Feb 24, 2000 meeting.

Marin Public Safety and Emergency Communications System

Final Environmental Impact Report
(Responses to Comments)

LEAD AGENCY:

Marin Emergency Radio Authority
SCH# 99092073
February 2000

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February 2000

prepared by:

John Roberto Associates
Marin Emergency Radio Authority
Hammett & Edison, Inc.
Visual Impact Analysis
Spectrasite

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I. INTRODUCTION

The Guidelines for Implementation of the California Environmental Quality Act (CEQA Guidelines) require lead agencies (the Marin Emergency Radio Authority) to respond significant environmental issues raised in the review of the Draft Environmental Impact Report (DEIR). MERA provided a 45-day review period which was initiated on November 15, 1999 and concluded on December 29, 1999.

1. Contents of the Final Environmental Impact Report

The Final Environmental Impact Report (FEIR) for the Marin Public Safety and Emergency Communications System project is comprised of the Responses to Comments, the DEIR (November 1999), and the Initial Study (September 16, 1999) prepared for the proposed project. The Response to Comments Chapter III includes all of the comments (letters and meeting minutes) received during the public review period for the DEIR. Chapter II is a list of public agencies, organizations, and persons commenting on the DEIR, and Chapters IV and V include the written responses to the significant environmental issues raised during the review period.

2. Format of Responses to Comments

The format used to respond to comments received on the DEIR is to list all the public agencies, organizations, and persons commenting on the DEIR. All letters received during the DEIR review period are listed, and a copy of the minutes summary from MERA's December 9, 1999 public hearing on the DEIR is included. Each relevant comment contained in the letters and the minutes summary is assigned a number. The number assigned to each comment corresponds directly to the number assigned to each written response.

Therefore, anyone reading this document can go directly to Chapter II and find the name of the public agency, organization or person commenting on the DEIR on the list. The information on the list includes the number assigned to each comment, the page number on which the comment is located, and the page number on which the written response to the comment can be found.

3. Master Responses

The review of the written letters and summary of meeting minutes found that the commentors raised certain issues multiple times. Some of the often repeated comments included questions about the process which was used in selecting telecommunications sites, as well as, the overall public notice and participation process. In addition, many of the persons participating in

neighborhood meetings, which were attended by MERA staff, asked for a refinement of the Turrini Tower Site Alternative on Dollar Hill in the City of San Rafael.

While each comment is responded to in writing in Chapter IV, the Master Responses are intended to put the written response in an overall context. Master Response #1 is an example of a draft Construction Management Plan which demonstrate how mitigation contained in the Initial Study and DEIR are implemented and monitored during project construction. Master Response #2 provides background information on the procedure which was used by the project design development team in selecting the proposed telecommunication sites. Response #3 is a summation of the entire public participation and review process for the proposed project, and Response #4 is a description and discussion of the refined Turrini Tower Site Alternative.

4. Disagreement on the Environmental Affects of the Proposed Project

The CEQA Guidelines for preparation of an EIR recognize that there may be differing opinions between experts and individuals on the environmental effects of a project. However, disagreement between experts or individuals does not make an EIR inadequate for certification (CEQA Guidelines, Section 15151). An EIR can be found adequate even if there is disagreement. The Courts have looked not for perfection, but for adequacy, completeness and a good faith effort at full disclosure. Accordingly, the Final EIR may not resolve disagreements, but will contain the differing opinions of the authors of the EIR and the commentors.

Some comments received on the DEIR offer a difference of opinion on the environmental affects of the proposed project from those identified in the DEIR. For example, some commentors challenge the standards that have been adopted by the Federal Communications Commission (FCC) for radio frequency exposures, but the EIR continues to use the adopted Federal ANSI standard as the threshold-of-significance for determining if the radio frequency exposure resulting from the project are significant or less-than-significant.

Likewise, other comments request an expansion in the scope of the analysis in the EIR to include resolution of the on-going scientific debate as to whether or not radio frequency exposures, including the level of exposure, can cause harmful affects on humans. The EIR was not expanded to resolve this debate, but continues to rely on the ANSI standards which were established by groups of scientists and engineers who evaluated research studies and formulated exposure limit guidelines based on recognized effects of radio frequency exposures.

It is recognized that there are differences in opinion in the interpretation of environmental impact between some commentors and the authors of the EIR will remain.

5. Content of the Draft EIR

None of the comments made on the DEIR warranted changes to the text of the draft. Therefore, the magnitude of impact and identified mitigation measures in the DEIR are unchanged. The Responses to Comments is a discussion of the issues raised during the DEIR review period, but few of the comments challenged the findings of the DEIR. Comments that included a request for an expansion of the scope of the EIR to address social and economic issues which were not environmentally based were discussed and rejected based on the provisions of the CEQA Guidelines.

6. Information Included in the Responses to Comments

The new, clarified and refined information contained in the Responses to Comments is not significant new information requiring recirculation of the DEIR as provided for in Section 15088.5 of the CEQA Guidelines. This conclusion is based on the following findings:

(1) No new significant environmental impacts were identified in comments received on the DEIR, or information provided in responses to the comment, which were not already identified in the draft. Furthermore, no new significant environmental impacts, beyond those already discussed in the DEIR, resulted from the refinement of the Turrini Tower Site Alternative or other vegetation and wildlife mitigation measures suggested in the comments or included in the responses.

(2) There is no substantial increase in the severity of an environmental impact based on the information contained in the Responses to Comments. The significant visual impacts identified in the DEIR still remain unmitigated, and other potentially significant impacts can still be mitigated to a less-than-significant level as concluded in the DEIR.

(3) The refinement and discussion of the Turrini Tower Site Alternative found that it was possible to construct a new tower and radio equipment shelter on the existing telecommunications site without having to first remove the existing tower or construct facilities in the adjacent open space lands. The refined design reduced anticipated impacts on plant and wildlife to an insignificant level, However the DEIR found that a new tower at the Turrini site would result in a potentially significant visual

impact and that finding remains unchanged because the new tower in the refined alternative would have to be 20 feet higher than the existing tower.

(4) The new information provided in the responses to comments and the master responses clarifies and amplifies the findings of the DEIR and does not identify any new significant environmental impacts resulting from the project, alternatives to the project, or mitigation measures recommended in the DEIR.

II. LIST OF PERSONS, ORGANIZATIONS AND AGENCIES

WRITTEN COMMENT	DATE	COMMENT NUMBER	COMMENT PAGE	RESPONSE PAGE
Federal Agencies				
U.S. Department of the Interior	12/29/99	1-15	6-8	110-112
State Agencies				
Water Quality Control Board	12/22/99	16-17	9-16	113
Local Agencies				
County of Sonoma	12/29/99	18-19	17-19	113
Town of San Anselmo	12/28/99	20-21	20	113
Organizations				
Barnabe Homeowners Assoc.	12/28/99	22-24	21	115-116
West End Neighborhood Assoc.	12/28/99	25-29	22	116-117
Health Council of Marin	12/28/99	30-38	23-24	117-122
Council on Wireless Technology Impacts	12/29/99	39-47	26-87	122-124
Persons				
Susan & John Van Der Wal	12/25/99	48-49	88	124
Walter Lindell	12/27/99	50-51	89	124
David Swain	12/27/99	52-57	90	124-125
Randy & Glen Coleman	12/28/99	58-63	91	125-127
Mr. & Mrs. Robert D. Irwin	12/28/99	64-77	92-99	127-130
Virginia Souders-Mason	12/28/99	78-79	100-102	130
Celia Brown	12/28/99	80	103	130
Roger Hopfensperger	12/28/99	81	104	130
Sue Lim & Rodney Yee	12/30/99	82-83	105	130
PUBLIC HEARING COMMENTS				
Persons				
Joan Ripple	12/9/99	84	108	131
Virginia Sauders-Mason	12/9/99	85	108	131
Elizabeth Kelly	12/9/99	86	108	131
Mary Lee Strebl	12/9/99	87	108	131

III. COMMENTS RECEIVED ON THE DRAFT EIR

United States Department of the Interior
NATIONAL PARK SERVICE
Point Reyes National Seashore
Point Reyes Station, California 94956

IN REPLY REFER TO:

December 29, 1999

Ms. Linda Christman
Executive Director
Marin Emergency Radio Authority
3501 Civic Center Drive, Suite 325
San Rafael, CA 94903-4157

Dear Ms. Christman:

We have received the draft environmental impact report for the proposed Marin Emergency Radio Authority system and offer the following comments:

Bolinas Ridge Site

1) The Northern Spotted Owl, a federally listed species, has been documented to nest in the vicinity. Add this species to the list of sensitive species in the area that will need to be monitored for prior to and during any proposed construction (p V-70 and VI-9). Federal law also protects raptors, (p. V-70 and VI-9). 1

2) There are known populations of two special-status plants - *Ceanothus masonii* and *Ceanothus gloriosus var. exaltatus* - occurring in the area. A third special-status plant - *Arctostaphylos virgata* - also may be present. Comprehensive preconstruction surveys will be required at the appropriate time of year to determine presence/absence of these taxa. If present and subject to project impact, appropriate mitigation measures would be required. Additionally, any impacts to northern maritime chaparral (a sensitive natural community) on adjacent NPS land should be avoided or mitigated. 2

3) Despite the proposed mitigation for visual impacts by adjusting the location of the reflector panel, the visual impacts associated with the Bolinas Ridge site facility remain significant. The site will be highly visible from adjacent NPS lands. There is significant recreational use along the Bolinas Ridge Fire Road that will be impacted by the visual intrusion of the proposed facility. The National Park Service recommends adopting Alternative Mitigation Measure VIS-2, which would use a land line between the Bolinas Fire Station and the Civic Center and eliminate the need for the Bolinas Ridge reflector panel and its impacts. 3

4 | 4) A comprehensive rare plant survey should be conducted along the access road.

Point Reyes Hill Site

This site is on federal land within the Point Reyes National Seashore. The NPS has determined that NEPA compliance requirements will be met through the CEQA process.

5 | 1) Page V-86 states the proposed facility would be visible from many directions, which conflicts with an earlier statement on page V-84.

6 | 2) The Northern Spotted Owl, a federally listed species, has been documented to nest in the vicinity. Add this species to the list of sensitive species in the area that will need to be monitored prior to and during any proposed construction or tree cutting (p VI-87 and VI-9). Federal law also protects raptors, (p VI-9).

7 | 3) The EIR should address wildlife impacts associated with generator operation at Point Reyes Hill site.

8 | 4) The new fence should be black vinyl coated to match the existing fence.

General Comments

9 | 1) Add *Ceanothus masonii* and *Ceanothus gloriosus var. exaltatus* (not listed but a species of concern due to limited distribution) to target list of special status species.

10 | 2) We will need to know the proposed construction schedule to determine potential impacts to wildlife associated with construction activities and noise.

3) Summary of Impacts and Mitigation Measures

11 | • Point Reyes National Seashore would like to have the botanist(s) conducting preconstruction surveys work with us to ensure proper identification of rare plants.

12 | • Mulch from chipping should be spread to a depth of 3" or less.

13 | • Nesting bird surveys should be conducted on GGNRA lands adjacent to Bolinas Ridge site as well as at Pt. Reyes Hill site and should be coordinated with PRNS or GGNRA wildlife biologists.

- PRNS would like information on the locations of construction vehicle wash stations. The spread of weed seed associated with construction is a prime concern. Also should add the mitigation for weed seed to the Bolinas Ridge Mitigation section. 14

Monitoring

15 1) PRNS would like contractor to have a trained Environmental Monitor on site during construction to ensure full compliance with mitigation measures.

Thank you for the opportunity to comment and if you have any questions please contact Assistant superintendent Frank Dean at (415) 663-8522, extension 244.

Sincerely,

Don L. Neubacher
Superintendent

California R gional Water Quality ontrol Board
San Francisco Bay Region

Winston H. Hickox
Secretary for Environmental Protection

Internet Address: http://www.swrcb.ca.gov
1515 Clay Street, Suite 1400, Oakland, California 94612
Phone (510) 622-2300 FAX (510) 622-2460

Gray Davis
Governor

Date: DEC 22 1999
File No. 2158.02 (DRH)

Ms. Linda Christman
Marin Emergency Radio Authority
3501 Civic Center Drive, Suite 325
San Rafael, CA 94903-4157

Re: Marin Public Safety and Emergency Communications Radio System
SCH# 99092073

Dear Ms. Christman:

We have received the above referenced Notice of Preparation (NOP) and offer the following comments with which the Regional Water Quality Control Board (RWQCB) is concerned.

The proposed project involves a public agency telecommunications system. It consists of a network of 17 microwave dishes, radio antennas, and radio equipment to allow regional conversations between dispatchers and mobile units throughout Marin County.

16 The proposed development would disturb more than five acres of land during construction. It must be covered under the State NPDES General Permit for Discharges of Storm Water Associated with Construction Activity (General Permit). This can be accomplished by filing a Notice of Intent with the State Water Resources Control Board, Division of Water Quality. The project sponsor must propose and implement control measures that are consistent with the General Permit and with the recommendations and policies of the local agency and the RWQCB.

17 Regional Board Staff are unable to offer more specific comment at this time. However, I have attached a copy of our **General Comments**, which discuss the Regional Board's area of responsibility, and which should help guide in the preparation of further CEQA documentation.

Regional Board staff also encourage the lead agency to obtain a copy of "Start at the Source," a design guidance manual for stormwater quality protection, which provides innovative ways of designing structures, parking lots, drainage systems, and landscaping. This manual may be obtained at most cities planning offices, or by calling the Bay Area Stormwater Management Agencies Association at 1-800-773-7247.

If you have any questions, please call me at 9510) 622-2362, or Jennifer Ackerman at (510) 622-2346.

Sincerely,

Dale R. Hopkins

Dale R. Hopkins
Environmental Specialist III

Enclosure
cc (w/o enclosure): State Clearinghouse
Bruce Wolfe, RWQCB

General Comments

The San Francisco Regional Water Quality Control Board (Regional Board or RWQCB) is charged with the protection of the Waters of the State of California in the San Francisco Bay Region. including wetlands and stormwater quality. The Regional Board is responsible for administering the regulations established by the Federal Clean Water Act. Additionally, the California Water Code establishes broad state authority for regulation of water quality. The San Francisco Bay Basin Water Quality Control Plan (Basin Plan) explains the Regional Board's strategy for regulating water quality. The Basin Plan also describes the range of responses available to the Regional Board with regard to actions and proposed actions that degrade or potentially degrade the beneficial uses of the Waters of the State of California.

NPDES

Water quality degradation is regulated by the Federal National Pollutant Discharge Elimination System (NPDES) Program, established by the Clean Water Act, which controls and reduces pollutants to water bodies from point and nonpoint discharges. In California, the program is administered by the California Regional Water Quality Control Boards. The Regional Board issues NPDES permits for discharges to water bodies in the San Francisco Bay Area, including Municipal (area- or county-wide) Stormwater Discharge Permits.

Projects disturbing more than five acres of land during construction must be covered under the State NPDES General Permit for Discharges of Storm Water Associated with Construction Activity (General Permit). This can be accomplished by filing a Notice of Intent with the State Water Resources Control Board. An NOI and the General Permit can be obtained from the Board at (510) 266-2300. The project sponsor must propose and implement control measures that are consistent with the General Permit and with the recommendations and policies of the local agency and the RWQCB.

Projects that include facilities with discharges of Storm Water Associated with Industrial Activity must be covered under the State NPDES General Permit for Discharges of Storm Water Associated with Industrial Activity. This may be accomplished by filing a Notice of Intent. The project sponsor must propose control measures that are consistent with this, and with recommendations and policies of the local agency and the RWQCB. In a few cases, the project sponsor may apply for (or the RWQCB may require) issuance of an individual (industry- or facility-specific) permit.

The RWQCB's Urban Runoff Management Program requires Bay Area municipalities to develop and implement storm water management plans (SWMPs). The SWMPs must include a program for implementing new development and construction site storm water quality controls. The objective of this component is to ensure that appropriate measures to control pollutants from new development are: considered during the planning phase, before construction begins; implemented during the construction phase; and maintained after construction, throughout the life of the project.

Impacts and Mitigation Measures

Wetlands

Wetlands enhance water quality through such natural functions as flood and erosion control, stream bank stabilization, and filtration and purification of contaminants. Wetlands also provide critical habitats for hundreds of species of fish, birds, and other wildlife, offer open space, and provide many recreational opportunities. Water quality impacts occur in wetlands from construction of structures in waterways, dredging, filling, and altering drainage to wetlands.

The Region 1 Board must certify that any permit issued by the U.S. Army Corps of Engineers pursuant to Section 404 of the Clean Water Act (covering, dredging, or filling of Waters of the United States, including wetlands) complies with state water quality standards, or waive such certification. Section 401 Water Quality Certification is necessary for all 404 Nationwide permits, reporting and non-reporting, as well as individual permits.

All projects must be evaluated for the presence of jurisdictional wetlands and other Waters of the State. Destruction of or impact to these waters should be avoided. If the proposed project impacts wetlands or other Waters of the State and the project applicant is unable to demonstrate that the project was unable to avoid those adverse impacts, water quality certification will most likely be denied. 401 Certification may also be denied based on significant adverse impacts to wetlands or other Waters of the State. In considering proposals to fill wetlands, the Regional Board has adopted the California Wetlands Conservation Policy (Executive Order W-59-93, signed August 23, 1993). The goals of the Policy include ensuring "no overall net loss and achieving a long-term net gain in the quantity, quality, and permanence of wetlands acreage and values." Under this Policy, the Regional Board also considers the potential post-construction impacts to wetlands and Waters of the State and evaluates the measures proposed to mitigate those impacts (see Storm Water Quality Control, below).

The Regional Board has adopted U.S. EPA's Clean Water Act Section 404(b)(1) "Guidelines for Specification of Disposal Sites for Dredge or Fill Material," dated December 24, 1980, in the Board's Basin Plan for determining the circumstances under which fill may be permitted.

Section 404(b)(1) Guidelines prohibit all discharges of fill material into regulated waters of the United States, unless a discharge, as proposed, constitutes the least environmentally damaging practicable alternative that will achieve the basic project purpose. For non-water dependent projects, the guidelines assume that there are less damaging alternatives, and the applicant must rebut that assumption.

The Section 404(b)(1) Guidelines sequence the order in which proposals should be approached. First, impacts to wetlands or Waters of the State must be avoided to the maximum extent practicable. Second, the remaining impacts must be minimized. Finally, the remaining unavoidable adverse impacts to wetlands or Waters of the State must be mitigated. Mitigation will be preferably in-kind and on-site, with no net destruction of habitat value. A proportionately greater amount of mitigation is required for projects that are out-of-kind and/or off-site. Mitigation will preferably be completed prior to, or at least simultaneous to, the filling or other loss of existing wetlands.

Successful mitigation projects are complex tasks and difficult to achieve. This issue will be strongly considered during agency review of any proposed wetland fill. Wetland features or ponds created as mitigation for the loss of existing jurisdictional wetlands or Waters of the United States cannot be used as storm water treatment controls.

In general, if a proposed project impacts wetlands or Waters of the State and the project applicant is unable to demonstrate that the project was unable to avoid adverse impacts to wetlands or Waters of the State, water quality certification will be denied. 401 Certification may also be denied based on significant adverse impacts to wetlands or other Waters of the State.

Storm Water Quality Control

Storm water is the major source of fresh water to creeks and waterways. Storm water quality is affected by a variety of land uses and the pollutants generated by these activities. Development and construction activities cause both site-specific and cumulative water quality impacts. Water quality degradation may occur during construction due to discharges of sediment, chemicals, and wastes to nearby storm drains or creeks. Water quality degradation may occur after construction is complete, due to discharges of petroleum hydrocarbons, oil, grease, and metals from vehicles, pesticides and fertilizers from landscaping, and bacteria from pets and people. Runoff may be concentrated and storm water flow increased by newly developed impervious surfaces, which will mobilize and transport pollutants deposited on these surfaces to storm drains and creeks. Changes in runoff quantity or velocity may cause erosion or siltation in streams. Cumulatively, these discharges will increase pollutant loads in creeks and wetlands within the local watershed, and ultimately in San Francisco Bay.

To assist municipalities in the Bay Area with complying with an area-wide NPDES Municipal Storm Water Permit or to develop a Baseline Urban Runoff Program (if they are not yet a co-permittee with a Municipal Storm Water Permit), the Regional Board distributed the *Staff Recommendations for New and Redevelopment Control for Storm Water Programs* (Recommendations) in April 1994. The Recommendations describe the Regional Board's expectations of municipalities in protecting storm water quality from impacts due to new and redevelopment projects, including establishing policies and requirements to apply to development areas and projects; initiating appropriate planning, review, approval, and inspection procedures; and using best management practices (BMPs) during construction and post-construction.

Project impacts should be minimized by developing and implementing a Storm Water Pollution Prevention Plan (SWPPP). A SWPPP is required by the State Construction Storm Water General Permit (General Permit). The SWPPP should be consistent with the terms of the General Permit, the Manual of Standards for Erosion & Sedimentation Control Measures by the Association of Bay Area Governments (ABAG), policies and recommendations of the local urban runoff program (city and/or county), and the Recommendations of the RWQCB. SWPPPs should also be required for projects that may have impacts, but which are not required to obtain an NPDES permit. Preparation of a SWPPP should be a condition of development. Implementation of the SWPPP should be enforced during the construction period via appropriate options such as citations, stop work orders, or withholding occupancy permits.

Impacts identified should be avoided and minimized by developing and implementing the types of controls listed below. Explanations of the controls are available in the Regional Board's construction *Field Manual*, available from Friends of the San Francisco Estuary at (510) 286-0924, in BASMAA's *Start at the Source*, and in the *California Storm Water Best Management Practice Handbooks*.

Site Planning

The project should minimize impacts from project development by incorporating appropriate site planning concepts. This should be accomplished by designing and proposing site planning options as early in the project planning phases as possible. Appropriate site planning concepts to include, but are not limited to the following:

- Phase construction to limit areas and periods of impact.
- Minimize directly connected impervious areas.
- Preserve natural topography, existing drainage courses and existing vegetation.
- Locate construction and structures as far as possible from streams, wetlands, drainage areas, etc.
- Provide undeveloped, vegetated buffer zones between development and streams, wetlands, drainage areas, etc.
- Reduce paved area through cluster development, narrower streets, use of porous pavement and/or retaining natural surfaces.
- Minimize the use of gutters and curbs which concentrate and direct runoff to impermeable surfaces.
- Use existing vegetation and create new vegetated areas to promote infiltration.
- Design and lay out communities to reduce reliance on cars.
- Include green areas for people to walk their pets, thereby reducing build-up of bacteria, worms, viruses, nutrients, etc. in impermeable areas, or institute ordinances requiring owners to collect pets' excrement.
- Incorporate low-maintenance landscaping.
- Design and lay out streets and storm drain systems to facilitate easy maintenance and cleaning.
- Consider the need for runoff collection and treatment systems.
- Label storm drains to discourage dumping of pollutants into them

Erosion

The project should minimize erosion and control sediment during and after construction. This should be done by developing and implementing an erosion control plan, or equivalent plan. This plan should be included in the SWPPP. The plan should specify all control measures that will be used or which are anticipated to be used, including, but not limited to, the following:

- Limit access routes and stabilize access points.
- Stabilize denuded areas as soon as possible with seeding, mulching, or other effective methods.
- Protect adjacent properties with vegetative buffer strips, sediment barriers, or other effective methods.
- Delineate clearing limits, easements, setbacks, sensitive areas, vegetation and drainage courses by marking them in the field.
- Stabilize and prevent erosion from temporary conveyance channels and outlets.
- Use sediment controls and filtration to remove sediment from water generated by dewatering or collected on-site during construction. For large sites, stormwater settling basins will often be necessary.

Chemical and Waste Management

The project should minimize impacts from chemicals and wastes used or generated during construction. This should be done by developing and implementing a plan or set of control measures. The plan or control measures should be included in the SWPPP. The plan should specify all control measures that will be used or which are anticipated to be used, including, but not limited to, the following:

- Designate specific areas of the site, away from streams or storm drain inlets, for storage, preparation, and disposal of building materials, chemical products, and wastes.
- Store stockpiled materials and wastes under a roof or plastic sheeting.
- Store containers of paint, chemicals, solvents, and other hazardous materials stored in containers under cover during rainy periods.
- Berm around storage areas to prevent contact with runoff.
- Cover open Dumpsters securely with plastic sheeting, a tarp, or other cover during rainy periods.
- Designate specific areas of the site, away from streams or storm drain inlets, for auto and equipment parking and for routine vehicle and equipment maintenance.
- Routinely maintain all vehicles and heavy equipment to avoid leaks.
- Perform major maintenance, repair, and vehicle and equipment washing off-site, or in designated and controlled areas on-site.
- Collect used motor oil, radiator coolant or other fluids with drip pans or drop cloths.
- Store and label spent fluids carefully prior to recycling or proper disposal.
- Sweep up spilled dry materials (cement, mortar, fertilizers, etc.) immediately--do not use water to wash them away.
- Clean up liquid spills on paved or impermeable surfaces using "dry" cleanup methods (e.g., absorbent materials, cat litter, rags) and dispose of cleanup materials properly.
- Clean up spills on dirt areas by digging up and properly disposing of the soil.
- Keep paint removal wastes, fresh concrete, cement mortars, cleared vegetation, and demolition wastes out of gutters, streams, and storm drains by using proper containment and disposal.

Post-Construction

The project should minimize impacts from pollutants that may be generated by the project following construction, when the project is complete and occupied or in operation. These pollutants may include: sediment, bacteria, metals, solvents, oil, grease, and pesticides, all of which are typically generated during the life of a residential, commercial, or industrial project after construction has ceased. This should be done by developing and implementing a plan and set of control measures. The plan or control measures should be included in the SWPPP.

The plan should specify all control measures that will be used or which are anticipated to be used, including, but not limited to, the source controls and treatment controls listed in the Recommendations. Appropriate control measures are discussed in the Recommendations, in:

- Table 2: Summary of residential post-construction BMP selection
- Table 3: Summary of industrial post-construction BMP selection
- Table 4: Summary of commercial post-construction BMP selection

Additional sources of information that should be consulted for BMP selection include the *California Storm Water Best Management Practice Handbooks*; the Bay Area Preamble to the *California Storm*

Water Best Management Practice Handbooks and New Development Recommendations; the BASMAA New Development Subcommittee meetings, minutes, and distributed information; and Regional Board staff. Regional Board staff also have fact sheets and other information available for a variety of structural stormwater treatment controls, such as grassy swales, porous pavement and extended detention ponds.

SONOMA COUNTY
PERMIT AND RESOURCE MANAGEMENT DEPARTMENT
2550 Ventura Avenue Santa Rosa, CA 95403-2829
(707) 565-1900 FAX (707) 565-3767

December 29, 1999

Marin Emergency Radio Authority
3501 Civic Center Drive
Room 325
San Rafael, CA 94903-4157

Att: Linda Christman,
Executive Director

Re: Draft EIR for Marin Public Safety and Emergency Communications Radio System

We appreciate the opportunity to comment on the above-referenced document. Our comments focus on the Draft EIR's responses to the attached October 19, 1999 letter concerning the two proposed sites within Sonoma County on Bay Hill Road and Sonoma Mountain. In that letter, we reviewed Sonoma County's approval requirements for the proposed facilities at these two sites. These requirements include building permits, review of consistency with the Sonoma County General Plan, visual analysis and alternatives analysis. We request that these
18 requirements be acknowledged in the Final EIR. The visual analysis and alternatives analysis provided in the Draft EIR appear to meet the applicable County Code requirements, but final determinations cannot be made until final construction plans and building permit applications are submitted to the Permit and Resource Management Department with the required analyses.

In our October 19, 1999 letter, we also expressed concerns about the effects of the proposed facilities on the County of Sonoma's telecommunications facilities. The Draft EIR has been reviewed by the County's General Services Department, and it does not appear that the project described in the Draft EIR will have significant effects on County facilities which cannot be
19 mitigated. The cumulative visual simulation of proposed facilities at the Bay Hill Road site on page 209 of the Draft EIR, which includes the additional microwave dish being considered by the County of Sonoma for this site, should be accompanied by inclusion of this antenna in the long-distance simulation on page 211, a description of the size and height of the antenna and a discussion of whether cumulative visual impacts are significant.

Please feel free to call me at 707-565-1917 if you have questions about permit requirements or visual impacts. If you have questions concerning existing or proposed County of Sonoma facilities, please contact George Waters at 565-1980 or Mike Wagner at 565-2977.

Sincerely,

Robert Gaiser

Robert Gaiser
Planner III

Copies: George Waters
Mike Wagner
Chris Thomas

SONOMA COUNTY
PERMIT AND RESOURCE MANAGEMENT DEPARTMENT
2550 Ventura Avenue Santa Rosa, CA 95403-2829
(707) 565-1900 FAX (707) 565-3767

October 19, 1999

Marin Emergency Radio Authority
3501 Civic Center Drive
Suite 325
San Rafael, CA 94903-4157

Att: Linda Christman,
Executive Director

Re: Notice of Preparation and Initial Study
for Marin Public Safety and Emergency Communications Radio System

We appreciate the opportunity to comment on the above-referenced document and incorporate our concerns into the Draft EIR being prepared. Our comments focus on the two facility sites within Sonoma County on Bay Hill Road and Sonoma Mountain and the related permit requirements, visual impacts and possible effects on the County of Sonoma's communications system.

The Sonoma County Code requires a building permit for nearly all of the proposed facilities at these two sites. Please contact Eric Mays of our department at 707-565-2936 to obtain information about the requirements for construction design and application submittal.

Sonoma County's zoning requirements for telecommunications facilities are stated in the two enclosed ordinances adopted in 1996. Ordinance No. 4973 amended the zoning regulations covering most of the County, including the Sonoma Mountain site. Ordinance No. 4974 addresses development in the Coastal Zone which includes the Bay Hill Road site. Both ordinances classify the antenna structures at these sites as "free-standing commercial telecommunications facilities". Use permits are not required for such facilities which are publicly-owned, but consistency with the Sonoma County General Plan is nonetheless required for approval of building permits. In addition, the California Government Code requires County review of all proposed public facilities for consistency with the General Plan.

In order to be found consistent with the General Plan, the enclosed General Plan amendment adopted with the telecommunications ordinances requires public telecommunication facilities to meet all applicable zoning standards and criteria. Since both sites are located in Scenic Landscape areas designated by the Open Space Plan Map in the General Plan, the General Plan specifically requires that the proposed facilities meet the siting and design criteria of the SR (Scenic Resources) zoning district. These requirements are stated on pages 17-22 of Ordinance No. 4973 and include a visual analysis (p. 17) and alternatives analysis (pp.21-22).

The permit requirements reviewed above should be stated in the Draft EIR. You may wish to consider providing in the EIR, not only a description of the Scenic Landscape /SR requirements which apply to both Sonoma County sites but also the required visual analysis for each site and the portions of the alternatives analysis pertaining to visual impacts. These analyses may be utilized in the future when permit applications are filed with the County.

The Initial Study's description of existing and proposed facilities at the two Sonoma County sites incorporates the County of Sonoma's facilities, but there is no discussion of the project's potential effects on County facilities. Consequently, we request analysis of this topic in the draft EIR as a potential cumulative impact. The EIR preparer should contact Mike Wagner of the County's General Services Department at 707-565-2977 for further information on the existing facilities at the Sonoma Mountain site and the County's future needs at both sites.

Please feel free to call me at 707-527-1917 if you have any questions about this letter or our concerns.

Sincerely,

Robert Gaiser

Robert Gaiser
Planner III

Copies: Mike Wagner
Joe Perez
Chris Thomas

bg\

THE TOWN OF
SAN ANSELMO
ADMINISTRATION AND FINANCE

December 28, 1999

Marin Emergency Radio Authority
Linda Christman, Executive Director
3501 Civic Center Drive, Suite 325
San Rafael, CA 94903-4157

RE: Marin Emergency Public Safety and Emergency Communications Radio System – Draft EIR

Dear Ms. Christman,

Thank you for the opportunity to comment on the Draft EIR prepared for the above noted project. San Anselmo is particularly concerned with the proposed 80-foot tower to be located at the Forbes Hill site in San Rafael.

As indicated in the Draft EIR, the 80-foot tower "will be visible from a number of off-site viewpoints" and will "result in a significant visual change from some off-site viewpoints." While we acknowledge that efforts have been made to reduce the visual impact of the proposed tower, it will still be highly visible to many San Anselmo residents. We have significant concerns regarding the impact the tower will have visually on the surrounding area and believe that the mitigation does not sufficiently reduce the severity of the impact. We request that an existing tower structure be
20 painted with the proposed non-reflective paint as a test for the effectiveness of this mitigation measure.

We are also concerned about the cumulative effects of EMF given the closeness of residences to this structure and the lack of data on the acceptable levels of human exposure limits. We do not
21 see sufficient justification to locate the tower as proposed given the number of nearby residents that could be exposed to the unknown long-term effects of EMF.

For the reasons stated above, we strongly object to the location and design of the new tower as proposed and would suggest that a more appropriate location be pursued. If it is determined that an antenna structure must be built in this location, additional mitigation to reduce the visual impacts and further assurance regarding the long term safety of EMF levels are still necessary.

Thank you for the opportunity to comment of this document.

Sincerely,

Peter Breen
Mayor

525 SAN ANSELMO AVENUE ■ SAN ANSELMO.CA94960
415.258.4600 ■ FAX 415.459.2477 ■ EMAIL SA_ADM-FINANCE@MIDAS.ORG

December 28, 1999

RECEIVED
MARIN COUNTY
ADMINISTRATOR'S OFFICE

1999 DEC 29 A 10:24

Linda Christman, Executive Officer
Marin Emergency Radio Authority
3501 Civic Center Drive, Suite 325
San Rafael, CA 94903

22 The Barnabe Homeowners Association strenuously objects to MERA's proposed emergency radio system which would include a new equipment building and a new free standing tower and three new dish antennas to be visible against the skyline.

In approximately 1994, with community members present, the Board of Supervisors discussed and agreed to vote on future refusal to build any additional towers or buildings on Mt. Barnabe. However, when the community members were absent, the Supervisors subsequently voted down their own resolution to stop building on Mt. Barnabe, as proof of their insincerity on this issue.

23 Yes, the new system may save a life every few years, but how many more lives will be lost through disorders caused by the damaging effects of electro-magnetic radiation? There have been many recent studies which leave no doubt as to the harmfulness of these radiations.

24 In 1996 the World Health Organization started an international project to study the biological effects of EMFs. The study will be completed in the year 2005 and should result in improved health standards. We therefore request that you not install any further towers, dishes, or equipment buildings until the safety of this system can be assured.

Mary Lee Strebl

Mary Lee Strebl
President, Barnabe Homeowners Association

cc: Board of Supervisors
Nancy Rubin , Director of Health & Human Services
Scott Davidson, Planning Director

WEST END NEIGHBORHOOD ASSOCIATION

December 28, 1999

MERA
Marin County Administration
Marin Civic Center, Rm. 325
3501 Civic Center Drive
San Rafael, CA 94903

Attn: Linde Christman
Subject: Comment on Draft EIR, Marin Emergency Radio Project

The Forbes Hill site is in the West End Neighborhood and is identified in the DEIR (pg. 97) as having a significant visual impact on this neighborhood.

25 1). Possible alternate sites for those having significant impacts are not discussed. Such discussion should be included with details on why proposed sites with impacts were chosen.

26 2).Why are the microwave dishes at the Forbes site located 35 and 45 feet above ground? The Mt. Tam focus is clearly visible from ground level and the Dollar Hill focus would be only visible from a lower level by removal or pruning of a few trees in the large grove in the line of sight (the reason given for proposed disk height). Note that the dishes on Mt. Tam are to be mounted "no higher than 20 feet above ground level"(pg. 22)

27 3). Why are 4 foot diameter dishes required when current technology can access multi channel TV from a satellite 20,000 miles away? By reducing dish size and height above ground the tower structure could be greatly reduced and still provide the stability necessary.

28 4). The mitigation measure of painting the tower will be ineffective from many lower neighborhood areas under varying daylight situations.

29 5). The statement that 3 existing towers will be replaced by 1 tower for a minus 2 count is cynical and misleading considering that the proposed tower is so much larger and more visible.

Harry Winters
President, WENA
201 Spring Grove Ave.
San Rafael, CA 94901

cc: S.R. City Mgr. Rod Gould
S.R. Councilman Cyr Miller

Health Council of Marin

Advisory to the Marin County Board of Supervisors

Joan M. Ripple, President

To: Board of Supervisors
County of Marin

Cc: Linda Christman
Deputy County Administrator, County of Marin, and
Executive Director, Marin Emergency Radio Authority

Nancy Rubin, Director
Department of Health and Human Services
County of Marin

From: Joan Ripple, President
Health Council of Marin

Re: Comments about the Draft EIR (Environmental Impact Report) regarding the Marin Public Safety and Emergency Communications Radio System

Date: December 28, 1999

The Health Council of Marin, your appointed advisors on health issues facing the county, would like to advise you that the Health Council has been actively engaged in a serious evaluation of the proposed Public Safety and Emergency Communications Radio System.

The Health Council of Marin submitted formal comments on the Initial Study Draft directly to you, the Board of Supervisors, with a copy to the MERA Executive Director, Ms. Linda Christman in October. The Health Council of Marin also testified before the MERA Board at a recent public hearing, held on December 9, 1999.

We are very supportive of the overall goal of the MERA, which is to improve public safety communications. In our role as your advisors our concern is, simply, in working together to improve public safety, let us do no harm. On the whole, our previously
30 submitted (October 1999) detailed comments still pertain to this version of the EIR. Almost all of our concerns or comments do not appear to be addressed. This statement combines comments on the Draft EIR with a statement on EMF (electromagnetic fields) as an environmental toxin.

Health Council of Marin – 101 Sunny Hills Drive #50, San Anselmo CA 94960
415- 457-8420

In our December 9th comments we pointed out a long list of government-approved standards and products that have since been pulled from the marketplace as more knowledge showed them to be dangerous to the public health. We are in a position today of having knowledge that makes the current standards and technology at least suspect for negative effects on public health. MERA uses the FCC guidelines governing human exposure that are based upon ANSI and NCRP standards that were 31 developed in 1982 and 1986. These guidelines do not recognize the current standards used by most European countries or the more recent low level studies by Dr. Henry Lai, which have been peer reviewed in the scientific literature and are impossible to refute. For example, at exposure conditions equal to 10 microwatts per centimeter squared, there are behavioral effects. Laboratory mammals demonstrate a temporary stoppage of pedal-pushing activity. Another Lai study, to be published in the January Biolelectromagnetics Society Journal, has linked radio frequency exposure to long-term memory function. According to Lai, irradiated laboratory mammals had their spatial reference mapping strategies affected.

Comparable exposure conditions could occur for certain populations or at certain locations in the county.

We recommend the County and the MERA continuously review new and emerging scientific and technical information, particularly focusing on uncontrolled exposure conditions caused by the major facilities and the building antennas. Children, people with immune disorders and the elderly are most at risk. Marin will certainly be exposed to more radiation when this system is initiated in late 2001. Workers, whose 32 occupations require them to install, maintain and operate these facilities or use the hand held or fixed equipment, will be exposed to more radiation. We also recommend that the system design include flexibility for making adjustments in the system when new and emerging scientific and technical information point to danger regarding public health.

We have learned that citizens have limited access to public information on the MERA proposal. The location and time of the December 9th and other meetings are another 33 access barrier. In a participatory democracy, citizens have the right to become informed about changes in public policy that affect their lives and their property.

If MERA proceeds to install this new utility without a well-defined plan for public health and safety protection and public accountability, the County, the participating 34 municipalities, and other units of government who operate the MERA, could later be deemed negligent and be held liable for adverse health consequences experienced by people in Marin County.

The County and/or MERA should define what procedures the public shall follow to 35 obtain full disclosure of information on County and the MERA operations related to this system. What remedies, outside of litigation, can the public seek should there be an exposure condition that exceeds the legal limit for safe human exposure?

36 Overall, based on our review of this information, this new wireless system as proposed may cause or intensify hazardous radio wave exposure conditions for human, animal

and plant life. Due to the many questions and controversies, it would be irresponsible for Marin County and the MERA to knowingly approve a wireless communication
37 system which potentially places health and safety at risk.
For the past several years, the Health Council of Marin has been increasingly concerned about environmentally caused or aggravated diseases.

We know that Marin, like most of the industrialized world, is showing evidence of increased rates of various types of cancer, increased respiratory problems, problems in human reproduction, and more neurological and behavioral problems as more exposures to environmental toxins occur and more cases of sensitivity to environmental toxins are identified. There are no hard numbers to go by but the numbers are going up. We are aware of this as we get calls from people who have developed environmentally related illnesses. Soon, we hope to see formal scientific studies done so we can get the facts.

We believe that electromagnetic fields (EMF) have joined the list of environmental toxin, based on our review of the scientific literature and interactions with many in the medical and scientific community and with affected populations. In 1985, the EPA studied microwave and radiofrequency radiation and defined EMF as a known possible carcinogen, a class 3. Drs. Guy and Chou did one of the scientific studies used to make this determination under an Air Force contract. However, the U.S. Congress never adopted this position due to internal division and political interference from lobbyists representing the electrical power and communications corporations.

38 Dr. Martin Meltz, a scientist and industry consultant who is the chair of the IEEE standard setting committee, said while being interviewed for the recently broadcast ABC 20/20 show, "I have to say that, now, there is evidence of risk." Dr. George Carlo, who ran the industry's research program for U.S. corporations for six years, raised new questions about microwave radiation and the safety of cellular telephones. He is saying the possibility of harm is very real. With recent studies that show adverse effects and recent admonitions by industry scientists, we cannot agree with industry spokesmen who say this is an environmentally safe technology.

Is this a safe technology? The prevailing wisdom is, in the absence of scientific certainty, EMF safety may not be assumed. Although there is controversy over how these effects can occur, it is beyond argument that bioeffects do occur across many radio frequencies and power intensities and standard absorption rate conditions.

This system as proposed may cause or intensify hazardous radio wave exposure conditions for human, animal and plant life. Due to the many questions and controversies, it would be irresponsible for Marin County and the MERA to knowingly approve a wireless communication system which potentially places health and safety at risk without building into the system and plan of operations the recommendations we have made for public health safety.

cwti

Council on Wireless Technology Impacts

Citizens and professionals concerned about responsible use of electromagnetic radiation

An Initiative of the Ad Hoc Association of Parties Concerned about the FCC's Radio Frequency Health and Safety Rules

936-B Seventh Street, Suite 206, Novato, California 94945

Phone 415-892-1863 Fax 415-892-3108 Email libbykelley@ccwti.org **Web** http://www.ccwti.org

December 29, 1999

Ms. Linda Christman
Deputy County Administrator, County of Marin, and
Executive Director, Marin Emergency Radio Authority
Civic Center Administration Building, Room 325
San Rafael, California

Re: Comments on The MERA Draft EIR

We are glad to have the opportunity to comment on this important new public safety communications system. I am a resident of Marin County and serve as the Executive Director of the Council on Wireless Technology Impacts (CWTI). CWTI is also known as the Ad Hoc Association of Parties Concerned about the FCC's Radiofrequency Health and Safety Rules. We have a major legal challenge in the U.S. Court of Appeals, 2nd circuit, to the FCC guidelines on human exposure to radiofrequency radiation based on for their inadequacy to protect public health and safety. This case is widely recognized by the telecommunications and broadcast industry as a highly significant case which may result in court mandated changes to current federal telecommunications policies. A summary of the case is attached

We have reviewed both the Initial Study Draft and the current Draft of the MERA Environmental Impact Report. We have the following questions:

- What are you putting into the air? How do the new and existing manmade EMF exposures affect public health and the environment?
- How are you planning to address seismic safety issues?
- How are you planning to address real property value losses?

In sum, we continue to be concerned that this Draft EIR does not adequately address these environmental impact concerns. We believe that this Draft EIR should more fully describe what the cities and county of Marin plans and operations will be.

- **What are you putting into the air?**

39 **The information provided in Hammet and Edison's engineering report is insufficient for use in evaluating the radiation power density from each of the proposed sites.** For example, the engineering report gives only one single number for each of the sites. Is this a pulsed system? If so, what are the frequencies signal patterns, antenna gain? What are the peak intensity averages? Do the measurements taken incorporate other RF sources from other antennas and nearby facilities – FM, TV, Radar, paging, existing public safety, PCS? Who is the
40 manufacturer of the new antennas and towers and what are the equipment model numbers?

41 **We would like to request a copy of the complete engineering studies in order to do an independent evaluation and compare the exposure conditions to the scientific literature on non-ionizing radiation.** It is generally acknowledged that no one can say precisely what is a safe distance from a RF source or a safe radiation power density. With the scientific uncertainty and the inadequacies in determining what the exposure conditions are, we strongly advocate
42 precautionary measures be taken before the system is installed. As the MERA system will be under County and city control, the MERA board and administrators has both the flexibility and the obligation to design and administer a public safety communications system which promotes public safety without doing harm.

43 As stated earlier, CWTI has a federal court appeal in progress challenging the FCC guidelines governing human exposure as not adequately protective of public health. These federal guidelines do not adequately measure the actual risk. They only protect against the thermal effect or ionization of body tissue. These guidelines are merely advisory and are not enforceable. They are based on industry-derived standards, ANSI and NCRP, which date as far back as 1982 and 1986. They do not include significant research findings including some important peer reviewed studies, which have been published since 1990.

In a letter to the Scottish Parliament, in October 1999, EMF Consultant Cindy Sage summarized the current state of the scientific literature. In that report, Sage states:

> Public policies to address the issue of decision making in the face of this scientific uncertainty are evolving. The precautionary principle (erring on the side of conservatism) is frequently promoted by public health advocates given the massive public health risk that is possible if such exposure is carcinogenic or has other adverse bioeffects. Even if the risk to an individual is slight (which is at present unknown), the sheer number of people around the globe who may be at risk makes this policy choice of utmost importance. The virtual revolution in science taking place now is based on a growing recognition that non-thermal or low intensity RF exposure can be detected in living tissues and result in well-defined bioeffects. Bioeffects that are reported to result from RF exposure include changes in cell membrane function, metabolism, cellular signal communication, activation of proto-oncogenes, and cell death. Resulting effects which are reported in the scientific literature include DNA breaks and chromosome aberrations, increased free radical production, cell stress and premature aging, changes in brain function including memory loss, learning impairment, headaches and fatigue, sleep disorders, neurodegenerative conditions, reduction in melatonin secretion, and cancer. (see attachment)

In sum, the FCC guidelines, which set a threshold for what is considered a safe human exposure, being set at tissue heating level, ignores the published peer reviewed research which shows cellular damage, neurological and behavioral changes, at much lower levels of intensity. These guidelines are not protective enough.

Recently, there have been some major developments:

- A new study by Dr. Henry Lai is to appear in the January issue of the Biolelectromagnetics Society Journal, a peer reviewed scientific journal; therefore, the studies cannot be refuted. This study shows long term memory loss in laboratory mammals, when exposed to cell phone frequencies.

- Last week, the Swiss government adopted a safety threshold for maximum radiating power not to exceed six (6) watts. The new rules apply to all existing and new radiating antennas, particularly near occupied buildings, kindergartens and undeveloped areas, such as parks and playgrounds, which are highly utilized. Salzburg, Austria has a limit of one (1) MW/cm2 on environmental radiation exposures, which, until the new law just passed in Switzerland, has been the lowest threshold for safe exposure in the world.

- The Italian government is presently considering a new proposal from a Congress recently held in Trento, Italy. Based on an analysis of the International Commission on Non-Ionizing Radiation Protection (ICNIRP) of people exposed to high frequency radiation the proposal is for a new limit of 0.5 V/m (0.03 microwatt/cm2).

However, there is nothing comparable under consideration in the U.S. The federal research agencies do not have a serious research program into the effects of non-ionizing radiation on human health. **Since the state of the scientific evidence does not prove that wireless communications are a safe technology, it is incredible that the federal government is not doing any research to ensure public health and safety as an integral part of encouraging new and emerging wireless technologies.**

- In June 1999, U.S. government scientists recently called for more research, including research on the effects of non-ionizing radiation on civilian populations in American communities, (see letter from Dr. Lotz to the IEEE, attached).
- In 1997, The Bioelectromagnetics Society Journal published a study by U.S. Government scientists, entitled, "Summary of Measured Radiofrequency Electric and Magnetic Fields (10 kHz to 30 Ghz) in the General and Work Environment". This is one of the few civilian reports on environmental and occupational exposure conditions and is based on old data. Among the relevant findings are that the there are some real or potential exposures that are either occupational or voluntary, such as the near fields of handheld transmitters, the electrical fields at ground level around microwave relay stations. (see attached study)

- In addition, the federal lawsuit, which we are party to, is consolidated with a similar case brought by the Communications Workers of America. CWA is challenging current FCC guidelines governing worker exposures due to safety concerns. There are 400,000 telecommunications workers who belong to the CWA in the U.S., who are at risk as they may be chronically over-exposed to nonionizing radiation. There are many hundreds of thousands more non-labor union worker who are being chronically over-exposed on a daily basis and are not being properly trained or advised about the hazards associated with this technology. This is a daily occurrence for the unknown non-union telecommunications workers in Marin.

- The Massachusetts State Department of Public Health just completed a health assessment of the potential impact of the Air Force PAVE PAWS installation on neighboring communities on Cape Cod. In that report, (attached) it is acknowledged that there are no harmful effects reported at or below a SAR value of 4/W/kg. At 4 W/kg, laboratory mammals demonstrate a temporary stoppage of pedal-pushing activity. (This is the same study by Dr. Lai to be reported in the Bioelectromagnetics Society Journal in January) At the frequencies emitted by PAVE PAWS, this would correspond to an intensity of approximately 10 microwatts per centimeter squared. This finding implies that biological effects are detected at much lower levels than the FCC threshold set for safe human exposure. We refer this report to you because, the proposed MERA system, which will transmit at 6 or 10 Gigahertz, with an operating frequency of 485 Megahertz, is very high intensity is comparable in some ways to PAVE PAWS. If MERA is a pulsed system, as PAVE PAVES is, there may be more potential for harm as pulsed systems are more bioactive.(see attached)

44

- Finally, there have been unpublished reports of increased ambient background levels in various U.S. cities since the introduction of more wireless telecommunications facilities. There is expressed concern that the cumulative effects of various frequencies operating in the open environment should be monitored and mitigated against. There is no federal monitoring, enforcement or mitigation of radiation exposure conditions being done by the FCC or any of the federal health agencies. It is up to state and local government to voluntarily conduct a monitoring program. The San Francisco County Health Department is doing this in a limited way in San Francisco.

45 **We would like to see the MERA include a routine monitoring and mitigation program as part of routine operations of general public and occupational exposure conditions.**

- <u>How are you planning to seismic safety issues?</u>

In the event of an earthquake, we would like to know how the MERA would respond to a public safety emergency should one of the high power beams (at 6 or 10 Gigahertz) go even slightly
46 astray. Perhaps the structure might tilt or fall in an earthquake. If this happened, the beam may then be aimed – even briefly - at people. A dynamic analysis of the Sutro Tower revealed numerous safety violations , which could have resulted in injuries or deaths and loss of property if there had been an earthquake.

- **How are you planning to address the real potential for real property value loss?**

47 What about our property values and our quality of life? What will the county and the cities of Marin do to protect the taxpayers from lowered property assessments and resale prices? At recent community meetings during this past month, I heard local residents express their concern about the loss of property values related to existing wireless facilities sites as well as the proposed public safety facilities. We are aware of civil court suits all over the country on property value issues related to telecommunication and broadcast towers. In two recent cases, one in Houston and another in Illinois, the claims of reduced property values were decided in favor of the homeowners. Is MERA prepared to face potential litigation from homeowners over actual property losses?

We hope that the MERA Board and Administration, which represents the County and the cities of Marin, will seriously consider these comments. Since the enactment of the Wireless Communication and Public safety Act of 1999, a new federal law mandates a national end-to-end public safety communication system. The law also protects the manufacturers, carriers and dispatchers, all that work with this system, from liability should there be any harm or injury. These facts makes it more imperative that Marin is not unduly harmed by this new wireless infrastructure.

We stand ready to assist in any way to help guide the development of a new public safety communications system for Marin, which protects but does not harm

If you care to contact me, my phone number is 415 892-1963.

Sincerely,

Elizabeth A. Kelley, MPA, Health Care Services
Executive Director
Council on Wireless Technology Impacts

cc. Members, Marin County Board of Supervisors
Nancy Rubin, Director, Department of Health and Human Services, County of Marin
Other interested parties

Enclosures: Summary of CWTI legal challenge to the FCC. *
Report to the Scottish Parliament on RF research by Cindy Sage, EMF Consultant, October 1999
Letter to Mr. Richard Tell, Chairman of the IEEE committee – June 1999
"Summary of Measured Radiofrequency Electric and Magnetic Fields (10 kHz to 30GHz) In the General and Work Environment)" Mantiply et al. – Bioelectromagnetics 18:563-577, 1997.
Massachusetts Department of Public Health, Health Assessment – PAVE PAWS, October 1999

* Further information on the CWTI legal challenge is available at **http://www.ccwti.org.**

Ad Hoc Association of Parties Concerned about the Federal Communications Commission Health and Safety Rules (AHA)

Summary of the Legal Challenge Under the Telecommunications Act of 1996, 2nd Circuit (No. 97-4328)

Background statement: In November 1997, following publication by the FCC (Federal Communication Commission) of final rules implementing the Federal Telecommunications Act of 1996, the AHA filed a request for judicial review in the U.S. Court of Appeals, under the Federal Administrative Procedures Act. Fifty-four (54) petitioners from all over the United States joined in this appeal and filed as co-petitioners. The Communications Workers of America national headquarters' organization and The Cellular Phone Task Force filed similar appeals. These appeals were consolidated with AHA's and the case was assigned the 2nd circuit for judicial review.

The FCC was joined in support by intervenors to the case, including the Cellular Telephone Industry Association, the National Association of Broadcasters, ATT Wireless, the Association of Maximum Service Television and the Electromagnetic Energy Association. Citizens from the New England area filed an "amicus curiae" in support of the petitioners. Oral arguments were heard on April 5, 1999. A judicial decision is expected later this year.

What is being challenged

The AHA is challenging the FCC under the Telecommunications Act of 1996 (TCA) on the basis of several constitutional and statutory violations. If the court upholds these claims, its decision would serve the common good by restoring traditional state and local government regulatory control over its traditionally held responsibility over planning, zoning and public health and safety, in regards to protection from any potential harm from radiofrequency radiation (RFR).

Constitutional violations being charged based on 10th, the 5th and the 1st amendments:

- The 10th amendment is being violated as, the TCA, Section 704 (B)(ii), states that local jurisdictions "shall process" permits for placing wireless service facilities and, under Section 704 (B)(iv) further requires that FCC rules on RF "environmental effects" be adhered to. AHA argues these rules constitute a "commandeering" of local jurisdictions to implement a federal program. (AHA cites Supreme Court cases Printz vs. United States, 117 S.Ct. 2365, 138 L.Ed.2d (1997); New York vs. United States 505 U.S. 144 (1992), and Alden et al. v. Maine 715 A. 2d 172 (1999) case 98-436. Amicus brief also cites Printz and New York.)
- The 1st amendment is being violated because the public is being denied their right to free speech in presenting evidence of adverse health effects at meetings to review zoning rules or permit applications. Such information has the impact of assisting local government to mitigate effects as well as to warn the public of the potential for harm. FCC 'temporary conclusions' in 97-303 para. #140 state that testimony about adverse health effects can serve to invalidate a zoning decision, even if not part of the formal reason for that decision. AHA argues this FCC decision encourages the impeding of free speech at zoning and permit hearings and thus is unconstitutional.
- The 5th amendment is also being violated as a result of the above FCC 'temporary conclusion' and as a result of not allowing free speech at zoning and permit hearings, because not allowing discussion of health effects at such hearings weakens any future tort liability claim charging harm due to health effects.

