



**DESIGN CRITERIA
MANUAL**

CHAPTER 4 PATHWAYS & TRAILS

MUNICIPALITY OF ANCHORAGE

**PUBLIC WORKS DEPARTMENT
PROJECT MANAGEMENT &
ENGINEERING DIVISION**

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Acronyms and Abbreviations

AASHTO	American Association of State Highway and Transportation Officials Guide for the Development of Bicycle Facilities
ADA	Americans with Disabilities Act
ADAAG	Americans with Disabilities Act Accessibility Guidelines
ADOT&PF	Alaska Department of Transportation and Public Facilities
ADT	Average Daily Traffic
AMC	Anchorage Municipal Code
ATP	Anchorage Trails Plan
DCM	Design Criteria Manual
FHWA	Federal Highway Administration
Ft	Feet
M.A.S.S.	Municipality of Anchorage Standard Specifications
MOA	Municipality of Anchorage
MUTCD	Manual on Uniform Traffic Control Devices
OS&HP	Official Streets and Highways Plan
PGDHS	Policy on the Geometric Design of Highways and Streets
PM&E	Project Management and Engineering
PROWAG	Public Rights-of-Way Accessibility Guidelines
ROW	Rights-of-way

SECTION 4.1 INTRODUCTION

This chapter provides discussion and design criteria for development of pedestrian and bicycle facilities within the Municipality of Anchorage. While the main focus is placed on multi-use paved paths (also called shared-use pathways, or sidepaths), it also includes trails primarily in parks, as well as AASHTO, Guide for Development of Bicycle Facilities 2012 (AASHTO) design considerations for safe bicycle travel on roadways are provided at the end of this chapter. This chapter provides design guidance based on the Anchorage Pedestrian Plan, Areawide Trails Plan (ATP) and the Anchorage Bicycle Plan which identifies proposed routes. Designers should consult these documents with respect to planning level decisions that affect the planning and design process.

In accordance with AASHTO, “All roads, streets, and highways, except those where bicyclists are legally prohibited, should be designed and constructed under the assumption that they will be used by bicyclists. Therefore, bicyclists’ needs should be addressed in all phases of transportation planning, design, construction, maintenance, and operations.”

4.1 A Objective

The objective of this chapter is to provide municipal guidelines for the design of pathways. All pathways shall be designed, located and signed to discourage incompatible use and to provide safe, enjoyable, and year-round use. In doing so, these design standards will provide for the public safety and welfare while helping to protect the Municipality against liabilities.

The criteria for path development and design include paving, alignment, stopping sight distance, intersections, grades, cross slopes, clearances, road separation, width of paths, striping and signage, lighting, drainage, surfacing, and pathway structure. Each of these is discussed in detail below. Additionally, specific attention should be placed on the landscaping of paths including trees, shrubs, topsoil, and seeding (Refer to Design Criteria Manual, Chapter 3).

4.1 B Sources Referenced

In developing design criteria for pathways, trails, or bicycle routes, it is important to understand the difference between each. Chapter 4 is largely an adoption of the design TRAILS standards as described within the Areawide Trails Plan, adopted April 1997 and the Anchorage Bicycle Plan, adopted March 2010 by the Municipality of Anchorage. Additional information for this chapter has been compiled from references listed at the end of this chapter.

4.1 C Definitions

Pathways:

The term “pathways” or “paths” as used in this document refers to the universe of trails. Shared use paths are sometimes referred to as “trails”. However, for our purposes the term “trail” means a recreational facility often unimproved and not near a roadway. Care should be taken not to use these terms interchangeably because they have distinctly different design guidelines.

Following are further definitions:

Shared-Use Pathway:

A “pathway” intended to accommodate various types of nonmotorized users, including walkers, bicyclists, in-line skaters, skiers, ski-jorers and equestrians; also referred to as a “multi-use pathway.” These pathways are not typically used by motorized vehicles, or sled dogs, except when reserved for special events following appropriate public notice, i.e., the Iditarod or Fur Rony sled dog races.

Typically multi-use pathways are two-way directional. One-way multi-use paths can be used, but designers are cautioned that unless measures are provided to control direction, one-way directional trails will most likely be used as two-way paths. An example of a multi-use pathway is along Southport Drive or the Chester Creek Greenbelt Trail.

Sidepaths:

A shared-use pathway located within the right-of-way and aligned with a roadway. Sidepaths should not be used to preclude on-road bicycle facilities, but rather to supplement them. Sidepaths may be separated or back of curb. An example is along Elmore Road north of Abbott Road.



Figure 1: On Street Bike Lane and Sidepath (Elmore Road)

Separated Pathway:

A sidepath physically separated from traffic by open space or barrier. Most shared use paths are wide enough to allow bicycles, pedestrians, and other nonmotorized users to pass each other. An example of a separated pathway is along A Street from Dimond Boulevard to Benson Boulevard.

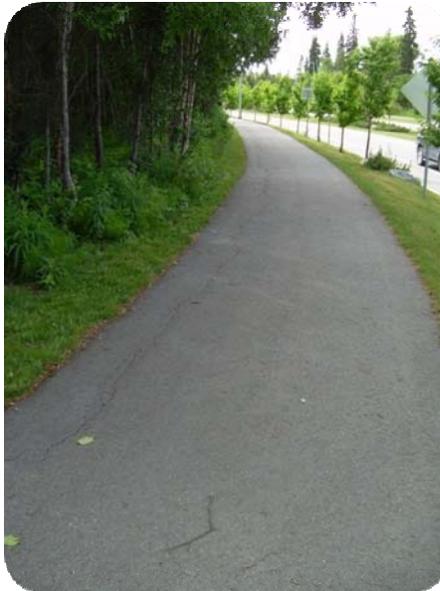


Figure 2: Separate Pathway (Southport Road)

Back of Curb Pathway:

A sidepath located immediately adjacent and parallel to a roadway. Users are less protected from vehicles and roadway splash and grit. An example of back of curb pathways is along Muldoon Road.



Figure 3: Back of curb pathway (Tudor Road)

Bikeways:

A generic term for any road, street, path or way which in some manner is specifically designated for bicycle travel, regardless of whether such facilities are designated for the exclusive use of bicycles or are to be shared with other transportation modes.

Designers should note that the MUTCD denotes on-road bikeways as “routes” and allows appropriate signage. Following are types of on-road bikeways.

Shared Road/Shared Lane:

A lane of traveled way that is open to both bicycle and motor vehicle travel.



Figure 4: Shared Road Facility

Bicycle Lane:

A one-way on-street facility that carries bicycle traffic in the same direction as adjacent motor vehicle traffic. A bicycle lane is typically 5 feet wide (including the stripe) and is marked and signed for bicycle traffic. Bicycle lanes can be found on Southport or Elmore Road.



Figure 5: Bicycle Lane

Paved Shoulder Bikeway:

A striped paved area located to the right of the travel lane. This area serves as a location for a vehicle break-down lane, provides for travel by pedestrians where no sidewalk/pathway facilities exist, and also accommodates bicycle travel. The paved shoulders on Rabbit Creek Road and Hillside Drive function as paved shoulder bikeways.



