzerland but that people could reduce their exposures by replacing their cordless domestic phones with conventional landlines at home. They determined that it was feasible to combine diary data with personal exposure measurements and that such data was useful in evaluating RFR exposure during daily living, as well as helpful in reducing exposure misclassification in future epidemiology studies.

Viel et al. (2009) also used personal exposure meters (EME SPY 120 made by Satimo and ESM 140 made by Maschek) to characterize actual residential exposure from antennas. Their primary aim was to assess personal exposures, not ambient field strengths. Two hundred randomly selected people were enrolled to wear measurement meters for 24 h and asked to keep a time–location–activity diary. Two exposure metrics for each radiofrequency were then calculated: the proportion of measurements above the detection limit of 0.05 V/m (0.0006631 $\mu W/cm^2$) and the maximum electric field strength. Residential addresses were geocoded and distances from each antenna were calculated. They found that much of the time-recorded field strength was below the detection level of 0.05 V/m, with the exception of the FM radio bands, which had a detection threshold of 12.3%. The maximum electric field was always lower than 1.5 V/m (0.5968 $\mu W/cm^2$). Exposure to GSM and digital cellular system (DCS) frequencies peaked around 280 m in urban areas and 1000 m from antennas in more suburban/rural areas. A downward trend in exposures was found within a 10 km distance for FM exposures. Conversely, UMTS, TV3, and TV 4 and 5 signals did not vary with distance. The difference in peak exposures for cell frequencies were attributed to microcell antennas being more numerous in urban areas, often mounted a few meters above ground level, whereas macrocell base stations in less urban areas are placed higher (between 15 and 50 m above ground level) to cover distances of several kilometres. They concluded that despite the limiting factors and high variability of RF exposure assessments, in using sound statistical technique they were able to determine that exposures from GSM and DCS cellular base stations actually increase with distance in the near source zone, with a maximum exposure where the main beam intersects the ground. They noted that such information should be available to local authorities and the public regarding the siting of base stations. Their findings coincide with Abdel-Rassoul et al. (2007) who found field strengths to be less in the building directly underneath antennas, with reported health complaints higher in inhabitants of the building across the street.

Amoako et al. (2009) conducted a survey of RFR at public access points close to schools, hospitals, and highly populated areas in Ghana near 50 cell phone base stations. Their primary objective was to measure and analyze field strength levels. Measurements were made using an Anritsu model MS 2601A spectrum analyzer to determine the electric field level in the 900 and 1800 MHz frequency bands. Using a GPS (global positioning system), various base stations were mapped. Measurements were taken at 1.5 m above ground to maintain line of sight with the RF source. Signals were measured during the day over a 3 h period, at a distance of approximately 300 m. The results indicated that power densities for 900 MHz at public access points varied from as low as 0.000001 $\mu W/cm^2$ to as high as 0.001 $\mu W/cm^2$. At 1800 MHz, the variation of power densities was from 0.000001 to 0.01 $\mu W/cm^2$. There are no specific RFR standards in Ghana. These researchers determined that while their results in most cites were compliant with the ICNIRP standards, levels were still 20 times higher than values typically found in the UK, Australia, and the U.S., especially for Ghana base stations in rural areas with higher power output. They determined that there is a need to reduce RFR levels since an increase in mobile phone usage is foreseen.

Clearly, predicting actual exposures based on simple distance from antennas using standardized computer formulas is inadequate. Although power density undoubtedly decreases with distance from a generating source, actual exposure metrics can be far more complex, especially in urban areas. Contributing to the complexity is the fact that the narrow vertical spread of the beam creates a low RF field strength at the ground directly below the antenna. As a person moves away or within a particular field, exposures can become complicated, creating peaks and valleys in field strength. Scattering and attenuation alter field strength in relation to building placement and architecture, and local perturbation factors can come into play. Power density levels can be 1 to 100 times lower inside a building, depending on construction materials, and exposures can differ greatly within a building, depending on numerous factors such as orientation toward the generating source and the presence of conductive materials. Exposures can be twice as high in upper floors than in lower floors, as found by Anglesio et al. (2001).

However, although distance from a transmitting source has been shown to be an unreliable determinant for accurate exposure predictions, it is nevertheless useful in some general ways. For instance, it has been shown that radiation levels from a tower with 15 nonbroadcast radio systems will fall off to hypothetical natural background levels at approximately 1500 ft ($\sim$500 m) (Rinebold 2001). This would be in general agreement with the lessening of symptoms in people living near cell towers at a distance over 1000 ft ($\sim$300 m) found by Santini et al. (2002) .

The previously mentioned studies indicate that accuracy in both test design and personal dosimetry measurements are possible in spite of the complexities and that a general safer distance from a cell tower for residences, schools, daycare centers, hospitals, and nursing homes might be ascertained.

13. Discussion

Numerous biological effects do occur after short-term exposures to low-intensity RFR but potential hazardous health effects from such exposures on humans are still not well es-

tablished, despite increasing evidence as demonstrated throughout this paper. Unfortunately, not enough is known about biological effects from long-term exposures, especially as the effects of long-term exposure can be quite different from those of short-term exposure. It is the long-term, low-intensity exposures that are most common today and increasing significantly from myriad wireless products and services.

People are reporting symptoms near cell towers and in proximity to other RFR-generating sources including consumer products such as wireless computer routers and Wi-Fi systems that appear to be classic "microwave sickness syndrome," also known as "radiofrequency radiation sickness." First identified in the 1950s by Soviet medical researchers, symptoms included headache, fatigue, ocular dysfunction, dizziness, and sleep disorders. In Soviet medicine, clinical manifestations include dermographism, tumors, blood changes, reproductive and cardiovascular abnormalities, depression, irritability, and memory impairment, among others. The Soviet researchers noted that the syndrome is reversible in early stages but is considered lethal over time (Tolgskaya et al. 1973).

Johnson-Liakouris (1998) noted there are both occupational studies conducted between 1953 and 1991 and clinical cases of acute exposure between 1975 and 1993 that offer substantive verification for the syndrome. Yet, U.S. regulatory agencies and standards-setting groups continue to quibble about the existence of microwave sickness because it does not fit neatly into engineering models for power density, even as studies are finding that cell towers are creating the same health complaints in the population. It should be noted that before cellular telecommunications technology, no such infrastructure exposures between 800 MHz and 2 GHz existed this close to so many people. Microwave ovens are the primary consumer product utilizing a high RF intensity, but their use is for very brief periods of time and ovens are shielded to prevent leakage above 1000 $\mu W/cm^2$ — the current FDA standard. In some cases, following the U.S. Telecommunications Act of 1996 preemption of local health considerations in infrastructure siting, antennas have been mounted within mere feet of dwellings. And, on buildings with roof-mounted arrays, exposures can be lateral with top floors of adjacent buildings at close range.

It makes little sense to keep denying health symptoms that are being reported in good faith. Though the prevalence of such exposures is relatively new to a widespread population, we, nevertheless, have a 50 year observation period to draw from. The primary questions now involve specific exposure parameters, not the reality of the complaints or attempts to attribute such complaints to psychosomatic causes, malingering, or beliefs in paranormal phenomenon. That line of argument is insulting to regulators, citizens, and their physicians. Serious mitigation efforts are overdue.

There is early Russian and U.S. documentation of long-term, very low-level exposures causing microwave sickness as contained in *The Johns Hopkins Foreign Service Health Status Study* done in 1978 (Lilienfield et al. 1978; United States Senate 1979). This study contains both clinical information, and clear exposure parameters. Called the Lilienfield study, it was conducted between 1953 and 1976 to determine what, if any, effects there had been to personnel in the U.S. Embassy in Moscow after it was discovered that the Soviet government had been systematically irradiating the U.S. government compound there.

The symptoms reported were not due to any known tissue heating properties. The power densities were not only very low but the propagation characteristics were remarkably similar to what we have today with cell phone base stations. Lilienfield recorded exposures for continuous-wave, broadband, modulated RFR in the frequency ranges between 0.6 and 9.5 GHz. The exposures were long-term and low-level at 6 to 8 h per day, 5 days per week, with the average length of exposure time per individual between 2 to 4 years. Modulation information contained phase, amplitude, and pulse variations with modulated signals being transmitted for 48 h or less at a time. Radiofrequency power density was between 2 and 28 $\mu W/cm^2$ — levels comparable to recent studies cited in this paper.

The symptoms that Lilienfield found included four that fit the Soviet description for dermographism — eczema, psoriasis, allergic, and inflammatory reactions. Also found were neurological problems with diseases of peripheral nerves and ganglia in males; reproductive problems in females during pregnancy, childbearing, and the period immediately after delivery (puerperium); tumor increases (malignant in females, benign in males); hematological alterations; and effects on mood and well-being including irritability, depression, loss of appetite, concentration, and eye problems. This description of symptoms in the early literature is nearly identical to the Santini, Abdel-Rassoul, and Narvarro studies cited earlier, as well as the current (though still anecdotal) reports in communities where broadcast facilities have switched from analog to digital signals at power intensities that are remarkably similar. In addition, the symptoms in the older literature are also quite similar to complaints in people with EHS.

Such reports of adverse effects on well-being are occurring worldwide near cell infrastructure and this does not appear to be related to emotional perceptions of risk. Similar symptoms have also been recorded at varying distances from broadcast towers. It is clear that something else is going on in populations exposed to low-level RFR that computer-generated RFR propagation models and obsolete exposure standards, which only protect against acute exposures, do not encompass or understand. With the increase in so many RFR-emitting devices today, as well as the many in the wings that will dramatically increase total exposures to the population from infrastructure alone, it may be time to approach this from a completely different perspective.

It might be more realistic to consider ambient outdoor and indoor RFR exposures in the same way we consider other environmental hazards such as chemicals from building materials that cause sick building syndrome. In considering public health, we should concentrate on aggregate exposures from multiple sources, rather than continuing to focus on individual source points like cell and broadcast base stations. In addition, whole categorically excluded technologies must be included for systems like Wi-Fi, Wi-Max, smart grids, and smart metering as these can greatly increase ambient radiation levels. Only in that way will low-level electromagnetic energy exposures be understood as the broad environmental factor it is. Radiofrequency radiation is a

form of energetic air pollution and it should be controlled as such. Our current predilection to take this one product or service at a time does not encompass what we already know beyond reasonable doubt. Only when aggregate exposures are better understood by consumers will disproportionate resistance to base station siting bring more intelligent debate into the public arena and help create safer infrastructure. That can also benefit the industries trying to satisfy customers who want such services.

Safety to populations living or working near communications infrastructure has not been given the kind of attention it deserves. Aggregate ambient outdoor and indoor exposures should be emphasized by summing up levels from different generating source points in the vicinity. Radiofrequency radiation should be treated and regulated like radon and toxic chemicals, as aggregate exposures, with appropriate recommendations made to the public including for consumer products that may produce significant RFR levels indoors. When indoor consumer products such as wireless routers, cordless/DECT phones, leaking microwave ovens, wireless speakers, and (or) security systems, etc. are factored in with nearby outdoor transmission infrastructure, indoor levels may rise to exposures that are unsafe. The contradictions in the studies should not be used to paralyze movement toward safer regulation of consumer products, new infrastructure creation, or better tower siting. Enough good science exists regarding long-term low-level exposures — the most prevalent today — to warrant caution.

The present U.S. guidelines for RFR exposure are not up to date. The most recent IEEE and NCRP guidelines used by the U.S. FCC have not taken many pertinent recent studies into consideration because, they argue, the results of many of those studies have not been replicated and thus are not valid for standards setting. That is a specious argument. It implies that someone tried to replicate certain works but failed to do so, indicating the studies in question are unreliable. However, in most cases, no one has tried to exactly replicate the works at all. It must be pointed out that the 4 W/kg SAR threshold based on the de Lorge studies have also not been replicated independently. In addition, effects of long-term exposure, modulation, and other propagation characteristics are not considered. Therefore, the current guidelines are questionable in protecting the public from possible harmful effects of RFR exposure and the U.S. FCC should take steps to update their regulations by taking all recent research into consideration without waiting for replication that may never come because of the scarcity of research funding. The ICNIRP standards are more lenient in key exposures to the population than current U.S. FCC regulations. The U.S. standards should not be "harmonized" toward more lenient allowances. The ICNIRP should become more protective instead. All standards should be biologically based, not dosimetry based as is the case today.

