

## Appendix A: Trails Plan Alternatives Methodology and Guidance

### New Trails

New trails would:

- Avoid an “Avoidance Area” defined as the following:
  - Within 33 feet of archeological sites
  - Within the perimeter of cemeteries (i.e., new connecting trails could come close to a cemetery perimeter, but not pass through the cemetery)
  - Generally within 30 feet of the banks of lakes, ponds, creeks, and perennial streams except where a trail crosses one of these features
  - Generally within 50 feet of wetlands except where a trail crosses a wetland
  - Within sensitive habitats (i.e., oligotrophic saturated forest, conservation planning boundary, and within 150 feet of Small Whorled Pogonia sites)
  - On slopes greater than 50 percent
- Minimize crossings of water resources and wetlands
- Avoid floodplains to the extent feasible
- Avoid connecting to Cabin Camps 1, 2, 4, and 5 to prevent potential disturbance of groups renting these cabin camps, unless specified within Plan
- Follow guidance for creating sustainable trails in relation to slopes as described in the U.S. Forest Service’s *Trail Construction and Maintenance Notebook 2007 Edition*, National Park Service (NPS) Denver Service Center’s *Trail System Planning: A Guidebook*, and Prince William County Department of Parks and Recreation’s *Prince William County Trail Standards*. According to this guidance, new connecting trails would, to the extent feasible:
  - Maintain an average trail slope of 10 percent or less, while minimizing trail sections on 15 to 50 percent slopes
  - Avoid slopes greater than 50 percent
  - Follow topographic contour lines
  - Traverse along the sideslope
  - Keep uphill and downhill trail sections on slopes less than 10 percent
- Be located, to the extent feasible, on soils rated as “Somewhat Limited” by the U.S. Department of Agriculture Natural Resource Conservation Service’s Web Soil Survey for paths and trails. These soils have features that are moderately favorable for paths and trails. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. No “Not Limited” soils (i.e., soils that have features that are very favorable for paths and trails) are located in Prince William Forest Park (PRWI).

### Design Parameters

The U.S. Forest Service’s *Forest Service Handbook (FSH) 2309.18 Trails Management Handbook* defines five trail classes: Trail Class 1 (Minimally Developed), Trail Class 2 (Moderately Developed), Trail Class 3 (Developed), Trail Class 4 (Highly Developed), and Trail Class 5 (Fully Developed). The Trail Class is the prescribed scale of development for a trail and represents its intended design and management standards. Trail Classes also generally reflect the level of recreational challenge provided by

a trail. The identification of the appropriate Trail Class for each trail or trail segment should be based on the management intent for the trail or trail segment. More information about the trail attributes of the five trail classes can be found in **Table 7**.

Each trail class has specific design parameters that are related to the trail's "Managed Use." A managed use is the mode of travel that is actively managed and appropriate on a trail based on its design and management. New trails would be designed and built to accommodate one "designed use," but more than one managed use may be allowed on the trail. The designed use is the managed use of the trail that requires the most demanding design, construction, and maintenance parameters. Generally, equestrian trails have the most demanding design specifications, followed by mountain biking, and then hiking (U.S. Forest Service 2008).

**Table 1** summarizes design parameters or technical guidelines for the survey, design, construction, and maintenance of Class 2 and Class 3 new trails that only allow hikers and pedestrians. New trails that allow hikers and pedestrians in addition to mountain bikers or equestrians would be designed, constructed, and maintained according to the design parameters summarized in **Table 3** or **Table 4**, respectively. New accessible trails would be designed and constructed to comply with the 2015 Architectural Barriers Act Standards.

### ***Additional Slope Guidance***

For sustainability purposes, new trails would:

- Be constructed in accordance with the "half rule" (i.e., the trail grade should be no more than half the side slope grade)
- Follow a rolling contour design (i.e., traverses a hill or side slope at a gentle grade)
- Include frequent grade reversals
- Include an outsloped tread (i.e., the tread is lower on outside or downhill side of the trail than it is on the inside or uphill side of the trail) of at least five percent

These design parameters would let water sheet across a trail in a manner that minimizes erosion and sedimentation. Some construction techniques, such as hardening or rock armoring, and soil types may reduce the need to strictly adhere to the 10 percent average slope parameter.