Figure 6: Paved Shoulder (Arctic Boulevard)



Figure 7: Paved Shoulder (C Street)

Wide Curb Lane:

A lane abutting the curb that is typically 14 feet wide. It can accommodate bicyclists and is sometimes designed for bicycle use when right-of-way constraints preclude installation of “full-width” bicycle lanes. Striping is not required, unless the lane is 15 feet or wider.



Figure 8: Wide Curb Lane

Sidewalks:

Typically a concrete paved surface within a vehicular right-of-way for use by pedestrians. Sidewalks are aligned with a road, and constructed either adjacent to the curb or separated from the curb. Compared to a separated pathway, a sidewalk is typically narrower and is intended primarily for walking. Standard or conventional widths are 5 feet that may be widened to 11 feet in the Central Business District.

AASHTO, 2012 states that the appropriate paved width for a shared-use path is dependent on the context, volume and mix of users. Typically designed for pedestrians, sidewalks are not designed for the faster speeds associated with bicycles. Sidewalks, particularly in urban locations are designed to give the pedestrian priority. The Anchorage Municipal Code (AMC 9.38) contains regulations affecting bicycle travel and precludes the riding of bicycles on sidewalks in the Anchorage Central Business District.



Figure 9: Sidewalk - Blueberry Road



Figure 10: Sidewalk - CBD (Central Business District)

Walkways:

Walkways are rights-of-way or easements, dedicated to the public, which cross between streets to provide connectivity between neighborhoods.

Trail Definitions**Multi-Use Trails:**

An access route for pedestrian type activities to include bicycling, jogging, cross-country skiing, skijoring, and also equestrian, natural and interpretive types of uses which is typically located in a greenbelt or park and consisting of a stable surface, either pavement or compacted granular fill. A trail is usually *not* aligned with a road. An example is the Coastal Trail or any of the trails in Far North Bicentennial Park.

Soft-surface trail:

An un-surfaced natural trail or trail surfaced with compacted earth, crusher fines, bark or gravel.

Trailhead:

An access point to a trail or trail system often accompanied by various public facilities, such as parking areas, toilets, water, directional and informational signs, and a horse unloading dock.

Trail Classifications:

Trails within MOA Parks and Greenbelts are defined by a trail classification system. This system is based on an existing classification system utilized by the MOA Far North Bicentennial Trail Improvement Plan (2011), the National Parks Service, Alaska State Parks and the Bureau of Land Management because of its thorough process for assessing trail conditions and planning for long-term trail management and maintenance.

The trail classification system has five different classes related to the experience or character of a trail. The five classes span the spectrum from an urban, asphalt paved trail that can be up to 10 feet wide to a narrow trail or route that goes up a mountain peak that has no distinguishable trail tread.

Trail Class 1 - Minimal/Undeveloped Trail:

These trails are primitive and are often narrow, steep, and indistinct. They are built from only native materials with obstacles such as rocks, logs, and brush overhanging the trail. There are no constructed features like bridges or foot crossings. The trail drainage functions without erosion control measures. Signage is minimal and generally limited to regulation and resource protection, so users may require route finding. Typically, these are social trails that do not play a significant role within the trail network. These trails are not maintained by MOA Parks & Recreation. Refer to Figure 11 for a Trail Class 1 example.



Figure 11: Trail Class 1 (Un-named Trail, Girdwood)

Trail Class 2 - Simple/Minor Development Trail:

Trails within this class have a discernible and continuous tread, though they may be narrow and rough. These trails are built with native materials. Blockages, such as downed trees, are cleared to define the route and protect resources, yet obstacles are occasionally present and vegetation may encroach into the trail. Structures are limited, though may be provided to protect trail infrastructure and resources. The trail drainage should function well and only primitive foot crossings and fords are to be used. Signage may be provided and generally limited to regulations and resource protection. There are typically few destination signs on these trails. Examples are the Black Bear Trail in Far North Bicentennial Park and the Kincaid Park Singletrack trails.

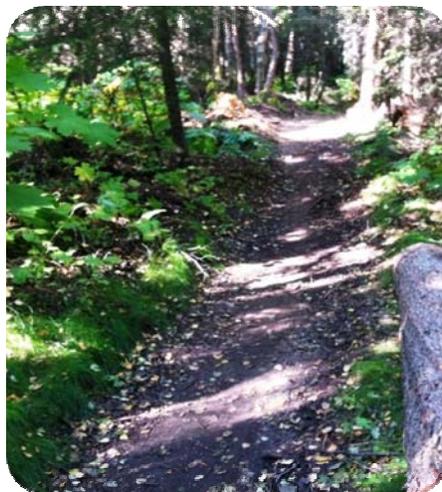


Figure 12: Trail Class 2 (Singletrack Trail, Kincaid Park)

Trail Class 3 - Developed/Improved Trail:

Class 3 trails are defined continuous, and wide enough for unhindered one-way travel with occasional allowances for passing. There are few obstacles and vegetation is cleared outside of the trail way. Trail structures (walls, steps, drainage, raised trail sections) may be common and substantial with bridges as needed for resource protection and to maintain appropriate access. Generally only native materials are used. Directional and destination signage are typically present with informational signs often provided. For safety reasons some of these trails are dedicated to single use. Examples are the Bog Trail and dog mushing trails in Far North Bicentennial Park.

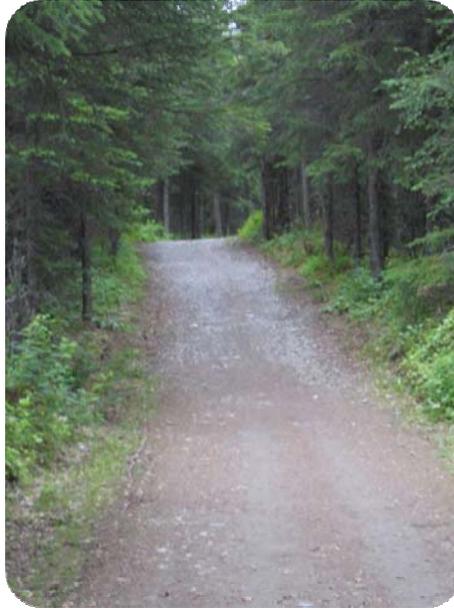


Figure 13: Trail Class 3 (Tour of Anchorage Trail)

Trail Class 4 - Highly Developed Trail:

This class of trail is relatively wide and smooth with grades typically below 12 percent. They can accommodate two-way travel. Obstacles are rare and vegetation is cleared outside of the trail way. They can be constructed from both native and imported materials and are often hardened, but not paved. Structures are frequent and substantial trail bridges are appropriate for water crossings. For safety reasons, some of these trails are dedicated as single-use only, such as the dog mushing trails in Far North Bicentennial Park. Trailside amenities may be present and a variety of signage is often used, including informational and interpretive signs. Trail Universal Access information is likely to be displayed at trailheads. Examples are the Gasline Connection in Far North Bicentennial Park and the Winner Creek Trail in Girdwood.



