MARINE WEATHER DISSEMINATION SYSTEMS STUDY

Prepared for
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400 7th Street, S.W.
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by

COMPUTER SCIENCES CORPORATION
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VOLUME III - SYSTEMS EFFECTIVENESS MEASUREMENT

MARINE WEATHER DISSEMINATION SYSTEMS STUDY, v. 3.

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16. Abstract

Systems effectiveness of marine weather dissemination systems is measured against carefully established criteria. First level effectiveness, accessibility, is measured in terms of coverage, audience, and system schedule. Second level effectiveness is examined in terms of timeliness. The analysis addresses systems operated by the U.S. Coast Guard, the National Weather Service, public coast stations and commercial broadcasters.

The work described was performed in the second phase of a study aimed at improving the dissemination of weather information to marine users and at establishing guidelines for future Coast Guard research and development efforts in this field.

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FOREWORD

This is the second of four reports prepared by Computer Sciences Corporation for the U.S. Coast Guard during the course of a Study of How Best to Utilize Coast Guard Communication Facilities for Weather Dissemination to Marine Users. The study was performed under Contract DOT-CG-00,579-A, which was awarded to CSC on August 31, 1970 and completed August 16, 1971.

The study was divided into four phases:

- Task 1 - Familiarization of the study team with existing marine weather dissemination systems, and the characterization of these systems in terms of their facilities, policies and procedures.
- Task 2 - Measurement of effectiveness of existing and planned weather dissemination systems, following the development of standards and criteria against which to measure this effectiveness.
- Task 3 - Formulation of recommendations for changes in the facilities, policies and procedures of the U.S. Coast Guard and other government and nongovernment agencies considered necessary to improve the dissemination of weather information to marine users.
- Task 4 - Generation of guidelines for future USCG research and development effort in the area of weather dissemination and alerting techniques in terms of operational constraints, performance requirements and cost data.

CSC wishes to acknowledge the assistance of CDR B. F. Hollingsworth, USCG, as Technical Representative to this study and also of LCDR E. Jones and CWO R. J. Williams in making data available for the study. CSC would also like to take this opportunity to thank Mr. Max Mull, Mr. William J. McKee, Jr., and

Mr. Warren Hight of the National Weather Service, NOAA, for their valuable contributions during the study.

It should be noted that the conclusions presented in this report are solely those of CSC and do not necessarily reflect the views of the above mentioned representatives of the USCG and NWS.

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SUMMARY

EXAMINATION OF THE PROBLEM

The rapid growth of the recreational boating community in recent years has led to the presence of a growing number of casual, inexperienced operators on waters under Coast Guard jurisdiction.

Unlike the more serious yachtsman, whose interest in sailing is an end in itself and who seeks skills in seamanship, the more casual boatman frequently uses his vessel as a means to enjoy interests such as fishing, water skiing, or skindiving.

By his very nature he is the least experienced, the most poorly equipped, and the most vulnerable member of the boating community. He represents by far the most numerous type among the estimated 8.5 million boatmen in the United States.

The Coast Guard has done much to ensure safety by requiring that boats be equipped with life-saving devices, fire extinguishers, lights and horns. However, the boatman often remains unaware of the dangers of the weather, and in many cases he lacks adequate means of communication with weather disseminating organizations.

The problem is not confined to the lack of equipment and experience on the part of the user. Weather dissemination systems and techniques have historically served the less vulnerable and better equipped users and are not geared to the needs of the small user. In addition, crowding of the airwaves and the policy changes by the Federal Communications Commission (FCC) to relieve this congestion make a reexamination of current practices essential before any serious reorganization can be implemented. The diversity of broadcast frequencies and modulation techniques, the use of both transceivers and monitors, the wide variations in broadcast schedules, and the immense range in user requirements render a simple decision on such reorganization impossible.

Recognizing these factors, CSC has developed a study tailored to the specific problems involved and using methodologies developed expressly for this purpose.

THE ANALYSIS

This phase of the study, effectiveness measurement, begins with an examination of the systems serving coastal waters and with a definition of effectiveness as applied to these systems.

Recognizing several levels of effectiveness, a methodology is developed that defines the first of these levels as "accessibility" and measures it as a function of coverage, audience and schedule. A second level is examined in terms of characteristic weather phenomena and user habits and is termed "timeliness." The development and application of these techniques is described in Section 1, Study Rationale and Methodology. Elements of the analysis are described in detail in Sections 2 through 5, Coverage, Audience, Schedule, and Timeliness.

Nonbroadcast systems that serve the user in a pre-excursion mode are examined separately in Section 6, Nonbroadcast Systems. Section 7, Offshore and High Seas Systems, discusses serving users in the offshore and high seas areas.

THE RESULTS

Analysis of the broadcast-mode coastal systems yields quantitative measurements of their effectiveness on a comparative basis. Because of the importance of each of the elements of level 1 effectiveness (coverage, audience, and schedule) the results for each of these stages of the analysis are presented separately in Section 8. The performance of the nonbroadcast coastal systems is also discussed in this section.

CONCLUSIONS

The analyses performed during this phase of the study lead to the conclusion that none of the systems examined is adequate to serve the needs of the majority of recreational boatmen.

The greatest effectiveness in terms of coverage and audience is exhibited by the commercial broadcast system. Other systems are limited either by poor coverage or by the size of the audience equipped to receive their broadcasts. When system schedule is taken into account, all systems are shown to have extremely low effectiveness.

SECTION 1

STUDY RATIONALE AND METHODOLOGY

1.1 INTRODUCTION

The systems that are the subjects of this analysis do not lend themselves to ready categorization, and as a consequence the techniques used to measure their effectiveness also vary considerably. To assist the reader in following these analyses, this section outlines the rationale upon which they are based and presents an overview of the major methodologies employed and their method of application.

1.2 SCOPE OF THE ANALYSIS

In examining the study requirements, CSC recognized a need for several different disciplinary approaches to certain tasks. This is especially true in the case of system effectiveness measurement, where existing systems vary widely in their modes of operation. It is also true when considering differences in services to the non-tidal, coastal, offshore, and high-seas users, since the number of systems and the range of user requirements are widely different in each application.

To ensure applicability of the study to USCG requirements, CSC directed the analysis of coastal systems toward six selected geographic areas representative of the U.S. Coast Guard jurisdiction. These areas, which were selected in consultation with Coast Guard personnel, are as follows:

a. Atlantic Coast Region, from Sandyhook to Cape May.

b. Chesapeake Bay, from Baltimore to Norfolk.

c. South Florida coast, from Jupiter Inlet to Bayport, including the keys.

d. Gulf Coast Region, From Galveston to Brownsville.

e. North Pacific Coast Region, from Grays Harbor to Florence.

f. Great Lakes Region, including the south coast of Lake Erie from Erie Station to Toledo, from Toledo to Port Huron, the west coast to Lake Huron, the east coast of Lake Michigan and the west coast of Lake Michigan to Green Bay.

These areas are illustrated in Figures 1-1 through 1-6.

Scenarios describing all the system and user parameters required for the analysis were developed for each of these areas. Each area was analyzed in detail to determine the effectiveness of the systems operating within its confines.

Since these areas encompass a large part of the U.S. where boating activities are high, and represent an excellent range of parameters such as types of boatmen, broadcast facilities, seasonal factors, and weather constraints, the results of the study of these scenarios are applicable to all regions of U.S. waters under USCG jurisdiction.

1.3 CHARACTERIZING THE SYSTEM

In any system study a proper characterization of the system is of paramount importance, for any omission or misrepresentation at an early stage may invalidate all or part of the analysis that follows. A thoroughly detailed description of all possible segments of the system and its interfaces permits a careful examination of the function of each element and the identification of those relevant to the study.

This approach was used by CSC to characterize a generic Marine Weather Dissemination (MWD) System.

1.3.1 The System - A Disseminator

A disseminator is defined as any organization that relays weather information from a weather information source to a user. As such, the information may be relayed by radio, by

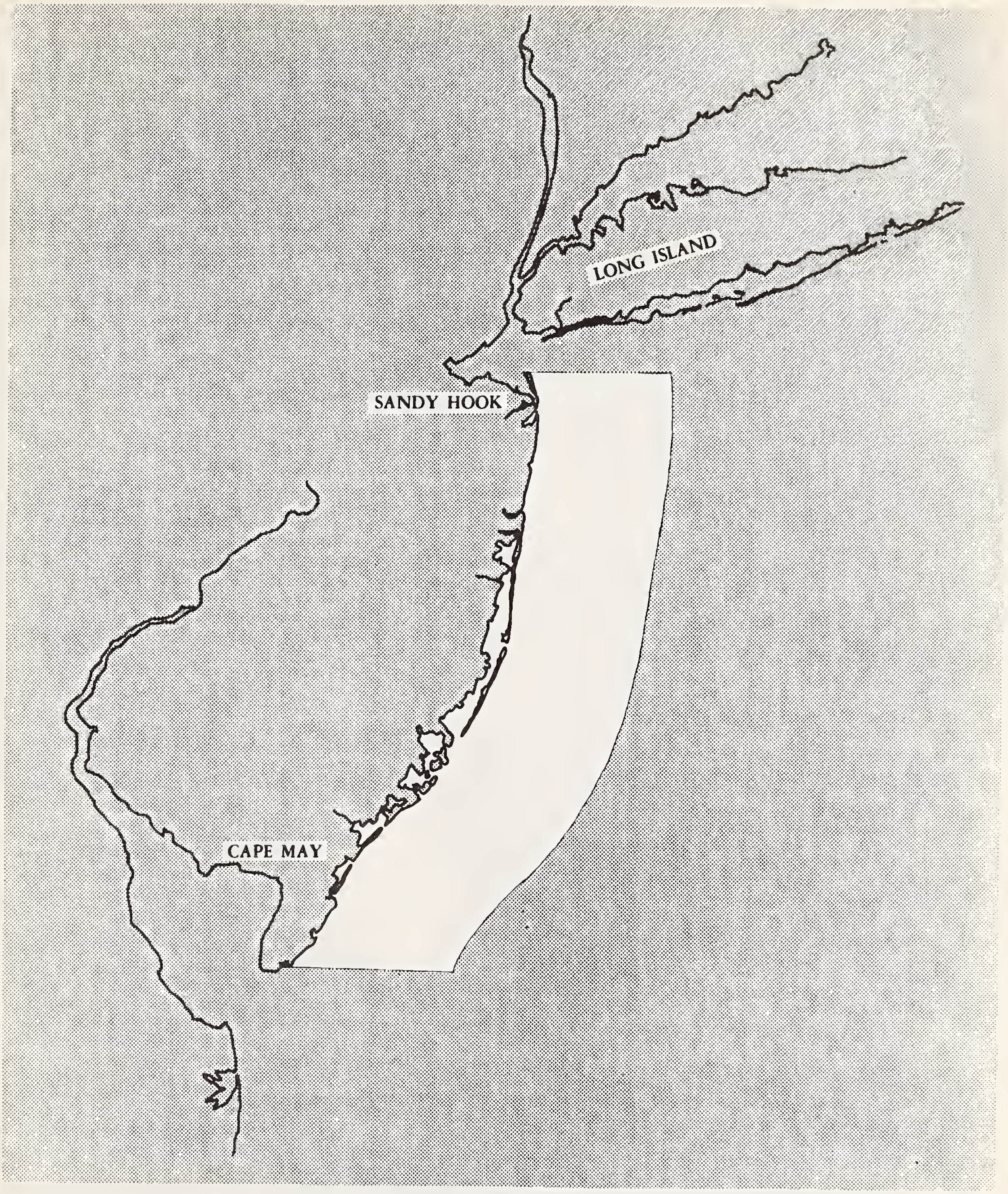

Figure 1-1. Scenario Area #1 - New Jersey Coast
(Analysis Area is Shown Unshaded)

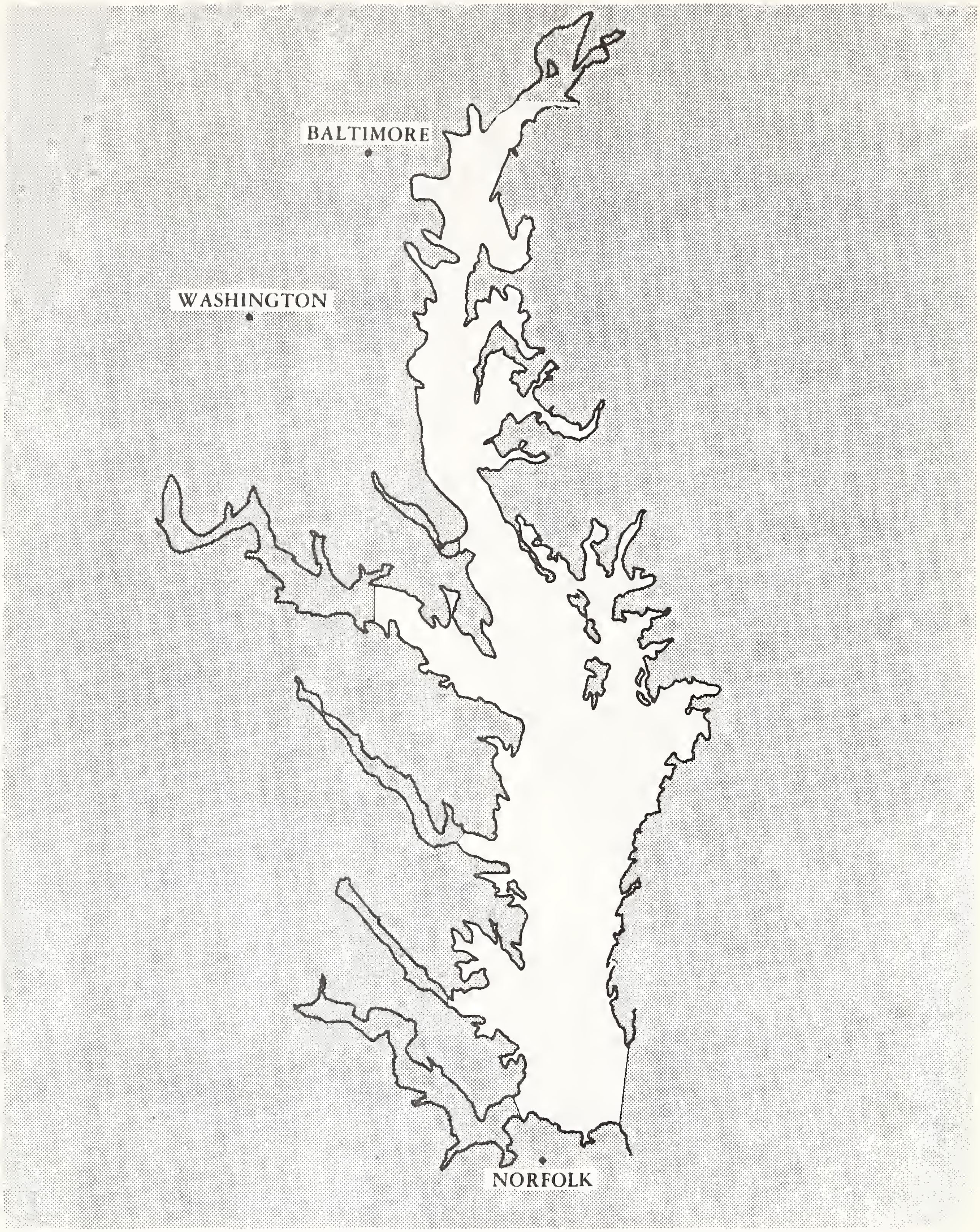

Figure 1-2. Scenario Area #2 - Chesapeake Bay
(Analysis Area is Shown Unshaded)

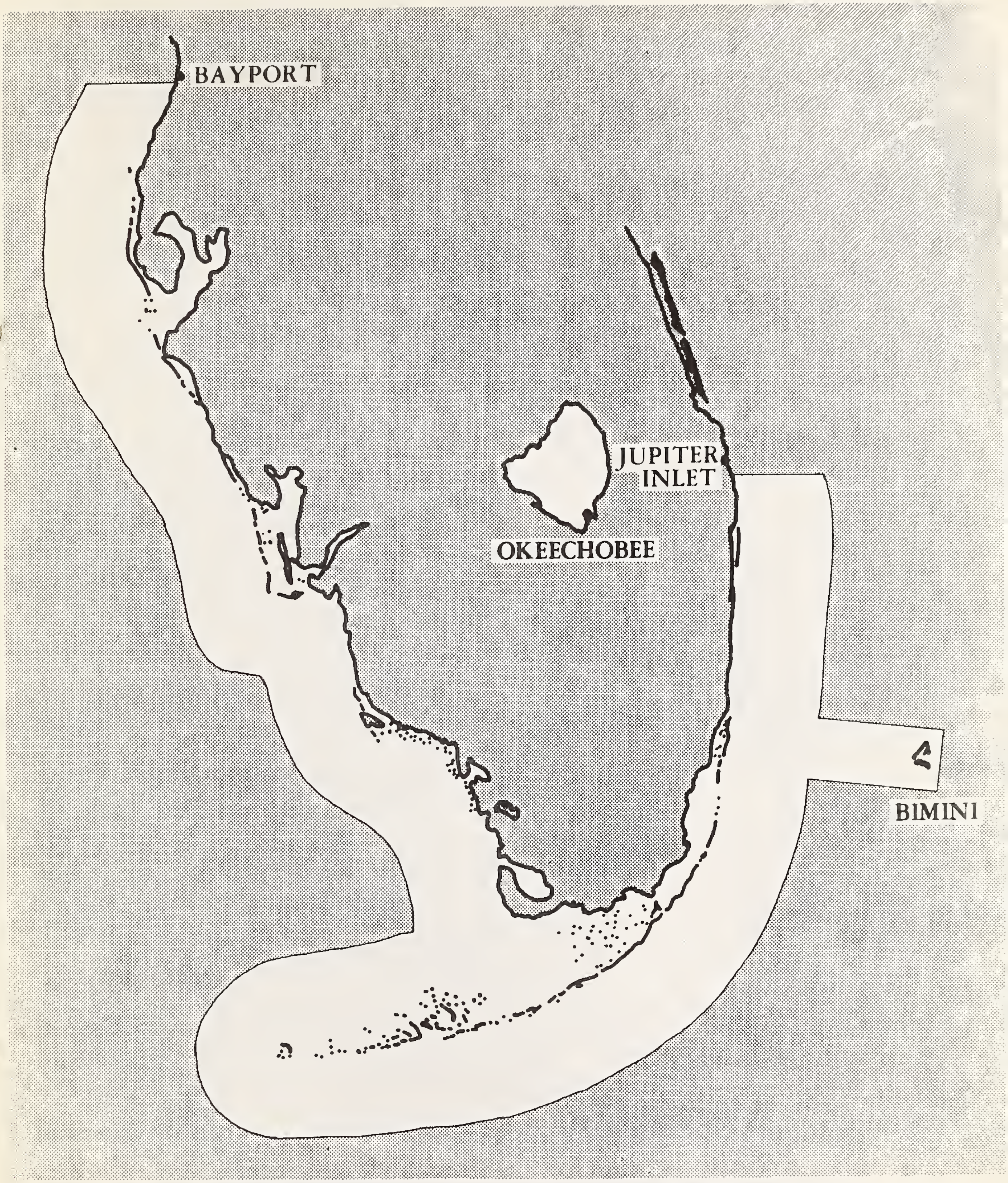

Figure 1-3. Scenario Area #3 - Florida Coast
(Analysis Area is Shown Unshaded)

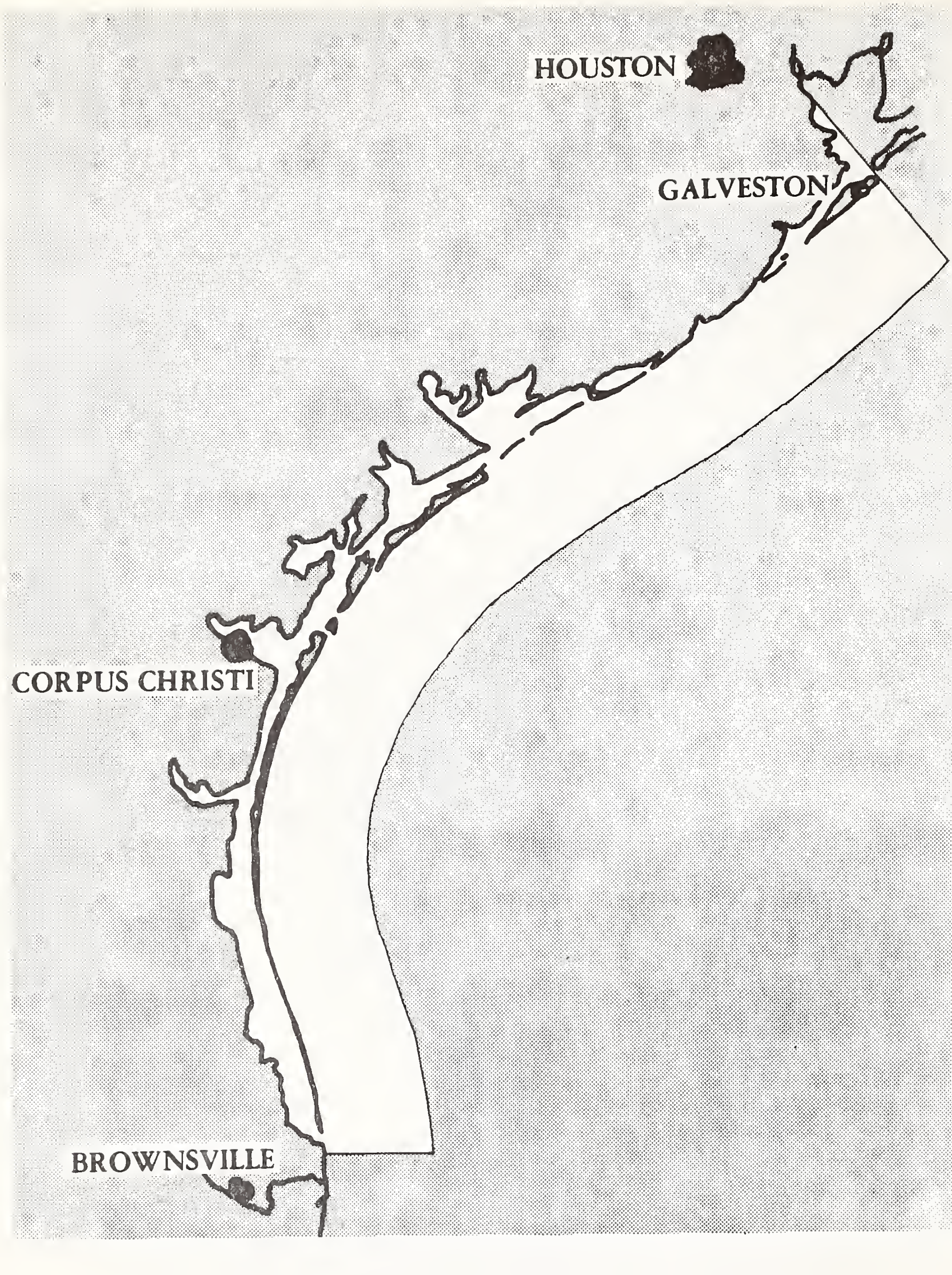

Figure 1-4. Scenario Area #4 - Gulf Coast
(Analysis Area is Shown Unshaded)

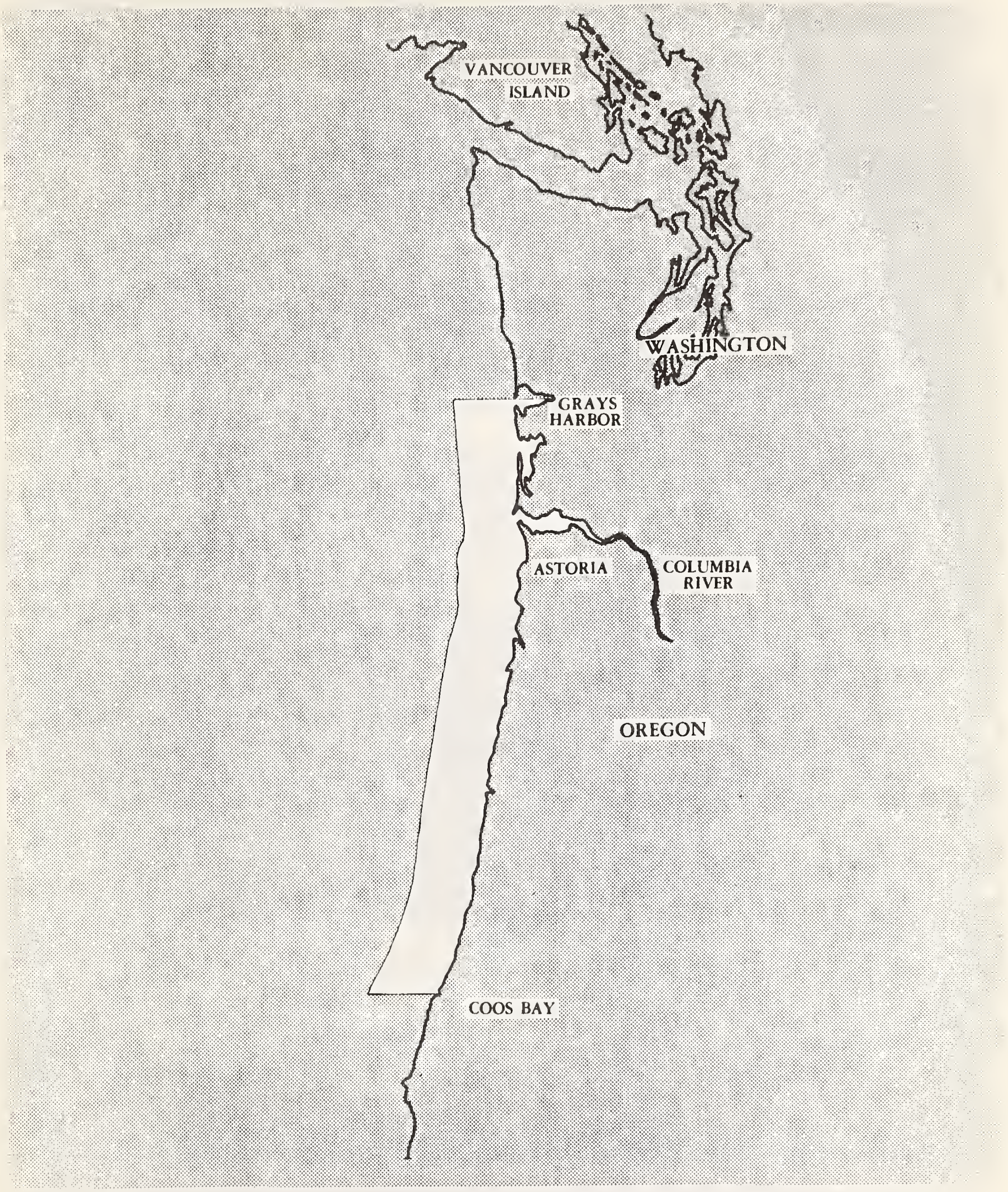

Figure 1-5. Scenario Area #5 - North Pacific Coast
(Analysis Area is Shown Unshaded)

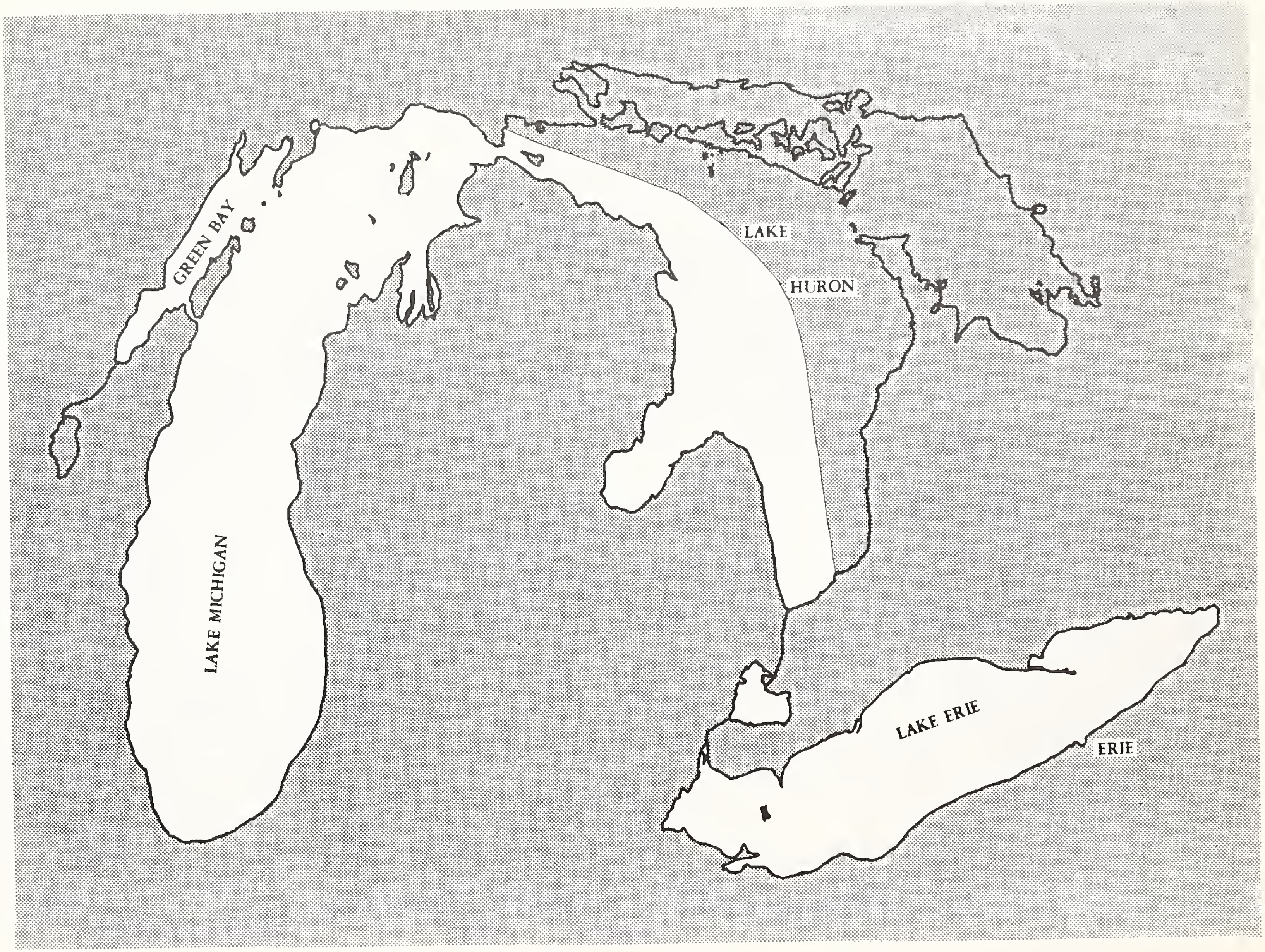

Figure 1-6. Scenario Area #6 - Great Lakes Region
(Analysis Area is Shown Unshaded)

landline (telephone, teletype, etc.) or visually. The disseminator may broadcast the information or relay it to individual users on request.

Functionally, the disseminator will:

a. Receive weather messages/requests for information

b. Edit or filter the message

c. Schedule transmissions

d. Broadcast message/respond to requests.

All of these functions are relevant to the MWD System and are considered part of the model.

1.3.2 System Interfaces

A disseminator must interface with a weather information source on one hand, and a user (or group of users) on the other. The characteristics of these interfaces may have a significant effect on the performance of the disseminator, and therefore on the effectiveness of the system. Interface characteristics must, therefore, be examined closely in defining the system model.

1.3.2.1 Weather Information Source/System Interface

Functionally, the weather information source must perform the following operations:

a. Data gathering

b. Interpretation

c. Forecasting

d. Message formatting and scheduling

e. Message transmittal.

In practice, current policy confines this role to the National Weather Service of NOAA (previously the Weather Bureau of ESSA). Although a 1968 directive gives selected Coast Guard stations the authority to initiate local (visual) weather warnings, they are not permitted to forecast weather conditions except under exceptional circumstances. Essentially, the Weather Service represents the only organization performing operations a, b, and c.

The system clearly depends on these three parameters, and faster, more accurate local weather forecasting would undoubtedly be valuable to the operation of the system. However, although the state-of-the-art in weather forecasting is continuously being advanced, changes in techniques and procedures must be made with caution. Moreover, initial analyses indicate that the system is only marginally sensitive to changes in these parameters. This portion of the weather data source segment is, therefore, regarded as outside the bounds of the model under development.

Message formatting, scheduling, and transmittal, on the other hand, may have a direct and more significant impact on the effectiveness of the system. These operations might be subject to modification if analysis of the MWD System shows this to be necessary.

For the purpose of this system description, therefore, a source of weather forecasts is assumed, and the MWD System is considered to begin with the formatting, scheduling, and transmission functions of the weather information source.

1.3.2.2 System/User Interface

The user clearly does not perform any positive function in the dissemination of weather data. Nevertheless, he forms an integral part of the system since his functions in intercepting the message, interpreting it, and acting upon it are the whole purpose of the system. In functional terms a user may:

a. Intercept or request a message

b. Interpret its meaning for his situation

c. Take corrective action.

The first function, message interception, depends primarily on readily quantized parameters such as distance from transmitter, receiver sensitivity and interference.

Message interception also depends upon whether or not the user has his receiver switched on and/or is listening. Similarly, the last two functions are dependent upon behavioral factors not easily quantized or measured. To determine which of these functions is relevant to the system model, it is necessary to know how the system effectiveness is to be measured.

The definition of effectiveness itself is dependent upon the system under consideration; effectiveness for the system that provides weather information by phone to recreational boatmen is likely to be quite different from that for the 8-MHz broadcasts to high-seas users. The definition of effectiveness is addressed in the following paragraphs.

1.4 DEFINING EFFECTIVENESS OF THE MWD SYSTEM

1.4.1 General

One classic definition of system effectiveness is "a quantitative measure of the extent to which a system may be expected to achieve a set of specific mission requirements." This definition was conceived for a military weapons system and is quite difficult to relate to the MWD System.

In the classic definition, effectiveness is regarded as a function of availability, dependability, and capability. Availability and dependability are, respectively, measures of the condition of the system at the start of and during the mission. The difficulty of defining a mission in the usual sense for the MWD System led CSC to reject the classic approach in favor of a tailored methodology that would meet the requirements of this study.

Further examination led to the realization that effectiveness may mean two quite different things for systems serving a recreational and a professional user. Differences may also exist between definitions for broadcast and inquiry systems, or between visual and radio systems.

The most complex systems, those requiring the most detailed approach, are those serving the coastal waters recreational user in the radio-broadcast mode, because these are the systems subject to the greatest variation in the largest number of parameters. The examination of effectiveness criteria that follows is developed with this type of system in mind, but may be modified to apply more accurately to the few systems that do not fall into this category.

1.4.2 Criteria for Defining System Effectiveness

In the course of defining system effectiveness for a MWD System, CSC examined criteria by which the system performance might be judged. Several criteria were established which, in being met, permit the identification of a hierarchy of system effectiveness levels.

The first and most obvious criterion is that the system must make the user aware of potentially hazardous weather situations. Failure to do so because of lack of coverage, lack of appropriate equipment on the part of the user, or lack of disseminated information constitutes a system failure.

The system may also be deemed to have failed if it makes the user aware but fails to do so in time for him to take effective measures to protect himself - thus, the consideration of timeliness.

The third criterion is the most general and the most demanding of all. It requires that the user not suffer death, injury, or property damage as a result of weather conditions. It demands, therefore, not only that the user be warned in sufficient time to take effective action, but also that he be given the necessary instruction and motivation to use the warning to avoid an incident due to weather. Measured against this criterion, the system is deemed to have failed if the user, made aware of a potentially hazardous weather situation in time to take effective corrective action, fails to do so either because he is unsure of what the action is or because he chooses to ignore the warning for any other reason.

This latter criterion is of admittedly debatable validity, since no system can be held accountable for the responsibility, sobriety, or sanity of every user. On the other hand, the message content can and will influence the comprehension and motivation of the person receiving that message and may directly or indirectly affect the outcome of his situation.

These criteria establish three levels of system effectiveness:

a. Level 1 - Access

b. Level 2 - Timely access

c. Level 3 - Effective, timely access.

The measure of effectiveness becomes more detailed, but also more difficult, at each successive level.

A rigorous evaluation would attempt to account for all system-sensitive parameters, including human behavioral factors, at the third level of effectiveness. The large number of parameters involved and their immense variability (especially those relating to the user) would result in an analysis well beyond the financial scope of this effort.

Recognizing this, CSC devoted considerable time to examining these various effectiveness levels to determine their worth, or meaning, relative to their difficulty of measurement. In developing a methodology for the quantitative measurement of effectiveness, CSC carefully examined each parameter to determine whether it was a necessary part of the analysis or if it could validly be omitted. Each parameter was weighed by asking the questions:

a. Is it relevant to the effectiveness of the system?

b. If relevant, is it measurable or quantifiable?

c. If relevant and measurable, is modification possible to improve the effectiveness of the system (i.e., is it within our control)?

As a result of this approach, CSC has developed an analysis that is realistic and falls within the scope of the study. Performance of this analysis is delineated in the following paragraphs.

1.5 METHODOLOGY FOR MWD SYSTEM EFFECTIVENESS MEASUREMENT

CSC chose to quantify the effectiveness of each MWD System in the following manner:

a. Measure its accessibility

b. Weigh accessibility according to its schedule

c. Test its capability to provide timely warnings.

The methodology for making these measurements and tests is outlined here.

1.5.1 Level 1 Effectiveness - Accessibility

1.5.1.1 Accessibility Model

Accessibility is defined as a measure of the system's availability to the user population. It is a function of coverage and audience.

Coverage is the percentage of the area under consideration in which system transmissions may be received, subject to given standards.

Audience is the percentage of users, in the area considered, equipped to receive transmissions of the type offered by the system under study.

The product of coverage and audience gives the percentage of the user population able to access the system, given that it is transmitting, therefore ACCESSIBILITY = COVERAGE x AUDIENCE.

This simplified model provides a precisely quantifiable measurement of the usefulness of the system at the first level.

In a practical application, this methodology is used as follows:

a. Determine the coverage provided by each system. The coverage is expressed as an estimated field strength contour serving the majority of users most of the time.

b. Determine the distribution of receiver types of commensurate quality within the scenario area. This distribution is modeled in discrete zones, giving the percentage of the total user population equipped to receive broadcasts in each zone.

c. Measure the percentage of zone coverage provided by the system.

d. Factor each area according to the audience density in that area.

e. Sum the resultant values over the scenario area to determine the accessibility of the system under study.

The methods of determining coverage are detailed in Section 2, and in Section 3 the development of a receiver distribution model (audience characteristic) is described.

1.5.1.2 Schedule

The quantitative measurements of accessibility for each system must be weighted according to the system's broadcast schedule. Clearly, a user has a higher probability at any instant in time of accessing a system that broadcasts continuously than he does of accessing one giving 3-minute weather forecasts every hour.

However, this probability of access is a somewhat unrealistic measurement for instantaneous access, since the average user will turn on his receiver and wait for a transmission for a certain period of time. A realistic measure of accessibility is the probability that he will access the system in this time period. Development of a model to account for the effect of schedule is given in Section 4. The output of this model is a "schedule factor" that is used to weight the effectiveness value previously determined.

1.5.2 Level 2 Effectiveness - Timeliness

Accessibility to the user is measured according to the method outlined in Paragraph 1.5.1. This method does not measure the ability of the system to get timely messages to the user.

Timeliness may be defined as the ability to provide a user with pertinent weather information in time for him to take appropriate action. An assessment of a system's ability to provide timely information can be valid only when made in an emergency situation, since under routine operation the system's response time will be dominated by its broadcast schedule (schedule effects were accounted for in Paragraph 1.5.1.2 at the first level).

Section 5 examines weather development times and boatman distributions in each of the scenario areas in an attempt to assess the warning time needed for the average boatman. The emergency response capability of each system may then be measured against this time to determine whether or not that system is capable of providing timely service.

SECTION 2

COVERAGE

2.1 INTRODUCTION

To measure system coverage, it was necessary to develop techniques for estimating the useful range of existing and potential weather dissemination radio transmission systems. The radio transmission systems considered are:

a. Coast Guard VHF/FM transmitters operating with "average" quality marine radiotelephone receiver installations

b. National Weather Service VHF/FM transmitter operating with portable inexpensive receivers

c. Public Coast Class III B (VHF/FM) transmitters operating with "average" quality marine radiotelephone receiver installations

d. Commercial AM and FM broadcasting stations operating with average inexpensive portable AM and FM receivers

e. Public Coast Class II B (MF/AM) transmitters operating with installed marine radiotelephone receivers.

The approach used determined allowable path loss, and hence range, based on available transmitter radiated power and the power level required at the receiver antenna for a given grade of audio quality at the output of the receiver. The common reference for all systems evaluated was the signal field strength, in microvolts per meter (μV/m) required to provide 9-dB signal-to-noise ratio at the receiver output (speaker). (See Appendix A.)

2.2 COMMERCIAL BROADCAST COVERAGE

Calculations for commercial broadcast coverage are based on AM and FM stations that provide weather information in the NOAA

Marine Facilities Charts. In certain areas of a number of scenarios where coverage seemed to be at a minimum (or non-existent), additional stations were considered. These stations were identified by researching The National Association of Broadcasters 1970 yearbook. All stations identified as having potential coverage were solicited for information on field strength contours. Unfortunately, not all stations responded. When no response was obtained, the field strength contours were estimated based on published transmitter parameters.

The most common format used in the field strength contour maps shows field strength contours of 1000, 500, and 100 μV/m for AM stations, and contours of 1000 and 50 μV/m for FM stations. Based on field tests and laboratory measurements, the required received signal field strength for the modeled commercial receivers was 1200 μV/m for small AM portable receivers, and 450 μV/m for small FM portable receivers. Detailed explanations and results of the receiver modeling for each of the systems appear in Appendix A. Appendix B demonstrates that the range limitation of performance for both the portable AM and FM receivers appears to be primarily a function of inefficient antenna and poor receiver sensitivity.

Since these values of field strength are not plotted directly on contour maps available from the stations or the FCC files, the nominal field strength gradients of the various stations were calculated to determine at what range from the transmitter the required field strength would exist. These calculations were performed using charts of ground wave field intensity as a function of distance from the transmitting antenna (Reference 1). Since these curves are normalized to an inverse distance field of 100 millivolts per meter (mV/m) at 1 mile, and are presented parametrically as a function of surface conductivity, it was possible to relate the field strength contour plots and the transmitter power of the various AM stations to a specific ground conductivity curve. With this relationship established, the curves were used to determine the 1200-μV/m field strength-range relationship.

When field strength contour plots were not available for specific AM stations, the effective range was estimated using the appropriate transmitter power and the average value of ground conductivity of the geographic area.

The field strength versus distance relationships are functions of frequency. A lower frequency has a greater range than a higher frequency, for a given transmitter power. The curves of Reference 1 are computed for specific frequencies of 550 kHz, 1000 kHz, and 1600 kHz. In the course of the calculations it became necessary to use the curve for the frequency closest to that of the particular station being measured. Hence, the effective areas calculated for some stations may be slightly greater than actually obtainable. Conversely, a few stations may be credited with a service area slightly smaller than that actually obtainable. However, since a conservative approach was taken in all areas where value judgements were required in the course of the calculations, and since many variables (such as the ambient noise level, height of receiver antenna, orientation of the antenna, accuracy of receiver tuning and many other factors) are encountered in a real-life situation, it is felt that the areas plotted are a good approximation to actual service areas.

In the case of FM station coverage, the appropriate curves were used from Reference 1. The contours for the modeled receiver requirement of 450 μV/m were determined from the parameters of transmitting antenna height and radiated power. Interpolations of existing field strength contour maps were made with the aid of transmitter parameters available from Reference 2. Again, range calculations and estimates were tempered with conservative judgement.

The commercial AM and FM stations used in this evaluation and the scenario areas in which they are considered are presented in Table 2-1.

TABLE 2-1. COMMERCIAL AM AND FM STATIONS USED IN THE COVERAGE ANALYSIS

SCENARIO AREA NO. 1

WJLK-AM-FM	*WABC-AM-FM
WFPG-FM	*WCBS-AM-FM
WMID-AM	*WNBC-AM-FM
WOND-AM	*WNEW-AM-FM
WOR-AM-FM	*WINS-AM
WMTR-AM	*WNYC-AM

SCENARIO AREA NO. 2

WCAO-AM-FM	WMAL-AM-FM
WAMD-AM	WGH-AM
WANN-AM	WNOR-AM-FM
WCEM-AM-FM	WYRE-AM
WRAP-AM	WVEC-FM
WLPM-AM	WRC-FM
WPIK-AM	WTOP-FM
WNAV-AM-FM	WFOG-FM
WBAL-AM-FM	WDOV-FM

SCENARIO AREA NO. 3

WQAM-AM	*WINK-AM-FM
WINZ-AM	*WSUN-AM
WKAT-AM	*WWBA-AM
WIOD-AM	*WKXY
WVCG-AM	*WNFM-FM

*Coverage for these stations is based on estimates, see text.

TABLE 2-1. COMMERCIAL AM AND FM STATIONS USED IN THE COVERAGE ANALYSIS (Continued)

SCENARIO AREA NO. 3 (Continued)

WYOR-FM	*WFYN-FM
WKIZ-AM	*WQXM-FM
*WNOG-AM	*WSAF-FM
*WMYR-AM-FM	*WDAE-FM
	*WUSF-FM

SCENARIO AREA NO. 4

KBOR-AM	*KGBC-AM-FM
KURV-AM	*KYOK-AM
KRGV-AM	*KXYZ-AM
*KIOX-AM	*KIOU-FM
*KCCT-AM	*KZFM-FM
*KEYS-AM	*KBNO-FM
*KYRS-AM	*KIKK-FM

SCENARIO AREA NO. 5

KOIN-FM	*KERG-AM
KAST-AM	*KUGN-AM
*KOOS-AM	*KDUN-AM
*KVAS-AM	*KXRO-AM
*KWRO-AM	*KZEL-FM
	*KELA-FM

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*Coverage for these stations is based on estimates, see text.

TABLE 2-1. COMMERCIAL AM AND FM STATIONS USED IN THE COVERAGE ANALYSIS (Continued)

SCENARIO AREA NO. 6

WMBN-AM-FM	WTAC-AM
WATZ-AM-FM	WJR-AM-FM
WATC-AM	WEOL-AM
WTCM-AM-FM	WBEA-FM
WTMJ-AM-FM	WGAR-AM
WBAY-AM	WPVL-AM
WBEN-AM-FM	WKYC-AM-FM
WGR-AM	WCJW-FM
WBCM-AM-FM	WLEC-AM-FM
WIXY-AM	WJW-AM
WHLS-AM-FM	WIOS-AM
WLEW-AM	WKBW-AM

2.3 NATIONAL WEATHER SERVICE, 162.55-MHz CONTINUOUS BROADCAST COVERAGE

Calculations for the coverage area of the continuous broadcasts on 162.55 MHz are based on a modeled receiver. The receiver is modeled as a small battery operated portable type, costing less than $40.00, and requiring a received signal field strength of 700 μV/m to provide acceptable service. The NWS transmitters and their pertinent characteristics are listed in Table 2-2.

Except under ideal conditions, highly precise path loss calculations in this frequency band cannot be made, because many variables with effects on path loss that cannot be precisely determined exist. These variables are most often due to the effects of hills, trees, buildings, and other objects that shadow and reflect the transmitted signal. In the band of interest, transmission loss is highly dependent on the transmission medium between transmitter and receiver. Loss will differ considerably over a fixed distance depending on whether the transmission is over salt water, fresh water, or land. Range is also a function of the effective height of both transmitting and receiving antenna, hence, raising the height of the receiving antenna, the transmitting antenna, or both, would result in greater effective range. The effective height of the antenna is not necessarily the same as the physical height of the transmitting or receiving antenna above ground level or mean sea level. The effective height is determined by the height of buildings, hills, or other obstructions in the immediate vicinity of the transmitting or receiving antenna. In the cases calculated in this report, the receiver is assumed to be located aboard a boat, and the height of the receiver is assumed to be 10 feet above mean sea level in each case.

Information on the physical height of each NWS transmitter is listed in Table 2-2. In some cases, where the transmitter sites are located in large cities, path loss calculations were corrected for transmitter effective height.

TABLE 2-2. NATIONAL WEATHER SERVICE - VHF TRANSMITTERS

SCENARIO AREA	ANTENNA TYPE	TOTAL HEIGHT (ft)	TRANSMITTER SITE
<u>No. 1</u>			
New York	Omni	940	40° 45' 32" 73° 58' 47"
Atlantic City	Omni	305	39° 22' 42" 74° 26' 53"
<u>No. 2</u>			
Washington	Directional	364	38° 57' 59" 76° 41' 00"
Norfolk	Directional	502	38° 46' 58" 76° 28' 00"
<u>No. 3</u>			
Miami	Directional	325	25° 41' 12" 80° 16' 43"
Tampa	Omni	181	27° 57' 48" 82° 48' 01"
<u>No. 4</u>			
Galveston	Omni	211	29° 18' 94° 49'
Corpus Christi	Omni	350	27° 47' 44" 97° 23' 41"
Brownsville, Texas	Omni	226	25° 57' 15" 97° 23' 12"

TABLE 2-2. NATIONAL WEATHER SERVICE - VHF TRANSMITTERS (Continued)

SCENARIO AREA	ANTENNA TYPE	TOTAL HEIGHT (ft)	TRANSMITTER SITE
<u>No. 5</u>			
Seattle	Omni	1704 AMSL	47° 33' 122° 48'
Portland	Directional	1096	45° 34' 122° 47'
<u>No. 6</u>			
Cleveland	Omni	400	41° 32' 22" 81° 19' 43"
Sandusky	Omni	450	41° 24' 11" 82° 49' 05"
Chicago	Omni (9 dB)	801	41° 49' 30" 87° 39' 48"

Path losses were determined using the methods outlined in Reference 3 (Bell System Standard Practices), since examination of other propagation reports and field test measurements (References 4, 5, 6, 7, 8, 9, and 10) showed that these latter methods and monographs most often result in optimistic performance predictions. It is felt that favoring the more conservative methods is justified for purposes of the analysis, since it is not possible to account for such things as shadowing losses and topographic anomalies (which certainly exist in many cases) within the scope of this effort. Based upon the reference material and the results of listener surveys conducted by KWO-35 in November, 1970, it is believed that the service area predicted for the NWS broadcast represents that area within which users of inexpensive portable VHF receivers will receive reliable service with greater than 90 percent confidence.

It should be remembered that users with the best portable equipment can be expected to attain reliable service at ranges nominally 50 percent greater than those attained by users with small, inexpensive receivers. However, presently obtainable data indicate that users with "better" equipment represent a minority of users to be serviced.

From the noise data of Appendix B, it can be concluded that the performance limitations of these portable receivers is primarily related to the poor receiver sensitivity and inefficient antennas generally found to exist with this equipment.

2.4 COAST GUARD VHF/FM SYSTEM COVERAGE

Coverage for the Coast Guard's VHF/FM system is calculated for users equipped with VHF radiotelephone equipment. Initial calculations based on the assumption of Coast Guard VHF service to recreational boatmen showed that the combination of low powered transmitters and relatively insensitive portable receivers would provide so little coverage as to be virtually ineffective.

It was quickly concluded that a system dependent on average quality Marine radiotelephone receivers had the greatest potential as a weather dissemination system among the systems present in the Coast Guard's VHF transmitter network. The receiver portion of this system is defined as a VHF Marine Radiotelephone with an average chassis sensitivity of 4 μV, and an installed antenna system closely approximating a half-wave dipole in performance, with an effective receiving antenna height of 30 feet. The average chassis sensitivity was determined after evaluating and surveying manufacturers' specifications, brochures, and other reference material (References 4 and 11).

Coverage was computed using the methods outlined in Reference 3. For each scenario area, Coast Guard stations capable of providing service and their pertinent parameters were identified through information supplied by the various Coast Guard Districts and Coast Guard Headquarters.

The calculations are performed for a one-way transmission, shore-to-boat at a frequency of 156.8 MHz. The receiver is assumed to be located in a noise environment defined as "suburban" (see Appendix B) and minimum acceptable received signal to noise quality is taken as 9 dB. Unless otherwise stated, all Coast Guard transmitters are assumed to use 25-watt power and have omni-directional antennas with an effective gain of 5 dB (6 dB - 1 dB transmission line loss). Representative plots of potential

Coast Guard VHF-FM coverage are shown in Section 8. The specific Coast Guard transmitters used in the calculations for each of the Scenario Areas are listed in Table 2-3. Also listed is the physical height above mean sea level of each of these sites.

A transmitter power of 50 watts is authorized in this band. Higher powers may be authorized based on need. The effect of assuming a transmitter power of 50 watts rather than 25 watts from Coast Guard VHF-FM sites would be to increase transmission range for the same quality of service by about 10 percent in most cases. If this system were to operate with the same inexpensive portable receivers as the NWS transmitters, the range of each site would be reduced to about 30 percent of that shown.

2.5 PUBLIC COAST CLASS III B (VHF-FM) RADIOTELEPHONE COVERAGE

Coverage for the VHF-FM radiotelephone stations was calculated based on the assumptions of maximum allowable transmitter power and the same "average quality" receiver system previously defined for the Coast Guard VHF-FM coverage calculations: a half-wave dipole receiving antenna 30 feet high, a receiver chassis sensitivity of 4 μV, and a transmitter power of 50 watts.

The Public Coast Class III B stations within the scenario areas of interest were identified from a listing of those stations available from the Marine Division of the FCC (Table 2-4). Considerable difficulty was encountered in obtaining the pertinent parameters of these stations. It was necessary to manually search through the commission's files to obtain addresses and physical parameters of the stations identified, and to further complicate matters, all pertinent files were not available for examination. Moreover, applications for proposed stations are being received at a frenzied pace, and the nature of this network is continually undergoing change. It was therefore necessary to examine the system as defined at some arbitrary

TABLE 2-3. COAST GUARD VHF-FM FACILITIES
AS OF 1 JANUARY 1971

UNIT NAME	ANTENNA HEIGHT ABOVE MEAN SEA LEVEL (ft.)
SCENARIO AREA NO. 1	
Atlantic City	40
Cape May	189
Atlantic Beach	15
Rockaway Station	110
Ambrose Lt. Station	108
Shark River Station	40
Sandy Hook	150
Manasquan Station	175
Barnegat Station	62
Great Egg Station	27
New York (Manhattan)	600
Townsend Inlet	25
Beach Haven Station	23
Fort Totten	40
SCENARIO AREA NO. 2	
Grp. Baltimore	64
Still Pond Station	100
Annapolis Station	112
Taylors Island Station	60
Dahlgren	66
Piney Point Station	100

TABLE 2-3. COAST GUARD VHF-FM FACILITIES
AS OF 1 JANUARY 1971 (Continued)

UNIT NAME	ANTENNA HEIGHT ABOVE MEAN SEA LEVEL (ft.)
SCENARIO AREA NO. 2	
Norfolk	113
Milford Haven Station	92
Little Creek Station	100
Chesapeake Lt. Station	108
SCENARIO AREA NO. 3	
Lake Worth	45
Fort Lauderdale	95
Miami Beach Base	100
Miami Radio Station	150
Islamorada	65
Marathon	65
Fort Meyers Beach	45
Key West Station	50
St. Petersburg A.S.	60
SCENARIO AREA NO. 4	
Houston	175
Freeport Station	42
Pt. O'Connor Station	61
Port Aransas	87
Galveston Station	90
Pt. Isabel	52

TABLE 2-3. COAST GUARD VHF-FM FACILITIES
AS OF 1 JANUARY 1971 (Continued)

UNIT NAME	ANTENNA HEIGHT ABOVE MEAN SEA LEVEL (ft.)
SCENARIO AREA NO. 5	
Yaquina Bay Station	650
Willapa Bay Station	72
Umpqua River	183
Astoria A.S.	61
Cape Disappointment	323
Tillamook Bay	77
Portland Grp.	1150
Kennewick Station	2380
Grays Harbor	37
Suislaw River	75
Depoe Bay	85
SCENARIO AREA NO. 6	
Buffalo Station	85
Erie Station	65
Ashtabula Station	105
Fairport Station	85
Sturgeon Bay	110
Plum Island	82
Sault St. Marie	305
Detour Reef Lt.	90

TABLE 2-3. COAST GUARD VHF-FM FACILITIES AS OF 1 JANUARY 1971 (Continued)

UNIT NAME	ANTENNA HEIGHT ABOVE MEAN LAKE LEVEL (ft)
SCENARIO AREA NO. 6	
Harbor Beach Station	85
Saginaw River Station	65
Tawas Station	88
Beaver Island Station	66
Calumet Harbor Station	1080
Grays Reef Lt. Station	80
Kenosha Station	85
Michigan City	85
Racine Station	33
Sheboygan Station	85
Two Rivers Station	85
Willmette Harbor	85
District Office (Cleveland Harbor)	440
White Shoal Lt.	120
Lansing Shoal	70
Charlevoix Station	180
N. Manetow Lt. Station	84
Frankfort Station	110
Manistee Station	85
Ludington Station	85

TABLE 2-3. COAST GUARD VHF-FM FACILITIES
AS OF 1 JANUARY 1971 (Continued)

UNIT NAME	ANTENNA HEIGHT ABOVE MEAN LAKE LEVEL (ft)
SCENARIO AREA NO. 6	
Muskeegon	85
Grand Haven	85
Holland Station	85
Chicago Cotp.	537
South Haven Station	85
St. Joseph Station	85
Pt. Huron Station	175
Belle Isle Station	480
Detroit River Lt. Station	55
Toledo Station	65
Marblehead Station	100
Sandusky Station	85
Lorain Station	80

TABLE 2-4. PUBLIC COAST CLASS III B MARINE RADIOTELEPHONE STATIONS

LOCATION	CALL LETTERS	ANTENNA HEIGHT ABOVE SEA LEVEL (ft.)
SCENARIO AREA NO. 1		
Atlantic Highlands, N.J.	KQU-556	300
Sea Isle City, N.J.	KGW-378	100
Point Pleasant, N.J.	KGW-202	135
SCENARIO AREA NO. 2		
Ridge, Md.	KAQ-383	220
Bodkin Pt., Md.	KGD-518	250
Norfolk, Va.	KIC-631	-
Cambridge, Md.	KRS-907	-
SCENARIO AREA NO. 3		
West Palm Beach, Fla.	KGW-294	172
Ft. Lauderdale, Fla.	KEW-823	183
Belle Glade, Fla.	KQU-544	155
Boca Raton, Fla.	KSK-208	175
Islamorada, Fla.	KQU-532	132
Marathon, Fla.	KSK-210	100
Naples, Fla.	KQU-410	150
Homestead, Fla.	KLU-791	-
Key West, Fla.	KQU-411	-
SCENARIO AREA NO. 4		
Houston, Tex.	KKD-739	160
Galveston, Tex.	KKD-742	-

TABLE 2-4. PUBLIC COAST CLASS III B MARINE RADIOTELEPHONE STATIONS (Continued)

LOCATION	CALL LETTERS	ANTENNA HEIGHT ABOVE SEA LEVEL (ft.)
SCENARIO AREA NO. 4		
Bay City, Tex.	KGW-304	370
Brownsville, Tex.	KLG-376	229
Corpus Christi, Tex.	KWB-424	300
Port Lavaca, Tex.	KGW-295	-
SCENARIO AREA NO. 5		
Astoria, Ore.	KOF-209	700
Coos Bay, Ore.	KTJ	680
SCENARIO AREA NO. 6		
Detroit, Mich.	KQB-666	1068
Muskeegon Heights, Mich.	KQU-546	700
Roger City, Mich.	WLC	70
Michigan City, Ind.	KLU-757	700
Portage, Ind.	KQU-578	700
Toledo, Ohio	KQU-421	400
Geneva, Ohio	KQB-668	265
Cleveland, Ohio	KQU-440	420
Lorain, Ohio	WMI	-
Erie, Pa.	KLU-745	280
Chicago, Ill.	WAY	300
Port Washington, Wisc.*	WAD	-

*Discontinued March 1971

point in time. For this reason, stations were chosen on the basis of the Public Coast Class III B list of September 1970.

These stations were canvassed by mail for information concerning antenna patterns and height above mean sea level. Only about 20 percent responded with positive information. The parameters of the nonresponding stations were taken as stated in the FCC files. Of the stations that responded with contours showing service areas, a variation of received signal level was evident as the defining line for service area. These ranged from received signal levels of -125 dBW to -135 dBW. Based on the analysis of external manmade radio noise presented in Appendix B and the requirement for a 9-dB signal-to-noise ratio at the receiver for minimum acceptable service level, a calculation of -125-dBW contours was used for coverage.

2.6 PUBLIC COAST CLASS II B RADIOTELEPHONE STATIONS

Public Coast Class II B shore stations transmit amplitude modulated (AM) signals, either single sideband or double sideband. Due to recent FCC rulings, these stations are converting to a single sideband modulation mode. The transmissions from these stations are in the 2-MHz band and can provide longrange communications to users well outside the offshore areas. The exact communication range of any given station is related to the atmospheric noise level at the receiver site, and is variable as a function of both noise level and propagation conditions. Under normal conditions, service over sea water paths can be expected at ranges of 200 miles and beyond; fresh water paths, such as service areas on the Great Lakes, may result in reliable service areas of less than 100 miles. In the Great Lakes, the 4-MHz and 8-MHz bands are also used by these stations.

