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THE NATIONAL HIGHWAY PLANNING SURVEY AND SECONDARY ROADS

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I like the keynote that was struck in his address of welcome by Mr. Smith. He set our eyes to the future. I take it that he implies that we are not to be too greatly concerned with the precedents of the past and certainly not too greatly concerned about some of the mistakes of the past. Our job here and in the future is to do the thing that we think is right for the future.

Now, in this past, that we perhaps ought to ignore except as it enters into our thinking for purposes of correcting its mistakes, the various governmental roadbuilding agencies have been acting much as if they were a group of blindfold barbers all trying to cut the same head of hair; each snipping away industriously at a particular area. Such a procedure would doubtless get the hair off, but it would be practically sure to result in a certain lack of symmetry and consistency.

It seems to me that we have all been doing much that sort of thing in the past. We started with an undeveloped highway system; a system of 3,000,000 miles in the country as a whole. Originally it was almost completely an unimproved system. We have been working on that system like blindfold barbers, each agency proceeding with its particular job, with little knowledge of what

the others were doing or trying to do. We have divided what should be a composite system into many systems. There is a federal-aid highway system, and a national forest system; there are forty-eight State systems, and 3,000 or more county systems, and an indefinite number of township systems; and all of those being mainly rural systems, we have added to them an indefinite number of city street systems. All of these systems comprise what should be essentially a total system that should be developed consistently and harmoniously into a usable and efficient whole.

In addition to having divided the job into many pieces and having worked on that job, each agency in its own sphere, as if its own part of the job were the only thing to be done, we have suffered from a lack of information regarding many of the conditions affecting the job and from a similar lack of any very definite goal for our labors. We haven't been able to perceive the job as a whole; and if we hoped eventually to produce a consistent total system, we haven't been able to form a very definite idea of what such a consistent total system would be like.

State-wide Surveys Undertaken as Basis of Planning

It is that condition which we aimed to correct when we undertook the State-wide highway planning surveys. As a Federal agency, the Public Roads Administration had been mainly concerned with the

Federal-aid system, that is, with primary roads, but we realized that primary roads without adequate secondary connections, and primary roads that failed to integrate adequately with city streets, would fail in giving the service that they should give as parts of a total consistent system. So we thought it was necessary, not only for our own guidance but also for the guidance of the State highway departments in their operations on the State systems, and for the operations of each county agency within its sphere, to develop information which would enable us all to see the whole problem and to see where in respect to that whole problem our respective efforts should be directed, so that they would each harmonize with, tie into, and supplement the efforts of the other agencies at work.

Now, after several years, the planning surveys are approaching the point where they can be of real use to all of us. And, looking forward to the time when they would be of such use, particularly in respect to the improvement of secondary and feeder roads, there was written into the rules governing the improvement of Federal-aid secondary roads, the requirement that a system of Federal-aid secondary roads should be selected or designated on the basis of information developed by the surveys. I believe that requirement leads in the right direction and toward the goal of which your President has spoken as a desirable goal; that is, the development of a program of work for the future.

The designation of the system required by the Federal rules will not provide, by any means, a complete program for secondary road improvement, but it will give us the nucleus of a complete program, and in the effort to designate that system, using the results of the highway planning surveys, we will acquire experience in the planning of a program of greater extent, which it will be possible then to project into a larger, orderly program covering the whole need of a complete systematic development of secondary roads, integrated with the primary roads, which have also the need of guidance by an orderly and revised program.

Federal-aid Secondary Roads Defined

Those of you who are familiar with the language of the Federal acts providing for the improvement of Federal-aid secondary roads will recall that those acts are couched in very brief and general language. They describe the roads to which their appropriations are to be applied simply as secondary or feeder roads, including farm-to-market roads, rural-free-delivery-mail roads and public-school-bus routes. They are to be secondary roads first; but secondary roads, you will note, which are of feeder character, which character is defined by implication by the terms farm-to-market roads, rural-free-delivery-mail roads, and public-school-bus routes.

To that brief definition, the rules, developed administratively, added one or two more definitions: First, the rules indicate that the roads to be improved shall be roads which are not included in the Federal-aid highway system. By that provision it is made clear that the term "secondary" is to be construed in relation to the routes of the Federal-aid system as primary. State highways not included in the Federal-aid system are not excluded as Federal-aid secondary roads, unless by reason of their character they fail to qualify as feeder roads. Next, amplifying further the character of the roads that are to be considered for improvement under the acts, there is added one other specifically defined class described as mine-to-market roads and a general class defined as "other roads of community value which connect with important highways or which extend reasonably adequate highway service from such highways or which lead to rail or water shipping points or local settlements."

There is the complete definition of the kinds of roads that we are to operate on under these appropriations as given in the law and in the administrative rules.

Then the rules go on to say that as soon as possible the various State highway departments are to undertake the selection and designation of an initial system or group of secondary or feeder roads based upon their relative importance as determined from factual data secured from State-wide studies for the planning

of a complete highway system. I am quoting from the rules. Finally, they stipulate further that the initial system or group of roads to be designated is not to exceed 10 percent of the highway mileage of the State, and that this initial system may be modified or increased from time to time as justified by the progress of its improvement.

Ten Percent System to be Designated

Pending the availability of the results of surveys, the State highway departments and the Public Roads Administration have been proceeding under an interim procedure, in which they have been selecting for improvement each year certain roads which they have considered to be of such importance as surely to be included in the secondary system to be designated on the basis of the facts to be developed. But, now that the results of the planning surveys are becoming available, the Administration is urging that they be applied to the effort to set up the program system - the so-called 10-percent system - that the rules require.

