UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
Boston Edison Company, et al.	)	
(Pilgrim Nuclear Generating Station,	)	Docket No.
Unit 2)	)	50-471
	)	LOCAL PDR

TESTIMONY OF PHILIP B. HERR ON PILGRIM 2
POPULATION DENSITY AND OTHER SITE
CHARACTERISTICS, SUBMITTED BY INTERVENOR
COMMONWEALTH OF MASSACHUSETTS
IN SUPPORT OF ITS CONTENTION NO. 12

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Commonwealth Contention 12:
Neither Applicants Nor Staff Have
Adequately Considered the Alternative
of Locating the Proposed Plant at a
Site More Suitable from a Population
Density and Environmental Standpoint.

My name is Philip B. Herr, and I am an Associate Professor of City Planning at the Department of Urban Studies and Planning, Massachusetts Institute of Technology. A copy of my resume is attached.

I. NRC SITING POLICY

It has been long-standing NRC policy to require the siting of nuclear power reactors away from densely populated areas. In the event of a serious radiological accident, emergency off-site measures will obviously be far more effective in sparsely populated areas,[1/] and this judgment is now quantified in Reg. Guide 4.7: if projected population density within a thirty-mile radius of a potential site exceeds 500 persons per square mile at the time of initi operation or 1,000 persons per square mile at its retirement, then "special attention should be given to the consideration of alternative sites with lower population densitites."

It is apparent that the trip levels contained in Reg. Guide 4.7 serve a very significant function with respect to reactor safety; because some residual risk will remain even after all reasonably attainable safety measures are built into

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1/See Statement of Considerations, 10 CFR Part 100, 27 FR 3509 (April 12, 1962); Regulatory Guide 4.7 (November, 1975); "Commission Action Paper", SECY 78-137 (March 7, 1978).

the design of a proposed nuclear reactor, careful evaluation of the size and distribution of the population surrounding that reactor appears to have emerged as the NRC's primary means of ensuring that the consequences of any accident more severe than design-basis events are mitigated as much as possible, including the siting of the proposed reactor in a less populous area. Population density, therefore, functions as a threshold indicator of residual risk and the potential consequences of the so-called Class 9 accidents, i.e. those beyond the design basis of the reactor. If the trip levels of Reg. Guide 4.7 are exceeded, then "special consideration" should be given to alternative sites, including (one would assume) a close look at just how each of the candidate sites would fare in the event of a Class 9 accident.

II. POPULATION DENSITIES SURROUNDING THE PILGRIM UNIT 2 SITE

The methodology used by the Staff and the Applicant in determining the Pilgrim 2 population distributions is discussed in detail below, expecially those techniques that tend to understate the final figures and obscure risk potential in the area surrounding the Rocky Point site. As a preliminary matter, however, the results that were reported for 1985 are shown in Figure 1, a chart prepared by the Staff for the 1975 Safety Evaluation Report (SER) which I updated by using data from Table 1 of the 1978 Draft Supplement to the Final Environmental Statement (Draft Supplement). For 40 and 50 miles, the figures were exponentially interpolated from the Prelimary Safety Analysis Report (PSAR), Table 2.1-8.

FIGURE 1. POPULATION VERSUS GUIDELINE (1985)

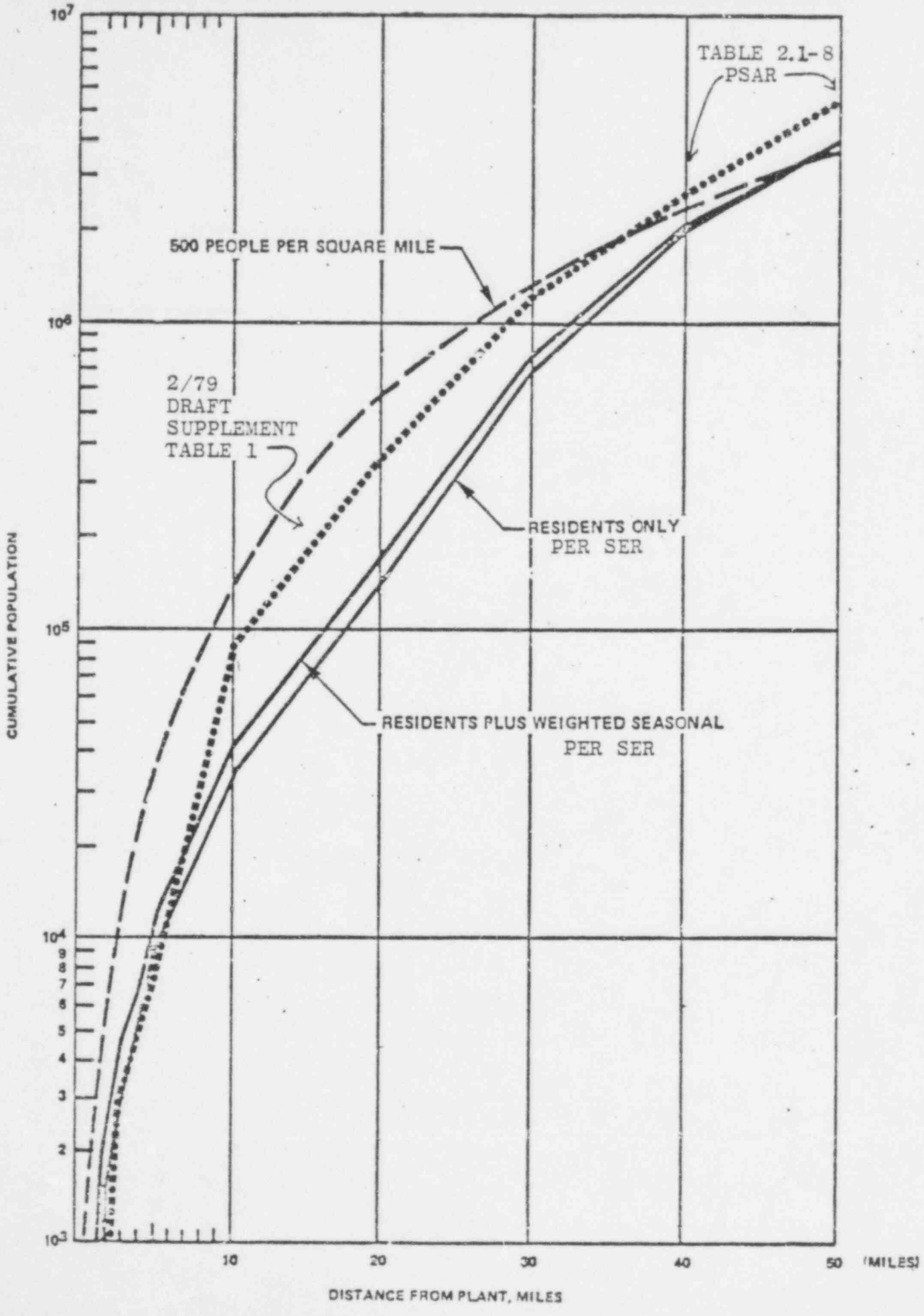

Figure 2.3 – CUMULATIVE POPULATION DISTRIBUTION

It is noteworthy that beyond ten miles the difference is much smaller between the 500 persons per square mile threshold line and the line plotting the most recent figures than between the recent figures line and the line plotting the earlier SER figures. It is also noteworthy that the 500 person per square mile threshold is reached only a modest distance beyond the 30 mile radius. Furthermore, should the initial year of commercial operation be deferred beyond 1985, the gap between projected population and the Reg. Guide threshold figure would be rapidly narrowed, given the UE&C estimated growth rate of nearly 2% per year.[2/]

Turning to the methodology employed in the Draft Supplement, if population density is to be used as an indicator of risk and as virtually the exclusive device for determining whether a Class 9 analysis is warranted as part of the NEPA review, then the work done by the Staff and the Applicant for Pilgrim 2 contains certain assumptions and ommissions that can not help but compromise the reliability of this factor.

