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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

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In the Matter of	)	
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Amendments of Part 21.902 of	)	PR-92-80
the Commission's Rules Governing	)	Regarding FCC 93-31
Use of Frequencies in the 2.1	)	
and 2.5 GHz Bands	)	

PETITION FOR RECONSIDERATION

Re: Rule changes adopted January 14, 1993 and released February 12, 1993

Petitioner: Marshall Communications, Inc.

SUMMARY

This petition specifically addresses the adopted Rule changes pertaining to 21.902 defined in FCC 93-31 REPORT AND ORDER, paragraph 17., i. e. the rule changes pertaining to the 100 mile map requirement. (Footnoted below for convenience). The adoption of the 100 mile map requirements to the Rules does not accomplish what it was intended to do and will not materially

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FCC 93-31 17. In addition, we agree with Hardin and Associates that future processing can be expedited by requiring MDS applicants to submit, upon initial filing of the MDS application, two maps. One map must show the boundaries of the protected service areas of each authorized or previously-proposed co-channel station with a transmitter site within 100 miles of the applicant's proposed transmitter site, and the 45 dB desired signal to undesired signal contour line of the applicants proposed MDS station for co-channel stations. A second map must show the boundaries of the protected service areas for authorized or previously proposed adjacent-channel stations within 100 miles of the applicant's proposed MDS station for adjacent-channel stations. The submission of these two maps of protected service areas, as this term is defined in 47 CFR § 21.902(d), will quickly highlight possible areas of interference or confirm the lack of the same, thereby further reducing the burden on Commission staff. Accordingly, we are amending 47 CFR § 21.902 to add the requirement that MDS applicants filed after lifting of the freeze must include the prescribed protected service area maps.

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expedite application processing, accordingly is not in the public interest. Additionally, it is burdensome upon applicants without imparting significant benefits to the Commission. Certain aspects of it are not achievable, nor of any benefit to anyone, indeed only add unnecessary information to applications. This petition addresses these shortcomings and presents modifications to the map rule to accomplish its intended goals more effectively, and addresses how to utilize the 45 dB D/U contour and plots of protected areas, adopted in the map rule, to accomplish superior studies. These modifications, if adopted, will effect more rigorous MMDS interference studies presented in a format that is extremely easy for the Commission to evaluate. These techniques will be of significant benefit to the Commission in three aspects. They present: 1.) a superior method for identifying stations where the potential for harmful interference exists is introduced; a method that can be evaluated by the Commission at a glance; 2.) an interference study technique that, while more rigorous than conventional study techniques, can also be evaluated by the Commission at a glance; it utilizes components recently adopted by the Commission in reference to the 100 mile map, but utilizes them in a significantly more beneficial manner; 3.) applications will be simplified by eliminating superfluous information pertaining to adjacent-channel interference analyses. The map rule is especially errant in regard to adjacent-channel interference studies. These insufficiencies are discussed and examples are presented to support comments made. The modifications contained herein are believed to be of sufficient importance to warrant bringing these matters before the Commission for formal consideration. Adoption of the standards described herein will result in more rigorous interference studies, expedited application processing, reduction of harmful interference (by virtue of improved study techniques). The end result will be in the public interest by expediting application processing and more timely grant of MMDS licenses. The benefits accruing to the Commission alone are sufficient to warrant adoption of the herein proposed rule modifications.

IDENTIFICATION OF STATIONS NEEDING TO BE INCLUDED IN THE ANALYSIS

1. An interference analysis consists of two stages; 1. Identifying the stations needing to be included in the analysis, and 2. conducting the actual analysis. Anything pertaining to the map rule should specifically be oriented toward *identifying* stations needing to be included in the analysis. This distinction should be kept clearly in focus. The map rule, as adopted, does not satisfy the criteria of *identifying* the stations needing to be included in the analysis. It merely lists additional information for the Commission to consider; it does not *demonstrate* the absence of these unobstructed electrical paths. Furthermore, the preparation of these maps is overly burdensome to applicants, i. e. if they are done properly and accurately. Additionally, though the 45 dB D/U contour is a brilliant concept, its benefits are not fully realized when plotted upon the 100 mile map. This does not achieve the maximum benefit that can be realized through its proper use. Methods to achieve this maximum benefit are discussed in CO-CHANNEL INTERFERENCE PROTECTION.

2. The Rules clearly establish the requirement to present an analysis for co-channel stations when unobstructed electrical paths exist, regardless of how far away. This requires an applicant to conduct an analysis to determine stations needing to be included in the analysis.

> 47 CFR 21.902(c)(1) requires "An analysis to determine the potential for co-channel interference with any authorized or previously proposed station, if: (i) The proposed transmitting antenna has an unobstructed electrical path into any part of the protected service area of any other station(s) that utilize(s), or would utilize, the same frequency;".

3. A strict interpretation of the Rules would imply that the applicant is required to *demonstrate* the absence of unobstructed electrical paths into the protected service areas of

stations not included in the analysis. This interpretation is appropriate and the Rules should be clarified to state this. Taking an applicant's word is not sufficient; generally he doesn't know, doesn't care and doesn't want an analysis conducted that is likely to turn something up. He only wants his license granted, period. Since many active participants in the MMDS industry do not choose to consider (or even recognize) the potential for harmful interference beyond a distance of 55 to 65 miles, it is entirely appropriate for the Commission to strengthen the Rules in this area. One hundred miles is a reasonable distance to consider the potential for harmful interference for co-channel stations. However, it is not an appropriate distance to consider adjacent-channel interference; this is specifically addressed in section ADJACENT-CHANNEL INTERFERENCE PROTECTION.

4. Terrain attenuation of the undesired signal is one of the most important factors in co-channel interference analysis. A shadow map is a perhaps the most powerful and easily evaluated analysis tool to determine the presence, or absence, of unobstructed electrical paths. The most effective method to identify stations needing to be included in the analysis, is to plot the protected service areas of stations beyond 50 miles upon a shadow map of 100 miles radius from the proposed station. This is also the easiest method for the Commission to evaluate. Unobstructed electrical paths into protected service areas are evident upon a casual perusal. Since the Rules require all co-channel stations closer than 50 miles to be included in the analysis, in any case, there is no benefit to cluttering the shadow map with their PSA plots. Accordingly, they need not be included. An example of such a shadow map/PSA plot is included in Appendix A (Figure 1). Contrast the efficacy of this method to what would have been possible had all stations within 100 miles been plotted upon a regular map. Its suitability to accomplish this task is intuitively obvious and requires no further comment. The protected service areas can be

manually plotted using templates of the appropriate size and shape. The examples presented in the Appendices were calculated by a properly configured spreadsheet program that calculates the PSA and creates a plot file to merge it into the shadow map program; this assures a high degree of precision and freedom from errors.

