

# FREQUENCY-SPECTRUM DILEMMA

## CRISIS OR OPPORTUNITY?

JAMES E. KLUGE, Senior Editor

"When man first discovered the resource of the electromagnetic spectrum less than a century ago, no one – not even Jules Verne – could have predicted that within 50 years of the first applications, man would be wrestling with apparent shortages of the means to accommodate an ever expanding demand. But, such is the pace of the information revolution." – *JTAC Report 1968, "Spectrum Engineering – The Key to Progress."*

Design Features



# "WE CANNOT TOLERATE A COMMUNICATIONS



"It is recommended that the Federal Communications Commission press forward with all possible vigor to completion of the proceedings under docket No. 18261 . . . that should the Commission fail to provide adequate relief for land-mobile users, that the Small Business Committee as constituted in the 91st Congress hold hearings at the earliest practicable date to ascertain the cause of such failure . . . that its hearings also address themselves to the recommendation made by The President's Task Force that the spectrum-management function be shifted to another entity within the federal government." *Subcommittee No. 5 of the Select Committee on Small Business, House of Representatives.*



# BREAKDOWN!"



Spectrum Saturation—Spectrum Utilization—Spectrum Conservation—Spectrum Management—Spectrum Engineering—Spectrum Crowding—Spectrum Congestion—Spectrum Pollution—Spectrum Strangulation—Spectrum Planning—Spectrum Sharing—Spectrum War—Spectrum Reallocation—Spectrum Priorities—Spectrum Clogging—Spectrum Coordination—Spectrum Resources—Spectrum Relief—National Defense—Public Safety—Public Services—Private Interests—Commercial Interests—Industrial Interests.

In one way or another these phrases point up the growing concern and serious need to solve the impending difficulties and acknowledge the seriousness of the matter. While frequencies apparently are becoming scarce, studies, reports, findings and recommendations are accumulating by "heaps and pounds". A solution goes begging while the problem becomes more critical.

The electromagnetic spectrum, as it is used for telecommunications, is an extremely valuable, in fact an essential, but also limited resource. It must be shared nationally and internationally among commercial, private and public interests. It must be utilized as effectively and efficiently as is practicable.

For nearly 100 years the radio spectrum was considered an unlimited resource. It is unlimited in that it cannot be depleted by use, but its utility can be drastically reduced by misuse and abuse.

In the past 20 years it has suffered from limitations caused by saturation in certain bands. Much of this problem stems from those whose efforts were devoted to spectrum *conservation* rather than *utilization*. Unused spectrum is wasted spectrum. Our goal should be to *use* the spectrum, not just conserve it.

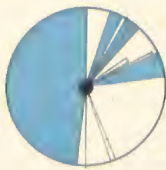
## Land-Mobile Problem

Although the congestion problem rears its head here and there throughout the frequency spectrum it presently is concentrated primarily in that segment of the spectrum that includes frequencies between 25 and 890 MHz. In the most critical area of all are those frequencies allocated to the land-mobile services, namely 25-50, 150-174 and 450-470 MHz. Land-mobile services include taxicabs, buses, railroads, mobile telephones, many types of consumer services like plumbing, heating, refrigeration and the delivery of essential materials like fuel oil and emergency oxygen. The public utilities (telephone, gas and electric companies) depend on mobile radio to dispatch their repair crews to emer-

(Continued)

(Motorola Inc.)





**Something of a war is shaping up between the broadcasters and the land-mobile people over the UHF-TV frequencies.**

gency situations. Other essential services include state and county highway departments, municipal street and water departments.

### **Public Safety Endangered**

The effectiveness of our police and fire departments definitely suffers during periods of civil disorder and natural catastrophe. During the Watts riots in Los Angeles, for example, police-radio transmissions continued without a break for 5 full days. During this time there was no break in the carrier and no break in the voice transmissions, according to Captain Kirby of the Los Angeles police department. Darwin Nielsen, chief communications officer of the Los Angeles fire department, described similar experiences relative to its use of two-way radios during the Watts riots. He said that at that time the department was controlling 110 companies by radio. "The air," he said, "was completely saturated and a large percentage of the messages were unintelligible or never did get through."

### **The Spectrum Squeeze**

The lack of sufficient frequencies in some portions of the spectrum is not in question. The question being debated is "do we simply need more frequencies or a better understanding of how to use those we have?" The Joint Technical Advisory Committee of the IEEE and EIA feels the answer is through more effective spectrum management implemented by a program of spectrum engineering. The President's Task Force on U.S. Communications Policy arrived at essentially the same conclusion and recommended an overhauling of our communication policies.

The plight of the land-mobile users, however, is well documented. Licensed transmitters have increased from 86,000 in 1949 to more than 3 million in 1969 with a conservative projection of more than 7 million in 1980. In 1949, 4.7 percent of the frequency spectrum was allocated to the land-mobile services. Today this same 4.7 percent must somehow serve this mushrooming demand. Certainly, adequate consideration has not been given to their needs.

### **What about UHF-TV Frequencies?**

After years of being ignored, the land-mobile users finally have gained the ear of a congressional subcommittee. The subcommittee in turn is putting pressure on the FCC.

In its docket No. 18261, the FCC proposed to reallocate UHF-TV channels 14 through 20 to be shared with the land-mobile services in 25 major urban areas of the U.S. The Electronic Industries Assn. objects on the grounds that such sharing will generate interference between TV and land-mobile users to the detriment of both. Such a situation, they claim, would help no one and would be unsatisfactory to nearly all concerned. The solution, they feel, is to allocate channels 14 to 20 exclusively to land-mobile services. In many U.S. cities such as Denver, the UHF-TV spectrum is totally unused and therefore wasted.

Another FCC proposal, docket No. 18262, concerns the future use of the frequency band containing 806 to 960 MHz and the amendment of the rules that govern operation in this proposed band. This group of frequencies would include UHF-TV channels 70 through 83. The land-mobile communication section of the Industrial Electronics Division of the EIA has recommended that the frequencies between 806 and 947 MHz should be allocated immediately to the land-mobile radio services. In addition, it feels that this band of frequencies should be developed extensively by the FCC to encourage investment in developing equipment and systems that will meet future land-mobile needs. The EIA went on to say that suballocating some of this band is premature until the results of a developmental program can be appraised.

### **War with the Broadcasters**

Something of a war is shaping up between the entrenched TV broadcasters and the land-mobile people. At this point, they are grouping their forces and readying for a battle over the UHF-TV frequencies.

The National Assn. of Broadcasters is making every effort to protect its coveted 82 TV channels. The broadcasters argue that the spectacular growth of radio and television broadcasting has been made possible because the broadcast industry had the time and the spectrum space in which to develop. Lack of spectrum space, according to land-mobile people, is hindering the growth of two-way radio. Broadcasters, on the other hand, feel that if it becomes necessary to reallocate the spectrum, some sort of priority of spectrum-user needs, based on both private and public interest, has to be established.

The executive director of the Assn. of Maximum Service Telecasters, a group whose purpose it is to main-

*(Continued)*

**Some typical applications of land-mobile radio.**





(MOTOROLA, INC.)



(GENERAL ELECTRIC CO.)



(MOTOROLA, INC.)



(GENERAL ELECTRIC CO.)



(MOTOROLA, INC.)



(MOTOROLA, INC.)



(GENERAL ELECTRIC CO.)

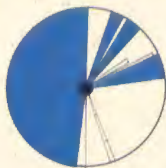


(GENERAL ELECTRIC CO.)



(MOTOROLA, INC.)





... The taboos established by the FCC in 1949 are ultra, ultra conservative and need up-dating and revising.

tain and encourage the growth of an 82-channel VHF- and UHF-TV system, states that in the top 10 markets, namely New York, Los Angeles, Chicago, Philadelphia, Boston, Detroit, San Francisco, Cleveland, Pittsburgh and Washington, D. C., there were three UHF-TV stations under construction and six stations on the air in the lower seven UHF channels. This means reassigning new frequency channels if those seven channels were reallocated to land-mobile users. The cost of shifting a station to another channel has been estimated to be in the order of \$100-125 thousand per station. His association also feels that until the FCC limits the free access to land-mobile frequencies by small businesses and other land-mobile users, land-mobile services should not be permitted access to TV frequencies.

Unfortunately, some spokesmen for the broadcasters have belittled the business use of land-mobile, implying that their motives are convenience and profit only. It would be difficult to imagine that the TV industry is not engaged in profit making.

#### Broadcasters Offered a Way Out

William L. Detwiler, president of Radio Specialists Co., Denver, Colo., and an engineer, offers a suggestion designed to free space in the UHF-TV band. He believes that the taboos established by the FCC in 1949

are ultra-, ultraconservative and need updating and revising. This, he feels, would free a lot of UHF spectrum space for other uses.

These taboos are rules establishing mileage spacings between UHF-TV stations operating on the same channel, adjacent channels, and channels separated by sound, picture and IF image frequencies.

Initial taboos were based on data available from the operation of VHF-TV (channels 2-6). They do not account for the shielding effects of varying terrain, they assume omnidirectional transmitting and receiving antennas, and maximum permissible effective radiated power and antenna height.

Taboos on IF beat, intermodulation, adjacent channel interference, oscillator radiation, sound image and picture image all are based on *anticipated* characteristics of UHF-TV receiver design as envisioned in 1948.

Detwiler points out that mobile-receiver design has produced equipment that is highly immune to this type of interference, even without taboos as provided for the TV industry. He claims that for a few cents per set, TV-set manufacturers could provide the necessary protection from interference and could relax, if not make unnecessary, some taboos. This, together with more realistic taboos based on today's information from NBS and other research groups, would free many megahertz

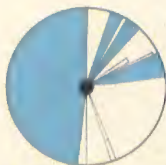
(Continued)











***It is apparent that congestion in the radio-frequency spectrum denies the public many of the benefits that land-mobile radio could provide.***

of UHF spectrum without reducing the total number of UHF-TV channels.

### **Congress Listens to Both Sides**

As might be expected, Congress finally is getting into the act. It is putting pressure to bear on the FCC in the interest of small business. One such congressional committee is the so-called Dingell Subcommittee on Small Business. Last year it conducted hearings in four major cities and in December published a report entitled "The Allocation of Radio Frequency and Its Effect on Small Business". Rep. John D. Dingell of Michigan, chairman of the subcommittee, set forth the purpose and scope of the hearings at the opening session. It can be summarized as follows:

"The frequency spectrum is a valuable economic resource of our nation. It is limited and is subject to competing claims. The apportionment for that part of the spectrum the subcommittee is to consider is the 25- to 890-MHz band allocated by the FCC in 1949. Approximately 60 percent of this band is allocated to FM and TV broadcasting, 34 percent to government, something less than 1 percent for point-to-point radio use and less than 5 percent for land-mobile radio services. Radio-frequency congestion, although only one of the problems facing business today, is a serious road block to business radio users who want to continue to serve the public with the services the public wants and the public needs. Until necessary action is taken to allocate additional frequencies to small businesses, the problem will continue to be one of primary interest to the committee who is interested in the problems of the small businessman."

### **Congressional Report Submitted**

The Dingell Committee submitted its report in December 1968. By holding hearings in Washington, Los Angeles, Detroit and Chicago, it heard the testimony of many two-way radio users, both business and public safety, as well as representatives of the commercial broadcasters. The Dingell Committee's conclusions define the problem quite well, and are summarized herewith:

There is no method of communication as effective as land-mobile radio in meeting the needs of a wide variety of small businesses, as well as those of fire, police, national state and local government services. Despite television's popular attraction, the development of land-mobile radio has had an equal, if not

greater, public impact. It affects not only the means by which people communicate with each other, but also the means by which they travel, earn their livelihood, conduct their business, insure their safety and happiness, and obtain efficiently, and at a lower cost than would otherwise be possible, the goods and services they use.

### **Land Mobile Serves Total Public**

Unlike other spectrum users in the 25- to 890-MHz band, land-mobile radio serves the total public. For example, it is used to dispatch electric, gas, water and telephone repair crews at the time of emergencies and natural disasters. A fuel-oil dealer radios one of his trucks about an urgent fuel-oil delivery; a plumber can be routed from one job to another without having to return to the shop. Police headquarters can deploy the nearest policemen to the scene of the accident or crime that has just been reported, and firemen inside a burning building can communicate with the fire chief outside. Even the taxi is dispatched from call to call by land-mobile radio. It is thus the means of most efficient use of personnel and vehicles that serve the public directly.

It is clearly apparent that congestion in the small land-mobile radio-frequency-spectrum allocation denies the public many of the benefits that land-mobile radio could provide. Indeed, the committee finds that it is essential, in the public convenience, interest and necessity, for ample, additional, usable frequency spectrum to be allocated without delay for this means of communication.

### **Emergency Needs Must Be Met**

Ample frequency spectrum, in this context, means ample spectrum to meet both the regular and emergency needs of the users of this form of communications. During times of major disturbances such as riots, the need for police communications not only increases in volume, but also is of the greatest importance in reducing and containing areas where trouble is about to erupt or has erupted. At these times, the number of calls the fire departments must meet also increases greatly, and the demands on the gas, water, telephone and electricity repair crews to shut off services to prevent fires and explosions or to reroute service to bypass damaged areas are much greater. A wide variety of businessmen also finds the calls for their services increase not only in number, but also in seri-



**Fire chief uses  
mobile radios  
to deploy  
fire-fighting  
forces effectively.**  
(Motorola, Inc.)



ousness at such times. The ambulance company and the plumber who must deal with broken gas and water pipes are but two examples.

The needs of the public not only continue during such emergencies but actually increase. Delivery of milk, food and fuel must be continued, to avoid areas of possible violence. The testimony of the fuel-oil dealer who pointed out the danger of a truck loaded with fuel being attacked by rioters emphasizes the need for adequate communications at such times. Ambulance services, funeral directors and even diaper-delivery work also must be able to carry on their normal work.

### **Home Deliveries Become Urgent**

During major disturbances, people may be restricted to their homes. It then becomes increasingly important that goods and services be brought to their homes, not only because they cannot go out to obtain them, but also to reduce the amount of travel in the streets at such times. As the committee learned, taxi and livery companies receive an overwhelming number of calls for transportation at such times, and many users of this type operate in close cooperation with the public-safety officials to utilize their vehicles only for the most urgent calls. The committee wishes to emphasize the fact that the need of the public to be served by the wide variety of uses of land-mobile radio may well be greater during times of civil disturbances and natural disasters than at other times and require an expanded rather than contracted use of communications by land-

mobile-radio users if the public interest is to be served properly.

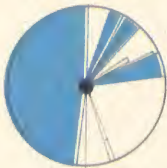
### **Innovation to Be Encouraged**

Ample frequency spectrum also means ample spectrum to allow for innovation, so that the public may have the benefit of such new uses, new equipment and new techniques as may be developed for land-mobile radio. There seems to be little doubt that the public presently is being denied the full extent of the benefits that land-mobile radio could provide today because of a lack of frequency spectrum to encourage such development. If adequate frequency spectrum is made available, these new uses, equipment and techniques will provide better law enforcement for our cities and rural areas, better state and local government services, and better service to the public from businesses at a lower cost than otherwise could be achieved.

Testimony presented to the committee repeatedly has emphasized two points concerning the amount of frequency spectrum that must be allocated to the land-mobile-radio services to serve adequately the public interest. First, witness after witness has said that when he first began using land-mobile radio he had little or no congestion resulting from an overloading of his frequency channel, but that congestion had increased steadily because "not only has my organization grown and my use of radio grown along with it, but also more users are using radio than before." Second, witness after witness said that he could not take advantage of all of the ways he could use radio

*(Continued)*





***"Relief is long overdue for land-mobile users and the public interest urgently requires prompt alleviation of this rapidly deteriorating situation."***

to serve the public better because the congestion in the portion of the spectrum allocated to land-mobile radio prevented a larger, effective use of his land-mobile-radio system.

In the committee's view, it is essential that newly allocated frequencies be suitable for equipment being used today or that can be made available quickly. As the committee uses the term "without delay", it means that the FCC should take every possible step to insure that its action is not delayed further.

### **UHF-TV Largely Unused**

It is evident that there is a substantial amount of UHF frequency spectrum allocated to television, which presently is unused for television and would remain unused even if the lowest seven UHF channels were allocated completely to land-mobile-radio use. Indeed, it is clear from the report of Land Assoc., commissioned by the National Assn. of Broadcasters, that any gain in program diversity decreases so rapidly with more than three television stations serving an area that there may be questionable justification for the large number of TV assignments in and around major urban areas. Many of these are in the UHF band and do not contain operating stations. That report also commented:

"What should be noted, in addition, is that the proliferation of similar program types that occurs when stations are added beyond three consists largely of

**Applications for new mobile-telephones** stack up waiting for frequencies to be made available. (AT & T Co.)

material already seen earlier on the network affiliates, that is, the so-called off-network, rerun programs of the situation comedy, quiz and game, adventure-drama types, along with feature films. The great bulk of the ETV allocations is going begging."

The committee also is aware of the fact that there have been suggestions by reputable radio engineers that it may be possible to narrow the present 6-MHz TV channel to 3 MHz, and thus make a substantial amount of VHF and UHF spectrum available for other uses if it should prove too difficult to provide for the reallocation of the lowest seven UHF channels to land-mobile radio.

### **FCC Commended for Acting**

The FCC is commended for its action in commencing the two proceedings to determine whether that portion of the electromagnetic radio spectrum currently allocated to UHF-TV should be reallocated in part to land-mobile radio (FCC docket No. 18261 and docket No. 18262). While these two proceedings are less than definitive, they do signal at least a commencement of awareness by the Commission of the very serious problems confronting land-mobile users and the public, which is dependent upon their services. It is to be noted that in docket No. 18262, the Commission states in paragraph 9, "The Commission is persuaded that the burgeoning needs of the land-mobile service can be met on a long-term basis only through the allocation of additional spectrum space to that service. . . ." This is undeniably true. It is likewise hard to fault the Commission's statement that ". . . at this point in time it is generally agreed that frequencies below about 1 GHz are most useful for general land-mobile applications. In looking to frequencies above 806 MHz to accommodate land-mobile service, the Commission recognizes that it will not meet immediate requirements and that several years of development may be required to establish a viable service. . . ." Conversely, the relief contemplated as the central strand of docket No. 18261, i.e., the awarding of the lowest seven UHF channels to land mobile, could, if properly delineated, afford immediate relief.

### **Land-Mobile Relief Long Overdue**

It is the conclusion of this committee, after studying all available pertinent facts, that relief is long overdue for land-mobile users, and that the public interest urgently requires prompt alleviation of this rapidly deteriorating situation. Further, it is clear that the





radio spectrum, being as it is a public resource, should be available in an amount ample for their needs, as a matter of right, to the many divergent small-business interests and the members of the public whom they serve, no less than commercial broadcasters. It is recognized that such uses as law enforcement, fire protection and similar public protection must be afforded sufficient spectrum to protect the public. Subject to this qualification, however, it is clear that small business and other land-mobile users are fully entitled to equitable participation in the allocation of this vital resource.

It appears improbable that most spokesmen for the commercial broadcasting interests care to engage in a debate wherein they would argue that even the typical prime-time fare offered over television today better serves the public interest than the more efficient dispatching of an ambulance, a fuel-oil truck, a power-line maintenance wagon or similar unit. Indeed, one would be hard pressed to imagine a more disadvantageous comparison that might be undertaken by commercial broadcasting spokesmen than that comparing the social utility of the second rerun of "I Love Lucy" to the typical land-mobile operation.

### Committee Demands Action

In issuing this report at the beginning of this year (1969) the subcommittee notified the FCC that either "it press forward with all possible vigor to completion of the proceedings under docket 18261" or be prepared to answer why the spectrum-management function should not be shifted to another entity within the federal government. The committee said that after studying all available pertinent facts it must conclude that "relief is long overdue for land-mobile users and that the public interest urgently requires prompt alleviation of this rapidly deteriorating situation". It also asked that frequency allocations be made by the FCC without delay, explaining that without delay means that the commission should take every possible step to insure that its action is not further delayed.

### A Microwave Squeeze Not Far Off

Although not concerned with the land-mobile problem, a saturation problem is shaping up in the microwave spectrum similar to what the land-mobile users experienced several years ago.

In the words of Richard P. Gifford, chairman of the JTAC, "... It appears that we have not yet learned the lesson. Recent regulatory action often has resulted



**Microwave spectrum already feels a squeeze** as business and utility services increase. (Collins Radio Co.)

in worse, not better spectrum engineering . . . It is time we made spectrum allocation subject to better engineering and management practices rather than a tool for administrative conveniences."

"User" or "block" allocations as an approach to spectrum administration have not produced the desired results in the HF or VHF bands. There is now little reason to believe that it can succeed in the microwave region.

It is interesting to note that in the HF band, block allocations were completely abandoned many years ago because of spectrum crowding that occurred even before WW II. Today, no government/commercial differentiation exists in the HF band.

With a saturation problem taking shape in microwave relay, and with data and video communications expanding at a rapid pace, a solution must be found, and soon.

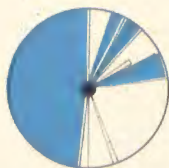
### Millimeter Waves Emerge as New Hope

Millimeter waves hold forth new hope in providing more usable spectrum. Millimeter waves refer to those frequencies between 30 and 300 GHz. A whole new technology recently has emerged that has opened up these frequencies to potential users. Going higher in frequency, however, poses new operational difficulties, but hopefully they will be surmounted.

Millimeter-wave technology is a whole new ball game. Components are available, but they're expensive.

(Continued)





**Experimental millimeter-wave radio links also are being studied as a possible system for relieving crowding in the microwave spectrum.**

Atmospheric absorption poses an operational problem, but there are frequency windows where absorption is minimal.

Bell Labs. has been doing extensive research on helix and circular waveguide for transmitting hundreds of thousands of voice channels securely and reliably. Experimental millimeter-wave radio links also are being studied as a possible system for relieving crowding in the microwave spectrum. However, such systems



**Richard P. Gifford** (left), chairman of the Joint Technical Advisory Committee of the IEEE and EIA, and **James D. O'Connell**, director of Telecommunications Management and special assistant to the President for telecommunications. (General Electric Co.)

may suffer from rain, fog and other atmospheric effects.

### Optical Systems

Laser communications is another technology being studied. There is much interest in the laser as a medium of transmission. However, in the earth's atmosphere it suffers from the same perturbing effects as millimeter waves. Space and planetary communications offer more promise since atmospheric effects are minimal. But then it wasn't too many years ago that the same skepticism was raised concerning the future of microwaves as a communication medium.

### Spectrum Engineering—A Partial Answer

Spectrum engineering is the technical component of spectrum management. It deals with the maximum effectiveness in using the frequency spectrum.

Three major functions of spectrum engineering are:

frequency selection, engineering planning and interference reduction.

The JTAC (Joint Technical Advisory Committee) of the IEEE and EIA, working for 5 years and producing a 1200-page report, formulated the development of a spectrum-engineering system founded on two basic principles. First, the system must be evolutionary. Changes in the system must be well thought out and announced beforehand to insure continued support from those concerned. Also, any future planning must consider the capital investment in existing equipment. Second, controlling the spectrum must *not* be accomplished through the application of simple but rather restrictive and rigid administrative rules. Instead, there should be increased technical assessment given to individual users and user applications in a given geographical location. If the block-allocation concept is to continue, then its application should be minimal and flexible. Objective measures should be employed to determine an applicant's need and his ultimate utilization of the spectrum.

### Spectrum-Engineering Functions

The frequency-selection function would be a day-to-day process to determine the applicant's technical requirements. Selection may be done by the applicant himself or a frequency-selection team.

Engineering planning concerns itself with long-term influences on spectrum utilization. These include preparation for international conferences on allocations, setting operating standards, prescribing procedures and criteria for frequency selection, prescribing analytical procedures for estimating potential interference and guidance for interference activities.

The interference-reduction function includes measurement of equipment characteristics for data base, measurement of equipment for performance to standards, monitoring unauthorized or improper spectrum use and fostering the development of new monitoring equipment.

Such a system of spectrum engineering would provide valuable planning data, permit sharing among spectrum users, reduce interference, eliminate many sources of EMI, and offer the objectivity, competence and manpower to evaluate technical proposals.

### Conclusion

It appears, then, that a fight is shaping up between the commercial interests of the TV broadcasters and



the private and public interests of the small businessmen. The small businessmen feel that the radio spectrum is a natural resource that should be available for public use. They see 60 percent of the spectrum tied up by the FM and TV broadcasters, the majority of this space unused and virtually wasted. Another 34 percent is tied up by the government. Their share—4.7 percent—is bursting at the seams. In general they feel that they've been given the "short end of the stick", and they're determined to correct the situation.

JTAC, the President's Task Force and others say that we need a complete overhaul of communication policy and administration—perhaps, even a new administrator. The FCC is under attack. There are seven commissioners—three Republicans and four Democrats. One has been a commissioner for 23 years, one is a former FBI agent, another a former UN ambassador, another a former employee of the National Assn. of Broadcasters and the other three are lawyers. Although the Commission has a staff of technically competent people, the decisions are made by the commissioners. This is where the battles between the broadcasters and land-mobile people will be fought. But regardless of who comes out the victor, the real battle will be won or lost within the FCC itself.

What about the future? Will we see more patchwork and delay or some fundamental policy and administrative changes as recommended by The President's Task Force and the JTAC?

The following article presents the land-mobile users' point of view that there now exists a serious shortage of available spectrum for use by land-mobile users, a shortage that is approaching crisis proportions. The answer, they feel, is to reallocate frequencies that presently are unused, such as UHF-TV. □

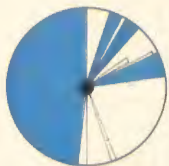
### ACKNOWLEDGMENTS

EDN is gratefully indebted to the following companies who have provided material for this special feature: MOTOROLA COMMUNICATIONS AND ELECTRONICS, INC., Schaumburg, Ill., and its Washington, D.C., Liaison office; GENERAL ELECTRIC CO., Communications Div., Lynchburg, Va.; RADIO SPECIALISTS CO., Denver, Colo.; RCA COMMERCIAL ELECTRONIC SYSTEMS DIV., Camden, N. J.; INSTITUTE FOR TELECOMMUNICATION SCIENCES, E. S.S.A., Boulder, Colo.; AERONAUTICAL RADIO, INC., Communications Center, Denver, Colo.; FAA, Stapleton International Airport, Denver, Colo.; COLLINS RADIO CO., Dallas, Tex.; MOUNTAIN STATES TELEPHONE CO., Denver, Colo.; REED AMBULANCES, Denver, Colo.; PUBLIC SERVICE CO. OF COLORADO, Denver, Colo.; CITY OF DENVER POLICE AND FIRE DEPARTMENTS; BELL TELEPHONE LAB., Murray Hill, N. J.

**Optical systems  
show future promise  
in opening up  
usable spectrum space.**  
(Bell Telephone Labs.)







**In 1949 land-mobile was allocated a mere 40 MHz out of 865 MHz. Since then, licensed land-mobile units have increased from 86,000 to over 3 million. Faced with growing demands and new services . . .**

# SOMETHING'S GOT TO GIVE!

WILLIAM L. DETWILER, Radio Specialists Co.

If the average citizen was asked to name some of the most pressing issues of today in the field of communications, he would most likely reply: CATV, violence on television and the proposed ban on over-the-air cigarette advertising. Few persons would mention the frequency congestion on two-way, land-mobile radio channels, which threatens to choke the communications used by police, fire, forestry conservation, highway maintenance and virtually all public-safety agencies, state and local governments, large and small businesses, utilities, manufacturers and transportation companies.

## Congestion Isn't New

Congestion really isn't anything new: it's simply unnoticed by the casual observer. With a television receiver in the living room of almost every American family, it's only natural that news coverage, violence and programming are the prime broadcast concerns of the public. But the average citizen does not see the benefits he reaps from the advantages offered by a radio-dispatched service, whether it be public safety, industrial or transportation.

Graphically, frequency congestion has been depicted by the Federal Communications Commission in its 1966 *Annual Report* as a "condition . . . not unlike that of a main highway on a summer weekend, so overcrowded with vehicles that traffic has come to a standstill. Getting it moving again . . . becomes a problem of gigantic proportions." But if each vehicle stuck on that highway were a service vehicle—police, fire, electrical, plumber, power, taxi, truck—the impact on the public would be far greater than just the inconvenience of a crowded thoroughfare. It would be devastating.

Never before has a society or an economy relied so heavily on services to protect life and property, and to serve the public interest, convenience and necessity. A

recent report of a House of Representatives Small Business Subcommittee underlined the impact of radio-equipped services on the public. The report described the uses of radio as unending.

## Room Needed for Growth

In addition to the vast number of services that require immediate frequency relief, innovations in land-mobile-communications technology are on the doorstep of fruition. In the next few years the public will be served by newer and more sophisticated forms of communications, particularly in the area of data-transmission and remote-control functions. For example, police and fire vehicles will receive messages via mobile teleprinter and will be capable of retrieving information over the air regarding missing persons, vehicle and gun registration from a central computerized information system. Special sensors will be employed by ambulances en route to transmit to hospitals a patient's electrocardiogram, pulse and respiratory beat; power services will employ sensors to transmit reservoir water levels to a central reporting station; fire-fighting equipment will be controlled remotely to operate in areas too hazardous for humans. Truly, land-mobile technology is entering an era of tremendous growth and of applications no one even visualized a few short years ago.

Yet, in spite of the unique and important role that land-mobile radio plays and will continue to play in the future, the lack of frequency space could hinder this new growth. With present land-mobile channels already overcrowded in the major metropolitan areas, the technological boom will place an even greater strain on these frequencies as newer applications for radio use come into being. Therefore, the need for spectrum relief for the land-mobile services is twofold: (1) to alleviate the severe congestion on the present





**Typical of the many new users of land-mobile radio** serving the general public is the ski patrol at Winter Park, Colo. Radio

communications means getting help to an injured skier faster with more effective first-aid treatment.

land mobile bands and (2) to accommodate the new land-mobile technology that will be upon us in the very near future.

### Effects of Congestion Far Reaching

The necessity for relieving the frequency congestion that exists today cannot be overstressed. It is a vital issue, the effects of which are far reaching. To illustrate, the Associated Public-Safety Communications Officers—a national organization representing the country's police and public-safety radio communicators—recommends a maximum 33-percent channel-loading factor for police radio. This means, in effect, that optimum usage time for a police-radio channel should be approximately 20 min out of the hour to provide for an adequate reserve factor in the event of emergencies. Testimony of witnesses before a Congressional Subcommittee has revealed that in Los Angeles, for example, the loading factor is closer to 60 percent and often more than 80 percent on a normal weekday. During the Watts riots in 1964, the channels were completely loaded for 5 straight days.

The situation in the business-radio service in Los

Angeles, while not measured in the same way as the public-safety-radio services, is similar. Public-safety frequencies are assigned by the FCC to police departments on an exclusive basis, as compared to business frequencies, which are shared by varying numbers of licensed business users. A telecommunications advisory panel of the U.S. Department of Commerce reported that in Los Angeles there may be up to 50 or 60 businesses on one radio channel with anywhere from 500 to 600 radio-equipped vehicles using that channel. While the statistics may vary from city to city, the top metropolitan areas—New York, Chicago, Los Angeles and Detroit—suffer from acute congestion of this type to the point where communications are being stifled.

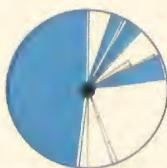
### Land-Mobile Continues Growing

The original frequency allocations were made by the FCC in 1949 when there were a mere 86,000 licensed land-mobile transmitters on the air. Of the usable radio spectrum from 25 to 890 MHz, land-mobile services were allocated a total of 40 MHz.

Today the situation is drastically different. Few persons in 1949 envisioned the multiplicity of uses that

*(Continued)*





**Many proposed solutions do not take into account the nature of the land-mobile user, his needs, the area he covers and the importance of his ability to communicate efficiently, rapidly and with timeliness.**

would develop for land-mobile radio in the ensuing 20 years, and during that time the number of licensed transmitters burgeoned to more than 3 million. In addition, several new land-mobile subservices that did not exist in 1949 were added to the FCC rules. The increasing strain on the 40 MHz allocated to the land-mobile services caused by the growing number of transmitters can be traced in the FCC Annual Reports for the past 10 years:

**1958**—“... the Commission’s objective (is) ... to relieve, to the greatest extent possible, the frequency congestion that prevails in most of these services.”

**1962**—“The various industrial services grow within the confines of a very small portion of the usable radio spectrum. This situation has led to extremely congested operating conditions in many areas.”

**Land-mobile radio** plays a vital role in protecting lives and property during periods of civil unrest and natural disasters.

**1964**—“One of the most pressing problems faced by the Commission is to find frequency relief for the public-safety, industrial and land-transportation radio services. These land-mobile-radio operations have grown rapidly in the past few years and frequency shortage has become acute in many geographic areas.”

**1966**—“The major problem facing the Land-Mobile-Radio Services, as well as one of the thorniest confronting the Commission, is the congestion in the limited spectrum space available to these intensively populated services.”

Existing land-mobile-radio channels already have been split by the FCC several times. The most recent was last June when channels in the 450- to 470-MHz band were reduced to 25 kHz. The FCC admittedly recognizes the splits as short-term measures until a more adequate and comprehensive solution is found. But the industry, in effect, has reached the technological point where channel splitting no longer can be accomplished effectively and economically. What now is required is additional spectrum.

#### **Proposed Solution for Relief**

However, while the existence of frequency congestion is obvious, the solution to the problem is not. Numerous and varying proposals are being advocated as the answer. Many of them do not take into account the nature of the land-mobile user, his needs, the area he covers and the importance of his ability to communicate efficiently, rapidly and with timeliness. Engineering solutions have technological limits and, with only a total of 40 MHz to work with, the limits of what can be done in the development of the state-of-the-art have been reached as far as channel bandwidth reduction is concerned.

Some experts in the communications field agree that realistic and immediate relief for the land-mobile services will have to come from the UHF-TV allocation, 470 to 890 MHz. Within this allocation, the FCC has provided for a total of 1098 station assignments across the country. To date, there are only 268 stations on the air, representing an actual operating assignment factor of 25 percent. There is no denying the need for other types of competitive broadcasting systems; however, there is a serious question with regard to the hundreds of idle UHF-TV assignments for which spectrum space is being held indefinitely, but which never may be filled. It is possible and feasible to employ UHF spec-





trum for land-mobile frequency relief while also permitting the full growth of a UHF-TV system and accommodating all UHF-TV assignments.

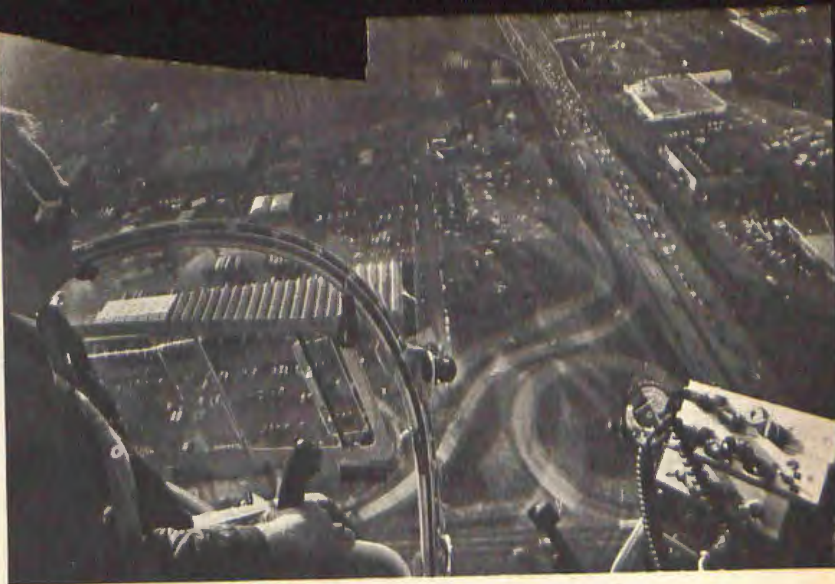
The next step, then, is to analyze several of the most current proposals for frequency relief that have been advanced by various agencies and groups concerned with the Land-Mobile-Radio Services.

**1. Geographic Sharing**—In one of its recent land-mobile Notices of Proposed Rulemaking, docket 18261, the FCC has proposed to reallocate to the land-mobile services in the top 25 urban areas unused channels from the block of UHF-TV channels 14 through 20. This proposal has become popularly known as "geographic sharing". The rulemaking would impose on the land-mobile systems employing these channels geographic, power and antenna-height limitations to protect the UHF-TV table of assignments—whether or not the stations are actually on the air.

Although the concept has a degree of merit, it does not face the realities of the typical land-mobile operation. Geographically, land-mobile users employing these new channels would be confined to the top 25 urban areas as defined by the 1960 census. Services, however, have no geographic boundaries. Furthermore, the physical limits of the urban area will be changed following the 1970 census and, in fact, will continue to expand as the population densities of suburban areas increase. The 1960 urban limits already are obsolete, and even then have never served to mark the boundaries of commercial zones, service areas or areas of public-safety responsibility.

A second major drawback to the sharing plan is that in a number of urban areas, the power and antenna-height restrictions are so stringent that few, if any, radio users would be afforded relief. In Chicago, for example, the maximum allowable power would be 50W effective-radiated power with an antenna height of 50 ft above average terrain. Under ideal conditions, the range of such a system would be approximately 5 miles. Not taken into account are the high-rise office and residential buildings that will reduce tremendously the range of an already restricted land-mobile system. A 50-ft antenna will be the same height approximately as a 5-story building—a miniature structure in a city where buildings are often more than 40 stories high.

**2. 900 MHz**—In a companion Notice of Proposed Rulemaking to docket 18261, the Commission has proposed to reallocate 806 to 947 MHz to the land-mobile-



Among the growing number of land-mobile radio users, police helicopters play a significant role in reporting rush-hour traffic snarls, coordinating public-safety operations over a wide area on the ground and assisting in the search for and pursuit of criminals.

radio services. The possibility of offering this region of the spectrum for land-mobile relief has been increased by the returning of 26 MHz of space in this band to the FCC's purview by the Office of Telecommunications Management.

At frequencies above 600 MHz, propagation characteristics become vastly more complex and unpredictable than at, say, 450 MHz. Land-mobile-radio equipment, comparable to that operating now in the present land-mobile bands, does not now exist that will operate at the higher UHF frequencies. If and when the 900-MHz band opens up, it will be best suited for short-range or multiple-base-station-type operations. It will not, however, be a reasonable substitute for 450 MHz because of its inherent short-range-only characteristics.

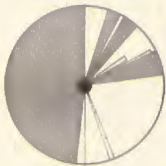
The 900-MHz region would be suitable for some new uses of land-mobile systems. But because of the long-term nature of 900-MHz band development and the complex engineering processes, additional lower-band frequencies still will be necessary to alleviate the immediate congestion.

### Trunking Offers Little Hope

Trunking methods often have been proposed as one of the panaceas for mobile-radio congestion. Taking the example of trunking methods used by telephone companies, many outside the mobile-radio industry claim that application of these principles to mobile radio can result in substantial improvement in the utilization of the few channels we have available. Although the economies of trunking are well known, and equations for the advantage gained by trunking are indisputable for telephone-type uses, they cannot be converted directly into mobile radio. Those who believe they can are assuming that the typical mobile-

(Continued)





## ***Land-mobile radio is seen as the unseen underpinning of a vital part of our economy and society.***

radio exchange of communications is similar in nature to a telephone call, and this simply is not so—the typical mobile-radio communication consists of a rapid-fire, short communication between two vehicles, or between a vehicle and its base station. The trunking arrangements used by the telephone companies in their mobile-telephone systems simply are not applicable to such rapid-fire communications. The time to switch to an unused channel, and meet the other party there, is longer than the typical mobile-radio exchange.

To apply the use of trunking to typical mobile-radio use, therefore, would require entirely new and automatic trunk-switching concepts. These are not impossible, but they certainly would be expensive—adding further and unnecessarily to the cost borne by the mobile-radio licensee. Once such an automatic system were put into operation, the courtesy between users—which now provides for rapid and efficient message dispatch—would be lost because attention no longer would focus on the occasional hogging of the channel by an individual user. The length of messages would tend to increase, and the end result might be even worse congestion.

In the case of public-safety services—such as police and fire—the trunking arrangement would provide absolutely no advantage. How could trunking have helped the Los Angeles people during their riots when all of their channels already were loaded in excess of 100-percent capacity? Anybody who has attempted to call the police department during a time of major emergency has had a demonstration of how trunking breaks down during such overloads. They just get a busy signal each time they call in.

A logical approach to solving congestion has been offered to the FCC by the Land-Mobile-Communications Council (LMCC), a comprehensive group of land-mobile user associations. In view of the present imbalance in spectrum allocations, the LMCC has urged that the Commission reallocate to the land-mobile services UHF-TV channels 14 through 20 on a nationwide basis.

The advantages of such a reallocation do not at first meet the eye. Television long has been an integral part of the household, the community and, in fact, the nation, and depriving the UHF-broadcast system of seven channels would appear to strike into every man's living room.

But this is not the case. Reallocation does not entail

any effort on the part of land-mobile users to curtail the full development of a UHF-TV broadcasting system, but merely acknowledges that there is ample spectrum space for all types of communications services without imposing hardships on one or the other.

Any reallocation plan would be designed to have minimal impact on television service. No television station now operating on channels 14 to 20 would go off the air. These stations would simply move to a channel higher than channel 20. Studies carried out by the FCC's Land-Mobile Frequency Relief Committee and by an outside engineering firm—Earl Cullum & Assoc., Dallas, Tex.—retained by the Land-Mobile Communications Council, show that any stations from channels 14 to 20 displaced by a reallocation can be found operating frequencies above channel 20.

Furthermore, a reallocation could take place over a specified time frame so that all television broadcasting from channels 14 to 20 would not have to be relocated all at one time. The relocation of many of the stations involved could be timed to coincide with their licensing or equipment amortization periods, which would further reduce any inconvenience they would face in changing frequencies.

### **Advantages of Reallocation**

The advantages of reallocation as a means of frequency relief are numerous. First, the potential for interference inherent in a sharing plan would be eliminated completely. Just as today's land-mobile systems operating on 470-MHz interface with channel 14 (470-476-MHz) in several cities, so under reallocation there still would be only one point of interface, but this time at 512 MHz, i.e., channel 21.

Second, there would be no necessity to impose geo-

**William L. Detwiler** has been president for 20 years of Radio Specialists Co., offering sales, service and installation of radio communication systems, and its manufacturing subsidiary, Micro Communications Co., Denver, Colo. He has testified before the Dingell Congressional Subcommittee investigating frequency allocations for small businesses. Detwiler holds an M.S.E.E. from the University of Colorado and is a director of the National Assn. of Business and Educational Radio.





graphic or power and antenna-height restrictions on land-mobile systems, as in a sharing scheme. At the same time, television stations in large cities, protected in a sharing plan by distance separation, could raise their transmitting power or change antenna sites to adapt to changing market conditions. Once a sharing plan is implemented, their present power output would represent a ceiling because nearby channels would be used by land-mobile units.

Finally, the UHF-TV spectrum shows little promise of being fully activated and could be employed usefully by a needy service. Wasting this public resource is not in the public interest as long as such important services as land-mobile have critical needs.

### New Spectrum Needed

Communications of all types are on the threshold of revolutionizing industry, transportation, public safety and literally the entire way in which the American citizen lives. There is no glamour attached to the operations of two-way radio, or the services rendered by a typical user, but they are the unseen underpinning of a vital part of our economy and society. There is ample room in the frequency spectrum for all services to flourish, and there is sufficient space to accommodate present and future broadcast applications. To assure the equitable distribution of frequencies to those services that make our way of life safe, convenient and comfortable, new spectrum is needed for the traditional uses and the newer ones just on the horizon. We need to make sure that they both get the chance to survive. □

### DATABANK

One of the best indicators of the urgency for solving the spectrum-congestion problem is the number of groups actively concerned with fact-finding and data-gathering. Countless studies have been made in the past 5 years, and thousands of pages of reports have been published. A few of the more significant are summarized below.

1. JTAC 1968, "Spectrum Engineering—The Key to Progress"—The Joint Technical Advisory Committee, comprised of technical and engineering people working under the auspices of the IEEE and EIA, has studied spectrum usage and conservation almost continuously since its formation in 1948. This 1200-page report represents more than 5 years of work involving more than a hundred radio experts. The committee envisages a continuous postponement of a crisis in spectrum saturation through sophisticated engineering techniques in spectrum usage. (JTAC, 345 E. 47th St., New York, N.Y. 10017.)

2. The Advisory Committee for the Land-Mobile-Radio Services, 1967. An ad hoc committee established by the FCC in

March 1964 studied serious frequency-congestion problems affecting land-mobile services. It explores measures to resolve those problems without allocating additional radio frequencies. Composed of more than 200 members representing specialized land-mobile expertise, the committee examined in detail for 3 years the technical, operational, administrative and spectrum-utilization facets of these services. The report made only two major recommendations for relief: (1) that channel spacing in 450-MHz band be reduced and new channels made available be allocated immediately; (2) that expanded interservice sharing of land-mobile channels be permitted to achieve maximum utilization.

3. The IRAC Spectrum-Planning Subcommittee, 1968. IRAC stands for Interdepartment Radio Advisory Committee working jointly with the FCC. Working Group 3 under its Spectrum Planning Subcommittee SPS-3 examined radio-frequency congestion in the first 10 standard metropolitan statistical areas of the U.S. Study was confined to bands of 138 to 174, 406 to 420 and 450 to 470 MHz. It appears that about 787 25-kHz channels in the above mentioned bands are unassigned in the Los Angeles area at this time. The report cautions that for various technical and operational reasons many of these apparently assignable channels are not usable in the area. SPS-3 indicated that the existing frequencies in the Los Angeles area are adequate to accommodate government land-mobile requirements through 1973. But it was unable to predict how long the presently allocated nongovernment land-mobile bands can accommodate expanding requirements in Los Angeles. SPS-3 concluded that the 380 newly derived channels at 450 to 470 MHz plus improved interservice sharing through the frequency-pool concept would suffice for the next 3 or 4 years.

4. "The Frequency-Card Study of the Land-Mobile Services", 1963. The land-mobile section of the Electronic Industries Assn. made a duplicate set of the FCC's 350,000 electronic computer cards relating to authorizations issued to the Public-Safety Industrial Land Transportation Citizens and Common Carrier Services in the 25- to 890-MHz band. The study was to confirm and support the knowledge of the number of land-mobile radio systems and units in specific geographical areas on each frequency assigned to each service and thereby enable all concerned to gain additional information pertinent to the loading of frequencies in any service in any area. Study showed a close correlation between numbers of transmitters and total population, e.g., more than 50 percent of licensed transmitters are concentrated in less than 8 percent of the U.S. land area. The report concluded that FCC should foster expanded use of mobile radio in the public interest rather than containing it. (EIA, 2001 Eye St. N.W., Washington, D.C. 20006.)

5. "Electromagnetic Spectrum Utilization—The Silent Crisis"—U.S. Department of Commerce, 1966. The Telecommunication Science Panel (TSP) was established ad hoc by the Commerce Technical Advisory Board with the cooperation of the director of Telecommunications Management, the Federal Communications Commission, the Department of Commerce and the Department of Defense. TSP, composed of recognized leaders in their field selected from outside govern-

(Continued)





## Frequency Spectrum Dilemma (Cont'd)

ment, studied the status of research in the U.S. designed to support and improve the utilization of the electromagnetic spectrum. The most significant of the conclusions are as follows:

1. There exists a variety of natural incentives and consequently adequate research programs to support continuous progress to seek extensions of the usable portion of the spectrum.

2. On the other hand, there is a clear lack of natural incentives and consequently almost no research to provide an evolutionary optimization of the use of the spectrum among the various functions on the basis of overall value to the nation.

The TSP recommended that the federal government establish or develop a research organization to support, but be independent of, the FCC and the director of telecommunications management in a clearly established responsibility for the allocation of the electromagnetic spectrum in the U.S.

6. "Frequency Management in the Executive Branch of the Government"—Office of Telecommunications Management, 1966. This report contains an appeal for immediate implementation of a major long-range planning program for the future allocation and use of the radio spectrum and to find ways other than radio to accomplish as many communication tasks as practicable.

7. FCC Planned Mobile-Frequency-Relief Committee—FCC, 1967. Report issued a public notice stating that it was undertaking an intensified in-house study of: (1) the feasibility of meeting the needs of the land-mobile-radio services within spectrum space now allocated to UHF television channels; (2) the feasibility of land-mobile use of a large number of TV channels on a geographic basis to minimize the impact on television displacement and growth potential; (3) reallocating the top 14 UHF television channels to the land-mobile-radio services.

The committee examined these three possibilities with two objectives in mind: (1) to afford immediate relief in those areas where the problem presently is acute, and (2) to make long-range plans commensurate with the projected requirements of the land-mobile services to the year 1980.

8. "National Association of Business and Education Radio" study, 1968. A study to discover what avenues might be pursued in providing a measure of relief for the land-mobile-radio services and what impact a possible course of action might have on present and future uses of this spectrum. The study was conducted in conjunction with the radio engineering firm of Molaney & Assocs. It was presented to the FCC staff in January 1968. The report concluded that part of the solution to the land-mobile-radio problem could be developed through the reallocation of channels 14 to 20 to those services, particularly in major urban areas, with minimal impact on UHF TV. (NABER, 1330 New Hampshire Ave. N.W., Washington, D. C. 20036.)

9. "Chicago Land-Mobile-Usage Survey." This is a comprehensive survey of every licensed transmitter in the Chicago area. The survey was conducted by the Motorola Co. of Chicago to evaluate channel loading, interference, service growth

rates, etc. The primary objective was to provide quantitative evidence of the land-mobile-service needs as a contribution to encourage better frequency management. Data were obtained from nearly 4000 land-mobile users.

The report points out: (1) The percentage of licensed base stations in operation varied from 60 to 80 percent, with the highest ratio in the 150-MHz band. Corresponding ratios for the mobile equipment could be as low as 50 percent. (2) Although the number of equipments in operation appeared significantly less than equipment authorized, it is difficult to attach any particular significance to this fact other than that the land-mobile services are concerned with their communication problems even though the equipments in operation may be fewer than indicated by the number of licenses issued. (Motorola Communications & Electronics, Inc., 4501 W. Augusta Blvd., Chicago, Ill. 60651.)

10. "A Survey of Public-Safety Telecommunication Requirements and Capabilities", conducted under contract by Kelly Scientific Co. for The President's Task Force on Communications Policy. Its objective was to "identify major U.S. metropolitan areas where lack of adequate radio communications hindered police and fire protection, rescue services or other aspects of public safety." Inadequate frequency resources for public safety were alleged to have contributed to crisis conditions such as recent riots and demonstrations.

11. "Managing the Spectrum Economically—Alternatives and Experiments". The TEMPO study was undertaken by the General Electric Co. for The President's Task Force on Communications Policy to investigate the feasibility of establishing an improved basis for assigning relative values in spectrum allocation. The study compares a number of alternative procedures whereby the federal government might license use of the radio-frequency spectrum. In the course of the study an analysis is made of what should constitute good spectrum management.

The study analyzes three major alternative spectrum-management systems. Namely: (1) the present FCC/OTM system, (2) spectrum engineering as "evolved for the armed forces and by ECAC", and (3) assignment of licenses to use spectrum through the "market" place—in other words, by auctioning.

12. Metropolitan Spectrum Congestion Task Group of The President's Task Force on U.S. Communications Policy. The members of this task group were made available by government agencies having a direct interest in telecommunications. The task group examined spectrum congestion in the Los Angeles metropolitan area.

The task group found that, although complete and accurate data on spectrum usage were not available, there was sufficient evidence to indicate that most present users generally were satisfied and that all current claimants can be satisfied. Application of current state-of-the-art technology and better operation practices, development and use of higher portions of the spectrum, and expanded use of systems engineering would resolve not only the much discussed land-mobile problem but also would satisfy all claimants for the foreseeable future.



Before the  
FEDERAL COMMUNICATIONS COMMISSION  
Washington, D. C. 20554

---

In the Matters of:

Amendment of Parts 2, 89, 91 and 93;	)	
Geographic Reallocation of UHF-TV	)	
Channels 14 through 20 to the Land	)	DOCKET NO. 18261
Mobile Radio Services for Use Within	)	
the 25 Largest Urbanized Areas of the	)	
United States	)	
	)	
Petition filed by the Telecommunications	)	
Committee of the National Association of	)	RM-566
Manufacturers to Permit Use of TV Channels	)	
14 and 15 by the Land Mobile Stations in	)	
the Los Angeles Area	)	

COMMENTS OF THE  
LAND MOBILE COMMUNICATIONS COUNCIL

---

R. L. Ransome, President  
Land Mobile Communications Council  
Post Office Box 2648  
Houston, Texas 77001

Date: February 3, 1969



## TABLE OF CONTENTS

	<u>PAGE</u>
I PRELIMINARY STATEMENT. . . . .	2
A. Function and Composition of LMCC. . . . .	2
B. Nature and Importance of Land Mobile Radio. . . . .	3
II SUMMARY OF COMMISSION'S GEOGRAPHIC ALLOCATION PROPOSAL AND RESTRICTIONS. . . . .	8
III COMMENTS. . . . .	12
A. General Observations. . . . .	12
B. Analysis of Impact of Proposed Restrictions and Limitations on Land Mobile Use of Lower Seven UHF-TV Channels. . . . .	13
"Urbanized Area" Service Area Limitation. . . . .	13
Effectiveness of Land Mobile Use Of Frequencies Is Even Further Reduced Because Of Power And Antenna Limita- tions Proposed To Afford Protection To Co-Channel TV Operations. . . . .	16
Land Mobile Service Areas Within Urbanized Areas May Be Further Reduced Because Of Mileage Separation Requirements Between Land Mobile Station and Mobile Operating Area And The Location Of Adjacent Or Co- Channel UHF-TV Stations. . . . .	16
C. Analysis of Television Interference Problems. . . . .	17
D. Exclusive Allocation to Land Mobile Services of the Lower Seven UHF-TV Channels is a More Effective Means of Relief. . . . .	19
IV SPECIFIC PROPOSALS. . . . .	21



TABLE OF CONTENTS

ii

- EXHIBIT NO. 1     Impracticality Of Applying Census Of  
Population "Urbanized Area" Boundary As a  
Limitation On Land Mobile Areas Of  
Operation
- EXHIBIT NO. 2     Impact Of Urbanized Boundaries Area And  
Power And Antenna Limitations on Typical  
Land Mobile UHF Users.
- EXHIBIT NO. 3     Impact Of Mileage Separation Require-  
ments Between Land Mobile Base Stations  
Or Mobile Operating Area And The Location  
Of Adjacent Or Co-Channel UHF-TV Stations
- EXHIBIT NO. 4     Report To The Allocations Research Council  
On A Means Of Reassigning The Lowest 7  
UHF-TV Channels From The Television To The  
Land Mobile Service By Making Reasonable  
Changes In The UHF-TV Mileage Separation  
Standards.  
By A. Earl Cullum, Jr. & Associates



Before the  
FEDERAL COMMUNICATIONS COMMISSION

Washington, D. C. 20554

In the Matters of:

Amendment of Parts 2, 89, 91 and 93;	)	
Geographic Reallocation of UHF-TV	)	
Channels 14 through 20 to the Land	)	DOCKET NO. 18261
Mobile Radio Services for Use Within	)	
the 25 Largest Urbanized Areas of the	)	
United States	)	
	)	
Petition filed by the Telecommunications	)	
Committee of the National Association of	)	
Manufacturers to Permit Use of TV Channels	)	RM-566
14 and 15 by the Land Mobile Stations in	)	
the Los Angeles Area	)	
	)	

COMMENTS OF THE  
LAND MOBILE COMMUNICATIONS COUNCIL

The Land Mobile Communications Council  
(hereinafter sometimes referred to as "LMCC"), by  
its President, respectfully submits its Comments  
in response to the Federal Communications Commission's  
Notice of Proposed Rulemaking<sup>1/</sup> in the above designated  
proceeding, which was adopted by the Commission on  
July 17, 1968 and released on July 26, 1968.

---

<sup>1/</sup> (FCC 68-743, No. 18463).



I

PRELIMINARY STATEMENT

A. Function and Composition of LMCC

1. LMCC is a non-profit association, the purpose of which is to achieve an allocation of radio frequencies for the Land Mobile Radio Services sufficient to meet their immediate and long term requirements. The membership of LMCC consists of:

Airlines Communications Administrative Council  
American Automobile Association  
American Gas Association  
American Petroleum Institute  
American Trucking Associations, Inc.  
American Telephone & Telegraph Company  
Association of American Railroads  
Associated Public-Safety Communications Officers, Inc.  
Eastern States Police Radio League  
Electronic Industries Association  
Forest Industries Radio Communication  
Forestry, Conservation Communications Association  
International Association of Chiefs of Police  
International Municipal Signal Association  
International Taxicab Association  
National Association of Business and Educational  
Radio, Inc.  
National Association of Manufacturers  
National Association of Radio-Telephone Systems  
National Committee for Utilities Radio  
Special Industrial Radio Service Association, Inc.  
United States Independent Telephone Association



2. From a review of LMCC's membership, it will be seen that virtually every Land Mobile Service has representation in LMCC. Through this broad membership base, LMCC truly speaks for the land mobile users, private or common carrier, large or small, government entity, corporation or individual.

B. Nature and Importance of Land Mobile Radio

3. Land Mobile Radio is unique. It provides the only means of communication to men in vehicles and on foot. Other modes of communication can employ cable or wire, thereby conserving spectrum, but for the policeman on the beat, the power utility crew locating a gas leak, and the fuel trucks delivering oil and coal quickly; there is no substitute.

4. The users of land mobile radio number many, many thousands but the benefits of that use are enjoyed by virtually every citizen of the United States. Land Mobile Radio aids in the control and



solution of air pollution problems, in summoning emergency medical aid to the sick and injured, in controlling the spread of fires in cities and forests, in the prevention of crimes; it is invaluable in the protection of life and property.

5. The nation's economy is also heavily dependent on land mobile radio. Bus lines use it to maintain on-time schedules; manufacturers utilize radio in-plant to operate cranes, and to deploy needed raw materials, and they rely on radio to move the finished product to the right customer at the right time. Oil companies use mobile radio in every stage of their operations from exploration and drilling to the distribution to the ultimate consumer hundreds and thousands of miles away.

6. To all these users, land mobile radio is a tool, a vehicle, whereby they can better perform their functions. In the Public Safety Radio Services, it is used to protect the lives and property of all Americans. In the various Industrial Services, it



improves the efficiency of production and distribution of goods to the public. In Transportation, it augments the movement of people and their belongings from one location to another rapidly and smoothly so that the pace of life in this country never slackens but in fact quickens. More often, there is an economic gain to the user: he employs people more effectively (one-man police squad cars rather than two are possible because of mobile radio); he minimizes idle time (taxis move from fare to fare via radio rather than aimlessly cruising the streets); and he responds to service requests faster (delivery trucks can be re-routed at any point on their daily runs).