A. Daily Recreational Visitors

First, neither the Applicant's 1978 update nor the Staff's Draft Supplement considers daily recreational visitors and tourists in determining population density, and the lines

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2/A 2% growth rate is in fact quite rapid: most recent year 2000 projections of Massachusetts population by the U.S. Bureau Census indicate between 0.6% and 0.8% per year statewide growth between 1975-2000 (see U.S. Bureau of the Census, "Population Estimates and Projections", Series P-25, no. 796, March 1974.

plotted on the chart at Figure 1 are understated to this extent. Of particular concern are daytrippers to tourist attractions in Plymouth itself; according to Table 2.1-4 of the PSAR, Mayflower II and the waterfront homes attract 400,000 tourists per year, and are only 4.5 miles west of the Rocky Point site, while Plimouth Plantation attracts 250,000 tourists per year and is only 2.5 miles west of the site. Six miles to the soutwest, Myles Standish State Forest attracts 300,000 campers and picnickers per year, and while some double counting clearly is present in the above figures, they all tend to corroborate a Plymouth Chamber of Commerce estimate that nearly one million persons per year currently visit the town.

One million person-days is equivalent to another 2,700 persons year-round on a time-weighted basis, most of those persons being located fewer than five miles from the Rocky Point site. This represents perhaps another 10% increase in the time-weighted population within five miles of the site, with smaller but significant percentage increases at greater distances. Of greater concern, however, is the fact that these people are not evenly distributed throughout the year, but for the most part visit Plymouth during the summer months, with a peak figure of 2,689 persons per day being reported by the Pilgrim Village and 3,400 per day (peak season) being reported by Mayflower II.[3/]

3/From May 14, 1979 conversation with David Case, Director of Plimouth Plantation, Inc.

The weighting methods employed by the Staff in measuring transients will be discussed in more detail below. For purposes of the Plymouth daytrippers, it suffices to note that exceptionally large numbers of people can be expected in close proximity to the site during at least two months of the year, people who already put a severe strain on Plymouth's traffic flow problems and people who will have had no prior instruction in emergency measures and no homes in which to shelter themselves.

B. Time Weighted Population Densities

In arriving at average population densities for the area surrounding the Rocky Point site, the Staff employed weighting factors of 1.0 for permanent residents and 0.25 for seasonal residents. As noted above, daily visitors were not considered at all, because the Staff concluded that when weighted these figures would be negligible (Draft Supplement, Section 3.3.3, pg. 20-21). Perhaps such weighting assumptions would hold true for an area experiencing moderate seasonal fluctuations in population, but when an area is as profoundly effected by tourists and summer residents, as is that surrounding the Rocky Point site, the use of weighted population density as an exclusive threshold indicator of residual risk is highly questionable. To the extent that the licensing process is concerned with the consequences of serious reactor accidents, it is illusory to obscure the crowded conditions that occur every summer in the Plymouth area by averaging the total transient inflow over the course of an entire year. A more realistic approach is suggested below in Section III.

C. Inclusion of the Water Area in Calculating Average Population Densities

The 53 municipalities which are at or less than 30 miles from the Rocky Point site have a projected 1985 population of 981,000 persons winter, 1,395,000 summer and a land area of 1,256 square miles, using the same sources and formulas as used by UC&E. This means a winter density of 780 persons per square mile of land area, a summer density (with summer-only population "discounted" at 100/365) of 870 persons per square mile, and an actual summertime population (seasonal plus year-round) of 1110 persons per square mile. These figures, which were derived by focusing exclusively on land area surrounding the site, are far more revealing than the Staff's in reflecting the actual living density of the area in question and local road capacity for evacuation, shelter or treatment.[4/] As with time weighted

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[4/] Indeed, even the sectoral analyses proposed below understates real density through inclusion of water areas. The south-southeast sector below Rocky Point has a five-mile density of under 2,000 persons per square mile, but the Priscilla Beach-White Horse Beach neighborhood which directly abuts the proposed station has a summertime density of about 20,000 persons per square mile, based on map measurement and PSAR data. That is the density for which shelter, evacuation and other emergency services must be adequate, not the sectoral density of 1,800 persons per square mile, or the time-averaged 30-mile density of about 400 persons per square mile.

population densitites, the Staff's methodology amounts to a gamble that certain variables (in this case, wind direction) will minimize consequences of a serious radiological accident. To the extent that population density is used as the NRC's exclusive indicator of people at risk, then such an approach appears questionable.

III. MAXIMUM RISK TO POPULATION

When assessing the comparative risk of a major accident in the site selection process, a question of critical concern is what the worst consequences will be at a given site. In order to rationally evaluate alternative sites, a decision maker must be able to assess the most likely consequences of an accident at each site, measured by the maximum number of people who might be exposed to risk. A determination of "average" risk to "average" population, as measured by Regulatory Guide 4.7, fails to capture the variations in population seasonality, density and distribution of unique site characteristics relevant to the inquiry of maximum risk.

At locations having unusual spatial and temporal distributions of population, as is true for the Rocky Point site, cumulative annular average density alone is an inadequate measure of accident consequence, and therefore an inadequate measure of risk. There is no explicit discussion in the Staff's Draft Supplement dealing with comparison between sites regarding the maximum number of persons potentially at risk in the event of a major accident.

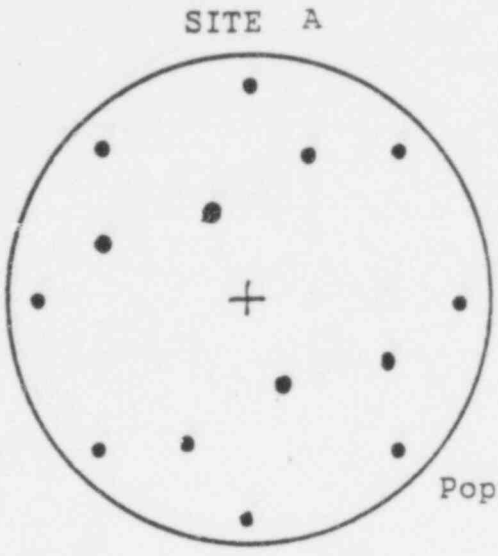
A realistic and useful analytic method for evaluating comparative accident risk, in addition to an average density analysis, is to assess the maximum consequences measured by the

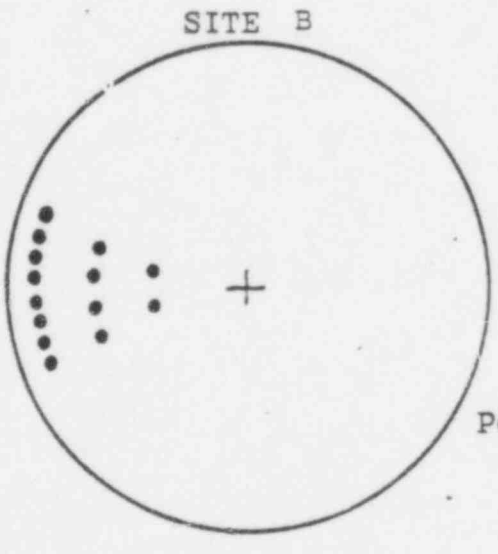
population at risk. Such a method permits examination of unique site and population characteristics, which are necessary and relevant for an intelligent assessment of accident consequences.

