

ALASKA STATE PARKS

TRAIL MANAGEMENT HANDBOOK

MAY 2015

SECTION 3: TRAIL DESIGN PARAMETERS



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Section 3: Trail Design Parameters

The following *Trail Design Parameters* are a close adaptation of the Trail Design Parameters that have been formally adopted by the USFS, and can be referenced in USFS TRACS course material. Trail design parameters provide guidance for the assessment, survey, design, construction, repair, and maintenance of trails. While the five trail classes apply, the specific design parameters vary under each trail class depending on the designed use. Site-specific circumstances may demand some exceptions or variances to the Design Parameters based on trail-specific conditions, topography, or other factors, provided that the deviations are consistent with the general intent of the applicable trail class. Any exception to a design parameter or trail classification should be adequately documented in a trail's TMO. All drawings in Section 3 are original artwork by Ted E. Kincaid (2010-2011).

Table 3.1 - Hiker / Pedestrian Terra Trail Design Parameters

Designed Use Hiker/Pedestrian: Terra Trail		Trail Class 1	Trail Class 2	Trail Class 3	Trail Class 4	Trail Class 5
Design Tread Width	Single Lane	0" – 12"	6" – 18"	18" – 36"	24" – 60"	36" – 72"
	Double Lane	36"	36"	36" – 60"	48" – 72"	72" – 120"
	Structures (Minimum Width)	18"	18"	18"	36"	36"
Design Surface	Type	Native, ungraded May be continuously rough	Native, limited grading May be continuously rough	Native, with some on-site borrow or imported material where needed for stabilization and occasional grading Intermittently rough	Native with improved sections of borrow or imported material, and routine grading Minor roughness	Likely imported material, and routine grading Uniform, firm, and stable
	Protrusions	≤ 24" Likely common and continuous	≤ 6" May be common and continuous	≤ 3" May be common, not continuous	≤ 3" Uncommon, not continuous	No protrusions
	Obstacles (Maximum Height)	24"	14"	10"	8"	No obstacles
Design Grade	Target Grade	5% – 25%	5% – 18%	3% – 12%	2% – 10%	2% – 5%
	Short Pitch Maximum	40%	35%	25%	15%	5% – 12%
	Maximum Pitch Density	20% – 40% of trail	20% – 30% of trail	10% – 20% of trail	5% – 20% of trail	0% – 5% of trail
Design Cross Slope	Target Cross Slope	Natural side slope	5% – 20%	5% – 10%	3% – 7%	2% – 3% (or crowned)
	Maximum Cross Slope	Natural side slope	25%	15%	10%	3%
Design Clearing	Height	6'	6' – 7'	7' – 8'	8' – 10'	8' – 10'
	Width	≥ 24" Some vegetation may encroach into clearing area	24" – 48" Some light vegetation may encroach into clearing area	36" – 60"	48" – 72"	60" – 72"
	Shoulder Clearance	3" – 6"	6" – 12"	12" – 18"	12" – 18"	12" – 24"

