CALIFORNIA COASTAL COMMISSION
CENTRAL COAST DISTRICT OFFICE
725 FRONT STREET, SUITE 300
SANTA CRUZ, CA 95060
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F10d

Appeal filed:	5/12/2008
49th day:	6/30/2008
Staff report prepared:	5/29/2008
Staff report prepared by:	Jonathan Bishop
Staff report approved by:	Dan Carl
Hearing date:	6/13/2008

APPEAL STAFF REPORT
SUBSTANTIAL ISSUE DETERMINATION ONLY

Appeal number.....**A-3-SLO-08-022, Sprint-Nextel Wireless Communications Facility**

Applicants.....Bonaire Investments and Sprint-Nextel

Appellant.....Judy Vick

Local government .....San Luis Obispo County

Local decision .....Coastal Development Permit (CDP) Application DRC 2006-00204 approved by the San Luis Obispo County Board of Supervisors on April 1, 2008.

Project location .....1337 Los Osos Valley Road, at the intersection of Los Osos Valley Road and South Bay Boulevard in the community of Los Osos, San Luis Obispo County (APN 074-314-019).

Project description.....Construct an unmanned wireless telecommunications facility consisting of three panel antennas mounted in the upper portion of the exterior walls of an existing office building (near the roof) and associated ground-mounted equipment in the basement of the building.

File documents.....Final Local Action Notice for San Luis Obispo County CDP Number DRC 2006-00204; San Luis Obispo County certified Local Coastal Program (LCP).

Staff recommendation ...**No Substantial Issue Exists**

A.Staff Recommendation

1. Summary of Staff Recommendation

San Luis Obispo County approved a CDP for construction of an unmanned wireless telecommunications facility consisting of three small panel antennas and associated ground-mounted equipment on and inside of an existing office building located at the intersection of Los Osos Valley Road and South Bay Boulevard in the community of Los Osos. The Appellant contends that the County's decision is inconsistent with the environmentally sensitive habitat area (ESHA) protection policies of the certified LCP. In support of this contention, the Appellant also asserts that the Coastal Commission is not preempted under the Federal Telecommunications Act (FTA) from regulating this wireless service

facility on the basis of the environmental effects of radio frequency emissions because it is not in compliance with Federal Communications Commission FTA regulations, and thus the Coastal Commission can evaluate the LCP habitat impacts and issues in this case despite the FTA preemption that typically applies to the Commission and its local government counterparts in this respect.

Staff has reviewed the relevant sections of the FTA related to regulating wireless service facilities and it appears that the County approved project complies with FTA regulations. Therefore, pursuant to the FTA, the Commission is barred by federal preemption from regulating this wireless service facility on the basis of the environmental effects of radio frequency emissions, as was San Luis Obispo County in making their decision. As a result, the appeal contentions are immaterial in a certain respect. Because the Commission cannot regulate in this area, the appeal contentions do not rise to the level of a substantial LCP conformance issue. Moreover, even if the County and Commission were not preempted in this way from regulating this project, there is insufficient scientific evidence at this time to conclusively show that there is an ESHA impact in this case. Although there have been some studies designed to evaluate such potential effects, the evidence is not definitive, and the degree to which radio frequency emissions from wireless facilities adversely impact sensitive wildlife and habitats is not completely established at the current time—including in relation to this case.

Staff recommends that the Commission find that the appeal does not raise a substantial LCP conformance issue, and thus decline to take jurisdiction over the CDP application for this project. The motion and resolution to effect this recommendation are found immediately below.

2. Staff Recommendation on Substantial Issue

Staff recommends that the Commission determine that **no substantial issue** exists with respect to the grounds on which the appeal was filed.

Motion. I move that the Commission determine that Appeal Number A-3-SLO-08-022 raises no substantial issue with respect to the grounds on which the appeal has been filed under Section 30603 of the Coastal Act.

Staff Recommendation of No Substantial Issue. Staff recommends a **YES** vote. Passage of this motion will result in a finding of No Substantial Issue and adoption of the following resolution and findings. If the Commission finds No Substantial Issue, the Commission will not hear the application de novo and the local action will become final and effective. The motion passes only by an affirmative vote by a majority of the Commissioners present..

Resolution to Find No Substantial Issue. The Commission hereby finds that Appeal Number A-3-SLO-08-022 does not present a substantial issue with respect to the grounds on which the appeal has been filed under § 30603 of the Coastal Act regarding consistency with the Certified Local Coastal Plan and/or the public access policies of the Coastal Act.

Report Contents

B.Findings and Declarations

The Commission finds and declares as follows:

1. Project Location

The project is located on a 1.7 acre parcel within the Office and Professional (O/P) land use category, at 1337 Los Osos Valley Road at the intersection of Los Osos Valley Road and South Bay Boulevard in the community of Los Osos, San Luis Obispo County (APN 074-314-019). The project would be located on the exterior walls (for the panels) and inside of (for the supporting equipment in the basement) an existing commercial office building. The building is located at a busy intersection corner, and is in an existing fairly developed area generally, with other similar development extending in both directions along both Los Osos Valley Road and South Bay Boulevard. In other words, the site is in the middle of a developed urban area and not an undeveloped rural area. The project site is in the Estero Planning Area and is located within the Los Osos Central Business District. See Exhibit A for a location map of the project area.

2. Project Description

The County approved project allows construction of three 2'-6" tall panel antennas located behind radio

frequency screening material in the southeast facing walls of an existing office building, and associated ground-mounted equipment located within the building basement. Two of the antennas would be located inside the 15" thick parapet wall of the building at a height of about 28.9 feet above ground and 5.5 feet above the roofline, and the third would be mounted above the second floor at about 28.7 feet above ground. Since panel antennas cannot transmit signals through typical building materials, the building siding around the antennas would be replaced with fiberglass reinforced plastic (FRP) screening, a material through which radio frequency can pass. The FRP screening would be painted to match the exterior color of the building.

The equipment associated with the panels would be located inside the building's basement in an area of approximately 250 square feet. Power and telephone cables would run from an existing point of connection in the building to the equipment in the basement. Coaxial cables would run from the equipment to the antennas through an existing conduit on the interior of the building. All antennas, cables, and equipment cabinets would be entirely screened from public view, as they are located within the building's walls and inside the building's basement. As a result, the finished project would not alter the appearance of the existing building, and would thus not be discernable from any public viewing area. See project information in the County's CDP action notice attached as Exhibit B.

3. San Luis Obispo County CDP Approval

On April 1, 2008, the San Luis Obispo County Board of Supervisors approved Coastal Development Permit (CDP) Number DRC 2006-00204. This final action was preceded by a series of County hearings over several years involving other types of wireless facilities as well as the current project (see discussion in County staff report in Exhibit B). Notice of the Board of Supervisor's action on the CDP was received in the Coastal Commission's Central Coast District Office on April 28, 2008. The Coastal Commission's ten-working day appeal period for this action began on April 29, 2008 and concluded at 5 p.m. on May 12, 2008. One valid appeal (see below) was received during the appeal period.

4. Appeal Procedures

Coastal Act Section 30603 provides for the appeal to the Coastal Commission of certain CDP decisions in jurisdictions with certified LCPs. The following categories of local CDP decisions are appealable: (a) approval of CDPs for development that is located (1) between the sea and the first public road paralleling the sea or within 300 feet of the inland extent of any beach or of the mean high tide line of the sea where there is no beach, whichever is the greater distance, (2) on tidelands, submerged lands, public trust lands, within 100 feet of any wetland, estuary, or stream, or within 300 feet of the top of the seaward face of any coastal bluff, and (3) in a sensitive coastal resource area; or (b) for counties, approval of CDPs for development that is not designated as the principal permitted use under the LCP. In addition, any local action (approval or denial) on a CDP for a major public works project (including a publicly financed recreational facility and/or a special district development) or an energy facility is appealable to the Commission. This project is appealable because it involves development that is not designated as the principal permitted use under the LCP.

The grounds for appeal under Section 30603 are limited to allegations that the development does not conform to the certified LCP or to the public access policies of the Coastal Act. Section 30625(b) of the Coastal Act requires the Commission to conduct a de novo CDP hearing on an appealed project unless a majority of the Commission finds that "no substantial issue" is raised by such allegations. Under Section 30604(b), if the Commission conducts a de novo hearing and ultimately approves a CDP for a project, the Commission must find that the proposed development is in conformity with the certified LCP. If a CDP is approved for a project that is located between the nearest public road and the sea or the shoreline of any body of water located within the coastal zone, Section 30604(c) also requires an additional specific finding that the development is in conformity with the public access and recreation policies of Chapter 3 of the Coastal Act. This project is not located between the nearest public road and the sea, and thus this additional finding does not need to be made if the Commission approves the project following a de novo hearing.

The only persons qualified to testify before the Commission on the substantial issue question are the Applicant, persons who made their views known before the local government (or their representatives), and the local government. Testimony from other persons regarding substantial issue must be submitted in writing. Any person may testify during the de novo CDP determination stage of an appeal.

5. Summary of Appeal Contentions

The Appellant contends that the County's CDP decision is inconsistent with certified LCP policies requiring development within or adjacent to ESHA to not significantly disrupt the resource. In addition, the Appellant contends that the County failed to demonstrate that there will be no significant impact on wildlife and that the proposed development will be consistent with the biological continuance of the habitat. The Appellant does not assert that the physical project elements (antenna, cables, equipment, etc.) will have adverse ESHA impacts at the site itself, but rather that the radio frequency emissions from the project will harm habitat and a variety of wildlife species in the region. The Appellant concludes that the project does not comply with federal regulations (FTA Section 704) and therefore the Coastal Commission is not barred by federal preemption from regulating the project on the basis of the environmental effects of radio frequency emissions. See Exhibit C for the complete appeal.

6. Substantial Issue Determination

A. Applicable LCP Policies

The appeal is based on the effects of radio frequency emissions from wireless communications facilities on environmentally sensitive habitat areas (ESHAs). The Appellant cites project inconsistencies with the following LCP Land Use Plan (LUP) policies:

> ***LUP ESHA Policy 1 (Land Uses Within or Adjacent to Environmentally Sensitive Habitats).*** *New development within or adjacent to locations of environmentally sensitive habitats (within 100 feet unless sites further removed would significantly disrupt the habitat) shall not significantly disrupt the resource. Within an existing resource, only those uses dependent on*

such resources shall be allowed within the area.

LUP ESHA Policy 2 (Permit Requirement). *As a condition of permit approval, the applicant is required to demonstrate that there will be no significant impact on sensitive habitats and that proposed development or activities will be consistent with the biological continuance of the habitat. This shall include an evaluation of the site prepared by a qualified professional which provides: a) the maximum feasible mitigation measures (where appropriate), and b) a program for monitoring and evaluating the effectiveness of mitigation measures where appropriate.*

B. Analysis

By virtue of the Federal Telecommunications Act of 1996 (FTA), the Coastal Commission and its local government counterparts are prohibited from regulating telecommunications facilities on the basis of the environmental effects of radio frequency emissions. Although the Commission has been active in this issue area with respect to certifying LCP amendments and reviewing CDPs in an effort to address other effects of such facilities (e.g., siting and design to avoid visual impacts, particularly such impacts as they relate to more rural and undeveloped areas), and has helped to develop model LCP provisions in this regard (including with respect to the Monterey and Santa Cruz County LCPs), the Commission has not inserted itself into the radio frequency emissions debate due to the FTA preemption. Section 704 of the FTA states in applicable part:

"No State or local government or instrumentally thereof may regulate the placement, construction, and modification of personal wireless service facilities on the basis of the environmental effects of radio frequency emissions to the extent that such facilities comply with the [Federal Communication] Commission's [FCC's] regulations concerning such emissions."

Thus, if a telecommunications project such as this complies with the FCC's regulations for radio frequency emissions, then the County on the original CDP decision and the Coastal Commission on appeal are barred from regulating such facilities on the basis of the environmental effects of such emissions. The Appeal is based on the environmental effects of such emissions.

In this respect, the Appellant asserts that the project exceeds federal standards for limiting exposure to radio frequency emissions, and that, as a result, the Coastal Commission is not preempted from regulating the project on the basis of the environmental effects of its radio frequency emissions. According to the County's action notice materials, the Applicant verified compliance with FCC regulations by submitting a radio frequency (RF) report prepared by the project's consulting engineer (see RF report in Exhibit D). As described in the RF report, the FCC has established both occupational and public limits for exposure to radio frequency emissions (or electromagnetic fields). The RF report calculated the project's maximum RF exposure level for a person anywhere at ground level at or near the site to be 1.3% of the FCC's maximum allowed public exposure limit. In addition, the maximum calculated RF exposure level at the second-floor elevation of the nearest building (at least 90 feet away) was estimated to be 3.6% of the public limit. The maximum calculated RF exposure level at the second floor level inside the building was estimated at 1.7% of the public limit. The maximum level of RF exposure at the second-floor elevation of the nearest residence (at least 260 feet away) was 0.65% of the

public limit. Thus, in terms of the FCC's public limits, the evidence in the County's record indicates that the project complies with FCC regulations with respect to the locations evaluated.

However, the Appellant questions whether the project complies with occupational and public exposure limits on the roof of the building itself. In this respect, and as cited by the Appellant, the RF report states that "power density levels may exceed the public limit on the roof of the subject building near the antennas." To address this issue, the RF report recommends (and the County approval includes) specific measures to prevent exposures in excess of FCC regulations. Specifically, to prevent occupational and public exposures in excess of the FCC limits, access within six feet of the antennas themselves (such as might occur during building maintenance activities) is prohibited while the site is in operation, unless other measures can be demonstrated to ensure that FCC occupational limits are not exceeded. In addition, access in front of the antennas is strictly limited, and explanatory warning signs must be posted at roof access locations and in front of each antenna (see Exhibit B, County Condition of Approval #14). These measures avoid potential exposure above FCC limits. More importantly in a regulatory sense, these types of mitigating measures are specifically allowed under the FTA as a means to comply with the FCC limits for exposure to radio frequency emissions (see Exhibit E, in particular document pages 1-11 and 52-59). In other words, with such measures in place, the County approved project appears to comply with FCC regulations under the FTA and, as a result, the Coastal Commission is barred from regulating this facility on the basis of the environmental effects of radio frequency, as is the basis of the appeal before the Commission.

Therefore, and based on the information provided in the County's record in this case, the Commission finds that the County approved project complies with the FCC's regulations concerning radio frequency emissions and thus the Commission is preempted from regulating the placement, construction, and modification of the wireless service facility on the basis of the environmental effects of radio frequency emissions. For this reason, the appeal contentions are immaterial because the Commission is explicitly prohibited from regulating the alleged environmental effects that form the basis of the appeal. Because the Commission cannot regulate in this area, the appeal contentions do not rise to the level of a substantial LCP conformance issue.

In addition, and even if the Commission were not preempted by the FTA from regulating this project, there is insufficient scientific evidence at this time to conclusively show that there is a habitat impact in this case. First, the Appellant has not identified a specific ESHA against which to evaluate the RF impact contention. Rather, the Appellant's contention is more broadly cast in terms of the potential for impact in general. As indicated before, the site itself is in a relatively developed area, and the Commission is not aware of any ESHAs and/or sensitive species in the immediate area. Second, the Commission's ecologist, Dr. John Dixon, has preliminarily investigated this issue, as well as the literature cited in the appeal, and the evidence regarding the effect of radio frequency emissions on wildlife and their habitat is not definitive. At least some studies to date appear to indicate a correlation between the degree of RF energy and habitat decline (see, for example, Balmori 2005, Balmori 2006, and Balmori 2007 submitted by Appellant in Exhibit C). However, such studies also identify the difficulty of controlling the multitude of variables affecting such habitat vitality in a manner capable of isolating the effect of RF emissions in that regard, and suggest that additional more rigorous analysis

would be necessary to conclude in a statistically relevant way on this point (see, for example, Balmori 2006 and Balmori 2007 that suggest additional controlled studies to develop more conclusive information in this regard).

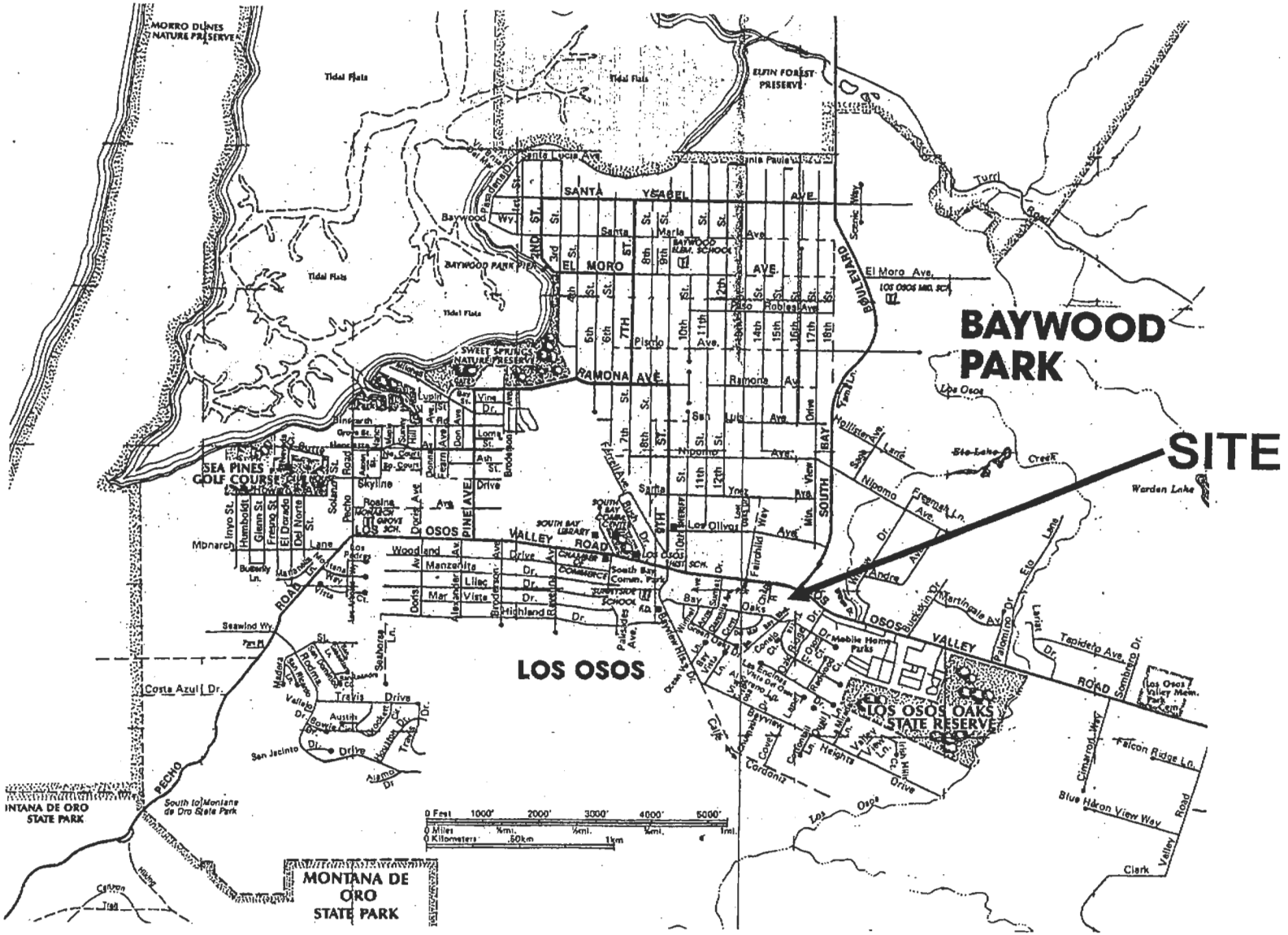
There is clearly some evidence that indicates that there may well be significant wildlife impacts from RF emissions, including at least some studies suggesting a relevant correlation and recommending additional research on this issue. That said, the degree to which radio frequency emissions from wireless facilities adversely impacts sensitive wildlife and habitats is not completely established—including in relation to this case. The questions being raised by the appeal are valid societal questions, both in terms of impacts on wildlife and on humans, but the science is still evolving in relation to such questions and there is not, to date, wide scientific consensus and conclusion on the issue. Thus, even if the federal preemption were not in effect, significant additional evaluation of the issue of emissions impacts would be necessary were the Commission and its local government partners to begin regulating telecommunications facilities based on these effects. Although the Commission is supportive of further investigation in that respect, including to the degree further information may lead to appropriate FTA regulatory standards, the Commission is not in a position to spearhead such a complex research and analysis effort, particularly in light of the federal preemption.

C. Substantial Issue Determination Conclusion

The County approved project appears to comply with prevailing FCC regulations for radio frequency emissions. Thus, the Commission is preempted from regulating the placement, construction, and modification of the wireless service facility on the basis of the environmental effects of such emissions. Even if the Coastal Commission weren't preempted by the FTA, there is insufficient scientific evidence at this time to conclusively show that there is an ESHA impact in this case. Although there have been some studies designed to evaluate such potential effects, the evidence is not definitive, and the degree to which radio frequency emissions from wireless facilities adversely impact sensitive wildlife and habitats is not completely established at the current time—including in relation to this case.

Thus, the Commission finds that no substantial issue is raised with respect to the grounds on which the appeal has been filed and declines to take jurisdiction over the CDP application for the proposed project.

SAN LUIS OBISPO COUNTY DEPARTMENT OF BUILDING AND PLANNING



CCC Exhibit A (page 1 of 4 pages)

4/1/2008

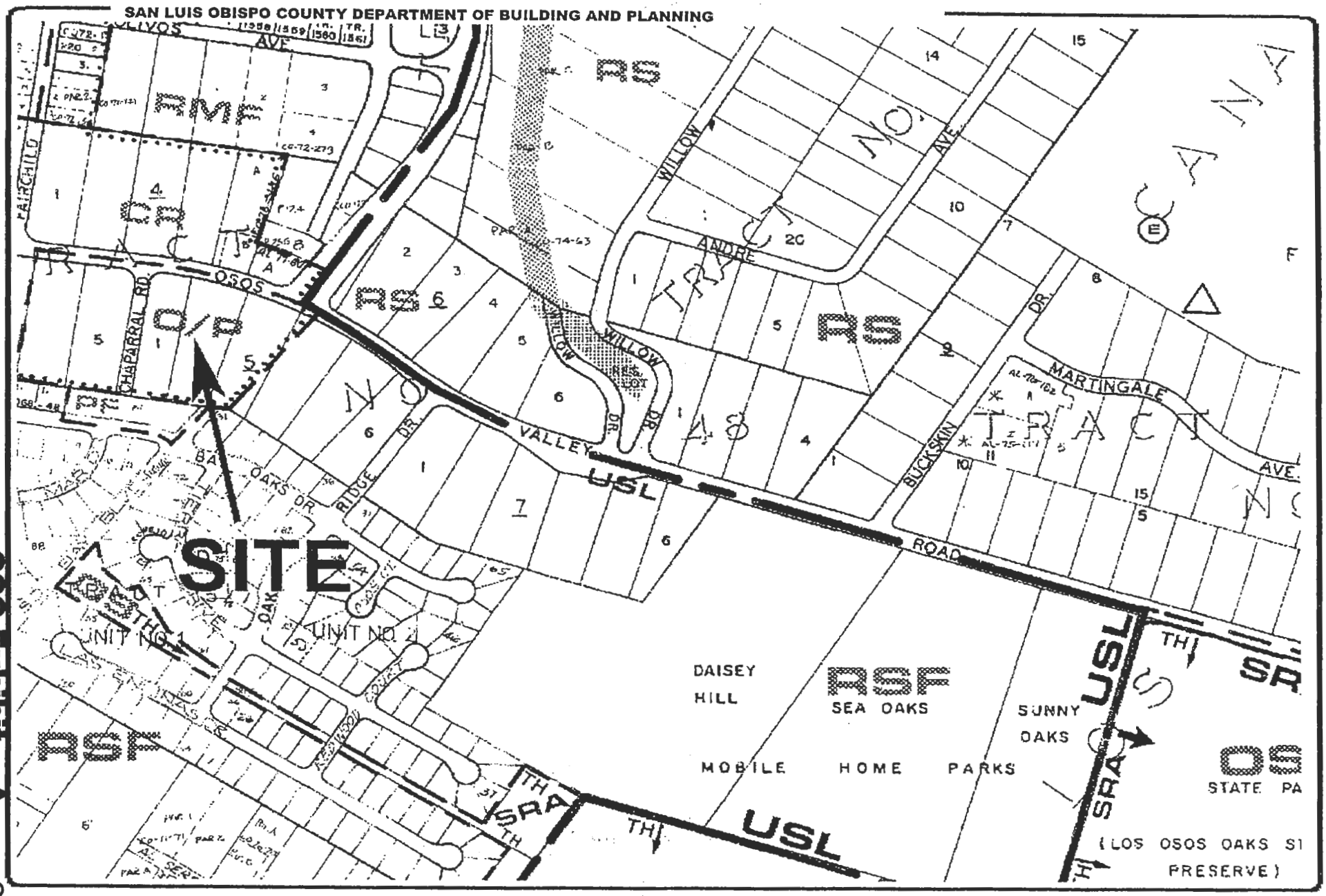
C1-50

PROJECT

Minor Use Permit/ Coastal Development Permit
Bonaire Inv./ Sprint-Nextel – DRC2006-00204

