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PRELIMINARY SITE SELECTION FOR PUBLIC TEST OF POLARIZED HEADLIGHTING

by

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ABSTRACT

A test site is required in which all motor vehicles can be modified by the incorporation of polarized headlight systems and operated on the public streets and highways. The site selected must be free from the intrusion of unmodified transient vehicles. These requirements can be best met by an island accessible only by ferry or oceangoing ships. All feasible locations in the United States and Canada were surveyed from available literature and by correspondence with local authorities. Five sites have been found to have high potential, but only an on-the-spot survey will determine which is the most acceptable.

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I. INTRODUCTION

Prior phases of this study have demonstrated the potential of polarization of vehicle headlights for providing adequate illumination of the highway and virtual elimination of glare from approaching vehicles.[1,2]* A preliminary cost-benefit analysis of the application of a polarized headlight system to all vehicles in the U.S.A. has revealed that many pertinent factors relating to the determination of the feasibility and desirability of such a course of action are only poorly known or understood.[3]

Particularly lacking at this time are factual information and data concerning the costs to the overall vehicular traffic and transportation system of inadequate headlights on automotive vehicles. Even such seemingly direct and important relationships as the number of accidents caused by glaring headlights of oncoming vehicles are recognized in the accident reporting procedures of only a few states. More subtle factors, such as accidents caused by overdriving the headlights (operating at speeds at which the stopping distance is greater than the visibility distance ahead), are universally unrecognized in accident reporting by any of the states. Additional benefits of improved highway visibility and elimination of glare, which cannot be adequately evaluated because of insufficient data, concern the potential improvement in highway utilization at night with consequent increase in traffic flow, higher safe driving speeds resulting in decreased travel time, and greater use of highways at night by older or glare sensitive drivers. Improved visibility of the road provides for better guidance with reduced traffic turbulence, marginal and interlane friction, and, hence, smoother and more efficient traffic flow.

Numerous additional factors of more subjective nature which have been observed and show improvement with polarized lighting but which can not be adequately supported by objective measurements relate to reduced tension and fatigue in driving. Increased detection distance available by use of polarized headlights will provide a longer period for "decision time" for the driver. What effect this will have on accidents, traffic flow, and efficiency of operation may be conjectured, but is not specifically known.

These deficiencies of supporting data were recognized early in the program, and it was determined that the most expeditious means of developing such data would be to conduct a test of the glare reducing system in a normal, rural/urban, real highway environment utilizing the driving public as test subjects. Such a test, conducted over an adequately long period of time under appropriate controls and with proper review of prior experience in the test site, should be capable of providing detailed data of benefits, advantages, disadvantages, operating costs, modification and operating problems, system inadequacies, and overall public response and acceptance, which have not been confirmable to date.

*Superscript numbers in parentheses refer to references listed on page 19.

The site selected for such a test to have requisite credibility should provide as near a cross section of the country's motoring public, highway system, and environment as possible. It must furthermore, and perhaps most importantly, be a location which can be kept essentially isolated, insofar as the intrusion of vehicles having normal, unpolarized headlights is concerned. There would be a short transition period during which vehicles in the test site area would be equipped with the polarized headlight systems, but this would be followed by an extended period when all operations would be with polarized headlights. The conversion period would be an expedited representation of a nationwide conversion to polarized lighting. The intrusion of unmodified vehicles after the initial transition period would adversely influence the data being developed. This requirement predisposes the selection of the site to an island accessible only by ferry or boat with a relatively small influx of unmodified transient vehicles which could be expeditiously modified before being allowed to mix with the other traffic.

Review of pretest traffic experience available from normal traffic surveys, accident reports, and especially developed studies and public interviews would be made to provide the base against which changes engendered by the incorporation of the new lighting system would be measured.

Upon completion of the test, sufficient data would be available to determine the feasibility of the nationwide adoption of polarized lighting with specific knowledge of all of the pertinent factors of cost, effectiveness, benefits and deficiencies, public acceptance, and operational characteristics in regular highway use.

II. TEST SITE EVALUATION AND SELECTION

A. Site Characteristics

The aim of such a public test as has been discussed is that the results to be obtained will be representative of those to be obtained throughout the country with full scale adoption of polarization. In order that this may be expected, it will be necessary to identify and select those site and environmental characteristics which have major influence on the motorists' performance and insure that these are as nearly representative of the whole as possible.

There is a primary requirement for isolation of the test area to avoid the continuous presence of unmodified headlight systems from uncontrolled influx of transient vehicles passing through the site. On the other hand, there is no technical reason why vehicles from the test site with polarized headlights cannot be operated outside the test site in the presence of other unmodified vehicles, as might be necessary for commuter traffic. The analyzer on the modified test site vehicle would be ineffectual in reducing the glare from the other vehicles' headlights, but by the same token, the polarized headlights of the modified vehicle would present no different appearance to the drivers of the unmodified vehicles. One factor which is of concern in operating test site vehicles outside the test area is the potential pilferage of polarizers from the headlights while these vehicles are parked and unattended, unless the polarizers are integrated with the headlamp lens. The novelty of these devices will make them particularly attractive to curious teenagers.

Other essential features of terrain, environment, highway, and motorists must also be considered:

(1) Road configuration;

(2) Vehicle population by number, type, and age;

(3) Traffic flow within and transiting site;

(4) Terrain and topography;

(5) Climate;

(6) Driver population.

  (a) Mean and distribution as to sex, age, and driving experience.