Figure 4: Trail Class 4 (Bash Trail)



Figure 5: Trail Class 4 (Winner Creek Trail, Girdwood)

Trail Class 5 - Fully Developed Trail:

Class 5 trails are wide, flat, and smooth. They generally accommodate two-lane and two-directional travel, but if not frequent passing turnouts are provided. These trails are commonly paved with asphalt or other imported material. No obstacles are present, and grades are typically less than 8 percent. Frequent structures may include curbs, handrails, trailside amenities, and boardwalks. Drainage structures are present and often include road-like design features, such as culverts. A wide variety of signage is present, including informational and interpretive signs. Trail Universal Access information is typically displayed at trailheads. Class 5 trails located in Parks and Greenbelts are maintained by the Municipality Of Anchorage Parks and Recreation Department. This can also be referred to as a multi-use trail; examples are Campbell Creek Trail, Coastal Trail, and Chester Creek Trail.



Figure 14: Trail Class 5 (Tony Knowles Coastal Trail)

4.1 D Authority

AMC 21.05.030 identifies the Anchorage Trails Plan as an element of the Comprehensive Plan. It is a guide for the construction of a trail and walkway network within the Municipality of Anchorage.

AMC 21.07.060 identifies transportation and connectivity standards and requirements for sidewalks, walkways and trail improvements.

AMC 21.07.060 identifies trail improvements to follow the Design Criteria Manual.

AMC 21.07.060E.2 establishes the generally applicable requirements for when and where to provide street sidewalks throughout the municipality.

AMC 21.07.060E.3 establishes requirements for through-block connections by pedestrian facilities.

AMC 21.07.060E.4 establishes the generally applicable on-site walkway requirement and development standards for on-site pedestrian facilities.

AMC 21.07.060E.5 establishes some standards for trails and refers to the DCM requirements for trails.

AMC 21.07.060E.6 establishes standards for the use, maintenance, and snow removal on sidewalks, walkways, and trails.

AMC 21.07.060E.2 provides tailored provisions for sidewalks/pathways for subdivisions on slopes.

AMC 21.080.030 gives the Platting Authority direction to require walkway dedication as part of subdivisions. This may be done when walkways or trails are necessary for adequate pedestrian circulation or safety.

AMC 21.08.040 gives the Platting Authority direction to require walkway dedication as part of subdivisions. This may be done when walkways or trails are necessary for adequate pedestrian circulation or safety.

AMC 21.08.040 directs the Platting Authority to require trail dedication when the trail is designated on an adopted municipal plan and cannot be located in an existing dedicated easement or right-of-way.

AMC 21.08.050 directs the Platting Authority to require pathway construction in location as identified in the Non-Motorized Transportation Plan, specifically the Pedestrian Plan and the Bicycle Plan.

AMC 21.08.050 directs that when a pathway and a sidewalk are co-located, the facility shall be constructed as per the specifications for a pathway.

AMC 21.08.050 provides some general provisions for the improvement of pedestrian facilities in subdivisions, and Table 21.08-8 establishes minimum widths and surfaces for sidewalk, walkways and trail improvements.

AMC 21.080.060 directs the Platting Authority to require trail dedication when the trail is designated on an adopted municipal plan and cannot be located in an existing dedicated easement or right-of-way.

AMC 21.85.090 establishes sidewalk needs for land development based on the Average Daily Traffic (ADT).

AMC 21.85.100 requires walkways and trails that are not part of required trail dedications to be improved in accordance with AMC 21.85 Table E.

AMC 21.85.Table E establishes minimum widths and surfaces for pathways and sidewalks.

4.1 E Applicability of the American with Disabilities Act (ADA)

The Americans with Disabilities Act Accessibility Guidelines (ADAAG) must be adhered to for all projects. It must be understood that there is a wide range of standards that deal with trails. Each project must be evaluated and the appropriate standard applied. There are a number of documents that apply to pathways and trails.

The ADAAG Manual: A Guide to the Americas with Disabilities Act Accessibility Guidelines for Buildings and Facilities (published July 2004 and amended August 2005) applies to many situations, governing “accessible routes”, parking and passenger loading zones, curb ramps, stairs, and signage. In particular, it should be consulted for the access along the fronts of buildings, within parking areas, and for sidewalks interior to a site development project.

Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way (July 2011) addresses access to newly constructed and altered public streets and sidewalks covered by ADA. The guidelines do not apply to existing public rights-of-way except those portions that are altered. The guidelines cover pedestrian features in new or altered public rights-of-ways, including sidewalks and other pedestrian ways, street crossings, medians and traffic islands, overpasses, under passes and bridges.

The guidelines apply to both permanent and temporary facilities. A design guide titled *Accessible Public Rights-of-Way: Planning and Designing for Alterations* (July 2007) is available to provide guidance to State and local governments on how to design and construct accessible public pedestrian facilities.

Draft Final Accessibility Guidelines for Outdoor Developed Areas (October 2009) provides the basis of what will become design requirements. Currently, the guidelines only apply to Federal land management agencies and public or private entities construct or alter facilities on Federal lands on behalf of the Federal government. However, they represent the currently accepted approach with respect to recreational facilities and should be consulted for design of trails for recreational purposes.

Project Managers and designers are cautioned that ADAAG presents evolving set of design criteria. The realm of trails in particular is changing. Design Study Reports should address the current standard to which trails will be designed. Typically, the most current guidelines that are issues, whether as part of the final rule or not, represent the best judgment of a committee of authorities within a field and should be given full consideration as to their applicability to a project. Design Study Reports should indicate where strict application of the criteria would be inappropriate for a project and specific exception to those criteria should be sought from the Municipal Engineer through the design variance process.

The Federal government recognizes that not all trails may be designed to meet ADAAG. Many times, making a trail fully “accessible” would destroy the surroundings and cause inappropriate environmental damage, thus some criteria may be compromised in some instances. However, designers should recognize that this does not remove the necessity to comply with other components of ADAAG that assist those with disabilities, such as the provision of flat, paved rest areas, benches, leaner rails and other accommodations.

Guidance documents and other information related to accessibility requirements can be found at: www.access-board.gov. Project Managers and designers should also recognize that other organizations offer considerable information on the subject of pedestrian environments.

4.1 F Design Variances

Designers, whether Municipal or private, shall adhere to the criteria established in this Design Criteria Manual and other referenced documents, unless compliance with such will compromise their judgment as professional engineers with regard to safety, welfare, cost effectiveness, and practicality. In such cases, a written variance request of the standard of criteria may be requested from the Municipal Engineer. Written variance requests shall be submitted through the municipal project manager or private development coordinator for a determination by the Municipal Engineer. Variance requests should contain supporting information, justification and suggested solutions.

In addition to the criteria presented in this manual, the Municipal Engineer may at his/her sole discretion impose greater standards and criteria when deemed appropriate to protect the safety and welfare of the public.

END OF SECTION 4.1

SECTION 4.2 DESIGN STANDARDS

Following is a discussion of design standards for multi-use pathways. These criteria will apply for virtually all paths that are separated from the roadway, except paths in recreational settings.

4.2 A Paving

Pathways in road rights-of-way shall be paved, except those that are:

- identified as multi-use unpaved trails in the Areawide Trails Plan or in an approved Park Master Plan;
- located in Girdwood that the Girdwood Board of Supervisors elects to waive; or
- in the Anchorage Bowl and Chugiak-Eagle River areas that the Planning and Zoning Commission elects to waive.