7. When land mobile radio is available to a bus driver when he is threatened by robbery, he, his company, his passengers and the public benefit. When land mobile radio is used to bring assistance to Mrs. Smith's stalled auto in a downtown intersection during rush hour, the auto emergency company receives



a benefit, so does Mrs. Smith and so do all the motorists who are behind her in traffic. The benefits of land mobile radio work that way: they accrue to the user, to those that user serves, and in an indirect but meaningful way to large segments of the public - a true demonstration of public interest.

8. Many specific examples of these important public safety and high priority uses of land mobile radio were fully documented in the pleadings and testimony in Docket No. 11997. However, the variety of land mobile use has increased enormously since that proceeding as the comprehensive and exhaustive report of the Commission's Land Mobile Advisory Committee has recently confirmed. It is obvious that the increase in our population produces a comparable demand for increased services; it is people who require an expanded use of land mobile radio, for better protection, more efficient services, and for the provision of better and less expensive products available when the public needs and wants them. It cannot be emphasized too strongly



that this is the sole reason for the existence and growth of land mobile radio: it helps do what the public demands must be done.

9. If our nation is to continue to enjoy the very real benefits derived from the development of land mobile radio, its use must be encouraged to continue to expand. More importantly, as has been recognized by the Commission through the issuance of the Notice in this Docket and the Notice in the companion proceeding in Docket No. 18262<sup>2/</sup>, adequate frequency space must be provided to the Land Mobile Services not only to meet present requirements and those in the immediately foreseeable future, but also, to accomodate new and presently unanticipated uses of mobile radio which will inure to the benefit of the entire population.

10. Since one of the primary purposes of LMCC is to achieve an allocation of radio frequencies for the Land Mobile Services sufficient to meet today's

---

<sup>2/</sup> (FCC 68-745, No. 18472, July 26, 1968)



needs, this proceeding is, of course, of vital interest to LMCC. In this connection, LMCC along with its constituent organizations has a responsibility to evaluate carefully and honestly the type of relief which can be reasonably expected from the proposals advanced in this Docket. Also, LMCC has the responsibility of evaluating and bringing to the Commission's attention means of achieving the frequency relief for the Land Mobile Services needed to provide adequate services to the public. With these matters in mind, LMCC respectfully submits these Comments in response to the proposals contained in the Notice of Proposed Rulemaking in this Docket.

## II

### SUMMARY OF COMMISSION'S GEOGRAPHIC ALLOCATION PROPOSAL AND RESTRICTIONS

11. In this proceeding, the Commission has proposed to "allocate" to the Land Mobile Services the lower seven (7) UHF-TV Channels within the 25 largest "urbanized areas" on a geographic basis, with appropriate protection to insure a minimum impact on television



reception. It is noted that no provision has been made for access to these frequencies by Part 21 licensees who are part of the Land Mobile Services and whose needs parallel those users licensed under Parts 89, 91 and 93.

12. The method proposed to be used to provide this appropriate protection to TV reception is labeled by the Commission as "Plan 3 - Grade B Contour Protection Method" wherein the TV receiver antennae are considered to have no directivity. Potential land mobile channels are based upon protecting the Grade B TV Contours from a 50 db desired to undesired signal strength ratio. The Commission indicated, however, that adjustments and changes can be expected based upon engineering data filed in this proceeding.

13. As to adjacent channel operations, the Commission proposes to limit the ratio of land mobile to adjacent channel TV signal strength to 0 db. Land mobile transmitters would be limited to a maximum



signal at the TV Grade B Contour that equals but does not exceed the Grade B signal at 64 dBu.

14. In order to readily implement this plan of protection to TV operations, the Commission has set forth in the Notice and in the Appendix to the Notice, limits of permissible land mobile use involving such matters as the service area, maximum power and maximum antenna height.

15. First of all, the Notice indicates that the location of land mobile base stations as well as the areas of operations of the mobile units must, at all times, be within the boundaries of these twenty-five (25) urbanized areas, as those boundaries are established by the Census of 1960.

16. Sections 89.102(d) and (e)<sup>3/</sup> of the proposed Rules, in effect, require that base station locations, mobile operating areas, effective radiated

---

<sup>3/</sup> Since the proposed rules in the Appendix to the Notice are drafted in terms of Part 89, these Comments will also refer to them in terms of Part 89, it being understood that substantially identical rules will be included in Parts 91 and 93, and shall be included in Part 21.



power and antenna height are to be determined by the distances from co-channel and adjacent channel TV stations as set forth in the tables in these sections.

17. In each instance the channels available for land mobile use would be chosen and their usage restricted "so as to be compatible with the current TV assignment table and such TV stations as may be authorized pursuant to the table". [Emphasis added]. Thus, it would appear that continued land mobile usage of a particular frequency within a given urbanized area might be subject to changes in the table of TV assignments which might occur subsequent to "finalization" of this rulemaking. For example, if the Commission would permit a change or "switch" of TV channels within or close to the Channel 14 through 20 range in areas close to an urbanized area, this could further restrict land mobile operations in the urbanized area on these frequencies. This would act as a deterrent to land mobile use of these frequencies.



III

COMMENTS

A. General Observations

18. In this Docket, the Commission has commendably recognized the acute nature of the land mobile frequency congestion problem and that the necessity of finding a prompt and effective solution dictates that, as a practical matter, immediate relief can only come from the allocation of frequencies from the lower portion of the UHF-TV spectrum. LMCC vigorously supports this basic policy decision. Yet, the manner in which the Commission proposes, in this Docket, to permit land mobile use of these frequencies appears to negate the Commission's basic policy decision which, if properly implemented, could afford prompt and adequate relief. Because of the severity of the restrictions proposed on land mobile use of the space from 470 MHz to 512 MHz, very little practical relief to the land mobile congestion problem can be expected. The geographic "allocation" in this



Docket amounts to nothing more than secondary sharing of these frequencies by land mobile users.

19. The Commission is defeating its intent to provide relief to land mobile congestion by imposing the following restrictions on and deterrents to land mobile use of these frequencies:

- a. Land mobile usage of the frequencies be confined to the area within the geographic perimeters of "urbanized areas" as established in the 1960 Census of Population;
- b. This limited area of utilization may even be further restricted or reduced depending upon the proximity of the Grade B Contour of co-channel and adjacent channel TV stations to the urbanized area;
- c. Possibility of denying continued land mobile use of frequencies within an urbanized area because of subsequent changes in TV Table of allocation in markets near the urbanized area.



Unless these restrictions and deterrents are eliminated or modified, the proposed "allocation" will afford very little relief for the immediate congestion problem.

B. Analysis of Impact of Proposed Restrictions and Limitations on Land Mobile Use of Lower Seven  
UHF-TV Channels

"Urbanized Area" Service Area Limitation

20. By limiting the service area of land mobile usage of these UHF-TV frequencies to within the boundaries of "urbanized areas" as established by the 1960 Census, very little practical relief to the land mobile frequency congestion problem will be derived from the proposals in this proceeding. The boundary of an urbanized area is defined in terms of <sup>4/</sup> "enumeration districts", which, for the most part, follow such features as roads, streets, railroads, streams and other clearly defined lines which may be easily identified by census enumerators in the field and seldom conform to the boundaries of political units.

---

<sup>4/</sup> A small area assigned to a census enumerator which must be canvassed and reported separately and which contains, in most cases, approximately 250 housing units.



21. An examination of geographic perimeters of these urbanized areas reveals that it is highly impractical to describe land mobile service areas in such terms. If the Commission does, in fact, intend to do this, it will only serve to deny the use of these frequencies to large numbers of land mobile licensees for the very simple reason that their mobile radio service areas do not coincide with the geographic boundaries of the urbanized areas as determined by the 1960 Census.

22. As time passes, the adverse impact of the 1960 urbanized area boundaries will become even greater. Many of the "growth areas", both residential and industrial, are not included within the 1960 urbanized area boundaries. Yet, there is already, and will continue to be, a tremendous amount of land mobile activity in protecting and servicing the businesses, industries, government agencies and families located in these areas just outside the 1960 urbanized area boundaries. If the Commission intends to continue to limit land mobile usage



of these frequencies to the territory within the 1960 boundaries of these urbanized areas, it will be applying what is, at least, a highly impractical solution of the "sixties" to a problem of the "seventies" and "eighties". (See Exhibit No. 1).

These boundaries will be changed as a result of the 1970 Census to reflect the population density situation as of that time. Even if the Commission would then use the 1970 Census "urbanized area" boundaries as the land mobile area limiting factor, the same problem would still exist since the "new" 1970 boundaries will be determined by enumeration districts, which have no relationship to land mobile service areas.

23. The use of the "urbanized area" boundary will also deny the use of these frequencies to governmental agencies with state-wide operations and to so-called "ribbon-type" users, such as pipelines, railroads, motor carriers, and electric utilities which traverse large sections of the country passing through and between many urbanized areas.



Effectiveness Of Land Mobile Use Of Frequencies Is  
Even Further Reduced Because Of Power And Antenna  
Limitations Proposed To Afford Protection To Co-Channel  
TV Operations

---

24. It is believed that the power and antenna height limitations imposed may effectively reduce the land mobile coverage areas in many of the urbanized areas to the point where many licensees simply could not efficiently use the frequencies because the coverage afforded under the proposed restrictions would not meet their operating requirements. This is demonstrated by an analysis of the coverage afforded and that required at various locations within the proposed permissible land mobile operating area of the urbanized areas of: Detroit, Michigan; New York - Northeastern New Jersey; and, Seattle, Washington. (See Exhibit No. 2).

Land Mobile Service Areas Within Urbanized Areas May Be  
Further Reduced Because Of Mileage Separation Require-  
ments Between Land Mobile Station and Mobile Operating  
Area And The Location Of Adjacent Or Co-Channel UHF-TV  
Stations

---

25. The application of the provisions of proposed Section 89.102(d) of the proposed Rules (Page 3 - Appendix to Notice of Proposed Rulemaking) to the land



mobile metropolitan operating areas reveals that in a number of cases the Land Mobile Service area within these urbanized areas will be reduced since the distance prescribed in the Table in Section 89.102(d) penetrates and encompasses portions of the urbanized area. (See Exhibit No. 3).

C. Analysis of Television Interference Problems

26. It should be recognized that interference to land mobile operations from television operations can be just as serious as interference from land mobile to television reception. It must be recognized, however, that even the possibility of interference to TV can be a real deterrent to land mobile use of these frequencies. Because of the obvious adverse reaction by TV viewers to such interference, many land mobile users would be reluctant to try to utilize these frequencies because of the public relations problem alone. Those land mobile users who have been involved in cases of television interference allegedly resulting from their land mobile operations in the 173 MHz band, or the 72-76 Mc/s band have found that



the adverse clamor is so great that they have been forced to stop utilizing the frequencies involved, even though the land mobile system was operated clearly within the rules and well within the parameters of all technical limitations.

27. Due to the severity of the restrictions imposed on land mobile use of these frequencies, it would seem that the possibility of mutual Land Mobile-TV interference will be rather small. The dimensions of the interference problem are covered by Commissioner Cox in his "Concurring Statement". However, even if the Commission is "totally unreceptive" to interference complaints, it will not silence these complaints and it is very likely that as a result, many land mobile licensees would forego this "relief" from their frequency congestion problem rather than face public wrath, even though the land mobile licensee may be operating completely within all technical limitations.

28. Of course, the other alternative posed by Commissioner Cox to the television-land mobile



interference problem, namely that the implementation of the sharing plan should proceed "rather slowly" appears to be contrary to the apparent intent of the Commission in this Docket, namely, to provide widespread, immediate relief for the most critical land mobile congestion areas.

D. Exclusive Allocation to Land Mobile Services of  
the Lower Seven UHF-TV Channels is a More Effective  
Means of Relief

---

29. An objective evaluation of the impact of the limitations proposed in this Docket upon land mobile usage of the lower seven UHF-TV channels demonstrates that the relief which the Commission apparently intended to provide the Land Mobile Radio Services would not be realized. LMCC respectfully submits that a more effective means of accomplishing the Commission's objective of early and adequate land mobile relief with a minimum disruption to TV is through the exclusive allocation of the lower seven UHF-TV channels to the Land Mobile Services.

30. There are a variety of ways in which such real relief can be provided by the Commission without



in any way comprising its objectives or the public interest. One way of accomplishing such an allocation is found in the "Report to the Allocations Research Council on a Means of Reassigning the Lowest Seven UHF-TV Channels from the Television to the Land Mobile Service by Making Reasonable Changes in the UHF-TV Mileage Separation Standards", prepared by A. Earl Cullum, Jr. & Associates (hereinafter referred to as the "Cullum Study"<sup>5/</sup>), which is attached hereto as Exhibit No. 4 and is made a part of these Comments.

31. The Cullum Study clearly indicates that it would be possible to divert the lowest seven (7) UHF television channels from the Television Service to the Land Mobile Services and to still retain, in the remaining TV Channels below Channel 70, essentially the present number of total assignments by modifying certain of the UHF-TV separation requirements or "taboos".

32. The plan of reallocation outlined in the Cullum Study reflects one reasonable method of solving the land mobile congestion problem in the earliest

---

<sup>5/</sup> Prepared for Allocations Research Council in response to the Commission's invitation in its Public Notice of April 14, 1967, FCC 67-471, No. 98583.



practicable time, with the minimum amount of impact on existing broadcast operations and with an insignificant impact on the overall television allocation plan. There are probably other plans which would also accomplish the same goal. The Cullum Study demonstrates that the means of accomplishing adequate relief does exist.

#### IV

##### SPECIFIC PROPOSALS

33. LMCC urges that the Commission immediately take the following steps to provide prompt and effective relief to the land mobile congestion problem:

- a. An interim step, preliminary to the exclusive allocation of the lower seven UHF frequencies to the Land Mobile Services, LMCC urges that the Commission issue a First Report and Order adopting the proposals in this Docket. Since the Part 21 Services are certainly a part of the Land Mobile Services, LMCC urges that the Part 21 Services should be



included among those Land Mobile Services for which rule changes are contemplated, with the allocation to sub-Services being made later as has been proposed for the other Land Mobile Services which were initially covered by this Docket. Although, because of the limitations on land mobile usage discussed above, the amount of relief will be small, some licensees will be able to make some utilization of these frequencies at the present time, even under the limitations proposed. For this reason alone, LMCC urges that the Commission issue a First Report and Order adopting the instant proposals.

- b. Authorize no new TV stations to construct facilities on Channels 14 through 20. In addition, where applications are now pending for such channels, the applications should be required to be amended to specify Channel 21 or above, taking into consideration the mileage separation changes discussed in the attached Cullum Study.



c. The immediate allocation to the Land Mobile Services, on a nation-wide basis, the frequencies encompassed by UHF-TV Channels 14 through 20, except:

- 1) In those areas where there are existing, "On -the-Air" UHF-TV operations on these channels;
- 2) Where authorized stations are actually under construction; and,
- 3) Where the stations are not under construction, the outstanding construction permits are of less than three years duration.

All other UHF-TV "assignments", including those upon which construction permits have been issued for a period greater than three years but which are not currently under construction, would be allocated to the Land Mobile Services for immediate use, subject, of course, to adequate protection against interference to existing "On-the-Air" UHF-TV operations and those under construction.



- d. Starting with the most congested of the twenty-five largest metropolitan areas, begin diverting those existing "On-the-Air" TV stations in the lower seven UHF-TV bands to higher frequencies.
- e. Institute at an early date a program of testing of the validity of all existing UHF-TV taboos.
- f. As soon as the program of testing of the validity of the existing taboos has been completely, the Commission should promptly conform its standards to the results of the findings derived from the testing program and divert, on a staged basis, the remaining TV operations to channels above Channel 20 but below Channel 70.
- g. Provide a reasonable cut-off date wherein all UHF-TV operations on Channels 14 through 20 would be diverted to land mobile use. This would be determined by establishing reasonable amortization periods for the broadcast stations involved.



34. If the Commission would follow the course of action outlined above, there would be some immediate, though minimal, relief through the geographic allocation as proposed in the instant Rulemaking. Through the exclusive allocation proposed in these Comments, frequencies in the lower seven UHF-TV channels would be made available to land mobile users on a nation-wide basis, not just in certain urbanized area "island". The impact would be minimized since the diversion of channels to land mobile would be on a staged basis geared to broadcast licensing and amortization considerations. More importantly, however, by first testing and then adopting taboo changes, such as those recommended in the Cullum Study, and by revising the Commission's allocation table so that most of the existing assignments are satisfied in Channels 21 through 69, the Commission will be making the most effective utilization of the spectrum and will be providing to the public substantially the same number of TV assignments as exist under the current table of assignments. At the same time, the Commission will have met, in a meaningful way, the requirements of the land mobile users.



WHEREFORE, THE PREMISES CONSIDERED, the Land Mobile Communications Council respectfully urges that the Commission should: adopt the Rulemaking as proposed herein; authorize no further TV stations in Channels 14 through 20 and require that applications for Channels in this range be modified to specify channels above Channel 21; and, promptly take the further steps necessary for the exclusive allocation to the Land Mobile Services of the frequencies now occupied by TV Channels 14 through 20, in the manner set forth in the Specific Proposals advanced in these Comments.

Respectfully submitted,

LAND MOBILE COMMUNICATIONS COUNCIL

(s) R. L. Ransome

By

R. L. Ransome, President  
Land Mobile Communications Council

Dated: February 3, 1969



VERIFICATION

STATE OF TEXAS     )  
                          )  SS  
COUNTY OF HARRIS )

R. L. Ransome, being first duly sworn, deposes and says:

That he is President of the Land Mobile Communications Council,  
that he has read the foregoing comments and exhibits thereto, and that  
to the best of his knowledge, information and belief the matter stated  
therein are true and correct.

(s) R. L. Ransome

---

R. L. Ransome  
President, Land Mobile  
Communications Council  
P. O. Box 2648  
Houston, Texas 77001

Subscribed and sworn to before me this 29th day of January,  
1969.

(s) Iris L. Morgan

---

Notary Public in and for the  
County of Harris

My Commission expires: June 1, 1969



Impracticality of Applying Census of Population  
"Urbanized Area" Boundary As a Limitation On  
Land Mobile Areas of Operation

An examination of the geographic boundaries of any of the "urbanized areas" as defined in the 1960 Census of Population, reveals that it is highly impractical to describe Land Mobile Service areas in such terms. For example, an examination of the Washington, D. C. urbanized area (one with which the Commission members should be personally familiar) reveals the unreasonableness of applying any limitation of this kind to land mobile areas of operation. The attached map, designated FIGURE 1, shows the boundaries of the Washington (D.C. - Md. - Va.) urbanized area as determined by the 1960 Census of Population. The various shaded areas constitute the territory falling within the urbanized area and the white territory constitutes the area falling outside the urbanized area. It will be



EXHIBIT NO. 1  
LMCC COMMENTS  
FCC DOCKET NO. 18261  
Page 2

noted that only portions of the surrounding Counties of Fairfax, Montgomery and Prince Georges are included within the urbanized area. Users with either a requirement to operate throughout the entire greater Washington Metropolitan Area, or throughout any of the surrounding Counties, such as the Police, or the electric, gas and water utilities, would find it impractical to use these frequencies because they would not be available for base station or even mobile unit use, in many portions of these Counties, including many new residential areas and light industrial areas. Other users such as fuel oil companies and ready-mix concrete companies operating throughout these surrounding Counties will also find it impractical to use these frequencies since they could not operate in all portions of surrounding Counties in which the companies might be engaged in business. For example, much



of the new construction which is dependent on ready-mix concrete, falls outside the urbanized areas as defined by the 1960 Census of Population. Thus, it is apparent that the imposition of any artificial boundaries such as urbanized areas to define land mobile areas of operation is unrealistic.

Of course, as time passes the adverse impact of the 1960 urbanized area boundary limitation will become even more severe. The unreality of applying the 1960 urbanized area boundaries as a limitation on land mobile areas operations, is highlighted when the 1960 urbanized area boundaries are compared with projected urbanized areas boundaries for 1980, only eleven short years away. In arriving at projections of the maximum urbanized area boundary limits for 1980, two sources were used. The first was the Census Bureau's "check" boundary outline maps which



are used by the Bureau for the review of the 1970 urbanized area Census. These Census maps contain boundary outlines for those areas where the Census Bureau will check the population density to determine if the area should be contained within the 1970 urbanized area geographical limits. These "check" boundary outlines were used in projecting the direction of urbanized area growth.

The second source was "DIMENSIONS OF METROPOLITANISM" by Jerome P. Pickard, (1967) of the Urban Land Institute, which contains projections of urbanized area population and total area in square miles through the year 2000. The projected land area increases for the urbanized areas were compared for the years 1960 and 1980 to obtain a percentage of increase in square mile area. This is presented for the top twenty-six urbanized areas in the attached tabular chart designated FIGURE 2.

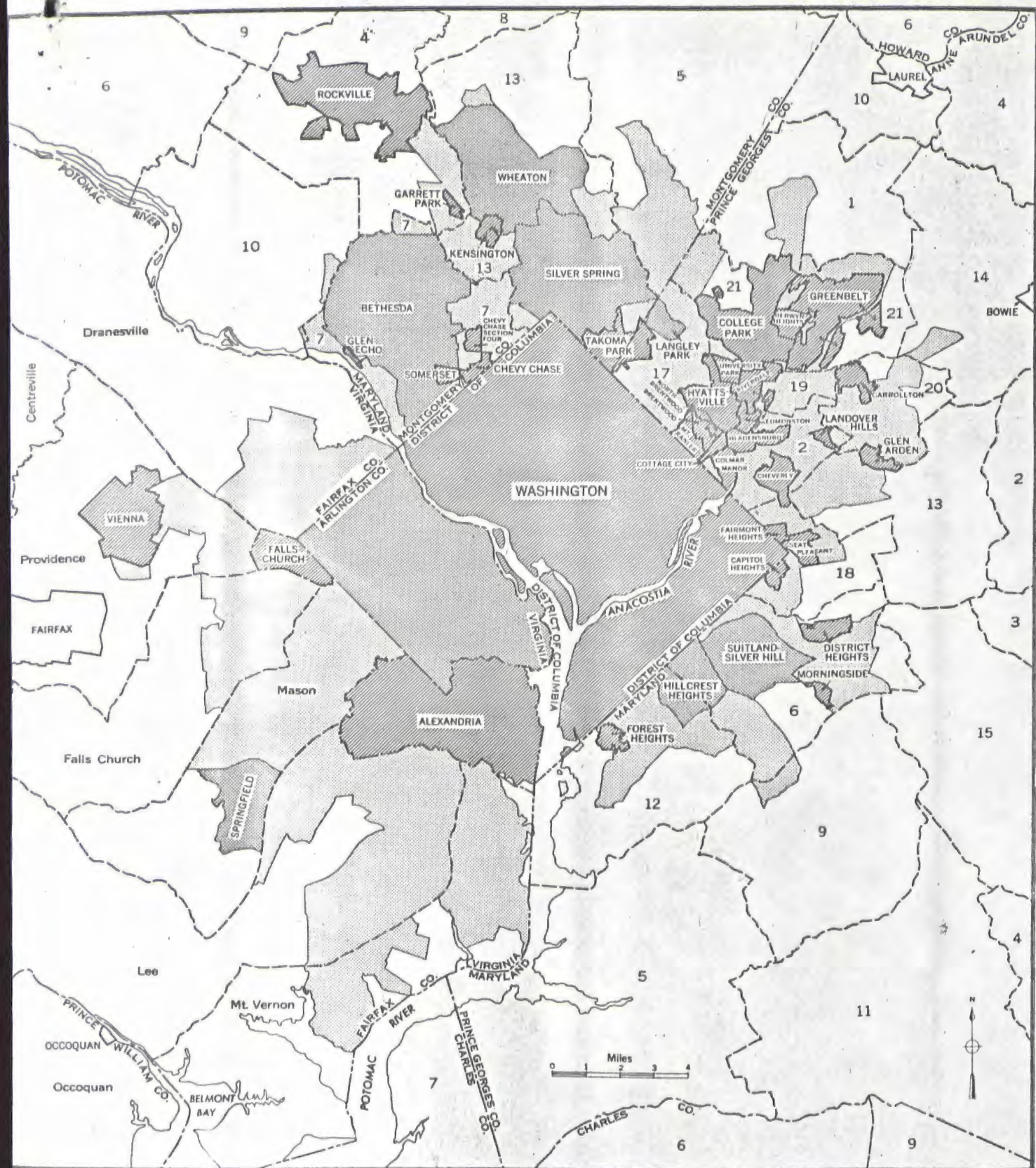


Using the data from these two sources, estimated maximum urbanized area boundaries were plotted for the year 1980 on the maps, designated FIGURE 3 through FIGURE 10. The term "maximum boundary" is used because in some cases the 1980 boundary line plotted was the nearest legal (county line) or natural (river or lake) boundary line. In such cases, the legal or natural boundary line chosen always provided for the maximum square mile increase in urbanized areas.

These maps graphically depict the unreality of using 1960 urbanized area boundaries as a limitation on land mobile operations in the 1970's and 1980's. However, it must be recognized that it would be equally unrealistic to apply even the 1980 boundaries since, for many licensees, even these boundaries would be completely unworkable in terms of land mobile service area of operations.



WASHINGTON (D.C.-MD.-VA.) URBANIZED AREA Figure 1



**COMPONENTS OF URBANIZED AREA**

- Incorporated Places
- Unincorporated Urban Places
- Other Unincorporated Area

**BOUNDARY SYMBOLS**

- State Line
- County Line
- Minor Civil Division Line

Maps showing boundaries in detail are available at cost on request to the Bureau of the Census.



URBANIZED AREA PROJECTION  
1960-1980

URBANIZED AREA	1960	AREA (SQ. MI)	1980	%	AREA (SQ. MI)	%
	POPULATION (000)		POPULATION (000)			
NEW YORK	14,102	1,841	19,255	37.2%	3,292	78%
NORTHEASTERN NEW JERSEY						
LOS ANGELES	6,489	1,370	12,744	96%	2,507	84%
CHICAGO-NORTHWESTERN INDIANA	5,840	921	8,083	38.2%	1,470	59.5%
PHILADELPHIA	3,626	566	4,847	34%	875	54%
DETROIT	3,354	616	5,500	64%	1,122	82%
SAN FRANCISCO-OAKLAND	2,455	603	5,332	118%	1,442	134%
BOSTON	2,443	534	3,111	27%	756	42%
WASHINGTON D.C.	1,808	343	3,339	85%	723	112%
CLEVELAND	1,719	413	2,626	53%	725	76%
PITTSBURGH	1,711	374	2,019	18%	472	26%
ST. LOUIS	1,668	324	2,230	34%	457	41%
BALTIMORE	1,419	220	2,098	47%	371	68%
MINNEAPOLIS-ST. PAUL	1,338	573	1,920	43%	851	48%
HOUSTON	1,140	423	2,263	98%	890	110%
MILWAUKEE	1,054	211	1,552	47%	469	122%
CINCINNATI	1,004	251	1,436	43%	407	62%
BUFFALO	936	134	1,370	46%	221	65%
DALLAS	932	464	2,625	182%	1,062	129%
KANSAS CITY	921	282	1,307	42%	445	58%
SEATTLE	864	232	1,495	73%	423	83%
MIAMI	853	183	3,092	262%	783	328%
NEW ORLEANS	837	120	1,224	31%	188	57%
SAN DIEGO	836	278	1,796	115%	563	102%
DENVER	804	164	1,407	75%	303	85%
ATLANTA	768	254	1,573	105%	709	179%
PHOENIX	552	224	1,405	154%	522	134%

DATA SOURCE: "Dimensions of Metropolitanism", Jerome P. Pickard  
Urban Land Institute, 1967.



# WASHINGTON (D.C.-MD.-VA.) URBANIZED AREA Figure 3



COMPONENTS OF URBANIZED AREA

- Incorporated Places
- Unincorporated Urban Places
- Other Unincorporated Area

BOUNDARY SYMBOLS

- State Line
- County Line
- Minor Civil Division Line

Maps showing boundaries in detail are available at cost on request to the Bureau of the Census.

U.S. GOVERNMENT PRINTING OFFICE: 1980-865787/33

1980 PROJECTED URBANIZED AREA BOUNDARY



BOSTON URBANIZED AREA, SECTION 1 Figure 4





# BOSTON URBANIZED AREA, SECTION 2

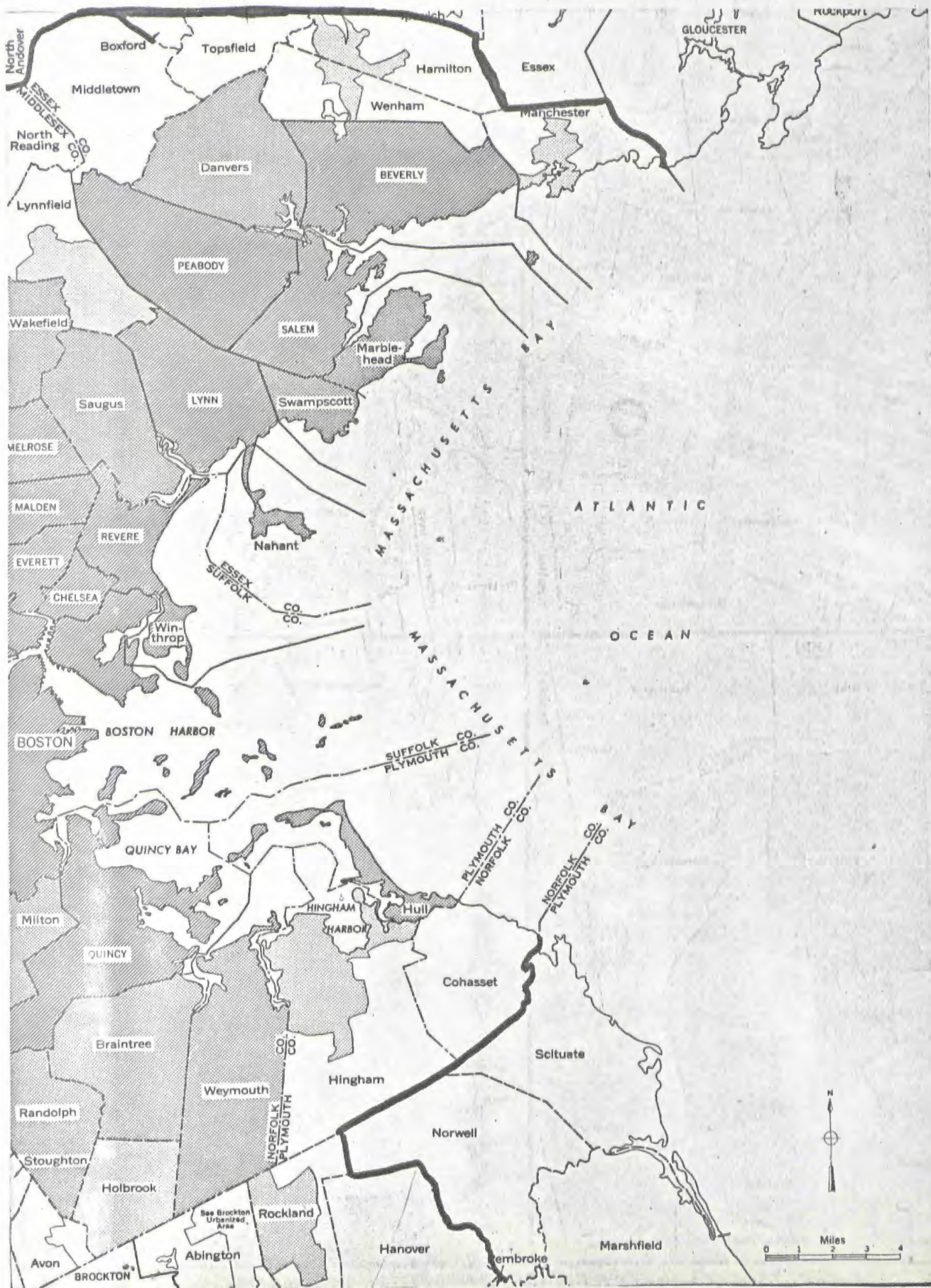




Figure 5





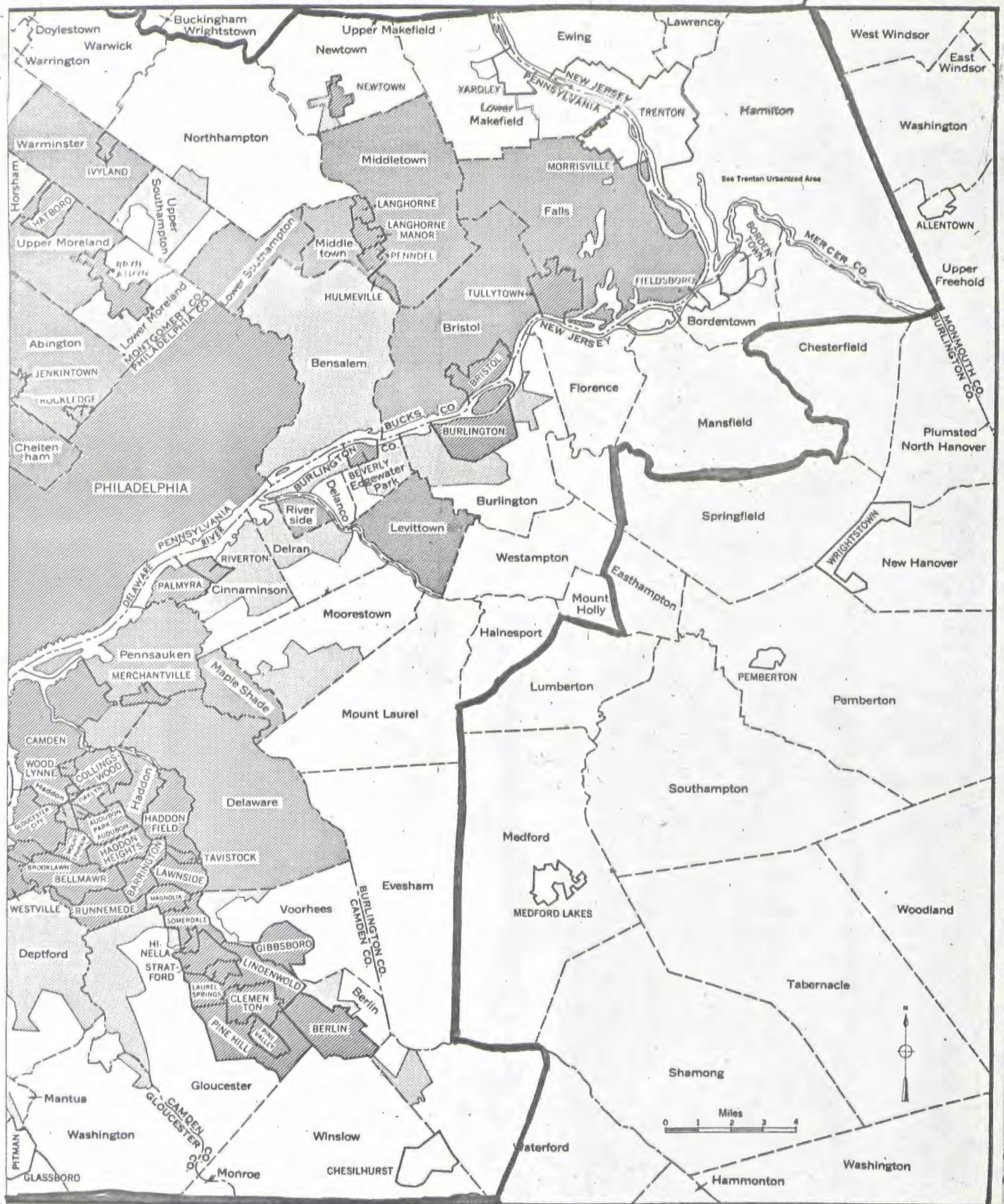
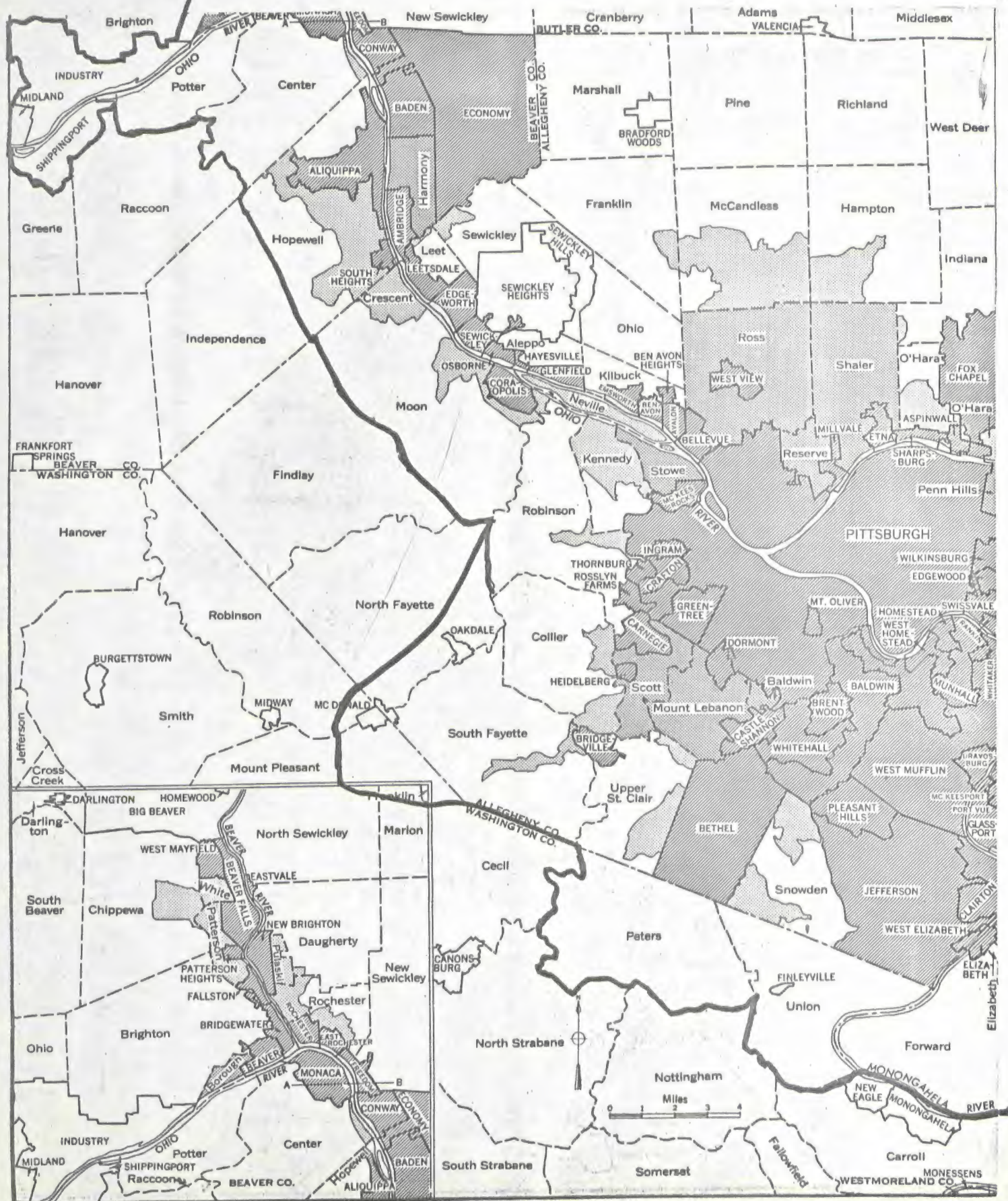




Figure 6





This map illustrates the geographical layout of Allegheny County, West Virginia. Key features include:

- Municipalities:** Labeled areas include West Deer, Frazer, East Deer, Springdale, Lower Burrell, New Kensington, Upper Burrell, Washington, Franklin, New Salem, Export, Salem, North Versailles, North Huntingdon, North Irwin, Irwin, Manor, Penn, Jeannette, Adamsburg, Greensburg, South West Greensburg, Hempfield, Madison, Youngwood, Hunker, East Huntingdon, Mount Pleasant, South Huntingdon, West Newton, Forward, Carroll, Rostraver, Lincoln, Clairton, Versailles, White Oak, MC Keesport, Liberty, Glassport, Port Vue, Duquesne, Forest Hills, Braddock, Wilkins, Churchill, Wilkinsburg, Penn Hills, Plum, Monroeville, Trafford, Wilmer, Wall, Last, Mc Keesport, North, South, and Versailles.
- Rivers:** The Allegheny River is shown flowing through the county, with tributaries like the Monongahela River and the Ohio River.
- Counties and States:** Surrounding areas include Butler County, Allegheny County, Westmoreland County, Armstrong County, Indiana, and Ohio.
- Other Labels:** Various other locations are marked, such as Bethel, Gilpin, Leechburg, Hyde Park, North Apollo, Apollo, Kiskiminetas, Young, Conemaugh, Saltburg, Loyalhanna, New Alexander, Derry, Unity, Youngstown, Ligonier, Cook, Donegal, and Mount Pleasant.



CLEVELAND URBANIZED AREA, SECTION 1 Figure 7





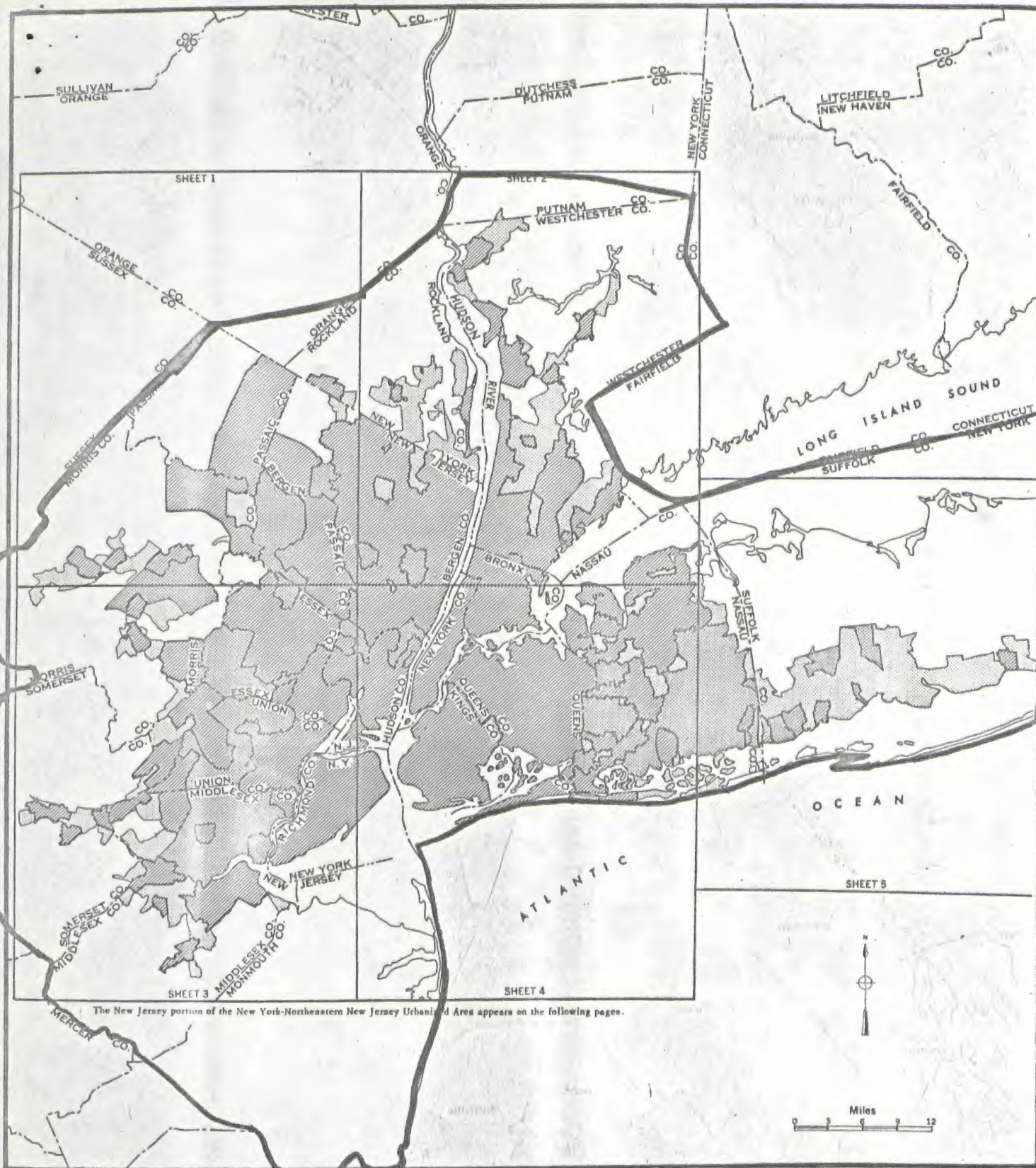
This map illustrates the geographical layout of Cuyahoga County, Ohio, with its numerous municipalities. The county is bordered by Lake Erie to the north and west, and by Cuyahoga County and Summit County to the south and east. The map shows the following municipalities:

- Northwestern:** Painesville, Mentor, Kirtland, Chardon, Chardon, Aquilla, Claridon, Huntsburg, Middlefield, Middlefield.
- Central:** Euclid, Wickliffe, Willoughby Hills, Mayfield, Mayfield Heights, Lyndhurst, University Heights, Shaker Heights, Beachwood, Woodmere, Orange, Moreland Hills, Chagrin Falls, Chagrin Falls, South Russell, Hunting Valley, Pepper Pike, Warrensville, North Randall, Warrensville Heights, Northfield, Northfield Center, Sagamore Hills, Brecksville, Richfield, Boston, Hudson, Streetsboro, Shalersville, Freedom, Windham.
- Eastern:** Painesville, Mentor, Kirtland, Chardon, Chardon, Aquilla, Claridon, Huntsburg, Middlefield, Middlefield, Parkman, Nelson, Hiram, Garretttsville, Mantua, Auburn, Troy, Bainbridge, Russell, Munson, Chester, Kirtland, Concord, Painesville, Fairport, Grand River, Mentor, Mentor, Kirtland Hills, Lake Geauga, Chardon, Hamden, Montville, Thompson, Leroy, Perry, Madison.

The map also includes a scale bar (0 to 4 miles) and a north arrow. The text "EXTEND TO CUYAHOGA COUNTY BOUNDARY" is visible at the bottom right.

EXTEND TO COWER COUNTY BOUNDARY





The New Jersey portion of the New York-Northeastern New Jersey Urbanized Area appears on the following pages.

1980 PROJECTED URBANIZED AREA BOUNDARY

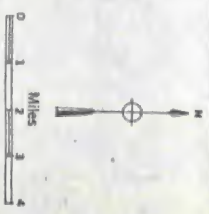


DETROIT URBANIZED AREA, SECTION 1 Figure 9



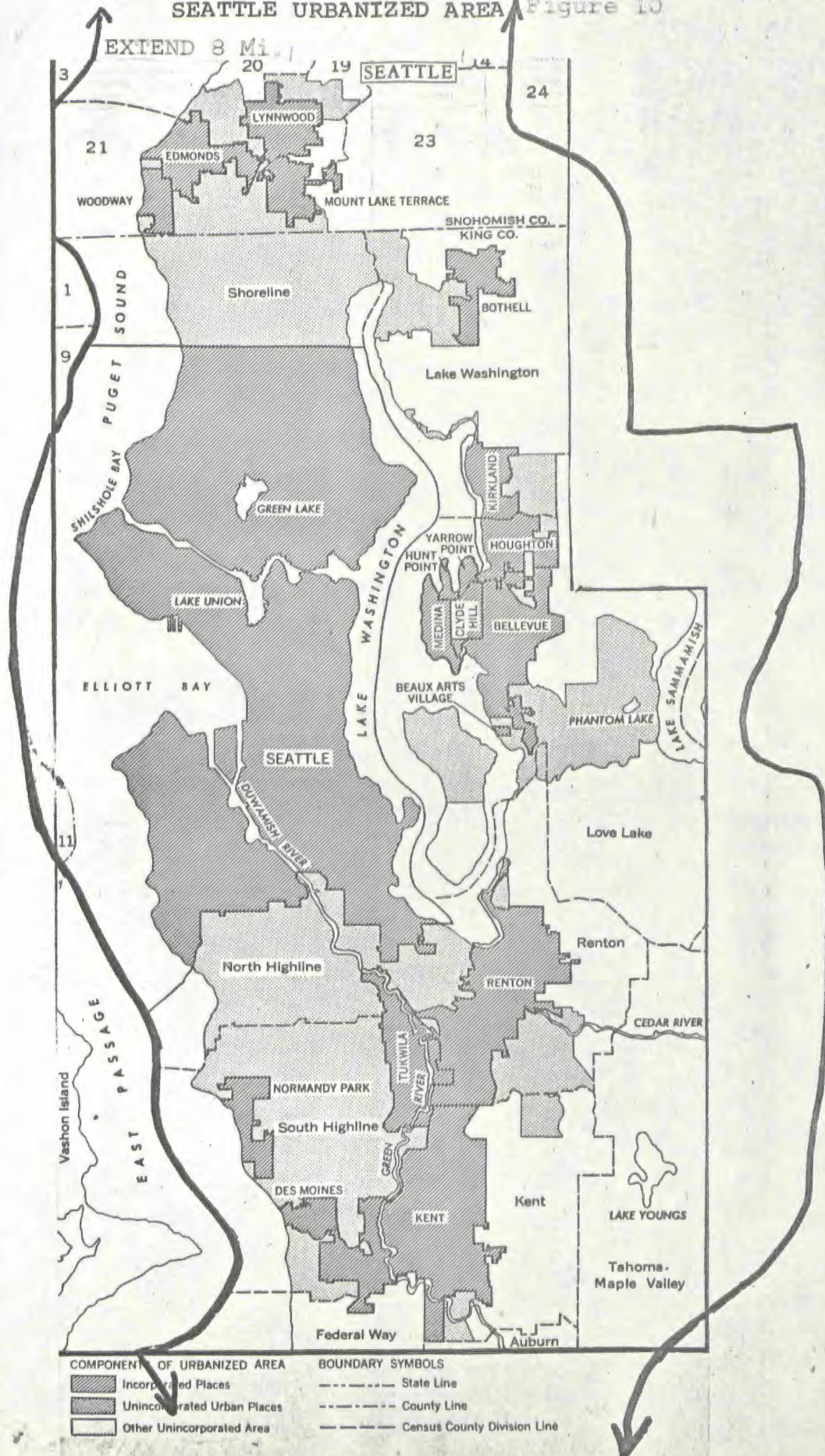


This map illustrates the geographical layout of Wayne County, Michigan, and its proximity to Detroit, Michigan, and the United States of Canada. The Detroit River is shown flowing through the center of the county, with the Detroit River International Waterway and the Detroit River International Bridge crossing it. The map includes labels for various cities and towns within Wayne County, such as Detroit, Dearborn, Warren, and Livonia. It also shows the locations of the Detroit River International Waterway and the Detroit River International Bridge. A scale bar and a north arrow are provided in the bottom left corner.





# SEATTLE URBANIZED AREA Figure 10





IMPACT OF URBANIZED BOUNDARIES AREA  
AND  
POWER AND ANTENNA LIMITATIONS  
ON  
TYPICAL LAND MOBILE UHF USERS

The Land Mobile Communications Council has assembled data on the current use of UHF spectrum by typical land mobile licensees. Users in New York, Detroit and Seattle were surveyed with respect to base station locations, antenna height, effective radiated power of base stations, rated mobile power output and system range. The purpose of the data is to relate the range requirements of typical land mobile radio users to the power and antenna height limitations specified in Docket No. 18261.

The New York and Detroit samples include only those licensees whose control point and base stations are located within the urbanized area as defined by the 1960 U. S. Census of Population. The range of the individual mobile radio systems surveyed in these two cities is shown in Figures 1 and 2. Figures 4 and 5 consolidate these



user samples to establish the percentage of the total in each city satisfied in various ranges in miles. The results indicated that only 33% of the users in New York and 14% in Detroit had range requirements of 15 miles or less. This range would appear to be reliably achievable only at the maximum of 400 watts (ERP) and 200 feet antenna height (AAT) allowed land mobile operation in any city under Docket No. 18261. In analyzing these figures however, it should be noted that many of the users sampled operate both inside and beyond the limits of the 1960 urbanized area. Thus, even some users who have requirements of only 15 miles or less would still be precluded from relief in this Docket because their operations would go beyond the established 1960 limits.

An example of how various classes of users would be affected both by the power and antenna height limitations as well as by the artificial 1960 urbanized boundaries can be seen from the analysis of Seattle.

In Seattle the sample is divided into three categories. Group A licensees are those surveyed whose control point and base station transmitter site are



within the urbanized area. Group B licensees are those whose control point is within the urbanized area, but whose primary base station transmitter location is outside the urbanized area. Group C licensees are those whose control point and base station transmitter are outside the urbanized area, but whose primary operating area includes all or a portion of the urbanized area.

The range of these Seattle users is shown in Figure 3.

Figure 6 consolidates these user samples to establish that only 11% of such users can be satisfied with a range of 15 miles or less.

To illustrate the situation in Seattle for the three groups of users described, we have included maps as Figures A-1 to A-20, B-1 to B-56, and C-1 to C-17.<sup>1/</sup> These maps show that few radio users operate exclusively

---

<sup>1/</sup> Heavy line is 1960 urbanized area boundary. Thin line is boundary of licensees land mobile operating range. Operating range for A-16, A-17 and A-19 is City of Seattle; for B-48, B-51 and B-53 it is King County.



within the boundaries of the Census Bureau's definition of the 1960 urbanized area. In fact, for the majority of users, this urbanized area constitutes less than 50% of the land area which must be covered.

It can therefore be concluded that the restrictions on power and antenna height proposed in this Docket on the use of frequencies in the 470-512 MHz band will preclude a large majority of the typical users from utilizing land mobile radio to meet their communications needs. When this is further coupled with the urbanized area boundary limitation, it appears obvious that the Commission's proposal is inadequate to meet the urgent need for frequency relief which will meet the operating requirements of these land mobile users.



NEW YORK

1. Bergen Printing Plates, Hackensack, N. J., (32 miles)
2. Road Materials Corp., Staten Island, N. Y., (7 miles)
3. Thomas J. Brown & Son, Staten Island, N. Y., (6 miles)
4. Gabriel's Auto Body Repair, Staten Island, N. Y., (6 miles)
5. Trans Air Systems Inc., Jamaica, N. Y., (12 miles)
6. Quiet Heat Oil Burner Co., Queens, N. Y., (14 miles)
7. Central Station Signals, N. Y., N. Y., (10 miles)
8. Limousines of New York, N. Y., N. Y., (24 miles)
9. H.C. Oil Co. Inc., Brooklyn, N. Y., (10 miles)
10. Complete Industrial Service, Brooklyn, N. Y., (23 miles)
11. Ada Car Service Inc., Brooklyn, N. Y., (13 miles)
12. Dime Savings Bank, Brooklyn, N. Y., (14 miles)
13. Arrow Private Cab Service, N. Y., N. Y., (24 miles)
14. Hilti Fastening Systems, N. Y., N. Y., (40 miles)
15. Heldman Catering, Whitestone, N. Y., (24 miles)
16. Santulli Mail Service, N. Y., N. Y., (31 miles)
17. Ideal Fuel Oil Corp. Queens, N. Y., (14 miles)
18. Isaacson Steel Erectors Inc., Brooklyn, N. Y., (22 miles)
19. Nu Euclid Private Cars Inc., Brooklyn, N. Y., (23 miles)
20. Aliaga Express & Moving, Astoria, N. Y., (23 miles)



FIGURE 1 (cont.)