Major statutory challenges to the FCC rules under the TCA:

- FCC exceeded its authority under Section 704 of the Act in determining that it can preempt local RF exposure ordinances over "operation" of personal wireless facilities. AHA argues that this was not what Congress intended. Further preemption of existing RF health and safety rules on operations would

require 'implicit' preemption (non-allowable under Section 601 of the Act.) AHA is encouraged by the recent Federal District Court of Vermont ruling that 'operation' is not addressed in the preemptions listed in Sec. 704 – see Appeal of Graeme 975 F. Supp. 570 (D.Vt. 1997).

- FCC exceeded its authority in determining that it can preempt health and safety rules. AHA argues that local rules over health effects do not come under the "environmental effects" as interpreted by FCC and Congress has not explicitly stated this was its intent. AHA cites Supreme Court rulings that preemption of local jurisdiction regulations, including health and safety, must be explicitly preempted. AHA also argues its claim by citing federal statutes that distinguish between environmental and health effects.
- FCC illegally issued its RF guidelines because it did not adequately evaluate the impacts of these guidelines as required by the National Environmental Policy Act of 1969 (NEPA)."
- **Therefore, AHA urgently requests the court orders FCC to conduct a thorough study on RF health and safety.** AHA filed materials with the brief documenting the body of scientific evidence which shows how certain RF exposures can cause increased cancer rates, DNA breakage, memory deficits, slowed reaction time, attention deficits and impacts of sex ratios (with fewer boys being born); health effects based on physical symptoms including microwave hearing, sleep disturbances, nausea, headache and, as claimed by some, internal bleeding and death. In addition, RF electrical interference affects normal operations of medical devices, home appliances and business equipment.

<u>Challenges to FCC administrative performance in issuing RF health and safety rules:</u>

- AHA submitted a Petition for Reconsideration, and subsequent comments to the FCC referencing several recently published studies. FCC did not refer these documents to the federal health agencies for review and comment. As a result, the AHA petition has not been reviewed by federal health agencies that have the health expertise in the matter. This is a violation of the Petitions for Reconsideration to FCC statute. (47 USC, Sec. 405).
- **FCC admits that it has no health expertise and states that it relies upon the federal health agency advice. Yet, FCC did not follow much of the advice of these federal agencies and did not ask them to review certain public comments regarding RF health concerns, including those of AHA. As a result, FCC has issued RF health and safety rules, which are unreliable, irrational and, do not adequately protect workers or the general public. Such arbitrary and capricious administrative behavior places the health and safety of workers and the general public undue risk. For example:**
  - Reports of workers exposed to RF fields which are within the FCC limits show complaints of nausea, headaches, and other adverse effects – yet, FCC made no comments on these reports. AHA and CWA provided affidavits to show that FCC proposals on allowable workers exposures were not reasonable (these guidelines permit many fold higher RF exposures so long as the 6 minute average exposures is not exceeded). FCC rules also do not consider cumulative exposure of workers from many transmitters so long as all do not exceed an arbitrarily set limit.
  - Transmitters set 34 feet or above ground are not required to be evaluated for exposures to nearby buildings, even if the upper floors of schools, offices or apartments are close by a transmitter.
  - FCC does not require a cumulative exposure study from all transmitters at a single site as long as each set of transmitters owned and operated by a single operator is within specified limits.
  - AHA argues that FCC must provide a database on where all transmitters are located. This would serve the interest of ensuring a comprehensive system of communications services as well as providing health agencies with data needed to study exposures and health effects.

What happens after the court ruling? We think the court may decide to reverse the FCC rules. We are concerned, should there be a reversal, our constitutional and statutory challenges may not addressed. We must be prepared to move quickly in order to challenge an unfavorable ruling or to respond to an appeal by the FCC and the intervenors. **This lawsuit has been brought in the public interest and we need your help in order to prevail.** *Further information about the lawsuit and how you might support us, please contact the Council on Wireless Technology Impacts through our website: http://www.ccwti.org. by email: libbykelley@ccwti.org or, by phoning us at 415-892-1863.*

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June 17, 1999

Mr. Richard Tell
Chair, IEEE SCC28 (SC4)
Risk Assessment Work Group
Richard Tell Associates, Inc.
8309 Garnet Canyon Lane
Las Vegas, NV 89129-4897

Dear Mr. Tell:

The members of the Radiofrequency Interagency Work Group (RFIAWG) have identified certain issues that we believe need to be addressed to provide a strong and credible rationale to support RF exposure guidelines. I am writing on behalf of the RFIAWG members to share these ideas with you and other members of the IEEE SCC28, Subcommittee 4 Risk Assessment Work Group. Our input is in response to previous requests for greater participation on our part in the SCC28 deliberations on RF guidelines. The issues, and related comments and questions relevant to the revision of the IEEE RF guidelines, are given in the enclosure. No particular priority is ascribed to the order in which the issues are listed.

The views expressed in this correspondence are those of the members of the Radiofrequency Interagency Work Group and do not represent the official policy or position of the respective agencies.

The members of the RFIAWG appreciate your consideration of our comments and welcome further dialog on these issues. Feel free to contact me or any member of the RFIAWG directly. A list of the members of the RFIAWG is enclosed, with contact information for your use.

Sincerely yours,

W. Gregory Lotz

W Gregory Lotz, Ph.D.
Chief, Physical Agents Effects Branch
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Enclosures (2)

cc: N. Hankin
J. Elder
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L. Cress
J. Healer

RF Guideline Issues

Identified by members of the federal RF Interagency Work Group, June 1999

Issue: Biological basis for local SAR limit

The C95.1 partial body (local) exposure limits are based on an assumed ratio of peak to whole body SAR; that is, they are dosimetrically, rather than biologically based. Instead of applying a dosimetric factor to the whole body SAR to obtain the local limits, an effort should be made to base local SAR limits on the differential sensitivity of tissues to electric fields and temperature increases. For example, it seems intuitive that the local limits for the brain and bone marrow should be lower than those for muscle, fat and fascia; this is not the case with the current limits which implicitly assume that all tissues are equally sensitive (except for eye and testicle). If no other data are available, differential tissue sensitivity to ionizing radiation should be considered.

If it is deemed necessary to incorporate dosimetric factors into the resulting tissue-specific SAR limits these should be based on up-to-date dosimetric methods such as finite-difference time-domain calculations utilizing MRI data and tissue-specific dielectric constants. For certain exposure conditions FDTD techniques and MRI data may allow better simulation of peak SAR values. Consideration should be given to the practical tissue volume for averaging SAR and whether this volume is relevant to potential effects on sensitive tissues and organs.

Issue: Selection of an adverse effect level

Should the thermal basis for exposure limits be reconsidered, or can the basis for an unacceptable/adverse effect still be defined in the same manner used for the 1991 IEEE guidelines? Since the adverse effect level for the 1991 guidelines was based on acute exposures, does the same approach apply for effects caused by chronic exposure to RF radiation, including exposures having a range of carrier frequencies, modulation characteristics, peak intensities, exposure duration, etc , that does not elevate tissue temperature on a macroscopic scale?

Selection criteria that could be considered in determining unacceptable/adverse effects include:

a) adverse effects on bodily functions/systems
b) minimal physiological consequences
c) measurable physiological effects, but no known consequences

If the adverse effect level is based on thermal effects in laboratory animals, the literature on human studies (relating dose rate to temperature elevation and temperature elevation to a physiological effect) should be used to determine if the human data could reduce uncertainties in determination of a safety factor.

Issue: Acute and chronic exposures

There is a need to discuss and differentiate the criteria for guidelines for acute and chronic exposure conditions. The past approach of basing the exposure limits on acute effects data with an extrapolation to unlimited chronic exposure durations is problematic. There is an extensive data base on acute effects with animal data, human data (e.g. MRI information), and modeling to address thermal insult and associated adverse effects for acute exposure (e.g., less than one day). For lower level ("non-thermal"), chronic exposures, the effects of concern may be very different from those for acute exposure (e.g., epigenetic effects, tumor development, neurologic symptoms). It is possible that the IEEE RF radiation guidelines development process may conclude that the data for these chronic effects exist but are inconsistent, and therefore not useable for guideline development. If the chronic exposure data are not helpful in determining a recommended exposure level, then a separate rationale for extrapolating the results of acute exposure data may be needed. In either case (chronic effects data that are useful or not useful), a clear rationale needs to be developed to support the exposure guideline for chronic as well as acute exposure

Issue: One tier vs two tier guidelines:

A one tier guideline must incorporate all exposure conditions and subject possibilities (e.g., acute or chronic exposure, healthy workers, chronically ill members of the general public, etc.). A two tier guideline, as now exists, has the potential to provide higher limits for a specific, defined population (e.g., healthy workers), and exposure conditions subject to controls, while providing a second limit that addresses greater uncertainties in the data available (about chronic exposure effects, about variations in the health of the subject population, etc.). A greater safety factor would have to be incorporated to deal with greater uncertainty in the scientific data available. Thus, a two-tier guideline offers more flexibility in dealing with scientific uncertainty, while a one-tier guideline would force a more conservative limit to cover all circumstances including the scientific uncertainties that exist.

Issue. Controlled vs uncontrolled (applicability of two IEEE exposure tiers)

The current "controlled" and "uncontrolled" definitions are problematic, at least in the civilian sector, particularly since there are no procedures defined in the document to implement the "controlled" condition. The new guidelines should offer direction for the range of controls to be implemented and the training required for those who knowingly will be exposed (e.g. workers), along the lines of the existing ANSI laser safety standards. This essential element needs to be included for whatever limits are defined, be they one-tier or two-tier.

For example, the OSHA position is that the "uncontrolled" level is strictly an "action" level which

indicates that there is a sufficiently high exposure (compared to the vast majority of locations) to merit an assessment to determine what controls and training are necessary to ensure persons are not exposed above the "controlled" limit. Many similar "action" levels are part of OSHA and public health standards. Should this interpretation be incorporated into the IEEE standard as a means to determine the need to implement a safety plan? [The laser standard has a multi-tiered (Class I, II, III, IV) standard which similarly requires additional controls for more powerful lasers to limit the likelihood of an excess exposure, even though the health effect threshold is the same]

On the other hand, if it is determined that certain populations (due to their health status or age) are more susceptible to RF exposures, then a multi-tiered standard, applicable only to those specific populations, may be considered.

The ANSI/IEEE standard establishes two exposure tiers for controlled and uncontrolled environments. The following statement is made in the rationale (Section 6, page 23): "The important distinction is not the population type, but the nature of the exposure environment." If that is the case, consideration should be given to providing a better explanation as to why persons in uncontrolled environments need to be protected to a greater extent than persons in controlled environments. An uncontrolled environment can become a controlled environment by simply restricting access (e.g., erecting fences) and by making individuals aware of their potential for exposure. After such actions are taken, this means that the persons who previously could only be exposed at the more restrictive uncontrolled levels could now be exposed inside the restricted area (e.g., inside the fence) at controlled levels.

What biologically-based factor changed for these people? Since the ostensible public health reason for providing greater protection for one group of persons has historically been based on biological considerations or comparable factors, it is not clear why the sentence quoted above is valid

Issue: Uncertainty factors

The uncertainties in the data used to develop the guideline should be addressed. An accepted practice in establishing human exposure levels for agents that produce undesirable effects is the application of factors representing each area of uncertainty inherent in the available data that was used to identify the unacceptable effect level. Standard areas of uncertainty used in deriving acceptable human dose for agents that may produce adverse (but non-cancer) effects include

(1) extrapolation of acute effects data to chronic exposure conditions,
(2) uncertainty in extrapolating animal data to humans in prolonged exposure situations,
(3) variation in the susceptibility (response/sensitivity) among individuals,
(4) incomplete data bases,
(5) uncertainty in the selection of the effects basis, inability of any single study to adequately address all possible adverse outcomes.

If guidelines are intended to address nonthermal chronic exposures to intensity modulated RF radiation, then how could uncertainty factors be used; how would this use differ from the historical use of uncertainty factors in establishing RF radiation guidelines to limit exposure to acute or sub-chronic RF radiation to prevent heat-related effects?

There is a need to provide a clear rationale for the use of uncertainty factors.

Issue: Intensity or frequency modulated (pulsed or frequency modulated) RF radiation

Studies continue to be published describing biological responses to nonthermal ELF-modulated and pulse-modulated RF radiation exposures that are not produced by CW (unmodulated) RF radiation. These studies have resulted in concern that exposure guidelines based on thermal effects, and using information and concepts (time-averaged dosimetry, uncertainty factors) that mask any differences between intensity-modulated RF radiation exposure and CW exposure, do not directly address public exposures, and therefore may not adequately protect the public. The parameter used to describe dose/dose rate and used as the basis for exposure limits is time-averaged SAR; time-averaging erases the unique characteristics of an intensity-modulated RF radiation that may be responsible for producing an effect.

Are the results of research reporting biological effects caused by intensity-modulated, but not CW exposure to RF radiation sufficient to influence the development of RF exposure guidelines? If so, then how could this information be used in developing those guidelines? How could intensity modulation be incorporated into the concept of dose to retain unique characteristics that may be responsible for a relationship between exposure and the resulting effects?

Issue: Time averaging

Time averaging of exposures is essential in dealing with variable or intermittent exposure, e.g., that arising from being in a fixed location of a rotating antenna, or from moving through a fixed RF field. The 0.1 h approach historically used should be reassessed, but may serve this purpose adequately. Time averaging for other features of RF exposure is not necessarily desirable, however, and should be reevaluated specifically as it deals with modulation of the signal, contact and induced current limits, and prolonged, or chronic exposure. These specific conditions are discussed in a little more detail elsewhere.

If prolonged and chronic exposures are considered to be important, then there should be a reconsideration of the time-averaging practices that are incorporated into existing exposure guidelines and used primarily to control exposure and energy deposition rates in acute/subchronic exposure situations.

Issue: Lack of peak (or ceiling) limits for induced and contact current

A recent change in the IEEE guidelines allows for 6 minute, rather than 1 second, time-weighted-averaging for induced current limits. This change increases the concern about the lack of a peak limit for induced and contact currents. Will the limits for localized exposure address this issue, i.e., for tissue along the current path?

Issue: Criteria for preventing hazards caused by transient discharges

The existing IEEE recommendation states that there were insufficient data to establish measurable criteria to prevent RF hazards caused by transient discharges. If specific quantitative criteria are still not available, can qualitative requirements be included in the standard to control this hazard (e.g., metal objects will be sufficiently insulated and/or grounded, and/or persons will utilize sufficient insulating protection, such as gloves, to prevent undesirable transient discharge)?

ISSUE. Limits for exposure at microwave frequencies

Concerns have been expressed over the relaxation of limits for continuous exposures at microwave frequencies above 1500 MHz. The rationale provided in the current guideline (Section 6.8) references the fact that penetration depths at frequencies above 30 GHz are similar to those at visible and near infrared wavelengths and that the literature for skin burn thresholds for optical radiation "is expected to be applicable." The rationale then implies that the MPE limits at these high frequencies are consistent with the MPE limits specified in ANSI Z136.1-1986 for 300 GHz exposures. This is apparently the rationale for "ramping up" to the MPE limits for ***continuous*** exposure of 10 mW/cm^2 at frequencies above 3 GHz (controlled) or 15 GHz (uncontrolled). The rationale should be given as to why this ramp function has been established at relatively low microwave frequencies (i.e., 1500 MHz and above), rather than being implemented at higher frequencies that are truly quasi-optical. For example, one option could be two ramp functions, one beginning at 300 MHz, based on whole- or partial-body dosimetry considerations, and another at higher frequencies (say 30-100 GHz) to enable consistency with the laser standard. Such a revision should help reduce concern that the standard is not restrictive enough for continuous exposures at lower microwave frequencies where new wireless applications for consumers could make this an issue in the future.

Issue: Replication/Validation

Published peer-reviewed studies that have been independently replicated/validated should be used to establish the adverse effects level from which exposure guidelines are derived The definition of "replicated/validated" should not be so restrictive to disallow the use of a set of reports that

are scientifically valid but are not an exact replication/validation of specific experimental procedures and results.

Peer-reviewed, published studies that may not be considered to be replicated/validated, but are well done and show potentially important health impacts provide important information regarding uncertainties in the data base used to set the adverse effect level (e.g., incomplete data base).

Issue: Important Health Effects Literature Areas:

Documentation should be provided that the literature review process included a comprehensive review of the following three areas:

1) long-term, low-level exposure studies (because of their importance to environmental and chronic occupational RFR exposure);
2) neurological/behavioral effects (because of their importance in defining the adverse effect level in existing RFR guidelines); and
3) micronucleus assay studies (because of their relevance to carcinogenesis).

Issue: Compatibility of RFR guidelines

Compatibility of national and international RFR guidelines remains a concern. It is important for the IEEE Committee to address this issue by identifying and discussing similarities and differences in a revised IEEE guideline and other RFR guidelines. Compatibility/noncompatibility issues could be discussed in the revised IEEE guideline or as a companion document distributed at the time the revised IEEE guideline is released to the public.

October 15, 1999

To: The Clerk to the Transport and the Environment Committee
The Scottish Parliament
Room 2.7 Committee Chambers
George IV Bridge
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EH9 1SP

From: Cindy Sage
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USA

Dear Members of the Telecommunications Inquiry Committee,

Thank you for the opportunity to submit written evidence on possible health effects of wireless communications, addressing the "state of the science" on what is known and not known. Further, my comments will speak to what information the Committee should consider in formulating "advice based on the present state of knowledge".

Comments

The weight of the evidence that bioeffects occur with RFR exposure is beyond argument and some of the evidence suggests that serious health effects may result, particularly from cumulative or chronic exposure. Scientific study on cumulative effects is very incomplete, and some studies report that low-intensity chronic exposure may be deleterious. The Commmittee should advise "public health precaution" and urge population exposures worldwide be kept to a minimum until further research can clarify risks.

Public exposure to electromagnetic radiation (radiofrequency and microwave) is growing exponentially worldwide with the introduction and use of cordless phones, cellular phones, pagers and antennas in communities designed to transmit their RF signals.

Long-term and cumulative exposure to such massively increased RF has no precedent in history. There are no conclusive studies on the safety of such exposures, and the growing body of scientific evidence reports such bioeffects and adverse health effects are possible, if not probable. The Committee should advise that involuntary, public exposure to low-level cumulative RFR may be potentially harmful, based on the weight of the existing scientific evidence.

Public policies to address the issue of decision making in the face of this scientific uncertainty are evolving. The precautionary principle (erring on the side of conservatism) is frequently promoted by public health advocates given the massive public health risk that is possible if such exposure is carcinogenic or has other adverse bioeffects. Even if the risk to an individual is slight (which is at present unknown), the sheer number of people around the globe who may be at risk makes this policy choice of utmost importance. The virtual revolution in science taking place now is based on a growing recognition that non-thermal or low intensity RF exposure can be detected in living tissues and result in well-defined bioeffects. Bioeffects that are reported to result from RF exposure include changes in cell membrane function, metabolism, cellular signal communication, activation of proto-oncogenes, and cell death. Resulting effects which are reported in the scientific literature include DNA breaks and chromosome aberrations, increased free radical production, cell stress and premature aging, changes in brain function including memory loss, learning impairment, headaches and fatigue, sleep disorders, neurodegenerative conditions, reduction in melatonin secretion, and cancer. The Committee should require the wireless industry to provide complete, honest and factual information to consumers, to independently

monitor any health effects of mobile phone use, and to strongly urge public-member participation in the global policy-making and regulation-making processes on RFR exposures and technologies.

The United States has a de facto policy of "post-sales surveillance" with respect to cell phones. That means cell phones can be sold to the public, and only after years of use will there be studies to characterize what health consequences, if any, have arisen as a result. In shorter terms, "we are the experiment" for health effects. The Committee should reject "post-sales surveillance" as inadequate to protect existing users.

While the scientific community continues to study and understand the physical (and quantum mechanic) basis for electromagnetic effects on living systems, there is little to protect or inform the public about consequences of unlimited reliance on these new technologies. For all the potential good which such inventions bring to us, including the immeasurable benefit of the telecommunications/internet revolution, we must be vigilant about what consequences may come uninvited.

Appendix A: Significant Scientific Papers That the Committee Should Consider

The evidence for an association between RFR and bioeffects in living systems spans the entire range from effects on individual atoms (calcium) and molecules (DNA or the genetic code in each living cell) to humans and other mammalian species. In the past 50 years, experimentation across the electromagnetic spectrum of frequencies has found replicable bioeffects on everything from mice to men. The cascade of biological, chemical and physical events that occur in living systems in response to RFR is better understood as the multi-disciplinary scientific community and its science matures. Disease is not the only endpoint of this research. The potential medicinal applications of RFR treatment offer an unparalleled opportunities for healing and wellness.

Effects on DNA

Lai and Singh (1995) first reported DNA strand breaks from microwave RFR at low intensity levels. A dose-dependent increase in DNA single- and double-strand breaks in brain cells exposed at 0.6 W/Kg and 1.2 W/Kg whole body specific absorption rate (SAR) was found after two hours of exposure to 2450 MHz RFR. Using the sensitive comet assay for DNA breakage developed by NP Singh, it was reported that exposure to both continuous-wave and pulsed RFR produced DNA damage. Published results appeared in two peer-reviewed scientific journals: The International Journal of Radiation Biology (1996;69-4:513-521) and Bioelectromagnetics (1995; 16:207-210)

A year later in 1998, Jerry Phillips et al reported DNA single-strand DNA breaks exposed to cellular telephone frequencies 813.5 MHz and 836.5 MHz at low SAR (average 2.4 and 24 μW/g-1). Phillips used the same comet assay techniques used by Lai and Singh. This assay is widely used by researchers to detect DNA damage produced by ionizing radiation. Phillips postulated that DNA-repair rates may be affected by exposure to RFR (Phillips et al, 1998). Of related interest, Phillips reported that 60 Hz ELF exposure caused a significant increase in DNA single-strand breaks at 1 G in Molt-4 lymphoblastoid cells (Department of Energy Contractors Conference, Tucson, Arizona, Abstract A-8, November 1998). He postulates that ELF magnetic field exposure can affect both DNA damage and repair processes, and lead to cell death (apoptosis).

Conventional wisdom has traditionally held that microwaves are not genotoxic (directly damaging to the genome or DNA) unless high temperatures are created (thermal effect of microwaves on genome).

Blank and Goodman (1997) postulate that the mechanism of EM signal transduction in the cell membrane may be explained by direct interaction of electric and magnetic fields with mobile charges within enzymes. Recent studies on DNA show that large electron flows are possible within the stacked base pairs of the double helix of DNA molecules. Therefore gene activation by magnetic fields could be due to a direct interaction with moving electrons within DNA. Electric fields as well as magnetic fields stimulate gene transcription and both fields could interact with DNA directly. Prior work on heat shock proteins by Goodman and Blank is referenced in this paper showing that cellular reponse to EM fields is activation of the same stress response system seen in heating, but at very much lower energy than the response to heat shock (see Gene Transcription and Induction).

Chromosome Aberrations and Micronuclei

Maes et al (1993) exposed human peripheral blood lymphocytes to microwaves at 2450 MHz. A marked increase in the frequency of chromosome aberrations and micronuclei (the formation of abnormal chromosome fragments) was reported at nonthermal levels. Chromosome aberrations increased with increasing time exposure (a dose-response). One type of damage seen (the creation of dicentric chromosomes) is considered to be the "hallmark" of ionizing radiation exposure. These results are consistent with results of microwave radiation damage at other frequencies and power densities reported by other researchers (Leonard et al, 1983; Garaj-Vrhovac et al, 1990, 1991; d'Ambrosio et al, 1992).

Maes et al (1995) reported that whole blood exposed to the radiating antenna of a GSM base station showed increased chromosome aberrations when placed within a distance of 5 cm or less with two hour exposures. Combined effects of 954 MHz radiofrequency radiation and the chemical mutagen mitomycin C were studied by the same authors using human lymphocytes. Blood samples were exposed to AM radiation from a GSM base station at an estimated SAR of 1.5 W/Kg. Microwave exposure enhanced the harmful effect of the chemical mutagen and showed a clear increase in a form of chromosome aberration (sister chromatid exchange). Single strand DNA breaks were also reported.

Effects on ornithine decarboxylase (ODC)

Litovitz et al (1993, 1997a, 1997b) and Penafiel et al (1997) tested cells for production of ornithine decarboxylase (ODC) which is an enzyme found in rapidly growing tissues, particularly tumors. They report that amplitude-modulated microwaves (but not FM or continuous wave) significantly affect ODC activity in L929 cells at an SAR of about 2.5 W/Kg at 835 MHz cellular telephone frequency. The effect was reported with several types of amplitude modulation, including a TDMA cellular telephone. The effect was notable at particular modulation frequencies from 16 Hz to 65 Hz, but no effect was reported at 6 Hz or 600 Hz. Importantly, Litovitz reported that no EMF-enhancement of ODC was observed if the field was not constant in time over intervals of longer than 1-10 seconds. If frequency was varied at intervals of 1 second or less, no enhancement of ODC was reported.

Gene Transcription and Induction

Goswami et al (1999) report that proto-oncogene mRNA levels in fibroblast cells exposed to cellular telephone frequency radiation show increased expression of the Fos mRNA levels. Exposure to 835.62 MHz (frequency modulated continuous wave) showed a 2-fold increase in

Fos mRNA levels that was statistically significant. The 847.74 MHz (code division multiple access or CDMA) cellular telephone frequency exposure resulted in a 40% and 90% increase in Fos mRNA that was also statistically significant. These results indicate that specific genes (in this case proto-oncogenes) may be affected by exposure to RFR signals from cellular telephones.

Stress Response

Daniells et al (1998) found that nematodes respond to microwave radiation with a stress response that can be assayed in the same fashion as for stress related to heat and toxic chemicals. The nematode model for measuring stress response induced by microwave radiation shows that lower power levels induced larger stress responses (the opposite of a simple heating effect). Microwave radiation caused measurable stress and protein damage within cells (induction of hsp or heat shock protein) comparable to damage from metal ions which are recognized to be toxic. The authors conclude that clear biological effects of microwave radiation have been demonstrated in terms of activation of cellular stress responses (hsp gene induction).

Cellular Effects of Microwave Radiation

Calcium ion balance in living tissue is exquisitely important in the proper function of cell communication, cell growth and other fundamental life processes. Interactions of calcium at the cell membrane have been identified as the first link in bioeffects from RFR. The seminal work of W. Ross Adey and his research team, formerly at the Veterans Hospital at Loma Linda, California has detailed much of the cascade of events by which cellular processes are affected by RFR. Only selected work is presented here, but the reader is referred to the extensive scientific works and testimony on this topic (summarized in Adey, 1997).

Adey (1993) provides a comprehensive summary of microwave bioeffects at the cellular level supporting the concept of athermal responses not mediated by tissue heating. Amplitude-modulated or pulse-modulated microwave exposure is a particular focus. Adey discusses the impact of free-radicals in the brain and vascular systems and in the regulation of oxidative stress diseases including Alzheimer's and Parkinson's disease, coronary heart disease, aging and cancer. Microwave exposure at athermal levels may act as a tumor promoter, leading to tumor formation in the absence of other chemical promoters. He cautions that observed bioeffects of low intensity microwave exposure require further investigation, particularly for nonlinear, nonequilibrium cooperative processes.

Dutta et al (1989) reported that RFR caused changes in calcium ion efflux from both bird and cat brain tissues, and from human neuroblastoma cells. Significant calcium efflux was found at SAR values of 0.05 and 0.005 W/Kg (a very low energy absorption rate) with RFR at 147 MHz when amplitude-modulated at 16 Hz. Further, enhanced calcium efflux at 0.05 W/Kg peaked at 13-16 Hz and at the 57.5-60 Hz modulation ranges. According to the authors "These results confirm that amplitude-modulated RFR can induce responses in cells of nervous tissue origin from widely different animal species, including humans. The results are also consistent with the reports of similar findings in avian and feline brain tissues and indicate the general nature of the phenomenon."

Immune System Cellular Effects

Lyle et al (1983) reported that exposure to sinusoidally amplitude-modulated RFR at nonthermal levels can reduce immune function in cells. A 450 MHz radiofrequency field was modulated with a 60 Hz ELF field. Tests showd that
the unmodulated carrier wave of 450 MHz by itself had no effect, and modulation frequencies of 40, 16 and 3 Hz had progressively smaller effects than 60 Hz. Peak suppression of the lymphocyte effectiveness (immune function effectiveness) was seen at 60 Hz modulation.

Veyret et al (1991) found that exposure to very low power, pulsed microwaves significantly affects the immune system (either sharp increases or decreases in immune response) at specific amplitude-modulated frequencies. Pulsed microwaves at 9.4 GHz were amplitude-modulated at modulation frequencies between 14 and 41 MHz and at power density of 30 μ/cm2, whole-body average SAR of about 0.015 W/Kg. Importantly, in the absence of amplitude-

modulation, exposure to the microwave frequency alone did not affect immune function. It was only with the addition of amplitude-modulation that effects were seen.

Elekes (1996) found that the effect of amplitude-modulated RFR and continuous- wave RFR induced moderate elevation of antibody production in male mice (but not female mice). The carrier frequency was 2.45 GHz (which is used in industry) with a modulation frequency of 50 Hz (which is similar to the frequency of some mobile phone systems like TDMA and other ELF-modulated mobile phone systems). Power density was 0.1 mW/cm2, which corresponds to that allowed in the workplace for long-term exposure under Hungarian standards. Exposure was short-term, and the authors remark that the moderate increase in immune function may be related to the brevity of exposure.

Blood-brain Barrier

The blood-brain barrier has a vital role in the body to exclude toxins from the blood stream from reaching sensitive brain tissues. This barrier is known to protect the brain from toxic or other harmful compounds. It is selectively permeable, allowing some molecules like glucose to pass, but restricting others. It has a dual role in preventing the brain from damage, while stabilizing and optimizing the fluids surrounding the brain.

Salford et al (1994) showed leakage through the blood-brain barrier (or increased permeability) is caused by 915 MHz RFR. Both continuous wave (CW) and pulsed microwave RFR have the ability to open up the blood-brain barrier to leakage. Salford reported that the number of rats exposed to SARs between 0.016 and 5 W/Kg which showed leakage of the blood-brain barrier was 56 of 184 animals, compared to only 5 of 62 control animals. Whether this constitutes a health hazard demands further investigation, but the concept that the blood-brain barrier is clearly breached by both types of low power microwave radiation is concerning. At least ten other scientific papers cited in his reference list also show blood-brain barrier effects of RFR.

Cancer

From the genetic building blocks of life to the whole organism, ELF/RFR has been demonstrated to produce bioeffects, which may be deleterious to health. The basic functions of the body, which control proper cell growth, cell proliferation, immune surveillance and toxin protection is shown to be adversely affected, in many cases at environmental levels of exposure. Cancer as a disease endpoint of RFR exposure has been studied for two decades, and both animal and human studies point to a link between exposure under some conditions and cancer. The major concern with mobile telephone technology is its rapid growth around the world, putting millions of users at potential risk, and the emerging evidence for brain tumors.

Guy et al (1984) conducted studies for the US Air Force on rats in the first major research specifically designed to approximate effects of microwaves on human beings. Guy remarked there were more than 6000 articles on the biological effects of RFR by 1984, but the question of low-level exposure as a human health hazard was unanswered.

In historical perspective, this study provided the first and, to that time, the best study of potential effects from long-term exposure to RFR. John Mitchell (1992), Brooks Air Force Base Armstrong Laboratory, the sponsor of the Guy et al rat study concluded "at our request, Bill Guy took up this challenge and conducted a landmark long-term study that was longer and better conceived and conducted than anything done previously with RFR. To expose animals continuously for more than two years, as envisioned by the experimental protocol, a whole new concept of exposure facilities had to be created."

Objectives of the study were "in a population of experimental animals throughout their natural lifetimes, to simulate the chronic exposure of humans to 450 MHz RFR at an incident power density of 1 mW/cm2. Our primary interest was to investigate possible cumulative effects on general health and longevity." (USAFSAM-TR-85-64).

The first publication of the Guy rat study was in the 1985 US Air Force USAFSAM-TR-85-64 report "Effects of long-term low-level radiofrequency radiation exposure on rats". It reported a four-fold statistically significant increase in primary malignancies.

Chou and Guy (1992) later reported the results of their 1984 cancer studies on rats which found a four-fold statistically significant increase in primary malignant tumors in the 1992 Biolelectromagnetics Journal honoring Dr. Guy on his retirement. The article restated the 1984-85 finding of increased cancer in rats with microwave exposure over the lifetime of the animals. Exposure conditions involved SARs of 0.15 to 0.4 W/Kg of 2450 MHz pulsed microwave (square wave modulated at 8 Hz). Note that the current standard for public exposure is 0.4 W/Kg SAR.

Although the Guy study urged immediate follow-up and verification studies, no such studies were conducted for more than a decade.

Repacholi et al (1997) conducted mice studies using 900 MHz mobile phone frequency radiation and found a statistically significant 2.4-fold increase in lymphomas. Lymphoma risk was found to be significantly higher in the exposed mice. He concluded that long-term intermittent exposure to RFR can enhance the probability that mice will develop lymphomas. It is noteworthy that the animals were exposed to normal cell phone frequency RFR for only two one-half hour periods per day for eight months. Current human use of mobile phones can exceed 2000 minutes per day for business travelers.

A second study of mice and cancer conducted by Repacholi (Harris et al, 1998) with 50 Hz magnetic fields alone did not result in increased cancer rates. The authors conclude that "in contrast, when Pim1 mice were exposed to pulse-modulated radiofrequency fields (900 MHz), a highly significant increase in lymphoma incidence from 22% to 43% occurred. Perhaps the increased incidence of cancer that in some epidemiological studies has been associated with residential proximity to high-current power-distribution wiring results from exposure to high-frequency transients rather than the primary 50/60 Hz magnetic fields. In our study, the magnetic fields to which the mice were exposed were switched on and off in a manner that minimized the production of transients."

Hardell (1999) has reported increased risk of brain tumors in humans using cellular telephones. The main type of brain tumors found to occur were malignant glioblastomas and astrocytomas and non-malignant meningiomas and acoustical neuromas. An increased risk (although statistically insignificant) was found for malignant brain tumors on the same side of the head on which the cell phone was used for analog cell phones. The increased risk was 2.45-fold for right side use, and 2.40-fold for left side. GSM users did not have adequate use over time for there to be adequate evaluation of risk. No association between RFR and acoustical neuromas was reported.

Adey (1996) found a slight protective effect of microwave mobile phone exposure with respect to brain tumors in rats, where a reduced number of the expected brain tumors resulted. The exposure was for NADC (North American digital cellular) producing a TDMA signal at 836.55 MHz. No brain tumor enhancing effect was found. Apparent "protective" effects (fewer tumors) were discussed but did not reach statistical significance. The authors conclude that TDMA field had no enhancing effect on incidence, type or location of nervous system tumors, although some protective effect may be possible and further research is warranted.

Brain Symptoms Reported Using Mobile Phones

Mild et al (1998) reported on a joint Swedish-Norwegian epidemiological study of cases using both GSM digital and analogue mobile phones. A statistically significant association between calling time/number of calls per day and the prevalence of warmth behind/around the ear, headaches and fatigue was reported. However, GSM digital phones were less associated with these symptoms than analogue phones. The Swedish data show that GSM users reported less headache and fatigue than for analogue users. Warmth sensations were also reported lower among GSM users.

Mobile phone usage was tested in humans (Hocking, 1998) to investigate whether normal use could result in immediate symptoms of the head and neck. He reported that of 40 respondents, headaches with pain radiating to the jaw, neck, shoulders or arm in a few respondents. A majority reported that sensations of head pain started in less than five minutes after commencing phone calls, and another 12 felt the sensation build up as the day progressed. All could distinguish the headaches as different in quality from typical headaches. Eleven cases reported transient effects on vision such as blurring. Fifteen cases reported feelings of nausea or dizziness or a "fuzziness" in the head, which made thinking difficult. One case had long-standing tinnitus, but after a prolonged mobile phone call developed deafness and vertigo lasting five hours. Three cases transferred the mobile phone to a belt. One reported pain in the area at nighttime and another felt a cold area over the place it was worn on the hip. A third person reported pain similar to injured muscles. Twenty eight cases reported symptoms using GSM digital mobile phones and ten with analogue mobile phones. Of the former, thirteen said they had used analogue phones without developing symptoms felt with GSM digital phones. Twenty two said they used mobile phones more than five times per day, and thirty four had changed their use of mobile phones as a result of symptoms.

Neurological Effects (Nervous System)

Neurologic effects of RFR have been examined at several levels in living organisms. At the ion and molecular levels there are many effects reported and replicated at nonthermal levels. These effects include calcium changes (essential cell communication and growth regulation), neurotransmitters (chemicals that conduct nerve signals and control such things as appetite, mood, behavior, drug responses, sleep, learning and memory), behavioral (memory and learning impairment in rats and humans), and on sleep disorders.

Lai (1994a) prepared a review of the literature on neurological effects of RFR on the central nervous system. It provides a concise overview of how the central nervous system (CNS) should normally work, and how RFR has been reported to affect functions of the CNS. The nervous system coordinates and controls an organism's response to the environment through autonomic and voluntary muscular movements and neurohumoral functions. Behavioral changes could be the most sensitive effects of RFR exposure.

The movement of calcium ions in brain tissue is changed by RFR. Calcium ions control many brain and body functions including the release and receptor function of neurotransmitters, and any change in their functioning could significantly affect health.

Psychoactive Drugs

The action of psychoactive drugs depends on proper functioning of neurotransmitters. RFR changes some neurotransmitter functions, which lead to changes in the actions of psychoactive drugs. Lai reports that RFR alters pentobarbital-induced narcosis and hypothermia at 0.6 W/Kg in rats. The nervous system becomes more sensitive to convulsions induced by drugs like pentylenetetrazol. RFR exposure makes the nervous system less susceptible to curare-like drugs that are used in anesthesia to paralyze patients during surgery. Antianxiety drugs like valium and librium may be potentiated in the body with RFR exposure. Lai has postulated that the endogenous opioids are activated by low-level RFR exposure (Lai, 1992, 1994b). This hypothesis can explain increased alcohol consumption seen in rats during RFR exposure, and the lessening of withdrawal symptoms in morphine-dependent rats. RFR-psychoactive drug interactions can be selectively blocked by pretreating animals with narcotic antagonists (i.e., compounds that block the actions of endogenous opioids) before exposure to RFR, suggesting that the endogenous opioid system is activated by RFR (Lai et al, 1986).

Serotonin

Serotonin activity is reported to be affected by RFR. Drugs which cause a depletion of serotonin (like fenfluramine) by themselves cause a severe and long-lasting depletion of serotonin together with RFR exposure (Panksepp, 1973 in Lai, 1994). Lai (1984) reported that hyperthermic effects of RFR could be blocked by pre-treatment by serotonin antagonists suggesting that the hyperthermia was caused by activation of serotonergic activity by RFR. Drugs which decrease serotonin activity in the brain are shown to suppress aggressive behavior (Panksepp et al, 1973 in Lai, 1994). Serotonin-related functions include sleep, learning, regulation of hormone secretion, autonomic functions, responses to stress and motor functions (Lai et al, 1984). In humans, a cluster of symptoms called serotonin-irritation syndromes include anxiety, flushing, headache and migraine headache and hyperperistalsis which are related to hyperserotonergic states (Lai et al, 1984). Further work to define the relationship between RFR and serotonin has not taken place.

Eye Damage

Drugs can also enhance the adverse effect of RFR on the eyes. Kues et al (1992) reported that a drug treatment used for glaucoma could worsen the effect of RFR on corneal eye damage.

Behavioral Changes

Behavioral changes due to RFR are reported in many scientific studies (D'Andrea, 1999). The performance disruption paradigm that is based acceptable levels of RFR on thermal limits does

not take into account reports of microwave effects on cognitive performance. D'Andrea (1999) discusses that "it is likely that effects on cognitive performance may occur at lower SARs than those required for elicitation of behavioral thermoregulation at levels that totally disrupt ongoing behaviors". Further, "the current literature on heat stress does not provide data or models that predict the behavioral effects of microwave absorption at low SAR levels". Finally, he notes that "the whole-body and partial-body absorption of microwaves (hotspots) is unique at each frequency in the range of 10 MHz to 100 GHz". Hotspots vary dramatically with RFR frequency, shape and size of the mammal and the animal's orientation in the field (D'Andrea, 1999). Performance of cognitively mediated tasks may be disrupted at levels of exposure lower than that required to behavioral changes due to thermal effects of RFR exposure. "Unlike the disruption of performance of a simple task, a disruption of cognitive functions could lead to profound errors in judgment due to alteration of perception, disruption of memory processes, attention, and/or learning ability, resulting in modified but not totally disrupted behavior." (D'Andrea, 1999).

Nervous and behavioral effects of RFR on humans have been reported for five decades. Silverman (1973) is an early reviewer of health effects linked to microwave exposure. She recounts that "the little experimental work that has been done on man has pointed towards possible alterations of the sensitivity of various sense organs, particularly auditory and olfactory threshold changes. There have been numerous case reports, rumors and speculations about the role of microwave radiation in a variety of disorders of the brain and nervous system, such as a causitive role in severe neurotic syndrome, astrocytoma of the brain, and a protective role in multiple sclerosis. In the main, however, the nervous and behavioral effects attributed to microwave irradiation at issue are those found in clinical studies of groups occupationally exposed to various intensities and frequencies of microwaves for variable but generally long periods of time." She discusses nonthermal effects of low-dose, long-term exposure in nine clinical studies of workers exposed to microwave-generating equipment in Czechslovakia, Poland, the USSR and USA. All studies show nervous system effects. Silverman notes that such published studies "virtually ceased in the USA after the 1950's while considerable investigation continued to be reported from the USSR and other eastern European countries".

Raslear et al (1993) reported that significant effects on cognitive function in rats were clearly observed with RFR exposure, particularly in the decision-making process.

Learning and Memory

Lai et al (1994) found that rats exposed for 45 minutes to 2450 MHz RFR at whole-body SAR of 0.6 W/Kg showed a learning deficit in the radial-arm maze which is a behavioral task involving short-term spatial memory function. In searching for the mechanisms for this deficit in learning and memory, Lai found that a drug that enhances cholinergic activity in the brain could block this microwave-induced learning deficit in the maze. Cholinergic systems in the brain are well known to be involved in spatial learning in the radial-arm maze (Lai et al, 1994).

Cognitive Functions

Preece (1999) reported that RFR at cell phone frequencies speeded the rate at which humans responded to tasks (reaction time) but did not affect memory. Students were exposed to both analog and GSM digital phone signals for one half an hour, and then were tested for memory and speed and accuracy on cognitive tests. The higher the power from the cell phone signal, the faster the response time was reported, indicating the cell phone signal is not biologically neutral but can affect the brain's activity.

Sleep

Sleep disruption related to RFR has been reported in several scientific studies. Mann et al (1996) reported that RFR similar to digital mobile telephones reduced REM sleep in humans and altered the EEG (brain wave) signal in humans during REM sleep. REM sleep is essential for information processing in the brain, particularly with respect to learning and memory functions. It is thought to be needed for selecting, sorting and consolidating new experiences and information received during the waking state, and linking them together with old experiences.

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Bioelectromagnetics 18:563–577 (1997)

Summary of Measured Radiofrequency Electric and Magnetic Fields (10 kHz to 30 GHz) in the General and Work Environment

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We have plotted data from a number of studies on the range of radiofrequency (RF) field levels associated with a variety of environmental and occupational sources. Field intensity is shown in units of volts/meter (V/m) for electric field strength and amps/meter (A/m) for magnetic field strength. Duty factors, modulation frequencies, and modulation indices are also reported for some sources. This paper is organized into seven sections, each cataloging sources into appropriate RF frequency bands from very-low frequency (VLF) to super-high frequency (SHF), and covers frequencies from 10 kHz to 30 GHz. Sources included in this summary are the following: Coast Guard navigational transmitters, a Navy VLF transmitter, computer visual display terminals (VDTs), induction stoves or range tops, industrial induction and dielectric heaters, radio and television broadcast transmitters, amateur and citizens band (CB) transmitters, medical diathermy and electrosurgical units, mobile and handheld transmitters, cordless and cellular telephones, microwave ovens, microwave terrestrial relay and satellite uplinks, and police, air traffic, and aircraft onboard radars. For the sources included in this summary, the strongest fields are found near industrial induction and dielectric heaters, and close to the radiating elements or transmitter leads of high power antenna systems. Handheld transmitters can produce near fields of about 500 V/m at the antenna. Fields in the general urban environment are principally associated with radio and TV broadcast services and measure about 0.1 V/m root-mean-square (rms). Peak fields from air traffic radars sampled in one urban environment were about 10 V/m, 300 times greater than the rms value of 0.03 V/m when the duty factor associated with antenna rotation and pulsing are factored in. *Bioelectromagnetics 18:563-577, 1997.* © 1997 Wiley-Liss, Inc.†

Key words: radiofrequency; microwave; exposure; environmental; occupational

INTRODUCTION

Measurements have been reported over the past 20 years that quantify environmental and workplace radiofrequency (RF) fields from a variety of systems. These results have been reported in a scattered literature that includes government reports with limited circulation and excessive detail. We have collected the results of these studies and present them here in a graphical format using standard field strength units. In some cases, the field strength values reported here have been scaled to allow for standardized exposure distances or for changes in typical transmitter power levels. These scalings are detailed in the main text.

This paper is limited to summarizing field strengths and does not make comparisons with permissible exposure limits recommended in various standards and guidelines. Specific absorption rate (SAR), a measure of dose rate as opposed to exposure, is the primary parameter for comparison to safety standards regardless of external field strength. Knowledge of instantaneous SAR or internal field is more fundamental than an external field strength measurement. This is particularly important in the near field of small sources such as handheld transmitters, where electric and magnetic field strength maxima do not necessarily occur at the same point in space or produce high peak SARs.

In addition to field strength, the time variation

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TABLE 1. Frequency Bands and Sources Included in Summary

Descriptive band designation	Abbreviation	Frequency range	Sources included
Very-low frequency	VLF	3 to 30 kHz	Omega navigational transmitters, a Navy communication transmitter, visual display terminals, induction stoves
Low frequency	LF	30 to 300 kHz	Loran navigational transmitters
Medium frequency	MF	300 to 3000 kHz	AM broadcast, 160 meter amateur radio, induction heaters, electrosurgical units
High frequency	HF	3 to 30 MHz	International broadcast, amateur and citizens band radio, dielectric heaters, shortwave diathermy
Very-high frequency	VHF	30 to 300 MHz	FM broadcast, VHF television, mobile and handheld transmitters, cordless telephones
Ultra-high frequency	UHF	300 to 3000 MHz	UHF television, cellular telephones, microwave ovens, microwave diathermy, air traffic radars
Super-high frequency	SHF	3 to 30 GHz	Microwave relays, satellite uplinks, aircraft onboard radar, police radar

(or modulation) and spatial character of the fields are discussed. As an example of spatial character, data on three exposure scenarios are included for broadcast stations. We first describe a range of general environmental levels; second, the range of field values found near grade or at buildings in the immediate vicinity of the transmitting antenna; and third, possible exposure values for an individual climbing the antenna tower. The temporal character of pulse or amplitude modulated fields is also considered, especially when there are large differences between peak and root-mean-square (rms) values.

This work is intended as an overview and bibliography for typically encountered RF fields. Earlier reviews contain more descriptive information on how fields are measured, calculated, and shielded [Stuchly, 1977; Hankin, 1986; Stuchly and Mild, 1987; Joyner, 1988; Mild and Lovstrand, 1990]. This summary is organized into the seven RF bands and covers the sources shown in Table 1.

As an example graph, Figure 1 displays the range of electric and magnetic field strengths measured in the very-low frequency (VLF) band from 10 to 30 kHz. This format communicates information about frequency and wavelength, relative field strengths, and the ratio of electric to magnetic field strength (field impedance). Each graph uses the same scales for electric and magnetic field strength, which are aligned so that the values found on a horizontal line correspond to the idealized case of fields in a plane electromagnetic wave propagating in free space where the ratio of the electric to the magnetic field strength magnitude is 377 ohms. A single data set is shown as a rectangle; its boundaries give the frequency and wavelength range and either the electric or magnetic field strength range for the data set. The rectangle is filled with hatching down to the right if electric field strength values are represented or filled with hatching down to the left for magnetic field strength data. For example, the upper rectangle for the induction stove represents magnetic field strengths ranging from 0.7 to 1.6 A/m in a frequency range of 26 to 29 kHz and wavelength range of 10.3 to 11.5 km.

Overlapping electric and magnetic field strength data sets result in a cross-hatched region, indicating a range of field magnitudes with ratios similar to 377 ohms. It is important to understand that in the near field case, the overlap is coincidental; i.e., the fields may not be related by 377 ohms. The typical rectangle represents the extreme range of field strengths measured at some fixed distance from a specific type of field source in several studies. However, each data set is defined individually in an effort to summarize the essence of each study. For example, some rectangles represent variation with distance and should not be considered a statistical sample.

For the sample data sets, the underlying statistical distribution of field strengths is typically log-normal. Because the field scales are logarithmic, in some cases one can visualize a normal distribution in the third-dimension oriented perpendicular to the page with low probability extreme values at the top and bottom rectangle boundaries, and with most values clustered near the center.

For graphical clarity and separation of data sets, the frequency range plotted is often schematic—the text gives exact frequency values. Also, reported field strengths can be found in the text that are not shown in the graphs. Where data sets overlap, obscure other data, or do not add qualitatively to the graph, the data is included only in the text.

Electric and magnetic field strength units have been used for all bands. Plane-wave equivalent power density units are normally used at higher frequencies.

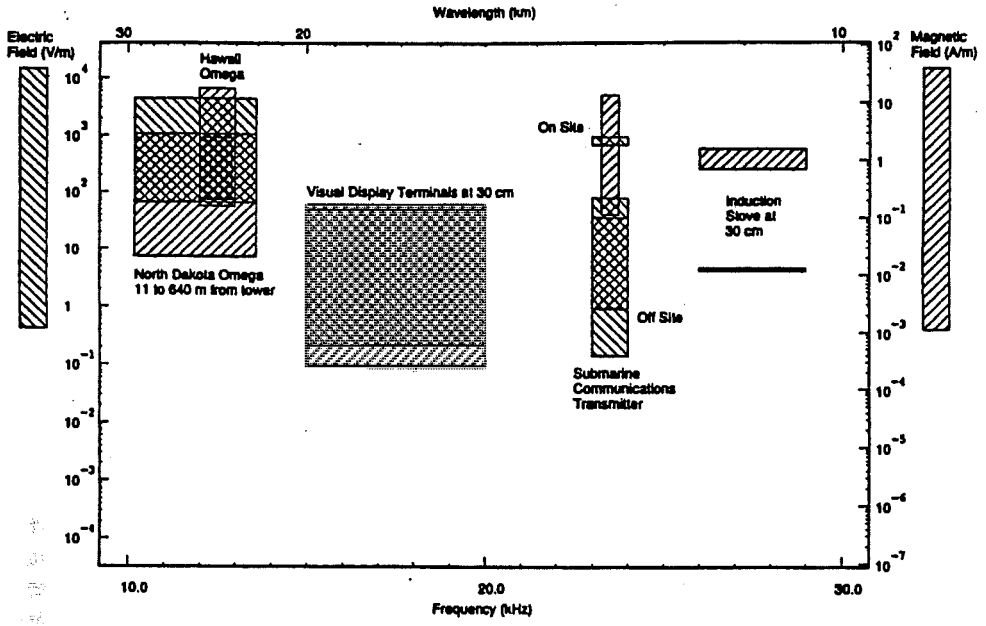

Fig. 1. Very-low frequency band.

This power density (S) in milliwatts per square centimeter (mW/cm^2) may be obtained from the electric field strength (E) using $S(mW/cm^2) = [E(V/m)]^2/3770$. Similarly, to convert the magnetic field strength (H) to power density use $S(mW/cm^2) = [H(A/m)]^2(37.7)$. Note that while power density may be scaled in direct proportion to power or duty cycle, rms field strength scales in direct proportion to the square root of power or duty cycle.

VERY-LOW FREQUENCY: 10 TO 30 kHz

The wavelengths for this frequency range vary from 30 km at 10 kHz to 10 km at 30 kHz. Antennas designed to transmit or radiate electromagnetic waves at these long wavelengths are large structures driven at high voltage. The typical antenna is similar to that for a standard AM radio broadcast station in which the entire tower is part of the antenna. However, in contrast to most AM. antennas, many VLF antennas use extended wire structures connected to the top of a tower or transmitter lead (feed line) to increase the effective height of the antenna. In all cases, the radiating structure is insulated and driven at some high RF potential referenced to a buried radial ground wire system. Large VLF transmitting systems that have been studied include omega navigational systems and the VLF submarine communication system at Lualualei, Hawaii. Sources such as visual display terminals (VDTs) and induction heaters can be described as near-field sources because VLF electric and magnetic fields are generated in their immediate vicinities but are not radiated as electromagnetic waves. Also, electric and magnetic field strength maxima may not occur at the same location. Figure 1 displays the range of field strengths measured for some VLF sources.

Omega Navigational Transmitters

There are eight "omega" very-long-distance navigational transmitters in the world. Two are in the United States—one in North Dakota and one in Hawaii [Gailey, 1987]. Omega transmitters switch between frequencies ranging from 10.2 to 13.6 kHz in a repeating 10-s cycle. The transmission is a series of eight single-frequency sinusoidal carriers switched on for 0.9 to 1.2 s with a pause of 0.2 s between each carrier. The drive voltage on omega antennas is about 250 kV. The North Dakota antenna is a single top-loaded tower, whereas the Hawaii antenna is an array of horizontal wires stretched across a valley and connected to the transmitter by a vertical feed line. For the North Dakota station, the measured rms electric field strength varied with distance along one radial from 66 V/m at 640 m to 4400 V/m at 12 m from the tower base. Similarly, the rms magnetic field strength varied from 20 mA/m at 640 m to 2.9 A/m at 11 m from the tower. The Hawaii omega station antenna is more complex, and so are the field variations. For example, outside the station building, electric field strengths varied from 57 to 938 V/m and magnetic field strengths varied from

1.2 to 4.4 A/m. The maximum magnetic field strength at the Hawaii site was 18 A/m near the main feed line [Gailey, 1987]. Other investigators reported magnetic field strengths from 0.2 to 6.2 A/m in the transmitter building and near the feed line [Guy and Chou, 1982].

VLF Submarine Communications System

The U.S. Navy operates a 23.4 kHz VLF submarine communications system at Lualualei, Hawaii [Mantiply, 1992]. The signal is frequency modulated with a small deviation relative to the carrier frequency so that it appears to be a constant sinusoidal carrier for field measurement purposes. Outside the station boundary the measured electric field strength varied from 0.15 to 82 V/m and the magnetic field strength varied from 2.5 to 99 mA/m. These measurements were made at distances between approximately 0.8 and 7 km from the transmitting antennas. On-site measurements [Guy and Chou, 1982] showed that the electric field strength varied from 972 to 700 V/m between about 80 and 150 m from the antenna. Measured magnetic field strength in the transmitter building and near the feed line varied from 0.11 to 14 A/m.

Visual Display Terminals

The common VDT employs a vertically oriented sawtooth-waveform VLF magnetic field that rapidly sweeps the electron beam horizontally across the screen. Horizontal extremely low-frequency (ELF) magnetic fields slowly sweep the electron beam vertically, but these ELF fields are outside the scope of this paper. VLF electric fields are also generated by the flyback transformer in the high-voltage power supply. The fundamental frequency of the VLF field is between 15 and 35 kHz (some high resolution terminals operate at higher frequencies) and harmonics exist up to several hundred kilohertz. Many studies and reviews have been made of fields near VDTs [Stuchly et al., 1983; Marha et al., 1983; Guy, 1987; Charron, 1988; Jokela et al., 1989; Tell, 1990; Tofani and D'Amore, 1991; Walsh et al., 1991; Schnorr et al., 1991; Kavet and Tell, 1991; Mild and Sandstrom, 1992]. Reported VLF electric field strengths 30 cm (1 foot) in front of the screen center, range from 0.22 to 52 V/m, and mean values reported by different investigators vary from 0.83 to 12.5 V/m. Reported VLF magnetic field strengths measured at 30 cm range from 0.26 to 170 mA/m, and mean values reported vary from 20 to 85 mA/m. These means are rms field strength summary values reported in some of the studies.

