City of Arkansas City

PLANNING COMMISSION MEETING

Tuesday, April 11, 2023 at 5:30 PM | 400 W Madison Ave, Arkansas City, KS | Agenda

GoTo Meeting: https://meet.goto.com/886282301 or call:+18722403212 **Access Code:** 886-282-301

Call to Order: ____________

Roll Call:

- ☐ **Dr. Tyson Blatchford**
- ☐ **Lloyd Colston**
- ☐ **Brandon Jellings**
- ☐ **Ian Kuhn**
- ☐ **Kyle Lewis**
- ☐ **Cody Richardson**
- ☐ **Dotty Smith**
- ☐ **Tom Wheatley**

Declaration:
At this time, Planning Commission members are asked to make a declaration of any conflict of interest or of any Ex parte or outside communication that might influence their ability to hear all sides on any item on the agenda so they might come to a fair decision.

Public Comments:
Persons who wish to address the Planning Commission regarding items not on the agenda. Speakers will be limited to three (3) minutes. Any presentation is for information purposes only. No action will be taken.

Consent Agenda:

1. Meeting Minutes, **February 14, 2023 and March 14, 2023 meetings.**

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Public Hearings:

2. Consider the advisability of vacating all of Taylor Avenue adjoining Lot 1 of Block 15 and Lot 14 of Block 4, Sleeth Addition.

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Consideration:

3. Amateur Radio Antenna Height discussion

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Other Items:

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Adjournment: ____________

City of Arkansas City

PLANNING COMMISSION MEETING
MINUTES

Tuesday, February 14, 2023 at 5:30 PM – 400 W Madison Ave, Arkansas City, KS

Call to Order

Prior to Roll Call Tom Wheatley asked Josh White to say a brief prayer in honor of longtime Planning Commissioner Mary Benton who had recently passed away. White agreed and led a short prayer to start the meeting.

Roll Call

PRESENT: Lloyd Colston, Brandon Jellings, Kyle Lewis, Cody Richardson, Tom Wheatley
ABSENT: Mary Benton, Ian Kuhn

Staff present at roll call was Principal Planner Josh White. Also present was Ken Harader and Harper Jellings.

Consent Agenda

1. Meeting Minutes, **January 10, 2023 meeting.**

   Motion made by Jellings, Seconded by Colston to approve the minutes as written.
   Voting Yea: Colston, Jellings, Lewis, Richardson, Wheatley

Consideration

2. **Consider a recommendation on the proposed 2022 Comprehensive Plan updates**
   Wheatley asked if anyone from the public had any further comments. There were no comments. He then asked White to explain any changes made to the Plan since the last meeting. White said he added two actions, one in Chapter 3 concerning the development of housing plans and one in Chapter 5 concerning a facility plan for the library. Richardson also discussed the Recreation Center but ultimately it was decided that a plan was already being formulated for that facility.
   Motion made by Colston, Seconded by Wheatley to recommend approval of the 2022 Comprehensive Plan updates to the City Commission.
   Voting Yea: Colston, Jellings, Lewis, Richardson, Wheatley

Other Items

Wheatley discussed a letter that was sent to and read by the City Commission at a recent meeting. He said the intent of the letter was just to communicate the frustration regarding the land purchase of the 101 acre parcel. It was written by himself and Kuhn. They didn't intend for it to be read publicly but it since it was he wanted to discuss it. It was discussed that the Planning Commission wasn't necessarily asking to have a say in land purchases but that they would like to be informed about them. Members of the public chose to go to the next public meeting after that City Commission meeting and members were frustrated because they didn't have any knowledge of the proposed action. Ken Harader of 1313 N 1st Street expressed that he was just looking for more transparency and felt like the item was rushed. Commissioners acknowledged that the item was tabled. White also mentioned a grant was being applied for now that would pay for the purchase of the land and infrastructure and another grant would be used for down payment assistance for the buyers that would be future residents of a potential development just north of Forrest Glenn. Harader also mentioned that he would like to see public notices placed on the city website in addition to the required publication in the newspaper. White promised to look into that.

Adjournment

Motion made by Colston, Seconded by Wheatley to adjourn the meeting.
Voting Yea: Colston, Jellings, Lewis, Richardson, Wheatley

City of Arkansas City

PLANNING COMMISSION MEETING
MINUTES

Tuesday, March 14, 2023 at 5:30 PM – 400 W Madison Ave, Arkansas City, KS

Chairman Ian Kuhn called the meeting to order at 5:30 PM.

Prior to Roll Call, Josh White swore in Dotty Smith as Planning Commissioner.

Roll Call

Members of the board present for this meeting included Kyle Lewis, Cody Richardson, Lloyd Colston, Ian Kuhn, Dotty Smith and Tom Wheatley.

Public Comments

Landon West of Ark City Recreation Center spoke of the community survey the Recreation Center is a part of. He encouraged Planning Commissioners to participate in it and to share it with others.

Consent Agenda

1. Meeting Minutes, **February 14, 2023 Meeting.**
   No action was taken on the consent agenda. The minutes from February 14 will be approved at the April 11 meeting.

Consideration

2. **Participate in a Training Workshop.**
   Jim Kaup led the Planning Commission in a training session.

Adjournment

Dotty Smith made the motion to adjourn the meeting at 8:27 PM and Lloyd Colston made the second. The motion carried.

Planning Commission Agenda Item

Meeting Date: 4/11/23

From: Josh White, Principal Planner

Item: Taylor Ave Vacation

Purpose: Consider the advisability of vacating all of Taylor Avenue adjoining Lot 1 of Block 15 and Lot 14 of Block 4, Sleeth Addition.

Background:

Melody Vaden has filed a request to vacate a portion of Taylor Avenue between G & the alley to the west. She desires to expand her yard space and has been maintaining the area for some time. All adjacent property owners were notified. The Technical Advisory Committee noted that there are no utilities within the area to be vacated and has no concerns.

Staff recommends approval of the request to vacate the area.

- No private rights will be injured or endangered. No utilities are present within the area to be vacated. The alley will remain open and can be used for rear access to the adjacent properties as well as for utility maintenance.

Action:

Hold a public hearing, at the close of the hearing make a motion to recommend the City Commission approve/disapprove the request to vacate a all of Taylor Avenue adjoining Lot 1 of Block 15 and Lot 14 of Block 4, Sleeth Addition.

Attachments:

Staff Report

Presentation Link: https://arcg.is/0iHPHj0

STAFF REPORT

City of Arkansas City Neighborhood Services Division
Josh White, Principal Planner
118 W Central Ave, Arkansas City, KS 67005
Phone: 620-441-4420 Fax: 620-441-4403 Email: jwhite@arkansascityks.gov Website: www.arkcity.org

CASE NUMBER VR-2023-044	APPLICANT/PROPERTY OWNER Melody Vaden
PUBLIC HEARING DATE April 11, 2023	PROPERTY ADDRESS/LOCATION A portion of Taylor Ave from G Street west to the east line of the alley

SUMMARY OF REQUEST

Melody Vaden has filed a request to vacate a portion of Taylor Avenue between G & the alley to the west. She desires to expand her yard space and has been maintaining the area for some time. All adjacent property owners were notified. The Technical Advisory Committee noted that there are no utilities within the area to be vacated and has no concerns.

Map data ©2023 Esri World Topographic Map with overlays

EXISTING ZONING	EXISTING LAND USE	SURROUNDING ZONING & LAND USE	SITE IMPROVEMENTS	SIZE OF PROPERTY
Not applicable	Vacant, platted as street	North-R-2; Residential East-R-2; Residential South-R-2;Residential West-I-1; Industrial	Gravel drive	Approx 0.24 acres

STAFF RECOMMENDATION

Staff recommends **approval**.

TECHNICAL ADVISORY COMMITTEE COMMENTS

There are no utilities in the area to be vacated and no other concerns were expressed.

PROPERTY HISTORY

This area was platted in 1888. At some point the railroad right of way took over the west half of the blocks in this area. No other land use cases were found for this area.

NOTICE GIVEN

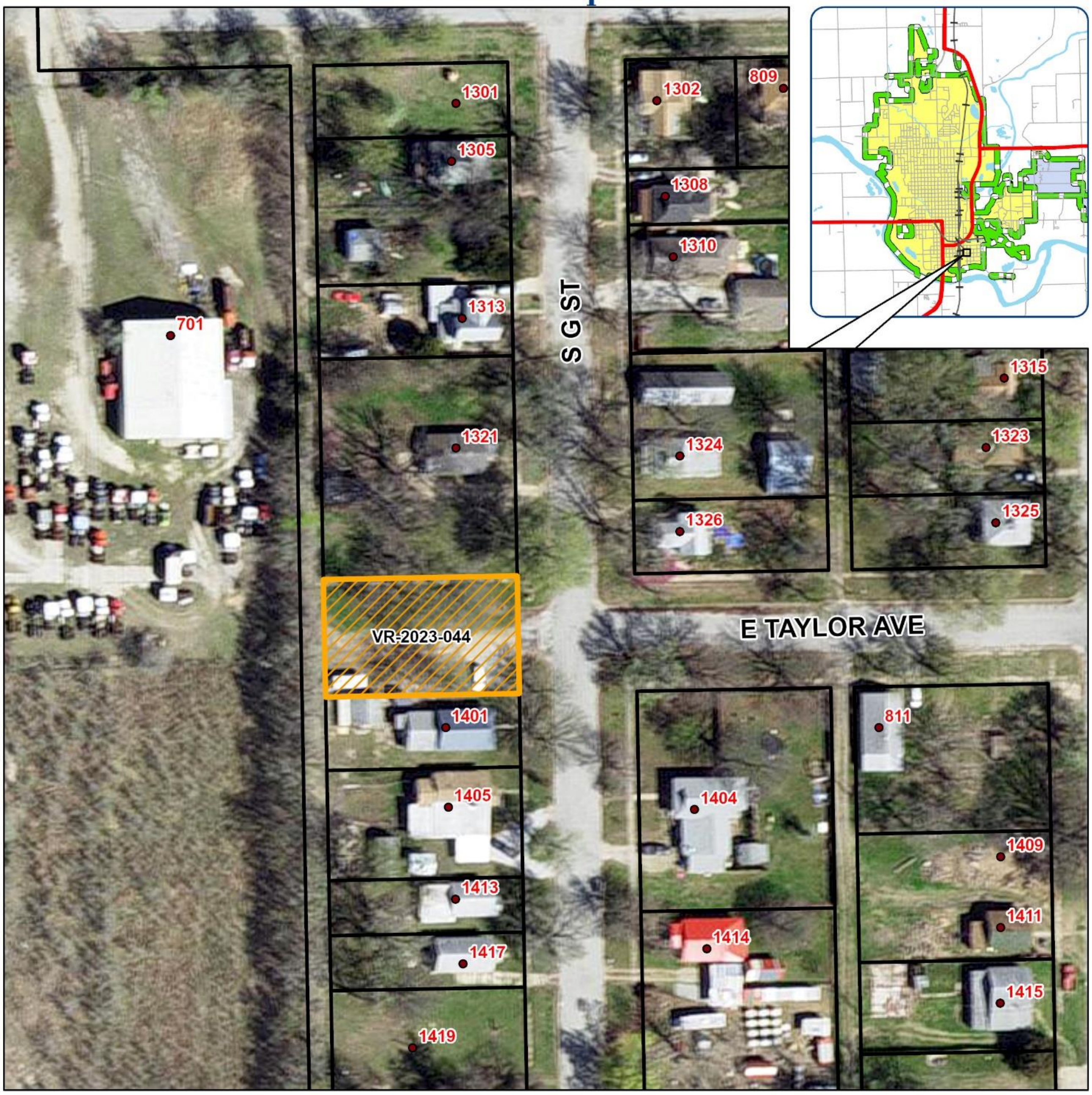
Proper notice was published in the newspaper. Notices were sent to the property owners within 200 feet.

PRIVATE RIGHTS /PUBLIC GAIN/LOSS

No private rights will be injured or endangered. No utilities are present within the area to be vacated. The alley will remain open and can be used for rear access to the adjacent properties as well as for utility maintenance.

Area map

Vacation Request



A request to vacate a portion of Taylor Avenue adjacent to Blocks 4 & 15, Sleeth Addition.