4.2 B Alignment

The significance of proper alignment, or design radii, varies with the use of the facility. For example, sidewalks and walkways are predominantly used for slow moving pedestrian traffic, while, bike and equestrian trails should be designed to accommodate greater speeds, greater volumes of users, and even greater user types. Pathway alignment should include both vertical and horizontal alignment and is related to design speed and sight stopping distance.

1. Design Speed:

Design pathways for an appropriate speed for cyclists. A minimum design speed of 18 mph should be used (AASHTO, 2012). While design and traffic controls can be used to deter excessive speeds, lower design speeds should not be used to artificially lower user speeds. When a downgrade exceeds 6 percent, a design speed of 30 mph or more is advisable.

2. Horizontal Alignment

The ATP (1997) recommends a minimum design radius of 95 feet when designing paths for bicycles, in-line skating, cross-country skiing, and dog mushing.

Horizontal alignment of pathways for bicycle use must be considered due to the necessity of the cyclist to lean into the turn. Generally, a maximum lean angle for casual cyclists is between 15° and 25° depending on the experience of the cyclist. For most cyclists, the minimum curvature of the pathway can be calculated for a given lean angle by the following equation:

Table 4-1 Minimum Radius of Curvature Based on Lean Angle		
$R = \frac{0.007V^2}{\tan\theta}$		
R	=	Minimum radii of curvature (ft)
V	=	Design speed (mph)
θ	=	Lean angle from the vertical (degrees)

Where the lean angle exceeds 20°, AASHTO (2012) recommends that the pathway should be widened with a centerline stripe placed down the middle of the path. ADAAG requires that cross slopes not exceed 2 percent to avoid severe slopes that preclude use by people in wheelchairs. The maximum super-elevation for most multi-use paths is 2 percent and requires a minimum transition distance of 25 feet be provided between the end and beginning of consecutive and reversing horizontal curves.

The tables below (AASHTO, 2012) present the minimum design radii for paved multi-use paths for 15° lean angle, and 2-percent super-elevation and 20° lean angle, respectively:

Table 4-2 Minimum Radii for Horizontal Curves on Paved, Shared-Use paths at 20-Degree Lean Angle	
Based on 20° Lean Angle (AASHTO,2012)	
Design Speed (V) (mph)	Minimum Radius (R) (ft)
12	27
14	36
16	47
18	60
20	74
25	115
30	166

Table 4-3 Minimum Radii of Curvature Based on Superelevation		
$R = \frac{V^2}{15(e + f)}$		
R	=	Minimum radii of curvature
V	=	Design speed (mph)
e	=	Rate of bikeway superelevation (percent)
f	=	Coefficient of friction

3. Vertical Alignment (Grades):

The AASHTO standards for grades for paved paths are as follows: “The maximum grade of a shared use path adjacent to a roadway should be 5 percent, but the grade should generally match the grade of the adjacent roadway. Where a shared use path runs along a roadway with a grade that exceeds 5 percent, the sidepath grade may exceed 5 percent but must be less than or equal to the roadway grade. Grades on shared use paths in independent right-of-way should be kept to a minimum, especially on long inclines. Grades steeper than 5 percent are undesirable because the ascents are difficult for many path users, and the descents cause some users to exceed the speeds at which they are competent or comfortable.” (AASHTO, 2012, page 5-16)

The ADAAG “Public Rights-of-Way Design Guide (2012) in Section 3.2.2 states, “On a new site, a knowledgeable designer can often manipulate cut and fill, entrance location, and approach direction and length to limit walkway running slope to 1:20 (5%), adding, where necessary, ramped segments with handrails and landings at or below the 1:12 (8.33%) slope specified in accessibility standards for ramps.

These slopes will not be consistently possible to achieve along public sidewalks and shared use paths, where running slope is tied to roadway gradient and underlying terrain. Nevertheless, running slope should be kept to the minimum feasible consistent with these factors. Artificial slopes should not be added as landscaping features, nor should meandering walkways that add significantly to the travel distance be permitted on a primary circulation route.”

Further, multi-use trails or paths may also serve a pedestrian circulation/transportation function, particularly in suburban and rural rights-of-way. “Where such a route is located in a public right-of-way and provides a direct pedestrian connection between neighborhoods, residential areas, schools, employment centers, and other origins and destinations, it must be accessible.”

Recognizing that there may be a need to exceed the five percent grade, AASHTO, 2012 recommends the following for bicycles for short sections, as a general guide:

5-6%	for up to 800 ft
7%	for up to 400 ft
8%	for up to 300 ft
9%	for up to 200ft
10%	for up to 100 ft
11% +	for up to 50ft

AASHTO provides the following recommendations to mitigate excessive grades:

- when using a longer grade, an additional 4-6 feet of width to permit slower speed bicyclists to dismount and walk may be considered;
- provide signing that alerts bicyclists to the maximum percent of grade;
- provide recommended descent speed signing;
- exceed minimum stopping sight distances;
- exceed minimum horizontal clearances, recovery area and/or protective bike rails;
- a series of short switchbacks to contain the speed of descending bicyclists;
- use higher design speeds;
- a resting area where long stretches of excessive grade are required, provide level rest areas with benches (changing surfacing to gravel in order to slow traffic is not an option due to safety and drainage concerns, if the grade is steep, the gravel tends to migrate freely, creating soft shoulders, and uneven surface); and
- max ground grade 3%.

These conditions pose serious handling issues, particular for those users on bicycles with narrower tires that are often used by commuters. This is also unsafe for children who may not be able to estimate their ability to slow down before reaching the gravel. Further, the migration of gravel may create drainage problems through short-circuiting of the designed drainage facilities as well as the possible introduction of fines into drainages.

Unpaved shared-use paths are generally used for multiple purposes in recreational settings. Designers and project managers should confer when planning these trails to determine the appropriate grade criteria relative to the users, the setting, and trail purposes.

4. Stopping Sight Distance:

The ability to react in a timely manner to unexpected obstacles on the pathway is a critical element in the design of both paths for bicycle use and multi-use paths. Of issue is the minimum stopping sight distance needed to stop to prevent an accident or a wildlife encounter. The design of the pathway, in order to provide a safe environment for all users, should consider the slope of the pathway, the length of the

vertical curve necessary to provide minimum stopping sight distance, and the minimum clearance needed for line of sight obstructions for horizontal curves.

The ATP (1997) states that the standard required stopping sight distance on flat surfaces shall be 125 feet for pathways. This standard is the same as the adopted Oregon standard that is based on the speed of the fastest bicycle (ATP, 1997). Increase this sight distance as necessary, to accommodate the factor of slope. Trails for equestrians may include shorter stopping sight distances, and dog mushers may require up to twice the distance, as much as 250 feet. Snowmobile trails are designed with a stopping distance of 225 feet (ATP, 1997).

AASHTO's Guide for the Development of Bicycle Facilities (2012) presents detailed information for the minimum stopping sight distance vs. grades for various design speeds, as well as tabular information for minimum length (L) of crest vertical curve based on stopping sight distance and minimum lateral clearance (M) for horizontal curves. General formulas for stopping distances are presented below.