Induction Heating Stoves

Induction heating stoves used in the home generate VLF magnetic fields with fundamental frequencies of about 22 to 34 kHz. These range tops heat food by inducing eddy currents in cooking utensils. Electric and magnetic field strengths have been measured near two stoves heating a variety of utensils [Stuchly and Lecuyer, 1987]. At 30 cm from the stove, electric field strengths averaged 4.3 to 4.9 V/m and magnetic field strengths varied from 0.7 to 1.6 A/m.

LOW FREQUENCY: 30 TO 300 kHz

Loran Navigational Transmitters

Loran navigational transmitters emit a pulsed signal centered at 100 kHz. Each transmitter generates a unique pulse train repeating at 10 Hz. Depending on the pulse train, instantaneous peak fields vary from 11 to 18 times greater than the rms fields reported here. Electric and magnetic field strengths were measured at nine different loran stations. Electric field strength varied from 28 to 350 V/m and magnetic field strength varied from 0.6 to 2.9 A/m at distances of 3 to 4 m from the antenna base or feed point. At a distance of 300 m the electric field strength varied from 3 to 9 V/m, and the magnetic field strength varied from 6 to 41 mA/m [Gailey, 1987]. These field values are shown in Figure 2.

The strongest fields are found in close proximity to the antenna insulator (electric field) or tuning coils (magnetic field). For example, at eight stations, the maximum electric field strength varied from 463 to 2830 V/m, and the maximum magnetic field strength varied from 3.8 to greater than 10 A/m [Gailey, 1987]. The electric and magnetic field maxima are not found at the same point in space. In another study, magnetic field strengths up to 52 A/m near loran feeds were reported [Guy and Chou, 1982].

MEDIUM FREQUENCY: 300 kHz TO 3 MHz

The medium frequency range from 300 kHz to 3 MHz has corresponding wavelengths of 1000 to 100 m. Sources that operate in this frequency range include AM standard broadcast transmitters operating at frequencies between 535 to 1705 kHz with wavelengths of 560 to 176 m, amateur radio transmitters at 1.8 to 2.0 MHz in the 160-m wavelength band, and industrial and medical devices such as induction heaters and electrosurgical units. Figure 3 summarizes fields in the medium frequency band.

AM Standard Broadcast

Studies of general population exposure in the United States showed that approximately 3% of the urban population were exposed to electric field strengths greater than 1 V/m from AM broadcast ser-

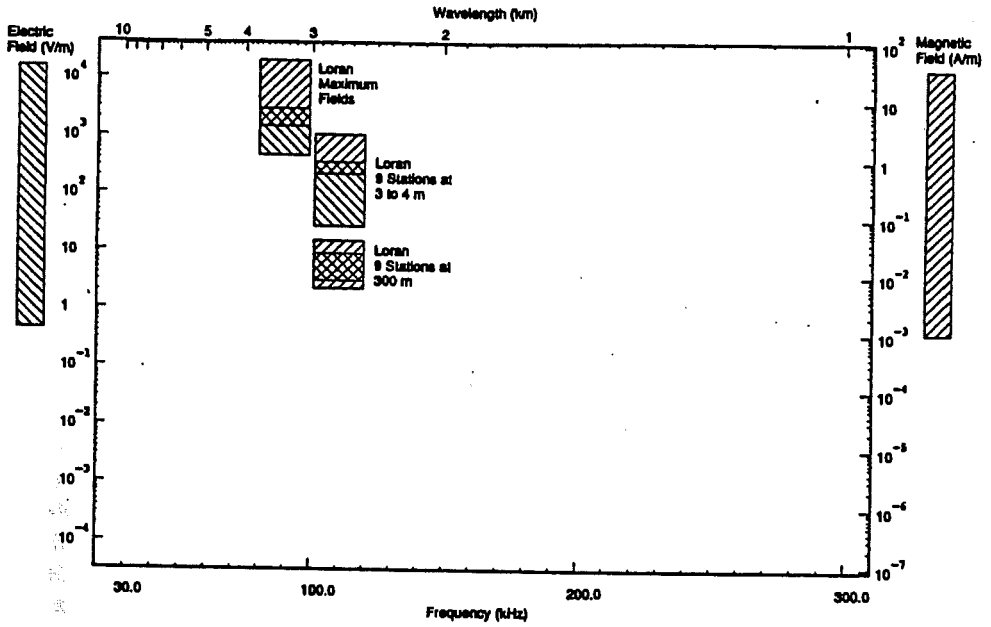

Fig. 2. Low frequency band.

vices. Ninety-eight percent of the population were exposed to greater than 70 mV/m, and the median exposure was about 280 mV/m [Hankin, 1986].

Electric and magnetic field strengths were measured near eight typical AM broadcast stations [Mantiply and Cleveland, 1991]. The fields were measured from 1 to 100 m from the center of each tower base. One station operated at the maximum power of 50 kilowatts (kW); three stations operated at approximately 5 kW; and the remaining four stations operated at 1 kW. Fields were measured along three radials at most stations. In the near field, at distances of 1 or 2 m, electric field strengths varied from 95 to 720 V/m and magnetic field strengths varied from 0.1 to

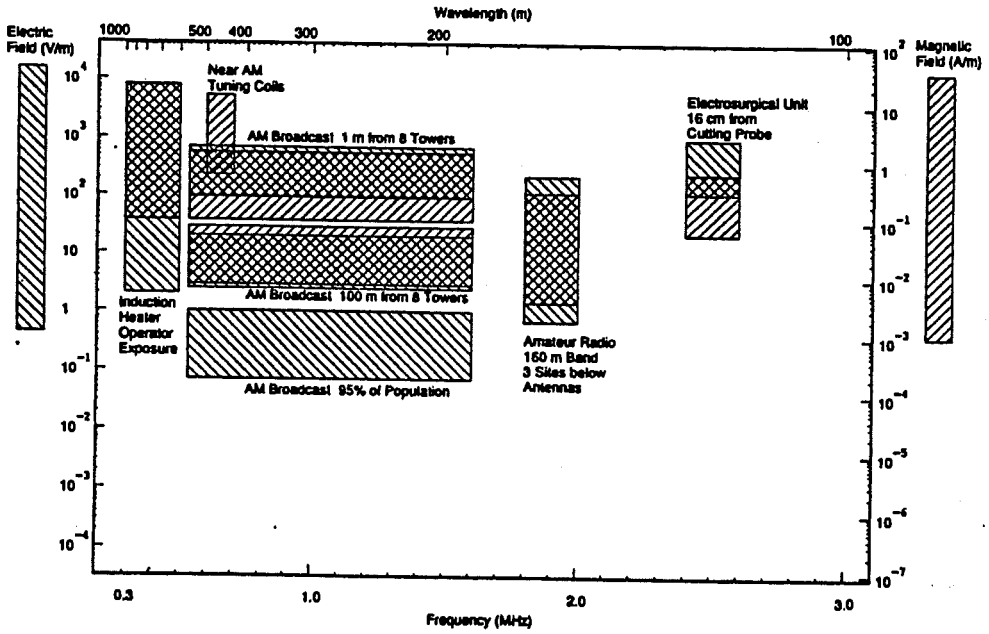

Fig. 3. Medium frequency band.

1.5 A/m. At 100 m from the tower, electric field strengths varied from 2.5 to 20 V/m; magnetic field strengths varied from 7.7 to 76 mA/m.

Fields were measured close to five AM towers operated at up to 30 kW in the Honolulu, Hawaii area [U.S. EPA, 1985]. Accessible regions near the tower base or tuning network were probed for maximum electric and magnetic field strength. The maximum electric field strength at the five towers varied from 100 to 300 V/m and the maximum magnetic field strength varied from 0.61 to 9.3 A/m. Wang and Linthicum [1976] measured magnetic field strengths up to 14.4 A/m at about 60 cm from an antenna tuning coil at the base of a 50 kW AM tower.

Studies of field strengths at residences and at a school near AM radio stations have been made in Spokane, Washington, and Honolulu, Hawaii [Tell et al., 1988; U.S. EPA, 1985]. In Honolulu, measurements were made at high rise condominiums adjacent to a 30 kW AM broadcast tower. Electric field strengths at an outdoor recreational area on the roof of one building were typically 100 to 200 V/m, and the magnetic field strength was 120 mA/m. Indoors in a 30th floor apartment, the electric field strength was 2 to 3 V/m, and the magnetic field strength was 240 mA/m. Electric and magnetic field strengths were also measured inside and outside a single family house in Spokane near a 50 kW AM station. At locations outside on the family property where the fields did not appear to be perturbed, the electric field strength varied from 9 to 19 V/m. Perturbed electric field strength inside the house varied from 1 to 55 V/m. The magnetic field strength outside varied from 30 to 40 mA/m and inside varied from 31 to 49 mA/m. Electric and magnetic field strengths were also measured inside an elementary school in Spokane approximately 100 m from the same AM station. The electric field strength in the school varied from 1 to 28 V/m and the magnetic field strength varied from 22 to 470 mA/m. Unperturbed electric and magnetic field strengths at the school were estimated to be 15 V/m and 40 mA/m. Clearly, both electric and magnetic field strengths due to medium frequency AM broadcast can be either increased or decreased in the indoor environment relative to the unperturbed values found outdoors. Any vertically extended conductor in a building, especially when grounded, strongly perturbs the RF electric field. RF currents induced on these conductors can generate relatively strong localized magnetic fields.

Standard AM broadcast uses conventional double sideband amplitude modulation at audio frequencies. Amplitude modulation is measured in percent: if the root-mean-square field goes to zero, the signal is 100% modulated. Modulation index is the ratio of maximum modulating signed amplitude to the carrier amplitude. Measurement of nine different AM signals in Las Vegas, Nevada, showed ELF modulation indices from 4 to 30% in the modulation frequency range of 3 to 100 Hz [unpublished data].

Amateur Radio (160 Meter Band)

Amateur radio operators may transmit up to 1.5 kW (peak envelope power) in the 160-m wavelength band (1.8 to 2.0 MHz). Electric and magnetic field strengths in this band were measured at three amateur radio installations [Cleveland and Mantiply, 1996]. These measurements were made outdoors at 1 or 2 m above ground beneath active antenna wires. The operator set the transmitter for a constant carrier at 1.95 MHz. Beneath an open line "modified T" antenna feed operating at 500 watts, electric field strengths varied from 52 to 240 V/m and magnetic field strengths varied from 37 to 310 mA/m. Beneath an "inverted V" dipole operating at 100 watts the electric field strength varied from 0.7 to 5.4 V/m, and the magnetic field strength varied from 4 to 100 mA/m. Beneath another 160-m dipole antenna operating at 80 watts, the electric field strength varied from 5 to 22 V/m, and the magnetic field strength varied from 13 to 78 mA/m.

Induction Heaters

Industrial induction (eddy current) heaters are used to heat metals or semiconductors by generating a strong alternating magnetic field inside a coil. Frequencies range from 50 Hz to 27 MHz. Lower frequency units produce stronger magnetic fields that also penetrate and heat the material more deeply. Higher frequencies are used for surface heating or heating small volumes. The strongest magnetic field strengths measured have been for heaters operating at frequencies below 10 kHz that are outside the scope of this summary [Stuchly and Lecuyer, 1985; Mild and Lovstrand, 1990]. In five studies [Aniolczyk, 1981; Centaur, 1982; Stuchly and Lecuyer, 1985; Conover et al., 1986; Andreuccetti et al., 1988] measurements were made near medium frequency induction heaters operating from 250 to 790 kHz. These near fields vary greatly over small distances and with the type of unit and process. Typically, the electric field strength decreases from 1000 to 100 V/m and the magnetic field strength decreases from 20 to 0.5 A/m as distance from the coil is increased from 20 to 100 cm. Reported electric and magnetic field strengths (unperturbed) at the operator position vary from 2 V/m to 8.2 kV/m and 0.1 to 21 A/m, respectively. These field values are not corrected for duty cycle, which is typically 50%. It is likely that RF induction heater fields are amplitude modulated at multiples of the power frequency. Gen-

erally, 60 or 50 Hz ripple in the power supply is not controlled for sources used solely for heating.

Electrosurgical Units

Medical electrosurgical units operate from 0.5 to 2.4 MHz with significant harmonics and spurious frequencies up to 100 MHz. Electric and magnetic near fields measured under typical conditions varied from about 200 V/m and 0.1 A/m at 40 cm to about 1000 V/m and 0.35 A/m at 10 cm from the cutting probe lead. The fields also vary greatly depending on operating mode. At 16 cm, fields varied from 120 to 1000 V/m and 0.06 to 0.71 A/m depending on the mode of operation. The unit may operate with amplitude modulation at frequencies of approximately 10 to 30 kHz [Ruggera, 1977].

HIGH FREQUENCY: 3 TO 30 MHz

A major use of the HF band or shortwave range of frequencies (from 3 to 30 MHz with corresponding wavelengths of 100 to 10 m) is long-range communication by ionospheric reflection. Because of this propagation characteristic, there is always an HF background of fields from distant sources. For example, one set of measurements showed about 50 signals between 0.1 and 1 mV/m from 3 to 30 MHz [Mantiply and Hankin, 1989]. HF is used in long-range radio communications for international broadcast by governments and private organizations, amateur radio operators, commercial communication with aircraft and ships at sea, and military communications. Typical transmitter powers for amateurs are 100 or 1000 watts; other classes of operators typically use 2 to 30 kilowatts (kW); and broadcasters normally operate at 50 to 500 kW. HF sources are also used in industry and medicine for plastic welding and diathermy. Figure 4 summarizes the range of fields measured for several types of HF sources.

Amateur Radio

Electric and magnetic field strengths were measured at nine amateur radio transmitting sites. Fields were measured beneath antennas at a height of 1 to 2 m for various antenna configurations and frequency bands [Cleveland and Mantiply, 1996]. The average transmitter power varied from 100 to 1400 watts for these measurements. The transmitters were set to transmit a constant carrier (no duty cycle correction). The range of measured field strengths for each of five frequency bands (80, 40, 20, 15, and 10 m) are shown in Figure 4. For all five bands, electric field strengths varied from 1 to 200 V/m and magnetic field strengths varied from 2 to 1400 mA/m. These are "example" values. Fields greater than these values were measured in some bands very close to antennas or feed points. Amateur keyed carrier and single-sideband voice transmissions are amplitude modulated at frequencies below 100 Hz. For example, one measurement of an amateur keyed carrier signal resulted in 90% modulation from 3 to 100 Hz [unpublished data].

Citizens Band Radio

The citizens band (CB) 40 channel frequency band extends from 26.965 to 27.405 MHz. Most transmission is AM, but single sideband can be used. Electric and magnetic fields near several CB antennas have been investigated in some detail [Ruggera, 1979]. Tests were performed with the antennas operating at 27.12 MHz and 4 watts. Near fields were measured as a function of height at a horizontal distance of 5, 12, and 60 cm from the antennas. The maximum electric and magnetic field strengths measured at 5 cm varied from 230 to 1400 V/m and 0.1 to 1.3 A/m; at 12 cm, from 90 to 610 V/m and 0.05 to 0.8 A/m. At 60 cm, maximum electric field strengths varied from 18 to 60 V/m, and maximum magnetic field strengths were less than the instrument sensitivity of 0.04 A/m. Maximum electric field strengths were found near the top of the antenna, and maximum magnetic field strengths were observed near the base.

International Broadcast

High-power HF transmitters are used for international broadcasts by governments and private organizations. Measurements at two Voice of America (VOA) sites are included here. Typically, VOA uses 250 kW transmitters (standard amplitude modulation) and large rhombic or curtain type antennas. Also, 50 kW dual independent sideband transmitters are used for relay. At the Bethany, Ohio, VOA station electric field strengths of 2.5 to 100 V/m were measured beneath RF transmission lines and rhombic antennas [unpublished data]. A study near the VOA transmitter site at Delano, California, emphasized measurements of potential exposures in a community 10 km from the VOA transmitter [Mantiply and Hankin, 1989]. High frequency electric and magnetic field strengths in the community due to the VOA antenna were measured at six sites and four frequencies: 6.155, 9.765, 9.815, and 11.74 MHz. For any one frequency, electric field strength varied from 1.5 to 64 mV/m, and magnetic field strength varied from 0.0055 to 0.16 mA/m. The maximum HF electric and magnetic field strengths measured just outside the Delano VOA boundary were 8.6 V/m and 29 mA/m.

Electric and magnetic field strengths were also measured on the VOA Delano site [unpublished data] along traverses 1 m above ground and perpendicular

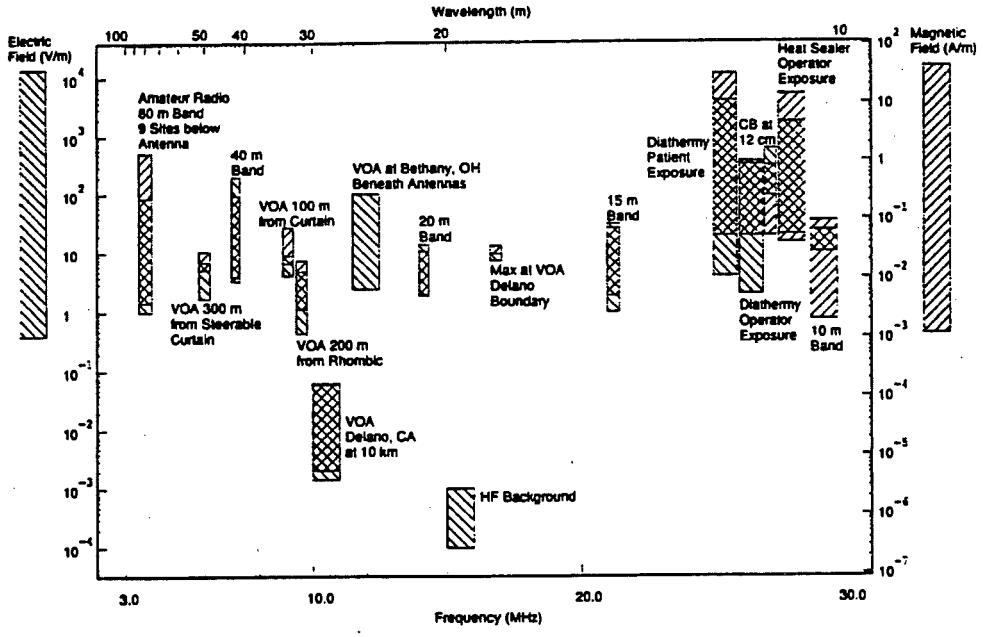

Fig. 4. High frequency band.

to the direction of propagation in front of a rhombic antenna and a conventional curtain antenna. Fields in front of a steerable curtain antenna were investigated by varying its operating direction. All three antennas were operated at 100 kW of input power. At a distance of 200 m in front of the rhombic antenna operating at 9.57 MHz, the electric and magnetic field strengths varied from 0.45 to 5.0 V/m and 3.0 to 20 mA/m, respectively, along the traverse. At a distance of 100 m in front of the conventional curtain antenna operating at 9.57 MHz the electric and magnetic field strength varied from 4.2 to 9.2 V/m and 18 to 72 mA/m along the traverse. At a distance of 300 m in front of the steerable curtain antenna operating at 5.96 MHz, the electric and magnetic field strength varied from 1.7 to 6.9 V/m and 14 to 29 mA/m as the antenna was electrically steered to angles of ± 25°.

Dielectric Heaters

Dielectric heaters (heat sealers) are used in industry to heat or weld nonconductors such as plastics by applying a strong alternating electric field between metal plates. Operating frequencies range from a few megahertz to greater than 120 MHz. The most common frequency is 27.12 MHz. Near fields measured at the operator's position are nonuniform and are not well correlated with system power and the electric and magnetic field strength maxima are not collocated. In 12 studies [Conover et al., 1975; Ruggera, 1977; Hietanen et al., 1979; Conover et al., 1980; Mild, 1980; Stuchly et al., 1980; Aniolczyk, 1981; Cox et al., 1982; Stuchly and Lecuyer, 1985; Joyner and Bangay, 1986; Bini et al., 1986; Conover et al., 1992], field measurements were made at various locations at the operator's body (head, chest, waist) for dielectric heaters operating from 6.5 to 65 MHz. In some of the earlier studies, measurements were made by simply positioning the field probe at the operator's body. More recent measurements have been made by positioning the probe at the operator's body as above, but then having the operator move away and reading the instrument with the operator absent. This procedure is an effort to prevent perturbation of the fields by the operator.

Measured electric and magnetic field strength in the 12 studies varied from about 20 to 1700 V/m and 0.04 to 14 A/m. Typical values are 250 V/m and 0.75 A/m. These values are not corrected for duty cycle and do not include values reported as greater or less than the range of a measuring instrument. Reported duty cycles varied from 2.5% to greater than 50%. Dielectric heaters typically operate 10% of the time.

Shortwave Diathermy

Shortwave diathermy is a medical treatment using continuous or pulsed 27 MHz RF fields to heat tissue within the body. RF power is coupled into the body using either insulated plates or a loop as an applicator. The applicator is connected to an RF power generator using two separate insulated leads. After the applicator is in place the generator is adjusted to optimize the

transfer of RF energy into a specific part of the body. Plate applicators generate relatively high electric fields to capacitively couple power into the tissue, whereas loop applicators generate relatively high magnetic fields to inductively couple power. Exposure of the patient is in the near field. Fields are produced along the leads from the generator as well as at the applicator.

The dominant source of fields at the operator's position may be the leads. Typical field strengths near the leads decrease from 2000 to 200 V/m and from 3 to 0.2 A/m as the distance from the cables increases from 5 to 35 cm. Two major studies found similar values for the fields at the operators' eyes and waists [Ruggera, 1980; Stuchly et al., 1982]. The range of values for the operator was 2 to 315 V/m for the electric field strength and 0.05 to 0.95 A/m for the magnetic field strength.

In one study [Kalliomaki et al., 1982] electric and magnetic field strengths were measured near the patient's body for various types of applicators or electrodes. As expected, patients are exposed to higher levels than operators. At the area of treatment, electric and magnetic field strengths varied from 400 to 4000 V/m and 3 to 30 A/m. At areas of the body not prescribed for treatment, field strengths varied from 20 to 4000 V/m and 0.2 to 14 A/m. Another investigator [Stuchly et al., 1982] found that electric and magnetic field strengths at untreated areas of the patient ranged from 4 to 2650 V/m and 0.05 to 1.6 A/m.

VERY HIGH FREQUENCY: 30 TO 300 MHz

The VHF frequency range is from 30 to 300 MHz with corresponding wavelengths of 10 to 1 m. Common sources include FM radio and VHF television broadcast stations. This frequency range is also popular for two-way voice communications. Note that at VHF and higher frequencies, transmitter towers are only support structures for antennas and not an active part of the antenna. Figure 5 shows the range of fields and population exposure for some VHF sources.

FM Radio Broadcast

The median electric field strength reported in urban areas in the United States from FM broadcast services (88 to 108 MHz) is about 0.1 V/m with 0.5% of the population exposed to field strengths above 2 V/m [Tell and Mantiply, 1980; Hankin, 1986]. The maximum electric field strengths at ground level beneath FM towers in the United States vary from about 2 to 200 V/m [Gailey and Tell, 1985; U.S. EPA, 1987]. One measurement, made on a rooftop directly below an antenna mounted 2 m above the roof, yielded an electric field strength of 800 V/m [unpublished data]. Measured fields on the transmitter tower varied from 60 to 900 V/m [Tell, 1976; Mild, 1981]; even higher electric field strengths exist within 30 cm of an antenna element. Magnetic field strengths up to 4.6 A/m have been reported near an element radiating about 300 watts in Sweden [Mild, 1981]. The power radiated from single antenna elements on U.S. towers is typically 5 kilowatts.

Fields from FM broadcast antennas are not intentionally amplitude modulated, but transmitter power supply imperfections can cause amplitude modulation (AM). In one case, significant 120 Hz AM was detected on an FM signal. Measurements on 10 FM radio stations showed amplitude modulation from 1 to 5% for frequencies between 3 and 100 Hz [unpublished data].

VHF Television Transmitters

The VHF television channels are separated into low band VHF-TV (channels 2 through 6) at 54 to 88 MHz and high band VHF-TV (channels 7 to 13) at 174 to 216 MHz. Calculations based on measurements in the late 1970s [Tell and Mantiply, 1980] showed that about 16% of the population were exposed to fields above 0.1 V/m and 0.1% were exposed to fields above 2 V/m due to low band VHF-TV. For high band VHF-TV, 32% of the population were exposed to electric field strengths above 0.1 V/m and about 0.005% were exposed to fields above 2 V/m. The maximum fields at ground level beneath VHF-TV towers are estimated to be between 1 and 30 V/m [Gailey and Tell, 1985]. Measured electric and magnetic field strengths on a transmitter tower adjacent (less than 30 cm) to a VHF-TV antenna radiating 4 kW were usually about 430 V/m and 2 A/m. Electric field strengths up to 900 V/m were seen in some cases [Mild, 1981].

The television signal consists of an amplitude-modulated video signal and a frequency-modulated audio signal. Amplitude modulation of 4 to 12% was measured for nine TV video signals at 59.94 Hz (the vertical retrace rate) [unpublished data].

Mobile Transmitters

Studies have been made of electric fields associated with VHF mobile transmitters in various motor vehicles with different antenna configurations [Lambdin, 1979; Adams et al., 1979]. Tests made with a 60 W, 164 MHz frequency-modulated radio resulted in electric field strengths ranging from 3.4 to 30 V/m, whereas tests made with a 100 watt, 41 MHz radio resulted in electric field strengths from 3.4 to 120 V/m near an occupant. Tests using 100 watt FM radios at 25, 35, 39, 51, and 145 MHz in a mid-size automobile resulted in fields from 50 to 150 V/m [Muccioli and Awad, 1987]. These fields were measured with the transmitter keyed and no correction for duty

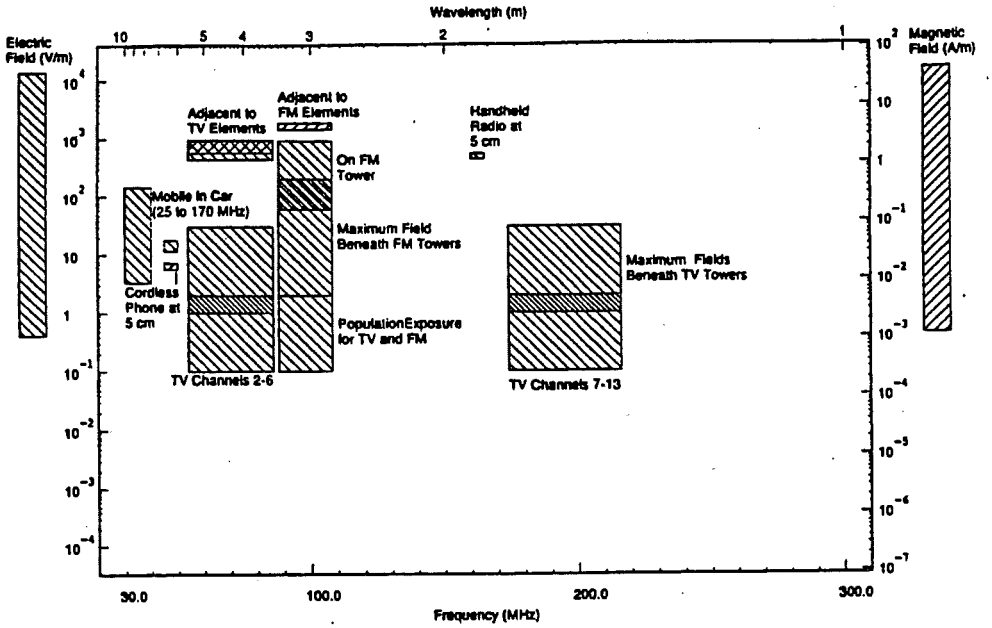

Fig. 5. Very-high frequency band.

cycle. The highest electric field strengths are normally seen near the occupant's head or the driver's hands. Magnetic field strengths were not reported. The replacement of metal with plastic and fiberglass in the bodies of newer vehicles can reduce shielding from an external antenna and increase occupant exposure.

Portable Transmitters

Electric and magnetic field strengths near handheld transmitters were measured by searching for the maximum unperturbed field 5 cm from any surface of the unit [unpublished data]. The largest electric and magnetic field strengths were typically found near the base of the antenna. The maximum electric and magnetic field strengths found near a 10 μW cordless telephone handset operating at 50 MHz were 15 V/m and 18 mA/m. Maximum fields near a 2 W handheld radio operating at 164 MHz were 470 V/m and greater than 0.73 A/m. As discussed in the introduction, these devices produce highly localized near-fields that may not couple well to the user and any comparison with safety standards requires dosimetric evaluation of SAR. That is, it is inappropriate to compare these fields with the corresponding field limits found in safety criteria.

ULTRA-HIGH FREQUENCY: 300 MHz TO 3 GHz

Use of the UHF frequency range of 300 MHz to 3 GHz (100 to 10 cm wavelength) includes UHF television, cellular telephone, microwave ovens, microwave diathermy, and air traffic control radar. Figure 6 shows the range of fields measured for several common UHF sources.

UHF Television Transmitters

The UHF-TV channels 14 to 67 operate in the frequency range of 470 to 806 MHz. Typical transmitter powers are on the order of 30 kW, with effective radiated powers (power into the antenna times the antenna gain over a dipole) of up to 5 MW. General-population exposure calculations showed that about 20% of the population was exposed to fields above 0.1 V/m and about 0.01% was exposed above 1 V/m [Tell and Mantiply, 1980]. Maximum electric fields at about a quarter wavelength above grade beneath UHF-TV towers were estimated to be between 1 and 20 V/m [Gailey and Tell, 1985; Hankin, 1986]. The maximum measured electric field strength near an antenna element was 620 V/m [Mild, 1981]. The modulation for UHF-TV is the same as for VHF-TV.

Cellular Telephones

Cellular base station transmitters in the United Staes operate in the frequency band of 869 to 894 MHz. Electric field strengths have been measured at about a meter above grade beneath base station antenna towers ranging in height from 46 to 82 m [Petersen and Testagrossa, 1992]. For simultaneous operation of up to 16 channels, the maximum electric field strength was found to be between 0.1 to 0.8 V/m. Portable and

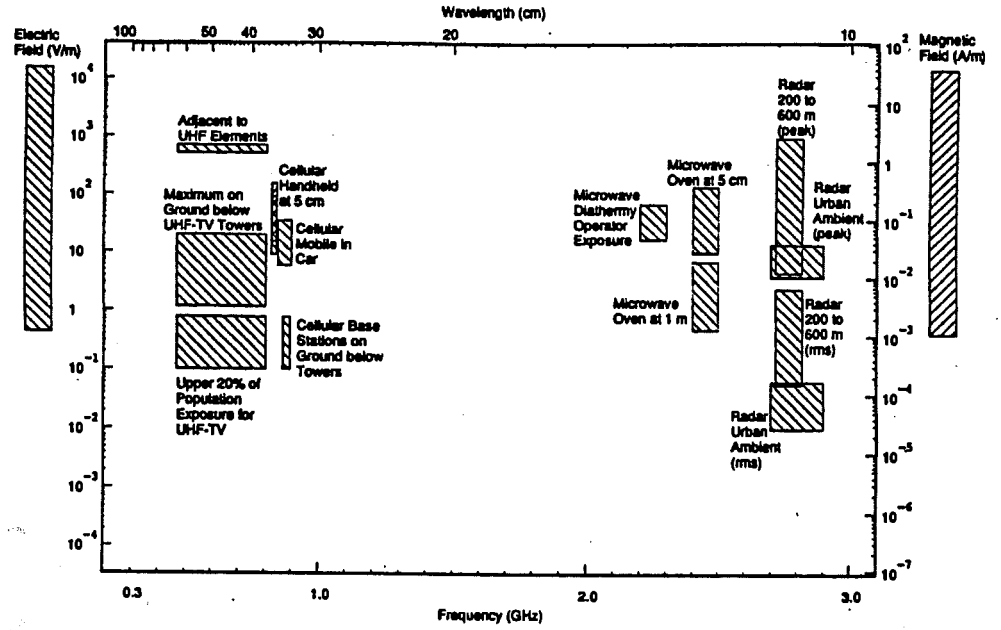

Fig. 6. Ultra-high frequency band.

mobile cellular telephones transmit in the frequency band of 824 to 849 MHz. The fields measured inside a car using an external antenna and 3 W transmitter were between 6 and 36 V/m [Balzano et al., 1986]. For handheld cellular phones, maximum fields of 9.4 to 94 V/m and 41 to 410 mA/m were calculated at a distance of 5 cm from the antenna for a variable power of 6-600 mW (current practice). This calculation is a simple scaling from measurements for an 800 mW fixed power phone [Balzano, 1984]. In that measurement, the maxima in both the electric and magnetic field strengths were found at the antenna base. As noted previously, these devices produce highly localized near-fields, and comparison with safety standards requires dosimetric evaluation of SAR.

These cellular telephone studies were made on systems using conventional frequency modulation, not the newer digital modulated systems. Note that the highest-frequency device for which the magnetic-field value is given in this paper is the handheld cellular phone. For sources operating at higher frequencies (and at many lower frequencies) only the electric field strength was measured. Also, as specified in the introduction, electric field strength may be converted to equivalent power density.

Microwave Ovens

Most household microwave ovens operate at 2.45 GHz and an RF power of about 600 W. Essentially all field measurements have been made at a distance of 5 cm from the oven and range from about 10 to 140 V/m [Mild and Lovstrand, 1990].

The electric field strengths 1 m in front of a microwave oven are estimated to range from 0.5 to 7 V/m, with typical values of 1 to 2 V/m when the oven is in use (with a typical load). The 1 m estimates are based on the 5 cm measurements, with the field decreasing by 1/r (where r is the distance from the front of the oven), which may be inaccurate if the physical size of the leaking area is large. However, this "point source" approximation has been previously justified [Osepchuck, 1979; Reynolds, 1989]. Microwave-oven fields vary in time in several ways. The field is amplitude modulated at 60 Hz because of the power supply. Operation of the field stirrer, changes in the load, such as boiling, and cycled low-power operation also amplitude modulate microwave oven fields.

Microwave Diathermy

Electric field strengths measured at the operator's location for a 2.45 GHz microwave diathermy system were between 17 and 70 V/m [Ruggera, 1980]. These values are lower than those reported for HF diathermy (2-315 V/m) because the shorter-wavelength fields are easier to control.

Pulsed Radar

Conventional pulsed radar emits a microwave pulse that is reflected from a target and returns before the radar antenna rotates significantly. The distance and

bearing to the target are determined from the time delay and antenna azimuth respectively. The pulsing and antenna rotation cause a large difference between peak and rms field strengths. For a typical air traffic radar, a 1-μs pulse is transmitted every 1000 μs, resulting in a pulse duty factor of 0.001. Also, the antenna rotates every 5 or 12 s and the horizontal width of the beam is about 3°, resulting in a 3°/360° duty factor for a full rotation. The total duty factor, which is the product of the rotation and pulse duty factors, is about 8×10^{-6}; therefore, the peak power density is 1.2×10^5 times higher than the average power density. Because the field strength is proportional to the square root of the power density, the peak field during the pulse while the narrow radar beam is directed at a measurement point is about 350 times higher than the rms field when pulsing and rotational factors are taken into account.

The peak-to-rms ratio is less in the near field or below the radar, where the radar beam is not well defined. Air traffic radars generally operate at about 1.3 or 2.8 GHz. The electric field strength measured at several locations at distances of 200 to 600 m from air traffic radars [Tell and Nelson, 1974a] were from 57 mV/m rms or 4.7 V/m peak to 2.5 V/m rms or 960 V/m peak. The results of measurements of all detectable radars operating from 1.3 to 9.5 GHz at three randomly chosen sites in the San Francisco area [Tell, 1977] were rms electric field strengths ranging from 10 to 64 mV/m and peak electric field strengths for any one radar of 4 to 14 V/m.

SUPER-HIGH FREQUENCY: 3 TO 30 GHz

The microwave SHF band from 3 to 30 GHz (wavelength of 10 to 1 cm) includes such sources as terrestrial microwave relays, satellite relay uplinks, onboard aircraft radars, and police traffic radars. Figure 7 shows measured fields for some of these sources.

Microwave Relay

Terrestrial point-to-point microwave radio is typically used to relay telephone traffic and data using frequency modulation with transmitter powers of about 1 W. The operating frequency varies for long-haul service from 2 to 13 GHz in several bands. Electric field strengths at ground level beneath microwave relay towers are in the range of 20 mV/m to 0.6 V/m [Petersen, 1980; Hankin, 1986].

Satellite Communications Uplinks

RF fields generated by a number of satellite uplink transmitters were measured in the community of Vernon, New Jersey [U.S. EPA, 1986]. Typical uplink transmitter powers are about 1 kW. In the 6 GHz band, fields varied from 70 V/m to 15 mV/m; in the 14 GHz band, from 0.2 to 33 mV/m. On a hill in front of one dish operating at a low elevation angle at 6 GHz, the electric field strength varied from 2.4 to 15 V/m. Calculations have shown that the maximum on-axis electric field strengths for individual satcom uplinks can range from 22 to 610 V/m [Hankin, 1986].

Aircraft Onboard Weather Radars

Measurements made in front of several aircraft onboard weather radars at 9.375 GHz typically showed rms fields ranging from 20 V/m at 10 m to 200 V/m at 10 cm. The calculated peak electric field strength in front of these radars was 19 kV/m [Tell and Nelson, 1974b; Tell et al., 1976]. Individuals could be exposed to these field strengths if the radar is operated while the aircraft is on the ground.

Police Traffic Radar

The maximum field in the transmitting aperture of police traffic radar units has been measured for some 5000 devices [Fisher, 1993]. For handheld 10.5 GHz units, the aperture field varied from 33 to 120 V/m; for 24 GHz units the aperture field varied from 27 to 125 V/m. Operator exposure was estimated to be from 1 to 15 V/m if the unit was pointed away from the operator. Fields at a distance of 30 to 300 m in front of these radars varied from about 1 to 0.1 V/m [Hankin, 1976]. Police radar units can be operated continuously and are not modulated.

DISCUSSION

Figure 8 is a compression of the data previously shown for each band. The major peaks represent the following measurement results: adjacent to omega and loran antenna feeds at about 10^{-2} and 10^{-1} MHz; for operators of industrial induction heaters and heat sealers at about 0.3 and 30 MHz; at the radiating elements of TV and FM antenna systems shown at about 70 and 100 MHz; for near fields at the antennas of handheld transmitters for CB, commercial use, and cellular telephone at about 30, 200, and 800 MHz; at the surface of some microwave ovens at about 2450 MHz, and for patients and operators of medical electrosurgical and diathermy equipment at about 2.4, 27, and 2450 MHz. These maxima represent real or potential exposures that are either occupational or voluntary.

In the occupational setting, there has been more characterization of exposure for industrial equipment operators than for workers at transmitter sites such as tower climbers and radar maintainers. However, transmitting antennas, which are engineered to intentionally generate fields, are relatively easy to characterize. Inci-

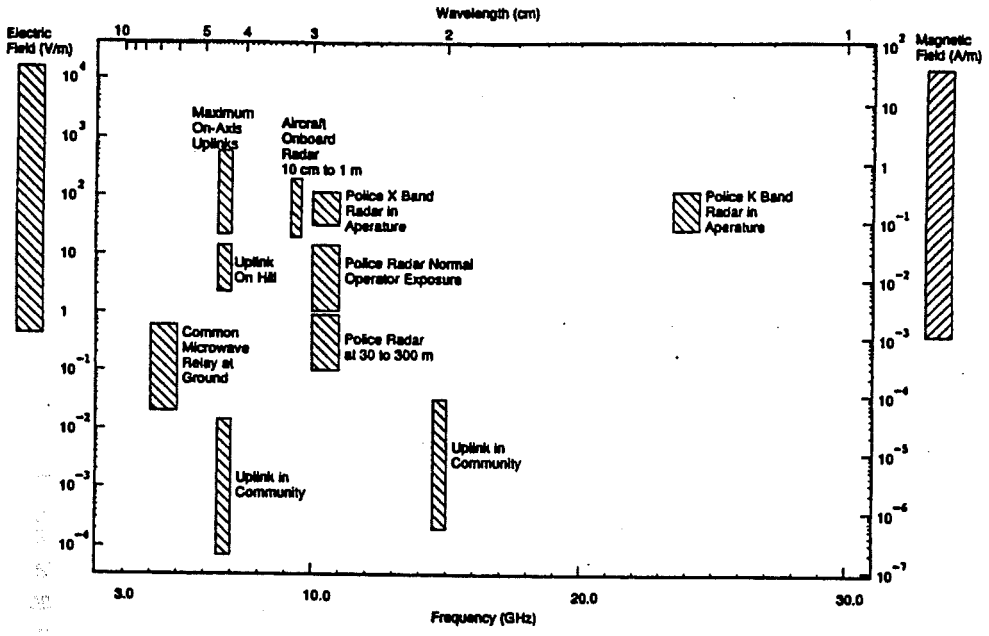

Fig. 7. Super-high frequency band.

dental sources such as video displays, microwave ovens, or industrial heaters require significant testing and statistical evaluation to determine exposure. Also, incidental and heating sources have no requirement for modulation control, so modulation (if of interest) must also be tested more extensively.

In the public environment, relatively high fields are reported at the base of some high-power AM and FM radio towers (shown at about 1 and 100 MHz). In the FM case, fields are more variable from one installation to the next because of differences in the height and radiation pattern of the antenna mounted on the tower. In the AM case, the tower is the antenna, so approaching the tower base results in a rapid climb in

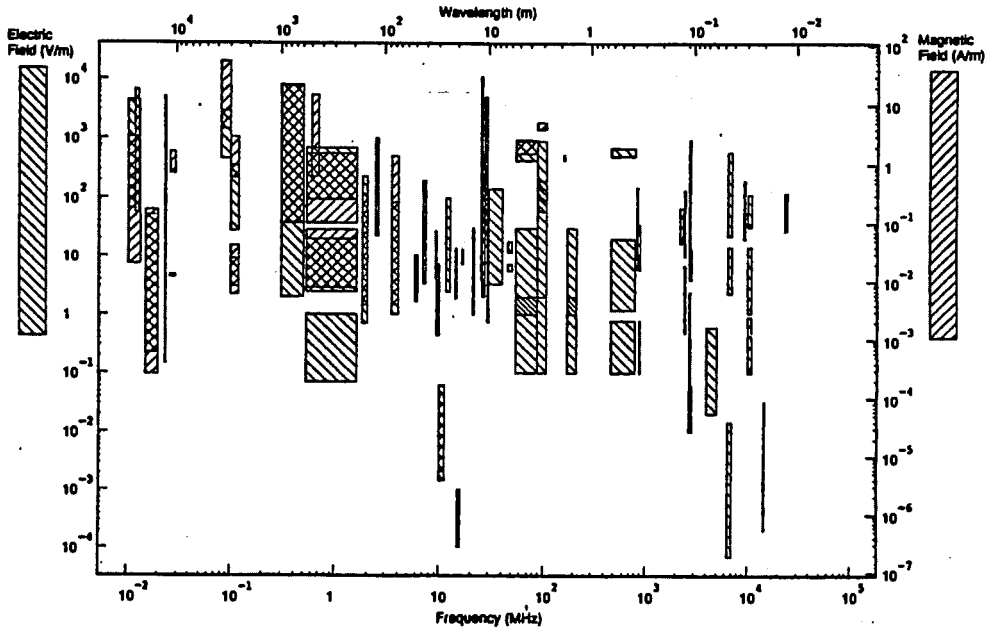

Fig. 8. Summary for all bands.

field strength that depends on transmitter power and tower impedance. TV transmitter antennas tend to be mounted higher on the tower and have more controlled patterns to illuminate the horizon, so that fields at the tower base are less than might be expected, especially for UHF-TV stations. If time-domain peak fields are considered, air traffic radars may generate relatively high field strengths out to several hundred meters (shown at about 3 GHz).

In the low-exposure general urban environment, peak fields due to air traffic radars may be significantly higher than peak (or rms) fields due to broadcast radio or TV. Some sources that generate only very weak fields in the public environment, such as cellular phone base stations, terrestrial microwave relay, and fixed satellite uplinks seem to have received an inordinate amount of attention and study.

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Massachusetts Department of Public Health
Bureau of Environmental Health Assessment

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Assessment of Public Health Concerns Associated with Pave Paws Radar Installations

Report Prepared for
The Massachusetts Department of Public Health

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I. INTRODUCTION AND BACKGROUND

The Expert Panel was asked to provide information to the Massachusetts Department of Public Health (MDPH) on how to assess the public health implications of exposure to radiofrequency electromagnetic radiation (RFR) from the PAVE PAWS radar antenna. Cape Cod residents have expressed concern regarding the possibility of adverse health effects from long-term low level exposures to the emissions from PAVE PAWS. These concerns have been exacerbated by reports of higher cancer rates on Cape Cod compared to the rest of Massachusetts [MDPH, 1999]. At a public meeting in Sandwich, MA on February 16, 1999, local residents have referred to several laboratory studies, epidemiology studies, and reviews, both published and unpublished, that cause them to question whether exposures from PAVE PAWS can affect the health of people on Cape Cod.

The charge from the MDPH to the expert panel was to review existing information regarding the potential health effects from exposure to radiofrequency electromagnetic radiation (RFR) from the Cape Cod PAVE PAWS radar installation. In particular, the panel should:

(1) Determine if existing PAVE PAWS RFR data is adequate to estimate exposure potential health effects on Cape Cod;

(2) If not, make recommendations for how to collect or estimate exposure that can be applied epidemiologically to identify the public health implication of PAVE PAWS on Cape Cod;

(3) Assuming adequate data is available, make recommendation for how to assess the public health implications from exposure; and

(4) Prepare a report that includes the above recommendations and a summary of the current scientific understanding of the health effects, particularly cancer, from exposure to the type of RFR emitted from PAVE PAWS and the aspects of RFR (i.e., peak or average power levels, pulse or constant exposure, etc) seemingly most responsible for the various health effects.

In response to the first and second charges, the Panel decided that additional measurements of exposure levels (power densities) in the vicinity of the PAVE PAWS installation would be necessary to estimate the potential health effects to the local community. It was recommended by the Panel that the measurements should be performed by experienced personnel approved by both the community and the MDPH. Measurements should be performed with proper equipment at six to twelve different locations being sure to include points of interest to the public, as well as the likely locations of maximum exposure to the public. The measurements should not be limited to just those frequencies emitted by PAVE PAWS, but should include a detailed frequency analysis of the RF spectrum from 30 kHz to 30 GHz. The latter is important to ascertain the total RFR environment to which the public is exposed. An interim report detailing the above points was submitted to the MDPH in August, 1999.

The second charge from MDPH to this Panel requests a recommendation on how to collect data to assess exposure "that can be applied epidemiologically to identify the public health implications of PAVE PAWS on Cape Cod". The recommendation in the Interim Report for a study delineating areas of higher and lower exposure in comparison to background will assist the MDPH: 1) in assessing the potential health risks from exposure, and 2) in determining the need for, and in planning epidemiological follow-up studies. The recommended measurements strategy was designed as a screening strategy, to limit the use of resources until more is known, and therefore is not likely to provide direct information for specific case-control or cohort studies of Cape Cod. For example, for any identified exposure sources, PAVE PAWS or other, systematic sampling may be needed based on distance from the source. In addition, if the measurements identify other RF sources, then additional measurements may be needed. Measurements can be used to evaluate the reliability of calculations, and to dpetermine whether calculations can be used to develop more extensive information on exposure potential.

Epidemiology studies generally require systematic measurements to estimate exposures of individuals. However, the proposed measurement strategy is designed to capture maximum exposures, and does not include systematic measurements to characterize population exposure by town or census tracts. The MDPH did support an epidemiology study of cancer for different towns and census tracts [Upper Cape Cod Cancer Incidence Review, June 1999]. Although cancer rates assessed by geopolitical areas (census tracts) in epidemiological studies cannot be directly linked to cause and effect, such studies provide a basis for defining priorities for additional study. Geographic correlations can be facilitated and refined by the use of geographic information systems (GIS), which permit precise mapping of disease and areas of exposure.

The measurement survey that has been recommended will enable the MDPH to assess exposure intensity in comparison to background levels in various environments. In health risk assessments, environmental levels that are compliant with existing standards or exposure limits, or are within the range of background levels (levels commonly found in areas removed from the influence of specific sources) are not generally regarded as having public health implications. Residents on the Cape have questioned some of these exposure limits, and for that reason may want to ensure that exposures are below these guidance limits, or to assess how they compare with background levels. One approach used to assess the implications of potential exposures is to calculate the ratio of measured or calculated exposure estimates to recommended exposure limits.

For nearly all environment exposures, average exposure over time is used as a practical measure of exposure, provided there is no experimental evidence that suggests otherwise. RFR intensities are highest close to the source, and decrease with increasing distance. The pulsed nature of the PAVE PAWS signal generates high intensity of extremely short duration. However, during the pulse, RFR intensities are relatively high. Therefore, peak levels are of interest, and the available information on peak levels should be examined. However,

there are no convincing experimental data indicating any adverse health effect at levels below national guidelines. Experimental studies involving pulsed RFR have shown 'microwave hearing' as the only non-thermal effect presently widely accepted by the scientific community This transient effect is an auditory sensation 'heard' upon exposure to very high intensity pulsed fields. The threshold is approximately 0.6 ?J/g/pulse or approximately 600 W/kg. There are no known or expected sequellae.

The movement of the beam means that RFR levels at a given point in space and time, whether measured or calculated, are not constant, but are changing. The RFR produced by the PAVE PAWS main beam or by its side lobes at any location at ground level is not continuous, but varies over time. To avoid underestimating exposure, exposure assessments, whether by calculation or measurement, should be based on the level when the beam is present.

The remainder of this report is the response of the Panel to the third and fourth charge. In order to do so in a fashion that responds to the primary charge to the Panel – to assess the public health implications of exposure to radiofrequency electromagnetic radiation (RFR) from the PAVE PAWS radar antenna – it is necessary to define what we know and what is not known about potential health effects from RFR (the scientific evidence assessment); and to then identify reasonable measures to take this information into account (the public health policy assessment). The foundation of available scientific evidence is sufficient to make interim public health recommendations by this Panel, even if it does not establish that conclusive scientific evidence is present.

In order to examine the possible health effects of exposure to the radiation of the PAVE PAWS radars, we need to consider the interaction of various features and parameters of radiofrequency radiation (RFR) exposure on biological systems. Both animal experimental studies and human epidemiological studies are important. In our review of the literature we have considered all pertinent articles, including those mentioned by members of the community that have not been published in the peer-reviewed literature (e.g. Cherry, 1998; Firstenberg, 1993). Reviews by other scientists provide insights, however our conclusions are based on our own comprehensive review of the data. The available data suggest a complex reaction. Many parameters of RFR exposure, including intensity, frequency, duration, waveform, frequency- and amplitude-modulation, are important determinants of biological responses. Therefore, great caution should be taken in applying the existing research results to evaluate the possible effect of exposure to RFR from the PAVE PAWS radar system. In addition, exposure to the PAVE PAWS radiation is a long-term exposure to low intensity RFR, of whose health effects we know little if anything.

2. CONCLUSIONS FROM EXPERIMENTAL STUDIES

The intensity (or power intensity) of RFR in the environment is measured in units such as mW/cm^2. However, the intensity provides little information on the biological consequence unless the amount of energy absorbed by the irradiated

object is known. This is generally given as the specific absorption rate (SAR), which is the rate of energy absorbed by a unit mass (e.g., one kg of tissue) of the object, and usually expressed as W/kg. The rate of absorption and the pattern of distribution of RFR energy in an organism depend on many factors. The pattern of energy absorption inside an irradiated body is non-uniform, and biological responses are dependent on distribution of energy and on the body part that is affected [Lai et al., 1984, 1988].

In the case of the PAVE PAWS radar, because of the distance from the radar, the power densities that one would be exposed to, and thus, the SARs, are small. Most studies described in the literature used relatively high intensities of exposure and although they may not be sufficiently similar to the present consideration, they do provide information on thresholds of biological effects that are widely accepted by the scientific community. However, some studies also show effects at power density levels lower than those involved in heating living tissue. There is controversy over how these effects can occur, although it is beyond argument that bioeffects do occur across many RF frequencies and power intensities and SAR conditions. It is important to distinguish between a biological effect that has no apparent adverse health effect and a biological effect which does. It is not known if any of the low level effects are capable of producing adverse health effects. Nevertheless, it is important not to dismiss "small" power densities and SARs that may have potential effects.

It has been estimated that there are some 7000 to 10,000 scientific reports on the biological effects of RFR in the literature. The overwhelming majority report no harmful effects providing the exposures remain at or below an SAR value of 4 W/kg. At 4 W/kg, laboratory mammals demonstrate a temporary stoppage of pedal–pushing activity. At the frequencies emitted by PAVE PAWS, this would correspond to an intensity of approximately 10 mW/cm^2. Exposure estimates and measurements regarding PAVE PAWS have been expressed in microwatts per square centimeter; 10 mW/cm^2 = 10,000 $\mu W/cm^2$.

In order not to overlook anything relevant to PAVE PAWS, the Panel has considered a number of studies investigating effects of low-intensity RFR. The following are some examples: Kwee and Raskmark [1997] reported changes in cell proliferation (division) at SARs of 0.000021- 0.0021 W/kg; Salford et al [1997] reported increase in blood-brain barrier permeability in mice exposed at 0.0004 W/kg; Navakatikian and Tomashevskaya [1994] reported a change in avoidance conditioned reflux in rats after 0.5 hr of exposure to RFR at 0.0027 W/kg and a drop in testosterone at 0.027 W/kg; Veyret et al. [1991 reported a change in immunological functions after RFR exposure at 0.015 W/kg; Ray and Behari [1990] reported a decrease in eating and drinking behavior in rats exposed to 0.0317 W/kg; Dutta et al. [1989] reported changes in calcium metabolism in cells exposed to RFR at 0.05-0.005 W/kg; Phillips et al. [1998] observed DNA damage at 0.024-0.0024 W/kg; Magnras and Xenos [1997] reported a decrease in reproductive functions in mice exposed to RFR intensities of 160-1053 nW/cm^2 (the SAR was not calculated); and Chiang et al [1989] reported a change in white blood cell functions in humans exposed to a 4 W/cm^2 field . It must be pointed out that most of the above studies investigated the effect of a single episode of RFR exposure for varying durations of

exposure, but not long-term chronic exposure. Also, other studies failed to observe these effects at much higher intensities. Another important parameter to consider is the frequency of RFR. Frequency is analogous to the color of a light bulb, and intensity is its wattage. There is a question of whether the effects of RFR of one frequency are different from those of another frequency. The answer to this question depends on the mechanism involved. Nearly all of the known adverse effects of RFR are due to temperature elevation of the exposed part, and for this the pertinent quantity is the SAR, regardless of the frequency employed. The question of frequency is vital If there are any harmful effects that could be frequency-specific. This also calls into question whether existing research data on the biological effects of RFR can apply to the case of PAVE PAWS, as most previous research studied frequencies different from those used in the radar system.

It must be pointed out that data showing different frequencies producing different effects, or an effect occurring at one frequency and not at another, are sparse. An example is the study by Sanders et al [1984] who observed that RFR at frequencies of 200 and 591 MHz, but not at 2450 MHz, produced effects on energy metabolism in neural tissue. There are also several studies that showed different frequencies of RFR producing different effects [D'Andrea et al., 1979, 1980; de Lorge and Ezell, 1980; Thomas et al., 1975]. It is not certain whether these differences were actually due to differences in the distribution of energy absorption in the body of the exposed animal at the various frequencies. However, some studies showed frequency-window effects, i.e., an effect is only observed at a certain range of frequencies and not at higher or lower ranges [Bawin et al., 1975; Blackman et al., 1979, 1980a,b, 1989; Chang et al., 1982; Dutta et al., 1984, 1989, 1992; Lin-Liu and Adey, l982; Oscar and Hawkins, 1977; Sheppard et al., 1979]. These results may suggest that the frequency of an RFR can be a factor in determining the biological outcome of exposure.

