Exceptional Trails

A guide to the planning, classification, design, construction and management of trail experiences on Public Lands

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Alberta

Acknowledgements

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Who Should Use This Manual?

Exceptional Trails provides guidance to everyone – public land managers, local governments, trail organizations, trail operators, trail volunteers, professional trail planners and designers, and private contractors – who is interested in the development of new trails or the upgrade and / or maintenance of existing trails on Alberta's Public Lands. The manual should be used by all to improve communications, ensure consistency and achieve the outcomes desired by trail enthusiasts and public land managers. The manual should be referenced during all phases of trail system planning and individual trail planning, design and construction.

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The Exceptional Trails manual provides leading trail planning, classification, design and construction guidelines for anyone interested in developing trails on Alberta's Public Lands.

1.0 Introduction

1.1 Purpose

Trails are one of the most desired recreational amenities in the Province. The demand for trail-based recreation on Alberta's public lands is increasing rapidly. Alberta Environment and Parks (AEP) recognizes that trails and trail-based recreation are an important contributor to the quality of life for Albertans, support healthy lifestyles, help to protect environmentally significant areas and provide opportunities to celebrate and present the heritage and culture of Alberta and Indigenous communities. AEP also recognizes that quality trails can be a significant economic driver that helps to strengthen and diversify local, regional and provincial economies.

Great trail systems and trails don't "just happen". They are the result of purposeful planning, design, construction and effective management. As trail users' quests for exceptional trail experiences continue to evolve, so must the way trails are planned, designed, constructed and managed. At the foundation of great trails are clear and consistent guidelines for trail planning, design, construction, maintenance and management.

Geographically focused on Alberta's Public Lands, the purpose of this Exceptional Trails manual is to:

- Enable the creation of quality and sustainable trail experiences,
- Provide consistent and practical guidelines for the planning, design, construction, maintenance and management of quality trails,
- Establish a consistent trail classification system that enhances clarity and communication between government agencies, trail operators and trail enthusiasts,
- Provide consistent and practical guidelines for the design of major trail infrastructure and amenities,
- Help trail operators effectively build and manage trails,
- Create a common language and definitions relating to trails and related infrastructure.

This manual serves as the single authoritative reference for anyone interested in planning, designing and developing new trails, or enhancing existing trails, on public lands in Alberta. By implementing the guidelines within this manual, the trail operator can feel confident that they will increase trail longevity, the trail will be operationally viable, public safety will be improved and risk reduced, environmental impacts will be avoided and / or mitigated, and the trail's tourism potential will be realized where appropriate.

A Trail Is…

a defined type of infrastructure that is purposefully designed and used for one or more recreation activities. To be a recognized trail, it must be approved by the landowner, mapped, marked and actively managed and maintained.

1.2 Development of the Manual

The Exceptional Trails manual is the direct result of extensive literature review from Alberta and leading trail jurisdictions and organizations, stakeholder engagement, and the proven expertise of leading trail designers and contractors. Interviews and workshops were held with representatives from a wide range of motorized and non-motorized trail enthusiast organizations, public land managers from across the Province, and trail planning and design experts from across Canada and the United States. Through interviews and workshops, these stakeholders helped to create the foundation of the manual and refine it as it evolved. A core design team of Government of Alberta staff and Trails Specialists from McElhanney Consulting Services provided leadership to the project. The collaboration between trail planning and design professionals, trail enthusiasts, and public land managers allows the manual to provide meaningful guidance to the development of trails of all types in all settings across Public Lands in the province.

1.3 What This Manual Is & Is Not

The Exceptional Trails manual **is:**

- A practical approach to help enhance the quality of trail experiences while, at the same time, enhancing the protection of Alberta's Public Lands and its natural and historic resources.
- A general guidance document and set of guidelines that can be used by anyone interested in developing new trails or enhancing existing trails on Public Lands.
- A compilation of proven practices for quality and sustainable trails planning, design and construction.

The Exceptional Trails manual **is not:**

- A regulation.
- A set of required standards.
- A land use decision making document or a guarantee that trail construction will be permitted if all planning and design guidelines in the manual are followed. Land-use decisions will continue to be made by the Public Lands managers in accordance with the Public Lands Act and other relevant provincial and federal legislation and approved land use plans. Users of the guide are required to understand and follow all applicable federal and provincial legislations and applicable local bylaws.

1.4 A "Trail" is not Always a "Trail"

Trail Operator

Is the individual, entity, trail organization or government organization that is leading the planning, design, construction and operation of a trail.

As a result of Alberta's legacy of past settlement, industrial expansion and exploration and informal public use, there is a great deal of linear access on Public Lands. Though commonly referred to as "trails", it is important to understand that much of these linear access routes are not actually "trails".

A trail is a defined type of infrastructure that is purposefully designed and used to enable one or more trail-based recreation activities. To be recognized as a trail, the infrastructure must meet the following criteria:

- Be approved by the public land manager,
- Be mapped,
- Marked with signage, and
- Be actively managed and maintained by a trail operator, or combination of operators, that has accepted responsibility for the management and maintenance of the trail and associated infrastructure.

If one or more of the criteria above are missing, the route is not a "trail". It is considered linear access.

Trail Tip

All dispositions, reservations and notations are registered in the government of Alberta's Land Status Automated System and can be viewed on the Government's Landscape Analysis Tool. Trail Operators can also request a Land Standing Report from their local public land manager. This is a good way to find out who some of the key stakeholders are that the Trail Operator may want to or need to engage with.

1.5 Trails & Trail Planning in a Shared Land Base

Alberta's public lands are a busy landscape. Timber harvesting, livestock grazing, development and transportation of oil, gas, electricity and other natural resources, tourism and recreation are all legitimate and, often, competing uses of public lands. In addition, public lands play a critical role in, and are managed for, habitat conservation and the protection of watersheds and biological diversity. Alberta's public lands are a mosaic of land uses that are managed to achieve a large diversity of priorities. Some land uses and management priorities are compatible together, while others are not.

It is essential that trail operators recognize and understand the many competing priorities facing public lands and, in particular, the lands that may be of interest for trail and trail amenity development. Public lands are a shared land base and trail development is but one of many land uses. Trail operators must work collaboratively with these other land users to identify ways to co-exist on public lands while still achieving conservation and ecological priorities.

The provincial government administers and makes decisions about the management and allocation of public lands. To help the government make good land use decisions, a variety of plans and policies have been developed. Some of the key plans and policies that trail operators should be aware of and familiarize themselves with include:

- Land Use Framework, including regional plans
- Issue Specific Plans (e.g. Recreation Management Plans, Landscape Management Plans)
- Forest Management Plans
- Species Recovery Plans

When land uses are approved on public lands, the provincial government will issue a disposition. A disposition is a land-use contract, such as an agreement, easement, lease, letter of authority, licence, permit or quota that gives individuals, companies or organizations rights to use public land for a specific purpose, for a specific period of time and under specific conditions. Dispositions can be issued for surface (on top of the land) and sub-surface (underground) interests. The government will also register interests in lands through the use of reservations and notations. These can be held by various departments in the government. Trail operators need to be familiar with the dispositions, reservations and notations that overlap areas of interest for trail development.

1.6 Legislative & Regulatory Framework

As with all land use on Alberta's public lands, the development of trails must be undertaken in accordance with federal and provincial legislation and regulations and, where applicable, municipal bylaws. The following section provides trail operators with a summary of the most common legislation and regulations that apply to trail development. The listing below is not comprehensive and is subject to change. Trail operators should discuss the applicable legislation and regulations with the local public land manager and ensure that all legislative, regulatory and bylaw requirements are met or exceeded.

Legislation/Regulation	Implications for Trail Development
Federal	
Species at Risk Act (SARA) (2002) Intended to prevent vegetation and wildlife species from becoming extirpated and promote the recovery of species that are extirpated, endangered or threatened. Protects the critical habitat of species listed under the Act.	• Trails must be routed to avoid the critical habitat of listed species. Discuss the presence of listed species and location of critical habitat of listed species with the public land manager and / or the environmental datasets. • Trails development and use should be planned, designed and managed to avoid impacts to listed species. • Permits are unlikely to be issued to approve trail development and use in areas of critical habitat for listed species. Avoidance is essential. • If a SARA permit is granted, the trail operator must ensure that all conditions assigned to the permit are met.
Fisheries Act Intended to protect and manage fish habitat by managing the permanent alteration or destruction of habitat and the deposition of deleterious substances into fish-bearing waters.	• Trails must be routed or have infrastructure installed that will avoid the destruction of fish habitat or the introduction of deleterious substances into any fish-bearing water. • A Department of Fisheries and Oceans (DFO), "self-assessment" should be completed. Trail operators should engage a qualified professional to undertake the self-assessment to evaluate the potential for the trail to alter or destruct fish habitat to introduce deleterious substances to the fish-bearing stream. • If the self-assessment identifies a potential for alteration or destruction or the introduction of deleterious substances, trail operators must submit the project to DFO using a "Request for Review". • If the review process confirms that mitigation measures are not sufficient to avoid the alteration, destruction of fish habitat or the introduction or deleterious substances, an authorization from DFO is required before the project can proceed. • If an authorization is granted by DFO, the trail operator must comply with all conditions assigned to the authorization.

Legislation/Regulation	Implications for Trail Development
Navigation Protection Act Intended to manage any works, obstructions, depositing/ throwing and / or dewatering activities on "scheduled" waters that support busy commercial or recreational traffic and any works, obstructions, or depositing/throwing and dewatering activities.	• Trail operators must provide notice to the Federal Minister of Transportation for any work (e.g. bridge installation) on scheduled waters and is not designated a 'Minor Work' as per the Navigation Protection Program (NPP). - Trail operators should obtain orders / permits (e.g. Minor Works Order) from the Minister to carry out work on the scheduled water. • Any work done under a legacy project on a non-scheduled water (e.g. works constructed under previous legislation that have transitioned to the NPA regime) require notification to the NPP. • Works on non-scheduled navigable waters that have the potential to affect navigability can formally 'Opt In' or 'Opt out' of the NPP. Should a project 'Opt In', the work would be regulated under the NPA and the owner of the work will have the assurance that the any interference that the work has on navigability is sanctioned under the NPA. The Opt-out option for legacy works is only available until April 1, 2019. • It is recommended a qualified professional be engaged for determination of requirements under the NPA.
Migratory Birds Convention Act Intended to protect migratory birds and their nests.	• Trail operators must not undertake any trail construction activities within the applicable nesting periods. • Trail operators should recognize that nesting periods vary by region from March through to the end of August and should review the general migratory bird nesting periods on the Federal Government website. • A formal permit for trail construction is not required under the Migratory Birds Convention Act. However, trail operators should enlist a qualified professional to complete nest surveys for any activities (e.g., ground disturbance, tree clearing) conducted within the migratory bird breeding window.

Legislation/Regulation	Implications for Trail Development
Provincial	
***Public Lands Act* & Public Lands Administration Regulation (PLAR)** Intended to manage the use of public lands. Public Lands are all lands administered by the Minister of Environment and Parks including most bed and shore of all permanent and naturally occurring water bodies and provincially owned lands but exclude lands managed under the Provincial Parks Act; Wilderness Areas, Ecological Reserves, Natural Areas and Heritage Rangelands Act or the Willmore Wilderness Park Act. The PLAR provides details about how use of public lands is to be approved and managed.	• In accordance with the PLAR Table A1, trail operators should work with the public land manager to determine what disposition(s) or authorization(s) will be granted to the trail operator for the development of the trail and associated infrastructure (e.g. staging areas, bridges, camping areas, toilets), trail maintenance and management activities and any events to be held on the trail. • Trail operators should obtain the written approval and disposition/ authorization from the public land manager before trail construction begins. • Trail operators must understand the terms of the disposition / authorization as well as any conditions assigned to the disposition. • Trail operators should work with the public land manager to determine if provisions of the PLAR can be used to designate the trail, govern trail use and enable enforcement of trail use.
Water Act Intended to manage all activities occurring on waterbodies. Waterbodies include watercourses and wetlands that may or may not contain water year-round.	• Trail operators should identify the classification of all water courses the trail crosses or is adjacent to. • Trail operators should work with the public land manager to determine if the trail project would be a) exempt from approval requirement completely, b) exempt from approval but subject to established codes of practice or c) require a Water Act approval. If the Codes of Practice is not applicable for an activity associated with a trail development, an approval under the Water Act from Alberta Environment and Parks is required (Alberta Environment 2001, AB 2014). • Trail operators should apply the Code of Practice for Watercourse Crossings (a regulatory framework that provides guidelines that

Legislation/Regulation	Implications for Trail Development
Provincial	
Wetland Policy Intended to protect wetlands of highest value and ensure their benefits and services are conserved and restored. The policy directs that wetlands are to be managed by avoiding, minimizing and replacing lost wetland value.	• For activities identified under a Code of Practice, Trail operators may be required to undertake a Wetland Assessment and Impact Form for activities identified under a Code of Practice. This is in addition to the Code of Practice Notification and must be authenticated by a qualified wetland science practitioner. • If permanent loss of wetland function will occur as a result of the trail project, trail operators must engage a qualified wetland science practitioner to undertake a wetland valuation through the Alberta Wetland Rapid Evaluation Tool - Desktop to determine the wetland's replacement value. • For any activities associated with the trail development that are not identified under a Code of Practice, the trail operator must obtain a Water Act approval. Trail operators must engage a qualified wetland science practitioner to complete a Wetland Assessment and Impact Report and wetland valuation through the Alberta Wetland Rapid Evaluation Tool – Actual. The Wetland Assessment and Impact Report must demonstrate that the project design has attempted to follow the Wetland Mitigation Hierarchy. This Hierarchy states that a project must first show avoidance of the wetland feature, if possible, or at least minimize the extent of any impacts. If avoidance or minimization is not possible, then replacement as specified by the province is required.
Wildlife Act Intended to protect wildlife species and associated habitats.	• Trail operators should work with the public land manager and local provincial biologist and / or a qualified wildlife biologist to review the trail project and determine which, if any, project specific permits are required under the Wildlife Act. • Trail operators should plan the trail to avoid harm to any nest or den site of prescribed wildlife.

Legislation/Regulation	Implications for Trail Development
***Environmental Protection & Enhancement Act* (EPEA)** Intended to regulate activities to protect Alberta's land, air and water.	• EPEA requirements are varied. Trail operators should work with the local public land manager and EPEA regulator to determine whether the trail project will trigger any provision in EPEA.
***Weed Control Act* and associated regulations** Intended to regulate and control the spread of noxious weeds and prohibited noxious weeds.	• Trail operators should utilize construction practices that will avoid of minimize the chances of introducing or spreading noxious and prohibited noxious weeds. • Trail operators must manage any outbreaks of noxious or prohibited noxious weeds along the trail in accordance with the Act.
Historical Resource Act Intended to regulate land-based activities to avoid impacts to historical resources.	• Trail operators must plan trails to avoid or mitigate impacts to historical resources. • Trail operators must obtain a Historical Resources Act Clearance during the trail planning process. • If known historic resources may be impacted or if the proposed activity occurs within a high potential area, trail operators must engage a qualified professional to undertake a Historical Resource Impact Assessment (HRIA). Trail operators may need to undertake further studies to determine how impacts to historic resource can be mitigated. Trail operators should consult Alberta Culture for direction. • If, during construction, a historical resource is discovered, trail operators must stop construction and notify Alberta Culture. Construction in the area should not resume until directed by Alberta Culture.

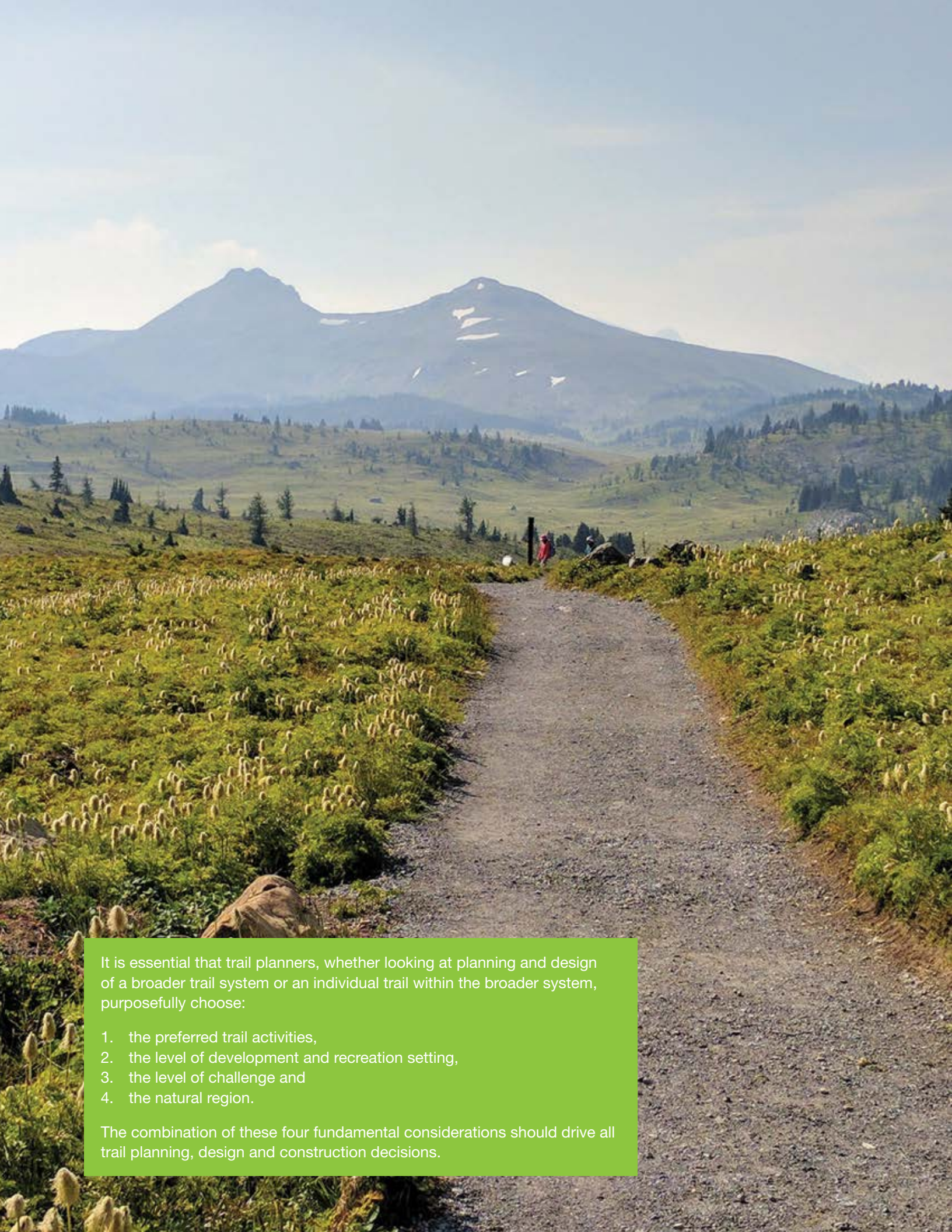
Legislation/Regulation	Implications for Trail Development
Other Considerations	
Municipal Bylaws	• Some municipal bylaws such as those associated with noise, buildings and road access may need to be followed depending on the nature of the trail development and proximity to local municipalities. Additionally, municipal requirements may need to be considered if the proposed trail ties into municipal trails systems or infrastructure. Trail operators should discuss the project with the local Planning Department in the local municipality.
Crossing & Proximity Agreements	• Development on or near pipelines and other utilities requires consultation with the owner of the utility or line. Trail operators must obtain crossing agreements if machinery is crossing or is to be developed on or across an existing right-of-way. Proximity agreements are required within a certain distance of a pipeline. This distance is dependent on the company and utility affected. Installation of any facilities within a right-of-way may require that trail operators obtain a facility installation agreement, depending on the company's requirements. Trail operators should always contact Alberta OneCall, or contact any utilities not subscribing to OneCall (e.g., Shaw at digshaw.ca) directly, prior to any ground disturbance activities.

1.6.1 Approvals & Permits

Trail operators are required to obtain and comply with all necessary approvals and permits as prescribed under federal and provincial legislation and regulation and municipal bylaws. Trail operators must determine which, if any, approvals and permits are required for each type of trail infrastructure included on the trail. The following matrix serves as a general resource to help trail operators determine which approvals / permits may be required. Trail operators should work directly with the local public land manager to confirm the necessary approvals and permits as the following matrix is general and subject to change as legislation, regulation, bylaws and policies are amended and instituted.

Table 1 Potential Approvals & Permits for Trail Infrastructure

Trail Infrastructure	Approval / Permit						
	Federal		Provincial		Municipal		Other
Trail Tread							
Staging Area							
Camping Area							
Skill Development & Youth Play Areas							
Hut / Fixed Roof Overnight Structure							
Warming Hut / Shelter							
Roadway Intersection							
Challenge Feature / Technical Trail Feature							
Toilets							
Site Furnishings (e.g. benches)							
Signage							
Retaining Structures							
Instream Bridge							
Clear-span Bridge							
Instream Watercourse Crossing							
Culvert							
Access & Visitor Use Control Structures							
Highway & Roadway Crossings							



It is essential that trail planners, whether looking at planning and design of a broader trail system or an individual trail within the broader system, purposefully choose:

1. the preferred trail activities,
2. the level of development and recreation setting,
3. the level of challenge and
4. the natural region.

The combination of these four fundamental considerations should drive all trail planning, design and construction decisions.

2.0 Planning Exceptional Trails

To plan exceptional trail experiences, a trail operator needs to:

- understand what a recreation trail opportunity is,
- apply sound trail planning principles and
- follow a rigorous trail planning process.

Each of these are outlined in this section.

2.1 Defining A Recreation Trail Opportunity

Before getting into the details about trails planning, design and construction, it is first important to understand what a recreation opportunity is and the key elements comprising it. For the purposes of this manual, a recreation opportunity is the "ability for an individual to engage in a preferred recreation activity within a desired recreation setting and natural region to obtain a desired experience" (see Figure 1). It is this positive experience that results in the individual, community, economic and environmental benefits that are sought from the recreation opportunity.

Recreation Opportunity

"The ability for an individual to engage in a preferred recreation activity within a desired recreation setting and natural region to obtain a desired experience"

To attain a positive experience, the user must be able to take part in their preferred trail activity (e.g. snowmobiling) at the desired challenge level (e.g. difficult) within their preferred recreation setting (e.g. backcountry) within their desired natural region (e.g. Rocky Mountains). Recognizing that there are many factors beyond the control of the trail operator that can influence whether a user has a positive experience, the role of the trail operator becomes one of ensuring the conditions are set to enable enthusiasts to obtain their desired experiences. Whether that experience is obtained is then a result of factors beyond the trail operators direct control or influence (e.g. poor weather, group dynamics).

Figure 1 Trail Experience Formula (Justin Ellis, 2018)

It is essential to understand that a recreation trail experience is comprised of more than just the trail activity the enthusiast is taking part in. Most trail enthusiasts would agree that taking part in their favorite trail activity on a difficult trail within the backcountry of the Rocky Mountains is a very different trail experience than taking part in the same trail activity on an easy trail in the front-country of the grasslands. The activities are the same, but the combination of the recreation setting, difficulty level, and the natural region dramatically change the trail experience.

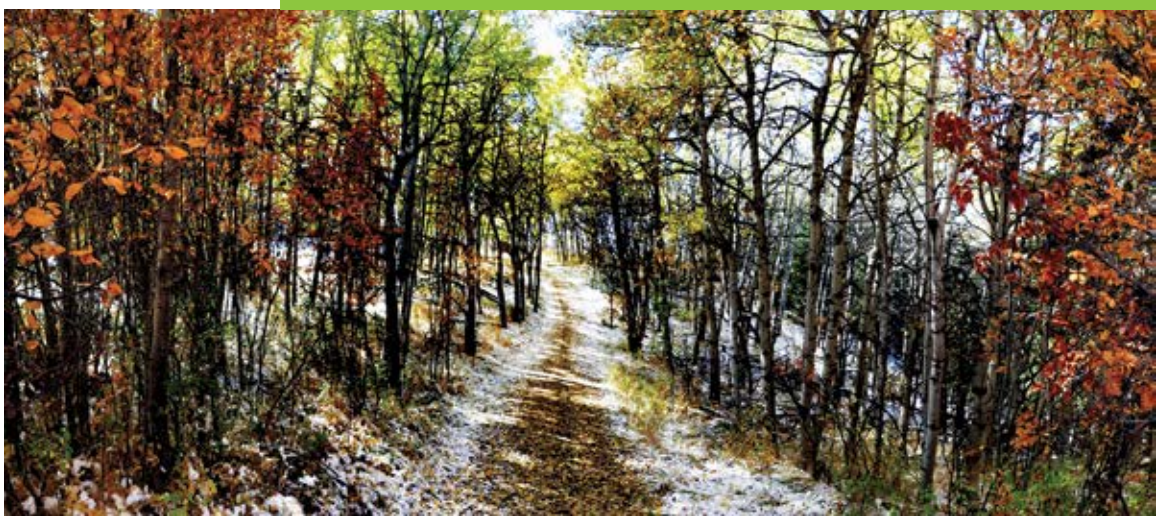
It is essential that trail planners, whether looking at planning and design of a broader trail system or an individual trail within the broader system, purposefully choose:

1. **the preferred trail activities;**
2. **the recreation setting;**
3. **the level of challenge; and**
4. **the natural region.**

The combination of these four fundamental considerations should drive all trail planning, design and construction decisions.

It must be recognized that a single trail cannot be, and should not attempt to be, all things to all people. It is impossible for a single trail, or even a few trails, to meet the diverse needs of all trail enthusiasts. However, with insightful and purposeful trail systems planning, the network of trails on public lands can meet the full range of recreation trail needs. Albertans and the province's trails tourists. Moving forward, the trail planning, design and construction guidelines outlined in this manual are driven by the fundamental elements of a recreation trail opportunity (Figure 1).

"Quality is never an accident; it is always the result of high intention, sincere effort, intelligent direction and skillful execution; it represents the wise choice of many alternatives." - William A. Foster



Quality trails keep users on the trail and in the long term reduce costs, environmental damage, maintenance, enforcement and increase safety. Aspire to provide a trails experience not a transportation experience.

Braiding and environmental damage (unmanaged trail on a linear disturbance)

Hatfield and McCoy purpose built trail system for motorized use.

2.2 Trail Planning Principles

The following section outlines the planning principles that should be incorporated into all aspects of the trail planning process.

2.2.1 Plan for Quality & Memorable Trail Experiences

Designing a trail to enable a quality trail experience is the best way to ensure trail enthusiasts remain on the trail. Getting recreational users onto appropriately sited and designed trails, and keeping them there, is the single most important strategy to mitigating the undesirable impacts of recreation on environmental and historic resource values and conflicts with other land users. If a trail fails to provide a quality and memorable experience, users will go elsewhere which often results in growing impacts and conflicts.

The way in which trails are planned, designed and constructed has a significant influence on a trail user's experience and the long-term sustainability of the trail. A quality trail experience is one that:

- Provides the desired trail experience and level of challenge for the target trail enthusiast(s),
- Provides the right level of development and amenities that complement the land base in which the trail is built,
- Is environmentally and socially sustainable, and
- Is operationally and financially viable.

However, as a trail experience can be affected by many things beyond the control of the trail operator (e.g. weather, group dynamics), it should be recognized that a trail operator can not guarantee that a trail enthusiast will achieve a quality and memorable experience. The role of the trail operator is to create the basic conditions that enable trail enthusiasts to have a positive experience by purposefully managing the following elements:

Figure 2 The Exceptional Trails Model

- Trail design and construction
- Trail condition and safety
- Activities permitted on the trail
- Level of development & recreation setting
- Volume of trail use supported on the trail
- Compliance with rules and responsible and ethical behaviours

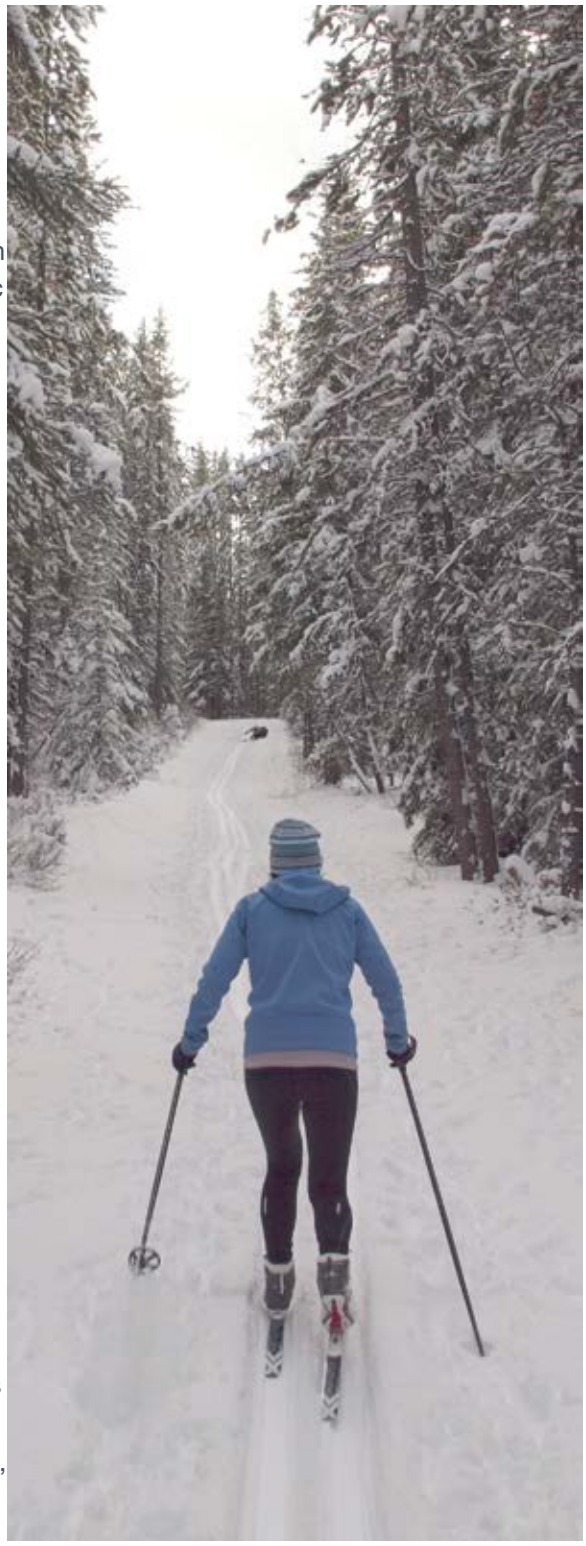
- Quality and siting of signage and other trail amenities

All of these elements affect the quality of the trail experience and are within the direct influence and control of the trail operator. A trail is truly successful only when it delivers the quality experience the enthusiast is seeking with little to no impacts to environmental and historic resources.

To plan for a quality and memorable trail experience, trail operators should:

Provide for the Enthusiast's Needs

Simply put, if a trail operator provides what a trail enthusiast(s) wants on the trail, they will have no reason to seek it off of the trail. It is essential the trails are designed with a specific type(s) of trail enthusiasts in mind. How does a trail operator do this? They first need to understand the enthusiasts they are targeting for the trail and the objectives those enthusiasts will want to achieve on the trail. With an understanding of the target enthusiasts, trail operators should clearly define the trail user objectives (See Table 1) for the trail in the earliest stage of the trail planning process. Is the trail being built to provide an opportunity get close to nature, for play, to challenge enthusiasts, to provide risk and excitement, provide opportunities for social interaction or perhaps the user objectives are a combination of all of these? Whatever the trail user objective(s), the trail needs to purposefully incorporate design features that allow the enthusiasts to achieve them. If trail operators are successful in providing what the enthusiasts wants, there will be far less time and money spent by public land managers on management, enforcement and education related to off-trail use and contraband trail building.



Trail operators, trail enthusiasts, and public land managers, often use different terms to describe the desired trail user objectives. This can lead to confusion, misinterpretation and unnecessary concerns. As such, there is a need to clearly define the major trail user objectives. Table 1 establishes a set of common terms and definitions for trail user objectives. No matter what the trail activity – whether it is motorized, non-motorized or mechanized – every trail user is seeking one or more of these objectives in their trail experience. It is the trail operator's primary objective to ensure that design features included in the trail create the conditions that enable enthusiasts to achieve their objectives.

Table 2 Trail User Objectives (adapted from BLM Guide to Quality Trails, 2017)

Trail User Objective	Different trail users may seek…
Nature	… the opportunity to connect to nature. Experiencing nature is an important objective for many trail users and can include travelling through urban forests to remote backcountry experiences.
Escape	…the opportunity to escape their daily grind and fully immerse in the trail experience. Often, trails will allow users to escape urbanized environments.
Solitude	… the opportunity to experience a sense of remoteness, isolation and aloneness where encounters with others are infrequent.
Challenge	… the opportunity to develop and refine their skills, fostering self-esteem and accomplishment.
Risk	… the opportunity to experience perceived risk including perceived exposure to danger, chance of harm or loss. Risk will create a thrill for trail users but will be managed through good trail and trail feature design as well as management practices that allow users to assess and determine their risk tolerance and abilities.
Fun & Playfulness	… the opportunity to engage in the trail activity purely for the enjoyment bringing a childlike wonder and excitement to the pursuit.
Exercise	… the opportunity to build fitness levels. For some trail users, this is a primary goal while for others, the fitness required to experience the trail is a barrier. The level of fitness required is essential in trail planning.
Variety	… the opportunity to experience variety. Variety comes in many different forms including trail type, difficulty, setting, ecosystems.
Connectivity	… designs that provide for connectivity. Connectivity enables trail users to customize their desired experience, build on a trail outing and easily adapt to changes in plans. It allows users of the same group but with different abilities to start the trail outing together, and allows users to easily find and utilize trail services and amenities.
Socializing	… the opportunity to meet, interact and build community with new people of similar and / or differing trail user types, backgrounds, and assorted trail user objectives.
Safety	… a trail experience that is free from unknown and unreasonable risks, with the necessary security of their personal belongings and well-being.
Efficiency	… a trail experience that enables them to access a trail or complete a task with the least amount of energy and effort expended. The trail designs should enable users to reach the desired trail experience without excessive and wasted effort (e.g. mountain bike climbing trails to reach the desired drop-in location).

Trail Tip

A trail operator cannot guarantee enthusiasts will have a positive trail experience. However, they can set the stage for it. The role of the trail operator is to ensure the conditions are set to enable trail enthusiasts to obtain their desired experiences

Prepare a Detailed Trail Management Objective

Before any attention is placed on design and siting of a trail, trail operators should clearly articulate the vision for the trail through the completion of a Trail Management Objective (TMO). A TMO synthesizes and documents, in a single form, the management intention for the trail in a clear, consistent and understandable way. TMO's guide all future trail planning, design, construction, maintenance and management decisions for the trail and are used to help public land managers understand, communicate and, ultimately, approve the development of the trail. TMO's are not set in stone.

A TMO is a critical piece of documentation and should be updated, as needed, throughout the trail planning and design process as decisions are made as well as during the operations of the trail as management issues arise. Some of the TMO content (e.g. permitted / prohibited use, level of challenge, season of operation, trail length etc.) should be incorporated into the trail's signage and communications strategy. The TMO should be retained on file as they can become an important documentation should any legal actions, as a result of injury on the trail, occur in the future. Figure 3 is an example TMO form that could be used by trail operators. Use of the example from is encouraged but not mandatory. If the provided form is not used, the TMO should document, at a minimum:

- Trail Name & Segment
- Season(s) of Operation
- Trail Design / Technical Trail Features (used to achieve the trail user objectives)
- Intended Level of Challenge
- Design Parameters
- Risk Management Strategies
- Trail Significance & Programming
- Trail Length
- Trail User Objectives
- Trail Classification (see section 4.0)
- Permitted and Prohibited Uses
- Management / Inspection Frequency
- Comfort & Convenience Amenities
- Special Considerations

Trail operators need to ensure that the trail time available to the enthusiasts matches the expectations of the enthusiasts. For example, if an enthusiast arrives at a trail seeking a full day outing but completes the trail by noon, they likely won't be satisfied. Similarly, if enthusiasts are likely to camp or spend multiple nights in an area, the trail operator should ensure there is enough trail time available to minimize the amount of time enthusiasts spend travelling the same trail segments.

Trail Management Objective (TMO)

Documents and describes the management intention of the trail in a clear, consistent and understandable way.

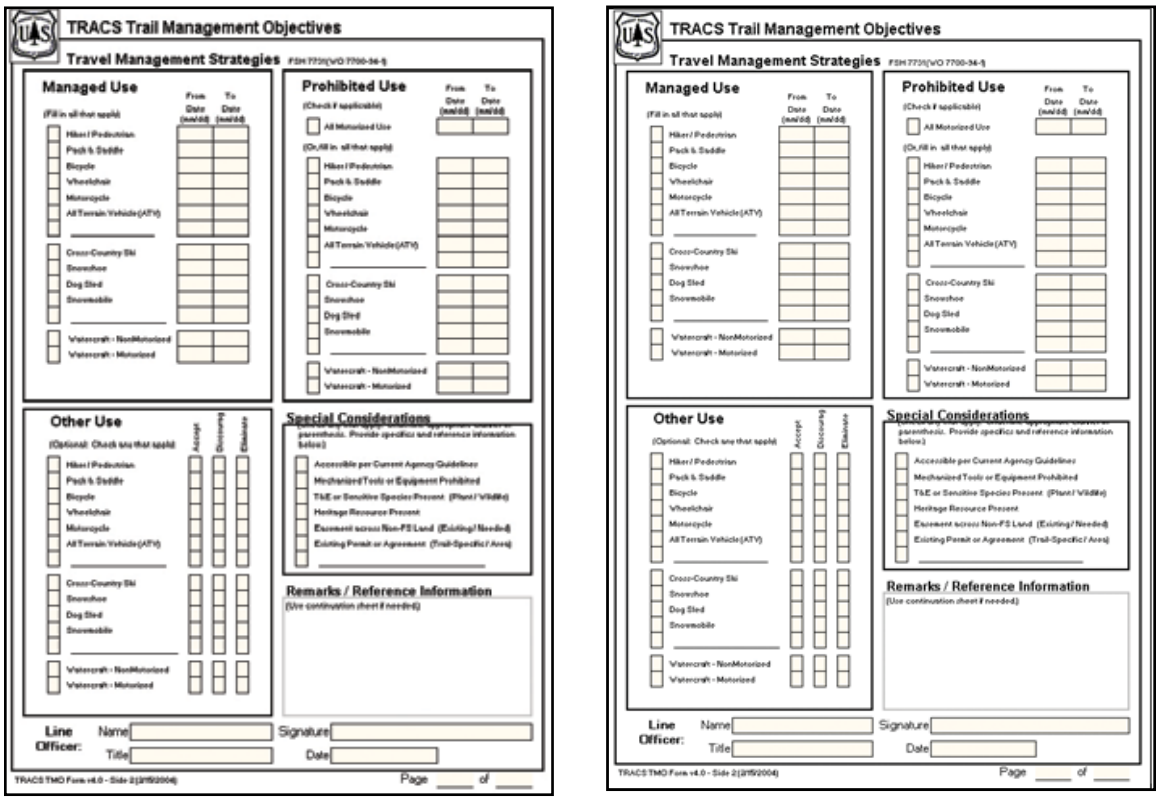


Figure 3 Example TMO Form - USFS

By ensuring diversity in the types of activities, the landscapes, the recreation settings and challenge levels, trail operators will be better ensuring the widest range of trail enthusiasts can find an experience that is right for them.

Ensure Diversity & Variety

Enthusiasts demands for trail experiences are diverse. A single trail, or a single trail system, can't be all things to all enthusiasts. However, the system of trails on public lands can be purposefully planned to ensure there are quality and sustainable trail opportunities for everyone. Trail operators, when planning a larger network of trails, should work to ensure a diversity of trail experiences can be available. By ensuring diversity in the types of activities, the landscapes, the recreation settings, the challenge levels, trail operators will be better ensuring the widest range of trail enthusiasts can find an experience that is right for them.

Variety is an important planning consideration at the individual trail scale as well. No enthusiast is seeking a homogenous trail experience where every kilometer is just like the kilometer before it. Trail operators should ensure trail designs incorporate variety, which will add interest and enhance the trail experience, by incorporating changes in topography, variable vegetation, change in challenge levels and providing loops where enthusiasts can piece together different circuits.

Ensure Appropriate "Trail Time"

There are few things that trail enthusiasts value more than their recreation time. When enthusiasts come to a trail, they want to be able to maximize their available time on the trail and they want a trail that provides for the appropriate amount of "trail time". Trail time (also referred to as seat time), is the time a trail enthusiast spends doing their activity on a trail in a given day. Simply put the the available trail time matches the enthusiasts expectations, the happier the trail enthusiast.

It is important to note that trail time doesn't necessarily equate to trail length. Trail operators should integrate design features into the trails to increase trail time by reducing speeds and increasing opportunities for enthusiasts to do other activities. This approach can increase trail time without necessarily increasing the trail length. Example of features that increase trail time can include:

- Interpretive signs and programming
- Viewpoints
- Rest stops
- Eating areas
- Gathering & social areas
- Trail narrowing, serpentine layout, choke / pinch points and other features such as challenge features that reduce the speeds in which the enthusiast travels along the trail
- Connect the trail to other recreation features that allow the enthusiast to engage in other activities (e.g. a lake or river that has good fishing, swimming areas)

Capitalize on the Physical Elements & Connect to Desirable Features

The landscape and the evolution of human use of the land can provide fertile ground for trail operators to take their trail from ordinary to extraordinary. Features on the landscape can be dominating or subtle; regardless, capitalizing on these features should be a focus for trail operators during the trail planning and design process. Trail operators should, during the site assessment phase of trail planning, work to identify, GPS and connect the trail to features that can create "wow" moments for trail enthusiasts. Trail operators should put serious emphasis on finding these appealing physical elements and features and highlighting them through creative trail siting. Potential features include:

- Great viewpoints and outlooks
- Unique rocks, cliffs and rock bluffs
- Unique vegetation patterns and large trees
- Canyons and arches the trail can pass through
- Old building and land use remnants
- Waterfalls, whitewater and other water features

Figure 4 Interesting Rock Outcrop

There is no substitute for on the ground field assessment and inventorying of desirable features. However, as a starting point, the province does maintain the Recreation and Tourism Features Inventory (RTFI) which can be obtained through the local Public Land Manager. This inventory is a GIS database of natural and built features that do or could facilitate recreation and tourism opportunities. Though it is not an exhaustive database, it should be obtained and reviewed for the trail area of interest to help trail operators identify recreation and tourism features.

Trail Tip

The Government of Alberta maintains the Recreation & Tourism Features Inventory (RTFI). This GIS database can be used, together with field inventorying, to help trail operators identify physical elements and features that can enhance the trail experience. Contact the local Public Land Manager to obtain the dataset. Any further inventorying completed as part of the trail planning process should be provided to the local Public Land Manager so the RTFI can be updated and kept current.

Figure 5 Water Features Bring Interest for Enthusiasts

Figure 6 Skiing through the “Mouse Trap” adds excitement to the experience

Figure 7 Waterfalls are Excellent Features to Incorporate into Trails

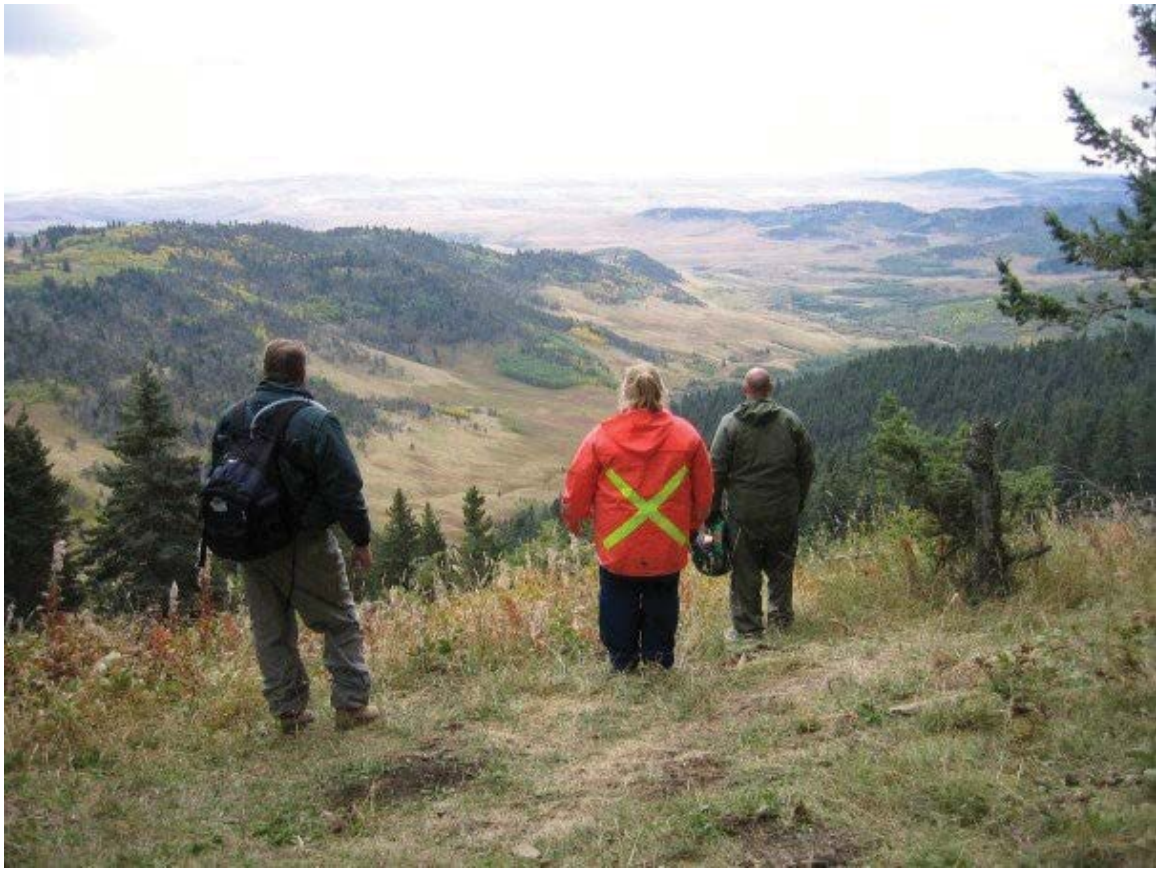


Figure 8 Viewpoints Bring a “Wow Factor”

Create a Great First Impression & Sense of Entry through Gateways

First impressions matter. They set the tone for the entire trail experience. When an enthusiast arrives at a trailhead, there should be an immediate and obvious sense of arrival and the building of excitement and interest. Trail operators should establish plans to create an appealing gateway(s) to the trail. Creating gateways at the start of the trail is an easy strategy to help make a positive first impressing and set the tone for the enthusiast’s experience. A gateway creates a formal starting point by confining the trail and framing it with the landscape, landscape features or built elements. Trail operators should create a great first impression and sense of entry by developing appealing gateways as the major trailheads.

Figure 9 Gateways

Utilize Interesting Trail Layouts

The layout and shape can positively or negatively impact the enthusiasts' experience. Simply put, straight is boring! A straight trail, though it may be efficient, does not provide the quality of experience most enthusiasts are looking for. Trail operators should ensure the layout and alignment of the trail will be interesting. To ensure an interesting trail, the focus should be on creating "trail flow". Flow is created by the continual vertical and horizontal movement of the trail within the landscape. Achieving a trail that flows is no accident. It is the result of purposeful planning and design and should leave enthusiasts asking, "what is around the next corner". More specifically, trail operators should:

- Avoid straight trails unless the purpose of the trail is point to point and highly efficient travel.
- Ensure a sinuous trail with curves. Curves can be gentle and open or tight and technical pending the TMO.
- Utilize stacked loop layouts.
- Utilize maze layout.

Emotional Response to Trail Shapes

The following shapes may induce predictable emotional responses

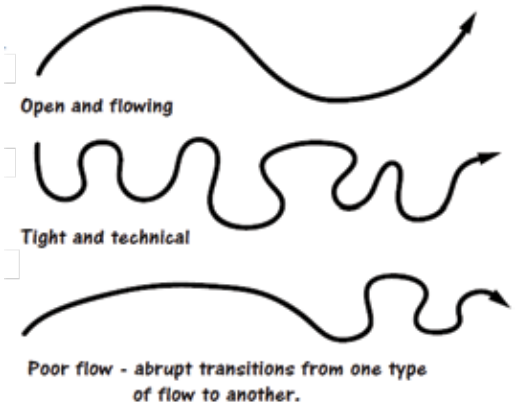


Figure 10 Typical Trail Layout Shapes (NOHVCC pg 218)

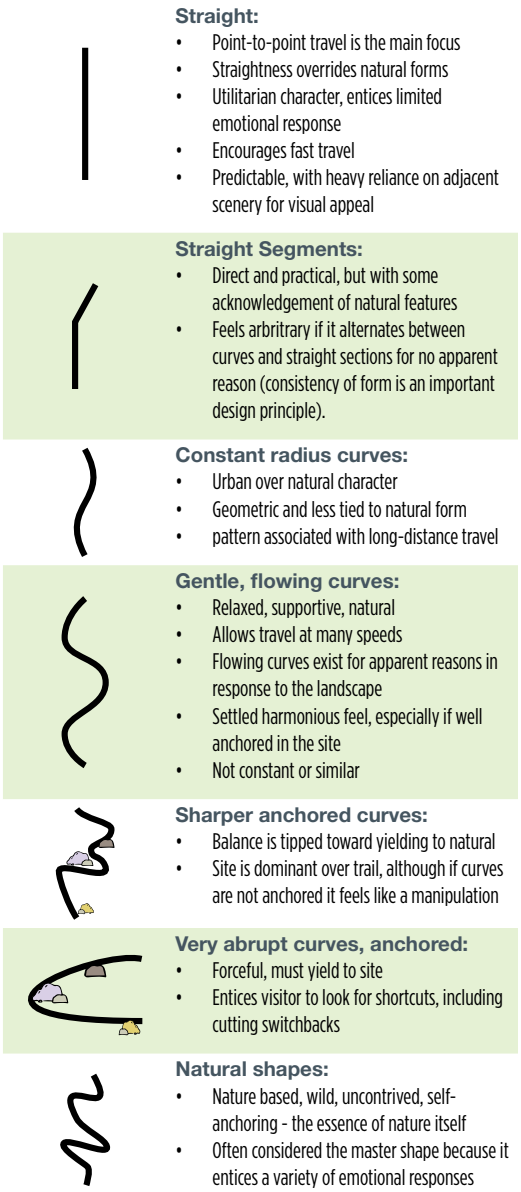


Figure 11 Enthusiast's Responses to a Trail's Physical Layout (NOHVCC pg 218)

Incorporate Appropriate Challenge Features

The level of challenge a trail provides the enthusiast can make or break their trail experience. It can also pose risk and liability issues for trail operators. It is essential that trail operators purposefully plan and design the level of challenge to meet the target enthusiast's abilities (see Section 5 for more information on challenge features). It is also essential that the level of challenge and characteristics of the trail be clearly communicated to trail enthusiasts through convenient and easy to find ways on and off the trail. Trail enthusiasts demand, and should be provided with, access to progressively more challenging trails. There are four main ways trail operators can introduce and provide for challenge. Trail operators can utilize:

1. **Natural Features –** Features such as rock slabs, boulders, outcrops, smooth rock, scree and cliffs are natural features that can be incorporated into the trail to vary the level of challenge.

