REPORT OF SUBCOMMITTEE ON HIGHWAY TYPES AND ROADSIDE AREAS

W. H. SIMONSON, *Chairman*

Senior Landscape Architect, Public Roads Administration

SYNOPSIS

The third annual report of the Subcommittee on Highway Types and Roadside Areas contains a brief review of the two previous reports of 1937 and 1938 as a background for the present report.

The 1937 report emphasized the need for a broader approach to the highway cross-section problem. The right-of-way as a whole should be considered a part of its surroundings.

The 1938 report further emphasized this relationship of the highway to its surroundings. The foundation of a well-balanced design is an adequate width of right-of-way, with roadbed, roadside, and adjacent lands all united in proper relation. The composite diagram in the report showing the "Trend in Expanding Widths of Divided Highways in Relation to Right-of-ways" presented basic information recognizing the need for those elements that contribute to a balanced program of highway development.

The present report includes typical highway cross-sections now in regular use in one specific administrative region consisting of Minnesota, Wisconsin, North and South Dakota to show the gains which have been made in recognition of the many advantages of orderly roadside development through integration of landscape practices in initial highway construction. The variable climatic and topographic features of the region are shown in a series of maps.

It is proposed that this single regional presentation serve as a sample for the guidance of further studies along similar lines in every administrative highway region of the United States.

In its first annual (1937) report, the subcommittee recognized as its first step the need for a survey of current practices in highway design which have a basic relation to the landscape development of highways. This report emphasized the need for a broader approach to the cross-section problem, by considering the right of way as a whole in relation to its surroundings. This recommendation questioned the customary practice of thinking of the highway cross-section as covering only certain limited portions of the width, such as the surfacing, shoulders, guard rail, superelevation and widening, and similar engineering details of construction.

Although available information relating to the landscape development of highways within the United States has not been fully correlated for classification purposes, the general survey of the evolution of the highway cross-section in regular construction, as tabulated in the 1937 Report on "The Design of the Highway Cross Section,"[1] may serve as a basis for greater coordination and uniformity for future design and construction practice.

A knowledge of the general trend toward a wider application of the principles of landscape design to typical highway cross-section grading and drainage problems is of practical value to officials who plan local programs of highway construction and maintenance.

The second annual (1938) report supplemented the previous report on the primary two-lane rural highway by covering, in a similar way, "The Sectional Layout of Multiple-Lane Highways."[2]

[1] *Proceedings,* Highway Research Board, Vol. 17, p. 255.

[2] *Proceedings,* Highway Research Board, Vol. 18, p. 190.

In addition, there was appended in the 1938 report of the subcommittee a digest of replies on the design of roadside areas: "Safety turnouts" and "Waysides."[3] This summary defined the purpose, the types and kinds, the size, the location, and the maintenance of "Wayside" facilities, with observed suggestions for application in future development of "Waysides."

These two reports (1937 and 1938) furnish a composite picture of current tendencies in the sectional layout of tomorrow's highways. Construction trends indicate a progressive widening of roadbed surfaces and shoulders, the flattening of crowns and of slopes of shoulders and gutters, as well as the flattening and rounding of cut and fill slopes and increasing right-of-way widths. The facts point toward a better balanced cross-section design with a growing emphasis placed on the landscape development of highways.

The 1937 and 1938 reports furnished a general survey of highway cross-section development over the United States from 1920 to about the present time.

This third report is aimed to be more specific in its application through geographical limitation to one administrative region or highway district of four States, North Dakota, South Dakota, Minnesota and Wisconsin.

The Summer (August 28, 29, 30, 1939) Meeting of the Joint Committee on Roadside Development held at St. Paul and Gull Lake, Minnesota, naturally suggested District 4 of the Public Roads Administration as a logical administrative area for specific study. It is the subcommittee's desire that this report covering a typical region of highway administration will encourage a similar analysis of cross-section practice to be made in each of the 12 Federal highway regions of the United States.

The variable climatic and topographic features in this administrative region of the two Dakotas, Minnesota and Wisconsin furnish a good basis for purposes of analysis and comparison of typical governing conditions which highway design, construction and maintenance must recognize. Data concerning the prevailing characteristics of the four States in District are given on maps as follows:

Figure 1: Topography (Elevation Reference).
Figure 2: Rainfall (Annual).
Figure 3: Soils (Distribution).
Figure 4: Temperature (35°+).
Figure 5: Temperature (55°+).
Figure 6: Temperature (55°−).
Figure 7: Temperature (35°−).
Figure 8: Frost (Fall).
Figure 9: Frost (Spring).
Figure 10: Vegetation (Natural).

Figure 1 indicates that the topography ranges from about El. 699 ft. along the shores of Lakes Michigan and Superior on the east to El. 7,242 ft. at Harney Peak in the Black Hills, west of Rapid City, South Dakota. For the purpose of cross-section analysis this region includes three general classifications of topography or landscape:

1. Smooth or easy topography (relatively level to gently rolling).
2. Moderate or rolling (heavy rolling, or hilly to light mountainous).
3. Rough or mountainous (heavy mountainous).