  (b) Accident experience.

1. Road Net

A complete variety of roads and highways should be available ranging from multilane divided freeways to rural two-lane roads and urban streets. Each road type should be of sufficient length and traffic volume that a reliable statistical sampling of motorists' performance can be assured, but the proportion of unlighted, two-lane rural to other types of roads should be not less than ten to one. Urban areas should include fixed lighting with a normal range of illumination intensities and uniformity ratios.

2. Vehicles

A representative ratio of passenger vehicles to trucks, buses, and other commercial vehicles should be available with approximately the same vehicle age distribution as the national average. In order that an adequate sample of traffic operations may be obtained, not less than 5,000 vehicles should be present in the test site. An upper limit must also be considered in order that costs for conversion kits may be kept within reasonable limits. It is considered that a vehicle population of less than about 5,000 will not provide adequate nighttime traffic levels to generate the volume of traffic situations and accidents needed to evaluate the proposed system, and, depending on the traffic characteristics of the area, even this may be too few vehicles on which to base the experiment.

3. Traffic

Nighttime traffic levels should be sufficient to provide a representative quantity of meetings, intersection encounters, passing maneuvers, and similar typical traffic situations both in rural and urban areas. After the initial transition period of a few weeks, all vehicles on the roads at night should be limited to use of the test headlight system. The number of vehicles coming into the test site must be limited to sufficiently low volumes as can be immediately modified before being allowed to operate on the roads after dark.

4. Topography

A representative variety of terrain, topographic, and ecologic features should be present including flatland, hills, straight and curved roads, farmland, and wooded areas to provide varied conditions of roadside features and background contrasts together with horizontal and vertical movements of approaching headlight beams.

5. Climate

A full range of climatic and environmental factors having influence on visibility should be provided to include clear and dry, haze, rain, fog, smoke, dust, and snow.

6. Drivers

As nearly as possible, the distribution of the population of drivers in the test site should be representative of the national averages with respect to sex, age, driving experience, and rate of accident involvement. No adjustment can be made in this regard for a given site, of course, but, if a choice of sites is possible, this factor becomes of concern in the final selection.

7. Accident Volume

Previous studies(3) have indicated, very conservatively, that some five percent of nighttime accidents may be caused by headlight glare. Since it is assumed that polarization will eliminate glare under most conditions of driving, it is desired that the site selected have a sufficiently high accident frequency for a prior period equal to that of the test period to indicate within a ten-percent confidence limit (± 5%) that a resulting change in accident experience during the period of the test is due to polarization of headlights.

It may be difficult to delineate these effects this accurately, however, Table I illustrates the variability of accident statistics experienced on several of the islands of Hawaii since 1961. It has not been determined that these are typical of all candidate sites, but they serve to illustrate the problem.

TABLE I. ACCIDENT RATES PER 100 MILLION MOTOR VEHICLE MILES

	Hawaii		Maui		Kauai	
Year	Rate	% Change*	Rate	% Change	Rate	% Change
1961	325.1	--	228.0	--	268.0	--
1962	312.1	-3.8	238.4	4.6	297.8	11.2
1963	311.7	-3.8	293.4	29.0	294.0	10.0
1964	379.0	16.5	237.7	20.0	372.0	39.0
1965	--	--	--	--	--	--
1966	361.0	11.3	298.0	30.7	297.0	11.0
1967	392.0	21.0	311.0	37.0	314.0	17.5

*% change from 1961 rates.

Thus, with year to year variations approaching as much as thirty percent in some cases and less than ten percent in others, it would seem to be essential that pretest analyses of accident causation, related particularly to the incidence of headlight glare and reduced visual capability in night accidents, be feasible, even if such data can only be extracted from individual accident reports. It is likewise essential that detailed analyses of accidents occurring after the initiation of the public test of polarization be conducted to determine the extents to which visual deficiencies are still present. It would seem improbable that statistical accident reduction values alone, without such a detailed review of accident reports, could be relied upon to delineate accident causation factors even at much higher nighttime accident frequencies than appears available in any of the sites studied.

B. Preliminary Site Selection

Consideration was given initially to the following locations (Table II) as possible sites for the public test.[5-11] Most of these were quickly eliminated from further consideration because of insufficient traffic, excessive transient traffic, or an inadequate road net.

In general, the prospective sites given consideration were islands since any other areas would generally be accessible by numerous roads and would present essentially uncontrollable problems with transient vehicles. If an island is accessible by bridge to the adjacent mainland area, it will still, in most cases, also be unsatisfactory by reason of excessive transient traffic.

Twelve sites (Table III) have been selected for detailed evaluation. These are isolated islands with vehicle access from the mainland by ferry or seagoing ship.

Further narrowing of this list of prospective sites may be made on the basis of a review of more detailed study of their characteristics.