NEW YORK (Cont'd)

21. Andero Heat & Power, Ozone Park, N. Y., (32 miles)
22. Madison Heat Corp., Brooklyn, N. Y., (15 miles)
23. Paul A. Reilly & Co., New Hyde Park, N. Y., (29 miles)
24. Clough Expediting, Queens, N. Y., (20 miles)
25. M. H. Greenbaum Inc., N. Y., N. Y., (15 miles)
26. Brusco Fuel Oil, N. Y., N. Y., (7 miles)
27. Taft Limousine Corp., 37-11 Chescent St., Long Island City, N. Y., (21 miles)
28. Telprompter Manhattan CATV Corp., 50 W. 44th St., N. Y., N. Y., (6 miles)
29. Town & Country Transportation Service Inc., 500 E. 77th St., N. Y., N. Y., (25 miles)
30. Radisch Bros. Inc., 643 East Sixth St., N. Y., N. Y., (23 miles)
31. Rumac Trucking Corp., 43-20 24th St., Long Island City, N. Y., (7 miles)
32. Ryco Private Car Co. Inc., 38-20 32nd St., Long Island City, N. Y., (25 miles)
33. S & B Limousine Service Inc., 185 E. 85th St., N. Y., N. Y., (24 miles)
34. F. M. Schildwachter & Sons Inc., 1400 Ferris Ave., Bronx, N. Y., (7 miles)
35. Sinclair Oil Corp., Commercial Ave., Garden City, N. Y., (8 miles)
36. Sweeny Vending Service Inc., 161 Hempstead Ave., W. Hempstead, N. Y., (18 miles)
37. Lehigh Marine Disposal Corp., 3085 Richmond Terrace, Staten Island, N. Y., (29 miles)
38. Lewis Oil Co. Inc., 65 Shore Rd., Port Washington, N. Y., (13 miles)
39. Morris Oil Svc's Inc., Far Rockaway, Long Island, N. Y., (9 miles)
40. Murray Air Freight Inc., 152-02 136th Ave., Jamaica, N. Y., (19 miles)
41. National Alarm Systems Inc., 715 Coney Island Ave., Brooklyn, N. Y., (22 miles)
42. The Earthbank Co., Inc., 748 Brush Ave., Bronx, N. Y., (24 miles)



NEW YORK (Cont'd)

43. Financial Center Truck Rental Inc., 551 Greenwich St., N. Y., N. Y., (25 miles)
44. First Due Messenger Service Inc., 38 W. 45th St., N. Y., N. Y., (22 miles)
45. Five Borough Glass Corp., 53rd Ave., D, N. Y., N. Y., (22 miles)
46. H. B. Hamilton Service Corp., 7 E. 43rd St., N. Y., N. Y., (21 miles)
47. Hercules Door & Store Front Co., 218 Skillman St., Brooklyn N. Y., (21 miles)
48. Howard Fuel Corp., 107 6th St., Brooklyn, N. Y., (8 miles)
49. IBI Security Services Inc., 89-31 161st St., Jamaica, N. Y., (15 miles)
50. IBM Research & Development Inc., 112 E. Post Road, White Plains, N. Y., (26 miles)
51. Brian Kenny, 25 Skillman St., Roslyn, N. Y., (12 miles)
52. Aacon Contracting Co. Inc., 145 Wolcott St., Brooklyn, N. Y., (18 miles)
53. Action Private Taxi Service Inc., 587 W. 207 St., N. Y., N. Y., (23 miles)
54. Aeronautical Radio Inc., La Guardia Airport, N. Y., (3 miles)
55. Aeronautical Radio Inc., JFK International Airport, (3 miles)
56. All City Radio Taxi Association Inc., 3007A Heath Ave., Bronx, N. Y., (18 miles)
57. All Hour's Private Limousine Inc., 2168 Westchester Ave., Bronx, N. Y., (28 miles)
58. American Express Co., 770 Broadway, N. Y., N. Y., (26 miles)
59. Astoria Community Volunteer Ambulance Corp. Inc., 22-58 48th St. Long Island City, N. Y., (21 miles)
60. Bel-Air Call-A Car LTD., 3619 Kingsridge Ave., Bronx, N. Y., (30 miles)
61. Beverly Vending Service, 1574 39th St., Brooklyn, N. Y., (18 miles)
62. Centrix Private Taxi Inc., 1005A Allenton Ave., Bronx, N. Y., (30 miles)
63. Charles P. Young Co., 41 Chamber St., N. Y., N. Y., (18 miles)



NEW YORK (Cont'd)

64. Coachman Livery Inc., 38-21 23rd St., Long Island City, N. Y.,  
(21 miles)
65. Decatone Fabricators Inc., 1207 Pennsylvania Ave., Linden, N. J.,  
(24 miles)
66. N. Troiano Inc., N. Y., N. Y., (14 miles)
67. Kelly & Morris Inc., Jersey City, N. J., (23 miles)
68. Amtol Radio Comm. Systems Inc., Whitestone, N. Y., (22 miles)
69. Benedict-Miller, Inc., Lyndhurst, N. J., (39 miles)
70. A-1 of Staten Island Corp., 290 Naughton Ave., Staten Island, N. Y.,  
(7 miles)
71. A & M Servicenter Inc., 5223 Flatlands Ave., Brooklyn, N. Y., (14 miles)
72. A & S Welding & Boiler Repair Inc., 3129 Park Ave., Bronx, N. Y.,  
(6 miles)
73. Queens Transit Corp., Flushing, N. Y., (15 miles)
74. Frank Maxcali & Sons., Flushing, N. Y., (22 miles)
75. Blandford Tree Surgeons, Brooklyn, N. Y., (28 miles)
76. GMS Inc., N. Y., N. Y., (19 miles)
77. New England Tank Lining Inc., Mount Vernon, N. Y., (22 miles)
78. Motorola C & E Inc., 15-00 Pollitt Dr., Fair Lawn, N. J., (50 miles)
79. M. W. Houck, Bronxville, N. Y., (26 miles)
80. Mirror Trucking Co., Patterson, N. J., (36 miles)
81. Don Dee Trucking, North Bergen, N. J., (33 miles)
82. United Services & Projects Inc., Jamaica, N. Y., (14 miles)
83. Reinauer Transp. Co. Inc., Newark, N. J., (30 miles)
84. Wolkow Braker Roofing Corp., Brooklyn, N. Y., (20 miles)



NEW YORK (Cont'd)

85. Bendix Corp., Teterboro, N. J., (19 miles)
86. Air Freight Transp. Corp., N. Y., N. Y., (20 miles)
87. KLM Royal Dutch Airlines, 609 5th Ave., N. Y., N. Y., (2 miles)
88. Weber Transportation Corp., 36-10 11th St., Long Island City, N. Y., (22 miles)
89. United City Contractors Co. Inc., 617 W. 48th St., N. Y., N. Y., (22 miles)
90. Travel Agents Limousine Service Inc., 710 Eighth Ave., N. Y., N. Y., (22 miles)
91. Dreker-Heisler Med. Lab., N. Y., N. Y., (27 miles)



DETROIT, MICHIGAN

1. Detroit Edison Company, 2000 Second Avenue, Detroit, Michigan (20 miles)  
Transmitter: 2303 Fenkell Avenue, Detroit, Michigan
2. Warren Police Dept., C/O Radio Dept., County Building, Warren, Mich.  
(5 miles)  
Transmitter: Memphis & Nine Mile Road, Warren, Michigan
3. Ford Motor Company, The American Road, Dearborn, Michigan (35 miles)  
Transmitter: Penobscot Building, Fort & Griswold, Detroit, Michigan
4. Livonia Department of Public Works, 12973 Farmington Road, Livonia,  
Michigan (6 miles)  
Transmitter: 15050 Farmington Road, Livonia, Michigan
5. Chrysler Corporation, E. Jefferson & Connors, Detroit, Michigan  
(2 miles--Paging System)
6. City of East Detroit, 23200 Gratiot, East Detroit, Michigan (2 miles)  
Transmitter: 17800 East Ten Mile Road, East Detroit, Michigan
7. Dohrn Transfer Company, 7151 Edward, Detroit, Michigan (25 miles)  
Transmitter: J. L. Hudson Building, 1206 Woodward, Detroit, Michigan
8. Ministrelli Construction Company, 12240 Merriman Road, Livonia,  
Michigan (35 miles)  
Transmitter: Penobscot Building, Fort & Griswold, Detroit, Michigan
9. Steve Brandt, 32205 Little Mack Avenue, Roseville, Michigan (35 miles)  
Transmitter: Penobscot Building, Fort & Griswold, Detroit, Michigan
10. George Odien Company, 1935 McGraw, Detroit, Michigan (35 miles)  
Transmitter: Thompson-Brown Tower, 35823 Twelve Mile Road,  
Farmington, Michigan
11. F. L. Lyle Trucking Company, 11460 Shoemaker, Detroit, Mich. (35 miles)
12. P. L. Concrete, 36721 Van Dyke, Detroit, Michigan (25 miles)
13. Weltronic Corporation, 19500 West Eight Mile Road, Southfield, Michigan  
(25 miles)
14. Braver Lumber Company, 5300 East Nevada Avenue, Detroit, Michigan  
(25 miles)
15. Automobile Club of Michigan, 139 Bagley, Detroit, Michigan (25 miles)



DETROIT, MICHIGAN (Cont'd)

16. Clinton Township, C/O Radio Dept., County Building, Mt. Clemens Mich. (4 miles)  
Transmitter: 1129 South Gratiot Avenue, Mt. Clemens, Michigan
17. Macomb Concrete, 33180 Kelly Road, Fraser, Michigan (18 miles)
18. Warren Dept. of Public Works, C/O Radio Dept., County Bldg.,  
Mt. Clemens, Michigan (5 miles)  
Transmitter: 12801 Stephens, Warren, Michigan
19. Warren Fire Dept., C/O Radio Dept., County Building, Mt. Clemens,  
Michigan (5 miles)  
Transmitter: 8321 East Nine Mile Road, Warren, Michigan
20. Detroit Police Department, P.O. Box 918, Detroit, Michigan (10 miles)  
Transmitter: 900 Merrill Plaisance, Detroit, Michigan
21. Detroit Police Department, P.O. Box 918, Detroit, Michigan (25 miles)  
Transmitter: 65 Cadillac Square, Detroit, Michigan
22. Michigan Consolidated Gas Company, 1 Woodward Avenue, Detroit,  
Michigan (25 miles)  
Transmitter: Schaefer Highway, Melvindale, Michigan
23. Denver-Chicago Trucking, 6408 West Vernor, Detroit, Michigan (25 miles)  
Transmitter: J. L. Hudson Building, 1206 Woodward Avenue, Detroit,  
Michigan
24. Ford Motor Company, 20900 West Road, Trenton, Michigan (3 miles)
25. J. C. Cornillie, 11810 Mack, Detroit, Michigan (15 miles)  
Transmitter: 30751 Little Mack, Roseville, Michigan
26. Eagle Trucking, 9300 Dix Avenue, Dearborn, Michigan (35 miles)  
Transmitter: Twelve Mile & Napier Road, West Novi, Michigan
27. Clawson Concrete, 9300 Dix Avenue, Dearborn, Michigan (35 miles)  
Transmitter: Twelve Mile & Napier Road, West Novi, Michigan
28. Clawson Concrete, 9300 Dix Avenue, Dearborn, Michigan (35 miles)  
Transmitter: Route 24 & I-75, Hillside, Michigan
29. Lincoln Park Dept. of Public Works, 500 Southfield, Lincoln Park,  
Michigan (25 miles)



DETROIT, MICHIGAN (Cont'd)

30. Gateway Transportation Company, 10400 Southern, Dearborn, Michigan (35 miles)  
Transmitter: 65 Cadillac Square, Detroit, Michigan
31. Michigan Memorial Park, 32163 Huron River Drive, Flat Rock, Michigan (20 miles)
32. Michigan Bell Telephone, 1365 Cass Avenue, Detroit, Michigan (25 miles)  
Transmitter: 25189 Lahser, Southfield, Michigan
33. Wayne County Road Commission, City-County Building, Detroit Michigan (35 miles)  
Transmitter: Penobscot Building, Fort & Griswold, Detroit, Michigan
34. Zeph Leduc, Contractor, 20054 Lorne, Taylor, Michigan (35 miles)  
Transmitter: Penobscot Building, Fort & Griswold, Detroit, Michigan
35. Corteville Electric, 14680 East Seven Mile Road, Detroit, Mich. (35 miles)  
Transmitter: Penobscot Building, Fort & Griswold, Detroit, Michigan
36. Commercial Messenger & Trucking, 23628 Cherry Hill Road, Dearborn, Michigan (35 miles)  
Transmitter: Penobscot Building, Fort & Griswold, Detroit, Michigan
37. Visi-Flash Rentals of Michigan, 12760 Allen Road, Taylor, Mich. (35 miles)  
Transmitter: Penobscot Building, Fort & Griswold, Detroit, Michigan
38. Union Coin Machine Service Company, 13505 Fenkell, Detroit Michigan (35 miles)  
Transmitter: Penobscot Building, Fort & Griswold, Detroit, Michigan
39. Survey Homes Incorporated, 16421 West Seven Mile Road, Detroit, Michigan (35 miles)  
Transmitter: Penobscot Building, Fort & Griswold, Detroit, Michigan
40. Ajax Asphalt Paving, 29815 John R, Madison Heights, Michigan (35 miles)  
Transmitter: Penobscot Building, Fort & Griswold, Detroit, Michigan



41. Redway Cartage Company, 5100 E. Nevada Ave., Detroit, Michigan  
(35 miles)  
Transmitter: Penobscot Building, Fort & Griswold, Detroit, Mich.
42. Hubbell, Roth & Clark, 2709 Telegraph Road., Bloomfield Hills, Mich.  
(35 miles)  
Transmitter: Penobscot Building, Fort & Griswold, Detroit, Mich.
43. Bonded Guard Service, 441 East Grand Boulevard, Detroit, Mich.  
(35 miles)  
Transmitter: Penobscot Building, Fort & Griswold, Detroit, Mich.
44. Ric-Man Construction Company, 42866 Merrill Road, Utica, Mich.  
(35 miles)  
Transmitter: Penobscot Building, Fort & Griswold, Detroit, Mich.
45. Arrow Wrecking Inc., 4440 Wyoming Ave., Dearborn, Mich. (35 miles)  
Transmitter: Penobscot Building, Fort & Griswold, Detroit, Mich.
46. Bankers Dispatch Corp., 1734 Wabash, Detroit, Mich. (35 miles)  
Transmitter: Penobscot Building, Fort & Griswold, Detroit, Mich.
47. Westland Standard Service, 1555 N. Wayne Road, Westland, Mich.  
(35 miles)  
Transmitter: Penobscot Building, Fort & Griswold, Detroit, Mich.
48. Domestic Air Express, 10800 Harrison Road, Romulus, Mich. (35 miles)  
Transmitter: Penobscot Building, Fort & Griswold, Detroit, Mich.
49. G.A. Morrison Co., 19366 Allen Road, Trenton, Michigan (35 miles)  
Transmitter: Penobscot Building, Fort & Griswold, Detroit, Mich.
50. Pacific Air Freight Inc., 27480 Wick Road, Inkster, Mich. (35 miles)  
Transmitter: Penobscot Building, Fort & Griswold, Detroit, Mich.
51. Edwin M. Orr Engineering, 22148 Michigan Ave., Dearborn, Mich.  
(35 miles)  
Transmitter: Penobscot Building, Fort & Griswold, Detroit, Mich.
52. Industrial Services of America, 301 S. Cavalry, Detroit, Mich. (35 miles)  
Transmitter: Penobscot Building, Fort & Griswold, Detroit, Mich.
53. La Strada Construction, 18435 James Couzens Highway, Detroit, Mich.  
(35 miles)  
Transmitter: Penobscot Building, Fort & Griswold, Detroit, Mich.



DETROIT, MICHIGAN (Cont'd)

54. Carissimi Electric, 25890 Mound Road, Warren, Mich. (25 miles)  
Transmitter: Penobscot Building, Fort & Griswold, Detroit, Mich.
55. Oakdale Electric, 28645 John R. Madison Heights, Michigan (35 miles)  
Transmitter: Penobscot Building, Fort & Griswold, Detroit, Mich.
56. Franklin Brown Freight Handling, 12829 Hillview, Detroit, Mich.  
(35 miles)  
Transmitter: Penobscot Building, Fort & Griswold, Detroit, Mich.
57. Miller Equipment Co., 32910 Plymouth Road, Livonia, Mich. (35 miles)  
Transmitter: Penobscot Building, Fort & Griswold, Detroit, Mich.
58. Black Top Asphalt Paving Co., 36100 Harper, Mt. Clemens, Mich.  
(35 miles)  
Transmitter: Penobscot Building, Fort & Griswold, Detroit, Mich.
59. Marczak & Son, P.O. Box 692, Roseville, Mich. (35 miles)  
Transmitter: Penobscot Building, Fort & Griswold, Detroit, Mich.
60. J.J. Curran Crane Co., 865 South Fort Street, Detroit, Mich. (35 miles)  
Transmitter: Penobscot Building, Fort & Griswold, Detroit, Mich.
61. Township of Romulus, 36515 Bibbins, Romulus, Michigan (18 miles)
62. W.F. Sell & Son, 16555 South Telegraph Road, Taylor, Mich. (25 miles)
63. Thomas E. Loughlin, 1100 Lakeshore Drive, Grosse Pointe Shores, Mich.  
(3 miles)
64. Munson & Sussman, Inc., 7233 E. Eight Mile Road, Warren, Mich.  
(35 miles)  
Transmitter: Book Building, 1249 Washington Blvd., Detroit, Mich.
65. City of St. Clair Shores, County Building, C/O Radio Dept.,  
Mt. Clemens, Michigan (25 miles)  
Transmitter: Eleven Mile Road & Jefferson Ave., Detroit, Mich.
66. Adler Kay Co., Inc., 3737 Venoy Road, Wayne, Michigan (30 miles)  
Transmitter: Book Building, 1249 Washington Blvd., Detroit, Mich.
67. Krutsch Heating Inc., 3505 Biddle, Wyandotte, Mich., (25 miles)
68. Longton Bros. Radio & Electronics, 1627 Eureka Ave., Wyandotte, Mich.  
(25 miles)



DETROIT, MICHIGAN (Cont'd)

69. Pepsi-Cola Bottling Company of Michigan, 20021 Exeter, Detroit, Mich.  
(30 miles)  
Transmitter: 2727 Beech-Daly Road, Detroit, Michigan
70. City of Dearborn Heights, 6045 Fenton, Dearborn Heights, Mich. (15 miles)  
Transmitter: 24600 Van Born Road, Detroit, Michigan
71. Slasor Heating & Cooling Company, 16023 Plymouth Road, Detroit, Mich.  
(60 miles)  
Transmitter: Book Building, 1249 Washington Blvd, Detroit, Mich.
72. Michigan Foundation Company, 110 W. Jefferson, Trenton Mich. (20 miles)
73. Michigan Burglar Alarm Service, 10410 W. Chicago Blvd., Detroit, Mich.  
(25 miles)  
Transmitter: North Park Tower, Southfield, Mich.
74. Wings & Wheels Inc., 29320 Goddard Road, Romulus, Michigan (35 miles)  
Transmitter: Penobscot Building, Fort & Griswold, Detroit, Michigan
75. Jerry Horgan Trucking, 26271 Fernwood, Roseville, Michigan (35 miles)  
Transmitter: Penobscot Building, Fort & Griswold, Detroit, Michigan
76. Clark Equipment Co., 20211 Greenfield, Detroit, Michigan (35 miles)  
Transmitter: Penobscot Building, Fort & Griswold, Detroit, Michigan
77. American District Telegraph, 150 Michigan Avenue, Detroit, Michigan  
(25 miles)
78. Binder & Lark Building Co., 25245 Five Mile Road, Detroit, Michigan  
(25 miles)
79. Perfection Building Co., 18930 W. Ten Mile Road, Southfield, Michigan  
(25 miles)
80. Detroit Police Department, P.O. Box 918, Detroit, Michigan (20 miles)  
Transmitter: Jeffersonian Hotel, E. Jefferson Ave., Detroit, Michigan
81. Detroit Police Department, P.O. Box 918, Detroit, Michigan (20 miles)  
Transmitter: 9999 Iris, Detroit, Michigan



SEATTLE, WASHINGTON-A

- A-1. Port of Seattle, Seattle Airport, Seattle, Washington (8 miles)
- A-4. King County Water Dist. No. 49, Seattle, Washington (16 miles)
- A-5. A.D.T. Alarm, 1326 5th Avenue, Seattle, Washington (21 miles)
- A-6. Consolidated Freight, 1565 6th St., Seattle, Washington (20 miles)
- A-7. Pacific-Inter Mt., 650 S. Hanford, Seattle, Washington (21 miles)
- A-8. Onc Trucking, 54 S. Dawson, Seattle, Washington (20 miles)
- A-9. Reiman Pacific Auto Parts, 411 Rainier S., Seattle, Washington (26 miles)
- A-10. Kenmore Redi-Mix, Bothell Way, Kenmore, Washington (47 miles)
- A-11. OK Cab Co., Inc., S.E. 164th & 108th S.E., Renton, Washington (58 miles)
- A-12. Bon Marche, 5005 3rd, Renton, Washington (13 miles)
- A-13. United Airlines, Sea-Tac Airport, Seattle, Washington (30 miles)
- A-14. Watson Hall, Inc., 631 N. 95th, Seattle, Washington (40 miles)
- A-15. Pacific Northern A.L., Sea-Tac Airport, Seattle, Washington (37 miles)
- A-16. City of Seattle Fire Dept., 408 Thomas St., Seattle, Washington (12 miles)
- A-17. City of Seattle Police Dept., Municipal Bldg., Seattle, Washington (8 miles)
- A-18. City of Renton, City Hall, Renton, Washington (6 miles)
- A-19. City of Seattle, Dept. of Engineering, Municipal Bldg., Seattle, Washington (9 miles)
- A-20. City of Bellevue, 111-116th Avenue, S.E., Bellevue, Washington (15 miles)



SEATTLE, WASHINGTON-B

- B-1. D.A. Burns, 1008 Yale N., Seattle, Washington (52 miles)
- B-2. S & T Construction, 9889 S.E. Carr Rd., Renton, Washington (22 miles)
- B-3. Certified Cleaning, 8046 16th N.E., Seattle, Washington (51 miles)
- B-4. Emery Air Freight, Sea-Tac Airport, Seattle, Washington (40 miles)
- B-5. Heath Lighting Co., 3810 Stone Way No., Seattle, Washington (28 miles)
- B-6. Hugh S. Ferguson, 7433 5th So., Seattle, Washington (37 miles)
- B-7. Ralph's Concrete Pumping, 7453 W. Mercer Way, Mercer Island, Washington (22 miles)
- B-8. Kennell Enterprises, Inc., 3534 Bagley, Seattle, Washington (38 miles)
- B-9. Washington National Disposal, 101 Nickerson, Seattle, Washington (19 miles)
- B-10. Palmer Supply, 250 Andover Park W., Tukwila, Washington (25 miles)
- B-11. Spoon Automotive, 1024 6th So., Seattle, Washington (52 miles)
- B-12. Scarscella Bros., 2207 S. 146th, Seattle, Washington (33 miles)
- B-13. Pioneer Sand & Gravel, 901 Fairview Avenue N., Seattle, Washington (37 miles)
- B-14. Glacier Sand & Gravel, 5975 E. Marginal Way, So., Seattle, Washington (31 miles)
- B-15. Sawdust Supply Co., 1045 S.W. Spokane, Seattle, Washington (35 miles)
- B-16. Emmanuels, Inc., 7601 Greenwood No., Seattle, Washington (35 miles)
- A-3. /  
B-17. Yellow Cab Service, 1916 Terry, Seattle, Washington (18 miles)
- B-18. Roscoe Oil, 11616 Aurora Avenue No., Seattle, Washington (33 miles)
- B-19. Catalina Homes, 201 So. Division Avenue, Kent, Washington (48 miles)
- B-20. Bayside Hauling, 2750 16th S.W., Seattle, Washington (21 miles)



SEATTLE, WASHINGTON-B (Cont'd)

- B-21. Pacific Coast Oil Co., 2300 Harbor Avenue, S.W., Seattle, Washington (27 miles)
- B-22. Mobile Communications, 15639 Pacific Highway So., Seattle, Washington (29 miles)
- B-23. Northwest Const., 3950 6th, N.W., Seattle, Washington (37 miles)
- B-24. American Auto Parts, 113 S. Central, Kent, Washington (42 miles)
- B-25. Youell Oil Co., 2155 N. Northlake Way, Seattle, Washington (29 miles)
- B-27. Washington Asphalt Co., 309 N.W. 39th, Seattle, Washington (28 miles)
- B-28. Superior, Inc., 3450 16th W., Seattle, Washington (48 miles)
- B-29. Bell & Valdez, 818 156th N.E., Bellevue, Washington (52 miles)
- B-30. Century Seahurst, 3910 Leary Way N.W., Seattle, Washington (38 miles)
- B-31. Metered Washer, 7601 Greenwood N., Seattle, Washington (30 miles)
- B-32. Northwest Automotive, 421 East Lake E., Seattle, Washington (38 miles)
- B-33. Smith Oil Co., 3053 20th West, Seattle, Washington (32 miles)
- B-34. Motorola C & E, Inc., 808 106th Ave., N.E., Bellevue, Washington (68 miles)
- B-35. Standard Service Tire Co., Fairview & Denny Way, Seattle, Washington (35 miles)
- B-36. Coluccio Constr., 7778 Seward Park S., Seattle, Washington (29 miles)
- B-37. Phototronics, Inc., 223 Westlake No., Seattle, Washington (56 miles)
- B-38. A-1 Gardening, 2154 N. 156th Place, Seattle, Washington (35 miles)
- B-39. Lane Development Co., 1452 Dash Point Road, Federal Way, Washington (41 miles)
- B-40. Salvation Army, 233 1st W., Seattle, Washington (42 miles)



SEATTLE, WASHINGTON-B (Cont'd)

- B-41. Vandyke Truck Lines, 4223 Maynard S., Seattle, Washington (47 miles)
- B-42. Howard Cooper, 5055 4th S. Seattle, Washington (41 miles)
- B-43. Bellevue Bulldozing, 1503 128th Pl., N.E., Bellevue, Washington (40 miles)
- B-44. Rustad Heating & Plumbing, 927 Rainier South, Seattle, Washington (31 miles)
- B-45. Alia Constr. Co., 9215 Empire Way S., Seattle, Washington (40 miles)
- B-46. Pike Paint & Glass Co., 501 E. Pike, Seattle, Washington (39 miles)
- B-47. Seattle Ready Mix, 6560 W. Marginal W. So., Seattle, Washington (36 miles)
- B-48. King County Highway Maintenance, King County Courthouse, Seattle, Washington (44 miles)
- B-49. Ness Constr., 1125 N.W. 53rd, Seattle, Washington (41 miles)
- B-50. Kixi, 1305 3rd Avenue, Seattle, Washington (26 miles)
- B-51. King County Sheriff, King County Courthouse, Seattle, Washington (44 miles)
- B-52. Southgate Elec. Inc., 14836 1st South, Seattle, Washington (37 miles)
- B-53. King County Garbage Utility, King County Courthouse, Seattle, Washington (44 miles)
- B-54. Grippen Fuel, 1210 S. Bailey, Seattle, Washington (37 miles)
- B-55. Mel Herr, 2400 Harbor S.W., Seattle, Washington (38 miles)
- B-56. Myers Concrete Const., 4000 Aurora N., Seattle, Washington (32 miles)



SEATTLE, WASHINGTON-C

- C-1. Erickson Paging Co., 14446 Sunset Highway, Bellevue, Washington (33 miles)
- C-2. Woodworth & Co., 1200 E. "A" Street, Tacoma, Washington (29 miles)
- C-3. Harrison Dental Lab, 502 E. 26th, Tacoma, Washington (38 miles)
- C-4. Buckley Nursery, 646 N. River St., Buckley, Washington (34 miles)
- C-5. McWick Enterprises, 6501 Motor Ave., S.W., Tacoma, Washington (37 miles)
- C-6. Bacom Maintenance, 426 E. 61st St., Tacoma, Washington (60 miles)
- C-7. Lakeside Sand & Gravel, 13620 Sunset Highway, Bellevue, Washington (32 miles)
- C-8. Concrete Conduit Co., 32222 148th S.E., Auburn, Washington (36 miles)
- C-9. Red-Samm Mining Co., Redmond, Washington (36 miles)
- C-10. Fedderly-Marion Freight Lines, 14204 Sunset Highway, Seattle, Washington (38 miles)
- C-11. Early Construction, 1119 Pacific Avenue, Tacoma, Washington (63 miles)
- C-12. M.A. Segalle, Inc., 18010 57th South, Kent, Washington (44 miles)
- C-13. Beagh Griggs Co., 920 Center Street, Tacoma, Washington (36 miles)
- C-14. Stoneway Sand & Gravel, Maple Valley Highway, Renton, Washington (28 miles)
- C-15. Richert & Sone, Star Route 1, Box 86, Shelton, Washington (38 miles)
- C-16. Tom Anderson Plumbing, 108-10th North, Issaquah, Washington (32 miles)
- C-17. Brown's Eastside Roofing, 7706 196th Avenue, N.E., Redmond Washington (43 miles)



New York City

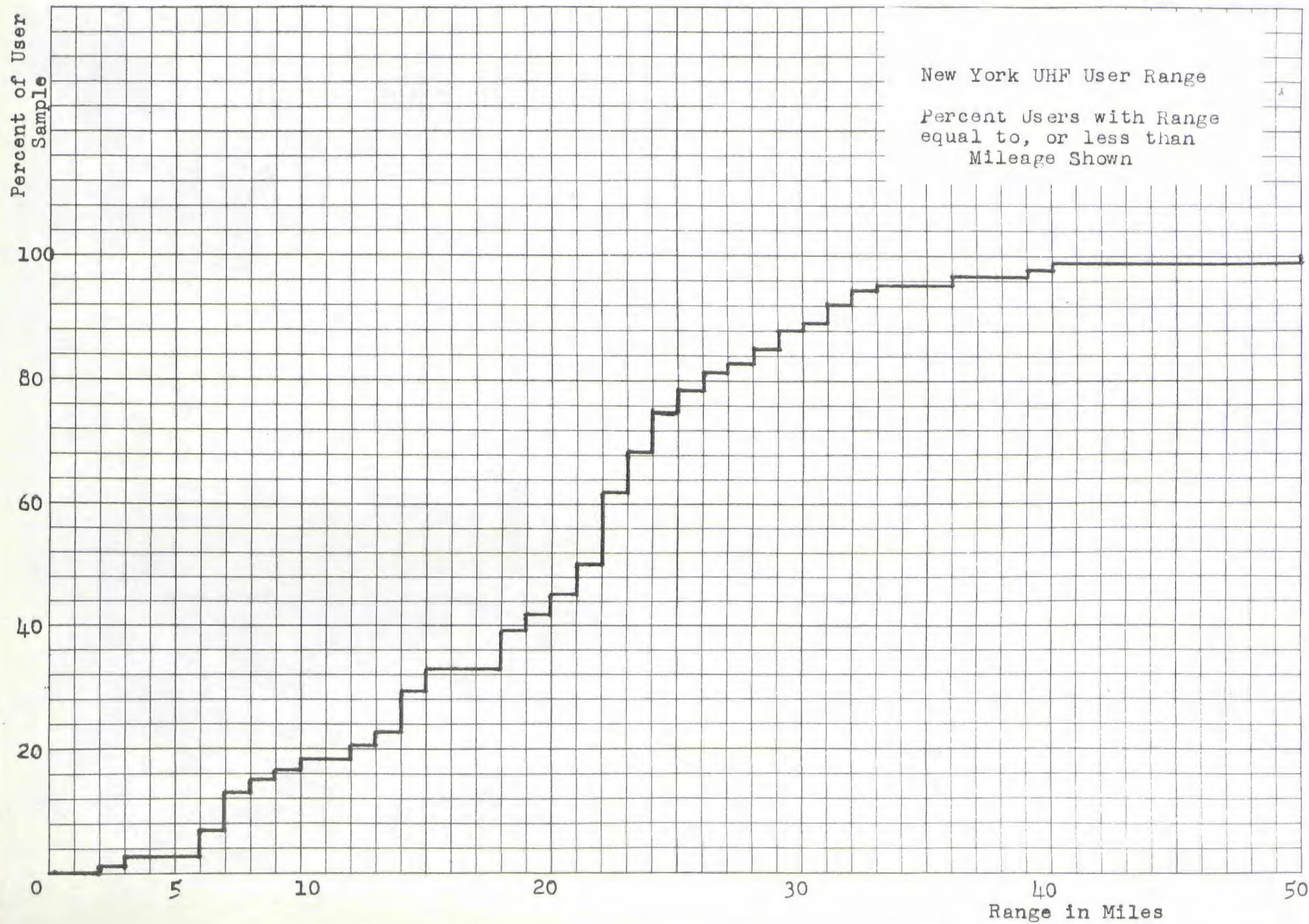


FIGURE 4



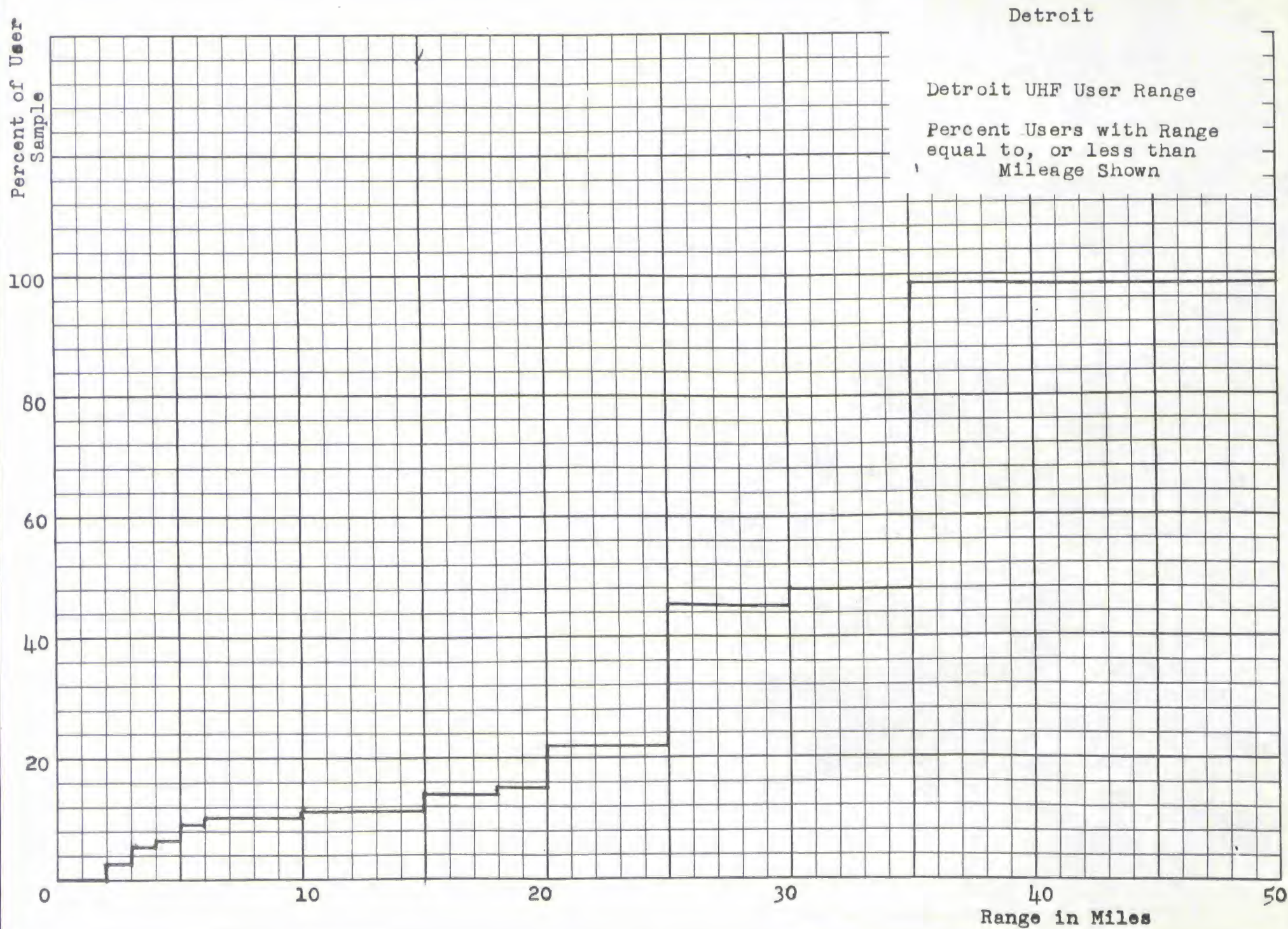


FIGURE 5



Seattle A & B & C

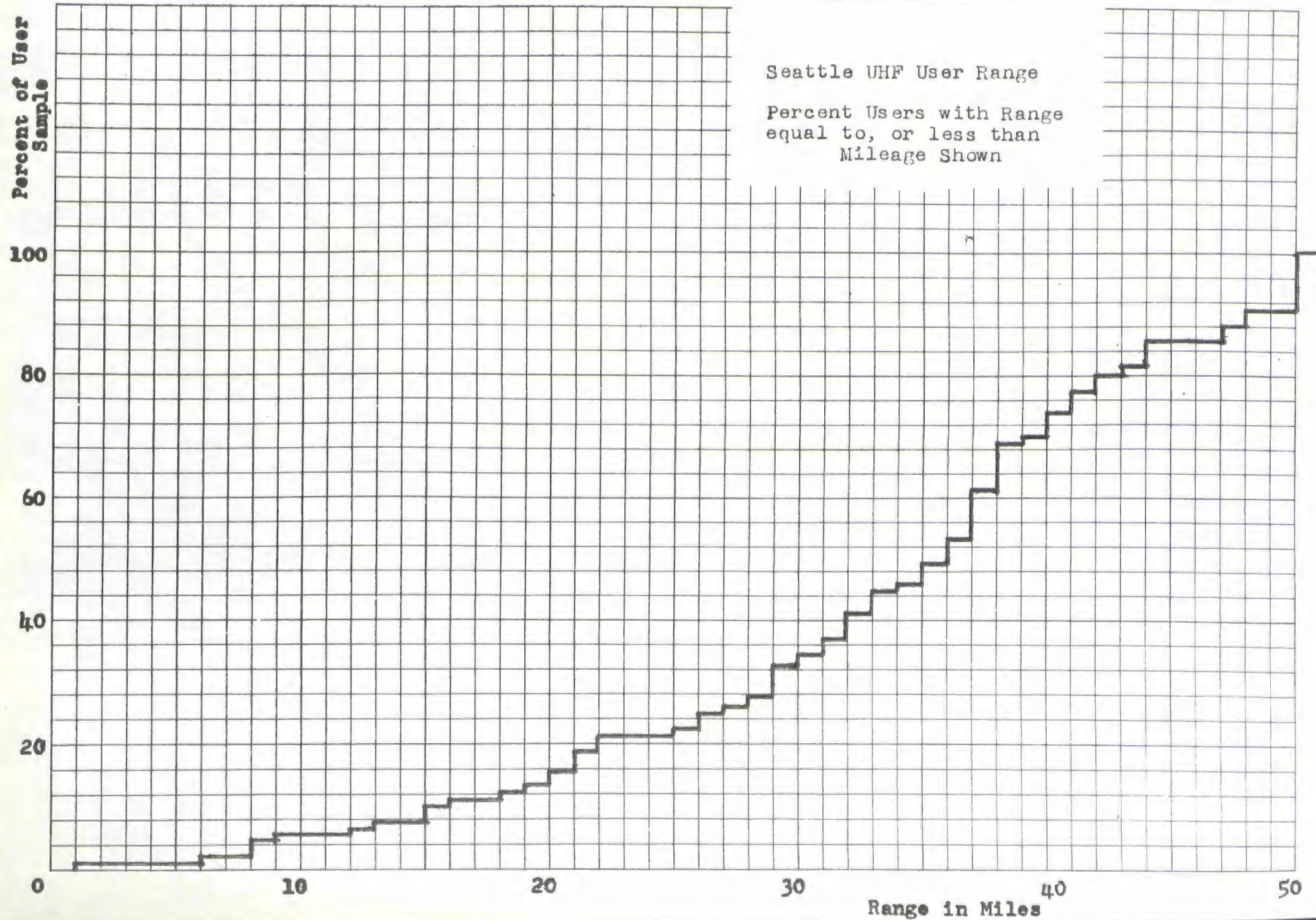
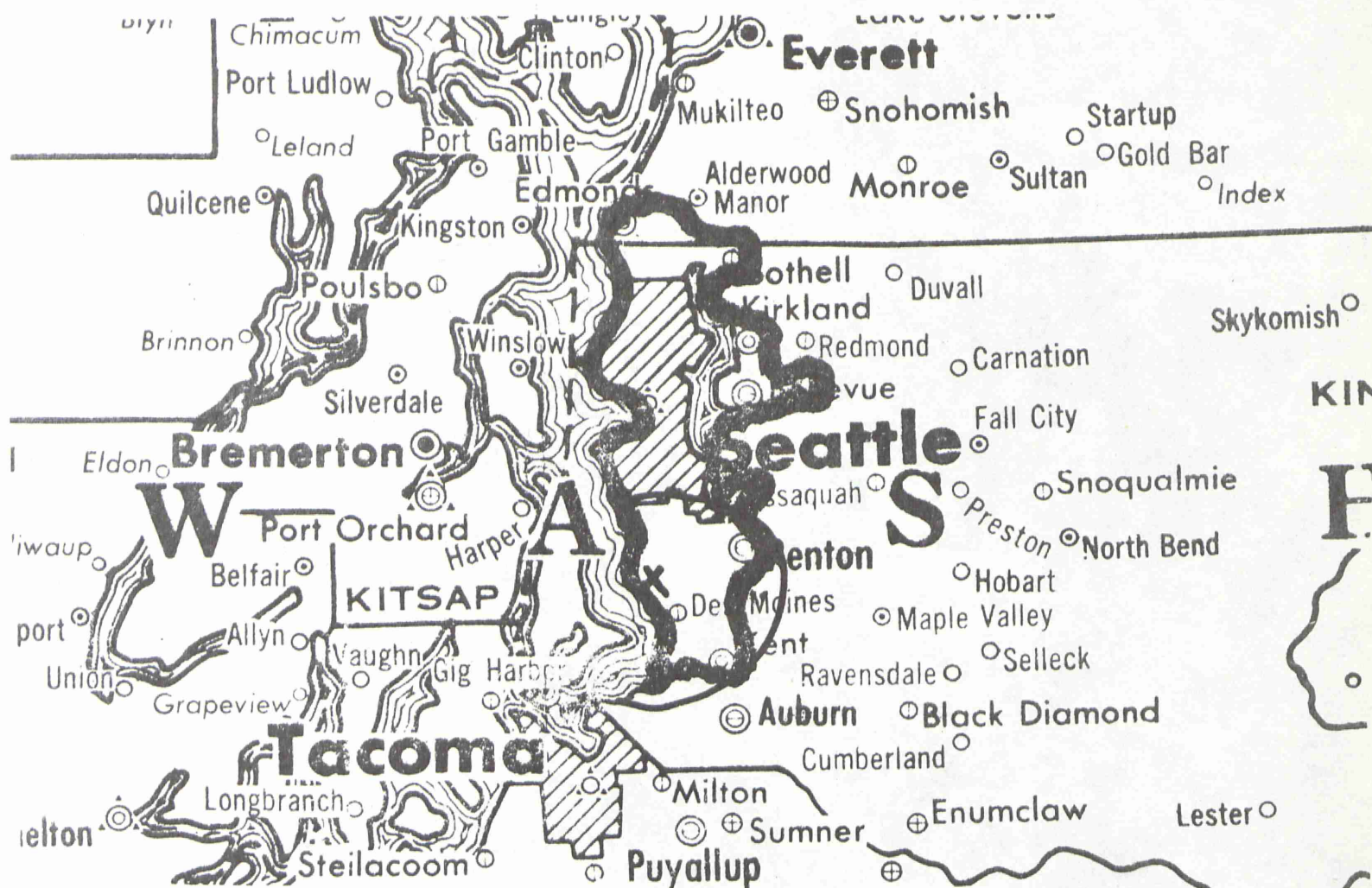


FIGURE 6





A-1

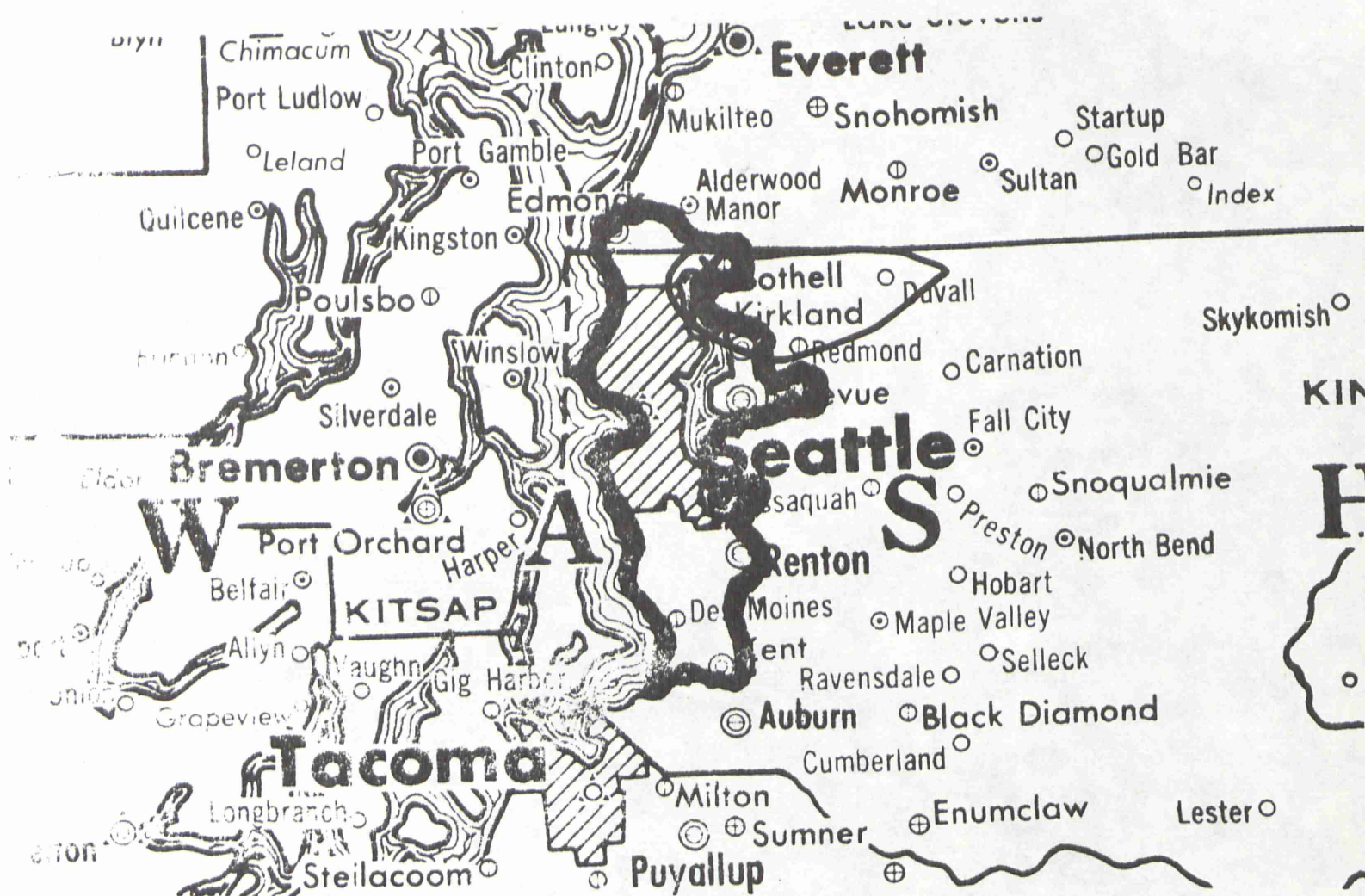
PORT OF SEATTLE, SEATTLE AIRPORT, SEATTLE, WASHINGTON (8 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





A-4  
KING COUNTY WATER DIST. NO. 49, SEATTLE, WASHINGTON (16 MILES)

# SEATTLE

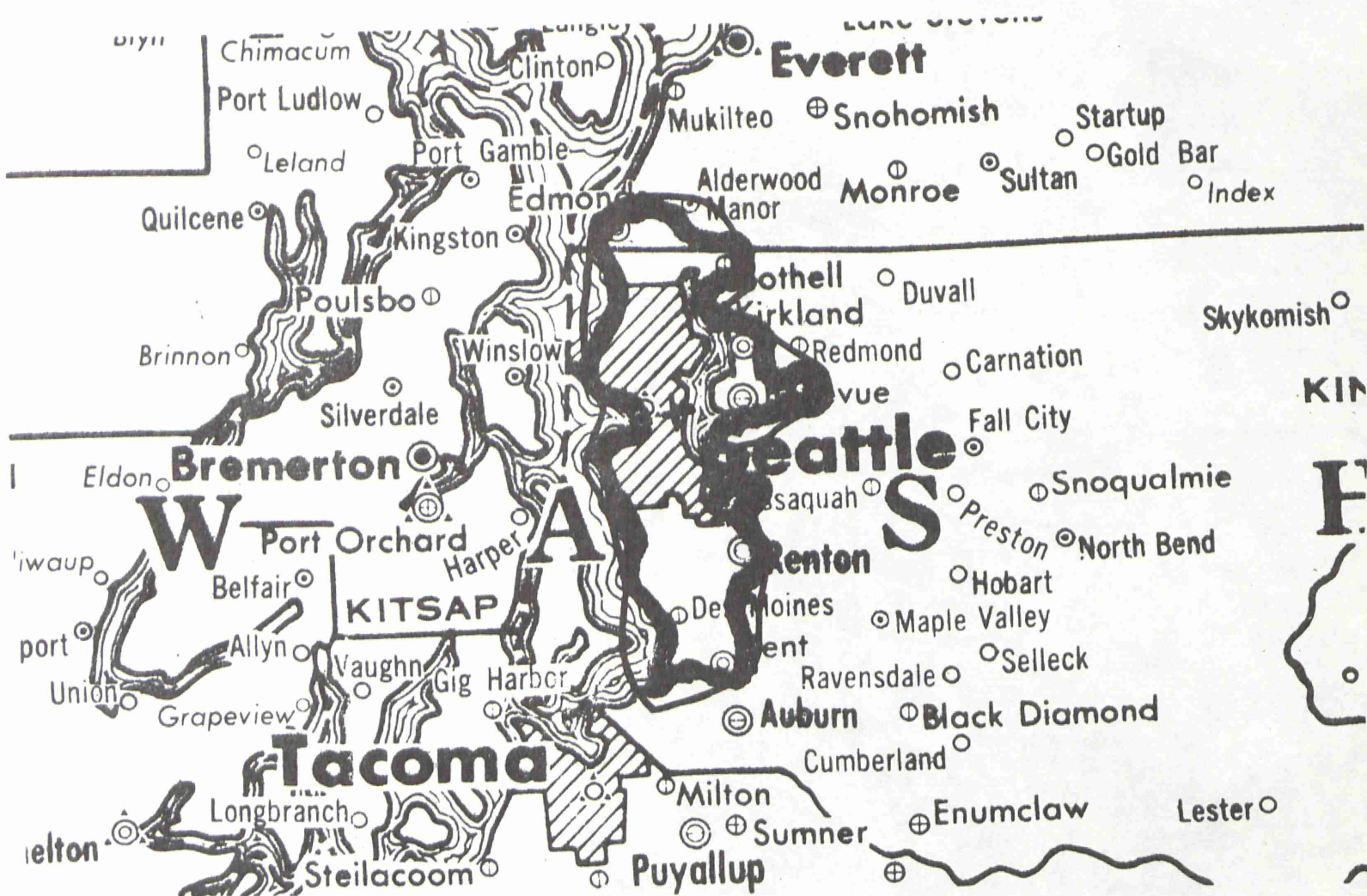


Copyright, American Map Co., Inc. No. 17501-A









A - 6

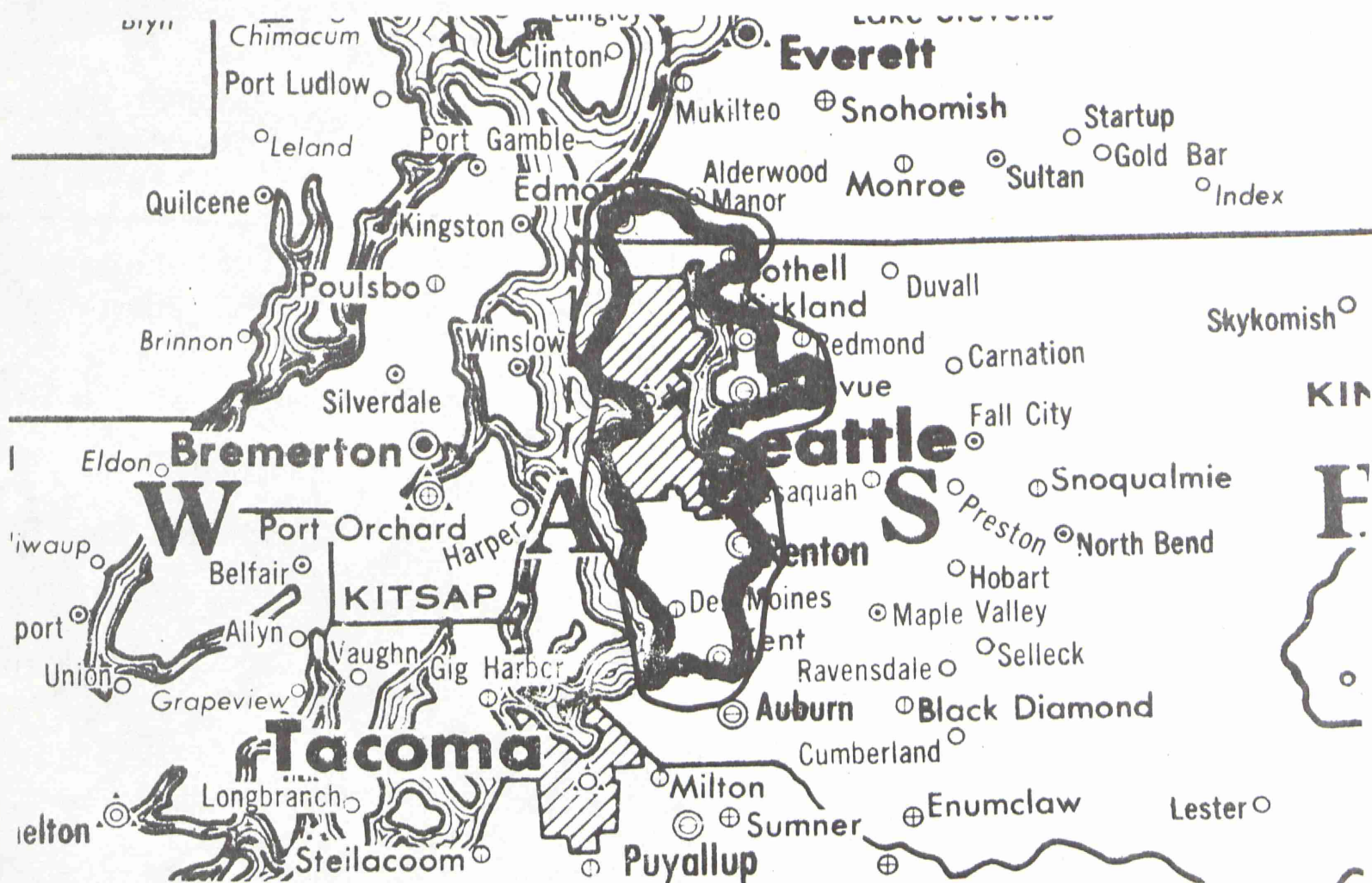
A - 6  
CONSOLIDATED FREIGHT, 1565 6TH ST., SEATTLE, WASHINGTON (20 MILES)

# SEATTLE



Copyright, American Map Co., Inc. **No. 17501-A**





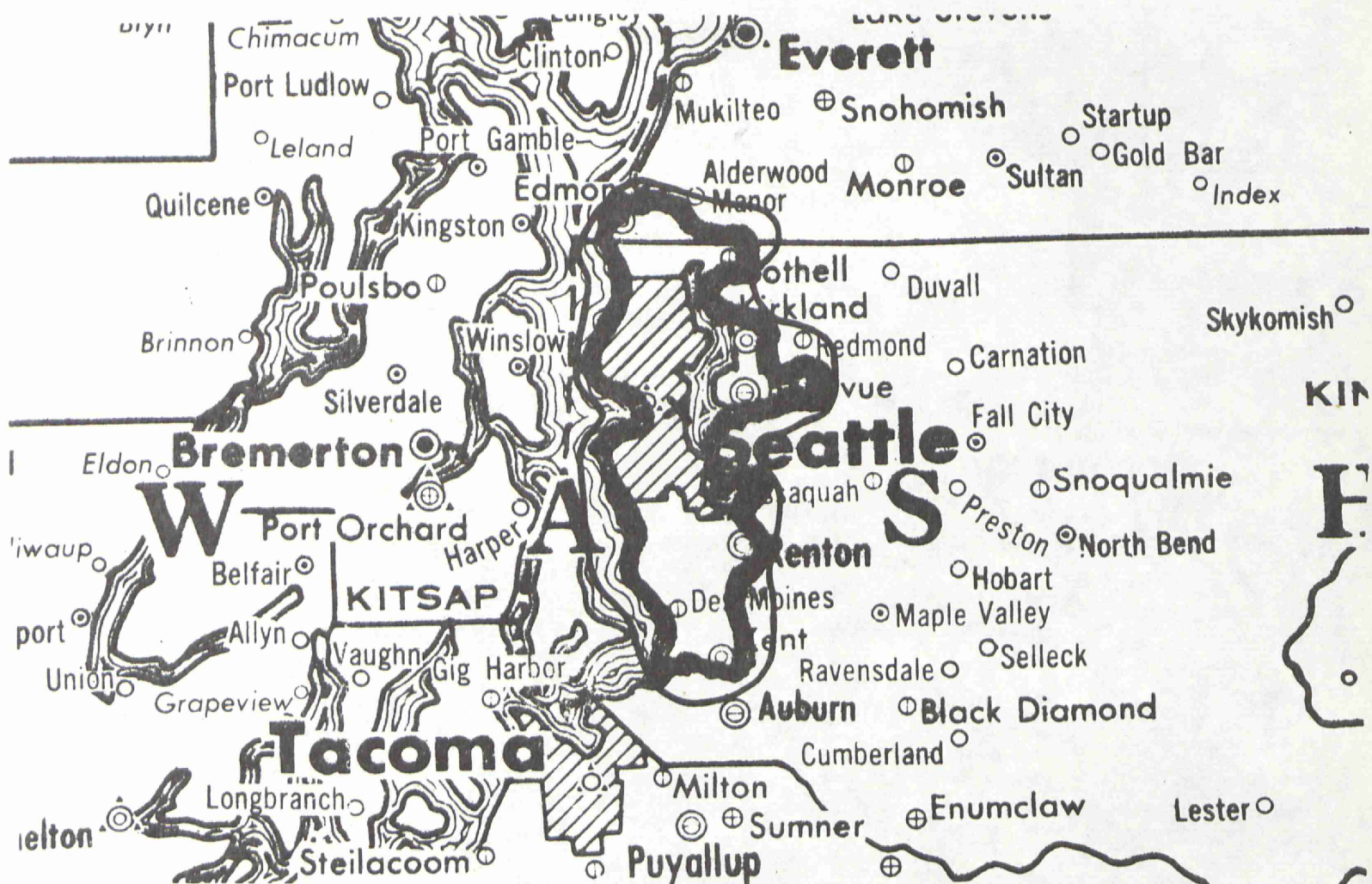
A-7  
 PACIFIC-INTER MT.  
 650 S. HANFORD, SEATTLE, WASHINGTON (21 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





A-8

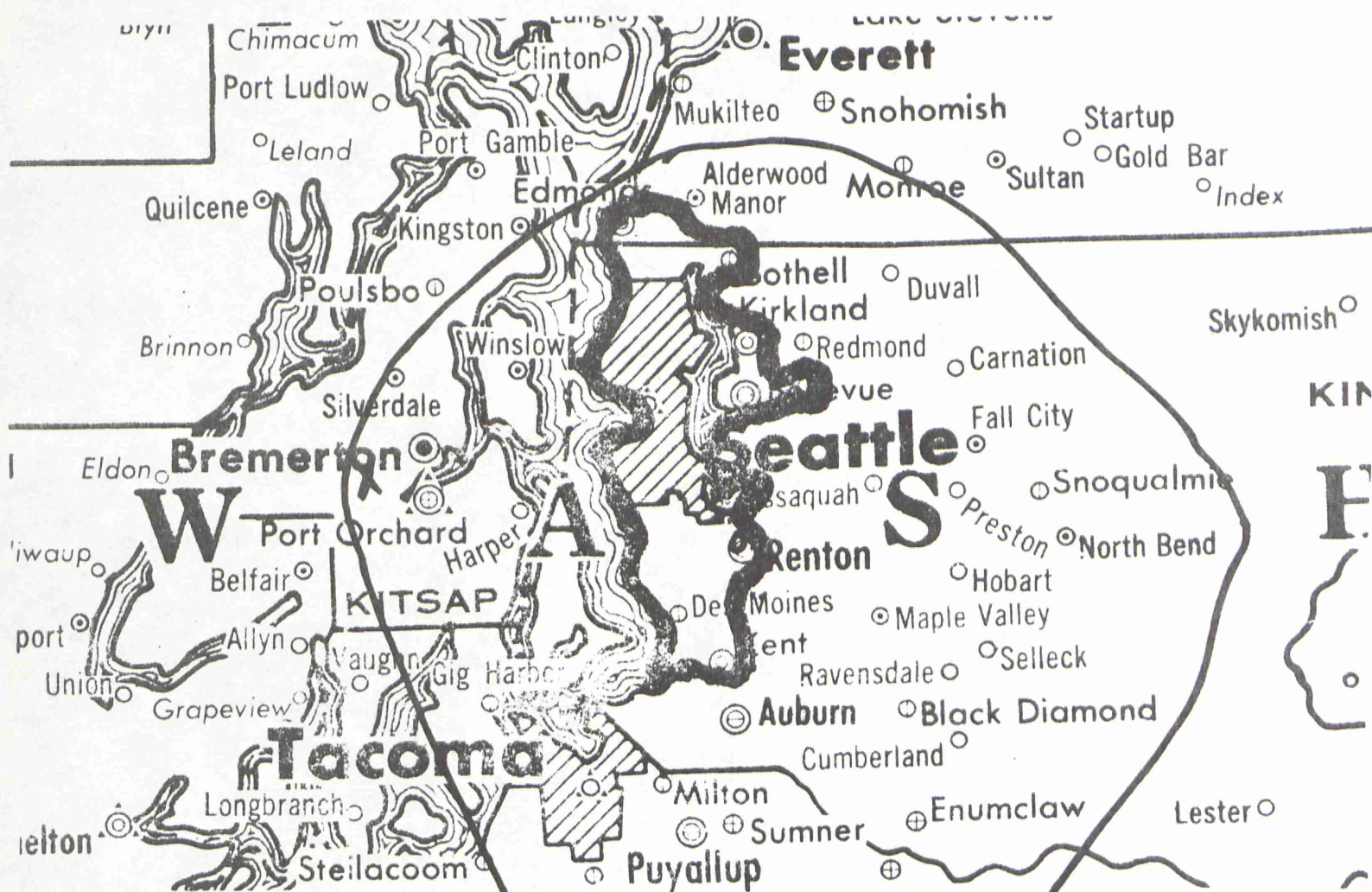
ONC TRUCKING, 54 S. DAWSON, SEATTLE, WASHINGTON (20 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