On the other hand, there are many more studies showing that different frequencies can produce the same effect. For example, changes in blood-brain barrier have been reported after exposure to RFRs of 915 MHz [Salford et al., 1994]; 1200 MHz [Frey et al., 1975], 1300 MHz [Oscar and Hawkin, 1977], 2450 and 2800 MHz [Albert, 1977], and effects on calcium have been reported at 50 MHz [Blackman et al., 1980b], 147 MHz [Bawin et al., 1975; Blackman et al., 1980a; Dutta et al., 1989], 450 MHz [Sheppard et al., 1979], and 915 MHz [Dutta et al., 1984]. If there is any difference in effects among different frequencies, it is a difference in quantity and not in quality. There are few studies on the frequencies (~400 MHz) used in the PAVE PAWS radars. One study specially designed to address this question is the study by Toler et al. [1997]. In that study, mice were exposed for 21 months (22 hr/day, 7 days/week) to a 435 MHz pulse-wave (1.0 ?s pulse width, 1 kHz pulse rate) at an SAR of 0.32 W/kg. The investigators did not find a significant increase in cancer in mice chronically exposed to the radiation. The only biological finding was that there was a statistically significant increase in the exposed animals of bilateral ovarian stromal tumors. Another related study is that of Lyle et al (1983) showing that exposure to sinusoidally amplitude-modulated RFR at nonthermal levels can reduce immune function in cells. A 450-MHz radiofrequency field was modulated with a 60 Hz ELF field. Tests showed that the unmodulated carrier

wave of 450 MHz by itself had no effect, and modulation frequencies of 40, 16 and 3 Hz had progressively smaller effects than 60 Hz. Peak suppression of the lymphocyte effectiveness (immune function effectiveness) was seen at 60 Hz modulation.

Another important question regarding the biological effects of RFR is whether the effects are cumulative, i.e., after chronic exposure, will a biological system adapt to the perturbation and, with continued exposure, its homeostasis will break down leading to irreparable damage? The question is important in considering the PAVE PAWS chronic exposure situation. Depending on the responses studied in the experiments, several outcomes have been reported. (1) An effect was observed only after prolonged (or repeated) exposure, but not after one period of exposure [e.g., Baranski, 1972; Baranski and Edelwejn, 1974; Mitchell et al., 1977; Takashima et al., 1979]; (2) an effect disappeared after prolonged exposure suggesting habituation [e.g., Johnson et al., 1983; Lai et al., 1992]; and (3) different effects were observed after different durations of exposure [e.g., Baranski, 1972; Dumansky and Shandala, 1974; Grin, 1974; Lai et al., 1989; Servantie et al., 1974; Snyder, 1971]. Cumulative exposure to long-term, low intensity RFR may have the potential to produce biological and potential health effects. Related to this is that various lines of evidence suggest that responses to RFR could be a stress response [Lai, 1992; Lai et al., 1987]. A recent study has reported that low intensity RFR can activate genes for the production of stress proteins (heat shock protein) [Daniells et al, 1998]. The production of heat shock protein is considered a protective response to further stress. Stress effects can cumulate over time and involve first adaptation and then an eventual breakdown of homeostatic processes when the stress persists. Although experimenters attempt to minimize the stress imposed on laboratory animals, the stress cannot be eliminated completely. This stress can be considerable if animals are restrained in laboratory experiments, regardless of whether or not they are exposed to RFR.

The consequences of a cumulative effect are particularly important in considering the risk of cancer. It is well known that x-rays and other forms of ionizing radiation are cumulative. That is, ionizing radiation insufficient to cause any harm in a single exposure will lead to an increased risk of cancer following multiple exposures. This results from the ability of the high intrinsic energy of ionizing radiation to dislodge electrons and ultimately cause DNA changes, which if not correctly repaired can lead to cancer. RFR is not ionizing. It does not possess sufficient intrinsic energy to cause ionization. However, an increased damage to macromolecules, such as DNA, might be caused indirectly, e.g., by an increase in free radicals in cells [Lai and Singh, 1997; Phelan et al., 1992] or a change in enzymatic mechanisms [Daniells et al, 1998; Litovitz et al., 1993, 1997; Singh et al., 1994].

An important conclusion of the research is that modulated, or pulsed, RFR seems to be more effective in producing an effect. It can also elicit a different effect when compared with continuous-wave radiation of the same frequency [Arber and Lin, 1985; Baranski, 1972; Frey and Feld, 1975; Frey et al., 1975; Lai et al., 1988; Oscar and Hawkins, 1977; Sanders et al., 1985, see also review by Juutilainen and de Seze, 1998]. This conclusion is important, since

PAVE PAWS signals are modulated signals. Another point which may be relevant to the PAVE PAWS situation is that RFR has been reported to synergistically interact with drugs [Lai, 1992; Lai et al., 1987], medicine [Kues et al., 1992] and carcinogens [see reviews of Juutilainen and Lang, 1997; Verschaeve and Maes, 1998].

Therefore, frequency, intensity, and exposure duration can affect the response to RFR, and these factors can interact with each other and produce different effects. In addition, in order to understand the biological consequence of RFR exposure, one must know whether the effect is cumulative, whether compensatory responses result, and when homeostasis will break down. For example, the different results of the following studies are related to the complex interactions to very different experimental designs: an increase in a variety of cancer types but no single type [Chou et al., 1992], an increase in lymphoma in a genetically altered mouse [Repacholi et al., 1997], a decrease in brain cancer following promotion [Adey et al., 1999], and no significant effect on cancer in a strain prone to breast cancer [Frei et al., 1999] have all been reported in studies of animals exposed to RFR. Care should be taken in applying the existing research results to evaluate the possible effects of radiation from PAVE PAWS.

Conclusions should consider all of the data, and to the extent possible, to avoid personal biases. Additionally, the scientific merit and credibility of research publications needs to be considered. In our review of the available data on the biological effects of RFR, we conclude that there is no definitive scientific evidence to claim that the anticipated low RFR levels from PAVE PAWS could cause any harmful effect to the public. But at the same time, there is suggestive scientific evidence that RFR produces bioeffects at much lower intensities than previously known. The scientific evidence cannot answer the question conclusively whether the PAVE PAWS radar will or will not cause harmful effects to humans in the community. Although Science can prove that something is harmful, it can not prove that something is safe, if safe is defined as zero risk for any effect or change. The question that is always present in making these policy decisions is then, "what do we do about public health when the possibility of harm cannot be totally ruled out?" The approach taken by several federal and public health agencies is to assess the weight of the evidence regarding public health. Policy decisions should include balancing the scientific weight of the evidence for risks, the human consequences of these risks, and the nature and extent of uncertainty against the known benefits and costs. This will be discussed in the Discussion and Summary sections.

3. CONCLUSIONS FROM EPIDEMIOLOGICAL STUDIES

The epidemiological studies of exposures to RFR reviewed by this Panel are pertinent to questions of health, particularly cancer. Several of these studies are of populations exposed to radars of various types.

3.1 SCIENTIFIC PROCEDURES FOR ASSESSING POTENTIAL FOR HUMAN RISK

SCIENTIFIC STANDARD FOR DECISION-MAKING: Standard procedures in epidemiology and health risk assessment can be used to respond to the charge to evaluate and summarize the "...current scientific understanding of the health effects, particularly cancer, from exposure to the type of RFR emitted from PAVE PAWS...". Hill's criteria, also recognized as the Surgeon General's criteria, are widely used in public health as the basis of an approach to assess cause and effect from scientific studies [Rothman, 1998; Susser, 1991]. The principle for these criteria as guidance is that the more firmly these criteria are met by the data, the more convincing is the evidence that observed statistical associations indicate cause and effect. These criteria overlap the standard risk assessment approach and the weight of evidence approach, because they include an assessment of the biological plausibility, which is rooted mostly in laboratory data. The weight of the evidence approach to risk assessment is followed by the World Health Organization (WHO) International Program for Chemical Safety; and the US Environmental Protection Agency [IARC, 1995; WHO, 1993]; USEPA, 1996].

PUBLIC HEALTH CRITERIA: In contrast to this scientific standard, which requires conclusive scientific evidence before there is an action (the action is the development of general consensus among scientists of a health risk), public health criteria for taking action on RFR exposures is developed using different standards. Good public health principles select for some level of action, even interim action, to avoid potentially risky exposures, based on the available scientific evidence, and updated as further knowledge is acquired. Prudent avoidance, or prudently limiting or avoiding exposures to possible and probable health risks is a firmly established public health principle, but it must be balanced with respect to the benefit/risk ratio. It is also necessary to consider all sources of environmental hazard in deciding which sources are most important to reduce. Public policy is nearly always made without absolute certainty of the outcome. To "err on the side of caution" when faced with uncertain science, with matters of great public concern, with potentially grave health hazards, and with involuntariness of exposure is the expression of prudent avoidance. It takes much wisdom to know how much caution is warranted; it ultimately depends on the benefit/risk ratio.

A major toxicological principle applied in circumstances other than RFR (chemicals, ionizing radiation) is the importance of amount of exposure. The capability of a substance to cause harm depends on dose, and higher doses produce more frequent or more severe responses (e.g. Fan and Chang, 1996). This is important because it governs the design and interpretation of both epidemiological and laboratory research in traditional toxicology [IARC, 1995; WHO, 1994; USEPA, 1996]. However, this approach has been questioned as applicable for RFR, since there may be non-linear responses.

3.2 EVALUATING EPIDEMIOLOGY STUDIES OF RFR EXPOSURES AND CANCER

Our review of epidemiology studies related to RF exposure concentrated on

those regarding cancer that were published in the peer reviewed scientific literature. All studies published in scientific journals were reviewed, as well as two unpublished epidemiological studies [Lilienfeld et al, 1978; Hill, 1988]. These two studies were included because they reported detailed descriptions of methods used, are of acceptable design, and have been evaluated in other papers and reports, including those of Federal agencies such as the Environmental Protection Agency. The study by Hill deals with occupational exposure to radars. Studies of power frequency fields, at 50 or 60 Hertz were excluded, because these fields have different characteristics than RF and hence not relevant. Less weight was given to studies where exposure is estimated only by occupation, or from a job title obtained from the death certificate. Reports of clusters have also been excluded, as these are not useful for directly assessing cause and effect, although such reports may prompt further analytical studies if a common factor can be identified [Rothman, 1990; CDC, 1991]

Some epidemiological studies of people potentially exposed to RFR have reported risk ratios above 1.0 for some types of cancer, whereas others have not. Other characteristics of the individual epidemiology studies of RFR should be considered in order to evaluate the study's results, such as the type of study design, response rate, the size of the study population, methods for selection of study participants, control of potential confounding factors.

The studies that were reviewed regarding cancer are included in the reference list, and the criteria for review are described above. The following discussion is a summary of our review, with somewhat more discussion allocated to studies published recently, or to those that appear to be the basis of discussion and public concern.

3.3 RECENT EPIDEMIOLOGICAL STUDIES

Descriptive statistics, such as disease rates for various age, race, gender groups or geographic areas, provide important public health information by describing the distribution of disease in populations. Epidemiological studies, or geographical correlation studies, link descriptive statistics of a specified group of people to estimates of exposure. Geographical correlation studies are generally viewed as less informative than case-control or cohort studies for determining cause and effect, because they do not examine data at an individual level. However, studies of epidemiological design involving RF, particularly a few recent studies, have been brought to the attention of the public and presented as evidence for cause and effect, for example on the Internet (e.g. Cherry, 1998). In these studies, rates of leukemia were compared among populations at different distances from high power TV or radio transmission antenna towers[1]. In published reviews, some authors highlight the positive associations reported in correlation studies; Goldsmith [1995] cites these epidemiological studies as a basis for concern, but clearly states that it is an opinion piece and not a balanced assessment.

Correlation studies have several limitations, so that it can be misleading to

single out risk ratios from a study of RFR sources and present them out of context. In addition, these studies can be misleading if the reader does not know about, or does not recognize the importance of related studies that have been published. For example, Dolk et al published two studies in the same journal in 1997 [Dolk et al, 1997a, b]. The first considered one broadcast tower, and the second considered 20 broadcast towers, so these two studies must be considered together. The study by Hocking et al [1996] was followed by a more detailed and complete assessment by McKenzie et al [1998].

Studies in England: The study of a single tower in England reported a weak association for adult leukemia, but reported no difference in childhood cancers [Dolk et al, 1997a]. The researchers wrote "no causal implications can be made from a single cluster investigation of this kind." To better evaluate the observed correlation, the researchers in London extended their analysis to examine the population around 20 different towers transmitting TV or FM frequencies [Dolk et al, 1997b]. In this larger study, no correlation was seen between the rate of childhood leukemia, or brain cancer, with distance from the transmitters. The rate of adult leukemia showed some decline with distance, which could be taken to suggest a link with the towers; however, the rate was not increased in the areas within two kilometers from the transmitter, where RF levels would be greater.

Studies in Australia: In Australia, the populations were identified by the geopolitical units, the local government area (LGA) [Hocking et al, 1996; McKenzie et al, 1998]. The first study reported that leukemia was higher in children and adults who lived in the inner area, less than 2 kilometers (about 1.2 miles) from the center of a group of three towers [Hocking et al, 1996]. Hocking et al [1996] defined the outer radius by including all LGA's north of the towers, and excluding the LGA's to the south. Other scientists in Australia re-analyzed the cancer data, including the LGA's to the south as well as those to the north [McKenzie et al, 1998]. No correlation was seen for calculated RF level and incidence of childhood leukemia. Only one of the three LGA's in the inner group had an increased incidence rate. This LGA resulted largely from cases diagnosed before TV transmission was introduced, when exposure in the area was the lowest.

Other Studies of Leukemia: The results of geographic correlation studies in Australia and the U.S. taken together do not support a link between proximity to RF sources and leukemia in children or adults. The U.S. Embassy study in Moscow [Lilienfeld et al. 1978] reported risk ratios for adults and for children that are above one, but these estimates are quite imprecise because they are based on only one or two cases and chance cannot be ruled out. Tynes et al. [1992] reported an increased risk ratio for leukemia in male workers. In that study no exposure levels at the workplaces were reported, and the authors acknowledge that confounding factors may have played a role. These researchers studied female radio and telegraph operators and did not find evidence for an association with leukemia [Tynes et al., 1996].

Studies of Military Workers: A study of Polish military workers [Szmigielski, 1996] merited intense scrutiny because of the strong statistical associations

reported. This was a study of the cancers that were reported over a 15-year period in a cohort of about 127,800 Polish military personnel. Szmigielski reported strong associations between RF exposure and several types of cancer and cancer overall. However, the design included a major source of bias in reporting exposure [Elwood, 1999]. The methods in analysis and reporting of data are not consistent with standard epidemiological methods; the number of cases observed and expected are not given, and the report provides no evidence that adjustments were made for the age differences between the exposed and comparison groups. Because basic data is absent, and the methods used are inadequate, it is difficult to accept the results as valid. By way of comparison, note that Robinette et al's study [1980] of personnel on U.S. Navy ships and Garland's two studies of U.S. Navy personnel also assessed cancer in military workers. Garland et al. [1988, 1990] found no increased rates of disease in the study of newly diagnosed cases (incidence) of lymphoma and of leukemia in a cohort of U.S. Naval personnel. Although exposure was estimated only by job title, the group was fairly large and the epidemiological methods were well described and adequate.

Studies of All Types of Cancer: Few environmental exposures or known causes of cancer increase all types of cancer. However, observed increases in total cancer would suggest that further study is needed to determine whether a specific type of cancer may increase. Several of the epidemiology studies report decreases in total cancer [Hill, 1988; Milham, 1988]. The decrease reported by Lilienfeld et al. [1978] may be chance, and its value limited by the relative short time and small size of the study. The workers studied by Hill were less likely to have been exposed to confounding factors and were followed for a long period of time, yet the risk ratio does not indicate a positive association. Tynes et al. [1996] reports a small increase in a study of women radio and telegraph operators. Based on the evidence available to date, there is no consistent or credible epidemiological evidence to suggest that long term RF exposure increases cancer overall.

Studies of Brain Cancer: Most cohort studies have not reported convincing associations between RF exposure and brain cancer. As discussed above, the weak association reported by Szymigielski does not appear to be based on reliable data. Of three case-control studies, one reported a risk ratio above one for occupations involving RFR exposure [Thomas et al., 1987]. The authors clearly noted the likelihood of confounding from chemicals in these occupations. Grayson [1996] reported an increased risk ratio for the surrogate measure of exposure - occupations more likely than others to incur exposure above the standard. No cases of brain cancer were found in the Moscow embassy cohort [Lilienfeld et al., 1978], or in Navy personnel on ships [Robinette et al, 1980]. If RF exposure contributed to brain cancer, one would expect a higher risk in cell phone users, because RF exposure from cell phones is manifold higher and more localized to the head than the exposures in other studies. The case-control study by Hardell et al. [1999] of cell phones provides no convincing evidence for a risk for brain cancer. However, the authors also pointed out that the sample size in their study was small and there may not have been enough time for cancer to develop.

Studies of Breast Cancer: Several studies have been completed regarding "EMF" and breast cancer in women and in men, but most pertain to electrical workers and power frequency fields. Few studies considered RFR specifically, and therefore they provide limited information for assessing cause and effect. Demers reported a non-significant association for men in communications and broadcasting. Tynes et al. [1996] reported a risk ratio slightly above one for breast cancer in women who worked as radio and telegraph operators aboard ships. He noted that these women were exposed to light at night, which is known to decrease melatonin levels. Because decreased melatonin is hypothesized as a risk factor for breast cancer, light at night may play a role as a confounder. Several studies have examined the association between different occupations and breast cancer. Pollan [1999], for example, reported a positive association with breast cancer for radio and telegraph operators. Lilienfeld's mortality study reported an increased risk ratio that may have been due to chance.

None of the epidemiology studies provided information on individual RF exposures, thus misclassification bias may lead to underestimation of an association if one exists, or provide misleading information. These studies also provide limited information because bias, chance, and confounding cannot be ruled out. However, laboratory studies can provide additional information regarding breast cancer. Several long-term studies used mammary-tumor prone animals, and exposed the animals for nearly their entire lifetime. The lack of evidence for a carcinogenic effect in these studies, such as one in which mice were exposed at 1 watt per kilogram over lifetime, is pertinent for weighing the evidence suggesting any relationship between RF and breast cancer [Frei et al, 1999]. Szmigielski et al., 1982 reported that female rats exposed to 2450-MHz microwaves, the same frequency as that used by Frei et al., developed mammary tumors faster and at a significantly greater number than sham-exposed controls. The increase occurred in animals exposed to 15 mW/cm2; but at 5 mW/cm2, the cancer rate was the same as in confinement stressed controls.

4. DISCUSSION AND SUMMARY

The epidemiology studies consist mainly of occupational studies in adults, and epidemiological studies. Many of the occupational studies clearly included opportunity for exposure to RFR levels higher than the recommended exposure limits, and thus much higher than levels calculated as being associated with PAVE PAWS. In these studies, risk ratios greater than one when reported are imprecise so chance cannot be ruled out, and sufficiently small so that the presence of confounding factors cannot be ruled out as a possible cause. Therefore, the epidemiological studies do not support the idea that RFR exposure increases the occurrence of cancer in general or any specific type of cancer. Nevertheless, there are deficiencies in the exposure assessment in all of the studies, and limitations such as small sample size or short follow-up time in some of the studies [e.g. Lagorio et al., 1997; Muhm, 1992].

Public health decisions are informed by data from a variety of sources, and

laboratory studies can be used to address some of the gaps and uncertainties regarding RFR and cancer. In health risk assessments, laboratory studies that use standard bioassay methods and well studied rodent models for cancer provide evidence on whether the long-term low level exposure can cause cancer or other adverse effects in mammals. Genotoxicity bioassays, which provide information on mutagenicity, are considered as well. Such studies of RFR have been reviewed and we conclude that the weight of evidence supporting a causal association between RFR exposure and cancer is weak.

There are a number of publications that report biological effects after exposure to RFR levels lower than the 'safe' limits given in national standards. These studies have been carefully reviewed and evaluated with respect to their credibility, their scientific merit, and the implications for potential health risks. It has been estimated that there are from 7000 to 10,000 published reports on RFR effects in the scientific literature, but only a handful report adverse health effects occurring at intensities below nationally accepted safe levels. Attempts to reproduce these findings have yielded conflicting results. There are no known and accepted physical mechanisms that can account for any of the adverse biological effects reported to occur at such low intensities. It is the opinion of this panel that the evidence for these "low level" (<10 microwatt/cm^2) effects does not reach a level sufficient to justify claims of any health hazard

Therefore, the Panel recognizes that in the face of scientific uncertainty and some evidence pointing to a possible problem, it is prudent for the MDPH to take interim action to limit public exposure to PAVE PAWS RFR, according to prudent avoidance and the precautionary principle, to levels considered safe by national standards, until such time as there is 1) good characterization of RFR exposure in the community, and 2) better scientific evidence to define the nature and magnitude of the health hazard, if any. If, with better scientific information, the evidence reaches the level sufficient to justify claims of a health hazard, it will be necessary to readjust their policy (the permissible safe limits) consistent with:

1. the likelihood and severity of an adverse effect,
2. exposure levels from Radio, TV and other RFR sources present in the environment
3. the risk of not having the security afforded by the PAVE PAWS, and
4. the benefit/risk ratio.

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APPROVAL OF DOCUMENT BY EXPERT PANEL

We, the authors of the document, ***Assessment of Public Health Concerns Associated with Pave Paws Radar Installations***, hereby show our approval of its contents. Also, let it be known that this completes the work of the expert panel, and that upon acceptance of this document by the Massachusetts Department of Public Health, this panel will disband.

Linda S. Erdreich, Ph.D. Date
Bailey Research Associates, Inc.

Om P. Gandhi, Sc.D. Date
University of Utah

Henry Lai, Ph.D. Date
University of Washington

Marvin C. Ziskin, M.D. Date
Temple University Medical School

Top of Page BEHA Homepage PAVE PAWS Page

John Van Der Wal
5 Vision Road
P.O. Box 264
Inverness, California 94937
(415) 669-7544

December 25, 1999

Marin Emergency Radio Authority
3501 Civic Center Drive, Suite 325
San Rafael, CA 94903

Gentlemen:

Please consider the following observations in your deliberations. We have no doubt that you have good reason to upgrade the San Rafael emergency communications system. However, the environmental (and economic) costs vs the social benefits to West Marin are unconvincing.

Placing six antennae on prominent hills in West Marin will be unsightly; no one can reasonably dispute that the beauty of the landscape will suffer. All this could possibly be set aside if the social benefits are so great as to outweigh the environmental degradation. But we have no communication problems in West Marin so great that we can't wait the two years or so for the coming dense-satellite communications systems. In your reported comments, no considered study of this possibility seems to have been made.

48

It is possible that San Rafael cannot wait, that its problems are so great that even at the cost of 20-years of debt service the city must act now. But West Marin can wait. And by waiting a few years we don't only protect the area's scenic qualities, but we also save our small economic base from twenty years of debt service. Waiting would give us outstanding communications capabilities without degradation of the environment and without our incurring capital costs.

49

Sincerely,

Susan Van Der Wal

John Van Der Wal

December 27, 1999

Ms. Linda Christman
Assistant County Administrator
3501 Civic Center Drive, Room 325
San Rafael, California 94903

Subject: Marin Emergency Radio Authority (MERA)
Environmental Impact Report

Dear Ms. Christman:
This letter will address only one portion of the new MERA system, specifically, the proposed radio tower at Forbes Hill.

As background for the following comments I mention the fact that before retirement I worked in the Radio Engineering Office, City of San Francisco, and am familiar with two-way and microwave radio system design.

After visiting Forbes Hill and reviewing the appropriate portions of the EIR (Section V-9, pages V-95 through V-104 and the four photo-simulations) I believe it may be possible to considerably reduce the visual impact of the proposed tower by two minor
50 system design revisions:

(1) Instead of either the initial or mitigated tower structures, the use of a Monopole type antenna support may provide less visual impact. It will be necessary to confirm with the contractor that this type of support would meet system design needs, and if so, photo simulations could be made, hopefully showing improvement.

(2) Current design shows the use of two microwave antennas mounted on a new tower. It may be possible to revise one of the two microwave paths to follow a line from Mt. Tam to Dollar Hill rather than from Forbes Hill to Dollar Hill and
51 thus remove one microwave antenna from the Forbes tower. The other microwave antenna (on the existing path) could be mounted on the new telecommunications shelter in much the same way as the existing antenna dish, with its relatively minor obtrusiveness.

If you believe these suggestions may improve the visual aspects of this portion of the new system, I will be happy to obtain more information and discuss it with you and the contractor.

Walter Lindell

Walter Lindell
112 Maywood Way
San Rafael,
California 94901

Telephone 415-454-9453

170 Ridgewood Drive
San Rafael, CA 94901

December 27, 1999

Linda Christman
C/O Marin Emergency Radio Authority
3501 Civic Center Drive, Room 325
San Rafael, CA 94903

Dear Ms. Christman:

I was told by Dick Watts, Chair of the Sun Valley Neighborhood Association, that you were the contact person to whom I should address my concerns and questions about the proposal to construct new emergency radio antennae in our neighborhood. I understand that there is real concern expressed by our neighbors, and I would also like to add my voice. I would like to ask the following:

52 How thorough has the Environmental Impact Review process been?

53 Will there be regular public meetings to solicit the opinions of neighbors and those directly affected?

54 Are there other alternatives, other technologies available, that would impact the environment less?

55 Have the health issues over microwave radiation been addressed and investigated?

56 Have other locations been considered?

57 Since these questions are not easily answered in a letter, my strongest opinion is that no decision should be made until all concerned citizens have had their questions answered to their satisfaction.

Please add me to whatever mailing list has been established by MERA. If you have questions, I can be reached during normal business hours at (415) 773-5958.

Sincerely yours,

David Swain

December 28, 1999

Ms. Linda Christman
Marin County Administrators Office
Marin Civic Center
San Rafael, CA 94903

Dear Ms. Christman:

58 We would like to register our objections to the suggestion that an eighty foot tower with a fifteen foot antenna be built on Forbes Hill. While our concerns were initially all about the visual impact of such a tower, certain health concerns were raised at a community meeting that we attended. These concerns were not adequately answered by the speakers.

In fact, there were several other points raised at that meeting at Rotary Manor that were not addressed adequately by the representatives from MERA:

59 * Is a system of towers the best technology available to provide for our emergency communication needs?
60 * Why are seven of seventeen towers located within San Rafael, when this plan serves the entire county? Were other sites considered?
61 * Why was the Forbes Hill site chosen when there are other taller hills in the area?
62 * Why was there inadequate notice given of this whole process? Most busy residents throw away newsletters from realtors, which is how we learned about the meeting at Rotary Manor. Every homeowner within sight of these towers should have been notified by the county.

63 The tower on Forbes Hill will mainly benefit the towns of San Anselmo and Fairfax. Yet it is the citizens of San Rafael that have to look at it and possibly suffer the consequences to their health and property values. Is it possible to redesign the system so that Forbes Hill would not be used? Is there any additional mitigation that could be considered for the proposed Forbes Hill tower?

Sincerely,

Randy and Glena Coleman
99 Windsor Avenue
San Rafael, CA 94901

Mr. and Mrs. Robert D. Irwin
34 Wildwood Way
San Rafael, CA 94901
415-454-5118

December 28, 1999

Ms. Linda Christman, Executive Officer
MERA
Marin County Civic Center
San Rafael, CA 94903

rec'd at mail room earlier not distributed until after 1p.
l c.

The Draft EIR states that: .."the Dollar Hill (San Rafael Hill) project would have a significant unavoidable effect on visual resourses" "the project may have an adverse impact on biological resources" and "may damage surrounding oak woodland habitats".

The following are our comments concerning the "Dollar Hill" ("San Rafael Hill") site for the major expansion of Antenna Towers. These comments are based on the Draft EIR and attendance at a small meeting of residents living on the East side of Fairhills, and the Federation of Neighborhoods meeting.

There is no doubt that major improvements in the communications systems of our public safety groups is necessary. It has been needed for over 10 years. To design a system that severely affects prime neighborhoods negatively doesn't make sense when these same past ten years have seen exponential developments in electronics, physics and
64 product development. It was noted at the meeting that the concept agreements by the Public Safety organizations of the County had been carefully worked out over time, but the actual program to be implemented had been done quickly. It was also noted that the public had not been included in the process until mid November.

Based on the EIR, and statements made by representatives at the Federation of Neighborhoods, the Fairhills, and the Sun Valley meetings, we have the following comments and suggestions:

1) The "Process" was very poor. No one from affected neighborhoods was included in the initial review, It appears that the process of involving public was designed to keep the public from knowing what was going on:

A) The dates for public comment were designed to keep the public from having
65 adequate time to study and participate. There were no available dates for a full public meeting of our neighborhood association, and most residents were deeply involved in work, travel, and families until after the holidays. Local neighborhood organizations were neither asked to participate in the initial study or the EIR, nor were they given the opportunity to establish study committees, or hire experts to help us analyze the situation as it affects us.

B) Many local people are experienced, willing and ready to work with local governments for needed improvements, had they been asked with adequate lead time.

C) The name "Dollar Hill " site made no sense to many living near-by. Locally it is called "San Rafael Hill". Attached is a photo, reproduced from the Marin Independent Journal, citing its name as used by local people.

2) A decision was made by MERA to only review "currently used sites", without any involvement from a public representative living near, or affected by, those sites.

A) You mention that the City of San Rafael has developed a firm policy that no
66 structures may be built within 100 feet of a ridgeline. This should be honored.

B) We know of no notification or information to local, well-organized neighborhoods in San Rafael. Many of these neighborhoods are on the regular notification lists of the San Rafael Planning Board and City by address (often P.O. Boxes), fax, and/or e-mail. Without the presentation at the Federation, most of us

would not have known anything. The only public program was scheduled for Dec. 9th in Marinwood, far from the Dollar Hill and Forbes sites.

67 3) Photos of the existing and planned antennas included in the EIR were taken from the Highway 101, not from near-by impacted neighborhoods, including Fairhills, Graceland, Bonnie Brae, El Cerrito, etc.

68 4) The cross shown in your photo provided some leavening from the antenna views has been vandalized and is now gone.

69 5) The report cites that the closest groups of homes are 1000 feet away to the East. There is no distance measure from the homes to the West on Wildwood Way, Oakmont Ave., Oakmont Ct., Culloden, Quarry, Twin Oaks or the six new home development on Academy Heights, the extension of Twin Oaks in the Quarry immediately below the current installations. There is no mention of homes on Ele Cerrito, or Bonnie Brae, etc.

A) There is no effort at mitigation for homes on any of the local streets, many of which are severely affected.

70 6) Some homes currently do not view the antennas because very large, extremely old (150-200 years) California Live Oaks screen them. Local residents are now experiencing a devastating die-off of these trees by the Ambrosia Beetle (information attached). Whole groups of huge old trees are being attacked and dying within three weeks of the first signs of the attack. None of us will live long enough to see replacements grow to cover the unsightly man-made antennas towers. Fast growing replacements trees , such as eucalyptus, bamboo and pines cannot be used because they are all pyrophytic (ignite quickly, burn intensely) in this fire -prone area.

71 7) Fire Danger--The report does not mention this well-documented danger at the San Rafael Hill site. (See S.R Fire Dept. Study on the "Urban/Wildland Interface", 1992/3). Severe fires occur every few years, and the existing towers were of great concern to local residents during the recent lightning storms.

72 8) The Fairhills area is noted for its historical value, its beauty, serenity, and, mostly, for its stunning views. We have been told by many Real Estate Brokers that additions to the antennas, as long as they can be seen from the homes, will negatively affect property values (home are currently selling for $ 800,000 to well over $1,000,000, depending on the view, and the condition of the home). As the "Turini" area has grown exponentially, iit has become more and more abominable. Any addition to it will devastate the home values on the East side of Fairhills.

73 9) At the local meeting, the Police representative argued that the new system emphasized the "inside building" capacity that would be given by the large new towers. However, the largest buildings are in San Rafael's industrial area, and it has been suggested that the towers should be placed closer to the need.

74 10) When asked about a proven system, we were assured that the San Diego system had been in place successfully for 10 years. However, exploding research in electronics and other physical sciences have developed successful new systems. A ten year old program is not appropriate if it destroys our beloved homes and views.

75 11) With questioning, if was noted at the Fairhills meeting that Mill Valley will be using it's existing sites at the City Hall. We believe that, with study, the local civic sites in San Rafael could provide the same coverage.

12) Health Risks: Cancer is of great concern, and there are local people more expert than we are in this area. We can let you know that residents on the East side of
76 Fairhills, from 40-60 years old, have experienced a number of cases of breast, ovarian, and prostate cancer.

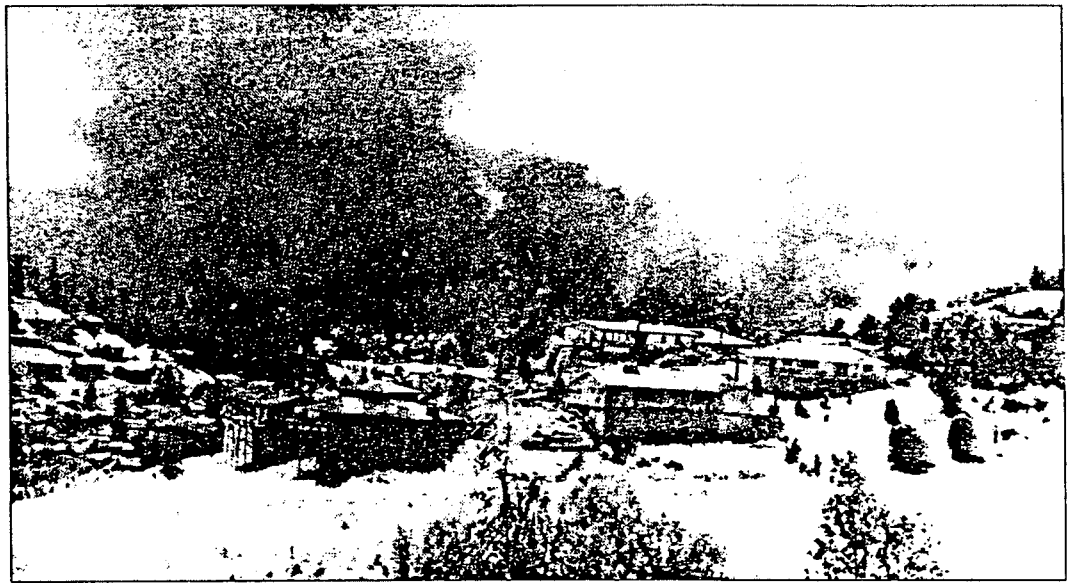
There is no doubt that the system must be upgraded and we are committed to help that happen. Our recommendation is that significant efforts should be made to evaluate
77 new technologies. If towers are still necessary, other sites than "previously used sites" near existing or planned homes or directly obstructing views should be found for forwarding necessary signals. The Turrini site must not be considered by MERA or expanded for any further private or public use.

Sincerely,

Mr. and Mrs. Robert D. Irwin

Attachments:

Page from "Fairhills" book
Two photos of Turrini and City site from 34 Wildwood
"Ambrosi Beetle/Live Oaks" article



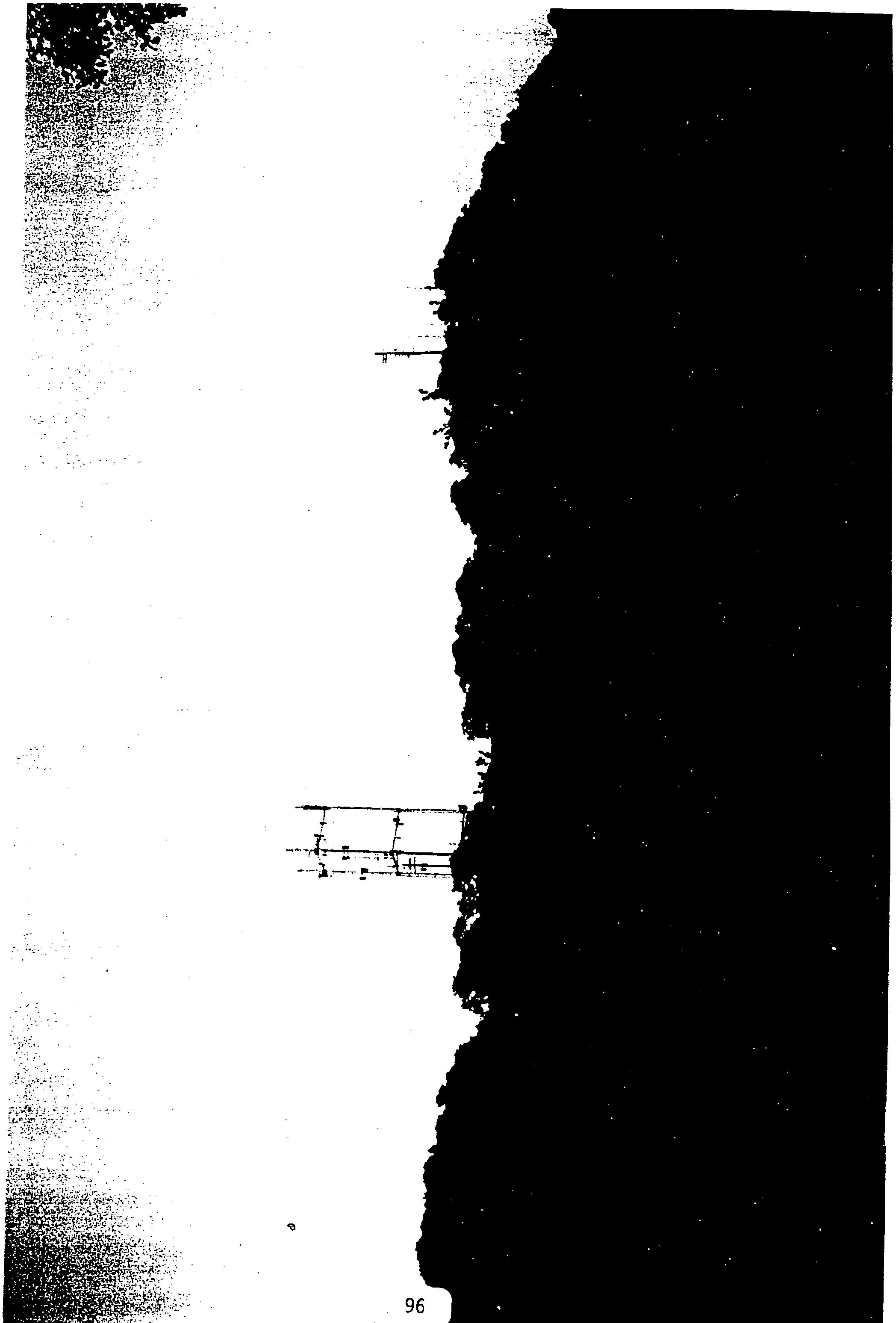
THE SAN RAFAEL HILL FIRE spread from Laurel Place and Dollar Drive over the quarry to Fairhills in June, 1976.

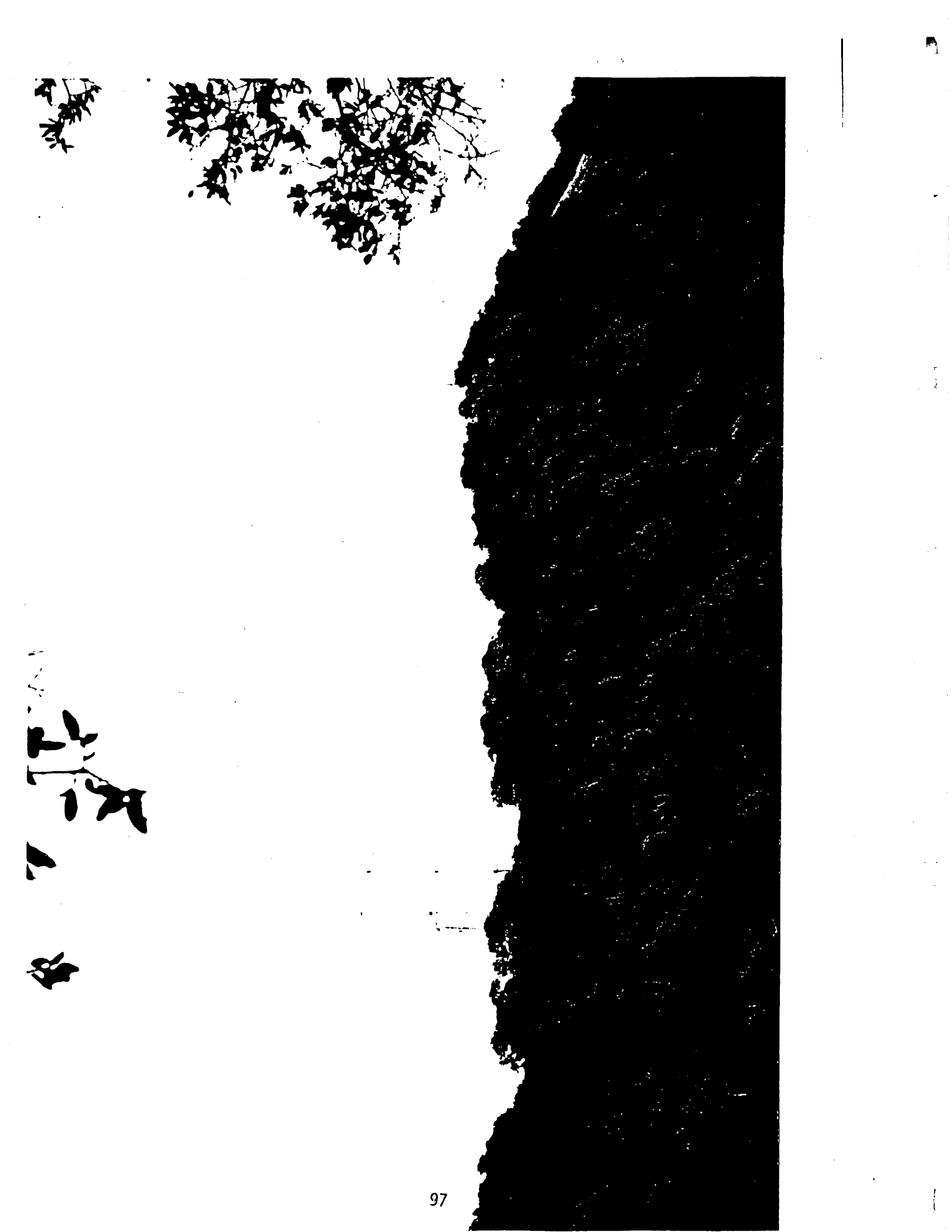
blamed for starting another serious fire above Mt. Tamalpais Cemetery below the Ridgewood area development.

On the other side of the hill, the fire came upon Fairhills. Residents were fleeing for their safety as the flames reached Wildwood Way, Fairhills and Oakmont Drives. At 1:00 p.m. air tankers were dispatched from the Forestry Service at Ukiah and the San Francisco Coast Guard began evacuating homes on Twin Oaks and Fairhills Drive, as well as Oakmont and Wildwood Way. The Red Cross established a First Aid center at the top of Fairhills Drive and dispensed six thousand gallons of reserved drinking water.

175 firemen, coming from as far away as Danville, worked on this fire, and three were hospitalized. Although the fire was contained by 5 p.m., it continued to smolder all night and was not fully contained until the next morning. By then , fifty acres had burned, half a dozen expensive homes sustained serious damage and one home on Wildwood Way burned to its shell. A catastrophe was averted by the air tankers and the perseverance and very hard work of many firefighters and homeowners.

From: "Fairhills, 125 years of Marin History" by Michel Rousselin, ©1990 21





FIRESafe MARIN

READY REFERENCE No. 4

Fall, 1999

Western Oak Bark Beetles and Ambrosia Beetles, Killers of Live Oaks

Pavel Svirha, University of California Cooperative Extension

Oak bark beetles and ambrosia beetles are very small insects (1.7 to 4 mm long) that attack and may kill oaks by boring beneath or through the bark into the sapwood and heartwood. Three species are common throughout California: the Western Oak Bark Beetle, *Pseudopityophthorus pubipennis*, the Oak Ambrosia Beetle, *Monarthrum scutellare*, and the Minor Oak Ambrosia Beetle, *M. Detinger*. These beetles appeared very suddenly and seasonally later than usual after the very cold spring of 1999, wreaking havoc among the California live oaks, *Quercus agrifolia*, in the landscape and natural forests of Marin County.

Western oak bark beetles and ambrosia beetles attack wounded and stressed trees. If environmental conditions contribute to stress oaks in areas where bark beetle populations have reached epidemic proportion, the beetles may attack and kill trees that appear to be healthy. Such a situation has developed during the last four years, when apparently healthy oaks in the gardens and natural forest have been killed in large numbers as far south as Sausalito and north to Novato. Timely removal of infested trees may reduce further tree losses, but there is little that can be done directly to stop bark beetle and ambrosia beetle epidemics in the natural forest. The best defense that arborists, pest control advisors and homeowners have against such losses is to learn about oak health care and the beetles' habits.

Life History and Habits

Western Oak Bark Beetle, *P. pubipennis*. These beetles usually attack severely injured, dying or dead trees. They reproduce in great numbers primarily in oak firewood, emerging to attack oaks and tanbark oaks in the landscape. Adults emerge in the spring and fly to dead or dying oak material, where they bore through the bark and construct two transverse egg galleries in the phloem and xylem tissues. Females lay eggs along both sides of galleries. As beetles continue to bore through the bark, they introduce a symbiotic fungus (not yet identified) that stains and kills the inner bark and sapwood around the egg galleries excavated perpendicular to the grain. The construction of egg galleries and the growth of symbiotic fungus girdle and plug the tree's vascular system (the vessels that transport water and nutrients to the tree). After eggs hatch, the larvae make fine threadlike tunnels through the phloem into the inner bark where they pupate. Newly formed adults make their own exit holes through the bark and fly to attack oaks in the vicinity or far away. This beetle has two or more generations a year.

Oak Ambrosia Beetle, *M. scutellare*. These beetles attack dying, weakened, or diseased trees, but most prefer just-killed trees or parts of trees. In March, the male penetrates the sapwood to a depth of 2.5 inches. The female joins the male, mates and introduces the symbiotic fungus, *Monilia brunnea*. Both sexes excavate two to four diverging galleries deep into the heartwood, each 2 to 6 inches long. The female excavates egg niches in the sidewalls of the galleries, which the larvae extend into "larval cradles." The ambrosia fungus grows into the cradles and serves as a food source. Excavation of egg galleries lasts 2 to 4 months; larval development, 6 to 8 weeks; and pupation, 2 to 3 weeks. After a total 3 to 4 months, new brood beetles emerge through the same entrance holes made by parent beetles. There are two generations per year with two major flight periods, the first in March and the second in October. However, the beetles may fly almost every day through the growing season because the different developmental stages overlap.

Minor Oak Ambrosia Beetle, *M. detinger*. The biology of this beetle is unknown but is probably similar to *M. scultellare*.

Look for Symptoms

The first step in dealing with potential bark beetle and ambrosia beetle problems is to learn to identify symptoms of their attack. In apparently healthy California live oaks ***dark brown to black colored granules and stained bark surface*** below the entrance holes of western oak bark beetles are the first signs of fresh infestation near the trunk base. ***Reddish-brown boring dust*** appears on the lower bark surface near the tree base. Sap flow and bark beetle borings attract oak ambrosia beetles and other associated insects to the same tree. They also bore in extremely high numbers into bark already occupied by oak bark beetles. However, the ambrosia beetles penetrate through the bark deep into the heartwood and ***fine white sawdust appears on the tree trunk***. The amount of their feeding depends on the wood's moisture and surrounding temperature. Large trees, more than 10 inches in diameter are usually attacked near ground level and succumb rather quickly. The foliage of an attacked live oak becomes pale green and then rather quickly changes into red.

Proper Oak Health Care Prevents Bark Beetle and Ambrosia Beetle Attack

There is no historical record about such rapid and massive dieback of live oaks as we are now experiencing in Marin County. The adage that "an ounce of prevention is worth a pound of cure" is certainly true with regard to the protection of landscape oaks. Epidemics of these beetles originated in naturally growing tanbark oaks, *Lithocarpus densiflorus*. In 1995, massive deaths of tanbark oaks from unknown causes began in the Mt. Tamalpais-Mill Valley region. These dead trees served as a staging base for new brood beetles to emerge and attack nearby live oaks in the natural forest and landscape. Tanbark oak and California live oak diebacks in forest stands cannot be controlled with chemicals at reasonable costs and for environmental reasons. Once these beetles have completed their attack, there are no chemical controls that will save the tree. We do not have complete biological information these pests. It is difficult to predict how long the epidemics in natural forests will last. Therefore, it is important to act promptly to reduce their impact in the landscape by:

- Promptly cutting down infested trees with the symptomatic brown foliage, chipping the smaller branches and splitting the wood for firewood. **Cover firewood immediately with <u>*clear plastic*</u> for six months to prevent new brood emergence and subsequent attack of oaks in the vicinity!**
- Removing dying, dead and damaged branches to maintain healthy and vigorous oaks.
- Avoiding heavy intermediate pruning cuts that open the oak canopy to physiological stress.
- Grinding the stump after the oak is removed.
- Preventing damage by insect defoliators such as oakworm and tent caterpillars, which are on the rise.
- Irrigating drought stressed oaks during summer to reduce drought damage to roots and improve tree vitality. Apply soaker hose to the area within the drip line of a tree once every six weeks. Lay down soaker hose across (at right angles) to the slope.
- Reducing damage to roots and the root crown area caused by frequent irrigation. Too much supplemental water or water applied too often deny oxygen to the roots, reduce tree vigor, predispose trees to beetle attack, and favors certain serious diseases.
- Minimizing soil compaction to prevent root diseases such as oak root fungus and Phytophthora fungus.

Spraying the trunk (up to 4 ft. above ground) twice with insecticide permethrin (Astro) in March and the end of September. Consider this for high-value ornamental oaks, oaks whose root system was disturbed by any construction or soil compaction, and oaks with the initial beetle attacks. However, these chemicals do not kill beetles already in the tree and, at best, are only mildly successful as preventatives.

10 Ash Ave
Kentfield, CA 94904
December 28, 1999

Ms. Linda Christman
Executive Director
Marin Emergency Radio Authority
3501 Civic Center Drive
San Rafael, CA 94903

Dear Director Christman,

I understand the need for all law enforcement agencies to be in communications and applaud the efforts to bring that effort to completion. The need to complete that effort should not be at the expense of the health of those you are attempting to protect. I am enclosing a copy of two pages from the Newton, Mass. study of breast cancer. I don't know what it means but there is certainly a difference between the high and low incidence areas regarding exposure to radio/TV towers. With the use of the technology proposed under MERA the number and distribution of towers would increase and thus citizen exposure to electro-magnetic frequencies would also increase. The breast cancer rates in Marin are already the highest in the country and, if this were truly an increased risk factor, then maybe another technology would be a better investment for the community.

78

There are many things about the proposed system that seem to not be appropriate. For instance, voice and fax should be available so that images could be sent on the same communication band. Two-way voice seems essential but I understand this is not possible with MERA. Why are we investing so much money in a system that can deliver so little of that which is important? In industry, there is a term for what has happened in the past and that is "Sunk Costs." You consider what has been spent as gone and go forward from there in a new direction. It is never too late to make sure the system we will be getting in Marin is actually what is needed.

79

Thank you for hearing my concerns.

Sincerely,

Virginia Souders-Mason

Virginia Souders-Mason

in the Newton Breast Cancer Study

	Factors more common in high-incidence area High-incidence area | Low-incidence area	Factors more common in low-incidence area High-incidence area | Low-incidence area
Breast cancer screening	• 27% | 17% At least 10 mammograms in life • 29% | 23% Breast self-exam usually monthly	
Socioeconomic status	• 62% | 28% Annual household income at least $100,000 • 56% | 33% Education at least master's degree • 37% | 17% Education of partner or childhood head of household at least master's degree • 93% | 77% Own current home	
Environmental factors associated with personal habits or activities	• 17% | 9% Used termite control products at least three times as an adult • 22% | 15% Used lice control products at least three times as an adult • 30% | 23% High routine pesticide use • 65% | 36% Ever used a professional lawn service • 6% | 3% Played golf • 21% | 14% Used vaginal spermicides for at least 5 years • 45% | 32% Used professional dry cleaning at least once a month	• 36% | 42% Ever used flea or tick products on pets • 30% | 37% High exposure to cigarette smoke
Environmental factors associated with place of residence in Newton	• 45% | 2% Lived with higher exposure to radio/TV towers	• 4% | 26% Lived within 1/10 mile of industrial zone • 6% | 14% Lived within 1/10 mile of hazardous waste site
Known risk factors	• 37% | 26% Had first child after age 30	• 28% | 42% High body mass index (weight for height) • 14% | 21% Never had term pregnancy • 37% | 51% Never breastfed

All differences listed are statistically significant ($p<0.05$)

Study conducted by Silent Spring Institute with funding from the Massachusetts Department of Public H

SILENT SPRING INSTITUTE

RESEARCHING THE ENVIRONMENT AND WOMEN'S HEALTH

29 Crafts Street, Newton MA 02458 617 332 4288 fax 617 332 4284
60 Park Street, Hyannis MA 02601 508 778 1942 fax 508 775 8468
email info@silentspring.org www.silentspring.org

BACKGROUND ON SILENT SPRING INSTITUTE'S CAPE COD BREAST CANCER AND ENVIRONMENT STUDY

The Cape Cod Breast Cancer and Environment Study grew from the efforts of breast cancer activists and legislators who were alarmed at the patterns of consistently elevated breast cancer on Cape Cod. Their work led to a $3.6 million three-year study conducted by Silent Spring Institute with funds administered by the Massachusetts Department of Public Health (MDPH). By December 1997, the results of this study suggested that continued exploration of environmental links to breast cancer on Cape Cod is needed. In May of 1998, MDPH selected Silent Spring Institute to continue the study.

Over the next three years, Silent Spring Institute plans to use three kinds of data to learn about how women are exposed to certain types of chemicals—pesticides, endocrine disruptors, and mammary carcinogens—that may increase breast cancer risk. Specifically, we will

- Interview 2,500 Cape women with and without breast cancer, collecting information on recognized risk factors, personal health history, various habits and activities, and home addresses on Cape Cod for the past 40 years.
- Test air and dust and women's urine for mammary carcinogens and estrogen mimics in 140 households.
- Estimate certain environmental exposures for all 2,500 study participants with the Geographic Information System (GIS) developed during the first study period.

This planned research would not have been possible without the substantial research previously completed by Silent Spring Institute and its team of multidisciplinary researchers.

By December of 1997, Silent Spring Institute researchers

- Showed that breast cancer is about 20% higher on Cape Cod than the rest of the state for the full period from 1982 to 1994.
- Determined that established risk factors for breast cancer such as reproductive history, family history of breast cancer, and age, as well as increased access to mammography are unlikely to fully explain the elevated rates of breast cancer on the Cape.
- Developed new scientific methods to test environmental samples for endocrine disruptors and other compounds that may be related to breast cancer risk.
- Created a comprehensive source of information on the Cape environment. When the study began, there was no integrated database to assess how environmental factors might be associated with increased breast cancer incidence. This information is now easily accessible through the Cape Study's Geographic Information System (GIS).
- Explored the scientific plausibility of nine environmental factors and their relevance to breast cancer on Cape Cod.
- Mapped the locations of 2,625 women diagnosed with breast cancer on the Cape (these data are kept strictly confidential).

Through our work in this next phase, we hope Cape Cod will be a source of important advances in our understanding of possible links between the environment and breast cancer and, ultimately, will help us identify preventable causes to protect girls and women everywhere.