For minimum stopping sight distance on slopes of varying design speeds:

Table 4-4 Minimum Stopping Sight Distance		
$S = \frac{V^2}{30(f \pm G)} + 3.07V$		
S	=	Stopping sight distance (ft)
V	=	Velocity (mph)
f	=	Coefficient of friction (use 0.16 for typical bike)
G	=	Grade (ft/ft) (rise/run)

For minimum lateral clearance on horizontal curves:

Table 4-5 Horizontal Sight Distance		
$HSO = R \left[1 - \cos \left(\frac{28.65S}{R} \right) \right]$		
$S = \frac{R}{28.65} \left[1 - \cos^{-1} \left(\frac{R - HSO}{R} \right) \right]$		
S	=	Stopping sight distance (ft)
R	=	Radius of centerline of lane (ft)
HSO	=	Horizontal sightline offset, distance from centerline of lane to obstruction (ft)

4.2 C Intersections

Intersections of pathways and trails should be perpendicular for safety reasons. Due to design constraints, it may not always be possible to have a 90-degree intersection. AASHTO allows a 45-degree latitude for intersecting pathways when crossing roadways, but where right-of-way is not an issue, crossings should be as close to perpendicular as possible.

The intersections of dog sled trails with other user groups shall intersect at 90-degrees. Sufficient clearing should be provided to ensure sight distances are adequate. All trail intersections shall be signed to alert users as to the type of crossing and the expected type of traffic, if the trails typically have different users. Depending on the amount of use of the mushing trail, fencing may be used to control use during race events.

Intersections between multi-use pathways and roadways are discussed in Section 4.2 Q Trail-Roadway Intersections.

4.2 D Cross Slopes

Though ADAAG allows cross-slopes up to 2 percent, designers should seek to achieve trail cross slopes of approximately 1 percent in accordance with criteria from the ATP. Where driveways cross paved pathways, the 2-percent maximum cross slope applies.

4.2 E Clearances

Horizontal and vertical clearances are important safety considerations. The greater the speed traveled on the path, the greater the tendency for users to “shy” or steer away from nearby obstructions such as trees, fences, bridges, light poles, and retaining walls. This creates a safety hazard by moving the user toward the center of the facility and/or distracting attention from other users. Minimum clear widths are measured from the edge of the paved path.

The minimum clear width for a bridge, underpass, overpass or other structure, should be the same as the approach of a paved multi-use path plus an additional minimum 2-foot wide clear areas on either side (AASHTO, 2012). The clear areas provide a minimum horizontal shy distance from railings, walls or barriers. The clear areas also provide additional room for maneuvering space to prevent conflicts between cyclists and other path users. ATP (1997) states that the minimum clear dimensions for tunnels and bridges should be 12-foot wide by 12-foot vertical regardless of usage.

Vertical clearances are dictated by the size of emergency and maintenance vehicles. Where practical, a vertical clearance of 12 feet is recommended by ATP regardless of activity. Railings, fences, or other barriers should be a minimum of 42 inches high.

Provide minimum 2-foot wide graded shoulders on each side of the path, measured from the edge of the paved surface, with a preferred slope of 3 to 5 percent. Wider shoulders of three feet are appropriate in situations with a high percentage of use by runners and joggers since they often prefer a soft surface. A clear zone of 3 feet from the edge of the traveled surface or pavement should be maintained from trees, poles, walls, signs, or other potential obstructions. Where slopes are adjacent to, streams, or open water, or are steeper than 3H:1V, a wider shoulder, not less than 5 feet, should be provided (AASHTO, 2012). A physical barrier may also be warranted in certain situations. Side slopes of embankments should slope at 3H:1V or flatter, and never steeper than 2H:1V.

4.2 F Thinning Existing Vegetation

It is advisable to incorporate a 100-foot selective thinning buffer along each side of all pathways, except those designated for cross-country skiing, equestrian, dog mushing, interpretive use, or any paths where preservation of the existing flora is important (ATP, 1997). Selective thinning of trees and brush shall only include limbing of trees to a height of 10 feet; removal of trees with calipers smaller than 2 inches; and removal of shrubs higher than 3 feet if they significantly restrict vision. Removal, or at a minimum, controlling invasive species (as defined by the Cooperative Extension Services list of invasive species) should also be a goal when pathway construction occurs. There shall be no selective thinning within 25 feet of streams.

Cottonwood (*Populus balsamifera*) roots may lead to significant long term maintenance issues including horizontal and longitudinal cracking on the pathway surface. Given the particular root problems associated with cottonwoods, it is recommended, at a minimum, these trees are cut flush to the ground surface for a minimum distance of thirty feet, preferably fifty feet from the centerline of the pathway. This problem is not generally associated with other tree species. Ideally, projects should seek to remove them completely including the root wad and fibrous roots. Where complete cottonwood removal is not possible, consider the inclusion of a commercial root barrier at the prism of the trail.

Removal of cottonwood trees and saplings by cutting the trunks flush to the ground will encourage the more desirable birch and spruce to receive greater amounts of light, water, and nutrients resulting in faster growth. Cutting cottonwoods flush to the ground causes less overall disruption to the existing natural forest floor.

4.2 G Road Separation

When paths are located adjacent to a road of collector or higher OS & HP classification, the designer should consider the need for horizontal and vertical separation between vehicles on the road and path users. Two-way directional, separated multi-use paths can create confusion and or problems between motorists and bicyclists, if the pathway is too close to the roadway. Separating these two uses increases safety and provides time for each to react to potential conflicts before they occur. Path separation from roadways also allows areas for snow storage, drainage channels, and separates path users from roadway tire splash.

Paths should have a 7-foot separation from the roadway. See the standard road sections in DCM Chapter 1 for the applicable standard for each road classification. The federally approved ADOT&PF Pre-construction Manual guides the development of paths within State rights-of-way.

AASHTO (2012) standards state that when the distance between the edge of the roadway and the bicycle path is less than 5 feet, a suitable physical divider should be considered. Such dividers serve both to prevent bicyclists from making unwanted movements between the path and the highway and to reinforce the concept that the bicycle path is an independent facility. Where used, the dividers should be a minimum 42-inches high in order to prevent bicyclists from toppling over them. Physical dividers should not become an un-necessary obstacle themselves in the roadside's clear zone. Consult AASHTO Roadside Design Guide (2012) for barrier design.

4.2 H Width of Pathways

The desired width of pathways is directly related to the volume of users and type of use it receives. Paved multi-use paths are typically 8 to 10 feet wide.

Because of increased speeds and joint use by bicyclists, walkers and joggers on paved paths, the minimum typical paved width is 10 feet. In areas where available right-of-way is limited, the width of the

paved trail may be reduced to 8 feet if separate on-street bicycle facilities are provided. The designer should consider whether high use, steep grades, and sharp turns may pose safety issues that would suggest trail widening. (Refer to Section 4.2 G Clearances for more information).

Minimum 2-foot wide shoulders are required on each side of the trail. Shoulders should be increased to 3 feet if high use by joggers or runners is expected. Shoulders should slope away from the trail at 3 to 5 percent in order to maintain positive drainage. The embankment from the road shoulder should slope 3H:1V or flatter and never steeper than 2H:1V.

Where traffic volumes are expected to exceed 1,000 users per day, the paved path width should be 10 feet with 3-foot unpaved shoulders on each side of the path. This will accommodate multiple use characteristics and users that travel at greatly differing speeds.

