

# **Twelve Mile Coulee Natural Environment Park Management Plan**

**Draft**

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**DRAFT**

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## **MAPS**

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## **INTRODUCTION**

### **Purpose**

Twelve Mile Coulee is a major Natural Environment Park located in northwest Calgary. The study area is approximately 190 hectares. It is bounded by Stoney Trail to the east, Nose Hill Drive to the south, the community of Tuscany to the west and Crowchild Trail to the north (Please refer to map 1). The area contains prominent geographic features within the Bow River West segment of Calgary's Urban Parks System. A series of knoll formations and depressions characterize the topography of the benchlands near Stoney Trail. The Coulee to the west is almost 290 meters wide and 50 meters deep at its southern end. A spring and stormwater fed creek meanders through the base of the coulee in a southerly direction from Tuscany Boulevard. Although grasslands comprise a large portion of the park, a number of other vegetation communities exist including: low shrub, upland tall shrub, riverine tall shrub, white spruce, balsam poplar and aspen. The value of the area in terms of its biophysical diversity, wildlife habitat suitability and recreational potential demonstrate the need for a comprehensive management plan.

### **Goal**

To provide the overall direction for the development, maintenance and protection of Twelve Mile Coulee to perpetuate the natural character of the landscape while providing compatible, quality recreational opportunities. The Management Plan is designed to be

consistent with the objectives and goals identified in the City of Calgary Natural Area Management Plan, the Calgary Urban Parks Master Plan, the Open Space Plan and the City's Cycling Policy for Undesignated Trails, all of which have been approved by City Council.

## **Objectives**

- Establish park boundary
- Catalogue the habitats and landscape features within the study area and use this information to establish management zones as well as pathway and trail routes that are compatible with the natural environment
- Develop the locations of general public access and parking
- Identify user facilities and signage that may be desirable (e.g. seating, garbage cans, pedestrian crossings, signage)
- Determine the location of the regional pathway system
- Determine the location of the trail network
- Review and determine the types and locations of compatible recreational use
- Address potential points of conflict between various user groups
- Develop recommendations for a public education program
- Prescribe restoration strategies and prioritize restoration zones impacted by prior land use (i.e. grazing, powerline right of way)
- Identify operational activities and their associated budget, manpower and resource requirements for plan implementation
- Provide implementation phasing, timelines and costs

## **MANAGEMENT PLAN DEVELOPMENT PROCESS**

### **Project Team**

A multidisciplinary team of City of Calgary staff worked together to develop the Twelve Mile Coulee Management Plan. The team included staff from the following Parks divisions: Resource Management (Natural Areas Section), and Public Education as well as representatives from the Engagement Resource Unit and Roads. Alberta Transportation, the University of Calgary and the Tsuu T'ina Nation also played key roles.

### **Citizen Participation**

The City of Calgary (Council and Administration) recognizes that decisions are improved by engaging citizens and other stakeholder groups where appropriate and is committed to transparent and inclusive processes that are responsive and accountable (Engage! Policy). The Twelve Mile Coulee Stakeholder Input Group was established with representatives from local communities and interest groups to provide input during the plan development process. Nine meetings and two field trips were held during 2004 and 2005 to:

- (1) Develop a shared understanding of the vision and objectives of Twelve Mile Coulee Natural Environment Park,
- (2) Obtain input into the four key management issues (trail and pathway network, appropriate management zones, appropriate recreational uses, and educational resources), and
- (3) Obtain City Council approval for the Management Plan.

The Engagement Resource Unit assisted Parks by facilitating discussions with the key stakeholders and using techniques outlined in the City Council approved Engage! Policy. The information collected was integrated with existing City policy and site specific reports to develop the Twelve Mile Coulee Management Plan. The draft plan was subsequently presented to the public at an open house and approved by City Council in the spring of 2005.

## **GUIDING DOCUMENTS**

The City of Calgary utilizes a number of documents that direct the management and development of Natural Environment Parks. The City Council approved documents listed below provided information that guided the development of the Twelve Mile Coulee Management Plan.

### **Plans**

- Calgary Open Space Plan (2003)
- Bears paw East Area Structure Plan (2002)
- Calgary Pathway and Bikeway Plan (2001)
- Urban Parks Management Plan (1994)
- Natural Areas Management Plan (1994)
- Revised West Scenic Acres ASP (1993)
- East Scenic Acres Area Structure Plan (1990)

### **Policies**

- City of Calgary Cycling Policy on Undesignated Trail in Parkland (1997)

### **Bylaws**

- Parks and Pathway Bylaw 20M2003
- Animal Control Bylaw 23M89

Council direction and a general vision regarding Twelve Mile Coulee Park is provided in the Natural Area Management Plan and the Urban Parks Master Plan.

## **Natural Area Management Plan**

Calgary Parks recognizes the value of natural habitat, relative to the healthy environmental and social functioning of the City of Calgary, and will maintain and protect the natural areas for public enjoyment, understanding and visitation.

Through appropriate resource management techniques, Calgary Parks will maintain, and/or reclaim significant natural habitat types and their relevant ecological associations.

### **Natural Environment Policies**

1. Calgary Parks will protect and maintain representative and viable natural habitat types, within City boundaries, as an integral component of the parks and open space system.
2. Calgary Parks will manage designated natural parklands in a manner, which will, by intent, maintain the natural character and integrity of these sites.
3. Calgary Parks will encourage and welcome informed public, corporate and community participation, stewardship and partnerships in the acquisition, management, research and protection of appropriate natural environments.
4. Year round enjoyment and use by all Calgarians will be encouraged with appropriate sensitivity to environmental impact and safety. Where recreational use and the long term survival of significant habitats conflict, protection of the resource will take precedence.
5. Recreational facilities will be designed and managed to minimise negative impact on natural areas.
6. The City of Calgary will work with adjacent municipalities to co-operatively protect contiguous natural habitat.
7. Natural areas will be acquired by:
  - Developer dedication as Environmental Reserve
  - Developer dedication as credit or non-credit Municipal Reserve
  - Density transfer from land and subsequent dedication by the developer as Environmental Reserve
  - Required development setback standards
  - Donations and land exchange
  - Outright purchase

### **Calgary Urban Park Master Plan**

The Urban Park Master Plan is a policy document that guides the development of Calgary's river valley park system. The plan identifies a core vision and 18 principles. (Please refer to appendix 1). The management of Twelve Mile Coulee Natural Environment Park will be guided by these principles.

Twelve Mile Coulee is identified as Planning Unit 3 in the Bow West River Segment. The direction provided in this document regarding the City's decisions for the use, management and maintenance of Twelve Mile Coulee is summarized below:

Twelve Mile Coulee is a prominent geographic feature with rich biophysical diversity which is further complemented by its association with Bowmont Park. The slopes of the escarpment and the coulee will be preserved in their native state. A regional pathway at the top of the escarpment will link a series of viewpoints overlooking the Bow River valley.

Improvements are proposed as follows:

- Rehabilitation of disturbed areas
- Regional pathway at top of slope
- Viewpoints at the crest of prominent ridges
- Unpaved secondary trails in Twelve Mile Coulee designed for pedestrian use
- Development setbacks for adjacent developments to allow for continuous public access at the top of the escarpment.

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## **NATURAL ENVIRONMENT PARK CLASSIFICATION**

The Natural Area Management Plan divides the City's natural environment parks into four categories: Special Protection Natural Areas, Major Natural Areas, Supporting Natural Areas, and Other Parks with Natural Area Zones.

A natural environment park classification system, is required to:

- provide recognition of the variation, conditions and management requirements of the habitats within a natural area;
- provide an objective method of assessing significance from a resource (ecological) perspective; and
- assign specific management or operational guidelines for different habitat types and conditions.

Based on the classification system, Twelve Mile Coulee was identified as a Major Natural Environment Park. Major Natural Environment Parks have the following characteristics:

- Overall Environmental Sensitivity: High to Moderate
- Resource Significance: City-wide
- Wildlife Habitat: Varying productivity
- Primary Zones: Natural Parkland
- Percentage of Natural Environment: >50%
- Natural Condition of environmental area: Majority high

Other examples of Major Natural Environment Parks include: Nose Hill and Bowmont.

## **DECISION MAKING CRITERIA**

The decision making criteria listed below are from City Council approved documents identified in the Guiding Documents Section of this plan. The criteria guided stakeholder and City decisions regarding the use, management and maintenance of Twelve Mile Coulee.

### **Use**

- Restricted to designated trails, disturbed areas and recreation areas (Natural Area Management Plan, 1994).
- Where recreational use and long-term survival of significant habitats conflict, protection of the resource will take precedence ( Calgary Open Space Plan; 2003; Natural Area Management Plan, 1994; Urban Parks Master Plan, 1994).