No arbitrary or ironclad rules have been laid down to govern the process of designation. The undertaking is viewed as a problem in planning, requiring a solution in each State consistent with the particular conditions and circumstances of that State; but certain general procedures are being employed in all the States, and as

methods are tried in one State and found to be useful, they are recommended by the Administration and adopted for use in others. In that way there is gradually emerging a generally usable procedure.

The first essential is the determination of the basic mileage, to which the 10 percent is to be applied. That mileage - the total for each State - has been obtained as one of the earliest results of the planning surveys; and ten percent of it is taken as the mileage that is to constitute the secondary system to be designated. The next problem is to apportion the total system mileage equitably to the various counties of the State; and to do that we are attempting to devise factors which will reflect the relative needs for secondary road mileage in various parts of the State, or specifically, in each county of the State.

These percentage factors are not intended to be regarded as rigid and fixed. They are simply an aid to judgment, and they are made up in each State from such subordinate indices as we think will produce reasonable and equitable final factors. Bearing in mind that what we are attempting to do is to set up a system of secondary or feeder roads, the statistical indices should be such as will reasonably reflect the need for secondary or feeder roads, or the need for roads to serve rural communities. We are not attempting to measure the need for main or through roads. We are

trying to find the need for roads that will connect the farming and rural communities, and the individual farm homes with the main routes. So, we attempt to choose factors to guide us in determining the relative needs of each county for such roads. In most cases one of the indices employed has been the area in farm lands. Farm land area, whether it be large or small, obviously determines in one way a need for secondary road mileage. Another factor that is used in some cases is the number of farms - the number of farms in each county. Another is the vehicle-mileage of local travel on the roads, excluding the through travel. Another is population; because the county which is densely populated obviously requires a greater mileage of secondary roads than counties which are sparsely populated.

In States in which mining is a major industry, either throughout the State or in portions of the State, we are using the value of mine production as one of the indices. In States which are primarily agricultural, we are using the value of agricultural production in each of the counties of the State. In one State, in which a very considerable portion of the rural population depends for its livelihood upon a tourist and recreational industry, we have suggested to the State highway department that they attempt to develop a factor which will reflect the need for roads to serve that tourist and recreational industry.

Taking any combination of such indices, each expressed in percentages applied to each county, we average them all together and so get a composite or average group of factors; and applying the average percentages to the 10-percent mileage to be allocated, we have a tentative determination of the mileage which should be allocated to each county.

Selection of Roads to Comprise the System

Having thus tentatively determined the mileage each county is to receive, the next step is to determine what particular roads in each county are to constitute the system within the county. That is where our planning-survey information becomes especially helpful.

It will be assumed that we have tentatively determined the mileage that we are to locate in one county; and, by way of example, we will say that the county is Thurston County in the State of Washington. In Thurston County there are 800 miles of rural roads, exclusive of those that are included in the primary Federal-aid highway system which are not eligible for selection as secondary roads. By the methods previously described it has been determined that Thurston County is entitled to a portion of the entire 10-percent mileage equal to 156 miles, which is 19.5 percent of the eligible mileage in the county; and we now have the problem of selecting the particular 156 miles which are to be included in the system to be designated.

As a first step we resort to the planning survey records of traffic volume, in which there are data on the average 24-hour use of every mile of road in the county. Employing these data we construct a curve of traffic volume vs. cumulative mileage, as shown in the lower part of figure 1. The data in regard to length and traffic volume for each section of eligible roads in the county are first arranged in order of traffic volume; and the curve is constructed by plotting against each successive traffic volume as abscissa the cumulative mileage of all sections of road carrying that volume and all greater volumes, beginning at the upper right-hand corner of the diagram with the section of greatest traffic volume. The scale of cumulative mileage is shown at the left of the diagram. The scale at the right is an equivalent scale of cumulative percentage of the total eligible mileage.

Remembering that we are to select in this particular county 156 miles or 19.5 percent of the total eligible mileage for inclusion in the secondary system, we can obtain a criterion that will enable us to select the 156 miles most important from the standpoint of traffic service by projecting across the diagram, at a distance from its top or zero mileage line equivalent to 156 miles, a horizontal line; and, from the point at which this line intersects the curve, dropping a perpendicular to the scale of traffic volume at the bottom. This has been done in figure 1, and it will be seen that the perpendicular intersects the traffic-volume scale at a point representing

a 24-hour traffic volume of 150 vehicles. This tells us that if we wish to select for the system the 156 miles of eligible roads in the county that are most important from the standpoint of traffic service, we should select all those sections of road on which the average traffic volume is 150 vehicles a day or greater.

Roads so selected, since they would be the most heavily-traveled roads in the county, would serve a percentage of the total traffic far in excess of their percentage of the total mileage; and exactly what percentage of the traffic they would serve we can see by referring to the upper diagram in figure 1. The construction of this diagram is similar to that of the lower diagram except that cumulative vehicle-mileage and percentage of the total vehicle-mileage served by all roads have been substituted for the cumulative mileage scales of the lower diagram, using as the horizontal scale the traffic volume base of the lower diagram. If, now, we extend the vertical dropped in the lower diagram to intersection with the upper curve, and through the point of intersection project a horizontal line, the point at which this intersects the vertical scale at the right will indicate the percentage of the total vehicle-mileage on all eligible roads in the county which would be served by the 156 miles carrying traffic of 150 vehicles a day or more. As will be seen, these roads, though comprising only 19.5 percent of the total mileage, would serve 72 percent of the total vehicle-mileage served by all eligible roads - a vehicle-mileage of nearly 57,000 out of a total of 80,000 on all roads.

We now know that if we select for the system the 156 miles of greatest traffic importance in the county, these roads, comprising 19.5 percent of the total eligible mileage, will all carry a daily traffic of 150 vehicles or more, and will serve 72 percent of the total travel accommodated by all eligible roads in the county. This gives us one criterion of selection - a traffic-volume criterion - and a definite measure of the relative value of the roads so selected.

