NTIA-REPORT-80-44

# Proposed Techniques for Adding FM Broadcast Stations in a Major Market

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August 1980

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# PROPOSED TECHNIQUES FOR ADDING FM BROADCAST STATIONS IN A MAJOR MARKET

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A study was conducted to investigate the technical capacity of the FM broadcast spectrum and to determine if the FM spectrum's utilization could be increased. More assignments are possible if some or all of the following recommendations are adopted: 1) protection to existing facilities rather than to maximum facilities is granted, 2) the effects of terrain on signal coverage and interference are considered, 3) directional antennas to control both coverage and interference are used, 4) reasonable changes to the signal-to-interference protection ratios for co-channel and adjacent channel operation are adopted, and 5) co-siting of second and third-adjacent channel transmitters with existing transmitters is permitted. To demonstrate the approach of adding new assignments to a saturated major market, the report shows how the number of FM broadcast stations in the Dallas-Ft. Worth region could be increased from the present 21 stations to 38 stations.

The recommendations, if adopted, could increase significantly the number of FM broadcast stations in almost all markets.

Key words: co-sited transmitters; directional antennas; FM broadcast; spectrum utilization; terrain

## 1. INTRODUCTION

### 1.1 Purpose

Under the current FCC rules, the top fifty FM broadcast radio markets in the U.S. are saturated; that is, nearly all of the slots in the Table of Assignments are assigned. However, the FM band in these markets is "filled to capacity" only because of the FM rules (FCC, 1962) which established the Table of FM Assignments. There have been many improvements over the past 20 years in the FM broadcasting and receiving equipment and in our ability to predict FM broadcast coverage including both signals and interference; these improvements and techniques could allow many new FM broadcast assignments in the major markets.

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The purpose of this study is to investigate the technical capacity of the FM broadcast spectrum and determine if today's equipment and techniques would allow the FM spectrum's utilization to be increased without noticeably decreasing the listening quality of FM radio. To bring about the increased number of assignments, we will consider:

1. the effects of terrain on signal coverage and interference,

2. the use of directional antennas to control both coverage and interference,

3. the effects of reasonable changes to the signal-to-interference protectional ratios for co-channel and adjacent channel operations, and

4. the actual facilities rather than maximum facilities.

## 1.2 Objectives

The study has four objectives:

1. To determine the background on FM separation rules and protection ratios.

2. To define ways for increasing the FM band's number of assignments.

3. To develop an approach to analyzing trade-offs among transmitter locations, powers, antenna heights and antenna patterns on signal coverage and potential interference.

4. To demonstrate the available analytical techniques for adding proposed stations in one major market.

With the improvements to station equipment and FM receivers over the past 20 years, consumers have come to expect the listening quality of the FM receiver to be almost as good as can be obtained from records or tapes. Although we are anxious to add new FM stations into a nearly full assignment table, we are not willing to sacrifice the listening quality of FM radio for additional stations.

## 2. BACKGROUND ON FM BAND ASSIGNMENT RULES

### 2.1 FM Band and Number of Channels

The present FM broadcast band occupies the 88 MHz to 108 MHz portion of the spectrum. In this 20 MHz band, there are 100 channels; each channel is 200 kHz wide. Due to interference concerns described below, no market has all 100 channels available for its own use. Instead, if all of the station separation rules as specified by the FCC were strictly followed, the maximum number of stations in any market would be 25. We will step through the rules to show how the 25 are derived.

### 2.2 FM Station Classes

The present FM frequency assignment structure allows for four different classes of FM stations. The four classes are defined to provide different levels of service to the public. For example, the Class A station is designed to provide service to a small community. The Class B or C station, on the other hand, is designed for a large urban area (Class B) or a large rural area surrounding a principal city (Class C). Lastly, the Class D station is designed for educational purposes and is to cover a small area such as a college campus. Each class has been assigned a particular range of operating characteristics, i.e., minimum to maximum allowed transmitted power, and a maximum allowed antenna height. Assuming that all stations would eventually operate at their maximum allowed characteristics, the FCC (1962) defined the minimum required distance separation between the classes of FM stations (paragraph 75, First Report*). The minimum distances, given in Table 2-1, were intended to ensure that any particular class of station could provide at least a minimum signal over a specified service area without unacceptable interference.

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*FCC Docket No. 14185, a petition for Changes in FM Assignment Rules, discusses much of the background leading to the present FM structure. From here on, references to the First Report and Third Report refer to Docket No. 14185 First Report and Order and to Docket No. 14185 Third Report, Memorandum Opinion and Order, respectively.

Table 2-1. FCC Minimum Distance Separation for FM Broadcast Transmitters

Required Spacing (miles)

| Class of Station | Class A | | | | Class B | | | | Class C | | | | Class D | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Co-ch. | 200 kHz | 400 kHz | 600 kHz | Co-ch. | 200 kHz | 400 kHz | 600 kHz | Co-ch. | 200 kHz | 400 kHz | 600 kHz | Co-ch. | 200 kHz | 400 kHz | 600 kHz |
| Class A | 65 | 40 | 15 | 15 | | 65 | 40 | 40 | | 105 | 65 | 65 | | 30 | 15 | 15 |
| Class B | | | | | 150 | 105 | 40 | 40 | 170 | 135 | 65 | 65 | | | 40 | 40 |
| Class C | | | | | | | | | 180 | 150 | 65 | 65 | | | 65 | 65 |
| Class D | | | | | | | | | | | | | | | | |

NOTE: Stations or assignments separated in frequency by 10.6 or 10.8 MHz (53 or 54 channels) will not be authorized unless they conform to the following separation table.

| Class to class | Required spacing in Miles |
|---|---|
| A to A | 5 |
| B to A | 10 |
| B to B | 15 |
| C to A | 20 |
| C to B | 25 |
| C to C | 30 |

## 2.3 Protected Signal Levels

In paragraph 62 of the First Report (FCC,1962), the FCC stated that FM assignments would be made so that each class of FM station would be provided with a protected signal service radius as given in Table 2-2. Paragraph 62 also gives the field strength for that protected distance, assuming a full facility station. In Table 2-2 we have listed the full facility parameters and their protected field strength for each class. These field strength values can be read directly off the FCC's F(50,50) FM propagation chart (FCC Part 3, Radio Broadcast Services, Section 3.333, Figure 1 amended 9-10-62).

Table 2-2. FM Protected Signal Distances and Field Strengths

| Class | Protected Service Radius (mi) | Full Facility Parameters: Power (kw) | Full Facility Parameters: Antenna Height (HAAT, ft) | Protected Field Strength ($\mu$V/m) | Protected Field Strength (dB$\mu$) |
|---|---|---|---|---|---|
| A | 15 | 3 | 300 | 927 | 59 |
| B | 40 | 50 | 500 | 562 | 55 |
| C | 65 | 100 | 2000 | 944 | 59 |

A more recent F(50,50) chart, designated as FCC Section 73.333 Figure 1, shows essentially no difference in field strength for a full facility Class A or Class B station; however, the full facility C has dropped from 59 dBμ at 65 miles to about 56 dBμ, a field strength reduction of about 3 dB. This is due to a re-calculation of the propagation curves, the latest set of curves having been amended as of July 1, 1975.

## 2.4 Co-channel Interference

In paragraph 15 of the First Report, the FCC defined that objectionable co-channel interference exists whenever the undesired rf signal level exceeds one-tenth of the desired rf signal level. Thus, the desired-to-undesired signal ratio must be 20 dB or greater if co-channel interference is to be avoided.

Paragraph c of Section 1.356, FCC Rules (amended August 8, 1962) states that "the distance to the applicable interference contour shall be determined by the F(50,10) curve . . ." Thus, we can reconstruct the FM station separation rules as given in paragraph 62 of the First Report. The distance to the protected Class A contour was to be 15 miles at which point the field strength from a full facility transmitter would be 59 dBμ. A 20 dB S/I ratio would require that the interference be no greater than 39 dBμ. The distance to the interference coutour of 39 dBμ for a full facility Class A station using the F(50,10) chart is a little less than 50 miles. Rounding up to 50 miles (interfering Class A station to the contour) plus 15 miles (desired Class A station to the contour) equals 65 miles, the total separation required between co-channel Class A stations. In the same manner, the other co-channel separations can be constructed.

A question remains, however, as to how the 20 dB S/I ratio value was established. Paragraph 15 of the First Report notes that the interference ratios were stated in the FCC Rules Section 3.313 (b), the Rules in effect at the time of the writing of the First Report. Paragraph 17 then goes on to say that neither new nor sufficient information was provided to the FCC to change the interference ratios.* Data gathered from consumer audio and hi-fi magazines indicate that good quality FM receivers available in the early 1960's had capture ratios of about 8 dB or less. Paragraph 66 of the First Report states that the assignment plan (and the FM rules) should be based on "receivers of reasonably good quality." Thus, it appears that the FCC had built-in a safety factor of about 12 dB when the 20 dB co-channel S/I ratio is compared with the performance available in 1962 good quality receivers. Today's good quality receivers have capture ratios of 2 dB or less. Assuming all else equal, if the co-channel separations were based only on the performance of good quality receivers, today's co-channel separation rules could be relaxed by 6 dB, while maintaining the 12 dB safety ratio.

### 2.5 Adjacent Channel Interference

In paragraph 15 of the First Report, objectionable first-adjacent-channel (200 kHz removed) interference is defined to exist whenever the undesired signal voltage exceeds one-half of the desired signal voltage; second-adjacent-channel (400 kHz removed) interference exists if the undesired signal voltage is more than 10 times the desired signal voltage; and third-adjacent-channel (600 kHz removed) interference exists if the undesired signal voltage is more than 100 times the desired signal voltage. Table 2-3 gives the protection ratios between co-channel and adjacent channel stations specified by the FCC (1962).

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*The Third Report does not shed any new light on how the 20 dB S/I ratio for co-channel interference was obtained but the 20 dB ratio coupled with typical community spacings in Zones I and II provides us with information on how the maximum facility parameter values were chosen for a fixed Table of FM Assignments. As the FCC notes in paragraph 21 of the Third Report, "The co-channel spacings we have chosen for each class of FM station represent near-optimum theoretical efficiency in terms of channel usage by stations operating with a particular set of maximum facilities. . . . assignments must be made in actual communities and not on a theoretical grid and such communities do not occur at the minimum spacings chosen but usually at greater spacings. To attain a substantial increase in the number of assignments possible in a table, it would be necessary to reduce spacing to a degree which would no longer be consistent with our objective of providing wide area service."

Table 2-3. FM Protection Ratios (FCC, 1962)

| Channel Relationship | Frequency Separation (kHz) | Required Desired Signal-to-Undesired Signal Ratio (dB) |
|---|---|---|
| Co-Channel | 0 | 20 |
| First-Adjacent | 200 | 6 |
| Second-Adjacent | 400 | -20 |
| Third-Adjacent | 600 | -40 |

By using the FCC's 1962 F(50,50) and F(50,10) propagation curves, the required separation between first-adjacent-channel stations can be reconstructed as was shown for co-channel interference separation. However, no charts are necessary to compute second- and third-adjacent channel separations because (in paragraph 65 of the First Report) the FCC required that "stations on second- and third-adjacent-channels to existing stations must be located further therefrom than the 'protected' distances specified above--15 miles where the existing station is Class A, 40 miles where it is Class B, and 65 miles where it is Class C."

We can describe some of the reasons why first-adjacent-channel protection is required. Although the FM channel width is 200 kHz, the FCC allows the broadcast FM signal to have spectrum occupancy limits which exceed 200 kHz, as shown in Figure 2-1. The allowed occupancy is 40 kHz greater than the channel width, as shown in the top of Figure 2-1. With an audio frequency of 15 kHz (the upper baseband frequency for monaural FM) and a deviation of 75 kHz (100 percent deviation in broadcast FM), the principal Bessel function sidebands are located at 15, 30, 45, 60, 75, 90, 105, and 120 kHz from the carrier, as shown in the upper photograph of Figure 2-1. Typical program material is shown in the lower photograph of Figure 2-1; the top trace is the peak/hold value at each frequency for all 100 sweeps of the spectrum analyzer, whereas the bottom trace shows a video average of 100 sweeps of an off-the-air signal. Receiver manufacturers, in turn, have designed their IF bandwidths to be about 265 kHz if less than 1 percent distortion is desired, or 225 kHz if less than 3 percent distortion is desired. Because of the allowed spectrum occupancy and associated receiver designs, it is obvious that the first-adjacent channels on either side of an assigned carrier are unavailable for future use in that market. Unfortunately, first-adjacent-channel selectivity is not usually reported by receiver manufacturers, so we are unable to tell

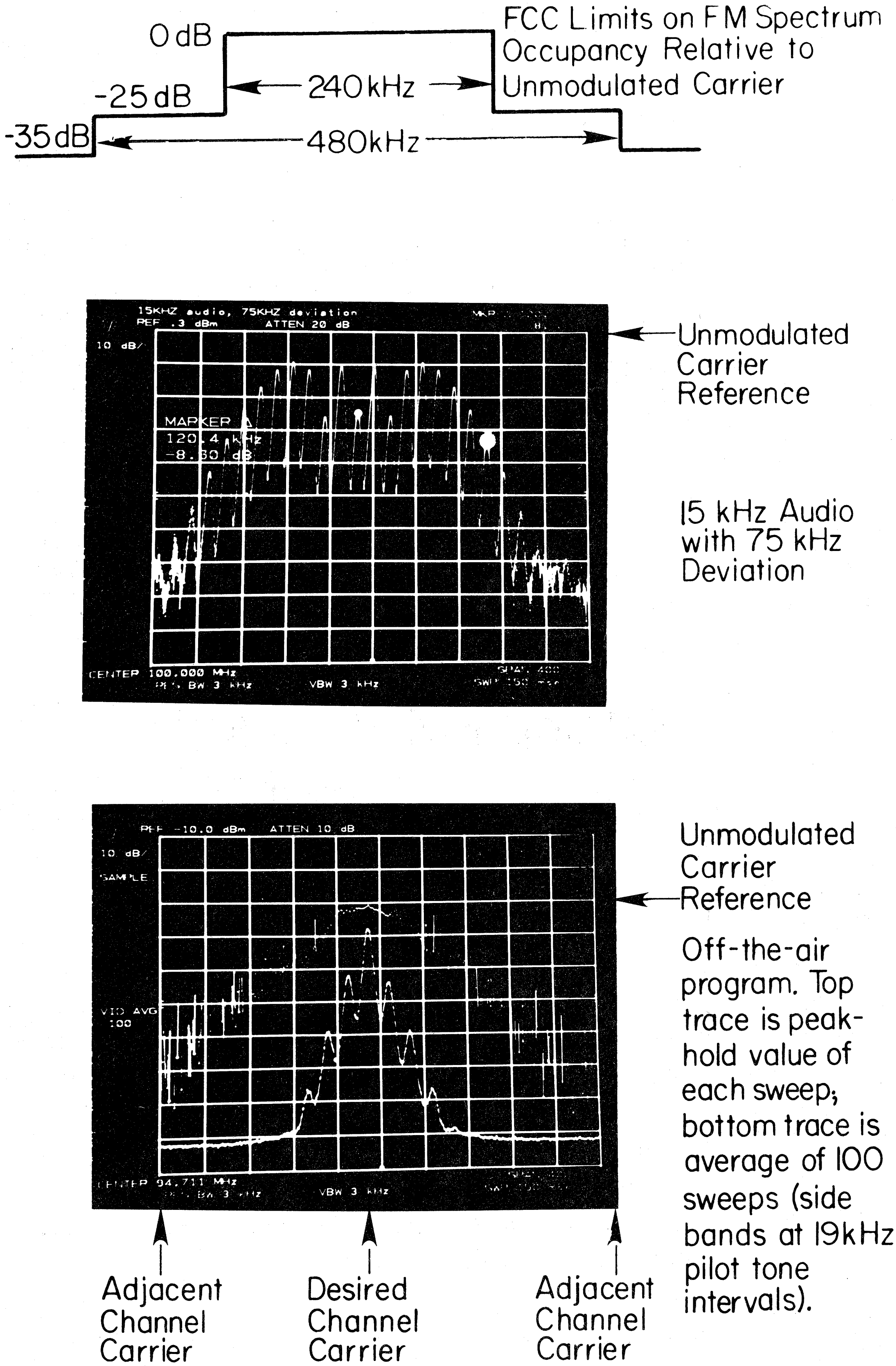


Figure 2-1. FCC's FM spectrum occupancy limits and typical FM spectrums.

how this performance factor has changed since 1962. As with co-channel interference, we have not been able, so far, to locate the basis (described in either the First or Third Reports) for fixing the second-adjacent-channel S/I ratio at 6 dB. Without a series of interference tests, we do not know the effects of changing this requirement.

The second- and third-adjacent-channel separation requirements appear to have been made more to give the existing station some degree of economic protection rather than to provide just technical protection. Paragraphs 64 and 65 of the First Report describe some of the reasoning used to arrive at the second- and third-adjacent-channel distance separations. In adopting the separations, the FCC had to balance several conflicting requirements: 1) the need to make numerous assignments, 2) the fact that interference caused a complete substitution of service, 3) the fact that interference occurred in a small area around the transmitter of the interfering station, and 4) the fact that "at least some" receivers were capable of suppressing second- and third-adjacent-channel interference. The FCC decided not to base the second- and third-adjacent-channel separations on signal-to-interference ratios, but instead elected to give the existing stations additional service area rights by requiring second- and third-adjacent channel stations to remain outside of the existing station's protected radius; i.e. 15 miles for Class A stations, etc. However, since good quality receivers can discriminate against second- and third-adjacent-channel interference, these separations could possibly be relaxed.

Receiver manufacturers do report second-adjacent-channel selectivity, called alternate-channel selectivity. In 1962, good quality receivers had alternate-channel selectivity values ranging from less than 20 dB to greater than 50 dB. Today's good quality receivers have alternate-channel selectivity values which exceed 50 dB, an improvement of at least 30 dB. The second- and third-adjacent-channel separations are the rules that we believe could be relaxed with least additional interference while providing for the greatest increase in FM broadcasting capacity.

## 2.6 IF Response Interference

A problem results in FM broadcasting when two nearby assignments have carrier frequencies that are separated by 10.6 or 10.8 MHz. Figure 2-2 shows a simplified block diagram of the front end of a typical FM broadcast receiver. The receiver is tuned to the frequency of the desired signal; this causes the tunable bandpass filter to center on the desired signal and causes the local oscillator to produce an output whose frequency is 10.7 MHz greater than the desired signal. Mixing of the local oscillator and the RF signal results in a mixer output signal at the IF frequency of 10.7 MHz. However, if two assigned carriers in one market or region are separated by 10.6 or 10.8 MHz, the heterodyning of their signals in the receiver can cause a 10.6 or 10.8 MHz interference signal to be created which also is accepted by the receiver's IF circuitry. For this reason, the current FCC rules restrict the distance separation of FM transmitters which are separated in frequency by 10.6 or 10.8 MHz.

The lower portion of Table 2-1 gives the separation between the various classes of FM transmitters whose carriers are separated by 10.6 or 10.8 MHz required by the current FCC rules. We were unable to determine from the First or Third Report just how these separations were derived; however, we can work backwards to see their effects on receivers.

If a receiver is located midway between two minimum-spaced Class A stations, for example, whose carriers are separated by 10.6 MHz and whose transmitters are at the maximum values for power and antenna height, then the field strength from either transmitter is 90 dBμV/m at the receiver location. For a dipole antenna and a 300-ohm receiver input, the field strength results in a received signal level of 29.7 mV. The receiver's mixer creates products of the input signals of the form:

$$\frac{A_1 A_1}{2} \cos 2\pi (f_1+f_2)t + \frac{A_1 A_2}{2} \cos 2\pi (f_1-f_2)t$$

If there were no input filtering or mixer conversion loss, the difference signal (the second term of the above form) would be at 10.6 MHz with an amplitude of 0.44 mV. It can be shown that the maximum amplitude signal out of the mixer, due to the 10.6 MHz-separated transmitters, occurs when the receiver is exactly at the midpoint between the transmitters.

Not knowing what IF response signal levels the FCC wished to protect against makes an analysis of alternative transmitter separations or of receiver performance improvements difficult. For example, the ability of an

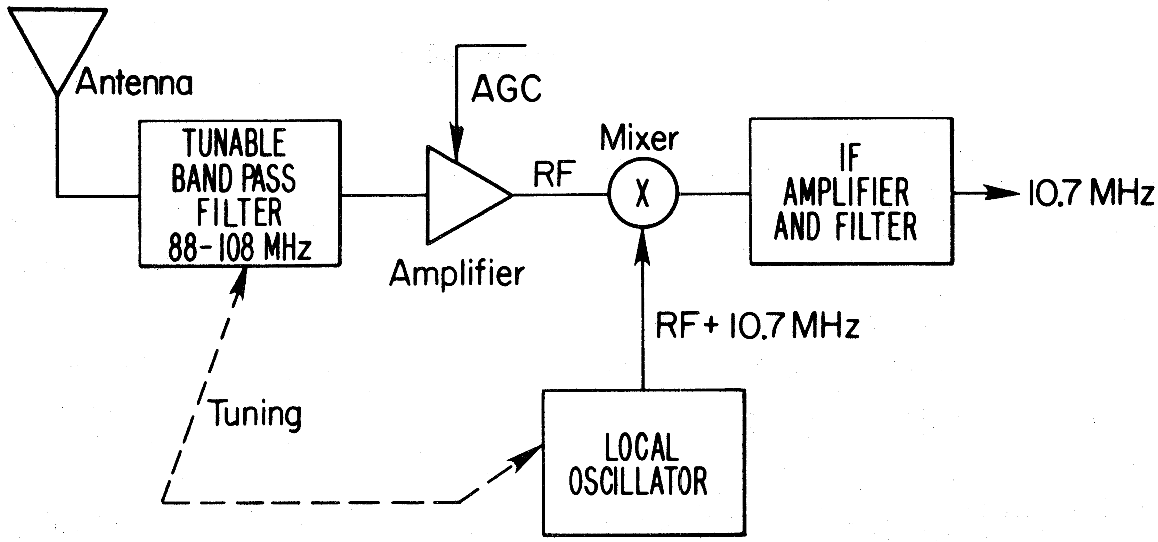


Figure 2-2. Typical front end for an FM broadcast receiver.

FM receiver to reject those signals that cause the 10.6 or 10.8 MHz signals is called the IF Response Rejection Ratio. Good quality receivers today have IF response ratios of greater than 50 dB compared with similar quality receivers of 1962 having ratios of 40 dB. This suggests the transmitter separations could be shorter than the current regulations require. Alternatively, suppose a Class B or C transmitter was co-sited with a lower power FM transmitter, separated in frequency by 10.6 or 10.8 MHz. Could we define a power ratio of the two transmitters that would cause no more IF response interference than current regulations allow? In this case the maximum IF response interference will be centered around the co-sited transmitters. Laboratory tests of good quality receivers are needed to determine the power ratios that give satisfactory results.

### 2.7 Example of One Area's Assignment Plan

Assuming for the moment that the various Classes of FM stations are not already assigned on specified channels, we can determine how channel assignments would be made in one area, observing the rules that we have

Table 2-4. Example FM Broadcast Assignment Pattern in One Area

| | | | | |
|---|---|---|---|---|
| 201 | 221 | 241 | 261 | 281 |
| 202* | 222* | 242* | 262* | 282* |
| 203 | 223 | 243 | 263 | 283 |
| 204 | 224 | 244 | 264 | 284 |
| 205 | 225 | 245 | 265 | 285 |
| 206* | 226* | 246* | 266* | 286* |
| 207 | 227 | 247 | ~~267~~ | 287 |
| 208 | 228 | 248 | ~~268~~ | 288 |
| 209 | 229 | 249 | 269 | 289 |
| 210* | 230* | 250* | 270* | 290* |
| ~~211~~ | 231 | 251 | 271 | 291 |
| ~~212~~ | 232 | 252 | 272 | 292 |
| ~~213~~ | 233 | 253 | 273 | 293 |
| 214* | 234* | 254* | 274* | 294* |
| ~~215~~ | 235 | 255 | 275 | 295 |
| ~~216~~ | 236 | 256 | 276 | 296 |
| ~~217~~ | 237 | 257 | 277 | 297 |
| 218* | 238* | 258* | 278* | 298* |
| 219 | 239 | 259 | 279 | 299 |
| 220 | 240 | 260 | 280 | 300 |

discussed in the previous sections. After making an assignment, then neither first-, second-, nor third-adjacent channels nor channels which are 53 or 54 channels removed can be assigned in the same immediate area. Thus, making one assignment eliminates eight other potential assignment channels. Maximum packing occurs when every fourth channel is selected for an assignment. Table 2-4 shows how assignments might be chosen, assuming we started with channel 202. For example, one assignment is channel 214, which eliminates adjacent channels 211, 212, 213, 215, 216, and 217. It also eliminates channels 267 and 268 (the ones that are 53 and 54 channels removed). Note also that assigning channel 266 eliminates 212 and 213 while assigning channel 210 eliminates 211, 212, and 213 and assigning 218 eliminates 215, 216, and 217. Each assigned channel has an asterisk beside it in Table 2-4. The total number of assignments in the one area is 25 FM channels, the maximum allowed under the strict adherence to current rules.

## 3. WAYS OF INCREASING THE NUMBER OF FM STATIONS

### 3.1 Improve FM Equipment

Improved FM equipment could allow a relaxation of the protection ratios and lead to more FM band assignments. Obviously, if receivers can be improved to discriminate against interference, then they are more capable of selecting a desired FM station in a dense FM environment. Figures 3-1 and 3-2 (NTIA, 1979) show the change in performance of good quality FM receivers, in different price ranges, over the past 20 years. In 1962, the price range of good quality FM receivers was between $200 and $600. Today a comparable quality receiver ranges in price from $150 to $1200. However, because of the change in the consumer price index, today's equivalent quality radios would range from $60 to $480, with 1962 dollars. So not only has the FM receiver's interference performance improved but the real cost of the receiver to the consumer is less than it was 20 years ago.

### 3.2 Relax FCC Rules on FM

In order to effectively increase the number of FM stations, the FCC rules would have to be changed. Such changes include:

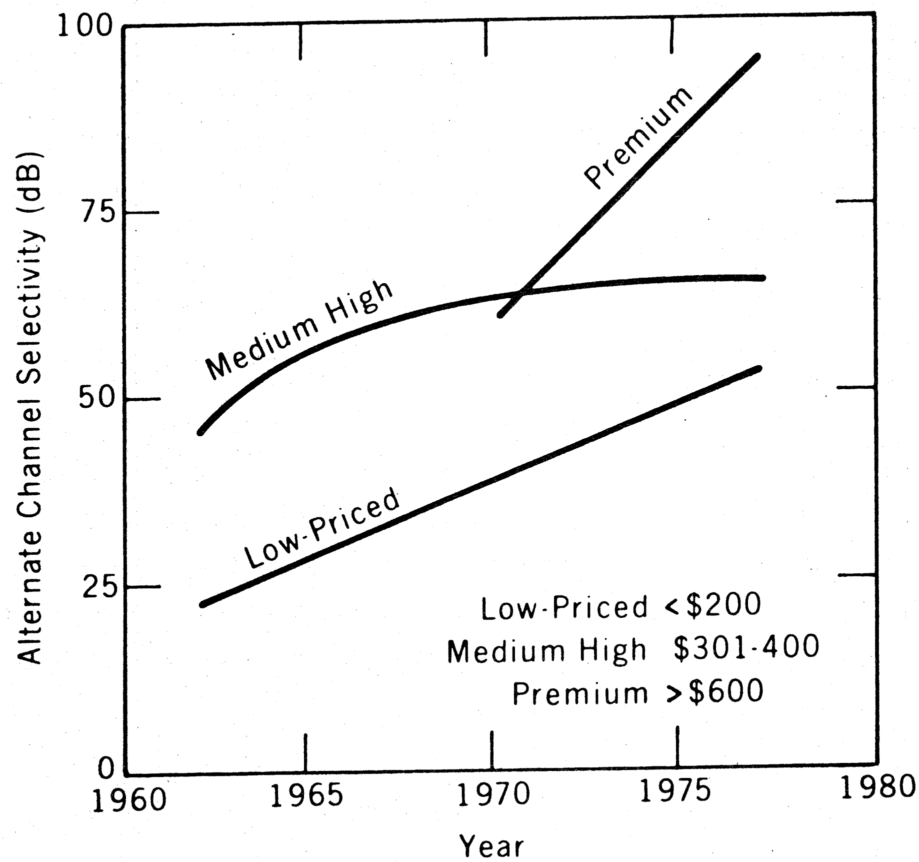


Figure 3-1. Improvement in second adjacent channel selectivity.

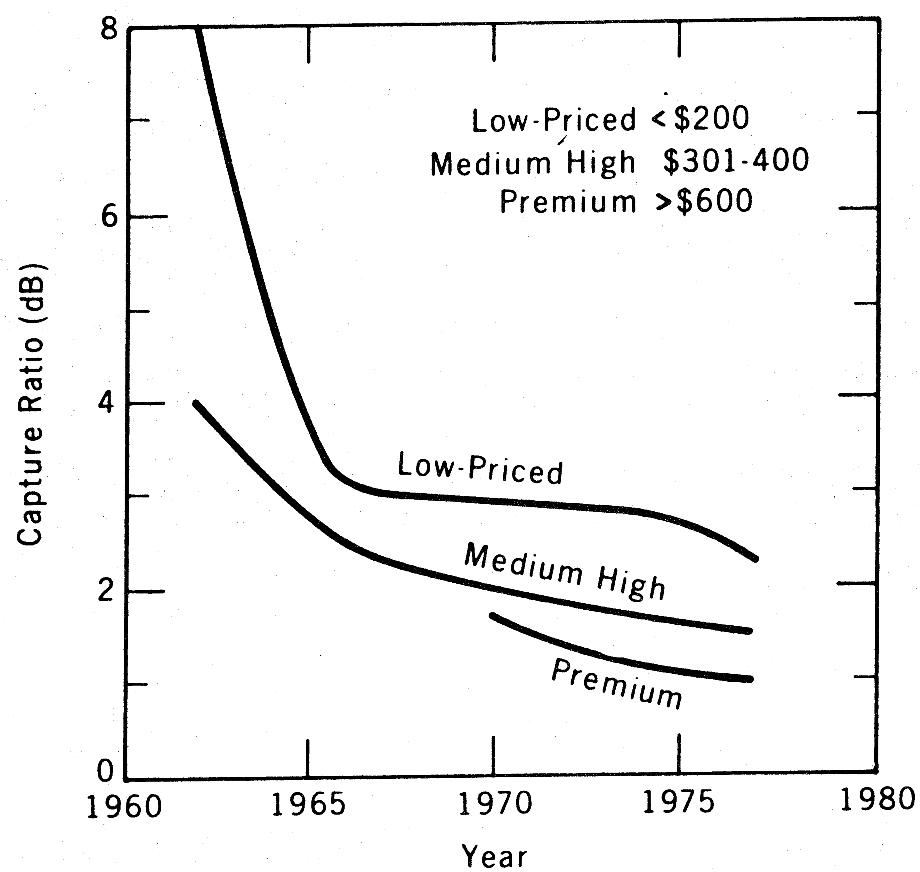


Figure 3-2. Improvement in capture ratio.

1. to allow locating second- and third-adjacent-channel stations near existing FM stations,

2. to allow locating stations that can cause IF response signals near existing FM stations,

3. to allow use of directional antennas,

4. to allow terrain features to be used in computing signal and interference coverage, and

5. to consider actual facilities rather than maximum facilities.

These are independent recommendations; each one could increase the assignment capacity without significantly decreasing the coverage of existing stations. Recommendations 1 and 2 would not require case-by-case engineering calculations. Recommendations 3, 4, and 5 would require a change in philosophy from that of developing a Table of Assignments to specific-situation engineering.

In the sections that follow, we show that these changes in the rules are now a feasible way to increase the number of FM stations. We also will show the impact of these rule changes on population and area coverage of current and proposed assignments.

### 3.3 Trade Off Between New Large or New Small Stations

When FM service was new, the FCC was concerned about providing service to large areas, avoiding interference conditions like that on night-time AM, and eliminating the procedural inefficiencies of engineering many small, directional-coverage FM systems. In paragraph 8 of the Third Report, the FCC notes that because of co-channel interference problems three Class C stations can cover about the same area as 55 Class A stations, the approximate number of assignments on each Class A frequency. However, now that FM service has matured and nearly everyone can receive several FM stations, there exists an opportunity to diversify. By allowing in more small facility stations that can cover selected populations, greater FM service is possible. A few larger stations may cover more area and population than many smaller stations but the smaller stations allow the listeners to have more alternatives in program material and the broadcaster can select specific audiences to be covered.

## 4. ANALYTICAL APPROACH

We will use computer-based analytical tools to compute the area and population covered by the desired signals and by the interference. The tools allow us to analyze all of the stations, using the same rules, the same data base, and the same methodology. The approach* is to:

1. Define the signal level to be protected for each station class.
2. Define the minimum allowed signal-to-interference (protection) ratio required at the protected signal contour.
3. Compute the distance to the protected signal contour for an existing station.
4. Evaluate facility alternatives for a proposed new station or a modified existing station.
5. Compare area and population of coverage for the alternatives.

## 5. DEMONSTRATION

In this section we will choose a major FM market to demonstrate how we propose to increase the capacity of the selected market's "saturated" FM broadcast band. We will use the means and approach as described in Sections 3 and 4. After selecting the market, we will determine from the FCC data base the locations and station characteristics of the existing assignments in the

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*In a fully developed system for analyzing FM applications or for engineering new facilities, the selection of the best facility/coverage alternative will involve the station owners. For the new owner, "best" may be limited by:

1) how much he is willing to pay for site selection with terrain features, transmitter power, antenna tower height, directional antennas, etc, or

2) where or what size of audience he is trying to reach.

Using tools such as those proposed here, the new owner can analyze for himself the trade-offs between transmitter antenna site location, transmitter power, antenna height, and directional antenna patterns.

region. We propose to increase the number of FM stations by adding second- and third-adjacent-channel stations, by adding IF response channel stations, by using directional antennas, by using terrain effects to determine actual coverage and interference contours, and by considering actual facilities for existing stations. Finally, for each proposed channel assignment, we will demonstrate what area and population is covered for proposed values of transmitter site location, power, antenna height, and directional antenna pattern.

## 5.1 Selection of Market

We have chosen the Dallas-Ft. Worth region, one of the top 10 radio markets (see Table 5-1 for comparative ranking), to demonstrate the addition of new assignments to a major market. The Dallas-Ft. Worth area has experienced rapid growth in the last twenty years and yet it was noted in the First Report (paragraph 35) as being near saturation for FM assignments even back in 1962.

## 5.2 Current Assignments

In Table 5-2 we have listed all of the FM assignments in the FCC data base within 180 miles of our Dallas reference location (32.7767 degrees North, 96.8117 degrees West). The 180 mile range includes all stations that could be co-channel with proposed Dallas Class C stations. Table 5-3 lists the current Dallas-Ft. Worth FM broadcast assignments within 80 miles of the reference location. The columns of Table 5-3 have been arranged to show channels which are potential IF response interferers; for example, two stations on channels 201 and 254 could produce an IF response frequency of 10.6 MHz and two stations on channels 201 and 255 could produce an IF response frequency of 10.8 MHz. Assignments on channels 201 and 254, channels 201 and 255, or channels 202 and 255, etc. are restricted to mileage separations given in the lower half of Table 2-1. Co-channel and adjacent channel assignments are restricted by the separations given in the upper half of Table 2-1. Note that all of the Dallas-Ft. Worth region assignments comply with the FCC rules for station-to-station spacing. As a result, there are only 21 FM assignments within a 30 mile radius of the chosen Dallas reference location and only 34 FM assignments within an 80 mile radius of the reference.

Table 5-1. Commercial and Non-commercial Radio Stations in Large Markets, 1979 (From FCC, Table 3 (1979))

| Total # Stations | Market | Commercial # AM | Stations # FM | Noncommercial # NPR | Stations # Other |
|---|---|---|---|---|---|
| 64 | Los Angeles | 29 | 28 | 4 | 3 |
| 59 | Chicago | 22 | 24 | 1 | 12 |
| 54 | New York | 23 | 22 | 3 | 6 |
| 42 | San Francisco | 18 | 16 | 3 | 5 |
| 40 | Boston | 16 | 15 | 2 | 7 |
| 37 | Dallas-Fort Worth | 16 | 15 | 1 | 5 |
| 36 | St. Louis | 14 | 11 | 1 | 10 |
| 36 | Seattle | 19 | 12 | 1 | 4 |
| 36 | Washington, D.C. | 18 | 13 | 2 | 3 |
| 35 | Detroit | 15 | 18 | 1 | 1 |
| 35 | Pittsburgh | 18 | 12 | 2 | 3 |
| 34 | Philadelphia | 15 | 14 | 1 | 4 |
| 31 | Atlanta | 18 | 8 | 1 | 4 |
| 31 | Houston | 14 | 12 | 1 | 4 |
| 31 | Miami-Miami Beach | 13 | 14 | 1 | 3 |
| 30 | Norfolk-Portsmouth-Newport News-Hampton | 14 | 11 | 1 | 4 |
| 30 | Minneapolis-St. Paul | 15 | 7 | 3 | 5 |
| 29 | Tampa-St. Petersburg | 18 | 9 | 1 | 1 |
| 28 | Cleveland | 11 | 13 | 1 | 3 |
| 28 | Phoenix | 19 | 8 | 1 | 0 |
| 28 | Portland | 15 | 10 | 3 | 0 |
| 28 | San Diego | 13 | 12 | 1 | 2 |
| 28 | Denver | 17 | 10 | 1 | 0 |
| 27 | Baltimore | 13 | 10 | 2 | 2 |
| 25 | Cincinnati | 11 | 8 | 1 | 5 |
| 25 | Kansas City | 11 | 10 | 1 | 3 |
| 24 | Hartford-New Britian | 9 | 10 | 0 | 5 |
| 24 | Milwaukee | 10 | 11 | 1 | 2 |
| 24 | San Antonio | 13 | 9 | 0 | 2 |
| 23 | Honolulu | 17 | 5 | 0 | 1 |
| 23 | Jacksonville | 14 | 7 | 1 | 1 |
| 22 | Albany-Schenectady-Troy | 9 | 8 | 2 | 3 |
| 22 | Louisville | 11 | 7 | 3 | 1 |
| 22 | Memphis | 10 | 7 | 1 | 4 |
| 22 | New Orleans | 11 | 8 | 1 | 2 |
| 22 | Oklahoma City | 9 | 12 | 0 | 1 |
| 22 | Orlando | 9 | 9 | 0 | 4 |
| 21 | Fresno | 12 | 7 | 1 | 1 |
| 21 | Indianapolis | 8 | 6 | 1 | 6 |
| 21 | Riverside-San Bernardino-Ontario | 9 | 8 | 1 | 3 |
| 21 | Albuquerque | 12 | 6 | 0 | 3 |
| 20 | Birmingham, Ala. | 11 | 7 | 1 | 1 |
| 20 | Buffalo | 8 | 9 | 3 | 0 |
| 20 | Raleigh-Durham | 10 | 6 | 0 | 4 |
| 20 | Salt Lake City | 14 | 6 | 0 | 0 |
| 20 | Spokane | 10 | 6 | 0 | 4 |
| 19 | San Juan | 12 | 6 | 1 | 0 |
| 19 | Nashville | 10 | 6 | 1 | 2 |
| 19 | Sacramento | 9 | 9 | 0 | 1 |
| 19 | Scranton | 10 | 5 | 1 | 3 |
| 18 | Richmond, Va. | 11 | 5 | 1 | 1 |
| 18 | Columbus, Ohio | 7 | 6 | 3 | 2 |
| 18 | Springfield-Chicopee-Holyoke | 9 | 3 | 0 | 6 |
| 18 | Syracuse | 8 | 8 | 1 | 1 |
| 17 | Colorado Springs | 8 | 7 | 0 | 2 |
| 17 | Portland, Maine | 6 | 10 | 1 | 0 |
| 17 | Greensboro, N.C. | 8 | 5 | 0 | 4 |
| 17 | Tucson | 10 | 5 | 2 | 0 |
| 17 | West Palm Beach | 9 | 6 | 1 | 1 |
| 17 | El Paso | 10 | 6 | 1 | 0 |
| 16 | Chattanooga | 8 | 6 | 0 | 2 |
| 16 | Columbia, S.C. | 6 | 6 | 1 | 3 |
| 16 | Rochester, N.Y. | 6 | 7 | 1 | 2 |
| 15 | Allentown, Pa. | 7 | 5 | 0 | 3 |

Table 5-2. FM Broadcast Assignments Within 180 Miles of Dallas Reference Location: 32.7767 Degrees North and 96.8117 Degrees West

| Channel No. | Distance from Reference (s mi) | ID* | Call Sign | Station Class | License** Status | Transmitter Location Latitude (Deg. N) | Transmitter Location Longitude (Deg. W) | Horizontal Power (kw) | Horizontal HAAT (ft) | Vertical Power (kw) | Vertical HAAT (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 201 | 35.7<br>DENTON | FM | KNTU | C<br>TX | APP | 33.2119 | 97.1456 | 17. | 136. | 17. | 136. |
| 202 | 39.9<br>KEENE | FM | KSUC | A<br>TX | LIC | 32.3950 | 97.3250 | 2. | 235. | 2. | 235. |
| 203 | 7.8<br>DALLAS | FM | KRSM | D<br>TX | LIC | 32.8900 | 96.8008 | 0. | 0. | 0. | 0. |
| 203 | 35.7<br>DENTON | FM | KNTU | A<br>TX | LIC | 33.2119 | 97.1456 | 0. | 125. | 0. | 125. |
| 203 | 177.1<br>LLANO | FA | | A<br>TX | | 30.7594 | 98.6753 | 0. | 0. | 0. | 0. |
| 204 | 25.2<br>FORT WORTH | FM | KTCUFM | A<br>TX | APP | 32.7603 | 97.2444 | 3. | 300. | 3. | 300. |
| 204 | 32.3<br>FORT WORTH | FM | KTCUFM | A<br>TX | LIC | 32.7110 | 97.3607 | 3. | 125. | 3. | 125. |
| 204 | 178.6<br>AUSTIN | FM | KAZI | A<br>TX | CP | 30.3258 | 97.7994 | 0. | 1120. | 0. | 1120. |
| 205 | 60.6<br>COMMERCE | FM | KETR | C<br>TX | LIC | 33.2381 | 95.9242 | 7. | 245. | 7. | 245. |
| 205 | 146.5<br>BROWNWOOD | FA | | C<br>TX | | 31.7200 | 98.9833 | 0. | 0. | 0. | 0. |
| 207 | .7<br>DALLAS | FM | KCBI | C<br>TX | APP | 32.7817 | 96.8014 | 10. | 655. | 10. | 655. |
| 207 | 160.4<br>HUNTSVILLE | FM | KSHU | D<br>TX | LIC | 30.7133 | 95.5494 | 0. | 0. | 0. | 0. |
| 208 | 178.6<br>AUSTIN | FM | KMFA | C<br>TX | APP | 30.3258 | 97.7994 | 7. | 878. | 7. | 878. |
| 209 | 65.0<br>DENISON | FM | KGCC | C<br>TX | LIC | 33.7083 | 96.6417 | 29. | 275. | 29. | 275. |
| 210 | 156.3<br>SAN SABA | FA | | A<br>TX | | 31.1944 | 98.7189 | 0. | 0. | 0. | 0. |
| 211 | 16.0<br>DALLAS | FM | KERAFM | C<br>TX | LIC | 32.5786 | 96.9533 | 95. | 1260. | 95. | 1260. |
| 211 | 150.0<br>NACOGDOCHES | FM | KSAU | A<br>TX | LIC | 31.6272 | 94.6364 | 1. | 115. | 0. | 0. |
| 212 | 146.5<br>BROWNWOOD | FA | | A<br>TX | | 31.7200 | 98.9833 | 0. | 0. | 0. | 0. |

*FM ≡ assigned allocation; FR ≡ translator; FA ≡ unassigned allocation.

**APP ≡ application for construction permit; CP ≡ construction permit; LIC ≡ license.

Table 5-2. (Continued)

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 213 | 178.9 | FM | KUTFM | C | CP | 30.3222 | 97.8028 | 100. | 960. | 100. | 960. |
| | AUSTIN | | | TX | | | | | | | |
| 215 | 15.6 | FM | KCHU | C | LIC | 32.5775 | 96.9386 | 100. | 790. | 100. | 790. |
| | DALLAS | | | TX | | | | | | | |
| 215 | 150.5 | FM | KAMUFM | C | LIC | 30.6300 | 96.3425 | 3. | 340. | 3. | 340. |
| | COLLEGE STATION | | | TX | | | | | | | |
| 216 | 143.0 | FM | KBWC | D | LIC | 32.5367 | 94.3747 | 0. | 0. | 0. | 0. |
| | MARSHALL | | | TX | | | | | | | |
| 217 | 132.4 | FM | KNCTFM | C | LIC | 30.9867 | 97.6297 | 50. | 1170. | 50. | 1170. |
| | KILLEEN | | | TX | | | | | | | |
| 219 | 15.6 | FM | KVTT | C | CP | 32.5775 | 96.9386 | 100. | 660. | 100. | 660. |
| | DALLAS | | | TX | | | | | | | |
| 220 | 88.6 | FM | KHIB | D | LIC | 34.0083 | 96.3750 | 0. | 0. | 0. | 0. |
| | DURANT | | | OK | | | | | | | |
| 220 | 166.3 | FA | | A | | 31.8317 | 99.4267 | 0. | 0. | 0. | 0. |
| | COLEMAN | | | TX | | | | | | | |
| 221 | 89.7 | FM | KROZ | A | LIC | 32.3808 | 95.3475 | 3. | 280. | 3. | 280. |
| | TYLER | | | TX | | | | | | | |
| 221 | 98.5 | FM | KRRO | A | LIC | 34.1842 | 97.1056 | 3. | 210. | 3. | 210. |
| | ARDMORE | | | OK | | | | | | | |
| 221 | 106.6 | FA | | A | | 31.7039 | 98.1231 | 0. | 0. | 0. | 0. |
| | HAMILTON | | | TX | | | | | | | |
| 221 | 150.0 | FM | WTAWFM | A | LIC | 30.6347 | 96.3556 | 3. | 275. | 3. | 275. |
| | COLLEGE STATION | | | TX | | | | | | | |
| 221 | 150.9 | FM | KTBC | A | LIC | 31.6111 | 94.6306 | 2. | 370. | 2. | 370. |
| | NACOGDOCHES | | | TX | | | | | | | |
| 221 | 158.1 | FM | NEW | A | APP | 30.5606 | 97.5081 | 3. | 300. | 3. | 300. |
| | TAYLOR | | | TX | | | | | | | |
| 221 | 174.3 | FA | | A | | 32.9433 | 99.8017 | 0. | 0. | 0. | 0. |
| | STAMFORD | | | TX | | | | | | | |
| 221 | 179.0 | FM | KETXFM | A | LIC | 30.7397 | 94.9250 | 2. | 370. | 2. | 370. |
| | LIVINGSTON | | | TX | | | | | | | |
| 223 | 16.1 | FM | KAFM | C | LIC | 32.5881 | 96.9761 | 99. | 1670. | 99. | 1670. |
| | DALLAS | | | TX | | | | | | | |
| 224 | 129.0 | FM | KIVYFM | A | LIC | 31.3056 | 95.4517 | 3. | 200. | 3. | 200. |
| | CROCKETT | | | TX | | | | | | | |
| 224 | 167.6 | FM | KDQNFM | A | CP | 34.0325 | 94.3286 | 3. | 220. | 3. | 220. |
| | DEQUEEN | | | AR | | | | | | | |
| 225 | 126.4 | FM | KBID | C | LIC | 33.9012 | 98.5391 | 100. | 920. | 100. | 920. |
| | WICHITA FALLS | | | TX | | | | | | | |
| 226 | 95.5 | FM | KTYL | C | LIC | 32.3750 | 95.2444 | 100. | 460. | 100. | 460. |
| | TYLER | | | TX | | | | | | | |
| 227 | 125.1 | FM | KIXSFM | C | LIC | 31.0897 | 97.5986 | 100. | 520. | 100. | 520. |
| | KILLEEN | | | TX | | | | | | | |
| 227 | 146.7 | FM | KTENFM | C | LIC | 34.9017 | 96.6769 | 100. | 630. | 100. | 630. |
| | ADA | | | OK | | | | | | | |

Table 5-2. (Continued)

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 228 | 52.1 | FM | KIKT | A | CP MOD | 33.1833 | 96.0553 | 3. | 300. | 3. | 300. |
| | GREENVILLE | | | TX | | | | | | | |
| 228 | 121.8 | FA | | A | | 32.7544 | 98.9033 | 0. | 0. | 0. | 0. |
| | BRECKENRIDGE | | | TX | | | | | | | |
| 229 | 179.5 | FM | KMBQ | C | LIC | 32.4997 | 93.7508 | 100. | 265. | 100. | 265. |
| | SHREVEPORT | | | LA | | | | | | | |
| 229 | 179.5 | FM | KLBJFM | C | LIC | 30.3100 | 97.7925 | 97. | 1050. | 97. | 1050. |
| | AUSTIN | | | TX | | | | | | | |
| 230 | 24.2 | FM | KESS | C | LIC | 32.6644 | 97.2050 | 100. | 430. | 100. | 430. |
| | FORT WORTH | | | TX | | | | | | | |
| 232 | 97.1 | FM | KLIS | A | LIC | 31.7800 | 95.6397 | 3. | 300. | 0. | 0. |
| | PALESTINE | | | TX | | | | | | | |
| 232 | 121.2 | FA | | A | | 31.8989 | 98.6064 | 0. | 0. | 0. | 0. |
| | COMANCHE | | | TX | | | | | | | |
| 232 | 152.5 | FA | | A | | 33.5917 | 99.2592 | 0. | 0. | 0. | 0. |
| | SEYMOUR | | | TX | | | | | | | |
| 233 | 61.1 | FM | KGAFFM | C | LIC | 33.6283 | 97.1069 | 100. | 370. | 100. | 370. |
| | GAINESVILLE | | | TX | | | | | | | |
| 233 | 170.7 | FM | KROK | C | LIC | 32.7044 | 93.8822 | 100. | 320. | 100. | 320. |
| | SHREVEPORT | | | LA | | | | | | | |
| 235 | 30.8 | FM | KWJS | C | APP | 32.4722 | 97.1990 | 100. | 453. | 100. | 453. |
| | ARLINGTON | | | TX | | | | | | | |
| 237 | 36.5 | FM | KMMK | A | LIC | 33.2717 | 96.5867 | 3. | 215. | 3. | 215. |
| | MCKINNEY | | | TX | | | | | | | |
| 237 | 36.5 | FM | KMMK | A | LIC | 33.2717 | 96.5867 | 3. | 215. | 3. | 215. |
| | MCKINNEY | | | TX | | | | | | | |
| 237 | 110.4 | FM | NEW | A | APP | 32.7275 | 94.9167 | 1. | 420. | 1. | 420. |
| | GILMER | | | TX | | | | | | | |
| 237 | 114.4 | FA | | A | | 34.0667 | 95.5668 | 0. | 0. | 0. | 0. |
| | HUGO | | | OK | | | | | | | |
| 238 | 88.5 | FM | KNFO | C | CP | 31.5319 | 97.1875 | 6. | 245. | 6. | 245. |
| | WACO | | | TX | | | | | | | |
| 238 | 157.2 | FM | KSPLFM | C | CP MOD | 31.2600 | 94.8117 | 50. | 440. | 50. | 440. |
| | DIBOLL | | | TX | | | | | | | |
| 238 | 171.6 | FR | | C | ADD | 33.1583 | 99.7317 | 0. | 0. | 0. | 0. |
| | HASKELL | | | TX | | | | | | | |
| 239 | 93.6 | FM | KKAJ | C | LIC | 34.0989 | 97.1817 | 100. | 450. | 100. | 450. |
| | ARDMORE | | | OK | | | | | | | |
| 240 | 75.2 | FM | KMWT | A | LIC | 32.8117 | 98.1031 | 3. | 295. | 3. | 295. |
| | MINERAL WELLS | | | TX | | | | | | | |
| 240 | 78.2 | FM | NEW | A | APP | 33.1666 | 95.5474 | 3. | 300. | 3. | 300. |
| | SULPHUR SPRINGS | | | TX | | | | | | | |
| 240 | 117.1 | FM | KKTX | A | LIC | 32.4028 | 94.8542 | 1. | 510. | 1. | 510. |
| | KILGORE | | | TX | | | | | | | |
| 240 | 146.4 | FA | | A | | 33.4600 | 94.4217 | 0. | 0. | 0. | 0. |
| | NEW BOSTON | | | TX | | | | | | | |
| 240 | 167.7 | FM | NEW | A | APP | 34.3333 | 99.0458 | 3. | 262. | 3. | 262. |
| | FREDERICK | | | OK | | | | | | | |

Table 5-2. (Continued)

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 242 | 16.1 | FM | KSCS | C | LIC | 32.5881 | 96.9761 | 99. | 1680. | 99. | 1680. |
| | FORT WORTH | | | TX | | | | | | | |
| 243 | 179.5 | FM | KEPT | C | LIC | 32.5139 | 93.7483 | 100. | 250. | 0. | 0. |
| | SHREVEPORT | | | LA | | | | | | | |
| 244 | 63.4 | FM | KIKMFM | A | LIC | 33.6761 | 96.5853 | 3. | 265. | 0. | 0. |
| | SHERMAN | | | TX | | | | | | | |
| 244 | 64.0 | FA | | A | | 33.2811 | 97.7383 | 0. | 0. | 0. | 0. |
| | BRIDGEPORT | | | TX | | | | | | | |
| 244 | 73.2 | FM | KMOOFM | A | LIC | 32.7511 | 95.5550 | 3. | 300. | 3. | 300. |
| | MINEOLA | | | TX | | | | | | | |
| 244 | 100.7 | FM | KLMT | A | LIC | 31.3167 | 96.9056 | 1. | 200. | 1. | 200. |
| | MARLIN | | | TX | | | | | | | |
| 244 | 117.4 | FM | NEW | A | APP | 32.3964 | 98.7739 | 3. | 171. | 3. | 171. |
| | EASTLAND | | | TX | | | | | | | |
| 244 | 131.3 | FM | NEW | A | APP | 34.6819 | 96.7611 | 3. | 300. | 3. | 300. |
| | ADA | | | OK | | | | | | | |
| 244 | 135.8 | FR | | A | ADD | 34.5000 | 97.9550 | 0. | 0. | 0. | 0. |
| | DUNCAN | | | OK | | | | | | | |
| 244 | 138.1 | FM | KWDG | A | LIC | 33.8817 | 94.8193 | 3. | 300. | 3. | 300. |
| | IDABEL | | | OK | | | | | | | |
| 244 | 156.3 | FA | | A | | 31.1944 | 98.7189 | 0. | 0. | 0. | 0. |
| | SAN SABA | | | TX | | | | | | | |
| 244 | 159.3 | FM | KGTNFM | A | LIC | 30.5872 | 97.6822 | 3. | 295. | 3. | 295. |
| | GEORGETOWN | | | TX | | | | | | | |
| 246 | 16.0 | FM | KFJZFM | C | LIC | 32.5786 | 96.9533 | 98. | 1460. | 98. | 1460. |
| | FORT WORTH-DALLAS | | | TX | | | | | | | |
| 246 | 28.2 | FA | | C | | 32.7500 | 97.2950 | 0. | 0. | 0. | 0. |
| | FORT WORTH | | | TX | | | | | | | |
| 248 | 104.5 | FM | KWTXFM | C | CP | 31.3219 | 97.3161 | 71. | 1570. | 71. | 1570. |
| | WACO | | | TX | | | | | | | |
| 249 | 116.4 | FM | NEW | A | APP | 31.8200 | 95.1719 | 1. | 423. | 1. | 423. |
| | RUSK | | | TX | | | | | | | |
| 249 | 131.3 | FM | KGOK | A | CP | 34.6589 | 97.1592 | 3. | 300. | 3. | 300. |
| | PAULS VALLEY | | | OK | | | | | | | |
| 249 | 131.3 | FM | KGOK | A | CP | 34.6589 | 97.1592 | 3. | 300. | 3. | 300. |
| | PAULS VALLEY | | | OK | | | | | | | |
| 250 | 16.1 | FM | NEWDID | C | APP | 32.5881 | 96.9761 | 100. | 1679. | 100. | 1679. |
| | DALLAS | | | TX | | | | | | | |
| 250 | 16.1 | FM | KZEW | C | LIC | 32.5881 | 96.9761 | 99. | 1680. | 99. | 1680. |
| | DALLAS | | | TX | | | | | | | |
| 251 | 153.3 | FM | KRLG | C | LIC | 34.5908 | 98.3528 | 100. | 200. | 0. | 0. |
| | LAWTON | | | OK | | | | | | | |
| 251 | 163.4 | FM | KTALFM | C | LIC | 32.9031 | 94.0061 | 100. | 1360. | 61. | 1360. |
| | TEXARKANA | | | TX | | | | | | | |
| 252 | 63.8 | FM | KFYZFM | A | CP | 33.5572 | 96.2203 | 3. | 300. | 3. | 300. |
| | BONHAM | | | TX | | | | | | | |
| 252 | 92.8 | FM | KWWM | A | LIC | 32.2022 | 98.2483 | 3. | 205. | 0. | 0. |
| | STEPHENVILLE | | | TX | | | | | | | |
| 252 | 92.8 | FR | KWWM | A | DEL | 32.2022 | 98.2483 | 0. | 0. | 0. | 0. |
| | STEPHENVILLE | | | TX | | | | | | | |

Table 5-2. (Continued)

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 252 | 100.5 | FM | KHIM | A | LIC | 31.7411 | 95.6033 | 3. | 300. | 3. | 300. |
| | PALESTINE | | | TX | | | | | | | |
| 252 | 106.7 | FM | KMCS | A | LIC | 31.3978 | 97.6400 | 3. | 300. | 3. | 300. |
| | GATESVILLE | | | TX | | | | | | | |
| 252 | 129.4 | FR | | A | ADD | 32.3850 | 98.9800 | 0. | 0. | 0. | 0. |
| | CISCO | | | TX | | | | | | | |
| 252 | 149.2 | FM | KORAFM | A | CP | 30.6472 | 96.3500 | 3. | 245. | 3. | 245. |
| | BRYAN | | | TX | | | | | | | |
| 252 | 178.6 | FM | KHFIFM | A | LIC | 30.3258 | 97.7994 | 1. | 420. | 1. | 420. |
| | AUSTIN | | | TX | | | | | | | |
| 254 | 15.9 | FM | KNUS | C | APP | 32.5893 | 96.9694 | 100. | 1683. | 100. | 1683. |
| | DALLAS | | | TX | | | | | | | |
| 255 | 164.3 | FR | | C | ADD | 32.1417 | 94.1000 | 0. | 0. | 0. | 0. |
| | CARTHAGE | | | TX | | | | | | | |
| 257 | 93.0 | FR | | A | ADD | 32.3450 | 95.3017 | 0. | 0. | 0. | 0. |
| | TYLER | | | TX | | | | | | | |
| 257 | 93.9 | FM | KACW | A | LIC | 33.6353 | 95.5539 | 3. | 300. | 3. | 300. |
| | PARIS | | | TX | | | | | | | |
| 257 | 100.0 | FR | | A | ADD | 32.2267 | 95.2267 | 0. | 0. | 0. | 0. |
| | WHITEHOUSE | | | TX | | | | | | | |
| 257 | 106.8 | FR | | A | ADD | 32.4667 | 95.0181 | 0. | 0. | 0. | 0. |
| | GLADEWATER | | | TX | | | | | | | |
| 257 | 143.3 | FM | KLTD | A | LIC | 31.0421 | 98.1562 | 3. | 180. | 3. | 180. |
| | LAMPASAS | | | TX | | | | | | | |
| 257 | 148.0 | FM | KLSN | A | LIC | 31.7056 | 99.0017 | 1. | 115. | 0. | 0. |
| | BROWNWOOD | | | TX | | | | | | | |
| 257 | 154.2 | FM | KPYN | A | CP MOD | 33.0814 | 94.1822 | 3. | 200. | 3. | 200. |
| | ATLANTA | | | TX | | | | | | | |
| 257 | 156.7 | FM | KDEY | A | LIC | 31.3642 | 94.7192 | 2. | 360. | 2. | 360. |
| | LUFKIN | | | TX | | | | | | | |
| 257 | 175.7 | FM | NEW | A | APP | 32.4558 | 99.7997 | 3. | 196. | 3. | 196. |
| | ABILENE | | | TX | | | | | | | |
| 258 | 16.5 | FM | KPLX | C | LIC | 32.5817 | 96.9756 | 100. | 1680. | 100. | 1680. |
| | FORT WORTH | | | TX | | | | | | | |
| 260 | 89.8 | FM | KHOO | C | LIC | 31.5142 | 97.1953 | 100. | 430. | 100. | 430. |
| | WACO | | | TX | | | | | | | |
| 260 | 126.4 | FM | KLUR | C | LIC | 33.9011 | 98.5392 | 100. | 830. | 100. | 830. |
| | WICHITA FALLS | | | TX | | | | | | | |
| 261 | 125.8 | FM | KGRIFM | A | LIC | 32.1461 | 94.7900 | 3. | 200. | 3. | 200. |
| | HENDERSON | | | TX | | | | | | | |
| 261 | 179.3 | FM | KCOZ | A | LIC | 32.5067 | 93.7536 | 3. | 300. | 3. | 300. |
| | SHREVEPORT | | | LA | | | | | | | |
| 262 | 16.0 | FM | KMEZ | C | LIC | 32.5853 | 96.9683 | 89. | 1280. | 89. | 1280. |
| | DALLAS | | | TX | | | | | | | |
| 264 | 108.3 | FM | KPXI | C | LIC | 33.1650 | 95.0056 | 100. | 155. | 100. | 155. |
| | MT PLEASANT | | | TX | | | | | | | |
| 264 | 178.9 | FM | KASE | C | LIC | 30.3228 | 97.8019 | 98. | 510. | 98. | 510. |
| | AUSTIN | | | TX | | | | | | | |

Table 5-2. (Continued)

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 265 | 122.5 | FM | KSDW | A | CP | 34.5492 | 96.9761 | 3. | 300. | 3. | 300. |
| | SULPHUR | | | OK | | | | | | | |
| 266 | 3.1 | FM | WRR | C | LIC | 32.7778 | 96.7581 | 100. | 500. | 100. | 500. |
| | DALLAS | | | TX | | | | | | | |
| 266 | 167.8 | FM | KRMDFM | C | LIC | 32.6856 | 93.9333 | 100. | 970. | 100. | 970. |
| | SHREVEPORT | | | LA | | | | | | | |
| 267 | 161.3 | FM | KNEDFM | C | LIC | 34.9367 | 95.7331 | 28. | 135. | 0. | 0. |
| | MCALESTER | | | OK | | | | | | | |
| 268 | 94.2 | FM | KNUE | C | CP MOD | 32.3750 | 95.2681 | 100. | 380. | 100. | 380. |
| | TYLER | | | TX | | | | | | | |
| 268 | 147.9 | FM | KOXE | C | LIC | 31.7258 | 99.0150 | 100. | 490. | 100. | 490. |
| | BROWNWOOD | | | TX | | | | | | | |
| 268 | 157.6 | FM | KLAW | C | APP | 34.5500 | 98.5389 | 100. | 585. | 100. | 585. |
| | LAWTON | | | OK | | | | | | | |
| 269 | 64.6 | FM | KDSQ | A | LIC | 33.6856 | 96.5411 | 3. | 260. | 3. | 260. |
| | DENISON-SHERMAN | | | TX | | | | | | | |
| 269 | 68.8 | FA | | A | | 33.7500 | 96.5467 | 0. | 0. | 0. | 0. |
| | DENISON | | | TX | | | | | | | |
| 269 | 142.1 | FM | NEW | A | APP | 30.7200 | 96.9839 | 3. | 300. | 3. | 300. |
| | CAMERON | | | TX | | | | | | | |
| 269 | 161.4 | FM | KSAMFM | A | LIC | 30.6967 | 95.5522 | 1. | 430. | 0. | 0. |
| | HUNTSVILLE | | | TX | | | | | | | |
| 271 | 16.5 | FM | KTXQ | C | LIC | 32.5817 | 96.9756 | 100. | 1420. | 100. | 1420. |
| | FORT WORTH-DALLAS | | | TX | | | | | | | |
| 271 | 28.2 | FA | | C | | 32.7500 | 97.2950 | 0. | 0. | 0. | 0. |
| | FORT WORTH | | | TX | | | | | | | |
| 271 | 28.2 | FA | | C | | 32.7500 | 97.2950 | 0. | 0. | 0. | 0. |
| | FORT WORTH | | | TX | | | | | | | |
| 272 | 136.9 | FM | KRHDFM | A | LIC | 34.5119 | 97.9681 | 3. | 160. | 3. | 160. |
| | DUNCAN | | | OK | | | | | | | |
| 272 | 165.3 | FM | KLCR | A | LIC | 31.8342 | 94.2147 | 3. | 300. | 3. | 300. |
| | CENTER | | | TX | | | | | | | |
| 272 | 170.7 | FM | KVWCFM | A | LIC | 34.1534 | 99.2691 | 1. | 340. | 0. | 0. |
| | VERNON | | | TX | | | | | | | |
| 272 | 178.6 | FM | KMXX | A | LIC | 30.3258 | 97.7994 | 1. | 550. | 1. | 550. |
| | AUSTIN | | | TX | | | | | | | |
| 273 | 55.2 | FM | KHBRFM | C | LIC | 32.0167 | 97.1089 | 3. | 155. | 0. | 0. |
| | HILLSBORO | | | TX | | | | | | | |
| 273 | 167.3 | FM | KOSYFM | C | LIC | 33.3733 | 94.0167 | 35. | 260. | 0. | 0. |
| | TEXARKANA | | | TX | | | | | | | |
| 275 | 16.5 | FM | KMGC | C | LIC | 32.5817 | 96.9756 | 100. | 1570. | 100. | 1570. |
| | DALLAS | | | TX | | | | | | | |
| 276 | 130.2 | FM | KOOV | A | LIC | 31.1331 | 97.9047 | 3. | 320. | 3. | 320. |
| | COPPERAS COVE | | | TX | | | | | | | |

Table 5-2. (Continued)

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 277 | 126.4 | FM | KNTO | C | LIC | 33.8964 | 98.5425 | 100. | 440. | 100. | 440. |
| | WICHITA FALLS | | | TX | | | | | | | |
| 277 | 150.1 | FM | KJCS | C | APP | 31.5808 | 94.6711 | 48. | 370. | 48. | 370. |
| | NACOGDOCHES | | | TX | | | | | | | |
| 279 | .0 | FA | | C | | 32.7767 | 96.8117 | 0. | 0. | 0. | 0. |
| | DALLAS | | | TX | | | | | | | |
| 279 | 16.5 | FM | KVILFM | C | LIC | 32.5817 | 96.9756 | 100. | 1570. | 100. | 1570. |
| | HIGHLAND PARK-DALLAS | | | TX | | | | | | | |
| 280 | 144.2 | FM | KMHTFM | A | LIC | 32.5639 | 94.3511 | 3. | 300. | 3. | 300. |
| | MARSHALL | | | TX | | | | | | | |
| 280 | 169.0 | FM | KMLA | A | LIC | 33.6781 | 94.0978 | 3. | 210. | 3. | 210. |
| | ASHDOWN | | | AR | | | | | | | |
| 281 | 148.0 | FM | KLSN | C | CP | 31.7056 | 99.0017 | 25. | 205. | 25. | 205. |
| | BROWNWOOD | | | TX | | | | | | | |
| 283 | .6 | FM | KKDAFM | C | CP MOD | 32.7808 | 96.8019 | 100. | 700. | 100. | 700. |
| | DALLAS | | | TX | | | | | | | |
| 283 | 5.1 | FM | KKDAFM | C | LIC | 32.7833 | 96.7250 | 100. | 390. | 0. | 0. |
| | DALLAS | | | TX | | | | | | | |
| 285 | 78.0 | FA | | A | | 31.6797 | 96.4819 | 0. | 0. | 0. | 0. |
| | MEXIA | | | TX | | | | | | | |
| 285 | 89.4 | FA | | A | | 32.9572 | 95.2900 | 0. | 0. | 0. | 0. |
| | WINNSBORO | | | TX | | | | | | | |
| 285 | 90.5 | FA | | A | | 34.0902 | 96.7725 | 0. | 0. | 0. | 0. |
| | MADILL | | | OK | | | | | | | |
| 285 | 122.8 | FM | KPLE | A | LIC | 31.0656 | 97.3992 | 3. | 300. | 3. | 300. |
| | TEMPLE | | | TX | | | | | | | |
| 285 | 144.3 | FM | NEW | A | APP | 30.7161 | 96.3689 | 3. | 300. | 3. | 300. |
| | BRYAN | | | TX | | | | | | | |
| 285 | 177.1 | FA | | A | | 30.7594 | 98.6753 | 0. | 0. | 0. | 0. |
| | LLANO | | | TX | | | | | | | |
| 286 | 152.7 | FM | KLUFFM | C | LIC | 31.4078 | 94.7647 | 57. | 660. | 57. | 660. |
| | LUFKIN | | | TX | | | | | | | |
| 286 | 166.0 | FM | KEANFM | C | APP | 32.2764 | 99.5942 | 100. | 825. | 100. | 825. |
| | ABILENE | | | TX | | | | | | | |
| 287 | 16.0 | FM | KOAX | C | LIC | 32.5853 | 96.9683 | 100. | 1560. | 100. | 1560. |
| | DALLAS | | | TX | | | | | | | |
| 288 | 167.4 | FM | KXXK | A | LIC | 35.0161 | 97.9375 | 3. | 195. | 3. | 195. |
| | CHICKASHA | | | OK | | | | | | | |
| 288 | 170.2 | FM | KSLE | A | CP | 35.2419 | 96.6361 | 3. | 295. | 3. | 295. |
| | SEMINOLE | | | OK | | | | | | | |
| 289 | 90.0 | FR | | C | ADD | 32.2200 | 98.2067 | 0. | 0. | 0. | 0. |
| | STEPHENVILLE | | | TX | | | | | | | |
| 289 | 113.7 | FM | KYKX | C | LIC | 32.6011 | 94.8708 | 100. | 1140. | 100. | 1140. |
| | LONGVIEW | | | TX | | | | | | | |
| 291 | 16.5 | FM | KDNTFM | C | APP | 32.9989 | 96.9172 | 100. | 480. | 100. | 480. |
| | DENTON | | | TX | | | | | | | |

Table 5-2. (Continued)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 292 | 125.4 | FM | KTONFM | A | LIC | 31.0628 | 97.5317 | 1. | 490. | 1. | 490. |
| | BELTON | | | TX | | | | | | | |
| 292 | 136.4 | FR | | A | ADD | 34.0983 | 98.5700 | 0. | 0. | 0. | 0. |
| | BURKBURNETT | | | TX | | | | | | | |
| 292 | 147.4 | FA | | A | | 34.0250 | 94.7400 | 0. | 0. | 0. | 0. |
| | BROKEN BOW | | | OK | | | | | | | |
| 292 | 171.1 | FM | KGOU | A | LIC | 35.2025 | 97.4447 | 3. | 180. | 3. | 180. |
| | NORMAN | | | OK | | | | | | | |
| 293 | 105.0 | FM | KOOI | C | LIC | 31.9800 | 95.2814 | 100. | 640. | 0. | 0. |
| | JACKSONVILLE | | | TX | | | | | | | |
| 293 | 140.0 | FR | | C | ADD | 34.0750 | 98.6750 | 0. | 0. | 0. | 0. |
| | BURKBURNETT | | | TX | | | | | | | |
| 294 | 67.3 | FR | | C | ADD | 32.3833 | 97.8667 | 0. | 0. | 0. | 0. |
| | GRANBURY | | | TX | | | | | | | |
| 295 | 12.5 | FM | NEW | D | APP | 32.9514 | 96.7569 | 0. | 0. | 0. | 0. |
| | RICHARDSON | | | TX | | | | | | | |
| 296 | 37.0 | FM | KLTRFM | A | CP | 32.7706 | 96.1758 | 3. | 300. | 3. | 300. |
| | TERRELL | | | TX | | | | | | | |
| 296 | 87.5 | FM | KSEOFM | A | LIC | 34.0003 | 96.4086 | 2. | 365. | 2. | 365. |
| | DURANT | | | OK | | | | | | | |
| 296 | 88.1 | FM | KWBU | A | LIC | 31.5308 | 97.1528 | 3. | 190. | 3. | 190. |
| | WACO | | | TX | | | | | | | |
| 296 | 106.3 | FM | KWKQ | A | LIC | 33.1269 | 98.5931 | 3. | 100. | 3. | 100. |
| | GRAHAM | | | TX | | | | | | | |
| 296 | 162.5 | FM | KHLBFM | A | LIC | 30.7636 | 98.2497 | 3. | 300. | 3. | 300. |
| | BURNET | | | TX | | | | | | | |
| 296 | 165.7 | FM | KSTAFM | A | LIC | 31.8544 | 99.4267 | 3. | 180. | 3. | 180. |
| | COLEMAN | | | TX | | | | | | | |
| 296 | 166.2 | FM | KADOFM | A | LIC | 33.4078 | 94.0458 | 3. | 160. | 3. | 160. |
| | TEXARKANA | | | AR | | | | | | | |
| 300 | 50.4 | FM | KXCL | C | LIC | 32.0906 | 96.5128 | 25. | 520. | 25. | 520. |
| | CORSICANA | | | TX | | | | | | | |
| 300 | 171.8 | FM | KFMN | C | LIC | 32.5103 | 99.7411 | 100. | 285. | 100. | 285. |
| | ABILENE | | | TX | | | | | | | |

Table 5-3. Current FM Assignments Within 80 Miles of Dallas Reference Location (32.7767 Degrees West)

| CH | CITY | CH | CITY |
|---|---|---|---|
| | | 254 | Dallas |
| 201 | Denton (35)[1] | | |
| | | 255 | |
| 202 | Keene (40) | | |
| | | 256 | |
| 203 | Denton (35) | | |
| | | 257 | |
| 204 | Ft. Worth | | |
| | | 258 | Ft. Worth |
| 205 | Commerce (60) | | |
| | | 259 | |
| 206 | | | |
| | | 260 | |
| 207 | Dallas | | |
| | | 261 | |
| 208 | | | |
| | | 262 | Dallas |
| 209 | Denison (65) | | |
| | | 263 | |
| 210 | | | |
| | | 264 | |
| 211 | Dallas | | |
| | | 265 | |
| 212 | | | |
| | | 266 | Dallas |
| 213 | | | |
| | | 267 | |
| 214 | | | |
| | | 268 | |
| 215 | Dallas | | |
| | | 269 | Denison (64) |
| 216 | | | |
| | | 270 | |
| 217 | | | |
| | | 271 | Dallas |
| 218 | | | |
| | | 272 | |
| 219 | Dallas | | |
| | | 273 | |
| 220 | | | |
| | | 274 | |

| CH | CITY | CH | CITY |
|---|---|---|---|
| | | 274 | |
| 221 | | | |
| | | 275 | Dallas |
| 222 | | | |
| | | 276 | |
| 223 | Dallas | | |
| | | 277 | |
| 224 | | | |
| | | 278 | |
| 225 | | | |
| | | 279 | Dallas |
| 226 | | | |
| | | 280 | |
| 227 | | | |
| | | 281 | |
| 228 | Greenville | | |
| | | 282 | |
| 229 | | | |
| | | 283 | Dallas |
| 230 | | | |
| | | 284 | |
| 231 | | | |
| | | 285 | |
| 232 | | | |
| | | 286 | |
| 233 | Gainsville (61) | | |
| | | 287 | Dallas |
| 234 | | | |
| | | 288 | |
| 235 | Arlington | | |
| | | 289 | |
| 236 | | | |
| | | 290 | |
| 237 | McKinney (36) | | |
| | | 291 | Denton |
| 238 | | | |
| | | 292 | |
| 239 | | | |
| | | 293 | |
| 240 | Mineral Wells (75) | | |
| | | 294 | |

| CH | CITY | CH | CITY |
|---|---|---|---|
| | | 294 | |
| 241 | | | |
| | | 295 | |
| 242 | Ft. Worth | | |
| | | 296 | Terrell (37) |
| 243 | | | |
| | | 297 | |
| 244 | Sherman (63) | | |
| | | 298 | |
| 245 | | | |
| | | 299 | |
| 246 | Ft. Worth | | |
| | | 300 | Corsicanna (50) |
| 247 | | | |
| 248 | | | |
| 249 | | | |
| 250 | Dallas | | |
| 251 | | | |
| 252 | Bonham (63) | | |
| 253 | | | |

[1] All assignments within 80 mi of Dallas reference location. Station distances greater than 30 mi from reference are shown in parentheses.

Columns are paired to show channels which potentially could cause IF response interference

first 20 channels are non-commercial assignments.

Figure 5-1 shows a partial map of Texas, including county boundaries. In the map's center is Dallas County with Dallas as the principal city and Tarrant county with Ft. Worth as the principal city. The asterisks plotted on the map indicate where FM facilities currently exist in the Dallas-Ft. Worth region. The densest concentration of stations exists in the southwest corner of Dallas County where fourteen FM transmitters are located.