2. **Design Features –** Adjusting design parameters such as grades, exposure, clearing widths, tread widths, tread alignments (e.g. chicanes), tread surfacing, dimensions of obstacles can increase the level of challenge. Typically, steeper, narrower trails with more substantive obstacles and greater exposure are seen as a more challenging trail.

3. **Past Resource Development Created Topographic Features –** These include past resource development sites such as mines, borrow pits, quarries, rock pits, well-sites and other areas that have been modified during past resource extraction activities. Often, these activities create distinct topographic features that may be able to be integrated into trails as challenge features and technical play areas and can be particularly appealing for motorized recreation. These sites can be converted into hill climbs, high marking, rock crawls and other challenges. These sites are already heavily impacted, assuming reclamation efforts haven't been undertaken, and recreational use is unlikely to create much additional impact within the disturbance.

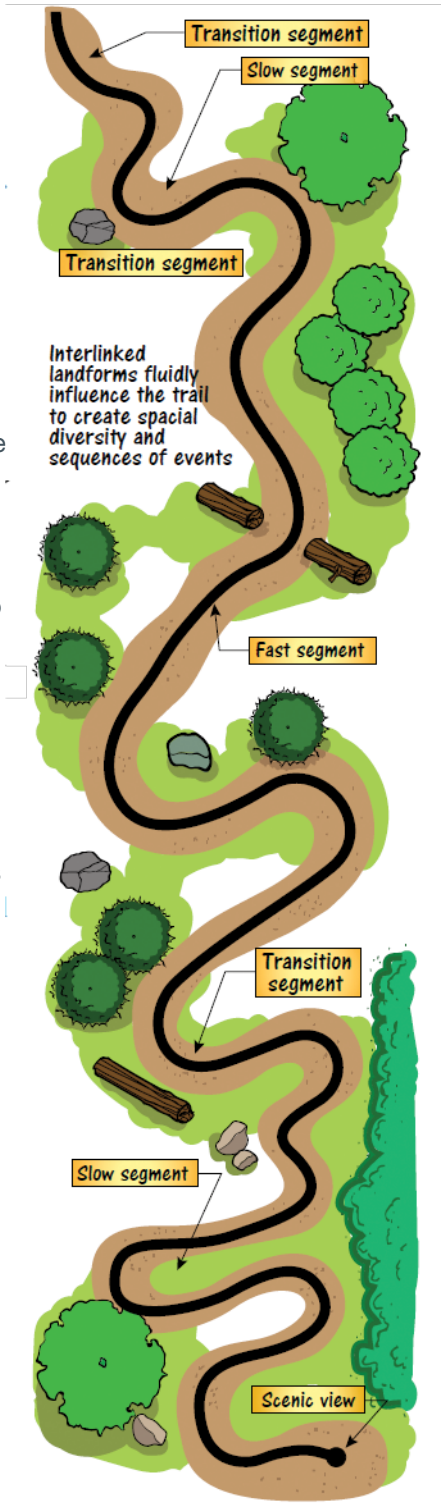


Figure 12 Trail Flow (NOHVCC pg 219)

4. **Manufactured Design Features –** when natural features, design features or features created from past resource development are not available or are insufficient to provide the desired challenge, trail operators have the option of designing and creating their own features. The type of features and designs need to be specific to the permitted trail activities.

Regardless of the types of challenge features used and the level of challenge desired, there are some essential design practices that all trail operators should incorporate into their trail designs to better ensure trail enthusiasts have the abilities needed to travel the trail safely. These include the use of:

- **Filters –** also known as qualifier obstacles, which are a high-skill low consequence feature that demonstrates the difficulty of the upcoming trail. Filters should be included early in the trail experience to allow enthusiasts to self-determine whether they have the abilities to navigate the trail before becoming too committed.
- **Easy Outs –** it's a reality that enthusiasts will travel through the filters placed early in the trail and find themselves at a challenge feature they do not feel comfortable attempting. Trail operators should use their judgements and, for any feature that some enthusiasts are unlikely to attempt, construct easy outs around the feature. The easy-outs can still be challenging, they just need to be easier than the challenge feature they are travelling around. Easy outs should also be considered so that trail maintenance equipment has a way to travel around challenge features that it cannot travel over.
- **Optional Lines –** Trail operators can also design optional lines around the same challenge feature. Each line can provide a different challenge level and, in turn, trail experience. Providing choice to the enthusiast can greatly enhance their experience and their confidence. Use of multiple lines, like easy-outs, can enable trail maintenance equipment to pass by challenge features efficiently and without damage to equipment.

Figure 13 Convert Natural Features into Challenge Features

Figure 14 Filter on a Mountain Bike Trail (BLM pg 46)

Trail Tip

Easy-outs and optional lines should be incorporated around challenge features to enable maintenance equipment to efficiently bypass the feature without damaging equipment or the feature.

Figure 15 Optional Lines on a Mountain Bike Trail (BLM pg 74)

Provide Enthusiasts with Appropriate Comfort & Convenience Amenities

Figure 16 Exposure Greatly Enhances a Trail's Challenge

Though the trail and its characteristics are the most important element of the trail experience, it is not the only element that trail operators need to give concerted attention to. Comfort and convenience amenities such as staging areas, parking, loading ramps, washrooms, picnic areas, site signage, kiosks, waste and recycling receptacles, corrals, bike / vehicle wash stations, day use shelters, cook shelters, campgrounds, potable water, power etc. can be critical elements of the trail experience. Recognizing that first impressions are fundamental to the enthusiast's trail experience, it is essential the enthusiasts feel welcomed, accepted, a sense that there is pride and care taken in the trail by the operator and safety. The quality of staging areas and provision of appropriate comfort and convenience amenities will reinforce these feelings and the set a positive first impression. Trail operators should ensure they provide appropriate comfort and convenience amenities to support the enthusiasts trail experience.

When selecting the comfort and convenience amenities that will be provided at the staging area and / or along the trail, trail operators should return to the TMO that was created. Trail operators should ask:

- Who are the target enthusiasts and what activities will they be doing?
- What do enthusiasts need / expect in order enhance their trail experience?
- What amenities are consistent with the trails intended level of development and surrounding recreation setting? (the less developed the intended trail and the more backcountry the setting, the fewer the amenities that ought to be provided. The more developed the intended trail and the more front-country to mid-country the recreation setting, the more amenities should be provided).
- Where are enthusiasts coming from? (the closer they are, the more likely the trail will be day-use and only require day-use amenities. The further away, the more likely the enthusiasts may seek amenities that enable and support overnight / multi-night excursions).
- Are the enthusiasts likely to be travelling in small or large groups?
- Do we intend to host events and programs that may attract large volumes of people in short periods of time?

Answers to these questions will affect the size and type of amenities that should be provided at staging areas and along the trail.

Ensure Effective Signage & Wayfinding

Effective signage and wayfinding are essential to providing a quality trail experience, improving trail management and enabling effective enforcement. Signage provides critical information about the trail, rules, orientation, key features on the trail, risks, responsible use and trail conditions in a consistent, easy to access and easy to understand manner. Signs can also elevate the enthusiasts experience through thoughtful and carefully located interpretive signs. A day on the trails can go from ordinary to extraordinary if interpretive information is thoughtfully developed and carefully located trail-side. Locals can learn more about their area's natural or cultural history while the visitor's experience becomes more memorable – interpretive signage, when done well, opens a window to deeper understanding and appreciation of a place's unique features. Though the benefits of good signage and wayfinding programs are known, many trails have poor signage and wayfinding systems. Trail operators should not overlook the importance of a robust signage and wayfinding program. Specifically, trail operators should:

- Contact the local public land manager to receive direction on standard trail signs that are to be applied on Public Lands (See section 5.2)
- Prepare and implement a signage plan that shows the type, location, content, design, construction specifications and materials for signs through the trail system.
- Consider working with local Indigenous communities to develop Indigenous themed stories to include in the signs.

- Ensure the frequency and placement of signs compliment the desired level of development of the trail and surrounding recreation setting (e.g. signs should be less frequent on trails that are working to provide a backcountry experience than they would be on trails providing a frontcountry experience).
- Ensure off-trail wayfinding (e.g. websites, maps, smart phone applications, signs on major highways / roads) are also readily available to attract and support the enthusiasts trip planning and on-trail travel.

For further design guidelines regarding signage, see section 5.2.

Think Beyond Trail Construction… Program the Trail & Market the Experience

All too often, trail operators' energy and focus are fully consumed by planning, designing, building and operating the trail. Often, trail operators believe that "if they build it, they will come". Under this moto, many trails across the province and in other jurisdictions remain underutilized. Many trail operators successfully build the trail but forget to consider what happens after the trail is built. In some cases, trail operators don't have the skillsets or interest in designing the programming and marketing of the trail.

For a moment, think of the trail like a sporting facility. Once the sporting facility is built, it needs to be programmed in order to fill it. Trails are similar. Exceptional efforts are invested in

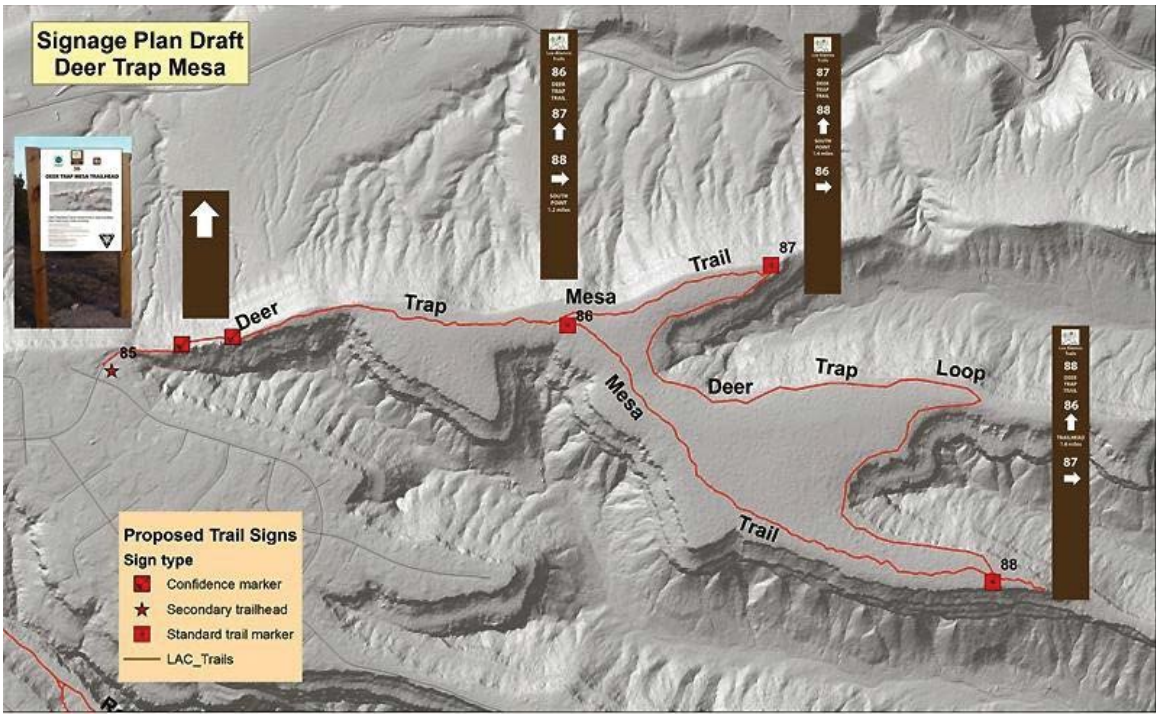


Figure 17 Example Illustration of a Signage Plan (Los Alamos)

designing and building quality trails, but, just as importantly, trail operators should plan early for the investment of time, money and energy to program and market the trail (where appropriate). Trail operators should identify partners who have the interest and ability to program and market the trail after it is built and work with these operators to prepare a trail program calendar and a marketing strategy.

Trails can be passively and actively programmed. Passive programming provides self-guided experiences for the enthusiast such as interpretive signs, public art, benches etc. Active programming includes organizing and hosting events, festivals, races and gatherings that bring many people to a trail. There are many creative opportunities to combine activities, music festivals, food festivals and other events with a quality trail. In some cases, approvals may be required before the events can be held. Trails operators should discuss any plans for events with the local public land manager.

Enthusiasts won't simply "find the trail". They must be told the trail exists and supported along their trip planning journey. With the trail programming determined, trail operators should work with partners as appropriate, to devise a plan to promote the trail. These plans can be simple or elaborate. The investment in programming should be aligned with the intended significance of the trail (e.g. is it a local trail or a signature trail).

Know When and When Not to Use Existing Linear Disturbance

Creation of new linear disturbance (e.g. cutlines, industrial roads, trails) can be a problem for wildlife and wildlife habitat due to fragmentation, introduction of invasive species and easier predator movements. As such, there is an easy, though often inappropriate, tendency to site

photo: David Fulmer

Trail Tip

To optimize trail use, trail operators should view their trail as an experience that should be marketed and sold to enthusiasts.

Effort should be invested in preparing:

- A trail programming plan / calendar
- A marketing plan

Some special events held on public lands require approvals (Temporary Field Authorization). Any plans for events should be reviewed with the local public land manager before they are organized.

trails on existing roads, cut lines and other linear disturbance. Though it seems, at first, like this is a good strategy for minimizing impacts to wildlife and habitats while meeting recreational needs; more often than not, it is a poor strategy. The reason being, past industrial roads and linear disturbance were never intended to provide quality or sustainable trails. Most old roads were designed for an efficient transportation experience, not an exceptional trail experience, while cutlines were never intended to provide any form of transportation. These disturbances do not provide the trail experience and appeal that properly and purpose-built trails do nor were they designed using parameters that will avoid or minimize common trail impacts (e.g. avoid fall lines, avoiding wet areas etc). And, as stated earlier, if an enthusiast doesn't find the experience they are looking for on "trail", they will seek it off-trail. Siting trails on past linear disturbance maintains that disturbance on the land while leading to:

- The creation of new disturbance as users go elsewhere to seek a better experience or avoid impassable trails,
- Contraband trail building
- Greater trail rutting, widening, erosion and sedimentation and, in many cases,
- Safety and liability risks.

Existing linear disturbances should be used cautiously and only where their designs can be enhanced to provide an appealing trail experience. Though they may seem to have low up-front costs and avoid further wildlife habitat fragmentation, the long-term probability is that they will result in much higher maintenance, infrastructure and management costs while delivering a lower quality experience.

At minimum, to consider converting an existing disturbance to a trail, the following criteria should be met:

1. The converted disturbance would meet the TMO and provide the desired trail experience,
2. Adequate funding and resources are available to convert the road to a trail and maintain it, and
3. The impacts (e.g. environmental, historic resource, safety etc.) from converting the road and continued use of the corridor are acceptable to the public land manager.


photo: Davebloggs007

Existing linear disturbance, if appropriate to become a trail, should be transformed through a purposeful design process into a natural-looking trail corridor with all the characteristics of a purpose-built trail. If the most basic elements are present, a good trail designer can convert many linear disturbances, particularly old roads, into quality trail experiences. Table 2 provides some factors trail operators should consider when determining if an existing linear disturbance, whether it's an industrial road, cutline or old recreational access, is reasonable to convert into a trail or when the development of a new trail may be more appropriate.

Table 3 Factors Favouring Use of an Existing Linear Disturbance or Developing a New Trail (adapted from Minnesota DNR)

	Use of an existing linear disturbance is more appropriate when…	**Creation of a new trail is more appropriate when…**
Legislation & Land Management Direction	• Legislation or land management direction exists that prevents, discourages trail development. • Creation of new trails will result in established linear disturbance thresholds being surpassed.	• Legislation & land management direction does not prohibit or discourage new trail development.
Trail Experience	• Intended experience is primarily a point to point connection. • The existing disturbance connects to other recreational features and points of interest that enthusiasts will want to travel to.	• The trail is to be a destination trail. • The trail is not simply a connection between two points. • The existing disturbance does not connect to other recreational features and points of interest desired by enthusiasts.
Environmental & Historic Resources	• The existing disturbance is the only route that will limit or avoid unacceptable impacts to important environmental & historic resources.	• There are few to no environmental or historic resource sensitivities. • Site has dry, upland areas that can support trail development. • The existing disturbance has largely been reclaimed by nature and is well integrated into the local ecology.
Physical Design	• Avoids fall-lines. • Incorporates design features to manage water (e.g. rolling grades, cross slopes) or can be easily modified to incorporate water management features. • Clearing limits of the existing disturbance are appropriate for the desired trail experience. • Grades along the existing disturbance are appropriate for the desired trail experience. • Surface of the existing disturbance has been compacted and / or hardened and can withstand use by the intended trail activities. • The existing disturbance is wide enough that a purpose-built trail can be designed and constructed on it. • The existing disturbance has appropriate sight-lines for intended trail activities. • The existing disturbance has characteristics that will increase trail time and manage speeds of trail enthusiasts.	• The existing disturbance is sited on fall-lines • Rolling grades and cross slopes are absent and erosion is likely. • Clearing limits greatly exceed the design parameters for the desired trail experience. • Grades exceed the design parameters for desired trail experience. • The surfacing has not been compacted and / or hardened. • The existing disturbance is too narrow to accommodate the design and conversion to a purpose-built trail. • The existing disturbance does not have appropriate sight-lines for the intended trail activities. • The existing disturbance does not have characteristics that will increase trail time and manage the speed of trail enthusiasts.

Here are some tips to consider when converting existing linear disturbances to trails:

- Ensure the width of the existing disturbance and the area available to work with is clearly defined. For example, is area available for conversion simply the road surface or is it the full road right-of-way?
- To the extent possible, narrow the existing disturbance to the desired clearing limits and tread width for the intended trail classification as outlined in the TMO. Vegetation transplants, logs, rocks, soil and other materials can be used to narrow the corridor and make it look more naturalized and appealing. This will reduce the size of the trail watershed and minimize the amount of water that needs to be managed on trail.
- Create an interesting and appealing serpentine alignment within the corridor. Be sure the alignment will maintain flow along the trail. Obstacles such as vegetation transplants, rocks, logs and other obstacles can be strategically placed to achieve the desired alignment.
- Creating rolling grades and opportunities to dump water off the alignment. Enhance, where needed, and replace other water management infrastructure such as culverts with water management infrastructure that is aligned with the intended trail experience and cost effective.
- Install filters early in the trail as well as access control structures and other amenities per the TMO.
- If possible, consider having the trail leave the existing disturbance and build new trail from time to time to add variety, interest and enhance the trail experience.
- Utilize overburden from new trail construction, or import native soils and, where possible, undertake seeding and plantings to encourage the growth of native vegetation and expedite the reclamation of the existing disturbance that is no longer being used for the trail.
- Minimize vegetation management to maintaining the clearing limits. Other native vegetation should be left to grow.

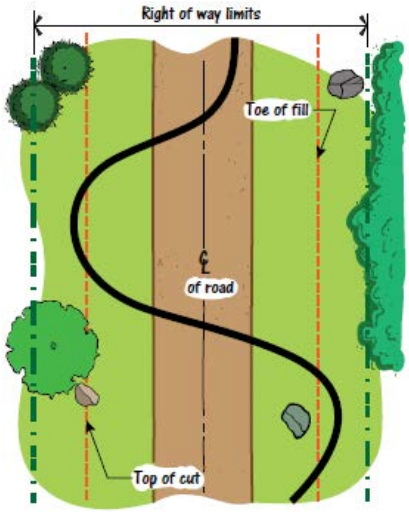
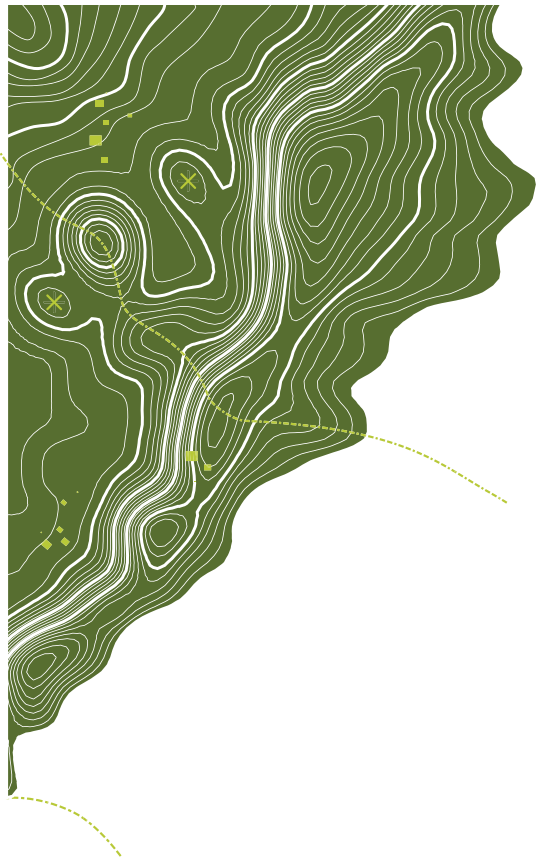


Figure 18 Converting Roads to Trails (NOHVCC pg 310)

Figure 19 A Successful Road to Trail Conversion

Figure 20 Road to trail conversions also provide good interpretive opportunities



2.2.2 Plan to Avoid or Minimize Environmental and Historic Resource Impacts

Trails, when improperly sited, constructed and poorly managed, lead to undesirable impacts on the environment and, potentially, historic resources on public lands. Trail operators must be committed to and accept responsibility for planning, designing, constructing and managing trails in ways that avoid or mitigate impacts to the natural environment and historic resources. The objective of the minimizing environmental impacts guidelines are to ensure sustainable trails are developed on public lands in a way that balances the protection of the environment with the provision of exceptional trail experiences. It is important for trail operators as well as land managers to acknowledge that the strict application of these guidelines have to be balanced against the need to locate trails where they will provide enthusiasts with an exceptional trail experience. Failure to maintain an exceptional trail experience as a result of environmental limitations will almost certainly lead to enthusiasts seeking their desired experience off-trail. This reality makes it essential that skilled biologists and qualified environmental professionals must work together closely with skilled trail planners and designers to achieve this delicate balance.

A sustainable trail is one that allows enthusiasts to obtain the desired trail experience while avoiding or creating minimal impact to the natural environment and historic resources, avoiding user conflicts and conflicts with adjacent land users and requiring only routine maintenance and management action (see Figure 21). Trails that don't do this are not sustainable.

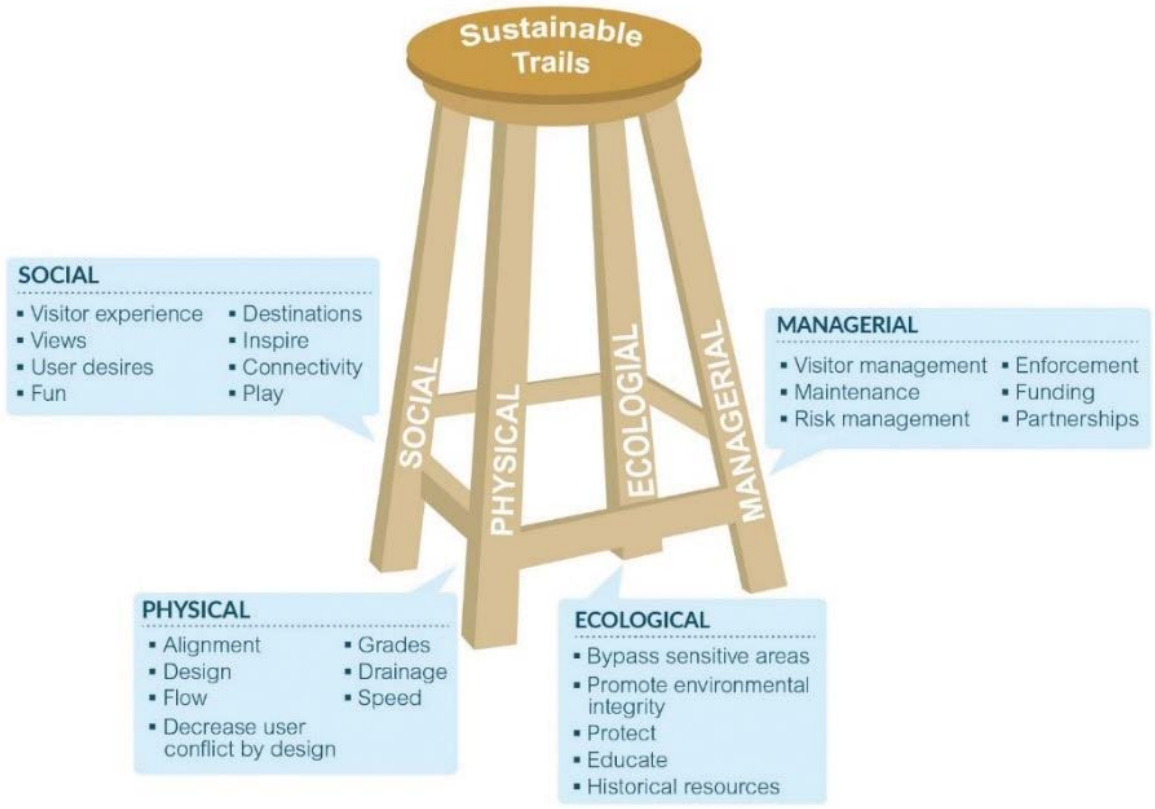


Figure 21 Sustainable Trail Model (Matt Hadley MCSL 2017)

To plan an environmentally sustainable trail, trail operators should:

Avoid Environmentally Sensitive Areas where Possible

All trails have an impact on the natural environment. Some impacts are direct (e.g. cutting of trees) while other impacts are indirect (e.g. changing wildlife patterns). The trail operator's obligation is to mitigate this impact to the extent possible through good planning, design, construction and management. Avoidance, though not the only approach to minimize impacts to environmentally sensitive areas, is always the best option and should be considered during trail planning. Environmentally sensitive areas to be avoided generally include:

- Waterbodies
- Wetlands and wet areas
- Nesting and den sites
- Habitat for animals that are sensitive to fragmentation
- Sensitive soils
- Riparian areas
- Critical habitats for species at risk
- Breeding areas
- Large unfragmented parcels of land
- Steep slopes

In Alberta, waterbodies, vegetation, wildlife and wildlife habitat, and fish and fish habitat are protected by federal and provincial legislation as ecologically valuable resources (EVR). Trail route selection should avoid these environmentally sensitive areas. Accurate information is the most important step to avoiding environmentally significant areas. Trail operators should review relevant databases, literature, regulations, databases, satellite and aerial imagery, as well as previous reports about the study area and clearly map the location of known environmentally sensitive areas. The most common databases and information sources about environmentally sensitive areas include:

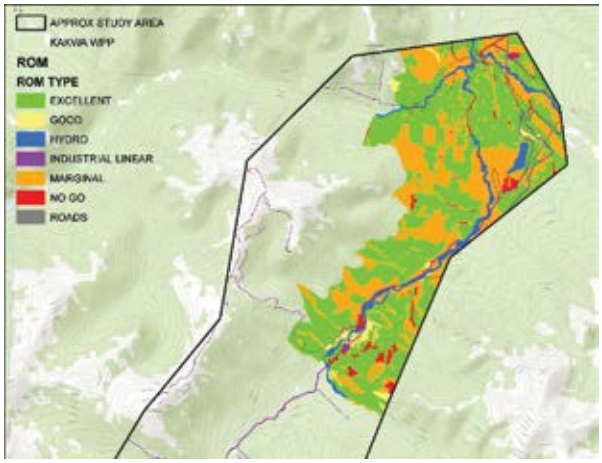


Figure 22 ROM in Use on the Kakwa Falls Trail Feasibility Study

- **Fish & Wildlife Internet Mapping Tool** (FWMIT) provides immediate access to the Fish and Wildlife Management Information System (FWMIS). FWMIS results include information on previously documented wildlife and fish species in an area, sensitive wildlife and their ranges, endangered and threatened plant ranges, as well as key wildlife and biodiversity zones.
- **Alberta Conservation Information Management System** (ACIMS) is a biodiversity database primarily focused on vegetation species, ecological communities of concern, and significant landform elements in Alberta. Biological elements are ranked and is identified as rare or of ecological concern and added to tracking or watch lists.
- **Species at Risk Public Registry** provides information on federally listed Species at Risk including current status, range, critical habitat, and existing management plans.
- **Landscape Analysis Tool** (LAT) is an online tool used for proposed projects on public land requiring a Temporary Field Authorization or disposition. The LAT report outlines specific approval standards and operation conditions for projects on public land, including mitigation for wildlife or vegetation, and reclamation requirements and/or guidelines.
- **Recreation Opportunity Model (ROM)** is a Geographic Information System (GIS) provincial dataset that describes the likelihood the soil conditions in an area will support sustainable trail use. The inventory helps to identify areas that may be more susceptible to rutting, compaction, braiding, or erosion due to poor drainage or wet conditions than other areas.

Other sources of information that trail operators can review include:

- The Alberta Soil Information Viewer;
- Alberta Geological Survey maps;
- GeoDiscover Alberta; and
- General Nesting Periods of Migratory Birds.

See the Trail Planning Process section below for more details on how these datasets and information sources can be used to inform trail planning.

Avoid Historic Resources

Public lands contain many known, and yet to be discovered, historic resources. Historic resources are defined as any work of nature or of humans that is primarily of value for its paleontological, archaeological, prehistoric, historic, cultural, natural, scientific or aesthetic interest including, but not limited to, a palaeontological, archaeological, prehistoric, historic or natural site, structure or object. Historic resources are protected under the Historic Resources Act. Avoidance of historic resources, though not the only approach to minimize impacts to historic, is always the best option and should be considered during trail planning.

Accurate information is the most important step to avoiding historic resources. Trail operators should review the Listing of Historic Resources to identify lands within the area of interest that contains or have a high potential to contain historic resources, including archaeological sites, palaeontological sites, Aboriginal traditional use sites of a historic resource nature (burials, ceremonial sites, etc.), and/or historic sites and structures. However, the Listing does not include all lands that may contain historic resources on public lands. When previously unknown historic resources are discovered, or high potential areas are identified, their locations are added to the Listing. If the area of interest contains a historic resource or areas of high potential, every effort should be made to avoid those areas. If avoidance is not possible, and the integrity of a historic resource or area of high potential to contain a historic resource may be compromised, trail operators may be required by Alberta Culture to undertake a Historic Resources Impact Assessment which can be costly and time consuming.

Apply Setbacks to Protect Environmentally Sensitive Areas and Historic Resources where Avoidance is Not Possible

In some cases, avoiding environmentally sensitive areas is not possible. In these instances, trail operators should establish setbacks to buffer sensitive areas from trail disturbance and maintain the integrity and function of the sensitive area. Setbacks are the minimum area between the features that is being protected (e.g., watercourse, wetland, nesting colony, historic resource) and the trail clearing limits. No development should occur within a setback, with an exception for management of storm water and run-off through natural infiltration within this area. For some environmentally sensitive areas and historic resources, setbacks may be identified in legislation,

while for other areas, setbacks may be established in best management practices and/or at the discretion of a qualified environmental professional as defined in the *Water Act*. Setbacks will vary based on:

- The sensitivity of the area / resource that is present
- The specific species or feature needs
- The type of trail being developed
- Degree of use the trail is anticipated to receive
- The desired trail experience.

The following GoA best practice guidelines provide setback guidance that should be referenced and incorporate during trail planning:

- Stepping Back from the Water outlines guidelines and suggested setbacks for development near water bodies including, watercourses and wetlands.
- Recommended Land Use Guidelines for Protection of Selected Wildlife Species and Habitat within Grassland and Parkland Natural Regions of Alberta provide guidelines to limit impacts to both wildlife and rare plants.
- Master Schedule of Standards and Conditions provides a comprehensive amalgamation of all recommendations and best management practices provided in LAT reports including wildlife species, vegetation, natural regions or features, reclamation, and other activities.

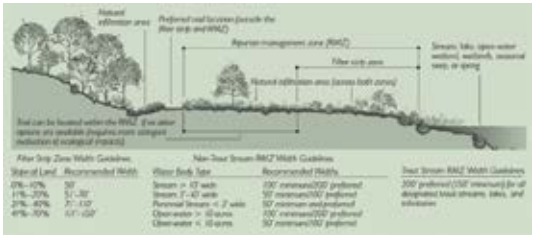


Figure 23 Buffer Width Guidelines adopted from Minnesota DNR

Figure 24 Buffer Along Slopes & Bluffs adopted from Minnesota DNR

Minimize Disturbance to the Landscape

Trail operators make many decisions during the trail planning process that can lead to increased or decreased disturbance to the landscape. It is essential that trail operators actively look for opportunities to avoid or minimize additional disturbance to the landscape early in the trail planning process. Trail operators should ask themselves:

- Can we make use of existing linear disturbances? If so, will these disturbances be sustainable? Can they provide the desired quality trail experience?
- Can we site the trail corridor in areas that will require the least amount of vegetation removal?

- Can the trail corridor be sited to avoid or minimize the need for water crossings?
- Can we site trail amenities in locations that are already disturbed (e.g. abandoned well-site, forestry laydown areas, abandoned gravel pits etc.)?
- What is the maximum clearing width of the trail and how can we limit the disturbance to vegetation within the clearing limit?

Early forethought during the planning process will ensure trail operators identify all opportunities to minimize the amount of disturbance that will result from trail development and operations.

Actively Manage and Maintain the Trail

A forgotten or ignored trail will become an unsustainable trail even when it is designed properly. Sustainable trails require active and ongoing management and maintenance. Frequent investment in the ongoing management and maintenance of a trail in the short-term is essential to controlling costs and environmental impacts over the long-term. Trail operators are responsible for developing and ensuring the implementation of management strategies and a regular maintenance program that focuses on the trail tread, the clearing limits, invasive species control, water management structures, infrastructure and amenities. Regularly maintenance allows for continued use, increases long term trail sustainability and reduces liability and risk to the trail operator.

In addition to maintenance, trail operators should establish clear limits of acceptable change for the conditions along the trail. Clear indicators relating to the trail condition and sustainability should be established during the trail planning process and monitored once the trail is built. Thresholds for each indicator should also be set during the trail planning process. These thresholds provide a foundation from which trail operators can determine if the trail is sustainable. As the physical conditions along the trail change and thresholds are approached or surpassed, the trail operator is triggered to undertake management actions (enforcement, education, engineering, maintenance) to resolve the issue.

Deactivate and Reclaim Unsustainable Trails

Unsustainable trails, even if they are no longer used for recreation, will continue to create undesirable environmental impacts (e.g. erosion and sedimentation, travel corridors for predators etc.). Ideally, abandoned or decommissioned trails should be formally and actively deactivated and reclaimed as resources are available. In most cases, the treads of unsustainable trails have been heavily compacted which extends the time it will take for nature to restore the trail disturbance near natural conditions. Trail deactivation can occur concurrently with new trail development for efficiency and potential

Trail Tip

Trail operators should develop and implement a regular maintenance program to identify and address trail sustainability problems early when they can be fixed cheaply and with less impact to the environment.

cost-savings. While some natural regeneration of areas may occur over time, the physical decommissioning of trails expedites the restoration process and prevents further use by recreationists, thereby reducing disturbance and encouraging regeneration of natural ecological processes.

The effectiveness of trail closures can depend on many factors including level and duration of use, proximity to other trails and features, visibility on the landscape, and existing environmental conditions. Reclamation and closure strategies will need to be considered on a project-by-project basis. When working to deactivate and reclaim unsustainable trails, trail operators should:

- **Provide other routing options -** Reroute existing users away from area prior to trail closure and reclamation. Maintain access to popular trail features and destination, where feasible, and ensure the high-quality trail experience of the new route.
- **Develop new sightlines -** Design the new trail to direct the user's eye towards the new trail route.
- **Blend the trail back into the original landform –** The trail tread, ruts and associated earthwork should be blended back into the original landform. If this doesn't happen, the trail will continue to erode which will extend the reclamation process. Stream crossing should be reshaped to approximate the original channel and efforts should be taken to stabilize the stream banks. Erosion control strategies such as drainage dips, erosion control blankets, thick slash, check dams may be required in order to minimize the erosion on reclaimed trails while vegetation is establishing. All work in riparian areas or stream banks should be advised by the appropriate environmental professional.

Figure 25 Trail Threshold Trigger adopted from Minnesota DNR

A properly reclaimed trail

- **De-compact soils -** Trails cause impacts such as soil compaction that can hinder the natural regeneration after abandonment. Soils should be de-compacted prior to reclamation activities using techniques such as “rough and loose,” scarifying, and ripping. Re-establish and maintain natural patterns of the area. It is important to manage water volume and velocity in and around a reclamation site to prevent further erosion. Permanent or temporary erosion and sediment control structures may be needed during the reclamation process.

- **Revegetate area for reclamation -** After soil decompaction, areas should be revegetated with site-appropriate approved native seed mixes and other native vegetation to assist in the regeneration of the disturbed area. Particularly dense plantings can be used at the entrances to the unsustainable trail to further disguise the trail. Trail operators should ensure they avoid the introduction and spread of non-native and invasive species during revegetation efforts. A qualified environmental professional or specialist should be consulted to assist in reclamation planning.

- **Install barriers and signage -** To prevent the further use of the closed and reclaimed trail corridor, natural or artificial barriers should be installed at the head of the trail. The trail corridor can be disguised by using trees, rocks, or other vegetation to visually cue riders that the trail is no longer in use. Signage can also be installed indicating closure and providing information on trail reroutes.

- **Actively manage the closure -** The closure should be monitored for success and adjustments to the closure strategy should be made as needed. The closed area should be inspected to ensure signs and barriers are replaced and maintained, especially in areas where trail closures are not supported by users. Documentation of reclamation activities can be valuable for future reclamation planning activities as well as for stakeholder presentations.

2.3 Trail Planning Process

Exceptional and sustainable trail experiences are the result of good planning. A clear vision, a good plan and proper implementation are essential. If appropriate time, money and energy is not invested up front, the success of the project will be at risk, the quality and the sustainability of the trail experience will be compromised, and the likelihood of receiving the public land manager approvals will be reduced. However, trail planning is not easy or for the faint of heart. Good trail planning requires experience and expertise in many different areas. Trail operators should ensure that the planning and design team has practical expertise in:

- Community, Indigenous & stakeholder engagement & communications
- Inventory and Assessment of Environmental (e.g. wildlife biologist, vegetation ecologist) & Historic Resources (e.g. archaeologist)

> "A Vision without action is a day dream! Action without a plan is a nightmare." (unknown)

- Federal, provincial and local legislation, regulations & permitting processes (e.g. planner)
- Engineering (e.g. structural, civil, transportation)
- Geographic Information Systems (GIS) based spatial analysis and mapping
- Tourism market research (if the trail is intended to be a destination trail)
- Trail planning (e.g. trail planner, recreation planner)
- Technical trail routing and design (e.g. trail design specialist, Landscape Architect)
- Trail construction (e.g. trail construction inspector/supervisor).

If done properly, the creation of a clearly defined vision and executable plan will become the foundation on which every future design, construction, maintenance and management decision will be based. In fact, the planning process for a trail should never stop. Under an adaptive management approach, trail operators should remain in a continual cycle of planning, implementing, managing, monitoring and adjusting (see Figure 26).

Figure 26 Trail Planning Cycle

Trail planning generally, but not always, follows a similar process. There are critical phases that all trail plans will go through, though the exact tasks within each phase may vary slightly based on the local public land manager, the land base, and the experience and track record of the trail operator.

Each of the phases contains a number of tangible steps. The general timing for implementation of each phase can vary considerably. Figure 27, provide a generalized timeframe for implementation. Actual implementation will vary based on the area of focus, environmental and historic resource sensitivities, type of trail, length of trail and other factors.

Recognizing that the exact process may vary somewhat from region to region and site to site, the typical steps in the trail planning process are described in the following sections.

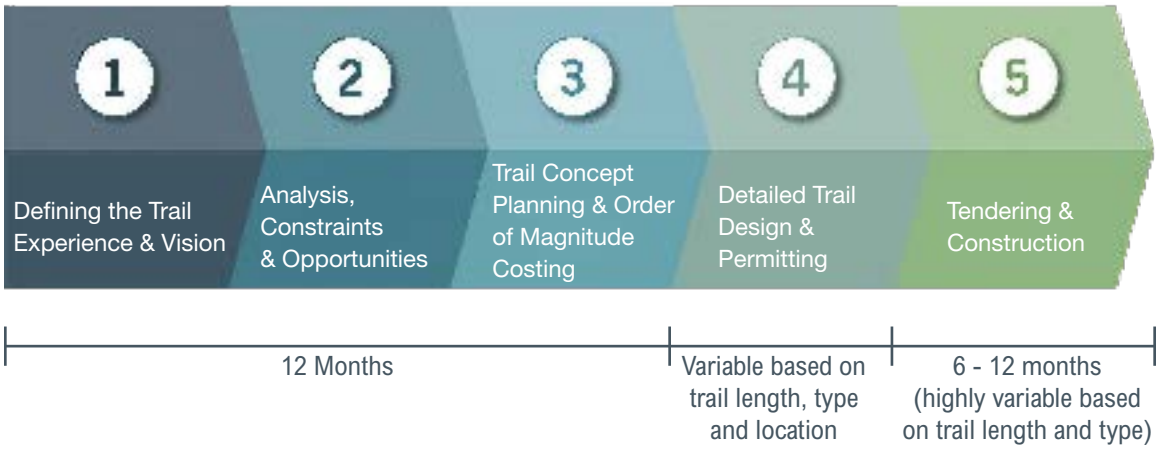


Figure 27 Trail Planning Process & General Timeline

Phase 1
Defining the Trail Experience and Vision

The purpose of this phase is to establish a clear vision for the trail, establish the trail classification, prepare a trail management objective, and initiate discussions with the local public land manager.

Step # 1.1: Identify the Area of Interest

The trail operator should identify the general area of interest for the trail development. The area of interest should be defined on a map as this boundary will be used in subsequent planning steps as well as for communications with the public land manager.

Step # 1.2: Determine Trail User Objectives

Planning for a quality and memorable trail experience begins with clearly understanding what trail user objectives the trail will meet (see fig. 27b). It is important to ask whether the focus of the trail is to provide enthusiasts with a connection to nature, a challenge, fitness, a social experience, skill improvement, or some other objective or combination of objectives. The trail operator and its team of planners and designers must be clear about the intended user objectives as these will directly influence the design of the trail. Specifically, trail operators should:

- Use Table 1 on p.21, to select the user objective, or combination of objectives, that the trail will be designed to provide.

Step # 1.3: Determine the Trail Classification

Next, trail operators need to determine the intended classification of the trail. A trail classification system provides essential planning, design and construction direction for a trail. Classifying a trail helps trail operators paint a clear picture of the trail experience, intended users, level of development and amenities, level of challenge, and physical characteristics for public land managers, stakeholders, and trail enthusiasts.

Specifically, trail operators should apply the Public Land Trail Classification System in Section 4, to:

- Determine the proposed trail type (land, snow, water, vertical)
- Select the Trail Enthusiast Group(s) that the trail will be designed and managed to accommodate (non-motorized, mechanized, motorized, mixed-use)
- Select the Use Type for the trail (single-use, multi-use, preferred-use)
- Determine the current and intended level of development (Developed, Moderately Developed, Minimally Developed) in line with the current recreation setting(s) in the area of focus. The Government of Alberta maintains a landscape-level inventory of recreation and tourism settings on public lands which is known as the Recreation and Tourism Opportunity Spectrum (RTOS). Trail operators should contact the local Public Land Manager to obtain the GIS data and / or a map showing the recreation settings in the area of focus. In some cases, the RTOS inventory may be out of date.
- Determine what trail activities the trail will be designed and managed to accommodate, and which will be prohibited on the trail.

Figure 28 Example Area of Interest Map - Meadows Trail

- Based on the trail user objectives, determine what degree of challenge the trail will be designed to achieve.

Step # 1.4: Determine the Desired Maintenance & Risk Management Frequency

Though maintenance and risk management begin in earnest after the trail is developed, it is critical that trail operators think about the level and frequency of maintenance and risk management efforts that they intend to provide on the trail early in the planning process. Doing so, will help trail operators ensure that there is resourcing (money and trained people) to undertake this work. How often will the trail be inspected? How quickly will deficiencies be addressed? How often will deadfall be cleared? How much effort will go into mitigating risks? These decisions have implications on operational budgets and resourcing as well as on liability. Making, and documenting, purposeful decisions about maintenance and risk management and clearly communicating the frequency and level of maintenance and risk management efforts to trail enthusiasts, is an important part of the risk management process. These decisions also allow trail operators to properly determine and plan operational budgets. Specifically, trail operators should:

- Determine the frequency of trail inspections
- Define the maximum response times to address identified trail deficiencies
- Determine the frequency of regular maintenance (e.g. deadfall clearing)

- Agree upon the strategies and actions that will be taken by the trail operator to mitigate and / or manage risks associated with the trail (e.g. what trail infrastructure is appropriate to be built to manage risks associated with the trail)

Step # 1.5: Determine the Design Features, Amenities and Challenge Features

As discussed in Section 5.0, the design features, amenities and challenge features that are incorporated into a trail will largely determine whether the intended trail user objectives and, ultimately, the intended trail experience can be achieved. Trail operators should determine what types of trail features will be provided on the trail and align those features with the trail user objectives. These decisions must be made early in order to ensure a clear vision for the trail can be presented to, and agreed upon, with key stakeholders. Specifically, trail operators should:

Refer to Section 5.0, and determine what types of design features, amenities and technical trail features will be incorporated into the trail.

Step # 1.6: Determine the "Trail Significance" & Theming

Some trails can motivate enthusiasts to travel to the trail from afar while others are predominantly enjoyed by local enthusiasts due to their proximity and convenience. Whether the trail will be planned, designed and managed as a tourism attraction or a local recreational resource should be a deliberate decision made early in the trail planning process. Will the trail offer something different or unique? Will the trail have a specific theme reflecting the history of the area or its environment? Where will enthusiasts travel from to experience the trail? Determining the general significance of the trail and a trail theme (if relevant) will have considerable implications for how the trails are designed, the amenities that are provided on the trail and nearby, the marketing that is undertaken, the signage / wayfinding and supporting services associated with the trail, and where the trail connects to (See Section 2.2 for Principles for Successful Trails Tourism). To make this decision, trail operators should:

- Determine whether the trail is intended to be a "Signature Trail" that motivates tourists to travel to the area of interest from near and afar or whether it is intended to predominantly serve the recreational interests of local enthusiasts. Select the level of significance of the trail (local, regional, provincial, signature).

Step # 1.7: Determine the Level of Trail Programming

Many trails are built at considerable expense but experience low levels of use. Though common, the “build it and they will come” approach has often proved unsuccessful. The most enjoyed trails are those that have active, deliberate and coordinated programming. That programming can be passively programmed (e.g. self-guided interpretive tours) or actively programmed (e.g. organization of special events). It is essential that trail operators consider the types of programming that are envisioned on the trail as these decisions will, in most cases, need to be considered during the trail master planning and design phase and certainly during the trail management and operations phase. Specifically, trail operators should:

- Determine if the trail will be actively or passively programmed and, if it’s to be programmed, the types of programming that are to be provided at various times of day, week and season and who will be responsible for planning and implementing programs.

Step # 1.8: Complete the Trail Management Objective

As indicated in Section 2.2, Trail Management Objectives (TMO) synthesize and document the management intention for the trail in a clear, consistent and understandable way. TMOs help to ensure subsequent trail planning, maintenance, and management decisions as well as monitoring and reporting are consistent with the original vision for the trail. Without a TMO, the original intent and purpose of the trail can be quickly lost as new technologies arise, enthusiast

photo: Davebloggs007

pressure mounts, or visitation begins to exceed the desired recreation setting. The TMO is the foundation that trail operators can use to justify and defend their decisions and can prove useful should litigation or other suits arise due to injury. Specifically, trail operators should:

- Summarize all decisions about the trail user objectives, trail classification, maintenance and risk management, trail significance and programming by completing a Trail Management Objective form (see Figure 3). The TMO should be saved on record and will form an essential submission to the Public Land Manager and for engagement.

Step # 1.9: Meet the Public Land Manager

With a clear vision in mind and an area of interest identified and mapped, it is time for the trail operator to meet with the public land manager. It is important that the trail operator initiate discussions with the public land manager early in the trail planning process. The public land manager can provide valuable guidance about the trail planning process, key stakeholders to engage, policy direction, legislative and regulatory requirements, and opportunities and constraints that will need to be addressed. Trail operators should:

- Arrange a meeting with the local public land officer to begin discussions about the desired trail, introduce the trail operator and the trail planning team, present the TMO and a general map of where the trail is going to be sited, and outline the intended trail planning process.

The purpose of this phase is to identify and understand the legislative and regulatory obligations, necessary permits, important land management policy direction, and existing constraints that need to be considered in the trail plan. In this phase, trail operators will undertake desktop and field-based inventories and assessments to further understand the site and determine if the site can accommodate the trail vision and TMO.