House Service of Roads Investigated

Now, let us refer to figure 2. In this figure there are also two diagrams, the construction of which is similar to that of the diagrams in figure 1, except that a scale of houses per mile has been substituted, as the horizontal scale, for the traffic-volume base of figure 1, and a scale of cumulative numbers of rural houses has been substituted for cumulative vehicle-mileage as the vertical scale of the upper diagram.

From these diagrams we are enabled to derive another criterion of selection - a criterion of relative rural house service. And, by a process similar to that described in connection with figure 1, we find that if we would select for the secondary system that 156 miles of roads in the county which serves, mile for mile, the greatest number of rural houses, we would select all those roads on which the houses number 7.5 per mile or more. We see further that the roads so

selected, comprising 19.5 percent of the total mileage, would serve directly 46 percent of the total number of rural houses reached by all eligible roads, or about 1,700 of the total of 3,700 houses directly served by all eligible roads.

We now have developed two criteria that we can use for the selection of roads to comprise that portion of the State's 10-percent system of secondary or feeder roads which has been allocated to Thurston County - a traffic-volume criterion, and a house-density criterion. The roads selected by these criteria are shown by means of appropriate symbols on the map which is reproduced as figure 3. In figure 3 there are two general types of indication, one by means of symbols within the narrow road bands, and one by means of overlaid wider bands of dark and light stipple. For the moment reference will be confined to indications of the narrow-band symbols. Where these bands are cross-barred with fine lines, the roads represented answer only the house-density criterion; where they are filled in with alternate solid and open sections they represent roads conforming to the traffic-volume criterion only; and where the bands are solid black they represent roads which qualify according to both criteria. Where the two criteria point to the same roads, such roads can be accepted for inclusion in the system to be designated with considerable confidence. Where the two criteria indicate

different roads, a choice is necessary; and as a further guide to such a choice it is desirable to consider other available indications of relative importance.

Among such other available indications are the usage of the roads by mail carriers and school busses. Since these are special uses their indications must be considered as subordinate to those of the house-density and traffic-volume criteria, which are more representative of general utility; but, so considered, they will assist toward a choice between the indications of the primary criteria.

To this end, figure 4 shows all roads in Thurston County that are used either by rural mail carriers, or school busses, or by both. In this figure the cross-barred narrow bands represent roads used by school busses; the bands of alternate open and solid section represent roads used by rural mail carriers; and the solid black bands represent roads used by both mail carriers and school busses.

Selected Roads Designated on Maps

With the further information of figure 4 as a guide, a group of roads has been selected to comprise the secondary or feeder road system of the county; and the roads so selected are indicated in figures 3 and 4 by overlaid bands of light stipple. In both figures

the selected roads are shown in relation to the existing primary Federal-aid routes in the county, which are indicated by overlaid bands of darker stipple.

The roads selected aggregate 159.4 miles - slightly more than the mileage tentatively apportioned to the county on the basis of economic factors. Approximately 131 miles of the selected roads qualify by either the traffic-volume or house-density criteria and either one or both of the supplementary criteria of use by mail carriers and school busses. About 38 miles of the roads selected meet all four tests; and 60 miles conform to both traffic-volume and house-density criteria. Only 26 miles lack the justification of conformity to either the house-density or traffic volume criterion, and practically all of this mileage is used either by mail carriers or school busses, there being only about 4 miles (essential for purposes of connection) which fail to conform to at least one of the criteria of selection.

Extending eastward from Tenino toward Yelm (see figures 3 and 4) a road is indicated, by a dashed band of dark stipple, to be a potential addition to the primary Federal-aid system. This road was included among the 800 miles considered as eligible for possible inclusion in the secondary system, and it was one of those qualifying for selection as serving a traffic in excess of 150 vehicles a day. As indicated by figures on the map (figure 3) its traffic ranges from 500 to 600 vehicles per day, which, from the standpoint of traffic

volume, marks it as one of the most important of eligible roads. In spite of its importance as a traffic server, however, it will be observed (figure 3) that this road fails to meet the house-density test; and for about half its length, from Tenino to Rainier, is not used by mail carriers. The indications are that this route is of greater importance as a through artery than as a feeder or land-service road and it is therefore proposed as an addition to the primary system.

By way of contrast, a road extending eastward from Olympia, and located south of the primary Federal-aid route running in the same general direction, is shown as a desirable selection for the secondary system. This road, as indicated by the traffic figures noted in figure 3, is even more heavily traveled than the Tenino-Yelm road, but for about half its length it qualifies by both the traffic-volume and house-density criteria. It is used by both mail carriers and school busses throughout nearly its entire length, and a short distance east of the county line it rejoins the Federal-aid primary route. By all of these indications this road appears to be essentially a heavily-traveled feeder road, serving the relatively populous area south of the Federal-aid route, and as such is eminently qualified as a secondary-road selection.

Designated System Includes the Heavily-Traveled Roads

Without attempting to discuss all of the roads selected, a few additional comments will sufficiently illustrate the method of selection. From figure 3 it will be noted that, with few exceptions, all of the roads qualifying by the traffic-volume test are included in the system selected. Where, as in the peninsulas north of Olympia, there are numerous short sections of road qualifying by the house-density criterion, the roads selected are those which, by the indication of their traffic volume, are proved to be the collectors of traffic from a group of the residential roads.

On the two peninsulas northwest of Olympia, the system selection is shown as extending beyond the sections justified either by house-density or traffic volume; and, although figure 4 shows that the extensions, in greater part, are both mail roads and school-bus routes, the more important reason for them is their service of waterside shipping points. By reason of their peninsular location and obvious relation to population clusters all four of the roads running northward from Olympia are distinctly of the feeder type.