EXHIBIT

Vicinity Map



CCC Exhibit A (page 2 of 4 pages) 4/1/2008 C1-51

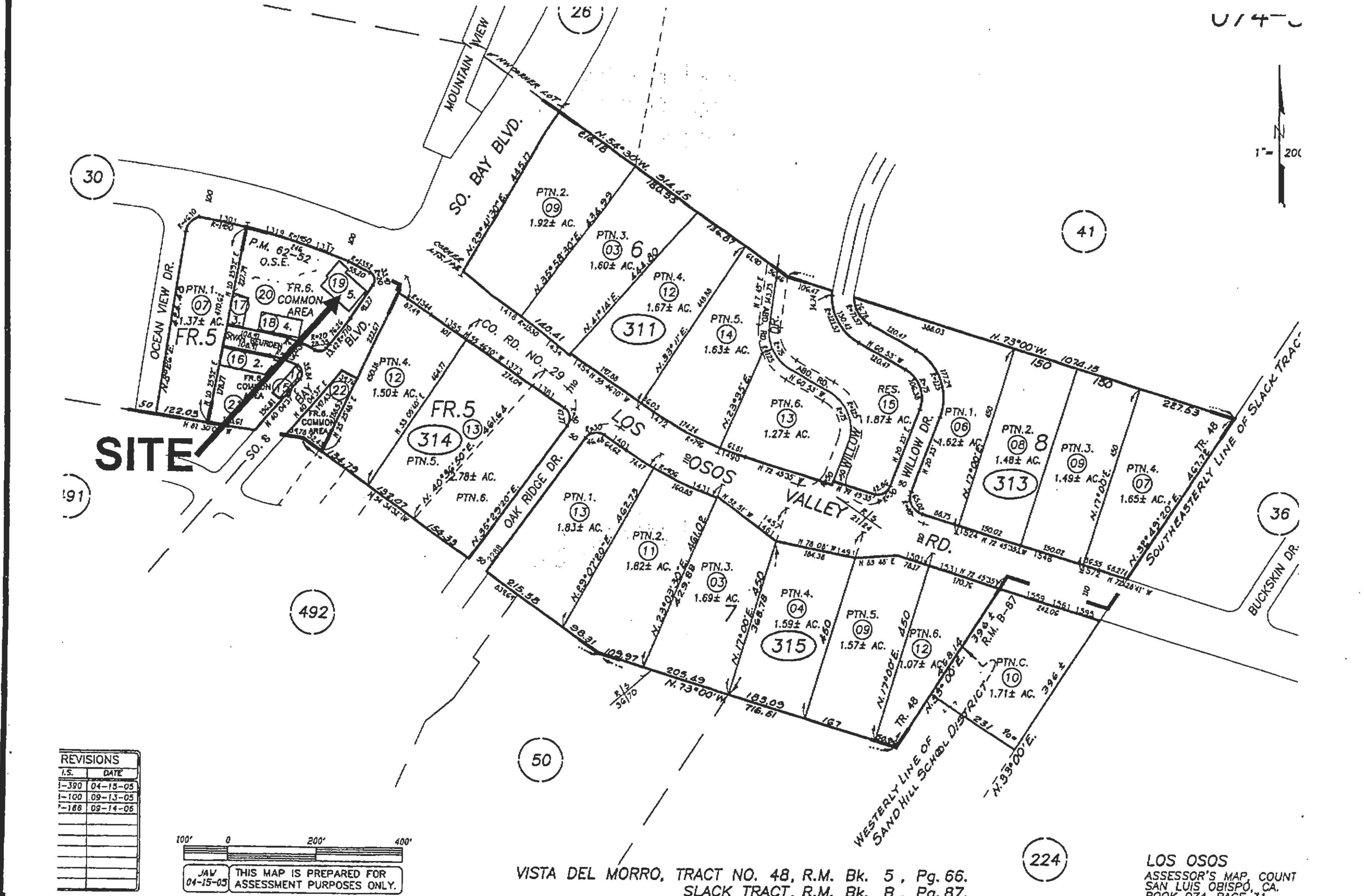
PROJECT

Minor Use Permit/ Coastal Development Permit
Bonaire Inv./ Sprint-Nextel – DRC2006-00204

EXHIBIT

Land Use Category Map

SAN LUIS OBISPO COUNTY DEPARTMENT OF BUILDING AND PLANNING



PROJECT

Minor Use Permit/ Coastal Development Permit
Bonaire Inv./ Sprint-Nextel – DRC2006-00204

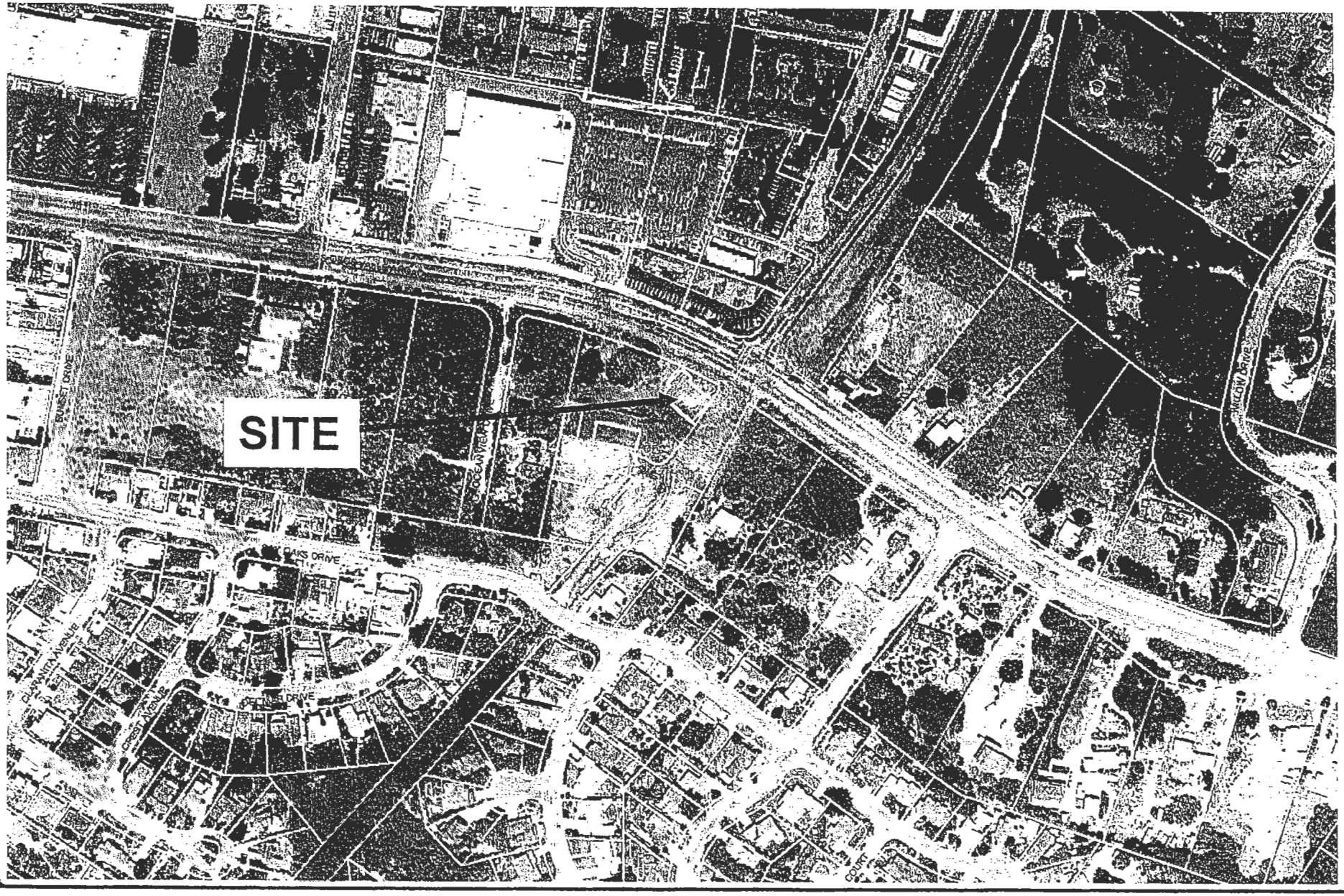
EXHIBIT

APN Map

CCC Exhibit A
(page 3 of 4 pages)

C1-52
4/1/2008

SAN LUIS OBISPO COUNTY DEPARTMENT OF BUILDING AND PLANNING



PROJECT

Minor Use Permit/ Coastal Development Permit
Bonaire Inv./ Sprint-Nextel – DRC2006-00204

EXHIBIT

Aerial Photograph

CCC Exhibit A (page 4 of 4 pages)

C1-53

4/1/2008

SAN LUIS OBISPO COUNTY
DEPARTMENT OF PLANNING AND BUILDING

VICTOR HOLANDA, AICP
DIRECTOR

April 24, 2008

FINAL LOCAL ACTION NOTICE
REFERENCE # 3-SLO-08-125
APPEAL PERIOD 4/29 - 5/12/2008

RECEIVED
APR 28 2008
CALIFORNIA COASTAL COMMISSION
CENTRAL COAST AREA

Tricia Knight for Sprint/Nextel
123 Seacliff Drive
Pismo Beach, California 93449

Bonaire Investments
P.O. Box 6451
Los Osos, CA 93402

NOTICE OF FINAL COUNTY ACTION

HEARING DATE: April 1,2008

SUBJECT: County File No. – DRC 2006-00204
Minor Use Permit/Coastal Development Permit

LOCATED WITHIN COASTAL ZONE: YES

The above-referenced application was approved by the Board of Supervisors, based on the approved Findings and Conditions, which are attached for your records. This Notice of Final Action is being mailed to you pursuant to Section 23.02.033(d) of the Land Use Ordinance.

This action is appealable to the California Coastal Commission pursuant to regulations contained in Coastal Act Section 30603 and the County Coastal Zone Land Use Ordinance 23.01.043. These regulations contain specific time limits to appeal, criteria, and procedures that must be followed to appeal this action. The regulations provide the California Coastal Commission ten (10) working days following the expiration of the County appeal period to appeal the decision. This means that no construction permits can be issued until both the County appeal period and the additional Coastal Commission appeal period have expired without an appeal being filed.

Exhaustion of appeals at the county level is required prior to appealing the matter to the California Coastal Commission. This second appeal must be made directly to the California Coastal Commission Office. Contact the Commission's Santa Cruz Office at (831) 427-4863 for further information on their appeal procedures.

If the use authorized by this Permit approval has not been established, or if substantial work on the property towards the establishment of the use is not in progress after a period of twenty-four (24) months from the date of this approval or such other time period as may be designated through conditions of approval of this Permit, this approval

CCC Exhibit B
(page 1 of 17 pages)

shall expire and become void unless an extension of time has been granted pursuant to the provisions of Section 23.02.050 of the Land Use Ordinance.

If the use authorized by this Permit approval, once established, is or has been unused, abandoned, discontinued, or has ceased for a period of six (6) months, or conditions have not been complied with, such Permit approval shall become void.

If you have questions regarding your project, please contact me at (805) 781-5198.

Sincerely,

AIRLIN SINGEWALD
Coastal Planning and Permitting

cc: California Coastal Commission,
725 Front Street, Suite 300, Santa Cruz, California 95060
Lee Andrea Caulfield, 748 Lilac Drive, Los Osos, CA 93402
Judy Vick, 1238 Third Street, Los Osos, CA 93402

(Planning Department Use Only – for California Coastal Commission)

Date NOFA copy mailed to Coastal Commission: April 25, 2008

Enclosed:
X Staff Report
X Resolution with Findings and Conditions

IN THE BOARD OF SUPERVISORS
COUNTY OF SAN LUIS OBISPO, STATE OF CALIFORNIA

Tues day April 1 ,2008

PRESENT: Supervisors Harry L. Ovitt, Jerry Lenthall, K.H. Katcho Achadjian, Chairperson James R. Patterson

ABSENT: Supervisor Bruce S. Gibson

RESOLUTION NO. 2008-107

RESOLUTION AFFIRMING THE DECISION OF THE HEARING OFFICER AND CONDITIONALLY APPROVING THE APPLICATION OF BONAIRE INVESTMENTS/SPRINT-NEXTEL FOR MINOR USE PERMIT DRC2006-00204

The following resolution is now offered and read:

WHEREAS, on January 18, 2008, the Zoning Administrator of the County of San Luis Obispo (hereinafter referred to as the "Hearing Officer") duly considered and conditionally approved the application of Bonaire Investments/Sprint-Nextel for Minor Use Permit DRC2006-00204; and

WHEREAS, Lee Andrea Caulfield and Judy Vick have appealed the Hearing Officer's decision to the Board of Supervisors of the County of San Luis Obispo (hereinafter referred to as the "Board of Supervisors") pursuant to the applicable provisions of Title 23 of the San Luis Obispo County Code; and

WHEREAS, a public hearing was duly noticed and conducted by the Board of Supervisors on April 1, 2008, and a determination and decision was made on April 1, 2008; and

WHEREAS, at said hearing, the Board of Supervisors heard and received all oral and written protests, objections, and evidence, which were made, presented, or filed, and all persons present were given the opportunity to hear and be heard in respect to any matter relating to said appeal; and

WHEREAS, the Board of Supervisors has duly considered the appeal and finds that the appeal should be denied and the decision of the Hearing Officer should be affirmed subject to the findings and conditions set forth below.

NOW, THEREFORE, BE IT RESOLVED AND ORDERED by the Board of Supervisors of the County of San Luis Obispo, State of California, as follows:

1. That the recitals set forth hereinabove are true, correct and valid.
2. That the Board of Supervisors makes all of the findings of fact and determinations set forth in Exhibit A attached hereto and incorporated by reference herein as though set forth in full.

3. That this project is found to be categorically exempt from the provisions of the California Code of Regulations, title 14, section 15303 (class 3).

4. That the appeal filed by Lee Andrea Caulfield and Judy Vick is hereby denied and the decision of the Hearing Officer is affirmed that the application of Bonaire Investments/Sprint-Nextel for Minor Use Permit DRC2006-00204 is hereby approved subject to the conditions of approval set forth in Exhibit B attached hereto and incorporated by reference herein as though set forth in full.

Upon motion of Supervisor Lenthall, seconded by Supervisor Ovitt, and on the following roll call vote, to wit:

AYES: Supervisors Lenthall, Ovitt, Achadjian

NOES: Supervisor Chairperson Patterson

ABSENT: Supervisor Gibson

ABSTAINING: None

the foregoing resolution is hereby adopted.

JAMES R. PATTERSON

Chairperson of the Board of Supervisors

ATTEST:

JULIE L. RODEWALD
Clerk of the Board of Supervisors

By: VICKI M. SHELBY Deputy Clerk

[SEAL]

APPROVED AS TO FORM AND LEGAL EFFECT:

R. WYATT CASH
County Counsel

By: _____
Deputy County Counsel

Dated: March 19, 2008

STATE OF CALIFORNIA)
COUNTY OF SAN LUIS OBISPO) ss

I, JULIE L. RODEWALD, County Clerk of the above entitled County, and Ex-Officio Clerk of the Board of Supervisors thereof, do hereby certify the foregoing to be a full, true and correct copy of an order entered in the minutes of said Board of Supervisors, and now remaining of record in my office.

Witness, my hand and seal of said Board of Supervisors this 4/18/08

JULIE L. RODEWALD
County Clerk and Ex-Officio Clerk of the Board of Supervisors

By _____ Deputy Clerk

CCC Exhibit B
(page 4 of 17 pages)

EXHIBIT A - FINDINGS

Environmental Determination

A. The project qualifies for a Categorical Exemption (Class 3) pursuant to CEQA Guidelines Section 15303 because the project is minor in nature, involves minimal site disturbance, and will not require the removal of any native vegetation.

Minor Use Permit

B. The proposed project or use is consistent with the San Luis Obispo County General Plan because the use is an allowed use and as conditioned is consistent with all of the General Plan policies.

C. As conditioned, the proposed project or use satisfies all applicable provisions of Title 23 of the County Code.

D. The establishment and subsequent operation or conduct of the use will not, because of the circumstances and conditions applied in the particular case, be detrimental to the health, safety or welfare of the general public or persons residing or working in the neighborhood of the use, or be detrimental or injurious to property or improvements in the vicinity of the use because the unmanned wireless communication facility does not generate activity that presents a potential threat to the surrounding property and buildings. The Radio Frequency report prepared for this site concluded the maximum RF level will be 3.6% of the applicable public exposure limit and this project is subject to Ordinance and Building Code requirements designed to address health, safety and welfare concerns.

E. The proposed project or use will not be inconsistent with the character of the immediate neighborhood or contrary to its orderly development because the cellular telecommunications facility will not conflict with the surrounding lands and uses.

F. The proposed project or use will not generate a volume of traffic beyond the safe capacity of all existing roads providing access to the project, either existing or to be improved with the project because no additional traffic beyond maintenance traffic (approximately one vehicle per provider per month) will be generated by the proposed use.

Coastal Access

G. The proposed use is in conformity with the public access and recreation policies of Chapter 3 of the California Coastal Act, because the project will not inhibit access to the coastal waters and recreation areas.

Archaeology

H. The proposed project design and development incorporates adequate measures to ensure protection of significant archaeological resources because no ground disturbance is proposed.

EXHIBIT B - CONDITIONS OF APPROVAL

Approved Development

1. This approval authorizes the installation and operation of one wireless telecommunications facility, including the following improvements:

    a. Three 2'-6" high panel antennas located behind proposed radio frequency (RF) screening material in the southeast-facing wall and parapet wall of an existing office building. RF screening material shall exactly match and seamlessly blend with the existing building siding;
    b. Equipment within the basement of the existing building, encompassing approximately 250 square feet;
    c. Power and teleco cables routed from point of connection in the existing building to equipment. Ground disturbance is not permitted. All cables shall be mounted on the building interior and shall not be visible.
    d. Coaxial cables routed from the equipment to the antennas through an existing chase on the interior of the building;
    e. All antennas, cables, and equipment shall be located on the interior of the existing building and completely screened from public view.

Conditions to be completed prior to issuance of construction permit

Aesthetic/Visual Resources

2. **Prior to issuance of a construction permit,** the applicant shall submit a color board for proposed RF screening material. The color, finish, and design of the RF screening material shall exactly match and seamlessly blend with the existing siding of the office building.

Condition Compliance Coordinator

3. **Prior to issuance of a construction permit,** a "condition compliance" sheet shall be added to construction plans that includes a complete copy of the final conditions of approval for the project.

4. **Prior to issuance of a construction permit**, the applicant shall identify a Condition Compliance Coordinator (CCC) to ensure all conditions of approval and mitigation requirements are met. The CCC shall be the County's contact and shall be responsible to ensure all mitigation requirements are met. A pre-construction meeting shall take place between the CCC and the County to review the application and establish the responsibility and authority of the participants.

Fire Safety

5. **Prior to issuance of construction permit**, all plans submitted to the Department of Planning and Building shall meet the fire and life safety requirements of the California Fire Code.

Hazards/Hazardous Materials

6. **Prior to issuance of a construction permit,** the applicant shall submit for review and approval a Hazardous Materials Business Plan for the proposed cellular facility to the County Environmental Health office for review and approval.

Site Restoration

7. **Prior to issuance of a construction permit,** the applicant shall post a performance agreement and bond with the County in an amount commensurate with the cost of facility removal and site restoration. The performance bond shall be released by the County at the time the facility is removed and the site is restored.

Conditions to be completed during project construction

Cultural Resources

8. In the event archaeological resources are unearthed or discovered during any construction activities, the following standards apply:

   a. Construction activities shall cease and the Environmental Coordinator and Planning Department shall be notified so that the extent and location of discovered materials may be evaluated by a qualified archaeologist, and disposition of artifacts may be accomplished in accordance with state and federal law. The applicant shall implement the mitigations as required by the Environmental Coordinator.

   b. In the event archaeological resources are found to include human remains, or in any other case where human remains are discovered during construction, the County Coroner is to be notified in addition to the Planning Department and Environmental Coordinator so that proper disposition may be accomplished.

Fire Safety

9. **During construction,** activities that pose an ignition source will have to comply with fire safety laws. This includes welding activities and use of heavy equipment. All equipment must be in compliance. Consideration of fuel breaks or other treatment shall occur in construction area. If a fire ignites due to construction activities the responsible party may be liable for suppression costs.

Conditions to be completed prior to occupancy or final building inspection/ establishment of the use

10. **Prior to final inspection,** the applicant shall contact the Department of Planning and Building to have the site inspected for compliance with the conditions of approval.

11. The facility shall not be operated until all conditions of approval have been met and all required building permits have received final inspection.

Aesthetic/Visual Resources

12. **Prior to final inspection**, the applicant shall paint the proposed RF screening material the color, finish, and design approved by the Department of Planning and Building.

13. **Prior to final inspection,** all proposed improvements including, but not limited to antennas, mounting brackets, cable, and equipment cabinets shall be completely screened from public view. The proposed RF screening material shall exactly match and blend with the existing siding of the building.

Explanatory Warning Signs for Occupational Exposures

14. **Prior to final inspection**, explanatory warning signs* to prevent occupational exposures in excess of the FCC guidelines are to be posted at the site entrance gate and on or at the barrier fence and antennas such that they would be readily visible from any angle of approach to persons who might need to work near the antennas. (*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).

Hazardous Materials

15. **Prior to final inspection,** the applicant shall provide verification from Environmental Health that the Hazardous Materials Business Plan has been implemented.

Mitigation Monitoring/Condition Compliance

16. **Prior to final inspection,** the CCC will incorporate the findings of the monitoring effort into a final comprehensive construction monitoring report to be submitted to the County of San Luis Obispo.

On-going conditions of approval (valid for the life of the project)

17. This land use permit is valid for a period of 24 months from its effective date unless time extensions are granted pursuant to Land Use Ordinance Section 23.02.050 or the land use permit is considered vested. This land use permit is considered to be vested once a construction permit has been issued and substantial site work has been completed. Substantial site work is defined by Land Use Ordinance Section 23.02.042 as site work progressed beyond grading and completion of structural foundations; and construction is occurring above grade.

18. All conditions of this approval shall be strictly adhered to, within the time frames specified, and in an on-going manner for the life of the project. Failure to comply with these conditions of approval may result in an immediate enforcement action by the Department of Planning and Building. If it is determined that violation(s) of these conditions of approval have occurred, or are occurring, this approval may be revoked pursuant to Section 23.10.160 of the Land Use Ordinance.

19. All obsolete or used facilities shall be removed within twelve months of cessation of the applicant's wireless communication operations on the site. The applicant shall be responsible for the removal of such facility and all associated structures and restoration of the site to pre-project condition. Restoration does not include removal of vegetation planted to provide visual screening. At the time the use of the facility is discontinued the owner of the facility must notify the Department of Planning and Building.

Access

20. Site access for construction and maintenance shall be from existing roads only. No road improvements shall occur.

Visual/Aesthetic Resources

21. The approved colors shall be maintained for the life of the project. Repainting and maintenance shall occur as necessary.

22. If new technology is developed that reduces the impacts of the proposed project, the applicant agrees to install such improvements within 6 months of notification by the county.

Co-location

23. The applicant agrees to allow other carriers to co-locate at this site, if technically feasible, subject to land use permit approval.

Electric and Magnetic Fields

24. The facility shall be designed and operated to ensure that power densities received from transmissions, with all transmitters at the site transmitting at full power, will comply with federal law and regulation.

Lighting

25. No exterior lighting is approved for the project.

Noise

26. HVAC units shall be sound attenuated to meet applicable County and State exterior noise standards, if applicable. The project shall be maintained in compliance with the county Noise Element (including emergency generators). Any back-up or emergency generators shall have a noise baffle cover and shall not exceed a maximum noise level of 65 dbl. at a distance of 50 feet from the generator.

Indemnification

27. The applicant shall as a condition of approval of this minor use permit defend, at his sole expense, any action brought against the County of San Luis Obispo, its present or former officers, agents, or employees, by a third party challenging either its decision to approve this minor use permit or the manner in which the County is interpreting or enforcing the conditions of this minor use permit, or any other action by a third party relating to approval or implementation of this minor use permit. The applicant shall reimburse the County for any court costs and attorney's fees which the County may be required by a court to pay as a result of such action, but such participation shall not relieve the applicant of his obligation under this condition.

COUNTY OF SAN LUIS OBISPO BOARD OF SUPERVISORS
AGENDA ITEM TRANSMITTAL

(1) DEPARTMENT	(2) MEETING DATE	(3) CONTACT/PHONE
Planning and Building	April 1, 2008	Airlin M. Singewald, Current Planning (805) 781-5198

(4) SUBJECT

Hearing to consider an appeal by Lee Andrea Caulfield and Judy Vick of the County Hearing Officer's approval of a request by Bonaire Investments/Sprint-Nextel for a Minor Use Permit/Coastal Development Permit to allow the construction and operation of an unmanned wireless communications facility consisting of three 2'-6" panel antennas located behind proposed radio frequency screening material in the southeast-facing wall and parapet wall of an existing office building, and associated ground-mounted equipment located within the existing building basement. The project is located on a 1.7 acre parcel within the Office & Professional land use category, located at 1337 Los Osos Valley Road at the intersection of South Bay Boulevard, in the community of Los Osos. The site is in the Estero Planning Area. Supervisorial District: 2.

(5) SUMMARY OF REQUEST

On January 18, 2008, the County Hearing Officer approved Minor Use Permit/Coastal Development Permit DRC2006-00204 to allow for construction and operation of an unmanned wireless communications facility. On January 25, 2008, an appeal was received from Lee Andrea Caulfield and Judy Vick, contending the proposed project did not include an adequate alternatives analysis, is inconsistent with the County's Local Coastal Program and the character of the surrounding neighborhood, and should not be exempted from the California Environmental Quality Act (CEQA).

(6) RECOMMENDED ACTION

Adopt and instruct the chairman to sign the resolution denying the appeal and affirming the decision of the Hearing Officer of County of San Luis Obispo and approve the application of Bonaire Investments/Sprint-Nextel for Minor Use Permit/Coastal Development Permit DRC2006-00204.

(7) FUNDING SOURCE(S)	(8) CURRENT YEAR COST	(9) ANNUAL COST	(10) BUDGETED?
Department budget	N/A	N/A	☐ No ☐ Yes ☒ N/A

(11) OTHER AGENCY/ADVISORY GROUP INVOLVEMENT (LIST):
California Coastal Commission, Los Osos Community Advisory Council

(12) WILL REQUEST REQUIRE ADDITIONAL STAFF? ☒ No ☐ Yes, How Many? _____
☐ Permanent ____ ☐ Limited Term ____ ☐ Contract ____ ☐ Temporary Help ____

(13) SUPERVISOR DISTRICT(S)	(14) LOCATION MAP	(15) Maddy Act Appointments Signed-off by Clerk of the Board
☐ 1st, ☒ 2nd, ☐ 3rd, ☐ 4th, ☐ 5th, ☐ All	☒ Attached ☐ N/A	N/A

(16) AGENDA PLACEMENT	(17) EXECUTED DOCUMENTS
☐ Consent ☒ Hearing (Time Est. 60 minutes) ☐ Presentation ☐ Board Business (Time Est._____)	☒ Resolutions (Orig + 4 copies) ☐ Contracts (Orig + 4 copies) ☐ Ordinances (Orig + 4 copies) ☐ N/A

(18) NEED EXTRA EXECUTED COPIES?	(19) APPROPRIATION TRANSFER REQUIRED?
☐ Number: _____ ☐ Attached ☒ N/A	☐ Submitted ☐ 4/5th's Vote Required ☒ N/A

(20) OUTLINE AGREEMENT REQUISITION NUMBER (OAR)	(21) W-9	(22) Agenda Item History
_____	☒ No ☐ Yes	☒ N/A Date_____

(23) ADMINISTRATIVE OFFICE REVIEW Vinf Morse

CCC Exhibit B
(page 10 of 17 pages)

C1-1
4/1/2008

SAN LUIS OBISPO COUNTY

DEPARTMENT OF PLANNING AND BUILDING

VICTOR HOLANDA, AICP
DIRECTOR

TO: BOARD OF SUPERVISORS

FROM: AIRLIN M. SINGEWALD, CURRENT PLANNING

VIA: WARREN HOAG, AICP, DIVISION MANAGER, CURRENT PLANNING

DATE: APRIL 1, 2008

SUBJECT: HEARING TO CONSIDER AN APPEAL BY LEE ANDREA CAULFIELD AND JUDY VICK OF THE COUNTY HEARING OFFICER'S APPROVAL OF A REQUEST BY BONAIRE INVESTMENTS/SPRINT-NEXTEL FOR A MINOR USE PERMIT/COASTAL DEVELOPMENT PERMIT TO ALLOW THE CONSTRUCTION AND OPERATION OF AN UNMANNED WIRELESS COMMUNICATIONS FACILITY CONSISTING OF THREE 2'-6" PANEL ANTENNAS LOCATED BEHIND PROPOSED RADIO FREQUENCY SCREENING MATERIAL IN THE SOUTHEAST-FACING WALL AND PARAPET WALL OF AN EXISTING OFFICE BUILDING, AND ASSOCIATED GROUND-MOUNTED EQUIPMENT LOCATED WITHIN THE EXISTING BUILDING BASEMENT. THE PROJECT IS LOCATED ON A 1.7 ACRE PARCEL WITHIN THE OFFICE AND PROFESSIONAL LAND USE CATEGORY, LOCATED AT 1337 LOS OSOS VALLEY ROAD AT THE INTERSECTION OF SOUTH BAY BOULEVARD, IN THE COMMUNITY OF LOS OSOS. THE SITE IS IN THE ESTERO PLANNING AREA. SUPERVISORIAL DISTRICT: 2.

