CLEARING AND EARTHWORK

SECTION 201 - CLEARING AND GRUBBING (Labor 20-55 percent) *& SECTION 202 – ADDITIONAL CLEARING AND GRUBBING*

General

There are too many variables reflected in the bids to use them solely as a basis for costs. Therefore Figure 201-1 is given as a starting point for an "average" new construction project. The designer will need to consider the uniqueness of the project and estimate accordingly. Also consider the amount of vacant (no clearing) area in relation to the acreage being cleared. The factors used are based on the use of the hydraulic excavator for clearing/ pioneering. **Clearing may need to be adjusted to meet total mechanical clearing.**

Clearing Classification

Classification by volume per acre of timber within clearing limits

The classification of clearing by volume per acre is shown on Figure 201-1, this section. It is essential that timber volumes be estimated within accuracy standards. Estimators should request gross volume figures for estimating use.

Clearing cost estimates should compensate for down material as well as that which is standing. In some cases the down volume is insignificant while in others it may be more difficult to handle than standing volume. Therefore, an adjustment factor for down material of 0 to 1.2 is appropriate.

Example

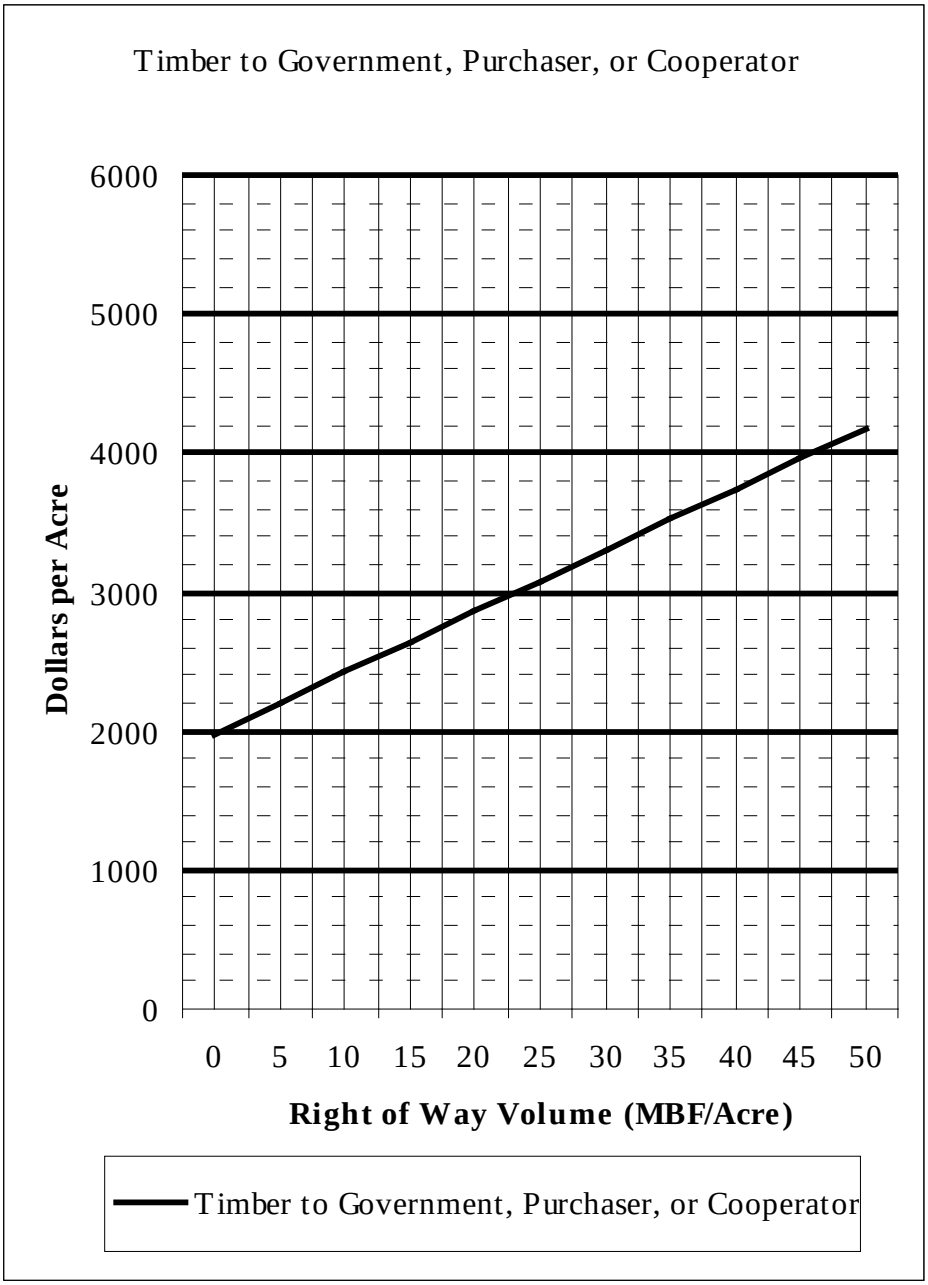
Gross volume from timber cruise: ..... 12 Mbf/ Acre
Gross down volume: ..... 6 Mbf/ Acre
Factor for down material: 0.5
Volume for classification: 12 + (6 x 0.5) = 15 Mbf/ Acre

Classification by Stand Description

Clearing classification by stand description is based on a uniform mixture of large and small trees. The classification can be based on the stem spacing and average diameter as shown on Figure 201-2, this section, or by the guidelines below. Additional items to be considered are the amount and size of down material and the size of stumps and limbs.