5. The Commission is petitioned to amend or clarify §21.902 of the Rules to require that applicants *demonstrate* the absence of unobstructed electrical paths into the protected service areas of all other co-channel stations located beyond 50 miles and within 100 miles of a proposed station when such stations are not included in the interference analysis. And, to outline a specific method of accomplishing this demonstration. It is recommended that this change be accomplished by modification of the 100 mile map requirement, adopted January 14, 1993. This modification should remove the 45 dB D/U requirement from the 100 mile map and require accurate plots of the protected service areas of all authorized, or previously proposed co-channel stations beyond 50 miles and within 100 miles of the proposed station to be plotted upon a *shadow map* of 100 miles radius. The 100 mile radius shadow map should be generated at one degree increments utilizing a 3 second terrain database.

CO-CHANNEL INTERFERENCE PROTECTION

6. The proper use of the 45 dB D/U contour will now be discussed. Since it was not defined in the Rule amendments, to eliminate the potential for misunderstanding, the definition, as it applies to comments herein, is stated as follows: The 45 dB D/U contour is a curve surrounding the desired station where the ratio of desired to undesired signals arriving at a receiver is equal to 45 dB. The 45 dB D/U curve consists of the summation of three separate

factors: 1). The ratio of the EIRP from each transmit antenna toward the receive point (expressed in dBm), taking into consideration the relative transmitter power, line losses and the horizontal radiation pattern of the respective transmit antennas in the direction toward the receive point. 2). The ratio of the free space path losses of the respective signals toward the receive point (expressed in dB), and, 3). The horizontal radiation pattern and cross polarization rejection (XPD)(as appropriate) of the FCC reference receive antenna (expressed in dBi). It is assumed that the receive antenna is oriented for optimal reception of the desired signal. Attenuation of the undesired signal from terrain shielding is expressly excluded; beam tilt is a second order effect of little importance in most cases and is not considered. D/U = "D" EIRP - "U" EIRP +"U" FSPL - "D" FSPL + Rec Ant Selectivity + Rec Ant XPD.

7. The maxim benefit of the 45 dB D/U contour is derived by using it in the actual co-channel interference studies, not on the 100 mile map. When the 45 dB D/U contour *and* the protected service area of the studied station is plotted upon a shadow map from the proposed station, a very rigorous and revealing interference study is realized. Furthermore, it is extremely easy to evaluate; this shadow map is typically a segment (or wedge) of appropriate dimension to encompass the protected service area of the desired station. See Figure 2 of Appendix A for a sample plot. By definition, harmful interference, as defined by the Commission, can *potentially* occur only in areas *outside* the 45 dB D/U contour yet *within* the protected service area. If unobstructed electrical paths from the undesired station occur within this area of potential interference (API), harmful interference, as defined by the Commission, will occur; if unobstructed electrical paths into the API do not occur, then harmful interference will not occur. The shadow map reveals whether these paths exist. If complete terrain shielding is evident throughout the API, harmful interference will not occur; if unobstructed paths are

evident, then harmful interference will occur. Evaluation of the study results presented in this format is as simple and easy as that.

8. Since the 45 dB D/U contour has been adopted into the Rules, the logical extension would be to modify the Rules such that its maximum benefit is derived; this is unquestionably realized by its use in individual co-channel interference studies. The power, elegance, yet the ultimate simplicity and functionality of this study technique should not be casually swept aside. Appendix A should be carefully considered in its entirety. It was taken from a real-world example and demonstrates the use of the 45 dB D/U contour-PSA-shadow map wedge study method and the 100 mile radius shadow map-PSA. Note: The proposed transmitter power was increased to 50 watts for the example to better illustrate the principles of the technique. It represents how the Applicant for the proposed station must deal with the interference issue at such time it proposes to increase transmitter power to 50 watts, rather than how it was dealt with in the actual application. The efficacy of the method speaks for itself.

9. The PSA-45 dB D/U contour-shadow map wedge study technique is so powerful and all encompassing that it rightfully should become the interference study standard, and the Rules should be configured such that the method is required for all co-channel stations identified as requiring studies. The new study technique is indeed head and shoulders above any other technique I have seen, and the Commission is encouraged to strive to thoroughly understand all its implications and to give it very careful consideration, for its adoption would be of substantial benefit to the Commission and to the MMDS industry. These same sentiments apply to the 100 mile shadow map-PSA standard. If these techniques are not made a study requirement, then, as a minimum, the Rules should allow those who have the capability the latitude of using these

superior methods. It is a more accurate method than perimeter studies commonly used, in conjunction with sketches and statements about radio horizon blockage of signals, etc.

10. Though commonly used, the PSA perimeter study method is not a valid study method when terrain attenuation is included, as in co-channel studies. Studied points on the "far side" have no validity. The method referred to as the PSA perimeter study consists of conducting the analysis at points located on the perimeter of the protected service area. Additionally, unobstructed electrical paths may exist within the PSA that will not be identified by the PSA perimeter study. Therefore, the PSA perimeter method is not accurate or adequate for co-channel studies. It is also relatively easy to "tailor" the study to conceal harmful interference. The new technique described herein does not suffer from these, or any other limitations.

11. The Commission is therefore petitioned to amend 21.902 to require each co-channel interference analysis to demonstrate the absence of harmful interference by presenting an interference analysis consisting of a shadow map or a segment of a shadow map from the proposed station containing an accurate plot of the 45 dB D/U contour and the protected service area of the desired station. The area(s) bounded by the PSA on the outer perimeter and by the 45 dB D/U contour on the inner perimeter must indicate complete terrain shielding as evidenced by the shadow map. Said shadow maps shall be conducted using a 3 second terrain database. Additionally, for stations beyond 50 miles, if the actual antenna pattern and EIRP are not available, a radius of 15 miles may be assumed for the protected service area and an EIRP of 100 watts may be assumed for calculation of the 45 dB D/U contour.

ADJACENT-CHANNEL INTERFERENCE PROTECTION

12. The potential for harmful interference to adjacent-channel stations is substantially less than that of co-channel stations. Accordingly, substantially less rigorous study techniques are appropriate. The newly adopted 100 mile map rule does not make this differentiation, therefore is in error and furthermore is overly burdensome to applicants. The petitioner is *not* in agreement that adjacent-channel interference need be considered beyond 50 miles, and certainly is not in agreement with the 100 mile map rule. This amendment to the Rules is inappropriate, and devoid of technical merit as we shall see. In fact, one must distort the station parameters to a worst case scenario in order for the 0 dB D/U contour to be small enough to fit on a map of reasonable scale. As a practical matter, no one really cares where the 0 dB D/U curve occurs. With regard to FCC applications, the only useful criteria is whether zero dB D/U signal ratio is achieved throughout the protected service area.

13. The zero dB D/U curves are enormous and can not be plotted in any meaningful manner. I have developed computer programs to automatically calculate these parameters and I know whereof I speak. As station spacing is decreased, interference will begin to occur on the near side in some cases and on the far side in other cases (eg. the example in Exhibit B). So a zero dB line between the stations does not present the entire picture. A complete adjacent-channel interference analysis is presented in Appendix B. It is for MMDS stations spaced 35 miles apart with the undesired (interfering) station at an EIRP 10 times greater than the desired; omni directional antennas are assumed and signals are of the same polarization. The spacing was selected such that the zero dB D/U contour lies just outside the protected service area of the desired station at the closest point. The zero dB contour extends out to approximately 200 miles

on either side. Figure 2 shows the same zero dB curve scaled to illustrate the enormous size of these plots. Consider the size of the plot if the stations are of the same EIRP, or if the signals are cross polarized.