## 5.3 Potential New Assignments

Our first step in deciding whether new assignments may be introduced is to determine what signal level is to be protected. For this example, we will stay with the present rules and use the equivalent field strengths at 65 miles for Class C stations and at 15 miles for Class A stations. Since both are close to the same value, we will use 59 dB as the signal level to be protected. Our next step is to decide what signal-to-interference protection ratios should be used. Table 5-4 shows what we believe to be reasonable ratios based upon today's good quality receivers and compares the ratios with the current requirements given in Table 2-3. These values are based on measurements of receivers as reported in popular audio magazines and by QSI (1979). From these data, today's receivers provide 30 dB of audio signal-to-interference when the rf signal-to-co-channel interference ratio is 1 to 2 dB and when the rf signal-to-second-adjacent-channel interference ratio is -50 dB. We assume the same ratio is valid for third-adjacent-channel interference as second-adjacent-channel interference.

Table 5-4. Signal-To-Interference Protection Ratios for New Assignment Demonstration

| Interference Condition | Proposed Required Signal-to-Interference Protection Ratio (dB) | Current Required Signal-to Interference Protection Ratio (dB) |
|---|---|---|
| Co-channel | 14 | 20 |
| Adjacent channel | | |
| First | 0 | 6 |
| Second | -50 | -20 |
| Third | -50 | -40 |
| IF Response | -50 | --- |

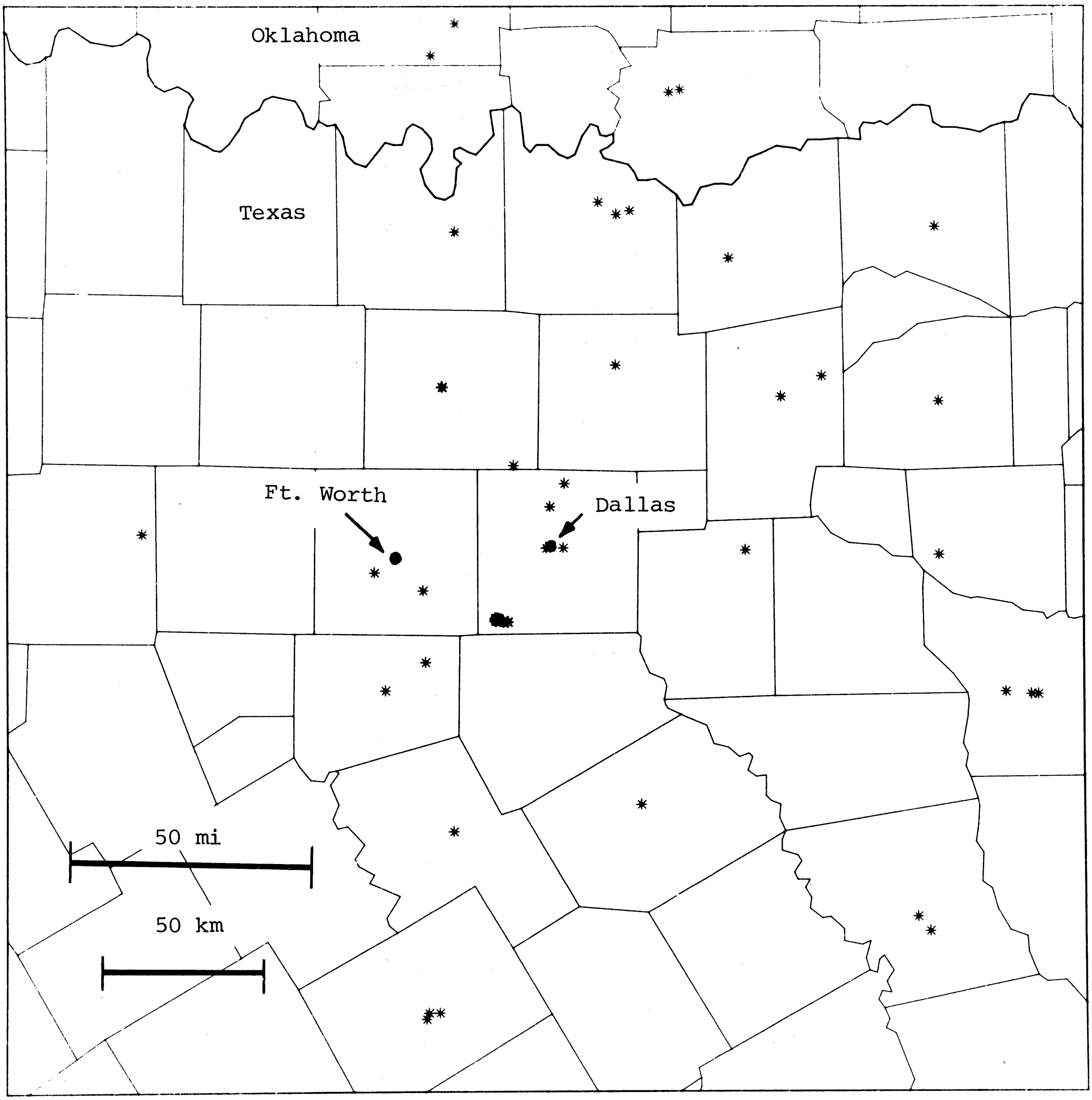



Figure 5-1. Locations of FM broadcast stations transmitter sites within 110 miles of Dallas.

Assuming that we are now free to test vacant channels for new assignments, Table 5-5 shows where we will attempt to bring new stations to the Dallas-Ft. Worth region. If all could be successfully introduced, the total number of FM stations within the 30 mile range of the Dallas reference location would increase from 21 to 44 stations. Table 5-5 is identical in format to Table 5-3 and also lists the current FM assignments in the Dallas-Ft. Worth region. Potential new assignments are indicated by either a super script next to the channel numbers. Note that most of the new potential assignments are second-adjacent channel to existing Dallas or Ft. Worth stations. Those assignments with a single asterisk are not expected to cause any IF response interference; whereas, those assignments with double asterisks are potential interferers along with nearby stations. For example, a new assignment in Dallas on channel 209 has a carrier frequency that differs in frequency with the existing Dallas station on channel 262 by the IF response frequency. Finally, some assignments may also require directional antennas to reduce interference. These new assignments are indicated by the DA printed after the single or double asterisk. For example, the new assignment on channel 209 is co-channel to an existing station in Denison, TX, located 65 miles from the reference location. Certainly a directional antenna will be needed by a Dallas channel 209 station to control the interference toward the Denison channel 209 station.

### 5.4 Protected Signal Coverage and Interference

In this section, we will plot protected signal coverage contours from existing stations and compute the population within those contours. Then we will show how trade-offs between power, antenna height, and directional antenna patterns for the new proposed facilities can allow us to cover those people we desire to reach and yet keep interference from the new facilities to acceptable levels. To do so, we will use a number of analytical tools developed at NTIA/ITS. Finally, we will give a limited example of a few of the possible trade-offs between the many alternatives available such as power, antenna height, directional antennas, etc.

Table 5-5. Potential FM Channel Assignments for Dallas-Ft. Worth Region

| CH | CITY |
|---|---|
| 201 | Denton (35) |
| 202 | Keene (40) |
| 203 | Denton (35) |
| 204 | Ft. Worth |
| 205 | Commerce (60) |
| 206 | |
| 207 | Dallas |
| 208 | |
| 209 | Denison (65)[2,3] |
| 210 | |
| 211 | Dallas |
| 212 | |
| 213[2] | |
| 214 | |
| 215 | Dallas |
| 216 | |
| 217[2,3] | |
| 218 | |
| 219 | Dallas |
| 220 | |

| CH | CITY |
|---|---|
| 254 | Dallas |
| 255 | |
| 256[1] | |
| 257 | |
| 258 | Ft. Worth |
| 259 | |
| 260[2,3] | |
| 261 | |
| 262 | Dallas |
| 263 | |
| 264[2,3] | |
| 265 | |
| 266 | Dallas |
| 267 | |
| 268[2,3] | |
| 269 | Denison |
| 270 | |
| 271 | Dallas |
| 272 | |
| 273[2,3] | |
| 274 | |

| CH | CITY |
|---|---|
| 221[2] | |
| 222 | |
| 223 | Dallas |
| 224 | |
| 225[2,3] | |
| 226 | |
| 227[2,3] | |
| 228 | Greenville (52) |
| 229 | |
| 230 | Ft. Worth |
| 231 | |
| 232[2,3] | |
| 233 | Gainsville (61) |
| 234 | |
| 235 | Arlington |
| 236 | |
| 237 | McKinney (36) |
| 238 | |
| 239[1,3] | |
| 240 | Mineral Wells (75) |

| CH | CITY |
|---|---|
| 274 | |
| 275 | Dallas |
| 276 | |
| 277[2,3] | |
| 278 | |
| 279 | Dallas |
| 280 | |
| 281[2,3] | |
| 282 | |
| 283 | Dallas |
| 284 | |
| 285[2] | |
| 286 | |
| 287 | Dallas |
| 288 | |
| 289[2,3] | |
| 290 | |
| 291 | Denton |
| 292 | |
| 293 | |
| 294 | |

| CH | CITY |
|---|---|
| 241 | |
| 242 | Ft. Worth |
| 243 | |
| 244 | Sherman (63)[2,3] |
| 245 | |
| 246 | Ft. Worth |
| 247 | |
| 248[1,3] | |
| 249 | |
| 250 | Dallas |
| 251 | |
| 252 | Bonham (63)[1,3] |
| 253 | |

| CH | CITY |
|---|---|
| 294[1] | |
| 295 | |
| 296 | Terrell (37) |
| 297 | |
| 298[1] | |
| 299 | |
| 300 | Corsicanna (50) |

[1] = New assignment with no IF response problems

[2] = New assignment with potential IF response problems

[3] = New assignment which may require directional antenna

### 5.4.1 Protected Signal Coverage from Existing Facilities

There are 21 FM broadcast stations serving within 30 miles of Dallas. The FCC rules state that Class C stations are to have service areas with a radius of 65 miles and Class A service areas are to have a radius of 15 miles. The service areas were defined by the FCC (1962) for full facility stations over average terrain; i.e., a full facility Class C station has a transmitter power of 100 kW and antenna height above average terrain (HAAT) of 2000 ft, a full facility Class A station has a transmitter power of 3 kW and antenna HAAT of 300 ft, and the average terrain has a roughness factor of 50 meters. The FCC also noted that the field strengths for the full facility stations are about 59 dBμV/m at 65 miles for the Class C stations and about 59 dBμV/m at 15 miles for the Class A stations, again over average terrain. The FCC intended that Class C stations would be free of objectionable interference within their 65 mile radius areas and Class A stations would be protected within their 15 mile radius areas. Most of the existing stations do not operate at maximum facilities and for various reasons, they do not expect to expand to the limit. For these reasons, we will use the stations' current characteristics to compute the protected signal coverage contours. We do not intend to provide protection out to the 65 and 15 mile limits established for full facility stations, but will provide protection out to the 59 dBμV/m contours for both classes. In this way we are providing signal-to-interference protection equivalent to that intended by the FCC. In Appendix A, we show plots of the 59 dBμV/m contours surrounding each of the 21 FM stations. The area and population within each contour also is computed and listed on the plots.

Before moving on, we would like to illustrate a point about trade-offs. Of the fourteen FM transmitters located in the southwest corner of Dallas County, the transmitters' powers range from 89 to 100 kW and the heights above average terrain (HAAT) range from 660 to 1683 ft. Figure 5-2 shows the predicted signal coverage to the 59 dBμV/m contour from the location's lowest transmitter (KVTT, 100 kW, 600 ft HAAT) and Figure 5-3 shows the signal coverage for the largest facility (KNUS, 100 kW, 1683 ft HAAT). Each plot has asterisks plotted to show the locations of Dallas and Ft. Worth and a "+" symbol plotted to show the transmitter location. In addition, the plot lists the total area and the total population within the contour. The signal coverage contours are computed using the FCC's F(50,50) propagation chart with corrections for terrain irregularity, as described by Hufford (1977). To see what benefits are gained by changing the antenna height, Figure 5-4 shows the additional coverage if the transmitters were to be boosted to 2000 ft HAAT. We note the following:

1. the terrain in this example has little effect on the shape of the contours,

2. the antenna height increase from 660 ft HAAT to 1683 ft HAAT increased the coverage area by 84 percent, while the height increase from 660 ft HAAT to 2000 ft HAAT increased the coverage area by 108 percent,

3. the antenna height increase from 660 ft HAAT to 1683 ft HAAT increased the population covered by 8 percent, while the height increase from 660 ft HAAT to 2000 ft HAAT increased the population covered by 10 percent.

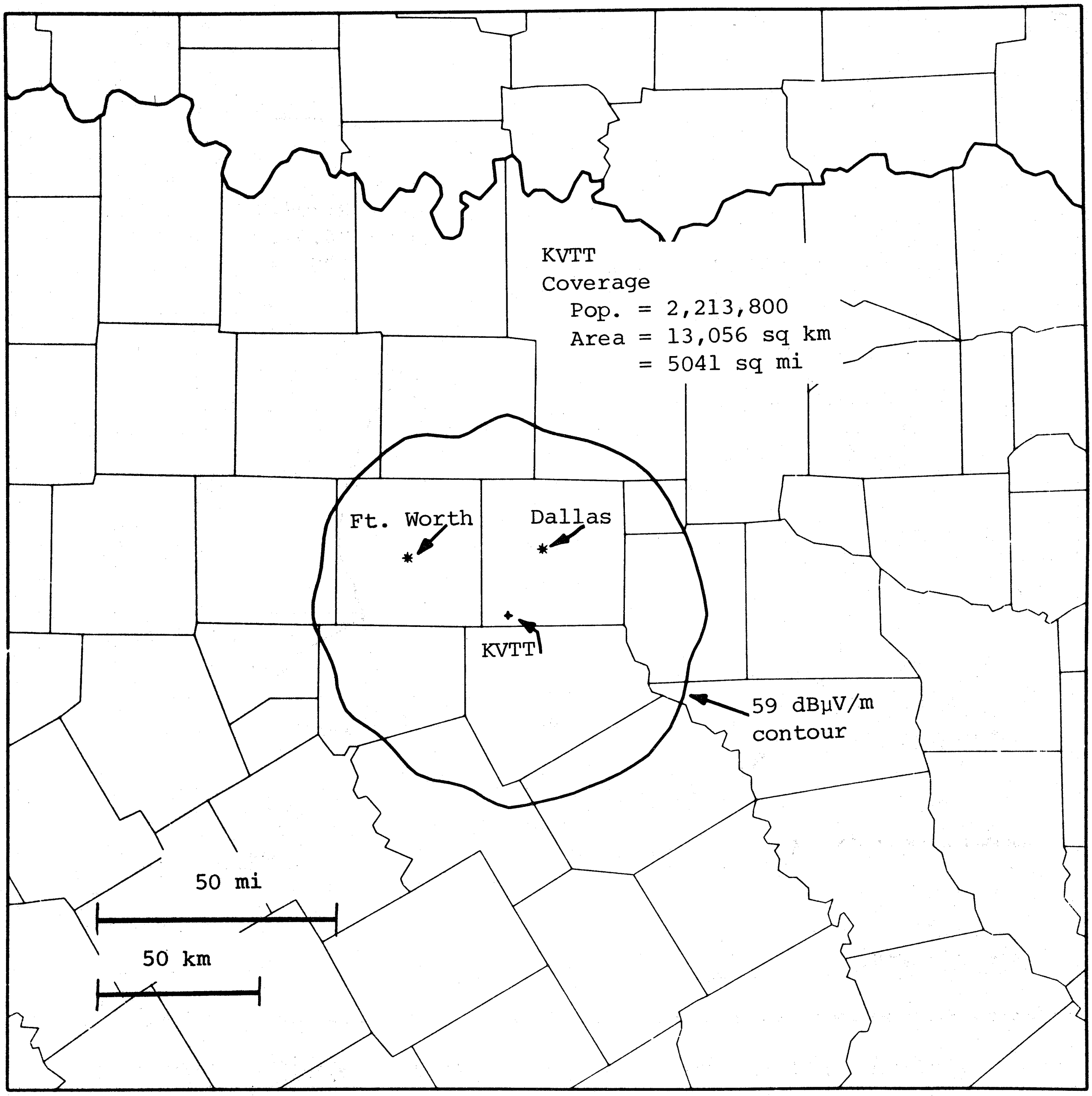
Table 5-6 emphasizes this relatively poor trade-off of antenna height and population. Broadcasting revenues depend on the population served rather than on the area served.

Table 5-6. Trade-Offs in Antenna Height Above Average Terrain for a Dallas FM Broadcast Transmitter Site

| Antenna HAAT (ft) | Increase in area covered relative to 660 ft HAAT (%) | Increase in Population covered relative to 660 ft HAAT (%) |
|---|---|---|
| 660 | 0 | 0 |
| 1683 | 84 | 8 |
| 2000 | 108 | 10 |

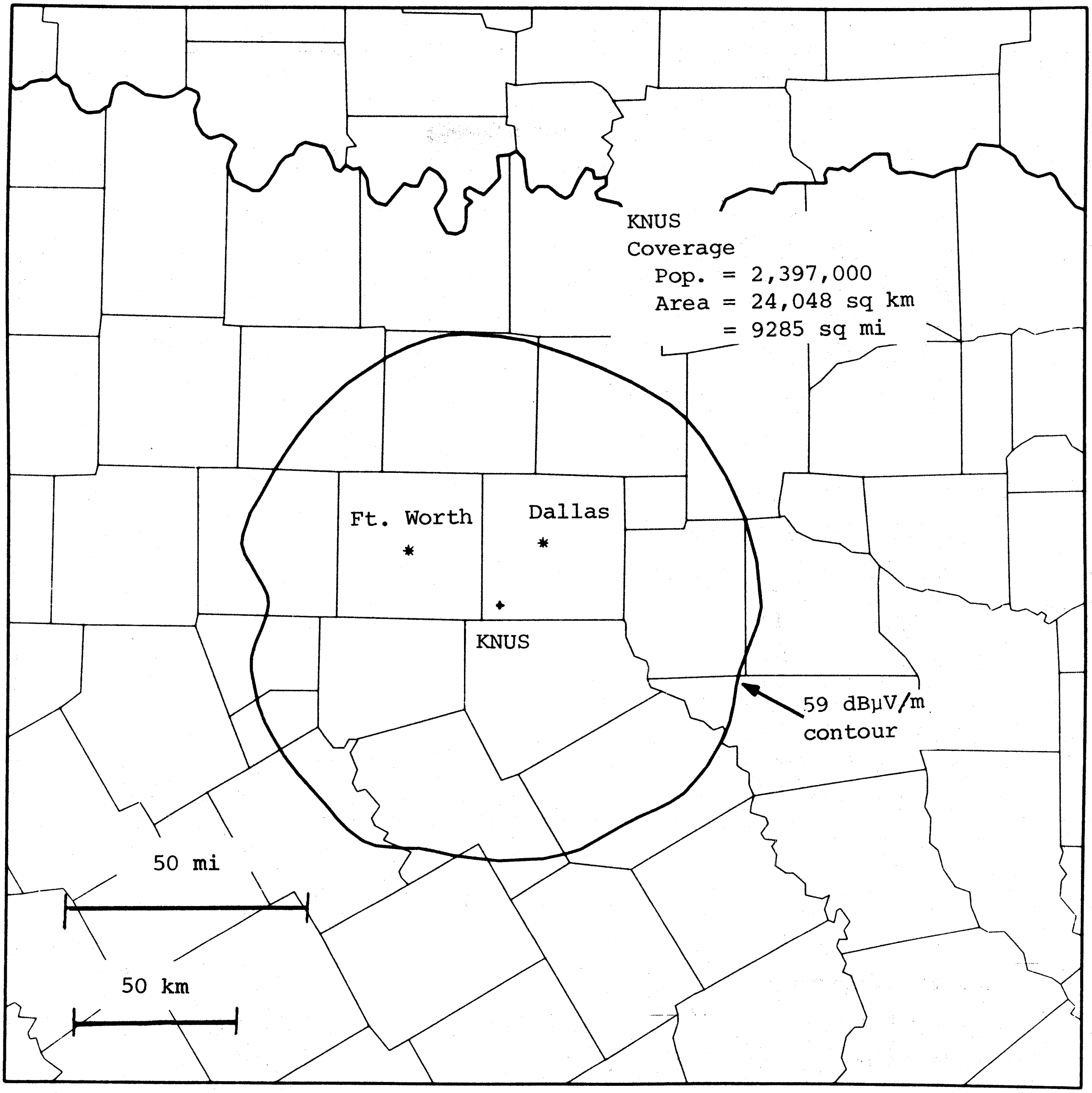
## 5.4.2 Interference

In Section 5.4.1, we defined the protected signal area for any transmitter to be that area bounded by the 59 dBµV/m contour from Class A and C stations. As we have seen, distance from the FM transmitter to the contour is a function of the facility characteristics and the terrain features. In this section we will define an interference threshold and show an example of interference from a proposed station to an existing one.




CH219 KVTT DALLAS TX 100KW 660FT HAAT

Figure 5-2. Signal coverage from station KVTT.




CH254 KNUS DALLAS TX 100KW 1683FT HAAT

Figure 5-3. Signal coverage from station KNUS.

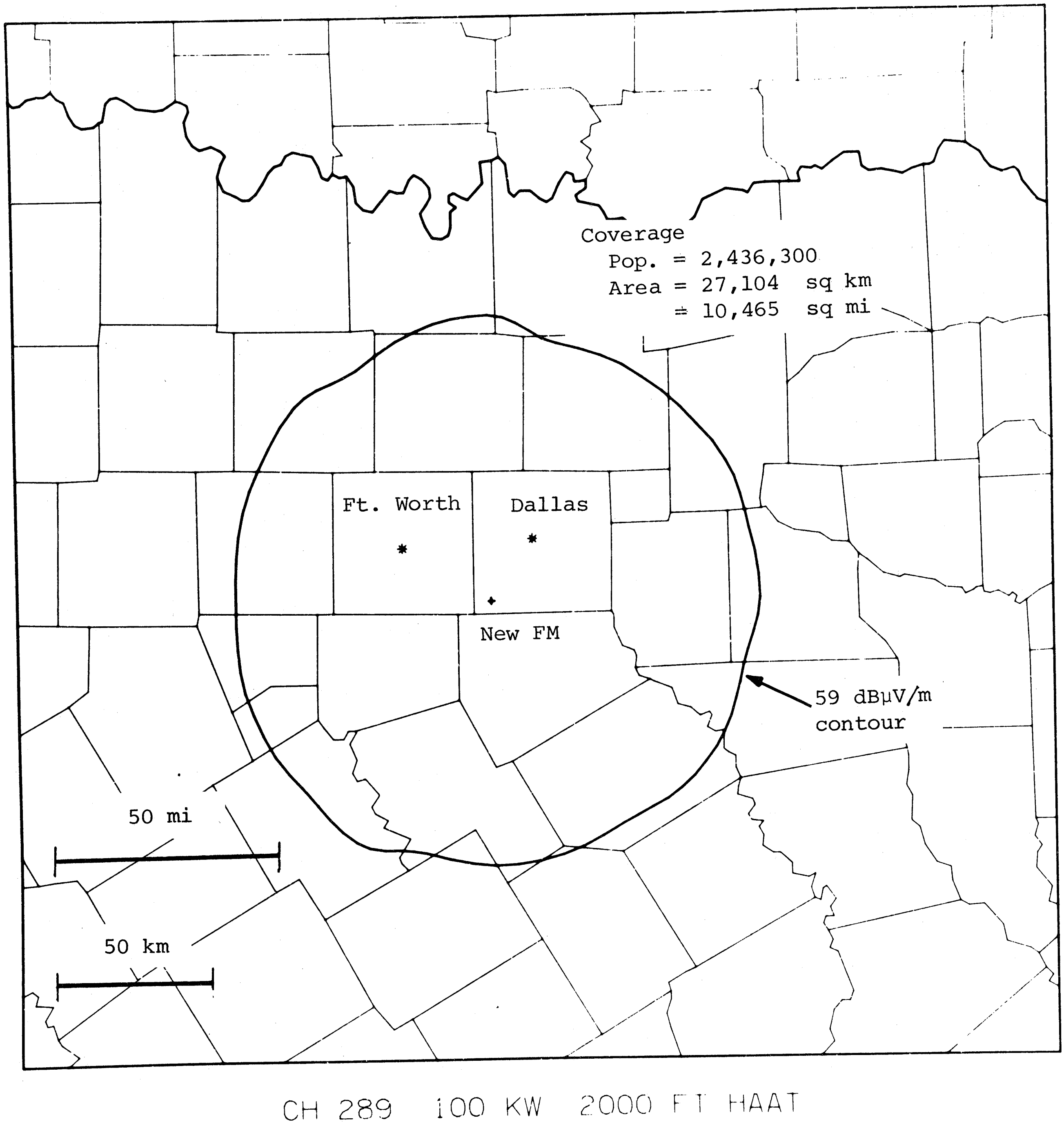



Figure 5-4. Signal coverage from a 2,000-ft HAAT facility.

When we consider the effects of interference, we will require the desired signal to be available for 50 percent of the locations and for 50 percent of the time; the undesired signal normally will be computed to be available for 50 percent of the locations and for 10 percent of the time. These statistics are long-term (signal levels averaged over time periods of one hour or greater) as opposed to short-term (instantaneous or moment-to-moment signal levels). Normally the interfering signal arrives at the receiver along different paths than does the desired signal. By choosing F(50,10) statistics for the undesired signal and F(50,50) statistics for the desired signal, we bias the results to provide more protection to the desired signal.*

If the desired signal source and the potential interference source are co-located, then their signals will follow essentially the same paths to the receiver. Therefore, these signals will be correlated and it does not make sense to consider different long-term statistics for the desired and undesired signals.

Thus, for those facilities that we propose to co-locate with other facilities at existing antenna sites, the desired-to-undesired ratio (D/U) will be assumed to be the same as the ratio of the two facilities' effective radiated power (ERP); e.g., if the desired signal's ERP is 100 kW (20 dBk) and the undesired signal's ERP is 3 kW (4.8 dBk) then we will assume the D/U ratio will be 15.2 dB at all locations.

Next we consider the effects of interference on the protected service areas when the stations are not co-located. This can be demonstrated by choosing a range of D/U ratios and then computing the resultant effect on the coverage area and population. In this example the desired station is KDNT (100 kW, 480 ft HAAT) located to the northwest of Dallas and the undesired station is a proposed second adjacent channel facility (say, 100 kW, 480 ft HAAT) located at the existing antenna farm southwest of Dallas. We will choose a series of D/U ratios from +10 to -50 dB; the results are plotted as shown in Figure 5-5. The "V" symbol indicates the desired station's location

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*Note that no analytical methods exist to reliably estimate what these statistics mean in terms of FM performance as determined by the listener. (We cannot say what fraction of the time interference will occur in what fraction of the locations <u>given</u> that the desired signal exceeds its threshold).

and the solid line indicates the 59 dB V/m desired signal contour. The "I" symbol indicates the interferer's location. The dashed line shows the specified D/U ratio contour, again using the techniques described by Hufford (1977). All of the area within the solid contour is to be protected; however, the shaded region indicates where the interference exceeds the specified D/U threshold. In the shaded region, the interference presumably is unacceptable. The coverage area and population numbers given on the plots refer to the values computed to be within the solid line, i.e., the service contour. The interference area and population numbers refer to the shaded region where interference is defined to be unacceptable.

For the 0 dB plot, if the desired signal and undesired signal statistics had been the same (e.g., both F(50,50)) then we would have expected a straight line for the interference contour separating the two facilities. Instead the contour tends to curve around the desired station at the ends of the contour. That happens because the F(50,10) field strength exceeds the F(50,50) field strength at distances greater than 10 miles from the stations. Note that the D/U = -10 dB contour tends to be a straight line separating the acceptable and unacceptable interference regions. This is because the F(50,10) signal levels exceed the F(50,50) levels by an amount in the neighborhood of 10 dB.

One objective of Figure 5-5 is to show graphically how the population and area affected by interference are reduced as the second-adjacent-channel interference threshold is reduced. The specific results shown in Figure 5-5 are unique to the chosen situation but, in general, we would expect these trends to apply. The benefits of changes in some characteristics, such as interference threshold, are demonstrated by the characteristic's affect on service area and population.

### 5.4.3 Alternatives for Proposed Facilities

In this section we will provide some possible facility characteristics for the proposed assignments given in Table 5-5. All of the assignments will be made to cover the Dallas-Ft. Worth region, although in practice we probably would want some of the stations to cover surrounding communities. To keep the interference to manageable and acceptable levels, we will co-locate (wherever it is feasible) the facilities with existing second- and third-adjacent-channel transmitters and we will use directional antennas for the proposed

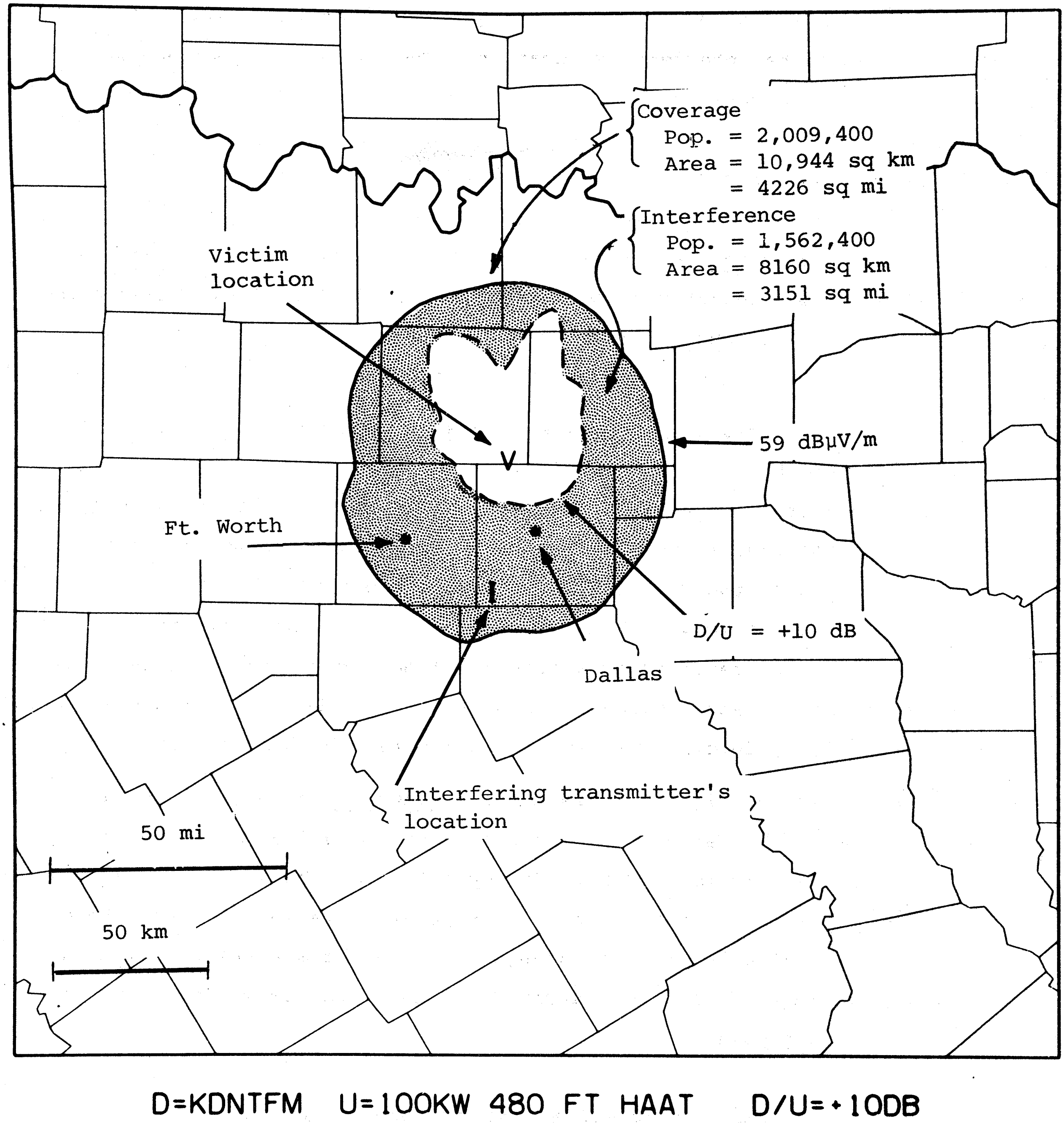



Figure 5-5a. Coverage and interference contours with a +10 dB D/U ratio.

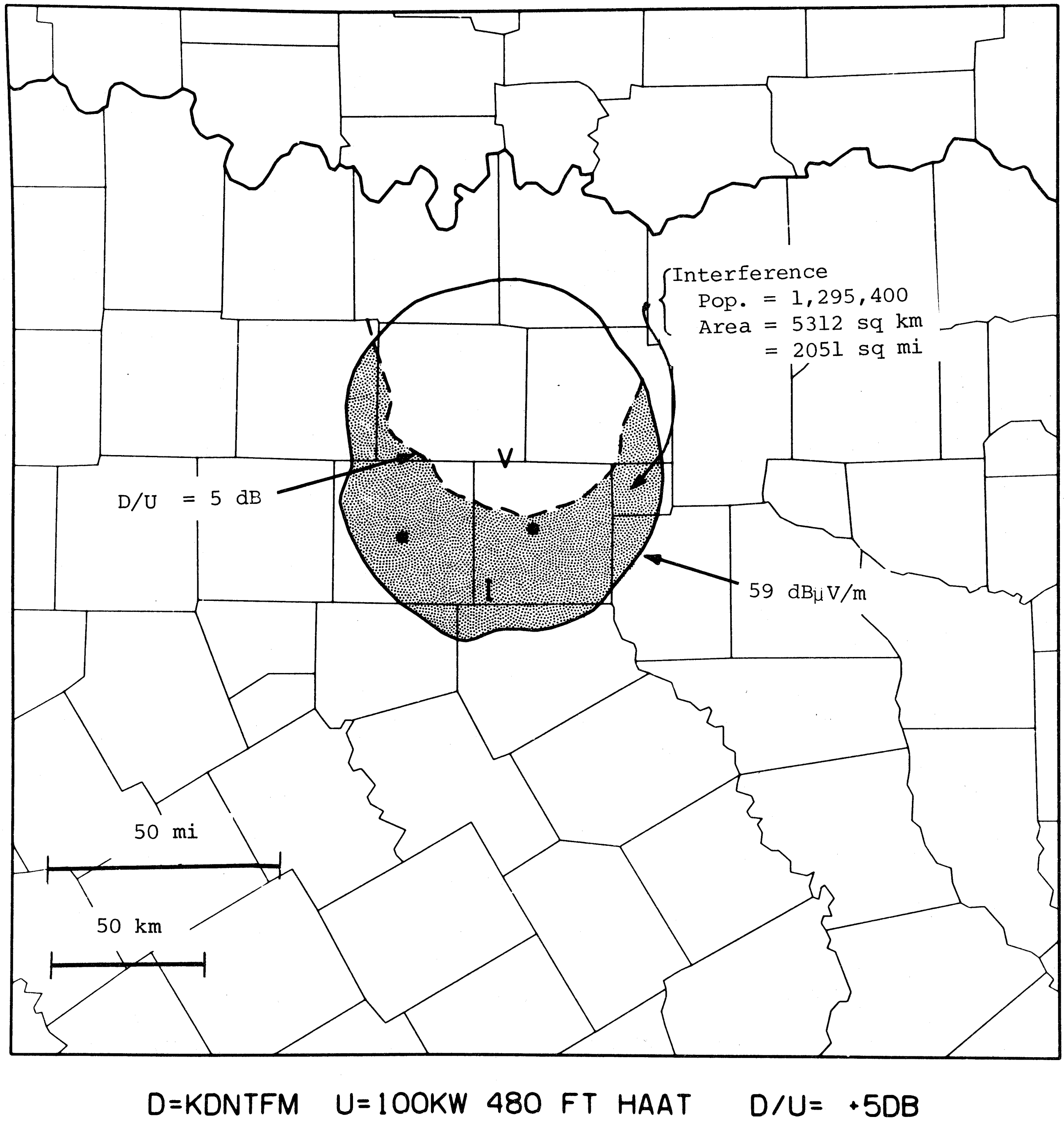



Figure 5-5b. Coverage and interference contours with a +5 dB D/U ratio.

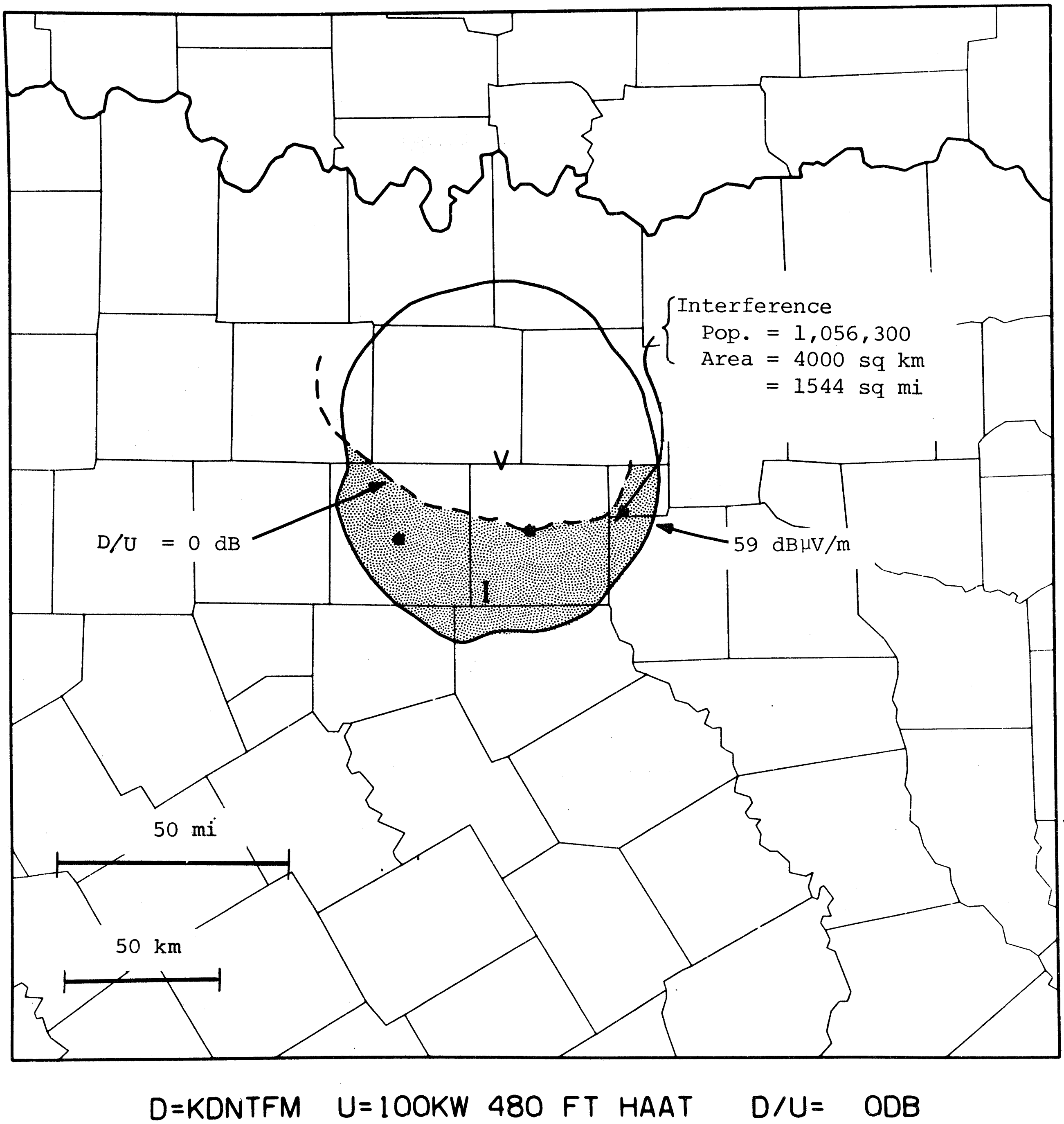



Figure 5-5c. Coverage and interference contours with a 0 dB D/U ratio.

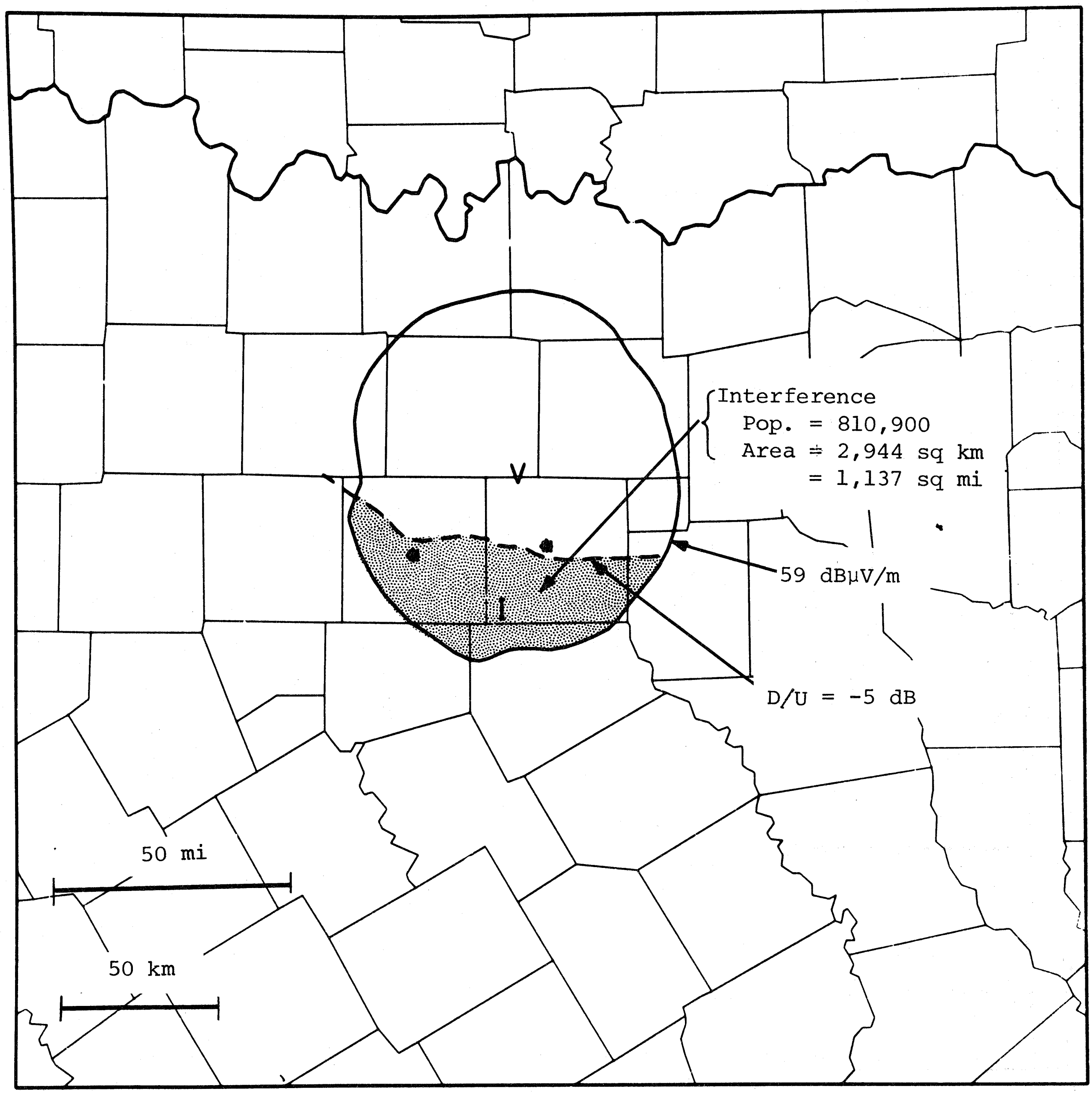



Figure 5-5d. Coverage and interference contours with a -5 dB D/U ratio.

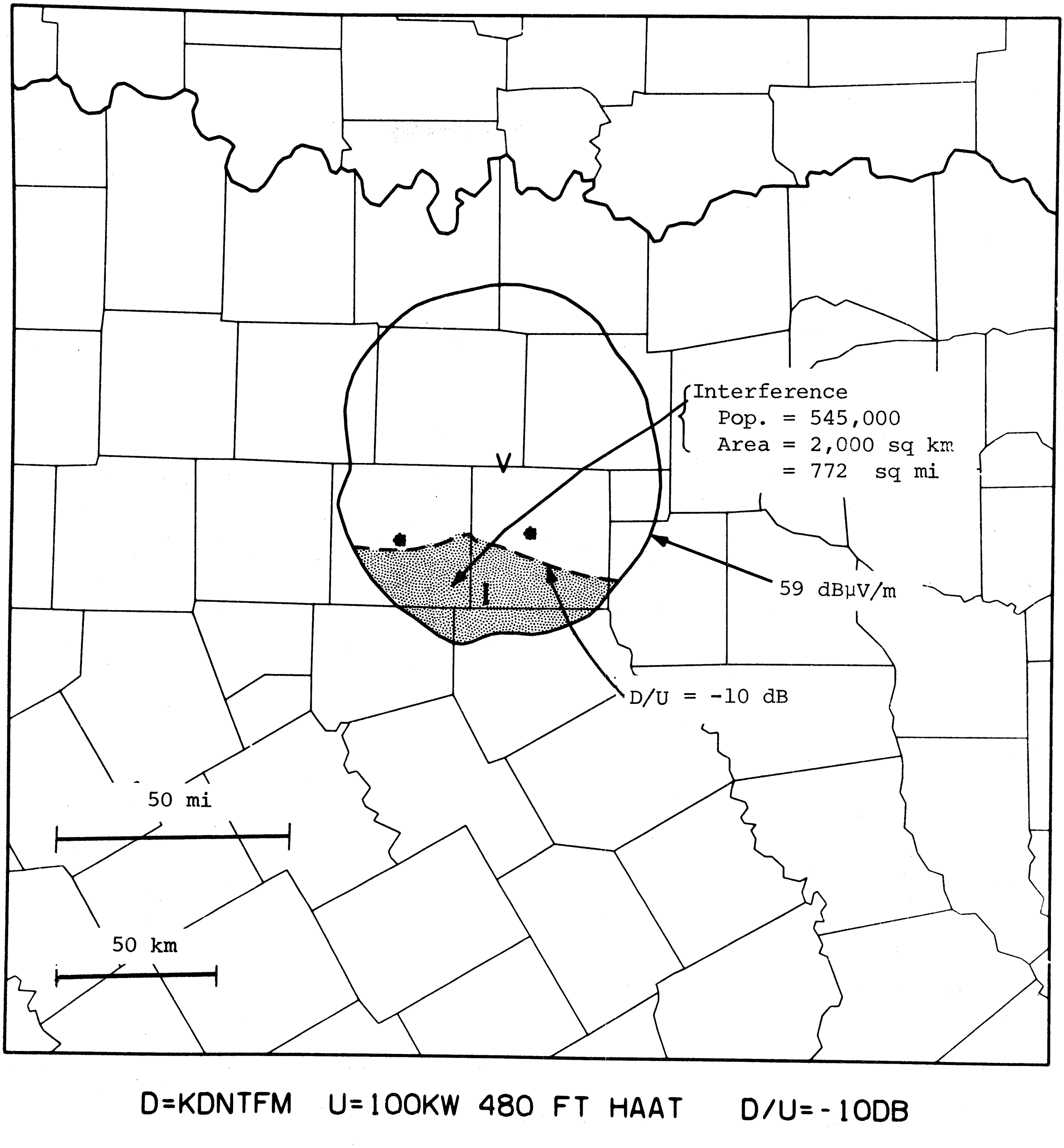



Figure 5-5e. Coverage and interference contours with a -10 dB D/U ratio.

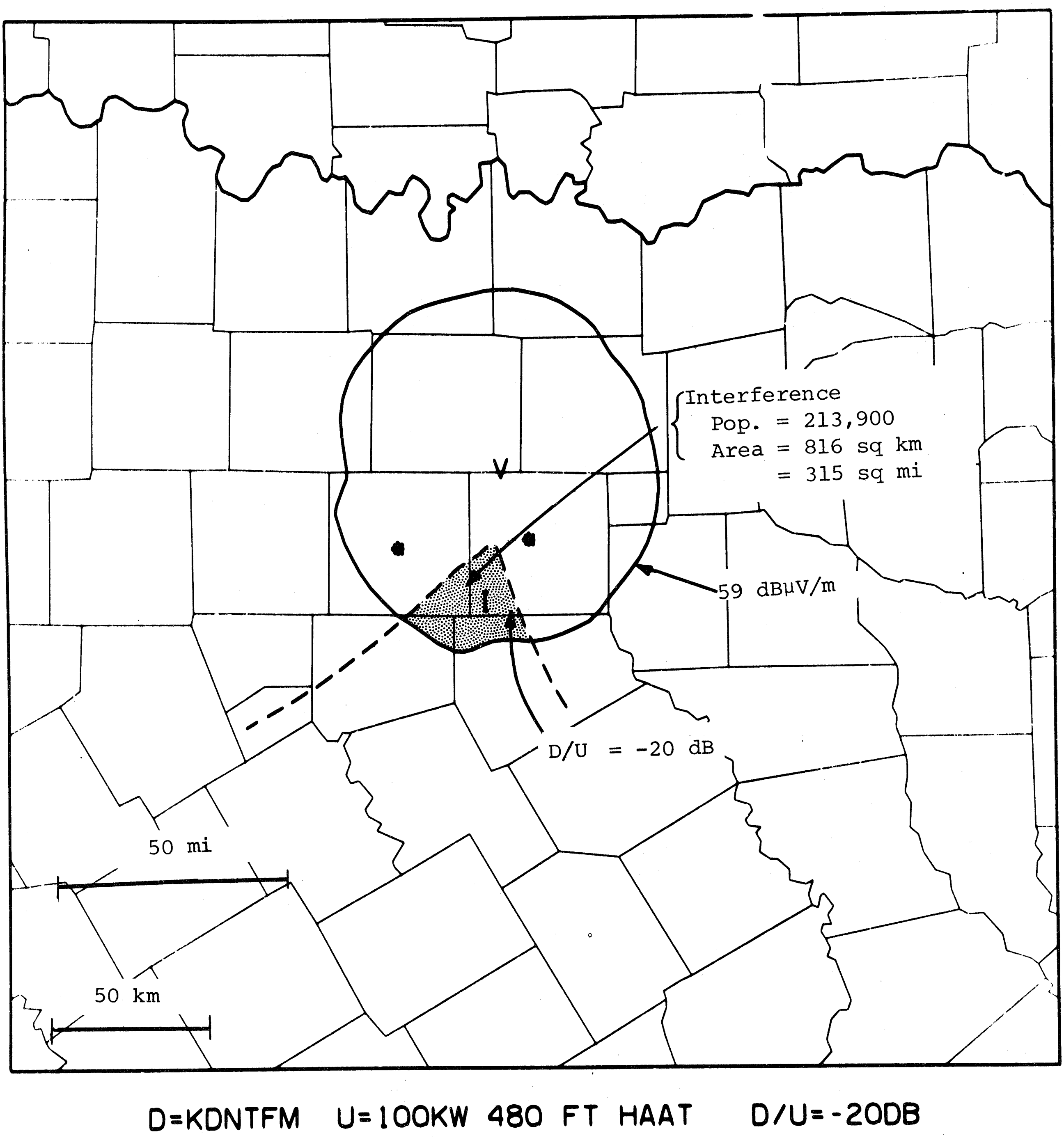



Figure 5-5f. Coverage and interference contours with a -20 dB D/U ratio.

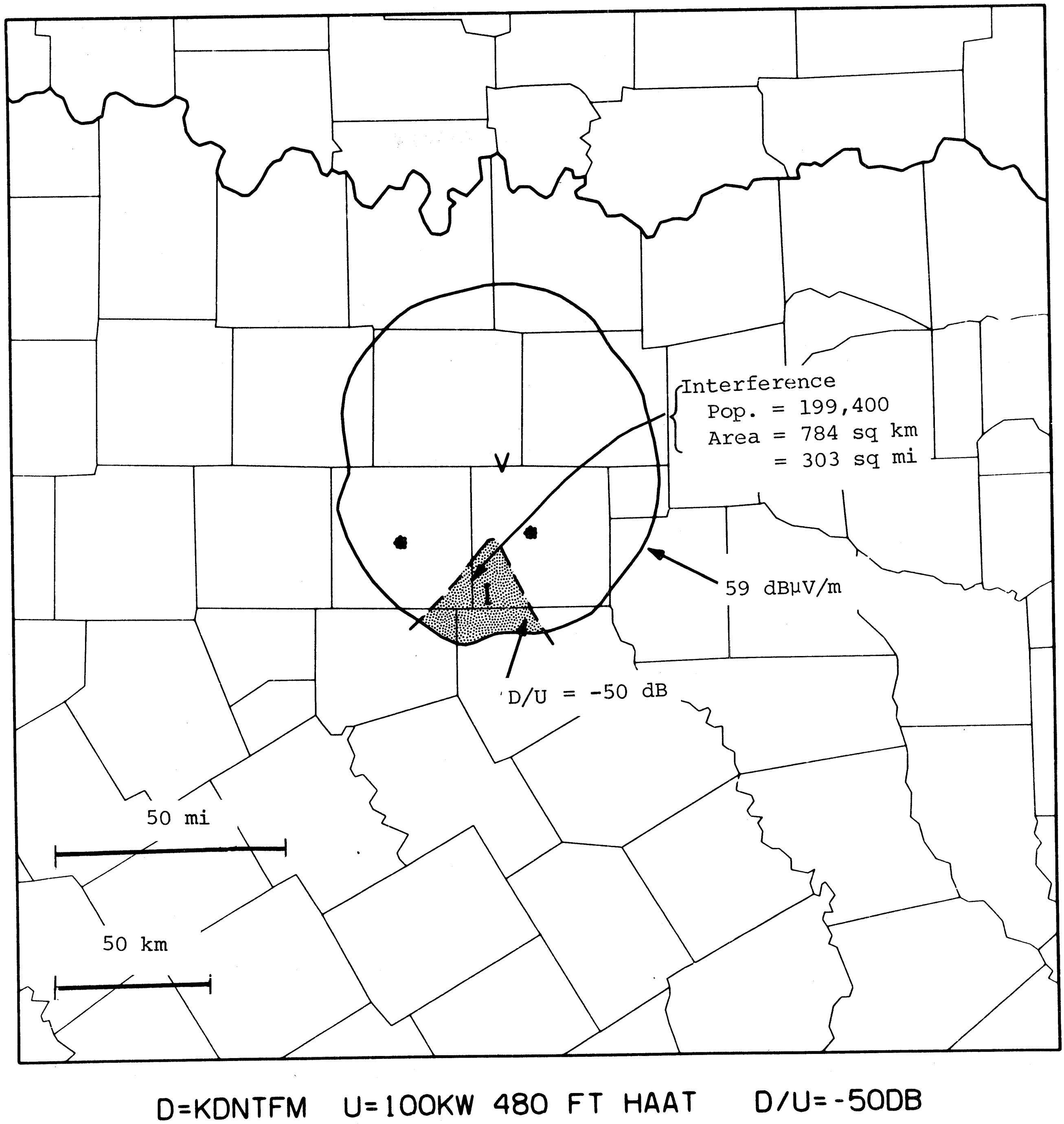



Figure 5-5g. Coverage and interference contours with a -50 dB D/U ratio.

facilities. Finally, we will adjust transmitter power, antenna height, and the directional pattern to give acceptable levels of coverage and interference. When we compute the interference contours, we will plot both sets of interference thresholds as given in Table 5-4; i.e., plots will be given with the current interference thresholds and plots will be given with the proposed interference thresholds.

For this study when directional antennas are used to reduce interference effects, we will utilize one of three simple dipole arrays for demonstration. Directional antenna 1 is a single dipole with a reflector to give the pattern shown in Figure 5-6. Directional antenna 2 has two dipoles, with reflectors, offset 90 degrees to give the second pattern shown in Figure 5-6. Finally, directional antenna 3 has two dipoles, with reflectors, offset 120 degrees to give the third pattern. Of course, there are many other patterns that are possible and could be used in place of these three.

The first proposed assignment will be on channel 209 with potential interference to a co-channel station (KGCC) and an adjacent channel station (KSHU). Figure 5-7 shows the coverage from the proposed facility, a 20-kW, 500-ft-HAAT transmitter with an omni-directional antenna. Figure 5-8 shows the coverage by, and the interference to, the existing stations. The upper solid contour shows the coverage from station KGCC to a population of 107,600 people and an area of 4768 sq km or 1841 sq mi The dashed contour (D/U = 20 dB) shows the interference region with a population of 15,500 and an interference area of 864 sq km or 110 sq mi Figure 5-9 shows the interference region if the co-channel interference exists at a D/U = 14 dB instead of 20 dB; the interference region has a population of 6200 and an area of 368 sq km or 142 sq mi.

Figure 5-10 shows the proposed facility's coverage if a directional antenna with pattern number 1 is used. An alternative to using a directional antenna would be to merely reduce the power and antenna height of the proposed facility until the interference regions in Figure 5-8 or 5-9 disappeared. However, this also would result in a significant reduction in the area and population covered by the proposed facility. The directional antenna provides to us a means of reducing the signal in the directions where potential interference may occur, while maintaining the full signal strength (of an equivalent omni-directional antenna) in those directions where interference is

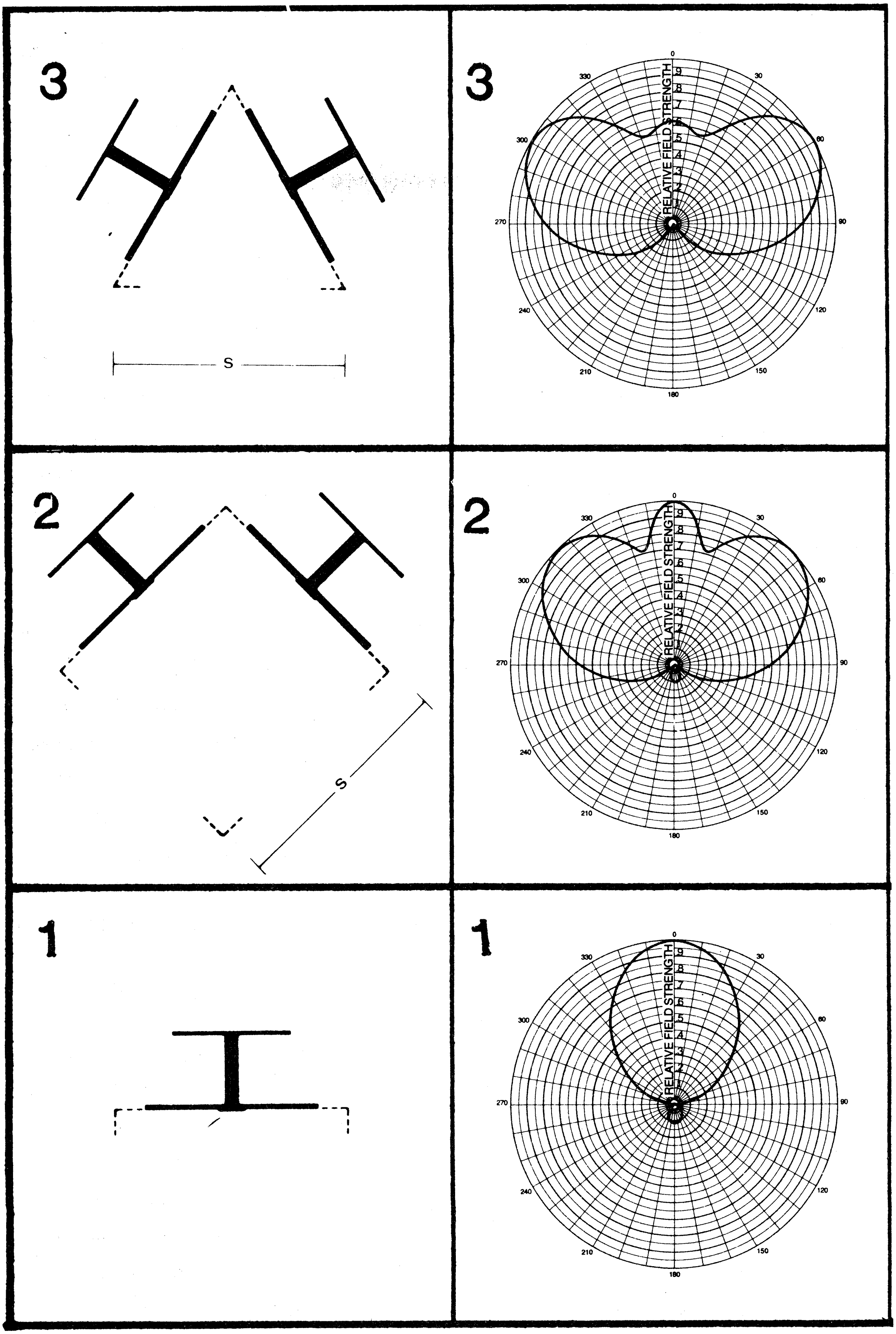



Figure 5-6. Commercial directional antennas and patterns for FM broadcast band. Patterns are shown on a voltage scale.

not likely to occur. Figures 5-11 and 5-12 show the corresponding coverage by, and the interference to, the existing stations. Using the directional antenna and the new criteria for interference (D/U = +14 dB for co-channel interference and D/U = -50 dB for second-adjacent-channel interference), Figure 5-12 shows there is no unacceptable interference to the existing stations from the proposed channel 209 station. Note that the proposed channel 209 transmitter is co-sited with the existing facility on channel 207. We will want to co-site as many of the following proposed facilities as is possible in order to control the interference areas.

The assignment on channel 209 is only the first of those proposed in Table 5-5. The corresponding plots showing coverage and interference for the other proposed assignments are given in Appendix B. As with the channel 209 assignment, the Appendix B plots show the interference areas when both sets of interference thresholds from Table 5-4 are used.

Table 5-7 summarizes the information given in Appendix B. From Table 5-5 we recall that nearly every proposed assignment has two second-adjacent-channel stations already existing in Dallas-Ft. Worth. In eleven cases, the proposed facility was co-sited with both of its second-adjacent-channel transmitters. In the remaining eleven cases, the proposed facility was co-sited with only one of its second-adjacent-channel transmitters; of these eleven proposed assignments, five had to be abandoned because too much of the Dallas-Ft. Worth area and population were predicted to receive second-adjacent-channel interference above the desired threshold (see Figure B-16, for example). Thus, seventeen new assignments could be available to Dallas-Ft. Worth with facilities having ERP's from 20 kW to 100 kW and antenna HAAT's from 500 ft to 1500 ft. Twelve of the seventeen new assignments need directional antennas in order to operate at the suggested facilities and eight would require a change in the receiver S/I thresholds to operate at the suggested facilities.

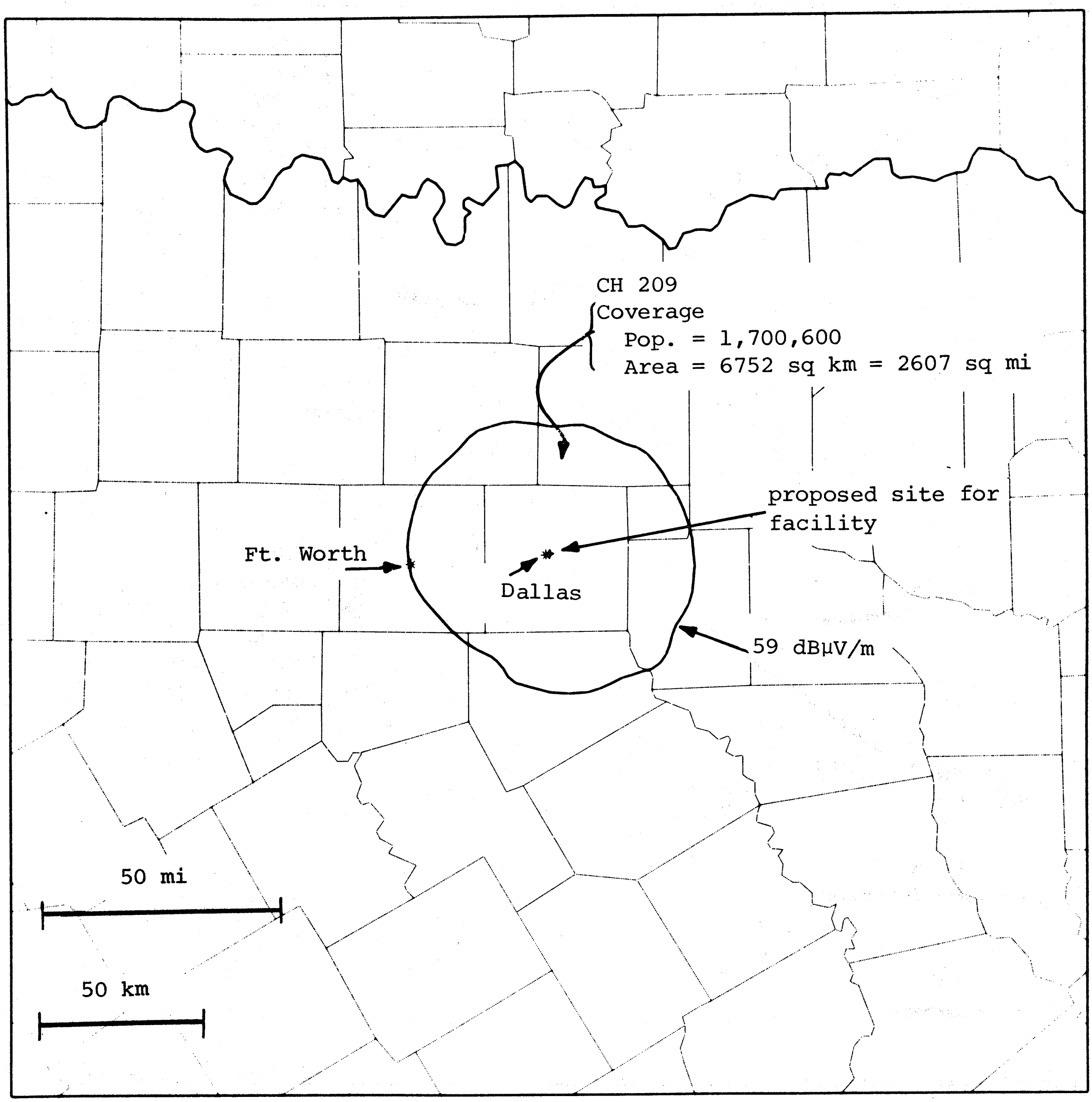
## 6. CONCLUSIONS

An examination of the background on the FM broadcast spectrum capacity has uncovered some reasons why today's major markets are "saturated":

1. the FCC rules were developed around good quality receivers of the late 50's technology,

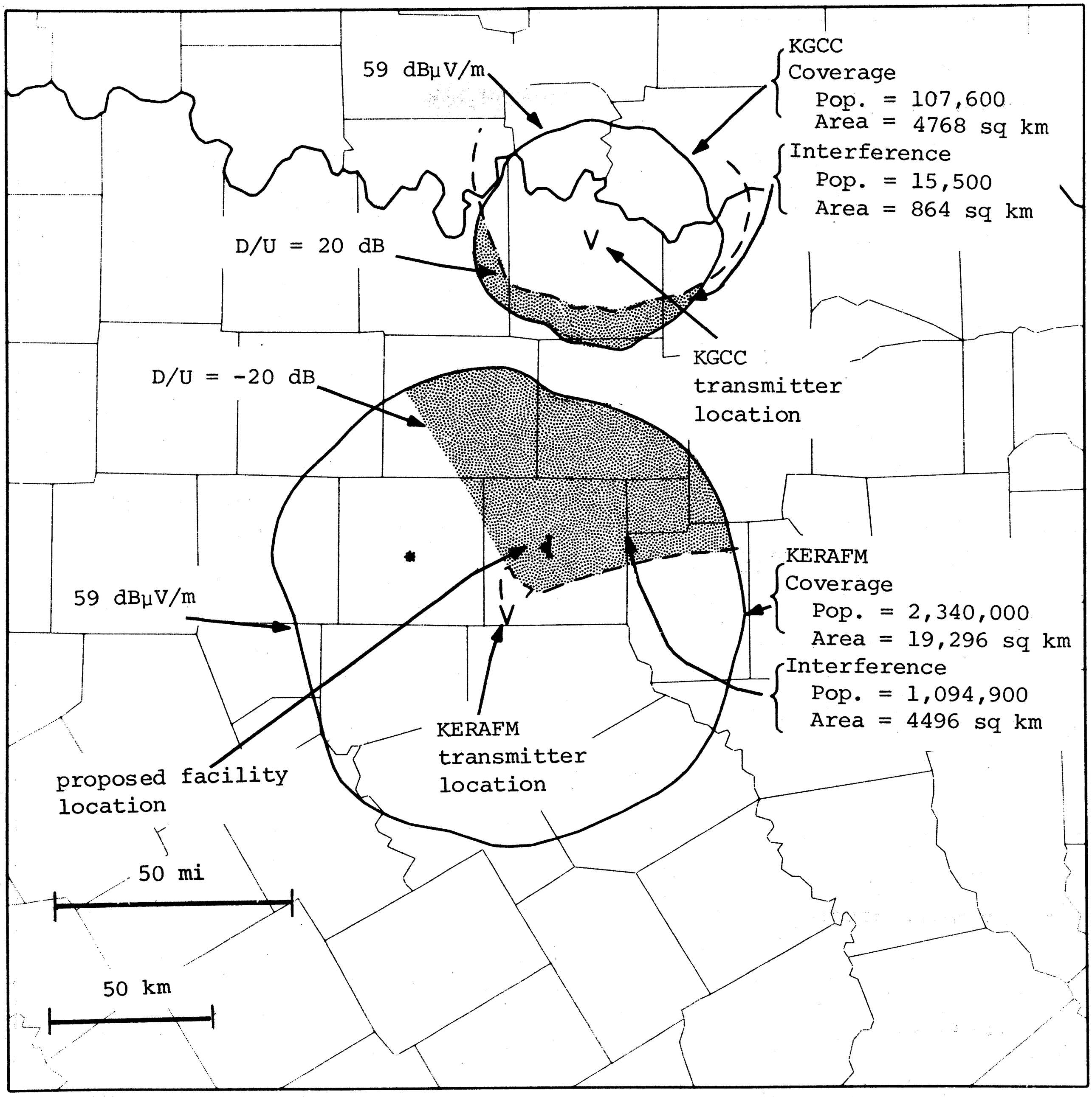
Table 5-7. Proposed Facilities for Potential FM Stations in Dallas-Ft. Worth

| Channel Number | Power ERP (kW) | Antenna Height (ft HAAT) | Directional Antenna Pattern No. | Co-located with 2nd Adjacent Channel Transmitters | Requires New S/I Receiver Thresholds |
|---|---|---|---|---|---|
| 209 | 20 | 500 | 1 | yes | yes |
| 213 | 100 | 1500 | none | yes | no |
| 217 | 100 | 1500 | 2 | yes | no |
| 221 | 100 | 1500 | 2 | yes | yes |
| 225 | 100 | 1500 | 1 | yes | yes |
| 228 | 100 | 1500 | 3 | yes | no |
| 232 | Unavailable; too much 2nd adjacent-channel interference in Dallas-Ft. Worth | | | | |
| 239 | Unavailable; too much 2nd adjacent-channel interference in Dallas-Ft. Worth | | | | |
| 244 | 20 | 500 | 2 | yes | no |
| 248 | 100 | 1500 | 3 | yes | yes |
| 252 | Unavailable; too much 2nd adjacent-channel interference in Dallas-Ft. Worth | | | | |
| 256 | 100 | 500 | none | yes | no |
| 260 | 100 | 1500 | 1 | yes | yes |
| 264 | 100 | 500 | 3 | yes | yes |
| 268 | 100 | 1500 | 3 | yes | yes |
| 273 | 100 | 1500 | 3 | yes | no |
| 277 | 100 | 1500 | 1 | yes | no |
| 281 | Unavailable; too much 2nd adjacent-channel interference in Dallas-Ft. Worth | | | | |
| 285 | 100 | 1500 | none | yes | yes |
| 289 | Unavailable; too much 2nd adjacent-channel interference in Dallas-Ft. Worth | | | | |
| 294 | 100 | 1500 | none | yes | no |
| 298 | 20 | 1500 | none | yes | no |



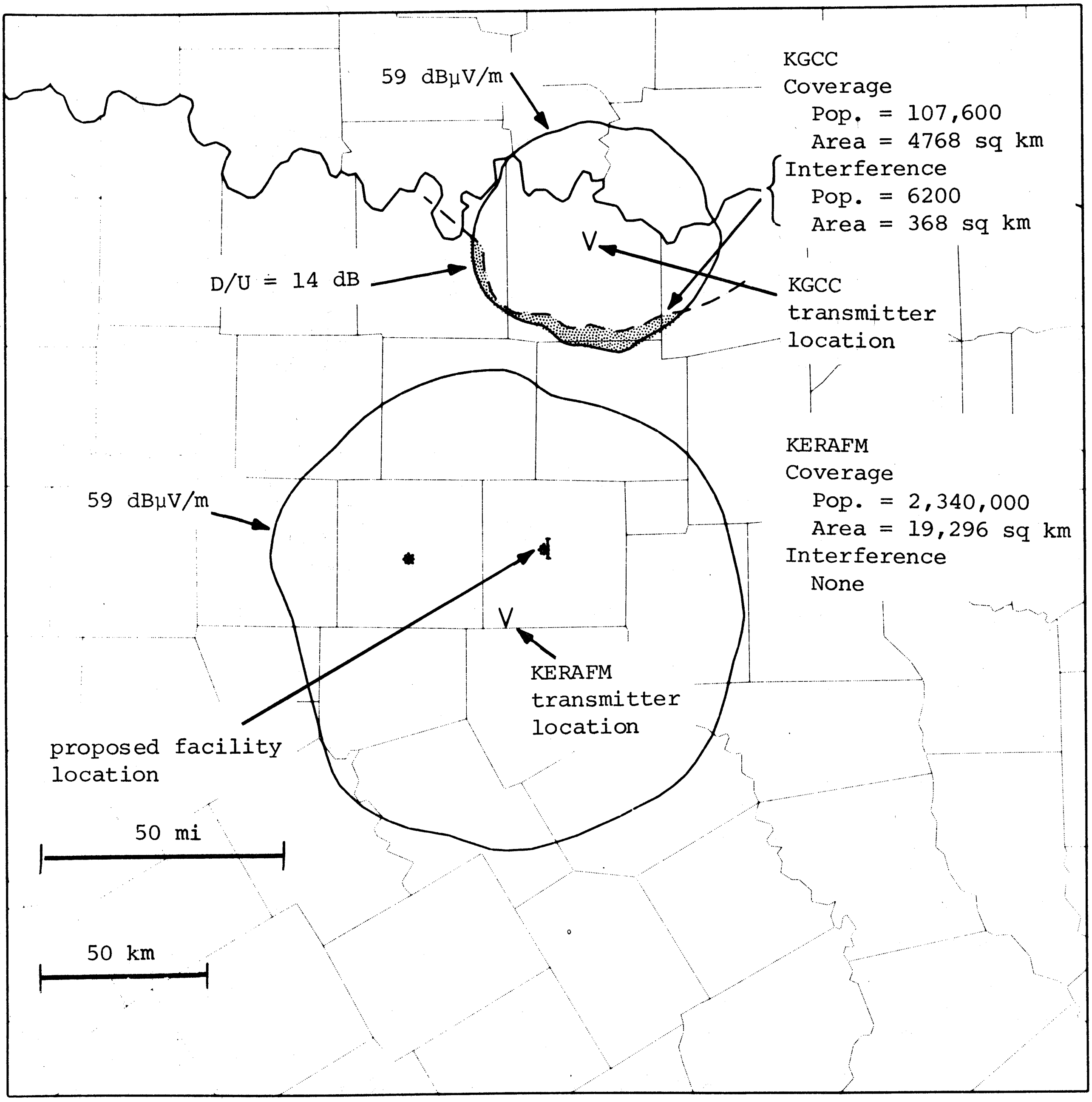

CH 209 20KW 500FT HAAT

Figure 5-7. Proposed channel 209 coverage.