RECOMMENDATION

Adopt and instruct the chairman to sign the resolution denying the appeal and affirming the decision of the Hearing Officer of County of San Luis Obispo and approve the application of Bonaire Investments/Sprint-Nextel for Minor Use Permit/Coastal Development Permit DRC2006-00204.

DISCUSSION

On January 18, 2008, the Planning Department Hearing Officer approved a Minor Use Permit/Coastal Development Permit application by Bonaire Investments/Sprint-Nextel to construct and operate an unmanned wireless communications facility. On January 25, 2008, the Planning Department received an appeal of this decision by Lee Andrea Caulfield and Judy Vick, contending the proposed project did not include an adequate alternatives analysis, is inconsistent with the County's Local Coastal Program (LCP) and the character of the surrounding neighborhood, and should not be exempted from the California Environmental Quality Act (CEQA).

976 OSOS STREET, ROOM 300 • SAN LUIS OBISPO • CALIFORNIA 93408 • (805) 781-5600
EMAIL: planning@co.slo.ca.us • FAX: (805) 781-1242

The proposed wireless communications facility consists of three 2'-6" high panel antennas in three sectors (A, B, and C), with one antenna per sector. Sector "A" and Sector "C" are located inside the 15" thick parapet wall of the existing office building at an elevation of 28'-9" above ground level. Sector "B" is located inside the top portion (immediately below roofline) of the southeast-facing wall of the existing office building at an elevation of 28'-7" above ground level. Since panel antennas cannot transmit signals through typical building materials (e.g. plywood and metal siding), the applicant proposes to replace the existing building siding around the proposed antennas with Fiberglass Reinforced Plastic (FRP) screening, a radio frequency transparent material. The FRP screening would be painted to exactly match the existing building exterior.

The associated equipment would be located inside the basement of the existing office building and would encompass approximately 250 square feet. Power and telephone cables would run from an existing point of connection in the building to the proposed equipment in the basement. Coaxial cables would run from the equipment to the antennas through an existing chase on the interior of the building.

All antennas, cables, and equipment cabinets would be entirely screened from public view, as they are located completely inside the building. The project would not be visible from any public area.

Project History

On September 13, 2005, the Board of Supervisors upheld an appeal and denied an application (Bonaire Investments/Sprint Development Plan/ Coastal Development Permit DRC2006-0008) to construct and operate a wireless communications facility on the proposed project site. This previous facility consisted of three panel antennas mounted inside a 50-foot, 12-inch diameter flag pole, and associated ground-mounted equipment in the existing office building basement. The appeal was upheld and application denied because the facility was found to be visually incompatible with the character of the surrounding area.

Revised Conditions of Approval

The following condition was added since the project was heard by the Hearing Officer:

Indemnification

27. The applicant shall as a condition of approval of this minor use permit defend, at his sole expense, any action brought against the County of San Luis Obispo, its present or former officers, agents, or employees, by a third party challenging either its decision to approve this minor use permit or the manner in which the County is interpreting or enforcing the conditions of this minor use permit, or any other action by a third party relating to approval or implementation of this minor use permit. The applicant shall

reimburse the County for any court costs and attorney's fees which the County may be required by a court to pay as a result of such action, but such participation shall not relieve the applicant of his obligation under this condition.

APPEAL ISSUES

Appeal Issue #1: The proposed wireless facility is considered a "Special" use, which is not an encouraged use by the LCP.

Staff Response: Under Table-O of the Coastal Zone Framework for Planning, a wireless communications facility is considered a "Special" use in the Office and Professional land use category. Special uses are allowable uses, but subject to special standards and processing requirements.

The special standards and processing requirements for wireless communications facilities are described in Coastal Zone Land Use Ordinance (CZLUO) Section 23.08.284 – Communications Facilities. As described in this report and the attached January 18, 2008 Minor Use Permit staff report, the proposed project complies with all applicable development standards. These standards are designed to ensure that the proposed facility is compatible with surrounding land uses.

Appeal Issue #2: The proposed project is inconsistent with Visual and Scenic Resources policies of the LCP because it is out of character with the surrounding "small-scale" single family residential neighborhoods.

Staff Response: Visual and Scenic Resource Policy #6 states that new development within areas defined as small-scale neighborhoods shall be sited and designed to complement and be visually compatible with existing characteristics of the community. Since the proposed project is located in the Los Osos Central Business District, which is not a designated "small-scale neighborhood," Policy #6 does not apply to this project. Visual and Scenic Resources Policy #2, however, does apply to the project. This policy states that new development shall be sited to protect views to and along the ocean and scenic coastal areas. The proposed project is consistent with this policy because it is completely screened from public view and is integrated into the architecture of the existing building.

Appeal Issue #3: The proposed project did not include an adequate alternatives analysis because less intrusive sites were not investigated. The proposed site is the most intrusive alternative because it is too close to surrounding residences and schools.

Staff Response: CZLUO Section 23.08.284b(2)(iv) requires minor use permit applications for wireless communications facilities to include a written report and map indicating all locations in the vicinity of the project where: (a) the location and height meet the minimum coverage requirements for the applicant's network; (b) a lease with

property owner can be obtained; and (c) the property is feasible for the construction of a wireless communications facility.

The proposed project complies with this section of the Ordinance because the application included a map and report describing the following four alternative project sites: (1) existing water tanks at 10th Street and at 16th Street in Los Osos; (2) Ralph's shopping center at the northwest corner of South Bay Boulevard and Los Osos Valley Road; (3) the dirt lot at the northeast corner of South Bay Boulevard and Los Osos Valley Road; and (4) the proposed project site at 1337 Los Osos Valley Road at the intersection of South Bay Boulevard.

The proposed project site was selected because it is the farthest from residences and does not require the construction of a new tower or structure. The selected site is consistent with the Ordinance's preferential order for the placement of wireless facilities, which gives top preference to side-mount antennas on existing structures or buildings, when completely screened from public view. The emphasis of the Communications Facilities Ordinance is to minimize the visibility of wireless facilities. Therefore, given the standards of the County's Ordinance, the proposed project site is the least intrusive alternative.

Appeal Issue #4: The proposed project did not include sufficient evidence showing that it is not feasible to locate the proposed facility where existing facilities currently exist.

Staff Response: According to CZLUO Section 23.08.284b(2)(iii), when co-location is not proposed, applications for communications facilities must provide information pertaining to the feasibility of joint-use antenna facilities, and discuss the reasons why such joint use is not a viable option or alternative to a new site.

Existing wireless facilities in the surrounding area are located on Clark Valley Road, on the hill above Morro Bay, and in the city-limits of Morro Bay. Co-location at these existing facilities does not meet Sprint's coverage objective, which is to provide service to its customers in downtown Los Osos.

The topography of the region combined with Sprint's relatively high (short traveling) frequency makes it technically infeasible for Sprint to fill its coverage gap in downtown Los Osos from existing wireless facility sites. Sprint-Nextel provided propagation maps depicting the current coverage gap and showing that it could not fill the gap from its nearest site at 2983 Clark Valley Road or from its recently approved (not yet constructed) sites at 8000 Los Osos Valley Road and in Morro Bay at 545 Shasta Avenue. These maps and the accompanying narration show compliance with CZLUO Section 23.08.284b(2)(iii).

Appeal Issue #5: The proposed project does not qualify for a Categorical Exemption (Class 3) under CEQA because the project: a) is not minor in nature, b)

conflicts with surrounding land uses, c) involves hazardous materials, and d) has potential impacts that may be individually limited but cumulatively considerable. The appeal issue also notes that the previous wireless facility proposed for this site was not exempted from CEQA.

Staff Response: The proposed project qualifies for a Categorical Exemption (Class 3) because the project is minor in nature and involves no new ground disturbance.

The following is staff's response to each part of this appeal issue:

a) Project is not minor in nature.

The proposed project is considered minor in nature because it involves no new ground disturbance or potential impacts to environmental resources. Typically, wireless facilities have potential impacts to visual and scenic resources, which should be considered under CEQA. The proposed project, however, is designed to be completely screened from public view, and therefore has no potential visual impact.

b) Project conflicts with surrounding land uses.

The proposed wireless facility does not conflict with surrounding land uses because it is a stealth design that would not be visible or discernable to the public, and it is an allowable use in the Office and Professional land use category. Furthermore, the proposed wireless facility cannot be considered incompatible with surrounding land uses on the basis of radio frequency emissions, per Section 704 of the Telecommunications Act of 1996, which states that "No State or local government or instrumentality thereof may regulate the placement, construction, and modification of personal wireless service facilities on the basis of the environmental effects of radio frequency emissions to the extent that such facilities comply with the Federal Communications Commissions' regulations concerning such emissions."

The applicant verified compliance with FCC regulations by submitting a radio frequency (RF) report, dated April 24, 2007, by Hammett & Edison, which calculated the project's maximum RF exposure level for a person anywhere at ground level to be 1.3% of the applicable FCC standard. According to the RF report, the maximum calculated level at the second-floor elevation of the nearest building (at least 90 feet away) is 3.6% of the applicable public limit; and the maximum calculated level at the second-floor elevation inside the subject building is 1.7% of the public limit. The applicant submitted a second RF report, dated September 19, 2007, by Hammett & Edison, which calculated the maximum level of RF exposure at the second-floor elevation of the nearest residence (at least 260 feet away) to be 0.65% of the public limit. To prevent occupational exposures in excess of the FCC guidelines, no access within 6 feet in front of the Sprint-Nextel antennas themselves, such as might occur during building maintenance activities, should be allowed while the site is in operation, unless other measures can be demonstrated to ensure that occupational protection requirements are met. The RF

report concludes that the proposed project would 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 calculated level in publicly accessible areas is much less than the prevailing standards allow for exposures of unlimited duration.

c) Project involves hazardous materials.

In a project referral response dated March 12, 2008, County Environmental Health indicated that the applicant would be required to submit a hazardous materials business plan prior to issuance of a building permit. This is a standard requirement for all wireless facilities. The project is conditioned to comply with all requirements of County Environmental Health. As previously discussed, the environmental effects of RF emissions associated with the project cannot be considered in the County's regulation of the proposed facility.

d) Project has environmental impacts that may be individually limited but cumulatively considerable.

The appeal cites the wireless industry's stated plans to develop at least two additional wireless facilities subsequent to the proposed project, and states that the project's contribution to the cumulative impacts of all future wireless facilities in Los Osos should be considered in the environmental review. Since no wireless facilities currently exist in Los Osos, the proposed project would not contribute to any cumulative environmental impact. Furthermore, individual environmental determinations will be conducted for future wireless facilities in Los Osos, and cumulative impacts will be assessed as appropriate. Any application by a carrier to co-locate a new wireless facility at an existing facility is required to include an RF report which measures and evaluates the cumulative RF emissions of all existing and proposed facilities at the site.

e) Previous wireless facility proposal was not exempted from CEQA.

A Mitigated Negative Declaration was issued for the previous Development Plan/ Coastal Development Permit application for a wireless facility at this site. This previous proposal consisted of panel antennas mounted inside a 50-foot tall, 12-inch diameter flag pole. The environmental review conducted for this proposal concluded that such a facility would have potentially significant visual impacts; therefore, the previous application did not qualify for a Categorical Exemption.

Appeal Issue #6: The County should impose a moratorium on wireless communications facilities, revise its Communications Facilities Ordinance, and develop a master plan for the siting of wireless facilities in the County.

Staff Response: The County must consider the proposed project under current rules and regulations. As discussed, the proposed project is an allowable use on the subject

property, complies with applicable development standards, and is consistent with applicable policies of the County General Plan and Local Coastal Program.

On February 28, 2008 the County Planning Commission held a study session to discuss the County's Communications Facilities Ordinance and land use planning issues related to wireless facilities. Staff is currently evaluating the need for an Ordinance revision, in response to Planning Commission comments during the study session.

OTHER AGENCY INVOLVEMENT

The California Coastal Commission –has authority to appeal the County's final action on the project.

Los Osos Community Advisory Council – In a referral response dated June 28, 2007, LOCAC recommended denial of the project.

FINANCIAL CONSIDERATIONS

The appeal fee is not required for Coastal issues, pursuant to our adopted policy and procedure.

RESULTS/IMPACT

Adopting the resolution denying the appeals and affirming the decision of the Hearing Officer will enable the construction and operation of the proposed wireless communications facility.

ATTACHMENTS

1. Resolution
   Exhibit A - Findings
   Exhibit B - Conditions of Approval
2. Vicinity Map
3. Propagation Maps and Narrative
4. Appeal from Lee Andrea Caulfield and Judy Vick, January 25, 2008
5. Letter from LOCAC opposing project, March 18, 2008
6. Staff Report – Planning Department Hearing, January 18, 2008

CCC Exhibit B
(page 17 of 17 pages)

RECEIVED

MAY 06 2008

CALIFORNIA
COASTAL COMMISSION
CENTRAL COAST AREA

STATE OF CALIFORNIA – THE RESOURCES AGENCY ARNOLD SCHWARZENEGGER, *Governor*

CALIFORNIA COASTAL COMMISSION

CENTRAL COAST DISTRICT OFFICE
725 FRONT STREET, SUITE 300
SANTA CRUZ, CA 95060-4508
VOICE (831) 427-4863 FAX (831) 427-4877

APPEAL FROM COASTAL PERMIT DECISION OF LOCAL GOVERNMENT

Please Review Attached Appeal Information Sheet Prior To Completing This Form.

SECTION I. Appellant(s)

Name: Judy Vick
Mailing Address: 1238 Third Street
City: Los Osos CA Zip Code: 93402 Phone: (805) 528-1688

SECTION II. Decision Being Appealed

1. Name of local/port government:
San Luis Obispo County Board of Supervisors

2. Brief description of development being appealed:
Bonaire Investments / Sprint-Nextel minor use coastal development permit in Los Osos, for an unmanned wireless communications facility,

3. Development's location (street address, assessor's parcel no., cross street, etc.):
1337 Los Osos Valley Road, Los Osos
(corner of Los Osos Valley Road and South Bay Blvd

4. Description of decision being appealed (check one.):

☒ Approval; no special conditions

☐ Approval with special conditions:

☐ Denial

Note: For jurisdictions with a total LCP, denial decisions by a local government cannot be appealed unless the development is a major energy or public works project. Denial decisions by port governments are not appealable.

TO BE COMPLETED BY COMMISSION:

APPEAL NO: _____

DATE FILED: _____

DISTRICT: _____

CCC Exhibit C
(page 1 of 57 pages)

FAXED 5/2/2008 to (831) 427-4877 (8 pages)

APPEAL FROM COASTAL PERMIT DECISION OF LOCAL GOVERNMENT (Page 2)

5. Decision being appealed was made by (check one):

- ☐ Planning Director/Zoning Administrator
- ☒ City Council/Board of Supervisors
- ☐ Planning Commission
- ☐ Other

6. Date of local government's decision: April 1, 2008

7. Local government's file number (if any): DRC 2006-00204

SECTION III. Identification of Other Interested Persons

Give the names and addresses of the following parties. (Use additional paper as necessary.)

a. Name and mailing address of permit applicant:

Tricia Knight for Sprint-Nextel
TEK Consulting
Permit Processing Services
123 Seacliff Dr.
Pismo Beach, CA 93449

/

Bonaire Investments
P.O. Box 6451
Los Osos, CA 93402

b. Names and mailing addresses as available of those who testified (either verbally or in writing) at the city/county/port hearing(s). Include other parties which you know to be interested and should receive notice of this appeal.

(1) The Coalition for the Appropriate Placement of Cell Antennas had numerous speakers from Los Osos at the County Board of Supervisors Appeal. I will inform that email list when a date for
(2) the appeal is set at the Coastal Commission.
Thank you.

(3)

(4)

CCC Exhibit C
(page 2 of 57 pages)

APPEAL FROM COASTAL PERMIT DECISION OF LOCAL GOVERNMENT (Page 3)

SECTION IV. Reasons Supporting This Appeal

PLEASE NOTE:

- Appeals of local government coastal permit decisions are limited by a variety of factors and requirements of the Coastal Act. Please review the appeal information sheet for assistance in completing this section.
- State briefly **your reasons for this appeal**. Include a summary description of Local Coastal Program, Land Use Plan, or Port Master Plan policies and requirements in which you believe the project is inconsistent and the reasons the decision warrants a new hearing. (Use additional paper as necessary.)
- This need not be a complete or exhaustive statement of your reasons of appeal; however, there must be sufficient discussion for staff to determine that the appeal is allowed by law. The appellant, subsequent to filing the appeal, may submit additional information to the staff and/or Commission to support the appeal request.

* please see attached 4 page document which lists reasons to support this appeal.

* please take special note of page 4 regarding reasons why, in this case, the Coastal Commission is not barred by federal preemption.

Thank you,

Judy Vick
1238 3rd St.
Los Osos, CA 93402
(805) 528-1688

CCC Exhibit C
(page 3 of 57 pages)

APPEAL FROM COASTAL PERMIT DECISION OF LOCAL GOVERNMENT (Page 4)

SECTION V. Certification

The information and facts stated above are correct to the best of my/our knowledge.

Signature of Appellant(s) or Authorized Agent

Date: May 2, 2008

Note: If signed by agent, appellant(s) must also sign below.

Section VI. Agent Authorization

I/We hereby
authorize _____
to act as my/our representative and to bind me/us in all matters concerning this appeal.

Signature of Appellant(s)

Date: _____

CCC Exhibit C
(page 4 of 57 pages)

APPEAL FROM COASTAL PERMIT DECISION OF LOCAL GOVERNMENT

San Luis Obispo County Board of Supervisors, April 1, 2008

Bonaire Investments/Sprint-Nextel Minor Use Coastal Development Permit in Los Osos, DRC2006-00204

Appellant: Judy Vick, 1238 Third Street, Los Osos, CA 93402 (805) 528-1688

The proposed project does not conform to the following LCP policies:

COASTAL PLAN POLICIES CHAPTER 6– ENVIRONMENTALLY SENSITIVE HABITATS

A. Policy 1: Land Uses Within or Adjacent to Environmentally Sensitive Habitats

New development within or adjacent to locations of environmentally sensitive habitats (within 100 feet unless sites further removed would significantly disrupt the habitat) shall not significantly disrupt the resource. Within an existing resource, only those uses dependent on such resources shall be allowed within the area.

Policy 2: Permit Requirement

As a condition of permit approval, the applicant is required to demonstrate that there will be no significant impact on sensitive habitats and that proposed development or activities will be consistent with the biological continuance of the habitat. This shall include an evaluation of the site prepared by a qualified professional which provides: a) the maximum feasible mitigation measures (where appropriate), and b) a program for monitoring and evaluating the effectiveness of mitigation measures where appropriate. ~ POLICY SHALL BE IMPLEMENTED PURSUANT TO SECTIONS 23.07.170-178 OF THE CZLUO.]

As noted in COASTAL PLAN POLICIES - ENERGY AND INDUSTRIAL DEVELOPMENT POLICY 3-c1: The coastline from Shell Beach to Morro Bay includes some of the most biologically productive, environmentally sensitive, pristine and irreparable (in the event of oil pollution) habitats and coastal resources along the San Luis Obispo County coastline. These include the important kelp-bed and rocky-intertidal

Appeal of Bonaire Investments/Sprint-Nextel Minor Use Coastal Development Permit in Los Osos, DRC2006-00204

habitats, the Morro Bay estuary, important off-shore rocks, a proposed state underwater park and the southern range of the threatened California Sea Otter.

Environmentally sensitive habitats are defined by the Coastal Act as "any area in which plant or animal life or their habitats are either rare or especially valuable because of their nature or role in an ecosystem and which could be easily disturbed or degraded by human activities and developments." The Morro Bay Estuary is one of the most significant migratory stops on the Pacific Flyway. Up to 25,000 waterfowl have been counted on one peak day and 89 species of water-associated birds have been observed. The winter months bring large numbers of Brant to the estuary. The rare black rail is believed to be breeding there and the California clapper rail has been seen here. The Los Osos area is known habitat for sensitive birds including resident Peregrine Falcon, Long-billed Curlew (non-breeding) and Bryant's Savannah Sparrow. California Black Rail and Swainson's Thrush may breed in the Sweet Springs preserve.

Recent research has found a strong correlation between the presence of electromagnetic signals from cellular phone masts and a marked decline of several species of birds in the UK and several European countries, with a strong dependency between bird density and field strength and the increasing installation of cellsites. ("The Urban Decline of the House Sparrow," Balmori and Hallberg, Electromagnetic Biology and Medicine, 26: 141-151, 2007). Nest and site abandonment, plumage deterioration, locomotion problems, and death were reported among those species found close to cellular phone antennas. Additional avian studies in Europe (Everaert and Bauwens 2007) found strong negative correlations between the amount of radiation presence (both 900 and 1800 MHz frequencies) and the presence of male House Sparrows, with fewer House Sparrow males seen in areas with high electric field strength values. Multiple studies have found similar effects on insects and vegetation (cited, Balmori and Hallberg).

Negative impacts on nest productivity up to 200 meters (650 feet) from the antennae have been documented ("Possible Effects of Electromagnetic Fields from Phone Masts on a Population of White Storks," Balmori, Electromagnetic Biology and Medicine, 26: 109-119, 2005), with 40% of nests within the 200m range never fledging chicks. This study concluded: "Consistent with these results, the microwaves could be affecting one or several reproductive stages: the construction of the nest, the number of eggs, the embryonic development, the hatching or the mortality of chicks in their first stages. ... We recommend electromagnetic contamination in the microwave range be considered a risk factor in the decline of some populations, especially urban birds, especially when exposed to higher radiation levels."

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The Commission should take note of the testimony before Congress of Albert M. Manville, II, Ph.D., Senior Wildlife Biologist Division of Migratory Bird Management, USFWS (May 10, 2007, "Congressional Staff Briefing on the Environmental and Human

Health Effects of Radiofrequency (RF) Radiation"). Dr. Manville reported the concerns of the U.S. Fish & Wildlife Service over potential radiation impacts of cellular communication towers on migratory birds and other wildlife.

Dr. Manville noted that in 2002, the USFWS list of "birds of conservation concern," saw an increase in the number of bird populations in trouble from 124 to 131 species, that this was "not good news," and in addition, 77 endangered and 15 threatened birds were included under ESA.

Dr. Manville went on to note that in 2002 "at a briefing similar to this one, T. Litovitz (Catholic Univ., pers. comm.) raised troubling concerns about the impact of low-level, non-thermal radiation from standard 915 MHz cell phone frequency impacting domestic chicken embryos (data from DeCarlo *et al.* 2002). Deformities, including some deaths under hypoxic conditions were noted."

Dr. Manville further noted that Colony Collapse Disorder (CCD) been recently documented in domestic honey bees – in 60% of U.S. West Coast apiaries and 70% on the East Coast. CCD is also being documented in Greece, Italy, Germany, Portugal, Spain and Switzerland (Harst *et al.* 2006, pilot study by Lean and Shawcross 2007). One theory as to the cause is radiation from cell phone antennas interfering with bees' navigation systems.

In 2006, the USFWS New England Field Office suggested to the Chairman of the Connecticut Siting Council that as a stipulation of a cell tower siting permit they fund a research effort at control and experimental study sites in Massachusetts to assess radiation effects.

Dr. Manville urged, because this issue is so potentially significant, that such experiments be carried out in the East, Midwest and West. The Coastal Commission could stipulate funding for such experiments as a condition of the permit, and for the permits of any and all future cell phone antennae projects allowed in the Coastal Zone, in addition to requiring that all such antennae be located at a prudent distance from known nesting and breeding areas, bird migration routes, and apiaries.

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THE COMISSION IS NOT BARRED BY FEDERAL PREEMPTION

Section 704 of the Federal Telecommunications Act of 1996 states, under General Authority: "Except as provided in this paragraph, nothing in this Act shall limit or affect the authority of a State or local government or instrumentality thereof over decisions regarding the placement, construction, and modification of personal wireless service facilities.... No State or local government or instrumentality thereof may regulate the placement, construction, and modification of personal wireless service facilities on the basis of the environmental effects of radio frequency emissions to the extent that such facilities comply with the Commission's regulations concerning such emissions."

Per the project's engineering report (Hammett & Edison, 2007), the RF radiation "power density may exceed the public limits on the roof at the subject building." At the San Luis Obispo County Board of Supervisors meeting of April 1, 2008, County staff admitted to this exceedence of FCC safe emission levels and cited the placement of "warning" signs on the roof of the subject building as sufficient mitigation. The Commission should note 1) This provides no mitigation for wildlife and habitat impacts, and 2) provides no immunity under Telecom Act Section 704, which does not admit of or contemplate mitigation. Because the Bonnaire antennae will not "comply with the [Federal Communications] Commission's regulations concerning such emissions," the Coastal Commission is not barred from "regulating the placement, construction, and modification of personal wireless service facilities on the basis of the environmental effects of radio frequency emissions."

The potential decimation of bird, bat, and insect species is not consistent with the biological continuance of habitat (Coastal Plan Policy 2).The Commission must require that the applicant demonstrate that there will be no significant impact on sensitive habitats and that proposed development or activities will be consistent with the biological continuance of the habitat. Failing that, the Commission should deny the permit.

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The incidence of electromagnetic pollution on the amphibian decline: Is this an important piece of the puzzle?

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Abstract
A bibliographical review on the possible effects of radiofrequency radiation (RFR) from wireless telecommunications on living organisms and its impact on amphibians is presented. The technical characteristics of this new technology and the scientific discoveries that are of interest in the study of their effects on wild fauna and amphibians are described. Electromagnetic pollution (in the microwave and in the radiofrequency range) is a possible cause for deformations and decline of some amphibian populations. Keeping in mind that amphibians are reliable bio-indicators, it is of great importance to carry out studies on the effects of this new type of contamination. Finally, some methodologies that could be useful to determine the adverse health effects are proposed.

Keywords: *Athermal effects, electromagnetic pollution, effects on amphibians, microwaves, phone masts*

Introduction

Amphibians are important components of the ecosystem and reliable bio-indicators; their moist skin, free of flakes, hair or feathers, is highly permeable to water chemicals (particularly larvae) and air pollutants (especially adults). Amphibian eggs are also directly exposed to chemicals and radiation. These characteristics make amphibians especially sensitive to environmental conditions, changes of temperature, precipitation or ultraviolet (UV) radiation and reliable monitors of local conditions [1].