The difference between the "expected value" analysis, which was done by the Staff, and the maximum risk analysis, which was not, can be illustrated by two hypothetical sites having equal numbers of nearby residents but different spatial configurations, as shown on Figure 2. The "expected value" of population risk is identical in the two cases: the expected value of risk is the product of the numbers of persons within a prescribed radius and a probability function, both of which are the same for each site. However, in the event of a major accident resulting in a westward plume, the affected population requiring evacuation, shelter, or other protective actions is perhaps seven times higher at Site B than at Site A. Site B can be said to have an unacceptably high number of persons potentially at risk. Only on an "expected value" basis are the two sites equivalent. If the objective of the analysis is to minimize maximum risk, or to avoid exceeding an acceptable threshold of risk, Site A is a far superior selection.

The demographic analysis done to date for the Pilgrim II site selection has measured and compared the time-weighted population summed over all directions, thus analyzing the expected value of population risk. However, study to date omits any explicit comparative analysis of sites regarding maximum risk in the event of a major accident. Because of that omission, studies to date fail to reflect the special site characteristics of the Rocky Point site: in some directions at some times, relative to its average

FIGURE 2. RISK: EXPECTED VERSUS MAXIMUM





density, this site exposes a high number of persons to risk. In this regard Rocky Point is more like hypothetical Site B than Site A.

There are two variations from the uniform distribution, assumed in the expected value model, which deserve analysis: temporal and sectoral.

A. Temporal Analysis

Both the PSAR and the Applicant's 1978 Update to the UE&C Siting Study focus on "weighted" seasonal population, appropriate for expected value analysis, but obscuring other critical concerns. For example, the PSAR "discounts" the 1975 peak seasonal population of 25,277 persons within five miles to 4,318 on a time-weighted basis. However, if an accident were to necessitate a five-mile evacuation in the summertime, there in fact would be 25,300 visitors requiring information, guidance, traffic capacity and shelter, not 4,300. The 1978 Update indicates a "weighted" 1985 population within five miles of Rocky Point at 19,800 persons. Similarly, this estimate grossly understates the magnitude of the evacuation task should one be necessitated in the summertime. Decision-makers are provided with no information to allow comparison of these maximum populations with those at other sites.

At ten miles, the issue of temporal variation is similarly obscured. The 1978 Update reports a "weighted" 1985 population of 58,000 within ten miles of Rocky Point. Our analysis of recent projections by the Old Colony Planning Council, Metropolitan Area Planning Council, and Cape Cod Planning and Economic Development

Commission largely support that figure on a weighted basis (we estimated 61,200 weighted population), but our analysis indicates a summer peak population of 76,800 persons, and this is exclusive of daytrippers. A population of 76,800 within ten miles is more indicative of the true number of persons potentially exposed to risk and the necessity of immediate relocation in the event of a major accident in the summertime. On fair weather days, an additional 10,000 persons can be expected to be within this zone of concern because of tourist attractions in the Plymouth area: beaches, historic sites, boating, sightseeing.[5/] The consequence of a summer accident, in fact, would involve half again as many persons as the weighted average suggests.

B. Sectoral Analysis

A sectoral analysis of population around a site permits examination of true population distributions, which are otherwise obscured by calculations of average densities. An assessment of persons and site characteristics located within a radial sector is a highly relevant consideration to a site evaluation of maximum risk of a major accident.

Population distribution surrounding the Rocky Point Site is extraordinarily uneven by radial sector. This extreme variation in distribution is shown on Table A, which provides cumulative permanent population (excluding seasonal residents and daytrippers) by 22.5° sectors (See PSAR, Table 2.1-8). The table demonstrates clearly that some sectors have as much as four times the average (mean) sectoral population. This dramatic variation in population

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5/See, PSAR, Table 2.1-4.

TABLE A

1990 PERMANENT POPULATION BY SECTOR, 0-30 MILES*

N	0
NNE	0
NE	0
ENE	1,830
E	4,740
ESE	24,050
SE	61,080
SSE	39,615
S	46,387
SSW	33,739
SW	131,131
WSW	96,085
W	142,324
WNW	290,996
NW	328,327
NNW	70,946
Mean	79,453
Total	1,271,250
Standard deviation:	97,591

* PSAR, Table 2.1 - 8

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distribution is not narrowly confined to one or two sectors, as indicated by the sectoral standard deviation of 97,591. Figure 3 illustrates geographically where the sectors of cumulative permanent population occur around the Rocky Point Site.

The following provides an examination of two sectoral regions of special concern to the assessment of maximum risk of a major accident at the Rocky Point Site.

1. The Northwest

The population density of the region northwest of the Rocky Point site is dramatically high. Nearly one half of the cumulative permanent population within 30 miles of the site is concentrated in the two northwesterly sectors (See Table A and Figures 3 and 4).[6/]

The northwest sector alone is projected to have a 1990 population of almost 330,000, and a density (excluding seasonal population and net in-commuting) of 1,858 persons per square mile.[7/] This average density is nearly quadruple the guideline density of 500 persons per square mile calculated for the date of plant

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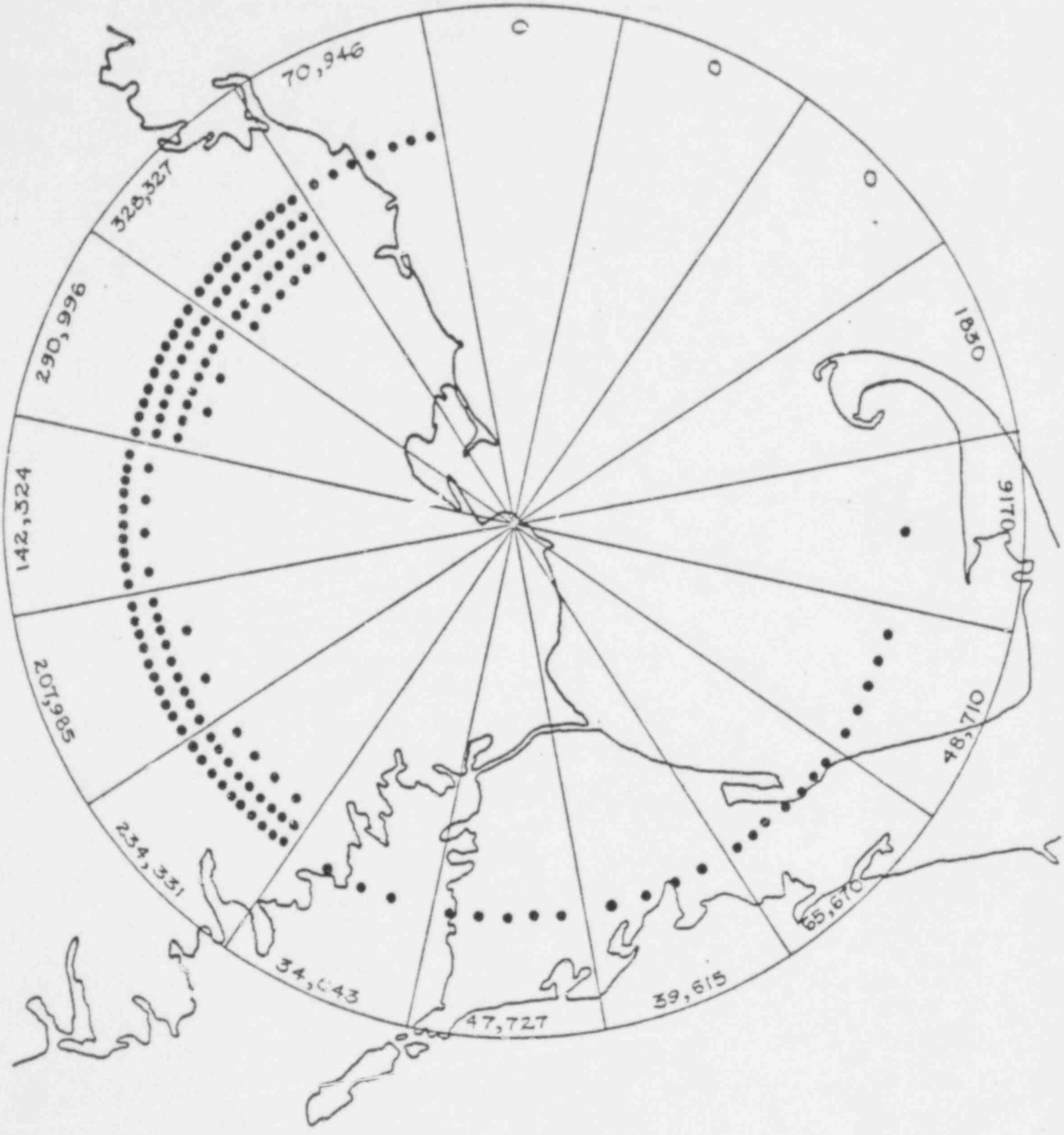
6/The total cumulative permanent population (excluding seasonal residents and daily transients) for the northwest (NW) and west-northwest (WNW) sectors in 1990, at a radial distance of 30 miles, is estimated to be 619,323. The Applicant has estimated the total cumulative permanent population for all 22.5° sectors at 30 miles to be 1,267,220 in 1990. (See, PSAR, Table 2.1-8). Our independent calculation of these sectors, based on PSAR Table 2.1-8, indicates that the total permanent population is 1,271,050 (See Table A).