1. Dukes Island/Nantucket Island (Figure 1)

These islands have a large seasonal fluctuation with an increase during the months of June through September of nearly eighty percent. Commuter travel indicative of increased summer population, varied in 1968 from 2,400 in January to 24,000 in August, with not less than 15,000 per month during the June through September period. Nonresident visitors bringing vehicles to the islands during this period averaged some 2,600 per month, but most were one day visitors. However, many of these could stay into the after-dark hours and would require temporary headlight modification. The peak average on a monthly basis would be about 150 per day; however, this is probably more accurately expressed in terms of five weekends at nine hundred vehicles with perhaps one-third remaining after dark. This would

TABLE II

Site	Comments
Vinalhaven Island, Maine	Ferry (2 points), vehicle population too small, insufficient road variety
Conanicut Island, Rhode Island	Bridge connection, excessive transient vehicles
Prudence Island, Rhode Island	Ferry, insufficient vehicle population and roads
Aquidneck Island, Rhode Island	Bridge connection
South Hero Island, Vermont (Lake Champlain)	Bridge connection
Martha's Vineyard (Dukes Island), Massachusetts	Ferry (2 points), good road net, acceptable vehicle population
Nantucket Island, Massachusetts	Ferry, good road net, acceptable vehicle population
Coinjack Island, North Carolina	Bridge connection, insufficient roads and vehicles
Beaufort Island, North Carolina	Bridge connection, too small
Alaska	Although isolated and having an extensive road system, nighttime traffic outside urban areas is not extensive and generally atypical of normal nighttime traffic in the mainland US.
Orcas Island, Washington	Ferry, good road net, small vehicle population, highly variable between winter and summer traffic
San Juan Island, Washington	Ferry, good road net, small vehicle population, highly variable between winter and summer traffic
San de Fuca Island, Washington	Bridge connection with large transient traffic, otherwise adequate
Vashon Island, Washington	Ferry (2 points), good road net, small vehicle population, high commuter population

TABLE II (Cont'd)

Site	Comments
Sturgeon Bay Island, Wisconsin (Lake Michigan)	Bridge connection, small traffic volume, highly variable between summer and winter
Bass Islands (Lake Erie)	Ferry, small vehicle population, insufficient roads
Prince of Wales Island, Alaska	Boat, insufficient roads and traffic
Catalina Island, California	Ferry (passenger only), insufficient traffic
Hawaii, Hawaii	Boat, large vehicle population, good road net, limited weather
Maui, Hawaii	Boat, large vehicle population, good road net, limited weather
Molokai, Hawaii	Boat, relatively small vehicle population, good road net, limited weather
Kauai, Hawaii	Boat, large vehicle population, fair road net, limited weather
St. Thomas, Virgin Islands	Boat, good vehicle population, extensive but obsolete road net, limited weather, atypical traffic characteristics
St. Croix, Virgin Islands	Boat, good vehicle population, large but obsolete roads, limited weather, atypical traffic characteristics
Prince Edward Island, Canada	Ferry (2 points), excellent road net, large vehicle population

TABLE III. SITE TRAFFIC CHARACTERISTICS

Site	Road Mileage Four-lane	Road Mileage Two-lane	Vehicles	Urban Areas/ Population	Veh Mi × 10^{-8}	Max ADT	Accidents Fatal/Inj/PD
Dukes Island[4]	-	80	5, 565[a]	3/5, 948[b]	-	1, 387[c]	-
Nantucket Island[4]	-	60	3, 636[a]	3/3, 714[b]	-	555[c]	-
Orcas Island[5]	-	45	2, 765[a]	7/734[d]	-	NA	0/12/3/total[a]
San Juan Island[5]	-	50	2, 765[a]	3/106[d]	-	NA	-
Vashon Island[5, 6]	-	50	NA	15/5, 900	-	-	-
Hawaii[7, 8]	NA	1, 338	31, 832[a]	4/61, 925[a]	2. 64	13, 830[a]	12/477/543[e] 4/196/186[c]
Maui[7, 8]	61[f], 37[g]	405[h]	24, 593[a]	4/38, 800[a]	1. 93	18, 640[a]	14/350/238[e]
Molokai[7, 8]	22[f]	59[h]	2, 247[a]	1/5, 850[a]	1. 93	2, 750[a]	8/123/81[c]
Kauai[7, 8, 9]	-	299	15, 568[a]	2/27, 110[a]	1. 23	11, 580	6/149/231[e] 3/65/100[c]
St. Thomas[10]	-	94	9, 000[i]	1/31/076[i]	1. 3	NA	5/346/1, 895[i]
St. Croix[10]	-	202	8, 700[i]	2/27, 645[i]	-	NA	14/431/642[i]
Prince Edward Is.[11, 12]	-	3, 371	36, 844[a]	3[j]/103, 000[a]	-	-	27/458/1, 346[e] 15/220/777[c]

(a) 1967
(b) 1965 (year around residents)
(c) Dusk to dawn 1967
(d) Registered voters 1968
(e) 1967 - All accidents
(f) Federal Aid Primary - rural
(g) Federal Aid Primary - urban
(h) Federal Aid Secondary and local
(i) 1968
(j) More than 100 villages