AASHTO (2012) recommends that for separated rights-of-way, the paved surface for a two-way directional, multi-use pathway should be 10 feet. A width of 8 feet can be used only when:

- bicycle traffic is expected to be low;
- pedestrian traffic is expected only to be occasional;
- a good horizontal and vertical alignment is present allowing for safe and frequent passing opportunities; and
- the pathway will not be continuously exposed to maintenance vehicle traffic causing damage to the pavement edges.

AASHTO standards state that, under certain conditions, it may be necessary or desirable to increase the width of a bicycle path to 12 feet. This is particularly true for paths that receive substantial bicycle volume or have steep grades.

4.2 I Striping and Signage

Signing and marking of multi-use pathways is essential in reducing conflicts between different path users and between path users and motorists at highway intersections. Signing and marking is also helpful in providing direction, destinations, distances, and crossing names.

The majority of paths are designed and constructed to minimize safety hazards. Therefore, signage and pavement markings are not significant concerns. However, the designer should closely evaluate the proposed grades, sight distances, and types of intersections for potential safety hazards. Paths that experience as much as 1000 users per day or have restricted sight distance shall have a solid 4-inch yellow centerline. This is also appropriate where separation of two-way directional traffic on the pathway is necessary, such as on busy sections, curves, intersections between different paths, unlit portions of the path, underpasses where passing is very limited, or where sight distance is reduced due to unavoidable obstructions. A broken 4-inch yellow line could also be considered in other areas where passing sight distance is greater.

Paths that do not fully meet ADAAG requirements should be signed to denote level of accessibility and challenge and must also meet the ADAAG sign requirements.

Paths shall be signed at the time of construction to indicate uses appropriate to the path. Wooden post signs are the park standard. Significant misunderstanding exists in the community over the compatibility of various uses on the many Anchorage paths. Signage is an important component in the resolution of many conflict issues, but it is also a maintenance expense.

All signage placed in the right-of-way must conform to the MUTCD and be approved by the Municipal Traffic Engineer. In ADOT & PF rights-of-way, approval of the State Traffic Engineer must also be

obtained. The MUTCD provides minimum traffic control measures that should be applied to bicycle facilities as well as roadways.

1. Signing of Shared Roadways:

Signed shared roadways are those roadways that have been identified as the preferred bike route. Signing suggests to the cyclist that the responsible agency has taken the necessary action to ensure the route is suitable for bicycles (AASHTO, 2012).

Bicycle-shared roadways should be signed as such. Destination signs also assist the cyclist with directions. In busy urban areas, signs should be placed approximately ¼ mile apart, at every turn, and at all signalized intersections (AASHTO, 2012).

Painted pavement markings should be used for multi-use or bicycle-shared roadways. This informs drivers that they are sharing the roadway and informs them that it is expected that bicyclists will use the roadway. This is particularly appropriate on those roadways where significant commuter traffic is expected within the curb lane, even though a separated trail may be available for slower traffic. It may also be appropriate in those roadways where no trail is available, thus both commuter and recreational traffic may be using the roadway.

4.2 J Lighting

Most sidepaths located adjacent to existing roads will have adequate illumination from existing streetlights but path illumination must be considered as part of the overall facility design. Illumination on paths and in tunnels not located on the right-of-way shall be in accordance with direction from the Parks and Recreation Department.

4.2 K Drainage

Trail and pathway designs shall give careful considerations to potential drainage impacts. Paths should be built above nearby roadways unless existing conditions prevent such placement. Particular attention shall be given to ponding along property lines and the possibility of path fill blocking drainage. Paths should be designed so that no adverse drainage impacts result from construction. Pathways should not be constructed by filling existing roadway ditches, which may result in water ponding on roadway and path and in deterioration of the road and path. The cross-slope on a pathway or trail should be in one direction, rather than by crowning the pathway, and drainage from the pathway surface should be routed to the inside curves, providing a max 2-percent super-elevation to the curve.

Culverts should be provided at appropriate intervals and should be sized to convey appropriate drainage flows. Frost heaving of culverts is often a problem on trails as a result of the “freeze/thaw bulb” created by cold air in the culvert, thus consideration should be given to insulating under the culvert to reduce the likelihood of a temperature differential between the rest of the trail and that area under the culvert.

1. Drainage Inlets and Grates:

Bicycle safe grates should be used on shared roads where bicyclists are encouraged to travel. These would be grates with openings oriented perpendicular to the path of bicycle travel. When road improvements are made, AASHTO (1999) recommends that curb opening inlets should be considered to minimize potential conflicts and obstructions. Grates and utility covers should be flush with the pavement surface. Bar grates with bars parallel with the travel way shall not be used, and should be replaced where possible.

4.2 L Surfacing

Several conditions must be considered when evaluating the appropriate surface to accommodate a particular pathway use. While DCM Table 4-6 is a guide, consideration must be given to environmental conditions, environmental impacts, accessibility needs, and the desirable challenge levels of each path. While equestrians may use trails built of native material, the environmental impact of each varies greatly.

Winter activities are generally compatible on any trail surface type, though other problems with compatibility may exist. Consideration must be given to snow pack in determining when particular activities are allowable. Popular trails, such as Chester Creek Greenbelt Trail, and Coastal Trail, can serve multiple winter uses when width allows.

Where a path is to be paved with asphalt, a minimum thickness of two inches of asphalt shall be placed.

Trail Use	Paved	RAP	Gravel	Natural
Biking (Mountain)	X	X	X	X
Biking (Non-Mt.)	X	X		
Dog Walking	X	X	X	X
Equestrian		+	X	X
Hiking		X	X	X
Interpretive	X	X	X	X
Jogging/Running	X	X	X	X
Natural			X	X
Roller Skiing	X			
In-line Skating	X			
Walking	X	X	X	X
Key: RAP = recycled asphalt pavement X = compatible + = may be compatible if not oiled or compacted				

(ATP, 1997)

4.2 M Trail Structure

Required trail structure is related to surface material. All pathways with paved surfaces shall be designed in accordance with Municipal and State criteria for roadway structural fill (ATP, 1997). Surfaces must withstand snow removal practices and wear from maintenance equipment. The designer should consider the impacts of each use when determining trail structure. For example, while equestrians prefer a native surface material, locating an equestrian trail in wetland conditions may require an engineered gravel structural section. Proper planning and design should attempt to locate pathways such that expensive engineering solutions are not needed for their construction.

For most applications, a minimum structural section will typically consist of the two-inch asphalt surface placed over two inches of base course or leveling course. A 2005 study, "Anchorage Areawide Trails Rehabilitation, Phase II DSR" by CRW Engineering Group and Golder Associates, found that minimum of 2-inches of asphalt treated base (ATB) course or recycled asphalt pavement (RAP) went a long way in preventing longitudinal cracking associated with freeze thaw conditions. Another option is four inches of AC. This will be placed over classified fill which overlies a geotextile fabric placed at the bottom of the excavation. The underlying subgrade should be evaluated for competency as part of the design process.