A - 11

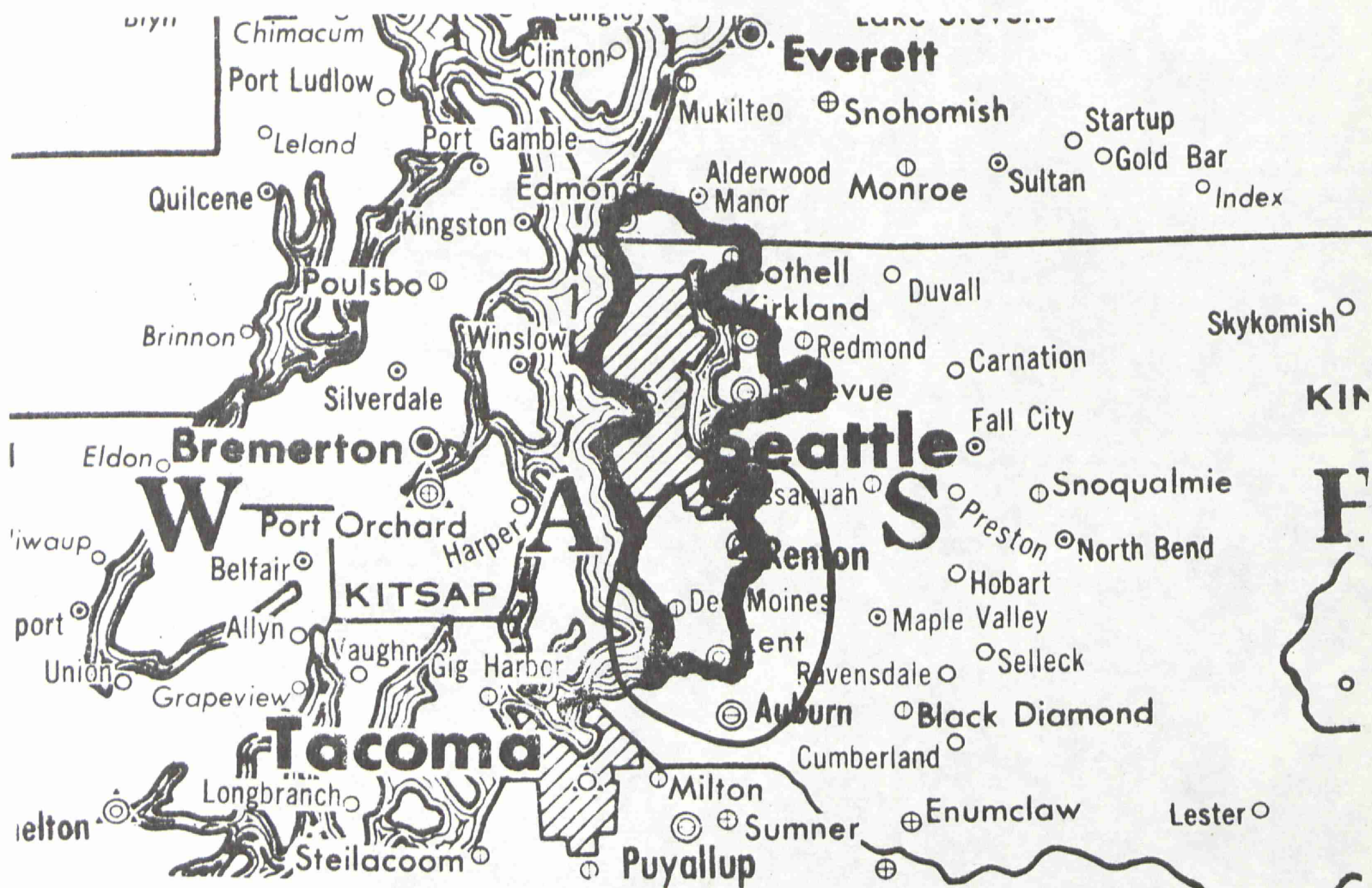
OK CAB CO., INC., S. E. 164TH & 108TH S. E., RENTON, WASHINGTON (58 MILES)

# SEATTLE



Copyright, American Map Co., Inc. **No. 17501-A**





A - 12

BON MARCHE, 5005 3RD, RENTON, WASHINGTON (13 MILES)

# SEATTLE

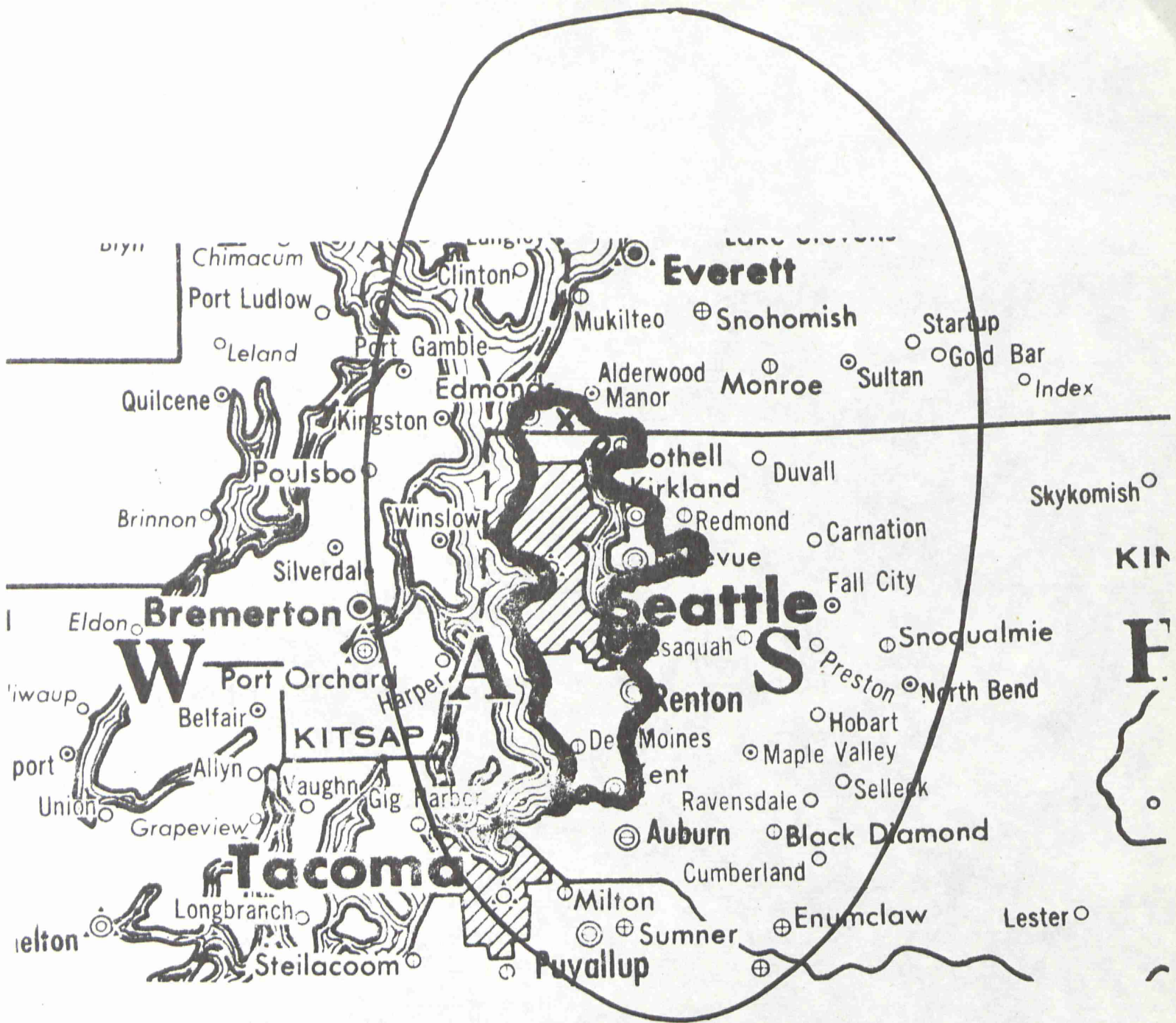


Copyright, American Map Co., Inc. No. 17501-A





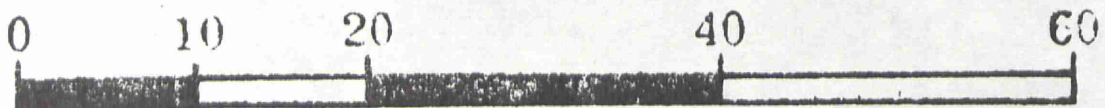




A - 10

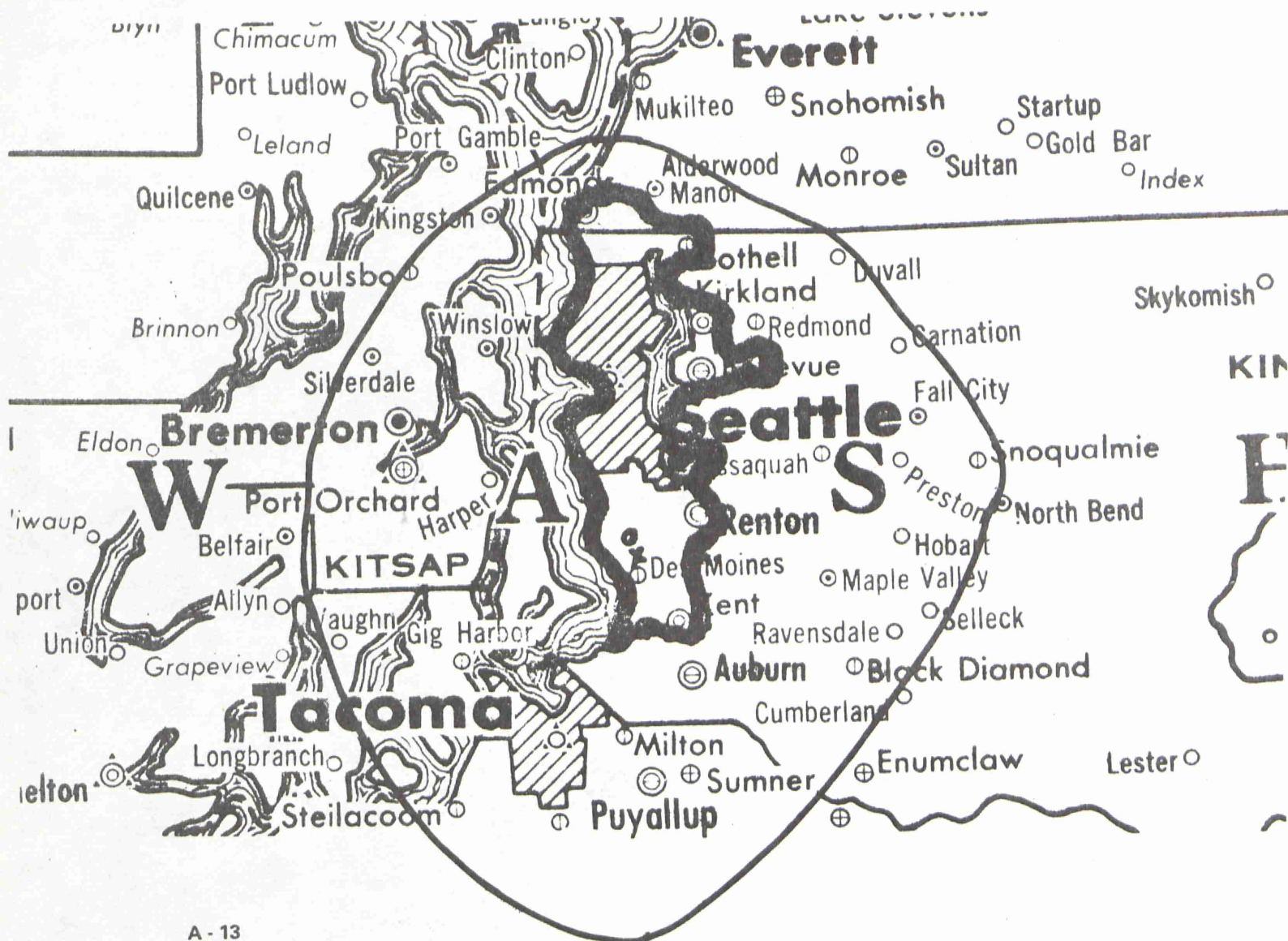
KENMORE REDI-MIX, BOTHELL WAY, KENMORE, WASHINGTON (47 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





A - 13

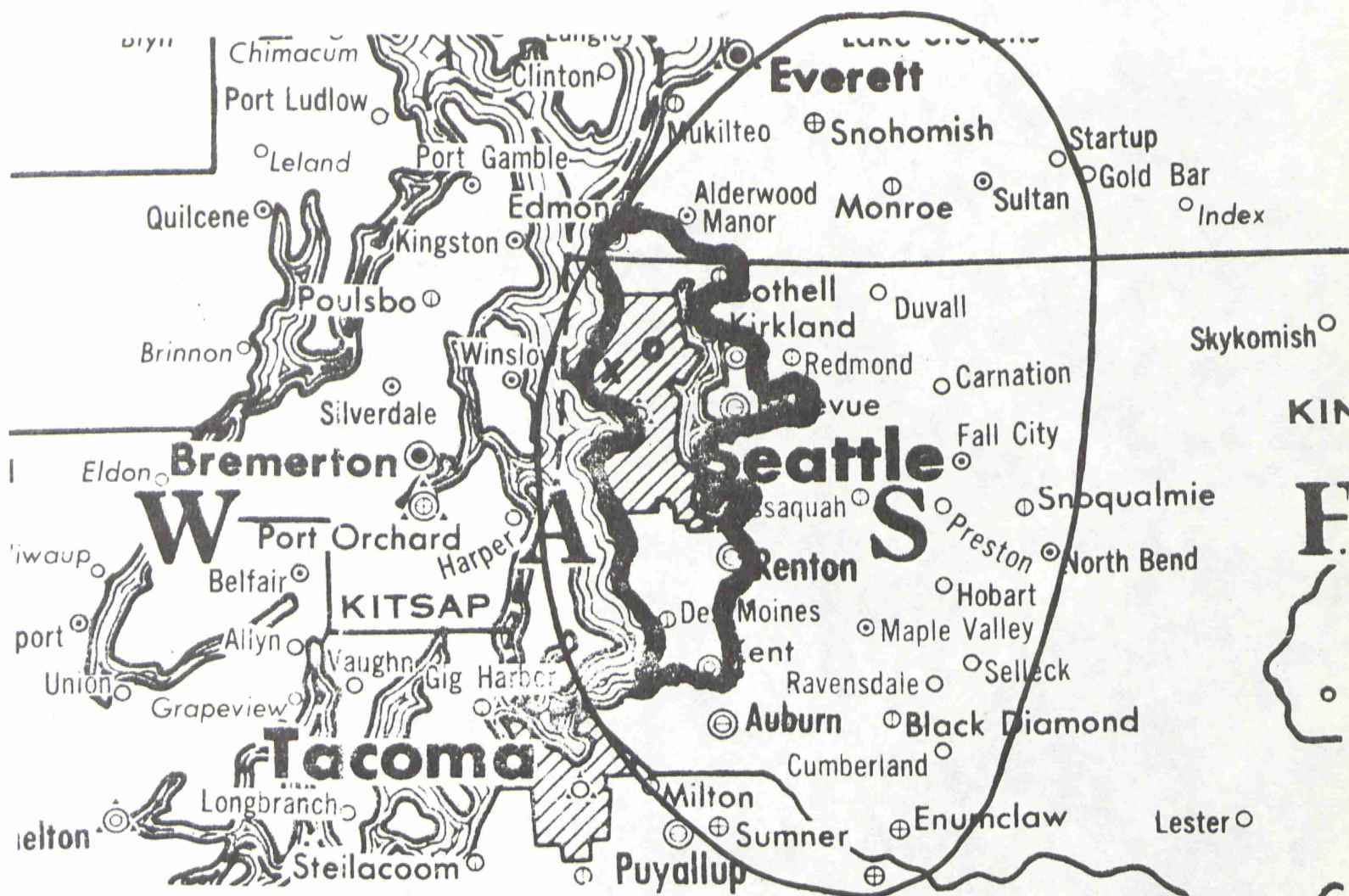
UNITED AIRLINES, SEA-TAC AIRPORT, SEATTLE, WASHINGTON (30 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





A - 14

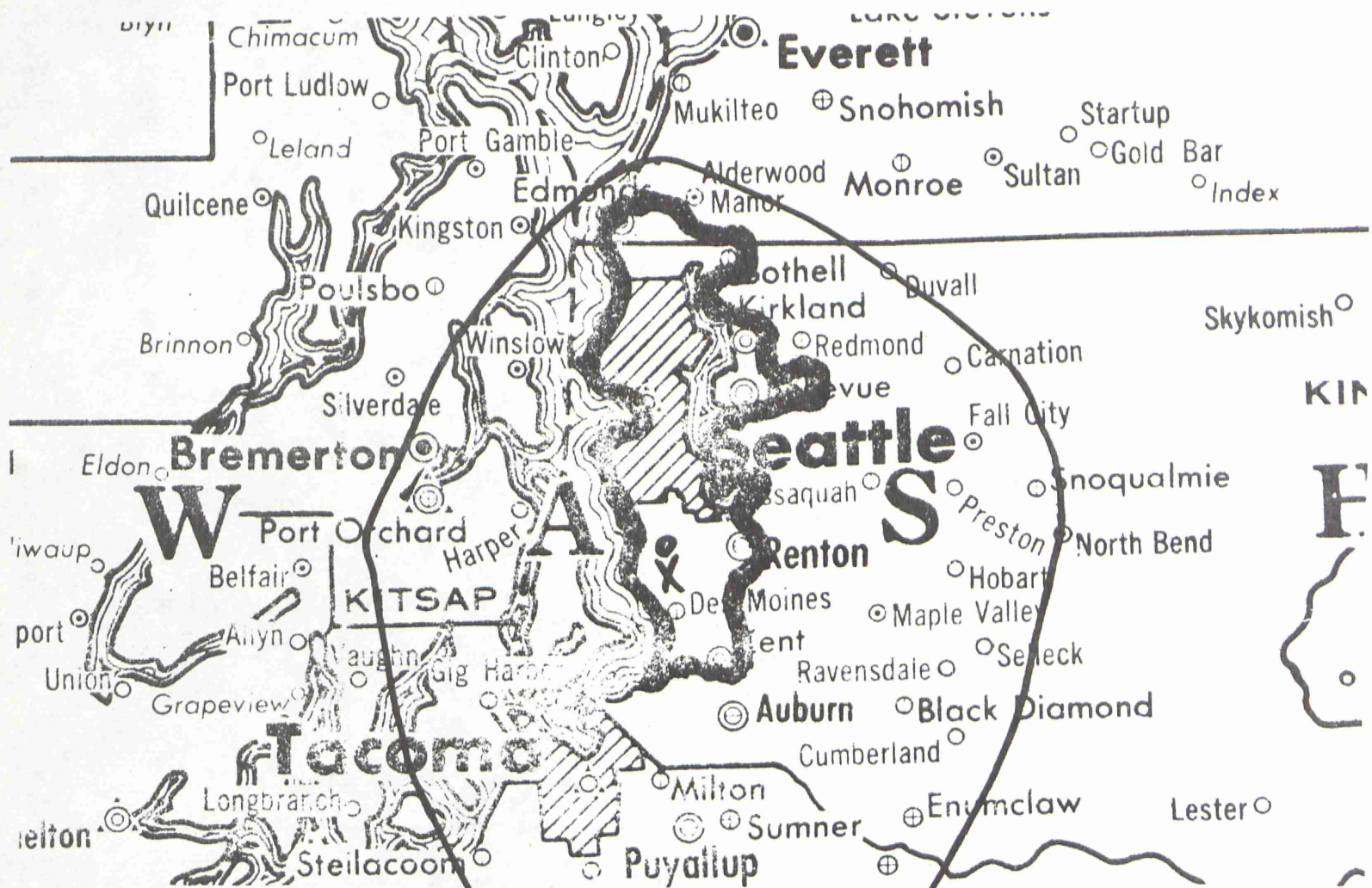
WATSON HALL, INC., 631 N. 95TH, SEATTLE, WASHINGTON (40 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





A - 15

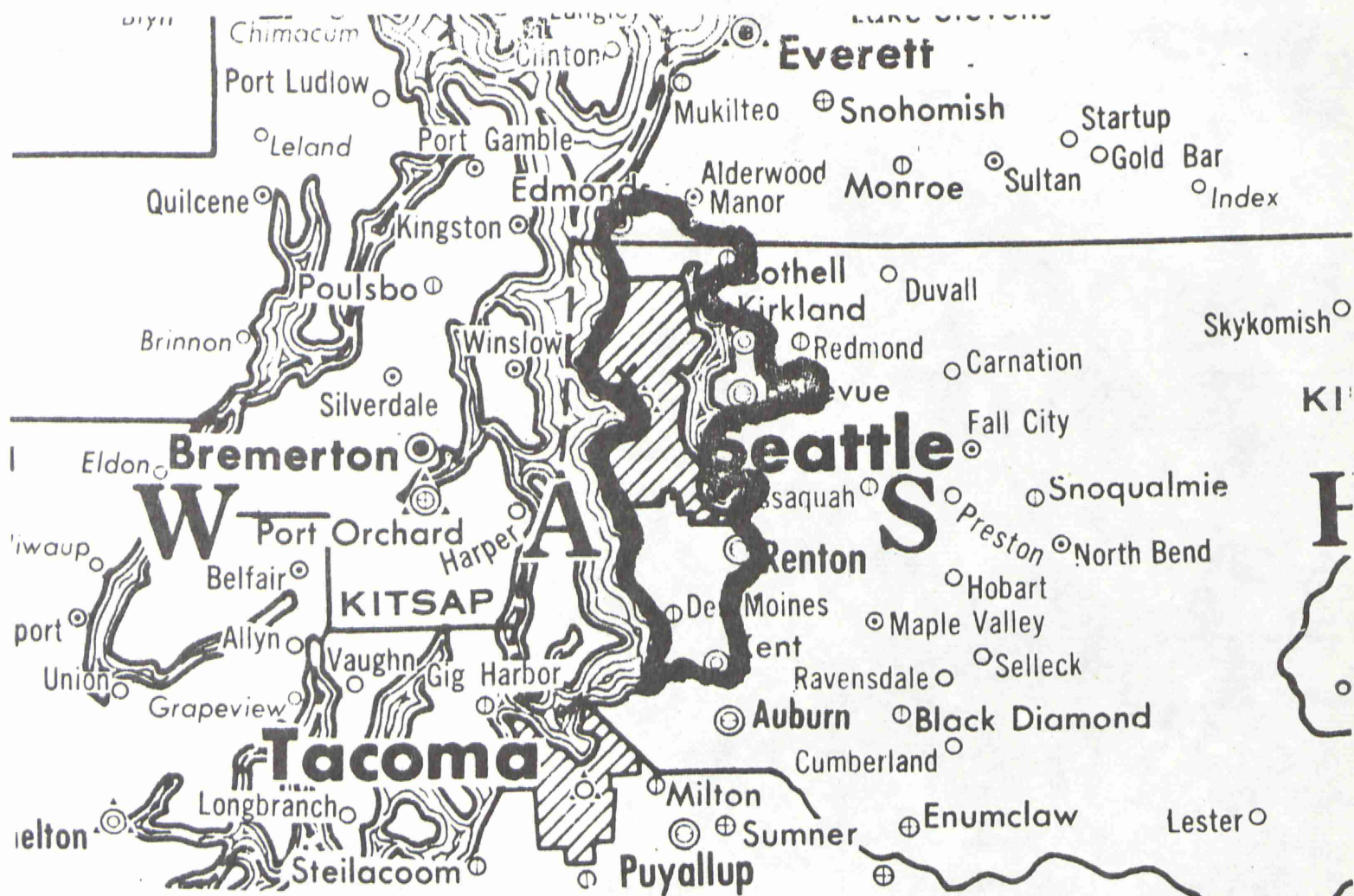
PACIFIC NORTHERN A. L., SEA-TAC AIRPORT, SEATTLE, WASHINGTON (37 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





A - 16

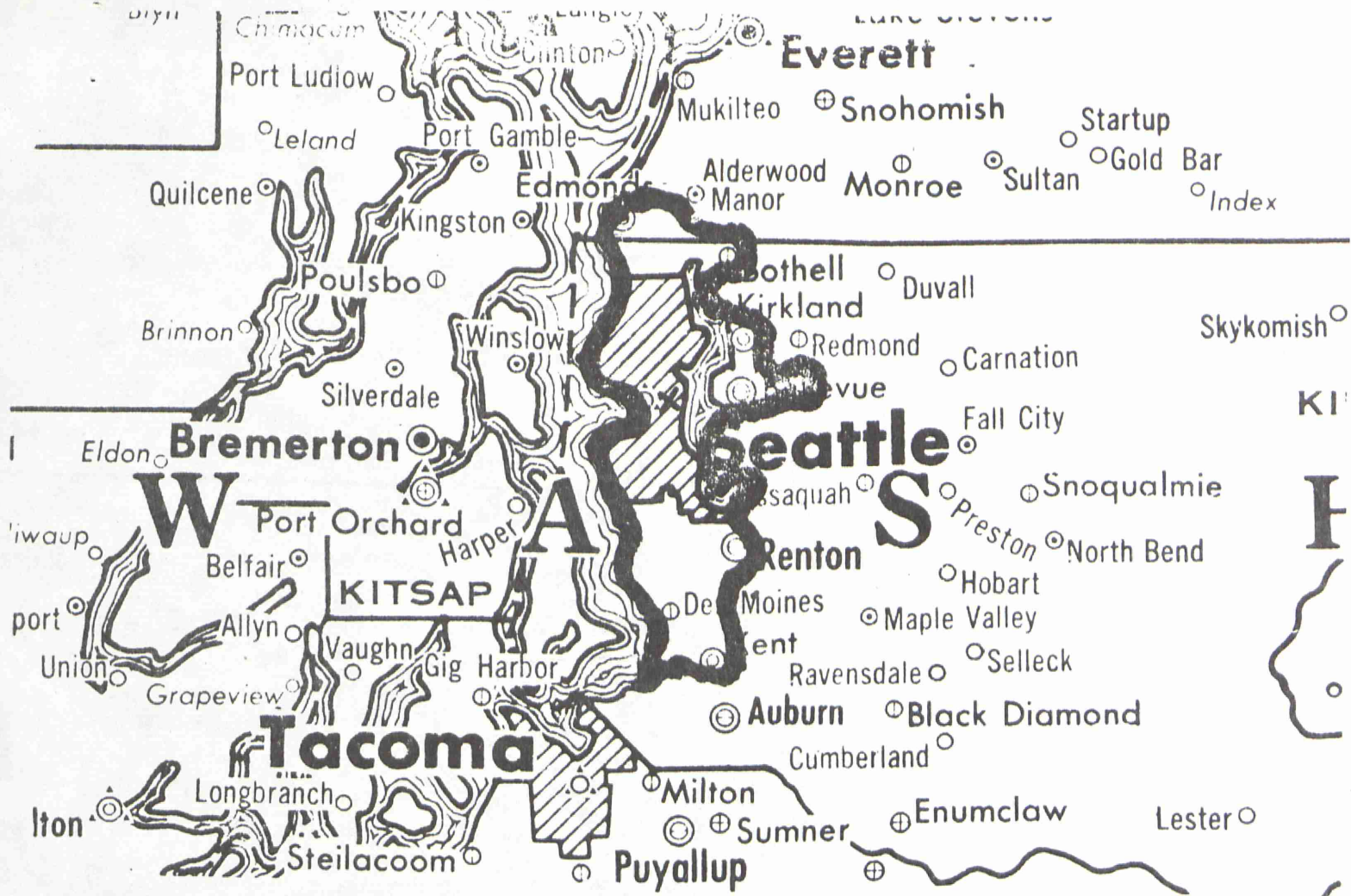
CITY OF SEATTLE FIRE DEPT., 408 THOMAS ST., SEATTLE, WASH. (12 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A

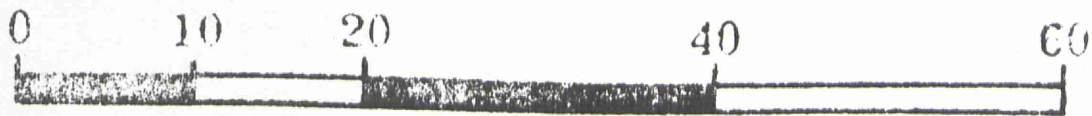




A - 17

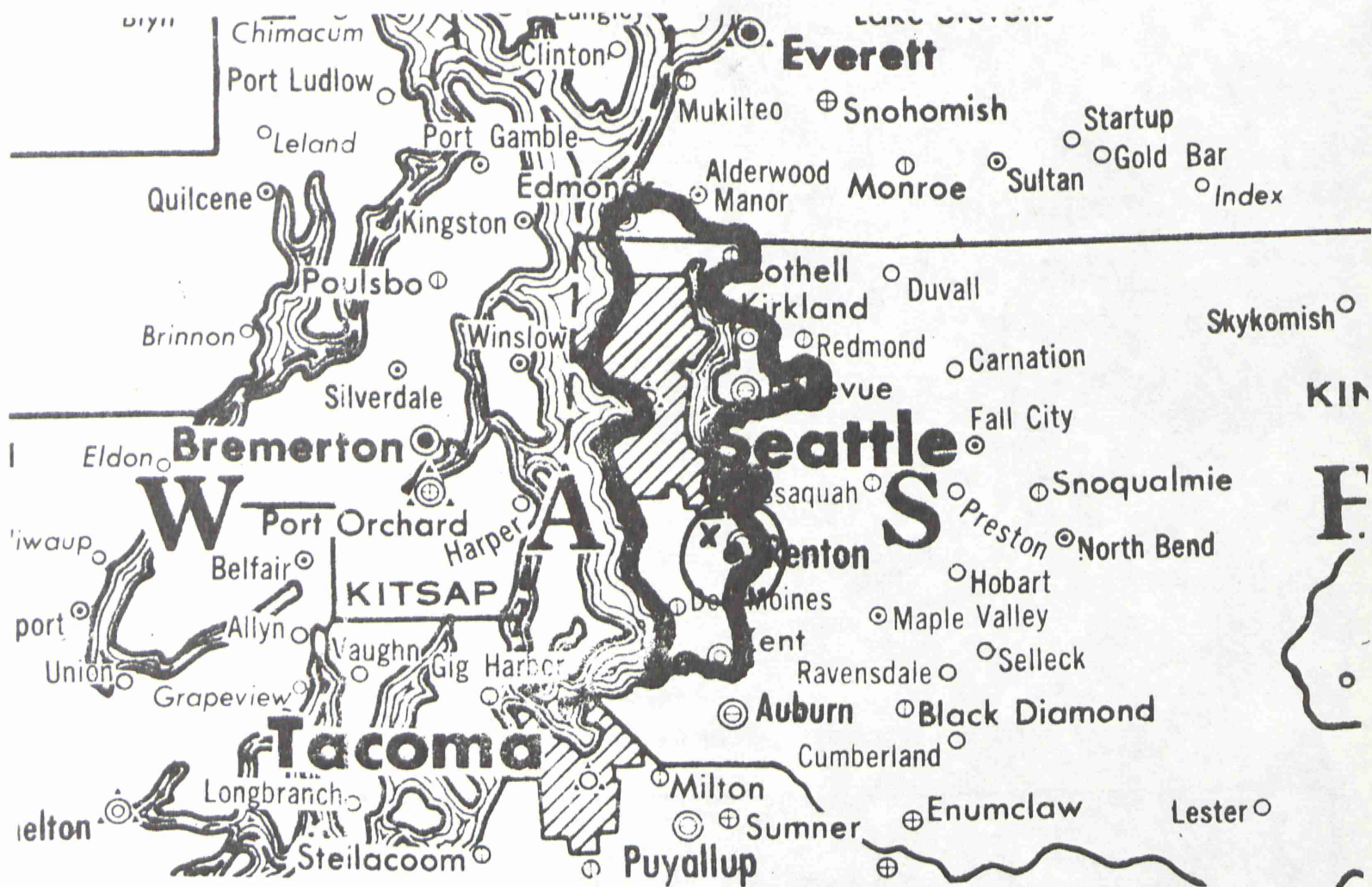
CITY OF SEATTLE POLICE DEPT., MUNICIPAL BLDG., SEATTLE, WASH. (8 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





A - 18

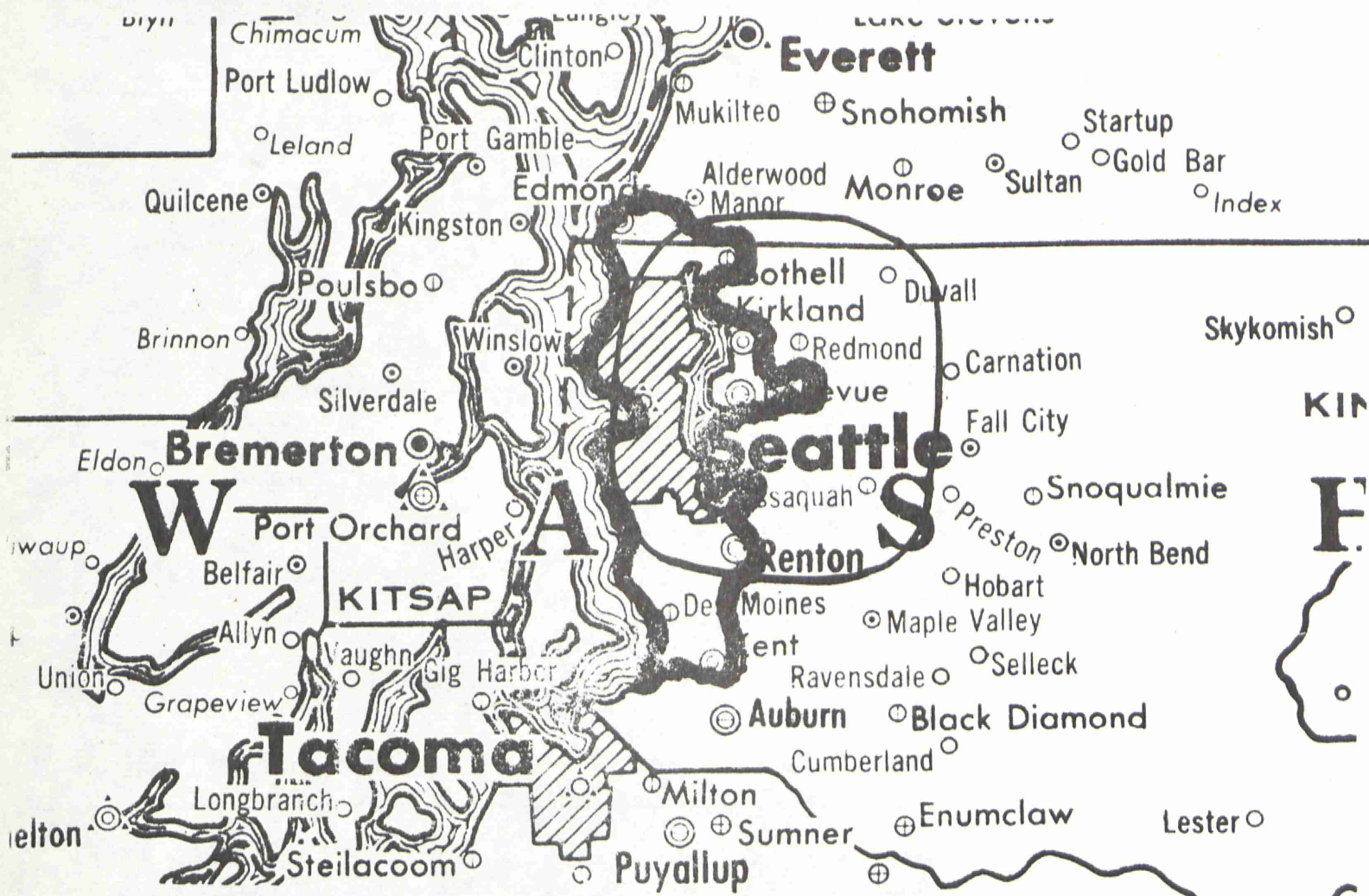
CITY OF RENTON, CITY HALL, RENTON, WASHINGTON (6 MILES)

**SEATTLE**



Copyright, American Map Co., Inc. **No. 17501-A**





A - 20

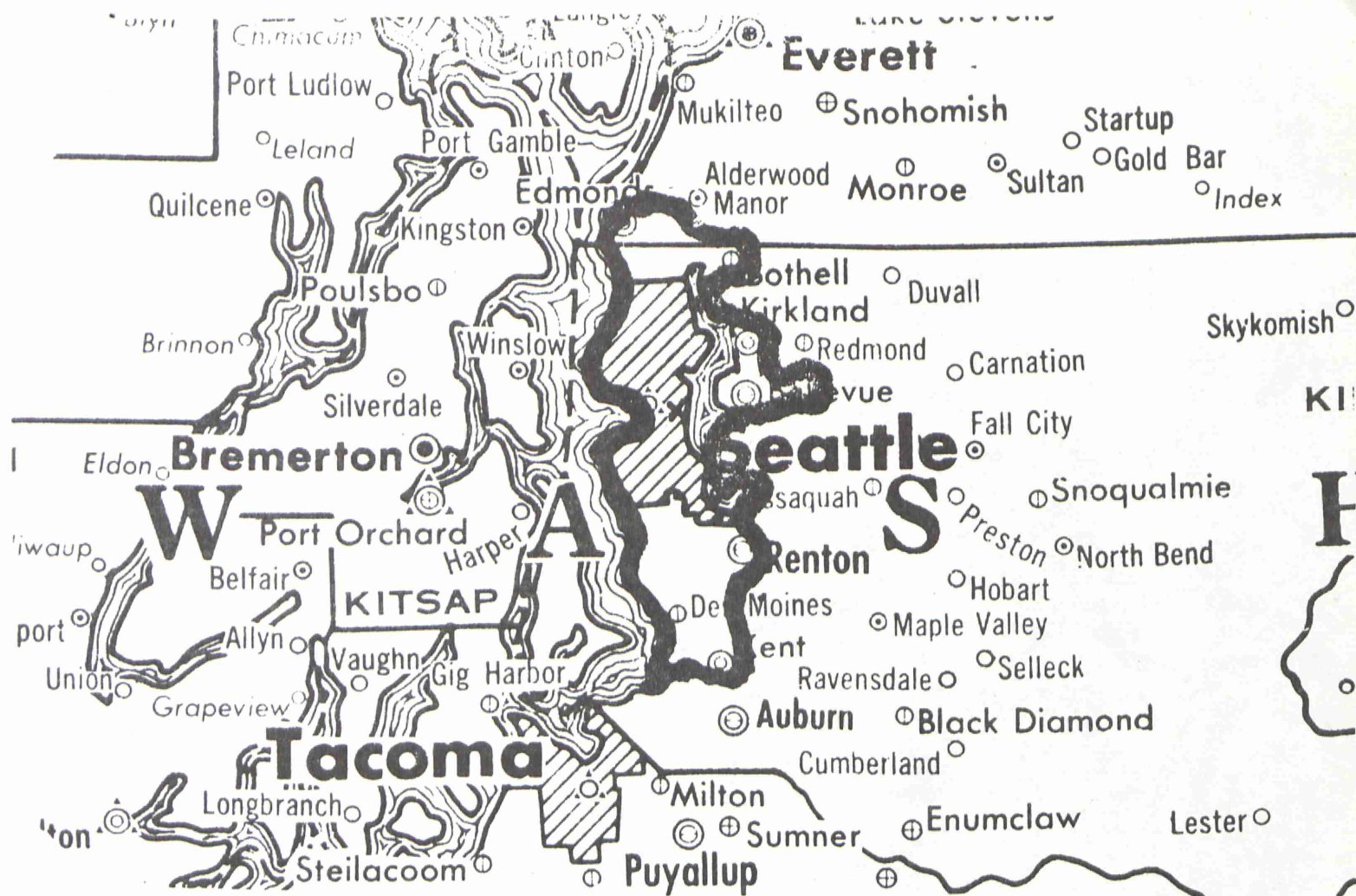
CITY OF BELLEVUE, 111 - 116TH AVENUE, S. E., BELLEVUE, WASHINGTON (15 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





A - 19

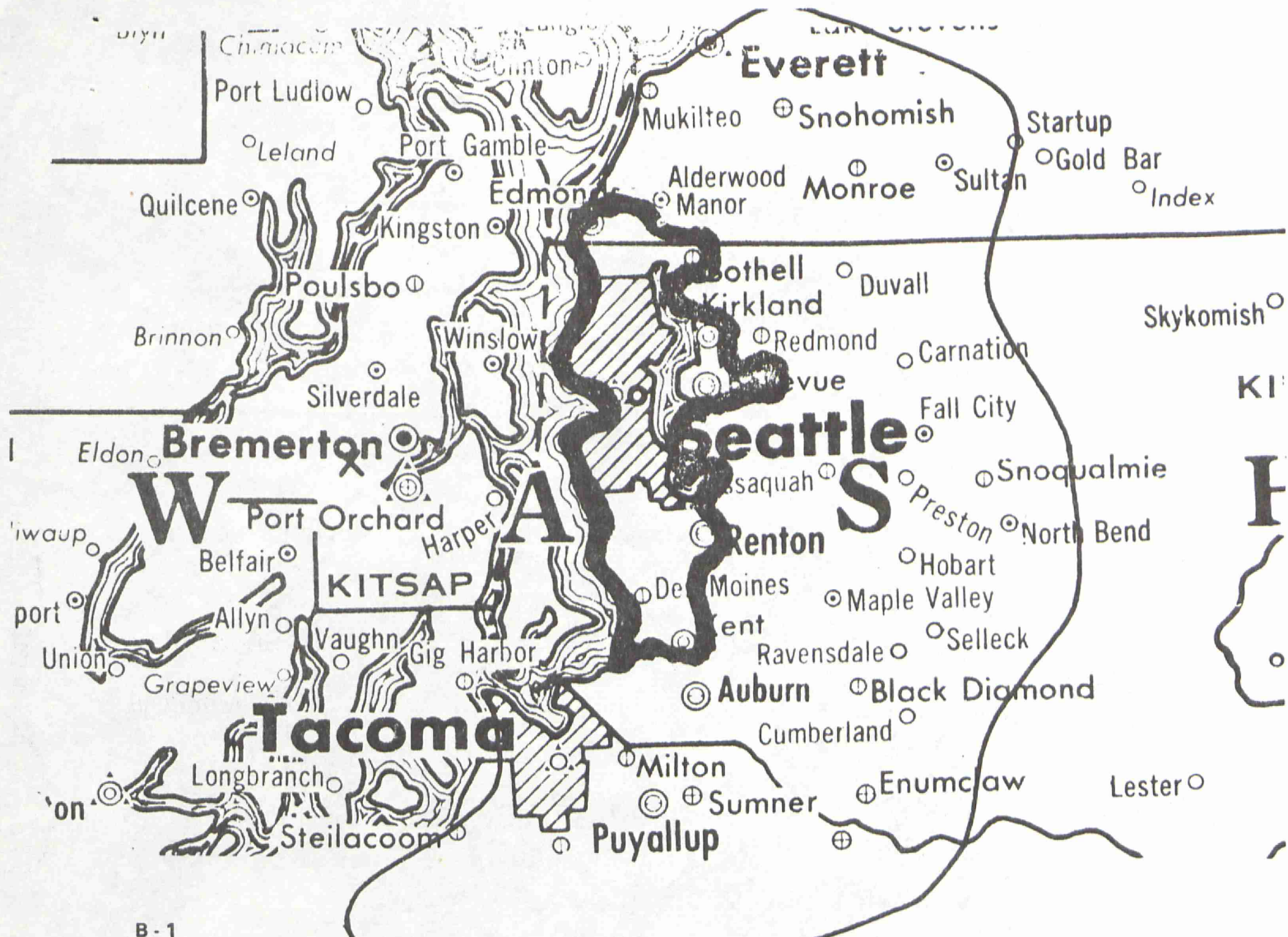
CITY OF SEATTLE, DEPT. OF ENGINEERING, MUNICIPAL BLDG., SEATTLE, WASHINGTON (9 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





B-1

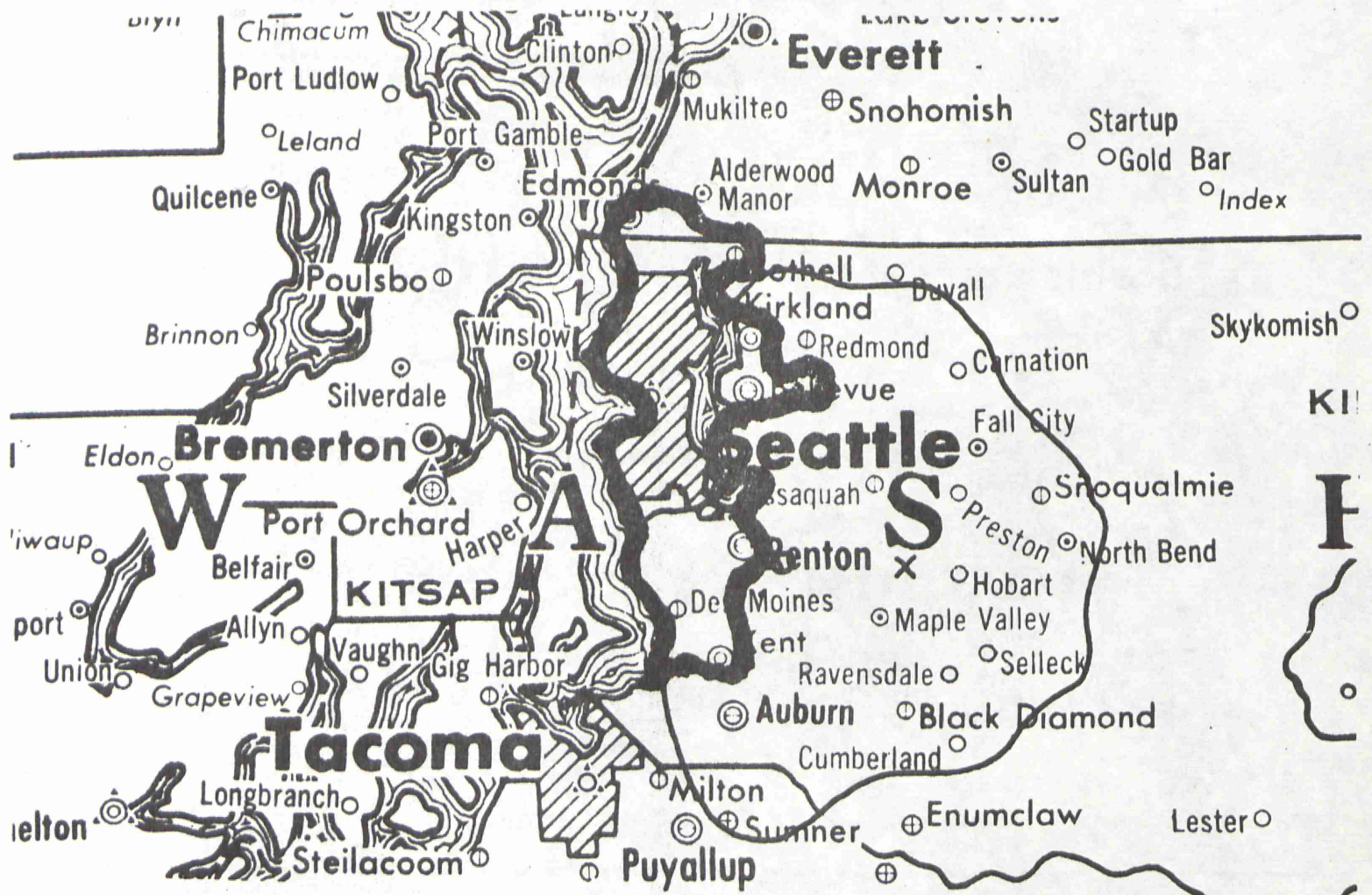
D. A. BURNS, 1008 YALE N., SEATTLE, WASHINGTON (52 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





B-2

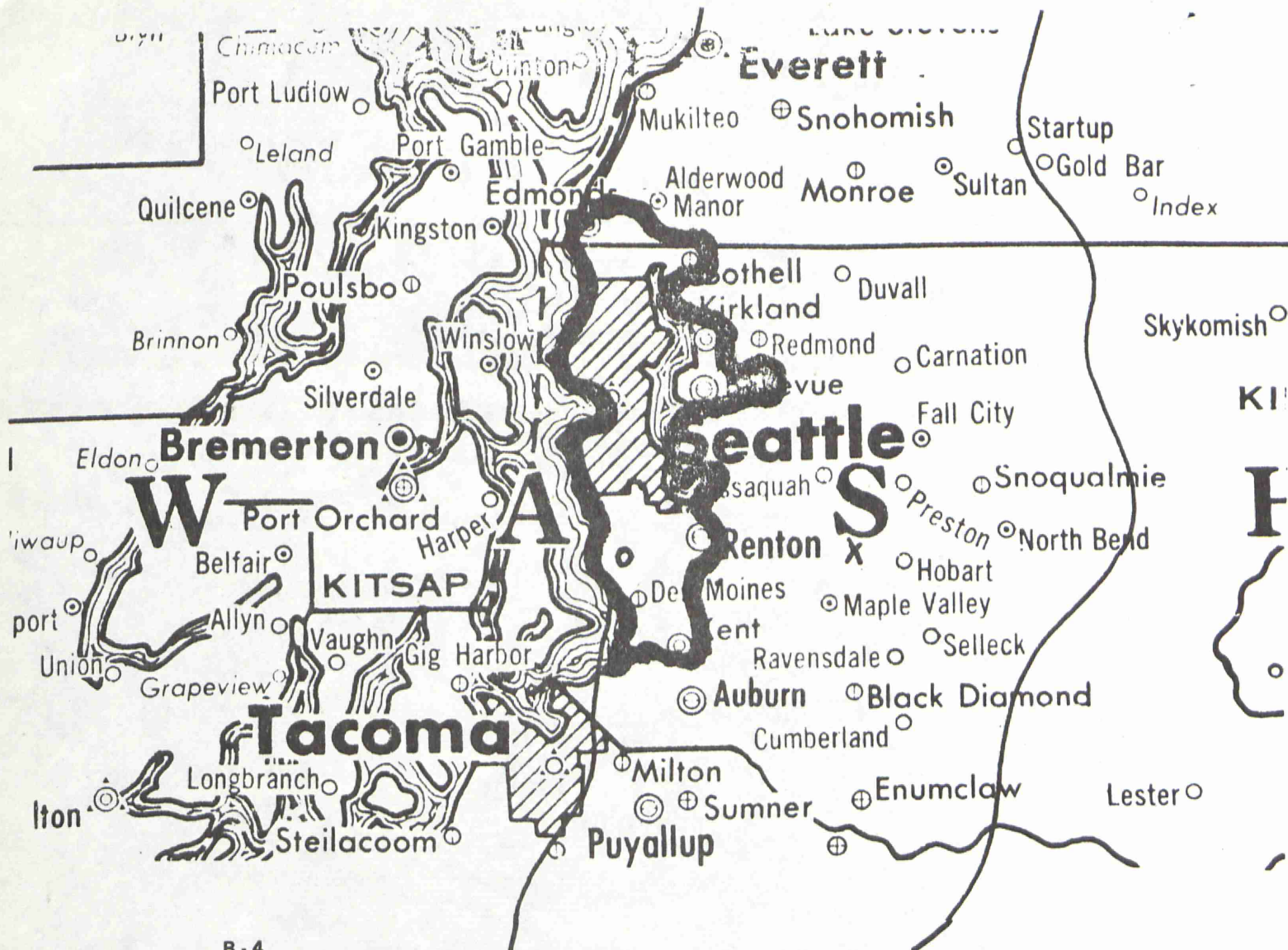
S & T CONSTRUCTION, 9889 S. E. CARR RD., RENTON, WASHINGTON (22 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





B-4

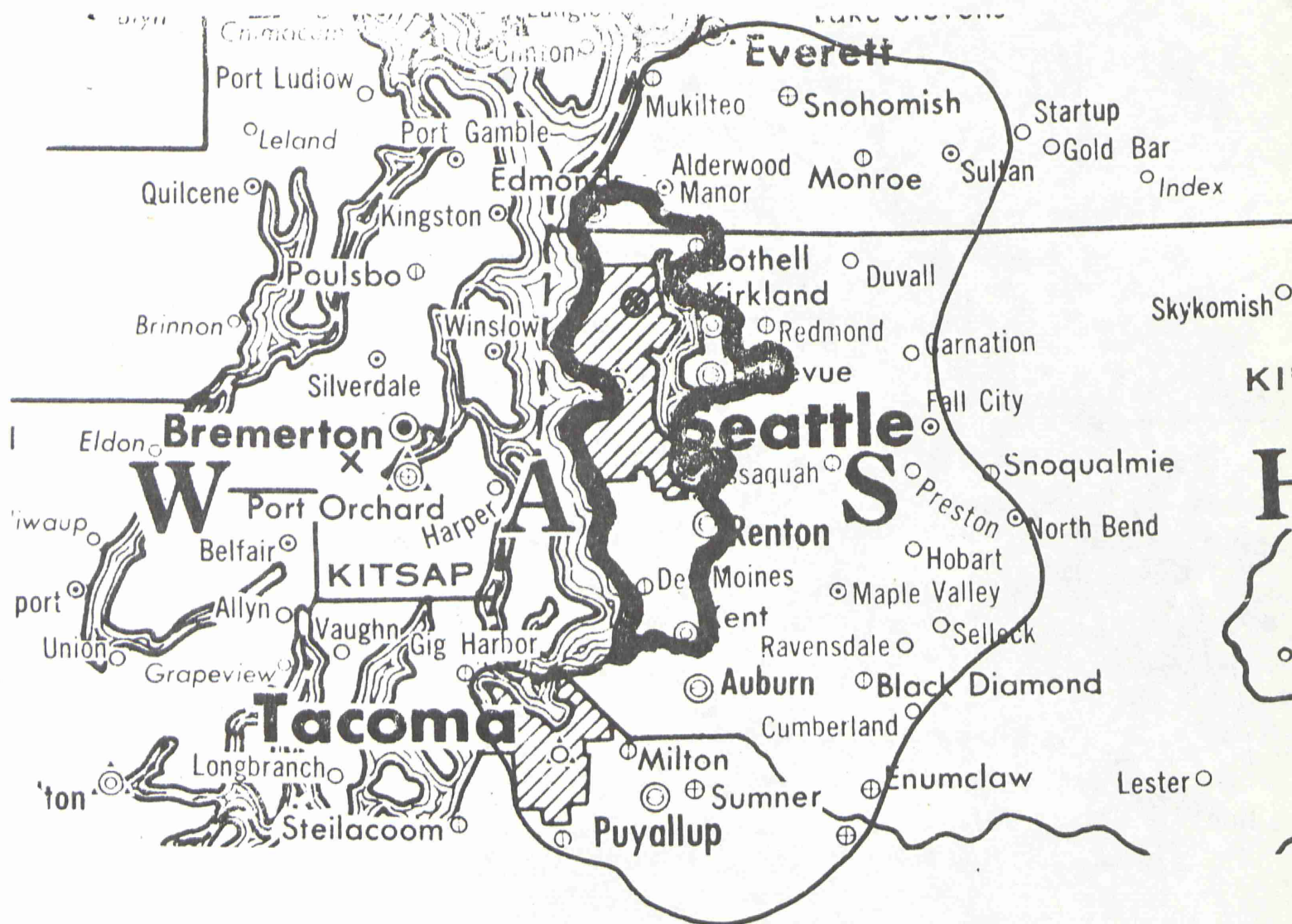
EMERY AIR FREIGHT, SEA-TAC AIRPORT, SEATTLE, WASHINGTON (40 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





B-3

CERTIFIED CLEANING, 8046 16TH N. E., SEATTLE, WASHINGTON (51 MILES)