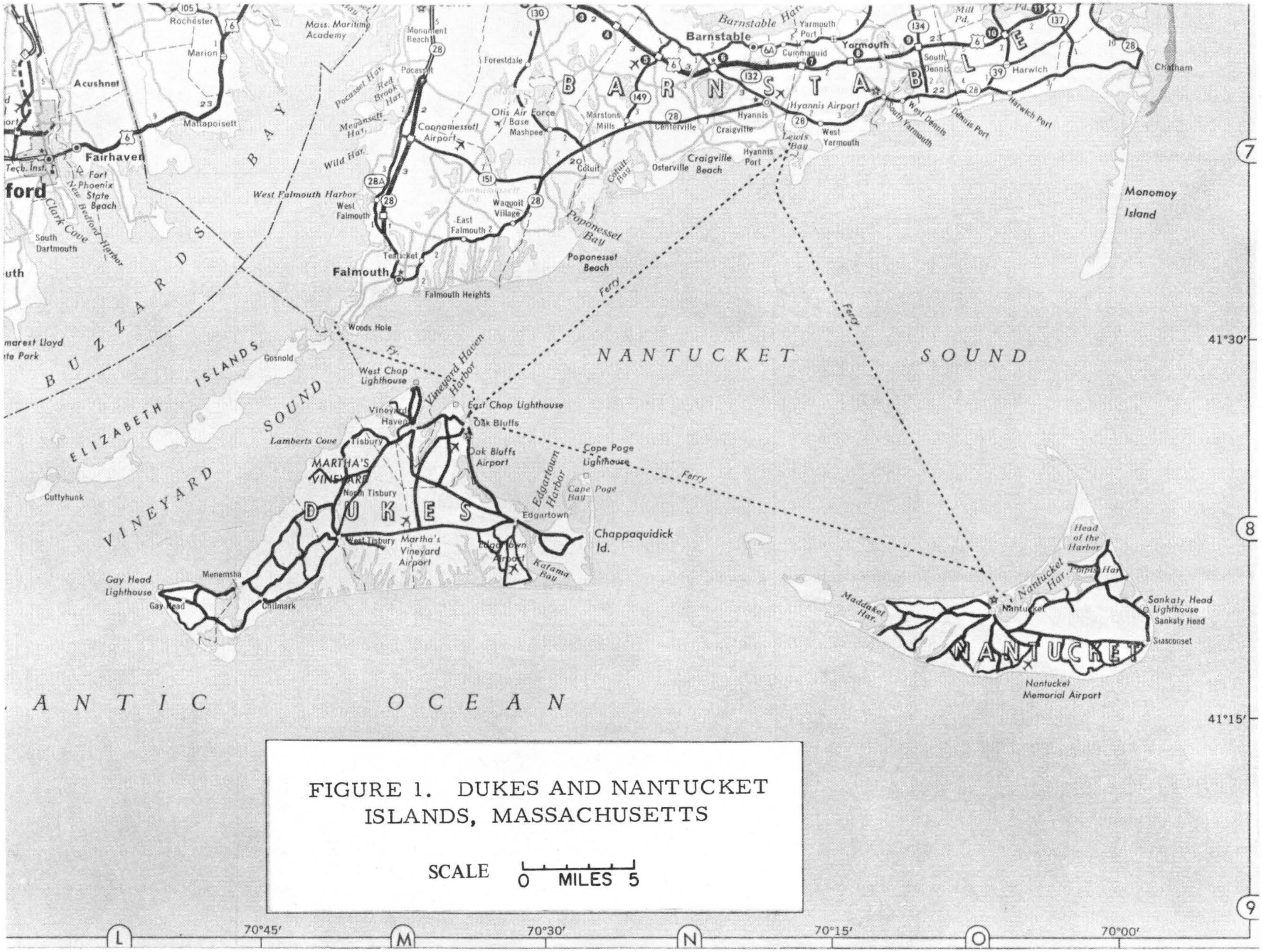

FIGURE 1. DUKES AND NANTUCKET ISLANDS, MASSACHUSETTS

SCALE 0 MILES 5

entail a formidable temporary modification load. The road net is not extensive nor representative of the nation as a whole. The weather would be generally representative of principal hazardous conditions. Accident statistics were not readily available but it is believed they would be inadequate to show the effect of elimination of headlight glare.

2. Orcas Island

The traffic here is comprised in large measure of passenger cars and recreational vehicles with practically no heavy trucks or commercial vehicles. There is a major increase in semipermanent population and transient recreational visitors during summer months but comparatively small nighttime traffic, and, like San Juan Island, a relatively low accident rate.

3. San Juan Island

San Juan Island is similar to Orcas Island; however, the town of Friday Harbor provides some increase in night traffic. The average daily traffic (ADT) for the connecting ferry to Anacortes (Bellingham and Seattle) of 343 for both San Juan and Orcas Islands is largely daytime commuter traffic, and, although hourly rates were unobtainable, respondents indicated that this represented relatively few transients who would be on the islands during the hours of darkness. The permanent population is relatively small, however.

4. Vashon Island (Figure 2)

There is a greater percentage of year-round permanent residents here than on San Juan or Orcas Islands. But, again, there is little after dark traffic, particularly after the last ferries leave at about 9:00 P.M. The ADT for the connecting ferries at each end of the island show:

To Southworth (Bremerton) -	82
To Fauntleroy (Seattle) -	1,587
To Pt. Defiance (Tacoma) -	299

This is commuter traffic, essentially, and reflects permanent residents going to and from work. It does not indicate a major problem of concern in the requirement for equipping transient vehicles with headlamp polarizer kits. No on-island ADT information, nor information concerning accident rates or permanent vehicle registration, could be obtained.