### **Off-Trail and Off-Pathway Use**

- Recommended on-trail and pathway use only except for disturbed and recreation zones (Natural Area Management Plan, 1994).

### **Dog Use**

- Dogs on leash, except in disturbed zones allocated for that use (Natural Area Management Plan, 1994).

### **Trails**

- The principle of multi-use should be respected and encouraged wherever possible except for exceptional environmental and safety reasons (City of Calgary Cycling Policy on Undesignated Trails in Parkland, 1997).
- No limitation to options trail surfaces (i.e. hardened, clay, shale, dirt, chip) depending on habitat requirement and public interest ( Parks and Pathway Bylaw 20M2003, Natural Area Management Plan, 1994).
- Locate pathway and trails, where possible, away from sensitive habitats and high wildlife use areas (Natural Area Management Plan, 1994).
- Mobility impaired access where environmentally sound and physically realistic (and safe) (Natural Area Management Plan, 1994).

## **PARK USE**

The Twelve Mile Coulee Telephone Survey (2002) and Twelve Mile Coulee Use Study (2003) provided a foundation of knowledge to direct the development of the Management Plan based on the behaviours, opinions and attitudes of park users and existing conditions of the natural area.

### **Twelve Mile Coulee Use Study (2003)**

In the summer of 2003, information was collected at Twelve Mile Coulee to gain understanding of current human usage patterns within the park. The objective was to aid Calgary Parks in setting the overall direction for the protection, development, and maintenance of Twelve Mile Coulee by:

- Determining current types of use patterns.
- Studying trail usage.
- Determining if current dog use was in compliance with City bylaws.
- Determining where current users live .

The study sites were distributed throughout the coulee area and were chosen to represent different geographic areas. All of these sites were entry and exit points of the park (Please refer to Map 2).

#### **Highlights of the Findings**

- Types of use observed included walking, running, cycling, and other.
- Walking was the most frequent activity (69.5%), followed by cycling (15.9%), then running (13.3%) and other (.6%).
- Other included inline skating, skateboarding, and city trucks.
- 5.9% of all people were using strollers or trailers.
- Overall the paved pathways had a much higher percentage of users.
- Users were most likely to visit the park on a weekend (64% of total visits).
- People with a dog or dogs comprised one third of total observations.
- Current dog use is not in compliance with bylaw (59% of dogs were recorded off-leash).
- More than half of the users (55%) were from the community of Tuscany
- During inclement weather fewer users were observed in 12-mile coulee.

#### **Southwest Site**

- Second highest frequency of total users was observed at this site.

### **Northwest Site**

- The highest frequency of total users was observed at this site, which was slightly shy of 50% and therefore nearly as much as all other sites combined.
- 62% of total weekday users were observed at the Northwest site.

### **Northeast Site**

- The Northeast site has the highest proportion of people with dogs (62%), but the site recorded only 13% of all users.
- 96% of observed dogs at the Northeast site were off leash, making this site the highest occurrence of non-compliance.
- During the weekdays only 9% of total users were observed at the Northeast site.

### **Southeast Site**

- The Southeast site had the second percentage of dogs off leash at 88% of all dogs observed at the site.
- Weekday and weekend use at the Southeast site, remained at a steady 14% of total users.

## **Twelve Mile Coulee Telephone Survey**

Twelve Mile Coulee Telephone Survey A telephone survey was conducted with Tuscany, Tanglewood and Scenic Acres residents between April 25 and May 7, 2002. In order for respondents to qualify for the survey, they had to be familiar with Twelve Mile Coulee Park and have used the park at least once. Of the 1,099 individuals contacted, 400 individuals participated in the survey. A sample size of 400 for a population of 5,376 produces a margin of error of  $\pm 4.7\%$  within a 95% confidence interval, or 19 times out of 20. A summary of the survey findings is presented below:

### **Types of Use and Locations**

Nearly two thirds (62.5%) of survey respondents stated that they visit Twelve Mile Coulee Park at least twice a month.

The top three activities respondents do when visiting Twelve Mile Coulee Park were:

- Walking (80.0%)
- Dog Walking (28.3%) and
- Cycling (22.3%)

The main reasons people visit the Park were cited as:

- To enjoy nature (30.0%)
- To exercise (28.3%) and
- To walk their dog (24.0%)

Specific questions related to dog ownership indicate that two-fifths of (42.5%) respondents currently own a dog.

- Additional questions determined that nearly all (91.2%) of these respondents take their dog for walks in Twelve Mile Coulee Park.
- When taking their dog for walks in the Park:
  - A third (32.3%) of respondents do not allow their dog to go off leash;
  - A third (32.9%) of respondents allow their dog to go off leash everywhere: and
  - A quarter (27.7%) of respondents allow their dog to go off leash on the open fields along the top of the Coulee.

While a quarter (28.0%) of survey respondents prefers to use the smaller, informal, non-paved pathways, nearly half (48.5%) prefer to use paved and smaller, informal, non-paved trails.

### **User Interests**

The most commonly cited Park features or points of interest enjoyed by respondents were.

- The stream (19.8%)
- Being in nature/undeveloped area (17.0%)
- The wild flowers (13.8%)
- Wildlife (13.0%) and
- The trees/greenery (11.5%)

### **User Issues and Needs**

Common issues, needs or user conflicts reported by respondents regarding Twelve Mile Coulee Park were (unaided response):

- Ensuring people clean up after their dogs (41.7%)
- Enforcing designated off leash areas (32.2%): and
- Restricting development in/near the park (19.0%)

The top three issues which respondents rated (aided responses) as high priorities for future planning/development of 12 Mile Coulee Park were:

- Preservation of natural areas (9.09 – mean score out of 10):
- Ensuring wildlife continues to use the park (9.00): and
- Pathway and trail maintenance and management (7.01).

### **Interpretive or Educational Programming in the Park**

Most respondents indicated they would like to learn more about the history (39.9%) and cultural history (35.5%) of the Park, and most would be interested in receiving educational information through signs or interpretive signs.

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## **BIOPHYSICAL INVENTORY AND ASSESSMENT**

The assessment of the living and non-living environment is an important step in determining the needs of any natural park space. It provides information on the existing conditions of the site and measures it against the expected characteristics of a relatively untouched area. The documents<sup>1</sup> listed below provided the foundation of knowledge that directed the development of the management plan based on the existing conditions of the natural area and the area's history.

- Landscape Evolution and Human Occupation during the Archaic Period on the Northern Plains (Oetelaar, 2004)
- River of Change; A Model for the Development of Terraces Along the Bow River, Alberta (Oetelaar, 2004)
- Checklist for Spring-Flowering Plants in Calgary - 2004 (CFNS, 2004)
- Twelve Mile Coulee Vegetation Analysis (Jacques Whitford Environmental Ltd., 2003)
- Biophysical Impact Assessment for the Proposed Extension of Nose Hill Drive NW (IEG, 2002)
- Biophysical Inventory for Proposed Encroachments in Tuscany (IEG, 2002)
- Twelve Mile Coulee Vegetation Communities Map (City of Calgary, 2001)
- Twelve Mile Coulee Vegetation Assessment (City of Calgary, 2001)
- Beyond Activity Areas: Structure and Symbolism in the Organization and Use of Space Inside Tipis (Oetelaar, 2000).

The information is summarized in the Geomorphology and Geology, Vegetation, Wildlife, History and Naming of the Coulee sections of the Plan.

### **Geomorphology and Geology**

The first page in Twelve Mile Coulee's landscape story began over two billion years ago. Geologic processes took place that led to the formation of bedrock, the solid rock foundation that underlies the soil. At that time igneous rock, formed by the slow cooling of molten rock several miles below the earth's surface, was pushed up over sections of the earth's surface including an area this is presently the interior of British Columbia. Particles from the igneous rock layers were stripped away and carried to Alberta by rivers originating from central British Columbia.

Over time, the particles accumulated on top of one another. The pressure created by the increased weight caused the layers to press and fuse together forming sedimentary

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<sup>1</sup> Official document references are located in the Additional Resources Section of the Plan.

rock. There are many types of sedimentary rock, depending on the size of particles that formed it. The sedimentary rock underlying the Calgary area, that can be seen in Twelve Mile Coulee, is sandstone from the Porcupine Hills Formation. The Formation was laid down approximately 60 million years ago when the landscape was flat and the climate was tropical. Deciduous forest, swamps and broad, slow rivers were the dominant features at that time.

