TRANSPORTATION PLANNING
ON THE WILLAMETTE NATIONAL FOREST

by

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TRANSPORTATION PLANNING

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ABSTRACT. The objective of this study is to answer four questions concerning the transportation network on the Willamette National Forest. These questions are 1) how many and what kind of roads exist on the forest, 2) how much annual traffic can these existing roads handle, 3) can the existing system handle projected traffic volumes and 4) if not, how many miles of new road are needed to complete the transportation system.

Road logs were collected on the existing transportation system. This data was then synthesized and coded for computer storage. Question one was answered by interpreting the road log data. Questions two through four were answered by running the road log data through different computer programs designed for each question.

The results of answering these four questions was a transportation model, which can predict the average yearly traffic volume for every road in the forest based on predicted timber harvest and can also predict the number of miles of new road needed for each new timber sale.

Since 1972 personnel on the Willamette National Forest of western Oregon have been developing a long range land use and timber management plan. Development of a plan that will effectively deal with the variety of uses and wealth of resources within the forest is a difficult and intense activity moreover, a plan for any National Forest must consider a host of laws and regulations including the Wilderness Act of 1964, the Multiple Use-Sustained Yield Act of 1960 and the National Environmental Policy Act of 1969. Also involved are U.S. Forest Service policies, plus regional and statewide planning efforts.[1]

The National Forests of the Pacific Northwest are divided into six planning areas. The Willamette National Forest is included in the Columbia-Willamette Planning Area with three other National Forests (Map 1). An area guide was prepared, establishing target outputs for major uses of these Forests which share common issues, objectives, and management directions.[2]

With this background, the Willamette National Forest started a planning process that developed a planning organization, a public involvement program, forest coordinating requirements, an inventory and analysis of data, and assumptions concerning the future uses of the forest.[3]

THE PROBLEM

Transportation planning must form an integral part of any overall planning process. The land use planning process used on the Willamette National Forest is a land allocation simulation examining seven alternatives. This process does not lend itself to the development of a single specific transportation plan because of the multiple alternatives to be considered. Therefore only four questions were posed for consideration in this problem concerning the forest transportation system.[4]

These are:

1) How many and what kind of road standards exist on the forest?
2) What is the existing transportation system capable of handling in terms of average annual traffic volumes?
3) Can the existing transportation system handle projected traffic volumes?
4) How many miles of proposed road are needed under each Land Use Planning alternative and what impacts these roads would have on:
   a) land out of production,
   b) cost of road construction, and
   c) amount of sediment produced from road construction.

THE STUDY AREA

To understand the problems associated with land use and transportation planning on the Willamette National Forest one must comprehend the location, size, and potential of the study area.

The Willamette National Forest stretches for 110 miles along the west central slopes of Oregon's Cascade Mountains. The forest lies in the upper and middle Willamette Valley, which is approximately from Salem south to the northern edge of Douglas County. The Willamette National Forest in within a one and one-half hour drive from Portland, a one hour drive from Salem, Albany, Corvallis, Springfield, and Eugene and a one-half hour drive from Bend. There are 1,800,000 acres within the proclaimed forest boundary: 1,688,000 acres of National Forest plus 112,000 acres of private or other publicly owned land.[5]

The Willamette National Forest serves mainly Lane, Linn, Marion, Benton, and Polk counties which include such communities as Detroit, Mill City, Sweet Home, Blue River, McKenzie Bridge, Lowell, and Oakridge to name a few (Map 2).

Another factor that needs to be taken into account when considering the Willamette National Forest is the wide range of land uses that exist within the forest boundaries. First of all, the Willamette is the top timber producer among the 154 National Forests in the United States. The water resource available on the forest is used in flood control, irrigation, hydroelectric power, domestic water supplies, and recreation. Recreational activities available on the forest include camping, fishing, hiking, hunting, picnicking, mountaineering and any other of the diverse activities that man is able to enjoy outdoors.[6] The forest provides a diverse habitat for many forms of wildlife such as deer, elk, bear, rabbit, chipmunks, squirrels, gophers, porcupines, wolverine, fox, cougar, coyote, racoon, skunk, and many other species. There are also a wide variety of birds, reptiles, insects, fish, and primitive organisms in the forest.[7] Minerals are also present in the forest, though recently they have become increasing less important, except for isolated cases. Today, interest is growing in exploring the forest's geothermal resources. Finally Wilderness and Natural Areas occupy a substantial amount of land area in the forest. The four Wilderness Areas are Mt. Jefferson, Diamond Peak, Mt. Washington, and the Three Sisters; they occupy approximately fifteen percent of the total forest area.[8]

FIELD STUDY AND RESEARCH DESIGN

My personal contribution to this study was collecting, synthesizing and recording road log data. The first step was to decide what to include in the road logs. Road number, mile point, grade, surfacing type, surfacing width and horizontal alignment were the factors decided upon. Data on these six factors were necessary for placing the roads into a classification system.

Next, I drove all the roads in the Blue River and McKenzie Ranger Districts and recorded the necessary data. I then took this raw data and condensed it into a computer format, which was key punched for computer storage. This condensed data provided the foundation for the transportation study. It was used in one form or another in answering all the questions associated with this study.

The rest of this paper will focus on answering the four questions posed earlier in the problem statement. Question one will deal with road inventory and classification. Questions two through four will show how the basic road log data was used to construct a transportation model.

INVENTORY OF EXISTING ROADS BY STANDARDS

The first step in initiating transportation planning on the Willamette National Forest deals with the question: How many and what kinds of road stands exist on the forest? To answer this question all the major roads and most tie-through roads (i.e. loop roads) were driven by motor vehicle. Road logs were collected and road standards assigned according to the information obtained. Appendix I illustrates the criteria used in defining the different road standards as well as the method in which the different road standards were recognized in the field.

Figure 1 lists the definition of each different road standard found on the forest. Figures 2 through 6 help equate these standards to the field. Figure 2 displays the minimum requirements needed to classify a road into its proper standard. All four elements must meet the minimum requirements before a standard can be assigned. Figure 3 explains the criteria used in determining nodes along a road. Each time a node was encountered road number, mile point, change in grade, surfacing type, surfacing width and horizontal alignment were entered in the road log.

Horizontal alignment ranges are displayed in Figures 4 and 5. Road standards are assigned to these ranges based on A.S.S.H.O.[9] requirements and the following formula:

Alignment = average radius/no. of curves per mile

Alignment ratings are as follows:

Excellent	80
Good	41 to 60
Fair	21 to 40
Poor	11 to 20
Primitive	11

To simplify the task of determining the radius of a curve, Figure 6 was developed to display the offset required for a 25 feet tangent on 50 to 1400 feet radius curves.