7/PSAR, Table 2.1-8; density calculated by author.

FIGURE 3:

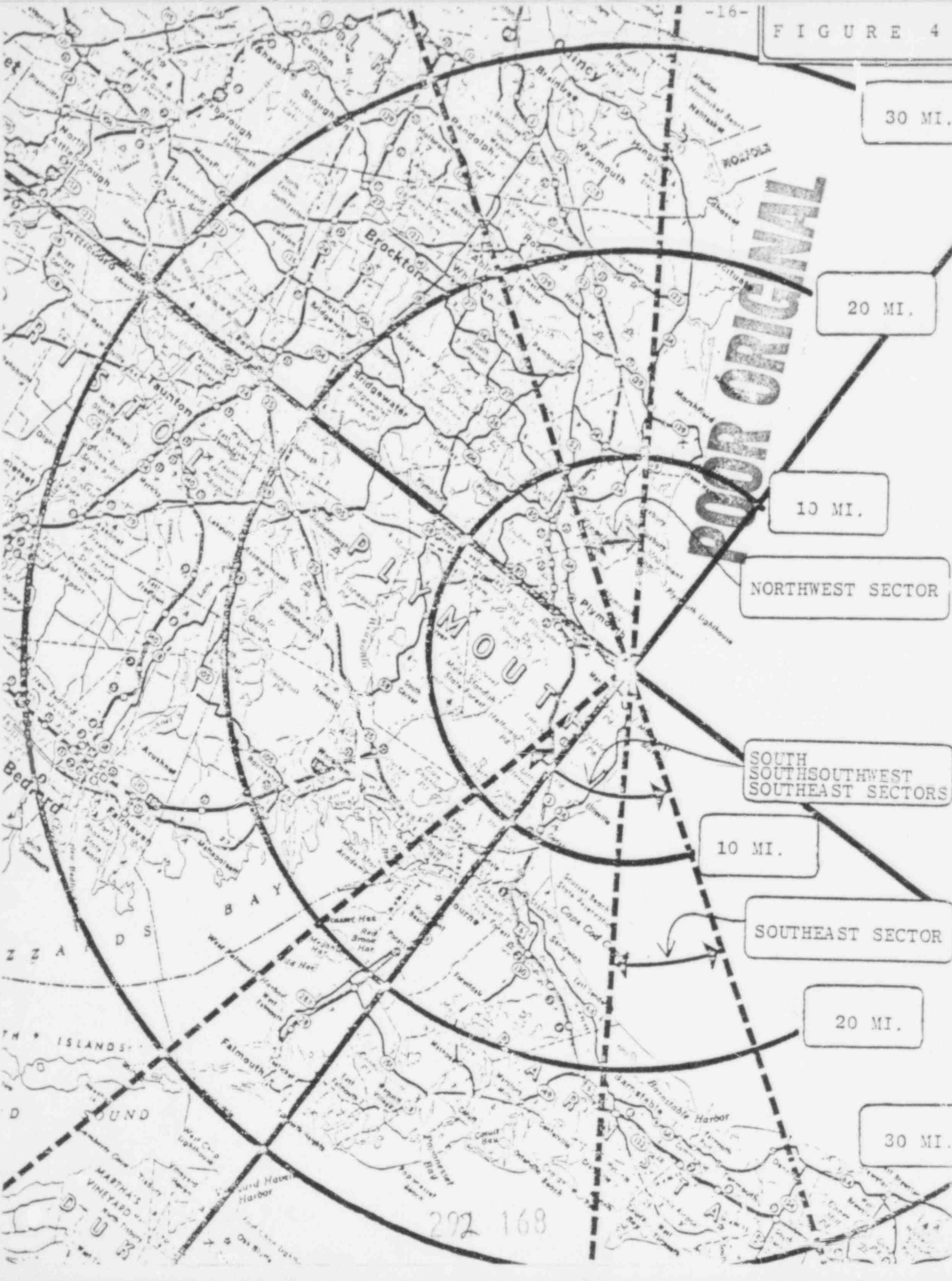
PERMANENT POPULATION BY SECTOR, 1990



• = 10,000 population

1990 Permanent Population,
30 Miles
Source: PSAR table 2.1-8

FIGURE 4



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operation.[8] In the year 2020, the northwest sectoral density, as projected in the PSAR, increases to 3,737 persons per square mile, or once again almost quadruple the guideline density of 1000 persons per square mile at the assumed end of plant life.

The Staff's application of the annual population density formula does not reveal the true numbers of persons at risk in this sector in the event of a major accident. Employing the staff's calculations, one would have to assume that for each alternative site each sector contains 1/16 of the total population. For Rocky Point, this would seemingly indicate approximately 77,000 persons will be located in the northwest sector in 1985, and approximately 160,000 persons in the sector in 2020.[9] In reality, as noted above, the numbers of persons potentially exposed to the risk of a major accident in this narrow 22.5° northwest section is far greater than the staff's analysis would suggest. The PSAR indicates that almost 330,000 permanent residents will in fact live in this sector in 1990, increasing to nearly 700,000 persons in 2020. In other words, a major radioactive release under wind

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[8]/NRC Staff Regulatory Guide 4.7, pp. 4.7-16. A 1990 date is used here for two reasons. First, the Applicant's PSAR population data (the only available source for sectoral analysis) is presented in ten year increments. Second, the NRC staff has indicated most recently that Pilgrim Unit [illegible] be needed until 1989/90. Accordingly, the year 19[illegible] to be a reasonable operational date for purposes of dem[illegible]nalysis.

[9]/See Draft Supplement, Table 1; persons per sector at 30 miles calculated by author.

conditions blowing to the northwest would affect a population as great as that affected at an alternative site having a uniformly distributed population averaging four times as high as that estimated for the Rocky Point site.

The potential exposure of 700,000 persons to hazard in the event of a major accident is clearly a relevant consideration in assessing the comparative risk to population at the Rocky Point site and its alternatives.

2. The Southeast

Another region of particular concern is that to the southeast of the Rocky Point site. This sectoral area is unique not only because of its population density and high seasonal fluctuations, but also because of its unusual land/water and transportation characteristics. It is within this region, which has the highest summer population, that the major transportation routes south from Rocky Point and from Cape Cod to the mainland converge. This convergence is significant in terms of both assessing total population at risk and the site specific problems associated with evacuation and emergency planning.

