



Magnum Communications -Township of Rutland

Engineering Statement  
Prepared for Dane County  
Re:  
Proposed WBKY Tower Site  
Township of Rutland  
Application for CUP #2270  
May 6, 2014

Prepared by:  
Evans Associates Consulting Engineers  
13716 N. Lake Shore Drive, Mequon, WI 53097  
Phone (262) 242-6000  
[www.evansassoc.com](http://www.evansassoc.com)  
© 2014 by Evans Associates  
All Rights Reserved  
Magnum Communications -Township of Rutland  
3768 Old Stage Road in the Township of Rutland



## **I. BACKGROUND**

This engineering report has been prepared by Ralph E. Evans, of Evans Associates Communications Consultants in Mequon, Wisconsin, regarding the proposed relocation of WBKY FM radio under CUP 2270 near 3768 Old Stage Road recently submitted to Dane County by Magnum Communications.

This report specifies a 486-foot guyed lattice tower structure and equipment shelter proposed to be located in the Township of Rutland in Dane County, Wisconsin. The tower is proposed on land currently owned by Stoughton Farms Incorporated, on a new 15.5 acre parcel of land in the southeast corner of the property. The tower is proposed to be next to a gravel pit, tucked into a grove of trees nearly equidistant from Old Stage road, North Union Road, Union-Dane Road, and Shady Willow Road. It is approximately 1800' from the nearest side road, a private drive servicing the gravel pit.

Evans Associates has been retained to evaluate the tower proposal from the standpoint of radio engineering and co-location conformance. The siting information utilized in the instant analysis has been provided to Evans Associates by Magnum Communications and the Dane County Division of Zoning. This information has been checked and updated using Evans' databases and software programs, with due consideration for Wisconsin State and Federal jurisdictions. The combined information has been used in evaluating the structure at this proposed location with respect to Dane County's Zoning Ordinance and matters of public safety. Magnum Communications is the licensee of Class A FM station WBKY, previously assigned to Portage, Wisconsin, but which is currently in the process of reassignment and relocation to Stoughton, Wisconsin in Dane County. Dane County's Tower Ordinance entitled "PROCEDURE AND STANDARDS FOR THE PLACEMENT, CONSTRUCTION OR MODIFICATION OF COMMUNICATION TOWERS" has provided the template for the engineering evaluation, except with respect to issues that trigger Wisconsin State or Federal preemption. The analysis and the conclusions contained herein have been prepared by or under the direction of Ralph Evans, of Evans Associates.

Information provided to Evans Associates by other parties is believed to be correct, and has been verified where feasible. Accordingly, this document and the attached exhibits are true and accurate to the best knowledge and belief of Evans Associates.

Pursuant to our employment, this statement has been prepared.

## **II. ABSTRACT**

Obtaining local approval to construct the tower site is the final step in WBKY's quest to move and improve its underutilized facility (according to the applicant, the 60 db Grade B service contour population (Grade B represents a good stereo service) would increase from 62,943 persons to 233,071 persons (applicant's calculation). Stoughton would obtain its first FM origination service while two other FM stations would remain in Portage. Evans' analysis shows similar, but not exactly the same populations of 48,512 and 213,585 persons respectively. In either case, this is a substantial facility



improvement, and it is consistent with the FCC's requirement that licensees maximize their facilities to the greatest extent possible to serve underrepresented communities (see Figure 6). As the below discussion affirms, Evans Associates is of the opinion that a grant of the Magnum application complies with the county communication tower ordinance, applicable state and federal statutes, and is respectful of environmental factors consistent with other installations of this type.

Broadcast radio facilities are mandated by the FCC to serve their cities of license. Depending upon the programming format used by the station, such service usually takes the form of entertainment (the current format is country, news, sports and local public safety information delivered to the licensed community and the surrounding area). Weather information and school closings are examples of typical public safety broadcasts.

Other aural services assigned to Madison or other nearby communities would not usually exhibit a local Stoughton focus. The proposed construction of the broadcast facility appears to have met the public interest requirements of the FCC, the FAA, the Wisconsin DOT Bureau of Aeronautics, and the U.S. Environmental Protection Agency. Accordingly, this document provides information that may be used to weigh land use, public safety and other environmental considerations attached to a 486' tower. The proposed site has been analyzed carefully from the standpoints of regulatory history, service necessity and availability of alternative sites. The conclusions reached herein represent the most complete engineering evaluation Evans is able to perform.

### **III. SITE ANALYSIS**

The following paragraphs represent our analysis of Magnum's application for a guyed antenna supporting structure in the Township of Rutland near Brooklyn, Wisconsin.