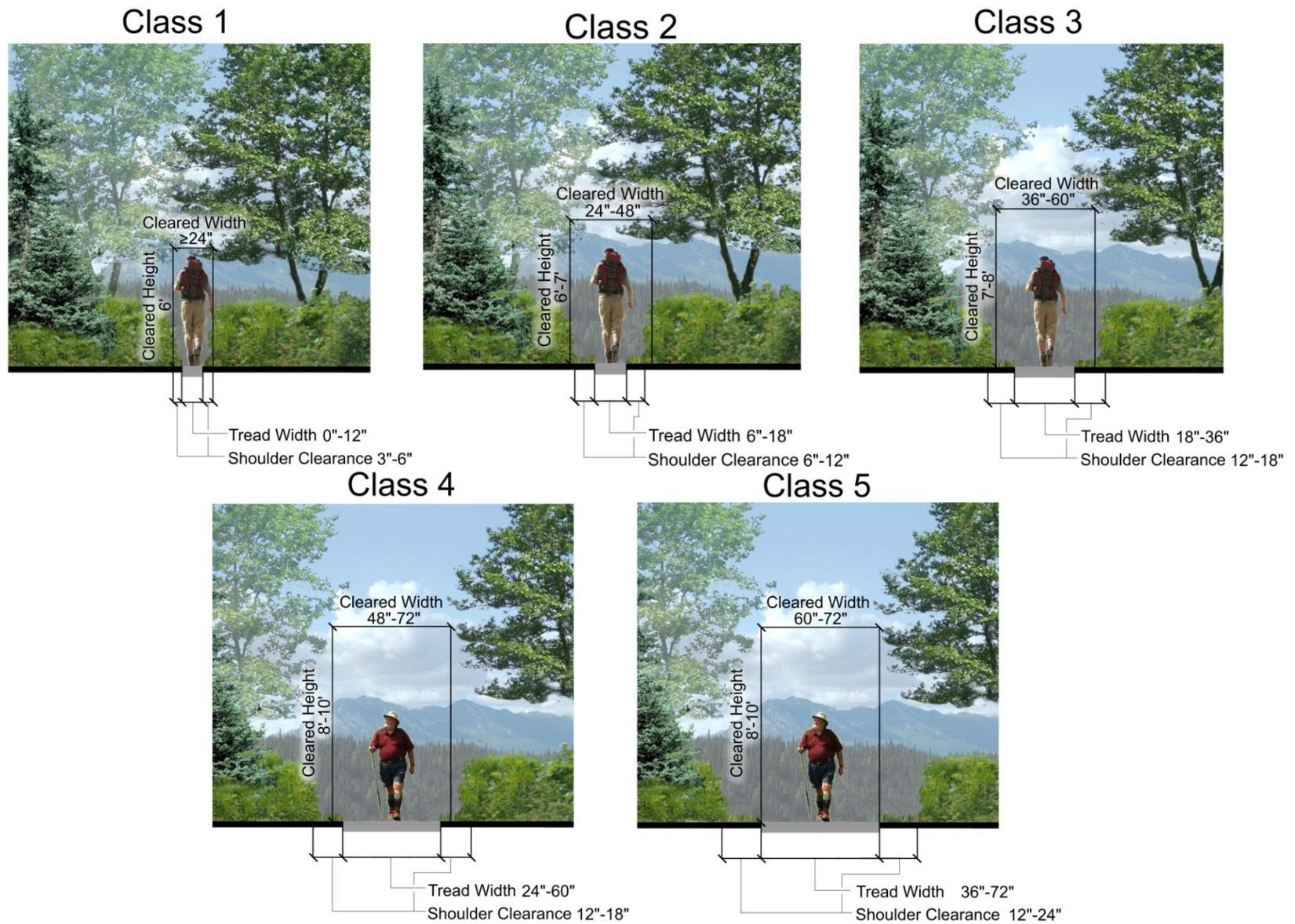


Figure 3.1 - Hiker / Pedestrian Terra Trail Design Parameters

Table 3.2 - Pack and Saddle Terra Trail Design Parameters

Designed Use Pack and Saddle: Terra Trail		Trail Class 1	Trail Class 2	Trail Class 3	Trail Class 4	Trail Class 5
Design Tread Width	Single Lane	Typically not designed or actively managed for equestrians, although use may be allowed	12" – 24" May be up to 48" along steep side slopes 48" – 60" or greater along precipices	18" – 48" 48" – 60" or greater along precipices	24" – 96" 48" – 60" or greater along precipices	Typically not designed or actively managed for equestrians, although use may be allowed
	Double Lane		60"	60" – 84"	84" – 120"	
	Structures (Minimum Width)		Other than bridges: 36" Bridges without handrails: 60" Bridges with handrails: 84" clear width	Other than bridges: 36" Bridges without handrails: 60" Bridges with handrails: 84" clear width	Other than bridges: 36" Bridges without handrails: 60" Bridges with handrails: 84" clear width	
Design Surface	Type		Native, with limited grading May be frequently rough	Native, with some on-site borrow or imported material where needed for stabilization and occasional grading Intermittently rough	Native, with improved sections of borrow or imported material and routine grading Minor roughness	
	Protrusions		≤ 6" May be common and continuous	≤ 3" May be common, not continuous	≤ 3" Uncommon, not continuous	
	Obstacles (Maximum Height)		12"	6"	3"	
Design Grade	Target Grade		5% – 20%	3% – 12%	2% – 10%	
	Short Pitch Maximum		30%	20%	15%	
	Maximum Pitch Density		15% – 20% of trail	5% – 15% of trail	5% – 10% of trail	
Design Clearing	Height		8' – 10'	10'	10' – 12'	
	Width	72" Some light vegetation may encroach into clearing area	72" – 96"	96"		
	Shoulder Clearance	6" – 12" Pack clearance: 36" x 36"	12" – 18" Pack clearance: 36" x 36"	12" – 18" Pack clearance: 36" x 36"		
Design Turn	Radius	4' – 5'	5' – 8'	6' – 10'		

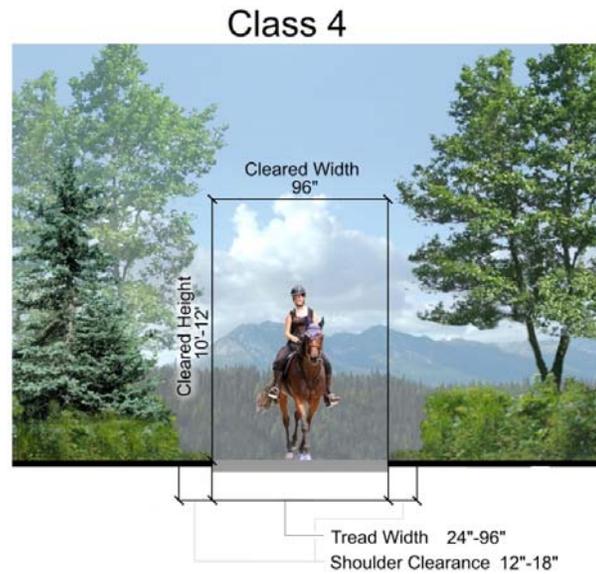
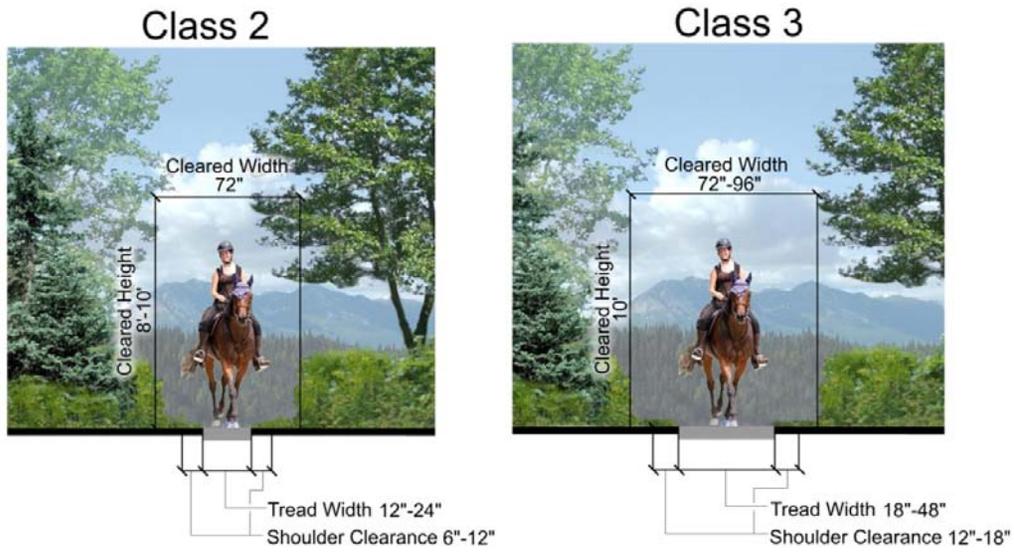


Figure 3.2 - Pack and Saddle Terra Trail Design Parameters

Table 3.3 - Bicycle Terra Trail Design Parameters

Designed Use BICYCLE: Terra Trail		Trail Class 1	Trail Class 2	Trail Class 3	Trail Class 4	Trail Class 5
Design Tread Width	Single Lane	6" – 12"	12" – 24"	18" – 36"	24" – 48"	36" – 60"
	Double Lane	36" – 48"	36" – 48"	36" – 48"	48" – 84"	72" – 120"
	Structures (Minimum Width)	18"	18"	36"	48"	60"
Design Surface	Type	Native, ungraded May be continuously rough Sections of soft or unstable tread on grades < 5% may be common and continuous	Native, with limited grading May be continuously rough Sections of soft or unstable tread on grades < 5% may be common	Native, with some on-site borrow or imported material where needed for stabilization and occasional grading Intermittently rough Sections of soft or unstable tread on grades < 5% may be present, but not common	Native, with improved sections of borrow or imported materials and routine grading Stable, with minor roughness	Likely imported material and routine grading Uniform, firm, and stable
	Protrusions	≤ 24" Likely common and continuous	≤ 6" May be common and continuous	≤ 3" May be common, but not continuous	≤ 3" Uncommon and not continuous	No protrusions
	Obstacles (Maximum Height)	24"	12"	10"	8"	No obstacles
Design Grade	Target Grade	5% – 20%	5% – 12%	3% – 10%	2% – 8%	2% – 5%
	Short Pitch Maximum	30% 50% on downhill segments only	25% 35% on downhill segments only	15%	10%	8%
	Maximum Pitch Density	20% – 30% of trail	10% – 30% of trail	10% – 20% of trail	5% – 10% of trail	0% – 5% of trail
Design Cross Slope	Target Cross Slope	5% – 10%	5% – 8%	3% – 8%	3% – 5%	2% – 3%
	Maximum Cross Slope	10%	10%	8%	5%	5%
Design Clearing	Height	6'	6' – 8'	8'	8' – 9'	8' – 9'
	Width	24" – 36" Some vegetation may encroach into clearing area	36" – 48" Some light vegetation may encroach into clearing area	60" – 72"	72" – 96"	72" – 96"
	Shoulder Clearance	0' – 12"	6" – 12"	6" – 12"	6" – 18"	12" – 18"
Design Turn	Radius	2' – 3'	3' – 6'	4' – 8'	8' – 10'	8' – 12'