In order to reverse the trail direction on hillsides and for quick elevation gains, new connecting trails would use switchbacks, climbing turns, or steps where appropriate. Switchbacks are appropriate for steeper terrain on slopes steeper than 15 percent and preferably on sideslopes ranging from 15 to 45 percent. Climbing turns are appropriate for gentle slopes that are typically 15 percent or less and ideally on 7 percent side slopes. Steps could also be used to quickly gain elevation in a short distance on trails. Trails steeper than 20 percent can be difficult to maintain and therefore, could incorporate steps or hardened surfaces into their design (Prince William County n.d., U.S. Forest Service 2007).

### ***Wetlands***

The appropriate structure used across wetlands is highly dependent on site conditions. Riverine crossings associated with new trails would be constructed to span the full channel width from uplands to uplands whenever possible, thereby avoiding impacts to riverine wetlands to the extent feasible. These crossings could involve bridges or other structures that do not require pilings, fill, or other support structures in the wetland/stream habitat. Trails across wetlands could also include boardwalks if the total wetland impact from fill placement is 0.1 acre or less (NPS 2016).

### **Realigned Trails**

Existing trail sections with moderate or severe erosion or other condition problems would be realigned to the extent practicable to:

- Avoid the Avoidance Area as previously described
- Be located on sustainable slopes as previously described
- Be located on soils rated as “Somewhat Limited” for paths and trails as previously described

**Design Parameters**

Realigned existing trail sections would be designed, constructed, and maintained in the same manner as new trails. The realigned section of the trail would connect to the existing trail with a smooth transition and not include any abrupt turns (U.S. Forest Service 2007). Trail markings and signage would be removed on the closed trail section and new trail markings or signage would be added to the new realigned trail section. Natural vegetation would be allowed to grow into the closed trail section.

**Table 1: Hiker/Pedestrian Trail Design Parameters<sup>1</sup>**

Designed Use		Trail Class	
		2	3 <sup>2</sup>
HIKER/PEDESTRIAN			
<b>Design Tread Width</b>	<b>Wilderness</b> (Single Lane)	6” – 18”	12” – 24” Exception: may be 36” – 48” at steep side slopes
	<b>Non-Wilderness</b> (Single Lane)	6” – 18”	18” – 36”
	<b>Non-Wilderness</b> (Double Lane)	36”	36” – 60”
	<b>Structures</b> (Minimum Width)	18”	18”
<b>Design Surface</b> <sup>3</sup>	<b>Type</b>	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
	<b>Protrusions</b>	≤ 6” May be common and continuous	≤ 3” May be common, not continuous
	<b>Obstacles</b> (Maximum Height)	14”	10”
<b>Design Grade</b> <sup>3</sup>	<b>Target Grade</b>	5% – 18%	3% – 12%
	<b>Short Pitch Maximum</b>	35%	25%
	<b>Maximum Pitch Density</b>	20% – 30% of trail	10% – 20% of trail
<b>Design Cross Slope</b>	<b>Target Cross Slope</b>	5% – 20%	5% – 10%
	<b>Maximum Cross Slope</b>	25%	15%

Designed Use		Trail Class	
		2	3 <sup>2</sup>
<b>HIKER/PEDESTRIAN</b>			
<b>Design Clearing</b>	<b>Height</b>	6' – 7'	7' – 8'
	<b>Width</b>	24" – 48" Some light vegetation may encroach into clearing area	36" – 60"
	<b>Shoulder Clearance</b>	6" – 12"	12" – 18"
<b>Design Turn</b>	<b>Radius</b>	2' – 3'	3' – 6'

Source: U.S. Forest Service 2008

<sup>1</sup> For definitions of Design Parameter attributes (e.g., Design Tread Width and Short Pitch Maximum), see FSH 2309.18, section 05.