A recent report from the International Union for Conservation of Nature (IUCN), prepared by 500 scientists from 60 countries, analyzed populations of 5743 amphibian

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species in the world and concluded that 1856 (32%) of them were considered threatened of extinction. Nine species have become extinct since 1980 and another 113 have not been observed in the recent years, and probably are also extinct [2]. The results demonstrate that amphibians are far more threatened than either birds or mammals, and the factors causing 'enigmatic' declines are driving the species toward extinction particularly rapidly. Unless these declines are quickly understood and reversed, hundreds of amphibian species can be expected to become extinct over the next few decades [3]. The disappearance of amphibians together with other organisms is a part of the global biodiversity crisis [4,5].

An associated phenomenon is the appearance of large numbers of deformed amphibians, with absent or extra limbs [5]. From 1995, at least 60 different species were affected with a high incidence of deformities, with several species affected in one place, in 46 states of United States and in regions of Japan, Canada, and several European countries [5,6]. The problem seems to have become more prevalent, with deformity rates of up to 25% in some populations, which is significantly higher than in previous decades [6].

The problem of deformities is complex because it is related to water quality, physiology, development, anatomy, and ecology [5]. The reduction in populations and the increase in deformities are a warning of serious environmental degradation [5].

Evidence exists that several populational declines are probably the result of complex interactions among several biotic and abiotic factors [1,4,7,8]. The proposed explanations are an increase of ultraviolet radiation (UV-B)[1,5,9–14]; chemical pollutants (pesticides, herbicides, fungicides, fertilizers, etc.) [5,15]; pathogen and parasites [1,6,16], destruction and alteration of habitat, changes in meteorological patterns (climatic change) [4,17], and introduced species [1,5].

The amphibian population declines are also occurring in relatively pristine places such as National Parks, or rural areas far from urban centers [3,14]. Humans and other animals can also be affected by the same environmental factors that damage amphibians [6].

A type of contamination whose effects on amphibians have not been studied up to now, is the electromagnetic pollution, especially microwaves and radiofrequencies from mobile telecommunications and radio station transmitters that will be discussed in this review. Before the 1990s, radiofrequencies were mainly from a few radio and television transmitters, located in remote areas and/or very high places. Since the introduction of wireless telecommunication in the 1990s, the rollout of phone networks has seen a massive increase in the electromagnetic contamination in cities and in the wilderness [18,19]. At the moment, new types of antennas are being investigated to reduce the power needed to establish communication [20,21]. Recently, there has also been an increase of other wireless transmitters (radio or television stations).

The objective of this review is to detail advances in the knowledge of biological mechanisms and effects from radiofrequencies and microwaves on animals, and some considerations are made on its possible relationship with deformations and the population decline of amphibians.

Main causes of populational decline and appearance of deformations in amphibian populations

Ultraviolet radiation

UV-B radiation (1) induces mutations and cellular death, (2) weakens the immune system, (3) reduces growth, and (4) induces several types of damage, like malformations

of the limbs, body, and eyes [1,5,12,14]. Not all the species respond in the same way [14]. Embryos with higher photolyase levels (DNA photorepair enzyme) are more resistant to UV-B radiation [11,12].

The eggs of some of the amphibian species experienced high mortality that may contribute to the populational declines [9]. UV acts in conjunction with other agents like pesticides to induce defects in the development [10]. UV also decreases defense mechanisms against illnesses making individuals more susceptible to pathogen and parasites, affecting normal development and increasing mortality that consequently impacts on the decline of some populations [10]. The egg mass protected from UV-B radiation have significantly more hatching, less deformities, and develop more quickly [10].

Synergy between a pathogenic fungus and UV-B radiation increased mortality among amphibian embryos [12]. The synergy may occur when developing amphibians have reduced ability to respond to a stressor in the presence of another stressor. For example, contamination exerts more deleterious effects with UV-B [1]. Animals use molecular and physiologic mechanisms and certain behaviors [22] to limit their exposure to UV-B and repair from UV-B damage [14].

Although cellular repair mechanisms of several species are not effective in the presence of persistent increase in UV-B radiation levels [14], amphibians are relatively resistant to this radiation if they can repair the damage effectively [14]. In some species, photoreactivation is the most important repair mechanism of UV-damaged DNA [9]. Heat shock proteins may also play a role in protecting cells from UV-B damage, since they prevent the denaturation of proteins during exposure to environmental stress [14].

Chemical pollutants

Chemical pollutants appear in areas where pesticides and fertilizers are applied extensively and produce mortality and deformities in amphibians. Although on a broad scale, no correlation between pesticide contamination and amphibian deformities was found, pesticides cannot be completely ruled out as causal agents [5].

Pathogens and parasites

Three pathogens received attention recently for having produced an amphibian populational decline in some areas: *Batrachochytrium denderobatidis*, *Saprolegnia ferax*, and an iridovirus (*Ambystoma tigrinum virus*) [1]. The parasite *Ribeiroia ondatrae* is an important source of malformations of amphibian extremities in western USA [16]. Larvae with malformations experience higher mortality before and during metamorphosis than the normal ones. The relevance of infection by *Ribeiroia* and the influence of habitat alteration on the pathology and biological cycle of this trematode, requires further investigation [16]. In relative pristine environments, the incidence of snails infected with *Ribeiroia* is low, but the habitat alteration can increase the rate of infestation [16]. Infection of amphibian larvae by the trematode *R. ondatrae* may represent a threat to amphibians or species in decline. Although deformities can be the cause of declines in some places, numerous populations of amphibians have greatly declined in the absence of any deformity, for which there must be other factors [6].

Climatic change

Climatic change influences breeding patterns of certain organisms which affect their populational structure and may be reflected in the populational declines of very sensitive

species such as amphibians. The pattern found up to now in the published studies is that some anurans of temperate areas show an early reproduction tendency [17]. Climate-induced reductions in water depth at egg-laying sites produced high embryo mortality by increasing their exposure to UV-B radiation which is more worrying than the reduction in ozone layer. Climate also increases their vulnerability to *S. ferax* [4].

Physical and technological characteristics of mobile telephone

Electromagnetic radiation (EMR) transmits small packages of energy denominated photons [23]. The radiofrequencies occupy the range from 10 MHz to 300 GHz. Cellsite antennae emit a frequency of 900 or 1800 MHz, pulsed at low frequencies, generally known as microwaves (300 MHz–300 GHz). Microwaves carry sound information by blasts or pulses of short duration, with small modulations of their frequency, that are transferred between wireless phones and base stations over dozens of kilometres.

The main variable that measures these radiations is 'power density' (measured in $W\,m^{-2}$, or $\mu W\,cm^{-2}$) expressing radiant power that impacts perpendicularly to a surface, divided by the surface area; and 'electric field intensity' (measured in $V\,m^{-1}$), a vectorial magnitude to the force exercised on a electric loaded particle, independent of their position in space.

For a concrete address with relationship to an antenna, the power density at a point varies inversely proportional to the square of the distance to the source. Though EMR have many and varied outputs, at a distance of 50 m the power density is about $10\,\mu W\,cm^{-2}$ [24], while at distances of 100 m at ground level it measures above $1\,\mu W\,cm^{-2}$ (pers. obs.). Between 150 and 200 m, the power density of the main lobe near the ground is typically some tenth of $1\,\mu W\,cm^{-2}$ [25].

Experimental difficulties

Experiments that study the effects of EMR on living organisms are complex, since a high number of variables exist that need to be controlled. Microwave radiation produces different effects depending on certain methodological positions such as frequency, power, modulation, pulses, time of exposure, etc. [26–28]. Some studies demonstrated different microwave effects depending on the wavelength in the range of mm, cm or m [28,29]. The dose–response relationships (of non-thermal effects), are not simple to establish since they present a non-linear relationship [30–32].

Pulsed waves (in blasts), as well as certain low frequency modulations exert greater biological activity [26,28,31,33]. These radiations also have accumulative effects that depend on the duration of exposure [19,34,35]. It is possible that each species and each individual, show different susceptibility to radiations, since the vulnerability depends on the genetic tendency, and the physiologic and the neurological state of the irradiated organism [31,36–41].

Effects and action mechanisms on biological systems

One of the well known effects of microwaves is their capacity to excite water molecules and other components in food, elevating their temperature. The resulting heating level depends on the radiation intensity and the exposure time. At a power density above $500\,\mu W\,cm^{-2}$

(microwave ovens) heating effects take place, below that level the effects are 'athermal non-heating'.

Animals are sensitive complex electrochemical systems that communicate with their environment through electrical impulses. In cellular membranes and body fluids, ionic currents and electrical potential exist [42]. Electromagnetic fields (EMFs) generated in biological structures, are characterized by certain specific frequencies. It is possible a frequency-specific, non-thermal electromagnetic influence, of an informational nature exists [25,31,43]. Some organs or systems like the brain, heart, and nervous system are especially vulnerable.

The wave systems have properties such as the frequency, which affect resonance capacity of living organisms to absorb the energy of an electromagnetic field [25]. Electromagnetic fields induce biological effects at "windows of frequency" (window effect) [44]. Living organisms are exposed to variable levels of radiofrequency electromagnetic fields, according to (1) distance to phone masts, (2) presence of metallic structures which are able to reflect or obstruct the waves (buildings or other obstacles), (3) number of phone masts, and (4) orientation and position [24].

Microwaves emitted by phone antennae affect organisms living in their vicinities, like vertebrate [45–47], insects [48–55], vegetables [56–58], and humans [25,31,59–63]. Small organisms are especially vulnerable: size approach to resonance frequency and thinner skull, facilitates an elevated penetration of radiation into the brain [24,31,64]. In a recent study carried out with bees in Germany, only few irradiated bees returned to the beehive and required more time to reach the hive. The weight of honeycombs is also smaller in the bees that were irradiated [54].

The microwave effects were investigated in a variety of living organisms, but the results found in vertebrates have special interest to amphibians. For more than 30 years, there is growing evidence on the existence of athermal effects on birds [65,66]. The exposed animals suffer a deterioration of health in the vicinity of phone masts [67,68]. Rats spent more time in the halves of shuttle boxes that were shielded from illumination by 1.2 GHz microwaves. The average power density was about $0.6\,mW\,cm^{-2}$. Data revealed that rats avoided the pulsed energy, but not the continuous energy, and less than $0.4\,mW\,cm^{-2}$ average power density was needed to produce aversion [69]. Navakatikian and Tomashevskaya [70] described a complex series of experiments in which they observed disruption of a rat behavior (active avoidance) by radiofrequency radiation (RFR). Behavioral disruption was observed at $0.1\,mW\,cm^{-2}$ ($0.027\,W\,kg^{-1}$) power density.

It has been documented that the radiofrequencies induce biological effects on biomolecules [27,51,71] that include changes in intracellular ionic concentration [72,73], cellular proliferation [74], interferences with immune system [19,75,76], effects on animals reproductive capacity [77,78], effects on stress hormones [79], in intrauterine development [80], genotoxic effects [81–87], effects on the nervous system [32,88–92], the circulatory system [93,94], and a decline in the number of births [47,95]. Firstenberg [18] proposed a connection between EMR, deformations, and the worldwide decline and extinction of amphibians.

Evidence that electromagnetic contamination may be responsible for the appearance of deformities and decline of amphibians

Some athermal effects of EMR on amphibians have been well known for more than 35 years [96,97]. The radiation of frogs with $30–60\,\mu W\,cm^{-2}$ produced a change in the heart

rhythm, probably due to the nervous system activation (Levitina, 1966 cited in [96]). When toad hearts were irradiated with pulses of 1425 MHz at a power density of $0.6\,\mu W\,cm^{-2}$, an increase in the heart rate and arrhythmia were observed [96]. Radiofrequency burst-type dilated arterioles were observed on the web of the anaesthetized frog (*Xenopus laevis*) by a athermal non-heating mechanism [93].

The exposure to magnetic fields on two species of amphibians induced deformities [48].

Frog tadpoles (*Rana temporaria*) developed under electromagnetic field (50 Hz, $260\,A\,m^{-1}$) have increased mortality. Experimental tadpoles developed more slowly and less synchronously than control tadpoles, remain at the early stages for a longer time. Tadpoles developed allergies and EMF causes changes in the blood counts [98].

Amphibians can be specially sensitive: thresholds of an overt avoidance response to weak electrical field stimuli down to $0.01\,V\,m^{-1}$ were found in *Proteus anguinus* and $0.2\,V\,m^{-1}$ in *Euproctus asper* at 20–30 Hz, but sensitivity covered a total frequency range of below 0.1 Hz to 1–2 kHz [99].

Deformities in nature

Ultraviolet radiation, UV-B. UV-B radiations produce deformities in amphibian embryos that go from lateral flexure of the tail to abnormal skin, eye damage, and lower survival rate [6,10]. However, numerous experiments carried out did not provide evidence that this exposure induces all types of deformities observed in nature, nor the appearance of extra limbs, one of the most frequent deformities noted [5,6]. On the other hand, most of the deformations for UV-B radiation occur in the legs or in reduction of the number of bilateral fingers. However, in the wild, amphibians exhibit a wide diversity of aberrations that are limited to only one side of the body, including problems in the skin, loss of legs, and twisted internal organs, reasons for which it was considered that this radiation is not the only source [5]. Similar abnormalities found in the wild and not induced by UV-B radiation have been obtained in laboratory studies, by exposing amphibian larvae to magnetic fields [48]. A similarity exists in the deformations of amphibians observed by Levengood [48] and Blaustein and Johnson [5]. Several studies addressed behavior and teratology in young birds exposed to electromagnetic fields [39,41]. Typical abnormalities include malformation of the neural tube and abnormal twisting of the chicken embryo. The electric currents are believed to have a significant role in the control of development and it is also possible that external EMR could influence these control systems [100]. The appearance of morphological abnormalities influenced by pulsed electromagnetic fields during embryogenesis in chickens [33,101] are similar to those produced by ultraviolet radiation [36]. The pulses are in fact a characteristic of mobile telephone radiations that have increased from 1995, when a marked rise in deformations started. Several experimental studies point out that the exposure to UV-B produced deferred effects (early exposure causes delayed effects in later stages) [1]. The exposure to electromagnetic fields also induces delayed effects and the tadpoles are the same as the control until the beginning of metamorphosis. The extra limbs and blistering were induced during the gastrula stage of the development which appeared to be the most sensitive stage [48]. The early *Rana pipiens* embryonic development was also inhibited by magnetic fields [97]. In rats, brief intermittent exposure to low-frequency EMFs during the critical prenatal period for neurobehavioral sex differentiation can demasculinize male scent marking behavior and increase accessory sex organ weights in adulthood [102]. Biological effects resulting from EMR field exposures might depend on the dose (e.g. duration of exposure). Short-term exposures up-regulate cell repair

mechanisms, whereas long-term exposures appear to down-regulate protective responses to UV radiation [103].

Parasites. The parasite *R. ondatrae* is an important and extensive cause of malformations in amphibian extremities in western USA [16]. Tadpoles with malformations experience higher mortality than the normal ones before and during metamorphosis. The *Ribeiroia* infection represents a threat for amphibian populations that are in decline. However, with a growing volume of data based on the experimental evidence, the infection from parasites does not seem to be the cause of all the malformations on limbs, since in some places with the presence of deformations, the parasite *R. ondatrae* was absent [5]. Further certain deformities like the absence of eyes, limbs, and twisted internal organs was not induced by the parasite [5].

In a laboratory study, eggs and embryos of *Rana sylvatica* and *Ambystoma maculatum* were exposed to magnetic fields at several development stages. A brief treatment of the early embryo produced several types of abnormalities: microcephalia, scoliosis, edema, and retarded growth [48]. Several of the treated tadpoles developed severe leg malformations and extra legs, as well as a pronounced alteration of histogenesis which took the form of subepidermal blistering and edema [48]. In chick embryos exposed to pulsed EMR a potent teratogenic effect was observed: microphthalmia, abnormal trunkal torsion, and malformations on the neural tube [33,36,101,104]. One of the possible reasons for these deformities appearing more often [5], may be due to wireless telecommunications and exponential increase of electromagnetic contamination.

Bioelectric fields have long been suspected to play a causal role in embryonic development. The electrical field may directly affect the differentiation of some tail structures, in particular those derived from the tail bud. Alteration of the electrical field may disrupt the chemical gradient and signals received by embryo cells. It appears that in some manner, cells sense their position in an electrical field and respond appropriately. The disruption of this field alters their response. Endogenous current patterns are often correlated with a specific morphogenetic events such a limb bud formation. The most common defect in chick embryos experimental group was in tail development. Internally, tail structures (neural tube, notochord, and somites) were frequently absent or malformed. Defects in limb bud and head development were also found in experimentally treated chick embryos, but less often than the tail defects [105]. Amphibians can be especially sensitive because their skin is always moist, and they live close to, or in water, which conducts electricity easily.

Populations' decline

Deformities found in nature can directly affect embryonic mortality and survival after hatching [10]. It seems interactions that exist among UV-B radiation and additional factors contribute to embryo mortality [9]. Water pollution and excessive ultraviolet radiation act jointly, producing specific problems and alter the immune system, making amphibians more vulnerable to parasitic invasions and pathogen infections [6,8,12,14]. It is proposed that there exists a possible relationship between the decline of amphibians and exponential increase of electromagnetic pollution. Several experiments with bird eggs showed a high mortality of embryos exposed to EMR from mobile phones [36,106,107]. EMFs increases mortality of tadpoles [98]. The EMR alters the immune, nervous, and endocrine systems, and operates independent or together with other factors like UV-B radiation or chemical pollutants. Death of embryos in nature is not due to UV radiation

as the capacity of DNA repair mechanisms like photolyase (photoreactivating enzyme) is effective [9]. EMR produces stress on the immune system [76,98] that obstructs DNA repair [42,108,109]. Heat shock proteins may play a role in protecting amphibians from UV-B damage [14] and animals exposed to EMR [27,51,71,110,111]. Different susceptibility to UV among species and even among populations exists [112], as seen with EMR [31,40].

Hallberg and Johansson [108,109] proposed that radiofrequencies increase the effects of UV radiation. A study on the causes of melanoma in humans conclude that the incidence increases and the mortality associated with this skin tumor cannot only be explained by the elevation in UV sun radiation, but rather by the continuous alterations on mechanisms of cellular repair, produced by EMR (radiofrequencies) resonant with the body, that amplify the carcinogenic effects of the cellular damage induced by the UV-B radiation. The cases of melanoma experienced a significant increase from the 1960–70s [108] that continues today, and also asthma and several types of cancer associated with deterioration of immune system. Data suggest there is an increase of electromagnetic pollution [108,113]. The public health situation in Sweden has become worse since the autumn of 1997. There is a correlation between the massive roll-out of GSM mobile phone antennae and adverse health effects [109].

Enigmatic decline of amphibian species are positively associated with streams at high elevations in the tropics and negatively associated with still water and low elevations [3]. In high places, the electromagnetic contamination is usually higher [47]. Microwave measurements of power density as low as $0.0006\,\mu W\,cm^{-2}$ show strong correlation with symptoms like depressive tendency, fatigue, and insomnia in humans [63].

Proposed research

To demonstrate the conclusive effect of microwave radiation on amphibians it is necessary to approach research with a control (non-exposed) and an experimental group. This methodological position is complicated at present due to the ubiquity of these radiations [98]. Studies that try to correlate populational evolution, appearance of deformities, or the presence or absence of amphibians with measurements of electromagnetic fields from radiofrequencies will be of great interest. Field investigations of urban park populations and phone masts surrounding territories need to be high-priority. A radius of $1\,km^2$ laid out in concentric circumferences at intermediate distances may be useful to investigate the differential results among areas, depending on their vicinity and corresponding levels of EMR. Laboratory studies on amphibians exposed to pulsated and modulated microwaves would also be of great interest.

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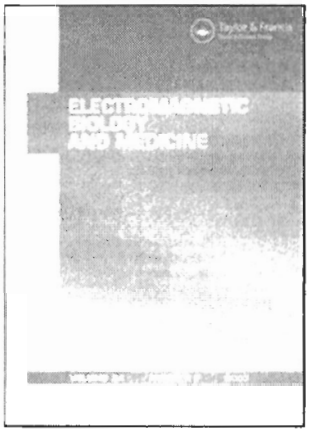

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The Urban Decline of the House Sparrow (*Passer domesticus*): A Possible Link with Electromagnetic Radiation

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During recent decades, there has been a marked decline of the house sparrow (Passer domesticus) population in the United Kingdom and in several western European countries. The aims of this study were to determine whether the population is also declining in Spain and to evaluate the hypothesis that electromagnetic radiation (microwaves) from phone antennae is correlated with the decline in the sparrow population.

Between October 2002 and May 2006, point transect sampling was performed at 30 points during 40 visits to Valladolid, Spain. At each point, we carried out counts of sparrows and measured the mean electric field strength (radiofrequencies and microwaves: 1 MHz–3 GHz range). Significant declines ($P = 0.0037$) were observed in the mean bird density over time, and significantly low bird density was observed in areas with high electric field strength. The logarithmic regression of the mean bird density vs. field strength groups (considering field strength in 0.1 V/m increments) was $R = -0.87$ ($P = 0.0001$).

The results of this article support the hypothesis that electromagnetic signals are associated with the observed decline in the sparrow population. We conclude that electromagnetic pollution may be responsible, either by itself or in combination with other factors, for the observed decline of the species in European cities during recent years. The appearently strong dependence between bird density and field strength according to this work could be used for a more controlled study to test the hypothesis.

Keywords Cellsites; Cellular phone masts; Decline; Electromagnetic fields; House sparrow; Microwaves; Non thermal effects; *Passer domesticus*; Urban bird populations.

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Introduction

Recent declines in the house sparrow (*Passer domesticus*) population have been reported in the United Kingdom (U. K.) and in several western European countries. A massive decrease has led to almost complete extinction in some urban centres; for example, there was a 71% decline in London from 1994–2002 (Raven et al., 2003). Urban bird populations in south east England seem to be declining more rapidly than suburban or rural populations (Crick et al., 2002); there have been dramatic declines, almost to the point of extinction, in Glasgow, Edinburgh, Hamburg, and Ghent, although the species has actually increased in Scotland and Wales (Summers-Smith, 2003). In 2002, the house sparrow was added to the Red List of U.K. endangered species (Summers-Smith, 2003).

In Brussels, many populations of sparrows have disappeared recently (De Laet, 2004); similar declines have been reported in Dublin (Prowse, 2002). Dröscher (1992) reported that house sparrows had become a rarity in West Berlin, but remained relatively common in East Berlin, possibly reflecting a general lack of urban development under the former communist regime (Crick et al., 2002). Van der Poel (cited in Summers-Smith, 2003) suggested that sparrows might be declining in Dutch urban centres as well.

Detailed studies have shown that in the U.K., the decline of sparrows in human settlements has been erratic (Summers-Smith, 2003). It is critical that comparative studies and surveys of house sparrow populations be performed in order to assess differences in abundance within different areas of the same city and between cities with different socio-economic, technological and cultural characteristics (Crick et al., 2002).

A number of hypotheses have been proposed to explain the population decline of the house sparrow in urban areas. These include lack of food, particularly aphids, which adults feed to nestlings, pollution from vehicles running on unleaded fuel, increased predation by domestic cats or sparrowhawks (*Accipiter nisus*), cleaner streets providing reduced foraging opportunities, competition for food from other urban species, loss of nesting sites, particularly under the eaves and in the roofs of houses, pollution (air quality), both in terms of immediate toxicity and indirect toxicity through the food supply, increased use of pesticides in parks and gardens, and disease transmission (Crick et al., 2002; Summers-Smith, 2003). Finally, reduction of colony size below some critical value may impair breeding behaviour to the extent that breeding declines, resulting in the disappearance of the colony as a breeding unit (the Allee effect; Summers-Smith, 2003).

Before the 1990's, electromagnetic energy was emitted from a few radio and television transmitters located in remote areas and/or high elevations. Since then, mobile base stations masts have been spreading across urban centres and have increased electromagnetic pollution. In Vienna, the greatest portion of that exposure was from mobile telecommunications (geometric mean 73%; Hutter et al., 2006). In Germany, global system for mobile communication (GSM) cellular phone tower radiation is the dominant high-frequency source in residential areas (Haumann et al., 2002), and GSM radiation is also the dominant high-frequency source in Spain (personal observation). House sparrows usually live in the urban environment, where electromagnetic contamination is higher; for this reason, sparrows may be a good biological indicator for detecting the effects of this radiation.

Anecdotal evidence, as well as some published reports, suggests that sparrows tend to avoid places with high levels of electromagnetic signals (Balmori, 2002, 2003). The disappearance of the sparrow and the introduction of phone mast GSM towers correlate closely in terms of time (Balmori, 2002, 2003). Balmori proposes: "It is recommended that electromagnetic contamination in the microwave range be considered as a possible factor in the decline of some at-risk populations, especially for urban birds who are subjected to higher radiation levels" (Balmori, 2004a).

The main aims of this study were to investigate whether the sparrow population is declining in an average-sized city in Spain and to determine whether electromagnetic radiation (microwaves) is related to the marked population reduction observed in several European countries.

Materials and Methods

To monitor the populations of house sparrows (*Passer domesticus*) in Valladolid, Spain, 40 visits were made between October of 2002 and May of 2006 (approximately one per month) to perform point transect sampling at 30 points (Bibby et al., 2000). Sampling was performed between 7:00 and 10:00 a.m, by the same ornithologist (AB) following the same protocol. Each sampling took place on Sunday, since there is less traffic and noise that day. The sampling was done in selected areas (the same between October 2002 and May 2006): squares, urban parks, and tree-lined, relatively isolated streets that facilitated the counting process (with a well-known and delimited area). In each area, we counted all sparrows that were heard or seen, without differentiating the birds by sex or age. In addition, we measured the mean electric field strength (radio frequencies and microwaves, range: 1 MHz–3 GHz) in V/m, using a portable broadband electric field meter (model LX 1435, Nuova Elettronica, Bologna, Italy) set at 10% sensitivity, using a unidirectional antenna.

For the analysis, with a plane of the city we calculate the surface of each point. The bird density (number of sparrows/hectare) was calculated for each point and for each visit (the final data-set had 1,200 data points). This bird density cannot be extrapolated to the entire city, as the density fluctuates depending on the location where the sampling was performed, and one cannot predict the density at any given point. The results of this survey may have resulted in slightly inflated estimates, as the points we used as observation points were concentrated in areas where house sparrows are plentiful.

Excel 2002 (Microsoft, Inc, Redmond, WA, USA) and Statistica v. 6.0 (Statsoft, Tulsa, OK, USA) were used for statistical analyses.

Results

Figures 1 and 2 shows the sparrow density vs. field strength with all reported data and 50, 90, and 95 percentiles.