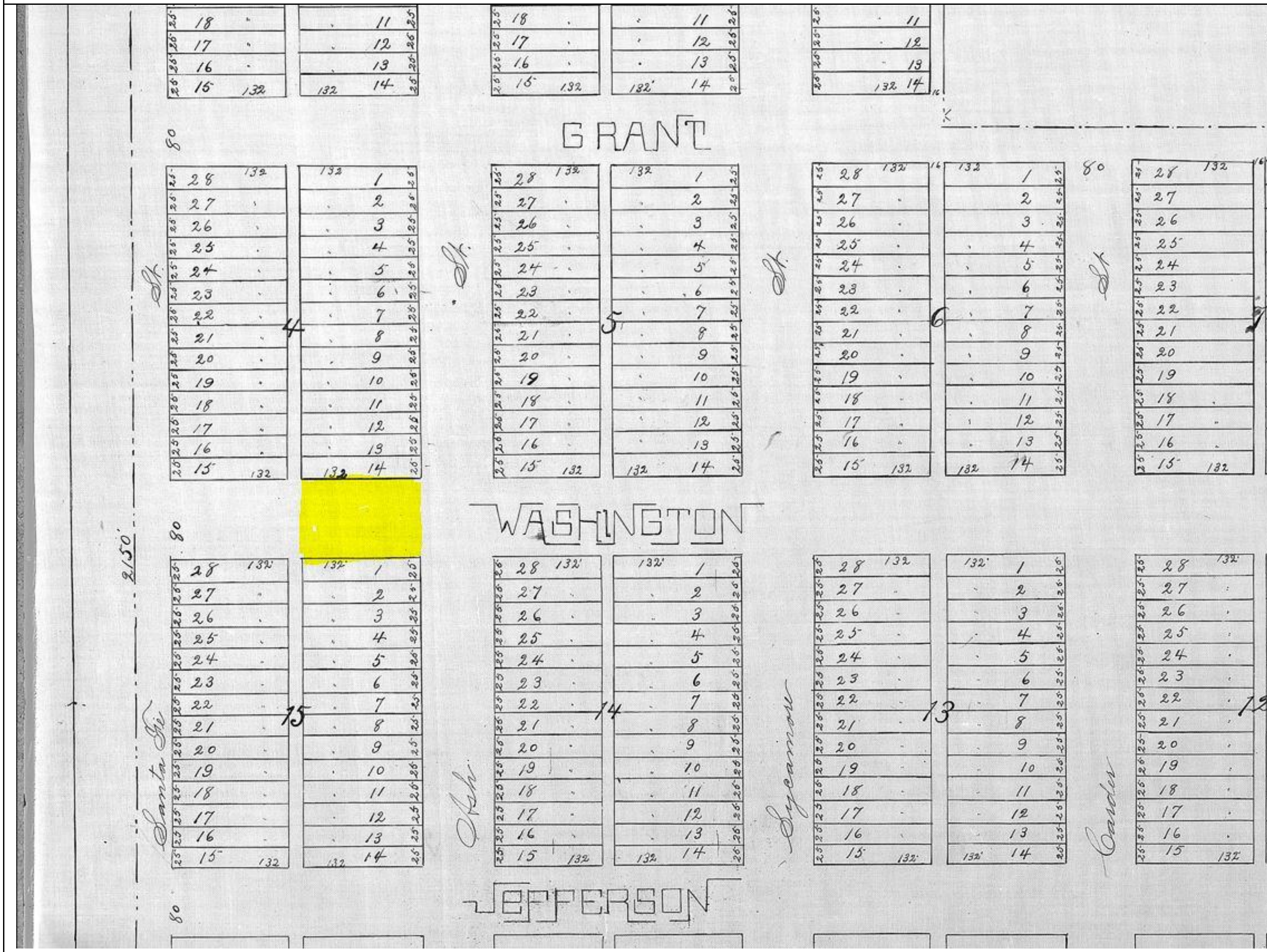
City Limits

Vacation Request

Property Lines

Produced by the
City of Arkansas City GIS
using the best available
data to date.
Created: February 21, 2023

Portion of Plat



This is a portion of the Sleeth Addition plat filed in 1888. Blocks 4 & 15 are located on the left of the image. The highlighted area shows the approximate location of the vacation request. Note that the name of the partial street to be vacated is Washington Avenue on this plat and was later renamed to Taylor Avenue. Also in this image, Grant Ave is now Polk Ave and Jefferson Avenue is now Filmore Avenue. Ash, Sycamore and Carder Streets are now G, H & J Streets respectively. The west half of Blocks 4 & 15 were vacated at some point although no records were found as to when this occurred. Santa Fe Street was vacated likely at the same time.

Neighborhood Photos

Taylor Avenue looking West

Taylor Avenue looking East

G Street looking South

G Street looking North

Alleyway provides sufficient access for utilities

Planning Commission Agenda Item

Meeting Date: 4/11/23

From: Josh White, Principal Planner

Item: Amateur Radio Antenna Height discussion

Purpose: Amateur Radio Antenna Height discussion

Background:

A group of area amateur radio operators including Planning Commissioner Lloyd Colston has suggested that the zoning regulations should be amended regarding the allowed height of amateur radio antenna. Staff have drafted some potential amendments but at this point, more discussion needs to be held before anything is moved forward to hearing.

Staff may also discuss upcoming proposed amendments if time permits.

Action:

Discuss the proposed amendments to the zoning regulations.

Attachments:

Proposed amendments

Proposed Amendments
~~Deletions structhrough in red~~
New provisions highlighted in italics

ARTICLE 20

SUPPLEMENTAL DISTRICT REGULATIONS

Sections:

SECTION 20-1 GENERAL

20-101. The regulations set forth in this article qualify or supplement, as the case may be, the district regulations appearing elsewhere in these regulations.

SECTION 20-2 HEIGHT AND YARD REGULATIONS

20-201

a. Height. Chimneys, cooling towers, elevator headhouses, fire towers, monuments, stacks, watertowers, or necessary mechanical appurtenances, usually required to be placed above the roof level and not intended for human occupancy, are not subject to the height limitations contained in the district regulations.

b. Yard.

1. *Front yards.* The front yards established by the district regulations are to be measured from the street right-of-way fronting a property, and shall be adjusted in the following cases:

(a) Where an official line has been established for the future widening or opening of a street or major thoroughfare upon which a lot abuts, the depth of a front or side yard shall be measured from such official line to the nearest line of the building.

(b) On through lots, the required front yard shall be provided on each street.

(c) Where a lot is located at the intersection of two (2) or more streets and there is a yard required on the side street, there shall be a yard of fifteen (15) feet on the side street. The yard on the side street shall not be greater than that of any other buildings on the side street within the same block, but the depth of the yard shall not be less than eight (8) feet on the side street.

(d) Open, unenclosed porches, platforms, or paved terraces, not covered by a roof or canopy and which do not extend above the level of the first floor of the building, may extend or project into the front and side yard not more than six (6) feet.

(e) Where twenty-five (25) percent or more of the street frontage or where twenty-five (25) percent or more of the street frontage within four hundred (400) feet of a property is improved with buildings that have a front yard that is six (6) feet greater or less than the required front yard in the district, no building shall project beyond the average front yard so established.

2. *Structural projections.* Every part of a required yard shall be open to the sky, unobstructed, except for accessory buildings or structures, and except for:

(a) Eave projections, sills, cornices and other ornamental features may project a maximum of twelve (12) inches into a required yard or setback.

(b) Open fire escapes, balconies opening onto a fire escape, chimneys and fireplaces may project no more than three and one-half (3.5) feet into a required side yard and five (5) feet into a required rear yard.

3. Additional setback requirements are set out at Section 20-11.

SECTION 20-3 NUMBER OF STRUCTURES ON A LOT

20-301. Where a lot is used for other than a single family residence, more than one principal use or structure may be located on such lot, provided that such buildings conform to all requirements for the district in which they are located, and all such buildings shall remain in single ownership unless such buildings and lots are certified as a condominium.

SECTION 20-4 CORNER VISIBILITY

20-401. Removal of Traffic Hazards. In all areas on public or private property at any corner formed by intersecting public streets, no traffic hazard shall be allowed by installing, setting out or maintaining or allowing the installation, setting out or maintenance of any sign, fence, hedge, shrubbery, natural growth or other obstruction to view, or the parking of any vehicle within that triangle formed as hereby described, such areas to be described as sight triangles:

a. Uncontrolled Intersections – Local Street to Local Street: A sight triangle is the triangular area formed by the intersection of two streets bound by two lines extending from the point of intersection along the edge of traveled way for a distance of 50 feet.

b. Uncontrolled Intersections – Local to Collector/Arterial: A sight triangle is the triangular area formed by the intersection of two streets bound by two lines extending from the point of intersection along the edge of traveled way for a distance 50 feet on the local street and 60 feet on the collector or arterial street.

c. Controlled Intersections – Partial Traffic Signalization/Signage: A sight triangle is the triangular area formed by the intersection of two streets bound by two lines extending from the point of intersection along the edge of traveled way for a distance of 25 feet on the street with the stop sign and 60 feet on the street with no traffic signage.

d. Controlled Intersections – Full Traffic Signalization or 4 Way Stop Signs: A sight triangle is the triangular area formed by the intersection of two streets bound by two lines extending from the point of intersection along the edge of traveled way for a distance of 25 feet.

20-402. Exceptions. The provisions of sight triangle shall not apply to those shrubs or bushes located within a designated sight triangle, the maximum height of which is less than three (3) feet measured from the established street level. For trees located within a sight triangle, a minimum height clearance for limbs and relative growth shall be trimmed for clearance of eight (8) feet from the established street level. Utility poles and equipment required for traffic control shall be exempt from this section's restrictions.

SECTION 20-5 SCREENING FOR COMMERCIAL AND INDUSTRIAL-ZONED PROPERTY

20-501. Commercial or industrial development adjacent to a residential zone shall be screened in accordance with the approved site plan.

SECTION 20-6 TEMPORARY USES

20-601.

a. Only the following temporary uses may be permitted.

1. Carnivals and circuses, located in a commercial or industrial zone or on public property, when located at least two hundred (200) feet from the boundary of a residential zone and for a time period not exceeding two (2) consecutive weeks.

2. Contractor's office and equipment sheds on the site of a construction project only during the construction period.

3. Model homes or development sales offices located within the subdivision or development area to which they apply, with such use to continue only until sale or lease of all units in the development.

4. Outdoor temporary sales on private property and not incorporated or in partnership with the existing business located on this property in a commercial or industrial zone, including commercial sales, swap meets or similar activities providing they do not operate for more than ten (10) consecutive days and there are no more than four (4) such sales on any one property in any calendar year.

5. One travel trailer or manufactured home to be used as a temporary office for any allowed use in an industrial or commercial zoning district, provided that such trailer or home shall not be used for more than a one year period starting the day the home is set upon the property.

b. Persons seeking approval for a temporary use authorized by items 1,2 and 4 in subsection a. of this section shall make application to the Zoning Administrator at least ten (10) days in advance of the time desired for usage. The Zoning Administrator may issue a certificate of temporary use upon the payment of the temporary use permit fee imposed by the fee ordinance and upon finding:

1. The temporary use will not impair the normal, safe and effective operation of any permanent use on the same or adjoining site.

2. The temporary use will not impact the public health, safety, or convenience and will not create traffic hazards or congestion or otherwise interrupt or interfere with the normal conduct of use and activities in the vicinity.

SECTION 20-7 ACCESSORY USES

20-701. Accessory uses are permitted in any zoning district in connection with any permitted principal use, consistent with the provisions of this section and section 20-8.

a. **Definitions.** An accessory use is a structure or use which:

1. Is subordinate to and serves a principal building and principal use.

2. Is subordinate in area, extent or purpose to the principal building or buildings served.

3. Contributes to the comfort, convenience or necessity of occupants, business or industry in the principal building or principal use served.

4. Is located on the same tract as the principal building or principal use served.

b. **Permitted accessory uses.** Any structure or use that complies with the terms of subsection a. of this article may be allowed as an accessory use or structure. Accessory structures and uses include, but are not limited to, the following:

1. Private garages and carports, whether detached or attached.

2. A structure for storage incidental to a permitted use.

3. A children's playhouse.

4. A private swimming pool and bathhouse.

5. A guest house or rooms for guests in an accessory building, provided such facilities are used for the occasional housing of

guests of the occupants of the principal building and not as rental units or permanent occupancy as house-keeping units.

6. Statuary, arbors, trellises, barbecue stoves, flagpoles, fences, walls, hedges and radio and television antennas.

7. Storm shelters.

8. Retail sales of products manufactured, processed or fabricated on site.

9. Storage of recreational equipment, such as boats, boat trailers, camping trailers and motor homes, provided no such equipment is occupied for dwelling purposes.

10. Restaurants, drug stores, gift shops, club and lounges and newsstands when located in a permitted hotel, motel or office building.

11. Offices for permitted business and industrial uses when the office is located on the same site as the business or industry to which it is an accessory.

12. The storage of retail merchandise when located within the same building as the principal retail business.

13. Accessory, open, and uncovered swimming pools and home barbecue grills may occupy a required rear yard; provided they are not located closer than five (5) feet to the rear lot line nor closer than three (3) feet to a side lot line.

c. **Prohibited accessory uses.** None of the following shall be permitted as an accessory use:

1. Outdoor storage, except as specifically permitted in the district regulations.

2. Storage of containers typically transported by tractor-trailer rigs, in a residential district, except where completely enclosed within a structure.

20-702. Existing accessory buildings or structures which do not meet the minimum setbacks may be repaired, maintained, or enlarged, providing those actions do not further decrease the existing setbacks.

Proposed Amendments
~~Deletions structhrough in red~~
New provisions highlighted in italics

20-703 Licensed Amateur Communications

The provisions of this section apply only to antennas and antenna support structures used in FCC Licensed Amateur Radio Service Communications. The provisions of this section shall control in the event of a conflict with the Height and Yard Regulations of the District Regulations in which the antenna support structure shall be placed. If said communications facilities do not comply with the following regulations, then a Conditional Use Permit as defined in Article 23 Telecommunications Towers shall be required unless such communications facilities are otherwise in compliance with and/or otherwise allowed under applicable district development standards.

a. ***Definitions***

For the purposes of this section and notwithstanding any conflicting definitions under any other section of this Code:

Amateur Radio Antenna. *means "antenna(s)" used for the purpose of receiving and/or transmitting licensed Amateur Radio Communications.*

Amateur Radio Antenna Support Structure. *means a structure, such as a mast, tower or pole, that is placed, erected or constructed to support one or more antennas for the purposes of engaging in licensed Amateur Radio Communications. Buildings and associated roof mounted equipment alone shall not be considered as antenna support structure.*

Licensed Amateur Radio Communications. *means any form of communication and/or testing, whether transmitted or received, that is licensed by the Federal Communication Commission under and pursuant to 47 C.F.R. Part 97,including all Operator and Station Licenses, under which communication/or testing is conducted by, or under the authority of, a licensed Amateur Radio Operator and Station holding a current valid Amateur Radio License.*

Detached Antenna Support Structure. *as applicable to Amateur Radio Antenna Support Structures shall mean those structures which are not physically attached to, or in any way supported by, a house or any other permitted structure on the subject property.*

Attached Antenna Support Structure. *as applicable to Amateur Radio Antenna Support Structures shall mean those structures which are physically attached to, or in any way supported by, a house or any other permitted structure on the subject property.*

b. ***Maximum Number of Detached Antenna Support Structures in Residential Districts***

No more than two detached guyed or freestanding antenna support structures shall be permitted as a matter of right in a residential district. Upon a reasonable showing of substantial need consistent with licensed Amateur Radio Communication, the Zoning Administrator shall have the right to administratively approve one or more additional detached antenna support structures on the condition that said additional structure(s) shall not create a risk of collapse on adjoining property not under the control of the Licensed Amateur Radio Operator requesting such additional structure(s).

Commented [JW1]: Should this be two or one?

c. Maximum Number of Attached Antenna Support Structures in Residential Districts

No more than two attached antenna support structures, whether guyed or unguyed, shall be permitted as a matter of right on a house or any other permitted structure on the subject property. Upon a reasonable showing of substantial need consistent with licensed Amateur Radio Communications, the Zoning Administrator shall have the right to administratively approve one or more additional attached antenna support structures on the subject property.

