

2/7/2018

Edcgov.us Mail - Fwd: Clerk of the Commission Meeting regarding cell towers

PC 2-8-18
#3



Serena Carter <serena.carter@edcgov.us>

Fwd: Clerk of the Commission Meeting regarding cell towers

1 message

Char Tim <charlene.tim@edcgov.us>
To: Serena Carter <serena.carter@edcgov.us>
Cc: Evan Mattes <evan.mattes@edcgov.us>

Wed, Feb 7, 2018 at 7:40 AM

Serena,

Please process this email with other public comments received today for the AT&T CAF4 project agendized for the February 8, 2018 meeting. Thank you.

----- Forwarded message -----

From: **Carla sutton** <lovetogarden05@gmail.com>
Date: Tue, Feb 6, 2018 at 7:47 PM
Subject: Clerk of the Commission Meeting regarding cell towers
To: "charlene.tim@edcgov.us" <charlene.tim@edcgov.us>

Please consider each tower as a separate "Special Use Permit" project AND provide ALTERNATIVE site analysis for EACH project location. Like further away from residential sites and schools. Regardless of availability of power and phone lines to the site.

Additionally, these "stealth pines" are unsightly and anything but stealthy.

Thank you
Carla Sutton
Garden Valley

--

Char Tim
Clerk of the Planning Commission

County of El Dorado
Planning and Building Department
2850 Fairlane Court
Placerville, CA 95667
(530) 621-5351 / FAX (530) 642-0508
charlene.tim@edcgov.us

2/7/2018

Edcgov.us Mail - Fwd: Conditional Use Permit S17-0016/AT&T CA F4

PC 2-8-18
#3



Serena Carter <serena.carter@edcgov.us>

Fwd: Conditional Use Permit S17-0016/AT&T CA F4

1 message

Char Tim <charlene.tim@edcgov.us>
To: Serena Carter <serena.carter@edcgov.us>
Cc: Evan Mattes <evan.mattes@edcgov.us>

Wed, Feb 7, 2018 at 10:41 AM

Serena,

Please process this email with other public comments received today for the AT&T CAF4 project. Thank you.

----- Forwarded message -----

From: **Ellen Vaughn** <ellenvaughn@hotmail.com>
Date: Wed, Feb 7, 2018 at 10:39 AM
Subject: Re: Conditional Use Permit S17-0016/AT&T CA F4
To: "charlene.tim@edcgov.us" <charlene.tim@edcgov.us>

Re: Conditional Use Permit S17-0016/AT&T CA F4

Please consider each tower as a separate project AND provide ALTERNATIVE SITE ANALYSIS further away from residential uses for each location regardless of availability of power and phone lines to the site.

--

Char Tim
Clerk of the Planning Commission

County of El Dorado
Planning and Building Department
2850 Fairlane Court
Placerville, CA 95667
(530) 621-5351 / FAX (530) 642-0508
charlene.tim@edcgov.us

PC 2-8-18
2018 FEB -7 PM 2:09 #3
RECEIVED 55 Pages
PLANNING DEPARTMENT

Dear Planning Commission,

Site 2 is the beginning of what the Natives called Grey Stone for the white lava that surrounded an ancient valley of the American River. Site 2 sits on snow ridge between north and south weber on the west end of the canyon. The sun sets there reminding us of the frailty of life and remembering those who have passed. My daughter married a descendent of Chief Hila, and our family and others have joined with each other to keep the remembrance of Gentle Bear and the Grand Fathers continuing till now. I own these properties that the Natives called Grey Stone. 77-091-10, 77-432-02, 77-091-11, 77-011-09, 77-732-91, 77-091-21, 77-091-08, 77-091-09, 77-732-29, 77-021-64, 77-021-98.

I commissioned a survey to be done and it shows the site is too close to my property and the clearance set back as required by the county standard would infringe on my property causing irreparable damage. The county requires a 30' set back and according to the survey conducted by Peter Brewster, ll, the markers are too close to my property at 27'. The tower will be very offensive to look at; additionally it will effectively shade anything I wish to grow there as it is below my south facing lot.

My Intention has always been to be off the grid whether it is just me or I complete the subdivision that has been started as phase 3 Rancho Del Sol. The tower will block my ability to sell or benefit from being off the grid and as I own these outright there is no bank to buffer the loss which could be more than 20%.

I respectfully request that you deny this site for these many reasons:

1. Native Mourning site
2. Surveys done by two of ATT's surveyor's place the site three feet too close to my property
3. The grading will be extensive and may weaken the sandy soil that is above the mineshafts and the tower may fall in a high fire zone.
4. The closeness to my property would require damage to my property for fire clearance as the Fire Marshall cleared plans for a site that was in the wrong place.
5. The cost of damage to my off the grid properties will be extensive
6. The vibration from the conversion from AC to DC (hum) is overwhelming to me and it may cause me to be unable to entertain and enjoy my quiet and peace of mind.
7. There is a frog pond that will be impacted and I would beg time to do a biological study as they may have done it in the drought of summer.

Sincerely,
Randy Hellesvig



BREWSTER & ASSOCIATES

2954 ALHAMBRA DRIVE, CAMERON PARK, CALIFORNIA 95682
Phone (530) 677-3348 Fax (530) 676-5373 brewsterandassociates.com

February 6, 2018

Randy Hellesvig
P.O. Box 122
Diamond Springs, CA 95619

Re: **Field Survey Report of Findings for Set-Back Stake Locations
Site 2 El Dorado County Planning Commission Agenda Item 18-0161
Proposed Wireless Telecommunication Facility (S17-0016)**

Your Property: Thundercloud Lane, Camino, California
Assessor's Parcel Number 077-732-29-100
Lot 1 of Rancho Del Sol Subdivision (F-90)

Dear Mr. Hellesvig:

Pursuant to your request on January 31, 2018 this office conducted a field survey to retrace the Southerly boundary of your above referenced property. The purpose of the retracement was to verify the set-backs for the currently staked wireless telecommunication facility pending the El Dorado County Planning Commission approval with respect to your boundary. Our findings are as follows:

- 1.0 The property requesting consideration for construction and operation of a wireless telecommunication facility consisting of a new monopine tower 122 feet above ground level, with individual ground equipment and fencing, Assessor's Parcel Number 077-091-06 being Parcel 1 of Parcel Map 8-36 (PM 8-36) adjoins your lot along a portion of your Southerly boundary.
- 2.0 Monuments delineating the Southerly line of your parcel were found to be of character and occupy their true positions pursuant to the map that created your parcel, AKA Assessor's Parcel Number 077-732-29-100, Lot 1 of Rancho Del Sol Subdivision (F-90). A portion of this Southerly line is synonymous with the Northerly line of the proposed wireless telecommunication facility site, AKA Assessor's Parcel Number 077-091-06 being Parcel 1 of Parcel Map 8-36 (PM 8-36).
- 3.0 Sheet C-1 of the improvement plans for Newtown Site Number 2 CVLO3158 as provided for the commission's consideration is attached hereto and made part of this report for reference. This sheet calls for set-back distances of 30 feet at the Northwesterlymost corner of the proposed fenced wireless lease area and 37.2 feet at the Northeastlymost corner of same.

- 4.0 Lath stakes were found and tied delineating the approximate 35 foot by 45 foot proposed fenced wireless lease area. Measured at right angles from your Southerly boundary, the Northwesterlymost corner of the proposed fenced wireless lease area was found to be approximately 27 feet from your Southerly boundary, and the Northeastlymost corner was found to be approximately 34.5 feet from same. Both of these distances fall short of those called for in 3.0 above and do not comport with the plan as submitted.

In relying on the recorded documents and field evidence described herein, Brewster & Associates does not warrant the work of previous surveyors. This letter constitutes an expression of professional opinion only, and does not constitute a warranty or guaranty, either expressed or implied.

This concludes our surveying services performed under your contract. I have sincerely enjoyed working with you. If you have any questions or need anything else, please don't hesitate to call me.

Sincerely,

BREWSTER & ASSOCIATES



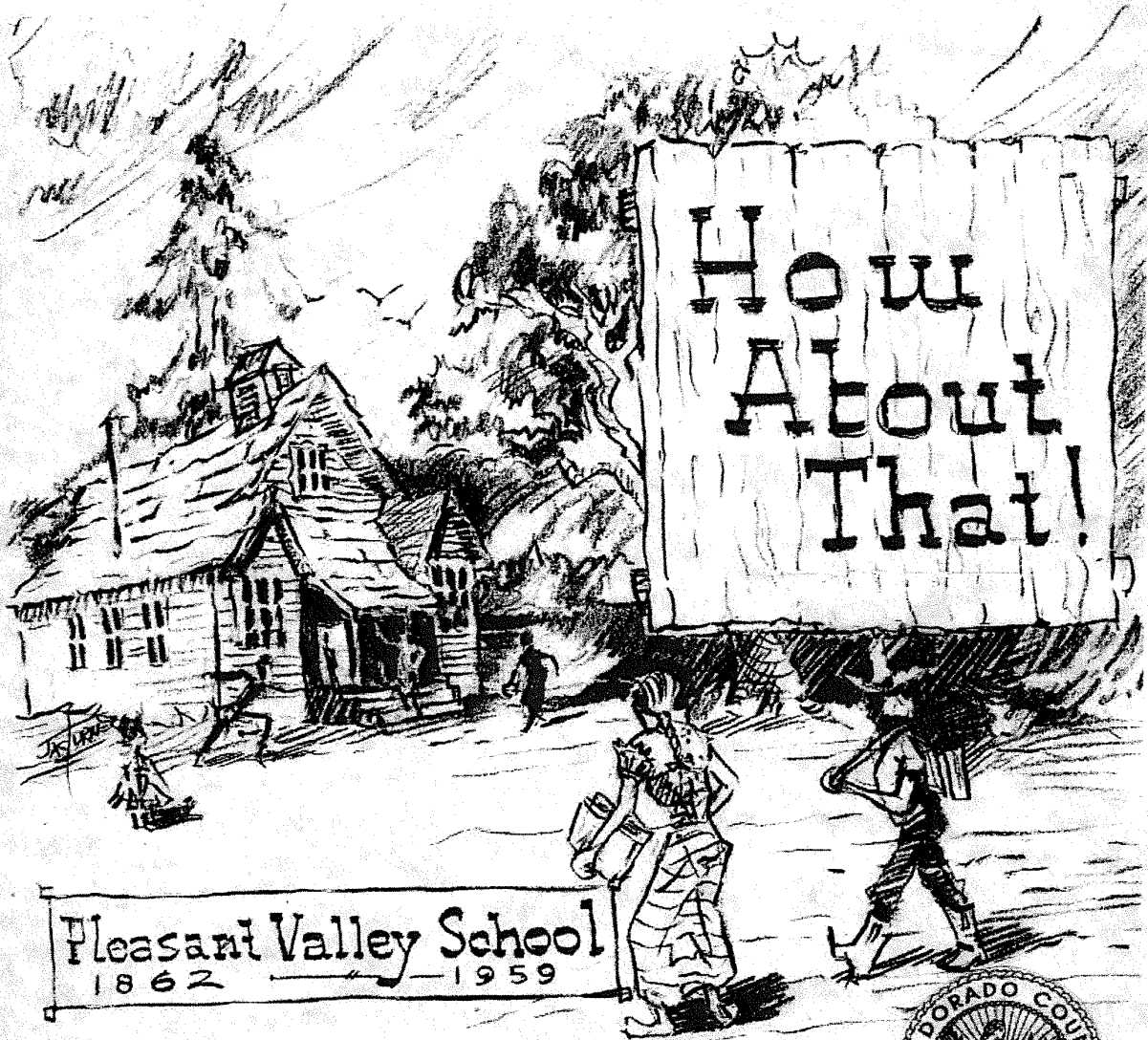
Peter S. Brewster, PLS



PB/me

Attachment

#61
\$28.95



AN ANTHOLOGY OF
 HISTORICAL STORIES...
 by George W. Peabody
 Illustrated by J. TURNER

THE KILLING OF GENTLE BEAR

One evening, when friends were toasting themselves around the pot-belly stove in Enrico Brandini's Cantina in Newtown, sipping wine and tired of cards, the story teller, old Rocco, began weaving a spell about the murder of an innocent Indian girl named Gentle Bear. She'd been killed by an Italian, and the Italian community of Newtown had refused to defend him. It happened long before the Newtown fire of 1872, that the "bad egg" named Gigio came to town bragging he'd stolen money from his parents to pay his way to America, and that he'd steal again to repay them. One lonely miner, Simon, had lost his partner; so Gigio just moved into Simon's cabin, and ate Simon's food. Gigio quit mining when he couldn't scoop up the gold without using a pick and shovel, and spend hours bending over gold pans full of black sand from the long tom, water washing out the gold.

Twice, men in the camps collected enough gold to send Gigio to San Francisco to find work; but each time, he'd returned in under two weeks, penniless after a good time.

Rocco said it was summer of each year when the Indians from Nevada, expert horsemen, arrived with a drove of wild horses to break and sell locally. They called themselves Pinion Indians and were led by Chief Hila. Their men and women were straight, tall, and handsome; and the women were athletic, equal to their men in horsemanship. The Pinions spoke English, paid their bills, asked no favors; and John Ringer (the unofficial Justice of the Peace at Smith Flat) had reason to wish the white men were as honest and law abiding.

A kindly person, Chief Hila's sister, Sarah was well known for her skill with herbs and Indian healing methods by which she'd restored health to the half dead members of the Donner Party (after their rescue) at Johnson's Ranch on Bear Creek and at Sutter's Fort in Sacramento, during 1847, where she continued to treat them.

While the Pinions were in the Newtown area, they built cedar bark dwellings at Graystone (thought to be a few hundreds yards or so upstream from Rugg Gulch and the old Hesque log barn, in Teepee Ravine below Starks Grade Road) where they staked out corrals and the women wove baskets for sale. (See second note regarding Creighton Valley, page 31.)

Some of the people of Newtown liked to spend Sunday afternoons at Graystone, watching the Pinions lasso and break their horses in the box-like canyon; and the Pinions enjoyed demonstrating their skills. Troublesome Gigio, always carrying Simon's revolver, swaggering, and looking for amusement, went there too. He was warned to keep away from the handsome Pinion women who might as readily break a man as a horse!

Distances about equal, Stephen returned with John Kinger just as Chief Hila's eight sons arrived in Newtown at sundown. One angry Pinion could be a frightening sight; but here, casting long shadows, were eight Pinions sitting very upright on tall horses, their mouths pressed tightly, their eyes glowering! Anything could happen! The Pinions were perfectly capable of setting fire to brittle dry Newtown, shooting everyone in site, maybe torturing the women! Aside from Gigio's revolver, only a few hunting rifles were available for defense. Not a lamp was lit anywhere in town, and, despite the heat, everyone knew that fearful chill in the air!

Gigio was crawling on the ground, groveling, and whimpering, "Get your guns! Those savages will come back to shoot me. You've got to protect me!" The other Italian men paid little attention to Gigio except to make sure he didn't get away.

Though the late afternoon was hot, a trembling chill fell upon the people of Newtown as Stephen (who ran the store) jumped the first saddled horse and streaked for Smith Flat to get deputy Justice of the Peace John Kinger. Meanwhile, men ran from house to house warning the women and children to stay inside.



Then, one torrid September afternoon, a Pinion couple named Fall Leaf and Gentle Bear came riding their horses to the stone store (now called Gardella's stone store) in Newtown. As was the Pinion custom, Gentle Bear waited on her horse in the heat, holding the reins of her companion's horse, while Fall Leaf purchased the camp supplies of sugar and flour.

Gigio's habit was to sit with the men in the late afternoon shade on the front porch of the stone store; and he tried to get Gentle Bear's attention with gestures. When this failed, he got up, stepped off the porch and walked toward her speaking what English he knew; but, she motioned him away. Before anyone could stop him, he stepped close to her horse; and as he grabbed for the reins, she lashed her quirt across his face. In less than a heartbeat, Gigio drew old Simon's hand gun and fired two shots! Gentle Bear fell from her horse, dying! At the sounds of the shots, Fall Leaf burst from the store, gathered into his arms Gentle Bear's bleeding body, and rode at full gallop toward Graystone.