- *EXTRA LIGHT:* Few tops and limbs. Few, if any, cull logs. Low scattered brush. Little or no falling or yarding of unmerchantable timber required.
- *LIGHT:* Light to moderate amount of tops and limbs. Few cull logs. Light brush. Little to moderate falling or skidding of unmerchantable required.
- *MEDIUM:* Light to moderate amount of cull logs. Many tops and limbs. Tall brush or dense unmerchantable trees requiring falling. Some unmerchantable material requiring skidding.
- *HEAVY:* Many tops and limbs from dense stand of unmerchantable timber. Tall, heavy brush or dense unmerchantable pole stand requiring falling and bucking numerous cull logs. Yarding of unmerchantable necessary.
- *EXTRA HEAVY:* Much cull material requiring falling. Many large, downed cull trees. Area may be swampy or wet. Closely spaced extra large stumps. Thick duff and other organic material.

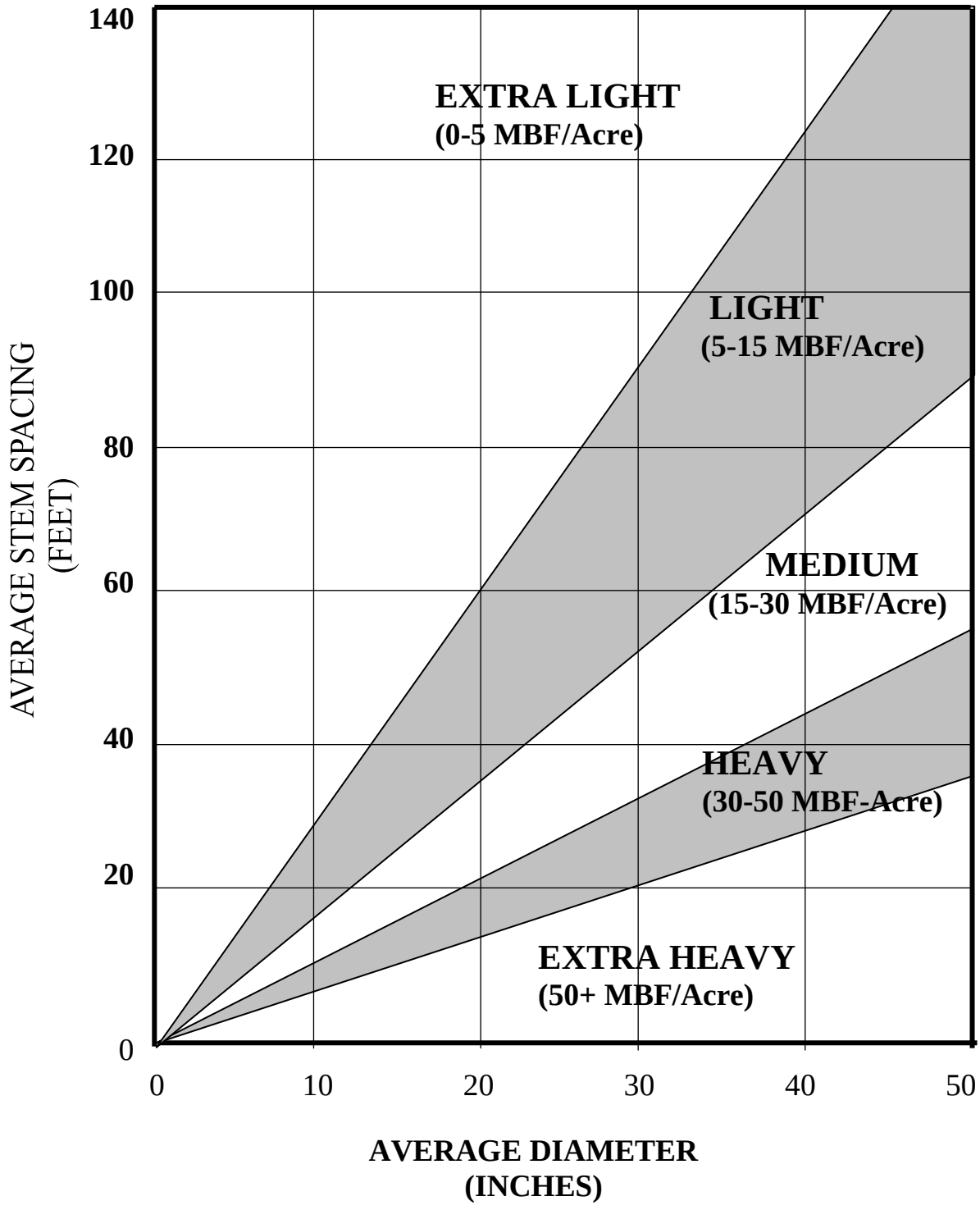
Figure 201-1 Clearing and Grubbing
(Costs Based on Windrowing)



Timber to Government, Purchaser, or Cooperator

	Right of Way Volume (MBF/Acre)										
	0	5	10	15	20	25	30	35	40	45	50
Dollars per Acre	1980	2200	2420	2640	2860	3080	3300	3520	3740	3960	4180

FIGURE 201-2
Equivalent Volume using Average Diameters and Stem Spacing



Topographic Factor

The cost-per-acre figures should be adjusted by the following topographic factors:

Ground Slope	Factor
Gentle (under 20 percent)	1.1
Moderate (20 to 45 percent)	1.0
Steep (over 45 percent)	1.1-1.3
Areas that require more than one pioneer or a long boom machine due to high cut/ fill	1.4-2.0

Slash/Cleanup Factor

Clearing estimates must be based on the lowest cost treatment option allowable to the contractor. The cost-per-acre figures must also be adjusted by the slash cleanup factor if the required treatment method is other than windrowing. Care must be exercised in applying this factor, however. For example, "scattering" in steep terrain or in areas of dense undergrowth can result in significantly higher costs than windrowing. The adjustment factor 1.15 for scattering would apply for average side slopes and open understory. If stumps are to be split or partially buried, the factor used for them may need to be adjusted.