Exposure of the general population to RFR from wireless communication devices and transmission towers should be kept to a minimum and should follow the "As Low As Reasonably Achievable" (ALARA) principle. Some scientists, organizations, and local governments recommend very low exposure levels — so low, in fact, that many wireless industries claim they cannot function without many more antennas in a given area. However, a denser infrastructure may be impossible to attain because of citizen unwillingness to live in proximity to so many antennas. In general, the lowest regulatory standards currently in place aim to accomplish a maximum exposure of 0.02 V/m, equal to a power density of 0.0001 $\mu W/cm^2$, which is in line with Salzburg, Austria's indoor exposure value for GSM cell base stations. Other precautionary target levels aim for an outdoor cumulative exposure of 0.1 $\mu W/cm^2$ for pulsed RF exposures where they affect the general population and an indoor exposure as low as 0.01 $\mu W/cm^2$ (Sage and Carpenter 2009). In 2007, *The BioInitiative Report, A rationale for a biologically based public exposure standard for electromagnetic fields (ELF and RF)*, also made this recommendation, based on the precautionary principle (Bioinitiative Report 2007).

Citizens and municipalities often ask for firm setbacks from towers to guarantee safety. There are many variables involved with safer tower siting — such as how many providers are co-located, at what frequencies they operate, the tower's height, surrounding topographical characteristics, the presence of metal objects, and others. Hard and fast setbacks are difficult to recommend in all circumstances. Deployment of base stations should be kept as efficient as possible to avoid exposure of the public to unnecessary high levels of RFR. As a general guideline, cell base stations should not be located less than 1500 ft ($\sim$500 m) from the population, and at a height of about 150 ft ($\sim$50 m). Several of the papers previously cited indicate that symptoms lessen at that distance, despite the many variables involved. However, with new technologies now being added to cell towers such as Wi-Max networks, which add significantly more power density to the environment, setback recommendations can be a very unpredictable reassurance at best. New technology should be developed to reduce the energy required for effective wireless communication.

In addition, regular RFR monitoring of base stations should be considered. Some communities require that ambient background levels be measured at specific distances from proposed tower sites before, and after, towers go online to establish baseline data in case adverse effects in the population are later reported. The establishment of such baselines would help epidemiologists determine what changed in the environment at a specific point in time and help better assess if RFR played a role in health effects. Unfortunately, with so much background RFR today, it is almost impossible to find a clean RFR environment. Pretesting may have become impossible in many places. This will certainly be the case when smart grid technologies create a whole new blanket of low-level RFR, with millions of new transceivers attached to people's homes and appliances, working off of centralized RFR hubs in every neighborhood. That one technology alone has the ability to permanently negate certain baseline data points.

The increasing popularity of wireless technologies makes understanding actual environmental exposures more critical with each passing day. This also includes any potential effects on wildlife. There is a new environmental concept taking form — that of "air as habitat" (Manville 2007) for species such as birds, bats, and insects, in the same way that water is considered habitat for marine life. Until now, air has been considered something "used" but not necessarily "lived in" or critical to the survival of species. How-

ever, when air is considered habitat, RFR is among the potential pollutants with an ability to adversely affect other species. It is a new area of inquiry deserving of immediate funding and research.

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Dangers of Cell Phone Radiation

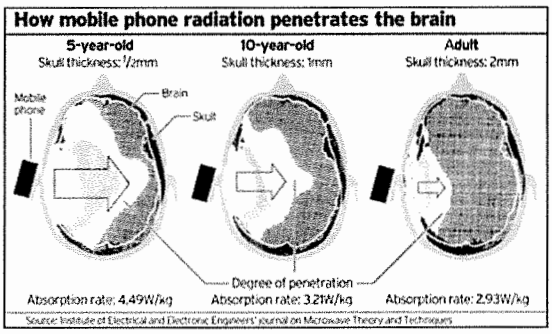
Whenever your cell phone is turned on, it is emitting potentially harmful EMFs. Possible side effects can range from disrupted sleep patterns to changes in DNA. Most people cannot function without their cell phone. But you can protect yourself against the danger.

EMF Danger from Cell Phones

When you hold your cell phone up to your ear, 10% to 80% of the radiation from the phone penetrates two inches into your

Know Your EMF Health Risks

brain. In children, the penetration is even deeper. Studies have shown that cell phones held near the head cause brain wave changes in 70% of people. The potential danger is so widely accepted that insurance companies are beginning to exclude coverage for injuries related to wireless phone radiation exposure.



These potential injuries can range from headaches and blurred vision to cancer:

Headaches
Genetic damage
Impaired immune system
Cancers, including brain tumors and melanoma
Break in the brain/blood barrier
Reduced melatonin
Interference with pacemakers
Memory loss
Changes in electrical activity in the brain
Cardiovascular stress
Fatigue
Eye problems

- Radiation from the Earth
- EMFs from Underground Pipes
- Smart Meters

Choose Products to Protect Yourself

SafeSpace Solutions

Earphones, headsets and speaker modes provide distance, but they don't eliminate danger. Anytime the power is turned on, **cell phones emit electromagnetic radiation** – even in stand-by mode and regardless if carried on belts, in pockets or purses—or set on the table in front of you.

More Important Facts about Cell Phones

- Cellphones emit two kinds of EMFs – microwave electromagnetic radiation from the antenna, and more EMFs from the phone body. Both are harmful.

- 20-80% of the radiation from a phone's antenna penetrates up to two inches into the adult brain.

- Cell phones have thermal effects (heating biological tissue) as well as non-thermal effects (affecting natural EMF frequencies)

- Studies have shown that people who sleep with a cellphone by the bed have poor REM sleep, leading to impaired learning and memory. Long-term effects remain to be seen.

- When the cellphone signal is held next to the head, brainwaves are altered a full 70% of the time.

- Many insurance companies are so alarmed by the evidence that they now exclude health issues related to cell phone radiation from coverage.

- Most brain surgeons limit their cellphone use, and counsel patients never to hold them to their ears.

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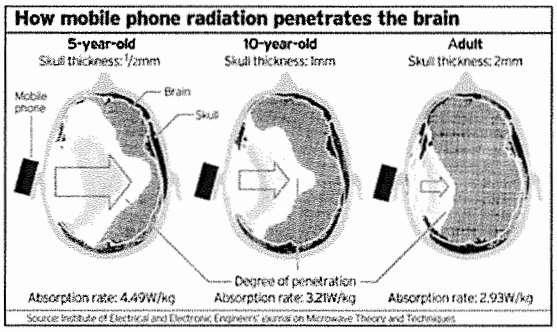

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Exposure Limits for Radiofrequency Energy: Three Models

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Introduction

This Conference is entitled "Criteria for EMF Standards Harmonization". Harmonization, used in the present context, is the process of reducing the large discrepancies in EMF exposure standards that are in effect throughout the world.

For many years, these differences were most apparent between limits of Russia and most of Eastern Europe (which originated in the days of the Soviet Union and the Warsaw Pact) and those of the United States and West Europe. This situation has become even more complicated with the recent adoption of "precautionary" limits by Switzerland, Italy, and a few other countries. Behind these differences are large differences in perception of science and health protection.

Before any "harmonization" can succeed, it is necessary first to understand the differences among these approaches. I focus on exposure guidelines to radiofrequency (RF) energy in the range around 1-2 GHz, which is used by mobile telephones (and a host of other applications).

Science-Based vs. Precautionary Limits

The Table below compares five different exposure limits for RF energy at 2000 MHz (similar to that used by many cellular telephones throughout the world). The limits are for long-term exposure to the general population.

Country	Limit for general public exposure to RF fields (2000 MHz) for extended periods of exposure, W/m^2 (applies to far-field exposure, extended duration)	Basis
ICNIRP (adopted in numerous countries worldwide)	10	Science-based
U.S. Federal Communications Commission (FCC) Bulletin 65, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields", Washington DC 1997. Generally follows IEEE C95.1-1999 with some modifications	10	Science-based
China	0.1	Science-based

UDC 614.898.5 GB 9175 –88		
Russia Sanitary Norms and Regulations 2.2.4/2.1.8.055-96	0.1	Science-based
Switzerland Ordinance on Protection from Non-ionising Radiation (NISV) of 23 December 1999	0.1	Precautionary
Typical Maximum Exposure from Cellular Base Station Mounted on 50 m tower (assuming a total effective radiated power of 2500 watts in each sector, summed over all channels)	0.01	

Limits in the United States, most Western European countries, and many countries in other parts of the world follow IEEE C95.1-1999[1] or the (quite similar) ICNIRP limits.[2] Those in the Russian Federation, (together with most of its former Warsaw Pact allies), China, Switzerland, and a few other countries are as much as a hundred times lower. I identify these limits as "science-based" and "precautionary", reflecting major differences in philosophy and approach.

Science-based limits are based on expert evaluation of the scientific literature to identify potential adverse effects of exposure. The resulting limits are designed to exclude identified hazards with an appropriate margin of safety. I have identified three of the limits in the Table as science-based, in this sense.

- US and most Western European limits (IEEE C95.1-1999 and ICNIRP). The rationale for these limits has been spelled out at length in the documentation accompanying the standards. These limits were based on an extensive review of the scientific literature to identify potentially hazardous effects and their thresholds. For example, in designing IEEE C95.1, "the most sensitive measures of potentially harmful biological effects were based on the disruption of ongoing behavior associated with an increase of body temperature in the presence of electromagnetic fields." Because of the "paucity of reliable data on chronic exposures", most of the literature concerned short-term (hours or less) exposure to RF energy. The hazards that are identified in the documentation are, for the most part, thermal in nature. The "averaging times" in the limits are short (6 to 20 minutes) and reflect thermal considerations.[3]
- Russian, Chinese, and most East European limits The Table shows a major Russian limit (Sanitary Norms and Regulations 2.2.4/2.1.8.055-96). The rationale for these limits is not described in the standard itself.[1] There is, however, a considerable body of commentary about the Russian and Eastern European standards by scientists who have been professionally involved in RF health and safety studies, including some by Russian and East European scientists (e.g. [4 5 6 7 8 9]).

[1] I thank Dr. A.G. Pakhomov for providing an English translation of the present Russian standard (SanPin 2.2.4/2.1.8.055-96).

The Russian (and several Eastern European) limits are clearly not designed principally to protect against thermal hazards. Their limits are far below thermally significant levels. More strikingly (from the perspective of Western limits) they embody the concept of dose, i.e. the incident power density multiplied by time, in a way that is unrelated to any conceivable thermal hazard. One Russian authority indicated that the limits of the Russian Federation for RF exposure at the frequencies used by wireless communications were set on the basis of biological experiments that found that a 3-hr daily exposure at 250 $\mu W/cm^2$ (950 MHz) could be regarded as a threshold for harmful physiological effects in experimental animals.[10]

Thus, Russian (and Eastern European) limits clearly reflect the conviction that long-term (hours or more) exposures at levels far below Western limits result in adverse health effects. Indeed, the Russian and Eastern European medical literature contains many reports of health effects from low-level exposure to RF energy. These include, for example, nonspecific problems (such as headaches, fatigability, irritability, sleep disorders, and dizziness) in workers in radio factories, who are exposed to RF energy at undetermined levels[11] [12]. The Chinese literature contains similar reports.[13] The Russian literature contains references to a "microwave disease" characterized by "asthenic, asthenovegetatic, and hypothalamic syndromes"[14] The disease is not recognized in Western medicine, and its diagnostic criteria would undoubtedly strike many Western physicians as vague and nonfalsifiable. Even some Eastern European physicians have complained about the nonspecificity of these criteria as well.[15] [16]

The large difference, between Russian and Eastern European exposure limits and those in the U.S. and most of Western Europe, is of longstanding duration. The latest Russian exposure standards (1996, 1997) are essentially identical to previous ones (1976, 1978, 1984). While IEEEC95.1 has evolved over the years, this has largely been a result of engineering calculations and a desire to provide a higher level of protection to nonoccupational groups, and not as a result of changes in the scientific understanding of the hazards involved.

Precautionary limits. Recently, Italy, Switzerland, and a few other countries have instituted exposure limits that are based on a totally different approach, the precautionary measures. Unlike science-based standards such as IEEE C95.1-1999, the ICNIRP limits, or the Russian limits (which are designed to avoid identified hazards), the Swiss limits were, in the words of the explanatory document accompanying the limits, "specifically intended to minimise the yet unknown risks" of RF and power-frequency electromagnetic fields.

The Swiss exposure guidelines were set at the lowest levels that were felt to be technically and economically feasible. In practice, that meant reducing the ICNIRP limits by a factor of 10 (in field strength) or 100 (in power density). (The law, however, is quite complex, with distinctions between "immissions" and "emissions", identification of places of sensitive use, new and old installations, etc. The limits in the table above would apply to most residential areas and near schools and hospitals.)

The Swiss law appears to result, at least in part, from concerns of the public about the safety of mobile telephone base stations. Its limits are somewhat above the levels of RF energy exposure from typical base stations mounted on towers at conventional heights, but might exclude base stations mounted at lower elevations on buildings (not to mention many broadcast facilities, airport radars, and other high-powered transmitters). The Swiss limits do not apply to wireless handsets, or to medical or industrial exposures – all potential sources of far exposures than wireless base stations.