HOW ABOUT THAT!

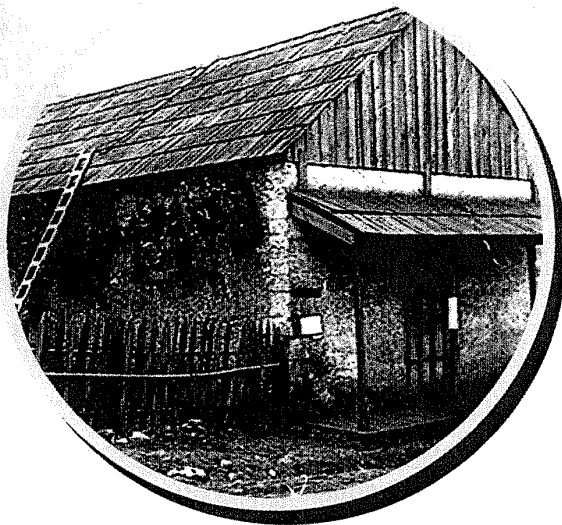
HOW ABOUT THAT!

John Ringer and Chief Hila's elder son dismounted stiffly from their horses and exchanged guarded greetings. For an hour, they tried to reach some settlement; and the full moon arose. While the Newtown men followed the talks carefully, Gigio was worming his way into the shadows and toward the edge of the woods.

Though Gigio managed to slip away, unnoticed by the townsfolk, one pair of eyes (possibly those of Fall Leaf or maybe old Simon) watched Gigio's every move. Shortly, from a nearby gulch, a rifle shot shattered the troubled night; Gigio's absence was discovered, then his body. That shot could have signaled the Italian men to fire upon the Indians had they any certainty that it was from a Pinion weapon, or if Gigio's life had meant much to anyone. But, the talks between Chief Hila's son and John Ringer continued into the moonlit night. Finally, the two men shook hands solemnly and the Pinions rode quietly into the shadows, back toward Graystone.

John Ringer said it was a temporary truce. Everyone was tense for a week, almost afraid to take a deep breath. Then, John Ringer went alone to Graystone and made a peace that no one felt sure of until the Pinions broke camp and returned to Nevada. Old Rocco, who'd witnessed the event, held always that the people of Newtown escaped with their lives because Chief Hila's sons were men of honor, and because John Ringer was a persuasive man of justice.

The wonderful Pinion horsemen and their fine strong women never again returned to Graystone. It was a grave loss; for their horses were well broken, the baskets were useful works of art which stood much wear, and the prices were fair. The exciting Sunday afternoons each summer at Graystone, watching the skilled Pinions' horsemanship and basket weaving, were a thing of the past.



GARDEZZA'S STORE
NEWTOWN

NOTE: The names Gentle Bear and Fall Leaf were given to the story as it was being rewritten by this author. The actual names are unknown.

NOTE: Graystone, now, is believed to be located in Creighton Valley, S16, T10N, R12E, on the north side of the South Fork of Weber Creek, east of Snow's Road, not in Teepee Ravine below Starks Grade Road as stated above. (1999)

#64
#700

PLEASANT VALLEY

EL DORADO COUNTY, CALIFORNIA

AN HISTORICAL PERSPECTIVE

By **GEORGE W. PEABODY**
Illustrations - **M. BERARDI**



THE

SQUAW HOLLOW SENSATION

AS PUBLISHED IN THE MOUNTAIN DEMOCRAT - 1879.

PLACERVILLE, CALIF.



HISTORICAL PERSPECTIVE (Continued)

Mormon Battalion veterans pressed on, leaving behind them Sly Park and a wagon trail that would be followed by smaller Mormon parties coming up from Pleasant Valley. Immigrant wagon trains from the east were encountered and the Mormon Wagon Trail was described to them. It was the first wagon trail opened from west to east out of Northern California, yet it was a trail which would bear thousands of gold and land seekers from east to west for eighteen years. At about this time, Charles M. Webber²² established the Webberville gold mining district, just west of Ringgold along the south shore of the Pul-Pul-Mul,²³ (now Weber Creek).

By February of 1849, five of the mormons had returned and mentioned the site of the Mormon Diggings²⁴ in Pleasant Valley. Prospectors from Hangtown, headed by George Russell,²⁵ located and worked the Mormon Diggings and a party of Chilean miners²⁶ occupied adjacent diggings until July of 1849, when the emigrants came teaming down the Mormon Trail by the hundreds, forming a tent city.²⁷ Timber was felled for firewood and log cabins; men devastated the country digging everywhere, even about the small springs. A cluster of cabins was erected on a low divide²⁸ between the Weber Creek forks and it was called "Iowaville".²⁴ Another cluster of cabins was erected at the second Mormon corral (Mormon Diggings) and named "Dog Town". The ridge between the Weber Creek Forks would be named "Snow Ridge", in remembrance of the Snow family, one of the early settlers in the area.²⁹

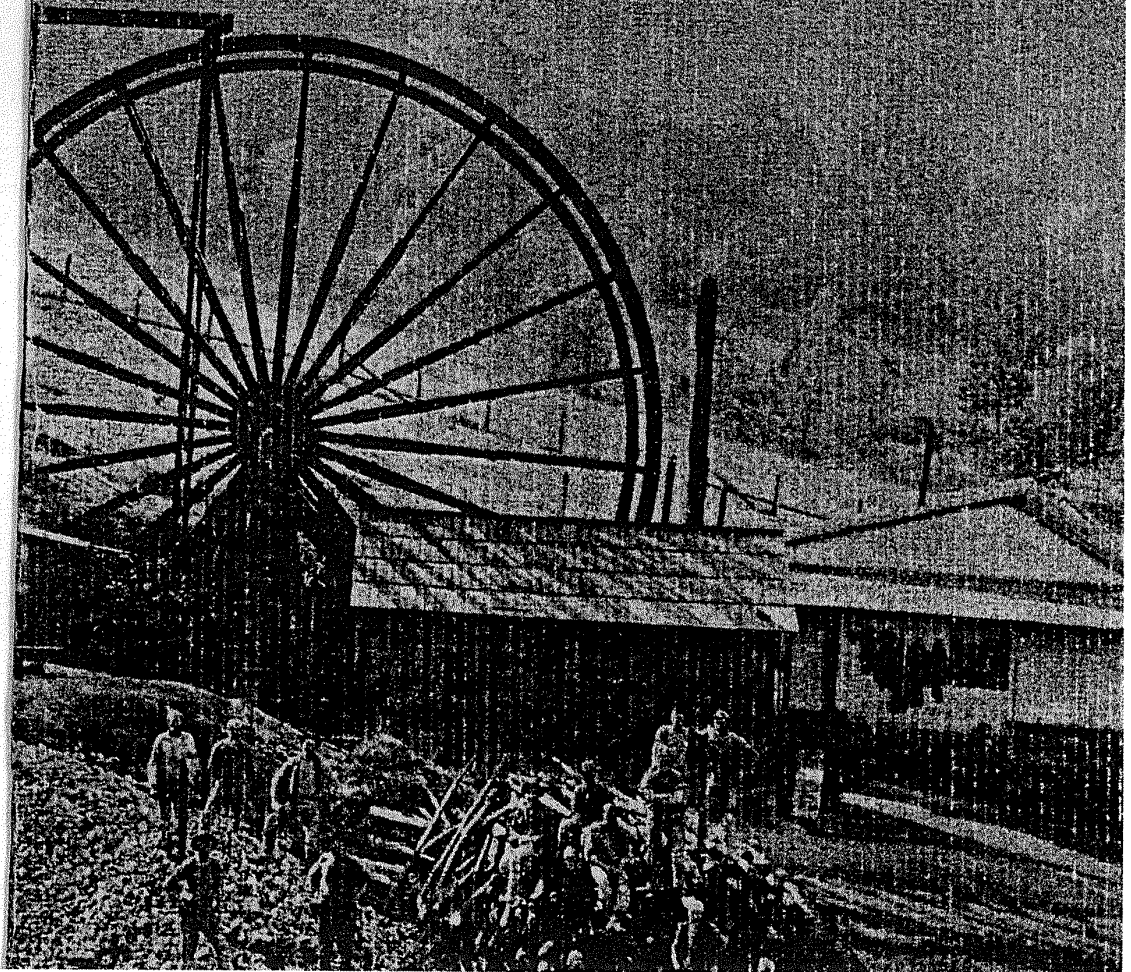
The Valley's population soared, exceeding that of Hangtown (earlier Old Dry Diggings) and mighty Coloma too, as the hopeful survivors of the cross county trek continued to pour down both the Mormon Wagon Trail and Starks Grade Road into what must have seemed a heavenly, oak studded meadow land after their desert and mountain ridge struggle. Rapidly, Starks Grade Road grew to bear the greater number of wagons, due to its more gentle grade, though the Mormon Trail bore heavy traffic, too. Businesses were established everywhere along the main wagon trails until a man could rest, water, and feed his horses, as well as himself, every three miles or less along the way. More people lived in the area by the end of 1850, when California was admitted to the Union, than lived here in 1950! Wayside stops and settlements toward Diamond Springs were mushrooming with names such as Ringgold, Tiger Lily,³⁰ Hanks Exchange,³¹ Clapp's, Cook's and Steele's. There was Newtown and Fort Jim, in addition to the already mentioned Iowaville, Dog Town, Sly Park and Pleasant Valley. Along the Cosumnes River North Fork, were Wisconsin Bar, Rocky Bar, Bucks Bar and the notorious Ladies Valley. The area was offering hotels, restaurants, dancing places, butcher shops, breweries, distilleries, beverage houses, billiard saloons, ten pin alleys, blacksmith shops, animal breeders, potteries, lumber and supplies, doctors, voting polls and post offices. A telegram



Reminiscences of
OLD NEWTOWN

by JOHN GARDELLA

22
325



18-0161 Public Comment
PC Rcvd 02-07-18

ONLY A FEW INDIANS were living in Newtown at the time about which I am writing. Except for Indian George and Lucinda, they kept pretty much to themselves. Indian George, who spoke better English than the rest, acted as a go-between. A week before the Fourth of July celebration, he came to the stone store to tell the storekeeper that he was taking Indian Jesse to the county hospital in Placerville. For the last five years Indian Jesse, who lived at Bartram's Mill, had been haunted by the ghost of his dead son Willie. It was said that Willie's ghost was trying to take his father to the happy hunting ground but his father wasn't ready to go. Running away from Willie's ghost one night, Jesse fell and broke his leg.

George was a Maidu. He used to tell us that before the gold discovery, a tribe of Maidus lived in Newtown. Stone mortars that they had used to pound corn were propped against trees and fences in most of our yards. When the miners came, the Indians fought to keep their homes. That's the time the white men said they had become violent. A trapper scout called Peg Leg Smith went around the county helping Indians and white men to make treaties. A treaty of sorts was made in Newtown, but after it was made most of the Indians moved away. In the 60s and 70s bands of Indians still visited their old home sites. George told us that his father came to Carshum Bowl on Texas Hill where as many as 200 braves met to perform ceremonial dances and hold cries.

I wasn't much over four when one of the last cries was held in Newtown. We were sitting on the porch after dinner. I was leaning against my father's shoulder half asleep. Suddenly I heard dogs barking and I saw a small band of Indians plodding up the dusty road. There was still light enough to see that they were all old. The faces of the women who pushed the carts were daubed with pitch.

"They must have come a long way," my mother whispered.

"They are on their way to the meadow above Kimmer Flat to hold a cry," my father said. "That's a memorial service for their dead. Bands used to come every year when I first came to Newtown."

"What's in the carts?" mother asked.

"Offerings to burn to their dead, like woven baskets and rugs and things to eat their dead liked."

That night we saw the flames rise from the memorial fires. People who lived near the meadow heard moans and cries all

through the night. It was said that the women who had pitch on their faces mourned their men by knocking their heads against trees. The next morning the Indians came by with drooping shoulders and empty carts. They tramped silently down the road toward Fort Jim. No one had spoken to them and they had spoken to no one.

Lucinda, we felt, belonged to Newtown as much as any of us. She was a hunched up little squaw with sunken cheeks and straggling hair. Lucinda and her two-hundred pound husband, Indian Jim, were nomads. A frequent sight except in winter, was big Jim shambling along the road while Lucinda followed dragging a cart or shouldering the sacks that held their camp equipment. One of their favorite camp sites was the field near my friend Henry's house.

We liked to watch Lucinda make camp. First, she made Jim comfortable under a tree and fed him jerky. Then, she made a shelter for a bed out of a piece of old canvas. For the bed she gathered pine needles, cleaning and fluffing them with her skilled, skinny hands. Two boxes held her camp goods: one was for a pan, flour, coffee and jerky, the other for her Indian basket things. Lucinda and Jim wore all their clothes when they were on the move, shedding and adding as the weather dictated.

Sometimes Lucinda invited us to eat flapjacks which she cooked over an open fire. She served them without butter or syrup and, more often than not, ashes got into them but we ate them with relish. Lucinda "begged" from the families she knew. Once a month she walked to their back doors, held out her right hand and said, "You give." All of them gave something, old clothes, scraps of food, old pots which no one ever saw her use. My mother kept a "Lucinda box" in which she put things for her.

Lucinda was as busy as Jim was idle. Whenever he was given a job to saw logs, she stood over him and most of the time, finished the job herself. We saw her digging soap root, cutting willow boughs for her basket making and looking for redbud to color them. She had learned to make baskets from a Pomo woman and the Pomos were the best basketmakers in the country. We used to watch Lucinda's claw-like hands weave strips around the ribs of willow root. When she coiled baskets, she used a sharp bone needle to sew the strips. The baskets that Indian George sold for her in Placerville, Lucinda decorated with feathers of orioles and tanagers which she hunted for hours.

In the fall, Lucinda gathered weeds and seed pods for her

cures. She was secretive about these, trying to explain to my mother that if she told what the weeds were, they would lose their healing power. When my Uncle Stephen fell from the roof he was mending and cut his arm, the cut didn't heal. He was ready to go to the doctor in Placerville when Lucinda brought a weed poultice which she folded around his arm. In two hours the swelling went down and the healing began. Aunt Rosa tried to find out what was in the poultice. She smelled tansy and yerba santa and chamomile and then gave up.

One winter afternoon I found out why my mother and the other women in Newtown accepted Lucinda as a friend.

"Golly, Ma," I said, "Lucinda must be a hundred years old."

She had just left the house after drinking a cup of coffee, with her sack of offerings under the man's raincoat she was wearing.

"Indian women grow old quicker than white women," my mother said. "Lucinda isn't much older than I am. She has had real trouble."

"You are friends, aren't you? Maybe like blood sisters?"

This expression was used about the friendship of Indians and white people. Everyone knew about Indian Sam Pete in Coloma who called himself the brother of James Marshall.

"Sharing joy and sorrow can make blood sisters," my mother said. "Lucinda had eight babies and they all died before they were a year old."

Then she told me more of Lucinda's story.

"You were about two years old the autumn that Lucinda carried her beautiful baby on her back in its straw cradle. The others had been little flat-nosed papooses who never smiled. As long as Lucinda carried a baby on her back, she never came to the back door. She sat with us on our porches or in the grape arbors as an equal. Maternity was her passport to acceptance. And we were all glad about it.

"We called the beautiful baby Angiolino Indiano. He had the same flat nose his brothers had had, but his eyes sparkled. He gurgled and he smiled. When Lucinda took him out of his cradle, he flapped his little arms and came to all of us wanting to be loved. And we all loved him as though he belonged to us.

"Lucinda beamed and kept saying, 'You like? You like?'"

"I felt that if that baby could be kept alive through the winter, he would have a chance to live. I wanted her to let me keep him warm and well fed and sheltered. I showed her the cradle you had just outgrown, piles of clean diapers, rows of nursing bottles and the little warm gowns you had worn. She smiled,

happy to know that someone wanted to care for her baby. Barbara and Angela had empty cradles and they offered to take the baby. Lucinda shook her head. I remember how proudly she walked down the path that day with Angiolino swaying and smiling in his cradle.