The areas of interest in this analysis are bounded by a 25-mile contour, as measured from the coastline. Based on the physical location of existing Class II B stations with respect to the scenario areas, reliable coverage to users within the 25-mile contour is expected 100 percent of the time.

The stations expected to provide service within the scenario areas of interest are listed in Table 2-5, along with their transmitter power ranges. It should be noted that based on the maximum atmospheric noise levels expected (Appendix B) performance of these receivers will be limited by external noise, rather than receiver sensitivity and antenna losses.

2.7 COAST GUARD STATIONS AVAILABLE FOR WEATHER BROADCAST IN THE 2-MHz BAND

Due to the reasoning previously stated, the Coast Guard Stations listed in Table 2-6 are considered capable of providing nearly 100 percent reliable coverage to users equipped with radiotelephone receivers operating in the 2- to 3-MHz band. Table 2-6 is not a listing of total Coast Guard capability in this area, but rather the facilities associated with the scenario areas under consideration.

2.8 ENVIRONMENTAL CHANNEL COVERAGE

Coverage calculations for transmissions at the 156.75-MHz frequency are identical to those for other services to VHF Marine radiotelephones. The ultimate use of this frequency allocation as a general environmental information dissemination system would be predicated on reception by lower cost (and quality) receivers than current radiotelephone equipment. Assessment of transmission to such a class of receivers, however, indicates that the coverage provided would be extremely small due to the imposed 50-W power level limit. This and other problems encountered in using this channel (see Section 8) led to a decision to limit the analysis of effectiveness to that for service to radiotelephone class receivers.

TABLE 2-5. PUBLIC COAST CLASS II B RADIOTELEPHONE STATIONS

LOCATION	CALL LETTERS	TRANSMITTER POWER RANGES (WATTS)
SCENARIO AREA NO. 1		
New York, N.Y.	WOX	500 to 700
Ocean Gate, N.J.	WAQ	500
Wilmington, Del.	WEH	500
SCENARIO AREA NO. 2		
Wilmington, Del.	WEH	500
Bodkin Point, Md.	WLF	500
Point Harbor, N.C.	WAE	120
Virginia Beach, Va.	WGB	500
SCENARIO AREA NO. 3		
Jacksonville, Fla.	WNJ	500
Miami, Fla.	WDR	500
Madiera Beach, Fla.	WFA	500
SCENARIO AREA NO. 4		
Pt. Surfire	WAK	500 to 700
Del Combe, La.	KGN	400
Galveston, Tex.	KQP	700
Corpus Christi, Tex.	KCC	500

TABLE 2-5. PUBLIC COAST CLASS II B RADIOTELEPHONE STATIONS (Continued)

LOCATION	CALL LETTERS	TRANSMITTER POWER RANGES (WATTS)
SCENARIO AREA NO. 5		
Eureka, Cal.	KOE	500
Empire, Ore.	KTJ	75
Portland, Ore.	KQX	120 to 500
Astoria, Ore.	KFX	500
Seattle, Wash.	KOW	700 to 1500
SCENARIO AREA NO. 6		
Buffalo, N.Y.	WBL	700 to 1200
Lorain, Ohio	WMI	700 to 1050
Detroit, Mich.	WFR	500
Detroit, Mich.	WFS	500
Pt. Huron, Mich.	WFV	700 to 1300
Rogers City, Mich.	WLC	700 to 1300
Chicago, Ill.	WAY	700 to 1500
Port Washington, Wisc.*	WAD	1400 to 1700

*Discontinued March 1971

TABLE 2-6. COAST GUARD STATIONS AVAILABLE FOR WEATHER BROADCAST IN THE 2-MHz BAND

LOCATION	CALL LETTERS	TRANSMITTER POWER (WATTS)
SCENARIO AREA NO. 1		
New York	NMY	400
Cape May, N.J.	NMK	60
SCENARIO AREA NO. 2		
Baltimore, Md.	NMX	400
Portsmouth, Va.	NMN	400
SCENARIO AREA NO. 3		
Jacksonville, Fla.	NMV	500
Miami, Fla.	NMA	500
St. Petersburg, Fla.	NOF	400
SCENARIO AREA NO. 4		
Galveston, Tex.	NOY	3000
Pt. Isabel, Tex.	NCH	400
SCENARIO AREA NO. 5		
Westport, Wash.	NMW	3000
Port Angeles, Wash.	NOW	400
Seattle, Wash.	NMW-43	60
SCENARIO AREA NO. 6		
Sault St. Marie	NOG	400
Belle Isle, Mich.	NMD-20	60
Buffalo, N.Y.	NMD-47	60
Marblehead	NMD-15	25

2.9 CONSIDERATION OF CITIZENS BAND RADIO SERVICE

Since the FCC has provided for the communications needs of vessels through its Maritime Mobile Service Rules, any use of citizens band radio for this purpose must be considered as a supplemental, unregulated service. A study prepared in 1968 (Reference 14) looked into the problems, as well as the potential advantages of using the citizens band in the maritime service. A prime point made in the recommendations of this study is that the concept of citizens band radio is incompatible with the communications requirements of boating safety.

While it is recognized that a number of recreational boatmen do rely on C.B. radio, only one documented instance of its use to promote weather information dissemination among a cooperating group of boatmen was found. It is concluded that some service in the interest of boating safety is provided to, and by, those equipped with C.B. radio. However, the very nature of its intended purpose and actual usage makes an objective evaluation of C.B. as a "system" virtually impossible.

SECTION 3
AUDIENCE

3.1 INTRODUCTION

Considerable attention was paid to the development of a valid model for the spatial distribution of receivers within the analysis areas. Initial considerations ranged from a completely uniform distribution (constant density, receivers/square mile) through sophisticated, continuous function, two-dimensional models. The latter were rejected because time did not permit their generation, and because early analysis indicated that such refinement was unnecessary. These same analyses, however, led to the conclusion that a uniform distribution was invalid and would introduce unacceptable errors into the effectiveness assessments. Consideration of available data led to the selection of a discrete function, one-dimensional model based on the distribution of boats, suitably weighted to reflect the distribution of receivers among those boats. The primary model was developed for the Chesapeake Bay area, for which considerable information was available. Data collated in other scenario areas was then used to modify the primary model to represent the distribution in those areas.

3.2 DEVELOPMENT OF THE MODEL

In a practical situation the distribution of radio receivers on a given body of water will fluctuate daily and seasonally with the habits of the boating population, and will also be subject to small-scale random variations. The predominant pattern, however, will be established by relatively stable factors such as the location of suitable harbors, rivers and population centers, and appropriate broadcast services. Obviously, the receivers must be where the boats are, so as a first approximation the distribution of boatmen will describe the location of receivers.

However, the distribution of one type of receiver is likely to be heavier in areas of good service; moreover, it is improbable that all types of receivers will be distributed uniformly among boatmen for other reasons. For example, small inexpensive boats are unlikely to be equipped with expensive VHF marine radiotelephones. In addition, boatmen frequenting coastal waters some distance from shore might choose to equip themselves with longer-range (albeit less expensive) AM radio telephones.

Ideally, the type of analysis required in this study would seek data describing actual distribution of radio receivers of all types in each area to be studied. Such data, however, is not readily available. During the data collection phase of this study, CSC was able to identify only one source of this type of information, namely, the Boating Statistics Information System (BSIS) file (Reference 12).

Initially, we attempted to generate the required function directly from the BSIS file, coding responses according to "equipment on board" and "distance from shore." However, the sample sizes resulting from this double screening process proved to be too small in many cases to provide data with the required confidence level. Moreover, the lack of interparametric dependency in absolute data of this type made it difficult to extrapolate the results to other scenario areas.

At this point it was decided to generate the distribution model based on the location of boatmen, modifying it to account for the uneven distribution of receivers among boatmen. This approach has two advantages. It permits the combination of two basic types of data (geographic distribution of boats, and distribution of receivers among boats), thus making available a much larger data base, and because this model is derived from two independent variables, it becomes possible to modify a model developed in one area to reflect the different circumstances obtaining in another.

3.3 INTERPRETATION OF THE DATA

Preparatory to development of a receiver distribution model, pertinent data were gathered from an extensive range of sources. The data falls into three basic categories:

a. Distribution of boatmen within and around the scenario areas.

b. Source of weather information most used.

c. Numbers and types of receivers used; the data is related variously to type and size of boat, total boat population, total receiver population, and distance of boatman from shore.

A compilation of the data is presented in Appendix C. Several problems were encountered in developing a model from the collected data. Distribution of boatmen is generally expressed in terms of county of residence and includes only numbered (registered) boats; data were obtained from state authorities and do not generally coincide with the scenario areas under study. Information concerning the service of weather information generally used failed to distinguish between sources used before leaving home and those used during boating activity. It is difficult to establish, therefore, whether a boatman has (for example) a commercial broadcast receiver on his boat or simply listens to the radio before embarking on a trip. Data on numbers and types of receivers were often incomplete, and were almost always drawn from samples not representative of the boating population as a whole. Therefore, it was impossible to derive valid statistical data on the distribution of receivers.

The notable exception was the data from the BSIS file for the Fifth District (Maryland, Virginia, North Carolina, and the District of Columbia), encompassing Scenario Area No. 2, Chesapeake Bay. The file was generated from responses to a well designed questionnaire that was administered by telephone to a carefully stratified sample of the public at large. The sum of individual response ("raw" data) was weighted in accordance with demographic data on the respondents' group to provide "projected" numbers for the area being surveyed. The questionnaire that provided the basis for this data included the following questions:

a. "Do you normally take on board your boat or have installed any kind of radio?"

b. "Which type of radio do you have on board and which do you use most to obtain weather information?"

c. "Considering distance in miles, how far away from shore do you usually operate your boat?"

Because of the pertinence of these (and other) questions, and because of the validity of the sampling method, it was decided to develop a receiver distribution model for the Chesapeake Bay area from the BSIS data, and to modify or extrapolate this model to represent other scenario areas using the remainder (non-BSIS) of the data inputs to compute the necessary modification factors.

3.4 STRUCTURE OF THE MODEL

The model used to describe the distribution of receivers in this study was developed from responses to questions included in the BSIS questionnaire and noted in Paragraph 3.3. The structuring of the reduced data dictated the actual character of the model to a large extent. This was a practical limitation that had to be accepted because, as stated earlier, the sampling techniques used in all other sources precluded valid statistical predictions concerning the boating population as a whole. The imposed limitations were as follows:

a. Distance from shore data were presented in zones - 0 to 1 mile, 2 to 5 miles, 6 to 10 miles, 11 to 25 miles, and greater than 25 miles.

b. Data were presented for boats of hull length less than 16 feet and greater than 16 feet.

c. Radio receiver types were recorded as follows:

1. One-way only receiver - AM/FM broadcast bands

2. One-way only receiver - Weather Bureau VHF/FM 162.55 MHz

3. One-way only receiver - RDF (radio direction finder)

4. Two-way transceiver - Marine 2 MHz (single sideband or double sideband

5. Two-way transceiver - VHF/FM Marine band

6. Two-way transceiver - Citizens band

7. Other (specify)

It should be noted that restrictions a and b are results of the presentation method only. The BSIS file contains data on actual distance in miles and actual hull length in feet. It would be possible, therefore, to recode the retrieval program to present this data by other categories. Restriction c, however, is inherent in the data since this is the way the questionnaire was worded.

Respondents were also asked on which body of water they most often conducted their boating activity. A list of the choices of water bodies presented is given in Table 3-1. By suitably coding the responses in retrieving the data, it was possible to present information pertaining only to Chesapeake Bay (Items B, C, D, E, and K in Table 3-1). Distance-from-shore data was presented as shown in Tables 3-2 through 3-10.

Examination of the data revealed that the distribution of boatmen in terms of distance from shore depends primarily on the length of the boat (under or over 16 feet), but is similar for motorboats and sailboats of equivalent length. It was therefore possible to collate the data as shown in Table 3-11, which shows the percentage of total boats in the scenario area as a function of hull length only.

Data representing the distribution of various types of radio receivers among boatmen were retrieved in a similar manner for boats under and over 16 feet in length, and presented as shown in Tables 3-12 through 3-27. Collated data are presented in Table 3-28 for the total Fifth District sample and for Chesapeake Bay, the Atlantic Offshore areas and the Inland Waters regions. Table 3-29 shows these same numbers as a percentage of the user class (i.e., percent of all boats in area less than 16 feet, or of all boats over 16 feet, as appropriate).

Combining the figures for Chesapeake Bay in Tables 3-11 and 3-28 results in a modeled distribution of radio receivers in zones of distance from shore for these two classes of boat. The model is shown in Table 3-30.

3.5 APPLICATION OF THE MODEL

The resultant model describes the distribution of various types of receivers as a percentage of the total boating population in the scenario area under analysis. These figures are broken down into zones of distance from shore as shown.

In a practical application, the model is used as follows:

a. STEP 1 - The area under analysis is zoned according to the model and the area in each zone is measured for the entire scenario.

b. STEP 2 - Coverage contours for a selected system are superimposed on the zoned scenario, and the coverage provided in each distance zone is measured by planimetric techniques.

Text continued on Page 3-37.

TABLE 3-1. BSIS QUESTIONNAIRE, ACTIVITY AREA QUESTION

11. Since August 1, 1969, in what one body of water have you been doing most of your boating? In what state is that? (RECORD ONE ANSWER IN COL. A) (PROBE FOR PROPER STATE AND AREA)

12. How far, in miles, do you have to travel over land from where you are now to this water area? (RECORD IN COL. B)

13. In what other bodies of water did you operate the motor boat since August 1, 1969? (RECORD AS MANY AS MENTIONED IN COL. C)

Area	(48) COL. A Q.11 Body of Water Operated in Most	(49-51) COL. B Q.12 Distance From Home (Miles)	COL. C Q.13 Other Bodies of Water Operated in
MARYLAND			
Patuxent River	A		52-1
Chesapeake Bay: The Head of the Bay (from Pooles Island North)	B		53-1
Pooles Island South to Bay Bridge	C		54-1
Bay Bridge S. to Patuxent River Mouth	D		55-1
Patuxent River Mouth S. to Maryland/Virginia Line (Smith Island)	E		56-1
Intra-Coastal Waters: (Chincoteague Bay, Indian River; all bay areas off Assateague Island)	F		57-1
Offshore: Atlantic Ocean	G		58-1
Potomac River (Upper/Lower)	H		59-1
Other (SPECIFY)	I		60-1

TABLE 3-1. BSIS QUESTIONNAIRE, ACTIVITY AREA QUESTION (Continued)

Area	(48) COL. A Q.11 Body of Water Operated in Most	(49-51) COL. B Q.12 Distance From Home (Miles)	COL. C Q.13 Other Bodies of Water Operated in
VIRGINIA			
Potomac River (Upper/Lower)	J		61-1
Chesapeake Bay: S. of Md./ Va. line (at Smith Island)	K		62-1
Smith Mountain Lake	L		63-1
John Kerr Reservoir	M		64-1
Hampton Roads: Norfolk/ Portsmouth Area	N		65-1
James, Rappahannock, York Rivers (N. of Hampton Roads)	O		66-1
Occoquan Creek	P		67-1
Offshore: Atlantic Ocean	Q		68-1
Other (SPECIFY)	R		69-1
NORTH CAROLINA			
Lake Norman/Lake Wiley	S		70-1
High Rock Lake/Lake Tillery/Baden Lake	T		71-1
Lake Gaston & Kerr Reservoir (Bugges Island Lake)	1		72-1
Albemarle Sound	2		73-1
Cape Fear River	3		74-1
Pamlico River/Pamlico Sound/Neuse (nōōs) River	4		75-1
Offshore: Atlantic Ocean	5		76-1
Other (SPECIFY)	6		77-1
DISTRICT OF COLUMBIA			
Anacostia Basin/Potomac	7		78-1

TABLE 3-2. BSIS DATA

CATA CRCUP, INC. #5C35// PROJECT #CG--00-457-A
DETAILED INTERVIEW WITH RECREATIONAL BOAT OPERATORS

USED MOTOR BOATS MOST IN PARTS OF CHESAPEAKE--RELATED TO OTHER FACTORS

OPERATE MOTOR BOATS MOST OF ALL = UNDER 16 FT // (MOTOR)BOAT OWNERSHP=OWNERS // TOTAL 5TH DISTRICT PROJECTED DATA = TOTAL DIS-TRICT

ROWS= OPERATE MOTOR BOAT AT THIS DISTANCE FROM SHORE COLUMNS= BODY OF WATER USED MOST -MOTOR BOATS

	HEAD OF THE BAY	POOLES ISLAND SCUTH	BAY BRIDGE SOUTH	PATUX-T RIVER MOUTH	SOUTH OF MD VA LINE	SUM	KEY
0-1 MILES	6	5	14	16	7	48	RAW
	2080	1790	1774	748	1726	8118	WTD
	60.0	62.5	77.8	69.6	53.8	66.7	RPC
	76.3	93.8	67.8	62.0	80.6	6879.7	WPC
	12.5	10.4	29.2	33.3	14.6	100.0	RPR
2-5	3	1	3	5	6	18	RAW
	354	118	726	300	416	1914	WTD
	30.0	12.5	16.7	21.7	46.2	25.0	RPC
	13.0	6.2	27.7	24.9	19.4	1622.0	WPC
	16.7	5.6	16.7	27.8	33.3	100.0	RPR
6-10	1		1	1		3	RAW
	291		118	40		449	WTD
	10.0		5.6	4.3		4.2	RPC
	10.7		4.5	3.3		380.5	WPC
	33.3		33.3	33.3		100.0	RPR
MORE THAN 25				1		1	RAW
				118		118	WTD
				4.3		1.4	RPC
				9.8		100.0	WPC
				100.0		100.0	RPR
NA,DK		2				2	RAW
							WTD
		25.0				2.8	RPC
							WPC
		100.0				100.0	RPR
SUMS	10	8	18	23	13	72	RAW
	2725	1908	2618	1206	2142	118	WTD
	100.0	100.0	100.0	100.0	100.0	100.0	RPC
	100.0	100.0	100.0	100.0	100.0	100.0	WPC
	13.9	11.1	25.0	31.9	18.1	100.0	RPR

TABLE 3-3. BSIS DATA

CATA GROUP, INC. #5035// PRCJECT #CG--Q0-457-A
DETAILED INTERVIEW WITH RECREATIONAL BOAT OPERATORS

USED MOTOR BOATS MOST IN PARTS OF CHESAPEAKE--RELATED TO OTHER FACTORS

OPERATE MOTOR BOATS MOST OF ALL = OVER 16 FT // (MOTOR)BCAT CWNERSHP=OWNERS // TOTAL 5TH DISTRICT PROJECTED DATA = TOTAL DIS-TRICT

ROWS= OPERATE MOTOR BCAT AT THIS DISTANCE FROM SHORE   COLUMNS= BODY OF WATER USED MOST -MOTOR BOATS

	HEAD OF THE BAY	POOLES ISLAND SCUTH	BAY BRIDGE SOUTH	PATUX-T RIVER MOUTH	SOUTH OF MD VA LINE	SUM	KEY
0-1	7	19	18	25	14	83	RAW
MILES	1337	4372	4912	2213	1736	14570	WTD
	23.3	42.2	38.3	61.0	20.9	36.1	RPC
	17.1	30.8	42.0	49.7	13.7	28.6	WPC
	8.4	22.9	21.7	30.1	16.9	100.0	RPR
2-5	18	18	17	12	30	95	RAW
	4869	5833	3319	1080	6020	21121	WTD
	60.0	40.0	36.2	29.3	44.8	41.3	RPC
	62.2	41.1	28.4	24.3	47.3	41.5	WPC
	18.9	18.9	17.9	12.6	31.6	100.0	RPR
6-10	3	2	8	2	16	31	RAW
	1450	636	2705	1104	4055	9950	WTD
	10.0	4.4	17.0	4.9	23.9	13.5	RPC
	18.5	4.5	23.1	24.8	31.9	19.6	WPC
	9.7	6.5	25.8	6.5	51.6	100.0	RPR
11-25	2	5	3	1	5	16	RAW
	174	3227	754	56	817	5028	WTD
	6.7	11.1	6.4	2.4	7.5	7.0	RPC
	2.2	22.7	6.4	1.3	6.4	9.9	WPC
	12.5	31.3	18.8	6.3	31.3	100.0	RPR
MORE		1			2	3	RAW
THAN		118			86	204	WTD
25		2.2			3.0	1.3	RPC
		.8			.7	.4	WPC
		33.3			66.7	100.0	RPR

TABLE 3-4. BSIS DATA

LATA GROUP, INC. #5035// PROJECT #CG--00-457-A
DETAILED INTERVIEW WITH RECREATIONAL BOAT OPERATORS

USED MOTOR BOATS MOST IN PARTS OF CHESAPEAKE--RELATED TO OTHER FACTORS

OPERATE MOTOR BOATS MOST OF ALL = OVER 16 FT // (MOTOR)BOAT OWNERSHP=OWNERS // TOTAL 5TH DISTRICT PROJECTED DATA = TOTAL DIS-TRICT

ROWS= OPERATE MOTOR BOAT AT THIS DISTANCE FROM SHORE COLUMNS= BODY OF WATER USED MOST -MOTOR BOATS

	HEAD OF THE BAY	POOLES ISLAND SOUTH	BAY BRIDGE SOUTH	PATUX-T RIVER MOUTH	SOUTH OF MD VA LINE	SUM	KEY
NA,DK				1	1		2 RAW
							WTD
				2.1	2.4		.9 RPC
							WPC
				50.0	50.0		100.0 RPR
SUMS	30	45	47	41	67	230	RAW
	7830	14186	11690	4453	12714	50873	WTD
	100.0	100.0	100.0	100.0	100.0	100.0	RPC
	100.0	100.0	100.0	100.0	100.0	100.0	WPC
	13.0	19.6	20.4	17.8	29.1	100.0	RPR

TABLE 3-5. BSIS DATA

CATA GROUP, INC. #5035// PROJECT #CG--00-457-A
DETAILED INTERVIEW WITH RECREATIONAL BOAT OPERATORS

USED MOTOR BOATS MOST IN PARTS OF CHESAPEAKE--RELATED TO OTHER FACTORS

OPERATE MOTOR BOATS MOST OF ALL = UNDER 16 FT // (MOTOR)BOAT OWNERSHP=NON-OWNERS // TOTAL 5TH DISTRICT PROJECTED DATA = TOTAL DIS-TRICT

ROWS= OPERATE MOTOR BOAT AT THIS DISTANCE FROM SHORE   COLUMNS= BODY OF WATER USED MOST -MOTOR BOATS

		HEAD OF THE BAY	POOLES ISLAND SOUTH	BAY BRIDGE SOUTH	PATUX-T RIVER MOUTH	SOUTH OF MD VA LINE	SUM	KEY
0-1 MILES		6	4	5	5	3	23	RAW
		1392	872	1785	796	1674	5469	WTD
		100.0	57.1	71.4	71.4	33.3	63.9	RPC
		100.0	38.6	93.6	87.7	26.8	[illegible]	WPC
		26.1	17.4	21.7	21.7	13.0	100.0	RPR
2-5			3	1	2	3	9	RAW
			1388	118	112	690	2308	WTD
			42.9	14.3	28.6	33.3	25.0	RPC
			61.4	6.4	12.3	27.4	[illegible]	WPC
			33.3	11.1	22.2	33.3	100.0	RPR
6-10						3	3	RAW
						1152	1152	WTD
						33.3	8.3	RPC
						45.8	[illegible]	WPC
						100.0	100.0	RPR
NA,DK				1			1	RAW
								WTD
				14.3			2.8	RPC
								WPC
				100.0			100.0	RPR
SUMS		6	7	7	7	9	36	RAW
		1392	2260	1853	908	2516		WTD
		100.0	100.0	100.0	100.0	100.0	100.0	RPC
		100.0	100.0	100.0	100.0	100.0		WPC
		16.7	19.4	19.4	19.4	25.0	100.0	RPR

TABLE 3-6. BSIS DATA

DATA GROUP, INC. #5035// PRCJECT #CG--00-457-A
DETAILED INTERVIEW WITH RECREATIONAL BOAT OPERATORS

USED MOTOR BOATS MOST IN PARTS OF CHESAPEAKE--RELATED TO OTHER FACTORS

OPERATE MOTOR BOATS MOST OF ALL = OVER 16 FT // (MOTOR)BCAT OWNERSHP=OWNERS NON- // TOTAL 5TH DISTRICT PROJECTED DATA = TOTAL DIS-TRICT

ROWS= OPERATE MOTOR BCAT AT THIS DISTANCE FRCM SHORE   COLUMNS= BODY OF WATER USED MOST -MOTOR BOATS

	HEAD OF THE BAY	POOLES ISLAND SCUTH	BAY BRIDGE SOUTH	PATUX-T RIVER MOUTH	SOUTH OF MD VA LINE	SUM	KEY
0-1 MILES	1	3	9	10	7	30	RAW
	291	954	2971	1220	631	6067	WTD
	33.3	23.1	64.3	52.6	33.3	42.9	RPC
	21.9	26.1	77.4	54.0	22.8		WPC
	3.3	10.0	30.0	33.3	23.3	100.0	RPR
2-5	2	10	4	7	8	31	RAW
	1036	2699	348	928	1112	6123	WTD
	66.7	76.9	28.6	36.8	38.1	44.3	RPC
	78.1	73.9	9.1	41.1	40.2		WPC
	6.5	32.3	12.9	22.6	25.8	100.0	RPR
6-10			1	2	2	5	RAW
			518	112	232	862	WTD
			7.1	10.5	9.5	7.1	RPC
			13.5	5.0	8.4		WPC
			20.0	40.0	40.0	100.0	RPR
11-25					3	3	RAW
					674	674	WTD
					14.3	4.3	RPC
					24.4		WPC
					100.0	100.0	RPR
MORE THAN 25					1	1	RAW
					116	116	WTD
					4.8	1.4	RPC
					4.2		WPC
					100.0	100.0	RPR
SUMS	3	13	14	19	21	70	RAW
	1327	3653	3837	2260	2765		WTD
	100.0	100.0	100.0	100.0	100.0	100.0	RPC
	100.0	100.0	100.0	100.0	100.0		WPC
	4.3	18.6	20.0	27.1	30.0	100.0	RPR

*****TABLE TOTALS... RAW= 408 WTD= 84243

TABLE 3-7. BSIS DATA

DATA GROUP, INC. #5035// PROJECT #CG--00-457-A
DETAILED INTERVIEW WITH RECREATIONAL BOAT OPERATORS

USED SAIL BOATS MOST IN PARTS OF CHESAPEAKE--RELATED TO OTHER FACTORS

OPERATE SAIL BOAT MOST OF ALL = UNDER 16 FT // SAIL BOAT OWNERSHIP =OWNERS // TOTAL 5TH DISTRICT PROJECTED DATA = TOTAL DIS-TRICT

ROWS= OPERATE SAIL BOAT AT THIS DISTANCE FROM SHORE   COLUMNS= BODY OF WATER USED MOST -SAILBOATS

	HEAD OF THE BAY	BAY BRIDGE SOUTH	PATUX-T RIVER MOUTH	SOUTH OF MD VA LINE	SUM	KEY
0-1 MILES	1	7	2	3	13	RAW
	315	1295	174	5972	7756	WTD
	25.0	87.5	100.0	50.0	65.0	RPC
	25.4	64.3	100.0	92.0		WPC
	7.7	53.8	15.4	23.1	100.0	RPR
2-5	3			1	4	RAW
	927			518	1445	WTD
	75.0			16.7	20.0	RPC
	74.6			8.0		WPC
	75.0			25.0	100.0	RPR
6-10		1			1	RAW
		718			718	WTD
		12.5			5.0	RPC
		35.7				WPC
		100.0			100.0	RPR
NA,DK				2	2	RAW
						WTD
				33.3	10.0	RPC
						WPC
				100.0	100.0	RPR
SUMS	4	8	2	6	20	RAW
	1242	2013	174	6490		WTD
	100.0	100.0	100.0	100.0	100.0	RPC
	100.0	100.0	100.0	100.0		WPC
	20.0	40.0	10.0	30.0	100.0	RPR

TABLE 3-8. BSIS DATA

DATA GROUP, INC. #5035// PROJECT #CG--00-457-A
DETAILED INTERVIEW WITH RECREATIONAL BOAT OPERATORS

USED SAIL BOATS MOST IN PARTS OF CHESAPEAKE--RELATED TO OTHER FACTORS

OPERATE SAIL BOAT MOST OF ALL = OVER 16 FT // SAIL BOAT OWNERSHIP =OWNERS // TOTAL 5TH DISTRICT PROJECTED DATA = TOTAL DIS-TRICT

ROWS= OPERATE SAIL BOAT AT THIS DISTANCE FROM SHORE COLUMNS= BODY OF WATER USED MOST -SAILBOATS

	HEAD OF THE BAY	POOLES ISLAND SOUTH	BAY BRIDGE SOUTH	PATUX-T RIVER MOUTH	SOUTH OF MD VA LINE	SUM	KEY
0-1 MILES	4				2	6	RAW
	1306				634	1940	WTD
	44.4				40.0	18.2	RPC
	43.2				53.7		WPC
	66.7				33.3	100.0	RPR
2-5	5	2	6	2	3	18	RAW
	1720	236	1108	1177	547	4788	WTD
	55.6	33.3	60.0	66.7	60.0	54.5	RPC
	56.8	9.2	47.2	90.9	46.3		WPC
	27.8	11.1	33.3	11.1	16.7	100.0	RPR
6-10		1	2			3	RAW
		518	1239			1757	WTD
		16.7	20.0			9.1	RPC
		20.1	52.8				WPC
		33.3	66.7			100.0	RPR
11-25		3		1		4	RAW
		1822		118		1940	WTD
		50.0		33.3		12.1	RPC
		70.7		9.1			WPC
		75.0		25.0		100.0	RPR
NA,DK			2			2	RAW
							WTD
			20.0			6.1	RPC
							WPC
			100.0			100.0	RPR
SUMS	9	6	10	3	5	33	RAW
	3026	2576	2347	1295	1181		WTD
	100.0	100.0	100.0	100.0	100.0	100.0	RPC
	100.0	100.0	100.0	100.0	100.0		WPC
	27.3	18.2	30.3	9.1	15.2	100.0	RPR

TABLE 3-9. BSIS DATA

DATA GROUP, INC. #5035// PROJECT #CG--00-457-A
DETAILED INTERVIEW WITH RECREATIONAL BOAT OPERATORS

USED SAIL BOATS MOST IN PARTS OF CHESAPEAKE--RELATED TO OTHER FACTORS

OPERATE SAIL BOAT MOST OF ALL = UNDER 16 FT // SAIL BOAT OWNERSHIP = NON-OWNERS // TOTAL 5TH DISTRICT PROJECTED DATA = TOTAL DIS-TRICT

ROWS= OPERATE SAIL BOAT AT THIS DISTANCE FROM SHORE   COLUMNS= BODY OF WATER USED MOST -SAILBOATS

	POOLES ISLAND SOUTH	BAY BRIDGE SOUTH	PATUX-T RIVER MOUTH	SOUTH OF MD VA LINE	SUM	KEY
0-1 MILES		3	1	3	7	RAW
		1554	552	1076	3182	WTD
		100.0	100.0	100.0	87.5	RPC
		100.0	100.0	100.0		WPC
		42.9	14.3	42.9	100.0	RPR
2-5	1				1	RAW
	518				518	WTD
	100.0				12.5	RPC
	100.0					WPC
	100.0				100.0	RPR
SUMS	1	3	1	3	8	RAW
	518	1554	552	1076		WTD
	100.0	100.0	100.0	100.0	100.0	RPC
	100.0	100.0	100.0	100.0		WPC
	12.5	37.5	12.5	37.5	100.0	RPR

TABLE 3-10. BSIS DATA

DATA GROUP, INC. #5035// PROJECT #CG--00-457-A
DETAILED INTERVIEW WITH RECREATIONAL BOAT OPERATORS

USED SAIL BOATS MOST IN PARTS OF CHESAPEAKE--RELATED TO OTHER FACTORS

OPERATE SAIL BOAT MOST OF ALL = OVER 16 FT // SAIL BOAT OWNERSHIP =NON-OWNERS // TOTAL 5TH DISTRICT PROJECTED DATA = TOTAL DIS-TRICT

ROWS= OPERATE SAIL BOAT AT THIS DISTANCE FROM SHORE   COLUMNS= BODY OF WATER USED MOST -SAILBOATS

	HEAD OF THE BAY	POOLES ISLAND SOUTH	BAY BRIDGE SOUTH	PATUX-T RIVER MOUTH	SOUTH OF MD VA LINE	SUM	KEY
0-1	3	3	1		2	9	RAW
MILES	1127	527	118		156	1928	WTD
	37.5	25.0	12.5		66.7	27.3	RPC
	42.0	14.1	2.3		23.1		WPC
	33.3	33.3	11.1		22.2	100.0	RPR
2-5	3	4	5	1	1	14	RAW
	1554	1445	4501	56	518	8074	WTD
	37.5	33.3	62.5	50.0	33.3	42.4	RPC
	58.0	38.6	87.0	9.2	76.9		WPC
	21.4	28.6	35.7	7.1	7.1	100.0	RPR
6-10		2	1	1		4	RAW
		670	552	552		1774	WTD
		16.7	12.5	50.0		12.1	RPC
		17.9	10.7	90.8			WPC
		50.0	25.0	25.0		100.0	RPR
11-25		2				2	RAW
		1104				1104	WTD
		16.7				6.1	RPC
		29.5					WPC
		100.0				100.0	RPR
NA,DK	2	1	1			4	RAW
							WTD
	25.0	8.3	12.5			12.1	RPC
							WPC
	50.0	25.0	25.0			100.0	RPR
SUMS	8	12	8	2	3	33	RAW
	2681	3746	5171	608	674		WTD
	100.0	100.0	100.0	100.0	100.0	100.0	RPC
	100.0	100.0	100.0	100.0	100.0		WPC
	24.2	36.4	24.2	6.1	9.1	100.0	RPR

*****TABLE TOTALS... RAW= 94 WTD= 36924

TABLE 3-11. BOAT DISTRIBUTION - CHESAPEAKE BAY
(BSIS WEIGHTED DATA BODIES OF WATER USED MOST)

MOTORBOATS AND SAILBOATS UNDER 16 FEET

Zone Miles From Shore	Motorboats Owned	Motorboats Not Owned	Sailboats Owned	Sailboats Not Owned	Total
0-1	8118	5469	7756	3182	24,525
2-5	1914	2308	1445	518	6,185
6-10	449	1152	718	--	2,319
11-25	---	---	---	---	---
25+	118	---	---	---	118
					33,147

MOTORBOATS AND SAILBOATS OVER 16 FEET

Zone Miles From Shore	Motorboats Owned	Motorboats Not Owned	Sailboats Owned	Sailboats Not Owned	Total
0-1	14,570	6,067	1,940	1,928	18,504
2-5	21,121	6,123	4,788	8,074	40,106
6-10	9,950	862	1,757	1,774	14,343
11-25	5,028	674	1,940	1,104	8,746
25+	204	116	---	---	320
					82,019

DISTRIBUTION OF MOTORBOATS & SAILBOATS AS PERCENTAGE OF TOTAL

Zone	Under 16 ft	Over 16 ft	
0-1	21.3	16.1	
2-5	5.4	34.8	
6-10	2.1	12.5	
11-25	---	7.5	
25+	.1	.2	
	28.9	71.1	100.0

TABLE 3-12. BSIS DATA

DATA GROUP, INC. #6035// PROJECT #CG--30-457-A
DETAILED INTERVIEW WITH RECREATIONAL BOAT OPERATORS

DO YOU TAKE ON BOARD OR HAVE INSTALLED ANY KIND OF RADIO EQUIPMENT..?

TOTAL 5TH DISTRICT TOTAL
PROJECTED DATA = DIS-
TRICT

ROWS= RADIO EQUIPMENT ON BOARD -MOTOR BOATS
COLUMNS= OPERATE MOTOR BOATS MOST OF ALL

	UNDER 16 FT	OVER 16 FT	TOTAL ANSWERG	KEY
TOTAL ANSWERG	604	968	1572	RAW
	180858	243297	424155	WTD
	100.0	100.0	100.0	RPC
	100.0	100.0	100.0	WPC
	19.2	30.8	50.0	RPR
NO RADIO ABOARD	504	587	1091	RAW
	152726	156738	309464	WTD
	83.4	60.6	69.4	RPC
	84.4	64.4	73.0	WPC
	23.1	26.9	50.0	RPR
RADIO ON BOARD	100	361	461	RAW
	27273	82415	109793	WTD
	16.6	37.3	29.3	RPC
	15.1	33.9	25.9	WPC
	10.8	39.2	50.0	RPR
AM/FM BANDS	82	204	286	RAW
	21838	50167	71005	WTD
	13.6	21.1	18.2	RPC
	12.1	20.6	17.0	WPC
	14.3	35.7	50.0	RPR
ONE WAY VHF/FM	2	27	29	RAW
	574	7171	7745	WTD
	.3	2.8	1.8	RPC
	.3	2.9	1.8	WPC
	3.4	46.6	50.0	RPR

TABLE 3-13. BSIS DATA

DATA GROUP, INC. #5035// PROJECT #CG--00-457-A
DETAILED INTERVIEW WITH RECREATIONAL BOAT OPERATORS

DO YOU TAKE ON BOARD OR HAVE INSTALLED ANY KIND OF RADIO EQUIPMENT..?

TOTAL 5TH DISTRICT TOTAL
PROJECTED DATA = DIS-TRICT

ROWS= RADIO EQUIPMENT ON BOARD -MOTOR BOATS   COLUMNS= OPERATE MOTOR BOATS MOST OF ALL

	UNDER 16 FT	OVER 16 FT	TOTAL ANSWERG	KEY
RDF	1	14	15	RAW
	40	2342	2382	WTD
	.2	1.4	1.0	RPC
		1.0	.6	WPC
	3.3	46.7	50.0	RPP
MARINE SIDE BAND	4	65	69	RAW
	605	14765	15370	WTD
	.7	6.7	4.4	RPC
	.3	6.1	3.6	WPC
	2.9	47.1	50.0	RPP
TWO WAY VHF/FM	5	57	62	RAW
	1359	10854	12213	WTD
	.8	5.9	3.9	RPC
	.9	4.5	2.9	WPC
	4.0	46.0	50.0	RPP
CITIZEN BAND	9	48	57	RAW
	3094	10217	13311	WTD
	1.5	5.0	3.6	RPC
	1.7	4.2	3.1	WPC
	7.9	42.1	50.0	RPP
NA/DK	2	6	8	RAW
	143	1275	1418	WTD
	.2	.6	.5	RPC
	.1	.5	.3	WPC
	12.5	37.5	50.0	RPP

*****TABLE TOTALS... RAW= 7200 WTD= 1935692

TABLE 3-14. BSIS DATA

DATA GROUP, INC. #5035// PROJECT #CG--00-457-A
DETAILED INTERVIEW WITH RECREATIONAL BOAT OPERATORS

DO YOU TAKE ON BOARD OR HAVE INSTALLED ANY KIND OF RADIO EQUIPMENT..?

CHESAPEAKE BAY MOTOR BOATS = BAY AREA // TOTAL 5TH DISTRICT PROJECTED DATA = TOTAL DIS-TRICT

ROWS= RADIO EQUIPMENT ON BOARD -MOTOR BOATS COLUMNS= OPERATE MOTOR BOATS MOST OF ALL

	UNDER 16 FT	OVER 16 FT	TOTAL ANSWERG	KEY
TOTAL ANSWERG	108	301	409	RAW
	20055	65325	85380	WTD
	100.0	100.0	100.0	RPC
	100.0	100.0	100.0	WPC
	13.2	36.8	50.0	RPR
NO RADIO ABOARD	73	131	204	RAW
	13246	26761	40007	WTD
	67.6	43.5	49.9	RPC
	66.0	41.0	46.9	WPC
	17.9	32.1	50.0	RPR
RADIO ON BOARD	35	164	199	RAW
	6809	37656	44465	WTD
	32.4	54.5	48.7	RPC
	34.0	57.6	52.1	WPC
	8.8	41.2	50.0	RPR
AM/FM BANDS	28	83	111	RAW
	5791	19519	25310	WTD
	25.9	27.6	27.1	RPC
	28.9	29.9	29.6	WPC
	12.6	37.4	50.0	RPR
ONE WAY VHF/FM	1	16	17	RAW
	518	5541	6059	WTD
	.9	5.3	4.2	RPC
	2.6	8.5	7.1	WPC
	2.9	47.1	50.0	RPR

TABLE 3-15. BSIS DATA

DATA GROUP, INC. #5035// PROJECT #CG--00-457-A
DETAILED INTERVIEW WITH RECREATIONAL BOAT OPERATORS

DO YOU TAKE ON BOARD OR HAVE INSTALLED ANY KIND OFRADIO EQUIPMENT..?

CHESAPEAKE BAY MOTOR BOATS = BAY AREA // TOTAL 5TH DISTRICT PROJECTED DATA // = TOTAL DIS-TRICT

ROWS= RADIO EQUIPMENT ON BOARD -MOTOR BOATS
COLUMNS= OPERATE MOTOR BOATS MOST OF ALL

	UNDER 16 FT	OVER 16 FT	TOTAL ANSWERG	KEY
RDF		7	7	RAW
		1252	1252	WTD
		2.3	1.7	RPC
		1.9	1.6	WPC
		50.0	50.0	RPR
MARINE SIDE BAND	2	35	37	RAW
	234	2212	2446	WTD
	1.9	11.6	9.0	RPC
	1.2	14.1	11.1	WPC
	2.7	47.3	50.0	RPR
TWO WAY VHF/FM		36	36	RAW
		7820	7820	WTD
		12.0	6.8	RPC
		12.0	9.2	WPC
		50.0	50.0	RPR
CITIZEN BAND	6	19	25	RAW
	440	2361	2801	WTD
	5.6	6.3	6.1	RPC
	2.[illegible]	5.1	4.5	WPC
	12.0	38.0	50.0	RPR
NA/DK		4	4	RAW
		1210	1210	WTD
		1.3	1.0	RPC
		1.0	1.4	WPC
		50.0	50.0	RPR

*****TABLE TOTALS... RAW= 2098 WTD= 445513

TABLE 3-16. BSIS DATA

DATA GROUP, INC. #5235// PROJECT #CG--20-457-A
DETAILED INTERVIEW WITH RECREATIONAL BOAT OPERATORS

DO YOU TAKE ON BOARD OR HAVE INSTALLED ANY KIND OF RADIO EQUIPMENT..?

OFFSHORE AREAS MOTOR BOATS = OFF SHORE AREAS // TOTAL 5TH DISTRICT PROJECTED DATA = TOTAL DISTRICT

ROWS= RADIO EQUIPMENT ON BOARD -MOTOR BOATS COLUMNS= OPERATE MOTOR BOATS MOST OF ALL

	UNDER 16 FT	OVER 16 FT	TOTAL ANSWERS	KEY
TOTAL ANSWERS	22	56	78	RAW
	5883	10688	16571	WTD
	100.0	100.0	100.0	RPC
	100.0	100.0	100.0	WPC
	14.1	35.9	50.0	RPR
NO RADIO ABOARD	18	27	45	RAW
	5264	6824	12088	WTD
	81.8	48.2	57.7	RPC
	89.5	63.8	72.9	WPC
	20.0	30.0	50.0	RPR
RADIO ON BOARD	5	29	34	RAW
	722	3864	4586	WTD
	22.7	51.8	43.6	RPC
	12.3	36.2	27.7	WPC
	7.4	42.6	50.0	RPR
AM/FM BANDS	3	16	19	RAW
	563	1658	2221	WTD
	13.6	28.6	24.4	RPC
	9.6	15.5	13.4	WPC
	7.9	42.1	50.0	RPR
ONE WAY VHF/FM	1	2	3	RAW
	56	529	585	WTD
	4.5	3.6	3.8	RPC
	1.0	4.9	3.5	WPC
	16.7	33.3	50.0	RPR

TABLE 3-17. BSIS DATA

DATA GROUP, INC. #5035// PROJECT #CG--00-457-A
DETAILED INTERVIEW WITH RECREATIONAL BOAT OPERATORS

DO YOU TAKE ON BOARD OR HAVE INSTALLED ANY KIND OFRADIO EQUIPMENT..?

OFFSHORE AREAS MOTOR BOATS = OFF SHORE AREAS // TOTAL 5TH DISTRICT PROJECTED DATA = TOTAL DIS-TRICT

ROWS= RADIO EQUIPMENT ON BOARD -MOTOR BOATS   COLUMNS= OPERATE MOTOR BOATS MOST OF ALL

	UNDER 16 FT	OVER 16 FT	TOTAL ANSWERG	KEY
RDF		5	5	RAW
		627	627	WTD
		9.0	6.4	RPC
		5.9	3.8	WPC
		50.0	50.0	RPR
MARINE SIDE BAND		4	4	RAW
		1065	1065	WTD
		7.1	5.1	RPC
		10.0	6.4	WPC
		50.0	50.0	RPR
TWO WAY VHF/FM		5	5	RAW
		244	244	WTD
		8.0	6.4	RPC
		2.3	1.5	WPC
		50.0	50.0	RPR
CITIZEN BAND		7	7	RAW
		1421	1421	WTD
		12.5	9.0	RPC
		13.3	8.6	WPC
		50.0	50.0	RPR
NA/OK	1		1	RAW
	103		103	WTD
	4.5		1.3	RPC
	1.9		.6	WPC
	50.0		50.0	RPR

*****TABLE TOTALS... RAW= 402 WTD= 7[illegible]22

TABLE 3-18. BSIS DATA

DATA GROUP, INC. #5025// PROJECT #CG--00-457-A
DETAILED INTERVIEW WITH RECREATIONAL BOAT OPERATORS

DO YOU TAKE ON BOARD OR HAVE INSTALLED ANY KIND OF RADIO EQUIPMENT..?

INLAND, RIVERS & OTHERS MOTOR BOATS — INLAND =RIVERS OTHERS // TOTAL 5TH DISTRICT // PROJECTED DATA // TOTAL = DIS-TRICT

ROWS= RADIO EQUIPMENT ON BOARD -MOTOR BOATS — COLUMNS= OPERATE MOTOR BOATS MOST OF ALL

	UNDER 16 FT	OVER 16 FT	TOTAL ANSWERG	KEY
TOTAL ANSWERG	425	545	970	RAW
	144218	159491	303709	WTD
	100.0	100.0	100.0	RPC
	100.0	100.0	100.0	WPC
	21.9	28.1	50.0	RPR
NO RADIO ABOARD	369	375	744	RAW
	124153	116602	240755	WTD
	86.8	68.8	76.7	RPC
	86.1	73.1	79.3	WPC
	24.8	25.2	50.0	RPR
RADIO ON BOARD	55	156	211	RAW
	19208	39663	58871	WTD
	12.9	28.6	21.9	RPC
	13.3	24.9	19.4	WPC
	13.0	37.0	50.0	RPR
AM/FM BANDS	48	98	146	RAW
	15321	28160	43481	WTD
	11.3	18.0	15.1	RPC
	10.6	17.7	14.3	WPC
	16.4	33.6	50.0	RPR
ONE WAY VHF/FM		7	7	RAW
		947	947	WTD
		1.3	.7	RPC
		.6	.3	WPC
		50.0	50.0	RPR

TABLE 3-19. BSIS DATA

DATA GROUP, INC. #5035// PROJECT #CG--00-457-A
DETAILED INTERVIEW WITH RECREATIONAL BOAT OPERATORS

DO YOU TAKE ON BOARD OR HAVE INSTALLED ANY KIND OFRADIO EQUIPMENT..?

INLAND,RIVERS & OTHERS MOTOR BOATS   INLAND =RIVERS OTHERS // TOTAL 5TH DISTRICT PROJECTED DATA = TOTAL DIS-TRICT

ROWS= RADIO EQUIPMENT ON BOARD -MOTOR BOATS   COLUMNS= OPERATE MOTOR BOATS MOST OF ALL

	UNDER 16 FT	OVER 16 FT	TOTAL ANSWERG	KEY
RDF	1	2	3	RAW
	40	463	503	WTD
	.2	.4	.3	RPC
		.3	.2	WPC
	16.7	33.3	50.0	RPR
MARINE SIDE BAND	2	24	26	RAW
	371	4334	4705	WTD
	.5	4.4	2.7	RPC
	.3	2.7	1.5	WPC
	3.8	46.2	50.0	RPR
TWO WAY VHF/FM	3	16	19	RAW
	873	2790	3663	WTD
	.7	2.9	2.0	RPC
	.6	1.7	1.2	WPC
	7.9	42.1	50.0	RPR
CITIZEN BAND	3	20	23	RAW
	2654	5242	7896	WTD
	.7	3.7	2.4	RPC
	1.8	3.2	2.6	WPC
	6.5	43.5	50.0	RPR
NA/DK	1	1	2	RAW
	40	11	51	WTD
	.2	.2	.2	RPC
				WPC
	25.0	25.0	50.0	RPR

*****TABLE TOTALS... RAW= 4302 WTD= 1329162

TABLE 3-20. BSIS DATA

DATA GROUP, INC. #5335// PROJECT #CG--30-457-A
DETAILED INTERVIEW WITH RECREATIONAL BOAT OPERATORS !

DO YOU TAKE ON BOARD OR HAVE INSTALLED ANY KIND OF RADIO EQUIPMENT..?

TOTAL 5TH DISTRICT PROJECTED DATA = TOTAL DIS-TRICT

ROWS= RADIO EQUIPMENT ON BOARD -SAILBOATS   COLUMNS= OPERATE SAIL BOAT MOST OF ALL

	UNDER 16 FT	OVER 16 FT	TOTAL ANSWERG	KEY
TOTAL ANSWERG	62	103	165	RAW
	22766	34073	56839	WTD
	100.0	100.0	100.0	RPC
	100.0	100.0	100.0	WPC
	18.8	31.2	50.0	RPR
NO RADIO ABOARD	59	54	113	RAW
	21812	15995	37807	WTD
	95.2	52.4	68.5	RPC
	95.8	46.9	66.5	WPC
	26.1	23.9	50.0	RPR
RADIO ON BOARD	3	46	49	RAW
	954	16321	17275	WTD
	4.8	44.7	29.7	RPC
	4.2	47.9	30.4	WPC
	3.1	46.9	50.0	RPR
AM/FM BANDS	2	26	28	RAW
	239	8597	8916	WTD
	3.2	25.2	17.0	RPC
	1.0	25.2	15.5	WPC
	3.6	46.4	50.0	RPR
ONE WAY VHF/FM		8	8	RAW
		4382	4382	WTD
		7.8	4.8	RPC
		12.9	7.7	WPC
		50.0	50.0	RPR

TABLE 3-21. BSIS DATA

DATA GROUP, INC. #5035// PROJECT #CG--D-457-A
DETAILED INTERVIEW WITH RECREATIONAL BOAT OPERATORS

DO YOU TAKE ON BOARD OR HAVE INSTALLED ANY KIND OF RADIO EQUIPMENT..?

TOTAL 5TH DISTRICT TOTAL
PROJECTED DATA = DIS-
TRICT

ROWS= RADIO EQUIPMENT ON BOARD -SAILBOATS COLUMNS= OPERATE SAIL BOAT MOST OF ALL

	UNDER 16 FT	OVER 16 FT	TOTAL ANSWERG	KEY
RDF		5	5	RAW
		1990	1990	WTD
		4.9	3.0	RPC
		5.8	2.5	WPC
		50.0	50.0	RPP
MARINE SIDE BAND	1	8	9	RAW
	718	2020	2733	WTD
	1.6	7.8	5.5	RPC
	3.2	5.9	4.8	WPC
	5.6	44.4	50.0	RPP
TWO WAY VHF/FM		8	8	RAW
		2026	2026	WTD
		7.8	4.8	RPC
		5.9	3.6	WPC
		50.0	50.0	RPP
CITIZEN BAND		1	1	RAW
		103	103	WTD
		1.0	.6	RPC
		.3	.2	WPC
		50.0	50.0	RPP
NA/DK		1	1	RAW
		103	103	WTD
		1.0	.6	RPC
		.3	.2	WPC
		50.0	50.0	RPP

****-TABLE TOTALS... RAW= 774 WTD= 264158

TABLE 3-22. BSIS DATA

DATA GROUP, INC. #5035// PROJECT #CG--00-457-A
DETAILED INTERVIEW WITH RECREATIONAL BOAT OPERATORS

DO YOU TAKE ON BOARD OR HAVE INSTALLED ANY KIND OF RADIO EQUIPMENT..?

CHESAPEAKE BAY SAIL BOATS	BAY = AREA	// TOTAL 5TH DISTRICT // PROJECTED DATA //	TOTAL = DIS- TRICT

ROWS= RADIO EQUIPMENT ON BOARD -SAILBOATS   COLUMNS= OPERATE SAIL BOAT MOST OF ALL

	UNDER 16 FT	OVER 16 FT	TOTAL ANSWERG	KEY
TOTAL	28	66	94	RAW
ANSWERG	14249	25315	39564	WTD
	100.0	100.0	100.0	RPC
	100.0	100.0	100.0	WPC
	14.9	35.1	50.0	RPP
NO	25	30	55	RAW
RADIO	13295	10285	23580	WTD
ABOARD	89.3	45.5	58.5	RPC
	93.3	40.6	59.6	WPC
	22.7	27.3	50.0	RPP
RADIO	3	33	36	RAW
ON	954	13273	14227	WTD
BOARD	10.7	50.0	38.3	RPC
	6.7	52.4	36.0	WPC
	4.2	45.8	50.0	RPP
AM/FM	2	16	18	RAW
BANDS	236	5989	6225	WTD
	7.1	27.3	21.3	RPC
	1.7	23.7	15.7	WPC
	5.0	45.0	50.0	RPP
ONE WAY		8	8	RAW
VHF/FM		4392	4392	WTD
		12.1	8.5	RPC
		17.3	11.1	WPC
		50.0	50.0	RPP

TABLE 3-23. BSIS DATA

DATA GROUP, INC. #5035// PROJECT #CG--00-457-A
DETAILED INTERVIEW WITH RECREATIONAL BOAT OPERATORS

DO YOU TAKE ON BOARD OR HAVE INSTALLED ANY KIND OFRADIO EQUIPMENT..?

CHESAPEAKE BAY SAIL BOATS = BAY AREA // TOTAL 5TH DISTRICT PROJECTED DATA = TOTAL DISTRICT

ROWS= RADIO EQUIPMENT ON BOARD -SAILBOATS   COLUMNS= OPERATE SAIL BOAT MOST OF ALL

	UNDER 16 FT	OVER 16 FT	TOTAL ANSWERG	KEY
RDF		3	3	RAW
		1754	1754	WTD
		4.5	3.2	RPC
		6.9	4.4	WPC
		50.0	50.0	RPP
MARINE SIDE BAND	1	6	7	RAW
	718	1784	2502	WTD
	3.6	5.1	7.4	RPC
	5.0	7.0	6.3	WPC
	7.1	42.9	50.0	RPP
TWO WAY VHF/FM		3	3	RAW
		1554	1554	WTD
		4.5	3.2	RPC
		6.1	3.0	WPC
		50.0	50.0	RPP

*****TABLE TOTALS... RAW= 452 WTD= 187576

TABLE 3-24. BSIS DATA

DATA GROUP, INC. #5025// PROJECT #CG--00-457-A
DETAILED INTERVIEW WITH RECREATIONAL BOAT OPERATORS

DO YOU TAKE ON BOARD OR HAVE INSTALLED ANY KIND OFRADIO EQUIPMENT..?

OFFSHORE AREAS SAIL BOATS = OFF SHORE AREAS // TOTAL 5TH DISTRICT PROJECTED DATA = TOTAL DIS-TRICT

ROWS= RADIO EQUIPMENT ON BOARD -SAILBOATS COLUMNS= OPERATE SAIL BOAT MOST OF ALL

	UNDER 16 FT	OVER 16 FT	TOTAL ANSWERG	KEY
TOTAL ANSWERG	3	5	8	RAW
	245	443	688	WTD
	100.0	100.0	100.0	RPC
	100.0	100.0	100.0	WPC
	18.8	31.3	50.0	RPP
NO RADIO ABOARD	3	2	5	RAW
	245	130	375	WTD
	100.0	40.0	62.5	RPC
	100.0	29.3	54.5	WPC
	30.0	20.0	50.0	RPP
RADIO ON BOARD		3	3	RAW
		313	313	WTD
		60.0	37.5	RPC
		70.7	45.5	WPC
		50.0	50.0	RPP
AM/FM BANDS		2	2	RAW
		236	236	WTD
		40.0	25.0	RPC
		53.3	34.3	WPC
		50.0	50.0	RPP
RDF		2	2	RAW
		236	236	WTD
		40.0	25.0	RPC
		53.3	34.3	WPC
		50.0	50.0	RPP

TABLE3-25. BSIS DATA

DATA GROUP, INC. #5035// PROJECT #CG--00-457-A
DETAILED INTERVIEW WITH RECREATIONAL BOAT OPERATORS

DO YOU TAKE ON BOARD OR HAVE INSTALLED ANY KIND OF RADIO EQUIPMENT..?

OFFSHORE AREAS SAIL BOATS = OFF SHORE AREAS // TOTAL 5TH DISTRICT PROJECTED DATA = TOTAL DISTRICT

ROWS= RADIO EQUIPMENT ON BOARD -SAILBOATS COLUMNS= OPERATE SAIL BOAT MOST OF ALL

	UNDER 16 FT	OVER 16 FT	TOTAL ANSWERG	KEY
MARINE SIDE BAND		1	1	RAW
		118	118	WTD
		30.0	12.5	RPC
		26.6	17.2	WPC
		50.0	50.0	RPR
TWO WAY VHF/FM		2	2	RAW
		105	105	WTD
		40.0	25.0	RPC
		44.0	28.3	WPC
		50.0	50.0	RPR

****TABLE TOTALS... RAW= 46 WTD= 4322

TABLE 3-26. BSIS DATA

DATA GROUP, INC. #5035// PROJECT #CG--03-457-A

DETAILED INTERVIEW WITH RECREATIONAL BOAT OPERATORS

DO YOU TAKE ON BOARD OR HAVE INSTALLED ANY KIND OF RADIO EQUIPMENT..?

INLAND,RIVERS & OTHERS SAIL BOATS — INLAND =RIVERS OTHERS // TOTAL 5TH DISTRICT // PROJECTED DATA = DIS- TRICT TOTAL

ROWS= RADIO EQUIPMENT ON BOARD -SAILBOATS — COLUMNS= OPERATE SAIL BOAT MOST OF ALL

	UNDER 16 FT	OVER 16 FT	TOTAL ANSWERG	KEY
TOTAL ANSWERG	27	24	51	RAW
	7294	5601	12895	WTD
	100.0	100.0	100.0	RPC
	100.0	100.0	100.0	WPC
	26.5	23.5	50.0	RPP
NO RADIO ABOARD	27	16	43	RAW
	7294	4102	11396	WTD
	100.0	66.7	84.3	RPC
	100.0	73.2	88.4	WPC
	31.4	18.6	50.0	RPP
RADIO ON BOARD		8	8	RAW
		1499	1499	WTD
		33.3	15.7	RPC
		26.8	11.6	WPC
		50.0	50.0	RPP
AM/FM BANDS		4	4	RAW
		1119	1119	WTD
		16.7	7.8	RPC
		20.0	8.7	WPC
		50.0	50.0	RPP
MARINE SIDE BAND		1	1	RAW
		118	118	WTD
		4.2	2.0	RPC
		2.1	.9	WPC
		50.0	50.0	RPP

TABLE 3-27. BSIS DATA

DATA GROUP, INC. #5035// PROJECT #CG--00-457-A
DETAILED INTERVIEW WITH RECREATIONAL BOAT OPERATORS

DO YOU TAKE ON BOARD OR HAVE INSTALLED ANY KIND OF RADIO EQUIPMENT..?