14. Requiring this map in applications accomplishes absolutely nothing but to add clutter and useless information. Indeed it makes application preparation and processing *more* burdensome without adding anything of value, to the Commission, or anyone else. Studies should be required *only* when the potential for harmful interference exists, and there is no potential for harmful interference to adjacent-channel stations located beyond 50 miles from a proposed station. I contend that the Commission has been sorely mislead on this particular issue. There is no technical merit to this rule change, whatsoever, and it should be rescinded immediately.

15. The requirement for demonstration of interference protection for adjacent-channel stations within 50 miles is more than adequate, even for stations utilizing the same polarization. The only possible situation where the zero dB D/U contour and PSA plot are of any value, is in very closely spaced stations where the PSA perimeter study indicates harmful interference. It is then, and only then, that the zero dB D/U contour and the PSA plotted upon a shadow map (or shadow map wedge) is useful as an interference analysis tool. In like manner to the co-channel study described above, non-interference is demonstrated if the API is terrain shielded throughout. That is, the shadow map must show complete terrain shielding throughout the area where the zero dB D/U contour overlaps into the protected service area. It should be abundantly clear that a cart blanche requirement for zero dB D/U contours to a distance of 100 miles is entirely inappropriate. The study method referred to as a PSA perimeter study is the most effective way to study adjacent channels. This type of study can be quickly and accurately

accomplished with a properly configured spreadsheet program. The PSA perimeter studies in the Appendices (Table 1) was computed by such a program. Since terrain attenuation of the U signal is not included in the PSA perimeter study for adjacent-channel studies, it is the preferred method.

16. Though less rigorous studies are sufficient for adjacent channel stations, with many stations using higher power transmitters and with some using directional antennas, the "generic" adjacent channel study referenced in some applications does not adequately address adjacent channel interference study requirements. These generic studies generally assume equal EIRP and omni antennas and show a table of calculations demonstrating better than zero dB at all points on the PSA perimeter.

17. The Commission is therefore petitioned to rescind the requirement to consider the potential for harmful interference for adjacent-channel MMDS stations located beyond 50 miles from a proposed station in the interference analysis. And to rescind the requirement for filing a map showing the adjacent-channel protected service areas and the zero dB D/U contours with initial applications. Rather, require that adjacent channel stations, authorized or proposed, within 50 miles of a proposed station demonstrate the absence of harmful interference by means of a study conducted at points on the perimeter of the desired station's protected service area. In cases where harmful interference is indicated by the PSA perimeter study, a shadow map, or shadow map segment with the protected service area and the zero dB D/U contour plotted thereon shall be presented in the analysis to demonstrate terrain shielding throughout the area of potential interference (API).

OTHER CONSIDERATIONS

18. An important consideration is whether the rule changes proposed herein would be unduly burdensome to applicants. An equally valid question is "are the recently adopted rule changes unduly burdensome to Applicants"? It is believed that the rule changes proposed herein are less burdensome upon applicants than the recently adopted rule changes (i.e. those pertaining to the map requirements). The only new component recommended in this petition is the mandated use of shadow maps. Commercially available micro computers and software can be utilized to efficiently and accurately accomplish all aspects of the herein proposed study techniques, consequently they cannot legitimately be considered overly burdensome.

19. By far the most burdensome factor pertaining to applicants, is the Commission's inability to respond to the flood of MMDS applications in a timely manner. The herein proposed rule changes will make the task of application processing substantially less burdensome to the Commission and will result in the Commission's ability to respond to MMDS applicant's needs in a more timely manner. Additionally, they will effect substantially more rigorous interference studies, enuring to the benefit of the MMDS industry in general. As more MMDS stations are built, superior methods of evaluating the potential for harmful interference (such as those proposed herein) are entirely appropriate, and indeed, will soon become a necessity.

CONCLUSION

20. These modifications, though simple in concept, effect a very substantial improvement in interference analysis techniques. The benefits derived from adopting the herein proposed

modifications are believed to easily outweigh any objection to their required use. It should be fully recognized by the Commission that the study techniques and format outlined herein present interference analyses in the most simple, clear, straightforward, easy-to-evaluate method currently known. With respect to the 100 mile radius shadow map, one can determine at a glance whether a station needs to be included in the analysis. Likewise, with regard to the proposed graphical presentation of co-channel studies, whether harmful interference will occur can also be determined at a glance. And, the PSA perimeter study for adjacent channels presented in the format illustrated are compact and easily evaluated.

21. In short, the proposals herein accomplish the goals of all concerned by conducting interference analyses in a rigorous manner, while presenting the results in a format the Commission can quickly and accurately evaluate. The Commission is urged to adopt these proposals so the entire MMDS industry can reap the benefits offered by use of their use. Adoption of these standards will be in the public interest by virtue of expediting application processing and the more timely grant of MMDS licenses.

Daniel J. Marshall

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March 11, 1993

VERIFICATION

I verify under penalty of perjury that, to the best of my knowledge, information and belief, the foregoing Petition for Reconsideration is supported by good grounds and that it is not interposed for delay.