The average annual precipitation, as shown on Figure 2, varies from less than 15 in. in certain western portions of the Dakotas, where only short grass will grow, to over 30 in. east of St. Paul, Minnesota, where moisture conditions

[3] January 1939 Report by The Joint Committee on Roadside Development, Highway Research Board and American Association of State Highway Officials. (P. 39—Appendix.)

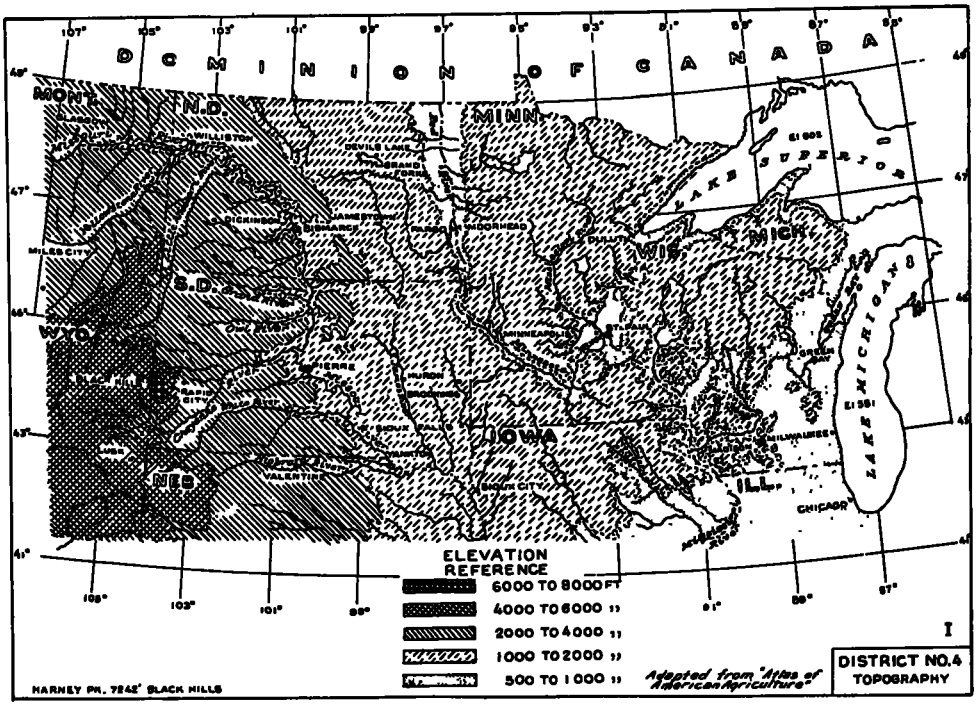

Figure 1

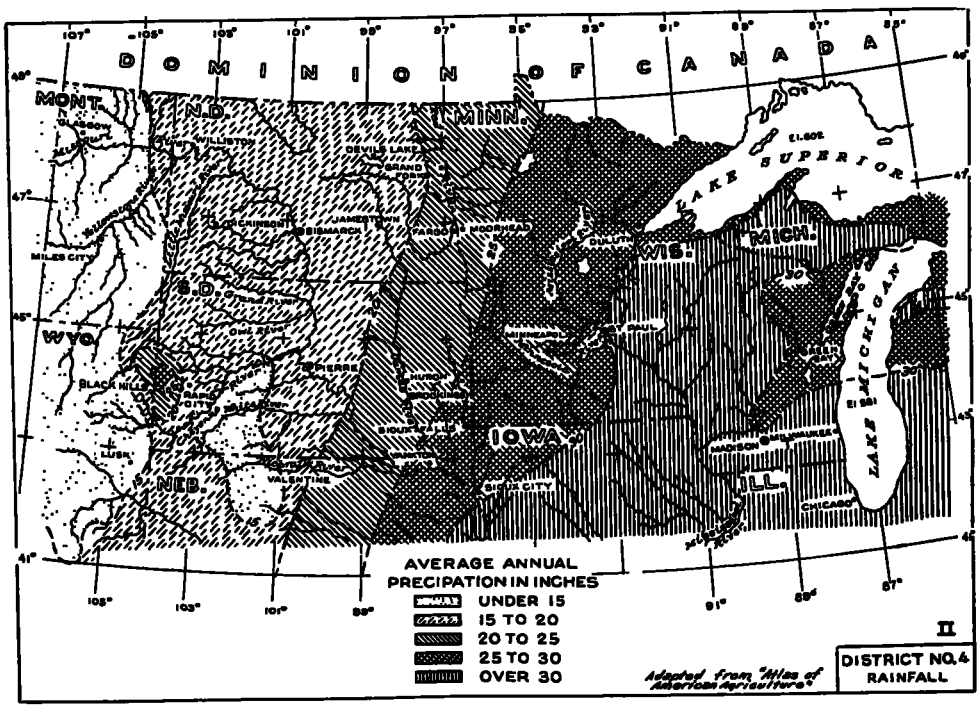

Figure 2

are favorable to deciduous and evergreen tree growth.