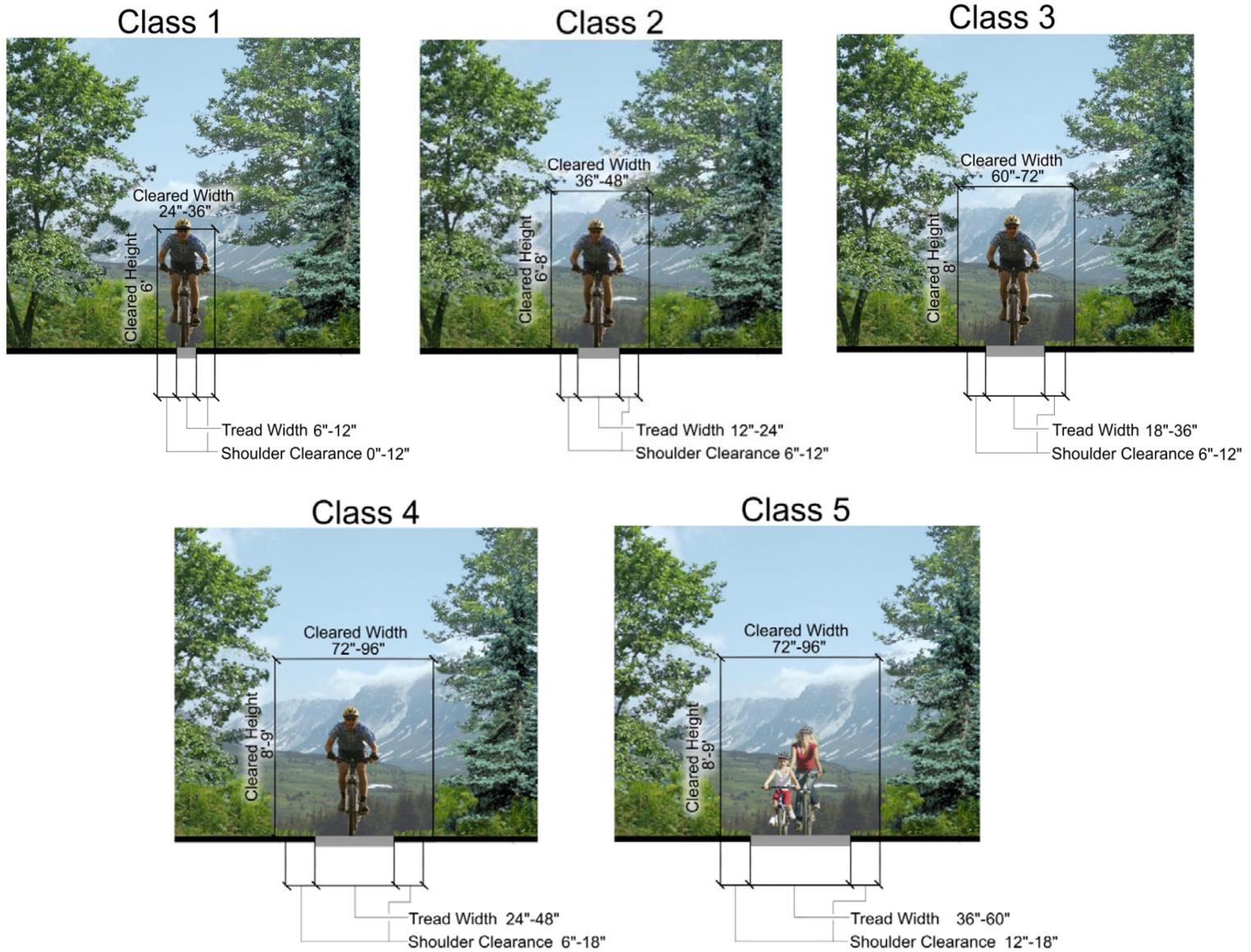


Figure 3.3 - Bicycle Terra Trail Design Parameters

Table 3.4 - All-Terrain Vehicle (ATV) Terra Trail Design Parameters

Designed Use ATV: Terra Trail		Trail Class 1	Trail Class 2	Trail Class 3	Trail Class 4	Trail Class 5
Design Tread Width	Single Lane	Typically not designed or actively managed for ATVs, although use may be allowed	48" – 60"	60"	60" – 72"	Typically not designed or actively managed for ATVs, although use may be allowed
	Double Lane Structures (Minimum Width)		96"	96" – 108"	96" – 120"	
Design Surface	Type		Native, with limited grading May be continuously rough Sections of soft or unstable tread on grades < 5% may be common and continuous	Native, with some on-site borrow or imported material where needed for stabilization and occasional grading Intermittently rough Sections of soft or unstable tread on grades < 5% may be present	Native, with imported materials for tread stabilization likely and routine grading Minor roughness Sections of soft tread uncommon	
			Protrusions	≤ 6" May be common and continuous	≤ 3" May be common, but not continuous	
	Obstacles (Maximum Height)		12" May be common or placed for increased challenge	6" May be common and left for increased challenge	3" Uncommon	
			10% – 25%	5% – 15%	3% – 10%	
Design Grade	Target Grade		35%	25%	15%	
	Short Pitch Maximum		20% – 40% of trail	15% – 30% of trail	10% – 20% of trail	
	Maximum Pitch Density		5% – 10%	3% – 8%	3% – 5%	
Design Cross Slope	Target Cross Slope		15%	10%	8%	
	Maximum Cross Slope	6' – 7'	6' – 8'	8' – 10'		
Design Clearing	Height	60"	60" – 72"	72" - 96"		
	Width (On steep side hills, increase clearing on uphill side by 6" – 12")	0" – 6"	6" – 12"	12" – 18"		
	Shoulder Clearance	6' – 8'	8' – 10'	8' – 12'		
Design Turn	Radius					