Commented [JW2]: Should this be two or one?

d. Height Limitations applicable to Amateur Radio Communications Antenna Support Structures

The maximum height for any Amateur Radio Communications antenna support structure in any district, whether attached or detached, shall be eighty feet. Upon a reasonable showing of substantial need consistent with licensed Amateur Radio Communications, the Zoning Administrator shall have the right to administratively approve a maximum height of one hundred (100) feet. Any antenna support structure that exceeds one hundred (100) feet in height above the ground shall be allowed only with the approval of a Conditional Use Permit.

Commented [JW3]: Can be adjusted to any height

Commented [JW4]: This height can also be adjusted if needed.

e. Antenna and Antenna Support Structure Standards

1. Number and Size

The number and/or size of antennas placed upon a properly erected antenna support structure used for licensed amateur radio communications shall not exceed the wind load requirements/limits for the supporting structure as specified by the manufacturer(s) of the antenna(s) and of the supporting structure, or in the absence of such specification, the wind load requirements contained in the current version of the City building codes if available, or under nationally recognized standards for wind loading determination.

2. Setbacks

Front Yards: Antenna support structures (including guy wires, foundations, anchor, and other components of the structure) shall not be permitted in required front yards. The Zoning Administrator may administratively approve the location of guy wires in a required front yard if it is demonstrated that there are limiting physical characteristics of the subject property that necessitate the location of guy wires in the front yard.

Side and Rear Yards: Guy wires shall be permitted in required side and rear yards. Minimum setbacks for antenna support structures shall be the same as those required for accessory buildings in the applicable residential district and as for all buildings in nonresidential districts, except that side yard encroachments equal to that allowed for fireplaces or other allowed side yard encroachments under single family district regulations shall be permitted.

Commented [JW5]: Do want to modify this? With this wording the setbacks would be 3 feet from the side and 5 feet from the rear. We could add a fall zone equal to the support structure height.

Separation: There shall be no minimum or maximum separation requirements for antenna support structures from other structures on the same property.

3. Lights

No lights shall be mounted on antenna support structures unless otherwise required by applicable State and/or Federal Regulations governing said structure. Any such lighting shall be as specified in said regulations.

4. Construction Standards

Antenna Support Structures shall be installed, maintained and/or modified in accordance with the support structures manufacturer's plans and specifications, or in accordance with engineering plans and specifications for said structure prepared by and under the seal of a registered professional engineer of the State of Kansas. All installations and maintenance thereon shall otherwise be performed in accordance with the usual and customary standards of care in the industry applicable to such installations in the State of Kansas.

5. Maintenance

All Antennas and antenna support structures shall be kept in good condition and properly maintained in accordance with manufacturers recommendations, the standards of the industry and any applicable Federal Amateur Radio License regulations. Antennas and Antenna support structures that have, due to damage, lack of repair, or other circumstances, become unstable, in danger of failure to support, or which no longer meet the applicable standards of installation and maintenance *shall be removed or brought into repair within 90 days following notice given by an authorized representative to the City. Notwithstanding said 90-day repair deadline, said authorized representative shall have the power to order such immediate remedial action as necessary, including removal of any offending antenna and/or antenna support structure if it is deemed to constitute an imminent threat to public safety or property.*

6. Amateur Radio License Requirements

No person, corporation, partnership, or other legal entity shall have any rights under, nor be subject to the provisions of this section except the person or entity to whom a current, valid Amateur Radio License has been issued by the F.C.C under the provisions of 47 C.F.R. Part 97.

7. Discontinuance of Amateur Radio Operations

Within 180 days of the date that Amateur Radio Operations have been discontinued at the subject property on which an antenna and/or antenna support structure is located the owner of said property shall remove, or cause to be removed, all such antennas and structures on the property excepting only if said antennas and/or structures are otherwise and independently authorized to be on the subject property under other provisions of these regulations or other applicable law unrelated to this section.

Discontinuance: Discontinuance of Amateur Radio Operations means voluntary termination of operation or termination of the legal right to operate an Amateur Radio Station, including but not limited to the following: F.C.C. revocation, suspension and or termination of Amateur Radio operator and/or station license; death of the license holder or termination of any legal entity holding said license; voluntary cessation of operation by the license holder; termination of ownership, lease, license or legal interest in the subject property by the license holder under which licensed Amateur Radio Operations were conducted on the subject property.

Commented [JW6]: Keep this italicized in final form

SECTION 20-8 ACCESSORY USES; ADDITIONAL REQUIREMENTS IN RESIDENTIAL DISTRICTS

20-801.

a. Detached accessory buildings shall not occupy a required yard other than a required rear yard if not located within five (5) feet of a rear property line or within three (3) feet of a side property line.

Proposed Amendments
~~Deletions structhrough in red~~
New provisions highlighted in italics

b. Detached accessory buildings shall not be located within ten (10) feet of the primary structure and shall be located behind the front building line of the primary structure.

20-802.

a. Accessory buildings in a zoning district having residences as a permitted use shall not collectively occupy more than 40% of the required yard spaces in the rear half of the lot.

b. No single accessory building in a zoning district having residences as a permitted use shall occupy more than 30% of the required yard spaces in the rear half of the lot.

c. No accessory building on a corner lot shall be located closer to the street side yard than the front yard abutting the street.

20-803. Garages shall not be constructed upon lots in residential-zoned districts upon which no principal dwelling is located.

20-804. Accessory buildings may be constructed with used materials, except the exterior shall be of new materials. Accessory buildings shall be of conventional wood or metal construction. Metal shipping containers, truck boxes, trailers, etc. are prohibited from use as detached accessory buildings on property located in residential (R) zoning districts.

SECTION 20-9 FENCES

20-901. Except as otherwise specifically provided elsewhere in these regulations or other codes and regulations of the City the following restrictions shall apply to the construction of all fences or improvements, replacements or extensions of existing fences.

a. No fence shall be constructed at a location where it would constitute a traffic hazard.

b. A property owner may install a fence within a dedicated easement at his or her own risk of having to remove or repair such fence due to the lawful activities of persons or entities under the easement.

c. For corner lots the following rules shall apply: All sides adjacent to a street shall be considered front yards, with the one on the non-address side having the lesser setback requirement. The primary front yard shall meet the applicable district setback.

Proposed Amendments
~~Deletions structhrough in red~~
New provisions highlighted in italics

d. For institutional uses in residential districts, such as schools, parks, hospitals and cemeteries, a fence may be constructed in the front yard setback provided it complies with subsections b, d and e of this section, and has a maximum eight (8) foot height.

e. A fence may be erected in a commercial district or industrial district to not more than eight (8) foot maximum height, except no fence shall have a height greater than six (6) feet in a required front yard, except where these Regulations provide otherwise.

f. A fence may be erected in a residential district to not more than eight (8) foot maximum height, provided a fence not more than four (4) feet in height may project into or enclose any required front yard to a depth from the street line equal to the required depth of the front yard.

g. Barbed wire fences are prohibited inside the City limits, except:

1. When property exclusively used for agricultural purposes is annexed into the City and the barbed wire fencing does not pose a risk to pedestrians. Risk to pedestrians shall be presumed when any barbed wire fencing is located within 10 feet of any pedestrian sidewalk, street or public thoroughfare.

2. On top of perimeter fencing of storage areas in industrial and commercial district zones, provided that barbed wire atop such fences shall be at least 6 feet above the ground with a maximum fence height of 8 feet;

h. Electric charged fences are prohibited inside the City limits, except:

1. An electric fence not exceeding 24 volts and completely contained within a landowner's fenced property shall be permitted if the landowner first obtains approval from City Code Enforcement;

2. Electronic detector loops for animal containment systems shall not be classified as an electric charged fence;

i. Concertina wire or looped barbed-wire fences are prohibited inside the City limits.

SECTION 20-10 RESIDENTIAL-DESIGN MANUFACTURED HOUSING STANDARDS

20-1001.

Proposed Amendments
~~Deletions structhrough in red~~
New provisions highlighted in italics

a. In order to be classified as a Residential-Design Manufactured Home a structure must be manufactured to the standards embodied in the National Manufactured Home Construction and Safety Standards generally known as the HUD Code established in 1976 pursuant to 42 U.S.C. Sec. 5403. Such structures shall provide all of the accommodations necessary to be a dwelling unit and shall be connected to all utilities in conformance with applicable City regulations. Such a structure shall be on a permanent-type, enclosed perimeter foundation which has minimum dimensions of 22 body feet in width excluding bay windows, garages, porches, patios, pop-outs and roof overhangs; a pitched roof; siding and roofing materials which are customarily used on site-built homes; and which complies with the following architectural or aesthetic standards so as to ensure their compatibility with site-built housing:

1. The roof must be predominantly double-pitched and must be covered with material that is customarily used on site-built dwellings, including but not limited to approved wood, asphalt composition shingles, clay or concrete title, slate or fiberglass, but excluding corrugated aluminum or corrugated fiberglass roof. The roof shall have a minimum eave projection and roof overhang on at least two sides of ten (10) inches which may include a gutter.

2. Exterior siding shall be of a nonreflective material customarily used on site-built dwellings such as wood, composition, simulated wood, clapboards, conventional vinyl or metal siding, brick, stucco, or similar materials, but excluding smooth ribbed or corrugated metal or plastic panels. Siding material shall extend below the top of the exterior of the foundation or curtain wall or the joint between siding and enclosure wall shall be flashed in accordance with any applicable City-adopted building codes.

3. The home shall be installed in accordance with the recommended installation procedure of the manufacturer and any applicable building code adopted by the City.

4. The running gear, tongue, axles and wheels shall be removed from the unit at the time of installation. Either a basement or a continuous, permanent masonry foundation or curtain wall, unpierced except for required ventilation and access which may include walk-out basements and garages, shall be installed under the perimeter of the home.

5. At the main entrance door there shall be a landing that is a minimum of twenty-five (25) square feet which is constructed to meet the requirements of any applicable City-adopted building codes.

6. On level sites, the main floor shall be no greater than twenty four (24) inches above the finished grade at the foundation. On sloping or irregular sites, the main floor at the side closest to grade level shall not be greater than twenty-four (24) inches above the finished grade at the foundation.

7. Stairs, porches, entrance platforms, ramps and other means of entrance and exit to and from the home shall be installed or constructed in accordance with the standards set by the City-adopted building codes and attached permanently to the primary structure and anchored permanently to the ground.

8. Any attached addition to such a home shall comply with all construction requirements of the City-adopted building codes, unless designed and constructed by a manufactured home factory.

b. For purposes of these regulations, the term "manufactured home", when used by itself, shall not include a "residential-design manufactured home".

SECTION 20-11 BUILDING SETBACKS

20-1101. For purposes of determining the applicability of building setback lines established in these regulations whenever any two or more provisions in these regulations establish building setback lines that are applicable to a given building or structure, the regulation establishing the more restrictive standard shall be the regulation which controls.

20-1102. Where allowed, gasoline or other fuel dispensing pumps, excluding canopies, shall not be located less than twelve (12) feet from any right-of-way line or easement.

20-1103. Canopies covering gas or other fuel pumps shall be located so that no part of the structure is less than ten (10) feet from the property line. Such structures shall meet all other setback requirements in these regulations.

SECTION 20-12 HOME OCCUPATIONS

20-1201. Home occupations as defined in Article 2 of these regulations shall be permitted in the A District, and the CS, MHS, R-1 and R-2 residential districts, subject to the following:

Proposed Amendments
~~Deletions structhrough in red~~
New provisions highlighted in italics

a. **Restrictions and Limitations; All Home Occupations.** The following shall apply to any home occupation in existence at the time of, or commenced after, the effective date of these Regulations:

1. No exterior alterations or other construction shall be made to the dwelling which changes the character or appearance from its primary residential use.

2. No equipment or material shall be used which creates any noise, vibration, smoke or odors perceptible at the boundary lines of the property, which would be in excess of that ordinarily created by a single family residential dwelling.

3. No merchandise shall be displayed or sold on the premises to members of the general public, except craft or articles made by the person operating the home occupation. In no instance shall there be any outside display of such articles in connection with the home occupation. "Members of the general public" shall not include persons who have prior individualized invitation.

4. The area of an accessory structure devoted to home occupations shall be limited to nine hundred (900) square feet.

b. **Restrictions and Limitations; New Home Occupations.** The following shall apply to any home occupation commenced after the effective date of these Regulations:

1. No more than one employee or volunteer shall engage in such home occupation in addition to the person occupying the dwelling unit as his or her place of residence.

2. There shall be no outdoor storage of materials or equipment used in the home occupation.

20-1202. Power of Zoning Administrator. The Zoning Administrator is hereby authorized to exercise such powers as may be necessary or convenient to carry out and effectuate the purposes and provisions of Section 20-12, including the power to:

a. Investigate any home occupation or alleged home occupation, to determine whether or not such is in compliance with these regulations.

b. Enter upon premises for the purpose of making examinations: provided that such entries shall be made in such manner as to cause the least possible inconvenience to the persons in possession, and obtain an order for this purpose from a court of competent jurisdiction in the event entry is denied or resisted.

20-1203. Permitted home occupations are primarily of a service nature similar to, but not limited to, the following:

a. Artists, sculptors and writers.

b. Custom dressmaking, tailoring or sewing of fabrics.

c. Giving of lessons of any type, provided instruction does not exceed five (5) pupils at a time. Such limitation shall not apply to recitals or other performances.

d. Professional offices for architects, engineers, computer software engineers, planners, lawyers, accountants, bookkeepers, realtors, insurance agents, brokers, sales representatives, contractors, and similar occupations.

e. Fabrication and/or assembly of handicraft or hobby articles.

f. Occupations where business is conducted primarily or exclusively over the Internet.

g. Photographic studios.

h. Beauty or barber shops having one chair, stand or station.

i. Multi-level marketing and home party product sales, including but not limited to, Avon, Mary Kay Cosmetics and Tupperware.

j. Sales of farm or garden produce, bulbs, plantings or cut flowers when grown on the same premises as the residence.

20-1204. Except where allowed as a permitted or conditional use, home occupations shall not in any event include the following:

a. Antiques, either retail or wholesale.

b. Animal care other than grooming.

Proposed Amendments
~~Deletions structhrough in red~~
New provisions highlighted in italics

c. Funeral homes or services.

d. Retail sale or rental of any goods or products, other than where the commercial exchange constituting such sales or rental is accomplished by means of catalog orders, whether in written or electronic form.

e. Automotive sales, repair or service of any type.

f. Appliance repairs (other than for small electronic devices including computers and hand-held household appliances).

g. Small-engine repairs.