Trail design, like that of highway design, requires an understanding of the soil conditions. A soils investigation should address the carrying capacities and frost classifications of the native soils and any special provisions necessary to construct the trail. While loads on pathways will be considerably less than those for highways, paths should be designed to sustain wheel loads of emergency, maintenance, or other occasional vehicles traveling the path as well as the freeze/thaw characteristics of the soils. For most purposes, there is little difference in the subgrade design section of roadway and that of a path.

Adequate edge support of the path's paved surface should be considered where vehicular traffic is anticipated as, typically, vehicle wheels will be at the edge of the pavement. A 10-foot paved surface width reduces the stress on the pavement edge where vehicular traffic will travel the path. The extra width is also considered an advantage, allowing greater maneuvering room for faster path users.

Where paved paths cross over unpaved driveways or roads, the unpaved driveway or road surface should be paved a minimum of 10 feet on each side of the trail crossing to reduce the amount of gravel being scattered on the path. These wide aprons should be designed with a structural base to prevent degradation of the asphalt surface.

Cottonwoods are problematic for trails. Because of the affinity of cottonwoods for damp, gravelly soils, efforts should be made to reduce the likelihood of cottonwood root intrusion into the trail fill prism. Where cottonwoods are prevalent, a trench immediately beside the fill material should be dug and a plastic, or metal membrane should be placed vertically from the ground surface to a minimum 18-inch depth to retard root growth. Where groundwater movement needs to be accommodated, weed barrier fabric may be used instead.

4.2 N Bridges

Bridges should be designed to match the design vehicle weight and width requirements, recognizing maintenance requirements as well as user needs. Many trail locations are remote from the vehicular circulation grid, thus trail bridges must be used as access for maintenance, safety and service needs. Recognizing this, bridges should typically be designed for 12,000-pound design vehicle. An exception may be made where reasonable access from the street grid is available to both ends of a bridge. Bridges shall be signed as to the design load capacity.

AASHTO specifies that minimum pedestrian bridge railing height is 48 inches.

If deemed necessary, rub-rails attached to the rail to prevent snagging should be deep enough to protect a wide range of bicycle handlebar heights.

4.2 O Amenities

Pathways and trails serve many purposes—transportation, recreation, education, special events and fitness. Path and trail corridors have clear identities in the minds of users and the trail should be designed to capture the character or to introduce character where appropriate. Recognizing the many aspects of trail use, it is appropriate to provide amenities that reflect many aspects of the trail. Appropriate amenities include benches, waste receptacles, signage, interpretive materials, wooden signage pylons, bollards and “hardscape” such as specialized paving, walls, and structural elements.

1. Benches

Benches are an integral part of trail infrastructure and provide seating for rest, and for lingering at scenic waysides, and interpretive locations. They are particularly important to small children, older adults, and the disabled. They should be provided within individual trail segments or, where a trail is continuous for

over one mile, at ½-mile increments at a minimum and more often when terrain is hilly. Crests of hills or midpoints at longer hills are appropriate locations for benches in order to mitigate prolonged slopes. Also, benches would be appropriate along trails that are in the proximity of playgrounds, elementary schools, or elderly housing.

When provided, benches should meet the requirements of the Americans with Disabilities Act Accessibility Guidelines for Outdoor Developed Areas. Where one fixed bench is provided, the bench must comply with requirements for height, back support, and must have at least one armrest. Where multiple benches are located at a site, at least 50 percent of the benches must meet those provisions, and 50 percent of those shall provide an armrest. It is appropriate to provide users a choice of bench configurations to accommodate different needs.

Benches should be located to capture views and not impede pedestrian travel. This requires a dedicated space off of the trail with room for the bench and a sitting person's legs. The area should be level. For maintenance purposes, it is advisable to mount benches on a concrete pad or provide paving around and under the bench to include a paved surface in front of the bench.

2. Waste Receptacles

Waste receptacles should be provided at intervals where numbers of individuals are expected to congregate, such as locations with a bench. Waste receptacles should not be provided without coordinating first with the appropriate property manager in order to ensure routine maintenance and upkeep will be performed. Where provided, waste receptacles should have a cover to prevent the accumulation of rain and snow in the trash compartment. Before specifying a type of waste receptacle, determine whether the owner or managing agency has a standard design that is preferred.

In most instances bear-proof trash receptacles are necessary. Designers should coordinate with the Parks and Recreation Department to determine whether bear-proof receptacles are necessary or recommended.

3. Educational Information

Interpretive information is appropriate at view locations, stream crossings, or other locations with remarkable attributes. Also, interpretive signage and visitor information is appropriate at trailheads.

Install interpretive structures such that the structure and the viewing public are separated from pathway traffic with a level viewing surface.

For projects that include interpretive panels, a duplicate panel should be manufactured in addition to the original, and the copy provided to Parks and Recreation Maintenance Division as a replacement should the original become damaged.

4. Other Considerations

Bollards should be provided at trailhead parking lots and street crossings. For multi-use pathways, bollards should be located 5 feet on-center. For most situations one bollard should suffice to deter motorized use. If width of opening demands multiple bollards - bollards should be 6 feet on-center.

Removable bollards should be provided at trailheads and crossings whenever bollards are required. This facilitates access by maintenance and emergency vehicles. Locks should be provided, keyed to Parks Department requirements.

Bicycle racks should be installed wherever bicyclists might be expected to dismount and continue by foot to another activity. This would include playgrounds, fishing docks, parks, trailheads, or where interpretive material is located.

Many pathways have established “thematic elements” that should be replicated along the trail in order to provide a consistency in message and a unity to the trail. Designers should consult with the Parks Department in order to determine whether specific colors, details, or other design elements have been used consistently for completed portions of trails being designed. Designers should also review completed portions of trails being designed in order to determine whether a theme can be recognized from the existing improvements.

Color can be an important component in highlighting waysides. Designers should consider the use of pigmented concrete or specific highlighting of details to interject color where appropriate.

4.2 P Pathway-Roadway Intersections

AASHTO (2012) describes three basic pathway-roadway intersections where trail users must interact with motorists: mid-block, adjacent path, and complex.

1. Types of Crossings

- a) Mid-block crossings: In general, mid-block crossings should be avoided. Drivers do not expect to see pedestrian or trail traffic crossing between intersections. However, where trail alignment, topographic features or other conditions require a mid-block crossing, they should be set far enough away from existing intersections to be clearly separate from the activity that occurs as motorists approach the intersection. Design considerations should include how motorists merge, accelerate and decelerate and prepare for entering turning lanes. Also consideration should be given to right-of-way assignment, traffic control devices, and sight distances for bicycles, as well as motorists, refuge islands, access control and pavement markings.

Mid-block crossings should be perpendicular to the roadway in order to assure good wayfinding and reduce crossing distance for pedestrians. In those instances where the crossing is skewed and right-of-way is not available to obtain a perpendicular crossing, less than a perpendicular crossing may be acceptable with concurrence of the Municipal Engineer. In no circumstance will an intersection of less than 45 degrees be acceptable.

Additional signage and pavement markings should be considered for mid-block crossings, e.g.:

- crosswalk markings;
- crossing signs;
- flashing beacon;

or others as approved by the Municipal Traffic Engineer.