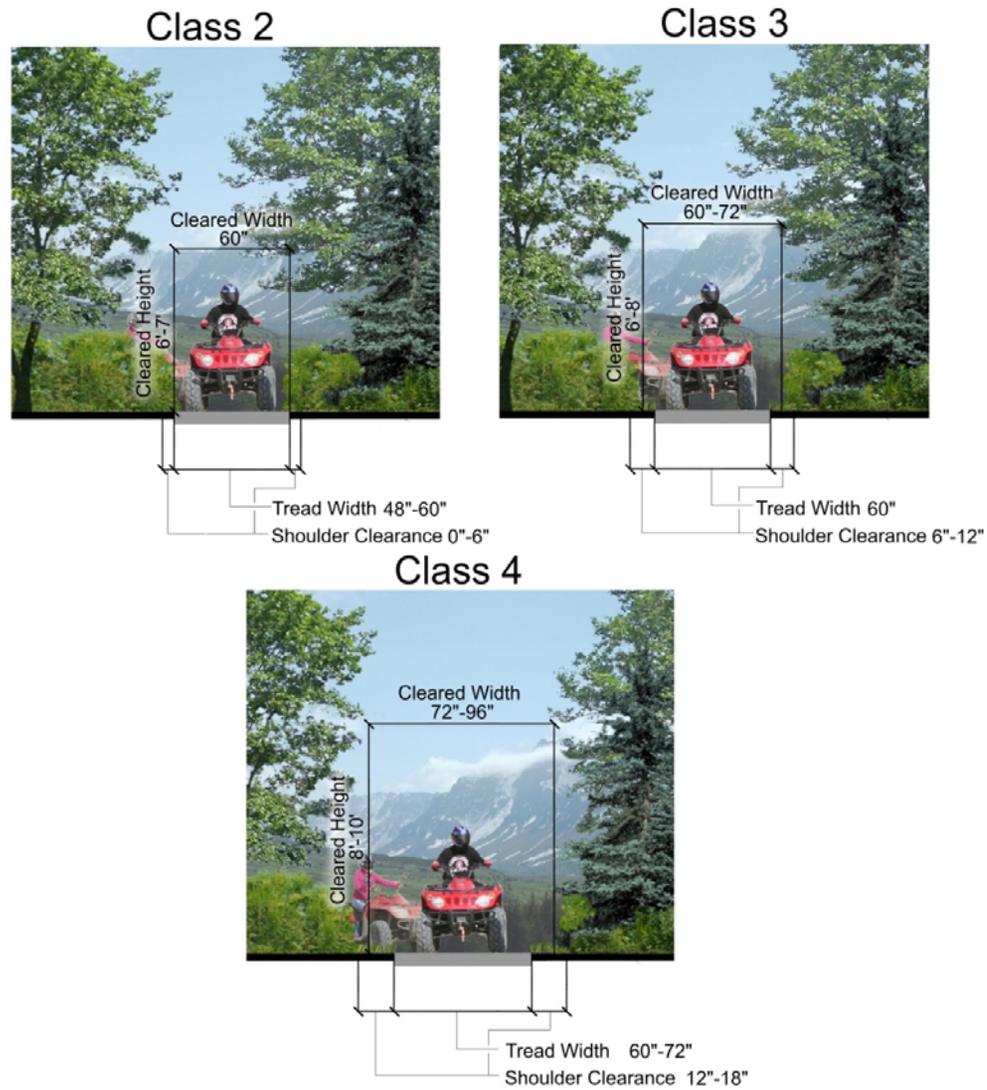


Figure 3.4 - All-Terrain Vehicle (ATV) Terra Trail Design Parameters

Table 3.5 - Snowmobile Snow Trail Design Parameters

Designed Use Snowmobile: Snow Trail		Trail Class 1	Trail Class 2	Trail Class 3	Trail Class 4	Trail Class 5
Design Tread Width	Single Lane	Typically not designed or actively managed for snowmobiles, although use may be allowed	4' – 6' Typically not groomed	6' – 8' Or width of grooming equipment. On turns with tight radius, increase groomed width to ≥ 10'	8' – 10' Or width of grooming equipment. On turns with tight radius, increase groomed width to ≥ 12'	Typically not designed or actively managed for snowmobiles, although use may be allowed
	Double Lane		10' Typically not groomed	10' – 12'	12' – 20'	
	Structures (Minimum Width)		6'	12'	18'	
Design Surface	Type		Generally no machine grooming Commonly rough and bumpy	May receive occasional machine grooming for snow compaction and conditioning Frequently rough and bumpy	Regular machine grooming for snow compaction and conditioning Commonly smooth	
	Protrusions		No protrusions	No protrusions	No protrusions	
	Obstacles (Maximum Height)		12" Uncommon	6" Uncommon (no obstacles if machine groomed)	No obstacles	
	Target Grade		0% – 12%	0% – 10%	0% – 8%	
Design Grade	Short Pitch Maximum		35%	25%	20%	
	Maximum Pitch Density		15% – 30% of trail	10% – 20% of trail	5% – 10% of trail	
	Target Cross Slope		0% – 10%	0% – 5%	0%	
Design Cross Slope	Maximum Cross Slope	15%	10%	5%		
	Height (Above normal maximum snow level)	6'	6' – 8' Provide sufficient clearance for grooming equipment	8' – 12' Provide sufficient clearance for grooming equipment		
Design Clearing	Width	6' – 12' Some light vegetation may encroach into clearing area	8' – 14' Light vegetation may encroach into clearing area	10' – 22' Widen clearing at turns or if increased sight distance needed		
	Shoulder Clearance	6" – 12"	12" – 18"	12" – 24"		
	Radius	8' – 10'	15' – 20' Or to accommodate grooming equipment	25' – 50'		