Silent Spring Institute is a non-profit organization dedicated to studying the links between the environment and women's health, particularly breast cancer. The Institute is a unique partnership of scientists, physicians, and activists. The study team includes researchers 102 oston University School of Public Health, Tufts University School of Medicine, Harvard School of Public Health, Applied Geographics, Inc., and JSI Research

December 28, 1999

RECEIVED
MARIN COUNTY
ADMINISTRATOR'S OFFICE

1999 DEC 29 A 10:24

Linda Christman, Executive Officer
Marin Emergency Radio Authority
3501 Civic Center Drive, Suite 325
San Rafael, CA 94903

To whom it may concern,

80 The County has taken an arrogant stand toward its citizens: the County attitude toward ridgelines and Mt. Barnabe in particular has been, and is now, to discourage all future building on the peaks and ridgelines, unless it's the County doing the building! The County does not apparently recognize the visual pollution of metal towers decorated with dish antennas and accessory buildings on Mt. Barnabe, but, oh how worried and cautious the County is when addressing any future building, even though private endeavors are subject to height limitations and design review, etc., etc. I find it quite outrageous that the County is so blatantly unfair in its treatment of its citizens, especially the citizens so directly effected by the "improvements".

Sincerely,

Celia Brown

Celia Brown
1 Mountain King Road
Lagunitas, CA 94938

cc: Board of Supervisors
Nancy Rubin, Director of Health & Human Services
Scott Davidson, Planning Director

December 28, 1999

RECEIVED
MARIN COUNTY
ADMINISTRATOR'S OFFICE
1999 DEC 29 A 10:24

Linda Christman, Executive Officer
Marin Emergency Radio Authority
3502 Civic Center Drive, Suite 325
San Rafael, CA 94903

Dear Ms. Linda Christman,

Since it is common knowledge that the Marin County bureaucrats are the most corrupt of any in all of California may I suggest that you admit that we the taxpayers will not be given any consideration concerning the illegal use of Mt. Barnabe for your MERA's program.

Let me give just one example of how worthless your county services are:

1. My friend's wife called 911 to report that he was on the floor with chest pains.
2. Your fire and paramedics people arrived and installed an I.V. into my friend.
3. In hauling him out they nearly killed him by stumbling down the stairs.
4. He feared for his life by their reckless driving.
5. When arriving at the E.R. the attending M.D. screamed at them for installing the I.V. incorrectly.
6. These lying cowards claimed that the I.V. was in place when they (the lying cowards) picked him up.
7. The I.V. bag was filling with my friend's blood thereby removing his blood from his body due to the incompetence of your excessively stupid bureaucrats.
8. My friend can't believe that he must pay a paramedics tax to support these incompetent lying cowards.

81

Can you explain how any morally grounded person can work for a corrupt county that would have these lying cowards on the payroll?

Sincerely,

Roger Hopfensperger
P.O. Box 530
Lagunitas, CA 94938

cc: Board of Supervisors
Nancy Rubin, Director of Health & Human Services
Scott Davidson, Planning Director

rec'd via fax

December 30, 1999

Ms. Linda Christman
Marin County Administrators Office
Marin Civic Center
San Rafael, CA 94903

Dear Ms. Christman,

82 We have recently been informed of some of the plans for a radio tower 80' high with another 15' of antenna and two 4' microwave attachments to be built on Forbes Hill. While we acknowledge the need and importance for emergency radio communications, we feel that it is equally necessary and important for the neighborhood residents to understand possible health risks and impact on property value.

83 Unfortunately, we were not able to attend the Sun Valley Neighborhood Association meeting at which this item was discussed. Such an issue needs to be more widely discussed and the county needs to inform all residents of the sites and impacts of the proposed seventeen towers.

We trust that this proposal is not proceeding beyond the "drawing board" and that there is consideration of additional input from the community.

Yours truly,

Sue Lim and Rodney Yee
101 Windsor Avenue
San Rafael, CA 94901-1053

DRAFT
MARIN EMERGENCY RADIO AUTHORITY

MINUTES OF DECEMBER 9, 1999

1. Call to Order

Vice President Brock Arner called the meeting to order at 5:00 p.m. at Marinwood Community Center, 775 Miller Creek Road, San Rafael.

PRESENT:

City of Belvedere	Ed San Diego (at 5:15 p.m.)
Bolinas Fire Protection District	Kevin Hicks
Town of Fairfax	Phil Gorny
Kentfield Fire Protection District	John Lando
City of Larkspur	Jean Bonander (at 5:10 p.m.)
County of Marin	Linda Christman
Marin Municipal Water District	Jon Mandell
Marinwood Community Services District	Tom Horne
City of Mill Valley	Don Hunter
City of Novato	Wally Bobkiewicz
Novato Fire Protection District	Ray Landi
Town of Ross	Tom Gaffney
Ross Valley Fire Service	Beth Pollard
Town of San Anselmo	Peter Kilkus
City of San Rafael	Rod Gould (at 5:10 p.m.)
City of Sausalito	Brock Arner
Town of Tiburon	Dave Hutton
Tiburon Fire Protection District	Al Harris
Twin Cities Police Department	Tony Hoke

ABSENT:

Town of Corte Madera
Inverness Public Utility District
Marin Community College District
Marin County Transit District
Southern Marin Fire District
Stinson Beach Fire Protection District

STAFF PRESENT:

Linda Christman, Executive Officer
Dave Byers, Legal Counsel

Richard Chuck, Communications Consultant
John Roberto, Planning Consultant
Scott Davidson, Planning Consultant
Margaret Ryan, Recording Secretary

2. Approval of the Agenda

The agenda was approved, with Item 5, Contract Amendment #1, being considered first.

5. Report of the Executive Officer

a. Approval of Contract Amendment #1

Executive Officer Linda Christman noted that the contract amendment had been approved at the last meeting pending language approval of the MERA attorney. Attorney Dave Byers reviewed the terms of the First Amendment to the Agreement betweeen MERA and Motorola, Inc. In exchange for the first payment to Motorola being expedited to December 31, 1999, Motorola has accepted the negotiated Change Order No. 2 in the amount of $299,166 additional from MERA and agreed that no further change orders will be presented for (1) services identified in the Detailed Design Review; (2) any mitigation described in the Draft EIR of November 15, 1999; (3) any site change, additional site work, installation or equipment change initiated by Motorola; or (4) any additional cost due to work initiated by Motorola to ensure compliance with the system functionality representation.

Rod Gould commended Linda Christman and Richard Chuck for their negotiations on the change order and recommended it be accepted.

M/s Fairfax - Novato FPD to approve the First Amendment to the Agreement Between Marin Emergency Radio Authority and Motorola, Inc., including Change Order No. 2, as recommended. The motion passed unanimously.

b. Project/Operating Budget Status

The revised Budget Projections for MERA project costs were given based on acceptance today of Contract Amendment #1, resulting in a projected balance in the special contingency of $12,240 and a projected balance in the project contingency of $283,834.

Ms. Christman reported the Technical Advisory Committee (TAC) has reviewed Motorola's schedule and now finds it complete, and therefore recommends the schedule be adopted as the project now includes everything MERA wants.

4. Public Hearing to Accept Comments on the Draft EIR

Planning consultant John Roberto was introduced by Vice President Brock Arner, who then informed members of the public that this hearing was to receive comments on the Draft

Environmental Impact Report (DEIR). Written comments should be submitted to the Executive Officer by December 29, 1999. The Final EIR will respond to the comments received and will be the subject of a public hearing tentatively scheduled for February 10, 2000.

Executive Officer Linda Christman explained the purpose MERA was formed and stated the member agencies hope to achieve an independent, coordinated high-band communications system to serve the public and assist mutual aid.

Mr. Roberto described the backbone structures necessary to provide 97 percent coverage in Marin County, stating 15 sites are in Marin County and 2 sites in Sonoma County. Only one site is new, Bolinas Ridge, and towers may be required at some existing sites such as Tiburon Ridge, Forbes Hill and Dollar Hill. Since the impact of some of the sites is significant, the EIR was expanded to address these environmental issues.

The public hearing was then opened.

Joan Ripple, President of the Health Council of Marin, said written comments made in October continue to be valid. She said more research is needed on the health exposure to pulsating
84 digital systems, the cumulative effects of microwaves, and electromagnetic fields (EMFs), citing studies indicating people can be harmed by these exposures. She thought this was a good project but MERA had to be cautious.

Virginia Saundus Mason, 10 Acacia, Kentfield, a member of the Board of Marin Breast Cancer
85 Watch, cited reports on the risk of breast and prostate cancers caused by proximity to radio towers.

Libby Kelley, Executive Director of the Council on Wireless Technology Impacts, 90 Paladini Drive, Novato, listed her qualifications in the health field and said she had a strong concern about environmental health. She asked what would be put into the air that would affect public
86 health and the environment, how seismic safety of the towers would be planned, and how to address the impact on loss of real estate value. Stating not enough analysis or measurements had been done on air samples, on the frequencies and power sources, and on the cumulative impact, she asked that a report on nonionizing radiation be part of the EIR.

The President of Barnabe Homeowners Association said the County of Marin did not allow
87 others to do measurements on Mt. Barnabe and that work has already started on the project. Mr. Arner and Ms. Christman assured her no work had been done on the project.

The public hearing was closed. Mr. Arner again invited members of the public to submit their comments in writing before December 29, and stated copies of the Final EIR could be obtained by contacting Linda Christman.

Mr. Roberto said once the EIR comment period is over, he will prepare written responses to comments raised regarding the environmental impacts of the project. The FEIR will be available ten days prior to the hearing.

3. Approval of Minutes of November 18, 1999

M/s Novato FPD-Kentfield to approve the minutes of November 18, 1999, as written. The motion passed unanimously.

6. Report of Project Manager

Project Manager Richard Chuck reported on a successful week reviewing the preliminary document with Motorola. The TAC met twice so that the change order could be approved tonight. The TAC will now focus on training and user operation issues so that they are identified beforehand while the system is being designed and tested. In response to Rod Gould's query whether all the TAC's concerns had been addressed, Mr. Chuck said the TAC was confident the document now meets the project's functional needs.

7. Open Time for Public Expression

None.

8. Items from Board Members

None.

9. Adjournment

President Pro Tem Arner adjourned the meeting at 6:10 p.m. The next Executive Committee meeting will be held at 4:00 p.m. on January 13, 2000, at the Marin Civic Center. The next Board meeting will be a public hearing on the Final EIR and is tentatively schedled for 5:00 p.m., February 10, 2000, in San Rafael.

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IV. RESPONSES TO COMMENTS RECEIVED ON THE DEIR

1. The Northern Spotted Owl is on the list of special status wildlife species potentially occurring in the area of the Bolinas Ridge Site (Initial Study, 9/16/99, Appendix 2, page 13; and Draft EIR, Table VI-2, page VI-8). Although no suitable habitat for the Northern Spotted Owl was found at the site, the Northern Spotted Owl will be added to the list of species that will be monitored for prior to and during project construction, as required by Mitigation Measure Bolinas Ridge BIO-2.

2. The Initial Study and Draft EIR identified Caenothus masonii and Arctostaphylos virgata as two special-status plants known to occur in the area of the Bolinas Ridge Site (Initial Study, Appendix 2, Table 2; and Draft EIR, Table VI-2). Ceanothus gloriosus var. porrectus was identified as a special status plant species potentially occurring in the area of the Bolinas Ridge Site. Ceanothus gloriosus var. exaltatus will be added to the list of special plant species known to occur in the area. The plant survey completed as part of the Draft EIR did not find these species at the Bolinas Ridge site. These three plant species will be added to the list of plants that will be surveyed for prior to construction activity at the project site (DEIR, Mitigation Measure BIO-1).

   National Park Service Land will be avoided during construction activities at the Bolinas Ridge Site.

3. The Draft EIR concluded that the relocation of the reflector panel, as recommended in Mitigation Measure Bolinas Ridge VIS-2, would reduce the visual impact of the reflector panel to a less-than-significant level (DEIR, pg. V-68). The National Park Service (NPS) is of the opinion that the visual impact will remain significant after implementation of Mitigation Measure VIS-2, and recommends that Alternative Mitigation Measure VIS-2 be adopted by MERA.

   The Draft EIR found that relocating the panel as suggested in the Mitigation Measure Bolinas Ridge VIS-2 would obscure the panel from trail users by placing it beyond the prominent knoll thereby using the knoll to block the view (DEIR pp. V-68 to V-69). The comment letter submitted by the NPS did not contain any new visual information to support their claim that the impact would remain significant. Therefore, the conclusions of the Draft EIR remain unchanged.

   MERA will decide which mitigation measure to implement when it acts on the proposed project. MERA, has the option of approving, approving with modifications, or denying the project as currently

proposed. However, MERA cannot take action on the proposed project until the environmental review process is completed.

4. No permanent access road is required to maintain the reflector panel at the Bolinas Ridge Site. However, a temporary access road will be required to construct the facility. Mitigation Measure VIS-2(b) recommends that the reflector panel be assembled on the existing fire road and lifted to the proposed site with a crane. This mitigation would reduce the amount of equipment and materials which have to be transported to the site, thereby reducing impacts on vegetation within the access route.

   The preconstruction plant survey recommended in Mitigation Measure Bolinas Ridge BIO-1 includes a survey of the temporary access route to the site. The findings of the plant survey will be used to determine the route. The intent is to avoid any sensitive plant species during site construction.

5. The sentence on page V-84 reads: "*The facility as proposed would not be visually apparent from the surrounding Point Reyes/Inverness environs in as much as the height is limited and the antennas are relatively small*". The sentence on page V-86 reads: "*The Point Reyes Hill facility would be visible from many directions; however, the viewing distances are great enough that the facility's details would not be discernible*". Although worded differently these statements are not inconsistent. Even though you will be able to see the location of the facility, the facility's dimensions are such that they would not be visually discernible, and will not change the existing visual setting from surrounding viewpoints (DEIR, pg. V-86).

6. The Northern Spotted Owl is on the list of special status wildlife species potentially occurring in the area of the Point Reyes Hill Site (Initial Study, 9/16/99, Appendix 2, page 13; and Draft EIR, Table VI-2, page VI-8). Although no suitable habitat for the Northern Spotted Owl was found at the site, the Northern Spotted Owl will be added to the list of species that will be monitored for prior to and during project construction, as required by Mitigation Measure Point Reyes Hill Site BIO-4.

7. The Initial Study prepared for the Marin Public Safety and Emergency Communication System (pp. 161-163) found that emergency generator maintenance and operation was a potential source of noise. The Initial Study concluded that noise resulting from the periodic short-term testing and operation of the emergency generator would result in a less-than-significant impact on the existing environment. Therefore,

the noise effects of the emergency generator were not discussed further in the Draft EIR.

8. The proposed fence will match the existing black vinyl fence at the FAA facility. Please refer to the photo montages following page V-89 in the Draft EIR.

9. Caenothus masonii is already on the list of special status species and Ceanothus gloriosus var. exaltatus will be added to the list. Also refer to Response #2.

10. A Construction Management Plan for the Bolinas Ridge and Point Reyes Hill sites will be prepared after entitlements are received from the County of Marin. A copy of the Construction Management Plan will be submitted to the National Park Service for their review and comment. If possible, site construction at Bolinas Ridge and Point Reyes Hill will be scheduled to avoid the nesting season for various wildlife species. If construction is to occur during the nesting season a qualified wildlife biologist will survey the surrounding area for nests. If nests are found, appropriate measures will be taken to avoid noise impacts which might include a delay in site construction.

11. The consultant retained to prepare the preconstruction plant and, if necessary, nesting surveys will be asked to coordinate the work with representatives of the National Park Service to ensure proper identification of rare plants.

12. The suggested spread of mulch for plantings will be incorporated into the final planting plan.

13. The GGNRA lands adjacent to the Bolinas Ridge Site will be included in the nesting bird survey. The areas to be surveyed around the Bolinas Ridge and Point Reyes Hill sites will be coordinated with the GGNRA and PRNS wildlife biologists.

14. The Construction Management Plan which will be prepared for the Bolinas Ridge and Point Reyes Hill sites will be submitted to the PRNS for review and comment. The plan will identify the location of the vehicle wash station. The plan will also include provisions for weed control (see Master Response #1).

15. Section 15097 of the Guidelines for Implementation of the California Environmental Quality Act requires the preparation and adoption of a Mitigation Monitoring and Reporting Program to ensure that the mitigation measures identified in the EIR are implemented. The

monitoring plan will include on-site visits by environmental monitor(s).

16. This is not a comment on the adequacy of the Draft EIR. MERA and its contractors will comply with the requirements of the San Francisco Regional Water Quality Control Board including the filing of a Notice of Intent with the State Water Resources Control Board, Division of Water Quality.

17. This is not a comment on the adequacy of the Draft EIR. MERA will comply with the provisions of the National Pollutant Discharge Elimination System Program (NPDES) to control run-off from improvements associated with the proposed project. This may include the adoption of a Storm Water Pollution Prevention Program and the incorporation of Best Management Practices in the erosion control program for project construction and post project construction.

18. As requested, Sonoma County's approval requirements for the proposed facilities at the Sonoma Mountain and Bay Hill Road sites are included in this document (see Appendix A). These requirements include building permits, review of consistency with the Sonoma County General Plan, visual analysis and alternatives analysis. As noted in the comment letter the visual analysis and alternatives analysis provided in the Draft EIR appears to meet the applicable County Code requirements. The Draft EIR also included a discussion of the consistency of the proposed project with the Sonoma County General Plan (DEIR, pp. IX-68 through IX-73).

19. The cumulative analysis on pages VIII-3 through VIII-5 of the Draft EIR discuss the size of the microwave dish and height of the antenna to be added to the existing tower at the Bay Hill Road site. The cumulative analysis concludes (DEIR, pg. VIII-4) that the combined visual affect of the MERA facilities and the planned Sonoma facilities is less-than-significant.

20. The Draft EIR concluded on page V-101 that the implementation of the recommended mitigation measures, including the application of reflective paint, would not reduce the visual effect to a less-than-significant level. The Draft EIR already concludes that the application of the reflective paint is not adequate to mitigate the impact. Painting an existing tower at this time would not change the findings of the EIR.

Should MERA decide to approve the project with a facility at Forbes Hill, the City of San Rafael may request that the effect of the reflective paint be demonstrated as part of its review and action on the project.

21. Currently there are several U.S. and international standards for RF and EMF exposure. These standards were established by groups of scientists and engineers who evaluated research studies, and formulated exposure limit guidelines based on recognized effects such as heating stress and behavior disruption in animals. They then applied an additional safety factor to reduce recommended exposure levels well below the levels known to produce any potentially harmful affect.

ANSI C95.1-1992, "Standards for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz," discusses this issue. The C95.1-1992 standard is a revision of the 1982 standard. As the revision process was described by the ANSI C95.1-1992 authors, "a total of 321 papers selected from the archival literature... were reviewed for biological, engineering, and statistical validity." The papers were selected and reviewed without regard to possible thermal or non-thermal mechanism. The Maximum Permissible Exposure (MPEs) for the general public in "Uncontrolled Environments" are 1/10 to 1/50 of the electromagnetic field levels where "potentially-deleterious health effects" occur. "No verified reports exist of injury to human beings or of adverse effects on the health of human beings who have been exposed to electromagnetic fields within the limits... of ANSI C95-1982".

The radio frequency analysis completed for the Forbes Hill Site by Hammett & Edison, Inc. on August 11, 1999 (IS, Appendix 3) found that the maximum ambient Radio Frequency (RF) levels anywhere at ground level due to the proposed MERA project operation were calculated to be 0.018 mW/cm^2, which is 5.7% of the applicable public limit (uncontrolled environment). Therefore, even without taking into consideration the expected reduction in exposure levels due to the relocation and replacement of the existing antennas on Forbes Hill, the maximum ambient levels anywhere at ground level due to the proposed operation in conjunction with existing facilities was calculated to be 6.1% of the applicable public limit, based upon measurement results, with a maximum of 26% of the public limit under any operating conditions (worst case).

The maximum ambient RF levels at ground level anywhere on the Forbes Hill reservoir were calculated to be 9.1% of the applicable public limit. The maximum ambient RF levels at ground level east of the Forbes Hill Site property line at the east end of the site were calculated to be less than 0.03% of the applicable public limit.

The Forbes Hill Site is a secured site and the public is not permitted access to the hill. Therefore, the maximum exposure to the public at the nearest private property line would be 0.03% of the applicable ANSI

standard for uncontrolled environments. This extremely low exposure level is far below the ANSI standard which itself is far below the level where harm to organisms is measured in scientific studies. Accordingly, the RF impacts of the project at the Forbes Hill were found to be less-than-significant and calculated exposure levels are far below the adopted exposure limits for uncontrolled environments.

22. This is a statement of opinion about the merits of the proposed project, and is not a comment on the adequacy of the Draft EIR. No response is required under the adopted CEQA Guidelines.

23. Currently there are several U.S. and international standards for RF and EMF exposure. These standards were established by groups of scientists and engineers who evaluated research studies and formulated exposure limit guidelines based on recognized effects such as heating stress and behavior disruption in animals. They then applied an additional safety factor to reduce recommended exposure levels well below the levels known to produce any potentially harmful affect.

The radio frequency analysis completed for the Barnabe Mountain Site by Hammett & Edison, Inc. on August 11, 1999 (IS, Appendix 3) found that the maximum RF levels at ground level due to the proposed MERA operation are calculated to be 0.021 mW/cm^2, which is 6.5 % of the applicable public limit. The maximum ambient RF levels at ground level due to the proposed operation in conjunction with existing facilities was calculated to be 6.62% of the applicable public limit.

There is an existing fire lookout adjacent to the proposed MERA facilities. The fire lookout in the Hammett & Edison, Inc. study is described as a publicly accessible area. Based on measurements performed on August 20, 1997, the maximum ambient RF levels in any publicly accessible area due to the existing facilities was 58.5% of the public limit. This occurs on the second floor balcony of the fire lookout. The maximum ambient RF levels in any publicly accessible area due to the proposed MERA operation was calculated to be 0.024 mW/cm^2, which is 16.2% of the applicable public limit. This occurs on the southeast corner of the lookout tower balcony. Assuming a worst-case, that the two areas are coincident, the maximum ambient RF levels in any publicly accessible area due to the proposed operation in conjunction with existing facilities was calculated to be 74.7% of the applicable public limit. It is noted that these results include several "worst case" assumptions and therefore are expected to overstate actual power density levels.

The nearest residence to the Mount Barnabe site is approximately 1,000 feet to the northeast. RF levels at that distance would be less than those calculated at the nearest property line to the Forbes Hill Site. The calculated level at property line at the Forbes Hill Site was 0.03% of the public limit (refer to Response #22). This extremely low exposure level is far below the ANSI standard which itself is far below the level where harm to organisms was measured in scientific studies. Accordingly, the RF impacts of the project at the Barnabe Mountain Site were found to be less-than-significant and calculated exposure levels are below the adopted exposure limits for uncontrolled environments.

24. This is a statement of opinion on the timing of the installation of any new towers, dishes, or equipment buildings, and is not a comment on the adequacy of the Draft EIR. No response is required under the adopted CEQA Guidelines.

25. Chapter VII in the Draft EIR discusses five alternatives to the proposed project. The alternatives analysis included identification and evaluation of alternative sites for the proposed telecommunication sites which were found to result in significant impacts on the environment. The alternatives analysis also discussed alternative emergency communications systems including a satellite system and a cellular phone system. Refer to Master Response #2 for a discussion of the process which led to the selection of the seventeen proposed telecommunication sites.

26. The microwave dishes at the Forbes Hill Site are located 35 and 45 feet above ground level because the Mount Tamalpais Site has an existing height limitation of 20 feet for microwave dishes. The microwave dishes at the Forbes Hill Site are mounted at the height recommended by the microwave system supplier to guarantee adequate signal strengths for the proposed microwave path. The path surveys take into account normal tree growth without removal or pruning of existing trees.

27. The 4 foot dishes are necessary to meet FCC guidelines for the congested Bay Areas telecommunications environment. The proposal will reduce microwave dish size by replacing the existing 8 foot microwave dish with the two smaller 4 foot dishes.

28. The Draft EIR concluded on page V-101 that the implementation of the recommended mitigation measures, including the application of reflective paint, would not reduce the visual effect to a less-than-significant level. Planting the perimeter of the exterior fence, and possibly other portions of the MMWD site as recommended in the

Draft EIR (Mitigation Measure VIS-3(e), would mitigate the tower's visibility from some lower neighborhood areas.

29. The statement that the 3 existing shorter towers will be replaced by a single taller tower is a true and factual statement. There is no need to change the description in the Draft EIR.

30. Those concerns and comments, in the October 16, 1999 letter, which were directly related to environmental issues were addressed in the Draft EIR prepared for the Marin Public Safety Emergency Communication System. In fact, much of the information requested in the October letter was already provided in the detailed Initial Study which was transmitted with the Notice of Preparation. The October letter requested that the EIR address six areas of concern. Some of these areas of concern were outside the environmental process and were not included in the EIR. The following is a short summary of how MERA addressed the issues raised in the letter.

(1) Environmental Analysis and Mitigation: The firm of Hammett & Edison, Inc. was hired to complete a radio frequency (RF) analysis for the 16 sites where new microwave dishes, radio antennas and radio equipment are proposed. The RF studies considered both the uncontrolled exposure conditions to which civilian populations are subjected and the controlled exposure conditions for workers, whose occupations require them to work in controlled environments.

The studies found that in the worst case cumulative analysis the facilities as sited and located at 15 of the proposed sites did not exceed the Federal ANSI standard for uncontrolled environments at ground level at the towers. In addition, the study found that RF exposure conditions quickly fell off when measured at distance from the tower. For example, the maximum ambient RF levels at ground level anywhere on the Forbes Hill reservoir site were calculated to be 9.1% of the applicable public limit. The maximum ambient RF levels at ground level east of the Forbes Hill Site property line were calculated to be less than 0.03% of the applicable public limit.

The only location where ground level exposures exceed the applicable ANSI standard was Point Reyes Hill. This exposure condition was mitigated by fencing the facility to create a controlled environment around the new pole on which antennas are to be placed. The area outside the fence will be within the exposure limits for uncontrolled environments (public limits).

The studies also found that on the towers themselves, generally from 25 feet to 35 feet above ground level, the exposure conditions exceeded the limit for controlled environments. The exposure limit was also expected to be exceeded on the roof of the transmitter building within the MERA compound at the Point Reyes Hill site. The study recommended that MERA post warning signs at each site, such that the signs would be visible to workers intending to perform work on the tower or roof of the transmitter building at the Point Reyes site.

MERA did not hesitate to include this recommendation into its project design. Warning signs which comply with ANSI C95.2 color, symbol and content conventions will be installed at each site. In addition, contact information will be provided (e.g. telephone numbers) to arrange for access to restricted areas.

The results of these RF studies show that in the worst case cumulative condition RF exposure conditions at ground level are below, and in most cases far below, the ANSI public exposure limits for uncontrolled environments. Accordingly, the proposed system as designed and mitigated complies with the exposure limit standards adopted by the FCC.

The ANSI standards were established by groups of scientists and engineers who evaluated research studies, and formulated exposure limit guidelines based on recognized effects such as heating stress and behavioral disruption in animals. They then applied an additional safety factor to reduce recommended exposure levels well below the levels known to produce any potentially harmful effect. It is MERA's understanding that the review and evaluation of research studies is an on-going activity, and therefore any findings which would affect public safety would result in modifications to the ANSI standard. MERA will comply with the current applicable standards and any further revision to the standards.

At your request the information you attached to the October letter is included in this volume of the EIR (see Appendix B)

(2) Prudent Avoidance: The worst case cumulative analysis of RF exposure conditions found that the exposure conditions at ground level were below, and in most cases far below, the exposure limit for uncontrolled environments. The only exception was the ground level exposure condition calculated at the Point Reyes Station site which has been mitigated by fencing.

Because the potential worst case cumulative exposure conditions are well below the applicable ANSI standards, the Hammett & Edison reports do not recommend on-going monitoring at these sites. The report for the Point Reyes Hill site does recommend that RF measurements be taken prior to the commencement of operation to determine the extent of ground level exposure in order to properly set the new fence location. MERA will comply with this recommendation.

The Health Council of Marin has argued in its October 19 letter for on-going monitoring of RF emissions. However, the measurements taken to date do not justify the need for on-going monitoring. Please refer to the findings and conclusions in the RF studies previously provided to you in the Initial Study, Appendix 3.

(3) Full Disclosure and Mutually Beneficial Remedies: The Motorola Response to Proposals has been superseded by a revised document called the "Detailed Design". This is a voluminous report and it is considered proprietary information and is not currently available to the public. Please note that Motorola is within their rights under the Public Information Act to withhold documents which they believe will give an unfair advantage to their competitors. Since Motorola is the only major supplier of public safety radio equipment which has invested in the development of a system to serve the "narrow-band" market; MERA staff understands their concern. Despite their right to withhold certain information, Motorola has agreed to review the "Detailed Design" for public release if a specific request for information is submitted.

A similar request for information was received from the Council on Wireless Technology Impacts, and was responded to by MERA's staff (see Appendix C). The Health Council of Marin can follow the same procedure if they wish to request Motorola's proprietary information.

All documents which are part of the public record including the Initial Study, Draft EIR, and administrative record are, and always have been, available for public review at the Marin County Administrator's Office, 3501 Civic Center Drive, Room 325, San Rafael, CA 94903. Office Hours are 9:00 am to 4:00 pm, Monday through Friday, except holidays, or telephone (415) 499-6358 for information requests.

(4) Physical Security Requirements: MERA has provided for the security of its proposed facilities (see DEIR, Chapter III, Project Description) in the design of the project, and in negotiating leases with the owners of private facilities.

(5) Project Feasibility and Cost Effectiveness: The questions listed under this heading address the design and merits of the proposed project, and do not address the environmental effects of the proposed project. The comment is noted, but no written response is required by the CEQA Guidelines.

(6) Impact on Property Values and Aesthetics: . The effect of a telecommunications project, especially at an existing telecommunications site, on nearby housing values is difficult to isolate. The housing market and the value of property within a given housing market is based on numerous factors. The proximity of a given property to other land uses including: places of employment, schools, shopping, freeways and roadways, open space and public facilities all have an effect on its value. However, factors such as the availability of housing, the demand for housing, and the cost and availability of financing have the greatest influence on the relative value of housing in a given market.

Based on the real estate information reported in local and regional newspapers, Marin County's housing prices are increasing at one of the highest rates in the nine San Francisco Bay Area Counties. In addition, housing prices in the vicinity of the existing and new telecommunication sites are also on the rise. Therefore, proximity to a telecommunications site does not appear to be driving housing prices down in Marin County.

This is not to say that some individual buyers may not wish to purchase a home which is near a telecommunications site, but it appears from the rising housing prices in Marin that there are other buyers who give other factors a higher priority in choosing a home (e.g. schools, shopping, and weather). Therefore, the proximity or visibility of a telecommunications site does not appear to be one of the primary factors in determining residential housing values in Marin County.

The issue of the effect of the proposed project on housing values in urbanized areas can be an on-going debate without resolution. It appears from the available information that the proximity of homes to existing telecommunication facilities and new telecommunication sites has not reduced property values.

CEQA recognizes that the social affects of a project are an issue of community concern, but do not result in physical impacts on the environment. Accordingly, these issues are not required to be addressed in an EIR. Section 15131 of the CEQA Guidelines reads "*Economic and Social Effects: Economic or social information may be included in an EIR or may be presented in whatever form the agency desires*". Accordingly, the EIR for the Marin Public Safety and Emergency Communication System is not required to address the impact of the project on property values, if any, before the EIR can be certified.

The aesthetic affects of the proposed project are discussed and documented in the Draft EIR. Please refer to the visual impact analysis and discussion for each proposed telecommunications site in Chapter V of the Draft EIR.

31. This is a statement acknowledging that the procedure used by MERA to evaluate the RF impacts of the proposed project is based on the current standards adopted by the FCC. The statement also includes the commentator's opinion that the current ANSI and NCRP standards are not adequate, and that changes to the standard may occur in the future.

The Health Council of Marin asked that MERA evaluate the potential RF impacts of the proposed project, and MERA complied with that request. The evaluation of RF impacts were based on the adopted FCC standards. The CEQA Guidelines, Section 15064.7(a), requires that the determination of the significance of the environmental effects of a project be based on existing adopted standards, and that compliance with the standard means the effect normally will be determined to be less-than-significant. The RF studies found that the worst case cumulative RF exposures were well below the applicable ANSI standard and concluded that the impact was less-than-significant.

The CEQA Guidelines, specifically Section 15064(f)(5), provides that argument, speculation, unsubstantiated opinion or narrative shall not constitute substantial evidence that an impact is significant. The argument that the ANSI standard, as to acceptable levels of radio frequency exposure, may change in the future is speculative. The evaluation of an impact's significance should not be based on speculative assumptions. MERA has already stated that its facilities will comply with adopted ANSI standards.

32. MERA has already stated that should scientific and engineering review of emerging scientific and technical information result in a change in

the applicable ANSI standard, the revised standard for exposure limits will be satisfied.

33. Master Response #3 provides information on MERA's public outreach program including the steps which have been taken to date to obtain public input on the project, and other opportunities which remain for public input.

34. MERA will comply with all applicable federal, state and local agency requirements for planning, constructing, and operating Marin County's emergency communications system.

35. This question was previously addressed. See Response #30-(3)

36. The commentator is making a statement about the merits of the proposed project. The CEQA Guidelines do not require a written response to project merit statements.

37. This question was previously addressed. See Response #30-(1).

38. This is a statement about electromagnetic fields research and a statement on the merits of the proposed project. A written response is not required under the CEQA Guidelines. Questions related to the potential RF affects of the project and other related issue were previously addressed (refer to Response Numbers 30-(1) through 30-(6), and 31).

39. The proposed telecommunications system is not a pulsed transmission system. Frequencies for the trunked system are in the 480 MHz to 495 MHz range. Microwave frequencies are in the 6 and 10 GHz range. Antenna patterns vary per site with the RF calculations taken at worst case. The on-site measurements of existing sites incorporates all existing users. The calculated measurements take into account all systems proposed as part of the MERA system and all known existing sources.

40. The antennas are proposed to be Decibel Products and the tower manufacturer is not yet known. Final design decisions will be made by MERA after considering the information in the EIR, and the concerns expressed by the public at MERA's upcoming public hearing on the proposed project.

41. MERA staff previously responded to this request by letter. A copy of the letter can be found in Appendix C. Also refer to Response #30-(3).

42. MERA will comply with all applicable federal, state and local agency requirements for planning, constructing, and operating Marin County's emergency communications system.

43. This issue was previously addressed. Please refer to Response #31. Furthermore, the EIR cannot speculate on the outcome of CWTI's Federal court appeal challenging the FCC guidelines.

44. The proposed telecommunications system is not a pulsed system. It appears from the information provided with this comment that the commentator already knew the answers to the questions asked in Comment #39.

45. The worst case cumulative analysis of RF exposure conditions found that the exposure conditions at ground level were below, and in most cases far below, the exposure limit for uncontrolled environments. The only exception was the ground level exposure condition calculated at the Point Reyes Station site which has been mitigated by fencing.

Because the potential worst case cumulative exposure conditions are well below the applicable ANSI standards, the Hammett & Edison reports do not recommend on-going monitoring at these sites. The report for the Point Reyes Hill site does recommend that RF measurements be taken prior to the commencement of operation to determine the extent of ground level exposure in order to properly set the new fence location. MERA will comply with this recommendation.

The request for routine monitoring is not supported by the findings of the RF studies. Please refer to the findings and conclusions in the RF studies in Appendix 3 of the Initial Study.

46. The question is hypothetical and Sections 15064 (d)(3) and 15064(f)(5) do not require EIRs to evaluate the potential environmental effects of hypothetical or speculative scenarios.

The proposed towers are designed to meet Zone 4 earthquake standards. Should a microwave beam be diverted during a seismic event or other natural or human-made catastrophe, the alarm system employed as part of the system will immediately notify MERA radio technicians of a loss of signal path. Technicians would then be dispatched to repair the problem. In a natural or human-made emergency repairs to the emergency telecommunications system are the highest priority, because without the system a coordinated response to the emergency cannot be delivered by health and safety providers (police, fire, paramedic, and public works).

47. This question about property values was previously addressed. Please refer to Response #30-(6). The issue of potential litigation and liability is speculative, and conclusions reached in the EIR cannot be based on speculation.

The second paragraph of this comment reads in part: "*Since the enactment of the Wireless Communication and Public Safety Act of 1999, a new federal law mandates a national end-to-end public safety communication system. the law also protects the manufacturers, carriers and dispatchers, all that work with this system, from liability should there be any harm or injury*". This statement appears to answer the speculative question asked in the first paragraph.

48. The Draft EIR includes a discussion of an alternative satellite based system. Please refer to Chapter VII, pages VII-23 through VII-24.

49. This is a statement of opinion about the merits of the proposed project. No response to a merits statement is required by the CEQA Guidelines.

50. A monopole was previously considered for the Forbes Hill Site. There was concern that the monopole due to its density and diameter may in fact be more visible than a lattice tower. The suggestion would be considered further by MERA if it further reduces the visual appearance of the facilities. However, the replacement of the tower with a monopole would not change the visual impact conclusions in the Draft EIR.

51. The proposed microwave dishes are mounted at the height recommended by the microwave system supplier to guarantee system performance. Two dishes are required at this site to meet system performance criteria. One of the two microwave dishes could be mounted on the roof of the new telecommunications shelter. This suggestion will be given further consideration by MERA staff. However, relocating one microwave dish does not eliminate the need for a new tower, and it is the tower that is creating the significant visual impact.

52. MERA's environmental review process meets and exceeds the requirements of the Guidelines for Implementation of the California Environmental Quality Act (CEQA Guidelines, Article 7). Please refer to Master Response #3 for further discussion of MERA's public and environmental review process.

53. As of the date of the preparation of this response to comments document MERA staff has held three neighborhood meetings in the City of San Rafael, and a community meeting in the San Geronimo Valley. An additional neighborhood meeting is scheduled in the City of San Rafael at the Community Center on B Street for Tuesday, February 8, 2000. In addition, MERA held a noticed public hearing on December 9, 1999 to obtain input on the Draft EIR.

MERA anticipates holding a public hearing on the proposed project on February 24, 2000. However, the date of that hearing may change depending on the date the Final EIR is completed. In either case, public notice of the meeting will be given as required by law. Should MERA approve the proposed project, or a modified project, additional noticed public hearings are required in each jurisdiction were new facilities and telecommunications sites require local approval. It is anticipated at this time that public hearings for the Forbes Hill and Dollar Hill sites will be held before the San Rafael Planning Commission and City Council. These meetings would be scheduled no sooner than March or April 2000.

All of these meetings are public hearings where concerned citizens can state their opinion on the proposed project or any aspect of the proposed project.

54. The Draft EIR discusses alternatives to the proposed project including two alternative technologies which are available. Refer to Chapter VII in the Draft EIR, pages VII-3 to VII-27.

55. The radio frequency exposure studies which were prepared for the 16 sites were new microwave dishes, radio antennas, and radio equipment are proposed found that the proposed facilities were below the public exposure limits established by the Federal Communications System, and the impact was deemed to be less-than-significant. For further discussion of this issue please refer to Response Numbers 30-(1), 30-(2), and 31.

56. Alternate locations for the proposed MERA facilities were considered during the schematic design development process. Please refer to Master Response #2 for additional information.

57. This is a statement of opinion as to when the proposed project should be acted upon. No response is required under the provisions of the CEQA Guidelines.

58. The ANSI standards adopted by the Federal Communications Commission were established by groups of scientists and engineers

who evaluated research studies, and formulated exposure limit guidelines based on recognized effects such as heating stress and behavioral disruption in animals. They then applied an additional safety factor to reduce recommended exposure levels well below the levels known to produce any potentially harmful effect. It is MERA's understanding that the review and evaluation of research studies is an on-going activity, and therefore any findings which would affect public safety would result in modifications to the ANSI standard. MERA will comply with the current applicable standards and any revision to the standards in the future.

The radio frequency exposure studies completed for the Draft EIR found that in the worst case cumulative analysis the facilities as sited and located at 15 of the proposed sites did not exceed the Federal ANSI standard for uncontrolled environments at ground level at the towers. In addition, the study found that RF exposure conditions quickly fell off when measured at distance from the tower. For example, the maximum ambient RF levels at ground level anywhere on the Forbes Hill reservoir site were calculated to be 9.1% of the applicable public limit. The maximum ambient RF levels at ground level east of the Forbes Hill Site property line were calculated to be less than 0.03% of the applicable public limit.

The RF exposure level at the nearest residential property line to the Forbes Hill Site is less than one tenth of one percent of the applicable ANSI standard for uncontrolled public access.

59. The MERA Board; which is comprised of representatives from all the cities in Marin County, special districts, and the County of Marin; set the performance and operational standards for the countywide emergency telecommunications network. The current proposed emergency communications system was found to be the best system available to meet MERA's criteria.

60. There are only three tower sites within the City of San Rafael. They are San Pedro Ridge, Dollar Hill and Forbes Hill. Each of these sites is an existing telecommunications site. Under the proposed project the existing towers on Dollar Hill and Forbes Hill would be removed and replaced with new taller towers. Other sites were considered during the design development stage of the project, but were rejected for various reasons. Additional information on the telecommunications site selection process is provided in Master Response #2.

61. The Forbes Hill site provides coverage in the lower valley areas in San Rafael, San Anselmo and Fairfax. Facilities are located on some of the taller hills in the area including Dollar Hill and San Pedro Ridge.

However, a facility is needed at a lower elevation like Forbes Hill in order to meet the "in-valley" coverage requirements.

62. MERA's environmental review process meets and exceeds the requirements of the Guidelines for Implementation of the California Environmental Quality Act (CEQA Guidelines, Article 7). Please refer to Master Response #3 for further discussion of MERA's public and environmental review process.

As of the date of the preparation of this response to comments document MERA staff has held three neighborhood meetings in the City of San Rafael, and a community meeting in the San Geronimo Valley. An additional neighborhood meeting is scheduled in the City of San Rafael at the Community Center on B Street for Tuesday, February 8, 2000. In addition, MERA held a noticed public hearing on December 9, 1999 to obtain input on the Draft EIR.

MERA anticipates holding a noticed public hearing on the proposed project on February 24, 2000. However, the date of that hearing may change depending on the date the Final EIR is completed. In either case, public notice of the meeting will be given as required by law.

Should MERA approve the proposed project, or a modified project, additional noticed public hearings are required in each jurisdiction were new facilities and telecommunications sites require local approval. It is anticipated at this time that noticed public hearings for the Forbes Hill and Dollar Hill sites will be held before the San Rafael Planning Commission and City Council. These meetings would be scheduled no sooner than March or April 2000.

All of these meetings are public hearings where concerned citizens can state their opinion on the proposed project or any aspect of the proposed project.

63. The Forbes Hill site provides coverage in San Rafael, San Anselmo and Fairfax. Subsequent to the neighborhood meetings, MERA staff and the engineers designing the system have looked at additional ways to mitigate the visual impact of the tower. At present, they are trying to further reduce the height of the Forbes Hill tower while maintaining an acceptable level of clear radio coverage in the area.

64. MERA's public and neighborhood communications program was initiated directly after the preliminary design for the proposed telecommunications system was submitted in September 1999.

The project's development design was not submitted until September 1999. The development design is comprised of the location of the various telecommunication sites to be used in the system, and the telecommunication facilities needed at each site in the system. After completion of the Initial Study on the proposed project (September 16, 1999) it was determined that an Environmental Impact Report was required for the project. As required by the State's CEQA Guidelines, MERA consulted informally with all responsible agencies including the State Clearing House. The Notice of Preparation, that MERA was going to prepare an EIR for the proposed project, was issued on September 20, 1999. In October 1999 MERA staff prepared a preliminary scope of work for the EIR and retained an environmental consultant to prepare the EIR.

MERA staff also meet with various public agencies, including the City of San Rafael, to identify local neighborhood and community groups that would be directly affected by the proposed project. From these meeting MERA staff compiled a list of groups and organizations to contact. At the end of October and beginning of November, 1999 MERA staff made phone calls to begin a series of meetings with local neighborhood groups. The first meeting was held in the City of San Rafael on November 16, 1999. Master Response #3 provides a summary of MERA's public participation and review process.

65. MERA's public notice and participation process for the proposed 'Marin Public Safety and Emergency Communications Project' and the Environmental Impact Report (EIR) prepared for the project exceeds the notice and public hearing requirements of the law. Please refer to Response #64 and Master Response #3.

66. Early in the development design process MERA's consultants reviewed a number of sites for the proposed telecommunications system. The matrix provided in Master Response #2 is a list of the sites which were considered. Each site was evaluated and ranked by the design team. Based on this information a number of sites were selected for the preliminary development design effort. As the design progressed some of the previously selected sites were rejected and others substituted for various reasons including radio coverage and potential environmental effects.

The design team considered adopted public policy and environmental factors in the project's development design phase. The MERA Board, which represented the various public agencies involved in the project, was regularly advised by staff on the progress of the development design effort.

67. The sites selected for the photo montages were intended to provide a distant and close view of the proposed facilities. The photo montages were used to determine the visual impact of the proposed project. The photo montages were not intended to provide a view of any project site from a specific neighborhood or home.

68. MERA is aware that the cross on Dollar Hill has been vandalized and removed since the visual analysis was completed. The removal of the cross from the hill top does not change any of the findings in the Draft EIR.

69. The estimate of the distance of the proposed facilities on Dollar Hill to the nearest home was based on existing available aerial photography. The comment does not indicate weather or not the homes on the listed streets may be closer to the facility. Therefore, no change is needed to the estimated distance measurement in the DEIR.

70. The Draft EIR found that the visual impact of the facilities proposed on Dollar Hill is significant, and that the impact, even with mitigation can not be reduced to a level-of-insignificance. The loss of some California Live Oaks on Dollar Hill might make the proposed small radio equipment building, and lower portion of the tower, more visible from some off-site view points. however, the loss of the trees to disease does not change the finding in the EIR. The proposed facilities will still result in a significant adverse visual impact.

71. The Initial Study (pages 122-123) prepared for the proposed project discussed the potential effects of wildfires on all project sites. The Initial Study recommended mitigation measures which would reduce this potential impact to less-than-significant. The mitigation measures have been incorporated into the project design as discussed on pages II-21 and II-22 of the Draft EIR.

72. This is a statement of opinion about the affect of the proposed project on home values in the Fairhills Area. Please refer to Response #30-(6) for a discussion of the issue of the impact of the proposed project on home values.

73. The current proposed design of the telecommunications project provides the in-building coverage requested by MERA. Relocating a site closer to the industrial buildings in San Rafael, could have a negative impact on in- building coverage elsewhere in the City of San Rafael and Marin County.

74. This is a statement of opinion about the merits of the proposed project. EIR's do not address the merits of a project, and a written response is not required by the CEQA Guidelines.

75. The Mill Valley City Hall site will receive its transmissions from an existing tower located at the Mill Valley Public Safety Building near Highway 101. The relocation of antennas to the City Hall site in San Rafael may not eliminate the need for a tower at Dollar Hill.

76. Comment noted. Please refer to Response Numbers 21, 23, 30-(1) and 30-(2) for additional discussion of this issue.

77. This is a statement of opinion on the merits of the proposed project and alternatives to the proposed project. EIR's do not address the merits of a project, and a written response is not required by the CEQA Guidelines.

78. Almost all of the sites in the proposed telecommunications network, where new towers are proposed, have existing towers. The only exception is the Mount Tiburon Tank site. MERA will replace some of the existing towers with new taller towers. Please refer to Response Numbers 21, 23, 30-(1) and 30-(2) for a discussion of the radio frequency affects of the proposed project.

79. This is a statement of opinion on the merits of the proposed project. EIR's do not address the merits of a project, and a written response is not required by the CEQA Guidelines.

80. This is a statement of opinion on the merits of the proposed project and the commentor's perception of Marin County's handling of telecommunication project applications. EIR's do not address the merits of a project, and a written response is not required by the CEQA Guidelines.

81. This is a letter which details the writer's perception of events that took place during a paramedic response to a 911 emergency. The letter does not address the Draft EIR. No response to the letter is required by the CEQA Guidelines.

82. The issue of radio frequency impacts is discussed in Responses Numbers 21, 23, 30-(1) and 30-(2), the issue of the proposed project's impact on home values is discussed in Response #30-(6). Please refer to these responses.

83. Please refer to Master Response #3 for a summary of MERA's public participation and review process.

84. Please refer to Responses 30-(1) through 30-(6). These are the responses to comments in the October 1999 letter from the Health Council of Marin.

85. Please refer to Responses Numbers 21, 23, 30-(1) and 30-(2) for a discussion of radio frequency impacts.

86. The comments made by Elizabeth Kelly were the same comments as the ones contained in the December 29, 1999 letter from cwti. These comments were previously addressed in Response Numbers 39 through 47.

87. Radio frequency measurements were taken by Hammett and Edison, Inc. A copy of their reports can be found in the Initial Study, Appendix #3.

V. MASTER RESPONSES

MASTER RESPONSE #1
DRAFT CONSTRUCTION MANAGEMENT PLAN
(Bolinas Ridge & Point Reyes Hill)

Purpose

The purpose of the construction management plan is to inform potential contractors of the procedure to be followed for site preparation and facilities construction. The provisions of this construction management plan must be incorporated into contractor bid documents, and must be implemented during project construction. MERA's contract documents will include a penalties clause if the provisions of the construction management plan are not implemented by the construction contractor.

Applicability

The provisions outlined below shall be incorporated into all bid documents for construction at the Bolinas Ridge and Point Reyes Hill sites.

Provisions

A. Preconstruction

1. Preconstruction plant and wildlife surveys will be completed for the Bolinas Ridge and Point Reyes Hill sites to determine if any species of concern have become established on the construction site, the access road, or planned construction staging areas. A qualified botanist shall conduct a pre-construction survey for Caenothus masonii, Arctostaphylos mirgata, Ceanothus gloriosus var. porrectus, Ceanothus gloriosus var. exaltatus, Campanula californica, Dirca occidentalis, and the other plant and wildlife species of concern listed in Table VI-2 of the Environmental Impact Report for the project.

   Should any of these species be found their location shall be marked, and the National Park Service (NPS) and Golden Gate National Recreation Area (GGNRA) representatives notified. The project construction drawings shall also be modified to avoid any impacts on any identified species of concern. The botanist shall also flag rare plants occurring near but not within the construction area. All environmentally sensitive areas shall be shown on the construction drawings and specifications. These plants shall be protected during construction by temporary fencing or some other means agreeable to the NPS and GGNRA.

In addition temporary construction fencing shall be installed around areas of Bishop pine closed-cone forest and any other sensitive plant communities along access roads to prevent accidental impacts.

2. A nest survey shall be conducted on the project site and the surrounding area, including GGNRA lands to determine if any nesting raptors or migratory birds are in the trees near the construction area. The survey need only be conducted if construction is anticipated during the nesting season (February 15 to July 15). If nesting birds are found in close proximity to the construction site, no construction shall occur within 500 feet of the nest unless a qualified botanist in consultation with representatives of the NPS and GGNRA have determined that the young birds have fledged.

3. Temporary fencing shall be installed along the access roads to protect coastal scrub vegetation.

4. A power washing station shall be designated in the final construction management plan. When construction begins, the tires and under-carriage of vehicles involved in construction, including employees private vehicles, shall be power washed before entering NPS, GGNRA, or Marin Municipal Water District lands near the Federal parks.

5. A construction plan designed to limit vegetation impacts shall be developed for the Bolinas Ridge Site. The plan should minimize impacts to chaparral shrubs in the vicinity of the site. The EIR suggests that the passive reflector be partially assembled on the existing fire road and then lifted onto the site with a crane. Concepts similar to this should be incorporated into the construction plan to limit vegetation impacts during construction.

6. A qualified archaeologist shall be retained prior to the start of construction. The archaeologist shall be present during any excavation and grading to observe and watch for the appearance of cultural resources.

7. Construction bid documents must incorporate all the relevant mitigation measures contained in the Initial Study and Environmental Impact Report prepared for the telecommunications project.

B. Site Preparation

1. Only silt fencing, erosion control blankets, or mulch generated on-site shall be used to control erosion. No straw bales, seed or other erosion control materials that could contain noxious weed seed shall be used at the construction sites or anywhere in or near NPS and GGNRA lands.

2. Areas disturbed during site preparation shall be reseeded with a mix of local native grasses and plants. The mulch should be created on site by chipping the vegetation material cleared for construction.

3. All areas to be protected by temporary construction fencing must be flagged and fenced before any site work begins.

4. If necessary, fuel loads (grass and brush) shall be reduced by mowing and pruning to reduce the risk of fire ignition on the construction site.

5. An emergency spill prevention and countermeasure plan shall be developed prior to commencement of site activities.

C. Construction

1. Project construction shall be monitored by a qualified biologist to ensure that protective fencing is in place, construction is occurring within designated areas, and that all the plant and wildlife protection provisions of the construction management plan are being satisfied. Any violation of the provisions of the construction management plan shall be reported by the biologist to the NPS, the GGNRA and the appropriate County officials.

2. The Construction project manager shall ensure that the contractor and all persons employed on the project are aware of the mitigation methods for avoiding non-native seed dispersal.

3. Contractors and construction personnel involved with any form of ground disturbance shall be advised that should cultural resources be uncovered during project construction, work shall be halted and the construction manager shall be notified. The construction manager shall notify the consulting archaeologist, who will ensure that the procedures required by law will be followed.

4. The contractor shall provide a water truck or portable water tank on or near the project site during all construction operations. The

amount of water to be stored shall be agreed to by the NPS, GGNRA and the Marin County Fire Department.

5. On-site fire response equipment (i.e. fire extinguishers, fire retardent blankets shovels, buckets) shall be maintained and clearly marked.

6. The contractor shall ensure that all construction workers are trained in workplace fire safety measures and the use of fire response equipment.

7. A wireless phone or other independent communication device shall be located at the construction site and clearly identified.

8. Any material excavated during construction shall be disposed of in previously approved disposal area or stored away from water resources.

9. Potential pollutants such as sanitary wastes and petroleum products shall be collected and removed from the job site as they accumulate. Petroleum products or other potential pollutants shall be stored away from drainage courses and wetland areas.

10. Construction wastes shall be either sorted or recycled prior to leaving the site or at a Materials Recovery Facility. Off-site disposal shall require the submittal of records to permitting officials for monitoring and verification.

11. All construction personnel shall be required to remove solid waste from the site when leaving.

12. Construction equipment shall be maintained and tuned at intervals recommended by manufacturers in order to minimize exhaust emissions.

13. Equipment idling shall be kept at a minimum when equipment is not in use. Moreover, no piece of equipment shall idle in one place for more than 30 minutes.

14. Stockpiles of debris, soils and other materials that could be blown by wind shall be covered and the covering anchored.

15. Any temporary or emergency power generators used during construction shall be equipped with emission and noise reduction devices. If noise reduction devices are not available for the

equipment, provisions should be made on-site to reduce the noise as heard in the surrounding area.

16. During construction operations the project manager shall post a publicly-visible sign that specifies the telephone number and person/agency to contact for complaints or inquiries.

MASTER RESPONSE #2
TELECOMMUNICATION SITE SELECTION PROCESS

One of the initial tasks in developing a public safety and emergency telecommunications network was to assess the potential risks associated with utilizing various sites for the land based backbone portion of the radio system. In order to achieve the radio coverage specifications formulated by the Marin Emergency Radio Authority, Marin County was separated into four area. The four areas are Eastern Marin, Central Marin, West Marin and Northern Marin. Topographic maps prepared by the United States Geologic Survey were then reviewed and potential telecommunication sites were identified.

The preliminary site selection process identified 34 potential sites. Most of the sites are in Marin County, but some sites are in Sonoma and San Francisco counties. Following the preliminary site selection process, the project's design development team prepared a list of general criteria to rank the risks associated with using any one of the potential sites in the in the telecommunications network.

The criteria which the development design team took into consideration included the geologic stability, plant and wildlife sensitivity, potential change in existing visual character, roadway access issues, general plan consistency issues, telecommunication plan consistency issues, the need for a new tower (including the anticipated height of the tower), potential radio coverage problems, land ownership, and whether or not the site was currently developed.

In order to evaluate and compare the potential risks associated with utilizing any of the 34 identified sites, a matrix was prepared , and each site was than ranked as to its relative degree of risk. A ranking of low, moderate or high risk was given to each criteria by site. It was agreed that any site which had the potential for a high degree of risk in any category would not be utilized in the system, unless the site was necessary to provide the coverage goal for each area of the County. The table on the following page shows the results of the preliminary assessment.