INLAND,RIVERS & OTHERS SAIL BOATS   INLAND =RIVERS OTHERS // TOTAL 5TH DISTRICT // PROJECTED DATA = TOTAL DIS-TRICT

ROWS= RADIO EQUIPMENT ON BOARD -SAILBOATS   COLUMNS= OPERATE SAIL BOAT MOST OF ALL

	UNDER 16 FT	OVER 16 FT	TOTAL ANSWERG	KEY
TWO WAY		3	3	RAW
VHF/FM		277	277	WTD
		12.5	5.9	RPC
		4.9	2.1	WPC
		50.0	50.0	RPP
CITIZEN		1	1	RAW
BAND		103	103	WTD
		4.2	2.0	RPC
		1.9	.9	WPC
		50.0	50.0	RPP
NA/DK		1	1	RAW
		103	103	WTD
		4.2	2.0	RPC
		1.9	.8	WPC
		50.0	50.0	RPP

*****TABLE TOTALS... RAW= 224 WTD= 55020

TABLE 3-28. BOATING STATISTICS INFORMATION SYSTEM DATA - FIFTH DISTRICT DETAILED SURVEY (RADIO RECEIVER DISTRIBUTION - WEIGHTED DATA)

OPERATE IN THIS AREA MOST OF ALL	TYPE OF RADIO RECEIVER ON BOARD BOAT	TOTALS		TYPE & SIZE OF BOAT MOST USED			
				MOTORBOAT		SAILBOAT	
		UNDER 16 FT	OVER 16 FT	UNDER 16 FT	OVER 16 FT	UNDER 16 FT	OVER 16 FT
ALL AREAS COMBINED (FIFTH DISTRICT TOTAL)	(No Radio)	174538	172733	152726	156738	21812	15995
	AM/FM Band + RDF	22247	64457	22011	53784	236	10673
	NWS Receiver (162.55 MHz)	574	11553	574	7171	---	4382
	AM Marine Radio-Tel	1323	16785	605	14765	718	2020
	VHF Marine Radio-Tel	1359	12880	1359	10854	---	2026
	Citizens Band	3094	10320	3094	10217	---	103
	TOTAL ANSWERING	203624	277370	180858	243297	22766	34073
CHESAPEAKE BAY	(No Radio)	26541	37046	13246	26761	13295	10285
	AM/FM Band + RDF	6027	29723	5791	21980	236	7743
	NWS Receiver (162.55 MHz)	518	9923	518	5541	---	4382
	AM Marine Radio-Tel	952	10996	234	9212	718	1784
	VHF Marine Radio-Tel	---	9374	---	7820	---	1554
	Citizens Band	440	3361	440	3361	---	---
	TOTAL ANSWERING	34304	90650	20055	65335	14249	25315
OFFSHORE AREAS	(No Radio)	5509	6954	5264	6824	245	130
	AM/FM Band + RDF	656	2757	656	2285	---	472
	NWS Receiver (162.55 MHz)	56	529	56	529	---	---
	AM Marine Radio-Tel	---	1183	---	1065	---	118
	VHF Marine Radio-Tel	---	439	---	244	---	195
	Citizens Band	---	1421	---	1421	---	---
	TOTAL ANSWERING	6128	11131	5883	10688	245	443
RIVERS, LAKES, INLAND WATERS, ETC.	(No Radio)	131447	120704	124153	116602	7294	4102
	AM/FM Band + RDF	15401	29856	15401	28634	---	1222
	NWS Receiver (162.55 MHz)	---	947	---	947	---	---
	AM Marine Radio-Tel	371	4452	371	4334	---	118
	VHF Marine Radio-Tel	873	3067	873	2790	---	277
	Citizens Band	2654	5345	2654	5242	---	103
	TOTAL ANSWER	151512	165092	144218	159491	7294	5601

TABLE 3-29. RADIO RECEIVER DISTRIBUTION BY SIZE OF BOAT AS A PERCENTAGE OF USER CLASS

OPERATES IN THIS AREA MOST OF ALL	TYPE OF RADIO RECEIVER ON BOARD BOAT	SIZE OF BOAT MOST USED	
		UNDER 16 FT	OVER 16 FT
ALL AREAS COMBINED = 5th DISTRICT TOTAL	AM/FM + RDF	10.93	23.21
	NWS WEATHER	0.28	4.16
	AM RADIO/TEL	0.65	6.05
	VHF RADIO/TEL	0.67	4.64
	CITIZENS BAND	1.52	3.72
CHESAPEAKE BAY	AM/FM + RDF	17.56	32.80
	NWS WEATHER	1.51	10.94
	AM RADIO/TEL	2.77	12.12
	VHF RADIO/TEL	---	10.34
	CITIZENS BAND	1.28	3.71
OFFSHORE AREAS	AM/FM + RDF	10.71	24.70
	NWS WEATHER	0.92	4.75
	AM RADIO/TEL	---	10.62
	VHF RADIO/TEL	---	3.94
	CITIZENS BAND	---	12.77
RIVERS, LAKES, INLAND WATERS, ETC.	AM/FM + RDF	10.71	18.08
	NWS WEATHER	---	0.57
	AM RADIO/TEL	0.24	2.70
	VHF RADIO/TEL	0.58	1.86
	CITIZENS BAND	1.75	3.23

c. STEP 3 - The area covered in each zone is expressed as a percentage of the total area of that zone in the scenario.

d. STEP 4 - The percentage coverage areas for each zone are factored by the corresponding audience percentage figure for that zone.

e. STEP 5 - The resultant numbers are summed to provide an effectiveness number for that system in that scenario in terms of the percentage of boatmen served.

TABLE 3-30. DISTRIBUTION OF RADIO RECEIVERS AS A PERCENTAGE OF TOTAL BOATING POPULATION (SCENARIO AREA 2 - CHESAPEAKE BAY)

ZONE MILES FROM SHORE	COMMERCIAL BCST	RADIO RECEIVER TYPE			
		NWS 162.55 MHz	AM MARINE RADIO TEL	VHF MARINE RADIO TEL	CITIZENS BAND
0 - 1	9.02	2.08	2.54	1.66	0.87
2 - 5	12.35	3.89	4.37	3.60	1.36
6 - 10	4.47	1.40	1.57	1.29	0.49
11 - 25	2.46	0.82	0.91	0.78	0.28
25 +	0.09	0.02	0.03	0.02	0.01

3.6 SIMPLIFICATION OF THE MODEL

The structure of the model in zones 0 to 1 mile, 2 to 5 miles, etc., was predicated on the availability of data in this format, as described in Paragraph 3.4. Initial application of the model in this form to analyses in Scenario Area No. 2 revealed that its structure could be simplified by deleting the first zonal discrimination with only a small loss in accuracy. Both parametric analysis and checks on practical applications showed a change of less than 2 percent in computed effectiveness value when using the model in the form 0 to 5 miles, 6 to 10 miles, etc. These analyses are detailed in Appendix D.

The impact of this simplification is greater than is apparent at first sight, since it affects the measurement of coverage itself, and in fact reduces the work required during this phase of the analysis to about half of that required with the more complex model. Moreover, in several scenario areas this change permitted the use of a single, relatively small scale chart in place of several larger scale charts. The overall saving in time enabled a more thorough analysis of the areas measured and permitted a redistribution of the workload into other phases, resulting in an increase in overall accuracy of the analysis.

3.7 MODIFICATION OF THE MODEL

3.7.1 Validation of the Model

A comparison of the figures in the BSIS-developed distribution model (Table 3-28) with available data indicated that the model was in error in at least one segment, namely that relating to VHF marine radiotelephones. The weighted total for this type of equipment in the Chesapeake Bay area was 9374. Data from the Federal Communications Commission (FCC) files show a total of 2362 licenses issued for this class of radiotelephone in the states of Maryland and Virginia, and the District of Columbia. Even allowing for the use of a number of VHF monitors in this area, the figure is much too high.*

The distribution of receivers in zones 11 to 25 miles and more than 25 miles results directly from answers to the BSIS questionnaire. Since no areas of water are more than 10 miles

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*Subsequent reexamination of the raw data by the BSIS contractor has revealed a number of erroneous responses by people who had misunderstood the question. The corrected responses lead to a weighted total of 1839 licenses, a number clearly commensurate with existing FCC data.

from the nearest coastline in Chesapeake Bay, it must be assumed that respondents answering in these zones were giving the total distance sailed, not distance from shore.

These discrepancies were corrected by estimating VHF radiotelephone numbers from FCC data and compressing the model into the first three zones. The development of distribution data for the corrected model and for those used in other scenario areas is detailed in the following paragraphs.

3.7.2 Marine Radiotelephone Distribution

A computer printout of the number of licensed AM and VHF/FM radiotelephones, broken down by state and year of license expiration, was obtained through the cooperation of the FCC. These data were used to determine the total number of each type of radiotelephone for each of the states with which the study is concerned.

Using the breakdown of number of registered boats by state (1970 Boating Statistics Report) as a baseline, the total number of boats was projected as a function of the numbering requirements of each state. In states where numbering requirements were stringent, such as "All Motorboats" and "All Watercraft," the total number of boats was projected to be 133 percent of the numbered boats. In states where numbering requirements were less stringent, such as "Motorboats over 10 HP" and "Sailboats over 25 ft," the total number of boats was projected to be 166 percent of the numbered boats. These were the only two expansion factors used and while arbitrary, represent conservative estimates based on the data available concerning total number of registered boats in the U.S., and boating industry estimates of total number of boats. The evolution of the distribution percentages for each of the scenario areas is outlined in the following paragraphs.

Scenario Area No. 1

State	Numbering Requirements	Percent AM/2 MHz	Percent VHF/FM
New Jersey	All Motorboats	9.05	0.8
Delaware	All Motorboats	7.8	0.66
New York	All Motorboats	4.95	0.41

Boatmen in this area will be primarily N.J. based. Since the N.J. percentages are significantly higher than those of neighboring states they will be the controlling factor in the distribution. Applying the expansion factor of 133 percent to estimate the total boat population from the numbered boat population, the percentage of receivers in Scenario Area No. 1 are:

6.8 percent AM/2-MHz radiotelephones

0.6 percent VHF/FM radiotelephones.

Scenario Area No. 2

State	Numbering Requirements	Percent AM/2-MHz	Percent VHF/FM
Maryland	Motorboats >7.5 HP; Sailboats >25 ft	11.5	1.98
Virginia	Motorboats >10 HP	9.1	1.12
Delaware	All Motorboats	7.8	0.66

The same reasoning applied to Area No. 1 is applicable here, except that the states supplying the primary boating populations have less stringent numbering requirements. Hence, the expansion factor used to estimate the total boating population will be 166 percent. The percentages of receivers are:

6.9 percent AM/2-MHz radiotelephones

1.18 percent VHF/FM radiotelephones.

Scenario Area No. 3

State	Numbering Requirements	Percent AM/2-MHz	Percent VHF/FM
Florida	All Motorboats >10 HP	13.6	2.4

Due to the nature of this scenario area, the boating population is considered to be made up almost entirely of Florida based boats. An expansion factor of 166 percent is used to determine the receiver distribution:

8.15 percent AM/2-MHz radiotelephones

1.45 percent VHF/FM radiotelephones.

Scenario Area No. 4

State	Numbering Requirements	Percent AM/2-MHz	Percent VHF/FM
Texas	Motorboats >10 HP and all boats >14 ft	2.6	0.43

Again, Texas-based boats are considered to be the vast majority of the boating population in this area. Due to numbering requirements that would tend to include a considerable portion of all boats, an expansion factor of 133 percent was used to determine receiver distribution:

1.95 percent AM/2-MHz radiotelephones

0.32 percent VHF/FM radiotelephones.

Scenario Area No. 5

State	Numbering Requirements	Percent AM/2-MHz	Percent VHF/FM
Washington	Motorboats >10 HP	13.5	5.4
Oregon	Motorboats >3.5 HP, Sailboats >12 ft	4.17	0.56

Since the scenario area covers the coasts of both states, neither state can be considered a primary contributor to the total population. Further, the receiver percentages of each state are widely divergent. In this case, the most reasonable approach to characterizing the boat population was to consider that each has nearly the same amount of numbered boats and to average the percentages. Since it is unlikely that boats with the characteristics of those not covered in either numbering system would be active in the rough coastal waters, the smaller expansion factor of 133 percent was considered most appropriate. The receiver distributions were:

7.1 percent AM/2-MHz radiotelephone

1.7 percent VHF/FM radiotelephone.

Scenario Area No. 6

Due to the fact that this scenario area encompassed three of the Great Lakes and draws its boating population from six different states, in various proportions, the straightforward approach used in the other scenario areas was not possible. To generate a distribution applicable to the entire area, the following approach was adopted.

First, a distribution was determined for each - Lake Michigan, Lake Huron, and Lake Erie. The same base data was used as in the previous cases, but modified as follows:

For Lake Michigan: The receiver percentages of Wisconsin, Illinois, Indiana, and Michigan were weighted according to each state's population contribution. The weighted percentages were summed and determined to be:

1.31 percent AM/2-MHz radiotelephones

0.22 percent VHF/FM radiotelephones.

For Lake Huron: The receiver percentages were taken to be those of the state of Michigan, since this state would provide the major contribution to the boating population of Lake Huron. The percentages for Lake Huron were:

2.04 percent AM/2-MHz radiotelephones

0.27 percent VHF/FM radiotelephones.

For Lake Erie: The boating population here would be drawn primarily from the states of Michigan, Ohio, and Pennsylvania. The receiver percentages for each of these states were weighted according to each state's contribution to the total boat population. The weighted percentages were summed and determined to be:

3.36 percent AM/2-MHz radiotelephones

0.37 percent VHF/FM radiotelephones.

To develop a distribution for the entire scenario area, the percentages for each of the Lakes were weighted as a function of each lake's area to the total scenario area. A distribution for the whole of the area was thus determined to be:

2.2 percent AM/2-MHz radiotelephones

0.25 percent VHF/FM radiotelephones.

The percentages for each state were expanded by 133 percent to arrive at the total boat population as a function of the numbered boat population.

3.7.3 NWS Receiver Distribution

It has been estimated that 2-1/2 million receivers capable of using the 162.55-MHz transmissions are in circulation (Item 14, Appendix C). Surveys made by NWS personnel have led to the conclusion that the use of these receivers for general weather information and for specific marine weather information is in the ratio 3:1. Accepting the Boating Industry Association's estimate of approximately 8-1/2 million boats on U.S. waters, it may be concluded that 7.5 percent of all boatmen use NWS receivers. This figure is established merely as a guideline for estimates made in each scenario area.

Data obtained by CSC during the course of the study was examined to establish estimated ownership and/or use of this type of receiver in each area. By weighting the response in accordance with the corresponding sample size involved, the following estimates were derived:

Scenario Area	NWS Receivers (%)
New Jersey Coast	9
Chesapeake Bay	8
Florida Coast	2
Gulf Coast	7
North Pacific Coast	2.5
Great Lakes Region	6

The figures shown above for NWS receivers, and those given in Paragraph 3.7.2 for radiotelephone equipment, were used in conjunction with boat distribution figures derived from Coast Guard and state data to modify the original receiver distribution model for each of the scenario areas. The resulting models are listed in Section 8, Analysis Results.

SECTION 4

SYSTEM SCHEDULE EFFECT

4.1 INTRODUCTION

The effect of a system's broadcast schedule on its accessibility cannot be ignored, for clearly a system broadcasting continuously is necessarily more accessible than one making only two or three short broadcasts each day.

However, to objectively measure the change in effectiveness due to schedule it is necessary to construct a model that embodies all the relevant aspects of schedule, retains sufficient simplicity to be applicable to a broad range of systems and which, when applied, results in a meaningful, proportionate change in the assessed effectiveness value.

In developing such a model, many alternatives were conceived, examined, and rejected before a satisfactory scheme was selected. The validity of the chosen model can best be demonstrated by examining this selection process.

4.2 DEVELOPMENT OF SCHEDULE MODEL

Suppose a system under analysis has a regular broadcast schedule, as shown in Figure 4-1.

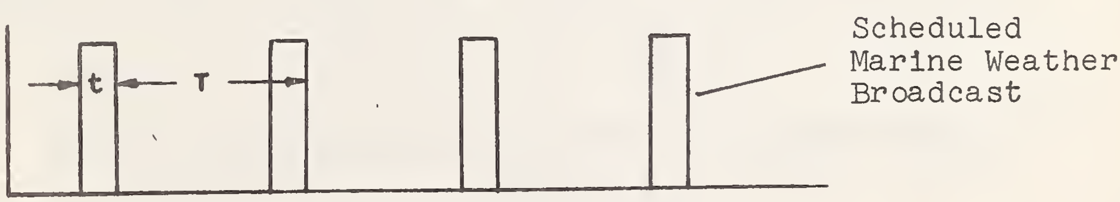

Figure 4-1. Regular Broadcast Schedule

The accessibility of this system in terms of coverage and audience must be weighted by some factor that reflects the probability that the user will intercept a marine weather broadcast at any arbitrarily selected time.

For comparative purposes, it would be valid to define this factor as t/T, the probability of instantaneous access at any time. However, the absolute value of accessibility thus obtained would be less than realistic, since the user will normally attempt to access the system over some finite time period, as shown in Figure 4-2.

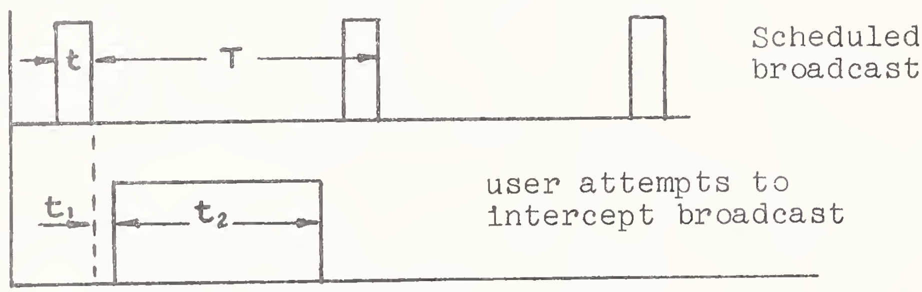

Figure 4-2. User Attempt to Access Broadcast

Here the user switches on his receiver t_1 minutes after the end of the last scheduled marine weather broadcast (MWB), and monitors the station (or frequency) for t_2 minutes. Now the probability that he will intercept a portion of a MWB is given by

$$P[t_1 > (T - t - t_2)]$$

If t_1 is assumed to be uniformly distributed in 0, T;

$$p(t_1) = \frac{1}{T},\ 0 < t_1 < T,$$

otherwise zero;

Then $$P[t_1 > (T - t - t_2)] = P_A = \frac{T - (T - t - t_2)}{T}$$

$$P_A = \frac{t + t_2}{T}$$

Although at first glance this seems to be a valid workable model, closer examination reveals two objections, one on the grounds of validity and the other in terms of applicability.

Its validity is suspect because it assumes that an interception of the MWB at any time during its transmission constitutes a successful access. Since the information content of the message is discretely distributed throughout its duration, access during transmission does not assure retrieval of that information in full. Indeed, since it is common practice in MWBs to give the important information first (for example, the area to which the broadcast pertains), access at any time after initiation may yield no useful information whatever.

Admittedly, many MWBs contain forecasts for several different areas which are transmitted sequentially, so it is possible for a user to access the MWB part way through and still be in time to hear the forecast for his area. It is feasible to model this probability, but such an exercise would considerably complicate the model with little gain in overall accuracy. Since the chosen model will be applied uniformly to all systems, the small differences in relative weighting thus realized are unlikely to justify the greatly increased effort required.

Instead, it was decided to apply as a criterion the requirement that each MWB be intercepted at its initiation. This is represented schematically in Figure 4-3. As shown, the user fails to access a broadcast since the transmission is not initiated during his "listening period," t_2. Applying a similar analysis to that used previously, it may be shown that

$$\text{Probability of Access, PA} = \frac{t_2}{T}$$

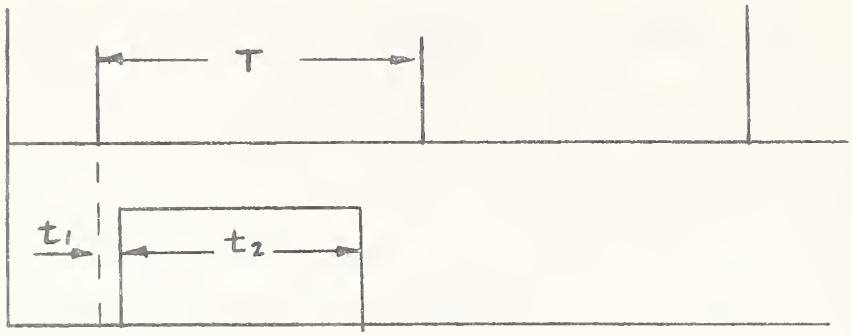

Figure 4-3. Model of Requirement for MWB Interception at Initiation

A second objection, which applies to this and the preceding model, is that it deals only with a system that has a regular (repetitive) broadcast schedule. This is not always the case, particularly when considering the commercial broadcast systems. To extend the applicability of the model while retaining its inherent simplicity, it is possible to closely approximate the user's probability of accessing one in a series of randomly scheduled broadcasts during a given time period, as described in the following paragraphs.

Suppose that during a known period of time a system transmits n MWBs. Immediately preceding each broadcast there is a period t_2 (the user's listening period) during which access may be attempted and be successful. The sum of such periods is nt_2, since t_2 is regarded as constant. If the total period considered is denoted by T_T, then the probability that the user will access a broadcast is given approximately by

$$\text{Probability of access, } P_A = \frac{nt_2}{T_T}$$

provided that t_2 is small compared to T_T.

To illustrate the application of the model, consider the performance of a system during the period 10:00 a.m. to 2:00 p.m., a total of 240 minutes. Assume that during this period the system broadcasts a total of six MWBs on a random schedule. Assume further that a user attempting to access this system will wait 5 minutes after switching on his receiver before becoming discouraged and switching off (i.e., $t_2 = 5$).

Then the probability that the user will intercept a broadcast is

$$P_A = \frac{nt_2}{T_T} = \frac{6 \times 5}{240} = \frac{1}{8}$$

If the system in question broadcasts marine weather information continuously, the same methodology may be applied by dividing the total period, T_T, by the repeat time of the broadcast, thus yielding the number of effective, complete broadcasts made in that period. If the repeat time or message length is equal to or less than the user's listening time, t_2, his probability of access will obviously be 100 percent. However, even for continuous systems with repeat times longer than t_2, and for ones in which the marine forecast is only a segment of the total message (such as the National Weather Service transmissions on 162.55 and 162.40 MHz), the probability of access should be regarded as 100 percent since the user will be motivated to "stay on the line" until the pertinent broadcast is given.

The model as developed still exhibits some objectionable aspects; it is necessary to select a value for the user's listening period (t_2), and the model does not account for any pre-knowledge of the system's schedule on the part of the user. However, for comparative purposes the absolute value of t_2 is not critical, since it produces a proportionate weighting factor, and the latter problem falls outside the realm of objective evaluation and must therefore be ignored in this analysis.

4.3 Application to Asynchronous Multi-Schedule Systems

In its developed form, the model described yields a weighting factor that is applied to a previously determined effectiveness value equal to COVERAGE X AUDIENCE. Such application is possible only to systems operating in a coordinated manner; i.e., broadcasting on a similar (though not necessarily regular) schedule from a number of stations. Where the elements of a system are not operating cooperatively, each element (or station) may be broadcasting on a different schedule. This is indeed the case for the commercial broadcast system.

The result of this type of operation is represented schematically in Figure 4-4, where two stations overlap in coverage as shown.

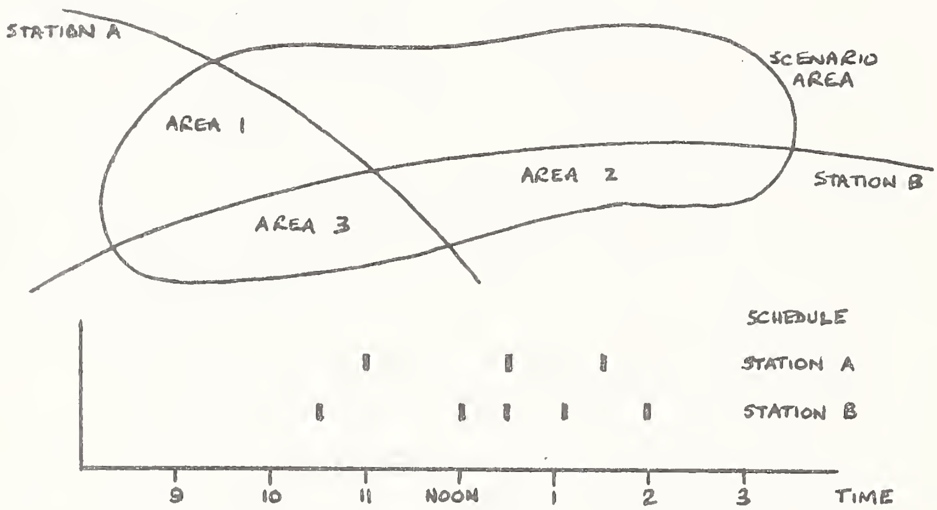

Figure 4-4. Two Overlapping Stations

In area 1, covered by Station A, there are three MWBs during the period 10:00 a.m. to 2:00 p.m., while Station B provides five transmissions to users in area 2 during the same period. Area 3, however, receives 7 MWBs (the two coincident broadcasts at 12:30 p.m. are counted as one), so each area yields a different schedule weighting factor as defined in the foregoing analysis.

In measuring the effectiveness of such systems, therefore, it is necessary to measure individual areas of overlap and determine which stations serve each area. The appropriate schedule weighting factor must then be applied to each area and the results totaled over the scenario before the effect of audience is introduced.

When it is considered that in a practical example as many as five stations may overlap, and that each area of overlap must be broken down into zones of user distribution density, it may be appreciated that the simplicity of the model selected to determine schedule weighting factor contributes essentially to the feasibility of its application.

SECTION 5

TIMELINESS

5.1 INTRODUCTION

The critical performance factor of a weather dissemination system in an emergency situation is its ability to respond quickly enough to provide the user with a timely warning; one which gives him enough time to take appropriate action to protect himself. To measure this capability, it is necessary to identify the various time elements involved in a typical emergency warning situation.

5.2 DEVELOPMENT OF THE MODEL

The system and its interfaces are all involved in response to an emergency situation. Correspondingly, there are three time elements involved:

a. Weather development time, T_{WD}

b. System reaction time, T_{SR}

c. User to safety time, T_{US}

A system is capable of providing timely warnings if $T_{WD} - T_{SR} > T_{US}$. This is illustrated in Figure 5-1.

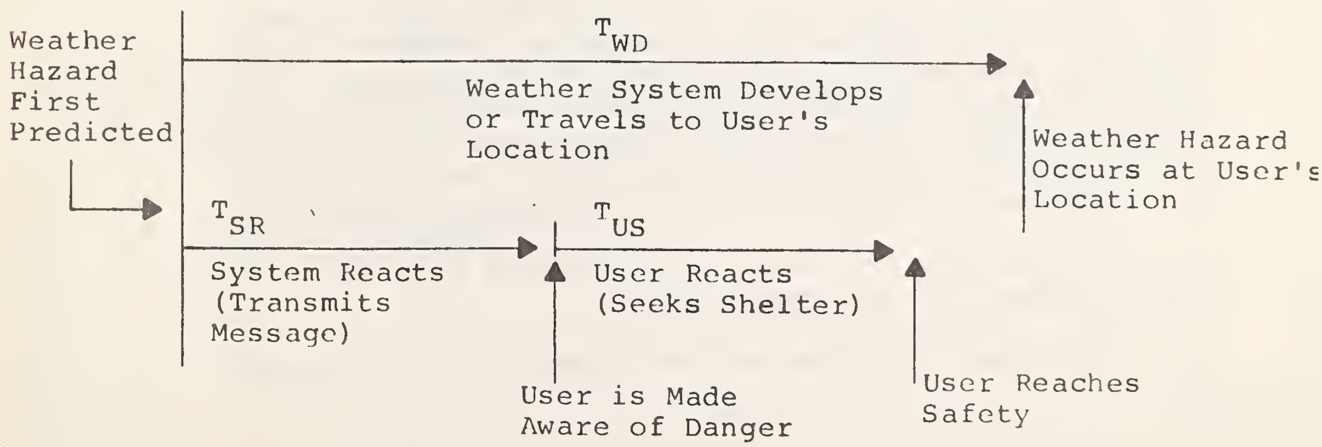

Figure 5-1. Relationship of Time Elements

These time elements, of course, are not consistent. They vary greatly in any given situation. Weather development times are dependent on the type of weather phenomenon, and user-to-safety time will be influenced by the user's distance from shore, boat size and power, sea and wind conditions and boat loading.

In an attempt to quantify these parameters, the development of a model relating these time elements to the probability of their occurrence (as shown in Figure 5-2) was considered. Such a model would permit the establishment of the probability of a failure to provide timely service by comparing the response time of the service to the curve in Figure 5-2 and determining the percentage of time that T_{SR} exceeds $(T_{WD} - T_{US})$.

5.3 WEATHER DATA

In response to a request from CSC, the NWS solicited information on weather development times from the directors of its Eastern, Southern, Central, Western, and Pacific Regions.

The request was phrased as follows:

> An attempt is being made by the study team to determine the time frame involved in recognition of a weather factor requiring issuance of a warning. This is a difficult problem. The time may vary widely according to geographic location and/or type of phenomena.
>
> For example, there may only be one-half hour to one hour from the time a fast developing thunderstorm is detected on the radar screen until it creates hazardous conditions on Chesapeake Bay. On the other hand, a number of hours may elapse between recognition of a threat to the Florida Coast by a hurricane, and the occurrence of high winds and waves on the coast.
>
> Any information you have or can obtain bearing on the above items will be appreciated.

The following response was received from the Eastern Region:

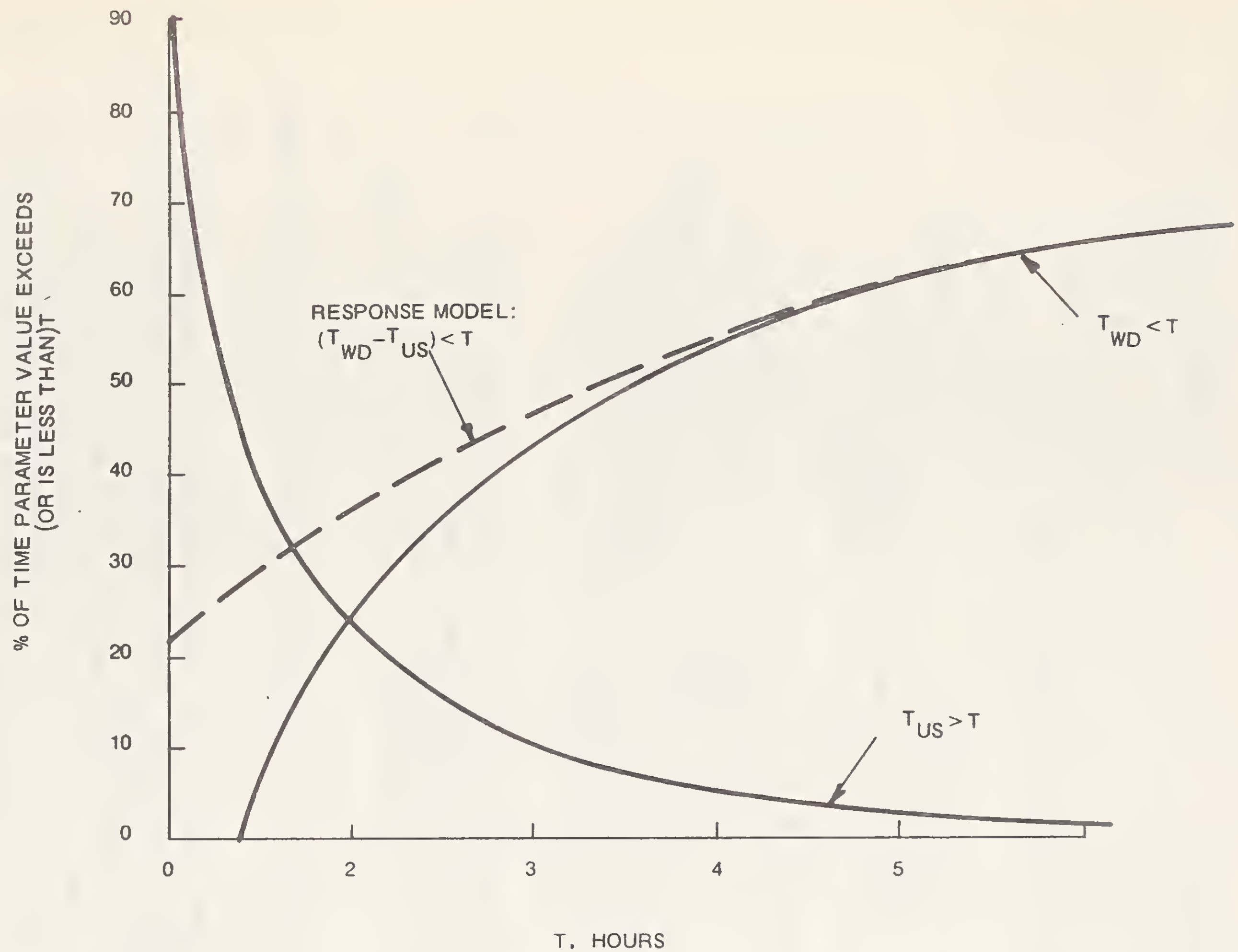

Figure 5-2. Characteristic Response Time Model

Reaction times to warning situations vary considerably as expected. In the Great Lakes, on Lake Erie, the following was indicated:

Phenomena	Reaction Time
Rough seas	0 - 6 hours
High winds	0 - 12 hours
Squall lines	0 - 1 hour
Severe weather (thunderstorms/ tornadoes)	0 - 1 hour
Surge	2 - 12 hours

Except for surges, these warnings are normally confined to the small boating season; high wind warnings (gale and storm) are year-round.

In the New England area, warnings for rough inlet conditions vary from immediate to 24 hours for well predicted large scale phenomena. Lead times vary from 0 - 2 hours for harbor warnings associated with summer thunder squalls to 18 hours or more for the offshore fishing fleet in advance of northwesterly gales (approximately 18 hours are required for a small trawler to reach safe harbor from the offshore grounds).

In both Chesapeake Bay and the more southern waters from Virginia to the Carolinas reaction times to squall lines and thunderstorms range from 0 - 2 hours. Larger scale phenomena have a lead time of six or more hours.

The Southern Region recognized the problem, but was unable to provide any data:

> You have stated very well the problems of determining the time frame involved in recognition of a weather factor requiring issuance of a warning. Besides depending on the type of weather factor, recognition and warning time will also be directly related to detection capability. This detection might be by radar but likely more often from storm spotters or other reports of visual sightings.
>
> We look forward to seeing the findings and recommendations of this important study.

No specific response was received from the other regions, although the Western Region provided a Sea State and Surf Forecaster's Manual (Reference 13).

CSC talked to 31 marine electronics supply organizations, seeking data on receiver distribution, and also asked for opinions on typical weather warning times in each of the scenario areas. Replies from different sources within the same area agreed. The responses are shown below:

Scenario Area		Weather Warning Time
No. 1	New Jersey Coast	About 1/2 hour
No. 2	Chesapeake Bay	About 1 hour
No. 3	Florida Coast	About 1/2 to 3/4 hour
No. 4	Gulf Coast	About 3 hours
No. 5	North Pacific Coast	1 to 1-1/2 hours for storms, but problem is fog which can occur within 1/2 hour.
No. 6	Great Lakes Region	About 1/4 hour, but storms have developed with only 3 to 5 minutes' warning

It is not possible to generate a probability curve for T_{WD} as shown in Figure 5-2 from those data. To develop such a model, it would be necessary to organize a massive statistical analysis of NWS records for each of the areas to be studied. Discussions with NOAA personnel indicate that the cost and time required for such an analysis prohibit its development within this study.

5.4 CONCLUSIONS

Since the T_{WD} curve was not developed, it was considered that the generation of a similar T_{US} curve was not justified. However, examination of available weather and boat distribution data indicates that there are always a certain number of boatmen whose distance from shore precludes their reaching safety within the warning period for sudden weather phenomena. This means that, even for a system with no delay in response to receipt of weather information ($T_{SR} = 0$), there will always be a percentage of boatmen who will not receive "timely" warnings.

It is concluded that an objective evaluation of the responsiveness of MWD systems along the lines proposed is not feasible with the data available, and that the relevance of a quantitative measure of timeliness is questionable. Consequently, no quantitative analysis was performed during this phase of the study. The collated data will be used to provide support for the analyses in Phase 3, during which the role of MWD's in a preferred mode will be studied.

SECTION 6

NONBROADCAST SYSTEMS

6.1 INTRODUCTION

Weather dissemination systems operating in the radio-broadcast mode can provide information and alert warnings to boatmen on the water. The utility of the visual display systems and telephone weather systems in this role is obviously limited, and the systems are used mainly for preexcursion information. For the purposes of this study, they have been classed as nonbroadcast systems and are treated separately from the coastal broadcast systems.

6.2 COASTAL WARNING DISPLAY SYSTEM

The Coastal Warning Display System, operated under the authority of the National Weather Service (NWS) of NOAA, uses a system of pennants and lights to denote the existence of local conditions meeting certain criteria and to warn boatmen of the associated hazards. The system provided the prime means of weather information dissemination prior to the availability of other means of communication, and less reliance is placed on this system as alternate methods become more prevalent. This fact is recognized by the NWS (Reference 13), but the decision to continue the service was made based on the growing numbers of small boatmen not equipped with communications gear.

The display stations are most often located at river and harbor mouths, often at marina and yacht club facilities, and sometimes at Coast Guard stations. Their primary function is to warn boatmen departing for an outing of prevailing and predicted weather conditions. The degree of effectiveness of these display systems is limited by their location and visibility. Conservative procedures employed in their operation may also reduce effectiveness. Evidence suggests that warnings displayed prior to an expected storm which fails to develop cause loss of faith in the system by less experienced boatmen.

In terms of information content the display system is the least valuable, for the whole message or warning is effectively compressed into a single word or symbol. Since the number of symbols (four combinations of two symbols are actually used) is limited to avoid confusion, each symbol or combination must denote a wide portion of the spectrum of possible situations to be signalled. This reduces utility by limiting the user's ability to interpret the warning into a meaningful hazard level for himself and by limiting the information on the time scale of the predicted phenomenon.

The only objective measure of effectiveness which can be made is the number of users having access to the system, since the other aspects are not quantifiable. To make such a measurement, it would be necessary to collate data giving the total number of boats in a given scenario moored and/or launched within areas exposed to a display sight. If it is assumed that all boatmen within the display site area would be made aware of a warning, then it would be possible to compute a first level effectiveness value as the percentage of those users within that scenario. It is possible that such data might be collated for a number of small, carefully selected zones by survey and observation. It is not possible to deduce these numbers from registration data, since they do not provide a sufficiently precise location. The performance of this type of analysis is beyond the scope of this study and was not attempted.

Such an evaluation of effectiveness, were it to be performed, would be a measure of the system's capability to provide preexcursion warnings. To compare this sytem to the broadcast-mode systems a different evaluation is required. Although not intended for use as a broadcast system, the Coastal Warning Display System has many stations that are visible from a major body of water. By determining the number of stations visible in a scenario area, and by assigning a range and arc of visibility in a general manner, it is possible to compute the total area within a scenario from which such stations are visible. When this area is combined with appropriate audience density figures, it is possible to provide an "accessibility at sea" figure which may be compared to the effectiveness figures for other broadcast systems.

Discussions with experienced boatmen led to the establishment of a range of about 1 mile for visibility of the display pennants during daylight. Although one boatman claimed to be able to see displays at 2 to 2-1/2 miles in good visibility, he stressed that it was necessary to know where the station was located and to look for the display deliberately. The 1-mile figure is based on the concept of adequate visibility to an average boatman having no knowledge of the location of the display site. Since it was not possible in the time available to determine the actual arc of visibility of each station, it was decided to assign 180° as a general figure. On an average basis, this figure is clearly the most likely one.

The area of visibility of each station is computed therefore as a semicircle of 1-mile radius. The total number of such areas is computed and shown as a percentage of zonal area in each scenario in Section 8.

6.3 TELEPHONE SYSTEMS

Unlike the visual display system, the organization of telephone-access weather reports does not lend itself to any type of broadcast analysis, even as a secondary measure. The service is operated by the NWS and by local telephone companies. Nine offices operated by the NWS (one of them seasonal) provide marine weather information exclusively:

a.	Baltimore, Maryland	- Number of Lines	4
b.	Washington, D. C.		5
c.	Juneau, Alaska		1

d.	Seattle, Washington	- Number of Lines	1
e.	Port Arthur, Texas		1
f.	Los Angeles, California		1
g.	Boston, Massachusetts		2
h.	Providence, Rhode Island (seasonal)		1
i.	Honolulu, Hawaii		1

The 26 other offices giving weather information by phone contain a marine weather segment. The Bell System maintains offices in many large cities, but none of these provides weather information specifically for the marine user.

Assessment of the effectiveness of these systems is complicated by the procedures employed in ensuring adequate service. The number of calls placed with "weather" offices is not measured, but the number of "trunk overflows" from originating offices to satellite offices is monitored. When this number indicates that the service probability is below 99 percent, extra lines are added to the system.

SECTION 7

OFFSHORE AND HIGH-SEAS SYSTEMS

7.1 INTRODUCTION

The requirements of users in offshore and the high seas are considerably different from those of the coastal user. In general, accessibility is high for systems serving these areas; coverage is adequate; and most users are equipped to utilize one or more of the available systems for weather dissemination. The effectiveness of such systems must be based on criteria quite different from those pertaining to coastal dissemination systems. These criteria are discussed in the following paragraphs.

7.2 EFFECTIVENESS CRITERIA

Offshore and high-seas weather is as important to vessels in these areas as it is to smaller craft in coastal waters. However, the weight or significance of some items differs in terms of impact or timing. In offshore or high-seas navigation, a greater geographical area and the probable forecasts for a greater span of time are of particular interest to avoid surprise. The operational phases in which weather information is essential may be grouped into four general categories:

a. Departure and Route Planning

b. Daily Routine for Fair Weather

c. Foul Weather Procedures

d. Sea Approaches to Harbors or Straits

The specific interest in various reported items is summarized in later paragraphs. The weather elements of interest are:

a. Wind, precipitation, visibility, and trends

b. Storm centers, and fronts (location, movement, wind velocity, and depth in miles)

c. Sea (wave) heights, directions, and the period in which the wave conditions have developed

d. Floating ice location and subfreezing conditions

e. Cloud cover probability

f. Ocean current (stream) changes, and temperature gradient

g. Any unusual weather phenomena

The elements by which dissemination of reports may be judged are considered to be:

a. Timeliness in permitting appropriate decisions

b. Coverage of the area of interest or impact

c. Accuracy of the report and forecast

d. Reliability of receipt - report and dissemination schedule, perishability of information, and probability of favorable reception

e. Clarity of information provided

f. Frequency of reports

7.3 OFFSHORE AND HIGH-SEAS APPLICATION

The differences in application of offshore or high-seas weather information may be illustrated by a review of typical operational decisions. Upon departure, the most economical route is planned commensurate with any risks that may be involved. Weather over the entire track, plus that capable of moving into the area, is examined. The probability of cloud cover as it affects navigation over the route is evaluated, and the route is modified to insure safe clearances. Winter ice locations, if appropriate, are reviewed. The presence of storm centers and wave conditions would influence the ship's trim; ballast plan; and labor expended topside on cargo tackle, boats, and lashings.

Thereafter, the daily condition, watch, day's run, and night steaming condition would be reviewed as routine weather reports indicate. Deck maintenance or engine room tasks may be planned for the next day. Weather information may be sufficient during fair conditions every 12 hours.

If deteriorating weather or seas are forecast, additional emphasis is placed upon present and predicted weather. The approach of storm centers becomes significant in shipboard preparations, securings, course and speed, and personnel safety measures. All previously mentioned weather elements are of interest, but additional items are significant. For example, what is the magnitude of winds expected, and how long may they be experienced? How deep is the front, and how long will it be affecting wave heights? Weather reports and forecasts are desired more frequently in judging improvement or additional steps.

With approaches to the coast, islands, or straits, the frequency of weather review is increased, and becomes more oriented to regional reports. There is increased interest in visibility, both surface and cloud cover. Since cloud cover would affect navigational sights, additional precautions are required if the ship's navigation is confined to dead-reckoning or electronic aids.

Passage through constricted waters; e.g., Bahamas, Florida Straits, or Mona Passage, would not be initiated without a weather evaluation. As port is approached, deck preparations for cargo handling and docking would be delayed if weather were unknown.

7.4 DISSEMINATION RESPONSIVENESS

The criteria for effectiveness of weather dissemination must judge how well the response meets the requirements within some defined acceptance of cost-effectiveness. This must be considered for an overall system including schedule of data collection, data reduction and evaluation, forecast preparation, forwarding to dissemination means, and transmission delays to the final user aboard ship. The general constraints which serve as a boundary in collecting and processing are the rates at which changes in weather become significant, and the extent to which reporting is feasible and/or economically sound. The dissemination of the processed report may be further evaluated in terms of understandable information provided (frequency, format, items covered, clarity) and effectiveness of the transmission media in relaying it to the user. The evaluation of the transmission media must consider the primary coverage and means, the marine mobile's ability to receive it, and the possibilities for alternate routing if the first broadcast is missed or garbled.

7.5 EVALUATION OF THE SYSTEMS

The criteria established for effectiveness assessment do not permit the application of the methodologies developed for coastal systems. Indeed, the effectiveness at levels 1 and 2 is seen to be high for systems serving the offshore and high-seas user. Performance parameters requiring study fall into the area of system growth and economics, intersystem capabilities, and information content and format.

In general, users in these areas indicate a need for more detailed weather information or more frequent updates. Techniques for improving service at this level must necessarily include an examination of advanced communications media, such as teletype and facsimile devices. The growth in use of these media will be predicated not only on their use in weather data reception but also on changing requirements in maritime communications and data processing in general. These factors will be examined during the third phase of this study to form the basis upon which recommendations for change in service are made.

SECTION 8

ANALYSIS RESULTS

8.1 COVERAGE

The results of coverage measurements in each scenario area are presented numerically in Tables 8-1 through 8-6. Coast Guard VHF coverage and National Weather Service (NWS) coverage are graphically presented in Figures 8-1 through 8-11. It will be noted that there is no coverage provided by the NWS system in scenario area 5.

Areas of coverage expressed as a percentage of total scenario areas are given similarly for each scenario in Tables 8-7 through 8-12.

8.2 AUDIENCE

The models developed in Section 3 to represent the distribution of radio receivers in each scenario area are presented in Table 8-13. Only four types of receivers are considered:

a. Marine VHF radiotelephones, served by both Coast Guard VHF-FM stations and Public Coast Class III-B stations.

b. Marine AM radiotelephones, served by both Coast Guard 2-MHz stations and Public Coast Class II-B stations.

c. Fixed crystal-tuned or tunable receivers of average quality, served by the National Weather Service broadcasts at 162.55 MHz.

d. Commercial broadcast band receivers of average quality, tunable in the AM band, FM band, or both.

The models presented were developed in accordance with the procedures defined in Paragraph 3.7.

8.3 SCHEDULE

Figures 8-12 through 8-23 present data on scheduled marine broadcasts made by Commercial, Public Coast and Coast Guard stations in each of the scenario areas. National Weather Service schedules are not presented since this service operates continuously.

To derive schedule weighting factors from these charts, a scenario period of operation was selected-from 10:00 a.m. to 6:00 p.m., to coincide with the normal peak boating activity period. A user listening time (t_2, as defined in Paragraph 4.2) was chosen as 5 minutes. The schedule weighting factor is therefore computed as follows:

$$F_s = \frac{nt_2}{T_T} = \frac{n.5}{480} = \frac{n}{96}$$

where n = number of non-simultaneous broadcasts in the period T_T, 1000 to 1800 hours.

Schedule factors derived in this manner are applied uniformly to the coverage x audience figures presented in the final tables, except in the case of commercial coverage in Scenario Areas 2 and 3. Because of the diversity of service in these areas and the considerable overlap in coverage from several stations, the results are presented in greater detail.

Table 8-14 presents the measurements made in Scenario Area 2, while those for Scenario Area 3 are given in Tables 8-15 and 8-16. Figures 8-24 and 8-25 show the manner in which the service areas are related.

8.4 SUMMARY OF RESULTS

The results of all the analyses are summarized in Tables 8-17 through 8-24; the results for each system are grouped in a single table showing three levels of effectiveness in six scenario areas. The figures presented are discussed in Section 9, Conclusions.

TABLE 8-1. SCENARIO AREA MEASUREMENTS - AREA NUMBER 1: NEW JERSEY COAST
ALL AREAS IN ACTUAL MEASURED SQUARE INCHES

Chart Scale - 1:80,000

SYSTEM DESCRIPTION	TOTAL AREA	ZONE 1 INLAND	ZONE 2 0 to 5 MILES	ZONE 3 6 to 10 MILES	ZONE 4 11 to 25 MILES
Scenario Total Areas	2077.91	157.11	384.9	383.7	1152.2
National Weather Service 162.55 MHz	165.3	21.3	56	48	40
Coast Guard VHF-FM	1616.31	157.11	384	383.7	691.2
Public Coast Stations (VHF-FM)	1244.11	131.11	309	304	500
Commercial BCST (All Stations)	1416.31	133.11	315	315	651.2
Commercial BCST (Direct Marine Broadcast Stations)	926.99	125.50	166.25	159.81	475.43
Commercial BCST Above: Schedule Factored	17.35	1.87	3.20	3.09	9.19
Visual Warning Displays	14.94	--	--	--	--
Coast Guard 2 MHz	2077.91	157.11	384.9	383.7	1152.2
Public Coast Stations - 2 MHz	2077.91	157.11	384.9	383.7	1152.2
Scenario Areas in Square Miles (1 sq in = 1.595 sq mi)	3314	251	614	612	1838

TABLE 8-2. SCENARIO AREA MEASUREMENTS - AREA NUMBER 2: CHESAPEAKE BAY ALL AREAS IN ACTUAL MEASURED SQUARE INCHES

Chart Scale - 1: 200,000

SYSTEM DESCRIPTION	TOTAL AREA	ZONE 1 0 to 1 MILE	ZONE 2 2 to 5 MILES	ZONE 3 6 to 10 MILES	ZONE 4 11 to 25 MILES
Scenario Total Areas	308.21	108.18	137	63.03	--
National Weather Service 162.55 MHz	25.83	13.87	11.75	.09	--
Coast Guard VHF-FM	233.98	82.27	110.48	40.06	--
Public Coast Stations	252.34	86.06	112.02	50.86	--
Commercial BCST (All Stations)	308.21	108.18	137	63.03	--
Commercial BCST (Direct Marine Broadcast Stations)	175.65	62.48	84.96	28.21	--
Commercial BCST Above: Schedule Factored	12.09	3.99	5.77	2.33	--
Visual Warning Displays	2.38	--	--	--	--
Coast Guard 2 MHz	308.21	108.18	137	63.03	--
Public Coast Stations - 2 MHz	308.21	108.18	137	63.03	--
Scenario Areas in Square Miles (1 sq in = 9.964 sq mi)	3071	1078	1365	628	--

TABLE 8-3. SCENARIO AREA MEASUREMENTS - AREA NUMBER 3: FLORIDA COAST
ALL AREAS IN ACTUAL MEASURED SQUARE INCHES

Chart Scale - 1:80,000
(Normalized)

SYSTEM DESCRIPTION	TOTAL AREA	ZONE 1 0 to 5 MILES	ZONE 2 5 to 10 MILES	ZONE 3 10 to 25 MILES	ZONE 4 BIMINI RUN
Scenario Total Areas	7693.27	1846.12	1620.23	4024.86	201.96
National Weather Service 162.55 MHz	484.96	253.40	131.60	99.96	--
Coast Guard VHF-FM	2847.11	530.99	724.70	1570.90	20.52
Public Coast Stations	5135.15	1175.55	1188.42	2771.18	--
Commercial BCST (All Stations)	7550.13	1846.12	1620.23	3881.82	201.96
Commercial BCST (Direct Marine Broadcast Stations)	5719.79	1846.12	1620.23	2072.84	180.60
Commercial BCST Above: Schedule Factored	92.82	31.06	25.32	34.15	2.29
Visual Warning Displays	42.6	--	--	--	--
Coast Guard 2 MHz	7693.27	1846.12	1620.23	4024.86	201.96
Public Coast Stations - 2 MHz	7693.27	1846.12	1620.23	4024.86	201.96
Scenario Areas in Square Miles (1 sq in = 1.595 sq mi)	12262	2950	2570	6420	322

TABLE 8-4. SCENARIO AREA MEASUREMENTS - AREA NUMBER 4: GULF COAST
ALL AREAS IN ACTUAL MEASURED SQUARE INCHES

Chart Scale - 1:460,732

SYSTEM DESCRIPTION	TOTAL AREA	ZONE 1 INLAND	ZONE 2 0 to 5 MILES	ZONE 3 6 to 10 MILES	ZONE 4 11 to 25 MILES
Scenario Total Areas	180.81	27.16	25.20	25.20	103.25
National Weather Service 162.55 MHz	8.32	5.18	2.41	.73	--
Coast Guard VHF-FM	81.64	18.73	20.53	20.37	22.01
Public Coast Stations	82.23	22.10	22.06	20.36	17.71
Commercial BCST (All Stations)	126.79	25.01	21.30	18.83	61.65
Commercial BCST (Direct Marine Broadcast Stations)	11.82	4.44	3.42	2.73	1.23
Commercial BCST Above: Schedule Factored	0.246	0.092	0.071	0.057	0.025
Visual Warning Displays	0.32	--	--	--	--
Coast Guard 2 MHz	180.81	27.16	25.20	25.20	103.25
Public Coast Stations - 2 MHz	180.81	27.16	25.20	25.20	103.25
Scenario Areas in Square Miles (1 sq in = 52.876 sq mi)	9560	1436	1332	1332	3459

TABLE 8-5. SCENARIO AREA MEASUREMENTS - AREA NUMBER 5: NORTH PACIFIC COAST ALL AREAS IN ACTUAL MEASURED SQUARE INCHES

Chart Scale 1:200,000

SYSTEM DESCRIPTION	TOTAL AREA	ZONE 1 0 to 5 MILES	ZONE 2 5 to 20 MILES	ZONE 3 10 to 25 MILES	ZONE 4 --
Scenario Total Areas	542.1	129.5	104.5	308.1	--
National Weather Service 162.55 MHz	--	--	--	--	--
Coast Guard VHF-FM	506.65	129.5	104.5	272.65	--
Public Coast Stations	269.6	78.5	53.4	138.2	--
Commercial BCST (All Stations)	471.35	127.75	94.5	249.10	--
Commercial BCST (Direct Marine Broadcast Stations)	156.62	59.65	33.28	63.69	--
Commercial BCST Above: Schedule Factored	2.34	0.89	0.52	0.93	--
Visual Warning Displays	2.34	--	--	--	--
Coast Guard 2 MHz	542.1	129.5	104.5	308.1	--
Public Coast Stations - 2 MHz	542.1	129.5	104.5	308.1	--
Scenario Areas in Square Miles (1 sq in = 9.964 sq mi)	5401	1290	1041	3070	--

TABLE 8-6. SCENARIO AREA MEASUREMENTS - AREA NUMBER 6: GREAT LAKES
ALL AREAS IN ACTUAL MEASURED SQUARE INCHES

Chart Scale - 1:500,000

SYSTEM DESCRIPTION	TOTAL AREA	ZONE 1 0 to 5 MILES	ZONE 2 5 to 10 MILES	ZONE 3 10 to 25 MILES	ZONE 4 25+ MILES
Scenario Total Areas	495.31	144.79	104.75	197.58	58.19
National Weather Service 162.55 MHz	26.88	11.51	8.14	7.23	--
Coast Guard VHF-FM	381.04	120.50	96.04	161.12	3.38
Public Coast Stations	171.92	37.65	33.62	69.79	20.86
Commercial BCST (All Stations)	359.94	97.09	76.56	143.82	42.47
Commercial BCST (Direct Marine Broadcast Stations)	57.60	19.40	17.61	20.14	0.45
Commercial BCST Above: Schedule Factored	0.596	0.203	0.184	0.210	--
Visual Warning Displays	1.98	--	--	--	--
Coast Guard 2 MHz	495.31	144.79	104.75	197.58	58.19
Public Coast Stations - 2 MHz	495.31	144.79	104.75	197.58	58.19
Scenario Areas in Square Miles (1 sq in = 62.274 sq mi)	31468	9017	6523	12304	3624