Southeast of Tumwater, in the direction of Rainier, a choice was necessary between a more direct route qualifying by the traffic-volume criterion and a less direct, stepped location meeting the

house-density test. Here the selection favors the latter route, which, as shown by figure 4, is used throughout by both mail carriers and school busses. The more direct route in this case is thought to be primarily of service to through traffic.

Referring to figure 4, it will be seen that much of the mileage of mail and school-bus routes in the county takes the form of short circuits extending out from and back to certain stem roads. In virtually every case, where they are not already in the primary Federal-aid system, the stem roads are the ones selected for inclusion in the secondary system, such selection being favored as giving a maximum of service to both special uses within the limits of mileage imposed.

These various considerations and others equally cogent suggest the selection of the particular roads indicated; and, although there are doubtless some parts of the selection as to which individual judgments might reasonably differ, it is believed that the roads chosen constitute, within the prescribed mileage limitations, a rationally defensible system of secondary or feeder roads. Omitting, though it does, the heavily-traveled Tenino-Yelm road, reserved as a potential addition to the Federal-aid primary system and a few shorter sections of the roads selected as important from the standpoint of traffic volume, this finally chosen system

still serves 65 percent of the total vehicle-mileage accommodated by the 800 miles originally considered as potentially eligible for selection. Of the traffic served by all of the originally considered roads with the exception of the Tenino-Yelm road, the finally chosen roads accommodate 74 percent; and joined with the existing routes of the primary Federal-aid system and the proposed addition to that system, they form a composite system which accommodates nearly 93 percent of the total traffic using all roads in the county.

Test of the Fairness of Mileage Allocation

It will now be recalled that the tentative allocation of secondary road mileage to Thurston County, made on the basis of the economic factors agreed upon, provided for a selection of 19.5 percent of the mileage of all roads in the county potentially eligible for inclusion in the secondary system. As the potentially eligible mileage excluded the existing primary Federal-aid routes, which aggregate 64 miles, it represented only about 18 percent of the total mileage of roads in the county. But, as this percentage is still considerably in excess of the average of 10 percent which is the limiting percentage for the State as a whole, it will be apparent that the surplus allowed to Thurston County must be balanced by a percentage below the average in some other county or counties. It may be questioned whether, in the division as tentatively suggested,

there are some elements of inequity. As bearing upon this question, table 1 presents pertinent data for Thurston County in comparison with similar data for several other counties of the State.

In two of the other counties listed - Snohomish and Whatcom - the percentage of potentially eligible mileage indicated for selection closely approximates the percentage allowed to Thurston County, and the selection of roads made in these other counties on the basis of the traffic-volume criterion is shown to accommodate a portion of the total vehicle-mileage of substantially the same order as in Thurston. In comparison with Thurston's 72 percent, the roads conforming to the traffic-volume criterion in Snohomish serve 79 percent, and those similarly selected in Whatcom County serve 74 percent of the total traffic accommodated by all eligible roads. In the minimum daily traffic served by the selected roads in these counties there is also a remarkable similarity - 150 vehicles in Whatcom and 140 in Snohomish as compared with the 150-vehicle minimum in Thurston.

Such similarities do not extend to the other counties on the list; but, although the differences to be observed do not necessarily mean that the tentative apportionment of mileage is erroneous they do afford an approximate check on the reasonableness of the allocation.

Table 1.--Mileage and usage of secondary rural highways in seven counties of Washington

County	Total miles	Allocated miles	Ratio of allocated miles to total miles	Total vehicle-miles	Vehicle-miles on allocated mileage	Ratio of allocated vehicle-miles to total vehicle-miles	Minimum 24-hour traffic volume on allocated mileage
			Percent			Percent	
Benton	1,689	67	4.0	25,975	18,718	89.0	100
Chelan	1,035	127	12.2	44,730	32,242	72.0	90
Ferry	1,025	36	3.5	8,072	2,171	27.0	50
Island	378	51	13.5	23,047	15,652	47.0	225
Snohomish	1,516	309	20.4	191,875	139,251	79.0	140
Thurston	800	156	19.5	82,020	59,054	72.0	150
Whatcom	930	209	21.5	180,685	133,677	74.0	150

Adjustment of the Tentative Allocation Indicated

Consider, for example, the data for Island County. The tentative apportionment of mileage to this county, as indicated by general economic factors, is 13.5 percent, as compared with the percentages ranging from 19.5 to 21.5 for Snohomish, Thurston, and Whatcom Counties. In consequence of the smaller percentage of mileage selected, the percentage of the total vehicle-mileage served is low - only 47 percent as compared with percentages above 70 for the other three counties; and the fact that the minimum traffic density reached by the Island County selection is 225 vehicles per day, which is substantially greater than the minima in the other counties, is proof that in relation to these counties the tentative Island allocation is not large enough, and an adjustment is indicated as desirable.

That the allocation of a lower percentage of the total eligible mileage is not always indicative of error in the apportionment, however, is exemplified by the Chelan County data. To this county the economic factors award a mileage which is only 12.2 percent of the potentially eligible mileage - a percentage less than that shown for Island County. But, whereas Island's 13.5 percent of mileage selected according to the traffic-volume criterion results in a service of only 47 percent of the total eligible-road vehicle-mileage,

the similar selection in Chelan County of 12.2 percent of the eligible mileage results in the service of 72 percent of the corresponding vehicle-mileage - equaling the Thurston County percentage. Moreover, the fact that the Chelan apportionment reaches a minimum traffic of 90 vehicles, as compared with the larger minima of the other counties mentioned supplies further evidence that the tentative Chelan apportionment is not unfairly small.