"Harmonization" – Can It Be Done?

"Harmonizing" RF exposure limits has long been a perceived need among standards setting committees, and is one major goal of the World Health Organization's EMF Project. Such harmonization would help meet a variety of needs. It addresses the desire of the World Health Organization to provide a consistent level of health protection to different people around the world (WHO). It would also minimize some practical problems in implementing the limit. Not least, bringing exposure limits around the world into line would help reduce some of the political controversy connected with RF fields.

However, given the very large differences in different national guidelines, "harmonization" will be a difficult task – if it can be accomplished at all. At least two separate issues can be identified:

1. Harmonization of Science-Based Limits.

The most longstanding and best documented issue related to "harmonization" is the large difference between the groups of exposure limits of the West (such as ICNIRP and IEEE C95.1-1999) and those of the Russian Federation and Eastern Europe. The comments below are offered from a Western perspective.

Evaluating the Russian and East European scientific literature in this field has posed great problems for Western scientists, for at least two reasons apart from the obvious language issue.

One problem is the brevity of the descriptions of many reports of the studies. The research reports often lack crucial information such as the frequency and intensity of exposure, SAR, or descriptions of aspects of experimental design that would be needed to ensure the validity of the findings. Western health agencies and standards setting bodies generally consider only studies that meet minimum standards of reporting and methodology. For example, IEEE C95.1-1999 says that "only peer-reviewed reports of studies at SAR = 10 W/kg, which had received favorable engineering and biological validation, should be considered relevant to the assessment of risk from exposure to electromagnetic fields." Thus, whatever the quality of the original studies may have been, many Russian and Eastern European studies would be excluded from consideration in the Western risk assessment process by virtue of inadequate documentation.

But also, many of the Russian and Eastern European studies appear to suffer from serious flaws and for that reason would carry little weight in the Western risk assessment process. For example, many of the Russian occupational health studies involving EMF are little more than case reports, as opposed to well-controlled studies that tested specific hypotheses. Many more suffer from extensive use of post hoc data analysis. That is, the investigators applied large batteries of tests to their subjects, and assumed that any variation in the results between the "exposed" and "control" individuals was a direct effect of RF exposure. (That may or not may be the case, depending on a host of considerations.) Of course, many Western studies contain similar flaws, and also have carried little weight in standards setting processes. But the combination of uncertain quality, together with inadequate reporting, is an impossible barrier.

Finally, many of the Russian and East European studies employ concepts that are unusual in Western medicine. For example, Vasilevskii et al[11] conclude, on the basis of EEG (electroencephalogram) and other tests, that workers exhaust the "functional reserves" of their central nervous system after 14 years of work with microwaves and other electromagnetic fields. The document that promulgates the Russian standard lists asthenic, astheno-vegetative, and hypothalamic syndromes as "clinical disorders resulting

from EMR [electromagnetic radiation] RF exposure".[17] Most Western health agencies would undoubtedly consider a "temporary disturbance in the homeostasis" of an individual to be vague and unquantifiable, and the criteria that have been used to diagnose it (eg. subtle changes in heart rate variability or EEG) to be nonspecific and having no clear health significance. But such concepts are familiar in Russian medicine, and the Russian and Eastern European literature on health effects of RF energy abounds with such concepts. Such differences stem in part from very different views about health and medicine.

Clearly, "harmonizing" Russian and US limits (for example) will be far more than a technocratic exercise. The differences between these science-based standards involve different medical traditions with different concepts of health and disease, and different standards of proof.

One useful first step would for different standards groups to sit down and decide on a uniform set of criteria for accepting scientific reports (publication in peer reviewed journals, appropriate exposure assessment, blinded study design, etc.), and then evaluate specific reports for inclusion or exclusion from consideration. Achieving convergence even in this preliminary step would be a worthwhile accomplishment.

A second useful step would be to identify Russian (and Chinese and other) studies that scientists involved with national standards setting process regard as demonstrating health effects of RF energy. These studies (which might be unpersuasive to Western risk assessors) should then be followed up by stronger studies with appropriate design and standards of reporting. Followup studies with superior design would be needed for any study, wherever in the world it was conducted, that suggested the existence of health hazards. Such studies, in the case of Russia, would probably have to be funded by Western health agencies, but should meet internationally accepted standards of design and reporting. Everybody would benefit from such studies.

Even more difficult will be reconciling "precautionary" limits in Switzerland and other countries, with science-based limits. The precautionary principle is well established in international law and enjoys widespread political support. However, it remains elusive in meaning and easily misused.[18] . And by their very nature, precautionary policies are set in the absence of scientific knowledge, not on the basis of such knowledge.

In a "Backgrounder" on the precautionary principle[19], the World Health Organization recommended that precautionary policies "be adopted only under the condition that scientific assessments of risk and science-based exposure limits should not be undermined by the adoption of arbitrary cautionary approaches. That would occur, for example, if limit values were lowered to levels that bear no relationship to the established hazards or have inappropriate arbitrary adjustments to the limit values to account for the extent of scientific uncertainty."

WHO noted that a variety of "precautionary" approaches (such as improved risk communication) can be taken to EMF regulation, apart from setting mandatory limits. WHO also noted that some European "precautionary" policies about EMF field regulation would seem to be inconsistent with recent commentary by the European Commission on the proper use of the principle.[20]

In the end, harmonization may come about from political and economic pressures rather than from scientific data. Recently, the Czech Republic revised its limits upwards, to those of ICNIRP, as part of the process of integration into the European Union. Other Eastern European nations, in their bids to join the EU, are considering similar changes.

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INTERNATIONAL EXPERTS' PERSPECTIVE ON THE HEALTH EFFECTS OF ELECTROMAGNETIC FIELDS (EMF) AND ELECTROMAGNETIC RADIATION (EMR).

June 11, 2011 (updated as of July 2014). Below are some of the key **resolutions, appeals,** and **declarations** released by expert scientific groups around the world since 1998, regarding the **biological and health effects** of both low frequency electromagnetic fields (**EMF**) associated with electricity and radio frequency (**RF**) electromagnetic radiation (**EMR**) generated by wireless devices.

Anyone who reads these cannot be left with the illusion (or delusion) that this form of energy is without adverse biological and health consequences at levels well below existing guidelines. Children are particularly vulnerable. It is irresponsible of governments to maintain the status quo in light of thousands of studies that have been published and statements by these experts.

Here are the resolutions/appeals/reports in reverse chronological order. **Note**: this page is update with new appeals/resolutions as they become available. Last updated July 12, 2014.

22. July, 2014: Canadian Physician's Declaration July 9, 2014.

There is considerable evidence and research from various scientific experts that exposure to microwave radiation from wireless devices; Wi-Fi, smart meters and cell towers can have an adverse impact on human physiological function. Many recent and emerging studies from university departments and scientific sources throughout the world support the assertion that energy from wireless devices may be causatively linked to various health problems including reproductive compromise, developmental impacts, hormonal dysregulation and cancer. In fact, in 2011 the World Health Organization listed microwave radiation as a Class 2B possible carcinogen and subsequent research strengthened the evidence that a stronger designation may be justified.

Physicians Call for Health Canada to Provide:

i) Wireless safety standards that are more protective of the health of Canadians; and

ii) Guidelines and resources to assist Canadian physicians in assessing and managing health problems related to microwave radiation.

To view document with 22 signature click here.

21. July, 2014: International Scientists Declaration July 9, 2014

Scientists call for Protection from Radiofrequency Radiation Exposure.

According to this international group of 53 scientists from 18 countries who do research dealing with electromagnetic fields and/or electromagnetic radiation, Canada's Safety Code 6 Guideline is fundamentally flawed and does not protect people

This expert group urgently calls upon Health Canada . . .

i) to intervene in what we view as an emerging public health crisis;

ii) to establish guidelines based on the best available scientific data including studies on cancer and DNA damage, stress response, cognitive and neurological disorders, impaired reproduction, developmental effects, learning and behavioural problems among children and youth, and the broad range of symptoms classified as EHS; and

iii) To advise Canadians to limit their exposure and especially the exposure of children.

Click here for pdf of this document with signatures as of July 9, 2014.

20. November, 2012: International Doctors' Appeal 2012 is a 10-year follow-up to the Freiburg Appeal of 2002 (see #5 below). In this appeal, physicians recognize that radio frequency radiation poses a serious health risk and they demand that precaution be exercised to protect public health.

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19. March, 2012: Guideline of the Austrian Medical Association for the diagnosis and treatment of EMF related health problems and illnesses (EMF syndrome) provides information on how to proceed if patients exhibit EMF-related health problems. It includes taking history of health problems and EMF exposure; examination and findings; measurement of EMF exposure; prevention or reduction of EMF exposure; diagnosis; and treatment. Click here for pdf.

18. May 31, 2011: International Agency for Research on Cancer (IARC) and World Health Organization (WHO) reclassified radio frequency electromagnetic fields as a Class 2B carcinogen (possibly carcinogen to humans). This applies to all forms of radio frequency radiation (and not just cell phones as some inaccurately claim). Click here for press release. Final report will be published in the July 1st issue of The Lancet Oncology.

17. May 2011: The Parliamentary Assembly Council of Europe (PACE) released Resolution 1815 on the *Potential Dangers of Electromagnetic Fields and their effect on the Environment.* This document has some excellent recommendations regarding cell phones, cordless phones, wireless baby monitors, WiFi, WLAN, WiMax, power lines, relay antenna base stations; with special concerns expressed for the protection of children and those who are electrosensitive. Click here for document.

16. May 2011: Multiple Chemical Sensitivity (MCS) and Electrohypersensitivity (EHS), Summary of meeting at the WHO headquarters Geneva, May 13, 2011. Click here for report. Some statements from this meeting are quoted below:

> *We need to include these illnesses [MCS and EHS] in the WHO International Classification of Diseases (ICD), because what makes it more difficult for legal recognition is precisely the lack of code for these diseases in the ICD.*
>
> *The adverse reactions to chemicals or electromagnetic radiation vary in duration according to each patient, and the manifestations differ too. When the patient is again exposed, symptoms usually worsen or result in the appearance of new symptoms.*
>
> *The process of these diseases (MCS and EHS) is chronic and the patient's situation is exacerbated if he/she lives in a toxic environment, such as near Tarragona petrochemical industry or subjected to electromagnetic radiation: emissions in the neighborhood, mobile phone antennas , etc. The patient has to avoid re-exposure.*
>
> *We are facing very high numbers of people already diagnosed . . . between 12% and 15% of the population has some kind of disturbance in the presence of a chemical substance. In the EHS, figures of affected people are between 3 and 6% of the population, but these numbers are growing continuously.*
>
> *Each country can recognize these diseases and include them in their ICE, independently of WHO, since according to the WHO countries have sovereignty on this issue.*

15. April 2011: The **Russian National Committee on Non-Ionizing Radiation Protection** (RNCNIRP) released their Resolution entitled "*Electromagnetic fields from Mobile Phones: Health Effect on Children and Teenagers*". *Click* here for report.

The Committee presents some startling statistics [references provided in original document].

> *In April 2008, the RNCNIRP reviewed the short-term and long-term effects of mobile phone use for children. In particular, it reviewed possible decrease of intellectual abilities and cognition together with possible increases in susceptibility to epileptic fits, "acquired dementia" and degeneration of cerebral nervous structures. The results of clinical studies have shown that chronic exposure to RF EMF may lead to borderline psychosomatic disorders. In 2010, a number of papers published in Russian and foreign peer-reviewed journals showed a response to RF EMF exposure from the immune system.*
>
> *. . . since 2000 there has been a steady growth in the incidence of childhood diseases identified by RNCNIRP as "possible diseases" from mobile phone use. Of particular concern is the morbidity increase among young people aged 15 to 19 years (it is very likely that most of them are mobile phone users for a long period of time). Compared to 2009, the number of CNS [central nervous system] disorders among 15 to 17 year-old has grown by 85%, the number of individuals with epilepsy or epileptic syndrome has grown by 36%, the number of "mental retardation" cases has grown by 11%, and the number of blood disorders and immune status disorders has grown by 82%. In group of children aged less than 14 years there was a 64% growth in the number of blood disorders and immune status disorders, and 58% growth in nervous disorders. The*

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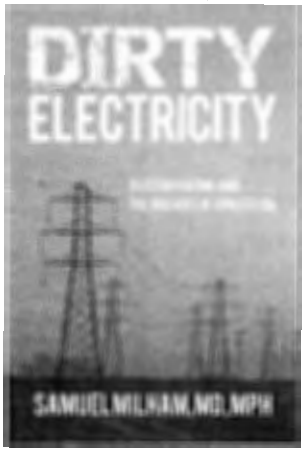

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number of patients aged 15 to 17 years old having consultations and treatment due to CNS disorders has grown by 72%.