<sup>2</sup> Trail Class 3 have the potential to be accessible. If assessing or designing trails for accessibility, refer to the Forest Service Trail Accessibility Guidelines (FSTAG) for more specific technical provisions and tolerances (FSM 2350).

<sup>3</sup> The determination of the trail-specific Design Grade, Design Surface, and other Design Parameters should be based upon soils, hydrological conditions, use levels, erosion potential, and other factors contributing to surface stability and overall sustainability of the trail.

Existing trail sections not re-aligned would be rehabilitated, if necessary, through trail improvements such as constructing grade dips; reestablishing outslopes; and placing, extending, or replacing bogwalks, footbridges, and other trail features in low-lying trail areas to minimize erosion and reduce drainage issues. PRWI could develop standards for dimensions, materials, railings, and other components in order to create uniform trail features.

**Accessible Trails**

Accessible trails outside of the Cabin Camps would:

- Provide loop trails and/or provide access to points of interest
- Connect to existing or new parking areas
- Be located on existing zero to twelve percent slopes to the extent feasible. The 2015 Architectural Barriers Act (ABA) Standards inform accessible trail routes and areas. Trails in compliance with ABA may have running slopes up to 12 percent. However, trail segments with slopes steeper than five percent are limited in length by the ABA Standards. Therefore, the construction of accessible trail segments on existing six to twelve percent slopes may require grade modifications to meet this length requirement. The construction of accessible trail segments on existing slopes steeper than 12 percent would require grade modifications.

Accessible trail areas in Cabin Camps 1, 2, 4, and 5 would:

- Avoid the Avoidance Area as previously described
- Create at least one accessible unit in each camp
- Connect buildings and features where cabin camp user groups congregate at or otherwise use on a daily basis (e.g., dining hall, craft lodge, pavilion, and council ring)
- Connect to the restrooms

- Minimize the footprint of accessible trails by creating the most direct route possible
- Be located on existing zero to twelve percent slopes to the extent feasible for reasons previously described. The construction of accessible trail segments on slopes steeper than five percent may require grade modifications to meet the 2015 ABA Standards as described previously.

**Design Parameters**

The design of accessible trails would comply with the 2015 ABA Standards. According to these standards, the surface of accessible trails, passing spaces, and resting intervals would be firm and stable. The surface of accessible trails would also be in accordance with the park’s cultural landscape and viewshed goals. The clear tread width would be a minimum of 36 inches. The running slope of any trail segment would not exceed 12 percent. Not more than 30 percent of the total length of the trail would have a running slope steeper than 8.33 percent. Where the running slope of a trail segment exceeds five percent, the maximum length of the trail segment would be in accordance with **Table 2** and a resting interval would be provided at the top and bottom of each segment. Accessible trails would also comply with additional accessible trail design parameters related to passing spaces, tread obstacles, openings, slopes, resting intervals, protruding objects, and trailhead signs in the 2015 ABA Standards.

**Table 2: Maximum Running Slope and Segment Length of Accessible Trails**

Running Slope of Trail Segment		Maximum Length of Segment
Steeper than	But not Steeper than	
1:20 (5%)	1:12 (8.33%)	200 feet
1:12 (8.33%)	1:10 (10%)	30 feet
1:10 (10%)	1:8 (12%)	10 feet

Source: U.S. Access Board 2015

**Mountain Biking Trails**

Mountain biking trails would:

- Provide a loop trail option
- Provide trails of shorter and longer options
- Connect trails that currently allow mountain biking
- Connect to existing or new parking areas
- Largely meet design grades for Class 2 (Moderately Developed) mountain biking trails and somewhat meet design grades for Class 3 (Developed) and Class 4 (Highly Developed) mountain biking trails as defined in the U.S. Forest Service’s *FSH 2309.18 Trails Management Handbook*

**Design Parameters**

New mountain biking trails, existing trails opened up to mountain bikers, and new mountain biking trails constructed parallel to existing maintained gravel roads, would allow hikers in addition to mountain bikers, but would be designed, constructed, and maintained according to the Class 2 and Class 3 design parameters summarized in **Table 3**.