For Benton County the tentative apportionment is shown to be only 4 percent of the county's potentially eligible mileage; and a system of this size selected according to the traffic-volume criterion is shown to serve only 49 percent of the total vehicle-mileage. We have seen that a closely similar percentage of vehicle-mileage in Island County was indicative of a relatively inadequate allocation of mileage. In Island County this indication was confirmed by a relatively largely minimum traffic. In Benton County there is no such confirmation. Even though the mileage selected is only 4 percent of the potentially eligible total, the minimum traffic volume served by the selected mileage is only 100 as compared with the minimum of 225 vehicles per day served by the 13.5 percent system of Island County. It is clear that the Benton County allocation, although comparatively small, is not unfairly restricted; and a similar conclusion is indicated with respect to the still smaller allocation to Ferry County.

The counties listed in table 1 were chosen as illustrative of the manner in which vehicle-mileage data for roads selected according to the traffic-volume criterion can be employed as an approximate check on the tentative allocation of mileage resulting from the general economic factors adopted. It is a check that can be applied as soon as a traffic-volume selection has been made of the tentatively allocated mileages in all counties of a State; and the adjustments indicated as desirable can be made before proceeding with the development of other criteria of selection.

Selection of System Affected by Character of Land

In the foregoing discussion employing Thurston County as an example no mention was made of the character of land and its economically and socially desirable uses as a condition affecting the selection of the secondary or feeder road system. In Thurston County this is not an especially important consideration, because differences in the character of lands in the county are not great. In some areas, however, there are wide differences in the productivity of included lands and in the ability of such lands to support population and industry; and in such areas the character of the land becomes a very important consideration in the selection of a secondary road system, particularly when the system to be selected is to comprise a relatively small percentage of the total road mileage.

Where the mileage to be selected is narrowly limited it is obviously desirable to locate the roads where they will give as much service as possible to the better lands of the area and equally desirable not to waste mileage on unproductive lands or lands which in their desirable uses do not require extensive road service.

Figure 5, a map of Orange County, Vermont, presents, as an example, an area in which the character of land is an important consideration, and one in which the secondary road system designated shows a proper regard for this consideration.

The lands of the county are classified into three general groups according to their productivity and optimum uses. The white areas on the map represent sections of greatest agricultural promise, sections in which the soil is good and well adapted either to the growing of crops or the support of a dairy industry. Single-hatched areas are sections that have not proved to be well adapted to agriculture and where, accordingly, farms are generally depreciating; and double-hatched areas are sections adapted primarily to forest use, in which existing farms are being abandoned.

It will be observed that the secondary roads designated in this county are well located to give a desirable service to lands of the highest class.

Methods Applicable to the Selection of Systems of Any Size

In this paper the entire discussion has been concerned with the selection of a secondary or feeder road system of the limited extent required for improvement with Federal-aid secondary road funds. For this purpose we are selecting only a 10-percent system. The same or similar methods, however, could be applied to the selection of a larger system upon which all available Federal funds could be expended. Or, going further, the same methods could be used by States and by counties for the designation of systems for prior improvement with local or State funds.