Daniel J. Marshall

Daniel J. Marshall

APPENDIX A

CO-CHANNEL AND 100 MILE SHADOW MAP

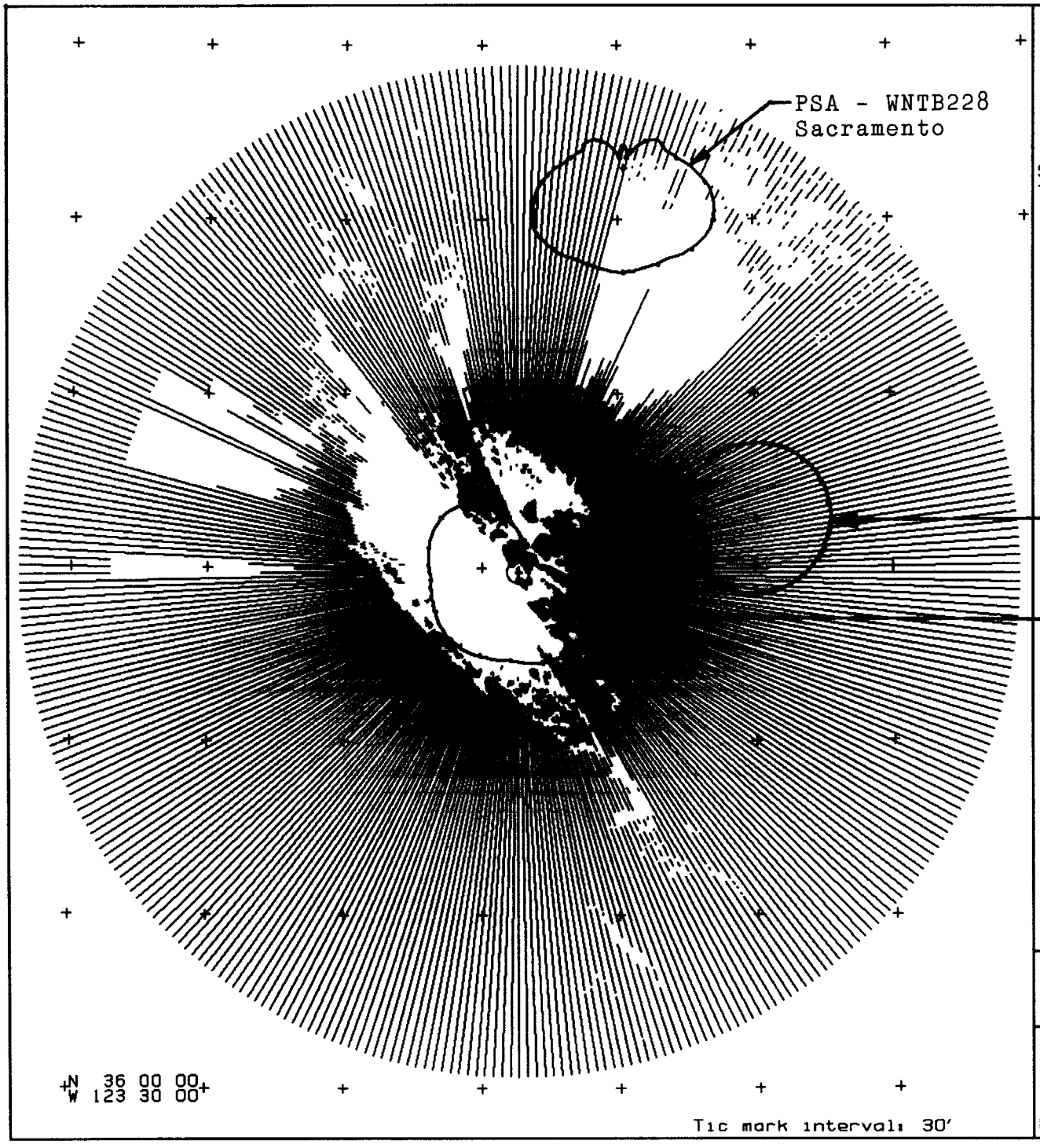
Appendix A consists of excerpts from a real world interference study. The EIRP of the proposed station was increased to illustrate how the actual areas of interference are identified.

1. Figure 1 is an example of the 100 mile radius shadow map with the protected service areas of the proposed station and two neighboring stations plotted. (Other stations were omitted). WNTB228 indicates the presence of unobstructed electrical paths into its protected service area. Therefore, it is identified as needing to be included in the interference analysis, even though it is located nearly 90 miles from the proposed station. It would be a simple matter to include the 45 dB D/U plot on the 100 mile shadow map. However, it is believed that they are more appropriately used in the individual interference analysis shown in Figure 2. In an actual study, Table E-1 would list the coordinates, distances and azimuths of surrounding stations in relation to the proposed station to allow a quick verification of the placement of the PSAs. WNTJ715 is completely terrain shielded. However, since it is located slightly less than 50 miles from WNTM579, the Rules require an interference analysis (not included in the example. According to the criteria set forth herein, there is no requirement to include it on the 100 mile shadow map. It is included for illustrative purposes only.

2. The page following Figure 1 lists the station parameters used in the study and various ancillary comments. (The three pages following Figure 1 are essentially an individual station interference analysis slightly modified for the example).

3. Figure 2 is an example of the PSA-45 dB D/U contour-Shadow map wedge interference analysis technique. The PSA and the computer calculated 45 dB D/U contour is plotted upon a shadow map segment from the proposed station. The 45 dB D/U contour takes into consideration the applicable station parameters of the two stations. Though a considerable amount of information is presented in this plot, its interpretation is intuitively obvious and comment is not required. That is the beauty of the technique. Of particular note is the fact that interference is evident even though the stations are spaced approximately 90 miles apart and the interfering station's transmit antenna is oriented substantially *away* from the desired station and the desired station transmit antenna is oriented substantially *toward* the interfering station.

4. Table 1 is a tabular listing of a PSA perimeter study for the same station. It is presented as a more familiar study technique for comparison. In an actual study it would require up to 18 Radio Path study plots, in contrast to the one page required by the proposed study technique. The PSA perimeter is not a valid study technique for co-channel stations, as it does not unfailingly reveal harmful interference as does the proposed method.



RADIO SHADOW MAP

K Factor: 1.333
RX Ant. Height: 30.0 feet AGL

Site	Ant Elv AMSL (feet)	ERPd (dBW)	Ant. Type	Ant. Orient (degs)	Latitude & Longitude
1	2739.0	25.40	DA	225.0	N 37 29 17 W 121 51 59