We found that the number of house sparrows in Valladolid, Spain, varied cyclically throughout the year: the number of sparrows increased towards a mid-winter peak, then decreased again through the spring. Variation was independent of the long-term decline in numbers that occurred during the period of study (Fig. 3). If this trend continues (a 5% annual decrease in the population), the house sparrow may become extinct by 2020. A significant declining trend ($p = 0.0037$) was also

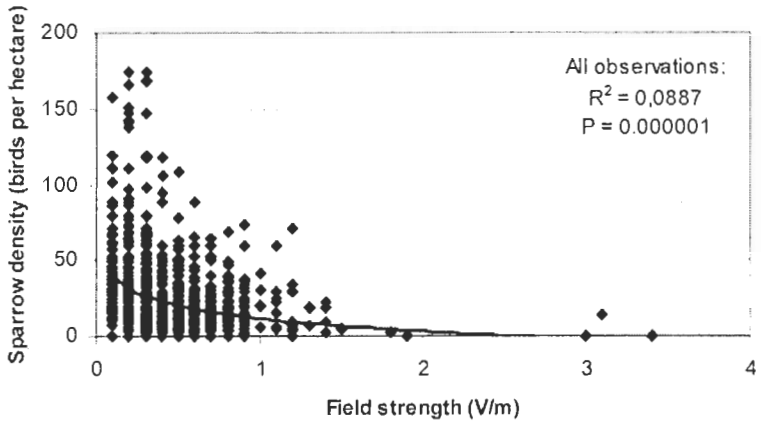

Figure 1. Sparrow density vs. field strength with all reported data.

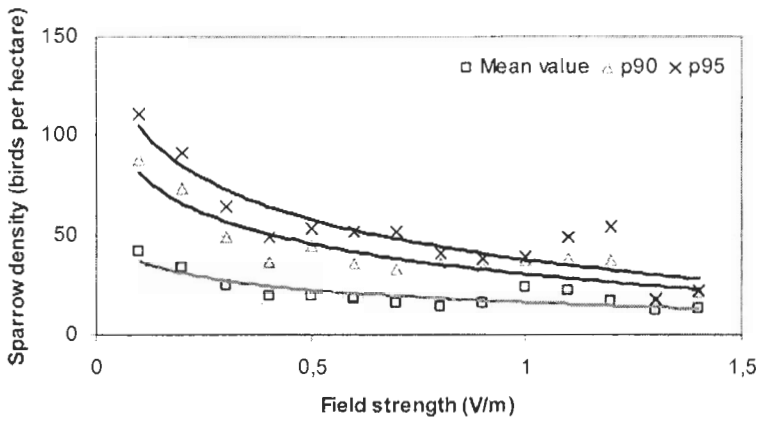

Figure 2. Sparrow density vs. field strength with 50, 90, and 95 percentiles.

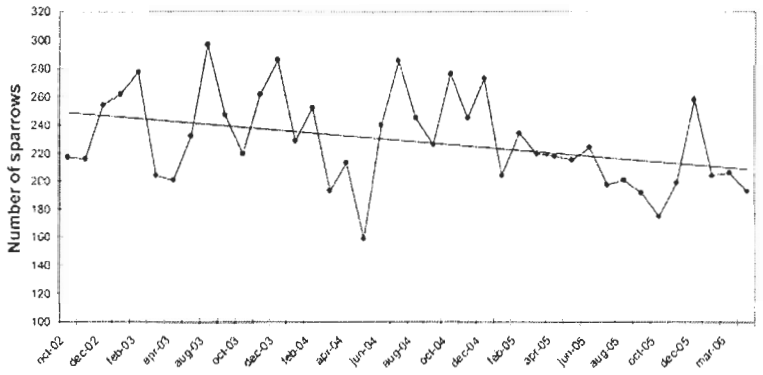

Figure 3. Changes in the total number of sparrows in the 30 sampled areas.

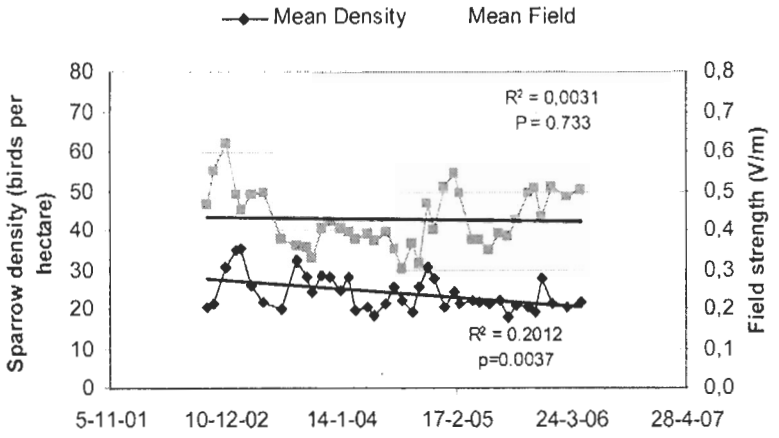

Figure 4. The mean sparrow density and mean electric field strength as a function of time in the 30 sampled areas.

observed in regards to the mean sparrow density over time for all monitored points, while the electromagnetic field intensity at these points fluctuated (Fig. 4).

The logarithmic regression of the mean bird density vs. field strength (considering field strength in 0.1 V/m increments) was: $R = -0.87$ ($p = 0.0001$; Fig. 5). According to this calculation, no sparrows would be expected to be found in an area with field strength >4 V/m.

Selecting the six sampling points with the highest and the six sampling points with lowest mean electromagnetic field strength, we see that the mean density of sparrows for the two groups are separated, and that the highest bird densities correspond to the lowest field intensity (Fig. 6).

In monitored Area 14, Plaza de la Libertad, a picocell was installed at the beginning of January 2005 and removed at the end of March 2005. Between January and March 2005, the mean field strength was greater than 3 V/m, and the number of sparrows decreased drastically (generally, the number of sparrows increases towards

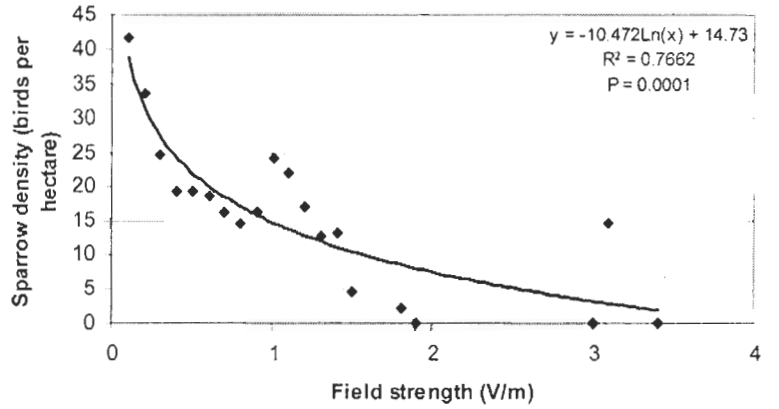

Figure 5. Mean sparrow density as a function of electric field strength grouped in 0.1 V/m.

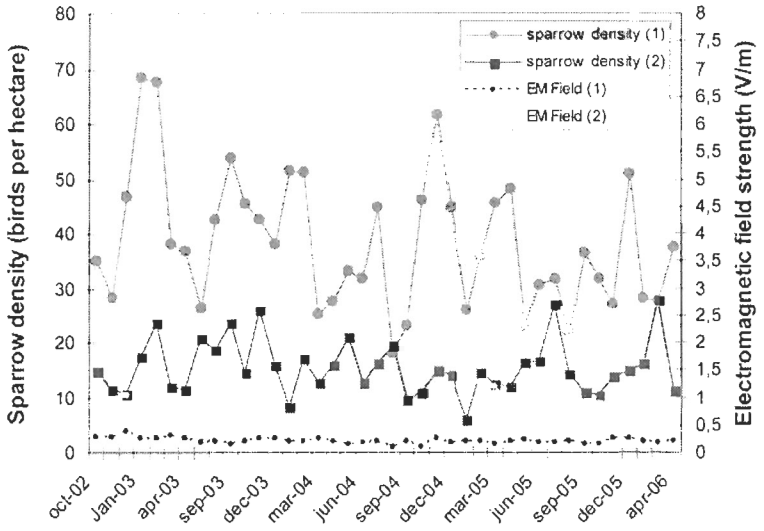

Figure 6. Comparison between the change in sparrow density (1) in the 6 least polluted sample areas (EM Field 1) and the change in sparrow density (2) in the 6 most polluted sample areas (EM Field 2).

a mid-winter peak). In April 2005, after the picocell was removed, the sparrows became abundant again.

Discussion

The pattern of sparrows number increased towards a mid-winter peak and decreased again through the spring. This pattern has previously been reported by (Crick et al., 2002). A long-term decline in numbers has occurred during the period of study. The disappearance of sparrows and the introduction of phone mast GSM towers are temporally correlated (Balmori, 2002, 2003). Our report shows that the number of sparrows correlates with electromagnetic pollution levels. Another recent study with sparrows in Flanders (Belgium) state: "Our data show that fewer House Sparrow males were seen at locations with relatively high electric field strength values of GSM base stations and therefore support the notion that long-term exposure to higher levels of radiation negatively affects the abundance or behaviour of House Sparrows in the wild" (Everaert and Bauwens, 2007).

In the U.K., where the allowed standard by law levels of electromagnetic radiation were until time very recently 20 times higher than those in Spain, a decline in several species of urban birds has recently taken place (Raven et al., 2003). The newspaper *The Observer* reported that mobile phones may be to blame for sparrow deaths (Townsend, 2003). In India, Dr. Vijayan pointed out that sparrows are disappearing from areas where mobile towers are installed and from cities where electromagnetic contamination is very heavy (Mukherjee, 2003).

Electromagnetic fields from powerlines affect reproductive success in birds (Doherty and Grubb, 1996; Fernie and Reynolds, 2005), and microwaves from phone masts were found to interfere with white stork reproduction (Balmori, 2005). A Greek study reported a progressive drop in the number of births of rodents

exposed to radio frequencies: mice exposed to 0.168 $\mu W/cm^2$ become sterile after five generations, while those exposed to 1.053 $\mu W/cm^2$ became sterile after only three generations. The affect seems be mediated by the central nervous system rather than the reproductive organs (Magras and Xenos, 1997). Currently, comparable amounts of power density are present in many places, including in the countryside for several hundred meters surrounding phone masts. This is discussed in detail in Balmori (2004b).

The avoidance of radiation sources was observed in an experimental study with mammals. Rats spent more time in the halves of shuttle boxes that were shielded from irradiation by 1.2 GHz microwaves. Data revealed that rats avoided pulsed but not continuous radiation, and less than 0.4 mW/cm^2 average power density (<38 V/m power strength) was needed to produce aversion (Frey and Feld, 1975). The high frequency radio frequency (RF) fields produced a response in many types of neurons in the avian central nervous system (Beasond and Semm, 2002). The electromagnetic fields emitted by mobile phones affect the permeability of the blood-brain barrier and can damage some neurons in the brain (Salford et al., 2003).

It has been documented that electromagnetic radiation can affect biomolecules such as DNA (Goodman and Blank, 2002; Lai and Singh, 1995, 1996; Reflex, 2004), and can influence the immune system (Galeev, 2000), reproductive capacity (Davoudi et al., 2002; Fernie et al., 2000; Fejes et al., 2005; Panagopoulos, 2007), the brain and nervous system (Kramarenko and Tan, 2003; Marino et al., 2003; Salford et al., 2003), and intrauterine development and miscarriages (Berman et al., 1990; Magras and Xenos, 1997).

Mobile communications and multiple other sources result in the chronic exposure of humans and wild animals to microwaves at non-thermal levels (Belyaev, 2005; Lai, 2005). Electromagnetic fields and microwaves affect the reproductive success of birds (Balmori, 2005; Doherty and Grubb, 1996; Fernie and Reynolds, 2005), and increase the embryonic mortality of chickens (Farrel et al., 1997; Grigoriev, 2003; Youbicier-Simo et al., 1998). Microwaves emitted by phone antennae can also affect other taxa that live in the vicinity, such as insects (Panagopoulos, 2004, 2007; Stever et al., 2005), vegetables (Balmori, 2004b; Balodis et al., 1996; Selga and Selga, 1996; Stever et al., 2005) and humans (Hallberg and Johansson, 2004a,b; Hutter et al., 2006; Navarro et al., 2003; Salford et al., 2003). Small organisms are especially vulnerable: thinner skulls approach the size of the resonance frequency, facilitating radiation penetration into the brain (Hyland, 2000; Maisch, 2003).

The Erratic Nature of the House Sparrow Population Decline

House sparrows are generally gregarious, living in colonies of 20–40 birds. They are relatively sedentary birds, rarely moving more than 1 km from their colony site, and usually substantially less than that, once they are adults (Crick et al., 2002). Dispersal distances are very limited for house sparrows, so the main demographic processes that drive population declines are a combination of changes in productivity and survival (Crick et al., 2002). Detailed studies have shown that the decline of sparrows in U.K. has been erratic (Summers-Smith, 2003). Differences in abundance exist within different areas of the same city and between cities (Crick et al., 2002). The decline in London is not merely a function of reduction in colony size, but rather of increased dispersion of the colonies (Summers-Smith, 2003).

The results of the monitoring carried out in Valladolid, Spain provide some clues that may explain the decrease of sparrows in the U.K. According to the results of this study, the distribution of the antennas (and the field strength in each area of the city) appears to be related to the patchy distribution of sparrows. Telecommunication masts usually are installed in high places in order to achieve better signal coverage. For a given point, the field strength is inversely proportional to the distance to the source. The measured field strength depends on whether the cell site antenna is in line of sight and on the reflections or the attenuation by certain structures.

The British sparrow population has collapsed in cities, but not in small towns. In fact, the number of phone masts and the use of mobile phones in cities, in general, are much greater than in small towns. Cities usually have more electromagnetic pollution, but this varies in different areas according to the proximity of phone masts. Small towns usually locate the telecommunication masts away from the urban center, because that is sufficient to maintain coverage. This may be the reason that the birds are less affected in small towns and villages and that the population of sparrows, in general, has not declined there. Thus, the cause underlying the decline in sparrows may be the increasing establishment of base stations for mobile telecommunication. As soon as stricter planning controls are enforced for mobile phones masts, the number of sparrows should increase (Balmori, 2002).

Other factors that could potentially have led to the declines of house sparrows in urban situations include air quality (pollution; Crick et al., 2002). Pollution is a factor that could affect house sparrow both directly, as a result of immediate toxicity, and indirectly through effects on the sparrow food supply. Currently, air pollution (SO_2, NO_2, CO, and benzene) has decreased in Valladolid, although airborne particles and the ozone level have increased slightly. In a study in Bristol, England, there was no correlation between wards with high levels of benzene in the air and low house sparrow numbers (Crick et al., 2002).

The availability of invertebrates used to feed chicks in the nest has been proposed as a possible explanation for urban population declines. Key prey that is fed to chicks includes aphids (Aphidoidea), weevils (Curculionidae), grasshoppers (Orthoptera), and caterpillars (Lepidoptera) (Crick et al., 2002). Van der Poel (in Summers-Smith, 2003) suggested that the decline of sparrows in Dutch urban centers was due to a lack of insects, and electromagnetic pollution might affect the number of insects that house sparrows feed to their chicks for the first few days after hatching (Balmori, 2006; Panagopoulos, 2004, 2007; Stever et al., 2005).

Crick et al. (2002) suggested that some of the factors that caused the decline in sparrow survival, leading to the observed population decline, are still affecting house sparrows. The results of our study support the hypothesis that electromagnetic pollution may be responsible, by itself or in conjunction with other factors, for the reduced number of the species in European cities during recent years. The appearently strong dependence between bird density and field strength according to this work could be used for a more controlled study to test the hypothesis.

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Possible Effects of Electromagnetic Fields from Phone Masts on a Population of White Stork (*Ciconia ciconia*)

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Monitoring of a white stork population in Valladolid (Spain) in the vicinity of Cellular Phone Base Stations was carried out, with the objective of detecting possible effects. The total productivity, in the nests located within 200 meters of antennae, was 0.86 ± 0.16. *For those located further than 300 m, the result was practically doubled, with an average of* 1.6 ± 0.14. *Very significant differences among the total productivity were found* ($U = 240$; $p = 0.001$, *Mann-Whitney test). In partial productivity, an average of* 1.44 ± 0.16 *was obtained for the first group (within 200 m of antennae) and of* 1.65 ± 0.13 *for the second (further than 300 m of antennae), respectively. The difference between both groups of nests in this case were not statistically significant* ($U = 216$; $P = 0.26$, *Mann-Whitney Test U). Twelve nests (40%) located within than 200 m of antennae never had chicks, while only one (3.3%) located further than 300 m had no chicks. The electric field intensity was higher on nests within 200 m* (2.36 ± 0.82 *V/m) than on nests further than 300 m* (0.53 ± 0.82 *V/m). Interesting behavioral observations of the white stork nesting sites located within 100 m of one or several cellsite antennae were carried out. These results are compatible with the possibility that microwaves are interfering with the reproduction of white storks and would corroborate the results of laboratory research by other authors.*

Keywords Cellsites; Cellular phone masts; *Ciconia ciconia*; Electromagnetic fields; Microwaves; Nonthermal effects; Reproduction; White stork.

Introduction

Most of the attention on the possible biological effects of electromagnetic fields (EMF) has been focused on human health. People frequently use wildlife as biological indicators to detect the alterations in the ecosystems and in an urban

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habitat. The numeric tendency of the populations of birds is of particular interest in the conservation of nature [1].

The cellsite antennae emit a frequency of 900 or 1800 MHz, pulsed in very low frequencies, generally known as microwaves (300 MHz–300 GHz), similar to the radar spectrum. The cellsite ordinarily have 3 sectors, with 3 antennae that cover an angle of 120 degrees each [2–5]. Though they have many and varied outputs, at a distance of 50 m, the power density is about 10 $\mu W/cm^2$ [2], while at distances of 100 m at ground level it measures above 1 $\mu W/cm^2$ (personal observation). Between 150 and 200 m, the power density of the main lobe near the ground is typically of some tenth of 1 $\mu W/cm^2$ [3].

In real life, living organisms are exposed to variable levels of electromagnetic fields (radiofrequencies), according to the distance from the cellular bases stations, the presence of passive structures to either amplify the waves (e.g., the metallic structures) or to shield them (buildings or other obstacles), the number of transmission calls within the transmitters and their position with relationship to the orientation of the antenna [2].

Animals are very sensitive electrochemical complexes that communicate with their environment through electrical impulses. Ionic currents and electric potential differences exist through the cellular membranes and corporal fluids [6]. The intrinsic electromagnetic fields from the biological structures are characterized by certain specific frequencies that can be interfered with by the electromagnetic radiation, through induction and causing modification in their biological responses [3]. Animals exposed to the EMF can suffer a deterioration of health, changes in behavior [7, 8], and changes in reproductive success [9, 10].

The low intensity pulsed microwave radiation from cellsites produces subtle athermal influences in the living organisms, because this radiation is able to produce biological responses by the microwave carrier and by the low frequency of pulses from GSM system. "Windows" exist in whereby EMFs produce biological effects at specific frequencies (window effect) [11]. Some effects are manifested exclusively with a certain power density [12], while others are manifested after a certain duration of the irradiation, which indicates long-term cumulative effects [13]. During lingering exposure, the effects can change from stimulant to inhibition, depending on the pulse shape [14, 15], the duration, development, and differentiation and the physiologic condition or health of the receiving organism [16], and their genetic predisposition [17]. These waves seem to cause different, and even contrary effects, depending on their frequency, intensity, modulation, pulses or time of exposure [12, 16, 18]. The pulsed waves (in bursts) and certain low frequency modulations, produce great biological activity [14, 15, 18]. The dose-response relationships (athermal) are nonlinear [19].

Research has shown such effects on the living organisms at molecular [12] and cellular levels [20] on immune processes [21], in DNA [22], on the nervous, cardiac, endocrine, immune, and reproductive systems [16, 23–28], modification of sleep and alteration of the cerebral electric response (EEG) [29], increase of the arterial pressure and changes in the heart rhythm [30], and an increase in the permeability of the blood brain barrier [31].

The objective of this study was to investigate if the phone mast cellsites caused effects in wild birds similar to the laboratory studies, and studies carried out on people exposed to this radiation [3, 5, 32–35].

Materials and Methods

For monitoring the breeding success of the white stork population, nests ($n = 60$) were selected and visited from May to June of 2003. The difficulty of the investigation in the field, (and when studying wild species) does not allow one to control all variables as in the laboratory; however, the selected nests had similar characteristics. They were located in the roof of churches and buildings inside urban nuclei in Valladolid (Spain). (The nests on trees and other natural supports or outside the urban nuclei were never studied.) Since the cellsite radiations are omnipresent, very few places exist with an intensity of 0 V/m near inhabited nuclei. For that reason, nests were chosen that were exposed at very high or very low levels of electromagnetic radiation, depending on the distance from the nests to the antennas.

The nests were selected and separated in two categories:

a) Nests ($n = 30$) located within 200 m of one or several cellsite antennae (GSM-900 MHz and DCS-1800 MHz), placed in masts and in the roof of the buildings at 15–30 m high.
b) Nests ($n = 30$) located further than 300 m of any cellsites.

The nest were observed using a prismatic Zeiss 8 × 30 and a "Leika" 20-60 X telescope. The number of young were counted.

For the analysis of the results of the reproduction, two indexes were used:

1) the total productivity (number of young flown by each couple, including nests with zero chicks).
2) the partial productivity (number of young flown by couples with some chicks, excluding nests with zero chicks).

To compare the breeding success of both groups of nests a nonparametric test was applied (Mann-Whitney test U).

Also, we measured the electric field intensity (radiofrequencies and microwaves) in V/m, using a "Nuova Elettronica" device Model LX 1435 with 10% sensitivity, from a unidirectional antenna (range: 1 MHz–3 GHz). Keeping in mind the inaccessibility of the nests, the measurements were made in their vacinity under similar conditions, recording the reproducible values obtained when directing the antenna of the device toward the cellsite antenna in line of sight.

Between February 2003 and June 2004, we carried out 15 and 10 visits, respectively, to 20 nests located within 100 m of one or several cellsite antennae to observe the behavior of the species. The visits covered all the phases of breeding, from construction of the nest, until the appearance of young storks exercising their wings and practicing flight.

Results

Table 1 presents the number of young and electric field intensity (V/m) of each studied nest.

The total productivity, in the nests located within 200 m of antennae was 0.86 ± 0.16. For those located further than 300 m, the result was practically doubled, with an average of 1.6 ± 0.14 (Table 1). Both groups showed very significant differences in the breeding success ($U = 240$; $P = 0.001$, Mann-Whitney Test U).

Table 1
Intensity of electric field, total and partial productivity in the nests within 200 m and further than 300 m to the phone mast

Nests within 200 m			Nests further than 300 m		
Nest	Number of young	EMF (V/m)	Nest	Number of young	EMF (V/m)
1	2	0.8	1	1	0.4
2	2	0.6	2	2	0.7
3	0	0.8	3	1	1.3
4	3	1.5	4	1	1.1
5	1	1.7	5	1	0.6
6	2	2.9	6	3	0.4
7	1	3.1	7	2	0.6
8	1	1.3	8	2	0.7
9	1	1.3	9	3	0.6
10	1	2.8	10	1	0.7
11	1	1.8	11	2	0.8
12	3	3.2	12	2	0.3
13	1	1.6	13	3	0.1
14	0	2.7	14	1	0.6
15	0	2.3	15	2	0.5
16	0	2.7	16	3	0
17	0	2.5	17	2	0.3
18	0	3.5	18	1	0.8
19	0	3.5	19	2	0.2
20	0	2.7	20	0	0.8
21	0	2.9	21	2	0.2
22	2	3.2	22	1	0.6
23	0	2.5	23	1	0.5
24	1	2.6	24	1	0.7
25	1	2.4	25	1	1.4
26	0	2.2	26	2	0.1
27	1	2.6	27	1	0.1
28	1	3.1	28	2	0.2
29	1	3.1	29	1	0
30	0	3.0	30	1	0.6
Mean EMF		2.36			0.53
Total productivity		0.86		1.6	
Partial productivity		1.44		1.65	
Nests without young		12 (40%)		1 (3.3%)	

In partial productivity in average of 1.44 ± 0.16 was obtained for the first group (within 200 m of antennae) and 1.65 ± 0.13 for the second (further than 300 m of antennae) respectively. The difference between both groups of nests in this case was not statistically significant ($U = 216$; $P = 0.26$, Mann-Whitney Test U).

Twelve nests (40%) located within 200 m of the antennae never had any chicks, while only one (3.3%), located further than 300 m, never had chicks.

The electric field intensity was higher on nests within 200 m (2.36 ± 0.82 V/m) that on nests further 300 m (0.53 ± 0.82 V/m) (Table 1).

The results of the findings and interesting behavioral observations of the white stork nesting sites located within 100 m of one or several cellsite antennae and on those that the main beam impacted directly (EFI > 2 V/m) included young that died from unknown causes. Also, within this distance, couples frequently fought over the nest construction sticks and failed to advance the construction of the nests. (Sticks fell to the ground while the couple tried to build the nest.) Some nests were never completed and the storks remained passively in front of cellsite antennae.

Discussion

The effects of athermal microwaves on birds have been well known for more than 35 years [36, 37]. Some authors obtained beneficial effects in the production of insect eggs and exposed birds, but found that the mortality was doubled [38]. In hen experiments, problems of health and a deterioration of the plumage arose, while in the autopsies, leucosis and tumors of the central nervous system appears [39]. Giarola and Krueger [40] obtained a large reduction of the rate of growth and also a reduction of the adrenal glands, in exposed chickens. Kondra et al. [41] obtained an increase in the frequency of ovulation of exposed birds, and a bigger production of eggs but with less weight, proposing that the pituitary gland was stimulated. Other authors also have obtained effects reducing the rate of growth in chickens and rats, reduction in the production of eggs in hens exposed to microwaves of different frequencies and intensities, increase of fertility, and a deterioration of the quality of the eggshell at certain frequencies [42]. An increase in the embryonic mortality of chickens also has been found [15, 17, 43, 44]. These microwave effects are athermal [45]. Recently, it also has been demonstrated that the microwaves used in cellphones produce an athermal response in several types of neurons of the nervous system in birds [46] and that they can affect the blood brain barrier as has been observed in rats [47].

Birds are especially sensitive to the magnetic fields [48]. The white stork (*Ciconia ciconia*) build their nests on pinnacles and other very high places with high electromagnetic contamination (exposed to the microwaves). Also, they usually live inside the urban environment, where the electromagnetic contamination is higher, and remain in the nest a lot of the time, for this reason the decrease on the brood can be a good biological indicator to detect the effects of these radiations.

The results indicate a difference in total productivity but not in partial productivity between the near nests and those far from the antennae. This indicate the existence of nests without chicks, or the death of young in their first stages in the nests near cellsites (40% of nest without young, compared to 3.3% in nests further 300 m). Also, in the monitoring of the nests near to cellsite antennae, some dead young were observed and several couples never built the nest.

In previous studies in Valladolid, the results of productivity were generally higher than those obtained in this study and less nests appeared without young (Table 2).

Consistent with these results, the microwaves could be affecting one or several reproductive stages: the construction of the nest, the number of eggs, the embryonic

Table 2
Results of censuses carried out in Valladolid (Spain).