Treatment Method	Factor
Windrow	1.0 - 1.1
Windrow and Cover	1.25
Scattering	1.15 - 1.35
Burying	1.6 – 2.0
Chipping	1.75
Pile and Burn	1.6 - 2.0
Deck Unmerchantable Material	1.1
Disposal in Cutting Units	1.2
Removal	2.0
Piling	1.3
Placing slash on embankment slopes	1.4

Different treatment methods may be specified for Tops and Limbs, Logs, and Stumps. When this occurs, the following table should be used to prorate costs based on the treatment method specified for each type of slash. Adjustments can be made to meet local project conditions.

COST PERCENTAGE FOR SLASH TREATMENT

	Tops & Limbs	Logs	Stumps
	40	35	25
If method (7) is designated for Stumps:	30	20	50

Example

Treatment Methods: Tops and Limbs - Pile and Burn
Logs - Windrow
Stumps - Scatter

Adjusted Slash Treatment Factor =

Tops & Limbs		Logs		Stumps
(0.40)(1.6)	+	(0.35)(1.00)	+	(0.25)(1.15) = 1.28

Other Factors

Additional areas and/ or strips may need to be cleared, but not grubbed, for burning bays, decking areas, and for windrowing right-of-way slash in dense lodgepole pine stands. The cost allowances for these situations should consider the treatment of tops and limbs, and logs, but not stumps. The factors for each of these is shown above. Clearing costs associated with campgrounds will normally be higher.

Cost allowance for *painting and branding* of logs, where required, is considered incidental to the clearing cost estimate, no separate allowance is generally required.

INDIVIDUAL REMOVAL OF TREES (Labor 80 percent)

This includes falling and treating hazard trees that lie outside of the clearing limits. Average cost: $30 per tree.

BRUSHING (Labor 50-90)

General: The designer will need to consider the uniqueness of the project and estimate accordingly. Consider the area being cleared and the type of equipment that can operate safely. Consider the spacing as well as the diameter of the trees and brush to be cleared when classifying the material. The topographic factors and the ground cover should be considered when selecting the type of equipment and slash treatment method to be used. If equipment can not operate safely use the hand labor factor.

Clearing Classification By Stand Description: Clearing classification by stand description is based on an average mixture of size, spacing, and density of the trees and brush.

Light ($400-$750/mile)
Few trees and low brush scattered along the shoulders of the roadway. Production rate approximately 1000 ft per hour.

Medium ($750-$1500/mile)
Trees and brush along the entire length of the shoulders of the roadway. Production rate approximately 750 ft per hour.

Heavy ($1500-$3000/mile)
Trees and brush scattered throughout the entire roadway. This cost range considers the grubbing of the roadbed. Production rate approximately 400 ft per hour.

Extra Heavy ($3000-$4000/mile)
Trees and brush densely spaced along the entire roadway. This cost range considers the grubbing of the roadbed. Production rate approximately 200 ft per hour.

Topographic Factor: assume work is being accomplished along and existing roadbed with cuts and fills needing special attention.

The unit cost should be adjusted by the following factors

Ground Slope	Factor
Gentle (under 20 percent)	1.0
Moderate (20 to 40 percent)	1.1
Steep (over 45 percent)	1.3

Labor Factor: Labor factor of 1.25 should be applied to projects that do not use a machine to do at least part of the brushing operation.

Slash Cleanup Factor: The unit cost should be adjusted by the following factors

Treatment Method	Factor
(4)Scattering	1.35
(5)Burying	1.50
(7)Piling and Burning	1.50
(11)Piling	1.30
(12)Placing slash on embankment slopes	1.35

SECTION 203 - REMOVAL OF STRUCTURES & OBSTRUCTIONS (Labor 30-50 percent)

Removal of Existing Bridges: This item should be estimated on an individual basis. Cost of equipment, labor, disposal, move-in and move-out of any special equipment, etc., needs to be considered. Use the equipment and labor costs in computing the cost (see Equipment Rates and Labor Rates).

Removal and Stockpiling/Disposing of Cattleguards: This item must be estimated on an individual basis. Cost of equipment, labor, disposal, move-in and move-out of any special equipment, etc., needs to be considered. Use the equipment and labor costs in computing the cost (see Equipment Rates and Labor Rates).

Removal and Disposal of Pipe Culverts: This should be estimated using time and equipment. Consideration should be given to the salvage value and disposal method of the culvert. Also consider if the culvert is being replaced at the same location.

Note: In addition to the above costs for removal of bridges, pipes, etc.; additional allowances may be necessary for removal of approach fills, reclamation and rehabilitation work, and for disposal of hazardous and toxic materials such as creosoted beams.

SECTION 204 - EXCAVATION AND EMBANKMENT (Labor 20-45 percent)

Localized conditions (slope, classification, etc.) have more impact on costs for small jobs because a full range of conditions may not exist as in a larger job.

Excavation for constructing catch basins on reconstruction projects which add drainage should have the same unit cost as the culvert excavation. Both jobs will be done using the same equipment; therefore, costs should be similar. Separate pay items should be used, one for construction of catch basins and one for culvert installation.

The average **BASE COST** of common excavation in ID or MT is $1.80/ cy.

Material adjustment factors are as follows:

Type	Factor
Common	1.0
Loose rock	1.5-1.75
Talus rock	1.5
Small glacial Boulders	1.75
Rippable rock	3.0
Large glacial boulders	5.0
Solid/ Shot rock	5.0-8.0

Base costs are to be adjusted by adding the following if required.

- **Tolerance Class**: See Finishing

- **Compaction Method**: (Does not include water, make an allowance or estimate under Section 160)

	ID or MT/cy
Method A – More than 80% retained on a No.4 Sieve	$1.02
Method B – 50% to 80% retained on a No.4 Sieve	$1.16
Method C – Less than 50% retained on a No. 4 Sieve	$1.30
Method D – Layer Placement (Hauling and Spreading Equipment)	$0.56
Method E – Layer Placement (Roller Compaction)	$0.90

Note: If applicable, make a subsidiary allowance to this pay item for contractor quality control for Compaction Methods (b) and (c).