MILES

20 0 20 40 60

SAN JOSE, CA

100 mile radius Shadow Map

March 7, 1993 Figure 1

MMDS CO-CHANNEL INTERFERENCE STUDY

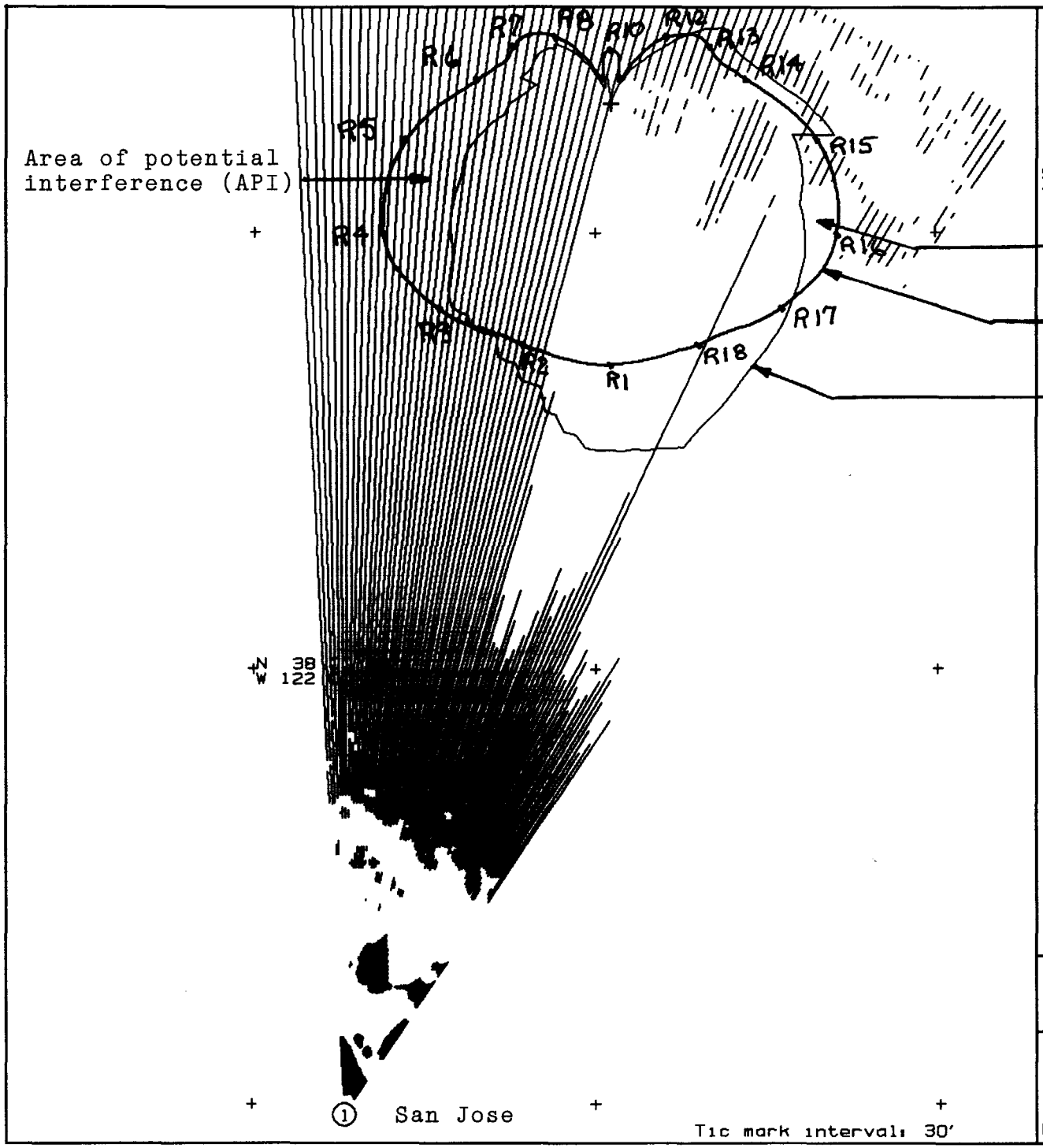
(PROPOSED vs WNTB228)

	Interfering Station:	Desired Station:
Station Call Letters:	WMNTM579	WNTB228
Station Location:	Jan Jose, CA	Sacramento, CA
Transmit Coordinates:	37-29-17N 121-51-59	38-38-54N 121-28-40W
Channels (Proposed/Auth.):	H2	H2
Licensee (Name):	N/A	N/A
Tx Antenna (mfg/model):	Bogner B16SA-W-H	Andrew HMD16HC
Tx Radiation Pattern:	Cardioid	Cardioid
Polarization:	Horizontal	Horizontal
Tx Azimuth (deg):	225	180
Tx Antenna Elev (ft. AMSL):	2739	450
Tx Antenna ht. (ft. AGL):	300	400
Tx Power (dBm):	47.0	47.0
Line Loss (dB):	2.4	3.0
Tx Antenna Gain (dBi):	16.0	17.0
EIRP (dBm):	60.6	61.0
EIRP (watts):	1148	1259

The D/U ratio of interfering signals from the herein proposed station to various receive sites of station WNTB228 was derived and compared to the Commission's definition of harmful interference prescribed in 47 CFR §21.902(b)(3) for MMDS stations operating on the same channels, 45 dB. Studies were conducted using the radiation envelope pattern of the FCC Reference Receive Antenna prescribed in 47 CFR §21.902(f)(3) (Figure 1). The polarization of the respective transmit signals was taken into account.

A conventional protected service area (PSA) perimeter study was conducted at 18 assumed receiving points spaced at 20 degree intervals on the PSA of WNTB228. Radio Path Loss Studies were conducted for all receive points demonstrating less than the required 45 dB D/U ratio. The tabulated results of this study are shown in Table 1.

Figure 2 is an alternate study method considerably more rigorous than the PSA perimeter study. It consists of two plots superimposed upon a shadow map segment from the proposed station. One curve is a very precise plot of WNTB228's PSA, the second curve is the 45 dB D/U contour; calculations are on a free space path loss basis. Harmful interference will occur only in areas where unobstructed electrical paths exist from the herein proposed station into the area *outside* the 45 dB D/U contour, and *inside* the PSA; this area is referred to as the area of potential interference or API. The shadow map clearly demonstrates areas where unobstructed electrical paths from the herein proposed station exist in the area known as the API. Both techniques demonstrate the presence of harmful interference.



RADIO SHADOW MAP

K Factor: 1.333
RX Ant. Height: 30.0 feet AGL

Site	Ant Elv AMSL (feet)	ERPd (dBW)	Ant. Type	Ant. Orient (degs)	Latitude & Longitude
1	2739.0	30.60	DA	225.0	N 37 29 17 W 121 51 59

Area of actual interference

PSA - Sacramento

45 dB D/U contour

MILES

10 0 10 20

San Jose/Sacramento

ShdMap, PSA & 45 dB D/U contour

March 7, 1993

Figure 2

MMDS CO-CHANNEL INTERFERENCE STUDY

Proposed vs WNTB228

The following is a tabulation of the individual components of the study pertaining to the D/U ratio of interfering signals from the herein proposed station vs WNTB228. Studies were conducted at 20 degree intervals on the PSA perimeter as illustrated in Figure 2.