Because of this the RNCNIRP considers it important to conduct a scientific study to determine whether the growth in morbidity resulted from EMF exposure from mobile phone use or whether it was caused by other factors.

14. 2010: Seletun Statement, Norway: The International Electromagnetic Field Alliance (IEMFA) released their report entitled *Scientific Panel on Electromagnetic Field Health Risks: Consensus Points, Recommendations, and Rationales* following a scientific meeting at Seletun Norway November 2009. The summary/abstract is provided below. Click here for publication. Click here for report and short video of Dr. Olle Johansson.

> ***Summary:*** *In November, 2009, a scientific panel met in Seletun, Norway, for three days of intensive discussion on existing scientific evidence and public health implications of the unprecedented global exposures to artificial electromagnetic fields (EMF). EMF exposures (static to 300 GHz) result from the use of electric power and from wireless telecommunications technologies for voice and data transmission, energy, security, military and radar use in weather and transportation. The Scientific Panel recognizes that the body of evidence on EMF requires a new approach to protection of public health; the growth and development of the fetus, and of children; and argues for strong preventative actions. New, biologically-based public exposure standards are urgently needed to protect public health worldwide.*

Conclusions in this report build upon prior scientific and public health reports and resolutions documenting the following consensus points:

> *a) Low-intensity (non-thermal) bioeffects and adverse health effects are demonstrated at levels significantly below existing exposure standards.*
>
> *b) ICNIRP and IEEE/FCC public safety limits are inadequate and obsolete with respect to prolonged, low-intensity exposures.*
>
> *c) New, biologically-based public exposure standards are urgently needed to protect public health world-wide.*
>
> *d) It is not in the public interest to wait.*

13. 2009: EU Parliament Electromagnetic Report and Resolution entitled: *European Parliament Resolution on health concerns associated with electromagnetic fields,* was adopted February 17, 2009 with 29 recommendations. Click here for report.

12. 2009: Porto Alegre Resolution, Brazil. Scientists and doctors recognize electrohypersensitivity and are concerned that exposure to electromagnetic fields may increase the risk of cancer and chronic diseases; that exposure levels established by international agencies (IEEE, ICNIRP, ICES) are obsolete; and that wireless technology places at risk the health of children, teens, pregnant women and others who are vulnerable. Click here for document.

11. 2008: Venice Resolution, Italy. International Commission for Electromagnetic Safety (ICEMS) Scientists recognize biological effects at non-thermal levels, that standards are inadequate, that electro-sensitivity exists and that there is a need to research mechanisms. Click here for Venice Resolution.

Three key statements are provided below:

> *We take exception to the claim of the wireless communication industry that there is no credible scientific evidence to conclude there a risk. Recent epidemiological evidence is stronger than before, which is a further reason to justify precautions be taken to lower exposure standards in accordance with the Precautionary Principle.*
>
> *We recognize the growing public health problem known as electrohypersensitivity; that this adverse health condition can be quite disabling; and, that this condition requires further urgent investigation and recognition.*
>
> *We strongly advise limited use of cell phones, and other similar devices, by young children and teenagers, and we call upon governments to apply the Precautionary Principle as an interim measure while more biologically relevant standards are developed to protect against, not only the absorption of electromagnetic energy by the head, but also adverse effects of the signals on biochemistry, physiology and electrical biorhythms.*

10. 2007: BioInitiative Report, USA. In response to statements that there are no scientific studies showing adverse biological effects of low level electromagnetic fields and radio frequency radiation, a group of researchers produced the BioInitiative Report that documents 2000 studies showing biological effects of extremely low frequency (ELF) electromagnetic fields and

radio frequency (RF) radiation and calling for biologically based exposure guidelines. This document was criticized for not having been peer-reviewed even though most of the studies cited in this document were peer-reviewed. Click here for pdf.

Since then some of the BioInitiative papers as well as ones by other authors have appeared in a special issue of the peer-reviewd journal Pathophysiology (Volume 16 Issues 2-3, 2009). The papers in this journal document EMF effects on DNA, EMF effects on the brain, EMF in the environment, and science as a guide to public policy. Click here for abstracts.

9. 2006: Benevento Resolution, Italy. The International Commission for Electromagnetic Safety (ICEMS) organized a conference entitled: *The Precautionary EMF Approach: Rationale, Legislation and Implementation.* Scientists at this conference signed the Benevento Resolution (click here for pdf) that consists of 7 major statements. Among those statements are the following:

> *1. . . . there are adverse health effects from occupational and public exposures to electric, magnetic and electromagnetic fields, or EMF, at current exposure levels. What is needed, but not yet realized, is a comprehensive, independent and transparent examination of the evidence pointing to this emerging, potential public health issue.*
>
> *4. Arguments that weak (low intensity) EMF cannot affect biological systems do not represent the current spectrum of scientific opinion.*
>
> *6. We encourage governments to adopt a framework of guidelines for public and occupational EMF exposure that reflect the Precautionary Principle– as some nations have already done.*

8. 2005: Helsinki Appeal, Finland. Physicians and researchers presented the Helsinki Appeal to the European Parliament. Click here for document. They state that:

> *The present safety standards of ICNIRP (International Commission of Non-Ionizing Radiation Protection) do not recognize the biological effects caused by non-ionizing radiation except those induced by the thermal effect. In the light of recent scientific information, the standards recommended by ICNIRP have become obsolete and should be rejected. Especially children and other persons at risk should be taken into account when re-evaluating the limits regarding the harmful effects of electromagnetic fields and radiation. Call for new safety standards, reject International Commission on Non-Ionizing Radiation Protection (ICNIRP) guidelines.*

7. 2005: Irish Doctors' Environmental Association (IDEA)**, Ireland.** Members of IDEA wrote a position paper on electromagnetic radiation. Doctors recognize electrohypersensitivity (EHS) is increasing and request advice from government on how to treat EHS. Click here for document. Below is a quote from this document.

> *The Irish Doctors' Environmental Association believes that the Irish Government should urgently review the information currently available internationally on the topic of the thermal and non-thermal effects of exposure to electro-magnetic radiation with a view to immediately initiating appropriate research into the adverse health effects of exposure to all forms of non-ionising radiation in this country, and into the forms of treatment available elsewhere. Before the results of this research are available, an epidemiological database should be initiated of individuals suffering from symptoms thought to be related to exposure to non-ionising radiation. Those claiming to be suffering from the effects of exposure to electro-magnetic radiation should have their claims investigated in a sensitive and thorough way, and appropriate treatment provided by the State.*
>
> *The strictest possible safety regulations should be established for the installation of masts and transmitters, and for the acceptable levels of potential exposure of individuals to electro-magnetic radiation.*

6. 2002. Catania Resolution, Italy. This resolution was signed by scientists at the international conference "State of the Research on Electromagnetic Fields-Scientific and Legal Issues". Click here for resolution. Three of their statements are provided below:

> *1. Epidemiological and in vivo and in vitro experimental evidence demonstrates the existence of electromagnetic field (EMF) induced effects, some of which can be adverse to health.*
>
> *4. The weight of evidence calls for preventive strategies based on the precautionary principle. At times the precautionary principle may involve prudent avoidance and prudent use.*
>
> *5. We are aware that there are gaps in knowledge on biological and physical effects, and health risks related to EMF, which require additional independent research.*

5. 2002 : Freiburg Appeal, Germany. Physicians request tougher guidelines for radio frequency exposure. This document was endorsed by thousands of healthcare practitioners. Click here for pdf. Below is a quote from this report.

> *We have observed, in recent years, a dramatic rise in severe and chronic diseases among our patients, especially:*
>
> *· Learning, concentration, and behavioural disorders (e.g. attention deficit disorder, ADD)*
> *· Extreme fluctuations in blood pressure, ever harder to influence with medications*
> *· Heart rhythm disorders*
> *· Heart attacks and strokes among an increasingly younger population*
> *· Brain-degenerative diseases (e.g. Alzheimer-s) and epilepsy*
> *· Cancerous afflictions: leukemia, brain tumors*
>
> *Moreover, we have observed an ever-increasing occurrence of various disorders, often misdiagnosed in patients as psychosomatic:*
>
> *· Headaches, migraines*
> *· Chronic exhaustion*
> *· Inner agitation*
> *· Sleeplessness, daytime sleepiness*
> *· Tinnitus*
> *· Susceptibility to infection*
> *· Nervous and connective tissue pains, for which the usual causes do not explain even the most conspicuous symptoms*
>
> *Since the living environment and lifestyles of our patients are familiar to us, we can see especially after carefully-directed inquiry a clear temporal and spatial correlation between the appearance of disease and exposure to pulsed high -frequency microwave radiation (HFMR), such as:*
>
> *· Installation of a mobile telephone sending station in the near vicinity*
> *· Intensive mobile telephone use*
> *· Installation of a digital cordless (DECT) telephone at home or in the neighbourhood*
>
> *We can no longer believe this to be purely coincidence, for:*
>
> *· Too often do we observe a marked concentration of particular illnesses in correspondingly HFMR-polluted areas or apartments;*
> *· Too often does a long-term disease or affliction improve or disappear in a relatively short time after reduction or elimination of HFMR pollution in the patient's environment;*
> *· Too often are our observations confirmed by on-site measurements of HFMR of unusual intensity.*

4. 2002: Salzburg Resolution, Austria. The *Salzburg Resolution on Mobile Telecommunication Base Stations* makes four recommendations including preliminary guidelines 0f 0.1 microW/cm2 for sum of all emissions from mobile phone stations. This is well below the current ICNIRP guidelines and those in Canada and the US (1000 microW/cm2) and is slightly lower than guidelines in Switzerland, Italy, Russia, China (10 mciroW/cm2). Click here for document.

3. 2000: Stewart Report, UK. The Independent Expert Group on Mobile Phones (IEGMP) produced a report, *Mobile Phones and Health,* that is commonly referred to as the Stewart Report, named after its Chairman Sir William Stewart. Click here for pdf. A quote from the foreward shows how much our understanding of this issue has changed since 2000.

> *The report points out that the balance of evidence does not suggest mobile phone technologies put the health of the general population of the UK at risk. There is some preliminary evidence that outputs from mobile phone technologies may cause, in some cases, subtle biological effects, although, importantly, these do not necessarily mean that health is affected. There is also evidence that in some cases people's well-being may be adversely affected by the insensitive siting of base stations. New mechanisms need to be set in place to prevent that happening.*

The report goes on to state that:

> *1.17. The balance of evidence to date suggests that exposures to RF radiation below NRPB and ICNIRP guidelines do not cause adverse health effects to the general population.*
>
> *1.18 There is now scientific evidence, however, which suggests that there may be biological effects occurring at exposures below these guidelines . . .*
>
> *1.19 . . . We conclude therefore that it is not possible at present to say that exposure to RF radiation, even at levels below national guidelines, is totally without potential adverse health effects, and that the gaps in knowledge are sufficient to justify a precautionary approach.*

1.20 In the light of the above considerations we recommend that a precautionary approach to the use of mobile phone technologies be adopted until much more detailed and scientifically robust information on any health effects becomes available.

2. 1998: Vienna EMF Resolution, Austria. At a *Workshop on Possible Biological and Health Effects of RF Electromagnetic Fields*, the scientists agreed on the following:

The participants agreed that biological effects from low-intensity exposures are scientifically established. However, the current state of scientific consensus is inadequate to derive reliable exposure standards. The existing evidence demands an increase in the research efforts on the possible health impact and on an adequate exposure and dose asses.

Base stations: How could satisfactory Public Participation be ensured?

The public should be given timely participation in the process. This should include information on technical and exposure data as well as information on the status of the health debate. Public participation in the decision (limits, siting, etc.) should be enabled.

Cellular phones: How could the situation of the users be improved?

Technical data should be made available to the users to allow comparison with respect to EMF-exposure. In order to promote prudent usage, sufficient information on the health debate should be provided. This procedure should offer opportunities for the users to manage reduction in EMF-exposure. In addition, this process could stimulate further developmentlow-intensity emission devices

Regarding legal aspects . . .

there is protection deficit in the public and private laws which is unsatisfactory. The legislator is requested to solve the conflict of interests between the industries commission on one side and the neighbours involvement and their interests on protection of life and health on the other side. Because of the constitutionally determined objectives of the state to comprehensively protect the environment, there is a demand of acting precautionary on the polititcal and legal level.

The Vienna declaration on electromagnetic fields recommended 13 detailed action items for parliament to consider. Click here to read those items and to download pdf.

1. 1997: Boston Physicians' and Scientists' Petition. We the undersigned physicians and scientists call upon public health officials to intervene to halt the initiation of communication transmissions employing ground level, horizontally transmitted, pulsed microwaves in Boston. This form of transmission is scheduled to begin June, 1997, by the Sprint Corporation for personal communications systems (PCS). Given the biological plausibility of negative health impacts, particularly to the human nervous system, as well as anecdotal evidence of illness and death from such exposures in cities where transmission has already been implemented, and voluminous medical studies indicating human and ecological harm from microwaves, we urge the suspension of that implementation pending full public notification of its potential hazards and the full review and determination of its safety by the scientific community.