DETERMINING AVERAGE ANNUAL TRAFFIC VOLUMES

The next step in the transportation planning process and of this study was to determine what each existing road was capable of handling in terms of average annual traffic volumes. To answer this question A.S.S.H.O. references and a computer model called "The Single Lane Simulator", were employed. The following table gives a description of how

Safe Traffic Volumes and Travel
Speeds by Road Standard

	Road Standard	Safe Travel Speed[1] (MPH)	Average Daily Traffic	Average Annual Traffic
1.	Single lane primitive	11	55[2]	12,000
2.	Single lane poor	15	110[2]	24,000
3.	Single lane fair	19	220[2]	48,000
4.	Single lane good	23	250[2]	55,000
5.	Double lane fair	25	400[3]	90,000
6.	Double lane good	35	565[3]	126,000
7.	Double lane excellent	50	800[4]	180,000

1. Experienced average safe speeds on the roads standards.

2. The single land simulator model was used to determine the safe average daily traffic over the various standards of single lane roads. This traffic volume ranged from 55 to over 800 vehicles per days. This range at the 55 end had very little delay time caused from congestion, while there was over 60 seconds delay at the higher end of the scales.

3. The average delay times used for fair and good standard double lane roads were taken from our traffic surveillance project.

4. The average delay times for excellent standard double lane roads was taken from A.A.S.H.O. data and reduced 25%.

these tools were used to determine traffic volume by road standard. Allowable traffic volumes for existing roads were assigned according to the results in the accompanying table. An eight hour day and 220 day season was used to determine the average annual traffic. The eight hour day was obtained from a traffic surveillance program which indicated 50% of the daily traffic occurred in a four hour period. The 220 day season was based on an average nine month access to the forest.

CAN THE EXISTING SYSTEM HANDLE PROJECTED TRAFFIC VOLUMES?

The third step in the problem analysis involved finding out whether or not the existing system was capable of handling projected traffic volumes. To answer this question the "Timber Transport Model", which was developed by the Transportation Analysis Group of Berkeley was used. The model employed the following process:

1) The first step was to build a network using the road log data obtained in Question 1. This data was coded in a Linory format for use in the computer model. Appendix II, Figures 1 and 2 list the Linory travel class codes and associated haul and maintenance costs used in the analysis.[10]

2) The second step was to divide the forest up into areas that could be considered timber sales areas or blocks in the transport analysis. These are areas delineated by natural geographic boundaries and/or logical access limits which may encompass many realistic timber sales. This was accomplished by taking into account many factors such as: soil

type, topography, drainage, vegetation, slope, aspect, current land use and soil capability to name a few. Five hundred thirty-eight "ecosystem" areas were delineated and acreage was planimetered by "ecosystem" area. Figure 3 displays a section of the map that resulted showing timber sales areas and the "ecosystems". Figure 4 displays the form used to store the acreage of each "ecosystem" within each timber sale. Figure 5 displays the process used to determine average yearly volumes per acre of timber harvest from areas that were allocated to timber harvesting activities in the R.C.S. Model.[11] Figure 6 shows the process used to determine yearly volumes of timber harvest by timber sale. The same timber sale areas and process was used to determine the number of recreation visitors that could be expected on the forest.[12]

3) The third step was to run the road network model through the first phase of the Timber Transport Model. The output from this model gave the number of loaded log trucks or passenger cars traveling in one direction, that is from timber sale to mill. To determine the total traffic generated by timber sales and recreation attractions, the traffic computed from the model had to be calibrated. Figure 7 explains the process used to calibrate these results.[13]

The results of this three step process is a transportation model to predict the average yearly traffic volumes for every road in the forest based on predicted timber harvest per "ecosystem" over a 100 year timber management period.

There are two factors the model failed to account for though, which could be important. First, the model failed to consider non-business traffic. This phenomena can create errors for some traffic volume projections. Second, the average annual traffic volumes are based on a 100 year period, which assumes that 1/100th of all the volume of timber will be removed each year. However many areas will have all their old growth removed well before 100 years. This could increase traffic volumes up to ten times that given in the model in certain areas. These two factors should be kept in mind when using predictions from the Transport Model.[14]

MILEAGE OF ROADS NEEDED FOR THE FUTURE

Question 4 dealt with the miles of proposed roads needed for each land use plan alternative and the impacts these roads would have on land out of production, cost of construction, and the amount of sediment produced from them. This question was addressed in the Resource Capabilities Systems model. It would have been an impossible task, considering time, manpower, and dollar constraints, to have determined the exact locations and mileages of proposed roads through a detailed transportation system developmental plan for each of the alternatives selected for the Land Use Plan.[15] Therefore, it was decided to add proposed roads as an acreage (1 mile of road = x acres) to be allocated to areas permitting timber harvest in the R.C.S. Model. To accomplish this, a typical road system was laid out for each of the various timber harvesting techniques on a sample of each of the "ecosystem" types found on the forest. This then yielded an average density of road needed to harvest timber by harvesting techniques, by "ecosystem". The density of the existing system was determined and subtracted from the total. The results were the miles of proposed roads needed for each harvesting technique by "ecosystem". Costs were then calculated for each mile of road by "ecosystem". Also sedimentation rates, land out of production, etc. were calculated. This data was entered into the R.C.S. Model as supplemental control rows. That is, when the R.C.S. Model allocated acreage to an activity allowing timber harvest, it also allocated acres of road necessary to harvest the timber. At the same time, it included the cost to construct the road and the sediment the road would produce. It was then possible to determine total proposed roads needed as well as to display the costs of those roads and sedimentation caused from them.[16]

SUMMARY

Results

The results obtained from this study are clear. First, an intensive inventory of the present road system on the forest was completed. All relevant information was collected and stored in computer banks ready for recall.

Second, the present capabilities of the existing system were calculated through the use of a model called the "Single Lane Simulator" and A.S.S.H.O. references, which are based on similar studies. This process yielded acceptable average annual traffic volumes for roads according to their road standard.

Third, the Timber Transport and R.C.S. Models were employed to discover whether or not the existing system could handle the volume of traffic projected for the future. The consequences of this process was the development of a transportation model, which could predict the average yearly traffic volume for every road in the forest, based on predicted timber harvest per "ecosystem" over a 100 year timber management period.