Rec. Site no.	Rec Site Coordinates		Angle from "D" TxAnt Gmax (deg)	Angle from "U" TxAnt Gmax (deg)	"D" EIRP (dBm)	"U" EIRP (dBm)	Dist. "U" Tx to Rx (mi)	"U" Free Space Path Loss (dB)	Dist. "D" Tx to Rx (mi)	"D" Free Space Path Loss (dB)	Excs "U" Path Loss (dB)	"D" Tx to Rx Azmth (deg)	"U" Tx to Rx Azmth (deg)	Angle of"U" Signl to Rx Ant (deg)	Rec. Ant. Model Used In Study	Rec. Ant. Disc. XPol (d/u) (dB)	Tot. D/U Rat. (dB)	Harm-ful Inter-fer-ence ?
R1	38 20 58N	121 28 40 W	0	154.5	60.7	46.8	63.2	140.9	20.7	131.2	0.0	180.0	19.5	160.5	FCC Ref	25.0	48.6	No
R2	38 22 20N	121 36 23 W	20	148.0	60.5	49.3	62.7	140.8	20.3	131.0	18.7	200.0	13.0	173.0	FCC Ref	25.0	64.7	No
R3	38 24 49N	121 43 48 W	40	141.6	60.9	51.5	64.4	141.1	21.2	131.4	29.2	220.0	6.6	146.6	FCC Ref	24.8	73.1	No
R4	38 29 53N	121 48 41 W	60	137.4	60.7	52.5	69.8	141.8	20.8	131.2	17.4	240.0	2.4	122.4	FCC Ref	21.3	57.4	No
R5	38 36 24N	121 46 52 W	80	138.4	58.8	52.0	77.4	142.7	16.6	129.3	17.7	260.0	3.4	103.4	FCC Ref	18.5	56.4	No
R6	38 40 32N	121 40 33 W	100	142.1	55.1	50.7	82.7	143.2	10.9	125.6	27.5	280.0	7.1	87.1	FCC Ref	18.0	67.5	No
R7	38 42 48N	121 37 20 W	120	143.8	53.5	50.7	85.7	143.5	9.0	124.0	27.8	300.0	8.8	68.8	FCC Ref	20.0	70.1	No
R8	38 43 28N	121 33 35 W	140	146.0	51.1	50.1	87.0	143.7	6.9	121.6	27.3	320.0	11.0	51.0	FCC Ref	20.0	70.3	No
R9	38 40 35N	121 29 27 W	160	148.9	40.7	48.7	84.6	143.4	2.1	111.1	17.2	340.0	13.9	33.9	FCC Ref	17.3	58.7	No
R10	38 42 35N	121 28 40 W	180	148.9	46.9	48.7	87.0	143.7	4.2	117.4	23.3	0.0	13.9	13.9	FCC Ref	13.9	61.6	No
R11	38 40 35N	121 27 53 W	200	149.8	40.7	48.7	85.0	143.5	2.1	111.1	11.4	20.0	14.8	5.2	FCC Ref	0.3	35.9	Yes
R12	38 43 28N	121 23 45 W	220	151.5	51.1	47.8	89.2	143.9	6.9	121.6	7.4	40.0	16.5	23.5	FCC Ref	16.0	49.0	No
R13	38 42 48N	121 20 0 W	240	153.7	53.5	47.3	89.5	143.9	9.0	124.0	14.6	60.0	18.7	41.3	FCC Ref	19.8	60.5	No
R14	38 40 32N	121 16 47 W	260	156.1	55.1	46.9	88.0	143.8	10.9	125.6	0.5	80.0	21.1	58.9	FCC Ref	20.0	46.9	No
R15	38 36 24N	121 10 28 W	280	160.8	58.8	47.0	86.0	143.6	16.6	129.3	1.6	100.0	25.8	74.2	FCC Ref	20.0	47.6	No
R16	38 29 53N	121 8 39 W	300	164.2	60.7	47.2	80.1	143.0	20.8	131.2	0.0	120.0	29.2	90.8	FCC Ref	18.0	43.2	Yes
R17	38 24 49N	121 13 32 W	320	163.4	60.9	47.1	72.9	142.1	21.2	131.4	0.0	140.0	28.4	111.6	FCC Ref	19.7	44.2	Yes
R18	38 22 20N	121 20 57 W	340	159.6	60.5	47.0	67.3	141.4	20.3	131.0	0.0	160.0	24.6	135.4	FCC Ref	23.2	47.1	No

The "Total D/U Ratio (dB)" column is: Tot D/U = "D" EIRP - "U" EIRP + "U" FSPL - "D" FSPL + Excess "U" Path Loss + Rec Ant Disc

Plots of the Radio Path Loss Studies illustrating the "Excess Path Loss" are omitted for brevity.

Table 1

APPENDIX B

ADJACENT-CHANNEL

1. Page 1 lists the station parameters used in the study and various ancillary comments. Station spacing is 35 miles.

2. Figure 1 illustrates the zero dB D/U contour-PSA-shadow map segment interference technique. It is useful for individual studies for short spaced stations where the PSA perimeter study indicates harmful interference.

3. Figure 2 is the same plot as Figure 1, except at a different scale to illustrate the enormous size of the zero dB D/U plots, even for stations where the undesired station's EIRP is ten times greater than the desired station and signals are of the same polarization. Such plots for typical cases are considerably larger, generally extending to infinity in some certain directions, and for most cross polarized stations, to infinity in all directions.

4. Table 1 is an example of an adjacent-channel MMDS interference study using the 18 point PSA perimeter study method. This study was conducted by a standard spreadsheet program. It accepts the information for both stations and imports the actual antenna pattern files (from a menu selection), then derives the PSA coordinates and conducts the entire study (at 180 points on the PSA). Eighteen of these points (at 20 degree intervals) are saved and included in the tabular listing in the interference study summary. Such programs are relatively straightforward to configure and they accomplish their task very quickly and accurately. The study results are then presented in a compact, easy to evaluate format. The desired D/U ratio can be specified, thus making the program usable for any type of PSA perimeter study. These tools greatly facilitate interference studies and virtually eliminate errors.

MMDS ADJACENT-CHANNEL INTERFERENCE STUDY

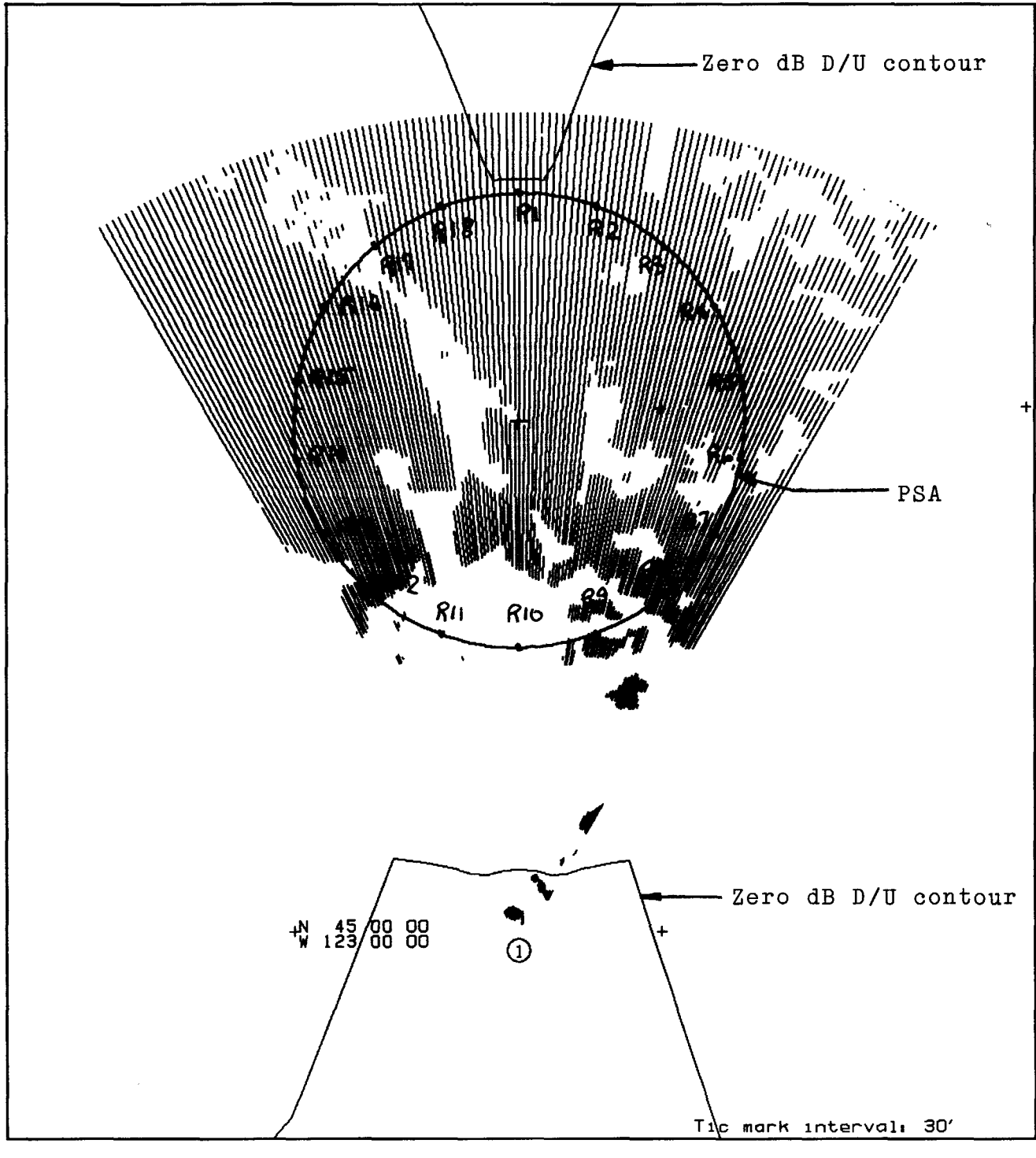
(PROPOSED vs XYZ123)