During the following several million years, enormous upheavals in the earth's crust resulted in the formation of Rocky mountains. The great landscape alteration was accompanied by changes in elevation, drainage and climate. The new rivers flowing from the mountains to the west were fast and carried large amounts of sand and pebbles. In the early days of the landscape formation the rivers laid down beds of gravel over wide areas. Over time they began to carve our well defined waterways known as the Bow and Elbow river valleys.

About two million years ago, the climate started to get much colder. Glacial activity peaked during the Ice Age that began approximately one million years ago. During this time, the climate on the earth went through a series of cooling and warming cycles. Large sections of North America were repeatedly covered by ice and then exposed as the climate warmed and the ice retreated. Although many events during the Ice Age had an impact on the landscape now called Twelve Mile Coulee, the last continental glaciation which took place 15,000 to 18,000 years ago was primarily responsible for the site's underlying character.

The south-western extension of the Laurentide ice field (originating from Hudson's Bay area) contacted the Cordilleran icefields that were extending east and southward from the Rocky Mountains. Together the glaciers formed a large glacier that slowly flowed towards Montana. The moving ice stripped away preglacial soil and debris. Armoured with a load of fragmented debris, the glacier scraped off the underlying bedrock and left in its path unsorted material of different sizes called till.

The Laurentide ice began to melt and retreat towards the northeast corner of Alberta approximately 14,000 years ago. Rock, rounded and sorted by glacial meltwater, was deposited from streams flowing from the melting ice. Approximately 10,000 years ago the meltwater was dammed by the Laurentide ice. This caused the formation of Glacial Lake Calgary. The lake stretched from the base of Nose Hill beyond downtown to the south and towards Cochrane to the west. The meltwater deposited thick layers of fine sediment on top of the glacial till and glacio-fluvial material. Following an early episode of incision by glacial meltwater, gravel of the Bighill Creek Formation were deposited within the Bow River valley between 11 500 and 10 000 years ago.

Approximately 10 000 years ago vegetation began to establish. Open forest was the predominant vegetation until grasslands began to recolonize the forested areas

between 5000 and 9000 years ago due to drier conditions. What would become the Bow River was flowing at this time and it had cut a relatively deep channel, creating what is now called the Twelve Mile Coulee escarpment. At that time the depressions of the Twelve Mile Coulee uplands were deeper than they are today. The river then went through a period when new rock material was deposited in the Bow River valley from 9000 to 5000 years ago. During that time, approximately 6730 years ago, Mount Mazama, also known as Crater Lake, Oregon erupted and deposited thick layers of ash. 1700 years later the layer of ash that was left behind had formed surface soil. A grassland community successfully established on the new soil. The grassland community was very similar to the one that currently exists. At this time, the river began its latest episode of downcutting in the river valley. That downcutting has continued to the present. Today, the Bow River has cut through the fine lake sediments and ash leaving the tall vertical cliffs on the north side of the Bow River across from Bowness Park.

The soil in Twelve Mile Coulee formed from the gradual mixing of the original rock materials including the fine lake sediments deposited by Glacial Lake Calgary with organic materials. The rock particles combined with organic material to form a simple soil mixture. Over time the soil matured to form distinct layers commonly referred to as horizons. The horizons differ from one and other in properties such as color, structure texture, consistency and composition. Based on the soil properties, the Twelve Mile Coulee soils have been classified as Black Chernozemic with Humic Gleysols in wet depressions based on the Canadian System of Soil Classification. Chernozemic soils have developed under grassland or grassland/forest plant communities. They are characterized by a dark coloured surface horizon, at least 10 cm thick, that results from the accumulation of organic material from grasses and forbs. Gleysolic soils are poorly drained soils that often form in the presence of a high or fluctuating water table.

## Vegetation

Calgary lies on the border of the Foothills Fescue Grassland and the Aspen Parkland Natural Ecoregions. An indistinct ecological break between them occurs somewhat west of Crowchild Trail. However, characteristics of each are found throughout Calgary including Twelve Mile Coulee. Twelve Mile Coulee Natural Environment Park is made up by a number of smaller units called “habitats”. A number of habitats exist within Twelve Mile Coulee including: native grassland, low shrub, upland tall shrub, riverine tall shrub, white spruce, balsam poplar and aspen (Please refer to map 3). The amount, quality, type and diversity of habitats are essential to the health of a park. Vegetation survey data and survey locations may be found in Appendix 2.

### Native Grasslands

#### Introduction

Native grasslands in the Calgary region have undergone many modifications over the years. Prior to the settlement of southern Alberta, rough fescue (*Festuca campestris*) likely was the dominant grassland type in this area. Originally, grasslands were influenced mainly by bison and wildfire. This ecosystem was in equilibrium until the bison succumbed to market hunting. Settlement of the prairies resulted in a decline in fire frequency as newly established communities sought to suppress this threat. Early settlers also brought livestock, and agricultural technology that subsequently changed the face of the prairies. Vast, open grasslands became rangelands for cattle and horses, or cropland. The prairie has been transformed into new grasslands—where cultivation, grazing, introduction of new species and overall human interference have left their mark.

#### Ecological Setting

Most grasses grow in exposed areas where wind and sun prevail. Moisture tends to be limiting, especially in steeper hillside situations. In the Calgary area, grasslands are commonly found on south or south-west-facing slopes.

#### Twelve Mile Coulee Grasslands

Grassland communities are largely confined to the south facing escarpment slopes and upper benches in Twelve Mile Coulee. The existing grassland vegetation communities are well established in the park with some of the best quality areas on the escarpment north of Nose Hill Drive Extension. This area is particularly important to wildlife because it forms a long corridor that connects Twelve Mile Coulee with other open spaces to the West.

Grasslands dominated by foothills rough fescue (*Festuca campestris*) are found on the upper, flat portions of south and west facing slopes. Slender wheat grass (*Agropyron trachycaulum*) is a common component of these grasslands. On steeper slopes needle grasses (*Stipa* species), wheat grasses (*Agropyron* species.) and June grass (*Koeleria*

*macrantha*) grow in mixed communities. The rarer Parry's oatgrass (*Danthonia parryi*) grows in association with the fescue in some areas. Along some of the steep escarpments where sandstone outcrops are visible, grassland/juniper communities exist.

Native grasslands support a wide variety of forbs and herbs, including an abundance of wildflowers. Prairie crocus (*Anemone patens*), early cinquefoil (*Potentilla concinna*), early blue violet (*Viola adunca*) and moss phlox (*Phlox hoodii*) are common spring flowers, while golden bean (*Thermopsis rhombifolia*), hedsarum (*Hedysarum boreale*), sticky purple geranium (*Geranium viscosissimum*), fleabane (*Erigeron* species), northern bedstraw (*Galium boreale*), goldenrod (*Solidago* species), and aster (*Aster* species) will bloom into fall.

Where the ground is disturbed there has been an invasion of smooth brome (*Bromus inermis*), Canada thistle (*Cirsium arvense*), and gumweed (*Grindelia squarrosa*). This is particularly evident on the benchlands adjacent to Stoney Trail and across from Scenic Acres Link.

## **Balsam Poplar**

### **Introduction**

Balsam poplar (*Populus balsamifera*) is the most abundant tree species in riparian ecosystems in Calgary. Riparian ecosystems are highly productive vegetation zones located along rivers, creeks or drainage courses between upland and aquatic ecosystems. They are among the most important habitats in North America for wildlife, especially for migratory and nesting bird usage.

### **Ecological Setting**

In Calgary, balsam poplar trees establish and grow to maturity in the span of 80 to 100 years. Historically, balsam poplar forests have established along the major rivers in Calgary in conjunction with natural flooding and drying processes or in areas with high water tables. They require moist ground with cycles of drying in order to survive, and may suffer accordingly if water table regimes are altered. A healthy balsam poplar forest is normally accompanied by an understory of red osier dogwood (*Cornus stolonifera*), willow (*Salix* species), water birch (*Betula occidentalis*), Saskatoon (*Amelanchier alnifolia*), and Canada buffaloberry (*Shepherdia canadensis*). Occasionally, white spruce (*Picea glauca*) may establish in shady, moist areas. A healthy forest understory can be directly correlated with increased wildlife use. A diversity of species and canopy structure allows for a variety of cover types for feeding, escape and nesting. Another significant factor in planning for healthy balsam poplar forests is the availability of other nearby vegetation communities such as wetlands and grasslands. This juxtaposition of different habitat types adds to the habitat diversity. These edge sites provide a higher food source and many species are dependent upon them, such as flycatchers which exist mostly on the border between forests and grasslands.