At thirty miles, the PSAR indicates a cumulative permanent 1990 population of 61,000 in the 22.5° southeast sector. A majority of this population is concentrated in the mid portion of Cape Cod, which is heavily impacted by population seasonality. The Pilgrim Area Conservation and Development Project data indicates seasonal population more than doubles seasonally in this area.[10/] These figures translate into a 1990 sectoral density of 850 persons per square mile, or a 2020 sectoral density of 2,000 persons per square mile during the summer season. The consequence of a major summertime accident with a southeasterly wind at Rocky Point, could be to expose to risk a population equal to that which would be affected at a site having a uniformly distributed population density double the guideline densities of 500 and 1,000 persons per square mile.

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10/See "Applicants Answers to the Commonwealth of Massachusetts' Interrogatories Set No. 4." (September 7, 1978).

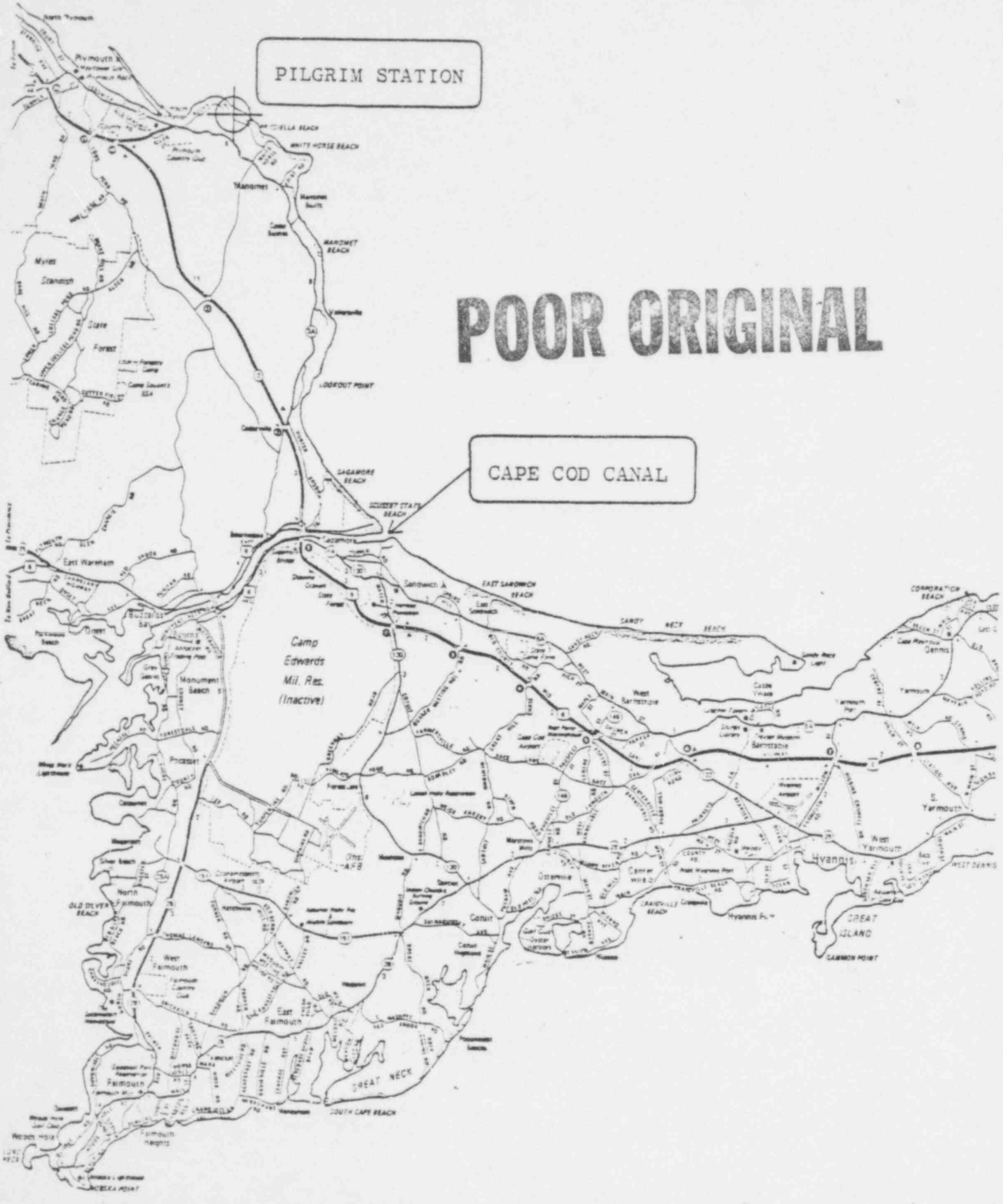
a. Unique Population and Site/Transportation Problems.

Egress configurations and limitations makes the southeast situation in the event of a major accident even more serious than population density suggest. As Figures 4 and 5 illustrate, there are special site circumstances regarding evacuation routes from the vicinity of Rocky Point, especially for population south or southwest of that site. Because of the presence of the Myles Standish State Forest and a vast largely undeveloped area, movement southwesterly through that area is possible only over a rudimentary maze of narrow, winding two-lane roads, many unpaved and discontinuous, all of them poorly marked.

As a consequence, the natural evacuation route for almost the entire population to the southeast, south, or southwest of Rocky Point is Route 3 southward to North Sagamore, then west along Route 6 on the northern border of the Cape Cod Canal (the "Scenic Highway") to Routes 25 and 6 leading west and northwest. A few persons may find and use Herring Pond Road, but that route leads almost unavoidably to the Scenic Highway as well. A few natives may thread their way to Glen Charlie Road in Wareham, the only real bypass to the Scenic Highway.

Evacuation from Cape Cod, whether voluntary or mandatory, would be via a road system notorious for its present deficiencies. Again, see Figure 5. For a variety of jurisdictional and policy reasons, those deficiencies are likely to only slowly be removed. Most obvious is the limitation that all egressing traffic must use the two Canal bridges of four narrow lanes each.

FIGURE 5



In the event of either voluntary or mandated evacuation, most Cape evacuees must move closer to the danger source in order to escape. The northern of the two Cape bridges, the Sagamore Bridge, is just over 10 miles from Rocky Point, and for much more than half of the potentially evacuating population from the Cape that is the easier bridge to reach. To avoid that bridge because of either congestion or hazard, only minor roads and a circuitous route are available for most of the affected population.

To estimate emergency road capacities, we have used lane capacities in common planning usage. Under ideal conditions, one lane of limited-access expressway can carry 2,000 vehicles per hour. Narrow unseparated lanes such as those on the Cape Cod Canal bridges or a road shoulder pressed into emergency use can theoretically carry up to 1,500 vehicles per hour. One lane on an ordinary country road is unlikely to carry more than 1,000 vehicles per hour. Three persons per vehicle is double the normally assumed vehicle occupancy, but is close to average household size.

In the event of a 1990 evacuation to 10 miles south of Rocky Point, we estimate a population of over 36,000 persons to be evacuated from the southeast through southwest quadrants.[11/] Based on an assumption of three persons per vehicle, this means

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11/The estimate of 36,000 for these three sectors is based on PSAR Table 2.1-8 (permanent population), with the percentage increase of seasonal population based on the same percentages shown in Table B. See, PSAR, Table 2.1-2a. Daytrippers are not included.

evacuating 12,000 vehicles over the Scenic Highway plus the back road maze. If two lanes of the Scenic Highway (which varies from 2 to 4 lanes) were reserved for westbound traffic and the Sagamore Bridge were closed to traffic leaving the Cape (in order to reserve Scenic Highway capacity for evacuees), the Scenic Highway would provide capacity for 3,000 vehicles per hour from the ten-mile zone. Another 1,000 vehicles per hour might use back roads. That means a three-hour minimum evacuation time, assuming no breakdowns, expert guidance, and good weather. This evacuation scenario is illustrated by Figure 6.