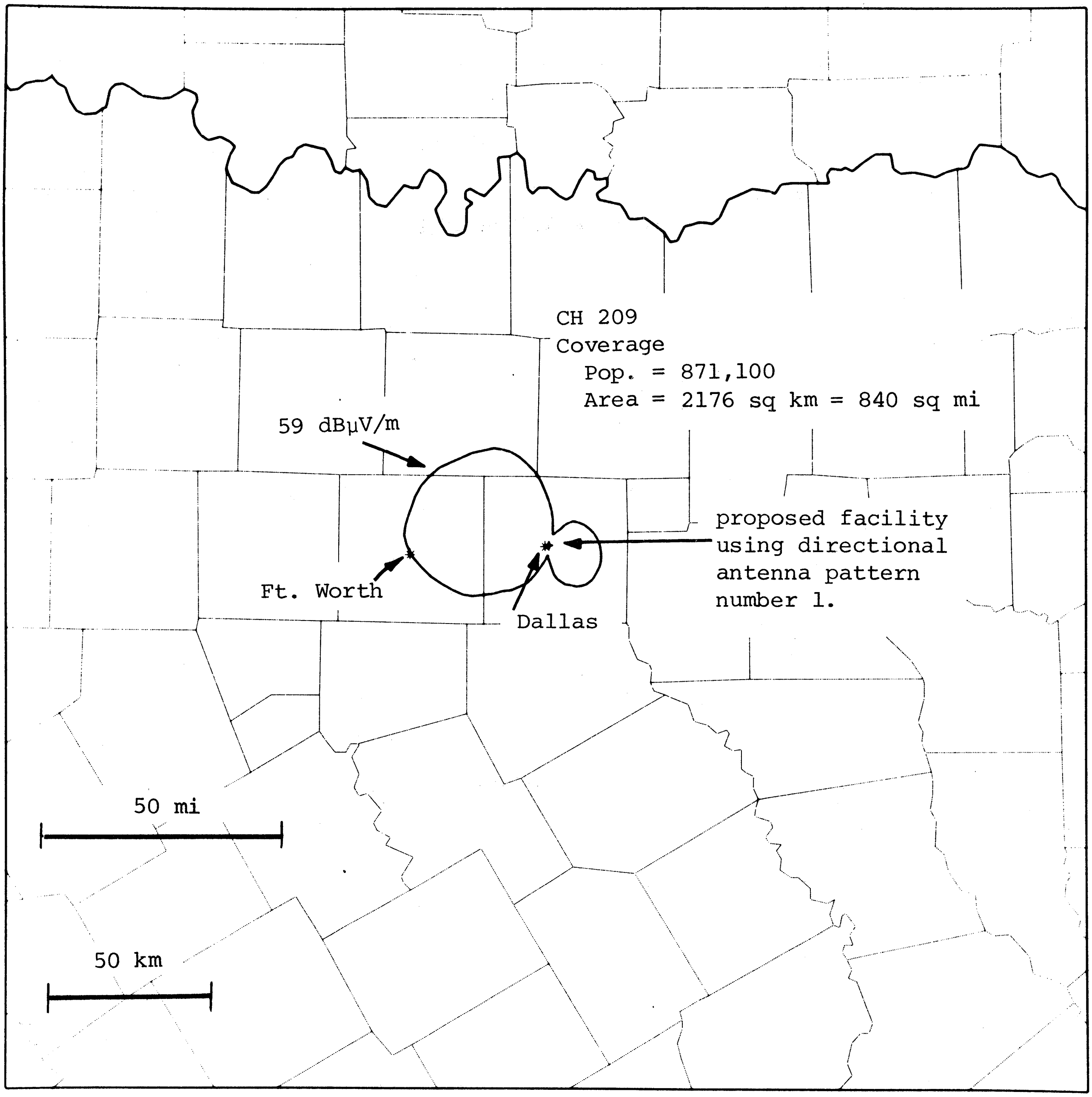

D=CH209 KGCC CH211 KERAFM U=20KW 500FT CH 209 D/U=20,-20DB

Figure 5-8. Existing stations' coverage and interference, existing protection standards.




D=CH209 KGCC CH211 KERAFM U=20KW 500FT CH 209 D/U=14,-50DB

Figure 5-9. Existing stations' coverage and interference, new protection standards.




CH 209 20KW 500FT HAAT DIR ANT PAT 1

Figure 5-10. Proposed channel 209 coverage with directional antenna.

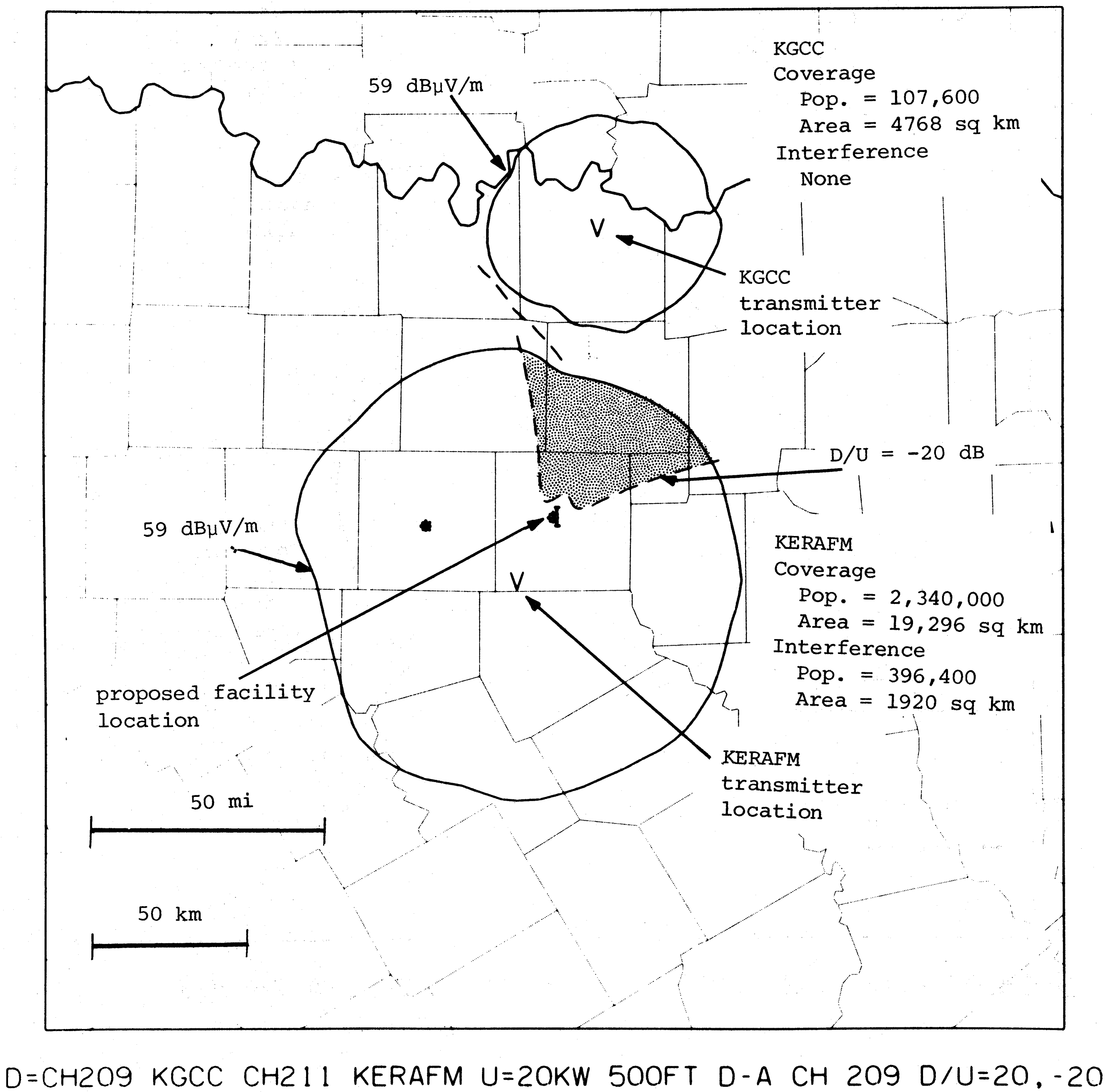
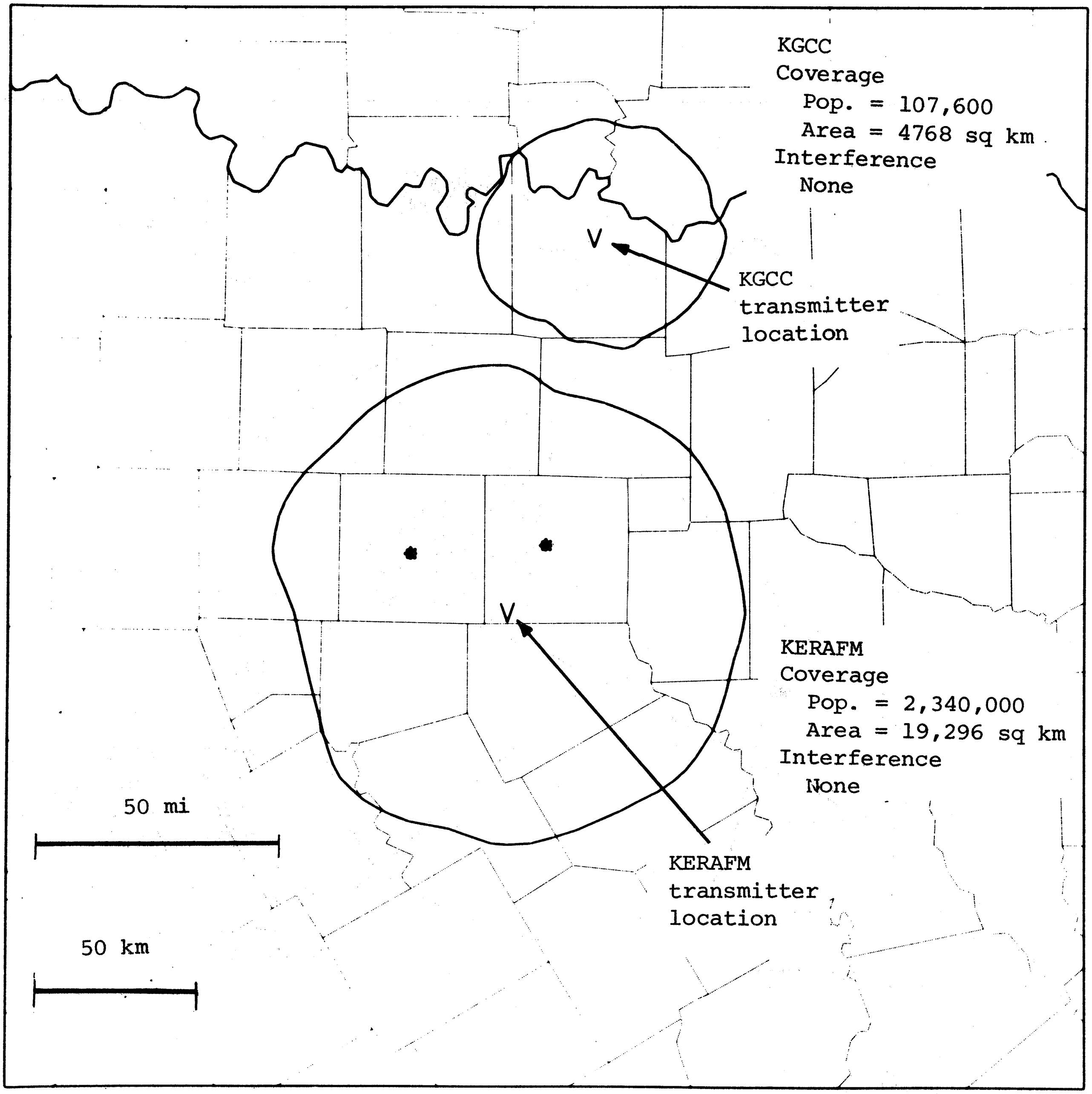



Figure 5-11. Interference with existing protection standards and directional antenna.




D=CH209 KGCC CH211 KERAFM U=20KW 500FT D-A CH 209 D/U=14,-5C

Figure 5-12. Interference with new protection standards and directional antenna.

2. the rules assumed that all stations eventually would have the maximum facilities allowed for their class,

3. the rules disallowed the use of terrain-dependent propagation algorithms, and

4. the rules disallowed the use of directional antennas for assignment purposes.

Using these and other guidelines, the FCC adopted a Table of Assignments for FM broadcast stations based on minimum mileage separations between transmitters. As a consequence, there are at most 25 out of a possible 100 channels assigned in any one location, when the FCC rules are strictly followed.

In this report, we have selected one of the ten most-saturated FM broadcast markets and have demonstrated what we believe are reasonable methods for increasing that market's number of FM stations. In particular, we have shown that the number of FM stations operating in the Dallas-Ft. Worth region could be increased from the present 21 stations to 38 stations. This was accomplished by using existing facilities rather than maximum facilities, co-siting of second- and third-adjacent channel transmitters with existing transmitters, terrain-dependent propagation algorithms, and directional antenna patterns when required and/or otherwise helpful.

## 7. RECOMMENDATIONS

We make several recommendations regarding the FM broadcast band:

1. the FCC should use techniques such as shown in this report to easily examine new applications for coverage and interference,

2. the effects of terrain should be included in the prediction of signal coverage and interference (although terrain did not have a significant influence in the relatively flat Dallas-Ft. Worth area),

3. directional antennas should be allowed,

4. co-siting of second- and third-adjacent-channel transmitters with existing transmitters should be encouraged,

5. service area protection should be granted to stations based upon their present (or seriously proposed) facilities rather than protection to the maximum facility allowable for the station's class, and finally,

6. the FM broadcast receiver protection standards should be developed around current good quality receivers.

We believe that if these recommendations were adopted, the number of FM stations could be increased significantly in almost all markets.

## 8. REFERENCES


FCC (1962), Revision of FM broadcast rules, Docket No. 14185, First Report and Order.

FCC (1963), Revision of FM broadcast rules, Docket No. 14185, Third Report, Memorandum Opinion and Order.

FCC (1979), Deregulation of radio, Docket No. 79-219, Notice of Inquiry and Proposed Rule Making.

Hufford, G.A. (1977), Techniques for the evaluation of proposed VHF TV drop-ins, OT Report 77-112, NTIS Access. No. PB 271212/AS.

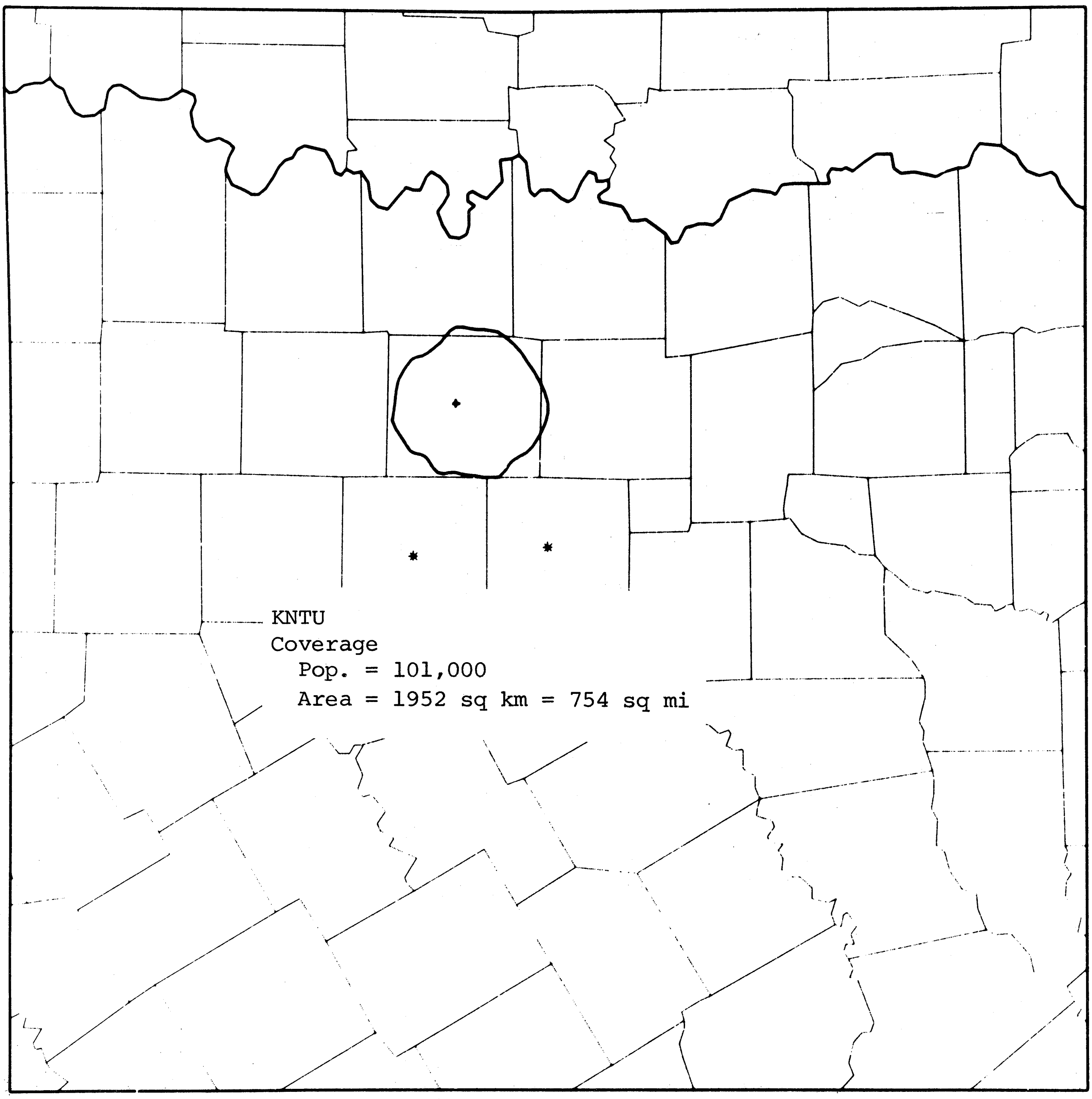
NTIA (1979), Revision of FM broadcast rules, petition for rulemaking, submitted to the FCC.

Quadracast Systems, Inc. (1979), Comments to the FCC further notice of inquiry on quadraphonic broadcasting, FCC Docket 21310.

# APPENDIX A

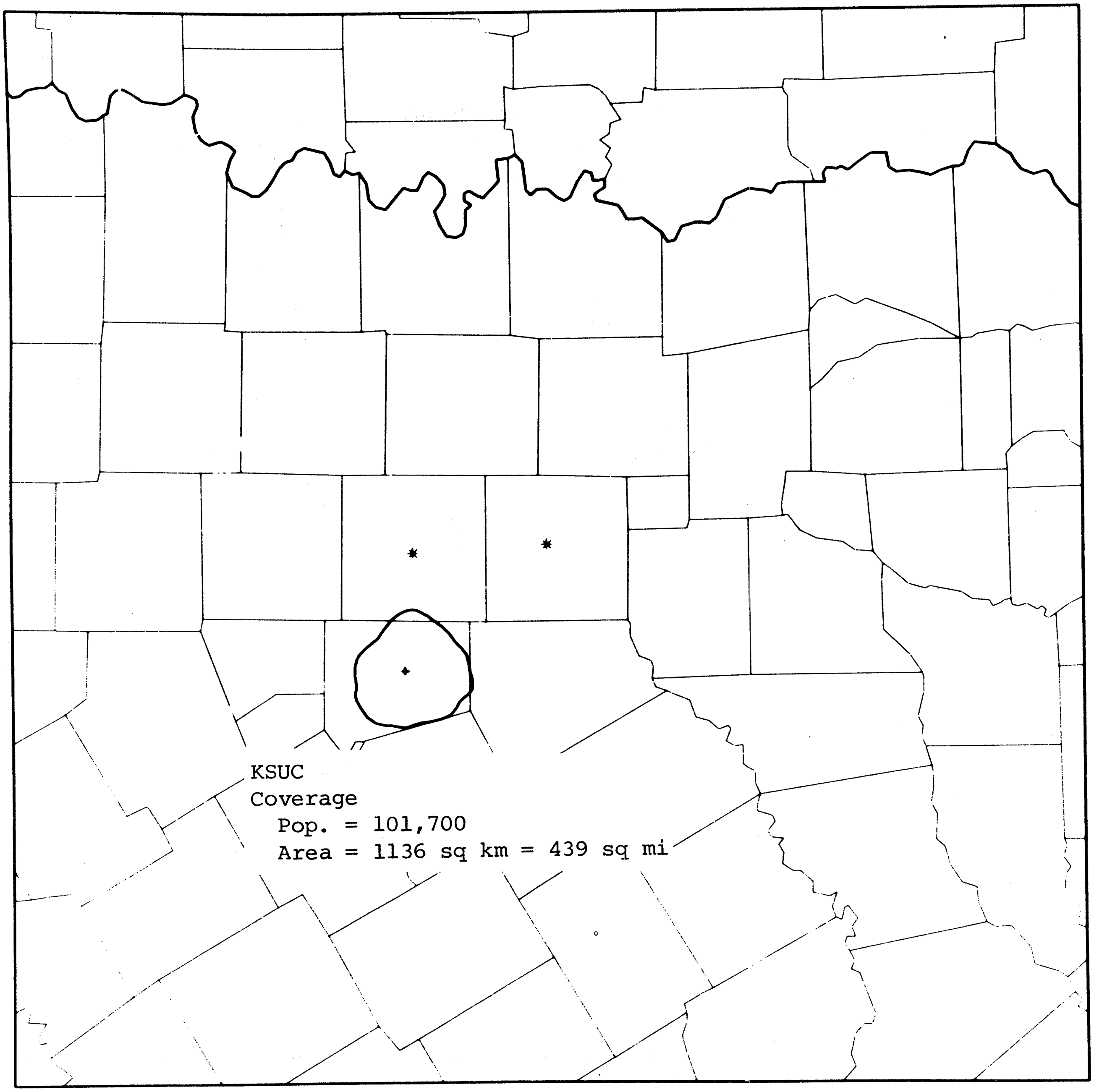
## COVERAGE PLOTS OF EXISTING STATIONS

The 59 dBµV/M contours of Figures A-1 through A-25 are for the existing FM broadcast Stations within 40 miles of Dallas reference location. The two asterisk symbols indicate the locations of Dallas and Ft. Worth. The plus symbol indicates the location of the transmitters. The 59 dBµV/m is plotted on each figure and was computed using the terrain effects and propagation model as described by Hufford (1977). The population within the contour was computed by the method also described by Hufford (1977).



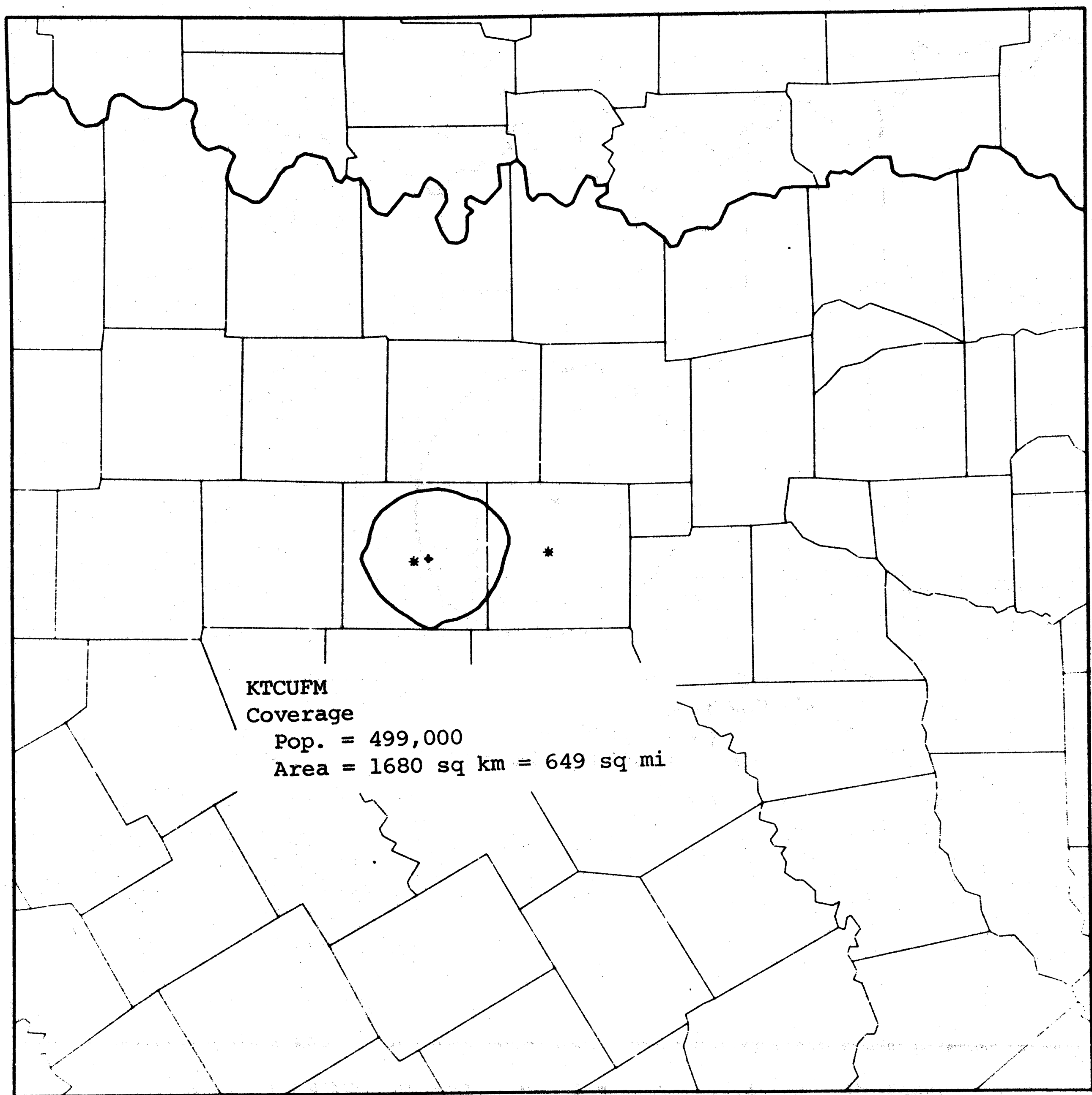

CH201 KNTU DENTON TX 17KW 136FT HAAT

Figure A-1. Channel 201.



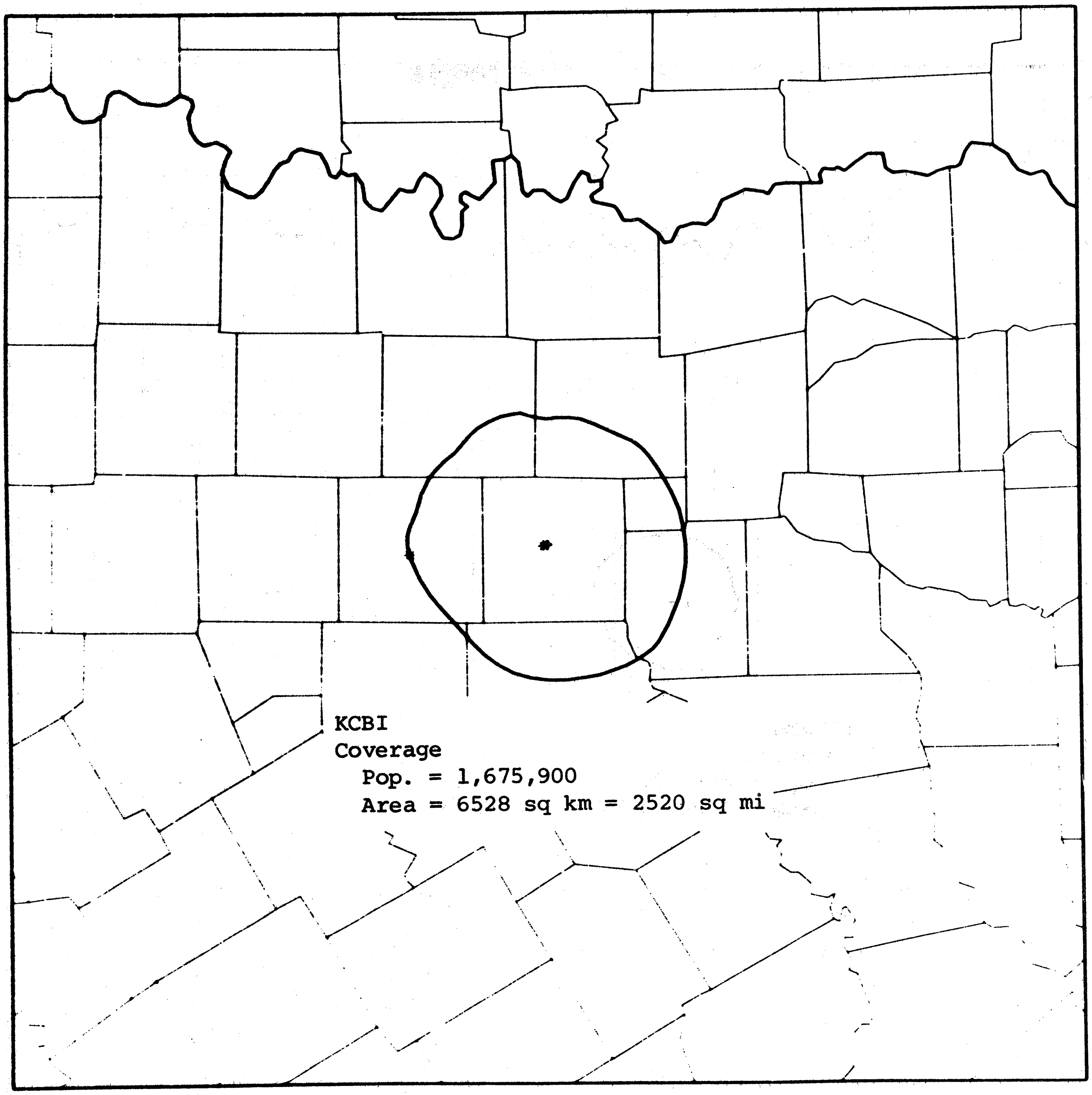

CH202 KSUC KEENE TX 2KW 235FT HAAT

Figure A-2. Channel 202.




CH204 KTCUFM FT. WORTH TX 3KW 300FT HAAT

Figure A-3. Channel 204.




CH207 KCBI DALLAS TX 10KW 655FT HAAT

Figure A-4. Channel 207.

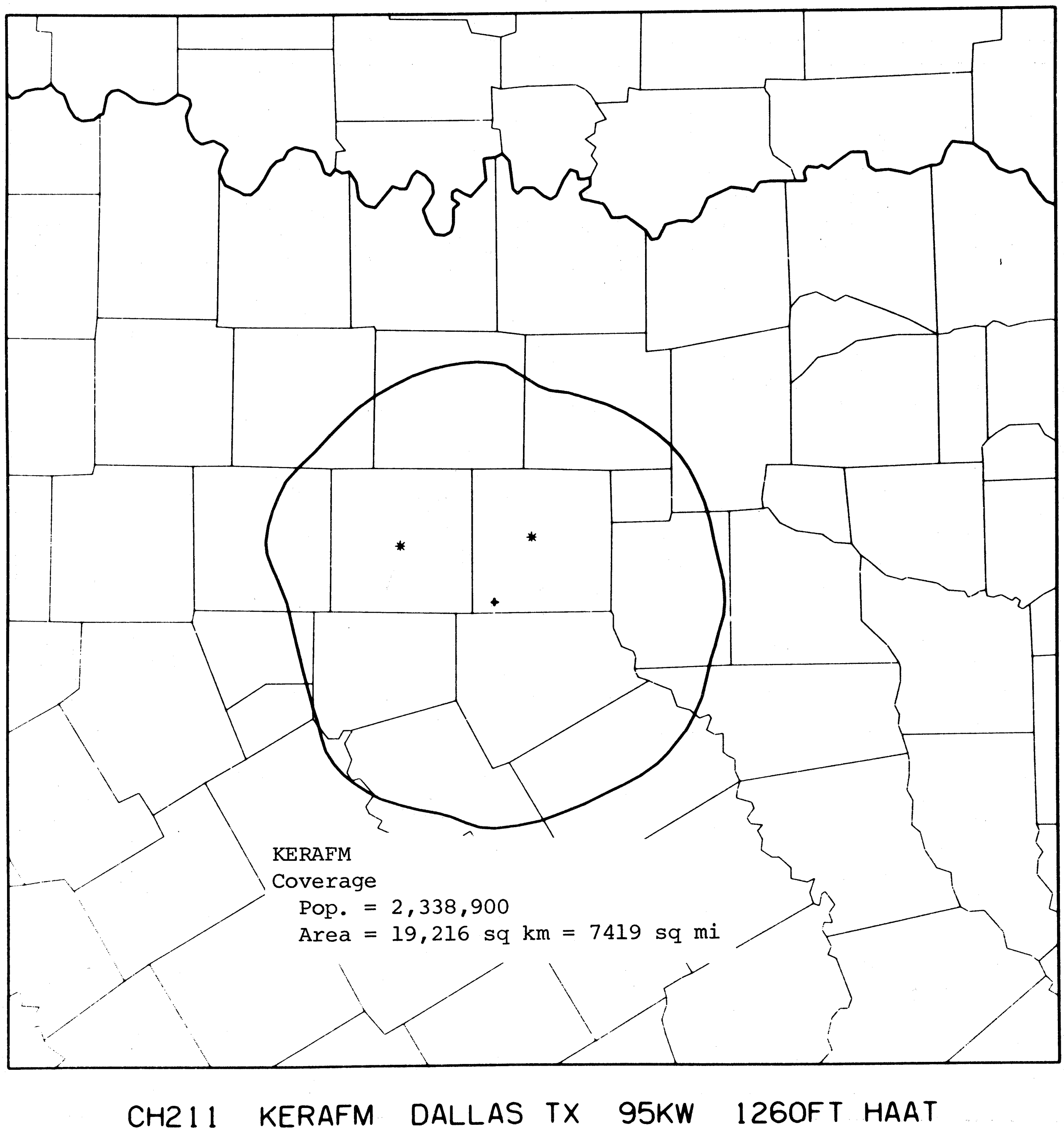



Figure A-5. Channel 211.

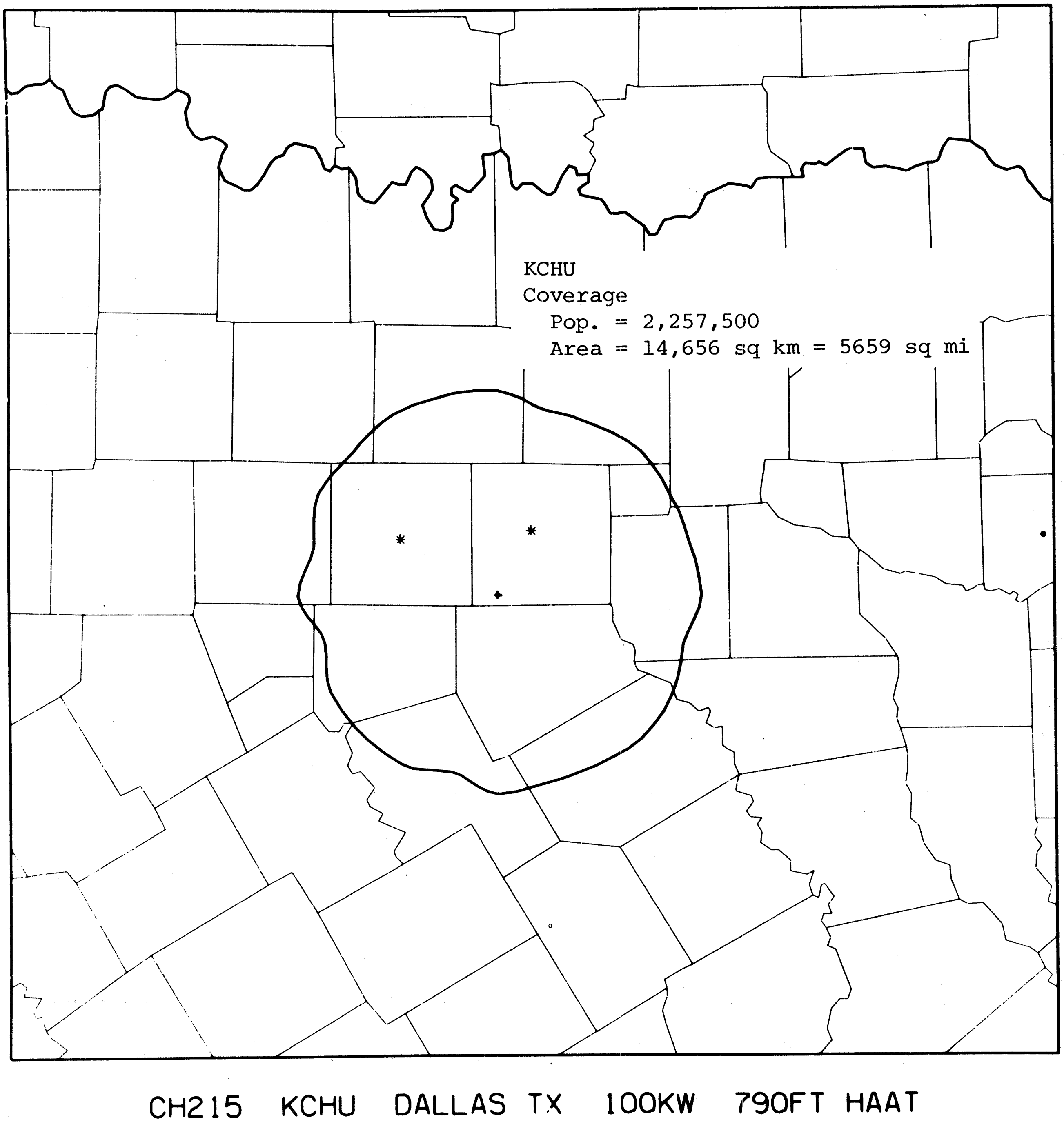



Figure A-6. Channel 215.

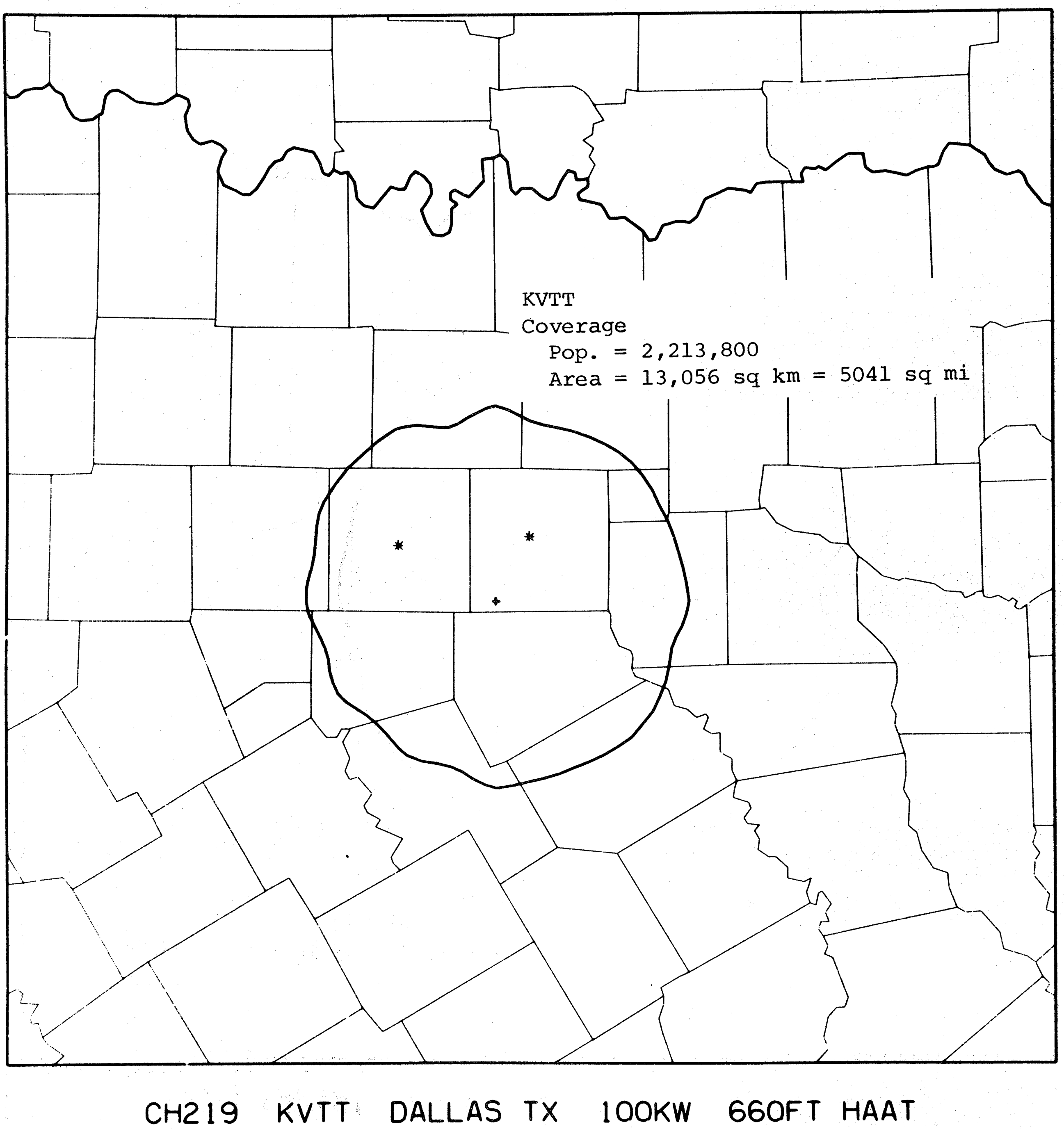



Figure A-7. Channel 219.

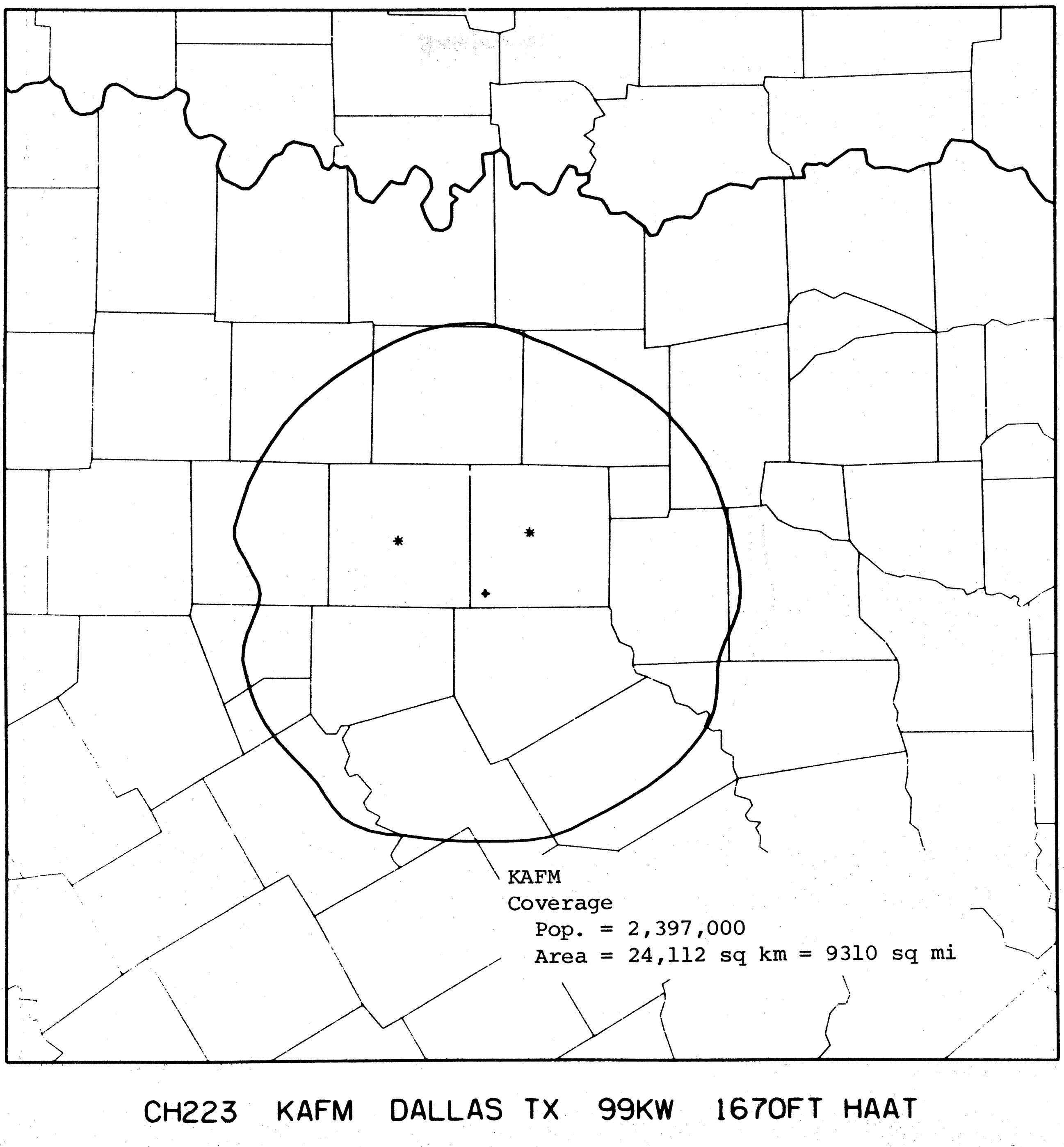



Figure A-8. Channel 223.

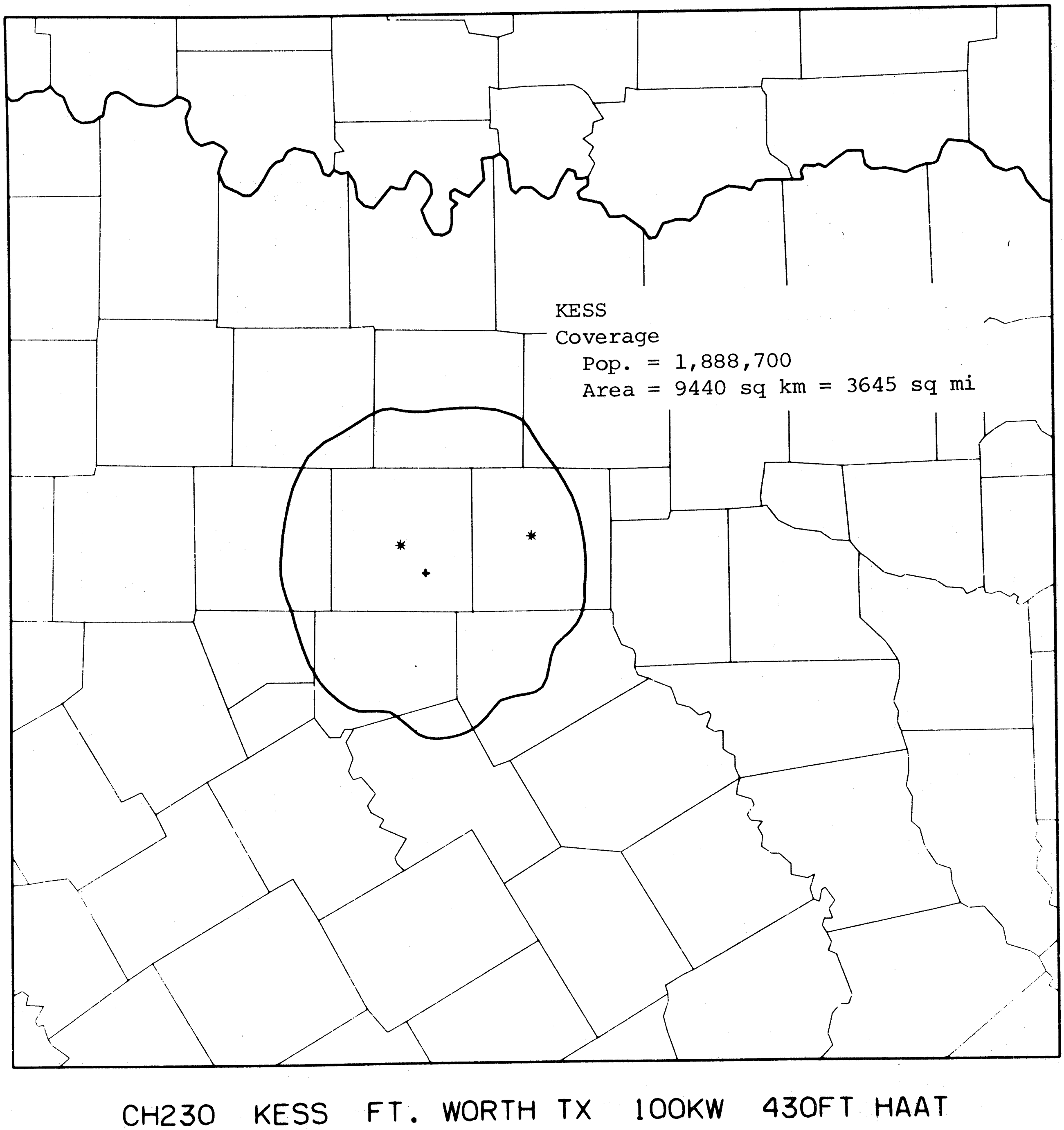
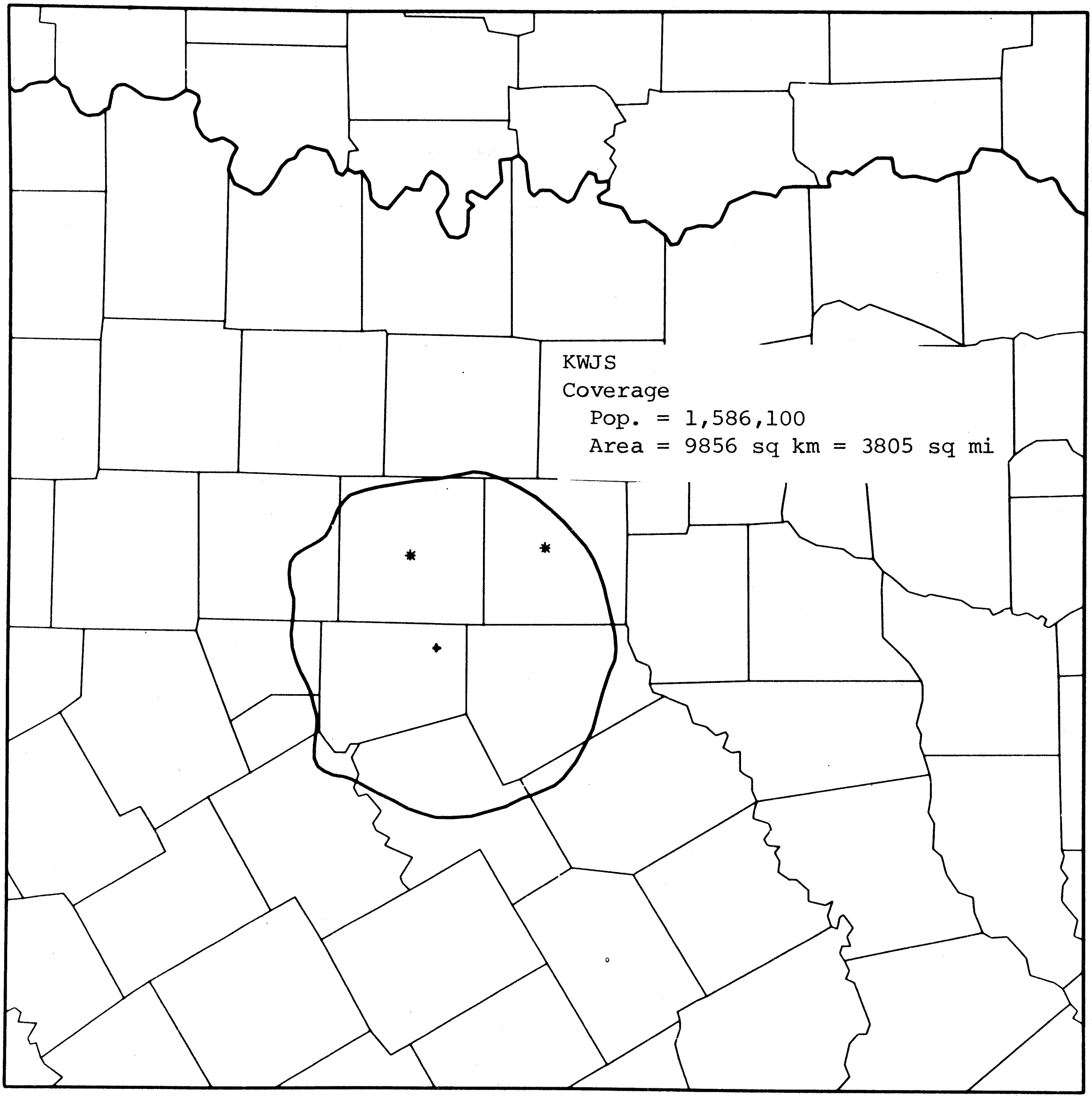
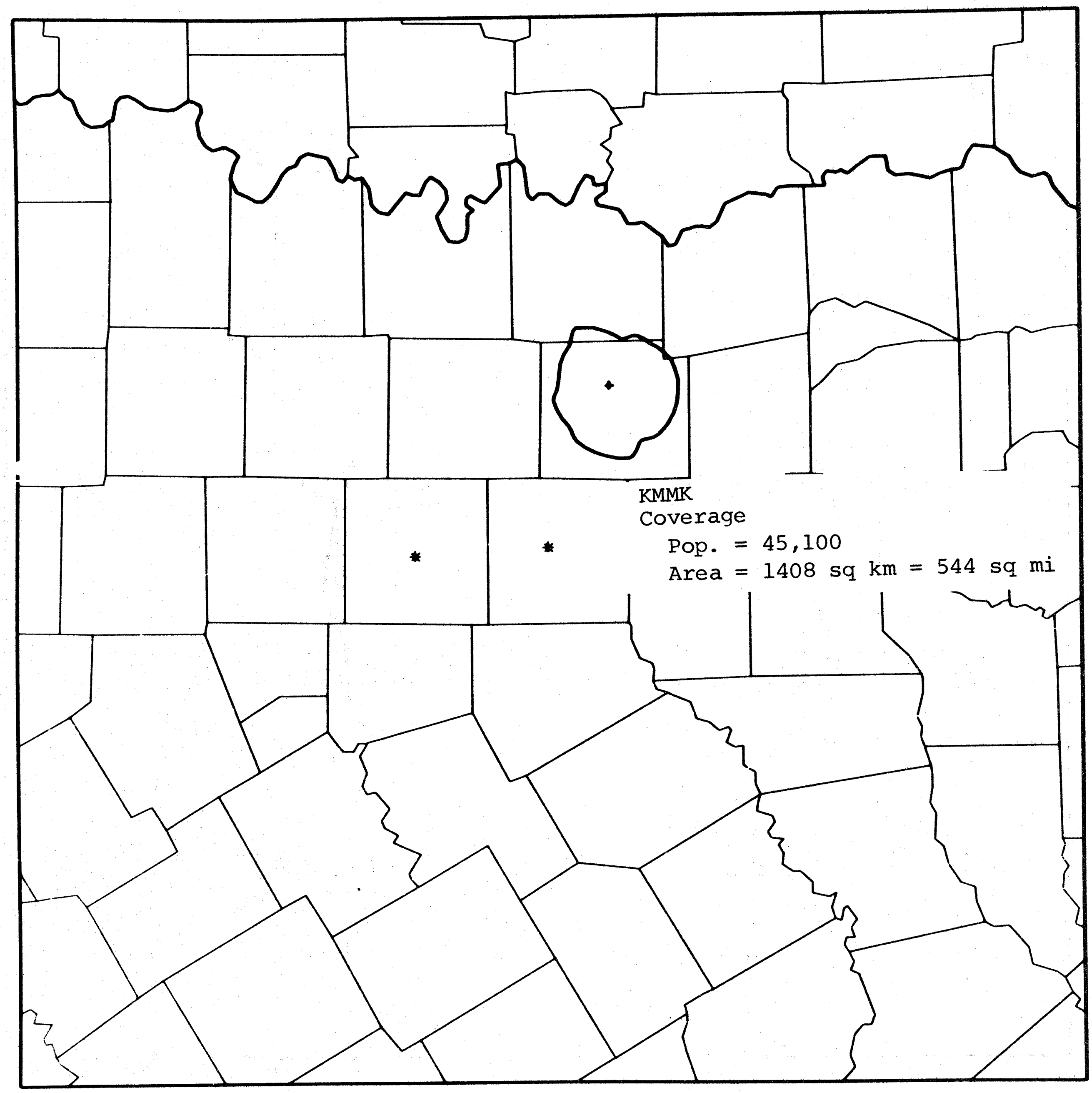



Figure A-9. Channel 230.



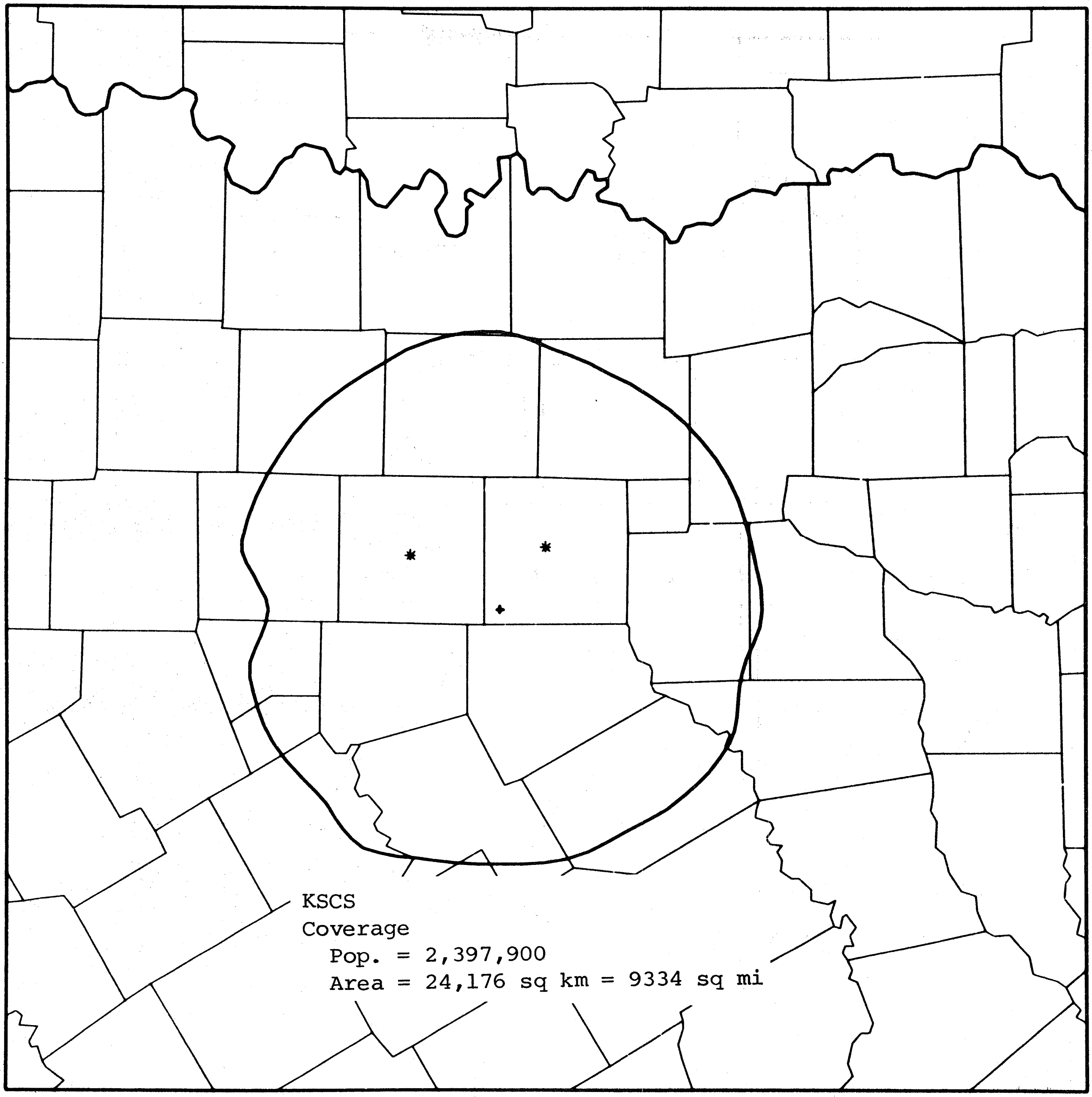

CH235 KWJS ARLINGTON TX 100KW 453FT HAAT

Figure A-10. Channel 235.




CH237 KMMK MCKINNEY TX 3KW 215FT HAAT

Figure A-11. Channel 237.




CH242 KSCS FT. WORTH TX 99KW 1680FT HAAT

Figure A-12. Channel 242.

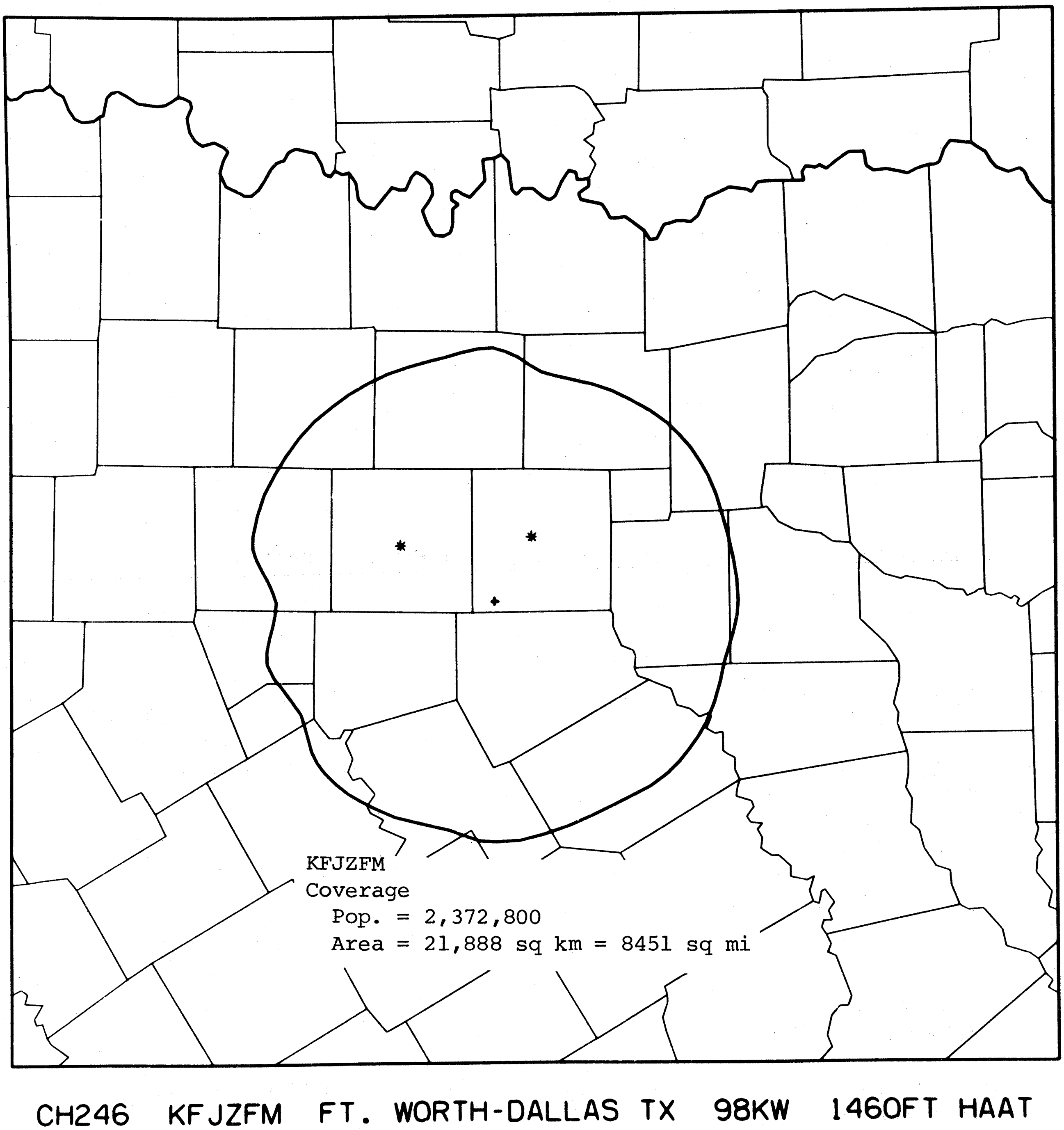



Figure A-13. Channel 246.

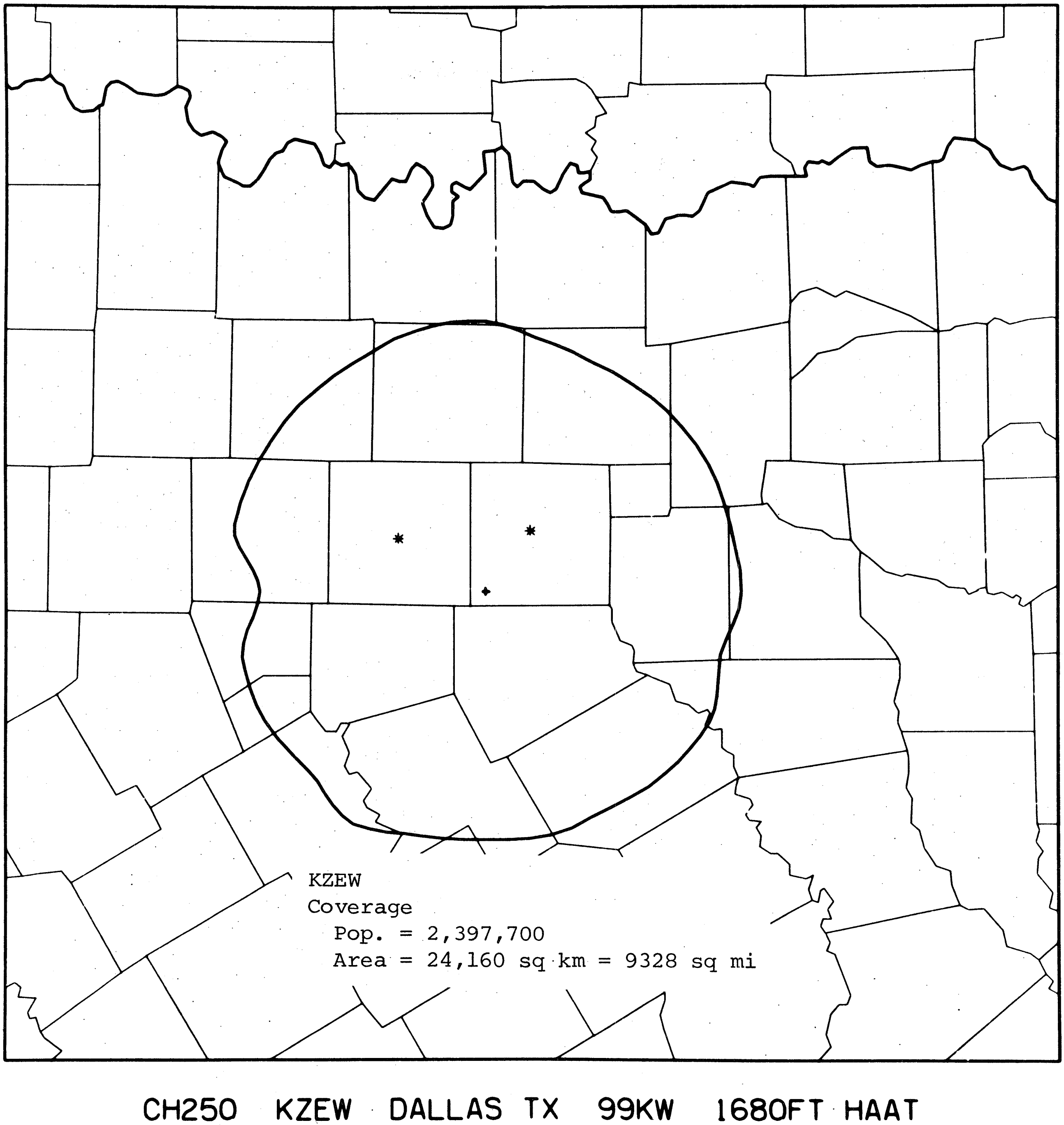
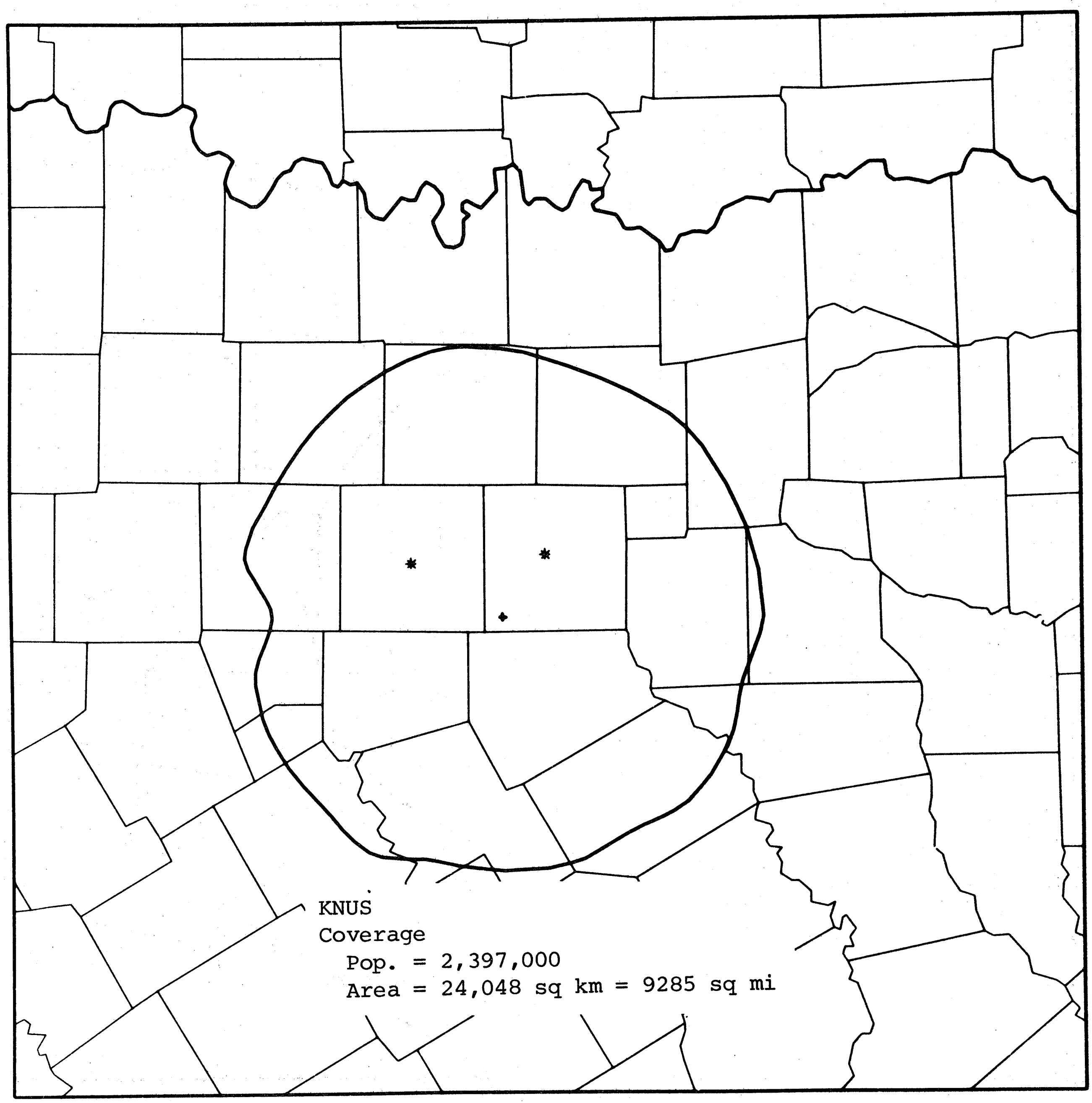
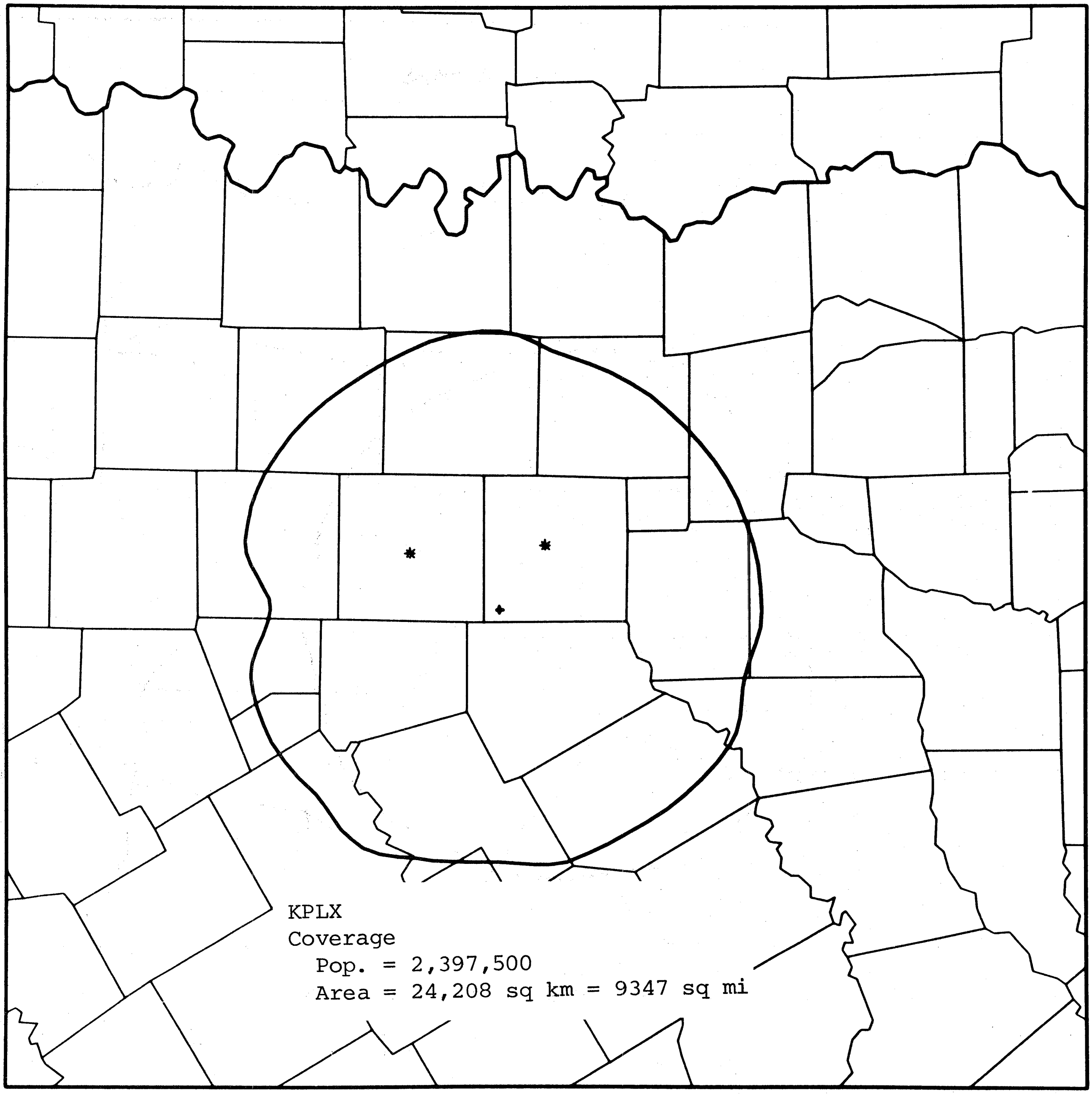



Figure A-14. Channel 250.




CH254 KNUS DALLAS TX 100KW 1683FT HAAT

Figure A-15. Channel 254.




CH258 KPLX FT. WORTH TX 100KW 1680FT HAAT

Figure A-16. Channel 258.