With 97 signatures sent to ENHALE (Environmental Health Advocacy League], Box 425 Concord MA, 01742.

*****

Based on these resolutions and appeals from international groups of physicians and scientists immediate action is required to protect public health from continued increasing exposure to radio frequency radiation and electromagnetic fields.

I call on . . .

1. ***regulators*** *around the world to reexamine existing guidelines for both EMF and EMR and to reduce them to the lowest possible levels to protect the public and workers. Values above 4 milliGauss (low frequency magnetic fields); above 0.1 microW/cm2 (power density for radio frequency radiation) and above 40 GS units (dirty electricity) have been associated with adverse health effects in peer reviewed scientific publications!*

2. ***government agencies*** *responsibility for the location of both base stations and power lines to keep distances at least 400 meters (base stations) and 100 meters (transmission lines) from residential properties as well as school and health care facilities.*

3. ***utilities*** *(water, gas, electricity) to reconsider the use of wireless smart meters and provide wired options for those who are sensitive, for those who do not want to be exposed, and for those in densely populated settings.*

4. ***manufacturers*** *who are providing technology that uses electricity and/or*

emits radio frequency radiation to re-engineer their products to provide the minimum radiation possible. This includes light bulbs, computers, wireless home devices like baby monitors and cordless phones, cell phones, smart meters, plasma TVs, among others.

5. ***architects, builders, electricians,*** *and* ***plumbers*** *to design and construct buildings that are based on principles of good electromagnetic hygiene. This includes using materials that absorb or shield building interiors from microwave radiation especially near external sources of this radiation and in multi-unit buildings; to provide wired alternatives to wireless devices; to properly wire and ground buildings to minimize low frequency electromagnetic fields and to eliminate ground current problems; and to install filters on electrical panels and/or throughout the building to ensure good power quality.*

6. *local, state, federal* ***health authorities*** *to educate medical professions about the potential biological effects of both low frequency and radio frequency electromagnetic energy; about the growing number of people who have electrosensitivity (ES) or electrohypersensitivity (EHS) and to alert them on how they can help their patients in terms of minimizing their exposure and promoting their recovery.*

7. ***hospitals*** *and*

8. ***school boards*** *should choose wired internet access over WiFi (wireless technology) and not allow towers/antennas within 400 meters of their school property.*

9. ***parents*** *to practice good electromagnetic hygiene especially in the bedroom and especially for their children. This involves using wired rather than wireless devices in the home, keeping electric appliances away from the bed, turning off/unplugging devices when not in use.*

10. *the* ***media*** *to provide information to the public about the health and safety of using this technology; to rely on "independent experts" who do not receive funding or other benefits based on the outcome of research studies; and to identify experts funded by the industry as "industry representatives". The integrity of many of these scientists leaves much to be desired.*

The Influence of Being Physically Near to a Cell Phone Transmission Mast on the Incidence of Cancer

Horst Eger, Klaus Uwe Hagen, Birgitt Lucas, Peter Vogel, Helmut Voit

Published in *Umwelt·Medizin·Gesellschaft* 17,4 2004, as:
'Einfluss der räumlichen Nähe von Mobilfunksendeanlagen auf die Krebsinzidenz'

Summary

Following the call by Wolfram König, President of the Bundesamt für Strahlenschutz (Federal Agency for radiation protection), to all doctors of medicine to collaborate actively in the assessment of the risk posed by cellular radiation, the aim of our study was to examine whether people living close to cellular transmitter antennas were exposed to a heightened risk of taking ill with malignant tumors.

The basis of the data used for the survey were PC files of the case histories of patients between the years 1994 and 2004. While adhering to data protection, the personal data of almost 1,000 patients were evaluated for this study, which was completed without any external financial support. It is intended to continue the project in the form of a register.

The result of the study shows that the proportion of newly developing cancer cases was significantly higher among those patients who had lived during the past ten years at a distance of up to 400 metres from the cellular transmitter site, which has been in operation since 1993, compared to those patients living further away, and that the patients fell ill on average 8 years earlier.

In the years 1999-2004, *ie* after five years' operation of the transmitting installation, the relative risk of getting cancer had trebled for the residents of the area in the proximity of the installation compared to the inhabitants of Naila outside the area.

Key words: cellular radiation, cellular transmitter antennas, malignant tumours

The rapid increase in the use of mobile telephony in the last few years has led to an increasing number of cell phone transmission masts being positioned in or near to residential areas. With this in mind, the president of the German governmental department for protection against electromagnetic radiation (Bundesamtes für Strahlenschutz) Wolfram König, has challenged all doctors to actively help in the work to estimate the risks from such cell phone masts. The goal of this investigation was therefore to prove whether on not people living near to cell phone masts have a higher risk of developing cancerous tumours.

The basic data was taken from the medical records held by the local medical authority (Krankenkasse) for the years 1994 to 2004. This material is stored on computer. In this voluntary study the records of roughly 1,000 patients from Naila (Oberfranken) were used, respecting the associated data protection laws. The results from this study show a significantly increased likelihood of developing cancer for the patients that have lived within 400 metres of the cell phone transmission mast (active since 1993) over the last ten years, in comparison to those patients that live further away. In addition, the patients that live within 400 metres tend to develop the cancers at a younger age. For the years 1999 to 2004 (*ie* after five or more years of living with the cell phone transmission mast), the risk of developing cancer for those living within 400 metres of the mast in comparison to those living outside this area, was three times as high.

Introduction

A series of studies available before this investigation provided strong evidence of health risks and increased cancer risk associated with physical proximity to radio transmission masts. Haider *et al.* reported in 1993 in the Moosbrunn study frequent psychovegetive symptoms below the current safety limit for electromagnetic waves (1). In 1995, Abelin *et al.* in the Swiss- Schwarzenburg study found dose dependent sleep problems (5:1) and depression (4:1) at a shortwave transmitter station that has been in operation since 1939 (2).

In many studies an increased risk of developing leukaemia has been found; in children near transmitter antennas for Radio and Television in Hawaii (3); increased cancer cases and general mortality in the area of Radio and Television transmitter antennas in Australia (4); and in England, 9 times more leukaemia cases were diagnosed in people who live in a nearby

area to the Sutton Coldfield transmitter antennas (5). In a second study, concentrating on 20 transmitter antennas in England, a significant increased leukaemia risk was found (6). The Cherry study (7) indicates an association between an increase in cancer and living in proximity to a transmitter station. According to a study of the transmitter station of Radio Vatican, there were 2.2 times more leukaemia cases in children within a radius of 6 km, and adult mortality from leukaemia also increased (8).

In 1997 Goldsmith published the Lilienfeld-study that indicated 4 times more cancer cases in the staff of the American Embassy in Moscow following microwave radiation during the cold war. The dose was low and below the German limit (9).

The three studies of symptoms indicated a significant correlation between illness and physical proximity to radio transmission masts. A study by Santini *et al.* in France resulted in an association between irritability, depression, dizziness (within 100m) and tiredness within 300m of a cell phone transmitter station (10).

In Austria there was an association between field strength and cardiovascular symptoms (11) and in Spain a study indicates an association between radiation, headache, nausea, loss of appetite, unwellness, sleep disturbance, depression, lack of concentration and dizziness (12).

The human body physically absorbs microwaves. This leads to rotation of dipole molecules and to inversion transitions (13), causing a warming effect. The fact that the human body transmits microwave radiation at a very low intensity means that since every transmitter represents a receiver and transmitter at the same time, we know the human body also acts as a receiver.

In Germany, the maximum safe limit for high frequency microwave radiation is based on purely thermal effects. These limits are one thousand billion times higher than the natural radiation in these frequencies that reaches us from the sun.

The following study examines whether there is also an increased cancer risk close to cellular transmitter antennas in the frequency range 900 to 1800 MHz. Prior to this study there were no published results for long-term exposure (10 years) for this frequency range and its associated effects to be revealed. So far, no follow-up monitoring of the state of health of such a residential population has been systematically undertaken.

Materials and Methods

Study area

In June 1993, cellular transmitter antennas were permitted by the Federal Postal Administration in the Southern German city of Naila and became operational in September 1993.

The GSM transmitter antenna has a power of 15 dbW per channel in the 935MHz frequency range. The total

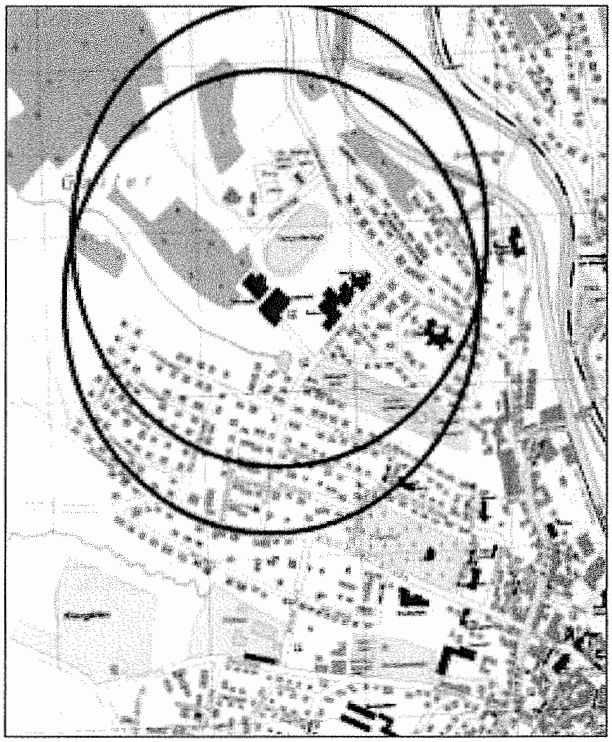

Fig. 1: Schematic plan of the antenna sites

transmission time for the study period is ca. 90,000 hours. In December 1997 there followed an additional installation from another company. The details are found in an unpublished report, appendix page 1-3 (14).

To compare results an 'inner' and 'outer' area were defined. The inner area covered the land that was within a distance of 400 metres from the cellular transmitter site. The outer area covered the land beyond 400 metres. The average distance of roads surveyed in the inner area (nearer than 400m) was 266m and in the outer area (further than 400m) 1,026m. Fig. 1 shows the position of the cellular transmitter sites I and 2, surrounded by circle of radius 400 metres. The geographical situation shows the transmitter sites (560m) are the highest point of the landscape, which falls away to 525m at a distance of 450m. From the height and tilt angle of the transmitter it is possible to calculate the distance where the transmitter's beam of greatest intensity strikes the ground (see Fig. 2).

The highest radiation values are in areas of the main

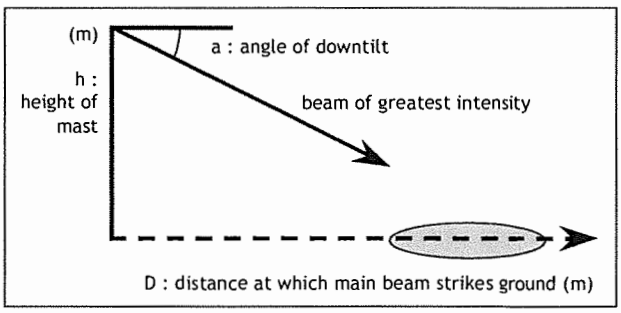

Fig. 2: From the mast height h and the downtilt angle a, the distance D at which the main beam reaches ground is given by D = tan(90-a) × h

beam where it hits the ground and from the expected associated local reflection; from this point the intensity of radiation falls off with the square of the distance from the transmitter.

In Naila the main beam hits the ground at 350m with a beam angle of 6 degrees (15). In the inner area, additional emissions are caused by the secondary lobes of the transmitter; this means in comparison that from purely mathematical calculations the outer area has significantly reduced radiation intensity.

The calculations from computer simulations and the measurements from the Bavaria agency for the environmental protection, both found that the intensity of radiation was a factor of 100 higher in the inner area as compared to the outer area. The measurements of all transmitter stations show that the intensity of radiation from the cell phone transmitter station in Naila in the inner area was higher than the other measurement shown in the previous studies of electromagnetic fields from radio, television or radar (14).

The study StSch 4314 from the ECOLOG Institute indicates an association between a vertical and horizontal distance from the transmitter station and expected radiation intensity on the local people (16). The reason for setting a distance of 400m for the differentiation point is partly due to physical considerations, and partly due to the study of Santini *et al.* who chose 300m (10).

Data Gathering

Similar residential streets in the inner area and outer areas were selected at random. The large old people's home in the inner area was excluded from the study because of the age of the inhabitants. Data gathering covered nearly 90% of the local residents, because all four GPs in Naila took part in this study over 10 years. Every team researched the names of the patients from the selected streets that had been ill with tumours since 1994. The condition was that all patients had been living during the entire observation time of 10 years at the same address.