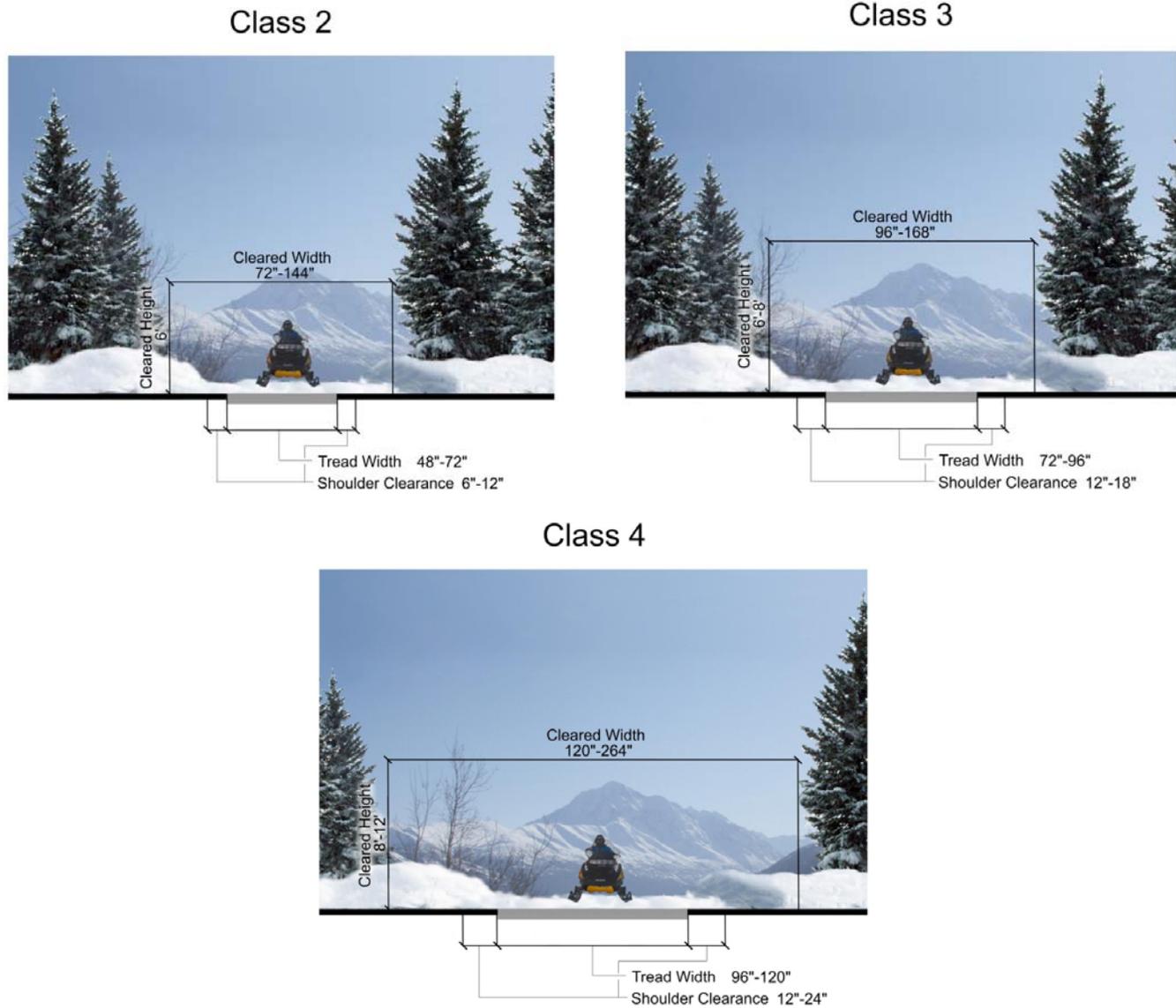
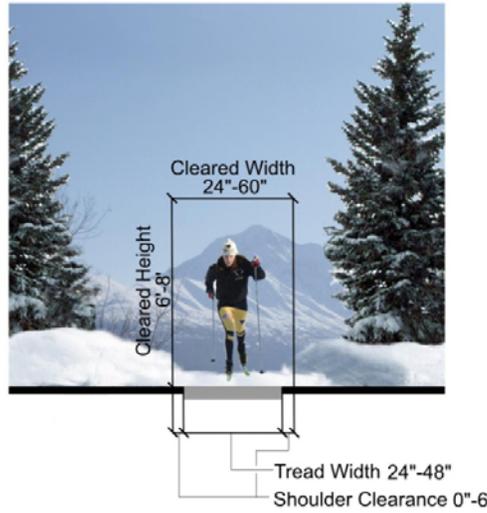


Figure 3.5 - Snowmobile Snow Trail Design Parameters

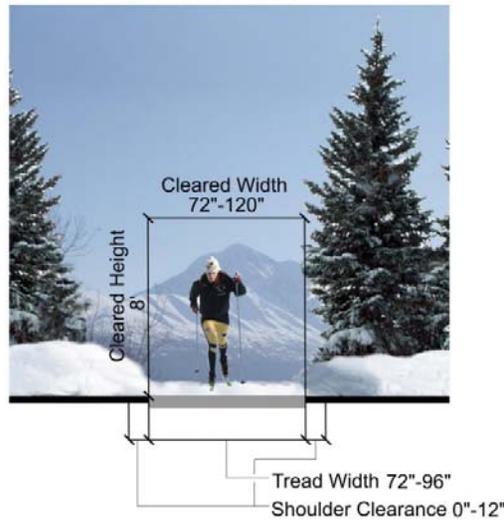
Table 3.6 - Cross-Country Ski Snow Trail Design Parameters

Designed Use (Diagonal / Classic ski) Cross-Country Ski: Snow Trail		Trail Class 1	Trail Class 2	Trail Class 3	Trail Class 4	Trail Class 5
Design Groomed Width	Single Lane	Typically not designed or actively managed for cross-country skiing, although use may be allowed	2' – 4' Typically not groomed	6' – 8' Or width of grooming equipment	8' – 10" Or width of grooming equipment	Typically not designed or actively managed for cross-country skiing, although use may be allowed
	Double Lane Structures (Minimum Width)		6' – 8'	8' – 12'	12' – 16'	
			36"	36"	36"	
Design Grooming and Surface	Type		Generally no machine grooming	May receive occasional machine grooming for snow compaction and track setting	Regular machine grooming for snow compaction and track setting	
	Protrusions		No protrusions	No protrusions	No protrusions	
	Obstacles (Maximum Height)		12" Uncommon	8" Uncommon (no obstacles if machine groomed)	No obstacles	
Design Grade	Target Grade		5% – 15%	2% – 10%	0% – 8%	
	Short Pitch Maximum		25%	20%	12%	
	Maximum Pitch Density		10% – 20% of trail	5% – 15% of trail	0% – 10% of trail	
Design Cross Slope	Target Cross Slope		0% – 10%	0% – 5%	0% – 5%	
	Maximum Cross Slope (For up to 50')	20%	15%	10%		
Design Clearing	Height (Above normal maximum snow level)	6' – 8'	8' Or height of grooming equipment	8' – 10'		
	Width	24" – 60" Light vegetation may encroach into clearing area	72" – 20" Light vegetation may encroach into clearing area	96" – 168" Widen clearing at turns or if increased sight distance needed		
	Shoulder Clearance	0" – 6"	0" – 12"	0" – 24"		
Design Turn	Radius	8' – 10'	15' – 20' Or to accommodate grooming equipment	≥ 25'		