### **Twelve Mile Coulee Balsam Forest**

In Twelve Mile Coulee, a corridor of balsam poplar forest extends from the southern extent of Twelve Mile Coulee to Tuscany Boulevard. The balsam poplar forest corridor is adjacent to the aquifer and storm water fed creek located at the base of the coulee. A shrub understorey of red osier dogwood (*Cornus stolonifera*), willows (*Salix* species.), Aspen (*Populus tremuloides*), Saskatoon (*Amelanchier alnifolia*), wolf-willow (*Eleagnus commutata*), and Bearberry (*Arctostaphylos uva-ursi*) accompany the balsam poplar. In some areas the forest has been disturbed through grazing and recreational use, resulting in a decrease in plant understorey diversity as well as the introduction of a number weeds and non-native grasses. Other areas adjacent to creek where park users frequently cross are becoming devoid of vegetation and are becoming severely eroded from trampling. Without management and restoration, it is likely that the health of forests will continue to decline.

### **White Spruce**

#### **Introduction**

In Calgary, white spruce (*Picea glauca*) stands may be found along the moist, shady, north-facing slopes of the Bow, Elbow, and Fish Creek valleys. They occupy relatively small localized areas within the City, in part, because they are not chinook wind- hardy or flood tolerant.

#### **Ecological Setting**

White spruce (*Picea glauca*) woods are not drought tolerant, and therefore require shade and moisture for suitable growth. These conditions are provided by steep escarpment faces along the river valleys in the City, and at scattered locations within the flood plains of rivers. This kind of forest provides important cover and winter shelter for many species of birds and mammals.

Mature spruce woods can form very dense canopies that are characterized by little in the way of shrub understorey. This is due, in part, to modifications imposed on the site by the trees themselves. Their long-term presence influences the soil regime, as the decomposed spruce needles create a highly acidic substrate. This, in combination with shade provided by the trees, results in limited establishment and propagation of a shrub understorey. Often, spruce forests have a homogenous moss carpet at ground level, and have few other complementing species. Open spruce woods have a greater variety of species. Wind throw, natural mortality of trees, or other disturbances create gaps, allowing light-seeking plants to enter for a short period.

### **Twelve Mile Coulee White Spruce Woodlands**

Within Twelve Mile Coulee, white spruce (*Picea glauca*) exist in mixed stands with balsam poplar and aspen along the steep north and north-east facing escarpments.

Wild Gooseberry (*Ribes Oxycanthoides*) and Canada buffaloberry (*Shepherdia canadensis*) are commonly found in the understory

The white spruce (*Picea glauca*) woods in this park have been significantly impacted by recreational use. Trail proliferation is resulting in soil erosion and the drastic decline of understory vegetation. The areas are difficult to rehabilitate due to their steep grades. They are a high priority for immediate management

## **Aspen**

### **Introduction**

Trembling aspen (*Populus tremuloides*) is the most widely distributed tree in North America. Its success can be attributed to its ability to establish in a range of site conditions, and its prolific reproduction through suckering. While abundant, aspen have a relatively short life span. In Calgary trees live approximately 65 to 80 years and individual trees are regularly regenerated. On poor quality sites their life span may be reduced to 40 years or less.

### **Ecological Setting**

In the Calgary area, aspen may be found in both stands and as a component of mixed woods. Aspen stands tend to form in well-drained, moist areas on open plains, and on the moist northern exposures of small hills and ravines. In a grassland setting, aspen stands form small "islands" of woodland, providing additional diversity and "edge" in the prairies and foothills. Several species of birds and mammals feed in the open grassland, but require the hiding and thermal cover afforded by small tree stands.

Large continuous aspen forests are found in Calgary mainly along escarpments, in ravines, and in other areas which have had minimal urban development or disturbance. They give shelter to a wide variety of wildlife and wildflowers. Some of the birds and mammals that find shelter in the groves include: Great Horned Owls (*Bubo virginianus*), Black-billed Magpies (*Pica pica*), American Robins (*Turdus migratorius*), Clay-colored sparrows and Song sparrows (*Melospiza* species), White-tailed and Mule Deer (*Odocoileus* species), rabbits and hares (*Lepus* species), as well as Meadow Voles (*Microtus pennsylvanicus*). These same areas often act as wildlife corridors, through and around developed sites.

### **Twelve Mile Coulee Trembling Aspen Stands**

Aspen groves are one of the most characteristic features of Twelve Mile Coulee. The stands are commonly found in depressions along the coulee slopes. A number of plant species are commonly found underneath the aspen canopy including: Saskatoon (*Amelanchier alnifolia*), prickly rose (*Rosa acicularis*), wild gooseberry (*ribes oxycanthoides*), silverberry (*Eleagnus commutata*), buckbrush (*Symphoricarpos occidentalis*), and shrubby cinquefoil (*Potentilla fruticosa*)

The aspen are in generally good health although some are being damaged by the formation of informal trails in the groves. There is one exception, a large number of trees in the aspen groves adjacent to the sandstone outcrops at the base of the coulee

are being damaged or destroyed as a result of vandalism. Trees are being cut down and burned at illegally placed fire pits located on the sandstone outcrops.

## **Shrub Communities**

### **Introduction**

Shrub habitats in Calgary's natural areas have been separated into **Riverine Tall Shrub**, **Upland Tall Shrub**, and **Low Shrub**. In Twelve Mile Coulee, all three communities exist in the park and are described below. These habitat types occur as isolated stands, as transition zones between grassland and woodland communities, or as opening species/understorey component in a woodland association.

### **Ecological Setting**

Shrub lands are a valuable habitat, as they provide cover for a variety of birds and mammals. The density of vegetation, along with the diversity of plant species usually found in these community types, makes shrublands an active and highly productive wildlife area. Shrub lands are often a vegetation transition zone, and represent valuable edge for grassland, and woodland wildlife species. Birds and mammals alike seek the berries, leaves, and bark of many shrub species in these communities. In addition to being a source of food and cover, shrubs also are attractive to some nesting birds and for the protection of birthing mammals. Where possible, trails and activity zones should avoid such areas.

The location of specific types of shrubs is regulated strongly by soil moisture, soil texture, shade and drainage. In open drier areas, taller shrubs will be confined generally to specific areas of higher moisture such as depressions, ravines, floodable areas or west, east or north-facing slopes. South-facing slopes are usually too exposed and dry to support shrubs. In these areas grasses have a competitive advantage. Places where moisture collects on south facing slopes, however, may permit the development of low shrub stands composed of buckbrush (*Symphoricarpos occidentalis*), wolf willow (*Eleagnus commutata*), and rose (*Rosa species*).

Pure shrub communities commonly form dense thickets that present a formidable barrier to humans. Riverine red osier dogwood (*Cornus stolonifera*) and tall willow (*Salix*) communities are good examples of this growth habit. Low shrubs such as buckbrush (*Symphoricarpos occidentalis*), cinquefoil (*Potentilla species*), or rose (*Rosa species*) may form dense mats effectively blocking out other competing grasses, forbs, and shrubs. Other species such as wolf-willow, may be opportunists, seeking and colonising disturbed areas.

### **Riverine Tall Shrub Characteristics**

Riverine shrubs are found throughout the floodway/floodplain of major river valleys in Calgary. These shrubs, which commonly include red osier dogwood (*Cornus stolonifera*) and a variety of willows (*Salix species*), can withstand periodic flooding and

are adapted to growth in coarse, unstable substrate. In general, riverine shrubs accompany balsam poplar woodland to form riparian areas along waterway. Riparian areas are often considered as highly productive, transition zones between wetland and the drier uplands. This area is particularly important to a variety of wildlife species. It has been estimated that 85% of wildlife use it for all or part of their lifecycles.

### **Upland Tall Shrub Characteristics**

Saskatoon (*Amelanchier alnifolia*) and chokecherry (*Prunus virginiana*) interact to form upland tall shrub communities. Typically these plants grow on the lower, more moist portions of a slope, or in protected ravines.

### **Low Shrub Characteristics**

Low shrub communities may consist of buckbrush (*Symphoricarpos occidentalis*), shrubby cinquefoil (*Potentilla fruticosa*), rose (*Rosa* species), or wolf-willow (*Eleagnus commutata*) in some cases. Canada buffaloberry (*Shepherdia canadensis*) and gooseberry (*Ribes oxycanthoides*) may be present, although they form a minor component of these shrub habitat types. Low shrub communities may be found along the dry, upper portions of the escarpment where ever some pockets of moisture may be present.