The data from patients was handled according to data protection in an anonymous way. The data was evaluated for gender, age, tumour type and start of illness. All cases in the study were based on concrete results from tissue analysis. The selection of patents for the study was always done in exactly the same way. Self-selection was not allowed. Also the subjective opinion of patients that the radio mast detrimentally affected their health has not affected this study. Since patients with cancer do not keep this secret from GPs, it was possible to gain a complete data set.

Population study

In the areas where data was collected 1,045 residents were registered in 31.12.2003. The registration statistics for Naila at the beginning of the study (1.1.1994) show the number of old people in the inner and outer areas, as shown in Table 1. The average age at the beginning

	female	male	total
Inner area	41.48	38.70	40.21
Outer area	41.93	38.12	40.20
Naila total	43.55	39.13	41.45

Table 1 : Overview of average ages at the beginning of the study in 1994

1994	inner 22.4%	outer 2.8%	Naila total 24.8%
2004	inner 26.3%	outer 26.7%	

Table 2 : Proportion of patients aged over 60

of the study (1.1.1994) in both the inner and outer areas was 40.2 years. In the study period between 1994-2004, 34 new cases of cancer where documented out of 967 patients (Table 3). The study covered nearly 90% of local residents.

The average age of the residents in Naila is one year more than that of the study due to the effects of the old people's home. From the 9,472 residents who are registered in Naila, 4,979 (52.6%) are women and 4,493 (47.4%) are men. According to the register office, in 1.1.1994 in the outer area, the percentage was 45.4% male and 54.5% female, and in the inner area 45.3% male and 54.6% female. The number of people who are over 60 years old is shown in Table 2.

The social differences in Naila are small. Big social differences like in the USA do not exist here. There is also no ethnic diversity. In 1994 in Naila the percentage of foreigners was 4%. Naila has no heavy industry, and in the inner area there are neither high voltage cable nor electric trains.

Results

Results are first shown for the entire 10 year period from 1994 until 2004. Secondly, the last five-year period 1999 to 2004 is considered separately.

Period 1994 to 2004

As a null hypothesis it was checked to see if the physical distance from the mobile transmission mast had no effect on the number cancer cases in the selected population, *ie* that for both the group nearer than 400 metres and the group further than 400 metres the chance of developing cancer was the same. The relative frequencies of cancer in the form of a matrix are shown in Table 3. The statistical test method used on this data was the chi-squared test with Yates's correction. Using this method we obtained the value of 6.27, which is over the critical value of 3.84 for a

Period 1994-2004	Inner area	Outer area	total
new cases of cancers	18	16	34
with no new cancer	302	631	933
total	320	647	967

Table 3 : numbers of patients with and without cancers, 1994-2004

statistical significance of 0.05).

This means the null hypothesis that both groups within the 400-metre radius of the mast and beyond the 400 metre radius, have the same chance of developing cancer, can be rejected with a 95% level of confidence. With a statistical significance of 0.05, an even more significant difference was observed in the rate of new cancer cases between the two groups.

Calculating over the entire study period of 1994 until 2004, based on the incidence matrix (Table 3) we arrive at a relative risk factor of 2.27 (quotient of proportion for each group, *eg* 18/320 in the strongly exposed inner area, against 16/647 in the lower exposed comparison group). If expressed as an odds ratio, the relationship of the chance of getting cancer between strongly exposed and the less exposed is 2.35.

The following results show clearly that inhabitants who live close to transmitter antennas compared to inhabitants who live outside the 400m zone, double their risk of developing cancer. In addition, the average age of developing cancer was 64.1 years in the inner area whereas in the outer area the average age was 72.6 years, a difference of 8.5 years. That means during the 10 year study that in the inner area (within 400 metres of the radio mast) tumours appear at a younger age.

In Germany the average age of developing cancer is approximately 66.5 years, among men it is approximately 66 and among women, 67 (18).

Over the years of the study the time trend for new cancer cases shows a high annual constant value (Table 4). It should be noted that the number of people in the inner area is only half that of the outer area, and therefore the absolute numbers of cases is smaller.

Table 7 shows the types of tumour that have developed in the cases of the inner area.

Period 1994 to 1999

No. of cases of tumours per year of study	inner area: of the 320 people		outer area: of the 647 people	
	total cases	per 1,000	total cases	per 1,000
1994	–	–	I	1.5
1995	–	–	–	–
1996	II	6.3	I	1.5
1997	I	3.1	III	4.6
1998	II	6.3	III	4.6
1999	II	6.3	I	1.5
2000	IIIII	15.6	I	1.5
2001	II	6.3	II	3.1
2002	II	6.3	II	3.1
2003-3/2004	II	6.3	II	3.1

Table 4 : Summary of the total tumours occurring per year (no. and per thousand)

Period 1994-1999	Inner area	Outer area	total
new cases of cancers	5	8	13
with no new cancer	315	639	954
total	320	647	967

Table 5 : numbers of patients with and without cancers, 1994-1999

For the first five years of the radio transmission mast operation (1994-1998) there was no significant increased risk of getting cancer within the inner area as compared to the outer area (Table 5).

Period 1999 to 2004

Under the biologically plausible assumption that cancer caused by detrimental external factors will require a time of several years before it will be diagnosed, we now concentrate on the last five years of the study between 1999 and 2004. At the start of this period the transmitter had been in operation for 5 years. The results for this period are shown in Table 6. The chi-squared test result for this data (with Yates's correction) is 6.77 and is over the critical value of 6.67 (statistical significance 0.01). This means, with 99% level of confidence, that there is a statistically proven difference between development of cancer between the inner group and outer group. The relative risk of 3.29 revealed that there was 3 times more risk of developing cancer in the inner area than the outer area during this time period.

Period 1999-2004	Inner area	Outer area	total
new cases of cancers	13	8	31
with no new cancer	307	639	946
total	320	647	967

Table 6 : numbers of patients with and without cancers, 1999-2004

The odds-ratio 3.38 (VI 95% 1.39-8.25, 99% 1.05-10.91) allows us with 99% confidence to say that the difference observed here is not due to some random statistical effect.

Discussion

Exactly the same system was used to gather data in the inner area and outer areas. The medical chip card, which has been in use for 10 years, enables the data to be processed easily. The four participating GPs examined the illness of 90% of Naila's inhabitants over the last 10 years. The basic data for this study were based on direct examination results of patients extracted from the medical chip cards, which record also the diagnosis and treatment. The study population is (in regards to age, sex and cancer risk) comparable, and therefore statistically neutral. The study deals only with people who have been living permanently at the same address for the entire study period and therefore

Type of tumour (organ)	no. of tumours found	total expected	incidence per 100,000	ratio inner: outer
breast	8	5.6	112	5:3
ovary	1	1.1	23	0:1
prostate	5	4.6	101	2:3
pancreas	m 3 f 2	0.6 0.9	14 18	2:1 1:1
bowel	m 4 f 0	3.7 4.0	81 81	2:2 0:0
skin melanoma	m 1 f 0	0.6 0.7	13 14	1:0 0:0
lung	m 3 f 0	3.6 1.2	79 24	2:1 0:0
kidney	m 2 f 1	1.0 0.7	22 15	1:1 1:0
stomach	m 1 f 1	1.2 1.1	27 23	0:1 0:1
bladder	m 1 f 0	2.0 0.8	44 16	0:1 0:0
blood	m 0 f 1	0.6 0.7	14 15	0:0 1:0

Table 7 : Summary of tumours occurring in Naila, compared with incidence expected from the Saarland cancer register

have the same duration of exposure regardless of whether they are in the inner area or outer area.

The result of the study shows that the proportion of newly developing cancer cases was significantly higher ($p<0.05$) among those patients who had lived during the past ten years within a distance of 400 metres from the cellular transmitter site, which has been in operation since 1993, in comparison to people who live further away. Compared to those patients living further away, the patients developed cancer on average 8.5 years earlier. This means the doubled risk of cancer in the inner area cannot be explained by an average age difference between the two groups. That the transmitter has the effect that speeds up the clinical manifestations of the illness and general development of the cancer cannot be ruled out.

In the years 1999-2004, *ie* after five years and more of transmitter operation, the relative risk of getting cancer had trebled for the residents of the area in the proximity of the mast compared to the inhabitants of Naila in the outer area ($p>0.01$). The division into inner area and outer area groups was clearly defined at the beginning of the study by the distance to the cell phone transmission mast. According to physical considerations people living close to cellular transmitter antennas were exposed to heightened transmitted radiation intensity.

Both calculated and empirical measurements revealed that the intensity of radiation is 100 times higher in the inner area compared to the outer area. According to the research StSch 4314 the horizontal and vertical position in regards to the transmitter antenna is the most important criterion in defining the radiation intensity area on inhabitants (16).

The layered epidemiological assessment method used in this study is also used in assessment of possible chemical environmental effects. In this case the layering is performed in regards to the distance from the cell phone transmitter station. Using this method it has been shown that there is a significant difference in probability of developing new cancers depending on the exposure intensity.

The number of patients examined was high enough according to statistical rules that the effects of other factors (such as use of DECT phones) should be normalised across the inner area and outer area groups. From experience the disruption caused by a statistical confounding factor is in the range between 20% and 30%. Such a factor could therefore in no way explain the 300% increase in new cancer cases. If structural factors such as smoking or excessive alcohol consumption are unevenly distributed between the different groups this should be visible from the specific type of cancers to have developed (*ie* lung, pharyngeal or oesophageal). In the study inner area there were two lung cancers (one smoker, one non-smoker), and one in the outer area (a smoker), but no oesophageal cancers. This rate of lung cancer is twice what is statistically to be expected and cannot be explained by a confounding factor alone. None of the patients who developed cancer was from a family with such a genetic propensity.

Through the many years experience of the GPs involved in this study, the social structures in Naila are well known. Through this experience we can say there was no significant social difference in the examined groups that might explain the increased risk of cancer.

The type and number of the diagnosed cancers are shown in Table 7. In the inner area the number of cancers associated with blood formation and tumour-controlling endocrine systems (pancreas), were more frequent than in the outer area (77% inner area and 69% outer area).

From Table 7, the relative risk of getting breast cancer is significantly increased to 3.4. The average age of patients that developed breast cancer in the inner area was 50.8 years. In comparison, in the outer area the average age was 69.9 years, approximately 20 years less. In Germany the average age for developing breast cancer is about 63 years. The incidence of breast cancer has increased from 80 per 100,000 in the year 1970 to 112 per 100,000 in the year 2000. A possible question for future research is whether breast cancer can be used as a 'marker cancer' for areas where there is high contamination from electromagnetic radiation. The report of Tynes *et al.* described an increased risk of breast cancer in Norwegian female radio and telegraph operators (20).

To further validate the results the data gathered were compared with the Saarland cancer register (21). In this register all newly developed cancers cases since 1970 are recorded for each Bundesland. These data are accessible via the Internet. Patents that suffer two separate tumours were registered twice, which increases the overall incidence up to 10%. In this

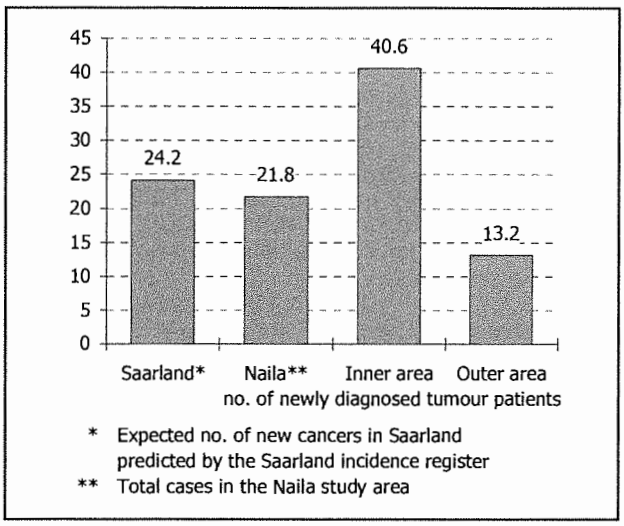

Fig. 3 : Number of new cancer cases 1999 to 2004, adjusted for age and gender, calculated for the 5,000 patient years

register there is no location-specific information, for instance proximity to cell phone transmission masts. The data in the cancer register therefore reflect no real control group but rather the effect of the average radiation on the total population.

From the Saarland cancer register for the year 2000 the incidence of new cancer cases was 498 per 100,000 for men and 462 per 100,000 for women. When adjusted for age and sex one would expect a rate of between 480 and 500 per 100,000 in Naila. For the years 1999 to 2004 there were 21 new cases of cancer among 967 patients. The expected number was 24 cases per 1,000 patients.