- **Benching Fill Slopes**:

30-45 percent slope:	$0.98/ LF
45-60 percent slope:	$1.54/ LF

Note: If hydraulic excavators are used, there will be no additional cost for benching fill slopes as work will be done during clearing/pioneering.

- **Finishing**:

Scarifying:

Add	$/Station (Single Lane) ID or MT
Light	$12.35
Average	$16.47
Heavy	$25.78

Shaping and Finishing:

Single Lane Roads *with Ditch* -- $/Station

Tolerance Class	A	B/C	D/E	F/G/H	I/J/K/L/M
Rate (days/ mi)	3.5	2.25	1.0	0.75	0.5
Cost*					
ID	$71.14	$45.53	$20.63	$14.94	$9.96
MT	$86.51	$55.50	$24.49	$18.78	$12.32

* For Double Lane, multiply single lane cost by 1.35

Single Lane Roads *without Ditch* -- $/Station

Tolerance Class	A	B/C	D/E	F/G/H	I/J/K/L/M
Rate (days/ mi)	2.0	1.25	0.75	0.5	0.25
Cost*					
ID	$39.76	$25.61	$14.94	$9.96	$4.98
MT	$49.79	$37.54	$18.78	$12.25	$6.53

* For Double Lane, multiply single lane cost by 1.35.

- Loading Material into Trucks:

	ID or MT/ cy
Common and loose rock	$0.98
Ripped rock	$1.41
Blasted rock and large boulders	$1.68

- Conservation of Rock:
  For use when excavating with a dozer or excavator and placing in small stockpile within 300 ft. When excavating and hauling to central stockpile or use point, the added cost of excavation should be covered above under Loading Material into Trucks.

- Haul:
  Haul should be included under this item at the rate of $0.16/ Sta. Yd. for both Idaho and Montana

- Conservation of Topsoil:

Stripping topsoil and windrowing with grader, relatively flat ground:	$12.20 / sta
Stripping topsoil with tracked loader and placing in stockpile within 300 ft. (91m):	$23.11 / sta

- Traffic Control:

Open to traffic twice during work shift	30 percent of Base excavation cost plus options
Open to traffic once during work shift	15 percent of Base excavation cost plus options
Open to traffic at end of work shift	5 percent of Base excavation cost plus options

- Slope Blending:
  Depending on material and type of slope blending specified, additional costs of $.05 to $.15/ LF are applicable. This assumes the work being done at start of excavation immediately following pioneering. Slope rounding is a more deliberate practice; estimates are made under Section 204

- Compaction Prior to Base and Surfacing Work (if required):

Singe Lane	Double Lane
$5.81/ sta	$7.75 / sta

- **Water:** estimate under Section 160, or include an allowance under this item.

- **Pit Development**: estimate under Section 641.

- **Quality Control:** estimate based on sampling and testing noted under Section 153 and as specified in FSSS 153 for project.

Rounding Cut Slopes
This work, if specified, applies to sophisticated "rounding" after initial pioneering and excavation, and not to blending of the cutslope with the natural ground during initial excavation which is can be done by a hydraulic excavator. Estimate by time and equipment, costs range from $0.50 to $0.75/ LF.

Drainage Excavation and Furrow Ditches
Drainage excavation can be estimated most easily by the lineal foot. The same piece of equipment is required for small quantities or larger amounts; but one may use something less efficient for very small amounts. Site conditions govern more than size considerations; estimate by time and equipment procedures.

Drainage Dips
Drainage dips on reconstruction can be estimated at $125 to $200 each depending on material and distance between dips.

Earth Berms
Continuous Berms cost about $15 per station or $.15/ LF

Example Earthwork Calculation

Given: Single lane, aggregate surfaced road with ditch, Compaction Method (e), Tolerance Class G, 30% labor
80,000 cy excavation
70 percent common
15 percent rippable rock
15 percent blasting rock
Benching: 30-45 % slope - 1500 LF, 45-60% - 2500 LF
Finishing:
Scarification: light-115 sta, avg-72 sta, hvy-15 sta
Shaping and Finishing: 262 sta
Compaction prior to aggregate base 262 sta.
Traffic Control - N/ A.

Location A.: Montana - Zone 3
Location B.: Idaho - Area 1 (Zone 2)

Solution - Location A. Montana Zone 3

Base Excavation

	Quantity		*Quantity Adjustment*		*Base Excavation Cost*		*Material Adjustment Factor*		*Cost*
Common:	80,000	x	0.7	x	$1.80	x	1.00	=	$ 100,800.00
Rippable:	80,000	x	0.15	x	$1.80	x	3.00	=	$ 64,800.00
Blast:	80,000	x	0.15	x	$1.80	x	5.00	=	$ 108,000.00

Additions to Base Excavation		*Quantity*		*Cost*		
Benching Fill Slopes:	30-45 percent:	1,500	x	0.98	=	$ 1,470.00
	46-60 percent:	2500	x	1.54	=	$ 3,850.00
Compaction Method (e):		80,000	x	0.90	=	$ 72,000.00
Finishing: (Tolerance Class G)	Scarifying:					
	Light:	115	x	$12.35	=	$ 1,420.25
	Average:	72	x	$16.47	=	$ 1,185.84
	Heavy:	15	x	$25.78	=	$ 386.70
	Shaping and Finishing:	262	x	$18.78	=	$ 4,920.36
	Compaction prior to base:	262	x	$5.81	=	$ 1,522.22
				Total Engineers Estimate w/o Quality Control	=	$ 360,355.37
				Quality Control - 1% of above	=	$ 3,603.55
				Total Engineers Estimate including Quality Control	=	$ 363,958.92

Unit Cost Calculation

Unit Cost ($/cy) w/o Quality Control = $360,355.37 / 80,000 = $4.50

Unit Cost ($/cy) w/Quality Control = $363,958.92 / 80,000 = $4.55

Location - Zone Calculation

	Unit Cost ($/cy)		*Adjustment Factor for Davis Bacon Zones*		*Adjusted Unit Cost ($/cy)*
Zone 3 Unit Cost (Engineers Estimate w/o Quality Control)	$4.50	x	1.00	=	$4.50
Zone 3 Unit Cost (Engineers Estimate with Quality Control)	$4.55	x	1.00	=	$4.55