Similarly, Figure 3 presents wide distribution of the great soils groups, from the moist and acid re-acting podzol soils of northern Minnesota and Wisconsin, through the brown soils of the northern prairies to the dry sandhills of Nebraska. The typical problems of wind and water

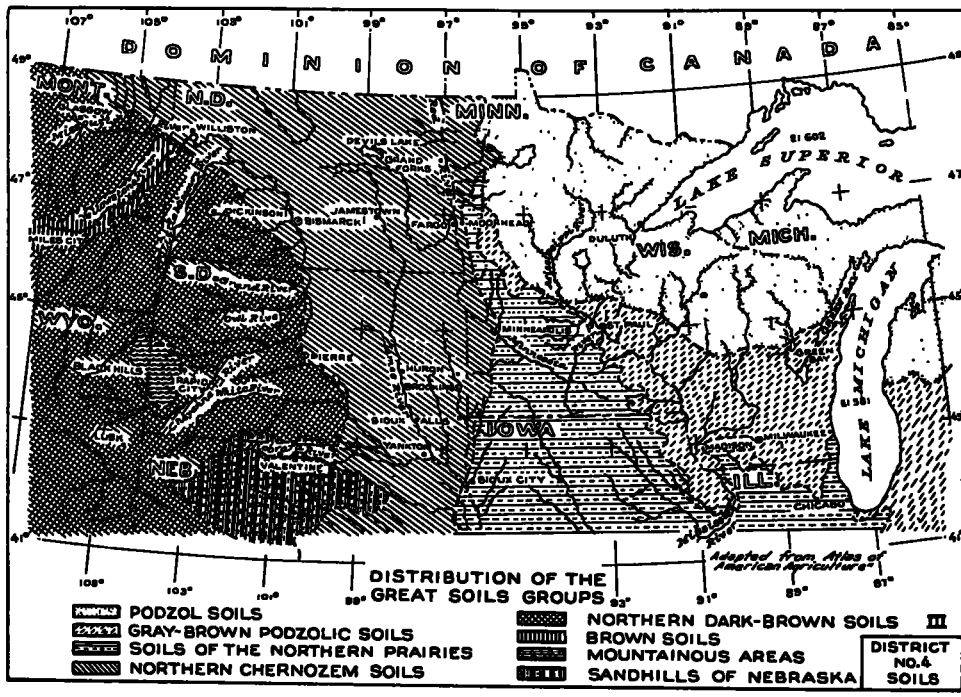

Figure 3

The average date when mean daily temperature rises above 55 degrees, or when plant growth gets active, covers a similar four weeks' period, from about May 1 to June 1 or later, as shown on Figure 5. Highway specifications need to make allowance for such factors.

Conversely, the average date when mean daily temperature falls below 55 degrees, or when plant growth becomes inactive, is shown on Figure 6 to vary from about September 15 to October 15. Thus, the length of the growing season in this region varies from about four to six months, seriously limiting seasonal operations in the colder northern portions to a relatively short working period.

erosion are evidenced by the soils found in these four States.

From north to south in this region, Figure 4 shows that the average date when the mean daily temperature rises above 35 degrees represents a spread of about four weeks, from March 15 to April 15. Freezing weather limits certain highway construction operations, especially the more seasonal items of work, like seeding, sodding and planting, as well as bituminous and cement operations.

On Figure 7, the average date when mean daily temperature falls below 35 degrees is indicated from before November 1 to after November 16. The fall

