Draft Memorandum

To: DJ Heffernan

CC:

From: Rory Renfro and Mia Birk

Date: February 2, 2007

Re: Redmond NAP and HAP – Recommended Trail Design Guidelines

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Introduction

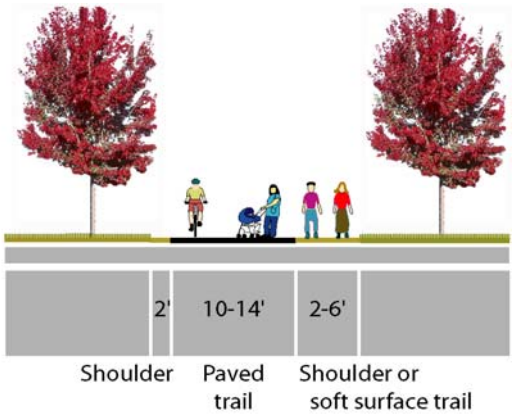
This memorandum discusses recommended design guidelines for trails in Redmond's Northwest Area Plan (NAP) and Highway 97 Area Plan (HAP). The text includes recommended trail-specific treatments (e.g., width, surface, etc.), strategies for addressing trail/roadway crossings, and an overview of amenities that can enhance the trail user experience.

Trail Design Elements

As the City of Redmond develops trails in the NAP, HAP and other parts of the community, several design issues should be taken into consideration. Trails should be designed to accommodate two-way bicycle and pedestrian traffic, and typically should have their own rights-of-way (for a minimum of 75 percent of their length to reinforce the experience of traveling on a trail). The trail surface should consist of asphalt or concrete (or a durable unpaved surface that is smooth and meets ADA requirements).

The graphic below depicts the recommended cross-section for trails in the NAP and HAP. The City's current paved trail width standard is 10'. A narrower width may be allowed (8' minimum) in physically constrained areas. Wider trail widths are recommended in areas where user volumes are expected to be high. Soft shoulders (at least 2' wide) should be provided on both sides of the trail, and a wider shoulder should be provided to accommodate runners and joggers where space permits. Soft shoulders may consist of bark or wood chips.

Trails should also be designed to restrict access from unauthorized vehicles. Removable or unlockable bollards can be placed at trail/roadway crossings to permit bicycle/pedestrian access while restricting vehicle access. Removable and unlockable bollards also maintain easy trail access for maintenance and emergency vehicles.



The table below highlights additional design recommendations for trails in the NAP and HAP. The recommendations are based on experience in other communities, as well as guidelines prescribed by AASHTO and the *Oregon Bicycle and Pedestrian Plan*.

Trail Design Recommendations

Parameter	Recommendation
Paved width	10'-14' (8' in constrained areas)
Soft surface width[1]	6'
Shoulder width[1]	2' minimum
Lateral clearance between path and adjacent signs	3'-6'
Overhead clearance	8' minimum
Separation from parallel roadway	5' minimum
Grade/running slope	5% maximum
Cross-slope	2% maximum
Fence height	54 inches
Bollards	5' minimum between bollards

Source: AASHTO *Guide for the Development of Bicycle Facilities*; ODOT *Oregon Bicycle and Pedestrian Plan*.

[1] A soft surface path paralleling the paved path can take the place of a shoulder on one side.

Trails along Canals

In addition to the design elements discussed above, additional consideration will be needed for trails along canals. Several trails in the NAP and HAP would travel on existing maintenance roads paralleling active Central Oregon Irrigation District (COID) canals. The maintenance roads are currently unpaved and accommodate heavy vehicles associated with daily canal inspection and periodic maintenance. To avoid the potential pavement damage caused by heavy maintenance vehicles, these trails/maintenance roads would likely remain unpaved. In order to preserve maintenance access to the canals, fencing would be prohibited between the canal and trail. Additionally, landscape materials along these corridors would require COID approval.