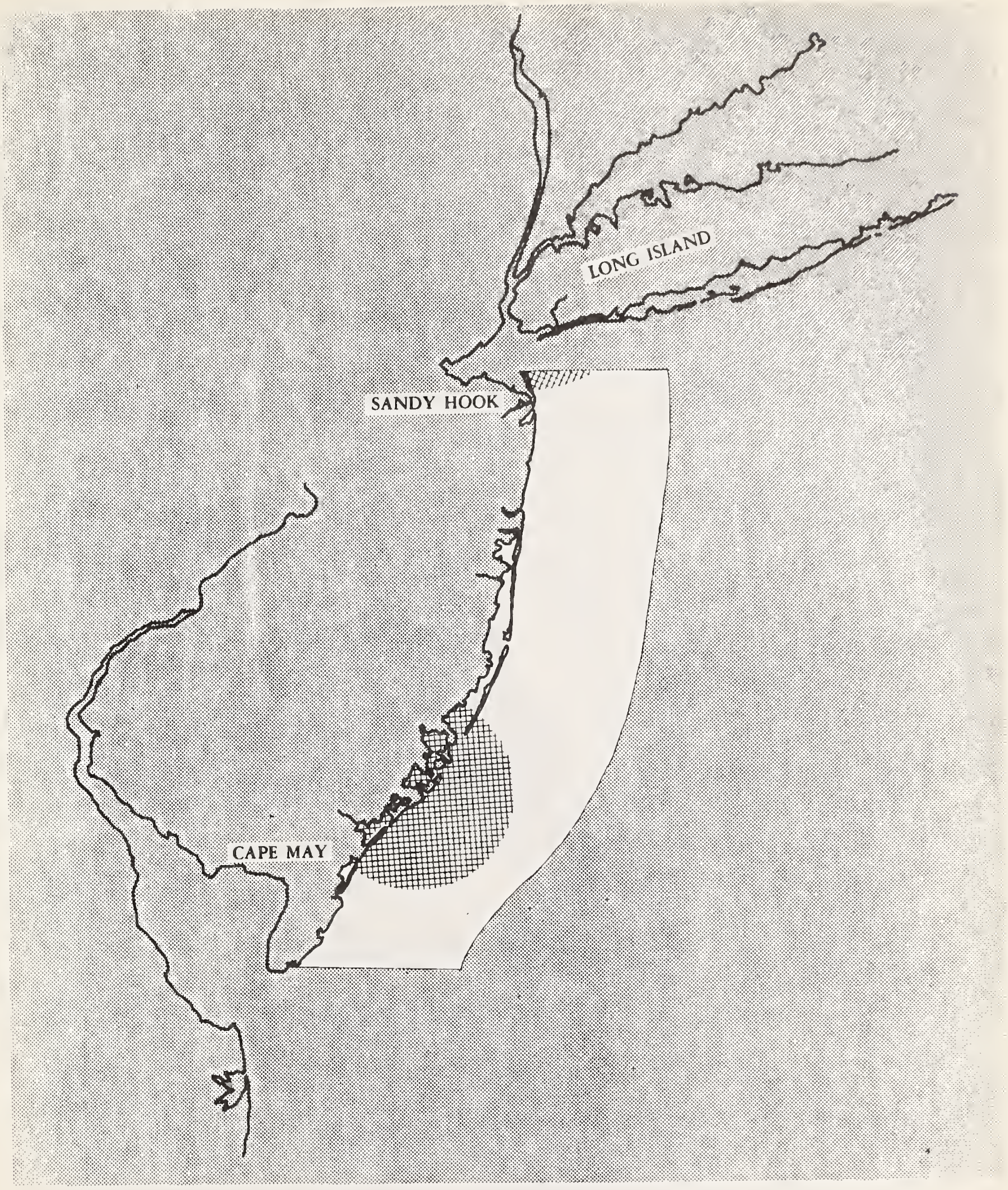

Figure 8-1. NWS Coverage - Scenario Area 1

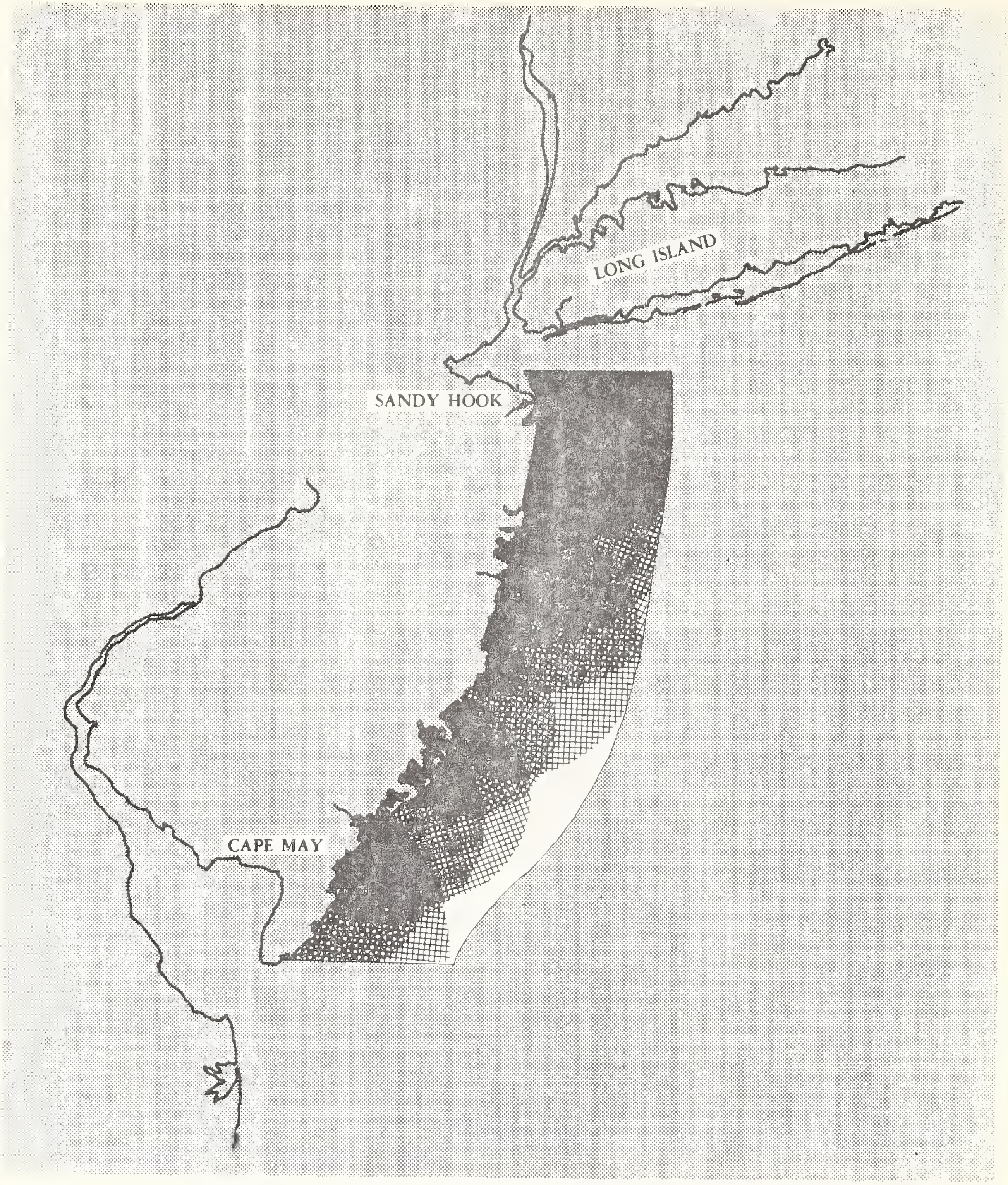

Figure 8-2. Coast Guard VHF Coverage - Scenario Area 1

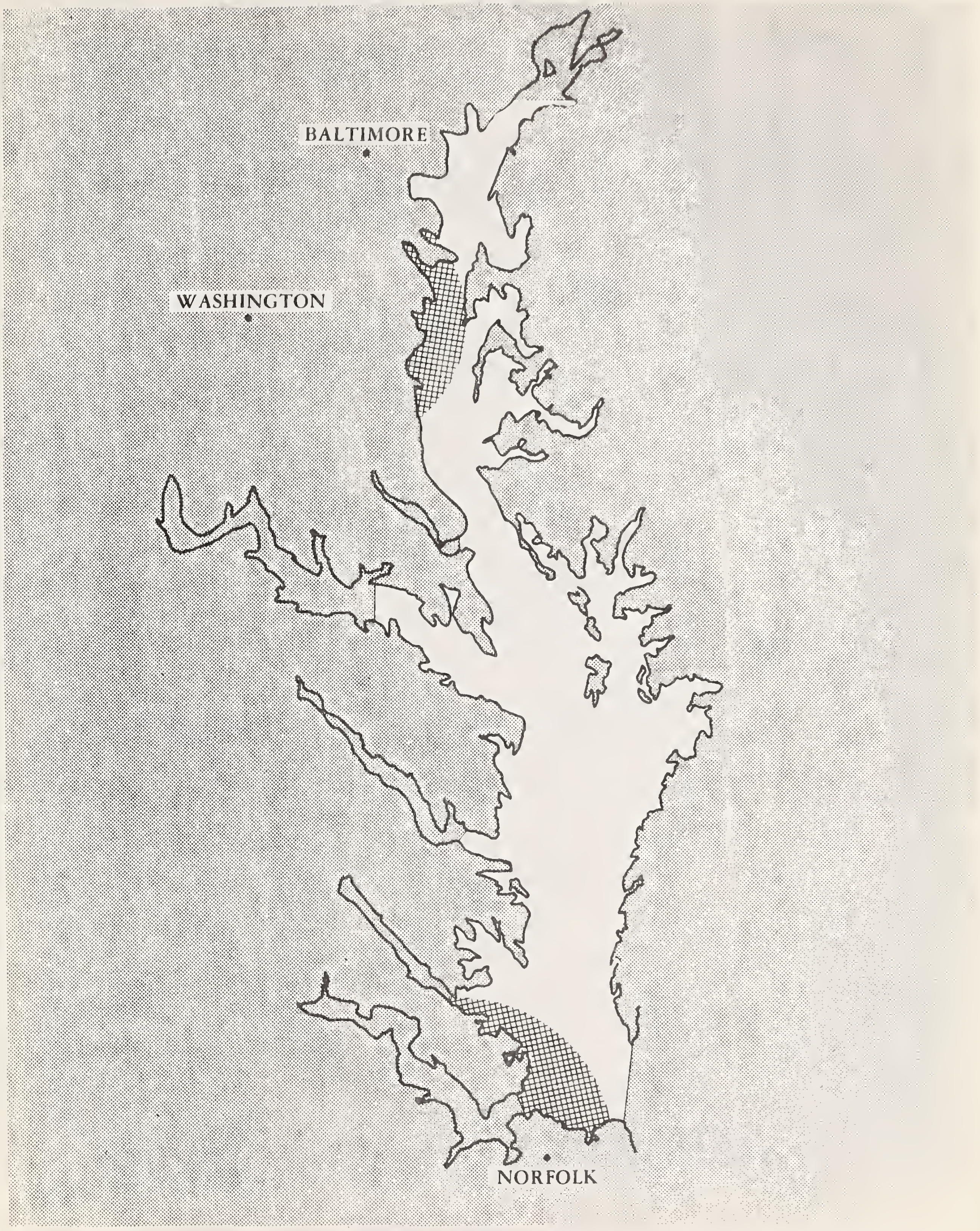

Figure 8-3. NWS Coverage - Scenario Area 1

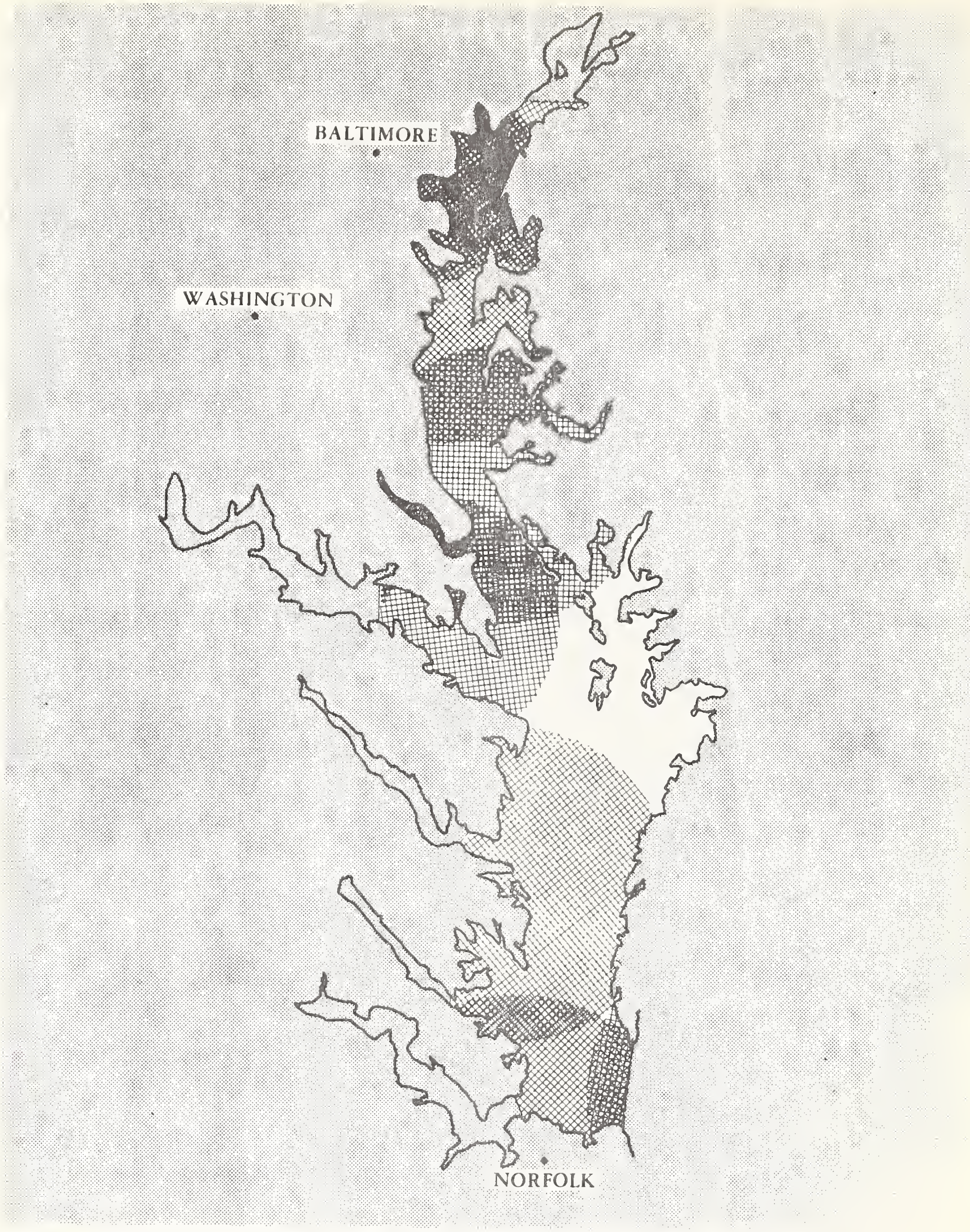

Figure 8-4. Coast Guard VHF Coverage - Scenario Area 2

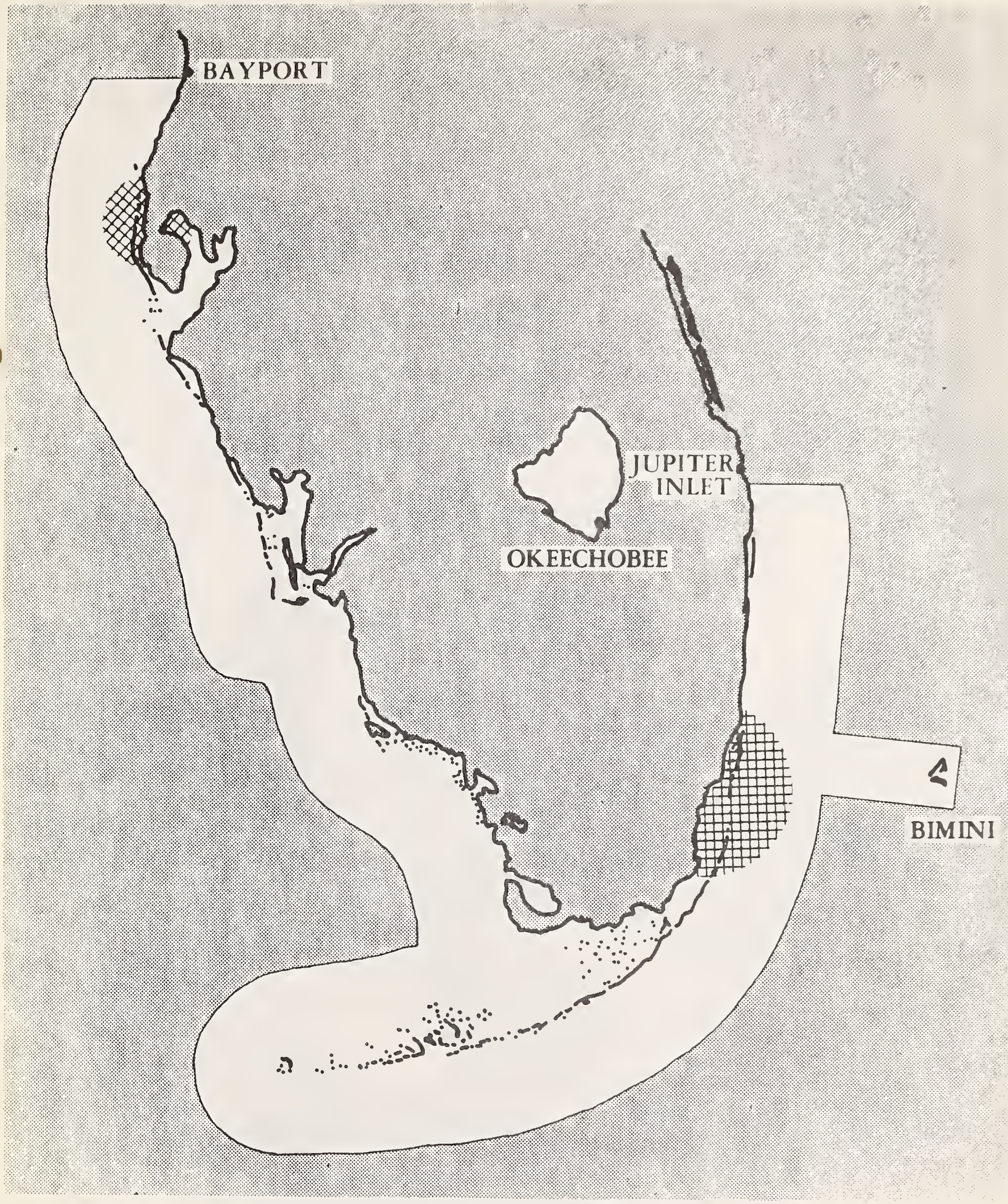

Figure 8-5. NWS Coverage - Scenario Area 3

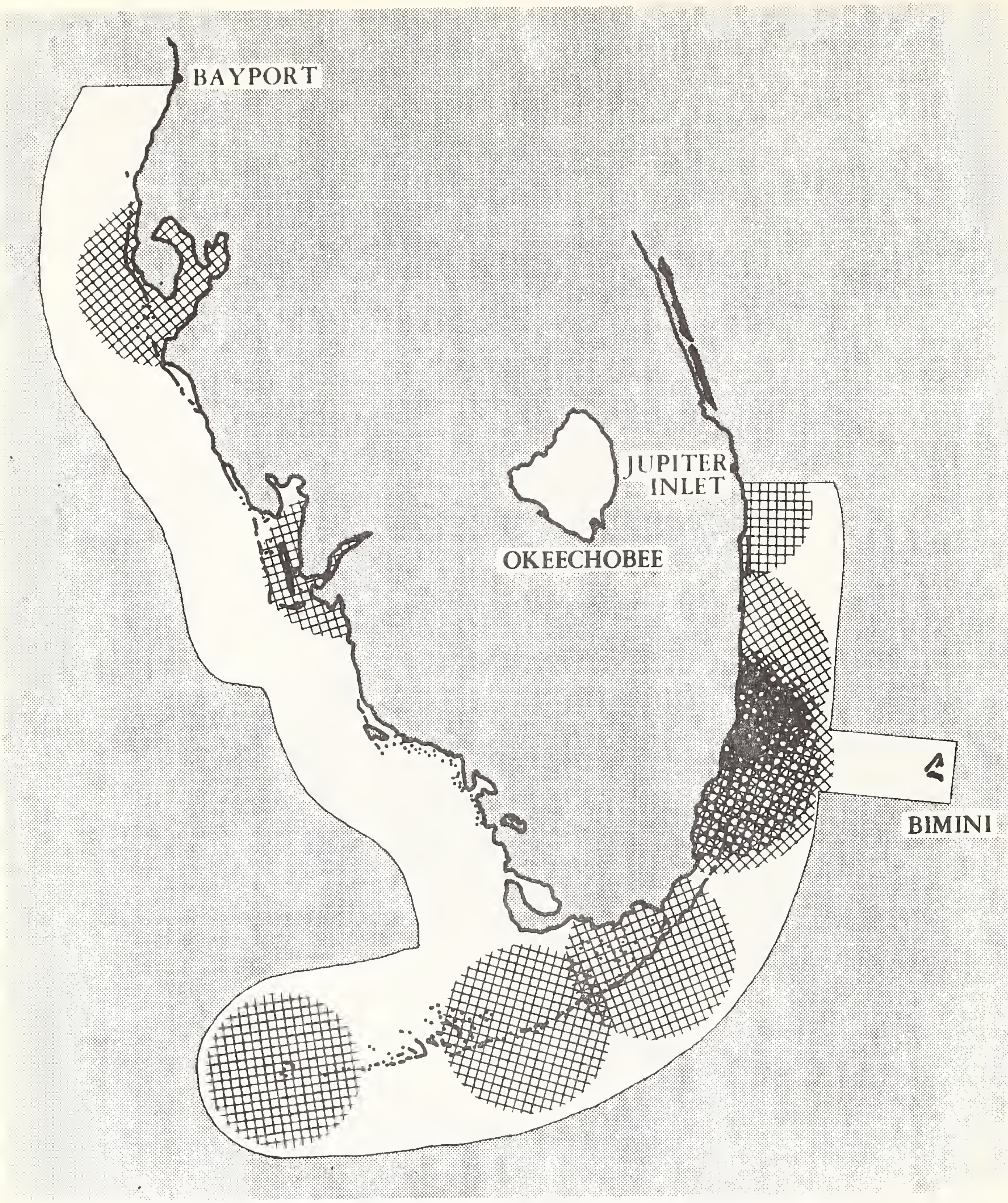

Figure 8-6. Coast Guard VHF Coverage - Scenario Area 3

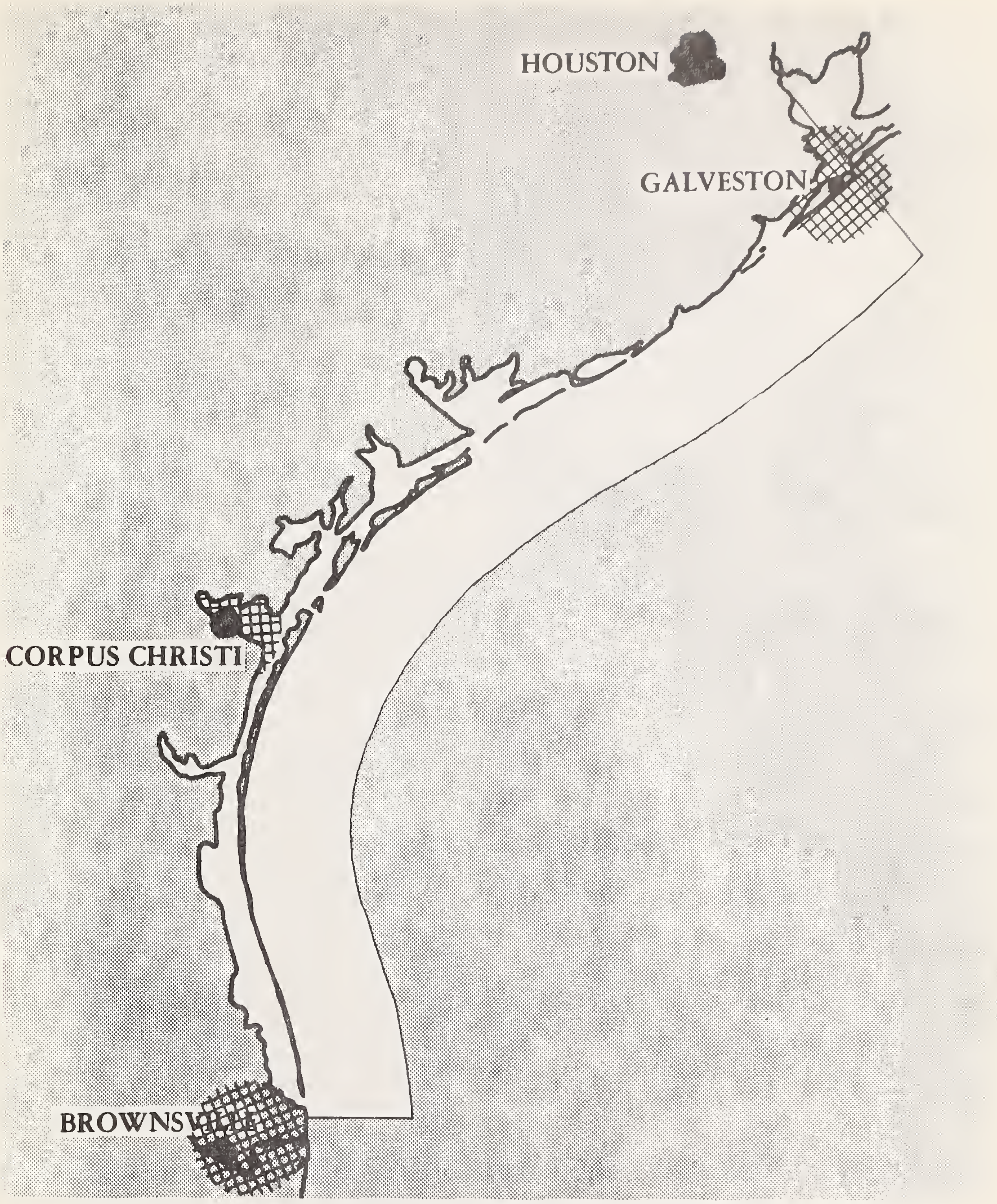

Figure 8-7. NWS Coverage - Scenario Area 4

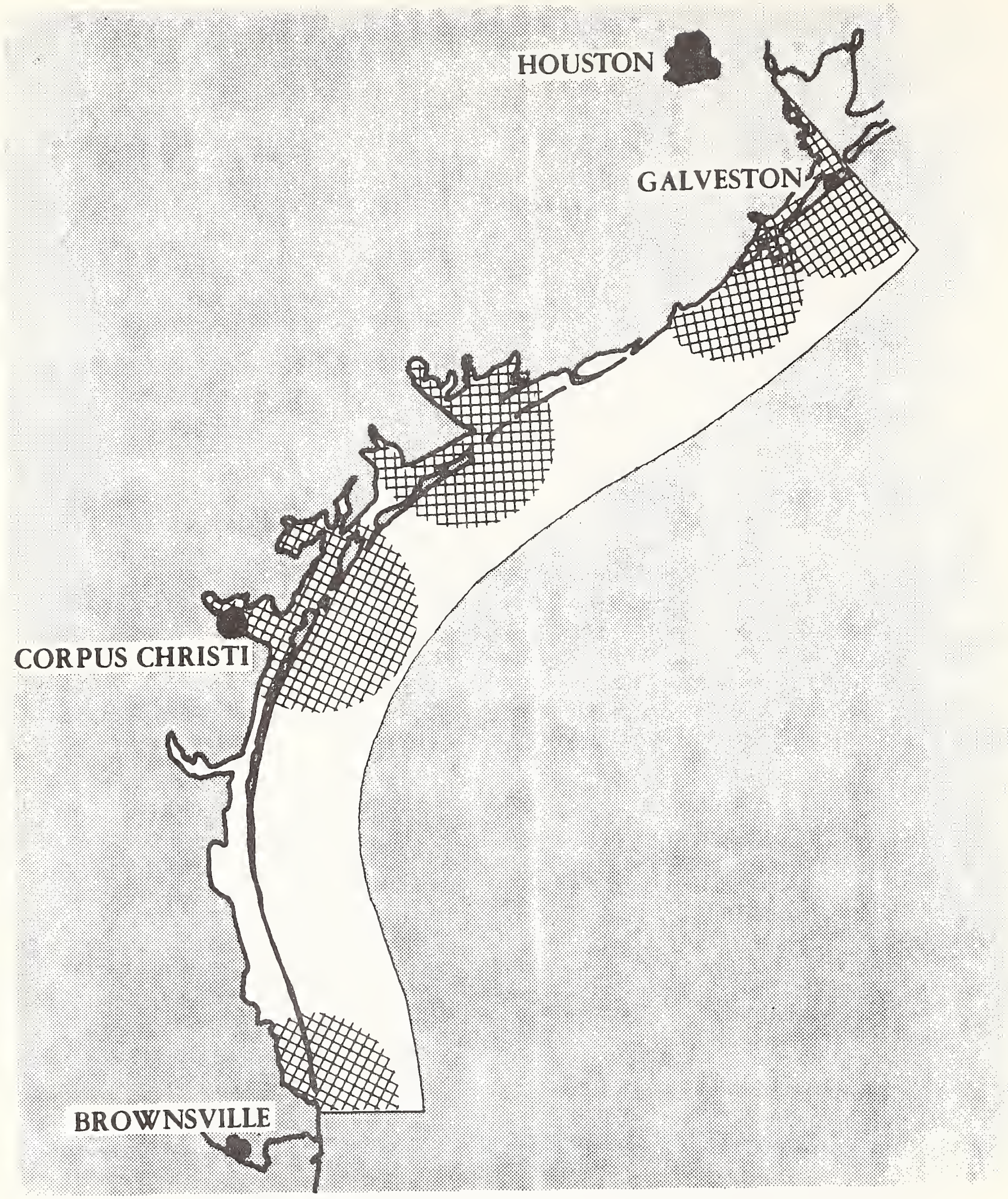

Figure 8-8. Coast Guard VHF Coverage - Scenario Area 4

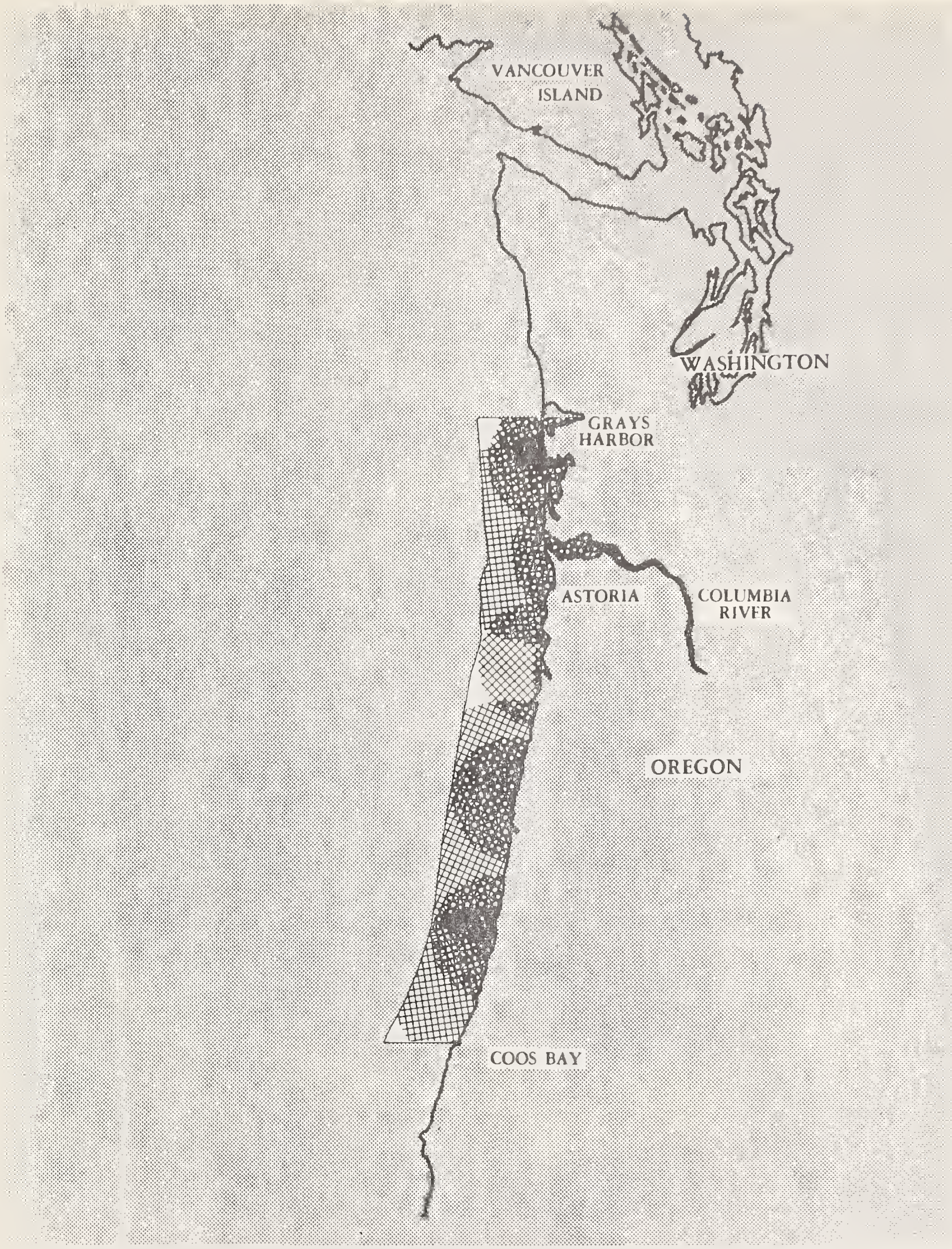

Figure 8-9. Coast Guard VHF Coverage - Scenario Area 5

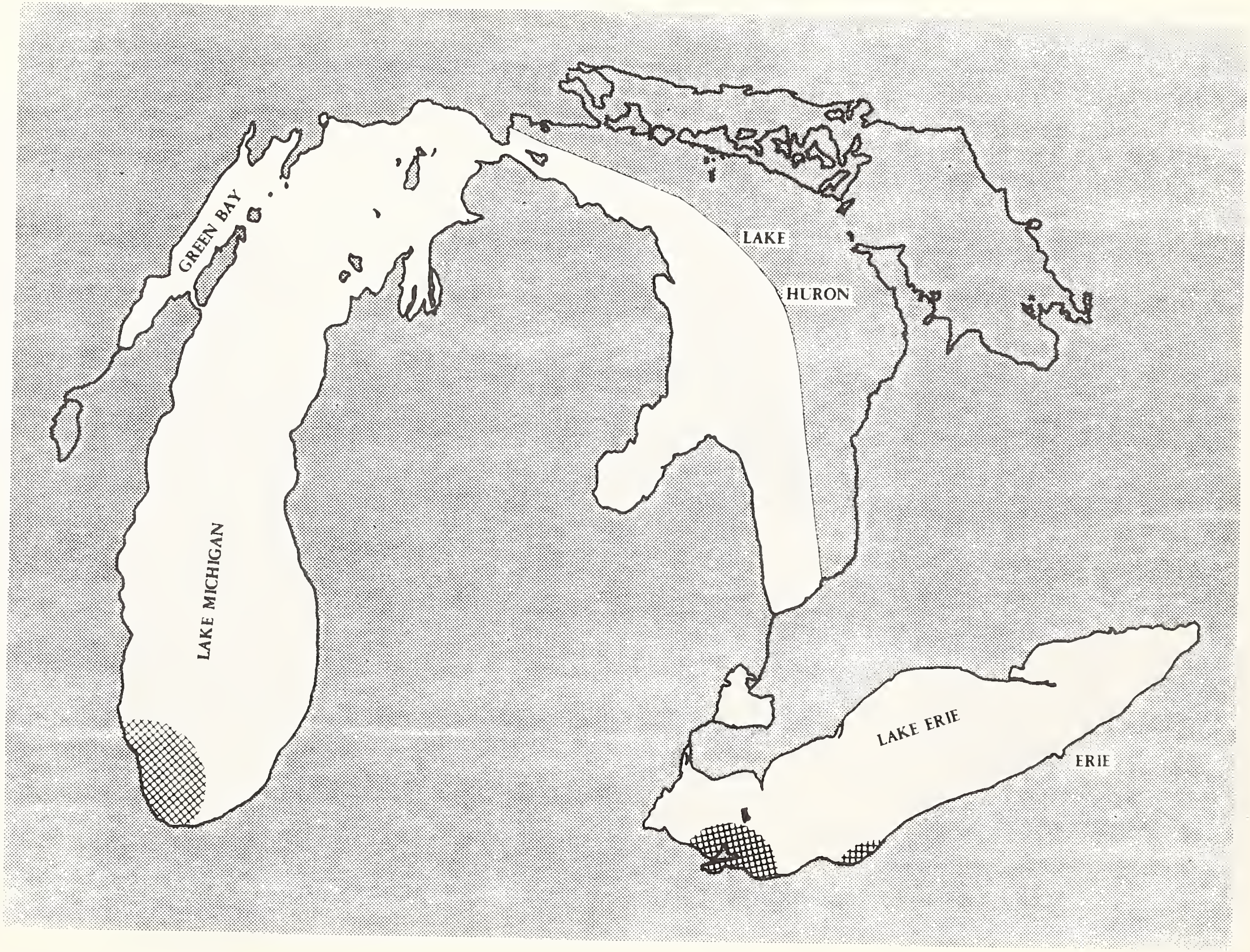

Figure 8-10. NWS Coverage - Scenario Area 6

Figure 8-11. Coast Guard VHF Coverage - Scenario Area 6

TABLE 8-7. SCENARIO AREA MEASUREMENTS (PERCENT AREAS)
AREA NUMBER 1: NEW JERSEY

SYSTEM DESCRIPTION	TOTAL AREA	ZONE 1 INLAND	ZONE 2 0 TO 5 MILES	ZONE 3 6 TO 10 MILES	ZONE 4 11 TO 25 MILES
Scenario Total Areas	100	100	100	100	100
National Weather Service - 162.55 MHz	7.96	13.56	14.55	12.51	3.47
Coast Guard VHF-FM	77.79	100.00	99.76	100.00	59.99
Coast Guard - 2 MHz	100	100	100	100	100
Public Coast Stations (VHF-FM)	59.87	83.45	80.28	79.23	43.40
Public Coast Stations 2 MHz					
Commercial BCST (All Stations)	68.06	84.72	81.84	82.10	56.52
Commercial BCST (Direct Marine Broadcast Stations)	44.61	79.88	43.19	41.65	41.26
Commercial BCST Above: Schedule Factored	0.83	1.19	0.83	0.81	0.80
Visual Warning Displays	0.72	-	-	-	-

TABLE 8-8. SCENARIO AREA MEASUREMENTS (PERCENT AREAS)
AREA NUMBER ¢: CHESAPEAKE BAY

SYSTEM DESCRIPTION	TOTAL AREA	ZONE 1 0 TO 1 MILE	ZONE 2 2 TO 5 MILES	ZONE 3 6 TO 10 MILES	ZONE 4 11 TO 25 MILES
Scenario Total Areas	100	100	100	100	100
National Weather Service - 162.55 MHz	8.38	12.82	8.58	1.43	-
Coast Guard VHF-FM	75.92	76.05	80.64	63.56	-
Coast Guard - 2 MHz	100	100	100	100	100
Public Coast Stations (VHF-FM)	81.87	79.55	81.77	80.69	-
Public Coast Stations - 2 MHz	100	100	100	100	100
Commercial BCST (All Stations)	100	100	100	100	-
Commercial BCST (Direct Marine Broadcast Stations)	56.99	57.76	62.01	44.76	-
Commercial BCST Above: Schedule Factored	3.92	3.69	4.21	3.70	-
Visual Warning Displays	0.77	-	-	-	-

TABLE 8-9. SCENARIO AREA MEASUREMENTS (PERCENT AREAS)
AREA NUMBER 3: FLORIDA COAST

SYSTEM DESCRIPTION	TOTAL AREA	ZONE 1 0 TO 5 MILES	ZONE 2 6 TO 10 MILES	ZONE 3 10 TO 25 MILES	ZONE 4 BIMINI RUN
Scenario Total Areas	100	100	100	100	100
National Weather Service - 162.55 MHz	6.30	13.73	8.12	2.48	-
Coast Guard VHF-FM	37.01	28.76	44.73	39.03	10.16
Coast Guard - 2 MHz	100	100	100	100	100
Public Coast Stations (VHF-FM)	66.75	63.68	73.35	68.85	-
Public Coast Stations - 2 MHz	100	100	100	100	100
Commercial BCST (All Stations)	98.14	100	100	96.45	100
Commercial BCST (Direct Marine Broadcast Stations)	74.35	100	100	51.50	89.42
Commercial BCST Above: (Schedule Factored)	1.21	1.68	1.56	0.85	1.13
Visual Warning Displays	0.55	-	-	-	-

TABLE 8-10. SCENARIO AREA MEASUREMENTS (PERCENT AREAS)
AREA NUMBER 4: GULF COAST

SYSTEM DESCRIPTION	TOTAL AREA	ZONE 1 INLAND	ZONE 2 0 TO 5 MILES	ZONE 3 6 TO 10 MILES	ZONE 4 11 TO 25 MILES
Scenario Total Areas	100	100	100	100	100
National Weather Service - 162.55 MHz	4.60	19.07	9.56	2.90	-
Coast Guard VHF-FM	45.15	68.96	81.47	80.83	21.32
Coast Guard - 2 MHz	100	100	100	100	100
Public Coast Stations (VHF-FM)	45.48	81.37	87.54	80.79	17.15
Public Coast Stations - 2 MHz	100	100	100	100	100
Commercial BCST (All Stations)	70.12	92.08	84.52	74.72	59.71
Commercial BCST (Direct Marine Broadcast)	6.54	16.35	13.57	10.83	1.19
Commercial BCST Above: Schedule Factored	0.14	0.34	0.28	0.23	0.02
Visual Warnings Displays	0.18	-	-	-	-

TABLE 8-11. SCENARIO AREA MEASUREMENTS (PERCENT AREAS)
AREA NUMBER 5: NORTH PACIFIC COAST

SYSTEM DESCRIPTION	TOTAL AREA	ZONE 1 0 TO 5 MILES	ZONE 2 6 TO 10 MILES	ZONE 3 11 TO 25 MILES	ZONE 4 -
Scenario Total Areas	100	100	100	100	-
National Weather Service - 162.55 MHz	-	-	-	-	-
Coast Guard VHF-FM	96.67	100	100	88.49	-
Coast Guard - 2 MHz	100	100	100	100	-
Public Coast Stations (VHF-FM)	51.44	60.62	51.10	44.86	-
Public Coast Stations - 2 MHz	100	100	100	100	-
Commercial BCST (All Stations)	89.94	98.65	90.43	80.85	-
Commercial BCST (Direct Marine Broadcast Stations)	29.88	46.06	31.85	20.67	-
Commercial BCST Above: Schedule Factored	0.45	0.69	0.50	0.30	-
Visual Warning Displays	0.45	-	-	-	-

TABLE 8-12. SCENARIO AREA MEASUREMENTS (PERCENT AREAS)
AREA NUMBER 6: GREAT LAKES REGION

SYSTEM DESCRIPTION	TOTAL AREA	ZONE 1 0 TO 5 MILES	ZONE 2 6 TO 10 MILES	ZONE 3 11 TO 25 MILES	ZONE 4 25+ MILES
Scenario Total Areas	100	100	100	100	100
National Weather Service - 162.55 MHz	5.43	7.95	7.77	3.66	-
Coast Guard VHF-FM	76.93	83.22	65.91	81.55	5.81
Coast Guard - 2 MHz	100	100	100	100	100
Public Coast Stations (VHF-FM)	34.71	26.00	32.10	35.32	35.85
Public Coast Stations - 2 MHz	100	100	100	100	100
Commercial BCST (All Stations)	72.67	67.06	73.09	72.78	72.99
Commercial BCST (Direct Marine Broadcast)	11.63	13.40	16.81	10.19	0.77
Commercial BCST Above: Schedule Factored	0.12	0.14	0.18	0.11	-
Visual Warning Displays	0.40	-	-	-	-

TABLE 8-13. AUDIENCE MODELS - DISTRIBUTION OF RADIO RECEIVERS AS A PERCENTAGE OF TOTAL BOATING POPULATION

SCENARIO AREA 1 - NEW JERSEY COAST

RECEIVER TYPE	INLAND WATERS	0 TO 5 MILES	5 TO 10 MILES	10 TO 25 MILES
Commercial Broadcast	15.00	12.00	2.70	0.30
NWS - 162.55 MHz	4.50	3.60	0.80	0.10
AM Radiotelephone	3.50	2.80	0.63	0.07
VHF Radiotelephone	0.30	0.24	0.05	0.01

SCENARIO AREA 2 - CHESAPEAKE BAY

RECEIVER TYPE	0 TO 1 MILES	1 TO 5 MILES	5 TO 10 MILES	10 TO 25 MILES
Commercial Broadcast	11.00	12.00	7.00	-
NWS - 162.55 MHz	3.00	3.20	1.80	-
AM Radiotelephone	2.60	2.80	1.60	-
VHF Radiotelephone	0.44	0.48	0.28	-

SCENARIO AREA 3 - FLORIDA COAST

RECEIVER TYPE	0 TO 5 MILES	5 TO 10 MILES	10 TO 25 MILES	BIMINI RUN
Commercial Broadcast	18.00	9.00	2.70	0.30
NWS - 162.55 MHz	1.20	0.60	0.18	0.02
AM Radiotelephone	4.80	2.40	0.72	0.08
VHF Radiotelephone	0.90	0.45	0.13	0.02

TABLE 8-13. AUDIENCE MODELS - DISTRIBUTION OF RADIO RECEIVERS AS A PERCENTAGE OF TOTAL BOATING POPULATION (Continued)

SCENARIO AREA 4 - GULF COAST

RECEIVER TYPE	INLAND WATERS	0 TO 5 MILES	5 TO 10 MILES	10 TO 25 MILES
Commercial Broadcast	15.00	12.00	2.70	0.30
NWS - 162.55 MHz	3.50	2.80	0.06	0.01
AM Radiotelephone	1.00	0.80	0.02	-
VHF Radiotelephone	0.15	0.12	0.03	-

SCENARIO AREA 5 - NORTH PACIFIC COAST

RECEIVER TYPE	0 TO 5 MILES	5 TO 10 MILES	10 TO 25 MILES	OVER 25 MILES
Commercial Broadcast	18.00	9.00	2.10	0.90
NWS - 162.55 MHz	1.50	0.75	0.17	0.08
AM Radiotelephone	4.20	2.10	0.50	0.20
VHF Radiotelephone	1.10	0.52	0.12	0.05

SCENARIO AREA 6 - GREAT LAKES REGION

RECEIVER TYPE	0 TO 5 MILES	5 TO 10 MILES	10 TO 25 MILES	OVER 25 MILES
Commercial Broadcast	24.00	4.50	1.20	0.30
NWS - 162.55 MHz	4.80	0.90	0.20	0.10
AM Radiotelephone	1.75	0.33	0.10	0.02
VHF Radiotelephone	0.20	0.04	0.01	-

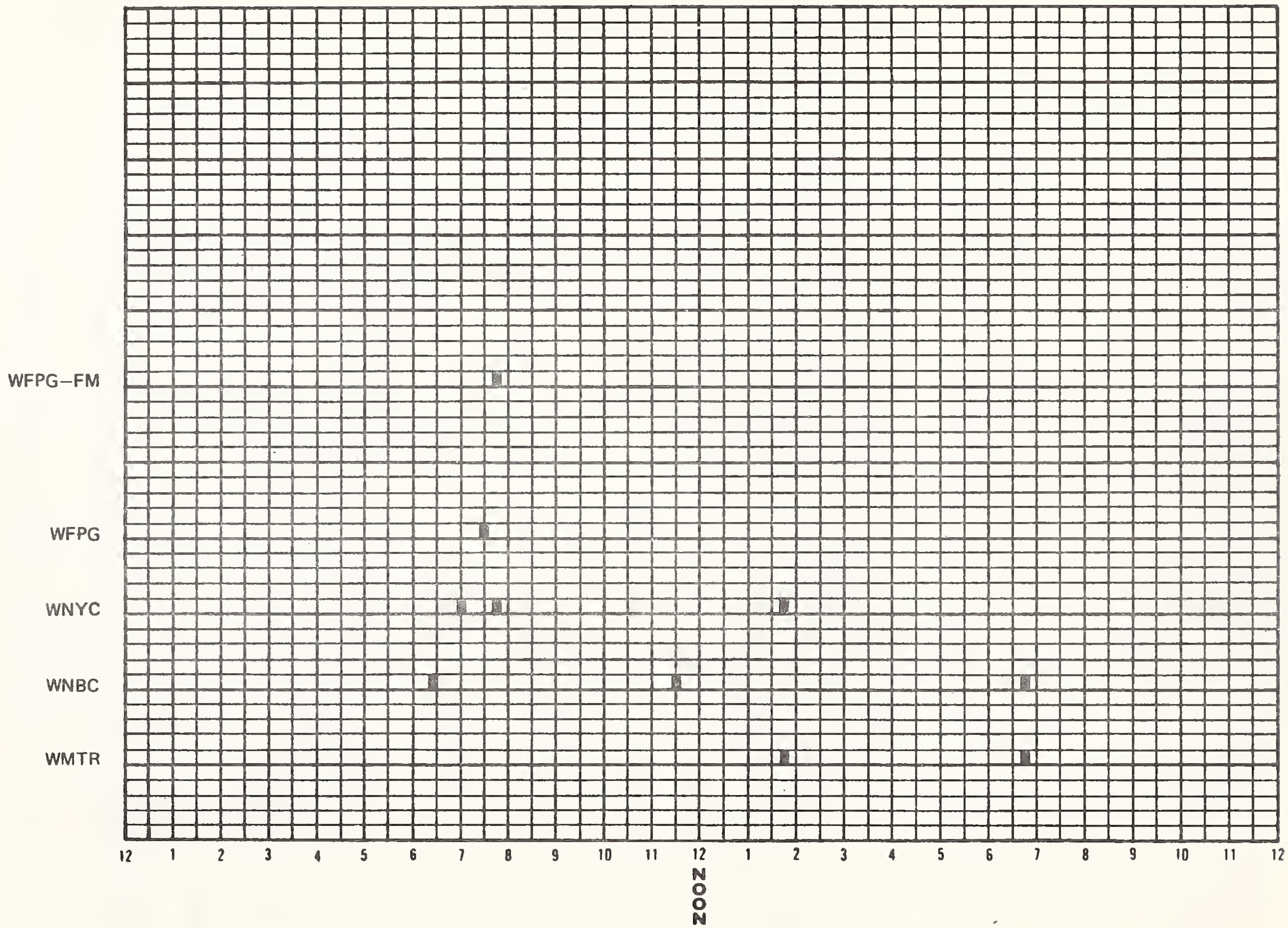

Figure 8-12. Commercial Direct Marine Broadcast Schedule, Scenario Area 1

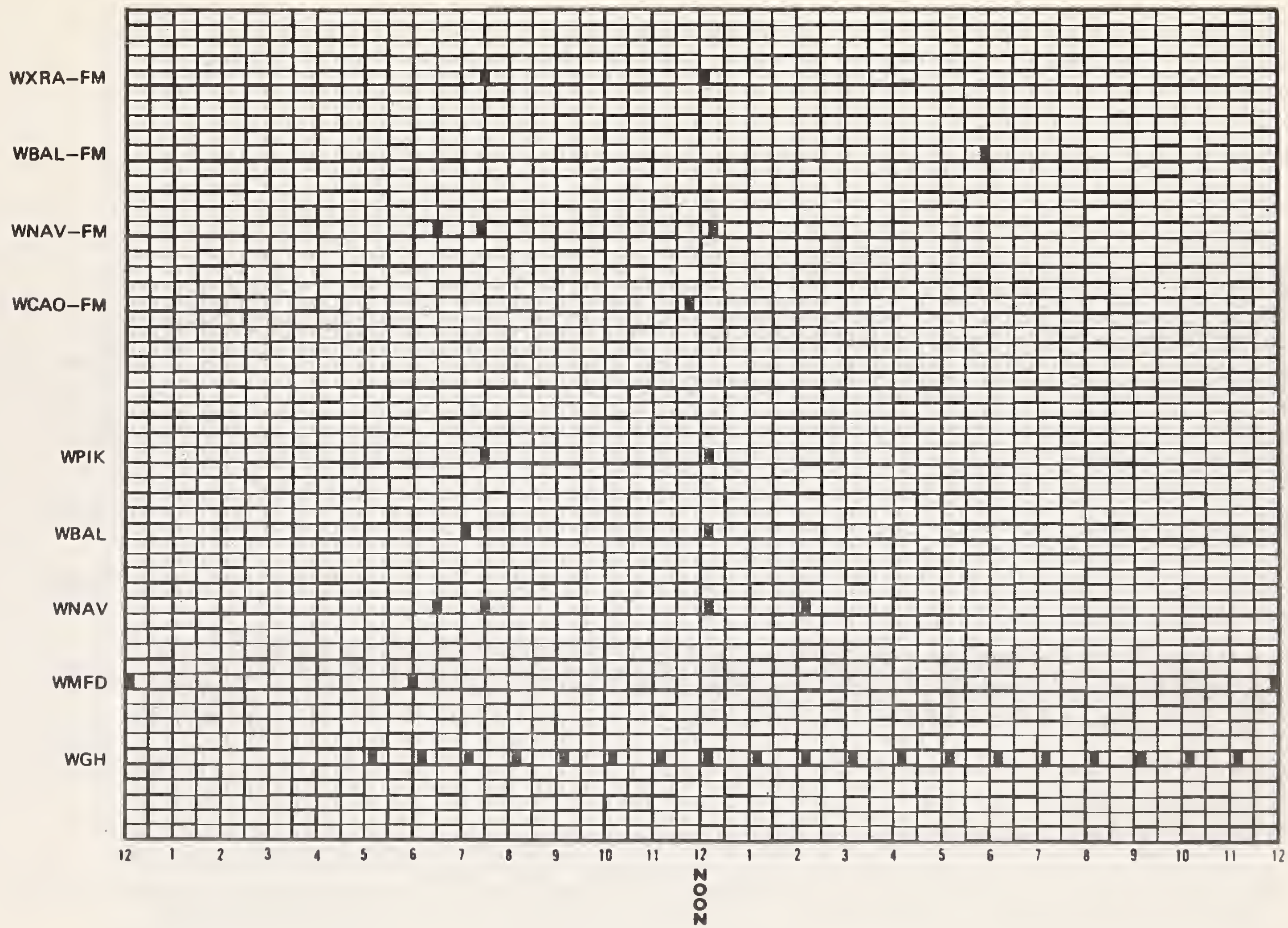

Figure 8-13. Commercial Direct Marine Broadcast Schedule, Scenario Area 2

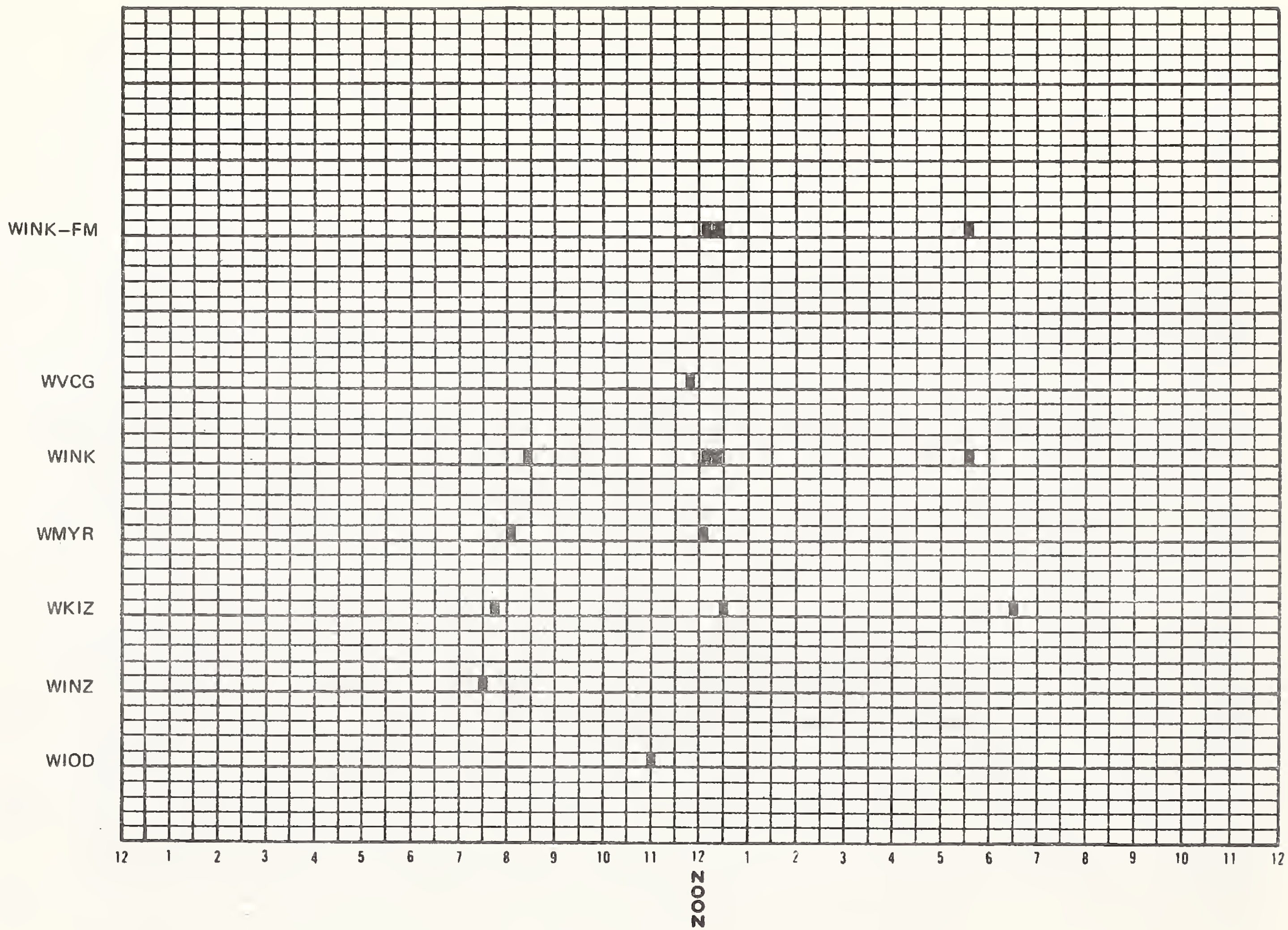

Figure 8-14. Commercial Direct Marine Broadcast Schedule, Scenario Area 3

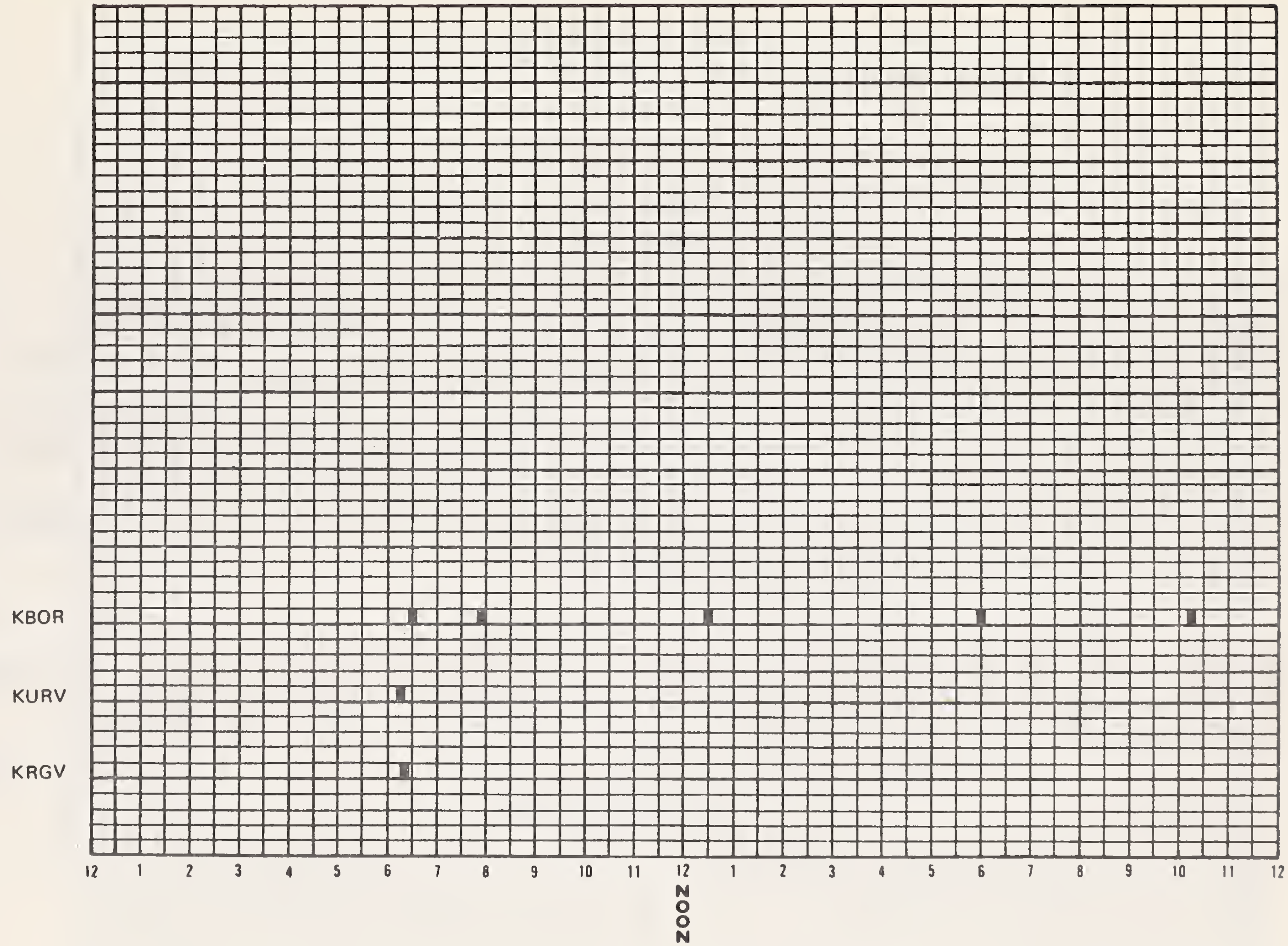

Figure 8-15. Commercial Direct Marine Broadcast Schedule, Scenario Area 4

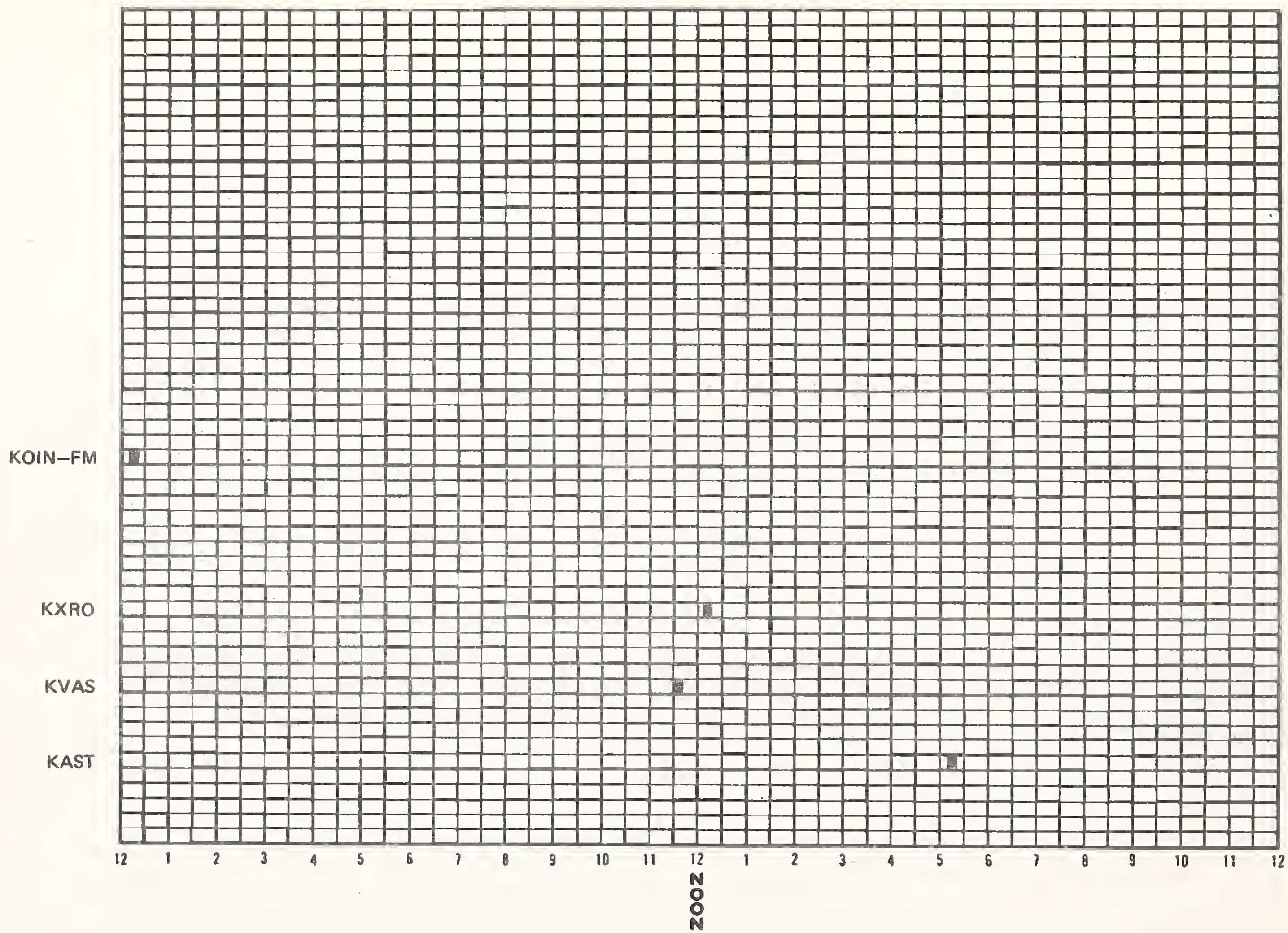

Figure 8-16. Commercial Direct Marine Broadcast Schedule, Scenario Area 5

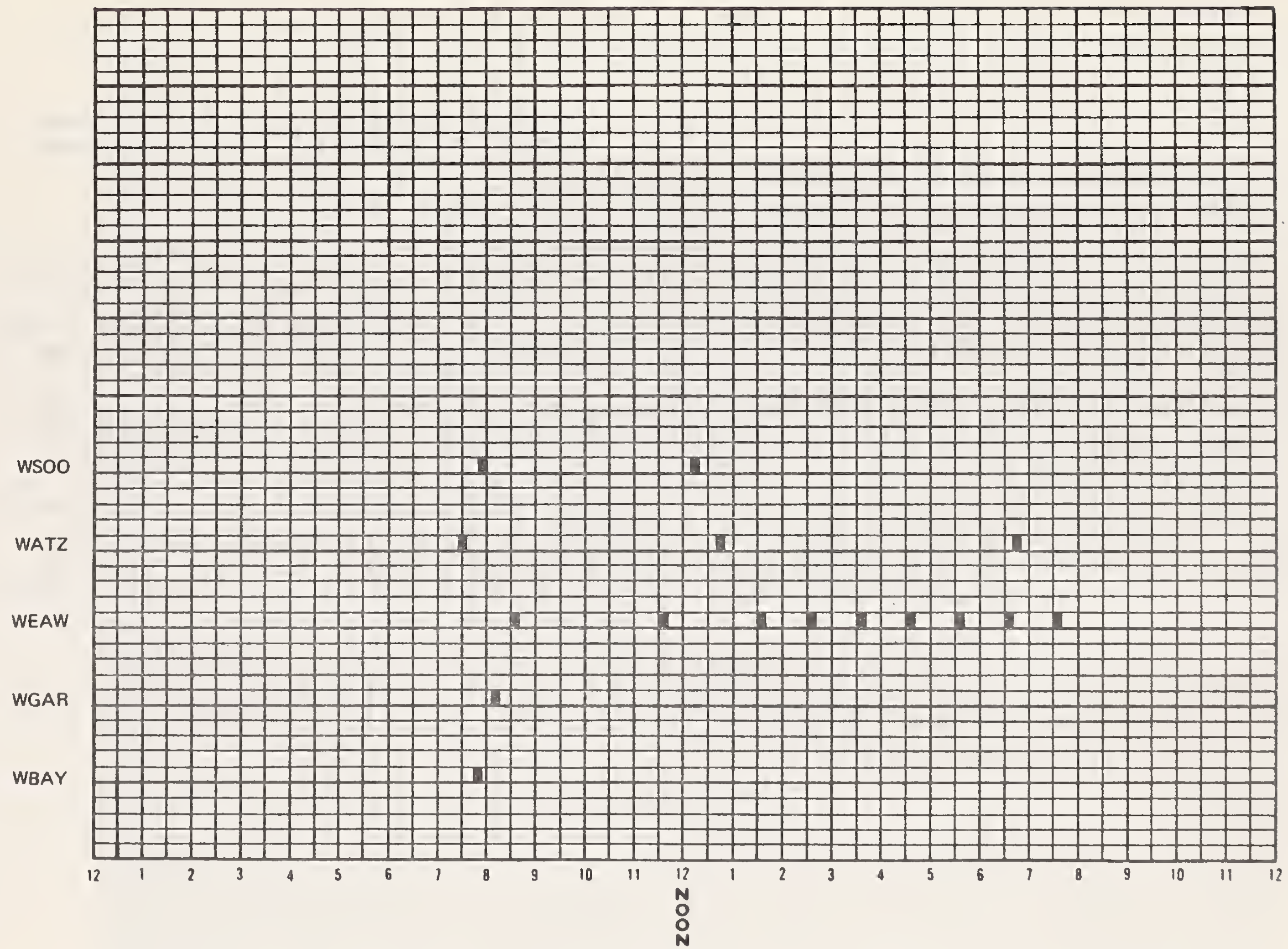

Figure 8-17. Commercial Direct Marine Broadcast Schedule, Scenario Area 6

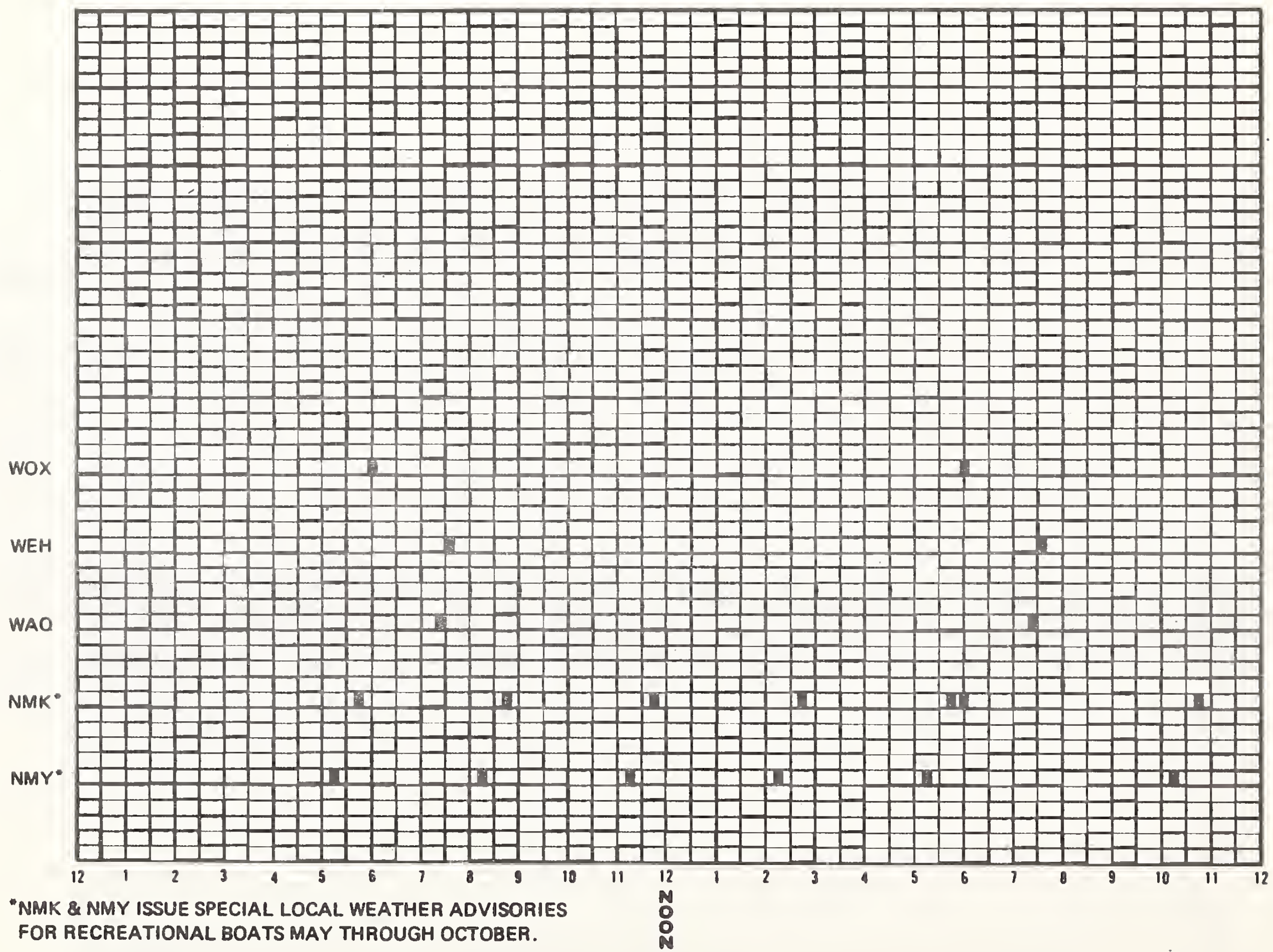

Figure 8-18. Scheduled Broadcasts of Marine Forecasts by Coast Guard and Public Coast Marine Radiotelephone. Scenario Area 1