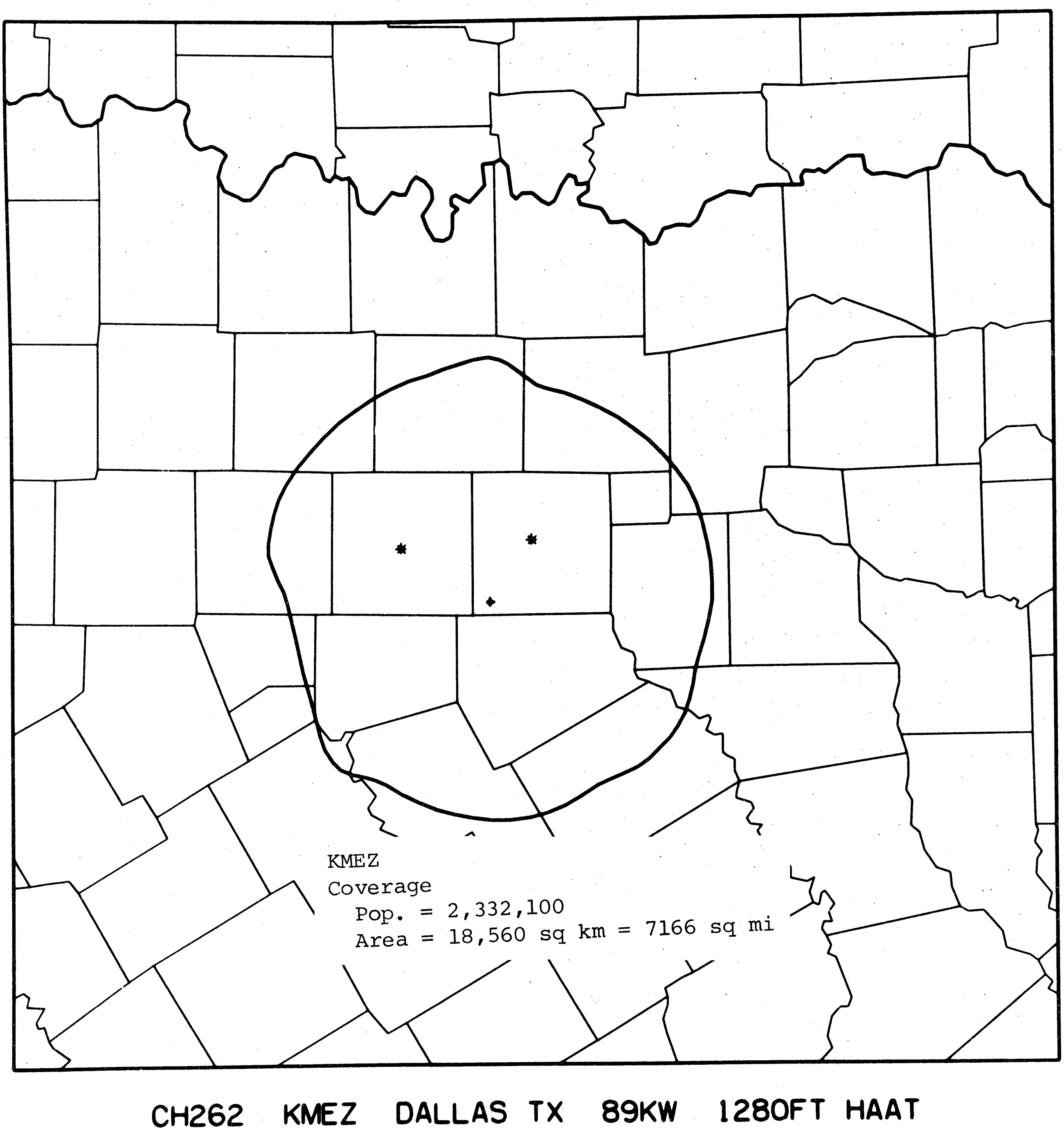
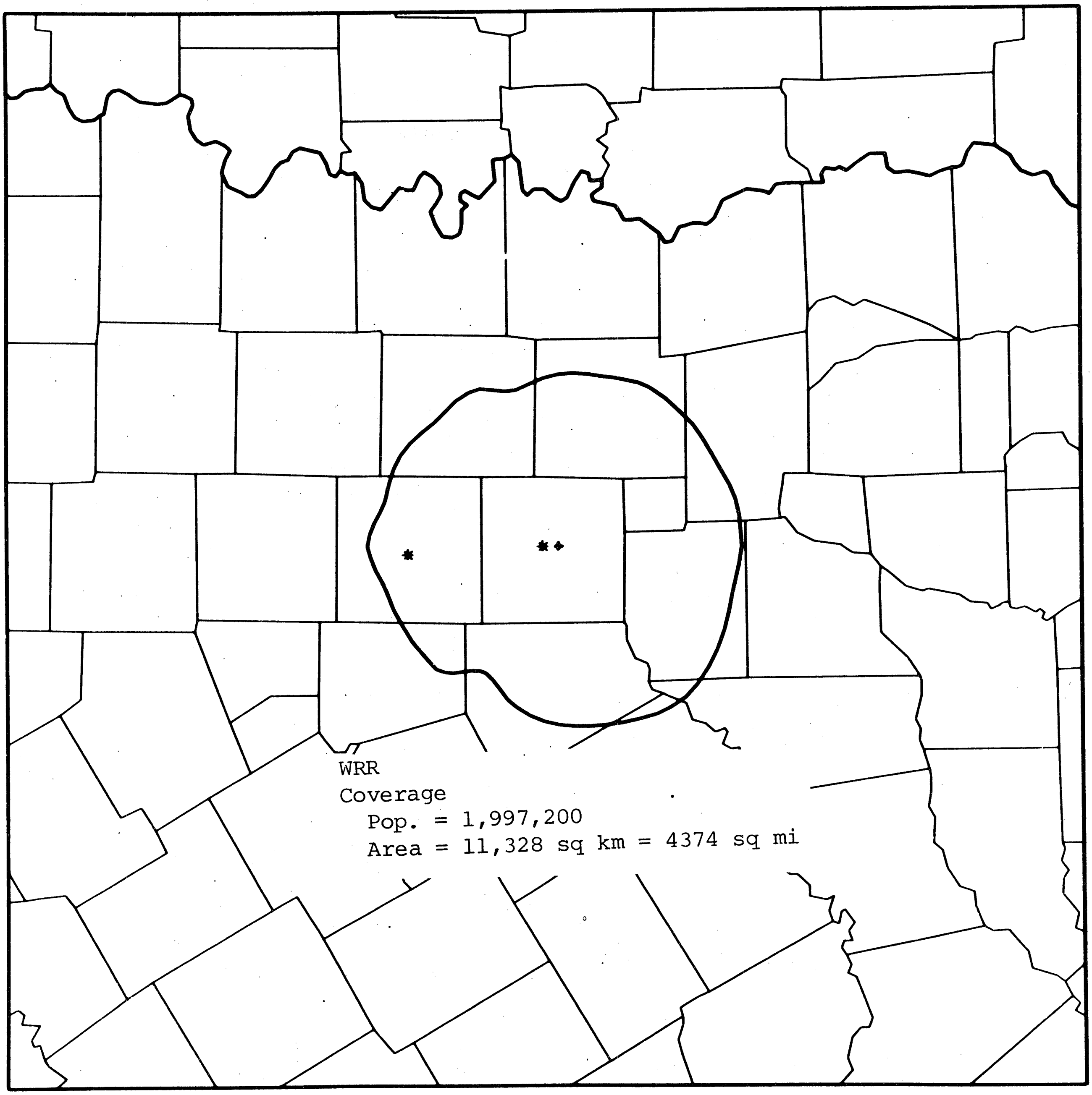
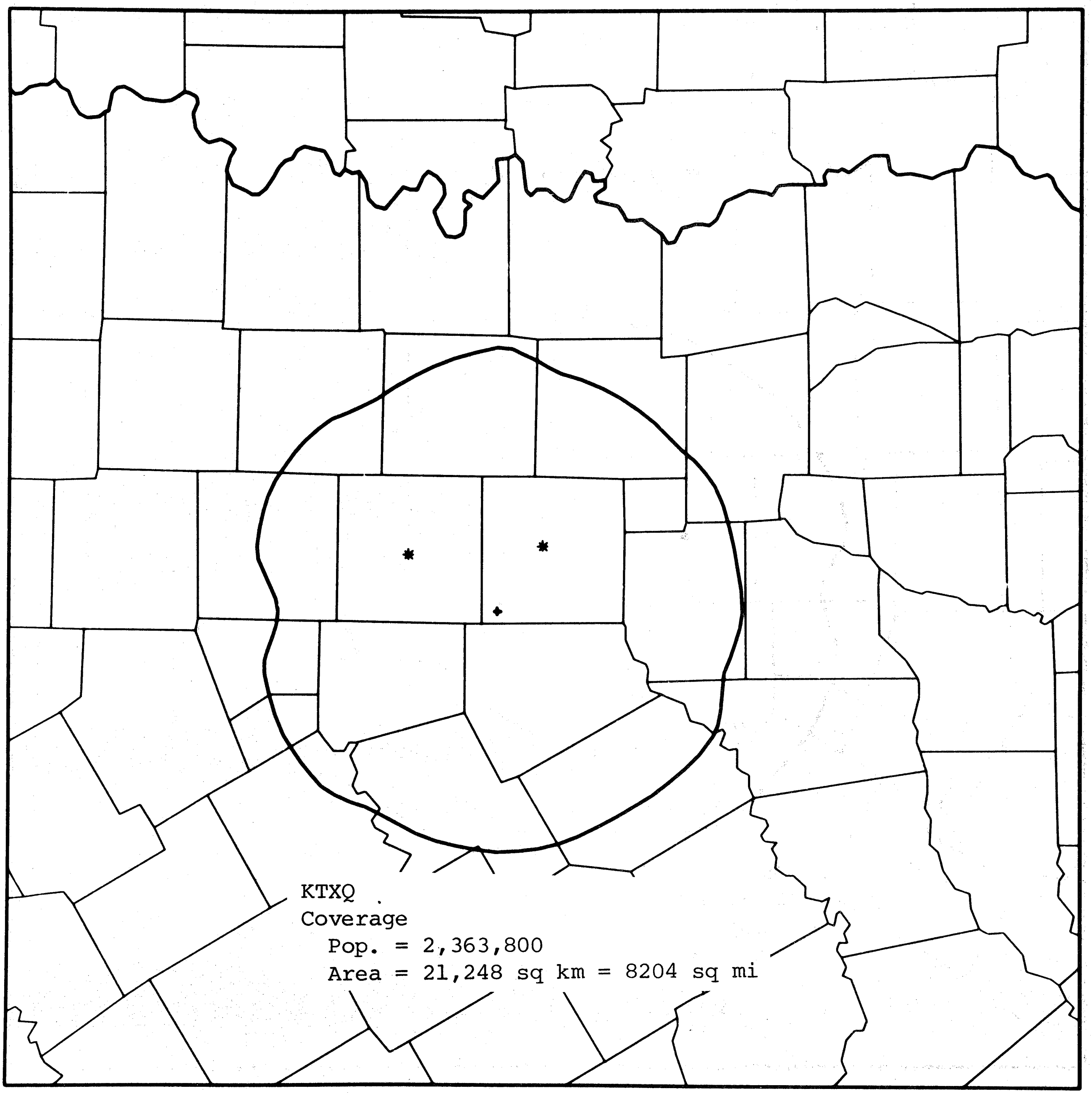



Figure A-17. Channel 262.




CH266 WRR DALLAS TX 100KW 500FT HAAT

Figure A-18. Channel 266.




CH271 KTXQ FT. WORTH-DALLAS 100KW 1420FT HAAT

Figure A-19. Channel 271.

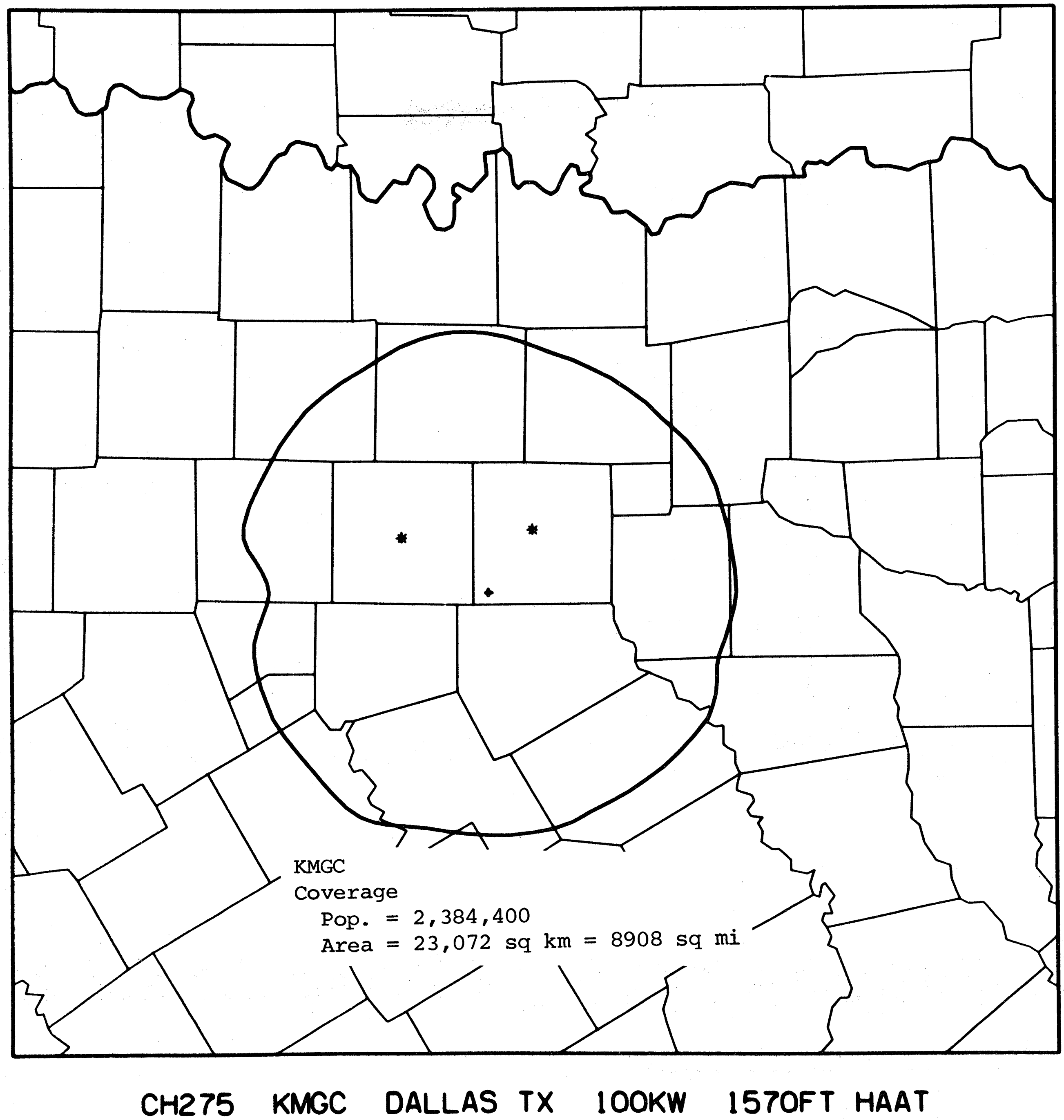
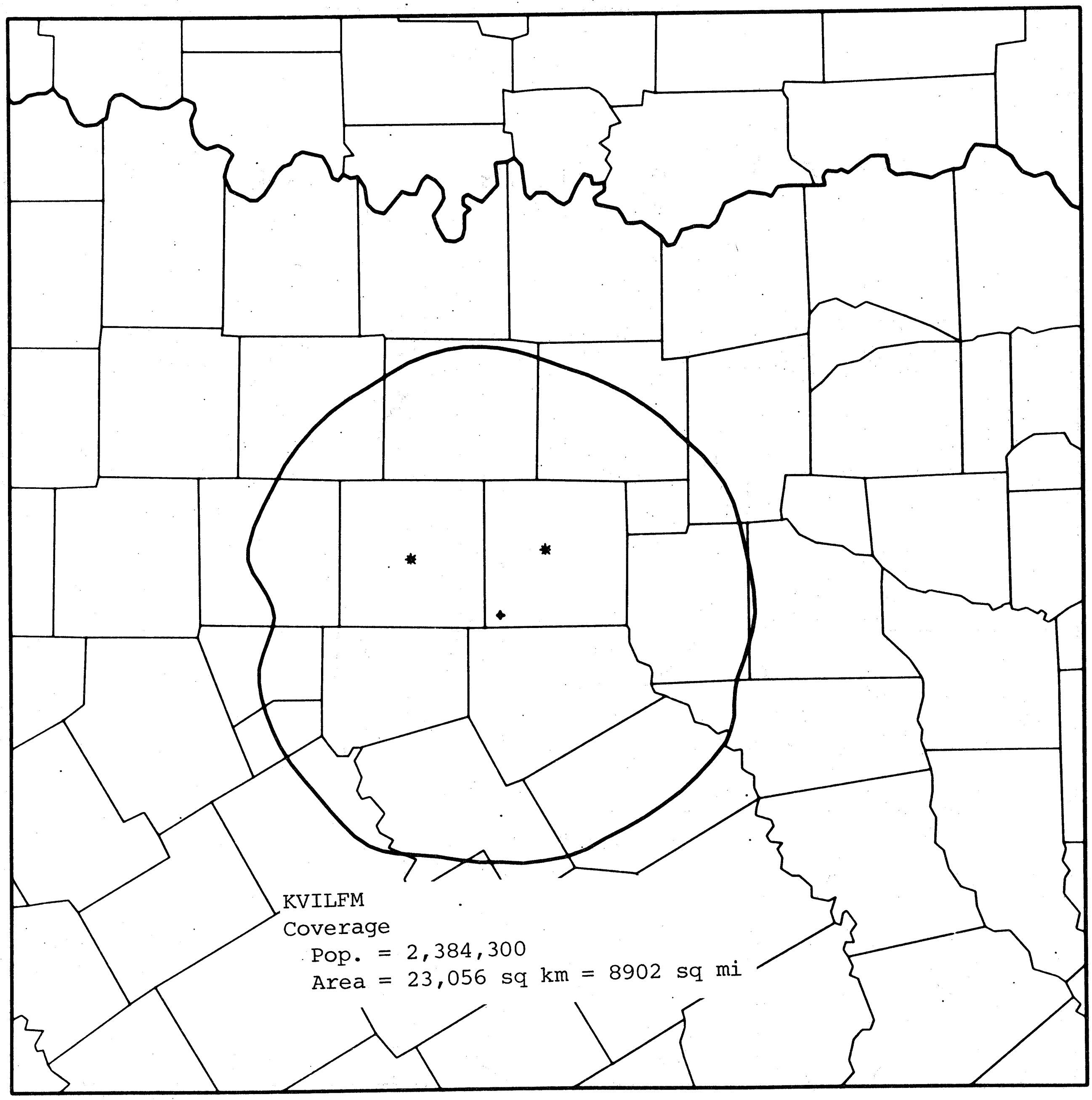



Figure A-20. Channel 275.




CH279 KVILFM HIGHLAND PARK-DALLAS TX 100KW 1570FT HAAT

Figure A-21. Channel 279.

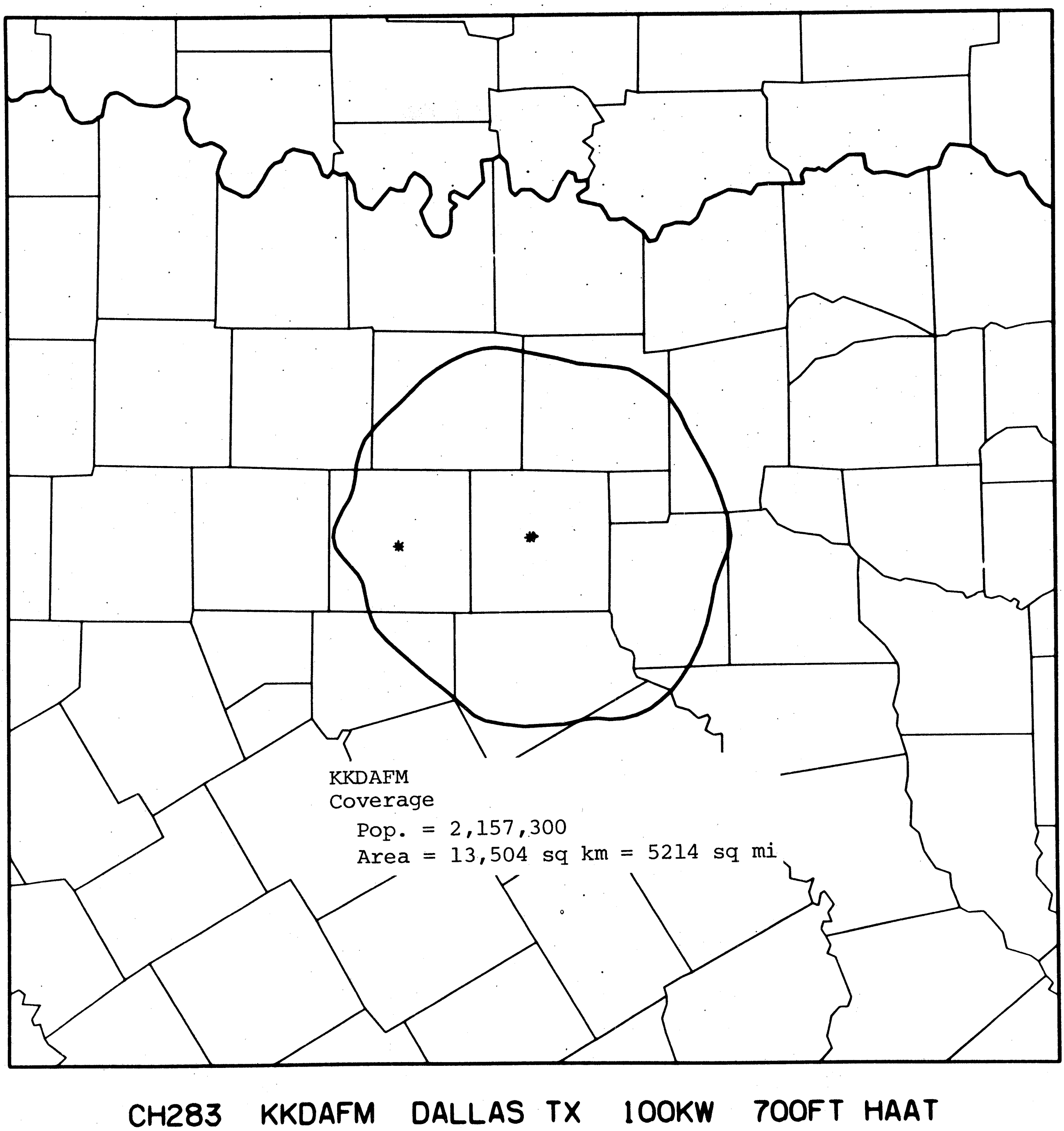



Figure A-22. Channel 283.

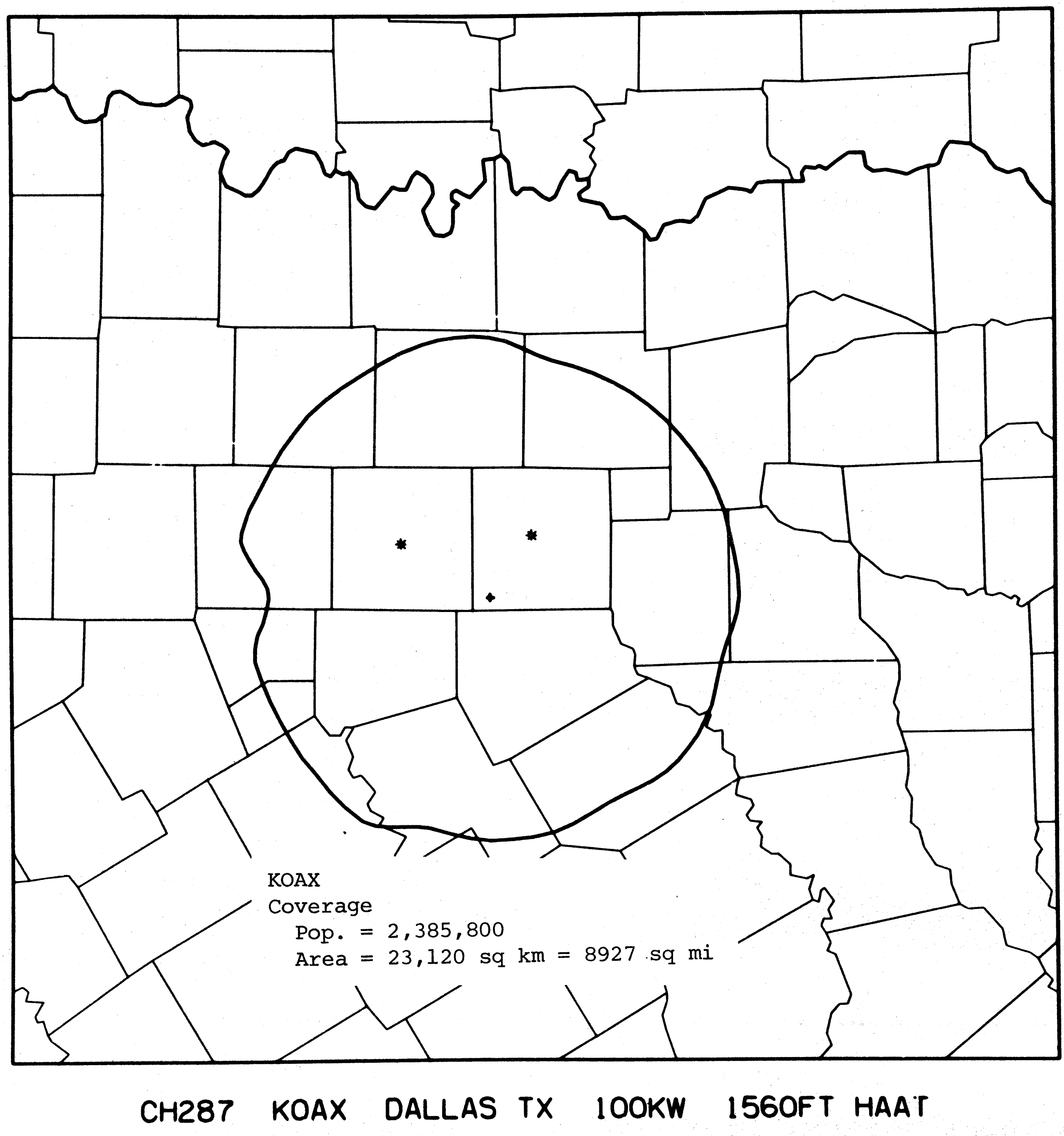



Figure A-23. Channel 287.

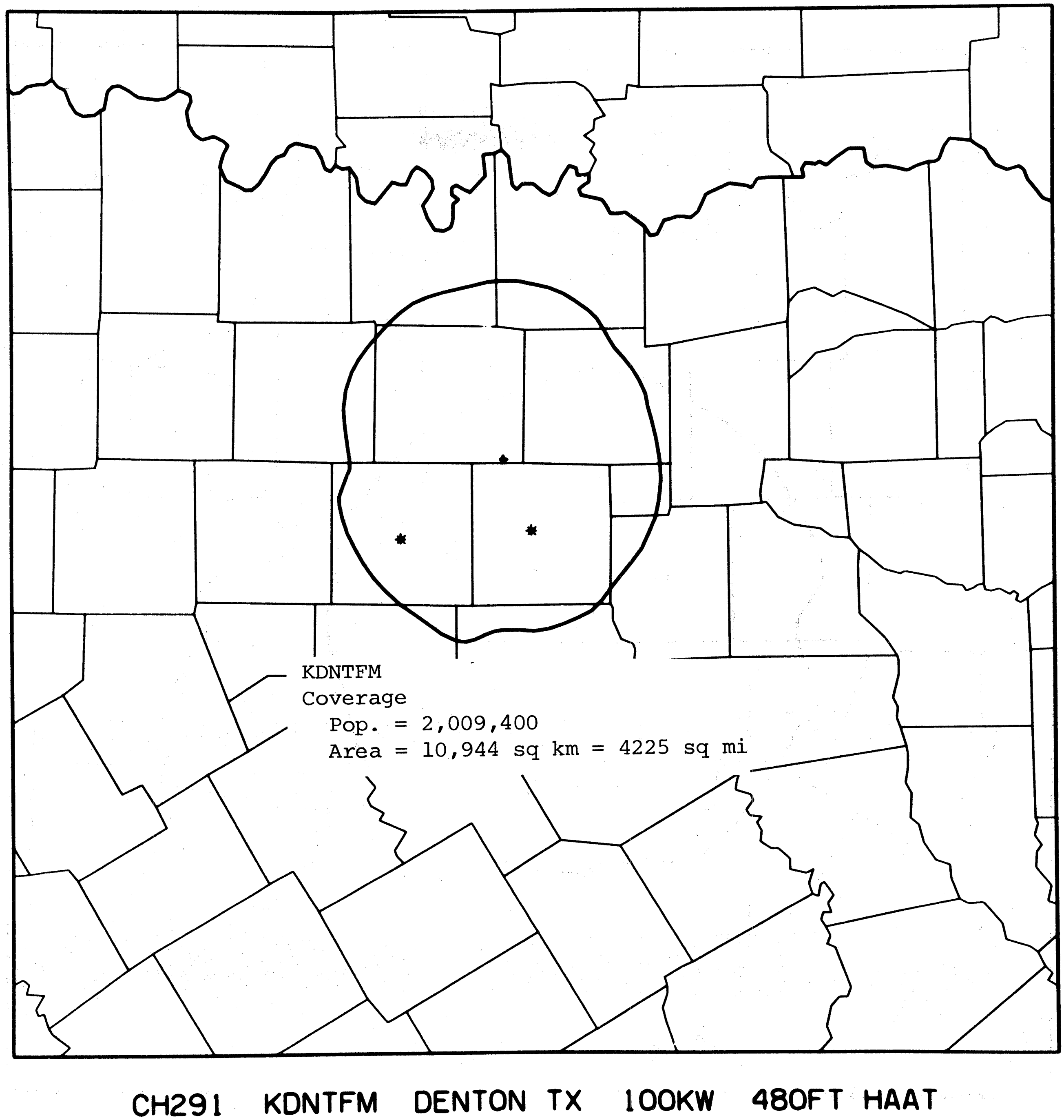
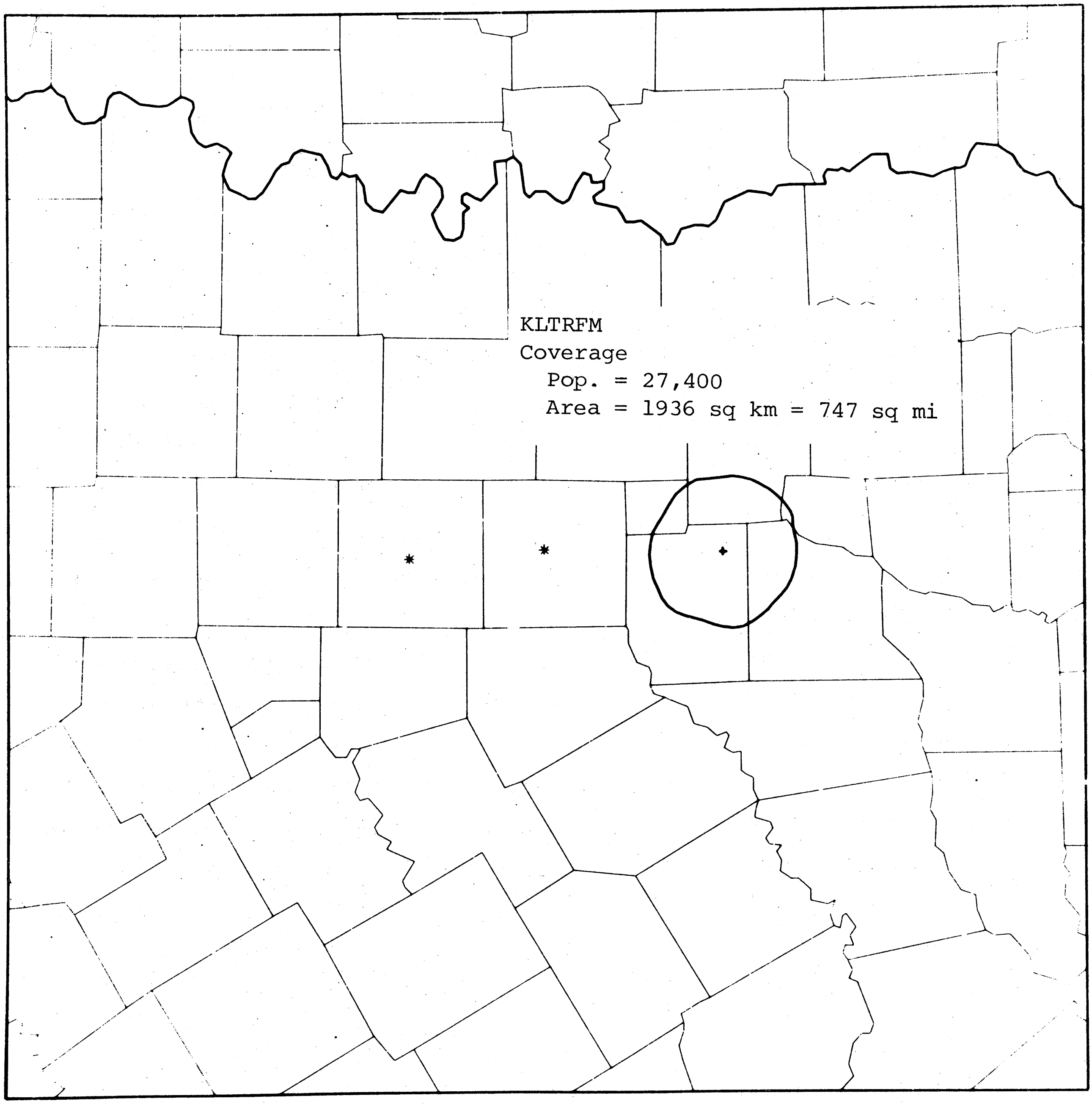



Figure A-24. Channel 291.




CH296 KLTRFM TERRELL TX 3KW 300FT HAAT

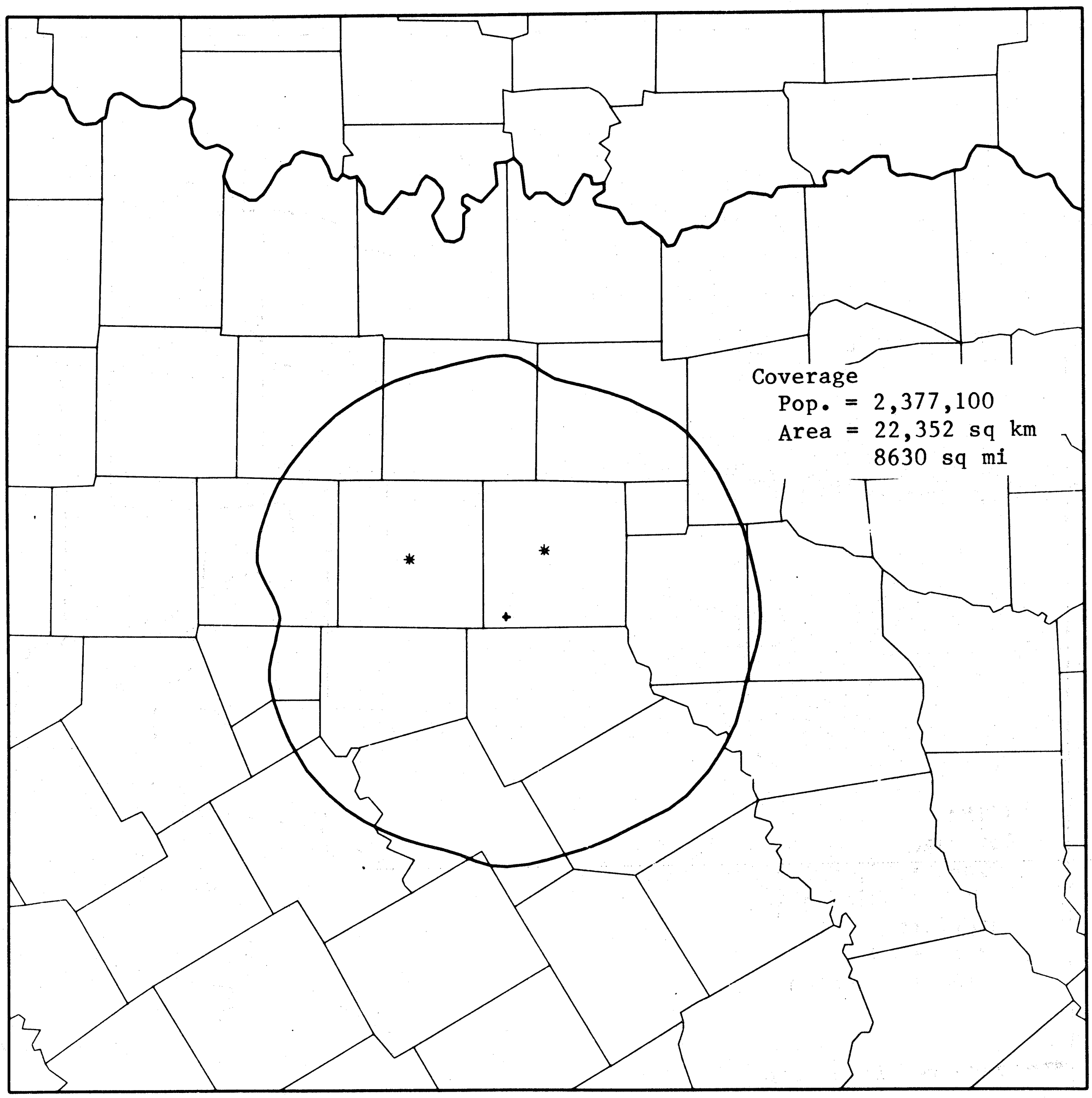
**Figure A-25.** Channel 296.

# APPENDIX B

## COVERAGE AND INTERFERENCE FROM PROPOSED STATIONS

As in Appendix A, the methods described by Hufford (1977) are used to compute the coverage and interference contours for the proposed facilities. There is a set of plots for each proposed facility. The first plot is for a new facility with an omnidirectional antenna; the next two plots show the new facility's interference using both the present protection standards and proposed protection standards. The solid line indicates the existing station's 59 dBμV/m contour and the dashed line indicates the interference. The existing station's location is represented by a V for victim and the new station's location is represented by an I for interferer.

In all cases, the new facility is co-located with an existing facility. In many cases, both second-adjacent-channel stations to a new proposed station were already co-located. For co-located facilities, the interference contours were not computed or plotted. In some cases, the new facility was co-located with one of its second-adjacent-channel stations but the other second-adjacent-channel station was located elsewhere; this resulted in too much interference as shown with the new facilities on channels 281 and 289. As a result, channels 232, 239, 252, 281 and 289 probably could not accept new facilities in the Dallas-Ft. Worth area. However 17 other new facilities apparently could be added to the Dallas-Ft. Worth market provided directional antennas were used and/or the protection standards were revised.




CH213 100KW 1500FT HAAT

Figure B-1. Proposed channel 213.

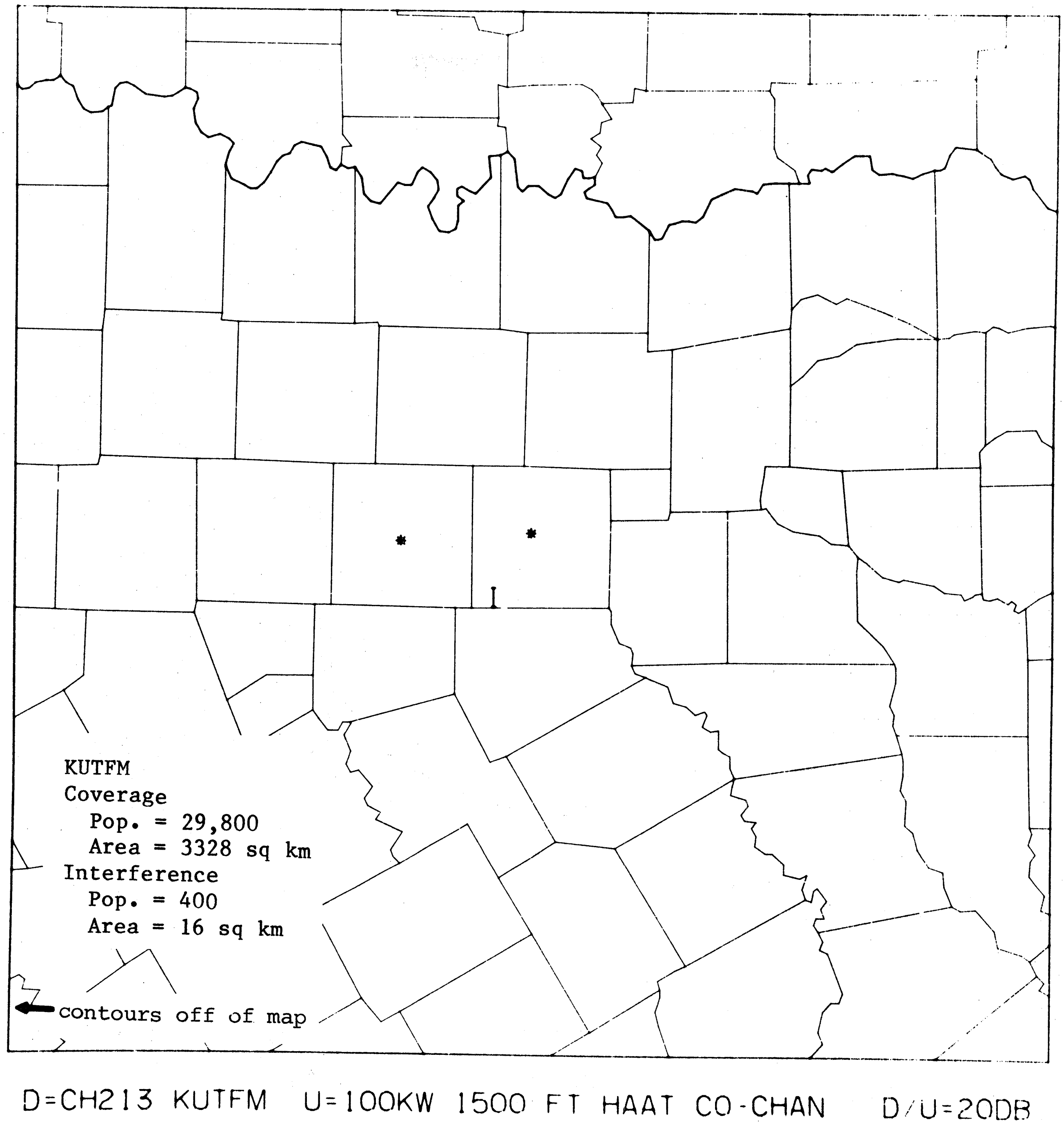



Figure B-1. (Continued).

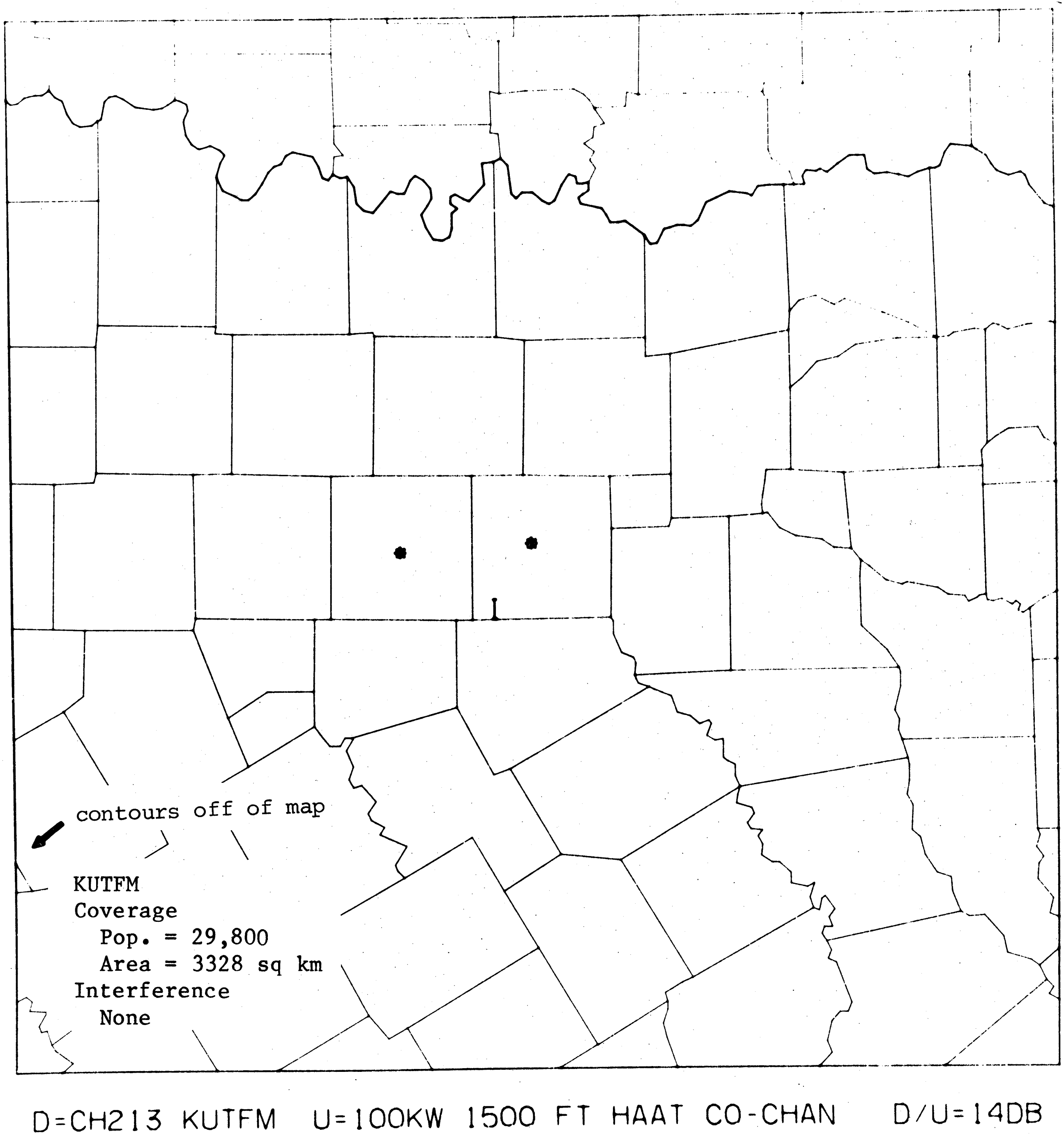
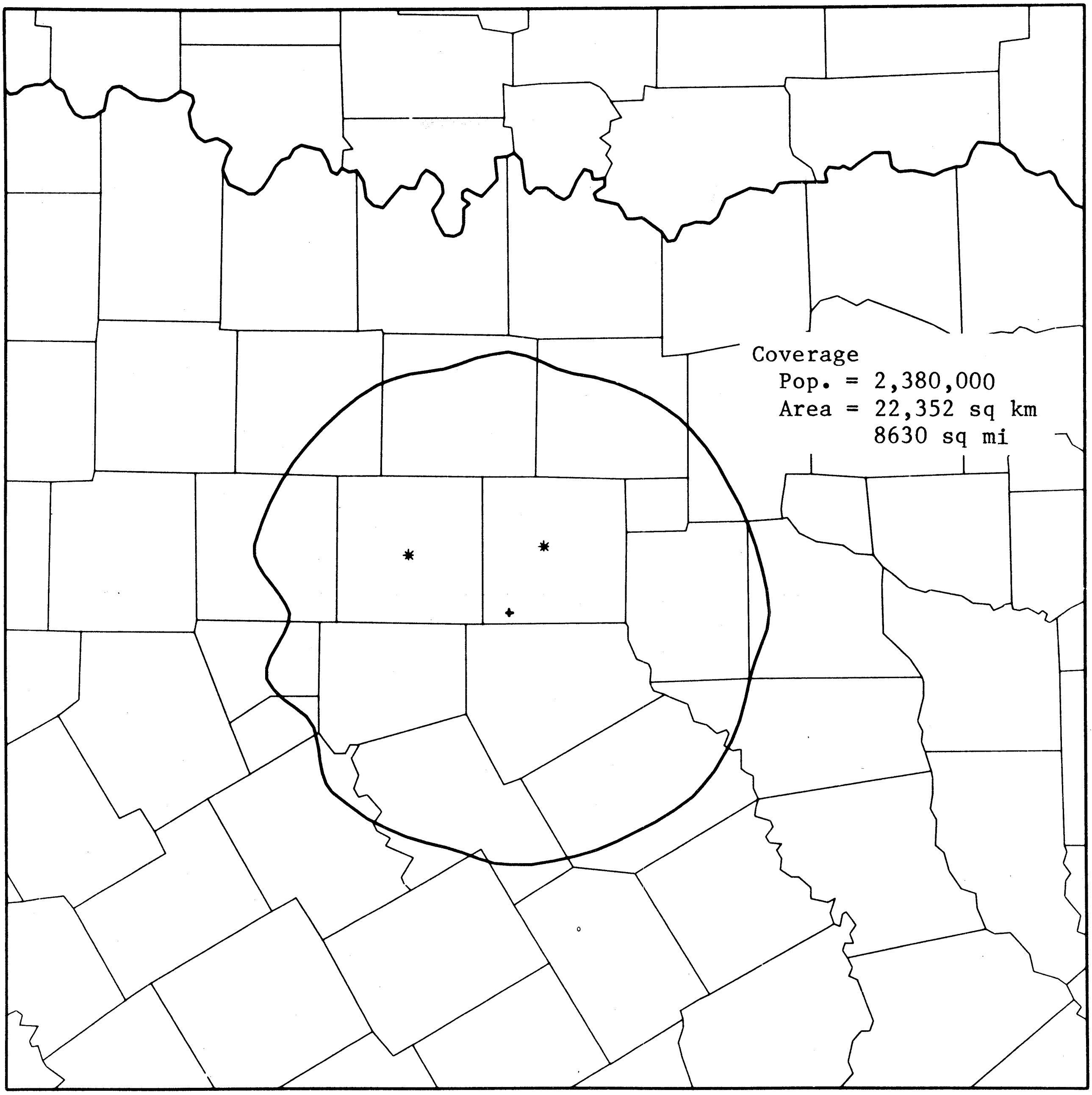
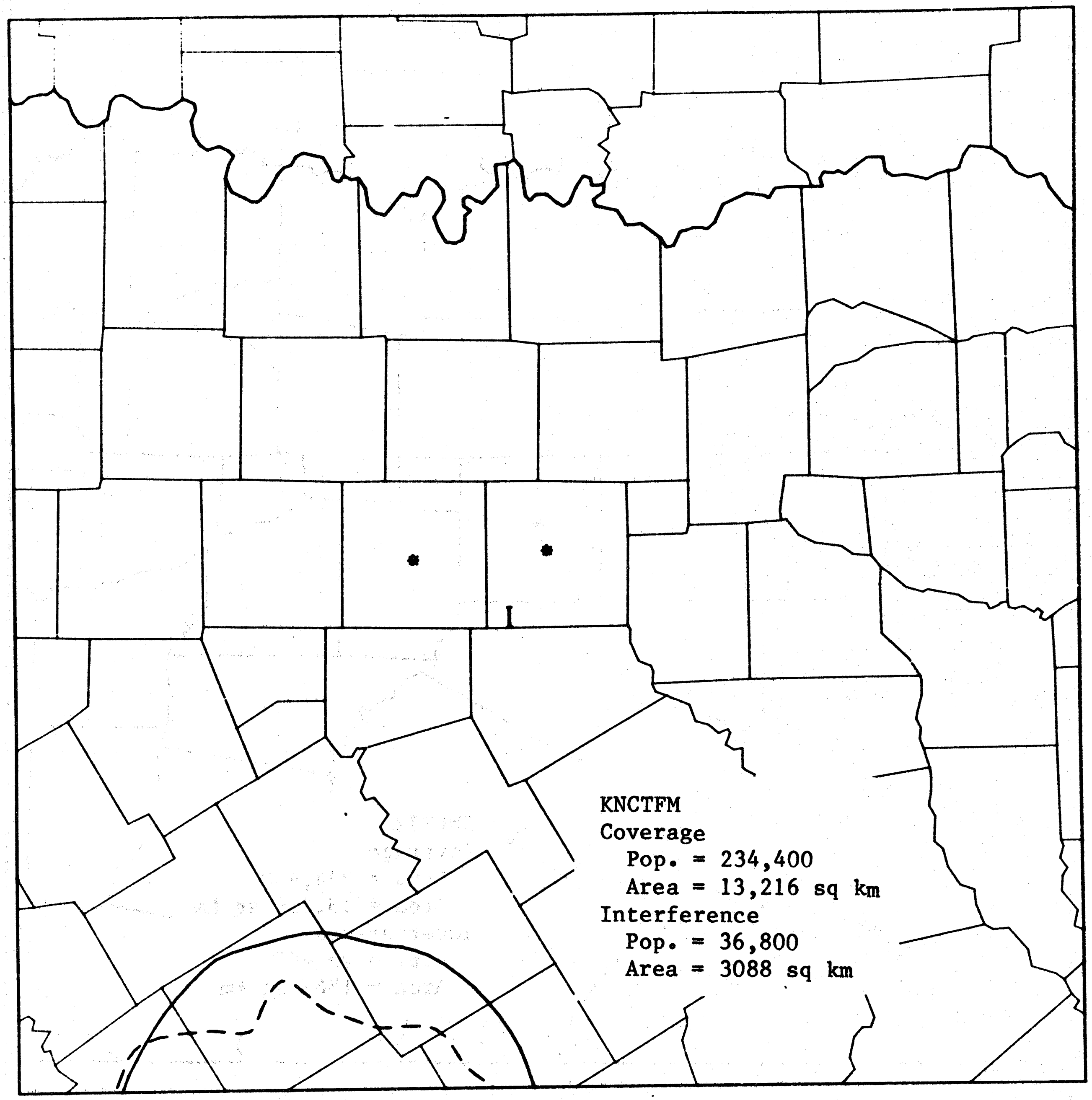



Figure B-1. (Continued).



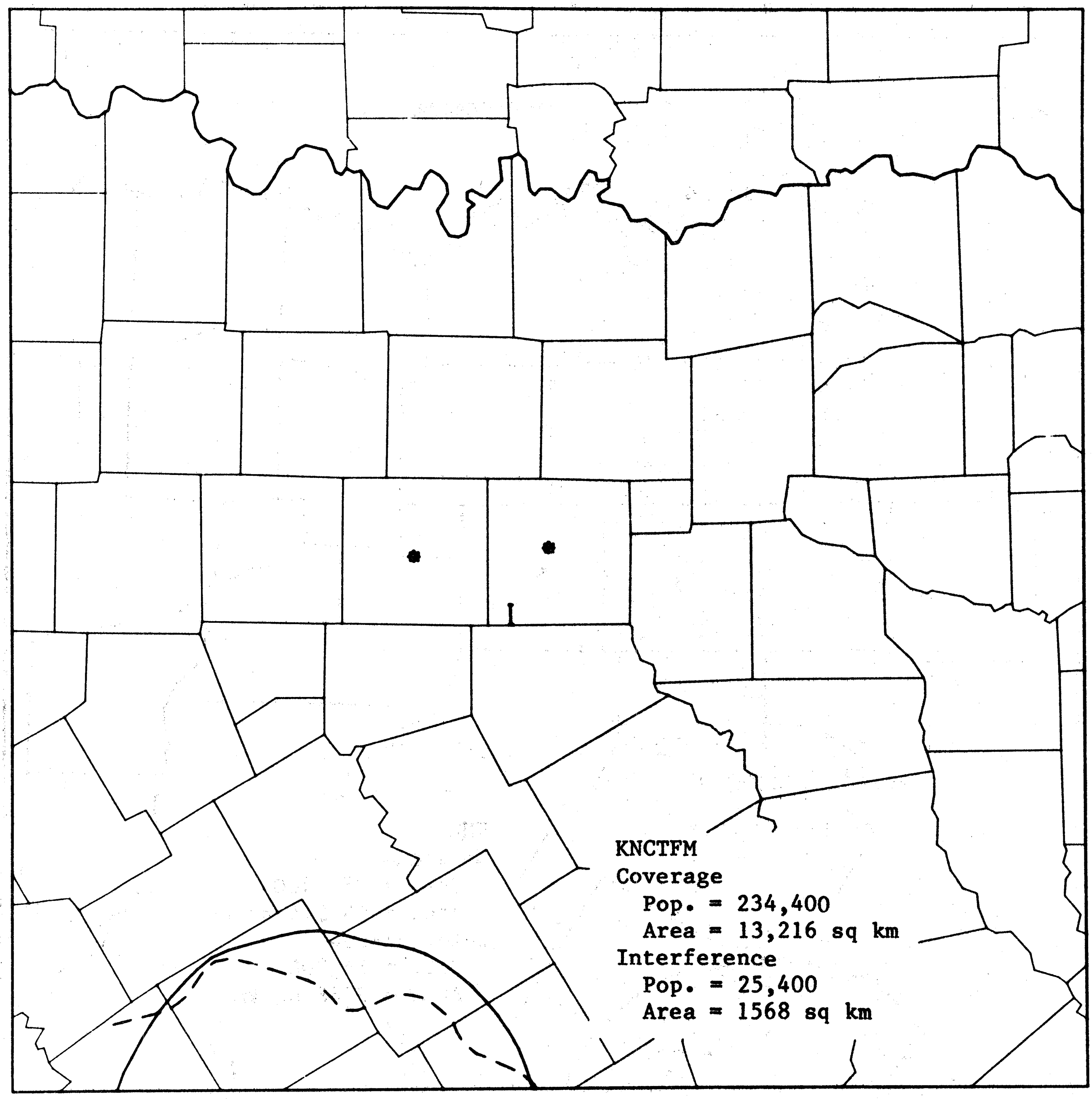

CH217 100KW 1500FT HAAT

Figure B-2. Proposed channel 217.



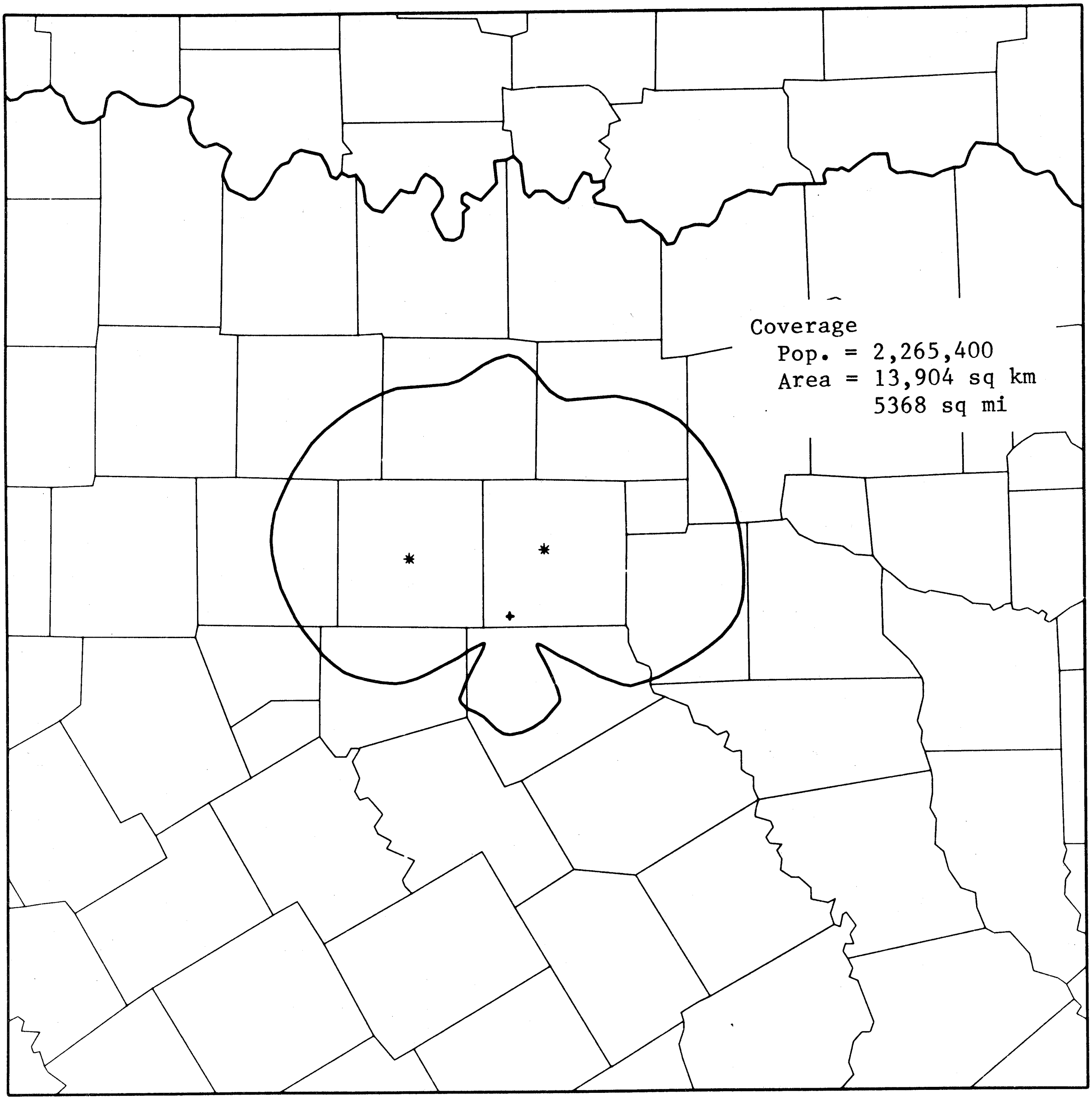

D=CH217 KNCTFM U=100KW 1500 FT HAAT CO-CHAN D/U=20DB

Figure B-2. (Continued).




D=CH217 KNCTFM U=100KW 1500 FT HAAT CO-CHAN D/U=14DB

Figure B-2. (Continued).




CH217 100KW 1500FT HAAT DIRECTIONAL ANT 2

Figure B-2. (Continued).

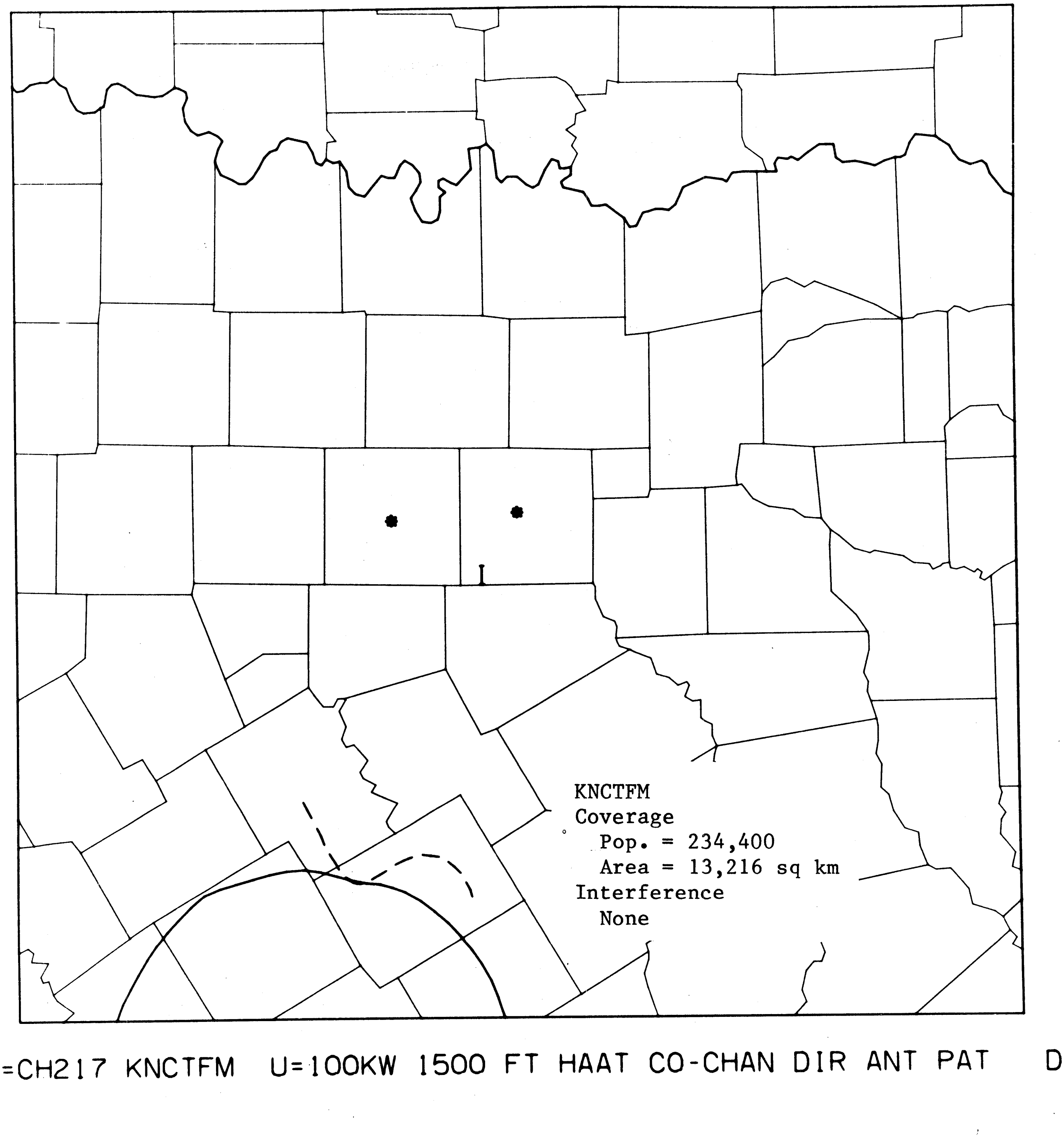
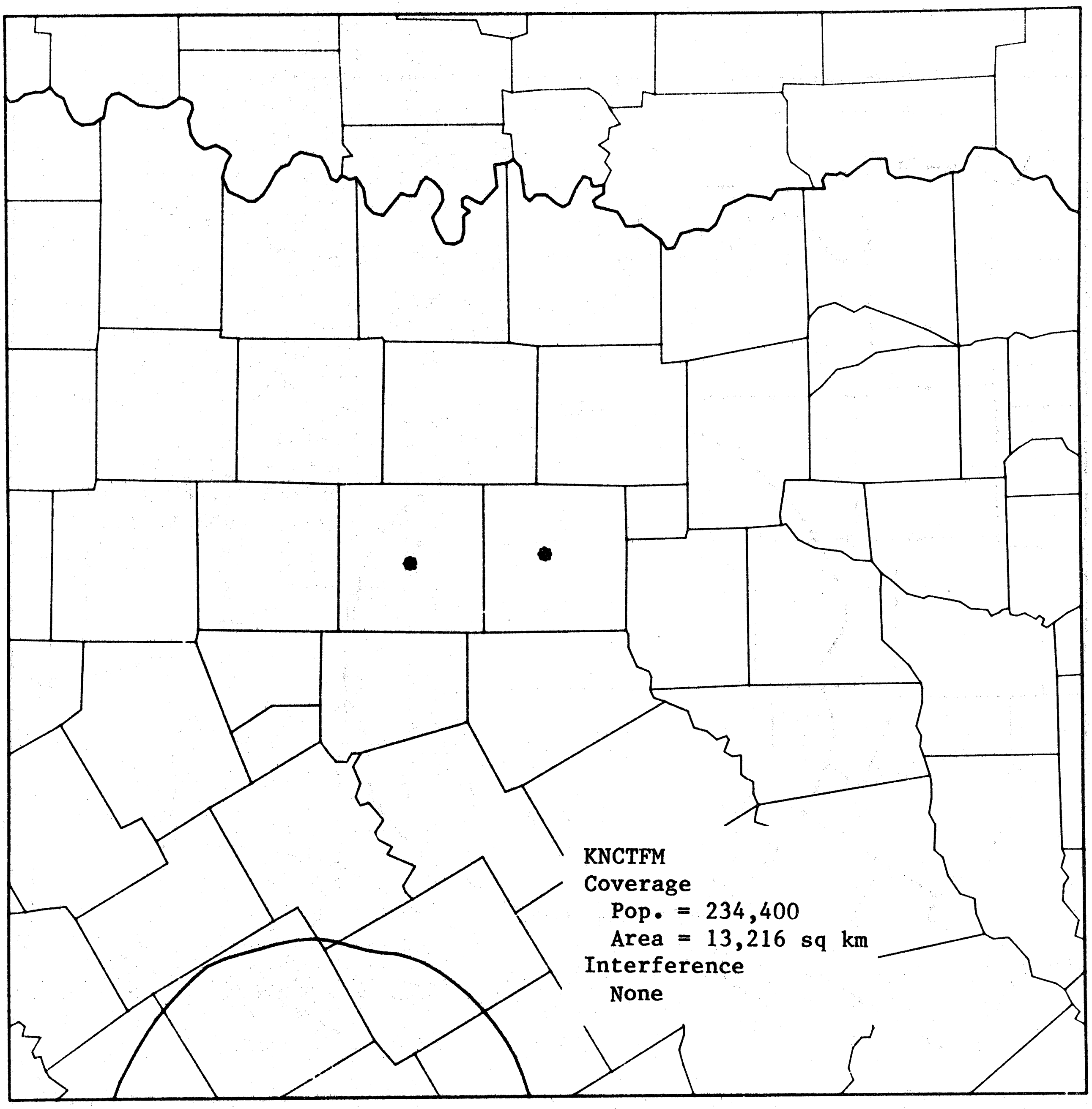
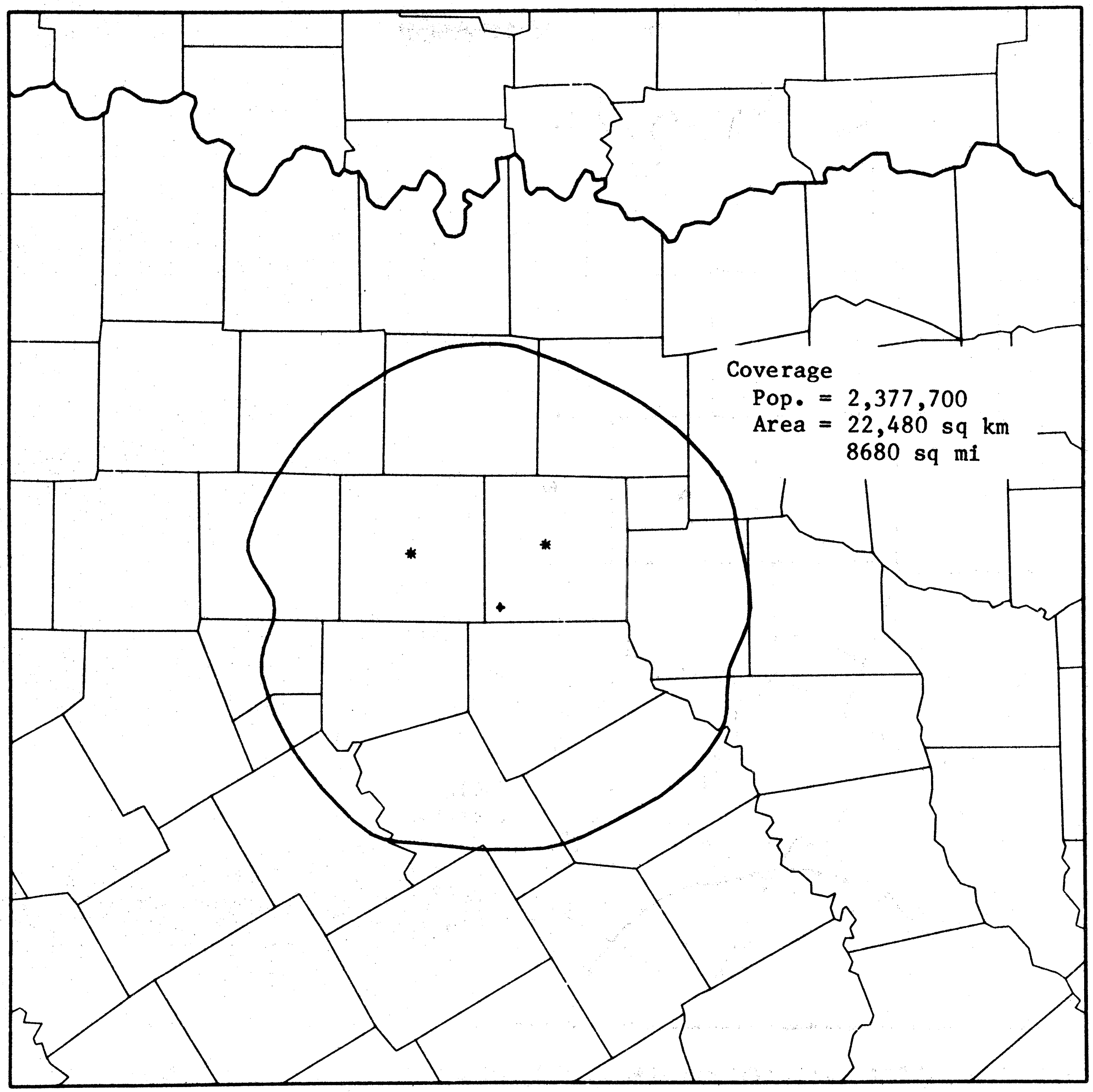



Figure B-2. (Continued).



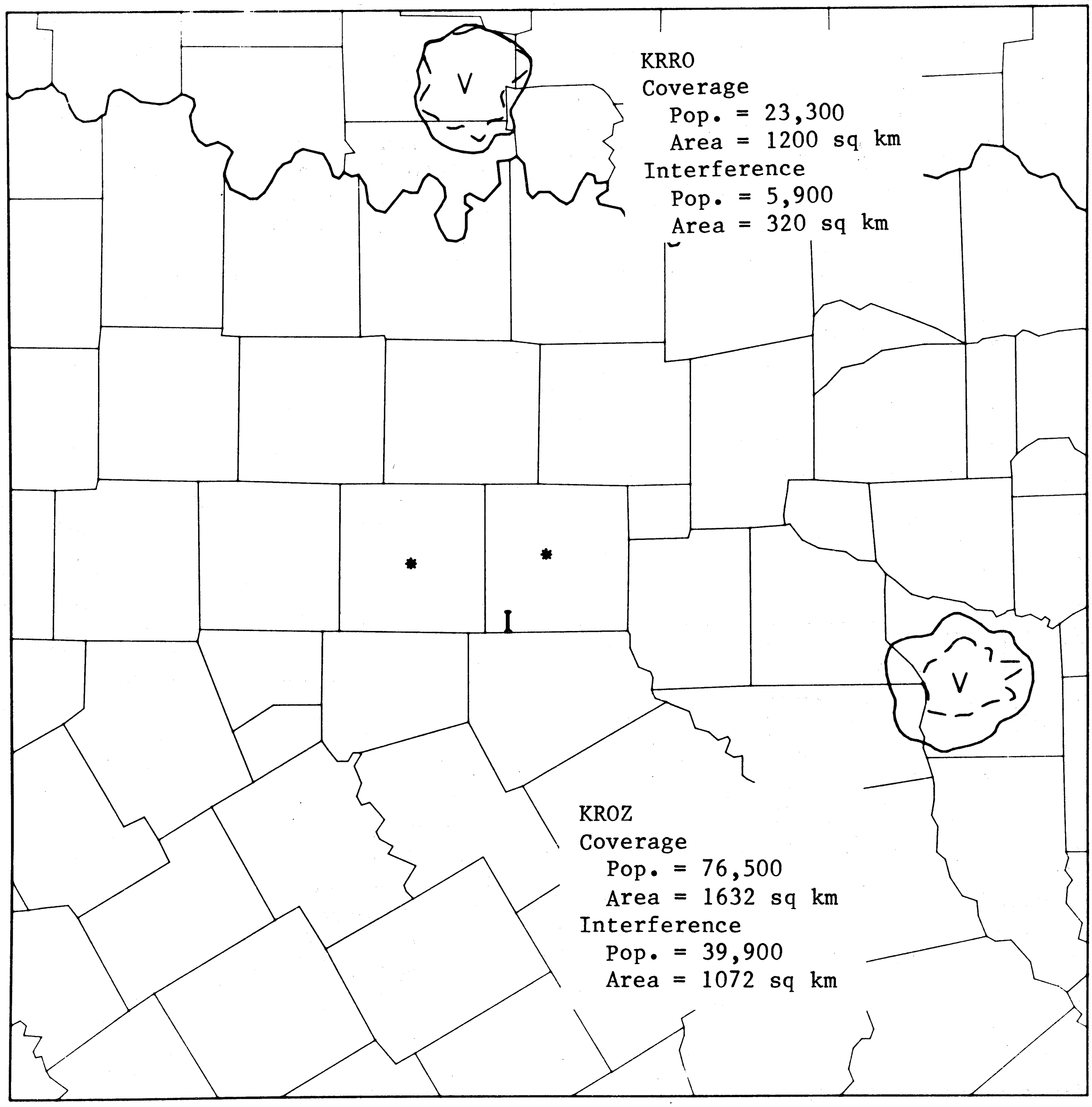

D=CH217 KNCTFM U=100KW 1500 FT HAAT CO-CHAN DIR ANT PAT D

Figure B-2. (Continued).