Trails along Roadways

Trails should not be placed directly adjacent to roadways (e.g., with minimal or no separation) for variety of reasons:

- Half of bicycle traffic would ride against the normal flow of vehicle traffic, contrary to the rules of the road.

- When the trail ends, cyclists riding against traffic tend to continue to travel on the wrong side of the street, as do cyclists making their way to the trail. Wrong-way bicycle travel is a major cause of vehicle/bicycle crashes.
- At intersections, motorists crossing the trail often do not notice bicyclists approaching from certain directions, especially where sight distances are poor.
- Bicyclists on the trail are required to stop or yield at cross-streets and driveways, unless otherwise posted.
- Stopped vehicles on a cross-street or driveway may block the trail.
- Because of the closeness of vehicle traffic to opposing bicycle traffic, barriers are often necessary to separate motorists from cyclists. These barriers serve as obstructions, complicate facility maintenance and waste available right-of-way.
- Trails directly adjacent to high-volume roadways diminish users' experience by placing them in an uncomfortable environment. This could lead to a trail's underutilization.

Trails can successfully be placed along roadways, provided several design considerations are met:

- A minimum 5' buffer should be provided between the trail and roadway to address potential conflicts between motorists and trail users.
- There are few vehicle/trail user conflict points (e.g., cross-streets and driveways).
- There is a commitment to provide trail continuity along the corridor.
- The trail can be terminated at each end onto streets with good bicycle and pedestrian facilities or onto another safe, well-designed trail though appropriate street crossing treatments.
- The trail should not take the place of bicycle/pedestrian facilities (e.g., sidewalks and bicycle lanes) on the parallel street.

These issues should be carefully considered as the City develops trails in the NAP and HAP, including potential trails along 27th Street and other major thoroughfares.

Trail/Roadway Crossings

Like most trails in built urban areas, trails in the NAP and HAP must cross roadways at certain points. While at-grade crossings create a potentially high level of conflict between trail users and motorists, well-designed crossings have not historically posed a safety problem, as evidenced by the thousands of successful trails around the United States with at-grade crossings. In most cases, trail crossings can be properly designed at-grade to a reasonable degree of safety and meet existing traffic and safety standards.

Evaluation of trail crossings involves analysis of vehicular and anticipated trail user traffic patterns, including vehicle speeds, traffic volumes (average daily traffic and peak hour traffic), street width, sight distance and trail user profile (age distribution, destinations served). Crossing features for all roadways include warning signs both for vehicles and trail users. The type, location, and other criteria are identified in the American Association of State Highway and Transportation Officials (AASHTO) *Guide for the Development of Bicycle Facilities* and the Manual on Uniform Traffic Control Devices (MUTCD). Consideration must be given for adequate warning distance based on vehicle speeds and line of sight, with visibility of any signing absolutely critical. Catching the attention of motorists jaded to roadway signs may require additional alerting devices such as a flashing light, roadway striping or changes in pavement texture. Signing for trail users must include a standard

"STOP" sign and pavement marking, sometimes combined with other features such as bollards or a kink in the trail to slow bicyclists. Care must be taken not to place too many signs at crossings lest they begin to lose their impact.

Directional signing may be useful for trail users and motorists alike. For motorists, a sign reading "Trail Xing" along with a Redmond emblem or logo helps both warn and promote use of the trail itself. For trail users, directional signs and street names at crossings help direct people to their destinations. The directional signing should impart a unique theme so trail users know which trail they are following and where it goes. The theme can be conveyed in a variety of ways: engraved stone, medallions, bollards, and mile markers. A central information installation at trailheads and major crossroads also helps users find and acknowledge the rules of the trail. They are also useful for interpretive education about plant and animal life, ecosystems, and local history.