Examples of the Land Management Policies & Plans to be considered:

- Land Use Framework Regional Plans
- Sub-Regional Recreation Management Plans
- Watershed Management Plan
- Access Management Plans
- Land Footprint Management Plans
- Local Land Management Plans
- Species Management & Recovery Plans
- Forest Management Plans
- Range Management Plans

Most plans and policies can be found on the Alberta Environment & Parks website at: www.aep.alberta.ca

Phase 2
Analysis, Constraints & Opportunities

Step # 2.1: Review & Summarize Relevant Provincial, Regional & Local Land Management Policy Direction

Public lands in Alberta are managed to achieve many different priorities. These priorities vary throughout the province. To help public land managers make land-use decisions, provincial, regional and local land management policy and plans are developed. The development of trails must follow established land management policy direction. Trail operators should review all policy direction that is relevant to the project area. It is important that trail operators can identify to public land managers how the proposed trail project aligns with and / or contributes to the policy priorities and direction set for the project area. In some cases, trail operators may find that the development of a trail may be prohibited by or misaligned with the management intent for the project area. In these cases, trail operators should seriously reconsider whether they want to pursue the project knowing it is not aligned with the policy direction. Specifically, trail operators should:

- Identify which land management policy and plans are relevant in the project area. The public land manager is a good resource who can help identify the relevant policy and plans. These plans and policies should be reviewed and summarized, and the operator should clearly document how the trail project aligns with or contributes to the direction in the relevant policies and plans.

Step # 2.2: Review & Summarize the Legislative & Regulatory Requirements

As indicated earlier, the use and development of public lands, and the resources on them (e.g. wildlife, fish, vegetation, species at risk, historic resources, waterways, etc.), are managed in accordance with various federal, provincial legislation and regulations and, in some cases, municipal bylaws (see Section 1.6). It is essential that trail operators understand the legislative, regulatory and bylaw requirements and permits that govern the development of trails and trail infrastructure on public lands. No development of trails or trail infrastructure is permitted to occur on public lands without the approval of the Minister. It is also important that trail operators understand how provincial regulations can be used to help manage the use of trails on public lands. Specifically, trail operators should work with the local public land manager to:

- Identify the legislation, regulations and, if relevant, municipal bylaws that apply to trail development in the project area.
- Review the Public Lands Act Administration Regulation Table A1 to understand the appropriate dispositions that can be granted for trail development and related trail infrastructure on public lands.
- Identify all permits and authorizations required during each stage of the trail planning, development, and management process.
- Determine if and how provincial regulations (e.g. Public Lands Administration Regulation) can be used to help the trail operator manage use of the trail and achievement of the TMO.

Step # 2.3: Review & Map Existing Land Uses, Land Tenures & Land Ownership

Public lands are busy. There are many different land users, disposition holders (dispositions to use Public Lands which may exclude other land uses, including trail users) that need to be considered when planning a trail. Some existing land uses may be compatible with trails while others will not be due to safety, aesthetics, security, or other reasons. Trail operators must identify and understand who owns the land within the project area as public lands often abut

Trail Tip

Public Lands that are under a grazing lease disposition need to receive special consideration during trail planning. The Public Lands Act's Recreational Access Regulation allows the grazing leaseholder to control public access to the lease in order to protect the land and livestock from harm while requiring the leaseholder to provide reasonable access to the leased lands for recreation. Trail Operators should meet early with grazing leaseholders if the areas of focus for the trail is subject to a grazing lease. The GOA's Recreational Access Internet Mapping Tool (available on the Public Land Manager's website) should be reviewed to determine the conditions for access and contacts of the leaseholder.

Trail Tip

Some disposition types grant exclusive access which means that trail development and recreational access is not permitted on lands under these dispositions. Exclusive use disposition types include:

- Farm Development Lease
- Mineral Surface Lease (AER)
- Mineral Surface Lease
- Department Miscellaneous Lease
- Pipeline Installation Lease (AER)
- Department Pipeline Installation Lease
- Surface Materials Lease

These disposition types should be avoided when planning a trail.

Disposition

An instrument used by the Minister to grant an interest, right or privilege on public lands. Different disposition have different term lengths, levels of exclusivity, submission requirements and processing

private lands (or lands owned or managed by local governments). To help understand the existing land uses, tenures, and land owners in the project area, trail operators should:

- Prepare maps, as well as a written summary, of the project area's:
  - Private lands, public lands, municipal lands
  - Provincial Parks & Protected Areas
  - National Parks & Federal Lands
  - First Nation Reserves
  - Metis Settlements
  - Existing surface and sub-surface tenures and their purposes – note, some dispositions grant exclusive use which means that public access for recreation and other purposes may not be permitted.
  - Grazing Reserves
  - Forest Management Agreements
  - Timber permits and timber quotas
  - All classes of roads and highways, and
  - Any notations and reservations land in the area of interest

Step # 2.4: Inventory Land Cover, Physical, Environmental & Historic Resource Values

Trail planning needs to consider and avoid or mitigate impacts to environmental and historic resource values. Avoiding or minimizing impacts to these values is both a legislative and social license requirement. Trails that would create unacceptable impacts to environmental and historic resource values should not be pursued. The first step in avoiding environment and historic resource impacts is understanding where specific values exist in the area of focus. Before undertaking a field assessment, trail operators can learn a lot about a focus area's environmental

and historic resource values through some desktop research and mapping. The province maintains a number of helpful environmental and historic resource inventories that may be available to be used to support trail planning. Trail operators should:

- Obtain, analyze and prepare maps, as well as a written summary, of the following environmental and historic resource inventories in the area of interest using the following tools:
  - **ACIMS Online Mapping Tool**
    - › Alberta Conservation Information Management System Element Occurrences
  - **FWMIS Online Mapping Tool**
    - › Fish & Wildlife Information Management System
  - **Geodiscover & Landscape Analysis Tool**
    - › Provincial Wildlife Sensitivity Layers
    - › Environmentally Significant Areas
    - › MULTISAR – species at risk in the grasslands
    - › Derived Ecosite Phase data (Vegetation & Soils)
    - › Hydrology (water courses & bodies)
    - › Flood Hazard Mapping
    - › Wet Areas Mapping
    - › Alberta Merged Wetland Inventory
    - › Hydrology & Water Body Classifications (focus should be on Class A & B waterbodies)
    - › Digital Elevation Model showing slopes (e.g. LiDar, Topography)

Trail Tip

Land ownership, tenures and land uses can be viewed through the Government of Alberta's Landscape Analysis Tool. The Landscape Analysis Tool (LAT) is a web-enabled geo-spatial mapping tool that identifies base and sensitive landscape features and how they interact with a proposed land location and activity being considered on Public Land. It allows users to view and map their proposed project and generate a LAT report required for all Alberta public land disposition applications.

Helpful Datasets for Inventorying Existing Recreation Features & Settings include:

- Provincial Trails Inventory
- Recreation & Tourism Features Inventory
- Recreation & Tourism Opportunity Spectrum
- Scenic Resource Assessment
- Strava Global Heat Map
- Trail Forks
- Back Road Mapbooks
- Local guidebooks

Trail Tip

Class A & B waterbody classes include sensitive fish habitat and will have timing restrictions for the installation of water course crossings.

Trail Tip

The spatial accuracy of field data and desktop data is critical for good trail planning. High quality GPS units with a minimum spatial accuracy of approximately 5m (open canopy) and 10m (heavy canopy) should be used for all site inventory and assessment work.

- **Recreation Opportunity Model**
  - › Land suitability for trail development based on soil moisture and slope
- **Historic Resource Values**
  - › Listing of Historic Resources
- **Satellite Imagery / Aerial Photography**
  - › Different sources including Google, Bing, SPOT, Vaultus,

Step # 2.5: Inventory Existing Recreation Use, Recreation Features & Nearby Amenities & Services

Before trail operators can plan a future trail, or network of trails, it is essential to understand the existing recreational uses and inventory of trails in the project area. It is also essential to understand what recreation settings and appealing recreation features and amenities exist in the project area. Finally, recognizing that trail enthusiasts require supporting services, trail operators should understand what trail-related services (e.g. supplies, accommodations, food) are available within, or nearby, the project area. There are numerous datasets available to trail operators that can help with this inventory before undertaking a site assessment. Many of these datasets are available online or through the local Public Land Manager. Trail operators should:

- Prepare maps and a written summary of the project area's:
  - Existing recreation uses (type, season, frequency)
  - Existing trails, trail conditions and issues
  - Existing recreation settings
  - Existing attractions and features of interest to trail enthusiasts

- Existing staging areas & trail amenities
- Scenic Resources
- Regional connections
- Supporting amenities & services (e.g. accommodations, food, supplies & equipment, servicing)

Step # 2.6: Conduct a Site Inventory & Assessment

Up to now, there has been little field study completed beyond preliminary reconnaissance to determine the general appeal of the area of interest for trail-based recreation. With the desktop work completed and a clear vision for the trail, it is now time to head to the field to validate and, as needed, refine and complete the desktop inventories. Trail operators should:

- Travel throughout the entire project area and lands immediately adjacent to the project area to validate the desktop inventories. GPS data should be collected in the field to address gaps or inaccuracies in the desktop inventories.

Step # 2.7: Build Support through Engagement

With a general understanding of the land owners, land users, tenure holders, Indigenous communities in and near the area of interest, the trail operator should reach out to and meet with key stakeholders who have a stake in the area of interest. The purpose of the engagement is to introduce the project idea and explore any concerns or ideas and general level of support stakeholders and Indigenous communities have with the project. There are many different approaches that can be used to engage stakeholders. It is critical that the engagement approach is meaningful and that trail operators listen and genuinely consider the input provided.

Specifically, trail operators should:

- Prepare and implement an engagement and communications plan for the project
- Review and apply the Government of Alberta's Guidelines on Consultation with First Nations on Land and Natural Resource Management and the Guidelines on Consultation with Metis Settlement on Land and Natural Resource Management to effectively engage Indigenous communities in the area of interest
- Engage stakeholders through a variety of approaches
- Work to understand the concerns and opportunities and incorporate them into the concept plan
- Advise stakeholders who participated in the process how their input influenced the draft trail concept plan and, if the input was not incorporated, why it wasn't

Step # 2.8: Prepare Opportunities & Constraints Maps

With the inventory data now confirmed, trail operators should turn the attention to mapping the constraints to developing the trail as well as the opportunities to ensure a quality trail experience. Constraints are the general areas that should be avoided and should be organized into the following categories **a) no-go areas, b) partial-go areas and c) don't want to go areas**. Opportunities are the elements that can greatly enhance the quality of the trail experience. They may provide a destination, a goal, a photo or learning opportunity, or a convenient connection of the trail to a broader experience. These will be the things that enthusiasts remember about the trail and, if at all possible, the trail operator should ensure the trail connects to them. Opportunities should be generally categorized as **a) design features, b) connections, c) attractions, and d) amenities.** Opportunities need to be evaluated to ensure that undesirable impacts to environmental values can be avoided or satisfactorily mitigated before they are included in the trail.

Specifically, the trail operator should:

- Identify, map and prepare a summary of the constraints to trail development in the project area.
- Identify, map and prepare a summary of the opportunities that should be taken advantage of to provide a quality trail experience in the project area.

Constraints Mapping

No-go areas – portions of the project area where trail development is not permitted or not possible (e.g. private land, tenured lands, legislated protected areas, historic resource sites).

Partial-go areas – portions of the project area where trail development may be possible but only if mitigation strategies are applied (e.g. nesting sites within a distance, wildlife corridors, seasonal ranges, riparian areas)

Don't want to go areas – portions of the project area that are free from restrictions but where the physical conditions may make trail development exceptionally costly, provide a poor experience, or result in enthusiast management challenges (e.g. undesirable ground, large open grassy areas, hazard features like steep drop-offs)

Opportunities Mapping

Common opportunities to inventory and map include:

- Highest points
- Water (e.g. lakes, ponds, rivers, waterfalls)
- Wildlife Viewing Areas
- Unique vegetation
- Viewpoints
- Historic & Interpretive Sites
- Regional trail connections
- Connectivity to existing camping, staging or day use areas
- Accommodations, Servicing & Food

Step # 2.9 Refine the TMO... if Necessary

Now that the opportunities and constraints of the project area are understood, it is time for the trail operator to reflect on the TMO. Can the direction in the TMO be achieved while avoiding the constraints and taking advantage of the opportunities? If yes, then the trail operator should proceed to the master planning phase. If not, then the trail operator should proceed with one of the following two options:

- Refine the TMO and trail vision to work within constraints and opportunities of the project area, or
- Reconsider the appropriateness of the trail project in the project area and seek another area.

Phase 3
Trail Concept Planning & Order of Magnitude Costing

Up to this point, the only visual and spatial concept of the project would have been a general area of interest boundary and the maps associated with the inventories and opportunities/ constraints analysis. The purpose of this phase is to conceptually translate the vision for the trail onto the ground in a way that meets any legislative and regulatory requirements, aligns with or complements existing policy, takes advantage of the opportunities, and avoids or mitigates impacts and conflicts with known constraints.

Step # 3.1: Draft Trail Concept Plan

It's now time to bring the vision to life. In the concept plan, the general trail corridor(s), rather than the exact trail tread location, will be prepared. The goal of this plan is to present the conceptual idea for the trail, trail amenities, signage and wayfinding, infrastructure, and attractions in a sketch map. Concept plans also typically include an overview of the trail operator, the vision for the trail, TMO, background information about the site, inventories, opportunities/constraints and strategies that will be applied to mitigate environmental and historic resource impacts from the trail. It is also recommended that general information about trail management strategies, maintenance, and risk management be provided. Generally, trail

Trail Tip

Trail planners should work with, rather than against, human nature. Create the WOW factor! Enthusiasts will want to go to the major attractions in the project area, but the route to get there must be convenient as well as interesting. Well-planned trails provide a sustainable way for enthusiasts to experience these attractions.

operators should begin the process of conceptual trail routing by assuming that all identified constraints (no-go, partial-go, and don't want to go areas) are to be avoided in trail corridor planning. In some cases, there can be multiple options for routing the trail. If appropriate, these options should be identified, and the pros and cons associated with each described to help select a preferred option. Trail operators should contact the local public land manager, prior to completing any mapping or data collection, to confirm the data standards for submission (e.g. accuracy of GPS data, scale of maps, map formatting and required content). Specifically, trail operators should prepare a trail concept plan , including sketch map(s), that illustrates and describes:

- Options for the trail corridor, the pros and cons of each option and the preferred option,
- Where the preferred trail corridor(s) will go, the trail classification for each segment, and which portions will make use of existing trails vs. those which will require new trail construction,
- Local and regional trail connections beyond the immediate project area,
- Type and general location of technical trail features,
- Type, general locations, and design of trail amenities (e.g. staging areas, washrooms, day-use / picnic shelters),
- Type and general location of major attractions,
- Type, general locations and design of trail infrastructure (e.g. access controls, water course crossings and water body type, boardwalks, retaining features),
- Signage plan,
- Type, general location, and design of roadway crossings,

Trail Tip

Trail operators can refer to the Master Schedule of Standards and Conditions, Species at Risk Recovery Plans, Guide to the Code of Practice for Watercourse Crossings including Guidelines for Complying with the Codes of Practice and the Listing of Historic Resources Instruction for Use to identify measures to mitigate impacts from the trail.

Trail Tip

The type, frequency and location of trail amenities and infrastructure can dramatically alter the trail experience. Trail operators should ensure the type and frequency of amenities and infrastructure is aligned with the desired level of development of the trail and available budgets and resourcing.

- Existing trails and access that will be closed and priorities for reclamation of existing trails in the area of interest,
- Measures that will be taken to mitigate the impacts of the trail on environmental resources, historic resources and land uses,
- Enthusiast management (e.g. education, enforcement), risk management, and maintenance strategies, and
- General trail statistics (e.g. kilometres of trail by type, number of amenities by type, number of infrastructure elements by type).

Step # 3.2: Build Support through Engagement

Now that the draft trail concept plan is prepared, it is time to involve trail enthusiasts, trail organizations, Indigenous communities, and other stakeholders (e.g. tenure holders, adjacent land owners, environmental organizations) in the review of the concept plan. There are many different approaches that can be used to engage stakeholders in the review of the concept. Whether it be in-person meetings, open houses, workshops or online approaches, it is critical that the approach is meaningful and that trail operators listen and genuinely consider the input provided.

Specifically, trail operators should:

- Prepare and implement an engagement and communications plan for the project
- Review and apply the Government of Alberta's Guidelines on Consultation with First Nations on Land and Natural Resource Management and the Guidelines on Consultation with Metis Settlement on Land and Natural Resource Management to effectively engage Indigenous communities in the area of interest
- Engage stakeholders through a variety of approaches

- If substantive comments are received, trail operators should incorporate them in the trail concept plan
- Advise stakeholders who participated in the process how their input influenced the final trail concept plan and, if the input was not incorporated, why it wasn't

Step # 3.3: Final Concept Plan & Order of Magnitude Cost Estimates

Now that the opinions, ideas and considerations of stakeholders are understood, the draft concept plan can be updated, and a final concept plan can be prepared. At this stage, there is enough information to enable the trail operator to prepare an order of magnitude cost estimate for the project. Specifically, the trail operator should:

- Revise the draft concept plan based on stakeholder input and prepare a final concept plan
- Prepare class D order of magnitude capital and operational cost estimates for the trail. The accepted accuracy of a class D cost estimate is +/- 50%
- Prepare a summary of engagement input

Step # 3.4: Public Lands Application & Referrals

With broad support achieved for the trail concept plan, it is now time to approach the public land manager with an application to develop the trail. The information generated to date and summarized in the concept plan is enough information to complete the application. It is essential that the trail operators meet with the local public land manager to present the concept plan and request direction about the application process, timelines, fees and other requirements. The application, when received, will be reviewed by the public land manager for completeness and, if acceptable, it will be referred to various government departments for review and comment. This process can be iterative, and it can take time. Specifically, the trail operator should:

- Meet with the public land manager to present the draft concept plan and request direction and assistance with the application preparation
- Prepare the application following the guidelines available and as directed by the public land manager
- Submit the application and final concept plan
- Address any requests for further information if they arise

Trail Tip

It often happens… the plan for the trail ends up costing more than the budget available. If this happens, trail operators should consider breaking the project into affordable phases. If this is done, careful consideration should be taken to ensure the phasing achieves efficient construction. Trail operators should avoid having equipment mobilizing and demobilizing over the same segment of trail multiple times.

Phase 4
Detailed Trail Design and Permitting

Step # 4.1: Detailed Trail Layout & Pin-Flagging

The concept plan identified the general corridor in which the trail would be located. Now, it's time to determine exactly where the trail tread and all amenities and infrastructure will be located. Following the design principles provided in earlier in the manual, trail operators should:

- Determine and flag the general corridor with flagging tape tied at eye level. At this stage each piece of flagging tape can be shot to with a clinometer to ensure that the trail grades meet those laid out in the TMO. The local public land manager may wish to ground truth and review the corridor layout with the trail operator.
- Once the corridor is visually defined, mark the exact location of the trail tread using pin flags located on the low side of the trail. The meandering of the pin flags denotes the flow of the trail and consequently the potential speed of travel of the users. Trees located below the pinflags are denoted to remain as anchors to keep the trail from creeping down the hillside. Trail features, amenities and other infrastructure should be denoted using pin-flags. The local public land manager may again wish to ground truth and review the detailed layout with the trail operator.
- Undertake a detailed GPS-based inventory of the trail tread, amenities and infrastructure locations and quantities which will be used to inform detailed cost estimates and tender package preparation.
- In some instances where the risk of trespass is high (e.g. trails being built close to the boundary of private lands, near national or provincial parks and protected areas or near exclusive use dispositions etc.) the public land manager may require that the trail operator complete a legal survey to ensure the detailed layout of the trail does not infringe upon another tenure holder or land owner. Trail operators should discuss the need for survey early with the local public land manager.

Step # 4.2: Prepare Construction Drawings or Commercial Product Specs

Moving from concept to detailed design means that the trail operators need to develop, acquire, and provide exact design direction for all elements associated with the trail. Specifically, the trail operator should:

- Prepare or acquire engineer-stamped construction drawings or, as appropriate, commercial product specs for the following:
    - Trail tread
    - Trail amenities (e.g. staging areas, furnishings, washrooms, waste / recycling receptacles, picnic tables, etc.)

- Technical trail features
- Trail Infrastructure (e.g. water crossing structures, retaining walls, stairs, boardwalks etc.)
    - › Signage (AEP may require the of established sign designs from available GOA sign manuals)

Step # 4.3: Final Detailed Cost Estimate

With the detailed design / location of the trail, construction drawings, and quantities complete, the trail operator has much more detailed information on which to base a detailed cost estimated. A revised detailed cost estimate should be prepared. The trail operator should:

- Utilize the detailed inventory to calculate the quantities for the tread length by type, trail amenities by type and infrastructure by type and dimension. This information should be set up in an Excel spreadsheet.
- Utilize the quantities to establish a detailed capital cost estimate for budgeting purposes.

Step # 4.4: Permitting & Approvals

With the final design details in the place, the trail operator is now ready to obtain final approvals, permits and permission to proceed with construction. The trail operator should enquire with the local public land manage to ensure that all required permits and approvals (e.g. environmental, historic resource, crossings, access etc.) have been identified and obtained. To support submissions for permits and approvals, the the trail operator should prepare the following:

- The final detailed trail routing along with the locations of all amenities and infrastructure identified by type.
- The detailed design specs for all trail amenities and infrastructure.
- Final detailed cost estimate.
- Proof that funding for the project has been secured and is sufficient to undertake the construction and the operations of the trail.
- Request written authorization to proceed with construction.

Where the trail operator is a non-government entity, the public land manager may also request the above information be provided before final permits and approvals are issued.

Phase 5
Tendering & Construction

You now have your approval and are ready to move forward with construction. There are many different ways that trails are actually built in the province. Given the broad nature and diverse audience for this manual, the following steps have been generalized. Some trail operators (e.g. Government of Alberta), have well established procurement procedures to follow and, as such, they may choose to ignore the following steps. However, for other trail operators, it may be the first time they have constructed a trail. The following steps are provided to support those trail operators who may need some guidance on the trail tendering and construction process.

Step # 5.1: Tendering & Procurement (if construction is by a contractor)

Some trail operators will build a trail with volunteers while others may procure the services of a professional trail builder. For those that elect to engage a trail contractor, the trail operator should apply the following tendering process:

- Prepare a bid package and quantities documents.
- Establish a Bid Review & Selection Team
- Advertise the procurement opportunity with trail contractors or on the Alberta Purchasing Connection
- Set up and host a pre-bid site meeting
- Provide opportunity for interested contractors to submit and receive responses to the questions of clarity
- Receive the bids and review and evaluate the bids with the Bid Review & Selection Team Review
- Award the project to the successful proponent and negotiate and sign the contract
- Prepare a clear project management plan for the implementation and management of the construction phase of the project.

Step # 5.2: Construction Management Plan

The construction of a trail can lead to undesirable impacts on the environment, historic resources, public safety, and visitor experience during the construction period. Trail operators should anticipate these impacts and proactively plan to avoid or minimize these impacts. Specifically, the trail operator should:

- Prepare a construction management plan that identifies the potential environmental, historic resource, public safety, and visitor experience impacts that can result during trail construction and the measures the trail builders, whether volunteers or contractors, will take to avoid or mitigate the impacts (see Section 6 for guidelines on minimizing impacts during trail construction)

Step # 5.3: Construct Trail

It is now time to build the trail. Trail operators should:

- Proceed with trail construction following all required construction guidelines and impact mitigation requirements.
- Install all required signage in accordance with Sign Plan.

Step # 5.4: Construction Administration & Inspection

It is now time to ensure the vision for the trail is effectively achieved on the ground. Trail operators need to remain on top of the construction process and implementation of the project management plan. Frequent communications with the trail builders are required to ensure the project remains on budget, on time and within the design plan and approval conditions. Regular inspections of the built trail and amenities should be undertaken to ensure the vision is being achieved and is within the conditions of the approvals. Specifically, trail operators should:

- Regularly review the construction progress against the conditions associated with the public land manager approval, the trail user objective and the design parameters and specifications. If deficiencies are found, the trail operator should require adjustments, as necessary, to achieve the intended design direction and trail experience.

Step #5.5: Final Acceptance & Opening

After a final inspection and confirmation that any deficiencies have been addressed satisfactorily, the trail operator is ready to accept the trail and demobilize the construction crew. Specifically, the trail operator should:

- Complete a final inspection of the trail(s). If acceptable, open the trail to the public.

Step #5.6: Submit Final Data to Public Land Manager

It is inevitable that minor adjustments to the trail route will occur during the construction phase. However, it is important that the public land manager receive the accurate trail alignment and location of trail amenities and infrastructure. The trail operator should:

- Complete a final as-built GPS and photo inventory of the trail and all amenities and infrastructure and supply the updated data to the public land manager.

2.4 Principles For Successful Trail-Based Tourism

Trails can help to strengthen, diversify and grow local, regional and the provincial economy through trails tourism. However, not all trails will have, or should be designed to have, tourism potential. The decision to develop a signature trail capable of driving trails tourism should be a purposeful decision made early in the trail planning process. Signature trails motivate travel and can generate significant economic benefits. Signature trail experiences are expected by target markets but are also desired by local enthusiasts. In many cases, signature trails, designed and built to drive tourism, also become some of the favorite trails for local enthusiasts.

It goes without saying that to be a signature trail, all of the planning principles need to be applied and an exceptional trail constructed. However, to become a successful trail destination, trail operators and host communities need to think broader than simply building great trails. The full visitor experience, from the time an enthusiast begins planning their trip, to when they arrive in the host community to when they depart for home needs to be considered when working to create a successful signature trail experience. To maximize the trail tourism potential of a signature trail, trail operators should work with partners and host communities to:

- Connect the signature trail directly into host communities so that visitors can leave directly from the community to start their signature trail experience.
- Create noticeable, appealing and themed gateways at the primary staging area(s) of the signature trail. Gateways will create an immediate, welcoming and positive first impression for the enthusiast.
- Enhance community beautification at and near the primary staging areas for the signature trail as well as near trail services and attractions.

Trail Tip

The Government of Alberta requires that final project data be submitted in an accurate and consistent format. Data requirements should be obtained from the public land manager prior to completing final field work.

Signature Trail

A trail that is capable of motivating travel to a destination by target markets. Though the trail type, length, level of development and difficulty can vary, the trail experience is regionally or provincially unique, the trail provides supporting amenities and services, and the trail is purposefully designed to meet the expectations of specific target markets.

- Install themed community banners and other markings that create a welcoming atmosphere for trail-based visitors as they travel through the host community.
- Install themed wayfinding signage within the host community to direct visitors to the primary staging areas as well as related services (e.g. accommodations, supplies etc.) and attractions desired by the enthusiasts.
- Work with partners and the business community to promote the development and offering of services required by trail enthusiasts such as accommodations, supplies, fuel, equipment and repair services.
- Work with the local Economic Development / Destination Marketing Organizations to develop a compelling and recognizable brand for the signature trail.
- Promote trail related services to enthusiasts who are using the signature trails to increase visitor spending within the host hamlets.
- Encourage, support and promote the organization and delivery of trails-oriented events (e.g. races, rallies, competitions) and programs on the signature trail.

Implementation of the above guidelines, together with the development of an exceptional trail, will help trail operators and local communities maximize the positive economic impact of the signature trail.

3.0 Factors Influencing Trail Design

3.1 Water & Drainage

Water management is one of the most important pieces of successful trail planning. It is incredibly powerful and can gradually move mountains into valleys. Never underestimate the power of water. Users will also try and avoid water that has pooled on the trail tread, leading to unplanned environmental damage. Upon initial trail scouting, identify all wet areas and wherever possible avoid these areas.

- Look & explore uphill – you need to know what is above the trail and going to affect the drainage on the trail – is there a massive bog which will constantly seep onto your trail - is there a highway culvert pointed at the trail? All these items dramatically affect what will be a sustainable trail alignment.
- Identify plant types that are indicative of wet areas.
- Try to cross seeps and drainages with the trail climbing out of the drainage from both sides to reduce the potential of water flowing down the trail tread and eroding the length of the trail.
- If appropriate for the challenge level dictated by the TMO and environmental regulations, avoid culverts, instead wherever possible harden the bottom of the gully with rock or a suitable material so water flows over top of the rock, and users travel on top of the rock. This will reduce the confinement of the channel due to a culvert and the potential of the culvert clogging and failing in a flood. For constant seeps where flooding is not anticipated, culverts may be appropriate.
- Design frequent grade reversals into any new trail to reduce the potential for water flowing down the trail.
- Use wet areas mapping, hydrological data and recreation opportunities mapping to identify potential problem areas prior to field work

3.2 Vegetation

Vegetation types can tell a lot about moisture content of the soil and soil stability (as referenced above), and vegetation can contribute to trail stability and enhance user experience.

- Trees can help with trail sustainability – trees will help keep an appropriate amount of moisture in the soil to slow down runoff thereby decreasing potential for large-scale erosion on the trail tread.
- During periods of drought, shade provided by trees can be an important factor in retaining moisture in the soils to help keep the trail tread intact and from the surface breaking down into dust.
- Trees can also provide shade and wind protection for the users, as well as a corridor to assist in navigation (compared to white out navigation for a trail in an open area).
- Trees are a very important tool to keep users on a trail and control user speeds. By maintaining living trees on the low edge of the trail, the designer creates anchors to prevent the trail from creeping down the slope. By dipping the trail down between large trees and back up at the trees, undulations can be created to direct water from the trail tread and force users to turn. This meandering and undulation will force users to slow down compared to a straight trail.
- Sight lines should be appropriate for the user group, with the large trees remaining where appropriate as anchors to create and enforce the corners, and branches removed to allow for visibility of the trail and of oncoming users (for two-way trails). Typically, deadfall should remain on the ground to block users from shortcutting the corners.
- Certain ecosystems host species at risk that may be difficult to fully identify in trail planning. Be aware of identifying features of sensitive plants or vegetation communities, such as five needle pine species (e.g. limber pine) and adjust on the ground construction accordingly

3.3 Sun

The amount of sunlight a trail receives will directly affect the trail users experience. In winter many users want north facing slopes to retain snow, and in areas of deep snowfall, south facing slopes to enjoy the warmth of the sun. For spring time, south facing slopes offer a chance to find the first dry soils to recreate on. In Summer, many users will be trying to find shade to avoid the heat of direct sunlight. In designing a trail system all these factors need to be considered in the TMO and trail network planning.

- South-facing slopes will dry out more quickly than north-facing slopes. Depending on the environment and moisture content of the atmosphere and soils, this may be positive or negative. In summer months, trails may degrade more quickly on south-facing slopes.

- Consider taking a trail to the desired number of open areas to allow users to enjoy views and sun yet allow them to escape it during overly hot periods.

If possible, view points and interpretive stations should offer a mix of sun and shade so that users can maintain comfort throughout the season and in different weather conditions.

3.4 Snow

Areas planned for winter use will need to consider historic snow fall charts as well as predictive climate modelling to ensure there will be enough months of the year with adequate snowfall for the desired recreation. Snow changes the clearance height and width requirements of trails – design and construction must account for snow depth and sag of vegetation for trails that are used in the winter. Timing restrictions may be required by the land manager, or should be considered by the trail operator to manage impacts of trail activities during thawing conditions on the trail.

3.4.1 Avalanche Terrain

Avalanches pose a significant risk to trail enthusiasts and liability for trail operators. Good planning and education is essential to managing the risk of avalanches to trail enthusiasts. For all new trail design and construction, trails should be routed out of Avalanche terrain wherever possible unless the trail is specifically designated as a summer use only trail or the level of risk is acceptable to the trail operator and land manager and can be effectively managed. For trails in avalanche terrain, trail operators should:

Figure 29 Avalanche map at Emerald Lake showing trail location, avalanche path, and educational information

- Avoid avalanche start zones, tracks, and run outs. If avoidance isn't possible, minimize the trail length crossing the slide path. Site trail to provide a full view of the avalanche slide path.
- Have terrain assessed by a qualified Avalanche Specialist and prepare an Avalanche Risk Assessment including:
  - Avalanche location mapping
  - Return frequency and size
  - Avalanche Terrain Exposure Scale (ATES) rating
  - Develop the Avalanche Hazard Index based on the expected return frequency, expected time spent in the avalanche zone, and expected level of use.
  - Communicate ATES rating to trail enthusiasts on trail and through web, brochures and other methods.

- Install signage notifying trail enthusiasts that the trail crosses avalanche terrain and stating the equipment and training that enthusiasts should have.

3.5 Physical Forces On Trails: Type & Degree Of Use

Soil displacement is the major factor resulting in ongoing trail maintenance. Displacement can occur from trail users in the form of compaction or erosion. Water is typically the driving force for soil displacement in the form of erosion on a trail. By designing trails to shed water, the tread and trail corridor will be more sustainable. A rolling contour trail will shed water better than a fall line trail.

- Design trails in such a way to keep the users on the trail. This is best achieved by creating quality trails specific to a user group, ensuring sufficient challenge and avoiding features that might cause frustration (e.g., an excessively long routing when there's obviously a more direct route). Users travelling off trail can be one of the worst sources of erosion and vegetation disturbance.
- Design trails with gradual changes in flow (ie gradual corners before sharp corners) to reduce dramatic acceleration and deceleration shear forces on the trail tread.
- The user type will also affect the level of erosion – throttle-heavy motorized users and equestrian users will break up the compacted trail tread surface and expose the soils to erosion, whether by water or wind.
- Higher user numbers will also affect the degradation of a trail; however, this can be mitigated with proper trail design and construction as well as appropriate levels of maintenance.

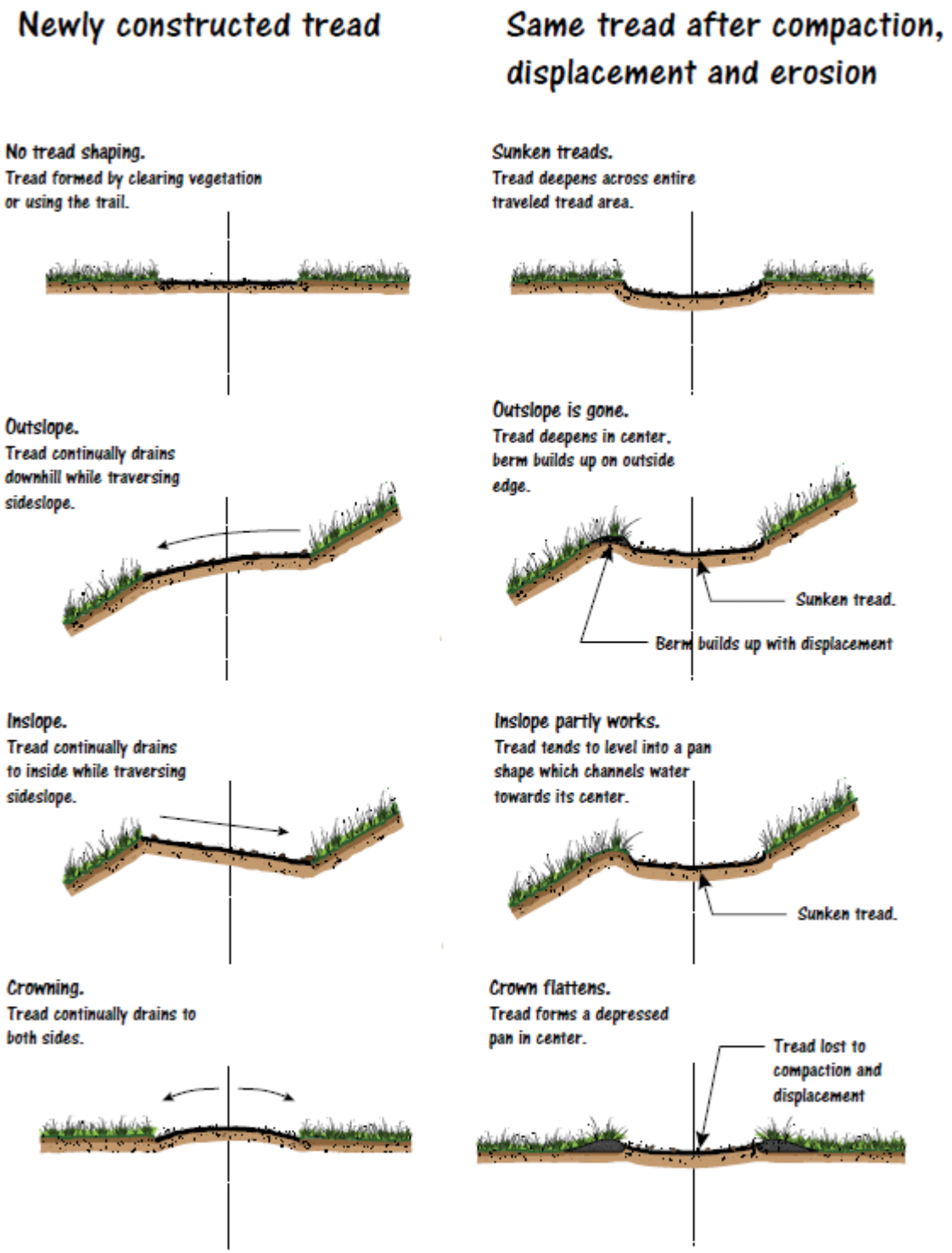


Figure 30 Lifecycle of a trail tread following compaction - from NOHVCC pg 62

- Four-wheel drive vehicles with locked differentials will displace soils when travelling through curves. This needs to be kept in mind during design to match the turn radius to the vehicle. Larger turns will result in less displacement.
- As the grade increases, the gravitational force becomes an angle to the trail tread, resulting in greater displacement of tread particles.

3.6 Universal Accessibility (Barrier Free Design)

Universally or Barrier Free trails are trails that can be enjoyed by all regardless of ability. These trails and amenities enable all trail enthusiasts, without assistance, to approach, enter, pass to and from, and make use of any area of the trail and its associated amenities. Universally accessible designed trails and trail amenities may be considered on public lands but are not anticipated to be typical. The desire for a trail to be universally accessible should be identified during the trail visioning and trail management objective setting stages of the trail planning process.

Universal design is a very broad topic that cannot be adequately or appropriately addressed in this manual. For more detailed direction on universal trail and trail amenity design, trail operators should refer to the Alberta Parks Accessibility Construction Guidelines manual. This manual includes information regarding Universal Design and Barrier Free codes, construction details as well as best practice recommendations that should be applied on trails whose objective is to provide a universally accessible trail experience.

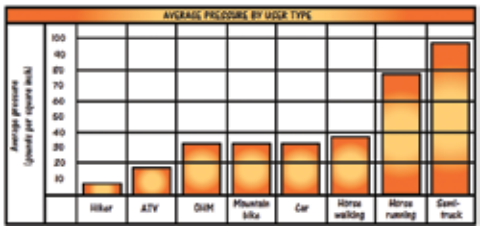


Figure 31 Average ground pressure by user type does not always imply greater soil displacement. The shear forces by these users results in greater displacement than the compaction forces. A hiker going slowly down a steep hill with large lugged boots will result in greater shear forces than a Mountain Bike or OHV coasting. NOHVCC 65

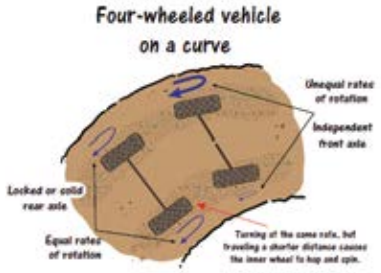


Figure 32 Four-wheel drive vehicles on a curve resulting in soil displacement. Users with low ground pressure can create more soil displacement than heavier ones if their shear forces are higher. NHOVACC 65

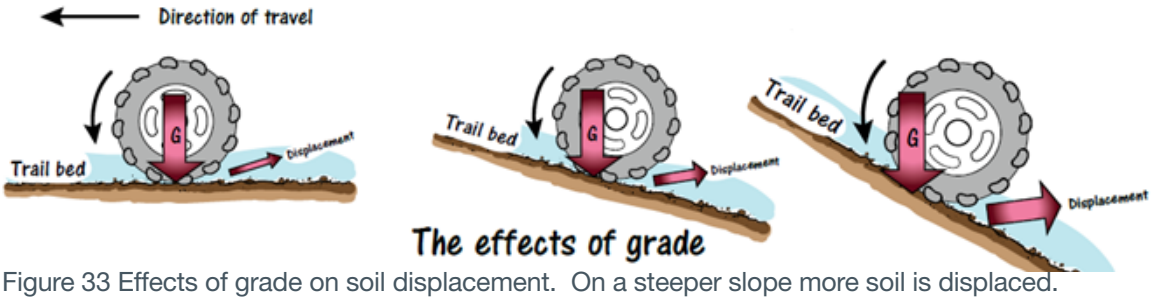


Figure 33 Effects of grade on soil displacement. On a steeper slope more soil is displaced. NHOVACC 63

Trail Tip

A single trail cannot be all things to all people. However, trail operators should ensure that the larger trail system provides an opportunity for everyone. Alberta Parks Accessibility Construction Guidelines manual should be referred to for direction on the creation of universally accessible or barrier free trail development.

4.0 Trail Classification

A common trail classification system is a fundamental building block of a well-planned and designed trail system. Without a common trail classification system, there will be little consistency in how trails are planned and designed which will almost certainly lead to lower quality trail experiences, greater safety risks and elevated liability risks to trail operators and public land managers. A trail classification system:

- Creates consistency in how trails are described and understood between trail enthusiasts, trail enthusiast organizations, trail planners, designers and builders, and public land managers,
- Allows trail operators to determine what trail activities are permitted on a given trail and to ensure compliance with the trail management objective,
- Enables consistent, quality and appropriate design and construction of trails across the Province's public lands,
- Enables trail operators to accurately communicate essential information to trail enthusiasts who can then confidently self-select trails that are aligned with their desired trail experience and capabilities,
- Helps to minimize user conflicts by ensuring trail enthusiasts know what activities are permitted on what trails, and

- Allows trail operators and public land managers to accurately inventory trails on public lands, understand the supply of trail experiences, and compare the supply of trail experiences with the demands of Albertans and trail tourists.

As all trail planners and designers know, some of earliest and most fundamental decisions made when planning and designing a trail include determining:

- What type of trail is to be constructed (land, snow, water, vertical),
- What modes of travel will be permitted on the trail (non-motorized, mechanized, motorized or a combination of these),
- Whether the trail will only permit one activity type or multiple activity types and, if multiple activities are to be permitted, whether the trail design will be optimized for a preferred activity type,
- For the activities that will be permitted on the trail, the design parameters of each activity,
- The recreation setting of the trail and the level of development and amenities that will be provided, and
- The difficulty level of the trail for the permitted activities.

The above considerations are equally important to trail enthusiasts. When considering what trail to recreate on, trail enthusiasts ask themselves similar questions:

- What trails permit my desired activity?
- What trails contain the technical trail features that will meet the objectives I have today?
- What trails allow my desired activity and are in the recreation setting I want?
- What trails provide the comfort and convenience amenities I need?
- Given my skill level, can I actually travel the trail safely and/or enjoyably?

Recognizing that trail planners and trail enthusiasts require very similar information, it only makes sense that a trail classification system would be based on, and clearly communicate, those fundamental characteristics.

The trail classification system that is to be applied consistently on Alberta's Public Lands is comprised of six fundamental elements:

1. **Trail Type**
2. **Travel Type**
3. **User Type**
4. **Level of Development**
5. **Activity Type**
6. **Degree of Challenge**

Each of the trail classification elements are further described in figure 34.

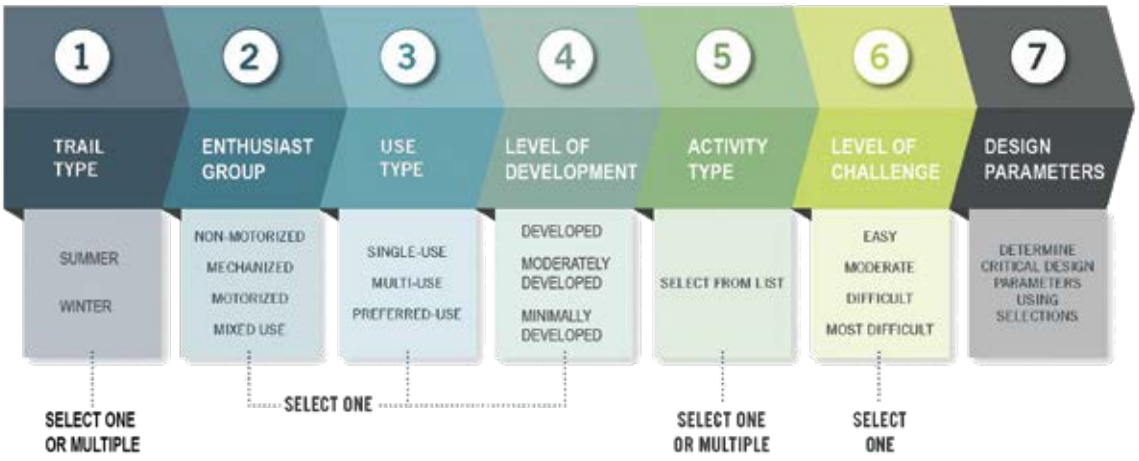


Figure 34 - Classification elements

4.1 Trail Type

The first consideration for trail planners and designers is to determine the trail type they wish to develop. The trail type is a category that communicates the predominant surface on which the trail is situated. There are four trail type categories:

- **Summer -** A trail that has a surface that is predominantly unfrozen ground and intended for use during non-frozen condition.
- **Winter –** A trail that has a surface that is predominantly snow and / or ice and intended for winter use.
- **Water –** A trail that has a surface that is predominantly water. A water trail may include some land-based portages.
- **Vertical –** A trail that is predominantly based on climbing vertical or near vertical rock faces.

At this time, the trail classification for public lands only provides guidance to summer and winter trail types. Trail operators interested in developing water and vertical trail types should consult with the local AEP office and utilize appropriate reference materials such as the International Scale of River Difficulty System and respective rock climbing grading systems.

When the elements of the trail classification system are combined, an example trail classification could be described as follows:

Non-motorized multi use moderately developed summer trail for pedestrians, equestrian and mountain bikers with a moderate difficulty level. This trail class description provides trail planners and designers, as well as trail enthusiasts, with most of the information necessary to plan and design the trail and ensure the trail is suited to meet the enthusiast's desired experience.

4.2 Enthusiast Group

Next, trail operators need to determine what trail enthusiast group(s) will be accommodated on the trail. The user group type is a category that broadly communicates the mode(s) of travel that the trail will be designed to accommodate. There are four broad enthusiast group categories:

- **Non-Motorized –** type of travel that is propelled by human or animal (e.g. horse, dog etc.) muscular power.
- **Mechanized –** type of travel that assists the trail enthusiast with travelling the trail by replacing, but not fully replacing, the need for the enthusiast to propel themselves by muscular power. Electric powered modes of travel are considered mechanized if they are electric assist. Modes of travel that remove, or are capable of removing, the need for the enthusiast to use at least some muscular power to propel themselves are considered motorized.
- **Motorized –** type of travel that is propelled by any power other than muscular power.
- **Mixed Use –** trails that incorporate any combination of non-motorized, mechanized or motorized user group types. A mixed used category can include the following combinations of user group types:
    - Non-motorized (e.g. hiking) and mechanized (e.g. mountain biking)
    - Non-motorized (e.g. snowshoeing) and motorized (e.g. snowmobiling)
    - Mechanized (e.g. e-assist mountain biking) and motorized

Trail Tip

When determining whether a trail should be designated for mixed-use or not, trail planners and designers should evaluate the existing recreation setting for the area using the province's Recreation & Tourism Opportunity Spectrum Inventory.

Some trails can be designated to accommodated different group types based on the season. For example, some trails may be designated non-motorized during the summer seasons but mixed use during the winter. In these cases, the TMO should be completed to identify the seasonal group type designation.

4.3 Use Type

With the broad user group(s) determined, trail planners and designers must then determine the intended "use type" for the trail. The use type is a category that communicates whether the trail will be designed and managed to accommodate one or more trail activities and /or whether the trail's design will be optimized for a particular trail activity. There are three use type categories:

Single-use – the trail is designed and managed to permit one single trail activity.

Benefits of Single-Use Trails

Single-use trails can…

- Be less crowded, reducing traffic jams.
- Cater more directly to a particular activity which can provide for a better trail experience for those enthusiasts.
- Be shared by enthusiasts with similar motivations, thus reducing potential conflicts, negative experiences, and safety risks.

Multi-use – the trail is designed and managed to permit multiple different activities in alignment with the intended travel type. Note, all mixed-use trails are, by definition, automatically assigned to the multi-use type as they are intended to permit more than one trail activity.

Benefits of Multi-Use Trails

Multi-use trails can…

- Provide quality, but not optimized, trail experiences for more trail enthusiasts on a single linear disturbance.
- Make the trail system cheaper to operate and manage overall. By having multiple users sharing the same trail, the total amount of trail can, depending on the levels of use, be reduced which minimizes the amount of trail that requires maintenance, monitoring and enforcement (e.g. 10 km of hiking and 10 km of ATV trail rather than a total of 10 km of mixed-use hiking / ATV trail).
- Enhance responsible use by exposing new trail enthusiasts to experienced enthusiasts who sharing their knowledge, expertise, and values. This can reduce maintenance and management requirements.

- **Preferred Use -** Preferred-use trails allow two or more activity types to utilize a trail but they are purposefully designed to optimize the trail experience for only one of the permitted activity types. Preferred-use trails can combine the benefits of both multi-use and single-use trails but, due to greater appeal of the design elements to optimized trail enthusiasts, these trails can become de facto single-use trails.

Preferred Use Trails

A trail can be managed to accommodate multiple different trail activities while, at the same time, be designed to specifically optimize the experience for a particular trail activity. For example, a non-motorized trail may permit hiking, equestrian use and mountain biking but the trail could be designed with appropriate technical trail features to optimize the experience for.

Activity-Optimized Features

Activity-optimized features are developed specifically to enhance the experience of preferred or single-use activities. They can be located on preferred-use, multi-use or single use trails. These features should be strategically placed in the trail corridor where they can be used for the preferred activity type but go relatively un-noticed by other permitted trail users. If you choose to pursue development of a preferred use trail, please see section 5.13 for examples of “activity-optimized” features that could be incorporated to optimize the experience for a range of trail enthusiasts.

Trail Tip

A trail that leads to a common point of interest or a destination that many different types of trail enthusiasts would like to and are permitted to visit should always be a multi-use trail. This doesn’t mean that the same trail should always be a mixed-use trail as mechanized or motorized recreation may not be consistent with the desired recreation experience for the area.

4.4 Level Of Development

With an understanding of the activities that the trail will be designed for, planners and designers now need to determine the level of development of the trail. Different trail enthusiasts seek different levels of development. Some look for remote settings where the comforts and conveniences of home are few and far between and encounters with others are limited. Others desire more developed trails where comfort and convenience amenities are readily available and encounters with others are frequent. While some may seek a level of development that falls somewhere in between. It is essential that the network of trails on public lands be purposefully planned to provide trail experiences across the full spectrum of development.