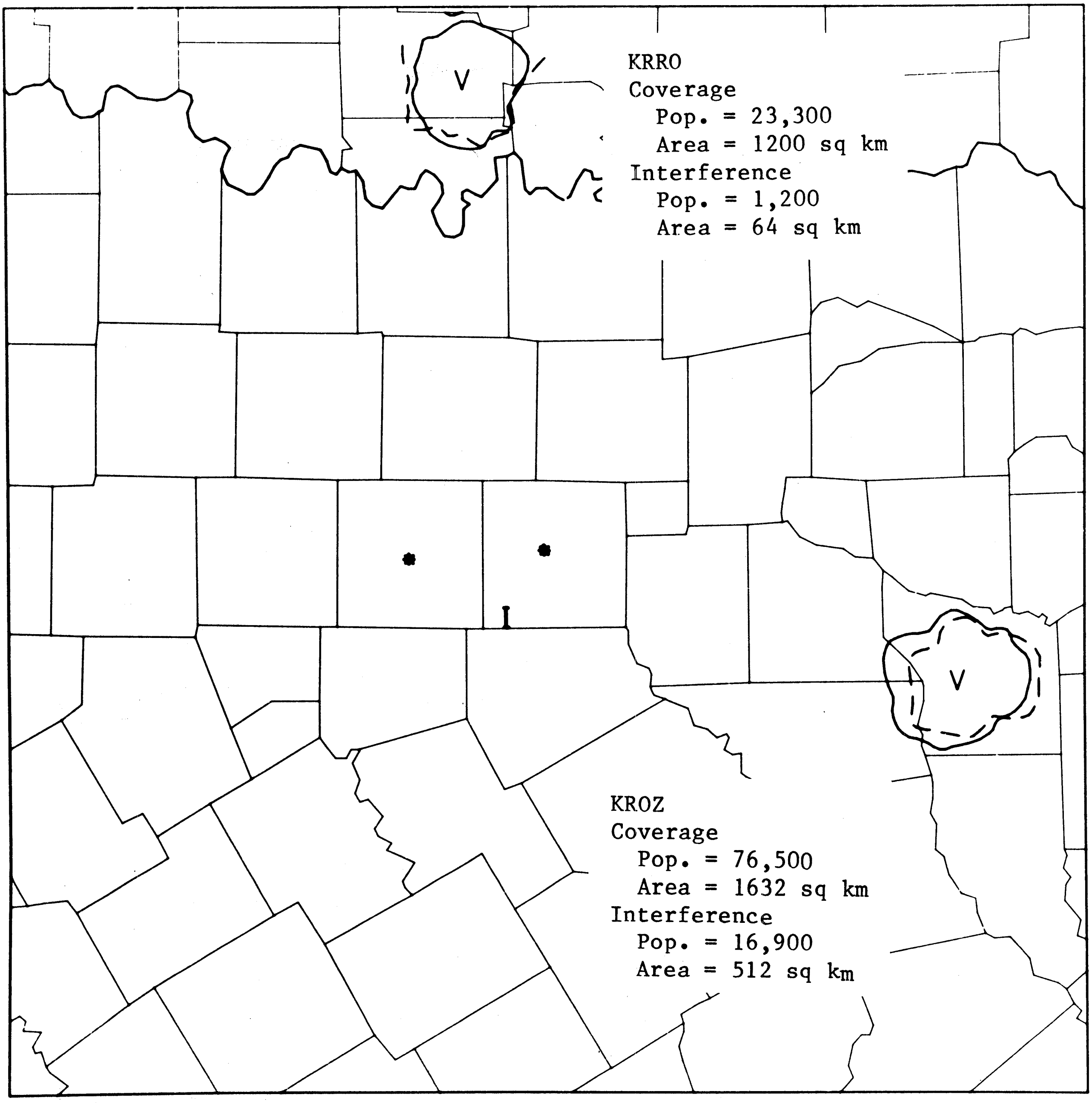

CH221 100KW 1500FT HAAT

Figure B-3. Proposed channel 221.



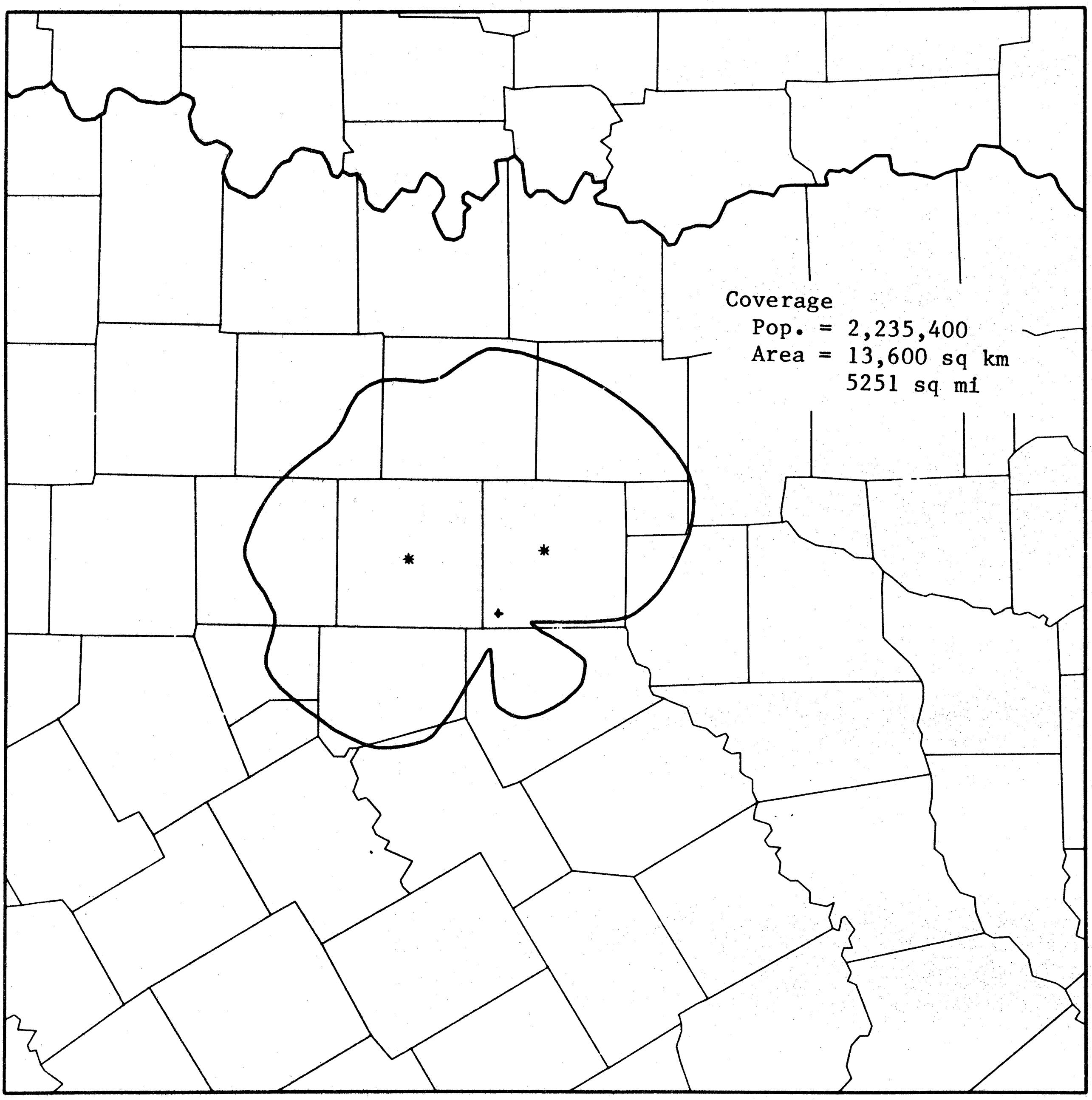

D=CH221 KROZ KRRO U=100KW 1500 FT HAAT CO-CHAN D/U=20DB

Figure B-3. (Continued).



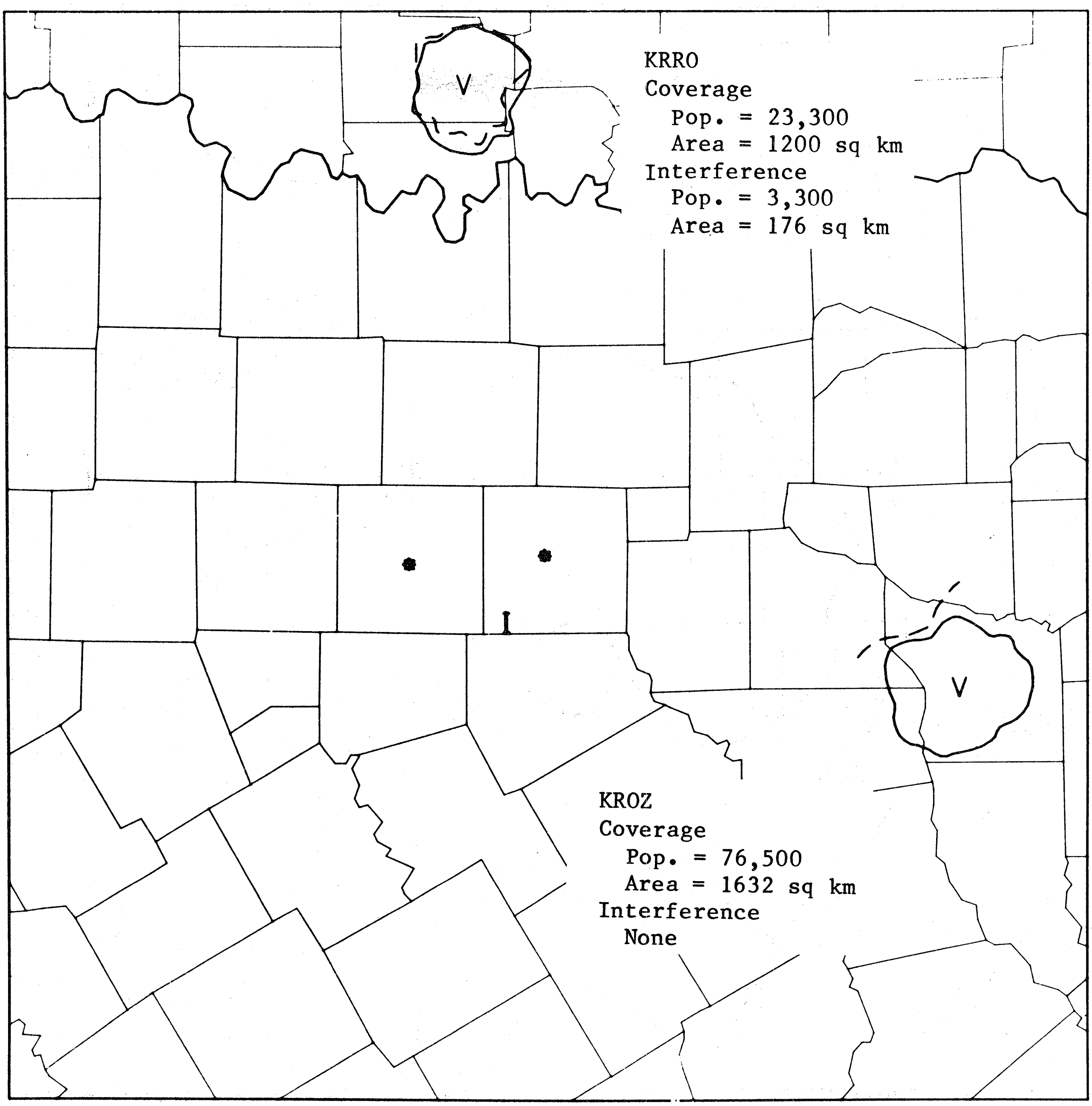

D=CH221 KROZ KRRO U=100KW 1500 FT HAAT CO-CHAN D/U=14DB

Figure B-3. (Continued).



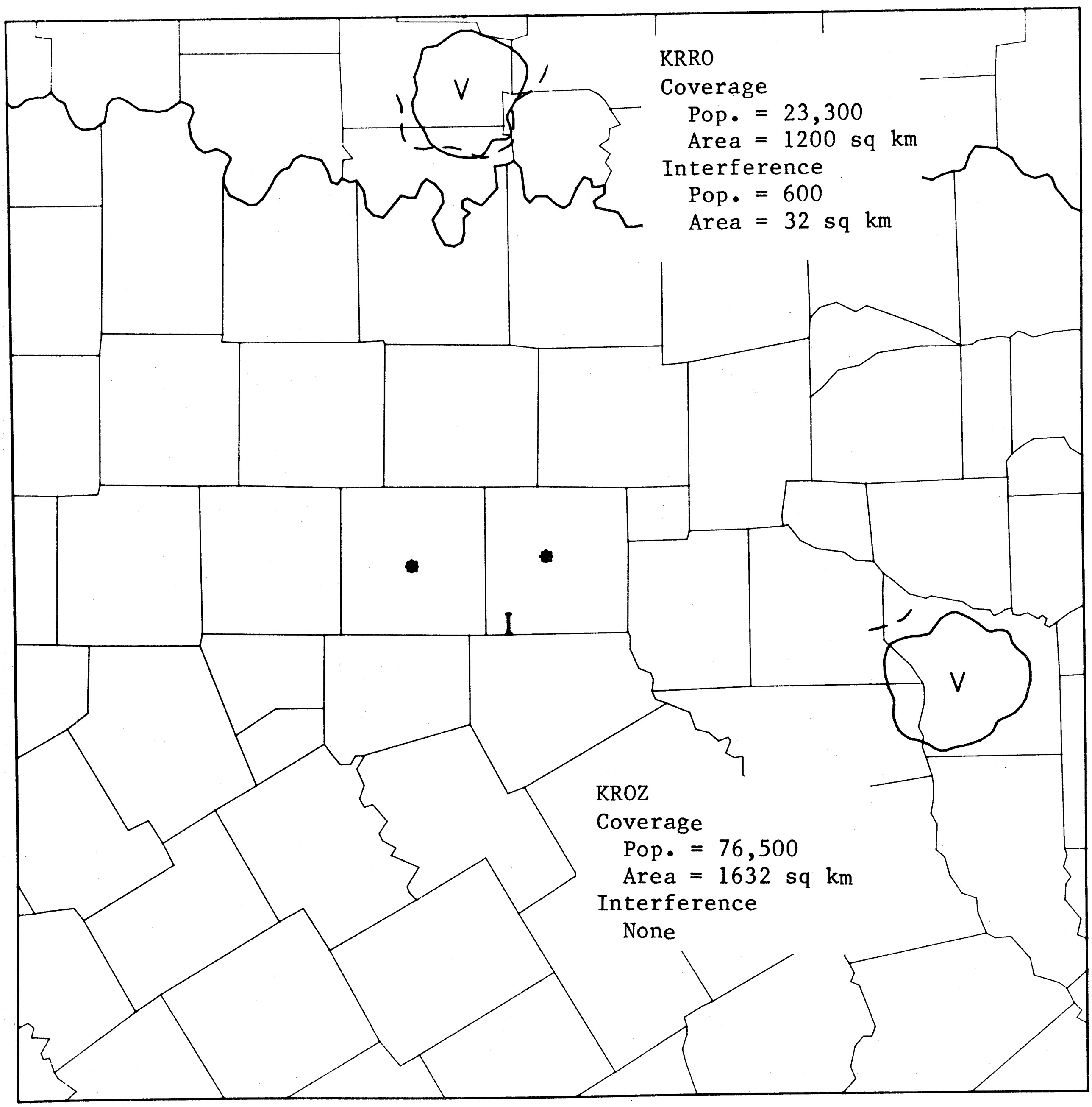

CH221 100KW 1500FT HAAT DIRECTIONAL ANT 2

Figure B-3. (Continued).



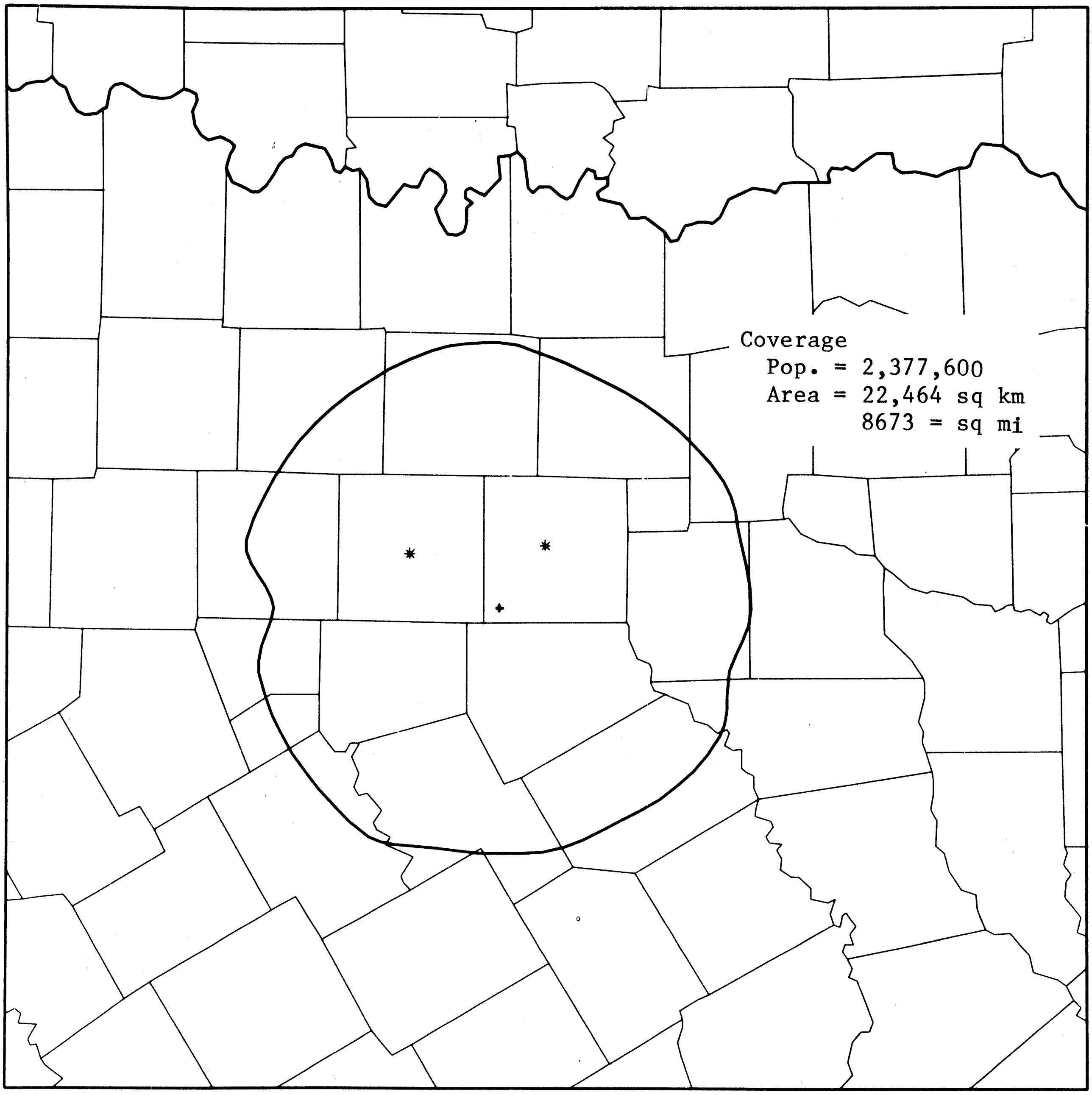

D=CH221 KROZ KRRO U=100KW 1500 FT HAAT D-A CO-CHAN D/U=20

Figure B-3. (Continued).



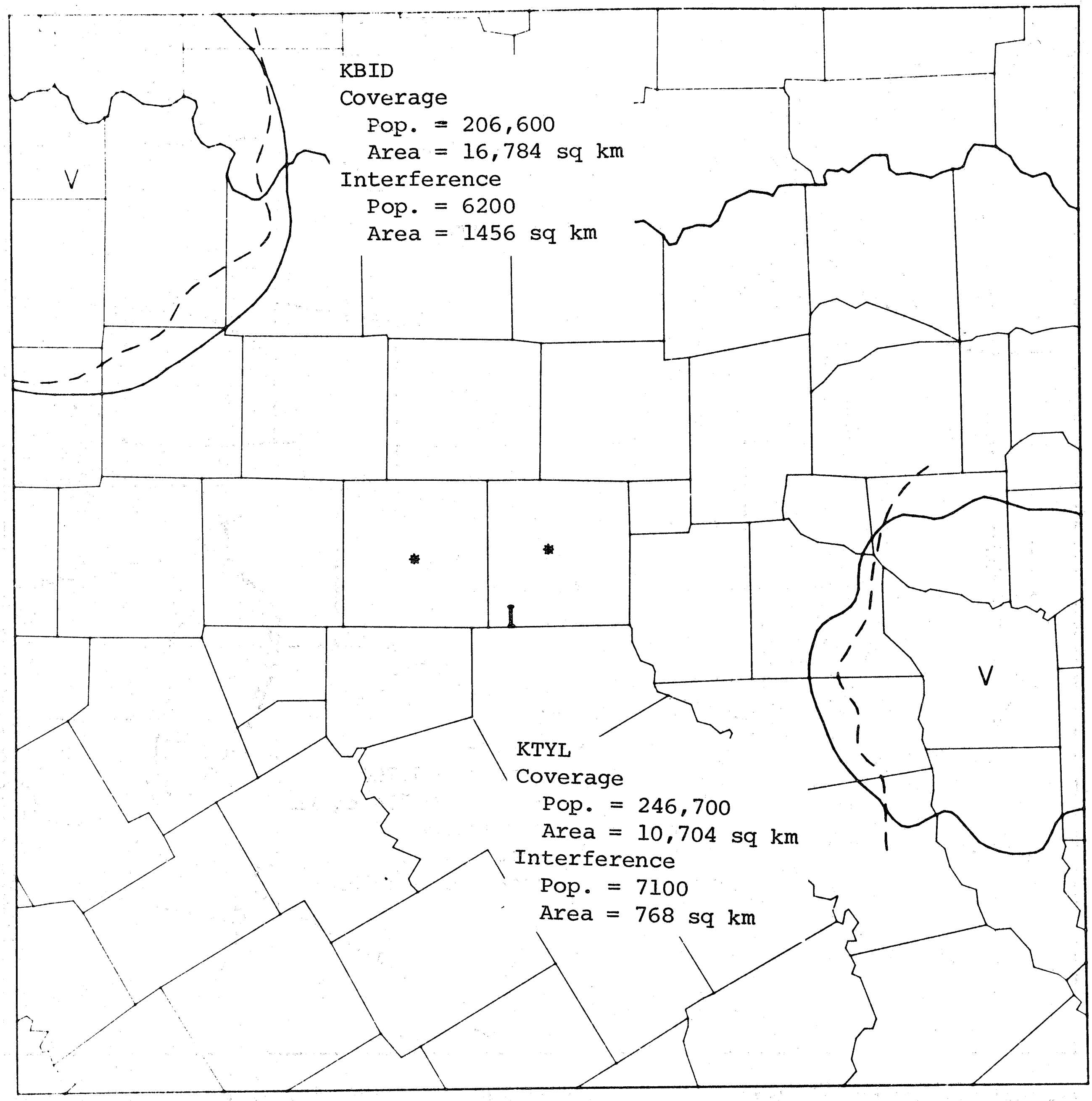

D=CH221 KROZ KRRO U=100KW 1500 FT HAAT D-A CO-CHAN D/U=14

Figure B-3. (Continued).




CH225 100KW 1500FT HAAT

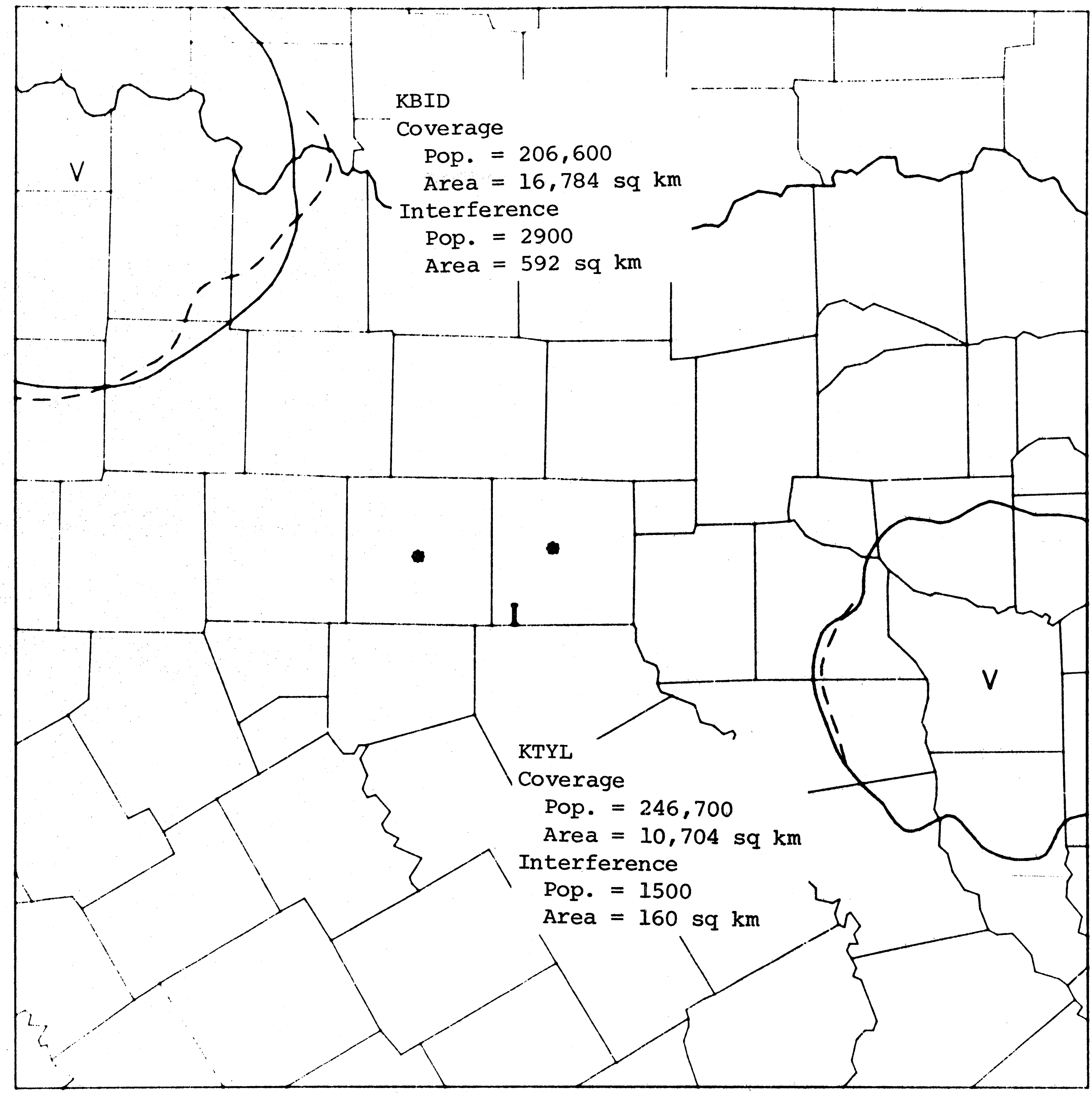
Figure B-4. Proposed channel 225.




D=CH225 KBID CH226 KTYL U=100KW 1500FT CH 225 D/U=20^6DB

PLOT NO. 1 TEXAS 1

Figure B-4. (Continued).




D=CH225 KBID CH226 KTYL U=100KW 1500FT CH 225 D/U=14^0DB

Figure B-4. (Continued).

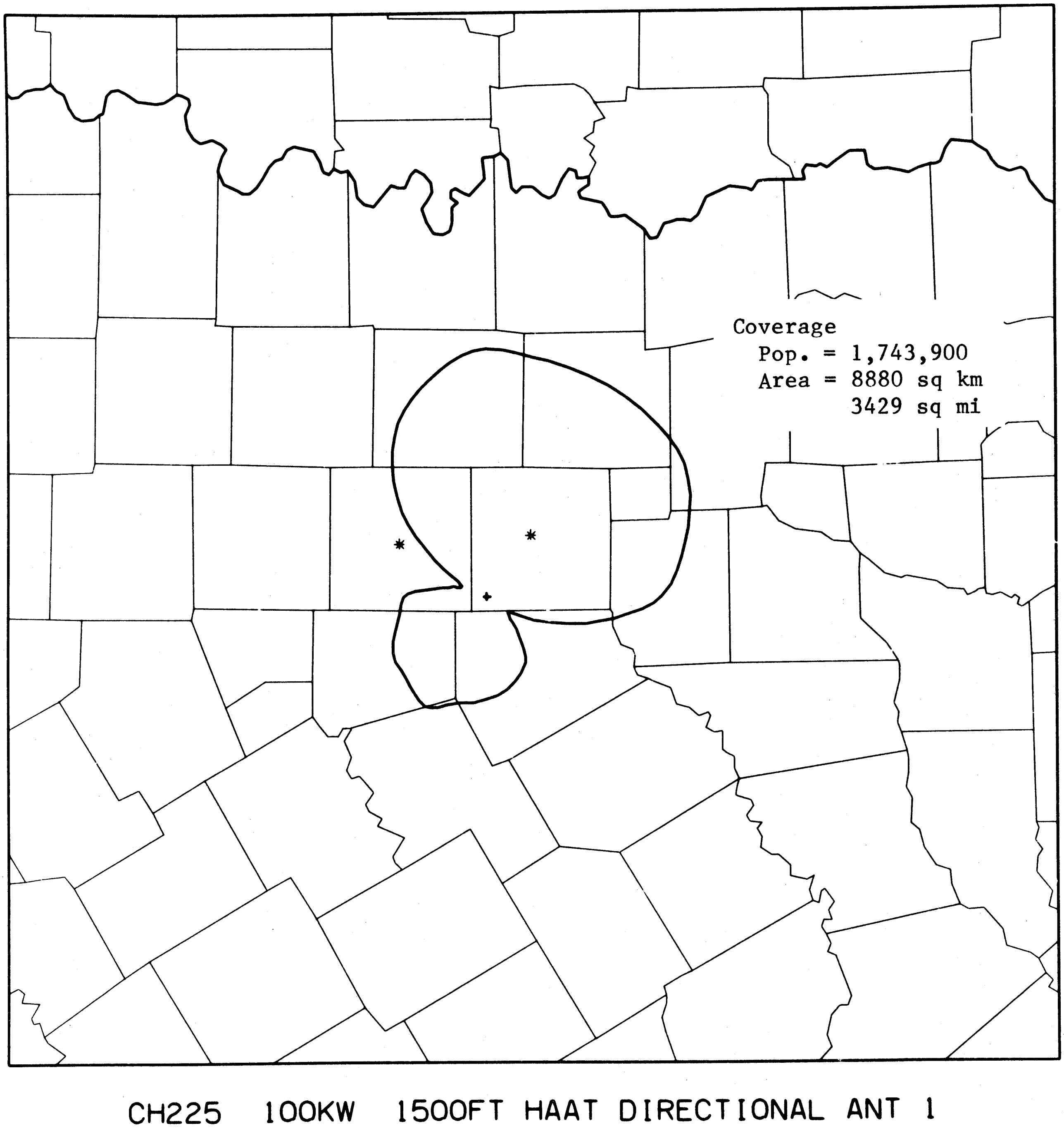
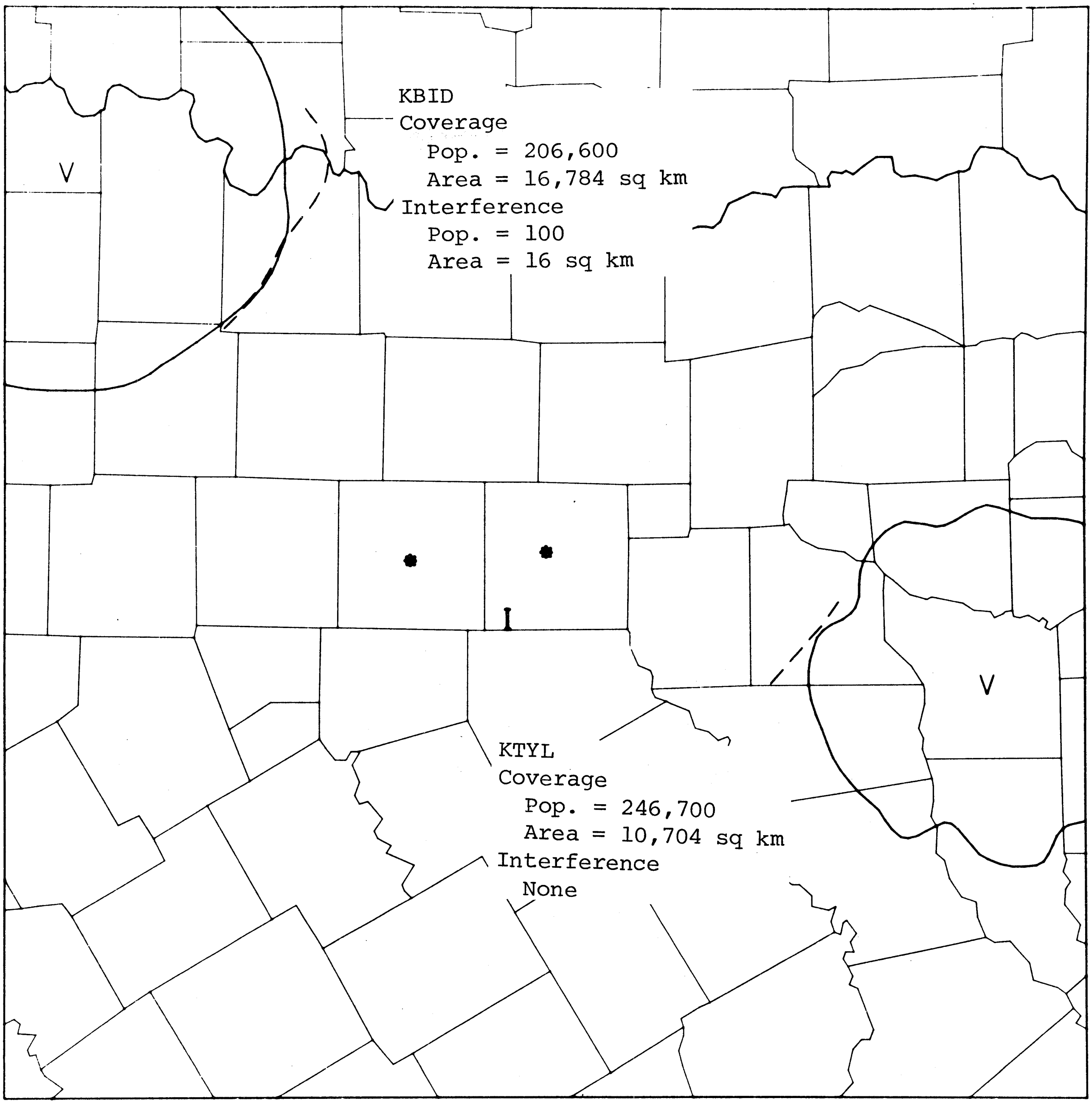
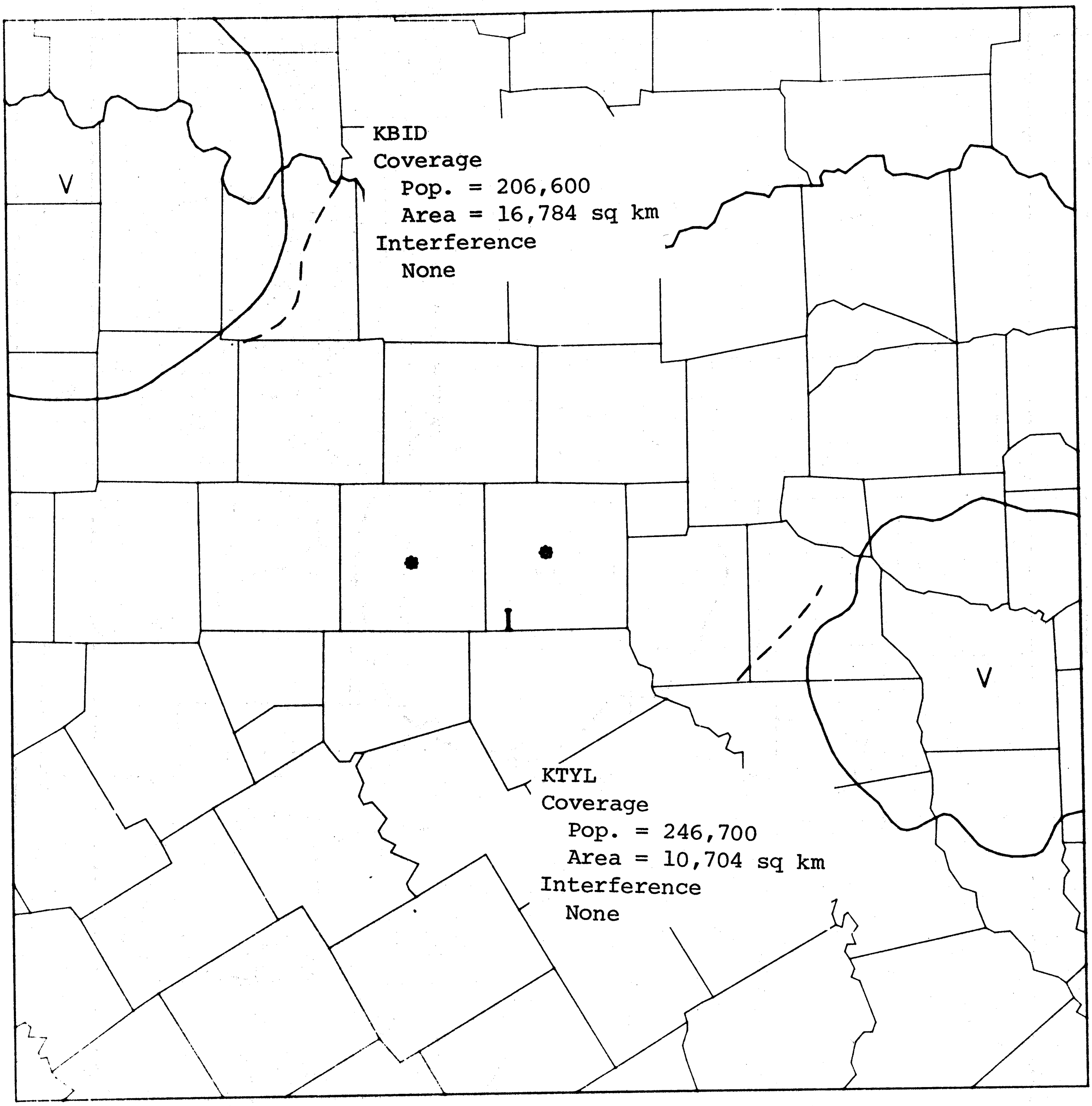



Figure B-4. (Continued).



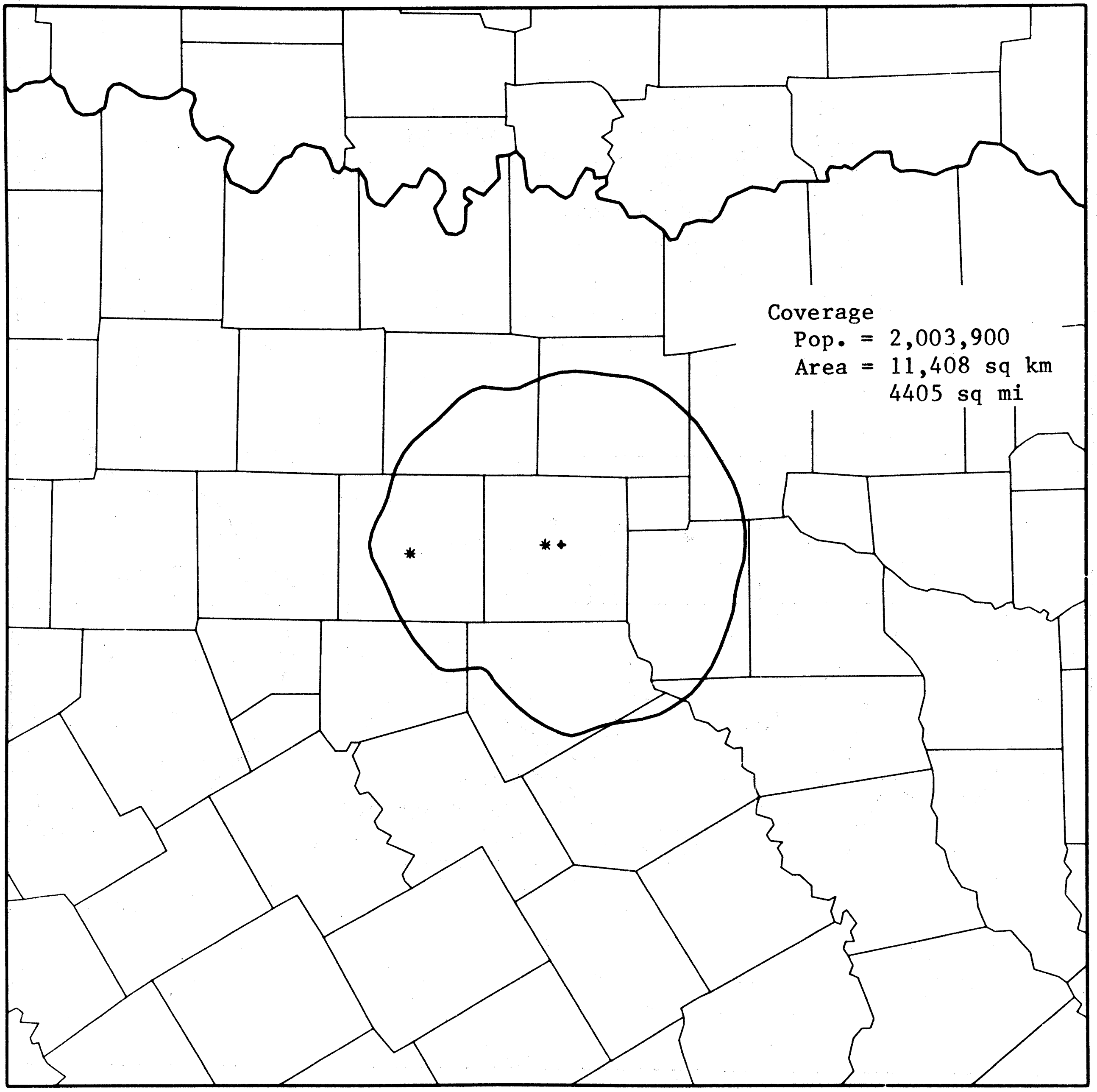

D=CH225 KBID CH226 KTYL U=100KW 1500FT D-A CH 225 D/U=20^6DB

Figure B-4. (Continued).



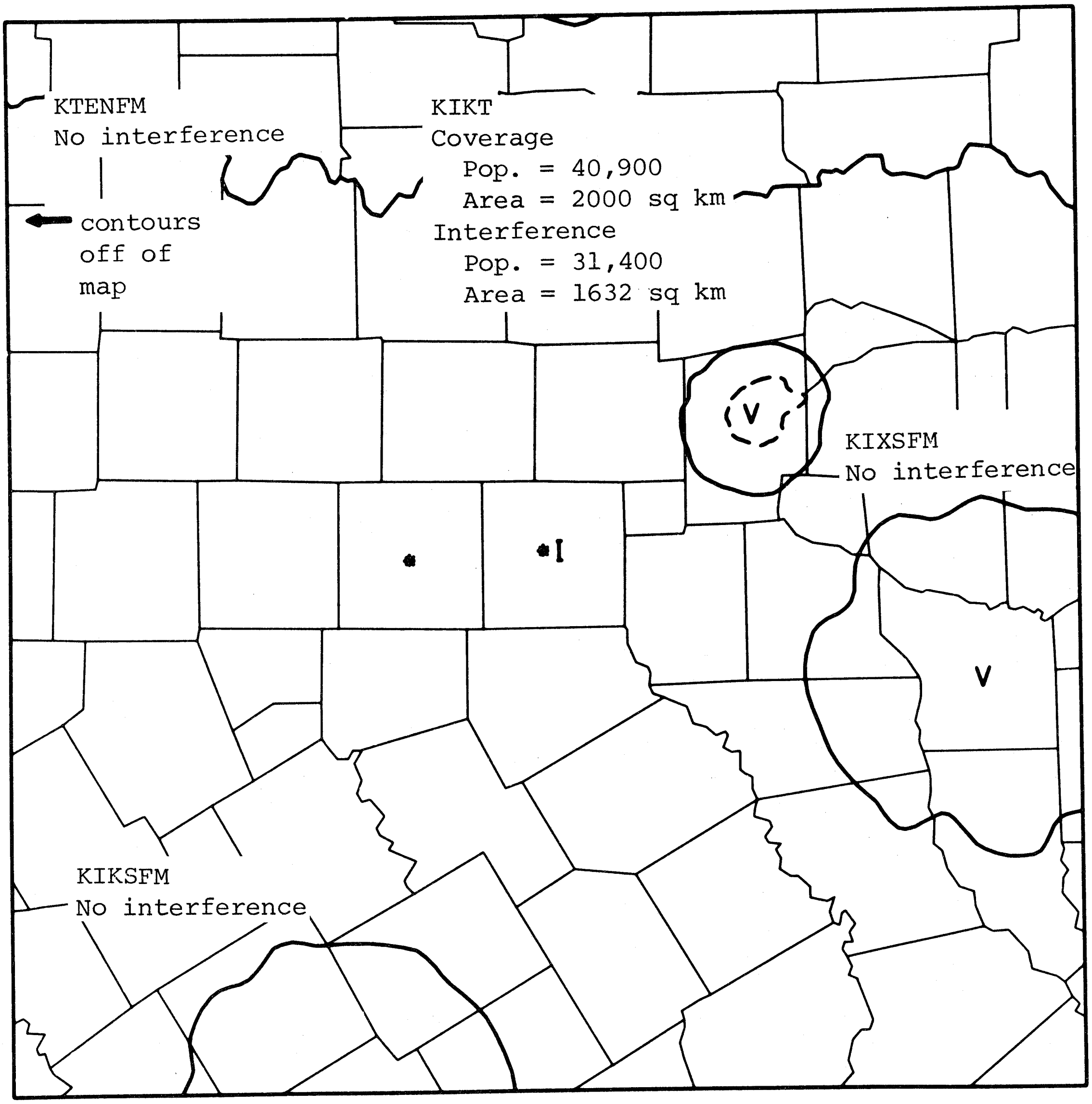

=CH225 KBID CH226 KTYL U=100KW 1500FT D-A CH 225 D/U=20^6DB

Figure B-4. (Continued).



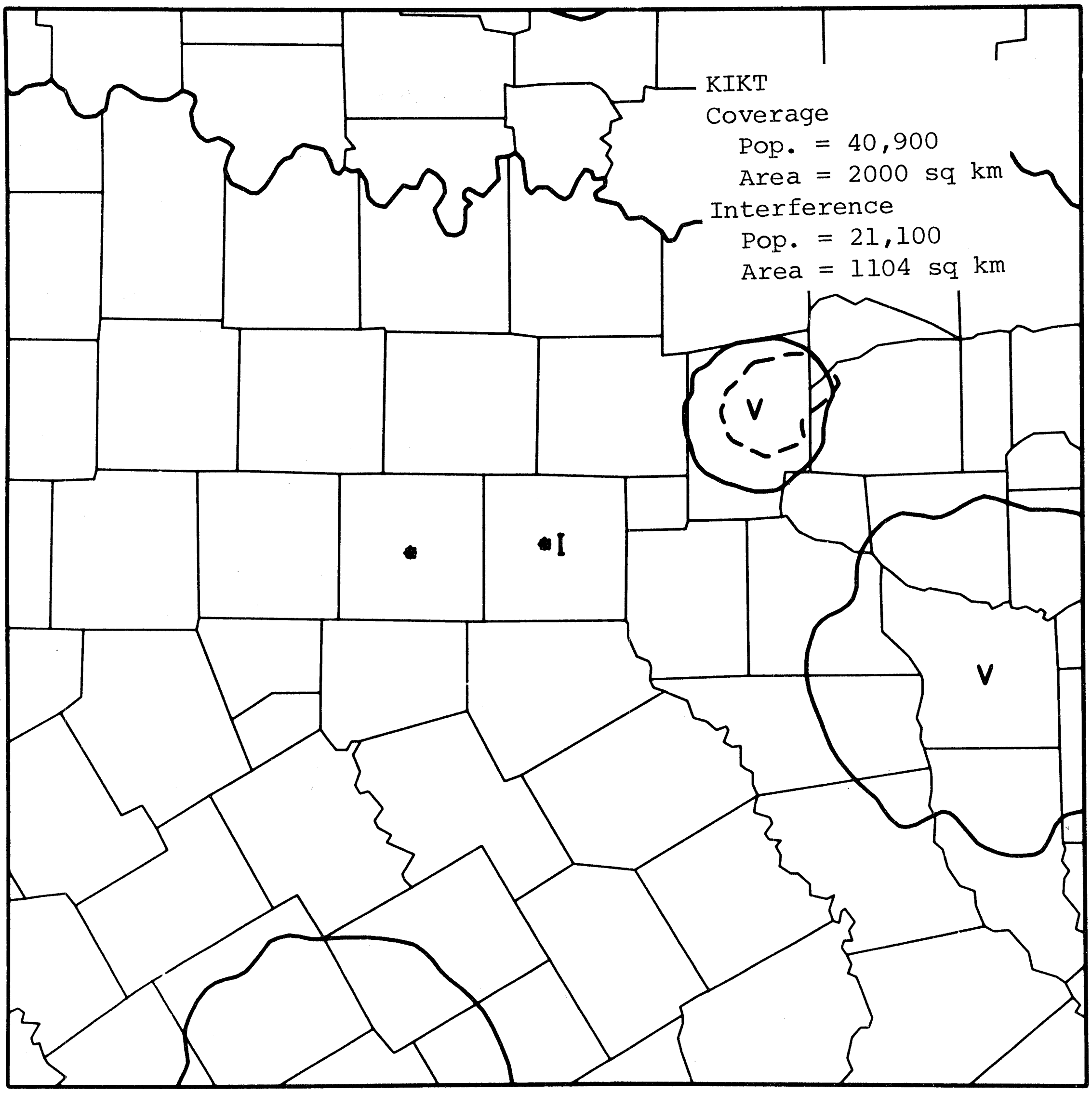

CH228 100KW 500FT HAAT

Figure B-5. Proposed channel 228.



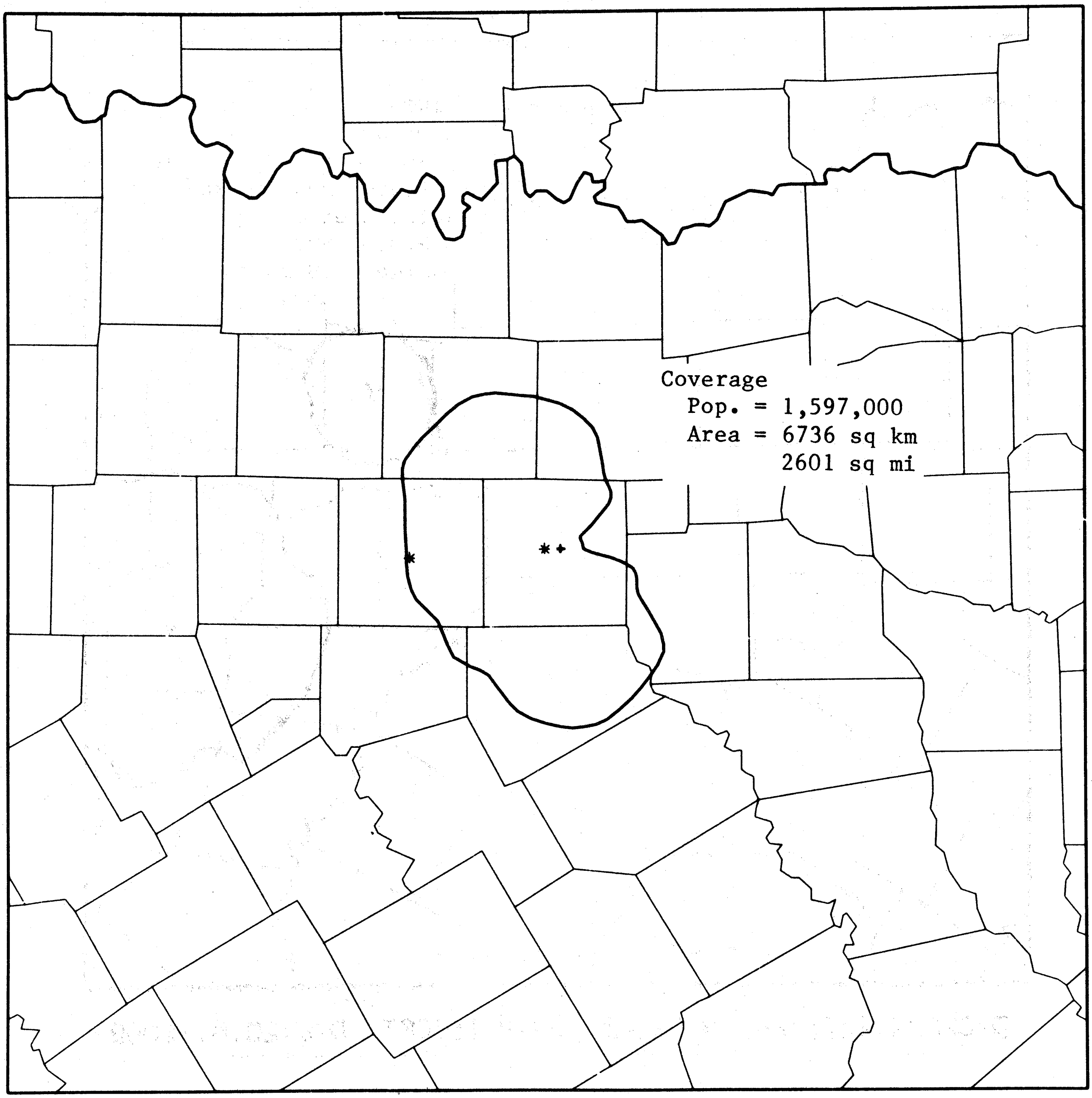

D=CH226,227,228 U=CH228 100KW 1500FT D/U=20,6,-20DB

Figure B-5. (Continued).



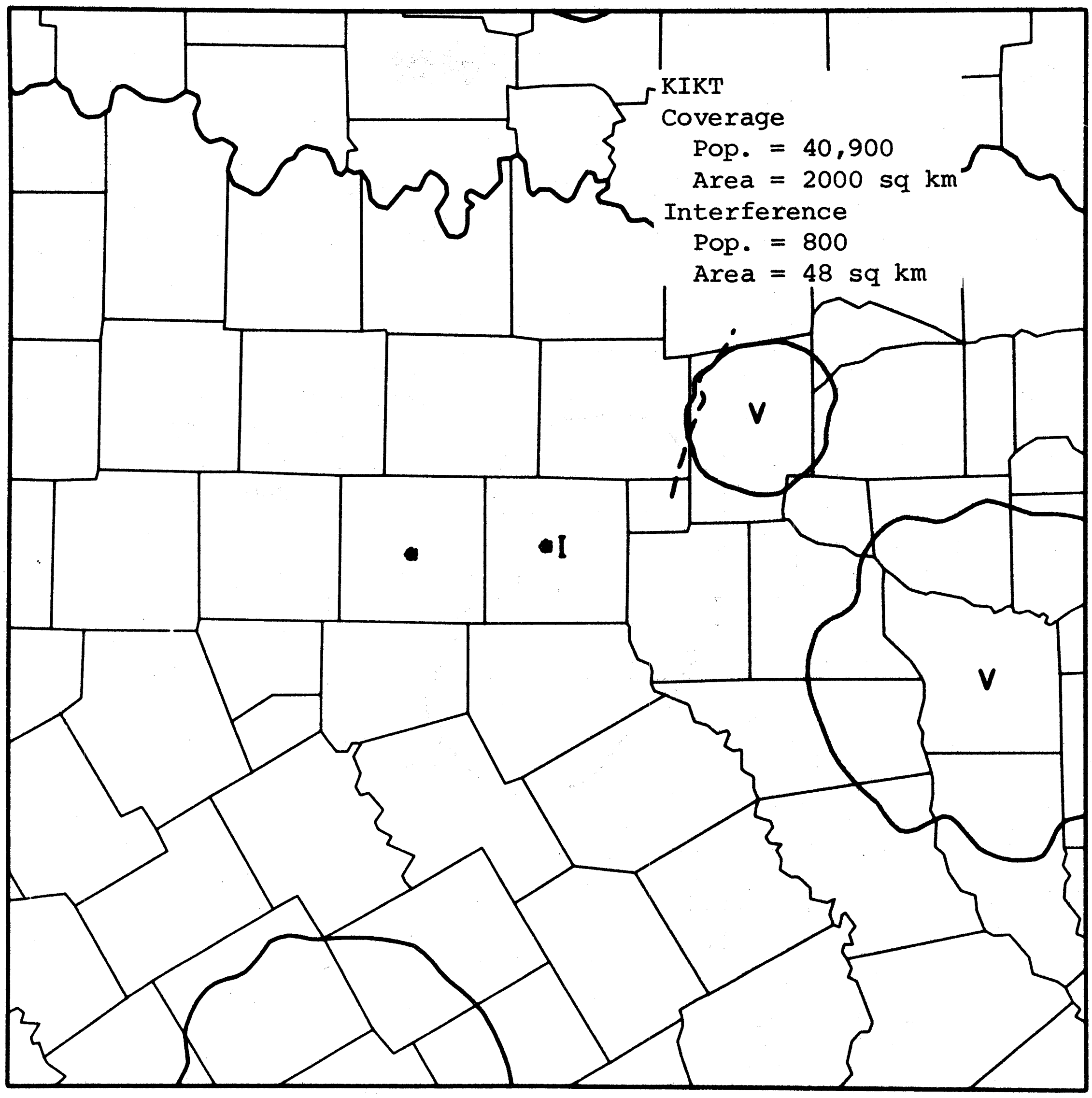

D=CH226,227,228 U=CH228 100KW 1500FT D/U=14,0,-50DB

Figure B-5. (Continued).



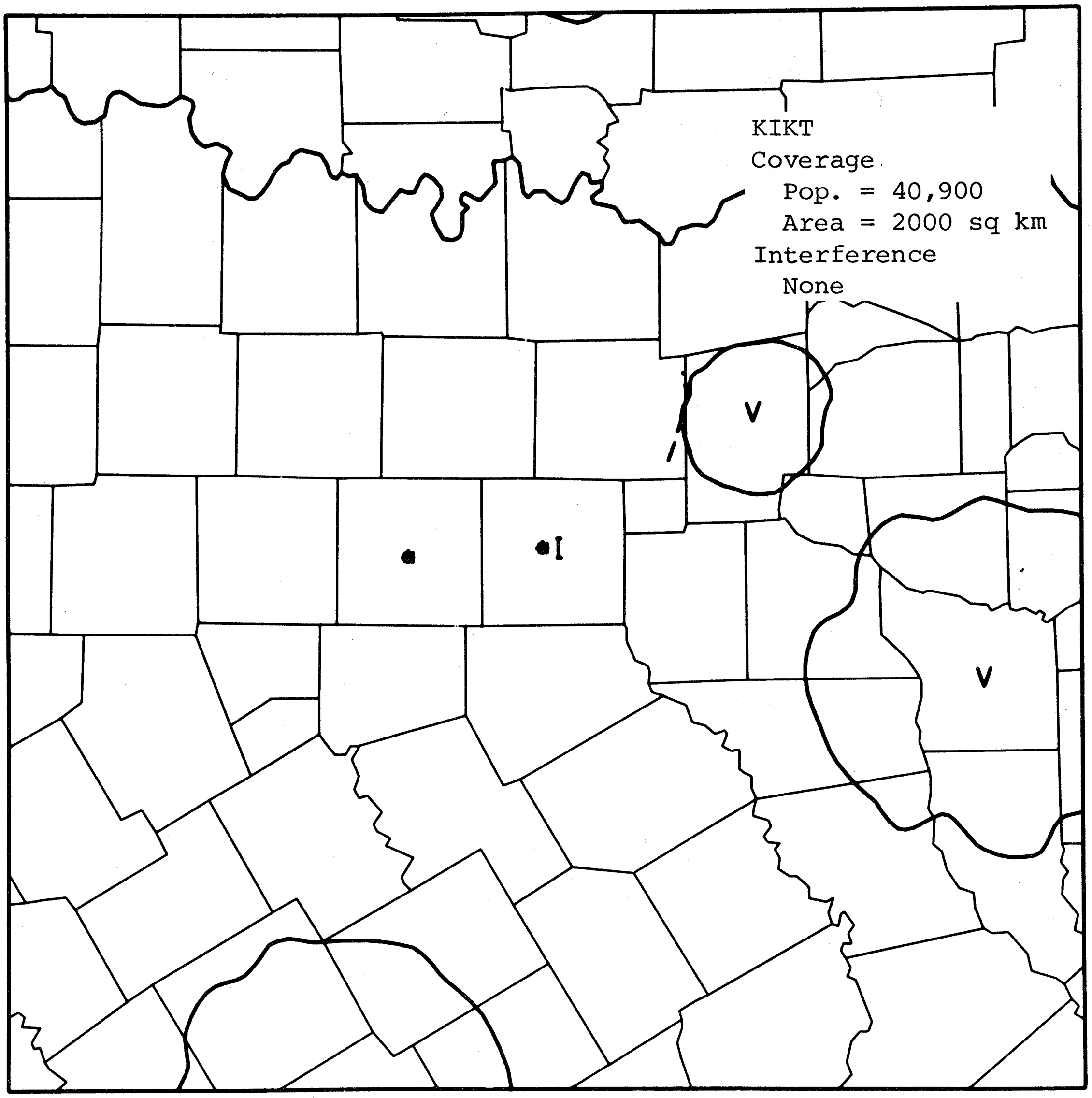

CH228 100KW 500FT HAAT DIRECTIONAL ANT 3

Figure B-5. (Continued).



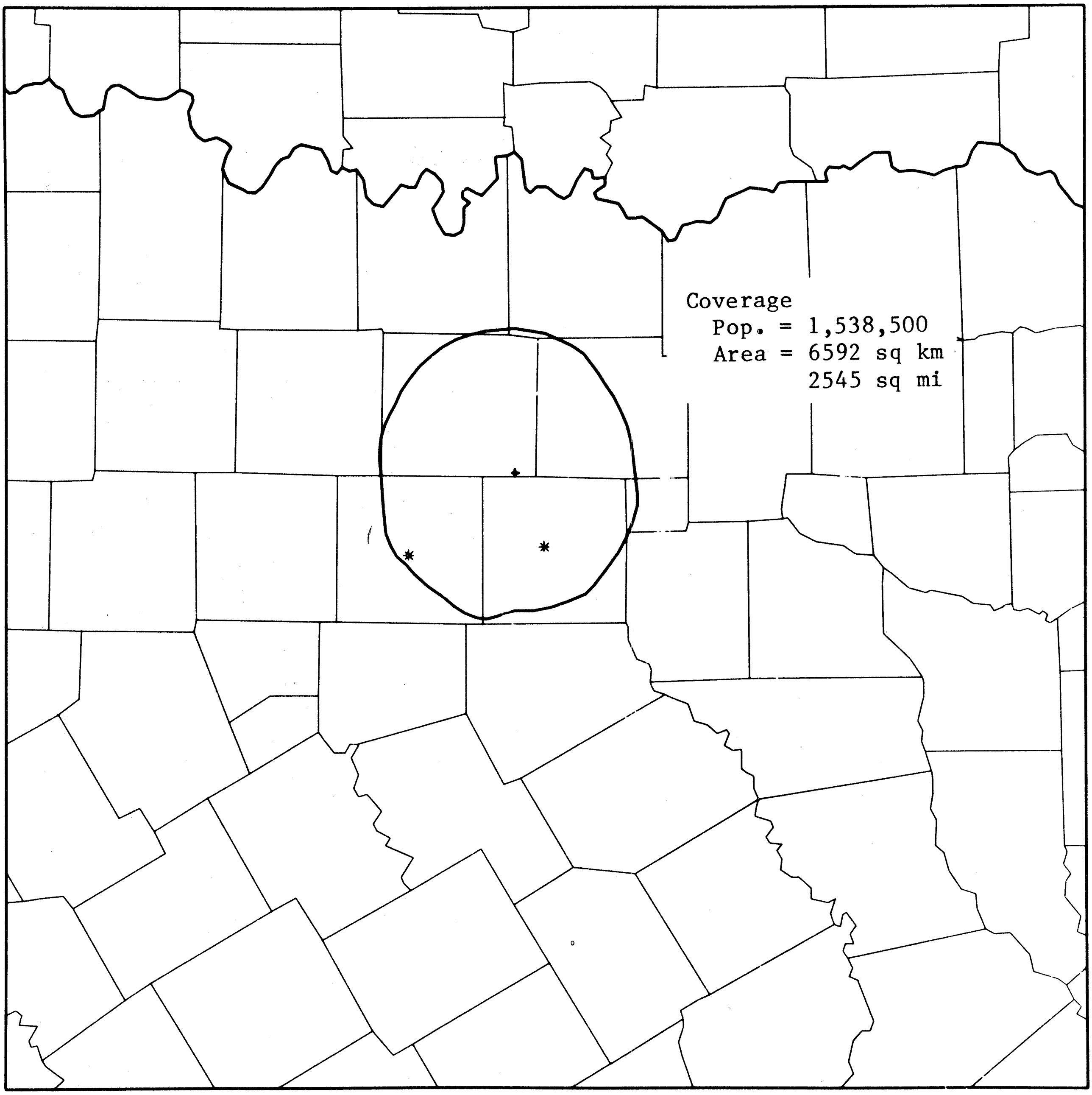

D=CH226,227,228 U=CH228 100KW 1500FT D/U=20,6,-20DB

Figure B-5. (Continued).



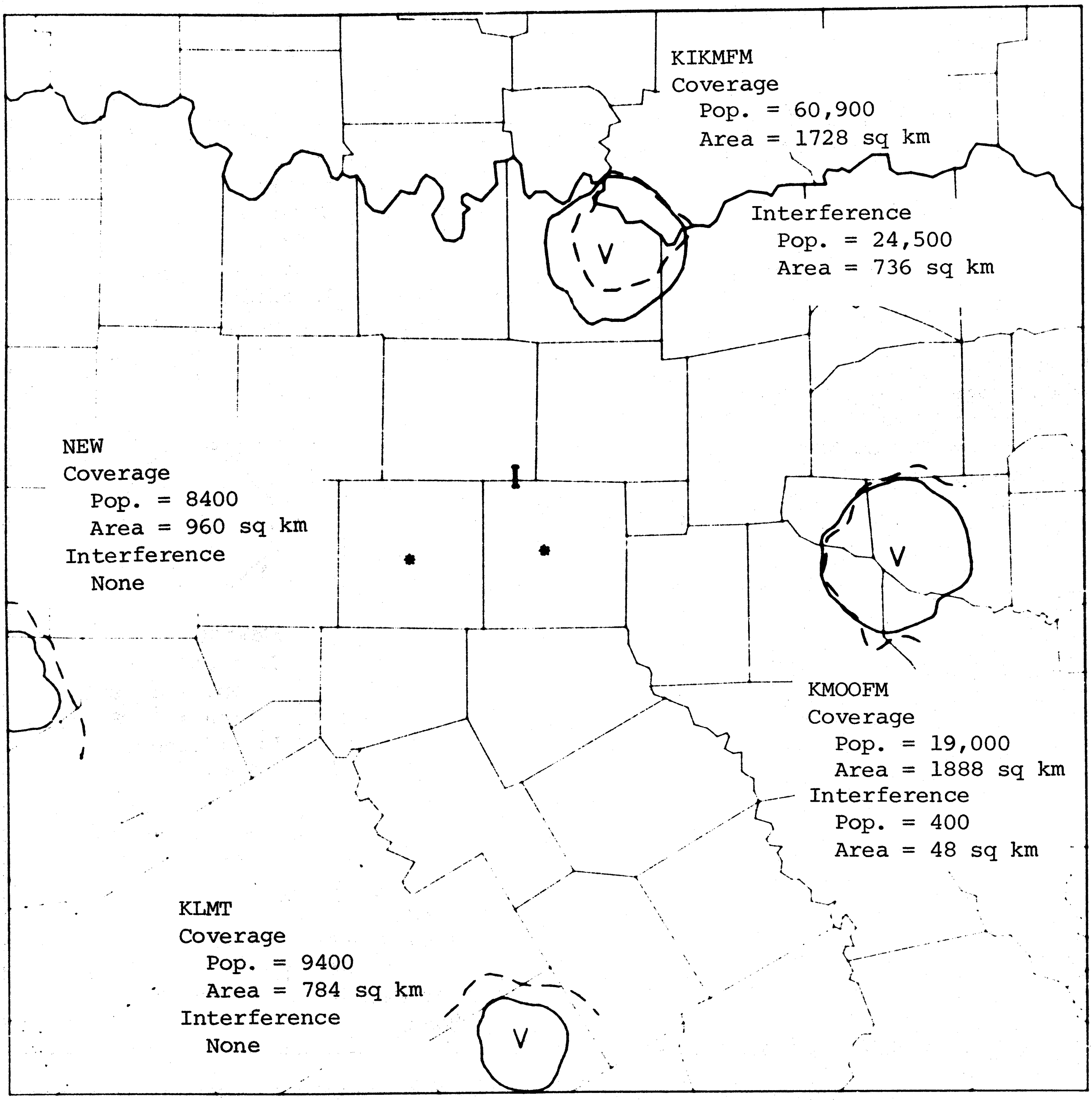

D=CH226,227,228 U=CH228 100KW 1500FT D/U=14,0,-50DB

Figure B-5. (Continued).




CH244 20KW 500FT HAAT

Figure B-6. Proposed channel 244.




D=CH244 U=CH244 20KW 500FT D/U=20DB

Figure B-6. (Continued).

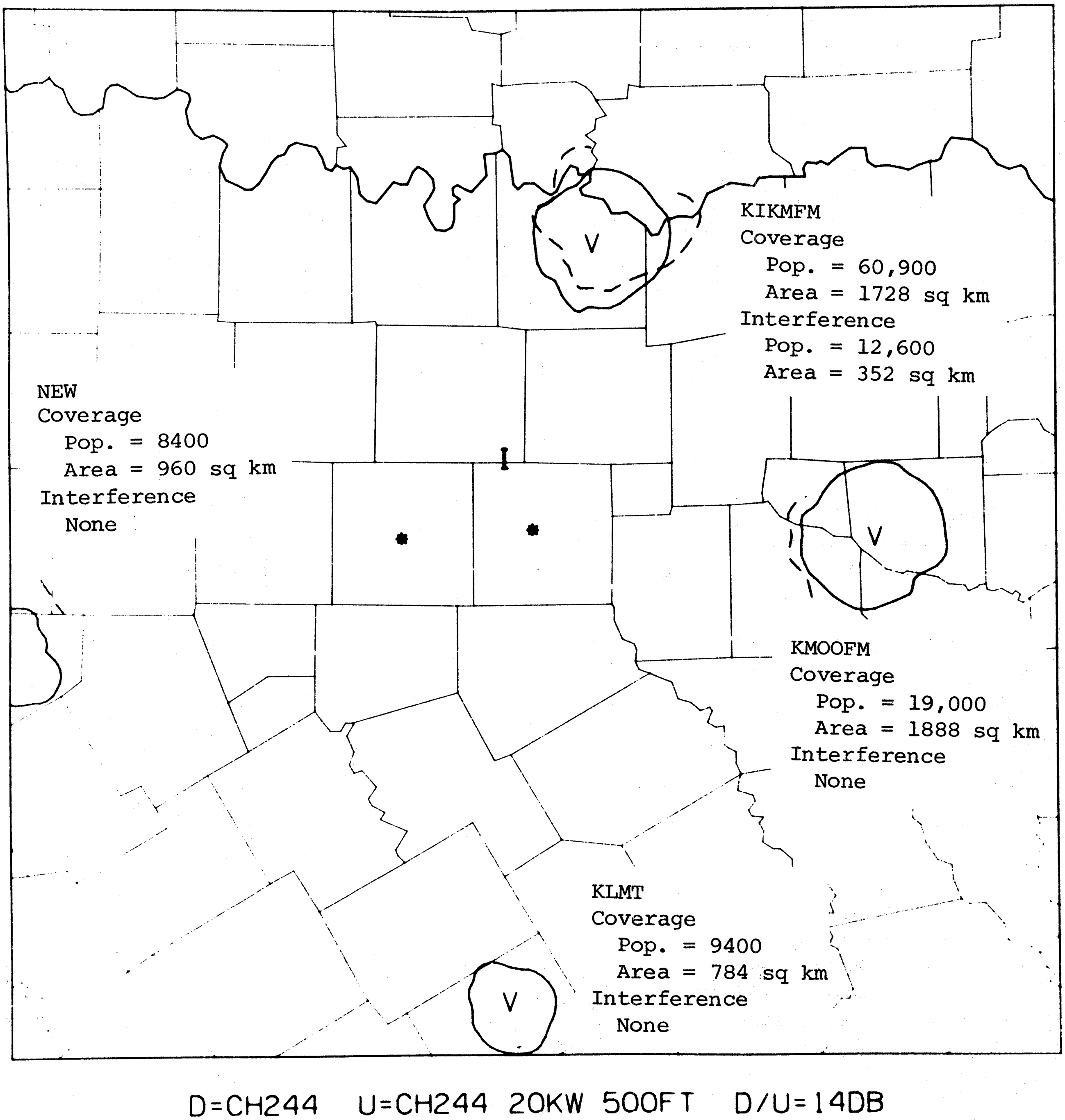
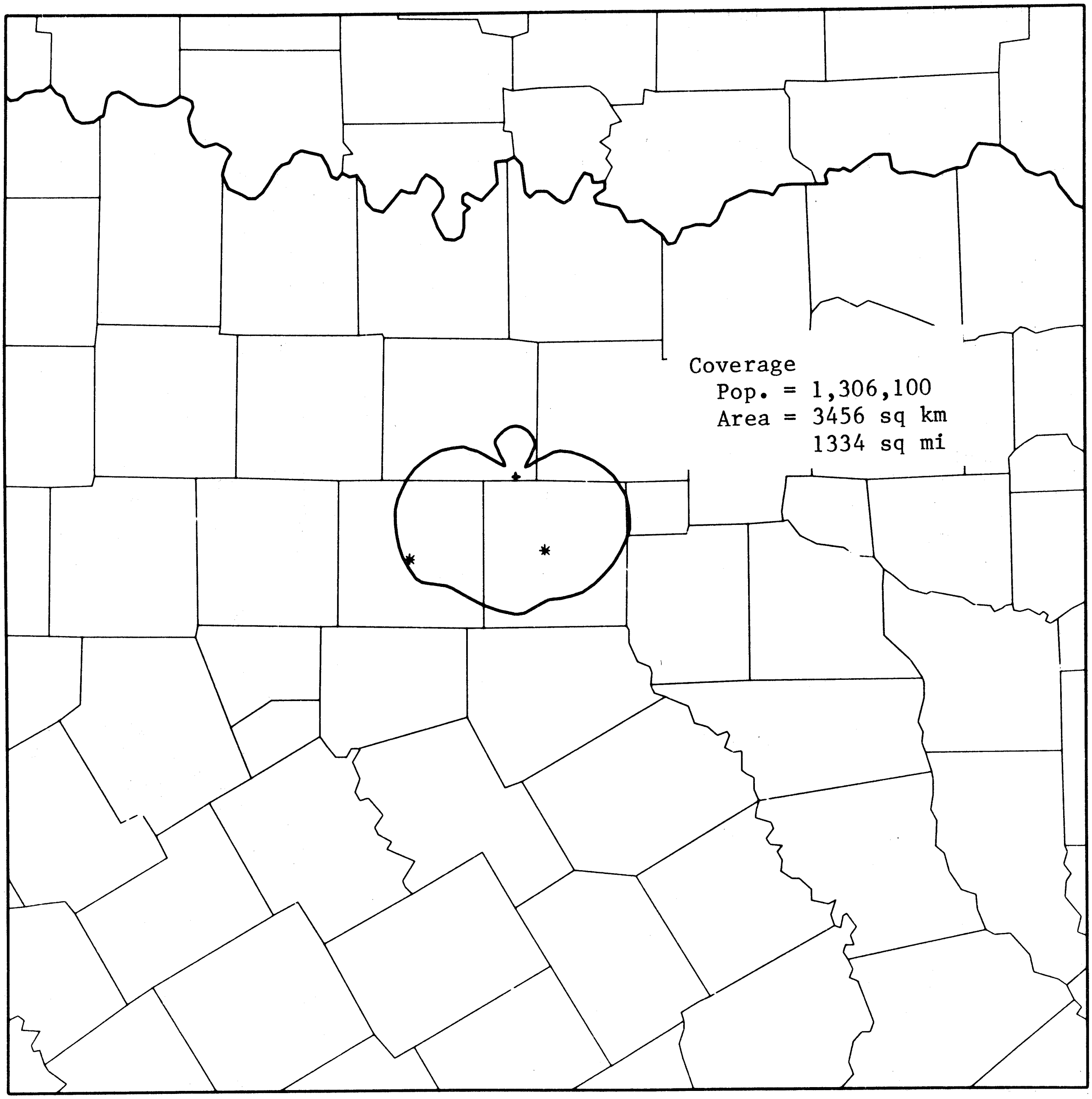
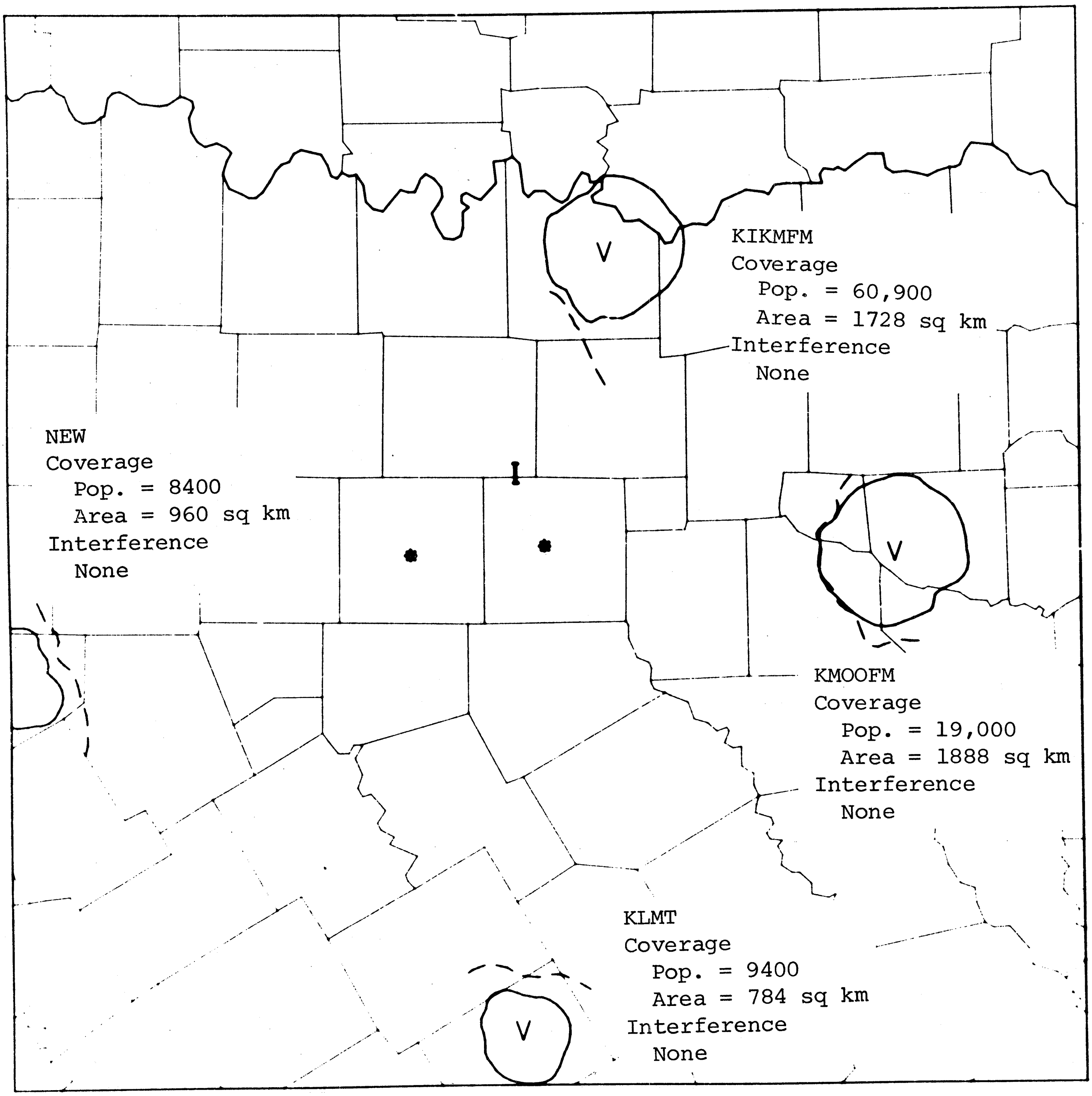



Figure B-6. (Continued).