Item 3.

Antenna Height and Communications Effectiveness

Second Edition

A Guide for City Planners and Amateur Radio Operators

By R. Dean Straw, N6BV, and Gerald L. Hall, K1TD
Senior Assistant Technical Editor and Retired Associate Technical Editor

The American Radio Relay League, Inc.
225 Main Street
Newington, CT 06111

Executive Summary

Amateur radio operators, or "hams" as they are called, communicate with stations located all over the world. Some contacts may be local in nature, while others may be literally halfway around the world. Hams use a variety of internationally allocated frequencies to accomplish their communications.

Except for local contacts, which are primarily made on Very High and Ultra High Frequencies (VHF and UHF), communicating between any two points on the earth rely primarily on high-frequency (HF) signals propagating through the ionosphere. The earth's ionosphere acts much like a mirror at heights of about 150 miles. The vertical angle of radiation of a signal launched from an antenna is one of the key factors determining effective communication distances. The ability to communicate over long distances generally requires a low radiation angle, meaning that an antenna must be placed high above the ground in terms of the wavelength of the radio wave being transmitted.

A beam type of antenna at a height of 70 feet or more will provide greatly superior performance over the same antenna at 35 feet, all other factors being equal. A height of 120 feet or even higher will provide even more advantages for long-distance communications. To a distant receiving station, a transmitting antenna at 120 feet will provide the effect of approximately 8 to 10 times more transmitting power than the same antenna at 35 feet. Depending on the level of noise and interference, this performance disparity is often enough to mean the difference between making distant radio contact with fairly reliable signals, and being unable to make distant contact at all.

Radio Amateurs have a well-deserved reputation for providing vital communications in emergency situations, such as in the aftermath of a severe icestorm, a hurricane or an earthquake. Short-range communications at VHF or UHF frequencies also require sufficient antenna heights above the local terrain to ensure that the antenna has a clear horizon.

In terms of safety and aesthetic considerations, it might seem intuitively reasonable for a planning board to want to restrict antenna installations to low heights. However, such height restrictions often prove very counterproductive and frustrating to all parties involved. If an amateur is restricted to low antenna heights, say 35 feet, he will suffer from poor transmission of his own signals as well as poor reception of distant signals. In an attempt to compensate on the transmitting side (he can't do anything about the poor reception problem), he might boost his transmitted power, say from 150 watts to 1,500 watts, the maximum legal limit. This ten-fold increase in power will very significantly increase the *potential* for interference to telephones, televisions, VCRs and audio equipment in his neighborhood.

Instead, if the antenna can be moved farther away from neighboring electronic devices—putting it higher, in other words—this will greatly reduce the likelihood of interference, which decreases at the inverse square of the distance. For example, doubling the distance reduces the potential for interference by 75%. As a further benefit, a large antenna doesn't look anywhere near as large at 120 feet as it does close-up at 35 feet.

As a not-so-inconsequential side benefit, moving an antenna higher will also greatly reduce the potential of exposure to electromagnetic fields for neighboring human and animals. Interference and RF exposure standards have been thoroughly covered in recently enacted Federal Regulations.

Antenna Height and Communications Effectiveness

By R. Dean Straw, N6BV, and Gerald L. Hall, K1TD
Senior Assistant Technical Editor and Retired Associate Technical Editor

The purpose of this paper is to provide general information about communications effectiveness as related to the physical height of antennas. The intended audience is amateur radio operators and the city and town Planning Boards before which a radio amateur must sometimes appear to obtain building permits for radio towers and antennas.

The performance of horizontally polarized antennas at heights of 35, 70 and 120 feet is examined in detail. Vertically polarized arrays are not considered here because at short-wave frequencies, over average terrain and at low radiation angles, they are usually less effective than horizontal antennas.

Ionospheric Propagation

Frequencies between 3 and 30 megahertz (abbreviated MHz) are often called the "short-wave" bands. In engineering terms this range of frequencies is defined as the *high-frequency* or *HF* portion of the radio spectrum. HF radio communications between two points that are separated by more than about 15 to 25 miles depend almost solely on propagation of radio signals through the *ionosphere*. The ionosphere is a region of the Earth's upper atmosphere that is ionized primarily by ultraviolet rays from the Sun.

The Earth's ionosphere has the property that it will refract or bend radio waves passing through it. The ionosphere is not a single "blanket" of ionization. Instead, for a number of complex reasons, a few discrete layers are formed at different heights above the earth. From the standpoint of radio propagation, each ionized layer has distinctive characteristics, related primarily to different amounts of ionization in the various layers. The ionized layer that is most useful for HF radio communication is called the *F layer*.

The F layer exists at heights varying from approximately 130 to 260 miles above the earth's surface. Both the layer height and the amount of ionization depend on the latitude from the equator, the time of day, the season of the year, and on the level of sunspot activity. Sunspot activity varies generally in cycles that are approximately 11 years in duration, although short-term bursts of activity may create changes in propagation conditions that last anywhere from a few minutes to several days. The ionosphere is not homogeneous, and is undergoing continual change. In fact, the exact state of the ionosphere at any one time is so variable that is best described in statistical terms.

The F layer disappears at night in periods of low and medium solar activity, as the ultraviolet energy required to sustain ionization is no longer received from the Sun. The amount that a passing radio wave will bend in an ionospheric layer is directly related to the intensity of ionization in that layer, and to the frequency of the radio wave.

A triangle may be used to portray the cross-sectional path of ionospheric radio-wave travel, as shown in **Fig 1**, a highly simplified picture of what happens in propagation of radio waves. The base of the triangle is the surface of the Earth between two distant points, and the apex of the triangle is the point representing refraction in the ionosphere. If all the necessary conditions are met, the radio wave will travel from the first point on the Earth's surface to the ionosphere, where it will be bent (*refracted*) sufficiently to travel to the second point on the earth, many hundreds of miles away.

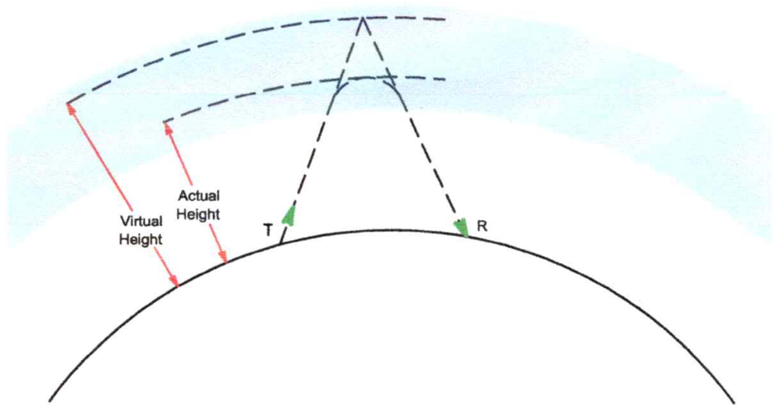


Fig 1—A simplified cross-sectional representation of ionospheric propagation. The simple triangle goes from the Transmitter T up to the virtual height and then back down to the Receiver R. Typically the F layer exists at a height of 150 miles above the Earth at mid-latitudes. The distance between T and R may range from a few miles to 2500 miles under normal propagation conditions.

Of course the Earth's surface is not a flat plane, but instead is curved. High-frequency radio waves behave in essentially the same manner as light waves—they tend to travel in straight lines, but with a slight amount of downward bending caused by refraction in the air. For this reason it is not possible to communicate by a direct path over distances greater than about 15 to 25 miles in this frequency range, slightly farther than the optical horizon. The curvature of the earth causes the surface to "fall away" from the path of the radio wave with greater distances. Therefore, it is the ionosphere that permits HF radio communications to be made between points separated by hundreds or even thousands of miles. The range of frequencies from 3 to 30 MHz is unique in this respect, as ionospheric propagation is not consistently supported for any frequencies outside this range.

One of the necessary conditions for ionospheric communications is that the radio wave must encounter the ionosphere at the correct angle. This is illustrated in **Fig 2**, another very simplified drawing of the geometry involved. Radio waves leaving the earth at high elevation angles above the horizon may receive only very slight bending due to refraction, and are then lost to outer space. For the same fixed frequency of operation, as the elevation angle is lowered toward the horizon, a point is reached where the bending of the wave is sufficient to return the wave to the Earth. At successively lower angles, the wave returns to the Earth at increasing distances.

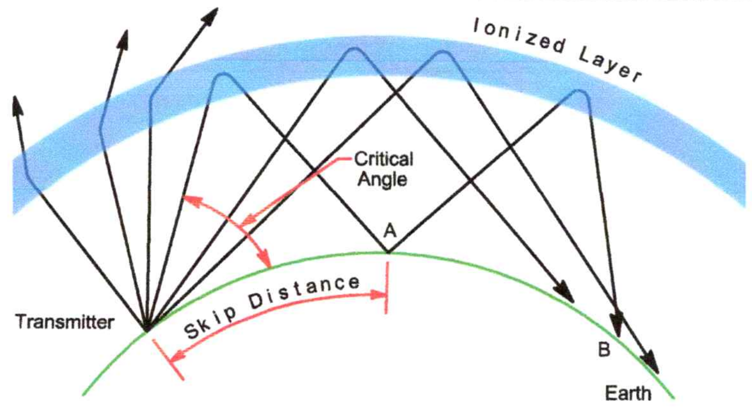


Fig 2—Behavior of radio waves encountering the ionosphere. Rays entering the ionized region at angles above the critical angle are not bent enough to return to Earth and are lost to space. Waves entering at angles below the critical angle reach the Earth at increasingly greater distances as the angle approaches the horizontal. The maximum distance that may normally be covered in a single hop is 2500 miles. Greater distances may be covered with multiple hops.

If the radio wave leaves the earth at an *elevation angle* of zero degrees, just toward the horizon (or just tangent to the earth's surface), the maximum distance that may be reached under usual ionospheric conditions is approximately 2,500 miles (4,000 kilometers). However, the Earth itself also acts as a reflector of radio waves coming down from the ionosphere. Quite often a radio signal will be reflected from the reception point on the Earth back into the ionosphere again, reaching the Earth a second time at a still more distant point.

As in the case of light waves, the angle of reflection is the same as the angle of incidence, so a wave striking the surface of the Earth at an angle of, say, 15° is reflected upward from the surface at the same angle. Thus, the distance to the second point of reception will be approximately twice the distance of the first. This effect is also illustrated in Fig 2, where the signal travels from the transmitter at the left of the drawing via the ionosphere to Point A, in the center of the drawing. From Point A the signal travels via the ionosphere again to Point B, at the right. A signal traveling from the Earth through the ionosphere and back to the Earth is called a *hop*. Under some conditions it is possible for as many as four or five signal hops to occur over a radio path, but no more than two or three hops is the norm. In this way, HF communications can be conducted over thousands of miles.

With regard to signal hopping, two important points should be recognized. First, a significant loss of signal occurs with each hop. Lower layers of the ionosphere absorb energy from the signals as they pass through, and the ionosphere tends to scatter the radio energy in various directions, rather than confining it to a tight bundle. The earth also scatters the energy at a reflection point. Thus, only a small fraction of the transmitted energy actually reaches a distant receiving point.

Again refer to Fig 2. Two radio paths are shown from the transmitter to Point B, a one-hop path and a two-hop path. Measurements indicate that although there can be great variation in the ratio of the two signal strengths in a situation such as this, the signal power received at Point B will generally be from five to ten times greater for the one-hop wave than for the two-hop wave. (The terrain at the mid-path reflection point for the two-hop wave, the angle at which the wave is reflected from the earth, and the condition of the ionosphere in the vicinity of all the refraction points are the primary factors in determining the signal-strength ratio.) Signal levels are generally compared in decibels, abbreviated dB. The decibel is a logarithmic unit. Three decibels difference in signal strengths is equivalent to a power ratio of 2:1; a difference of 10 dB equates to a power ratio of 10:1. Thus the signal loss for an additional hop is about 7 to 10 dB.

The additional loss per hop becomes significant at greater distances. For a simplified example, a distance of 4,000 miles can be covered in two hops of 2,000 miles each or in four hops of 1,000 miles each. For illustration, assume the loss for additional hops is 10 dB, or a 1/10 power ratio. Under such conditions, the four-hop signal will be received with only 1/100 the power or 20 dB below that received in two hops. The reason for this is that only 1/10 of the two-hop signal is received for the first additional (3^{rd}) hop, and only 1/10 of that 1/10 for the second additional (4^{th}) hop. It is for this reason that no more than four or five propagation hops are useful; the received signal eventually becomes too weak to be heard.

The second important point to be recognized in multihop propagation is that the geometry of the first hop establishes the geometry for all succeeding hops. And it is the elevation angle at the transmitter that sets up the geometry for the first hop.

It should be obvious from the preceding discussion that one needs a detailed knowledge of the range of elevation angles for effective communication in order to do a scientific evaluation of a possible communications circuit. The range of angles should be statistically valid over the full 11-year solar sunspot cycle, since the behavior of the Sun determines the changes in the nature of the Earth's ionosphere. ARRL did a very detailed computer study in the early 1990s to determine the angles needed for propagation throughout the world. The results of this study will be examined later, after we introduce the relationship between antenna height and the elevation pattern for an antenna.

Horizontal Antennas Over Flat Ground

A simple antenna that is commonly used for HF communications is the horizontal half-wave *dipole*. The dipole is a straight length of wire (or tubing) into which radio-frequency energy is fed at the center. Because of its simplicity, the dipole may be easily subjected to theoretical performance analyses. Further, the results of proper analyses are well borne out in practice. For these reasons, the half-wave dipole is a convenient performance standard against which other antenna systems can be compared.

Because the earth acts as a reflector for HF radio waves, the directive properties of any antenna are modified considerably by the ground underneath it. If a dipole antenna is placed horizontally above the ground, most of the energy radiated downward from the dipole is reflected upward. The reflected waves combine with the direct waves (those radiated at angles above the horizontal) in various ways, depending on the height of the antenna, the frequency, and the electrical characteristics of the ground under and around the antenna.