	Undesired Station:	Desired Station:
Station Call Letters:	ABC123	XYZ123
Station Location:	Centerville, USA	Nearby, USA
Transmit Coordinates:	44-58-56N 122-41-40W	45-29-20N 122-41-40W
Channels (Proposed/Auth.):	E1-E4	F1-F4
Licensee (Name):	John Doe	Jane Doe
Tx Antenna (mfg/model):	Andrew HMD16HO	Andrew HMD16HO
Tx Radiation Pattern:	Omni	Omni
Polarization:	Horizontal	Horizontal
Tx Azimuth (deg):	0	0
Tx Antenna Elev (ft. AMSL):	1500	1500
Tx Antenna ht. (ft. AGL):	300	300
Tx Power (dBm):	50.0	40.0
Line Loss (dB):	2.0	2.0
Tx Antenna Gain (dBi):	14.0	14.0
EIRP (dBm):	62.0	52.0
EIRP (watts):	1585	158.5

The D/U ratio of interfering signals from the herein proposed station to various receive sites of station XYZ123 was derived and compared to the Commission's definition of harmful interference prescribed in 47 CFR §21.902(b)(4) for MMDS stations operating on the adjacent channels, zero dB. Studies were conducted using the radiation envelope pattern of the FCC Reference Receive Antenna prescribed in 47 CFR §21.902(f)(3)(Figure 1).

A conventional protected service area (PSA) perimeter study was conducted at 18 assumed receiving points spaced at 20 degree intervals on the PSA of XYZ123. The tabulated results of this study are shown in Table 1. The D/U ratio of signals from XYZ123 to the interfering signals from the herein proposed station at the 18 studied points are in excess of the required zero dB, therefore, no harmful interference from the herein proposed station will occur.

Additionally, for purposes of illustration of the technique, Figure 1 shows the protected service area (PSA) and the calculated 45 dB D/U contour plotted upon a shadow map wedge from the interfering station. Since the zero dB D/U contour does not cross over into the PSA, non-interference is demonstrated. This same plot is shown in Figure 2 at a different scale. It is included to illustrate the enormous size of the zero dB D/U contours. Also, it is reasonably easy to extrapolate how this method is useful to study adjacent-channel stations where harmful interference is indicated by the PSA perimeter study. Were the stations a bit closer together, the zero dB D/U contour would cross over into the PSA (near R1) and display an area of potential interference (API). The shadow map indicates terrain shielding in this area. In cases where terrain shielding is evident throughout the API, harmful interference will not occur. (Note: the asymmetry of the contour to the South is due to very rapid changes in this area being affected by the incremental nature of the study, i. e. being conducted upon two degree intervals. The curve here is tangent to the 2 degree study radial lines; the asymmetry is attributable to Tx Antenna.Pat lookup tables using a current value until the next radial is encountered. This situation is rarely encountered to an observable extent).



RADIO SHADOW MAP

K Factor: 1.333
RX Ant. Height: 30.0 feet AGL

Site	Ant Elv AMSL (feet)	ERPd (dBW)	Ant. Type	Ant. Orient (degs)	Latitude & Longitude
1	1500.0	32.00	OMNI		N 44 58 56 W 122 41 40