The preliminary assessment identified nineteen sites which were not expected to present a high degree of risk. These sites included: in Eastern Marin (Sugarloaf-Upper Water Tank, Mount Tiburon Water Tank, Mill Valley City Hall, Pacific Bell Central Office Building, Dollar Hill-City, Dollar Hill-Turrini, Forbes Hill Reservoir, San Pedro Ridge, Big Rock Ridge-Motorola, Big Rock Ridge-C&C, and Mount Burdell); in Central Marin (Mount Tamalpais and Barnabe Mountain); in West Marin (Fort Miley- San Francisco, Bolinas Fire Station, Point Reyes Hill); and in Northern Marin (Bay Hill Road, Sonoma Mountain-CellularOne, and Sonoma Mountain-County).

PRELIMINARY ASSESSMENT OF POTENTIAL TELECOMMUNICATION SITES

POTENTIAL SITES	Geologic Issues	Plant- Wildlife Issues	Change Visual Character	Road Access Issues	General Plan Issues	Telecom. Plan Issues	New Tower Height	Radio Coverage Problems	Land Ownership	Existing Site
Eastern Marin County										
1. Sugarloaf - Upper Water Tank									P	Developed
2. Mount Tiburon Water Tank									P	Developed
3. Sugarloaf - Lower Water Tank									P	Developed
4. Mill Valley City Hall									P	Developed
5. Pacific Bell Central Office Building									Pv	Developed
6. Mill Valley Public Safety Building									P	Developed
7. Blithdale Canyon									Pv	Open
8. San Rafael Hill - Water Tank #1									P	Developed
9. San Rafael Hill - Water Tank #2									P	Developed
10. Dollar Hill - Hilltop									P	Developed
11. Dollar Hill - Turrini Site									Pv	Developed
12. Forbes Hill Reservoir									P	Developed
13. Moore Hill Water Tank									P	Developed
14. Red Hill									-	Open
15. Bald Hill										Open
16. San Pedro Ridge									Pv	Developed
17. Big Rock Ridge - Motorola									Pv	Developed
18. Big Rock Ridge - C&C									Pv	Developed
19. Mount Burdell - AT&T									Pv	Developed
CENTRAL MARIN COUNTY										
20. Mount Tamalpais - West Peak									P	Developed
21. Mount Tamalpais - Middle Peak									Pv	Developed
22. Mount Tamalpais - East Peak									P	Open
23. Barnabe Mountain									P	Developed
WEST MARIN										
24. Fort Miley - San Francisco	?								P	Developed
25. Bolinas Fire Station									P	Developed
26. RCA Antenna Farm									Pv	Developed
27. Bolinas Ridge - MMWD									P	Open
28. Mount Vision										Developed
29. Bolinas Ridge - GGNRA									P	Open
30. Point Reyes Hill									P	Developed
NORTHERN MARIN COUNTY										
31. Dillon Beach Area - Marin									Pv	Open
32. Bay Hill Road - Sonoma									Pv	Developed
33. Sonoma Mountain - Cell One									Pv	Developed
34. Sonoma Mountain - Sonoma County									P	Developed

Degree of Risk

Low	
Moderate	
High	
Public Land	P
Private Land	Pv

Subsequent to the identification of the nineteen potential sites, the development design team initiated technical and engineering work on the system. As a result of the initial technical and engineering work some of the preliminary selected sites were rejected, and other sites which were previously rejected were brought into the system. The changes were made to achieve the radio coverage requirements of MERA. The following is a summary of the reasons for the changes.

1. Sugarloaf-Upper Tank vs. Mount Tiburon Water Tank Site: Either of these sites can be designed to meet the radio coverage desired in Tiburon, Corte Madera, Larkspur, and portions of San Rafael The Sugarloaf-Upper Water Tank Site was rejected because the surrounding topography was an obstacle to attaining microwave dish sight-line requirements, as well as, radio coverage objectives. The Mount Tiburon Water Tank site had direct sight-lines to Mount Tamalpias and San Pedro Ridge. In addition the Mount Tiburon Tank site's topography had fewer constrains in achieving radio coverage objectives.

2. Mill Valley City Hall vs. Pacific Bell Central Office Building: Either of these sites can be used to meet the radio coverage objectives for the lower valley areas in Mill Valley. However, the city's existing land use regulations allowed for the installation of public telecommunications equipment at City Hall. Therefore, the Pacific Bell site was rejected.

   A problem common to both sites was the need for an 80 foot high tower to make the microwave link to Mount Tamalpais. The need to find an alternative to the tower led to change number 3.

3. Mill Valley Public Safety Building Site: This site was not included in the preliminary list of potential sites because it did not provide the radio coverage desired in the lower valley areas of Mill Valley. However, the Public Safety Building site already had a microwave dish, and engineering studies found that if the existing dish was replaced, the site could be used as the microwave link between Mount Tamalpais and Mill Valley City Hall. The addition of the Public Safety Building site to the system eliminated the need for a tower at the City Hall site.

4. Dollar Hill-Hilltop vs. Turrini Sites: Either of these sites can provide the radio coverage objectives in San Rafael and other portions of Marin County. Both of these sites will require new towers. The tower at Turrini would be higher than the tower at the hilltop site. There were also plant and wildlife issues, and the combination of public and private communications facilities, associated with the Turrini Site.

Since there were more issues associated with the Turrini Site, it was rejected.

5. Big Rock Ridge - Motorola Site: Both the Motorola and C&C sites will achieve MERA's coverage objectives in this area. However, fewer improvements would have to be made at the C&C site, and the ranking of the two sites was identical. Therefore, the Motorola site was removed from the list.

6. Fort Miley Site - San Francisco: The Fort Miley Site in San Francisco was needed in order to provide a communications link from the Bolinas area in West Marin to Mount Tamalpais. However, preliminary technical and engineering studies found that a tower approximately 180 feet high might be needed at the Bolinas Fire Station to communicate with Fort Miley. Additional technical work found that the tower at Bolinas Fire Station Site could be reduced in height to 60 feet if a telecommunications link was provided on the Bolinas Ridge. The Fort Miley Site was taken off the list.

7. Bolinas Ridge - MMWD Site: The Bolinas Ridge MMWD site was not included in the preliminary list of potential sites because the two microwave dishes previously anticipated at the site were expected to result in a high degree of risk in many areas. However, further studies found that if the facility on Bolinas Ridge was changed to a passive reflector the impacts would be far less than that associated with the dual microwave dishes. The microwave dishes required, platforms, a power source, and access road for construction and maintenance. The passive reflector did not. The change to a passive reflector meant that a larger microwave dish would be required at the Bolinas Fire Station. It was anticipated that the microwave dish required at Bolinas Fire could then be located and screened on the existing building.

8. Sonoma Mountain - CellularOne vs. Sonoma County Sites: Either of these sites can provide the desired radio coverage in northern portions of Marin County. The risks of utilizing either site was expected to be similar. It was decided that combining MERA's facilities with an existing public facility made more sense than combining with a private facility. The CellularOne Site was rejected.

There were other issues (visibility) associated with making improvements at other sites on the list including Forbes Hill Reservoir and Dollar Hill-Hilltop sites. However, efforts to find other sites that had fewer issues and could meet the radio coverage objectives of the system were non-productive.

The more detailed technical and engineering work which followed the preliminary site selection reduced the number of potential sites from 19 to 15.

The other two sites in the proposed project (Novato Police Station and Marin County Civic Center-Prime Site) were added later to meet the telecommunication and coordinating links required for the system.

MASTER RESPONSE #3
PUBLIC PARTICIPATION AND REVIEW PROCESS

There were a number of comments received on the Draft Environmental Impact Report (DEIR) concerning the provision of adequate time for public review and comment on the DEIR and proposed project. MERA has complied with all the notice and review requirements contained in the Guidelines for Implementation of the California Environmental Quality Act (CEQA). In addition, MERA has scheduled public hearings, and community and neighborhood meetings to solicit public comment on the DEIR and the proposed project. The following is a summary of MERA's project design development, environmental review, and public participation program.

Project Design Development

MERA was formed in response to a critical need to design and construct a public emergency telecommunications network that would provide dependable countywide wireless radio coverage under emergency conditions. MERA also wanted to minimize the environmental effects of the new system's design. Accordingly, MERA adopted a project design development program that incorporated continuous and on-going environmental review of the evolving telecommunication network design.

During the design development phase of the project, environmental and other data was evaluated for potential telecommunications sites and was given to the design development team for their consideration. As the system design was further developed, a detailed Initial Study on the potential environmental effects of the project was undertaken by MERA. The purpose of the detailed Initial Study was to collect more precise information on the potential environmental effects of the project, and to identify mitigation measures that could be incorporated into the project design.

The draft Initial Study found that the new towers proposed for the system at Forbes Hill, Dollar Hill, and the Bolinas Fire Station, as well as the receive and send site proposed on the Bolinas Ridge, would be visible from populated view points in the surrounding area. The project's development design team was asked by MERA staff to explore alternatives to reduce tower and facility visibility including alternative site plans and alternative locations for these facilities. Alternative sites on San Rafael Ridge and Dollar Hill were found to have similar visual impacts, and the lack of a facility at Forbes Hill had a negative effect on attaining the system's emergency radio coverage objectives. Accordingly, these alternate sites were rejected and an effort was made to minimize the visual appearance of these facilities.

The Initial Study completed on September 16, 1999 recommended a number of mitigation measures which, if incorporated into the project design, would

reduce potential impacts to a level of insignificance. The project design team agreed to incorporate these mitigation measures into the project. The Initial Study also found that the efforts made by the project design team to mitigate the visual affects of the project at Forbes Hill, Dollar Hill, Bolinas Fire Station and Bolinas Ridge did not reduce the visual change at these sites to a less-than-significant level. Accordingly, MERA staff directed that an Environmental Impact Report (EIR) be prepared for the project, and that the EIR explore further efforts to mitigate the visual affects of the proposed project at these four locations.

Project and Environmental Review Process

1. Marin Emergency Radio Authority (MERA)

The development design phase for the 'Marin Public Safety and Emergency Telecommunications System' was completed in September 1999. The MERA staff issued a Notice of Preparation (NOP) on September 20, 1999. The Notice informed other public agencies and persons who previously filed a written request for notices that an Environmental Impact Report (EIR) was going to be prepared on the proposed public safety and emergency telecommunication's project design. The NOP included a description of the proposed project design, a map showing the location of project facilities, and a statement of the project's probable effects. Other public agencies and interested persons were given thirty (30) days to respond to the NOP.

Based on the findings of the completed Initial Study and comments received on the NOP the EIR consultants were asked to prepare a full EIR focusing on the visual, vegetation and wildlife (biological resources), and radio frequency exposure effects of the project. The EIR was also requested to include a discussion of the consistency of the proposed project design with the adopted planning policies of responsible agencies, and an evaluation of alternatives to the proposed project.

On November 15, 1999 a Notice of Completion was posted by the MERA staff initiating a forty-five (45) day review period for the Draft EIR. The Draft EIR was circulated to all responsible and trustee agencies and persons who had submitted written requests for the document. In addition, copies of the Draft EIR were provided to public libraries and the City Clerks in the communities were project facilities were proposed. MERA also held a noticed public hearing on the Draft EIR on December 9, 1999. The purpose of the public hearing was to solicit public comments on the DEIR.

In addition, to the environmental review and comment process, MERA staff held a number of meetings with neighborhood groups and organizations in communities were the environmental effects of the project were found to be potentially significant. The purpose of these meetings was to provide

information on the proposed project, solicit local community comment on the proposed location and design of facilities, and to familiarize people with the environmental review and project decision making process.

As of the preparation of this Response to Comments neighborhood meetings were held in the City of San Rafael on November 16, December 4 and December 14, 1999. Another community meetings has been noticed in San Rafael for February 8, 2000. A community meeting was also held in the San Geronimo Valley on December 13, 1999. MERA staff has also responded to telephone calls about the project, and provided copies of public documents and information upon written request.

MERA is providing a two week opportunity to review and comment on the Final EIR. Written comments received during this time will be reviewed and presented with the staff report at the February 24, 2000 public meeting.

2. Other Public Agency Review

MERA's approval of the project as proposed, or a modified version of the project, is not a grant of entitlement to construct the project. However, the project cannot move forward without first receiving approval form MERA. Subsequent to MERA's approval, permits and entitlements are required from a number of public agencies including: the County of Marin, County of Sonoma, City of San Rafael, City of Novato and Town of Tiburon. It is anticipated at this time that noticed public hearings will be required for some of the sites under the jurisdiction of the County of Marin and the City of San Rafael, respectively. Noticed public hearings may also be required by Sonoma County, Novato and Tiburon depending on the provisions of their respective zoning regulations.

MASTER RESPONSE #4
TURRINI TOWER SITE ALTERNATIVE (REFINED)

Refined Description of Alternative

Alternative # 3 in the Final EIR continues assume the use of the existing Turrini Tower Site as an alternate location for the facilities proposed for the Dollar Hill-Hilltop site. The Draft EIR anticipated a new 100 foot tower at this site. The refined alternative found that the new tower would have to be 120 feet high to accommodate the antennas and equipment on the existing tower plus the new MERA facilities.

The DEIR assumed that since all existing ground space within the Turrini facility was occupied, the new radio shelter required for MERA would have to be constructed outside the existing fence on open space lands. More refined study of the Turrini site found that a radio shelter could be constructed within the existing site if it was designed as a two-story structure. The first floor would be constructed around the existing equipment on the ground, and MERA's radio equipment would be located on the second floor.

The statement in the DEIR that the existing facility at the Turrini site is heavily loaded with commercial users and would require extensive modifications to the tower to meet MERA's requirements is still valid. The refined alternative found that it is possible to construct the new tower by first fist constructing three new monopoles and linking them together with trellised horizontal elements. The new monopoles would be placed at different ground locations than the existing vertical trellis poles, and the new horizontal elements would be placed at different elevations than the existing ones. Equipment on the existing tower would than be transferred to the new tower, the MERA equipment added, and the existing tower elements would then be removed. The new two-story radio shelter would be constructed of the same materials as the existing buildings on the site.

The drawings on the following page show the existing site plan and refined site plan for the Turrini Tower Site Alternative.

Visual Impacts

The DEIR found that the construction of a new tower and building at the Turrini site would result in a significant unavoidable visual impact. The photomontages prepared for the refined alternative, included herein, show that the visual impact of the refined alternative would still be a significant unavoidable impact, especially as viewed from the Dominican area east of site. Therefore, the visual impacts in the DEIR remain unchanged.

Biological Impacts

The DEIR found that construction of the radio shelter outside the existing Turrini site could result in potentially significant impacts on local vegetation. Mitigation included replacement for removed trees and preconstruction raptor surveys to protect nesting wildlife. The refined alternative found that the potential impacts of tree and vegetation removal could also be mitigated by constructing a two story structure within the existing site. However, raptor surveys for nesting birds would still have to be conducted before project construction. The conclusion in the DEIR that plant and wildlife impacts can be mitigated to a level-of-insignificance remains unchanged in the refined alternative.

Radio Frequency Exposure

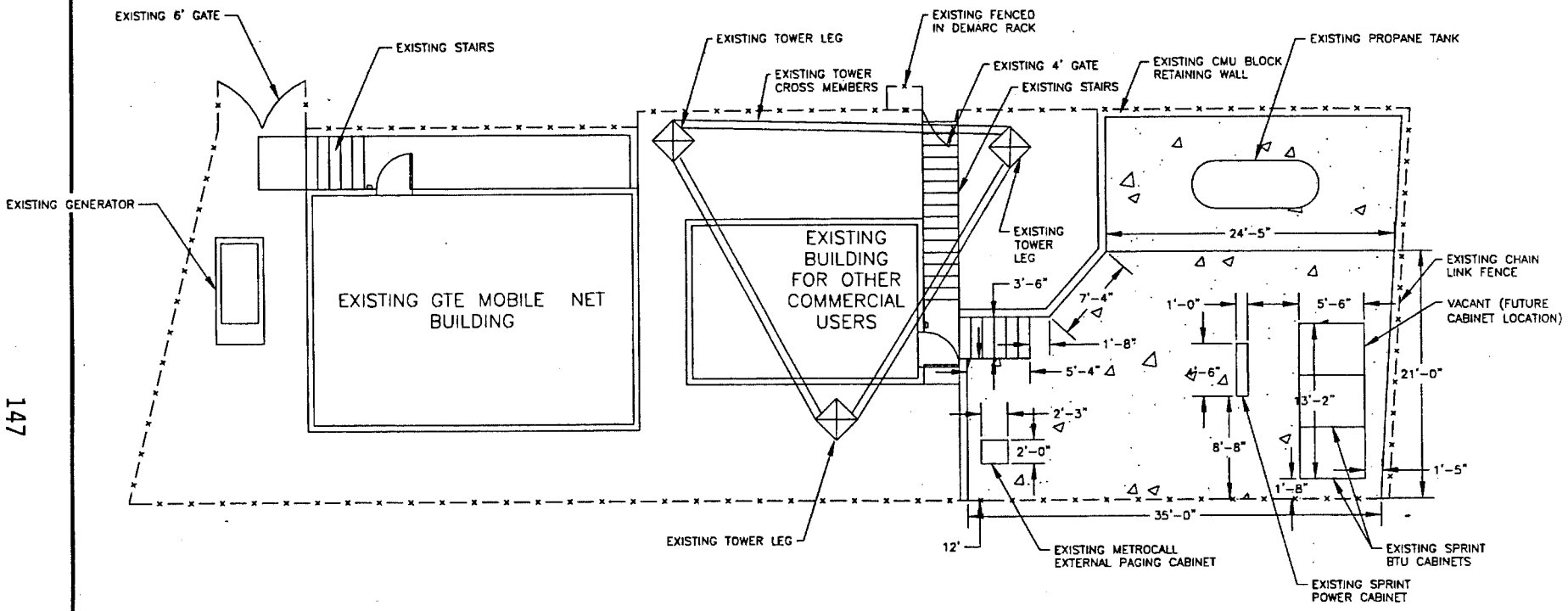
The DEIR did not include a study of the radio frequency exposures at the alternate Turrini site. It was assumed in the DEIR that the refined design for any alternative would comply with the public and occupational exposure thresholds set by the FCC.

The refinements to the Turrini Tower Site Alternative include a measurement and calculation of the existing RF exposures at the existing site, and a calculation of the exposure associated with the Refined Alternative.

The study found that the maximum existing RF level at the Turrini Tower Site measured 52% of the most restrictive public exposure limit. The study also found that if all the existing facilities at the Turrini and Dollar Hill sites were operating at the same time the exposure level was estimated to be 68% of the applicable public limit.

The ambient RF exposure at ground level due to the proposed MERA facilities operating in conjunction with exiting facilities was calculated at 59% of the applicable public limit, with a maximum of 75% of the public limit under any operating condition. However, a reduction in existing ground level RF exposure of about 25% is expected, due to the increased height of the new tower, and relocation of the existing private FM antenna to the top of the tower. After completion of the project, under this alternative, the expected maximum ambient RF level at ground level for Turrini is 44% of the applicable public limit, with a maximum of 56% of the public limit under any operating condition.

Based on this analysis the assumption made in the DEIR that the RF exposures would not exceed adopted public and occupational exposure limits is valid, and the RF impact would be less-than-significant. A copy of the Hammett & Edison, Inc. report is included in this Master Response.



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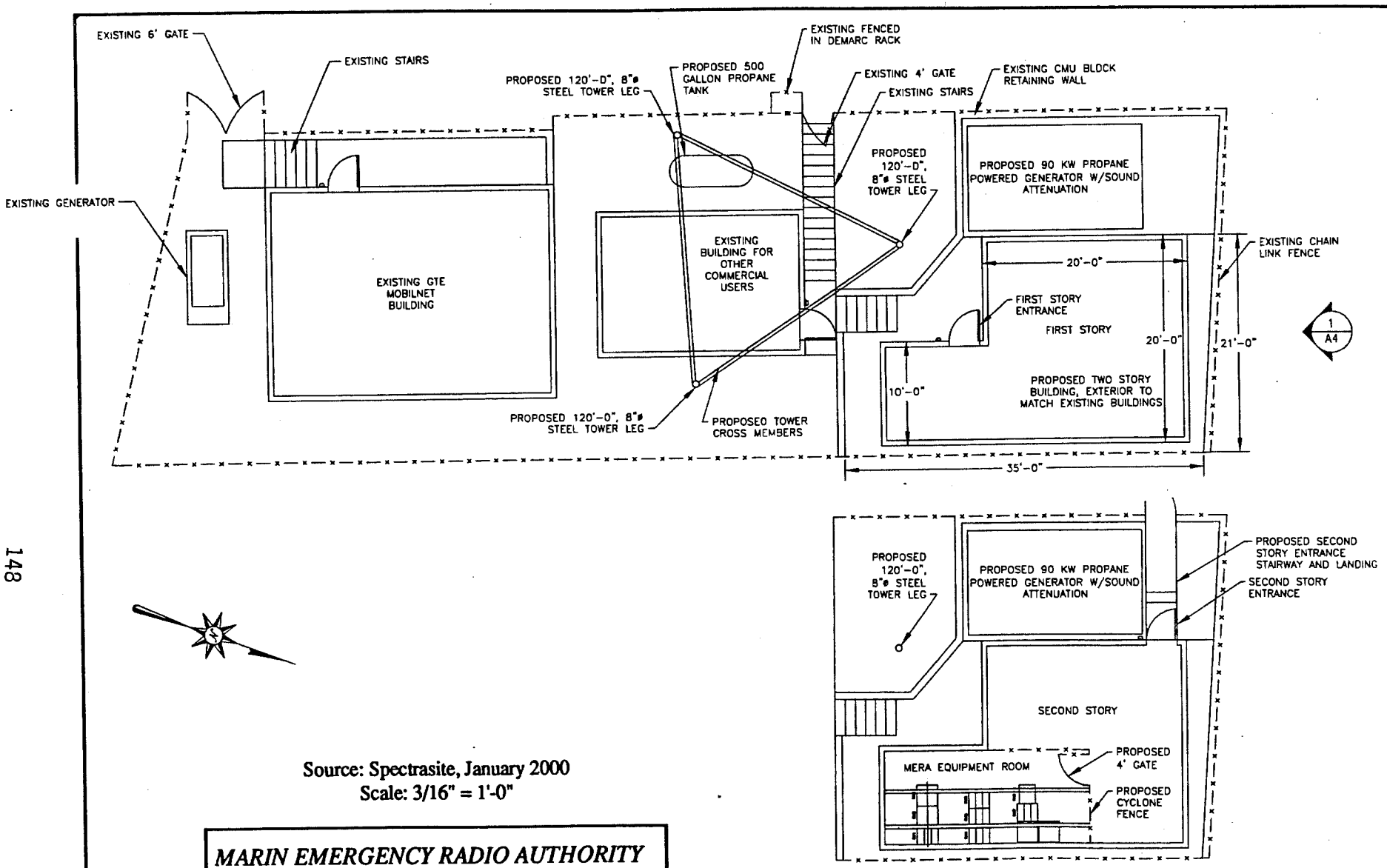
MARIN EMERGENCY RADIO AUTHORITY

Source: Spectrasite, January 2000
Scale: 3/16" = 1'-0"

John Roberto Associates
P.O. Box 31330 San Francisco, CA 94131

TURRINI TOWER SITE ALTERNATIVE EXISTING SITE PLAN

Figure 1



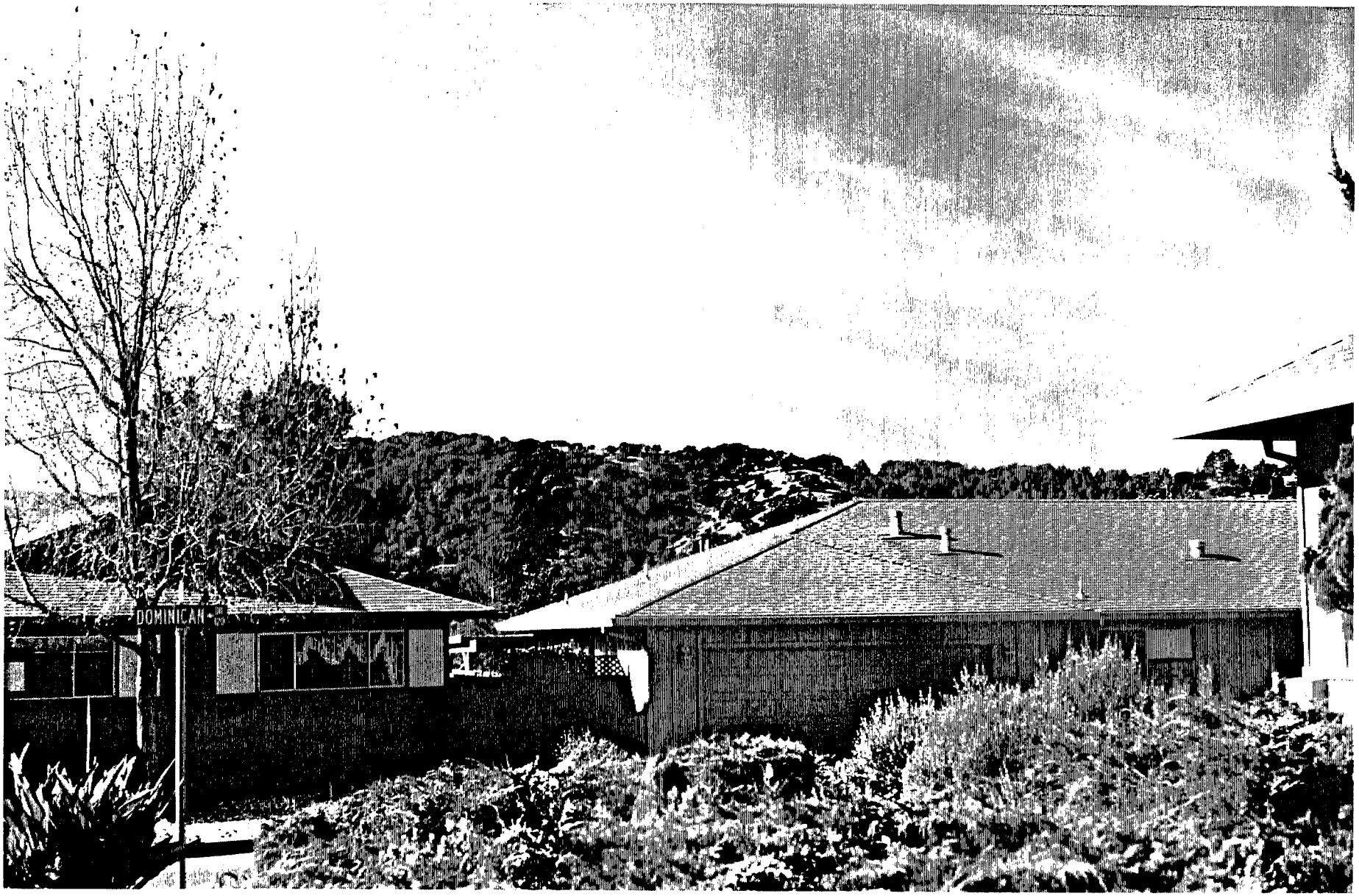
Source: Spectrasite, January 2000
Scale: 3/16" = 1'-0"

MARIN EMERGENCY RADIO AUTHORITY

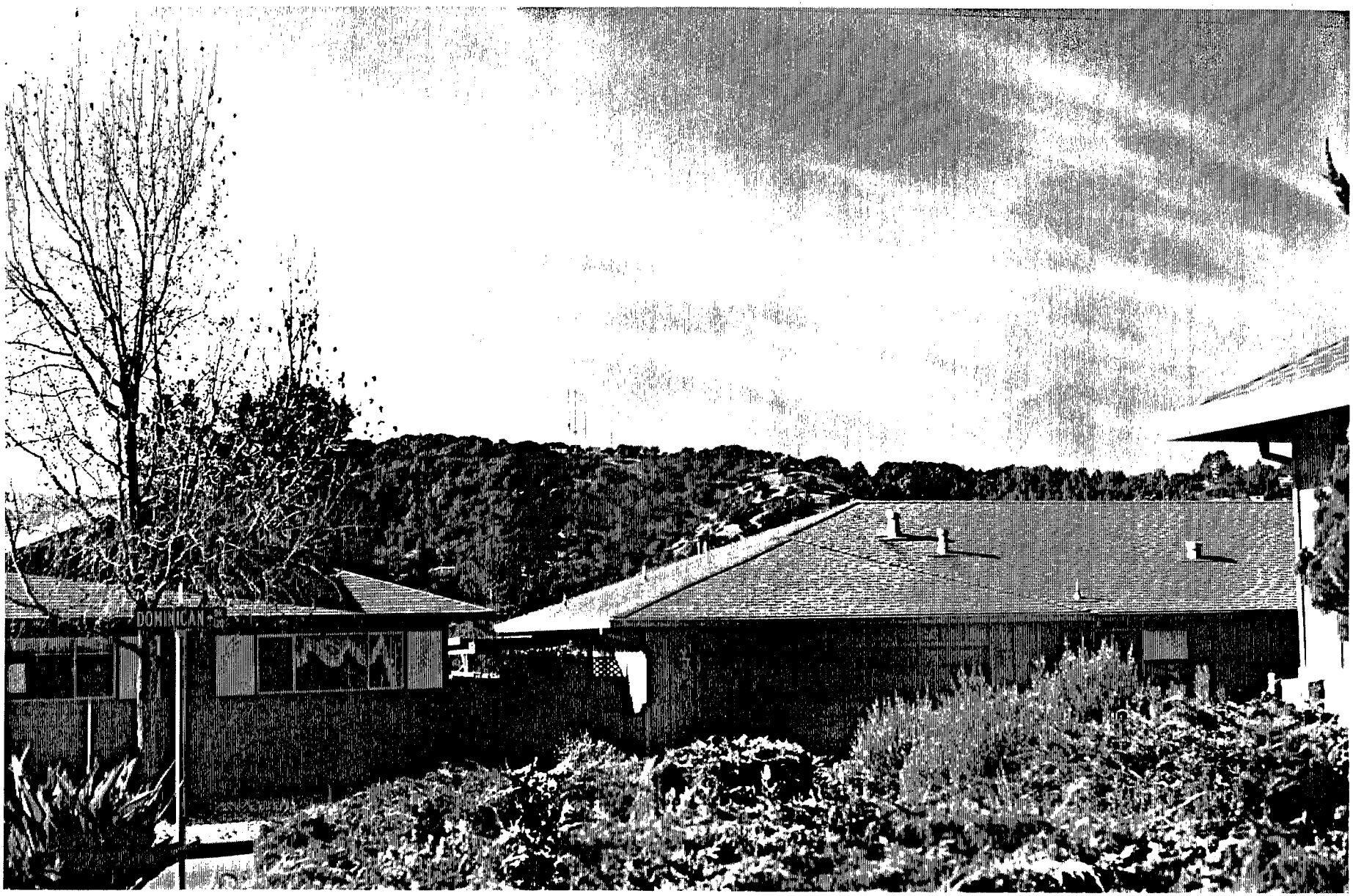
John Roberto Associates
P.O. Box 31330 San Francisco, CA 94131

TURRINI TOWER SITE PROPOSED ALTERNATIVE SITE PLAN

Figure 2



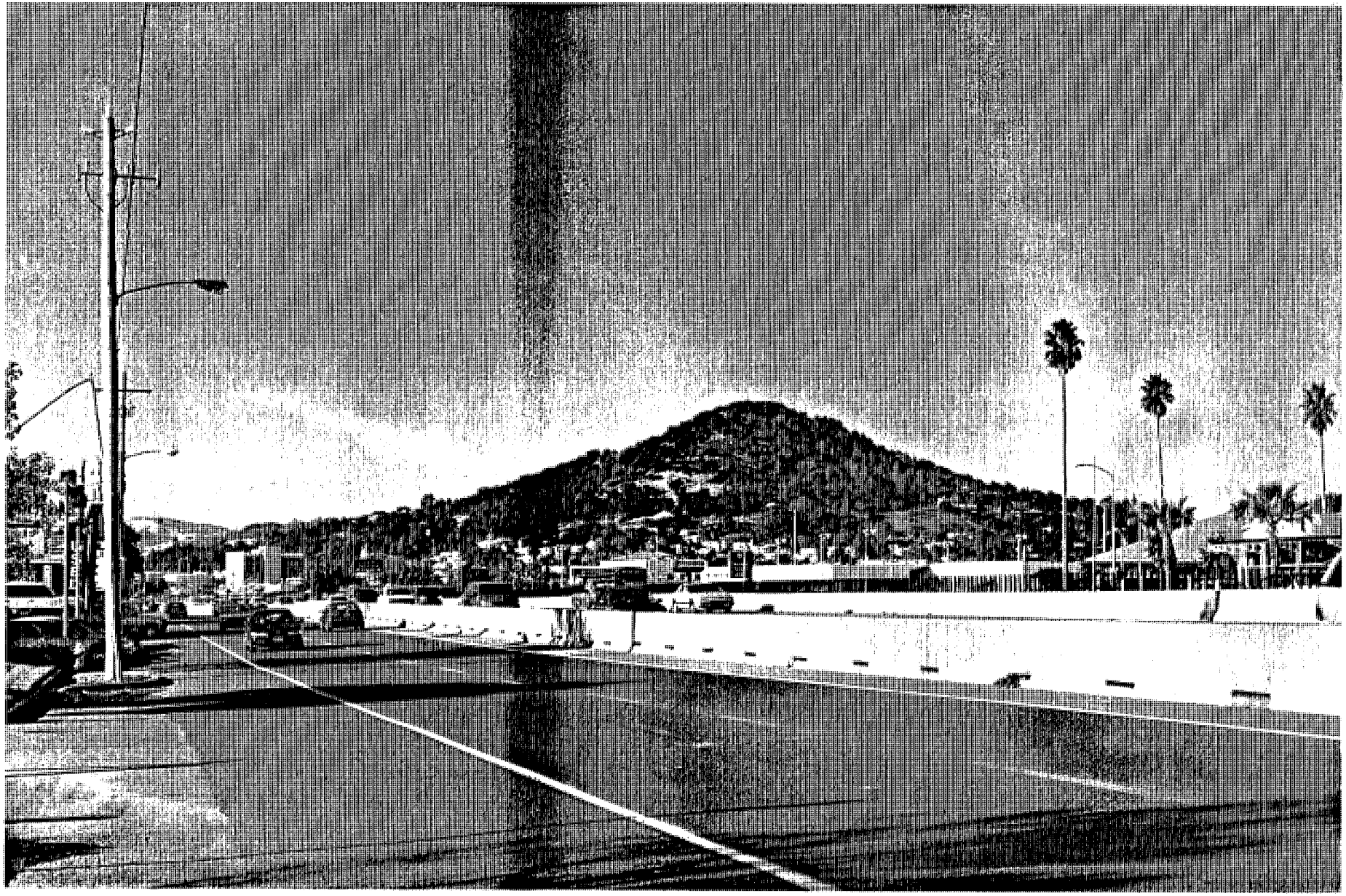
Existing Turrini Tower looking from Angelica Ct. at Dominican Dr. , San Rafael



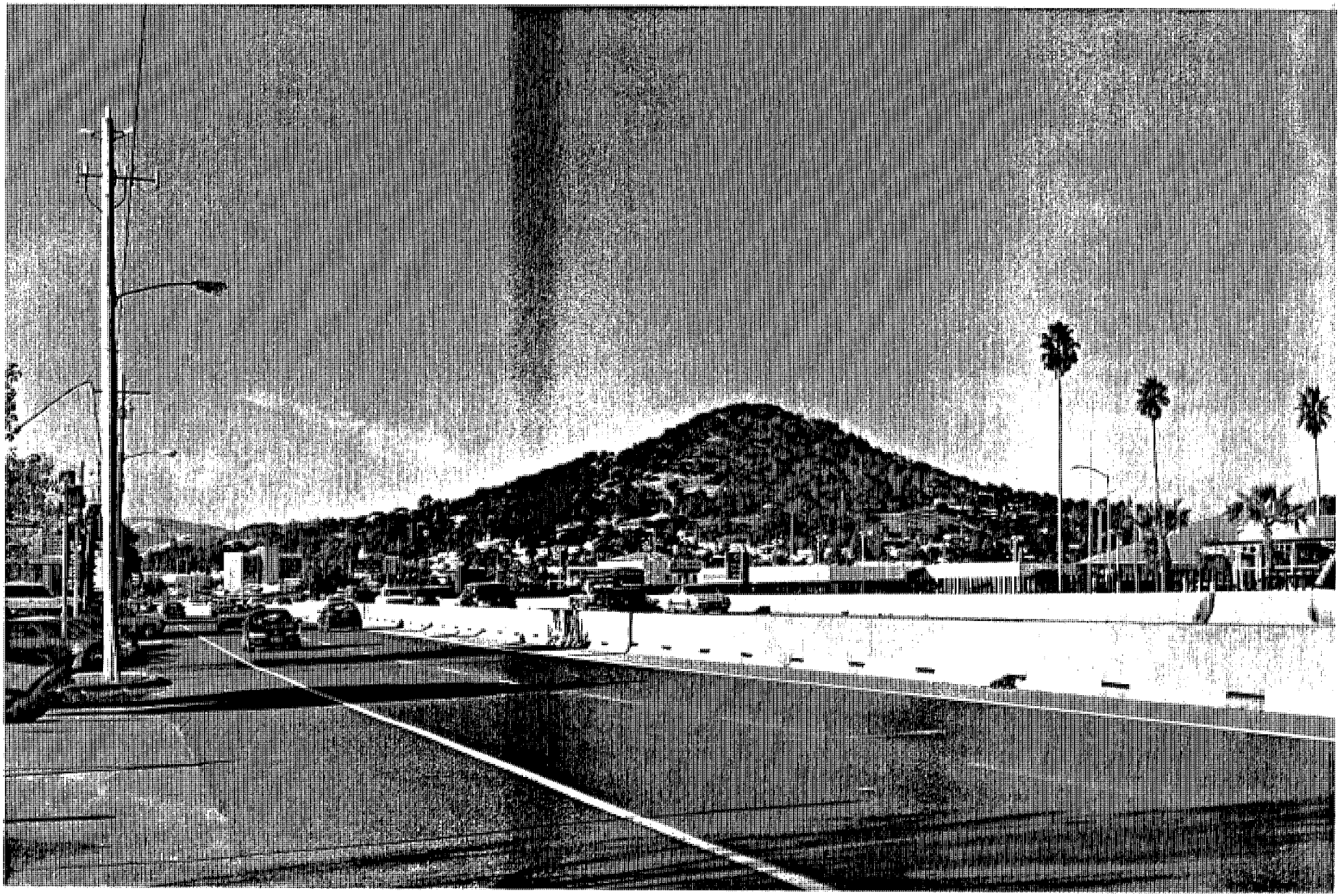
Turrini Tower Site Alternative looking from Angelica Ct. at Dominican Dr., San Rafael

Existing Turrini Tower looking from Fairhills Drive, San Rafael

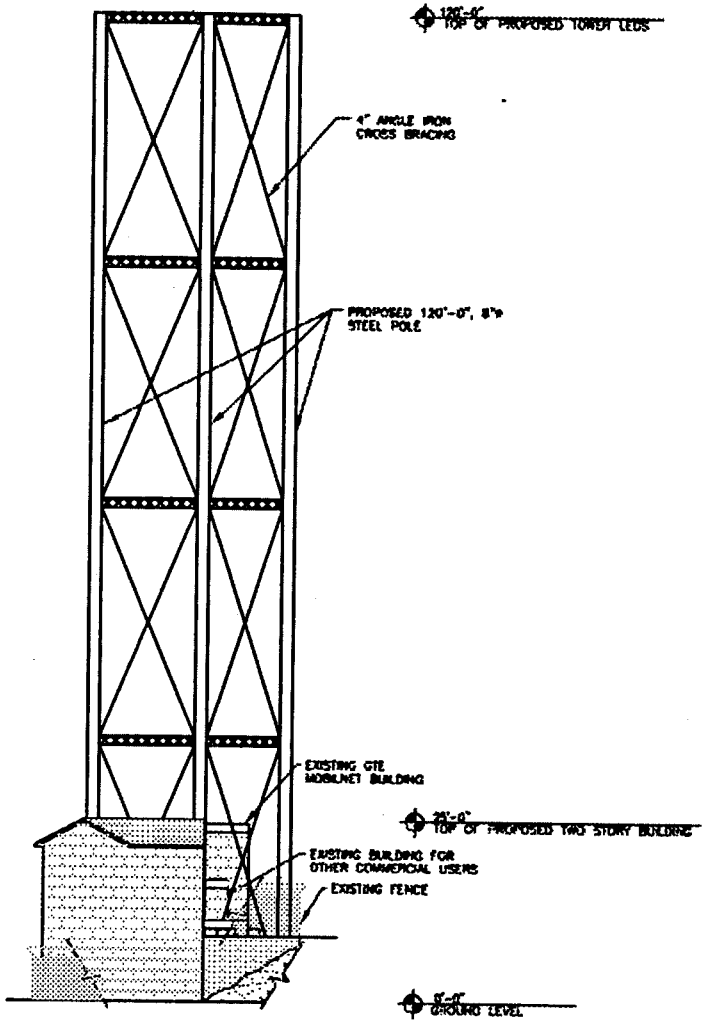
Turrini Tower Site Altenative looking from Fairhills Drive, San Rafael



Existing Turrini Tower looking from West Francisco Blvd., San Rafael



Turrini Tower Site Alternative looking from West Francisco Blvd., San Rafael



1 PROPOSED DEVELOPMENT

SCALE: 1/8" = 1'-0"

John Roberto Associates P.O. Box 31330 San Francisco, CA 94131	***TURRINI TOWER SITE*** ***ALTERNATIVE TOWER & BUILDING***	**Figure** **3**

Westcom Towers, LLC • Turrini Communications Site
Robert Dollar Scenic Drive • San Rafael, California

Statement of Hammett & Edison, Inc., Consulting Engineers

The firm of Hammett & Edison, Inc., Consulting Engineers, has been retained by the Westcom Towers, LLC, to evaluate the proposed replacement tower at the Turrini Communications Site, Robert Dollar Scenic Drive, San Rafael, California, for compliance with appropriate guidelines limiting human exposure to radio frequency electromagnetic fields.

Prevailing Exposure Standards

The U.S. Congress has required of the Federal Communications Commission ("FCC") that it evaluate its actions for possible significant impact on the environment. In Docket 93-62, effective October 15, 1997, the FCC adopted the human exposure limits for field strength and power density recommended in Report No. 86, "Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields," published in 1986 by the National Council on Radiation Protection and Measurements ("NCRP"). A summary of the exposure limits contained in NCRP-86 is shown in Figure 1. Separate limits apply for occupational and public exposure conditions, with the latter limits generally five times more restrictive. The more recent American National Standards Institute ("ANSI") Standard C95.1-1992, "Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz," includes nearly identical exposure limits.

The most restrictive thresholds for exposures of unlimited duration to radio frequency ("RF") energy for several personal wireless services are as follows:

Personal Wireless Service	Operating Frequency	Occupational Limit	Public Limit
Personal Communication ("PCS")	1,900 MHz	5.0 mW/cm^2	1.0 mW/cm^2
Cellular Telephone	870	2.9	0.58
Specialized Mobile Radio ("SMR")	850	2.8	0.57
[most restrictive frequency range]	30–300	1.0	0.20

Computer Modeling Method

The FCC has provided direction for determining compliance in the Office of Engineering and Technology Bulletin No. 65, "Evaluating Compliance with FCC-Specified Guidelines for Human Exposure to Radio Frequency Radiation," dated August 1997. The attached Figure 2 describes the ground level calculation methodology in detail and the computerized techniques for modeling particular sites. This method of evaluating expected exposure conditions is accepted by the FCC, and its conservative nature has been verified by numerous field tests.

Westcom Towers, LLC • Turrini Communications Site
Robert Dollar Scenic Drive • San Rafael, California

Site and Facility Description

The Turrini Site presently consists of a three-leg communications tower, of approximately 100 feet in height, occupied by about 20 omnidirectional whip antennas, 14 panel antennas, 5 Yagi antennas, two dipole antennas and a 6 kW Radio Station, KJQI-FM. Access to the site is by gated road, with the site enclosed by a fence. Based upon data provided Westcom Towers, it is proposed to replace the tower with a new structure of similar design, approximately 20 feet greater in height, immediately adjacent to the existing facility. All existing communications antennas will be relocated to the new tower, with the eventual removal of the existing structure. All antennas will be installed at heights above ground level equal to or greater than their existing locations, with a planned increase in height above ground level of about 20 feet for KJQI-FM.

It has also been proposed to install the Marin Emergency Radio Authority facilities, currently planned to be located at the nearby Dollar Hill Communications Site, on the new tower. The majority of the existing transmitters at Dollar Hill will discontinue operation after the MERA construction has been completed, with reportedly only the city of San Rafael data system, an FBI VHF transmitter, and three amateur radio antennas to remain operating. It is also proposed that these facilities would relocate to the new tower at the Turrini site with a height above ground level of, at minimum, 45 feet. Based upon information provided by Cord Communications, the MERA facilities are to consist of two omnidirectional whip antennas for transmitting and one for receive, with a height above ground of about 65 feet for the transmit antennas and an effective radiated power of 1,800 watts, which is the maximum in any direction. It is also proposed to install two microwave dish antennas at the site.

Measurement Procedure and Results

The site was visited by Mark D. Neumann, a qualified engineer employed by Hammett & Edison, Inc., on June 18, 1999, and on January 10, 2000. The measurement equipment used was a Wandel & Goltermann Type EMR-300 Radiation Meter with a Type 25 Isotropic Electric Field Probe (Serial No. P0008, last calibrated by the manufacturer on January 20, 1999). Testing was conducted in compliance with FCC guidelines for the measurement of RF emissions and was conducted during normal business hours on a non-holiday weekday. At each test point, the measurement results were compared with applicable FCC standards. The maximum ambient RF levels anywhere at ground level measured 52% of the most restrictive public exposure limit; this occurred midway between the two communications sites, about 100 feet south of the Turrini Site, with the primary contribution at this point coming from the FM station and cellular facilities at the

communications site. The maximum ambient RF levels anywhere at ground level inside the fenced compound at the Turrini Site measured 20% of the applicable occupational exposure limit.

Study Results

At the prospective site, the maximum existing RF levels measured 52% of the most restrictive public exposure limit. In the highly unlikely event that all existing two-way communications facilities at the site, including those at Dollar Hill, are in operation at the same time, the maximum ambient RF levels from the existing antennas, based on knowledge of typical operating facilities for two-way sites, are estimated to be less than 68% of the applicable public limit, even without considering the 30-minute time-averaging allowance in the FCC guidelines.

The maximum ambient RF levels anywhere at ground level due to the proposed MERA operation are calculated to be 0.023 mW/cm^2, which is 7.2% of the applicable public limit. Without taking into consideration the expected reduction in exposure levels due to the relocation and replacement of existing antennas and the increase in height above ground for KJQI-FM, and assuming the areas of maximum exposure are coincident, the maximum ambient RF levels anywhere at ground level due to the proposed operation in conjunction with existing facilities are calculated to be 59% of the applicable public limit based upon measurement results, with a maximum of 75% of the public limit under any operating conditions. However, a reduction in existing RF levels of about 25% is expected due to the increased height above ground of KJQI-FM and the Dollar Hill facilities, giving an expected maximum ambient RF level at ground level for the Turrini site following the completion of construction of 44% of the applicable public limit based upon measurement results, with a maximum of 56% of the public limit under any operating conditions.

The nature of microwave dish antennas is such that narrow beams are created to preclude interference to co-channel users. As such, RF exposure contributions at ground level from dish antennas are negligible.

Recommended Mitigation Measures

Access to the antennas will not be available to the general public. Such access as would allow authorized personnel close approach to transmitting antennas on the Turrini Site may result in exposure levels greater than the occupational limit and so should be prohibited while the pertinent facilities are in operation.

A complete power reduction study for on-tower access has not been performed for the Turrini Site. Since it is assumed that the majority of the existing facilities will remain operational during the

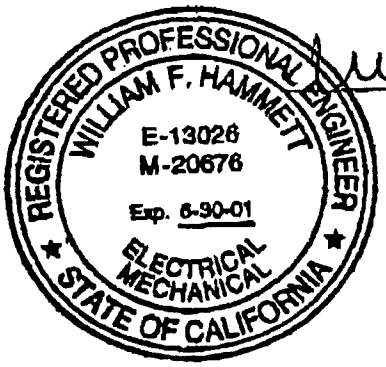
construction of the new tower, it is recommended that, during the period of construction, workers employed at the site be provided with personal dosimeters so as to ensure that occupational exposure limits are not exceeded. In areas where the occupational exposure limits are approached, appropriate mitigation measures such as cessation of operation or power reduction are required. Warning signs* posted at the site, such that they would be visible to workers intending to perform work on the tower, would then be sufficient to meet FCC-adopted standards.

Conclusion

Based on the information and analysis above, it is the undersigned's professional opinion that the proposed replacement tower at the Turrini Communications Site, on Robert Dollar Scenic Drive, San Rafael, California, with the addition of the MERA wireless communications facility and remaining transmitters at Dollar Hill, can comply with the prevailing standards for limiting human exposure to radio frequency energy and, therefore, need not for this reason cause a significant impact on the environment. The highest measured level in publicly accessible areas is much less than the prevailing standards allow for exposures of unlimited duration.

Authorship

The undersigned author of this statement is a qualified Professional Engineer, holding California Registration Nos. E-13026 and M-20676, which expire on June 30, 2001. This work has been carried out by him or under his direction, and all statements are true and correct of his own knowledge except, where noted, when data has been supplied by others, which data he believes to be correct.



William F. Hammett, P.E.

January 14, 2000

* Warning signs should comply with ANSI C95.2 color, symbol, and content conventions. In addition, contact information should be provided (*e.g.*, a telephone number) to arrange for access to restricted areas. The selection of language(s) is not an engineering matter, and guidance from the landlord, local zoning or health authority, or appropriate professionals may be required.

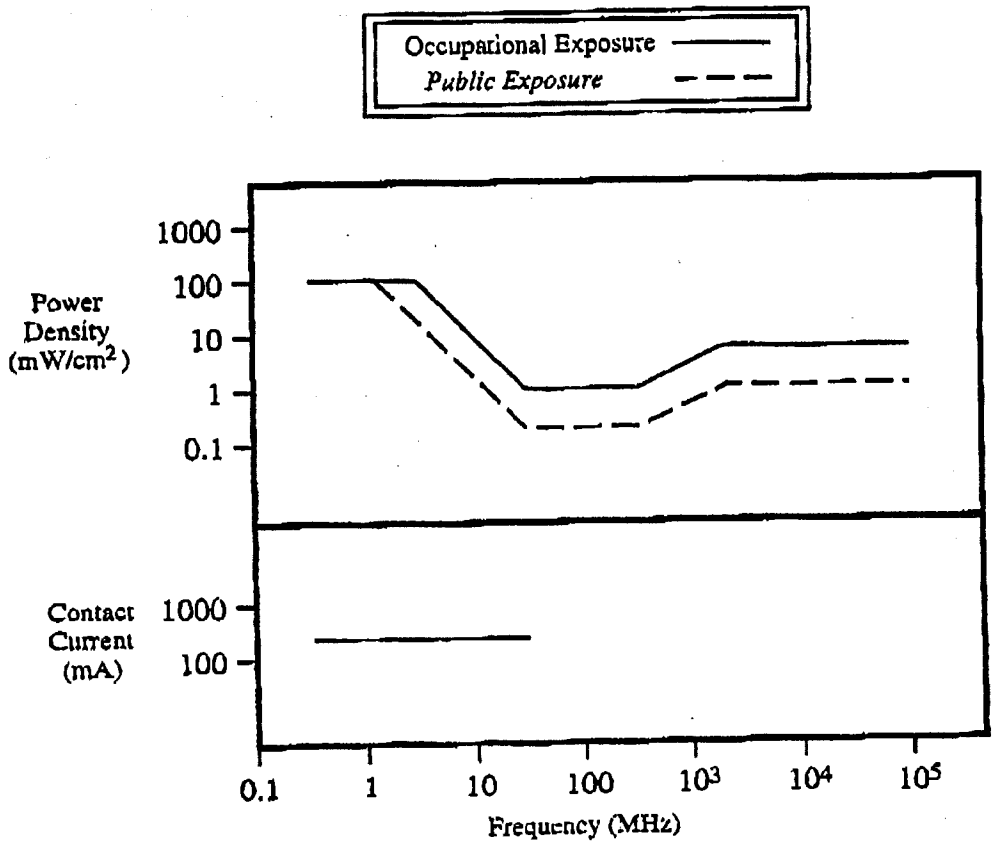
National Council on Radiation Protection and Measurements

Report No. 86 (Published 1986) "Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields"

Radio Frequency Protection Guide

Frequency Applicable Range (MHz)	Electromagnetic Fields: Electric Field Strength (V/m)		Magnetic Field Strength (A/m)		Equivalent Far-Field Power Density (mW/cm^2)		Contact Currents (mA)
0.3 – 1.34	614	*614*	1.63	*1.63*	100	*100*	200
1.34 – 3.0	614	*823.8/f*	1.63	*2.19/f*	100	*180/f²*	200
3.0 – 30	1842/f	*823.8/f*	4.89/f	*2.19/f*	900/f²	*180/f²*	200
30 – 300	61.4	*27.5*	0.163	*0.0729*	1.0	*0.2*	no limit
300 – 1,500	3.54√f	*1.59√f*	√f/106	*√f/238*	f/300	*f/1500*	no limit
1,500 – 100,000	137	*61.4*	0.364	*0.163*	5.0	*1.0*	no limit

Note: f is frequency of emission, in MHz.



RFR.GROUND™ Calculation Methodology
Determination by Computer of Compliance with Human Exposure Limitations

The U.S. Congress has required of the FCC that it evaluate its actions for possible significant impact on the environment. In Docket 79-144, the FCC adopted the radio frequency protection guide of the American National Standards Institute Standard C95.1-1982, "Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 300 kHz to 100 GHz." Exposures are to be averaged over a six-minute period. In 1992, ANSI published a revised standard, C95.1-1992, which defined "controlled" and "uncontrolled" environments, setting for the latter limits generally five times more restrictive. The C95.1-1992 controlled (*i.e.*, occupational) limits are approximately the same as in C95.1-1982. In Docket 93-62, the FCC adopted the exposure limits for field strength and power density recommended in Report No. 86, "Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields," published in 1986 by the National Council on Radiation Protection and Measurements. This standard is very similar to C95.1-1992, and the effective date for applying it to all FCC licensees was October 15, 1997.

The FCC Office of Engineering and Technology Bulletin No. 65 (August 1997) gives the formula for calculating power density from an individual radiation source:

$$\text{power density} \quad S = \frac{2.56 \times 1.64 \times 100 \times RFF^2 \times [VERP + AERP]}{4\pi D^2}, \text{ in } mW/cm^2,$$

where VERP = 0.4 × total peak visual ERP (all polarizations), in kilowatts for NTSC,
= average power (all polarizations), in kilowatts for DTV,

AERP = total aural ERP (all polarizations), in kilowatts,

RFF = relative field factor at the direction to the actual point of calculation, and

D = distance from the center of radiation to the point of calculation, in meters.

The factor of 2.56 accounts for the increase in power density due to ground reflection, assuming a reflection coefficient of 1.6 (1.6 × 1.6 = 2.56). The factor of 1.64 is the gain of a half-wave dipole relative to an isotropic radiator. The factor of 0.4 converts NTSC peak visual ERP to an average RMS value; for FM, cellular, and PCS stations, of course, the value of VERP is zero. The factor of 100 in the numerator converts to the desired units of power density.

This formula has been built into a computer program by Hammett & Edison that calculates, at each location on an arbitrary rectangular grid, the total expected power density from any number of individual radiation sources. The program also allows for the description of the actual terrain at the site to obtain more accurate projections.