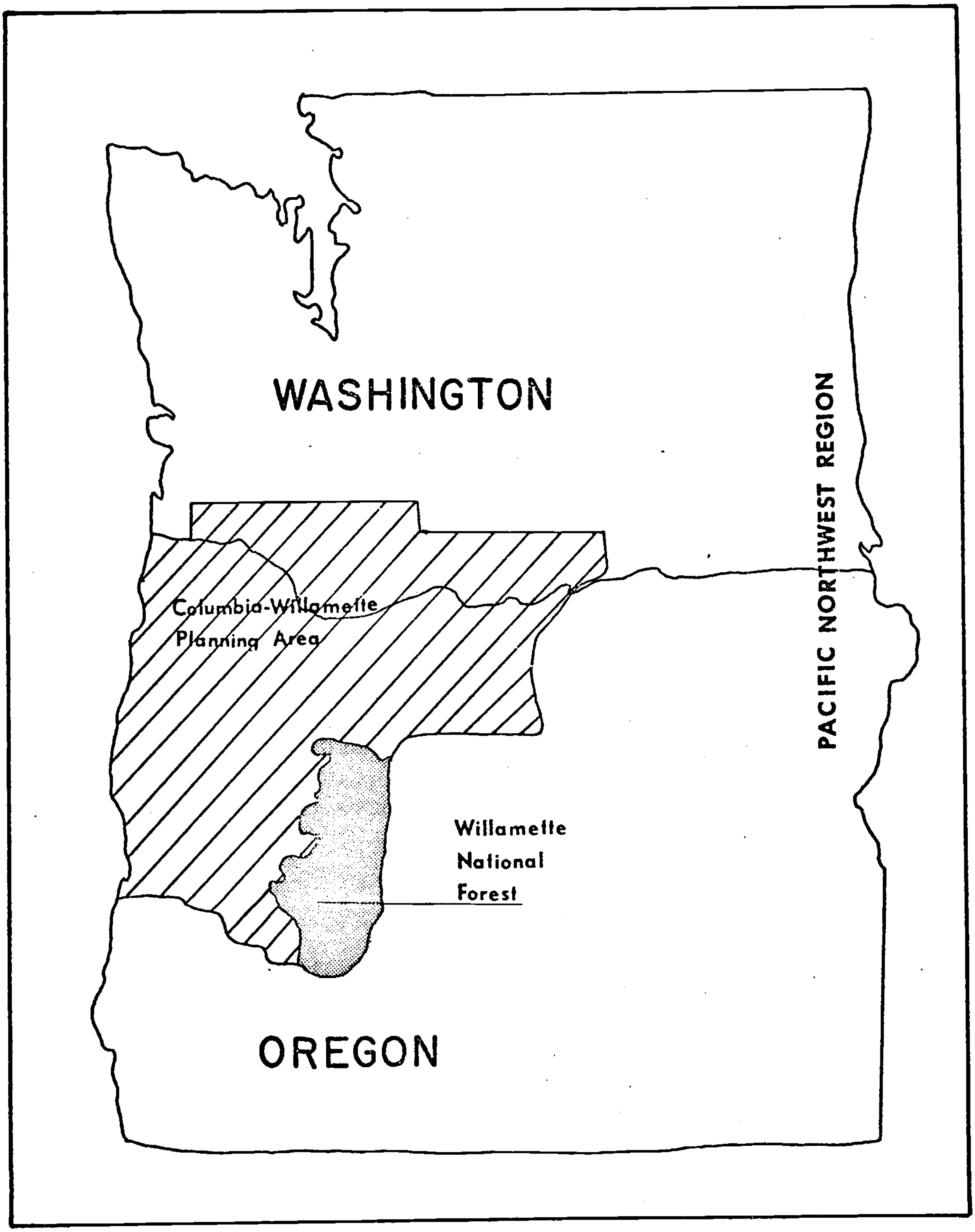
Finally, the total amount of roads needed to complete the transportation system on the forest was calculated using the R.C.S. Model. When the Model allocated acreage to a timber harvesting activity it also allocated the number of miles of new road needed to harvest that timber. Included in this allocation, was cost of construction and the sedimentation the road would produce.

Need for Further Study

Although the transportation planning process used on the Willamette National Forest was comprehensive, there is a need for further research in certain areas. Data pertaining to existing road standards needs to be continually updated as reconstruction and improvements are carried out. This is essential in keeping the transportation model up to date.

Also more research is needed on single lane roads. Specific areas which need more research include: average travel speeds on the various road standards, maximum acceptable delay times reasonable to both recreationalists and industry and maximum acceptable traffic capacities of the various road standards.[17]