"We didn't see Lucinda again until it was almost spring. Her shoulders unburdened by the cradle sagged hopelessly. She had one baby after that, a puny thing who lived only a couple of months. Life has been hard for her."

I thought about the baby Angiolino when I went to Lucinda's campsite to eat flapjacks, the next time she camped near us. He would be playing with us I was sure, if she had let my mother take care of him that winter.

The last of my Indian stories happened before the fire. I had heard my mother say that an Italian killed an Indian girl in cold blood and that the Italians refused to help him. She didn't know how or when it happened. Rocco told us the story one evening:

Gigio was a bad egg from the start. When he had been in Newtown a week, he told us that he had stolen money from his parents to come to America and that he was going to steal more to pay them back. He quit mining as soon as he found out that he couldn't scoop up gold from the ground without using a pick and shovel.

We warned old Simon that Gigio wasn't to be trusted. But Simon had just lost his partner and he was lonely. Gigio lived in his cabin and ate his food. Twice the men in camp made up purses for Gigio so he could go to San Francisco to find work. Both times he came back broke in less than two weeks.

This was the time that Chief Hila's sons who called themselves Pinons, came from Nevada to Graystone in the summer to tame horses. The Hilas spoke English. They had taken an English name, Smith or Wilson, I've forgotten. They were independent Indians who paid their bills and asked no favors. One of their women, Indian Sarah the Chief's sister, had been at Johnson's Ranch on Bear Creek when five members of the Donner Party came there half dead. She was skilled in the use of herbs and Indian ways of healing and nursed them back to health. She went to Sutter's Fort to nurse some of the rest of the party after they were rescued.

The Hilas built tepees of cedar bark for their summer houses and staked out corrals for their horses. The women made Indian baskets. John Ringer, the unofficial Justice of the Peace, used

to say he wished all white men were as honest and law-abiding as the Hilas.

On Sunday afternoon some of us used to hike to Graystone to watch the Indians lasso their horses in the big corral. It was a diversion for us and the young Indians liked to show off their skill to the white man. Gigio, always on the lookout for any amusement, went with us. We had warned him to keep away from the Hila squaws, handsome women who could tame a horse almost as easily as any of their men.

On a September evening one of the Hila men came to the stone store to buy flour and sugar. A young squaw, riding her own horse, was with him. She sat on her horse while her companion went inside to do the buying. It was a warm evening. I was sitting on the bench with some of the men. Gigio was one of them. I saw him try to get the girl's attention. When he failed, he walked over to her horse and talked to her in the little English he knew. The girl motioned him away. When he got close to the horse and tried to take hold of the rein, she lashed her short whip across his face. He drew a gun—it was Simon's—and fired two shots before we could get to him. The girl fell off her horse, dead.

At the sound of the shot, the Pinon ran from the store. He picked up the girl's bleeding body and galloped away. We knew there would be trouble. Some of us went to warn the women and children to stay indoors. Stephen, who was running the store, jumped on the nearest horse and rode to Smithflat to get John Ringer. Gigio was crawling on the ground.

"Get your guns," he kept whimpering. "Those savages will come back to shoot me. You've got to protect me."

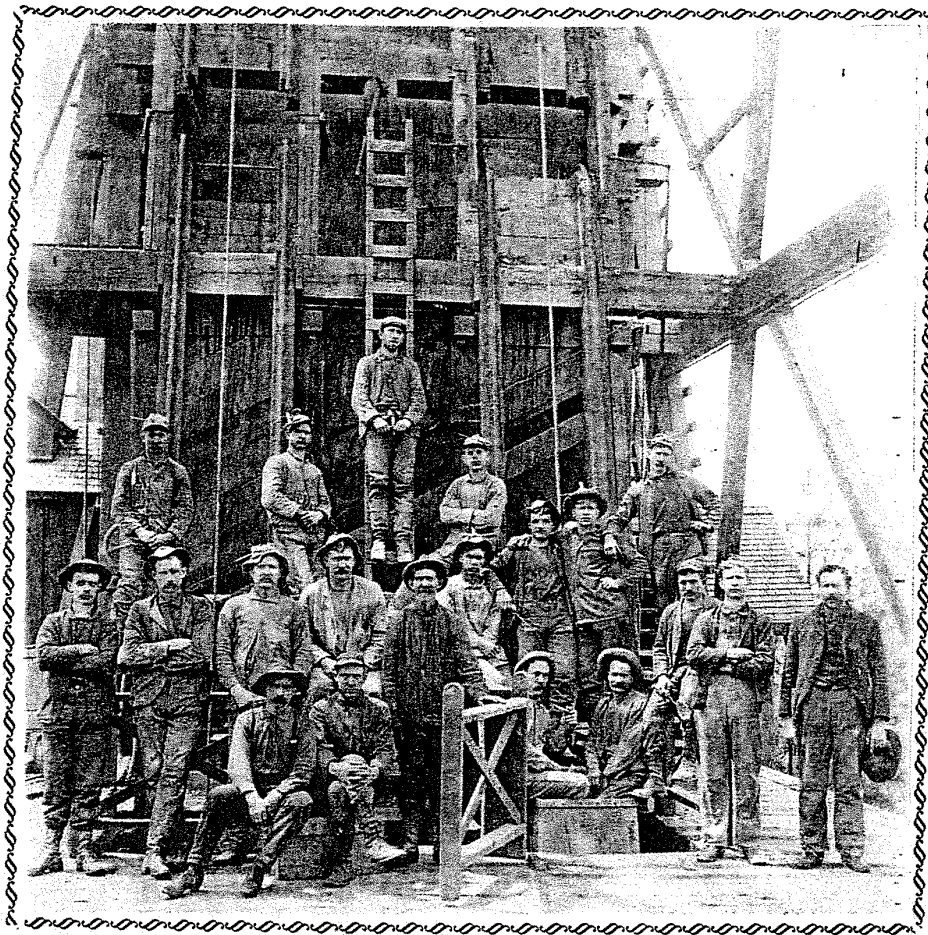
We didn't pay any attention to him except to see that he didn't get away. Ringer came back with Stephen at the same time that the Chief's eight sons arrived. They sat upright on their horses, mouths tightly pressed, eyes blazing. A mad Indian is an ugly sight. Anything could happen. The Hilas could set fire to the camp, torture our women or shoot us all. Except for Simon's gun, we had only a few hunting rifles among us. There was a moon that night. No lights were lit anywhere. I remember the chill in the air, although the day had been oppressively hot.

Ringer and Hila's oldest son got off their horses and greeted each other. After a parley had gone on for an hour, a shot rent the air. One of the Hilas, perhaps the one who had picked up the dead girl's body, shot and killed Gigio who had been worming his way to the edge of the crowd. Again all hell could have

broken loose. Ringer and the young chief talked on. Finally, they shook hands solemnly and the Indians rode away.

Ringer said it was a truce. After a week of anxiety during which we were even afraid to draw a deep breath, Ringer went to Graystone alone and made peace. We didn't go back to our everyday life until we heard that the Pinons had broken camp. The young chief sent word to Ringer that he and his people were going back to Nevada. They never came back to Graystone. I think we escaped with our lives because Chief Hila's sons were men of honor and Justice Ringer was a persuasive one.

**THE
HISTORICAL PERSPECTIVE SUPPLEMENT
FOR THE
PLEASANT VALLEY - OAK HILL - SLY PARK AREA PLAN
AND ENVIRONMENTAL IMPACT REPORT**



Our Historical Resources

A catalog of the old mines,
with information source references
through the turn-of-the-century.

THIRD EDITION

**EL DORADO COUNTY
COMMUNITY DEVELOPMENT DEPARTMENT
PARKS AND RECREATION DIVISION**

Snow Consolidated Placer gold S16, T10N, R12E
 Patented to Joseph and Charles Snow.
 Ref. 8 (index 14, 1938), 226, 762 (F, Pg. 466, 1905)

J. Snow Deposit Silica S--, T--N, R--E
 Location unknown. But, the deposit was sold in 1880 by
 Joseph Snow.
 Ref. 272, 783 (some connection?)

Snow Quartz Lode gold S20, T10N, R12E
 Located within the boundaries of the French Ravine Hydraulic
 Mine in the Iowaville Mining District during 1889.
 Ref. 285, 710

Joseph Snow & Company Mine Placer gold S16, T10N, R12E
 Ref. 8 (index 15, 1938), 176, 226, 315 (P16-20), 346, 347
 (Item 3405), 353, 373

Snow & Woods Claim Placer gold S16, T10N, R13E
 Located and working in the Newtown vicinity by 1896. Also,
 see Phelps & Wood.
 Ref. 363, 473, 491, 535, 745, 811C(37, Wood)

Snyder Mine gold S31, T10N, R11E
 Ref. 226

Michael Solari Tunnel Placer gold S20, T10N, R12E
 Michael was born in Italy during 1846 and naturalized in
 1882.
 See: Ventura Mine
 Ref. 315 (P16-19), 348 (Item 2486), 811 C(33), 822 (pg. 148)

South Superior Quartz Lode gold S--, T--N, R--E
 Located by D. H. Jackson in the Diamond Springs Mining
 District in 1899.
 Ref. 622

Southwick Placer gold S34, T10N, R11E
 Owned by Hiram Southwick in 1891.
 Ref. 309 (Item 54), 821

Southerner #1 Tunnel gold S--, T10N, R12E
 The tunnel was started in 1855, and located in Mormon Hill
 near Newtown.
 Ref. 772

Spaniard Quartz Mine
 See: First Chance Mine



UNITED FIREFIGHTERS
of
LOS ANGELES CITY
Local 112 IAFF AFL-CIO-CLC

September 24, 2014

Honorable Mitch Englander
Chairman, Public Safety Committee
200 N. Spring Street
Los Angeles, CA 90012

Dear Chairman Englander:

Just two weeks ago, I was made aware of the Los Angeles Regional Interoperable Communications System (LA-RICS) plan to install Long Term Evolution (LTE) broadband communication equipment at more than 25 Los Angeles City Fire Stations and facilities. When I learned of this plan, I immediately informed Fire Chief Terrazas of our public safety concerns related to the health and safety of our Firefighters with the planned installation of these transmission towers and radio antennas being just a few yards away from our members' sleeping quarters (see attached). I received no response to this letter.

On Wednesday, October 1, the Los Angeles City Council's Public Safety Committee is scheduled to hear this item and give approval for the LA-RICS project to proceed. I am asking that this matter be continued until we are 100% certain that these communication towers will not have a negative health impact on our Firefighters, Paramedics, and the surrounding residents who live and work near facilities where tower installations are planned.

On September 18, a letter from Mayor Garcetti was transmitted to the City Council stating that the LA-RICS Authority was granted a California Environmental Quality Act (CEQA) exemption for the 231 proposed broadband sites. Full environmental clearance to begin construction on LA City sites has not even been granted yet. By waiving traditional CEQA requirements, there is an immediate red flag concern regarding this project. The fact that LA-RICS has not yet received full environmental clearance in accordance with the National Environmental Protection Act (NEPA) gives us additional reason for concern.

It's my understanding that in 2009, the Board of the Los Angeles Unified School District voted to ban cell sites on school property and increased setbacks near cell sites located near schools due to safety concerns. It's hard to understand why we have concluded that cell towers pose a risk to our children and school employees, yet LA-RICS is trying to install these same towers right next to our fire stations where our members spend more than one-third of their lives.

While I can appreciate that there is a September 2015 deadline to access federal funds for the completion of the LA-RICS project, it is inexcusable that once again our Firefighters in the field



were the last ones to know about a massive \$150 million dollar project that could jeopardize their health and safety. In fact, we were notified of the planned installations after a Firefighter in the field called to inform us that a contractor was at his fire station taking measurements for the planned project - which will be less than 10 feet away from their fire station. Nobody talked to us and we have not heard from one single expert who has told us that this project will be safe.

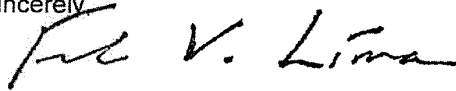
On behalf of more than 3,000 Firefighters, Paramedics, Dispatchers, Inspectors, and Pilots of the Los Angeles Fire Department who I am honored to represent, UFLAC will strongly oppose the use of Fire Stations as base locations for cell towers and/or antennas for the conduction of communication transmissions until a study with the highest scientific merit on health effects of exposure to low-intensity radiation is conducted and it is proven that such sites are not hazardous to the health of our members.

I am asking you to delay action on this item unless and until we can be given firm scientific evidence that proves the safety of the LA-RICS project.

I will also be sending separate communication to Chief Terrazas reiterating the position in our September 11th letter that the City must immediately cease and desist from the installation and construction of these facilities and demand that this installation be discussed as part of a meet and confer process with the United Firefighters of Los Angeles City.

Thank you for your careful consideration of this request.

Sincerely



Frank Lima
President

FL/mr
opeiu #537
afl-cio-clc

CC: Honorable Eric Garcetti, Mayor of Los Angeles
Honorable Members of the Los Angeles City Council
Chief Ralph Terrazas, Los Angeles Fire Department
Board of Fire Commissioners
Ana Guerrero, Chief of Staff to Mayor
Dave Gillotte, President, Los Angeles County Firefighters, Local 1014
Harold Schaitberger, President, International Association of Firefighters
James Ferguson, International Association of Firefighters
Lou Paulson, President, California Professional Firefighters
Marvin Kropke, President IBEW Local 11
Brian D'Arcy, President IBEW Local 18



UNITED FIREFIGHTERS of LOS ANGELES CITY

Local 112 IAFF AFL-CIO-CLC

2014 OCT - 8 AM 11:19
OFFICE OF THE
FIRE CHIEF

September 24, 2014

Ralph Terrazas, Fire Chief
Los Angeles City Fire Department
200 North Main Street
Los Angeles, California 90012

Chief Terrazas:

On September 11, 2014, we wrote to you expressing our health and safety concerns relating to the installation of cellular telephone transmission towers and radio antennas at many work locations of our bargaining unit members, including less than ten feet from our members' sleeping quarters. I have attached a copy of our September 11th letter for your convenience.

You have chosen to not respond in writing. Please understand that we fully intend to do everything within our power to protect the health and safety of our members and of the people living and working in the neighborhoods surrounding the planned installations.

We must therefore reiterate the demand in our September 11th letter that you immediately cease and desist from the installation and construction of these facilities and demand that you immediately meet and confer with this organization.

Sincerely,

Frank Lima
President

FL/mr
opeiu #537
afl-cio-clc



Login (<http://client.prod.iaff.org/Auth/Index?ReturnUrl=%02Fhs%02FFacts%02FCellTowerFinal.asp>) | Contact Us

Health, Safety & Medicine



INTERNATIONAL ASSOCIATION OF FIRE FIGHTERS DIVISION OF OCCUPATIONAL HEALTH, SAFETY AND MEDICINE

Position on the Health Effects from Radio Frequency/Microwave (RF/MW) Radiation in Fire Department Facilities from Base Stations for Antennas and Towers for the Conduction of Cell Phone Transmissions

The International Association of Fire Fighters' position on locating cell towers commercial wireless infrastructure on fire department facilities, as adopted by its membership in August 2004 ⁽¹⁾, is that the IAFF oppose the use of fire stations as base stations for towers and/or antennas for the conduction of cell phone transmissions until a study with the highest scientific merit and integrity on health effects of exposure to low-intensity RF/MW radiation is conducted and it is proven that such sitings are not hazardous to the health of our members.

Further, the IAFF is investigating funding for a U.S. and Canadian study that would characterize exposures from RF/MW radiation in fire houses with and without cellular antennae, and examine the health status of the fire fighters as a function of their assignment in exposed or unexposed fire houses. Specifically, there is concern for the effects of radio frequency radiation on the central nervous system (CNS) and the immune system, as well as other metabolic effects observed in preliminary studies.