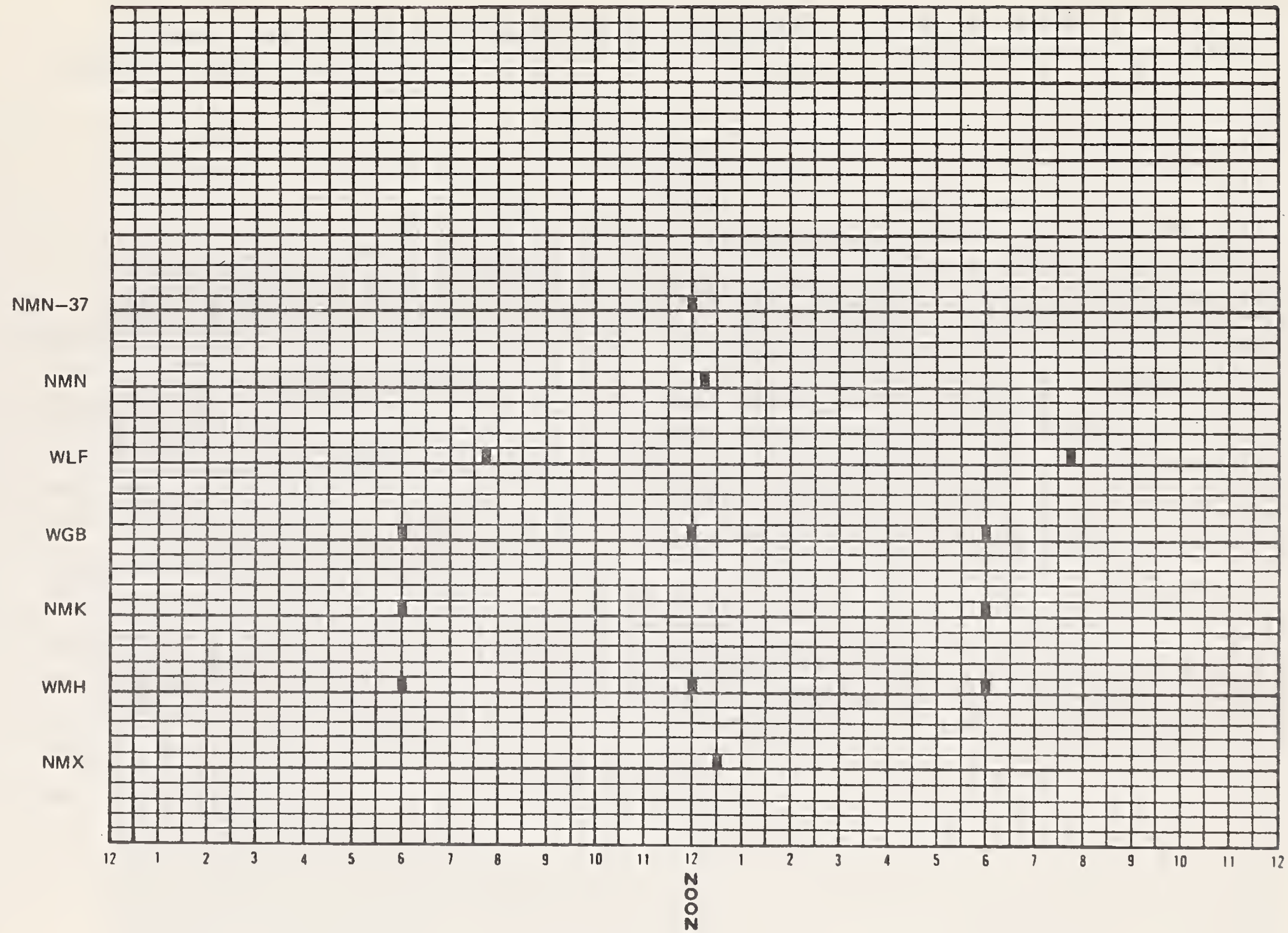

Figure 8-19. Scheduled Broadcasts of Marine Forecasts by Coast Guard and Public Coast Marine Radiotelephone. Scenario Area 2

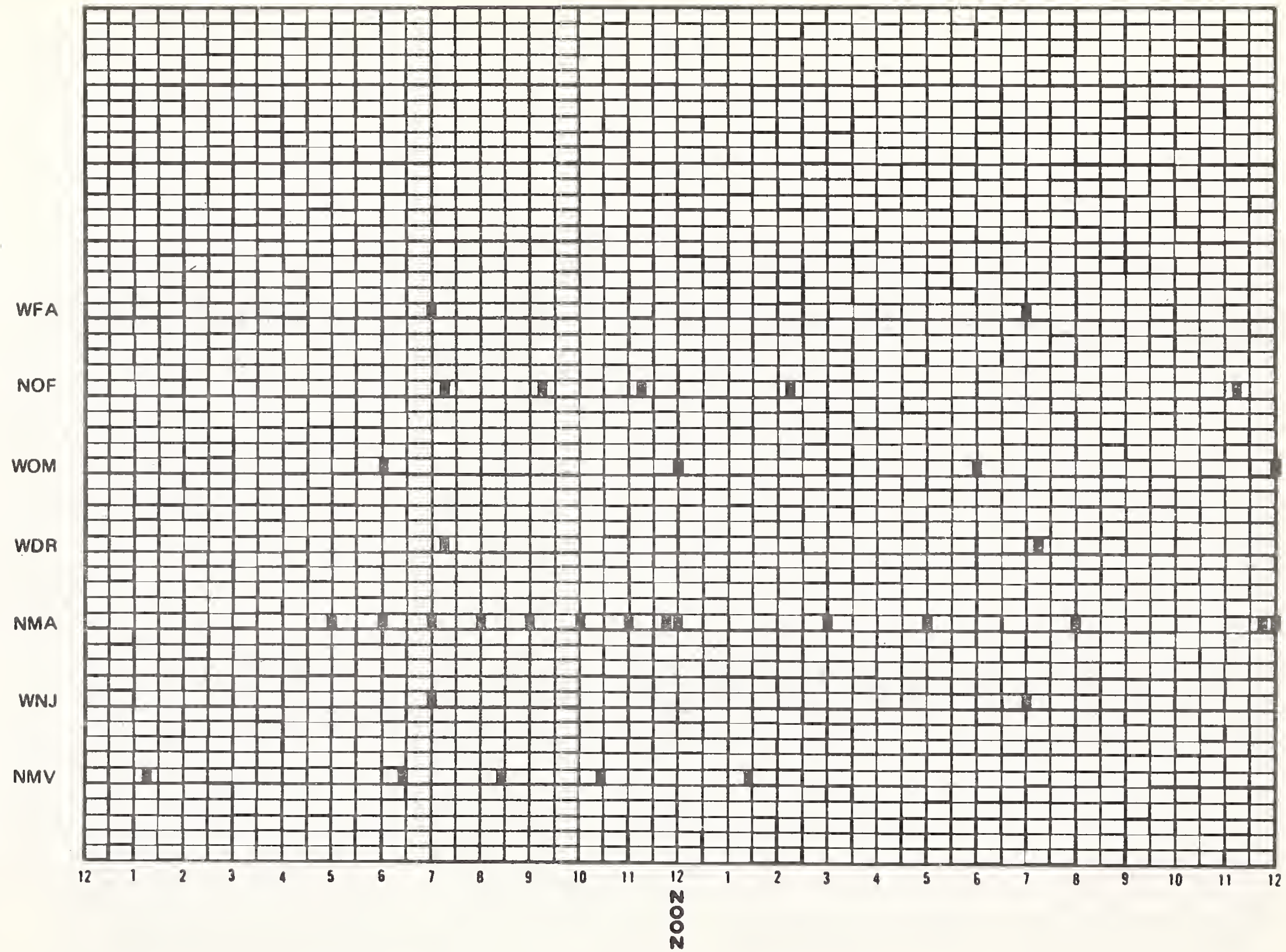

Figure 8-20. Scheduled Broadcasts of Marine Forecasts by Coast Guard and Public Coast Marine Radiotelephone. Scenario Area 3

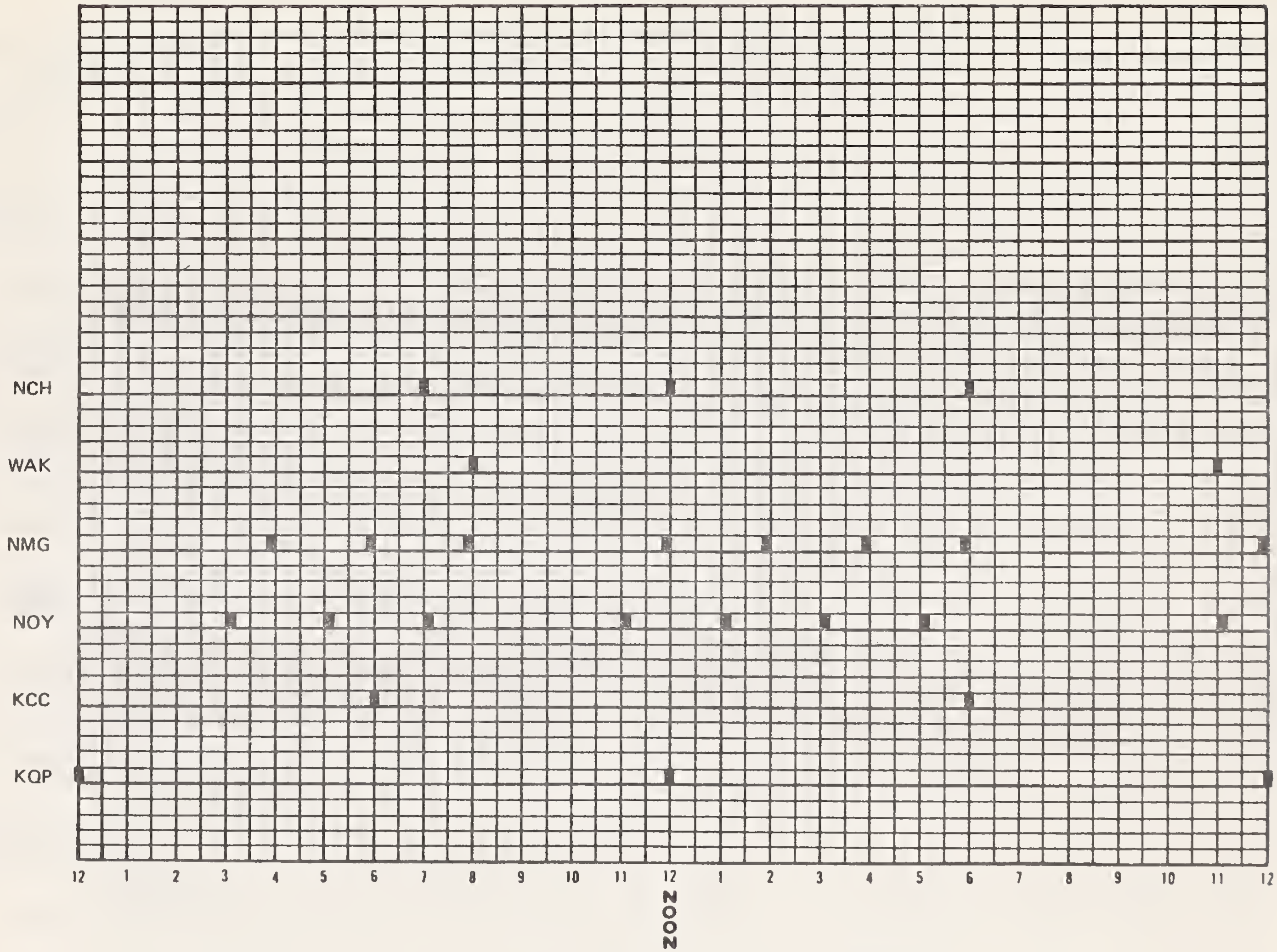

Figure 8-21. Scheduled Broadcasts of Marine Forecasts by Coast Guard and Public Coast Marine Radiotelephone. Scenario Area 4

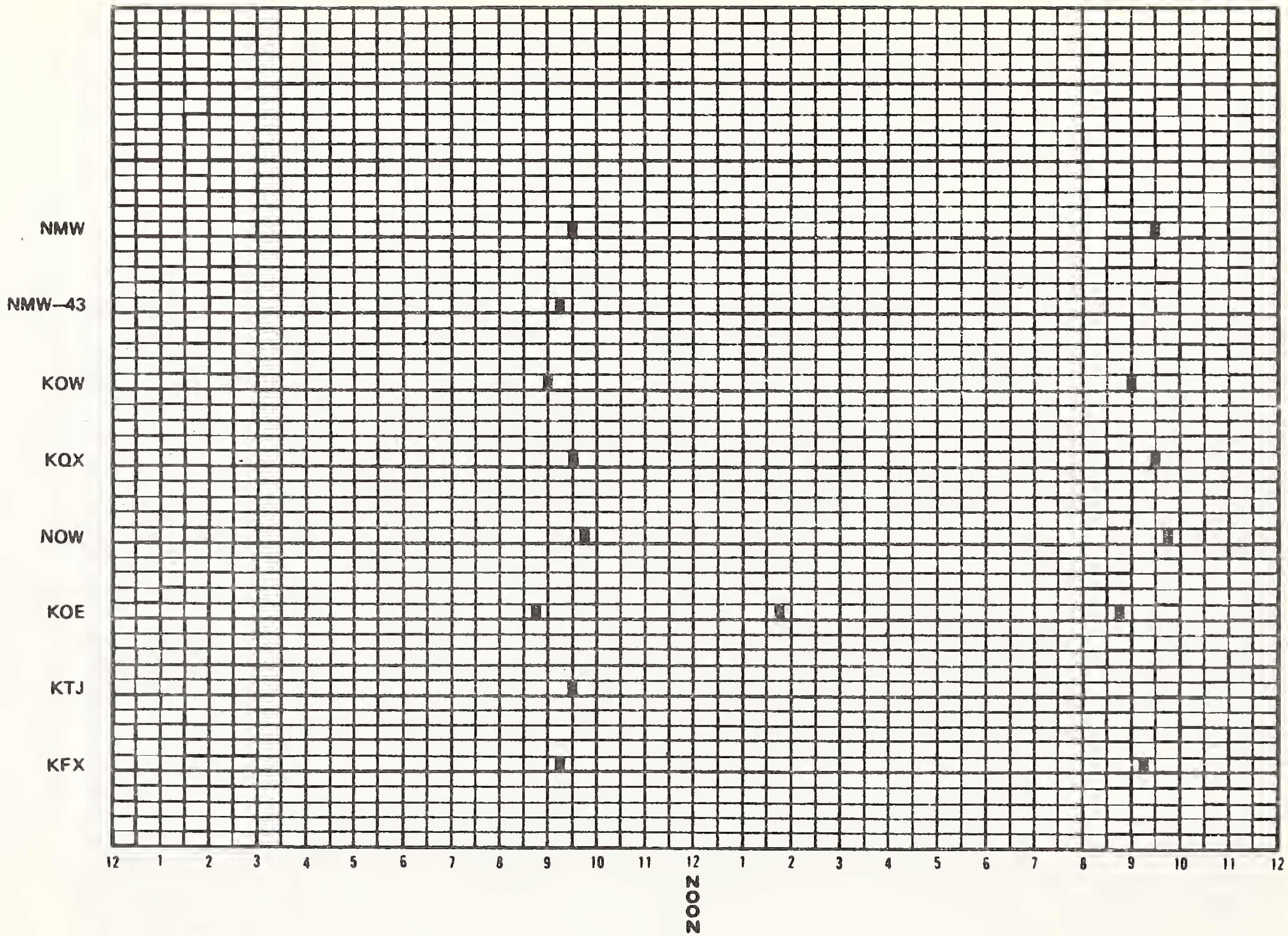

Figure 8-22. Scheduled Broadcasts of Marine Forecasts by Coast Guard and Public Coast Marine Radiotelephone. Scenario Area 5

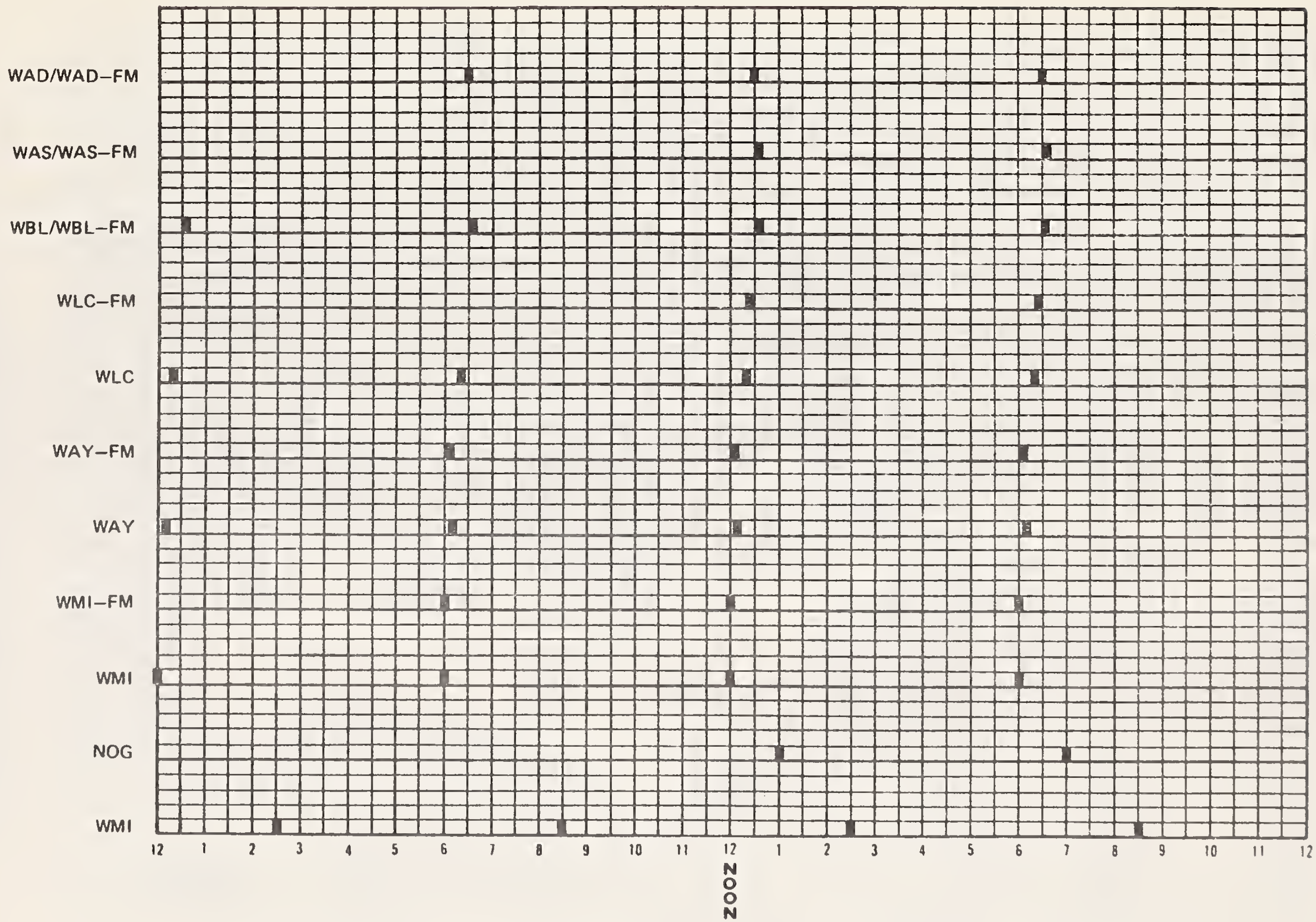

Figure 8-23. Scheduled Broadcasts of Marine Forecasts by Coast Guard and Public Coast Marine Radiotelephone. Scenario Area 6

TABLE 8-14. COMMERCIAL DIRECT MARINE BROADCAST SYSTEM SCHEDULE FACTOR AREA MEASUREMENT SCENARIO AREA 2 - CHESAPEAKE BAY

SEGMENT NUMBER	SERVICE KEY*	ZONE (MILES)	NUMBER OF SCHEDULED BROADCASTS N	SCHEDULE FACTOR F_S	MEASURED AREA	WEIGHTED AREA
1	A	0-1	5	0.0521	10.49	0.547
2	A	1-5	5	0.0521	15.39	0.802
3	A	5-10	5	0.0521	0.12	0.006
4	B	0-1	4	0.0416	1.66	0.069
5	B	1-5	4	0.0416	5.26	0.219
6	B	5-10	4	0.0416	0.32	0.013
7	C	0-1	4	0.0416	6.85	0.286
8	C	1-5	4	0.0416	4.27	0.178
9	D	0-1	5	0.0521	17.14	0.894
10	D	1-5	5	0.0521	13.84	0.721
11	E	0-1	8	0.0833	26.34	2.190
12	E	1-5	8	0.0833	46.20	3.850
13	E	5-10	8	0.0833	27.77	2.310

*Service key below identifies station or stations serving areas indicated. (All stations are AM unless otherwise indicated.)

A WPIK; WXRA-FM; WBAL; WBAL-FM; WNAV; WNAV-FM; WCAO-FM

B WPIK; WXRA-FM; WBAL; WNAV; WNAV-FM; WCAO-FM

C WBAL; WNAV; WNAV-FM; WCAO-FM

D WBAL; WBAL-FM; WNAV; WNAV-FM; WCAO-FM

E WGH

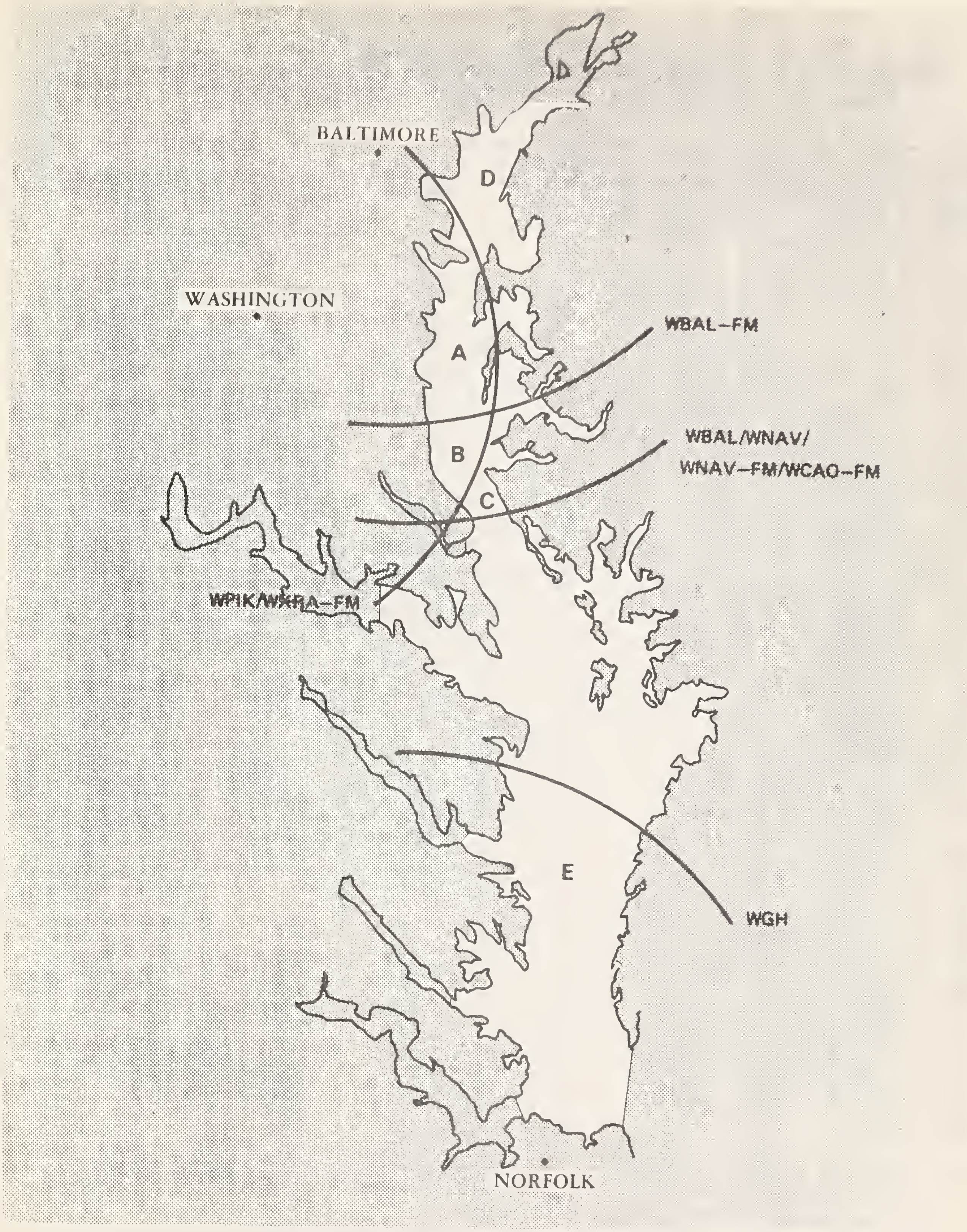

Figure 8-24. Commercial Direct Marine Broadcast System Service Areas - Scenario Area 2

TABLE 8-15. COMMERCIAL DIRECT MARINE BROADCAST SYSTEM SCHEDULE FACTOR AREA MEASUREMENT SCENARIO AREA 3 - FLORIDA COAST

SEGMENT NUMBER	SERVICE KEY*	ZONE (MILES)	NUMBER OF SCHEDULED BROADCASTS N	SCHEDULE FACTOR F_S	MEASURED AREA	WEIGHTED AREA
1	A	0-5	1	0.010	76.72	0.7672
2	A	5-10	1	0.010	46.48	0.4648
3	A	10-25	1	0.010	16.80	0.1688
4	B	0-5	1	0.010	363.16	3.6316
5	B	5-10	1	0.010	379.68	3.7968
6	B	10-25	1	0.010	388.08	3.8808
7	B	BR**	1	0.010	51.52	0.5152
8	C	0-5	2	0.021	458.64	9.55
9	C	5-10	2	0.021	286.44	5.96
10	C	10-25	2	0.021	633.64	13.20
11	C	BR**	2	0.021	85.12	1.778
12	D	0-5	2	0.021	147.28	3.062
13	D	5-10	2	0.021	115.36	2.40
14	D	10-25	2	0.021	12.88	0.268
15	E	0-5	1	0.010	400.64	4.0064
16	E	5-10	1	0.010	432.15	4.3215
17	E	10-25	1	0.010	145.04	1.4504
18	F	0-5	0	-	87.36	-
19	F	5-10	0	-	91.28	-
20	F	10-25	0	-	389.48	-
21	F	BR**	0	-	43.96	-
22	G	0-5	3	0.031	125.44	3.81
23	G	5-10	3	0.031	127.12	3.86
24	G	10-25	3	0.031	201.04	6.27
25	H	0-5	4	0.042	19.10	0.795
26	H	5-10	4	0.042	3.80	0.158
27	I	0-5	4	0.042	19.10	0.795
28	I	5-10	4	0.042	3.80	0.158
29	J	0-5	3	0.031	148.68	4.64
30	J	5-10	3	0.031	134.12	4.20
31	J	10-25	3	0.031	285.88	8.91

*Service key is shown in Table 8-16.

**Bimini Run areas.

TABLE 8-16. COMMERCIAL DIRECT MARINE BROADCAST SYSTEM SERVICE KEY SCENARIO AREA 3 - FLORIDA COAST

Service key indicates station or stations serving the areas indicated in Table 8-15. (All stations are AM unless otherwise indicated.)

A	WIOD
B	WIOD; WINZ
C	WIOD; WINZ; WVCG
D	WIOD; WINZ; WKIZ
E	WKIZ
F	WINZ
G	WINZ; WINK-FM
H	WINZ; WINK; WINK-FM; WMYR
I	WINK; WINK-FM; WMYR
J	WINK-FM

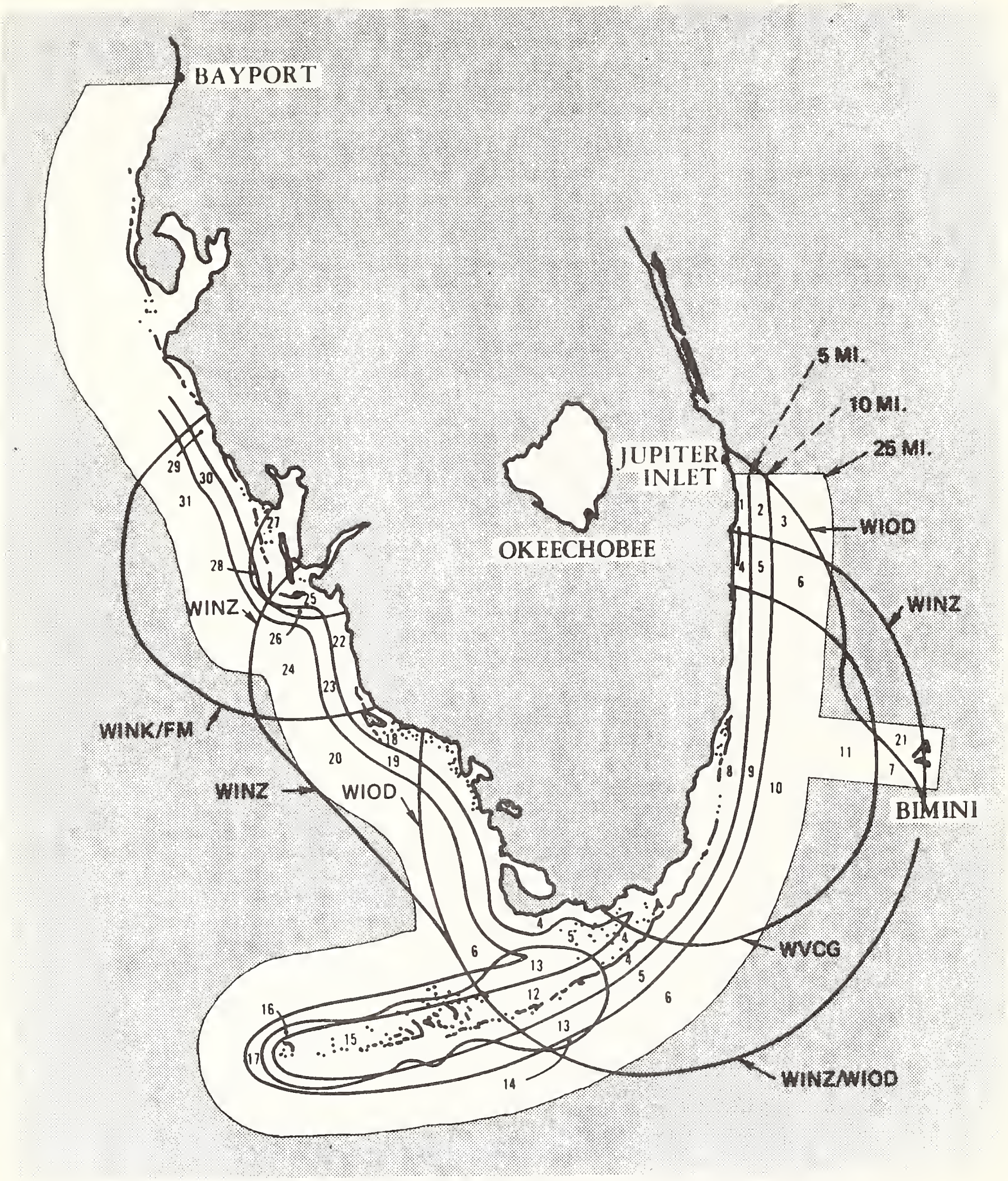

Figure 8-25. Commercial Direct Marine Broadcast System Service Areas - Scenario Area 3

TABLE 8-17. SYSTEM EFFECTIVENESS RESULTS

SYSTEM - National Weather Service System

CHARACTERISTICS - NWS Transmitters Broadcasting to Users Equipped with Average Quality Receivers on 162.55 and 162.40 MHz.

LEVEL 1 EFFECTIVENESS:	SCENARIO AREA #					
	1	2	3	4	5	6
A Coverage Only	0.080	0.084	0.063	0.046	---	0.054
B Coverage x Audience (Accessibility)	0.012	0.007	0.002	0.009	---	0.005
C Schedule-Weighted Accessibility	0.012	0.007	0.002	0.009	---	0.005

COMMENTS: This system broadcasts continuously; schedule-weighted accessibility is therefore the same as the coverage x audience figure.

TABLE 8-18. SYSTEM EFFECTIVENESS RESULTS

SYSTEM - Coast Guard VHF Broadcasts

CHARACTERISTICS - USCG Facilities Broadcasting to Users Equipped with VHF Marine Radiotelephone Installations.

LEVEL 1 EFFECTIVENESS:	SCENARIO AREA #					
	1	2	3	4	5	6
A Coverage Only	0.778	0.759	0.370	0.452	0.967	0.769
B Coverage x Audience (Accessibility)	0.006	0.009	0.005	0.002	0.017	0.002
C Schedule-Weighted Accessibility	---	---	---	---	---	---

COMMENTS: No regularly scheduled marine weather broadcasts are made by this system, although trial programs have been conducted in some areas. The schedule-weighted accessibility is therefore zero.

TABLE 8-19. SYSTEM EFFECTIVENESS RESULTS

SYSTEM - Coast Guard 2-MHz Broadcasts

CHARACTERISTICS - USCG Facilities Broadcasting to Users Equipped with AM Marine Radiotelephone Installations.

LEVEL 1 EFFECTIVENESS:	SCENARIO AREA #					
	1	2	3	4	5	6
A Coverage Only	1.00	1.00	1.00	1.00	1.00	1.00
B Coverage x Audience (Accessibility)	0.070	0.070	0.080	0.020	0.070	0.022
C Schedule-Weighted Accessibility	0.001	0.001	0.008	0.001	---	0.002

TABLE 8-20. SYSTEM EFFECTIVENESS RESULTS

SYSTEM - Public Coast Stations (Class IIIB)

CHARACTERISTICS:- Public Coast VHF Stations Broadcasting to Installed VHF Marine Radiotelephones.

LEVEL 1 EFFECTIVENESS:	SCENARIO AREA #					
	1	2	3	4	5	6
A Coverage Only	0.599	0.819	0.668	0.455	0.514	0.347
B Coverage x Audience (Accessibility)	0.005	0.010	0.010	0.003	0.010	0.001
C Schedule-Weighted Accessibility	---	---	---	---	---	---

TABLE 8-21. SYSTEM EFFECTIVENESS RESULTS

SYSTEM - Public Coast Stations (Class IIB)

CHARACTERISTICS - Public Coast AM Stations Broadcasting to Installed AM Marine Radiotelephones.

LEVEL 1 EFFECTIVENESS:	SCENARIO AREA #					
	1	2	3	4	5	6
A Coverage Only	1.00	1.00	1.00	1.00	1.00	1.00
B Coverage x Audience (Accessibility)	0.070	0.070	0.080	0.020	0.070	0.022
C Schedule-Weighted Accessibility	---	0.001	0.002	---	0.001	0.001

TABLE 8-22. SYSTEM EFFECTIVENESS RESULTS

SYSTEM - COMMERCIAL BROADCAST SYSTEM

CHARACTERISTICS - Commercial AM and FM Stations Broadcasting to Users Equipped with Average Quality AM, FM or Combined AM/FM Portable Receivers.

LEVEL 1 EFFECTIVENESS:	SCENARIO AREA #					
	1	2	3	4	5	6
A Coverage Only	0.681	1.00	0.981	0.701	0.899	0.727
B Coverage x Audience (Accessibility)	0.249	0.300	0.299	0.262	0.276	0.205
C Schedule-Weighted Accessibility			SEE "COMMENTS"			

COMMENTS: Because of the large number of stations involved, considerable overlap in coverage, and the lack of regularly scheduled marine weather broadcasts, it is not possible to weight the accessibility of this system according to schedule. See "Direct Marine Broadcast Commercial System."

TABLE 8-23. SYSTEM EFFECTIVENESS RESULTS

SYSTEM - Direct Marine Broadcast Commercial System

CHARACTERISTICS - Commercial AM and FM Stations Broadcasting Regularly Scheduled Marine Weather Information to Users Equipped with Average Quality AM, FM or Combined AM/FM Portable Receivers.

LEVEL 1 EFFECTIVENESS:	SCENARIO AREA #					
	1	2	3	4	5	6
A Coverage Only	0.446	0.570	0.744	0.065	0.299	0.116
B Coverage x Audience (Accessibility)	0.184	0.169	0.286	0.044	0.116	0.041
C Schedule-Weighted Accessibility	0.003	0.012	0.004	0.001	0.002	---

TABLE 8-24. SYSTEM EFFECTIVENESS RESULTS

SYSTEM - Coastal Warning Display System

CHARACTERISTICS - Visual Displays Measured in Terms of Visibility to Water-Borne Observers During Daylight Hours.

LEVEL 1 EFFECTIVENESS:	SCENARIO AREA #					
	1	2	3	4	5	6
A Coverage Only	.007	.008	.006	.002	.005	.004
B Coverage x Audience* (Accessibility)	.007	.008	.006	.002	.005	.004
C Schedule-Weighted Accessibility	SEE "COMMENTS"					

COMMENTS: This system has no schedule since it is primarily a warning system. It is not possible, therefore, to determine a schedule-weighted accessibility.

*Audience is assumed to be 100% since this is a visual system.

SECTION 9

CONCLUSIONS

9.1 GENERAL PERFORMANCE

An examination of the effectiveness results given in Tables 8-17 through 8-24 reveals that the performance of existing Marine Weather Dissemination Systems is less than adequate to meet the needs of the recreational boatman. Accessibility, measured in terms of Coverage, Audience and Schedule, is extremely low. The probability of a scheduled broadcast reaching the average marine user on a random basis between the hours of 10:00 a.m. and 6:00 p.m. is 0.012 at best, and less than 0.001 in many cases.

This figure is difficult to interpret as a practical measure of service, and it is given mainly to provide a basis for valid, objective comparison between different systems. However, the figures measuring accessibility in terms of Coverage and Audience alone are also low. With the exception of the commercial broadcast systems, accessibility ranges from 0.001 to 0.017 for NWS and other VHF systems, and from 0.022 to 0.080 for 2-MHz band systems. In practical terms, this means that on the average, no more than two boatmen in 100 will access VHF broadcasts, or eight in 100 access the 2-MHz transmissions. In other areas access is as low as one in 1,000 and two in 100, respectively.

The commercial broadcast system shows some promise at this level. Due to its extensive coverage and the large number of commercial receivers in the hands of the public, this system has the capability to reach 30 percent of the marine users in most areas. Even if consideration of coverage is limited to those stations relaying regularly scheduled broadcasts directly from local weather forecast offices (and listed on the Marine Weather Services Charts published by the NWS), this system exhibits a capability of reaching between 4 and 28 percent of the boating population in all areas - considerably higher than any other system.

The Coastal Warning Display System is seen to have a low effectiveness similar to most of the noncommercial systems. It must be stressed, however, that this is not a realistic measure of its worth, since it is intended to operate in a preexcursion warning mode, not as a disseminator to waterborne boatmen. The measurements given are presented to provide a comparison with the other systems. An objective measure of this system's performance in its intended mode cannot be made within the scope of this study. CSC believes that this system should be regarded as a complement to the other systems analyzed in this study.

9.2 VALIDITY OF THE RESULTS

The measurements of coverage provided by each system are based on known parametric data and well established receiver performance estimates. The results are established with a high level of confidence.

Receiver distribution figures, on the other hand, are based on a variety of data, some less reliable than others. Figures for marine radiotelephones have been established with good confidence from FCC data, but those for NWS receivers and commercial AM/FM receivers must be regarded as engineering estimates.

Nevertheless, CSC feels that the difference in performance between the commercial system and other systems is sufficiently pronounced to establish its greater capability beyond doubt. Coverage limitations of the NWS system and the relatively small percentage of boatmen equipped with marine radiotelephone installations inherently limits this system in terms of overall accessibility. Although providing an essential service to certain groups of boatmen, the system cannot serve the needs of the majority of the casual recreational sailors, who represent about 90 percent of the recreational boating population.

9.3 FUTURE STUDY

CSC recognizes the organizational problems involved in the use of commercial broadcasters to disseminate essential marine weather information. The planned growth of the NWS 162.55-MHz and 162.40-MHz systems and the trend toward the use of more VHF-FM radiotelephone equipment are further factors acknowledged by the study team.

During Phase 3 the changes that may be brought about by these growth factors will be examined and measured against a postulated system designed to serve the majority of marine users in an effective manner. Operational, political, and economic implications will be taken into account, and the role of Coast Guard services in this area will be examined in the context of an overall Marine Weather Dissemination framework.

APPENDIX A

CHARACTERIZATION OF RECEIVER TYPES

A.1 INTRODUCTION

This appendix presents a detailed report of the test procedures used to characterize the performance of portable AM, FM, and VHF receivers. The resultant performance characterization, in the form of input/output curves, are also included.

The potential utility of a given weather dissemination system depends primarily on the parameters of the receivers being used since the parameters of the transmitters are more or less fixed. This is particularly true for commercial AM and FM broadcasts, where the types and qualities of receivers can greatly vary. The variability of receiver parameters is not nearly so great for Public Coast radiotelephone and Coast Guard VHF broadcasting systems, since these receivers are of the "installed" rather than "portable" variety.

A.2 SCOPE

Considerable effort was expended in gathering specifications on various kinds and types of receivers and on determining the precise meaning and definition of the performance parameters quoted by various manufacturers and suppliers. It soon became apparent that while much of the specification information was useful in comparing one receiver against another, it was virtually impossible in most cases to determine absolute receiver performance from it. The performance parameters of major interest are "sensitivity," which is a measure of the signal power required for a given level of performance; and "selectivity," which is a measure of a receiver's ability to reject out of band interfering signals.

In the case of "installed" receivers, such as VHF/FM and MF/AM radiotelephone equipment, the available specifications were consistent and sufficient to characterize an "average" receiver. For VHF/FM equipment, the average sensitivity was determined to be approximately 4 μV for Grade 3 service. This figure was corroborated in a survey reported in Reference 15. In the areas being studied for MF/AM receivers, the noise floor of the receivers will be determined by the atmospheric, or external, noise level (Appendix B). Hence, the absolute sensitivity of these receivers is not of major importance.

Unfortunately, specification data available and obtainable was inconsistent and not sufficient to characterize the performance range of portable receivers likely to be used by recreational boatmen to monitor commercial broadcasts or the NWS VHF/FM broadcasts. To this end, a series of tests was designed to allow performance predictions to be made, in terms of useful range, for these portable receivers. These tests were carried out with the cooperation of the U.S. Coast Guard, which provided marine transportation and equipment required, and the National Weather Service, which provided most of the receivers to be evaluated.

A.3 TEST PROCEDURE

In the design and planning of the tests, every effort was made to conform to EIA and/or IEEE standards and definitions wherever possible (References 15, 16, 17, 18, 19, 20, 21, 22 and 23). Specifically, the tests were performed using a 1-kHz tone, 60 percent modulation for AM, and 3.3-kHz peak deviation for FM. The measured sensitivity should be termed "radiation sensitivity," since the performance was plotted as a function of the signal strength at the antenna rather than at the input to the receiver (chassis sensitivity).

The outputs of the receivers were measured at the speaker terminations. The "signal + noise" measurement was made with a modulated sinusoidal 1-kHz tone applied to the receiver; the "noise" measurement was made with the modulation removed, but with carrier present. Audio output measurements were made as the input signal power was varied.

This type of testing was necessary since the available specifications were:

a. "Chassis sensitivity" numbers, which were referenced to a 50-ohm input impedance (determination of actual effective input impedances for the variety of available receivers was beyond the scope of the study).

b. In no way related to the wide range of variability in required signal power imposed by the different sizes, types, and qualities of antennas presently in use on commercially available receivers.

The purpose of these tests was to characterize the effect of receiver performance variations on the potential useful range of given weather dissemination broadcast systems. The tests were not designed to provide an absolute characterization of the performance of any one receiver or receiver type, and the results should not be interpreted in such a manner. Essentially, the tests provided a framework of control conditions within which it was possible to make a subjective evaluation of range limitations imposed by representative receivers with known relative performance parameters.

A.4 PERFORMANCE OF THE TESTS

Three types of tests were performed:

a. Open field tests under controlled conditions.

b. Laboratory tests under controlled conditions.

c. Subjective open field evaluation of actual broadcasts.

The receivers tested were of three types:

a. Portable AM broadcast receivers employing ferrite loop antennas.

b. Portable FM broadcast receivers employing extendible whip antennas.

c. Portable VHF-FM receivers employing extendible whip antennas; both fixed crystal tuned and variable tuned types.

The specific receivers tested were:

VHF - Sentry	-	Sonar FR103 - Ser. 1487743 (VHF & AM)
VHF Monitor	-	Lafayette - Stock No. 99-3531L
VHF Monitor	-	Hallicrafter - Model CRX-102
VHF Monitor	-	E.R.I. Multivox, Model 140 (VHF & AM)
VHF Monitor	-	Federal Sign and Signal - Model 1010 - Ser. 21222
VHF Monitor	-	Lafayette - PB-150 - Ser. 18310
Broadcast	-	Lafayette - Model 17-0167L (AM & FM)
Broadcast	-	Zenith - Royal - Model 51 (AM & FM)

The configuration of the test equipment is shown in Figures A-1 and A-2. The following equipment was used:

Stoddart Power Supply - Model 91923-2 - S.N. 66B156

Stoddart RI-FI Meter - NM-30A - S.N. 66AD81

Stoddart RI-FI Meter Assy. - NM-20B - S.N. 414-20

Stoddart Power Supply - Model 90780-2 - S.N. 414-20

High Frequency Antenna Kit - Model 91870-2

Loop Antenna Model 90298-2

Tripod - Model 91933-2

Cable Package

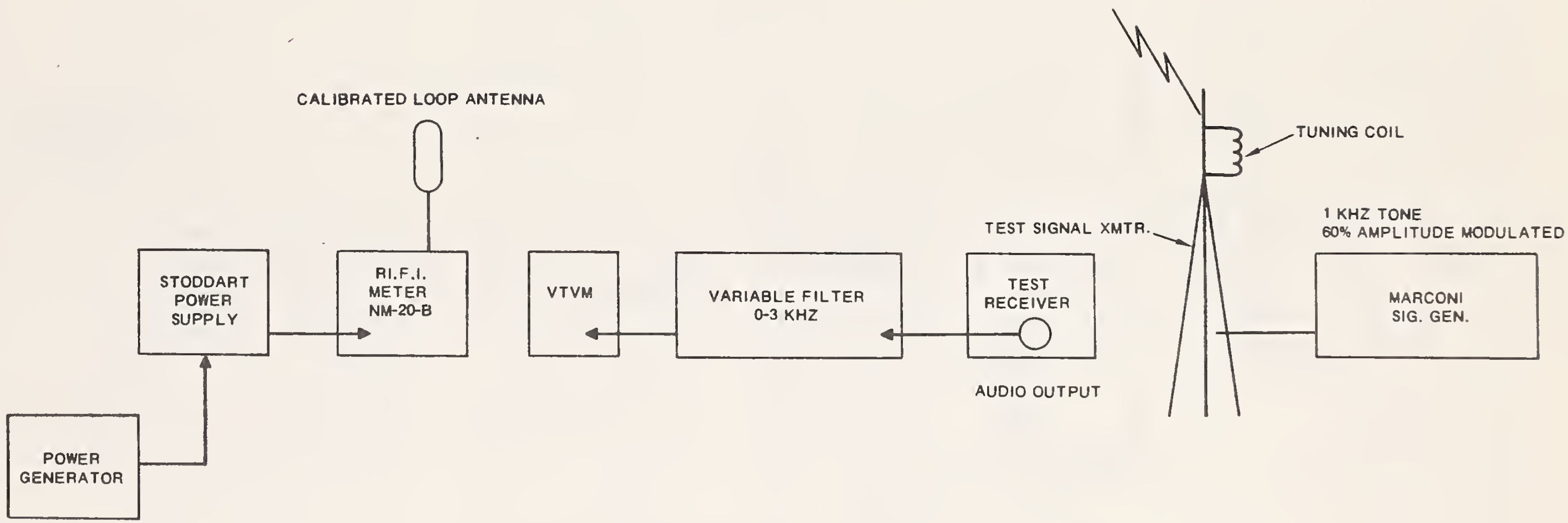

Figure A-1. Field Test Configuration - AM Portable Receivers

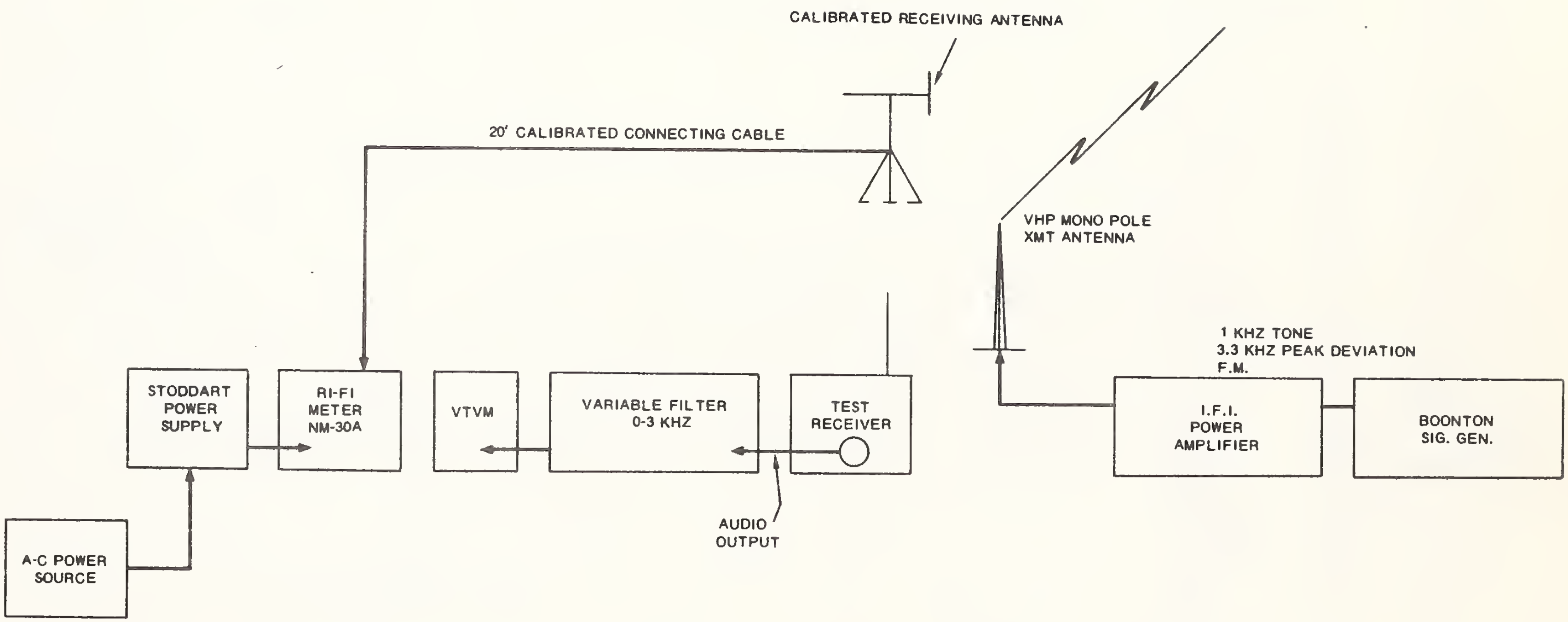

Figure A-2. Field Test Configuration for FM Portable Receivers

Marconi Signal Generator - Model TF144/H4 - S.N. 662500895

Ballentine RVTVM - Model 320A - S.N. 6538

R.I.I. Variable Filter - R-5000 Series

Tuning Coil - 92 μ Henry

100 ft. Power Extension Cord

Portable Power Generator

I.F.I. Power Amplifier - S.N. 01017

Boonton Signal Generator FM/AM - Type 202H - S.N. 662506893

The open field tests were performed at a site in Alexandria, Virginia. For the AM receiver tests, the receivers and field strength measuring equipment were located a little more than one-quarter mile from the transmitting antenna to ensure that the receivers would be located in the "farfield" of the transmitting antenna. Due to this requirement, it was not possible to perform additional testing of AM receivers within the confines of the laboratory.

The open field tests on FM receivers were performed in the same general location, but the distance between the test signal transmitter and the receivers was less than 200 feet. These tests were repeated within the laboratory using the same configuration depicted in Figure A-2 but different transmitting antenna.

For the AM receiver open field tests, the transmitted signal power was varied over a range that produced measured field strength at the receivers of from 400 μV/m to 5600 μV/m. For the FM receiver open field tests, received field strength was varied between 200 μV/m and 20,000 μV/m. These ranges of received field strength were adequate to ensure measurements from below receiver noise to saturation.

Laboratory tests were performed on the portable FM receivers over a range of signal strengths varying from 5 μV/m to 32,000 μV/m, as measured at the receiver. These tests were performed on two successive days under conditions of high and low external noise levels.

On 24 November, CSC personnel were taken aboard a 40-ft. Coast Guard boat from the Annapolis, Md., station. The test receivers were taken aboard and stops were scheduled at approximately 5-mile intervals so that receiver performance could be evaluated while actually monitoring commercial broadcasts and NWS station KHB-36. These evaluations were performed on the Chesapeake Bay between Annapolis and Cove Point. Commercial AM broadcasts were monitored from stations WBAL, WCAO, WPIK, and WNAV. Commercial FM broadcasts were monitored from stations WCAO and WNAV. The locations of each stop were determined by Coast Guard personnel so that each set of evaluations could be related to the distance from each of the transmitting sites. The expected field strength at each of the monitoring points was then determined by interpolating from these stations published field strength contours, using standard transmission curves of References 1 and 3.