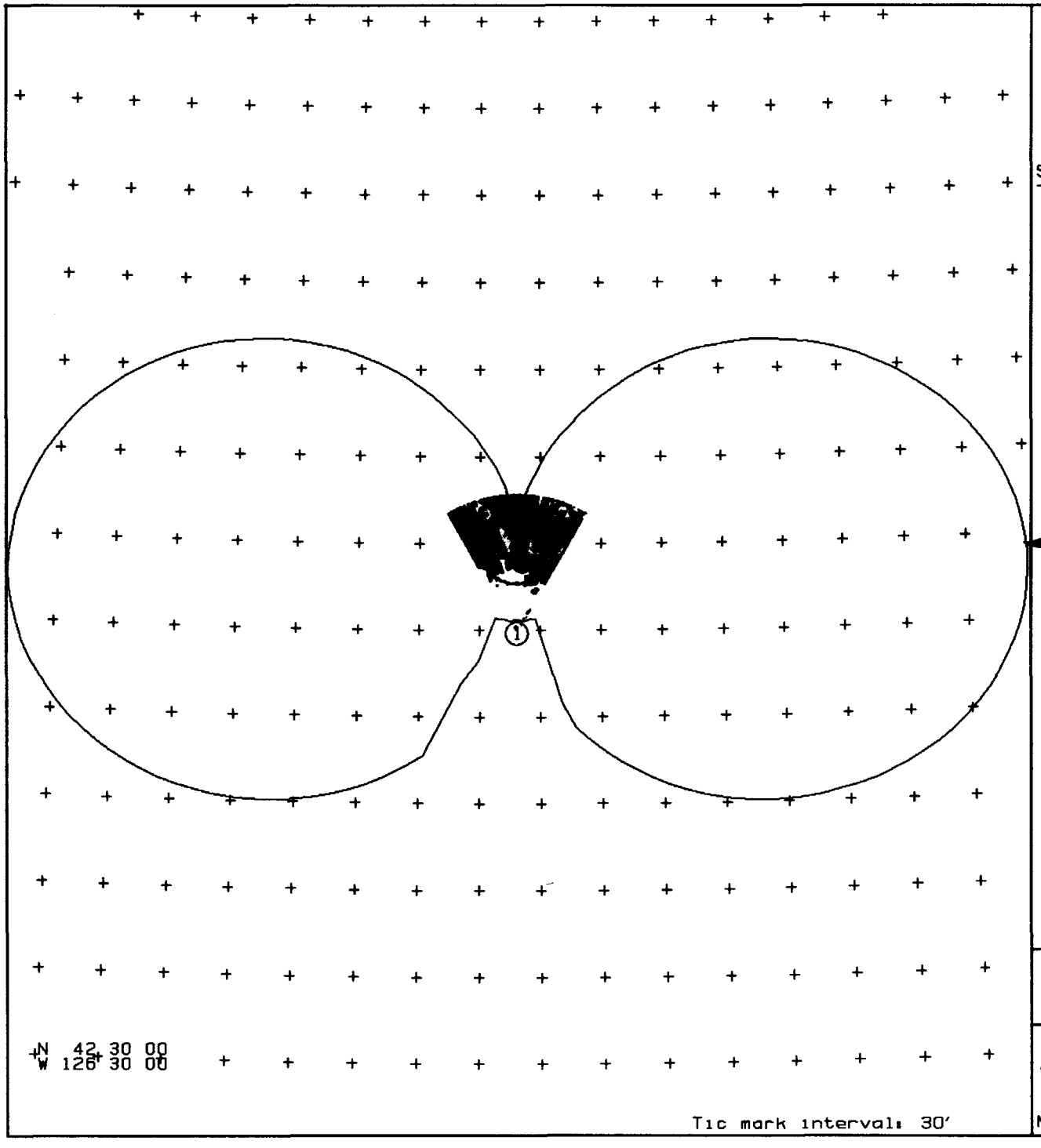
MILES

5 0 5 10 15 20

Adjacent Channel Study

ShdMap, PSA & 0 dB D/U Contour

March 6, 1993 Figure 1



RADIO SHADOW MAP

K Factor: 1.333
RX Ant. Height: 30.0 feet AGL

Site	Ant Elv AMSL (feet)	ERPd (dBW)	Ant. Type	Ant. Orient (degs)	Latitude & Longitude
1	1500.0	32.00	OMNI		N 44 58 56 W 122 41 40

MILES

50 0 50 100

Adjacent Channel Study

ShdMap. PSA & 0 dB D/U Contour

March 6, 1993 Figure 2

MMDS ADJCENT-CHANNEL INTERFERENCE STUDY

Proposed vs XYZ123

The following is a tabulation of the individual components of the study pertaining to the D/U ratio of interfering signals from the herein proposed station vs XYZ123. Studies were conducted at 20 degree intervals on the PSA perimeter as illustrated in Figure 1.

Rec. Site no.	Rec Site Coordinates		Angle from "D" TxAnt Gmax (deg)	Angle from "U" TxAnt Gmax (deg)	"D" EIRP (dBm)	"U" EIRP (dBm)	Dist. "U" Tx to Rx (mi)	"U" Free Space Path Loss (dB)	Dist. "D" Tx to Rx (mi)	"D" Free Space Path Loss (dB)	Excs "U" Path Loss (dB)	"D" Tx to Rx Azmth (deg)	"U" Tx to Rx Azmth (deg)	Angle of"U" Signl to Rx Ant (deg)	Rec. Ant. Model Used In Study	Rec. Ant. Disc. CoPol (d/u) (dB)	Tot. D/U Rat. (dB)	Harm-ful Inter-fer-ence ?
R1	45 42 22N	122 41 40 W	0	0.0	52.0	62.0	50.0	139.0	15.0	128.6		0.0	0.0	0.0	FCC Ref	0.0	0.5	No
R2	45 41 34N	122 35 19 W	20	5.9	52.0	62.0	49.4	138.9	15.0	128.6		20.0	5.9	14.1	FCC Ref	14.1	14.5	No
R3	45 39 19N	122 29 43 W	40	11.7	52.0	62.0	47.5	138.6	15.0	128.6		40.0	11.7	28.3	FCC Ref	15.4	15.5	No
R4	45 35 51N	122 25 34 W	60	17.0	52.0	62.0	44.5	138.0	15.0	128.6		60.0	17.0	43.0	FCC Ref	20.0	19.4	No
R5	45 31 36N	122 23 22 W	80	21.4	52.0	62.0	40.4	137.2	15.0	128.6		80.0	21.4	58.6	FCC Ref	20.0	18.6	No
R6	45 27 4N	122 23 22 W	100	24.5	52.0	62.0	35.6	136.1	15.0	128.6		100.0	24.5	75.5	FCC Ref	20.0	17.5	No
R7	45 22 49N	122 25 34 W	120	25.3	52.0	62.0	30.5	134.7	15.0	128.6		120.0	25.3	94.7	FCC Ref	18.0	14.2	No
R8	45 19 21N	122 29 43 W	140	22.3	52.0	62.0	25.4	133.2	15.0	128.6		140.0	22.3	117.7	FCC Ref	20.6	15.2	No
R9	45 17 6N	122 35 19 W	160	13.8	52.0	62.0	21.5	131.7	15.0	128.6		160.0	13.8	146.2	FCC Ref	24.7	17.9	No
R10	45 16 18N	122 41 40 W	180	0.0	52.0	62.0	20.0	131.1	15.0	128.6		180.0	0.0	180.0	FCC Ref	25.0	17.5	No
R11	45 17 6N	122 48 1 W	200	346.2	52.0	62.0	21.5	131.7	15.0	128.6		200.0	346.2	146.2	FCC Ref	24.7	17.9	No
R12	45 19 21N	122 53 37 W	220	337.7	52.0	62.0	25.4	133.2	15.0	128.6		220.0	337.7	117.7	FCC Ref	20.6	15.2	No
R13	45 22 49N	122 57 46 W	240	334.7	52.0	62.0	30.5	134.7	15.0	128.6		240.0	334.7	94.7	FCC Ref	18.0	14.2	No
R14	45 27 4N	122 59 58 W	260	335.5	52.0	62.0	35.6	136.1	15.0	128.6		260.0	335.5	75.5	FCC Ref	20.0	17.5	No
R15	45 31 36N	122 59 58 W	280	338.6	52.0	62.0	40.4	137.2	15.0	128.6		280.0	338.6	58.6	FCC Ref	20.0	18.6	No
R16	45 35 51N	122 57 46 W	300	343.0	52.0	62.0	44.5	138.0	15.0	128.6		300.0	343.0	43.0	FCC Ref	20.0	19.4	No
R17	45 39 19N	122 53 37 W	320	348.3	52.0	62.0	47.5	138.6	15.0	128.6		320.0	348.3	28.3	FCC Ref	15.4	15.5	No
R18	45 41 34N	122 48 1 W	340	354.1	52.0	62.0	49.4	138.9	15.0	128.6		340.0	354.1	14.1	FCC Ref	14.1	14.5	No

The "Total D/U Ratio (dB)" column is: Tot D/U = "D" EIRP - "U" EIRP + "U" FSPL - "D" FSPL + Excess "U" Path Loss + Rx Ant Disc

The directional characteristics and the polarization discrimination (as appropriate) of the receive antenna are summed together and shown in the same column.

Table 1

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