It is the belief of some international governments and regulatory bodies and of the wireless telecommunications industry that no consistent increases in health risk exist from exposure to RF/MW radiation unless the intensity of the radiation is sufficient to heat body tissue. However, it is important to note that these positions are based on non-continuous exposures to the general public to low intensity RF/MW radiation emitted from wireless telecommunications base stations. Furthermore, most studies that are the basis of this position are at least five years old and generally look at the safety of the phone itself. IAFF members are concerned about the effects of living directly under these antenna base stations for a considerable stationary period of time and on a daily basis. There are established biological effects from exposure to low-level RF/MW radiation. Such biological effects are recognized as markers of adverse health effects when they arise from exposure to toxic chemicals for example. The IAFF's efforts will attempt to establish whether there is a correlation between such biological effects and a health risk to fire fighters and emergency medical personnel due to the siting of cell phone antennas and base stations at fire stations and facilities where they work.

Background

Critical questions concerning the health effects and safety of RF/MW radiation remain. Accordingly, should we allow exposure of our fire fighters and emergency medical personnel to this radiation to continue for the next twenty years when there is ongoing controversy over many aspects of RF/MW health effects? While no one disagrees that serious health hazards occur when living cells in the body are heated, as happens with high intensity RF/MW exposure (just like in a microwave oven), scientists are currently investigating the health hazards of low intensity RF/MW exposure. Low intensity RF/MW exposure is exposure which does not raise the temperature of the living cells in the body.

Additionally, a National Institute of Environmental Health Sciences panel designated power frequency electromagnetic fields (ELF/EMF) as "possible human carcinogens." ⁽²⁾ In March 2002 The International Association on Research on Cancer of the World Health Organization also assigned this designation to ELF/EMF in Volume 80 of its *IARC Monographs on the Evaluation of Carcinogenic Risks to Humans*. ⁽³⁾

Fixed antennas used for wireless telecommunications are referred to as cellular base stations, cell stations, PCS ("Personal Communications Service") stations or telephone transmission towers. These base stations consist of antennas and electronic equipment. Because the antennas need to be high in the air, they are often located on towers, poles, water tanks, or rooftops. Typical heights for freestanding base station towers are 50-200 feet.

Some base stations use antennas that look like poles, 10 to 15 feet in length, that are referred to as "omni-directional" antennas. These types of antennas are usually found in rural areas. In urban and suburban areas, wireless providers now more commonly use panel or sector antennas for their base stations. These antennas consist of rectangular panels, about 1 by 4 feet in dimension. The antennas are usually arranged in three groups of three antennas each. One antenna in each group is used to transmit signals to wireless phones, and the other two antennas in each group are used to receive signals from wireless phones.

At any base station site, the amount of RF/MW radiation produced depends on the number of radio channels (transmitters) per antenna and the power of each transmitter. Typically, 21 channels per antenna sector are available. For a typical cell site using sector antennas, each of the three transmitting antennas could be connected to up to 21 transmitters for a total of 63 transmitters. When omni-directional antennas are used, a cellular base station could theoretically use up to 96 transmitters. Base stations used for PCS communications generally require fewer transmitters than those used for cellular radio transmissions, since PCS carriers usually have a higher density of base station antenna sites.

The electromagnetic RF/MW radiation transmitted from base station antennas travel toward the horizon in relatively narrow paths. The individual pattern for a single array of sector antennas is wedge-shaped, like a piece of pie. Cellular and PCS base stations in the United States are required to comply with limits for exposure recommended by expert organizations and endorsed by government agencies responsible for health and safety. When cellular and PCS antennas are mounted on rooftops, RF/MW radiation levels on that roof or on others near by would be greater than those typically encountered on the ground.

The telecommunications industry claims cellular antennas are safe because the RF/MW radiation they produce is too weak to cause heating, i.e., a "thermal effect." They point to "safety standards" from groups such as ANSI/IEEE or ICNIRP to support their claims. But these groups have explicitly stated that their claims of "safe RF/MW radiation exposure is harmless" rest on the fact that it is too weak to produce a rise in body temperature, a "thermal effect."⁽⁴⁾

There is a large body of internationally accepted scientific evidence which points to the existence of non-thermal effects of RF/MW radiation. The issue at the present time is not whether such evidence exists, but rather what weight to give it.

Internationally acknowledged experts in the field of RF/MW radiation research have shown that RF/MW transmissions of the type used in digital cellular antennas and phones can have critical effects on cell cultures, animals, and people in laboratories and have also found epidemiological evidence (studies of communities, not in the laboratory) of serious health effects at "non-thermal levels," where the intensity of the RF/MW radiation was too low to cause heating. They have found:

- Increased cell growth of brain cancer cells ⁽⁵⁾
- A doubling of the rate of lymphoma in mice ⁽⁶⁾
- Changes in tumor growth in rats ⁽⁷⁾
- An increased number of tumors in rats ⁽⁸⁾
- Increased single- and double-strand breaks in DNA, our genetic material ⁽⁹⁾
- 2 to 4 times as many cancers in Polish soldiers exposed to RF ⁽¹⁰⁾

- More childhood leukemia in children exposed to RF ⁽¹¹⁾
- Changes in sleep patterns and REM type sleep ⁽¹²⁾
- Headaches caused by RF/MW radiation exposure ⁽¹³⁾
- Neurologic changes ⁽¹⁴⁾ including:
 - Changes in the blood-brain-barrier ⁽¹⁵⁾
 - Changes in cellular morphology (including cell death) ⁽¹⁶⁾
 - Changes in neural electrophysiology (EEG) ⁽¹⁷⁾
 - Changes in neurotransmitters (which affect motivation and pain perception) ⁽¹⁸⁾
 - Metabolic changes (of calcium ions, for instance) ⁽¹⁹⁾
 - Cytogenetic effects (which can affect cancer, Alzheimer's, neurodegenerative diseases) ⁽²⁰⁾
- Decreased memory, attention, and slower reaction time in school children ⁽²¹⁾
- Retarded learning in rats indicating a deficit in spatial "working memory" ⁽²²⁾
- Increased blood pressure in healthy men ⁽²³⁾
- Damage to eye cells when combined with commonly used glaucoma medications ⁽²⁴⁾

Many national and international organizations have recognized the need to define the true risk of low intensity, non-thermal RF/MW radiation exposure, calling for intensive scientific investigation to answer the open questions. These include:

- The World Health Organization, noting reports of "cancer, reduced fertility, memory loss, and adverse changes in the behavior and development of children." ⁽²⁵⁾
- The U. S. Food and Drug Administration (FDA) ⁽²⁶⁾
- The International Agency for Research on Cancer (IARC) ⁽²⁷⁾
- The Swedish Work Environmental Fund ⁽²⁸⁾
- The National Cancer Institute (NCI) ⁽²⁹⁾
- The European Commission (EC) ⁽³⁰⁾
- New Zealand's Ministry of Health ⁽³¹⁾
- National Health and Medical Research Council of Australia ⁽³²⁾
- Commonwealth Scientific Industrial Research Organization of Australia (CSIRO) ⁽³³⁾
- The Royal Society of Canada expert group report prepared for Health Canada ⁽³⁴⁾
- European Union's REFLEX Project (Risk Evaluation of Potential Environmental Hazards from Low Frequency Electromagnetic Field Exposure Using Sensitive *in vitro* Methods) ⁽³⁵⁾
- The Independent Group on Electromagnetic Fields of the Swedish Radiation Protection Board (SSI) ⁽³⁶⁾
- The United Kingdom's National Radiological Protection Board (NRPB) ⁽³⁷⁾
- The EMF-Team Finland's Helsinki Appeal 2005 ⁽³⁸⁾

Non-thermal effects are recognized by experts on RF/MW radiation and health to be potential health hazards. Safe levels of RF/MW exposure for these low intensity, non-thermal effects have not yet been established.

The FDA has explicitly rejected claims that cellular phones are "safe." ⁽³⁹⁾

The Environmental Protection Agency (EPA) has stated repeatedly that the current (ANSI/IEEE) RF/MW safety standards protect only against thermal effects. ⁽⁴⁰⁾

Many scientists and physicians question the safety of exposure to RF/MW radiation. The CSIRO study, for example, notes that there are no clear cutoff levels at which low intensity RF/MW exposure has no effect, and that the results of ongoing studies will take years to analyze. ⁽⁴¹⁾

Internationally, researchers and physicians have issued statements that biological effects from low-intensity RF/MW radiation exposure are scientifically established:

- The 1998 Vienna-EMF Resolution ⁽⁴²⁾
- The 2000 Salzburg Resolution on Mobile Telecommunication Base Stations ⁽⁴³⁾
- The 2002 Catania Resolution ⁽⁴⁴⁾
- The 2002 Freiburger Appeal ⁽⁴⁵⁾
- The 2004 Report of the European Union's REFLEX Project (Risk Evaluation of Potential Environmental Hazards from Low Frequency Electromagnetic Field Exposure Using Sensitive *in vitro* Methods) ⁽⁴⁶⁾
- The 2004 Second Annual Report from Sweden's Radiation Protection Board (SSI) Independent Expert Group on Electromagnetic Fields Recent Research on Mobile Telephony and Health Risks ⁽⁴⁷⁾
- Mobile Phones and Health 2004: Report by the Board of NRPB (The UK's National Radiological Protection Board) ⁽⁴⁸⁾

The county of Palm Beach, Florida, the City of Los Angeles, California, and the county of New Zealand have all prohibited cell phone base stations and antennas near schools due to safety concerns. The British Columbia Confederation of Parent Advisory Councils [BCCPAC] passed a resolution in 2003 banning cellular antennae from schools and school grounds. This organization is comparable to the Parent Teachers Association (PTA) in the United States. The resolution was directed to B.C. Ministry of Education, B.C. Ministry of Children and Family Development, B.C. School Trustees Association, and B.C. Association of Municipalities.

US Government Information

In the United States, the Federal Communications Commission (FCC) has used safety guidelines for RF/MW radiation environmental exposure since 1985.

The FCC guidelines for human exposure to RF/MW radiation are derived from the recommendations of two organizations, the National Council on Radiation Protection and Measurements (NCRP) and the Institute of Electrical and Electronics Engineers (IEEE). In both cases, the recommendations were developed by scientific and engineering experts drawn from industry, government, and academia after extensive reviews of the scientific literature related to the biological effects of RF/MW radiation.

Many countries in Europe and elsewhere use exposure guidelines developed by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). The ICNIRP safety limits are generally similar to those of the NCRP and IEEE, with a few exceptions. For example, ICNIRP recommends different exposure levels in the lower and upper frequency ranges and for localized exposure from certain products such as hand-held wireless telephones. Currently, the World Health Organization is working to provide a framework for international harmonization of RF/MW radiation safety standards.

In order to affirm conformity to standards regarding heating of tissue, measurements are time averaged over 0.1 hours [6 minutes]. This method eliminates any spikes in the readings. Computer power bars have surge protectors to prevent damage to computers. **Fire fighters and emergency medical personnel do not!**

The NCRP, IEEE, and ICNIRP all have identified a whole-body Specific Absorption Rate (SAR) value of 4 watts per kilogram (4 W/kg) as a threshold level of exposure at which harmful biological thermal effects due to tissue heating may occur. Exposure guidelines in terms of field strength, power density and localized SAR were then derived from this threshold value. In addition, the NCRP, IEEE, and ICNIRP guidelines vary depending on the frequency of the RF/MW radiation exposure. This is due to the finding that whole-body human absorption of RF/MW radiation varies with the frequency of the RF signal. The most restrictive limits on whole-body exposure are in the frequency range of 30-300 MHz where the human body absorbs RF/MW energy most efficiently. For products that only expose part of the body, such as wireless phones, exposure limits in terms of SAR only are specified.

Similarly, the exposure limits used by the FCC are expressed in terms of SAR, electric and magnetic field strength, and power density for transmitters operating at frequencies from 300 kHz to 100 GHz. The specific values can be found in two FCC bulletins, OET Bulletins 56 and 65.

OET Bulletin 56, "Questions and Answers about Biological Effects and Potential Hazards of Radiofrequency Electromagnetic Fields" was designed to provide factual information to the public by answering some of the most commonly asked questions. It includes the latest information on FCC guidelines for human exposure to RF/MW radiation. Further information and a downloadable version of Bulletin 56 can be found at: <http://www.fcc.gov/oet/info/documents/bulletins/#56> (<http://www.fcc.gov/oet/info/documents/bulletins/#56>)

OET Bulletin 65, "Evaluating Compliance With FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields" was prepared to provide assistance in determining whether proposed or existing transmitting facilities, operations or devices comply with limits for human exposure to RF/MW radiation adopted by the Federal Communications Commission (FCC). Further information and a downloadable version of Bulletin 65 can be found at: <http://www.fcc.gov/oet/info/documents/bulletins/#65> (<http://www.fcc.gov/oet/info/documents/bulletins/#65>)

The FCC authorizes and licenses products, transmitters, and facilities that generate RF and microwave radiation. It has jurisdiction over all transmitting services in the U.S. except those specifically operated by the Federal Government. Under the National Environmental Policy Act of 1969 (NEPA), the FCC has certain responsibilities to consider whether its actions will significantly affect the quality of the human environment. Therefore, FCC approval and licensing of transmitters and facilities must be evaluated for significant impact on the environment. Human exposure to RF radiation emitted by FCC-regulated transmitters is one of several factors that must be considered in such environmental evaluations. In 1996, the FCC revised its guidelines for RF/MW radiation exposure as a result of a multi-year proceeding and as required by the Telecommunications Act of 1996.

For further information and answers to questions about the safety of RF/MW radiation from transmitters and facilities regulated by the FCC go to <http://www.fcc.gov/oet/rfsafety/rf-faqs.html> (<http://www.fcc.gov/oet/rfsafety/rf-faqs.html>).

Canadian Government Information

Industry Canada is the organization that sets regulatory requirements for electromagnetic spectrum management and radio equipment in Canada. Industry Canada establishes standards for equipment certification and, as part of these standards, developed RSS-102, which specifies permissible radiofrequency RF/MW radiation levels. For this purpose, Industry Canada adopted the limits outlined in Health Canada's Safety-Code 6, which is a guideline document for limiting RF exposure. A downloadable version of "RSS-102 - Evaluation Procedure for Mobile and Portable Radio Transmitters with respect to Health Canada's Safety Code 6 for Exposure of Humans to Radio Frequency Fields", as well as additional information can be found at: [http://strategis.ic.gc.ca/epic/internet/insmt-gst.nsf/vwapj/rss102.pdf/\\$FILE/rss102.pdf](http://strategis.ic.gc.ca/epic/internet/insmt-gst.nsf/vwapj/rss102.pdf/$FILE/rss102.pdf) ([http://strategis.ic.gc.ca/epic/internet/insmt-gst.nsf/vwapj/rss102.pdf/\\$FILE/rss102.pdf](http://strategis.ic.gc.ca/epic/internet/insmt-gst.nsf/vwapj/rss102.pdf/$FILE/rss102.pdf))

Safety Code 6 specifies the requirements for the use of radiation emitting devices. This Code replaces the previous Safety Code 6 - EHD-TR-160. A downloadable version of "Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 3 kHz TO 300 GHz - Safety Code 6", as well as further detailed information can be found at <http://www.hc-sc.gc.ca/hecs-sesc/ccrpb/publication/99ehd237/toc.htm> (<http://www.hc-sc.gc.ca/hecs-sesc/ccrpb/publication/99ehd237/toc.htm>).

US and Canadian Legal Issues

Although some local and state governments have enacted rules and regulations about human exposure to RF/MW radiation in the past, the Telecommunications Act of 1996 requires the United States Federal Government to control human exposure to RF/MW radiation. In particular, Section 704 of the Act states that, "No State or local government or instrumentality thereof may regulate the placement, construction, and modification of personal wireless service facilities on the basis of the environmental effects of radio frequency emissions to the extent that such facilities comply with the Commission's regulations concerning such emissions." Further information on federal authority and FCC policy is available in a fact sheet from the FCC's Wireless Telecommunications Bureau at www.fcc.gov/wtb (<http://www.fcc.gov/wtb>).