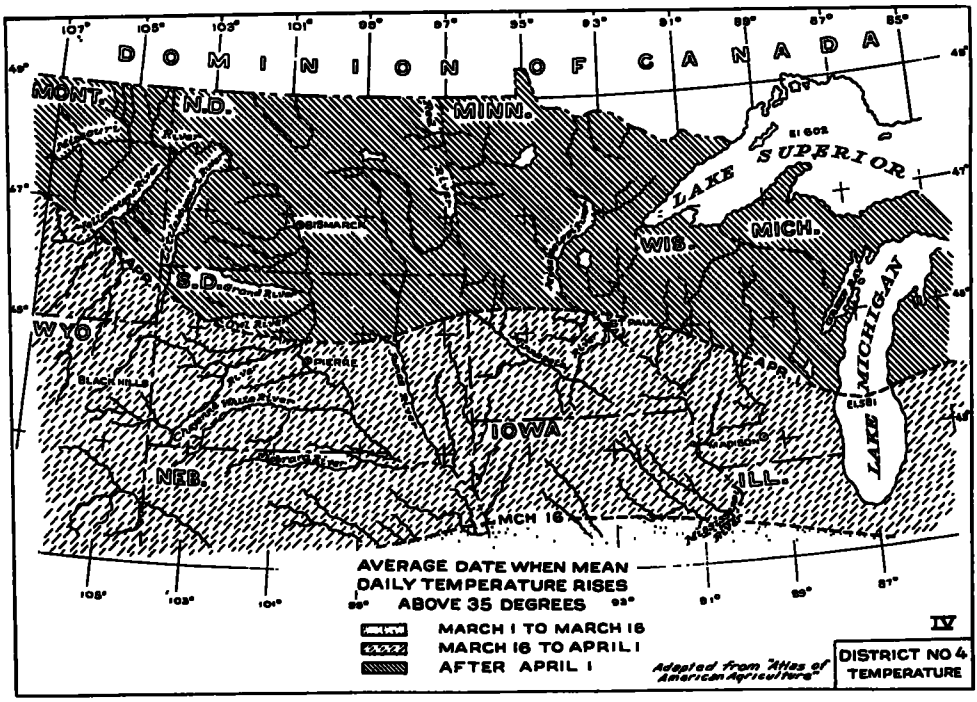

Figure 4

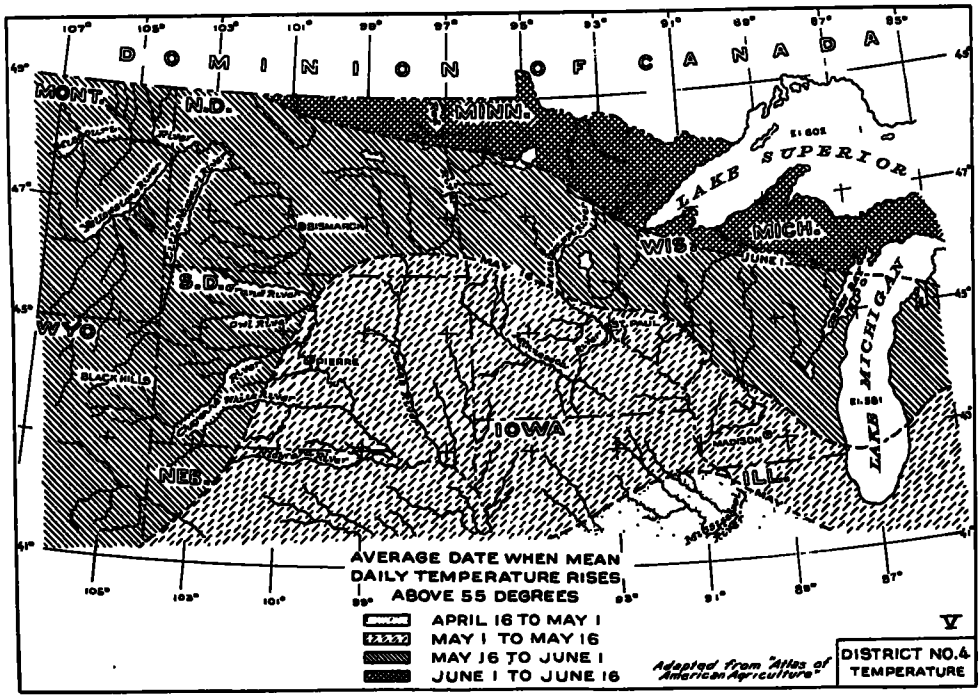

Figure 5

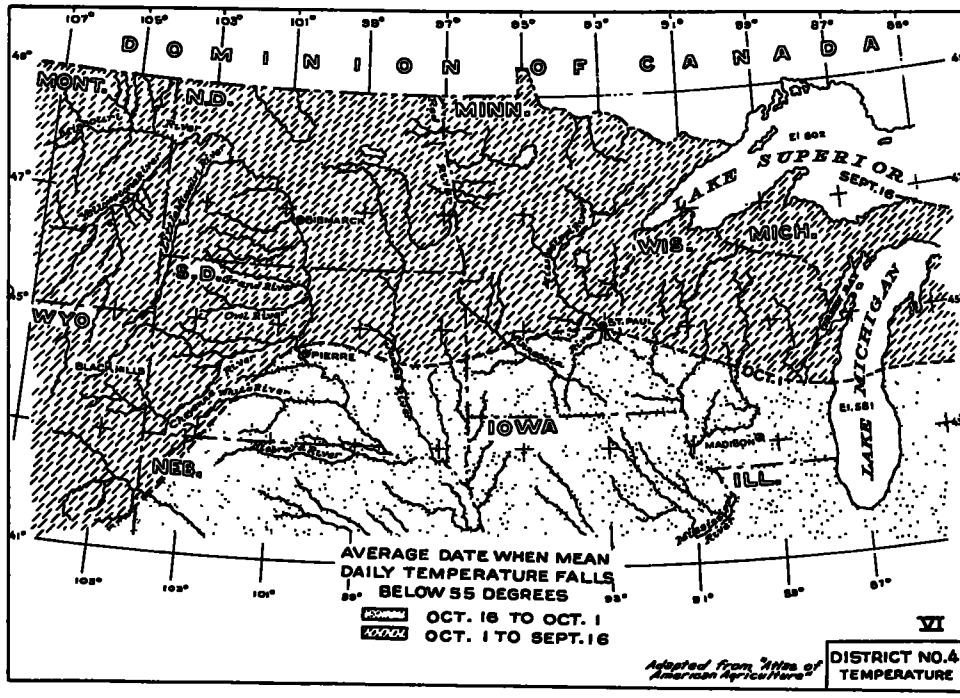

Figure 6

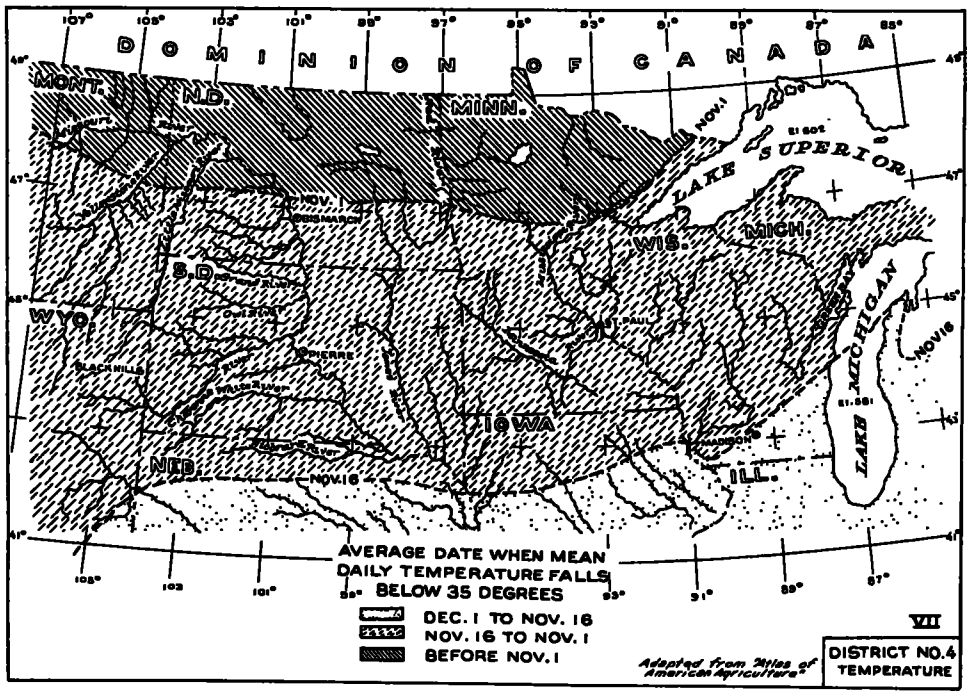

Figure 7

closing date for strictly seasonal items of work appears to be less variable than the opening dates in the spring.

According to Figure 8 the average dates of the first killing frost in the fall range from about September 10 in the north to about October 10 in the south; and according to Figure 9, the average dates of the last killing frost in the spring vary from about May 1 to about June 1 of the prairie grassland in the mid-region to the short grass of the dry plains grassland of the western portion.

It is generally recognized that these varying factors control plant growth in a region and, therefore, influence roadside planting work. It is not so generally recognized, however, that these same factors influence road design as well as landscape design, although nonseasonal high-