### **Twelve Mile Coulee Shrub Habitat**

#### **Riverine Tall Shrub**

The riverine tall shrub understory is associated with balsam poplars (*Populus balsamifera*) along the creek. It is comprised of a willow dominated shrub community (*Salix* species) that also includes red osier dogwood (*Cornus stolonifera*) and prickly rose (*Rosa acicularis*). False Solomon's seal (*Smilacina racemosa*), harebell's (*Campanula rotundifolia*) and veiny meadow rue (*Thalictrum venulosum*) contribute to the diversity of this habitat.

#### **Upland Tall Shrub**

The upland tall shrub vegetation communities that predominate in Twelve Mile Coulee include wolf willow (*Eleagnus commutata*) and Saskatoon/chokecherry (*Amelanchier alnifolia/Prunus virginiana*). These communities are found on the escarpments in shallow depressions. A number of shrubs, forbs, wildflowers and grasses are also commonly found within upland tall shrub communities of the Park including: bearberry (*arctostaphylos uvi-ursi*), wild strawberry (*Fragaria virginiana*), American vetch (*Vicia americana*), northern bedstraw (*Galium boreale*), and Canada buffaloberry (*Shepherdia canadensis*).

#### **Low Shrub**

One of the most common types of low shrubland habitat found in Twelve Mile Coulee is the buckbrush/rose (*Symphoricarpos occidentalis/ Rosa acicularis*) community. It is found on moderately steep south and west-facing slopes. It is often associated with a high diversity of forbs and dense grass understories. The grasses commonly found

include rough rescue (*Festuca campestris*), slender wheat grass (*Agropyron trachycaulum*) and June grass (*Koeleria macrantha*). Three flowered avens (*Geum triflorum*), early yellow locoweed (*Oxytropis sericea*), golden bean (*Thermopsis rhombifolia*), sticky purple geranium (*Geranium viscosissimum*) and shrubby cinquefoil (*Potentilla fruticosa*) create a colorful understory.

## **Wetlands**

### **Introduction**

The majority of wetlands in Calgary are found in the north-east and south-east quadrants of the city. Commonly, wetlands are situated in depressions along rolling or flat terrain, but they may also exist wherever the water table is in contact with the surface.

### **Ecological Setting**

Wetlands are characterized by saturated ground on a semi-permanent basis, and associated water-loving vegetation. Although a variety of trees, shrubs, forbs, and grasses may be found in wetlands of the Calgary region, cattails, sedges, bulrushes and rushes are generally identified as being the most dominant species.

### **Wetlands in Twelve Mile Coulee**

The wetlands in Twelve Mile Coulee largely include the water edge along the intermittent creek. The emergent vegetation that can be found along the edges of the intermittent creek include: sedges (*Carex* species.), rushes (*Juncus* species.) and reed canary grass (*Phalaris aruncinacea*). Water hemlock (*Cicuta maculata*) has also been found.

## **Disturbed/Introduced**

### **Introduction**

Disturbance simply refers to areas where the majority of native species have been removed leaving either bare ground or introduced plant species. There is little native growth. Non-native grassland refers to disturbed areas dominated by non-native grasses and weeds. These areas are often incorrectly assumed to be native grasslands.

### **Ecological Setting**

Disturbed areas are a significant problem in Natural Environment Parks. They occur for a number of reasons including material dumping, utility construction, previous agricultural practices, encroachment and site use. Disturbances can be found along the top of the escarpments, in some ravines as well as in the along the bottom of the escarpments. Non-native grassland species that are commonly found in Calgary include smooth brome (*Bromus inermis*), crested wheat grass (*Agropyron cristatum*), Kentucky blue grass (*Poa pratensis*) and timothy hay. Canada thistle (*Cirsium arvense*), and toad flax (*Linaria vulgaris*) are weeds that are commonly present.

The more disturbed that a site is, the less structure (complexity) the area usually contains biologically, and therefore, the less likely it is to be utilized by wildlife. Without much of a structure weed species find it much easier to get established. Reclamation aims to restore the structure, native species, and ecological role to an area.

***Disturbed Areas in Twelve Mile Coulee***

Twelve Mile Coulee Park has been affected by a number of activities including previous agricultural practices (cattle and horses), current recreational uses, introduced species (smooth brome, Canada thistle), vehicles (off road) and utility use (power lines) surrounding land use (roads, housing) and road construction. Even with these disturbances the park is generally in good condition. The following disturbed communities exist in Twelve Mile Coulee Natural Environment Park: unvegetated, smooth brome/Canada thistle, balsam poplar/manicured grass, and manicured grass/s smooth brome. They are commonly seen adjacent to Stoney trail, the regional pathway and heavily used informal trails. Other species commonly associated with disturbed areas include: yellow sweet clover (*Melilotus officinalis*), dandelion (*Taraxacum officinale*) and goat's beard (*Tragopogon dubius*).

## Wildlife

Over 111 vertebrate species may potentially use habitats within the Twelve Mile Coulee and surrounding areas including Bowmont Natural Environment park to the east, Bow River Corridor to the South and the Douglas Fir Preserve on the south side of the river.

A habitat assessment was conducted to identify key wildlife habitat within and surrounding Twelve Mile Coulee. The approach involved the identification, description and mapping of habitat types, and the subsequent ranking of each habitat relative to its importance in sustaining wildlife groups represented by selected wildlife species. This process has been used by US Fish and Wildlife Services as well as widely used throughout Alberta and other parts of Canada. Calgary Parks perspective is that the type and quality of vegetation communities directly correlate to the potential for wildlife use.. The diversity of vegetation communities and the size of the park enhance Twelve Mile Coulee's quality. The assessment concluded that Twelve Mile Coulee is a diverse natural area with high wildlife suitability. It is an important park within a network of natural areas in the City of Calgary.

<b>MAMMALS</b>			
American badger ( <i>Taxidea taxus taxus</i> ) <sup>s</sup>	least weasel ( <i>Mustela nivalis</i> )	prairie shrew ( <i>Sorex haydeni</i> )	southern red-backed vole ( <i>Clethrionomys gapperi</i> )
American mink ( <i>Mustela vison</i> )	little brown back ( <i>Myotis lucifugus</i> )	pygmy shrew ( <i>Sorex hoyi</i> )	striped skunk ( <i>Mephitis mephitis</i> )
cougar ( <i>Felis concolor</i> )	long-tailed weasel ( <i>Mustela frenata</i> )	raccoon ( <i>Procyon lotor</i> )	thirteen-lined ground squirrel ( <i>Spermophilus tridecemlineatus</i> )
coyote ( <i>Canis latrans</i> )	masked shrew ( <i>Sorex cinereus</i> )	red fox ( <i>Vulpes vulpes</i> )	western jumping mouse ( <i>Zapus princeps</i> )
deer mouse ( <i>Peromyscus maniculatus</i> )	meadow vole ( <i>Microtus pennsylvanicus</i> )	red squirrel ( <i>Tamiasciurus hudsonicus</i> )	white-tailed deer ( <i>Odocoileus virginianus</i> )
dusky shrew ( <i>Sorex monticolus</i> )	mule deer ( <i>Odocoileus hemionus</i> )	Richardson's ground squirrel ( <i>Spermophilus richardsonii</i> )	white-tailed jack rabbit ( <i>Lepus townsendii</i> )
Franklin's ground squirrel (only known record in Calgary)	nothern pocket gopher ( <i>Thomomys talpoides</i> )	silver haired bat ( <i>Lasionycteris noctivagans</i> )	
hoary bat ( <i>Lasiurus cinereus</i> )	porcupine ( <i>Erethizon dorsatum</i> )	snowshoe hare ( <i>Lepus americanus</i> )	
<b>AMPHIBIANS &amp; REPTILES</b>			
boreal chorus frog ( <i>Pseudacris maculata</i> )	northern leopard frog (prairie population) ( <i>Rana pipiens</i> ) <sup>1,E</sup>	tiger salamander ( <i>Ambystoma tigrinum</i> )	western toad ( <i>Bufo boreas</i> )
Canadian toad ( <i>Bufo hemiophrys</i> ) <sup>R</sup>	plains garter snake ( <i>Thamnophis radix</i> )	wandering garter snake ( <i>Thamnophis elegans</i> )	wood frog ( <i>Rana sylvatica</i> )