- b) Sidepath Crossings: Sidepath crossings occur when the path crosses a roadway at an existing
- c) Intersections at Major Arterials: Improvements to these crossings must be made on a case-by-case basis. Crossings at major arterials may be complicated by traffic volume and crossing distance. AASHTO (2012) suggests in each case the following options be considered:
 - grade separated crossing;
 - install a signal;
 - change signalization timing, or provide a two-step crossing with a refuge island;

- a two-step crossing for path users; and
- no turn on red.

In all intersection cases where the trail crosses the road, assigning who has the right-of-way should not be based entirely on highway classification, volume and speed alone. Consideration should be given to the comfort and convenience level of the path user, as well as the behavioral characteristics of both the motorist and the path user. Design should recognize the behavioral characteristics of the path user. Path users may have:

- low delay tolerance;
- desire to maintain momentum;
- little traffic knowledge (particularly with children); and
- poor adherence to regulations by some users.

2. Traffic Signs/Stop Signs

AASHTO (2012) recommends that signs be installed on the pathway at all pathway-roadway intersections.

Path stop signs and stopping bars should be placed as close to the intersection as possible. The size, type, and location of stop sign should conform to the MUTCD. Care should be taken when placing both pathway stop signs and yield signs, as well as roadway signs so as not to confuse the motorist or the path user.

Notification shall be provided to both path users and motorists prior to termination of paths at an existing roadway. All intersections along the pathway should be considered by the designer as a potential entry/exit point for the path user.

3. Sight Distance

There are three main sight distance issues with pathway design:

- stopping sight distance;
- intersection sight distance; and
- decision sight distance.

There are two ways that the motorists' ability to notice path users can be improved. AASHTO (2012) suggests that increasing the standard sight perception-reaction time value of 2.5 seconds for motorists' stopping distance could potentially improve the sight distance for motorists approaching an intersection, where a path crossing exists. Selecting the most appropriate decision sight distance value from Table III-3 in AASHTO's Policy on Geometric Design of Highways and Streets (Green Book) could also improve the motorists' ability to notice path users, although the Green Book does not really address path crossings.

Decision sight distance for bicyclists involves providing clear sight lines based on the distances that approaching motor vehicles will travel in the time it takes the bicyclist to clear the intersection from a "stop-go" decision point. This concept acknowledges the bicyclists' desire to maintain momentum.

4. Approach Treatments

Intersections and approaches of multi-use paths should be on flat grades. Stopping sight distances at intersections should be appropriately signed providing the bicyclist adequate stopping time before

reaching the intersection. AASHTO (2012) states that paved aprons extending a minimum of 10 feet from the edge of the paved road should be provided for unpaved multi-use paths.

5. Ramp Widths

Ramp Widths: Ramps for curbs at intersections should be at least the same width as the multi-use pathway. A smooth transition should be provided between the pathway and the roadway. AASHTO (2012) states that a 5-foot radius or flare should be provided to allow bicycles to make right-hand turns.

6. Refuge Islands

Refuge Islands: Refuge islands should be considered in design where one or more of the following apply:

- high volumes of traffic or excessive speeds make crossing conditions unacceptable for path users;
- roadway width is excessive given the available crossing time for path users; or
- it is anticipated that the path users will be slower in crossing the intersection.

AASHTO (2012) suggests that the refuge area be designed large enough to accommodate groups of people, including wheelchairs, bicycles, strollers, and equestrians (where permitted). Adequate space should be provided so those within the refuge area do not feel threatened by passing vehicles while waiting to complete the crossing.

4.2 Q Path-Path Intersections

Path to path intersections generally do not pose the same hazards as for trail-roadway intersections, but the possibility of conflict and injury still exists.

Treatment of path to path intersections should be much the same as trail to roadway intersections. Areas adjacent to the intersection paths should be cleared to provide adequate sight distance for the intersecting paths. The approaches should be on relatively flat grades. Warning signs should be provided. Also, a minimum five-foot radius should be provided at the corners of the intersection to facilitate right turns.

Path “roundabouts” should be considered for path to path intersections, particularly for paths that receive heavy use (greater than 1000 users per day). Roundabouts should include a minimum planted area with a 10-foot inside radius with a rolled curb. A five-foot radius should be provided between the pavement edge of the intersecting trail with that of the circle. The circle should be mounded, planted with a barrier plant that can thwart “cut-through” traffic. Bollards should be placed at the intersecting centerline of each intersecting trail. The trail around the roundabout should be a minimum of 10 feet wide, wider where higher levels of traffic are expected. The roundabout nodes are suitable locations for seating and rest areas, but such amenities should be placed such that users of the rest areas do not become impediments or hazards to bicycle traffic.

Paths used by dogs and skier need appropriate consideration of transitions to allow flow-turning.

END OF SECTION 4.2

SECTION 4.3 DESIGN FOR MAINTENANCE

Sideways parallel to roadways should be physically separated by a combination of distance, barrier, or elevation in order to reduce maintenance problems. Where the recommended horizontal distance cannot be achieved, a physical barrier (Refer to Section 4.2 H Road Separation) should be placed between the path and roadway so as to protect the path users from road splash, and reduce the amount of dirt and debris that comes onto the path. Path shoulders should be grassed. The shoulders should be maintained for walking or running and should not be allowed to settle below the elevation of the path surface, which could cause bicycle tires to drop off the edge or a pedestrian to be injured.

All utilities, traffic control pedestals, hydrants, signs, mailboxes, and utility pole boxes should be placed a minimum of two feet from the edge of the paved edge of path. (Refer to Section 4.2 G Clearances for further discussion).

Consideration should be given to the use of an impermeable surface such as textured concrete, where separation of paths from the back of curb is less than two feet. When unpaved, these areas, particularly along high capacity roadways, do not support vegetative cover and pose on-going maintenance problems for the path and roadway. A textured surface can help warn users (especially young users) of the proximity of the roadway. Care should be exercised to ensure that the texture that is used does not direct path users into the roadway, nor cause them to lose control of bicycles or in-line skates.

Consideration should be given to the type of maintenance and emergency vehicles that will be maintaining paths. Bridges should be designed for a 20,000-pound design vehicle, if access is not readily available to both sides of a bridge (Refer to Section 4.2 M Bridges).

Paths groomed for skiing should be designed to accommodate ski grooming equipment. For ski paths groomed for multiple uses or for skate skiing, a cleared, level tread (including path, shoulders, and clear zone) needs to be clear of all obstructions and be level enough to provide for grooming by a 17-foot wide grooming machine. Tunnels under crossings should have a minimum of 10 foot head clearance.

END OF SECTION 4.3

SECTION 4.4 SELECTED REFERENCES

In addition to Title 21, designers of sidewalks, walkways, trails and bicycle routes should be familiar with the following:

AASHTO, *Guide for the Planning, Design, and Operational of Pedestrian Facilities*, Edition 1. 2004.

AASHTO LRPD Bridge Design Specifications, *Third Edition, 2004*.

AASHTO, *Policy on Geometric Design of Highways and Streets*, 2004.

AASHTO, Task Force on Geometric Design. *Guide for the Development of Bicycle Facilities*, 2012.

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U.S. Department of Transportation, Federal Highway Administration (FHWA). *Designing Sidewalks and Trails for Access-Best Practices Guide*. Publication No. FHWA-EP_01-027 HEPH/8-01 (10M)E, 2001.

END OF SECTION 4.4