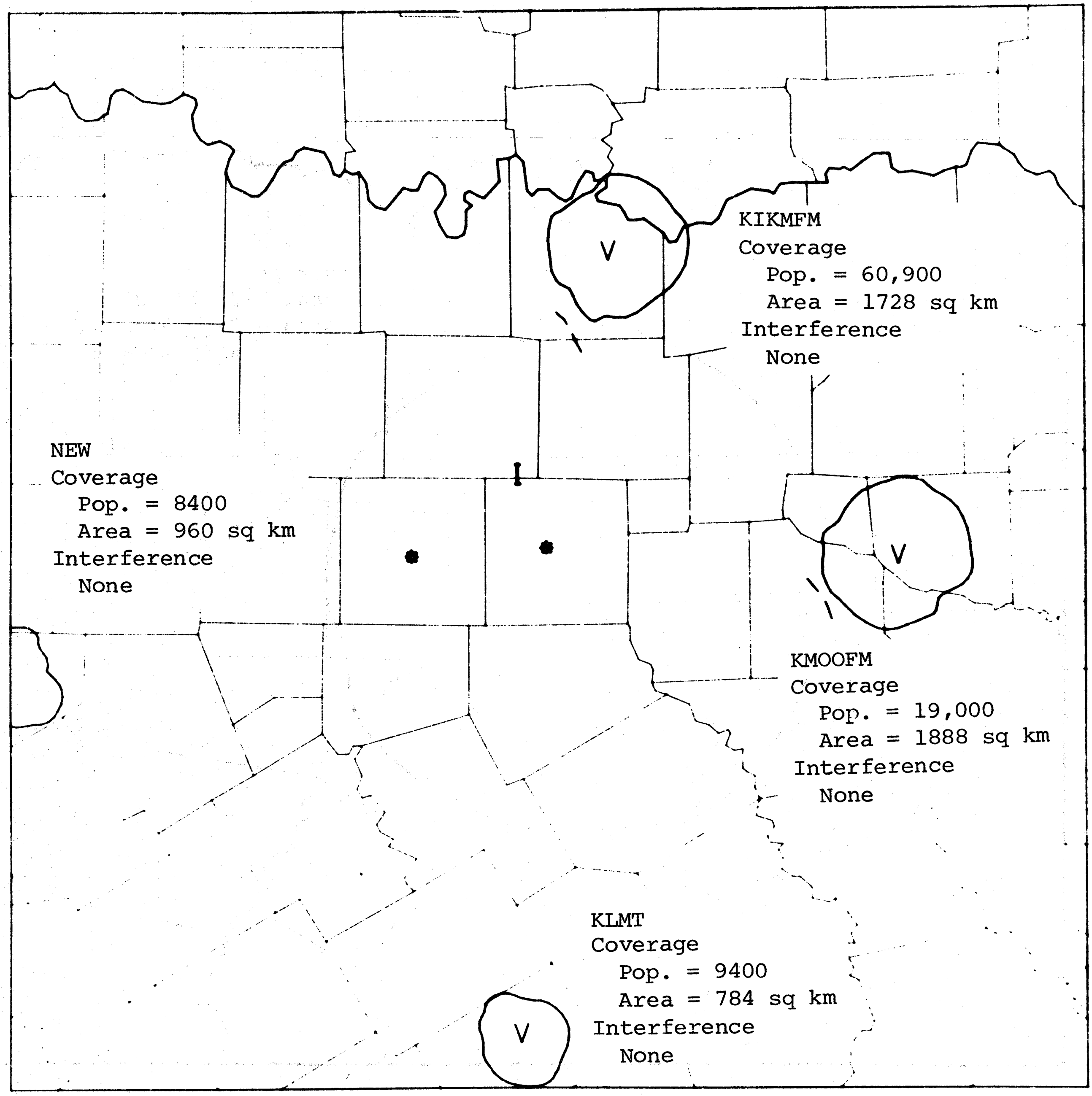

CH244 20KW 500FT HAAT DIRECTIONAL ANT 2

Figure B-6. (Continued).



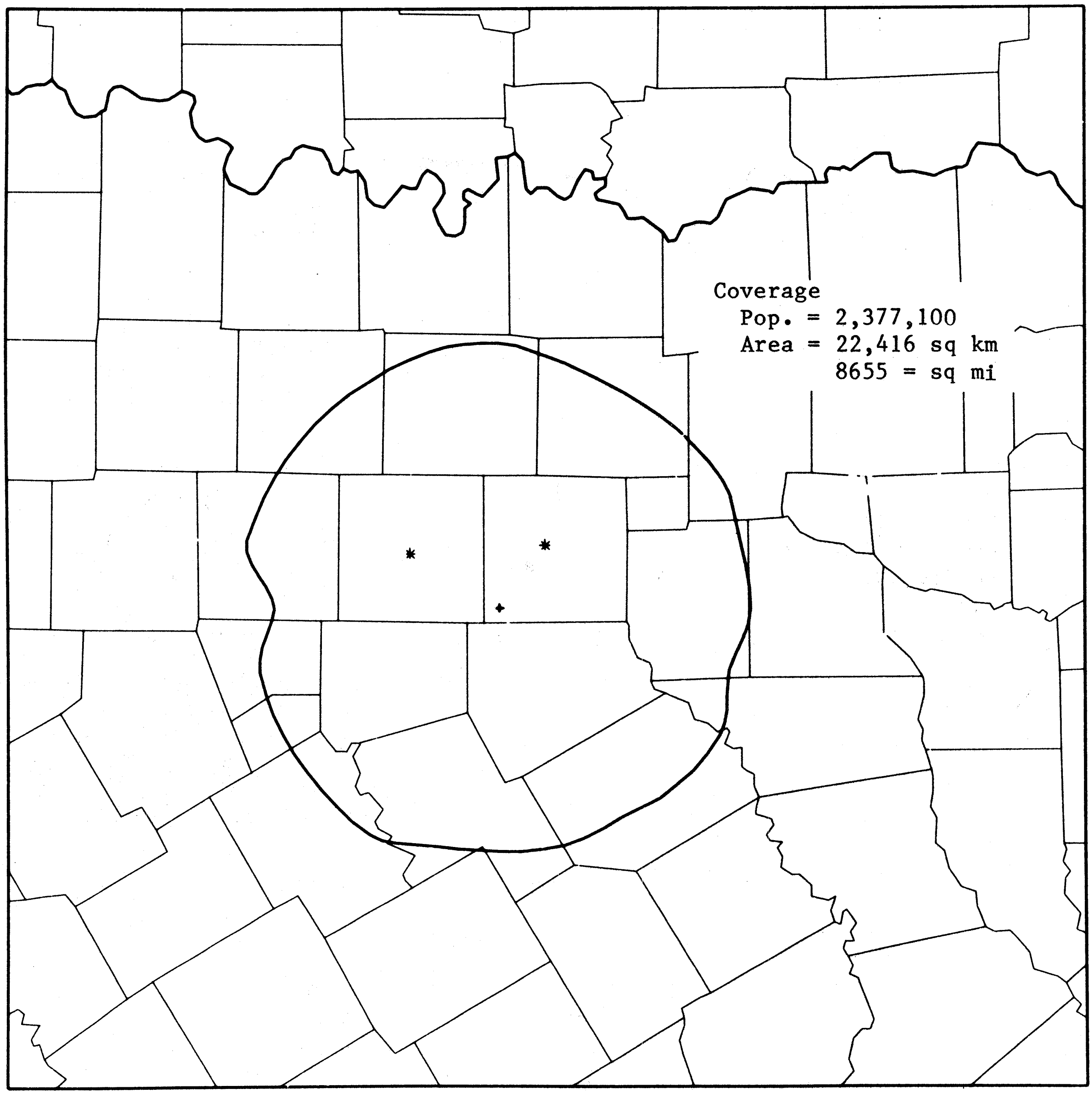

D=CH244 U=CH244 20KW 500FT D/U=20DB

Figure B-6. (Continued).




D=CH244 U=CH244 20KW 500FT D/U=14DB

Figure B-6. (Continued).




CH248 100KW 1500FT

Figure B-7. Proposed channel 248.

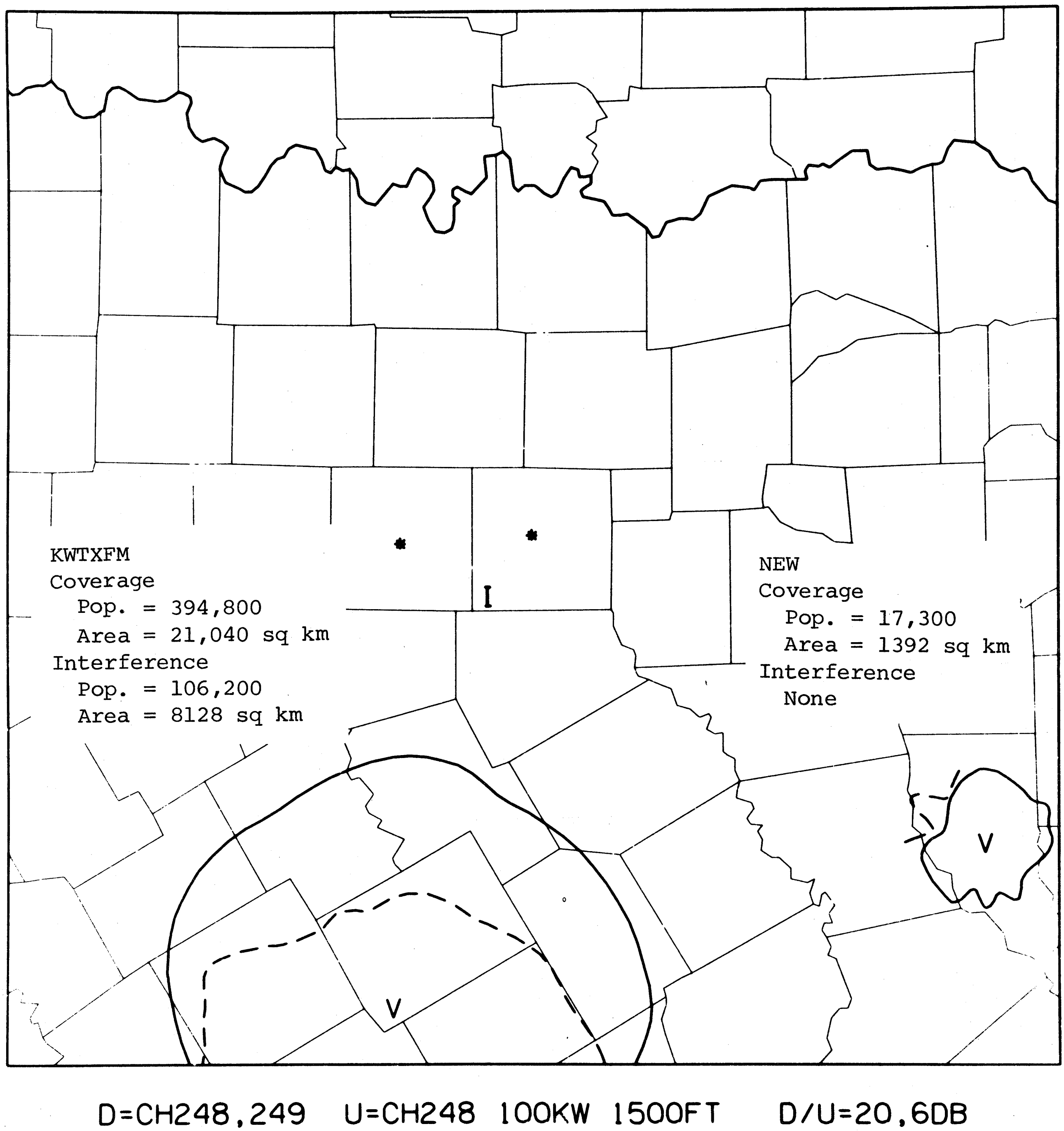
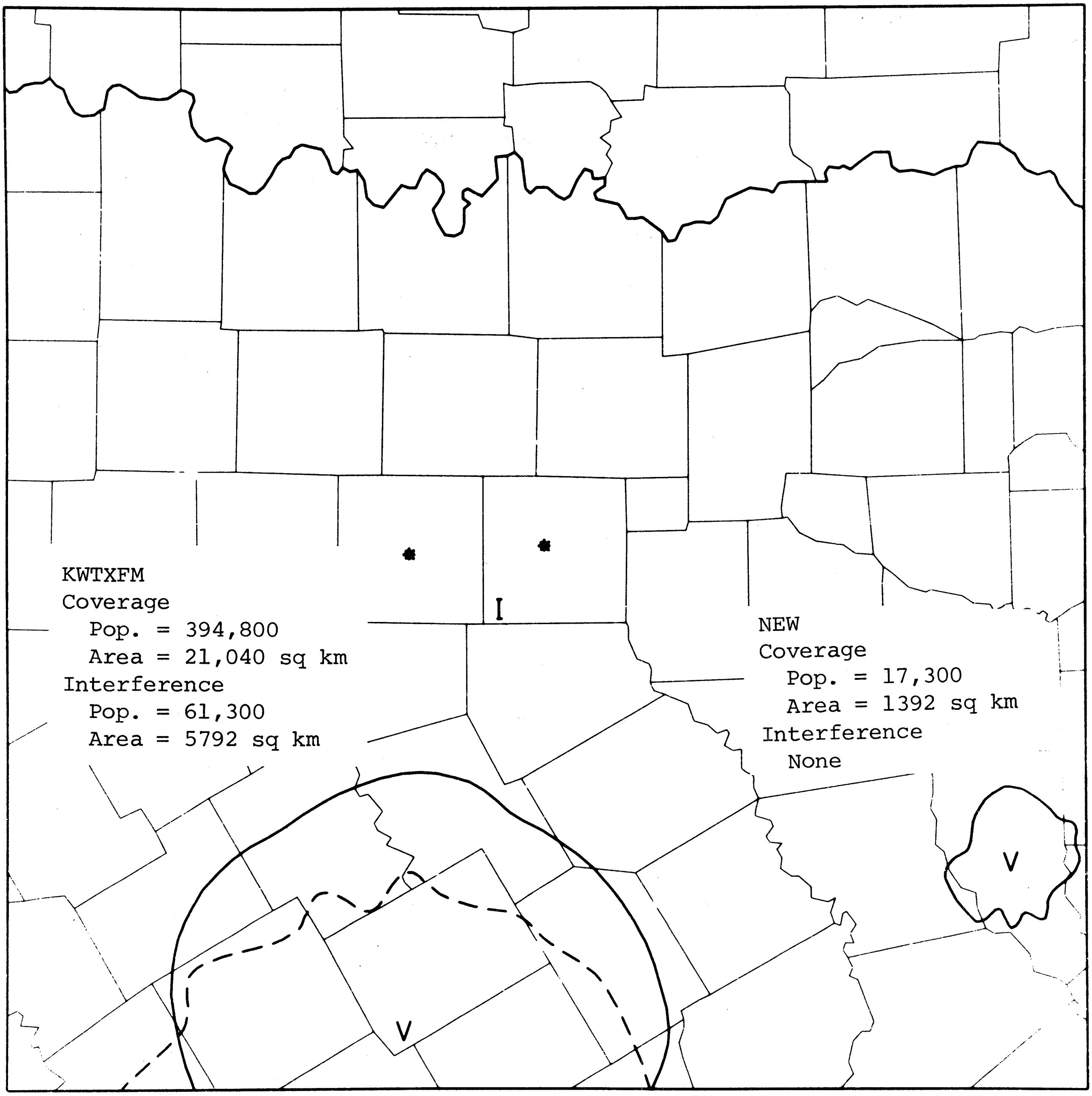



Figure B-7. (Continued).




D=CH248,249 U=CH248 100KW 1500FT D/U=14,0DB

Figure B-7. (Continued).

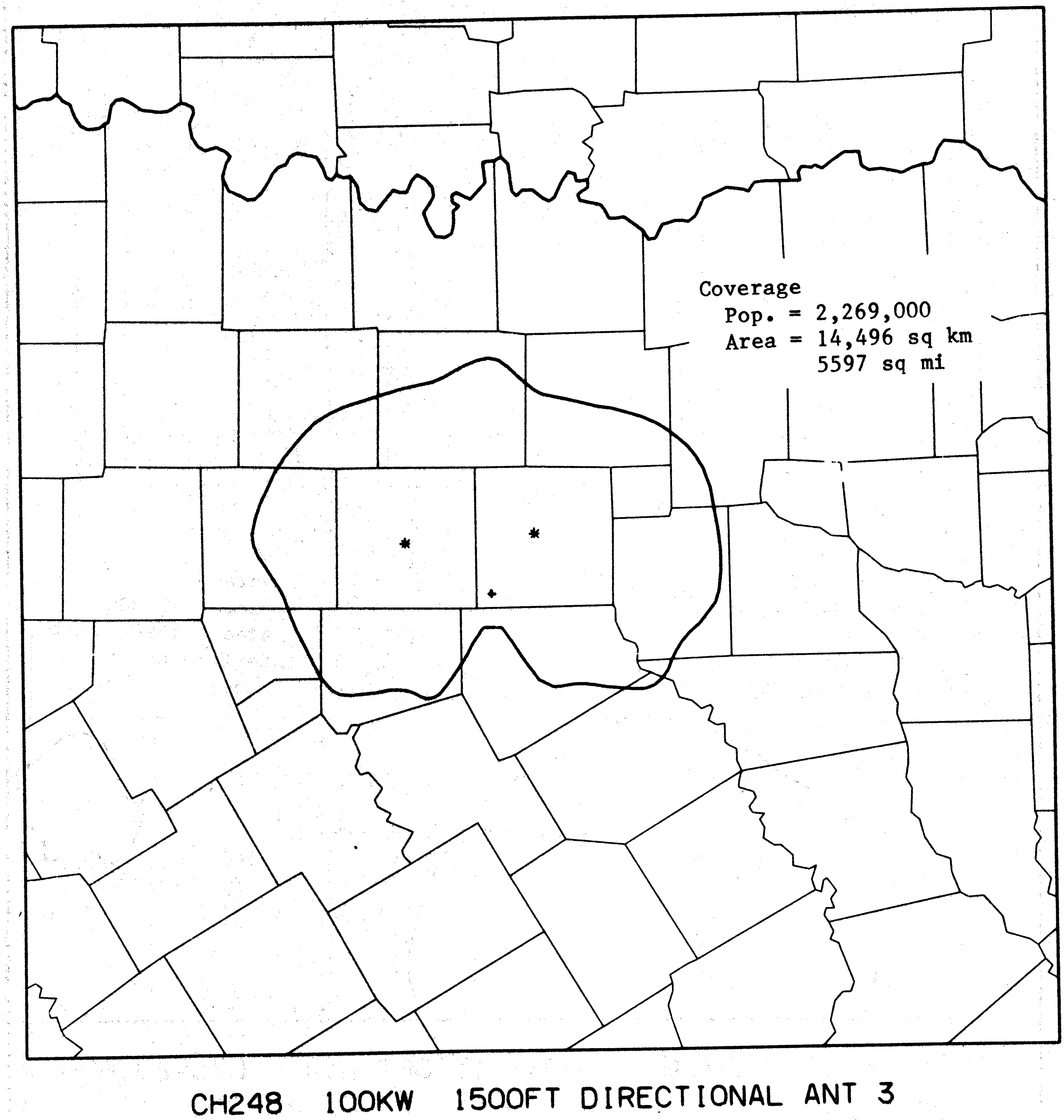



Figure B-7. (Continued).

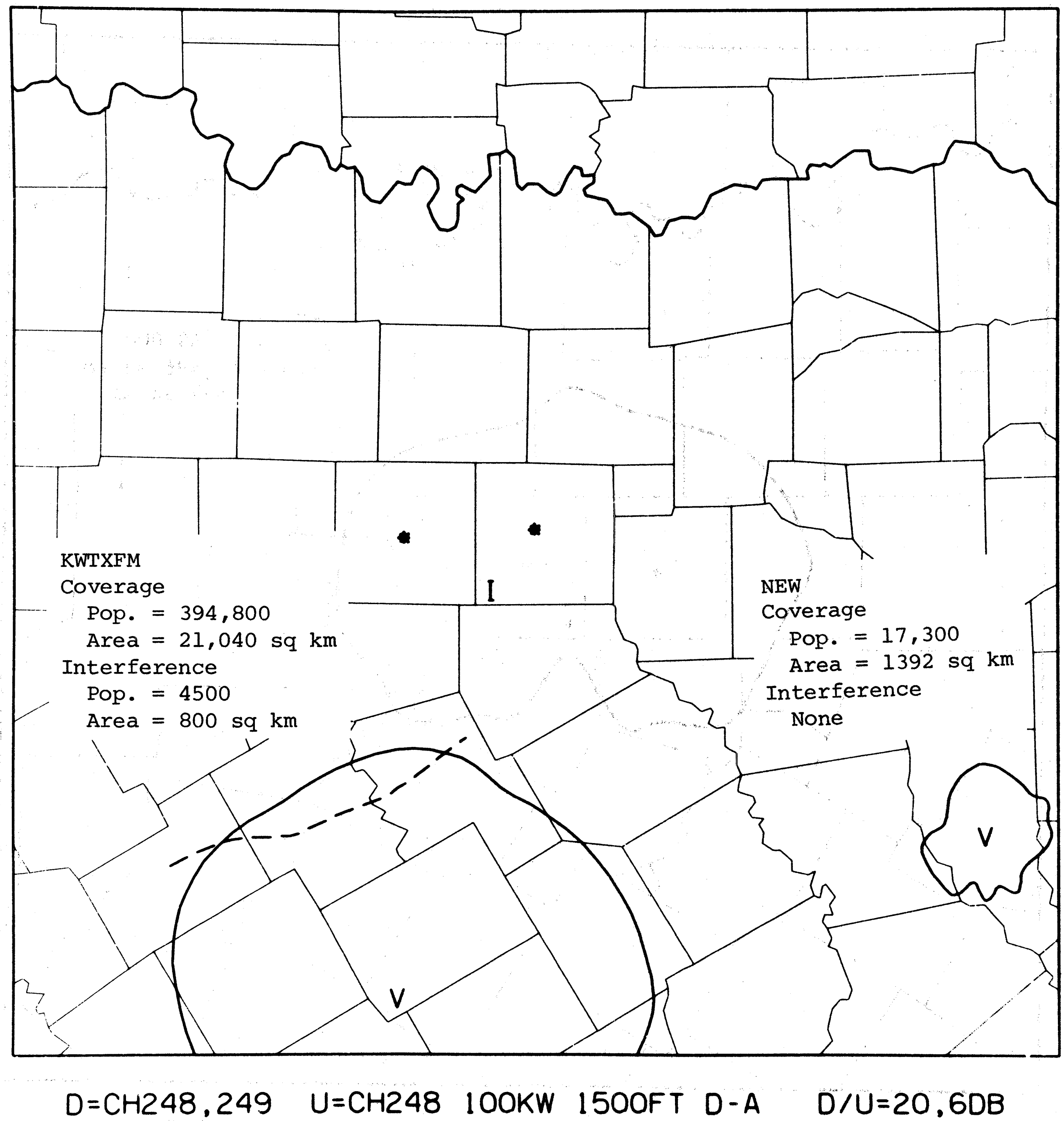
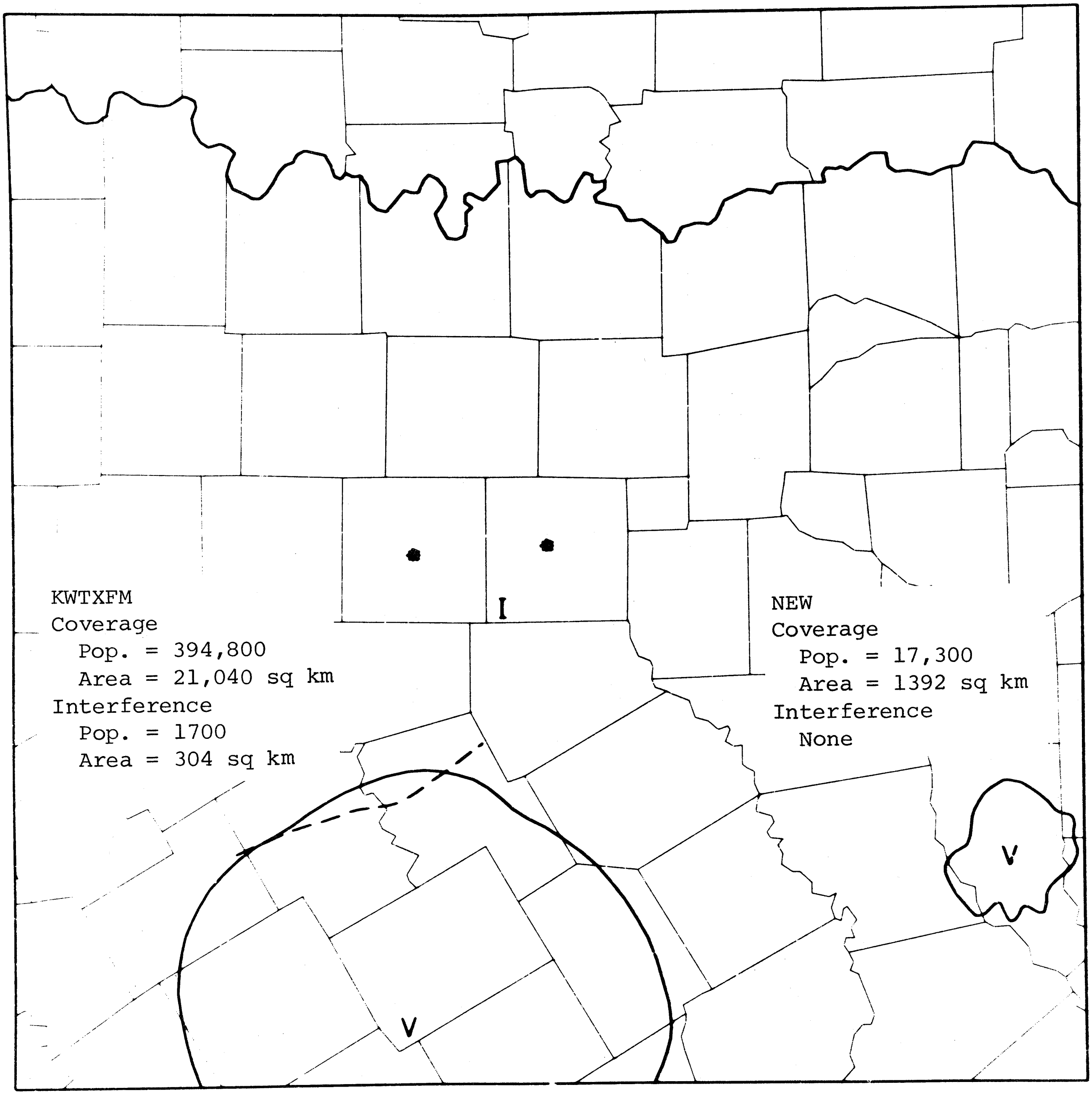
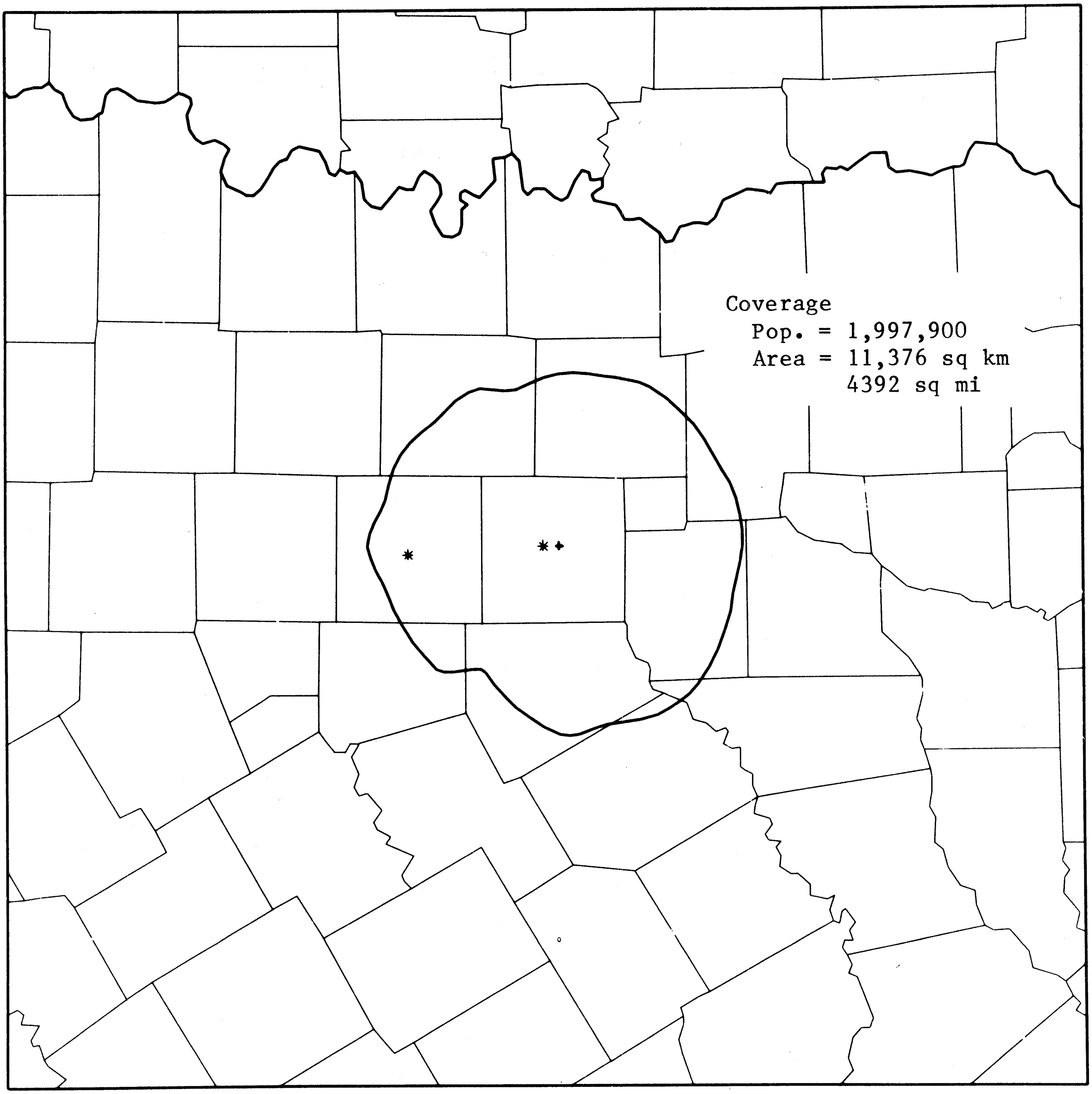



Figure B-7. (Continued).




D=CH248.249 U=CH248 100KW 1500FT D-A D/U=14.0DB

Figure B-7. (Continued).




CH256 100KW 500FT HAAT

Figure B-8. Proposed channel 256.

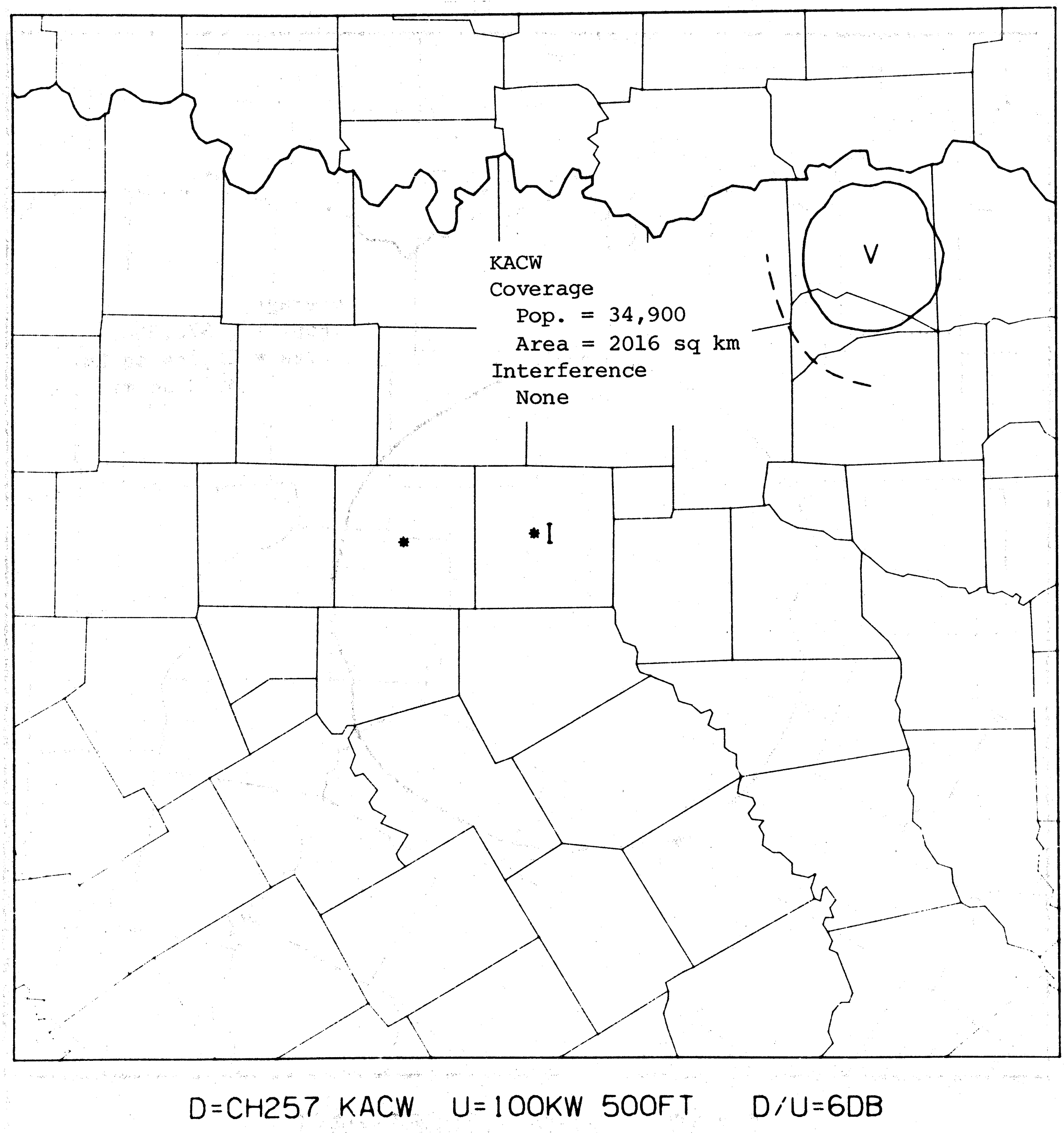
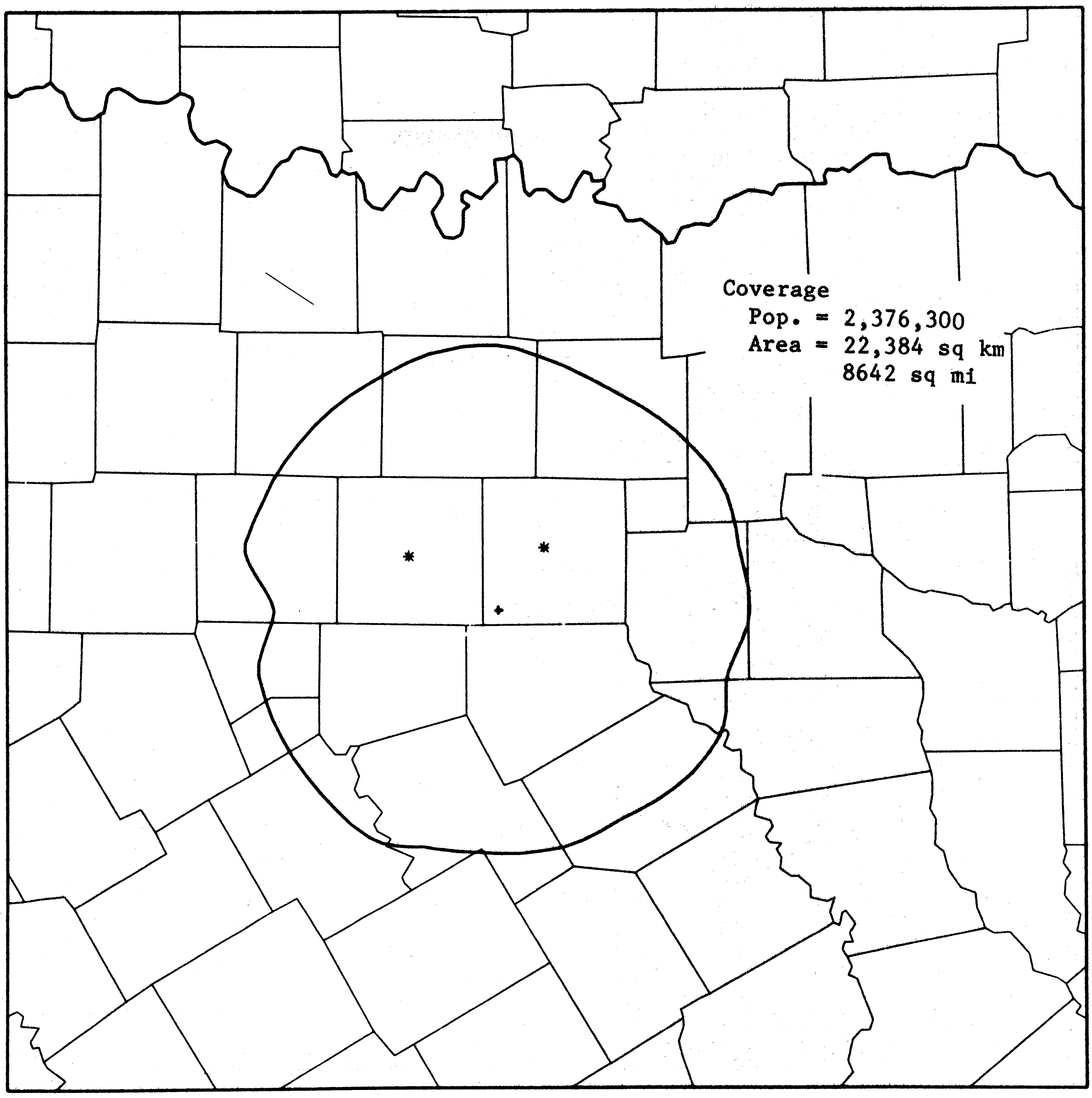
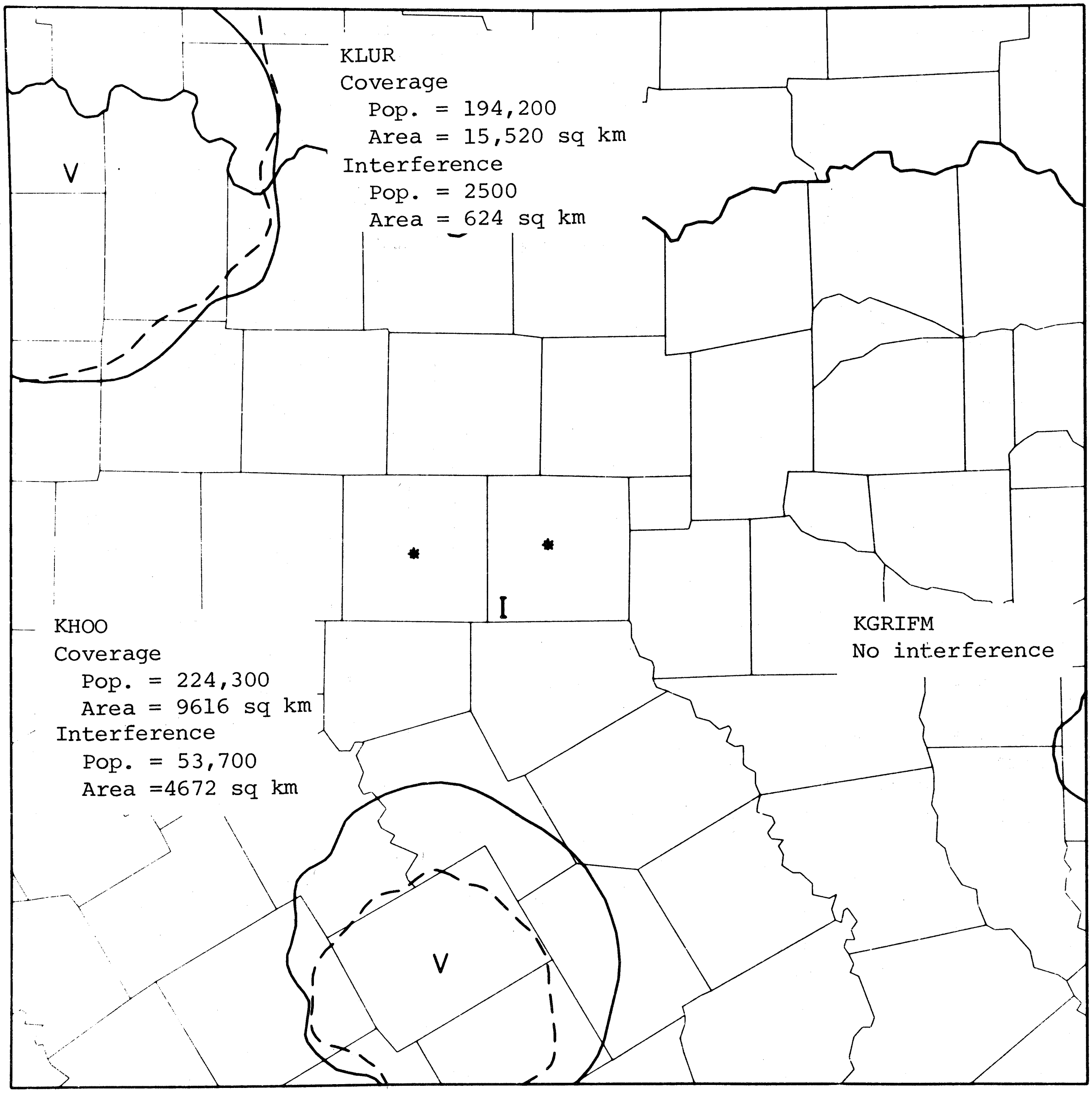



Figure B-8. (Continued).




CH260 100KW 1500FT HAAT

Figure B-9. Proposed channel 260.




D=CH260,261 U=CH260 100KW 1000FT D/J=20,6DB

Figure B-9. (Continued).

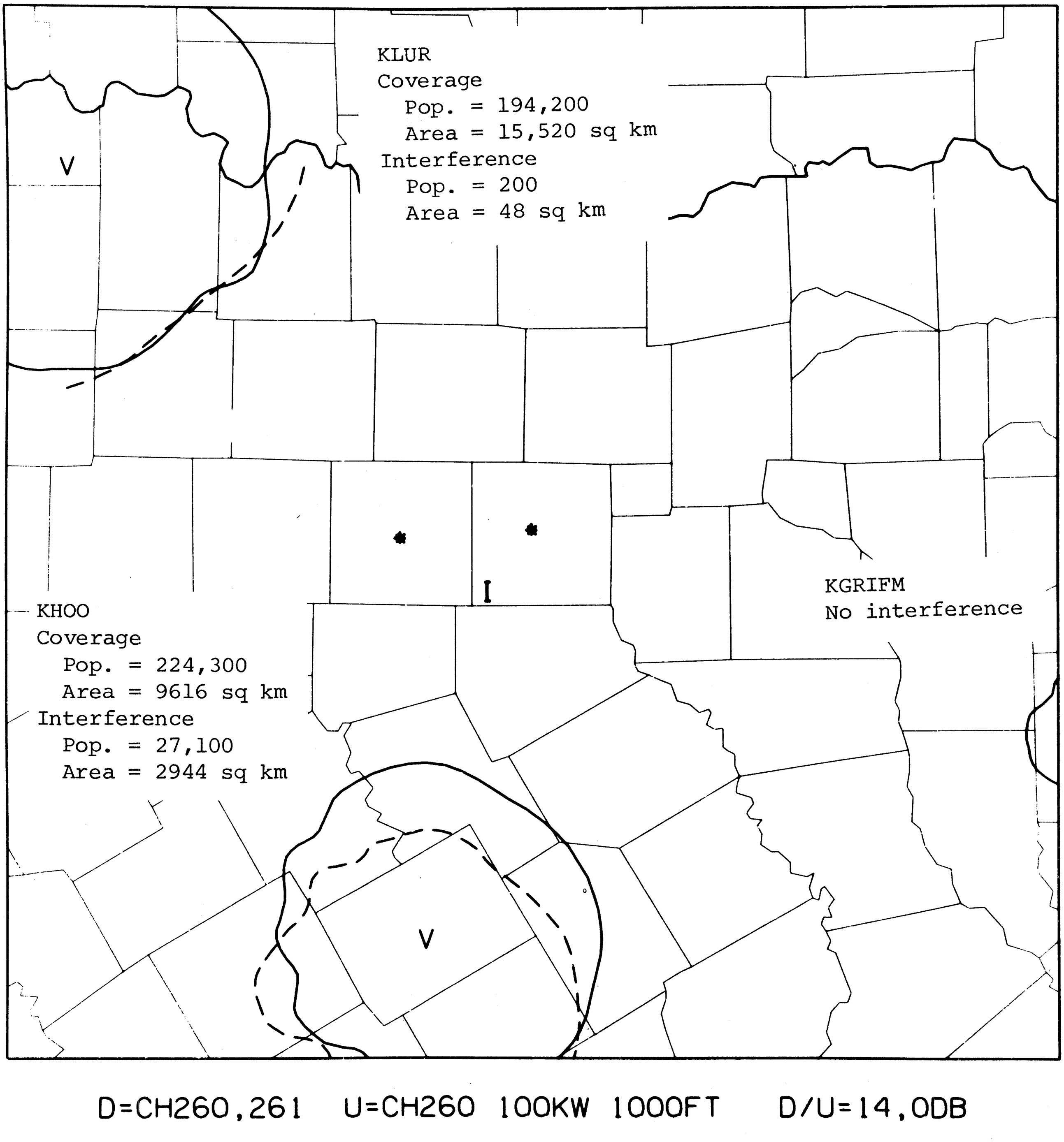
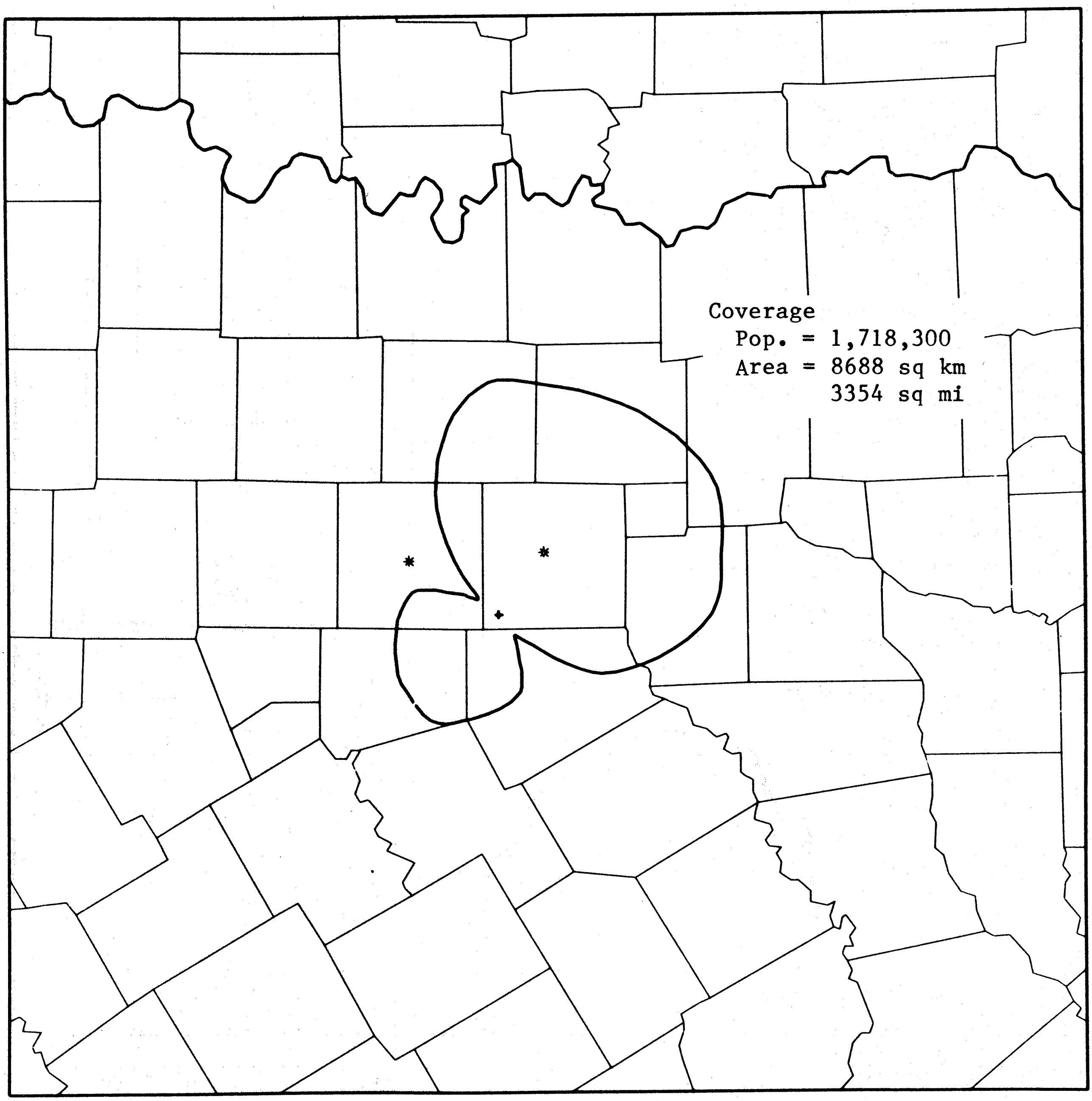
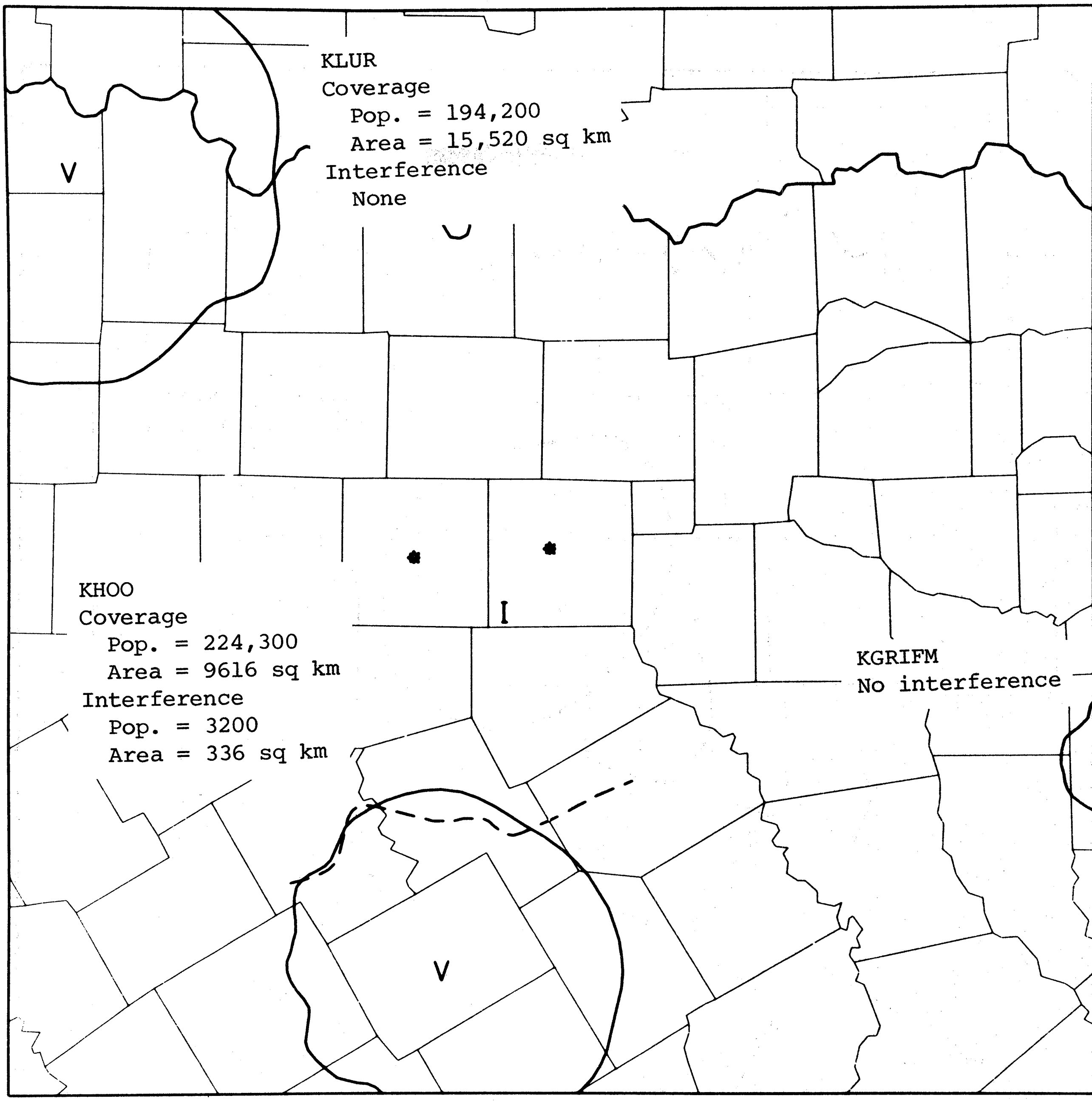



Figure B-9. (Continued).




CH260 100KW 1500FT HAAT DIRECTIONAL ANT 1

Figure B-9. (Continued).




D=CH260,261 U=CH260 100KW 1000FT D-A D/U=20.6DB

Figure B-9. (Continued).

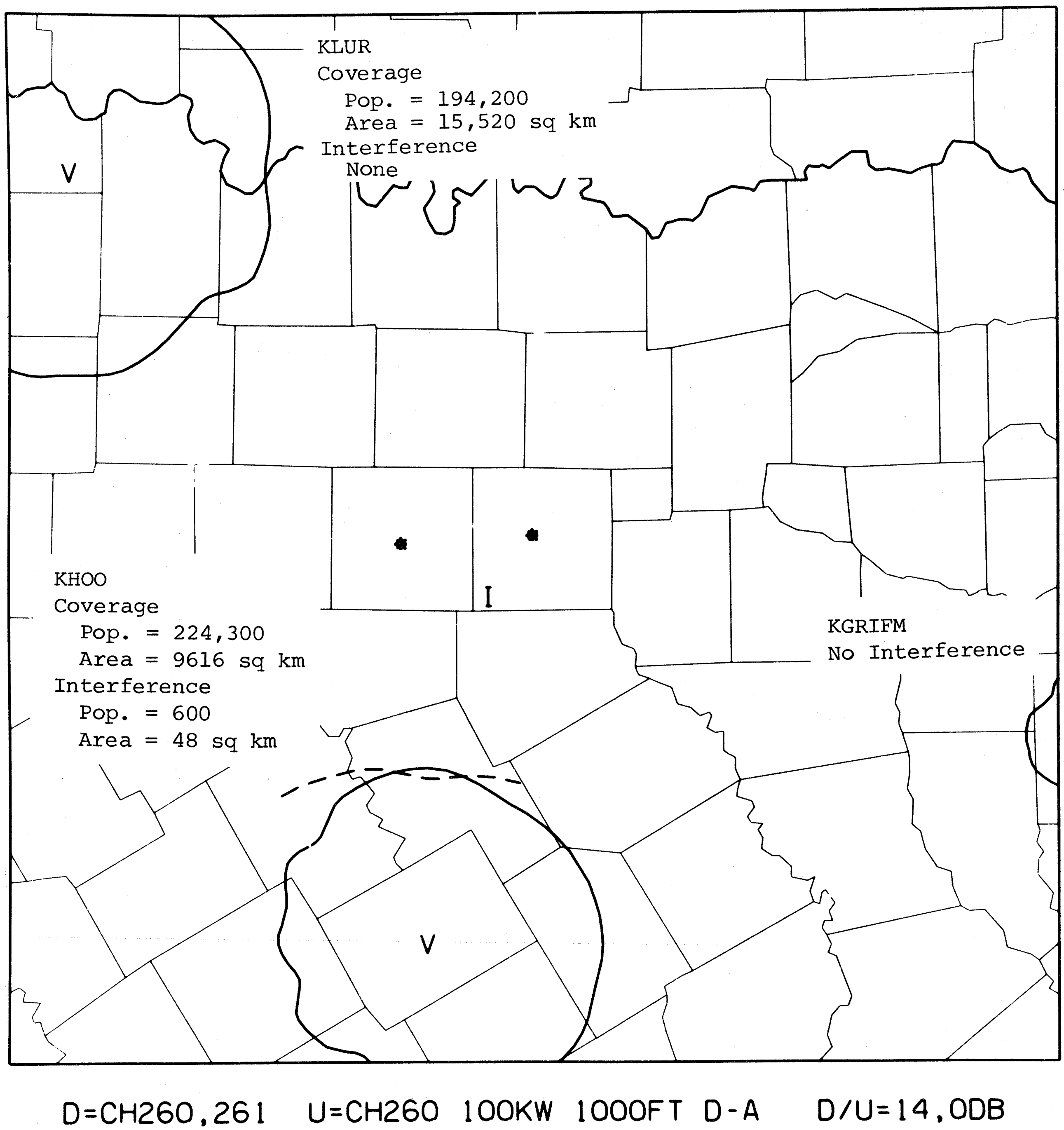
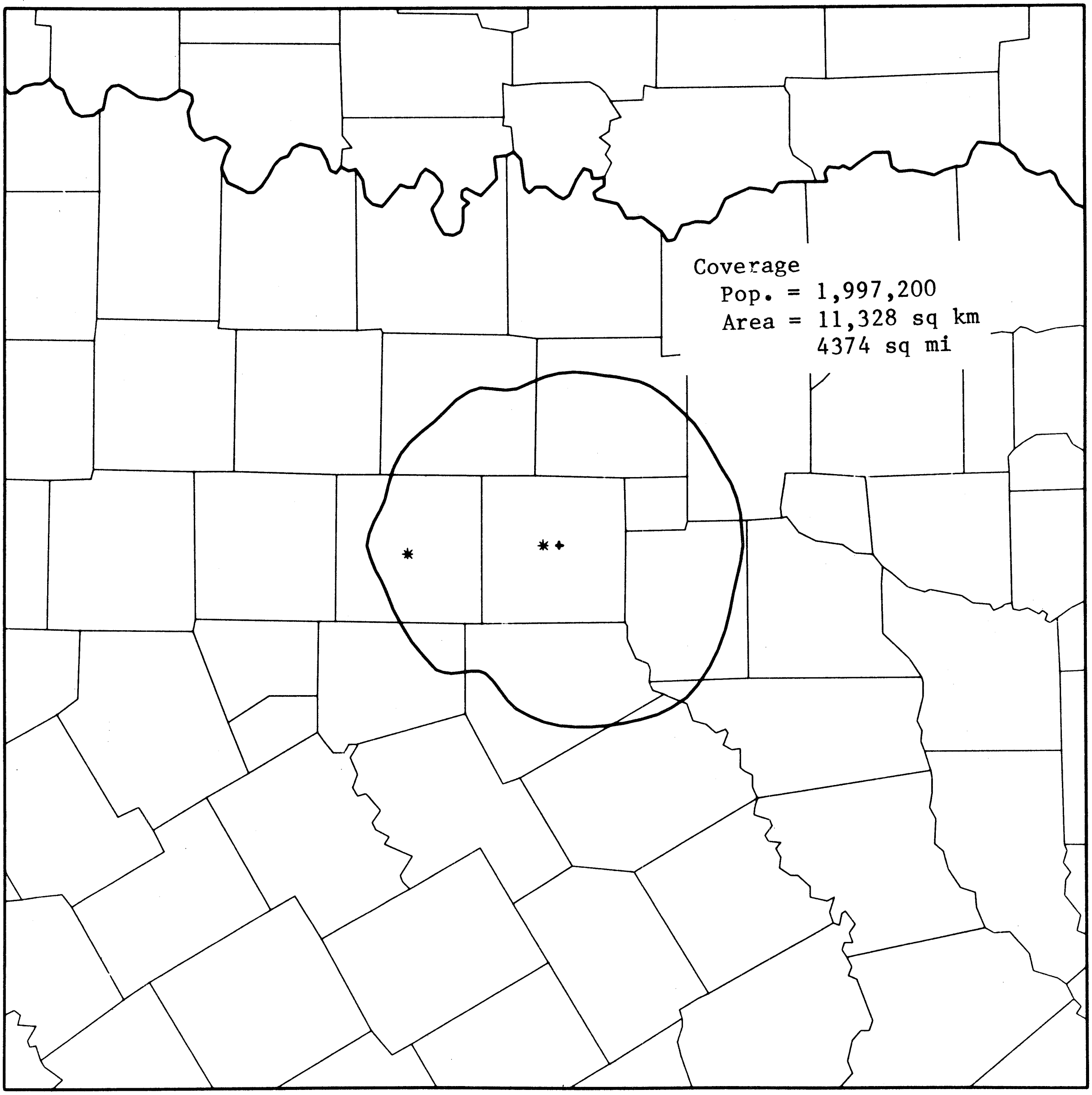
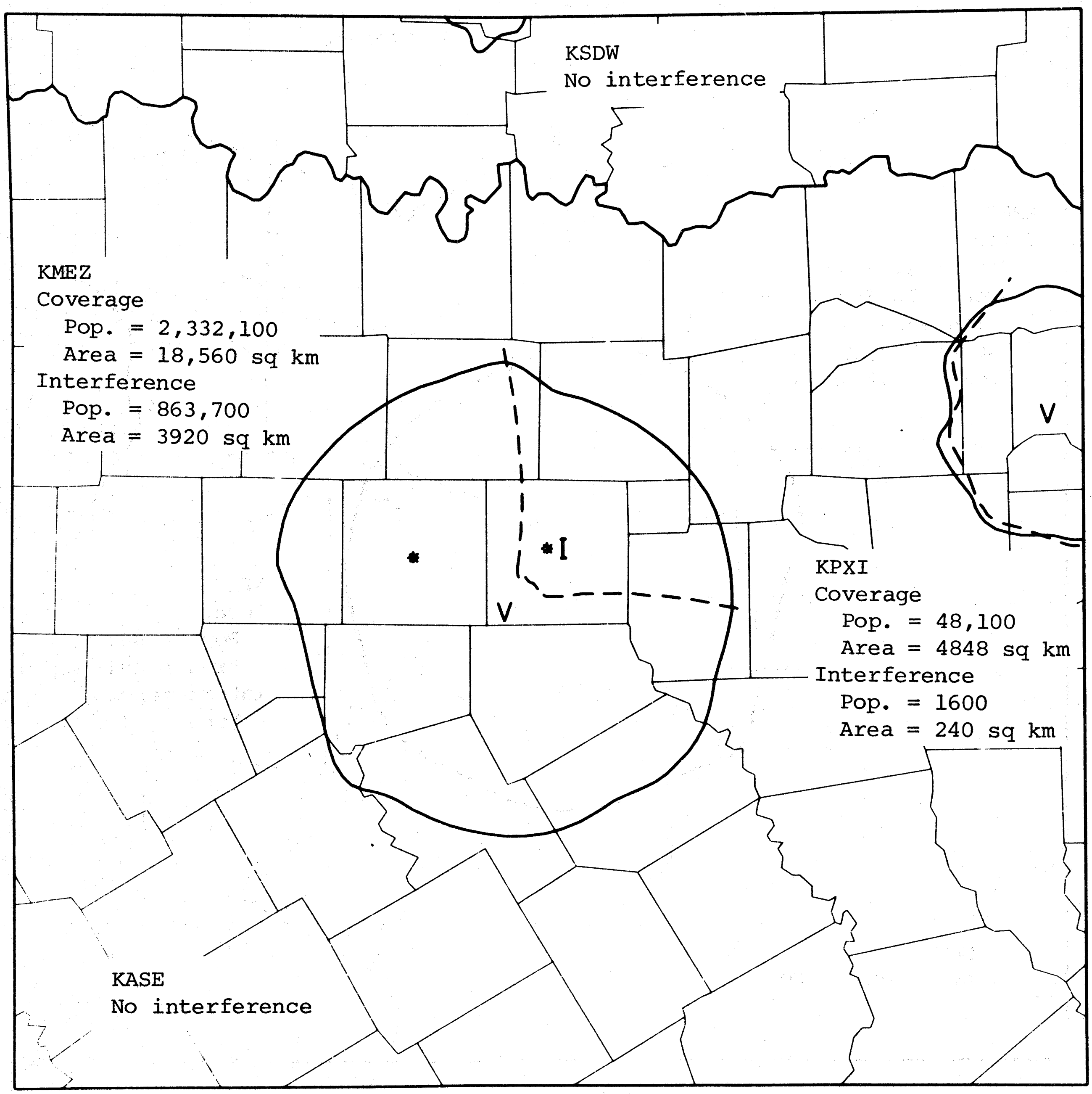



Figure B-9. (Continued).



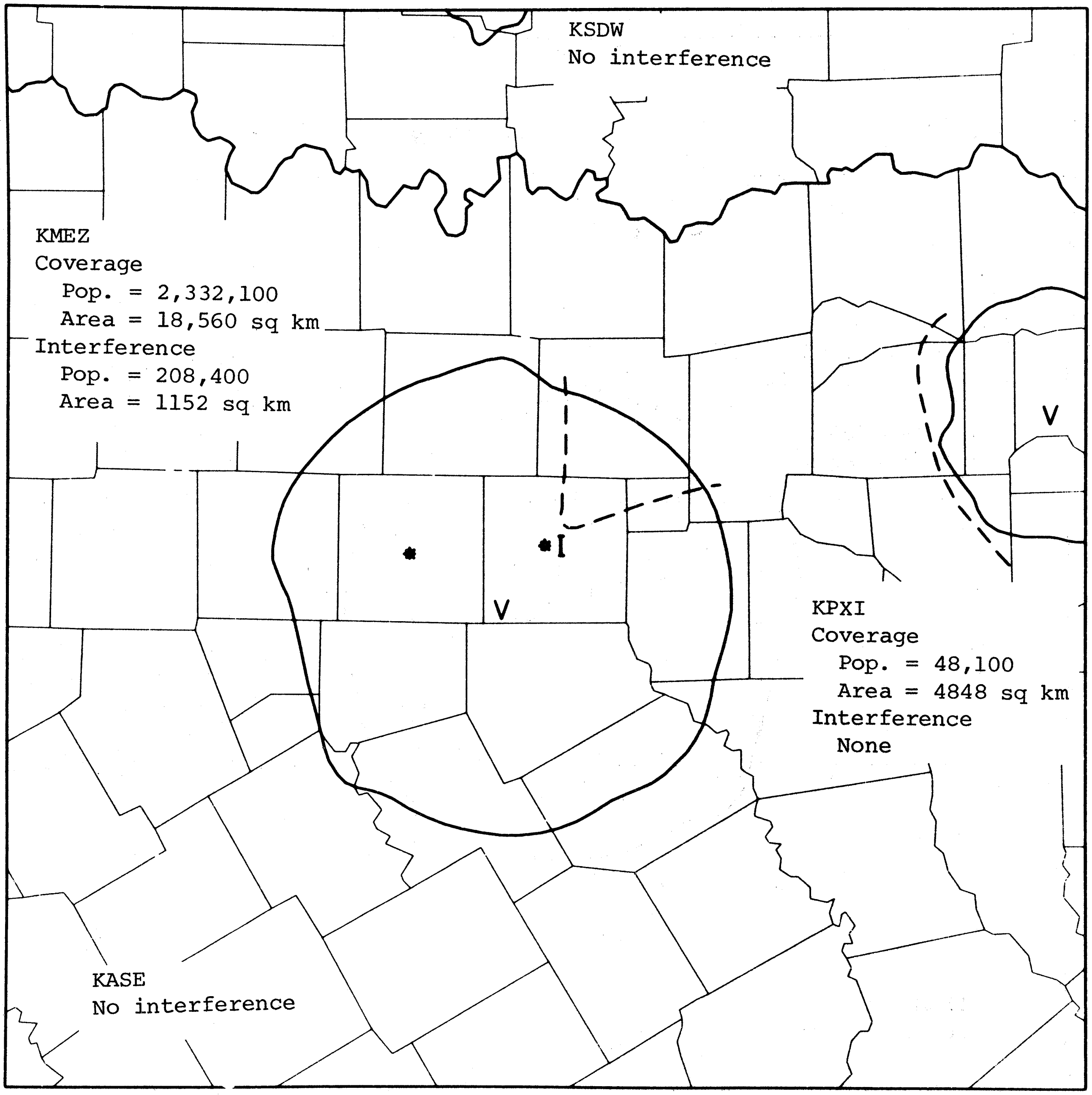

CH264 100KW 500FT HAAT

Figure B-10. Proposed channel 264.



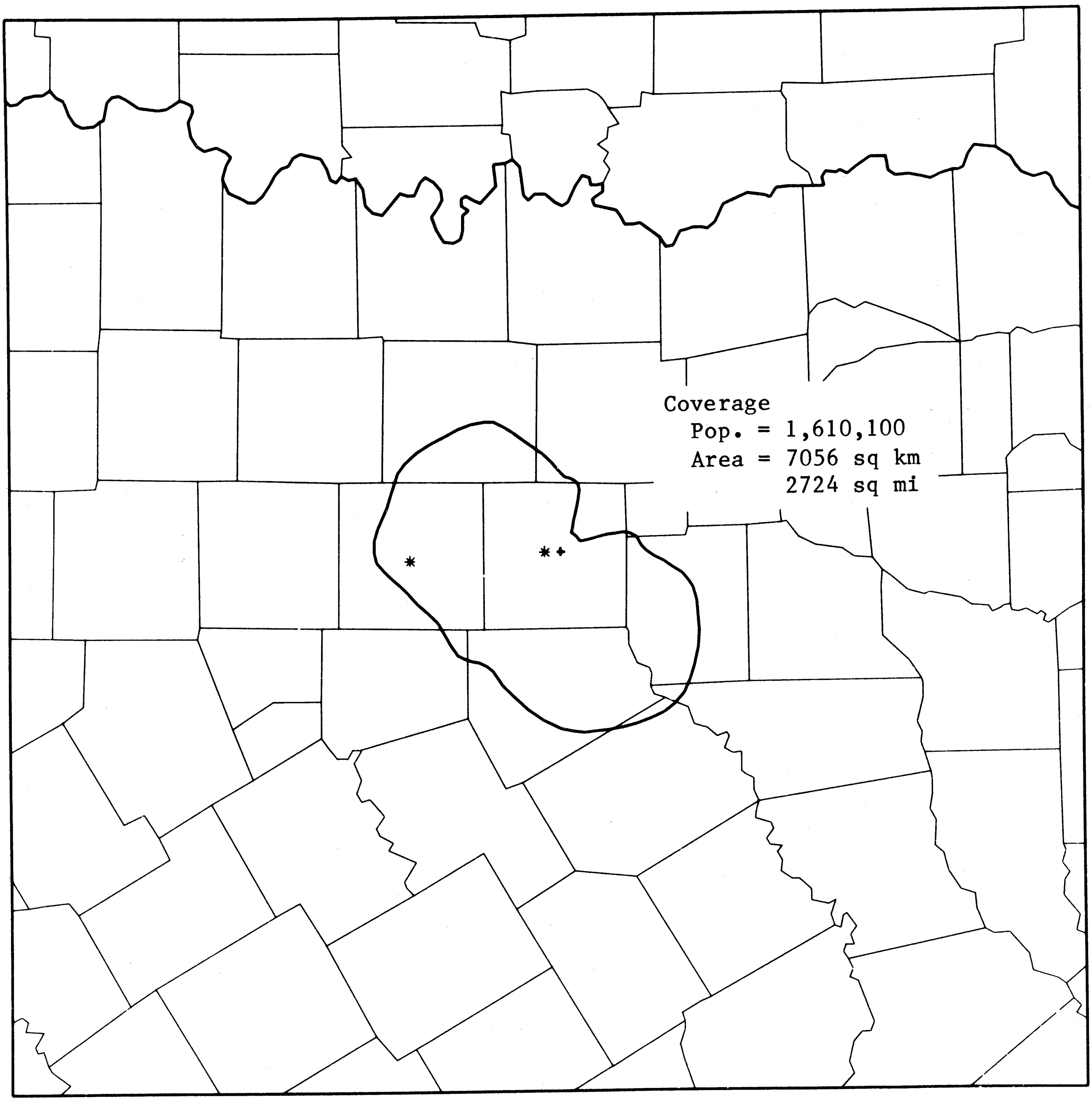

D=CH262,264,265 U=CH264 100KW 1500FT D/U=20,6,-20DB

Figure B-10. (Continued).