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common garter snake ( <i>Thamnophis sirtalis</i> )			
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<b>BIRDS (NON-PASSERINE)</b>			
American kestrel ( <i>Falco sparverius</i> )	gray partridge ( <i>Pedix perdix</i> )	northern flicker ( <i>Colaptes auratus</i> )	short-eared owl ( <i>Asio flammeus</i> ) <sup>B</sup>
anatum peregrine falcon ( <i>Falco peregrinus anatum</i> ) <sup>2,E,R</sup>	great horned owl ( <i>Bubo virginianus</i> )	northern harrier ( <i>Circus cyaneus</i> )	sora ( <i>Porzana carolina</i> )
bald eagle ( <i>Haliaeetus leucocephalus</i> )	green-winged teal ( <i>Anas crecca</i> )	osprey ( <i>Pandion haliaetus</i> )	Swainson's hawk ( <i>Buteo Swainsonii</i> )
blue-winged teal ( <i>Anas discors</i> )	hairy woodpecker ( <i>Picoides villosus</i> )	red-naped sapsucker ( <i>Sphyrapicus nuchalis</i> )	upland sandpiper ( <i>Bartramia longicauda</i> )
burrowing owl ( <i>Speotyto cunicularia hypugaea</i> ) <sup>3,E,R</sup>	killdeer ( <i>Charadrius vociferous</i> )	red-tailed hawk ( <i>Buteo jamaicensis</i> )	yellow-bellied sapsucker ( <i>Sphyrapicus varius</i> )
common snipe ( <i>Gallinago gallinago</i> )	merlin ( <i>Falco columbarius</i> )	ring-necked pheasant ( <i>Phasianus colchicus</i> )	
downy woodpecker ( <i>Picoides pubescens</i> )	mourning dove ( <i>Zenaida macroura</i> )	sharp-tailed grouse ( <i>Typanuchus phasianellus</i> )	
<b>BIRDS (PASSERINE)</b>			
alder flycatcher ( <i>Empidonax alnorum</i> )	chipping sparrow ( <i>Spizella passerina</i> )	house wren ( <i>Troglodytes aedon</i> )	Sprague's pipit ( <i>Anthus spragueii</i> ) <sup>2,B</sup>
American goldfinch ( <i>Carduelis tristis</i> )	clay-colored sparrow ( <i>Spizella pallida</i> )	least flycatcher ( <i>Empidonax minimus</i> )	Tennessee warbler ( <i>Vermivora pergrina</i> )
American robin ( <i>Turdus migratorius</i> )	common crow ( <i>Corvus brachyrhynchos</i> )	Le Conte's sparrow ( <i>Ammodramus leconteii</i> )	tree sparrow ( <i>Tachycineta bicolor</i> )
Baird's sparrow ( <i>Ammodramus bairdii</i> )	common grackle ( <i>Quiscalus quisqualis</i> )	mountain bluebird ( <i>Siala currucoides</i> )	veery ( <i>Catharus fuscescens</i> )
black-billed magpie ( <i>Pica pica</i> )	common raven ( <i>Corvus corax</i> )	northern oriole ( <i>Icterus galbula</i> )	vesper sparrow ( <i>Pooecetes gramineus</i> )
black-capped chickadee ( <i>Parus atricapillus</i> )	common yellowthroat ( <i>Geothlypis trichas</i> )	northern rough-winged swallow ( <i>Stelgidopteryx serripennis</i> )	warbling vireo ( <i>Vireo gilvus</i> )
blue jay ( <i>Cyanocitta cristata</i> )	dusky flycatcher ( <i>Empidonax oberholseri</i> )	prairie loggerhead shrike ( <i>Lanius ludovicianus</i> ) <sup>2,Y</sup>	western meadowlark ( <i>Sturnella neglecta</i> )
Brewer's blackbird ( <i>Euphagus cyanocephalus</i> )	eastern kingbird ( <i>Tyrannus tyrannus</i> )	red-eyed vireo ( <i>Vireo olivaceus</i> )	western wood pewee ( <i>Contopus sordidulus</i> )
brown-headed cowbird ( <i>Molothrus ater</i> )	eastern phoebe ( <i>Sayornis phoebe</i> )	rose-breasted grosbeak ( <i>Pheucticus ludovicianus</i> )	white-breasted nuthatch ( <i>Sitta carolinensis</i> )
brown thrasher ( <i>Toxostoma rufum</i> )	European starling ( <i>Sturnus vulgaris</i> )	rufous-sided towhee ( <i>Pipilo erythrophthalmus</i> )	yellow warbler ( <i>Dendroica petechia</i> )
cedar waxwing ( <i>Bombycilla cedrorum</i> )	grey catbird ( <i>Dumetella carolinensis</i> )	savannah sparrow ( <i>Passerculus sandwichensis</i> )	
chestnut-collared longspur ( <i>Calcarius ornatus</i> )	horned lark ( <i>Eremophila alpestris</i> )	song sparrow ( <i>Melospiza melodia</i> )	

## **History**

The following historical summary is based on the work completed by Dr. Gerald Oetelaar from the Department of Archaeology at the University of Calgary/

Under the terms of the Alberta Heritage Act, all developers must conduct mitigative work before initiating construction of new subdivisions. The Tuscany Archaeological project in Twelve Mile Coulee began in 1995 when Carma Developers signed a two year contract with the University of Calgary to fund a program of archaeological research and public education. The objectives of the Project included:

- To meet permit obligations in order to proceed with the development,
- To conduct archaeological research,
- To provide hands on educational opportunities for students, and
- To increase the involvement of Alberta's Native community in archaeological research.

Before investigations began, members of the Tsuu t'ina Nation were contacted and invited to participate in the project. Elders in the community not only performed the appropriate ceremonies but also provided instructions on the proper treatment of the remains. Their active participation in the archaeological research makes this cooperative venture somewhat unique in the province.

Two sites of particular significance were found. The sites are significant because they included the remains of four occupations spanning at least 8000 years.. One of the sites, EgPn-375, was found on an intermediate terrace on the eastern margin of Tuscany (Please refer to map X).

Two cultural deposits were found in the sediments which extended 2 m below the surface Artifacts recovered from the oldest cultural layer included stone tool remnants, fire broken rock and bone fragments. It is believed that the initial occupation occurred when the upland location consisted of a moist linear depression supporting trees and shrubs. Human groups may have found this spot appealing as a campsite because the upland location offered expansive views of the nearby floodplain, as well as good access to the Bow River. About 7000 years ago, or just before the eruption of Mount Mazama, this location was used by a second group of people who stayed at the site briefly to kill and butcher bison. During this occupation, the vegetation was predominantly grassland. Following the deposition of Mazama ash, human groups did not return to set up camp at this location until 5000 years ago. Approximately 2000

years ago, a stone circle thought to be used by Blackfoot Indians was located at this site. It is believed that the stone circle marks the location where a tipi once stood. The stone circle provides a framework for interpreting the organization of space within the tipi. A sleeping platform, storage space and work area were arranged in an orderly fashion relative to the entrance, the hearth and the family altar. Today, the stone circle remains as a reminder of the past inhabitants.

### **Naming of Twelve Mile Coulee**

In 1873, Methodist minister George McDougal built a mission church at Morleyville located close to the Stoney and Blackfoot reservations. The mission was located by the McDougal Church on the 1A highway. In 1875, the North West Mounted Police built Fort Calgary at the confluence of the Bow and Elbow rivers. A trail was created between the two locations largely following existing native trails. Twelve Mile Coulee is approximately twelve miles from Fort Calgary heading west towards Morleyville. As a result, it was used as a convenient mileage marker.

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## **PARK OWNERSHIP**

The Park is comprised of Transportation Utility Corridor (TUC) and Environmental Reserve (ER) (Please refer to Map 4). The Environmental Reserve is owned and managed by the City of Calgary. The TUC is owned by the Province of Alberta and managed by the City under a lease agreement that has specific conditions including the requirement to obtain written authorization prior to any surface disturbance. Because the Twelve Mile Coulee Management Plan may make recommendations for improvements on TUC land, representatives from Alberta Transportation have been working with the City during the plan development process to provide advice and guidance.

### **Transportation Utility Corridor (TUC)**

The objective of the TUC is to facilitate development within Calgary by accommodating the provincial Ring Road system, major power lines, pipelines, regional water and sewer lines and telecommunication lines. The Ring Road system includes Highway 22x and Stoney Trail (Hwy 201).

The TUC was established on the principle that long-term planning for the accommodation of a number of transportation and utility facilities within a Corridor can maximize the use of the Corridor and also provide an open space in an area that will be surrounded by urban development. The TUCs protect Ring Road and utility alignments from advancing urban development and offer a long-term solution to many of the land use problems associated with developing major linear facilities in the urban context.

Although a large amount of the TUC will remain as part of the Twelve Mile Coulee Natural Environment Park, Alberta Transportation has planned road improvements that will alter the current park boundary. The road improvements include the realignment of Tuscany Boulevard and the Crowchild/Stoney Trail interchange. Following the completion of the road improvements the park size will be reduced, but access to the park from Stoney Trail will be improved (Please refer to Map 5). The estimated completion date for the work has yet to be determined.