Trail/Roadway Crossing Prototypes

The proposed intersection approach that follows is based on established standards, published technical reports,[1] and experiences from cities around the country.[2] At-grade trail-roadway crossings will fit into one of four basic categories:

- Type 1: Marked/Unsignalized, Type 1+: Marked/Enhanced
- Type 2: Route Users to Existing Intersection
- Type 3: Signalized/Controlled
- Type 4: Grade-separated crossings

Type 1: Marked/Unsignalized Crossings

A marked/unsignalized crossing (Type 1) consists of a crosswalk, signage, and often no other devices to slow or stop traffic. The approach to designing crossings at mid-block locations depends

[1] Federal Highway Administration (FHWA) Report, "Safety Effects of Marked vs. Unmarked Crosswalks at Uncontrolled Locations."

[2] In particular, the recommendations in this report are based in part on experiences in cities like Portland (OR), Seattle (WA), Tucson (AZ), and Sacramento (CA), among others.

on an evaluation of vehicular traffic, line of sight, trail traffic, use patterns, vehicle speed, road type and width, and other safety issues such as proximity to schools. The following thresholds recommend where unsignalized crossings may be acceptable:

Maximum traffic volumes:

- ≤9,000-12,000 Average Daily Traffic (ADT) volumes
- Up to 15,000 ADT on two-lane roads, preferably with a median.
- Up to 12,000 ADT on four-lane roads with median.

Maximum travel speed:

- 35 MPH

Minimum line of sight:

- 25 MPH zone: 155 feet
- 35 MPH zone: 250 feet
- 45 MPH zone: 360 feet

If well-designed, crossings of multi-lane higher-volume arterials over 15,000 ADT may be unsignalized with features such as a combination of some or all of the following: excellent sight distance, sufficient crossing gaps (more than 60 per hour), median refuges, and/or active warning devices like flashing beacons or in-pavement flashers. These are referred to as "Type 1 Enhanced" (Type 1+). Such crossings would not be appropriate; however, if a significant number of school children used the trail. Furthermore, both existing and potential future trail usage volume should be taken into consideration.

On two-lane residential and collector roads below 15,000 ADT with average vehicle speeds of 35 MPH or less, crosswalks and warning signs ("Trail Xing") should be provided to warn motorists, and stop signs and slowing techniques (bollards/geometry) should be used on the trail approach. Curves in trails that orient the trail user toward oncoming traffic are helpful in slowing trail users and making them aware of oncoming vehicles. Care should be taken to keep vegetation and other obstacles out of the sight line for motorists and trail users. Engineering judgment should be used to determine the appropriate level of traffic control and design.