By purposefully picking a desired level of development for the trail and ensuring that level of development compliments the surrounding landscape level recreation setting, trail operators can better ensure the type and level of trail amenities provided on the trail are appropriate for the intended trail experience. Selecting the desired level of development can also enable trail operators to take steps to actively manage the volume of trail use by setting limits of use that is deemed consistent with the desired level of development for the trail and, if necessary, taking management actions to limit use of the trail (e.g. setting carrying capacities) to ensure the intended trail experience is achieved.

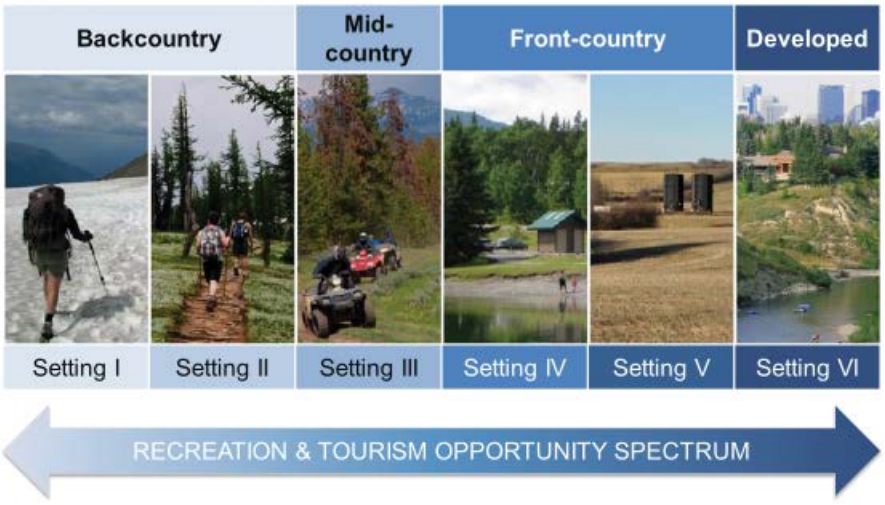


Figure 35 Alberta's Recreation & Tourism Opportunity Spectrum – Landscape Level Settings

There are three general levels of development a trail operator can choose:

- Developed
- Moderately Developed
- Minimally Developed

Not all levels of development are consistent with the surrounding recreation settings. As noted above, trail operators should work to ensure the level of development compliments the current and future recreation setting(s) in the area of focus. Table 3. Illustrates how desirable each level of trail development is in each of the core recreation / tourism settings identified in the Provincial Recreation & Tourism Opportunity Spectrum.

The type and level of trail amenities can significantly alter the trail experience and, for some, the trail difficulty. For example, it would be inappropriate to develop higher level of service washrooms, install frequent signage and other visitor amenities along trails that have been designed to provide a minimally developed experience. Similarly, it would be inconsistent with the desired trail experience not to provide trail enthusiasts with those amenities on trails intended to provide a developed experience. To better enable a quality trail experience, it is essential that the type degree of trail amenities is consistent with the desired level of development for the trail. To help trail operators align the trail amenities with the intended level of development, Table 4 provides guidance on which amenities are more or less appropriate for each level of trail development.

Table 4 Level of Development by RTOS Setting

Recreation Setting (based on Provincial RTOS Model)	Level of Development		
	Developed	Moderately Developed	Minimally Developed
Developed	Not Applicable on Public Lands.		
Frontcountry	Desirable	Desirable	Less Desirable
Mid-country	Less Desirable	Desirable	Less Desirable
Backcountry	Not Desirable	Less Desirable	Desirable

Table 5 Appropriateness of Amenities by Intended Level of Development

Amenities		Level of Development		
		Developed	Moderately Developed	Minimally Developed
Trail Infrastructure		Structures are frequent and typically constructed of imported materials. May include bridges, boardwalks, curbs, handrails etc.	Structures of limited size, scale, and quantity; typically constructed of native materials. Structures adequate to protect trail infrastructure and resources. Bridges as needed for resource protection and appropriate access.	Structures minimal to non-existent. Drainage typically accomplished without structures. Natural fords. Typically, no bridges.
Access	Type 1 Staging Area – Major Trailhead	Appropriate – pending degree of use / trail significance.	Appropriate – pending degree of use / trail significance.	Appropriate – pending degree of use / trail significance.
	Type 2 Staging Area – Minor Trailhead	Appropriate – pending degree of use / trail significance.	Appropriate – pending degree of use / trail significance.	Appropriate – pending degree of use / trail significance.
	Type 3 Staging Area – Rustic Trailhead	Appropriate – pending degree of use / trail significance.	Appropriate – pending degree of use / trail significance.	Appropriate – pending degree of use / trail significance.
Signage & Wayfinding	Major Trailhead Signs with Maps	Appropriate	Inappropriate	Inappropriate
	Minor Trail Signs with Maps	Appropriate	Appropriate	May be Appropriate
	Trail Markers/ Directional Signs	Appropriate	Appropriate	Appropriate – but bare minimum required to navigate
	Regulatory/ Caution/ Advisory Signs	Appropriate	Appropriate	Appropriate – but minimal
	Interpretive Signs	Appropriate	May be Appropriate	Appropriate – but minimal
Comfort & Convenience	Flush Toilet	May be Appropriate	Inappropriate	Inappropriate
	Composting Toilet	May be Appropriate	Appropriate	Appropriate
	Vault Toilet	Appropriate	Appropriate	Appropriate
	Waste Receptacles	Appropriate	Inappropriate	Inappropriate
	Recycling Receptacles	Appropriate	Inappropriate	Inappropriate
	Benches	Appropriate	May be Appropriate	Inappropriate
	Picnic Tables	Appropriate	Inappropriate	Inappropriate
	Off-loading ramps	May be Appropriate	May be Appropriate	Inappropriate

4.5 Activity Types

Now, trail planners need to determine the specific trail activities that will be permitted. The trail activities are organized by trail user group types – 1) non-motorized, 2) mechanized and 3) motorized. The following activity types have been identified for each user group and pictures are provided to illustrate the general activity type:

Non-Motorized Trail Activities

Type of travel that is propelled by human or animal (e.g. horse, dog etc.) muscular power.

Pedestrian (Walking, Running, Hiking, Backpacking)

Equestrian (Saddle & Pack, Endurance Riding)

Equestrian - Horse Drawn Vehicle (Horse & Buggy / Cart, Covered Wagon, Horse Drawn Sleigh)

Cross-Country Skiing – Classic

Cross-Country Skiing – Skate

Snowshoeing

Dog-Sledding & Skijoring

Mechanized Trail Activities

Off-Road Cycling (self-propelled & e-assist)

Motorized Trail Activities

Type of travel that is propelled by any power other than human or animal muscular power.

Two-wheeled Motorized Vehicle (one front & one back)

Snow Vehicle with width 1.5 meters (60”) or less

Motorized vehicle with width 1.5 meters (60”) or less

Motorized vehicle with width greater than 1.5 meters (60”) but 1.83m (72”) or less

Snow Vehicle with width greater than 1.5 meters (60”)

Motorized vehicle with width greater than 1.83 m (72”)

4.6 Degree of Challenge

Finally, trail planners and designers must determine how difficult the trail is intended to be for typical users. Will the trail be easy and intended for all skill levels or will it be difficult and appropriate for only the most experienced enthusiast? Changing key design parameters (e.g. grades, clearings) and technical trail features greatly influences the challenge the trail provides for enthusiasts. It is imperative that trail operators deliberately choose how challenging the trail will be. Four general challenge levels can be selected:

- Easy
- Moderate
- Difficult
- Most Difficult

The degree of challenge then needs to be reflected in the design of the trail and its trail challenge features. Table 5 outlines the key messages that should be delivered to enthusiasts based on each level of challenge. Given the diverse combination of trail activities anticipated to occur on trails on public lands, trail operators are not required to assign a general difficulty rating to the trail (e.g. green, blue, black, double black). Instead, it is expected that trail operators provide clear descriptions of the level of challenge and challenge features must be to enthusiasts through marketing materials, websites, guides, trailhead signage as well as signage at the challenge features. More information on degree of challenge is provided in section 5.2 Signage and Wayfinding.

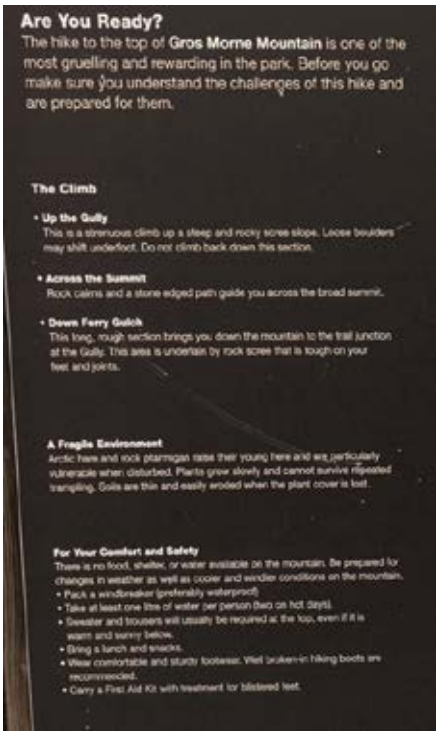


Figure 36 Level of Challenge Information Provided in Trail Signage

Table 6 Degree of Challenge Descriptions

Element	Degree of Challenge			
	Easy	Moderate	Difficult	Most Difficult
Suitability, Fitness & Trail Experience	Suitable for most visitors (may or may not be universally accessible) including those with no trail experience.	Suitable for most visitors who are physically active and have basic trail experience.	Suitable for visitors who are in good physical condition and have trail experience.	Suitable for visitors who are very fit and have exceptional trail experience.
Speciality Equipment and Skill	No speciality equipment, supplies or skills are required to travel this trail safely. *Note, all visitors should be encouraged to bring water, food, extra clothes and bear spray (when in bear country).*	No speciality equipment or supplies are required to travel this trail safely. Basic outdoor skills are recommended. *Note, all visitors should be encouraged to bring water, food, extra clothes and bear spray (when in bear country).*	Speciality equipment and supplies may be required to travel this trail safely (e.g. navigation, first aid kit, Communications, overnight shelter, winch etc.). More advanced outdoor skills are recommended. *Note, all visitors should be encouraged to bring water, food, extra clothes and bear spray (when in bear country).*	Specialty equipment and supplies are recommended to travel this trail safely (e.g. navigation, first aid kit, communications, overnight shelter, winch etc.). Navigation skills (e.g. GPS, compass, map reading) may be required. Advanced outdoor skills are recommended. *Note, all visitors should be encouraged to bring water, food, extra clothes and bear spray (when in bear country).*

Element	Degree of Challenge			
	Easy	Moderate	Difficult	Most Difficult
Obstacles & Hazards	Hard packed surface. Few to no obstacles, protrusions and/or minimal stairs. Little or no elevation gain or loss.	Mostly stable surface. Infrequent obstacles, protrusions and/or stairs may be present. May experience moderate elevation gain with some short steep sections.	Variety of surface types including non-established surfaces. Frequent obstacles, protrusion and/or stairs may be present. May experience major elevation gain and loss with long steep sections.	Highly variable surface types including non-established surfaces. Frequent obstacles, protrusions and/or stairs will be present. Expect to experience a variety of terrain with highly variable elevation gain and loss with steep sections.

4.7 Design Parameters

4.7.1 Understanding Trail Design Parameters

Design parameters provide technical direction to trail designers and contractors regarding the trail's physical dimensions and characteristics. Trail design parameters have significant implications of the quality of the trail experience, the degree of challenge of the trail as well its sustainability. It is essential that appropriate design parameters are chosen for each trail based on the intended combination of trail activities, the intended level of development and desired challenge level. There are a number of critical design parameters that trail planners and designers must consider. Before looking at the design parameters for each trail activity, let's take a moment to ensure the definition each parameter is understood.

Clearing Limits

An area over and beside the trail tread that is cleared of any obstructions that may impede use of the trail by the trail enthusiast. There are two key clearing limit parameters:

Clearing Height

The minimum height of the clearing limit measured from the trail tread to the lowest obstacle above the trail tread. For winter activities, the dimension provided is from the top of the average snow level (varies by location), not from the ground surface.

Clearing Width

The minimum width of the clearing limit measured horizontally across the trail corridor at its narrowest point along the trail.

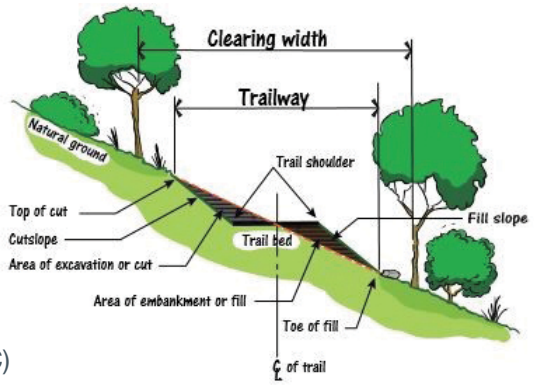


Figure 37 Trail Design Parameters (from NOHVCC)

Trail Tip

When determining the desired clearing height and clearing widths of snow-based trails, be sure to account for the typical snow depths in the local area and the potential for vegetation and other potential obstacles to "sag" into the clearing limit as a result of snow loading.

Tread Width

The width of the portion of the trail on which the trail enthusiast directly travels. It is likely that trails with more diverse uses and higher volumes of use will need to be wider than those will fewer use types and lower volumes; however, this design decision needs to be made in the context of other factors to ensure that the trail is not over-designed for realistic use types and levels.

Figure 38 Structure Width

Figure 39 Recent Ad Showing Vehicle Designs to Meet Trail Designs

Tread Width

The minimum width of the trail tread that is appropriate for the permitted trail activities and intended difficulty rating.

Structure Width

The minimum width of all structures through or over which the trail passes (e.g. bridges). The structure width should be, at minimum, equal to the tread width to enable trail enthusiasts to travel over or through the structure without a narrowing of the trail tread width. Structure width and loading should also consider the desired maintenance equipment for the trail.

Tread Surfacing

Characteristics about the surface of the trail on which enthusiasts' travel, including tread type, protrusions, and obstacles.

Surface Type

The general type of material used to surface the trail tread. There are three general categories of trail surfacing:

Natural

Tread is composed of soils, rocks, snow, ice or other natural materials found nearby or on the trail. Native surfaces are virtually always most suitable for backcountry settings.

Imported

Materials imported for trail construction need to meet technical specifications (e.g., permeability, stability, accessibility) while being appropriate to the recreation setting and desired experience. In some cases, organic materials (e.g., shredded bark mulch) may meet the objectives, while in others, an inorganic material such as a compacted crushed granular surface may be required. Imported surfacing materials are most likely to be found in front-country settings, and occasionally in mid-country settings depending on the activities and desired experience.

Structurally Stabilized

Where environmental conditions (e.g., poor drainage) or technical requirements of the activity justify it (e.g., repeated torque on specific turns), geogrid or similar structural means can be considered beneath various types of surfacing. A wide range of products is available including Geotextiles, Geonets, Geogrids, Geocells, Geocomposites, Sheet Drains, and Turf Reinforcement Unit Pavers - a clear understanding of the objectives and conditions will guide the selection of a product and surface that will perform well with minimal maintenance over time.

Paved

Paved trails (e.g., asphalt, concrete) are typically associated with Developed settings, but may be found in popular Front-country settings as well. This is especially true when designing for universally accessible trail experiences. Well-constructed compacted granular trails, or granular/soil trails hardened with bonding agents, are also accessible for many users with mobility impairments.

In addition to the tread materials, it is also important to determine if trail tread imperfections may exist (protrusions) and whether those imperfections may have impacts (obstacles) on any permitted trail activities.

Protrusions

Trail tread imperfections (e.g. rock, roots, holes, stumps, steps, and structures) that are within an acceptable range of tread roughness for the intended trail difficulty rating for the trail and that do not obstruct any permitted trail activities.

Obstacles

Natural obstacles may add a challenge to a difficulty rating. (e.g. rocks, roots, logs, holes, ledges etc.) Technical trail features are elements that have been introduced to add a challenge to the difficulty rating. (e.g. rocks, logs, bridges, jumps, drop offs, etc.)

Grades

The vertical distance of ascent or descent of the trail which is expressed as a percentage of the horizontal distance. Grade is commonly measured as a ratio of rise to length or as a percent. There are three major design parameters relating to a trail's grade:

Target Grade

The average vertical steepness of a trail over its entire length (or segment of trail) which is deemed to be appropriate for the permitted trail activities and intended difficulty rating.

Maximum Grade

The steepest acceptable vertical grade permitted on the trail (or segment of trail) that is deemed to be appropriate for the permitted trail activities and intended difficulty rating.

Maximum Grade Proportion

The proportion of a trail with grades that exceed the Target Grade but are less than or equal to the Maximum Grade.

For example, if a trail meets its target grade over 80% of its length, then its maximum grade proportion is 20% (grade exceeds target but is less than maximum grade).

Cross Slope

The percentage grade of the trail tread measured perpendicular to the direction of travel. There are two major design parameters regarding cross slope:

Target Cross Slope

The average horizontal grade of the trail tread, measured perpendicular to the centreline, over the trail's entire length (or segment of trail) which is deemed to be appropriate for the permitted activities and intended difficulty rating.

Maximum Cross Slope

The steepest acceptable horizontal grade, measured perpendicular to the centreline, permitted on the trail (or segment of trail) that is deemed to be appropriate for the permitted trail activities and intended difficulty rating.

Grade is calculated using the following formula:

Rise / Run X 100 = Grade

For example, if a trail rises 2 m over a 100 m run, its grade is 2%.

Figure 40 Calculating Grade

Turning Radius

The horizontal radius a trail activity requires to negotiate a curve (e.g., switchback, climbing turn, or horizontal turn) in a single maneuver. There is one major design parameter relating to a trail's turning radius:

Target Turning Radius

The minimum horizontal radius required for a permitted trail activity to negotiate a curve in a single maneuver.

Sight Lines

The distance a trail enthusiast can clearly and safely observe the trail ahead or behind. Providing appropriate sight distance allows the trail enthusiast to have the time to recognize an obstruction such as debris, other trail users, and intersections and take the appropriate action. There is one critical design parameter regarding sight lines:

Sight Line Distance

The minimum distance that a trail enthusiast must be able to see which is appropriate for the permitted trail activities and intended difficulty rating of the trail.

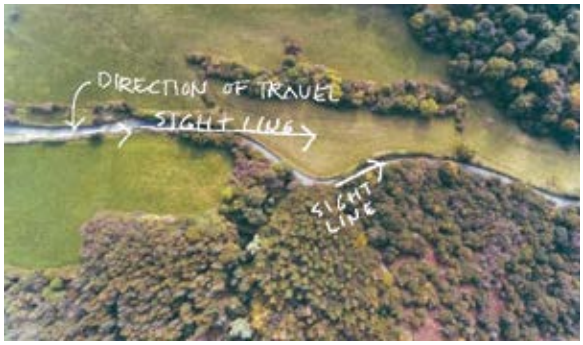


Figure 41 Sight Lines

Figure 42 Turning Radius Calculation

4.7.2 Design Parameters by Trail Activity

The following section presents the trail design parameters for each of the most common trail activity types occurring on public lands. The basic trail design parameters vary based on the desired level of challenge for the trail. By manipulating the design parameters of the trail, trail operators can make a trail more or less challenging to travel. As such, the design parameters have been organized by the desired level of challenge for each trail activity.

Trail Operators should recognize that these design parameters are general in nature. In the case of some single use or preferred use trails, it may be appropriate to apply available activity specific design guidance. See Section 8.0 for additional design resources.

Trail Tip

The design parameters provided are guidelines. Though trail operators are encouraged to apply the guidelines consistently, local conditions may warrant deviation from the guidelines in select instances.

4.7.2.1 Non-Motorized Trail Activities

Pedestrian (Walking, Running, Hiking, Backpacking)

Design Parameter		Degree of Challenge			
		Easy	Moderate	Difficult	Most Difficult
Clearing Limit	Clearing Width	2.0 - 3.0 m	1.5 - 2.0 m	0.6 – 1.5 m	0.5 m min
	Clearing Height	3.0 m	3.0 m	2.5 m	2.5 m
Tread Width	Tread Width	1.0 - 2.5 m	1.0 - 1.5 m	0.3 - 1.0 m	0.3 m min
	Structure Width (minimum width)	Tread + 0.15 m each side	Tread + 0.15 m each side	Same as tread	Same as tread
Surfacing	Surface Type	Compacted granular or paved	Granular	Natural	Natural
	Protrusions	None	Occasional	Frequent	Very frequent
	Obstacles (max height)	0.15 m max ht, few vertical steps	0.25 m max ht, occasional vertical steps	0.3 max ht, frequent vertical steps	0.4 max ht, frequent vertical steps
Grades	Target Grade	3%	10%	15%	20%
	Maximum Grade (short)	7%	15%	25%	40%
	Maximum Grade Proportion	5 – 10%	10 – 15%	15 – 20%	15 – 20%
Cross Slope	Target Cross Slope	2 – 3 % or crowned	3 – 7%	5 – 15 %	Natural
	Maximum Cross Slope	3%	10%	15%	30%
Turning	Target Turning Radius	1.8 - 2.4 m	1.2 - 2.4 m	0.9 - 1.8 m	No minimum

4.7.2.1 Non-Motorized Trail Activities
Equestrian (Saddle & Pack, Endurance Riding)

Design Parameter		Degree of Challenge			
		Easy	Moderate	Difficult	Most Difficult
Clearing Limit	**Clearing Width**	4.0 m +	2.0 – 4.0 m	1.5 - 2.5 m	1.5 - 2.5 m
	Clearing Height	3.5 m	3.5 m	3.5 m	3.5 m
Tread Width	**Tread Width**	2.5 m +	1.0 - 2.5 m	1.0- 2.0 m	0.5 - 2.0 m
	Structure Width (minimum width)	Tread + 0.3 m	Tread + 0.3 m	Varies	Varies
Surfacing	**Surface Type**	Compacted granular or natural surface; ensure traction (e.g., avoid large flat rocks, roots)	Compacted granular or natural surface; ensure traction	Semi-packed granular or natural surface	Natural
	Protrusions	Rare	Occasional	Frequent	Frequent
	Obstacles (max height)	0.15 m max ht., pref. full width of trail; if steps, landings min 3.0 m deep	0.15 m max ht; if steps, landings min 3.0 m deep	0.3 m max ht; if steps, landings min 1.5 m deep	0.3 m max ht; if steps, landings min 1.2 m deep
Grades	**Target Grade**	≤5%	≤10%	≤12%	≤15%
	Maximum Grade (short)	10%	15%	20%	25%
	Maximum Grade Proportion	5 - 10%	5 – 15%	15 – 20%	15 – 20%
Cross Slope	**Target Cross Slope**	2– 5%	3 – 5%	5 – 10%	5 – 10%
	Maximum Cross Slope	5%	8%	10%	10%
Turning	**Target Turning Radius**	1.8 - 3.0 m	1.5 - 2.4 m	1.2 - 1.5 m	1.2 - 1.5 m

4.7.2.1 Non-Motorized Trail Activities

Horse Drawn Vehicle (Horse & Buggy / Cart, Covered Wagon, Horse Drawn Sleigh)

Design Parameter		Degree of Challenge			
		Easy	Moderate	Difficult	Most Difficult
Clearing Limit	**Clearing Width**	4 - 5 m	3.5 - 4 m	N/A	N/A
	Clearing Height	3.5 m	3.5 m	N/A	N/A
Tread Width	**Tread Width**	3 - 4 m	2.5 - 3 m	N/A	N/A
	Structure Width (minimum width)	Tread + 0.3 m each side	Tread + 0.3 m each side	N/A	N/A
Surfacing	**Surface Type**	Hard packed imported material/ paved, groomed or packed in winter	Semi-packed natural, occasionally groomed or packed in winter	N/A	N/A
	Protrusions	Rare (< 0.1 m ht)	Few (< 0.1 m ht)	N/A	N/A
	Obstacles (max height)	No obstacles or stairs	Few obstacles, no stairs	N/A	N/A
Grades	**Target Grade**	0 - 5%	5 - 10%	N/A	N/A
	Maximum Grade (short)	10 %	15%	N/A	N/A
	Maximum Grade Proportion	5 -10%	10 -15%	N/A	N/A
Cross Slope	**Target Cross Slope**	0 – 3%	0 –5%	N/A	N/A
	Maximum Cross Slope	3%	5%	N/A	N/A
Turning	**Target Turning Radius**	3.0 - 5.0 m, to suit total length	3.0 - 5.0 m, to suit total length	N/A	N/A
Sight Lines	**Sight Line Distance**	30 m	30 m	N/A	N/A

4.7.2.1 Non-Motorized Trail Activities

Cross-Country Skiing – Classic

Design Parameter		Degree of Challenge			
		Easy	Moderate	Difficult	Most Difficult
Clearing Limit	Clearing Width	2.0 - 4.0 m	2.0 - 4.0 m	1.0 - 2.0 m	1.0 - 2.0 m
	Clearing Height	3.0 m	3.0 m	3.0 m	3.0 m
Tread Width	Tread Width	1.5 - 4.0 m	1.5 - 4.0 m	1.0 – 2.0 m	1.0 – 2.0 m
	Structure Width (minimum width)	N/A	N/A	N/A	N/A
Surfacing	Surface Type	Track set	Track set	Ungroomed, not packed	Ungroomed, not packed
	Protrusions	None/rare	None/rare	Occasional (rocks, logs, etc.)	Frequent (rocks, logs, etc.)
	Obstacles (max height)	None	Rare, max 0.15 m ht (e.g., bridges)	Occasional, up to 0.3 m	Occasional, up to 0.5 m
Grades	Target Grade	0 – 8%	2 - 10%	5 – 15%	10 – 20%
	Maximum Grade (short)	10%	20%	25%	30%
	Maximum Grade Proportion	5 -10%	10 - 15%	10 - 20%	10 - 20%
Cross Slope	Target Cross Slope	0 – 5%	0 – 5%	5 – 15%	5 – 15%
	Maximum Cross Slope	10%	15%	20%	20%
Turning	Target Turning Radius	5 – 8 m per grooming equipment	5 – 8 m per grooming equipment	2 – 5 m	2 – 5 m

4.7.2.1 Non-Motorized Trail Activities

Cross-Country Skiing – Skate

Design Parameter		Degree of Challenge			
		Easy	Moderate	Difficult	Most Difficult
Clearing Limit	Clearing Width	5.0 m+	5.0 m+	5.0 m+	5.0 m +
	Clearing Height	3.0 m	3.0 m	3.0 m	3.0 m
Tread Width	Tread Width	5.0 m+	5.0 m+	5.0 m+	5.0 m+
	Structure Width (minimum width)	N/A	N/A	N/A	N/A
Surfacing	Surface Type	Groomed	Groomed	Groomed	Groomed
	Protrusions	None	None	None	None
	Obstacles (max height)	None	None	None	None
Grades	Target Grade	5%	8%	10%	15%
	Maximum Grade (short)	0 – 8%	2 – 10%	5 – 15%	10 – 20%
	Maximum Grade Proportion	5 - 10%	10 – 15%	15 – 20%	15 – 20%
Cross Slope	Target Cross Slope	0 – 5%	0 – 8%	0 - 10%	0 - 10%
	Maximum Cross Slope	5%	10%	15%	20%
Turning	Target Turning Radius	5 – 8 m per grooming equipment	5 – 8 m per grooming equipment	5 – 8 m per grooming equipment	5 – 8 m per grooming equipment

4.7.2.1 Non-Motorized Trail Activities

Dog-Sledding & Skijoring

Design Parameter		Degree of Challenge			
		Easy	Moderate	Difficult	Most Difficult
Clearing Limit	Clearing Width	4.0 m	2.0 - 3.0 m	1.5 - 2.5 m	1.5 - 2.0 m
	Clearing Height	3.0 m	3.0 m	3.0 m	3.0 m
Tread Width	Tread Width	3.0 m+	2.0 - 3.0 m	1.5 - 2.5 m	5.0 m
	Structure Width (minimum width)	N/A	N/A	N/A	N/A
Surfacing	Surface Type	Double track groomed or packed	Single track groomed or packed	Ungroomed	Ungroomed
	Protrusions	None	Rare	Occasional	Common
	Obstacles (max height)	None	Rare; 0.15 m. max height	Occasional; 0.25 m. max height	Occasional; 0.25 m. max height
Grades	Target Grade	0-5%	5-10%	5-10%	10-20%
	Maximum Grade (short)	10%	15%	20%	30%
	Maximum Grade Proportion	0-5%	5-10%	10-15%	15-20%
Cross Slope	Target Cross Slope	0 – 5%	0 – 5%	5 - 10%	5 - 10%
	Maximum Cross Slope	7%	10%	15%	15%
Turning	Target Turning Radius	20m	15m	12m	12m

4.7.2.2 Mechanized Trail Activities

Off-Road Cycling (self-propelled & e-assist)

Design Parameter		Degree of Challenge			
		Easy	Moderate	Difficult	Most Difficult
Clearing Limit	Clearing Width	3.5 m+	2.5 - 3.5 m	2.0 - 3.0 m	1.0 - 2.0 m
	Clearing Height	3.5 m	3.5 m	3.0 m	3.0 m
Tread Width	Tread Width	2.5 m+	1.5 - 2.5 m	1.0 - 2.0 m	0.3 - 1.0 m
	Structure Width (minimum width)	Tread + 0.3 m each side	Tread + 0.3 m each side	Varies	Varies
Surfacing	Surface Type	Natural, smooth	Natural, rutted	Natural or Unsurfaced	Natural or Unsurfaced
	Protrusions	Rare, < 0.10 m	Occasional, < 0.10 m	Common, < 0.15 m	Frequent, < 0.15 m
	Obstacles (max height)	Rare, < 0.10 m	Common, < 0.3 m	Common, < 0.3 m	Frequent, < 0.45 m, placed for challenge
Grades	Target Grade	3 – 8%	5 – 12%	10 – 20%	15 – 25%
	Maximum Grade (short)	10%	15%	25%	40%
	Maximum Grade Proportion	10 – 20%	15 – 25%	20 – 30%	20 – 30%
Cross Slope	Target Cross Slope	2 – 4%	3 – 5%	5 – 8%	5 – 10%
	Maximum Cross Slope	8%	10%	12%	15%
Turning	Target Turning Radius	1.5 - 2.5 m	1.2 - 2.0 m	1.0 - 1.5 m	1.0 - 1.5 m

4.7.2.3 Motorized Trail Activities

Two-wheeled motorized vehicle (one front & one back)

Design Parameter		Degree of Challenge			
		Easy	Moderate	Difficult	Most Difficult
Clearing Limit	Clearing Width	3.5 m+	2.5 - 3.5 m	2.0 - 3.0 m	1.0 - 2.0 m
	Clearing Height	3.5 m	3.5 m	3.0 m	3.0 m
Tread Width	Tread Width	2.5 m+	1.5 - 2.5 m	1.0 - 2.0 m	0.3 - 1.0 m
	Structure Width (minimum width)	Tread + 0.3 m each side	Tread + 0.3 m each side	Varies	Varies
Surfacing	Surface Type	Natural, smooth	Natural, rutted	Natural or Unsurfaced	Natural or Unsurfaced
	Protrusions	Rare, < 0.10 m	Occasional, < 0.10 m	Common, < 0.15 m	Frequent, < 0.15 m
	Obstacles (max height)	Rare, < 0.10 m	Common, < 0.3 m	Common, < 0.3 m	Frequent, < 0.45 m, placed for challenge
Grades	Target Grade	3 – 8%	5 – 12%	10 – 20%	15 – 25%
	Maximum Grade (short)	10%	15%	25%	40%
	Maximum Grade Proportion	10 – 20%	15 – 25%	20 – 30%	20 – 30%
Cross Slope	Target Cross Slope	2 – 4%	3 – 5%	5 – 8%	5 – 10%
	Maximum Cross Slope	8%	10%	12%	15%
Turning	Target Turning Radius	1.5 - 2.5 m	1.2 - 2.0 m	1.0 - 1.5 m	1.0 - 1.5 m

4.7.2.3 Motorized Trail Activities

Motorized vehicle with width 1.5 m (60”) or less

Design Parameter		Degree of Challenge			
		Easy	Moderate	Difficult	Most Difficult
Clearing Limit	Clearing Width	4.0 m	3.0 - 4.0 m	2.5 - 3.5 m	2.5 - 3.5 m
	Clearing Height	3.5 m	3.5 m	3.5 m	3.5 m
Tread Width	Tread Width	2.5 - 3.0 m	2.0 - 3.0 m	1.5 - 2.5 m	1.5 - 2.5 m
	Structure Width (minimum width)	Tread + 0.3 m each side	Tread + 0.3 m each side	Varies	Varies
Surfacing	Surface Type	Natural, smooth	Natural, rutted	Natural or unsurfaced, rutted	Unsurfaced
	Protrusions	Rare, < 0.10 m	Occasional, < 0.10 m	Common, < 0.15 m	Frequent, < 0.15 m
	Obstacles (max height)	Rare, < 0.10 m	Common, < 0.15 m	Common, < 0.3 m	Frequent, < 0.30 m
Grades	Target Grade	3 – 8%	5 – 10%	8 – 15%	10 – 25%
	Maximum Grade (short)	5%	10%	20%	30%
	Maximum Grade Proportion	10 – 20%	15 – 25%	20 – 30%	25 – 40%
Cross Slope	Target Cross Slope	2 – 5%	3 – 8%	5 – 8%	5 – 10%
	Maximum Cross Slope	5%	8%	10%	15%
Turning	Target Turning Radius	2.5 - 3.5 m	2.5- 3.5 m	2.0 - 3.0 m	2.0 - 3.0 m

4.7.2.3 Motorized Trail Activities

Snow Vehicle with width 1.5 m (60”) or less

Design Parameter		Degree of Challenge			
		Easy	Moderate	Difficult	Most Difficult
Clearing Limit	Clearing Width	5.0 m	5.0 m	3.0 m	2.0 - 3.0 m
	Clearing Height	5.0 m	5.0 m	4.0 m	3.5 m
Tread Width	Tread Width	5.0 m	5.0 m	3.0 m	2.0 - 3.0 m
	Structure Width (minimum width)	N/A	N/A	N/A	N/A
Surfacing	Surface Type	Regularly groomed	Occasionally groomed	Ungroomed or Occasionally groomed	Ungroomed
	Protrusions	None	None	None	None
	Obstacles (max height)	None	None	Uncommon, up to 0.15 m	Uncommon, up to 0.3 m
Grades	Target Grade	0 – 8%	0-10%	0 – 12%	0 – 15%
	Maximum Grade (short)	15%	20%	30%	45%
	Maximum Grade Proportion	5 – 10%	10 – 15%	15 – 20%	20 – 25%
Cross Slope	Target Cross Slope	0%	0 – 5%	0 – 8%	0 – 10%
	Maximum Cross Slope	5%	10%	10%	15%
Turning	Target Turning Radius	10 – 15 m or per grooming equipment	5 – 7 m or per grooming equipment	3 – 5 m or per grooming equipment	2 – 5 m

Trail Tip

If the trail operator intends to provide a groomed winter trail for snow vehicles with a width of 1.5m or less, the clearing limits and associated structure widths must be sufficient to accommodate the grooming equipment that will be used to maintain the trail. These wider limits does not necessarily mean the trail is classified for large vehicle use. Trail operators will have to install removable limiters at the trailheads to ensure unintended vehicles cannot access the trail.

4.7.2.3 Motorized Trail Activities

Motorized vehicle with width greater than 1.5 m (60”) but 1.83 m (72”) or less

Design Parameter		Degree of Challenge			
		Easy	Moderate	Difficult	Most Difficult
Clearing Limit	Clearing Width	6.0 m	4.0 - 6.0 m	3.5 - 5.0 m	3.0 - 4.0 m
	Clearing Height	3.5 m	3.5 m	3.5 m	3.5 m
Tread Width	Tread Width	5.0 m	3.5 - 5.0 m	3.0 - 4.0 m	2.0 - 3.0 m
	Structure Width (minimum width)	Tread + 0.3 m each side	Tread + 0.3 m each side	Varies	Varies
Surfacing	Surface Type	Natural, smooth	Natural, rough	Natural, rough or unsurfaced	Unsurfaced
	Protrusions	< 0.1 m, may be common and continuous	< 0.2 m, may be common and continuous	< 0.3 m, may be common and continuous	< 0.3 m, may be common and continuous
	Obstacles (max height)	Up to 0.3 m, uncommon	Up to 0.45 m, common, left for challenge	Up to 0.6 m, common, left for challenge	Up to 0.9 m, common, left or placed for challenge
Grades	Target Grade	5 – 12%	5 – 18%	10 – 20%	15 – 25%
	Maximum Grade (short)	10%	15%	25%	30%
	Maximum Grade Proportion	5 – 10%	10 – 15%	15 – 25%	20 – 30%
Cross Slope	Target Cross Slope	3– 5%	5 – 8%	8 – 12%	10 – 15%
	Maximum Cross Slope	5%	8%	12%	15%
Turning	Target Turning Radius	7 – 10 m	5 – 7 m	3 – 5 m	3 – 5 m

4.7.2.2 Motorized Trail Activities

Snow Vehicle (touring, transportation) with width greater than 1.83 m (72”)

Design Parameter		Degree of Challenge			
		Easy	Moderate	Difficult	Most Difficult
Clearing Limit	Clearing Width	5.0 m	5.0 m	4.0 m	3.5 m
	Clearing Height	5.0 m	5.0 m	3.5 m	3.5 m
Tread Width	Tread Width	5.0 m	4.0 - 5.0 m	3.0 - 4.0 m	2.5 m
	Structure Width (minimum width)	N/A	N/A	N/A	N/A
Surfacing	Surface Type	Sufficient snow	Sufficient snow	N/A	N/A
	Protrusions	Rare	Rare	Occasional	Occasional
	Obstacles (max height)	None	None	Up to 0.15 m	Up to 0.3 m
Grades	Target Grade	0 – 5%	5 – 10%	10 – 15%	10 – 20%
	Maximum Grade (short)	15%	20%	25%	30%
	Maximum Grade Proportion	10 – 15%	15 – 20%	15 – 20%	20 – 25%
Cross Slope	Target Cross Slope	0 – 5%	0 – 10%	5 – 15%	5 – 15%
	Maximum Cross Slope	5%	8%	12%	15%
Turning	Target Turning Radius	10 – 15 m	8 – 12 m	8 – 12 m	5 – 10 m

4.7.2.2 Motorized Trail Activities

Motorized vehicle with width greater than 1.83 m (72”)

Design Parameter		Degree of Challenge			
		Easy	Moderate	Difficult	Most Difficult
Clearing Limit	Clearing Width	6.0 m	5.0 m	4.0 - 5.0 m	3.0 - 4.0 m
	Clearing Height	4.0 m	4.0 m	3.5 m	3.5 m
Tread Width	Tread Width	5.0 m	4.0 - 5.0 m	3.0 - 4.0 m	2.0 - 3.0 m
	Structure Width (minimum width)	Tread + 0.3 m each side	Tread + 0.3 m each side	Varies (natural)	Varies (natural)
Surfacing	Surface Type	Natural, smooth	Natural, rutted	Natural, rutted	Unsurfaced
	Protrusions	Occasional	Common	Frequent. Left for challenge	Frequent, left for challenge
	Obstacles (max height)	< 0.3 m	< 0.45 m	< 0.6 m	< 0.9 m, left or placed for challenge
Grades	Target Grade	5 – 10 %	8 - 12%	10 – 20%	15 – 25%
	Maximum Grade (short)	10%	25%	35%	45%
	Maximum Grade Proportion	5 - 10%	10 – 15%	15 – 20 %	20 – 25%
Cross Slope	Target Cross Slope	3 – 5%	5 – 8%	8 – 12%	12 – 15%
	Maximum Cross Slope	5%	8%	12%	15%
Turning	Target Turning Radius	10 – 12 m	8 – 10 m	8 – 10 m	6 – 8 m

4.7.3 Critical Design Parameters for Multi-Use Trails

As illustrated in the design parameter tables above, each trail activity has unique design requirements. As such, when mixed use, multi-use or preferred use trails are planned, design parameters must be selected to meet the basic design needs of all permitted trail activities and the trail's intended degree of challenge. Known as "critical design parameters", these trails must be designed in accordance with the "most demanding" (or greatest) design parameters from the combined designed parameters of the permitted trail activities.

To illustrate the concept of critical design parameters, consider a mixed use, mid-country trail, moderate difficulty trail for equestrian, pedestrian, mountain biking, two wheeled vehicles and motorized vehicles with a width of 1.5m or less. Table 6 indicates which trail activity types' design parameter would be used as that activity have the most demanding (or greatest) design requirement.

Critical Design Parameter

The most demanding (or greatest) design parameters from the permitted trail activities.

Figure 43 Critical Design Parameters for Multi-Use Trails

4.7.4 New or Evolving Trail Activities

When one thinks back to the types of trail activities that were occurring on public lands just ten years ago, it is apparent that the recreation industry is evolving rapidly. New activities will emerge, and existing activities will change. As such, it is important that the trail classification system for public lands is flexible enough to adapt to almost guaranteed changes in trail activities. Design parameters have been provided for the most common trail based activities occurring on public lands. As new activities arise, or existing activities evolve, the trail operator can determine the design parameters for those activities by:

- Selecting design parameters from the activities described above that are closest to the needs of the particular activity while ensuring user safety,
- Proposing design parameters based on established or precedent design parameters from an authoritative organization governing the activity or a precedent jurisdiction, or
- Working with the local public land manager to prepare design parameters for the particular activity if there is no authoritative organization governing the activity or precedents from another jurisdiction.

Table 7 Illustrating the Critical Design Parameters for a Multi-Use Trail

Design Parameter		Activity with Most Demanding Design Parameter
Clearing Limit	Clearing Width	Equestrian
	Clearing Height	Equestrian
Tread Width	Tread Width	Motorized Vehicle equal or less than 1.5m
	Structure Width (minimum width)	Motorized Vehicle equal or less than 1.5m
Surfacing	Surface Type	Equestrian
	Protrusions	Mountain Biking
	Obstacles (max height)	Mountain Biking
Grades	Target Grade	Equestrian
	Maximum Grade (short)	Equestrian
	Maximum Grade Proportion	Equestrian
Cross Slope	Target Cross Slope	Motorized Vehicle equal or less than 1.5m
	Maximum Cross Slope	Motorized Vehicle equal or less than 1.5m
Turning	Target Turning Radius	Motorized Vehicle equal or less than 1.5m
Sight Lines	Sight Line Distance	Motorized Vehicle equal or less than 1.5m

4.8 Applying The Trail Classification

Once the trail classification is determined, it is important that trail operators document the classification decisions in the TMO and ensure critical classification information is integrated into trail signage and other information sources such as trail maps, brochures websites, smart phone applications etc. As a minimum, the following information should be incorporated:

- Permitted trail activities through the use of standardized icons representing the trail activities,
- Prohibited trail activities through the use of standardized icons representing the trail activities,
- Level of challenge of the trail by describing the trail characteristics (See Table 6), and
- Amenities available on / along the trail.

Further trail signage guidelines are available in Section 5.0.

5.0 Trail Infrastructure Design Guidelines

This section covers design best practices for a complete trail experience – starting with the staging area, facilities and signage before moving into trail tread location and shaping for user control, enjoyment and water management.

5.1 Staging Areas & Trailheads

Staging Area Typology

Staging areas planning is one of the most important logistic elements to a trail system. A thoughtfully planned staging area sets the tone for the trail experience and provides supporting amenities. Establishing a typology of staging areas will help ensure that a consistent level of service is delivered to trail users at a level of service that is appropriate to each trail type. Considering the diverse conditions throughout the Province, the following matrix outlines the three different types of staging areas and the general types of infrastructure that are compatible and incompatible with each:

Staging Area Planning

Planning for the type of users expected at the staging area, how they arrive, and any specialized needs, are the first steps in staging area planning. Consider a hiking only trail to a fishing area where users arrive by ATV or bicycle, their needs are going to be different from a staging area designed for highway vehicles. Parking, vehicle type and size, circulation, amenities and signage, and future growth are the main layout considerations for a staging area. The Level of Use of the staging area should dictate the parking capacity and quantity of amenities and wherever possible the level of development of the trail should match the level of development of the staging area.

Table 8 Staging Area Infrastructure Compatibility

Level of Use	Vehicle Parking	Toilets	Garbage Receptacles	Trailhead Signage	Seating Area	Loading Ramps	Misc. Structures
High Use	C	C	C	C	C	C	C
Medium Use	C	C	C	C	I	I	I
Low Use	C	C	I	C	I	I	I

C - Consistent I – Inconsistent

In front country settings or where the staging area provides access to large network of mid and back country trails, a transportation impact assessment may need to be considered. Consultants with civil engineering and recreation planning expertise may be retained to advise on a feasible design.

Staging areas are not intended to function as day use areas however they are sometimes used by trail enthusiasts as such. Staging areas can be upgraded or designed to include day use amenities such as fire pits and picnic shelters. It is recommended that the fire pit size be small to reduce wood usage. If the staging area is frequently too full for trail users to find parking spaces, designing a separate day use area with separate parking can reduce the pressure on the staging area to provide all things to all users.

Staging Area Type 1: High Use

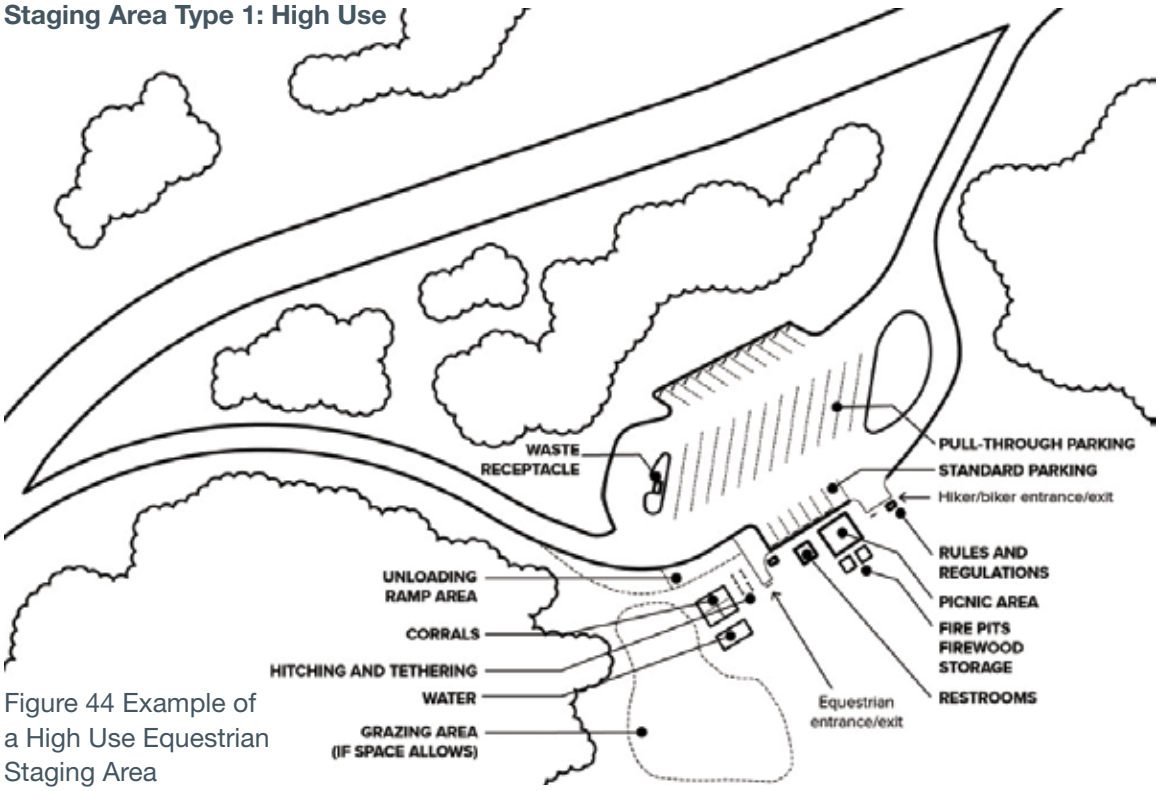


Figure 44 Example of a High Use Equestrian Staging Area

High Use staging areas are designed for trail systems with high volume expected use. To avoid conflicting uses such as equestrian and ATV's, separate areas can be planned for parking.

- Universal Design standards should be considered
- Toilet facilities, portable toilets or permanent with running water, should be provided where possible
- Garbage receptacles should be provided and should be animal proof, with an option for recyclables.
- Trailhead Signage
- Animal proof food lockers
- A map kiosk of the park or trail system is required. Information should include orientation signage which shows the user's current location, rules, and regulations of the park or trail permitted uses, and potential hazards, Alberta Environment and Parks contact information and hours of operation.
- Picnic tables or bench should be provided for seating.
- Lockable bike cages or animal proof food lockers and bike racks
- Bike Repair Station
- Hitching post for equestrian
- If space allows and there is a high level of equestrian use, then the design should include space for horse trailers as well as hitching rails and corrals.
- Design of the staging area should consider the needs of emergency vehicles, have barriers to control circulation (e.g., bollards) and should also consider the need for bus access.