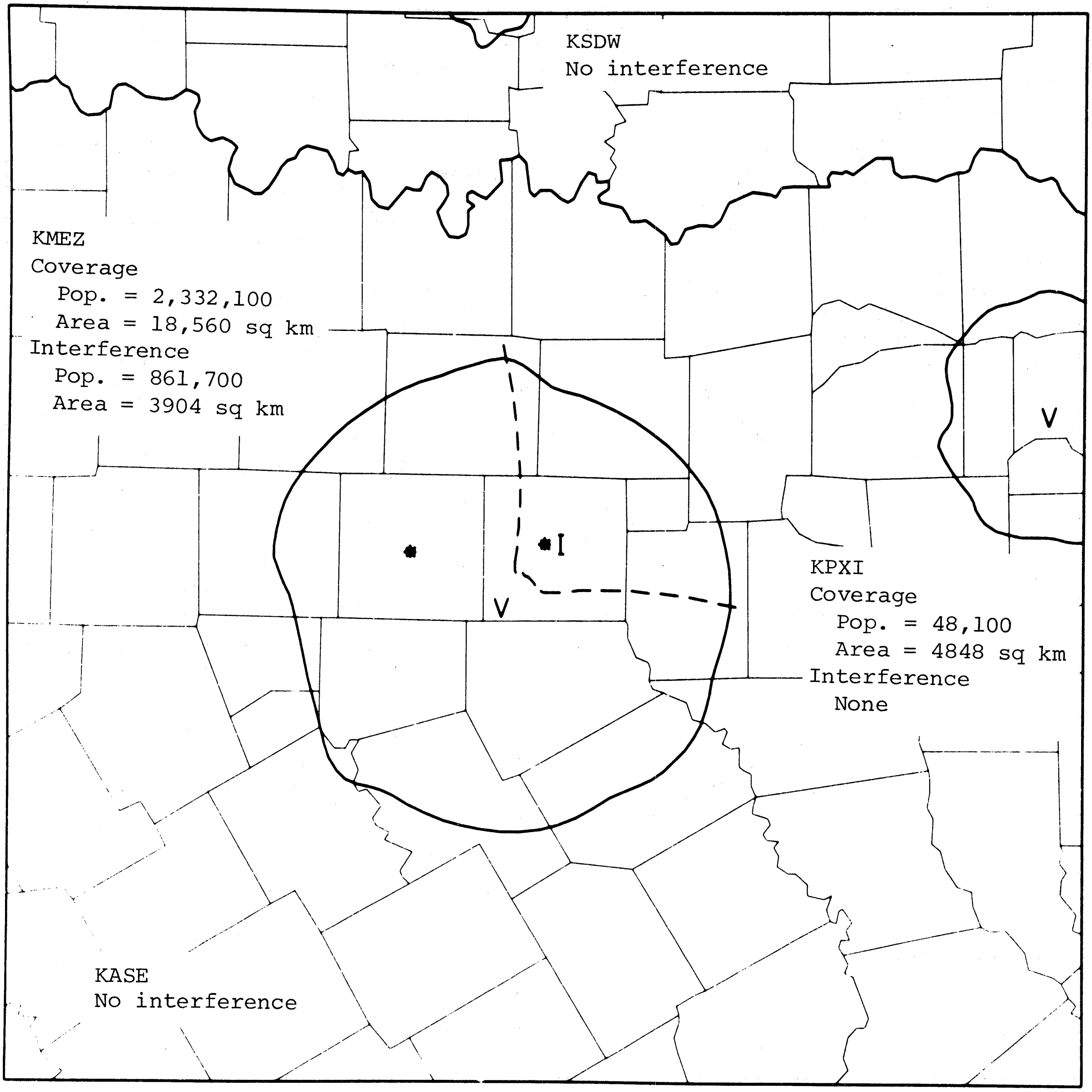

D=CH262,264,265 U=CH264 100KW 1500FT D/U=14,0,-50DB

Figure B-10. (Continued).




CH264 100KW 500FT HAAT DIRECTIONAL ANT 3

Figure B-10. (Continued).




D=CH262,264,265 U=CH264 100KW 1500FT D/U=20,6,-20DB

Figure B-10. (Continued).

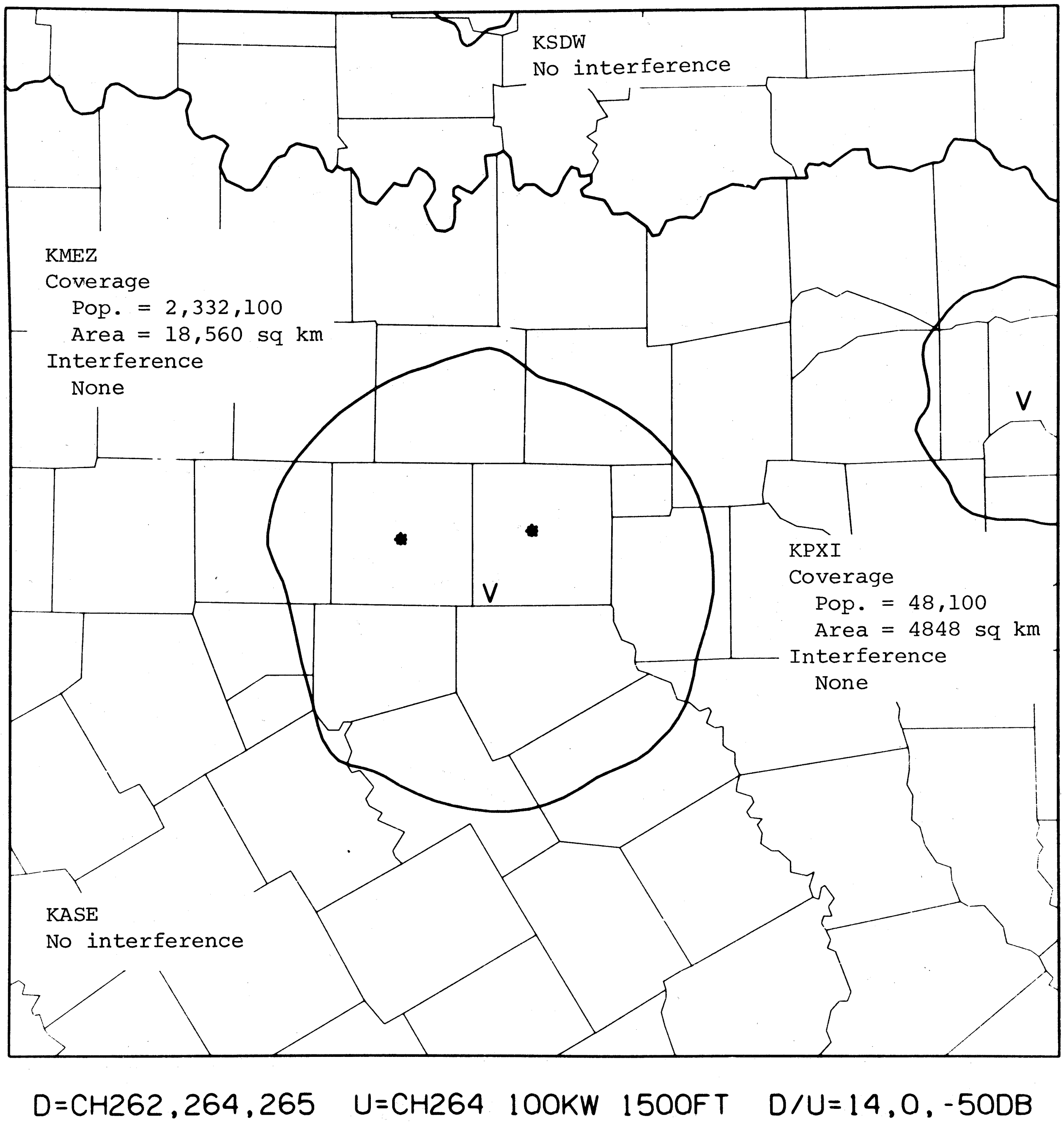
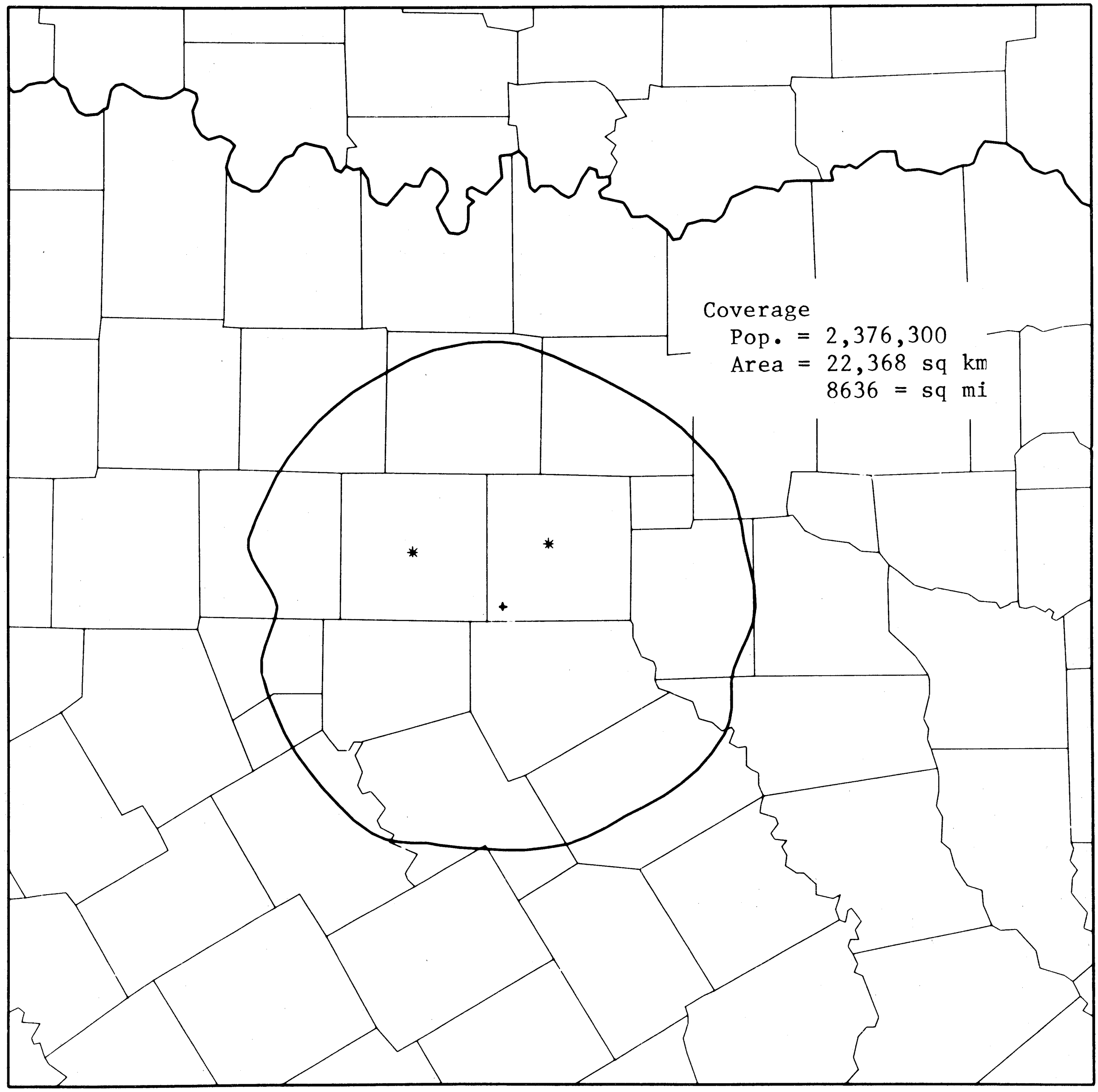
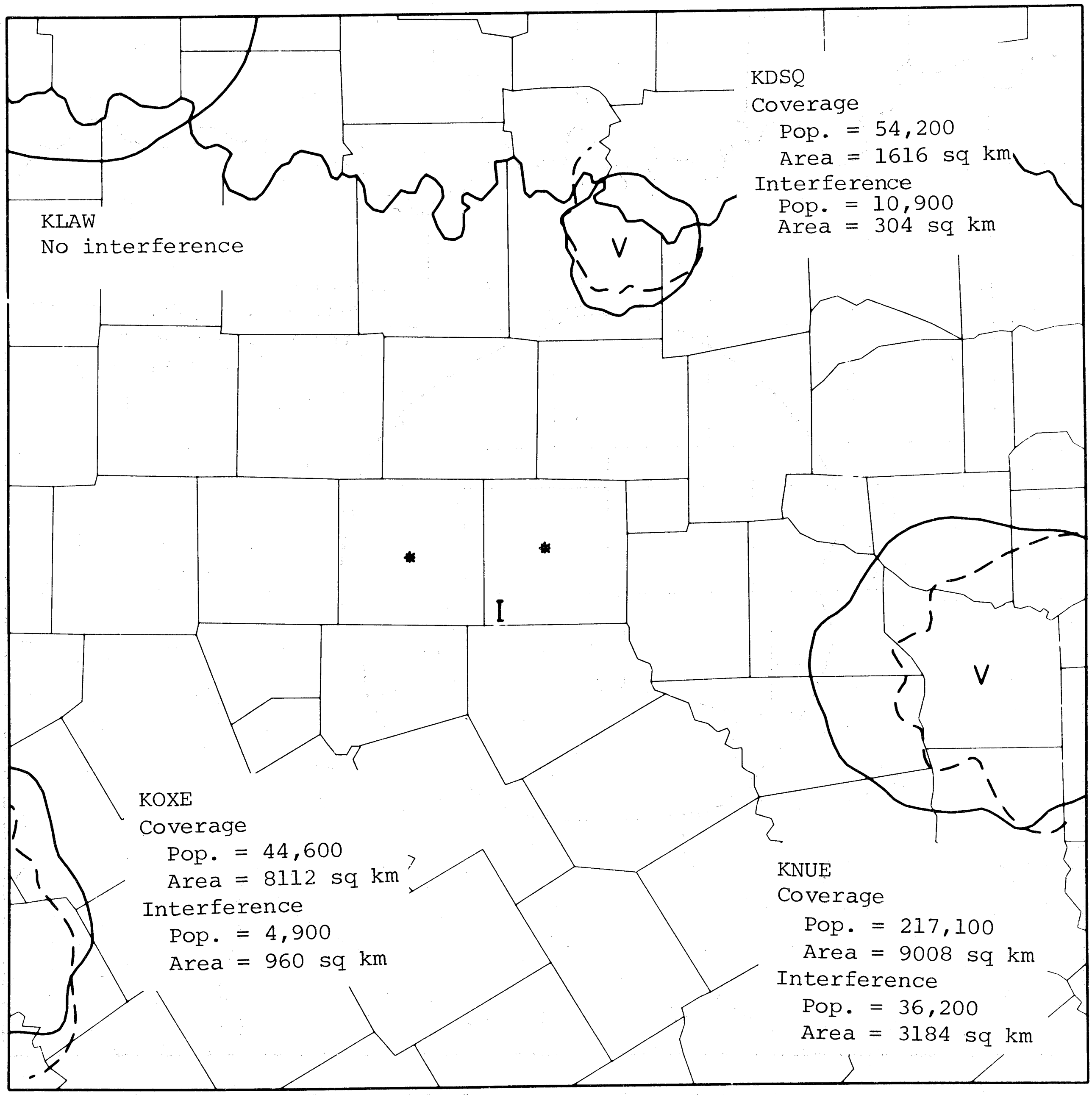



Figure B-10. (Continued).




CH268 100KW 1500FT HAAT

Figure B-11. Proposed channel 268.




D=CH267,268,269 U=CH268 100KW 1500FT D/U=20.6DB

Figure B-11. (Continued).

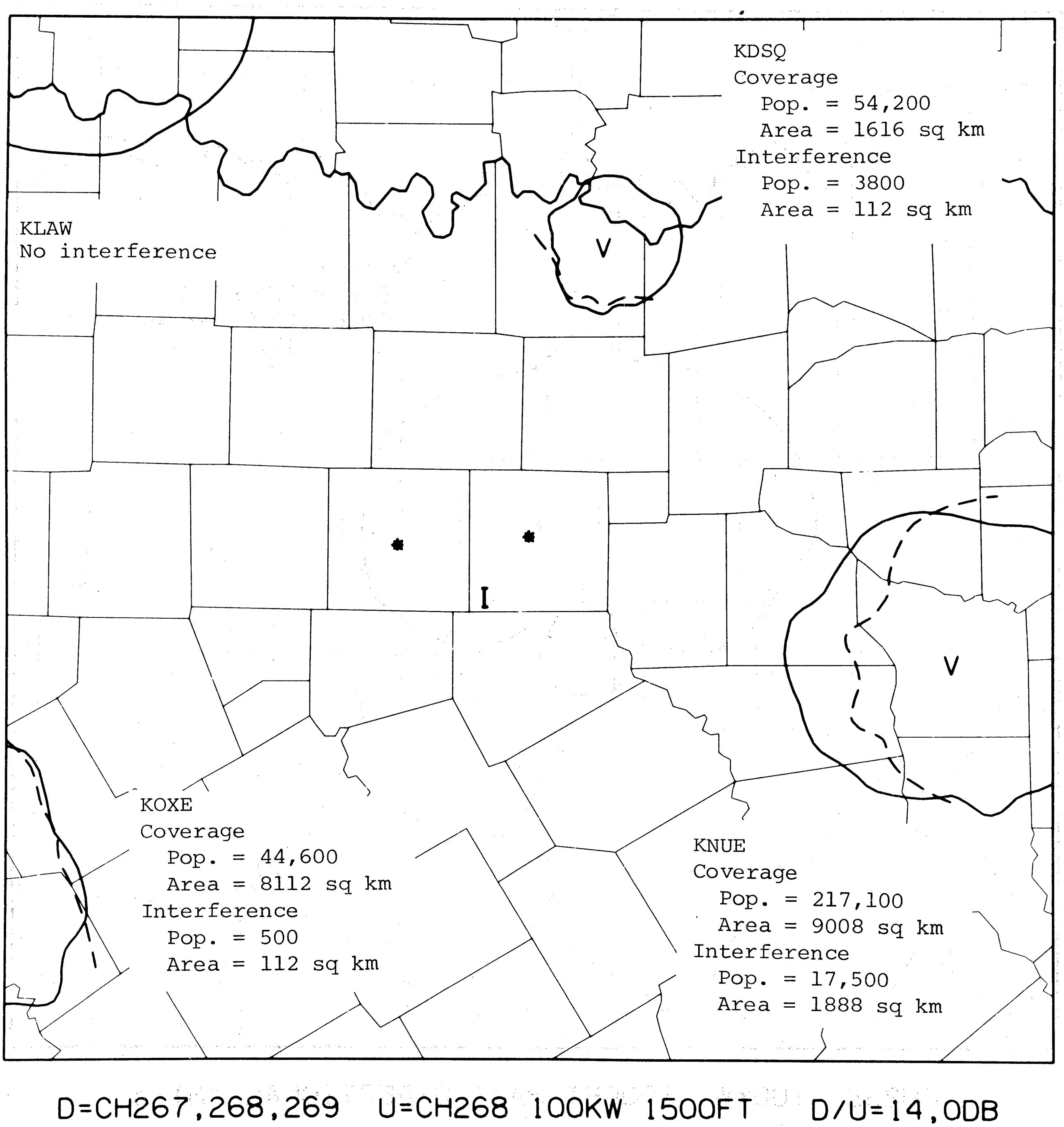
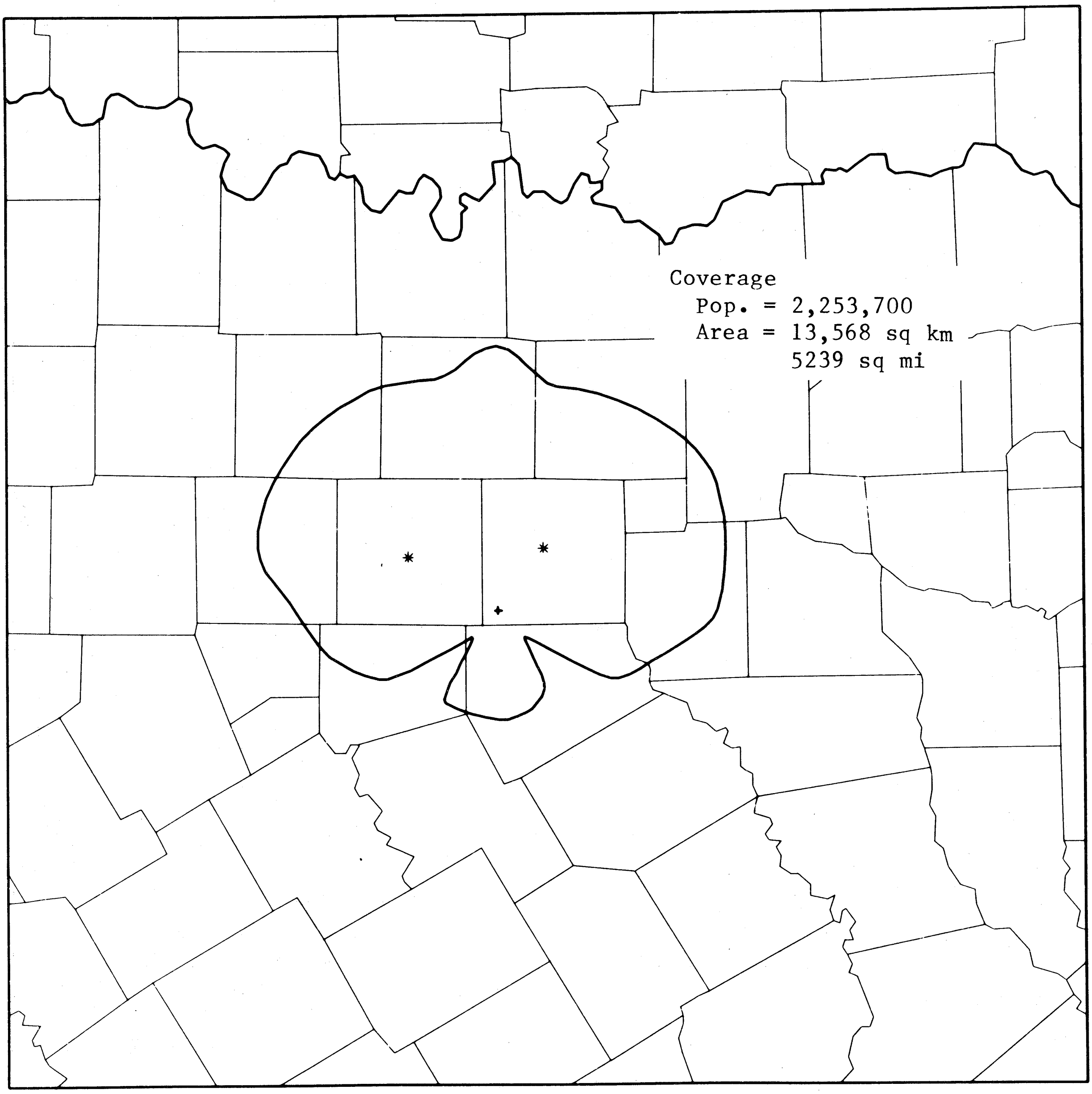
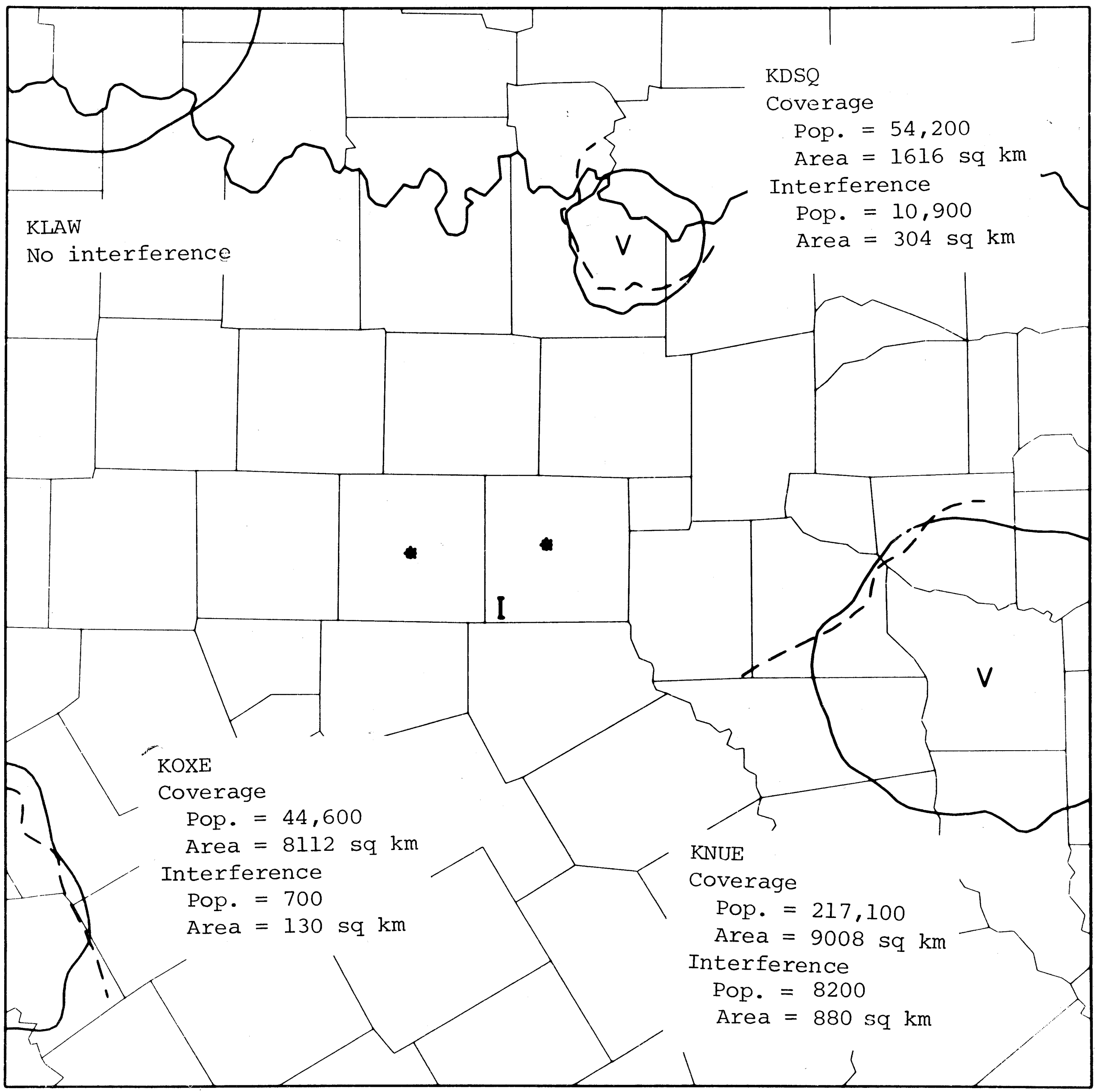



Figure B-11. (Continued).



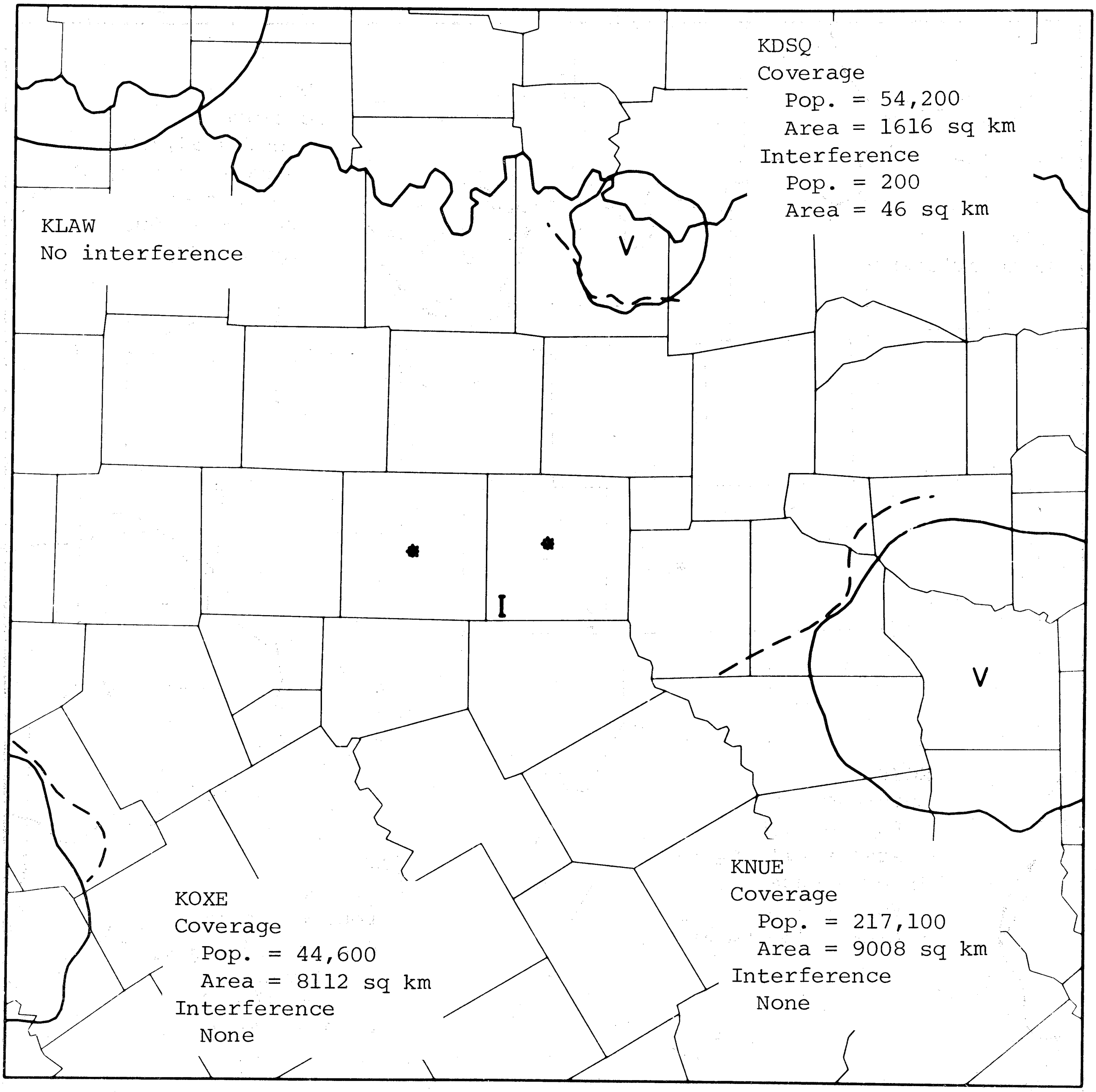

CH268 100KW 1500FT HAAT DIRECTIONAL ANT 3

Figure B-11. (Continued).




D=CH267,268,269 U=CH268 100KW 1500FT D/U=20.6DB

Figure B-11. (Continued).




D=CH267,268,269 U=CH268 100KW 1500FT D/U=14,0DB

Figure B-11. (Continued).

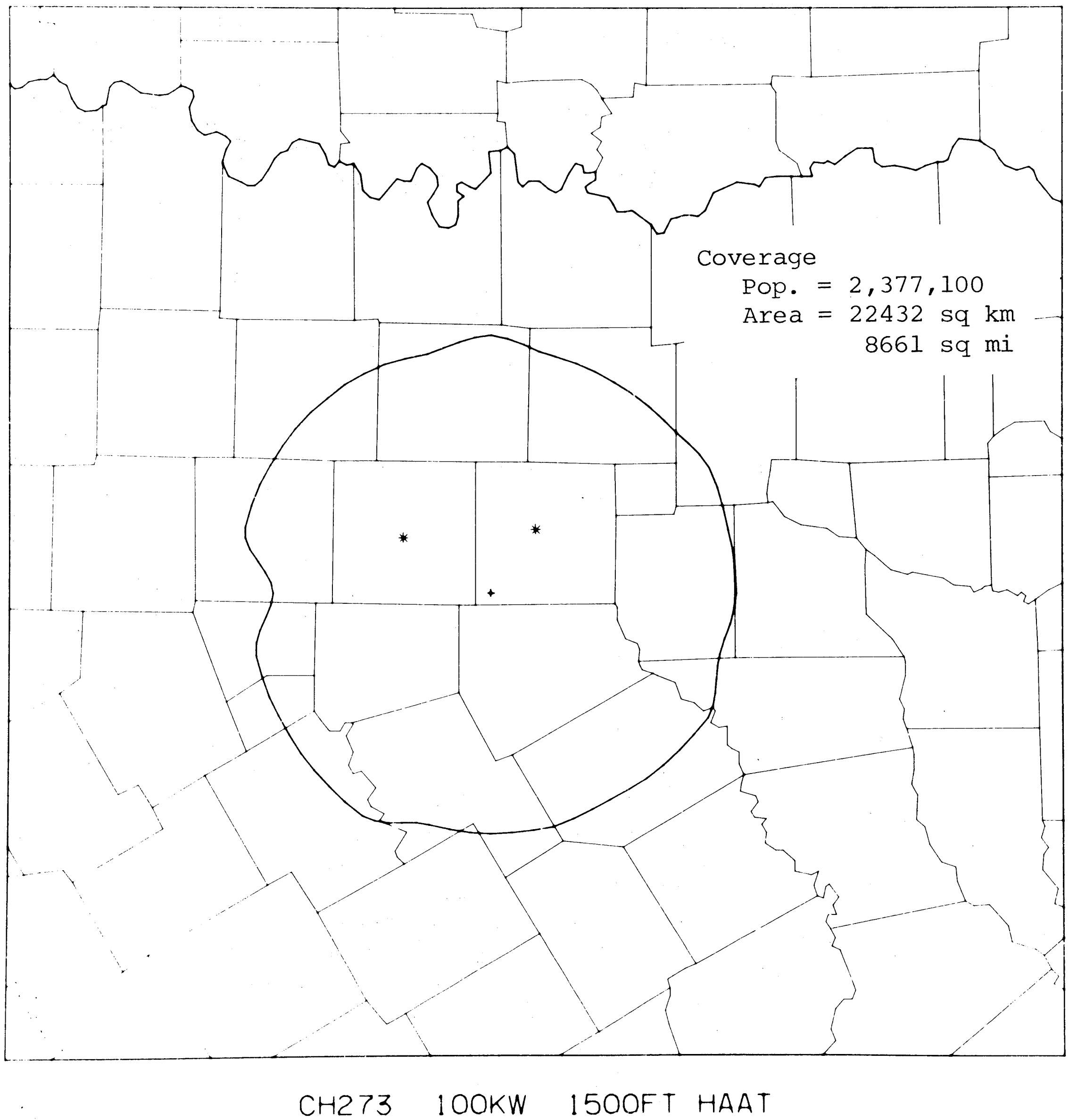
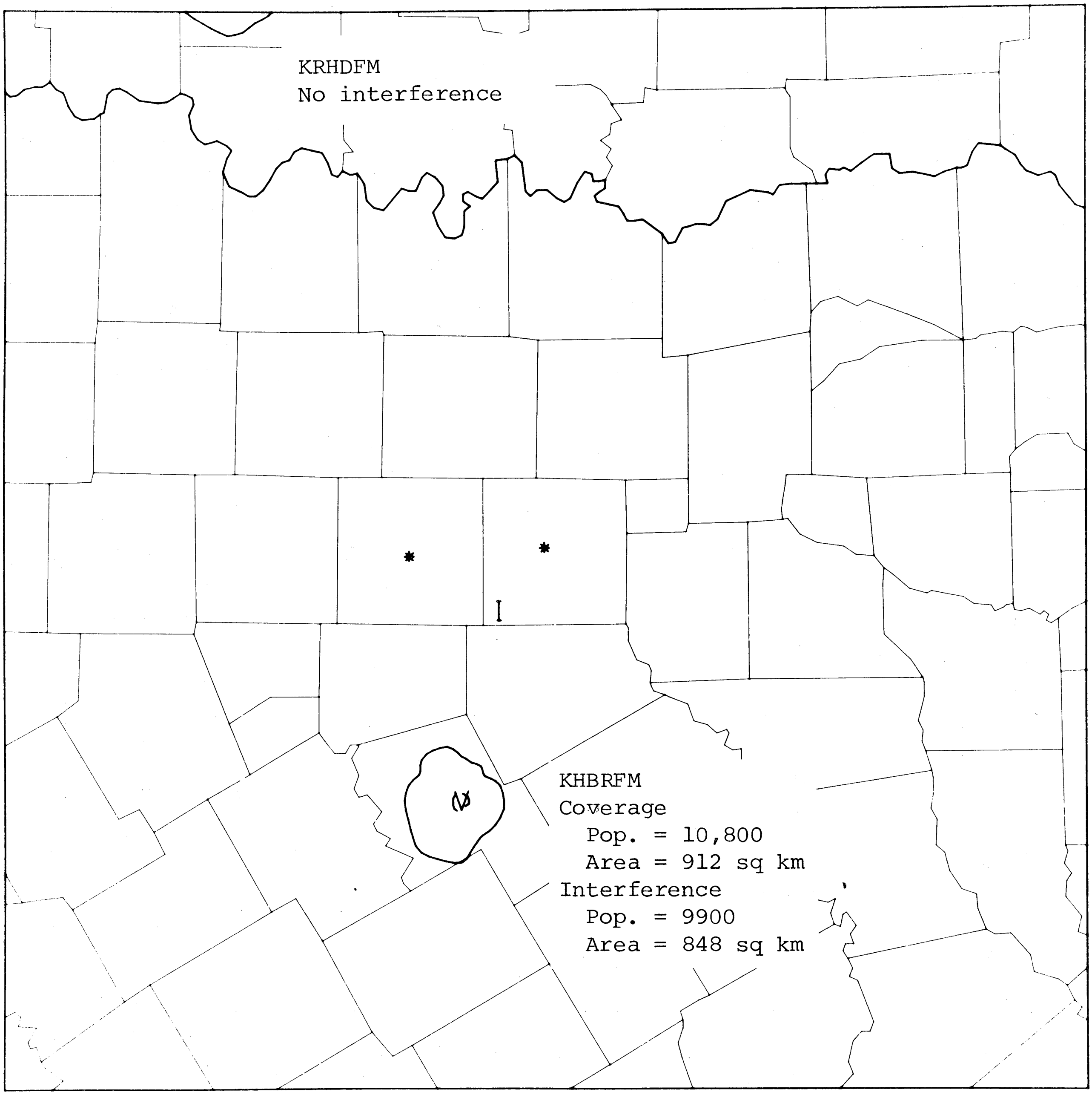
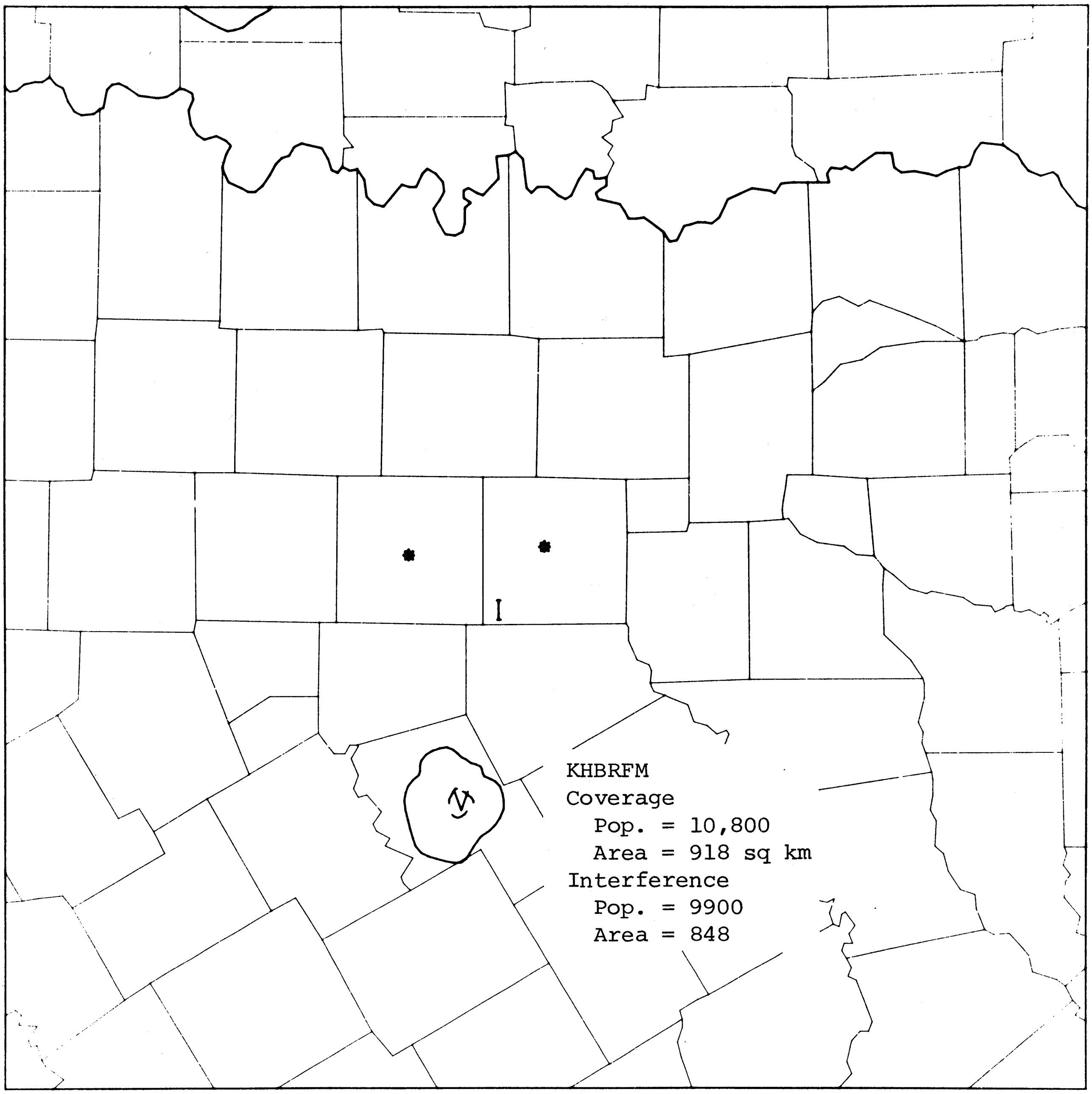



Figure B-12. Proposed channel 272.



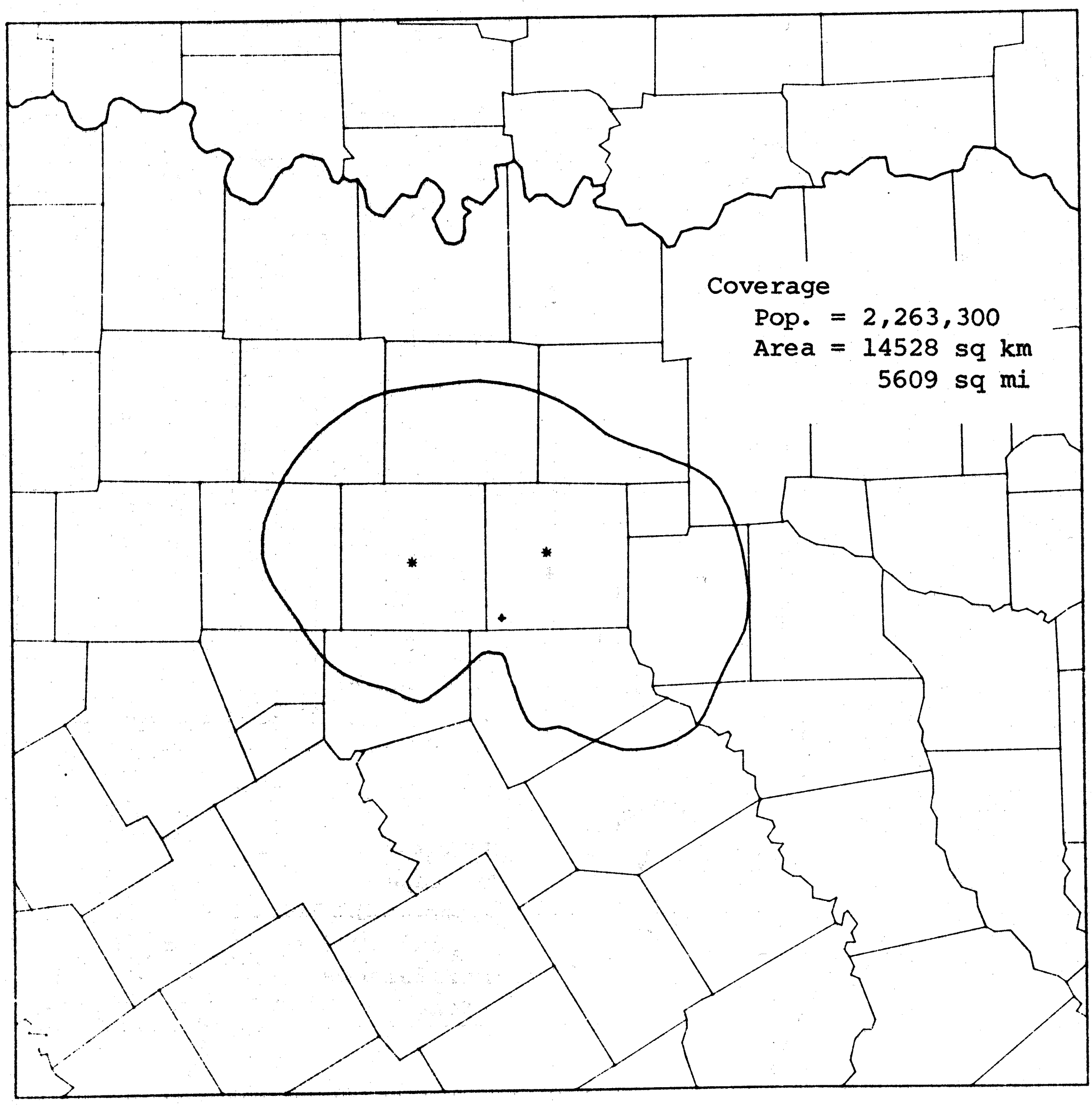

D=CH272,273 U=CH273 100KW 1500FT D/U=20.6DB

Figure B-12. (Continued).




D=CH272,273 U=CH273 100KW 1500FT D/U=14,0DB

Figure B-12. (Continued).




CH273 100KW 1500FT HAAT DIRECTIONAL ANT 3

**Figure B-12.** (Continued).

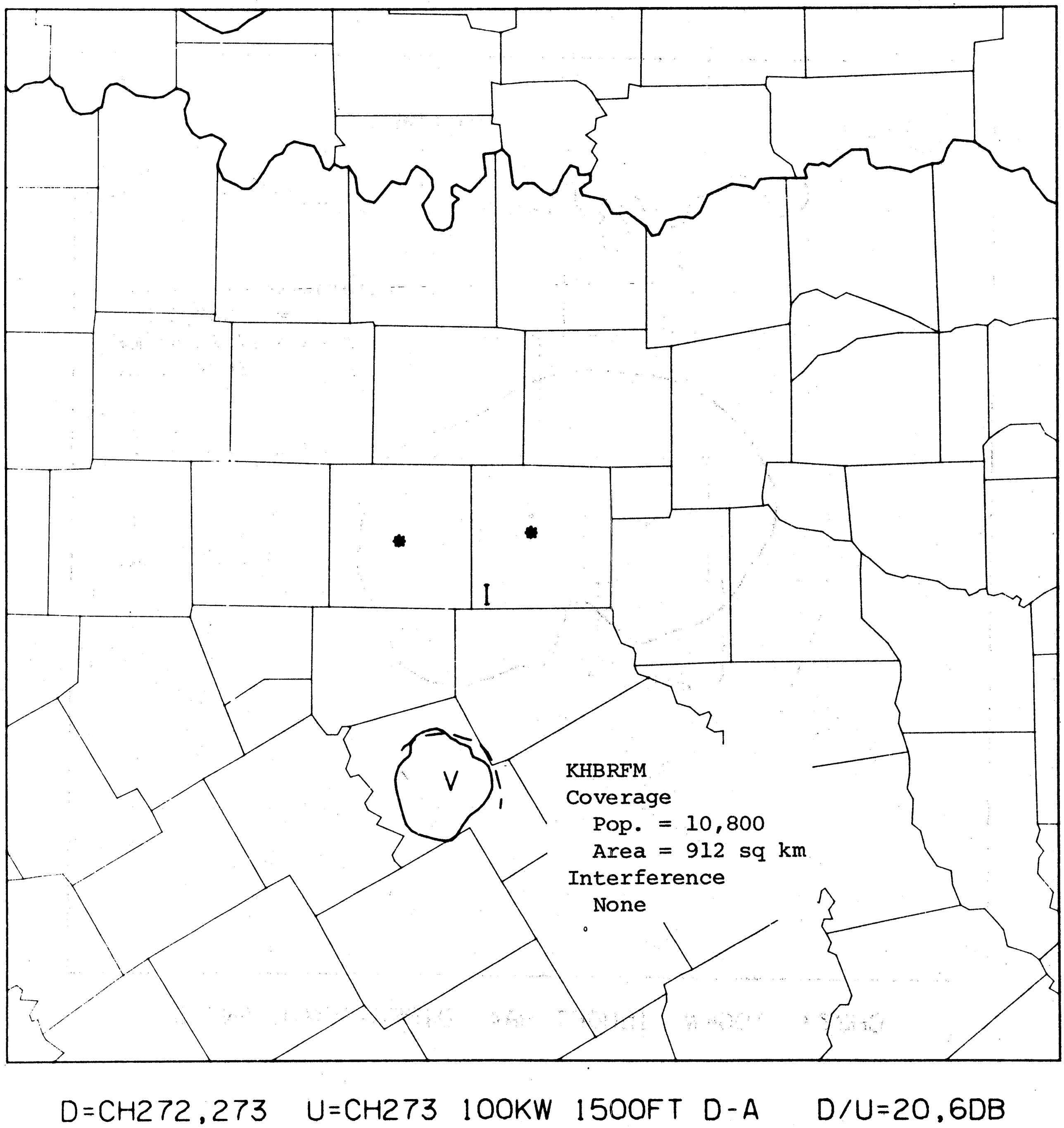
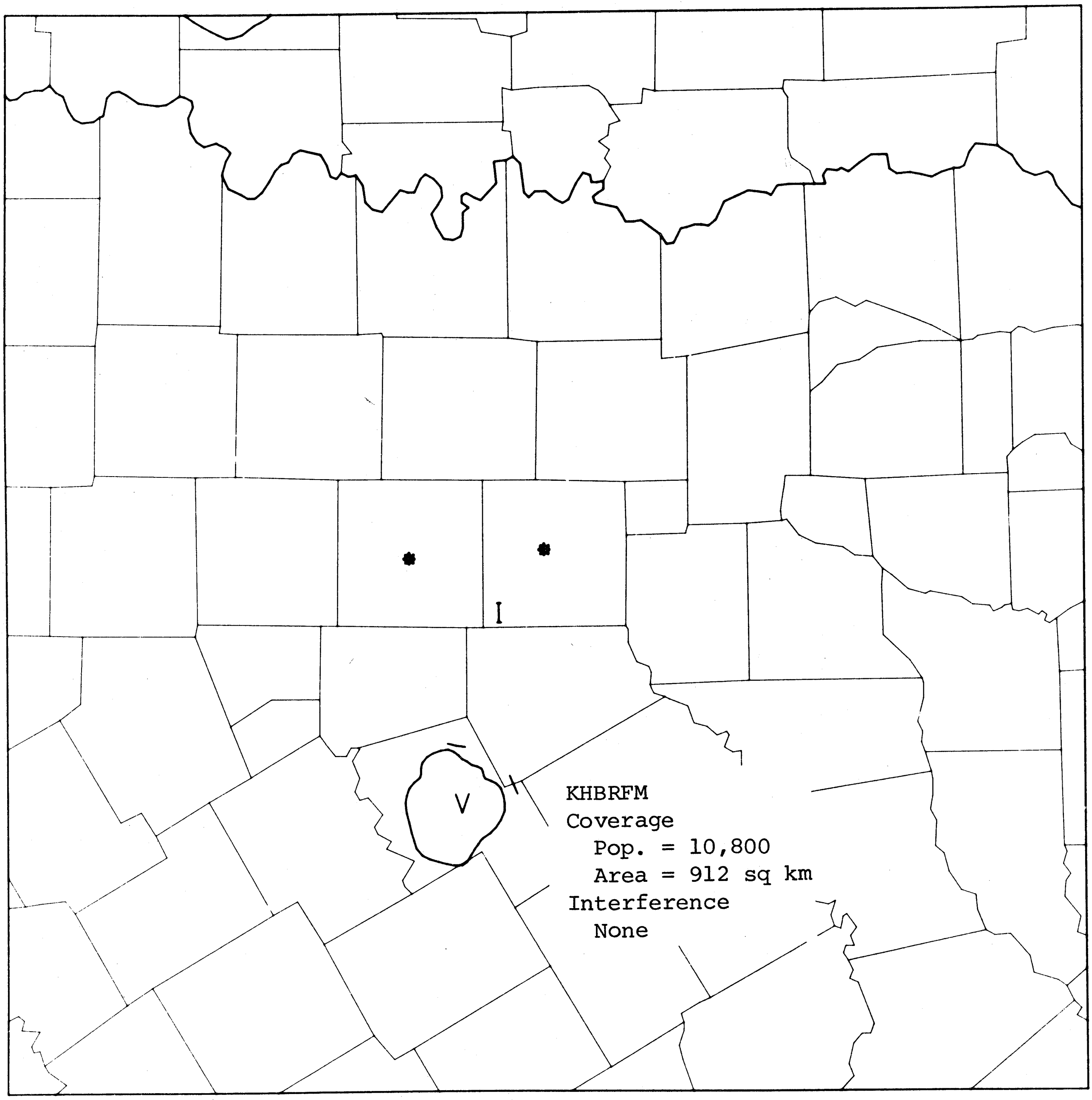
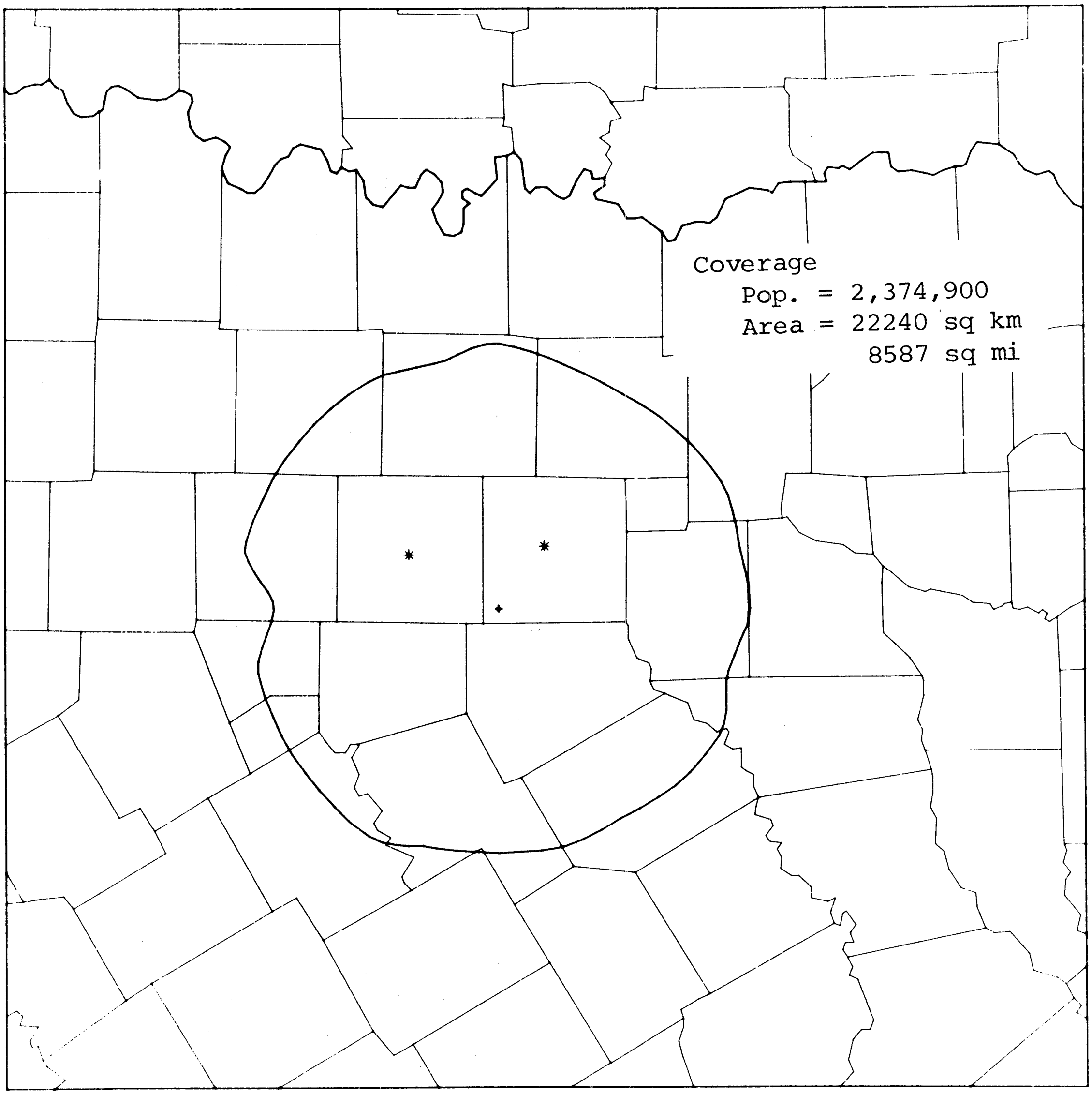



Figure B-12. (Continued).



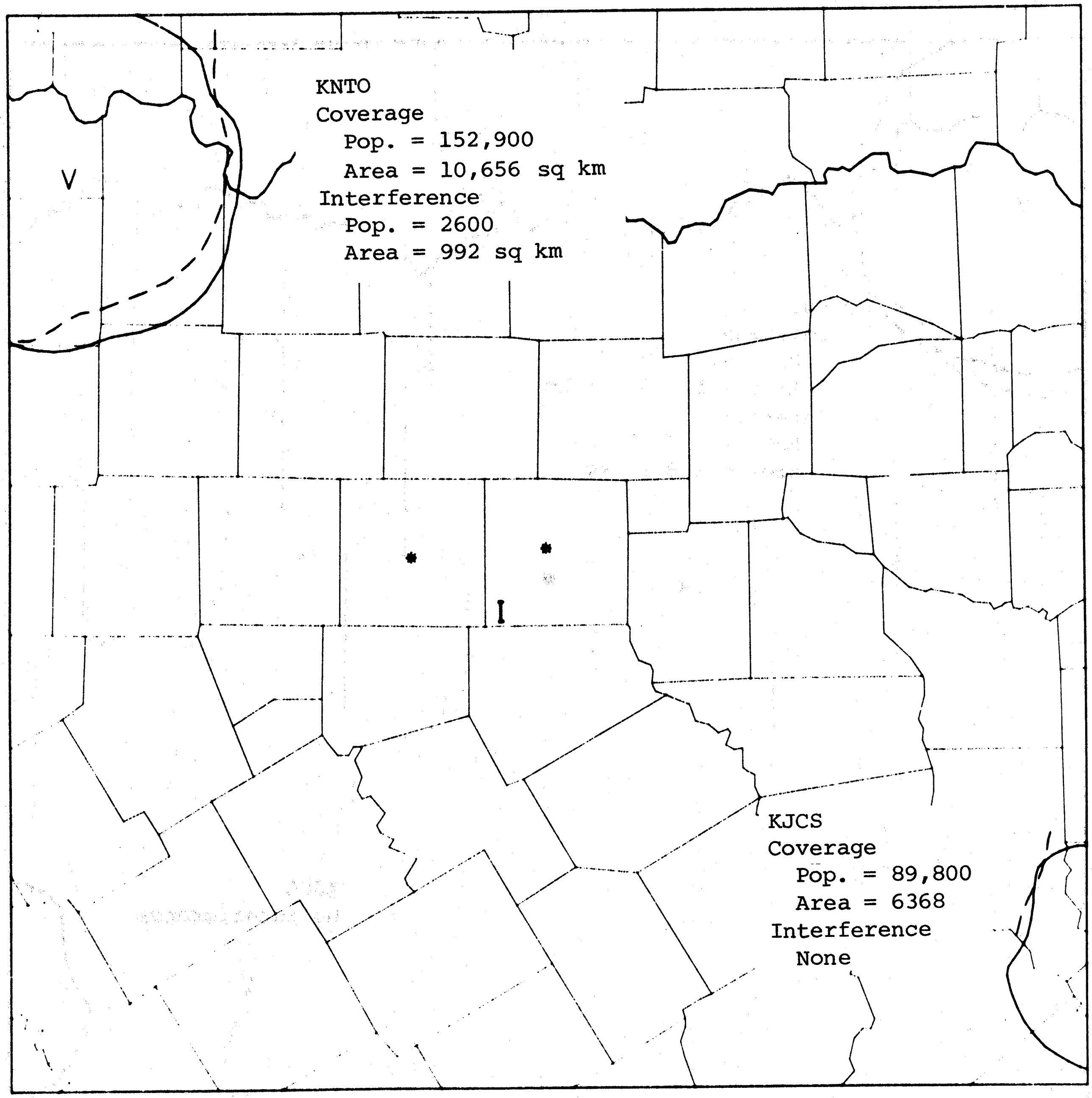

D=CH272,273 U=CH273 100KW 1500FT D-A D/U=14,0DB

Figure B-12. (Continued).



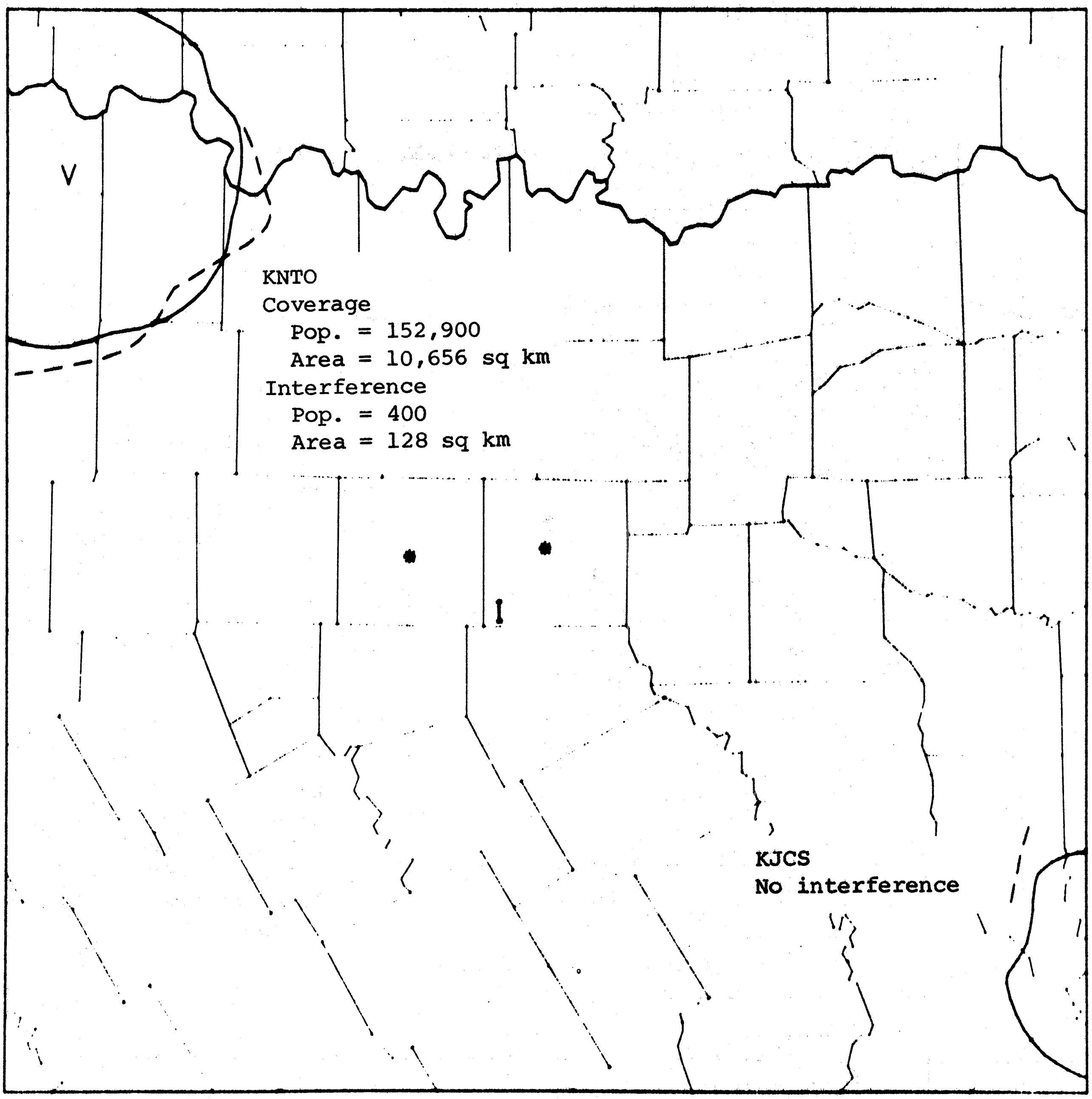

CH277 100KW 1500FT HAAT

Figure B-13. Proposed channel 277.



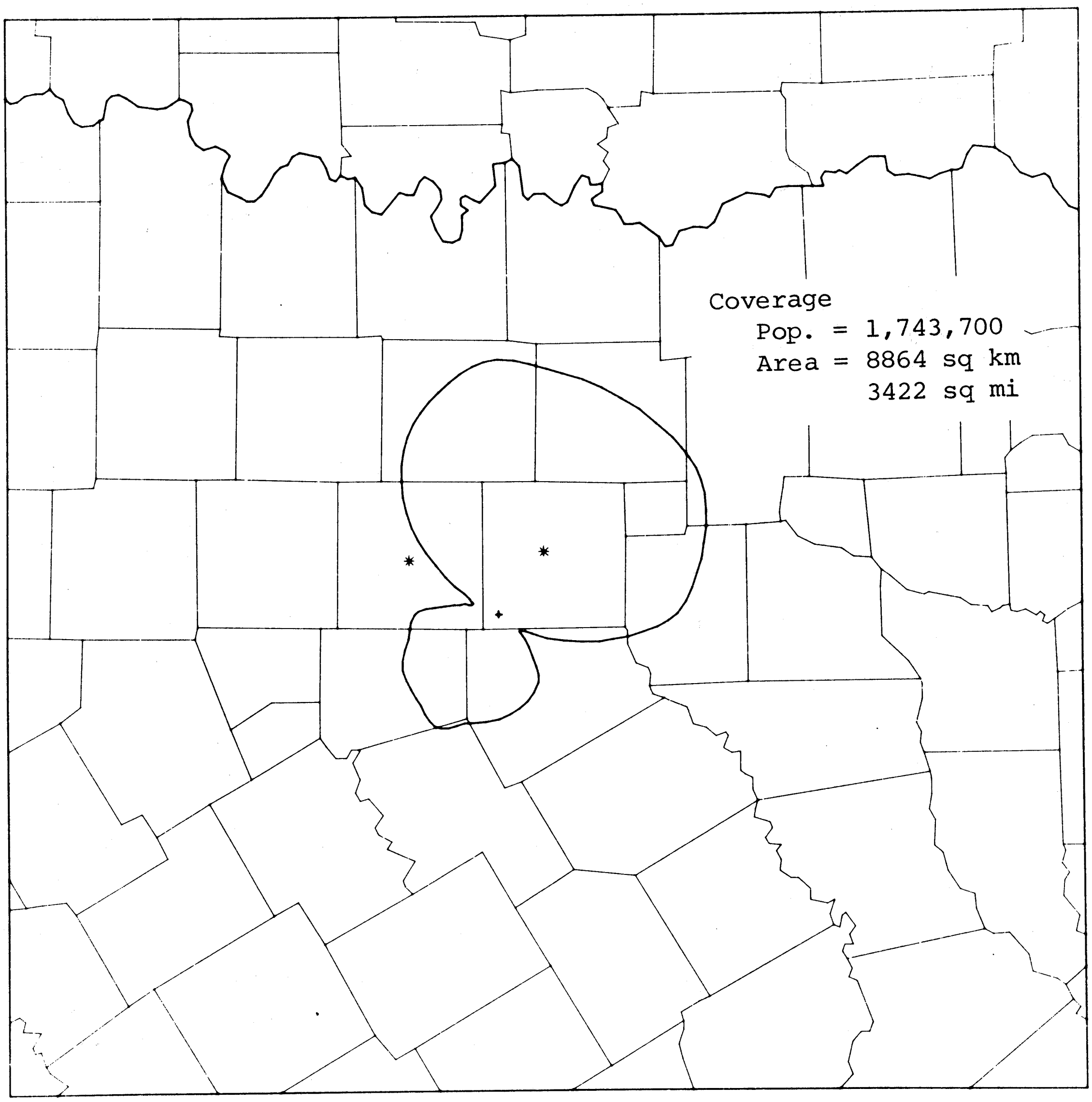

D=CH277 U=CH277 100KW 1500FT D/U=20DB

Figure B-13. (Continued).




D=CH277 U=CH277 100KW 1500FT D/U=14DB

Figure B-13. (Continued).




CH277 100KW 1500FT HAAT DIRECTIONAL ANT 1

Figure B-13. (Continued).

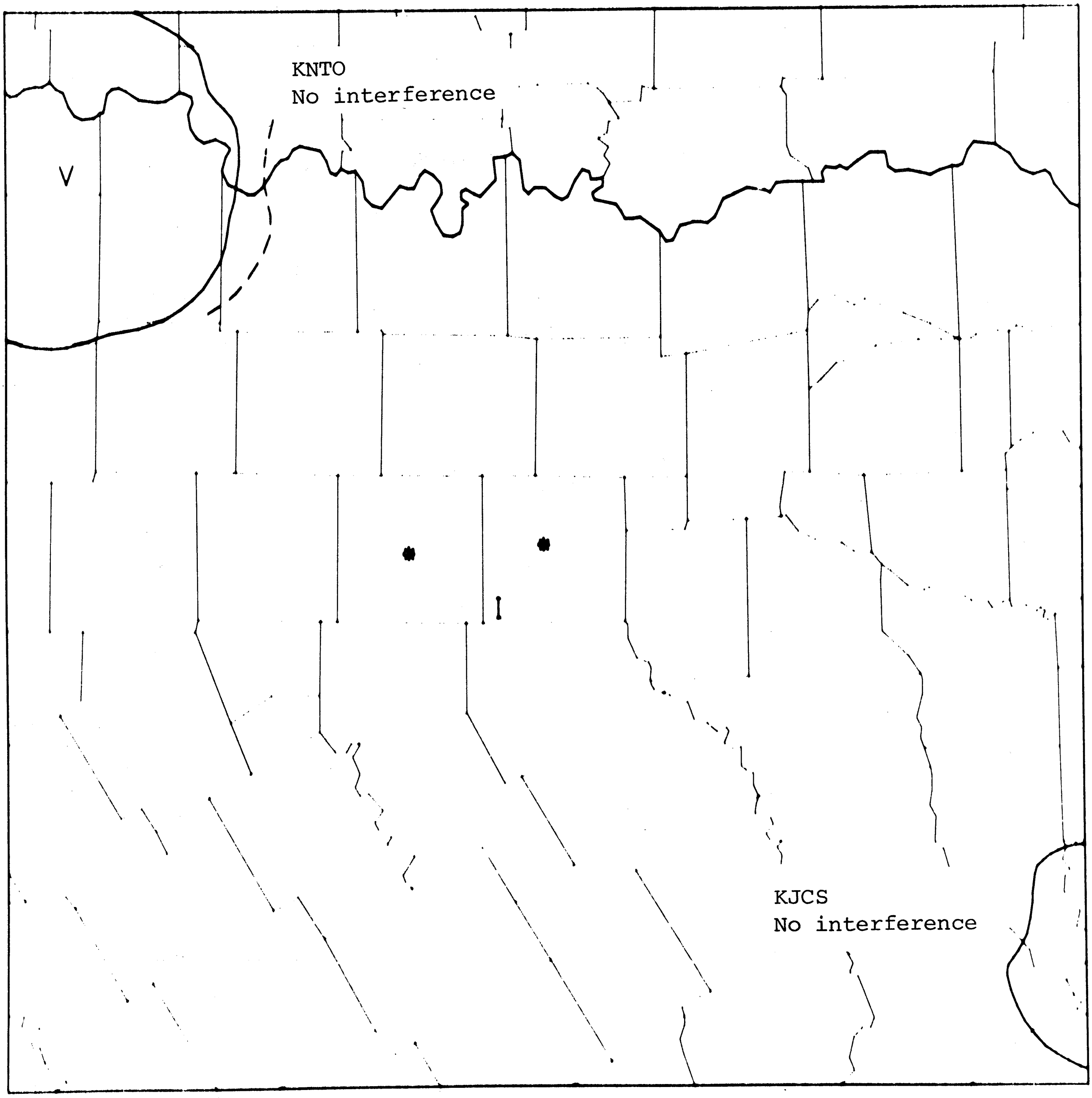
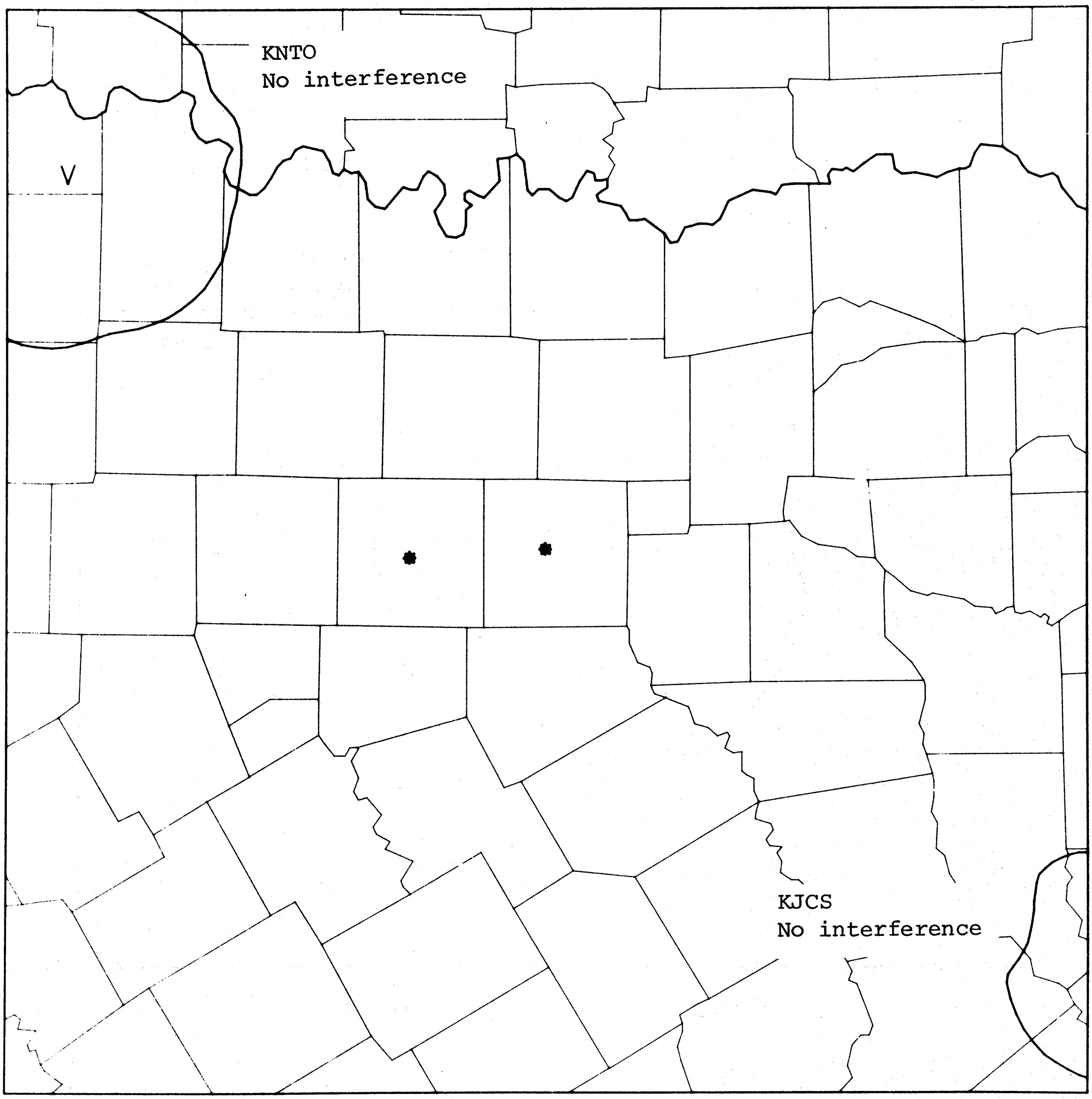
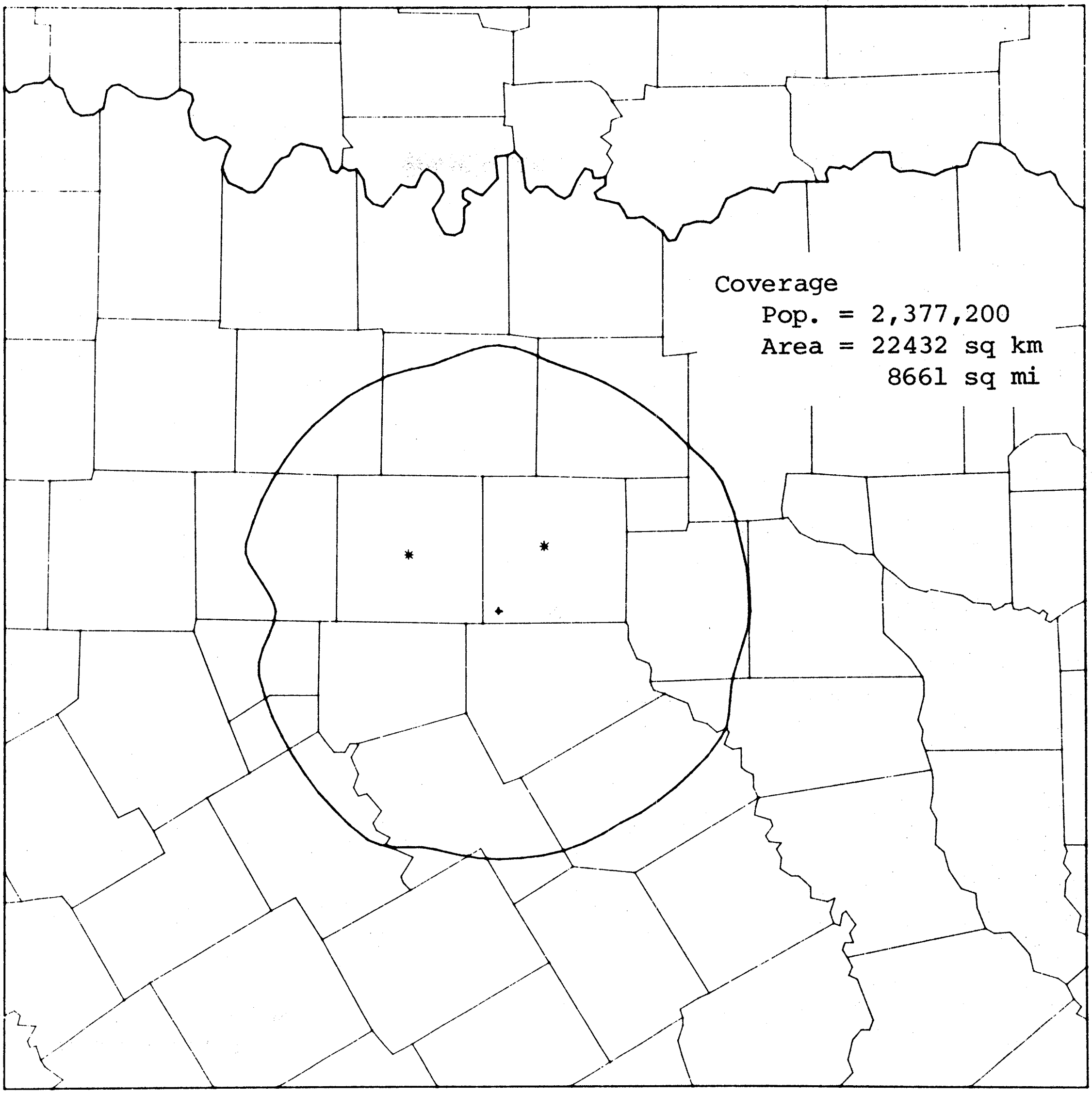



Figure B-13. (Continued).