#### **1. Validation of RF Information**

The proposed site utilizes an FM antenna that will be mounted in two sections near the top of the tower. The topmost section radiates the "Main" or analog channel, while the lower section utilizes digital modulation that may propagate one to four digital programs. These antennas both provide full omnidirectional coverage. The antenna height proposed has been requested by Magnum in order to "fill in" behind hills and avoid multipath distortion, which, in this engineer's experience, is a challenge for "high definition" digital FM radio channels.

#### **2. Effect of shorter towers**

The Longley-Rice (propagation) study of Figure 2 shows the area (red) that would receive broadcast-quality digital radio programs within the "Grade A" (city grade, or 70 db) contour. Even at the proposed height of 486', some degradation of signal is shown at the edges of the city grade contour by the yellow shaded areas at the periphery.

According to the applicant, the tower will be built with sufficient reserve capacity to ensure suitability for numerous additional co-locators, certainly four or more as required by the County's ordinance (see Section VIII-5). This observation is further discussed in the "Recommendations" section of this document. Because of the topography of the area, the proposed tower would provide a unique opportunity for other wireless networks to collocate and supply high-reliability services, such as land mobile radio and broadband Internet. Relatively taller structures are necessary to serve areas behind hills, in buildings and through dense trees with high-speed high frequency services.

To evaluate the effect of shorter towers than that proposed by the applicant, Evans ran Longley-Rice propagation analyses at 315' and 400' in addition to the proposed height of 486 feet (see Figures two through four). In Magnum's opinion, the full requested height represents the minimum that will achieve the required technical objectives. The attached propagation maps show the effect of decreasing tower height, and paragraph VII shows the relative population associated with each. While the 315', 400' and 486' maps show definite differences in coverage, it certainly may be argued that the difference in performance between a tower of an intermediate height, say 450', would be minor compared to that at 486'. However, the differential visual impact would be minor as well, thereby achieving a dubious benefit. Accordingly, Evans agrees with the assessment by Magnum that the full tower height is required for efficiency and technical conformance.

### **3. Site restraints**

Figure 1, attached, shows the area within which the tower may be located according to the FCC's allocation and city coverage rules. There are no known FCC registered towers within this area, the closest being only 200' high and outside of the siting window. Also affecting proper tower location within the allocation area is minimization of multipath reception, which is an extremely complex calculation. Consideration must also be given to the compatible nature of the adjacent land, as well as nearby population density.

It should be noted that cell towers under 200 feet do not require FCC registration.

### **IV. RF Considerations**

In the experience of this engineer, the proposed site with its Class A power level will meet FCC RF exposure requirements with respect to the general population, and will not interfere with public safety radio networks as long as industry-standard equipment is used and good engineering practices are followed during construction. FCC rules require that a tower climbing power-down procedure be put in place during antenna maintenance. It is suggested that the applicant's OET 65 based document (RF exposure calculations according to procedures outlined

in the FCC's Office of Engineering Technology, along with its companion document OET 56) be supplied to Dane County for the record.

Accordingly, with the RF energy standards utilized in the evaluations by this consultant, and as per previous concurring opinions from the Medical College of Wisconsin, it is concluded that there is no credible radio frequency concern related to RF health risks with respect to the described site as long as the industry standard construction practices are followed.

**V. Alternative Ways of Addressing a Particular Service Area Void**

In the search area defined by FCC and FAA rules, along with multipath avoidance, there appears to be no clearly superior alternative location identified for this tower. Moving the site south would be disadvantageous, even if a site could be found, because it would reduce the population served. Moving northeast may be problematical because of increased residential density. Political subdivisions are not pertinent in allocations, because they are secondary to the general public necessity and technical limitations.

Evans has checked the Magnum allocation search area map, and the result is shown in Figure 1. The proposed site is located at the northwestern boundary of the permissible area. At this location, the tower appears to be most compatible with land use as the area around the tower has a relatively low population density. It is the intent of the County's ordinance to populate the county with the minimum number of structures by requiring co-location. Since there are several Internet, cell and PCS providers in the Dane County area, additional providers could be expected to co-locate at this unique site, especially as wireless Internet services become more prevalent. The tower will be placed near a gravel pit, partially shielded by trees. In this engineer's opinion, it probably would be difficult to replicate this confluence of factors within the remainder of the siting area.