Year	Number of visited nests	Total productivity	Partial productivity	Couples without young(%)	References
1984	113	1.69	2.13	7	[65]
1992	115		1.93	5.2	[62]
1994	24	1.84		7.6	[63]
2001	35		2.43		[64]
2003 (<200 m)	30	0.83	1.44	40	This study
2003 (>300 m)	30	1.6	1.65	3.3	This study

development, the hatching or the mortality of chicks in their first stages. The faithfulness of the white stork to nest sites can increase the effects of the microwaves. A Greek study [49] relates to a progressive drop in the number of births of rodents. The mice exposed to $0.168\,\mu W/cm^2$ become sterile after 5 generations, while those exposed to $1.053\,\mu W/cm^2$ became sterile after only 3 generations. The interaction seems to take place through the central nervous system more than on the reproductive gland directly. Other studies find a decrease of fertility, increase of deaths after the birth in rats and dystrophic changes in their reproductive organs [16]. A recent study shows a statistically significant high mortality rate of chicken embryos subjected to the radiation from a cellphone, compared to the control group [43]. EMF exposure affected the reproductive success of kestrels (*Falco sparverius*), increasing fertility, egg size, embryonic development and fledging success but reduced hatching success [10]. An increase in the mortality [50] and the appearance of morphological abnormalities, especially of the neural tube [14, 15, 17] has been recorded in chicken embryos exposed to pulsed magnetic fields, with different susceptibility among individuals probably for genetic reasons. It is probable that each species, even each individual, shows different susceptibility to the radiation, since the susceptibility depends on the genetic bias, and of the irradiated living organisms physiologic and neurological state [4, 51]. Different susceptibility of each species also has been proven in wild birds exposed to CEM from high-voltage powerlines [9]. When the experimental conditions (power density, frequency, duration, composition of the tissue irradiated, etc.) change, their biological effects also change [25, 52]. Microwaves have the potential to induce adverse reactions in the health of people [2–5, 34, 35, 47]. Although the power output differs per site and type of transmitter, at more than 300 m distance from the antennas, most of the symptoms recorded in people diminish or disappear [34, 35]. It also has been pointed out that below 0.6 V/m the effects on the people disappear (Salzburg resolution).

Since, we cannot see symptoms for white storks, it is necessary to use objective variables such as the Total and Partial Productivity, and other characteristics of behavior (nonconstruction of nest, sticks fall, etc.). We recommend electromagnetic contamination in the microwave range be considered a risk factor in the decline of some populations, especially urban birds, especially when exposed to higher radiation levels. Because of their thinner skull, their great mobility and the fact that they use areas with high levels of microwave electromagnetic radiation, birds

are very good biological indicators. The freedom of movement of birds and their habit of settling in the proximity and even on the cellsites, makes them potentially susceptible to such effects. Small organisms (children, birds, small mammals, etc.) are especially vulnerable, as absorption of microwaves of the frequency used in mobile telephones is greater as a consequence of the thinner skull of a bird, the penetration of the radiation into the brain is greater [2, 49, 53, 54].

Several million birds of 230 species die annually from collisions with the masts of telecommunication facilities in United States during migration [55]. The cause of the accidents has yet to be proven, although one knows that they mainly take place during the night, in fog, or bad weather. The birds use several orientation systems: the stars, the sun, the site-specific recognition and the geomagnetic field [48]. The illumination of the towers probably attracts the birds in the darkness, but it is possible that the accidents take place in circumstances of little visibility, because at the time, other navigational tools are not available. The perception to the terrestrial magnetic field can be altered by the electromagnetic radiation from the antennae. The reports of carrier pigeons losing direction in the vicinity of cellsites are numerous, and more investigation is necessary.

In the United Kingdom, where the allowed radiation levels are 20 times higher than those of Spain, a decline of several species of urban birds has recently taken place [56], coinciding with the increasing installations of cellsites. Although this type of contamination is considered at the present time by some experts as the most serious [4], inspection systems and controls have never been developed to avoid their pernicious effects on living organisms. Some of the biological mechanisms of the effects of these waves are still ignored [12], although the athermal effects on organisms have been sufficiently documented. The telephone industry could be taking advantage of the complexity of the biological and physical processes implied, to create an innocuous atmosphere, repeatedly denying the existence of harmful effects in living organisms. For this reason the reports related to animals are of special value, since in this case it can never be alleged that the effects are psychosomatic [3].

Future investigation should be carried out with long-term monitoring of the breeding success, of the sleeping places and of the uses of the habitat for species more vulnerable to the microwaves. Of special interest should be investigations that try to make correlations with the radiofrequency electromagnetic field measurements. Field studies investigating populations of urban parks and territories surrounding cellsites should be a high-priority. A radius of 1 sq K and the layout of concentric lines at intermediate distances can be useful to investigate differential results among areas depending on their vicinity and the radiation levels. We consider that the birds most affected from the microwave electromagnetic contamination could be:

1) those bound to urban environments with more sedentary customs, in general those that spend more time in the vicinity of the base stations;
2) those that live or breed in high places, more exposed to the radiation and at higher power density levels;
3) those that breed on open structures where the radiation impacts directly on adults and chicks in the nest;
4) those that spend the night outside of holes or structures that attenuate the radiation.

In far away areas, where the radiation decreases progressively, the chronic exposure can also have long term effects [13, 49]. Effects from antennas on the habitat of birds are difficult to quantify, but they can cause a serious deterioration, generating silent areas without male singers or reproductive couples. The deterioration of the ecosystem can also take place from the impact of the radiation on the populations of invertebrate prey [54, 57, 58] and on the plants [59].

Bioelectromagnetics is historically a frontier discipline. Controversy is frequent when the scientists recognize serious effects on health and on the environment that cause high economic losses. Independent investigators state the necessity of a drastic reduction of the emmitted power levels on people and the ecosystems and that it is technically viable although more expensive for the industry [4, 22, 60]. Our opinion is that areas of continuous use should never exist at the height of the antennas either inside the beam or within a radius of several hundreds meters. The restriction to exposure to fauna presents special complexity; the main reason for the drastic reduction in the emission power of the antennae is presented as the only viable and effective solution to prevent these effects. Some authors have already propose that we are withessing a paradigm change in biology [61].

Acknowledgment

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Jonathan Bishop

From: judy V. [venturemind@hotmail.com]
Sent: Friday, May 23, 2008 4:50 PM
To: Jonathan Bishop
Subject: Environmental Impact Analysis: New Requirement for Cell Towers (USA)

Subject: Fw: Environmental Impact Analysis: New Requirement for Cell Towers (USA)

Here is an article published February 21, 2008, on a new D.C. Circuit Court of Appeals ruling requiring the Fec Communications Commission to conduct Environmental Impact Assessments of cell towers on migratory birds b granting permits. Projecting forward, this ruling could be a new opening to raise concerns over other effects of t radiation. We believe this is a significant move forward as it is a crack in the veneer created by the mobile phor the Telecommunications Act of 1996 where EISs were explicitly excluded. Expect the mobile phone industry to begin legislative moves to counter this high court decision....Stay tuned.....

WILDLIFE: Cell towers must protect birds, U.S. court rules *(02/19/2008*

Allison Winter, *E&ENews PM* reporter

The government must require cell phone towers to be equipped with protection for migratory birds, a federal cou

The split decision by the U.S. Circuit Court of Appeals for the District of Columbia says that the Federal Commu Commission illegally licensed 6,000 towers along the Gulf Coast. The court says the agency must reassess tho: make sure the communications towers comply with the Endangered Species Act and National Environmental P

The decision addresses FCC's ruling on towers in the Gulf of Mexico, but lawyers who argued for environmenta case said it could have broader reach for all of the agency's permits on new communications towers.

"The reason we think it's significant is that it directs FCC to carefully review the environmental impact of towers issue the permits," said Steve Roady, a lawyer with Earthjustice.

Two members of the three-judge panel said FCC should consult with wildlife experts and require environmental assessments for the towers. The court also said FCC failed to sufficiently involve the public in its tower approva Circuit Judge Brett Kavanaugh dissented. He said the suit was premature because FCC is re-examining the issu migratory birds and towers in in a separate, broader rulemaking.

"The Catch-22 for the interested parties ... is that the commission provides public notice of individual tower appl after approving them," Judges Judith Rogers and Merrick Garland wrote in their majority opinion.

The American Bird Conservancy and other environmental groups had sued FCC in an effort to block the commu towers along the Gulf Coast, a major migratory corridor for birds. The group says 5 million to 50 million birds are year in collisions and other accidents with communications towers.

"We are very pleased by today's ruling, which will require the FCC to assess the environmental impacts of towe Schroeder of the American Bird Conservancy. "Given the large number of bird deaths caused by towers, an env review is long overdue." He added that the decision a "huge victory" for birds.

Aviation lights on communications towers can attract and confuse birds, especially in foggy conditions, environn Groups say birds could be saved if FCC would change its requirements for lighting on the towers, placing white over the constant red lights, to alert the birds. Some industry groups say the lighting schemes would be expensi questionable benefits.

Click here to read the decision.

CCC Exhibit 5
(page 45 of 57 pages)

CCC Exhibit C
(page 46 of 57 pages)

THREAT OF HARMFUL EFFECTS

ON MIGRATORY BIRDS AND ENDANGERED SPECIES

FROM PROPOSED BEEBE HILL CELL TOWER

Statement Submitted to

Connecticut Siting Council

At Public Hearing

October 12, 2006

By

Janet Newton

President of The EMR Policy Institute

A non-profit educational organization

506 Thistle Hill Road, Marshfield, VT 05658

Introduction

1. I am President of The EMR Policy Institute, Inc., an independent non-profit educational organization whose headquarters are located at 506 Thistle Hill Road, Marshfield VT. This statement is submitted in accordance with the stated mission of The EMR Policy Institute:

> The EMR Policy Institute Mission Statement
>
> We believe that the unfettered use of electromagnetic radiation (EMR) — radiofrequency/microwave radiation (RF/MW) present in all wireless and communications technologies, as well as the extremely low frequencies (ELF) present in power-line supplies — is ill advised given research that has accumulated over the last two decades. The Mission of The EMR Policy Institute is to foster a better understanding of the environmental and human biological effects from such exposures. Our goal is to work at the federal, state and international levels to foster appropriate, unbiased research and to create better cooperation between federal regulatory agencies with a responsibility for public health in order to mitigate unnecessary exposures that may be deemed to be hazardous.
>
> To implement its Mission, The EMR Policy Institute maintains a public website [www.emrpolicy.org] where it posts studies and reports from around the worked on the biological effects of low-intensity RF radiation. The EMR Policy Institute also provides technical assistance to individuals and local groups. It has provided such assistance to this property owner and offers to provide the same to the Connecticut Siting Council and to other persons interested in the cell tower issues in this proceeding. Our goal is to encourage the fullest possible public disclosure and understanding of the biological effects of RF radiation from wireless and communications technologies and to encourage federal research into those effects.

2. The purpose of this statement is to call the Siting Council's attention to various scientific studies published in scholarly periodicals relating to biological and other physical effects caused by low-power density signals transmitted by cell towers, and in particular as proposed to be transmitted from the Beebe Hill Cell Tower, which is the subject of this hearing. To avoid duplication, the statement refers to studies already marked as exhibits by the Petitioner (many of which were supplied by The EMR Policy Institsute as part of its technical assistance).

3. This statement focuses on biological effects relating to migratory birds and endangered species.

Radiofrequency Radiation Power Density Calculations for Beebe Hill Tower Site

4. Attention is directed to the radiofrequency radiation power density calculations compiled by Alfred R. Hislop, MSEE[1] in Attachment "A", which show power densities at various distances from the

[1] Mr. Hislop is an electronics engineer with more than 30 years of experience in microwave and millimeter wave technologies. He has designed and patented components that are currently is use sending signals back from deepest space in order to map the universe. See attached *curriculum vitae*.

Beebe Hill Cell Tower, based on the specifications in Petition 701 approved by the Connecticut Siting Council in January, 2005.

Biological Effects on Wildlife from Exposure to Low Intensity Radiofrequency Radiation

5. The proposed Beebe Hill cell tower threatens to destroy wildlife habitats; kill large numbers of nesting and migratory birds; disrupt natural food chains; and jeopardize frogs, other amphibians, and rare plants in Connecticut's most unique inland wetland.

6. Scientific studies from nations around the world establish beyond any reasonable doubt that low-power cell tower high frequency radiation, comparable to the specifications for the proposed cell tower on Beebe Hill, has produced many of these biological results in carefully monitored field studies.

7. People everywhere have witnessed in despair the wholesale disappearance and deformity of frogs and many other wildlife species. While all of the causes are not yet known, there is powerful evidence that the proliferation of wireless telecommunications is a least one of the causes of this tragic phenomenon with transmitters operating from towers just like this one with no precautions of any kind to minimize impacts on the environment.

8. The record before the Siting Council in this proceeding contains the proof that supports this conclusion. The starting point is Attachment A, containing expert projections of the power density levels at various distances from the Beebe Hill cell tower. These power density levels can easily be compared to the power densities observed in the existing studies of adverse effects from prolonged exposure of birds and wildlife at exactly these same power densities.

9. Comparing these calculations to the scientific study of irreversible infertility in mice in Thessalonika, Greece caused by radiofrequency radiation shows that the same power densities that caused this result will extend 488 meters out from the Beebe hill cell tower -- the equivalent of five football fields long – destroying a major food supply for several species of endangered and migratory birds. (See Exhibit 13A.)

10. Similarly, comparing these projected power densities to the scientific study of infertility among nesting white storks in Valladolid, Spain, shows that this same infertility for nesting birds can be expected within 300 meters of the Beebe Hill tower. (Exhibit 13; Attachment "B")

11. By making similar comparisons of power densities to the power levels in other studies, the conclusion is inescapable that the Beebe Hill cell tower will potentially have the following harmful effects on the wildlife and endangered species in that area:

Harm to Migratory Birds

12. More than two hundred species of migratory birds use the Beebe Hill area as a flyway to feeding grounds in the Hollenbeck River watershed and Robbins Swamp in their annual trips from Central and South America and the Southern United States. The Beebe Hill cell tower is located near the center of this flyway and will produce significant tower kills

of these birds by disorienting birds in their flight patterns, especially at night, through disruption of neurons in the brain and by creating a false magnetic field. (Exhibits 10, 11, 11A and 17B.)

Harm to Nesting Birds

13. As noted, scientific studies in Spain have demonstrated the destructive effects of cell tower radiation on the reproduction of offspring by nesting birds. (Exhibits 12 and 13).

Harm to Food Supplies

14. We have also pointed out the destructive effects on mice of cell tower radiation at very low power densities. There are also studies of impacts on insects, another major food source for birds and various other species of wildlife. (Exhibit 13A).

Harm to Frogs and Other Amphibians

15. No one has established for certain why so many deformed frogs have appeared in recent years, or why there has been a sharp worldwide decline in frogs, but there is a reasonable basis for concluding that the cause may be resonance arising from constant cell tower radiation. Creatures, objects, and physical cavities measuring one-half of any radiofrequency wavelength will resonate when bombarded by signals at that frequency. In the case of the Beebe Hill cell tower, the frequency will be 851 megahertz, with a wavelength of 13.879 inches. (Attachment "A") A half wavelength will therefore measure 6.94 inches. Any bird, frog, salamander, plant, leaf, insect, or ground creature that is approximately 7 inches long will resonate when bombarded by this tower radiation at 851 megahertz. The Wood Turtle, for example, is directly in this size range (Exhibit 23A), and Mud Puppies can reach a full wavelength (Exhibit 22A).The resonance effect builds up a "hot spot" of substantially increased power (and heat) in the center of the resonating object. For birds, frogs, and salamanders this hot spot often coincides with the location of their reproductive organs, potentially causing destruction of eggs or deformities in offspring.

The Coupling Factor

16. One other negative impact from cell towers is caused by the proposed location of this telecommunications mast on top of an existing stanchion carrying power lines. These lines can serve as carriers or "wave guides" to convey the cell tower radiation a considerable distance, until they reach a bend or other obstruction. (Attachment "C") It is to be noted that there are two nearby bends in the power lines north of Beebe Hill, both over the Hollenbeck River watershed, habitat for many endangered species (Exhibit 15d).

Harm to Endangered Species

17. Harmful biological effects from the Beebe Hill cell tower are particularly significant because of the presence of large numbers of endangered species recorded by the Connecticut Department of Environmental Protection (DEP) (Exhibit 17 A). These are protected by state law which is being disregarded by the proposed erection of this tower.

18. In addition the DEP's written records of listed species, bird naturalist John McNeely has noted the presence of the following rare species within a two-mile radius form the Beebe Hill cell tower:

Sharp-shinned Hawk
Whip-poor-will
Hedge Wren
Raven
Kestrel
Snipe
Bobolink
Alder Flycatcher
Meadowlark
Henslow's Sparrow
Golden-winged Warbler

19. All of these protected species will be threatened by the constant exposure to radiation from the proposed Beebe Hill cell tower, seven days a week, 24 hours a day each day.

20. There are numerous studies documenting harmful biological effects from low power densities that will be evidenced at two miles or more from the proposed Beebe Hill cell tower: (Exhibit 36). Nothing has been proposed in this proceeding to minimize this damage to rare and endangered species.

Sworn to before me

This _____ day October, 2006

_____ _____

Notary Public Janet Newton

Alfred R. Hislop, MSEE
Pacific Millimeter Products
Golden, CO
303-526-7866
www.pacificmillimeter.com

Beebe Hill Cell Tower
Calculations of Power Density and Resonance Factors
Based on Nextel Communications Petition 701
Before the Connecticut Siting Council

Power Density Levels Calculated from Beebe Hill Cell Tower Site

Exhibit "D" to Nextel Petition 701 specifies an Effective Radiated Power (ERP) of 1200 watts at a frequency of 851MHz. Based on these specifications, at the following distances from the Beebe Hill cell tower, power densities in the main beam of the antenna would be:

Distances in meters from the tower	Power Density in microwatts/cm squared
100 meters	4.0
200 meters	1.0
300 meters	.445
400 meters	.251
488 meters	.168
500 meters	.160
600 meters	.111
700 meters	.082
800 meters	.063
900 meters	.049
1000 meters	.040
1609 meters (1.0 miles)	.015
2414 meters (1.5 miles)	.007
3219 meters (2.0 miles)	.004

Resonance Factors Generated from the Beebe Hill Cell Tower

The wavelength for 851 MHz radiofrequency radiation is 13.879 inches. One-half wavelength at this frequency is 6.94 inches. Resonating objects measuring one full wavelength would develop two "hot spots", each at about one fourth of the distance from each end (about 3.5 inches). Resonating objects measuring one-half wavelength would develop one "hot spot" in the center (about 3.5 inches).

Prepared by:

A. R. Hislop

Alfred R. Hislop
Date: September 20, 2006

Attachments: 1. Exhibit D to Nextel Petition 2. Alfred R. Hislop *Curriculum vitae*

ATTACHMENT "A"

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PACIFIC
MILLIMETER
PRODUCTS

The formula used to calculate RF power densities is taken from FCC OET Bulletin 65, and is

$$S = \frac{33.4 \times ERP}{R^2}$$

Where
S is power density in microwatts/centimeter squared
ERP is effective radiated power in watts
R is distance from antenna in meters

A. R. Hislop

Alfred R. Hislop

September 20, 2006

PACIFIC MILLIMETER PRODUCTS
64 LOOKOUT MOUNTAIN CIRCLE, GOLDEN, CO. 80401
TEL (303) 526-7866 FAX (303) 526-7865

Canaan, CT (145 Beebe Hill Rd.) CT3667 - CT Siting Council Power Density Calculations

Nextel Directional Antennas ESMR - 851 MHz at centerline 120' AGL ***

Only 120' centerline will be used for worst case purposes

Transmitters:	Frequency in MHz	CT Standard mW/ cm²	Number of Channels	ERP (W) per channel	Centerline of Tx antennas AGL (ft.)	Power density calculated at base of tower	% of CT Standard
						Note: Power densities are in mW/ cm²	
Nextel Digital ESMR	851	0.5673	12	100	114	0.033185596	5.8494%
Total % of CT Standard							5.8494%

** Nextel antenna centerline is 120' adjusted to 114' per OET 65 Bulliten for 6' average head height.

EXHIBIT D

CCC Exhibit C
(page 54 of 57 pages)

Alfred R. Hislop

BSEE California Polytechnic College, Pomona, 1971

MSEE University of California, Irvine, 1973

Engineer, Naval Ocean Systems Center, San Diego, CA. 1972-1987

UHF Technology Group: Designed spread spectrum communications systems.

Microwave and Antennas Group: Designed and developed microwave antennas and radar systems, including three dimensional high resolution imaging radars.

Millimeter Wave Technology Group: Designed and developed millimeter wave components, radars, surveillance receivers and communications systems.

1984-present: Owner, Pacific Millimeter Products.

Design millimeter wave components for use in ground and space based radio astronomy, test instrumentation, communication systems, anti-collision radar and fusion plasma diagnostics.

Patents:

4,286,229	Multiple Frequency Oscillator
4,433,314	Millimeter Wave Multiplexer
4,492,960	Switching Mixer
4,873,501	Transmission Line Notch Filter Element

Publications:

"A Broadband 40-60 GHz Balanced Mixer," IEEE Transactions on Microwave Theory and Techniques, Volume 24, No. 1, pp 63 & 64, January, 1976.

"An 88-100 GHz Receiver Front-End," IEEE 1979 International Symposium on Microwave Theory and techniques, digest pp 222 & 223.

"Millimeter Wave Coupled Line Filters," Microwave Journal, October, 1980, pp 67-78.

"Suspended Substrate Ka Band Multiplexer," Microwave Journal, June, 1981, pp 73-77.

"A Compact, Low-Cost 60 GHz Communicator," IEEE 1982 International Symposium on Microwave Theory and Techniques, digest pp 231 & 232.

Table 1

Intensity of electric field, total and partial productivity in the nests within 200m and further than 300m to the phone mast

Nests within 200m				Nests further than 300m			
Nest	Number of young	EMF (V/m)	EMF (uw/cm^2)	Nest	Number of young	EMF (V/m)	EMF (uw/cm^2)
1	2	0.8	0.17	1	1	0.4	.042
2	2	0.6	.095	2	2	0.7	0.13
3	0	0.8	0.17	3	1	1.3	0.45
4	3	1.5	.597	4	1	1.1	0.32
5	1	1.7	.767	5	1	0.6	.095
6	2	2.9	2.23	6	3	0.4	.042
7	1	3.1	2.55	7	2	0.6	.095
8	1	1.3	0.45	8	2	0.7	0.13
9	1	1.3	0.45	9	3	0.6	.095
10	1	2.8	2.08	10	1	0.7	0.13
11	1	1.8	0.86	11	2	0.8	.17
12	3	3.2	2.72	12	2	0.3	.024
13	1	1.6	0.68	13	3	0.1	.003
14	0	2.7	1.93	14	1	0.6	.095
15	0	2.3	1.40	15	2	0.5	.066
16	0	2.7	1.93	16	3	0	0
17	0	2.5	1.66	17	2	0.3	.024
18	0	3.5	3.25	18	1	0.8	.17
19	0	3.5	3.25	19	2	0.2	.011
20	0	2.7	1.93	20	0	0.8	.17
21	0	2.9	2.23	21	2	0.2	.011
22	2	3.2	2.72	22	1	0.6	.095
23	0	2.5	1.66	23	1	0.5	.066
24	1	2.6	1.79	24	1	0.7	0.13
25	1	2.4	1.53	25	1	1.4	0.52
26	0	2.2	1.28	26	2	0.1	.003
27	1	2.6	1.79	27	1	0.1	.003
28	1	3.1	2.55	28	2	0.2	.011
29	1	3.1	2.55	29	1	0	0
30	0	3.0	2.39	30	1	0.6	.095

ATTACHMENT "B"

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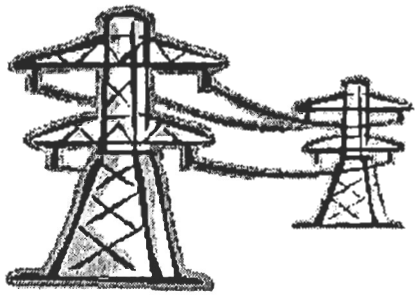
(page 56 of 57 pages)

A radiating panel antenna located on a transmission pole near utility wires provides radiation and possible near field electromagnetic coupling to the horizontal utility wires through well known surface wave propagation on open wire insulated or non insulated conductors. Such surface wave propagation along the pole wires may propagate for considerable distances with the utilit wire acting essentially as a waveguide. The fields cling to the wire surface as the field propagates. Generally speaking, some radiation of electromagnetic energy may occur from the wire but the radiation pattern is in the wire direction and not broadside as i a conventional dipole antenna. When the wave hits a termination (discontinuity) or is at a bend in the wire radiation may occur in directions away from the wire. The strength or weakness of radiation field derived from the propagating wave along the outer surface of the utility wire wave is very complex. Frequencies of the radiating panel, the intensity distribution and polarization of the near field and radiation pattern of the panel antenna relative to the transmission wire locations in space dictate how strong the energy coupling may be.



The really characteristic feature of the surface wave is its non-radiating property except at bends in the wires and at connection points such as pole transformers and/or capacitors, etc. Imagine the "wings of a butterfly" as representing the radiation pattern of a conventional dipole antenna. Surface wave radiation would represent a butterfly at rest with wings tucked toward its body. The pattern of electromagnetic energy hugs the wire surface. At discontinuities, such as referenced above, the wings open up representing radiation of surface wave energy from the discontinuity.

The pole wires can be thought of conduits for the conveyance of some microwave energy from the panel antenna to end points or termination points This energy has the possibility of entering buildings that are connected to the power lines at various remote locations from the original site of the pole mounted panel antenna.

In summary, surface wave electromagnetic coupling is a definite possibility for pole mounted antennas in proximity to insulated wir transmission lines. However, the resultant radiation of this energy is weak except at wire bends and connections to other pole mounted electrical devices such as transformers and capacitors. The induced microwave currents in the lines may propagate over considerable distances without significant attenuation and represent radiofrequency interference problems with equipment such as computers or electronic control circuitry. The radiation fields from discontinuities would be significantly less, in general, than that provided by the pole mounted antenna itself.

Ray Kasevich PE.

8/21/2006

ATTACHMENT "C"

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(page 57 of 57 pages)

Sprint Nextel • Proposed Base Station (Site No. SN60xc186B)
1337 Los Osos Valley Road • San Luis Obispo, California

Statement of Hammett & Edison, Inc., Consulting Engineers

The firm of Hammett & Edison, Inc., Consulting Engineers, has been retained on behalf of Sprint Nextel, a personal wireless telecommunications carrier, to evaluate the base station (Site No. SN60xc186B) proposed to be located at 1337 Los Osos Valley Road in San Luis Obispo, California, for compliance with appropriate guidelines limiting human exposure to radio frequency ("RF") electromagnetic fields.

Prevailing Exposure Standards

The U.S. Congress requires that the Federal Communications Commission ("FCC") 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 Congressionally chartered National Council on Radiation Protection and Measurements ("NCRP"). Separate limits apply for occupational and public exposure conditions, with the latter limits generally five times more restrictive. The more recent Institute of Electrical and Electronics Engineers ("IEEE") Standard C95.1-2005, "Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz," includes similar exposure limits. A summary of the FCC's exposure limits is shown in Figure 1. These limits apply for continuous exposures and are intended to provide a prudent margin of safety for all persons, regardless of age, gender, size, or health.