Location - Wage Differential Calculation

	Unit Cost ($/cy)		*Adjustment Factor for Wage Differentials*		*Adjusted Unit Cost ($/cy)*
Specified Road Construction Cost (without Quality Control)	$4.50	/	1.12	=	$4.02

Solution - Location B. Idaho Area 1 (Zone 2)

Base Excavation

	Quantity		*Quantity Adjustment*		*Base Excavation Cost*		*Material Adjustment Factor*		*Cost*
Common:	80,000	x	0.7	x	$1.80	x	1.00	=	$100,800.00
Rippable:	80,000	x	0.15	x	$1.80	x	3.00	=	$ 64,800.00
Blast:	80,000	x	0.15	x	$1.80	x	5.00	=	$108,000.00

Additions to Base Excavation		*Quantity*		*Cost*		
Benching Fill Slopes:	30-45 percent:	1,500	x	0.98	=	$ 1,470.00
	46-60 percent:	2500	x	1.54	=	$ 3,850.00
Compaction Method (e):		80,000	x	0.90	=	$ 72,000.00
Finishing: (Tolerance Class G)	Scarifying:					
	Light:	115	x	$12.35	=	$ 1,420.25
	Average:	72	x	$16.47	=	$ 1,185.84
	Heavy:	15	x	$25.78	=	$ 386.70
	Shaping and Finishing:	262	x	$14.94	=	$ 3914.28
	Compaction prior to base:	262	x	$5.81	=	$ 1,522.22
				Total Engineers Estimate w/o Quality Control	=	$ 359,349.29
				Quality Control - 1% of above	=	$ 3,593.49
				Total Engineers Estimate including Quality Control	=	$ 362,942.78

Unit Cost Calculation

Unit Cost ($/cy) w/o Quality Control = $\frac{\$\ 359{,}349.29}{80{,}000}$ = $4.49

Unit Cost ($/cy) w/Quality Control = $\frac{\$\ 362{,}942.78}{80{,}000}$ = $4.54

Location - Zone Calculation	*Unit Cost ($/cy)*		*Adjustment Factor for Davis Bacon Zones*		*Adjusted Unit Cost ($/cy)*
Zone 3 Unit Cost (Engineers Estimate w/o Quality Control)	$4.49	x	1.00	=	$4.49
Zone 3 Unit Cost (Engineers Estimate with Quality Control)	$4.54	x	1.00	=	$4.54

Location - Wage Differential Calculation	*Unit Cost ($/cy)*		*Adjustment Factor for Wage Differentials*		*Adjusted Unit Cost ($/cy)*
Specified Road Construction Cost (without Quality Control)	$4.49	/	1.07	=	$4.20

HAUL (Labor: Cu Yd Mile, 35 percent; Sta Yd, 25 percent. Note: the haul of asphalt and aggregate may be a contract item. If so, do not reduce, if the subcontractor is expected to pay Davis-Bacon wages)

Note: Haul is not a pay item, costs are incidental to and included in other items of work)

Station yards is used when material is moved using dozer pushes; where as; cubic yard-mile is used when material is hauled by truck.

Cost for Haul, in Idaho and Montana is $0.12/ sta-yd; and $.50 to $1.00/ cubic yard-mile depending on haul distance, road conditions, etc.

Cost for cubic yard-mile haul of excavation, aggregate, riprap, borrow excavation, etc., should be derived with the use of the following procedure.

Haul of material includes the fixed costs (for the truck only) of spotting, load, and turnaround in addition to the variable "underway" cost while hauling equipment is moving. Loading costs for the loading labor and equipment should be included under the parent specification for that work.

Haul of excavated material is to be measured (for payment) in terms of excavated cubic yards in the original position (in place). Costs shown below are based on loose cubic yards; therefore, a compaction factor adjustment (CF) must be made to provide costs based on excavated cubic yards.

$$CF = \frac{\text{in place density}}{\text{loose density}}$$

To compute haul of aggregate, borrow, riprap, etc., the compaction factor, CF, must be adjusted to fit the method of measurement; i.e., in place, vehicle quantity, compacted in place, etc. The costs per ton shown below are based upon 1.4 tons per cubic yard. Note that haul of excavation, when authorized as a pay item, is usually calculated by the cubic-yard-mile. Haul of materials that are weighed in tons are calculated in ton-miles.

When computing variable haul cost, the estimator should consider all the factors that affect the haul over each segment of the haul route. These factors include grade, alignment, road width, type of surface, road condition, sight distance, turnout spacing, and other traffic using the road. Use the correct truck for the type of road on the haul route (belly dumps are inappropriate for crooked narrow roads).

Variable costs should be increased if load limits (bridges, city streets, etc) on the route preclude loading trucks to rated capacity. The average distance from the point of dumping to the turn-around should be included in the variable cost haul distance. On single-lane roads this may range up to 2-3 miles additional length, on two-lane roads no addition is usually necessary since the trucks can turnaround nearby. Also, if there are similar conditions at the material source which affect travel distance, make allowance.

The following are general guidelines the estimator should use in determining average round-trip travel speeds for haul computations.

Average Travel Speed	Road Characteristics
5-15 mph	Narrow dirt road, steep grades, numerous sharp curves, poor sight distances and few turnouts
10-30 mph	Dirt or gravel surface, single lane, grades to 8%, fair to good alignment, adequate turnouts, and good sight distance
25-50 mph	Gravel or paved surface, double lane, moderate grades to 6%, good to excellent alignment, excellent sight distance

Fixed Cost: (Increase fixed costs to reflect difficult or unique situations in loading or dumping material, such as asphalt or riprap.)