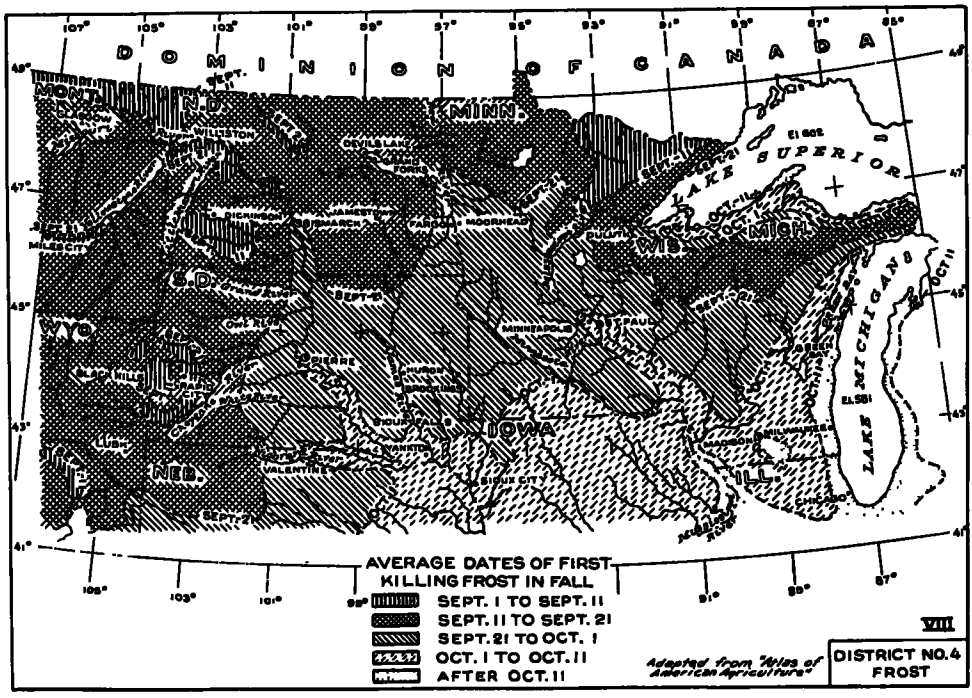

Figure 8

for the region. The comparative analysis of topographic and climatic factors which govern road design and landscape design operations must be the basis for the intelligent application of technical research data.

The product of all these climatic and topographic features is the natural vegetation of a particular locality or region. The moisture loving tree growths of the eastern portion (both deciduous and evergreen) are modified to the tall grass way operations are not so subject to these factor variations as are seasonal roadside activities.

Figure 10 furnishes a clear picture showing the extreme variation in the resulting products of different combinations of soil and climate.

While the map information accompanying this report may serve as a basis for research analysis in a wide range of roadside development studies, the present report is confined to an analysis of