The most restrictive limit for exposures of unlimited duration to radio frequency energy for several personal wireless services are as follows:

Personal Wireless Service	Approx. Frequency	Occupational Limit	Public Limit
Personal Communication ("PCS")	1,950 MHz	5.00 mW/cm^2	1.00 mW/cm^2
Cellular Telephone	870	2.90	0.58
Specialized Mobile Radio	855	2.85	0.57
[most restrictive frequency range]	30–300	1.00	0.20

General Facility Requirements

Base stations typically consist of two distinct parts: the electronic transceivers (also called "radios" or "cabinets") that are connected to the traditional wired telephone lines, and the passive antennas that send the wireless signals created by the radios out to be received by individual subscriber units. The transceivers are often located at ground level and are connected to the antennas by coaxial cables about 1 inch thick. Because of the short wavelength of the frequencies assigned by the FCC for wireless services, the antennas require line-of-sight paths for their signals to propagate well and so are

CCC Exhibit D
(page 1 of 6 pages)

installed at some height above ground. The antennas are designed to concentrate their energy toward the horizon, with very little energy wasted toward the sky or the ground. Along with the low power of such facilities, this means that it is generally not possible for exposure conditions to approach the maximum permissible exposure limits without being physically very near the antennas.

Computer Modeling Method

The FCC provides direction for determining compliance in its Office of Engineering and Technology Bulletin No. 65, "Evaluating Compliance with FCC-Specified Guidelines for Human Exposure to Radio Frequency Radiation," dated August 1997. Figure 2 attached describes the calculation methodologies, reflecting the facts that a directional antenna's radiation pattern is not fully formed at locations very close by (the "near-field" effect) and that at greater distances the power level from an energy source decreases with the square of the distance from it (the "inverse square law"). The conservative nature of this method for evaluating exposure conditions has been verified by numerous field tests.

Site and Facility Description

Based upon information provided by Sprint Nextel, including zoning drawings by SAC Wireless, dated March 27, 2007, it is proposed to mount three Andrew directional panel PCS antennas on the commercial building located at 1337 Los Osos Valley Road in San Luis Obispo. One Model RR65-15-02DP antenna and one Model RR85-19-VDPL2 antenna would be mounted with 2° downtilt behind the penthouse wall at an effective height of about 28 1/2 feet above ground, 5 1/2 feet above the roof, and would be oriented toward the west and north, respectively. One RR65-15-08DP antenna would be mounted with 2° downtilt behind the southeastern wall of the building, above the second floor, at an effective height of about 27 1/2 feet above ground, and would be oriented toward the southeast. The maximum effective radiated power in any direction for Sprint Nextel would be 1,230 watts, representing two channels operating simultaneously at 615 watts each. There are reported no other wireless telecommunications base stations nearby.

Study Results

For a person anywhere at ground, the maximum ambient RF exposure level due to the proposed Sprint Nextel operation is calculated to be 0.013 mW/cm^2, which is 1.3% of the applicable public limit. The maximum calculated level at the second-floor elevation of any nearby building* is 3.6% of the applicable public limit; the maximum calculated level at the second-floor elevation inside the subject building is 1.7% of the public limit. It should be noted that these results include several "worst-case"

* Located at least 90 feet away, based on aerial photographs from Terraserver.

assumptions and therefore are expected to overstate actual power density levels. Power density levels may exceed the public limit on the roof of the subject building near the antennas.

Recommended Mitigation Measures

Due to their mounting locations, the Sprint Nextel antennas are not accessible to the general public, and so no mitigation measures are necessary to comply with the FCC public exposure guidelines. To prevent occupational exposures in excess of the FCC guidelines, no access within 6 feet in front of the Sprint Nextel antennas themselves, such as might occur during building maintenance activities, should be allowed while the site is in operation, unless other measures can be demonstrated to ensure that occupational protection requirements are met. Posting explanatory warning signs† at roof access location(s) and on the screen in front of each antenna, such that the signs would be readily visible from any angle of approach to persons who might need to work within that distance, would be sufficient to meet FCC-adopted guidelines.

Conclusion

Based on the information and analysis above, it is the undersigned's professional opinion that the base station proposed by Sprint Nextel at 1337 Los Osos Valley Road in San Luis Obispo, California, 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 calculated level in publicly accessible areas is much less than the prevailing standards allow for exposures of unlimited duration. This finding is consistent with measurements of actual exposure conditions taken at other operating base stations.

† Warning signs should comply with OET-65 color, symbol, and content recommendations. 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.

Sprint Nextel • Proposed Base Station (Site No. SN60xc186B)
1337 Los Osos Valley Road • San Luis Obispo, California

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, 2007. 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.

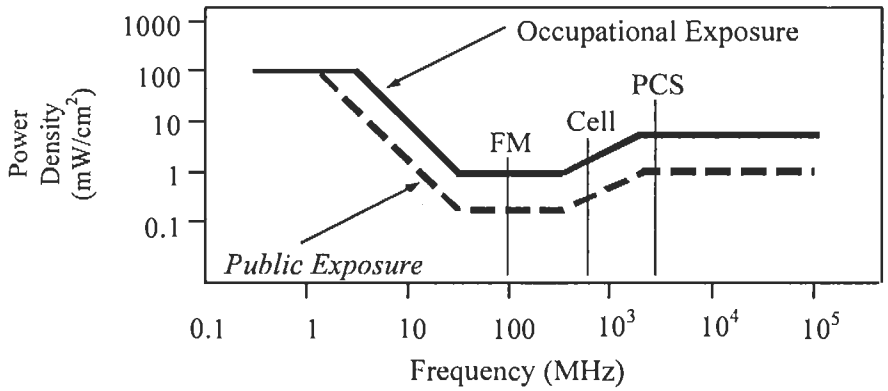
April 25, 2007

FCC Radio Frequency Protection Guide

The U.S. Congress required (1996 Telecom Act) the Federal Communications Commission ("FCC") to adopt a nationwide human exposure standard to ensure that its licensees do not, cumulatively, have a significant impact on the environment. The FCC adopted the limits from Report No. 86, "Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields," published in 1986 by the Congressionally chartered National Council on Radiation Protection and Measurements, which are similar to the more recent Institute of Electrical and Electronics Engineers Standard C95.1-2005, "Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz." These limits apply for continuous exposures from all sources and are intended to provide a prudent margin of safety for all persons, regardless of age, gender, size, or health.

As shown in the table and chart below, separate limits apply for occupational and public exposure conditions, with the latter limits (in *italics* and/or dashed) up to five times more restrictive:

Frequency	Electromagnetic Fields (f is frequency of emission in MHz)					
Applicable Range (MHz)	Electric Field Strength (V/m)		Magnetic Field Strength (A/m)		Equivalent Far-Field Power Density (mW/cm^2)	
0.3 – 1.34	614	*614*	1.63	*1.63*	100	*100*
1.34 – 3.0	614	*823.8/f*	1.63	*2.19/f*	100	*180/f^2*
3.0 – 30	1842/ f	*823.8/f*	4.89/ f	*2.19/f*	900/ f^2	*180/f^2*
30 – 300	61.4	*27.5*	0.163	*0.0729*	1.0	*0.2*
300 – 1,500	$3.54\sqrt{f}$	*$1.59\sqrt{f}$*	$\sqrt{f}/106$	*$\sqrt{f}/238$*	f/300	*f/1500*
1,500 – 100,000	137	*61.4*	0.364	*0.163*	5.0	*1.0*



Higher levels are allowed for short periods of time, such that total exposure levels averaged over six or thirty minutes, for occupational or public settings, respectively, do not exceed the limits, and higher levels also are allowed for exposures to small areas, such that the spatially averaged levels do not exceed the limits. However, neither of these allowances is incorporated in the conservative calculation formulas in the FCC Office of Engineering and Technology Bulletin No. 65 (August 1997) for projecting field levels. Hammett & Edison has built those formulas into a proprietary program that calculates, at each location on an arbitrary rectangular grid, the total expected power density from any number of individual radio sources. The program allows for the description of buildings and uneven terrain, if required to obtain more accurate projections.

RFR.CALC™ Calculation Methodology

Assessment by Calculation of Compliance with FCC Exposure Guidelines

The U.S. Congress required (1996 Telecom Act) the Federal Communications Commission ("FCC") to adopt a nationwide human exposure standard to ensure that its licensees do not, cumulatively, have a significant impact on the environment. The maximum permissible exposure limits adopted by the FCC (see Figure 1) apply for continuous exposures from all sources and are intended to provide a prudent margin of safety for all persons, regardless of age, gender, size, or health. Higher levels are allowed for short periods of time, such that total exposure levels averaged over six or thirty minutes, for occupational or public settings, respectively, do not exceed the limits.

Near Field.
Prediction methods have been developed for the near field zone of panel (directional) and whip (omnidirectional) antennas, typical at wireless telecommunications base stations, as well as dish (aperture) antennas, typically used for microwave links. The antenna patterns are not fully formed in the near field at these antennas, and the FCC Office of Engineering and Technology Bulletin No. 65 (August 1997) gives suitable formulas for calculating power density within such zones.

For a panel or whip antenna, power density $S = \frac{180}{\theta_{BW}} \times \frac{0.1 \times P_{net}}{\pi \times D^2 \times h}$, in mW/cm^2,

and for an aperture antenna, maximum power density $S_{max} = \frac{0.1 \times 16 \times \eta \times P_{net}}{\pi \times h^2}$, in mW/cm^2,

where θ_{BW} = half-power beamwidth of the antenna, in degrees, and
P_{net} = net power input to the antenna, in watts,
D = distance from antenna, in meters,
h = aperture height of the antenna, in meters, and
η = aperture efficiency (unitless, typically 0.5-0.8).

The factor of 0.1 in the numerators converts to the desired units of power density.

Far Field.
OET-65 gives this formula for calculating power density in the far field of an individual RF source:

$$\text{power density } S = \frac{2.56 \times 1.64 \times 100 \times RFF^2 \times ERP}{4 \times \pi \times D^2}, \text{ in } mW/cm^2,$$

where ERP = total 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 x 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 100 in the numerator converts to the desired units of power density. This formula has been built into a proprietary program 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 uneven terrain in the vicinity, to obtain more accurate projections.

Federal Communications Commission
Office of Engineering & Technology

Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields

OET Bulletin 65

Edition 97-01

August 1997

CCC Exhibit E
(page 1 of 24 pages)

Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields

OET BULLETIN 65
Edition 97-01

August 1997

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NOTE: Mention of commercial products does not constitute endorsement by the Federal Communications Commission or by the authors.

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Cellular Telecommunications Industry Association
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INTRODUCTION

This revised OET Bulletin 65 has been prepared to provide assistance in determining whether proposed or existing transmitting facilities, operations or devices comply with limits for human exposure to radiofrequency (RF) fields adopted by the Federal Communications Commission (FCC). The bulletin offers guidelines and suggestions for evaluating compliance. ***However, it is not intended to establish mandatory procedures, and other methods and procedures may be acceptable if based on sound engineering practice.***

In 1996, the FCC adopted new guidelines and procedures for evaluating environmental effects of RF emissions. The new guidelines incorporate two tiers of exposure limits based on whether exposure occurs in an occupational or "controlled" situation or whether the general population is exposed or exposure is in an "uncontrolled" situation. In addition to guidelines for evaluating fixed transmitters, the FCC adopted new limits for evaluating exposure from mobile and portable devices, such as cellular telephones and personal communications devices. The FCC also revised its policy with respect to categorically excluding certain transmitters and services from requirements for routine evaluation for compliance with the guidelines.

This bulletin is a revision of the FCC's OST Bulletin 65, originally issued in 1985. Although certain technical information in the original bulletin is still valid, this revised version updates other information and provides additional guidance for evaluating compliance with the the new FCC policies and guidelines. The bulletin is organized into the following sections: Introduction, Definitions and Glossary, Background Information, Prediction Methods, Measuring RF Fields, Controlling Exposure to RF Fields, References and Appendices. Appendix A provides a summary of the new FCC guidelines and the requirements for routine evaluation. Additional information specifically for use in evaluating compliance for radio and television broadcast stations is included in a supplement to this bulletin (Supplement A). A supplement for the Amateur Radio Service will also be issued (Supplement B), and future supplements may be issued to provide additional information for other services. This bulletin and its supplements may be revised, as needed.

In general, the information contained in this bulletin is intended to enable an applicant to make a reasonably quick determination as to whether a proposed or existing facility is in compliance with the limits. In addition to calculations and the use of tables and figures, Section 4, dealing with controlling exposure, should be consulted to ensure compliance, especially with respect to occupational/controlled exposures. In some cases, such as multiple-emitter locations, measurements or a more detailed analysis may be required. In that regard, Section 3 on measuring RF fields provides basic information and references on measurement procedures and instrumentation.

For further information on any of the topics discussed in this bulletin, you may contact the FCC's RF safety group at: +1 202 418-2464. Questions and inquiries can also be e-mailed to: rfsafety@fcc.gov. The FCC's World Wide Web Site provides information on FCC decision documents and bulletins relevant to the RF safety issue. The address is: www.fcc.gov/oct/rfsafety.

DEFINITIONS AND GLOSSARY OF TERMS

The following specific words and terms are used in this bulletin. These definitions are adapted from those included in the American National Standards Institute (ANSI) 1992 RF exposure standard [Reference 1], from NCRP Report No. 67 [Reference 19] and from the FCC's Rules (47 CFR § 2.1 and § 1.1310).

Average (temporal) power. The time-averaged rate of energy transfer.

Averaging time. The appropriate time period over which exposure is averaged for purposes of determining compliance with RF exposure limits (discussed in more detail in Section 1).

Continuous exposure. Exposure for durations exceeding the corresponding averaging time.

Decibel (dB). Ten times the logarithm to the base ten of the ratio of two power levels.

Duty factor. The ratio of pulse duration to the pulse period of a periodic pulse train. Also, may be a measure of the temporal transmission characteristic of an intermittently transmitting RF source such as a paging antenna by dividing average transmission duration by the average period for transmissions. A duty factor of 1.0 corresponds to continuous operation.

Effective radiated power (ERP) (in a given direction). The product of the power supplied to the antenna and its gain relative to a half-wave dipole in a given direction.

Equivalent Isotropically Radiated Power (EIRP). The product of the power supplied to the antenna and the antenna gain in a given direction relative to an isotropic antenna.

Electric field strength (E). A field vector quantity that represents the force (**F**) on an infinitesimal unit positive test charge (**q**) at a point divided by that charge. Electric field strength is expressed in units of volts per meter (V/m).

Energy density (electromagnetic field). The electromagnetic energy contained in an infinitesimal volume divided by that volume.

Exposure. Exposure occurs whenever and wherever a person is subjected to electric, magnetic or electromagnetic fields other than those originating from physiological processes in the body and other natural phenomena.

Exposure, partial-body. Partial-body exposure results when RF fields are substantially nonuniform over the body. Fields that are nonuniform over volumes comparable to the human body may occur due to highly directional sources, standing-waves, re-radiating sources or in the near field. See **RF "hot spot".**

Far-field region. That region of the field of an antenna where the angular field distribution is essentially independent of the distance from the antenna. In this region (also called the free space region), the field has a predominantly plane-wave character, i.e., locally uniform distribution of electric field strength and magnetic field strength in planes transverse to the direction of propagation.

Gain (of an antenna). The ratio, usually expressed in decibels, of the power required at the input of a loss-free reference antenna to the power supplied to the input of the given antenna to produce, in a given direction, the same field strength or the same power density at the same distance. When not specified otherwise, the gain refers to the direction of maximum radiation. Gain may be considered for a specified polarization. Gain may be referenced to an isotropic antenna (dBi) or a half-wave dipole (dBd).

General population/uncontrolled exposure. For FCC purposes, applies to human exposure to RF fields when the general public is exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Therefore, members of the general public always fall under this category when exposure is not employment-related.

Hertz (Hz). The unit for expressing frequency, (*f*). One hertz equals one cycle per second.

Magnetic field strength (H). A field vector that is equal to the magnetic flux density divided by the permeability of the medium. Magnetic field strength is expressed in units of amperes per meter (A/m).

Maximum permissible exposure (MPE). The rms and peak electric and magnetic field strength, their squares, or the plane-wave equivalent power densities associated with these fields to which a person may be exposed without harmful effect and with an acceptable safety factor.

Near-field region. A region generally in proximity to an antenna or other radiating structure, in which the electric and magnetic fields do not have a substantially plane-wave character, but vary considerably from point to point. The near-field region is further subdivided into the reactive near-field region, which is closest to the radiating structure and that contains most or nearly all of the stored energy, and the radiating near-field region where the radiation field predominates over the reactive field, but lacks substantial plane-wave character and is complicated in structure. For most antennas, the outer boundary of the reactive near field region is commonly taken to exist at a distance of one-half wavelength from the antenna surface.

Occupational/controlled exposure. For FCC purposes, applies to human exposure to RF fields when persons are exposed as a consequence of their employment and in which those persons who are exposed have been made fully aware of the potential for exposure and can exercise control over their exposure. Occupational/controlled exposure limits also apply where exposure is of a transient nature as a result of incidental passage through a location where exposure levels may be above general population/uncontrolled limits (see definition above), as long as the exposed person has been made fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

Peak Envelope Power (PEP). The average power supplied to the antenna transmission line by a radio transmitter during one radiofrequency cycle at the crest of the modulation envelope taken under normal operating conditions.

Power density, average (temporal). The instantaneous power density integrated over a source repetition period.

Power density (S). Power per unit area normal to the direction of propagation, usually expressed in units of watts per square meter (W/m^2) or, for convenience, units such as milliwatts per square centimeter (mW/cm^2) or microwatts per square centimeter ($\mu W/cm^2$). For plane waves, power density, electric field strength (E) and magnetic field strength (H) are related by the impedance of free space, i.e., 377 ohms, as discussed in Section 1 of this bulletin. Although many survey instruments indicate power density units ("far-field equivalent" power density), the actual quantities measured are E or E^2 or H or H^2.

Power density, peak. The maximum instantaneous power density occurring when power is transmitted.

Power density, plane-wave equivalent or far-field equivalent. A commonly-used terms associated with any electromagnetic wave, equal in magnitude to the power density of a plane wave having the same electric (E) or magnetic (H) field strength.

Radiofrequency (RF) spectrum. Although the RF spectrum is formally defined in terms of frequency as extending from 0 to 3000 GHz, for purposes of the FCC's exposure guidelines, the frequency range of interest in 300 kHz to 100 GHz.

Re-radiated field. An electromagnetic field resulting from currents induced in a secondary, predominantly conducting, object by electromagnetic waves incident on that object from one or more primary radiating structures or antennas. Re-radiated fields are sometimes called "reflected" or more correctly "scattered fields." The scattering object is sometimes called a "re-radiator" or "secondary radiator".

RF "hot spot." A highly localized area of relatively more intense radio-frequency radiation that manifests itself in two principal ways:

(1) The presence of intense electric or magnetic fields immediately adjacent to conductive objects that are immersed in lower intensity ambient fields (often referred to as re-radiation), and

(2) Localized areas, not necessarily immediately close to conductive objects, in which there exists a concentration of RF fields caused by reflections and/or narrow beams produced by high-gain radiating antennas or other highly directional sources. In both cases, the fields are characterized by very rapid changes in field strength with distance. RF hot spots are normally associated with very nonuniform exposure of the body (partial body exposure). This is not to be confused with an actual thermal hot spot within the absorbing body.

Root-mean-square (rms). The effective value, or the value associated with joule heating, of a periodic electromagnetic wave. The rms value is obtained by taking the square root of the mean of the squared value of a function.

Scattered radiation. An electromagnetic field resulting from currents induced in a secondary, conducting or dielectric object by electromagnetic waves incident on that object from one or more primary sources.

Short-term exposure. Exposure for durations less than the corresponding averaging time.

Specific absorption rate (SAR). A measure of the rate of energy absorbed by (dissipated in) an incremental mass contained in a volume element of dielectric materials such as biological tissues. SAR is usually expressed in terms of watts per kilogram (W/kg) or milliwatts per gram (mW/g). Guidelines for human exposure to RF fields are based on SAR thresholds where adverse biological effects may occur. When the human body is exposed to an RF field, the SAR experienced is proportional to the squared value of the electric field strength induced in the body.

Wavelength (λ). The wavelength (λ) of an electromagnetic wave is related to the frequency (f) and velocity (v) by the expression $v = f\lambda$. In free space the velocity of an electromagnetic wave is equal to the speed of light, i.e., approximately 3×10^8 m/s.

Section 1: BACKGROUND INFORMATION

FCC Implementation of NEPA

The National Environmental Policy Act of 1969 (NEPA) requires agencies of the Federal Government to evaluate the effects of their actions on the quality of the human environment.[1] To meet its responsibilities under NEPA, the Commission has adopted requirements for evaluating the environmental impact of its actions.[2] One of several environmental factors addressed by these requirements is human exposure to RF energy emitted by FCC-regulated transmitters and facilities.

The FCC's Rules provide a list of various Commission actions which may have a significant effect on the environment. If FCC approval to construct or operate a facility would likely result in a significant environmental effect included in this list, the applicant for such a facility must submit an "Environmental Assessment" or "EA" of the environmental effect including information specified in the FCC Rules. It is the responsibility of the applicant to make an initial determination as to whether it is necessary to submit an EA.

If it is necessary for an applicant to submit an EA that document would be reviewed by FCC staff to determine whether the next step in the process, the preparation of an Environmental Impact Statement or "EIS," is necessary. An EIS is only prepared if there is a staff determination that the action in question will have a significant environmental effect. If an EIS is prepared, the ultimate decision as to approval of an application could require a full vote by the Commission, and consideration of the issues involved could be a lengthy process. Over the years since NEPA implementation, there have been relatively few EIS's filed with the Commission. This is because most environmental problems are resolved in the process well prior to EIS preparation, since this is in the best interest of all and avoids processing delays.

Many FCC application forms require that applicants indicate whether their proposed operation would constitute a significant environmental action under our NEPA procedures. When an applicant answers this question on an FCC form, in some cases documentation or an explanation of how an applicant determined that there would ***not*** be a significant environmental effect may be requested by the FCC operating bureau or office. This documentation may take the form of an environmental statement or engineering statement that accompanies the application. Such a statement is ***not*** an EA, since an EA is only submitted if there is evidence for a significant environmental effect. In the overwhelming number of cases, applicants attempt to mitigate any potential for a significant environmental effect before submission of either an environmental statement or an EA. This may involve informal

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[1] National Environmental Policy Act of 1969, 42 U.S.C. Section 4321, et seq.

[2] See 47 CFR § 1.1301, et seq.

consultation with FCC staff, either prior to the filing of an application or after an application has been filed, over possible means of avoiding or correcting an environmental problem.

FCC Guidelines for Evaluating Exposure to RF Emissions

In 1985, the FCC first adopted guidelines to be used for evaluating human exposure to RF emissions.[3] The FCC revised and updated these guidelines on August 1, 1996, as a result of a rule-making proceeding initiated in 1993.[4] The new guidelines incorporate limits for Maximum Permissible Exposure (MPE) in terms of electric and magnetic field strength and power density for transmitters operating at frequencies between 300 kHz and 100 GHz. Limits are also specified for localized ("partial body") absorption that are used primarily for evaluating exposure due to transmitting devices such as hand-held portable telephones. Implementation of the new guidelines for mobile and portable devices became effective August 7, 1996. For other applicants and licensees a transition period was established before the new guidelines would apply.[5]

The FCC's MPE limits are based on exposure limits recommended by the National Council on Radiation Protection and Measurements (NCRP)[6] and, over a wide range of frequencies, the exposure limits developed by the Institute of Electrical and Electronics Engineers, Inc., (IEEE) and adopted by the American National Standards Institute (ANSI) to

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[3] *See Report and Order,* GEN Docket No. 79-144, 100 FCC 2d 543 (1985); and *Memorandum Opinion and Order,* 58 RR 2d 1128 (1985). The guidelines originally adopted by the FCC were the 1982 RF protection guides issued by the American National Standards Institute (ANSI).

[4] See *Report and Order*, ET Docket 93-62, FCC 96-326, adopted August 1, 1996, 61 Federal Register 41,006 (1996), 11 FCC Record 15,123 (1997). The FCC initiated this rule-making proceeding in 1993 in response to the 1992 revision by ANSI of its earlier guidelines for human exposure. The Commission responded to seventeen petitions for reconsideration filed in this docket in two separate Orders: *First Memorandum Opinion and Order,* FCC 96-487, adopted December 23, 1996, 62 Federal Register 3232 (1997), 11 FCC Record 17,512 (1997); and *Second Memorandum Opinion and Order and Notice of Proposed Rulemaking,* adopted August 25, 1997.

[5] This transition period was recently extended. With the exception of the Amateur Radio Service, the date now established for the end of the transition period is October 15, 1997. See *Second Memorandum Opinion and Order and Notice of Proposed Rule Making,* ET Docket 93-62, adopted August 25, 1997. Therefore, the new guidelines will apply to applications filed on or after this date. For the Amateur Service only, the new guidelines will apply to applications filed on or after January 1, 1998. In addition, the Commission has adopted a date certain of September 1, 2000, by which time all existing facilities and devices must be in compliance with the new guidelines (see *Second Memorandum Opinion and Order*).

[6] *See Reference 20,* "Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields," NCRP Report No. 86 (1986), National Council on Radiation Protection and Measurements (NCRP), Bethesda, MD. The NCRP is a non-profit corporation chartered by the U.S. Congress to develop information and recommendations concerning radiation protection.

replace the 1982 ANSI guidelines.[7] Limits for localized absorption are based on recommendations of both ANSI/IEEE and NCRP. The FCC's new guidelines are summarized in Appendix A.

In reaching its decision on adopting new guidelines the Commission carefully considered the large number of comments submitted in its rule-making proceeding, and particularly those submitted by the U.S. Environmental Protection Agency (EPA), the Food and Drug Administration (FDA) and other federal health and safety agencies. The new guidelines are based substantially on the recommendations of those agencies, and it is the Commission's belief that they represent a consensus view of the federal agencies responsible for matters relating to public safety and health.

The FCC's limits, and the NCRP and ANSI/IEEE limits on which they are based, are derived from exposure criteria quantified in terms of specific absorption rate (SAR).[8] The basis for these limits is a whole-body averaged SAR threshold level of 4 watts per kilogram (4 W/kg), as averaged over the entire mass of the body, above which expert organizations have determined that potentially hazardous exposures may occur. The new MPE limits are derived by incorporating safety factors that lead, in some cases, to limits that are more conservative than the limits originally adopted by the FCC in 1985. Where more conservative limits exist they do not arise from a fundamental change in the RF safety criteria for whole-body averaged SAR, but from a precautionary desire to protect subgroups of the general population who, potentially, may be more at risk.

The new FCC exposure limits are also based on data showing that the human body absorbs RF energy at some frequencies more efficiently than at others. As indicated by Table 1 in Appendix A, the most restrictive limits occur in the frequency range of 30-300 MHz where whole-body absorption of RF energy by human beings is most efficient. At other frequencies whole-body absorption is less efficient, and, consequently, the MPE limits are less restrictive.