A.5 RESULTS

The results of the above tests and evaluations were combined and are presented in the form of input/output characteristics in Figures A-3 through A-6. These curves are the result of averaging the measured data. They compared favorably with the subjective evaluation performed on the Chesapeake Bay. The curves represent the characteristics to be expected of commercially available portable receivers, and should not be interpreted as the "specified" or performance characteristics of any given receiver. Their main purpose is to provide a data base from which the expected effective range of various potential

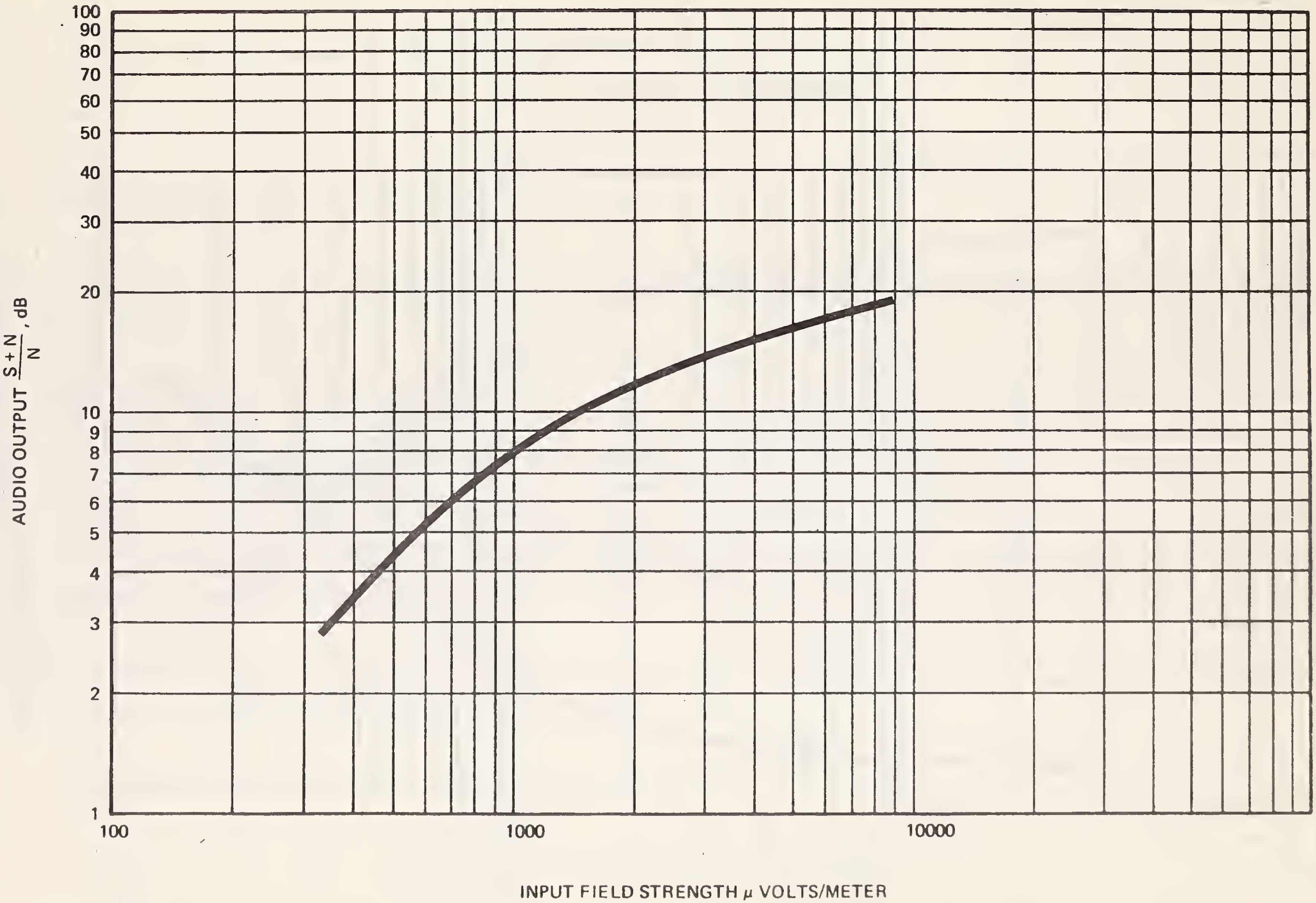

Figure A-3. Average Characteristics for Portables AM-Broadcast Receivers - Ferrite Loop Antenna

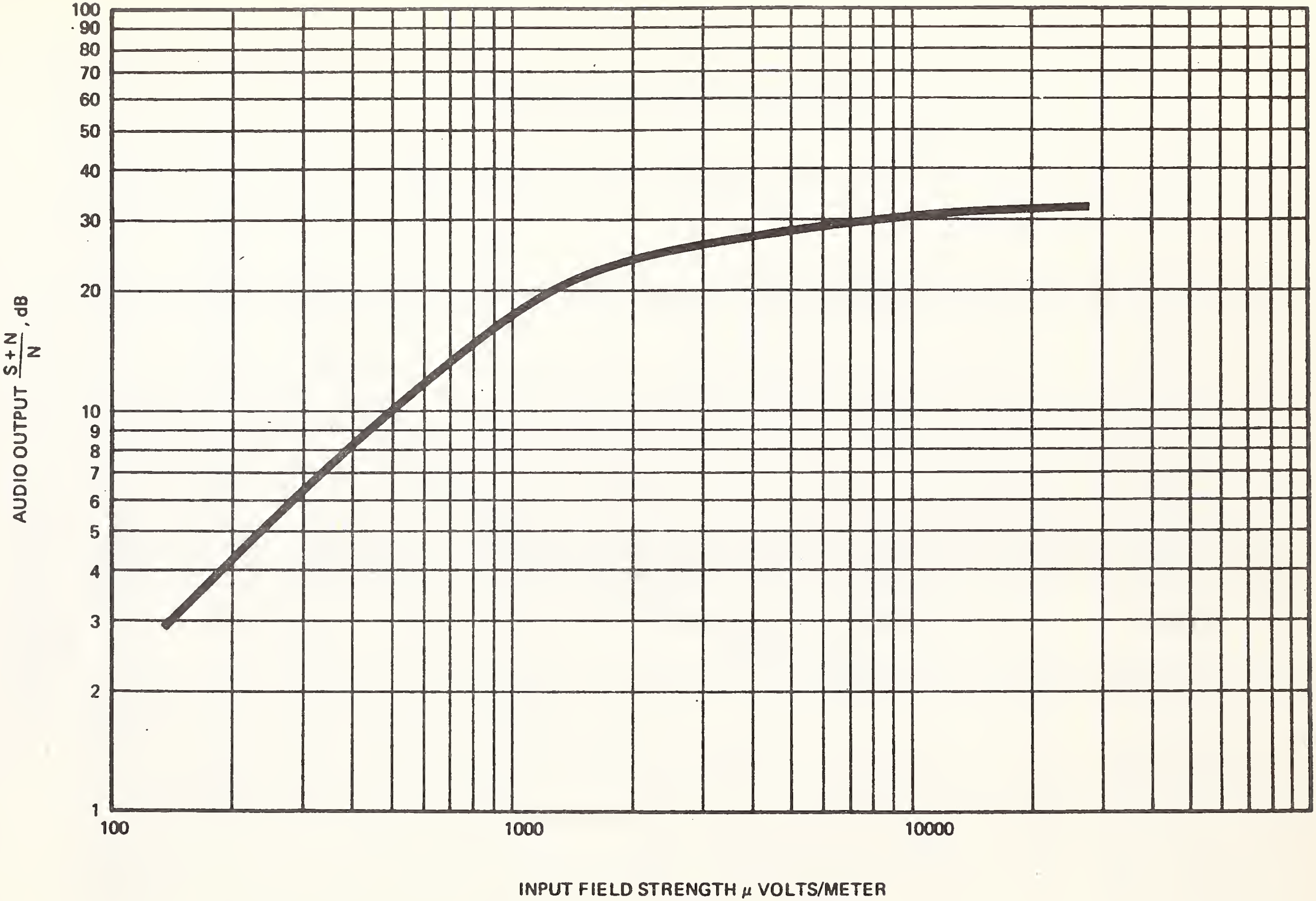

Figure A-4. Average Characteristics For Portable FM Broadcast Receivers Using "Whip" Antenna

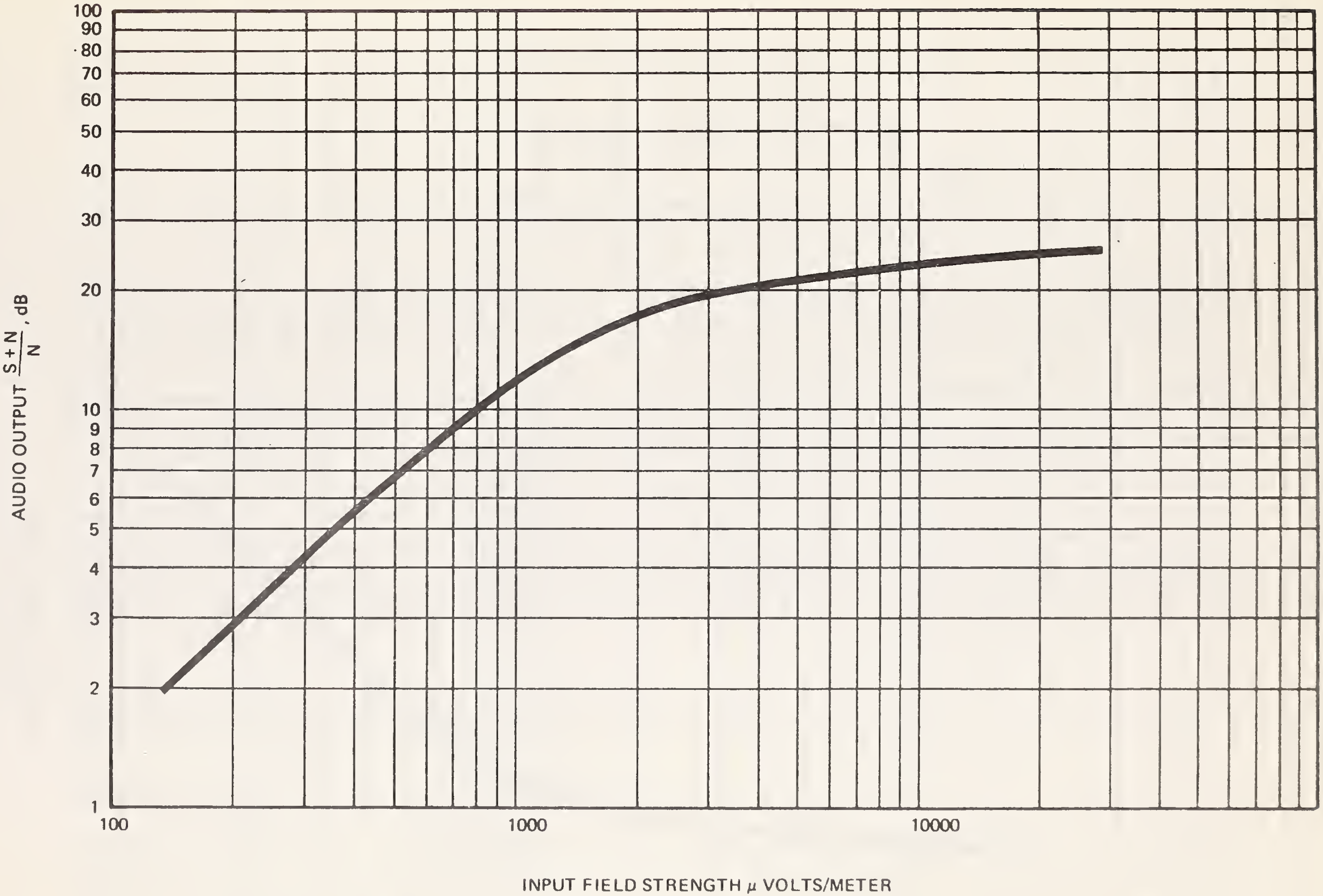

Figure A-5. Composite Characteristics of "Average" VHF Portable Receivers - Using "Whip" Antenna

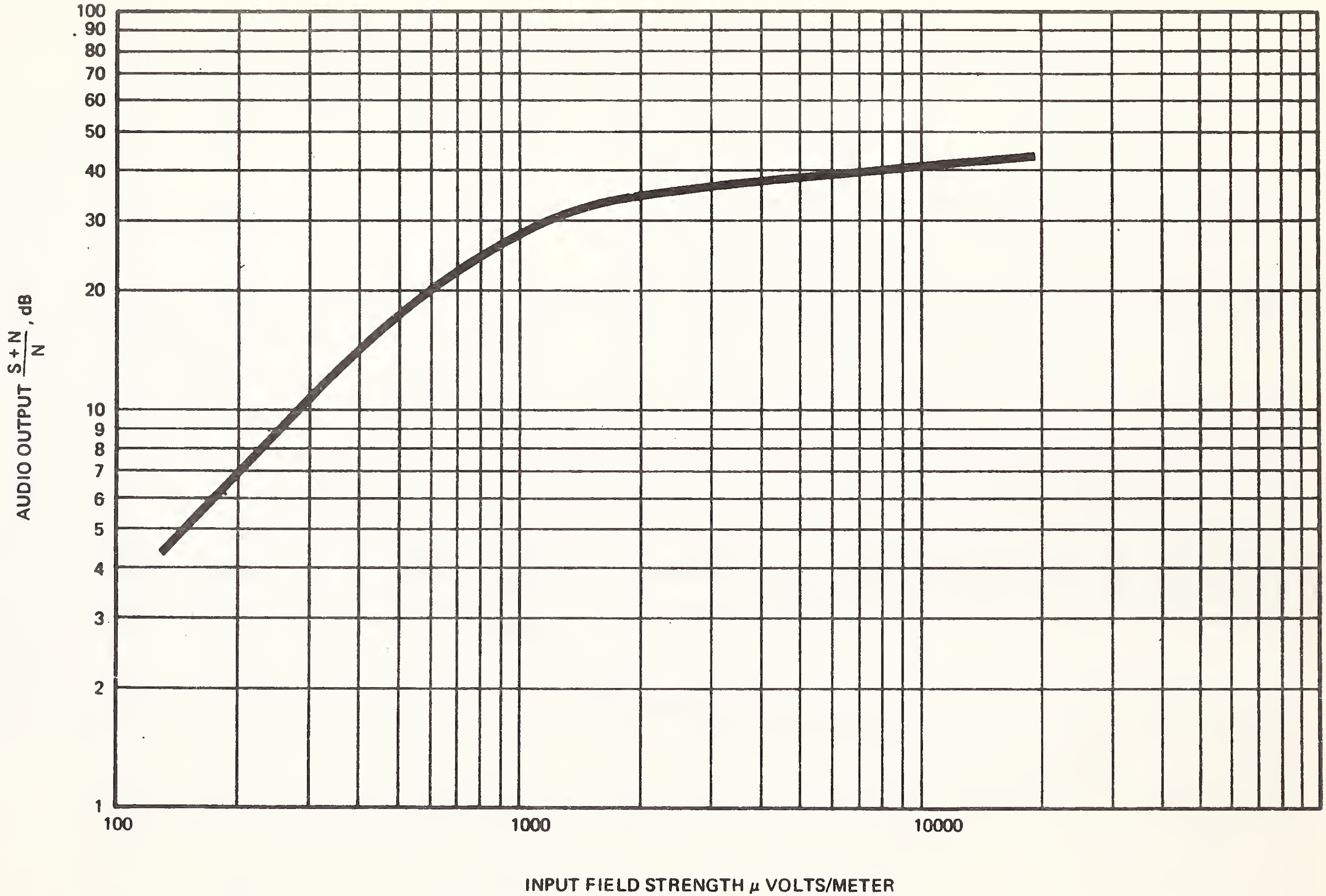

Figure A-6. Composite Characteristics of "Excellent" VHF Receivers Using "Whip" Antenna weather dissemination systems may be calculated. Evaluation and averaging procedures used in developing these curves represent conservative estimates. For this reason, it is felt that the "type" receivers characterized will for a great percentage of the time actually exhibit performance that will at least equal that represented in Figures A-3 through A-6.

Figures A-3 and A-4 represent the average characteristics to be expected from small, inexpensive portable receivers available for the AM and FM broadcast bands, respectively. Figure A-5 represents the average characteristics to be expected from small low to medium priced (under $80) receivers available for receiving in the VHF band, particularly those designed to include the NWS broadcasts at 162.55 MHz. Figure A-6 is representative of the performance to be expected from higher quality - more expensive - VHF receivers. The performance characteristics of this figure are considered "excellent."

A.6 CONCLUSIONS

As a result of this testing and evaluation a baseline has been developed for receiver performance. Due to the variety of receiver types examined and the variability of performance among individual receiver types, it was decided that an average characteristic, defined in Figures A-3, A-4, and A-5, would be most useful for determining system range limitation. It is also believed the development of an average curve minimizes differences of selectivity exhibited by the receivers tested, especially since tests performed under both high and low external noise conditions were included in the averaging. A major factor to be considered is the choice of an audio signal-to-noise ratio that is to be used in setting a minimum acceptable performance level. This choice is made difficult by a number of unknown factors. Specifically, the ambient noise level due to conversations, the noise of engines, or other disturbances due to the primary activity taking place aboard a boat is difficult to determine, nor is it possible to determine the distance of the boat operator from a radio receiver, especially when portable equipment is being used. Those two uncertainties compound the difficulty of determining which audio output signal-to-noise ratio would be minimally adequate to ensure that warnings or important factors in a given broadcast would not be missed or misunderstood. Consequently, it was decided that the criteria presently used for public mobile telephone service would be at least as valid as any that could be developed within the scope of this effort. Therefore, the adoption of circuit merit 3 as the minimum acceptable performance level was agreed upon. The grading of circuit merit levels is related to empirical testing involving measures of speech intelligibility as a function of a speech-to-noise ratio. Specifics of the development of this rating scheme may be found in the references. Receiver performance quality of circuit merit 3 implies a signal plus noise-to-noise ratio ranging between 9 and 16 dB. The range limitations imposed by the various receivers were determined by relating the input field strength requirements associated with a 9-dB S+N/N on the curves of Figures A-3, A-4, and A-5. Hence, for purposes of calculating coverage contours for commercial AM, FM, and VHF systems, the required signal field strengths were determined to be:

a. AM - 1200 μV/m

b. FM - 450 μV/m

c. VHF - 700 μV/m

APPENDIX B

EXTERNAL AND MANMADE RADIO NOISE

B.1 INTRODUCTION

To evaluate the limiting performance factors of the types of receivers being considered in the course of this study, the maximum noise levels to be expected in different portions of the radio band were determined.

For medium frequency AM radiotelephones, the maximum expected noise level was calculated at 2670 kHz. For commercial AM broadcasts, the noise level was determined at a frequency of 1000 kHz, which is approximately in the middle of the broadcast band. For receivers operating in the VHF/FM region, the noise levels were calculated at a frequency of 160 MHz.

In the AM broadcast and medium frequency radiotelephone bands, the maximum noise levels to be expected in each of the scenario areas were determined, as well as the season and local time block during which these maxima are expected to occur. The results are presented in Tables B-1 through B-5. It should be noted that the noise levels given are levels that will not be exceeded 90 percent of the time (90 percent service probability) and that they represent atmospheric noise. Fa is the "noise factor" expressed in decibels (Reference 24) and En is the rms noisefield strength for a 1-kHz bandwidth, expressed in decibels above 1 μV/m. E is the corresponding value of En, expressed in μV/m.

In the VHF/FM band used by the Coast Guard, Weather Service Continuous Broadcasts, and Public Coast Class III B radiotelephone receivers, the levels of galactic and manmade noise are calculated. Manmade noise levels are determined for urban, suburban, and rural environments (References 25 and 26). The results of these calculations are listed in Tables B-6 and B-7.

TABLE B-1. NOISE LEVEL, AREAS 1 AND 2

Chesapeake Bay New Jersey Coast	Summer 2000 to 2400 hrs
Frequency = 1 MHz	Fa = Fm + Du Fa = 90 + 9.8 = 99.8 dB
BW = 200 Hz	En = Fa + 20 log $\frac{f(mc)}{sec}$ - 65.5 = 34.3 dB above 1 μV/m E = 51.9 μV/m
Frequency = 2.67 MHz BW = 200 Hz	Fa = 76 + 8 = 84 dB En = 27.5 dB above 1 μV/m E = 23.9 μV/m

TABLE B-2. NOISE LEVEL, AREA 5

Oregon, Washington States	Fall, 1700 to 2100 hrs (Pacific)
1 MHz	Fa = Fm + Du Fa = 70 + 9.9 = 79.9 dB
BW = 200 Hz	En = 24.4 dB above 1 μV/m E = 16.6 μV/m
2.67 MHz	En = 11 dB above 1 μV/m E = 3.55 μV/m

TABLE B-3. NOISE LEVEL, AREA 4

Texas Gulf	Summer, 1900 to 2300 hrs
1 MHz BW = 200 Hz	Fa = Fm + Du Fa = 85 + 9.8 = 94.8 dB En = 29.3 dB above 1 μV/m E = 29.2 μV/m
2.67 MHz	Fa = 72.5 + 8.0 = 80.5 dB En = 24 dB above 1 μV/m E = 18.8 μV/m

TABLE B-4. NOISE LEVEL, AREA 3

South Florida	Summer, 2000 to 2400 hrs
1 MHz BW = 200 Hz	Fa = Fm + Du Fa = 90 + 9.8 = 99.8 dB En = 34.3 dB above 1 μV/m = 51.9 μV/m
2.67 MHz	Fa = 76 + 8 = 84 En = 27.5 dB above 1 μV/m

TABLE B-5. NOISE LEVEL, AREA 6

Great Lake Area	Summer, 1900 to 2300 hrs
Frequency = 1 MHz BW = 200 Hz	Fa = Fm + Du Fa = 90 + 9.8 = 99.8 dB En = 34.3 dB above 1 μV/m E = 51.9 μV/m
Frequency = 2.67 MHz	Fa = 76 + 8 = 84 dB En = 27.5 dB above 1 μV/m E = 23.9 μV/m

TABLE B-6. GALACTIC NOISE AT 160 MHz

$Ng = -\left(165 + 9.555 \ln\left(\frac{f}{3}\right)\right)$ (Reference 25)
f: frequency in MHz
Ng = -203 dBW (Reference 25, BW = 1 Hz)
Eg = 0.3 μV/m (Reference 26, BW = 10 kHz)

TABLE B-7. MANMADE NOISE

Manmade Noise BW = 1 Hz

$$Nm = No + b \log \left(\frac{f}{3}\right) \text{ dBW}$$

1. Urban No = -132.5 b = -22.5 $Du = D_e = 7.4$

$$Nm = -132.5 - 22.5 \log \frac{160}{3}$$

= -161.3 dBW (Reference 25, BW = 1 Hz)

Em = 15 μV/m (Reference 26, BW = 10 kHz)

2. Suburban No = -142.2 b = -24

$$Nm = -142.2 - 24 \log \frac{160}{3}$$

= -183.7 dBW (Reference 25, BW = 1 Hz)

Em = 9.5 μV/m (Reference 26, BN = 10 kHz)

3. Rural No = -155.4 b = -25

$$Nm = -155.4 - 25 \log \frac{160}{3}$$

= -198.6 dBW (Reference 25, BW = 1 Hz)

In Table B-6, Ng is the expected median value of the galactic noise power in dB relative to 1-W per 1-Hz bandwidth, and Eg is the galactic noise level expressed in μV/m in 10-kHz bandwidth.

In Table B-7, Nm is the manmade noise power in dB below 1 W per Hz. N and b are constants derived from measurements reported in Reference 25, and Em is the manmade noise level expressed in μV/m for a 10-kHz bandwidth.

B.2 PORTABLE RECEIVERS

For AM portable receivers with small ferrite loop antennas, a 1200-μV/m signal field strength is required at the input to the antenna to attain a 9-dB S+N/N ratio at the output. Modifying the atmospheric noise of Table B-1, noise in the 2-kHz signal bandwidth is

$$51.9\ \mu V/m \left(\sqrt{\frac{2\ kHz}{200\ Hz}}\right) = 164\ \mu V/m = Ne\ \text{(external noise)}$$

Therefore,

$$\text{input } S+Ne = 1200\ \mu V/m$$

$$\text{input } Ne = 164\ \mu V/m$$

$$\text{input } \frac{S+Ne}{Ne} = 20 \log \frac{1200}{164} = 17.5\ dB$$

Since this input signal level only results in a 9-dB output S+N/N, it would appear that the inefficiencies of the small antenna, combined with relatively poor receiver chassis sensitivity of the small portable radios modeled, limit performance to less than the expected from external noise limitations.

The external noise level is not very different for standard broadcast band FM portable receivers and VHF/FM receivers. Using the Urban noise level of Table B-7 of 15 μV/m in a 10-kHz bandwidth, an example similar to that for the AM case can be developed.

For FM broadcast band receivers a 450-μV/m input signal level is required to obtain a 9-dB $\frac{S+N}{N}$ at the receiver output.

As before: input S+Ne = 450 μV/m

input Ne = 15 μV/m

$$\text{input } \frac{S+Ne}{Ne} = 20 \log \frac{450}{15} = 29.4 \text{ dB}$$

Again it can be seen that the performance of these inexpensive portable receivers is limited by a combination of inefficient antenna and poor chassis sensitivity.

For the small portable NWS receivers, a 700-μV/m input is required to attain a 9-dB output $\frac{S+N}{N}$. Using calculations similar to the above, it can be seen that the same limitations apply.

B.3 INSTALLED RECEIVERS

When considering VHF/FM marine telephone receiver installations, calculations are made based on the assumption of a half-wave dipole receiving antenna and a chassis sensitivity of 4 μV. From the relationship expressing available power from a matched half-wave dipole, it can be shown that a received signal field strength of 11 μV/m is required at the antenna for 4 μV of signal be delivered to the receiver front end. Calculations based on receiver chassis sensitivity, then, inherently assume that signal-to-noise performance of the receiver is determined by the receiver sensitivity. Since a signal level of 11 μV/m will meet this requirement, it can be seen that for this assumption to be valid

$$\text{Input } \frac{S+Ne}{Ne} \geqslant \frac{S+N \text{ internal}}{N \text{ internal}}$$

since $\frac{S+N \text{ internal}}{N \text{ internal}}$ is taken to be at least 9 dB for minimally acceptable performance, then

$$\frac{S+Ne}{Ne} \geq 9 \text{ dB}$$

and since S must be at least 11 μV/m, the maximum allowable external noise level can be calculated as

$$20 \log \frac{11}{X} = 9 \text{ dB}$$

$$\frac{11}{X} = \text{alog } 0.45 = 2.8 \therefore x = 3.9 \ \mu V/m$$

It can be seen from Table B-7 that this will be true only in a rural noise environment and, hence, the performance of receivers operating in higher noise environments would be limited by external noise levels rather than chassis sensitivities.

Marine radiotelephone receivers operating in the 2670 (MF) band are of relatively high quality and operate with antennas whose effective length is significantly greater than the ferrite loop antennas used in portable receivers. The chassis sensitivity of these receivers is also known to be considerably better. Hence, the performance of these receivers will be determined primarily by the signal-to-external noise ratios of the available signal and noise field strengths.

B.4 CONCLUSIONS

From the noise levels predicted in the foregoing tables and the receiver characteristics of Appendix A, it can be seen that:

a. The performance/range limitation of the VHF/FM portable NWS receivers, as well as AM and FM commercial broadcast portable receivers, is essentially imposed by a combination of antenna system losses and poor sensitivity, rather than external noise levels.

b. VHF marine radiotelephones with receiver sensitivities of less than approximately 4 μV would be limited in range/performance in suburban and urban noise environments by the level of external noise. For receivers with values of sensitivity greater than 4 μV, performance limitations would tend to be imposed by their sensitivity rather than external noise levels.

c. AM marine radiotelephones operating in the MF band will, in most cases, have their range/performance limited by external noise levels rather than receiver sensitivity.

APPENDIX C

RECEIVER DISTRIBUTION DATA

This section is a compilation of the data used to derive a model distribution of radio receivers in the six scenario areas analyzed. The data fall generally into three categories:

- Boating Activity and Registration
- Equipment Distribution and Use
- Utilization of Weather Information Sources.

Data relating to boating activity gave little information about spatial distribution on the water. The best data were from the Department of Chesapeake Bay Affairs, Maryland, and from the state of Oregon. Numbers of boats registered in each county were listed and broken down according to size of boat. Oregon warned, however, that it was not possible to determine the numbers of boatmen on coastal waters since many boats registered in inland counties moved to the coast during the summer season. In both cases, the data represented only a portion of a scenario, and it was not possible to obtain corresponding information for the remaining portions served by adjacent states. A further problem was caused by the fact that a large percentage of boats in all areas are not required to be registered, and many of those that are registered may be used on waters distant from the state and county of residence since they are "trailer" boats. None of the state data provided information on the distribution of boats in terms of distance from shore. Only the Coast Guard SAR data and BSIS file provided such figures.

Surveys conducted to determine the distribution of communications equipment among users were generally drawn from samples not representative of the entire boating population, and in most cases from samples that were not sufficiently well-defined or controlled to permit extrapolation. Data from the BSIS file were the exception to this general rule, but the accuracy of this data was shown to be suspect in at least one area during checks on the validity of the initial model.

Some of the better surveys were those seeking to establish the degree of dependence placed on various sources of weather information by users in several areas. Once again, however, the sampling techniques applied precluded the extraction of valid statistical data, and in many cases no distinction was drawn between the use of a given source (such as commercial radio) on or off the water.

The data used are presented here as part of the documentation for the study. They appear, in many cases, in original form. They are identified by item numbers corresponding to those given in the table below.

BOATING ACTIVITY AND REGISTRATION DATA

ITEM NUMBER	TITLE
1	U.S. Coast Guard Publication CG-357 "Boating Statistics 1969."
2	State Boating Registration Data - Maryland
3	State Boating Registration Data - Virginia
4	State Boating Registration Data - Florida
5	State Boating Registration Data - Texas
6	State Boating Registration Data - Oregon
7	State Boating Registration Data - Washington
8	"Great Lakes Basin Framework Study - Appendix No. 9 - Navigation" Great Lakes Basin Commission.
9	Boating Statistics Information System - Distance From Shore by Activity Data (5th District Total)
10	Search and Rescue Statistics, U.S. Coast Guard

EQUIPMENT DISTRIBUTION AND USE DATA

ITEM NUMBER	TITLE
11	Federal Communication Commission Marine Radiotelephone License Application Data - Presentation by State.
12	Radio Technical Commission for Maritime Services - Survey Results
13	Communications Equipment Use Survey - CSC
14	Abstract from Office of Telecommunications Policy Letter
15	Navigational Equipment Survey - Geonautics, Inc.
16	Coast Guard Auxiliary Survey, District 8

UTILIZATION OF WEATHER INFORMATION SOURCES

ITEM NUMBER	TITLE
17	U.S. Coast Guard Weather Sources Survey, San Francisco Area.
18	U.S. Coast Guard Weather Sources Survey, Hawaii/ Honolulu
19	Extract from National Weather Service Survey, Eastern Region
20	Boating Statistics Information System - Weather Source Used by Activity Data (5th District Total)

Item 1. U.S. Coast Guard publication CG-357: "Boating Statistics - 1969".

This publication is not reproduced in this report since it is readily available.

ITEM 2

STATE OF MARYLAND

DEPARTMENT OF CHESAPEAKE BAY AFFAIRS
1825 Virginia Street
Annapolis, Maryland 21401

1970 BOATING REPORTS

TYPES OF REGISTERED VESSELS
AS OF DECEMBER 31, 1970

	Number	%
Runabouts	40301	58.7
Cruisers	15480	22.5
Work Boats	3091	4.5
Auxiliary Sail	1636	2.4
Sail	217	0.3
Other	7989	11.6
Total	68714	100.0

USES OF REGISTERED VESSELS

	Number	%
Pleasure	63529	92.5
Commercial	3441	5.0
Other	1744	2.5
Total	68714	100.0

STATE OF MARYLAND

DEPARTMENT OF CHESAPEAKE BAY AFFAIRS
1825 Virginia Street
Annapolis, Maryland 21401

1970 BOATING REPORT

BOATS REGISTERED IN MARYLAND - BY RESIDENCE OF OWNER AS OF DECEMBER 31, 1970

COUNTY	TYPE OF USE PLEAS.	COMM.	OTHER	TOTAL VALID CERTIFICATES	%
Allegany	542	0	6	548	0.8
Anne Arundel	9964	246	456	10666	15.5
Baltimore County	10319	113	114	10546	15.3
Baltimore City	4733	56	74	4863	7.1
Calvert	943	101	79	1123	1.6
Caroline	406	40	3	449	0.7
Carroll	452	1	5	458	0.7
Cecil	954	44	164	1162	1.7
Charles	1110	181	91	1382	2.0
Dorchester	1288	522	25	1835	2.7
Frederick	651	1	5	657	1.0
Garrett	324	1	85	410	0.6
Harford	1857	28	68	1953	2.8
Howard	596	5	4	605	0.9
Kent	708	240	25	973	1.4
Montgomery	4776	10	35	4821	7.0
Prince Georges	7472	29	57	7558	11.0
Queen Annes	787	258	74	1119	1.6
St. Marys	1736	398	115	2249	3.3
Somerset	788	390	14	1192	1.7
Talbot	1550	411	49	2010	2.9
Washington	581	2	4	587	0.9
Wicomico	1421	119	18	1558	2.3
Worcester	845	110	95	1050	1.5
TOTAL - MARYLAND	54803	3306	1665	59774	87.0
District of Columbia	1182	12	7	1201	1.7
Delaware	589	5	2	596	0.9
New Jersey	183	3	2	188	0.3
Pennsylvania	4857	10	32	4899	7.1
Virginia	1418	81	17	1516	2.2
West Virginia	180	0	1	181	0.3
All Other	156	0	0	156	0.2
Unknown	161	24	18	203	0.3
TOTAL OUT OF STATE	8726	135	79	8940	13.0
GRAND TOTAL	63529	3441	1744	68714	100.0

STATE OF MARYLAND

DEPARTMENT OF CHESAPEAKE BAY AFFAIRS
1825 Virginia Street
Annapolis, Maryland 21401

1970 BOATING REPORT

HOMEPORTS OF MARYLAND REGISTERED - BY COUNTY
AS OF DECEMBER 31, 1970

COUNTY	NUMBER OF BOATS	%
Anne Arundel	13215	19.2
Baltimore County	6018	8.7
Cecil	3258	4.7
St. Marys	2506	3.6
Dorchester	1980	2.9
Garrett	1680	2.4
Calvert	1513	2.2
Harford	1466	2.1
Talbot	1413	2.1
Kent	1291	1.9
Queen Annes	1253	1.8
Charles	965	1.4
Somerset	759	1.1
Worcester	653	1.0
Wicomico	504	0.7
Prince Georges	472	0.7
Washington	414	0.6
Montgomery	282	0.4
Caroline	170	0.2
Frederick	134	0.2
Baltimore City	123	0.2
Allegany	16	-
Carroll	10	-
Howard	9	-
Virginia	153	0.2
West Virginia	80	0.1
District of Columbia	77	0.1
Delaware	2	-
Total Boats Kept on water	40416	58.8
Trailer Boats Kept at home	27637	40.2
Unknown	661	1.0
Total Registered Boats	68714	100.0

STATE OF MARYLAND

DEPARTMENT OF CHESAPEAKE BAY AFFAIRS
1825 Virginia Street
Annapolis, Maryland 21401

1970 BOATING REPORT

HOMEPORTS OF REGISTERED VESSELS AS OF DECEMBER 31, 1970

RIVER OR PLACE	TOTAL VESSELS		ON TIDAL WATERS		ON NON-TIDAL WATERS	
	No.	%	No.	%	No.	%
Potomac River	4082	5.9	3180	8.4	902	33.3
Middle River	3435	5.1	3435	9.1	-	-
Severn River	3259	4.7	3259	8.6	-	-
Patapsco River	2971	4.3	2971	7.9	-	-
Magothy River	2440	3.6	2440	6.5	-	-
South	2388	3.5	2388	6.3	-	-
Patuxent River	1907	2.8	1872	5.0	35	1.3
Choptank River	1811	2.6	1811	4.8	-	-
Deep Creek Lake	1675	2.4	-	-	1675	61.8
Back River	1465	2.1	1465	3.9	-	-
Northeast River	1358	2.0	1358	3.6	-	-
Susquehanna River	1240	1.8	1240	3.3	-	-
Herring Bay Area	1222	1.8	1222	3.2	-	-
West River	961	1.4	961	2.6	-	-
Chester River	923	1.3	923	2.4	-	-
Elk River	771	1.1	771	2.0	-	-
Gunpowder River	635	0.9	635	1.7	-	-
Bush River	554	0.8	554	1.4	-	-
Sassafras River	506	0.7	506	1.3	-	-
Little Choptank River	446	0.6	446	1.2	-	-
Bayside, Calvert County	439	0.6	439	1.2	-	-
Miles River	433	0.6	433	1.2	-	-
Whitehall Bay	424	0.6	424	1.1	-	-
Ocean City	424	0.6	424	1.1	-	-
Wicomico River	395	0.6	395	1.0	-	-
Rock Hall	384	0.6	384	1.0	-	-
Kent Narrows	381	0.5	381	1.0	-	-
Nanticoke River	347	0.5	347	0.9	-	-
Bohemia River	297	0.4	297	0.8	-	-
Rhode River	285	0.4	285	0.8	-	-
Honga River	248	0.4	248	0.7	-	-
Eastern Bay	226	0.3	226	0.6	-	-
Tilghman Island	202	0.3	202	0.5	-	-
Fishing Bay	193	0.3	193	0.5	-	-
St. Jerome Creek	188	0.3	188	0.5	-	-
Little Annemessex River	174	0.3	174	0.5	-	-
Wye River	173	0.3	173	0.5	-	-
Pocomoke Sound $ River	165	0.2	165	0.4	-	-
Manokin River	160	0.2	160	0.4	-	-

(more)

HOMEPORTS (CONTINUED)

Smith Island	133	0.2	123	0.4	-	-
Horton Creek	99	0.1	99	0.2	-	-
Assawoman Bay	90	0.1	90	0.2	-	-
Chincoteague Bay						
Conowingo Lake	75	0.1	--	--	75	2.8
Deal Island	67	0.1	67	0.2	-	-
Bay Ridge Area	66	0.1	66	0.2	-	-
Kent Island, Bayside	47	0.1	47	0.1	-	-
Stillpond Creek	46	0.1	46	0.1	-	-
Big Annemessex River	39	0.1	39	0.1	-	-
Fairlee Creek	37	0.1	37	0.1	-	-
Monocacy River	23	-	-	-	23	0.1
C. & D Canal	14	-	14			
Youghegheny River	5	-	-	-	5	-
Total on Water	40416	58.8	37701	100.0	2715	100.0
Trailer Boats (Home)	27637	40.2				
Unknown	661	1.0				
TOTAL VESSELS	68714	100.0				

TOTALS

	As of Dec. 31, 1970		As of Dec. 31, 1969		Increase	
	No.	%	No.	%	No.	%
On Tidal Waters	37701	54.9	37621	57.8	80	0.2
On Non-Tidal Waters	2715	3.9	2678	4.1	37	1.4
Total on Waters	40416	58.8	40299	61.9	117	0.3
On Trailers	27637	40.2	24327	37.3	3310	13.6
Unknown	661	1.0	554	0.8	107	18.6
Grand Total	68714	100.0	65180	100.0	3534	5.4

VESSELS ON TIDAL WATERS

	No.	% on Tidal Water	% Total Vessels
Susquehanna R, Thru Herring Bay	21345	56.6	31.0
South of Herring Bay Thru Potomac R.	5679	15.1	8.3
Northeast R. Thru Choptank R.	7708	20.4	11.2
South of Choptank R. Thru Pocomoke R.	2367	6.3	3.5
Ocean Areas	602	1.6	0.9
Total	37701	100.0	54.9
Western Shore	27024	71.6	39.4
Eastern Shore	10677	28.4	15.5
Total	37701	100.0	54.9
Northern Bay (C & D Canal Thru Choptank river and Herring Bay)	29053	77.1	42.3
Southern Bay (South of Choptank R. and Herring Bay)	8648	22.9	12.6
Total	37701	100.0	54.9

STATE OF MARYLAND

DEPARTMENT OF CHESAPEAKE BAY AFFAIRS
1825 Virginia Street
Annapolis, Maryland 21401

1970 BOATING REPORT

TRAILER BOATS KEPT AT HOME - By County
AS OF DECEMBER 31, 1970

COUNTY	NUMBER	%
Allegany	140	0.5
Anne Arundel	3362	12.2
Baltimore County	4301	15.6
Baltimore City	1939	7.0
Calvert	381	1.4
Caroline	252	0.9
Carroll	340	1.2
Cecil	287	1.0
Charles	613	2.1
Dorchester	473	1.7
Frederick	426	1.5
Garrett	54	0.2
Harford	904	3.3
Howard	377	1.4
Kent	292	1.1
Montgomery	2714	9.8
Prince George's	4771	17.3
Queen Anne's	317	1.1
St. Mary's	628	2.3
Somerset	504	1.8
Talbot	585	2.1
Washington	234	0.8
Wicomico	1065	3.9
Worcester	586	2.1
Total - Maryland	25545	92.4
District of Columbia	316	1.2
Delaware	84	0.3
New Jersey	29	0.1
Pennsylvania	1272	4.6
Virginia	257	0.9
West Virginia	30	0.1
All Other	104	0.4
Total Out of State	2092	7.6
Grand Total	27637	100.0

ITEM 3

FORM APPROVED BUREAU OF BUDGET NO 04-R3056

DEPARTMENT OF TRANSPORTATION
U. S. COAST GUARD
CGHQ-3923 (Rev. 9-68)

REPORT OF CERTIFICATES OF NUMBER ISSUED TO BOATS

(Total Valid State Certificates Outstanding To Date)

FOR YEAR ENDING: 70

STATE OR TERRITORY OF: Virginia

VESSELS PROPELLED BY INBOARD OR OUTBOARD MOTORS

HULL MATERIAL	UNDER 16 FEET					16 TO LESS THAN 26 FEET					26 TO LESS THAN 40 FEET				
	INBOARD	OUTBOARD	INBOARD OUTBOARD	AUXILIARY SAIL INBOARD	AUXILIARY SAIL OUTBOARD	INBOARD	OUTBOARD	INBOARD OUTBOARD	AUXILIARY SAIL INBOARD	AUXILIARY SAIL OUTBOARD	INBOARD	OUTBOARD	INBOARD OUTBOARD	AUXILIARY SAIL INBOARD	AUXILIARY SAIL OUTBOARD
WOOD	107	10258				3188	11688				3995	130			
FIBERGLASS (Plastic)	165	15854				4852	14420				395	22			
ALUMINUM	24	4840				157	1980				69	71			
STEEL	20	78				60	296				99	82			
OTHER					9				381	11					
TOTAL	316	31030			9	8257	28384		381	11	4558	305			

HULL MATERIAL	40 TO 65 FEET					OVER 65 FEET					TOTAL				
	INBOARD	OUTBOARD	INBOARD OUTBOARD	AUXILIARY SAIL INBOARD	AUXILIARY SAIL OUTBOARD	INBOARD	OUTBOARD	INBOARD OUTBOARD	AUXILIARY SAIL INBOARD	AUXILIARY SAIL OUTBOARD	INBOARD	OUTBOARD	INBOARD OUTBOARD	AUXILIARY SAIL INBOARD	AUXILIARY SAIL OUTBOARD
WOOD	216	6									7506	22082			
FIBERGLASS (Plastic)	40	3									5452	30299			
ALUMINUM	11	2									261	6893			
STEEL	42	5									221	461			
OTHER														381	20
TOTAL	309	16									13440	59735		381	20

OTHER WATERCRAFT

HULL MATERIAL	NOT MECHANICALLY PROPELLED			AIR BOATS	JETS	OTHER	TOTAL
	ROWBOATS	SAILBOATS	CANOES				
WOOD							73
FIBERGLASS (Plastic)							125
ALUMINUM							6
STEEL							2
OTHER							
TOTAL							206

SCOPE OF CURRENT NUMBERING SYSTEM

Motorboats having a total propulsion force of 10 or more horsepower.

Total Virginia registration as of December 31, 1970
73,782

COMMENTS (Continue on Plain paper or reverse)

Auxiliary Sail figures were only separated for part of the year. Majority of this type boat were just classified as either inboard or outboard. Inboard-outboard are listed with inboard.

PREVIOUS EDITION MAY BE USED

ITEM 4

FORM APPROVED BUREAU OF BUDGET NO. 04-R3056

DEPARTMENT OF TRANSPORTATION U. S. COAST GUARD CGHQ-3923 (Rev. 9-68)	REPORT OF CERTIFICATES OF NUMBER ISSUED TO BOATS (Total Valid State Certificates Outstanding To Date)	FOR YEAR ENDING June 30, 1969	STATE OR TERRITORY OF Florida

VESSELS PROPELLED BY INBOARD OR OUTBOARD MOTORS

HULL MATERIAL	UNDER 16 FEET					16 TO LESS THAN 26 FEET					26 TO LESS THAN 40 FEET				
	INBOARD	OUTBOARD	INBOARD OUTBOARD	AUXILIARY SAIL INBOARD	AUXILIARY SAIL OUTBOARD	INBOARD	OUTBOARD	INBOARD OUTBOARD	AUXILIARY SAIL INBOARD	AUXILIARY SAIL OUTBOARD	INBOARD	OUTBOARD	INBOARD OUTBOARD	AUXILIARY SAIL INBOARD	AUXILIARY SAIL OUTBOARD
WOOD	528	31,675			394	7,975	15,323			420	6,266	303			62
FIBERGLASS (Plastic)	515	59,550			653	14,163	45,022			1,100	2,450	219			92
ALUMINUM	180	10,983			1,026	234	2,746			38	128	85			6
STEEL	39	177			76	127	176			4	202	64			5
OTHER	14	1,230			45	121	658			32	17	3			4
TOTAL	1,276	103,615			2,194	22,620	63,925			1,594	9,063	674			169

HULL MATERIAL	40 TO 65 FEET					OVER 65 FEET					TOTAL				
	INBOARD	OUTBOARD	INBOARD OUTBOARD	AUXILIARY SAIL INBOARD	AUXILIARY SAIL OUTBOARD	INBOARD	OUTBOARD	INBOARD OUTBOARD	AUXILIARY SAIL INBOARD	AUXILIARY SAIL OUTBOARD	INBOARD	OUTBOARD	INBOARD OUTBOARD	AUXILIARY SAIL INBOARD	AUXILIARY SAIL OUTBOARD
WOOD	2,685	43		45		216	2		8		17,670	47,346		53	876
FIBERGLASS (Plastic)	310	15		10		10	9				17,448	104,815		10	1,845
ALUMINUM	28	1				1	3				571	13,818			1,070
STEEL	122	5		9		68			13		558	422		22	85
OTHER	3	1		2							-55	1,892		2	81
TOTAL	3,148	65		66		295	14		21		36,402	168,293		87	3,957

OTHER WATERCRAFT

HULL MATERIAL	NOT MECHANICALLY PROPELLED ROWBOATS	NOT MECHANICALLY PROPELLED SAILBOATS	NOT MECHANICALLY PROPELLED CANOES	AIR BOATS	JETS	OTHER	TOTAL
WOOD							
FIBERGLASS (Plastic)							
ALUMINUM							
STEEL							
OTHER							
TOTAL							

SCOPE OF CURRENT NUMBERING SYSTEM: 208,739

COMMENTS (Continue on Plain paper or reverse)

PREVIOUS EDITION MAY BE USED

ITEM 5

TEXAS PARKS AND WILDLIFE DEPARTMENT BOAT REGISTRATION STATISTICS

CODE	-COUNTY- NAME	CLASS	COUNT	HULL	COUNT	PROP - FUEL	COUNT	USE	COUNT	USE	COUNT
020	BRAZORIA	UNDER 16	2,463	WOOD	970	OUTBOARD	3,327	PLEASURE	3,516	OTHER	
		16 TO 26	1,135	STEEL	25	IN OR IN/OUT	355	LIVERY	51	POLITICAL	
		26 TO 40	95	ALUM	798	OTHER	17	COM-FISH	76	COM-NO-FEE	2
		40 TO 66	5	F GLS	1,783	GASOLINE	3,668	COM-OTHER	54	DEALERS	
		OVER 65	1	OTHER	123	DIESEL	29				
		TOTAL	3,699			OTHER	2				
029	CALHOUN	UNDER 16	736	WOOD	520	OUTBOARD	955	PLEASURE	903	OTHER	2
		16 TO 26	342	STEEL	19	IN OR IN/OUT	225	LIVERY	25	POLITICAL	30
		26 TO 40	109	ALUM	306	OTHER	11	COM-FISH	92	COM-NO-FEE	70
		40 TO 66	4	F GLS	305	GASOLINE	1,135	COM-OTHER	69	DEALERS	
		OVER 65		OTHER	41	DIESEL	56				
		TOTAL	1,191			OTHER					
031	CAMERON	UNDER 16	1,015	WOOD	537	OUTBOARD	1,328	PLEASURE	1,372	OTHER	1
		16 TO 26	488	STEEL	5	IN OR IN/OUT	208	LIVERY	27	POLITICAL	2
		26 TO 40	31	ALUM	212	OTHER	2	COM-FISH	45	COM-NO-FEE	49
		40 TO 66	3	F GLS	680	GASOLINE	1,531	COM-OTHER	42	DEALERS	
		OVER 65	1	OTHER	104	DIESEL	7				
		TOTAL	1,538			OTHER					
084	GALVESTON	UNDER 16	2,699	WOOD	1,751	OUTBOARD	4,169	PLEASURE	4,283	OTHER	
		16 TO 26	1,985	STEEL	37	IN OR IN/OUT	751	LIVERY	155	POLITICAL	34
		26 TO 40	237	ALUM	498	OTHER	15	COM-FISH	195	COM-NO-FEE	106
		40 TO 66	12	F GLS	2,483	GASOLINE	4,853	COM-OTHER	162	DEALERS	
		OVER 65	2	OTHER	166	DIESEL	74				
		TOTAL	4,935			OTHER	8				
131	KENEDY	UNDER 16	5	WOOD	1	OUTBOARD	7	PLEASURE	8	OTHER	
		16 TO 26	2	STEEL		IN OR IN/OUT	1	LIVERY		POLITICAL	
		26 TO 40	1	ALUM	1	OTHER		COM-FISH		COM-NO-FEE	
		40 TO 66		F GLS	6	GASOLINE	8	COM-OTHER		DEALERS	
		OVER 65		OTHER		DIESEL					
		TOTAL	8			OTHER					

TEXAS PARKS AND WILDLIFE DEPARTMENT BOAT REGISTRATION STATISTICS (Continued)

CODE	-COUNTY- NAME	CLASS	COUNT	HULL	COUNT	PROP - FUEL	COUNT	USE	COUNT	USE	COUNT
137	KLEBERG	UNDER 16	255	WOOD	153	OUTBOARD	409	PLEASURE	420	OTHER	
		16 TO 26	193	STEEL	2	IN OR IN/OUT	46	LIVERY	6	POLITICAL	4
		26 TO 40	9	ALUM	53	OTHER	2	COM-FISH	7	COM-NO-FEE	11
		40 TO 66		F GLS	232	GASOLINE	456	COM-OTHER	9	DEALERS	
		OVER 65		OTHER	17	DIESEL	1				
		TOTAL	457			OTHER					
158	MATAGORDA	UNDER 16	651	WOOD	462	OUTBOARD	920	PLEASURE	891	OTHER	
		16 TO 26	368	STEEL	6	IN OR IN/OUT	147	LIVERY	23	POLITICAL	4
		26 TO 40	54	ALUM	200	OTHER	8	COM-FISH	73	COM-NO-FEE	35
		40 TO 66	2	F GLS	374	GASOLINE	1,044	COM-OTHER	49	DEALERS	
		OVER 65		OTHER	33	DIESEL	30				
		TOTAL	1,075			OTHER	1				
178	NUECES	UNDER 16	2,931	WOOD	1,591	OUTBOARD	4,261	PLEASURE	4,530	OTHER	
		16 TO 26	1,814	STEEL	36	IN OR IN/OUT	685	LIVERY	64	POLITICAL	23
		26 TO 40	155	ALUM	658	OTHER	22	COM-FISH	99	COM-NO-FEE	99
		40 TO 66	7	F GLS	2,323	GASOLINE	4,862	COM-OTHER	93	DEALERS	
		OVER 65	1	OTHER	300	DIESEL	42				
		TOTAL	4,908			OTHER	4				
196	REFUGIO	UNDER 16	235	WOOD	125	OUTBOARD	322	PLEASURE	310	OTHER	
		16 TO 26	108	STEEL	2	IN OR IN/OUT	26	LIVERY	2	POLITICAL	2
		26 TO 40	6	ALUM	64	OTHER	2	COM-FISH	11	COM-NO-FEE	9
		40 TO 66	1	F GLS	146	GASOLINE	348	COM-OTHER	16	DEALERS	
		OVER 65		OTHER	13	DIESEL	2				
		TOTAL	350			OTHER					
285	SAN PATRICIO	UNDER 16	1,042	WOOD	510	OUTBOARD	1,325	PLEASURE	1,352	OTHER	2
		16 TO 26	406	STEEL	23	IN OR IN/OUT	196	LIVERY	22	POLITICAL	5
		26 TO 40	66	ALUM	304	OTHER	3	COM-FISH	51	COM-NO-FEE	54
		40 TO 66	10	F GLS	625	GASOLINE	1,494	COM-OTHER	38	DEALERS	
		OVER 65		OTHER	62	DIESEL	27				
		TOTAL	1,524			OTHER	3				

TEXAS PARKS AND WILDLIFE DEPARTMENT BOAT
REGISTRATION STATISTICS (Continued)

CODE	-COUNTY- NAME	CLASS	COUNT	HULL	COUNT	PROP - FUEL	COUNT	USE	COUNT	USE	COUNT
245	WILLACY	UNDER 16	221	WOOD	125	OUTBOARD	299	PLEASURE	293	OTHER	
		16 TO 26	113	STEEL	4	IN OR IN/OUT	43	LIVERY	4	POLITICAL	1
		26 TO 40	9	ALUM	23	OTHER	2	COM-FISH	25	COM-NO-FEE	16
		40 TO 66	1	F GLS	168	GASOLINE	339	COM-OTHER	5	DEALERS	
		OVER 65		OTHER	24	DIESEL	5				
		TOTAL	344			OTHER					

ITEM 6

Enclosed is a data processing listing of the number of boats registered by hull length.

Under propulsion code, the following applies:

1 - Outboard	3 - Sail
2 - Inboard	4 - Steam
5 - Other	

The code for the hull material is:

1 - Aluminum	3 - Wood
2 - Steel	4 - Plastic or Fiberglas
5 - Other	

In those counties which encompass the region from Florence to Astoria, the following number of boats are registered:

Lane - 10,370	Lincoln - 1,771
Tillamook - 1,221	Clatsop - 1,497

I am sure you realize that local registration does not, nor will it, reflect the true use of coastal waters; and perhaps more uses of those waters are made by boats registered in the more populous areas of Multnomah County (Portland) and the Willamette Valley.

This is especially true during the summer sport fishing season when the inland boat owners move their vessels to the coast for summer moorage. Many others are trailered for a day's or weekend's use.

In Lane County there is but one access to the ocean -- the Siuslaw River. The majority of the 10,370 boats in Lane County are used in the reservoirs and lakes in the Eugene area. I do not mean to indicate that the Siuslaw and adjacent ocean waters are not used, for they are -- and heavily. But this use is by only a small percentage of Lane County's boats compared to the total county registration. Out-of-county boats supplement the use, also. The same will be found at the other coastal ports, especially Astoria where during the summer season more Multnomah County boats will be found than the local Clatsop County boats.

Under separate cover there has been mailed a listing of the boats registered in Lane, Lincoln, Tillamook, and Clatsop counties. Under the "M - P - U" column, the letter "U" indicates the primary use of the vessel. Number 1 is for pleasure; 2 - livery; 3 - dealer; 4 - manufacturer; 5 - commercial fishing; 6 - commercial passenger; 7 - tug; and 8 - other.

If we can be of further assistance, please write.