VI. APPENDICIES

FOR IMMEDIATE RELEASE
7 October 1999

CONTACT: Nancy Akers
202-296-7000

GROUP CALLS FOR HELP IN DISTRIBUTING IMPORTANT INFORMATION TO CONSUMERS ABOUT WIRELESS PHONE HEALTH EFFECTS

Washington, DC, 7 October, 1999. "Through this announcement we are calling on government, foundations, institutes, universities, industry and virtually any concerned citizen in an open invitation to help in the production and distribution of Wireless Phones and Your Health: A self protection guide for consumers on the purchase and safe use of wireless phones." said Cynthia Perno, President of Health Risk Management Group, Inc.

"This is the appropriate public health intervention in a time of uncertainty regarding health effects and we need help delivering this intervention to consumers. This information package, which has been painstakingly developed with the consumer in mind, empowers individuals with an informed pathway to educated decision making regarding the use of cellular phones. This package belongs in the hands of the consumer but getting it there is too great a task to successfully accomplish without support. We are making a concerted effort in asking for that support." continued Ms. Perno.

Her group is calling for assistance to help in the production and distribution of a new consumer empowerment workbook, Wireless Phones and Your Health: A self protection guide for consumers on the purchase and safe use of wireless phones. The workbook is based on the compilation of findings and recommendations from the recently completed $27 million Wireless Technology Research (WTR) program, an independent effort supported by government and industry. WTR Chairman, Dr. George Carlo, has also requested help in this effort personally from several top executives in the wireless industry. (Please see attached letter).

The consumer package includes information about why the scientific research on the health effects of wireless phones is presently unclear, and why no one can say for certain whether or not these phones are safe. Also included are work sheets aimed at empowering consumers to make informed decisions about these products as well as a number of sections, for example, on available alternatives such as pagers and head sets, how wireless phones work, health effects, and automobile safety, to name a few.

"Our goal is to protect the consumer plain and simple, including the many children now using wireless phones, by giving them what they need to help themselves. We are filling in the gaps that government and industry have missed," added Ms. Perno.

Wireless Phones and Your Health will be available for distribution in approximately two to three weeks.

Appendix B

Hand delivered to M.A.C.

Health Council of Marin

Joan M. Ripple, President

October 16, 1999

Linda Christman
Deputy County Administrator
Executive Director, Marin Emergency Radio Authority
3501 Civic Center Drive
San Rafael CA 94903

Dear Ms. Christman:

The Health Council of Marin is pleased to have the opportunity to comment on the initial study regarding the Marin Public Safety and Emergency Communications Radio System. Protecting and advocating on behalf of the health of the citizens of Marin is our highest priority. After careful review of this Draft Report, we strongly recommend expanding the scope of the next version of the Marin Emergency Radio EIR Report to comply with the suggestions in the attached report.

We also suggest that the comment time for the next version of this report be posted at a time when there is a full 30 days notice. It has come to our attention that the next version may be available for comment on December 21st or thereabouts. While that timing may meet the letter of the "law" for notice, we are concerned that it may miss the spirit of the "law" since the first two weeks of the notice would be in the swing of a major holiday season. Further, for a subject of this magnitude, the County and MERA should offer an opportunity for working citizens to be able to participate in the hearing/comment process by providing evening or Saturday hearings.

We look forward to working with the Board of Supervisors, the County of Marin Department of Health and Human Services and the Marin Emergency Radio Authority to bring about an improved public safety system in the county. If you have any questions about this letter, please contact me at 415-459-8420.

Cordially,

Joan M. Ripple

Joan M. Ripple

Note: In order to accommodate people with allergies, asthma, chemical sensitivity and other respiratory conditions, please refrain from wearing scented products to this meeting. If you have special needs, please contact the Health Council at 415/457-8420.

October 16, 1999

To: Board of Supervisors
County of Marin

cc. Linda Christman
Deputy County Administrator, County of Marin, and
Executive Director, Marin Emergency Radio Authority

Nancy Rubin, Director
Department of Health and Human Services
County of Marin

From: Joan Ripple, President
Health Council of Marin

Re: Draft Comments ~ Initial Study regarding the Marin Public Safety and Emergency Communications Radio System

The Marin Health Council is pleased to have the opportunity to comment on the initial study regarding the Marin Public Safety and Emergency Communications Radio System. Protecting and advocating on behalf of the health of the citizens of Marin is our highest priority. After careful review of this Draft Report, we strongly recommend expanding the scope of the next version of the Marin Emergency Radio Authority's EIR (Environmental Impact Report) to address the following questions:

1. Environmental Analysis and Mitigation

- How does the MERA plan to address ongoing public concern about the impact of wireless telecommunications on health and the environment? We recommend the County and the MERA continuously review new and emerging information, which addresses the scientific and technical uncertainties, related to uses of a wireless communication system, particularly focussing on the uncontrolled exposure conditions civilian populations are subjected to and, for the controlled exposure conditions for workers, whose occupations require them to work under, potentially hazardous conditions with wireless technology on a daily basis, including public safety workers.

- Based on our review of this information, this new wireless system may cause or intensify hazardous exposure conditions for human, animal and plant life. Due to the many questions and controversies, it would be irresponsible for Marin County and the MERA to knowingly approve a wireless communication system which places health and safety at risk.

- Has MERA taken into account the information on potential and actual EMF hazards, which we have summarized below? (Referenced documents appear in the Appendix to this letter.) If MERA proceeds to install this new utility without careful evaluation of this information, even though current law may not require it, the County and the MERA could later be deemed negligent and could be held liable for the health of the people in Marin County. We

recommend the scope of the Draft EIR be expanded to incorporate a review the materials summarized below:

- A list of citations for published scientific studies, which show adverse biological effects at non-ionizing levels.

- A press release about a May 1999 report to Congress prepared by the National Institute of Health's National Institute of Environmental Health Sciences which gives official recognition to a causal link between certain power line exposures (60 hertz frequency) and childhood leukemia and adult lymphocytic leukemia.

- A June 1999 letter from The Radiofrequency Interagency Work Group, a committee of federal government scientists, whose respective agencies (FCC, FDA, OSHA, EPA, NTIA and NIOSH) that are primarily responsible for administering telecommunication policies and conducting related health research. This group independently initiated a letter to the IEEE (Institute of Electronic and Electrical Engineers) listing issues that they believe need to be addressed. They state, "in order to provide a strong and credible rationale to support RF (radiofrequency) exposure guidelines". The issues include need for:

    - a biological basis for local SAR (standard absorption rate) limit;
    - selection of an adverse effect level other than the current level that is based on acute exposure conditions;
    - need to develop guidelines for chronic exposure conditions; the effect of a two tier set of guidelines on acute versus chronic exposures, which subjects the worker populations to greater exposures, regardless of variations in the health of the subject populations;
    - the effect of controlled exposures on civilian populations without procedural guidance;
    - several scientific and technical uncertainties, including: extrapolation of acute effects to chronic exposure conditions and variations in the susceptibility (response/sensitivity) among individuals, incomplete data bases,
    - intensity of frequency modulated (pulsed or frequency modulated RD radiation; and, criteria for preventing hazards caused by transient discharges.

- A letter from Dr. George Carlo, former Director of the Wireless Technology Research Group to C. Michael Armstrong, Chairman and CEO of AT&T. Dr. Carlo, who headed up a six-year surveillance and research program funded by the wireless industry, reviewed a presentation he gave in April 1999 to the wireless industry where he summarized his research findings, including:

    - The rate of death from brain cancer among handheld phone users was higher than the rate of brain cancer death among those who used non-handheld phones that were away from their head;

- The risk of acoustic neuroma, a benign tumor of the auditory nerve that is well in range of the radiation coming from a phone's antenna, was fifty percent higher in people who reported using cell phones for six years or more; moreover, that relationship between the amount of cell phone use and this tumor appeared to follow a dose-response curve;

- The risk of rare neuro-epithelial tumors on the outside of the brain was more than doubled, a statistically significant risk increase, in cell phone users as compared to people who did not use cell phones;

- There appeared to be some correlation between brain tumors occurring on the right side of the head and the use of the phone on the right side of the head;

- Laboratory studies looking at the ability of radiation from a phone's antenna to cause functional genetic damage were definitively positive, and were following a dose-response relationship.

Dr. Carlo closed his letter with an appeal to Chairman Armstrong to "do the right thing". He states, "[The] wireless industry is missing a valuable opportunity by dealing with these public health concerns through politics, creating illusions that more research over the next several years helps consumers today, and false claims that regulatory compliance means safety. The better choice by the wireless industry would be to implement measured steps aimed at true consumer protection."

- Finally, a summary of the major federal case, being heard in the U.S. Court of Appeals, challenging certain rules under the Federal Telecommunications Act as administered by the FCC. The MERA proposal does not come under the Telecommunications Act; however, the health concerns are intrinsic to all man-made sources of non-ionizing radiation. In this case, The FCC radiofrequency human exposure guidelines are challenged for not providing adequate protection for public health and safety.

2. Prudent Avoidance ~ A systemic county-wide approach is needed

- How will the Draft EIR address the need for post-installation surveillance monitoring and health studies to evaluate the radiation exposure conditions as a routine part of the MERA operations? What will be done to ensure, on a continuing basis no harm is created? At some time in the future, should there be evidence to show harm, how will the MERA respond?

- The Marin Health Council, in commenting on the Marin Telecommunications Master Plan, called for prudent avoidance when operating communications services using RF (radiofrequency) or low microwave signals. Current FCC standards governing radiofrequency exposure do not protect against non-ionizing radiation exposures for civilian populations. The civilian branch of the federal government has no ongoing national radiofrequency or low microwave research program to study the effects of long term or excessive exposure.

Therefore, the responsibility to assure this technology is applied in a safe and prudent manner is with the County and the MERA.

- On several occasions the Marin Health Council has formally recommended periodic monitoring of RF emissions and the development of a computerized model of the county to map RF sources as a baseline for future epidemiological or health studies. The Sustainable Marin Draft Plan includes an indicator on RF source mapping. Therefore, we recommend that, as part of the scope of this Draft EIR, the Marin County Department of Health and Human Services

  - Set up an RF/MW risk assessment program to be considered a critical element in the MERA operations;

  - That monitoring should include measurement for such environmental conditions as signal reflection, resonance, intensification, and "hot spots" due to cross currents and varying frequencies to assure the exposure conditions are within legal limits.

  - The results should be easily accessible public information.

3. Full disclosure and mutually beneficial remedies:

We have learned that citizens are unable to inspect, read or obtain a copy of the Request for Proposal or the Motorola Bid or any correspondence or records about it. The issue of lack of accessibility to public information needs to be addressed. Presently, citizens do not have access to these documents and are unable to assess the system or determine what the impact would be.

What procedures shall the public follow to obtain full disclosure of information on County and the MERA operations related to this system? What remedies, outside of litigation, can the public seek should there be an exposure condition that exceeds the legal limit for safe human exposure? Would the County and the MERA consider using mediation to resolve such disputes?

4. Physical Security Requirements

- Specifically, how will Marin County and MERA assure that the physical location of these facilities will remain secure throughout the life of this system? The initial study EIR states that MERA wishes to maintain secure sites at the seventeen (17) communications facility locations it proposes to erect in the County. MERA also states it does not intend to lease space for commercial use at these sites. Yet, some facility locations are already leased for commercial communications purposes.
- We believe that to assure physical security all MERA facility lease agreements with site owners should specifically prohibit site owners from entering into new commercial leases and that existing leases not be renewed.

5. Project feasibility and cost effectiveness

We support the major intent behind the proposal, which is to improve and unify radio communications for all of Marin's public safety agencies. However, we are not convinced that this proposed communication system is feasible or cost-effective. We also are not certain that the MERA can assure system maintenance and operations or that this utility will be fail-safe. Due to the fact that this system will cost Marin County taxpayers more than $27 million dollars, we believe the public deserves to know more. We believe the following questions should be addressed in the EIR:

- Will the Motorola systems provide for duplex communications? Will it utilize a single bandwidth? These design specifications are an essential improvement and are necessary to unify all public safety agencies, facilitate two-way conversations, and accommodate voice and data stream communications.

- Are Motorola's design specifications consistent with the most advanced state of the art technology? Is it stipulated in the Motorola contract that this system be updated? Does the contract stipulate the technology be least obtrusive and harmful?

- What criteria and procedures will Marin County and the MERA apply to determine cost-effectiveness is being achieved? How will this information be conveyed to the public? This information should be made available for public disclosure upon request.

6. Re: Impact on property values and aesthetics

- How will the County and the MERA protect and mitigate against property value loss? What will happen if properties located near by or with a view of a transmitting tower are reassessed at lower values or sell below fair market value? If the facility becomes a co-location site, how will this affect value?
- There are a large and growing number of civil lawsuits on the property value and aesthetic issues. Due to the perception of risk, aesthetic appeal or, actual harm, many people across the country have been forced into litigation. There is case law to support that telecommunications facilities do affect property values. Many people have been forced to sell and move away from their homes and places of business in order to avoid the risk. With the proliferation and ubiquitous nature of this stealth-like technology living or working near wireless facilities is becoming harder to avoid.
- One example of a "worst case scenario" is on Lookout Mountain in Golden, Colorado, where there is an "antenna farm" in a residential neighborhood. There are epidemiological studies and real estate appraisals to prove that harm is being done. The Federal Communications Commission has stated that it does not intend to remove the telecommunications facilities nor remove the broadcasting sites, nor does it intend to mitigate the well-documented problems.

In Marin, several proposed facilities would be located in dense residential areas. Some proposed facilities will be installed on existing sites already leased out for commercial purposes. How does MERA plan to prevent "antenna farms" from being established in Marin? How will MERA protect the public should there be actual harm? It should be pointed out that; to "wait and see" what the next generation of this technology brings is not a wise solution.

We look forward to working with you, the County of Marin Department of Health and Human Services and the Marin Emergency Radio Authority to bring about an improved public safety system in the county. If you have any questions about this letter, please contact me at 415-459-8420.

Attachments

NIEHS CONTACTS: Bill Grigg , (301) 402-3378
or Tom Hawkins, (919) 541-1402

NIEHS PR #9-99

ENVIRONMENTAL HEALTH INSTITUTE REPORT CONCLUDES EVIDENCE IS 'WEAK' THAT ELECTRIC and MAGNETIC FIELDS CAUSE CANCER

After six years of accelerated, Congressionally mandated research, the National Institute of Environmental Health Sciences today announced it has concluded that the evidence for a risk of cancer and other human disease from the electric and magnetic fields (EMF) around power lines is "weak."

NIEHS' review and analysis of the existing data came in a report to Congress, released today. The report applies to the extremely low frequency electric and magnetic fields surrounding both the big power lines that distribute power and the smaller but closer electric lines in homes and appliances.

While sections of the report say EMF exposure "cannot be recognized as entirely safe," the report concludes: "The NIEHS believes that the probability that EMF exposure is truly a health hazard is currently small. The weak epidemiological associations and lack of any laboratory support for these associations provide only marginal scientific support that exposure to this agent is causing any degree of harm."

Research continues on some "lingering concerns," the report says, and efforts to reduce exposures should continue.

NIEHS said that the "strongest evidence" for health effects comes from statistical associations observed in human populations with childhood leukemia and chronic lymphocytic leukemia in occupationally exposed adults such as electric utility workers, machinists and welders. "While the support from individual studies is weak," according to the report, "these epidemiological studies demonstrate, for some methods of measuring exposure, a fairly consistent pattern of a small, increased risk with increasing exposure that is somewhat weaker for chronic lymphocytic leukemia than for childhood leukemia."

However, laboratory studies and investigations of basic biological function do not support these epidemiological associations, according to the report. It says, "Virtually all of the laboratory evidence in animals and humans and most of the mechanistic studies in cells fail to support a causal [cause and effect] relationship."

NIEHS Director Kenneth Olden, Ph.D., said, "The lack of consistent, positive findings in animal or mechanistic studies weakens the belief that this association is actually due to EMF, but it cannot completely discount the epidemiological findings. For that reason, and because virtually everyone in the United States uses electricity and therefore is routinely exposed to EMF, efforts to encourage reductions in exposure should continue. For example, industry should continue efforts to alter large transmission lines to reduce their fields and localities should enforce electrical codes to avoid wiring errors that can produce higher fields." An interagency committee established by the President will make a subsequent report to Congress about the findings of this report and whether any remedial actions are needed to minimize exposures.

Dr. Olden said NIEHS would continue to support some research on EMF, though not at the high levels Congress provided in special legislation and appropriations.

The NIEHS report follows a six-year research program and a two-year review by the institute and by

DEPARTMENT OF HEALTH AND HUMAN SERVICES

Public Health Service

National Institute for Occupational
Safety and Health
Robert A Taft Laboratories
4676 Columbia Parkway
Cincinnati OH 45226-1998

June 17, 1999

Mr. Richard Tell
Chair, IEEE SCC28 (SC4)
Risk Assessment Work Group
Richard Tell Associates, Inc.
8309 Garnet Canyon Lane
Las Vegas, NV 89129-4897

Dear Mr. Tell:

The members of the Radiofrequency Interagency Work Group (RFIAWG) have identified certain issues that we believe need to be addressed to provide a strong and credible rationale to support RF exposure guidelines. I am writing on behalf of the RFIAWG members to share these ideas with you and other members of the IEEE SCC28, Subcommittee 4 Risk Assessment Work Group. Our input is in response to previous requests for greater participation on our part in the SCC28 deliberations on RF guidelines. The issues, and related comments and questions relevant to the revision of the IEEE RF guidelines, are given in the enclosure. No particular priority is ascribed to the order in which the issues are listed.

The views expressed in this correspondence are those of the members of the Radiofrequency Interagency Work Group and do not represent the official policy or position of the respective agencies.

The members of the RFIAWG appreciate your consideration of our comments and welcome further dialog on these issues. Feel free to contact me or any member of the RFIAWG directly. A list of the members of the RFIAWG is enclosed, with contact information for your use.

Sincerely yours,

W. Gregory Lotz

W Gregory Lotz, Ph.D.
Chief, Physical Agents Effects Branch
Division of Biomedical and
Behavioral Science

Enclosures (2)

cc: N. Hankin
J. Elder
R. Cleveland
R. Curtis
R. Owen
L. Cress
J. Healer

RF Guideline Issues

Identified by members of the federal RF Interagency Work Group, June 1999

Issue: Biological basis for local SAR limit

The C95.1 partial body (local) exposure limits are based on an assumed ratio of peak to whole body SAR; that is, they are dosimetrically, rather than biologically based. Instead of applying a dosimetric factor to the whole body SAR to obtain the local limits, an effort should be made to base local SAR limits on the differential sensitivity of tissues to electric fields and temperature increases. For example, it seems intuitive that the local limits for the brain and bone marrow should be lower than those for muscle, fat and fascia; this is not the case with the current limits which implicitly assume that all tissues are equally sensitive (except for eye and testicle). If no other data are available, differential tissue sensitivity to ionizing radiation should be considered.

If it is deemed necessary to incorporate dosimetric factors into the resulting tissue-specific SAR limits these should be based on up-to-date dosimetric methods such as finite-difference time-domain calculations utilizing MRI data and tissue-specific dielectric constants. For certain exposure conditions FDTD techniques and MRI data may allow better simulation of peak SAR values. Consideration should be given to the practical tissue volume for averaging SAR and whether this volume is relevant to potential effects on sensitive tissues and organs.

Issue: Selection of an adverse effect level

Should the thermal basis for exposure limits be reconsidered, or can the basis for an unacceptable/adverse effect still be defined in the same manner used for the 1991 IEEE guidelines? Since the adverse effect level for the 1991 guidelines was based on acute exposures, does the same approach apply for effects caused by chronic exposure to RF radiation, including exposures having a range of carrier frequencies, modulation characteristics, peak intensities, exposure duration, etc , that does not elevate tissue temperature on a macroscopic scale?

Selection criteria that could be considered in determining unacceptable/adverse effects include:

a) adverse effects on bodily functions/systems
b) minimal physiological consequences
c) measurable physiological effects, but no known consequences

If the adverse effect level is based on thermal effects in laboratory animals, the literature on human studies (relating dose rate to temperature elevation and temperature elevation to a physiological effect) should be used to determine if the human data could reduce uncertainties in determination of a safety factor.

Issue: Acute and chronic exposures

There is a need to discuss and differentiate the criteria for guidelines for acute and chronic exposure conditions. The past approach of basing the exposure limits on acute effects data with an extrapolation to unlimited chronic exposure durations is problematic. There is an extensive data base on acute effects with animal data, human data (e.g. MRI information), and modeling to address thermal insult and associated adverse effects for acute exposure (e.g., less than one day). For lower level ("non-thermal"), chronic exposures, the effects of concern may be very different from those for acute exposure (e.g., epigenetic effects, tumor development, neurologic symptoms). It is possible that the IEEE RF radiation guidelines development process may conclude that the data for these chronic effects exist but are inconsistent, and therefore not useable for guideline development. If the chronic exposure data are not helpful in determining a recommended exposure level, then a separate rationale for extrapolating the results of acute exposure data may be needed. In either case (chronic effects data that are useful or not useful), a clear rationale needs to be developed to support the exposure guideline for chronic as well as acute exposure

Issue: One tier vs two tier guidelines:

A one tier guideline must incorporate all exposure conditions and subject possibilities (e.g., acute or chronic exposure, healthy workers, chronically ill members of the general public, etc.). A two tier guideline, as now exists, has the potential to provide higher limits for a specific, defined population (e.g., healthy workers), and exposure conditions subject to controls, while providing a second limit that addresses greater uncertainties in the data available (about chronic exposure effects, about variations in the health of the subject population, etc.). A greater safety factor would have to be incorporated to deal with greater uncertainty in the scientific data available. Thus, a two-tier guideline offers more flexibility in dealing with scientific uncertainty, while a one-tier guideline would force a more conservative limit to cover all circumstances including the scientific uncertainties that exist.

Issue. Controlled vs uncontrolled (applicability of two IEEE exposure tiers)

The current "controlled" and "uncontrolled" definitions are problematic, at least in the civilian sector, particularly since there are no procedures defined in the document to implement the "controlled" condition. The new guidelines should offer direction for the range of controls to be implemented and the training required for those who knowingly will be exposed (e.g. workers), along the lines of the existing ANSI laser safety standards. This essential element needs to be included for whatever limits are defined, be they one-tier or two-tier.

For example, the OSHA position is that the "uncontrolled" level is strictly an "action" level which

indicates that there is a sufficiently high exposure (compared to the vast majority of locations) to merit an assessment to determine what controls and training are necessary to ensure persons are not exposed above the "controlled" limit. Many similar "action" levels are part of OSHA and public health standards. Should this interpretation be incorporated into the IEEE standard as a means to determine the need to implement a safety plan? [The laser standard has a multi-tiered (Class I, II, III, IV) standard which similarly requires additional controls for more powerful lasers to limit the likelihood of an excess exposure, even though the health effect threshold is the same]

On the other hand, if it is determined that certain populations (due to their health status or age) are more susceptible to RF exposures, then a multi-tiered standard, applicable only to those specific populations, may be considered.

The ANSI/IEEE standard establishes two exposure tiers for controlled and uncontrolled environments. The following statement is made in the rationale (Section 6, page 23): "The important distinction is not the population type, but the nature of the exposure environment." If that is the case, consideration should be given to providing a better explanation as to why persons in uncontrolled environments need to be protected to a greater extent than persons in controlled environments. An uncontrolled environment can become a controlled environment by simply restricting access (e.g., erecting fences) and by making individuals aware of their potential for exposure. After such actions are taken, this means that the persons who previously could only be exposed at the more restrictive uncontrolled levels could now be exposed inside the restricted area (e.g., inside the fence) at controlled levels.

What biologically-based factor changed for these people? Since the ostensible public health reason for providing greater protection for one group of persons has historically been based on biological considerations or comparable factors, it is not clear why the sentence quoted above is valid

Issue: Uncertainty factors

The uncertainties in the data used to develop the guideline should be addressed. An accepted practice in establishing human exposure levels for agents that produce undesirable effects is the application of factors representing each area of uncertainty inherent in the available data that was used to identify the unacceptable effect level. Standard areas of uncertainty used in deriving acceptable human dose for agents that may produce adverse (but non-cancer) effects include

(1) extrapolation of acute effects data to chronic exposure conditions,
(2) uncertainty in extrapolating animal data to humans in prolonged exposure situations,
(3) variation in the susceptibility (response/sensitivity) among individuals,
(4) incomplete data bases,
(5) uncertainty in the selection of the effects basis, inability of any single study to adequately address all possible adverse outcomes.

If guidelines are intended to address nonthermal chronic exposures to intensity modulated RF radiation, then how could uncertainty factors be used; how would this use differ from the historical use of uncertainty factors in establishing RF radiation guidelines to limit exposure to acute or sub-chronic RF radiation to prevent heat-related effects?

There is a need to provide a clear rationale for the use of uncertainty factors.

Issue: Intensity or frequency modulated (pulsed or frequency modulated) RF radiation

Studies continue to be published describing biological responses to nonthermal ELF-modulated and pulse-modulated RF radiation exposures that are not produced by CW (unmodulated) RF radiation. These studies have resulted in concern that exposure guidelines based on thermal effects, and using information and concepts (time-averaged dosimetry, uncertainty factors) that mask any differences between intensity-modulated RF radiation exposure and CW exposure, do not directly address public exposures, and therefore may not adequately protect the public. The parameter used to describe dose/dose rate and used as the basis for exposure limits is time-averaged SAR; time-averaging erases the unique characteristics of an intensity-modulated RF radiation that may be responsible for producing an effect.

Are the results of research reporting biological effects caused by intensity-modulated, but not CW exposure to RF radiation sufficient to influence the development of RF exposure guidelines? If so, then how could this information be used in developing those guidelines? How could intensity modulation be incorporated into the concept of dose to retain unique characteristics that may be responsible for a relationship between exposure and the resulting effects?

Issue: Time averaging

Time averaging of exposures is essential in dealing with variable or intermittent exposure, e.g., that arising from being in a fixed location of a rotating antenna, or from moving through a fixed RF field. The 0.1 h approach historically used should be reassessed, but may serve this purpose adequately. Time averaging for other features of RF exposure is not necessarily desirable, however, and should be reevaluated specifically as it deals with modulation of the signal, contact and induced current limits, and prolonged, or chronic exposure. These specific conditions are discussed in a little more detail elsewhere.

If prolonged and chronic exposures are considered to be important, then there should be a reconsideration of the time-averaging practices that are incorporated into existing exposure guidelines and used primarily to control exposure and energy deposition rates in acute/subchronic exposure situations.

Issue: Lack of peak (or ceiling) limits for induced and contact current

A recent change in the IEEE guidelines allows for 6 minute, rather than 1 second, time-weighted-averaging for induced current limits. This change increases the concern about the lack of a peak limit for induced and contact currents. Will the limits for localized exposure address this issue, i.e., for tissue along the current path?

Issue: Criteria for preventing hazards caused by transient discharges

The existing IEEE recommendation states that there were insufficient data to establish measurable criteria to prevent RF hazards caused by transient discharges. If specific quantitative criteria are still not available, can qualitative requirements be included in the standard to control this hazard (e.g., metal objects will be sufficiently insulated and/or grounded, and/or persons will utilize sufficient insulating protection, such as gloves, to prevent undesirable transient discharge)?

ISSUE. Limits for exposure at microwave frequencies

Concerns have been expressed over the relaxation of limits for continuous exposures at microwave frequencies above 1500 MHz. The rationale provided in the current guideline (Section 6.8) references the fact that penetration depths at frequencies above 30 GHz are similar to those at visible and near infrared wavelengths and that the literature for skin burn thresholds for optical radiation "is expected to be applicable." The rationale then implies that the MPE limits at these high frequencies are consistent with the MPE limits specified in ANSI Z136.1-1986 for 300 GHz exposures. This is apparently the rationale for "ramping up" to the MPE limits for ***continuous*** exposure of 10 mW/cm^2 at frequencies above 3 GHz (controlled) or 15 GHz (uncontrolled). The rationale should be given as to why this ramp function has been established at relatively low microwave frequencies (i.e., 1500 MHz and above), rather than being implemented at higher frequencies that are truly quasi-optical. For example, one option could be two ramp functions, one beginning at 300 MHz, based on whole- or partial-body dosimetry considerations, and another at higher frequencies (say 30-100 GHz) to enable consistency with the laser standard. Such a revision should help reduce concern that the standard is not restrictive enough for continuous exposures at lower microwave frequencies where new wireless applications for consumers could make this an issue in the future.

Issue: Replication/Validation

Published peer-reviewed studies that have been independently replicated/validated should be used to establish the adverse effects level from which exposure guidelines are derived The definition of "replicated/validated" should not be so restrictive to disallow the use of a set of reports that

are scientifically valid but are not an exact replication/validation of specific experimental procedures and results.

Peer-reviewed, published studies that may not be considered to be replicated/validated, but are well done and show potentially important health impacts provide important information regarding uncertainties in the data base used to set the adverse effect level (e.g., incomplete data base).

Issue: Important Health Effects Literature Areas:

Documentation should be provided that the literature review process included a comprehensive review of the following three areas:

1) long-term, low-level exposure studies (because of their importance to environmental and chronic occupational RFR exposure);
2) neurological/behavioral effects (because of their importance in defining the adverse effect level in existing RFR guidelines); and
3) micronucleus assay studies (because of their relevance to carcinogenesis).

Issue: Compatibility of RFR guidelines

Compatibility of national and international RFR guidelines remains a concern. It is important for the IEEE Committee to address this issue by identifying and discussing similarities and differences in a revised IEEE guideline and other RFR guidelines. Compatibility/noncompatibility issues could be discussed in the revised IEEE guideline or as a companion document distributed at the time the revised IEEE guideline is released to the public.

Appendix C

MARIN EMERGENCY RADIO AUTHORITY

DATE: **1/7/00**

TO: **Elizabeth Kelley, MPA, Health Care Services**
Council on Wireless Technology Impacts
Executive Director

FROM: **Linda Christman, Assistant County Administrator & Staff to MERA**

SUBJ: **Request for Engineering Studies**

On page two of the comments that you submitted concerning our Draft Environmental Impact Report (dated 12/29) you requested a copy of the "complete engineering studies" so that you can conduct your own independent evaluation. I assume that you want the complete Hammett & Edison emissions study. You have a copy of the Initial Study which includes all but one of the studies. I have included the missing six-page report as an attachment to this memo. Please submit a check for $45.90 which will cover the cost of this report plus the DEIR and the Initial Study which you have already received. I do not show receipt of your check for the two environmental documents as yet. Our consulting Communications Engineer informs me that these are the complete documents which you will need in order to conduct an independent analysis of the radio frequency emissions.

If your request for "complete engineering studies" extends to the Motorola Response to Proposals, you should know that the Response has been superceded by a revised document called the "Detailed Design." This is a voluminous report and it is considered proprietary information and is not currently available to the public. Please note that Motorola is within their rights under the Public Information Act to withhold documents which they believe will give an unfair advantage to their competitors. Since Motorola is the only major supplier of public safety radio equipment which has invested in the development of a system to serve the "narrow-band" market; I can understand their concern.

Despite their right to withhold certain information, Motorola has agreed to review the "Detailed Design" for public release if you will submit a specific request for the information that you wish. Your current request for "complete engineering studies" is not sufficiently detailed to provide a response. If you want to investigate this offer, I suggest that you ask your consulting engineer to call Jack Price of Motorola at (650)286-7073. Together, the two engineers may be able to come up with a specific request which Motorola will review for release to you and other members of the public.

If you have any questions please give me a call.

Cc: Jack Price, Motorola Project Manager

The Express. UK 10/16/99

'Mobile has given me memory loss'

AN ENGINEER launched a lawsuit against his former bosses at British Telecom earlier this year, claiming the mobile phone they gave him caused brain damage.

Father-of-three Steve Corney, left, worked for BT from 1986 until 1996, then went sick until leaving the firm on health grounds last year.

Mr Corney, 40, of Kempston, Beds, spent several hours a day on his BT mobile before falling ill. He claims radiation from it caused short-term memory loss and eventually made even the simplest tasks a nightmare.

"I would do the shopping, pay with cash and then forget I had done it, so I would do it all again and pay with a credit card," he said. Yesterday he welcomed the stand taken by Dr Carlo. Mr Corney said: "Mobile phones aren't safe and it is time that the companies admitted they do cause harm. Anything which can get this message across is important."

Study on cancer was 'ignored' by telephone firms

EXCLUSIVE BY IAN GALLAGHER AND DENNIS RICE

In an astonishing attack on the industry for which he once acted as spokesman, he accused firms of not taking safety seriously.

"The companies are now spending millions trying to discredit me because, basically, they didn't like what I told them," he revealed to The Express last night. "I feel angry and let down."

His research body, which was hand-picked by the industry, was given LiSmilhion to carry out a six-year study into the health effects of mobile phones -but after presenting its results to the phone companies in February, he claims they failed to take the "appropriate steps to protect consumers". Dr Carlo, a leading public health scientist based in Washington, said: "They have shown total disregard for mobile phone users."

His study showed there "appeared to be some correlation between brain tumours on the right side of the head and use of phone on the right side of the head". Laboratory studies looking at the "ability of radiation from a phone's antenna to cause genetic damage" also proved positive.

Dr Carlo said: "Since I presented my findings, the firms have failed to do anything. In that time, there have been another iSmillion users in the States and thousands more in Britain. From a consumer point of view, the delaying tactic is not good but from a business point of view it's great."

Last night Alasdair Phillips, of the consumer group Powerwatch, said: "To have someone like him, who has even acted as a spokesman for the industry, come out and say this is amazing~ There is now a definite link between mobiles and brain bitterly criticised them for failing to act on his findings.

Dr George Carlo found that the rate of death ignored the scientific findings suggesting potential health effects." He said some companies had "repeatedly and falsely claimed" that mobiles "are safe for all consumers including children".

His findings add to concern over the safety of mobiles . used by 13million in Britain alone, with the number rising daily Dr Carlo warned of a consumer backlash and said customers should be given more information on the risks. He advised users to cut the time they spend on their mobile or use hands-free phones, which do not come into direct contact with the ear.

Last night the Federation of the Electronics Industry, which represents the UK cellular phone companies, said it understood public concern. "The industry is supporting and will continue to support independent research in this area, and will share information h~ an open and honest way.

"All mobile phones operate on strict exposure guidelines established by expert bodies. The consensus of scientific opinion is that there is no consistent evidence that phones operating within these guidelines have any adverse health effects."

Earlier this year, British researchers found that mobile-type radiation created "hot spots" which could damage children's developing brains. Days later, a study of 11,000 volunteers found a link with headaches, dizziness and concentration lapses.

No one from CTIA, which represents US mobile phone companies, was available for comment last night. But in a written reply, president Thomas Wheeler said that when Dr Carlo presented his findings he said they "did not pose a public health

WIRELESS TECHNOLOGY RESEARCH, LLC

7 October 1999

Mr. C. Michael Armstrong
Chairman and Chief Executive Officer
AT&T Corporation
32 Avenue of the Americas
New York, New York 100313-2412

Dear Mr. Armstrong:

After much thought, I am writing this letter to you, personally, to ask your assistance in solving what I believe is an emerging and serious problem concerning wireless phones. I write this letter in the interest of the more than 80 million wireless phone users in the United States and the more than 200 million worldwide. But I also write this letter in the interest of your industry, a critical part of our social and economic infrastructure.

Since 1993, I have headed the WTR surveillance and research program funded by the wireless industry. The goal of WTR has always been to identify and solve any problems concerning consumers' health that could arise from the use of these phones. This past February, at the annual convention of the CTIA, I met with the full board of that organization to brief them on some surprising findings from our work. I do not recall if you were there personally, but my understanding is that all segments of the industry were represented.

At that briefing, I explained that the well-conducted scientific studies that WTR was overseeing indicated that the question of wireless phone safety had become confused.

Specifically, I reported to you that:

- the rate of death from brain cancer among handheld phone users was higher than the rate of brain cancer death among those who used non-handheld phones that were away from their head;
- the risk of acoustic neuroma, a benign tumor of the auditory nerve that is well in range of the radiation coming from a phone's antenna, was fifty percent higher in people who reported using cell phones for six years or more; moreover, that relationship between the amount of cell phone use and this tumor appeared to follow a dose-response curve;
- the risk of rare neuro epithelial tumors on the outside of the brain was more than doubled, a statistically significant risk increase, in cell phone users as compared to people who did not use cell phones;

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- there appeared to be some correlation between brain tumors occurring on the right side of the head and use of the phone on the right side of the head;

- laboratory studies looking at the ability of radiation from a phone's antenna to cause functional genetic damage were definitively positive, and were following a dose-response relationship.

I also indicated that while our overall study of brain cancer occurrence did not show a correlation with cell phone use, the vast majority of the tumors that were studied, were well out of range of the radiation that one would expect from a cell phone's antenna. Because of that distance, the finding of no effect was questionable. Such mis-classification of radiation exposure would tend to dilute any real effect that may have been present. In addition, I reported to you that the genetic damage studies we conducted to look at the ability of radiation from the phones to break DNA were negative, but that the positive finding of functional DNA damage could be more important, perhaps indicating a problem that is not dependent on DNA breakage, and that these inconsistencies needed to be clarified. I reported that while none of these findings alone were evidence of a definitive health hazard from wireless phones, the pattern of potential health effects evidenced by different types of studies, from different laboratories, and by different investigators raised serious questions.

Following my presentation, I heard by voice vote of those present, a pledge to "do the right thing in following up these findings" and a commitment of the necessary funds.

When I took on the responsibility of doing this work for you, I pledged five years. I was asked to continue on through the end of a sixth year, and agreed. My tenure is now completed. My presentation to you and the CTIA board in February was not an effort to lengthen my tenure at WTR, nor to lengthen the tenure of WTR itself. I was simply doing my job of letting you know what we found and what needed to be done following from our findings. I made this expressly clear during my presentation to you and in many subsequent conversations with members of your industry and the media.

Today, I sit here extremely frustrated and concerned that appropriate steps have not been taken by the wireless industry to protect consumers during this time of uncertainty about safety. The steps I am referring to specifically followed from the WTR program and have been recommended repeatedly in public and private fora by me and other experts from around the world. As I prepare to move away from the wireless phone issue and into a different public health direction, I am concerned that the wireless industry is missing a valuable opportunity by dealing with these public health concerns through politics, creating illusions that more research over the next several years helps consumers today, and false claims that regulatory compliance means safety. The better choice by the wireless industry would be to implement measured steps aimed at true consumer protection.

Alarmingly, indications are that some segments of the industry have ignored the scientific findings suggesting potential health effects, have repeatedly and falsely claimed that wireless phones are safe for all consumers including children, and have created an illusion of responsible follow up by calling for and supporting more research. The most important measures of consumer protection are missing: complete and honest factual information to allow informed judgement by consumers about assumption of risk; the direct tracking and monitoring of what happens to consumers who use wireless phones; and, the monitoring of changes in the technology that could impact health.

I am especially concerned about what appear to be actions by a segment of the industry to conscript the FCC, the FDA and The World Health Organization with them in following a non-effectual course that will likely result in a regulatory and consumer backlash.

As an industry, you will have to deal with the fallout from all of your choices, good and bad, in the long term. But short term, I would like your help in effectuating an important public health intervention today.

The question of wireless phone safety is unclear. Therefore, from a public health perspective, it is critical for consumers to have the information they need to make an informed judgement about how much of this unknown risk they wish to assume in their use of wireless phones. Informing consumers openly and honestly about what is known and not-known about health risks is not liability laden - it is evidence that your industry is being responsible, and doing all it can to assure safe use of its products. The current popular backlash we are witnessing in the United States today against the tobacco industry is derived in large part from perceived dishonesty on the part of that industry in not being forthright about health effects. I urge you to help your industry not repeat that mistake.

As we close out the business of the WTR, I would like to openly ask for your help in distributing the summary findings we have compiled of our work. This last action is what always has been anticipated and forecast in the WTR's research agenda. I have asked another organization with which I am affiliated, The Health Risk Management Group (HRMG), to help us with this public health intervention step, and to put together a consumer information package for widespread distribution. Because neither WTR nor HRMG have the means to effectuate this intervention, I am asking you to help us do the right thing.

I would be happy to talk to you personally about this.

Sincerely yours,

George L. Carlo, Ph.D., M.S., J.D.
Chairman

ORDINANCE NO. 4974

AN ORDINANCE OF THE BOARD OF SUPERVISORS OF THE COUNTY OF SONOMA, STATE OF CALIFORNIA, AMENDING CHAPTER 26C (COASTAL ZONING ORDINANCE) OF THE SONOMA COUNTY CODE RELATIVE TO TELECOMMUNICATION FACILITIES SUCH AS TELEVISION AND RADIO BROADCASTING, LAND-MOBILE, CELLULAR TELEPHONE, MICROWAVE, PERSONAL COMMUNICATION, AND OTHER RELATED FACILITIES.

The Board of Supervisors of the County of Sonoma, State of California, ordains as follows:

SECTION I. The Board finds that the adoption of this Ordinance is necessary to protect the public health, safety, and welfare. The Board further finds and declares that the basis for this finding is as follows:

A. The demand for wireless telecommunication services has resulted in demand to locate commercial radio, telephone, and other telecommunication facilities in the county. This demand has been increasing and is expected to continue to increase in future years.

B. Sonoma County recognizes the public need for telecommunication facilities in the county, but desires to ensure that they are sited and designed in a manner that promotes efficient use of land resources, achieves aesthetic and other community values, prevents safety hazards, externalities and incompatibility between land uses, and complies with the provisions of the General Plan and the Zoning Ordinance. To that end, the Board wishes to exercise the regulatory authority permitted by law over the siting and design of such facilities within the county.

C. Sonoma County has a strong concern that telecommunication facilities may not be appropriate uses in residential areas because of the aesthetic, safety, compatibility, and other conflicts that arise when these facilities are located in close proximity to residential uses.

D. Sonoma County also recognizes the need to assist in meeting the demand for telecommunication facilities by establishing permitting procedures which are streamlined and efficient, but which do not undermine the ability of the County to protect the public interest in maintaining neighborhood land use compatibility, scenic quality, health and safety, and other aspects of the quality of life of Sonoma County residents.

E. While recognizing the need and demand for a variety of telecommunication services in the future, Sonoma County desires to encourage the development of smaller facilities which can more readily blend in with local surroundings and facilities which are attached to and designed in harmony with other buildings and structures and to discourage proliferation of larger free-standing facilities which are more likely to detract from the quality of the County's scenic resources, tourism, agricultural industry, and quality of life. To accomplish this goal, the County is providing for administrative review of smaller telecommunication facilities as an incentive to avoid proliferation of larger facilities.

F. Sonoma County recognizes the role played by all members of the telecommunication industry and community in providing critical emergency service assistance to the residents, businesses, and local agencies of the County. Of particular note is the contribution of the amateur radio community which is able to greatly enhance communication efforts during emergencies.

SECTION II. Section 26C-18 (Definitions) of Chapter 26C of the Sonoma County Code is hereby amended as follows:

a) Section 26C-18 (Definitions) is amended to revise the definition of "public service use or facility" to read as follows:

> **"Public service use or facility"** means a use operated or used by a public body or public utility in connection with any of the following services: water, waste water management, public education, parks and recreation, fire and police protection, solid waste management, utilities, hospitals, or other public service uses.

(b) Section 26C-18 (Definitions) is amended to add the following definitions pertaining to telecommunication facilities to read as follows:

> **"Antenna"** means the transmitting and/or receiving device, including wires, rods, discs, or similar devices, that transmits or receives electromagnetic signals.
>
> **"Antenna, vertical"** means a vertical type antenna with no horizontal components other than a small radial element at its base.
>
> **"Attached Commercial Telecommunication Facility"** means a Commercial telecommunication antenna which is affixed, fastened, or joined to a residence, business, or similar structure, other than another telecommunication facility, and which does not include a tower.
>
> **"Co-located Telecommunication Facility"** means a telecommunication facility which is comprised of a single tower containing a combination of antennas owned or operated by more than one public or private entity.
>
> **"Free-standing Commercial Telecommunication Facility"** means a telecommunication facility which is operated in whole or part for commercial purposes such as mobile radio services, cellular telephone services, tv and radio broadcast, personal communication services, but which is not affixed, fastened, or joined to a residence, business, or similar structure. A facility which includes an antenna(s) placed upon a tower which is attached to a structure is considered to be a Free-standing facility. Telecommunication facilities operated in whole or part by public agencies are included in this category. However, a telecommunication facility installed by a public utility for the sole purpose of monitoring and protecting its gas and electric facilities shall not be considered a telecommunication facility and shall be exempt from the telecommunication standards of this ordinance.
>
> > **Major Facility:** Such facility which involves a combination of towers and antennas greater than 130' in height.
> >
> > **Intermediate Facility:** Such facility which involves a combination of towers and antennas greater than 40' and less than or equal to 130' in height.
> >
> > **Minor Facility:** Such facility which involves a combination of towers and antennas less than or equal to 40' in height.

"Multiple-user Telecommunication Facility" means a telecommunication facility which is comprised of multiple towers containing a combination of antennas owned or operated by more than one public or private entity.

"Non-Commercial Telecommunication Facility" means a telecommunication facility which is operated solely for personal use and not for commercial purposes.

"Roof" means the exterior surface on the top of a building or structure, as shown in the accompanying illustration.

"Silhouette" means a calculation of the exposed surface area of the towers and antennas associated with a telecommunication facility, as seen from an elevation perspective, as shown in the accompanying illustration.

"Structure Ridgeline" means the long, narrow crest at the top of the juncture of two or more surfaces making up the roof of a building or structure, as shown in the accompanying illustration.

"Tower" means the support structure, including guyed, monopole and lattice types, upon which antennas are located as part of a telecommunication facility. Tower does not include mounting brackets or similar devices utilized to attach an antenna directly onto the roof or side of a building.

"Telecommunication Facility" means a facility that sends and/or receives electromagnetic signals, including antennas and towers to support receiving and/or transmitting devices along with accessory structures, and the land on which they are all situated.

SECTION III. Articles II (NR), and III (TP) of Chapter 26C of the Sonoma County Code are amended as follows:

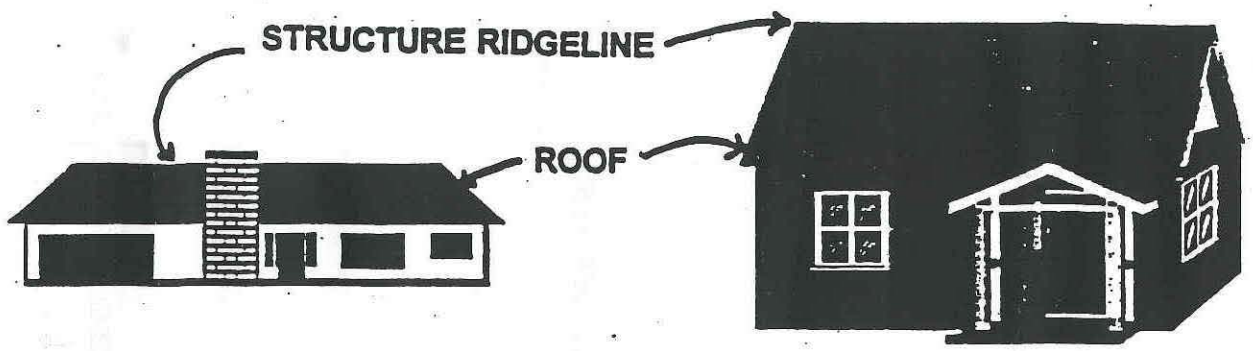
(a) The following sections are added to read as shown below. Where necessary, subsequent sections are renumbered accordingly. Section 26C-21 (d) (6), (7), and (8) [NR]; Section 26C-31 (d)(7), (8), and (9) [TP].

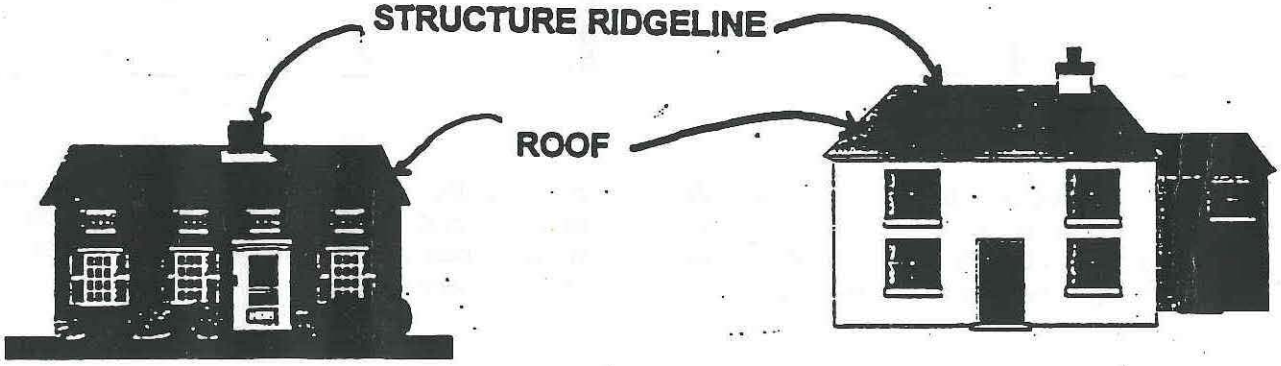
6,7. Attached Commercial Telecommunication Facilities subject to the applicable criteria set forth in Section 26C-450 (j).

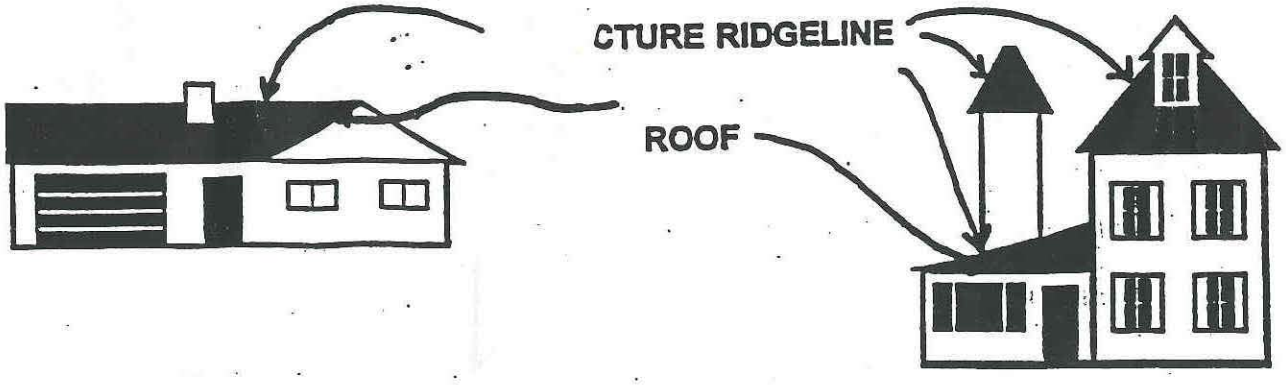
7,8. Minor Free-standing Commercial Telecommunication Facilities, subject to the applicable criteria set forth in Section 26C-450 (j), and subject to approval of a zoning permit, including environmental review, for which notice, including a site plan and one elevation with dimensions for such facility, is mailed to adjacent property owners and posted on the subject property at least ten (10) days prior to issuance of the permit and provided that no appeal pursuant to Article 47 has been received from any interested person. In the event of an appeal, a hearing on the project shall be held pursuant to the above Article.

8,9. Non-commercial Telecommunication Facilities eighty feet (80') or less in height subject to the applicable criteria set forth in Section 26C-450 (j). Facilities between forty feet (40') and eighty feet (80') in height are subject to approval of a ministerial zoning permit for which notice is mailed to adjacent property owners and posted on the subject property at least ten (10) days prior to issuance of the permit and provided that no appeal pursuant to Article 47 has been

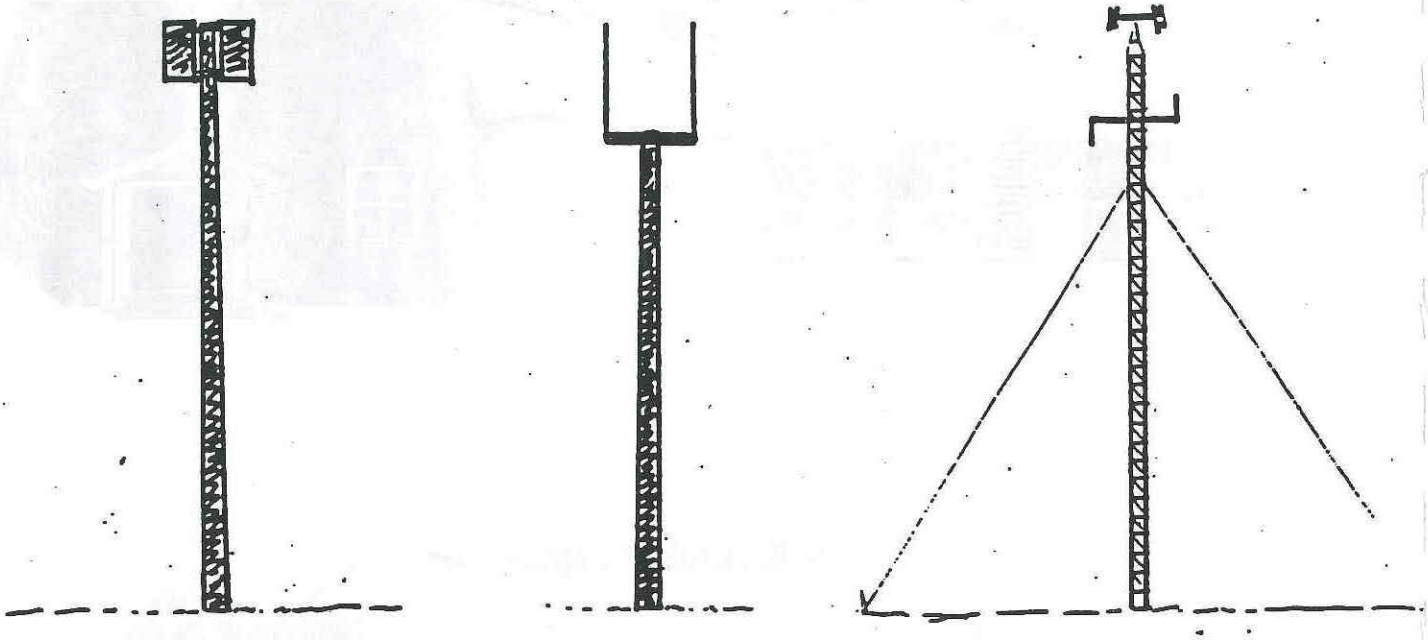
ROOF;
STRUCTURE RIDGELINE



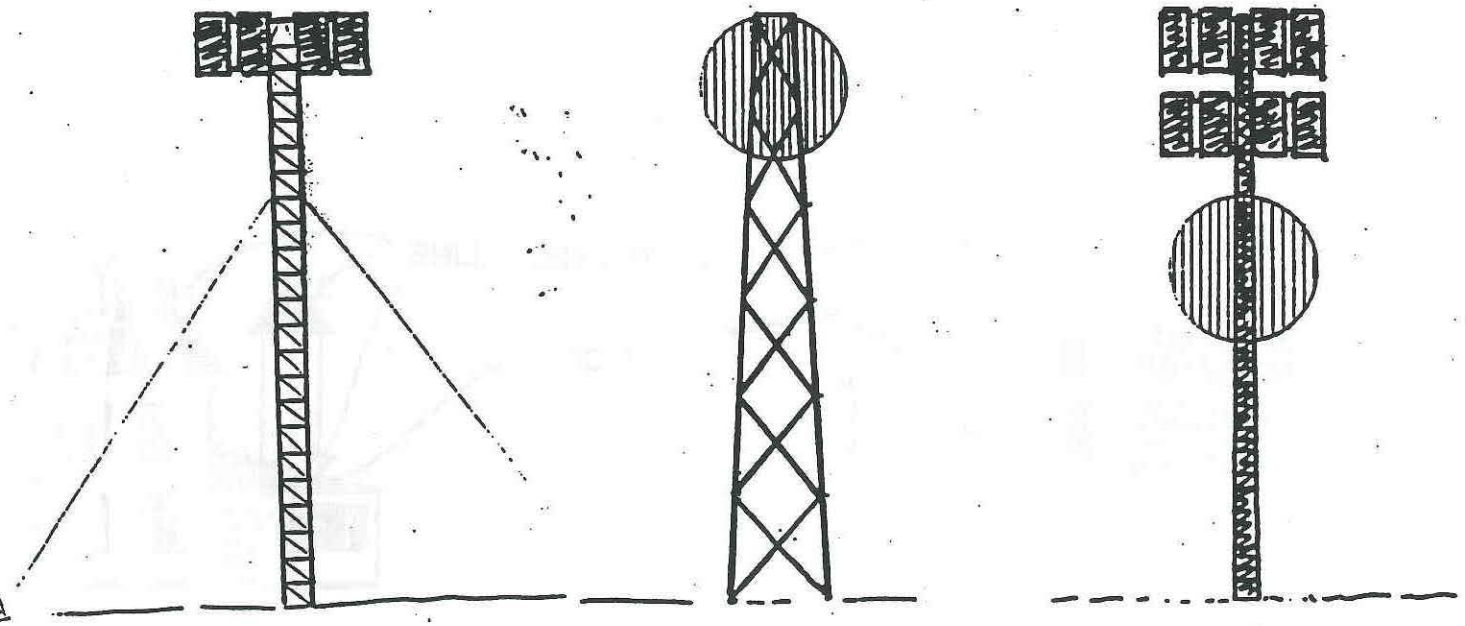




SILHOUETTES



The silhouette is a calculation of the physical surfaces of the combined tower and antenna(s) included in a telecommunication facility. Only the physical surfaces, and not the air spaces in between, are counted in the calculation. The silhouette calculation is measured from the viewing angle which presents the largest surface exposure from an elevation perspective.



received from any interested person. In the event of an appeal, a hearing on the project shall be held pursuant to the above Article.