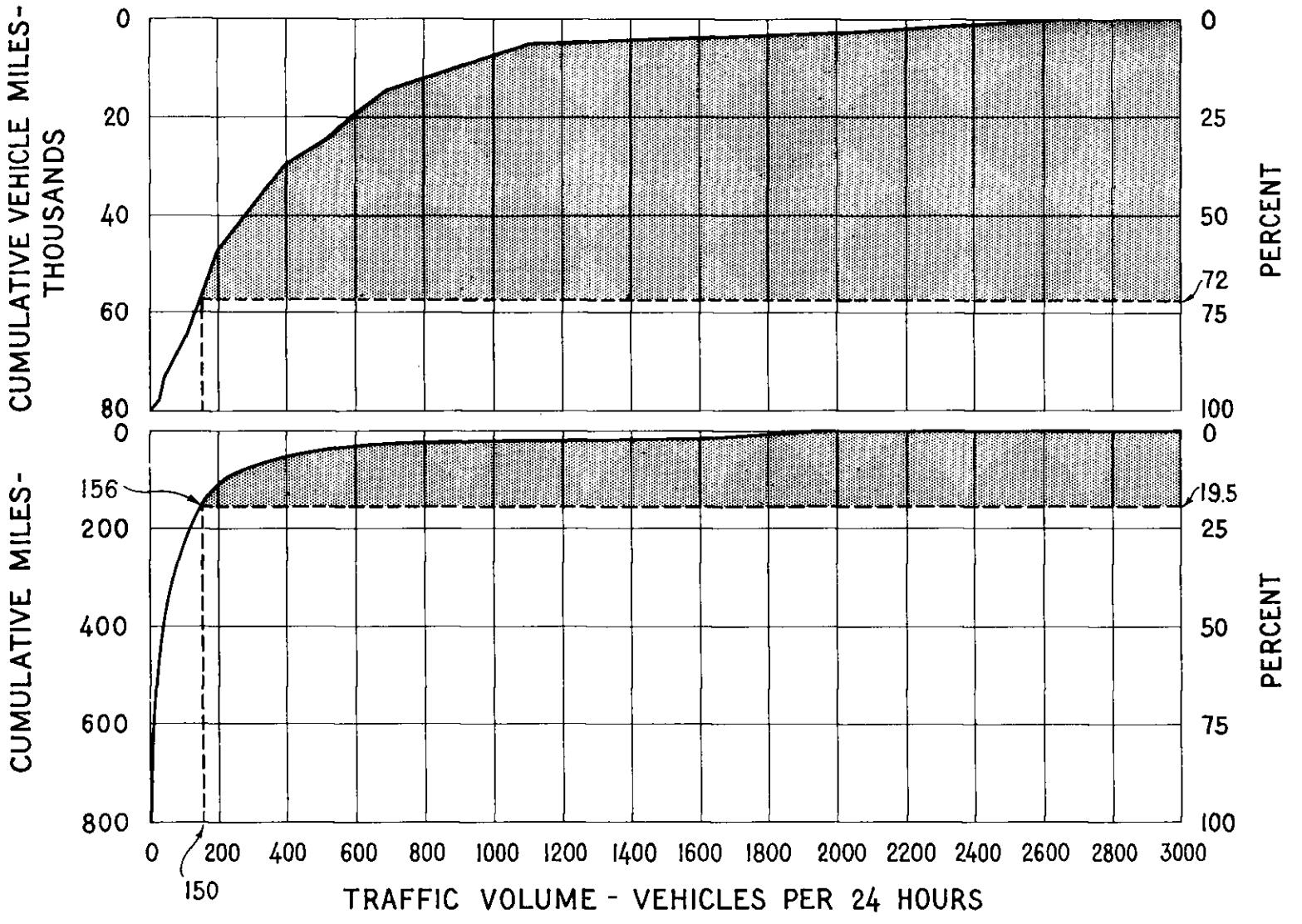

Fig. 1. - Cumulative traffic-volume on potentially eligible secondary roads in Thurston County, Washington.

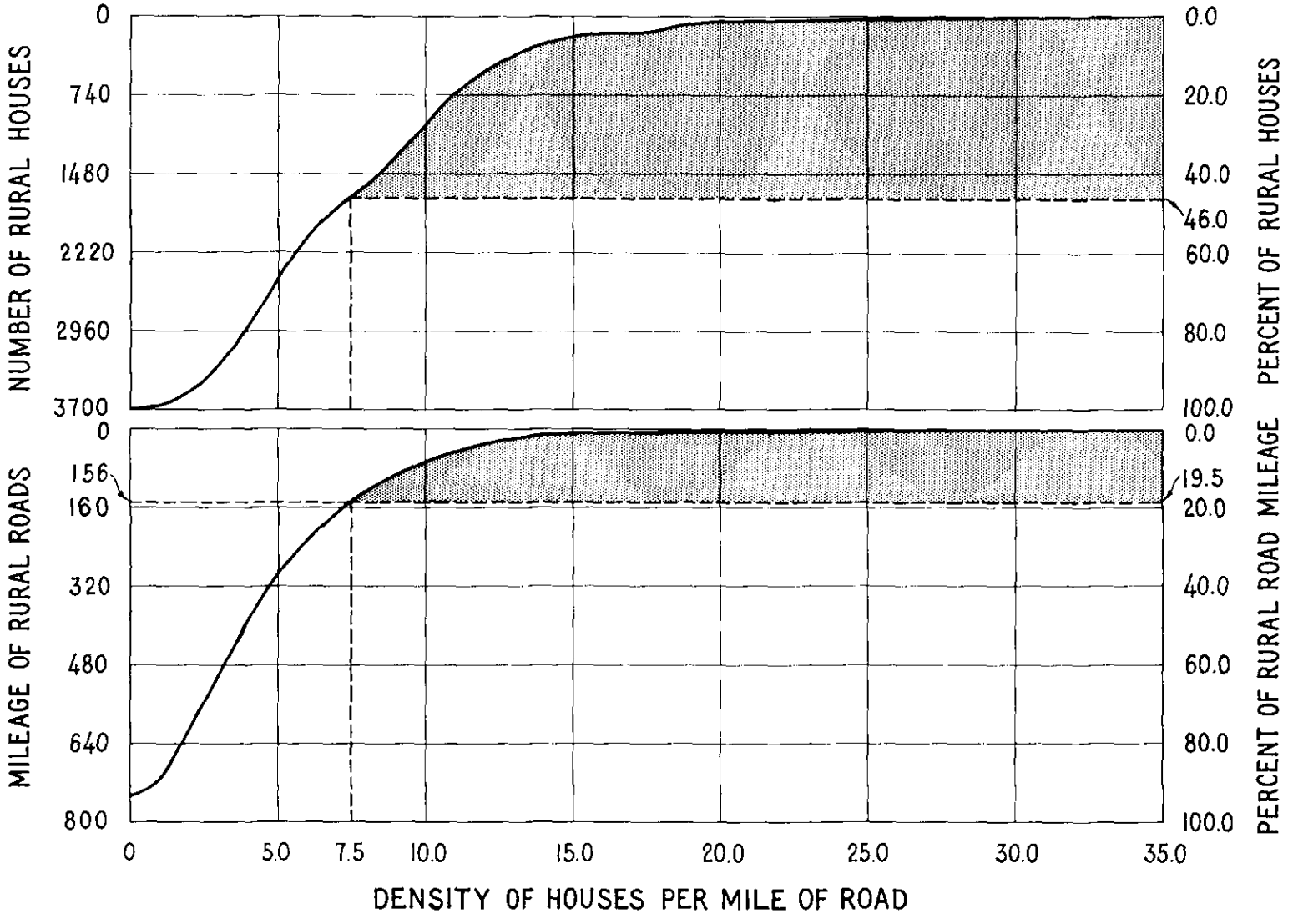

Fig. 2. – Cumulative house density on potentially eligible secondary roads in Thurston County, Washington.