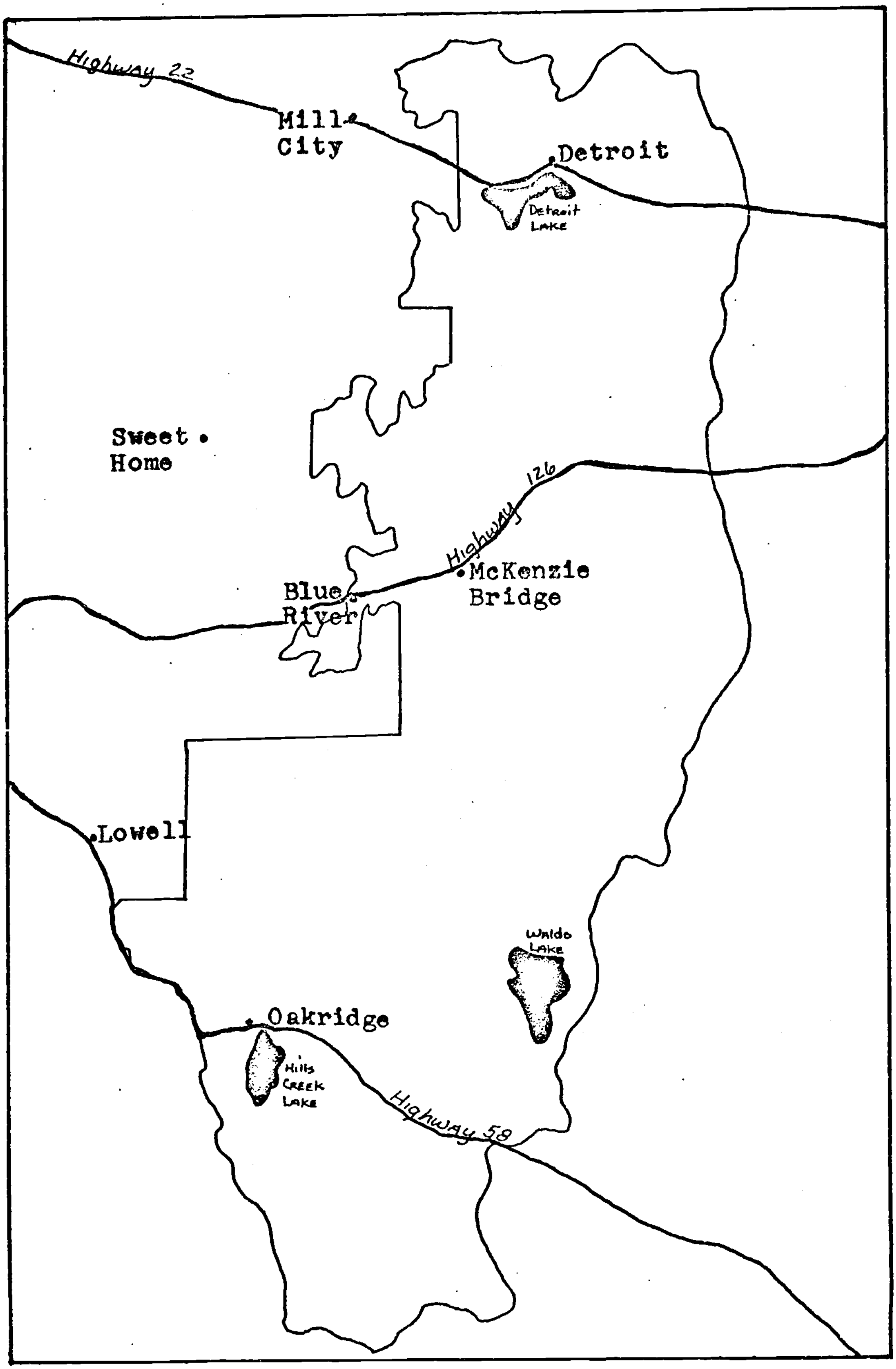
Map 1



United States Forest Service

Pacific Northwest Region

Map 2



Willamette National Forest

Appendix I

Figure 1

Road Standards for the Willamette National Forest

Seven distinct road standards (types and classes) were established for the Willamette National Forest. They are :

Double Lane/Excellent Alignment (State secondary roads)--Generally grades do not exceed six percent. They have paved surfaces with running lanes 24 feet wide plus four foot shoulders. Subgrade widths ranges from 34 to 37 feet, and occupy 5.7 to 14.5 acres per mile of road.

Double Lane/Good Alignment--Generally, grades do not exceed eight percent. They are generally paved, but this is not a requirement. Running lanes are 22 feet wide, plus two foot shoulders. Subgrade widths range from 30 to 33 feet, and occupy 5.1 to 13.3 acres per mile of road.

Double Lane/Fair Alignment--Generally, grades do not exceed nine percent; they have a mixture of paved and gravel surfacing, with 22 feet of running lane width and no shoulders. Subgrade widths range from 26 to 29 feet, and occupy 4.7 to 11.7 acres per mile of road.

Single Lane/Good Alignment--Generally, grades do not exceed eight percent; they have a mixture of paved and gravel surfacing with running lanes 14 feet wide. These roads include: 3:1 surfacing slope shoulders; intervisable turnouts; and adequate drainage structures. Subgrades range from 18 to 21 feet wide, and occupy 3.3 to 8.2 acres per mile of road.

Single Lane/Fair Alignment--Generally, grades do not exceed nine percent; these roads are generally gravel surfaced with running lanes 12 feet wide. They include both 2:1 and 3:1 surfacing slope shoulders, intervisable turnouts, and adequate drainage structures. Subgrade widths range from 15 to 18 feet, and occupy 3.0 to 8.2 acres per mile of road.

Single Lane/Poor Alignment--Grades range from 0 to 18 percent. These roads have a mixture of crushed and pit run gravel surfacing. Running lane widths range from 10 to 12 feet. They include mostly 2:1 surfacing slope shoulders, turnouts that are usually intervisable, with adequate drainage structures which include both standard ditching with culverts and in-slope/out slope road-bed with drainage dips. Subgrade widths range from 10 to 18 feet, and occupy 2.8 to 8.2 acres per mile of road.

Primitive/Poor Alignment--Grades range from 0 to 20 percent. They generally are non-surfaced roads without adequate drainage. Their running lane ranges from 10 to 12 feet. There are very few turnouts that mostly are not intervisable. Subgrades range from 10 to 14 feet, and occupy 2.8 to 7.0 acres per mile of road.

Figure 2

Minimum Requirements for Assigning Road Standard

Road Standard	Vertical Align. (grades) favorable	Vertical Align. (grades) adverse	Horizontal Align. (curves)	Road Surface Type Paved	Road Surface Type Gravel	Road Surface Type Soil	Road Surface Width (feet)
Double Lane							
Excellent	6	6	See	X	X		28+
Good	8	8	Figure	X	X		24+
Fair	9	9	4	X	X		20+
Single Lane							
Good	8	8	See	X	X		14+
Fair	9	9	Figure	X	X		12+
Poor	12	12	5	X	X		10+w-w/o ditch
Primitive	16	16		X	X	X	10+w/o ditch

Figure 3

Establishment of Nodes

Node	Example
A. Road Junctions (System and Spur)	A_1 Road # 1678 left A_2 Spur Road right
B. Changes in Road Standards	
1. changes in surfacing type	B_1 Gravel to soil
2. changes in surfacing widths	B_2 24' to 12'
3. changes in horizontal alignment	B_3 Good to poor
4. changes in vertical alignment	B_4 5% grade to 10% grade
C. Bridges	C_1 Bridge
D. Major Culverts	D_1 Culvert
E. Changes in Road Condition	
1. land slides	E_1 100' long slide on road
2. drainage problems	E_2 Culvert plugged
3. erosion problems	E_3 Ditch full
4. surface deterioration	E_4 Pavement breaking up
5. etc.	

Node = Stopping point where road log data was collected, usually not more than 0.5 miles apart along each road.