In a recent opinion filed by Senior Circuit Judge Stephen F. Williams, No. 03-1336 *EMR Network v. Federal Communications Commission and United States of America*, the Court upheld the FCC's decision not to initiate an inquiry on the need to revise its regulations to address non-thermal effects of radiofrequency (RF) radiation from the facilities and products subject to FCC regulation as EMR Network had requested in its September 2001 Petition for Inquiry.

At the request of the EMR Network, the EMR Policy Institute provided legal and research support for this appeal. On January 13, 2005, a Petition for Rehearing *en banc* by the full panel of judges at the DC Circuit Court of Appeals was filed. Briefs, background documents and the DC Circuit decision are found at: http://www.emrpolicy.org/litigation/case_law/index.htm (http://www.emrpolicy.org/litigation/case_law/index.htm).

The Toronto Medical Officer of Health for the Toronto Board of Health recommended to Health Canada that public exposure limits for RF/MW radiation be made 100 times stricter; however the recommendation was not allowed, since, as in the US, only the Canadian federal government can regulate RF/MW radiation exposure level.

World Health Organization Efforts

In 1996, the World Health Organization (WHO) established the International EMF Project to review the scientific literature and work towards resolution of health concerns over the use of RF/MW technology. WHO maintains a Web site that provides addition information on this project and about RF/MW biological effects and research. For further information go to <http://www.who.int/peh-emf/en/> (<http://www.who.int/peh-emf/en/>).

Conclusion

For decades, the International Association of Fire Fighters has been directly involved in protecting and promoting the health and safety of our membership. However, we simply don't know at this time what the possible health consequences of long-term-exposure to low-intensity RF/MW radiation of the type used by the cell phone base stations and antennas will be. No one knows—the data just aren't there. The chairman of the International Commission on Non-Ionizing Radiation Protection (ICNIRP), one of the leading international organizations which formulated the current RF/MW radiation exposure guidelines, has stated that the guidelines include "no consideration regarding prudent avoidance" for health effects for which evidence is less than conclusive⁽⁴⁹⁾

Again, fire department facilities, where fire fighters and emergency response personnel live and work are not the proper place for a technology which could endanger their health and safety

The only reasonable and responsible course is to conduct a study of the highest scientific merit and integrity on the RF/MW radiation health effects to our membership and, in the interim, oppose the use of fire stations as base stations for towers and/or antennas for the conduction of cell phone transmissions until it is proven that such sitings are not hazardous to the health of our members.

Footnotes

[back] 1. Revised and Amended IAFF Resolution No. 15; August 2004

Study of Firefighters Exposed to Radio Frequency (RF) Radiation from Cell Towers/Masts

WHEREAS, fire stations across the United States and Canada are being sought by wireless companies as base stations for the antennas and towers for the conduction of cell phone transmissions; and

WHEREAS, many firefighters who are living with cell towers on or adjacent to their stations are paying a substantial price in terms of physical and mental health. As first responders and protectors of the general public, it is crucial that firefighters are functioning at optimal cognitive and physical capacity at all times; and

WHEREAS, the brain is the first organ to be affected by RF radiation and symptoms manifest in a multitude of neurological conditions including migraine headaches, extreme fatigue, disorientation, slowed reaction time, vertigo, vital memory loss and attention deficit amidst life threatening emergencies; and

WHEREAS, most of the firefighters who are experiencing symptoms can attribute the onset to the first week(s) these towers/antennas were activated; and

WHEREAS, RF radiation is emitted by these cellular antennas and RF radiation can penetrate every living cell, including plants, animals and humans; and

WHEREAS, both the U. S. and Canadian governments established regulatory limits for RF radiation based on thermal (heat) measurements with no regard for the adverse health effects from non-thermal radiation which is proven to harm the human brain and immune system; and

WHEREAS, the U. S. Environmental Protection Agency stated in a July 16, 2002, letter, "Federal health and safety agencies have not yet developed policies concerning possible risk from long-term, non-thermal exposures. The FCC's exposure guideline is considered protective of effects arising from a thermal mechanism (RF radiation from cell towers is non-thermal) but not from all possible mechanisms. Therefore, the generalization by many that the guidelines protecting human beings from harm by any or all mechanisms is not justified"; and

WHEREAS, an Expert Panel Report requested by the Royal Society of Canada prepared for Health Canada (1999) stated that, "Exposure to RF fields at intensities far less than levels required to produce measurable heating can cause effects in cells and tissues. These biological effects include alterations in the activity of the enzyme ornithine decarboxylase, in calcium regulation, and in the permeability of the blood-brain barrier. Some of these biological effects brought about by non-thermal exposure levels of RF

could potentially be associated with adverse health effects"; and

WHEREAS, based on concerns over growing scientific evidence of dangers from RF radiation, an international conference was convened in Salzburg, Austria, in the summer of 2000 where renowned scientists declared the upper-most RF radiation exposure limit from a tower-mast should be 1/10th of 1 microwatt (Note that 1/10th of 1 microwatt is 10,000 times lower than the uppermost limit allowed by the U. S. or Canada.); and it should be noted this limit was set because of study results showing brain wave changes at 1/10th of 1 microwatt; and

WHEREAS, in a recently cleared paper by Dr. Richard A. Albanese of the U. S. Air Force, a highly recognized physician in the area of the impact of radiation on the human body, Dr. Albanese states, "I would ask a good faith effort in achieving as low exposure rates as are possible within reasonable financial constraints. Also I would fund targeted studies using animal subjects and human groups living or working in high radiation settings or heavy cellular phone users, emphasizing disease causations. I urge acceptance of the ideal that there should be no unmonitored occupational or environmental exposures whose associated disease rates are unknown." (The opinions expressed herein are those of Dr. Albanese, and do not reflect the policies of the United States Air Force.); and

WHEREAS, recently a study, not affiliated with the wireless industry, was conducted of firefighters exposed to RF radiation from cell towers/antennas affixed to their stations.** The study revealed brain damage that can be differentiated from chemical causation (such as inhalation of toxic smoke) suggesting RF radiation as the cause of the brain damage found on SPECT scans; and

WHEREAS, firefighters are the protectors of people and property and should be protected under the Precautionary Principle of Science and therefore, unless radiation is proven safe and harmless, cellular antennas should not be placed on or near fire stations; therefore be it

RESOLVED, That the IAFF shall seek funding for an initial U. S. and Canadian study with the highest scientific merit and integrity, contrasting firefighters with residence in stations with towers to firefighters without similar exposure; and be it further

RESOLVED, That in accordance with the results of the study, the IAFF will establish protective policy measures with the health and safety of all firefighters as the paramount objective; and be it further

RESOLVED, That the IAFF oppose the use of fire stations as base stations for antennas and towers for the conduction of cell phone transmissions until such installations are proven not to be hazardous to the health of our members.

**Note: A pilot study was conducted in 2004 of six California fire fighters working and sleeping in stations with towers. The study, conducted by Gunnar Heuser, M.D., PhD, of Agoura Hills, CA, focused on neurological symptoms of six fire fighters who had been working for up to five years in stations with cell towers. Those symptoms included slowed reaction time, lack of focus, lack of impulse control, severe headaches, anesthesia-like sleep, sleep deprivation, depression, and tremors. Dr. Heuser used functional brain scans - SPECT scans - to assess any changes in the brains of the six fire fighters as compared to healthy brains of men of the same age. Computerized psychological testing known as TOVA was used to study reaction time, impulse control, and attention span. The SPECT scans revealed a pattern of abnormal change which was concentrated over a wider area than would normally be seen in brains of individuals exposed to toxic inhalation, as might be expected from fighting fires. Dr. Heuser concluded the only plausible explanation at this time would be RF radiation exposure. Additionally, the TOVA testing revealed among the six fire fighters delayed reaction time, lack of impulse control, and difficulty in maintaining mental focus.

[back] 2. An international blue ribbon panel assembled by the National Institute of Environmental Health Sciences (NIEHS) designated power frequency electromagnetic fields (EMF) as "possible human carcinogens" on June 24, 1998. The panel's decision was based largely on the results of epidemiological studies of children exposed at home and workers exposed on the job. The evaluation of the EMF literature followed procedures developed by the International Agency for Research on Cancer (IARC), based in Lyon, France. The working group's report will be the basis for the NIEHS report to Congress on the EMF Research and Public Information Dissemination program (EMF RAPID). The National Radiological Protection Board (NRPB) of the United Kingdom noted that the views of its Advisory Group on Non-ionizing Radiation are "consistent with those of the NIEHS expert panel."

June 26, 1998 statement of the National Radiological Protection Board, cited in Microwave News, July/August 1998

[back] 3. *World Health Organization; International Agency for Research on Cancer; IARC Monographs on the Evaluation of Carcinogenic Risks to Humans; Volume 80 Non-ionizing Radiation, Part 1: Static and Extremely Low-Frequency (ELF) Electric and Magnetic Fields; 2002; 429 pages; ISBN 92 832 1280 0; See <http://www-cie.iarc.fr/htdocs/monographs/vol80/80>. (<http://www-cie.iarc.fr/htdocs/monographs/vol80/80.html>)* This IARC Monograph provides the rationale for its designation of ELF/EMF as a possible human carcinogen. It states that:

A few studies on genetic effects have examined chromosomal aberrations and micronuclei in lymphocytes from workers exposed to ELF electric and magnetic fields. In these studies, confounding by genotoxic agents (tobacco, solvents) and comparability between the exposed and control groups are of concern. Thus, the studies reporting an increased frequency of chromosomal aberrations and micronuclei are difficult to interpret.

Many studies have been conducted to investigate the effects of ELF magnetic fields on various genetic end-points. Although increased DNA strand breaks have been reported in brain cells of exposed rodents, the results are inconclusive; most of the studies show no effects in mammalian cells exposed to magnetic fields alone at levels below 50 µT. However, extremely strong ELF magnetic fields have caused adverse genetic effects in some studies. In addition, several groups have reported that ELF magnetic fields enhance the effects of known DNA- and chromosome-damaging agents such as ionizing radiation.

The few animal studies on cancer-related non-genetic effects are inconclusive. Results on the effects on in-vitro cell proliferation and malignant transformation are inconsistent, but some studies suggest that ELF magnetic fields affect cell proliferation and modify cellular responses to other factors such as melatonin. An increase in apoptosis following exposure of various cell lines to ELF electric and magnetic fields has been reported in several studies with different exposure conditions. Numerous studies have investigated effects of ELF magnetic fields on cellular end-points associated with signal transduction, but the results are not consistent.

[back] 4. The International Commission on Non-ionizing Radiation Protection (ICNIRP) statement "Health Issues Related to the Use of Hand-Held Radiotelephones and Base Transmitters" of 1996 reads:

"Thermally mediated effects of RF fields have been studied in animals, including primates. These data suggest effects that will probably occur in humans subjected to whole body or localized heating sufficient to increase tissue temperatures by greater than 1C. They include the induction of opacities of the lens of the eye, possible effects on development and male fertility, various physiological and thermoregulatory responses to heat, and a decreased ability to perform mental tasks as body temperature increases. Similar effects have been reported in people subject to heat stress, for example while working in hot environments or by fever. The various effects are well established and form the biological basis for restricting occupational and public exposure to radiofrequency fields. In contrast, non-thermal effects are not well established and currently do not form a scientifically acceptable basis for restricting human exposure for frequencies used by hand-held radiotelephones and base stations."

International Commission on Non-ionizing Radiation Protection, "Health Issues Related to the Use of Hand-Held Radiotelephones and Base Transmitters," Health Physics 70:587-593, 1996

The ANSI/IEEE Standard for Safety Levels of 1992 similarly states:

"An extensive review of the literature revealed once again that the most sensitive measurements 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, IEEE Subcommittee IV focused on evidence of behavioral disruption under acute exposures, even disruption of a transient and fully reversible nature."

IEEE Standards Coordinating committee 28 on Non-ionizing Radiation Hazards: Standard for Safe Levels With Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 KHz to 300 GHz (ANSI/IEEE C95.1-1991), The Institute of Electrical and Electronics Engineers, New York, 1992.

[back] 5. Drs. Czerska, Casamento, Ning, and Davis (working for the Food and Drug Administration in 1997) using "a waveform identical to that used in digital cellular phones" at a power level within our current standards (SAR of 1.6 W/Kg, the maximum spatial peak exposure level recommended for the general population in the ANSI C95.1-1991 standard) found increases in cellular proliferation in human glioblastoma cells. This shows that "acceptable" levels of radiation can cause human cancer cells to multiply faster. The authors note that "because of reported associations between cellular phone exposure and the occurrence of a brain tumor, glioblastoma, a human glioblastoma cell line was used" in their research.

E.M. Czerska, J. Casamento, J. T. Ning, and C. Davis, "Effects of Radiofrequency Electromagnetic Radiation on Cell Proliferation," [Abstract presented on February 7, 1997 at the workshop 'Physical Characteristics and Possible Biological Effects of Microwaves Applied in Wireless Communication, Rockville, MD] E. M. Czerska, J. Casamento Centers for Devices and Radiological Health, Food and Drug Administration, Rockville, Maryland 20857, USA; H. T. Ning, Indian Health Service, Rockville, Maryland 20857, USA; C. Davis, Electrical Engineering Dept., Univ. of Maryland, College Park, Maryland 20742, USA

[back] 6. Dr. Michael Repacholi (in 1997, currently the director of the International Electromagnetic Fields Project at the World Health Organization) took one hundred transgenic mice and exposed some to radiation for two 30 minute periods a day for up to 18 months. He found that the exposed mice developed lymphomas (a type of cancer) at twice the rate of the unexposed mice. While telecommunications industry spokespersons criticized the experiment for using mice with a mutation which predisposed them to cancer (transgenic) the researchers pointed out that "some individuals inherit mutations in other genes...that predispose them to develop cancer, and these individuals may comprise a subpopulation at special risk from agents that would pose an otherwise insignificant risk of cancer."

Dr. Repacholi stated "I believe this is the first animal study showing a true non-thermal effect." He repeated the experiment in 1998 using 50 Hz fields instead of the 900 MHz pulsed radiation (the type used by cellular phones) used in the original experiment and found no cancer risk. He stated that this new data had implications for his original cellular phone study: "the control groups for both our RF and 50 Hz field studies showed no statistical differences, which lessens the possibility that the RF/MW radiation study result was a chance event or due to errors in methodology."

It is extremely important to note that Dr. Michael Repacholi was Chairman of the ICNIRP at the time its Statement on Health Issues Related to the Use of Hand-Held Radiotelephones and Base Transmitters was developed in 1996.

M. Repacholi et al., "Lymphomas in Eμ-Pim1 Transgenic Mice Exposed to Pulsed 900 MHz Electromagnetic Fields," *Radiation Research*, 147, pp.631-640, May 1997

[back] 7. Dr. Ross Adey (Veterans Administration Hospital at Loma Linda University in 1996) found what appeared to be a protective effect in rats exposed to the type of radiation used in digital cellular phones. The rats were exposed to an SAR of 0.58-0.75 W/Kg 836 MHz pulsed radiation of the TDMA type two hours a day, four days a week for 23 months, with the signals turned on and off every 7.5 minutes, so total exposure was 4 hours a week. Interestingly this effect was not present when a non-digital, analog signal was used. Rats exposed developed cancer less often. This study shows that low power fields of the digital cellular frequency can influence cancer development. Whether they would protect or promote in our children is a question for further study.

Ross Adey of the Veterans Administration Hospital at Loma Linda University, CA presented the results of pulsed (digital cellular) radiation on June 13, 1996 at the 18th Annual Meeting of the Bioelectromagnetics Society in Victoria, Canada. He presented the findings of the analog cellular phone radiation effect at the June 1997 2nd World Congress for Electricity and Magnetism in Biology and Medicine in Bologna, Italy. Reviews can be found in *Microwave News* issues July/August, 1996 and March/April 1997.