Class 2



Class 3



Class 4

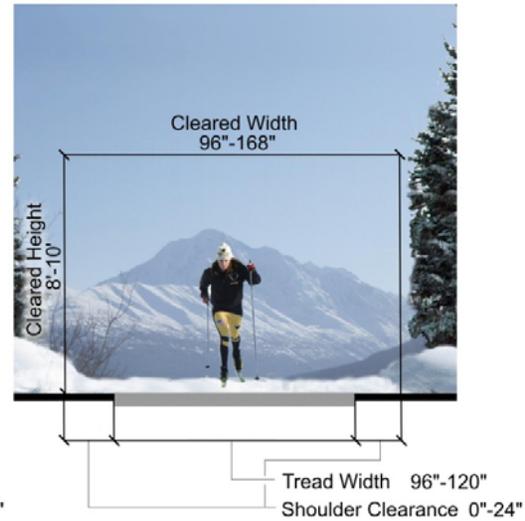


Figure 3.6 - Cross-Country Ski Snow Trail Design Parameters

Table 3.7 - Nordic / Skate Ski Snow Trail Design Parameters

Designed Use Nordic / Skate Ski: Snow Trail		Trail Class 1	Trail Class 2	Trail Class 3	Trail Class 4	Trail Class 5
Design Groomed Width	Single Lane	Typically not designed or actively managed for skate skiing, although use may be allowed	Typically not designed or actively managed for skate skiing, although use may be allowed	6' – 8'	8' – 12'	12' -16'
	Double Lane¹			Or width of grooming equipment	Or width of grooming equipment	Or width of grooming equipment
	Structures (Minimum Width)			8' – 12'	12' – 16'	14' -24'
Design Grooming and Surface	Type			36"	36"	36"
	Protrusions			May receive occasional machine grooming for snow compaction and track setting	Smooth compaction using implements designed for creating skate lanes.	Smooth compaction using implements designed for creating skate lanes.
	Obstacles (Maximum Height)			No protrusions	No protrusions	No protrusions
Design Grade	Target Grade			8"	No obstacles	No obstacles
	Short Pitch Maximum			Uncommon (no obstacles if machine groomed)		
	Maximum Pitch Density			2% – 10%	0% – 8%	0% – 6%
Design Cross Slope	Target Cross Slope			20%	20%	20%
	Maximum Cross Slope (For up to 50')			5% – 15% of trail	5% - 10% of trail	5-8% of trail
				0% – 5%	0% – 5%	0% – 5%
Design Clearing	Height (Above normal maximum snow level)			15%	12%	10%
	Width			Or height of grooming equipment	8' – 10'	At least 10'
	Shoulder Clearance			6' – 14'	Or height of grooming equipment	Or height of grooming equipment
Design Turn	Radius			Light vegetation may encroach into clearing area	8' – 18'	Widen clearing at turns or if increased sight distance needed
				0" - 12"	0" – 24"	0" – 24"
				15' – 20'	≥ 25'	25' - 30'
				Or to accommodate grooming equipment	Or to accommodate grooming equipment	Or to accommodate grooming equipment

¹ Double lane may accommodate a combination of diagonal and skate ski lanes with room to pass.

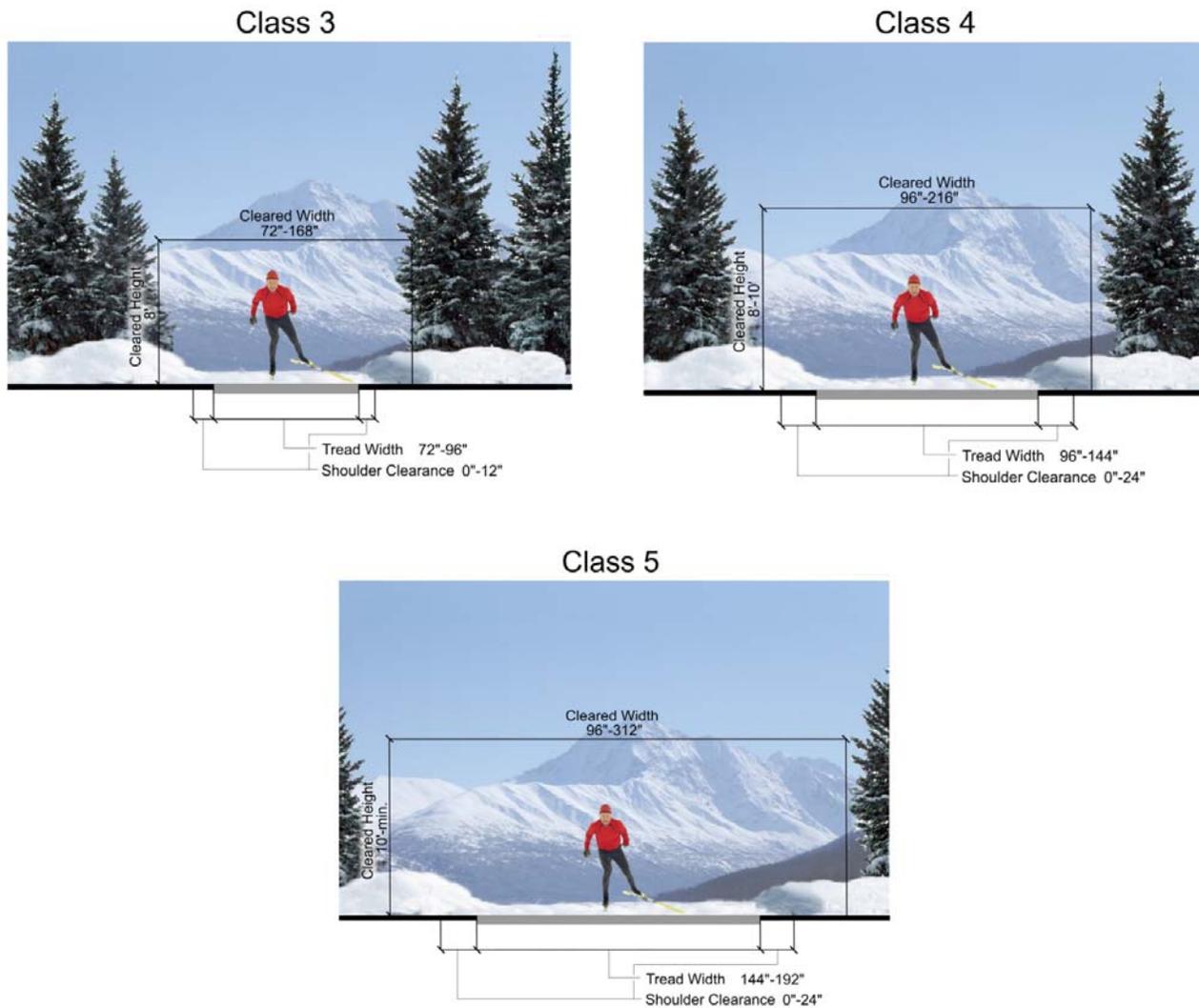


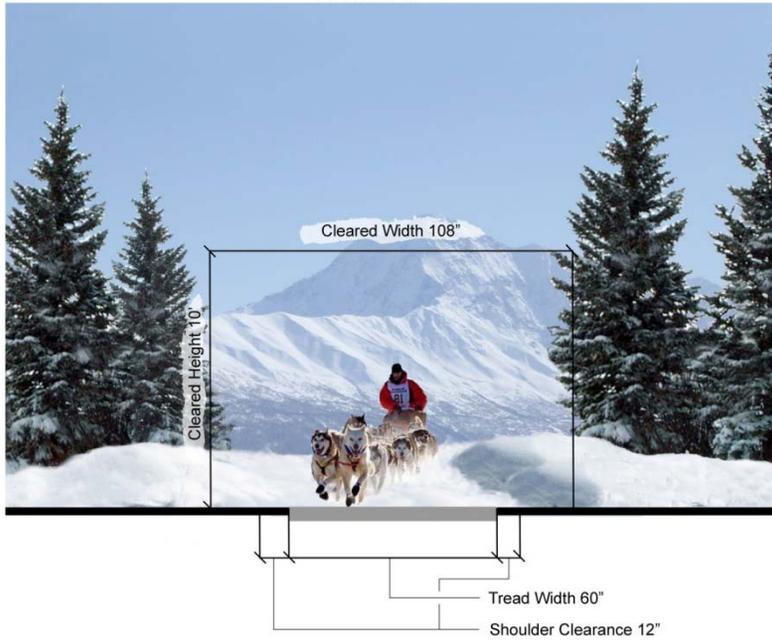
Figure 3.7 - Nordic / Skate Ski Snow Trail Design Parameters