# SEATTLE

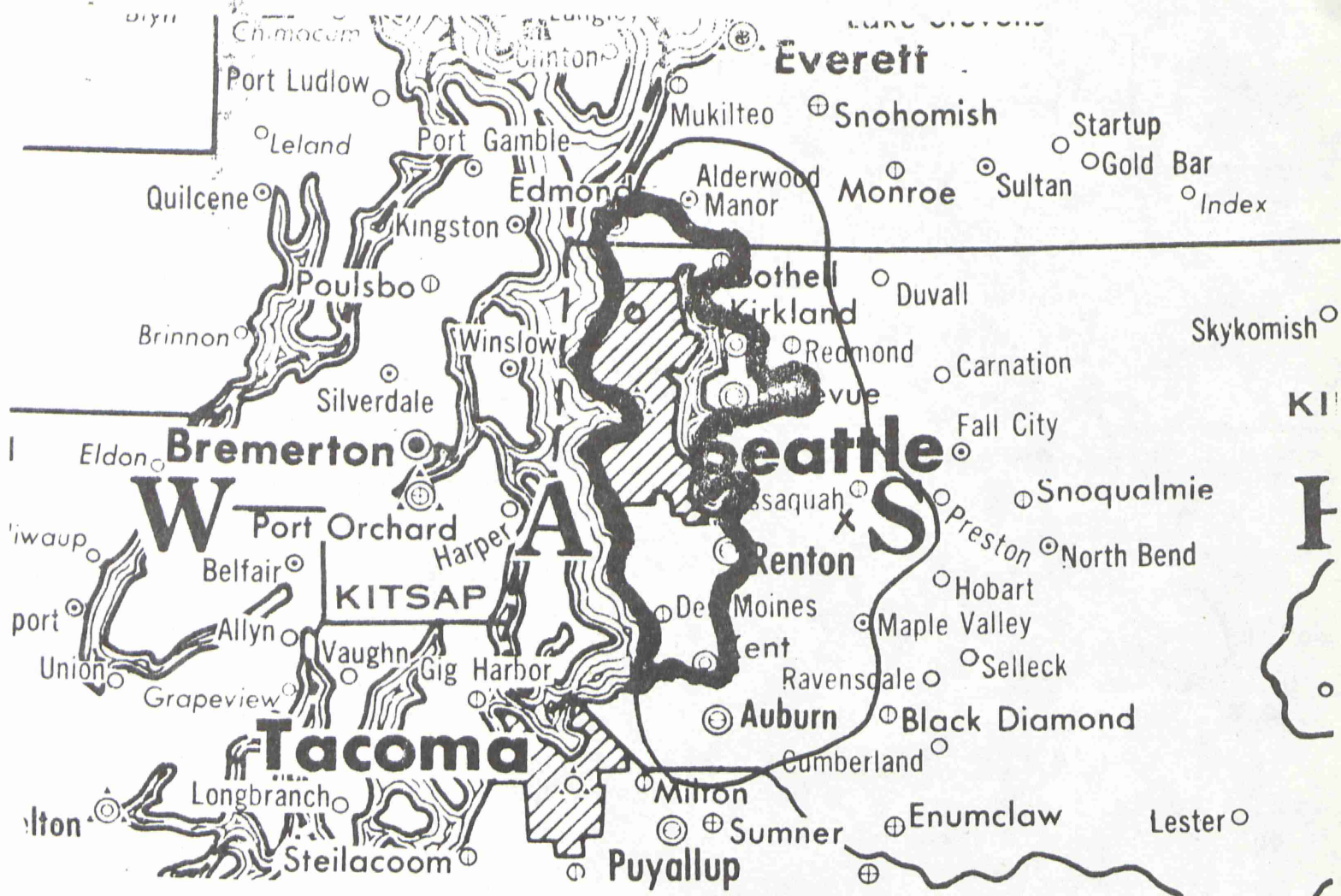


Copyright, American Map Co., Inc. No. 17501-A









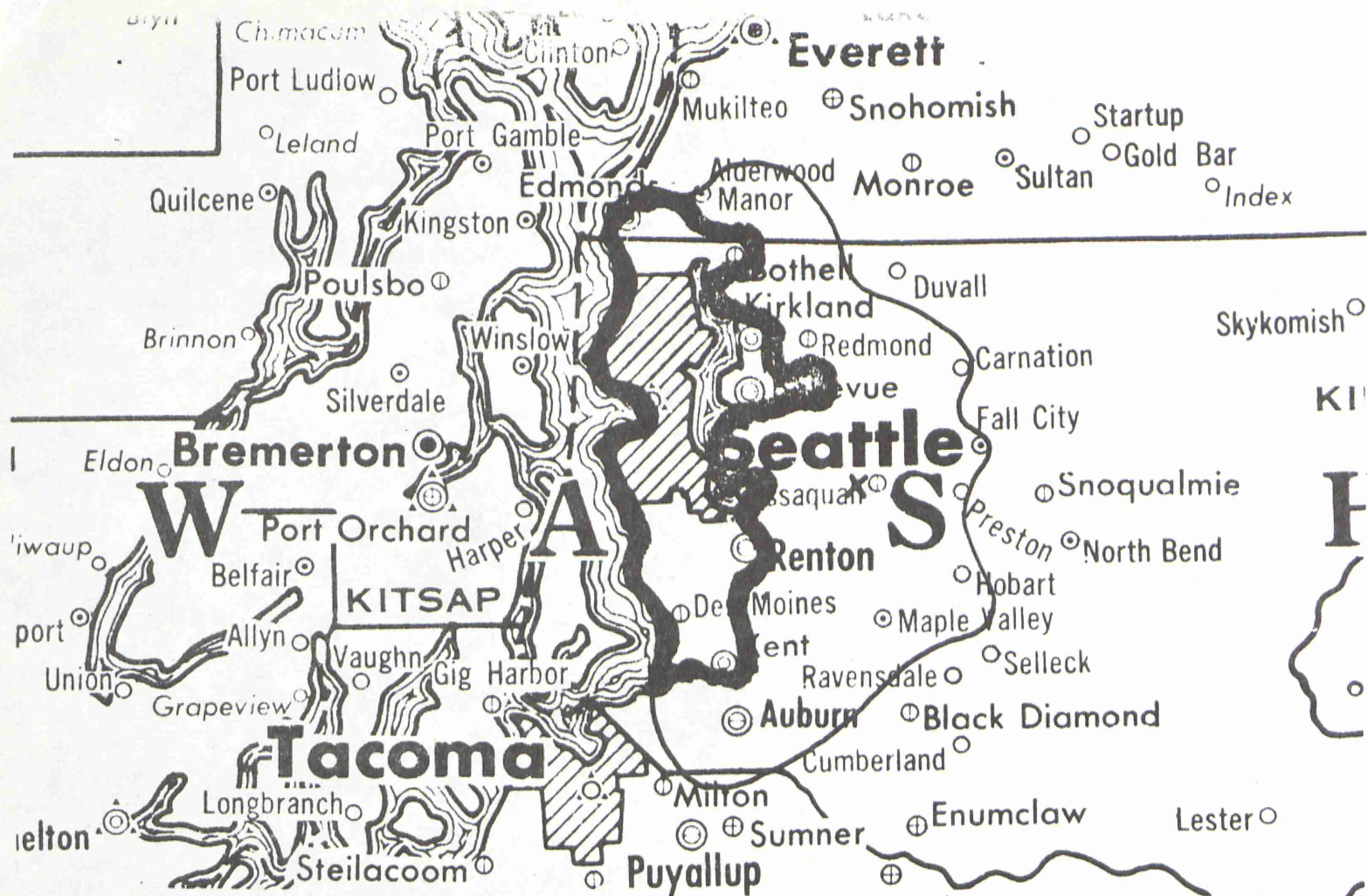
B-5  
HEATH LIGHTING CO., 3810 STONE WAY NO., SEATTLE, WASHINGTON (28 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





B-7

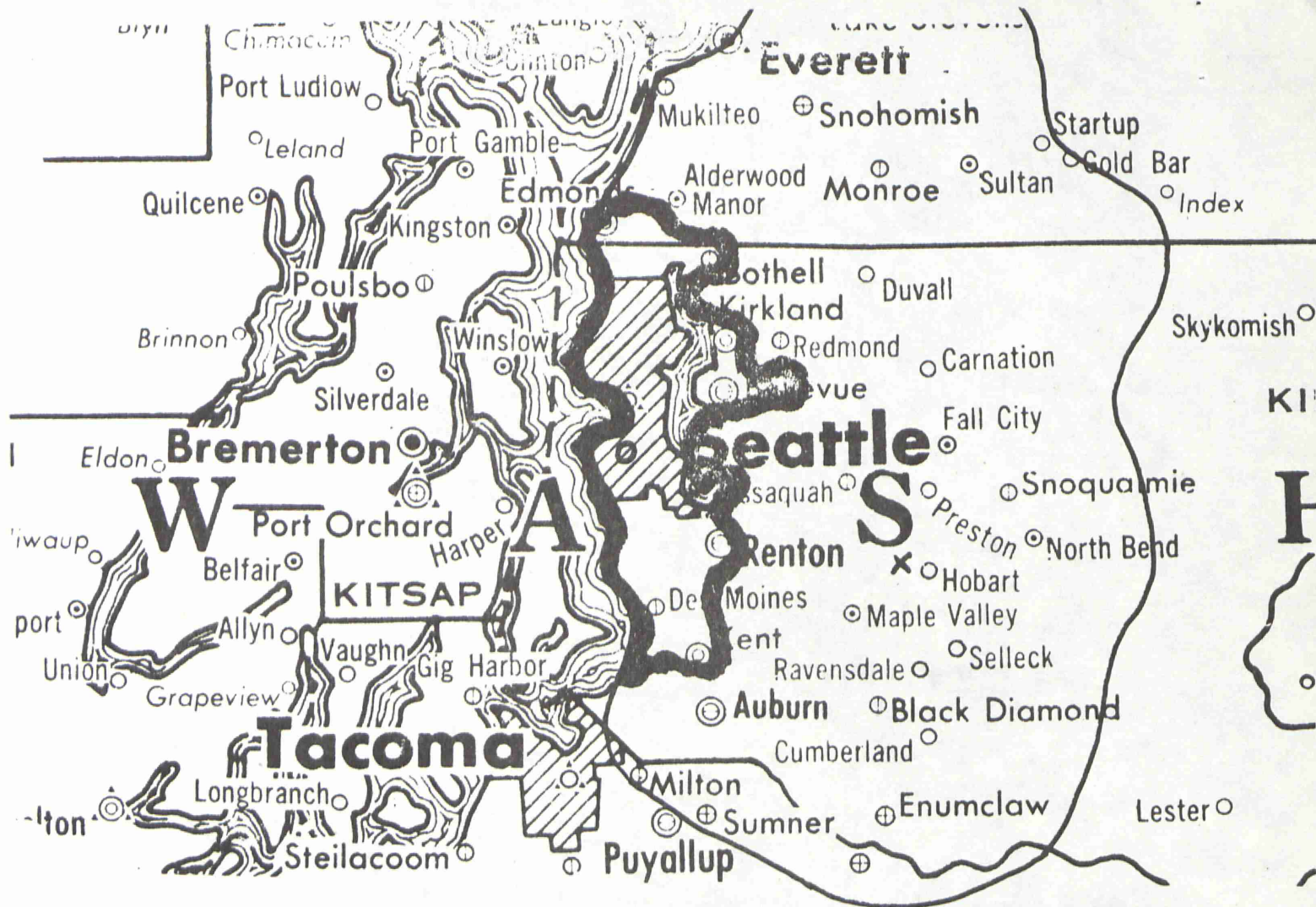
RALPH'S CONCRETE PUMPING, 7453 W. MERCER WAY., MERCER ISLAND, WASH. (22 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





B-8

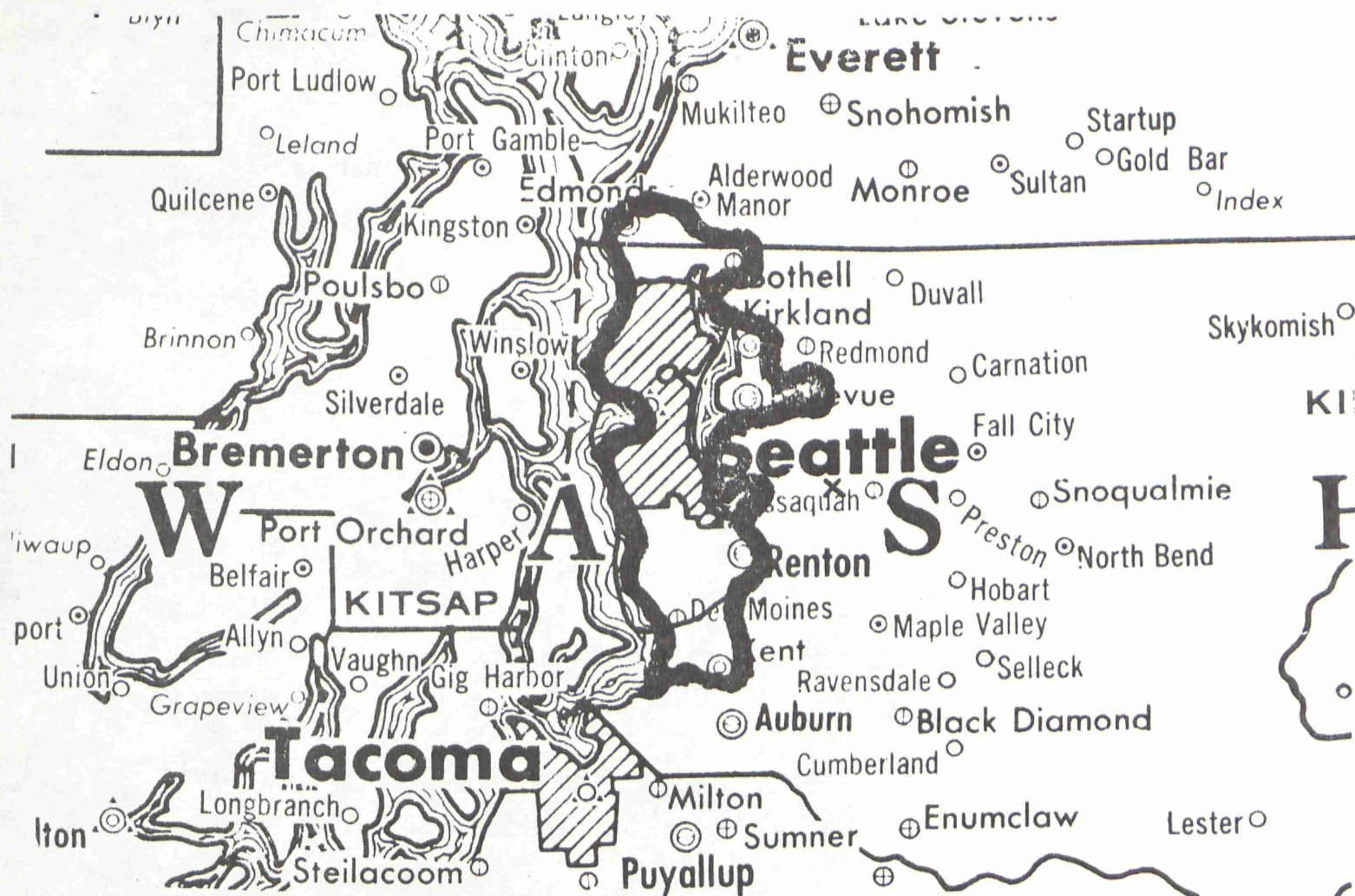
KENNEL ENTERPRISES, INC., 3534 BAGLEY, SEATTLE, WASH. (38 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





B - 9

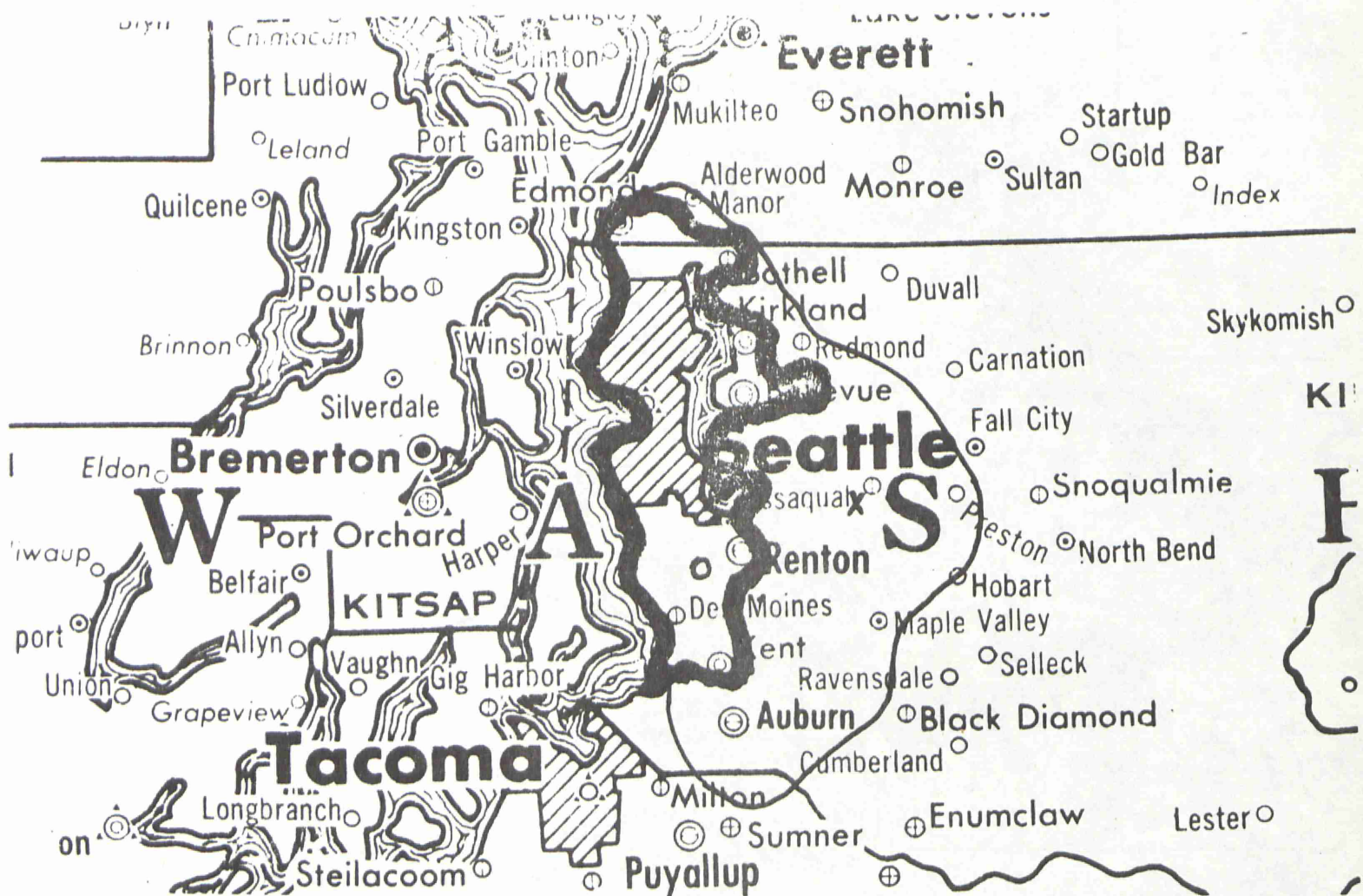
WASHINGTON NATIONAL DISPOSAL, 101 NICKERSON, SEATTLE, WASHINGTON (19 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





B - 10

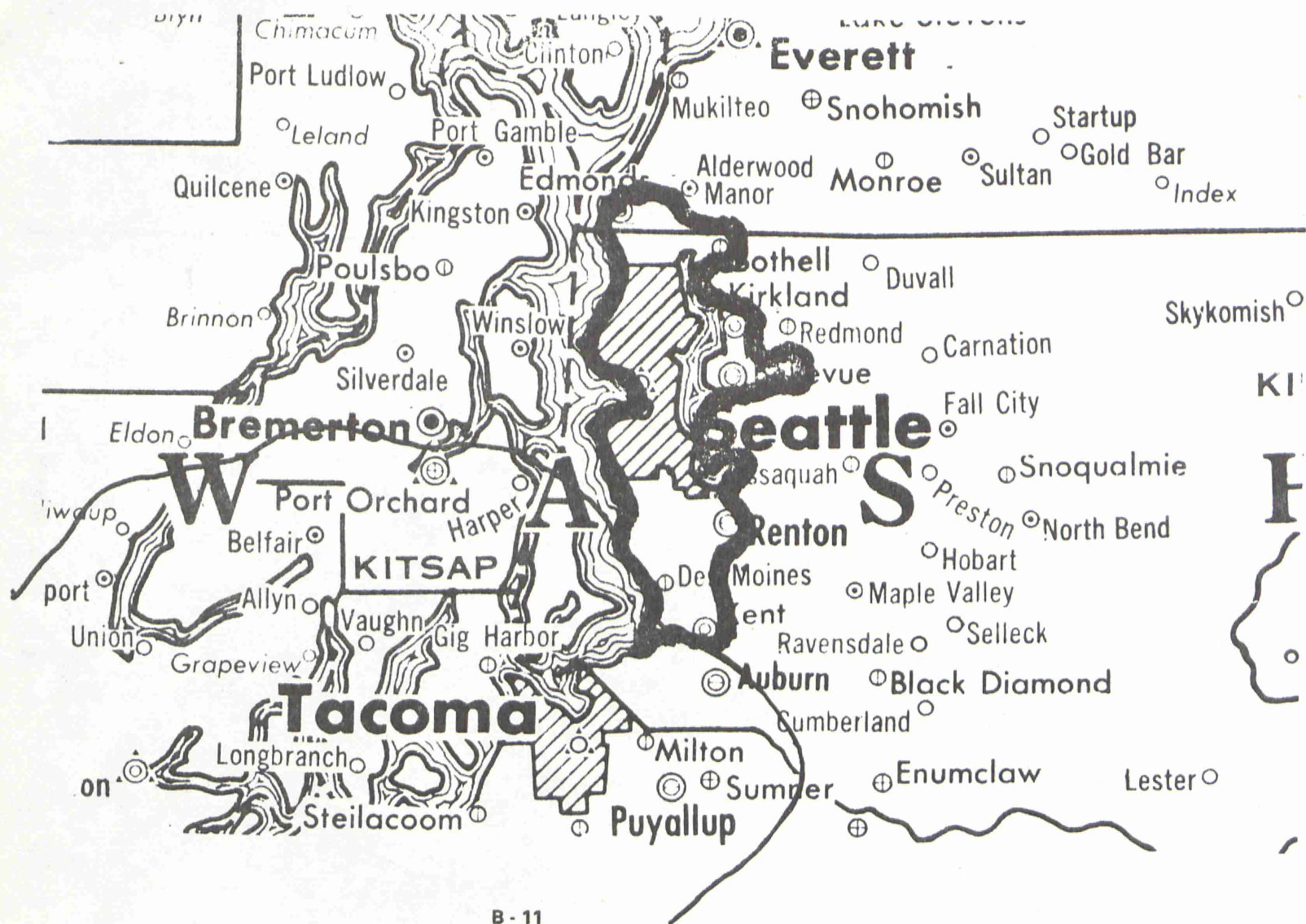
PALMER SUPPLY, 250 ANDOVER PARK W., TUKWILA, WASHINGTON (25 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





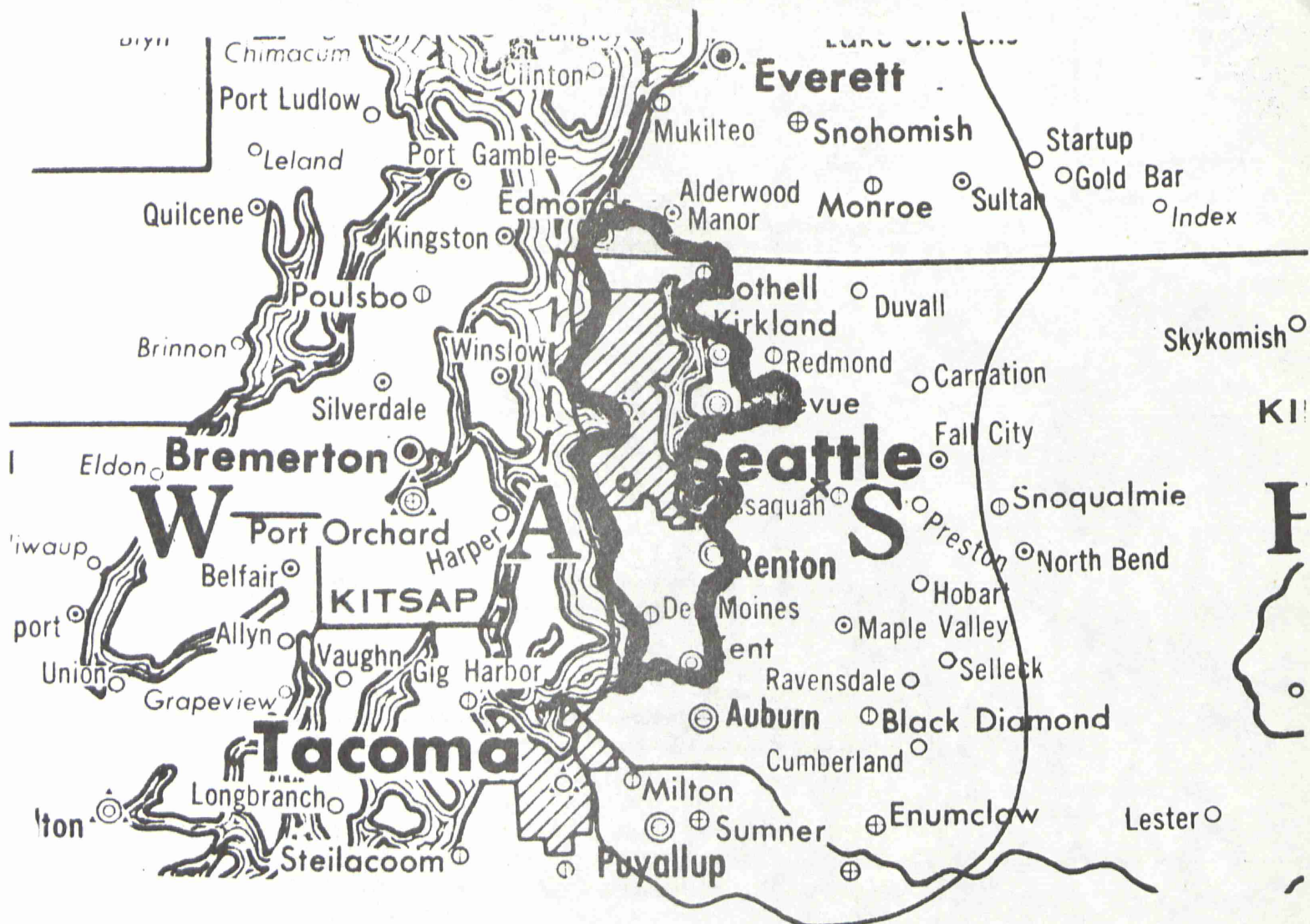
X \*CAPITAL PEAK  
B - 11  
SPOON AUTOMOTIVE, 1024 6 TH SO., SEATTLE, WASHINGTON (52 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





B - 12

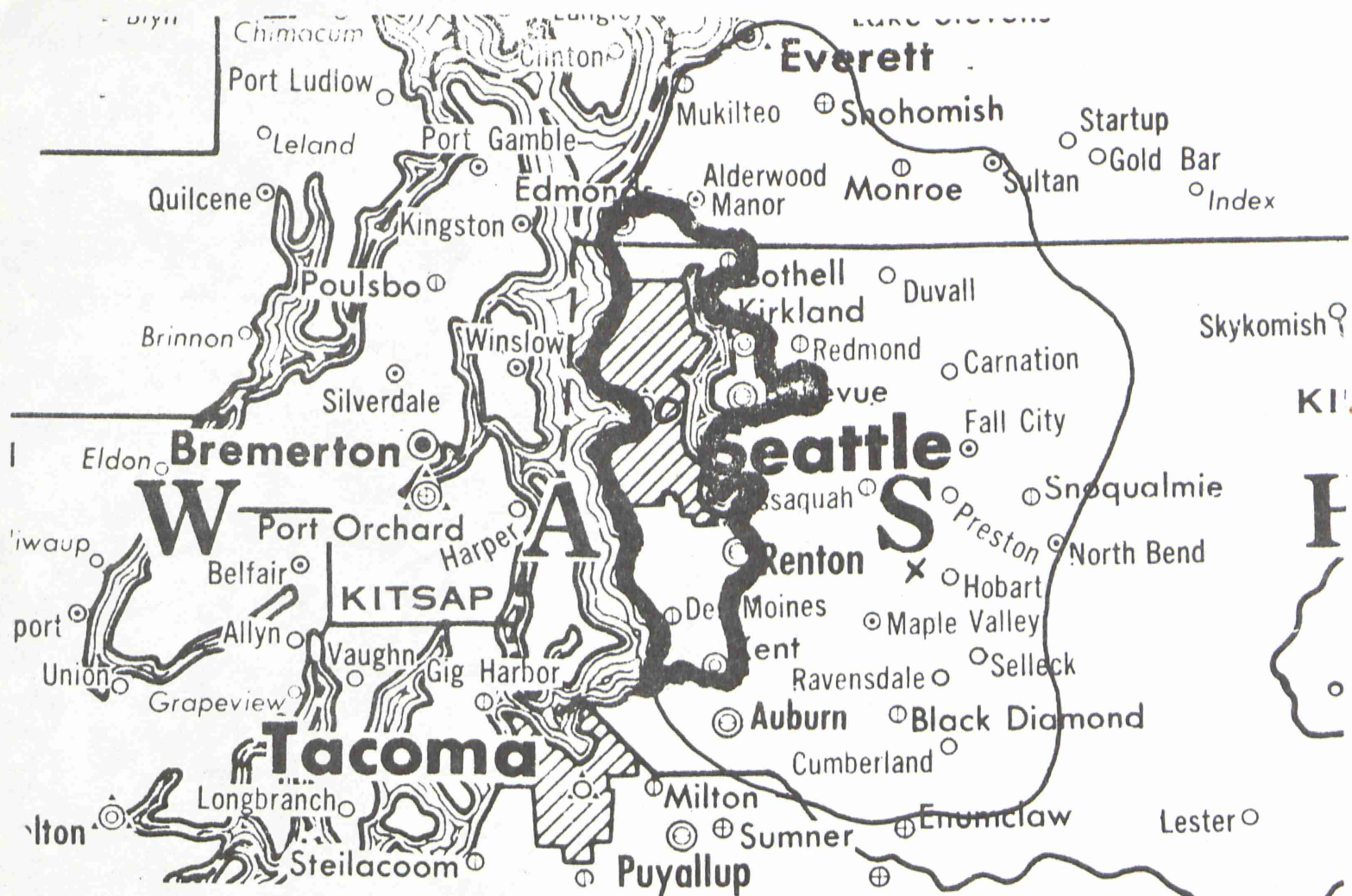
SCARSCILLA BROS., 2207 S. 146TH, SEATTLE, WASHINGTON (33 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





B - 13

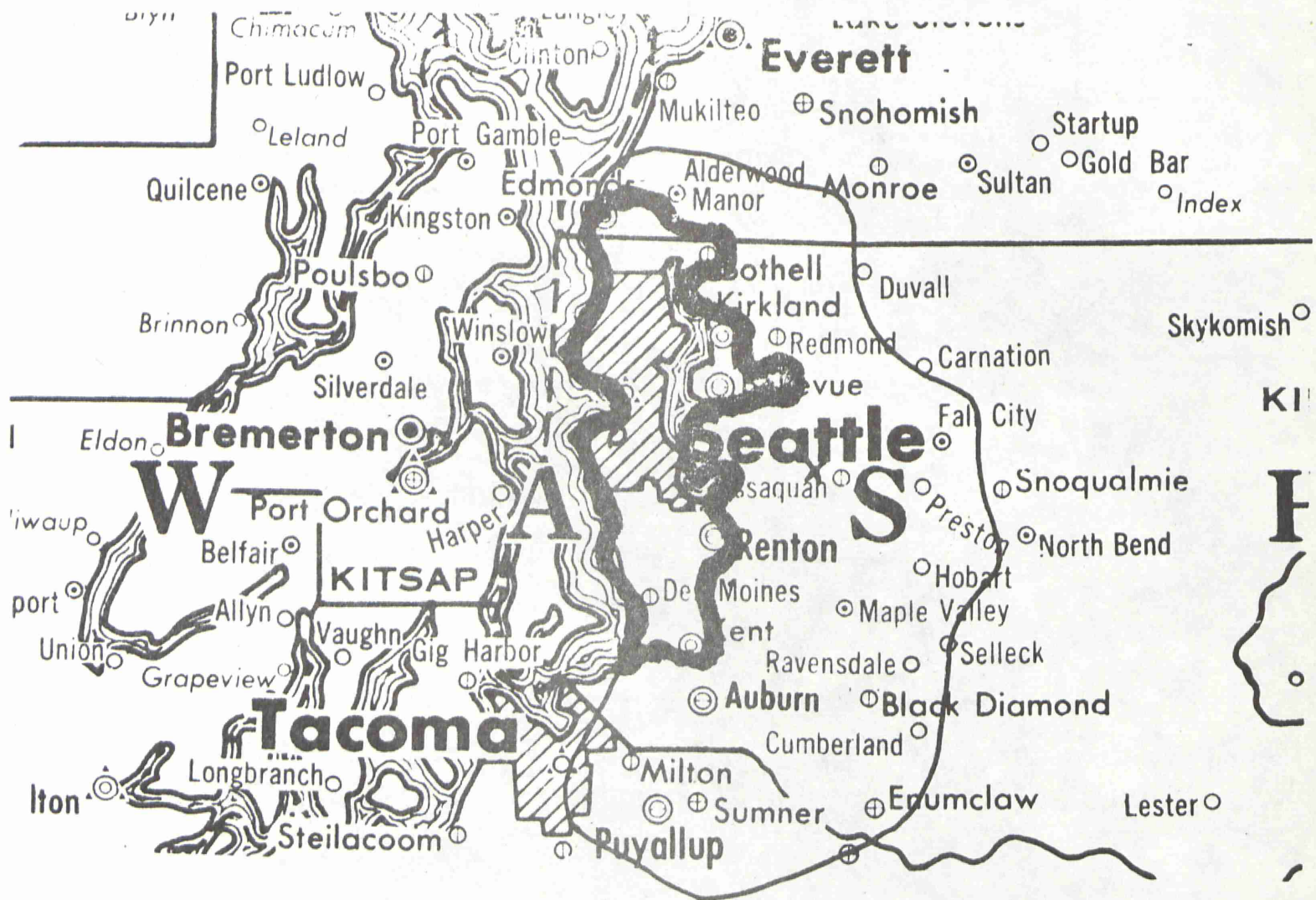
PIONEER SNAD & GRAVEL, 901 FAIRVIEW AVENUE N., SEATTLE, WASH. (37 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





B - 14

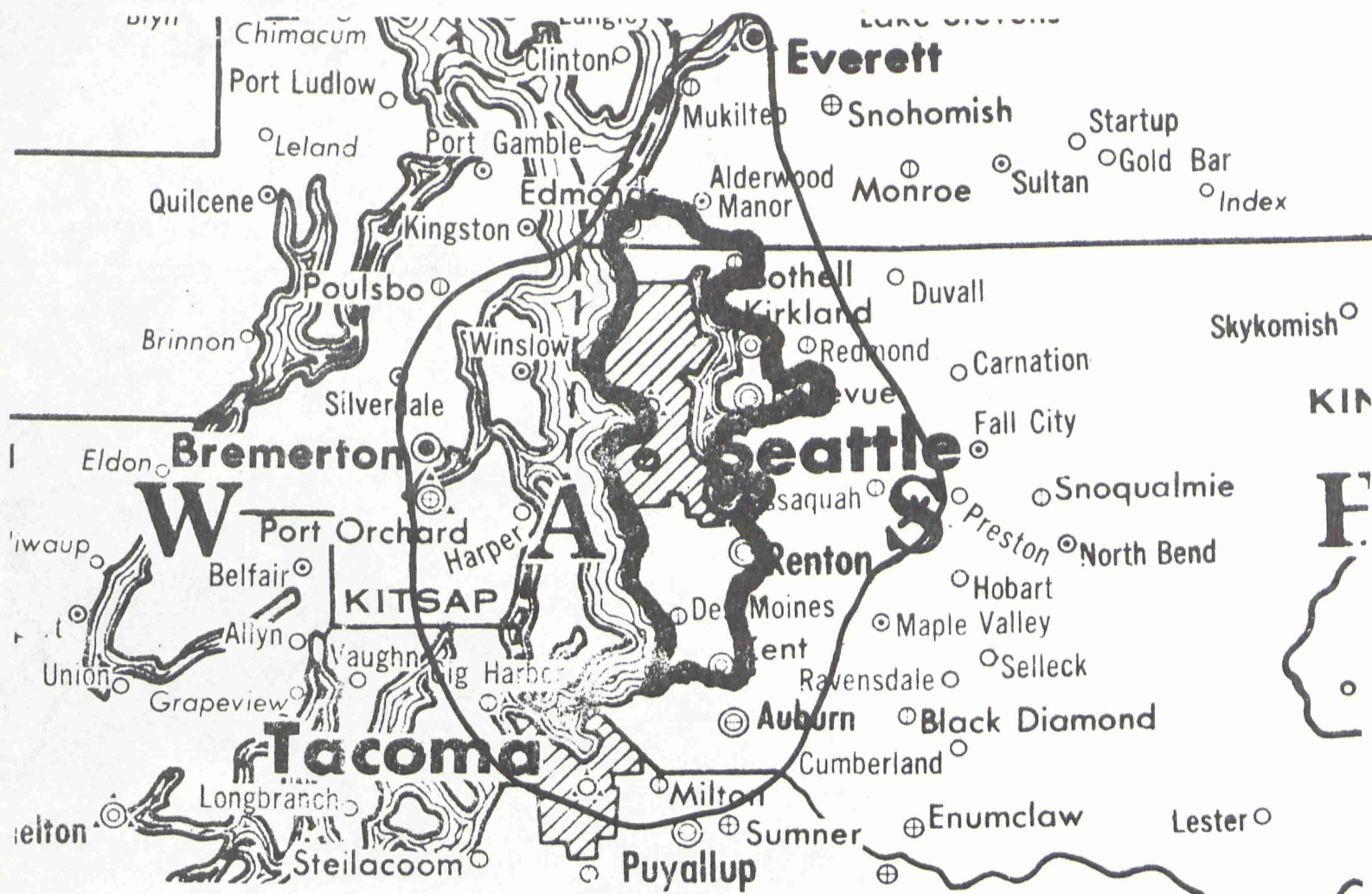
GLACIER SAND & GRAVEL, 5975 E. MARGINAL WAY, SO., SEATTLE, WASH. (31 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





B - 15

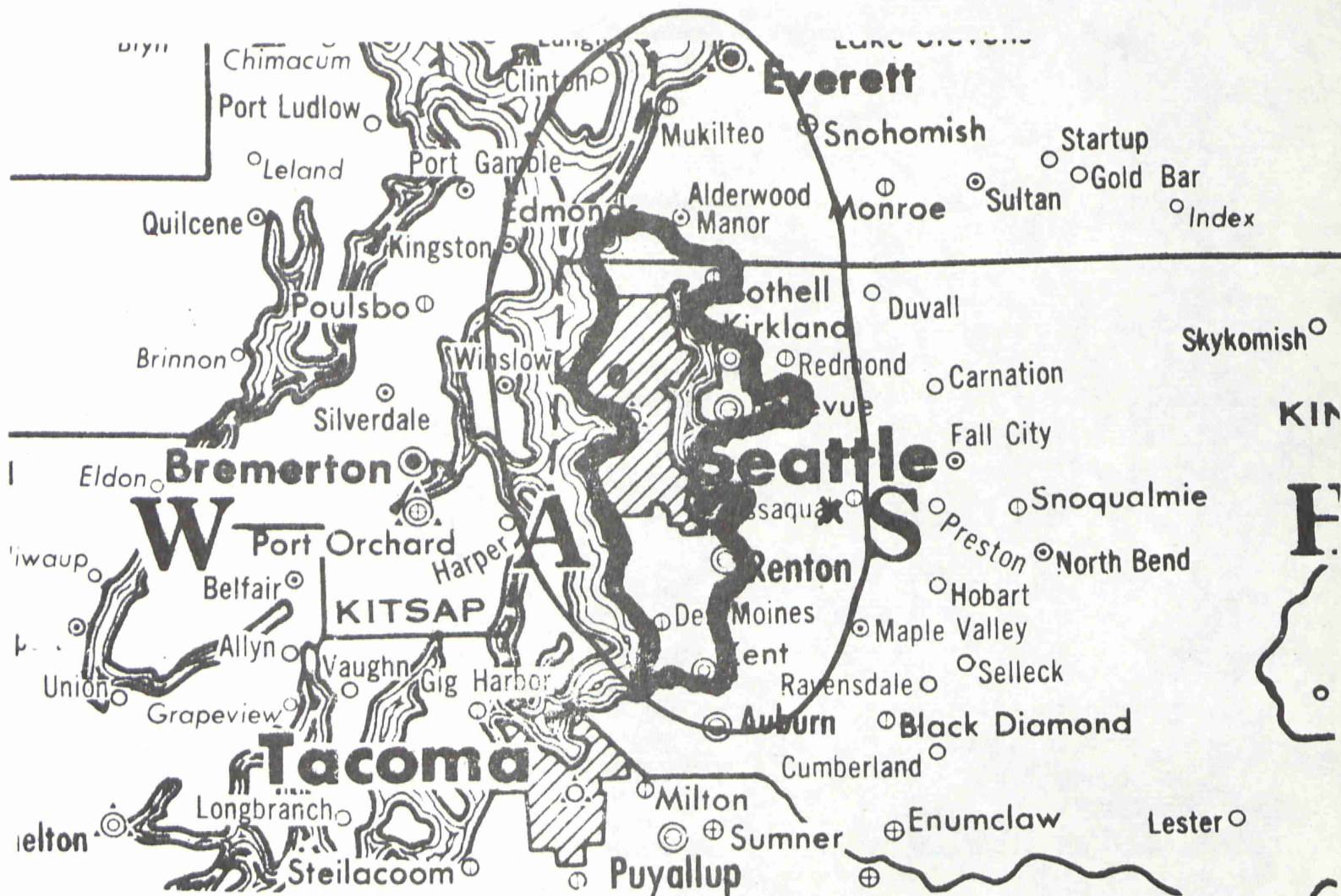
SAWDUST SUPPLY CO., 1045 S. W. SPOKANE, SEATTLE, WASHINGTON (35 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





B - 16

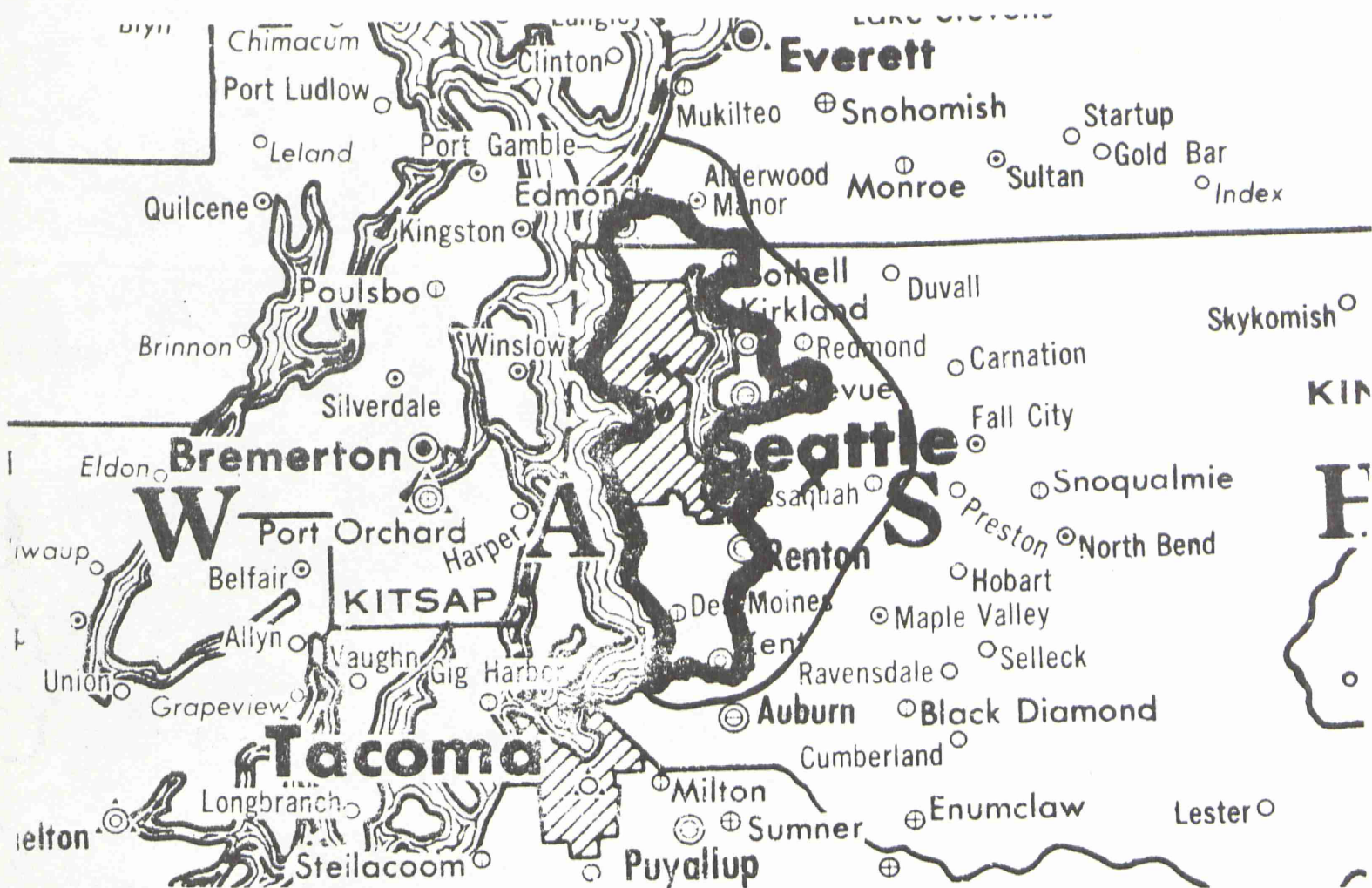
EMMANUELS, INC., 7601 GREENWOOD NO., SEATTLE, WASHINGTON (35 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





A - 3/B - 17

YELLOW CAB SERVICE, 1916 TERRY, SEATTLE, WASHINGTON (18 MILES)

# SEATTLE

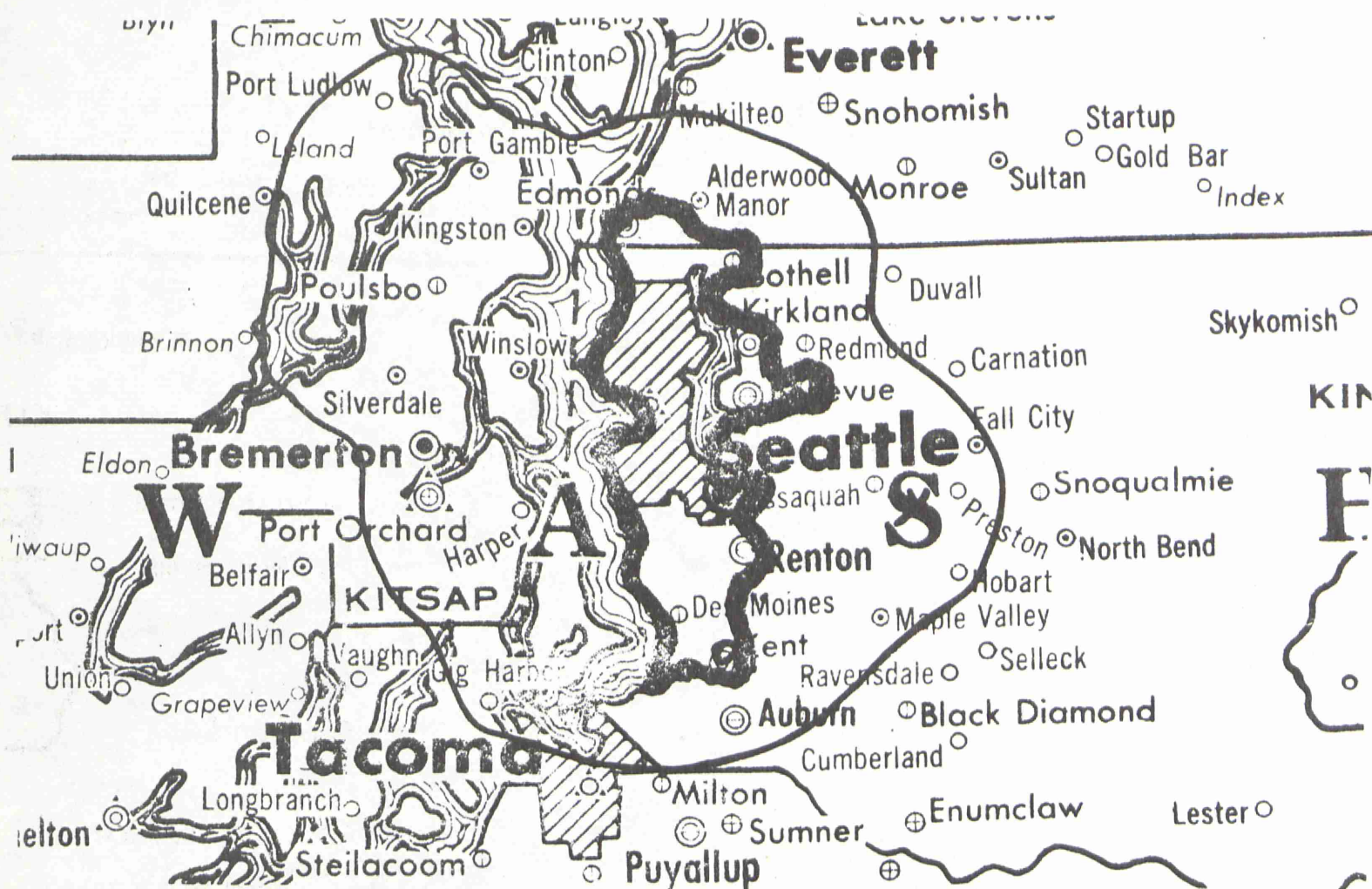


Copyright, American Map Co., Inc. No. 17501-A









B - 19

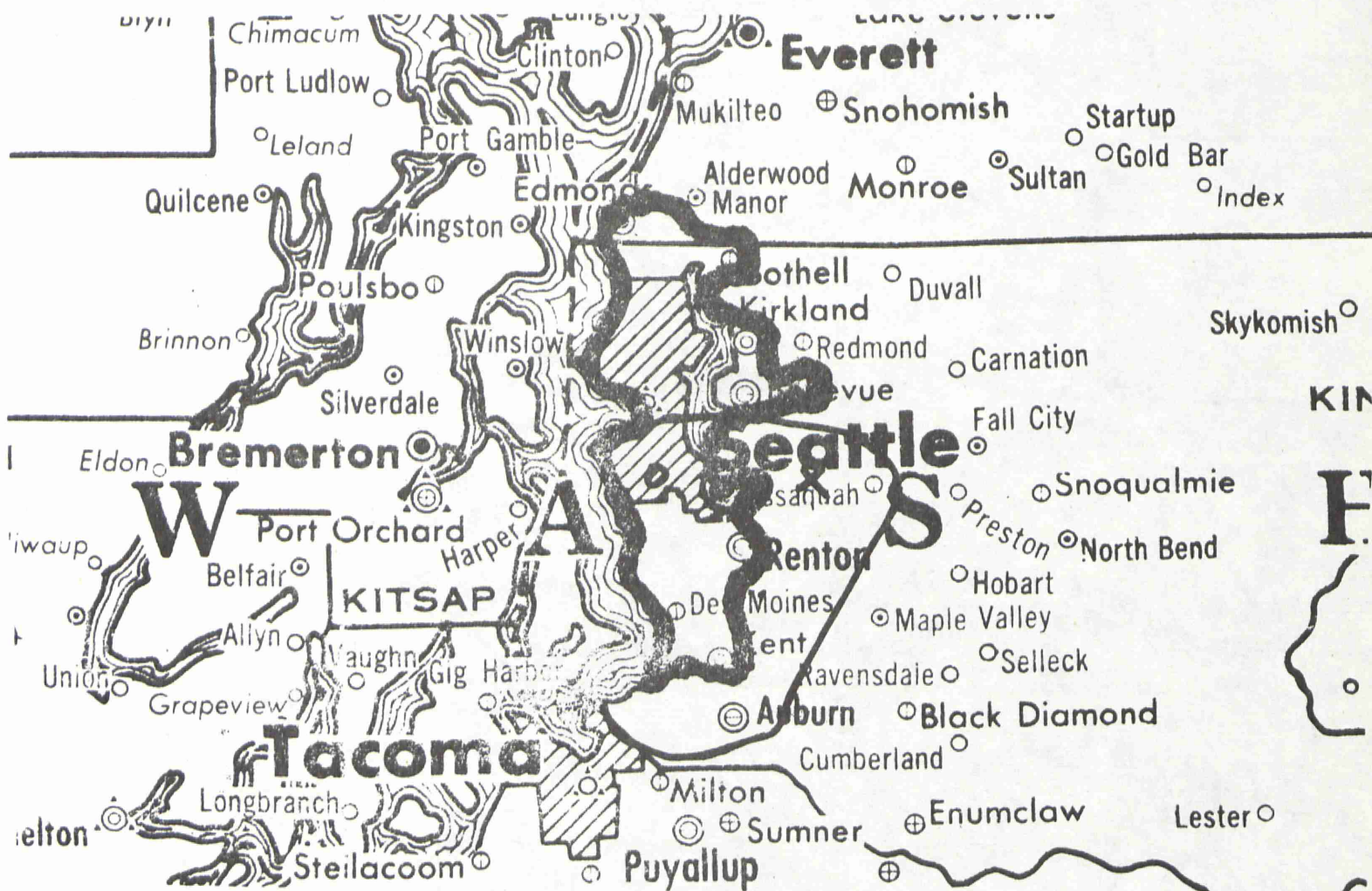
CATALINA HOMES, 201 SO. DIVISION AVENUE, KENT, WASHINGTON (48 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





B - 20

BAYSIDE HAULING, 2750 16TH S.W., SEATTLE, WASH. (21 MILES)

# SEATTLE

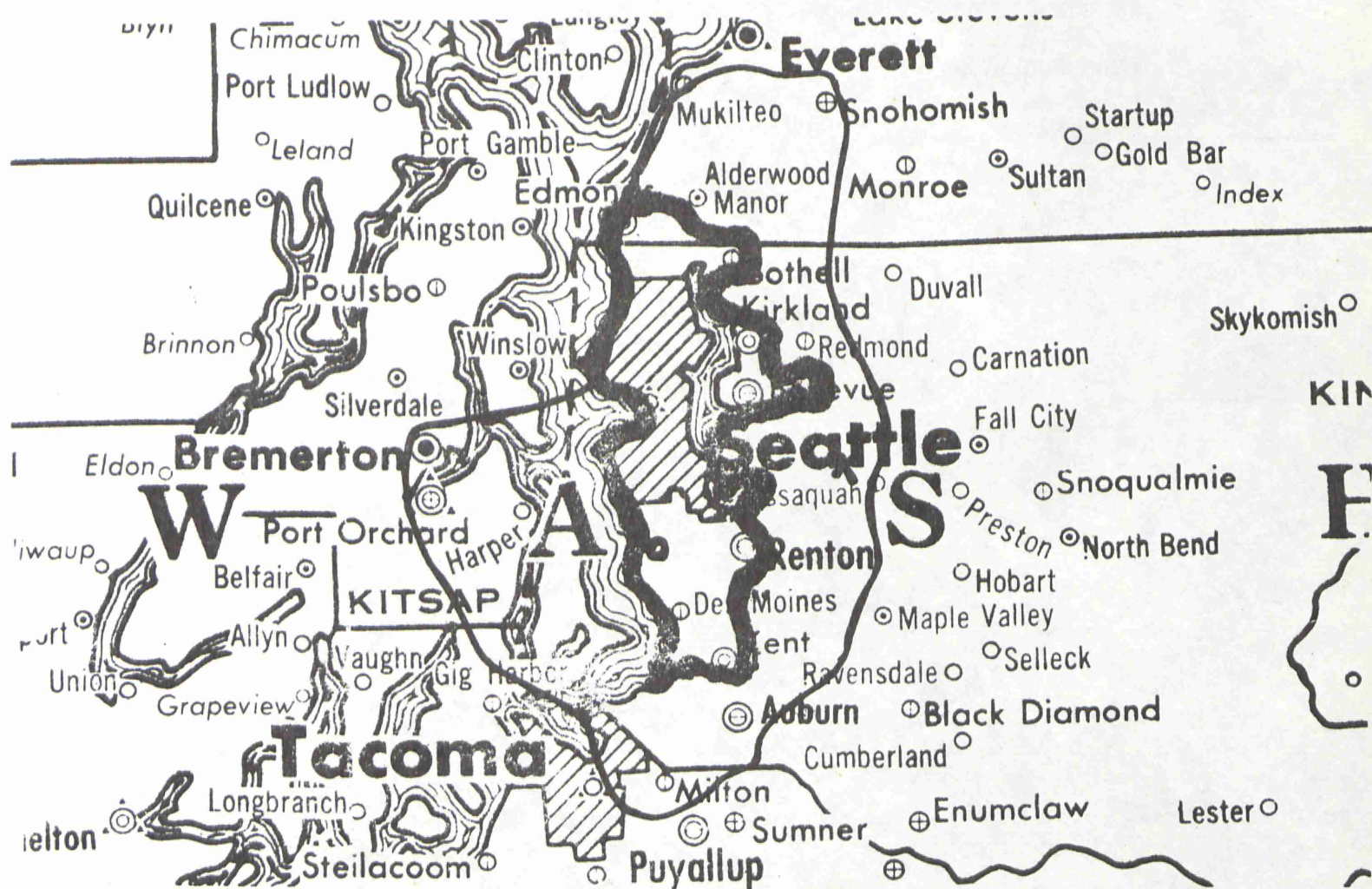


Copyright, American Map Co., Inc. No. 17501-A









B - 22

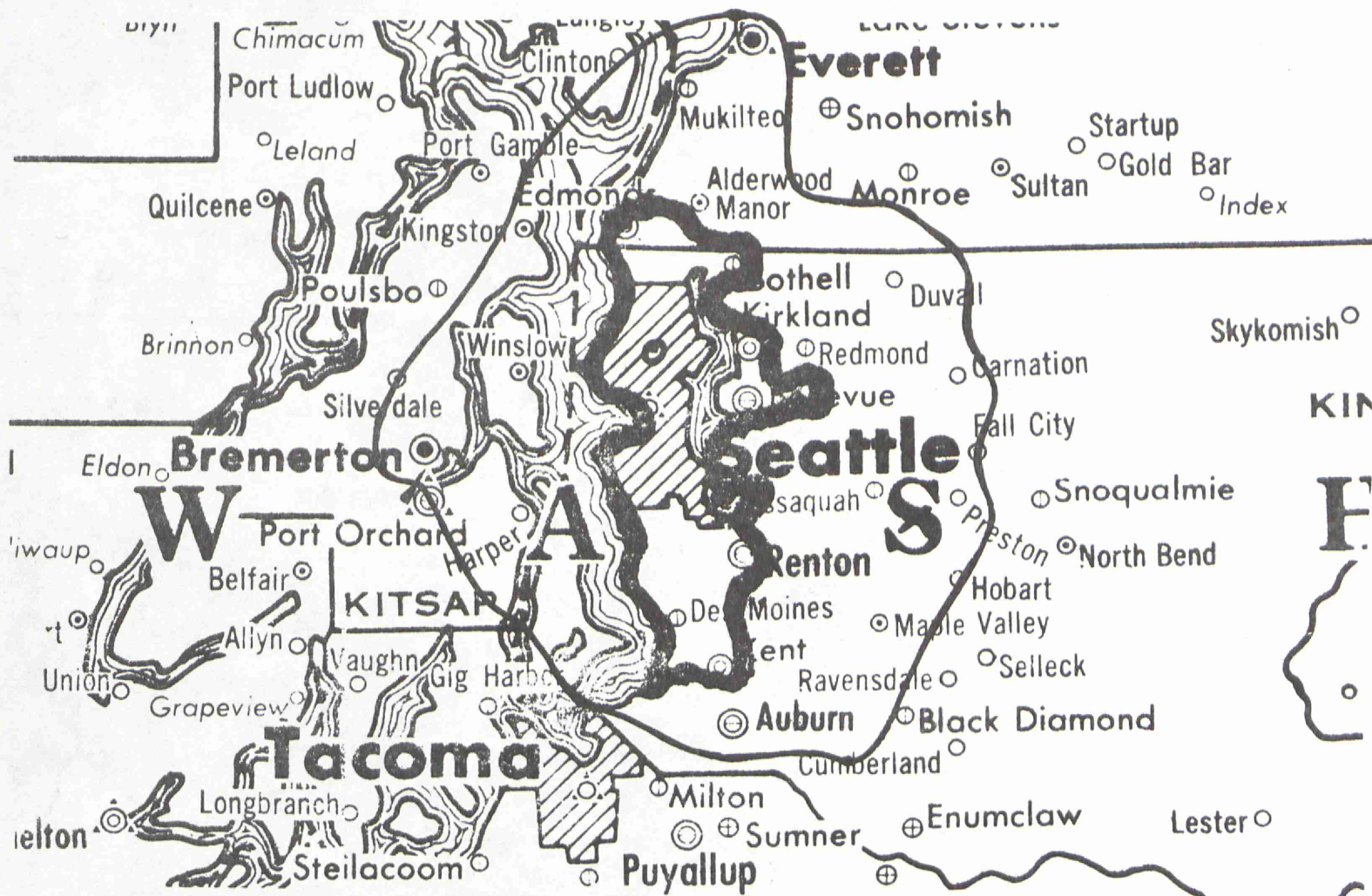
MOBILE COMMUNICATIONS, 15639 PACIFIC HIGHWAY SO., SEATTLE, WASHINGTON (29 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