Staging Area Type 2: Medium Use

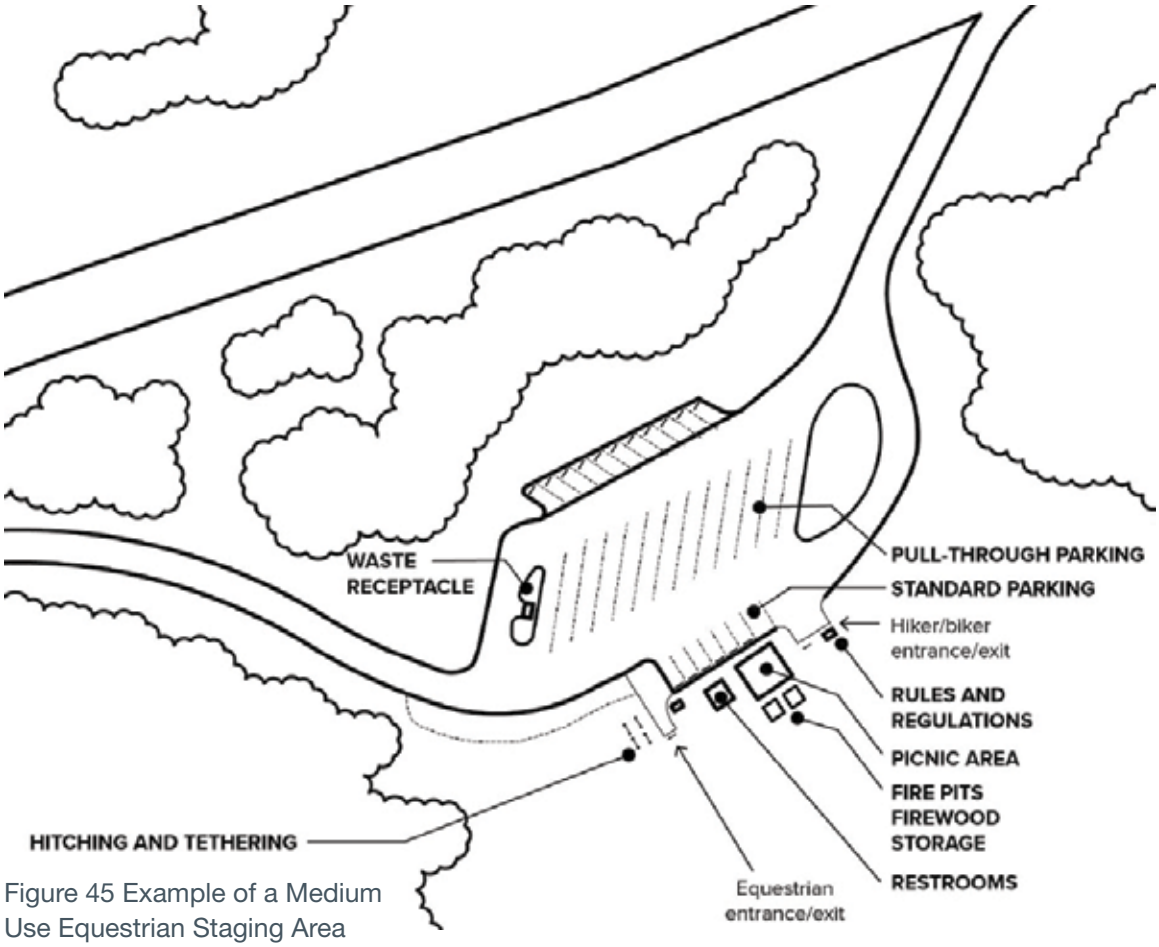


Figure 45 Example of a Medium Use Equestrian Staging Area

Medium use staging areas are designed for trail systems with moderate to low volume expected use.

- Universal Design standards should be considered.
- Toilet facilities, mainly portable toilets, should be provided.
- Garbage receptacles should be provided and should be animal proof, with an option for recyclables.
- Trailhead Signage
- bike racks
- Animal proof food lockers
- Hitching post for equestrian
- A map kiosk of the park or trail system is required. Information should include orientation signage which shows the user's current location, rules, and regulations of the park or trail permitted uses, and potential hazards, Alberta Environment and Parks contact information and hours of operation.
- Design of the staging area must consider the needs of emergency vehicles and should have barriers to control circulation (e.g., bollards).

Staging Area Type 3: Low Use

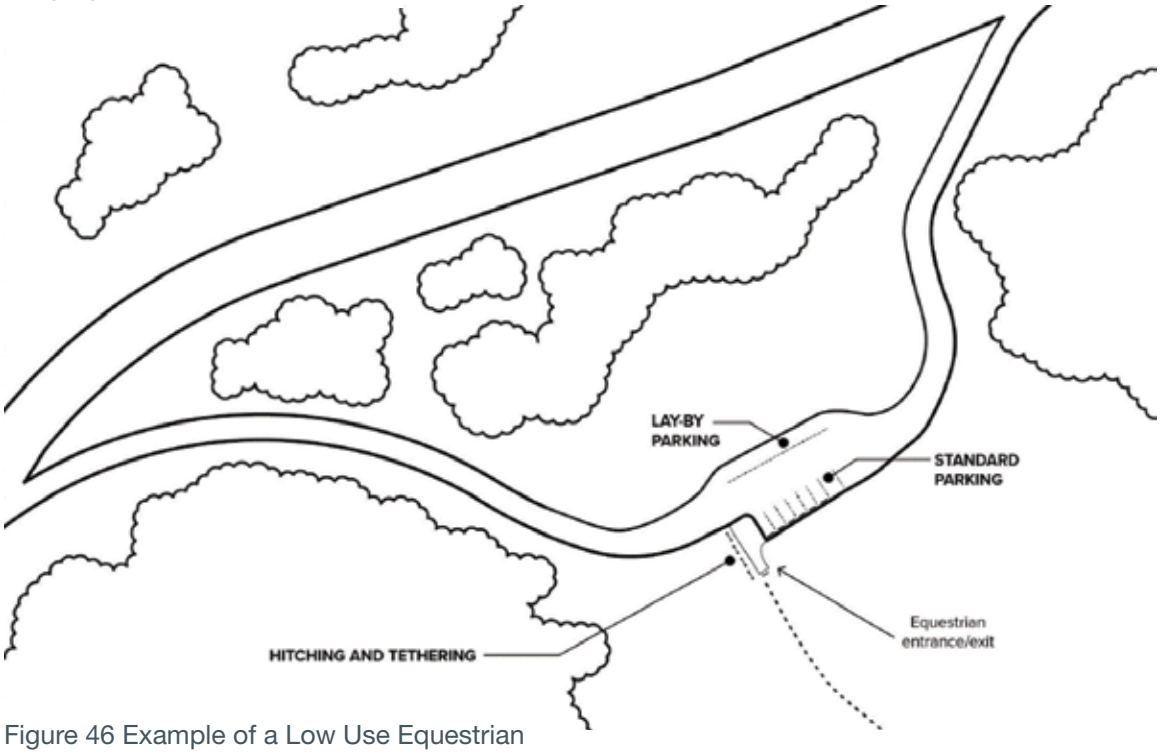


Figure 46 Example of a Low Use Equestrian Staging Area

Low use staging areas are designed for trail systems with low volume expected use.

- Universal Design standards should be considered
- Trailhead Signage
- Toilet facilities, mainly portable toilets, should be provided.
- Animal proof food lockers
- bike racks
- Hitching post for equestrian
- A map kiosk of the park or trail system is required. Information should include orientation signage which shows the user's current location, rules, and regulations of the park or trail permitted uses, and potential hazards, Alberta Environment and Parks contact information and hours of operation.

Figure 47 Example of a Low Use Staging Area. The bear-proof garbage would be better located close to the trail head kiosk where users will walk past it and make use of it.

5.2 Signage & Wayfinding

Trail enthusiasts of all types and abilities have a common need: to be oriented! To be effective, wayfinding and signage systems should be intuitive and attractive, and should be designed to support a safe and memorable visitor experience. Recognizable signage located in strategic locations enables trail users to make informed decisions as they plan their outbound and return routes. Signs should be concentrated at trailheads, parking areas, or other accesses, and should be kept to a safe minimum throughout the network, particularly in backcountry areas. Interpretive signs that are not site-specific should be located to create natural rest points and take advantage of views, scenic features, and shade or shelter.

5.2.1 Signage Planning & Siting

The signage system is designed as a hierarchy of sign types, each with a unique function and form within the network. The Public Land Manager will work with the trail operator to provide the current signage standards and determine acceptable sign designs and required regulatory and risk management messages. The trail operator will be responsible for preparing the sign plan for review by the Public Land Manager.

Signage and Wayfinding Goal:

To support safe and memorable trail experiences for users of varying abilities and interests through recognizable and legible signage in strategic locations.

- The signs need to be consistently branded graphically (e.g., Alberta Government logo) and through materials so that users will recognize that they are on the same network – predictability enhances users' confidence in the wayfinding system so that they feel comfortable exploring further. If stewardship groups, sponsors, or private landowners have contributed to construction or maintenance of the trail, signs may acknowledge them through logos.
- Sign types are located strategically (e.g., at hazards or decision points) so that relevant information is provided where it's needed without cluttering the trails with repetitive or unnecessary messages.
- Interpretive signs, or other information-rich signs, should be located far enough off the trail that users will not block traffic while they read the content.

5.2.2 Trail Information

Five general categories of information can be included on trail-related signage. Some sign types will include two or more of these categories – for example, trailhead signage is a great opportunity to communicate multiple important messages to trail enthusiasts who will branch onto different parts of the trail network shortly after accessing the system.

Figure 48 Staging Area Signage

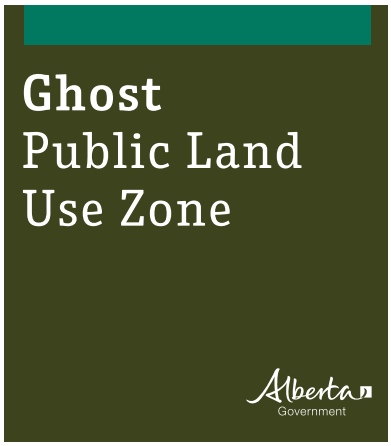


Figure 49 Area Identification Signage

The five categories of sign information include:

1. Wayfinding/Route Planning

Area Identification – includes trail network/trail name at primary/secondary entrances, boundary signs (e.g., at private land property lines), and notices (e.g., event dates, wildlife in area)

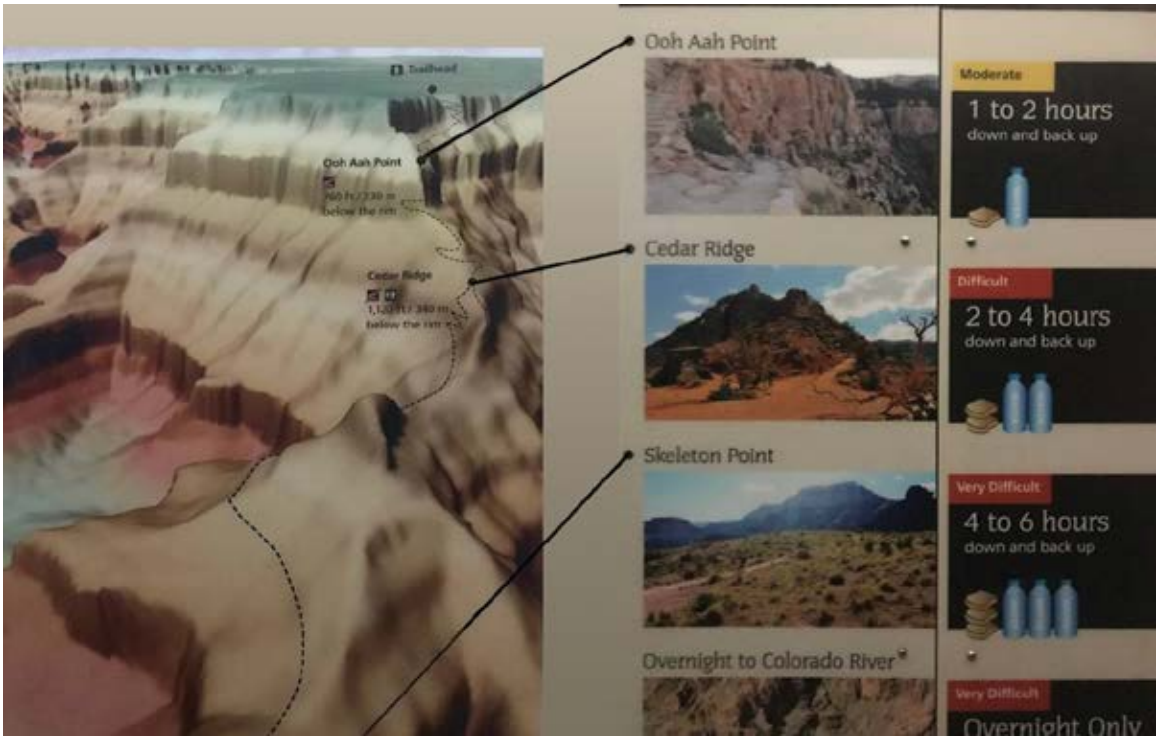
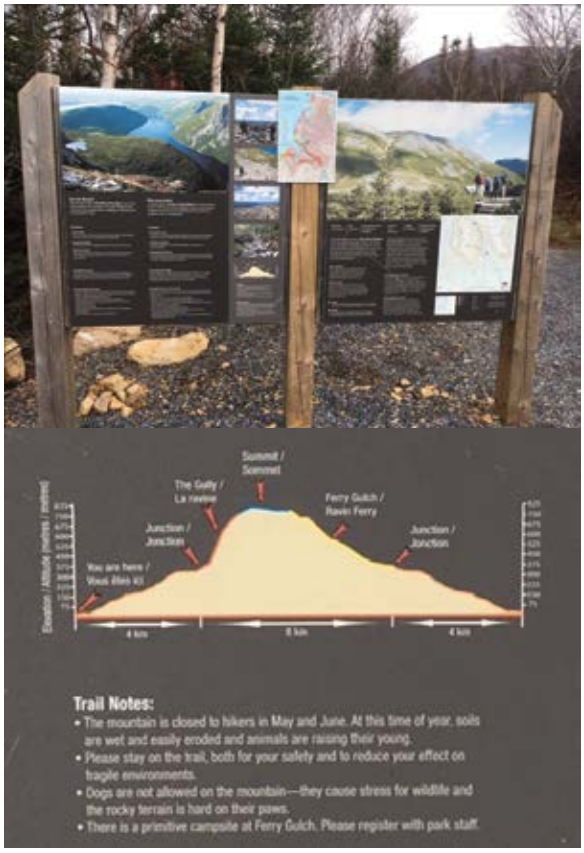


Figure 50 This map at the Grand Canyon shows terrain through shading. Decision support is provided with distance, approximate duration, and photos as to what the trail looks like at each major turnaround point. By providing these destinations along the route, users can "succeed" at achieving a midpoint destination and safely turn around as opposed to "failing" to reach the river at the bottom of the Grand Canyon. By understanding the psychology of the trail user, the land manager has reduced the number of rescues for people who went too far.

Figure 51 This map of Sunshine Village AB is an artists rendering to display the relief in the terrain. Relatively few members of the public can visualize and interpret topographic maps. The sidebar of this map provides decision support regarding distance, duration, elevation gain, and a profile.

Navigation/Directional – includes trail maps with "You Are Here" points, text and graphics indicating direction/distance to destination, amenity, or trailhead, and sometimes topographic maps/elevation profiles of the trail. For destination trails, vehicular wayfinding signs to trailheads is recommended.

Figure 52 Difficulty Rating Symbols



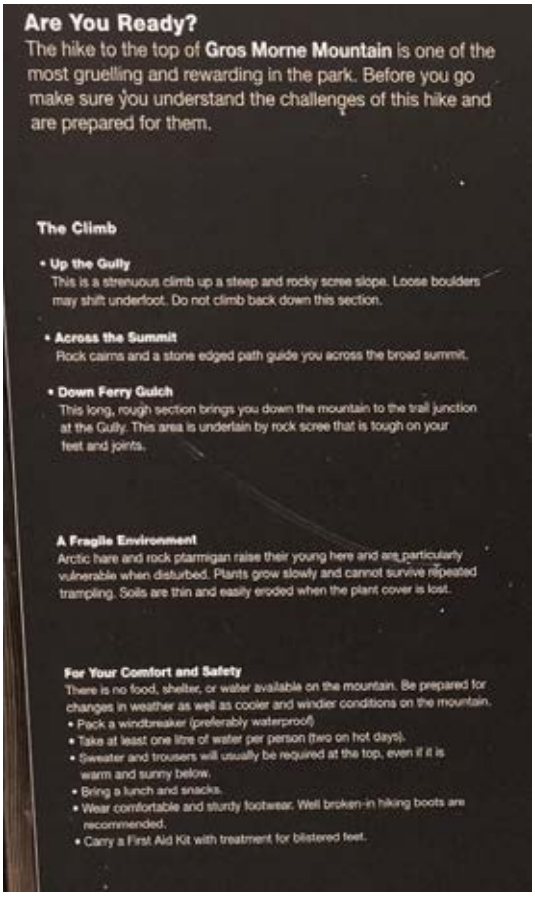


Figure 53 Information kiosk with: Decision Support information “Are you ready?” An explanation of lack of availability of food, water, and shelter on this trail, a trail description with example images of what to expect to explain the trail difficulty with images, length and elevation changes of the trail, total distance, typical duration, environmental and regulatory information, emergency information, and a useful map.

Figure 54 Bread crumb signage for navigation. Trails 12, 13, 14, & 15 go right, and 11 goes straight. In this instance the blue squares also indicate difficulty.

Figure 55 Example of emergency response trail junction number

Trail Marker Numbers – some trail networks include a unique code on wayfinding signage that will allow emergency crews to accurately locate trail users in distress

2. Regulatory

- **Instructional Information** – includes regulations (e.g., pack out your garbage, pets must be on leash), trail etiquette messages
- **Prohibitive** – text and graphics with red circle and line indicating a use is prohibited (e.g., mountain biking on a single-use hiking trail, motorized uses on a non-motorized trail)
- **Permissive** – text and graphics indicating permitted uses for a given trail
- A combination of prohibitive and permissive symbols is generally found at trailheads to define uses at the access point

Figure 56 Regulatory Signage

3. Advisory

- Warning – includes trail closures, “Warning – Bear in Area”, advance notice of trail intersections (e.g., bike crossing ahead), and delineation of private property boundaries – standard colours are yellow and black
- Danger – used in cases of elevated risk, e.g., “Do Not Enter – Area Closed Due to Flooding” –standard colours are red, black, and white

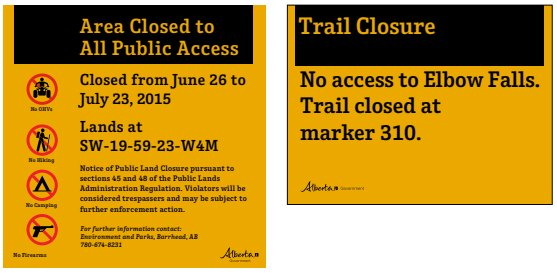


Figure 57 Advisory Signage

4. Educational Awareness

- Resource Protection – includes messages such as “Stay on the Trail,” “Leave Nothing Behind”
- Stewardship – includes messages such as “Sustaining Fish Populations”

Figure 58 Educational Awareness Signage

5. Interpretive

- Graphics and text aim to tell a story and provide in-depth information on a feature of environmental, cultural, or historical interest. If there are sufficient features along a trail, it could be developed and promoted as an interpretive trail.

Figure 59 Example of interpretive signage

5.2.3 Sign Typology

The typology below lists the proposed signage hierarchy and indicates the type of information that should be included with each type (from the descriptions above). The sign types' appropriateness for each recreation setting is summarized in Table 4 in Section 4.

Major Trailhead Sign(s)

- Area identification, including map(s)
- Navigation/Directional
- Decision Support
- Trail Marker Number (intro to system) + emergency contact info
- Regulatory
- Advisory
- Educational Awareness
- Interpretive

Kiosks

Trailhead/entrance kiosks serve to set the stage for trail experience and can be furnished with the signage information types listed above. They should provide a formal welcoming arrival and offer enthusiasts with essential information for a safe and enjoyable trail experience. The design style chosen should complement the landscape setting and may reflect the theme of the trail and other supporting amenities. Kiosk structures that include a covered roof over the information board will provide protection from the elements. Construction materials should be durable and low maintenance such as wood and/or steel. Consider solar lighting when designing the kiosk structure.

Figure 60 Trailhead Kiosk

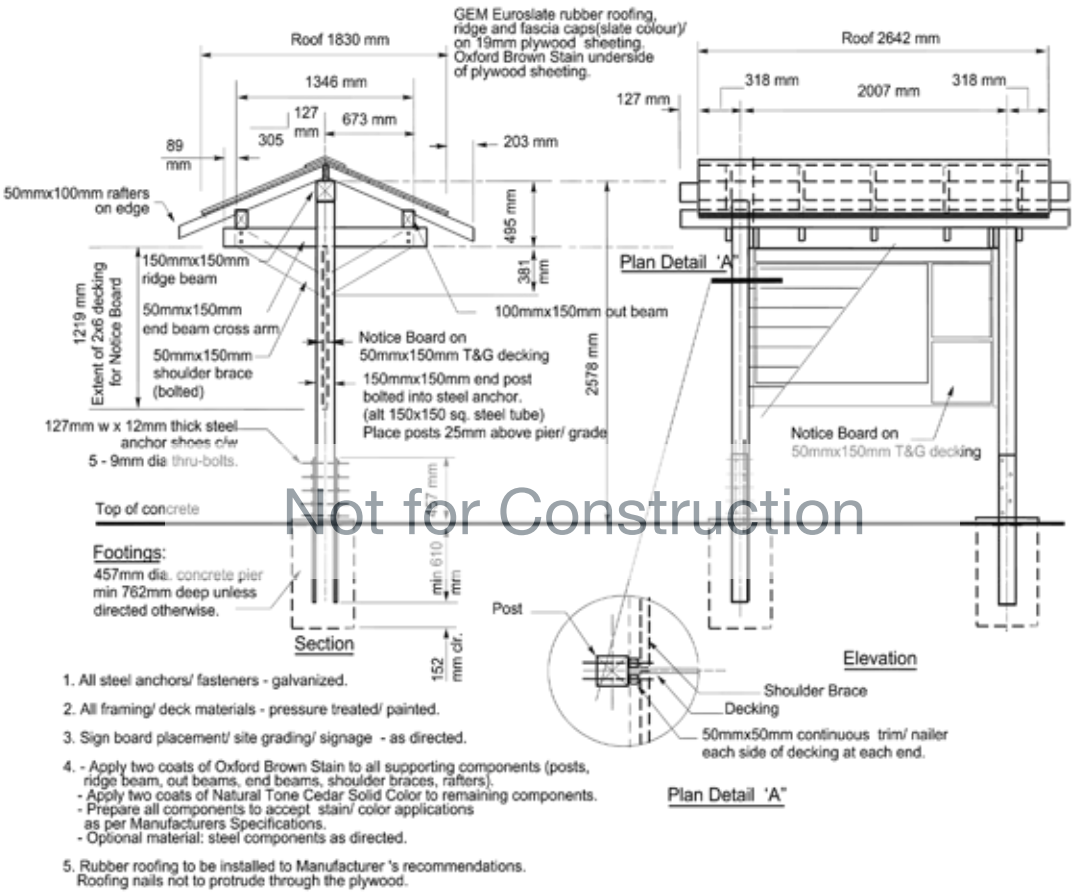


Figure 61 Trailhead Kiosk Detail

Minor Trailhead/Major Trail Intersection Sign

- One sign maximum, map if possible
- Essential messages only from Major Trailhead content
- Trail marker number + emergency contact info

Remote Trailhead Sign

- One small sign, generally no map
- Minimal wayfinding, regulatory, and advisory content
- Trail marker number + emergency contact info

Figure 62 Trail Marker

Figure 63 Regulatory Sign

Figure 64 Advisory Sign

Figure 65 Example of Interpretive signage at a wetland

Major Trail Marker

- At intersections/decision points
- Simple wayfinding information
- Essential regulatory/advisory symbols
- Trail marker number + emergency contact info

Minor Trail Marker

- Mid-trail (not at intersection)
- Trail name only on wand/post – intended to confirm “on route”

Regulatory Sign

- Single symbol or multiple symbols on larger sign (locate strategically, e.g., potential access points for non-authorized users)

Advisory Sign

- Single symbol or multiple symbols on larger sign (keep to safe minimum)

Educational Awareness Sign

- One or more messages on given sign
- Locate trailside and adjacent to resource of concern, but do not clutter views

Interpretive Sign

- One or more messages on given sign – check if provincial catalogue has already-designed signs that would be applicable to trail setting, or work with experts to develop new content and graphics
- Disperse throughout trail network to create welcome rest points in a sequence of interpretive messages
- Locate just off trail to permit for safe viewing and passage of other trail users

5.3 Amenities & Site Furnishings

Trail amenities are constructed features which may provide for basic needs (washrooms) or allow the user to slow down and enjoy their surroundings with various features designed for resting.

5.3.1 Shade & Day Use Shelters

Shelters can take a wide variety of forms, from the highly refined picnic shelter which may be expected in the front-country, to a rustic log structure placed to take advantage of a view along a mid-country trail, to a lean-to style shelter for year-round users of a backcountry trail.

Figure 66 Example of a Picnic Shelter at a Campground/Daily Use Area

Figure 67 Example of a warming hut

Figure 68 Example of a Washroom Building with Flush Toilets, Boulton Creek Campground (google Image)

Figure 69 Example of a PreCast Washroom with a pump-out basin – (Google image from Timberwolf PreCast website)

5.3.2 Warming Hut

Warming huts are highly valued by winter trail users, both motorized and non-motorized, and are in areas with key attractions, located at intersection points of various trails. At a minimum, the fully enclosed shelter offers a chance to warm up – many warming huts also offer picnic benches, litter receptacles, a vault toilet nearby, and equipment racks (e.g. leaning skis)

A wood stove/fire is an option if staff/ volunteers are available to tend to it periodically.

5.3.3 Washrooms and Toilet Facilities

There are a range of options for the provision of washroom and toilet facilities and the choice is dependant on factors such the intended level of development, recreation setting and the level of use. Each site will have its own set of unique requirements that will help determine the type of washroom or toilet required.

Flush Toilets + Vault Toilets

Unless a trail or trailhead is shared with a front-country park or developed campground, flush toilets and sinks are generally not justified or appropriate. If use levels justify it and water supply is convenient, they can be considered. If feasible, a water fountain or tap is highly desirable in association with the washroom or trailhead.

Composting Toilet

Composting toilets are suited to use in backcountry if they can be integrated into the natural setting, but generally they will be more appropriate to front and mid-country settings. They represent a balance between the primitive vault toilet and the flush toilet which is “overkill” for all but the busiest and most developed trailheads or staging areas. Running water is generally not expected in the mid- and back-country but is valued if it’s available.

Aerobic composting systems transform human waste into a rich, well-stabilized mulch. Manufacturers claim that it is odorless, and requires no water for flushing, making it an environmentally friendly option that is suitable for public facilities, and seasonal camps. Mid and back country applications.

Vault Toilet

A vault toilet that can be installed with minimal impact to the mid- or backcountry setting is preferred. Particularly in the backcountry, most trail enthusiasts are not expecting anything more than rustic facilities.

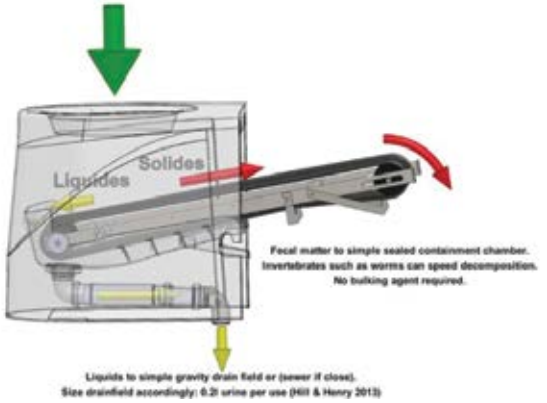


Figure 70 Example of a urine diversion aerobic composting toilet (source: Phoenix website & google images)

Figure 71 Vault Toilet at Romulus Campground, the house is on top of two bins and can slide on rails to allow the full bin to be lifted out by machinery or a helicopter. The bins are water tight with a sealing lid and lifting loops.

Figure 72 Back Country Vault toilet (source: Google)

Figure 73 Example Benches

Figure 74 Mid or Back Country Shelter and Bench

Figure 75 Animal proof garbage and recycling bins

5.3.4 Benches

Generally, benches will be buried under snow in the winter, so they are provided with summer users in mind.

For developed trails, benches with backs can be provided, either mounted on concrete pads or, ideally, into footings in the ground to be less obtrusive visually and to avoid trip hazards as the nearby trail is weathered. Bench locations should consider points of interest, elevation changes and lookouts.

For moderately developed trails, fewer benches are expected, and may be limited to backless benches located towards a view. In both the mid- and backcountry, benches may be crafted from logs or boulders found along the trail to maintain an unspoiled aesthetic.

5.3.5 Waste & Recycling Receptacles

Waste and recycling receptacles are not always provided at trails. These amenities tend to be associated with higher use trails in more developed settings. If trail operators decide to provide waste and recycling receptacles, they should generally sited in trailheads, major trail intersections, and picnic shelters or warming huts. Consideration should be given to how the waste and recycling will be removed and it is essential that only wildlife proof receptacles are used. In bear country, only bear proof receptacles should be used to prevent habituation and wildlife-human conflicts.

5.3.6 Bicycle Parking Amenities & Repair Stations

For trails that are attracting cyclists, or where cycling is a common mode of travel to access the trail, trail operators should consider providing secure bicycle parking options. Bicycle parking amenities can be ground-mounted or on concrete pads at major or minor trailheads, though ground-mounted is preferred. If fence or sign posts are available and acceptable for bike parking, separate racks may not be required.

Bikes are often highly valuable and, due to theft and tampering, cyclists may be reluctant to leave them in an exposed bike rack. Bike packing (riding multiday off-road trips self supported with minimal gear) is becoming extremely popular. Sheltered bicycle parking at high usage locations such as bike packing route rest areas or campgrounds can serve to provide bicycle security and protection from rain or snow. Typically, they are constructed of steel or reinforced fiberglass with high security locking mechanisms and can be branded or signed to match the trailhead design theme. To be the most effective they should be animal proof to allow bike packers to store a bike with all their panniers and food in the locker without having rodents or large wildlife affect their gear.

Figure 76 Example of Bike Storage Lockers

Figure 77 Example Bicycle Parking Rack

Figure 78 In areas of low development, bikes can be locked to trees or other available infrastructure, preferably in a manner without impeding traffic flow.

Figure 79 Bike repair station with tools and a pump

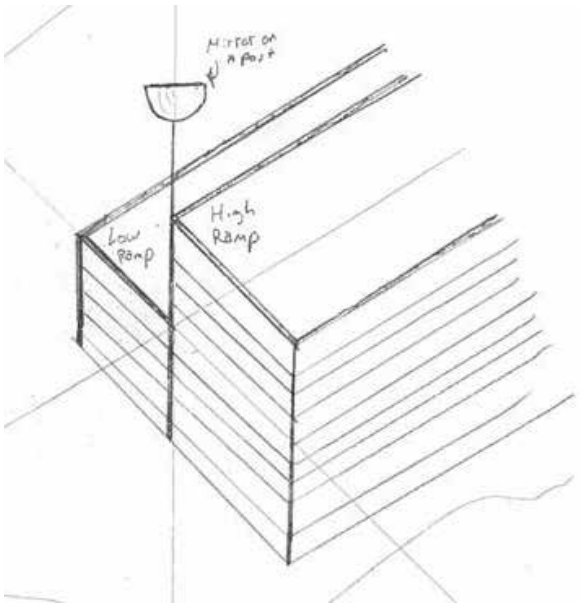


Figure 80 Conceptual loading ramp for motorized equipment from both a sled deck height and a tailgate height. Sketch from Michael Veltri

Bicycle parking and bike locker are generally not expected or appropriate in the moderately or minimally developed trails. In addition to bike storage and locking, enabling enthusiasts to service their bicycles is an ideal consideration. Trail operators should consider the appropriateness of bicycle repair stations.

Bike repair stations should be located at trailheads or in areas with high visibility and cycle traffic. Bike repair stations on more developed trails may be more complex and provide a wider assortment of tools while stations in moderately or minimally developed should be basic and may not provide more than an a few essential tools and a hand pump secured to a robust repair stand.

5.3.7 Loading / Off-Loading Ramps

Loading and off-loading ramps are becoming increasingly obsolete. Many motorized and equestrian enthusiasts tend to carry their own loading ramps or use trailers which have been modified to make onsite loading / off loading ramps unnecessary. If ramps are to be provided, they should be sited at the trail staging area of more developed trails. The ramps should be constructed of durable materials and at a height that allows easy loading and off-loading from a pick-up truck. Ramps can be equipped with accessories such mirrors to help the driver assess their positioning at the ramp.

5.4 Trail Alignment, Grading And Drainage

This section covers ideal trail alignment scenarios and common misconceptions for design and construction. Further details of specific water management structures and crossings are found in the following two sections.

5.4.1 Trail Alignment for Sustainability

As highlighted in Section 3, the ideal trail alignment for a sustainable trail tread from a physical sustainability standpoint (erosion) and socially sustainable (to diminish trail braiding) is a rolling contour trail.

Water is the number one cause of erosion, and minimizing the volume, velocity, and length of time it stays on the trail will allow for a more sustainable trail tread. Moving water will carry away loose particles from the trail, and the size of the particles is proportional to the volume and speed of the water. Two principles to follow are:

1. Do not allow water flows to concentrate
2. Do not allow water to gain speed.

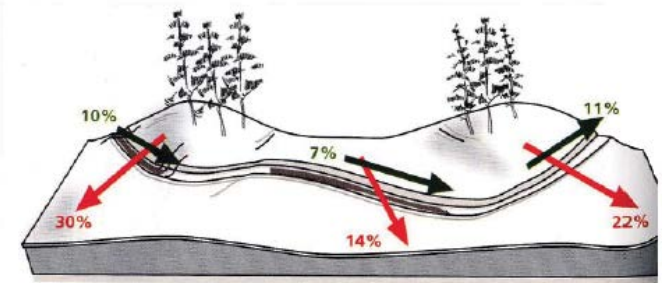


Figure 81 Half Rule adopted from Minimizing Risk & Liability

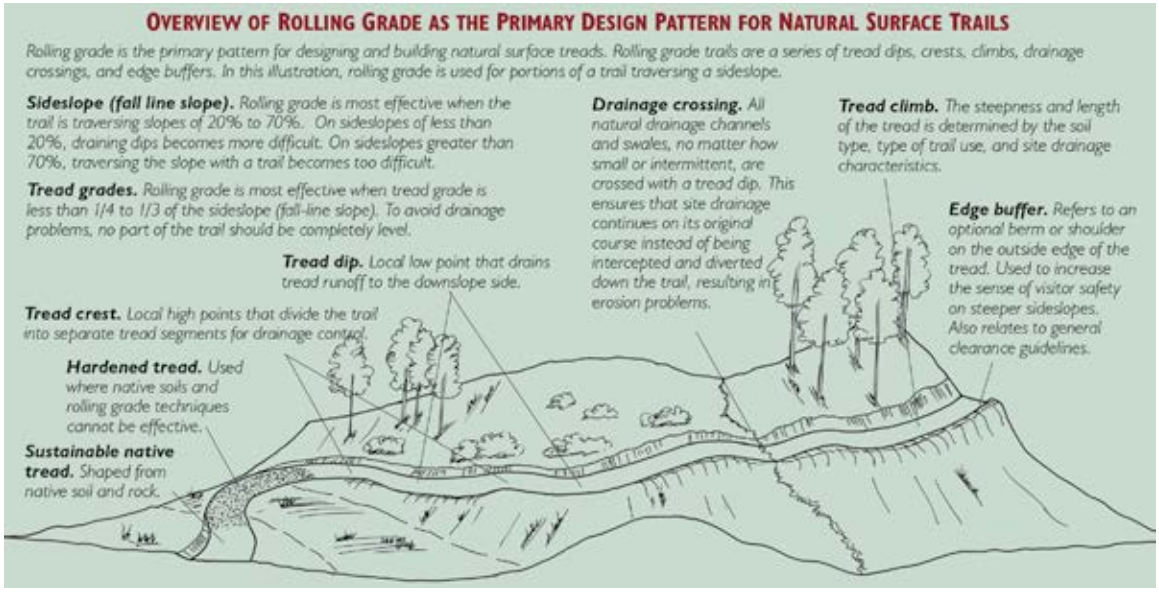


Figure 82 Rolling Grade Design adopted from Minnesota DNR

The folowing design parameters should be followed for any trail alignemnt which disturbs the ground:

1. **Half Rule –** Meaning that the trail grade should never exceed half the grade of the sidehill on which it is located on. Anything more than this and the outslope is prone to failing and water may flow down the trail tread.

2. **Align trails using the "rolling grade design" illustrated above.** A rolling contour trail with a proper outslope (2-5%) will allow water to sheet flow across as opposed to flowing down it with a fall line trail, or pooling on it for a trail in a flat area. Frequent changes in grade (grade reversals see section 5.7.1) are your insurance policy that if the outslope fails due to lack of maintenance that water will not flow down the trail for extended distances.

3. **As a general rule,** keep the average trail grade to 10% or less to maximize trail tread longevity and minimize soil displacment from users and water.

4. **Maintain existing vegetation** close to the trail, or plant drought resistant native shrubs, or grasses whose root systems will stabalize the soils (see Section 5.7.2 on planting and seeding).

5. **The trail tread can never be the lowest point -** Avoid aligning trails through flat areas. This may seem like the easy way initially because the trail will be "walked/ridden in"; however, the low area will cup and water will pool. This will result in water ponding, soil saturation, and degradation of the trail tread (see Section 5.4.3).

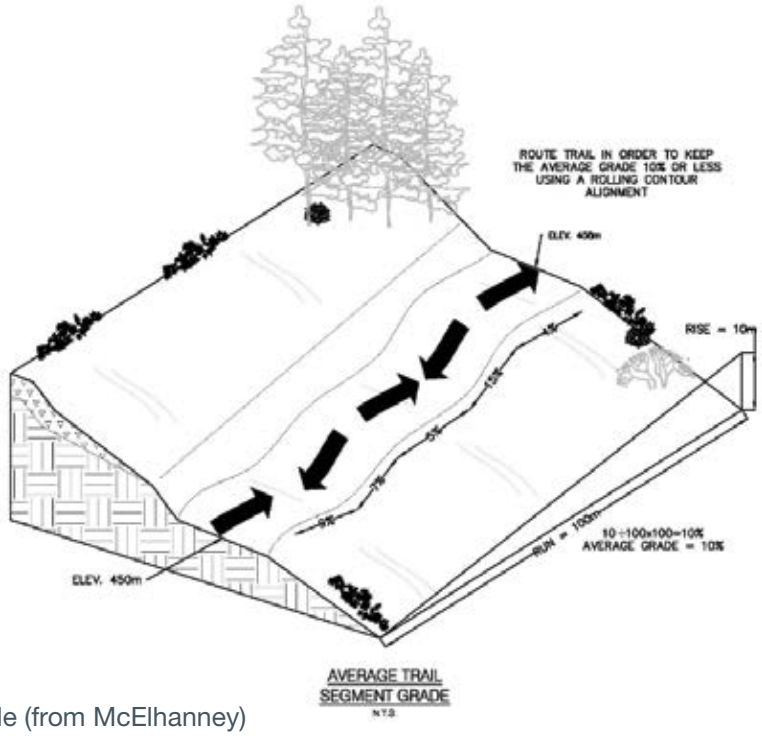


Figure 83 Achieving a 10% Grade (from McElhanney)

5.4.2 Bench Cut Trails

A rolling contour trail has a trail tread or “bench” which is “cut” into a hillside hence the bench cut trail. The backslope is the terrain above the trail on a bench cut. A bench cut trail enables trail users to ascend or descend slopes without exceeding the prescribed trail gradient or cross-slope.

A bench cut trail with a backslope keeps the user on the trail tread because the trail tread is the path of least resistance.

Figure 84 Example of a Bench Cut Trail & Backslope adopted from BLM

5.4.3 Trails in Flat Areas

Trails in flat areas typically fail for 2 reasons:

1. Trail braiding or creep due to users avoiding a challenging obstacle such as rocks or roots,
2. Water pooling resulting in trail tread saturation, failure and users trail braiding or creep around the wet area.

Compare this situation to a benchcut trail where the backslope, down slope, and anchors make it quite challenging to bypass an undeseriable feature. To prevent creep around a challenging obstacle, appropriately placed anchors can be installed, or depending on the desired TMO difficulty level, maintenance to remove the challenging obstacle.

Where the only option is to route a trail in a flat area, signifigant engineering design and costly construction techniques will need to be considered. A raised trail tread will need to be constucted for flat areas. Ideally this is done by importing suitable material from a nearby benchcut to raise the trail tread 5-15 cms above the surrounding terrain. Importing material in this manner typically (see figure 85 Raised Tread) results in a safer trail for the trail user compared to constructing ditches.

Figure 85 Example of water pooling and trail braiding due to a trail in a flat area, and a raised trail tread during construction.

Culverts or rock armoured crossing may need to be installed to prevent the raised trail tread from acting as a dam. Geotextile fabrics may also need to be considered if a raised trail tread is to be constucted though a wet area.

A raised tread may also be constructed by lowering the surrounding terrain and raising the trail tread. In this instance all organics must be removed and the ditches on each side should be gradual in nature such that a user can exit the ditch should they travel off the trail.

Section 5.6 discusses other methods to cross flat wet areas, such as; boardwalk, puncheon, corduroy roads, and in Section 5.7.5 presents guidelines for the use of geotextiles.

Figure 86 Examples of Trails in Flat areas

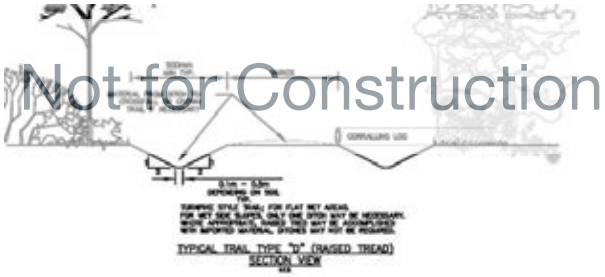


Figure 87 Typical Design for a Raised Tread Trail (from McElhanney)

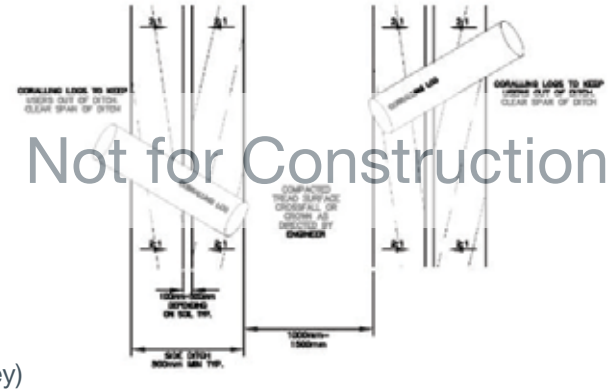


Figure 88 Coralling Logs (from McElhanney)

5.4.4 Trails in Steep Areas

Its not always possible to avoid siting the trail through overly steep terrain. When a rolling contour trail needs to climb a steeper slope, breaks in the terrain such as plateaus should be located to provide a turning platform, as shown by the wider spaced contours at the turn in Figure 89. The greater the distance between the entrance and exit of the turn, the larger the chance of success of keeping users on the trail tread and preventing short cutting.

Figure 89 Use contour data to find natural flat areas in steep terrain where switch back turns can be located

Switchbacks

Switchbacks are approximately 180 degree turns that are used in very rocky or steep terrain (e.g., side-slopes greater than 35%). These sharp turns have a radius of less than 2.4 m and should be nearly flat at the apex of the turn. It is recommended that the trail tread widens in these steep scenarios to help users safely navigate the sharp turn and, if the trail is two-way, to avoid oncoming users.

Wherever possible switchbacks should be avoided. Users looking for a trail user objective of efficiency (typically hikers) will short cut switchbacks leading to trail braiding, erosion, and loss of environmental integrity. A trail designer needs to predict user patterns and route a trail into the terrain to be meet user desires as well as physically sustainable from erosion. The adjacent image shows a switch backing trail forming a Z, with all the yellow segments are established short cuts from users.

Figure 90 A Switchback – notice all the shortcut trails

Climbing Turns

Climbing turns are far more sustainable, both socially sustainable (for both the user) and physically than switchbacks (for erosion). They are used when side-slopes are less than 25% and there is room or a turn radius of more than 2.4 m. These wider turns maintain flow momentum better than switchbacks, are suited to a wider range of activities and difficulty levels, and minimize tread wear and tear as well as maintenance. The trail should have a grade reversal before and after the turn to shed water prior to the fall line section in the middle of the turn.

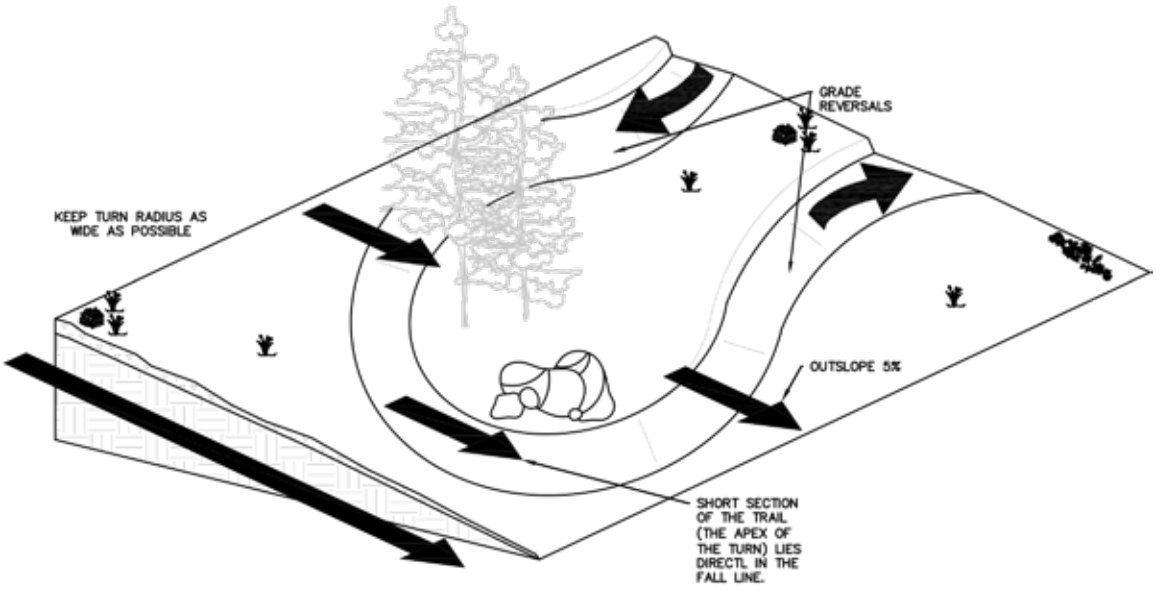


Figure 91 Climbing Turn Concept

5.4.5 Anchors / Corrals

Anchor or corral points along a trail are designed to regulate speed and add variety to the experience. Anchors are also used to keep a trail from creeping down a hillside or braiding around a technical section of trail. Examples of these feature are:

- A boulder or tree and deadfall on the low edge of a trail to block users from drifting downhill (creating trail creep) around obstacles or wet areas
- Trees retained on both sides of a trail to create an opening just wide enough for handlebars, forcing the rider to slow down in order to navigate the narrow point safely
- Boulders or trees close to the trail tread but offset to create a sharp turn, again forcing riders to slow down

Figure 92 Example of an anchor adopted from BLM

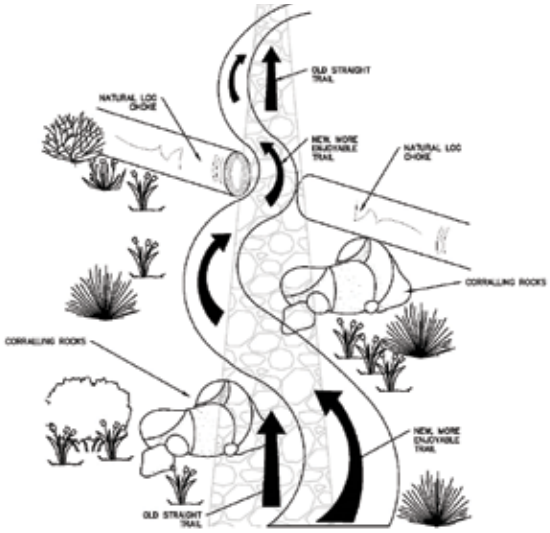


Figure 93 Example of corralling features and layout (from McElhanney)

5.4.6 Tread Armouring

Tread armouring is used in areas prone to soil erosion. These areas are typically required due to poor trail design resulting in excessive breaking or acceleration by users, or extremely poor soil conditions. They can also be used as Technical Trail Features to cause users to slow down as a management control. Typically, large anchors called “Gargoyles” will need to be placed directly adjacent to the armoured area to force users to stay on the trail tread. Examples of tread armouring include:

- Stone Pitching where rocks are buried deeply on their side to form a very durable surface
- Recycled concrete slabs
- Turfstone or similar product
- Wood boxes filled with pitched stones

Figure 94 Example of tread armouring adopted from BLM

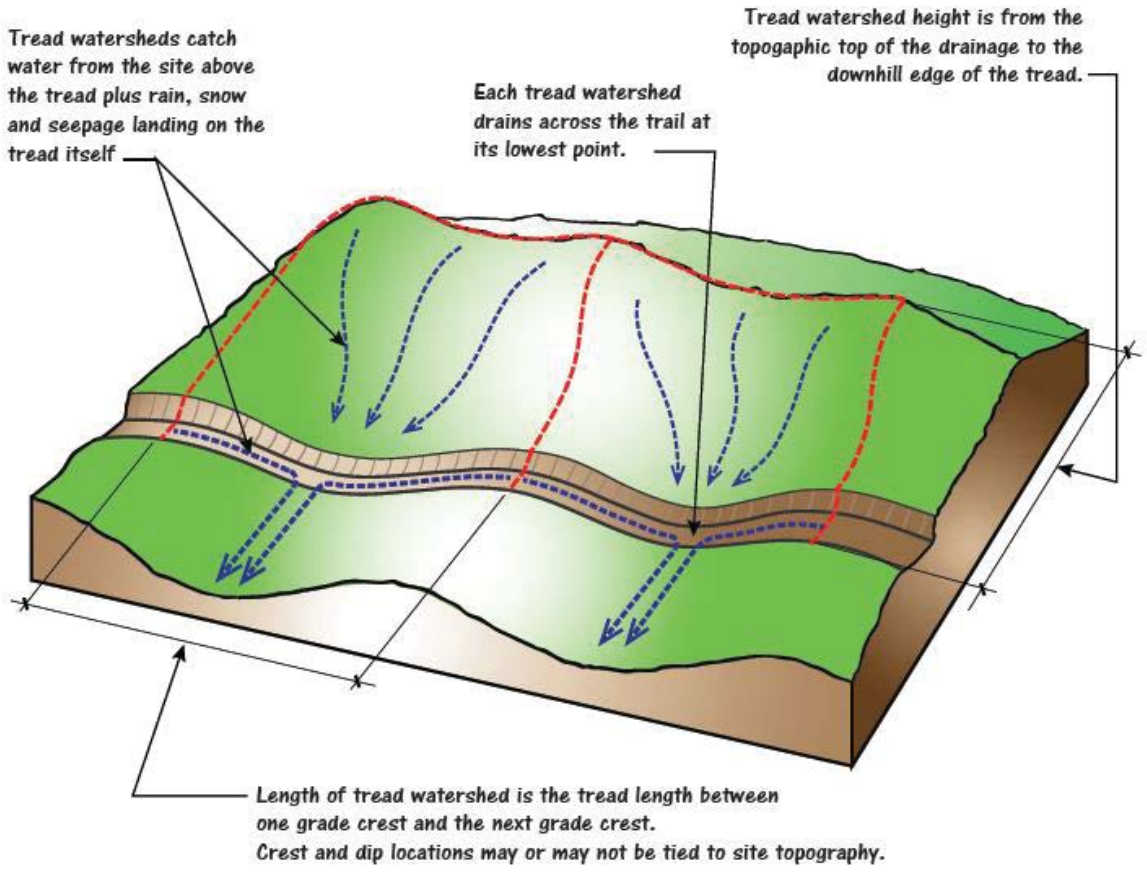


Figure 95 Grade Reversals help to Drain Water from the Trail Watershed

5.5 Water Management Structures

Any alteration of drainage patterns needs to be carefully assessed from both technical and environmental perspectives in the trail planning stages. Refer to Section 1.6 for details on responding to legislation and regulations as part of trail design.