As per Figure 1, the proposed siting window is highly constrained and cannot be moved outside of the "grey" area without causing prohibited interference to co-channel and/or adjacent channel stations in any direction without compromising coverage toward one or more of its designated markets. This is because of short-spacing to WMAD-FM, WRIT-FM and the FCC's city of license requirement (see CFR 47 73.215 of the FCC Rules) and the FAA's obstruction standards in FAR 77. It is the opinion of Evans Associates that the tower is well positioned to serve as a multiple-use supporting tower sufficient to address the needs of possible future co-locators. Alternative sites in Dane or Rock County have not been identified that meet all these criteria.

It should also be noted that this location could be an excellent site for other public safety and Internet initiatives known to be proceeding in Dane County. While such use cannot be guaranteed, it is suggested that the Sheriff's Communications Committee and the State Patrol

(Wisconsin Department of Transportation) be made aware of the existence of the tower if it is constructed.

**VI. Conformance to Industry Standards**

The proposed site has received clearance from the FCC, FAA and the Wisconsin Department of Transportation, Bureau of Aeronautics (see Figure 1). No issue was identified with respect to the Federal Environmental Protection Agency; however in order to reduce the environmental impact of the new tower, Magnum has sought a waiver from the FAA so that the sidelight luminosity may be reduced. This waiver was recently granted.

Assuming no serious malfunction of transmitters or land mobile radio receivers, interference to public safety or other RF services is not expected. In any case, all transmitters and receivers located at common sites should observe good engineering practice with respect to tower bonding and grounding. Stray voltage should be minimized by connecting tower lights and other tower mounted AC circuits in a "balanced" configuration (grounded center-tapped transformer).

**VII. Proposed Height Verification**

As per the discussion in Item III-1, the tower height is dictated by the antenna height necessary for reliable coverage, which is influenced by topography and "look angle." This proposal appears to be reasonable at 486 feet above ground level, considering that Magnum intends to accommodate additional carriers, and desires to service the maximum possible number of listeners. The effectiveness of the tower height can be seen in the following population table vs. tower height:

Facility Contour Population

WBKY Existing 60 db	48,512 persons
WBKY Proposed 60 db	213,585 persons
WBKY New 400' Tower	202,303 persons
WBKY New 315' Tower	195,731 persons

These figures were determined by Evans Associates. The 60 db service contour represents the minimum signal that will yield good stereo audio and relatively artifact-free digital programming.



Because of the service area increase, it is the opinion of Evans Associates that construction of the new broadcast supporting structure at the requested height is in the public interest.

**VIII. Response to Nearby Residents' Questions**

Several objections to the new tower have been received on behalf of local residents and town representatives. In addition, several other issues have been identified by Evans Associates appropriate to changes in the regulatory environment. These issues are discussed individually below.

**1. Is the "fall down" radius sufficient?**

Evans Associates is very familiar with the work products and services of both *Edge Consulting Engineers* and *Electronics Research, Inc.*, the proposed tower manufacturer. Based upon Evans' 45 years of designing tower-based facilities, it is our experience that Edge has never failed to design towers for their clients that are properly configured to service the desired application.

According to the engineering information provided, the proposed tower has been designed to specifications set by the Electronic Industries Association, which provides standards and safety factors for broadcast towers that are configured to hold antennas in wind and ice conditions appropriate to the Midwest area. Similarly, Evans is also familiar with numerous broadcast facilities that have been constructed and maintained by Electronics Research Inc., such as towers for Midwest Broadcasting Company in Green Bay and Wausau.

In Evans' 45 years of experience, broadcast towers have never been known to fail absent a preventable outside influence, because they are designed for very high margins and specifications, representing hurricane forces and thousands of pounds of ice load. In addition to the EIA standards, guyed towers may be designed to respect any fall-down radius, including a 200% to 300% safety factor or higher. Of course, the towers must be properly manufactured, installed and maintained. Generally, in the rare event they may fail, perhaps due to improper installation or maintenance, they usually fold up upon themselves like a carpenter's rule inside the outer guy radius.

The primary danger to a tower is the case of sabotage when the guy wires are cut. This is less likely to occur with the subject tower because there are six anchor points, each holding three or four guy wires. However, in an abundance of caution, the applicant may wish to consider installing fencing, barbed wire and a security system protecting the tower base and all six-guy points (see item #3 below).

**2. Can "ice fall" or "guy wire ice riding" be a hazard? Should the tower be designed and inspected by a Registered Tower Engineer?**

It is possible that ice falling from the tower could pose a hazard to persons on the ground in certain cases. This ice will usually fall within the outer guy radius, except in instances where it can "ride" down the guy wires. To address this issue, "ice breakers" (large cable clamps) and "preform clips" (lead caps to keep preforms closed) should be installed on the guy wires.

In addition, it is suggested that a professional engineer inspect the finished tower for manufactured or installed defects and report to the building inspector.