Meanwhile, there may well be Cape Cod population simultaneously seeking to leave the Cape. This would be the case if a twenty or thirty mile evacuation were suggested or ordered. Even without official notice, it is reasonable to assume that the Cape transient population would probably need nothing more than the remote threat of trouble to start heading for the bridges, since even rain produces that effect. In other words, it is not unreasonable to assume that persons will seek acess to the mainland from the Cape in the event of a major accident at Rocky Point.

However, giving priority to 10-mile evacuees on the vital Scenic Highway link would limit Cape Cod evacuation to about 100,000 persons with six hours as shown in Table B. Six hours is the maximum time during which access to the bridges and the Scenic Highway can be assured. This evacuation time is based on the assumption that a radioactive plume traveling in a south or southwesterly direction could reach this critical transportation

Figure 6 SAGAMORE BRIDGE CLOSED: EMERGENCY VOLUMES & CAPACITIES

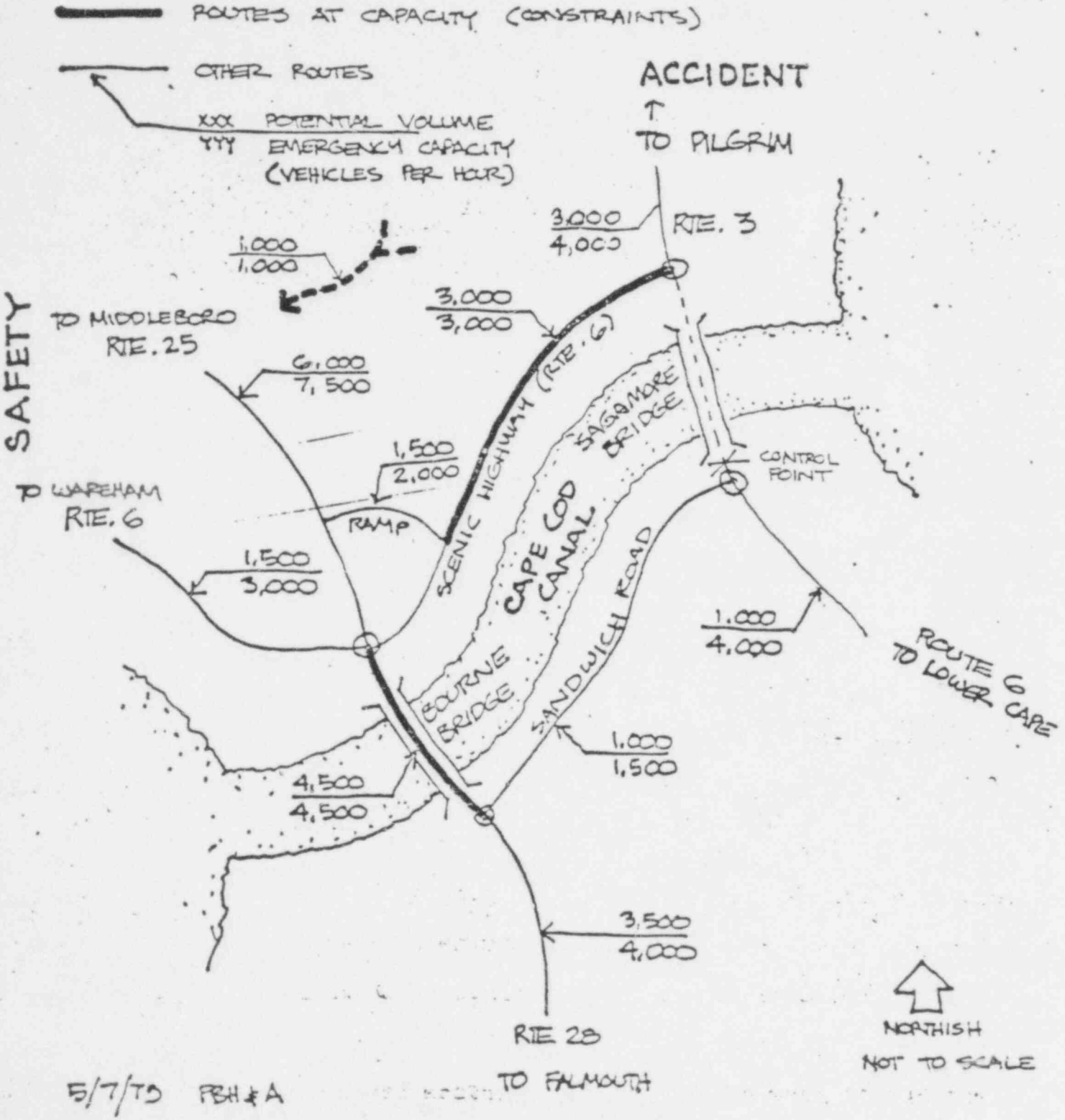

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TABLE B

CAPE COD EVACUATION CAPACITY

Hour*	Hourly capacity	Cumulative total
1	13,500 persons	13,500 persons
2	13,500	27,000
3	13,500	40,500
4	22,500	63,000
5	22,500	85,500
6 Assume Sagamore closed	13,500	99,000
7 Assume Bourne closed	0	99,000
		99,000

*Hour 0-3: Sagamore Bridge assumed to be closed to Cape population to allow evacuation of 0-10 mile area around Rocky Point (sectors SE, SSE, S, SSSW, SW only). Cape evacuation during this time is assumed only via Bourne Bridge.

*Hours 4-5: Both bridges accessible to Cape population.

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network within six hours, most likely causing thereafter the closure of the Scenic Highway and either or both of the Cape Cod Canal bridges.[12] See Figure 7.

The 1990 summer-only population of Cape Cod is projected to be about 360,000 persons, in addition to 180,000 year round residents.[13] That means that within 6 hours, only a quarter to a third of the tourists could get off the Cape, assuming all the natives stay home or in other shelters.

By similar analysis, it would take eight hours to accomplish a 10-mile evacuation of the 2020 population over that same road network, allowing only 80,000 to escape the Cape within six hours. By 2020, we estimate there will be approximately 680,000 persons within 30 miles of Rocky Point on the Cape in the summer (doubling the relevant PSAR table 2.1-8 sectoral permanent population figures). That means that one person in eight on the Cape could leave the pennisula in the assured time available, given optimal notice. It is easy to imagine that far more than one in eight persons on the Cape will seek immediate access to the mainland even if directed to stay home and seek shelter.