Figure 4

Nomograph for Determining
Horizontal Alignment-Double Lane

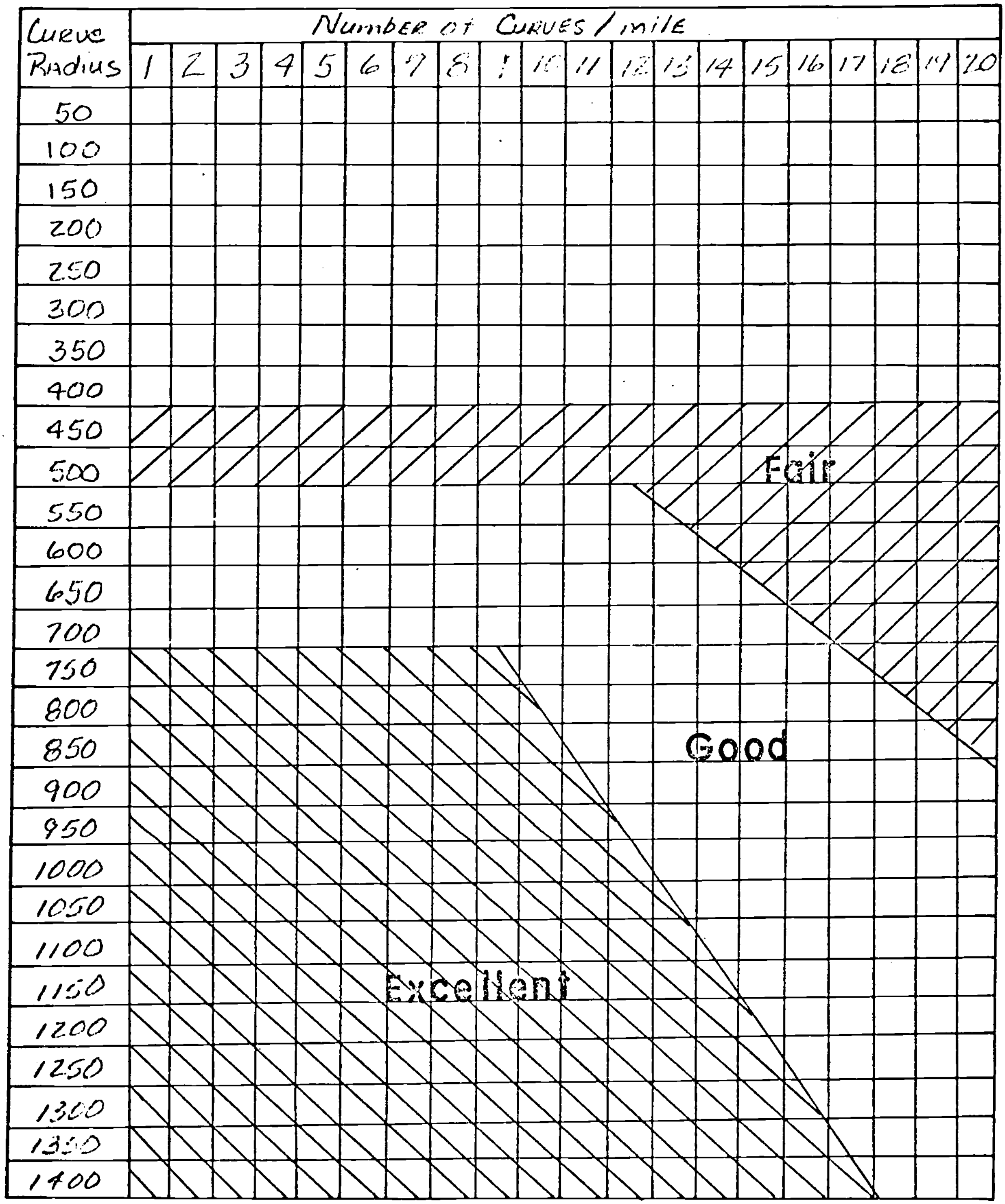


Figure 5

Nomograph for Determining
Horizontal Alignment-Single Lane

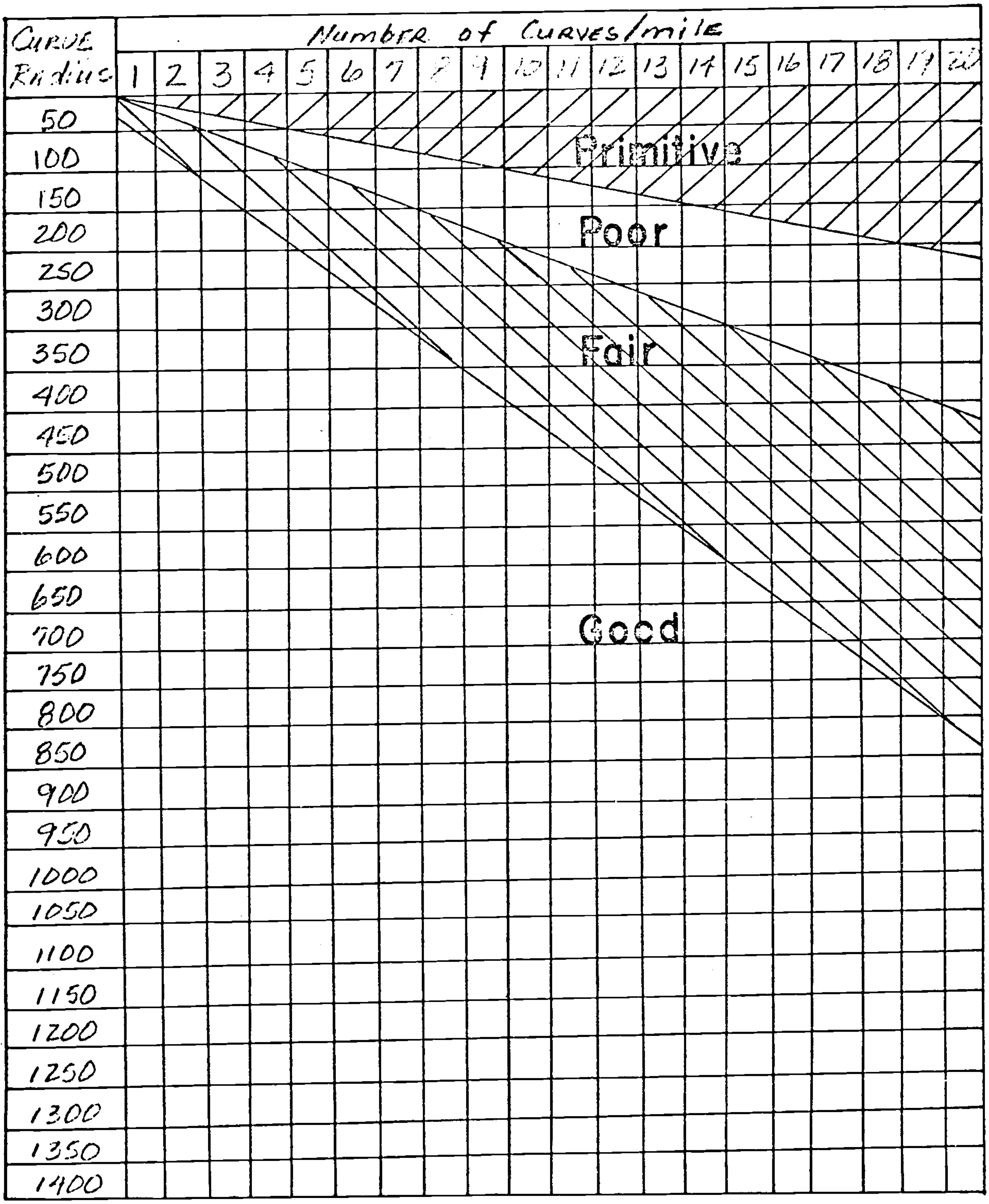


Figure 6

Simplified Method of Determining Curve Radius

Radius of Curve (in feet)	offset based on 25' tangent (in feet)	Radius of Curve (in feet)	offset based on 25' tangent (in feet)
50	6.4	750	0.4
100	3.1	800	0.4
150	2.5	850	0.4
200	1.6	900	0.3
250	1.3	950	0.3
300	1.0	1000	0.3
350	0.9	1050	0.3
400	0.8	1100	0.3
450	0.7	1150	0.3
500	0.6	1200	0.3
550	0.6	1250	0.3
600	0.5	1300	0.2
650	0.5	1350	0.2
700	0.4	1400	0.2