In recognition of his more than three decades of "fundamental contributions to the emerging science of the biological effects of electromagnetic fields," the authors of the November 2004 Report of the European Union's REFLEX Project (*Risk Evaluation of Potential Environmental Hazards From Low Frequency Electromagnetic Field Exposure Using Sensitive in vitro Methods*) chose to include Dr. Adey's personal views on Electromagnetic Field Exposure research as the Foreword to that report. To view the entire report, see: http://www.itis.ethz.ch/downloads/REFLEX_Final%20Report_171104.pdf

The following is taken from Dr. Adey's Foreword found on pages 1-3 of the REFLEX Report:

The Future of Fundamental Research in a Society Seeking Categorical Answers to Health Risks of New Technologies

In summary, we have become superstitious users of an ever-growing range of technologies, but we are now unable to escape the web that they have woven around us.

Media reporters in general are no better informed. Lacking either responsibility or accountability, they have created feeding frenzies from the tiniest snippets of information gleaned from scientific meetings or from their own inaccurate interpretation of published research. In consequence, the public has turned with pleading voices to government legislatures and bureaucracies for guidance . . .

We face the problem brought on by the blind leading the blind. Because of public pressure for rapid answers to very complex biological and physical issues, short-term research programs have been funded to answer specific questions about certain health risks.

In many countries, and particularly in the USA, the effects of such harassing and troublesome tactics on independent, careful fundamental research have been near tragic. Beguiled by health hazard research as the only source of funding, accomplished basic scientists have diverted from a completely new frontier in physical regulation of biological mechanisms at the atomic level. Not only have governments permitted corporate interests in the communications industry to fund this research, they have even permitted them to determine the research questions to be addressed and to select the institutions performing the research.

[back] 8. Dr. A. W. Guy reported an extensive investigation on rats chronically exposed from 2 up to 27 months of age to low-level pulsed microwaves at SARs up to 0.4 W/Kg. The exposed group was found to have a significantly higher incidence of primary cancers.

A. W. Guy, C. K. Chou, L. Kunz, L. Crowley, and J. Krupp, "Effects of Long-Term Low-Level Radiofrequency Radiation Exposure on Rats." Volume 9. Summary. Brooks Air Force Base, Texas, USAF School of Aerospace Medicine, USF-SAM-TR-85-11; 1985

[back] 9. Drs. Henry Lai and N. P. Singh of the University of Washington in Seattle have reported both single- and double-strand DNA breaks in the brains of rats exposed to radiofrequency electromagnetic radiation at an SAR of 1.2 W/Kg. DNA is the carrier of the genetic information in all living cells. Cumulated DNA strand breaks in brain cells can lead to cancer or neurodegenerative diseases.

H. Lai and N. P. Singh, "Single- and Double-Strand DNA Breaks in Rat Brain Cells After Acute Exposure to Radiofrequency Electromagnetic Radiation," *International Journal of Radiation Biology*, Vol 69, No. 4, 513-521, 1996

[back] 10. Dr. Stanislaw Szmigielski has studied many thousands of Polish soldiers. He has found that those exposed to radiofrequency and microwave radiation in the workplace had more than double the cancer rate of the unexposed servicemen analyzing data from 1971-1985. He has presented further data suggesting a dose-response relationship with soldiers exposed to 100-200 W/cm² suffering 1.69 times as many cancers as the unexposed, and those exposed to 600-1000 W/cm² suffering 4.63 times as many cancers. The level considered safe for the public according to FCC regulations is 1000 W/cm². Occupational exposure up to 5000 W/cm² is allowed.

S. Szmigielski, "Cancer Morbidity in Subjects Occupationally Exposed to High Frequency (Radiofrequency and Microwave) Electromagnetic Radiation," *The Science of the Total Environment* 180:9-17, 1996

[back] 11. Dr. Bruce Hocking found an association between increased childhood leukemia incidence and mortality in the proximity of television towers. The power density ranged from 0.2-8.0 W/cm² nearer and 0.02 W/cm² farther from the towers.

B. Hocking, I. R. Gordon, H. L. Grain, and G. E. Hatfield, "Cancer Incidence and Mortality and Proximity to TV Towers," *Medical Journal of Australia* 165: 601-605; 1996

[back] 12. Drs. Mann and Röschke investigated the influence of pulsed high-frequency RF/MW radiation of digital mobile radio telephones on sleep in healthy humans. They found a hypnotic effect with shortening of sleep onset latency and a REM (Rapid Eye Movement) suppressive effect with reduction of duration and percentage of REM sleep. "REM sleep plays a special physiological role for information processing in the brain, especially concerning consolidation of new experiences. Thus the effects observed possibly could be associated with alterations of memory and learning functions."

K. Mann and J. Röschke, "Effects of Pulsed High-Frequency Electromagnetic Fields on Human Sleep," *Neuropsychobiology* 33:41-47, 1996

[back] 13. Dr. Allen Frey has been researching RF/MW radiation for over 3 decades. Here is the abstract on a paper concerning headaches and cellular phone radiation. "There have been numerous recent reports of headaches occurring in association with the use of hand-held cellular telephones. Are these reported headaches real? Are they due to emissions from telephones? There is reason to believe that the answer is "yes" to both questions. There are several lines of evidence to support this conclusion. First, headaches as a consequence of exposure to low intensity microwaves were reported in the literature 30 years ago. These were observed during the course of microwave hearing research before there were cellular telephones. Second, the blood-brain barrier appears to be involved in headaches, and low intensity microwave energy exposure affects the barrier. Third, the dopamine-opiate systems of the brain appear to be involved in headaches, and low intensity electromagnetic energy exposure affects those systems. In all three lines of research, the microwave energy used was approximately the same—in frequencies, modulations, and incident energies—as those emitted by present day cellular telephones. Could the current reports of headaches be the canary in the coal mine, warning of biologically significant effects?"

A. H. Frey, "Headaches from Cellular Telephones: Are they Real and What Are the Implications?" *Environmental Health Perspectives* Volume 106, Number 3, pp.101-103, March 1998

[back] 14. Henry Lai's review of the literature concerning neurological effects of RF/MW radiation: Existing data indicate that RF/MW radiation of relatively low intensity can affect the nervous system. Changes in blood-brain barrier, morphology, electrophysiology, neurotransmitter functions, cellular metabolism, and calcium efflux, and genetic effects have been reported in the brain of animals after exposure to RF. These changes can lead to functional changes in the nervous system. Behavioral changes in animals after exposure to RR have been reported.

Even a temporary change in neural functions after RF/MW radiation exposure could lead to adverse consequences. For example, a transient loss of memory function or concentration could result in an accident when a person is driving. Loss of short term working memory has indeed been observed in rats after acute exposure to RF/MW radiation.

Research has also shown that the effects of RF/MW radiation on the nervous system can cumulate with repeated exposure. The important question is, after repeated exposure, will the nervous system adapt to the perturbation and when will homeostasis break down? Related to this is that various lines of evidence suggest that responses of the central nervous system to RF/MW radiation could be a stress response. Stress effects are well known to cumulate over time and involve first adaptation and then an eventual break down of homeostatic processes.

H. Lai, "Neurological Effects of Radiofrequency Electromagnetic Radiation Relating to Wireless Communication Technology," Paper presentation at the IBC-UK Conference: "Mobile Phones-Is There a Health Risk?" September 16-17, 1997, Brussels, Belgium

[back] 15. Blood-Brain-Barrier: The blood-brain-barrier (BBB) is primarily a continuous layer of cells lining the blood vessels of the brain. It is critical for regulation of the brain's activity. Lai notes that "Even though most studies indicate that changes in the BBB occurs only after exposure to RF/MW radiation of high intensities with significant increase in tissue temperature, several studies have reported increases in permeability after exposure to RF/MW radiation of relatively low intensities...Pulsed RF seems to be more potent than continuous wave RF." Pulsed RF/MW is the type used in digital cellular systems. Effects on the BBB were noted at the 0.2 W/cm² level, and even at SAR of 0.016-5 W/kg. These effects could lead to local changes in brain function.

H. Lai, Ibid

[back] 16. Cellular Morphology: RF/MW radiation induced morphological changes of the central nervous system cells and tissues have been shown to occur under relatively high intensity or prolonged exposure to the RF/MW radiation. However, there are several studies which show that repeated exposure at relatively low power intensities caused morphological changes in the central nervous system. Again here pulsed (as in digital phone use) RF/MW radiation produced more pronounced effects. Certain drugs given to nonhuman primates sensitized them, for instance allowing eye damage to occur at very low power intensities. Dr Lai notes "Changes in morphology, especially cell death, could have an important implication on health. Injury-induced cell proliferation has been hypothesized as a cause of cancer." Some of these experiments were in the range of SAR 0.53 W/kg or even 0.26 W/kg.

H. Lai, Ibid

[back] 17. Neural Electrophysiology: Changes in neuronal electrophysiology, evoked potentials, and EEG have been reported. Some effects were observed at low intensities and after repeated exposure, suggesting cumulative effect. Energy density levels were as low as 50 W/cm².

H. Lai, Ibid

[back] 18. Neurotransmitters: Neurotransmitters are molecules which transmit information from one nerve cell to another. Early studies have reported changes in various neurotransmitters (catecholamines, serotonin, and acetylcholine) in the brain of animals only after exposure to high intensities of RF/MW radiation. However, there are more recent studies that show changes in neurotransmitter functions after exposure to low intensities of RF radiation. For example, effects were seen at 50 μ W/cm² in one experiment. U.S. and Canadian RF/MW radiation safety policies allow exposures of 1000 μ W/cm² at that frequency.

RF/MW radiation activates endogenous opioids in the brain. Endogenous opioids are neurotransmitters with morphine-like properties and are involved in many important physiological and behavioral functions, such as pain perception and motivation.

The response to RF/MW radiation depends on the area of the brain studied and on the duration of exposure. Exposure to RF/MW radiation has been shown to affect the behavioral actions of benzodiazepines (these are drugs such as Valium).

H. Lai, Ibid

[back] 19. Metabolic Changes in Neural Tissue: Several studies investigated the effects of RF/MW radiation exposure on energy metabolism in the rat brain. Surprisingly, changes were reported after exposure to relatively low intensity RF/MW radiation for a short duration of time (minutes). The effects depended on the frequency and modulation characteristics of the RF/MW radiation and did not seem to be related to temperature changes in the tissue.

Calcium ions play important roles in the functions of the nervous system, such as the release of neurotransmitters and the actions of some neurotransmitter receptors. Thus changes in calcium ion concentration could lead to alterations in neural functions. This is an area of considerable controversy because some researchers have also reported no significant effects of RF/MW radiation exposure on calcium efflux. However, when positive effects were observed, they occurred after exposure to RF/MW radiation of relatively low intensities and were dependent on the modulation and intensity of the RF/MW radiation studied (window effects). Some studies had SARs as low as 0.05-0.005 W/Kg.

H. Lai, Ibid

[back] 20. Cytogenetic effects have been reported in various types of cells after exposure to RF/MW radiation. Recently, several studies have reported cytogenetic changes in brain cells by RF/MW radiation, and these results could have important implication for the health effects of RF/MW radiation. Genetic damage to glial cells can result in carcinogenesis. However, since neurons do not undergo mitosis, a more likely consequence of neuronal genetic damage is changes in functions and cell death, which could either lead to or accelerate the development of neurodegenerative diseases. Power densities of 1 mW/cm² were employed, a level considered safe for the public by the FCC.

RF/MW radiation-induced increases in single and double strand DNA breaks in rats can be blocked by treating the rats with melatonin or the spin-trap compound N-t-butyl-phenylnitrene. Since both compounds are potent free radical scavengers, these data suggest that free radicals may play a role in the genetic effect of RF. If free radicals are involved in the RF-induced DNA strand breaks in brain cells, results from this study could have an important implication on the health effects of RF exposure. Involvement of free radicals in human diseases, such as cancer and atherosclerosis, has been suggested. Free radicals also play an important role in the aging process, which has been ascribed to be a consequence of accumulated oxidative damage to body tissues, and involvement of free radicals in neurodegenerative diseases, such as Alzheimer's, Huntington, and Parkinson, has also been suggested. One can also speculate that some individuals may be more susceptible to the effects of RF/MW radiation exposure.

H. Lai, Ibid

[back] 21. Dr. A. A. Kolodynski and V. V. Kolodynska of the Institute of Biology, Latvian Academy of Sciences, presented the results of experiments on school children living in the area of the Skrunda Radio Location Station in Latvia. Motor function, memory, and attention significantly differed between the exposed and control groups. The children living in front of the station had less developed memory and attention and their reaction time was slower.

A. A. Kolodynski, V. V. Kolodynska, "Motor and Psychological Functions of School Children Living in the Area of the Skrunda Radio Location Station in Latvia," The Science of the Total Environment 180:87-93, 1996

[back] 22. Dr. H. Lai and colleagues in 1993 exposed rats to 45 minutes of pulsed high frequency RF/MW radiation at low intensity and found that the rats showed retarded learning, indicating a deficit in spatial "working memory" function.

H. Lai, A. Horita, and A. W. Guy, "Microwave Irradiation Affects Radial-Arm Maze Performance in the Rat," Bioelectromagnetics 15:95-104, 1994

NOTE: Dr. Lai's January 2005 compilation of published RF/MW radiation studies demonstrating biological effects of exposure to low-intensity RF/MW radiation is included as a Reference section at the end of this report.

[back] 23. Dr. Stefan Braune reported a 5-10 mm Hg resting blood pressure rise during exposure to RF/MW radiation of the sort used by cellular phones in Europe. The Lancet, the British medical journal where the report appeared, stated that "Such an increase could have adverse effects on people with high blood pressure."

S. Braune, "Resting Blood Pressure Increase During Exposure to a Radio-Frequency Electromagnetic Field," The Lancet 351, pp. 1,857-1,858, 1998

[back] 24. Dr. Kues and colleagues (of Johns Hopkins University and the Food and Drug Administration) found that placing timolol and pilocarpine into the eyes of monkeys and then exposing them to low power density pulsed RF/MW radiation caused a significant reduction in the power-density threshold for causing damage to the cells covering the eye and the iris. In fact the power was reduced by a factor of 10, so that it entered the "acceptable, safe" level of the FCC, 1 mW/cm²! Timolol and pilocarpine are commonly used by people suffering from glaucoma. This is a very important study, as it points to the fact that laboratory experiments under "ideal" conditions are rarely what one finds in real life. The "safe" level of RF/MW radiation exposure for healthy people is likely to be very different than for those of us who suffer from illness, take medications, or are perhaps simply younger or older than those in the experiments.

H. A. Kues, J. C. Monahan, S. A. D'Anna, D. S. McLeod, G. A. Luty, and S. Koslov, "Increased Sensitivity of the Non-Human Primate Eye to Microwave Radiation Following Ophthalmic Drug Pretreatment," *Bioelectromagnetics* 13:379-393, 1992

[back] 25. The World Health Organization states that "concerns have been raised about the safety of cellular mobile telephones, electric power lines and police speed-control 'radar guns.' Scientific reports have suggested that exposure to electromagnetic fields emitted from these devices could have adverse health effects, such as cancer, reduced fertility, memory loss, and adverse changes in the behaviour and development of children." Therefore, "In May 1996, in response to growing public health concerns in many Member States over possible health effects from exposure to an ever-increasing number and diversity of EMF sources, the World Health Organization launched an international project to assess health and environmental effects of exposure to electric and magnetic fields, which became known as the International EMF Project. The International EMF Project will last for five years." "A number of studies at [frequencies above about 1 MHz] suggest that exposure to RF fields too weak to cause heating may have adverse health consequences, including cancer and memory loss. Identifying and encouraging coordinated research into these open questions is one of the major objectives of the International EMF Project."