In general, with trail design we want to start with a simple solution first. Don't do a $10,000 fix for a $100 problem. For simple ephemeral seeps, consider constructing a rock armoured crossing. By hardening the bottom of a seep or gully with stone, users can travel through it and water can travel over it, neither one creating soil displacement. For small seeps that are constantly flowing consider culverts. Culverts placed in streams that are prone to flooding or debris have a high chance of failure are not a preferred option. For any constantly flowing water, a clear span bridge is recommended. More is provided on each of these options in the sections that follow.

Figure 96 Grade Reversals adopted from NOHVCC

5.5.2 Tread/Grade Reversal

Tread or grade reversals are created by working with natural rolling topography or by intentionally creating brief or extended trail segments on which the trail gradient is reversed relative to the overall gradient. Where the grade transitions from negative to positive, a low point is created, allowing runoff to drain away from the tread surface. Where the grade transitions from positive to negative, a high point is created, effectively acting as a ridgeline for the tread "watersheds". The rolling sequence created by this grading strategy enhances the trail enthusiast's experience while ensuring that tread "watersheds" are not too large and runoff is locally dispersed. Grade reversals are the insurance policy for trail tread water management for when the outslope fails due to compaction, displacement, organics build up and lack of maintenance.

5.5.3 Rolling Grade Dip

A rolling grade dip is a grade reversal that is constructed on a linear road or trail which is experiencing erosion and requires a water management structure. While a grade reversal follows the contours of the terrain, a Rolling Grade Dip is a large continuous undulation in the trail to forcibly shed water from the trail tread, compared to a waterbar which is easily overrun. They are typically constructed retroactively to fix a mistake in a road or trail alignment, as they require far more material to be moved than by using the terrain to construct a grade reversal.

Spacing frequency of water management features varies based on numerous factors including the soil type, typical moisture content of the terrain, size and steepness of catchment area above the trail, nearby vegetation, trail or road tread width and the grades. Ideally a rolling contour trail is constructed with grade reversals to match those naturally occurring in the terrain or more frequently. If this is not possible or of insufficient frequency, rolling grade dip frequency can be based on the following table.

Table 9 Rolling grade frequency guide from BC Watershed Restoration Program Resource road rehabilitation guidebook (Moore, 1994) meters. Cross ditch and water bar spacing guide.

Gradient (%)	Soil Type		
	Fine texture (silt/clay) (m)	Med Texture (loams) (m)	Course (sand/gravel) (m)
< 5	100	160	210
6-10	80	110	160
11-15	50	90	130
>16	Site specific	Site specific	Site specific

Trail Tip

Grade reversals should be 1.5X the length of the longest trail user equipment, for user safety and to prevent soil displacement from clogging the low point. Use grade reversals – water doesn't flow uphill!

5.5.4 Knick & Sump

A knick is used during trail maintenance on a trail that has lost its out-slope drainage. It is crescent-shaped that can be carved into the trail tread to create a localized increase in cross-slope, allowing water running down the trail to drain off in a controlled manner. Knicks are field fit to remove the curb of soils or organics that has built up and is causing water to pool. They can only be used on trail gradients less than 10% otherwise they need to be combined with a rolling grade dip or grade reversal to prevent from being over-run. A knick is far more effective and longer lasting than a ditch the width of a Pulaski or mini excavator bucket width, as these narrow ditches quickly clog with organics.

A sump is used when the trail is the lowest point and is collecting water. It is a quicker fix than full raised tread and may be sufficient in many areas. The sump is an area off trail which is carved out to a grade below the trail tread. The soils in the sump must remain uncompacted to allow water percolation.

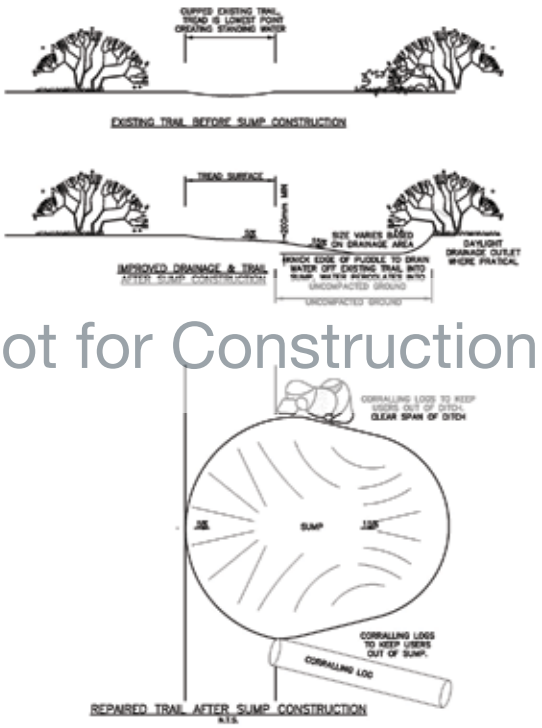


Figure 97 Knick and Sump construction (from McElhanney)

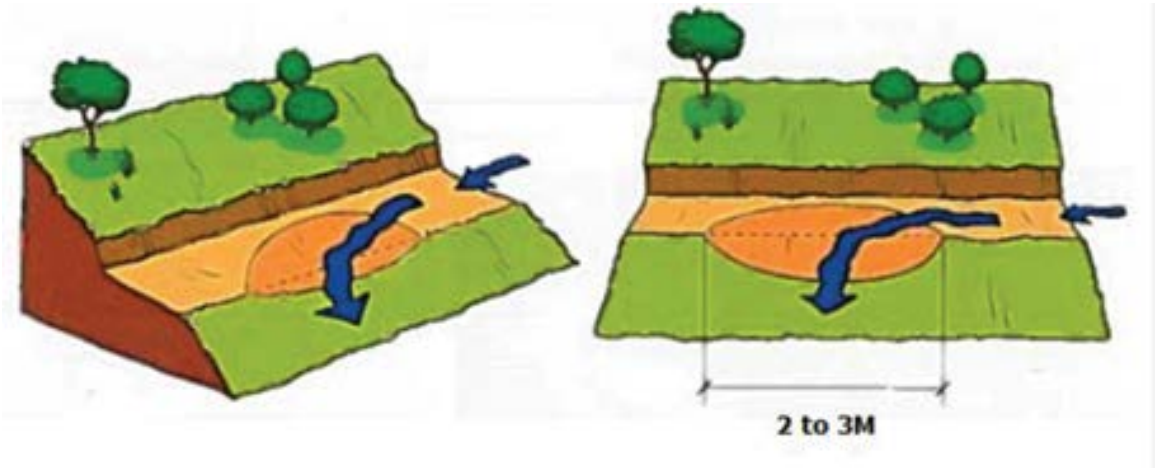


Figure 98 Knicks adopted from NOHVCC

5.5.5 Waterbar

Waterbars are used on the trail to shed water off the trail tread. However, waterbars are prone to sediment deposition and consequently being over topped by large rain events or concentrating the flow to a very narrow channel leading to increased water velocity erosion. Wherever possible grade reversals should be used as the preferred water management treatment as the bottom of a grade reversal is far shallower and wider, and the grade reversal goes uphill. If waterbars are used, they should be designed to intercept water running along the trail and direct it to the out-slope side of the trail. They should be installed at a sixty degree angle. Waterbars may be constructed using rocks or logs. A pressure-treated timber waterbar is typical. Waterbars must be actively maintained on a regular basis to prevent clogging. When the waterbar becomes closed with sediment and debris, water will travel over top and continue to erode the trail tread.

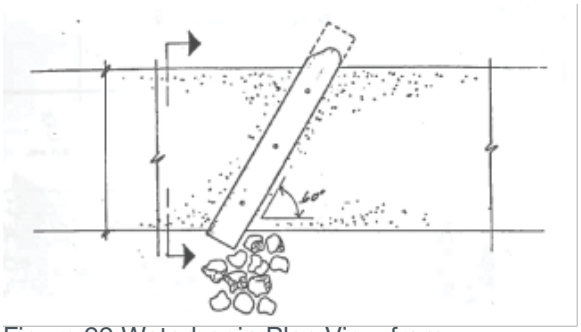


Figure 99 Waterbar in Plan View from BTFRP pg 12

5.5.6 Ditch/Cross Ditch (Drain Dip)

Ditches are used to prevent water from crossing the trail tread except in pre-determined locations. Ditches may run parallel to the trail or may cross trails perpendicular to the direction of travel. For ditches running parallel to the trail, its design (width, depth) parameters must reflect anticipated flows, gradients, erodibility of ditch materials, and maintenance regime. As a general rule, ditches and other features that concentrate runoff should be used sparingly, and natural drainage patterns (e.g., sheet flow) should be maintained as much as possible. Abrupt turns in ditches and water flows are areas extremely prone to erosion due to the momentum and swirling nature of moving water. These bends should be minimized or armoured with riprap. Ditch blocks to slow down water flow are shown in section 5.5.6.

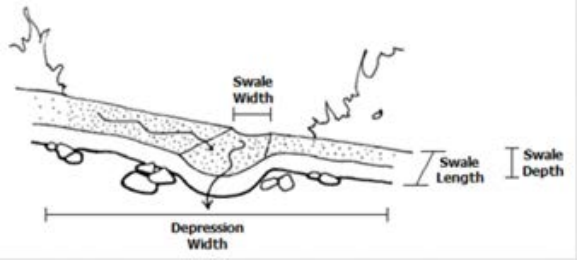


Figure 100 Swale / Ditch crossing the trail tread

Trail Tip

"V" is for Velocity. Ditches with a wide bottom are better at reducing the speed that water travels in the ditch, compared to a "V" shaped ditch with concentrates the flow of water and increases the Velocity of the water and sediment runoff.

5.5.7 Subsurface Drains

Subsurface drains are used to intercept water from seeps, springs, ephemeral streams, or other subsurface sources that may negatively impact the trail tread and direct it away from the trail. Subsurface drains may be longitudinal to the trail (curtain drain) to intercept a sheet flow subsurface water source or perpendicular to the trail (French drain) to collect a point source of water on the upslope side of the trail and convey it to the downslope side. Regardless of the application, the principals of design and construction are similar for each:

- Excavate a trench to an appropriate depth to intercept the problematic water source. Where the drain crosses the trail tread, dig the bottom of the trench deep enough maintain a minimum of 0.3 m cover over the top of the drain rock.
- Lay non-woven geotextile to cover all sides of the trench and leave enough overlap to wrap over the top once the trench is backfilled.
- Use minimum 100 mm diameter perforated drain pipe wrapped in a non-woven geotextile – bigger is better. Alternative products may be available from geotextile suppliers as well.
- Surround the perforated drain pipe or alternative with at least 150 mm of free-draining rock or gravel (drain rock) on all sides.
- Wrap the geotextile over top of the drain rock filled trench and install the minimum 0.3 m thick trail tread where applicable, otherwise 150 mm natural cover.
- Ensure proper installation as maintenance usually involves starting over.

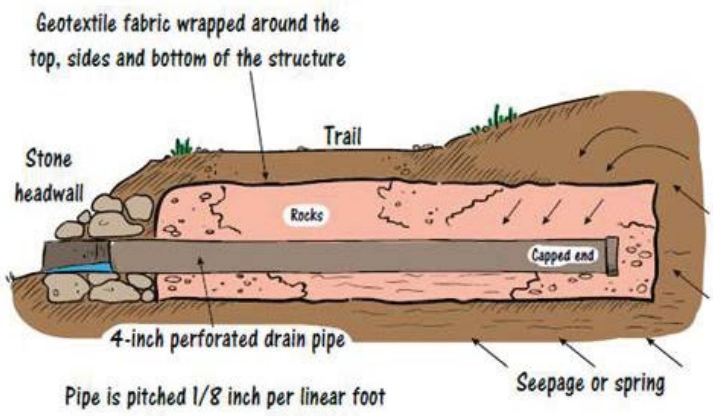


Figure 101 French Drain Concept (from NOHVACC)

Trail Tip

Subsurface drains typically fail due to clogging or inadequate burial depth. Ensure that buried pipe ends are capped and that the drain rock material is free of fine-grained soils (sand, silt, and clay) to prevent clogging of the pipe and ensure the minimum cover is suitable for the intended use of the trail.

5.6 Water Course Crossings

Figure 102 Minor Hardened Crossing

There are many different types of water course crossings available to trail operators. Choosing the right crossing is dependent upon the type of water course, bank conditions, volume of water, type of trail and, of course, the budget available for the work. However, trail operators must understand that all water crossing design proposals must be submitted to the public land manager for approval. Approval and relevant permits must be obtained before work can begin as outlined in section 1.6.

Regulatory approvals include but may not be limited to:

- Alberta Environment and Parks
- Alberta Transportation
- Transport Canada (*Navigable Waters Protection Act*)
- Fisheries and Oceans Canada.

A qualified professional such as a Qualified Aquatic Environment Specialist must deem the dimensions such as the width and height of the water crossing and the opening below the water crossing to be acceptable to AEP. Additional applications and authorizations may be required if work occurs outside the approved period.

Figure 103 Turfstone hardened Crossing

5.6.1 Hardened Crossings

For gullies prone to water pooling or infrequent flooding, hardening with stone pitching (see section 5.4.6 tread armouring for stone pitching techniques) is preferred. Stones should be placed in a manner to allow the water to flow over the top without scouring the edges away. Stones should be large with the bulk of them buried to prevent any wiggling. A smooth inviting surface should be focused at the center of the trail tread. Concrete products such as “Turfstone” may be appropriate for beginner or intermediate difficulty trails in front country locations.

Figure 104 A ford using interlocking blocks which are tied together to resist lateral forces from the water (From NOHVAC pg 110)

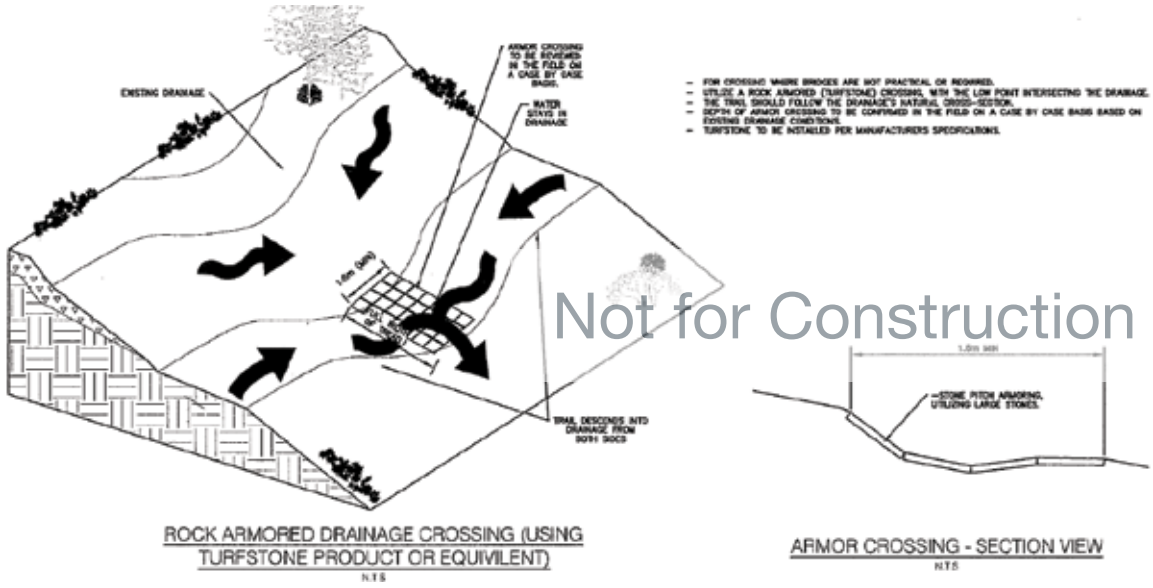


Figure 107 Interlocking Blocks

5.6.2 Culverts

From a trails perspective culverts are best suited for small seeps which flow constantly but are not prone to flooding. This use can prevent the trail tread from becoming saturated or acting as a dam.

Culverts may also be used when trails cross drainage swales or watercourses (environmental permitting applies) to allow for a structurally sound and consistent trail surface and avoid the need for bridges. Depending on the location, consultation with an engineer and a Qualified Environmental Specialist may be required.

Figure 105 Arch culvert from NOHVCC pg 121

Clear span bridges are preferred to culverts as clear span bridges do not damage the natural stream bed and restrict fish and wildlife movement. Culvert installation alters or damages the natural stream bed since the culvert covers or replaces the natural stream bed. Culverts often require a lengthy environmental approval process.

In drainages which are prone to flooding, culverts are very prone to clogging up, with trees blocking the entrance or stones filling the pipe. Bigger is better to a point, and a qualified engineer can specify which size of culvert is required by conducting a hydrological study based on the watershed. At minimum, spec a culvert of adequate size to fit a shovel or garden hoe inside to clean it out when it clogs. To reduce the potential of clogging, the ends of the culvert should be beveled to encourage debris to shed over top of it instead of becoming pinned against the end. If used, culverts should be maintained and regularly inspected for clogs and scouring issues.

While culverts are installed to manage water flow, they can be subject to erosion and block fish passage if not properly installed. Proper culvert install requires mechanically compacting the soil on both sides of the culvert evenly, in thin lifts, to ensure blow outs do not happen beside the culvert. Culverts should also have appropriately sized and located rip rap installed at both ends to reduce the scour potential of swirling water.

Culverts should be buried by a minimum of 15cms of soil for pedestrian only traffic, and 30cms for heavier uses.

Material types for culverts are extremely varied, typically for remote trail applications corrugated HDPE (High Density Polyethylene plastic) are preferred due to their light weight, ease of transport and ability to cut to length with appropriate trail tools.

Types of culverts are nearly limitless, common ones useful for trail applications include:

- Corrugated HDPE
- Corrugated Steel Pipe (CSP)
- Arch culverts of HDPE or CSP with open or closed bottoms which allow for a wider streambed and a wide mouth which is less likely to clog.

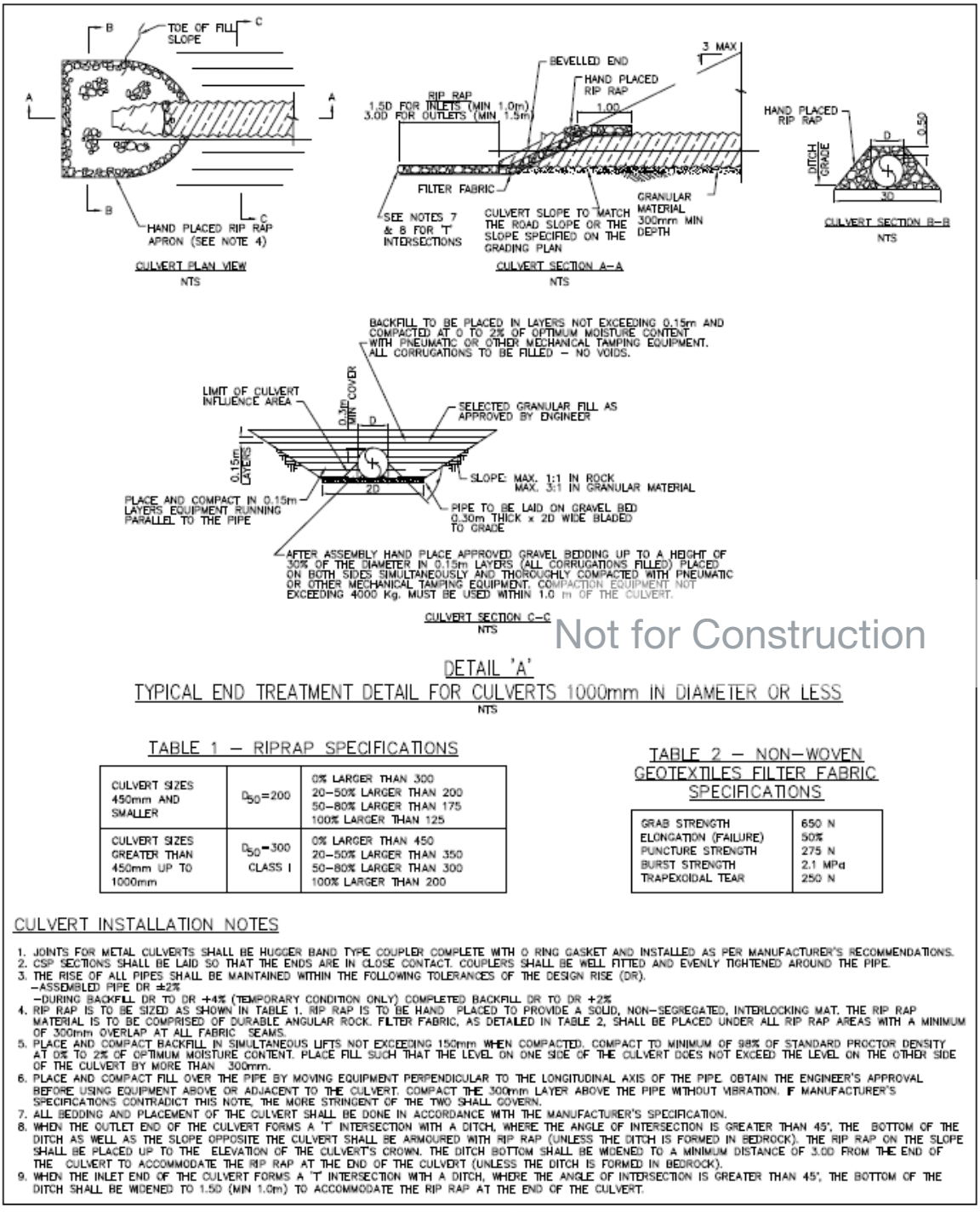


TABLE 1 – RIPRAP SPECIFICATIONS

CULVERT SIZES 450mm AND SMALLER	D_{50}=200	0% LARGER THAN 300 20–50% LARGER THAN 200 50–80% LARGER THAN 175 100% LARGER THAN 125
CULVERT SIZES GREATER THAN 450mm UP TO 1000mm	D_{50}=300 CLASS I	0% LARGER THAN 450 20–50% LARGER THAN 350 50–80% LARGER THAN 300 100% LARGER THAN 200

TABLE 2 – NON–WOVEN GEOTEXTILES FILTER FABRIC SPECIFICATIONS

GRAB STRENGTH	650 N
ELONGATION (FAILURE)	50%
PUNCTURE STRENGTH	275 N
BURST STRENGTH	2.1 MPa
TRAPEZOIDAL TEAR	250 N

CULVERT INSTALLATION NOTES

1. JOINTS FOR METAL CULVERTS SHALL BE HUGGER BAND TYPE COUPLER COMPLETE WITH O RING GASKET AND INSTALLED AS PER MANUFACTURER'S RECOMMENDATIONS.
2. CSP SECTIONS SHALL BE LAID SO THAT THE ENDS ARE IN CLOSE CONTACT. COUPLERS SHALL BE WELL FITTED AND EVENLY TIGHTENED AROUND THE PIPE.
3. THE RISE OF ALL PIPES SHALL BE MAINTAINED WITHIN THE FOLLOWING TOLERANCES OF THE DESIGN RISE (DR).
   –ASSEMBLED PIPE DR ±2%
   –DURING BACKFILL DR TO DR +4% (TEMPORARY CONDITION ONLY) COMPLETED BACKFILL DR TO DR +2%
4. RIP RAP IS TO BE SIZED AS SHOWN IN TABLE 1. RIP RAP IS TO BE HAND PLACED TO PROVIDE A SOLID, NON–SEGREGATED, INTERLOCKING MAT. THE RIP RAP MATERIAL IS TO BE COMPRISED OF DURABLE ANGULAR ROCK. FILTER FABRIC, AS DETAILED IN TABLE 2, SHALL BE PLACED UNDER ALL RIP RAP AREAS WITH A MINIMUM OF 300mm OVERLAP AT ALL FABRIC SEAMS.
5. PLACE AND COMPACT BACKFILL IN SIMULTANEOUS LIFTS NOT EXCEEDING 150mm WHEN COMPACTED. COMPACT TO MINIMUM OF 98% OF STANDARD PROCTOR DENSITY AT 0% TO 2% OF OPTIMUM MOISTURE CONTENT. PLACE FILL SUCH THAT THE LEVEL ON ONE SIDE OF THE CULVERT DOES NOT EXCEED THE LEVEL ON THE OTHER SIDE OF THE CULVERT BY MORE THAN 300mm.
6. PLACE AND COMPACT FILL OVER THE PIPE BY MOVING EQUIPMENT PERPENDICULAR TO THE LONGITUDINAL AXIS OF THE PIPE. OBTAIN THE ENGINEER'S APPROVAL BEFORE USING EQUIPMENT ABOVE OR ADJACENT TO THE CULVERT. COMPACT THE 300mm LAYER ABOVE THE PIPE WITHOUT VIBRATION. IF MANUFACTURER'S SPECIFICATIONS CONTRADICT THIS NOTE, THE MORE STRINGENT OF THE TWO SHALL GOVERN.
7. ALL BEDDING AND PLACEMENT OF THE CULVERT SHALL BE DONE IN ACCORDANCE WITH THE MANUFACTURER'S SPECIFICATION.
8. WHEN THE OUTLET END OF THE CULVERT FORMS A 'T' INTERSECTION WITH A DITCH, WHERE THE ANGLE OF INTERSECTION IS GREATER THAN 45°, THE BOTTOM OF THE DITCH AS WELL AS THE SLOPE OPPOSITE THE CULVERT SHALL BE ARMOURED WITH RIP RAP (UNLESS THE DITCH IS FORMED IN BEDROCK). THE RIP RAP ON THE SLOPE SHALL BE PLACED UP TO THE ELEVATION OF THE CULVERT'S CROWN. THE DITCH BOTTOM SHALL BE WIDENED TO A MINIMUM DISTANCE OF 3.0D FROM THE END OF THE CULVERT TO ACCOMMODATE THE RIP RAP AT THE END OF THE CULVERT (UNLESS THE DITCH IS FORMED IN BEDROCK).
9. WHEN THE INLET END OF THE CULVERT FORMS A 'T' INTERSECTION WITH A DITCH, WHERE THE ANGLE OF INTERSECTION IS GREATER THAN 45°, THE BOTTOM OF THE DITCH SHALL BE WIDENED TO 1.5D (MIN 1.0m) TO ACCOMMODATE THE RIP RAP AT THE END OF THE CULVERT.

Figure 106 Typical End Treatment for Culverts (from McElhanney)

5.6.3 Bridges

Trail Bridge Construction Standards for Alberta's Crown Land (Alberta Environment & Parks, 2015 Draft) addresses the life-cycle of motorized vehicle bridge planning, permitting, design, construction, environmental protection, and maintenance. Design standards and loads, widths, railings, materials and surfacing need to reflect the planned use(s) of the trail and maintenance vehicles that may use the structure (e.g., pickup trucks, groomers). Specifically, this draft document proposes minimum bridge widths of:

- 1 m – Pedestrian/Cycling
- 1.8 m (72") – Motorized Vehicle width less than 1.8m (72")
- 3.0 m (118") – Motorized Vehicle width greater than 1.8m (72")
- 3.6 m (142") – Snow Groomer

Bridges for non-motorized uses may be narrower than 1.8 m, and their design standards need to reflect single vs. multi-use, one-way vs. two-way travel, recreation setting, and environmental context, among other factors.

Site Selection

Selection of the bridge crossing location is one of the most important factors in ensuring a successful, sustainable and cost-effective crossing. Trail operators should consider the following when selecting the bridge crossing location:

- The required line of sight for the intended trail use. For example, faster moving users require a longer line of sight therefore tight curves at bridge approaches should be avoided.
- The bridge should be installed in a location where potential damage in high water events is minimized. For example, sharp bends in the stream are more likely to be subjected to increased erosion in high water events and subsequently cause damage to the structure, therefore bridges should be ideally installed within a reasonably straight stretch of channel.

Figure 108 Native and/or ungraded timber

- The accessibility to site should be considered as well since it may limit the size and type of materials that can be transported to site. For example, spans should be minimized as much as possible in remote locations to reduce imported material weight or allow the use of native materials.
- The ground conditions should be assessed prior to the selection of a bridge site as well since this will determine the type of abutment required.
- As discussed in previous sections of this document, the required approvals should be considered as well since it can affect the construction schedule.

Bridge Material Selection

Bridges can be constructed from different materials. The materials chose must reflect with intended use, the size of the crossing, the intended life cycle and the budget available for bridge construction. Bridge materials include:

Native and/or ungraded timber

Native timber describes timber cut at the bridge site which has not been graded or manufactured. Other ungraded timber may included repurposed materials, such as power poles, for which no grading information is available. This type of bridge is mainly recommended for pedestrian loading in remote locations where sacrificial structures may be required based on site conditions.

Dimensional timber

This refers to square or rectangular graded and manufactured timber. Dimensional timber may be used as single rectangular stringers or built up stringers. This type of bridge is ideal in locations with pedestrian loading only or for OHV loading on shorter spans. The construction costs can be maintained reasonably low since no skilled labour is required for assembly.

Figure 109 Dimensional timber

Glulam

Aluminum

Fiberglass

Steel

Glulam

Glued laminated engineered beams can also be considered as bridge materials. These would likely be used where a timber look is desired in a high profile location or for longer spans as it is more costly than dimensional timber.

Aluminum

Aluminum is a light weight material that can be considered for locations where construction operations may be challenging. Aluminum truss bridges can be pre-assembled and flown in to site hence minimizing site labour and potentially eliminating the need for large equipment on a remote site.

Fiberglass

Similar to aluminum, fiberglass is a lightweight material that can be considered for remote locations. Fiberglass bridges can be prefabricated or assembled on site. On-site assembly does not required skilled labour and can even be completed by volunteer groups. These structures can be designed for medium spans under pedestrian and OHV loading.

Steel

Steel structures will offer the widest range of possible spans. There is variety of design styles to consider with steel such as prefabricated steel trusses for pedestrian bridges or large steel stringers for vehicle bridges. Steel construction required skilled labour and large equipment for installation, therefore steel bridges should be considered for locations with easy vehicle access.

See Table 10, for a summary of the key considerations based on the different types of bridge materials.

Table 10 Key considerations based on the different types of bridge materials.

	Ungraded Timber	Dimensional Timber	Glulam	Aluminum	Fiberglass	Steel
Description	Native materials cut at site or repurposed material such as power poles	Manufactured graded timber, square, rectangular or built up stringers	Glued laminated engineered stringers/ beams	Prefabricated aluminum trusses	Prefabricated fiberglass trusses	Steel stringers or trusses
Manufacture	Material readily available No skilled labour typically required. Skilled labour may be required for log scribing.	Material readily available No skilled labour required	Material readily available Fabrication required by qualified manufacturer	Material readily available Fabrication required by qualified manufacturer	Material not readily available Fabrication required by qualified manufacturer	Material readily available Fabrication required by qualified manufacturer
Spans	Short spans only	Short to medium span	Medium span	Short to medium span	Medium span	Medium to long span
Loading	Pedestrian/ Cycling	Pedestrian/ cycling, equestrian and OHV(1) on shorter spans	Pedestrian/ Cycling and OHV	Pedestrian/ Cycling, equestrian, OHV	Pedestrian/ Cycling, equestrian, OHV	Pedestrian/ cycling, equestrian, OHV and roadway vehicles
Substructure(2)	Log/timber cribbing or sills	Log/timber cribbing or sills	Engineered abutments such as concrete	Engineered abutments such as concrete	Log/timber cribbing, sills or engineered concrete abutment	Engineered abutments such as concrete
Installation	On-site assembly, no skilled labour required No large scale equipment required	On-site assembly, no skilled labour required No large scale equipment required for short spans but may be required for medium spans	On-site assembly, skilled labour required Pre-assembly possible, requires large equipment for installation	Pre-assembly allows for installation in remote locations via helicopter or with crane in accessible locations	On-site assembly, no skilled labour required. Supplied in lightweight pieces that can be transported to site manually Pre-assembly possible, will likely require fly-in or crane installation	On-site assembly, skilled labour required Pre-assembly possible, will require large equipment for installation

	Ungraded Timber	Dimensional Timber	Glulam	Aluminum	Fiberglass	Steel
Durability	Medium impact resistance Low weather resistance (can be improved with pressure treatment or stain) Short life expectancy	Medium impact resistance Low weather resistance (can be improved with pressure treatment or stain) Medium life expectancy	Medium impact resistance Medium weather resistance Medium life expectancy	High resistance to debris impact High weather resistance Long life expectancy	Low resistance to debris impact High weather resistance Long life expectancy	High resistance to debris impact High weather resistance Long life expectancy, can be improved with galvanized and/or painted steel
Maintenance(3)	Medium maintenance requirements, frequent No skilled labour required for maintenance Low routine maintenance and repair costs	Medium maintenance requirements, frequent No skilled labour required for maintenance Low routine maintenance and repair costs	High maintenance Medium weather resistance	Low maintenance requirements, less frequent than timber Repairs may require skilled labour and on site equipment High weather resistance	Medium maintenance Repairs may required skilled labour Materials for repair not readily available and more costly High weather resistance	Low maintenance, not frequent Repairs would require engineering and skilled labour, material readily available High weather resistance with galvanized and/or painted steel
Location	Any short span location Ideal for remote short span locations	Any locations	Near access points/roads Ideal for high visibility (show case) locations	Any location Ideal for remote locations where fly-in is required	Any location Ideal for remote locations where fly-in is required	Near access points/roads
Aesthetics	Natural rustic look	Natural rustic look	Refined look	Stands out Can be painted, or dressed with wood	Can be made to look like wood therefore natural look	Weathered steel can be made to look like wood Steel can be painted

(2) The type of substructure should be selected based on the ground conditions at the bridge site. Some locations may require different types of substructures than those discussed in this table such as rock anchors.

(3) This refers to routine maintenance of structures only and does not address repairs that may be required following impact to the structure or high water events.

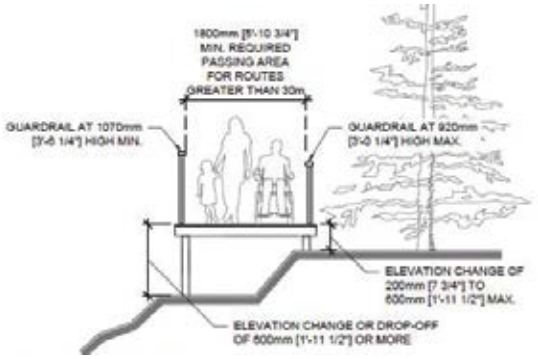


Figure 110 Example of a Boardwalk Cross Section

Figure 111 Helical piles being installed with hand sized equipment to form the uprights for a boardwalk

Figure 112 Example of a Boardwalk Concept Plan

5.6.4 Boardwalks

A boardwalk is a typically a constructed crossing over wetlands, bogs or fragile ecosystems in areas that have deeper water than what can be crossed with puncheon. They can be installed to reduce negative effects of trail traffic on the environment. Construction materials typically include pilings, or wooden structural supports and timber/plank decking. Alternatively, a steel structure such as helical piles could be considered for locations where durability is a concern. A boardwalk can be planned to provide interpretive components such as descriptions of ecosystems, habitats, flora and fauna. The trail experience should be considered during the planning and design phases and may incorporate universal design and opportunities for viewpoints.

A boardwalk is an expensive piece of infrastructure which will require ongoing inspections and maintenance. If other options are possible, such as a re-route or raised trail tread they should be considered first.

Diamond Pier concrete supports are another footing method for a boardwalk support. The 4 steel pipes are driven in to manufactures standards at diagonals, which forms a stable and frost resistant structure. Uprights of the desired material are then attached to the concrete footing.

Figure 113 Helical piles being installed with hand sized equipment to form the uprights for a boardwalk.

Figure 114 Example of a boardwalk designed to provide an upgraded trail experience and take advantage of a natural feature and vista

5.6.5 Puncheons

Puncheons are supported by sleepers and are designed to span wet or boggy ground with minimal impact. Sleepers are used to raise the tread above soil that is wet but does not contain enough water to seriously hamper trail work (also ensuring that periodic floodwaters will not immerse treads). More refined puncheons incorporate sleepers, stringers, and decking. Puncheons constructed from pressure-treated lumber may be from more sustainable sources and will have a longer lifespan than logs harvested at the site.

Figure 115 Example Boardwalk

5.6.6 Corduroy Roads

Corduroy roads or trails are an ancient technique to cross wet areas. Construction techniques consist of cutting timber sufficiently longer than any piece of equipment that will travel the trail and laying the logs out parallel to each other. They then should be buried with sufficient soil to create an anaerobic environment to reduce rotting and provide a stable surface. In some cases, these roads have functioned for 200 years or more. On a narrow trail application, long logs should still be used to prevent them from becoming dislodged by a heavy trail user such as a horse stepping on the end.

Figure 116 Corduroy Road

5.7 Erosion Control

5.7.1 Erosion Control Structures

Erosion control structures are designed to address past erosion along the trail corridor as well as prevent future erosion. With proper trail layout, design, construction and maintenance these structures should not be required in a typical trail system. The trail should be constructed with small enough watersheds to have water cross the trail in sheet flow or at designed crossings without running for long distances down the trail or edge of the trail. Locating grade reversals at natural drainages will drastically reduce the need for these structures. These structures are highly site-specific and require an understanding of the broader context as well as each “tread watershed”. The following are examples of erosion control structures:

- Check dams/ Swale Ditch Block– typically constructed of logs and rocks, but sandbags or hay bales are options when a short-term installation is required while stabilizing vegetation gets established
- Herringbone log/rock patterns in ditches – the pattern interrupts and slows the flow of runoff
- Scarification – if compacted ground adjacent to the trail is contributing to erosion problems, the area could be scarified and revegetated to promote infiltration as opposed to overland runoff

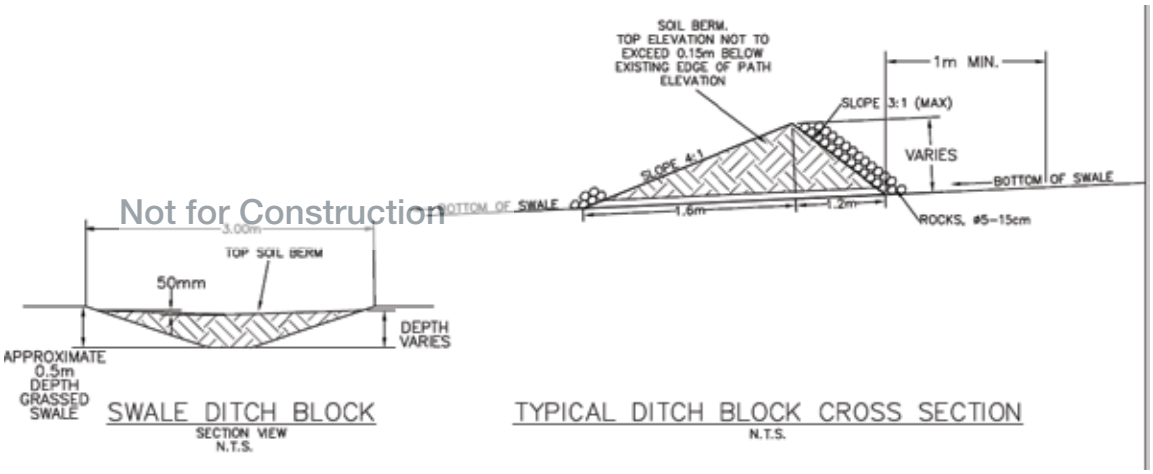


Figure 117 Check Dam Design Concept (from McElhanney)

5.7.2 Planting & Seeding – Reclamation and Slope Stabilization

While planting and seeding improve the aesthetics of a newly constructed trail corridor, they are equally important in stabilizing soils, particularly on sloping sites. Many native species of trees and shrubs have spreading root systems (e.g., willows) while some also fix nitrogen (e.g., alders), making more nutrients available to vegetation. The principle of "rough and loose" soils applies to restoration sites where the goal is to retain moisture for planted species and trap wind- or water-borne seeds from surrounding natural vegetation.

Where slopes exceed a stable angle of repose, various techniques can be used to stabilize them while vegetation gets established, including:

- Contour Grading on side slopes to reduce runoff and aid vegetation regrowth
- Erosion control blankets (e.g., fiber, biodegradable, and compost blankets/mats)
- Terraces made from wood, concrete, bio-mechanical/green walls, willow stakes (wattle fences)
- Drainage features (e.g., diversion ditches, pole drains)

Site specific conditions such as natural region of the Province, elevation, terrain, slope and soils will affect the seed mix needed to responsibly mimic existing plant communities. Determining a seed mix to use for restoration or reclamation work, best management practice suggests a seed mix recommended by a Qualified Plant Biologist and/or Professional Biologist. If work is being done in or near protected habitat zones, a rare plant inventory may be required

Trail operators should refer to the Native Plant Revegetation Guidelines for Alberta. These guidelines provide a clear, consistent and integrated information package about using native plant materials throughout Alberta where the revegetation goal is to re-establish a native plant community. The guidelines are not prescriptive. Site specific circumstances, including landowner preferences and land use objectives, have to be considered when planning revegetation projects.

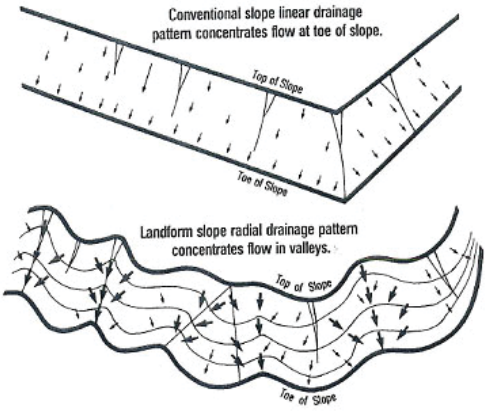


Figure 118 Contour Grading reduces erosion by concentrating flows to valleys where the high moisture content can support erosion resistant large plants such as trees and shrubs.
From www.dot.ca.gov

5.7.3 Tread Compaction

Soil compaction is critical to the durability of any fill soils placed and the final trail surface. It reduces rutting, minimizing trail cupping, and increases the resistance of soils to erosion by water, wind, and users. Compaction should be performed by at least 8 passes using mechanized equipment, such a walk-behind vibratory compactor or a motorized drum roller that is appropriately sized for the trail width. To achieve adequate compaction, moisture content of the soil must be at an optimum level – not too wet and not too dry. The optimum water content varies with every soil, so experiment with compaction in a variety of conditions to achieve the firmest surface possible

- Apply over the tread width, ensure the outer edge of the trail tread is adequately compacted to reduce the effect of cupping due to most users all travelling the same line.
- Ensure the bottom and drainage exit of all grade reversals and low points are compacted to allow water to drain out of these features and not pool in the bottom.
- Compaction is the stage to ensure that the trail product is not a series of stutter bumps which will provide a poor trail experience to any user travelling at speed. These stutter bumps form from equipment operators knuckling the trail with their bucket, or from the removal of rocks from the trail tread. Ideally, a compactor will be compacting the high points and filling the low points by pushing a small amount of fill with it. Care needs to be given to ensure the flow and shape of the trail is not ruined at this stage. Roller compactors may accentuate these bumps and should be used with caution.
- Specialized equipment is the most preferred method for compaction:
    - Mini tracked skid-steer with hydraulic down pressure vibratory compactor
    - Vibratory roller
    - Sheep’s foot compactor
    - Plate tamper (aggregates only)
    - Jumping jack
    - Vibratory roller
- Track packing is the least effective method of compaction, if track packing, contractors should make at least five passes over the tread surface with equipment heavier than 10 tonnes and ground pressure no less than 30kPa, ensuring they cover the entire trail surface including the center.
- Small and medium tracked equipment are not suitable for track packing. Where clearing width dictates the use of small or medium equipment, track packing cannot be used for trail compaction.

5.7.4 Mechanical & Chemical Soil Stabilization

Ideal trail tread soils are well graded gravels with a mix of fines right up though to small to medium sized rocks. When soils are found with predominately one material size, they lack cohesiveness as the voids are not filled between large particles or they are missing large particles which act as anchors to bond the soils together. In areas of one material size, potentially materials of the missing sizes can be mechanically mixed in, such as with an excavator bucket, and then compacted with appropriate moisture content to lock the material together.

The following table from BC Ministry of Transportation shows soil sieve sizes, the High Fines Surface Aggregate (HFSA) shows a well graded trail mix with particles from 25mm to 0.075mm. It has enough particles of varying size to lock together and fill the voids.

In cases of extremely high use, hot and dry areas, or very poor soils, a chemical hardener compound such as calcium or magnesium chloride, a wax based hardener or cement based hardener, or various other commercially available products may be mixed into the soils and compacted as per the local environmental regulations and manufactures specifications.

Sieve Size (mm)	Percent Passing (%) Sieve Size													
	Surfacing Aggregate	Base Course									Sub-Base Aggregates			Bridge End Fill
	HFSA	WGB			IGB			OGB			SGSB	IGSB	OGSB	BEF
		25mm	50mm	75mm	25mm	50mm	75mm	25mm	50mm	75mm				
75	---	---	---	100	---	---	100	---	---	100	100	100	100	100
50	---	---	100	---	---	100	55 - 100	---	100	70 - 100	---	55 - 100	70 - 100	30 - 100
37.5	---	---	80 - 100	60 - 100	---	60 - 100	40 - 80	---	75 - 100	50 - 85	---	40 - 80	50 - 85	---
25	100	100	---	---	100	40 - 75	---	100	---	---	---	---	---	---
19	85 - 100	80 - 100	50 - 100	35 - 80	65 - 100	---	17 - 40	75 - 100	35 - 65	15 - 55	15 - 100	17 - 40	15 - 55	20 - 100
12.5	---	---	---	---		15 - 40	---	---	---	---				
9.5	60 - 85	50 - 85	35 - 75	25 - 60	30 - 70	---	---	30 - 65	5 - 35	---	0 - 100	---	---	---
6.3	---	---	---	---	---	---	---	---	---	0 - 20	---	---	0 - 20	---
4.75	40 - 70	35 - 70	25 - 55	20 - 40	15 - 40	---	---	5 - 30	0 - 15	---	---	---	---	10 - 60
2.36	---	25 - 50	20 - 40	15 - 30	10 - 30	10 - 25	10 - 25	0 - 10	0 - 10	0 - 10	---	10 - 25	0 - 10	---
1.18	20 - 50	15 - 35	15 - 30	10 - 20	---	---	---	---	---	---	---	---	---	6 - 32
0.600	---	---	---	---	---	---	---	---	---	---	0 - 100	---	---	---
0.300	10 - 30	5 - 20	5 - 15	3 - 10	5 - 15	5 - 15	4 - 15	0 - 8	0 - 8	0 - 8	0 - 15	4 - 15	0 - 8	4 - 15
0.075	5 - 15	0 - 5	0 - 5	0 - 5	0 - 5	0 - 5	0 - 5	0 - 5	0 - 5	0 - 5	0 - 5	0 - 5	0 - 5	0 - 5

Figure 119 Soil sieve sizes for varying trail to road uses

5.7.5 Geotextile Fabrics and Geogrids

Geogrid, geocell, and geotextiles may be used in some instances. These materials provide a way to distribute the load of users across a large surface area and “float” over a softer surface. The materials provide separation and keep a layer of good quality aggregate from intermixing with poor quality softer soils. Consultant with a geotechnical engineer or manufactures specifications is advised to ensure the appropriate strength of fabric and permeability of moisture and materials is obtained to prevent fabric/cell migration though the soils and exposure.

When used on a trail surface, the geosynthetic must be wider than the intended trail tread width. This will allow the load to be centered on the trail and provide an effective weight bearing surface. It will also keep users off the edges of the trail tread which will protect the edges from soil displacement and the fabric becoming exposed. These fabrics need to be adequately buried to provide flotation from the high-quality aggregate placed on top of them, and to allow this surfacing to be of sufficient depth to bond together to prevent soil displacement and fabric exposure.