12 CY End Dump	$0.76/ CY	or $0.54/ Ton
20 CY Bottom Dump	$0.92/ CY	or $0.65/ Ton

Variable Cost - $/CY-Mile or $/Ton-Mile:

	12 CY End Dump		20 CY Bottom Dump	
mph	CY	Ton	CY	Ton
10	$2.98	$2.11	$2.16	$1.51
15	$1.99	$1.47	$1.43	$1.02
20	$1.50	$1.07	$1.06	$0.78
25	$1.19	$0.88	$0.84	$0.62
30	$0.99	$0.69	$0.71	$0.49
40	$0.76	$0.55	$0.52	$0.39
50	$0.59	$0.43	$0.43	$0.31

Example
The following is an example format to be used for computing variable cost.

QUANTITY_____LOOSE CUBIC YARDS

HAUL COST

Road Segment	Average Speed Roundtrip	Length Miles	$/ CY-Mile or $/ Ton-Mile	Tons or CY	Variable Cost
Totals				(2)	(1)

The *total haul cost* is the sum of the variable costs and fixed cost; the unit cost will be the variable unit cost plus the fixed cost.

Total Cost/ CY or Ton = (1) Total Variable Cost / (2) Loose CY or Ton + Fixed Cost = (1) / (2) + _____ = $_____/ CY or Ton

SECTION 208 - STRUCTURE EXCAVATION AND BACKFILL FOR SELECTED MAJOR STRUCTURES (Labor 50 percent)

Costs range from $30/ cy to $45/ cy. More if large boulders are present or if there are excessive dewatering problems. If applicable make a subsidiary allowance to this pay item for contractor quality control.

Higher prices can be expected for excavation of large boulders, solid rock, etc.

SECTION 211 – ROADWAY OBLITERATION (Labor 40 percent)

Obliteration may range from merely ripping and scarifying the road surface, removing culverts, and rounding off the cutslope to complete removal of the road template and recontouring to the original natural profile. A laborer should be included to saw replacement slash and seed/ fertilize behind the equipment.

This work is generally performed from the end of the road to the beginning. Estimator needs to consider the existing condition of the road. Clearing and excavation may be required to access the end of the road to perform the roadway obliteration with the required equipment.

Method	Closure Device	Mitigation	Cost Range*
Method 2	Gate	Outslope, seed, fertilize. Normal drainage. May treat noxious weeds.	$500-$1,500 / mile
Method 2	Gate, guardrail, concrete or earth barrier, or Recontour at intersection	Drain dips, drivable waterbars, or outslope. Scarify 2-3 inches, seed & fertilize. May scatter slash on roadway. May treat noxious weeds.	$1000-$2,500 / mile
Method 2	Recontour at intersection or rock or earth barrier	Waterbar or intermittent outslope. Remove CMP's & restore all watercourses to natural channels & floodplains. Rip 6-12 inches, seed and fertilize. May scatter slash on road. May treat noxious weeds.	$2,500-$3,500 / mile
Method 2	Recontour at intersection or Rock or earth barrier	Waterbar or intermittent outslope. Selective recontour along the road. Remove CMP's & restore all watercourses to natural channels & floodplains. Rip 12-18 inches, seed & fertilize. Scatter slash on recontoured slope. May treat noxious weeds.	$3,000-$7,500 / mile
Method 1	Recontour	Recontour the entire road prism to almost pre-road conditions. Remove CMP's & restore all watercourses to natural channels & floodplains. Seed & fertilize. Scatter clash on recontoured slope. May treat noxious weeds.	$7,500 up / mile

*Costs do not include gates, guardrails, and concrete barriers.
*Costs include minor structure removal.
*Cost do not include weed treatment.

SECTION 212 LINEAR GRADING (Labor 45 percent)

This section is intended for use on single purpose roads in relatively gentle/ moderate and uniform terrain. It can be used in conjunction with most construction control methods. The specification combines clearing and grubbing, excavation, and erosion control.

The entire preconstruction effort including location, survey, design, and cost estimating should be consistent with the road standard, desired end product, and risk factor. A high degree of sophistication is not warranted when developing the cost estimate for this work.

Use of **Tables 212-1 through 212-4** on the following pages is quite appropriate and fits the intent of the specification. The tables consider each of the typical sections commonly used in the Region. The assumptions listed below were used in preparing the tables:

Clearing and Grubbing: Clearing limits (top of cut - toe of fill) (minimum 25' width)
Topographic factor - see Section 201.

Tables 212-1 and 212-2 show clearing cost for Government, purchaser, or cooperator-owned timber such as that found on timber sale contracts, on public works contracts R/ W timber should be decked by the contractor to be sold by the Forest Service. R/ W timber volume value should not be made a consideration of bid for clearing items on public works contracts.

(Cost allowance for painting and branding of logs, where required, is considered incidental to clearing, no separate allowance is required.)

Excavation: Self balanced sections.
Compaction factor used (.25 to .75).
No allowance for drain dips, finishing and/ or shaping, slough widening, curve widening, turnouts, turnarounds, or haul.
Note: an additional allowance may be made for these items.

To determine costs, use the procedure outlined below. *Be sure to use the correct table for the appropriate road backslope, and road template.*

Step 1 Determine base Clearing and Grubbing Costs in dollars per mile by entering **Table 212-1** (for 3/ 4:1 backslopes) or **Table 212-2** (for 1:1 backslopes) with known values for sideslopes and right-of-way volume per acre. (Note: the minimum clearing width is 25 feet or 3 acres per mile.) Adjust the clearing cost by multiplying the base clearing and grubbing cost by the slash disposal adjustment and the widening factors.

Slash Disposals Factors:

Method	Factor
Windrowing	1.0-1.1
Scattering	1.15-1.35
Piling	1.3

Widening Factors (Clearing):

Method	Factor
No additional widening	1.0
Slough widening, turnouts, log truck curve widening, turnarounds	1.2

Step 2 Add allowance for Individual Removal of Trees – Section 201, Cost Guide.