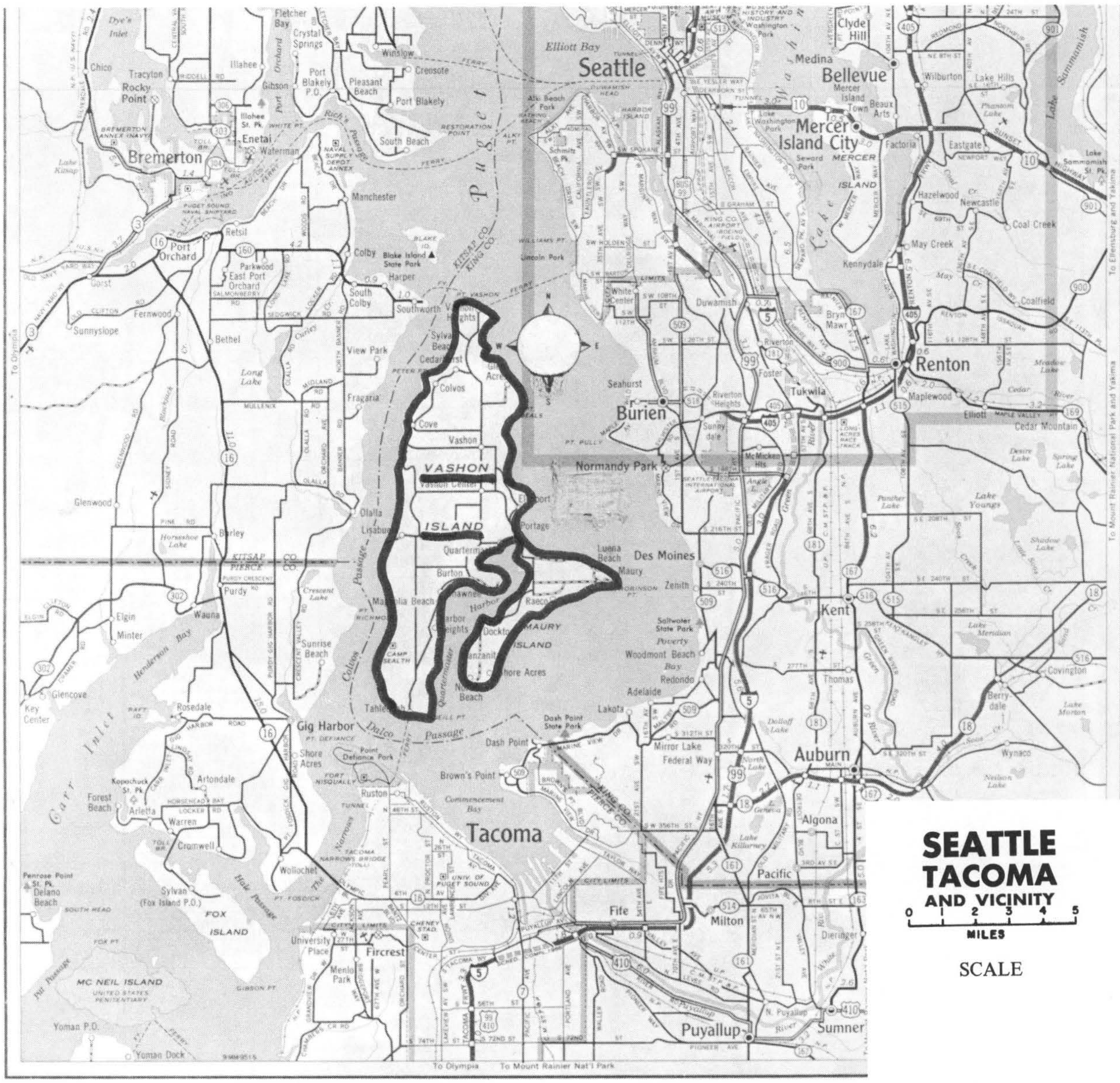

FIGURE 2. VASHON ISLAND, WASHINGTON(8)

5. Hawaii (Figure 3)

The largest of the islands in the State of Hawaii, it has a comparatively large road net but little urban area, except in Hilo in which 26,000 of the 62,000 population reside. Although there is a relatively high military vehicle population (0.3 percent in 1967), it is probable that only a few operate on the highways at night and the military would probably be quite amenable to participation in the test program, if properly approached. The large vehicle population is a disadvantage from the standpoint of cost of modification, but the greater accident experience would assure more reliable evaluation of the effects of the headlight change. It also has an environmental disadvantage, common to all the tropical islands, of having no U.S. typical winter weather.

6. Maui (Figure 4)

With a vehicle population of almost 25,000 and several distinct urban areas, this should be considered as a potential site. Traffic volume shows average meeting frequencies of 114 per hour from "lights on" time (8:00 P.M.) to midnight, and 45 per hour from midnight to 6:00 A.M. Current night accident rates should be sufficiently high that the probability of demonstrating the effects of the test headlamp system on night driving safety can be assured.

7. Molokai

This area has too few vehicles, urban areas, and accidents to provide a representative experiment.

8. Kauai

Kauai has a large vehicle population and an extensive urban/rural road net. The night accident rate is not as high as Maui, and may not be adequate to disclose the effects of headlight system modifications. It has the advantage of requiring less funding for procurement of modification kits for the test.