B - 23

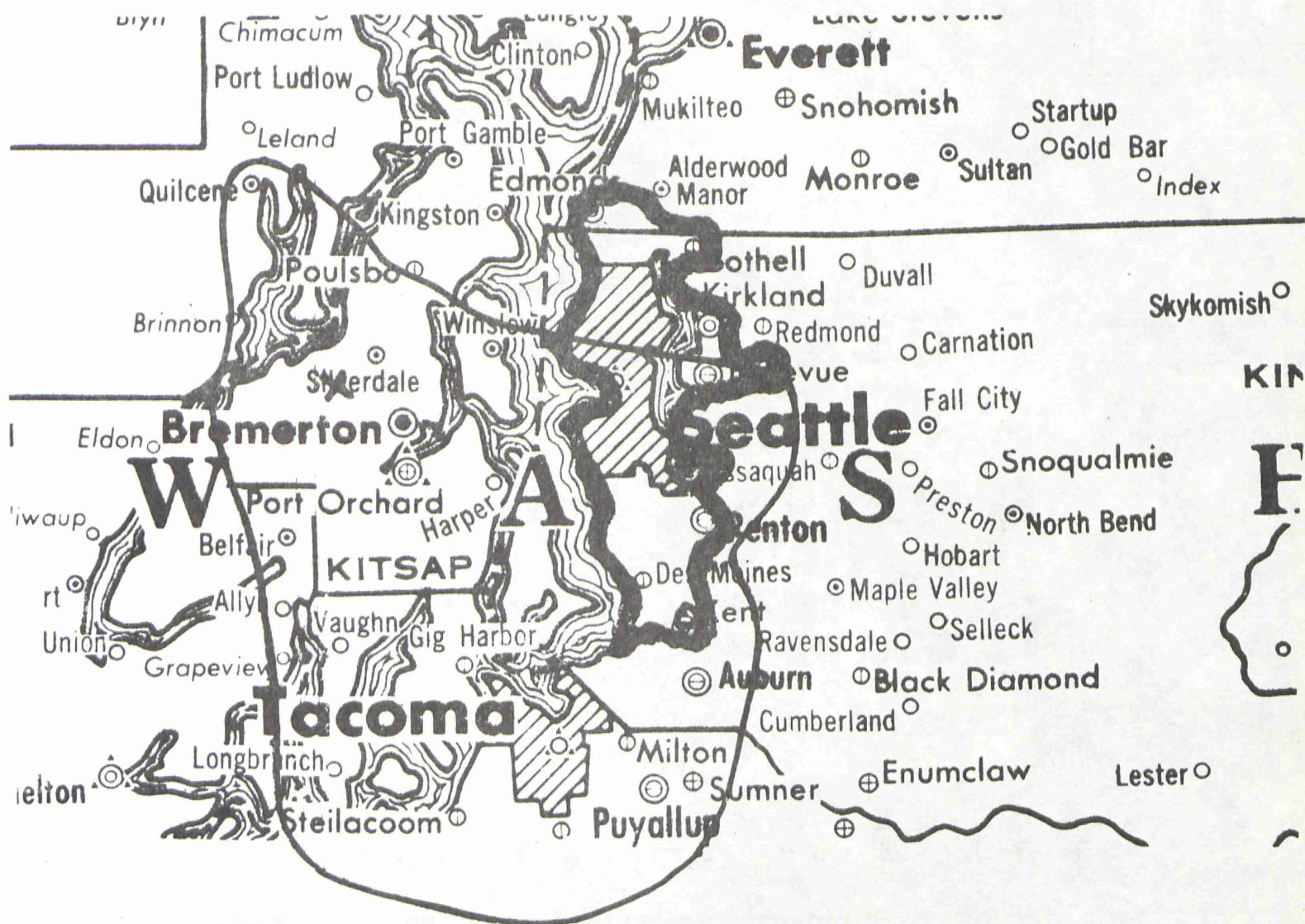
NORTHWEST CONST., 3950 6TH, N. W., SEATTLE, WASHINGTON (37 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





B - 24

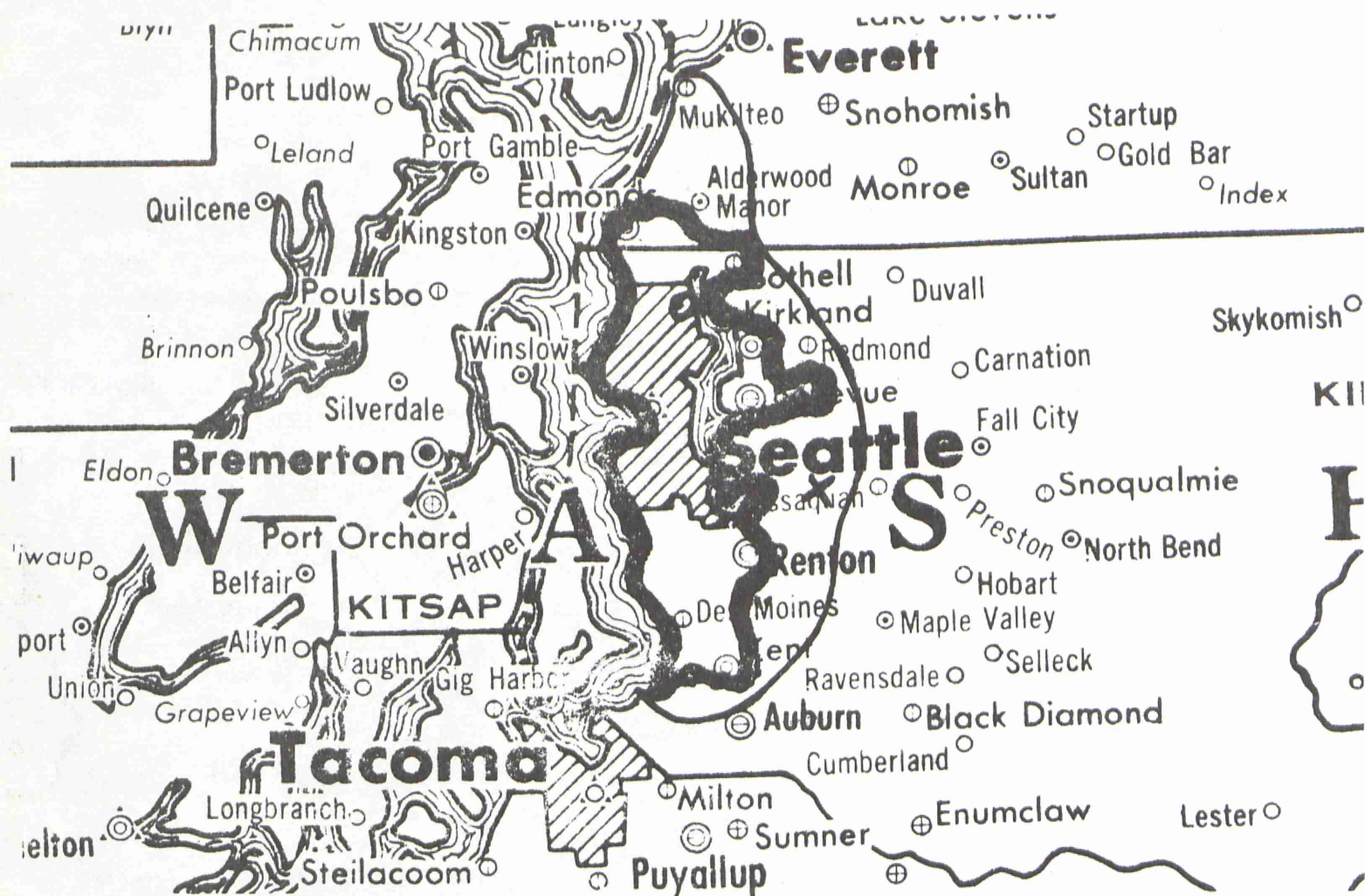
AMERICAN AUTO PARTS, 113 S. CENTRAL, KENT, WASHINGTON (42 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





B - 25

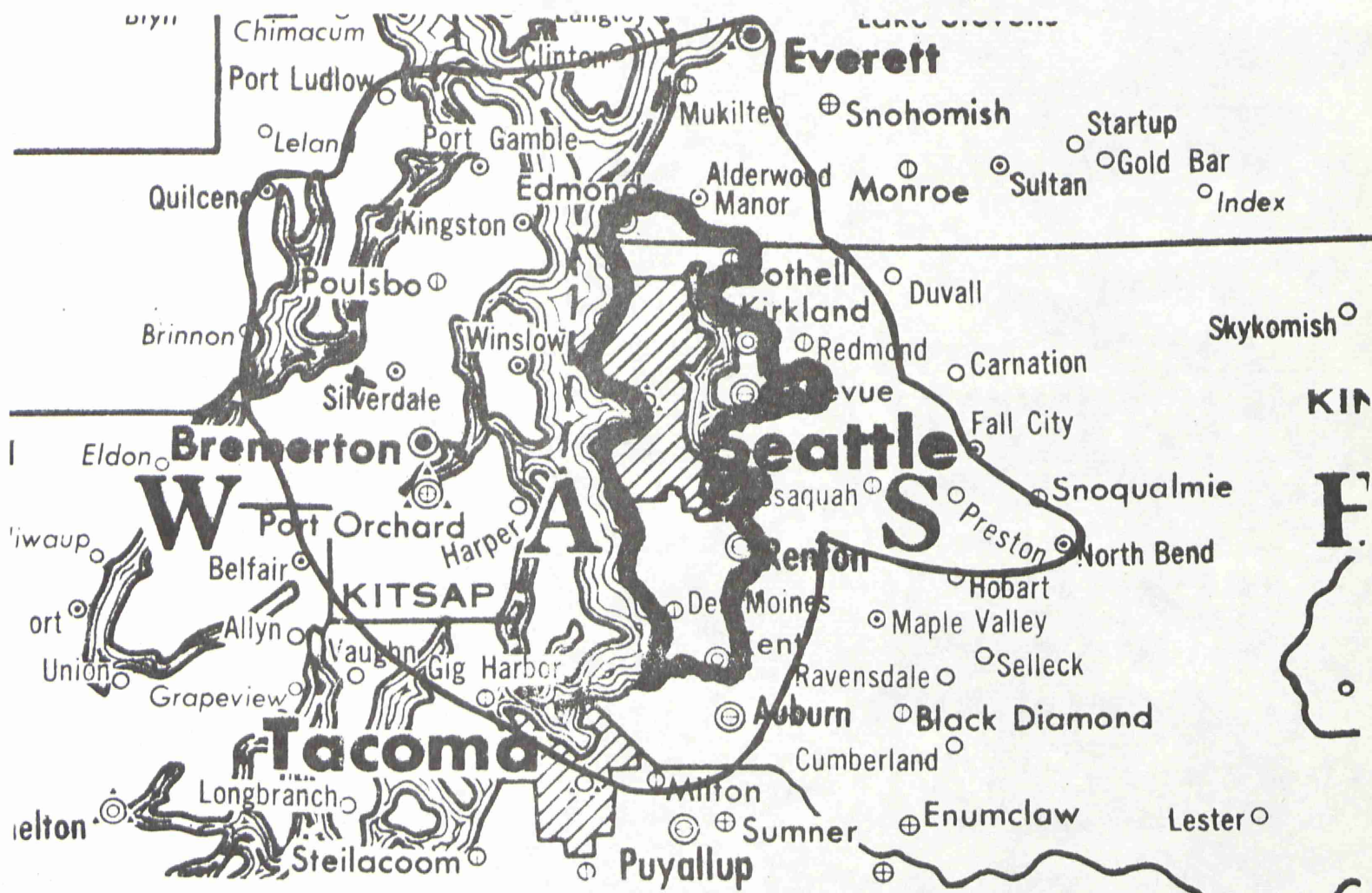
YOUELL OIL CO., 2155 N. NORTHLAKE WAY, SEATTLE, WASHINGTON (29 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





B - 26

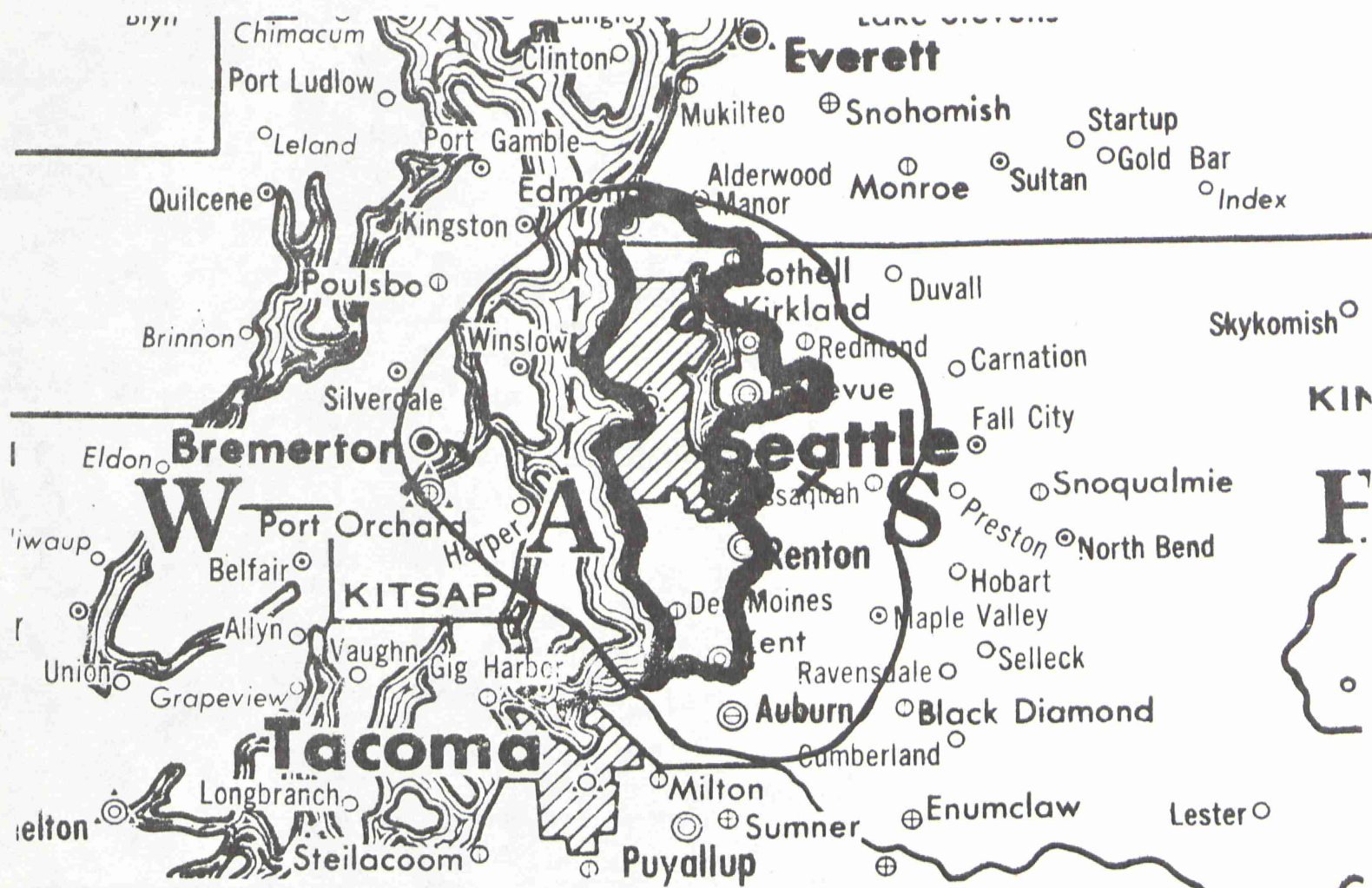
CONCRETE CONST. CO., 1407 179TH PINE, BELLEVUE, WASHINGTON (48 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





B - 27

WASHINGTON ASPHALT CO., 309 N. W. 39TH, SEATTLE, WASHINGTON (28 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





B - 28

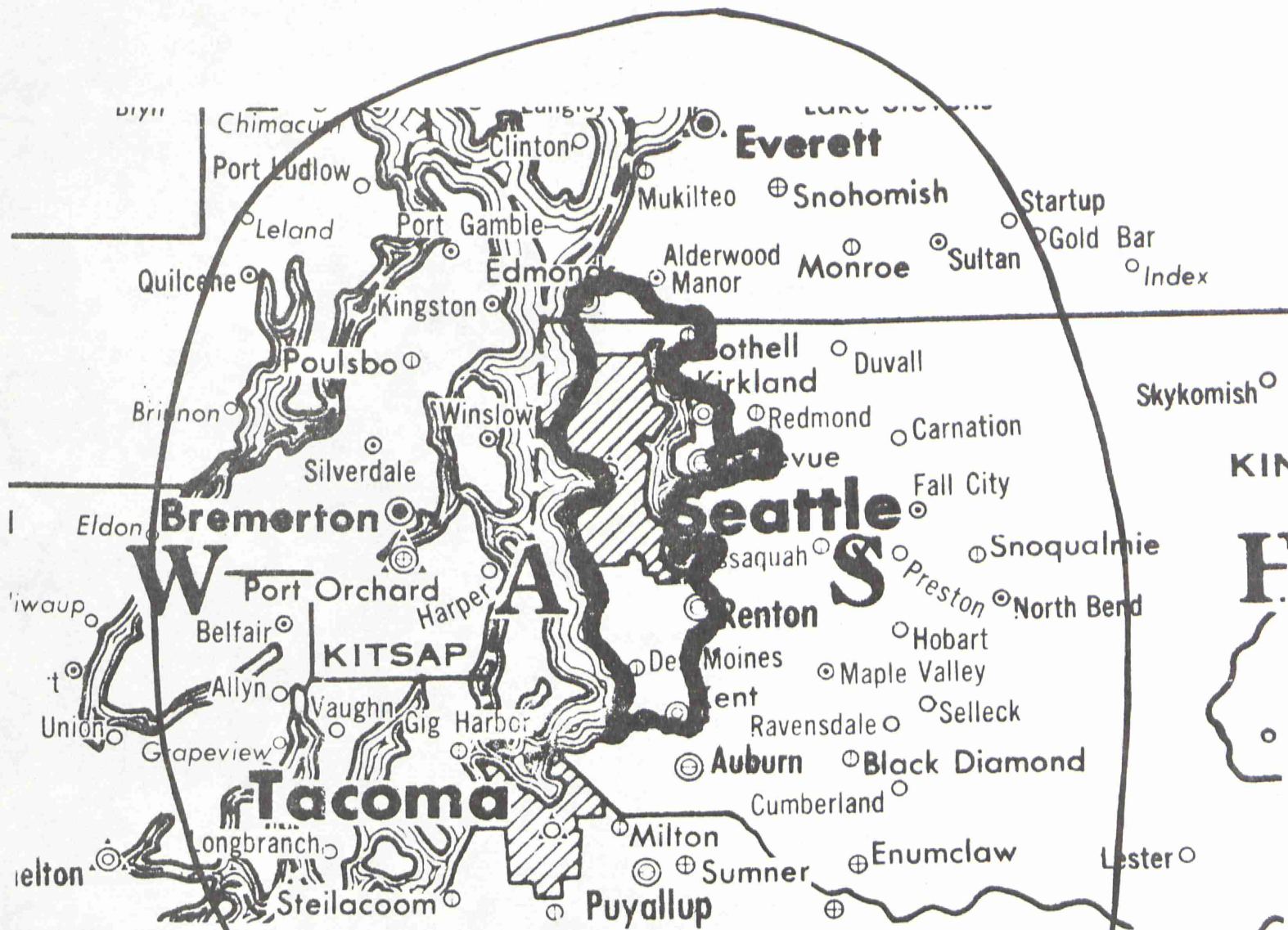
SUPERIOR, INC., 3450 16TH W., SEATTLE, WASHINGTON (48 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





B - 29

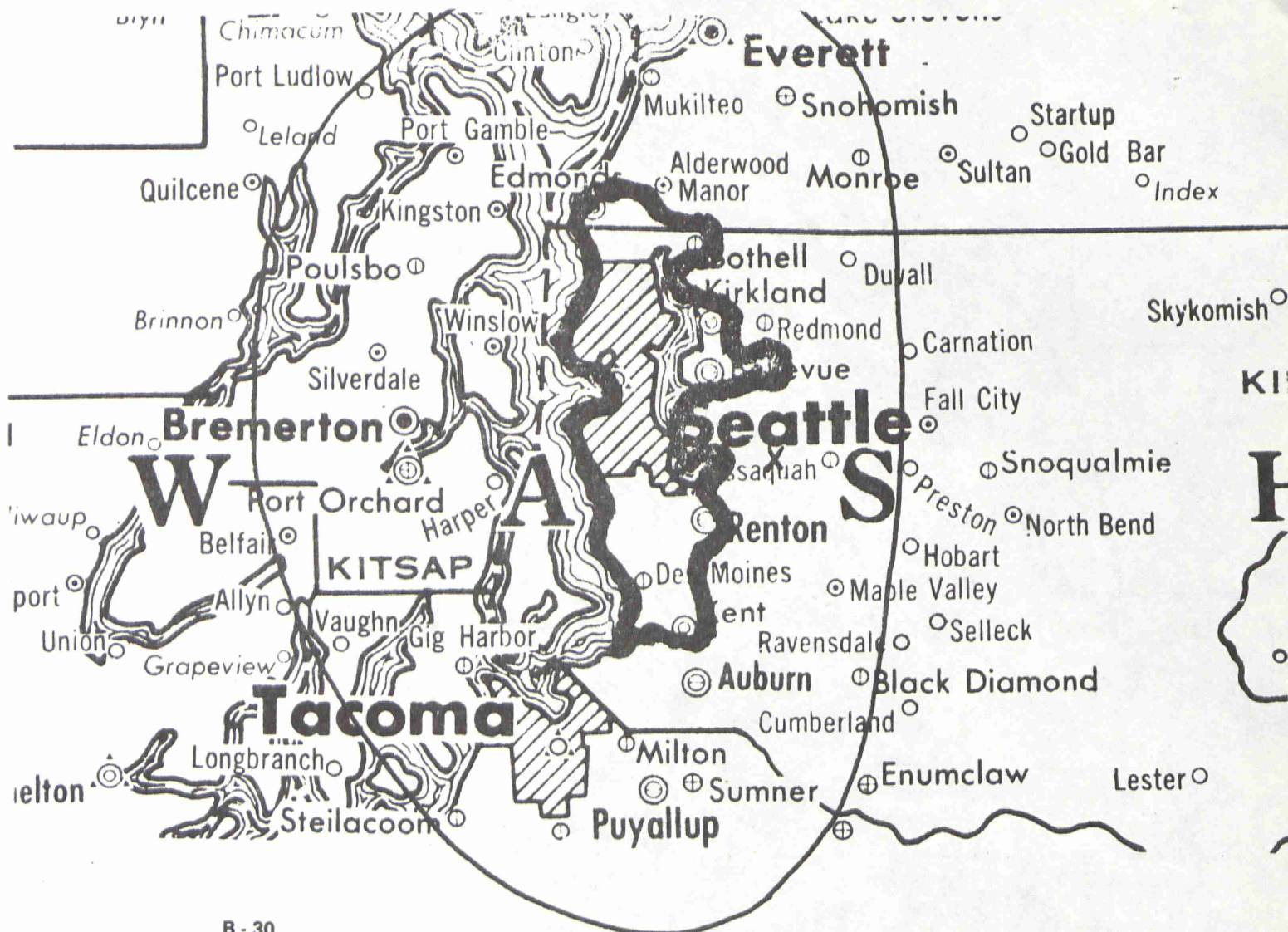
BELL & VALDEZ, 818 156TH N. E., BELLEVUE, WASH. (52 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





B - 30

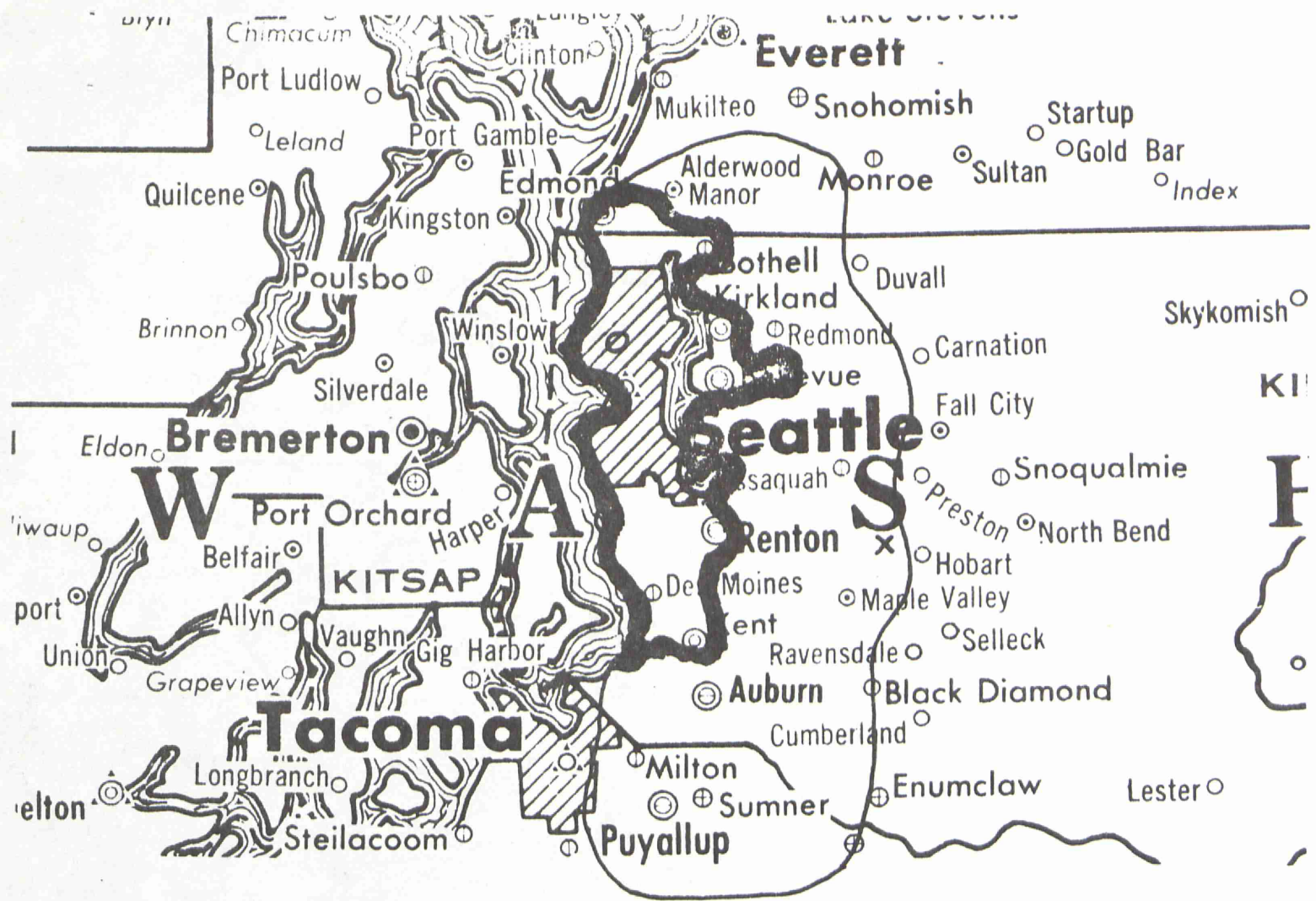
CENTURY SEAHURST, 3910 LEARY WAY N. W., SEATTLE, WASHINGTON (38 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





B - 31

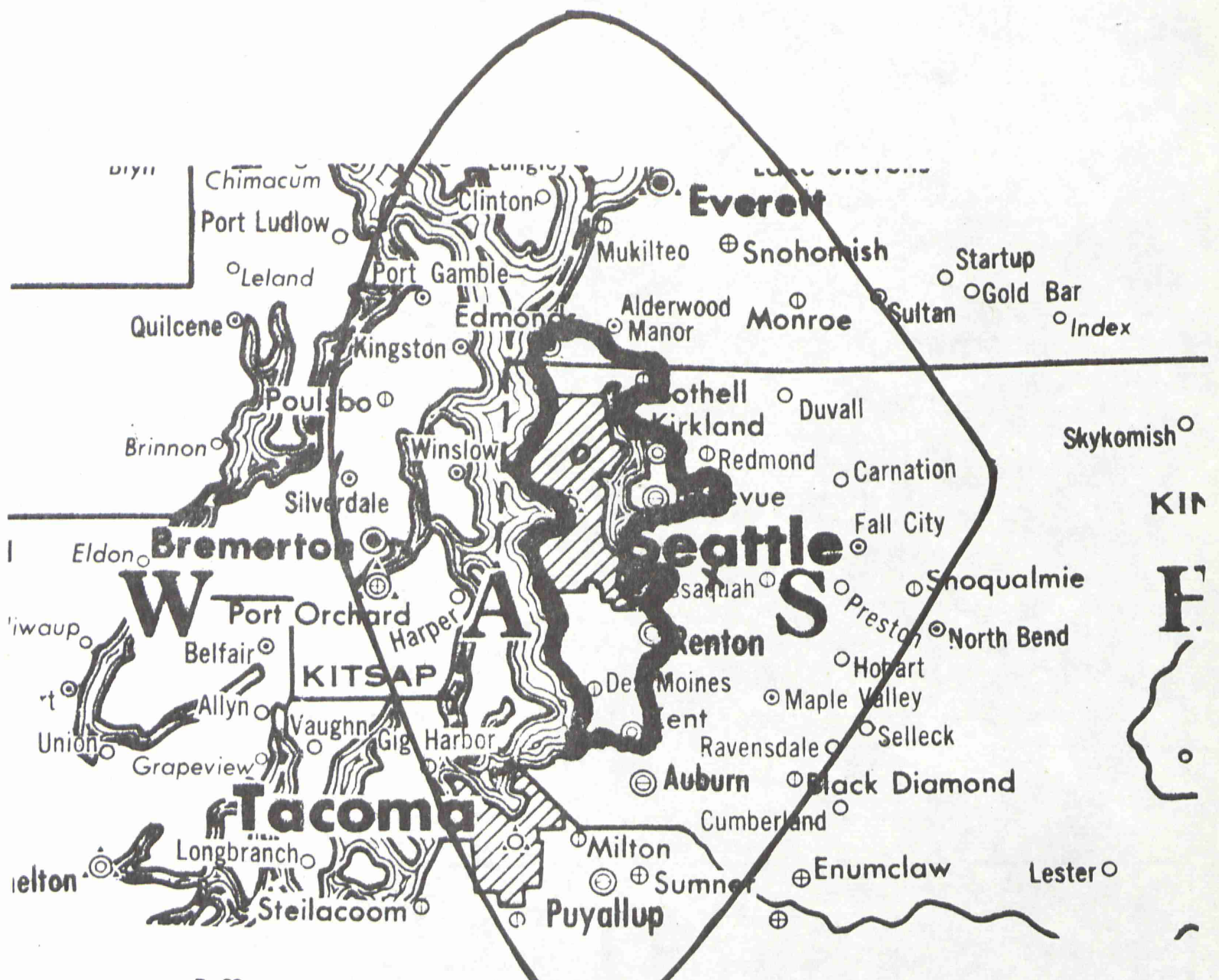
METERED WASHER, 7601 GREENWOOD N., SEATTLE, WASHINGTON (30 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





B - 32

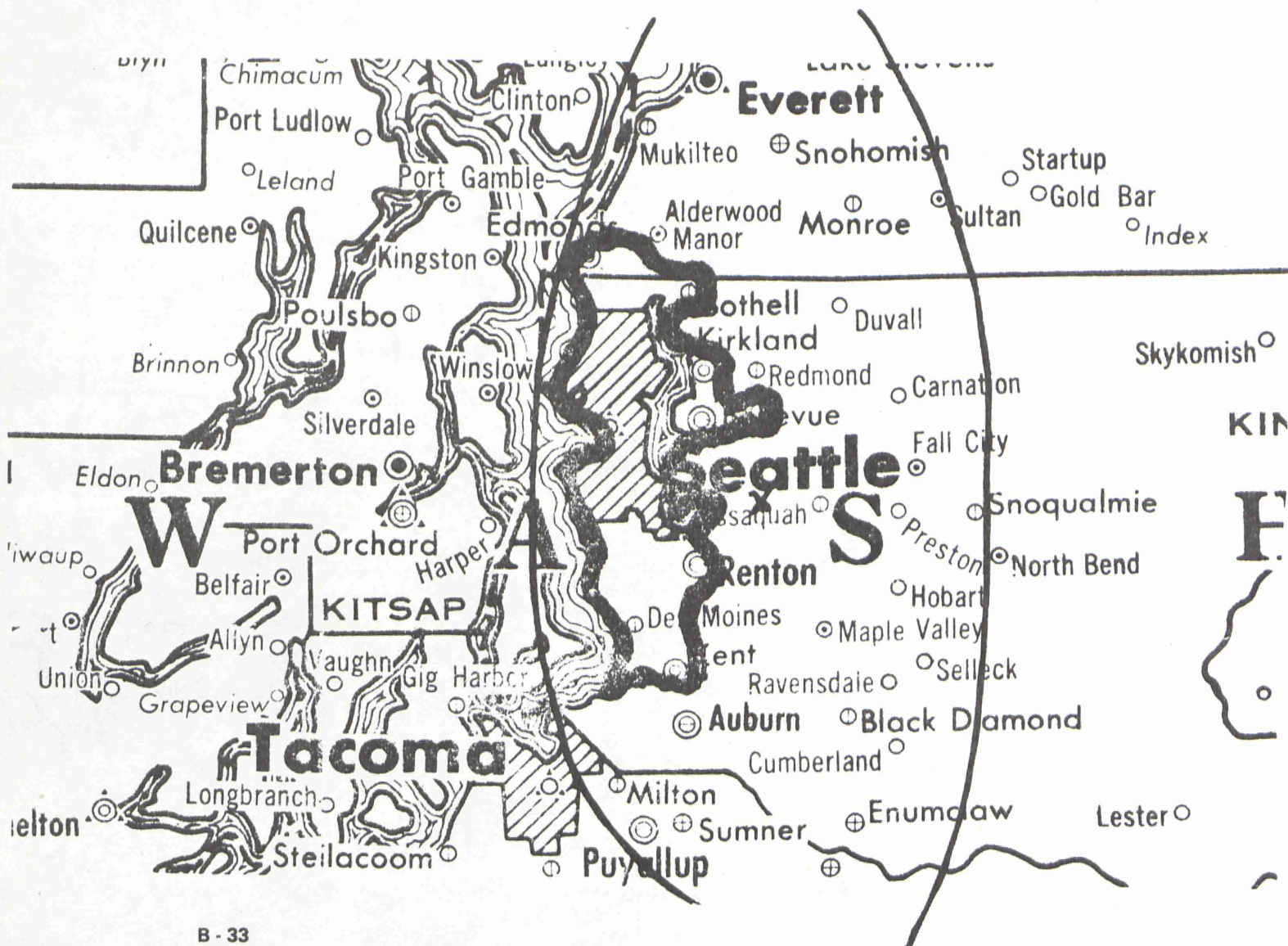
NORTHWEST AUTOMOTIVE, 421 EAST LAKE E., SEATTLE, WASH. (38 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





B - 33

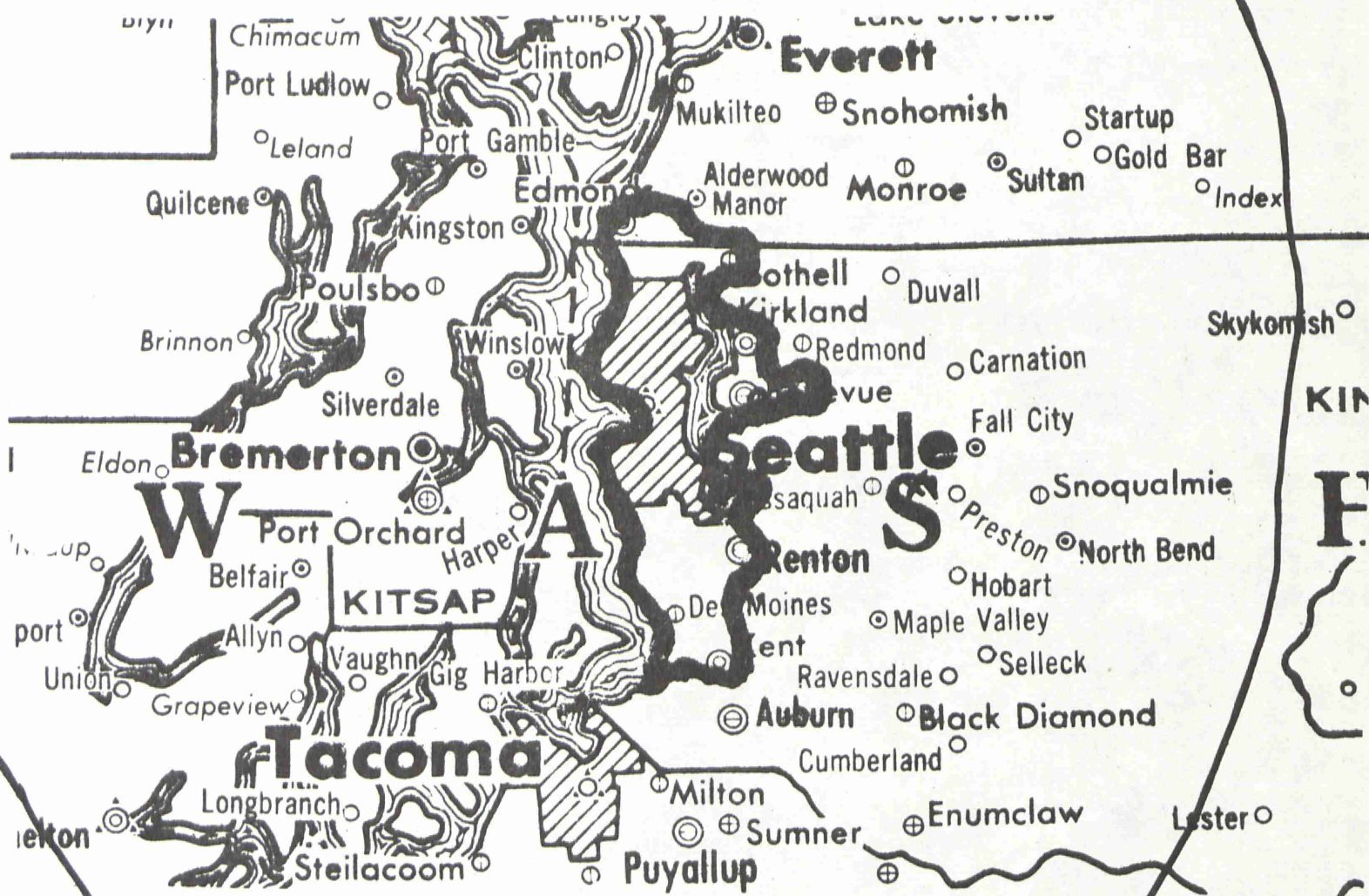
SMITH OIL CO., 3053 20TH WEST, SEATTLE, WASH. (32 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





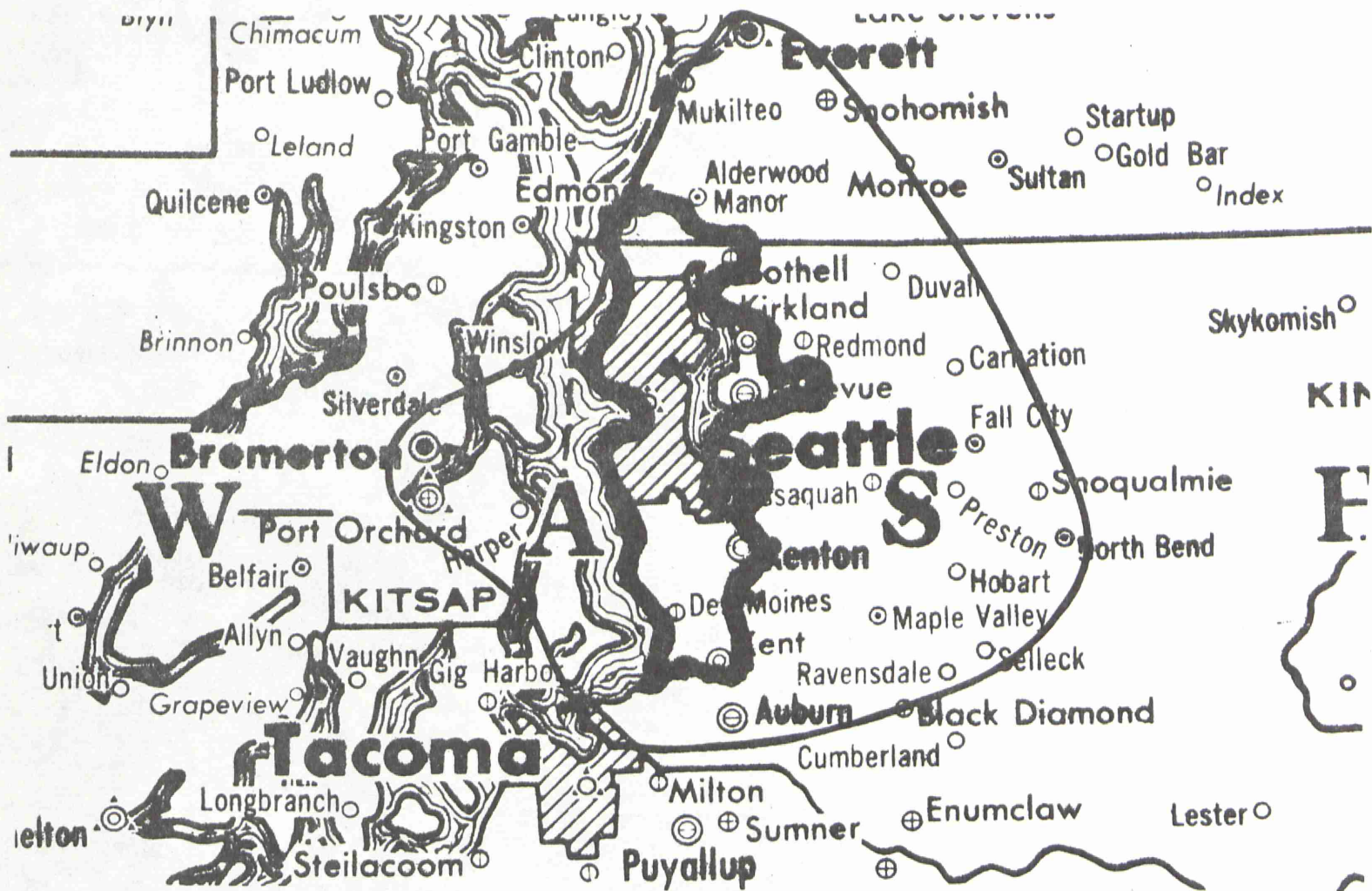
B - 34  
MOTOROLA C & E, INC., 808 106TH AVE., N. E., BELLEVUE, WASH. (68 MILES)

SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





B - 35

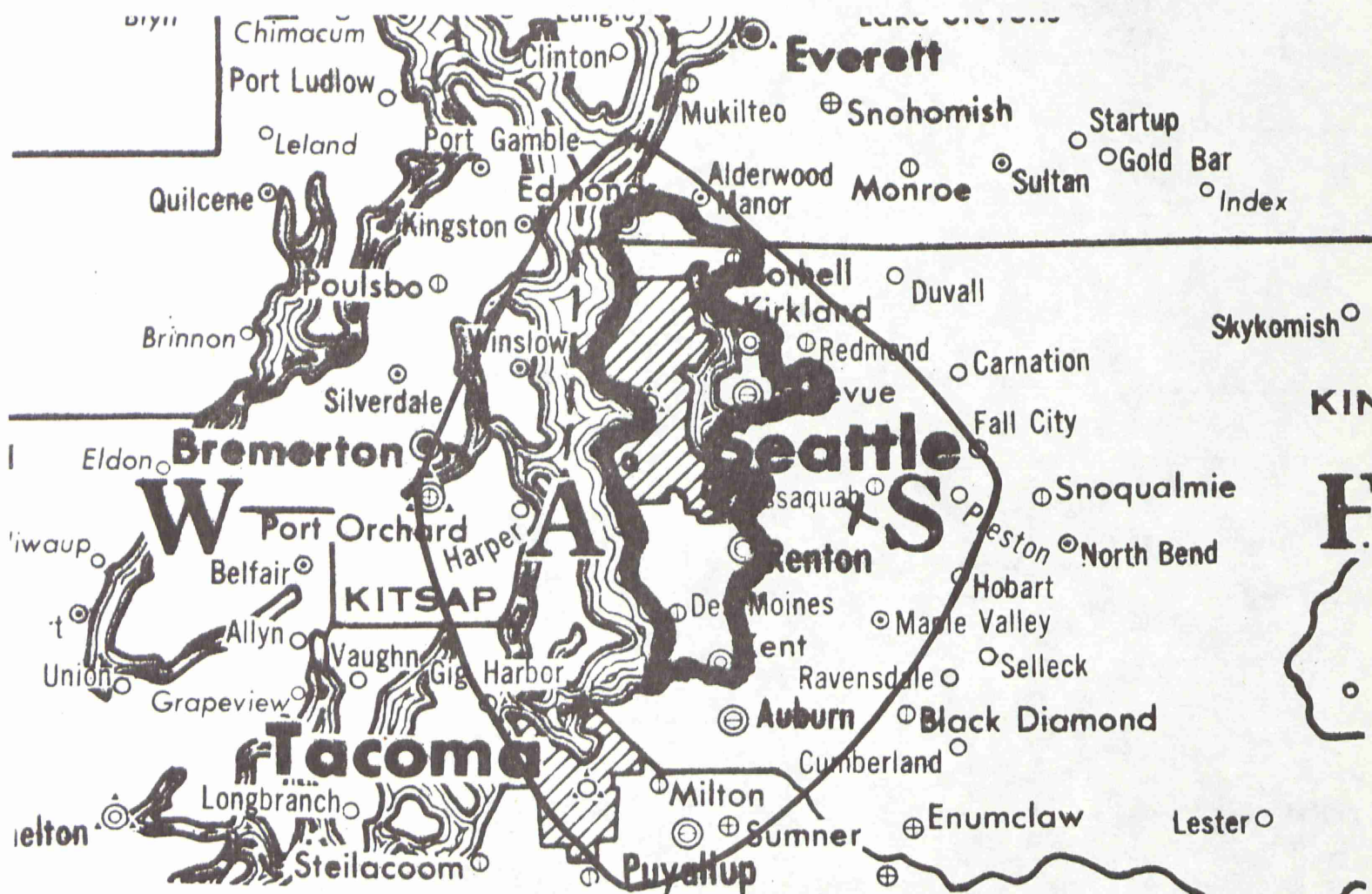
STANDARD SERVICE TIRE CO., FAIRVIEW & DENNY WAY, SEATTLE, WASH. (35 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





B - 36

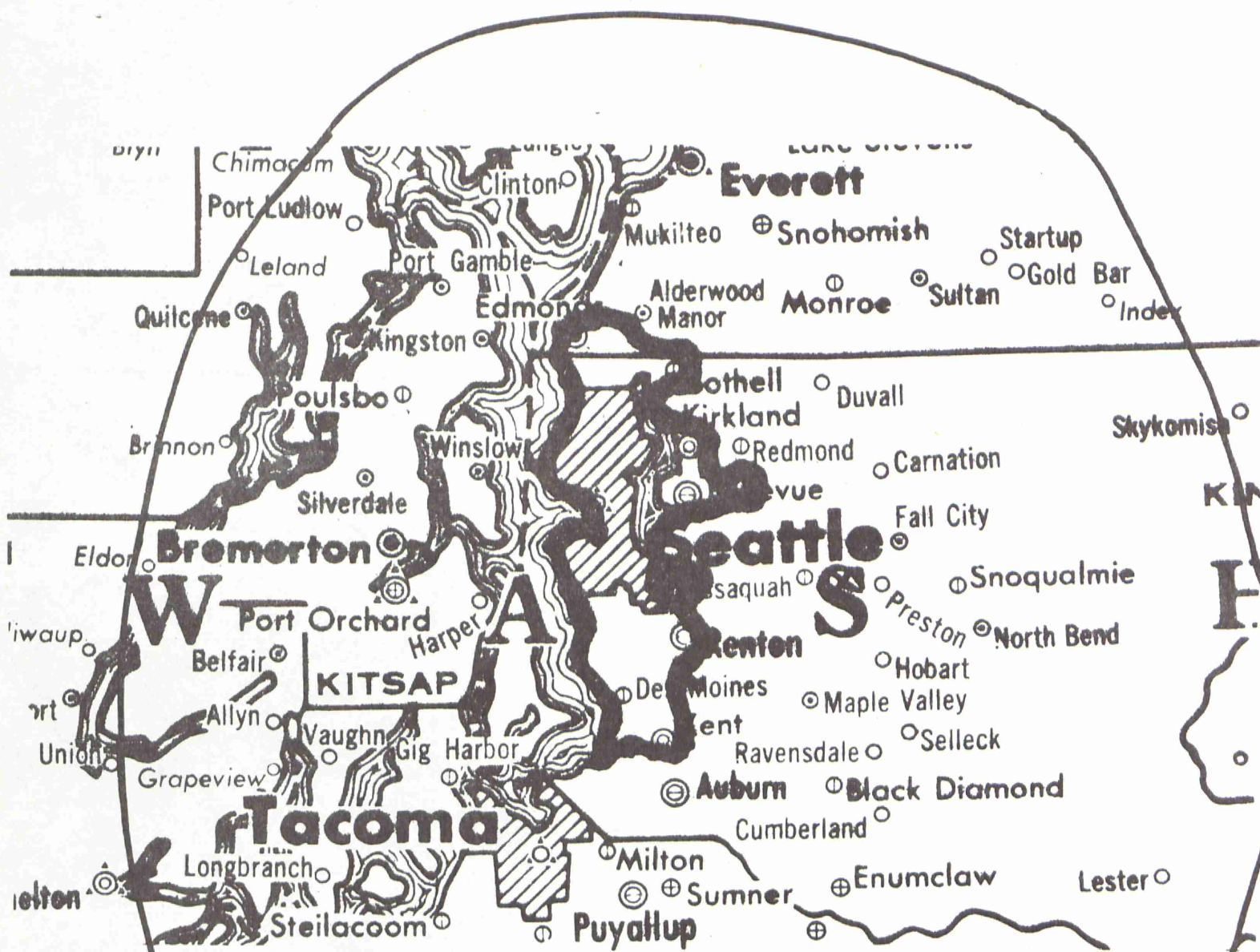
COLUCCIO CONSTR., 7778 SEWARD PARK S., SEATTLE, WASHINGTON (29 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





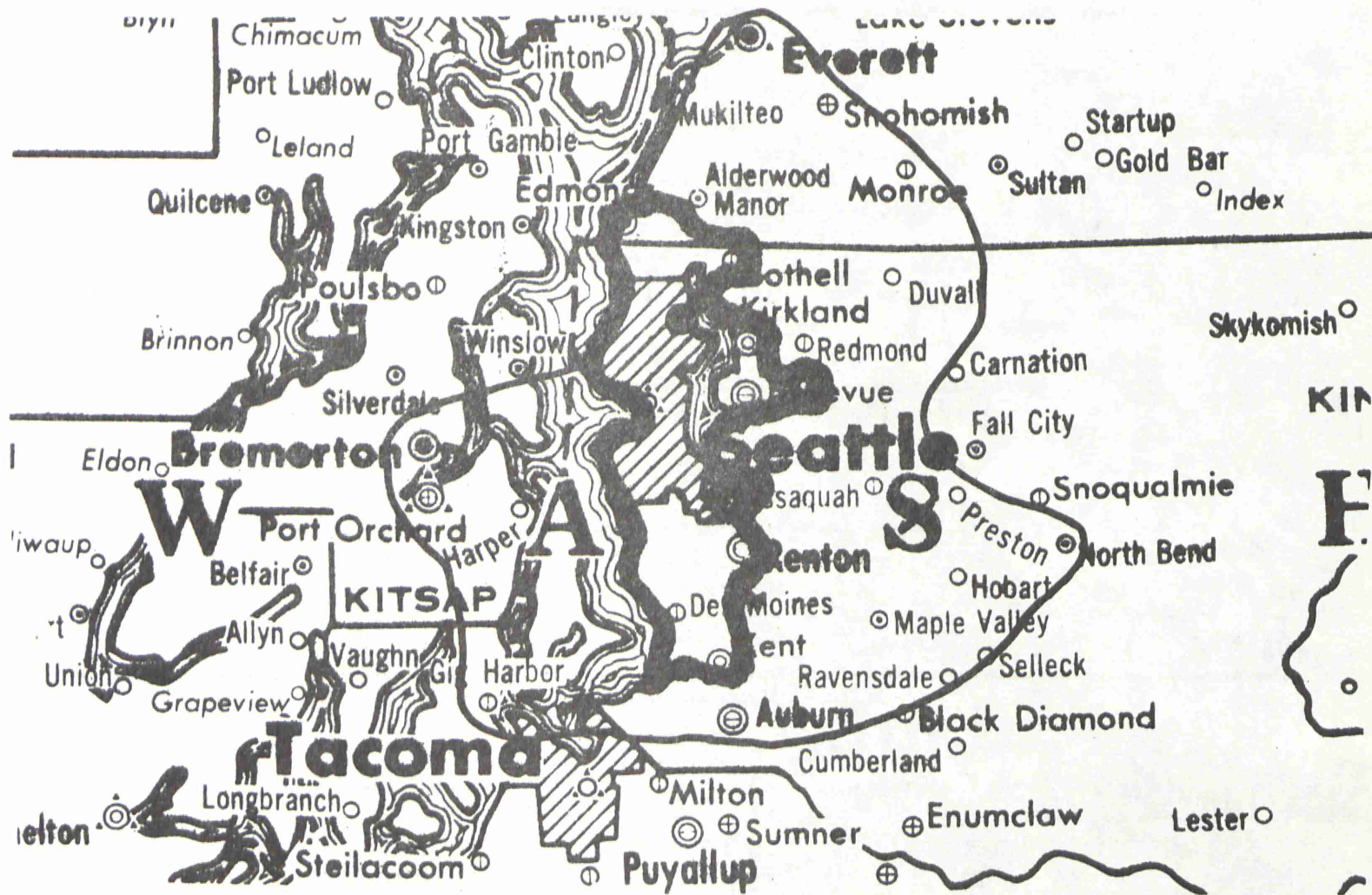
B - 37  
PHOTOTRONICS, INC., 223 WESTLAKE NO., SEATTLE, WASH. (56 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





B-38

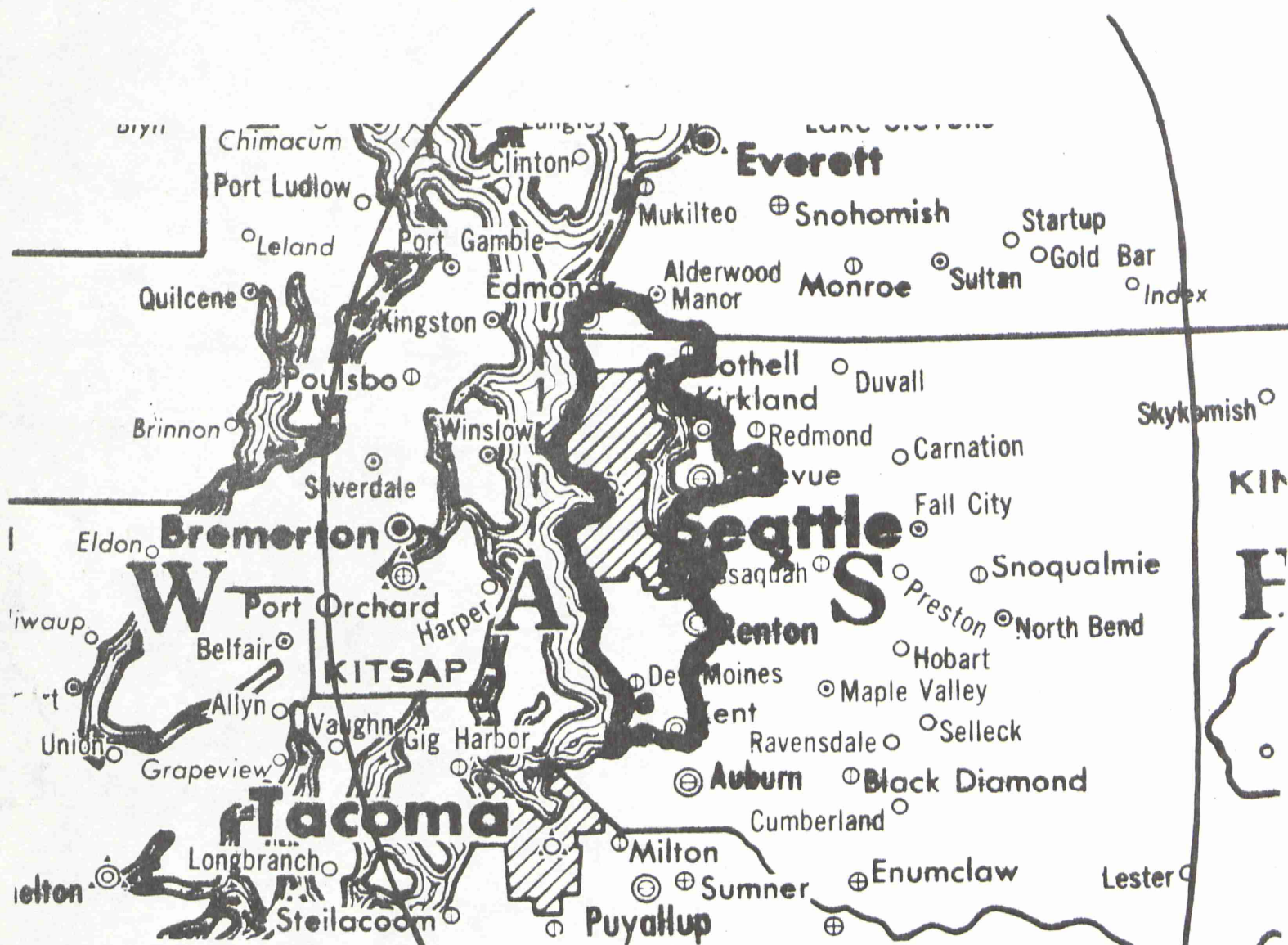
A-1 GARDENING, 2154 N. 156TH PLACE, SEATTLE, WASH. (35 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