**3. Should a security alarm system be installed?**

A security system consisting of a fence, barbed wire, vibration sensors and cameras are recommended to protect the tower base, the equipment building, and all anchor points in order to avoid vandalism.

**4. Could a directional antenna be used so that the search area could be expanded?**

The FCC's rules allow the use of FM directional antennas only in very limited circumstances, mostly with respect to "grandfathered" short-spaced facilities. Section 73.215 and other referenced sections of the FCC rules make their use difficult or impossible if fully-spaced sites are available according to the FCC's allocation rules. In addition, directional antennas are extremely expensive and unavoidably cause distortion in the digital (high definition) signal.

**5. Does the proposed multi-use tower conform to Dane County's co-location requirements?**

The proposed tower will be built with the following probable and possible services attached:

1. One analog FM Broadcast
2. Two to five digital broadcast
3. One studio-transmitter link
4. Possible inter-city relay, backhaul and Internet node
5. Possible 4G telephone and data service (1 to 3 carriers)

The proposed antenna site would therefore improve wireless services in the designated area and would serve as an aggregation co-locating point.



**6. Can the site be moved to Rock County?**

Sites are selected to meet technical criteria irrespective of political divisions. No compliant sites have been identified that respect allocation requirements, airport obstruction standards, population density and multipath distortion that are located in Rock County.

**7. Can the tower's adverse visual impact be reduced?**

Edge Consulting has provided a set of photo simulations showing how the structure will look at various ground locations. The photo simulations indicate that surrounding mature trees will partially obscure the view of the tower from close-in vantage points. At greater distances, the relatively small tower diameter should help it "blend in" with the ground and sky.

Edge has also provided a conceptual drawing of the proposed tower (see Figure 5).

**IX. Alternative Sites**

According to the applicant, there are no known existing structures that would supply essentially the same functionality as the proposed tower off of Old Stage Road. Indeed, Evans found no record of any existing or planned communications towers within 4.7 kilometers of the proposed search area in the FCC or FAA databases, other than Magnum's own applications for the Brooklyn site (#1263803), and a previous abandoned application for a location in Oregon, Wisconsin (#1276118). Within the allocation siting area shown in Figure 1, there does not appear to be a clearly superior location or tower site offering the same or better tree screening and road setbacks in either Dane or Rock counties.

The history of the search for a suitable solution to the broadcast coverage deficiency reveals few options for alternative sites. It is the opinion of Evans Associates that Magnum has done a thorough job of searching for alternative sites, and, in our opinion, has met the pertinent requirements of the Dane County ordinance as well as other State and Federal agencies.

**X. Co-location Capabilities**

According to the applicant, the proposed tower has been designed to accommodate additional carriers in the future. The Dane County standard is a minimum of two additional cellular carriers. Due to the unique facility being requested, the tower appears to be robust enough to support at least four more carriers in addition to the proposed two broadcast antennas. This is a good way of encouraging consolidation, thereby reducing tower proliferation.

**XI. Propagation Analysis**

The attached figures 2, 3 and 4 show the level of reception to be expected at 486, 315, and 400 feet above ground level. The color scheme used for the attached propagation maps is as follows:

Red – acceptable analog and digital coverage

Orange – marginal digital coverage

Yellow – Some digital artifacts present and some stereo noise in analog signal

Green – The minimum reception level for most listeners using line-cord or mobile antennas

The best service among these three exhibits is rendered at 486 feet.

**XII. RECOMMENDATIONS**

Evans Associates has received all information necessary to support the instant analysis.

Evans concurs that there is no other known structure within the siting area that could reasonably be extended to the required height, nor are there any identified clearly preferable locations meeting all allocation criteria.

It is this engineer's opinion that Magnum has sufficiently demonstrated a need for building a tower at the proposed site, to be used by Class A broadcasting station WBKY. There are no alternative existing towers or sites that can reasonably be determined to be superior locations. Assuming that a qualified contractor does the installation, no undue impact is expected to public safety or convenience, as defined by the County's tower ordinance. Once built, however, the tower should be configured to support as many co-locators as reasonably possible in order to prevent additional tower proliferation.


This consultant recommends the approval of the proposed construction at the requested height above ground of 486 feet, subject to the conditions tabulated below. In Evans' opinion, cutting the tower below the 486 level would offer little or no commensurate visual impact benefit. With the adoption of the recommendations contained herein, it is the opinion of this consultant that the proposed tower will accommodate the communication needs of residents and businesses while protecting the public health, safety and general welfare, with respect to those items for which Evans Associates is expert. Dane County also will ensure its own compliance with the new Wisconsin statutory regulations regarding FM broadcast facilities.