At some vertical angles above the horizon, the direct and reflected waves may be exactly in phase—that is, the maximum signal or field strengths of both waves are reached at the same instant at some distant point. In this case the resultant field strength is equal to the sum of the two components. At other vertical angles the two waves may be completely out of phase at some distant point—that is, the fields are maximum at the same instant but the phase directions are opposite. The resultant field strength in this case is the difference between the two. At still other angles the resultant field will have intermediate values. Thus, the effect of the ground is to increase the intensity of radiation at some vertical angles and to decrease it at others. The elevation angles at which the maxima and minima occur depend primarily on the antenna height above ground. (The electrical characteristics of the ground have some slight effect too.)

For simplicity here, we consider the ground to be a perfectly conducting, perfectly flat reflector, so that straightforward trigonometric calculations can be made to determine the relative amount of radiation intensity at any vertical angle for any dipole height. Graphs from such calculations are often plotted on rectangular axes to show best resolution over particularly useful ranges of elevation angles, although they are also shown on polar plots so that both the front and back of the response can be examined easily. **Fig 3** shows an overlay of the polar elevation-pattern responses of two dipoles at different heights over perfectly conducting flat ground. The lower dipole is located a half wavelength above ground, while the higher dipole is located one wavelength above ground. The pattern of the lower antenna peaks at an elevation angle of about 30°, while the higher antenna has two main lobes, one peaking at 15° and the other at about 50° elevation angle.

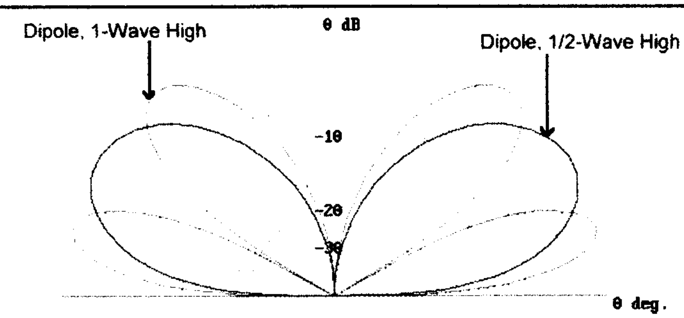


Fig 3–Comparison of elevation responses for two dipoles: one ½-wavelength high, and the other 1-wavelength high.

In the plots shown in Fig 3, the elevation angle above the horizon is represented in the same fashion that angles are measured on a protractor. The concentric circles are calibrated to represent ratios of field strengths, referenced to the strength represented by the outer circle. The circles are calibrated in decibels. Diminishing strengths are plotted toward the center.

You may have noted that antenna heights are often discussed in terms of *wavelengths*. The reason for this is that the length of a radio wave is inversely proportional to its frequency. Therefore a fixed physical height will represent different electrical heights at different radio frequencies. For example, a height of 70 feet represents one wavelength at a frequency of 14 MHz. But the same 70-foot height represents a half wavelength for a frequency of 7 MHz and only a quarter wavelength at 3.5 MHz. On the other hand, 70 feet is 2 wavelengths high at 28 MHz.

The lobes and nulls of the patterns shown in Fig 3 illustrate what was described earlier, that the effect of the ground beneath an antenna is to increase the intensity of radiation at some vertical elevation angles and to decrease it at others. At a height of a half wavelength, the radiated energy is strongest at a rather high elevation angle of 30°. This would represent the situation for a 14-MHz dipole 35 feet off the ground.

As the horizontal antenna is raised to greater heights, additional lobes are formed, and the lower ones move closer to the horizon. The maximum amplitude of each of the lobes is roughly equal. As may be seen in Fig 3, for an antenna height of one wavelength, the energy in the lowest lobe is strongest at 15°. This would represent the situation for a 14-MHz dipole 70 feet high.

The elevation angle of the lowest lobe for a horizontal antenna above perfectly conducting ground may be determined mathematically:

$$\theta = \sin^{-1}\left(\frac{0.25}{h}\right)$$

Where

θ = the wave or elevation angle
h = the antenna height above ground in wavelengths

In short, the higher the horizontal antenna, the lower is the lowest lobe of the pattern. As a very general rule of thumb, the higher an HF antenna can be placed above ground, the farther it will provide effective communications because of the resulting lower radiation angle. This is true for any horizontal antenna over real as well as theoretically perfect ground.

You should note that the *nulls* in the elevation pattern can play an important role in communications—or lack of communication. If a signal arrives at an angle where the antenna system exhibits a deep null, communication effectiveness will be greatly reduced. It is thus quite possible that an antenna can be *too high* for good communications efficiency on a particular frequency. Although this rarely arises as a significant problem on the amateur bands below 14 MHz, we'll discuss the subject of optimal height in more detail later.

Actual earth does not reflect all the radio-frequency energy striking it; some absorption takes place. Over real earth, therefore, the patterns will be slightly different than those shown in Fig 3, however the differences between theoretical and perfect earth ground are not significant for the range of elevation angles necessary for good HF communication. Modern computer programs can do accurate evaluations, taking all the significant ground-related factors into account.

Beam Antennas

For point-to-point communications, it is beneficial to concentrate the radiated energy into a beam that can be aimed toward a distant point. An analogy can be made by comparing the light from a bare electric bulb to that from an automobile headlight, which incorporates a built-in focusing lens. For illuminating a distant point, the headlight is far more effective.

Antennas designed to concentrate the radiated energy into a beam are called, naturally enough, *beam antennas*. For a fixed amount of transmitter power fed to the transmitting antenna, beam antennas provide increased signal strength at a distant receiver. In radio communications, the use of a beam antenna is also beneficial during reception, because the antenna pattern for transmission is the same for reception. A beam antenna helps to reject signals from unwanted directions, and in effect boosts the strength of signals received from the desired direction.

The increase in signal or field strength a beam antenna offers is frequently referenced to a dipole antenna in free space (or to another theoretical antenna in free space called an *isotropic antenna*) by a term called *gain*. Gain is commonly expressed in decibels. The isotropic antenna is defined as being one that radiates equally well in all directions, much like the way a bare lightbulb radiates essentially equally in all directions.

One particularly well known type of beam antenna is called a *Yagi*, named after one of its Japanese inventors. Different varieties of Yagi antennas exist, each having somewhat different characteristics. Many television antennas are forms of multi-element Yagi beam antennas. In the next section of this paper, we will refer to a four-element Yagi, with a gain of 8.5 dBi in free space, exclusive of any influence due to ground.

This antenna has 8.5 dB more gain than an isotropic antenna in free space and it achieves that gain by squeezing the pattern in certain desired directions. Think of a normally round balloon and imagine squeezing that balloon to elongate it in one direction. The increased length in one direction comes at the expense of length in other directions. This is analogous to how an antenna achieves more signal strength in one direction, at the expense of signal strength in other directions.

The elevation pattern for a Yagi over flat ground will vary with the electrical height over ground in exactly the same manner as for a simpler dipole antenna. The Yagi is one of the most common antennas employed by radio amateurs, second in popularity only to the dipole.

Putting the Pieces Together

In **Fig 4**, the elevation angles necessary for communication from a particular transmitting site, in Boston, Massachusetts, to the continent of Europe using the 14-MHz amateur band are shown in the form of a bargraph. For each elevation angle from 1° to 30°, Fig 4 shows the percentage of time when the 14-MHz band is open at each elevation angle. For example, 5° is the elevation angle that occurs just over 12% of the time when the band is available for communication, while 11° occurs about 10% of the time when the band is open. The useful range of elevation angles that must accommodated by an amateur station wishing to talk to Europe from Boston is from 1° to 28°.

In addition to the bar-graph elevation-angle statistics shown in Fig 4, the elevation pattern responses for three Yagi antennas, located at three different heights above flat ground, are overlaid on the same graph. You can easily see that the 120-foot antenna is the best antenna to cover the most likely angles for this particular frequency, although it suffers at the higher elevation angles on this particular propagation path, beyond about 12°. If, however, you can accept somewhat lower gain at the lowest angles, the 70-foot antenna would arguably be the best overall choice to cover all the elevation angles.

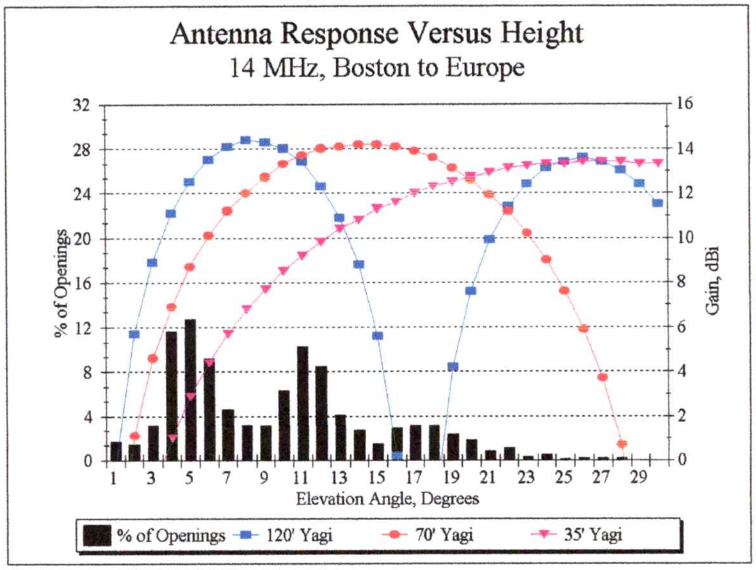


Fig 4—Elevation response patterns of three Yagis at 120, 70 and 35 feet, at 14 MHz over flat ground. The patterns are overlaid with the statistical elevation-angles for the path from Boston to continental Europe over the entire 11-year solar sunspot cycle. Clearly, the 120-foot antenna is the best choice to cover the low angles needed, but it suffers some at higher angles.

Other graphs are needed to show other target receiving areas around the world. For comparison, **Fig 5** is also for the 14-MHz band, but this time from Boston to Sydney, Australia. The peak angle for this very long path is about 2°, occurring 19% of the time when the band is actually open for communication. Here, even the 120-foot high antenna is not ideal. Nonetheless, at a moderate 5° elevation angle, the 120-foot antenna is still 10 dB better than the one at 35 feet.

Fig 4 and Fig 5 have portrayed the situation for the 14-MHz amateur band, the most popular and heavily utilized HF band used by radio amateurs. During medium to high levels of solar sunspot activity, the 21 and 28-MHz amateur bands are open during the daytime for long-distance communication. **Fig 6** illustrates the 28-MHz elevation-angle statistics, compared to the elevation patterns for the same three antenna heights shown in Fig 5. Clearly, the elevation response for the 120-foot antenna has a severe (and undesirable) null at 8°. The 120-foot antenna is almost 3.4 wavelengths high on 28 MHz (whereas it is 1.7 wavelengths high on 14 MHz.) For many launch angles, the 120-foot high Yagi on 28 MHz would simply be too high.

The radio amateur who must operate on a variety of frequencies might require two or more towers at different heights to maintain essential elevation coverage on all the authorized bands. Antennas can sometimes be mounted at different heights on a single supporting tower, although it is more difficult to rotate antennas that are "vertically stacked" around the tower to point in all the needed directions. Further, closely spaced antennas tuned to different frequencies usually interact electrically with each other, often causing severe performance degradation.

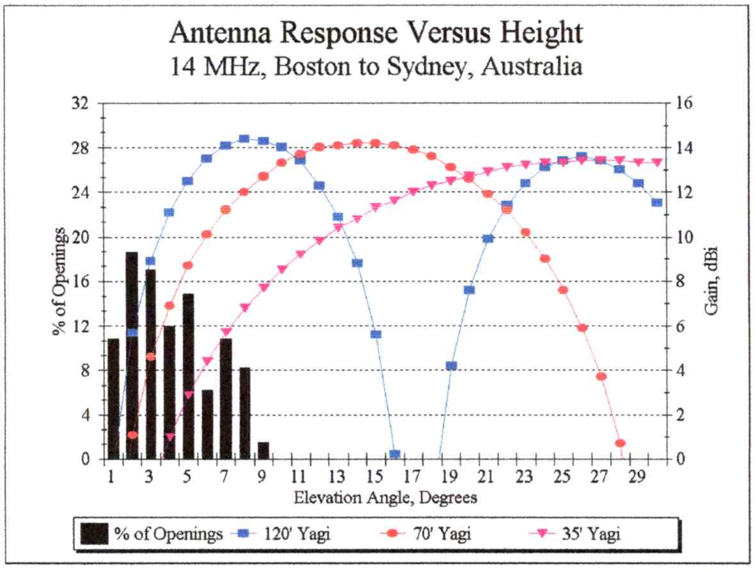


Fig 5—Elevation responses for same antennas as Fig 4, but for a longer-range path from Boston to Sydney, Australia. Note that the prevailing elevation angles are very low.

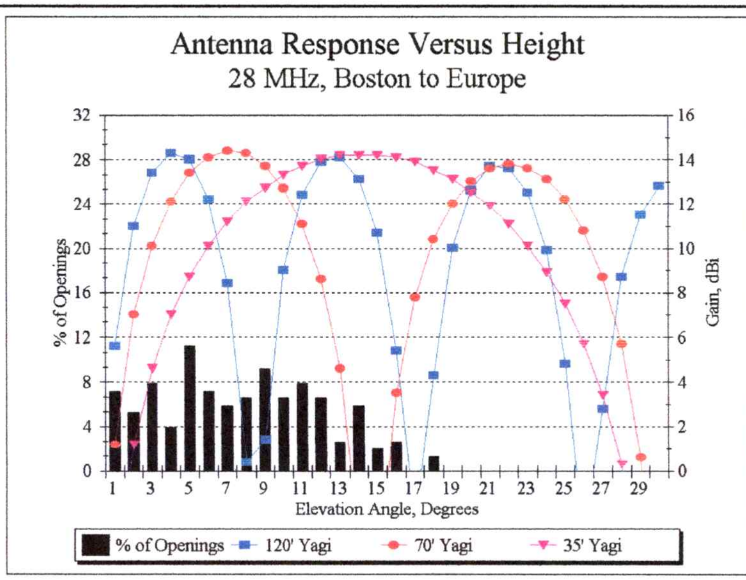


Fig 6—Elevation angles compared to antenna responses for 28-MHz path from Boston to Europe. The 70-foot antenna is probably the best overall choice on this path.