(b) Section 26C-22 (d)9 [NR] is amended to read as shown below:

9. Public service and utility uses, including business offices, fire stations, police stations and detention facilities; telephone equipment buildings, power stations, transformer stations, transmission lines, pumping stations, reservoirs, storage tanks, communications stations and facilities and service yards (telecommunication facilities excepted), sewage treatment plants and disposal facilities, water systems and parks which do not adversely affect the primary purpose of the district.

(c) Section 26C-22 (d)10. and 11. [NR] are added to read as shown below:

10. Intermediate and Major Free-standing Commercial Telecommunication Facilities subject at a minimum to the applicable criteria set forth in Section 26C-450 (j)

11. Non-commercial Telecommunication Facilities greater than eighty feet (80') in height subject at a minimum to the applicable criteria set forth in Section 26C-450 (j)

(d) The following sections are revised to read as shown below. Section 26C-23 (c) [NR]; Section 26C-35 (c) [TP].

(c) Maximum Building Height.

1. Fifty (50) feet provided that additional height may be permitted where special structures are required if a use permit or Use Permit Waiver is first secured in each case.

2. Maximum height for telecommunication facilities is subject to the provisions of this Article and Section 26C-450 (j).

SECTION IV. Articles VII (AE), VIII (AP), and IX (AS) of Chapter 26C of the Sonoma County Code are amended as follows:

(a) The following sections are added to read as shown below. Section 26C-71 (d)6, 7, and 8. [AE]; Section 26C-81 (d)6, 7, and 8. [AP]; Section 26C-91 (d)5, 6, and 7. [AS].

6,6,5. Attached Commercial Telecommunication Facilities which meet the applicable criteria set forth in Section 26C-450 (j).

7,7,6. Minor Free-standing Commercial Telecommunication Facilities, subject to the applicable criteria set forth in Section 26C-450 (j), and subject to approval of a zoning permit, including environmental review, for which notice, including a site plan and one elevation with dimensions for such facility, is mailed to adjacent property owners and posted on the subject property at least ten (10) days prior to issuance of the permit and provided that no appeal pursuant to Article 47 has been received from any interested person. In the event of an appeal, a hearing on the project shall be held pursuant to the above Article.

8,8,7. Non-commercial Telecommunication Facilities eighty feet (80') or less in height subject to the applicable criteria set forth in Section 26C-450 (j). Facilities between forty feet (40') and eighty feet (80') in height are subject to approval of a ministerial zoning permit for which notice is mailed to adjacent property owners and posted on the subject property at least ten (10) days prior to issuance of the permit and provided that no appeal pursuant to Article 47 has been received from any interested person. In the event of an appeal, a hearing on the project shall be held pursuant to the above Article.

(b) The following sections are added or revised (and existing sections renumbered) to read as shown below. Section 26C-72 (d)7. [AE]; Section 26C-82 (d)10. [AP]; Section 26C-92 (d)4. [AS].

7,10,4. Public service and utility uses, including business offices, fire stations, police stations and detention facilities, telephone equipment buildings, power stations, transformer stations, transmission lines, pumping stations, reservoirs, storage tanks, communications stations and facilities and service yards (telecommunication facilities excepted), sewage treatment plants and disposal facilities, water systems and parks which do not adversely affect the primary purpose of the district.

(c) The following sections are added (and existing sections renumbered) to read as shown below. Section 26C-72 (d)8. and 9. [AE]; Section 26C-82 (d)11. and 12. [AP]; Section 26C-92 (d)5. and 6. [AS].

8,11,5. Intermediate and Major Free-standing Commercial Telecommunication Facilities subject at a minimum to the applicable criteria set forth in Section 26C-450 (j)

9,12,6. Non-commercial Telecommunication Facilities greater than eighty feet (80') in height subject at a minimum to the applicable criteria set forth in Section 26C-450 (j).

(d) The following sections are revised to read as shown below. Section 26C-73 (c) [AE]; Section 26C-83 (c) [AP].

(c) Maximum Building Height:

1. Fifty (50) feet provided that additional height may be permitted where special structures are required if a use permit or Use Permit Waiver is first secured in each case.

2. Maximum height for telecommunication facilities is subject to the provisions of this Article and Section 26C-450 (j).

(e) Section 26C-94 (c) [AS] is revised to read as shown below:

(c) Maximum Building Height:

1. Sixty-five (65) feet provided that additional height may be permitted where special structures are required if a use permit or Use Permit Waiver is first secured in each case.

2. Maximum height for telecommunication facilities is subject to the provisions of this Article and Section 26C-450 (j).

SECTION V. Articles XI (AR) and XII (RR) of Chapter 26C of the Sonoma County Code are amended as follows:

(a) The following sections are added (and existing sections renumbered) to read as shown below. Section 26C-111 (d)5, 6, and 7. [AR]; Section 26C-121 (c)4, 5, and 6. [RR].

5,4. Attached Commercial Telecommunication Facilities which meet the applicable criteria set forth in Section 26C-450 (j).

6,5. Minor Free-standing Commercial Telecommunication Facilities, subject to the applicable criteria set forth in Section 26C-450 (j), and subject to approval of a zoning permit, including environmental review, for which notice, including a site plan and one elevation with dimensions for such facility, is mailed to adjacent property owners and posted on the subject property at least ten (10) days prior to issuance of the permit and provided that no appeal pursuant to Article 47 has been received from any interested person. In the event of an appeal, a hearing on the project shall be held pursuant to the above Article.

7,6. Non-commercial Telecommunication Facilities eighty feet (80') or less in height subject to the applicable criteria set forth in Section 26C-450 (j). Facilities between forty feet (40') and eighty feet (80') in height are subject to approval of a ministerial zoning permit for which notice is mailed to adjacent property owners and posted on the subject property at least ten (10) days prior to issuance of the permit and provided that no appeal pursuant to Article 47 has been received from any interested person. In the event of an appeal, a hearing on the project shall be held pursuant to the above Article.

b) The following sections are amended to read as shown below. Section 26C-112 (d)7. [AR]; Section 26C-122 (g)1. [RR].

7,1. Public service and utility uses, including business offices, fire stations, police stations and detention facilities, telephone equipment buildings, power stations, transformer stations, transmission lines, pumping stations, reservoirs, storage tanks, communications stations and facilities and service yards (telecommunication facilities excepted), sewage treatment plants and disposal facilities, water systems and parks which do not adversely affect the primary purpose of the district.

(c) The following sections are added (and existing sections renumbered) to read as shown below. Section 26C-112 (d)8 and 9 [AR]; Section 26C-122 (i)1 and 2 [RR].

(i) Incidental Uses.

8,1. Intermediate and Major Free-standing Commercial Telecommunication Facilities subject at a minimum to the applicable criteria set forth in Section 26C-450-(j).

9,2. Non-commercial Telecommunication Facilities greater than eighty feet (80') in height subject at a minimum to the applicable criteria set forth in Section 26C-450 (j).

(d) The following sections are amended to read as shown below. Section 26C-113 (c) [AR]; Section 26C-123 (e) [RR].

(c or e) Maximum Building Height.

1. Thirty-five (35) feet provided that additional height may be permitted where special structures are required if a use permit or Use Permit Waiver is first secured in each case.

2. Maximum height for telecommunication facilities is subject to the provisions of this Article and Section 26C-450 (j).

SECTION VI. Articles XIII (R1), and XIV (R2) of Chapter 26C of the Sonoma County Code are amended as follows:

(a) The following sections are added (and existing sections renumbered) to read as shown below. Section 26C-131 (b)3, 4, and 5 [R1]; Section 26C-141 (b)5, 6, and 7 [R2].

3,5. Attached Commercial Telecommunication Facilities which meet the applicable criteria set forth in Section 26C-450 (j).

4,6. Minor Free-standing Commercial Facilities, subject to the applicable criteria set forth in Section 26C-450 (j) and subject to approval of a zoning permit, including environmental review, for which notice, including a site plan and one elevation with dimensions for such facility, is mailed to adjacent property owners and posted on the subject property at least ten (10) days prior to issuance of the permit and provided that no appeal pursuant to Section 26-92-040 has been received from any interested person. In the event of an appeal, a hearing on the project shall be held pursuant to the above Section.

5,7. Non-commercial Telecommunication Facilities eighty feet (80') or less in height subject to the applicable criteria set forth in Section 26C-450 (j). Facilities between forty feet (40') and eighty feet (80') in height are subject to approval of a ministerial zoning permit for which notice is mailed to adjacent property owners and posted on the subject property at least ten (10) days prior to issuance of the permit and provided that no appeal pursuant to Article 47 has been received from any interested person. In the event of an appeal, a hearing on the project shall be held pursuant to the above Article.

(b) Section 26C-132 (e)1. [R1] is revised to read as shown below:

1. Public service and utility uses, including business offices, fire stations, police stations and detention facilities, telephone equipment buildings, power stations, transformer stations, transmission lines, pumping stations, reservoirs, storage tanks, communications stations and facilities and service yards (telecommunication facilities excepted), sewage treatment plants and disposal facilities, water systems and parks which do not adversely affect the primary purpose of the district.

(c) The following sections are added (and existing sections renumbered) to read as shown below. Section 26C-132 (g)1 and 2 [R1]; Section 26C-142 (g)1 and 2 [R2].

(g) Incidental Uses.

1. Intermediate Free-standing Commercial Telecommunication Facilities subject at a minimum to the applicable criteria set forth in Section 26C-450-(j).

2. Non-commercial Telecommunication Facilities greater than eighty feet (80') in height subject at a minimum to the applicable criteria set forth in Section 26C-450 (j).

(d) Section 26C-133 (d) [R1] is amended to read as shown below:

(d) Maximum Building Height.

1. Thirty-five (35) feet provided that additional height may be permitted where special structures are required if a use permit or Use Permit Waiver is first secured in each case.

2. Maximum height for telecommunication facilities is subject to the provisions of this Article and Section 26C-450 (j).

e) Section 26C-143 (e) [R2] is amended to read as shown below:

(e) Maximum Building Height.

1. Fifteen (15) feet, provided that an additional story to a maximum of two (2) stories or thirty-five (35) feet, whichever is less may be permitted if a use permit or use permit waiver is first secured. Accessory structures shall not exceed one (1) story.

2. Where an R2 district abuts an RR or R1 District, the height of any building within fifty (50) feet of the RR or R1 District shall not exceed one (1) story, unless a use permit or use permit waiver is first secured in each case.

3. Maximum height for telecommunication facilities is subject to the provisions of this Article and Section 26C-450 (j).

SECTION VII. Article XVII (PC) of Chapter 26C of the Sonoma County Code is amended as follows:

(a) Sections 26C-173 (b), (c), (d), and (e) [PC] are added to read as shown below.

(b) Attached Commercial Telecommunication Facilities which meet the applicable criteria set forth in Section 26C-450 (j).

(c) Minor Free-standing Commercial Telecommunication Facilities, subject to the applicable criteria for such facilities in the RR District set forth in Section 26C-450 (j) and subject to approval of a zoning permit, including environmental review, for which notice, including a site plan and one elevation with dimensions for such facility, is mailed to adjacent property owners and posted on the subject property at least ten (10) days prior to issuance of the permit and provided that no appeal pursuant to Article 47 has been received from any interested person. In the event of an appeal, a hearing on the project shall be held pursuant to the above Section.

(d) On lands designated as limited commercial or general commercial on the general plan land use map, Intermediate Free-standing Commercial Telecommunication Facilities fifty feet (50') or less in height subject to the applicable criteria for such facilities in the CS District set forth in Section 26C-450 (j) and subject to approval of a zoning permit, including environmental review, for which notice, including a site plan and one elevation with dimensions for such facility, is mailed to adjacent property owners and posted on the subject property at least ten (10) days prior to issuance of the permit and provided that no appeal pursuant to Section 26-92-040 has

been received from any interested person. In the event of an appeal, a hearing on the project shall be held pursuant to the above Section.

(e) Non-commercial Telecommunication Facilities eighty feet (80') or less in height subject to the applicable criteria set forth in Section 26C-450 (i). Facilities between forty feet (40') and eighty feet (80') in height are subject to approval of a ministerial zoning permit for which notice is mailed to adjacent property owners and posted on the subject property at least ten (10) days prior to issuance of the permit and provided that no appeal pursuant to Article 47 has been received from any interested person. In the event of an appeal, a hearing on the project shall be held pursuant to the above Article.

(b) Section 26C-174 (g)11 [PC] is amended to read as shown below:

11. Public service and utility uses, including business offices, fire stations, police stations and detention facilities, telephone equipment buildings, power stations, transformer stations, pumping stations, reservoirs, storage tanks, communications stations and facilities (telecommunication facilities excepted).

(c) The following sections are added to read as shown below: Sections 26C-174 (h)1, 2, 3, and 4 [PC].

(h) Telecommunication facilities.

1. On lands designated as urban residential on the general plan land use map, Intermediate Free-standing Commercial Telecommunication Facilities subject at a minimum to the applicable criteria set forth for such facilities in the R1 District in Section 26C-450-(j) and only if the applicant demonstrates to the satisfaction of the decision-making body that there is no technically feasible alternative site(s) or strategy which would provide the needed service on lands which are not zoned AR, RR, R1, R2, R3, or PC with a UR or RR land use designation.

2. On lands designated as rural residential on the general plan land use map, Intermediate and Major Free-standing Commercial Telecommunication Facilities subject at a minimum to the applicable criteria set forth for such facilities in the RR District in Section 26C-450 (j) and only if the applicant demonstrates to the satisfaction of the decision-making body that there is no technically feasible alternative site(s) or strategy which would provide the needed service on lands which are not zoned AR, RR, R1, R2, R3, or PC with a UR or RR land use designation.

3. On lands designated as limited commercial or general commercial on the general plan land use map, Intermediate Free-standing Commercial Telecommunication Facilities greater than fifty feet (50') in height subject at a minimum to the criteria for such facilities in the CS District set forth in Section 26C-450 (j).

4. Non-commercial Telecommunication Facilities greater than eighty feet (80') in height subject at a minimum to the applicable criteria set forth in Section 26C-450 (j).

(d) Section 26C-176 (c) [PC] is amended to read as shown below:

(c) Maximum Building Height.

1. Thirty-five (35) feet or as indicated on the approved Precise Plan.

2. Maximum height for telecommunication facilities is subject to the provisions of this Article and Section 26C-450 (j).

SECTION VIII. Article XVIII (CS) of Chapter 26C of the Sonoma County Code is amended as follows:

(a) The following sections are added to read as shown below: Sections 26C-181 (c)1, 2, 3, and 4 [CS].

1. Attached Commercial Telecommunication Facilities subject to the applicable criteria set forth in Section 26C-450 (j).

2. Minor and Intermediate Free-standing Commercial Telecommunication Facilities fifty feet (50') or less in height subject to the applicable criteria set forth in Section 26C-450 (j).

3. Non-commercial Telecommunication Facilities eighty feet (80') or less in height subject to the applicable criteria set forth in Section 26C-450 (j).

(b) Section 26C-182 (k)1 [CS] is amended to read as shown below.

(k)1. Public service and utility uses, including incidental business offices, fire stations, police stations and detention facilities, telephone equipment buildings, power stations, transformer stations, transmission lines, pumping stations, reservoirs, storage tanks, communications stations and facilities and service yards (telecommunication facilities excepted).

(c) The following sections are added (and existing sections renumbered) to read as shown below. Section 26C-182 (m)1 and 2 [CS].

1. Intermediate Free-standing Telecommunication Commercial Facilities greater than fifty feet (50') in height subject at a minimum to the applicable criteria set forth in Section 26C-450 (j).

2. Non-commercial Telecommunication Facilities greater than eighty feet (80') in height subject at a minimum to the applicable criteria set forth in Section 26C-450 (j).

(d) Section 26C-183 (c) [CS] is amended to read as shown below.

(c) Maximum Building Height:

1. Thirty-five (35) feet provided that additional height may be permitted if a use permit or use permit waiver is first secured.

2. Maximum height for telecommunication facilities is subject to the provisions of this Article and Section 26C-450 (j).

SECTION IX. Articles XIX [CT], XXII [C2], XXIII [C3], and XXIV [CF] of Chapter 26C of the Sonoma County Code are amended as follows:

(a) The following sections are added (and existing sections renumbered) to read as shown below. Section 26C-191 (d)2, 3, and 4 [CT]; Section 26C-221 (i)1, 2, and 3 [C2]; Section 26C-231 (f)1, 2, and 3 [C3]; Section 26C-241 (c)1, 2, and 3 [CF].

2,1,1,1. Attached Commercial Telecommunication Facilities subject to the applicable criteria set forth in Section 26C-450 (j).

3,2,2,2. Minor and Intermediate Free-standing Commercial Telecommunication Facilities eighty feet (80') or less in height subject to the applicable criteria set forth in Section 26C-450 (j).

4,3,3,3. Non-commercial Telecommunication Facilities eighty feet (80') or less in height which meet the applicable criteria set forth in Section 26C-450 (j).

(b) The following sections are amended to read as shown below. Section 26C-192 (i)1 [CT]; Section 26C-222 (i)1 [C2]; Section 26C-232 (i)1 [C3]; Section 26C-242 (h)1 [CF].

1,1,1,1. Public service and utility uses, including incidental business offices, fire stations, police stations and detention facilities, telephone equipment buildings, power stations, transformer stations, transmission lines, pumping stations, reservoirs, storage tanks, communications stations and facilities and service yards (telecommunication facilities excepted).

(c) The following sections are added (and existing sections renumbered) to read as shown below. Section 26C-192 (k)1 and 2 [CT]; Section 26C-222 (k)1 and 2 [C2]; Section 26C-232 (k)1 and 2 [C3]; Section 26C-242 (i)5 and 6 [CF].

1,1,1,5. Intermediate and Major Free-standing Commercial Telecommunication Facilities greater than eighty feet (80') in height subject at a minimum to the applicable criteria set forth in Section 26C-450 (j).

2,2,2,6. Non-commercial Telecommunication Facilities greater than eighty feet (80') in height subject at a minimum to the applicable criteria set forth in Section 26C-450 (j).

(d) Section 26C-193 (c) [CT] is amended to read as shown below.

(c) Maximum Building Height:

1. Thirty-five (35) feet provided that additional height may be permitted if a use permit or use permit waiver is first secured.

2. Maximum height for telecommunication facilities is subject to the provisions of this Article and Section 26C-450 (j).

(e) The following sections are added to read as shown below: Section 26C-223 (d) [C2]; Section 26C-233 (d) [C3].

(d) Telecommunication facilities:

1. Maximum height of telecommunication facilities is subject to the provisions of this Article and Section 26C-450 (j).

(f) Section 26C-243 (b) is amended to read as shown below.

(c) Maximum Building Height:

1. Twenty-four (24) feet provided that additional height may be permitted if the greater height will not adversely affect coast views and there are overriding considerations.

2. Maximum height for telecommunication facilities is subject to the provisions of this Article and Section 26C-450 (j).

SECTION X. Article XLV (Special Use and Bulk Regulations and Exceptions) of Chapter 26C of the Sonoma County Code is amended to add new Subsection 26C-450 (j) to read as follows:

(j) Telecommunication Facilities.

1. The following are the minimum criteria applicable to telecommunication facilities. In the event that a project is subject to discretionary and/or environmental review, mitigation measures or other conditions may also be necessary.

a. Except as noted, all Telecommunication Facilities shall comply with the following:

(a) any applicable easements or similar restrictions, including open space easements, on the subject property.

(b) any applicable provisions of the General Plan or Local Coastal Plan and the permit requirements of any agencies which have jurisdiction over the project.

(c) the regulations of any applicable combining district.

(d) The height of any free-standing facility shall include the height of any structure upon which it is placed.

(e) All setbacks shall be measured from the base of the tower closest to the applicable property line or structure.

(f) The facility shall be operated so that they shall not result in human exposure to Nonionizing Electromagnetic Radiation (NIER) in excess of the levels specified in the most current standard governing human exposure to NIER utilized by the Federal Communications Commission (FCC) in its licensing decision for the applicable facility. The applicant shall be responsible for demonstrating that the proposed facility will comply with this standard and may do so in any one of the following ways:

1. Provide evidence in the form of an FCC license or construction permit that the FCC has accepted the applicant's certification that the facility meets the FCC standard.

2. Provide evidence that the FCC has categorically excluded the applicant from demonstrating compliance with the FCC standard.

3. Provide an independent analysis by or on behalf of the applicant which demonstrates that the facility will comply with the FCC standard by such calculations and measurements as may be necessary. The calculations, measurements, and all related methods utilized to determine compliance shall be consistent with FCC policies and procedures.

(g) Replacement of aging, defective, or obsolete legally-established antennas or towers is permitted without new zoning or use permit approval, provided that such

replacement does not increase the height or result in a substantial change in the appearance of the facility. A legal non-conforming facility may be expanded one time not to exceed ten percent (10%) of the total existing silhouette, subject to all other applicable requirements of the Sonoma County Code.

(h) In the event that a proposed telecommunication facility does not meet the required standards for such facility in the applicable district, it may be considered as the next larger facility, subject to the criteria therefor. For example, a Minor Facility that exceeds the allowed silhouette limit may be considered as an Intermediate Facility requiring a use permit, or an Attached Facility that exceeds the allowed silhouette limit may be considered as a Minor Facility requiring a zoning permit.

b. In addition to the standards of subsection a. above, Attached Commercial Telecommunication Facilities shall meet, at a minimum, the following criteria:

(a) The project description and permit shall include a specified maximum allowable silhouette of the facility. The silhouette shall be measured from the "worst case" elevation perspective, but shall not include support cables and guy wires as part of the silhouette calculation.

(b) A single vertical antenna not exceeding twenty-five feet (25') in height or four inches (4") in diameter may be included on a tower without being considered in the measurement of the height or silhouette of the facility.

(c) Antennas shall be located, designed, and screened to blend with the existing natural or built surroundings so as to minimize visual impacts and to achieve compatibility with neighboring residences and the character of the community to the extent feasible considering the technological requirements of the proposed telecommunication service.

(d) The owner/operator of any facility that causes interference with local television or radio reception shall be responsible for mitigation of such interference in accordance with the operator's applicable FCC license requirements.

(e) Approval of all Commercial Facilities is subject to the decision-making body finding that the proposed site results in fewer or less severe environmental impacts than any feasible alternative site.

c. In addition to the standards of subsection a. above, Free-standing Commercial Telecommunication Facilities shall meet, at a minimum, the following criteria:

(a) Potential adverse visual impacts which might result from project related grading or road construction shall be minimized.

(b) Facility towers, antennas, and other structures and equipment shall be located, designed, and screened to blend with the existing natural or built surroundings so as to minimize visual impacts and to achieve compatibility with neighboring residences and the character of the community to the extent feasible considering the technological requirements of the proposed telecommunication service.

(c) Potential adverse impacts upon nearby public use areas such as parks or trails shall be minimized.

(d) Following assembly and installation of the facility, all waste and debris shall be removed and disposed of in a lawful manner.

(e) Significant adverse impacts on biotic resources, including any threatened, rare or endangered species, shall be mitigated.

(f) Drainage, erosion, and sediment controls shall be required as necessary to avoid soil erosion and sedimentation of waterways. Structures and roads on slopes of 30% or greater shall be avoided. Erosion control measures shall be incorporated for any proposed facility which involves grading or construction near a waterway or on lands with slopes over 10%. Natural vegetation and topography shall be retained to the extent feasible.

(g) The project description and permit shall include a specified maximum allowable silhouette of the facility. The silhouette shall be measured from the "worst case" elevation perspective, but shall not include support cables and guy wires as part of the silhouette calculation.

(h) A single vertical antenna not exceeding twenty-five feet (25') in height or four inches (4") in diameter may be included on a tower without being considered in the measurement of the height or silhouette of the facility.

(i) Upon abandonment or termination, the entire facility, including all equipment, towers, antennas, etc, shall be removed and the site restored to its pre-construction condition or other authorized use.

(j) The owner/operator of any facility that causes interference with local television or radio reception shall be responsible for mitigation of such interference in accordance with the operator's applicable FCC license requirements.

(k) Facilities shall be designed so as to provide adequate warning of potential hazards as well as location and operator identification and telephone number for public contact. Facilities may also be required to provide anti-climb devices or other security measures.

(l) The facility operator and property owner are encouraged to make available unutilized space for future co-located or multiple-user telecommunication facilities, including space for those entities providing similar, competing services.

(m) All applications for zoning permits or use permits shall include a statement or other documentation that all owners of property within three hundred feet (300') of the subject property have been provided with a written notification of the filing of the application.

(n) An alternatives analysis (required for Major Free-standing Facilities in all districts and for Intermediate Free-standing Facilities in the AR, RR, R1, R2, R3, and PC districts with a UR or RR land use designation) shall include the following content:

1. A topographic map of the proposed local service area which identifies the local network of facilities with which the proposed facility will connect.

2. A small scale map of the applicable franchise area which identifies the regional network of facilities with which the local network will connect.

3. Identification of the following on the local topographic map:

a. All other existing telecommunication facilities, including those owned or operated by the applicant for the same type of service, and those which provide other wireless services which could potentially support the proposed facility.

b. All other existing structures which might provide an opportunity for attached facilities.

c. Lands which are zoned for commercial or industrial use.

d. Lands which are designated as open space.

4. Identification of any existing service gaps in the proposed local service area as well as any service gaps which may remain in the event that the proposed facility is approved and constructed.

5. Identification of at least two alternative service plans which could provide comparable service to the intended service area. An explanation must be included if there are not at least two alternative plans. Alternatives which do not produce a minimum quality signal, or which would substantially interfere with another service do not need to be included.

6. The alternatives should include a mix of service strategies which incorporate existing, attached, and/or other free-standing facilities. The alternatives analysis for a facility proposed within a designated scenic resource area and/or a residential zone (AR, RR, R1, R2, R3, or PC with a UR or RR land use designation) shall include any feasible alternatives outside these respective areas. They should also be designed to offer clear tradeoffs involving:

a. the level of service provided.
b. the number of towers.
c. variety in tower heights and silhouettes.
d. potential visual impacts.
e. residential proximity and compatibility.
f. proximity to service area.
g. other applicable potential environmental impacts.

7. A description of each alternative, including its ancillary equipment and structures and associated roads and compare and contrast the alternatives using the above factors. The alternative plans need not be analyzed at the same level of detail as the proposed project, but the justification for selection of the proposed project must be presented.

(o) Tower setbacks may be waived under any one of the following circumstances:

1. The facility is proposed to be co-located onto or clustered with an existing, legally-established telecommunication facility.

2. All of the owners of affected properties agree to the reduced setback. A property is considered affected if its dwelling unit lies within a distance equivalent to the required setback for the subject tower prior to reduction and the reduced setback would result in the tower being located closer to the dwelling unit than the above setback would otherwise allow.

3. Overall, the reduced setback enables further mitigation of adverse visual and other environmental impacts than would otherwise be possible.

(p) Approval of all Commercial Facilities is subject to the decision-making body finding that the proposed site results in fewer or less severe environmental impacts than any feasible alternative site.

2. Additional standards for Telecommunication Facilities pertaining to specific districts.

a. NR, AP, AE, AS, TP Districts:

(a) Attached Commercial Facilities may be flush-mounted on the side or roof of a structure but are subject to a limit of five (5) square feet of silhouette above the structure ridgeline or twenty-five (25) square feet above the roof of any single structure and a cumulative total silhouette for all attached commercial antennas on the subject lot of one hundred (100) square feet above the roofs of structures. The Director may allow these silhouette limits to be exceeded without requiring a zoning or use permit provided that the silhouette would be effectively unnoticeable

(b) Minor Free-standing Commercial facilities shall meet the following standards:

1. Towers shall be set back from the nearest offsite dwelling unit by a minimum distance equivalent to 110% of the height of the facility or the yard requirements of the applicable base district, whichever is more restrictive, provided that such setbacks may be waived pursuant to Section 26C-450 (j) 1. c. (o)

2. The cumulative total silhouette of the facilities on the subject lot shall not exceed one hundred and sixty-five (165) square feet at full design capacity.

(d) Intermediate and Major Free-standing Commercial facilities shall meet the following standards:

1. Towers shall meet the setback standards of Section 26C-450 (j)2. a. (b) 1.

2. For any proposed Major Facility, an alternatives analysis shall be prepared by or on behalf of the applicant, subject to the approval of the decision making body, which meets the requirements of Section 26C-450 (j) 1. c. (n).

4. A visual analysis.

b. AR, RR, R1, and R2 Districts:

(a) Attached Commercial Facilities may be flush-mounted on the side or roof of a structure but the cumulative total silhouette of all attached commercial antennas on the subject lot shall not exceed five (5) square feet above structure ridgelines or fifteen

(15) square feet above the roofs of structures. The Director may allow these silhouette limits to be exceeded without requiring a zoning or use permit provided that the silhouette would be effectively unnoticeable

(b) Minor Free-standing Commercial facilities shall meet the following:

1. Towers shall be set back from the nearest offsite dwelling unit by a minimum distance equivalent to 110% of the height of the facility or the yard requirements of the applicable base district, whichever is more restrictive, provided that such setbacks may be waived pursuant to Section 26C-450 (j) 1. c. (o).

2. The cumulative total silhouette of the facilities on the subject lot at full design capacity shall not exceed seventy (70) square feet in the AR and RR districts and shall not exceed forty five (45) square feet in the R1, R2, and R3 districts.

(c) Intermediate and Major Free-standing Commercial Facilities shall not be approved in these districts unless allowed by the base district and unless the applicant demonstrates to the satisfaction of the decision-making body that there is no technically feasible alternative site(s) or strategy which would provide the needed service on lands which are not zoned AR, RR, R1, R2, R3, or PC with a UR or RR land use designation. In addition to such demonstration, the project shall meet the following standards:

1. An alternatives analysis shall be prepared by or on behalf of the applicant, subject to the approval of the decision making body, which meets the requirements of Section 26C-450 (j) 1. c. (n)

2. A visual analysis, which may include photo montage, field mock up, or other techniques, shall be prepared by or on behalf of the applicant which identifies the potential visual impacts, at design capacity, of the proposed facility. Consideration shall be given to views from public areas as well as from private residences. The analysis shall assess the cumulative impacts of the proposed facility and other existing and foreseeable telecommunication facilities in the area, and shall identify and include all feasible mitigation measures consistent with the technological requirements of the proposed telecommunication service.

c. CS District:

(a) Attached Commercial Facilities may be flush-mounted on the side or roof of a structure but the cumulative total silhouette of all attached commercial antennas on dwelling units on the subject lot shall not exceed five (5) square feet above structure ridgelines or fifteen (15) square feet above the roofs of residential structures.

(b) Minor and Intermediate Free-standing Commercial Facilities fifty feet (50') or less in height shall meet the following:

1. Towers setbacks shall be the same as those for other structures in the base district.

2. The cumulative total silhouette of the facilities on the subject lot shall not exceed two hundred and ten (210) square feet at full design capacity.

(c) Intermediate Free-standing Commercial Facilities greater than fifty feet (50') shall meet the following:

1. Towers shall be set back by a minimum distance equivalent to 50% of the height of the facility from the property line of any property zoned AR, RR, R1, R2, R3, or PC with a UR or RR general plan land use designation and shall meet the yard requirements of the applicable base district, provided that such setbacks may be waived pursuant to Section 26C-450 (j) 1. c. (o).

2 A visual analysis.

d. CT, C2, C3, and CF Districts:

(a) Attached Commercial Facilities may be flush-mounted on the side or roof of a structure but the cumulative total silhouette of the antennas on dwelling units on the subject lot shall not exceed five (5) square feet above structure ridgelines or fifteen (15) square feet above the roof of residential structures.

(b) Minor and Intermediate Free-standing Commercial facilities eighty feet (80') or less in height shall meet the following:

1. Towers setbacks shall be the same as those for other structures in the base district.

2. The cumulative total silhouette of the facilities on the subject lot shall not exceed two hundred and ten (210) square feet at full design capacity.

(c) Intermediate and Major Free-standing Commercial facilities greater than eighty feet (80') shall meet the following:

1. For Intermediate facilities, towers shall be set back by a minimum distance equivalent to 50% of the height of the facility from the property line of any property zoned AR, RR, R1, R2, R3, or PC with a UR or RR general plan land use designation or the yard requirements of the applicable base district, whichever is more restrictive, provided that such setbacks may be waived pursuant to Section 26C-450 (j) 1. c. (o).

2. For Major facilities, towers shall be set back by a minimum distance equivalent to 100% of the height of the facility from the property line of any property zoned AR, RR, R1, R2, R3, or PC with a UR or RR general plan land use designation or the yard requirements of the applicable base district, whichever is more restrictive, provided that such setbacks may be waived pursuant to Section 26C-450 (j) 1. c. (o).

3. For any proposed Major Facility, an alternatives analysis shall be prepared by or on behalf of the applicant, subject to the approval of the decision making body, which meets the requirements of Section 26C-450 (j) 1. c. (n).

4. A visual analysis.

(vi) The facility shall be operated so that it shall not result in human exposure to Nonionizing Electromagnetic Radiation (NIER) in excess of the levels specified in the most current standard governing human exposure to NIER utilized by the Federal Communications Commission (FCC) in its licensing decision for the applicable facility. The applicant shall be responsible for demonstrating that the proposed facility will comply with this standard and may do so in any one of the following ways:

(A) Provide evidence in the form of an FCC license or construction permit that the FCC has accepted the applicant's certification that the facility meets the FCC standard.

(B) Provide evidence that the FCC has categorically excluded the applicant from demonstrating compliance with the FCC standard.

(C) Provide an independent analysis by or on behalf of the applicant which demonstrates that the facility will comply with the FCC standard by such calculations and measurements as may be necessary. The calculations, measurements, and all related methods utilized to determine compliance shall be consistent with FCC policies and procedures.

(vii) Replacement of aging, defective, or obsolete legally-established antennas or towers is permitted without new zoning permit or use permit approval, provided that such replacement does not increase the height or result in a substantial change in the appearance of the facility. Pursuant to Section 26-94-010 (b), a legal non-conforming facility may be expanded one time not to exceed ten percent (10%) of the total existing silhouette, subject to all other applicable requirements of the Sonoma County Code.

(viii) In the event that a proposed telecommunication facility does not meet the required standards or criteria for such facility in the applicable district, it may be considered as the next larger facility, subject to the criteria therefor. For example, a Minor Facility that exceeds the allowed silhouette limit may be considered as an Intermediate Facility requiring a use permit, or an Attached Facility that exceeds the allowed silhouette limit may be considered as a Minor Facility requiring a zoning permit.

(2) In addition to the standards of subsection (1) above, Attached Commercial Telecommunication Facilities shall meet, at a minimum, the following criteria:

(i) The project description and permit shall include a specified maximum allowable silhouette of the facility. The silhouette shall be measured from the "worst case" elevation perspective, but shall not include supporting cables and guy wires as part of the silhouette calculation.

(ii) A single vertical antenna not exceeding twenty-five feet (25') in height or four inches (4") in diameter may be included on a tower without being considered in the measurement of the height or silhouette of the facility.

(iii) Antennas shall be located, designed, and screened to blend with the existing natural or built surroundings so as to minimize visual impacts and to achieve compatibility with neighboring residences and the character of the community to the extent feasible considering the technological requirements of the proposed telecommunication service.

(iv) The owner/operator of any facility that causes interference with local television or radio reception shall be responsible for mitigation of such interference in accordance with the operator's applicable FCC license requirements.

(v) Approval of all Commercial Facilities is subject to the decision-making body finding that the proposed site results in fewer or less severe environmental impacts than any feasible alternative site.

(3) In addition to the standards of subsection (1) above, Free-standing Commercial Telecommunication Facilities shall meet, at a minimum, the following criteria:

(i) Potential adverse visual impacts which might result from project related grading or road construction shall be minimized.

(ii) Facility towers, antennas and other structures and equipment shall be located, designed, and screened to blend with the existing natural or built surroundings so as to minimize visual impacts and to achieve compatibility with neighboring residences and the character of the community to the extent feasible considering the technological requirements of the proposed telecommunication service.

(iii) Potential adverse impacts upon nearby public use areas such as parks or trails shall be minimized.

(iv) Following assembly and installation of the facility, all waste and debris shall be removed and disposed of in a lawful manner.

(v) Significant adverse impacts on biotic resources, including any threatened, rare or endangered species, shall be mitigated.

(vi) Drainage, erosion, and sediment controls shall be required as necessary to avoid soil erosion and sedimentation of waterways. Structures and roads on slopes of 30% or greater shall be avoided. Erosion control measures shall be incorporated for any proposed facility which involves grading or construction near a waterway or on lands with slopes over 10%. Natural vegetation and topography shall be retained to the extent feasible.

(vii) The project description and permit shall include a specified maximum allowable silhouette of the facility. The silhouette shall be measured from the "worst case" elevation perspective, but shall not include supporting cables and guy wires as part of the silhouette calculation.

(viii) A single vertical antenna not exceeding twenty-five feet (25') in height or four inches (4") in diameter may be included on a tower without being considered in the measurement of the height or silhouette of the facility.

(ix) Upon abandonment or termination, the entire facility, including all equipment, towers, antennas, etc, shall be removed and the site restored to its pre-construction condition or other authorized use.

(x) The owner/operator of any facility that causes interference with local television or radio reception shall be responsible for mitigation of such interference in accordance with the operator's applicable FCC license requirements.

(xi) Facilities shall be designed so as to provide adequate warning of potential hazards as well as location and operator identification and telephone number for public contact. Facilities may also be required to provide anti-climb devices or other security measures.

(xii) The facility operator and property owner are encouraged to make available unutilized space for future co-located or multiple-user telecommunication facilities, including space for those entities providing similar, competing services.

(xiii) All applications for zoning permits or use permits shall include a statement or other documentation that all owners of property within three hundred feet (300') of the subject property have been provided with a written notification of the filing of the application.

(xiv) An alternatives analysis (required for Major Free-standing Facilities in all districts and for Intermediate Free-standing Facilities in the AR, RR, R1, R2, R3, and PC districts with a UR or RR land use designation) shall include the following content:

(A) A topographic map of the proposed local service area which identifies the local network of facilities with which the proposed facility will connect.

(B) A small scale map of the applicable franchise area, which identifies the regional network of facilities with which the local network will connect.

(C) Identification of the following on the local topographic map:

i. All other existing telecommunication facilities, including those owned or operated by the applicant for the same type of service, and those which provide other wireless services which could potentially support the proposed facility.

ii. All other existing structures which might provide an opportunity for attached facilities.

iii. Lands which are zoned for commercial or industrial use.

iv. Lands which are designated as open space.

(D) Identification of any existing service gaps in the proposed local service area as well as any service gaps which may remain in the event that the proposed facility is approved and constructed.

(E) Identification of at least two alternative service plans which could provide comparable service to the intended service area. An explanation must be included if there are not at least two alternative plans. Alternatives which do not produce a minimum quality signal, or which would substantially interfere with another service do not need to be included.

(F) The alternatives should include a mix of service strategies which incorporate existing, attached, and/or other free-standing facilities. The alternatives analysis for a facility proposed within a designated scenic resource area and/or a residential zone (AR, RR, R1, R2, R3, or PC with a UR or RR

General Plan land use designation) shall include any feasible alternatives outside these respective areas. They should also be designed to offer clear tradeoffs involving:

i. the level of service provided.
ii. the number of towers.
iii. variety in tower heights and silhouettes.
iv. potential visual impacts.
v. residential proximity and compatibility.
vi. proximity to service area.
vii. other applicable potential environmental impacts.

(G) A description of each alternative, including its ancillary equipment and structures and associated roads and compare and contrast the alternatives using the above factors. The alternative plans need not be analyzed at the same level of detail as the proposed project, but the justification for selection of the proposed project must be presented.

(xv) Tower setbacks may be waived under any one of the following circumstances:

(A) The facility is proposed to be co-located onto or clustered with an existing, legally-established telecommunication facility.

(B) All of the owners of affected properties agree to the reduced setback. A property is considered affected if its dwelling unit lies within a distance equivalent to the required setback for the subject tower prior to reduction and the reduced setback would result in the tower being located closer to the dwelling unit than the above setback would otherwise allow.

(C) Overall, the reduced setback enables further mitigation of adverse visual and other environmental impacts than would otherwise be possible.

(xvi) Approval of all Commercial Facilities is subject to the decision-making body finding that the proposed site results in fewer or less severe environmental impacts than any feasible alternative site.

(b) Additional standards for Telecommunication Facilities pertaining to specific districts.

(1) LIA, LEA, DA, RRD, RRDWA, TP Districts:

(i) Attached Commercial Facilities may be flush-mounted on the side or roof of a structure but are subject to a limit of five (5) square feet of silhouette above the structure ridgeline or twenty-five (25) square feet above the roof on any single structure and a cumulative total silhouette for all attached commercial antennas on the subject lot of one hundred (100) square feet above the roofs of structures. The Director may allow these silhouette limits to be exceeded without requiring a zoning or use permit provided that the added silhouette would be effectively unnoticeable.

(ii) Minor Free-standing Commercial facilities shall meet the following standards:

(A) Towers shall be set back from the nearest offsite dwelling unit by a minimum distance equivalent to 110% of the height of the facility or the yard requirements of the applicable base district, whichever is more restrictive, provided that such setbacks may be waived pursuant to Section 26-88-130 (a)(3)(xv).

(B) The cumulative total silhouettes of the towers and antennas on the subject lot shall not exceed one hundred and sixty-five (165) square feet at full design capacity.

(iv) Intermediate and Major Free-standing Commercial facilities shall meet the following standards:

(A) Towers shall meet the setback standards of Section 26-88-130 (b)(1)(ii)(A).

(B) For any proposed Major Facility, an alternatives analysis shall be prepared by or on behalf of the applicant, subject to the approval of the decision making body, which meets the requirements of Section 26-88-130 (a)(3)(xiv).

(C) A visual analysis.

(2) AR, RR, R1, R2, and R3 Districts:

(i) Attached Commercial Facilities may be flush-mounted on the side or roof of a building but the cumulative total silhouette of all attached commercial antennas on the subject lot shall not exceed five (5) square feet above structure ridgelines or fifteen (15) square feet above the roofs of structures. The Director may allow these silhouette limits to be exceeded without requiring a zoning or use permit provided that the added silhouette would be effectively unnoticeable.

(ii) Minor Free-standing Commercial facilities shall meet the following:

(A) Towers shall be set back from the nearest offsite dwelling unit by a minimum distance equivalent to 110% of the height of the facility or the yard requirements of the applicable base district, whichever is more restrictive, provided that such setbacks may be waived pursuant to Section 26-88-130 (a)(3)(xv).

(B) The cumulative total silhouette of the towers and antennas on the subject lot at full design capacity shall not exceed seventy (70) square feet in the AR and RR districts and shall not exceed forty-five (45) square feet in the R1, R2, and R3 districts.

(iv) Intermediate and Major Free-standing Commercial Facilities are not allowed in these districts unless the applicant demonstrates to the satisfaction of the decision-making body that there is no technically feasible site or method of providing the needed service on lands which are not zoned AR, RR, R1, R2, R3, or PC with a UR or RR land use designation. Such demonstration shall be accompanied by the following:

(A) An alternatives analysis which meets the requirements of Section 26-88-130 (a)(3)(xiv).

(B) A visual analysis, which may include photo montage, field mock up, or other techniques, shall be prepared by or on behalf of the applicant which identifies the potential visual impacts, at design capacity, of the proposed facility. Consideration shall be given to views from public areas as well as from private residences. The analysis shall assess the cumulative impacts of the proposed facility and other existing and foreseeable telecommunication facilities in the area, and shall identify and include all feasible mitigation measures consistent with the technological requirements of the proposed telecommunication service.

(3) CO, C1 Districts:

(i) Attached Commercial Facilities may be flush-mounted on the side or roof of a building but the cumulative total silhouette of the antennas placed upon dwelling units on the subject lot shall not exceed five (5) square feet above structure ridgelines or fifteen (15) square feet above the roofs of residential structures.

(ii) Minor and Intermediate Free-standing Commercial Facilities fifty feet (50') or less in height shall meet the following:

(A) Towers setbacks shall be the same as those for other structures in the base district.

(B) The cumulative total silhouette of the facilities on the subject lot shall not exceed two hundred and ten (210) square feet at full design capacity.

(iii) Intermediate Free-standing Commercial Facilities greater than fifty feet (50') in height shall meet the following:

(A) Towers shall be set back by a minimum distance equivalent to 50% of the height of the facility from the property line of any property zoned AR, RR, R1, R2, R3, or PC with a UR or RR general plan land use designation or the yard requirements of the applicable base district, whichever is more restrictive, provided that such setbacks may be waived pursuant to Section 26-88-130 (a)(3)(xv).

(B) A visual analysis.

(4) C2, C3, LC, RC, AS, K, MP, M1, M2, and M3 Districts:

(i) Attached Commercial Facilities may be flush-mounted on the side or roof of a building but the cumulative total silhouette of the antennas on dwelling units on the subject lot shall not exceed five (5) square feet above structure ridgelines or fifteen (15) square feet above the roofs of residential structures.

(ii) Minor and Intermediate Free-standing Commercial facilities eighty feet (80') or less in height shall meet the following:

(A) Towers setbacks shall be the same as those for other structures in the base district.

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(B) The cumulative total silhouette of the facilities on the subject lot shall not exceed two hundred and ten (210) square feet at full design capacity.

(iii) Intermediate and Major Free-standing Commercial Facilities greater than eighty feet (80') shall meet the following:

(A) For Intermediate facilities, towers shall be set back by a minimum distance equivalent to 50% of the height of the facility from the property line of any property zoned AR, RR, R1, R2, R3, or PC with a UR or RR general plan land use designation or the yard requirements of the applicable base district, whichever is more restrictive, provided that such setbacks may be waived pursuant to Section 26-88-130 (a)(3)(xv).

(B) For Major facilities, towers shall be set back by a minimum distance equivalent to 100% of the height of the facility from the property line of any property zoned AR, RR, R1, R2, R3, or PC with a UR or RR general plan land use designation or the yard requirements of the applicable base district, whichever is more restrictive, provided that such setbacks may be waived pursuant to Section 26-88-130 (a)(3)(xv).

(C) For any proposed Major Facility, an alternatives analysis shall be prepared by or on behalf of the applicant, subject to the approval of the decision making body, which meets the requirements of Section 26-88-130 (a)(3)(xiv).

(D) A visual analysis.

SECTION XV. Notwithstanding the regulations contained in this ordinance, development applications for telecommunication facilities accepted as complete for filing prior to June 7, 1996 shall be considered under the regulations in effect at the time of such complete application. All other such applications shall be subject to the regulations in effect at the time of the action on the application by the decision-making body.

SECTION XVI. Ordinance No. 4829, dated November 1, 1994, which amended Chapter 26 of the Sonoma County Code and established a temporary moratorium on new applications for communication and transmission towers and antennas, and Ordinances No. 4834, dated December 13, 1994 and No. 4899 dated October 31, 1995 which extended Ordinance No. 4829, are hereby repealed.

SECTION XVII. This ordinance shall be reviewed periodically for its effectiveness, including at least one full review no later than five (5) years from the date of adoption.

SECTION XVIII. If any section, subsection, sentence, clause or phrase of this Ordinance is for any reason held to be unconstitutional and invalid, such decision shall not affect the validity of the remaining portion of this Ordinance. The Board of Supervisors hereby declares that it would have passed this Ordinance and every section, subsection, sentence, clause or phrase thereof, irrespective of the fact that any one or more sections, subsections, sentences, clauses or phrases be declared unconstitutional or invalid.

SECTION XIX. This Ordinance shall be published once before the expiration of fifteen (15) days after said passage, with the names of the Supervisors voting for or against the same, in the Press Democrat, a newspaper of general circulation published in the County of Sonoma, State of California.

In regular session of the Board of Supervisors of the County of Sonoma introduced on the 23rd day of July 1996, and finally passed and adopted this 1st day of October, 1996, on regular roll call of the members of said Board by the following vote:

SUPERVISORS:

CALE aye HARBERSON abstain SMITH aye KELLEY aye CARPENTER absent

AYES 3 NOES ___ ABSTAIN 1 ABSENT 1

WHEREUPON, the Chair declared the above and foregoing ordinance duly adopted and

SO ORDERED.

Chair, Board of Supervisors
County of Sonoma

ATTEST:

EEVE T. LEWIS, County Clerk and
ex-officio Clerk of the Board of Supervisors

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snap. Editors' Choice

"Unrecognized risks are still risks; uncertain risks are still risks; denied risks are still risks! The precautionary principle embodies the belief that it is prudent to attempt to diminish risks with particularly severe consequences, even if the probability of occurrence is moderate or the uncertainty is high. Excessive confidence in our own ability to solve problems after harm has been done could result in awkwardness or tragedy."

- Dr. John Cairns Jr., Virginia Polytechnic Institute and State University, Blacksburg, VA, in an editorial, "Absence of Certainty Is Not Synonymous with Absence of Risk." Environmental Health Perspectives, February 1999 Page 57.

"A new scientific truth does not triumph by convincing its opponents and making them see the light, but rather because its opponents eventually die, and a new generation grows up that is familiar with it."

- Max Planck

WAVEGUIDE

What are the Studies Telling Us?

The following studies indicate biological effects at exposure levels *far below* what would be explained by "thermal effects", and well within the range people are commonly exposed to every day.

NOTE: Most of these exposures lie FAR BELOW the current advisory exposure standards in the US.

Studies by Increasing Power Density

Power Density	Reported Biological Effects	References
0.1 $\mu W/cm^2$ (0.001 W/Kg SAR)	EEG brain waves are altered when exposed to cell phone signal	Von Klitzing, 1995
0.16 $\mu W/cm^2$	Motor function, memory and attention of school children affected (Latvia)	Kolodynski, 1996
0.168 - 1.053 $\mu W/cm^2$	Irreversible infertility in mice after 5 generations of exposure to cell phone signals from antenna park	Magras & Xenos, 1997
0.2 - 8 $\mu W/cm^2$	Two-fold increase in childhood leukemia from AM-FM exposure	Hocking, 1996
1.3 - 5.7 $\mu W/cm^2$	Two-fold increase in leukemia in adults from AM RF exposure	Dolk, 1997
2.4 $\mu W/cm^2$	Interference with medical devices at least up to 1000 MHz	Joyner, 1996
2 - 4 $\mu W/cm^2$	Direct effect of RFR on ion channels in cells/opening of acetycholine channels	D'Inzeo, 1988
4 - 10 $\mu W/cm^2$	Visual reaction time in children is slowed//lower memory function in tests	Chiang, 1989
5 - 10 $\mu W/cm^2$	Impaired nervous system activity	Dumanski, 1974
10 $\mu W/cm^2$	Significant differences in visual reaction time and reduced memory function	Chiang, 1989
10 - 25 $\mu W/cm^2$	Changes in the hippocampus of the brain	Belokrinitskiy, 1982
30 $\mu W/cm^2$ (0.015 W/Kg SAR)	Immune system effects - elevation of PFC count (antibody producing cells)	Veyret, 1991
50 $\mu W/cm^2$	An 18% reduction in REM sleep (important to memory and learning	Mann, 1996

SAR	Standards	
0.2 W/Kg	IEEE standard for whole body SAR for general public (1/6 of an hour)	IEEE
1.6 W/Kg	FCC (IEEE) SAR limit over 1 gram of tissue (cell phone to ear)	FCC, 1996
Power Density	Standards	
579μW/cm^2	800-900 MHz Cell Phone Signal Standard	ANSI/IEEE
1000μW/cm^2	PCS STANDARD for public exposure (as of September 1, 1997)	FCC, 1996
5000μW/cm^2	PCS STANDARD for occupational exposure (as of September 11997)	FCC, 1996
	Background Levels	
0.003 μW/cm^2	Ambient background RF exposure in cities and suburbs in the 1990's	Mantiply, 1997
1 - 10 μW/cm^2	Ambient RF exposure within 100-200 feet of cell/PCS antenna array (or roughly 0.2 to 0.5 mW/Kg SAR in the human body')	Sage, 1998, unpublished

Listing of Full Citations Refrenced Above

Study	Description
Adey, WR., et. al., 1996.	Brain tumor incidence in rats chronically exposed to digital cellular telephone fields in an initiation-promotion model. Bioelectromagnetics Society 18th Annual Meeting, Proceedings, Abstract A-7-3.
Belokrinitskiy, VS., 1982.	"Destructive and reparative processes in hippocampus with long-term exposure to nonionizing radiation." In U.S.S.R. Report, Effects of Nonionizing Microwave Radiation, No. 7, JPRS 81865, pp. 15-20.
Chiang, H., et. al., 1989.	Health effects of environmental electromagnetic fields. Journal of Bioelectricity, 8: 127-131
Chou, CK., & Guy, AW., 1992.	Long-term low level microwave irradiation of rats. Bioelectormagnetics 13:469-496
D'Inzeo, G., et. al., 1988.	Microwave effects on acetycholine-induced channels in cultured chick myotubes. Bioelectromagnetics 9; 363-372.
Dolk, H., et. al., 1997.	Cancer incidence near radio and television transmitters in Great Britain. Am J Epidemiology 145(1) P 1-9 Jan 1997.
Dumanski, J.D., and Shandala, M.G., 1974	"The Biological Action and Hygenic Significance of Elecromagnetic Fields of Superhigh and Ultrahigh frequencies in Densely Populated Areas," from Biological Effects and Health Hazards of Microwave Radiation. Proceedings of an International Symposium, Warsaw 15-18 October, 1973, Polish Medical Publishers, Warsaw, 1974.
Dutta, SK., et. al., 1989.	Radiofrequency radiation-induced calcium ion efflux enhancement from human and other neuroblastoma cells in culture. Bioelectromagnetics 10: 197-202.
Elekes, E., 1996.	Effect on the immune system of mice exposed chronically to 50 Hz amplitude-modulated 2.45 GHz microwaves. Bioelectromagnetics 17:246-8.
Hocking, B., et. al., 1996.	Cancer incidence and mortality and proximity to TV towers Med J Aust 165(11-12) P. 601-5 Dec 2-16, 1996.

Szmigielski, S., et. al., 1982.	Cancer morbidity in subjects occupationally exposed to high frequency (radiofrequency and microwave) electromagnetic radiation. Sci Total Environ 1996; 180:9-17
Veyret, B., et. al., 1991.	"Antibody responses of mice exposed to low-power microwaves under combined, pulse and amplitude modulation," Bioelectromagnetics 12: P 47-56.

I want to thank Libby Kelley at the California Council on Wireless Technology Impacts for passing this along to me, and Cindy Sage of Sage Associates, for tabulating this *Important* information.

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Updated 6-5-99, by Over-the-Hill Consulting

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