The following items are recommended as Conditions of Use, along with any other conditions the committee may recommend:

1. A copy of the FCC required radiation calculations should be provided according to Office of Engineering and Technology (OET) Bulletin 65 and its revisions.

2. A statement of compliance concerning the inspection of the erected tower by a Registered Professional tower engineer should be provided.
  3. A statement should be provided that the proponent and the tower erector will be responsible to install "ice breakers" and "preform clips" on the guy wires for extra safety. (The reason for the preform clips is to keep the loops at the ends of the guy wires from "unraveling", thereby weakening the attachment points.) Ice breakers should be installed every 100' of guy wire.
  4. 10' fences with barbed wire should be installed to secure the guy anchors and tower base.
  5. A security system should be considered specifying vibration sensors, door open, and possibly cameras.
  6. All tower components, appurtenances and transmission lines should be securely bonded and grounded to prevent RF interference caused by stray signals.
- Public access within ice fall areas should be restricted; the ice fall area should be defined by a professional tower engineer.

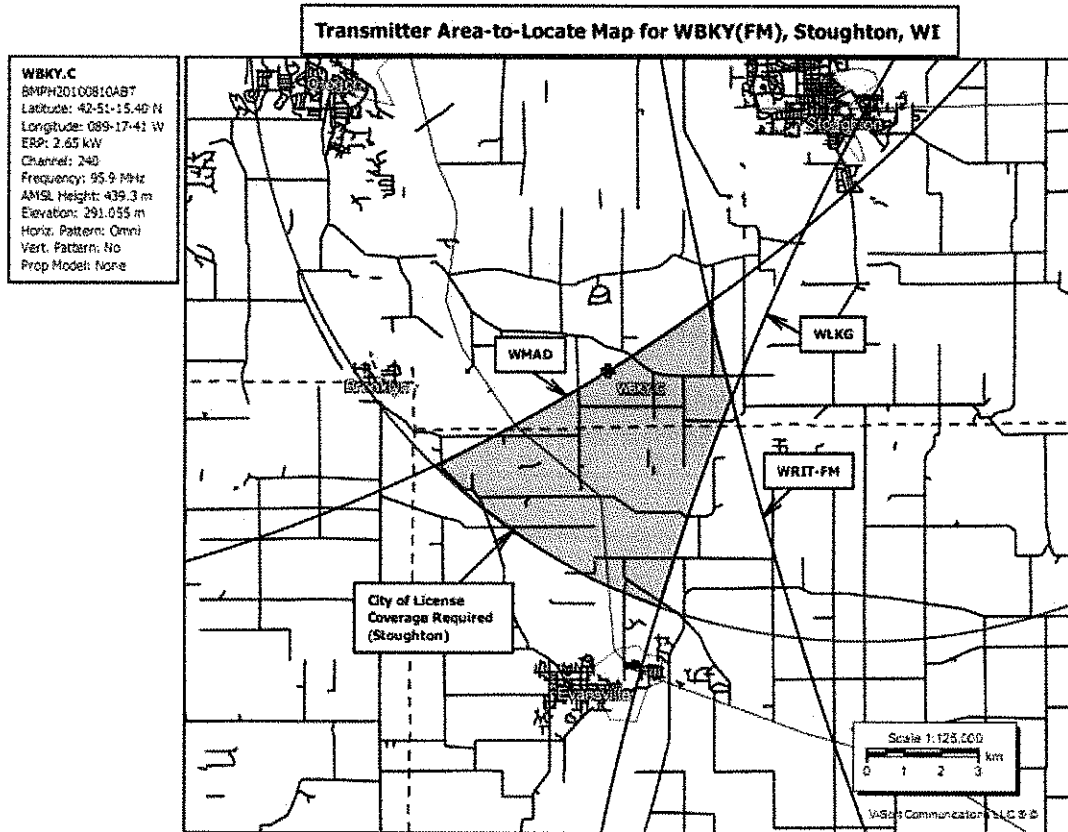
Respectfully submitted,

A handwritten signature in black ink, appearing to read "Ralph E. Evans".