The results of the study are shown graphically in Fig. 3. The bars of the chart represent the number of new cancer cases per 1,000 patients in the separate areas, over the five years (bars 2 to 4). The first bar represents the expected number from the Saarland cancer register.

In spite of a possible underestimation, the number of newly developed cancer cases in the inner area is more than the expected number taken from the cancer register, which represents the total population being irradiated. The group who had lived during the past five years within a distance of 400 m from the cellular transmitter have a two times higher risk of developing cancer than that of the average population. The relative risk of getting cancer in the inner area compared with the Saarland cancer register is 1.7 (see to Table 7).

Conclusion

The result of this retrospective study in Naila shows that the risk of newly developing cancer was three times higher among those patients who had lived during past ten years (1994-2004), within a distance of 400m from the cellular transmitter, in comparison to those who had lived further away.

Cross-sectional studies can be used to provide the decisive empirical information to identify real problems. In the 1960s just three observations of birth deformities were enough to uncover what is today an academically indisputable Thalidomide problem.

This study, which was completed without any external financial support is a pilot project. Measurements of individual exposure as well as the focused search for further side effects would provide a useful extension to this work, however such research would need the appropriate financial support.

The concept of this study is simple and can be used everywhere, where there it a long-term electromagnetic radiation from a transmitting station.

The results presented are a first concrete epidemiological sign of a temporal and spatial connection between exposure to GSM base station radiation and cancer disease.

These results are, according to the literature relating to high frequency electromagnetic fields, not only plausible and possible, but also likely.

From both an ethical and legal standpoint it is necessary to immediately start to monitor the health of the residents living in areas of high radio frequency emissions from mobile telephone base stations with epidemiological studies. This is necessary because this study has shown that it is no longer safely possible to assume that there is no causal link between radio frequency transmissions and increased cancer rates.

Acknowledgements

Our thanks go to all those involved in developing this study, in particular, Herrn Professor Frentzel-Beyme for his advice on all the epidemiological questions.

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Footnotes

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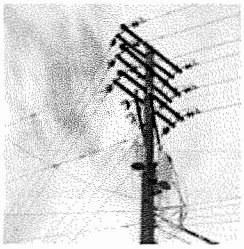
SAFETY & PREVENTION

Electromagnetic Fields: A Hazard to Your Health?

Household Appliances:



For most people, their highest magnetic field exposures come from using household appliances with motors, transformers, or heaters.

- If a parent is concerned about electric and magnetic field exposure from appliances, identify the major sources of exposure and limit a child's time near those appliances.
- Manufacturers have reduced magnetic field exposures from electric blankets (since 1990) and from computers (since the early 1990s).
- Because magnetic fields decline rapidly with increasing distance, an easy measure is to increase the distance between children and the appliance.

Power Lines:

A Massachusetts study published back in 1993 showed a significant association between proximity to power lines and depressive symptoms; that is, people who were able to see the towers from their house or yard were nearly 3 times more likely than those living farther away to experience depression. A Finnish study done a few years later confirmed a much higher risk of severe depression among those living within 100 yards of a power line.

There remains some degree of uncertainty in the literature on electric and magnetic field exposure and developing cancer (/English/health-issues/conditions/cancer/Pages/default.aspx). This uncertainty should be considered in the context of the low individual risk and the comparable environmental risks (eg, traffic accidents) in other locations.

Obtaining magnetic field measurements in the home sometimes will show that field levels are at approximately the average level despite proximity to the power line.

Cell Phones:

In recent years, concern has increased about exposure to radio frequency electromagnetic radiation emitted from cell phones and phone station antennae. An Egyptian study confirmed concerns that living nearby mobile phone base stations increased the risk for developing:

- Headaches (/English/health-issues/conditions/head-neck-nervous-system/pages/Headaches.aspx)
- Memory problems
- Dizziness (/English/health-issues/conditions/head-neck-nervous-system/Pages/Dizziness-and-Fainting-Spells.aspx)
- Depression (/English/health-issues/conditions/emotional-problems/pages/Childhood-Depression-What-Parents-Can-Do-To-Help.aspx)
- Sleep problems

Short-term exposure to these fields in experimental studies have not always shown negative effects, but this does not rule out cumulative damage from these fields, so larger studies over longer periods are needed to help understand who is at risk. In large studies, an association has been observed between symptoms and exposure to these fields in the everyday environment.

Last Updated 11/21/2015
Source Adapted from Pediatric Environmental Health, 3rd Edition (Copyright © American Academy of Pediatrics 2011)

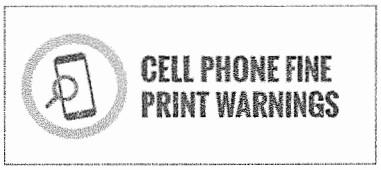
American Academy Of Pediatrics Issues New Recommendations To "Reduce Exposure To Cell Phones"

Nation's largest group of children's doctors responds to new government study linking cell phone radiation to cancer

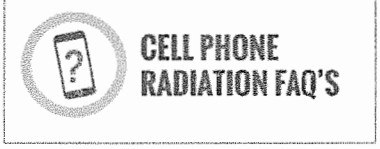
In response to the U.S. National Toxicology Program study results finding exposure to wireless radiation significantly increased the prevalence of highly malignant heart and brain cancers in rodents, the American Academy of Pediatrics (AAP) has issued specific recommendations to reduce wireless cell phone exposure and updated their online resources for parents concerning cell phones and wireless devices.

"They're not toys. They have radiation that is emitted from them and the more we can keep it off the body and use (the phone) in other ways, it will be safer," said Jennifer A. Lowry, M.D., FAACT, FAAP, chair of the AAP Council on Environmental Health Executive Committee in the AAPs press release on the NTP Study Results (http://www.aappublications.org/news/2016/05/27/Cancer052716).

The AAP issued the following cell phone safety tips on their webpage Healthy Children Webpage on Cell Phones. (https://www.healthychildren.org/English/safety-prevention/all-around/Pages/Cell-Phone-Radiation-Childrens-

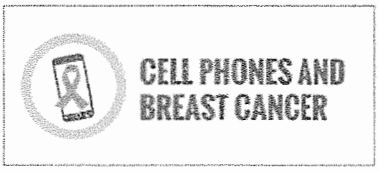


(https://ehtrust.org/key-issues/fine-print-warnings/)



(https://ehtrust.org/take-action/educate-yourself/cell-phones-and-wireless-radiation-faqs/)

(https://ehtrust.org/key-issues/wifi-in-schools/)



Health.aspx)They specifically recommend to reduce exposure to wireless radiation:

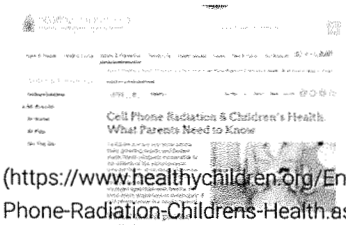
(https://ehtrust.org/key-issues/cell-phones-and-breast-cancer/)

Cell phone safety tips for families:

- Use text messaging when possible, and use cell phones in speaker mode or with the use of hands-free kits.
- When talking on the cell phone, try holding it an inch or more away from your head.
- Make only short or essential calls on cell phones.
- Avoid carrying your phone against the body like in a pocket, sock, or bra. Cell phone manufacturers can't guarantee that the amount of radiation you're absorbing will be at a safe level.
- Do not talk on the phone or text while driving (https://www.healthychildren.org/English/ages-stages/teen/safety/Pages/Sample-Driving-Rules-Teens-Must-Follow.aspx). This increases the risk of automobile crashes.
- Exercise caution when using a phone or texting while walking or performing other activities. "Distracted walking" injuries are also on the rise.
- If you plan to watch a movie on your device, download it first, then switch to airplane mode while you watch in order to avoid unnecessary radiation exposure.
- Keep an eye on your signal strength (i.e. how many bars you have). The weaker your cell signal, the harder your phone has to work and the more radiation it gives off. It's better to wait until you have a stronger signal before using your device.
- Avoid making calls in cars, elevators, trains, and buses. The cell phone works harder to get a signal through metal, so the power level increases.
- Remember that cell phones are not toys or teething items.

Click HERE to Download a document with the American Academy of Pediatrics Recommendations. (https://ehtrust.org/wp-content/uploads/AAP-Recommendations-Fact-Sheet-3.pdf)

"The findings of brain tumors (gliomas) and malignant schwann cell tumors of the heart in the NTP study, as well as DNA damage in brain cells, present a major public health concern because these occurred in the same types of cells that have been reported to develop into tumors in epidemiological studies of adult cell phone users," stated Ronald L. Melnick, PhD, the National Institutes of Health toxicologist who lead the NTP study design and senior advisor to the Environmental Health Trust. "For children the cancer risks may be greater than that for adults because of greater penetration and absorption of cell phone radiation in the brains of children and because the developing nervous system of children is more susceptible to tissue-damaging agents. Based on this new information, regulatory agencies need to make strong recommendations for consumers to take precautionary measures and avoid close contact with their cell phones, and especially limit or avoid use of cell phones by children."



(https://www.healthychildren.org/English/safety-prevention/all-around/Pages/Cell-Phone-Radiation-Childrens-Health.aspx)The AAP has updated their Healthy Children Webpage on Cell Phones (https://www.healthychildren.org/English/safety-prevention/all-around/Pages/Cell-Phone-Radiation-Childrens-Health.aspx) entitled *Cell Phone Radiation & Children's Health: What Parents Need to Know.* The webpage reiterated children's unique vulnerability to cell phone radiation stating, *"Another problem is that the cell phone radiation test used by the FCC is based on the devices' possible effect on large adults—not children. Children's skulls are thinner and can absorb more radiation."*

(https://ehtrust.org/resources-to-share/printable-resources/?mgi_139=10722/Protect%20the%20ones%20you%20love%20postcards%20Academy%20of%20Pediatrics%20Recommendations%20Safety%2

(https://ehtrust.org/resources-to-share/printable-resources/?mgi_139=10722/Protect%20the%20ones%20you%20love%20postcards%20Academy%20of%20Pediatrics%20Recommendations%20Safety%2

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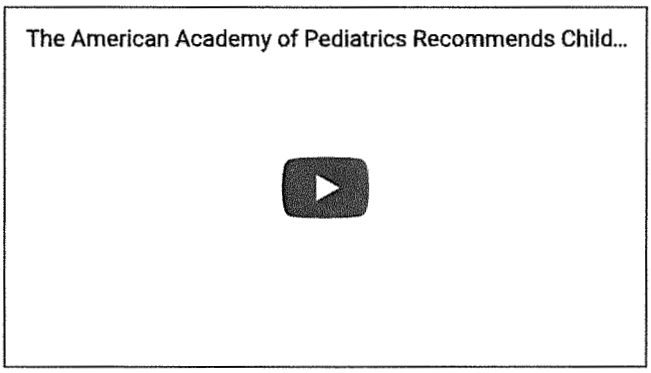

American Academy Of Pediatrics Webpage on Cell Towers and Electromagnetic Fields

"An Egyptian study confirmed concerns that living nearby mobile phone base stations increased the risk for developing:

- Headaches
- Memory problems
- Dizziness

- Depression
- Sleep problems

Short-term exposure to these fields in experimental studies have not always shown negative effects, but this does not rule out cumulative damage from these fields, so larger studies over longer periods are needed to help understand who is at risk. In large studies, an association has been observed between symptoms and exposure to these fields in the everyday environment."

Click here to go to the American Academy Of Pediatrics Webpage on Cell Towers and Electromagnetic Fields (https://www.healthychildren.org/English/safety-prevention/all-around/Pages/Electromagnetic-Fields-A-Hazard-to-Your-Health.aspx)

In 2012, the AAP published *Pediatric Environmental Health, 3rd Edition* recommending, "exposures can be reduced by encouraging children to use text messaging when possible, make only short and essential calls on cellular phones, use hands free kits and wired headsets and maintain the cellular phone an inch or more away from the head."

The official position of the AAP is documented in three letters they have written to government officials describing children's unique vulnerability to wireless radiation and calling on the federal government to review and strengthen radiation standards for wireless devices in order to protect pregnant women and children's health. In 2012, the AAP sent a letter (https://ehtrust.org/wp-content/uploads/2015/12/aap_support_letter_cell_phone_right_to_know_act.pdf)in support of the newly proposed federal legislation referred to as the Cell Phone Right to Know Act. In 2012, the AAP wrote a letter (https://ehtrust.org/wp-content/uploads/American-Academy-of-Pediatrics-letter-to-the-FCC-July-12-2012.pdf)to the Federal Communications Commission calling for them to open up a review of radiofrequency limits. In 2013, after the FCC opened up "Reassessment of Exposure to Radiofrequency Electromagnetic Fields Limits and Policies (https://www.federalregister.gov/documents/2013/06/04/2013-12713/reassessment-of-exposure-to-radiofrequency-electromagnetic-fields-limits-and-policies)" the AAP submitted a letter with their official comment (https://ehtrust.org/wp-content/uploads/7520941318.pdf).