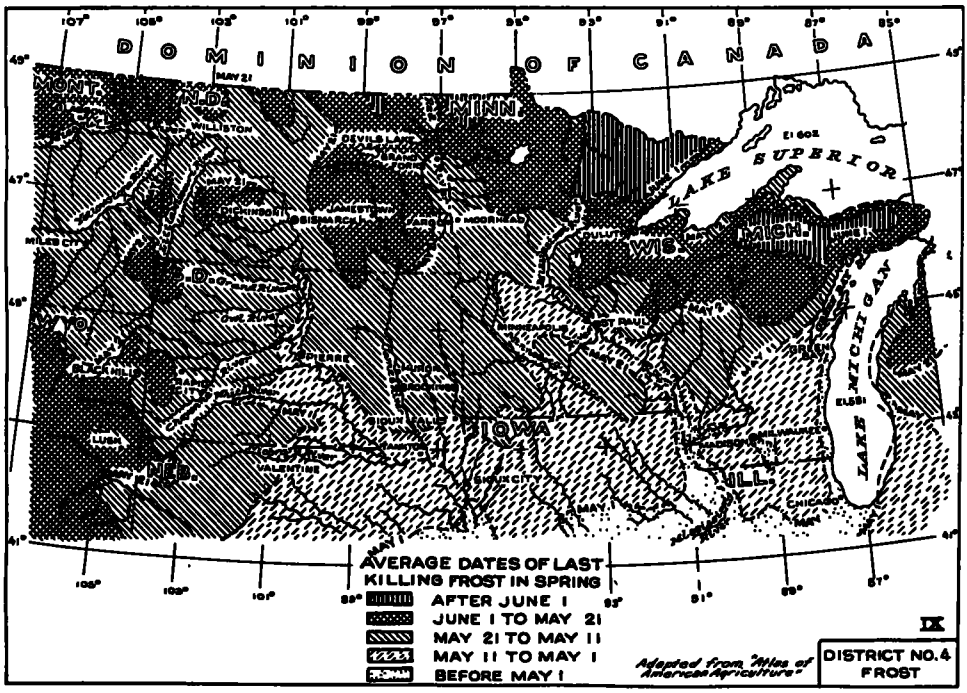

Figure 9

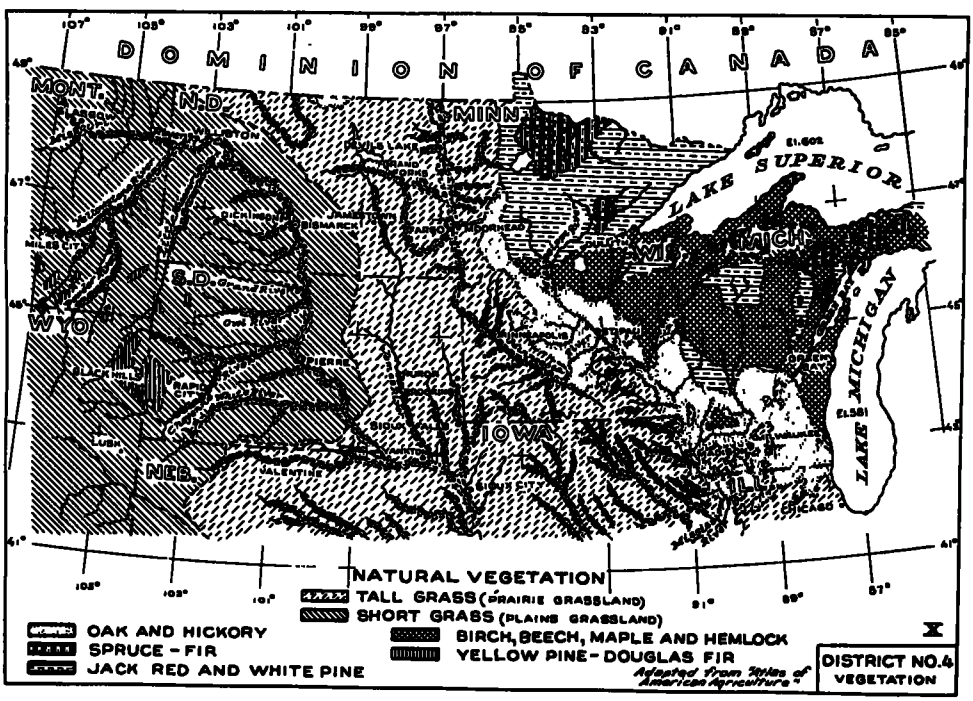

Figure 10

the highway cross-section in relation to topography, using as a basis the typical cross-sections now in regular use in each of the States of PRA District No. 4.

A summary of the typical sections is presented in Table 1, which indicates that:

(1) Graded roadbed widths vary from 40 ft. down to 24 ft. and 26 ft., although 36 ft. and 26 ft. to 28 ft. appear to be largely used, considering the region as a whole.

(2) Gutter slope ratios are 4:1 with few exceptions.

(3) The widths of gutter slopes are variable, with from 5 to 10 ft. used as a minimum. Gutter rounding is practiced in Minnesota and Wisconsin.

(4) Cut slope ratios vary from a 2:1 maximum to a 6:1 minimum, with the average about 4:1.

(5) Fill slope ratios vary from 4:1 to 2:1, with guard rail. There is indicated some relation of ratios to heights of fill, with 4:1 used on fills up to 5 ft. in North Dakota, 4:1 used on fills under 10 ft. in South Dakota, 4:1 used up to 6 ft. in Minnesota, and in Wisconsin wherever guard rail is not used.

(6) Right-of-ways are uniformly wide, ranging from 80 to 100 ft. through 150 to 200 ft.

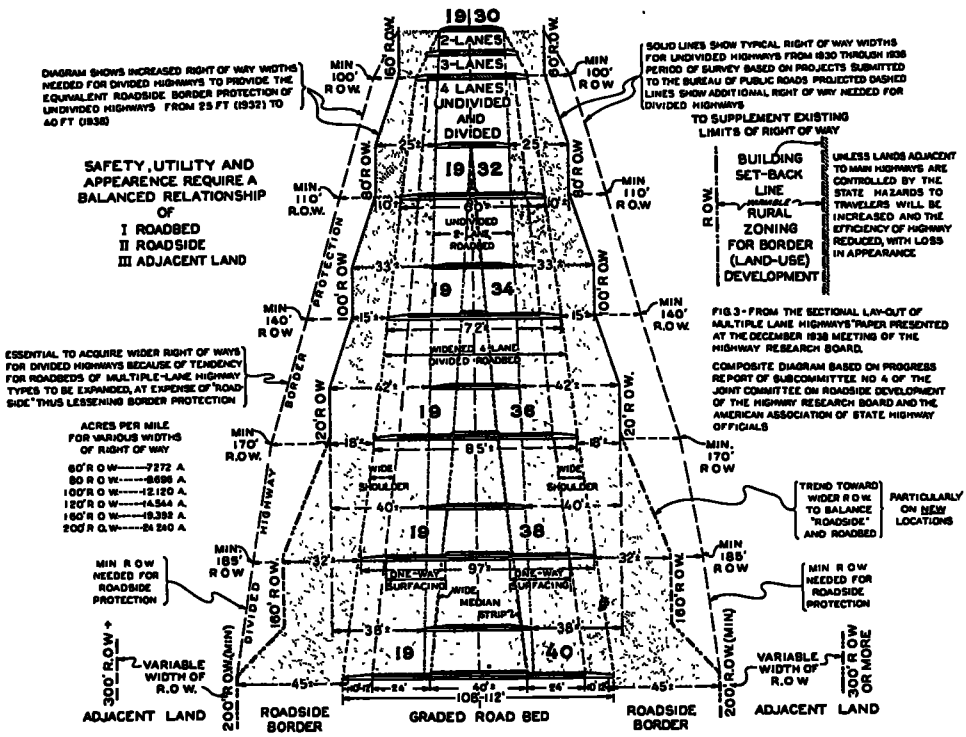

Figure 11. Trend in Expanding Widths of Divided Highways in Relation to Right of Ways

The flat and easy topography over the larger part of this region is favorable to these stream-lined cross-sections, which require adequate right-of-way width to keep fences and pole lines far enough

back from the center line so as not to cause snow drifting.

The relationship of topography to graded width as outlined in General Administrative Memorandum No. 74, issued by the Public Roads Administration under date of March 15, 1939, may be of interest.