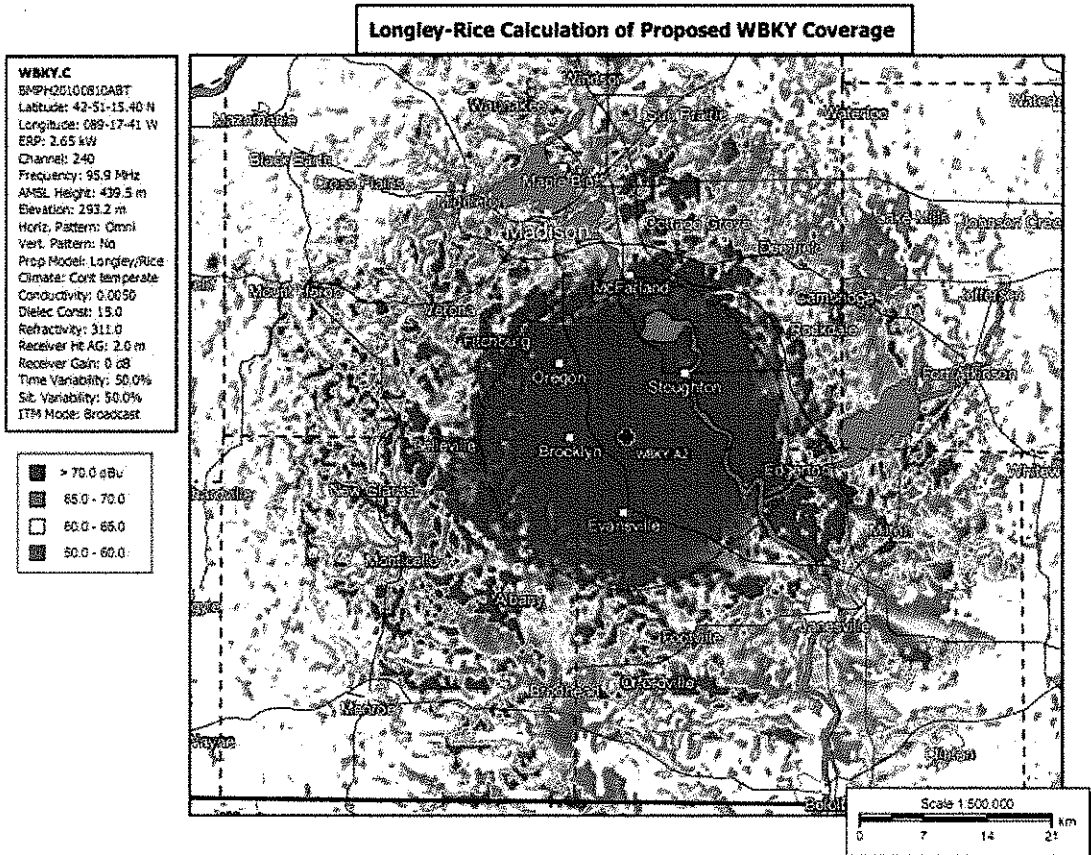
Ralph E. Evans  
Evans Associates

April 30, 2014

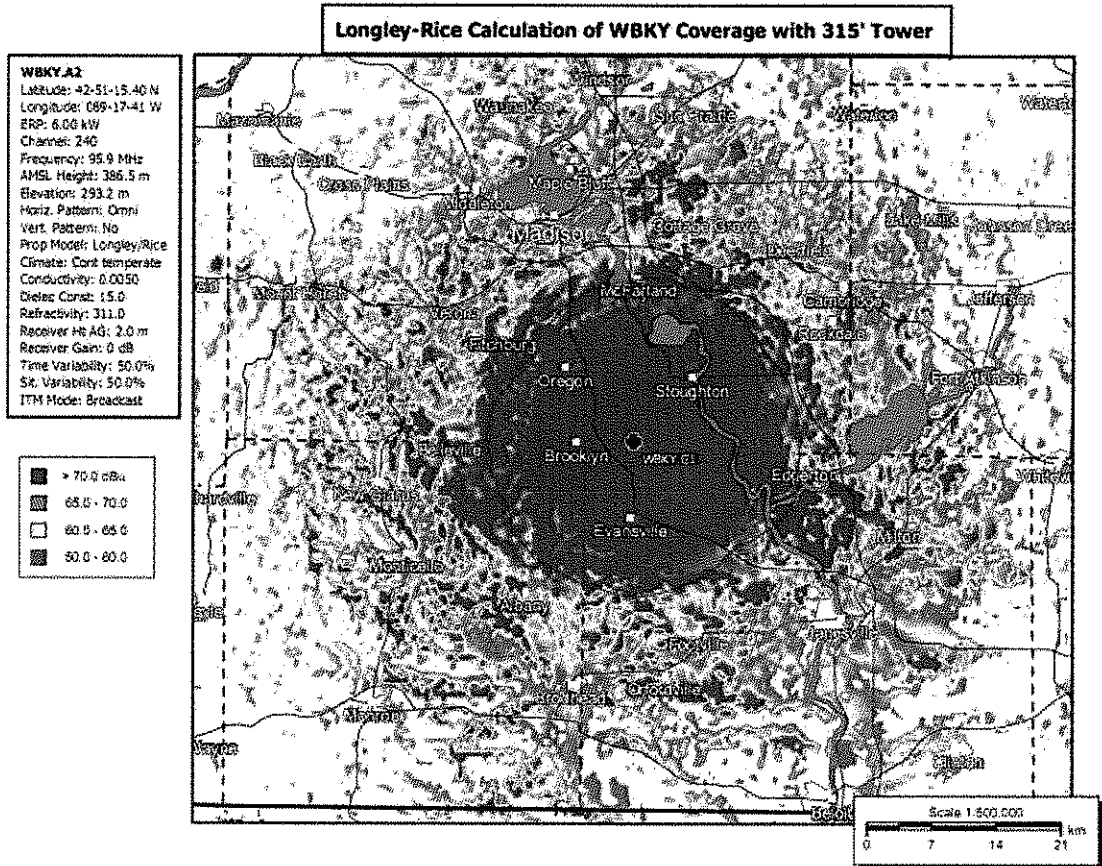
**Figure 1 – Site Location Area**



**Figure 2 – Propagation Map Using Proposed Facilities**



**Figure 3 - Propagation Map at 