Table 3.8 - Sled Dog Snow Trail Design Parameters

Designed Use Dog Sled: Snow Trail		Trail Class 1	Trail Class 2	Trail Class 3	Trail Class 4	Trail Class 5
Design Groomed Width*	Single Lane	N/A not designed or managed for dog sleds as primary user.	3'- 4'. If groomed, width of grooming equipment.	6'- 8' (or minimum width of grooming equipment).	8' -10', but typically managed to accommodate two-way passage.	N/A not designed or managed for dog sleds as primary user.
	Double Lane		Typically not designed for two-lane travel. Employ 6'-8' passing areas in steeper sections.	>8' (or minimum width of grooming equipment) and/or accommodate with passing areas 8'-12' wide.	12'-14'	
Design Surface	Type		Coarse compaction. Occasional or no grooming (may be ski-packed). Snowmobile packing is sufficient. Track layer is optional.	Groomed or compacted using implements and/or tracklayer when packed surface is snow-covered, drifted, melted, or skied out.	Well-groomed with tiller and/or other implements. Groomed frequently, and when groomed surface becomes degraded or buried.	
	Obstacles (Max. Height) Caused by use, lack of grooming, melt or surface/subsurface protrusions)		Dips, bumps, or ruts to 12" common and may be tightly spaced. Surface obstacles may occasionally require off-trail bypass.	Generally smooth, dips bumps, or ruts to 8" uncommon and widely spaced. Surface obstructions not present.	Consistently smooth. Small, rolling bumps, dips and rises. Surface obstructions not present.	
Design Grade	Target Grade (> 90% of trail)		< 15%	0% – 10%	0% – 8%	
	Short Pitch Maximum (Up to 200' lengths)		25%	20%	12%	
	Maximum Pitch Density		< 10% of trail	< 5% of trail	< 5% of trail	
Design Cross Slope	Target Cross Slope		< 10%	< 5%	< 5%	
	Maximum Cross Slope		15%	10%	5%	
Design Clearing	Height (Above normal maximum snow level)		6'-8' or height of grooming machinery, if used.	> 8' or height of grooming machinery	10'	
	Width	4'-6' (or minimum width of grooming equipment, if larger). Light vegetation may encroach into clearing area.	>1' outside of groomed edge. Light vegetation may encroach slightly into clearing area.	>2' outside of groomed edge. Widen clearing at turns or if increased sight distance is needed.		
Design Turns	Radius (Use climbing turn versus switchbacks)	8'-10' if Cat-groomed. OR; minimum based on turning limits of grooming machine.	15' – 20' (Provide sufficient radius for grooming equipment).	> 25'		

Dog Sledding Trail

Class 3



Dog Sledding Trail

Class 4

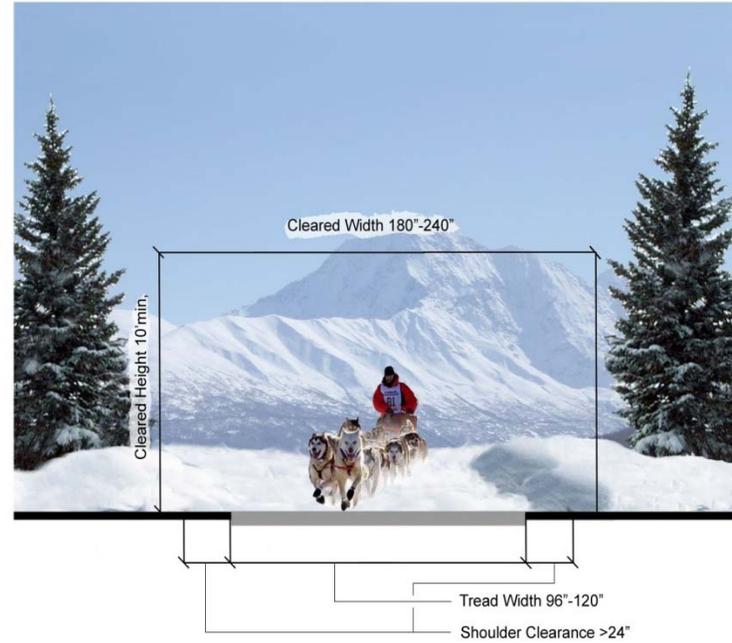


Figure 3.7 – Sled Dog Snow Trail Design Parameters

Table 3.9 - Non-Motorized Watercraft Water Trail Design Parameters

Designed Use Non-Motorized Watercraft: Water Trail		Trail Class 1	Trail Class 2	Trail Class 3	Trail Class 4	Trail Class 5
Design Tread Width	Structures	Water route shown on maps and used to access other trails or portages, but with no trail structures, facilities, signs, or recurring maintenance needs along route. Signs and/or parking facilities at initial access points only and likely associated with other trails or sites.	Few markers or route designators. Low profile structures or facilities occasionally present; primarily to reduce beach and bank impacts. Structures typically consist of native material hardening of portage/water entry points. Signs and/or parking facilities at initial access points only and likely associated with other trails or sites.	Buoys or markers possible to identify route Typically, facilities provide for improved access and to reduce beach and bank impacts. Well-developed parking and launch facilities at primary access points, but facilities and structures rare along the trail. Interpretive and informational displays typically present at primary access points	Buoys or markers are high profile and may be inter-visible and or route is readily followed. Highly developed launch facilities, docks, and amenities typically proved for user convenience. Well-marked approaches to facilities and portages. Interpretative displays, maps, information kiosks and signs typically present at access points and along route	Typically not designed or actively managed for watercraft, although use may be allowed
Design Surface	Protrusions	May be common and continuous	May be common and continuous	May be common, but not continuous	Uncommon and not continuous	
	Obstacles	May be common or placed for increased challenge	May be common or placed for increased challenge	May be common and left for increased challenge	Uncommon	
Design Clearing		In densely vegetated areas, users will commonly need to lift vessels over logs, shoals, or matted vegetation.	Path is typically narrow, shallow, and may occasionally require user to lift over obstacles or break path through some vegetation and duck under overhanging branches	Path is typically cleared wide enough for ready passage and maneuvering of at least one vessel, and usually two-way vessel passage, with only occasional low overhanging vegetation	Path is consistently cleared wide enough for unhindered, easy passage of two or more vessels.	

* For Portage sections of Water Trails see Figures 4.0, 4.1, 4.2. Water Trail design parameters are given primarily to provide guidance in applying the appropriate Trail Class. Additional design parameters should be developed by the resource manager for areas with extensive portages requiring maintenance and attention.