Step 3 Determine base excavation costs in dollars per mile using **Table 212-3** with known values for backslopes and sideslopes. Adjust the excavation cost for materials, topography, and additional widening by multiplying the base excavation cost by the respective adjustment factors. Add additional cost for scarifying (if necessary), drainage dips, haul, etc.

Material Factor: (% Common)(1.0) + (%Loose Rock)(1.5-1.75) + (% Rip)(3.0) + (% Blast & Boulders)(5.0)

Topography Factor:

Method	Factor
Self balanced sections	1.0
Some through fills and free haul	1.25

Widening Factor (Excavation):

Method	Factor
No additional widening	1.0
Slough widening, turnouts, log truck curve widening, turnarounds	1.15

Drainage Dips: see Cost Guide Section 204

Haul: see Cost Guide Section 204

Total Excavation Cost = (Base Cost) x (Material Factor) x (Topography Factor) x (Widening Factor) + (Drainage Dips) + (Haul)

Step 4 Determine seeding cost in dollars per mile by using **Table 212-4**.

Step 5 Total results in steps 1, 2, 3, and 4 to determine unit cost.

Example Linear Grading Calculation:

Location: Montana Zone 3
Length: 1.7 miles
Average side slope: 30 percent
R/ W timber classification: Light-Med (15 MBF/ Ac), Purchaser owned
Windrow construction slash
Hazard Trees: 12 (Total)
Excavation classification:
85 percent common
15 percent rip
0 percent blast
Template: 14 ft w/ o ditch, 3/ 4:1 backslope, self balanced sections, no through fills or free haul. Allow for turnouts every 1,000 feet, normal curve widening, one turnaround per mile, and 4 drainage dips. Seed, dry method, without mulch.

Step 1: Base Clearing Cost = $8,350 per mile (Table 212-1)
Adjusted Clearing Cost:
Slash Disposal Factor = 1.0
Widening Factor = 1.2
Cost = $8,350per mile *1.0 *1.2 = $10,020 per mile

Step 2: Allowance for Removal of Trees Miscellaneous
12 Trees *$30 per tree / 1.7 miles = $212 per mile.

Step 3: Base excavation cost = $4,590 per mile (Table 212-3)
Adjusted excavation cost:
Material Factor = (0.85 *1.0) + (0.15 *3.0) + (0 *5.0) = 1.3
Topography Factor = 1.0
Widening Factor = 1.15
Drainage Dips = 4 @$125/ 1.7 = $294 per mile
Cost = ($4,590 per mile *1.3 *1.0 *1.15) + $294 = $7,156 per mile

Step 4: Seeding Cost = $710 per mile (Table 212-4) (calculated under Section 625)

Step 5: Unit Cost = $10,020 + $212 + $7,156 + $710 = $15,152 per mile

Adjust for Zone 3 (labor, 45%): $18,098 per mile *1.00 = $18,098 per mile

Table 212-1

Clearing and Grubbing Cost per mile for Specification 212

Backslope: 3/4 : 1

Road Template SS%	Vol/Acre	Purchaser Owned R/W Timber 12 w/o Ditch	14 w/o Ditch	12 w/ Ditch
0	5	$7,380	$7,380	$7,380
10	5	$7,380	$7,380	$7,380
20	5	$6,780	$6,780	$6,780
30	5	$6,780	$6,780	$6,780
40	5	$6,780	$7,020	$8,110
50	5	$8,830	$10,410	$11,860
0	10	$8,230	$8,230	$8,230
10	10	$8,230	$8,230	$8,230
20	10	$7,500	$7,500	$7,500
30	10	$7,500	$7,500	$7,500
40	10	$7,500	$7,750	$9,080
50	10	$9,920	$11,620	$13,310
0	15	$9,200	$9,200	$9,200
10	15	$9,200	$9,200	$9,200
20	15	$8,350	$8,350	$8,350
30	15	$8,350	$8,350	$8,350
40	15	$8,350	$8,590	$10,040
50	15	$11,010	$12,830	$14,640
0	20	$10,040	$10,040	$10,040
10	20	$10,040	$10,040	$10,040
20	20	$9,080	$9,080	$9,080
30	20	$9,080	$9,080	$9,080
40	20	$9,080	$9,440	$11,010
50	20	$12,100	$14,040	$16,090
0	25	$10,890	$10,890	$10,890
10	25	$10,890	$10,890	$10,890
20	25	$9,920	$9,920	$9,920
30	25	$9,920	$9,920	$9,920
40	25	$9,920	$10,290	$11,860
50	25	$13,070	$15,240	$17,420

Table 212-1 (Continued)

Clearing and Grubbing Cost per mile for Specification 212

Backslope: 3/4 : 1

Road Template SS%	Vol/ Acre	Purchaser Owned R/ W Timber 12 w/ o Ditch	14 w/ o Ditch	12 w/ Ditch
0	30	$11,860	$11,860	$11,860
10	30	$11,860	$11,860	$11,860
20	30	$10,770	$10,770	$10,770
30	30	$10,770	$10,770	$10,770
40	30	$10,770	$11,130	$12,830
50	30	$14,160	$16,580	$18,870
0	35	$12,700	$12,700	$12,700
10	35	$12,700	$12,700	$12,700
20	35	$11,500	$11,500	$11,500
30	35	$11,500	$11,500	$11,500
40	35	$11,500	$11,860	$13,790
50	35	$15,240	$17,780	$20,320
0	40	$13,550	$13,550	$13,550
10	40	$13,550	$13,550	$13,550
20	40	$12,340	$12,340	$12,340
30	40	$12,340	$12,340	$12,340
40	40	$12,340	$12,700	$14,760
50	40	$16,210	$18,990	$21,660
0	45	$14,400	$14,400	$14,400
10	45	$14,400	$14,400	$14,400
20	45	$13,070	$13,070	$13,070
30	45	$13,070	$13,070	$13,070
40	45	$13,070	$13,550	$15,730
50	45	$17,300	$20,200	$23,110
0	50	$15,370	$15,370	$15,370
10	50	$15,370	$15,370	$15,370
20	50	$13,910	$13,910	$13,910
30	50	$13,910	$13,910	$13,910
40	50	$13,910	$14,400	$16,700
50	50	$18,390	$21,410	$24,440