9. St. Thomas, St. Croix

These islands of the Virgin Islands group have reasonably large vehicle populations and urban/rural road nets of two-lane configuration. There are some major, atypical characteristics of the road net and traffic in the Virgin Islands which may seriously influence the results of a public test at this site. The "left-hand" rule of driving is used, but virtually the entire vehicle population is left-hand drive, including the headlights, which are thus deflected downward but toward oncoming drivers when switching from high to low beams. The roads are almost entirely two-lane, largely under twenty

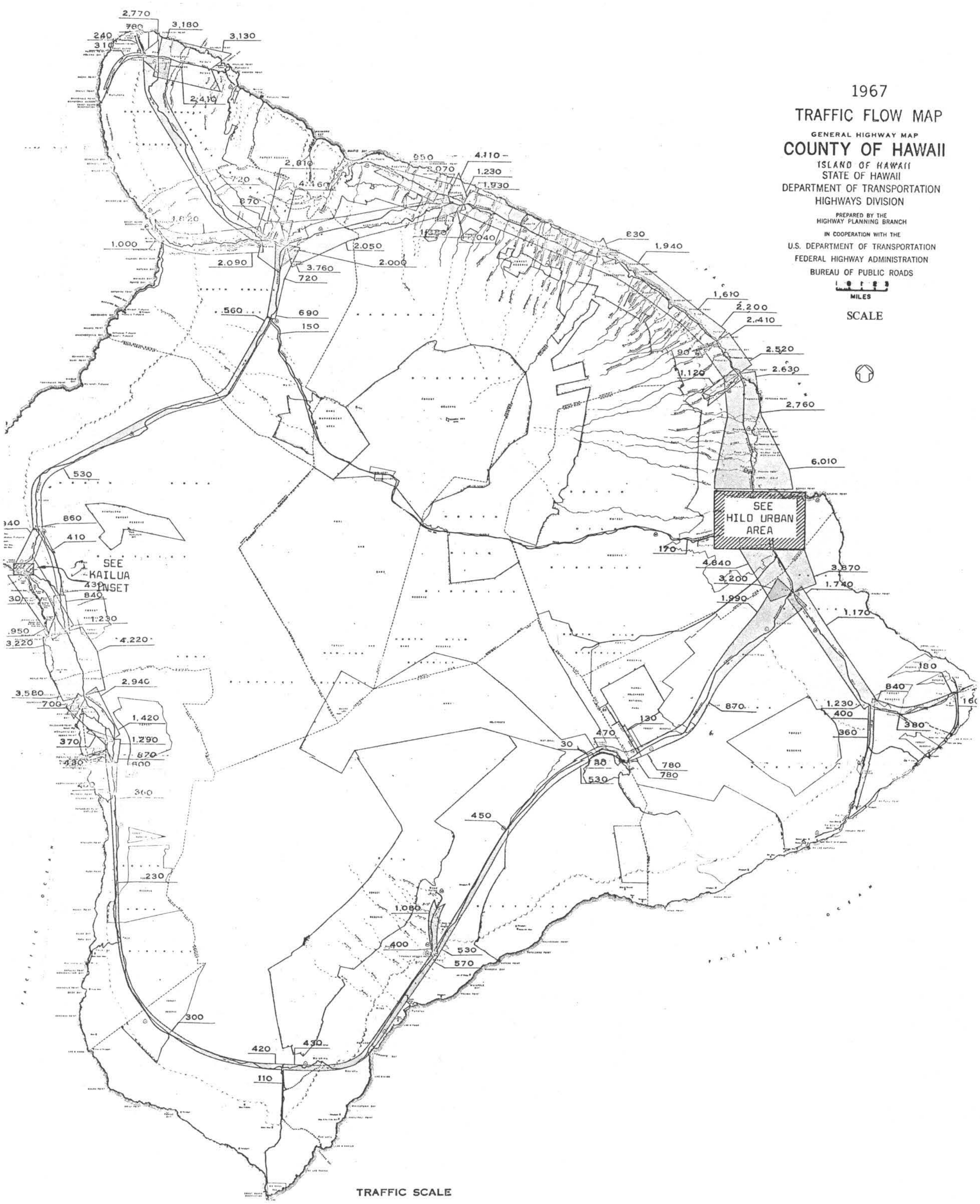

FIGURE 3. ISLAND OF HAWAII(5)