**Table 3: Bicycle Trail Design Parameters<sup>1</sup>**

Designed Use		Trail Class	
		2	3
<b>BICYCLE</b>			
<b>Design Tread Width</b>	<b>Single Lane</b>	12" - 24"	18" - 36"
	<b>Double Lane</b>	36" - 48"	36" - 48"
	<b>Structures (Minimum Width)</b>	18"	36"
<b>Design Surface<sup>2</sup></b>	<b>Type</b>	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
	<b>Protrusions</b>	≤ 6" May be common and continuous	≤ 3" May be common, but not continuous
	<b>Obstacles (Maximum Height)</b>	12"	10"
<b>Design Grade<sup>2</sup></b>	<b>Target Grade</b>	5% - 12%	3% - 10%
	<b>Short Pitch Maximum</b>	25% 35% on downhill segments only	15%
	<b>Maximum Pitch Density</b>	10% - 30% of trail	10% - 20% of trail
<b>Design Cross Slope</b>	<b>Target Cross Slope</b>	5% - 8%	3% - 8%
	<b>Maximum Cross Slope</b>	10%	8%
<b>Design Clearing</b>	<b>Height</b>	6' - 8'	8'
	<b>Width</b>	36" - 48" Some light vegetation may encroach into clearing area	60" - 72"
	<b>Shoulder Clearance</b>	6" - 12"	6" - 12"
<b>Design Turn</b>	<b>Radius</b>	3' - 6'	4' - 8'

Source: U.S. Forest Service 2008

<sup>1</sup> For definitions of Design Parameter attributes (e.g., Design Tread Width and Short Pitch Maximum), see FSH 2309.18, section 05.

<sup>2</sup> The determination of the trail-specific Design grade, Design Surface, and other Design Parameters should be based upon soils, hydrological conditions, use levels, erosion potential, and other factors contributing to surface stability and overall sustainability of the trail.

**Equestrian Trails**

Equestrian trails would:

- Provide a loop trail option
- Connect to a new parking area with horse trailer parking
- Provide a new trail use in PRWI
- Largely meet design grades for Class 2 (Moderately Developed) equestrian trails and somewhat meet design grades for Class 3 (Developed) equestrian trails as defined in the U.S. Forest Service’s *FSH 2309.18 Trails Management Handbook*

**Design Parameters**

New equestrian trails, existing trails opened up to equestrians, and new equestrian trails constructed parallel to existing maintained gravel roads, would allow hikers in addition to equestrians, but would be designed, constructed, and maintained according to the Class 2 and Class 3 design parameters summarized in **Table 4**.

**Table 4: Equestrian Trail Design Parameters<sup>1</sup>**

Designed Use		Trail Class	
		2	3
<b>EQUESTRIAN</b>			
<b>Design Tread Width</b>	<b>Wilderness (Single Lane)</b>	12” – 18” May be up to 48” along steep side slopes 48” – 60” or greater along precipices	18” – 24” May be up to 48” along steep side slopes 48” – 60” or greater along precipices
	<b>Non-Wilderness (Single Lane)</b>	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
	<b>Non-Wilderness (Double Lane)</b>	60”	60” – 84”
	<b>Structures (Minimum Width)</b>	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
<b>Design Surface <sup>2</sup></b>	<b>Type</b>	Native, with limited grading May be frequently rough	Native, with some on-site borrow or imported material where needed for stabilization and occasional