Very truly yours,

R. F. Rittenhouse

R. F. Rittenhouse
Director

RFR:mt

OREGON — COUNTY DISTRIBUTION BY LENGTH — UNDER 16 / 16 AND OVER (FEET)

COUNTY	UNDER 16 FEET	16 FEET AND OVER	
NOT OREGON	0	2	
BAKER	86	515	
BENTON	351	1322	
CLACKAMAS	1754	5265	
CLATSOP	557	940	
COLUMBIA	458	946	
COOS	872	2978	
CROOK	67	380	
CURRY	367	593	
DESCHUTES	263	2087	
DOUGLAS	787	2917	
GILLIAM	17	57	
GRANT	26	205	
HARNEY	12	205	
HOOD RIVER	103	326	
JACKSON	681	3802	
JEFFERSON	87	387	
JOSEPHINE	280	1396	
KLAMATH	390	2438	
LAKE	10	136	
LANE	2395	7975	
LINCOLN	447	1324	
LINN	743	2746	
MALHEUR	116	725	
MARION	1147	3915	
MORROW	35	126	
MULTNOMAH	5821	12987	
POLK	267	822	
SHERMAN	31	64	
TILLAMOOK	338	883	
UMATILLA	228	806	
UNION	97	394	
WALLOWA	31	159	
WASCO	153	492	
WASHINGTON	1430	3398	
WHEELER	5	35	
YAMHILL	324	1016	
COUNTY TOTALS	20776	64754	85530

LENGTH FEET	PROPULSION (CODE)	HULL MATERIAL 1	2	3	4	5	TOTAL
5	1	0	0	0	0	0	0
	2	0	0	0	0	0	0
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	0	0	0	0
6	1	0	0	2	4	1	7
	2	0	0	0	6	0	6
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	2	10	1	13
7	1	0	0	37	7	0	44
	2	0	0	0	7	0	7
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	1	0	1
		0	0	37	15	0	52
8	1	7	1	191	70	0	269
	2	0	1	2	27	0	30
	3	0	0	0	1	0	1
	4	0	0	0	0	0	0
	5	0	0	0	3	0	3
		7	2	193	101	0	303
9	1	40	0	142	74	1	257
	2	0	0	2	1	0	3
	3	0	0	0	1	0	1
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		40	0	144	76	1	261

LENGTH FEET	PROPULSION (CODE)	HULL MATERIAL 1	2	3	4	5	TOTAL
10	1	256	5	318	726	25	1330
	2	0	0	1	4	0	5
	3	1	0	0	2	0	3
	4	0	0	0	0	0	0
	5	0	0	0	1	0	1
		257	5	319	733	25	1339
11	1	7021	34	2384	2401	100	11940
	2	3	0	4	1	0	8
	3	1	0	3	1	0	5
	4	1	0	0	0	0	1
	5	4	0	2	1	0	7
		7030	34	2393	2404	100	11961
12	1	2527	21	876	1622	63	5109
	2	1	1	9	3	0	14
	3	0	0	12	21	1	34
	4	0	0	0	0	0	0
	5	2	0	1	1	0	4
		2530	22	898	1647	64	5161
13	1	1354	49	4738	3352	156	9649
	2	5	20	13	6	1	45
	3	2	0	50	90	0	142
	4	0	0	0	0	0	0
	5	1	0	2	1	0	4
		1362	69	4803	3449	157	9840
14	1	3626	30	5240	7930	323	17149
	2	1	17	33	60	1	118
	3	1	1	46	228	3	279
	4	0	0	0	0	0	0
	5	2	0	12	4	1	19
		3630	48	5331	8222	328	17565

LENGTH FEET	PROPULSION (CODE)	HULL MATERIAL 1	2	3	4	5	TOTAL
15	1	757	30	5714	7391	180	14072
	2	9	6	170	360	3	548
	3	1	0	77	50	1	129
	4	0	0	0	0	0	0
	5	1	0	6	2	0	9
		768	36	5967	7803	184	14758
16	1	728	15	1308	3474	47	5572
	2	23	27	198	942	5	1195
	3	0	2	21	60	1	84
	4	0	0	0	0	0	0
	5	0	0	3	20	0	23
		751	44	1530	4496	53	6874
17	1	100	5	1254	2076	40	3475
	2	15	2	232	1313	8	1570
	3	2	0	15	72	8	97
	4	0	0	0	0	0	0
	5	1	0	4	13	1	19
		118	7	1505	3474	57	5161
18	1	508	10	1139	737	14	2408
	2	216	5	232	966	2	1421
	3	0	0	67	26	2	95
	4	0	0	0	1	0	1
	5	4	0	5	20	0	29
		728	15	1443	1750	18	3954
19	1	29	7	800	275	8	1119
	2	17	6	192	407	0	622
	3	0	0	41	37	0	78
	4	0	0	1	0	0	1
	5	1	0	1	10	0	12
		47	13	1035	729	8	1832

LENGTH FEET	PROPULSION (CODE)	HULL MATERIAL 1	2	3	4	5	TOTAL
20	1	22	14	523	120	1	680
	2	3	15	195	299	2	514
	3	0	0	10	36	0	46
	4	0	0	0	0	0	0
	5	0	0	1	5	0	6
		25	29	729	460	3	1246
21	1	37	2	308	39	0	386
	2	110	5	180	177	1	473
	3	0	0	8	35	0	43
	4	0	0	0	0	0	0
	5	0	0	0	4	0	4
		147	7	496	255	1	906
22	1	4	7	203	23	1	238
	2	24	37	237	48	1	347
	3	0	2	4	36	0	42
	4	0	1	0	0	0	1
	5	0	0	0	0	0	0
		28	47	444	107	2	628
23	1	24	1	69	13	0	107
	2	9	6	173	218	0	406
	3	0	0	4	6	0	10
	4	0	0	0	0	0	0
	5	0	0	1	7	0	8
		33	7	247	244	0	531
24	1	20	13	40	7	0	80
	2	15	32	206	85	0	338
	3	0	0	4	23	0	27
	4	0	0	0	0	0	0
	5	0	1	0	2	0	3
		35	46	250	117	0	448

LENGTH FEET	PROPULSION (CODE)	HULL MATERIAL 1	2	3	4	5	TOTAL
25	1	0	3	27	16	0	46
	2	0	44	364	24	0	432
	3	0	0	7	22	0	29
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	47	398	62	0	507
26	1	0	2	18	2	0	22
	2	8	41	292	16	0	357
	3	0	0	8	4	0	12
	4	0	0	0	0	0	0
	5	0	0	0	2	0	2
		8	43	318	24	0	393
27	1	1	0	13	2	0	16
	2	1	4	274	27	1	307
	3	0	0	2	5	0	7
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		2	4	289	34	1	330
28	1	1	5	12	3	0	21
	2	4	26	278	17	1	326
	3	0	0	4	3	0	7
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		5	31	294	23	1	354
29	1	0	0	3	0	0	3
	2	0	4	70	11	0	85
	3	0	0	0	9	0	9
	4	0	0	0	0	0	0
	5	0	0	1	0	0	1
		0	4	74	20	0	98

LENGTH FEET	PROPULSION (CODE)	HULL MATERIAL 1	2	3	4	5	TOTAL
30	1	2	2	9	0	0	13
	2	1	27	155	9	0	192
	3	0	0	1	5	0	6
	4	0	0	0	0	0	0
	5	0	1	0	0	0	1
		3	30	165	14	0	212
31	1	1	1	3	0	0	5
	2	0	24	92	18	0	134
	3	0	0	1	2	0	3
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		1	25	96	20	0	142
32	1	0	2	1	0	0	3
	2	7	10	116	12	1	146
	3	0	0	2	3	0	5
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		7	12	119	15	1	154
33	1	0	0	2	0	0	2
	2	0	5	54	17	0	76
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	5	56	17	0	78
34	1	0	1	2	0	0	3
	2	0	11	35	21	0	67
	3	0	0	1	5	0	6
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	12	38	26	0	76

229

LENGTH FEET	PROPULSION (CODE)	HULL MATERIAL 1	2	3	4	5	TOTAL
35	1	0	1	2	0	0	3
	2	0	13	42	4	0	59
	3	0	0	2	0	0	2
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	14	46	4	0	64
36	1	0	0	3	1	0	4
	2	1	12	61	4	0	78
	3	0	0	0	4	0	4
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		1	12	64	9	0	86
37	1	0	0	0	0	0	0
	2	1	5	18	0	0	24
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		1	5	18	0	0	24
38	1	0	0	3	0	0	3
	2	2	6	19	5	0	32
	3	0	0	1	0	0	1
	4	0	0	0	0	0	0
	5	0	0	1	0	0	1
		2	6	24	5	0	37
39	1	0	1	0	0	0	1
	2	0	2	15	0	0	17
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	3	15	0	0	18

LENGTH FEET	PROPULSION (CODE)	HULL MATERIAL 1	2	3	4	5	TOTAL
40	1	0	0	0	0	0	0
	2	1	1	24	1	0	27
	3	0	0	1	0	0	1
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		1	1	25	1	0	28
41	1	0	0	0	0	0	0
	2	0	2	5	1	0	8
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	2	5	1	0	8
42	1	0	1	1	0	0	2
	2	2	2	22	3	0	29
	3	0	0	0	1	0	1
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		2	3	23	4	0	32
43	1	0	0	0	0	0	0
	2	0	0	3	0	0	3
	3	0	0	1	0	0	1
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	4	0	0	4
44	1	0	0	0	0	0	0
	2	0	0	3	0	0	3
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	3	0	0	3

LENGTH FEET	PROPULSION (CODE)	HULL MATERIAL 1	2	3	4	5	TOTAL
45	1	0	0	0	0	0	0
	2	0	4	3	0	0	7
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	4	3	0	0	7
46	1	0	0	0	0	0	0
	2	0	1	7	3	0	11
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	1	7	3	0	11
47	1	0	0	0	0	0	0
	2	0	0	5	1	0	6
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	5	1	0	6
48	1	0	0	0	0	0	0
	2	1	0	0	0	0	1
	3	0	0	1	0	0	1
	4	0	0	0	0	0	0
	5	0	1	0	0	0	1
		1	1	1	0	0	3
49	1	0	0	0	0	0	0
	2	0	0	1	0	0	1
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	1	0	0	1

LENGTH FEET	PROPULSION (CODE)	HULL MATERIAL 1	2	3	4	5	TOTAL
50	1	0	0	0	0	0	0
	2	0	0	3	0	0	3
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	3	0	0	3
51	1	0	0	0	0	0	0
	2	0	0	1	0	0	1
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	1	0	0	1
52	1	0	0	0	0	0	0
	2	0	0	1	0	0	1
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	1	0	0	1
53	1	0	0	0	0	0	0
	2	0	0	1	0	0	1
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	1	0	0	1
54	1	0	0	0	0	0	0
	2	0	0	2	0	0	2
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	2	0	0	2

LENGTH FEET	PROPULSION (CODE)	HULL MATERIAL 1	2	3	4	5	TOTAL
55	1	0	0	0	0	0	0
	2	0	0	1	0	0	1
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	1	0	0	1
56	1	0	0	0	0	0	0
	2	0	0	0	0	0	0
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	0	0	0	0
57	1	0	0	0	0	0	0
	2	0	0	2	0	0	2
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	2	0	0	2
58	1	0	0	0	0	0	0
	2	0	0	0	0	0	0
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	0	0	0	0
59	1	0	0	0	0	0	0
	2	0	0	0	0	0	0
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	0	0	0	0

LENGTH FEET	PROPULSION (CODE)	HULL MATERIAL 1	2	3	4	5	TOTAL
60	1	0	0	0	0	0	0
	2	0	0	0	0	0	0
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	1	0	0	0	1
		0	1	0	0	0	1
61	1	0	0	0	0	0	0
	2	0	0	0	0	0	0
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	0	0	0	0
62	1	0	0	0	0	0	0
	2	0	0	1	0	0	1
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	1	0	0	1
63	1	0	0	0	0	0	0
	2	0	0	1	0	0	1
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	1	0	0	1
64	1	0	0	0	0	0	0
	2	0	1	0	0	0	1
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	1	0	0	0	1

LENGTH FEET	PROPULSION (CODE)	HULL MATERIAL 1	2	3	4	5	TOTAL
65	1	0	0	0	0	0	0
	2	0	1	0	0	0	1
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	1	0	0	0	1
66	1	0	0	0	0	0	0
	2	0	0	0	0	0	0
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	0	0	0	0
67	1	0	0	0	0	0	0
	2	0	0	0	0	0	0
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	0	0	0	0
68	1	0	0	0	0	0	0
	2	0	0	0	0	0	0
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	0	0	0	0
69	1	0	0	0	0	0	0
	2	0	0	0	0	0	0
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	0	0	0	0

LENGTH FEET	PROPULSION (CODE)	HULL MATERIAL 1	2	3	4	5	TOTAL
70	1	0	0	0	0	0	0
	2	0	0	1	0	0	1
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	1	0	0	1
71	1	0	0	0	0	0	0
	2	0	0	1	0	0	1
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	1	0	0	1
72	1	0	0	0	0	0	0
	2	0	0	0	0	0	0
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	0	0	0	0
73	1	0	0	0	0	0	0
	2	0	0	0	0	0	0
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	0	0	0	0
74	1	0	0	0	0	0	0
	2	0	0	0	0	0	0
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	0	0	0	0

LENGTH FEET	PROPULSION (CODE)	HULL MATERIAL 1	2	3	4	5	TOTAL
75	1	0	0	0	0	0	0
	2	0	0	0	0	0	0
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	0	0	0	0
76	1	0	0	0	0	0	0
	2	0	0	0	0	0	0
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	0	0	0	0
77	1	0	0	0	0	0	0
	2	0	0	0	0	0	0
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	0	0	0	0
78	1	0	0	0	0	0	0
	2	0	0	0	0	0	0
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	0	0	0	0
79	1	0	0	0	0	0	0
	2	0	0	0	0	0	0
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	0	0	0	0

LENGTH FEET	PROPULSION (CODE)	HULL MATERIAL 1	2	3	4	5	TOTAL
80	1	0	0	0	0	0	0
	2	0	1	0	0	0	1
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	1	0	0	0	1
81	1	0	0	0	0	0	0
	2	0	0	0	0	0	0
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	0	0	0	0
82	1	0	0	0	0	0	0
	2	0	0	0	0	0	0
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	0	0	0	0
83	1	0	0	0	0	0	0
	2	0	0	0	0	0	0
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	0	0	0	0
84	1	0	0	0	0	0	0
	2	0	0	0	0	0	0
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	0	0	0	0

LENGTH FEET	PROPULSION (CODE)	HULL MATERIAL 1	2	3	4	5	TOTAL
85	1	0	0	0	0	0	0
	2	0	0	0	0	0	0
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	0	0	0	0
86	1	0	0	0	0	0	0
	2	0	0	0	0	0	0
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	0	0	0	0
87	1	0	0	0	0	0	0
	2	0	1	0	0	0	1
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	1	0	0	0	1
88	1	0	0	0	0	0	0
	2	0	0	0	0	0	0
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	0	0	0	0
89	1	0	0	0	0	0	0
	2	0	0	0	0	0	0
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	0	0	0	0

LENGTH FEET	PROPULSION (CODE)	HULL MATERIAL 1	2	3	4	5	TOTAL
90	1	0	0	0	0	0	0
	2	0	0	0	0	0	0
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	0	0	0	0
91	1	0	0	0	0	0	0
	2	0	0	0	0	0	0
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	0	0	0	0
92	1	0	0	0	0	0	0
	2	0	0	0	0	0	0
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	0	0	0	0
93	1	0	0	0	0	0	0
	2	0	0	0	0	0	0
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	0	0	0	0
94	1	0	0	0	0	0	0
	2	0	0	0	0	0	0
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	0	0	0	0

LENGTH FEET	PROPULSION (CODE)	HULL MATERIAL 1	2	3	4	5	TOTAL
95	1	0	0	0	0	0	0
	2	0	0	0	0	0	0
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	0	0	0	0
96	1	0	0	0	0	0	0
	2	0	0	0	0	0	0
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	0	0	0	0
97	1	0	0	0	0	0	0
	2	0	0	0	0	0	0
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	0	0	0	0
98	1	0	0	0	0	0	0
	2	0	0	0	0	0	0
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	0	0	0	0	0
99	1	0	0	0	0	0	0
	2	0	1	0	0	0	1
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	0	0	0	0	0
		0	1	0	0	0	1

(242)

ITEM 7
OCTOBER 1967

WASHINGTON STATE DEPARTMENT OF COMMERCE

AND ECONOMIC DEVELOPMENT

BOATING PROFILE IN WASHINGTON

Introduction

Washington had an estimated 223,547 boats as of October, 1966. The typical boat in Washington is made of wood, is a pleasure boat, is between 13 and 17 feet in length, is powered by an out board gas engine, and was made between 1958 and 1963. Although wooden boats have held around 70% of the total market share, there has been a continual decline in their production since 1955. On the other hand, fiberglass boats have shown to be gaining an increasing share of the market, which now accounts for 30% of the total. Aluminum boats have never gained an important segment of the total market, ranging from less than 1% to a high of 8% in 1963.

Number of Boats Manufactured by Year

Year	Wood	Steel	Aluminum	Fiberglass	Other	Total
1939 or older	1,975	30	10	20	-	2,035
1940 - 1944	1,549	122	30	10	-	1,711
1945 - 1949	2,805	152	61	71	10	3,099
1950 - 1954	7,747	81	344	243	101	8,506
1955	3,808	10	233	385	61	4,497
1956	4,749	41	233	800	152	5,975
1957	5,063	-	274	1,499	233	7,069
1958	6,531	10	284	3,200	486	10,511
1959	5,782	30	344	4,739	729	11,614
1960	3,757	41	354	3,848	213	8,213
1961	2,228	30	182	2,572	20	5,032
1962	1,762	30	142	1,884	50	3,868
1963	1,432	72	195	2,067	40	3,766

Wooden Boats

The most popular use of wooden boats is for pleasure craft, which, in 1965, was 90% or 51,000 of the total wooden boats. Wood, more than any other material, blankets the field from tiny car top boats, to heavy inboard cruisers. Wood accounted for 90% of all boats until the mid 1950's. With the beginning of the boating boom in the early 50's and the introduction of fiberglass boats, wood's share of the market began to drop and continued downward to a low of about 40% in 1963. Apparently, much of the gain by fiberglass, during this period, was at the expense of wood. Sales of wood boats reached a peak in 1958, when over 6,500 boats were sold.

Aluminum Boats

The aluminum boat has many properties that seem to make it an ideal boat material. It is strong and light, and resists damage better than either wood or fiberglass. Yet, it has never gained much popularity with Washington boaters. Because of registration laws in Washington, aluminum boats are probably the most misrepresented type. There are many small aluminum boats cartops, prams, etc.- with 10 or less h.p. engines which are not required to register. Perhaps this partly explains aluminum's low share of the total. Aluminum boat sales reached a peak in 1960 when over 350 were sold.

Fiberglass

Boats of fiberglass make up 25% or 21,000 of Washington's total boats. In 1939 fiberglass accounted for less than 1% of the total. Its share of the market grew slowly until the mid 50's which saw the boating boom. Fiberglass suddenly emerged as the second most popular material for boat construction. In 1960, fiberglass boats took over the number one spot which they have continued to hold. The sudden rise to prominence was a combination of many factors, the most important being the tremendous promotion campaign that sparked the demand. The most popular fiberglass boat is over 13 and less than 17 foot pleasure boat, outboard powered, which accounts for 70% of the total.

Pleasure Boats

Pleasure boats number around 186,000, or over 90% of the total in the State. Only 62,200 are registered or documented craft. Of this number, about 60% are wooden, while 30% are fiberglass, 5% are aluminum, and steel and other material make up the remainder. The most popular length is over 13 to less than 17 foot range which accounts for 50% of the total. Almost 50% of the pleasure boats were built between 1955 and 1961. Outboard motor propulsion is by far the most common form of power for the pleasure boat, and accounts for almost 60% of all pleasure boats.

In the Puget Sound area, there are 94 boats per 1,000 population as compared to 40.8 nationwide, and 53 in the Strait of Georgia area, British Columbia.

Inboard	18,200
Outboard	94,400
Auxiliary Sailboats	1,400
Sailboats without power	6,300
Miscellaneous (rowboats, etc.)	65,700
Total	186,000

Commercial Boats

Since commercial boats fall under the Coast Guard's registration system, about 50% of the total number of registered boats are commercial. Wood again accounts for a high percent of the boats, nearly 88% of the total. Over 60% are at least 21 feet in length, and inboard engines supply about 75% of the power.

Imported Boats

Of the total boats registered in Washington, about 22,000 boats are imported. Almost half the boats are wooden and 38% are fiberglass, while 10% are aluminum.

The Pacific region, excluding Washington, is the largest single source of imported boats which supply 40% of all imports. The East North Central region of the U.S. is second in exporting boats to Washington and supplies 22% of the total imports into the State. Third is the West North Central region which accounts for 16.5% of all imports. These three areas have maintained a relatively stable percentage of around 75% of the total boat exports to Washington for the last six years.

Oregon, in the Pacific region, has supplied over 1,500 wood boats to Washington. Surprisingly the Atlantic seaboard, although 3,000 miles or more distant, supplied 3,500 boats to Washington. Minnesota alone exported 1,200 aluminum boats to Washington, which is nearly one third of the total number of aluminum boats within the State. The States of Michigan, Wisconsin and Minnesota have exported about 5,000 boats to Washington.

Public and Private Boat Facilities

The following excerpts are from an unpublished report prepared by the Seattle District, Corps of Engineers, & Pacific Northwest Region, Bureau of Outdoor Recreation, Seattle, Washington.

There are a total of 167 marinas supplying 16,219 rental moorages for the boating public. One hundred and eighty-three trailer boat ramps with 221 launching lanes are scattered throughout the study area. Twenty-three State parks and 14 State marine parks are located along the 2,350 miles of Puget Sound and Adjacent Waters shoreline including Lake Washington and the Lake Washington Ship Canal. An estimated nine miles of shoreline are occupied by public and private pleasure boat facility developments. An additional 160 miles of shoreline are suitable for development.

A third of the registered boat owners use their craft at least once every month during the year, and nearly all use their craft from May through August. Rental moorage demand also follows seasonal patterns with 10 percent more boaters requiring permanent summer moorage than permanent winter moorage and twice as many boaters requiring temporary summer moorage than temporary winter moorage. All auxiliary sailboat owners and 70 percent of inboard owners indicated a demand for permanent summer rental moorage facilities. Only 30 percent of the outboard owners indicated a demand for this type of facility. A need for an additional 23,000 summer rental moorages and 11,500 winter moorages is indicated for the Puget Sound area, based on the 1966 rental moorage inventory. Covered rental moorage is demanded by 62.6 percent of the boaters indicating a need for permanent summer moorage facilities and by 85.5 percent of boaters indicating a need for permanent winter moorage facilities. Permanent summer wet moorage is in demand by 74.4 percent of these boaters and permanent winter wet moorage by 56.1 percent.

The questionnaire survey indicated that more launching ramps are needed in the Puget Sound area. The demand by registered trailer boat owners residing in the study area indicates a need for an additional 90 lanes of launching ramp. To provide for the non-resident boater trailering his craft from outside the region, this value could be increased by 10 percent for a total net need of about 100 launching ramp lanes.

Over 36,000 registered boat owners now use or would use new saltwater picnicking facilities and approximately 22,000 now use or would use new saltwater camping facilities. Harbors of refuge are needed by about 28,000 boaters. Pleasure boat damage during 1965 and 1966 averaged an estimated $950,000 annually with the majority of the damage occurring as a result of floating debris.

Pleasure boat ownership in the study area is projected to increase dramatically from 186,000 in 1966 to 299,000 by 1980, 593,000 by 2000, and 1,239,000 by 2020.* The additional pleasure craft will result in a correspondingly greater demand for boating facilities. Demand for moorages is forecast to grow at the same rate as pleasure boat ownership. From a gross need of 39,300 permanent summer

* Projections subject to revision pending resolution of conflict between CSC and OBE economic data.

rental moorages in 1966, moorage needs are projected to reach 60,800 by 1980, 115,000 by 2000, and 230,500 by 2020. The gross need for permanent winter rental moorages are projected to grow from 26,400 in 1966 to 41,700 by 1980, 80,800 by 2000, and 166,000 by 2020.* Launching ramp gross needs are forecast to rise from 280 launching ramp lanes in 1966 to 440 by 1980, 820 by 2000, and 1,650 by 2020. The demand for camping and picnicking facilities, harbors of refuge and moorage service facilities is also expected to parallel pleasure boat ownership growth.

The rapidly growing number of pleasure craft in the study area are already placing a demand on moorage and launching ramp facilities that exceeds their capacity. The current high demand for adequate facilities and the growth that is forecast for the next fifty years must be satisfied by additional capital investments. Breakwater-protected small boat harbors, due to high development costs, will require public investment at many locations. Generally, marinas located in naturally protected coves or waterways can be expanded within the capability of the private operator. However, careful consideration must be given to the type of facilities desired by the boater and the location of the demand to insure that the facilities are used once constructed.

The high demand for picnicking and camping facilities suggests that further study be given to determining the need for expanding these facilities or acquiring additional sites to serve the recreational boater. Harbors of refuge are needed throughout the Puget Sound area, as evidenced by the high boater response for this facility. Consideration should be given to allocating space

* Projections subject to revision pending resolution of conflict between CSC and OBE economic data.

within protected small boat basins for craft seeking temporary shelter. Also, studies are suggested for providing protected harbors at critical locations specifically constructed as harbors of refuge. The large amount of boat damage reported emphasizes the need for a possible expanded debris removal program. Consideration should also be given to preventing debris entry into navigable waters.

Conclusion

About one out of every four families in Washington owns a boat. This is due to the great Puget Sound area, and the many lakes and rivers within the State.

Of the estimated 222,719 boat owners in Washington, 129,469 of these are boats with outboard motors. Rowboats without motors, prams and skills are estimated at 61,907. Larger boats with inboard motors are 20,026. Sailboats were measured at 5,526 and canoes numbered 1,598, and finally 4,193 rubber rafts were accounted for in the State.

111,088 of the boats are under 13½ ft. long, while 42,352 are over 16 ft. long. The remaining 79,284 are between 13½ ft. and 16 ft.

Popularity of materials used in boat construction ranges in order: wood, fiberglass, aluminum, rubber and steel.

Item 8. "Great Lakes Basin Framework Study - Appendix 9 - Navigation (Draft) - Great Lakes Basin Commission

This item has not been reproduced in part or in whole at the request of the originator because it is in preliminary draft form.

(250)

ITEM 9
BSIS DATA
5th DISTRICT TOTAL

Activity Most Done	Distance From Coastal Shore	Total	Type and Size of Boat Most Used			
			Motorboat		Sailboat	
			Under 16'	16'& Over	Under 16'	16'& Over
All Activities Combined	0 - 1	296745	133406	136744	17911	8684
	2 - 5	124815	31701	74064	3507	15543
	6 - 10	27557	5551	17388	718	3900
	11+	17945	1147	12980	-	3818
	Total	467062	171805	241176	22136	31945
Fishing	0 - 1	125278	76761	48517	-	-
	2 - 5	55555	17553	37450	-	552
	6 - 10	15887	4544	11343	-	-
	11+	7890	527	7363	-	-
	Sub Total	204610	99385	104673	-	552
Water Skiing	0 - 1	63494	27003	36491	-	-
	2 - 5	14250	5386	8864	-	-
	6 - 10	261	118	143	-	-
	11+	1067	-	1067	-	-
	Sub Total	79072	32507	46565	-	-
Pleasure Cruising	0 - 1	100649	28846	50291	14134	7378
	2 - 5	51778	8153	27059	3216	13350
	6 - 10	11409	889	5902	718	3900
	11+	8859	620	4539	-	3700
	Sub Total	172695	38508	87791	18068	28328
Racing	0 - 1	5633	445	105	3777	1306
	2 - 5	2541	609	-	291	1641
	6 - 10	-	-	-	-	-
	11+	118	-	-	-	118
	Sub Total	8292	856	105	4068	3065
Hunting	0 - 1	1891	551	1340	-	-
	2 - 5	691	-	691	-	-
	6 - 10	-	-	-	-	-
	11+	11	-	11	-	-
	Sub Total	2593	551	2042	-	-
Other	0 - 1	-	-	-	-	-
	2 - 5	-	-	-	-	-
	6 - 10	-	-	-	-	-
	11+	-	-	-	-	-
	Sub Total	-	-	-	-	-

Raw Total 1708

ITEM 10

The following data is for the number of SAR "responses" by the C.G. in each district broken down in distance from shore for FY 1969. Distance is in miles.

DISTRICT	0 - 1/2	1/2 - 10	11-20	21-50	51-150	151-300	301-999	Over 999
1st	2180	949	46	24	13	2	4	
2nd	44						3	
3rd	5666	2349	145	37	20	2	35	
5th	2095	1039	47	28	19	9	14	
7th	2594	2161	215	202	106	26	48	4
8th	1684	770	195	141	46	9	8	1
9th	2256	1252	52	19	2	6	16	
11th	838	956	136	48	12	5	11	3
12th	1377	683	71	33	16		9	1
13th	1764	1843	53	45	38		29	
14th	64	110	23	3	4		5	2
17th	266	132	3	2			9	
Totals	20828	12244	986	582	276	59	191	11

Total Responses: 35,177

ITEM 11

MARINE TELEPHONE FREQUENCY STATISTICS

PRODUCED BY DATA PROCESSING DIVISION OF FEDERAL COMMUNICATIONS COMMISSION

SP57MP10 - - M PATTERSON

STATE	EXP. YEAR	TELEPHONE	VHF
	1971	215	1
	1972	222	4
	1973	261	23
	1974	270	26
	1975	333	36
	TOTALS	1301	90
P R	1974	1	
P R	TOTALS	1	
A	1971	3	
A	TOTALS	3	
ALA	1971	226	12
	1972	279	17
	1973	280	30
	1974	275	75
	1975	253	89
ALA	TOTALS	1313	223
ALAS	1971	482	2
	1972	624	12
	1973	603	27
	1974	767	81
	1975	982	163
ALAS	TOTALS	3458	285
AN	1975	1	
AN	TOTALS	1	
ARIZ	1971	41	
	1972	58	
	1973	72	3
	1974	90	11
	1975	84	25
ARIZ	TOTALS	345	39

STATE	EXP. YEAR	TELEPHONE	VHF
ARK	1971	9	
	1972	13	1
	1973	10	3
	1974	26	24
	1975	29	41
ARK	TOTALS	87	69
AS	1971	1	
AS	TOTALS	1	
BAHM	1972	1	
	1973	1	
	1974	1	
BAHM	TOTALS	3	
BWI	1971	1	
BWI	TOTALS	1	
CAL	1971	4670	47
	1972	5685	125
	1973	6399	552
	1974	6703	3025
	1975	7420	4236
CAL	TOTALS	30877	7985
CAN	1971	1	
	1974	1	
CAN	TOTALS	2	
COLO	1971	12	
	1972	9	
	1973	7	2
	1974	14	4
	1975	27	13
COLO	TOTALS	69	19

STATE	EXP. YEAR	TELEPHONE	VHF
CONN	1971	800	15
	1972	1043	40
	1973	1234	157
	1974	1234	176
	1975	1202	324
CONN	TOTALS	5513	712
D C	1971	168	14
	1972	156	11
	1973	166	55
	1974	179	72
	1975	172	92
D C	TOTALS	841	244
DEL	1971	142	2
	1972	190	5
	1973	282	10
	1974	268	28
	1975	286	55
DEL	TOTALS	1168	100
FLA	1971	3727	29
	1972	5388	97
	1973	6285	336
	1974	7119	1426
	1975	7404	3451
FLA	TOTALS	29923	5339
GA	1971	244	6
	1972	302	9
	1973	409	13
	1974	444	31
	1975	462	107
GA	TOTALS	1861	166
GUAM	1973	1	
GUAM	TOTALS	1	

02-05-71 MARINE TELEPHONE FREQUENCY STATISTICS

STATE	EXP. YEAR	TELEPHONE	VHF
HWA	1971	182	1
	1972	294	4
	1973	301	2
	1974	321	12
	1975	402	27
HWA	TOTALS	1500	46
IDA	1971	8	
	1972	13	1
	1973	16	3
	1974	12	4
	1975	12	4
IDA	TOTALS	61	12
ILL	1971	739	31
	1972	912	89
	1973	1025	219
	1974	1025	297
	1975	987	379
ILL	TOTALS	4688	1015
IND	1971	181	8
	1972	281	42
	1973	271	46
	1974	262	49
	1975	243	121
IND	TOTALS	1238	266
IOWA	1971	35	1
	1972	52	6
	1973	42	13
	1974	57	20
	1975	32	45
IOWA	TOTALS	218	85
JAP	1974	1	
JAP	TOTALS	1	

STATE	EXP. YEAR	TELEPHONE	VHF
KANS	1971	7	
	1972	9	
	1973	6	2
	1974	10	2
	1975	19	9
KANS TOTALS		51	13
KY	1971	119	12
	1972	147	28
	1973	153	50
	1974	143	70
	1975	114	79
KY TOTALS		676	239
LA	1971	1039	70
	1972	1227	182
	1973	1362	378
	1974	1324	506
	1975	1449	705
LA TOTALS		6401	1841
LAND	1972	1	
LAND TOTALS		1	
MASS	1971	1540	18
	1972	1857	42
	1973	2020	63
	1974	2159	216
	1975	2410	785
MASS TOTALS		9986	1124
MD	1971	1141	10
	1972	1404	44
	1973	1632	227
	1974	1586	287
	1975	1709	709
MD TOTALS		7472	1277

STATE	EXP. YEAR	TELEPHONE	VHF
ME	1971	321	6
	1972	429	14
	1973	463	16
	1974	523	57
	1975	489	117
ME	TOTALS	2225	210
MEX	1975	1	
MEX	TOTALS	1	
MICH	1971	1212	10
	1972	1711	59
	1973	2164	210
	1974	2244	389
	1975	2243	579
MICH	TOTALS	9574	1247
MINN	1971	54	13
	1972	90	12
	1973	92	34
	1974	98	45
	1975	112	76
MINN	TOTALS	446	180
MISS	1971	100	3
	1972	181	23
	1973	176	52
	1974	122	31
	1975	160	65
MISS	TOTALS	739	174
MO	1971	132	16
	1972	155	16
	1973	218	48
	1974	214	68
	1975	191	105
MO	TOTALS	910	253

STATE	EXP. YEAR	TELEPHONE	VHF
MONT	1972	2	
	1973	6	1
	1974	3	1
	1975	5	2
MONT	TOTALS	16	4
N C	1971	340	9
	1972	419	8
	1973	516	8
	1974	530	36
	1975	573	86
N C	TOTALS	2378	147
N H	1971	58	
	1972	84	3
	1973	74	11
	1974	100	14
	1975	113	42
N H	TOTALS	429	70
N J	1971	1830	21
	1972	2326	70
	1973	2529	168
	1974	2720	328
	1975	2804	499
N J	TOTALS	12209	1086
N Y	1971	3218	83
	1972	4290	155
	1973	4605	351
	1974	4658	473
	1975	4543	708
N Y	TOTALS	21314	1770
NDAK	1971	1	
	1972	1	
	1973	4	1

STATE	EXP. YEAR	TELEPHONE	VHF
	1974	9	
	1975	5	
NDAK	TOTALS	20	1
NEBR	1971	5	1
	1972	17	
	1973	16	1
	1974	10	2
	1975	11	7
NEBR	TOTALS	59	11
NEV	1971	22	3
	1972	14	1
	1973	47	3
	1974	41	12
	1975	68	17
NEV	TOTALS	192	36
NMEX	1971	12	1
	1972	6	
	1973	10	
	1974	14	1
	1975	11	3
NMEX	TOTALS	53	5
OHIO	1971	1136	80
	1972	1578	101
	1973	1764	125
	1974	1618	229
	1975	1548	433
OHIO	TOTALS	7644	968
OKLA	1971	19	
	1972	9	
	1973	11	6
	1974	17	10
	1975	32	13
OKLA	TOTALS	88	29

STATE	EXP. YEAR	TELEPHONE	VHF
OREG	1971	660	26
	1972	886	50
	1973	1027	83
	1974	823	90
	1975	941	201
OREG	TOTALS	4337	450
P R	1971	13	
	1972	23	
	1973	24	
	1974	17	1
	1975	34	
P R	TOTALS	111	1
PA	1971	898	25
	1972	1202	46
	1973	1312	109
	1974	1390	140
	1975	1471	262
PA	TOTALS	6273	582
R	1973	1	
R	TOTALS	1	
R I	1971	320	9
	1972	443	9
	1973	452	57
	1974	435	77
	1975	492	135
R I	TOTALS	2142	287
S A	1971	1	
S A	TOTALS	1	
S C	1971	166	7
	1972	224	3

STATE	EXP. YEAR	TELEPHONE	VHF
	1973	254	12
	1974	328	24
	1975	308	47
S C TOTALS		1280	93
SDAK	1975	1	
SDAK TOTALS		1	
TENN	1971	170	6
	1972	216	18
	1973	264	51
	1974	197	56
	1975	158	87
TENN TOTALS		1005	218
TEX	1971	1009	25
	1972	1401	78
	1973	1611	226
	1974	1614	343
	1975	1531	519
TEX TOTALS		7166	1191
UTAH	1971	6	
	1972	4	
	1973	4	1
	1974	5	3
	1975	5	3
UTAH TOTALS		24	7
V I	1971	2	
	1972	10	
	1973	1	
	1974	8	
	1975	4	
V I TOTALS		25	
VA	1971	971	16

STATE	EXP. YEAR	TELEPHONE	VHF
	1972	1239	39
	1973	1424	152
	1974	1574	231
	1975	1624	403
VA	TOTALS	6832	841
VT	1971	13	
	1972	14	1
	1973	19	1
	1974	16	2
	1975	21	4
VT	TOTALS	83	8
W VA	1971	27	20
	1972	36	17
	1973	36	10
	1974	29	15
	1975	38	23
W VA	TOTALS	166	85
WASH	1971	1834	54
	1972	2369	118
	1973	2566	467
	1974	2625	1467
	1975	2763	1661
WASH	TOTALS	12157	3767
WISC	1971	166	9
	1972	226	25
	1973	276	54
	1974	274	72
	1975	317	120
WISC	TOTALS	1259	280
WYO	1971	6	
	1972	3	
	1973	3	
	1974	2	1

02-05-71 MARINE TELEPHONE FREQUENCY STATISTICS

STATE	EXP. YEAR	TELEPHONE	VHF
	1975	5	
WYO	TOTALS	19	1

YEARLY TOTALS

	TELEPHONE	VHF
71	30466	722
72	39779	1626
73	44802	4472
74	46548	10661
75	48646	17710
GRAND TOTALS	210241	35191

ITEM 12
RTCM SURVEY

The following data were derived from a survey published in boating magazines by the Radio Technical Commission for Maritime Services (RTCM). The request and questionnaire formats are shown on the following pages.

CSC coded the results from 127 responses and formatted the appropriate data as shown in the following tables.

ELECTRONICS COMMUNICATIONS
SURVEY

The Radio Technical Commission for Marine Services (RTCM) is an association of interested marine communication people which is sponsored by government, equipment manufacturers, communication companies, and user groups. RTCM Special Committee 43 was formed to study "The present and future communication needs of voluntarily equipped non-commercial craft."

To help accomplish their purpose, the RTCM Special Committee is asking the cooperation of Motor Boating readers in filling out the attached questionnaire. These answers, which hopefully will include yours, will provide the committee with a great deal of information-information that up until now has been unobtainable-about what equipment, facilities, and services boatmen really need and want.

Although taking the time and trouble to send in the questionnaire will yield an individual exactly nothing in the way of immediate rewards, the improvements in marine electronics communications we can realistically expect as a direct result of this survey should be extensive. Your cooperation is therefore most earnestly solicited.

Once again, the mailing address is:

RTCM Special Committee 43
Box 8, West Southport, Maine

ELECTRONICS COMMUNICATIONS SURVEY

Usual area of operation ____________________

Percentage of Use Day __________ % Night __________ %

Affiliation

USPS ________ USCGA ________ YACHT CLUB ________

COMMERCIAL ________ OTHER ________

Boat Identy

Length
Less than 16' ________
16-26' ________
Over 40' ________
Type
Open ________
Cabin ________
Houseboat ________
Sail ________
Power
Outboard ________
Inboard ________
I/O ________

Electronic Equipment

	Have	Might Get
Transmitter/Rcvr		
2Mc/s		
Double Sideband	____	____
Single Sideband	____	____
2670 Kc/s	____	____
VHF/FM 156-162 Mc/s	____	____
HF 4Mc/s & above	____	____
Other		
Direction Finder	____	____
Depth Finder	____	____
VHF Weather Rcvr	____	____
Citizens Band	____	____
Radar	____	____
Omni	____	____
Loran	____	____
Portable AM Rcvr	____	____

Safety and Distress 2 Mc/s and VHF/FM

		Yes	No
1.	Is 2182Kc/s overloaded in your area?	___	___
2.	Is VHF/FM coast station coverage on 156.8 (Channel 16) adequate in your area?	___	___
3.	Would you use an Automatic Distress locator device?	___	___
4.	Would you use an Automatic Distress alarm signal?	___	___

Radio-Beacons

1. Do you use an RDF? Yes___ No___

   285-325 Kc/s_____ Broadcast______ 2 Mc/s Band___________

2. If you use 285-325 Kc/s, do you prefer continuous_______ or sequenced transmission (One minute of every six)_____

3. Would you buy a hand held DF (Cost about $100) if a short range Radio-beacon were developed? Yes___ No __________

Weather Information now available:

Check usual source of weather information. AM Radio______
FM Radio________ TV_______ Newspaper_____ Telephone Recording___
Low Frequency Aircraft_________ 2 Mc/s Coast Guard_________
2Mc/s Marine Operator_________ Weather Bureau VHF/FM_______

Please indicate preference in above______________________________

Do you consider available weather information in your area to be:
Excellent _____ Good _____ Fair _____ Poor ________

General:

		Yes	No
1.	Do you now use 2 Mc/s Public Correspondence?	___	___
2.	If so, is it adequate in your area?	___	___
3.	Do you use VHF/FM Public Correspondence?	___	___
4.	If so, is it adequate in your area?	___	___
5.	Do you use MF (2 Mc/s & Above) Pub. Corr.?	___	___
6.	If so is it adequate in your area?	___	___
7.	Would you enroll in a six hour Marine Radio communication course if held near you?	___	___

COMPILED BY
THE AEROSPACE SYSTEMS OPERATION
OF
COMPUTER SCIENCES CORPORATION
FALLS CHURCH VA 22046

THE FOLLOWING EQUIPMENT INFORMATION WAS OBTAINED
FOR SCENARIO AREA NO. 1
CHESAPEAKE BAY

EQUIPMENT	LESS THAN 16			16 TO 26			26 TO 40			OVER 40		
	HAVE	MAY GET	NO ANS	HAVE	MAY GET	NO ANS	HAVE	MAY GET	NO ANS	HAVE	MAY GET	NO ANS
TRANS/RCVR 2MC/S DOUBLE SIDEBAND	0	0	0	2	5	0	2	15	0	0	1	0
TRANS/RCVR 2MC/S SINGLE SIDEBAND	0	0	0	6	1	0	14	1	2	1	0	0
TRANSMITTER/RCVR 2670KC/S	0	0	0	3	4	0	6	11	0	1	0	0
VHF/FM 156-162 MC/S	0	0	0	5	0	1	9	1	8	1	0	0
HF 4MC/S AND ABOVE	0	0	0	7	0	0	16	0	1	1	0	0
DIRECTION FINDER	0	0	0	2	4	1	0	16	1	0	1	0
VHF WEATHER RECEIVER	0	0	0	3	2	2	5	9	3	1	0	0
CITIZENS BAND	0	0	0	2	2	3	12	2	3	1	0	0
PORTABLE AM RECEIVER	0	0	0	1	6	0	1	16	0	0	1	0
TOTAL NUMBER CHECKED FOR EACH OF THE BOAT RANGES		0			7			17			1	

(Column group heading: BOAT SIZE RANGE (FEET))

IN THE ABOVE SCENARIO AREA
WEATHER INFORMATION IS OBTAINED FROM THE FOLLOWING SOURCES

SOURCES	TOTALS	LESS THAN 16	16 TO 26	26 TO 40	OVER 40
AM RADIO	24	0	6	17	1
FM RADIO	10	0	3	6	1
TV	11	0	5	6	0
NEWSPAPERS	7	0	3	4	0
TELPHONE RECORDING	9	0	0	9	0
LOW FREQUENCY AIRCRAFT	4	0	0	4	0
2 MC/S COAST GUARD	12	0	4	8	0
2 MC/S MARINE OPERATOR	13	0	2	10	1
WEATHER BUREAU VHF/FM	13	0	2	11	0

(Column group heading: BOAT SIZE RANGES (FEET))

THE TOTAL NUMBER OF RECORDS CHECKED FOR THE ABOVE SCENARIO AREA WAS 25

ITEM 12

COMPILED BY
THE AEROSPACE SYSTEMS OPERATION
OF
COMPUTER SCIENCES CORPORATION
FALLS CHURCH VA 22046

THE FOLLOWING EQUIPMENT INFORMATION WAS OBTAINED
FOR SCENARIO AREA NO. 2
N.J. COAST

EQUIPMENT	BOAT SIZE RANGE (FEET) LESS THAN 16			16 TO 26			26 TO 40			OVER 40		
	HAVE	MAY GET	NO ANS	HAVE	MAY GET	NO ANS	HAVE	MAY GET	NO ANS	HAVE	MAY GET	NO ANS
TRANS/RCVR 2MC/S DOUBLE SIDEBAND	0	0	0	0	2	0	4	6	1	3	4	0
TRANS/RCVR 2MC/S SINGLE SIDEBAND	0	0	0	2	0	0	10	0	1	3	2	2
TRANSMITTER/RCVR 2670KC/S	0	0	0	0	2	0	6	5	0	4	3	0
VHF/FM 156-162 MC/S	0	0	0	0	0	2	6	0	5	4	1	2
HF 4MC/S AND ABOVE	0	0	0	2	0	0	11	0	0	7	0	0
DIRECTION FINDER	0	0	0	2	0	0	5	4	2	1	6	0
VHF WEATHER RECEIVER	0	0	0	1	1	0	4	5	2	1	4	2
CITIZENS BAND	0	0	0	2	0	0	9	1	1	4	2	1
PORTABLE AM RECEIVER	0	0	0	1	1	0	1	10	0	2	5	0
TOTAL NUMBER CHECKED FOR EACH OF THE BOAT RANGES		0			2			11			7	

IN THE ABOVE SCENARIO AREA
WEATHER INFORMATION IS OBTAINED FROM THE FOLLOWING SOURCES

SOURCES	TOTALS	BOAT SIZE RANGES (FEET) LESS THAN 16	16 TO 26	26 TO 40	OVER 40
AM RADIO	18	0	1	10	7
FM RADIO	9	0	1	2	6
TV	5	0	1	3	1
NEWSPAPERS	7	0	1	4	2
TELPHONE RECORDING	8	0	2	5	1
LOW FREQUENCY AIRCRAFT	0	0	0	0	0
2 MC/S COAST GUARD	6	0	1	2	3
2 MC/S MARINE OPERATOR	4	0	1	2	1
WEATHER BUREAU VHF/FM	8	0	2	3	3

THE TOTAL NUMBER OF RECORDS CHECKED FOR THE ABOVE SCENARIO AREA WAS 20

COMPILED BY
THE AEROSPACE SYSTEMS OPERATION
OF
COMPUTER SCIENCES CORPORATION
FALLS CHURCH VA 22046

THE FOLLOWING EQUIPMENT INFORMATION WAS OBTAINED
FOR SCENARIO AREA NO. 3
FLA. COAST

EQUIPMENT	BOAT SIZE RANGE (FEET) LESS THAN 16			16 TO 26			26 TO 40			OVER 40		
	HAVE	MAY GET	NO ANS	HAVE	MAY GET	NO ANS	HAVE	MAY GET	NO ANS	HAVE	MAY GET	NO ANS
TRANS/RCVR 2MC/S DOUBLE SIDEBAND	0	0	0	1	3	0	2	10	0	0	5	0
TRANS/RCVR 2MC/S SINGLE SIDEBAND	0	0	0	4	0	0	10	1	1	2	0	3
TRANSMITTER/RCVR 2670KC/S	0	0	0	2	2	0	4	8	0	1	3	1
VHF/FM 156-162 MC/S	0	0	0	1	1	2	6	2	4	2	1	2
HF 4MC/S AND ABOVE	0	0	0	4	0	0	12	0	0	3	1	1
DIRECTION FINDER	0	0	0	2	2	0	1	9	2	2	3	0
VHF WEATHER RECEIVER	0	0	0	1	3	0	7	4	1	2	2	1
CITIZENS BAND	0	0	0	2	2	0	6	6	0	3	2	0
PORTABLE AM RECEIVER	0	0	0	0	4	0	1	11	0	1	4	0
TOTAL NUMBER CHECKED FOR EACH OF THE BOAT RANGES		0			4			12			5	

IN THE ABOVE SCENARIO AREA
WEATHER INFORMATION IS OBTAINED FROM THE FOLLOWING SOURCES

SOURCES	TOTALS	BOAT SIZE RANGES (FEET) LESS THAN 16	16 TO 26	26 TO 40	OVER 40
AM RADIO	15	0	3	10	2
FM RADIO	5	0	2	3	0
TV	14	0	2	10	2
NEWSPAPERS	8	0	1	7	0
TELPHONE RECORDING	2	0	1	1	0
LOW FREQUENCY AIRCRAFT	10	0	2	3	5
2 MC/S COAST GUARD	10	0	3	4	3
2 MC/S MARINE OPERATOR	6	0	2	0	4
WEATHER BUREAU VHF/FM	7	0	3	4	0

THE TOTAL NUMBER OF RECORDS CHECKED FOR THE ABOVE SCENARIO AREA WAS 21

COMPILED BY
THE AEROSPACE SYSTEMS OPERATION
OF
COMPUTER SCIENCES CORPORATION
FALLS CHURCH VA 22046

THE FOLLOWING EQUIPMENT INFORMATION WAS OBTAINED
FOR SCENARIO AREA NO. 4
GULF COAST

EQUIPMENT	LESS THAN 16			16 TO 26			26 TO 40			OVER 40		
	HAVE	MAY GET	NO ANS	HAVE	MAY GET	NO ANS	HAVE	MAY GET	NO ANS	HAVE	MAY GET	NO ANS
TRANS/RCVR 2MC/S DOUBLE SIDEBAND	0	0	0	2	5	1	0	5	0	0	0	0
TRANS/RCVR 2MC/S SINGLE SIDEBAND	0	0	0	7	0	1	5	0	0	0	0	0
TRANSMITTER/RCVR 2670KC/S	0	0	0	5	3	0	5	0	0	0	0	0
VHF/FM 156-162 MC/S	0	0	0	1	3	4	2	1	2	0	0	0
HF 4MC/S AND ABOVE	0	0	0	7	1	0	5	0	0	0	0	0
DIRECTION FINDER	0	0	0	0	7	1	0	4	1	0	0	0
VHF WEATHER RECEIVER	0	0	0	1	5	2	3	2	0	0	0	0
CITIZENS BAND	0	0	0	2	5	1	3	2	0	0	0	0
PORTABLE AM RECEIVER	0	0	0	3	5	0	2	3	0	0	0	0
TOTAL NUMBER CHECKED FOR EACH OF THE BOAT RANGES		0			8			5			0	

IN THE ABOVE SCENARIO AREA
WEATHER INFORMATION IS OBTAINED FROM THE FOLLOWING SOURCES

SOURCES	TOTALS	LESS THAN 16	16 TO 26	26 TO 40	OVER 40
AM RADIO	9	0	5	3	0
FM RADIO	3	0	1	2	0
TV	8	0	5	3	0
NEWSPAPERS	6	0	3	3	0
TELEPHONE RECORDING	4	0	3	1	0
LOW FREQUENCY AIRCRAFT	6	0	4	2	0
2 MC/S COAST GUARD	4	0	3	1	0
2 MC/S MARINE OPERATOR	4	0	1	3	0
WEATHER BUREAU VHF/FM	6	0	6	0	0

THE TOTAL NUMBER OF RECORDS CHECKED FOR THE ABOVE SCENARIO AREA WAS 13

COMPILED BY
THE AEROSPACE SYSTEMS OPERATION
OF
COMPUTER SCIENCES CORPORATION
FALLS CHURCH VA 22046

THE FOLLOWING EQUIPMENT INFORMATION WAS OBTAINED
FOR SCENARIO AREA NO. 5
N. PACIFIC

EQUIPMENT	BOAT SIZE RANGE (FEET) LESS THAN 16 HAVE	MAY GET	NO ANS	16 TO 26 HAVE	MAY GET	NO ANS	26 TO 40 HAVE	MAY GET	NO ANS	OVER 40 HAVE	MAY GET	NO ANS
TRANS/RCVR 2MC/S DOUBLE SIDEBAND	0	0	0	0	2	0	1	4	0	0	1	0
TRANS/RCVR 2MC/S SINGLE SIDEBAND	0	0	0	1	0	1	4	0	1	0	1	0
TRANSMITTER/RCVR 2670KC/S	0	0	0	1	1	0	2	3	0	0	1	0
VHF/FM 156-162 MC/S	0	0	0	1	0	1	3	1	1	1	0	0
HF 4MC/S AND ABOVE	0	0	0	2	0	0	4	1	0	1	0	0
DIRECTION FINDER	0	0	0	0	1	1	1	3	1	1	0	0
VHF WEATHER RECEIVER	0	0	0	1	1	0	4	1	0	1	0	0
CITIZENS BAND	0	0	0	0	1	1	1	3	1	1	0	0
PORTABLE AM RECEIVER	0	0	0	1	1	0	3	2	0	0	1	0
TOTAL NUMBER CHECKED FOR EACH OF THE BOAT RANGES		0			2			5			1	

IN THE ABOVE SCENARIO AREA
WEATHER INFORMATION IS OBTAINED FROM THE FOLLOWING SOURCES

SOURCES	TOTALS	BOAT SIZE RANGES (FEET) LESS THAN 16	16 TO 26	26 TO 40	OVER 40
AM RADIO	3	0	1	1	1
FM RADIO	1	0	0	1	0
TV	6	0	2	3	1
NEWSPAPERS	3	0	2	0	1
TELPHONE RECORDING	1	0	1	0	0
LOW FREQUENCY AIRCRAFT	1	0	0	1	0
2 MC/S COAST GUARD	5	0	2	3	0
2 MC/S MARINE OPERATOR	6	0	1	5	0
WEATHER BUREAU VHF/FM	3	0	1	2	0

THE TOTAL NUMBER OF RECORDS CHECKED FOR THE ABOVE SCENARIO AREA WAS 8

COMPILED BY
THE AEROSPACE SYSTEMS OPERATION
OF
COMPUTER SCIENCES CORPORATION
FALLS CHURCH VA 22046

THE FOLLOWING EQUIPMENT INFORMATION WAS OBTAINED
FOR SCENARIO AREA NO. 6
GREAT LAKES

EQUIPMENT	BOAT SIZE RANGE (FEET) LESS THAN 16			16 TO 26			26 TO 40			OVER 40		
	HAVE	MAY GET	NO ANS	HAVE	MAY GET	NO ANS	HAVE	MAY GET	NO ANS	HAVE	MAY GET	NO ANS
TRANS/RCVR 2MC/S DOUBLE SIDEBAND	0	0	0	1	1	1	3	15	0	0	6	0
TRANS/RCVR 2MC/S SINGLE SIDEBAND	0	0	0	3	0	0	15	1	2	4	0	2
TRANSMITTER/RCVR 2670KC/S	0	0	0	2	1	0	9	8	1	3	3	0
VHF/FM 156-162 MC/S	0	0	0	0	1	2	4	5	9	2	2	2
HF 4MC/S AND ABOVE	0	0	0	2	1	0	15	2	1	5	1	0
DIRECTION FINDER	0	0	0	1	2	0	1	15	2	1	5	0
VHF WEATHER RECEIVER	0	0	0	2	1	0	8	6	4	4	2	0
CITIZENS BAND	0	0	0	1	1	1	13	3	2	4	2	0
PORTABLE AM RECEIVER	0	0	0	0	3	0	3	15	0	1	5	0
TOTAL NUMBER CHECKED FOR EACH OF THE BOAT RANGES		0			3			18			6	

IN THE ABOVE SCENARIO AREA
WEATHER INFORMATION IS OBTAINED FROM THE FOLLOWING SOURCES

SOURCES	TOTALS	BOAT SIZE RANGES (FEET) LESS THAN 16	16 TO 26	26 TO 40	OVER 40
AM RADIO	24	0	3	15	6
FM RADIO	9	0	0	7	2
TV	15	0	2	10	3
NEWSPAPERS	10	0	1	6	3
TELPHONE RECORDING	8	0	1	5	2
LOW FREQUENCY AIRCRAFT	11	0	2	8	1
2 MC/S COAST GUARD	17	0	1	13	3
2 MC/S MARINE OPERATOR	12	0	0	9	3
WEATHER BUREAU VHF/FM	7	0	1	4	2

THE TOTAL NUMBER OF RECORDS CHECKED FOR THE ABOVE SCENARIO AREA WAS 27

Item 13. CSC Equipment Survey

CSC staff members contacted a total of 33 electronics equipment retailers in the six scenario areas for information on equipment distribution, weather characteristics and sailing habits of boatmen. Contacts were established through the Chamber of Commerce, Washington, D.C., and local Chambers of Commerce; local newspaper's boating columnists; yacht clubs and marinas; and by referrals from previous contacts.

The following questions were asked:

What percentage of the recreational boaters in your area have the following:

1. VHF marine radiotelephone 156 MHz
2. AM marine radiotelephone 2182 kHz
3. AM portables for receiving the broadcast band
4. FM portables for receiving the broadcast band
5. "Weather Bureau: portable 162.55 MHz
6. Combination AM/FM portables possibly including the marine band and police band.
7. No equipment of any kind at all
8. How many boats are you considering in your estimate?

Do you have any general comments in regard to weather warning time and range of small boats operations from the shore?

Note: Weather warning time is defined as the minimum amount of time between normal boating weather and weather condition hazardous to small boats. This could be just high winds, fog, or similar hazardous conditions.

The responses received in each area are documented in the following tables.

1. Jersey Shores - Sandyhook to Cape May 12/21/70

	A	B	C
1	5	1	10
2	95	90	50
3	50	0	75
4	10	0	60
5	10	1	30
6	10	25	(40)
7	30	50	20
8	2000	100	15,000

A - Larry Smith Sr. of Smith Electronics Atlantic City, N.J. 08401
609-641-6309

B - George Munger of Mueller Electronics Cape May, N.J. 08204
609-884-8433

C - Al Struncius of Charles Rogers & Son Electronics Manasquan, N.J. 08736
201-223-1949

COMMENTS

1. The small boats go about 5 miles off shore
2. Weather warning time is about 1/2 hour

2. Chesapeake Bay 12/21/70

	A	B	C	D
1	3	4	2	0
2	75	70	80	50
3	1	20	50	35
4	3	10	10	35
5	.5	3	(20)	1
6	0	3	10	35
7	20	40	20	40
8	1,000	20,000	25,000	2,000

A - Jack Laudet of American Technical Services Bethesda, MD. 20900
301-654-5260

B - John Carpenter of Electronic Marine Products Annapolis, MD. 21400
301-268-8101

C - Paul Dunn of Priest Electronics Norfolk, VA. 23500
703-855-0141

D - Mr. Budd of Cambridge Shipyard Cambridge, MD. 21613
301-228-4880

COMMENTS

1. Small boats range over the entire bay
2. Weather warning time is about one hour
3. The C.G. should check radios to insure they're operating properly

8

3. South Florida Coast 12/14/70

	A	B	C	D	E
1	25	8	.25	0	5
2	74	100	65	100	99
3	0	100	29	33 1/3	0
4	0	5	2.5	0	0
5	0	0	2.5	∿0	0
6	1	15	1	33 1/3	0
7	8	5	0	33 1/3	0
8	5,000	8,000	49,000	20,000	10,000

A - Harold Holland Jr. of HWH Electronics St. Petersburgh, Fla. 33700
813-363-1671

B - Earl Jackson of Jackson Electronics Ft. Lauderdale, Fla. 33300
305-523-7815

C - Ted Johnson of Marine Acoustical Services Miami, Fla. 33100
305-642-7515

D - Mrs. Hartzell of Naples Marine Electronics Naples, Fla. 33940
813-649-8874

E - Gene Sykes of Gene Sykes Electronics West Palm Beach, Fla. 33401
305-833-5298

COMMENTS

1. The small boats venture out about 5 miles
2. Weather warning time is about 1/2 to 3/4 hour
3. All boats that have VHF also have something else

9

4. <u>Gulf Coast - Galveston to Brownsville</u>

	A	B	C	D
1	2.5	1	10	1
2	100	100	90	100
3	15	90	75	100
4	10	0	0	20
5	2.5	1	0	100
6	2	20	5	100
7	1	0	15	60
8	7,500	500	1,200	450

A - Gulf Radio Telephone, Inc. Corpus Christi, Texas 78400
512-758-2021

B - Dick Sexton of Gulf Marine Radio Brownsville, Texas 78520
512-731-4567

C - Mr. Campbell of Mackay Radio Galveston, Texas 77550
713-644-9246

D - Ed Dumas of Palacios Freezers Palacios, Texas 77465
512-972-2527

COMMENTS

1. The small boats stay inside breakwater area (1-3 miles)
2. Weather warning time about 3 hours
3. Column D answers were for commercial shrimp boats mainly

5. North Pacific - Grays Harbor to Florence

	A	B	C	D
1	10	10	1	10
2	80	80	15	30
3	20	50	50	5
4	1	0	0	0
5	5	1	5	0
6	15	10	2	2
7	10	10	10	45
8	1,200	1,500	300	500
9CB			75	40

A - Mr. Harpster of Rad.Comm. Electronics, Inc. Aberdeen, Wash. 98520
206-532-6916

B - Don Ivanoff of Oregon Marine Supply Co. Astoria, Oregon 97103
503-325-2621

C - Paul Kaufori of The Radio Center Newport, Oregon 97365
503-265-2731

D - Warner Pinkney of The Sportsman Florence, Oregon 97439
503-997-3336

COMMENTS

1. Small boats go about 5 miles offshore
2. Weather warning is 1 - 1 1/2 hours for storm but big problem is fog which can occur within 1/2 hour
3. The citizens band equipment shown in 9 above is used alot in the region below the Columbia River

6. <u>Great Lakes - Green bay to Erie</u> 12/21/70

	A	B	C	D	E	F	G	H	I	J	K
1	10	5	1	3	3	90	2	1	1	20	3
2	75	99	90	85	33	20	15	95	95	100	95
3	100	50	90	100	90	0	30	20	100	75	30
4	25	0	25	0	20	8	10	30	100	10	15
5	10	0	1	0	1	0	1	40	0	20	25
6	10	0	10	20	15	0	1	40	1	5	15
7	15	5	5	15	5	4	70	15	0	50	15
8	30,000	500	1000	8000	450	2000	5000	20,000	400	2000	1100

A - Ken Sidoti of Cleveland Mobile Radio, Inc. Cleveland, Ohio 44121
216-749-1535

B - Al Camp of Camp Communications Erie, PA. 16503
814-454-1568

C - Mr. Wilson of Wilson Electronics Green Bay, Wisc. 54305
414-435-0651

D - George Hemminger of Airlansea Co. Toledo, Ohio 43610
419-693-0706

E - Lafe Nelson of Lancer Electronics Milwaukee, Wisc. 53201
414-762-6500

F - Great Lakes Towing Co. Chicago, Ill. 60690
312-768-2204

G - Sanford Marlatt of Aviation & Marine Electronics Traverse City, Mich 49684
616-947-9852

H - Waldo Wilson Car-Phone Comm. 4045 Hoyt St. Muskegon, Mich. 49444
616-733-2109

I - Harvey Peltz of Central Radio & Telegraph Rogers City, Mich. 49779
517-734-2146

J - Dick Conant of Conant Radio Communications Port Huron, Mich. 48060
313-YU22927

K - Bob Jones of Brennan Marine Electronics Bay City, Mich. 48706
517-894-2725

6. Great Lakes Continued

COMMENTS

1. Small Boats go out between 5-10 miles
2. Weather warning about 15 minutes. A storm of 4th of July 1970 came up in 3-5 minutes
3. Column F answers were from a Tug boat operator and mainly for a commercial operation. However, it is included in average since the responder indicated some small boats are included in his opinion

FOR AGENDA

Doc. 13509/1-2.7.11

ITEM 14

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF TELECOMMUNICATIONS POLICY
WASHINGTON, D.C. 20504

October 21, 1970

DIRECTOR

6a. - 10/27/70 (N)

Honorable Dean Burch
Chairman
Federal Communications Commission
Washington, D. C. 20554

Dear Mr. Chairman:

The lack of adequate measures in the design and development of receivers, from the standpoint of their susceptibility to interference, has been a matter of concern for some time. The Joint Technical Advisory Committee report "Spectrum Engineering - The Key to Progress" touched on this point, as did the 1968 Task Force Report on Communications Policy.

While the FCC has, perhaps wisely, not ventured into the field of receiver regulation, per se, there are problems arising which point to the need for a systems engineering approach to be taken in the interest of improved spectrum management. The enclosure contains examples of problems in this area. Additional difficulties are to be expected due to the characteristics of certain foreign import radio products.

I consider that given adequate guidelines, the industry might regulate itself in this regard and this is a desirable objective. Some mechanism, however, would appear necessary to afford greater consumer/user protection than afforded at present.

It is suggested that we appoint a joint group to study the matter and recommend procedures and actions which might be taken short of mandatory regulation to ensure that receiver characteristics are given increased consideration. For instance, it might be possible to place greater emphasis on the procedure wherein the allocation of spectrum and authorization of transmitters is made on the basis of assumed receiver characteristics. Also, perhaps a "labeling" system would have merit which would permit the consumer to evaluate the "usability" of receivers prior to purchase.