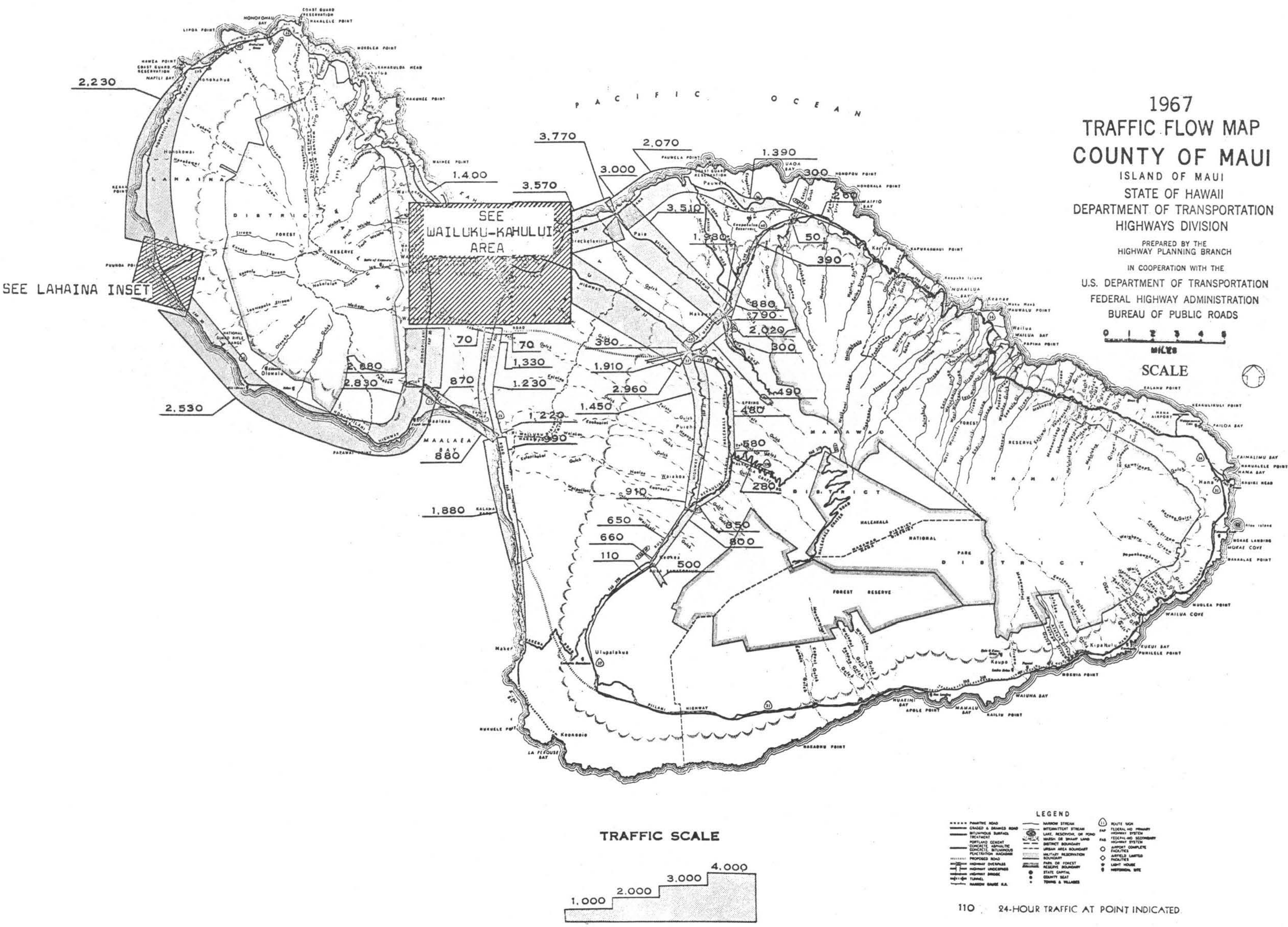

FIGURE 4. ISLAND OF MAUI(5)

feet in width, with sharp curves, grades to fifteen percent or more, and short sight distances both vertically and horizontally. On St. Croix, sixty-three percent of the roads have shoulders of one foot or less and ninety-six percent three feet or less. On St. Thomas, these proportions are thirty-five percent and eight-two percent. Highway marking and signing are heterogeneous non-standard, and generally nonreflectorized, and hazardous obstacles and road conditions abound. Fatalities per 100 MVM are 2.7 times the U.S. average, 14.6 (1968-V.I.) vs 5.5 (1967-U.S.), respectively. There was a transient population of 813,000 in 1968; however, very few of these people brought in their own transportation and over fifty percent stayed only one day or less. These islands also share the climatic disadvantage of the Hawaiian Islands of not providing representative winter weather.

10. Prince Edward Island (Figure 5)

This site presents a combination of sizeable urban areas, villages, and rural roads together with a variety of terrain and adverse climatic conditions. Its use as a test site was suggested by conversations with Professor Douglas H. Rogers of the Royal Military College of Canada, who is chairman of a task group of the Highway Safety Research Committee of the Engineering Institute of Canada. There is no comparable isolated site in the United States. Its principal disadvantages are the large vehicle population of some 37,000, heavy transient traffic during the summer, and the joint U.S./Canada coordination required. The major ferry (Port Borden to Cape Tormentine) carried 280,838 vehicles in 1967, of which some 205,200 were local vehicles and 75,600 transient, or 200 transient per day average during the year. The bulk of these visitors, however, arrived during the summer months of July and August and many did not remain overnight. If the other site characteristics are advantageous, consideration might be given to limiting the test period to exclude those two months. It is not as yet known whether the coordination between the two countries will present any major problems; it could be distinctly advantageous by providing the impetus of international interest and cooperation to the solution of a highway safety problem.