Appendix II

Figure 1-a

Travel Class Code

		GRADES		CODES		
		FROM	TO	PAVED	GRAVEL	LOW STANDARD GRAVEL - SOIL
Double Lane Excellent Alignment	GRADES	8	9	1	8	
		6	7	2	9	
		4	5	3	10	
		2	3	4	11	
		1	-5	5	12	
		-6	-8	6	13	
		-9	-11	7	14	
Double Lane Good Alignment	GRADES	10	<	15	23	
		8	9	16	24	
		6	7	17	25	
		4	5	18	26	
		2	3	19	27	
		1	-5	20	28	
		-6	-8	21	29	
		-9	-11	22	30	
Double Lane Fair Alignment	GRADES	10	<	31	40	
		8	9	32	41	
		6	7	33	42	
		4	5	34	43	
		2	3	35	44	
		1	-6	36	45	
		-7	-9	37	46	
		-10	-12	38	47	
		-13	-14	39	48	
Single Lane Good Alignment	GRADES	12	<	49	59	
		10	11	50	60	
		8	9	51	61	
		6	7	52	62	
		4	5	53	63	
		2	3	54	64	
		1	-7	55	65	
		-8	-9	56	66	
		-10	-12	57	67	
		-13	-14	58	68	

Figure 1-b

		GRADES		CODES		
		FROM	TO	PAVED	GRAVEL	LOW STANDARD GRAVEL - SOIL
Single Lane Fair Alignment	GRADES	12	<	95	69	
		11	12	96	70	
		9	10	97	71	
		7	8	98	72	
		5	6	99	73	
		3	4	100	74	
		2	-9	101	75	
		-10	-11	102	76	
		-12	-13	103	77	
		-14	<	104	78	
Single Lane Poor Alignment	GRADES	12	<	105	79	
		10	11	106	80	
		8	9	107	81	
		6	7	108	82	
		4	5	109	83	
		3	-11	110	84	
		-12	-13	111	85	
		-14	<	112	86	
Single Lane Bad Alignment	GRADES	13	14		113	87
		11	12		114	88
		9	10		115	89
		7	8		116	90
		5	6		117	91
		3	4		118	92
		2	-12		119	93
		-13	-14		120	94
Trail on Easy Terrain	GRADES			121		
Trail on Average Terrain	GRADES	8	<	122		
		8	>	123		
Trail on Rough Terrain	GRADES	12	<	124		
		12	>	125		

Figure 2-a

Cost/Travel Class Code for Logging Trucks

CODE	MAINTENANCE $/MILE/MBF	HAUL $/MILE/MBF
1	.19	.70
2	.19	.57
3	.19	.44
4	.19	.31
5	.19	.24
6	.19	.34
7	.19	.43
8	.30	.77
9	.30	.63
10	.30	.50
11	.30	.37
12	.30	.26
13	.30	.38
14	.30	.48
15	.19	.80
16	.19	.70
17	.19	.57
18	.19	.44
19	.19	.33
20	.19	.25
21	.19	.34
22	.19	.44
23	.30	.87
24	.30	.77
25	.30	.63
26	.30	.50
27	.30	.38
28	.30	.29
29	.30	.38
30	.30	.48
31	.19	.80
32	.19	.70
33	.19	.57
34	.19	.45
35	.19	.36
36	.19	.28
37	.19	.37
38	.19	.47
39	.19	.56
40	.30	.87
41	.30	.77
42	.30	.63
43	.30	.50