During periods of low to moderate sunspot activity (about 50% of the 11-year solar cycle), the 14-MHz band closes down for propagation in the early evening. A radio amateur wishing to continue communication must shift to a lower frequency band. The next most highly used band below the 14-MHz band is the 7-MHz amateur band. **Fig 7** portrays a 7-MHz case for another transmitting site, this time from San Francisco, California, to the European continent. Now, the range of necessary elevation angles is from about 1° to 16°, with a peak statistical likelihood of about 16% occurring at an elevation of 3°. At this low elevation angle, a 7-MHz antenna must be *very* high in the air to be effective. Even the 120-foot antenna is hardly optimal for the peak angle of 3°. The 200-foot antenna shown would be far better than a 120-foot antenna. Further, the 35-foot high antenna is *greatly* inferior to the other antennas on this path and would provide far less capabilities, on both receiving and transmitting.

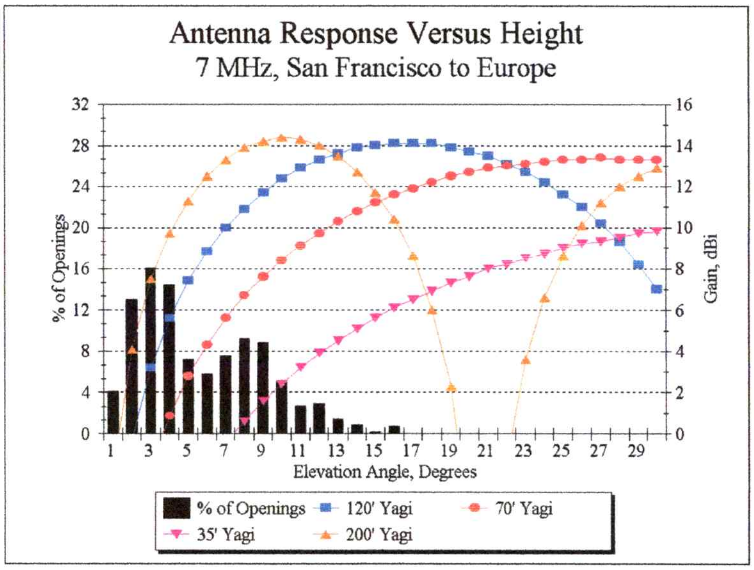


Fig 7—Comparison of antenna responses for another propagation path: from San Francisco to Europe on 7 MHz. Here, even a 120-foot high antenna is hardly optimal for the very low elevation angles required on this very long path. In fact, the 200-foot high antenna is far better suited for this path.

What If the Ground Isn't Flat?

In the preceding discussion, antenna radiation patterns were computed for antennas located over *flat ground*. Things get much more complicated when the exact local terrain surrounding a tower and antenna are taken into account. In the last few years, sophisticated ray-tracing computer models have become available that can calculate the effect that local terrain has on the elevation patterns for real-world HF installations—and *each* real-world situation is indeed different.

For simplicity, first consider an antenna on the top of a hill with a constant slope downward. The general effect is to lower the effective elevation angle by an amount equal to the downslope of the hill. For example, if the downslope is –3° for a long distance away from the tower and the flat-ground peak elevation angle is 10° (due to the height of the antenna), then the net result will be 10° – 3° = 7° peak angle. However, if the local terrain is rough, with many bumps and valleys in the desired direction, the response can be modified considerably. **Fig 8** shows the fairly complicated terrain profile for Jan Carman, K5MA, in the direction of Japan. Jan is located on one of the tallest hills in West Falmouth, Massachusetts. Within 500 feet of his tower is a small hill with a water tower on the top, and then the ground quickly falls away, so that at a distance of about 3000 feet from the tower base, the elevation has fallen to sea level, at 0 feet.

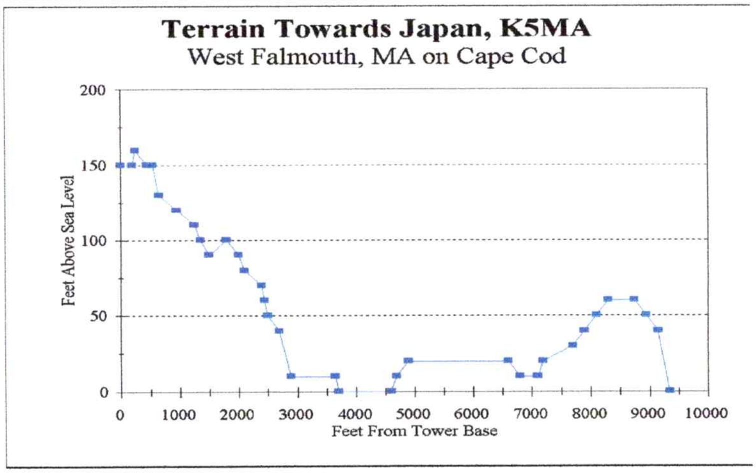


Fig 8—Terrain profile from location of K5MA, Jan Carman, in West Falmouth, MA, towards Japan. This is a moderately complicated real-world terrain on one of the highest hills on Cape Cod.

The computed responses toward Japan from this location, using a 120- and a 70-foot high Yagi, are shown in **Fig 9**, overlaid for comparison with the response for a 120-foot Yagi over flat ground. Over this particular terrain, the elevation pattern for the 70-foot antenna is actually better than that of the 120-foot antenna for angles below about 3°, but not for medium angles! The responses for each height oscillate around the pattern for flat ground — all due to the complex reflections and diffractions occurring off the terrain.

At an elevation angle of 5°, the situation reverses itself and the gain is now higher for the 120-foot-high antenna than for the 70-foot antenna. A pair of antennas on one tower would be required to cover all the angles properly. To avoid any electrical interactions between similar antennas on one tower, two towers would be much better. Compared to the flat-ground situation, the responses of real-world antenna can be very complicated due to the interactions with the local terrain.

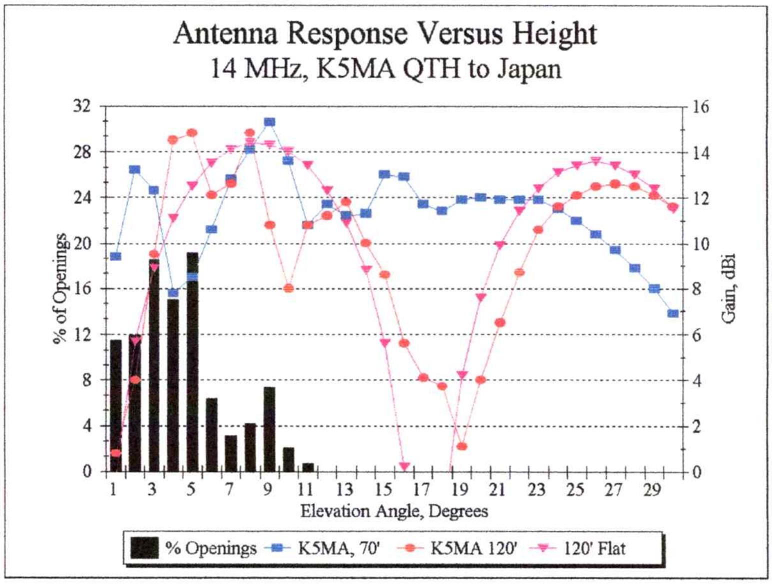


Fig 9—Computed elevation responses of 120- and 70-foot high Yagis, at the K5MA location on Cape Cod, in the direction of Japan and over flat ground, for comparison. The elevation response of the real-world antenna has been significantly modified by the local terrain.

Fig 10 shows the situation for the same Cape Cod location, but now for 7 MHz. Again, it is clear that the 120-foot high Yagi is superior by at least 3 dB (equivalent to twice the power) to the 70-foot high antenna at the statistical elevation angle of 6°. However, the response of the real-world 120-foot high antenna is still up some 2 dB from the response for an identical antenna over flat ground at this angle. On this frequency, the local terrain has helped boost the gain at the medium angles more than a similar antenna 120 feet over flat ground. The gain is even greater at lower angles, say at 1° elevation, where most signals take off, statistically speaking. Putting the antenna up higher, say 150 feet, will help the situation at this location, as would adding an additional Yagi at the 70-foot level and feeding both antennas in phase as a vertical stack.

Although the preceding discussion has been in terms of the transmitting antenna, the same principles apply when the antenna is used for reception. A high antenna will receive low-angle signals more effectively than will a low antenna. Indeed, amateur operators know very well that "If you can't hear them, you can't talk to them." Stations with tall towers can usually hear far better than their counterparts with low installations.

The situation becomes even more difficult for the next lowest amateur band at 3.5 MHz, where optimal antenna heights for effective long-range communication become truly heroic! Towers that exceed 120 feet are commonplace among amateurs wishing to do serious 3.5-MHz long-distance work.

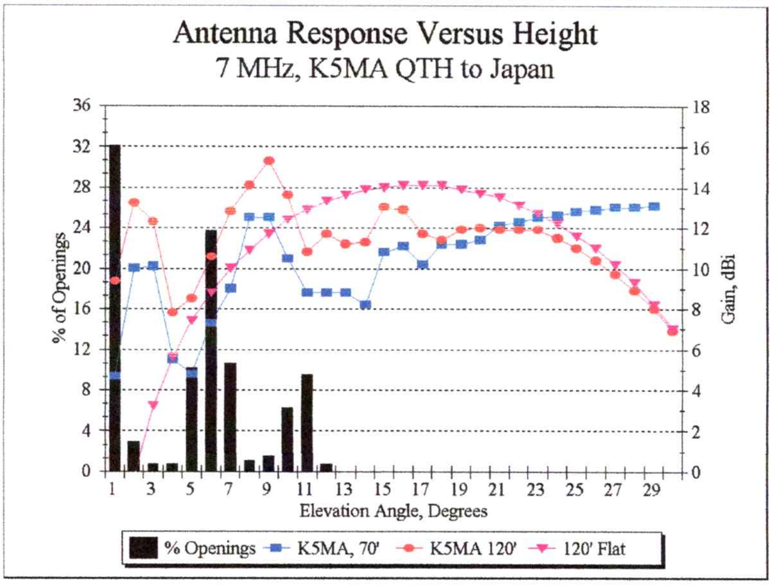


Fig 10—Elevation response on 7 MHz from K5MA location towards Japan on 7 MHz. The 120-foot high Yagi is definitely superior to the one only 70-feet high.

The 3.5 and 7-MHz amateur bands are, however, not always used strictly for long-range work. Both bands are crucial for providing communications throughout a local area, such as might be necessary in times of a local emergency. For example, earthquakes, tornadoes and hurricanes have often disrupted local communications—because telephone and power lines are down and because local police and fire-department VHF/UHF repeaters are thus knocked out of action. Radio amateurs often will use the 3.5 and 7-MHz bands to provide communications out beyond the local area affected by the disaster, perhaps into the next county or the next metropolitan area. For example, an earthquake in San Francisco might see amateurs using emergency power providing communications through amateurs in Oakland across the San Francisco Bay, or even as far away as Los Angeles or Sacramento. These places are where commercial power and telephone lines are still intact, while most power and telephones might be down in San Francisco itself. Similarly, a hurricane that selectively destroys certain towns on Cape Cod might find amateurs in these towns using 3.5 or 7.0 MHz to contact their counterparts in Boston or New York.

However, in order to get the emergency messages through, amateurs must have effective antennas. Most such relatively local emergency situations require towers of moderate height, less than about 100 feet tall typically.

Antenna Height and Interference

Extensive Federal Regulations cover the subject of interference to home electronic devices. It is an unfortunate fact of life, however, that many home electronic devices (such as stereos, TVs, telephones and VCRs) do not meet the Federal standards. They are simply inadequately designed to be resistant to RF energy in their vicinity. Thus, a perfectly legal amateur-radio transmitter may cause interference to a neighbor's VCR or TV because cost-saving shortcuts were taken in the design and manufacture of these home entertainment devices. Unfortunately, it is difficult to explain to an irate neighbor why his brand-new $1000 stereo is receiving the perfectly legitimate transmissions by a nearby radio operator.

The potential for interference to any receiving device is a function of the transmitter power, transmitter frequency, receiver frequency, and most important of all, the proximity of the transmitter to the potential receiver. The transmitted field intensity decreases as the inverse square of the distance. This means that doubling the height of an antenna from 35 to 70 feet will reduce the potential for interference by 75%. Doubling the height again to 140 feet high would reduce the potential another 75%. Higher is better to prevent interference in the first place!

Recently enacted Federal Regulations address the potential for harm to humans because of exposure to electromagnetic fields. Amateur-radio stations rarely have problems in this area, because they use relatively low transmitting power levels and intermittent duty cycles compared to commercial operations, such as TV or FM broadcast stations. Nevertheless, the potential for RF exposure is again directly related to the distance separating the transmitting antenna and the human beings around it. Again, doubling the height will reduce potential exposure by 75%. The higher the antenna, the less there will any potential for significant RF exposure.

THE WORLD IS A VERY COMPLICATED PLACE

It should be pretty clear by now that designing scientifically valid communication systems is an enormously complex subject. The main complications come from the vagaries of the medium itself, the Earth's ionosphere. However, local terrain can considerably complicate the analysis also.

The main points of this paper may be summarized briefly:

> **The radiation elevation angle is the key factor determining effective communication distances beyond line-of-sight. Antenna height is the primary variable under control of the station builder, since antenna height affects the angle of radiation.**
>
> **In general, placing an amateur antenna system higher in the air enhances communication capabilities and also reduces chances for electromagnetic interference with neighbors.**

Ham Radio Antennas: What Does the Law Require of Localities or Municipalities?

By
Fred Hopengarten[1]

A series of materials instruct states, localities and municipalities (hereafter "localities") as to what the law requires when a radio ham applies for an antenna permit. This challenge of localities is that they must meet each and every element of these requirements. This paper is designed to be helpful to localities in drafting an ordinance, by offering a series of questions, with the answer that is necessary for the ordinance to withstand a court challenge.

FCC Materials

PRB-1. The full text of the FCC's seminal 1985 Order, known as PRB-1, may be found at http://www.fcc.gov/wtb/amateur/prb-1.html. While characterized as a "Memorandum Opinion and Order", it has the full force of a Federal regulation or statute, and may preempt state or local law. *Fidelity Federal Savings & Loan Ass'n v. de la Cuesta,* 458 U.S. 141 (1982).