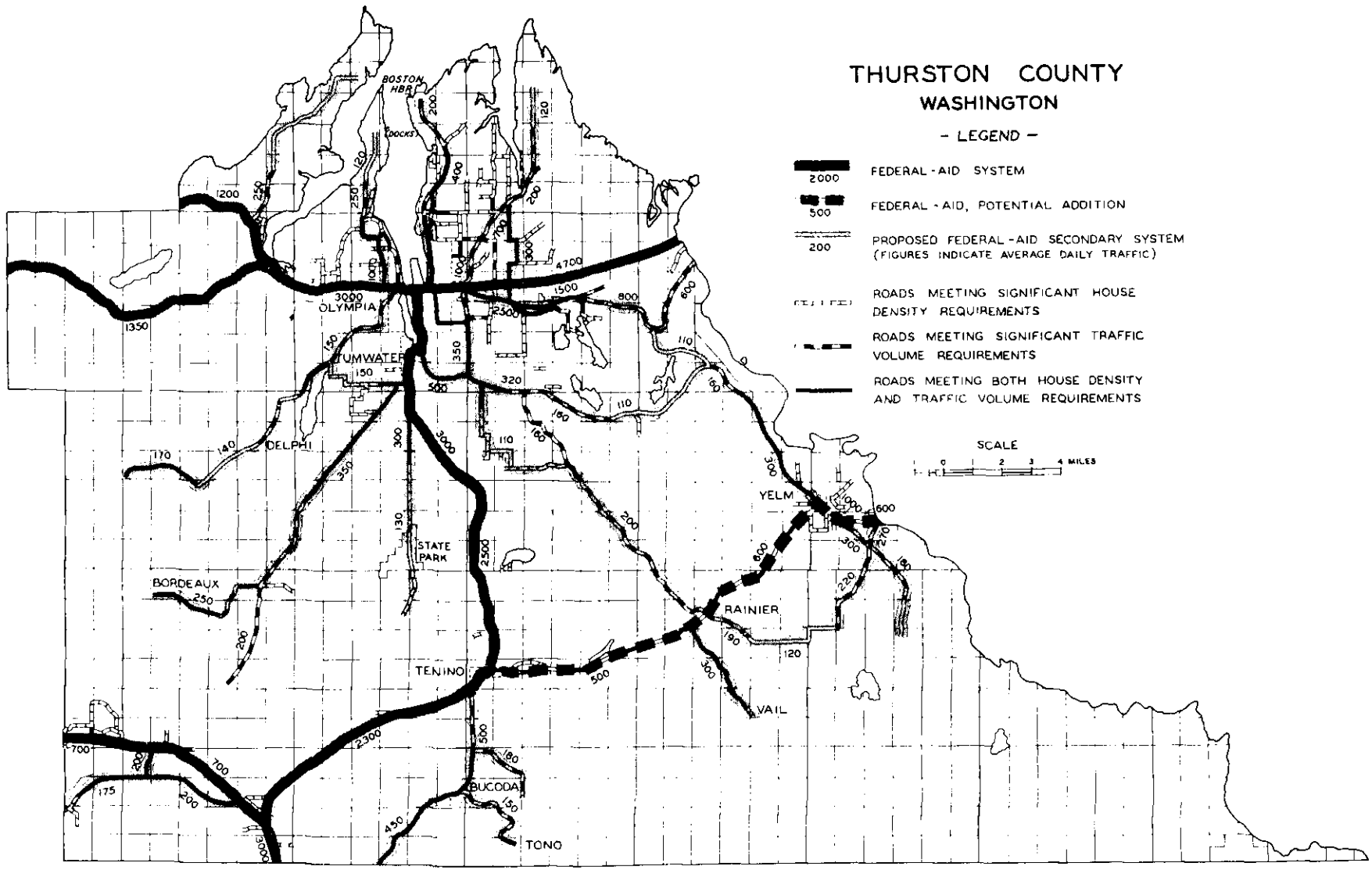

Fig. 3. - Roads selected according to traffic volume and house-density criteria in Thurston County, Washington.