MPE limits are defined in terms of power density (units of milliwatts per centimeter squared: mW/cm^2), electric field strength (units of volts per meter: V/m) and magnetic field strength (units of amperes per meter: A/m). In the far-field of a transmitting antenna, where the electric field vector (E), the magnetic field vector (H), and the direction of propagation

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[7] *See Reference 1*, ANSI/IEEE C95.1-1992, "Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz." Copyright 1992, The Institute of Electrical and Electronics Engineers, Inc., New York, NY. The 1992 ANSI/IEEE exposure guidelines for field strength and power density are similar to those of NCRP Report No. 86 for most frequencies except those above 1.5 GHz.

[8] Specific absorption rate is a measure of the rate of energy absorption by the body. SAR limits are specified for both whole-body exposure and for partial-body or localized exposure (generally specified in terms of spatial peak values).

can be considered to be all mutually orthogonal ("plane-wave" conditions), these quantities are related by the following equation.[9]

$$S = \frac{E^2}{3770} = 37.7H^2 \qquad (1)$$

where: S = power density (mW/cm^2)
E = electric field strength (V/m)
H = magnetic field strength (A/m)

In the near-field of a transmitting antenna the term "far-field equivalent" or "plane-wave equivalent" power density is often used to indicate a quantity calculated by using the near-field values of E^2 or H^2 as if they were obtained in the far-field. As indicated in Table 1 of Appendix A, for near-field exposures the values of plane-wave equivalent power density are given in some cases for reference purposes only. These values are sometimes used as a convenient comparison with MPEs for higher frequencies and are displayed on some measuring instruments.

The FCC guidelines incorporate two separate tiers of exposure limits that are dependent on the situation in which the exposure takes place and/or the status of the individuals who are subject to exposure. The decision as to which tier applies in a given situation should be based on the application of the following definitions.

Occupational/controlled exposure limits apply to situations in which persons are exposed as a consequence of their employment and in which those persons who are exposed have been made fully aware of the potential for exposure and can exercise control over their exposure. Occupational/controlled exposure limits also apply where exposure is of a transient nature as a result of incidental passage through a location where exposure levels may be above general population/uncontrolled limits (see below), as long as the exposed person has been made fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means. As discussed later, the occupational/controlled exposure limits also apply to amateur radio operators and members of their immediate household.

General population/uncontrolled exposure limits apply to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Therefore, members of the general public would always be considered under this category when exposure is not employment-related, for example, in the case of a telecommunications tower that exposes persons in a nearby residential area.

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[9] Note that this equation is written so that power density is expressed in units of mW/cm^2. The impedance of free space, 377 ohms, is used in deriving the equation.

For purposes of applying these definitions, awareness of the potential for RF exposure in a workplace or similar environment can be provided through specific training as part of an RF safety program. Warning signs and labels can also be used to establish such awareness as long as they provide information, in a prominent manner, on risk of potential exposure and instructions on methods to minimize such exposure risk.[10] However, warning labels placed on low-power consumer devices such as cellular telephones are not considered sufficient to achieve the awareness necessary to qualify these devices as operating under the occupational/controlled category. In those situations the general population/uncontrolled exposure limits will apply.

A fundamental aspect of the exposure guidelines is that they apply to power densities or the squares of the electric and magnetic field strengths that are spatially averaged over the body dimensions. Spatially averaged RF field levels most accurately relate to estimating the whole-body averaged SAR that will result from the exposure and the MPEs specified in Table 1 of Appendix A are based on this concept. This means that local values of exposures that exceed the stated MPEs may not be related to non-compliance if the spatial average of RF fields over the body does not exceed the MPEs. Further discussion of spatial averaging as it relates to field measurements can be found in Section 3 of this bulletin and in the ANSI/IEEE and NCRP reference documents noted there.

Another feature of the exposure guidelines is that exposures, in terms of power density, E^2 or H^2, may be averaged over certain periods of time with the average not to exceed the limit for continuous exposure.[11] As shown in Table 1 of Appendix A, the averaging time for occupational/controlled exposures is 6 minutes, while the averaging time for general population/uncontrolled exposures is 30 minutes. It is important to note that for general population/uncontrolled exposures it is often not possible to control exposures to the extent that averaging times can be applied. In those situations, it is often necessary to assume continuous exposure.

As an illustration of the application of time-averaging to occupational/controlled exposure consider the following. The relevant interval for time-averaging for occupational/controlled exposures is six minutes. This means, for example, that during any given six-minute period a worker could be exposed to two times the applicable power density limit for three minutes as long as he or she were not exposed at all for the preceding or following three minutes. Similarly, a worker could be exposed at three times the limit for two minutes as long as no exposure occurs during the preceding or subsequent four minutes, and so forth.

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[10] For example, a sign warning of RF exposure risk and indicating that individuals should not remain in the area for more than a certain period of time could be acceptable. Reference [3] provides information on acceptable warning signs.

[11] Note that although the FCC did not explicitly adopt limits for ***peak*** power density, guidance on these types of exposures can be found in Section 4.4 of the ANSI/IEEE C95.1-1992 standard.

This concept can be generalized by considering Equation (2) that allows calculation of the allowable time(s) for exposure at [a] given power density level(s) during the appropriate time-averaging interval to meet the exposure criteria of Table 1 of Appendix A. The sum of the products of the exposure levels and the allowed times for exposure must equal the product of the appropriate MPE limit and the appropriate time-averaging interval.

$$\sum S_{exp} t_{exp} = S_{limit} t_{avg} \qquad (2)$$

where:
S_{exp} = power density level of exposure (mW/cm^2)
S_{limit} = appropriate power density MPE limit (mW/cm^2)
t_{exp} = allowable time of exposure for S_{exp}
t_{avg} = appropriate MPE averaging time

For the example given above, if the MPE limit is 1 mW/cm^2, then the right-hand side of the equation becomes 6 mW-min/cm^2 (1 mW/cm^2 X 6 min). Therefore, if an exposure level is determined to be 2 mW/cm^2, the allowed time for exposure at this level during any six-minute interval would be a total of 3 minutes, since the left side of the equation must equal 6 (2 mW/cm^2 X 3 min). Of course, many other combinations of exposure levels and times may be involved during a given time-averaging interval. However, as long as the sum of the products on the left side of the equation equals the right side, the ***average*** exposure will comply with the MPE limit. It is very important to remember that time-averaging applies to ***any*** interval of t_{avg}. Therefore, in the above example, consideration would have to be given to the exposure situation both before and after the allowed three-minute exposure. The time-averaging interval can be viewed as a "sliding" period of time, six minutes in this case.

Another important point to remember concerning the FCC's exposure guidelines is that they constitute ***exposure*** limits (not ***emission*** limits), and they are relevant only to locations that are ***accessible*** to workers or members of the public. Such access can be restricted or controlled by appropriate means such as the use of fences, warning signs, etc., as noted above. For the case of occupational/controlled exposure, procedures can be instituted for working in the vicinity of RF sources that will prevent exposures in excess of the guidelines. An example of such procedures would be restricting the time an individual could be near an RF source or requiring that work on or near such sources be performed while the transmitter is turned off or while power is appropriately reduced. In the case of broadcast antennas, the use of auxiliary antennas could prevent excessive exposures to personnel working on or near the main antenna site, depending on the separation between the main and auxiliary antennas. Section 4 of this bulletin should be consulted for further information on controlling exposure to comply with the FCC guidelines.

meter reading. Any significant change usually indicates pickup in the leads and interference problems. When a field strength meter or spectrum analyzer is used in the above environments, the antenna cable should occasionally be removed and replaced with an impedance matched termination. Any reading on the device indicates pickup or interference.

As noted previously, substantial errors may be introduced due to zero drift. If a device is being used which requires zeroing, it should frequently be checked for drift. This should be done with the probe shielded with metal foil, with the probe removed from the field or, ideally, with the source(s) shut off.

With regard to compliance with the FCC's guidelines in mixed or broadband fields where several sources and frequencies are involved, the fraction or percentage of the recommended limit for power density (or square of the field strength) incurred within each frequency interval should be determined, and the sum of all contributions should not exceed 1.0 or 100% (see discussion of this topic in Section 1 of this bulletin). As mentioned before, probes with "shaped" responses may be useful in these environments.

Section 4: CONTROLLING EXPOSURE TO RF FIELDS

Public Exposure: Compliance with General Population/Uncontrolled MPE Limits

Studies have indicated that the majority of the United States population is normally exposed to insignificant levels of RF radiation in the ambient environment (e.g. see References [22] and [30]). However, there are some situations in which RF levels may be considerably higher than the median background, and in those cases preventive measures may have to be taken to control exposure levels.

As discussed in Section 1 of this bulletin (also see Appendix A), the FCC's guidelines for exposure incorporate two tiers of limits, one for conditions under which the public may be exposed ("general population/uncontrolled" exposure) and the other for exposure situations usually involving workers ("occupational/controlled" exposure). Exposure problems involving members of the general public are generally less common than those involving persons who may be exposed at their place of employment, due to the fact that workers may be more likely to be in close proximity to an RF source as part of their job. However, if potential exposure of the general public is a problem there are several options available for ensuring compliance with the FCC RF guidelines.

In general, in order for a transmitting facility or operation to be out of compliance with the FCC's RF guidelines an area or areas where levels exceed the MPE limits must, first of all, be in some way ***accessible*** to the public or to workers. This should be obvious, but there is often confusion over an ***emission*** limit, e.g., a limit on field strength or power density

at a specified distance from a radiator that always applies, and an ***exposure*** limit, that applies anywhere people may be located. The FCC guidelines specify exposure limits not emission limits, and that distinction must be emphasized. This is why the accessibility issue is key to determining compliance. The MPE limits indicate levels above which people may not be safely exposed regardless of the location where those levels occur. When accessibility to an area where excessive levels is appropriately restricted, the facility or operation can certify that it complies with the FCC requirements.

Restricting access is usually the simplest means of controlling exposure to areas where high RF levels may be present. Methods of doing this include fencing and posting such areas or locking out unauthorized persons in areas, such as rooftop locations, where this is practical.[32] There may be situations where RF levels may exceed the MPE limits for the general public in remote areas, such as mountain tops, that could conceivably be accessible but are not likely to be visited by the public. In such cases, common sense should dictate how compliance is to be achieved. If the area of concern is properly marked by appropriate warning signs, fencing or the erection of other permanent barriers may not be necessary.[33]

In some cases, the time-averaging aspects of the exposure limits may be used by placing appropriate restrictions on occupancy in high-field areas. However, such restrictions are often not possible where continuous exposure of the public may occur. In general, time averaging of exposures is usually more practical in controlled situations where occupational exposure is the only issue.

Although restricting access may be the simplest and most cost-effective solution for reducing public exposure, other methods are also available. Such methods may be relevant for reducing exposure for both the general public and for workers. For example, modifications to antennas, elevating antennas on roof-top installations or incorporation of appropriate shielding can reduce RF fields in locations accessible to the public or to workers.

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[32] Standard radiofrequency hazard warning signs are commercially available from several vendors. They incorporate the format recommended by the American National Standards Institute (ANSI) as specified in ANSI C95.2-1982 (Reference [3]). Although the ANSI format is recommended, it is not mandatory. Complaints have been received concerning the lack of color durability in outdoor environments of the yellow triangle specified by ANSI. In that regard, long-lasting and clearly visible symbols are more important than the exact color used, and the use of the ANSI format with more durable colors may be more practical in certain environments. When signs are used, meaningful information should be placed on the sign advising of the potential for high RF fields. In some cases, it may be appropriate to also provide instructions to direct individuals as to how to work safely in the RF environment of concern. U.S. vendors of RF warning and hazard signs include: National Association of Broadcasters (800-368-5644), EMED Co., Inc. (800-442-3633) and Richard Tell Associates (702-645-3338).

[33] Regarding this issue, the Commission's Mass Media Bureau released a Public Notice, on January 28, 1986, entitled, "Further Guidance for Broadcasters Regarding Radiofrequency Radiation and the Environment," (No. 2278). This Notice lists several typical exposure situations around broadcast sites and explains what is expected of broadcast licensees and applicants with respect to ensuring compliance with the FCC's RF guidelines. This Notice may be useful as guidance for other antenna sites. A summary of the major points of the 1986 Public Notice are included as Appendix B of this bulletin. Also, another Public Notice, dealing primarily with occupational exposure, was issued by the Mass Media Bureau on August 19. 1992 (No. 24479).

With regard to antennas used for FM broadcast stations, the EPA found that there are several corrective measures that may be taken to reduce ground-level field strength and power density (Reference [11]). Some of these findings may also be relevant to other similar types of antenna systems. EPA's examination of measured elevation patterns for several different types of FM antennas has shown that some antennas direct much less radiation downward than others. Therefore, in some cases a change of antenna may be an appropriate way to reduce ground-level fields below a given level.

A more expensive, but also effective, approach for FM antennas involves modifying the array pattern by reducing the spacing between the radiating elements. The pattern of an FM antenna is the product of the element pattern and the array pattern. FM antennas typically use one-wavelength spacing between elements. Because the wave from each element adds in phase with all the other elements, at points directly beneath the elements the array pattern results in downward radiation that can be significant and, in the case of dipole elements, could equal that in the main beam. If the spacing is reduced to one-half wavelength spacing (for an antenna with an even number of bays), each wave will have a counterpart which is out-of-phase. This will result in a significant reduction in the energy radiated toward the ground.

The disadvantage of this method is that the shorter aperture that will occur with one-half wavelength spacing reduces the overall gain of the antenna. To maintain the original gain of the antenna, the number of elements (bays) has to be increased and, usually, doubled. Alternatively, the spacing between elements could be reduced so that waves from element (n) and from element (N/2 + n) are exactly out of phase, where n is a particular element in an array with a total of N bays.

Use of the latter method would result in a smaller increase in the total number of bays that would be necessary. However, EPA has noted that feeding such an array would be more difficult since the length of the transmission line between bays determines phasing. For one-half wave spacing, EPA suggests that criss-crossing the transmission line or turning alternate elements upside down will yield proper phasing.

The EPA's report (Reference [11]) contains a table showing suggested interbay spacings required to reduce downward radiation in the array pattern of FM antennas. Unfortunately, the optimum spacing may differ for different types of antennas. Coupling effects may occur at spacings of less than one wavelength that are not easy to predict theoretically. EPA has studied this problem, and Reference [11] also contains figures showing the effects of altering spacing for three types of FM antenna elements.

Another possible method for reducing downward radiation that has been suggested involves using 1.5-wavelength spacing between elements. This method reportedly results in little significant change in antenna gain.

Other actions that could be taken to reduce the potential for excessive exposure would be raising the height of an FM or TV antenna or relocating a broadcast tower. However, such

actions would have to take into account other factors including signal coverage, land use limitations, and air traffic safety.

In the case of television broadcast antennas, the EPA identified two methods for reducing potential exposure, besides the obvious method of restricting access discussed above. The first measure that might be taken, as with FM antennas, would be a change of antenna. EPA verified, for example, that arrays for VHF-TV antennas can be designed to minimize downward radiation to as little as 7% of the main beam field. However, such antennas apparently are at least twice as expensive as standard antennas. Antennas used for UHF-TV have very high gain in the main beam and radiate relatively little directly down toward the ground. Therefore, these antennas already are designed for minimum downward radiation. The remaining option for both VHF-TV and UHF-TV antennas would be an increase in antenna height above ground. However, this could involve the same difficulties as discussed above with regard to FM broadcast facilities.

With respect to AM radio broadcast stations, monopole antennas are used for transmissions. The MPE limits in the AM broadcast band (see Appendix A) are given in terms of electric and magnetic field strength, since significant exposures always occur in the near-field of these antenna systems. Electric and magnetic field strengths near monopole antennas decrease rapidly with increasing distance, and normally the MPE limits can only be exceeded very close-in to these antennas. Therefore, exposure problems due to AM radio antennas are usually those involving workers or others who have access to the immediate vicinity of these antennas (see discussion below).

Occupational Exposure: Compliance with Occupational/Controlled MPE Limits

Exposure to RF fields in the workplace or in other controlled environments usually presents different problems than does exposure of the general public. For example, with respect to a given RF transmitting facility, a worker at that facility would be more likely to be close to the radiating source than would a person who happens to live nearby. Although restricting access to high RF field areas is also a way to control exposures in such situations, this may not always be possible. In some cases a person's job may require him or her to be near an RF source for some part of the workday. Depending on the level and time of exposure this may present a problem with respect to compliance with the MPE limits.

In general, a locked rooftop or other appropriately restricted area that is only accessible to workers who are "aware of" and "exercise control over" their exposure would meet the criteria for occupational/controlled exposure, and protection would be required at the applicable occupational/controlled MPE limits for those individuals who have access to the rooftop. Persons who are only "transient" visitors to the rooftop, such as air conditioning technicians, etc., could also be considered to fall within the occupational/controlled criteria as long as they also are "made aware" of their exposure and exercise control over their exposure (see Appendix A for definitions of exposure tiers and MPE limits).

As explained in Section 1 of this bulletin, the MPE limits adopted by the FCC are ***time-averaged*** exposure limits. This means that the exposure duration should be taken into account when evaluating a given exposure situation, and this is especially relevant for cases of occupational/controlled exposure. For example, a person walking into an area where RF fields exceed the ***absolute*** MPE limit (in terms of field strength or power density) might not exceed the ***time-averaged*** MPE limit as long as the exposure was for an appropriately short period of time (relative to the time-averaging interval). However, if that person were to remain in the area for an extended period it is more probable that the time-averaged limit would be exceeded. Therefore, in order to comply with the FCC's guidelines, in some situations it may be necessary to limit exposure in certain areas to specific periods of time. For example, in workplace situations where extended maintenance tasks must be performed in areas where RF fields exceed MPE limits, the work may have to be divided up and carried out during several intervals of time so that the time-averaged exposure during each interval is acceptable. The actual exposure time allowed during any given interval would have to be determined by use of the appropriate averaging time specified in the guidelines (six-minutes for occupational exposure) as explained in Section 1.

In addition to time-averaging, other means are available for controlling exposures in occupational or controlled environments. These include reducing or shutting off power when work is required in a high RF area, switching to an auxiliary transmitter (if available) while work on a main system is in progress or incorporating appropriate shielding techniques to reduce exposure.

In multiple-transmitter environments, reducing power or RF shielding may be especially important for allowing necessary work procedures to be carried out. For example, on-tower exposures due to nearby co-located transmitting sources may be more significant when work on another station's tower is required. In such complex environments power reduction agreements may often be necessary to ensure that all licensees are aware of the potential for their station to expose other individuals at the site and site occupants are generally jointly responsible for compliance with FCC guidelines (see discussion of multiple-transmitter sites in Section 2 of this bulletin).

Although reduction of power at broadcasting and other telecommunications sites is one approach to reducing personnel exposure, this may not always be possible. For example, measurements have shown that relatively high RF fields may exist in the immediate vicinity of high-powered antennas such as those used at FM broadcast stations (Reference [25]). If power reduction or other measures are not practical, alternative means for protecting personnel from excessive exposure may be necessary when access to these areas is required. In such instances, the use of radiofrequency protective clothing may facilitate compliance with RF exposure guidelines even in the presence of intense RF fields.

Radiofrequency protective clothing has become commercially available in recent years that appears to effectively attenuate fields over a broad frequency band. This clothing has been manufactured into RF protective suits that cover the entire body of the user and allow him or her to perform maintenance and other procedures in the presence of RF fields that may

exceed MPE limits. A recent study performed for the FCC by Richard Tell Associates, Inc., concluded that if properly used by appropriately trained personnel, and with adequate coupling to ground potential, RF protective suits can provide significant reduction in whole-body RF absorption (Reference [29]).

Recently, direct measurements of reduction in SAR afforded by one RF protective suit were completed using a full-size human phantom filled with a dielectric fluid having the RF absorption characteristics of biological tissue.[34] The SAR was determined by scanning the interior of the body of the phantom with a robotically controlled miniature, isotropic electric-field probe with and without the suit covering the phantom. Near-field exposure conditions were duplicated at frequencies of 150 MHz, 450 MHz and 835 MHz. The measurement results supported the contention that the protective suit provides a nominal minimum reduction in SAR of 10 times or more. These measurements also were consistent with measurement data obtained by the Deutsche Telekom Technologiezentrum (German Telekom).[35]

Another observation from the tests performed by Tell is that the peak SAR in the unprotected head of the phantom clothed with the protective suit did not reach the SAR limit of 8 W/kg (localized partial-body exposure limit for occupational/controlled environments) until the 150-MHz near-field exposure was 23 times the most restrictive whole-body averaged MPE limit of 1.0 mW/cm^2. At 450 MHz, the maximum field incident on the unprotected head was found to be more than 11 times the applicable MPE limit of 1.5 mW/cm^2, and, at 835 MHz, more than 3 times the MPE limit of 2.8 mW/cm^2. Such data suggest that, at least in some environments, complete coverage of the body may not be necessary for compliance with MPE limits.

In general, the use of RF protective clothing may be considered an acceptable mitigation technique for occupational exposures as long as sufficient precautions are taken to comply with all of the clothing manufacturer's recommendations and caveats and to ensure that use of the clothing is confined to RF environments for which it is designed in terms of RF field intensity and frequency range. As with any personal protective equipment, RF protective clothing should be considered as a method of choice only when other engineering or administrative controls cannot be used to reduce exposure or are otherwise impractical. Those employing or supervising the wearer should ensure that the wearer has full knowledge of the proper use and limitations of the protective clothing being used. Also, users should be knowledgeable of the approximate RF environment before spending a prolonged period of time in areas where RF fields are believed to significantly exceed MPE limits. Users of RF protective clothing are cautioned that, in addition to evaluating RF field intensity and frequency considerations, they should routinely visually inspect the clothing material for

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[34] Tell, Richard A. (1996). *SAR Evaluation of the Naptex™ Suit for Use in the VHF and UHF Telecommunications Bands.* Presented at the International RF Safety Workshop, Schwangau, Germany, September 25-26.

[35] Heinrich, W. (1996). *Test Method for Determining the Attentuation of RF-protective Clothing.* Presented at the International RF Safety Workshop, Schwangau, Germany, September 24-26.

indications of substantial wear, such as tears and rips, that may reduce the clothing's effectiveness in reducing exposure. When users are climbing towers, special caution is advised regarding possible safety hazards from RF shocks and burns, trip hazards, decreased mobility/agility and reduced visibility (if a protective hood is worn) that may occur while climbing.

In addition to the issue of protective clothing, Tell's 1995 study for the FCC investigated the use of RF personal monitors that have become commercially available in recent years. These monitors are warning devices that are worn by the user and alert him or her by an audible or visible signal to the presence of RF fields that approach the MPE limits for occupational/controlled exposure. The Tell study concluded that such devices can act as reliable RF detectors and the device tested generally responded in accordance with the manufacturer's specifications. Such devices could be especially useful in areas where multiple transmitters are located and it may not be easy or possible to predict the presence of high RF fields. Work procedures could be instituted requiring the wearer of such a device to leave an area or take other precautions when the device alerts that an RF field approaching the MPE limit is present. These monitors can be a valuable component of an RF safety program. However, they should be viewed only as warning devices and should not be viewed as protective devices.

For workers who must occupy areas near AM broadcast antennas, MPE limits are normally only exceeded very close to an antenna. Even for a 50 kW transmitter, distances from an antenna of less than fifteen meters are required before field strengths are likely to approach the FCC limits (References [26] and [33]). For multiple-tower arrays the spacing between adjacent antennas would not be less than 35 meters, so that, as one antenna is approached, the contribution of field strength from other antennas in the array would decrease to relatively insignificant levels. However, if work on or immediately adjacent to a tower is required it may be necessary to designate zones within which a worker may remain for specified periods of time appropriate for compliance with the FCC limits.

Tuning circuits for AM broadcast antennas have been identified as a source of locally intense magnetic fields (Reference [31]). These magnetic fields decrease rapidly with distance from the tuning circuits but should be carefully considered when evaluating exposure very near the base of AM towers or at other locations where such coils may be located. It should be possible to locate the tuning circuits in such a way as to greatly reduce the potential for exposures exceeding the FCC magnetic field limits. For example, separating the circuits from normally accessible areas by a few meters should provide sufficient protection. Time-averaging exposure near such coils is another method for complying with the MPE limits.

Probably the most common means by which workers at AM radio stations may be exposed in excess of the FCC exposure guidelines occurs when persons must climb actively transmitting AM antennas to perform maintenance tasks. Measurement surveys and studies conducted by the FCC and the EPA have clearly indicated that significant RF currents exist in the body of a person climbing such a tower (References [6], [27], [28] and [32]). As addressed by the 1992 ANSI/IEEE standard, such currents can cause significant levels of RF

absorption in the body that can be well in excess of allowable SAR thresholds (see discussion in Section 1 of this bulletin).

Although the FCC RF exposure guidelines did not specifically adopt limits on RF body currents, evaluation of such currents is the only practical means to control exposure of persons climbing transmitting AM radio towers. The FCC and EPA studies referenced above include data and models that allow a correlation to be made between the power fed into an AM antenna and the potential current that will be induced in the body of a person climbing the antenna. This current can be correlated with the appropriate limit on whole-body absorption specified by the FCC's guidelines and thereby can be used as a guideline for the appropriate power reduction that an AM station must undertake when a person is on a tower. Further information and guidance on controlling such exposures can be found in Supplement A to this bulletin that is designed for radio and television broadcast applications.

With regard to maintenance of FM and TV broadcast transmitters and antennas, two situations are of particular interest and should be noted. Because currents and voltages in power amplifier cabinets can be lethal, it is common practice that cabinet doors be closed when the transmitter is on. However, it may not be recognized that at multiple station locations high RF field strengths can be encountered even when the transmitter being worked on is completely shut down. This is because the antenna for a particular station is likely to pick up high levels of energy from other stations. That energy can be conducted to the final amplifier cubicle and produce high field strengths and high voltages in the vicinity of the cubicle. Therefore, if measurements are made in a multistation environment this factor should be evaluated. If such induced field strength levels are found to be a problem, it should be possible to reduce them to acceptable levels by either opening the RF transmission line leading to the antenna or by bypassing the center conductor to ground of the coaxial line wherever access can be conveniently achieved.

With regard to protecting personnel at paging and cellular antenna sites, Motorola, in association with Richard Tell Associates, Inc., has developed a video for electromagnetic energy awareness that is focused on wireless telecommunications service providers. Although this video was originally produced for Motorola's use and is copyrighted, Motorola has decided to make this video commercially available to other interested industrial users.[36] Also, as mentioned earlier, software has been developed by various organizations for use in estimating RF levels and ensuring compliance at transmitter sites, particularly rooftop sites used for personal wireless, cellular and paging services.[37]

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[36] The title of the video is: "EME Awareness for Antenna Site Safety," ©Motorola, 1996. Copies are available in the U.S.A. from Stephen Tell Productions (702-396-5912), or from Narda Microwave Corporation, (516) 231-1700 (Narda Part No. 42929000).

[37] *See* footnote 23.