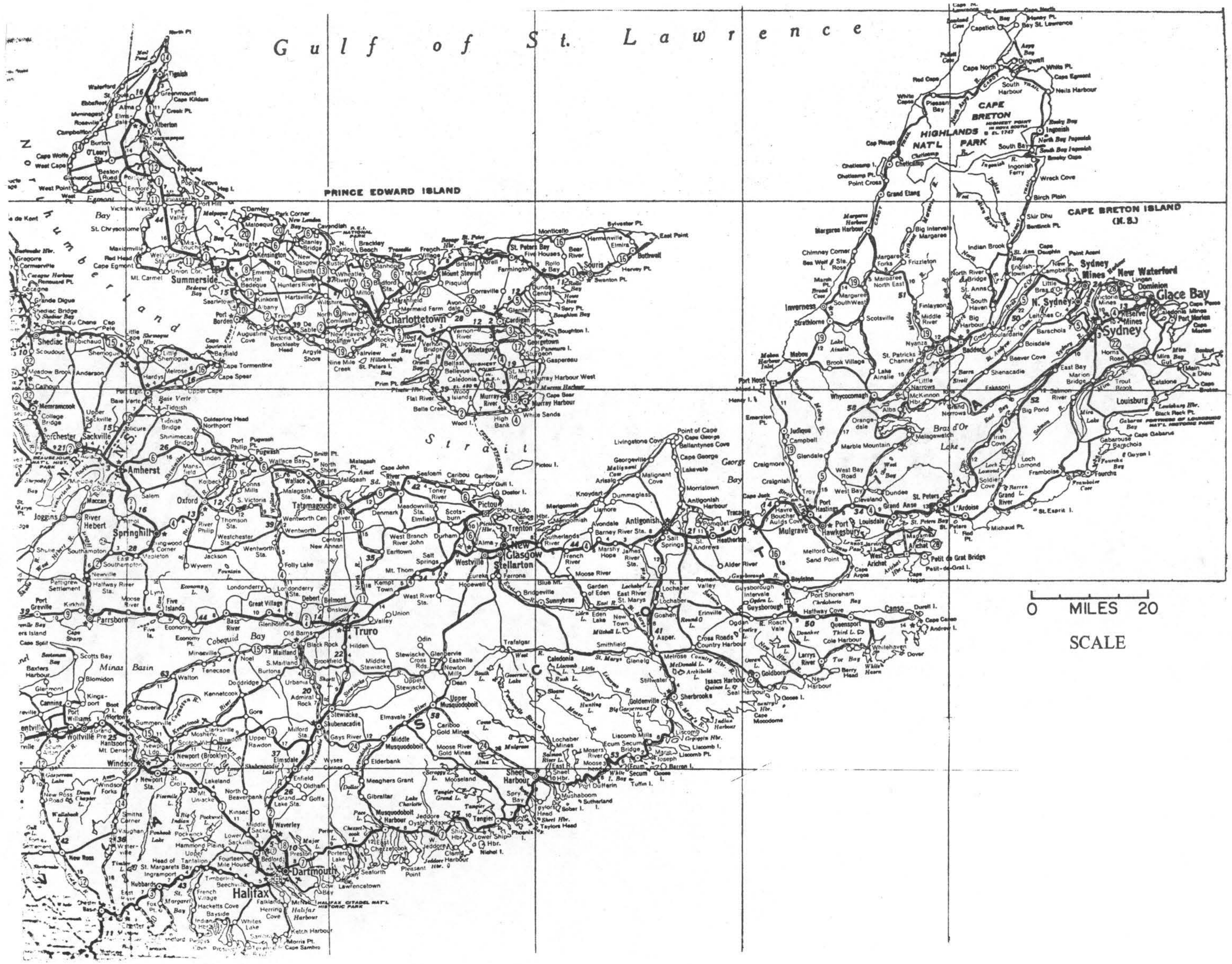

FIGURE 5. PRINCE EDWARD ISLAND, CANADA(10)

III. SUMMARY AND CONCLUSIONS

It is concluded that the review of the preceding information has reduced the list of areas to be considered as test sites to the minimum that can be achieved without an on-the-spot survey.

Those sites which must be evaluated by on-the-spot reviews of their physical characteristics and in-depth analysis of traffic criteria for final determination of one optimally acceptable location are:

(1) Vashon Island, Washington,

(2) Hawaii, Maui or Kauai, Hawaii, and

(3) Prince Edward Island, Canada.

In the case of Prince Edward Island, coordination with the Canadian Government, in addition to that which has already been accomplished with the Engineering Institute of Canada, would be essential before any further evaluation should be considered.

From prior work in this program[3], Phase V, "Preliminary Cost-Benefit Study of Headlight Glare Reduction," the retail cost for producing and installing a polarization kit on a privately owned, existing vehicle was estimated to vary from $26.00 to $45.00, in large volume production, depending on the type of modification required. Although the volume required for this test would not be comparable, it is sufficiently high that, for government procurement and installation, costs should probably fall below those values. For purposes of the test, it is assumed that all four of the headlamp variations outlined in the previous study would be utilized. These include standard and high intensity, two-lamp and four-lamp, headlight systems, with manually and automatically operated visors and spectacles being provided as analyzers.

REFERENCES

1. Hemion, R. H., "The Effect of Headlight Glare on Vehicle Control and Detection of Highway Vision Targets," Phase I Report for U.S. Bureau of Public Roads; Southwest Research Institute Report No. AR-640, May 1968; Department of Commerce CHSTI Access No. PB-179441.

2. Hemion, R. H., "Disability Glare Effects During a Transition to Polarized Vehicle Headlights," Phase IV Report for U.S. Bureau of Public Roads; Southwest Research Institute Report No. AR-672, February 1969.

3. Hemion, R. H., "A Preliminary Cost-Benefit Study of Headlight Glare Reduction," Phase V Report for U.S. Bureau of Public Roads; Southwest Research Institute Report No. AR-683, 31 March 1969.

4. Personal communication, New York Regional Office, Federal Highway Administration.

5. Washington State Highway Commission, Department of Highways, "Annual Traffic Report, 1967."

6. Gousha, H. M. and Co., "Seattle Street Map - 1965 Edition," published for Standard Oil Co. of California.

7. Hawaii, State Department of Transportation, "Traffic Summary - Islands of Kauai, Hawaii, Maui, and Molokai, 1967," Publications No. HP68-3, 4, 5.

8. Hawaii, State Department of Transportation, "Major Traffic Accidents, Summary and Analysis, State of Hawaii, 1967," Publication No. TE68-1.

9. Rand, McNally and Co., "Premier World Atlas," 1967.

10. Commissioner, Virgin Islands, "1967 Annual Report of the Virgin Islands to the Secretary of the Interior."

11. Rand, McNally and Co., "Texaco Touring Atlas," 1967.

12. Personal communication, Professor Douglas H. Rogers, Highway Safety Research Committee, Engineering Institute of Canada.