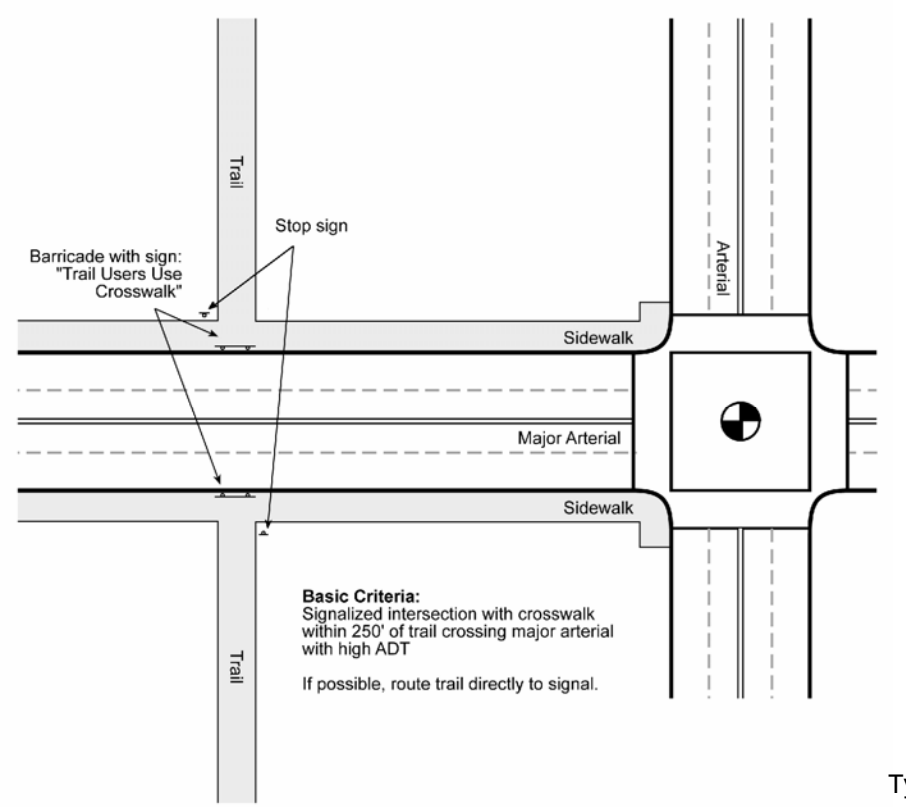
Type 1 crossing

On roadways with low to moderate traffic volumes (<12,000 ADT) and a need to control traffic speeds, a raised crosswalk may be the most appropriate crossing design to improve pedestrian visibility and safety. These crosswalks are raised 75 millimeters above the roadway pavement (similar to speed humps) to an elevation that matches the adjacent sidewalk. The top of the

crosswalk is flat and typically made of asphalt, patterned concrete, or brick pavers. Brick or unit pavers should be discouraged because of potential problems related to pedestrians, bicycles, and ADA requirements for a continuous, smooth, vibration-free surface. Tactile treatments are needed at the sidewalk/street boundary so that visually impaired pedestrians can identify the edge of the street.

Type 2: Route Users to Existing Intersection

Crossings within 250 feet of an existing signalized intersection with pedestrian crosswalks are typically diverted to the signalized intersection for safety purposes. For this option to be effective, barriers and signing may be needed to direct trail users to the signalized crossings. In most cases, signal modifications would be made to add pedestrian detection and to comply with the Americans with Disabilities Act.



Type 2 crossing

Type 3: Signalized/Controlled Crossings

New signalized crossings may be recommended for crossings that meet pedestrian, school, or modified warrants, are located more than 250 feet from an existing signalized intersection and where 85th percentile travel speeds are 40 MPH and above and/or ADT exceeds 15,000 vehicles. Each crossing, regardless of traffic speed or volume, requires additional review by a registered engineer to identify sight lines, potential impacts on traffic progression, timing with adjacent signals, capacity, and safety.

Trail signals are normally activated by push buttons, but also may be triggered by motion detectors. The maximum delay for activation of the signal should be two minutes, with minimum crossing

times determined by the width of the street. The signals may rest on flashing yellow or green for motorists when not activated, and should be supplemented by standard advanced warning signs.

Various types of pedestrian signals exist and can be used at Type 3 crossings. The following text describes some innovative approaches.

Pelican Signals

A Pelican (**Pe**destrian **L**ight **C**ontrol **A**ctivated crossi**n**g) signal incorporates a standard red-yellow-green signal light that rests in green for vehicular traffic until a pedestrian wishes to cross and presses the button. The signal then changes to yellow, then red, while Walk is shown to the pedestrian. The signal can be installed as either a one-stage or two-stage signal, depending on the characteristics of the street. In a two-stage crossing, the pedestrian crosses first to a median island and is then channelized along the median to a second signalized crossing point. At that point, the pedestrian then activates a second crossing button and another crossing signal changes to red for the traffic while the pedestrian is given a Walk signal. The two crossings only delay the pedestrian minimally and allow the signal operation to fit into the arterial synchronization, thus reducing the potential for stops, delays, accidents, and air quality issues. A Pelican crossing is quite effective in providing a pedestrian crossing at mid-block locations when the technique can be integrated into the roadway design.