In setting up Rules and Regulations for Secondary Highway Funds for the fiscal year 1940 and subsequent authorizations, it is stated that:

"(f) The design requirements for alinement and grade for secondary or feeder roads shall be consistent with the topography and the purpose to be served by the improvement. The minimum graded width of roadbed from out to out of shoulders shall be not less than 26 feet in easy topography; not less than 24 feet in rolling topography; and not less than 20 feet in mountainous topography with a greater width than the 20-foot minimum on through fills. Where roadbed slopes are flattened to 3 or 4 to 1 the minimum graded width in easy topography may be reduced to 24 feet. Abbreviated plans may be accepted when the

TABLE 1

COMPAPATIVE SUMMARY OF TYPICAL SECTIONS

State	(1) Graded roadbed width ft.	(2) Gutter slope ratio	(3) Gutter slope ft.	(4) Cut slope ratio	(5) Fill slope ratio	(6) R.O.W. width ft.
North Dakota..	36	4:1	10 min.....	4:1 (rounded)	Var. 4:1 to 2:1	200
	26	4:1	Var. 5 min.	4:1 (rounded)	4:1 to * 2:1	
South Dakota...	32	4:1	Var. 10 min.	5:1	4:1 (under 10′) 2:1 (10′ up) 8:1 used in borrow design	100
	26	4:1	Var. 8 min.	5:1	4:1 (under 10′) 2:1 (10′ up)	80±
Minnesota.....	40 and 36	4:1	Liberally rounded. Seeded or sodded.	4:1 2:1	4:1 (0′–6′) 3:1 (6′–12′) 2:1 (over 12′)	Variable approx. 150
	28	3:1	Rounded...	3:1	3:1	
	24	4:1	Rounded...	4:1 2:1	4:1 to 3:1	
Wisconsin.....	40	4:1 and 4:1 in combination with 10:1	Variable rounded.	Variable 2:1 max. 4:1 min. rounded.	4:1 and 2:1 (with guardrail)	100
	36	4:1 and 4:1 in combination with 10:1	Variable rounded.	Variable 2:1 max. 4:1 min. rounded.	4:1 2:1 (with guardrail)	100
	26	4:1 and 4:1 in combination with 10:1	Variable rounded.	Variable 2:1 max. 4:1 min. rounded.	4:1 2:1 (with guardrail)	66 to 80

* NOTE: For fills over 14 feet widen 1 foot and use 2 to 1 slopes.

character of the improvement warrants, provided they are in sufficient detail to show the quantity and kind of work involved."

SUMMARY

Since grading may be divided into three or four general types of topography or landscape, it is recommended that typical cross-sections be studied and developed to fit each type of topography in a proposed topographic classification for each region.

It is assumed that for smooth or easy topography the classifications "Relatively Level" and "Gently Rolling" will be uniformly understood. The moderate or rolling topography might refer to country which, while not mountainous, would require almost continuous heavy cuts and fills to meet line and grade requirements. "Light Mountainous" could be considered topography of the type generally encountered in the older and less rugged chains. The classification "Heavy Mountainous" refers to the heaviest mountain work customarily associated only with relatively limited areas in the most rugged mountains. The grading volumes per mile of highway corresponding to the several definitions may be considered roughly as doubling in quantity for each successive type in such an ordered classification; i.e., "easy topography" requiring from 25,000 to 50,000 cu. yd. of grading per mile of two-lane highway, for instance, would mean in relative terms that "moderate topography" would require about double this volume or from about 50,000 to 100,000 cu. yd., while "rough topography" would require at least four times the volume of grading for "easy topography," or from about 100,000 to 200,000 or more cu. yd.

RECOMMENDATIONS

1. It is proposed that research study develop the possibilities of classifying cross-sections on a basis of topographic relationship, showing slope ratios differentiated, for various depths of cut or fill.

2. It is desirable that typical sections show the full width of right-of-way with location of pole lines, tree planting controls and other details indicated in relation to the whole graded section.

3. It is necessary for erosion and snowdrift control that slopes be flattened and rounded as liberally as local conditions in the region permit. Highway safety, good appearance, and easy maintenance are equally served where such practices are applied.

4. Adjustments in grading for the saving of topsoil and of trees should be provided as alternate parts of the typical sections.

5. With these streamlined grading and conservation practices applied more uniformly in each region in connection with original highway construction the foundation for establishment of natural ground cover protection will have been provided at the lowest cost.

6. In order to provide for factors of safety and recreation, the modern highway should include provision for "wayside" areas in addition to the fundamentals of highway requirements.

CONCLUSION

This report in Table 1 includes typical highway sections now in regular use in one specific administrative region or highway district to show the gains which have been made in recognition of the many advantages of ordinary roadside development through integration of landscape practices in initial highway construction. The cross-sections for the region selected typify the evolutionary progress in the improvement of the right-of-way and the relation of the right-of-way to adjacent lands.

It is expected that this single regional presentation will encourage further studies along similar lines in every administrative highway region of the United States, looking toward the more uniform application of the improved practices and 6-point summary of recommendations listed.