315'**



**Figure 4 - Propagation Map at 400'**

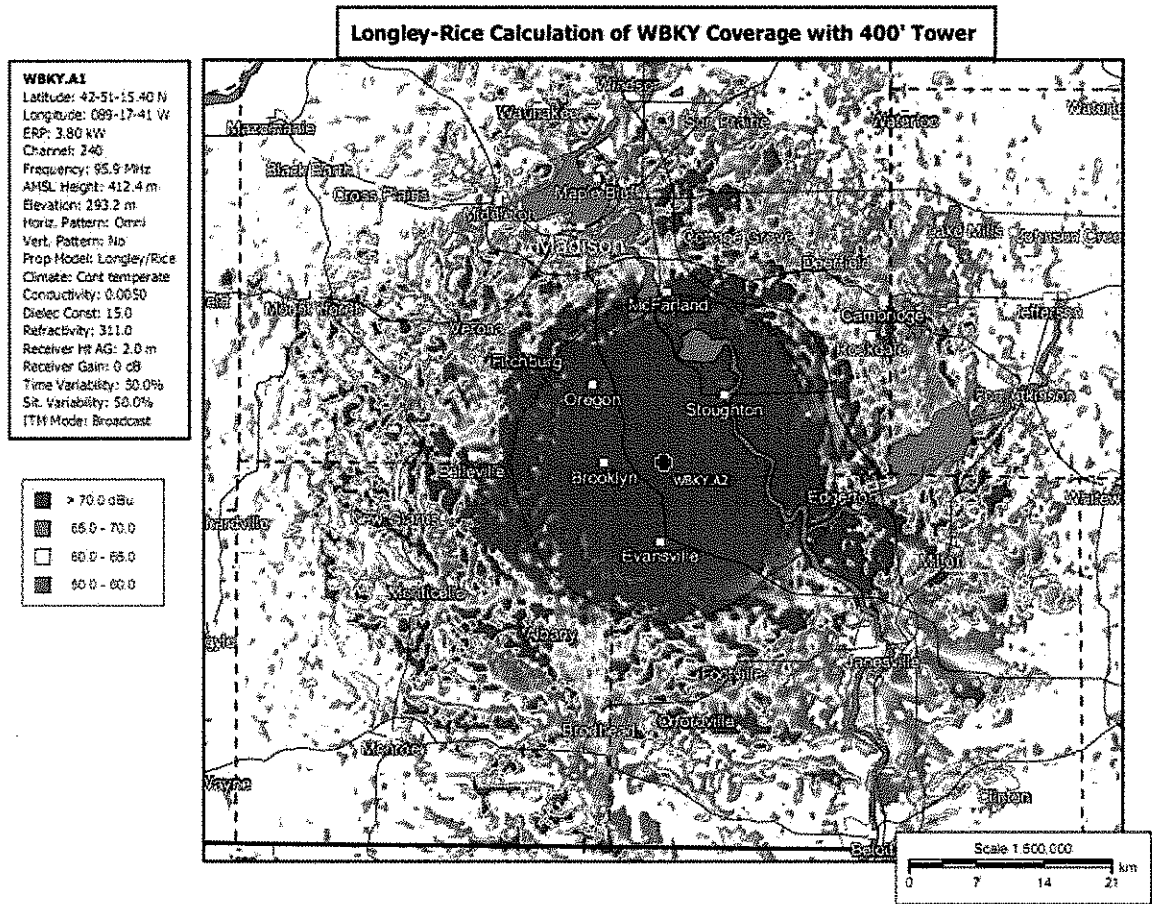
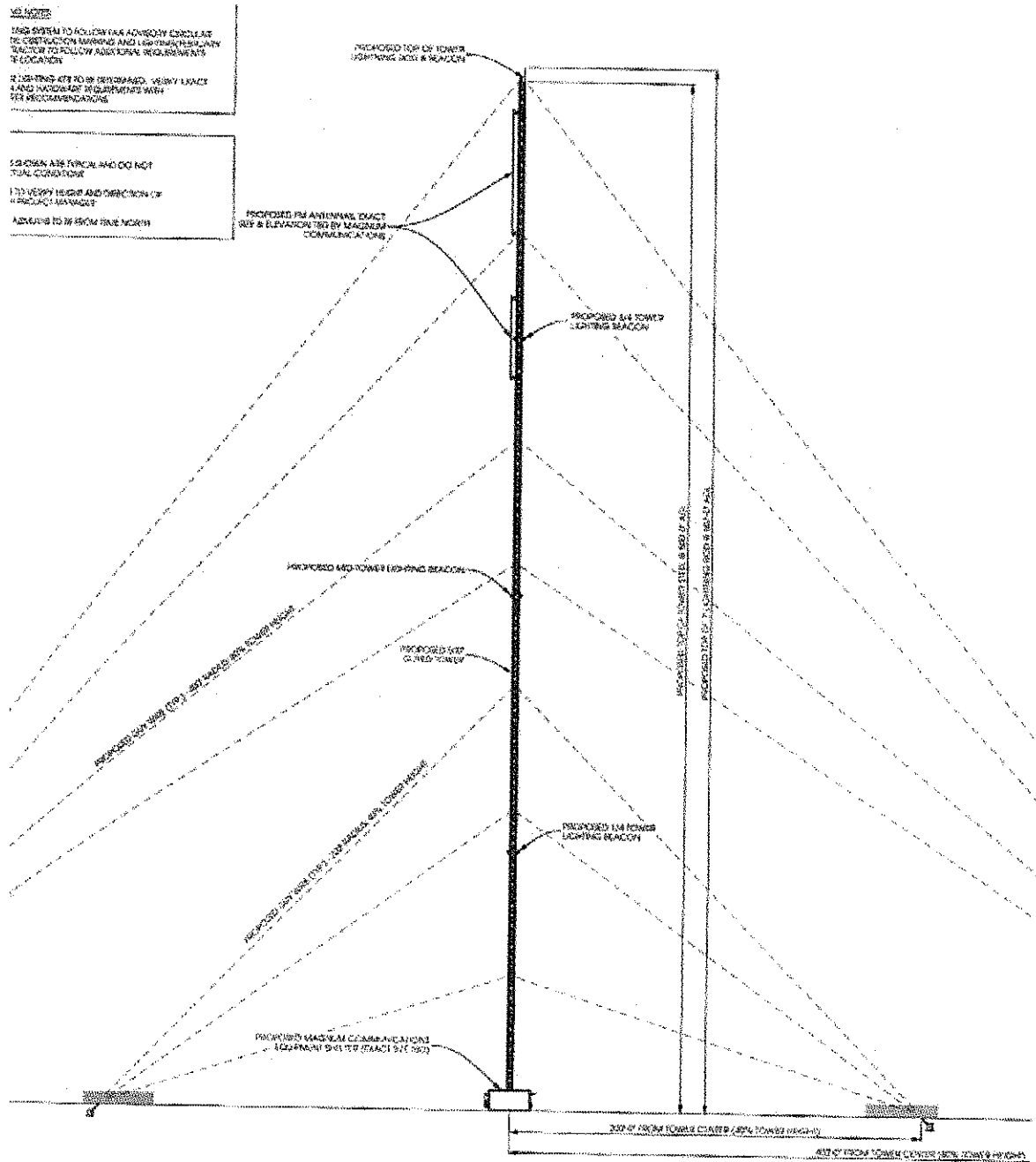


Figure 5 – Tower Diagram



**A**  
**TOWER PROFILE (SOUTH ELEVATION)**  
SCALE: 1" = 17' - 1" = 60'  
2" = 34' - 1" = 30'



**Figure 6 - Proposed coverage area for WBKY 95.9 FM Stoughton, Wisconsin**

The following map shows the proposed new coverage contours for the relocated facility (the center purple contour shows coverage at 60 dbmv, which is the level necessary for noise-free reception):