Pelican signal

Puffin Signals

A Puffin (**P**edestrian **U**ser **F**riendly **In**telligent) crossing signal is an updated version of a Pelican crossing. The signal consists of traffic and pedestrian signals with push-button signals and infrared or pressure mat detectors. After a pedestrian pushes the button, a detector verifies the presence of the pedestrian at the curbside. This helps eliminate false signal calls associated with people who push the button and then decide not to cross. When the pedestrian is given the Walk signal, a separate motion detector extends the Walk interval (if needed) to ensure that slower pedestrians have time to cross safely. Conversely, the signal can also detect when the intersection is clear of pedestrians and return the green signal to vehicles, reducing vehicle delay at the light. Puffin signals are designed to be crossed in a single movement by the pedestrian, unlike the Pelican signal, which can be designed to cross in either one or two stages.

Puffin signal

HAWK Signals

A Hawk (**H**igh-Intensity **A**ctivated Cross**w**al**k**) signal is a combination of a beacon flasher and traffic control signaling technique for marked crossings. The beacon signal consists of a traffic signal head with a red-yellow-red lens. The unit is normally off until activated by a pedestrian. When pedestrians wish to cross the street, they press a button and the signal begins with a flashing yellow indication to warn approaching drivers. A solid yellow, advising the drivers to prepare to stop, then follows the flashing yellow. The signal is then changed to a solid red, at which time the pedestrian is shown a Walk indicator. The beacon signal then converts to an alternating flashing red, allowing the drivers to proceed after stopping at the crosswalk, while the pedestrian is shown the flashing Don't Walk signal.

HAWK signal

Type 4: Grade-separated Crossings

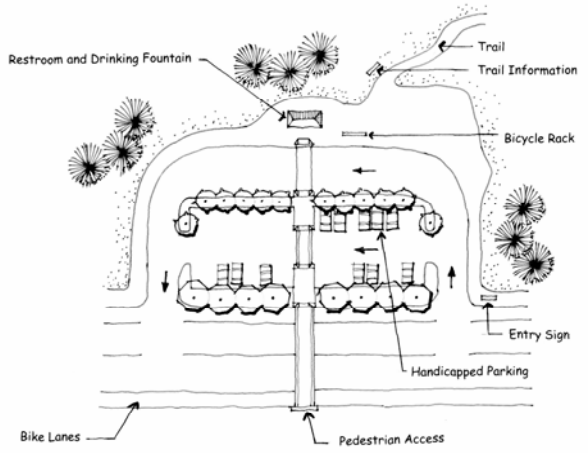
Grade-separated crossings may be needed where ADT exceeds 25,000 vehicles, and 85th percentile speeds exceed 45 MPH. Safety is a major concern with both overcrossings and undercrossings. In both cases, trail users may be temporarily out of sight from public view and may have poor visibility themselves. Undercrossings, like parking garages, have the reputation of being places where crimes occur. Most crime on trails, however, appears to have more in common with the general crime rate of the community and the overall usage of the trail than any specific design feature.

Design and operation measures are available which can address trail user concerns. For example, an undercrossing can be designed to be spacious, well-lit, equipped with emergency cell phones at each end and completely visible for its entire length prior to entering.

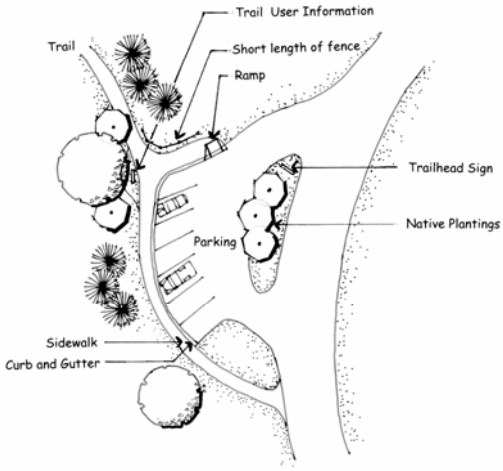
Other potential problems with undercrossings include conflicts with utilities, drainage, flood control, and maintenance requirements. Overcrossings pose potential concerns about visual impact and functional appeal, as well as space requirements necessary to meet ADA guidelines for slope.