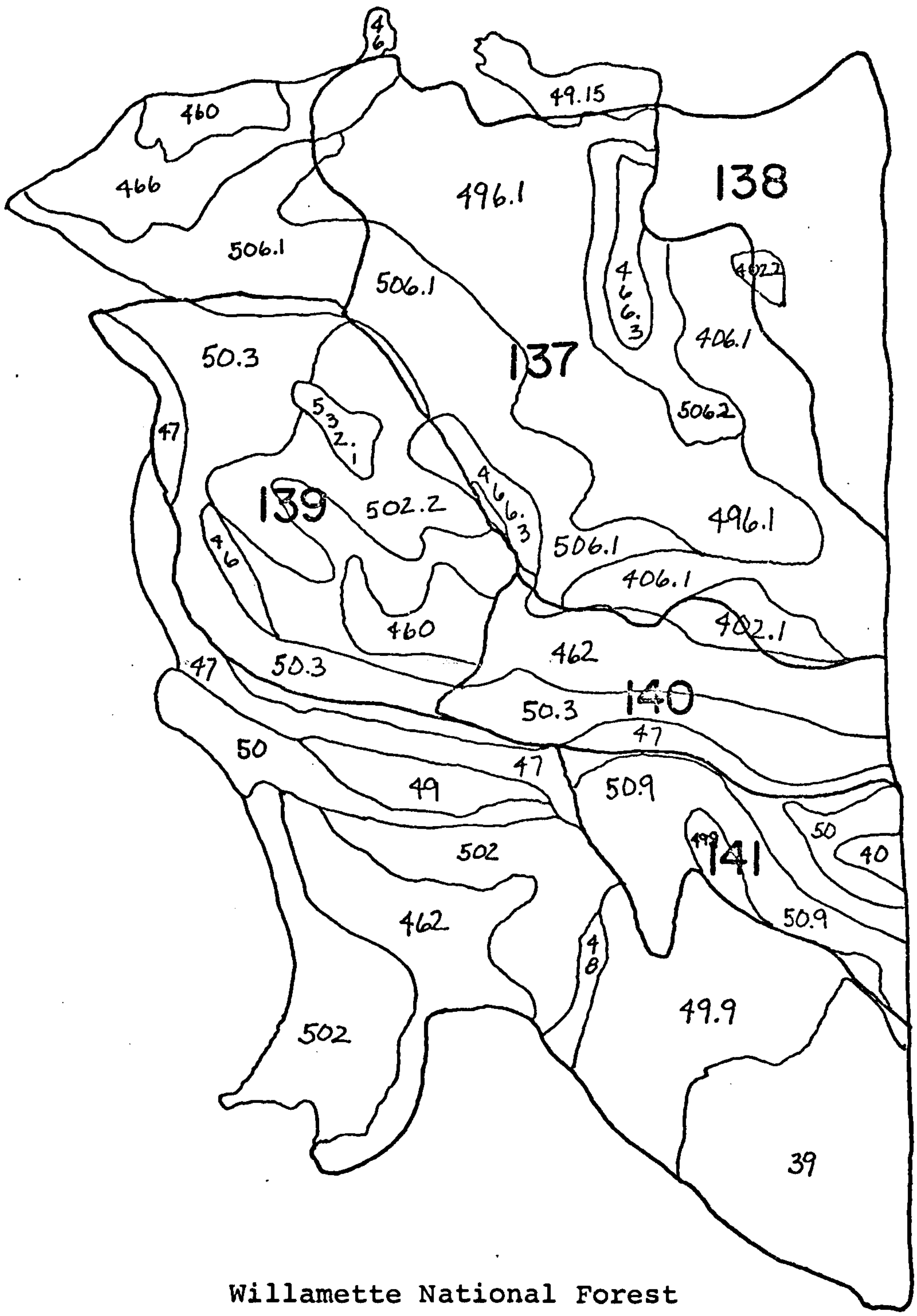
Figure 2-b

CODE	MAINTENANCE $/MILE/MBF	HAUL $/MILE/MBF
44	.30	.41
45	.30	.33
46	.30	.41
47	.30	.51
48	.30	.59
49	.16	.94
50	.16	.84
51	.16	.71
52	.16	.59
53	.16	.48
54	.16	.38
55	.16	.32
56	.16	.38
57	.16	.47
58	.16	.56
59	.28	1.01
60	.28	.90
61	.28	.77
62	.28	.64
63	.28	.54
64	.28	.44
65	.28	.37
66	.28	.43
67	.28	.51
68	.28	.60
69	.28	1.01
70	.28	.94
71	.28	.84
72	.28	.73
73	.28	.61
74	.28	.51
75	.28	.44
76	.28	.49
77	.28	.56
78	.28	.61
79	.28	1.01
80	.28	.92
81	.28	.81
82	.28	.71
83	.28	.61
84	.28	.51
85	.28	.56
86	.28	.61
87	.35	1.25
88	.35	1.13
89	.35	1.00
90	.35	.90
91	.35	.80
92	.35	.69
93	.35	.61
94	.35	.65

Figure 2-c

CODE	MAINTENANCE $/MILE/MBF	HAUL $/MILE/MBF
95	.16	.95
96	.16	.88
97	.16	.78
98	.16	.67
99	.16	.55
100	.16	.45
101	.16	.37
102	.16	.43
103	.16	.50
104	.16	.55
105	.16	.95
106	.16	.86
107	.16	.75
108	.16	.65
109	.16	.55
110	.16	.45
111	.16	.50
112	.16	.55
113	.30	1.15
114	.30	1.03
115	.30	.90
116	.30	.80
117	.30	.90
118	.30	.59
119	.30	.51
120	.30	.55

Figure 3



Willamette National Forest

Timber Sales Areas 137-141

Showing Ecosystem Divisions

Figure 4

Sample Computer Print-out of
Forest Data of Location of Timber Resource

T.S. #	Road #	M.P.	MAP REF.	ACRES	MAP REF	ACRES	MAP REF	ACRES
___	___	___	___	___	___	___	___	___
LP Factor			___	x ___	___	x ___	___	x ___
Total MBF (		)		=	MBF	=	MBF	=
1/	2/	3/	4/	5/				
137	1778	16.5	502.2	62	462.3	76	402.1	218
LP Factor			___	x ___	___	x ___	x ___	___
Total MBF (		)		=	MBF	=	MBF	
137	1778	16.5	406.1	2768	506.2	974	466.1	330
LP Factor			___	x ___	___	x ___	x ___	___
Total MBF (		)		=	MBF	=	MBF	
137	1778	16.5	506.1	2506	496.1	5555	49.15	20
LP Factor			___	x ___	___	x ___	___	___
Total MBF (		)		=	MBF	=	MBF	=

1 T.S.# = Timber Sale Area Number

2 Road # = Road Number

3 M.P. = Mile point which was designated as the Timber Sale Node for the Analysis Model

4 Map Ref. = Refers to ecosystem number having acreage within the Timber Sale Area

5 Acres = Refers to acres involved with Map Ref.

Figure 5

Average Yearly Volumes of Timber Harvest

R.A.U. 1/	Activity 2/	Allocated Acres 3/	Harvest Potential MBF/Acre/Yr.	Harvest By Allocated Acres In MBF/Year	Eco-System 4/	Class 5/	Map Key Number 6/	(L.P. Factor) MBF/Acre 7/
070	2385	7,742	2.200	17,032	2A	Roadless	152,382	0.7964
110	2385	4,504	2.200	9,909	2B	Roadless	162,392	0.2731
155	2385	28	2.240	63	2C	Road	40	0.0111
250	2444	431	1.650	711	2E	Road	42	0.3909
255	2385	1,861	2.190	4,076	2E	Road	42	0.3909
305	2385	424	2.190	929	2F	Road	43	0.1091
350	2385	862	1.170	1,009	2G	Road	44	2.435
355	2405	1,561	4.670	7,290	2G	Road	44	2.435
455	2385	2,819	2.180	6,145	3A	Road	25,46,65,86	0.1708
470	2385	1,181	2.180	2,575	3A	Roadless	252,462,652,862	0.1075
505	2385	633	4.500	2,849	3C	Road	26,47,66,87	0.0512
510	2385	55	4.500	248	3C	Roadless	262,472,662,872	0.1211
555	2385	5,669	3.970	22,506	3D	Road	27,48,67,88	0.2566
620	2385	64	3.650	234	3E	Roadless	282,492,682,892	0.0116
655	2385	60,508	2.860	173,053	3F	Road	29,50,69,90	0.7775
660	2402	60,101	5.720	343,778	3F	Roadless	292,502,692,902	4.4984
705	2385	29,983	3.230	96,845	3G	Road	30,51,70,91	0.5227
710	2385	270	3.230	872	3G	Roadless	302,512,702,912	0.0897

1/ R.A.U. = Resource Allocation Unit is described in the "Basic Quantitative Data Book."
2/ Activity = the activity that was allocated in the RCS Model.
3/ Allocated Acres = acres allocated in the RCS Model to a specific activity.
4/ Ecosystem = Ecosystem classification.
5/ Class = Roadless or Roaded Area
6/ Map Key Number = Map reference number (see Exhibit V)
7/ L.P. Factor = This is a calculated timber volume obtained by dividing the "Harvest by Allocated Acres" by the total number of acres in an R.A.U.