World Health Organization Fact Sheet N181, "Electromagnetic Fields and Public Health, The International EMF Project," reviewed May 1998 and World Health Organization Fact Sheet N182, "Electromagnetic Fields and Public Health, Physical Properties and Effects on Biological Systems," reviewed May 1998,

[back] 26. The U. S. Food and Drug Administration in a January 14, 1998 letter to the House Telecommunications Subcommittee stated it "believes additional research in the area of RF is needed." In 1997 the FDA established the following priorities:

- Chronic (lifetime) animal exposures should be given the highest priority.
- Chronic animal exposures should be performed both with and without the application of chemical initiating agents to investigate tumor promotion in addition to tumorigenesis.
- Identification of potential risks should include end points other than brain cancer (e.g. ocular effects of RF radiation exposure).
- Replication of prior studies demonstrating positive biological effects work is needed. A careful replication of the Chou and Guy study (*Bioelectromagnetics*, 13, pp.469-496, 1992) which suggests that chronic exposure of rats to microwaves is associated with an increase in tumors, would contribute a great deal to the risk identification process for wireless communication products.
- Genetic toxicology studies should focus on single cell gel studies of DNA strand breakage and on induction of micronuclei.
- Epidemiology studies focused on approaches optimized for hazard identification are warranted.

Food and Drug Administration Recommendations quoted in *Microwave News*, March/April, 1997

[back] 27. The International Agency for Research on Cancer (IARC) is planning a multi-country, multi-million dollar study of cancer among users of wireless phones, beginning 1998. *Microwave News*, January/February, 1998

[back] 28. The Swedish Work Environmental Fund initiated a new epidemiological study on cellular phone radiation and brain tumors in 1997. *Microwave News*, November/December, 1997

[back] 29. The National Cancer Institute announced plans for a 5 year study of brain tumors and RF/MW radiation in 1993. *Microwave News*, January/February, 1993

[back] 30. The European Commission (EC) Expert Group on health effects of wireless phones called for a 5 year research program with a \$20 million budget, reported 1997. *Microwave News*, January/February, 1997

[back] 31. A report commissioned by New Zealand's Ministry of Health stated that "It is imperative that the scientific issues be clarified as soon as possible, as there is much at stake." It called for more research to examine the potential health effects of RF radiation. *Microwave News*, November/December, 1996

[back] 32. The National Health and Medical Research Council of Australia announced its sponsorship of a 5 year, \$3.5 million project on potential health effects of mobile phone technology in 1996. *Microwave News*, November/December, 1996

[back] 33. The Commonwealth Scientific Industrial Research Organization (CSIRO) of Australia concluded in 1995 that the safety of cellular telephones cannot be resolved "in the near future." Dr. Stan Barnett, a principal researcher of CSIRO, states that "My goal is to establish a national committee to approach this problem by coordinating relevant and focused research." He estimated a budget of \$3 million over a 3 year period would be necessary.

Commonwealth Scientific Industrial Research Organization, "Status of Research on Biological Effects and Safety of Electromagnetic Radiation: Telecommunications Frequencies," a report prepared by Dr. Stan Barnett, as cited in *Microwave News*, September/October, 1995

[back] 34. In Canada, Expert Panels are formed in response to requests from governments and other organizations for guidance on public policy issues where specialized knowledge is required. The Royal Society of Canada (RSC) is the only national academic organization, encompassing all fields of study in the sciences, arts and humanities that provides, through its Committee on Expert Panels, a service to Canadians by convening Expert Panels that produce publicly disseminated, arms-length, third party reviews. The most recent Expert Panel report addressing RF/MW radiation examines new data on dosimetry and exposure assessment, thermoregulation, biological effects such as enzyme induction, and toxicological effects, including genotoxicity, carcinogenicity, and testicular and reproductive outcomes. Epidemiological studies of mobile phone users and occupationally exposed populations are examined, along with human and animal studies of neurological and behavioural effects. All of the authoritative reviews completed within the last two years have supported the need for further research to clarify the possible associations between RF fields and adverse health outcomes that have appeared in some reports. See: http://www.rsc.ca/index.php?lang_id=1&page_id=120 (http://www.rsc.ca/index.php?lang_id=1&page_id=120).

Recent Advances in Research on Radiofrequency Fields and Health: 2001-2003; A Follow-up to The Royal Society of Canada, Report on the Potential Health Risks of Radiofrequency Fields from Wireless Telecommunication Devices, 1999

[back] 35. The European Union effort to address this issue is in the study *Risk Evaluation of Potential Environmental Hazards from Low Energy Electromagnetic Field Exposure Using Sensitive in vitro Methods* (REFLEX). Exposure to electromagnetic fields (EMF) in relation to health is a controversial topic throughout the industrial world. So far epidemiological and animal studies have generated conflicting data and thus uncertainty regarding possible adverse health effects. This situation has triggered controversies in communities especially in Europe with its high density of population and industry and the omnipresence of EMF in infrastructures and consumer products. These controversies are affecting the siting of facilities, leading people to relocate, schools to close or power lines to be re-sited, all at great expense. The European Union believes that causality between EMF exposure and disease can never be regarded as proven without knowledge and understanding of the basic mechanisms possibly triggered by EMF. To search for those basic mechanisms powerful technologies developed in toxicology and molecular biology were to be employed in the REFLEX project to investigate cellular and sub-cellular responses of living cells exposed to EMF in vitro.

The REFLEX data have made a substantial addition to the data base relating to genotoxic and phenotypic effects of both ELF-EMF and RF-EMF on *in vitro* cellular systems. While the data neither precludes nor confirms a health risk due to EMF exposure nor was the project designed for this purpose, the value lies in providing new data that will enable mechanisms of EMF effects to be studied more effectively than in the past. Furthermore, the REFLEX data provide new information that will be used for risk evaluation by WHO, IARC and ICNIRP. For further information on REFLEX see: http://europa.eu.int/comm/research/quality-of-life/ka4/ka4_electromagnetic_en.html (http://europa.eu.int/comm/research/quality-of-life/ka4/ka4_electromagnetic_en.html)

[back] 36. The Swedish Radiation Protection Institute (SSI) endeavors to ensure that human beings and the environment are protected from the harmful effects of radiation, both in the present and in the future. SSI has focused on epidemiological research on cancer and exposure from mobile phones and transmitters as well as experimental cancer research. In addition three selected topics were also discussed, namely blood-brain barrier, heat shock proteins, and precautionary framework. For further information on SSI see: http://www.ssi.se/forfattning/eng_forfattlista.html (http://www.ssi.se/forfattning/eng_forfattlista.html)

[back] 37. In the United Kingdom, the National Radiological Protection Board (NRPB) was created by the Radiological Protection Act 1970. The statutory functions of NRPB are to advance the acquisition of knowledge about the protection of mankind from radiation hazards through research and to provide information and advice to persons (including Government Departments) with responsibilities in the United Kingdom in relation to the protection from radiation hazards either of the community as a whole or of particular sections of the community. The NRPB believes that there is a need for better occupational studies rather than simply for more. In particular, the studies need to be of occupational groups for whom measurements show that there is genuinely a substantially raised exposure to RF fields. If the studies are to be more informative than those so far, a key requirement will be for improved exposure measurement (or improved estimation of exposure) for individuals, or at least for occupational groups. It would be desirable, as far as practical, that the studies should measure the intensity and timing of RF field exposures, and also that they should include some assessment of major RF field exposures from sources other than the current occupation. Ideally, exposure assessment needs to be anatomical site (organ)-specific, because some sources result in greatly differing doses to different parts of the body. It is a difficulty in these prescriptions, of course, that the appropriate exposure metric is unknown. For further information on NRPB see: <http://www.nrpb.org/index.htm> (<http://www.nrpb.org/index.htm>)

[back] 38. On January 5, 2005, the EMF-Team Finland issued the Helsinki Appeal 2005 to members of the European Parliament. In it physicians and researchers call on the European Parliament to apply the Precautionary Principle to electromagnetic fields, especially in the radio- and microwave- frequency bands. They criticize the present RF/MW radiation safety standards that do not recognize the biological effects caused by non-thermal exposures to non-ionizing radiation [i.e., RF/MW radiation.] They also call for continued refunding of the REFLEX EMF research program. The text of the Helsinki Appeal 2005 is found at: <http://www.emrpolicy.org/news/headlines/index.htm> (<http://www.emrpolicy.org/news/headlines/index.htm>)

[back] 39. On July 19, 1993 Dr. Elizabeth Jacobson, Deputy Director for Science, Center for Devices and Radiological Health, Food and Drug Administration criticized Thomas Wheeler, President of the Cellular Telecommunications Industry Association:

"I am writing to let you know that we were concerned about two important aspects of your press conference of July 16 concerning the safety of cellular phones, and to ask that you carefully consider the following comments when you make future statements to the press. First, both the written press statements and your verbal comments during the conference seemed to display an unwarranted confidence that these products will be found absolutely safe. In fact, the unremittingly upbeat tone of the press packet strongly implies that there can be no hazard, leading the reader to wonder why any further research would be needed at all....More specifically, your press packet selectively quotes from our Talk Paper of February 4 in order to imply that FDA believes that cellular phones are "safe." ("There is no proof at this point that cellular phones are harmful.") In fact, the same Talk Paper also states, "There is not enough evidence to know for sure, either way." Our position, as we have stated it before, is this: Although there is no direct evidence linking cellular phones with harmful effects in humans, a few animal studies suggest that such effects could exist. It is simply too soon to assume that cellular phones are perfectly safe, or that they are hazardous—either assumption would be premature. This is precisely why more research is needed."

Full text of letter can be found in *Microwave News*, July/August, 1993

[back] 40. In 1993 the Director of the Office of Radiation and Indoor Air of the Environmental Protection Agency suggested that the FCC not adopt the 1992 ANSI/IEEE standard "due to serious flaws," among them (1) "the ANSI/IEEE conclusion that there is no scientific data indicating that certain subgroups of the population are more at risk than others is not supported by NCRP and EPA reports" and (2) "the thesis that ANSI/IEEE recommendations are protective of all mechanisms of interaction is unwarranted because the adverse effects level in the 1992 ANSI/IEEE standard are based on a thermal effect."

Letter from Margo T. Oge, Director, Office of Radiation and Indoor Air to Thomas Stanley, Chief Engineer, Office of engineering and Technology, FCC, dated Nov 9, 1993

[back] 41. A brief sampling of the CSIRO report:

Problems in studies of human populations published to date include imprecise estimates of exposure. As a result, such epidemiological studies may underestimate any real risk. The likelihood of epidemiological studies providing useful information is questionable, particularly if the biological end point cannot be predicted. Its value in the short term (less than 10 years) must be negligible unless there was an enormous increase in the rate of cancer growth. Interestingly, the incidence of brain tumors in the EC countries has increased substantially in recent years.

RF safety cannot be assessed in the absence of reported serious effects when so little research has been aimed at the problem. It is somewhat surprising, and rather disappointing, to find that although the literature contains many hundreds of publications, there are very few areas of consensus....At low levels the absence of clear thresholds and [the] presence of intensity and frequency windows have created questions rather than provided answers.

There is no doubt that the interpretation of bioeffects data has been clouded by a preoccupation with thermally mediated processes. In fact, development of the ANSI/IEEE standard is based only on well-established thermal effects, and ignores the more subtle non-thermal processes that are more difficult to interpret and apply to human health.

Commonwealth Scientific Industrial Research Organization, "Status of Research on Biological Effects and Safety of Electromagnetic Radiation: Telecommunications Frequencies," a report prepared by Dr. Stan Barnett, as cited in Microwave News, September/October, 1995

[back] 42. Statement from the October 25-28, 1998 "Symposium of Mobile Phones and Health - Workshop on Possible Biological and Health Effects of RF Electromagnetic Fields" held at the University of Vienna, Austria.

The preferred terminology to be used in public communication: Instead of using the terms "athermal", "non-thermal" or "microthermal" effects, the term "low intensity biological effects" is more appropriate.

Preamble: 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 assessment.

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 developments of low-intensity emission devices.

[back] 43. Statement from the June 7-8, 2000 International Conference on Cell Tower Siting Linking Science and Public Health, Salzburg, Austria. The full report can be found at: www.land-sbg.gv.at/celltower (<http://www.land-sbg.gv.at/celltower>)

- It is recommended that development rights for the erection and for operation of a base station should be subject to a permission procedure. The protocol should include the following aspects:
 - Information ahead and active involvement of the local public
 - Inspection of alternative locations for the siting
 - Protection of health and wellbeing
 - Considerations on conservation of land- and townscape
 - Computation and measurement of exposure
 - Considerations on existing sources of HF-EMF exposure
 - Inspection and monitoring after installation
- It is recommended that a national database be set up on a governmental level giving details of all base stations and their emissions.
- It is recommended for existing and new base stations to exploit all technical possibilities to ensure exposure is as low as achievable (ALATA-principle) and that new base stations are planned to guarantee that the exposure at places where people spend longer periods of time is as low as possible, but within the strict public health guidelines.
- Presently the assessment of biological effects of exposures from base stations in the low-dose range is difficult but indispensable for protection of public health. There is at present evidence of no threshold for adverse health effects.
 - Recommendations of specific exposure limits are prone to considerable uncertainties and should be considered preliminary. For the total of all high frequency irradiation a limit value of 100 mW/m² (10 µW/cm²) is recommended.
 - For preventive public health protection a preliminary guideline level for the sum total of exposures from all ELF pulse modulated high-frequency facilities such as GSM base stations of 1 mW/m² (0.1 µW/cm²) is recommended.

[back] 44. Scientists attending the September 13-14, 2002 International Conference "State of the Research on Electromagnetic Fields – Scientific and Legal Issues," organized by ISPESL (National Institute for Prevention and Work Safety, Italy), the University of Vienna, and the City of Catania, held in Catania, Italy, agreed to the following:

- Epidemiological and *in vivo* and *in vitro* experimental evidence demonstrates the existence for electromagnetic field (EMF) induced effects, some of which can be adverse to health.
- We take exception to arguments suggesting that weak (low intensity) EMF cannot interact with tissue.
- There are plausible mechanistic explanations for EMF-induced effects which occur below present ICNIRP and IEEE guidelines and exposure recommendations by the EU.
- 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.
- 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.

[back] 45. The Freiburger Appeal is a German based appeal by mainly medical practitioners who are concerned about the effects, they believe, from mobile phone technology including masts that are appearing in their patients. It started in Oct 2002 and with very little international publicity has got 50,000 signatories with at least 2000 medical signatures from across the world. Mast These physicians and scientists agreed to establish an international scientific commission to promote research for the protection of public health from EMF and to develop the scientific basis and strategies for assessment, prevention, management and communication of risk, based on the precautionary principle.

Excerpt:

On the basis of our daily experiences, we hold the current mobile communications technology (introduced in 1992 and since then globally extensive) and cordless digital telephones (DECT standard) to be among the fundamental triggers for this fatal development. One can no longer evade these pulsed microwaves. They heighten the risk of already-present chemical/physical influences, stress the body-immune system, and can bring the body-still-functioning regulatory mechanisms to a halt. Pregnant women, children, adolescents, elderly and sick people are especially at risk.

Statement of the physicians and researchers of Interdisziplinäre Gesellschaft für Umweltmedizin e. V. (Interdisciplinary Association for Environmental Medicine) IGUMED, Sackingen, Germany, September 19, 2002. The Freiburger Appeal can be found at: <http://www.mastsanity.org/doctors-appeals.html>

[back] 46. Report of the European Union's REFLEX Project (Risk Evaluation of Potential Environmental Hazards from Low Frequency Electromagnetic Field Exposure Using Sensitive *in vitro* Methods), November 2004. The Project studied ELF and RF exposures to various animal cell types. The report is found at: http://www.itis.ethz.ch/downloads/REFLEX_Final%20Report_171104.pdf (http://www.itis.ethz.ch/downloads/REFLEX_Final%20Report_171104.pdf)

From the Summary: *[t]he omnipresence of EMF's in infrastructures and consumer products have become a topic of public concern. This is due to the fear of people that based on the many conflicting research data a risk to their health cannot be excluded with some certainty. Therefore, the overall objective of REFLEX was to find out whether or not the fundamental biological processes at the cellular and molecular level support such an assumption. For this purpose, possible effects of EMF's on cellular events controlling key functions, including those involved in carcinogenesis and in the pathogenesis of neurodegenerative disorders, were studied through focused research. Failure to observe the occurrence of such key critical events in living cells after EMF exposure would have suggested that further research efforts in this field could be suspended and financial resources be reallocated to the investigation of more important issues. But as clearly demonstrated, the results of the REFLEX project show the way into the opposite direction.*

[back] 47. From the Discussion section of the December 20, 2004 Second Annual Report of Sweden's Radiation Protection Board (SSI) entitled: *Recent Research on Mobile Telephony and Health Risks: Second Annual Report from SSI's Independent Expert Group on Electromagnetic Fields*. The complete report is available at: http://www.ssi.se/english/EMF_exp_Eng_2004.pdf (http://www.ssi.se/english/EMF_exp_Eng_2004.pdf)

To date, little is known about the levels of radiofrequency radiation exposure in the general population from sources such as mobile phones being used by oneself or other people, mobile phone base stations, and radio and television transmitters. Measurements that have been performed have usually been made as a result of public concern about base station exposures or other specific sources, and have therefore been made at locations that could be assumed to have higher fields than would be the case if measurement locations were selected randomly. Furthermore, all measurements have been stationary, and there is today no knowledge about the level of exposure that an individual will have throughout the day.