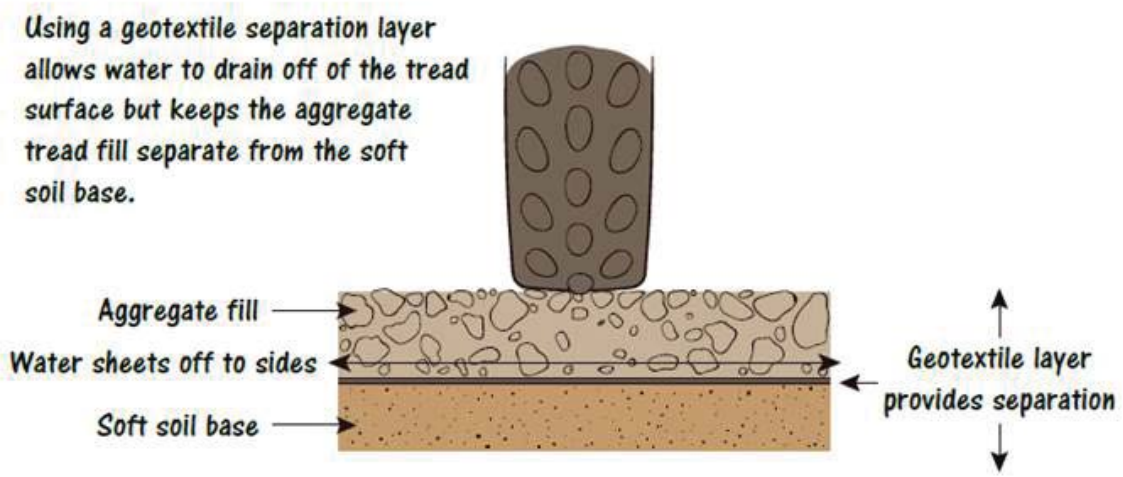


Figure 120 Geotextile Layer Cross Section adopted from NOHVCC

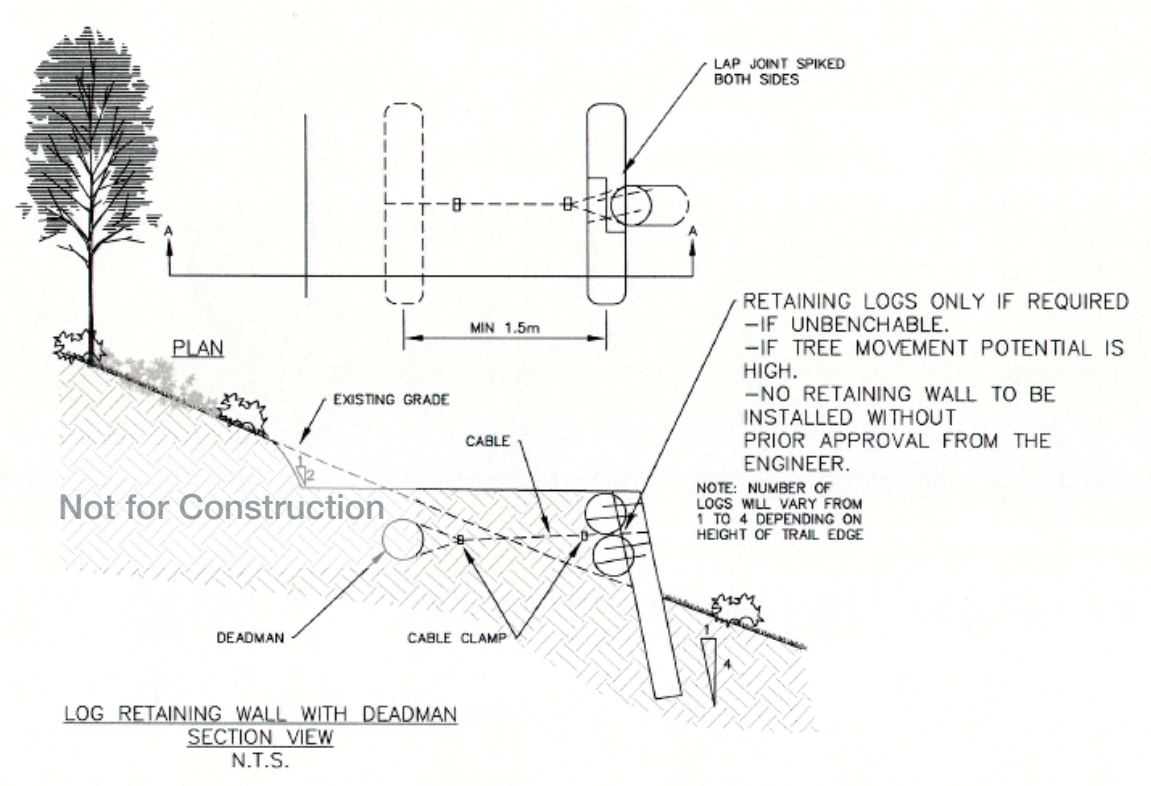


Figure 121 Log Retaining Wall with Deadman (from McElhanney)

5.8 Retaining Structures

Wherever possible, retaining structures should be avoided to reduce initial capital costs and ongoing maintenance costs. Wood retaining walls will eventually rot, and complex retaining walls will require ongoing inspections to ensure the desired structural strength is maintained. Retaining walls also act as a “curb” and trap water on the trail tread, preventing sheet flow and causing it to flow down the trail resulting in erosion. To prevent such trail tread cupping, maintenance is required to overfill the retaining structure with appropriate soils. To avoid the issues associated with retaining walls, proper trail routing or re-routing can be considered onto a side slope of appropriate grade to allow for a backslope which will not slump.

Figure 122 Vegetated retaining walls, each bag is filled with an appropriate mix of organics and soils and seeded – from Deltalok, and google images need permission

5.8.1 Retaining Walls

Many different retaining wall styles are available. Where possible those requiring the least ongoing maintenance should be considered. The more complex retaining walls listed below should be installed to the manufactures specifications with the guidance of an engineer or geotechnical engineer.

- Replacement or scattering of native mosses or organics
- Planting and seeding
- Bioengineering with willow shoots
- Coconut matting
- Rip rap
- Stacked stone retaining walls
- Vegetated retaining walls
- Pinned log retaining walls
- Deadman anchored retaining walls
- Concrete lock blocks

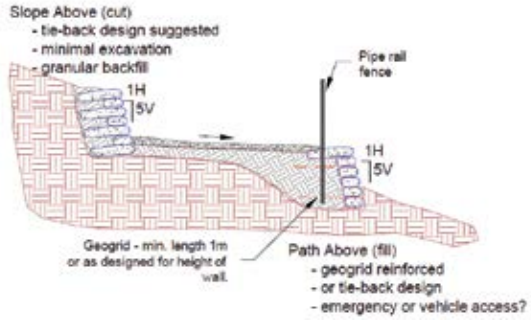


Figure 123 Retaining a trail tread with vegetated retaining bags

5.9 Trail Junctions

Trail junctions are an inherent part of an interesting trail system with multiple loops. The type and scale of junction will reflect the recreation setting, the activity types, and difficulty level. All junctions should be designed with safety in mind (particularly if motorized and non-motorized uses intersect).

Trail Operators should:

- Provide several junctions close to the trailhead for quick dispersal
- Provide junction ahead warning signage for sports that travel at speed
- Locate junctions on level ground to reduce incoming user speed and prevent erosion caused by heavy use and braking and accelerating forces

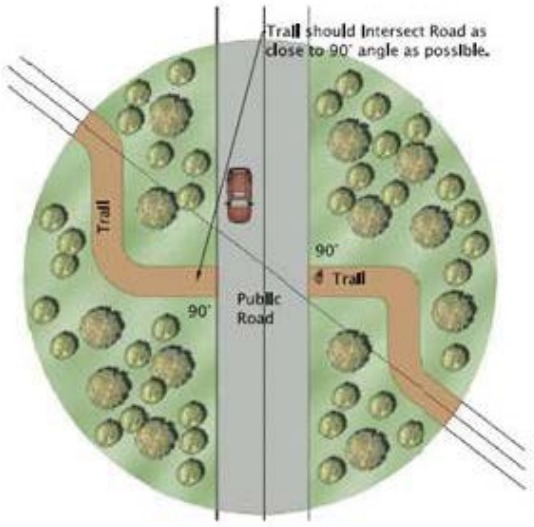
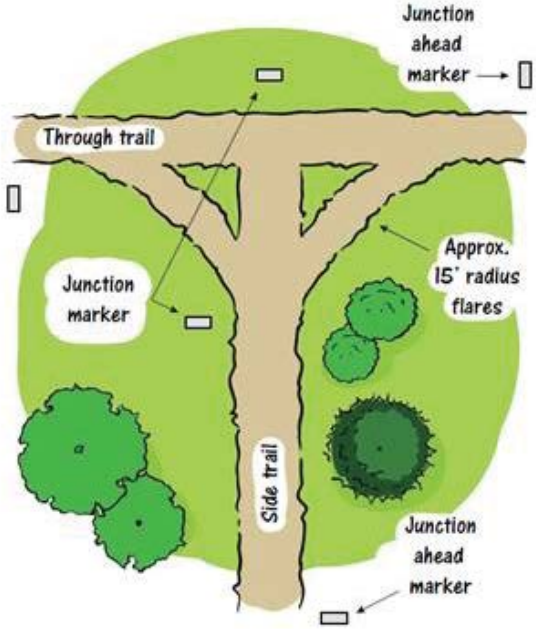


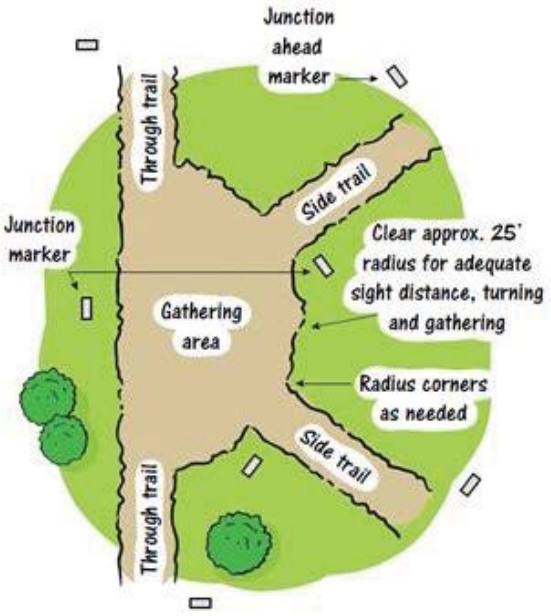
Figure 124 Trail junction with a series of turns, each of tighter radius to progressively slow the user down prior to approaching the main trail.

- For minor trails approaching a major trail, have the minor trail conduct a series of turns with each turn being of tighter radius than the last to progressively slow users down. This will reduce the development of braking bumps, and improve safety by providing users a chance to see other oncoming users
- Avoid multiple 3-way intersections located in close proximity to each other. Each intersection requires signage and is a point of stopping and confusion for users. Instead align them as one 4 way or larger intersection – except – in some instances on motorized trails where the goal is to slow the users down, the T intersections of the more minor trail can be offset from the major trail
- To avoid constant stopping and starting of users, space junctions as far apart from each other as possible, at least ½ km is desirable on a motorized trail
- Manage drainage on each trail prior to the junction to avoid concentrating runoff at junctions
- Avoid locating junctions in sensitive areas as some users may pass the junction and decide that was where they wanted to go conduct a U-turn on or off the trail

Typical T-junction



Typical half hub junction



Typical hub junction

Figure 125 Types of trail junctions from NOHVCC pg 244

5.10 User Management & Risk Controls

5.10.1 Filters

Filters are features of representative difficulty of the trail itself. They are installed near the trail access point to test trail enthusiasts' skill levels before they are too far along the trail. These features support users' self-assessment and decisions about trails that are suited to their abilities. Examples of filters are:

- An obstacle/drop of a given height or narrow technical feature
- A lower or narrower clearing dimension, or typical tread obstacles, on a moderate or difficult equestrian trail to ensure horse will not startle
- A steep portion at the start of a trail with a rough surface
- A sequence of gradually narrowing trail-side features in advance of a bridge, intersection, or other feature that should be navigated at a slow speed

Figure 126 Example Filter adopted from BLM

Figure 127 Tires used as filter adopted from NOHVCC pg 139

5.11 Access & Visitor Use Control Structures

5.11.1 Limiters

Limiters are obstructions that are intentionally placed within the trail cross-section. Their role is to limit access to only those vehicles able to navigate the narrowed trail width. Having a clear barrier supports enforcement efforts when an officer can point to the barrier that was circumvented.

Figure 128 Boulders used as limiters adopted from NOHVCC

Width of the "limited" openings varies depending on the design use or uses – for example, a limiter designed to permit equestrian trail users but exclude side-by-side motorized users will be wider than if it allowed only pedestrians and non-motorized cyclists. Because limiters can increase risk to trail users, they should be highly visible, installed on a tangent, and preceded by tightening of the cross-section of the trail corridor to reduce speed.

Limiters should be designed with maintenance equipment in mind. Removable bollards or a secondary larger gate opening can allow maintenance equipment to pass.

In areas prone to enforcement issues, limiters should be placed in natural constraints in the terrain. Ideally these would be on a benchcut trail with a side slope below and a backslope above.

Figure 113 Example Bollard removable with key – suitable for summer use only

Such a situation would need to provide space for users to turn around on their side of the limiter. Limiters placed in flat open terrain will need to be supported by a fence or row of boulders. Ideally, limiters or fences are backed up by education to users as to why they are supposed to avoid that area.

Limiters may include:

- Bollards
- Fences with narrow openings
- Boulders or logs
- Concrete roadside barriers placed parallel to the trail centreline
- Locked gates for maintenance equipment with a narrow pedestrian bypass for activities such as cross country skiing, hiking, or mountain biking

Figure 129 A variety of fences and barriers, from NOHVCC PG 114

5.11.2 Fences, Fence Crossings and Gates

The primary question when desigining a fence or gate is who or what uses do we want to keep in and out - is it cattle, all motorized users, some motorized users, or is it a hiking only trail? Fences are an effective method to keep users out of environmentally sensitive areas or other areas of interest. Their design and construction can affect the tone and enjoyment of an area. A steel pipe fence or chain link fence may detract from the experience of an area but will convey a stronger message than a split rail cedar fence or other attractive fence designs. Fences need to be designed with wildlife in mind to prevent their entanglement and from creating unwanted habitat fragmentation. Some fences may require wildlife gates to prevent entrapment of wildlife.

For gates intended to keep users out, do not use chain or braided wire rope as they are not adequately visible to rapidly moving motorized traffic. Instead use a solid gate with reflective markings.

For fence crossings to be effective, mechanisms and fasteners need to be quick access/user friendly or vandalism may occur. Typically, Texas gates are preferred by motorized users but may become an unwanted barrier on accessible trails and equestrian trails. If gates are to be used, fast, efficient latches should be employed to ensure ease of use and reduce the potential for vandalism.

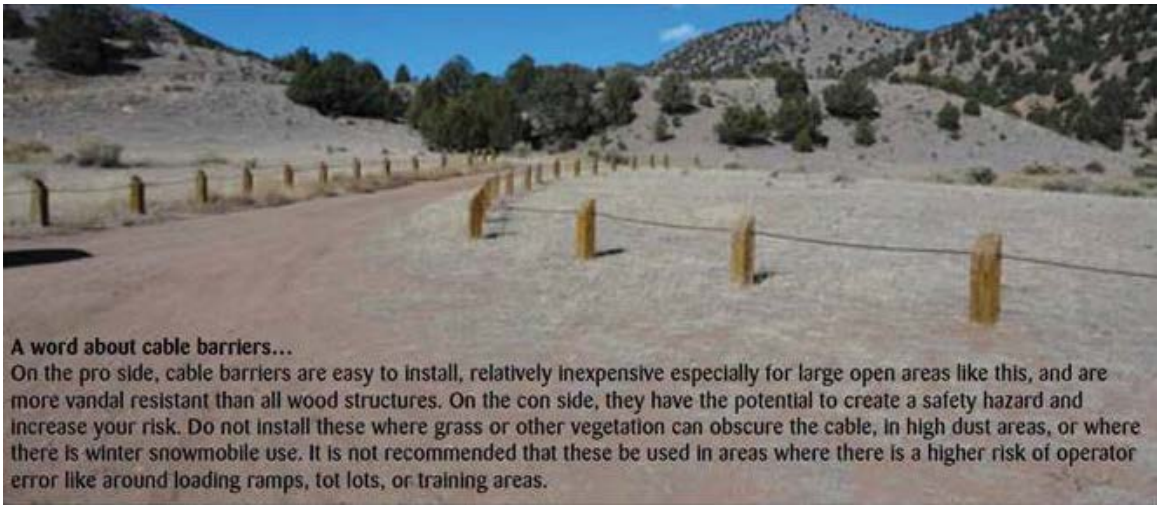


Figure 130 Cable barriers, NOHVCC pg 144

Figure 131 left: Offset fence for a pedestrian only trail – for safety reasons ensure they are installed at the top and bottom both of such a section. right: Chicane gates can be used to slow certain users down prior to an important intersection. Significant caution needs to be employed in locating such gates as the gate itself can be hazard. Ideally these are located with a series of turns prior to slow the user down but still provide good sight lines and warning signage of the gate ahead. As shown in this photo these may be a barrier to users with accessibility needs. Proper trail design should be employed to slow users down before considering use of such gates.

Figure 132 Variety of fence crossing methods for non-motorized users. The stile ladder should only be used on trails where the TMO does not provide for persons with accessibility needs. The two “kissing gates” better provide for accessibility needs if designed properly (google images)

Figure 133 gate with a weight serving as the latch to return the gate to closed.

Figure 134 A solar powered electrified mat for a fence crossing that keeps users with paws out. A bypass gate is provided as well. Source Google Images sykscanner

Figure 135 Texas gate (google images Alamy)

5.12 Highway & Roadways

Highways and road can create barriers for trail and impede trail connectivity. Recognizing the importance of connectivity, it may be necessary for trails to cross highways and roadways. Public lands intersect with many different types of roads (e.g. primary highways, municipal roads and resource roads). Administration of and responsibility for the roadway varies depending on the roadway classification. In general, primary highways are administered by the Province, municipal roads are administered by the local municipality while resource roads are typically administered by the disposition holder.

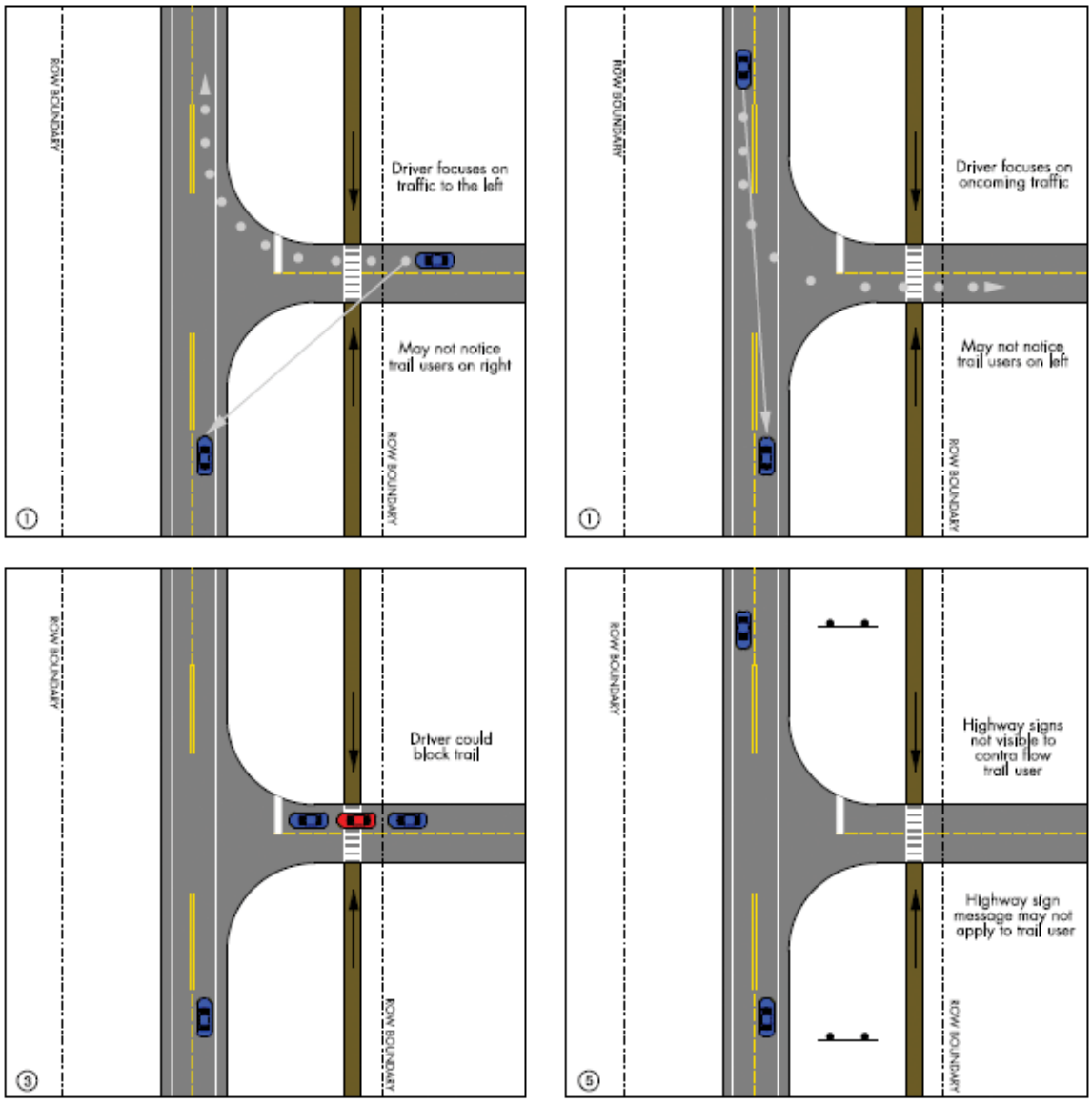
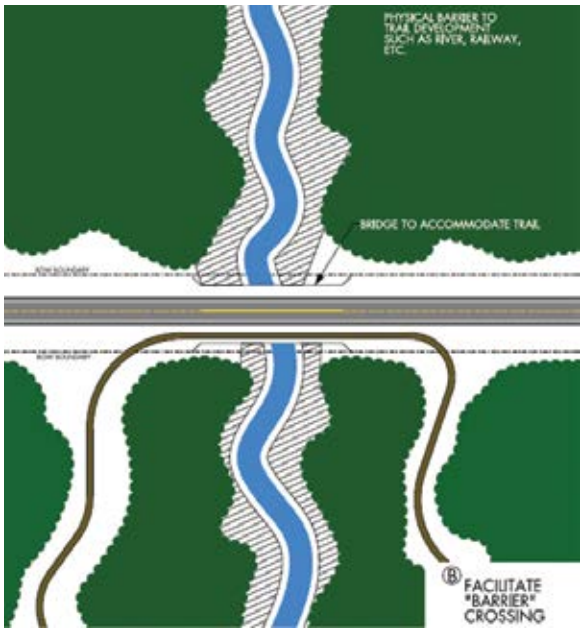
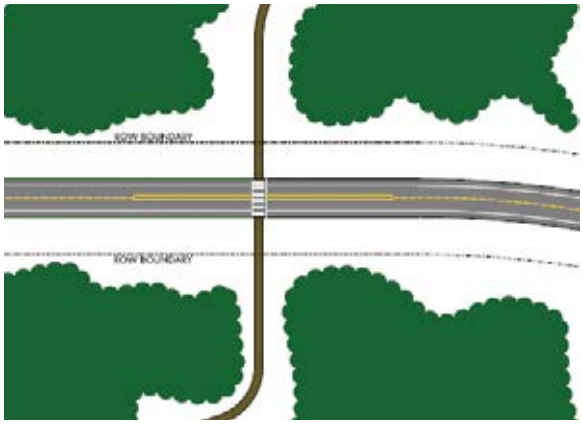


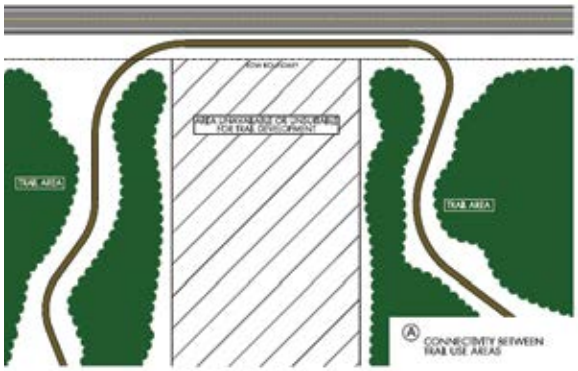
Figure 136 Potential Safety Issues with Trails in Roadway Right-of-Ways (Alberta Transportation)

Trails developed in roadway rights-of-way and trail crossings can create both operational and safety concerns (see Figure 136) for motorists and trail users and, often, provide a lower quality trail experience. Though typically not encouraged, the administrator may permit trails to cross the roadways or be developed within the roadway right-of-ways. Some roadways administrators may allow trail crossings of development within roadway right-of-ways but recognizing the value of trails and the occasional need for trails to cross or, in some cases, run parallel to roadways, the Province developed the Trails in Alberta Highway Rights-of-Way Policies, Guidelines, and Standards manual. Though focused on primary highways managed by the Province, this document is intended to provide Alberta Transportation staff, other government agencies, municipalities, and other proponents with the necessary information and tools for considering and developing trails in roadway rights-of-way. Trail operators should refer to this manual for more detailed planning and design guidelines. Specifically, trail operators should:

- To extent possible, undertake trails in roadway rights-of-way and crossings where they are needed to.
- Provide connectivity between popular trail areas in a more direct and / or publicly accessible route (e.g. avoid private land).
- Facilitate movement of trail enthusiasts across a major barrier (e.g. river).
- Provide connectivity for a trail when the trail exists on both sides of the roadway outside the roadway right-of-way.
- Determine the classification of the roadway the trail will cross or run parallel to and who the roadway administrator is.







- Contact and apply for a screening application from the Province for all proposed trail development, including change in use of an existing trail or access within 300 meters of the provincial highway right-of-way boundary or within 800 meters of he centre point of an intersection of the provincial highway with another public road.
- Contact other non-provincial roadway administrators to discuss any permitting, design or other requirements related to trail development or crossings.

Trails Parallel to Roadways

- Avoid siting trails parallel to roadways where there are numerous existing accesses (e.g. driveways, industrial access, field access) to / from the roadway. Each access will require specific crossing treatments and will increase the potential for conflicts between motorists and trail enthusiasts as well as costs to the trail operator.
- Where accesses to the roadway exist, trail operators should site the trail in stretches that will cross lower use accesses rather than higher use access as the vehicular traffic will be lower which, in turn, will lower the potential for safety incidents.
- Determine and document how many, the type and general levels of use of existing accesses to the roadway that the trail will need to cross.
- For trails that cannot be located outside of the right-of-way, they should be sited in the following locations within the right-of-way (see Figure 137):
    - At the edge of the right-of-way beyond the roadway clearance zone (most preferred),
    - Outside of the clearance zone (second choice),
    - Within the clearance zone but not closer than 2 meters from the edge of the shoulder with a physical barrier separating the trail from the highway (least preferred).
- Site and design trails to minimize impacts on the roadway water drainage patterns while still enabling the trail to appropriately shed water.

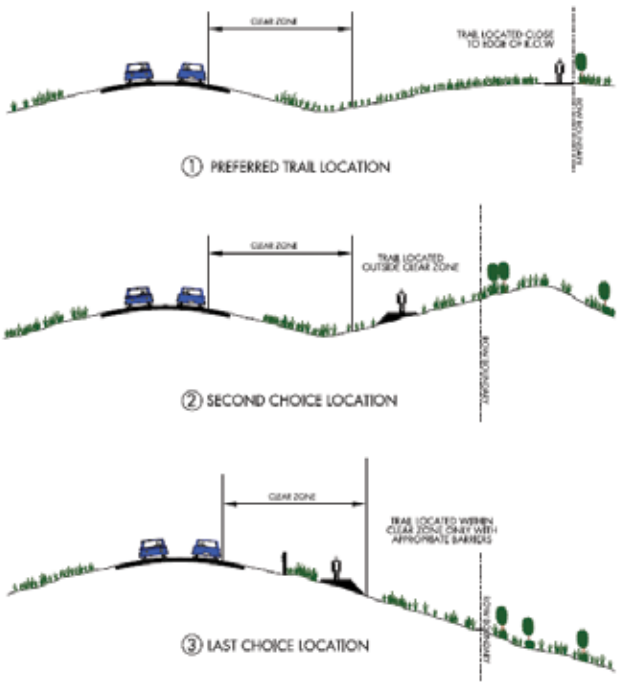


Figure 137 Trail Locations by Order of Preference (Alberta Transportation)

Trails Crossing Roadways

- Site crossings in areas where the probability and severity of a collision between a motorist and trail enthusiast will be low and where motorists already expect to encounter roadway crossings / pedestrians / trail enthusiasts. The roadway geometry, vehicle volumes and types, trail volumes and type, stopping sight distances, sight distances should be considered when identifying a potential crossing location.
- Design the trails to intersect the roadway at 90 degrees to the roadway.
- Ensure that the trails are designed to provide adequate sight distance and stopping site distances for the permitted trail activities at all crossings to allow the trail enthusiast and motorist to see each other and stop early enough to avoid a conflict (see Figure 138). It is also necessary to provide sufficient unobstructed sight distance down the roadway to allow the trail user to see far enough to assess whether they have enough time to cross the roadway safely (known as Departure Sight Distance).
- Provide clearly marked roadway crossings as well as measures to warn motorists such as:
  - Early warning signals
  - Illuminated crossings
  - Signalized crossings where warranted
  - Pedestrian / trail enthusiast signals where warranted
  - Speed limit reductions

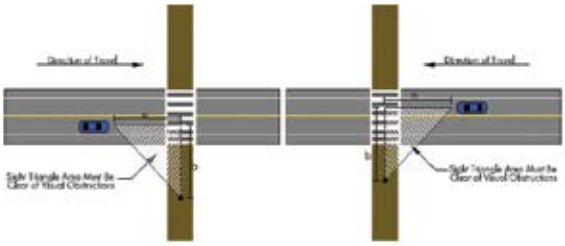


Figure 138 Intersection Sight Distance Approach Sight Triangles (Alberta Transportation)

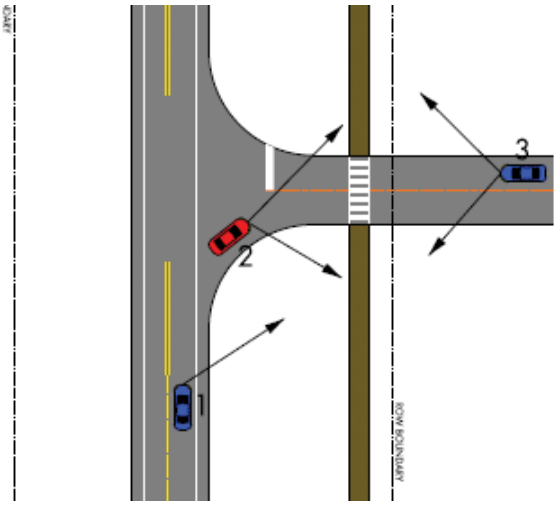


Figure 139 Trail Crossing at Edge of the Roadway (Alberta Transportation)

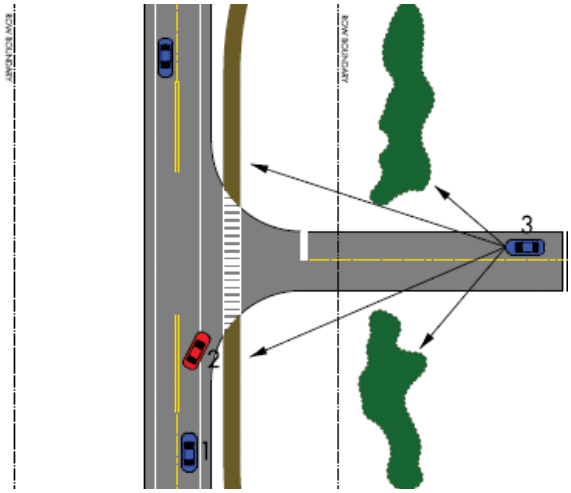


Figure 140 Trail Crossing at Edge of the ROW (Alberta Transportation)

- Site roadway crossings in the following locations:
    - At the edge of the right-of-way (see Figure 140)
    - Edge of the roadway (see Figure 139)
- Recognize that Alberta Transportation will only consider grade-separated crossings on Freeways and Expressways.

Signs & Markings

- Develop a sign plan for each roadway crossing and segment of trail that runs parallel to a roadway. The plan should ensure that signage is used to alert both the motorist and the trail enthusiast. Standard signage, as identified in the Trails in Alberta Highway Rights-of-Way Policies, Guidelines, and Standards manual or other Transportation Association of Canada standards should be applied.
- Apply signs and markings to help manage the safe and efficient flow of trail enthusiasts and motorists where trails cross roadways or run parallel to them.
- Utilize the minimum number of signs and markings necessary to effectively convey the message.

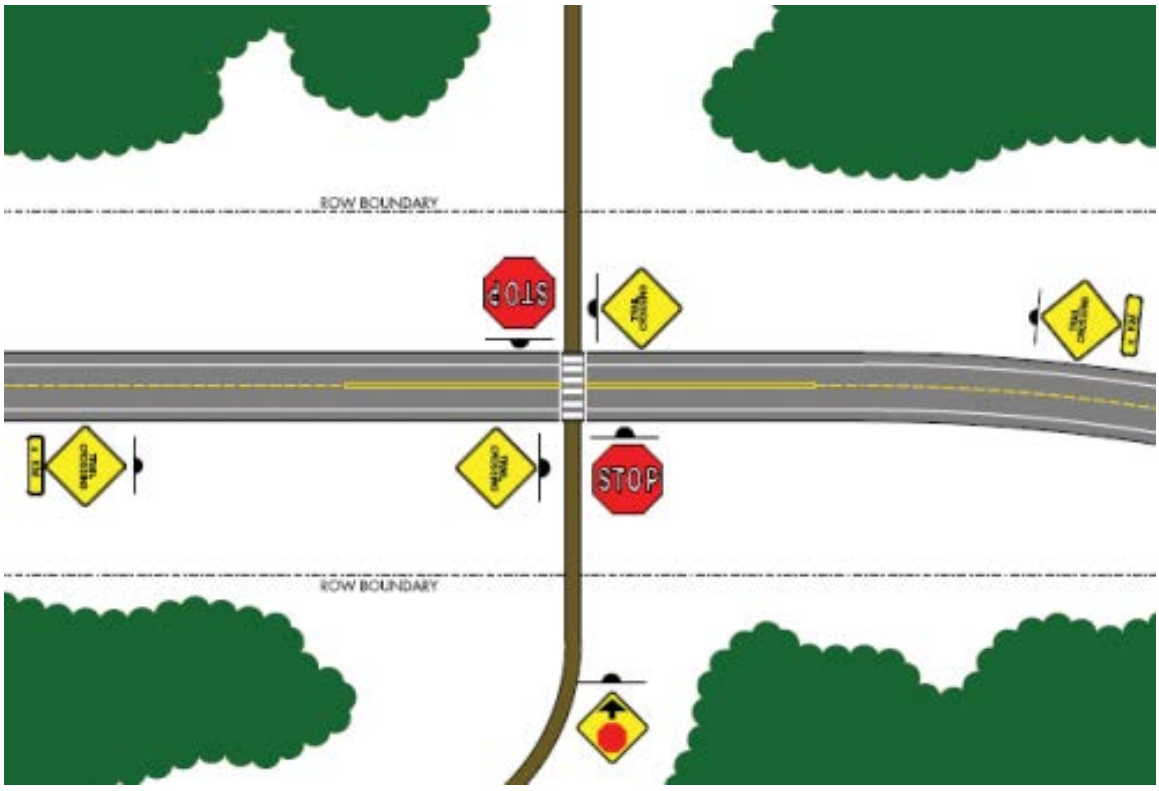


Figure 141 Example Signage Plan for a Mid-block Trail Crossing Two-Lane Undivided Roadway (Alberta Transportation)

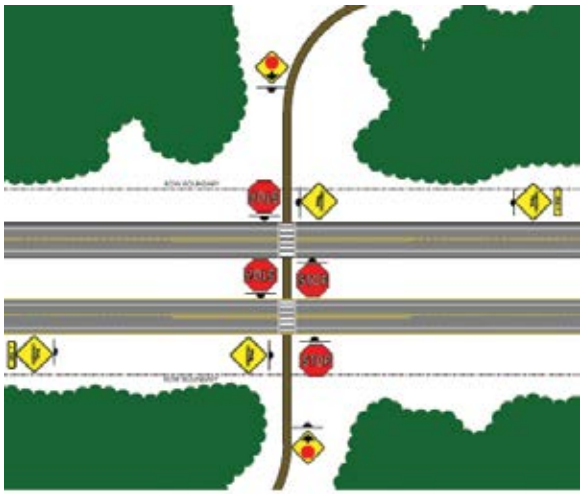


Figure 142 Example Signage Plan for Trail Crossing Mid-Block of Multilane Roadway (Alberta Transportation)

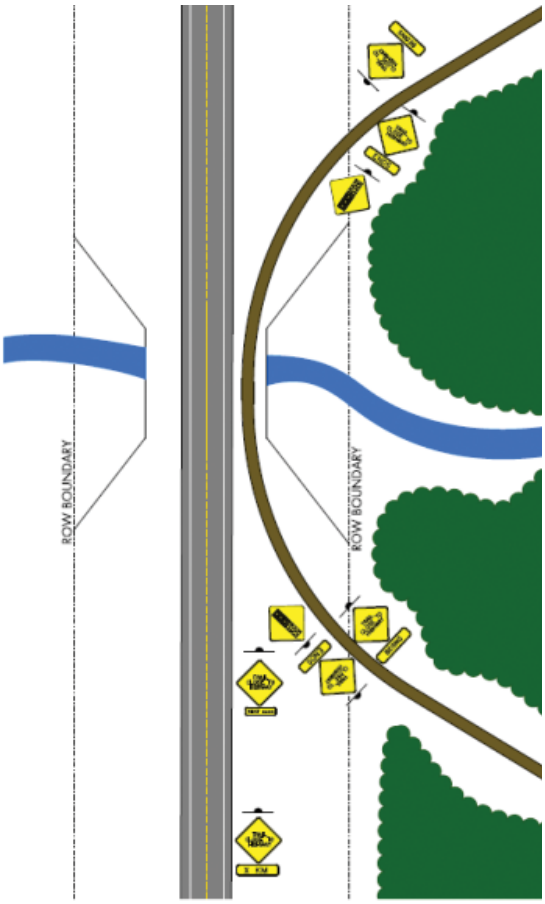


Figure 144 Example Signage Plan for Trail Tying into Roadway Bridge (Alberta Transportation)

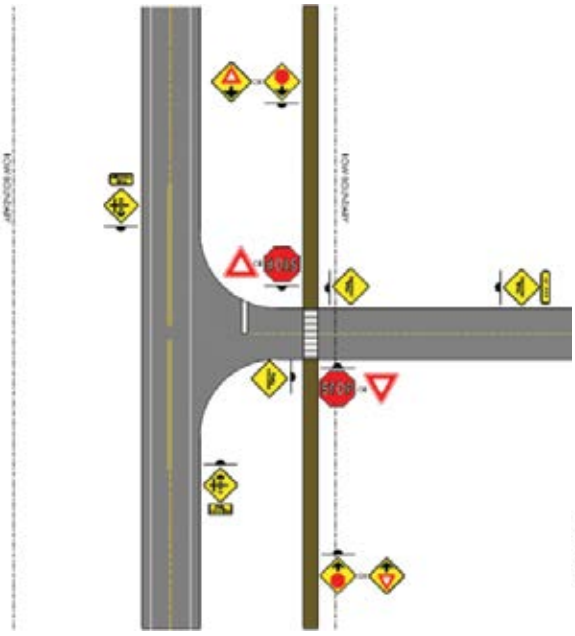
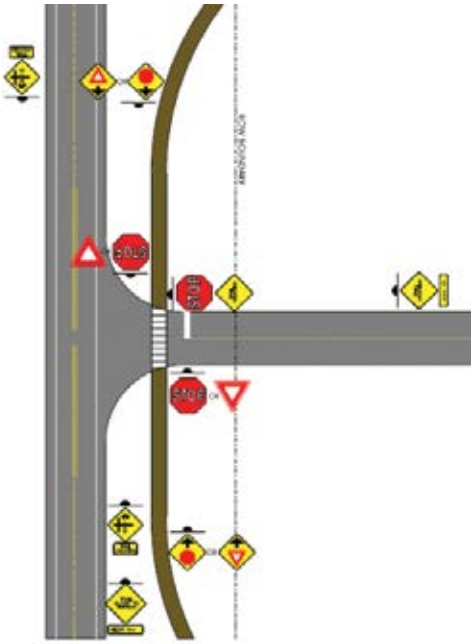


Figure 143 Example Signage Plan for Trail Crossing Side Road Outside the Clear Zone (Alberta Transportation)

Figure 145 Example Signage Plan for Trail Crossing Side Road Inside Clear Zone (Alberta Transportation)



5.13 Activity Optimized & Technical Trail Features

To develop quality trail experiences, trail designers need to recognise that there are many different trail user objectives. By designing trails to deliver these objectives, as outlined in table 1 in section 2.2, trail operators can ensure a better experience while limiting unauthorized trail construction or modifications. Trails need to incorporate features that provide for the objectives enthusiasts are seeking in a way that is consistent with the TMO. These natural or constructed features are known as Technical Terrain Features (TTF's). Wherever possible, TTF's should be constructed out of naturally available features and must be appropriate for the level of challenge and user objectives the trail is being designed to provide. The following sections provides guidelines and ideas of features that trail operators can incorporate into their designs to provide for some of the most common user objectives including play, challenge, escape, and risk.

5.13.1 Play

Play is conducting an activity purely for enjoyment. Such a trail may be part of a trail to no-where and form a loop as opposed to a destination-based trail. Play is an important characteristic in many sports where speed is a key element of the sport.

TTF's include:

- making use of natural rolls or gullies in the terrain
- constructing grade reversals and rolling grade dips of the appropriate spacing and dimensions such that advanced users can achieve some air time
- constructing banked turns (which can assist with reduced erosion and trail creep)
- constructing purpose-built jumps appropriate for the desired user difficulty of the trail.

From BLM

5.13.2 Challenge

Trails of appropriate difficulty provide challenge to users by allowing them to improve their technical and or physical abilities, or to solve a difficult problem, "clean" a TTF or trail segment, all of which results in a sense of accomplishment. Key challenges for land managers are to meet these needs in as environmentally friendly a location as possible. Such activities can be contained by providing the appropriate challenge on the trail and a designated easier option line. Corrals and anchors may need to be employed to prevent trail braiding and creep and areas with thick undergrowth combined with anchors will help to contain users to the trail tread.

TTF's Include:

- Technical trail segments with rocks, roots, logs, potentially combined with steep gradients
- Hill climbs
- Natural features such as rocks, tree roots, fallen logs, mud bogs
- Constructed features such as rock climb step ups, rock gardens, and drops

5.13.3 Escape

Escape is something that takes users away from the daily grind and become lost in the experience of the outdoors. It may mean escape from the urban environment, however play or challenge presented by a contained area can provide escape from daily life. As trail designers, recognizing the need for escape from daily life is important.

Trail design features which support this are:

- The minimal amount of human disturbance for a safe and sustainable experience (preventing signage pollution)
- Minimal trail tread modifications, minimally developed rollers with less regular spacing than a front country trail
- Features constructed of rustic materials such as stone, logs, or rough cut timbers
- Reduced clearing width pinch points, and trail proximity to natural features such as cliff edges
- Narrow singletrack trails
- TTF's from naturally occurring rock, log, and soil features

5.13.4 Risk

Risk is a thrill many trail users desire to experience. For trail users it can be a positive or negative part of the trail experience depending on trail user expectations and risk tolerance. Risk is separate from Challenge in that it is the consequence of falling. As land managers and trail designers, providing the perception of risk to users with minimal actual risk to them is important.

Features which provide for risk are:

- Minimal navigational aids
- Remote location of challenging features
- Proximity to large trees/rocks/cliffs on the uphill edge
- Exposure/empty space adjacent to the trail, trail tread may be wider than typical to reduce the hazard

5.1.3.5 Technical Trail Features by Activity Type

The following table presents typical technical trail features that could be incorporated to help optimize by trail experience for each activity type. This listing is not exhaustive but provides a reasonable starting point for trail operators to think about the TTF's that could be included in the trails.

Table 11 Trail features by activity type

Technical Trail Feature type	User Type					
	Pedestrian	Equestrian	Cross Country Skiing	Mountain Biking	Wheeled Motorized	Snow Motorized
Skinny Features	•		•	•	•	
Rollers			•	•	•	•
Jumps		•	•	•	•	•
Berms			•	•	•	•
Dirt Mound		•		•	•	
Sand Pit	•	•		•	•	
Mud Hole					•	
Log Stack	•			•	•	
Log Triangle	•			•	•	
Rock Garden	•	•		•	•	
Rock Crawling	•	•		•	•	
Tire Crawl					•	
Hill Climbs	•		•	•	•	•
Drops			•	•	•	•
Steep Chutes	•		•	•	•	•

5.14 Skill Development & Youth Infrastructure

Providing for adequate skill development across a trail network is a key technique for land managers to reduce liability. Progression of skills from beginner, to intermediate, to expert can be provided within a designated skills area as well as throughout the trail network. Stacked loop trail systems typically locate advanced difficulty trails farther from the trail head so that fitness as well as skill filter unsuitable users from accessing trails too difficulty for their abilities. Providing optional features on the side of a trail is an excellent way to allow for progression. A beginner difficulty trail may have some beginner features on the main trail tread followed by intermediate difficulty features located to the edge of the trail tread.

Figure 146 photo example of skill development for slalom and limbo balance skills

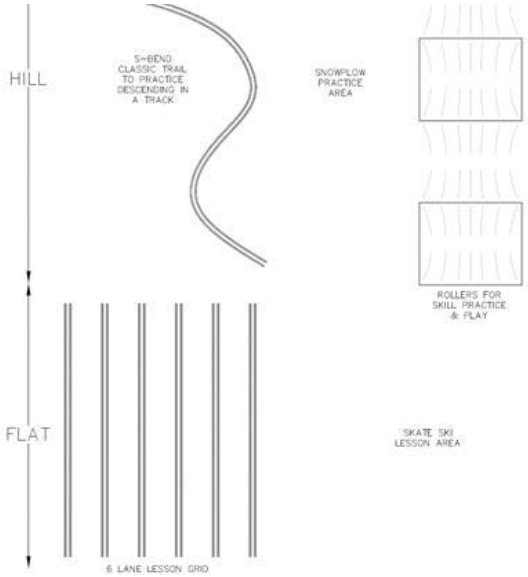


Figure 147 photo example of skill development for slalom and jumping skills

5.14.1 Skill Development Areas

A skill development area is a contained way to provide progression to trail users. Typically, these areas are located close to an area of high use such as the staging area, a community, or campground. Often these areas are fenced with a gateway feature that forces users to view and read educational, warning, and navigational signage about the area. These areas can provide an excellent area to warm-up for a trail ride and teach users how to negotiate the features found on the trail in an area designed with safe fall zones.

Figure 148 Images of mountain bike appropriate bike park with many optional features of varying technical difficulty allowing for progression of riders skills

Figure 149 Example motorized vehicle skill development areas (from NOHVCC)

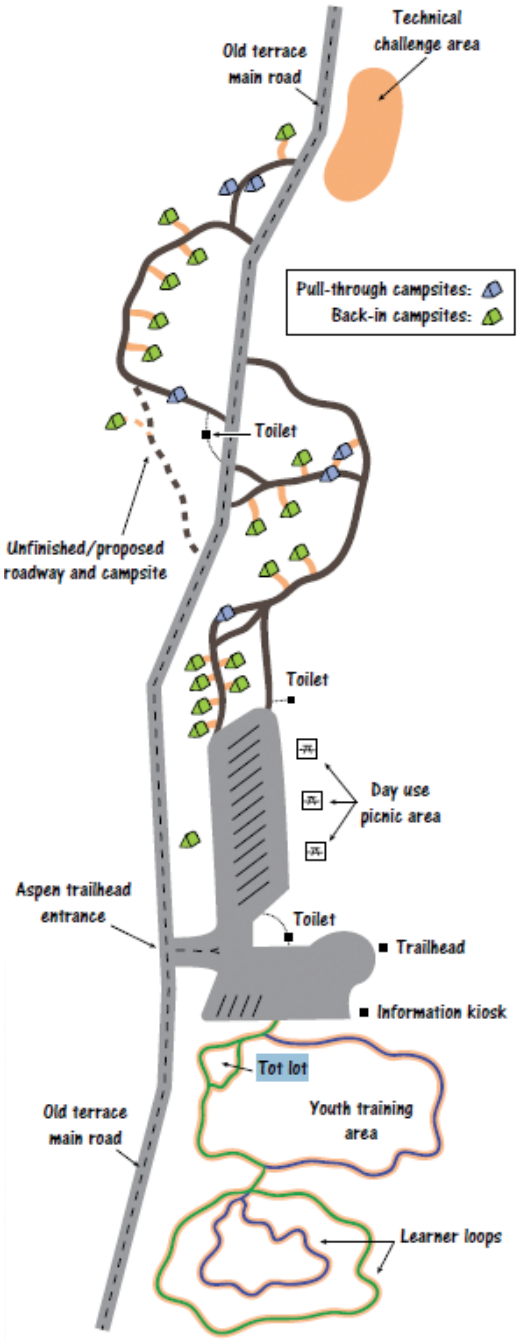


Figure 150 Conceptual Layout of a Trail with Learning / Skill Development Areas (from NOHVCC)"

6.0 Trail Construction Guidelines

Construction is where the trail plan and designs become reality. With construction of the trails comes a new energy and excitement within the trail planning team. Though it is an exciting, it is also a stressful time and one of the most critical times. Mistakes during construction can have serious consequences on the quality of the trail experience, the sustainability of the trail as well as legal implications if approval conditions are not followed.

The construction phase involves much more than just clearing vegetation and churning dirt – it involves important documentation and processes to ensure that the vision, planning, and design developed in previous phases is properly communicated to the construction crew and realized in the final product. To facilitate a smooth construction process, it is critical that trail operators take the time to develop a thorough construction package and seamlessly integrate the trail designers into the construction team to provide direction and oversight of build and ensure the TMO and the desired trail experience is built.

6.1 Pre-Construction

The pre-construction step is the bridge between trail planning / design phase and the construction phase. Prior to breaking ground, trail operators assemble / develop background information to accurately convey the design and intentions of the trail to the construction crew or contractor. Appropriate work plans, management plans, and contracts must be in place to minimize the risk of the constructed product not accomplishing the goals set out in the previous phases of the project. While not an exhaustive list, the following sections provide guidelines on the types of documentation and items to include in each to effectively transfer the trail vision and design to the finished product.

Trail Tip

Remember that the construction crew or contractor selected for trail construction likely has not been involved in the vision, planning, or design process and will not be aware of the background work that has gone into the project. Providing context to the construction crew about the background of the project will help convey the importance of realizing the project design and specifications in the constructed product.