D=CH277 U=CH277 100KW 1500FT D-A D/U=14DB

Figure B-13. (Continued).




CH281 100KW 1500FT HAAT

Figure B-14. Proposed channel 281.

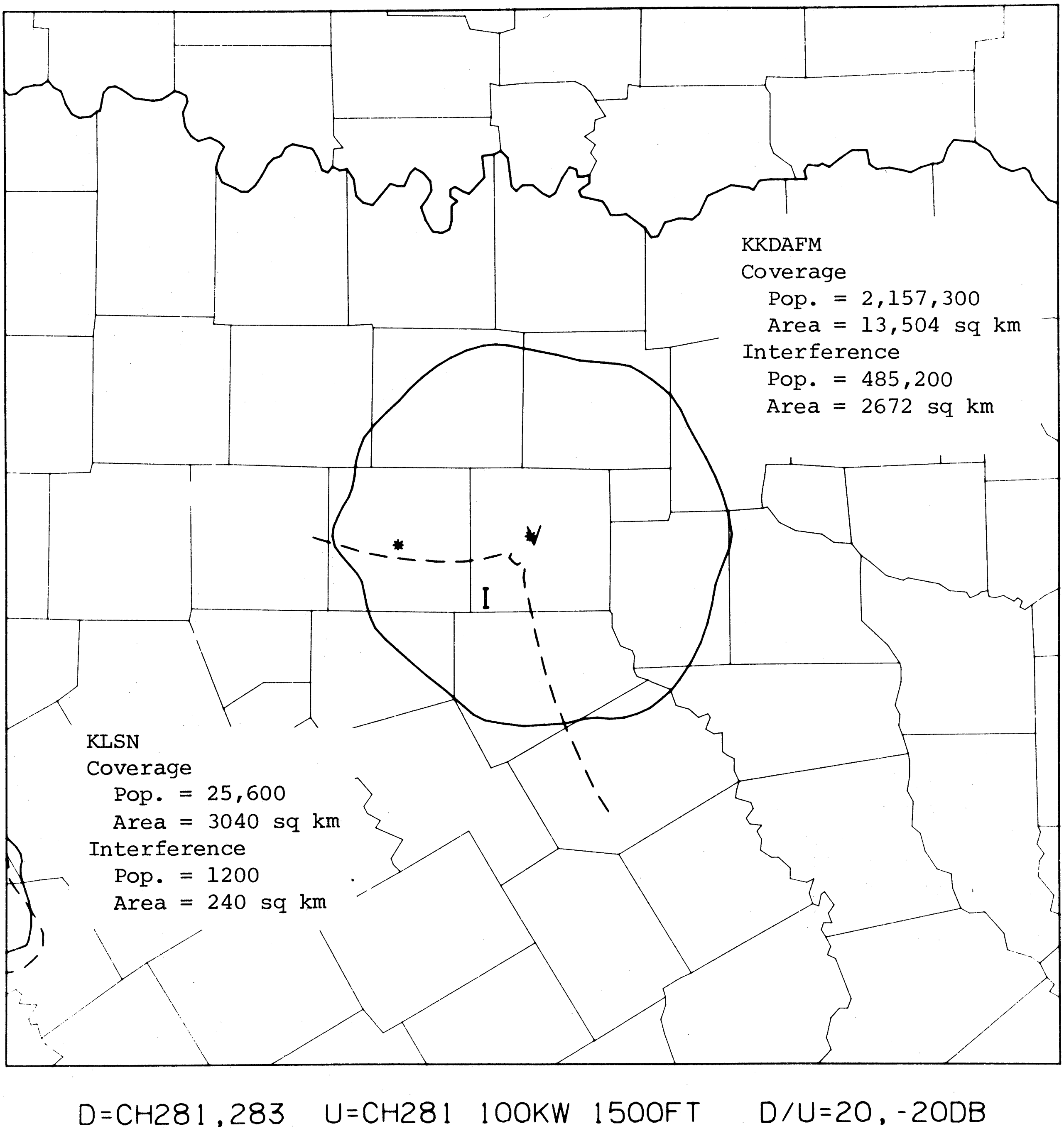
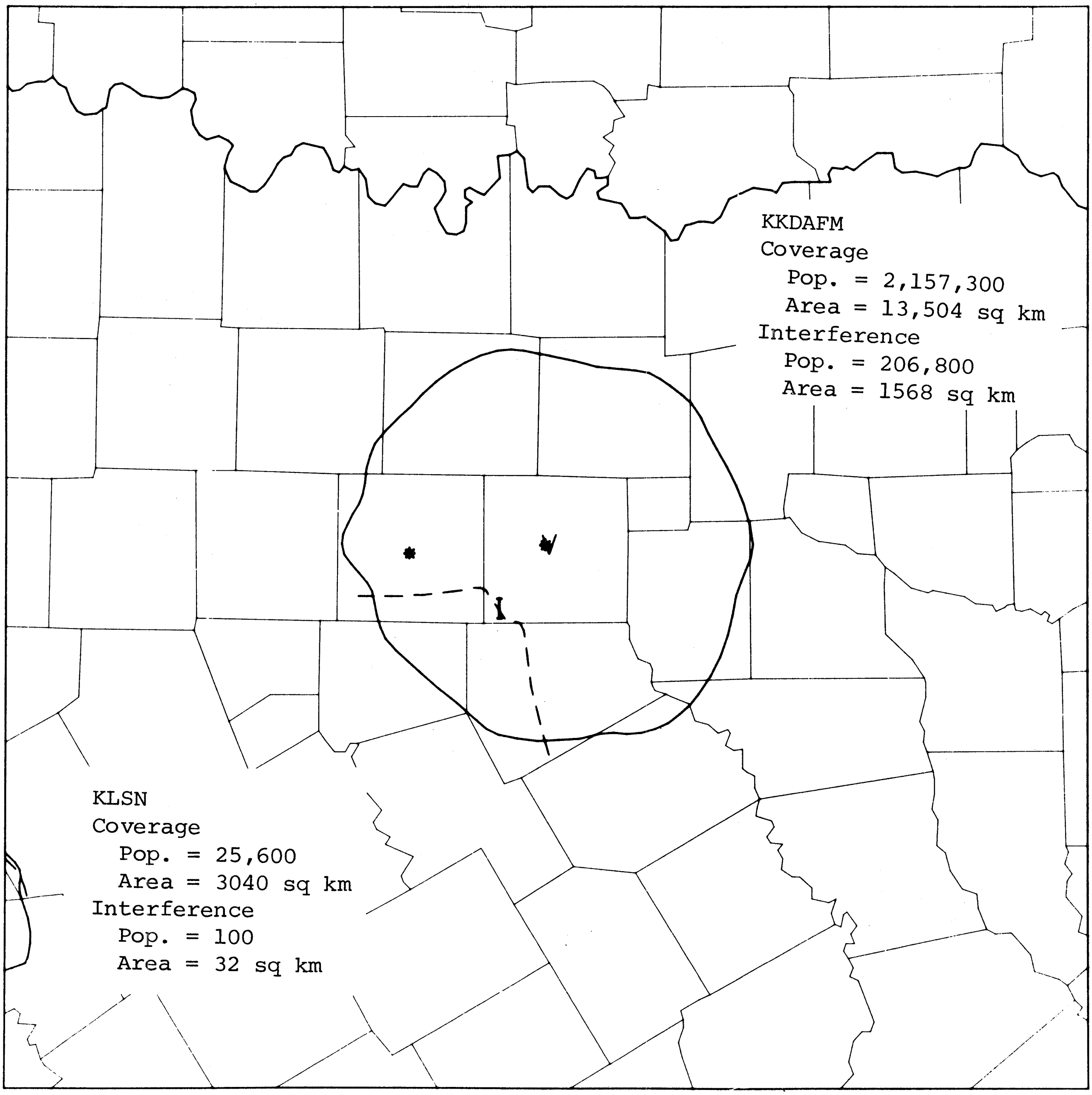



Figure B-14. (Continued).




D=CH281,283 U=CH281 100KW 1500FT D/U=14,-50DB

Figure B-14. (Continued).

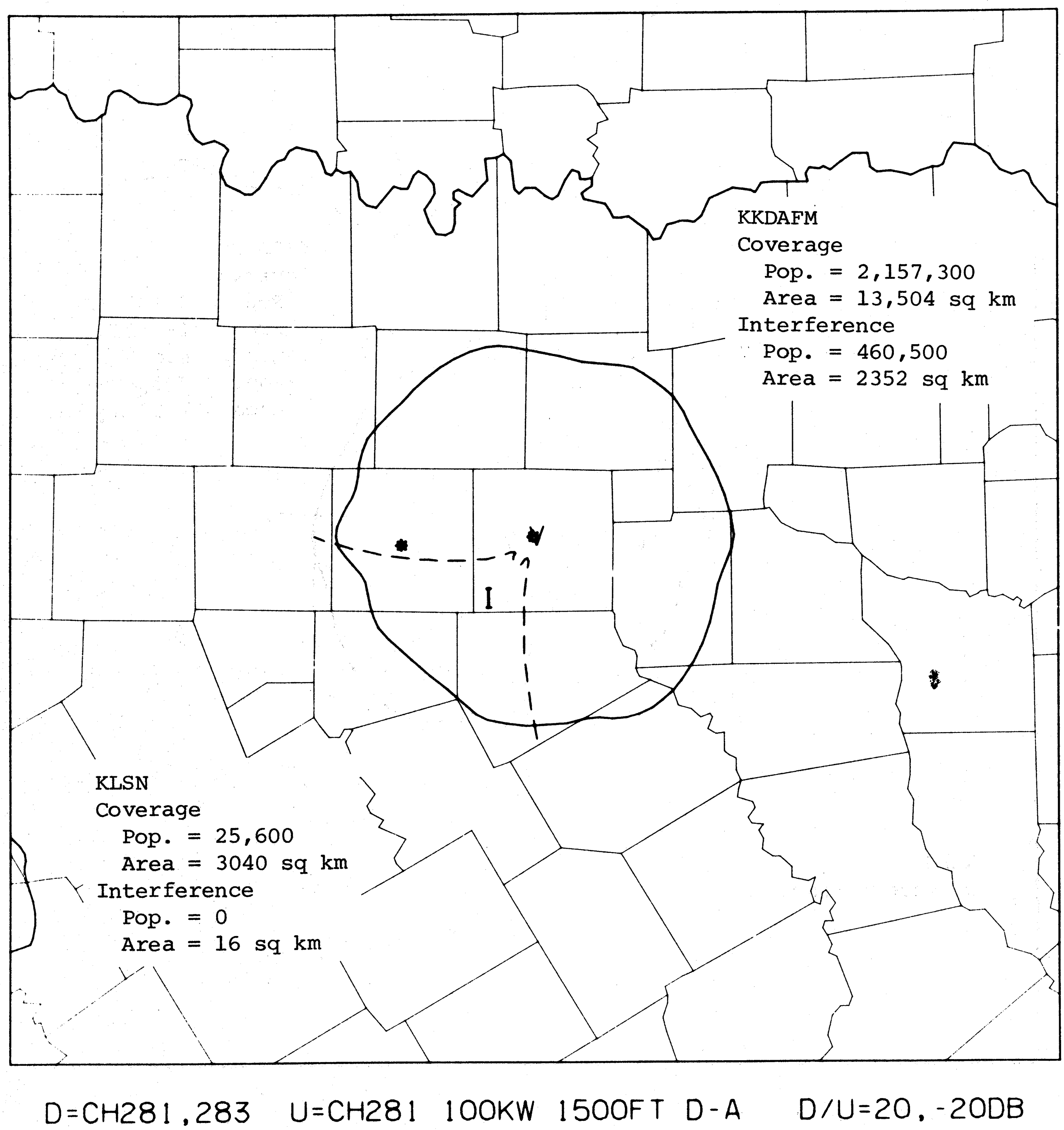
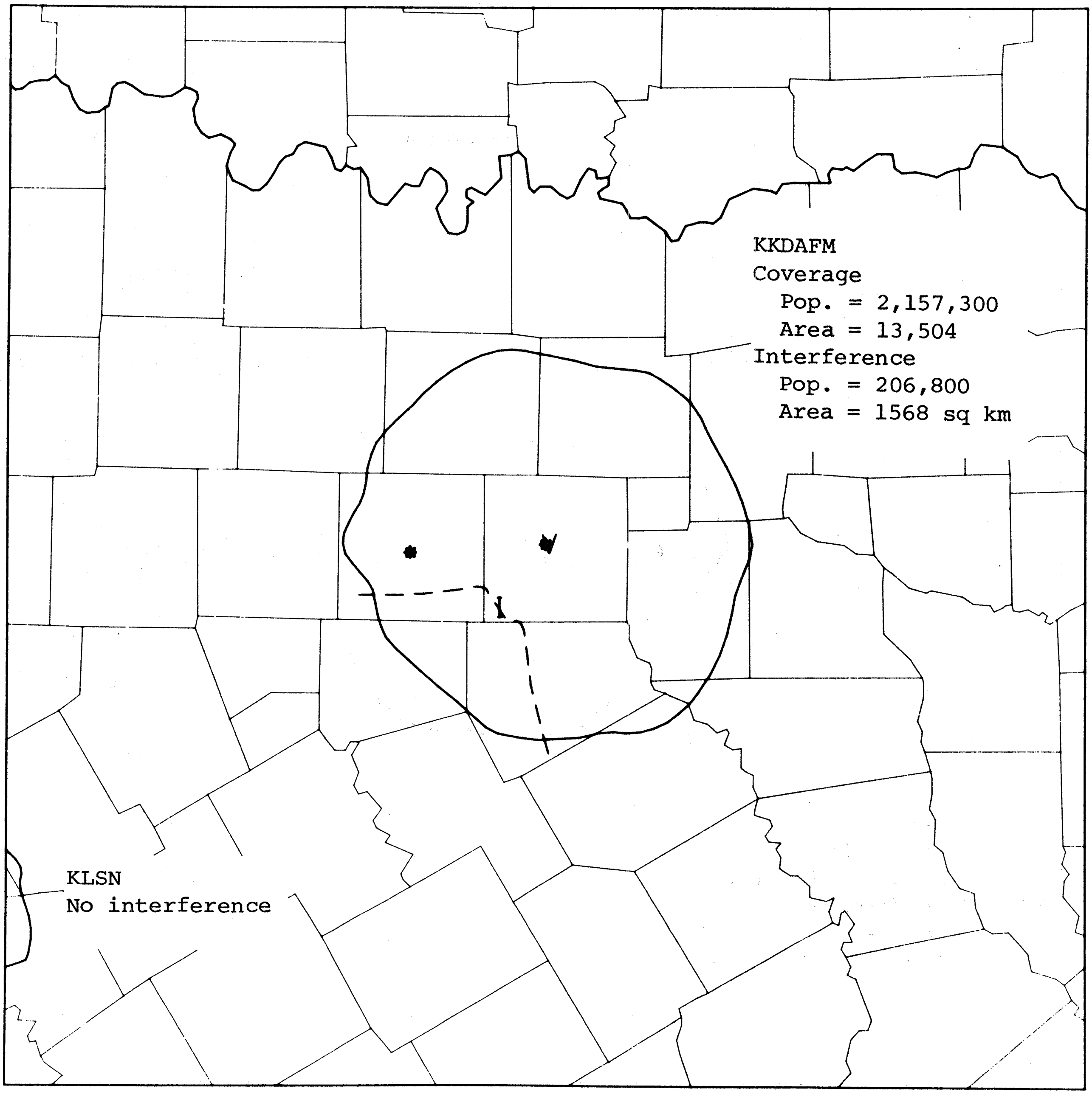
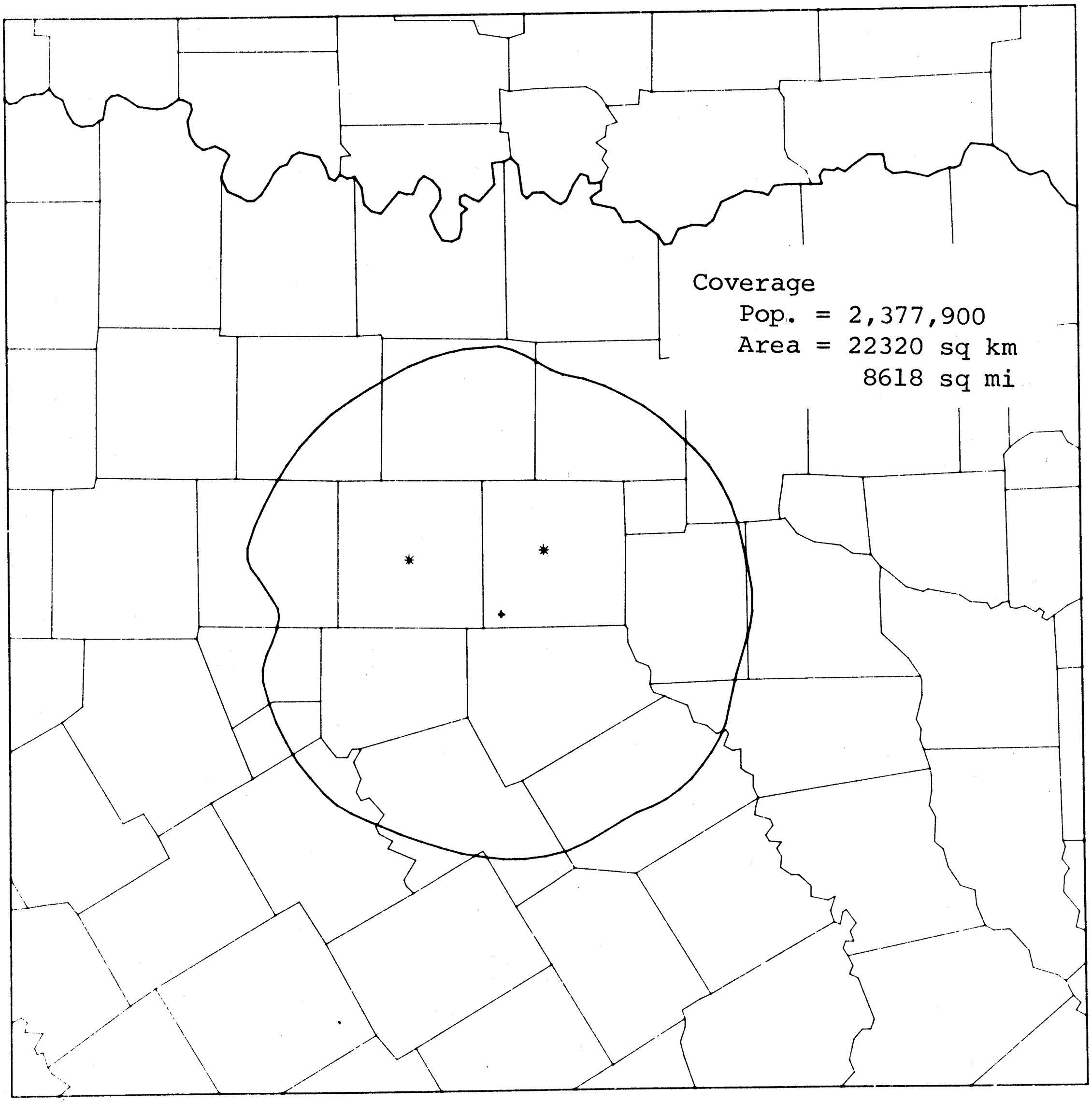



Figure B-14. (Continued).



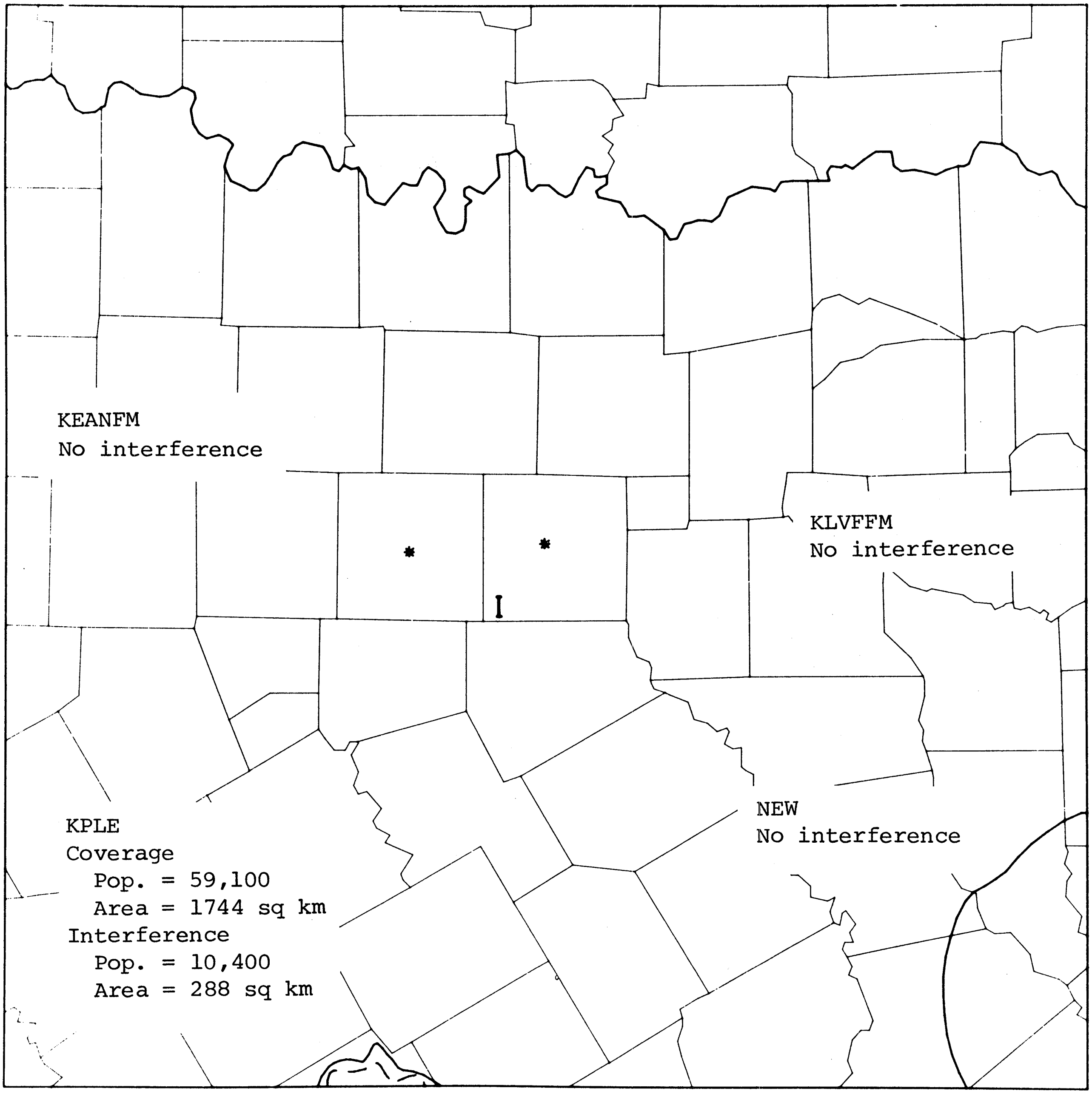

D=CH281,283 U=CH281 100KW 1500FT D-A D/U=14,-50DB

Figure B-14. (Continued).




CH285 100KW 1500FT HAAT

Figure B-15. Proposed channel 285.




D=CH285,286 U=CH285 100KW 1500FT D/U=20,6DB

Figure B-15. (Continued).

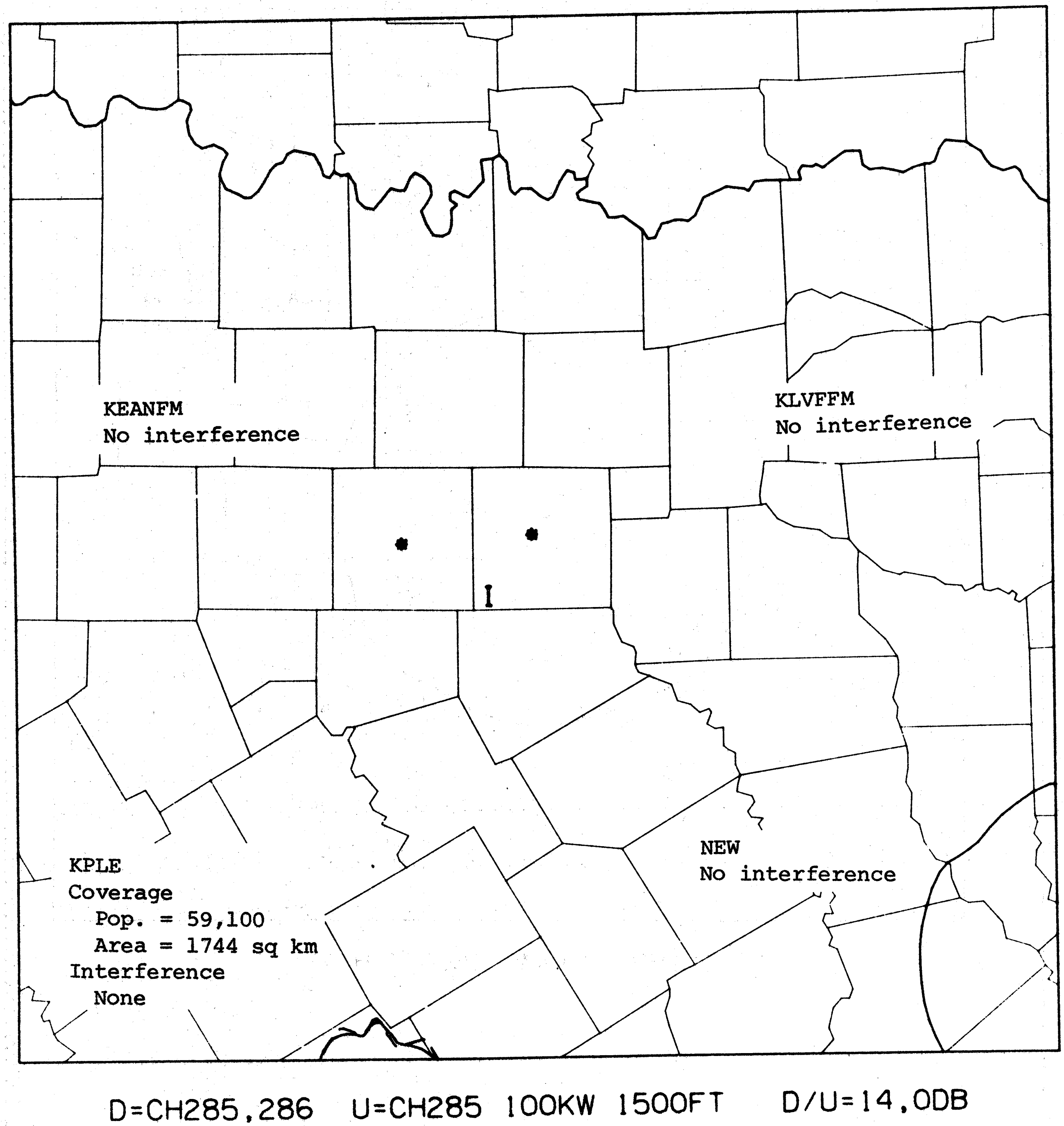



Figure B-15. (Continued).

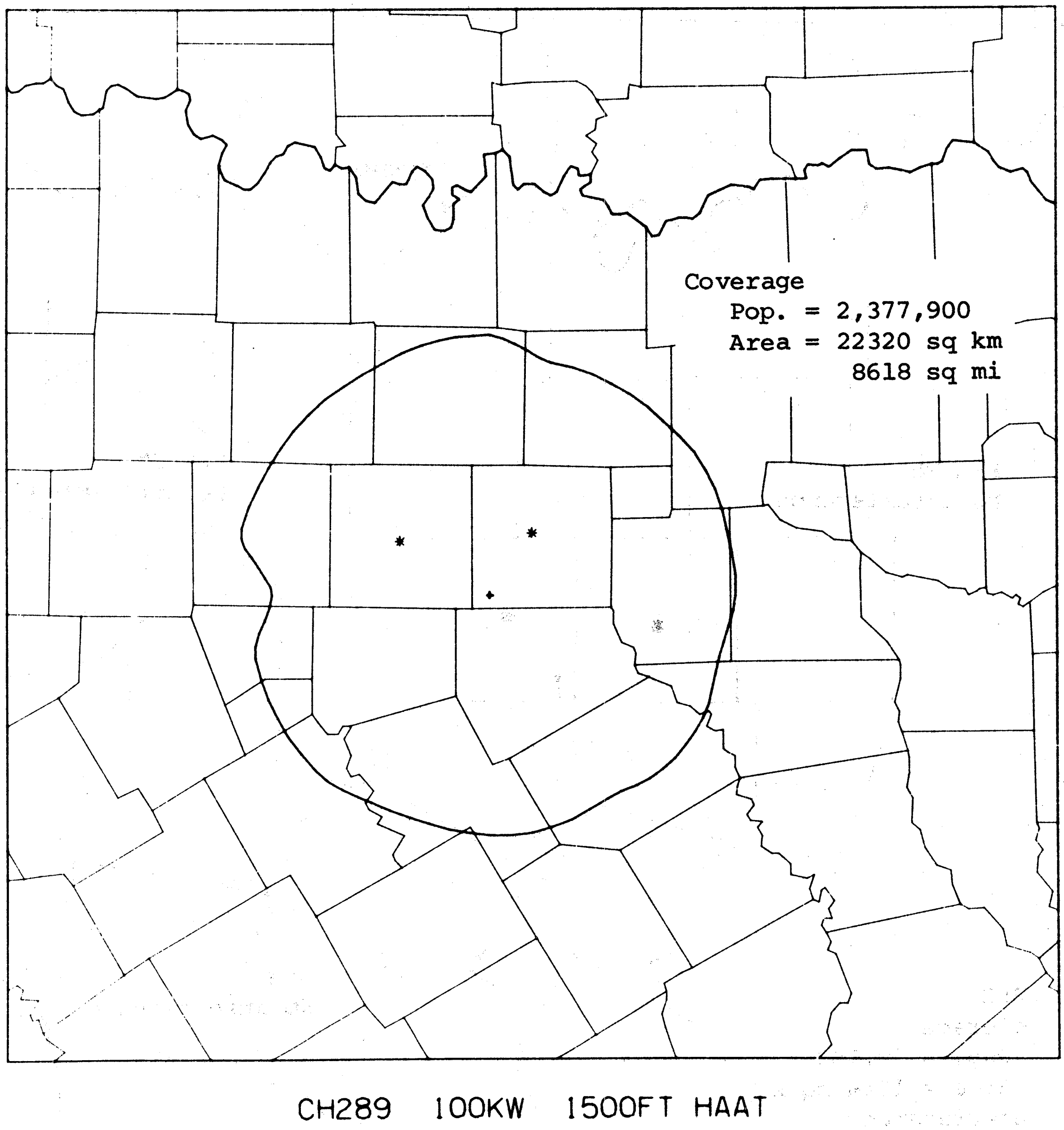
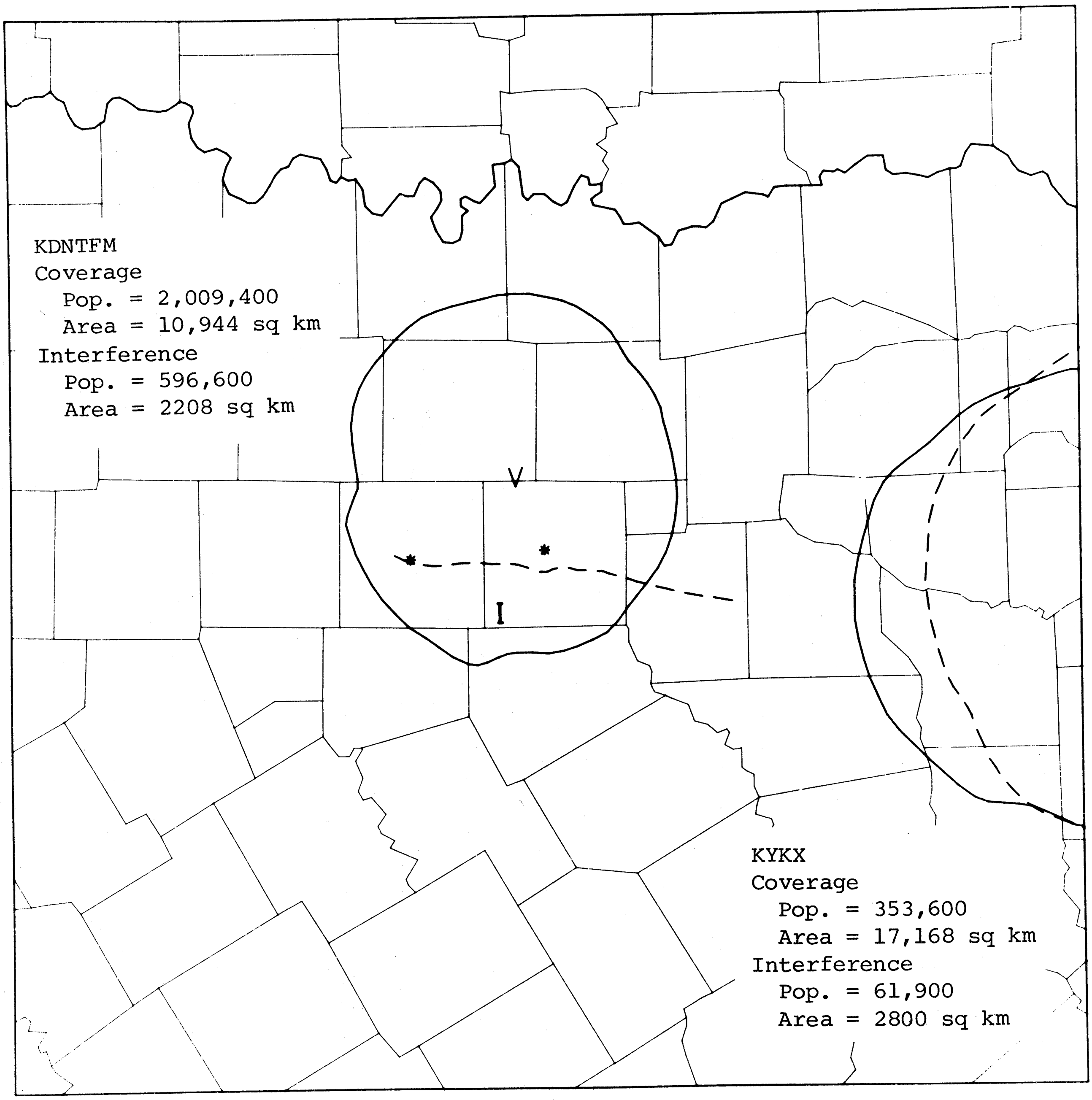
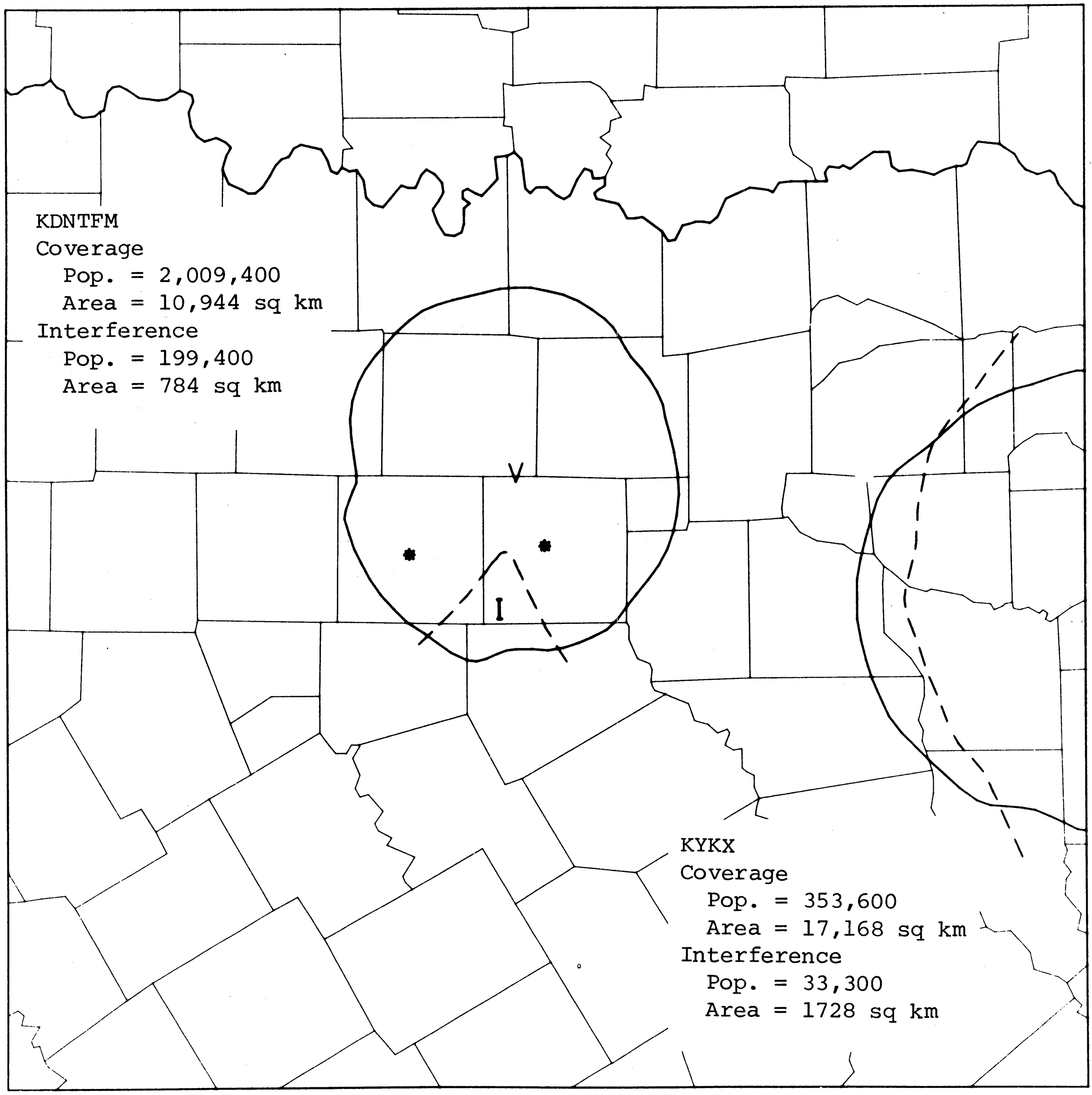



Figure B-16. Proposed channel 289.




D=CH289,291 U=CH289 100KW 1500FT D/U=20,-20DB

Figure B-16. (Continued).




D=CH289,291 U=CH289 100KW 1500FT D/U=14,-50DB

Figure B-16. (Continued).

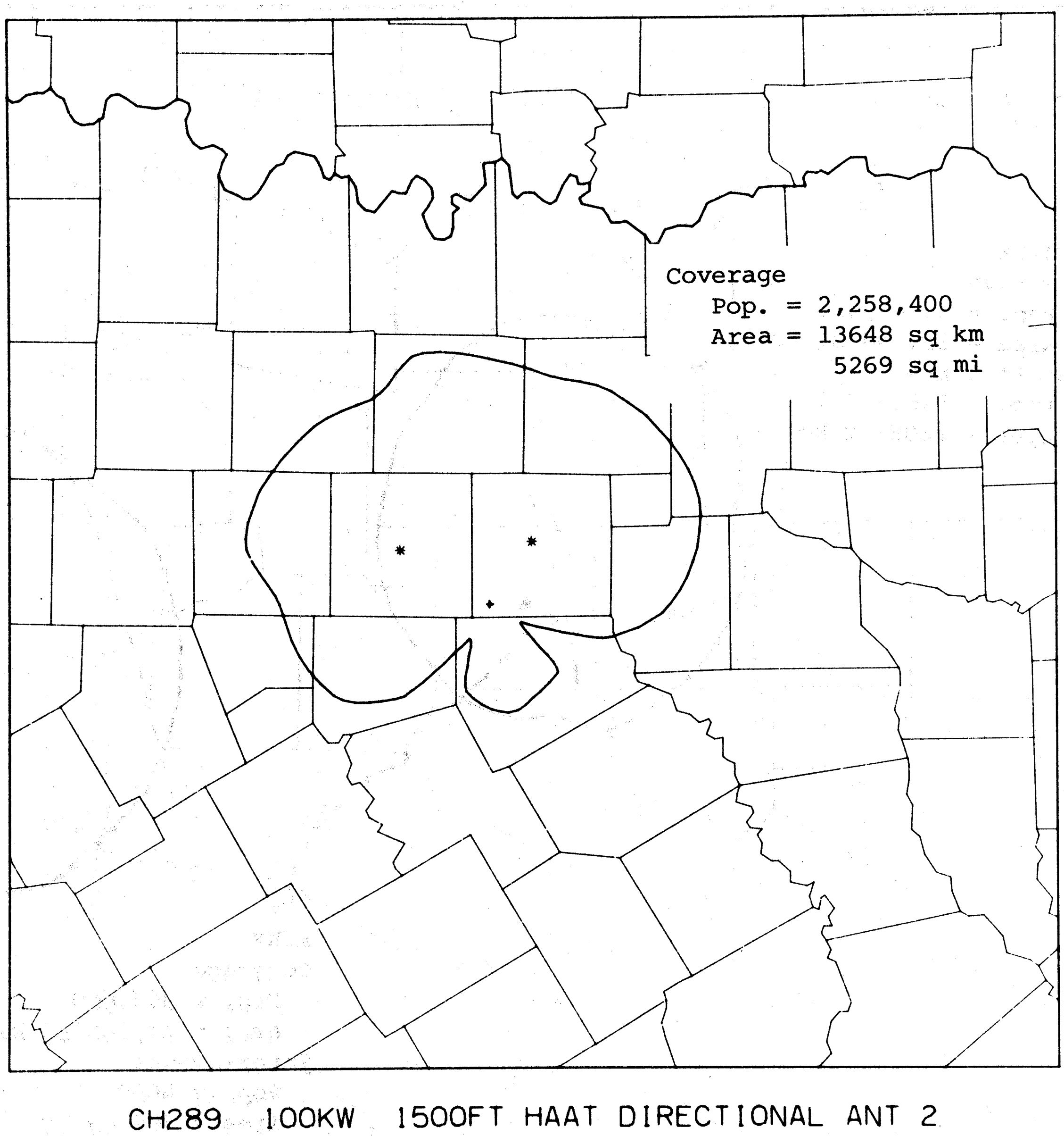



Figure B-16. (Continued).

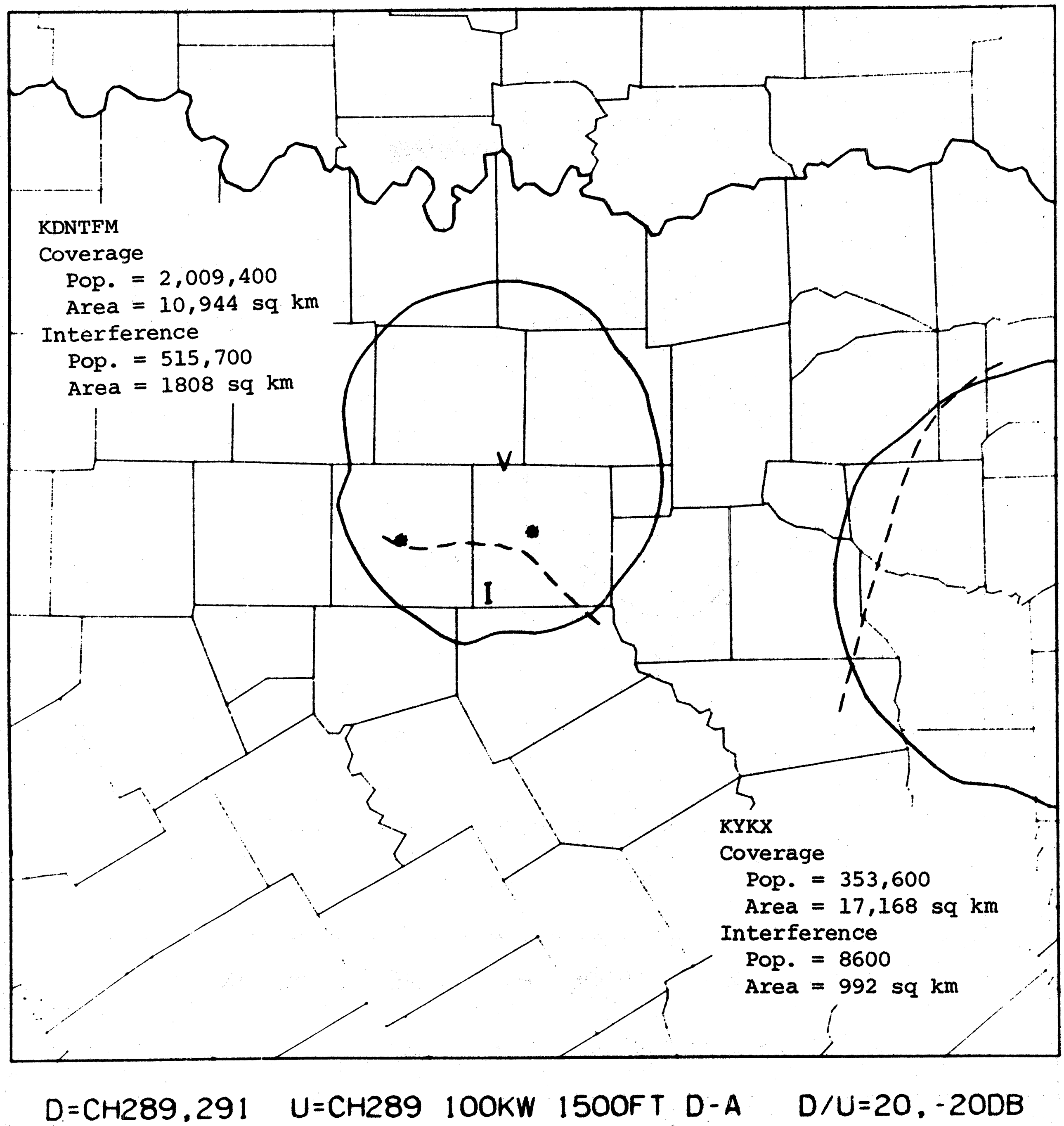



Figure B-16. (Continued).

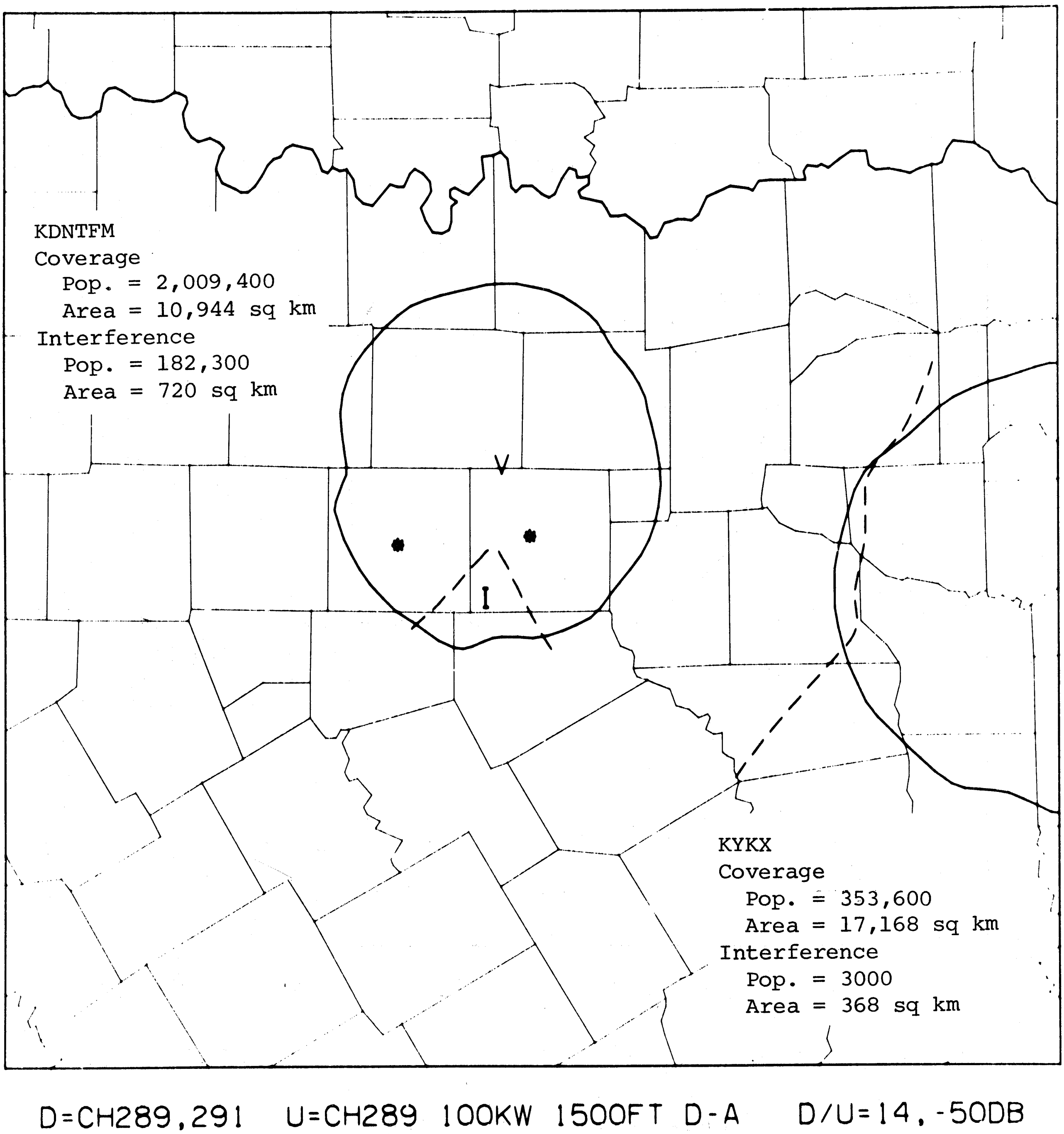



Figure B-16. (Continued).

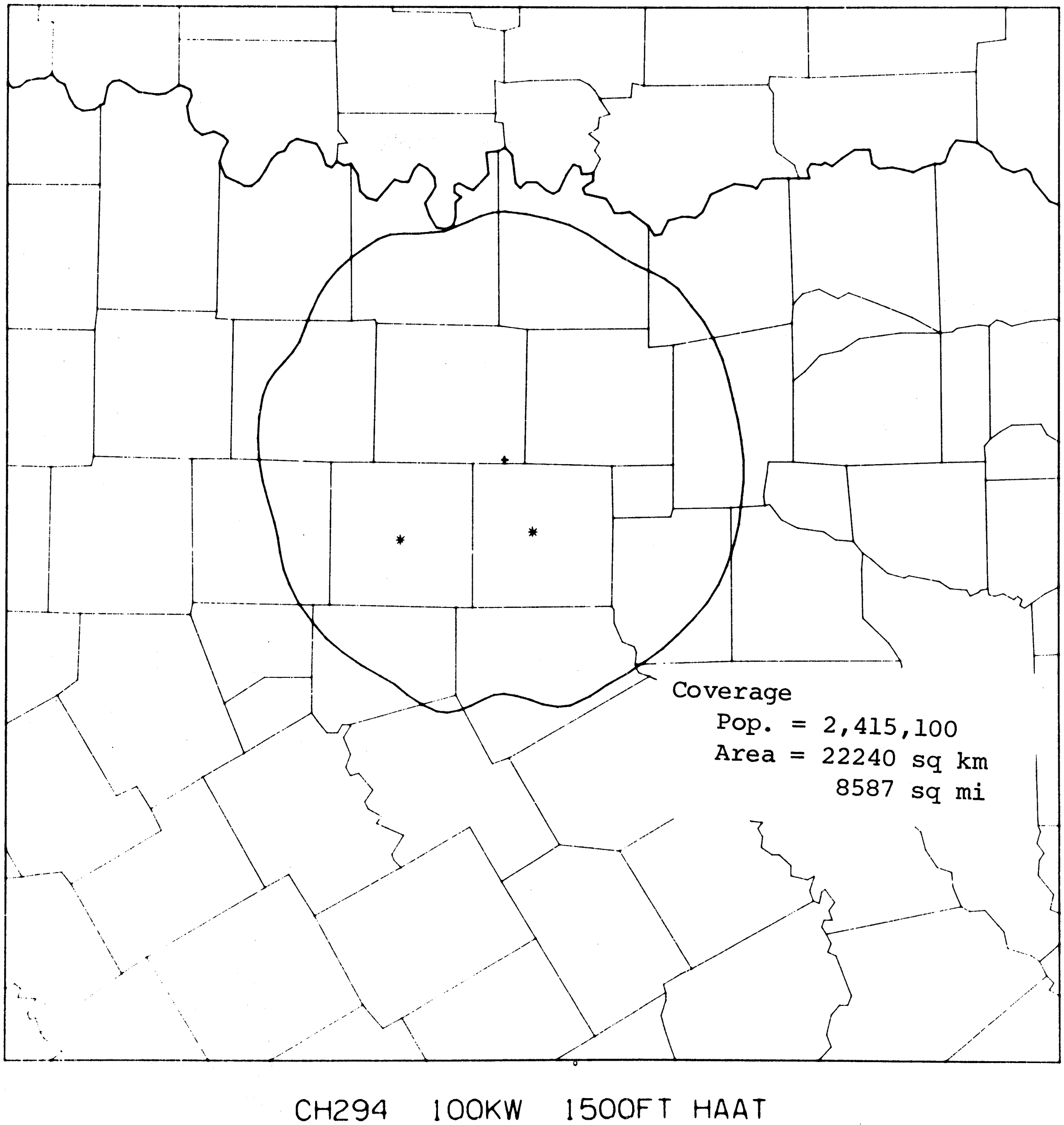
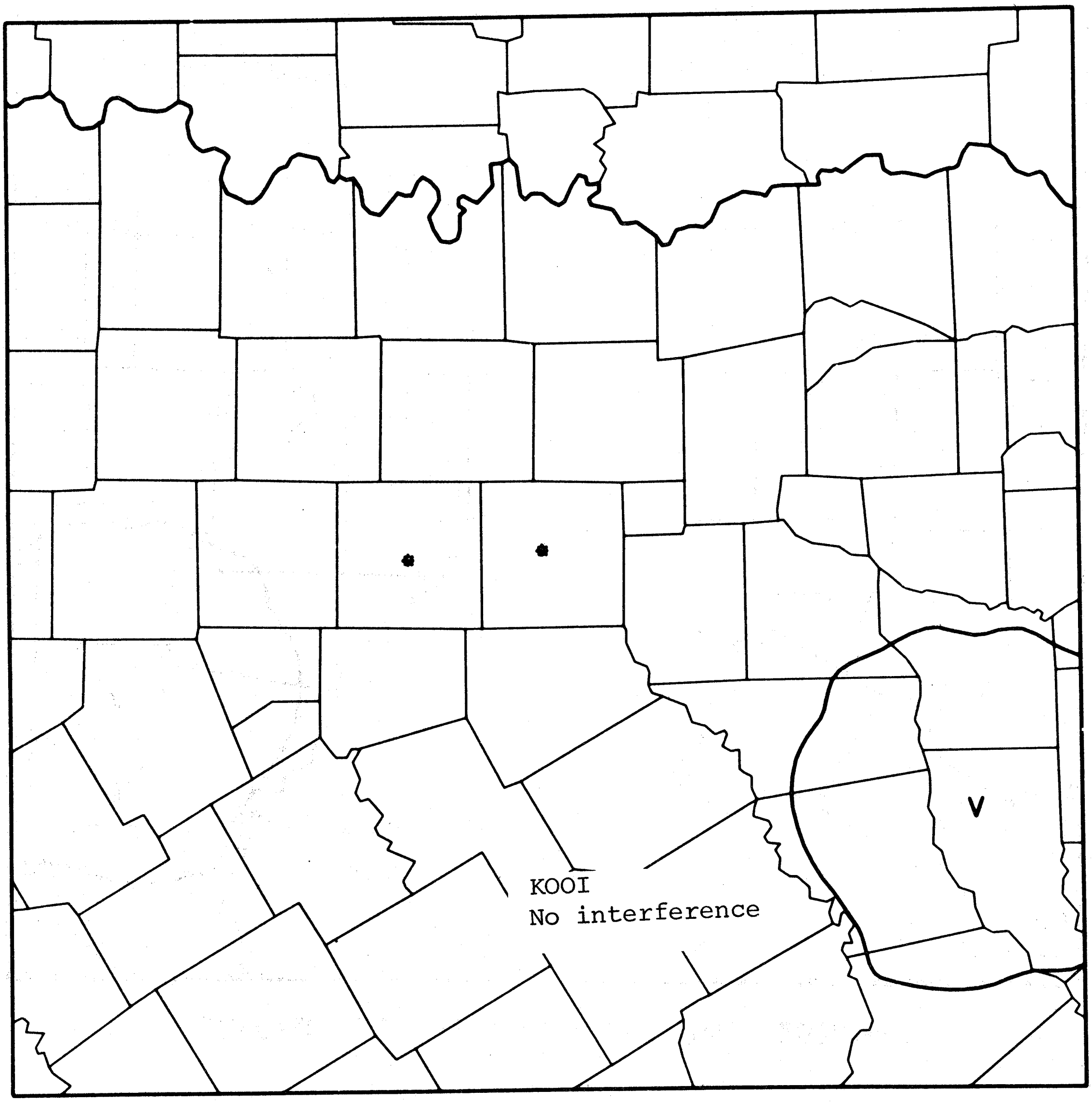
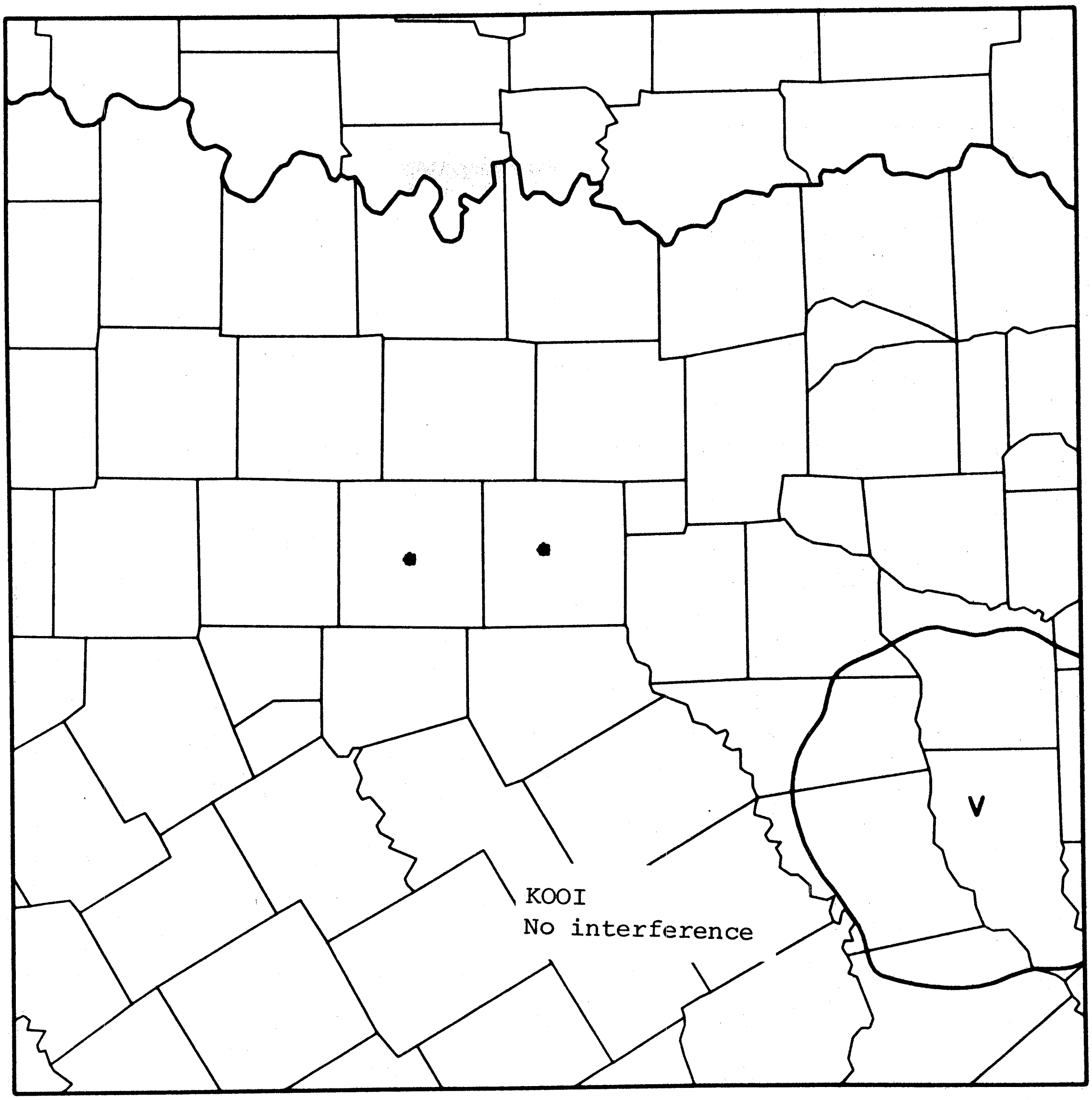



Figure B-17. Proposed channel 294.




D=CH293 U=CH294 100KW 1500FT D/U=6DB

Figure B-17. (Continued).




D=CH293 U=CH294 100KW 1500FT D/U=0DB

Figure B-17. (Continued).

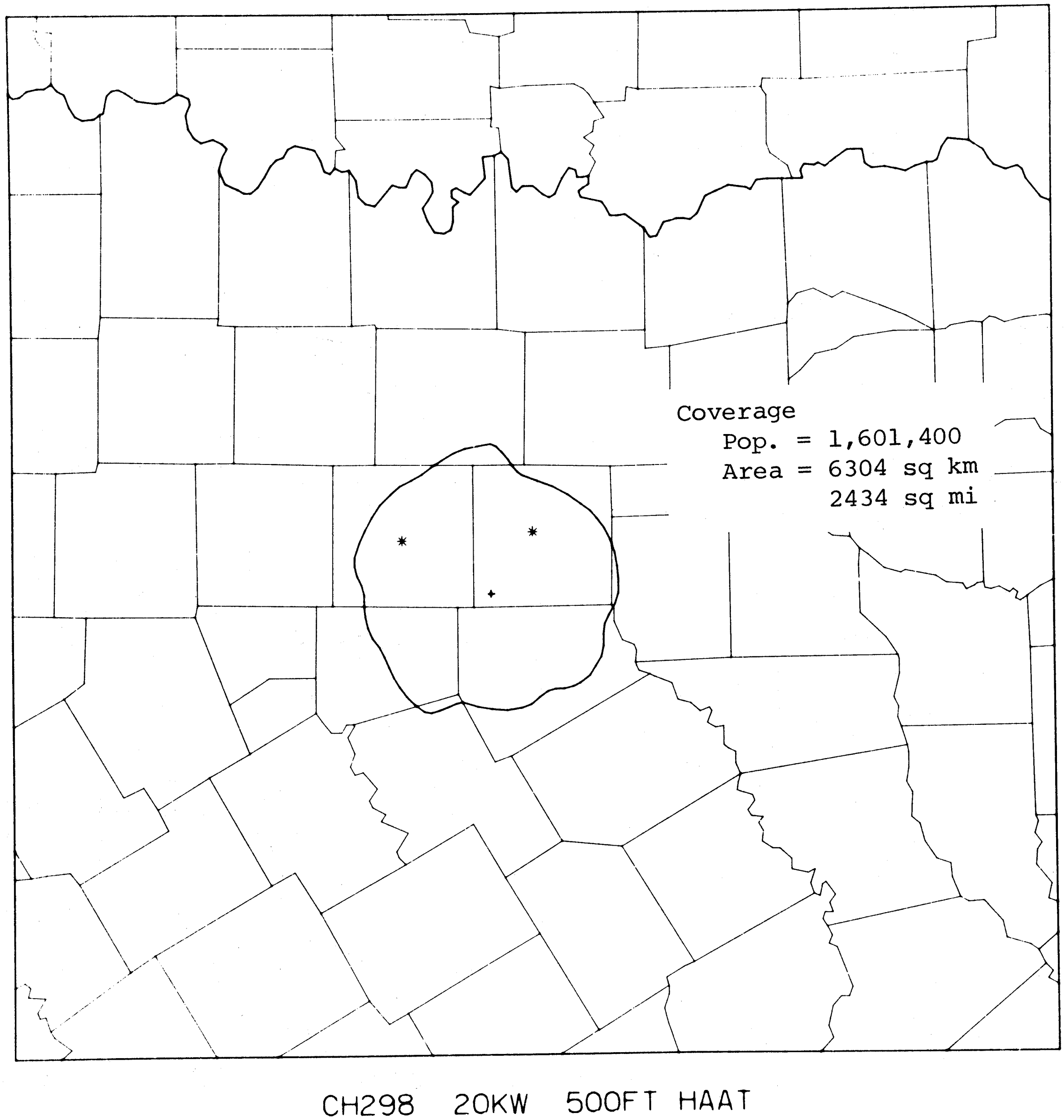
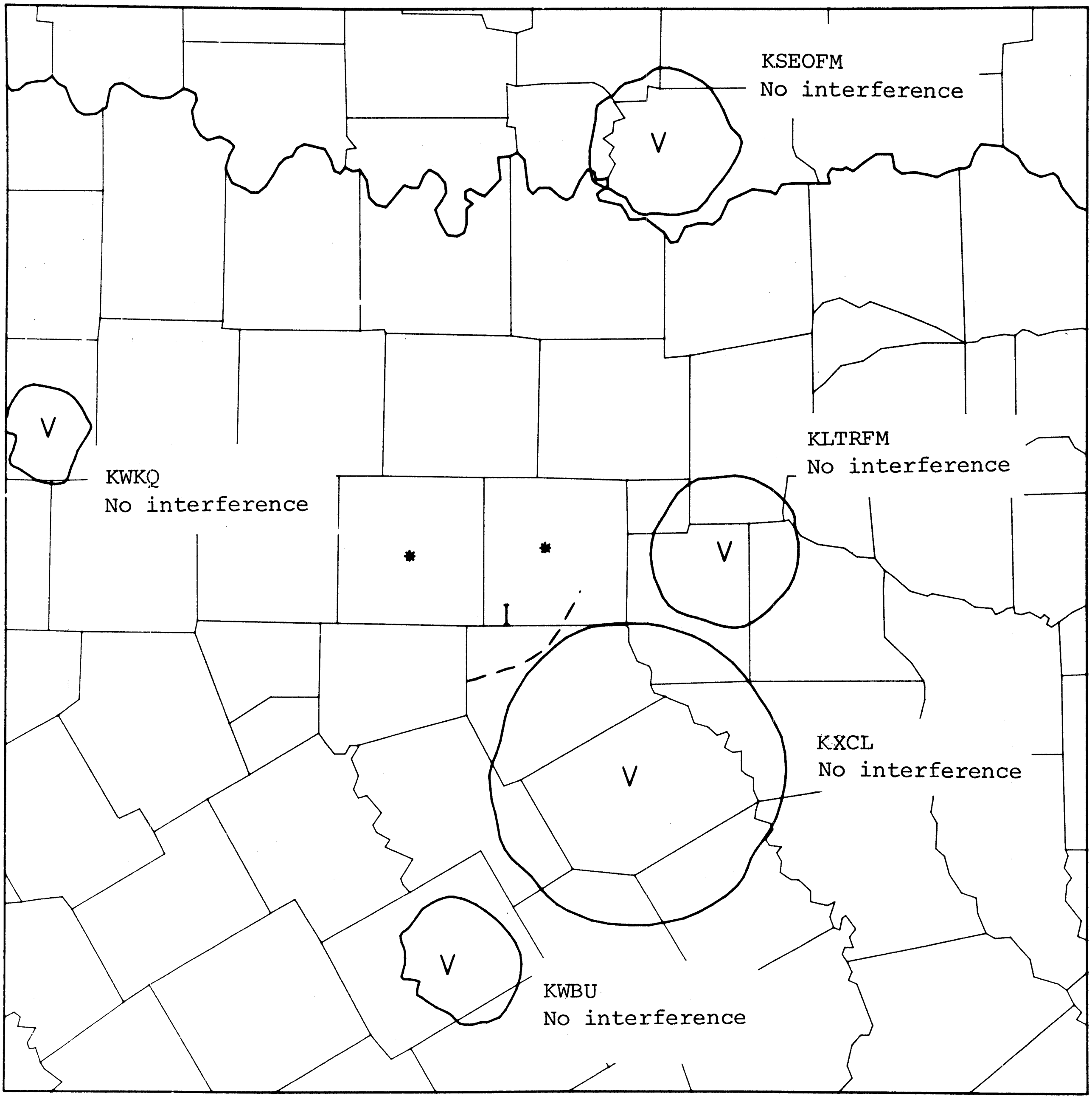



Figure B-18. Proposed channel 298.




D=CH296,300   U=20KW 500FT CH 298   D/U=-20DB

Figure B-18. (Continued).

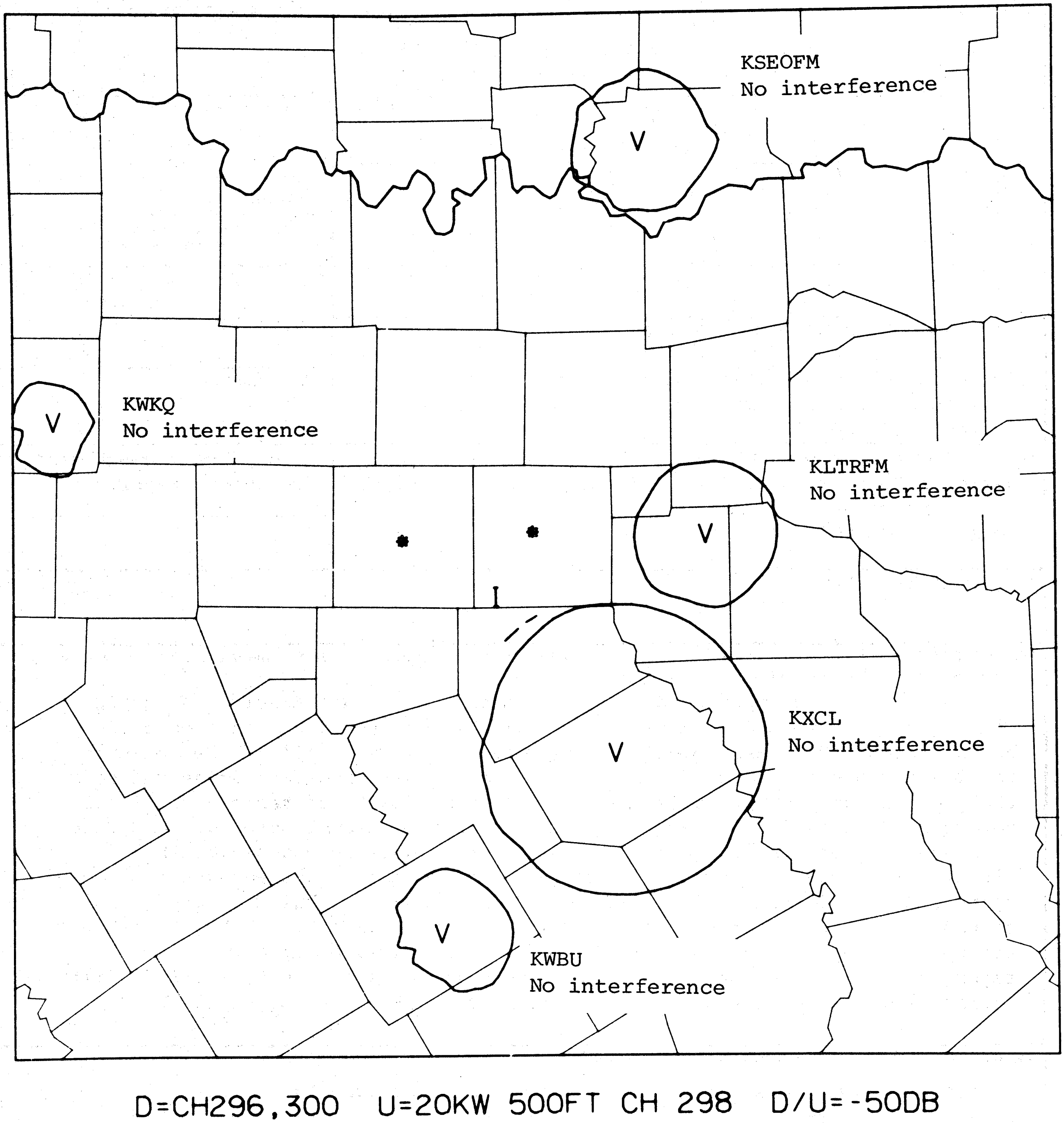



Figure B-18. (Continued).

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(3-73)

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# BIBLIOGRAPHIC DATA SHEET

| | | |
|---|---|---|
| 1. PUBLICATION OR REPORT NO. NTIA Report 80-44 | 2. Gov't Accession No. | 3. Recipient's Accession No. |
| 4. TITLE AND SUBTITLE PROPOSED TECHNIQUES FOR ADDING FM BROADCAST STATIONS IN A MAJOR MARKET | | 5. Publication Date August 1980 |
| | | 6. Performing Organization Code NTIA/ITS-1 |
| 7. AUTHOR(S) | | 9. Project/Task/Work Unit No. 9101131 |
| 8. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Department of Commerce National Telecommuniations and Information Admin. Institute for Telecommunication Sciences Boulder, CO 80303 | | 10. Contract/Grant No. |
| 11. Sponsoring Organization Name and Address National Telecommunications and Information Admin. U.S. Department of Commerce Boulder, CO 80303 | | 12. Type of Report and Period Covered Technical Report |
| | | 13. |

14. SUPPLEMENTARY NOTES

15. ABSTRACT *(A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.)*


A study was conducted to investigate the technical capacity of the FM broadcast spectrum and to determine if the FM spectrum's utilization could be increased. More assignments are possible if some or all of the following recommendations are adopted: 1) protection to existing facilities rather than to maximum facilities is granted, 2) the effects of terrain on signal coverage and interference are considered, 3) directional antennas to control both coverage and interference are used, 4) reasonable changes to the signal-to-interference protection ratios for co-channel and adjacent channel operation are adopted, and 5) co-siting of second- and third-adjacent channel transmitters with existing transmitters is permitted. To demonstrate the approach of adding new assignments to a saturated major market, the report shows how the number of FM broadcast stations in the Dallas-Ft. Worth region could be increased from the present 21 stations to 38 stations.


16. Key words *(Alphabetical order, separated by semicolons)*

co-sited transmitters; directional antennas; FM broadcast; spectrum utilization; terrain

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|---|---|---|
| 17. AVAILABILITY STATEMENT | 18. Security Class *(This report)* UNCLASSIFIED | 20. Number of pages 176 |
| [X] UNLIMITED. | | |
| [ ] FOR OFFICIAL DISTRIBUTION. | 19. Security Class *(This page)* UNCLASSIFIED | 21. Price: |


USCOMM-DC 29716-P73
USCOMM - ERL

☆ U. S. GOVERNMENT PRINTING OFFICE 1980 - 679-771/37 Reg. 8