Designed Use		Trail Class	
		2	3
<b>EQUESTRIAN</b>			grading Intermittently rough
	<b>Protrusions</b>	≤ 6" May be common and continuous	≤ 3" May be common, not continuous
	<b>Obstacles (Maximum Height)</b>	12"	6"
<b>Design Grade <sup>2</sup></b>	<b>Target Grade</b>	5% – 20%	3% – 12%
	<b>Short Pitch Maximum</b>	30%	20%
	<b>Maximum Pitch Density</b>	15% – 20% of trail	5% – 15% of trail
<b>Design Cross Slope</b>	<b>Target Cross Slope</b>	5% – 10%	3% – 5%
	<b>Maximum Cross Slope</b>	10%	8%
<b>Design Clearing</b>	<b>Height</b>	8' – 10'	10'
	<b>Width</b>	72" Some light vegetation may encroach into clearing area	72" – 96"
	<b>Shoulder Clearance</b>	6" – 12" Pack clearance: 36" x 36"	12" – 18" Pack clearance: 36" x 36"
<b>Design Turn</b>	<b>Radius</b>	4' – 5'	5' – 8'

Source: U.S. Forest Service 2008

<sup>1</sup> For definitions of Design Parameter attributes (e.g., Design Tread Width and Short Pitch Maximum), see FSH 2309.18, section 05.

<sup>2</sup>The determination of the trail-specific Design Grade, Design Surface, and other Design Parameters should be based upon soils, hydrological conditions, use levels, erosion potential, and other factors contributing to surface stability and overall sustainability of the trail.

**Parking**

New parking areas would:

- Avoid the Avoidance Area as previously described
- Be located on 10 percent or less slopes
- Use areas with existing tree clearings or prior, non-historic development (i.e., disturbed), when possible

Expanded existing parking areas would:

- Avoid the Avoidance Area as previously described

- Be located on 10 percent or less slopes

The proposed maximum number of parking spaces and surface for each new parking area and expanded existing parking area are provided in **Table 5** and **Table 6**.

**Table 5: New Parking Areas**

<b>New Parking Area</b>	<b>Proposed Maximum Number of Parking Spaces</b>	<b>Surface</b>
VA 234 (Dumfries Road) at Spriggs Lane/Waterway Drive	100 spaces for various vehicle types/sizes including cars, buses, and RVs	Paved
VA 646 (Aden Road) at Independent Hill	33 spaces including 25 car spaces and 8 horse trailer spaces	Packed
Lykes Lane	15 spaces including several accessible parking spaces	Packed
<b>Total Maximum Parking Spaces</b>	<b>148</b>	

**Table 6: Expanded Existing Parking Areas**

<b>Existing Parking Area</b>	<b>Number of Parking Spaces</b>			<b>Surface</b>
	<b>Existing</b>	<b>Proposed Maximum Addition</b>	<b>Total</b>	
E	8	12	20	Paved
F	9	11	20	Paved
H	9	11	20	Paved
Oak Ridge Campground Front Lot	13	12	25	Paved
<b>Total Maximum Addition</b>		<b>46</b>		

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**Table 7: Trail Attributes by Trail Class<sup>1</sup>**