Localities must take heed of several provisions of PRB-1:

> 24. . . . [T]here is . . . a strong federal interest in promoting amateur communications.
>
> 25. Because amateur station communications are only as effective as the antennas employed, antenna height restrictions directly affect the effectiveness of amateur communications. Some amateur antenna configurations require more substantial installations than others if they are to provide the amateur operator with the communications that he/she desires to engage in. . . . [L]ocal regulations which involve placement, screening, or height of antennas based on health, safety, or aesthetic considerations must be crafted to accommodate reasonably amateur communications, and to represent the minimum practicable regulation to accomplish the local authority's legitimate purpose.

Thus, the locality must answer "yes" to each of the following questions:

- Is the ordinance crafted to reasonably accommodate amateur communications? [Note: If the ordinance was crafted to restrict antenna systems in ways that prevent or inhibit amateur communications, presenting unusual hurdles to amateur radio applications not present in similar accessory uses, the answer would be no.]
- Does the ordinance represent the minimum practicable regulation to accomplish the authority's legitimate purpose? [Note: If the ordinance is not the minimum necessary, the answer would be no.]

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[1] Mr. Hopengarten is an attorney whose principal practice is antenna law. He has been a licensed radio amateur (K1VR) since 1956, and an attorney since 1972. He may be reached at hopengarten@post.harvard.edu, or through www.antennazoning.com.

47 CFR §97.15(b). Subsequent to the issuance of the FCC's Order, the essence of PRB-1 was issued as a Federal regulation. The text of 47 CFR §97.15 may be found at: http://frwebgate.access.gpo.gov/cgi-bin/get-cfr.cgi?TITLE=47&PART=97&SECTION=15&YEAR=1999&TYPE=TEXT, but is short enough to be included here:

Sec. 97.15 Station antenna structures.

(a) Owners of certain antenna structures more than 60.96 meters (200 feet) above ground level at the site or located near or at a public use airport must notify the Federal Aviation Administration and register with the Commission as required by part 17 of this chapter.
(b) Except as otherwise provided herein, a station antenna structure may be erected at heights and dimensions sufficient to accommodate amateur service communications. (State and local regulation of a station antenna structure must not preclude amateur service communications. Rather, it must reasonably accommodate such communications and must constitute the minimum practicable regulation to accomplish the state or local authority's legitimate purpose. See PRB-1, 101 FCC 2d 952 (1985) for details.)

[64 FR 53242, Oct. 1, 1999]

Thus, the locality must answer "yes" to this additional question:

- Does the ordinance permit "heights and dimensions" sufficient to accommodate amateur service communications? [Note: Restrictions on height and dimensions are subject to this scrutiny.]

DA 99-2569. An additional FCC order was issued in 1999, stating the FCC position on two items which some localities and courts had found confusing. DA 99-2569 rejects balancing tests ("it is clear that a "balancing of interests" approach is not appropriate"). The local authority may not balance the interests of the community against those of the amateur, as the FCC has already done the balancing and issued a Federal rule.

The FCC further ordered that "the very least regulation necessary for the welfare of the community must be the aim of its regulations so that such regulations will not impinge on the needs of amateur operators to engage in amateur communications."

This Order may be found at http://www.fcc.gov/Bureaus/Wireless/Orders/1999/da992569.txt.

Thus, the locality must answer "no" to these questions:

- Does the ordinance permit a "balancing of interests" approach to the application for a permit?
- Does the ordinance "impinge on the needs of amateur operators to engage in amateur communications"?

Court Decisions

As with many statutes and rules, the Courts have been required to resolve controversies in which a locality acted badly. Here follows a discussion of those cases, detailing further requirements of the law of amateur radio antennas.

An Open Mind.

When Andy Bodony sought to erect an 86' tall antenna system in a town with a maximum height of 25', the Court found that the town had not approached the application with an open mind. In that case, the town sought out advice from counsel in advance of a hearing on just what would be necessary to deny a permit. *Bodony v. Sands Point, NY*, 681 F. Supp. 1009 (E.D. NY 1987), www.qsl.net/k3qk/bodony.html. In what was effectively a substantive due process case, it may interest local government officials that the amateur was awarded $60,000 in damages.

No Fixed or Unvarying Height Limit.

The *Bodony* case, above, also stands for the proposition that an arbitrarily chosen height limitation, without the consideration of the applicant's need for height, is preempted. ("We base our ruling on PRB-1, in preempting the right of the Zoning Board to arbitrarily fix a limitation on the height of an antenna to 25 feet.")[2]

Similarly, *Izzo v. River Edge, NJ*, 843 F.2d 765 (3d Cir. 1988), upholds the preemptive effect of PRB-1 to a 35' height limitation: "The effectiveness of radio communication depends on the height of antennas." At p. 768. The Court awarded fees of $10,000.

See also *Howard v. Burlingame*, CA, 937 F2d 1376 (9th Cir. 1991), (a case in which the bylaw required special permit for heights over 25'): "[T]hose [ordinances] which establish absolute limitations on antenna height . . . are . . . facially inconsistent with PRB-1."

Furthermore, see *Brower v. Indian River County Code Enforcement Board, FL*, No. 91-0456 CA-25 (June 23, 1993), 1993 WL 228785 (Fla.Cir.Ct.). (This case involved an antenna support structure of 68.88 feet, plus antennas to total of 95.6 feet; 72.4 feet from neighbor's property line.) The ordinance had an absolute prohibition on towers over 70'. The ordinance was held facially void as an unvarying maximum height: "We agree with the *Evans* court's adoption of prior rulings in that case which concluded that flat

---

2 "One factor in determining the range and effectiveness of radio communication is the height of the antenna. Measurement from the ground tells us little. A 25 foot antenna in a valley surrounded by hills might be useless, while that equipment on a mountain top might give optimum results. An antenna rising above the obstacles that interfere with radio signals obviously gives a greater range and better reception than an antenna of a lesser height."

prohibitions of this nature are not permitted, *Evans,* at 976." [Refers to Evans I, the Federal District Court case in *Evans v. Boulder, CO*, 994 F2d 755 (10th Cir. 1993)].

In *Pentel v. Mendota Heights, MN*, 13 F3d 1261 (8th Cir., 1994) http://www.qsl.net/k3qk/pentel.html, an absolute 25' height limit was preempted. In *Palmer v. Saratoga Springs, NY,* 180 F. Supp. 2d 379 (N.D.N.Y. 2001), http://www.nysd.uscourts.gov/courtweb/pdf/D02NYNC/01-12259.pdf, an absolute height limit of 20' was preempted. "[A]n unvarying height restriction on amateur radio antennas would be facially invalid in light of PRB-1." (Citing *Pentel* and *Evans*.)

In other words, if a variance is required to go over a certain height, the ordinance is pre-empted.

Effective Communications and Reasonable Accommodation is Found in the Specifics of the Application, and from the Ham's Perspective.

In *Marchand v. Town of Hudson, NH,* 788 A.2d 250 (N.H. 2001), http://webster.state.nh.us/courts/supreme/opinions/0112/march221.htm, a case involving three antenna systems, each totaling 100' tall, in addition to ruling that balancing of interests is not appropriate, the Court held that: "[T]o "reasonably accommodate" amateur radio communications . . . the ZBA may consider whether **the particular height and number of towers are necessary to accommodate the particular ham operator's communication objectives.** (Emphasis added.)

Similarly, in *Snook v. Missouri City, TX,* http://users3.ev1.net/~osnook/34.pdf (reproducing the slip opinion) (USDC, SDTX, 2003), the Court held:

"To conduct effective emergency communications, Snook must be able to achieve at least a 75 to 90 percent successful signal under the changing variables that impact emergency or other amateur radio communications." At ¶9.

"PRB-1 requires a site-specific, antenna-specific, array-specific, operations-specific, ordinance-specific, and city action-specific analysis. PRB-1 at p. 7." At ¶16.

An Attempt to Negotiate a Satisfactory Compromise.

Finally, localities should realize that saying no is never enough. *Howard v. Burlingame, CA* (*id.*), requires that the city "consider the application, make factual findings, and attempt to negotiate a satisfactory compromise with the applicant." At 1380.

Similarly, *Pentel (id.)* quotes with favor the Howard case, saying that reasonable accommodation requires an attempt to negotiate a satisfactory compromise.

No Consideration of Radio Frequency Interference.

The simplest restriction on a locality is that it cannot consider the potential of interference to home electronic equipment, public service communications, and so forth. The interference preemption cases are quite plain.

Broyde v. Gotham Tower, 13 F.3d 994, 997 (6th Cir. 1994), http://pacer.ca6.uscourts.gov/cgi-bin/getopn.pl?OPINION=94a0007p.06.html (FL. Affirmed dismissal of nuisance suit regarding interference with home electronic equipment because interference falls within the FCC's exclusive jurisdiction over radio transmission technical matters).

Southwestern Bell Wireless Inc. v. Johnson County Board Of County Commissioners, 199 F.3d 1185, 1193 (10th Cir. 1999), cert. denied, 2000 WL 343599 (2000), U.S. S. Ct. Dkt. No. 99-1575, 529 U.S. ____ (2000), http://lawdns.wuacc.edu/ca10/cases/1999/12/98-3264.htm, http://www.kscourt.org/ca10/cases/1999/12/98-3264.html. http://laws.findlaw.com/10th/983264.html (KS. Allowing local zoning authorities to condition construction and use permits on any requirement to eliminate or remedy interference "stands as an obstacle to the accomplishment and execution of the full purposes and objectives of Congress.")

Freeman v. Burlington Broadcasters, 204 F. 3d 311 (2d Cir. 2000), cert. denied, 531 U.S. 917 (2000) http://www.tourolaw.edu/2ndCircuit/February00/97-9141.html (VT. Found that "given the FCC's pervasive regulation in this area", allowing local zoning authorities to condition construction and use permits on any requirement to eliminate or remedy RF interference to public service communications 'stands as an obstacle to the accomplishment and execution of the full purposes and objectives of Congress'")

For a review of the field, see "The Ghost in the Computer: Radio Frequency Interference and the Doctrine of Federal Preemption", Brock, Computer Law Review and Technology Journal (1999), pp. 17-36.

Summary

Pity the drafters of a local ordinance. The task is not simple when the meaning of "reasonable accommodation" is not plain. Nonetheless, it can be done.

Questions to the Locality

A locality must answer "**yes**" to each of the following questions:

- Is the ordinance crafted to reasonably accommodate amateur communications?
- Does the ordinance represent the minimum practicable regulation to accomplish the authority's legitimate purpose?
- Will the permit granting authority approach each application with an open

mind?

- Will the permit granting authority consider the amateur's need for effective communications from the amateur's perspective, and work to reasonably accommodate effective communications?

The locality must answer "**no**" to these questions:

- Does the ordinance permit a "balancing of interests" approach to the application for a permit?
- Does the ordinance "impinge on the needs of amateur operators to engage in amateur communications"?
- Is there a fixed or unvarying height limit, after which the only possible way to get a permit is by variance?
- Has the permit granting authority considered radio frequency interference (RFI) or television interference (TVI)?

Keeping Lines of Communication Open—CERT & Ham Radio

July 1, 2019

Community Emergency Response Team (CERT) members know that communication during an emergency is vital. Don Lewis of the Alexandria Radio Club in Virginia wants CERTs around the country to know how amateur radios can help.

Amateur radios, also known as ham radios, are useful tools. Lewis, who is trained in CERT, explained that ham radios are more powerful than regular radios. They aren't incredibly expensive, and they have a wide range of uses.

Sometimes CERTs may need to work together throughout a large area. They need to be able to report things that they have found. They sometimes even need to request medical support. Using a radio is easier, safer, and more efficient than sending a person back with messages, says Lewis. Ham radios enable a CERT to communicate over much greater distances than standard radios. This can improve the level at which a CERT can coordinate. CERTs already use ham radios in exercises and they have extended their range and effectiveness.

The City of Berkeley, California's CERT has already begun using ham radios in city-wide disaster drills. In the winter of 2018, they held a 24-hour mock disaster where they practiced their ham radio skills to better prepare their city. They were able to maintain communications in the whole city for the entire 24-hour exercise. This allowed them to relay critical information to citizens and disaster crews. They were also able to use hams to aid the city during a blackout in November of 2017. The CERTs used solar powered batteries in their ham radios. This allowed them to function even when power and phones were down.

Ham radio instructions are also built into Pasadena, California's emergency management system. The area experiences earthquakes several times a year. The quakes can destroy cell towers and phones lines in an instant. Ham radios can be a huge asset during a disaster like this, so Pasadena has a network of radio operators trained to take over communications at any time they need. They can contact hospitals or fire stations to better serve their community. Ham operators can even aide families in contacting one another once a disaster has passed.

Are you interested in learning how to operate a ham radio of your own to serve your community? Then the Amateur Radio Emergency Service (ARES (http://www.arrl.org/ares)) may be for you. They are a group of radio operators who volunteer for various disasters and public service events. They can provide guidance for training, equipment, licensing, and anything else that you may like to know about hams!

This article first appeared in the monthly Individual and Community Preparedness Newsletter. Subscribe here (https://public.govdelivery.com/accounts/USDHSFEMA/subscriber/new?topic_id=USDHSFEMA_1450).

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Radio Amateur Civil Emergency Service Working Group Charter

1. Purpose: The Radio Amateur Civil Emergency Service Working Group is responsible for the preparation and maintenance of the Kansas RACES Plan. The plan provides for background data that prescribes specific procedures for the recruitment, training, and activation of participating amateur radio operators to support state and local governments; as well as identification of frequencies for broadcast transmission and relay procedures by participating amateur radio operators.
2. The Radio Amateur Civil Emergency Service Working Group shall have the following functions, powers, and duties:
   a. The Communications Act of 1934, Section 606, as amended
   b. Title 47 Code of Federal Regulations, Part 97, Subpart F, and RACES
   c. Executive Order 12472, Assignment of National Security and Emergency Preparedness Telecommunications Functions
   d. Civil Preparedness Guide 1-15: Guidance for Radio Amateur Civil Emergency Service
   e. Staff support will be supplied through the Kansas Division of Emergency Management
3. Membership: The Radio Amateur Civil Emergency Service Working Group shall be offered to representatives in each of the categories listed below.
   a. Representative from each of the Kansas Emergency Management Association Regions
   b. Representative from each of the Regional Incident Management Teams
   c. State Radio Amateur Civil Emergency Service Officer
   d. Adjutant General's Department, Division of Emergency Management
   e. Adjutant General's Department, Office of Interoperable Communications
   f. Additional representatives to bring additional expertise to the group for outreach missions
4. Chairperson: State Radio Amateur Civil Emergency Service Officer
5. Vice-Chairperson: Selected annually by the Radio Amateur Civil Emergency Service Working Group members
6. Time allotted: The Radio Amateur Civil Emergency Service Working Group shall have the authority to convene as necessary; however, meeting times shall be at least once annually. The Chairperson shall be responsible for finalizing agenda issues and determining meeting times
7. Level of Empowerment: Prepare the State Radio Amateur Civil Emergency Service Plan and dissemination
8. Feedback: Publish a summary of meetings; report progress of to the Commission on Emergency Planning and Response

Item for consideration

FCC Rules & Regulations for Title 47

Wireless Bureau

https://www.fcc.gov/wireless/bureau-divisions/technologies-systems-and-innovation-division/rules-regulations-title-47

Kansas

12-16,126. Kansas emergency communications preservation act. (a) In order to enhance and preserve the operation of federally licensed amateur radio communications and to ensure its continued role in serving as an integral resource during times of emergency for Kansas and its communities, there is hereby enacted an act which may be known and cited as the Kansas emergency communications preservation act.