### **Recommendations:**

- A number of utilities are situated in the park and there are, or will be requirements to maintain or upgrade them.
- Any utility upgrades or proposal for utilities in the Park will require a Biophysical Impact Assessment including public consultation.
- Adverse environmental or aesthetic impacts without mitigation will not be permitted, except where alternatives do not exist. Mitigation measures will be fully identified prior to approval.

- • Access and rights will be maintained to existing utilities.

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## **MANAGEMENT ZONES**

Resource zonation is a management tool used to define suitable dominant management strategies/goals in specific areas of a park. Resource zones are based on environmental sensitivity (to disturbance), resource significance (relative to city-wide and park-specific perspectives), appropriateness as wildlife habitat and general habitat condition. Assessments are used to establish priorities for projects such as habitat restoration, and to determine the appropriateness of park amenities and facilities. These zones are not meant to be used as strict regulation but rather to provide guidance in decision-making.

The Twelve Mile Coulee Management Plan has made use of resource zonation (Red, Yellow, Green and Purple) to allow for appropriate emphasis on protection, restoration and public use. The zones are identified on map 6 and are described below.

### **Red –Restoration Zones**

The restoration zones identify areas requiring immediate intervention and management. These areas are considered of high quality and have high potential for rehabilitation into productive wildlife habitats. These areas are worthy of intensive management practices to help re-establish and maintain a natural state. These areas will require the highest funding and monitoring. Included in this zone are the creek crossing structures as well as the sandstone outcrops and surrounding areas that have been vandalized.

The key management objectives in these areas are to prevent further deterioration (weeds, soil compaction, erosion, trail degradation, habitat fragmentation), begin to re-establish functional habitats that will be better utilized by wildlife and create a safe designated trail system that includes creek crossings where required. Designated trails will be provided for public access. Informal trails will be closed and rehabilitated.

### **Yellow– Ecological Enhancement Zones**

These areas are highly significant and sensitive. The primary management objective for these areas is to improve habitat quality. The creek and adjacent riparian area are included in this zone. Designated trails will be provided for public access. Informal trails will be closed and rehabilitated.

The key management objectives are to control invasive, non-native plants; close informal trails; formalize the designated trail network; and re-establish native vegetation.

**Green– Protection Zones**

Generally the habitat can be considered healthy. It contains a high diversity of native plants and forms a block of relatively unfragmented habitat. It functions as a food source, resting area and a critical movement corridor for wildlife. It also contains the largest segments of native prairie within the park. The management priorities include: implementing designated trail network to provide public access as well as closing and rehabilitating informal trails. Long term monitoring of the area will also be critical to identify and quickly address any changes in habitat health.

**Purple – Off Leash Zones**

These fenced areas have been intentionally designed for active recreation and facilities or amenities to support these pursuits will be provided. Permitted activities include off-designated trail access and dogs off-leash.

The management priorities required to ensure a positive recreational experience in these zones include: fence construction, benches, and trail repairs when necessary.

## OFF LEASH ZONES

There is a high public expectation for dog use areas in this park. As a result, two off leash zones have been planned for (Please refer to map 7). The zones have been designed to minimize the possibility of conflicts between users and to minimize negative impacts to wildlife.

### Description

Off-leash zones will be fenced to clearly distinguish the area for park users and to reduce the potential for wildlife/off-leash dog interactions. The area will be managed to withstand heavy use. This may include the use of non-native plant material. The location of housing, regional pathways and well established trails around the periphery of these zones significantly reduces the likelihood of non-native grasses from the off-leash zones encroaching into the natural habitats

### Planning Direction

As part of the planning process, staff worked with stakeholder input group members to identify potential areas within the park that would be suitable as off-leash sites. Areas were selected based on the following general principles which were derived from informal discussions with the stakeholder input group members:

- The most sensitive and environmentally significant areas of the park will remain as on-leash. The intent is to concentrate all users on designated trails to reduce impacts to the rest of the park.
- Off-leash areas should have clearly identifiable boundaries.
- Selected areas should not be located in zones that are planned for immediate major restoration.
- Off-leash zones will be determined by taking into account safety, environmental and access considerations.
- Conflicts with the Regional Pathway or designated trails should be avoided wherever possible and warning signage should be used to reduce the potential for conflict.
- Off-leash areas should be located to facilitate access from adjacent neighbourhoods and parking points.
- Consider creating long, circular walking routes within the off-leash area.
- An effective educational program will be required to promote understanding and encourage compliance with the off-leash areas, including information on key wildlife areas in the park.
- Where possible, minor restoration methods may be required to enhance the off leash areas (i.e., tree and shrub planting to improve aesthetics).
- The need for and location of more refuse cans will be evaluated over time; however users will be encouraged to pick up after their dogs and take the waste home for disposal.

## DESIGNATED MULTI – USE TRAIL AND REGIONAL PATHWAY NETWORK

A designated multi-use trail and regional pathway network has been developed for Twelve Mile Coulee Natural Environment Park (Please refer to map # 8). The network will provide park users with an opportunity to experience the natural resource, while curtailing damage to surrounding vegetation caused by the proliferation of informal trails. The goal is to balance “use” and “protection”, while taking into account user preferences, environmental impact, and safety. This approach relies on appropriate user behaviour, and as such, monitoring as well as an intensive public education program will be required.

- *Regional Pathway* - Paved surface. Permitted uses include non-motorized activities for recreational and transportation purposes. All areas of Regional Pathway within the park are on-leash.
- *Designated Multi-use Trails* –Formally recognised and maintained trails. Permitted uses include slow speed cycling (10km/hr maximum, for safety and environmental reasons), and pedestrian activities.

### Regional Pathway

The routing takes advantage of existing desire lines, topography and special features within the park. The regional pathway planned for this park:

- Follows the top of the coulee and escarpment on the west and south sides of the park respectively.
- Connects Tuscanry with Scenic Areas
- Provides access to the Bow River
- Forms an important regional pathway network link
- Connects to designated trail system within the Park
- Provides mobility-impaired access

### Designated Multi-Use Trail

This routing takes advantage of existing desire lines, topography and special features within the park. Existing undesignated (informal) trails that are not identified as part of the designated trail network will be rehabilitated over time as deemed appropriate under the restoration priorities for this plan.

### Planning Direction

As part of the planning process, staff worked with the stakeholder input group to identify a conceptual routing system that would satisfy park access and park protection

requirements. The following set of principles was developed to aid in the delineating the designated trail system. The general principles were derived from informal discussions with the stakeholder input group members. These principles will be integral in the management of Twelve Mile Coulee's trail system.

- To do nothing will result in increasing degradation of the park. If we do not provide adequate designated trail access to the park, people will continue create their own trails.
- Designated Trails will be used as a tool to protect natural environments, as well as provide necessary access (avoid sensitive and dangerous sites, or provide controlled access through areas of concern.).
- Trails will be multiple-use where appropriate (in keeping with Cycling Policy for Undesignated Trails)
- Connections will be required across the coulee
- Where possible, accepted best practices such as City of Calgary standards will be used in trail design and maintenance.
- Designated trail surfacing will be varied, and will be intended primarily to ensure sustainability of each trail. Surfacing materials will not include pavement or asphalt but may include compacted gravel (Parks Trail Mix), or dirt, depending on localized conditions of slope, surface drainage, usage and context.
- Trails may be a variety of widths to suit safety and environmental objectives.
- Railings may be required where trails are adjacent to steep terrain.
- Creek crossing will connect trails where necessary
- Final designated trail alignment will be located in the field to work with the existing conditions.
- Designated trails will follow natural contours where possible
- Provide benched trails with positive drainage across the trail surface.
- Avoid using fill in trail subgrades; build the trail on existing compacted subgrades
- Use switchbacks to ease trail gradients
- A public education program is required to encourage appropriate trail usage.
- Mobility-impaired access will be provided where environmentally sound and physically realistic.
- Seasonal closures of trails may be considered for wildlife needs.
- After the approval of this Management Plan, no new designated trails will be constructed without a biophysical impact assessment and public consultation.
- It will be a fundamental message that trail sharing, trail use education and appropriate behaviour be included in the operation of the trails within the park
- Where disturbance due to trail construction occurs, the impacted areas will be rehabilitated

## **PARKING**

As stated in Guiding Documents section, Twelve Mile Coulee is a major regional park in Calgary. Year round enjoyment and use by all Calgarians will be encouraged with appropriate sensitivity to environmental impact and safety. Two parking lots are proposed for the park: Tuscany Ravine Road and Stoney Trail /Scenic Acres Link (Please refer to Map 5).