If you are in agreement that we should jointly explore this area, I designate Mr. W. Dean, Jr. of my staff to represent this Office.

Sincerely,

Clay T. Whitehead

Enclosure

Sample 11 only is indicated

The IRAC, in striving to keep pace with the state-of-the-art and to accommodate the ever increasing demand on the radio frequency spectrum, has reduced channel spacing and has required conversion to narrowband technical standards in a number of land mobile bands.

A problem has developed in this regard with respect to local weather broadcasts operated continuously by the Department of Commerce on 162.55 MHz. Although transmitters in this service have been converted to narrowband (16F3) emission and this information has been promulgated with the weather information in repeated broadcasts, the vast majority of receivers in the hands of the public remain inexpensive wideband devices.

This resulted recently in a case of interference between a Government operation (Veterans Administration) on 162.5875 MHz, with 16F3 emission, and the reception by the public on a wideband receiver of the weather broadcasts from 162.55 MHz. The Veterans Administration was forced to move to another frequency. As an additional measure, to minimize the chance of a similar incident in the near future, a number of changes were made in the channeling plan for the band 162-174 MHz. Chief among these were the designation of the frequency 162.575 MHz for Commerce use, with 16F3 emission, and the deletion of the channel centered at 162.5875 MHz.

Although the foregoing action is not considered to be good frequency management, it was taken as an expedient to assure the implementation of the mandate to the Department of Commerce to provide the best and widest dissemination of weather information to the public. It is understood that there are 24 transmitters providing service at this time, by the end of 1970 there will be approximately 40 transmitters, and in 3-5 years as many as 300. It is also estimated that there are already 2-2½ million receivers for this service in the hands of the public today. The projected growth illustrates clearly that the receiver difficulty will intensify unless remedial measures are taken. By looking through the ads, one notes that receivers are being made available with wideband characteristics throughout the band 162-174 MHz, although, with but few exceptions, channeling is 25 kHz or less.

Item 15. Survey of Coast Guard Auxiliary and Power Squadron Members by Geonautics, Inc.

Under contract number DOT-CG-83291-A, Geonautics, Inc. (a CSC subsidiary) performed a "Study of Maritime Aids to Navigation in the Short Distance Maritime Environment." This study, performed in 1968-69, contained a questionnaire that was circulated among Coast Guard Auxiliary and Power Squadron members. The results of this survey are summarized in the following tables.

The tables at the end of this item give a detailed breakdown of certain data by size of boat. This data was compiled specially for the Weather Dissemination Systems Study, and did not form part of the original Geonautics, Inc. report.

Please return to:
WEEMS & PLATH
48 Maryland Avenue
Annapolis, Maryland
21401

ALL AREAS
PLEASURE BOATS

All of the following questions refer to pleasure boats. Even though you may own other types of vessels or other pleasure boats, please answer these questions as they apply to the specific vessel identified in answer to questions one and two, unless otherwise directed, check appropriate answer.

1. What is your home or primary port?

	City	State
During April and May	a)________	b)________
During June to September inclusive	a)________	b)________
During October to March inclusive	a)________	b)________

2. What kind of boat is it?

Class:

a) Power boat 78% b) Sailboat with or without auxiliary engine 20%

c) Motor sailer 2%

Size:

a) Under 16' 3% b) 16'-26' 31% c) 26'-40' 49% d) 40'-65 16% e) Over 65' 1%

3. What type of boating do you engage in principally?

a) Day cruising 46% b) Overnight cruising 59% c) Fishing 5%

In what general areas do you do this during periods indicated? (If you don't cruise during a period, leave spaces blank).

	During * April-May	During * June-September	During * October-March
Navigable rivers	a) 37%	b) 41%	c) 23%
Great Lakes	a) 8%	b) 16%	c) 5%
Protected or sheltered waters	a) 42%	b) 48%	c) 35%
Open waters near shore	a) 37%	b) 56%	c) 28%
Open sea	a) 16%	b) 32%	c) 13%

4. How many persons, including yourself, are usually available to handle the boat?

a) One 13% b) 2-5 85% c) Over 5 2

*Over 100% because some indicated more than one category.

5. Is most of your boating conducted within the following distances from home or primary port?

a) 20 miles 22% b) 20/-100 miles 59% c) Over 100 miles 10% No reply 9%

6. How many hours per month is your boat normally underway in these areas during during periods indicated? (If you don't cruise during a period, leave spaces blank).

	During Apr.-May	During June-Sept.	During Oct.-Mar.
Navigable rivers	a) 35	b) 39	c) 24
Great Lakes	a) 30	b) 76	c) 27
Protected waters	a) 43	b) 56	c) 36
Open waters near shore	a) 28	b) 55	c) 33
Open sea	a) 39	b) 64	c) 68

7. Is your boating ever hindered by low visibility? a) Yes 79% b) No 18% No reply 3%

8. If your answer to question 7 is "Yes", and a navigational system were to become available that would let you cruise in fog or low visibility in about the same manner as in clear weather, how much do you think it increases the percentage of time per week that you could cruise during the periods indicated?

	None	10%	25%	Over 25%	No reply
During April - May	a) 30%	b) 22%	c) 5%	d) 3%	40%
During June - September	a) 24%	b) 38%	c) 13%	d) 6%	21%
During October - March	a) 27%	b) 15%	c) 5%	d) 3%	50%

9. How much space is available, or could be made available, near the control station of your vessel for a navigational device?

	As replacement device	No reply	As additional device	No reply
12"x12"x18" or less	a) 22%		b) 40%	
18"x18"x18"	a) 10%		b) 26%	
More than 18"x18"x18"	a) 9%		b) 10%	
Don't know	a) 3%	56%	b) 4%	20%

10. What electrical service does your vessel have?

a) None 4% b) AC110V 27% c) DC12V 60% d) DC32V 2% c) Other 2% No reply 4%

Rating if known: a) Watts________ b) Ampere________ No reply________

9

11. During what period do you need navigational aids provided by the Coast Guard:

	Clear	Low Visibility
Daytime only	a) 9%	b) 9%
Night only	a) 7%	b) 2%
Day and Night	a) 71%	b) 76%
No response	a) 13%	b) 13%

12. How accurately do you need to know your position in the following listed areas both in clear weather and low visibility?

	1/4 channel width	1/2 channel width	Other	No reply
100-300' channel or river, clear	a) 27%	b) 51%	c) 3%	d) 18%
100-300' channel or river, low visibility	a) 42%	b) 38%	c) 1%	d) 18%
600' channel or river, clear	a) 21%	b) 39%	c) 4%	d) 35%
600' channel or river, low visibility	a) 38%	b) 27%	c) 3%	d) 32%
2000' channel or river, clear	a) 25%	b) 32%	c) 6%	d) 37%
2000' channel or river, low visibility	a) 37%	b) 23%	c) 5%	d) 34%

13. How accurately do you need to know your position in the following listed areas both in clear weather and during periods of fog and low visibility?

	50 yds. or less	50-100 yds.	100 yds. 1/2 mi.	1/2 mi. 1 mi.	Other	No Reply
In areas near shore in clear weather	a) 20%	b) 19%	c) 27%	d) 24%	e) 1%	9%
In areas near shore in low visibility	a) 36%	b) 28%	c) 23%	d) 5%	e) 0%	8%
In areas beyond 50 miles from shore in clear	a) 1%	b) 0%	c) 6%	d) 41%	e) 10%	42%
In areas beyond 50 miles from shore in low visibility	a) 2%	b) 2%	c) 15%	d) 31%	e) 8%	42%

14. How often do you need to know your position in the following listed areas both in clear weather and in fog or low visibility?

	Continuous	Less than 1 min.	Betw. 1 & 5 mins.	Betw. 5 min. & 1 hr.	Betw. 1 & 2 hrs.	Other	No Reply
In a channel or river in clear weather	a) 30%	b) 8%	c) 23%	d) 22%	e) 4%	f) 1%	12%
In a channel or river in low visibility	a) 47%	b) 15%	c) 20%	d) 6%	e) 0	f) 0	12%
In areas near shore in clear weather	a) 13%	b) 4%	c) 22%	d) 35%	e) 8%	f) 1%	17%
In areas near shore in low visibility	a) 28%	b) 13%	c) 28%	d) 13%	e) 1%	f) 1%	16%
In areas beyond 50 mi. from shore in clear weather	a) 2%	b) 1%	c) 5%	d) 23%	e) 24%	f) 1%	44%
In areas beyond 50 mi. from shore in low visibility	a) 3%	b) 1%	c) 10%	d) 26%	e) 14%	f) 1%	45%

15. How long do you think it should take you to determine your position in the following listed areas both in clear weather and during fog and low visibility?

	Immediately	Betw. 30 sec. & 3 min.	Betw. 3 & 10 min.	Betw. 10 & 60 min.	Other	No Reply
In a channel or river in clear weather	a) 44%	b) 35%	c) 8%	d) 1%	e) 0	12%
In a channel or river in low visibility	a) 46%	b) 34%	c) 8%	d) 1%	e) 0	11%
In areas near shore in clear weather	a) 23%	b) 38%	c) 23%	d) 3%	e) 0	13%
In areas near shore in low visibility	a) 25%	b) 40%	c) 17%	d) 3%	e) 0	15%
In areas beyond 50 miles from shore in clear weather	a) 1%	b) 7%	c) 30%	d) 21%	e) 0	41%
In areas beyond 50 miles from shore in low visibility	a) 1%	b) 10%	c) 29%	d) 18%	e) 0	42%

16. If a navigational system particularly suited to your requirements became available, what would you consider to be an acceptable price for the equipment for your vessel?

a) Less than $100 15%

b) $100 - $500 63%

c) $500 - $1,000 14%

d) Over $1,000 4%

e) No reply 4%

17. If a new and improved navigational system became available to you, how much training time (study manuals, lectures, practice) would you consider acceptable to learn to operate the equipment?

a) 2 hours 9%

b) 6 hours 44%

c) 12 hours or more 41%

d) No reply 6%

18. Do you use a searchlight or spotlight to pick up the reflectors installed on some buoys and beacons?

a) Yes 80%

b) No 10%

c) Not available in my area 5%

d) No reply 5%

If your answer is "Yes", do you think the number of buoys and beacons equipped with reflectors should be:

a) Increased? 76%

b) Decreased? 0

c) Remain the same 17%

d) No opinion 13%

e) No reply N/A

Over 100% because some responded who had not answered yes in first part.

19. What methods do you now use to navigate? (Check as many as apply to you).

	Use Regularly	Use Occasionally	Never Use	Do not have equipment	Service not Provided	No Reply
Piloting	a) 75%	b) 11%	c) 2%	d) 1%	e 0	11%
Dead Reckoning	a) 59%	b) 29%	c) 1%	d) 0	e) 0	11%
Judgment (seamans Eye)	a) 73%	b) 12%	c) 1%	d) 0	e) 0	14%
Magnetic Compass	a) 80%	b) 15%	c) 0	d) 1%	e) 0	4%
Gyro Compass	a) 1%	b) 2%	c) 2%	d) 56%	e) 2%	37%
Radio Direction Finder for homing	a) 14%	b) 38%	c) 2%	d) 28%	e) 1%	17%
Radio Direction Finder for position fix	a) 16%	b) 34%	c) 2%	d) 28%	e) 1%	19%
Auto RDF (radio compass)	a) 2%	b) 3%	c) 1%	d) 59%	e) 2%	33%
Radar	a) 2%	b) 3%	c) 1%	d) 59%	e) 2%	33%
Loran A	a) 2%	b) 1%	c) 1%	d) 62%	e) 3%	31%
Loran C	a) 0	b) 0	c) 1%	d) 61%	e) 4%	34%
Omni-range	a) 2%	b) 1%	c) 1%	d) 61%	e) 4%	31%
Consolan	a) 3%	b) 7%	c) 4%	d) 49%	e) 7%	30%
Other Electronic Aid (Please write in type)	a) 1%	b) 0	c) 1%	d) 19%	e) 1%	78%
Celestial	a) 5%	b) 26%	c) 22%	d) 16%	e) 1%	30%
Depth Finder	a) 61%	b) 16%	c) 1%	d) 12%	e) 0	10%
Visual landmarks	a) 95%	b) 2%	c) 0	d) 0	e) 0	3%
Visual with unlighted buoys	a) 90%	b) 4%	c) 0	d) 0	e) 0	6%
Visual with lighted aids	a) 87%	b) 8%	c) 0	d) 0	e) 0	5%
Navigational Ranges	a) 61%	b) 21%	c) 2%	d) 1%	e) 3%	12%
Sound signals from lighthouses, lightships	a) 22%	b) 36%	c) 12%	d) 3%	e) 10%	17%
Distance finding (radio and fog signal)	a) 7%	b) 26%	c) 20%	d) 14%	e) 8%	25%
Bell, Gong & Whistle Buoys	a) 58%	b) 22%	c) 3%	d) 1%	e) 6%	10%
Nautical charts	a) 91%	b) 6%	c) 0	d) 0	e) 0	3%

93

20. Do you use a depth finder?

a) For navigation 77% b) To locate fish 0 c) No depth finder 20% d) No reply 3%

21. If a new electronic aids to navigation are provided, do you feel that the number of unlighted aids presently in use:

a) Should be decreased and funds applied to other navigational aids 7%
(Please write in which type to decrease)________

b) Should be increased and funds taken away from other navigational aids 8%
(Please write in which type to increase)________

c) Should remain the same as now 64%

d) No opinion 15% e) No reply 6%

The number of lighted aids presently in use:

a) Should be decreased and the funds applied to other navigation aids 2%
(Please write in which type to decrease)________

b) Should be increased and funds taken away from other navigational aids 16%
(Please write in which type to increase)________

c) Should remain the same as now 61%

d) No opinion 14% e) No reply 7%

22. As aids to navigation, fog signals have inherent defects in that sound travels through air in variable and unpredictable ways. While they may be valuable as warnings the mariner should not place implicit reliance upon them for position fixings. They are only warning devices. Do you believe that it would be beneficial to pursue a policy of providing more unmanned-automatic fog signals of moderate range in lieu of the more powerful fog signals now requiring manned stations?

a) Yes 50% b) No 16% c) No opinion 30% d) No reply 4%

23. At some stations, the audio fog signal and the radio signal are transmitted as sychronized signals to permit their use to determine the distance to the station. Do you use this system of determining range?

a) Yes 25% b) No 42% c) Not available in my area 30% d) No reply 3%

24. Do you use either of the two Consolan stations (Nantucket, Mass. and San Francisco, Calif.) for obtaining bearings?

a) Yes 12% b) No 50% c) Not available 34% d) No reply 4%

Would you like a second Consolan Station established on your coast to provide a crossing line of position?

a) Yes 26% b) No 11% c) No opinion 56% d) No reply 7%

25. Do you consider Radio Direction Finder: a) Necessary 35% b) Convenient 32%

c) Not necessary 4% d) No opinion 2% e) No RDF 24% f) No reply 3%

26. Most long range radiobeacons cannot be on the air continuously because they interfere with other long range beacons. Shorter range beacons can be on the air at all times. In view of this fact, would it be acceptable to you if, at many of these stations, a continuous signal of reduced strength were substituted for the present signal?

a) Yes 53% b) No 13% c) No opinion 29% d) No reply 5%

If your answer is "Yes", what should the useful range be?

a) Under 10 miles 12% b) 10 miles 34% c) 20 miles 54% d) No reply____

Would it be helpful if radio beacon gave you a numerical readout on your equipment rather than your having to tune for the null?

a) Yes 53% b) No 8% c) No opinion 29% d) No reply 10%

27. For your operations, do you consider LORAN-A to be: a) Necessary 3%

b) Convenient 5% c) Not necessary 9% d) No opinion 4%

e) Don't have LORAN-A 72% f) No reply 7%

28. For your operations, do you consider LORAN-C to be: a) Necessary 0

b) Convenient 3% c) Not necessary 13% d) No opinion 5%

e) Don't have LORAN-C 72% f) No reply 7%

29. In some large European ports, harbor advisory radar service, coupled with line-of-sight radio voice communication, is provided to furnish mariners with information on traffic, weather, and their ship's position. If you use any major seaports, do you believe that harbor advisory radar would be helpful to you?

a) Yes 22% b) No 7% c) No opinion 15% d) Don't use major Seaports 51% e) No reply 5%

If answer above is "yes," in congested ports, do you feel that harbor advisory radar service is:

	Necessary	Convenient	Not Necessary	No Opinion	No Reply
In clear weather	a) 1%	b) 12%	c) 8%	d) 8%	e) 71%
Fog or limited visibility	a) 18%	b) 5%	c) 0	d) 8%	e) 69%

30. Some experimental work has been done on RATAN (Radar Television Aid to Navigation), a system whereby shore-based harbor radar stations transmit pictures to moving vessels equipped with a standard UHF television receiver. The presentation shows the user's position, the channel limits, and all other

vessels in the area. Audio advice could also be provided. If you use any major seaports, do you believe that RATAN would be helpful to you?

a) Yes 27% b) No 5% c) No opinion 15% d) Don't use major seaport 48% e) No reply 5%

In congested ports, do you feel that RATAN is:

	Necessary	Convenient	Not necessary	No opinion	No reply
In clear weather	a) 3%	b) 23%	c) 13%	d) 34%	e) 27%
Fog or limited visibility	a) 32%	b) 11%	c) 2%	d) 33%	e) 22%

31. Do you have problems of intermixing of traffic due to use of same port by:

Commercial Ships and Tugs?	a) Yes 20%	b) No 58%	22%
Other pleasure boats?	a) Yes 36%	b) No 46%	18%
Fishing vessels?	a) Yes 19%	b) No 57%	24%

32. What is your feeling about the system of entering and departing lanes (sea lanes) for commercial traffic presently used on the Great Lakes and the approaches to New York and San Francisco harbors?

a) It should be established in more areas 19%

b) It should remain the same 9% c) No opinion 63% d) No reply 9%

If it should be used in more areas, where should they be located?

______

______

______

33. In areas of heavy traffic, do you feel that a system of traffic control by a shore-based radar station is:

	Necessary	Desirable	Not necessary	Undesirable	No opinion	No reply
In clear weather	a) 3%	b) 20%	c) 23%	d) 7%	e) 34%	f) 13%
Fog or limited visibility	a) 20%	b) 28%	c) 5%	d) 4%	e) 33%	f) 10%

34. Are navigational charts presently available to you satisfactory for use?

a) Yes 81% b) No 12% c) No opinion 1% d) No reply 6%

If your answer is "No," please state briefly how they can be improved.

______

______

35. Some charts indicate the configuration of the bottom of the sea by numerous lines of equal depth similar to the occasional equal fathom curve now used. This idea could be extended to varied shading of equal depth areas similar to topography of the land.

Would such a chart used in conjunction with a depth-finder be of value in determining position? a) Yes 71% b) No 10% c) No opinion 11% d) No reply 8%

36. Are you familiar with the Uniform State Waterway Marking System for aids to Navigation?

a) Yes 66% b) No 24% c) No reply 10%

Do you consider that the additional marking and buoyage concepts and colors are beneficial to the user? a) Yes 65% b) No 6% c) No reply 29%

If the answer to second question is "No," what do you propose as an alternate solution?

____

____

____

37. Do you consider that greater use should be made of signs and pointers as markers to show channels, hazards, general directions and mileage to or from specific locations?

a) Yes 65% b) No 16% c) No opinion 6% d) No reply 13%

38. Have you completed a course in Navigation?

a) Yes 79% b) No 11% No reply 10%

If "Yes," please name course: ____________________

39. Are the navigation aids currently available to you satisfactory where you operate?

	Yes	No	No opinion	No reply
Channels and rivers	a) 61%	b) 13%	c) 3%	d) 22%
Great Lakes	a) 13%	b) 3%	c) 19%	d) 65%
Protected or sheltered waters	a) 56%	b) 12%	c) 3%	d) 29%
Open waters near shore	a) 50%	b) 13%	c) 4%	d) 33%
Open sea	a) 29%	b) 6%	c) 11%	d) 54%

If the answer to any of the above questions is "No," please indicate briefly in general terms why the aids are not sufficient. Also, if you have any other suggestions that would assist aids to navigation services, your comments would be appreciated.

OPERATING AREAS

Size	Number of Responses	Rivers	Great Lakes	Sheltered Waters	Near Shore	Open Sea
< 16'	12			8	4	
16' - 26'	117	16	13	23	41	24
26' - 40'	189	16	23	23	66	61
40' - 65'	67	1	4	9	14	39
> 65'	4					4

AMOUNT OWNER WILL SPEND FOR NAVIGATION EQUIPMENT

Size	a. <$100	b. $100-$500	c. $500-$1000	d. >$1000	No Response
< 16'	5	3			4
16'-26'	35	73			9
26'-40'	16	129	35	3	6
40'-65'	1	27	24	10	5
> 65'		1		2	1

USE OF RDF

Size	Use Regularly	Use Occasionally	No Response	Do Not Have Equipment
< 16'	1	1	5	5
16' - 26'	10	33	26	48
26' - 40'	22	100	17	50
40' - 65'	22	31	6	8
> 65'	4			

ITEM 16

31 July 1970

Results of a survey of CCGD8 Auxiliary Members.

Weather needs and services to the boating public.

Elements of weather most interested:	70 Inland Units	53 Coastal Units
1. General forecast information- - - - - - - -	68	50
2. Small craft warnings- - - - - - - - - - - - -	60	47
3. Wind direction- - - - - - - - - - - - - - - -	55	40
4. Wind speed- - - - - - - - - - - - - - - - - -	59	44
5. Wind warnings (inland waters) - - - - - - -	58	29
6. Water conditions- - - - - - - - - - - - - - -	40	34
7. Tide information- - - - - - - - - - - - - - -	19	20
8. Water temperature - - - - - - - - - - - - - -	23	15
What times of day would you need weather information:		
1. Early mornings- - - - - - - - - - - - - - - -	11	11
2. Early mornings and late afternoons- - - -	6	9
3. Late afternoons - - - - - - - - - - - - - - -	5	2
4. All day - - - - - - - - - - - - - - - - - - -	37	21
Weather services used:		
1. Listen to local radio or TV station for WX information- - - - - - - - - - - - - - - -	69	47
2. Listen to WX Bureau VHF/FM continuous broadcast - - - - - - - - - - - - - - - - - -	21	32
3. Telephone local Weather Bureau office - -	27	18
4. Listen to Coast Guard WX broadcast on 2670 kHz- - - - - - - - - - - - - - - - - - -	25	27
5. Listen to Federal Aviation Agency "NAVAID" ground radio - - - - - - - - - - -	9	8
6. Listen to Marine Telephone Operator - - -	7	11
7. Other:		
(a) Citizen's Band - - - - - - - - - - - -	4	--
(b) Newspaper- - - - - - - - - - - - - - -	3	2

(300)

Radio equipment on your boat:	70 Inland Units	53 Coastal Units
1. Radio telephone	35	37
(a) 2-3 MHz AM	35	37
(b) 147-174 VHF/FM	5	6
2. Portable radio on board	61	43
Receiving capabilities:		
(a) Standard broadcast band	54	40
(b) VHF/FM (147-174 MHz)	13	20
(c) 2-3 MHz AM band	24	24
(d) Other bands: VHF/FM 95-108 MHz	2	4
SW 3.8/12 MHz	2	1
Citizens Band	15	3
Beacon	--	4

ITEM 17

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

Address reply to:
Commander (oc)
Twelfth Coast Guard District
63Ø Sansome Street
San Francisco, CA 94126

3140
2 OCT 1970

From: Commander, Twelfth Coast Guard District
To: Commandant (OC)

Subj: Weather Dissemination; study of

Ref: (a) Phone Conv. CDR HOLLINGSWORTH/LCDR SARDESON 29 Sep 197Ø
(b) COMDTINST 314Ø.2

1. Recently this district distributed about 26ØØ self addressed cards utilizing the printed notice to mariners as a mailing list. Addressees were requested to fill out the card and answers to the appropriate questions relative to weather dissemination. The notice to mariners and the card are attached as enclosure (1). Thus far, about 6ØØ cards have been returned. It is realized that the use of the NTM mailing list is not a random sample of the boating population. However, these persons, by their desire to receive the NTM's, are perhaps a better group to sample in evaluating the adequacy of weather dissemination in this district. As can be seen by reviewing the card, there is additional information that can be obtained from a total analysis of the reports received. This is particularly true in the sources used to obtain weather information. Reference (a) indicated a desire for the information gathered to be provided to the Commandant as soon as possible. An initial check of the responses has indicated the following:

a. BAY - DELTA COMPLEX

(1) 469 operators of pleasure boats in the bay-delta area responded thus far. 313 or 67% indicated that the present weather information was adequate for their use and area. The remainder either modified their yes answer with words like usually, sometimes, etc., 12%; responded no, 15%; or did not answer the question, 6%. 38% of these operators indicated that one method used to receive weather information was the VHF-FM continuous weather broadcast on 162.55 MHz.

(2) 61 commercial operators in this area responded. 51 or 84% indicated present weather information was adequate for their use and area of operation. 41% indicated they receive the VHF-FM broadcast.

b. OTHER RESPONSES OUTSIDE THE SF AREA

(1) Thus far only 71 responses have been received from areas in this district outside of the Bay-Delta Complex. 54% indicated the present weather information is adequate and 37% indicated a capability to copy the VHF-FM broadcasts.

Subj: Weather Dissemination; study of

2. Comments written on the cards generally related to two items in which improvement was desired:

a. The broadcasts are not updated frequently enough.

b. Information provided in certain areas is not complete.

3. Although this report is preliminary, the facts tend to support actions taken by this district subsequent to publication of reference (b). In cooperation with the local weather office, action was taken to increase the number of reports, the number of reporting stations, and sea state was added in certain locations. Voice reports were accepted from commercial tugs. Several additional reporting stations are pending at this time. The Commandant is urged to again encourage the Weather Bureau to equip our stations and lightships being automated by LAMP and the LNB program. These automations will seriously reduce the weather reporting capability along the Pacific coast unless automated equipment is furnished in the near future.

4. The data obtained from the cards will be digested further. However, as the Commandant presently has a contract team studying this subject it may be more desirable to furnish the raw data at this time for their use. In any case, once the Coast Guard has completed its use of the cards it is our intention to provide the information to the local Weather Bureau office for their review.

W. E. ADAMS
By direction

Encl: (1) NTM and card

CG-3535-PP
(Rev. 1-54)

DEPARTMENT OF TRANSPORTATION

UNITED STATES COAST GUARD

LOCAL NOTICE TO MARINERS

ISSUED BY: COMMANDER, TWELFTH COAST GUARD DISTRICT
630 SANSOME STREET, SAN FRANCISCO, CALIFORNIA 94126 PHONE 556-2560

WEATHER RECEPTION QUESTIONNAIRE

The responsibility for weather broadcasts and warnings lies with the United States Weather Bureau. It is generally felt that existing weather dissemination procedures and services to the general public are adequate. In order to determine if additional weather dissemination is required, answers to the questions listed on the enclosed postage-paid, pre-addressed card are requested.

Your cooperation in submitting the card would be greatly appreciated. Additional information relative to this questionnaire can be mailed to Commander, Twelfth Coast Guard District (oc), 630 Sansome Street, San Francisco, California 94126.

CALIFORNIA - MOSS LANDING HARBOR - AIDS CHANGED.

The following changes, previously reported made temporarily to better mark the Moss Landing Harbor Channel, have been made permanent:

a. Moss Landing Harbor Channel Lighted Buoy 6 (LL 617) has been renumbered 8, and Buoys 7 and 9 (LL Pg. 46) have been renumbered 11 and 13.

b. Moss Landing Harbor Channel Buoy 6 (LL Pg. 46), a nun painted red with red reflector, has been established in 11 feet of water about 350 yards 053° from Moss Landing Harbor Entrance Light (36° 48.4' N., 121° 47.2' W.).

c. Moss Landing Channel Buoy 9 (LL Pg. 46), a can, painted black, with white reflector, has been established in 18 feet of water about 350 yards 076° from Moss Landing Harbor Entrance Light.

(L.N.M. 47, C.G., San Francisco, 12 August 1969)
C. & G. S. Chart 5403

CALIFORNIA - SEACOAST - LIGHTSHIP INFORMATION.

The Relief Lightship has replaced San Francisco Lightship (LL 47). No other change.

C. & G. S. Charts 5532, 5072, 5402, 5502, 5021, 5002, 5052

CALIFORNIA - SAN FRANCISCO BAY - SAN JOAQUIN RIVER - BRIDGE INFORMATION.

The State of California, Division of Highways advises that the lift span of the Antioch Bridge is jammed in the full open position due to a collision by a vessel with the south tower. The bridge will remain in this position until completion of repairs, estimated at 4 to 6 months.

Commencing approximately 21 September 1970, floating equipment will be working at the south tower, and will, at times, be working in the channel.

During the repair period, there will be no tender at the bridge, navigation lights will remain on at all times and radio communication for the Antioch Bridge will be handled by the Rio Vista Bridge.

The State advises that the damage to the south tower renders the bridge very vulnerable to further damage by collision.

C. & G. S. Charts 5576, 5527-SC, 165-SC

REPORT DEFECTS IN AIDS TO NAVIGATION TO NEAREST COAST GUARD UNIT

 CONTINUED ON REVERSE

NAME:______________________________ VESSEL:______________________________

NORMAL
OPERATING AREA:_______________ VESSEL OPERATION (Circle one or More):

1. Commercial 2. Pleasure 3. Sail 4. Passenger 5. Weekend Fishing

A. WHAT METHOD IS CURRENTLY BEING USED TO RECEIVE WEATHER INFORMATION (Mark one or more)

(1) Local Radio (KCBS KSFO KNBR KSAN KRED)?

(2) Television?

(3) Newspaper?

(4) Coast Guard Radio Broadcasts?

(5) VHF-FM (162.55 MHz)?

(6) Pacific Telephone Company (KLH KOE)?

(7) Visual Display?

(8) High Seas Marine Operator (KMI)?

B. AT WHAT TIME DO YOU RECEIVE WEATHER INFORMATION?

C. IS THE WEATHER INFORMATION RECEIVED ADEQUATE FOR YOUR USE AND AREA?

SAN FRANCISCO SURVEY OF METHODS USED TO RECEIVE WEATHER INFORMATION

SERVICE USED	SAN FRANCISCO BAY - DELTA AREA		SAN FRANCISCO COASTAL AREA		PERCENTAGE RESPONSES COMBINED AREAS	
	COMMERCIAL	PLEASURE	COMMERCIAL	PLEASURE	COMMERCIAL	PLEASURE
Local Radio BCST	36	408	11	28	44	72
Television BCST	20	221	4	14	23	39
Newspapers	18	208	1	23	18	39
Coast Guard Radio BCST	36	136	20	25	53	26
NWS VHF/FM BCST	29	226	15	16	41	40
Pacific Telephone Co. BCST	28	142	16	23	41	25
Visual Displays	21	104	2	9	22	18
High Seas Marine Operator	13	17	8	13	20	5
*Call Weather Bureau	8	26	1	3	-	-

*Non-Solicited Response

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

Address reply to:
COMMANDER (oc)
Fourteenth Coast Guard District
677 Ala Moana
Honolulu, Hawaii 96813

2300
Serial 35481
4 December 1970

From: Commander, Fourteenth Coast Guard District
To: Commandant (OC)
Via: Commander, Coast Guard Western Area

Subj: Small boat weather and safety communications

1. Several months ago this command announced the Coast Guard's policy on Citizens Band by means of a flyer mailed to over 7,000 registered boat owners in the State of Hawaii. Attached to this flyer was a pre-addressed questionnaire designed to solicit information for communications planning purposes. The following is a summary of this survey. A copy of the flyer and questionnaire is attached as enclosure (1).

2. Of 7,313 questionnaires mailed, approximately 1,500, or 20%, were returned. 1,489 were tabulated, indicating 393 radio-equipped boats. Seventy percent of these registered boats are under 20 feet in length. Thirty-five percent of those that are radio equipped are in this category with 43% falling in the 20-29 foot range. Many boats have more than one capability; the 2-4 MHz marine band is the most popular with 242 sets. Next is CB with 104 sets. Comments concerning the CB policy are quoted in enclosure (3); however, it is noted that only 17 took exception to it.

3. This survey was made prior to the publication of the new regulations requiring the single sideband and VHF-FM modes. Inasmuch as the boating public was not yet aware of these changes, the replies to the associated questions were in a negative vein. Copies of an FCC notice announcing the change and reasons therefor and the recommended VHF-FM channelization have since been distributed to many of the local boatmen at a recent symposium and through the mail.

4. The survey revealed that most boaters obtain their weather information from more than one source. Most of the boatmen rely on commercial broadcast stations, with the National Weather Service telephone recording a close second. Newspapers, the CG 2670 kHz broadcast, marine operator and KBA-99 were far behind in that order. Of 124 responses to satisfaction with the content of the CG broadcast, 7 indicated dissatisfaction.

4 December 1970

Subj: Small boat weather and safety communications

5. There were many comments expressing difficulty in receiving Radio Station Honolulu (NMO) in certain areas. The URG-II transmitters and a high-angle log periodic antenna have recently been installed and should correct this situation. It is planned to check these areas utilizing a WPB.

6. Enclosure (2) is a breakdown of the survey by islands. If a boater did not indicate that he had communications equipment, then any answers he provided for items 12, 13 and 14 were not counted. If he gets his weather information from more than one source, each source was counted; but if he did not indicate which one he used the most, then item 5 was not tabulated. If he did not indicate the 2670 broadcast as a source and answered item 7, then item 7 was not counted. It is felt there may have been some confusion as to whose "content" was meant. It was intended to mean the content of the 2670 broadcast; however, it may have been construed to mean the content of all sources. Of those indicating their boat is radio equipped, some had more than one capability. Therefore, if the 2-4 MHz column reads 80 and the CB column reads 20, this does not mean that 100 boats are radio equipped.

R. J. TATMAN
By direction

Encl: (1) Copy of flyer and questionnaire
(2) Breakdown of survey by islands
(3) Citizens Band comments by registered boat owners of Hawaii

COAST GUARD

1. What is the length and type of your boat? ______ ______________

2. What type of radio equipment do you have on your boat?
Receiver only________ Transmitter/Receiver________

2-4 MHz Yes__ No__ Citizens Band Yes__ No__

VHF-FM Yes__ No__ Amateur Radio Yes__ No__

3. Which do you use the most?

4. From which of the following do you get your weather information?
Newspaper____Telephone Recording____Marine Operator____KBA-99____

Commercial (AM/FM) Broadcast Station___ Which station? _______

Coast Guard 2670 kHz broadcast_____

5. If you checked more than one of the above, which one do you use the most? ______________________________

6. Which Coast Guard Broadcast do you listen to?

5AM____ 8 AM ____ 11 AM ____ 2 PM ____ 5 PM ____ 8 PM ____ 11 PM ____

7. Is the content satisfactory for your use? Yes_____ No_____

8. Where do you normally operate your boat? ______________________

9. Do you consistently launch or moor your boat at the same location?

Yes______ No_______

10. I launch/moor my boat at ______________________________

(a) Is this place radio equipped? Yes______ No ______

(b) Does it have:

1. 2 MHz Yes___ No___ (Crystal____ Tunable____)

2. Citizens Band Yes___ No___ Channels ________________

3. VHF-FM Yes___No___ Channels____________________

4. Amateur Radio Yes____No____ Which bands?______________

11. What boating organizations are you a member of?______________

____

12. Do you plan to convert your 2-4 MHz from double sideband to single sideband? Yes_____ No_____

13. Do you plan to replace your 2-4 MHz with VHF-FM? Yes_____ No_____

14. Do you plan to add VHF-FM? Yes_____ No______

15. How can we help you?

ALL
(Island)

	RETURNS	HAS RADIO	2–4	VHF	CB	HAM	WEATHER SOURCE: NEWSPAPER	PHONE	MO	KBA-99	COML BCST	CG	MOST USED	CONTENT: S	U	CONVERT TO SSD: Y	N	CONVERT TO VHF: Y	N	ADD VHF: Y	N
0 TO 19'	1091	136	73	19	57	4	413	376	32	25	521	49	BCST 161 FONE 116 NP 52 KBA 11 CG 8 M.O. 7	44	3	6	45	6	14	14	
20 TO 29'	278	170	98	16	28	7	56	142	31	14	125	49	FONE 45 BCST 31 CG 9 M.O. 8 NP 2 KBA 2	41	1	8	47	12	45	3	
30 TO 39'	82	56	47	8	11	2	16	44	12	4	35	29	BCST 11 FONE 11 CG 6 NP 2 MO 2 KBA 0	22	3	3	33	3	28	5	
40' AND OVER	38	31	24	3	8	7	12	19	12	3	16	11	BCST 9 FONE 6 CG 6 MO 1 NP 0 KBA 0	10	0	4	14	1	15	2	
TOTAL	1489	393	242	46	104	20	497	581	87	46	697	138	BCST 265 FONE 157 NP 60 CG 29 M.O. 18 KBA 16	117	7	21	139	22	132	27	

C-104

ENCLOSURE

310

OAHU
(Island)

	RETURNS	HAS RADIO	2-4	VHF	CB	HAM	WEATHER SOURCE: NEWSPAPER	PHONE	MO	KBA-99	COML BCST	CG	MOST USED	CONTENT S	CONTENT U	CONVERT TO SSB Y	CONVERT TO SSB N	CONVERT TO VHF Y	CONVERT TO VHF N	ADD VHF Y	ADD VHF N
0 TO 19'	768	85	53	14	29	3	298	313	27	15	310	32	BCST-104 FONE-101 NP 35 CG 7 M.O. 7 KBA 6	29	1	5	29	4	33	9	
20 TO 29'	198	127	66	12	19	6	35	125	24	10	68	36	FONE 46 BCST 14 CG 7 M.O. 6 VP 1 KBA 0	29	1	6	34	6	36	4	
30 TO 39'	57	39	34	3	6	1	12	36	12	4	17	24	FONE 11 BCST 5 CG 5 M.O. 2 VP 1 KBA 0	19	1	2	22	2	21	4	
40' AND OVER	29	23	18	2	6	4	10	15	7	2	12	7	BCST 6 CG 5 FONE 3 M.O. 1 KBA 0 VP 0	6	0	4	9	0	10	2	
TOTAL	1052	274	171	31	60	14	355	489	70	31	407	99	FONE-161 BCST-132 NP 41 CG 24 M.O. 16 KBA 9	83	3	17	94	12	100	19	

HAWAII
(Island)

	TURNS	RADIOS	2-4	VHF	CB	HAM	NEWSPAPER	PHONE	MO	KBA-99	COML BCST	CG	MOST USED	CONTENT S	CONTENT U	CONVERT TO SSB Y	CONVERT TO SSB N	CONVERT TO VHF Y	CONVERT TO VHF N	ADD VHF Y	ADD VHF N
0 TO 19'	149	29	8	3	22	-	62	45	3	2	79	6	BCST-29 FONE-12 NP 7 KBA 1	5	0	0	7	0	6	4	
20 TO 29'	24	8	6	2	5	-	8	7	1	2	16	2	BCST 6 FONE 2 CG 1 M.O. 1	1	0	0	1	1	0	0	
30 TO 39'	9	7	4	3	2	-	1	7	0	0	6	2	BCST-2	1	1	0	4	0	3	0	
40' AND OVER	6	6	4	0	1	3	2	3	4	1	2	4	FONE-3 BCST 1 CG 1	4	0	0	5	0	5	0	
TOTAL	188	50	22	8	30	3	73	62	8	5	103	14	BCST-37 FONE-17 NP 7 CG 2 KBA 1 M.O. 1	11	1	0	17	1	14	4	

KAUAI
(Island)

							WEATHER SOURCE							CONTENT		CONVERT TO SSB		CONVERT TO VHF		ADD VHF	
	RETURNS	HAS RADIO	2-4	VHF	CB	HAM	NEWSPAPER	PHONE	MO	KBA-99	COML BCST	CG	MOST USED	S	U	Y	N	Y	N	Y	N
0 TO 19'	82	8	5	0	4	0	23	5	0	5	63	4	BCST 10 KBA 4 UP 2 FONE 2	4	0	1	4	1	2	1	
20 TO 29'	25	17	13	1	2	0	5	5	4	2	21	4	BCST 3 KBA 2 FONE 1	4	0	2	8	3	5	3	
30 TO 39'	6	1	1	0	0	0	0	0	0	0	6	1	–	1	0	0	1	0	1	0	
40' AND OVER	1	1	1	1	1	0	0	1	0	0	1	0	BCST 1	0	0	0	0	0	0	0	
TOTAL	114	27	20	2	7	0	28	11	4	7	91	9	BCST 14 KBA 6 FONE 3 UP 2	9	0	3	13	4	8	4	

MAUI (Island)

	RETURNS	HAS RADIO	2-4	VHF	CB	HAM	WEATHER SOURCE: NEWSPAPER	PHONE	MO	KBA-99	COML BCST	CG	MOST USED	CONTENT S	CONTENT U	CONVERT TO SSB Y	CONVERT TO SSB N	CONVERT TO VHF Y	CONVERT TO VHF N	ADD VHF Y	ADD VHF N
0 TO 19'	52	7	4	1	2	1	11	6	0	1	44	4	BCST 11 NP 3	3	1	0	1	1	1	0	
20 TO 29'	21	14	12	1	2	1	4	3	2	0	16	7	BCST 5 CG 1 M.O. 1	7	0	0	3	1	3	1	
30 TO 39'	6	5	5	1	1	0	1	0	0	0	4	2	CG 1 NP 1	1	1	0	3	1	2	0	
40' AND OVER	2	1	1	0	0	0	0	0	1	0	1	0	–	0	0	0	0	1	0	0	
TOTAL	81	27	22	3	5	2	16	9	3	1	65	13	BCST 16 NP 4 CG 2 M.O. 1	11	2	0	7	4	6	1	

McLEAN
(Island)

	RETURNS	HAS RADIO	2-4	VHF	CB	HAM	WEATHER SOURCE: NEWSPAPER	PHONE	MO	KBA-99	COML BCST	CG	MOST USED	CONTENT S	CONTENT U	CONVERT TO SSB Y	CONVERT TO SSB N	CONVERT TO VHF Y	CONVERT TO VHF N	ADD VHF Y	ADD VHF N
0 TO 19'	35	6	2	1	0	0	9	6	2	1	16	3	NP 3 BCST 2 PHONE 1 CG 1	3	1	0	3	0	1	0	
20 TO 29'	8	3					4	2	0	0	3	0	BCST 1 NP 1	0	0	0	0	1	0	0	
30 TO 39'	3	3	2	1	2	1	1	1	0	0	1	0	-	0	0	0	3	0	1	0	
40' AND OVER																					
TOTAL	36	12	4	2	2	1	14	9	2	1	20	3	NP 4 BCST 3 PHONE 1 CG 1	3	1	0	6	1	2	0	

LANAI
(Island)

	RETURNS	HAS RADIO	2-4	VHF	CB	HAM	WEATHER SOURCE: NEWSPAPER	PHONE	MO	KBA-99	COML BCST	CG	MOST USED	CONTENT: S	U	CONVERT TO SSB: Y	N	CONVERT TO VHF: Y	N	ADD VHF: Y	N
0 TO 19'	15	1	1	0	0	0	10	1	0	1	9	0	BCST 5 NP 2	0	0	0	1	0	1	0	
20 TO 29'	2	1	1	0	0	0	0	0	0	0	1	0		0	0	0	1	0	1	0	
30 TO 39'	1	1	1	0	0	0	1	0	0	0	1	0	BCST 1	0	0	1	0	0	0	1	
40' AND OVER																					
TOTAL	18	3	3	0	0	0	11	1	0	1	11	0	BCST 6 NP 2	0	0	1	2	0	2	1	0

ITEM 19

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL WEATHER SERVICE – EASTERN REGION
585 Stewart Avenue
Garden City, New York 11530

Date: January 4, 1971

Reply to Attn of: WFEx1

Subject: Summary of Listener Survey of VHF-FM Tranamissions

To: Director, Eastern Region

During a four day period beginning on November 5, 1970, eight VHF-FM stations in the Eastern Region conducted a listener survey to obtain information on the size and variety of the audience, as well as the extent of coverage. In addition to the eight established stations, WSO Portland, ME did an independent survey during their test period prior to commissioning and prior to any publicity. They obtained about 150 written replies. Over 1,300 replies were received by the eight established stations - Boston, Hartford/New London, New York, Atlantic City, Washington, DC, Norfolk, VA, Charleston, SC, Cleveland/Akron/Sandusky, OH.

The following message was recorded on tape every six hours:

"This office is conducting a listener survey to obtain an idea of user response and effectiveness of these VHF-FM transmissions.

"Kindly send a letter or postal card to Weather Service Office (or WSFO), address. . . indicating

1. Your location
2. Type receiver used
3. Whether you use special antenna
4. Quality of the signal received
5. Value of the service and how used
6. Suggestions for improvement

"To repeat, the address is WSO or WSFO, etc."

As a result of the surv ey the following information was obtained:

1. Response - 45% marine interest
   36% general public
   19% special interests

The replies ranged from 60 at Hartford, CT to 464 at WSO New York.

2. Marine interests included fishermen, harbor masters, marine suppliers, scuba divers, lobster fishermen, deep sea fishermen, yacht racers, pleasure boatmen, marinas.

3. Amongst the general public about 20% included ham operators, as well as news media, schools, hospitals, office building superintendents and the like.

4. Special users included fuel companies, industrial concerns, construction companies, pilots, municipal and county offices, catering dealers, astronomer, radio suppliers, ice cream manufacturers, trucking companies, ski enthusiasts, wild life services and agricultural interests.

The survey was taken after the normal boating season and does not fully represent the marine nor agricultural listening audience, but does reflect the growing interest from other than marine users.

There is no way of determining the true size of the listening audience on the basis of this sample. However, the MIC at Portland, ME called some of the radio suppliers and from their response it was estimated that over 1,000 VHF-FM receivers were purchased in the two weeks following the dedication of the PWM VHF. The dealers estimated sales for Christmas could be expected to reach up to ten times this number.

99 and 44/100% of the respondents wrote favorably about the service and included many constructive suggestions for improving the service.

A very large percentage (over 50% in Connecticut and 90% in the Boston area) of the listeners are using the inexpensive receivers.

ITEM 20

BSIS DATA, FIFTH
DISTRICT TOTAL

Activity Most Done	Weather Information Source	Total	Type and Size of Boat Most Used			
			Motorboat		Sailboat	
			Under 16'	16' & Over	Under 16'	16' & Over
1	2	3	4	5	6	7
All Activities Combined	Newspaper	26674	9952	12155	1840	2727
	Television	47939	19336	26019	842	1742
	Radio Receiver	129312	35130	76086	5324	12772
	Radio 2-Way	4721	512	3337	118	754
	Weather Bureau	78776	25283	40351	2460	10682
	Telephone CG	27009	3342	18416	1534	3717
	Other	43341	18274	19218	370	5479
	Total	357772	111829	195582	12488	37873
Fishing	Newspaper	12706	4932	7774	-	-
	Television	28281	13005	15276	-	-
	Radio Receiver	59107	19566	39541	-	-
	Radio 2-Way	2497	512	1985	-	552
	Weather Bureau	44971	18949	22973	-	-
	Telephone CG	13589	1056	12533	-	-
	Other	20851	14087	6764	-	-
	Sub Total	179505	72107	106846	-	552
Water Skiing	Newspaper	5320	3905	1415	-	-
	Television	10503	3747	6756	-	-
	Radio Receiver	15659	5186	10473	-	-
	Radio 2-Way	664	-	664	-	-
	Weather Bureau	6952	2275	4677	-	-
	Telephone CG	2597	734	1863	-	-
	Other	6590	3137	3453	-	-
	Sub Total	48285	18984	29301	-	-

Activity Most Done	Weather Information Source	Total	Type and Size of Boat Most Used			
			Motorboat		Sailboat	
			Under 16'	16'& Over	Under 16'	16'& Over
1	2	3	4	5	6	7
Pleasure Cruising	Newspaper	8130	1115	2966	1840	2209
	Television	8273	2458	3749	842	1224
	Radio Receiver	53053	10203	25286	5310	12254
	Radio 2-Way	1560	-	688	118	754
	Weather Bureau	26800	4059	12041	1442	9258
	Telephone CG	10694	1552	4009	1534	3599
	Other	14146	862	9001	79	4204
	Sub Total	122656	20249	57740	11165	33502
Racing	Newspaper	518	-	-	-	518
	Television	585	67	-	-	518
	Radio Receiver	532	-	-	14	518
	Radio 2-Way	-	-	-	-	-
	Weather Bureau	1908	-	-	1036	872
	Telephone CG	118	-	-	-	118
	Other	1754	188	-	291	1275
	Sub Total	5415	255	-	1341	3819
Hunting	Newspaper	-	-	-	-	-
	Television	297	59	238	-	-
	Radio Receiver	961	175	786	-	-
	Radio 2-Way	-	-	-	-	-
	Weather Bureau	660	-	660	-	-
	Telephone CG	11	-	11	-	-
	Other	-	-	-	-	-
	Sub Total	1929	234	1695	-	-

Raw Total 1525

APPENDIX D

RECEIVER DISTRIBUTION - ZONE SELECTION ERROR ANALYSIS

D.1 INTRODUCTION

The primary model developed for the distribution of radio receivers in Chesapeake Bay was based on a predetermined zoning system derived from BSIS data. Observations made during the initial applications of this model indicated that the structure was unnecessarily detailed, and that a reduction in detail would result in a significant saving in time with little loss in accuracy in subsequent analyses. To ensure that this was true, a parametric analysis was performed to establish the sensitivity of the analysis to the model structure, using a typical range of operational parameters.

D.2 PARAMETRIC ANALYSIS

A typical scenario situation is depicted schematically in Figure D-1. A hypothetical scenario area is shown in Figure D1-A. It is divided into zones by lines 1 through 4; the distance from shore of these zone lines is W, X, Y, and Z miles, respectively. The number of receivers of a given type in each zone is denoted by N_1, N_2, N_3 and N_4; the sum is the total number of receivers in the scenario area, N

$$N = N_1 + N_2 + N_3 + N_4$$

The area of each zone is denoted by A_1, A_2, A_3 and A_4, respectively.

In Figure D-1B the coverage of a hypothetical transmitter located at the edge of the scenario area is depicted by a semi-circle of radius R. The length of the scenario area, L, is chosen to be equal to 2R, since this represents a criterion for differential coverage between zones. The coverage provided in zones 1 through 4 is denoted by a_1, a_2, a_3 and a_4, respectively.

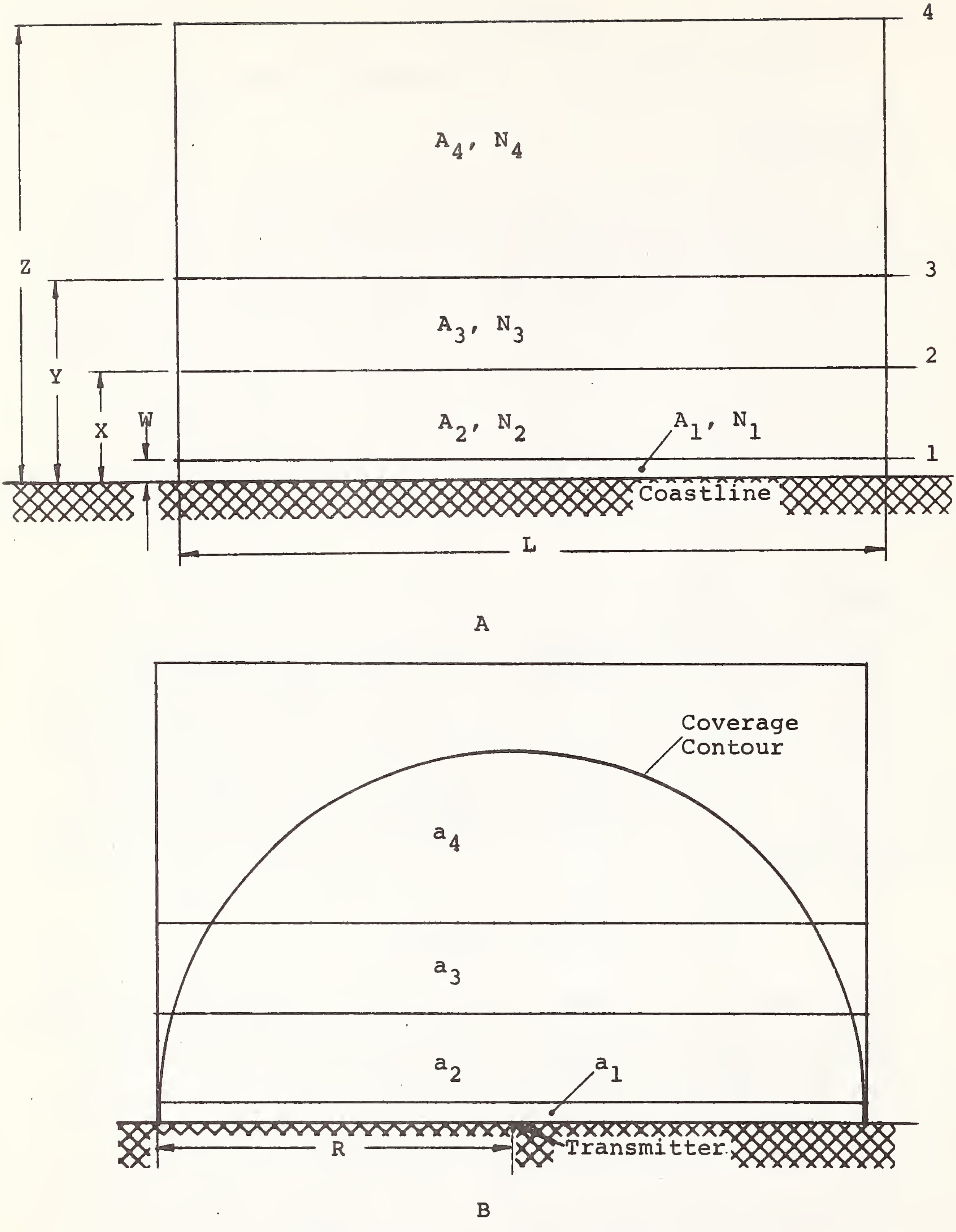

Figure D-1. Hypothetical Scenario Area Schematic Representation

The effectiveness of the system under analysis is denoted by E,

where $$E = \frac{a_1}{A_1} \cdot \frac{N_1}{N} + \frac{a_2}{A_2} \cdot \frac{N_2}{N} + \frac{a_3}{A_3} \cdot \frac{N_3}{N} + \frac{a_4}{A_4} \cdot \frac{N_3}{N} \qquad \text{(D-1)}$$

If the distinction between zones 1 and 2 is ignored, the effectiveness measurement becomes an approximation denoted by E_A,

where $$E_A = \left(\frac{a_1 + a_2}{A_1 + A_2}\right)\left(\frac{N_1 + N_2}{N}\right) + \frac{a_3}{A_3} \cdot \frac{N_3}{N} + \frac{a_4}{A_4} \cdot \frac{N_4}{N} \qquad \text{(D-2)}$$

The error is introduced in the first two terms of Equation (D-1). Since terms 3 and 4 make only a minor contribution to the value of E (receivers are concentrated near the shore in general), we shall measure the error as a percentage of the first two terms only. This represents a criterion, since the addition of the unchanged terms 3 and 4 tends to reduce the overall error as a percentage of E.

If the partial effectiveness computed from the first two terms is denoted by e:

$$e = \frac{a_1}{A_1} \cdot \frac{N_1}{N} + \frac{a_2}{A_2} \cdot \frac{N_1}{N}$$

or $$e = a_1' \quad N_1' + a_2' \cdot N_2' \qquad \text{(D-3)}$$

where $$a_1' = \frac{a_1}{A_1},\ N_1' = \frac{N_1}{N},\ \text{etc.}$$

then the approximate partial effectiveness may be denoted by e_A,

where $$e_A = \left(\frac{a_1 + a_2}{A_1 + A_2}\right)\left(\frac{N_1 + N_2}{N}\right) \qquad \text{(D-4)}$$

or $$\left(e_A = a_1 + a_2\right)' \cdot \left(N_1' + N_2'\right)$$

where $$\left(a_1 + a_2\right)' = \frac{a_1 + a_2}{A_1 + A_2}$$

It follows that the error, expressed as a percentage of e, is, a_1, N_1, etc.

$$\text{error} = \frac{\left(a_1'N_1' + a_2'N_2'\right) - \left(a_1 + a_2\right)'\left(N_1' + N_2'\right) \times 100}{\left(a_1'N_1' + a_2'N_2'\right)} \qquad \text{(D-5)}$$

The area of zonal coverage, a_z, of a zone H miles wide may be computed as shown in Figure D-2.

$$\text{Area } 1 = \pi R^2 \times \frac{b}{2\pi}$$

$$\text{Area } 2 = \frac{H}{2} \times R\cos b$$

$$a_z = 2\left[\frac{\pi R^2 b}{2\pi} + \frac{HR\cos b}{2}\right]$$

$$= \left(R^2 b + RH\cos b\right) \qquad \text{(D-6)}$$

$$\text{where } b = \sin^{-1}\frac{H}{R}$$

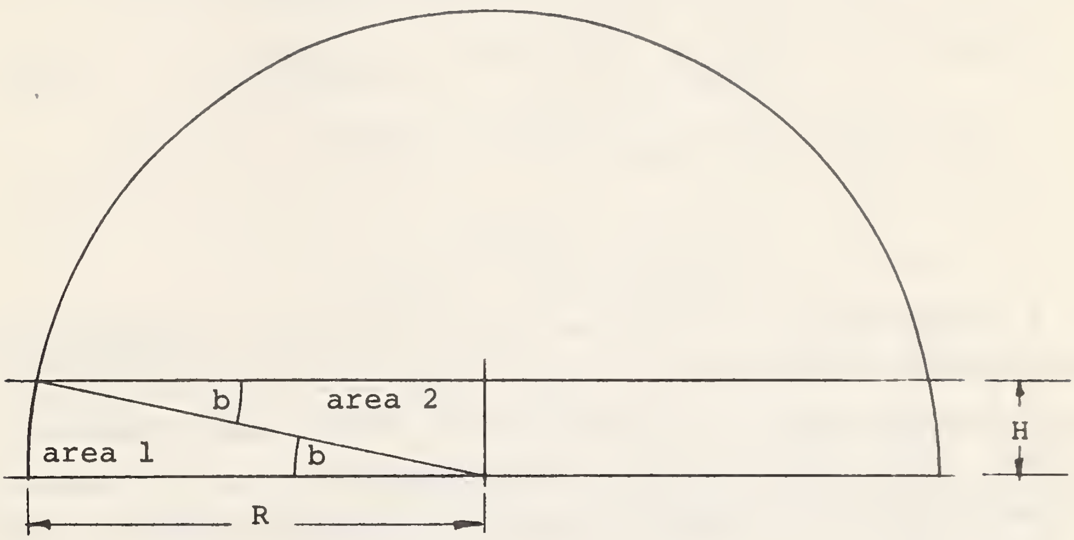

Figure D-2. Zone Measurement Geometry

5

Substituting the following typical values for the various parameters

$R = 20$ miles

$H = W = 1$ mile (zone 1)

$H = X = 5$ miles (zone 2) we have:

$$a_1 = 39.974 \qquad a_1' = 0.99938$$

$$(a_1 + a_2) = 197.75 \qquad (a_1 + a_2)' = 0.98874$$

$$a_2 = (a_1 + a_2) - a_1 = 197.75 - 39.974 = 157.774$$

$$a_2' = 0.98609$$

A computerized routine was used to exercise Equation (D-5) using values for the ratio of N_1' to N_2' from 9999 to 0.0001 (error depends only on the ratio of N_1'/N_2', not on absolute values). The results of this exercise showed the maximum error occurred when $N_1' = 1$ and $N_2' = 0$ had a value of 1.03 percent. The error with $N_1' = N_2'$ was 0.402 percent, and with $N_1' = 0$, $N_2' = 1$ was 0.269 percent, with a minimum value of 0.121 percent occuring when $N_1'/N_2' = 0.7$

A model similar to that depicted in Figure D-1 was developed for a non-coastal located transmitter, siting the transmitter 5 miles from the shore and setting the range R to 20 miles. The induced error from this model, computed in the same way as in the previous example, was shown to be less than 2 percent at maximum.

D.3 ERRORS IN PRACTICAL CALCULATIONS

Practical values for two systems in the Chesapeake Bay Scenario Area are shown below.

System	a_1'	a_2'	$(a_1 + a_2)'$
NWS	0.1282	0.0858	0.1045
COMML. DMB	0.5776	0.6201	0.6014

Partial effectiveness values based on these figures and on the distribution model data of Section 8 are computed as follows, using the terminology of the previous analysis

e

NWS: $e = 0.006591$ $e_A = 0.006478$

error = 1.714 percent

COMML. DMB: $e = 0.13795$ $e_A = 0.13832$

error = 0.268 percent

D.4 CONCLUSION

It is concluded that the modifications to the model outlined above may be made at the expense of a loss in accuracy of effectiveness not exceeding 2 percent. This is within the accuracy of the raw data upon which the model is based and is regarded as an acceptable error.

APPENDIX E

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APPENDIX F

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