B - 39

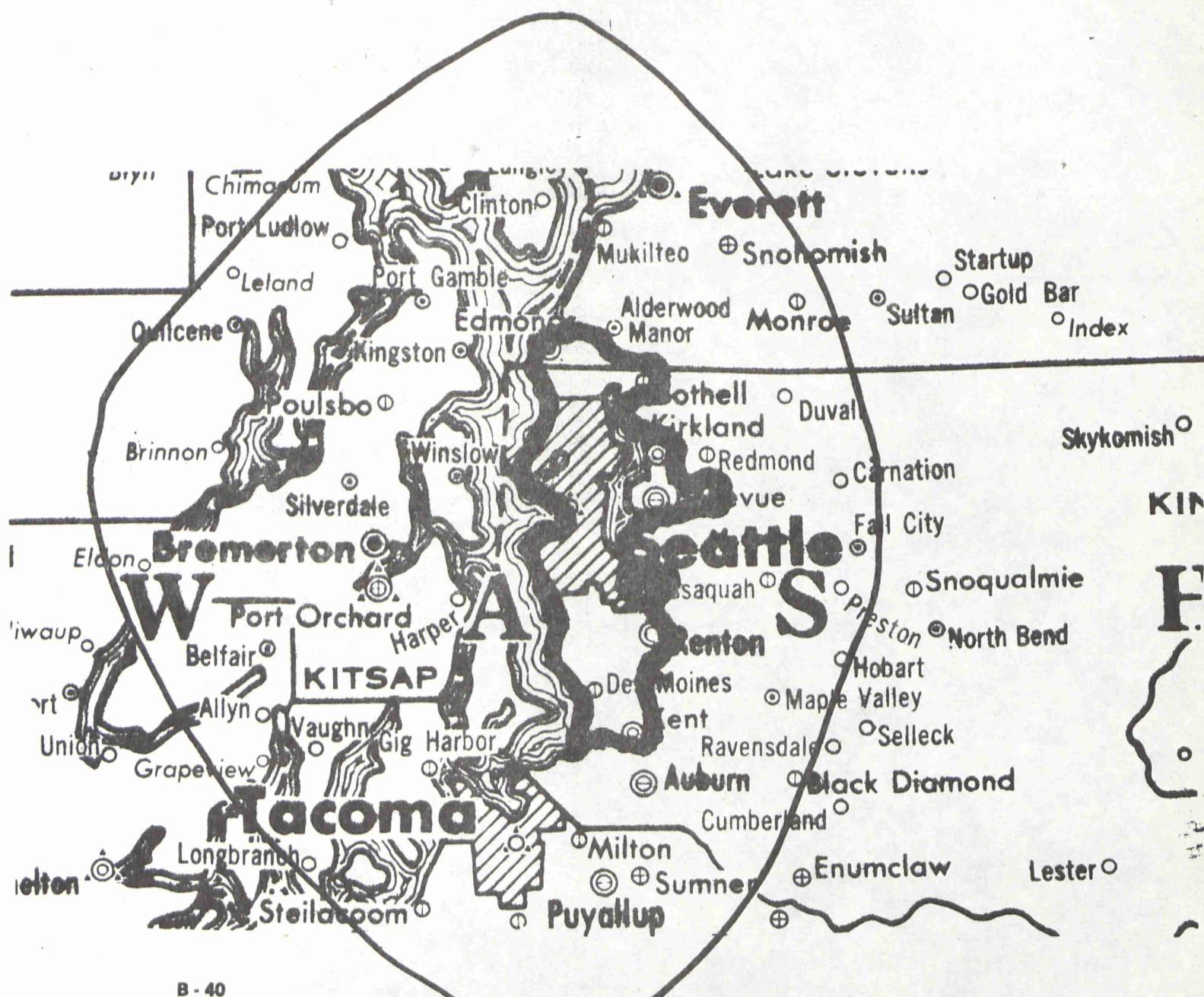
LANE DEVELOPMENT CO., 1452 DASH POINT ROAD, FEDERAL WAY, WASH. (41 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





B - 40

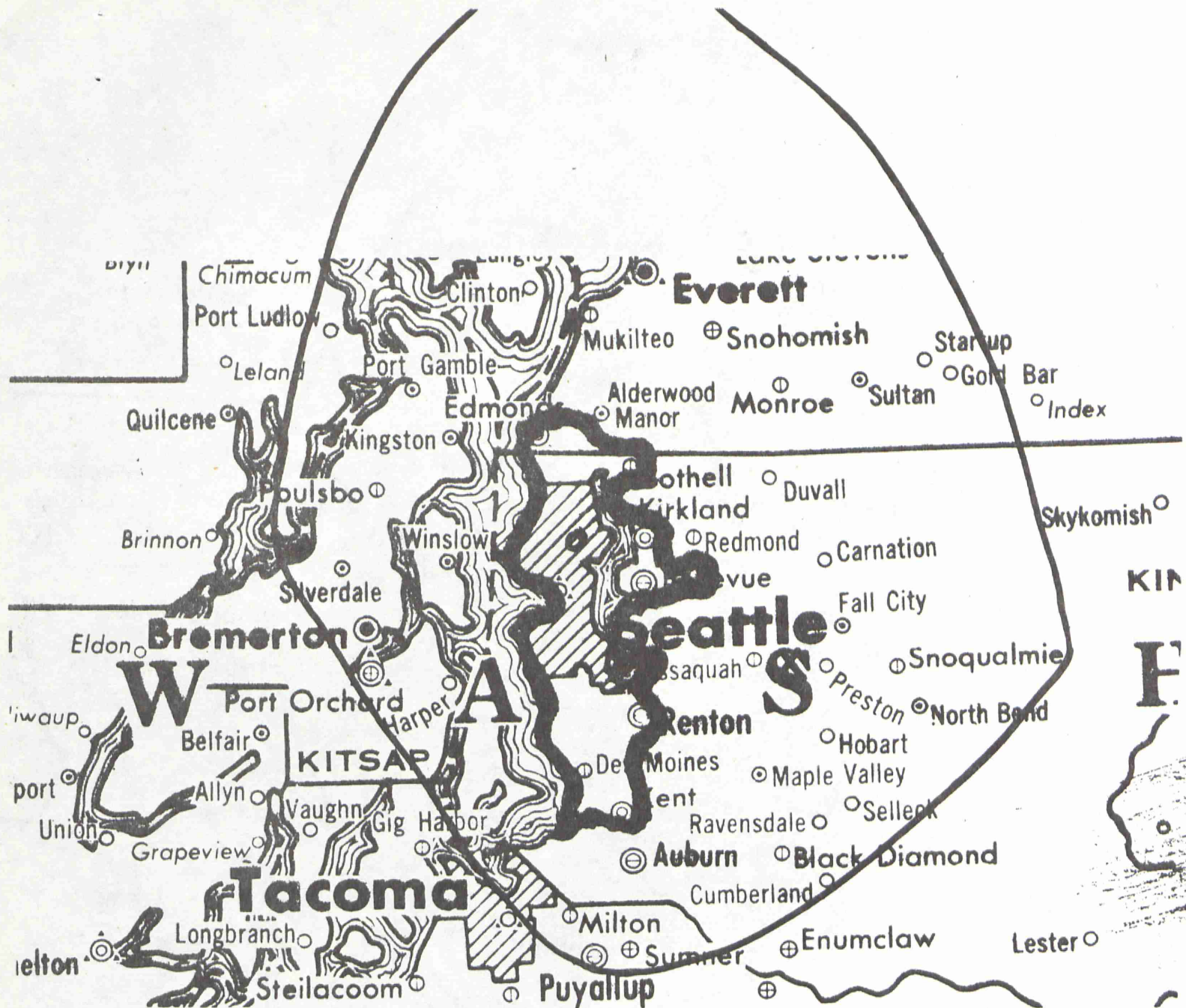
SALVATION ARMY, 233 1ST W., SEATTLE, WASHINGTON (42 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





B-41

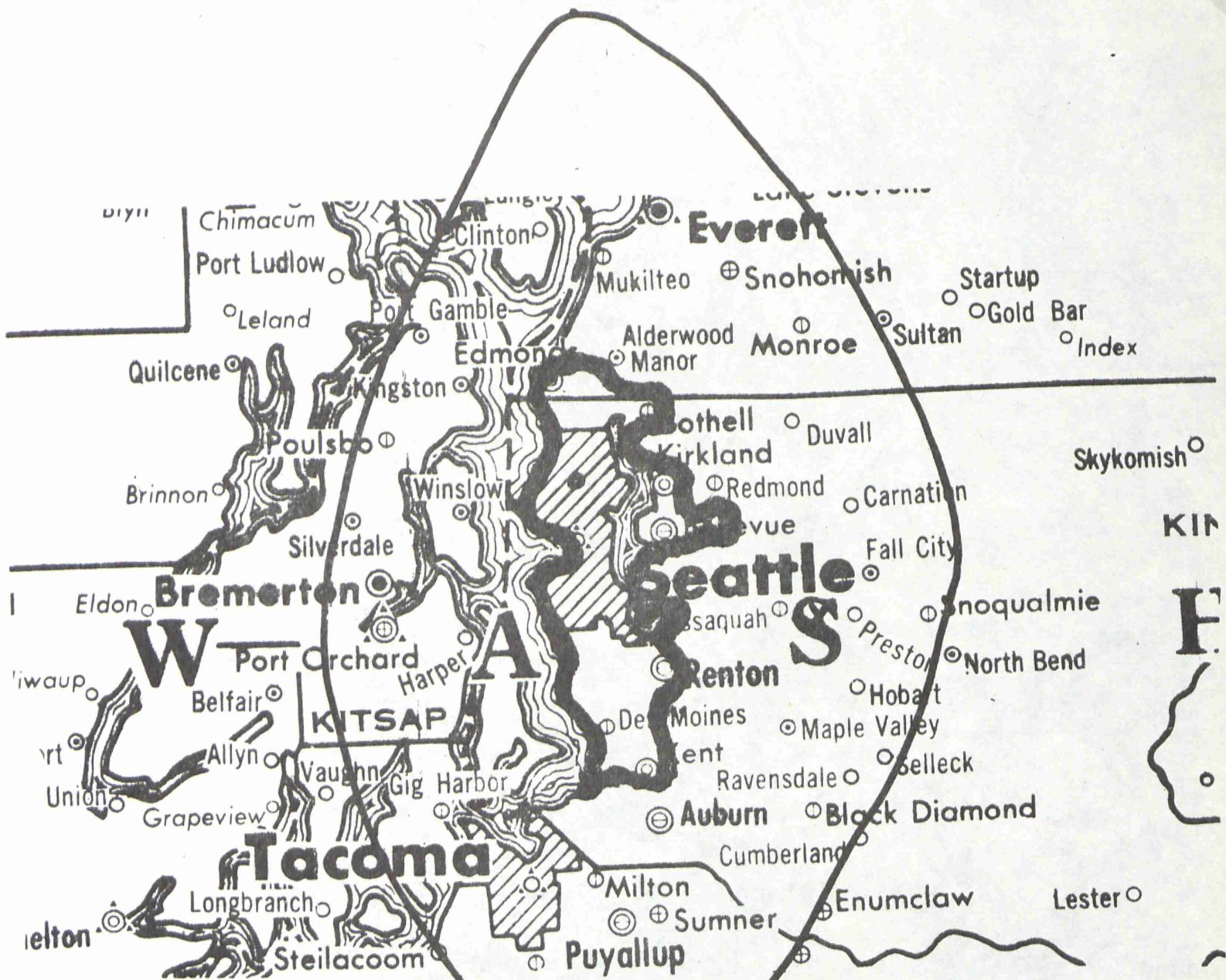
VANDYKE TRUCK LINES, 4223 MAYNARD S., SEATTLE, WASHINGTON (47 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





B-42  
HOWARD COOPER, 5055 4TH S., SEATTLE, WASHINGTON (41 MILES)

# SEATTLE

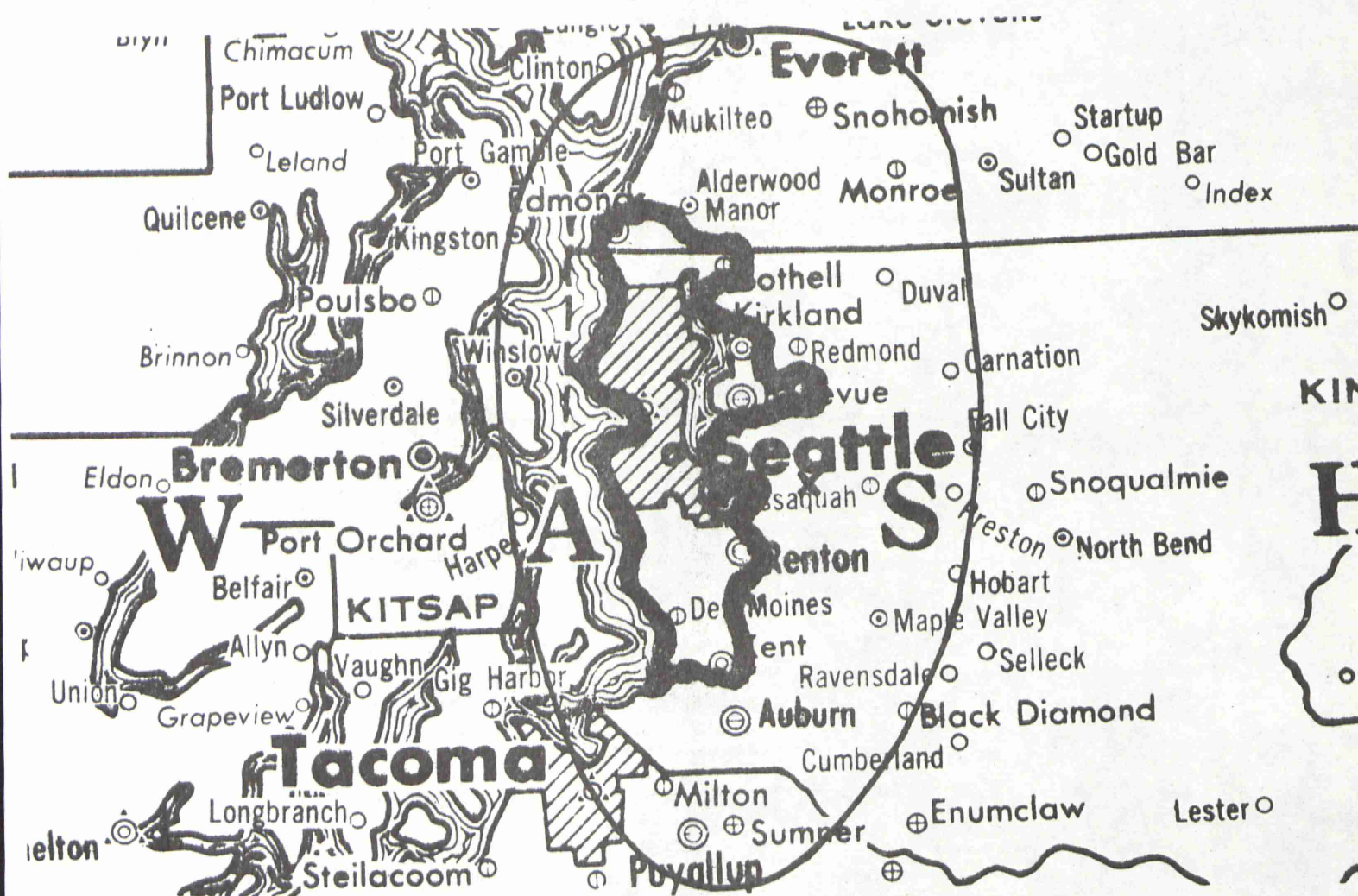


Copyright, American Map Co., Inc. No. 17501-A









B - 44

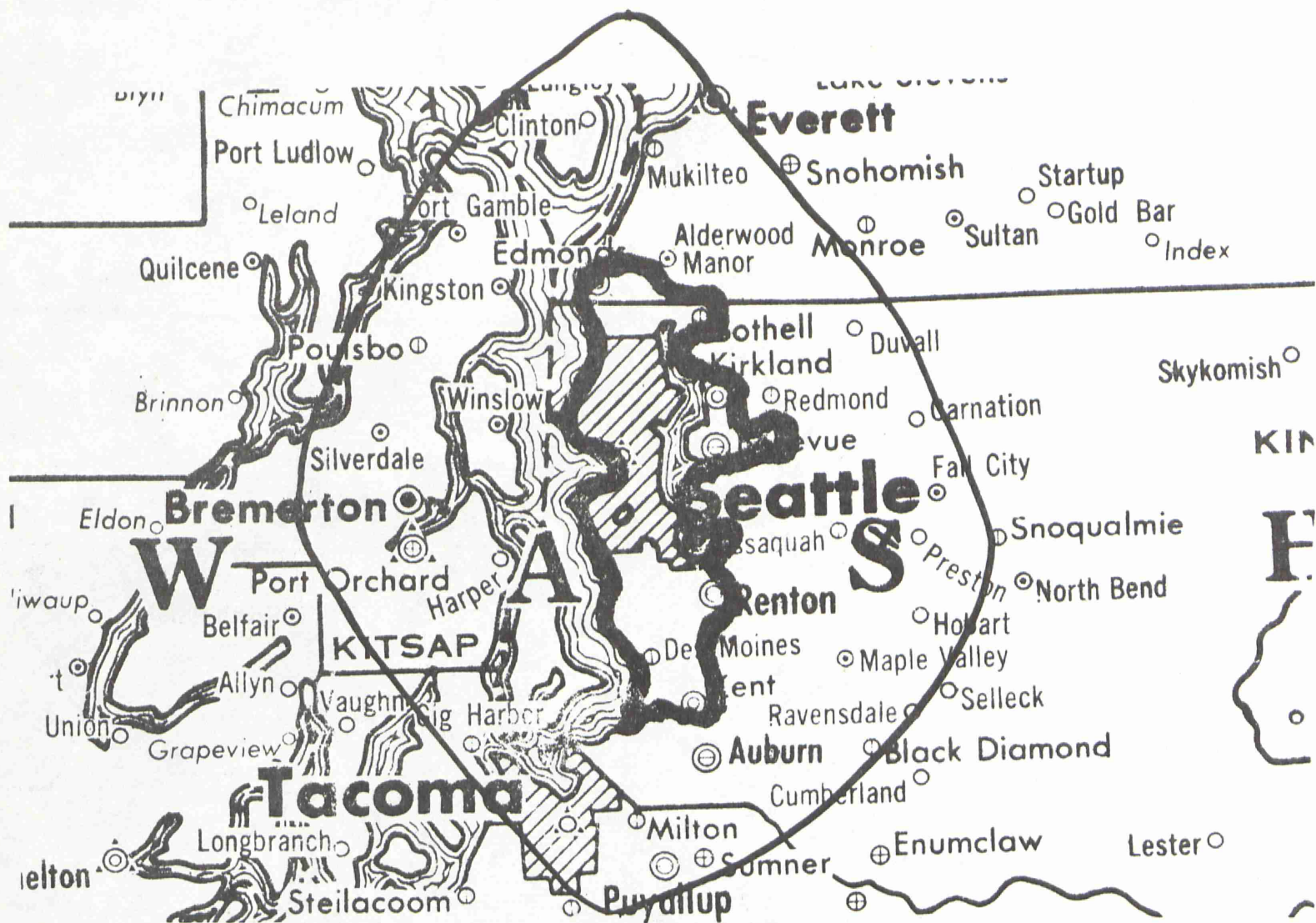
RUSTAD HEATING & PLUMBING, 927 RAINIER SOUTH, SEATTLE, WASH. (31 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





B - 45

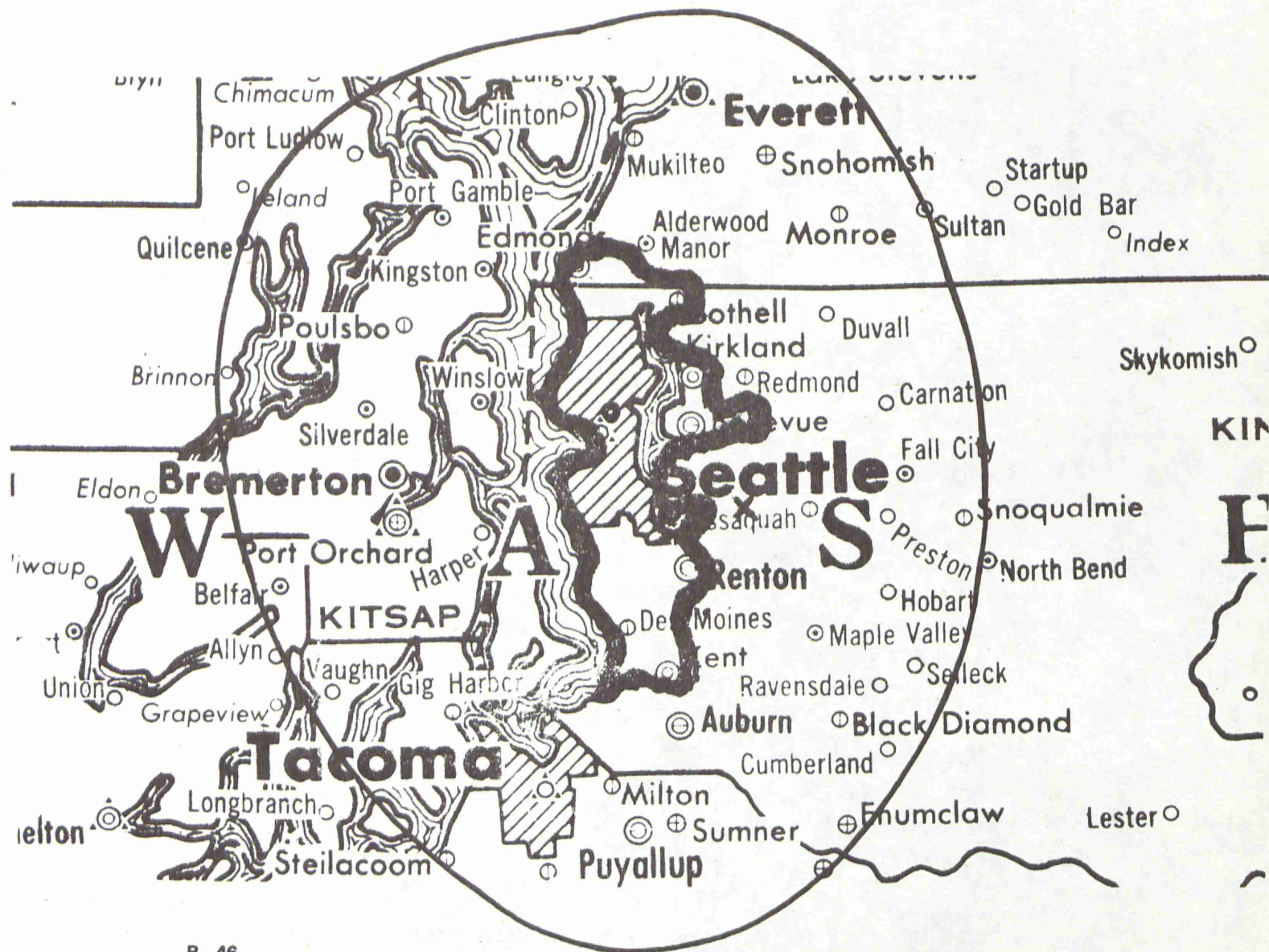
ALIA CONSTR. CO., 9215 EMPIRE WAY S., SEATTLE, WASH. (40 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





B - 46

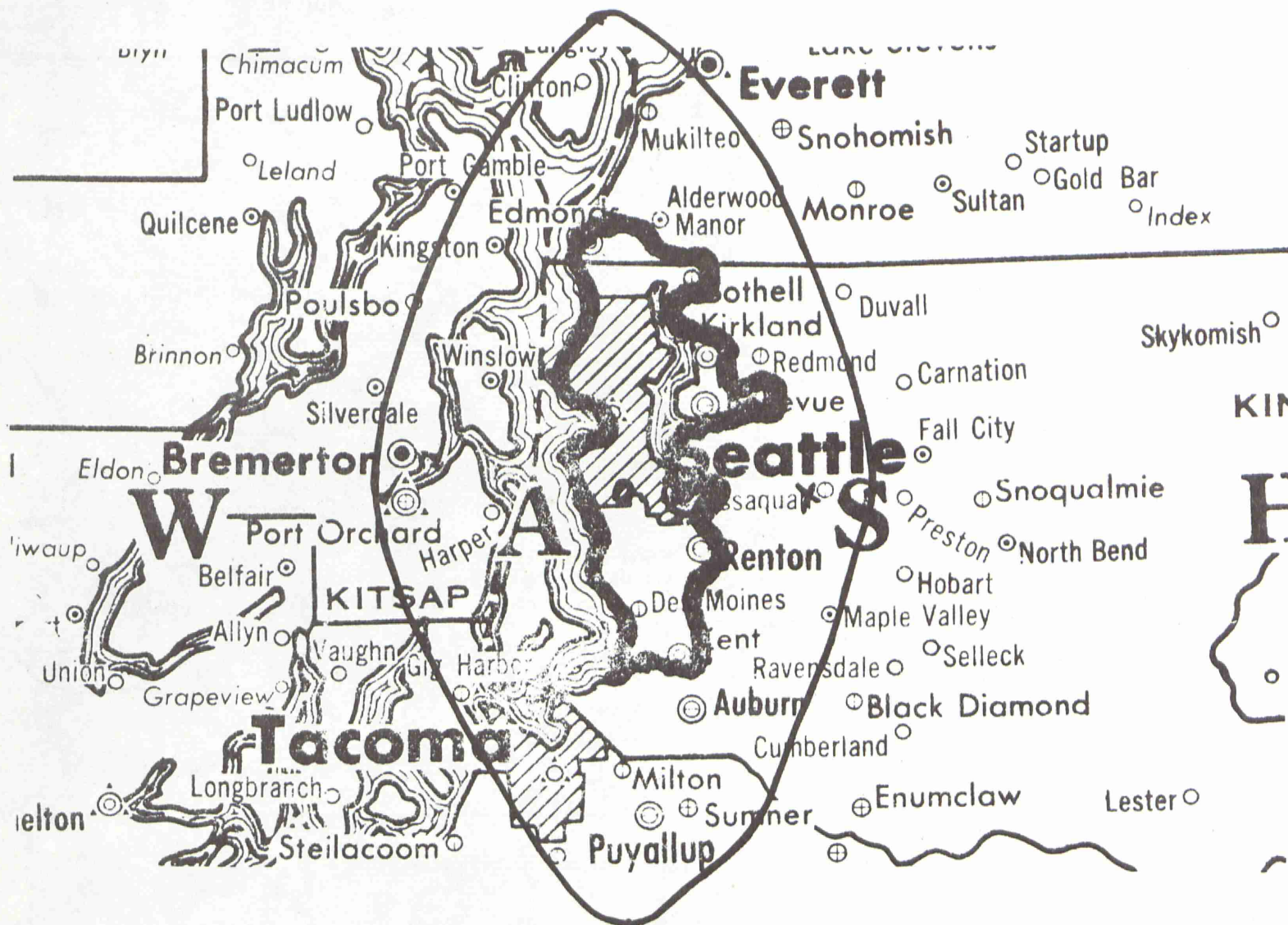
PIKE PAINT & GLASS CO., 501 E. PIKE, SEATTLE, WASH. (39 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





B - 47

SEATTLE READY MIX, 6560 W. MARGINAL W. SO., SEATTLE, WASH. (36 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A

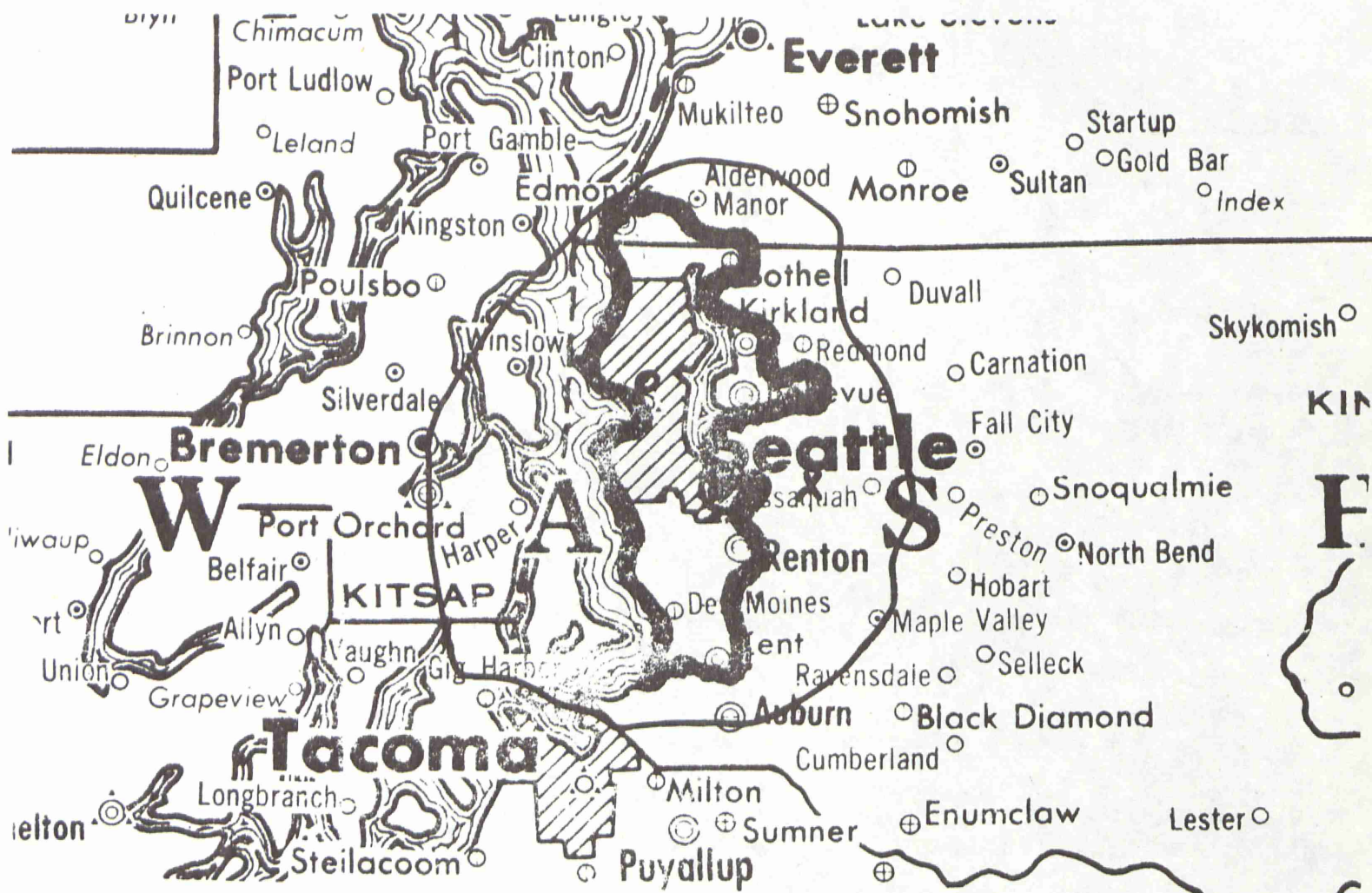












B - 50

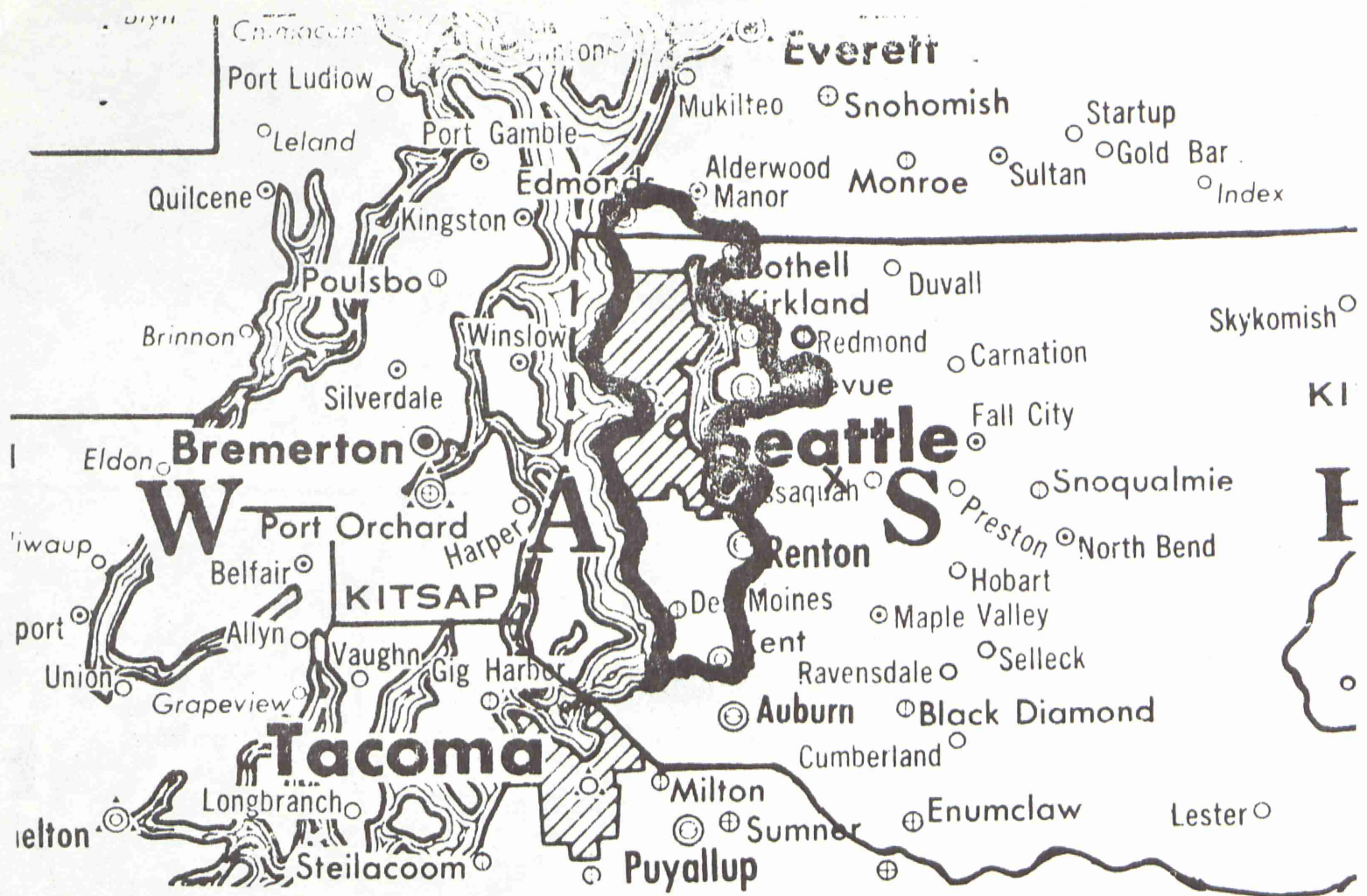
KIXI, 1305 3RD AVENUE, SEATTLE, WASHINGTON (26 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





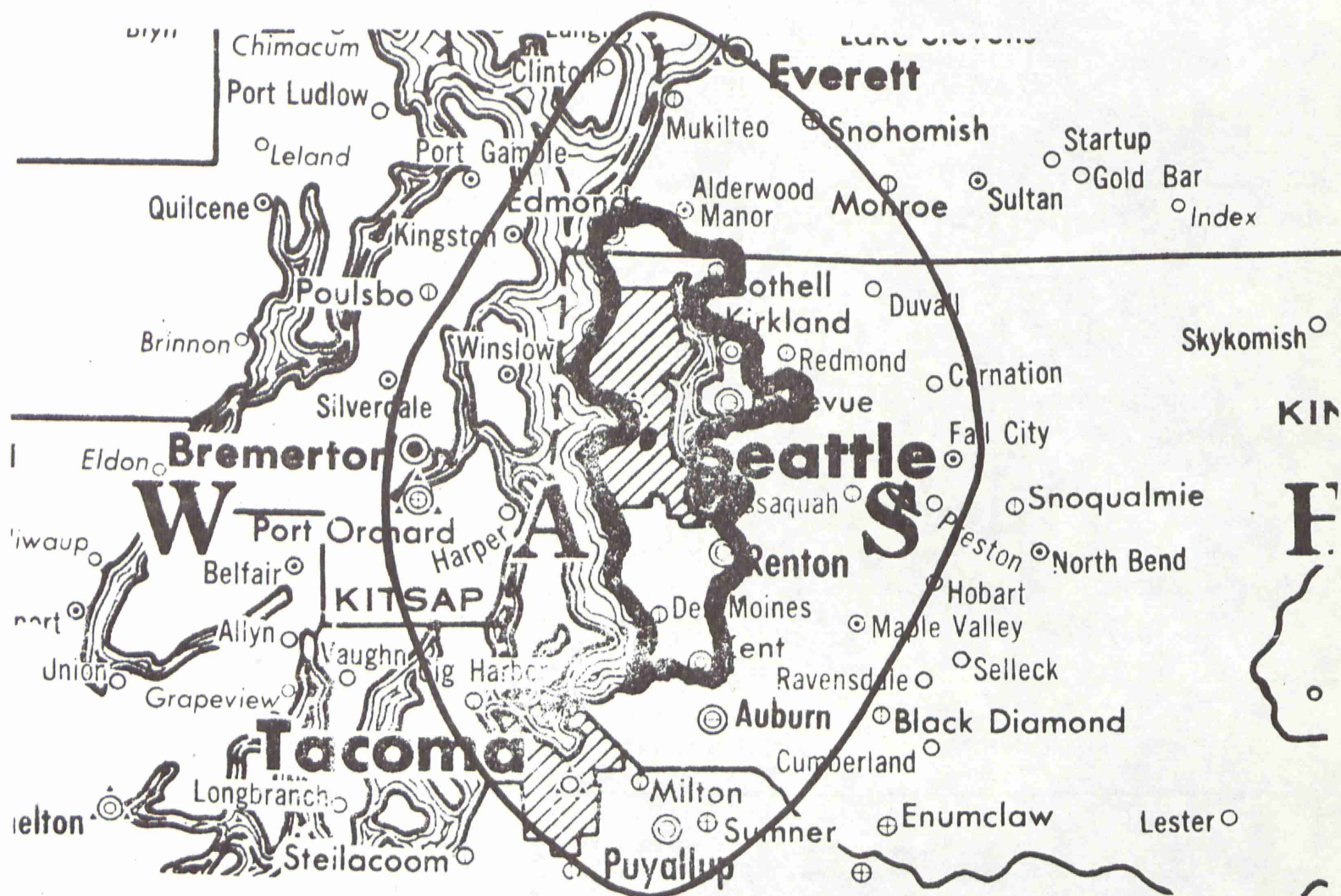
B - 51  
KING COUNTY SHERIFF, KING COUNTY COURTHOUSE, SEATTLE, WASH. (44 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A

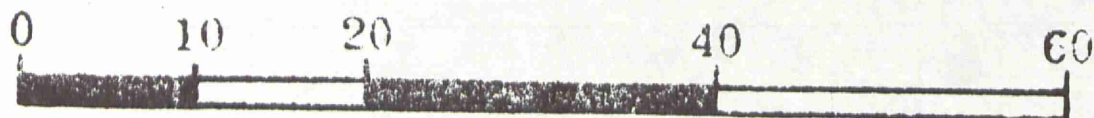




B - 52

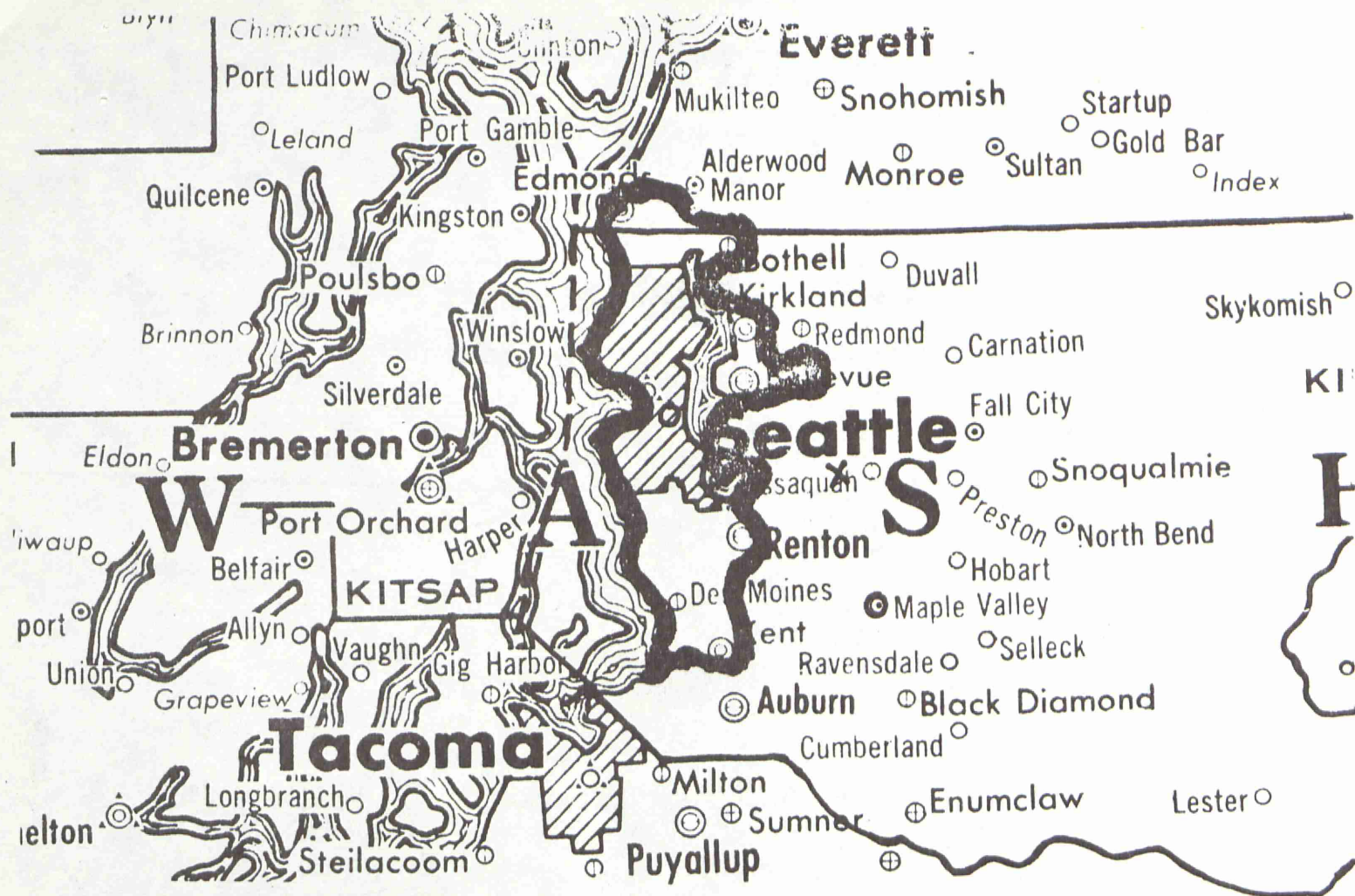
SOUTHGATE ELEC. INC., 14836 1ST SOUTH, SEATTLE, WASH. (37 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





B - 53

KING COUNTY GARBAGE UTILITY, KING COUNTY COURTHOUSE, SEATTLE, WASH. (44 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A

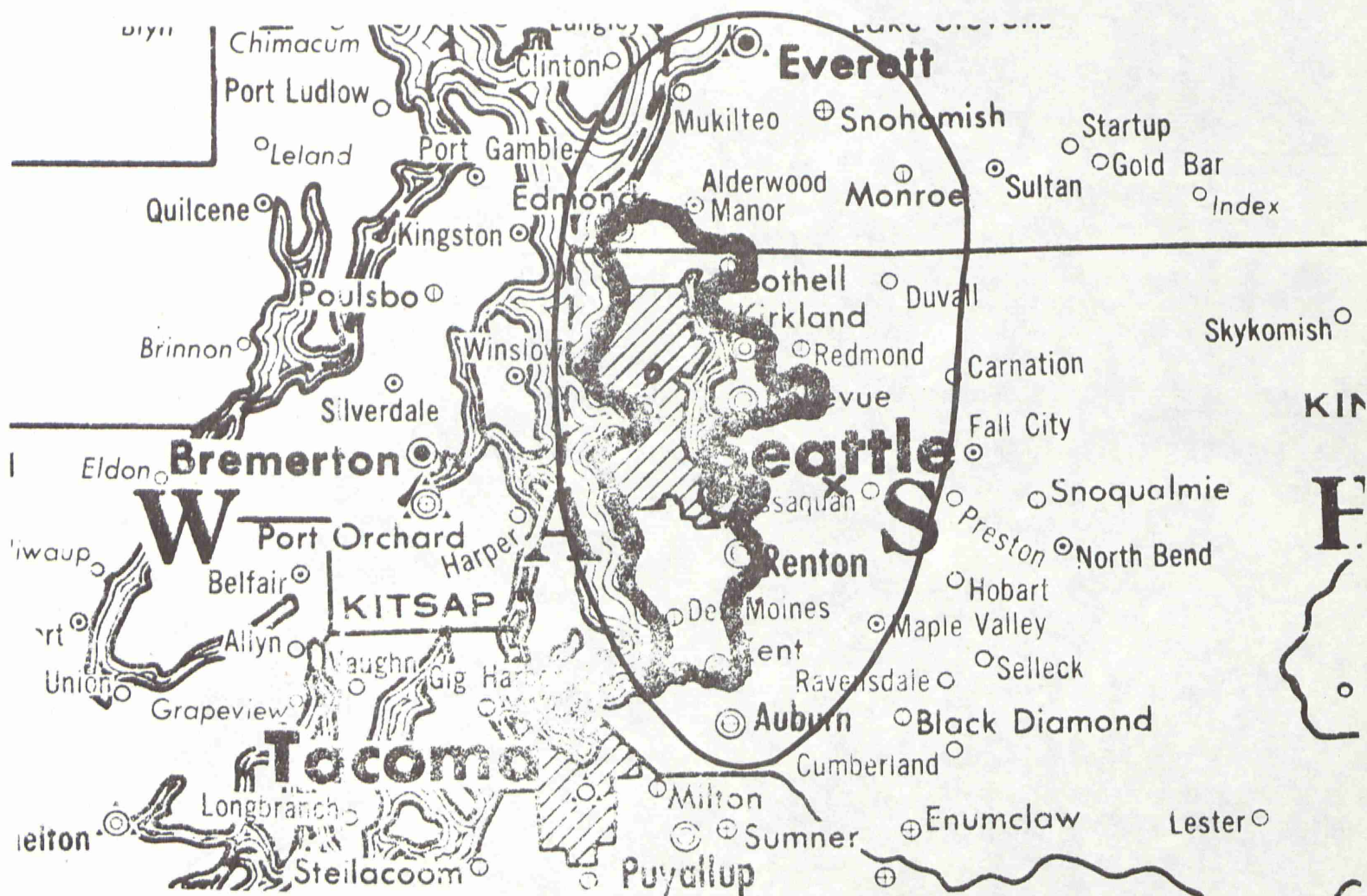












B - 56

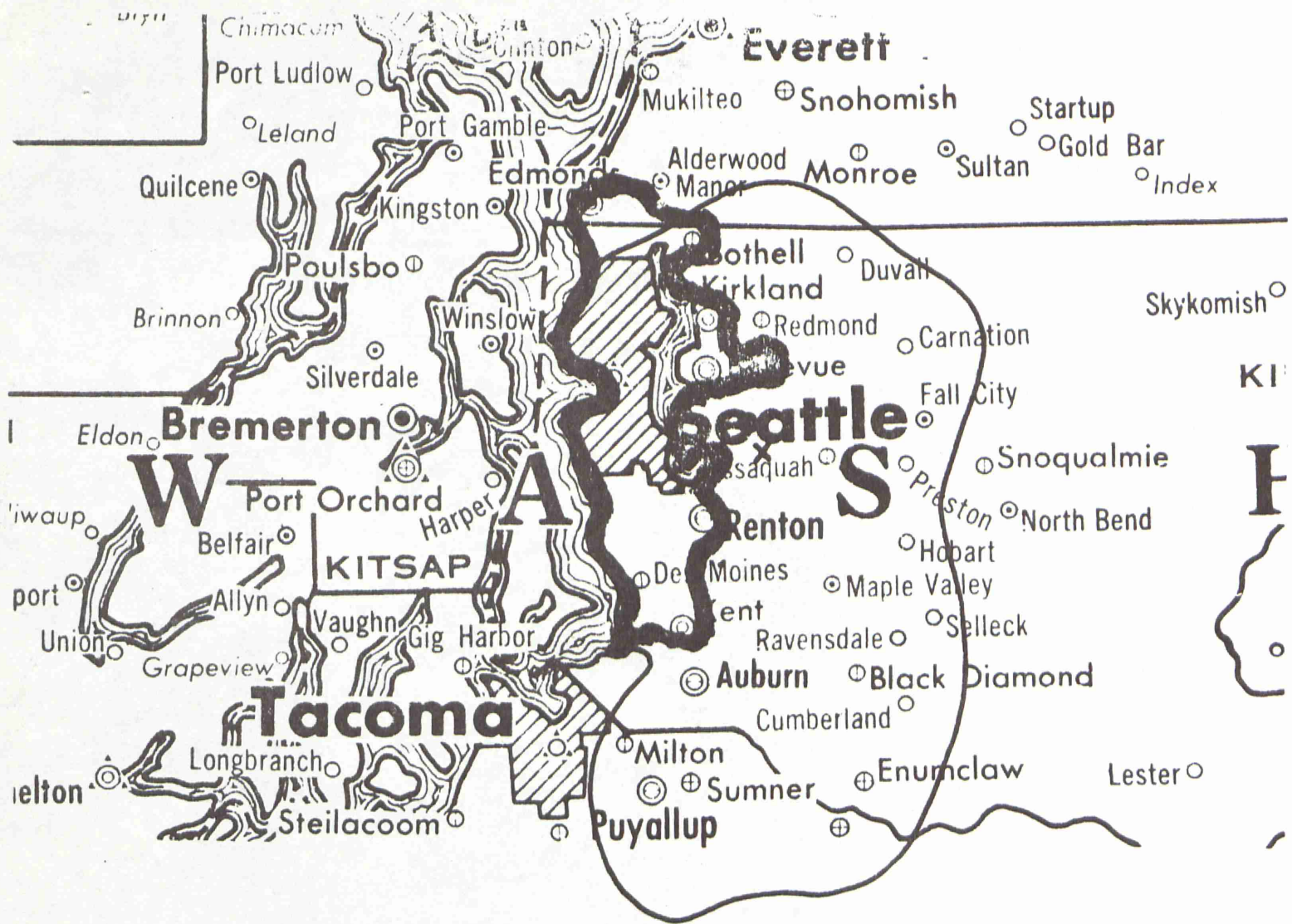
MYERS CONCRETE CONST., 4000 AURORA N., SEATTLE, WASHINGTON (32 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





C-1

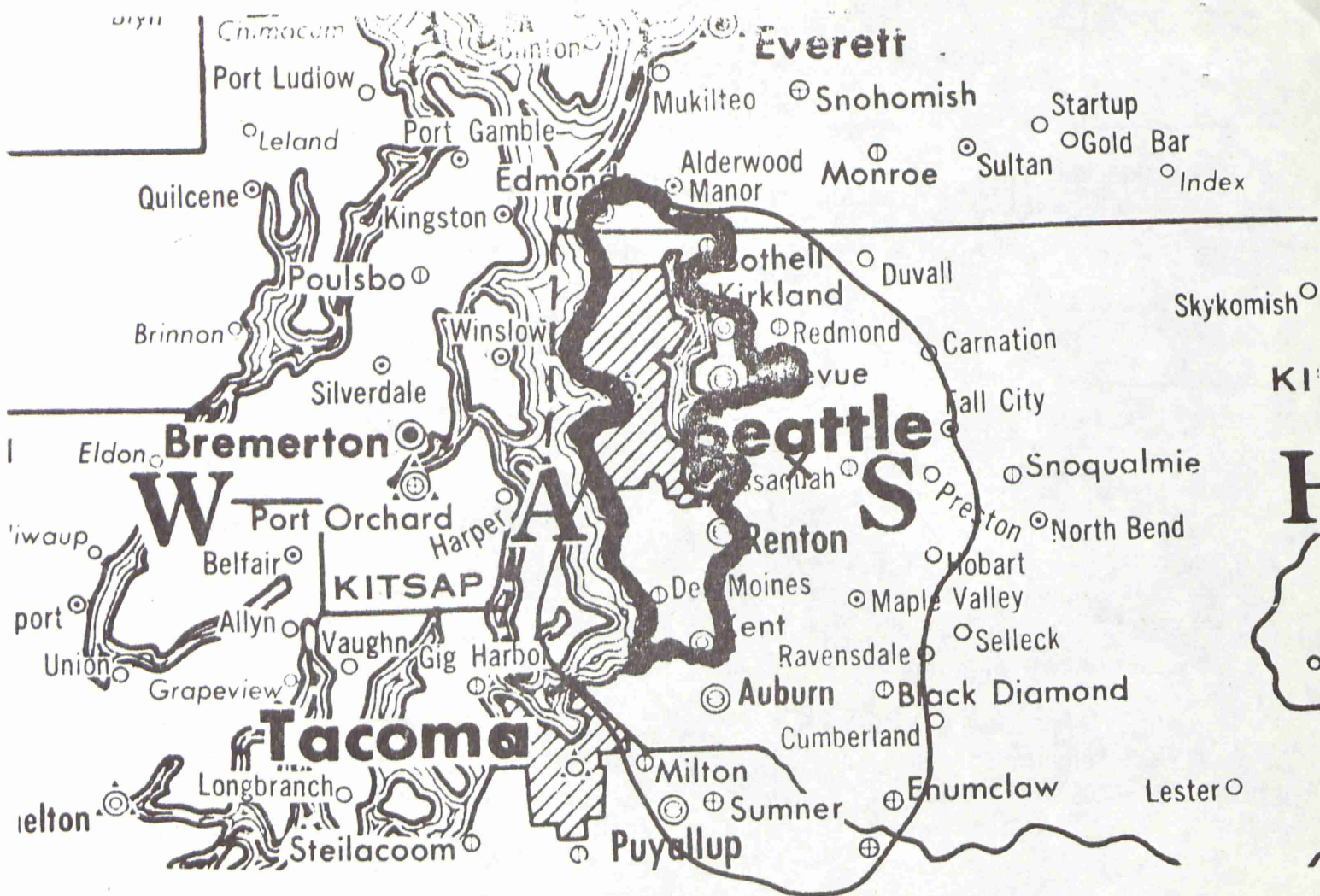
ERICKSON PAGING CO., 14446 SUNSET HIGHWAY, BELLEVUE, WASHINGTON (33 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





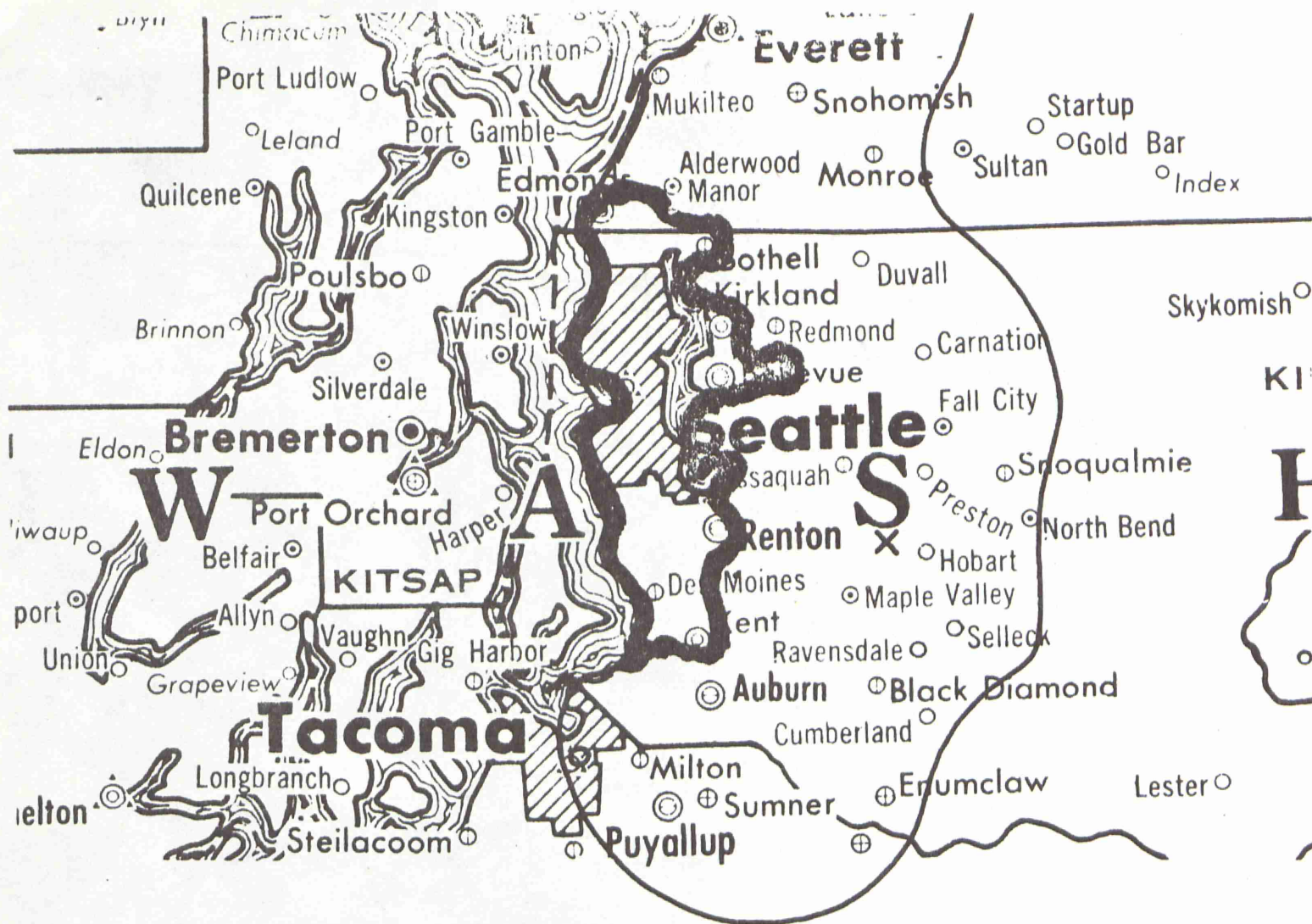
C-2  
WOODWORTH & CO., 1200 E. "A" STREET, TACOMA, WASHINGTON (29 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