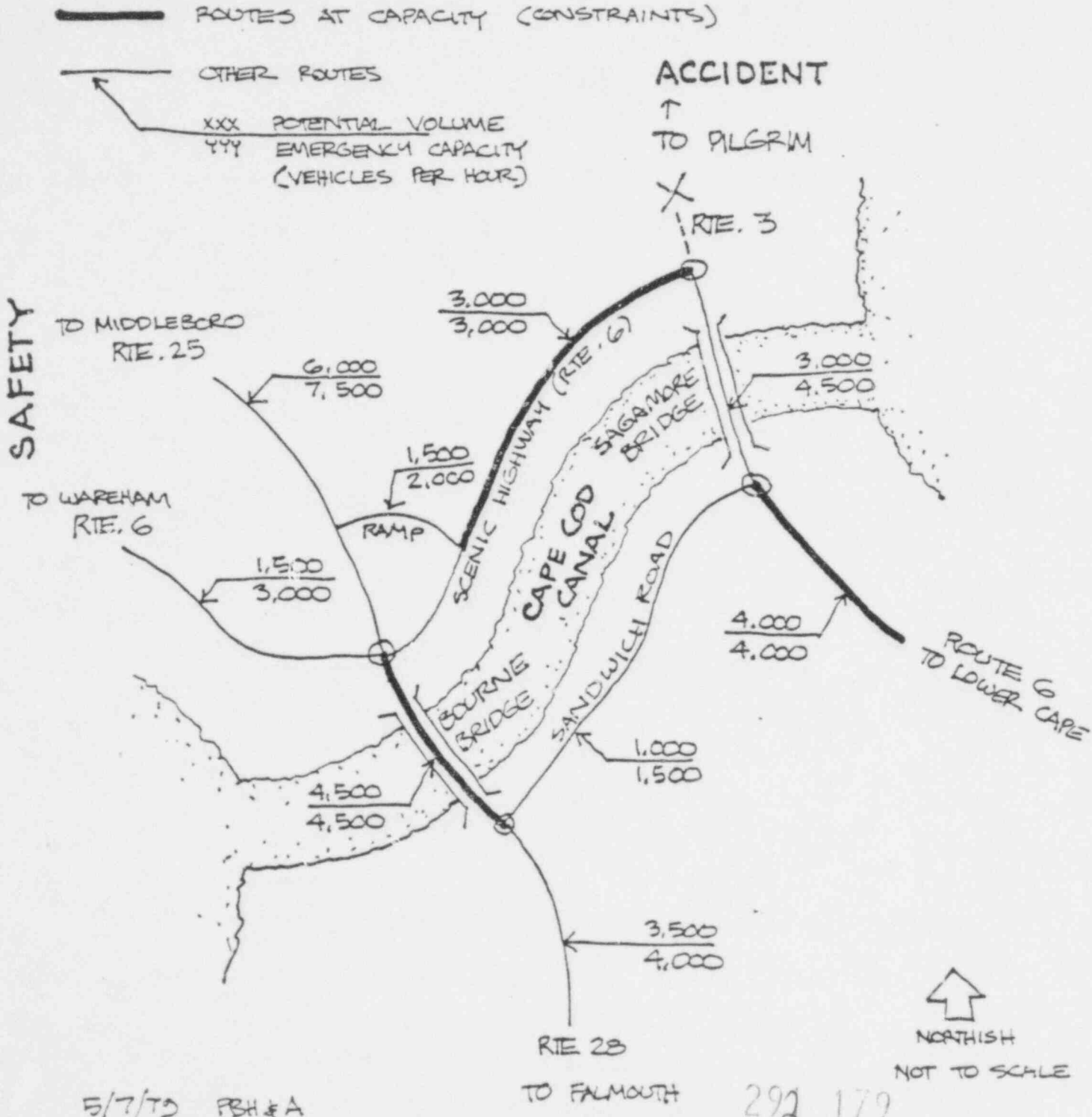
b. Nearby Population-South/Southeast

Maximum risk is of concern not only at the 10 to 30 distances impacting Cape Cod. At much closer range, the maximum risk in the event of accident is also far greater than suggested by average density figures, or by any of the data directly presented in the documentation prepared for or by the Staff.

12/ At a rate of travel based upon AEC Staff, "Population Distribution Around Nuclear Power Plant Sites", April 1973, pg. 2.

13/ Herr Associates, Development Projections for Cape Cod, for the CCPEDC, April, 1976.

Figure 7 ROUTE 3 NORTH CLOSED EMERGENCY VOLUMES & CAPACITIES



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The peculiar configuration of the Rocky Point site is such that a south-southeast plume trajectory would carry an accidental release along a coastal corridor densely populated in the summertime. PSAR Table 2.1-2a indicates "current" peak seasonal population by sector and out to 5 miles,[14] and when added to PSAR Table 2.1-8 permanent resident data for 1972 gives a fair reflection of early 1970's peak seasonal conditions (see Table C). On that basis, the south-southeast sector alone contained nearly 9,000 persons within 5 miles of the Rocky Point site during early 1970's summers, a density of 1800 persons per square mile, more than triple the 500 persons per square mile guideline of Regulatory Guide 4.7. The fact that this high density is "balanced" by lower densities at other seasons and in other sectors does nothing to diminish the magnitude of the problem of exposure if a major accident occurs at an unfavorable season under unfavorable wind conditions.

As with Cape Cod, the configuration of land, water and roads limit emergency evacuation measures. Based on PSAR data, Priscilla Beach, White Horse Beach and Manomet Heights have a summer resident population of some 7,000 persons; all are within a narrow arc and less than two miles from the Rocky Point site (see Figure 8). Only two narrow two-lane roads provide that population

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[14] We understand those figures to reflect early 1970's conditions and to be exclusive of year-round residents (Note that in some sectors 1972 "permanent" population from PSAR Table 2.1-8 exceeds "peak seasonal" population from Table 2.1-2a)

TABLE C

EARLY 1970's SEASONAL POPULATION BY SECTOR, 0-5 MILES

	Permanent	Peak Seasonal	Total
N	0	0	0
NNE	0	0	0
NE	0	0	0
ENE	0	0	0
E	0	0	0
ESE	0	0	0
SE	1,170	5,728	6,898
SSE	1,593	7,136	8,729
S	190	145	335
SSW	24	155	179
SW	285	96	381
WSW	532	215	747
W	3,894	3,491	7,385
WNW	1,575	6,712	8,287
NW	18	994	1,012
NNW	0	605	605
Total	9,281	25,277	34,558

Source: PSAR Tables 2.1-2a and 2.1-8

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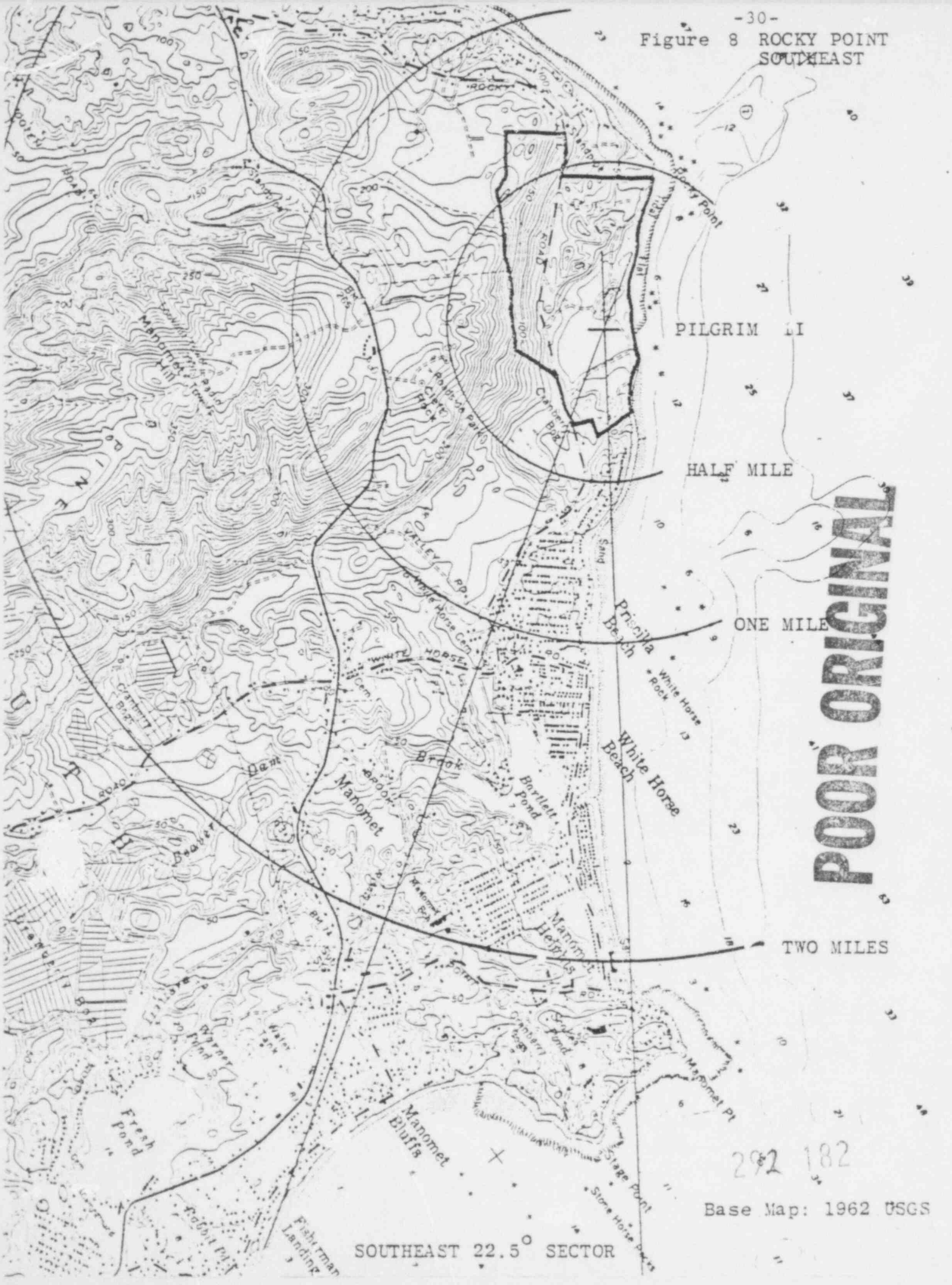
Figure 8 ROCKY POINT SOUTHEAST