Table 212-2

Clearing and Grubbing Cost per mile for Specification 212

Backslope: 1 : 1

Road Template SS%	Vol/ Acre	Purchaser Owned R/ W Timber 12 w/ o Ditch	14 w/ o Ditch	12 w/ Ditch
0	5	$7,380	$7,380	$7,380
10	5	$7,380	$7,380	$7,380
20	5	$6,780	$6,780	$6,780
30	5	$6,780	$6,780	$6,780
40	5	$6,780	$7,620	$8,710
50	5	$9,920	$11,620	$13,310
0	10	$8,230	$8,230	$8,230
10	10	$8,230	$8,230	$8,230
20	10	$7,500	$7,500	$7,500
30	10	$7,500	$7,500	$7,500
40	10	$7,500	$8,590	$9,800
50	10	$11,010	$12,950	$14,880
0	15	$9,200	$9,200	$9,200
10	15	$9,200	$9,200	$9,200
20	15	$8,350	$8,350	$8,350
30	15	$8,350	$8,350	$8,350
40	15	$8,350	$9,440	$10,890
50	15	$12,220	$14,400	$16,450
0	20	$10,040	$10,040	$10,040
10	20	$10,040	$10,040	$10,040
20	20	$9,080	$9,080	$9,080
30	20	$9,080	$9,080	$9,080
40	20	$9,080	$10,410	$11,860
50	20	$13,430	$15,730	$18,030
0	25	$10,890	$10,890	$10,890
10	25	$10,890	$10,890	$10,890
20	25	$9,920	$9,920	$9,920
30	25	$9,920	$9,920	$9,920
40	25	$9,920	$11,250	$12,950
50	25	$14,520	$17,060	$19,600

Table 212-2 (Continued)

Clearing and Grubbing Cost per mile for Specification 212

Backslope: 1 : 1

Road Template SS%	Vol/ Acre	Purchaser Owned R/ W Timber 12 w/ o Ditch	14 w/ o Ditch	12 w/ Ditch
0	30	$11,860	$11,860	$11,860
10	30	$11,860	$11,860	$11,860
20	30	$10,770	$10,770	$10,770
30	30	$10,770	$10,770	$10,770
40	30	$10,770	$12,100	$13,910
50	30	$15,730	$18,510	$21,290
0	35	$12,700	$12,700	$12,700
10	35	$12,700	$12,700	$12,700
20	35	$11,500	$11,500	$11,500
30	35	$11,500	$11,500	$11,500
40	35	$11,500	$13,070	$15,000
50	35	$16,940	$19,840	$22,860
0	40	$13,550	$13,550	$13,550
10	40	$13,550	$13,550	$13,550
20	40	$12,340	$12,340	$12,340
30	40	$12,340	$12,340	$12,340
40	40	$12,340	$13,910	$15,970
50	40	$18,030	$21,290	$24,440
0	45	$14,400	$14,400	$14,400
10	45	$14,400	$14,400	$14,400
20	45	$13,070	$13,070	$13,070
30	45	$13,070	$13,070	$13,070
40	45	$13,070	$14,880	$17,060
50	45	$19,240	$22,620	$26,010
0	50	$15,370	$15,370	$15,370
10	50	$15,370	$15,370	$15,370
20	50	$13,910	$13,910	$13,910
30	50	$13,910	$13,910	$13,910
40	50	$13,910	$15,730	$18,150
50	50	$20,450	$23,950	$27,580

Table 212-3
Excavation Cost Per Mile For Specification 212

Road Template SS%	Backslope 3/ 4:1			Backslope 1:1		
	12 w/ o Ditch	14 w/ o Ditch	12 w/ Ditch	12 w/ o Ditch	14 w/ o Ditch	12 w/ Ditch
10	$3,850	$3,850	$3,850	$3,850	$3,850	$3,850
15	$3,850	$3,850	$3,850	$3,850	$3,850	$3,850
20	$3,850	$3,850	$4,280	$3,850	$3,850	$4,440
25	$3,850	$3,850	$4,910	$3,850	$3,940	$4,910
30	$3,850	$4,590	$5,990	$3,850	$4,870	$6,360
35	$4,300	$5,860	$7,640	$4,640	$6,320	$8,240
40	$5,430	$7,380	$9,640	$5,960	$8,100	$10,590
45	$6,840	$9,310	$12,160	$7,680	$10,450	$13,660
50	$8,450	$11,500	$15,020	$9,740	$13,250	$17,300

Table 212-4
Seeding Cost Per Mile for Specification 212

Road Template SS%	Backslope 3/ 4:1			Backslope 1:1		
	12 w/ o Ditch	14 w/ o Ditch	12 w/ Ditch	12 w/ o Ditch	14 w/ o Ditch	12 w/ Ditch
0	$250	$260	$280	$260	$270	$290
5	$250	$260	$280	$260	$270	$290
10	$250	$260	$280	$260	$270	$290
15	$300	$350	$370	$330	$370	$390
20	$390	$440	$490	$420	$480	$520
25	$500	$570	$630	$530	$600	$680
30	$620	$710	$790	$690	$760	$850
35	$760	$860	$970	$850	$960	$1,080
40	$940	$1,070	$1,210	$1,060	$1,210	$1,360
45	$1,180	$1,360	$1,510	$1,340	$1,540	$1,740
50	$1,510	$1,730	$1,960	$1,730	$2,010	$2,280

Note: Seeding cost does not include the roadbed.
Seeding cost does not consider native seed, if native seed is required, contact supplier for costs and availability.

End of Clearing and Earthwork