Trailheads

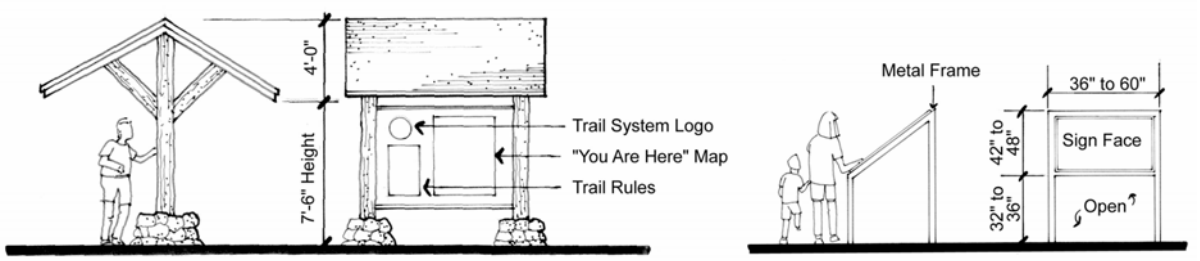
Good access to the trail system is a key element for its success. Trailheads (formalized parking areas) serve the local and regional population arriving to the trail and trail system by car, transit, bicycle or other modes. Trailheads provide essential access to the trail system and include amenities like parking for vehicles and bicycles; restrooms (at major trailheads); and posted maps. A central information installation also helps users find their way and acknowledge the rules of the trail. They are also useful for interpretive education about plant and animal life, ecosystems and local history.



Major Trailhead



Trailhead with Small Parking Area


4'-0"
7'-6" Height
Trail System Logo
"You Are Here" Map
Trail Rules
Metal Frame
36" to 60"
42" to 48"
32" to 36"
Sign Face
Open

Trail Amenities

A variety of amenities can make a trail inviting to the user. The following table highlights some common items that make trail systems stand out. Costs vary depending on the design and materials selected for each amenity.

Trail Amenities

	**Interpretive Installations** Interpretive installations and signs can enhance the trail experience by providing information about Redmond. Installations can also discuss local ecology, environmental concerns, and other educational information.
	**Water Fountains and Bicycle Parking** Water fountains provide water for people (and pets, in some cases) and bicycle racks allow trail users to safely park their bicycles if they wish to stop along the way, particularly at parks and other desirable destinations.
	**Pedestrian-Scale Lighting and Furniture** Pedestrian-scale lighting improves safety and enables the trail to be used year-round. It also enhances the aesthetic of the trail. Lighting fixtures should be consistent with other light fixtures in the city, possibly emulating a historic theme. Providing benches at key rest areas and viewpoints encourages people of all ages to use the trail by ensuring that they have a place to rest along the way. Benches can be simple (e.g., wood slates) or more ornate (e.g., stone, wrought iron, concrete).
	**Maps and Signage** A comprehensive signing system makes a trail system stand out. Informational kiosks with maps at trailheads and other pedestrian generators can provide enough information for someone to use the trail system with little introduction – perfect for areas with high out-of-area visitation rates as well as local citizens.
	**Art Installations** Local artists can be commissioned to provide art for the trail system, making it uniquely distinct. Many trail art installations are functional as well as aesthetic, as they may provide places to sit and play.
	**Landscaping** Landscape features, including street trees or trees along trails, can enhance the visual environment and improve the trail user experience. Trees can also provide shade from heat and also provide protection from rain.
	**Restrooms** Restrooms benefit trail users, especially in more remote areas where other facilities do not exist. Restrooms can be sited at major trailheads or at other strategic locations along the trail system.