There is need for information about the personal exposure to RF fields in the general population, to enhance the understanding of the relative importance of exposure from base stations close to the home, from radio and television transmitters, and from the use of mobile phones . . . Studies with personal RF exposure measurements of randomly selected samples of the general population are strongly encouraged.

[back] 48. Released January 11, 2005, Mobile Phones and Health 2004: Report by the Board of NRPB Documents of the NRPB: Volume 15, No. 5. See: http://www.nrpb.org/publications/documents_of_nrpb/abstracts/absd15-5.htm (http://www.nrpb.org/publications/documents_of_nrpb/abstracts/absd15-5.htm)

From the Executive Summary:

The Board notes that a central recommendation in the Stewart Report was 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.

The Board considers that it is important to understand the signal characteristics and field strengths arising from new telecommunications systems and related technologies, to assess the RF exposure of people, and to understand the potential biological effects on the human body.

[back] 49. The ICNIRP exposure guidelines are only designed to protect against "known adverse health impacts," according to Dr. Jürgen Bernhardt, ICNIRP's chairman. Bernhardt reviewed the updated limits, which cover the spectrum from 1 Hz to 300 GHz, in a presentation at the *20th Annual Meeting of the Bioelectromagnetics Society* in St. Pete Beach, FL, on June 10. The limits protect against "short-term, immediate health effects" such as nerve stimulation, contact shocks and thermal insults, according to the guidelines, which appear in the April issue of *Health Physics* (74, pp.494-522, 1998). Despite "suggestive" evidence that power frequency magnetic fields can be carcinogenic, ICNIRP has concluded that this and other non-thermal health effects have not been "established." ICNIRP has long followed this approach to standard-setting. In his talk, Bernhardt noted that the guidelines include "no consideration regarding prudent avoidance" for health effects for which evidence is less than conclusive.

Microwave News, July/August 1998

Additional References and Studies

The following references reporting biological effects of radiofrequency radiation (RFR) at low intensities through January 2005 were compiled on 12/27/04 by Henry C. Lai PhD, Research Professor of Bioengineering, University of Washington, Seattle, WA

Balode *Sci Total Environ* 180(1):81-85, 1996 - blood cells from cows from a farm close and in front of a radar installation showed significantly higher level of severe genetic damage.

Boscol et al. *Sci Total Environ* 273(1-3):1-10, 2001 - RFR from radio transmission stations (0.005 mW/cm²) affects immune system in women.

Chiang et al. *J. Bioelectricity* 8:127-131, 1989 - people who lived and worked near radio antennae and radar installations showed deficits in psychological and short-term memory tests.

de Pomerai et al. *Nature* 405:417-418, 2000. *Enzyme Microbial Tech* 30:73-79, 2002 - reported an increase in a molecular stress response in cells after exposure to a RFR at a SAR of 0.001 W/kg. This stress response is a basic biological process that is present in almost all animals - including humans.

de Pomerai et al. (*FEBS Lett* 22:543(1-3):93-97, 2003 - RFR damages proteins at 0.015-0.020 W/kg.

D'Inzeo et al. *Bioelectromagnetics* 9(4):363-372, 1988 - very low intensity RFR (0.002 – 0.004 mW/cm²) affects the operation of acetylcholine-related ion-channels in cells. These channels play important roles in physiological and behavioral functions.

- Dolk et al. *Am J Epidemiol* 145(1):1-91997- a significant increase in adult leukemias was found in residents who lived near the Sutton Coldfield television (TV) and frequency modulation (FM) radio transmitter in England.
- Dutta et al. *Bioelectromagnetics* 10(2):197-202 1989 - reported an increase in calcium efflux in cells after exposure to RFR at 0.005 W/kg. Calcium is an important component of normal cellular functions.
- Fesenko et al. *Bioelectrochem Bioenerg* 49(1):29-35, 1999 - reported a change in immunological functions in mice after exposure to RFR at a power density of 0.001 mW/cm².
- Hallberg O, Johansson O, (2004) concluded that continuous disturbance of cell repair mechanisms by body-resonant FM electromagnetic fields seems to amplify the carcinogenic effects resulting from cell damage caused e.g. by UV-radiation.
- Hjollund et al. *Reprod Toxicol* 11(6):897, 1997 - sperm counts of Danish military personnel, who operated mobile ground-to-air missile units that use several RFR emitting radar systems (maximal mean exposure 0.01 mW/cm²), were significantly lower compared to references.
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- Ivaschuk et al. *Bioelectromagnetics* 18(3):223-229, 1999 - short-term exposure to cellular phone RFR of very low SAR (26 mW/kg) affected a gene related to cancer.
- Kolodynski and Kolodynska, *Sci Total Environ* 180(1):87-93, 1996 - school children who lived in front of a radio station had less developed memory and attention, their reaction time was slower, and their neuromuscular apparatus endurance was decreased.
- Kwee et al. *Electro- and Magnetobiology* 20: 141-152, 2001 - 20 minutes of cell phone RFR exposure at 0.0021 W/kg increased stress protein in human cells.
- Lebedeva et al. *Crit Rev Biomed Eng* 28(1-2):323-337, 2000 - brain wave activation was observed in human subjects exposed to cellular phone RFR at 0.06 mW/cm².
- Magras and Xenos *Bioelectromagnetics* 18(6):455-461, 1999 - reported a decrease in reproductive function in mice exposed to RFR at power densities of 0.000168 - 0.001053 mW/cm². Irreversible sterility was found in the fifth generation of offspring.
- Mann et al. *Neuroendocrinology* 67(2):139-144, 1998 - a transient increase in blood cortisol was observed in human subjects exposed to cellular phone RFR at 0.02 mW/cm². Cortisol is a hormone involved in stress reaction.
- Marinelli et al. *J Cell Physiol.* 198(2):324-332, 2004 - exposure to 900-MHz RFR at 0.0035 W/kg affected cell's self-defense responses.
- Michelozzi et al. *Epidemiology* 9 (Suppl) 354p, 1998 - leukemia mortality within 3.5 km (5,863 inhabitants) near a high power radio-transmitter in a peripheral area of Rome was higher than expected.
- Michelozzi et al. *Am J Epidemiol* 155(12):1096-1103, 2002 - childhood leukemia higher at a distance up to 6 km from a radio station.
- Navakatikian and Tomashevskaya "Biological Effects of Electric and Magnetic Fields, Volume 1," D.O. Carpenter (ed) Academic Press, San Diego, CA, pp.333-342. 1994 - RFR at low intensities (0.01 - 0.1 mW/cm²; 0.0027- 0.027 W/kg) induced behavioral and endocrine changes in rats. Decreases in blood concentrations of testosterone and insulin were reported.
- Novoselova et al. *Bioelectrochem Bioenerg* 49(1):37-41, 1999 -low intensity RFR (0.001 mW/cm²) affects functions of the immune system.
- Park et al. *International Archives of Occupational and Environmental Health* 77(6):387-394, 2004 - higher mortality rates for all cancers and leukemia in some age groups in the area near the AM radio broadcasting towers.
- Persson et al. *Wireless Network* 3:455-461, 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 envelops the brain and protects it from toxic substances.
- Phillips et al. *Bioelectrochem. Bioenerg.* 45:103-110, 1998 - reported DNA damage in cells exposed to RFR at SAR of 0.0024 - 0.024 W/kg.
- Polonga-Moraru et al. *Bioelectrochemistry* 56(1-2):223-225, 2002 - change in membrane of cells in the retina (eye) after exposure to RFR at 15 µW/cm².
- Pyrpasopoulou et al. *Bioelectromagnetics* 25(3):216-227, 2004 - exposure to cell phone radiation during early gestation at SAR of 0.0005 W/kg (5 µW/cm²) affected kidney development in rats.
- Salford et al. *Environ Health Persp* Online January 29, 2003 - Nerve cell damage in mammalian brain after exposure to microwaves from GSM mobile phones signal at 0.02 W/kg.
- Santini et al. *Pathol Biol* (Paris) 50(6):369-373, 2002 - increase in complaint frequencies for tiredness, headache, sleep disturbance, discomfort, irritability, depression, loss of memory, dizziness, libido decrease, in people who lived within 300 m of mobile phone base stations.
- Sarimov et al. *IEEE Trans Plasma Sci* 32:1600-1608, 2004 - GSM microwaves affect human lymphocyte chromatin similar to stress response at 0.0054 W/kg.
- Schwartz et al. *Bioelectromagnetics* 11(4):349-358, 1990 - calcium movement in the heart affected by RFR at SAR of 0.00015 W/kg. Calcium is important in muscle contraction. Changes in calcium can affect heart functions.
- Somogyi et al. *Scanning Microsc* 5(4):1145-1155, 1991 - RFR at 0.024 W/kg caused molecular and structural changes in cells of mouse embryos.
- Stagg et al. *Bioelectromagnetics* 18(3):230-236, 1997- glioma cells exposed to cellular phone RFR at 0.0059 W/kg showed significant increases in thymidine incorporation, which may be an indication of an increase in cell division.
- Stark et al. *J Pineal Res* 22(4):171-176, 1997 - a two- to seven-fold increase of salivary melatonin concentration was observed in dairy cattle exposed to RFR from a radio transmitter antenna.
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- Veyret et al. *Bioelectromagnetics* 12(1):47-56, 1991 - low intensity RFR at SAR of 0.015 W/kg affects functions of the immune system.
- Wolke et al. *Bioelectromagnetics* 17(2):144-153, 1996 - RFR at 0.001W/kg affects calcium concentration in heart muscle cells of guinea pigs.

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The International Association of Fire Fighters recognizes IAFF Local 3368, Carpinteria-Summerland, California, who brought this issue to the attention of our membership through the Resolution 15, submitted through our biennial convention in August 2004. Additionally, the following local affiliates provided support for the passage of the resolution: Brookline, Massachusetts, San Diego, California, San Francisco, California and Vancouver, British Columbia. We also acknowledge the efforts of Dr. Henry C. Lai,

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RMD; 3/2005

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IAFF-TV (<https://www.youtube.com/user/IAFFTV>)

IAFF 2016 Convention (<http://client.prod.iaff.org/#page=Conv2016>)

IAFF 2014 Convention (<http://iaffconvention2014.org/>)

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Union Sportsmen's Alliance (<http://unionsportsmen.org/>)

IAFF Foundation (<http://foundation.iaff.org/>)

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 Technology⁷

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 1.5 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 1991⁹ 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 Bottemiller²⁸ 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 Freeman³⁵ and Rosen³⁶). 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 questionnaires³⁷ 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: \$51,550NZ, \$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 85% 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 15% 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 Court⁴³ and later Griliches,⁴⁴ and further developed by Freeman⁴⁵ 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:

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

where:

P_i = property price at the i th location
 $X_{1,i}, \dots, X_{n,i}$ = 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.

$$\ln P_i = b_0 + b_1 \times X_{1i} + b_2 \times X_{2i} + b_3 \times X_{3i} \\ \dots \dots \dots + b_n \times X_{ni} + a_0 \times D_0 + \\ \dots \dots \dots + a_m \times D_m + e_0$$

where:

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

b_0 = the intercept

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

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

$D_0 \dots D_m$ = 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 sepa-

rately 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 (m²); 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 AIC⁵³ and BIC⁵⁴ statistics; and t -test of significance of the coefficients and F -statistic.

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.

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 $100 \cdot (b_n)$. The resulting model included all the available variables as follows:

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

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 <i>R</i> 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 $e^{0.1135} \approx 1.12$ (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 *MATEFAX* (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 (1.58%). 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 *MATEFAX* indicates that, when all the other variables are held constant, for each additional m² the price would increase by $e^{0.0022314} \approx 1.0022314$ (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 <i>R</i> 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*, *MATEFAX* (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 *MATEAX* 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 $e^{-0.2540} \approx 0.79$ (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 <i>R</i> 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 <i>R</i> 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 *MATEAX* 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.

Additional Reading

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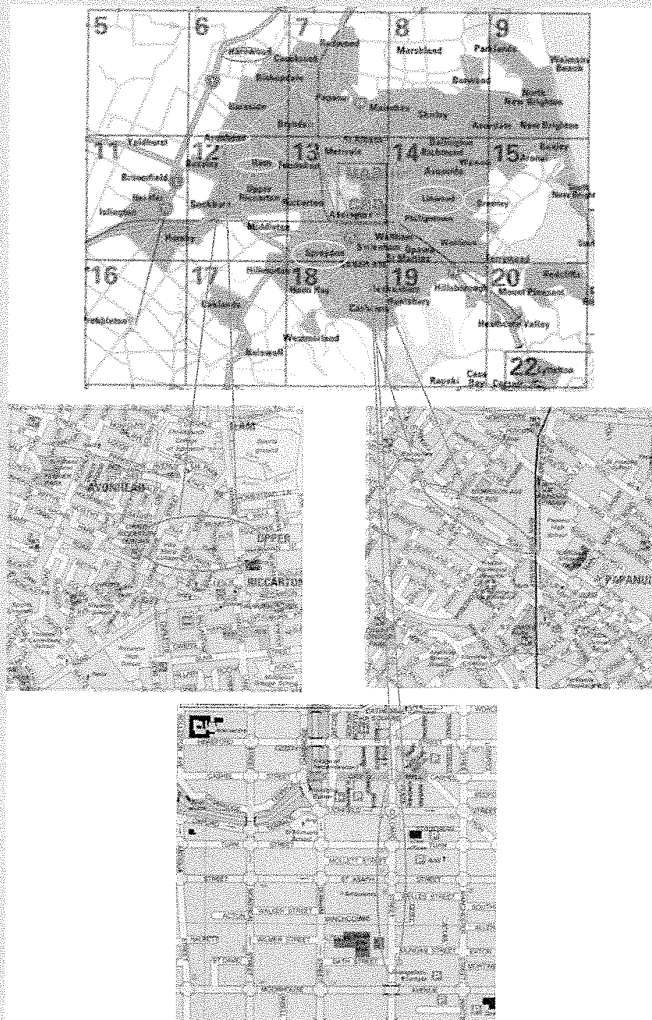
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Appendix I Location Map



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	Response	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

$$\log(\text{SLNETX}) = \text{TOWER} + \text{CATGYX2} + \text{CATGYX4} + \text{TIMESOLD.Q} + \text{AGE} + \log(\text{LANDAX}) + \text{MATFAX} + \text{SITSTX}$$

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 ***
SITSTXMCDUGALL 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

$$\ln(\text{formula} = \log(\text{SLNETX}) \sim \text{TOWER} + \text{SITSTX} + \text{TIMESOLD.Q} + \text{AGE} + \log(\text{LANDAX}) + \text{MATFAX} + \text{WALLCNX} + \text{ROOFCNX} + \text{CATGYX4}, \text{data} = \text{Papanui.final})$$

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

ln(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 **	
SITSTXB00N 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	
SITSTXSOUTHHEY 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

ln(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