Trail Attributes	Trail Class				
	1 Minimally Developed	2 Moderately Developed	3 Developed	4 Highly Developed	5 Fully Developed
<b>Tread &amp; Traffic Flow</b>	Tread intermittent and often indistinct May require route finding Single lane, with no allowances constructed for passing Predominantly native materials	Tread continuous and discernible, but narrow and rough Single lane, with minor allowances constructed for passing Typically native materials	Tread continuous and obvious Single lane, with allowances constructed for passing where required by traffic volume in places where there is no reasonable opportunity to pass Native or imported materials	Tread wide and relatively smooth, with few irregularities Single lane, with allowances constructed for passing where required by traffic volume in places where there is no reasonable opportunity to pass Double lane where traffic volume is high and passing is frequent Native or imported materials May be hardened	Tread wide, firm, stable, and generally uniform Single lane, with frequent turnouts where traffic volume is low to moderate Double lane where traffic volume is moderate to high Commonly hardened with asphalt or other imported material
<b>Obstacles</b>	Obstacles common, naturally occurring, often substantial, and intended to provide increased challenge Narrow passages; brush, steep grades, rocks and logs present	Obstacles may be common, substantial, and intended to provide increased challenge Blockages cleared to define route and protect resources Vegetation may encroach into trailway	Obstacles may be common, but not substantial or intended to provide challenge Vegetation cleared outside of trailway	Obstacles infrequent and insubstantial Vegetation cleared outside of trailway	Obstacles not present Grades typically < 8%
<b>Constructed Features &amp; Trail Elements</b>	Structures minimal to non-existent Drainage typically provided without structures Natural fords Typically no bridges	Structures of limited size, scale, and quantity; typically constructed of native materials Structures adequate to protect trail infrastructure and resources Natural fords Bridges as needed for resource protection and appropriate access	Structures may be common and substantial; constructed of imported or native materials Natural or constructed fords Bridges as needed for resource protection and appropriate access	Structures frequent and substantial; typically constructed of imported materials Constructed or natural fords Bridges as needed for resource protection and user convenience Trailside amenities may be present	Structures frequent or continuous; typically constructed of imported materials May include bridges, boardwalks, curbs, handrails, trailside amenities, and similar features
<b>Signs<sup>2</sup></b>	Route identification signing limited to junctions Route markers present when trail location is not evident Regulatory and resource protection signing infrequent Destination signing, unless required, generally not present Information and interpretive signing generally not present	Route identification signing limited to junctions Route markers present when trail location is not evident Regulatory and resource protection signing infrequent Destination signing typically infrequent outside wilderness areas; generally not present in wilderness areas Information and interpretive signing uncommon	Route identification signing at junctions and as needed for user reassurance Route markers as needed for user reassurance Regulatory and resource protection signing may be common Destination signing likely outside wilderness areas; generally not present in wilderness areas Information and interpretive signs may be present outside wilderness areas	Route identification signing at junctions and as needed for user reassurance Route markers as needed for user reassurance Regulatory and resource protection signing common Destination signing common outside wilderness areas; generally not present in wilderness areas Information and interpretive signs may be common outside wilderness areas Accessibility information likely displayed at trailhead	Route identification signing at junctions and for user reassurance Route markers as needed for user reassurance Regulatory and resource protection signing common Destination signing common Information and interpretive signs common Accessibility information likely displayed at trailhead
<b>Typical Recreation Environments &amp; Experience<sup>3</sup></b>	Natural and unmodified ROS: Typically Primitive to Roded Natural WROS: Typically Primitive to Semi-Primitive	Natural and essentially unmodified ROS: Typically Primitive to Roded Natural WROS: Typically Primitive to Semi-Primitive	Natural and primarily unmodified ROS: Typically Primitive to Roded Natural WROS: Typically Semi-Primitive to Transition	May be modified ROS: Typically Semi-Primitive to Rural WROS: Typically Portal or Transition	May be highly modified Commonly associated with visitor centers or high-use recreation sites ROS: Typically Roded Natural to Urban Generally not present in Wilderness areas

Source: U.S. Forest Service 2008

<sup>1</sup> For National Quality Standards for Trails, Potential Appropriateness of Trail Classes for Managed Uses, Design Parameters, and other related guidance, refer to FSM 2353 and FSH 2309.18.

<sup>2</sup> For standards and guidelines on the use of signs and posters on trails, refer to the Sign and Poster Guidelines for the Forest Service (EM-7100-15).

<sup>3</sup> The Trail Class Matrix shows combinations of Trail Class and Recreation Opportunity Spectrum (ROS) or Wilderness Recreation Opportunity Spectrum (WROS) settings that commonly occur, although trails in all Trail Classes may and do occur in all settings. For guidance on the application of the ROS and WROS, refer to FSM 2310 and 2353 and FSH 2309.18.

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## References

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