(b) As used in this section:

(1) "Amateur radio services" means:

(A) Amateur service, as defined in 47 C.F.R. § 97.3 (April 25, 2001) as a radiocommunication service for the purpose of self-training, intercommunication and technical investigations carried out by amateurs, that is, duly authorized persons interested in radio technique solely with a personal aim and without pecuniary interest;

(B) amateur-satellite service, as defined in 47 C.F.R. § 97.3 (April 25, 2001) as a radiocommunication service using stations on earth satellites for the same purpose as those of the amateur service; and

(C) radio amateur civil emergency service, as defined in 47 C.F.R. § 97.407 (February 10, 2000).

(2) "Amateur service communications" means communications carried out by one or more of the federally licensed amateur radio services.

(3) "Amateur station" means a station in an amateur radio service consisting of the apparatus necessary for carrying on radiocommunications.

(4) "Station antenna structures" means the antennas that serve a federally licensed amateur station, including such appurtenances and other structures as may be necessary to support, stabilize, raise, lower or otherwise adjust the antennas. The station antenna structures shall not be construed to be permanent structures.

(c) A governing body of a city or county shall not adopt an ordinance, resolution, regulation or plan, or take any other action that precludes federally licensed amateur radio service communications, or that in any manner does not conform to the provisions of 47 C.F.R. § 97.15

and the limited preemption entitled "amateur radio preemption, 101 F.C.C. 2d 952 (1985)" as issued by the federal communications commission.

(d) If a governing body of a city or county adopts an ordinance, resolution, regulation or plan, or takes any other action that regulates the placement, screening, number or height of a station antenna structure based on health, safety or aesthetic considerations, the ordinance, resolution, regulation, plan or action must:

(1) Reasonably accommodate federally licensed amateur radio service communications; and

(2) constitute the minimum regulation practicable to carry out the legitimate purpose of the governing body.

(e) The provisions of this section do not apply to any district organized pursuant to federal, state or local law, for the purpose of historic or architectural preservation.

(f) Any ordinance, resolution, regulation, plan or other action adopted or taken by a governing body in violation of the provisions of this section is void.

(g) Station antenna structures constructed prior to the effective date of this section are exempted from subsequent changes in zoning regulations by the city or county and may be repaired as required.

History: L. 2008, ch. 68, § 1; July 1.

KS RACES

https://www.kansastag.gov/AdvHTML_doc_upload/State%20RACES%20Plan%202013.pdf

Item 3.

Public Law 103-408

Public Law 103-408--Joint Resolution of Congress to Recognize the Achievements of Radio Amateurs as Public Policy

Public Law 103-408--Oct. 22, 1994

Public Law 103-408
103d Congress
Joint Resolution

To recognize the achievements of radio amateurs, and to establish support for such amateurs as national policy.

Whereas Congress has expressed its determination in section 1 of the Communications Act of 1934 (47 U.S.C. 151) to promote safety of life and property through the use of radio communication;

Whereas Congress, in section 7 of the Communications Act of 1934 (47 U.S.C. 157), established a policy to encourage the provision of new technologies and services;

Whereas Congress, in section 3 of the Communications Act of 1934, defined radio stations to include amateur stations operated by persons interested in radio technique without pecuniary interest;

Whereas the Federal Communications Commission has created an effective regulatory framework through which the amateur radio service has been able to achieve the goals of the service;

Whereas these regulations, set forth in Part 97 of title 47 of the Code of Federal Regulations clarify and extend the purposes of the amateur radio service as a--

(1) voluntary noncommercial communication service, particularly with respect to providing emergency communications;

(2) contributing service to the advancement of the telecommunications infrastructure;

(3) service which encourages improvement of an individual's technical and operating skills;

(4) service providing a national reservoir of trained operators, technicians and electronics experts; and

(5) service enhancing international good will;

(1) radio amateurs are hereby commended for their contributions to technical progress in electronics, and for their emergency radio communications in times of disaster;

(2) the Federal Communications Commission is urged to continue and enhance the development of the amateur radio service as a public benefit by adopting rules and regulations which encourage the use of new technologies within the amateur radio service; and

(3) reasonable accommodation should be made for the effective operation of amateur radio from residences, private vehicles and public areas, and that regulation at all levels of government should facilitate and encourage amateur radio operation as a public benefit.

Approved October 22, 1994.

Regulatory & Advocacy >> Federal >> Federal Regulatory >> RFI Regulatory Information >> Public Law 103-408

EXPLORE ARRL

Whereas Congress finds that members of the amateur ra service community has provided invaluable emergency communications services following such disasters as Hurricanes Hugo, Andrew, and Iniki, the Mt. St. Helens Eruption, the Loma Prieta earthquake, tornadoes, floods, wild fires, and industrial accidents in great number and variety across the Nation; and

Whereas Congress finds that the amateur radio service has made a contribution to our Nation's communications by its crafting, in 1961, of the first Earth satellite licensed by the Federal Communications Commission, by its proof-of-concept for search rescue satellites, by its continued exploration of the low Earth orbit in particular pointing the way to commercial use thereof in the 1990s, by its pioneering of communications using reflections from meteor trails, a technique now used for certain government and commercial communications, and by its leading role in development of low-cost, practical data transmission by radio which increasingly is being put to extensive use in, for instance, the land mobile service: Now, therefore, be it

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. FINDINGS AND DECLARATIONS OF CONGRESS

Congress finds and declares that--

Model Zoning Ordinance v8

Fred Hopengarten, Esq., K1VR

Section 000. AMATEUR RADIO STATION ANTENNA STRUCTURES

000.1. INTRODUCTION. This ordinance is intended to implement the limitations on government entities created by federal law 47 CFR § 97.15(b), with respect to station antenna structures used in the Amateur Radio Service.

000.2. DEFINITIONS.

(a) "Amateur Radio Station Antenna Structure" means the rigid part of an assembly that receives or transmits radio energy and the mast or tower on which the assembly is mounted, but does not include non-rigid items such as wire, cable, transmission lines, lightning rods, guy wires, or guy wire anchors (including guy wire anchor posts less than six feet in height).[1]

(b) "Amateur operator," "amateur radio services," "amateur service," and "amateur station" have the meanings given such terms in the Code of Federal Regulations, 47 C.F.R. § 97.3.

000.3. PURPOSE. An Amateur Radio use promotes the general welfare, public health and safety. By federal law, 47 CFR § 97.1, Amateur Radio has a fundamental purpose as expressed in the following principles:

(a) Recognition and enhancement of the value of the amateur service to the public as a voluntary noncommercial communication service, particularly with respect to providing emergency communications.
(b) Continuation and extension of the amateur's proven ability to contribute to the advancement of the radio art.
(c) Encouragement and improvement of the amateur service through rules which provide for advancing skills in both the communication and technical phases of the art.
(d) Expansion of the existing reservoir within the amateur radio service of trained operators, technicians, and electronics experts.
(e) Continuation and extension of the amateur's unique ability to enhance international goodwill.

[1] Original definition found at Anne Arundel County Code, Article 18 Zoning, Title 1 Definitions. Go to http://www.aacounty.org/CountyCode/index.cfm and click on "Access the Anne Arundel County Code (Select this link)." § 18-1-101. Definitions.

As a result of, and in order to promote, the many benefits provided by Amateur Radio, the [city/town/county/parish] has determined to be in the best interests of the [city/town/county/parish] that amateur operators be given as much flexibility as possible to erect Amateur Radio Station Antenna Structures subject only to those limitations necessary protect fundamental interests of the community.[2]

000.4. ORDINARY ACCESSORY USE: An Amateur Radio Station Antenna Structure shall be considered an ordinary accessory use in all districts. It may also be a principal structure in all districts.

000.5. BUILDING PERMITS REQUIRED: Vertical antennas resembling a flag pole, or where the main vertical element does not exceed five inches in diameter, and all wire antennas, require no building permit. Lattice towers, and vertical masts exceeding five inches in diameter, that exceed 12 feet in height require a building permit. Except where a Special Use Permit is required, no Notice to Abutters or public hearing shall be required.

000.6. MAXIMUM HEIGHT: Except by Special Use Permit, Amateur Radio Station Antenna Structures shall not exceed a maximum height of 120 feet (inclusive of both the support structure and any attached antennas) in any district.

Alternative
000.6 MAXIMUM HEIGHT: Except by Special Use Permit, Amateur Radio Station Antenna Structures shall not exceed a maximum height of 75 feet (inclusive of both the support structure and any attached antennas) on any lot less than 20,000 square feet in size; or 120 feet (inclusive of both the support structure and any attached antennas) on any lot less than two acres.

000.7. LOCATION: Amateur Radio Station Antenna Structures shall be located in a rear or side yard, except in Rural and Single Family Residential zoning districts on sites of two acres or larger where such antennas and support structures may be located anywhere on the buildable area of the lot. On sites of less than two acres, except for a flag pole-style antenna, an Amateur Radio Station Antenna Structure may only be located in a front yard for good cause shown.

000.8. SETBACKS

000.8.1: GENERALLY: Amateur Radio Station Antenna Structures must meet the yard requirements of primary buildings or structures of the zoning district in which they are located.

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[2] This phrasing intended to meet the requirement of the original PRB-1, at ¶ 25 which reads, in relevant part: "[L]ocal **regulations** which involve placement, screening, or height of antennas based on health, safety, or aesthetic considerations **must be crafted** to accommodate reasonably amateur communications, and to represent the minimum practicable regulation to accomplish the local authority's legitimate purpose."

000.8.2: NON-RIGID ELEMENTS: Non-rigid elements such as wire, cable, transmission lines, lightning rods, guy wires, or guy wire anchors (including guy wire anchor posts less than six feet in height), shall not be included in any determination of set-back or required yard.[3]

000.8.3: SUPPORT STRUCTURES: Amateur radio antennas and amateur radio antenna support structures shall be set back one foot for every three feet in height which the antenna or support structure exceeds the height limitation of the zoning district in which it is located. Such setback shall be measured from the lot line to the closest point of the base of the antenna or support structure, but such setback measurement shall not be the distance to the furthest extent of an antenna supported by an antenna support structure.

000.8.4: GUY WIRE ANCHORS: Guy wire anchors may be installed within a required setback, but shall not be placed within three feet of any lot line, or within any easement, sight distance triangle/ runway or landing strip.

000.9. NUMBER OF ALLOWED STRUCTURES: Nothing in this section shall preclude the installation of two or more Amateur Radio antenna support structures on any lot in the Rural and Single Family Residential zoning districts, provided the standards of this section are met and there is at least 3,000 square feet of lot area for each antenna support structure. There is no limit to the number of antennas, including wire antennas, that may be mounted on an antenna support structure. There is no limit to the number of amateur radio antennas mounted to a building and such structures shall be considered a building appurtenance.

000.10. DEVIATION FROM STANDARDS: Any Amateur Radio Station Antenna Structure requiring a deviation from the height or setback standards of this section shall require a Special Use Permit. If the deviation is minor, the Building Department is authorized to grant the building permit for good cause shown.

000.11. PLACEMENT ON AN EXISTING ANTENNA SUPPORT. Where a Radio Amateur chooses to use an existing structure as an antenna or antenna support structure, creating no additional material element, no building permit shall be required.

000.12. SUBMISSION REQUIREMENTS. Upon submission of the following information, no further engineering data, nor the stamp or certification of a professional engineer, shall be required. Such information prepared by the manufacturer of the antenna or tower, as the building inspector may reasonably require, including but not limited to the following:

(a) The make and model.
(b) The manufacturer's suggested installation instructions.

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[3] *ibid.*

(c) The manufacturer's suggested maintenance and/or inspection procedures, if any.
(d) The color or colors of the tower. In all cases, gray shall be acceptable.
(e) The type of tower (monopole, guyed, freestanding or other).
(f) Construction drawings, including drawings and specifications for any concrete base.

000.13. CHANGES. Due to the experimental nature of the amateur radio service, antennas mounted on a tower may be modified and changed at any time so long as the published allowable load on the tower is not exceeded and the structure of the tower remains in accordance with the manufacturer's specifications.

000.14. EXPENSES, FEES, AND CONDITIONS. Unreasonable expenses or fees, especially those out of proportion to the cost of the Amateur Radio Station Antenna Structure, and onerous or impracticable conditions may not be required as part of a submission for, or grant of, a permit.[4] However, antennas and antenna support structures shall be installed in compliance with manufacturer's specifications and the state building code.

[Alternative: In no event shall application or review fees for antennas, or antenna support structures, exceed the fees for residential projects of comparable cost. Onerous or impracticable . . .]

000.15. FAILURE TO ACT. Failure of the Building Department to grant or deny an application eligible for a building permit within 45 days from the time that the Radio Amateur applies shall be deemed to be approval, and equivalent to the grant of a building permit.

[4] See *Matter of Modification & Clarification of Policies & Procedures Governing Siting & Maintenance of Amateur Radio Antennas & Support Structures, & Amendment of Section 97.15 of the Commission's Rules Governing the Amateur Radio Serv.*, 14 FCCR 19413, 19416). As to excessive fees, see also *Landstein v. Town of LaGrange*, 86 N.Y.S.3d, 166 A.D.3d 100 (2018)