Figure 6

Sample Computer Print-out of Potential Harvest of Timber Resource

T.S. #	Road #	M.P.	Map Ref.	Acres	Map Ref	Acres	Map Ref	Acres
L P Factor				x		x		x
Total MBF ( )				=	MBF	=	MBF	=
137	1778	16.5	502.2	62	462.3	96	402.1	218
L P Factor				x 4.4984		x 0.1075		x 0
Total (389)				= 279	MBF	= 10	MBF	= 0
[1] 137	[2] 1778	[3] 16.5	[4] 406.1	[5] 2768	506.2	974	466.1	380
L P Factor [6]				x 0		x 0		x 0
Total [7] (0)				= 0	MBF	= 0	MBF	= 0
137	1778	16.5	506.1	2506	496.1	5555	49.1	20
L P Factor				x 0		x 0		x 0
Total (0)				= 0	MBF	= 0	MBF	= 0

1 T.S. # = Timber Sale Area Number

2 Road # = Road Number

3 M.P. = Mile point which was designated as the Timber Sale Node for the Analysis Model

4. Map Ref. = Refers to ecosystem number having acreage within the Timber Sale Area

5 Acres = Refers to acres involved with Map Ref.

6 LP Factor = Linear Program Factor is a multiplier used to determine the amount of timber harvested per acre per year in each ecosystem by timber sale area

7 Total = Summation of total MBF of timber to be harvested in each of the timber sale areas

Figure 7

FACTORS BY WHICH THE COMPUTED TRAFFIC VOLUMES (IN THE TRANSPORT ANALYSIS MODEL) MUST BE INCREASED

I. The following displays the relationship of log and other traffic summarized from 37 samples for the four road traffic mix classifications (Table A).

Road Classification	% Traffic by Mix			% of Rec. Traffic		Ratio of Log Trucks to Log Related Traffic
	Rec.	Log.	Log Rel.			
High Recreation	66	11	23	>.50	=	1 Log : 2 Log Related
Medium Recreation-Low Timber	38	32	30	30-50	=	1 Log ; 1 Log Related
Low Recreation-Medium Timber	27	42	31	15-30	=	1 Log : 3/4 Log Related
High Timber	8	59	33	<15	=	1 Log : 1/2 Log Related

II. Based on the 37 traffic counter sites (Table B) with visual classification back-up, the following log truck-other traffic relationship has been established with factors to be applied to traffic volumes generated by "Pick" (a phase of the Transport Model), which only generates loaded log trucks and/or one-way recreationists.

% of Recreation Traffic on Road	Ratio of Log Trucks to Log Related Traffic	Factors by which "Pick" Results were Increased	
		Recreation Traffic 1/	Timber Traffic 2/
> 50	1 Log : 2 Log Related	2.0	6.0
30-50	1 Log : 1 Log Related	2.0	4.0
15-30	1 Log : 3/4 Log Related	2.0	3.5
< 15	1 Log : 1/2 Log Related	2.0	3.0

1/ Recreation traffic was doubled to include the return trip. This does not reflect all of the system use that occurs once people are out in the Forest.

2/ Example for determining timber traffic:

1 Log : 2 other vehicles equates to 1 loaded truck plus 2 Log Related vehicles one way plus 1 empty truck plus the 2 Log Related vehicles returning = 6 vehicles; Therefore,

1 Log to 2 Log Related = 6
1 Log to 1 Log Related = 4, etc.

Table A

ROAD CLASSIFICATION BASED ON THE FOLLOWING ASSUMPTIONS

% Traffic Volumes by Mix		
Recreation %	Log %	Road Classification
>50	<15	High Recreation Road
>30	>15	Medium Recreation/Low Timber
>15	>30	Low Recreation/Medium Timber
<15	>50	High Timber Road

Table B

TRAFFIC SURVEILLANCE SAMPLES

% of Traffic Volumes by Mix				Road Classification			
Recreation	Log	Log Related	Road No.	High	Medium	Low	Timber
24	48	28	2042			X	
29	42	29	2042			X	
9	58	33	196				X
18	51	31	196			X	
4	59	37	191				X
7	55	38	196				X
39	37	24	211		X		
46	23	30	211		X		
64	12	24	210	X			
56	20	24	210		X		
8	59	33	211				X
30	33	35	211		X		
20	42	38	243			X	
31	38	31	211		X		
28	37	35	2401			X	
74	11	15	RS46	X			
63	5	32	103	X			
7	63	30	1311				X
36	20	44	1311		X		
39	34	27	1345		X		
26	40	34	1177			X	
31	48	21	1263		X	X	
4	57	39	1311				X
18	46	36	1645			X	
49	27	24	149		X		
63	13	24	163	X			
32	32	36	149		X	X	
38	43	19	163		X	X	
14	57	29	1663				X
41	25	34	163		X		
15	46	39	181			X	
31	35	34	181		X	X	
65	15	20	181	X			
10	54	36	191				X
7	70	23	191				X

FOOTNOTES

1. U.S. Forest Service Land Use Planning Team, Highlights of the Draft Environmental Statement on the Willamette National Forest's Land Use Plan and Timber Management Plan (published by the Willamette National Forest, 1975), page 4.

2. U.S. Forest Service Land Use Planning Team, Narrative of the Draft Environmental Statement on the Willamette National Forest's Land Use Plan and Timber Management Plan (published by the Willamette National Forest, 1975), page 27.

3. Highlights, op. cit., footnote 1, page 4.

4. Henry Parkins, Transportation Planning for Level II Land Use Plan (printed by the Willamette National Forest, 1975), page 3.

5. Narrative, op. cit., footnote 2, page 13.

6. Highlights, op. cit., footnote 1, page 2.

7. Highlights, op. cit., footnote 1, page 2.

8. Highlights, op. cit., footnote 1, page 3.

9. A.S.S.H.O. is the American Association of State Highway Officials.

10. Henry Parkins, op. cit., footnote 4, page 4.

11. R.C.S. is the Resource Capabilities System computer model.

12. Henry Parkins, op. cit., footnote 4, page 4.

13. Henry Parkins, op. cit., footnote 4, page 4.

14. Henry Parkins, op. cit., footnote 4, page 5.

15. Henry Parkins, op. cit., footnote 4, page 5.

16. Henry Parkins, op. cit., footnote 4, page 6.

17. Henry Parkins, op. cit., footnote 4, page 1.

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