Scope of Work

The scope of work for construction must be clearly defined in writing for the trail crew or contractor prior to construction. Scope of work documentation should provide an overview of the project and a general description of existing conditions, constraints, goals, and outcomes of the project. This information includes some or all of the following information:

- Trail concept plan
- Trail Management Objective (TMO)
- Site location maps, including appropriate access routes for equipment and personnel.
- Photographs and/or descriptions of the existing site conditions (e.g. typical slopes, vegetation type/thickness, moisture conditions, soil types, rock conditions, etc.).
- Environmental, social, economic, or known physical constraints that may impact the work.
- Clearly defined deliverables and Project Management and Construction Review requirements.
- Scheduling requirements.

Trail Tip

Unit rate payment contracts offer benefits and flexibility to both the project owner and the contractor for typical trail construction projects.

Contract Preparation (if applicable)

Contract preparation is only applicable to projects where a third-party contract or organization will be utilized for construction. If applicable, trail operators should select a contract form appropriate to the size of the project, the project funding source, landowner requirements, and/or risk level of the project. Typically, government organizations and public funding sources have existing procurement requirements that include procurement rules and contract formats which must be followed. In lieu of applicable requirements, trail operators should seek services from an experienced professional to assist with developing a contract appropriate for the project.

Work Plan

Where internal resources, volunteers, or local clubs/organizations are utilized for construction, the trail operator should engage the trail crew to develop a suitable work plan for construction. Contractors may be requested to provide a work plan or document the contents of a work plan in the Construction Management Plan (see p.193). The work plan should define:

- Equipment/tools to be used and construction methodology (see Section 6.3).
- Schedule
- Personnel
- Health and safety procedures and protocols
- Construction mobilization and staging plan
- Project management requirements
- Material ordering and lead times
- Materials required
- Construction demobilization
- Environmental permitting requirements (if applicable)

Trail Tip

Avoid preparing a work plan for a third-party contractor if possible – specifying the means and methods of work required by a contractor will negatively impact bid prices and increase risk assumed by the trail operator.

Construction Standards and Design Documents

Provide the construction crew with the trail log and applicable construction standards, specifications and trail design parameters developed for the project. These may include:

- Trail log describing the features, amenities and infrastructure and the location along the trail.
- The final Trail Management Objective document.
- Reference to applicable trail construction guidelines, specifications and standards, including only relevant items.

- Project-specific design details, such as bridge designs, signage designs, site-specific challenge features, or other items specifically designed for the project.
- GIS data or maps for the design trail layout.

Construction Management Plan

Trail construction projects may impact the environment, visitor experience, visitor safety, public infrastructure, nearby property owner, or any number of other items. To mitigate any potential impacts on the surrounding area, the Trail Operator should prepare a Construction Management Plan (CMP). The purpose of the CMP is to consider the possible environmental and social impacts of the construction works and mitigate the possible impacts through implementation of construction best practices. The CMP should also incorporate any applicable permitting requirements from regulatory agencies that must be followed.

At the minimum, typical CMPs should consider the following items:

- Impacts to soil, particularly erosion and sediment control measures
- Environmental controls
- Fire risk
- Working near watercourses
- Fish and Wildlife
- Vegetation
- User experience and safety
- Public access
- Noise
- Historical resources and other social land values
- Worker safety
- Other permit or regulatory requirements

Trail Tip

Where Contractor's are requested to complete a CMP, the document may also include proposed work methods and a staging plan describing how the work will be accomplished and a description of the best practices that will be implemented to mitigate any potential impacts.

Where the CMP identifies potential impacts due to the construction works, construction best practices or site-specific strategies may be implemented to mitigate the impacts. Some of the typical best practices and guidelines for various aspects of construction are provided in Section 6.3.

6.2 Construction Crew Selection

An exceptional trail plan and design can fail during construction if the construction crew does not have the skill, experience, equipment, resources, or personnel to complete the job. Trail construction is a highly skilled trade that requires specialized training or years of experience, familiarity with construction best practices, appropriate tools and equipment to complete the task, and a high level of skill to operate the tools and equipment. Trail operators must take particular care in selecting the best construction crew for the job. Trails can be constructed by different types of builders.

Contractor

Specialty contractors are commonly used on all types of trail construction projects and are typically the preferred trail crew to select when speed and quality is important, and the trail operator may lack the resources to manage volunteers or well-trained volunteers. Often agency procurement requirements dictate selection criteria for contractors; however, it is highly recommended that contractors are evaluated using a points matrix that considers experience, qualifications, past references, work quality, equipment, personnel, project understanding, and price. Selection of a Contractor with membership in an applicable professional association, such as the Professional Trail Builders Association (PTBA), is highly recommended.

Agency Resources

Government or other trail operator organizations may utilize employees and agency-owned equipment to perform trail construction projects and are typically the preferred trail crew to select for price and quality. Agency trail crews should be led by a crew leader specifically trained by a qualified professional or organization in trail construction practices and experienced in the type of construction work proposed. A mentorship program for training staff may be utilized to ensure the level of skill and knowledge is maintained in the organization. Agency-owned equipment should be appropriate for the task at hand, otherwise rental equipment may be utilized (see Section 6.3.2 for equipment selection).

COMPLETENESS, COMPLIANCE WITH MANDATORY SUBMISSION REQUIREMENTS AND RFP REQUIREMENTS	PASS/FAIL	
CRITERIA	**POINTS AVAILABLE**	**POINTS AWARDED**
A) PROPONENT COMPANY PROFILE • Profile and professionalism of the company • Professional Trail Builders Association (PTBA) membership (preferred)	 5 5	
B) EXPERIENCE AND QUALIFICATIONS OF THE PROPONENT • Detailed demonstration of completion of natural surface trail construction projects of similar size and scope for comparable organizations in the last five years • Experience in assessment and development of design solutions for natural surface trails and trail safety in a natural environment setting	 15 10	
C) PROPOSED STAFF TEAM AND RESOURCES • Experience of the team proposed by the Proponent. • Previous successful experience with key staff as a team in similar projects	 15	
D) UNDERSTANDING OF RFP AND PROPOSED SOLUTION • Demonstrated high level of understanding of the scope of work and of the RFP goals and requirements. • Proposed approach for achieving the RFP goals. • Identification of possible issues, innovative ideas • Demonstrated ability to carry out all aspects of the project.	 10 10 5 5	
FEES: [FORMULA: (lowest cost proposal / Proponent's proposal cost x 20]	20	
TOTAL SCORE	**100**	

Figure 151 Example contractor selection criteria for a trail construction Request for Proposals

Trail Tip

There are 3 basic factors for all construction projects that are desired: good, cheap, and fast. Unfortunately, it is usually only possible to achieve two of the three factors on any given project. If its good and cheap, it won't be fast – if its cheap and fast, it won't be good - and if it's good and fast, it won't be cheap. Trail Operators must consider priorities carefully for a specific project and have realistic expectations for the project outcomes depending on the circumstances.

Volunteers

Volunteer organizations are often engaged to complete smaller trail construction projects or portions of larger projects. It must be recognized that trail construction is a profession that demands experienced and trained people. Though volunteers bring tremendous energy, not all volunteers have the skills and know-how to construct a quality and sustainable trail. At minimum, volunteer trail crews must be supervised by a trained and competent trail crew leader. Wherever possible, volunteer organizations should seek professional training for trail crews with a qualified organization or consultant, such as a private trail design and construction contractor, International Mountain Bike Association (IMBA) or the Professional Trail Builders Association. Training programs should introduce construction techniques and best practices consistent with those presented in this manual. Ideally, the crew leader for volunteer organizations should be a person with extensive trail construction experience or a third-party expert or contractor. If engaging volunteers, trail operators owe the same duty of care to the volunteers as they do to their own staff. It is imperative the volunteers are equipped with, or bring, and wear all required personal protective equipment, are trained in the use of any equipment and established health and safety protocols, undertake regular reviews of the safety protocols with the volunteers (e.g. daily tailgate meetings) and are monitored to ensure compliance with health and safety protocols. Trail operators should ensure that the appropriate Workers Compensation Board insurance coverage is obtained and maintained to protect the volunteers and the trail operators in case of a safety incident.

Figure 152 McElhanney Consulting Staff volunteering for trail construction on the High Rockies Trail

6.3 Construction

6.3.1Construction Process

For the most part, the process for physically building a trail should follow a consistent 8-step process. Each step is described below.

1. **Mobilization:** movement and delivery of equipment, personnel, and materials to the site. In addition,
2. **Environmental & Historic Resource Monitoring:** attain all environmental and historic resource approvals and ongoing monitoring and compliance with established approval conditions is required through the construction process.
3. **Clearing/Grubbing/Slashing:** removal and trees, brush, stumps, roots, woody debris, and other vegetation within the design trail corridor. This may be done by hand using chainsaws or brush saws or may be completed by larger equipment if appropriate for the trail width.
4. **Subgrade Preparation:** Organics and overburden soil must be removed from the trail tread footprint to expose compact, undisturbed native mineral soil that is free of debris, ice/snow, standing water, organic materials, and/or other deleterious construction substances. The subgrade should be firm and supportive for equipment travel and should be out-sloped to provide positive drainage away from the trail corridor. The subgrade preparation area must extend to the toe of any proposed fill slopes to be placed in later steps to establish the trail tread.
5. **Amenities and Infrastructure:** Trail amenities and infrastructure should be added following subgrade preparation whenever possible. Particularly, non-tread related structures required for access, such as crossing structures and retaining walls, should be completed before the next step to allow for equipment access. Wherever materials for amenity or infrastructure construction are required, these should be mobilized to their location during or following subgrade preparation.

Trail Tip

Mobilization of equipment and materials for amenity and infrastructure construction throughout the trail should be completed as soon as possible as to avoid operating machinery on the completed trail tread surface. Operating equipment on the finished trail tread may result in damage and will require re-work of the final construction steps.

6. **Trail Prism Establishment:** the trail prism is established by cut and fill of native or imported soils as required to meet the trail alignment and design criteria. All fills and imported soils must be placed only on prepared subgrade as described above. Compact all fill materials in maximum 250 mm thick lifts is recommended. During this stage, any required subgrade improvement measures are installed (eg. geotextiles) and imported materials (eg. crushed gravel) are placed. Structures and TTFs associated with the trail prism, such as grade reversals, rolling dips, and ditches, are constructed during this step.

7. **Final Grading:** The finer details of trail finishing are completed during final grading. Final shaping of the finished trail tread is completed, including out-sloping and shaping of any TTFs. Compaction of the trail final trail tread is performed to create a firm and durable surface.

8. **Finishing Work:** Finishing work is the final stage of construction where the disturbed area is restored to as natural a state as possible. Finishing work tasks may include:

    - Final shaping or smoothing of cut/fill slopes
    - Pruning and lopping of roots or vegetation impacting the trail prism
    - Installation of signage, fences, gates, and other associated structures
    - Naturalizing stockpiles, laydown areas, and staging areas
    - Backfilling and naturalizing borrow pit
    - Re-vegetation and/or seeding of disturbed areas wherever possible
    - Removing flagging, pin flags, stakes, and other construction controls
    - Final dispersal of slash and woody debris to a natural condition

Trail Tip

Soil compaction is critical to the durability of any fill soils placed and the final trail surface. It reduces rutting, minimizing trail cupping, and increases the resistance of soils to erosion by water. Compaction should be performed by at least 8 passes using mechanized equipment, such a walk-behind vibratory compactor or a motorized drum roller, that is appropriately sized for the trail width. To achieve adequate compaction, moisture content of the soil must be at an optimum level – not too wet and not too dry. The optimum water content varies with every soil, so experiment with compaction in a variety of conditions to achieve the firmest surface possible.

9. **De-Mobilization:** removal of equipment, personnel, and materials from the site.

6.3.2 Construction Equipment

Trail construction may be performed by hand, small machine, large machine, or any combination of these methods. The appropriate method should be selected primarily based on consideration of the trail design criteria outlined in the TMO – select the most efficient method for construction to accomplish the vision and design of the trail.

Figure 153. Example of <1.2 m width tracked compactor

6.4 Project Management

Sound project management and coordination is required for all trail construction projects. The purpose of ongoing project management is to monitor the administrative side of the project, including scope changes, contractual requirements, costs, and scheduling. A Project Manager should be assigned by the Trail Operator in the Scope of Work document who will be responsible for administrative management of the project. The Project Manager may be any person or persons experienced and trained in project management, such as an employee, consultant, or team leader.

The specific project management requirements may vary by project depending on contractual obligations, requirements from funding sources, and/or governing policy of the trail operator or land manager and should be reflected in the Scope of Work documentation. As a minimum, project managers are responsible for ensuring the following are completed:

- Facilitation of project kickoff, progress, and completion meetings and information sharing.
- Applying for, holding and ensuring compliance with approval and permit conditions.
- Dissemination of important information to project team.
- Ensuring compliance with heath and safety protocols and response to safety concerns and incidents
- Clarification of project requirements to contractor, staff or volunteers.
- Managing the supply chain for essential materials and equipment.
- Main point of contact for project communications.
- Documentation of project scope changes through change orders.
- Ongoing monitoring of construction progress and implementation of construction management plan.
- Project risk identification (e.g. weather delays) and implementation of risk management strategies.

Trail Tip

It is not uncommon that, during trail construction, new environmental, historic or other unknown resource values are discovered. Project Managers must know what to do if / when these instances arise. Response protocols should be identified in the construction management plan.

- Development and implementation of a communications plan about the project, timelines and progress.
- Maintenance of project records, photographs, and reports.
- Post-construction and project close-out (see Section 6.5).

Though the project manager may not directly complete the tasks above, ultimately, they are accountable to ensure the tasks are completed.

6.5 Construction Review

Perhaps the most important aspect of construction is review of the works by the trail operator. This activity is critical to verify that the plan and design intents described in the pre-construction documents are realized in the finished product. The construction team should have a designated construction reviewer. The construction reviewer is a person (or multiple) who is highly knowledgeable and experienced in the entire trail planning, design, and construction process performed for the specific project, who is also a highly skilled and experienced trail user for the intended trail. Ideally, the trail designer should be retained for the role of construction reviewer. The duties of the construction reviewer typically include:

- Regular field review of the construction works to verify compliance with project design intentions and specifications.
- Coordinates necessary parties to resolve any discrepancies between the product and project specifications.

- Verify that procedures or permit requirements set out in the Work Plan or Construction Management Plan are executed during construction.
- Verify implementation of construction best practices are implemented.
- Quality control testing of completed trail to verify that design intentions and objectives are met.
- Recording deficiency lists during construction and verify that items are addressed prior to completion of construction.
- Provide written documentation and photographs of reviews to the Project Manager.

6.6 Post-Construction

At completion of trail construction, several important administrative and management tasks are required to close-out the project. As applicable, contractual obligations for quantity measurements and payments should be completed and finalized by all parties. As-built mapping of the trail should be completed to record the final alignment of the trail and location of amenities and infrastructure and submitted to the public land manager for record purposes and updating the provincial trails inventory. Active permits and permissions set out in the Construction Management Plan should be closed out with the applicable authorities and necessary reporting completed. All equipment and excess materials should be removed from site.

For completion of the project, a final walkthrough with all involved parties (contractor or trail crew, project manager, trail operator, construction reviewer and public land manager) should be performed to verify that all parties are in agreeance of substantial completion of the project. Written notification of project completion should be provided by the trail operator to all parties along with all final payments to indicate completion of the construction phase.

Trail Tip

Depending on the conditions at the time of completion, the Trail Operator may wish to develop a management plan to limit use in the first year to allow natural hardening of the trail surface and re-establishment of vegetation. Heavy use in dry or wet conditions, events, and speed races may detrimentally impact the new trail in the first year and should be limited if possible.

6.7 Construction Management Guidelines and Best Practices

The following section provides guidance and best practices to trail operators on how to minimize the safety, environmental and visitor experience impacts of trail building activities. While not exhaustive, this summary can provide a basis for the development of project specific construction management plan. It is important for trail operators to remember that there are legislative and regulatory obligations that must be met (see Section 1.6) and conditions associated with any permits and approvals must be followed. As regulations and best management practices are dynamic over time, it is recommended to engage with qualified professionals (e.g. environmental) to ensure the practices incorporated will successfully mitigate the impacts of construction.

General Practices

- Avoid work during adverse weather conditions (rain, high winds, snow, freezing conditions, etc).
- Remove all construction materials upon project completion.
- Complete all servicing locates before excavation.
- Use existing disturbed areas for site access, staging, and laydown.
- During forest fire season (March 1 to November 30), maintain appropriate fire suppression equipment in each vehicle and piece of equipment as per Alberta Agriculture and Forestry recommendations. Check Alberta Wildfire daily for any forestry work restrictions for the work area.
- Smoke only in designated areas and dispose of butts in designated containers only.

Machinery

- Machinery must be cleaned before arriving onsite to ensure it is clean and free of leaks, debris, and noxious/weedy vegetation material.
- Avoid stream fording – construct crossing structures as soon as possible in the construction process or use an alternative access.
- Use temporary crossing structures on highly erodible soils.
- Wash, refuel, and maintain equipment back from watercourse top of bank or wetland margin (minimum 30 m).
- Use secondary containment for all generators and pumps used in or around water bodies.
- Ensure no deleterious materials can enter a water body (grease, oil, paint, chemicals, etc).

Where practical, environmentally-friendly hydraulic fluids should be utilized on machinery working near a water body (i.e. excavators, crane, hoist, etc.).

- Operate machinery above the ordinary high-water mark, as feasible.
- Spill kits must be made immediately available for deployment during instances of hydrocarbon or hydraulic fluid spills.
- Report spills to the appropriate authorities (Alberta Environment and Parks Response Line 1-800-222-6514), including all spills release into a water body.

Water

- Follow Alberta Environment and Parks Decontamination Protocol to prevent the transfer of species and diseases between water bodies and/or watersheds (e.g. whirling disease, zebra mussels).
- All materials used in a watercourse must be clean, free from debris, and riprap/rock materials be certified as non-acid generating and non-metal leaching rock.
- Develop and implement a spill response plan.
- Do not use explosives in or around water.
- Manage water flowing onto and off site, ensuring that it is diverted or filtered before entering a waterbody. Diversion is recommended for vegetated areas or a designation settling area.
- Minimize disturbance to in water habitat and limit project footprint, including temporary workspace, as feasible.
- Time any instream work outside of the restricted activity period of the watercourse as directed by a qualified environmental professional.
- Minimize duration of instream work.
- Conduct work at low water flow periods, as feasible, to limit erosion and maintain ecological integrity.
- Water quality should be monitored by a qualified environmental professional during in-water activities.
- Fish passage should not be affected by construction activities or instream structures. Ensure project does not result in channel constriction, reduce flow or strand/kill fish.
- All instream activities should be conducted within an isolation of flowing water. Waterflow downstream of construction site must maintain flow. All instream isolation should be conducted with a qualified environmental professional onsite. Wetland isolation may also be required at the qualified professional's discretion.

- Salvage fish within isolation prior to construction, which must be conducted by a qualified environmental professional.
- Do not pump water from a water body for use during construction without appropriate permitting.
- All water pumps should be fitted with an intake screen designed for fish protection. Pump speeds should prevent impingement on the screens and the intakes regularly checked for fish entrapment. Screen with maximum opening widths of 2.54 mm (DFO 1995).
- Restore bed and banks to original gradient and contour upon completion of the works.

Wildlife

- Do not harass or feed wildlife.
- Remove all food wrappers and edible materials from site at the end of each day and keep in appropriate receptacles.
- Secure steel plates or equivalent over excavations that are left overnight to ensure no wildlife is entrapped or harmed. Contact AEP Fish and Wildlife Officer for wildlife handling and removal or other qualified professionals.
- Avoid work, including tree clearing, within the migratory bird window (e.g., approximately April 1 through August 31) or within other restricted timing windows for wildlife. Consult qualified wildlife biologist to ensure all appropriate regulatory processes are followed, especially for work timed within a restricted activity period.
- Engage a qualified wildlife biologist to conduct wildlife sweeps prior to construction.
- Ensure construction area does not impeded wildlife migration though an area (e.g., fencing, etc.).
- All workers should seek Bear Awareness training from an accredited supplier. If necessary, have a bear monitor on-site to mitigate potential human-wildlife conflicts.
- If work is occurring in a high wildlife value area, engage a qualified professional biologist to develop site-specific mitigated strategies and reporting guidelines.

Vegetation

- Ensure machinery arriving on site is clean of debris to limit pathogen and invasive species spread.
- Prevent the spread of noxious and weedy species. Manage all weeds as per the Weed Control Act including clean machinery, screen areas prior to clearing, remove and bag noxious and weedy species prior to construction to prevent spread. Dispose of at an approved facility.

- Minimize clearing of vegetation and use of temporary work spaces.
- Do not remove riparian vegetation if identified within the critical habitat of an aquatic SARA listed species.
- Minimize clearing of riparian vegetation. Stabilize sites where vegetation has been removed through revegetation or other appropriate measures to reduce erosion.
- Incoming fill used onsite must be from sources known to be free of invasive species.
- Use location-specific approved native plant species and seed mixes for revegetation.
- Rare plant or Species-At-Risk listed species surveys must be conducted by a qualified rare plant biologist, as needed.

Soil

- Develop and implement an Erosion and Sediment Control (ESC) plan or measures until the ground is stabilized and no longer poses sedimentation or erosion risks. Inspect and maintain ESC measures for the duration of project and remove all temporary measures upon project completion and/or site stabilization. Sites must be stabilized within one growing season.
- Minimize ground disturbance and project footprint.
- Cover spoil piles to prevent wind and water erosion. Locate spoil piles away from water bodies.
- Salvage and stockpile topsoil and store separately from other material. Additionally, stockpile and label riparian and/or wetland soils separately from upland soils.
- Aerate and mix disturbed areas prior to reclamation to promote vegetation regrowth.
- Whenever possible, complete trail prism cut/fill with soils directly from the trail corridor. If required, locate any borrow pits well away from the trail corridor and backfill with waste soils and debris immediately upon completion of work in the area.

Historical Resources

- In the event that historical resources are discovered during construction, mitigation measures are regulated by Section 31 of the Historical Resource Act and include a requirement to communicate finds to Alberta Culture.
- Where historical resources are known to exist in an area prior to construction, Trail Operator should clearly identify and mark these resources and provide direction to the Trail Crew or Contractor to avoid disturbance.

Visitor Experience and Public Safety

- Provide adequate signage at all trails heads and at the site advising trail enthusiasts of the project, safety measures and phased construction timelines.
- Travel in vehicles at slow speeds with due attention to other trail users.
- Construction personnel and equipment should yield to trail users or members of the public on all trails and roads.
- At the site, the site should be cordoned off to minimize risks that park users will enter the site. Where user access must be maintained through the construction site, designate a safe temporary route for travel through the area or stop work while users pass through.
- Construction crews should be attentive while machinery is operating to ensure no trail users enter areas under active construction.
- Pits and holes should be fenced while not being utilized and should be backfilled as soon as reasonably practicable.
- Where noise may negatively impact users or the public, set designated work hours that have been developed in consultation with the impacted parties.

7.0 Trail Management & Operations Guidelines

7.1 Trail Management Program

Trail-based recreation is one of Albertan's top recreational activities. Some trails on public lands attract thousands, or even tens of thousands, of enthusiasts each year. Trail use can lead to undesirable environmental impacts, conflicts between trail activities, conflicts between other land users and trail enthusiasts and undesirable effects on the trail experience. Trails operators must remain committed to providing safe and memorable trail experiences while protecting biodiversity, habitat, ecosystems and historic resources and minimizing conflicts with other land users and between different trail activities.

Active trail management is essential. Trails can't simply be built and then ignored. Unfortunately, there is no single "silver bullet" to resolve all trail problems. But, there are a number of critical management strategies that, when effectively applied, will increase the trail operator's success.

The most effective approach to managing visitor impacts is through the application of a comprehensive visitor management program based on the "4E's" of recreation management:

1. Effective engineering and design,
2. Proactive visitor education,
3. Timely and targeted enforcement,
4. Evaluation through ongoing visitor experience and impact monitoring.

A trail engineering and design was addressed earlier in the manual, the following sections provides trail operators with proven guidelines for successful visitor education, enforcement and evaluation.

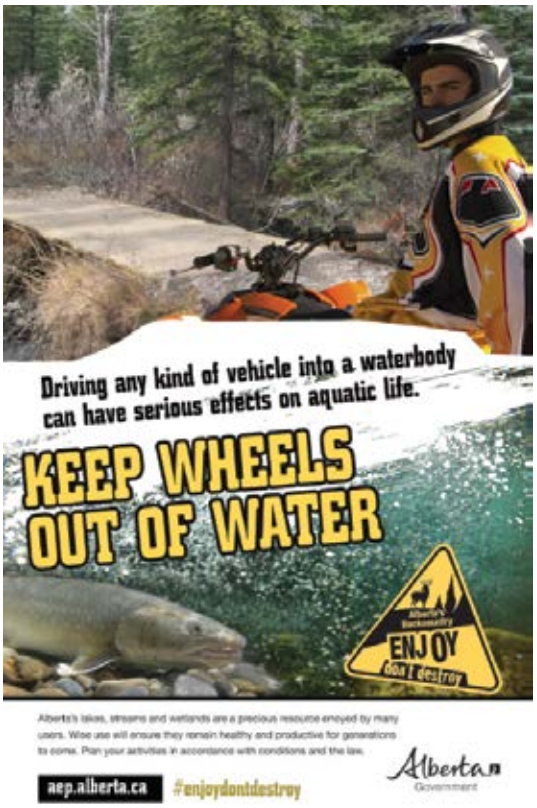
Enthusiast Education & Ethics

Trail operators should acknowledge that if they don't tell enthusiasts what they expect, they shouldn't be upset when they don't get what they want. Educated trail enthusiasts will be more responsible and compliant trail enthusiasts. Education is an essential trail management strategy. For the most part, enthusiasts want to do what is right. However, some visitors are simply unaware of appropriate actions and rules, others lack the skills and knowledge of how to mitigate their impacts while, unfortunately, other enthusiasts knowingly choose to ignore the rules and trail etiquette. Education is most effective for enthusiasts who are simply unaware or unskilled. Education will be less successful for those enthusiasts who knowingly choose to ignore the rules. Educating visitors about trail etiquette, low-impact skills and the rules should be a significant focus of trail operators management program.

Education Program

Trail operators should prepare a comprehensive education program that educates enthusiasts about:

- The trail experience and types of activities permitted on the trail.
- The attractions along the trail and what is unique about the trail.
- Level of challenge, skills and equipment they need.
- Hazards and risks associated with the trail.
- Hierarchy of yielding on the trail.



- Rules and restrictions associated with the trail (e.g. trail activities, seasonal closures, temporary closures etc.) and why the rules and restrictions are in place.
- Appropriate behaviours, ethics and etiquette while on the trail.
- Where to get further information about the trail and the trail operator.
- How to report incidents and maintenance problems.

Trail Tip

If trail operators don't tell enthusiasts what they expect, they shouldn't be upset when they don't get what they want. Education will be most effective in changing the behaviours of enthusiasts who are simply unaware of the rules or proper etiquette. Enforcement is the appropriate management tool for those enthusiasts who knowingly ignore the rules and proper etiquette.

Timing, Message & Delivery is Everything

It is well established the when designing a trail education program, trail operators need to give considerable attention to a) the timing of the message, b) the method the message is delivered through and c) who delivers the message.

Trail enthusiasts don't just "show up" at the trail. They progress along a "pathway to participation" where the enthusiast:

1. Dreams about the trail experience they want to achieve,
2. Evaluate their trail options,
3. Selects a trail that is likely to meet their desired experience,
4. Plans the trail experience,
5. Travels to the trail,
6. Engages in the trail experience, and, finally
7. Returns home and tells their friends and family about the experience.

Trail Tip

Trail operators should adopt or develop a user education program based on low-impact skills and ethics. Before developing a new program, trail operators should consider adopting an existing, well established, program such as:

- Leave No Trace (www.leavenotrace.ca)
- Respect the Land

Figure 154 Education & Outreach Comes in Many Different Forms

It is important for trail operators to provide the right information at the right time to help enthusiasts make the right decisions. Each step along this pathway provides trail operators with an opportunity to reach the enthusiast with critical information and education about the trail, the rules, and appropriate etiquette. Table 7, summarizes the type of information enthusiasts need to know at each stage of the pathway to participation.

Figure 155 Trail Yield Hierarchy

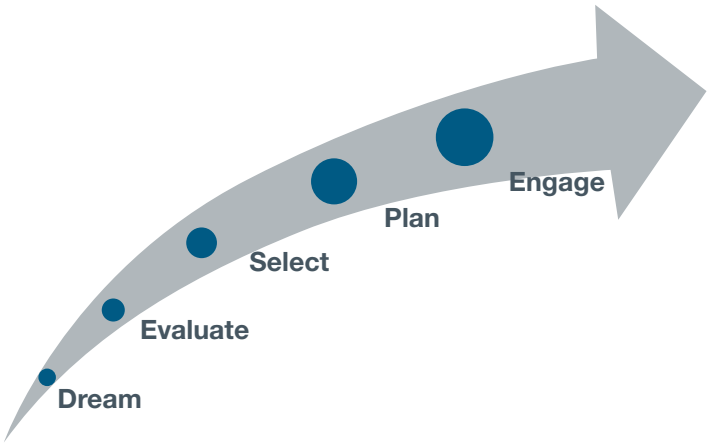


Figure 156 Trail Experience Pathway to Participation (Ellis, Justin 2018)

Trail Tip

Managing expectations early is one of the best approaches to avoiding and minimizing conflicts between trail activities. Trail operators should clearly communicate which activities are permitted on the trail (e.g motorized, mechanized, non-motorized) and the trail setting so that enthusiasts can select the right trail for them.

Table 12 Information to be Supplied Along the Pathway to Participation

Pathway to Participation	Enthusiasts need to know…	Trail operators can educate and inform enthusiasts through…
Dream	• Trail activities • Trail setting • Unique attractions	• Websites • Social media • Trail web cams • Online enthusiast forums • Smart phone applications • Visitor information centers • Print materials • Tourism marketing channels
Evaluate & Selects	• Permitted activities • Trail setting • Unique attractions • Length • Challenge level • Closures & restrictions • General trail conditions	• Websites • Trail web cams • Online enthusiast forums • Smart phone applications • Print materials
Plan	• Rules, restrictions, closures • Trail routing & elevation change • Hazards & risks • Trail conditions • Nearby by amenities (e.g. accommodations) • Skills & equipment needed	• Trip plan website • Online maps, downloadable maps & GPS tracks • Trail web cams • Online enthusiast forums • Visitor information centers • Smart phone applications • Print maps & trip planning materials
Engage	• Rules, restrictions, closures • Proper etiquette • Skills & practices to minimize impacts	• Staging area signage • Trail signage • Trail stewards • Enforcement officers • Smart phone applications & electronic trail guides • Print maps & trail guides
Share	• Photos • Stories to share • Blogs • Trail quality ratings & review	• Websites • Social media • Smart phone applications • Print materials • Tourism marketing channels

Trail operators should train their staff, volunteer trail stewards, enforcement officers and others in established visitor education programs such as Leave No Trace Skills & Ethics and Respect the Land so that these skills and ethics can be passed along to enthusiasts directly. Trail operators should also consider running awareness courses and sessions to further educate enthusiasts about proper trail etiquette and how they can avoid or minimize the impact of their trail use. Targeted education campaigns can be undertaken during prime summer and winter seasons and special events to capture enthusiasts while they on trail.

Enforcement

For those visitors who willingly ignore rules, enforcement is a required compliance assurance strategy. Enforcement is critical to good trail management but should be applied judiciously yet consistently. Enforcement is just about writing tickets. Effective enforcement uses officer presence, communication as well as verbal and written warnings to help gain compliance. One goal of trail management is to assure compliance with the rules, but this must be done in a way that builds and maintains positive relationships with the enthusiasts. The reality is, trail operators need to build a stewardship ethic within enthusiasts as there will never be enough enforcement officers to be on the trails at all times. If enthusiasts are only doing what they are supposed to when an officer is around, trail management will not be successful.

Furthermore, they ability to enforce trail use varies greatly depending on the land the trail exists on and the type of enforcement officer that is patrolling those lands. In general, the following are trail relates issues that are typically enforceable on public lands pending the authorities of the enforcement officer that is present:

- Insurance and registration for on and off-highway vehicles
- Off-highway vehicle equipment (e.g. lights, approved muffler)
- Using and off-highway vehicle without a helmet
- Riding in or alongside watercourses
- Trespassing
- Alcohol consumption on trail
- Littering

If the trail is located within a Public Land Use Zone, further regulations may be available to help trail operators manage the types of trail activities, timing, location of trail use among others management controls. Trail operators should work with the local public land manager to fully understand what, if any, regulations will govern the use of the trail, enthusiast behaviours and what types of enforcement for what infractions will be possible on the trail.

In many cases, officer and operator presence is enough to assure compliance. As enthusiasts see and encounter uniformed officers and personnel on the trail, they will know the trail is being actively management and are likely to comply with the rules and proper etiquette. Though volunteer trail stewards cannot carry out enforcement and are not permitted to pretend to have enforcement authorities, they can share information with enthusiasts, and contact enforcement officers to inform them of violations.

Trail Tip

The regulation and enforcement of trail use may or may not be possible on your trail. Trail operators should work with the local public land manager to fully understand what, if any, regulations will govern the use of the trail, enthusiast behaviours and what enforcement, by who, will be possible on the trail.

As violations are observed or become a problem, trail operators and enforcement officers should reflect upon why the violations are occurring. It could be that the enthusiasts are simply uneducated because the signs are no longer in place or the rules and messaging aren't clear. It could also be that the design of the trail is encouraging or enabling the violations to occur (e.g. a bridge is not wide enough to accommodate permitted activity forcing enthusiasts to ford the watercourse). Whatever the case, trail operators should remain focused on using the appropriate management tools to build a long-term stewardship ethic within the enthusiasts.

Evaluation – Visitor Experience & Impact Monitoring

Trail operators should regularly evaluate whether their trail design and management strategies are working. Good trail management decisions need to be based on good data and information about trail users, visitor experience and trail conditions. Understanding visitation patterns and use of the trail is vital. It is equally as important for trail operators to monitor the condition of the trail, environment and social impacts from trail use and associated trail amenities. To provide trail operators with a sound understanding of trail use and the trail impacts, trail operators should

- Design and implement a trail use monitoring program to understand:
- Whether the TMO is being met or not
- Number of trail users
- Type of trail users
- Timing of trail use (day, week, season)
- Purpose for trail use
- Origin of trail users
- Visitor satisfaction
- Establish a trail impact monitoring program to monitor impacts such as:
    - Extent of trail compaction and erosion
    - Trail widening
    - Social trail proliferation
    - Invasive species presence and spread
    - Prevalence of vandalism
    - Visitor conflicts

Trail operators should establish limits of acceptable change for the physical trail conditions as well as the experience of enthusiasts. These limits should be evaluated through the monitoring program and strategies should be implemented, as necessary, to respond to undesirable conditions occurring on the trails.

7.2 Trail Maintenance

Trail maintenance is critical to the sustainability of every trail and is a key component of risk management for the trail operator. It is an ongoing process that begins the moment the trail is first opened to the public and despite implementation of the best planning, design, and construction principals described in this manual, it is required for every trail on a regular basis. The underlying principal of trail maintenance is to continuously review the trail and perform the necessary works to perpetuate the intended trail design and experience expressed in the TMO.

7.2.1 Maintenance Objectives

The objectives of trail maintenance are seemingly simple, yet often overlooked over the lifespan of a trail. At the highest level, trail operators must look back at the immense effort put into creating an exceptional trail experience and realize that the primary objective of trail maintenance is the protection of the investments made in the planning, design and construction processes. By perpetuating the intended design and function of the trail with a suitable maintenance program, the long-term maintenance objectives can be met:

- Provide exceptional trail experiences.
- Ensure continued resource protection (social and environmental).
- Protect trail user safety and manage trail operator risk.

Figure 157 It is important to choose maintenance and inspection vehicles for the specific trail. A Rokon (two wheel drive motor bike with ATV tires) and an E-fat bike are suitable maintenance vehicles for singletrack. A 4 wheel drive vehicle with a locked differentials (such as an ATV) will destroy the singletrack trail tread and change the trail user experience from single track to double track.

7.2.2 Trail Maintenance Plan

A proactive approach to trail maintenance is far more successful than a reactive approach. To be proactive, trail operators should prepare a trail maintenance plan (TMP). The TMP should be a long-term systematic program that outlines the specific maintenance objectives for a trail or network based on the TMO and describes how and when they will be accomplished in a proactive manner. It should describe who will perform the various tasks of the TMP and what equipment, materials, time, and/or funding may be required to accomplish the tasks. Trail operators should ensure the TMP answers the following questions:

- Who will be responsible for oversight of the trail maintenance program?
- Condition assessments – who will perform them and how often? What forms or checklists are required for the trail-specific infrastructure?
- Who will review condition assessments and prioritize the required maintenance projects?
- What will the criteria be for prioritization of maintenance projects?
- Who will perform maintenance tasks?
- What equipment is needed and available?

The answer to each of these items must be determined on a trail-by-trail basis and must consider a multitude of factors including the TMO, location, infrastructure, trail operator, trail setting, risk assessment, and historical performance of the trail. The following sections provide some guidance on determining the appropriate details for a site-specific TMP.

Conditions Assessments

Regular and ongoing condition assessments must be performed by qualified maintenance personnel who have reviewed the TMO in detail and are aware of the trail maintenance objectives. The frequency of conditions assessments should be specified in the TMP and may require adjustment over time based on consideration of several factors, including the volume/type of users, types of infrastructure on the trail, performance history of the trail, risk assessment, and user input. As a minimum, condition assessments should be performed at the start and end of each season of use each trail.

Trail Tip

Risk/liability should not be confused with the intended challenge of a trail. Risk is where an unforeseen condition or circumstance resulting in an un-planned hazard or condition; challenge is a planned aspect of the trail design utilized to enhance the user experience. Trail Operators must avoid the common complaint of “dumbing down the trail” by unnecessarily removing challenge from a trail when confused with a risk.

The framework for an effective condition assessment is to consider the following items:

- Are the key design parameters of the TMO reflected on the trail (eg. grades, tread width, clearing corridor width, etc.)?
- Is the trail or portion of trail fulfilling its intended function?
- Is the user experience negatively impacted by the condition of any part of the trail?
- Are the TTFs are in a condition consistent with the original design
- Is there an unforeseen risk to user safety?
- Are the environmental or social values of the trail degraded or at risk of degradation?

If the answer to any of these questions is yes, a more detailed review of the specific area is required and with detailed documentation. Specifically note the problem areas, document with photographs, record the exact location and extents of the problem areas, and determine the root cause if possible.

Trail Operators should develop a form or checklist for maintenance personnel to record condition assessment information. Maintain records of all condition assessments, even if there are no significant adverse conditions encountered as they are an important component of risk management. Specific trail infrastructure, such as bridges or TTFs, require item-specific inspection checklists based on the design of the structure. In some cases, the design of some structures may require inspection by a qualified professional.

Maintenance Personnel

Trail maintenance personnel essentially require the same high level of skill and experience as trail construction crews. Personnel performing condition assessments require a thorough understanding of the trail from a holistic approach, from the planning/design of a trail to root-cause analysis of condition problems to the implementation of trail construction best practices. Trail Operators must hire, designate, or mentor highly skilled personnel to perform and condition assessment and maintenance tasks.

Maintenance Frequency

Trail maintenance should be performed as soon as reasonably practicable to maintain an exceptional trail user experience level. The Trail Operator should routinely review the condition assessments and prepare a prioritized list of maintenance projects for maintenance personnel. Prioritization is a subjective matter specific to the trail's risk factors and management objectives; however, typically safety issues related to the trail and/or infrastructure are the highest priority for maintenance and should be addressed as soon as reasonably practicable.

Over time, the frequency of maintenance may change for a specific trail. Whenever changes occur, the Trail Operator should consider the root cause of the change and attempt to address the problem at the source through other means, such as changes to the Trail Management Program.

7.3 Risk Management

Risk management is a process used by trail operators to identify and control unreasonable risks on their trails and reduce the adverse effects of accidents. Though participation in trail-based recreation involves varying levels of inherent risk to enthusiasts; trail planning, design, maintenance, visitor management and communications can increase or decrease the risk to enthusiasts and liability exposure for the trail operators. In accordance with the Occupiers Liability Act, all trail operators have a responsibility to provide a reasonable "duty of care" that contributes to the safety of trail users. Under the act, "an occupier (e.g. trail operator) is liable to trespassers for damages for death or injury to the user that result from the occupier's wilful or reckless conduct". "Wilful" conduct requires a deliberate act intended to cause injury while "reckless" conduct implies gross negligence on the part of the occupier (trail operator). Trail operators should also recognize that a higher duty of care is owed to children as they are less perceptive of dangers along a trail and / or are less able to make reasonable choices to avoid the dangers.

Trail operators should recognize that anyone who experiences damages during the use of a trail can bring a civil case against the trail operator. It is essential that a trail operator is able, at all times, to demonstrate that the trail and infrastructure was designed and constructed to appropriate industry practices; maintain an effective and appropriate system for inspecting trails, documenting findings and resolving unsafe conditions; and how the level of challenge and inspections levels are clearly communicated to trail enthusiasts.

Risk management does mean that trails can't be designed to have elements of risk and challenge. It is important to remember that, for some enthusiasts, risk and challenge are a critical objective of the trail experience. Removing risk and challenge is often inappropriate and detrimental to the enthusiast's experience. However, at the same time, ignoring or failing to plan and actively manage the risks associated with a trail is equally inappropriate. Trail operators must strike a balance between liability and the trail experience. The goods news is, this can be done through proper trail planning, design, maintenance, management and communications.

Trail Tip

Risk and challenge is often a motivator for many trail enthusiasts. Removing risk and challenge is not necessary and would be inappropriate. Appropriately planning for and actively managing risk is; however, essential.

7.3.1 Risk Assessment & Management Process

In accordance with Alberta's Minimizing Risk and Liability: Best Practice Guidelines for Trail Stewards, Operators, Managers and Owners manual (2010), trail operators should apply the following process to properly assess and manage risk on their trails:

1. Identify potential risks
2. Determine if the risks align with or exceed the TMO and desired level of challenge for the trail
3. Evaluate probability and severity of the risk
4. Identify and examine the risk management options
5. Determine the favoured risk management strategy(s)
6. Implement the chosen risk management strategy(s)
7. Monitor incidents and enthusiast feedback and take action, as necessary, to further mitigate unreasonable risks

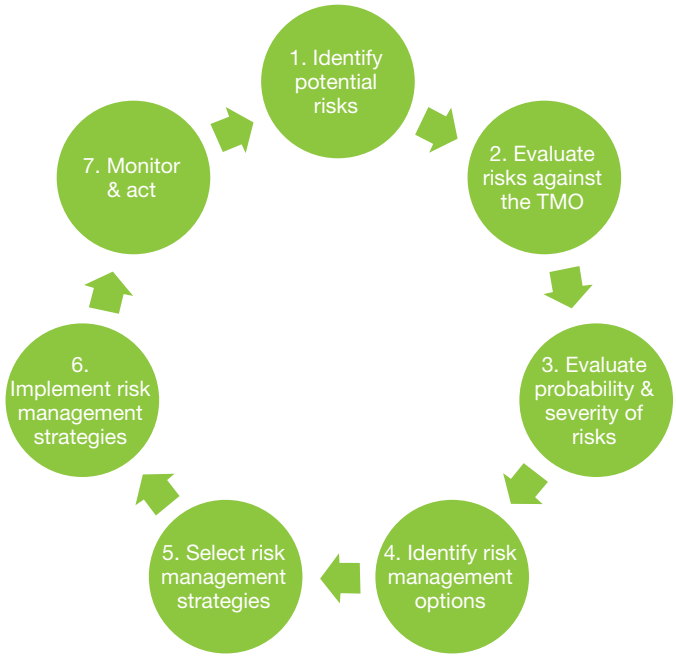


Figure 158 Risk Management Process

Risk management is an ongoing task for trail operators. It doesn't end after the trail is built and opened. Trail operators must actively manage their trail, continually assess risks and be ready to take actions as conditions change along the trail, weather changes, adjacent land uses change and / or trail conditions change.

Trail Tip

Risk management is an ongoing task for trail operators. It doesn't end after the trail is built and opened. Trail operators must actively manage their trail, continually assess risks and be ready to take action.

7.3.2 Risk Management Approaches

Generally, speaking, there are three typical approaches available to trail operators to manage risk. In most cases, the most appropriate risk management strategy for a trail is a combination of the three approaches. Trail operators can manage risk through:

8. **Avoidance —** undertake trail design and management actions that avoid the introduction of risk into the trail
9. **Transferring Risk —** transfer risk to another party through the use of waivers and by obtaining proper insurance;
10. **Reduction —** employ design, management and education measures to reduce the likelihood and/ or severity of the risk

Trail Tip

Filters are a critical risk management strategy. Filters should be used on all trails with higher levels of challenge to help users self-determine that skills match the demands of the trail.

Figure 159 An Example Trail Use Responsibility Code

Trail Tip

Trails that are developed to a higher standard and receive greater volumes of visitation should be inspected more frequently than less developed trails with lower use.

7.3.3 Avoiding, Transferring, Reducing & Managing Risk

The following are examples of measures that trail operators should take to avoid, reduce and / or manage risk. include installing signage conveying risks and skills needed, limiting trail user numbers, regular monitoring and maintenance, & adequate tread surface. Trail operators should:

- Avoid risk by:
    - To the extent possible, planning trails to avoid areas that pose undue risk to visitors by exposing them to natural (e.g. rock slides, slope failures, avalanches) and human created (e.g. industrial areas, hydrogen sulfide) hazards.
    - When the trail can't be sited to avoid natural and human created hazards, trail operators should ensure trail enthusiasts are appropriately educated about the risks and the actions to take to reduce or mitigate risks to them when they are travelling the trail.
    - Ensuring the design of the trail and technical trail features and the level of challenge they provide to enthusiasts are aligned with the TMO, are built to appropriate industry standards and match the communications provided to enthusiasts about the challenge on the trail.
- Transfer risk by:
    - Ensuring trail enthusiasts have easy and obvious opportunity to learn about the trail conditions, difficulty, skills needed, equipment needed and the risks they may encounter on the trails before they get to the trail (e.g. website, maps, trip planning tools), when they arrive at the trail (e.g. trailhead signage) and while travelling along the trail (e.g. warning signage).
    - Maintaining an appropriate level of insurance coverage.
- Reduce risk by:
    - Designing and constructing the trails to meet the critical design parameters for the permitted trail activities (e.g. use of filters, appropriate trail surfacing, vertical and horizontal clearing, gradients).
    - Establish a trail code and educate enthusiasts about safe and responsible trail use.
    - Provide adequate, and appropriately placed, signage and other information (e.g. website, print materials, smart phone apps) to help enthusiasts understand the equipment needed, challenge level of the trail, skills required for each trail, navigation of the trail and communicate trail conditions, risks and potential injuries to trail users.
    - Identifying potential conflicts between permitted trail activities and taki ng actions to mitigate those conflicts (e.g. speed limits, signage, education programs, timing restrictions etc.).

- Developing a clear inspection protocol policy.
- Establishing and implement a clear maintenance program with regular inspections of the trails to identify hazardous conditions and maintenance requirements. Ensure systematic documentation and record keeping of inspections and maintenance actions.
- Ensuring maintenance "staff" (volunteers and employees) are appropriately trained to undertake the inspection and maintenance tasks they are assigned and possess and utilize the appropriate personal protective equipment. Warning signage should be applied to let enthusiasts know that maintenance and construction is in progress.
- Providing a means for trail users to report trail conditions, injuries and maintenance issues to trail operators.
- Responding in a timely way to address reported and discovered hazardous conditions and maintenance issues.
- Investigate reported injuries or accidents on the trail, undertake corrective actions and document the findings and actions taken.
- Closing or re-routing trails where hazardous weather (e.g. floods) and conditions (e.g. wildlife) cannot be mitigated.
- Develop and maintain up to date trail safety and emergency response plans to deal with unexpected events (e.g. accidents, avalanches, wildfires, industrial accidents, wildlife etc).
- Avalanche management and safety plan if the trail is within avalanche terrain. The plan should ensure that enthusiasts are made aware of the Avalanche Terrain Exposure Scale Rating (www.avalanche.ca). A Qualified Avalanche Planner (see Avalanche Canada minimum training and experience requirements) should be engaged to evaluate the terrain, confirm the appropriateness for the trail location and prepare the avalanche management and safety plan.

Further details and example tools to help trail operators manage risk can be found in *Alberta's Minimizing Risk and Liability: Best Practice Guidelines for Trail Stewards, Operators, Managers and Owners manual (2010)* which is available on the Government of Alberta's website.

8.0 Additional Resources

Exceptional Trails guide provides planning, classification, design, construction and management direction that is relevant to all trails on public lands regardless of the classification. However, some trail projects or challenges associated with a trail project may require more detailed direction than is available in this manual. Whether it be the designed of a preferred use trail (e.g. mountain bike trail), bridge design or the design provincial highway crossing the following resources can be helpful and should be thought of as a supplement to this manual:

Trail Planning & Design

- Great Trails: Providing Quality OHV Opportunities through Sound Management, Conservation, and Design
- Trail Solutions: IMBA's Guide to Building Sweet Single Track
- Bike Parks: IMBA's Guide to New School Trails
- BLM Guide to Quality Trail Experiences
- Whistler Trail Standards: Environmental & Technical Trail Features
- USFS Equestrian Design Guidebook for Trails, Trailheads & Campgrounds
- Minnesota Department of Natural Resources: Trail Planning, Design, and Development Guidelines
- British Columbia Recreation Management Manual: Chapter 10 Recreation Trail Management
- AmericanTrails.org

Trail Infrastructure

- Alberta Environment & Parks: Backcountry Timber Bridge Installation Guidelines
- Alberta Code of Practice for Watercourse Crossings
- USFS Trail Plans & Specifications Website: https://www.fs.fed.us/recreation/programs/trail-management/trailplans/index.shtml

Accessibility

- Alberta Parks Accessibility Construction Guidelines

Trails in Highway Right of Ways

- Trails in Highway Rights of Way

Risk & Liability

- Minimizing Risk & Liability: Best Practice Guide for Trail Stewards, Operators, Managers and Owners

Trail & Visitor Management

- US Visitor Use Management Framework: A Guide to Providing Sustainable Outdoor Recreation
- Managing Mountain Biking: IMBAs Guide to Providing Great Mountain Riding