C-3

HARRISON DENTAL LAB, 502 E. 26TH, TACOMA, WASHINGTON (38 MILES)

# SEATTLE

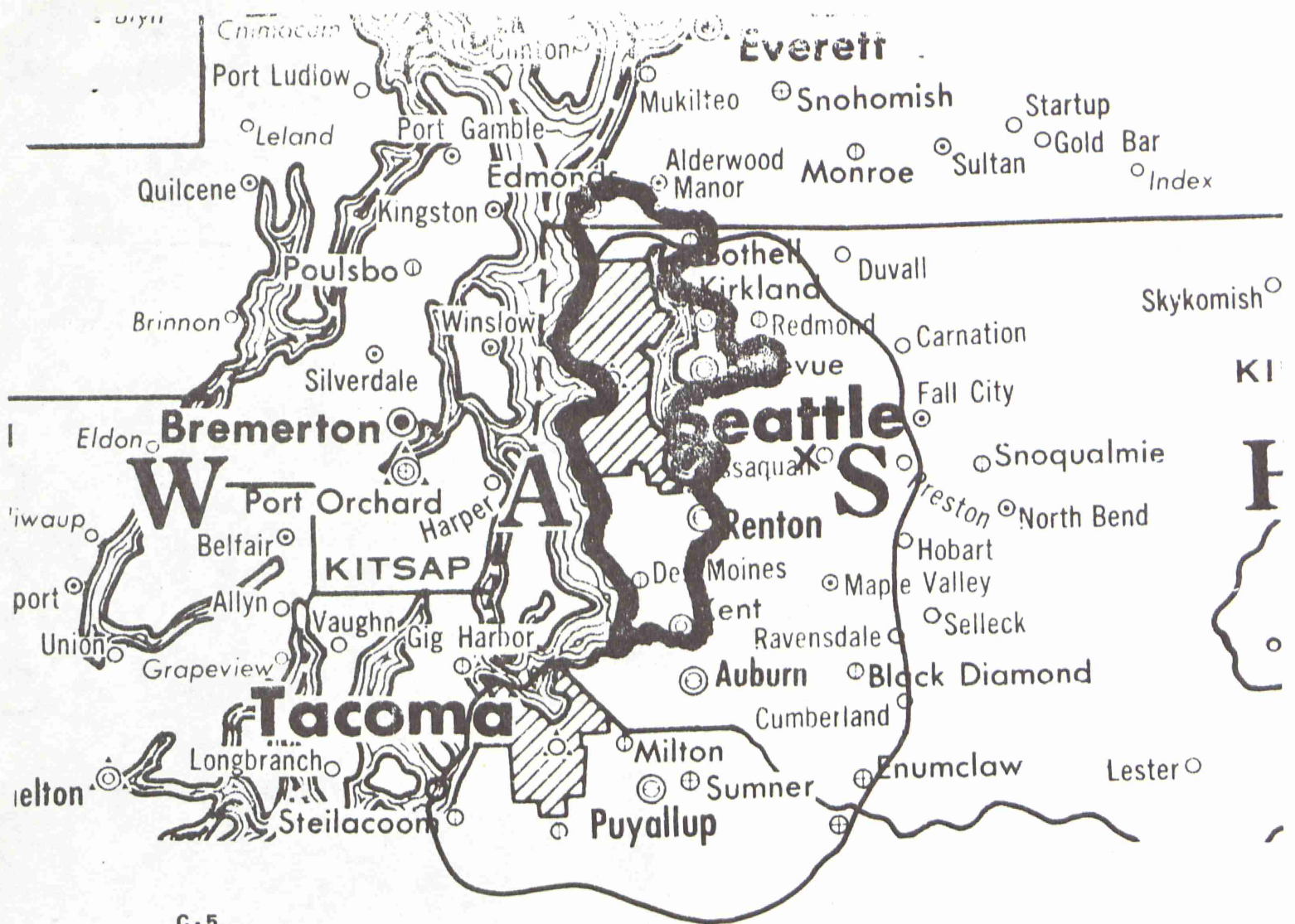


Copyright, American Map Co., Inc. No. 17501-A









C-5

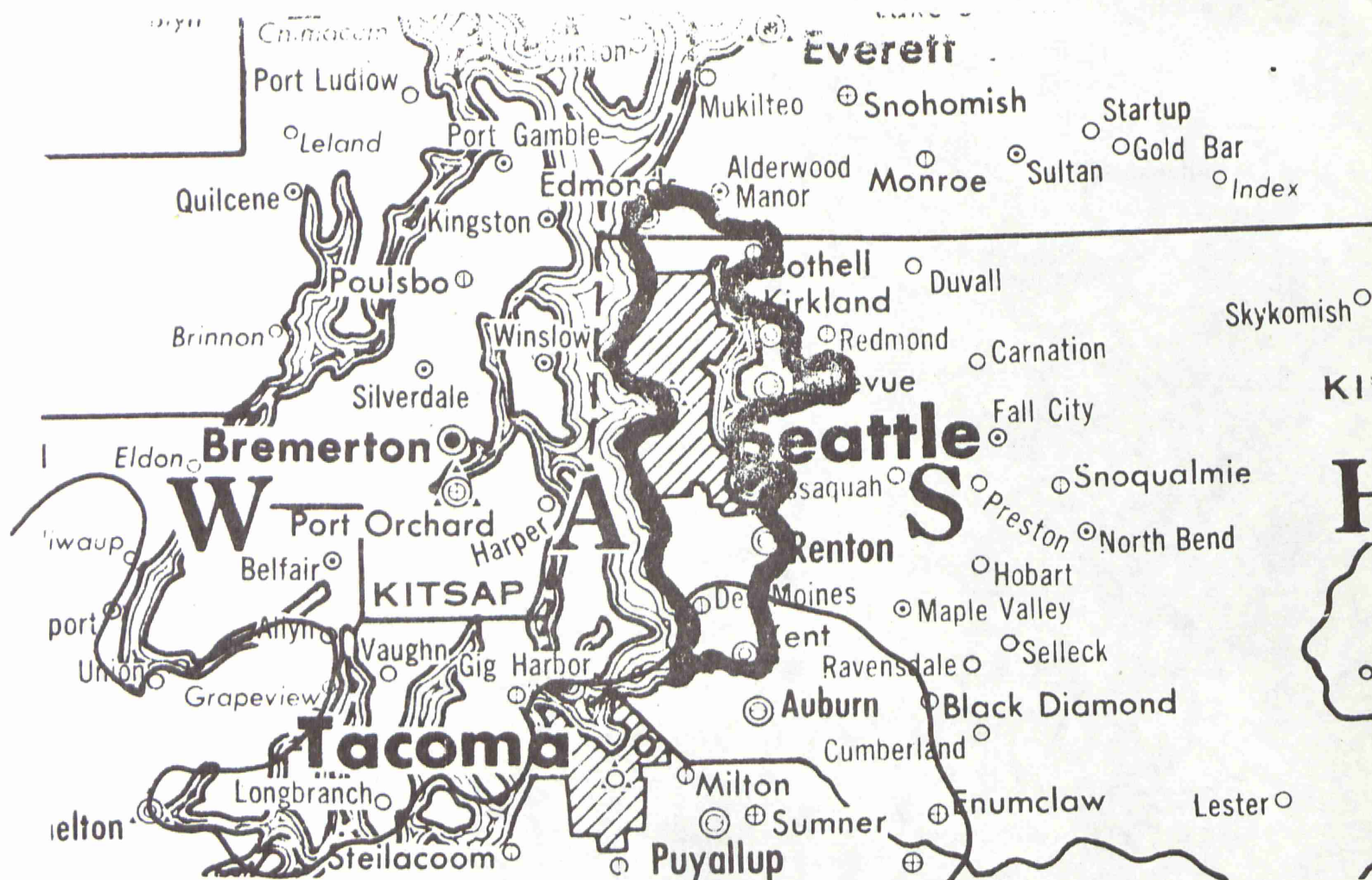
McWICK ENTERPRISES, 6501 MOTOR AVE., S. W., TACOMA, WASHINGTON (37 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





X CAPITAL PEAK

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A

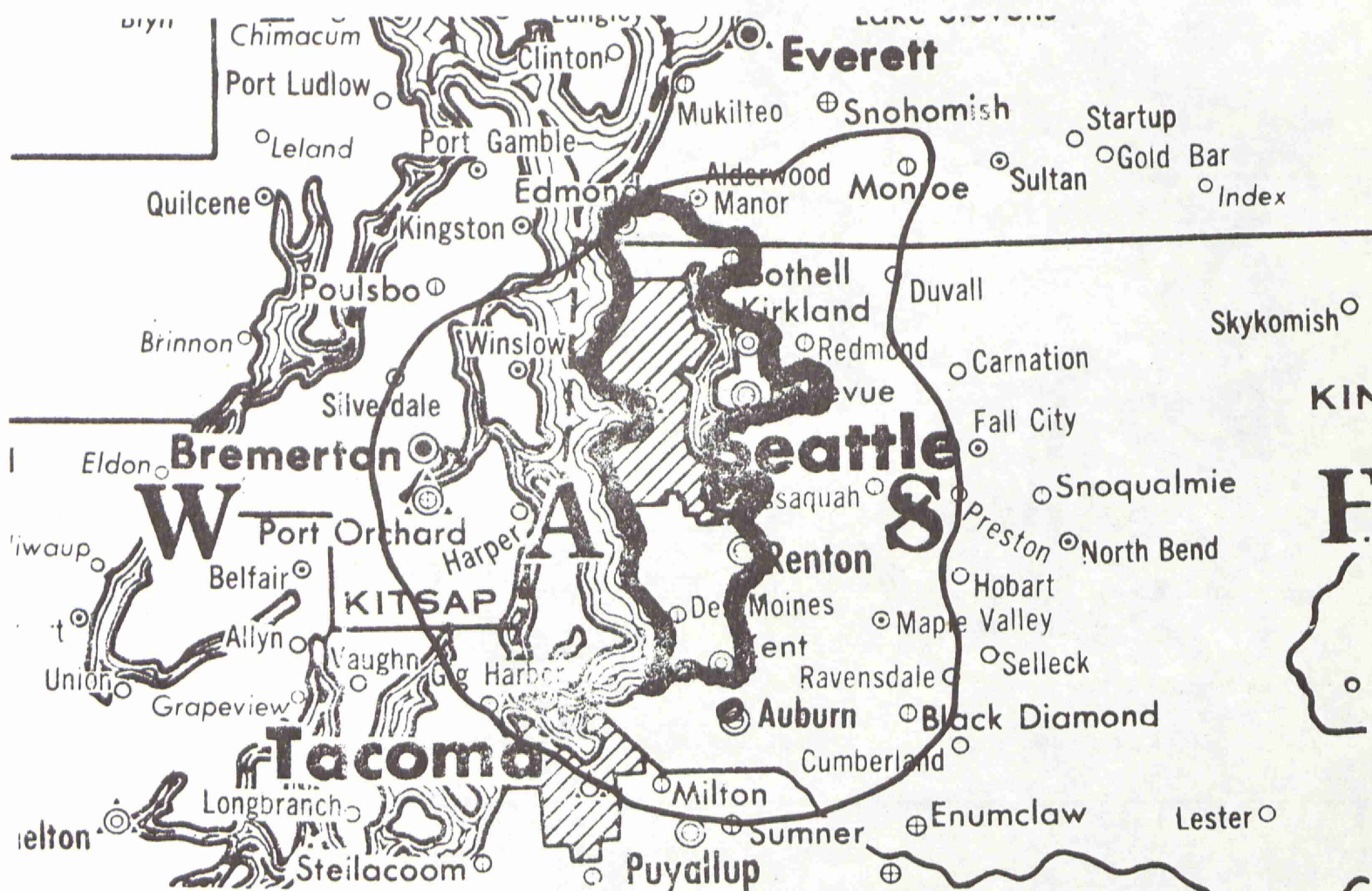
C-6

BACON MAINTENANCE, 426 E. 61ST ST., TACOMA, WASHINGTON (60 MILES)









C-8

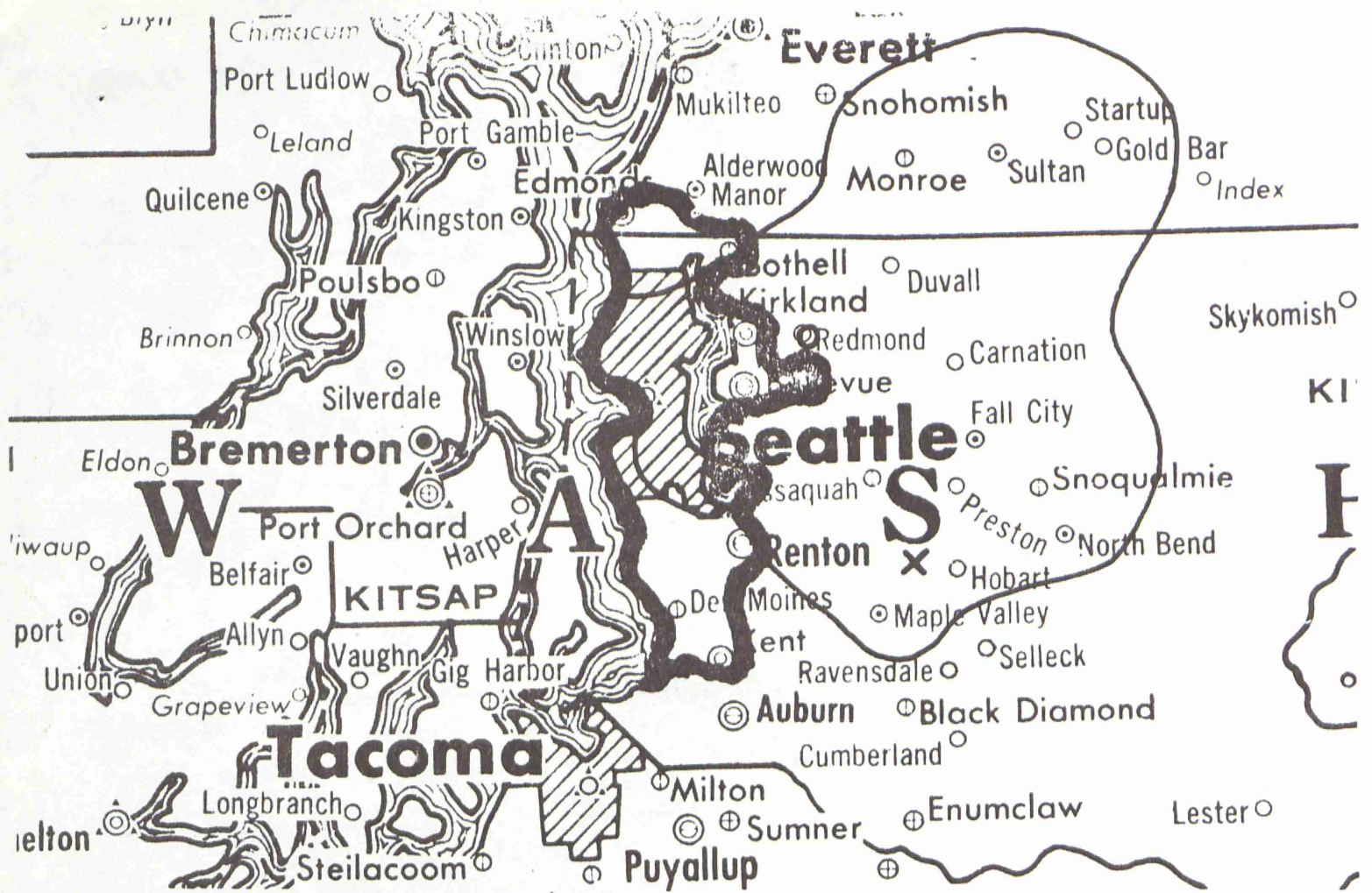
CONCRETE CONDUIT CO., 32222 148TH S. E., AUBURN, WASHINGTON (36 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





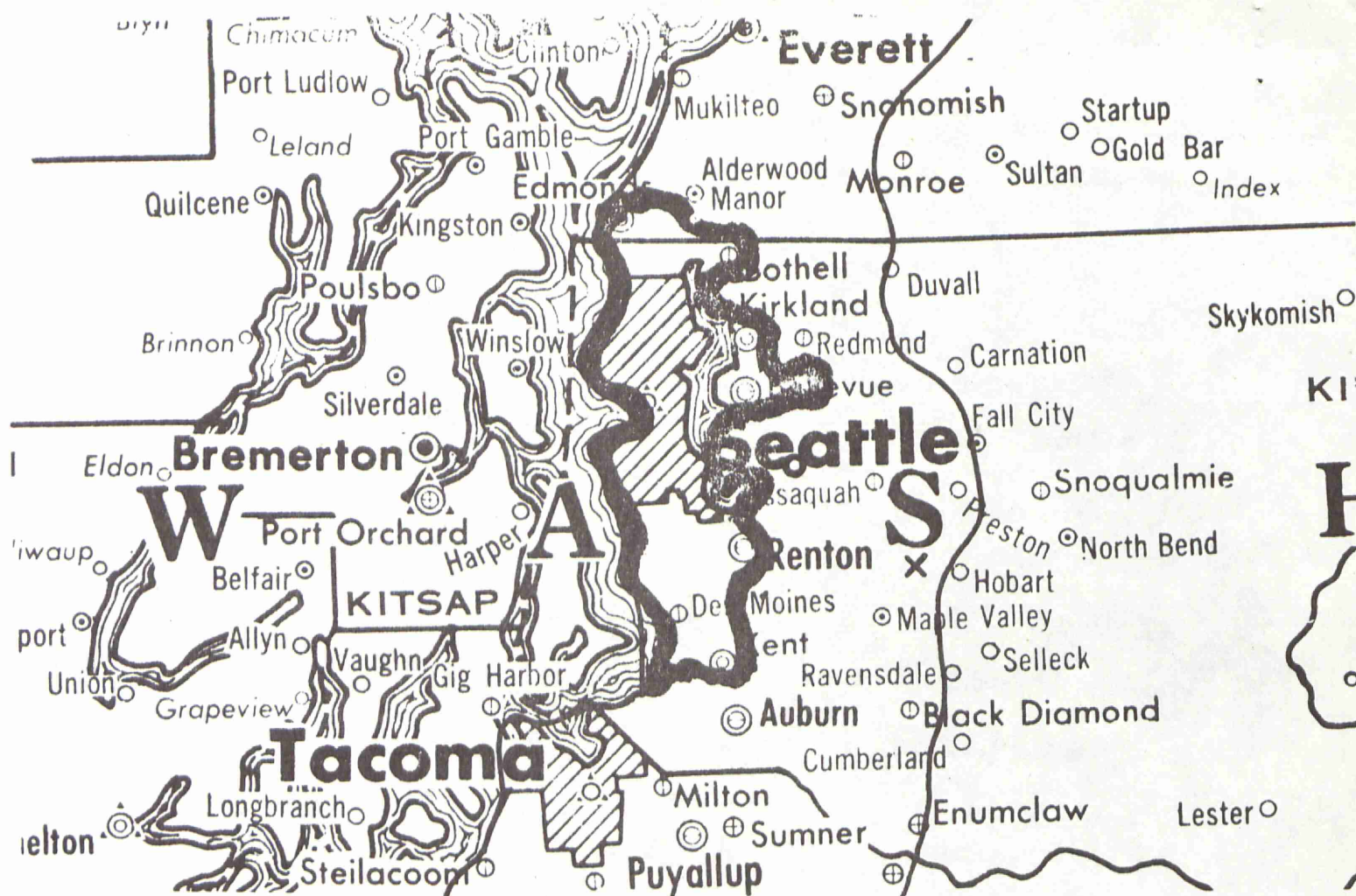
C-9  
RED-SAMM MINING CO., REDMOND, WASHINGTON (36 MILES)

# SEATTLE



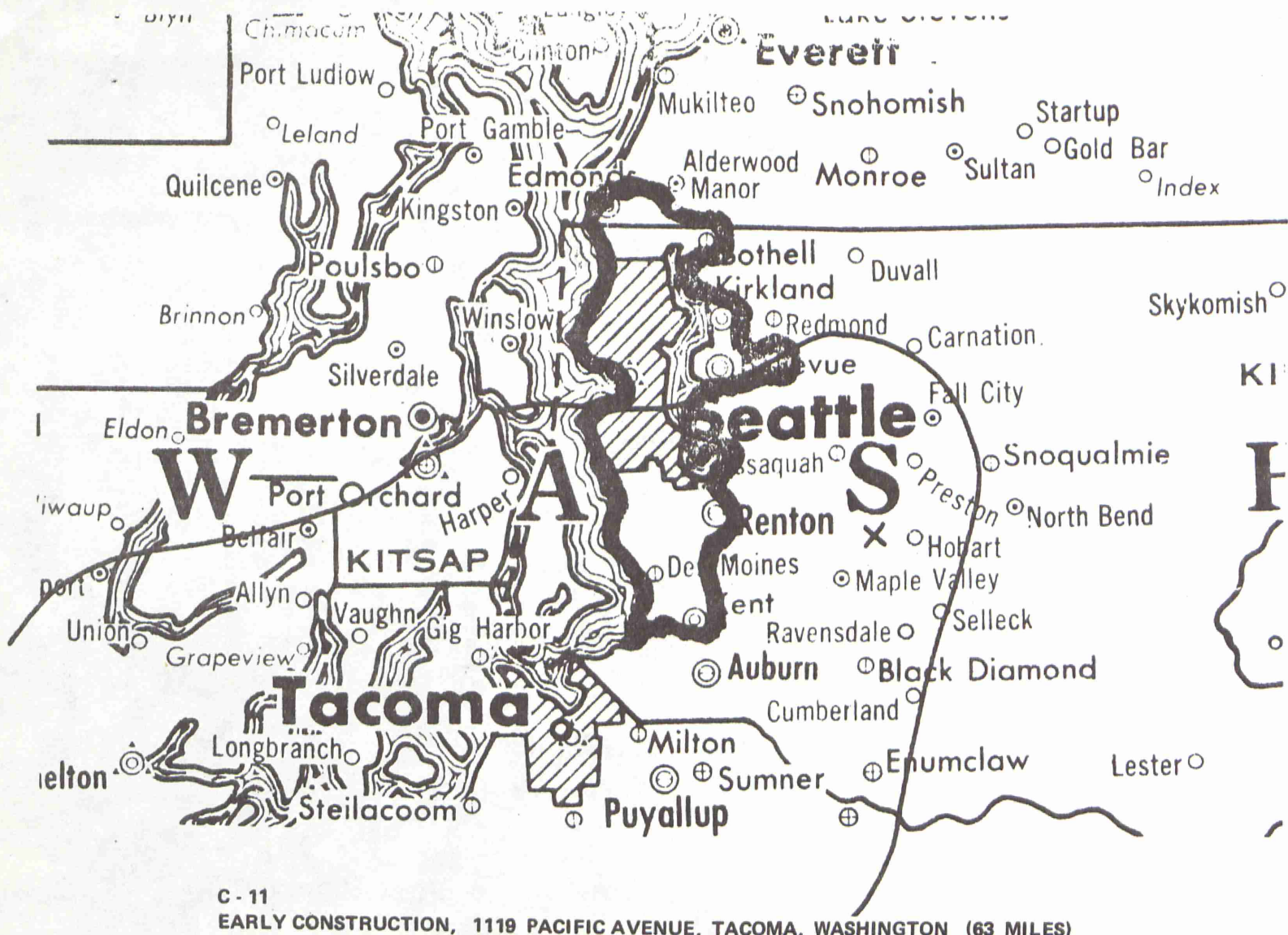
Copyright, American Map Co., Inc. No. 17501-A





# SEATTLE





C-11

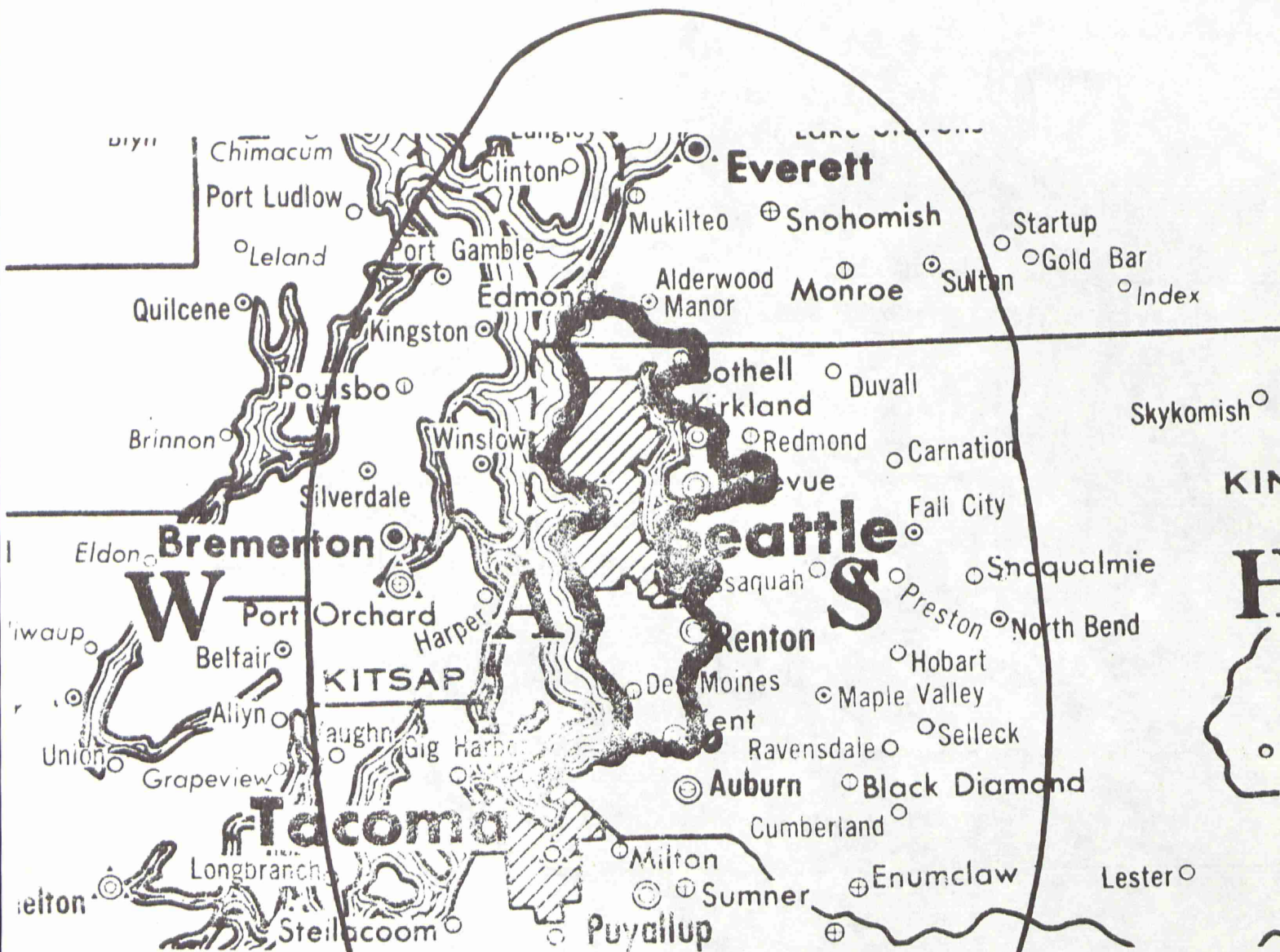
EARLY CONSTRUCTION, 1119 PACIFIC AVENUE, TACOMA, WASHINGTON (63 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





C-12

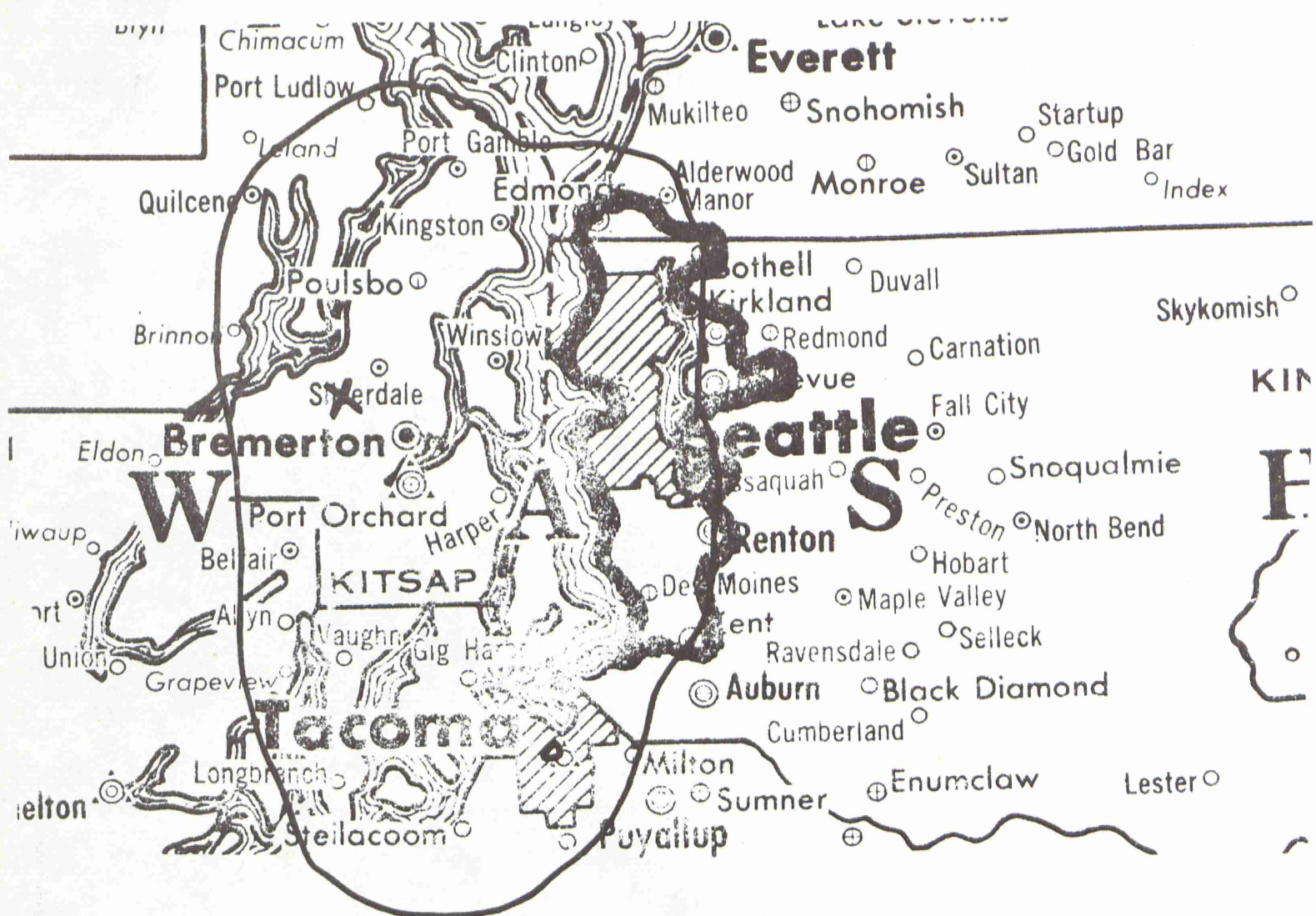
M. A. SEGALLE, INC., 18010 57TH SOUTH, KENT, WASHINGTON (44 MILES)

SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





C-13

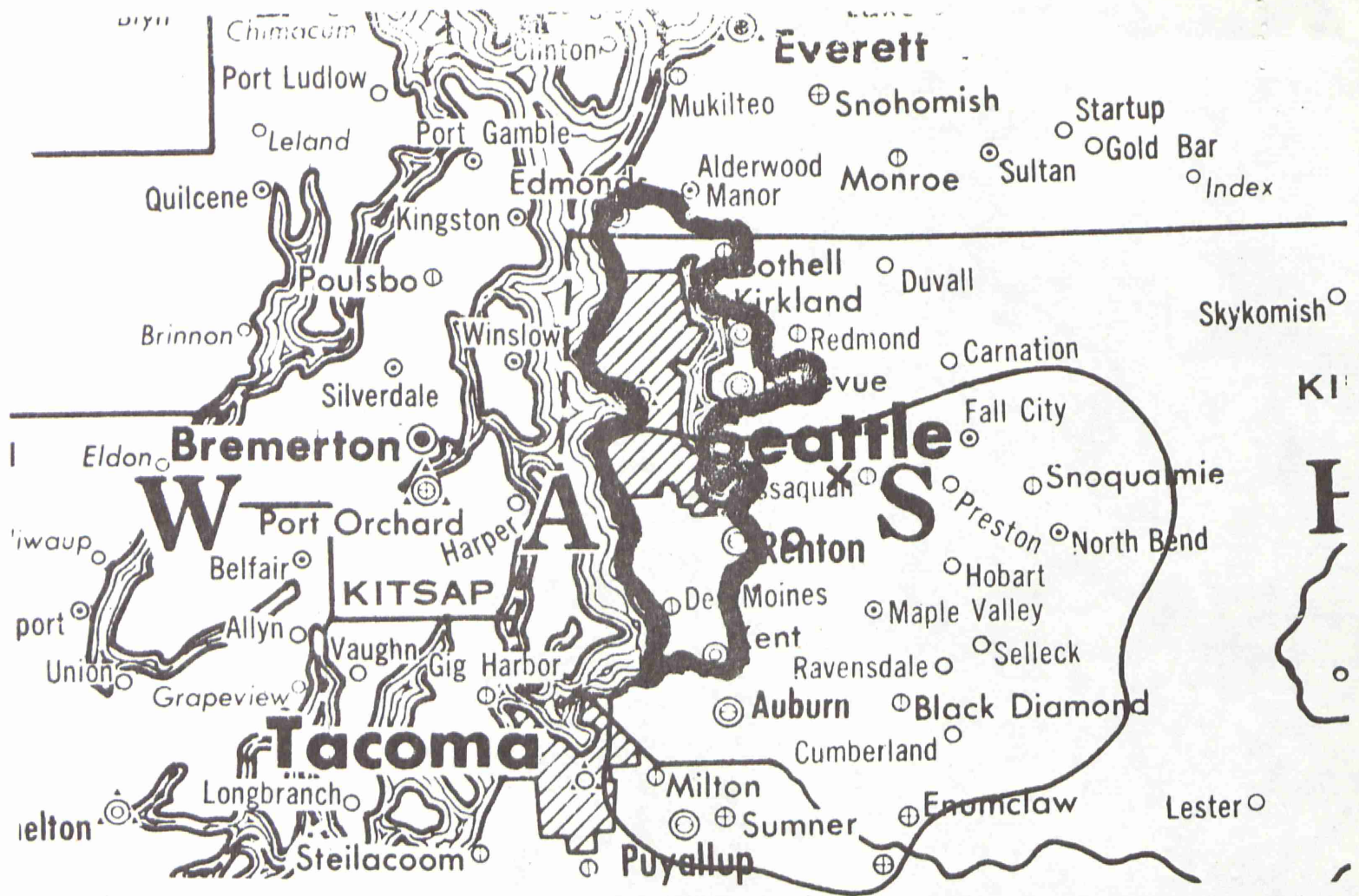
BEAGH GRIGGS CO., 920 CENTER STREET, TACOMA, WASHINGTON (36 MILES)

SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





C - 14

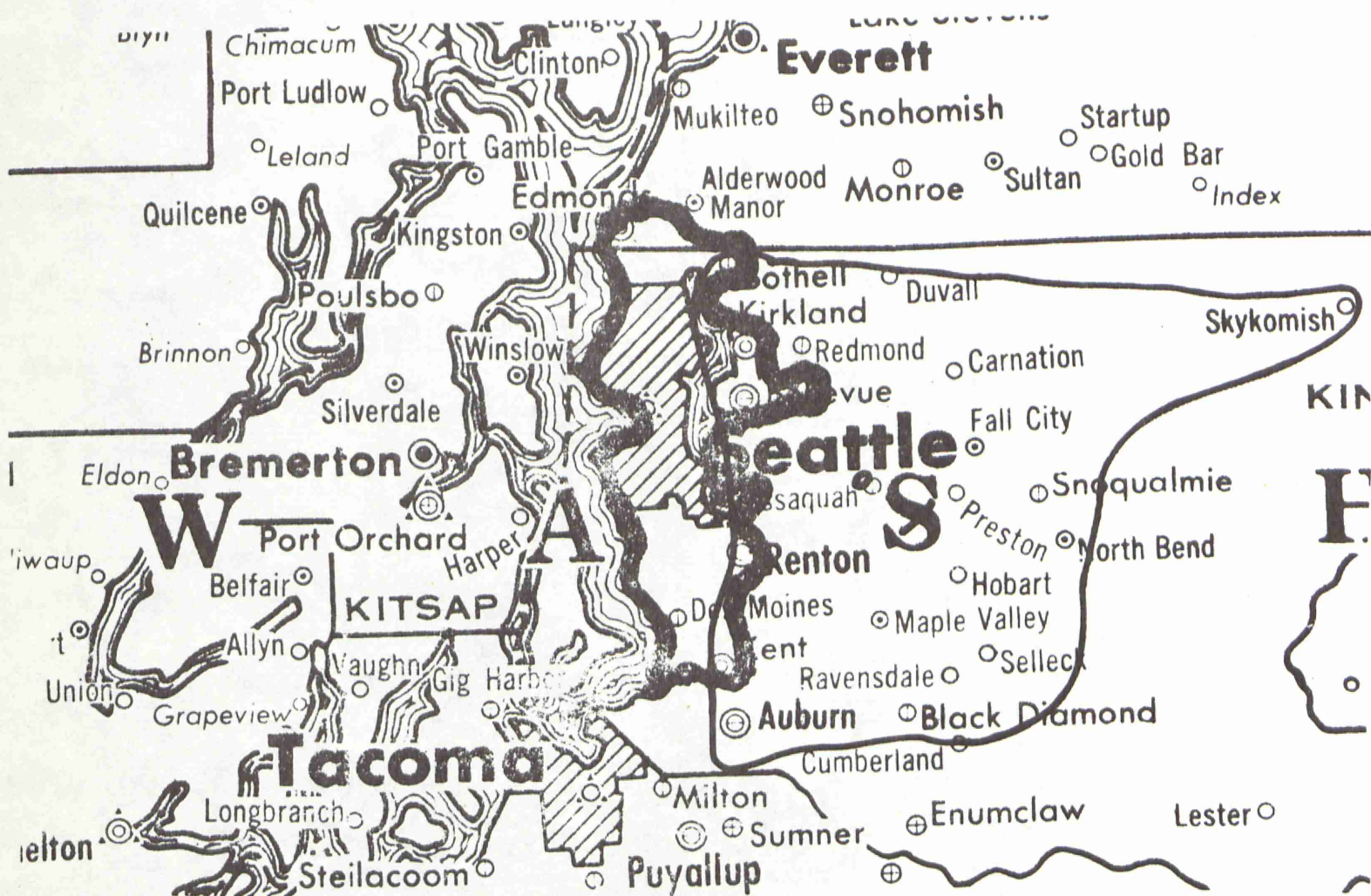
STONEWAY SAND & GRAVEL, MAPLE VALLEY HIGHWAY, RENTON, WASHINGTON (28 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A





C - 16

TOM ANDERSON PLUMBING, 108 - 10TH NORTH, ISSAQUAH, WASHINGTON (32 MILES)

# SEATTLE

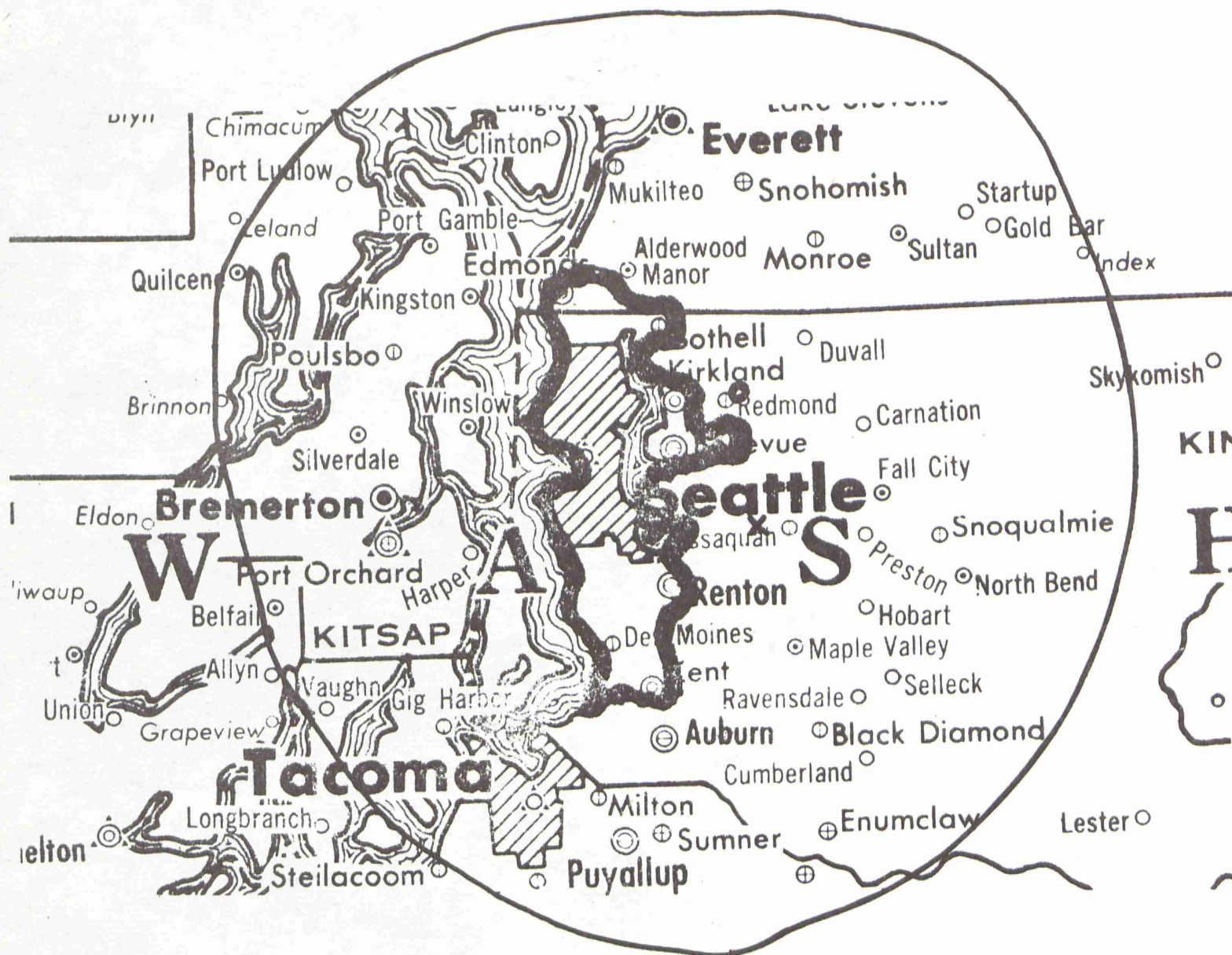


Copyright, American Map Co., Inc. No. 17501-A









C - 17

BROWN'S EASTSIDE ROOFING, 7706 196TH AVENUE, N.E., REDMOND, WASH. (43 MILES)

# SEATTLE



Copyright, American Map Co., Inc. No. 17501-A



IMPACT OF MILEAGE SEPARATION REQUIREMENTS BETWEEN  
LAND MOBILE BASE STATIONS OR MOBILE OPERATING  
AREA AND THE LOCATION OF ADJACENT OR CO-CHANNEL  
UHF-TV STATIONS

---

As was demonstrated in Exhibit 1, the application of a boundary limitation such as the "urbanized area boundary", particularly the 1960 urbanized area boundaries, will preclude the use of these frequencies by many land mobile licensees whose operations extend beyond the urbanized area boundaries.

Exhibit No. 2 demonstrates that the antenna height and power limitations set forth in proposed Section 89.102(e) of the Rules, will further preclude the use of these frequencies even by those licensees whose areas of operations are within the urbanized area boundaries, since the antenna height and power limitations will not afford sufficient range reliability or coverage for many of these licensees.



Some land mobile users whose operating areas are entirely within the boundaries of the urbanized area and whose operations are such that the range reliability afforded by the maximum antenna height and power limitations set forth in Section 89.102(e) would be adequate for their operating requirements, still could not effectively use these frequencies in substantial portions of many of the urbanized areas, because parts of these urbanized areas fall within the minimum distance from the co-channel or adjacent channel UHF-TV stations as prescribed in Section 89.102(d) of the Rules. Land Mobile licensees whose base stations are located in those portions of the urbanized areas which fall within the minimum mileage separation cannot use the maximum antenna height and powers in Section 89.102(e) which, at best, affords marginal range reliability. Rather they must further reduce their power and antenna height



with resulting reduced range reliability or coverage.

The tabular chart, designated FIGURE 1, lists the urbanized areas where such encroachment occurs. It is noted that 13 of the top 25 urbanized areas suffer such encroachment.

The impact of this limitation is graphically depicted in FIGURES 2 through 5 which show those portions of the 1960 urbanized areas of Cleveland, Pittsburgh, Philadelphia and Boston, where base station operations will be curtailed because portions of these urbanized areas fall within the minimum mileage separation criteria set forth in Section 89.102(d). It should be noted that with respect to each of the urbanized areas depicted in FIGURES 2 through 5, all of the frequency bands which are available for base station operations suffer, to varying degrees, this encroachment resulting from the mileage separation criteria.



EXHIBIT NO. 3  
LMCC COMMENTS  
FCC DOCKET NO. 18261  
Page 4

The net effect is that the maximum power and antenna height provided for in Section 89.102(e), which is needed to derive, at best, marginal range reliability and coverage, can only be used in portions of each of these urbanized areas. Thus, even if the Commission would eliminate altogether the urbanized area limitation concept, the distant separation requirements set forth in Section 89.102(d) would effectively preclude land mobile licensees from using these frequencies in many portions of these cities and the areas surrounding them.



FIGURE 1

URBANIZED AREAS WHERE ENCROACHMENT RESULTS FROM  
LAND MOBILE-TV STATION SEPARATION REQUIREMENTS

New York - Northeastern New Jersey

Los Angeles - Long Beach

Chicago - Northern Indiana

Philadelphia

Detroit

Boston

Washington, D. C. - Maryland - Virginia

Pittsburgh

Cleveland

Baltimore

Milwaukee, Wisconsin

New Orleans

San Diego



Figure 2  
CLEVELAND URBANIZED AREA

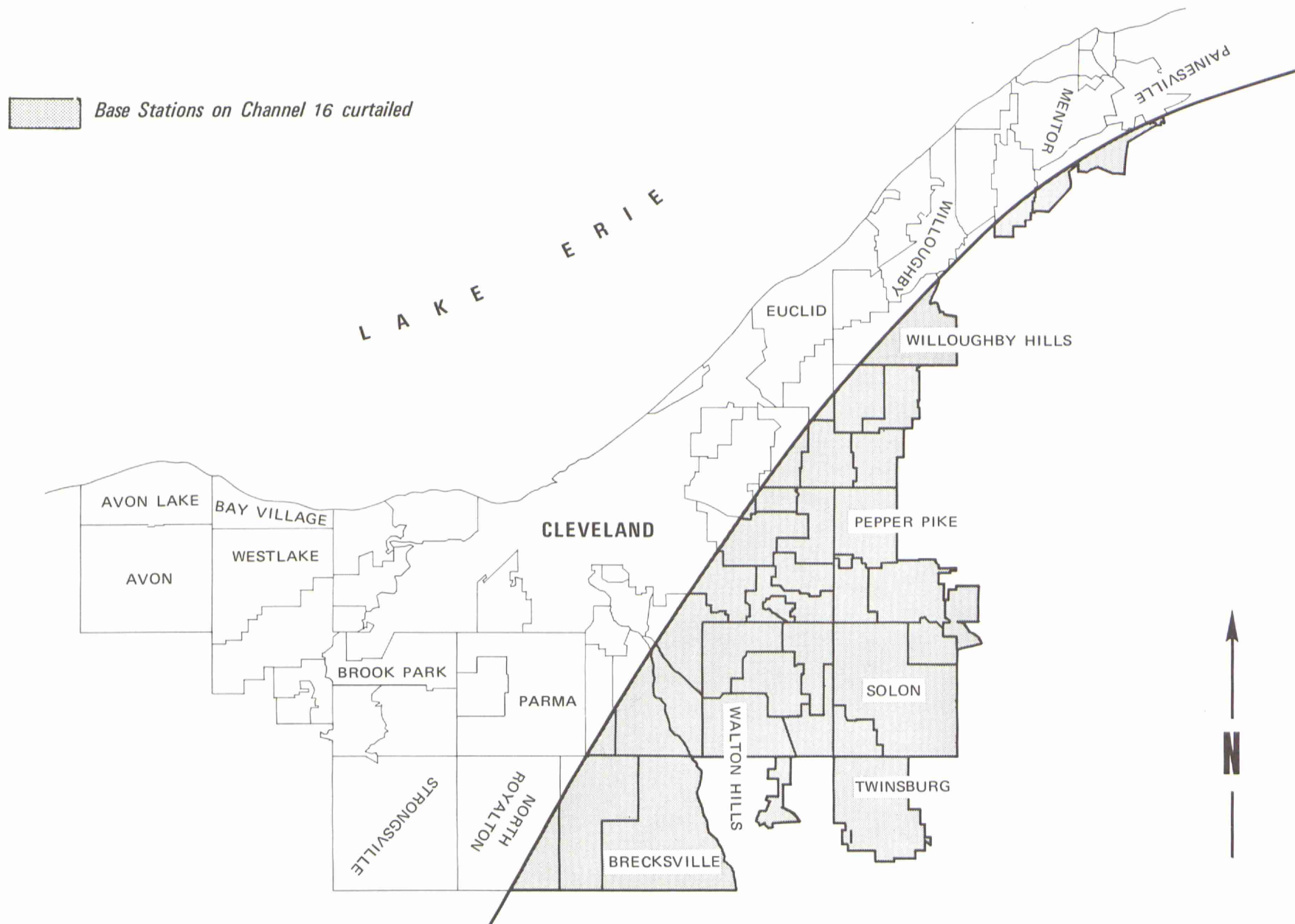




Figure 3  
PITTSBURGH URBANIZED AREA

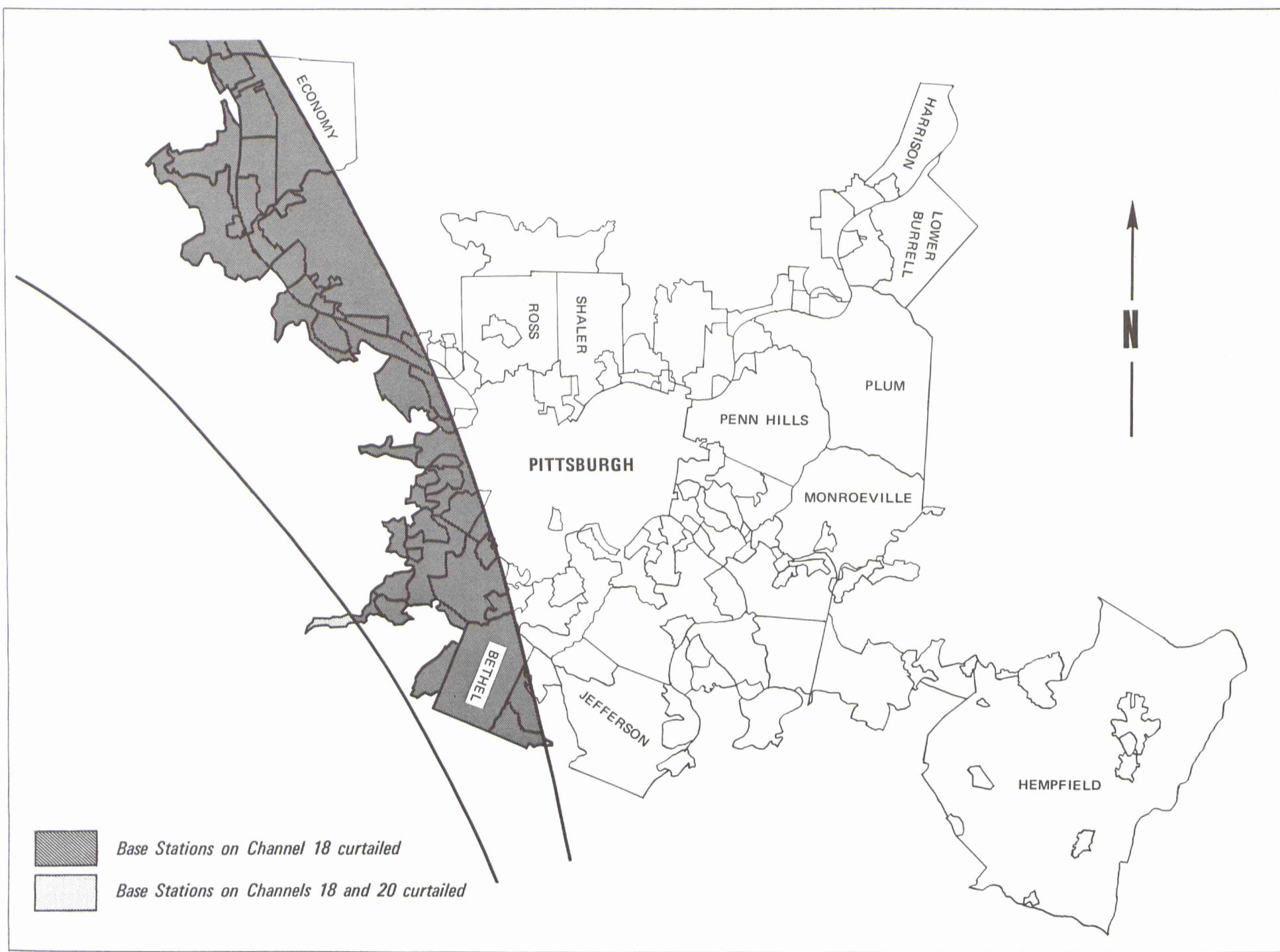




Figure 4  
PHILADELPHIA URBANIZED AREA

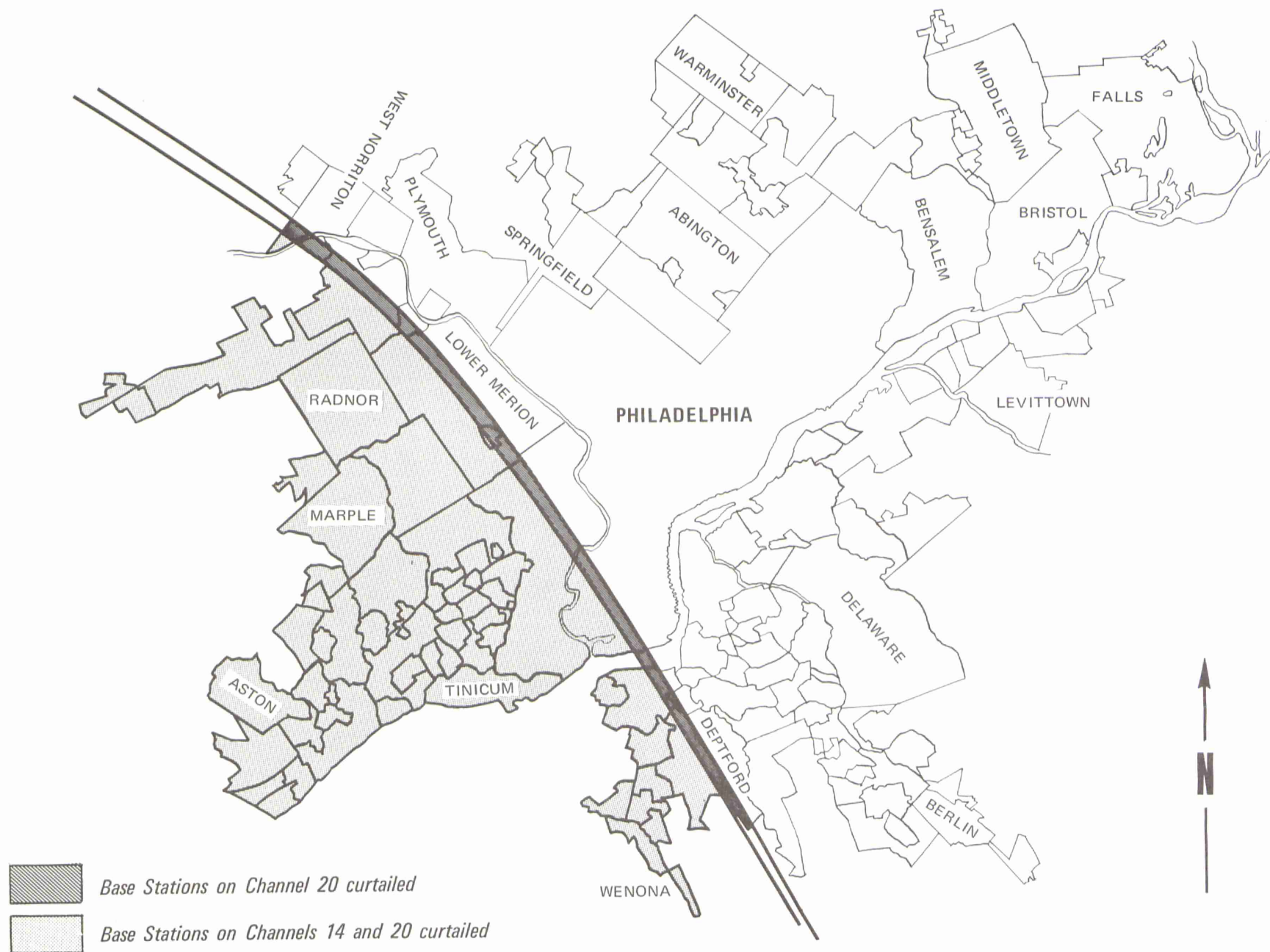




Figure 5  
BOSTON URBANIZED AREA