Click HERE to Download a hyperlinked document with the American Academy of Pediatrics Recommendations. (https://ehtrust.org/wp-content/uploads/AAP-Recommendations-Fact-Sheet-3.pdf)

American Academy of Pediatrics Documents

AAP Healthy Children.org Cell Phone Radiation & Children's Health: What Parents Need to Know (https://www.healthychildren.org/English/safety-prevention/all-around/Pages/Cell-Phone-Radiation-Childrens-Health.aspx)

AAP Healthy Children Website on Cell Tower Radiation and Health Effects (https://www.healthychildren.org/English/safety-prevention/all-around/Pages/Electromagnetic-Fields-A-Hazard-to-Your-Health.aspx)

"AAP responds to study showing link between cell phone radiation, tumors in rats" AAP Press Release May 27, 2016 (http://www.aappublications.org/news/2016/05/27/Cancer052716)

Pediatric Environmental Health, Textbook of Children's Environmental Health 3rd Edition edited by Philip J. Landrigan, Ruth A. Etzel. Chapter 41 , Electromagnetic Fields (https://books.google.com/books?id=5dhBAgAAQBAJ&printsec=frontcover&dq=electromagnetic+fields++Philip+J.+Landrigan,+Ruth+A.+Etzel&hl=en&sa=X&ved=0ahUKEwjngM
Oxford Medicine Chapter 41 (http://oxfordmedicine.com/view/10.1093/med/9780199929573.001.0001/med-9780199929573-chapter-41)

"More study needed on risk of brain tumors from cell phone use" AAP Press Release, September 25, 2011: (http://www.aappublications.org/content/32/10/28?sso=1&sso_redirect_count=1&nfstatus=401&nftoken=00000000-0000-0000-0000-000000000000&nfstatusdescription=ERROR%3a+No+local+token)

American Academy of Pediatrics Official Letters on Cell Phones and Wireless Radiation

2013 AAP Letter to FCC Commissioner Mignon Clyburn and FDA Commissioner Margaret Hamburg calling for a review of RF guidelines (https://ehtrust.org/wp-content/uploads/7520941318.pdf)

2012 AAP Letter to US Representative Dennis Kucinich in Support of the Cell Phone Right to Know Act (https://ehtrust.org/wp-content/uploads/2015/12/aap_support_letter_cell_phone_right_to_know_act.pdf)

2012 AAP Letter to the FCC Chairman calling for the FCC to open up a review of RF guidelines (https://ehtrust.org/wp-content/uploads/American-Academy-of-Pediatrics-letter-to-the-FCC-July-12-2012.pdf)

News Reports

WMKY Public Radio: AAP Recommends Putting Cellphone Use on Hold for Children's Health (http://wmky.org/post/aap-recommends-putting-cellphone-use-hold-childrens-health#stream/0)

WebMed: Children Face Higher Health Risk From Cell Phones (http://www.webmd.com/children/news/20140819/children-cell-phones#3)

Baltimore Sun: Pediatric researchers suggest potential dangers for children from cellphone exposure (http://www.baltimoresun.com/health/blog/bal-cell-phones-child-brain-story.html)

National Center for Health Research: Children and cell phones: is phone radiation risky for kids? (http://center4research.org/child-teen-health/children-and-cell-phones-is-phone-radiation-risky-for-kids/)

Time Magazine (2012): Pediatricians Say Cell Phone Radiation Standards Need Another Look (http://healthland.time.com/2012/07/20/pediatricians-call-on-the-fcc-to-reconsider-cell-phone-radiation-standards/)

CNN Sanjay Gupta: Children and Cell Phones Report (https://www.youtube.com/watch?time_continue=3&v=kL2ncKs9K8o)

The American Academy of Pediatrics recommendations are highlighted in this FACTSHEET **(https://ehtrust.org/wp-content/uploads/Parents_SafeTech_Flyer_V5.pdf)**on children and wireless.

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Guidelines for Installation of the Mobile Towers

Comments(208) Sub Category: Cell Phone Towers , Common Area Safety , Property Renting , Safety Tips
Posted On: Feb 15, 2011

The Department of Telecommunications (DoT) is in the process of finalizing tougher norms for radiation emitting from cell towers. India currently follows the ***International Commission for Non Ionizing Radiation Protection (ICNRIP)***, a German independent body's guidelines set for exposure to radiation.

Mobile phone towers installed on top of buildings are a definite threat to human health. According to experts, radiation from mobile phones used for long durations is higher than those from mobile towers.

The advantage of a telecom tower is that a single installed unit can be home to multiple telecom providers. Meanwhile, the same telecom tower can be used by multiple companies for distributing signals. The government framed a policy in 2006 in which guidelines, rules and regulations were framed for installing a tower. Under the guidelines, mobile service providers have to take clearances from the government before installing a tower.

Important Guidelines for Installation of Mobile Towers

As per the Environment (Protection) Act, 1986 and rules made under it, all mobile phone service providers are hereby directed to follow the following guidelines strictly at the time of installation of the mobile towers.

- Installation of Base station antennas within the premises of schools and hospitals must be avoided because children and patients are more susceptible to electromagnetic radiations.
- Installation of Base Station Antennas in narrow lanes should be avoided in order to reduce the risks caused by any earthquake or wind related disaster.
- The Base Station Antennas should be at least 3 m away from nearby buildings and antennas should not directly face a building. Further, the lower end of the antenna should be at least 3 meters above the ground or roof.
- In case of multiple transmitter sites at a specific locality, sharing of a common tower infrastructure should be explored, as far as possible, which can be coordinated through a nodal agency.
- Access to Base Station Antenna sites should be prohibited for general public by suitable means such as wire fencing, locking of the door to the roof etc. Access to tower sites, even for maintenance personnel, should be for a minimum period as far as possible.
- Sign boards/warning signs are to be provided at Base Station Antenna sites which should be clearly visible and identifiable. A warning sign should be placed at the entrance of such zones.
- The "Warning Sign" should discourage longer stay in the zone, even for the maintenance personnel. The sign board may contain the following text :

1. Danger ! RF radiations. Do not enter !
2. Restricted Area

- The operators and maintenance personnel, who are dealing with radio frequency devices, specially with Base Station Antennas installed on towers and at any other outdoor sites, should be protected from electromagnetic radiations. It is required that operators and maintenance personnel should be educated for

Apartment Reviews


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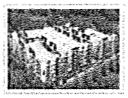
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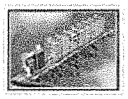
MJR Platina
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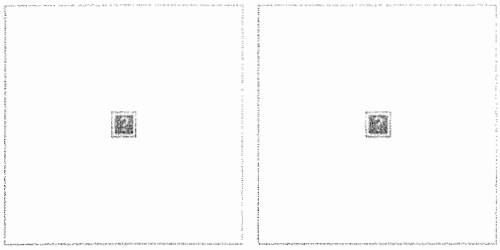
possible hazards from these devices.

All local authorities are also requested that before giving any permission for installation of mobile towers, aforementioned guidelines should be considered.

Location of Tower



As per the guidelines framed in 2006, rules and regulations have been framed for installing a tower. No tower should be installed within 100 meter radius of hospitals and educational institutes. But these are not followed as many towers are seen without taking care of the guidelines. With regards to the location of towers, cellular operators shall avoid residential areas for erection of the same.

- First preference shall be given to the location of towers in forest areas.
- Second preference shall be given to the location of tower in the open or public areas away from residential locations.
- Where it is not possible to avoid the location of the tower in residential area, the same shall not be located in open spaces or parks, with prior consent of the owners of adjoining residential houses.
- Erection of towers shall not be allowed within a radius of 100 meters from residential buildings, schools and hospitals.

Permissions or Documents Required

- **Structural safety certificate from designated institute:** This is an important certificate for installation of towers in buildings if the tower is installed on the building of a school.
- **Consent from authority:** Mobile phone operators and building owners have to get the consent of the municipality or the respective authority. Ensure that the school or building owner has obtained required permission from the concerned authority to set up the tower.
- **Indemnity Bond:** This is is required from the owner or service provider for the installation of the tower. Indemnity Bond is to take care of any loss or injury due to any accident caused by the tower.

In cities like Delhi, Mumbai, Chennai, Hyderabad & Bangalore, the civic body has launched a drive to remove the illegal cell phone towers in these cities. The civic body has observed that housing societies are giving permissions to service providers to erect towers for a rent. Before erecting such towers, it is necessary to check the structural stability of the building according to the Development Control (DC) rules.

advantage of a telecom tower is that a single installed unit can be home to multiple telecom providers. Meanwhile, the same telecom tower can be used by multiple companies for distributing signals. The government framed a policy in 2006 in which guidelines, rules and regulations were framed for installing a tower. Under the guidelines, mobile service providers have to take clearances from the government before installing a tower.

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Tags: Base Station Antennas, Cell phone tower radiation, cell phone tower radiation effects, cell phone tower radiation risk, Department of Telecommunications, DoT, Environment (Protection) Act 1986, Guidelines for Installation of the Mobile Towers, ICNRIP, Important Guidelines for Installation of the Mobile Towers, Indemnity Bond, Installation of Base Station Antennas, International Commission for Non Ionizing Radiation Protection, Location of Tower, Mobile phone towers installed on top of buildings, Mobile Towers, Structural safety certificate, Telecom Tower

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March 20, 2013 at 10:58 am
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Reply

Surya P J says:
April 7, 2013 at 7:02 pm
Useful info. Lucky me I discovered your web site by chance, and I'm surprised why this accident didn't came about earlier! I bookmarked it.

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Rolf Zampella says:
April 17, 2013 at 3:12 am
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Reply

Navajawan Ganesh Mandal says:
June 10, 2013 at 11:38 pm
we are also same problem

Reply

jagtar says:
June 30, 2014 at 8:45 am
Sir im jagtar singh from punjab and i applied form throught agents who come in my contact through newspaper advertisement. They are demanding 20000 for N.O.C. is it required or im in fraud?????? Plz reply on my email i will be thankfull to you..

Reply

Sibaprasad Mandal says:
July 14, 2014 at 10:42 am
Dear sir, I want to install any company mobile tower on my roof in my village. Address.vill-hariharpur, psot-byabattarhat,dist-purbamedinipur, pin-721648

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TO: Los Angeles Unified School District
FROM: Martha R Herbert, PhD, MD
RE: Wireless vs. Wired in Classrooms
DATE: February 8, 2013

I am a pediatric neurologist and neuroscientist on the faculty of Harvard Medical School and on staff at the Massachusetts General Hospital. I am Board Certified in Neurology with Special Competency in Child Neurology, and Subspecialty Certification in Neurodevelopmental Disorders.

I have an extensive history of research and clinical practice in neurodevelopmental disorders, particularly autism spectrum disorders. I have published papers in brain imaging research, in physiological abnormalities in autism spectrum disorders, and in environmental influences on ndurodevelopmental disorders such as autism and on brain development and function.

I recently accepted an invitation to review literature pertinent to a potential link between Autism Spectrum Disorders and Electromagnetic Frequencies (EMF) and Radiofrequency Radiation (RFR). I set out to write a paper of modest length, but found much more literature than I had anticipated to review. I ended up producing a 60 page single spaced paper with over 550 citations. It is available at http://www.bioinitiative.org/report/wp-content/uploads/pdfs/sec20_2012_Findings_in_Autism.pdf.

In fact, there are thousands of papers that have accumulated over decades – and are now accumulating at an accelerating pace, as our ability to measure impacts become more sensitive – that document adverse health and neurological impacts of EMF/RFR. Children are more vulnerable than adults, and children with chronic illnesses and/or neurodevelopmental disabilities are even more vulnerable. Elderly or chronically ill adults are more vulnerable than healthy adults.

Current te chnologies were designed and promulgated without taking account of biological impacts other than thermal impacts. We now know that there are a large array of impacts that have nothing to do with the heating of tissue. The claim from wifi proponents that the only concern is thermal impacts is now definitively outdated scientifically.

EMF/RFR from wifi and cell towers can exert a disorganizing effect on the ability to learn and remember, and can also be destabilizing to immune and metabolic function. This will make it harder for some children to learn, particularly those who are already having problems in the first place.

Powerful industrial entities have a vested interest in leading the public to believe that EMF/RFR, which we cannot see, taste or touch, is harmless, but this is not true. Please do the right and precautionary thing for our children

I urge you to step back from your intention to go wifi in the LAUSD, and instead opt for wired technologies, particularly for those subpopulations that are most sensitive. It will be easier for you to make a healthier decision now than to undo a misguided decision later.

Thank you.

Martha Herbert, PhD, MD
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USA