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Base Map: 1962 USGS

SOUTHEAST 22.5° SECTOR

with egress to Route 3A. Any accident, breakdown or construction obstruction would seriously impair the ability of the network to accommodate emergency demand.

As with the larger area of concern, therefore, the special circumstances of ocean, density patterns and transportation networks within five miles of the site combine in perverse ways. At times, the Rocky Point site could expose far more people to risk than would a site of comparable average density but uniform sectoral and temporal distribution. Further, this problem is compounded by the fact that the areas of highest density proximate to the site have limited evacuation potential.

RESUME OF PHILIP B. HERR

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PHILIP B. HERR

EDUCATION

Massachusetts Institute of Technology, Masters in City Planning, J.C. Nichols Fellowship.

Rensselaer Polytechnic Institute, Bachelor of Architecture, Tau Beta Pi, Sigma Xi honoraries, Thesis Prize.

CURRENTLY

Associate Professor of City Planning, M.I.T., Department of Urban Studies and Planning. Courses and research in growth and land use planning, participation, coastal zone management, design, impact analysis.

Principal, Philip B. Herr and Associates, consultants in land use planning, development regulation, impact analysis, participatory design.

Member, Revere Beach Design Review Board (appointed by Secretary of Environmental Affairs).

Member, American Society of Planning Officials, Urban Land Institute.

Registered Architect, Commonwealth of Massachusetts.

RESEARCH PARTICIPATION

Development Impact Assessment, funded by Massachusetts Department of Community Affairs, through Herr Associates, 1975-1976, and Rockefeller Foundation, through M.I.T. Design of methods for local analyses of development consequences. Publication: Evaluating Development Impact, M.I.T. Laboratory for Architecture and Planning, August, 1978.

Environmental Impact Assessment, funded by Rockefeller Foundation and others through M.I.T. Laboratory for Architecture and Planning, 1976-1978 (with Lawrence Susskind and others). Studies of institutional considerations in assessing comprehensive consequences of infrastructure systems design, case study of coastal zone management.

Maine Development Strategy, funded by Rockefeller Brothers Foundation and Maine Bureau of Public Lands, through M.I.T. Department of Urban Studies and Planning, 1974 (with Lloyd Rodwin and others). Design of an approach to utilization of state-owned lands through new organizational approaches. Publication: Economic Development and Resource Conservation: A Strategy for Maine.

RESEARCH PARTICIPATION (continued)

Cambridgeport/Ecologue, funded by U.S. Office of Education, Office of Environmental Education, and others, through M.I.T. Department of Urban Studies and Planning, 1969-1972 (with Stephen Carr and others). Development of innovative methods for enabling community residents to develop neighborhood plans. Publication: article in Progressive Architecture, December, 1976.

Mobility for the Poor, funded by U.S. Department of HUD, through the M.I.T.-Harvard Joint Center for Urban Studies, 1968-1970 (with Aaron Fleisher). Analysis of travel patterns and disabilities of the poor, and of possible remedies, based on survey data from Boston, Memphis, St. Louis, Milwaukee and Baltimore.

CONSULTING

Participatory planning and design. Program design and technical assistance for a variety of New England towns and regional planning agencies, including Bourne, Edgartown, Franklin, Gloucester, Oak Bluffs, Rowe, Sharon, Sherborn, Sunderland, and Tisbury, Massachusetts; Hanover, New Hampshire; Cape Cod Planning and Economic Development Commission.

Innovative development control. Techniques designed have included growth timing (Bourne, Falmouth, Franklin, Greenfield, Sandwich); performance zoning (Clinton, Franklin County, Gay Head, Sandwich); transfer of development rights (TDR) (Sunderland); critical resource zoning (Sherborn, Sunderland); regional land use control (Franklin County, Martha's Vineyard Commission).

Other development control. Over twenty zoning bylaws and ordinances have been rewritten and adopted, numerous other controls designed and adopted in more incremental fashion.

Impact analyses. Cape Cod National Seashore (for National Park Service), open space acquisition (for Association for Preservation of Cape Cod), dog track (for Blackstone), PUD (for Natick), resort development (for Franklin County), nuclear power plant (for Franklin County).

Central area studies. Amherst, Andover, Gloucester, Lexington, Northampton, Salem, among others, in each case utilizing alternatives to conventional federal-aided urban renewal.

Regional efforts have included "208" Water Quality Management planning for Cape Cod, creation of a regional housing authority and regional building inspection system for Franklin County, model cluster zoning legislation for Cape Cod.

JOURNAL PUBLICATIONS

American Institute of Planners, Planners Notebook, October, 1973, "Performance Zoning: The Small Town of Gay Head, Massachusetts, Tries It", with Kevin Lynch.

Eno Foundation, Traffic Quarterly, April, 1962, "Timing of Highway Impact".

Urban Land Institute, Urban Land, February, 1960, "Regional Impact of Highways".

Extensive descriptions of Herr's community work have appeared in Progressive Architecture, November and December, 1976; Journal of the American Institute of Planners, January, 1975; The Land Use Controversy in Massachusetts (L. Susskind, Ed., 1975); Performance Standards: A Technique for Controlling Land Use, Oregon State University Extension Service.

PREVIOUS EXPERIENCE

Chairman, Planning Subcommittee, Governor's Task Force on Coastal Resources.

Member, Steering Committee, Coastal Zone Management Program.

Director of Planning (subsequently, President), Economic Development Associates, Inc.

Research Associate, Greater Boston Economic Study Committee.

Consulting Associate, Adams, Howard and Greeley.

Planner, City of Berkeley, California.

Instructor, Boston University, Wentworth Institute, Boston Architectural Center.

Architectural draftsman/designer, George W.W. Brewster, Warren C. Obes.

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:	)	
	)	
BOSTON EDISON COMPANY et al.	)	
	)	Docket No. 50-471
(Pilgrim Nuclear Generating Station, Unit 2)	)	

I, LAURIE BURT, hereby certify that the foregoing "Testimony of Phillip B. Herr on Population Density and Site Characteristics Surrounding the Pilgrim Unit 2 Site, Submitted by Intervenor Commonwealth of Massachusetts In Support of Its Contention No. 12" has been served on the following by depositing copies thereof in the United States Mail, first class postage prepaid, this 14th day of May 1979:

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U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

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