Class 1



Class 2



Class 3



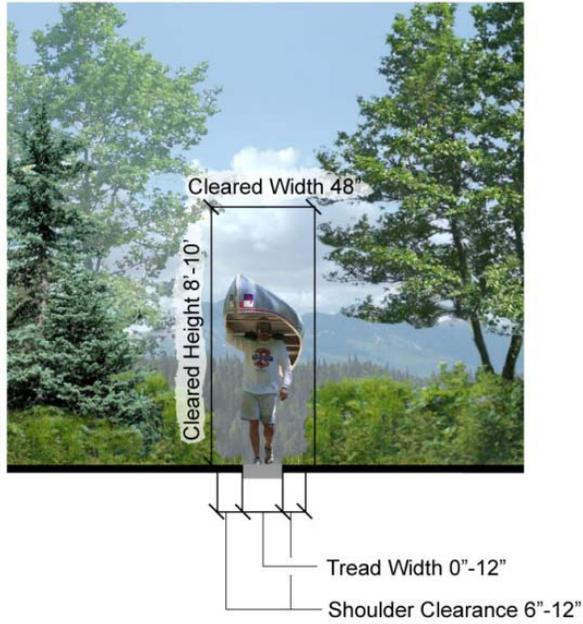
Class 4



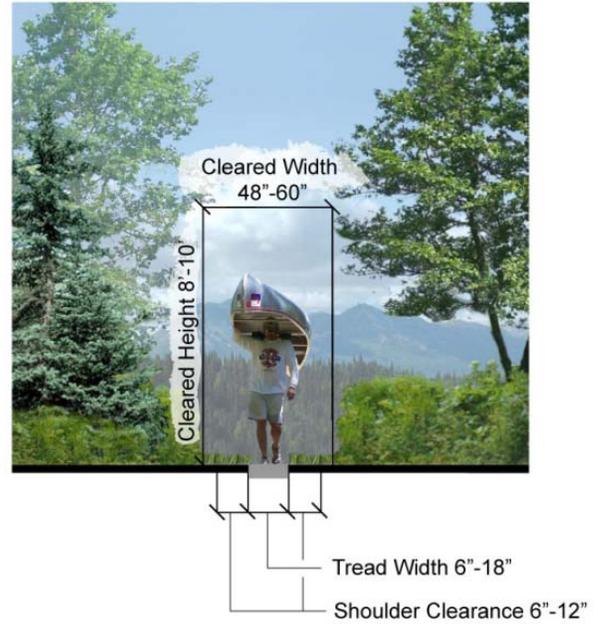
Figure 3.9 - Non-Motorized Watercraft Water Trail Design Parameters

Canoe Portage Trail

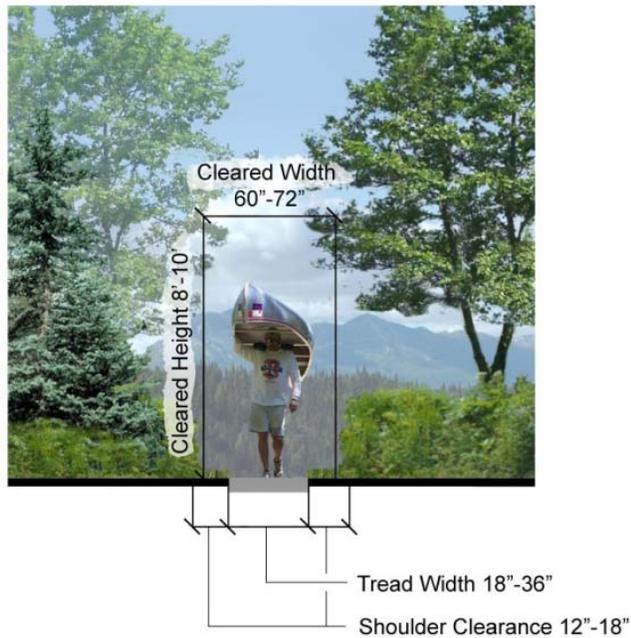
Class 1



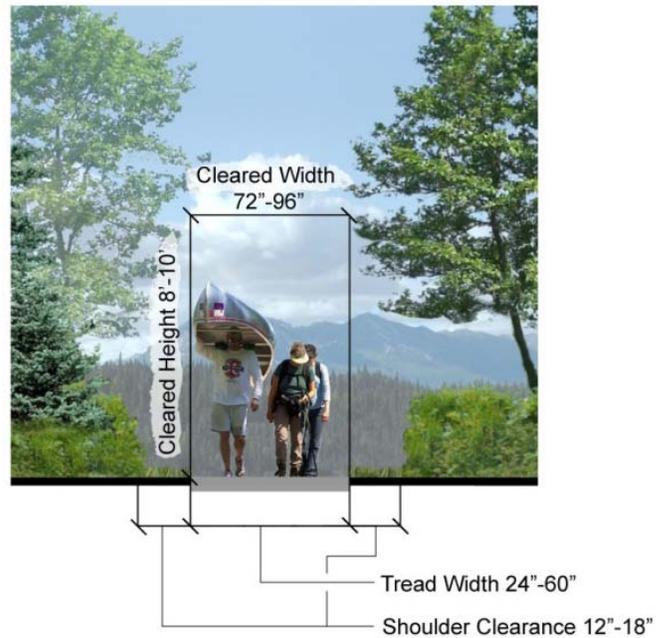
Class 2



Class 3



Class 4



Class 5

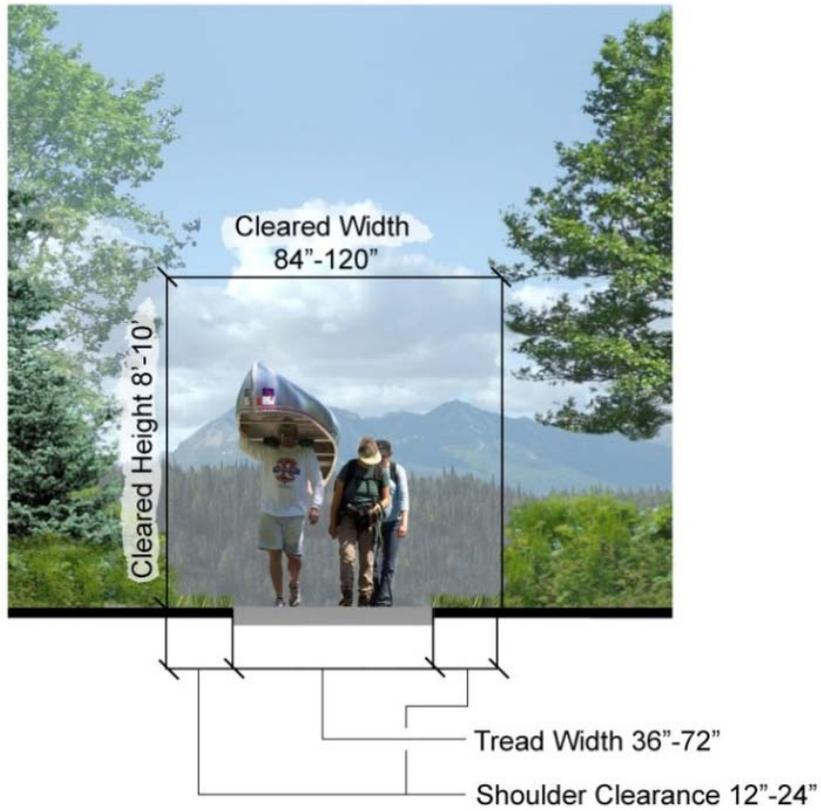


Figure 3.9.1 Canoe Portage Trail Design Parameters