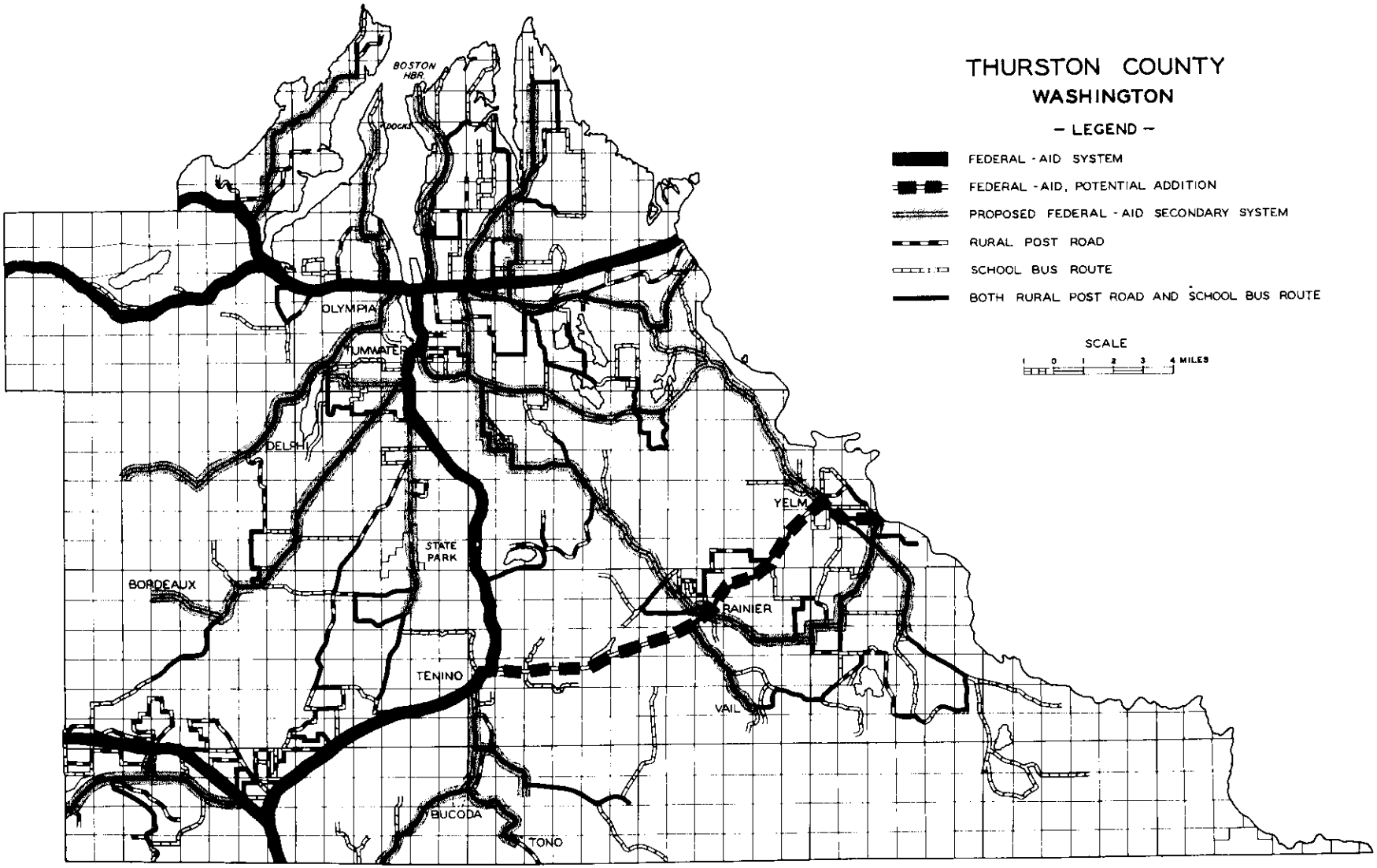

Fig. 4. - Rural post roads and public-school-bus routes in Thurston County, Washington.

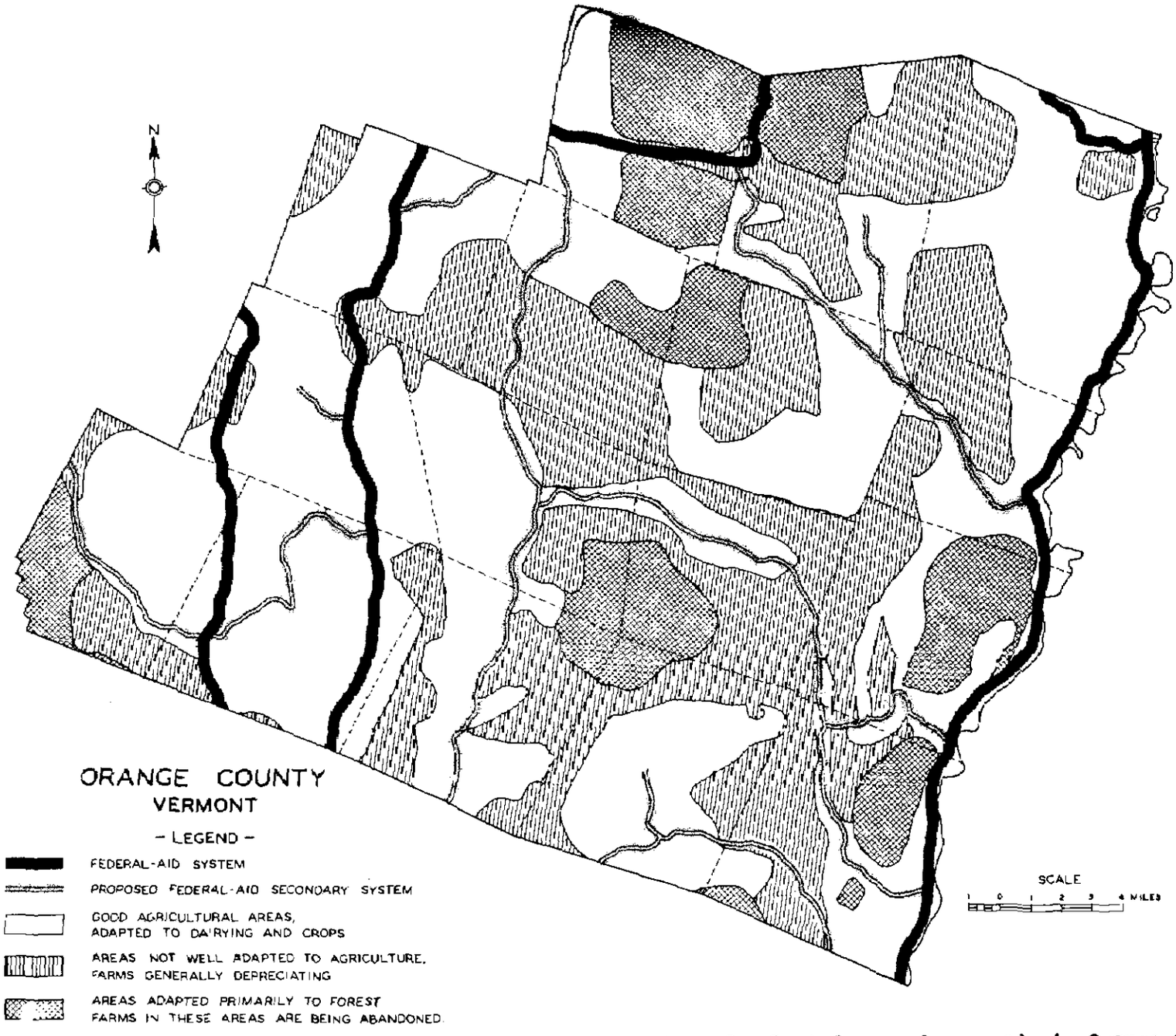

Fig. 5. - Location of selected secondary roads in Orange County, Vermont, in relation to the character of land.