The proposed parking areas will be gravel or dirt surfaced. Fencing or curb stops will serve to delineate the parking areas from the park. The entries to the park from parking areas will well defined with connecting trails, signage and entry features welcoming park users.

### **Tuscany Ravine Road Parking Lot**

The Tuscany Ravine Road parking lot will be small with a capacity of approximately 10 to 15 vehicles. Construction of the lot will be a high priority following the completion and City Council approval of the Twelve Mile Coulee Management Plan. This will help to minimize on-street parking in the community of Tuscany. Landscaping will be used to minimize aesthetic impacts.

### **Stoney Trail and Scenic Acres Link Parking Lot**

Pending final approval from Alberta Transportation, the proposed parking lot will be constructed on the east side of Twelve Mile Coulee at the junction of Stoney Trail and Scenic Acres Link. It will provide access for park users coming from other parts of the City. The parking lot capacity will be approximately 30 vehicles. Construction of the lot will be a high priority when the realignment of Tuscany Boulevard is completed (Please refer to the Park Ownership Section for additional details)

### **Additional Parking Options**

The parking lot on Bearspaw Dam Road adjacent to Baker Park will also be available for parking. The regional pathway system will provide a connection from the parking lot to Twelve Mile Coulee.

### **Planning Direction**

As part of the planning process, staff worked with the stakeholder input group to identify suitable parking lot locations. Additional guidelines regarding parking lot development are provided below.

- All of the parking lots will be formalized with clearly defined parking spots.
- All of the parking lots be surfaced with gravel.
- Curb stops and post and cable fencing will be used to delineate the parking areas and prevent spill over into the park.

- Existing areas of on-street parking will be monitored to determine if additional off-street parking is required.

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## **AMENITIES**

Amenities will be kept to a minimum in Twelve Mile Coulee Park. This is in keeping with Parks intent to manage Twelve Mile Coulee in a manner that will maintain the natural character and integrity of the park. Where needed, the following amenities will be incorporated into the park: benches, garbage cans, picnic tables, and signage.

### **Benches**

Specific considerations are required when placing benches in Natural Environment Parks. Enough benches should be placed in a park to satisfy user needs without taking away from the natural character of the area. Appropriate bench styles and installation criteria are important considerations. For example, the use of hard surfaces like brick or concrete under benches should be discouraged in natural areas. The impact of increased traffic (potential for trail proliferation and ground disturbance), maintenance, vandalism, and litter are also important considerations when identifying a suitable bench location.

#### **Recommendations:**

- The benches that currently exist in the park will remain.
- Six additional bench locations are recommended (Please refer to Map 9 for details). They are strategically located along designated trails, the regional pathway or at entry nodes to provide rest areas that take advantage of views or unique park features.
- Memorial benches will be permitted in the park at the 6 bench locations identified above. They must be the same style and placed in the same location as the pre-existing benches. No additional locations are recommended.
- Hard surfacing under the benches will not be permitted.
- The placement of additional benches within the park requires the written approval of the Natural Areas Management Coordinator.

### **Picnic Tables**

#### **Recommendations:**

- The picnic area located at the base of Twelve Mile Coulee will remain.
- Garbage cans will not be provided. Users will be encouraged to remove all waste and take it home for disposal.

### **Garbage Cans**

Garbage cans should be located at major access points close to the regional pathway and designated trails. Operational realities should be considered when placing garbage cans (e.g. winter conditions, park topography)

**Recommendations:**

- Garbage cans will be located at major park entry points and at high traffic areas along the regional pathway and designated trails (Please refer to Map 9).
- The dog off-leash areas will be monitored to determine the need for additional waste receptacles, however, off-leash area users will be encouraged to pick up dog waste and dispose of it at home.

**Washrooms**

At this time washrooms are not planned for this park. Through continued dialogue with stakeholders, Parks will monitor if a washroom is a future requirement.

**Memorial Trees**

Memorial trees place a large obligation on Parks. There is an expectation that the tree will be maintained for a long period of time. This requires a regular schedule of water, pruning and usually the placement of a plaque.

**Recommendation:**

The planting of memorial trees will not be permitted in Twelve Mile Coulee for the following reasons:

- Isolation — an isolated tree is more likely to be skipped in any routine maintenance or watering schedule
- Access — the site will have to be easy to reach, limiting most sites to pathways and manicured areas nearby.
- Maintenance — this level of maintenance is not compatible with most management/maintenance levels in natural areas.

**Signage**

The purpose of signage is to enhance users experience without being visually intrusive. Signage will be strategically located to provide critical information while minimizing the number of signs required. The signage used will be designed in a manner that is in keeping with the beauty of the area.

**Recommendation:**

Four types of signage are required at Twelve Mile Coulee Park.

### **Entry Features**

- Provide detailed routing map and orientation point identifying “You Are Here”
- Provide users with an overall understanding of the designated trail and regional pathway system

### **Interpretive (Educational) Signage**

- Provide interesting, relevant information on special interest areas
- Inform users of the importance of respecting a particular area
- Educate users of historic, culturally and environmentally significant areas
- Help users gain an understanding of their natural environment
- Create awareness and social responsibility toward the park

### **Trail Markers**

- Distinguish designated trail route to reduce trail proliferation
- Aid users in staying on the designated trail

### **Regulation Signs**

- Speed limits
- Trail closures
- Restoration zones

### **Planning Direction**

As part of the planning process, staff worked with the stakeholder input group to identify suitable locations for amenities. Direction for appropriate use of amenities is provided below:

- Keep the number of amenities to a minimum.
- Focus on placing interpretive signs along the regional pathway for the education and enjoyment of all users.
- Place garbage cans at major entrance locations that are easily accessible by Parks staff.

## **RESOURCE MANAGEMENT**

One of the most difficult aspects of natural area management is the need to balance the public interest in “use” of parkland, with the public interest in its “protection”. Imposing restrictions creates limits to human use; while allowing overuse, negatively affects the quality of the habitat and the interactions of wildlife, as well as public enjoyment. Not only is there a potential for conflict between park users and the environment, but also between users themselves. Potential impacts can be managed through the use of a

designated trail system, public education, vegetative rehabilitation, management zoning and volunteer stewardship.

The overall goal of park management is to provide as much access as possible, without negatively affecting the environmental conditions of the site. With respect to the level of park usage, one should expect and encourage city-wide use, due to the special nature of the Twelve Mile Coulee Natural Environment Park. The closeness of the surrounding urban development will add to the pressure of human activity on the site. Due to the sensitive nature of the site, extra emphasis will be required to design facilities to aid in habitat protection (e.g creek crossings) along with enhanced educational programs to encourage appropriate human behaviour. Activities such as bird watching, hiking, plant identification or simply sitting and watching the creek, will be promoted.

## **Trails**

A significant problem in Twelve Mile Coulee Park is the damage to vegetation and fragmentation of habitat caused by the proliferation of undesignated trails (Please refer to map 10). Access to the park will be limited to the regional pathway and designated trails.

Informal undesignated trails will be closed and revegetated when they occur. It is important to identify priorities for vegetative rehabilitation of disturbed and impacted areas in the park, as park improvements will need to be staged over time.

### **Trail Restoration Priorities**

Priorities for restoration to be undertaken are as follows:

- Closure and rehabilitation of undesignated trails in spruce vegetation zone
- Closure and rehabilitation of undesignated trails leading towards the wildlife underpass. Educational signage explaining the restricted use of the underpass for wildlife only will be included at the closure locations.
- Clear identification of the designated trail system
- Construction of the creek crossings – the major missing link in the designated trail system

## **Creek Crossings**

The designated trail route crosses the creek 30 times (Please refer to map 10). Due to the topography of the area (steep and narrow ravine) and desire of users to move through the coulee, other feasible designated trail routing options that limited the number of creek crossings were not identified.

**Recommendations:**

- Creek crossing structures are a high priority for construction to complete the designated trail system and reduce impacts to the creek and surrounding vegetation.
- The areas surrounding the creek crossings require restoration.
- The design of the crossings will be in keeping with the character of the natural area.
- Railings may be required in some instances for safety reasons.

## **Wildlife Underpass**

The wildlife underpass is located at the north east corner of park below Nose Hill Drive. It was constructed in 2004 to facilitate the movement of wildlife from Twelve Mile Coulee to the Bow River (Please refer to map 11).

**Recommendations:**

- Educational signage is required to inform park users that the underpass is for wildlife only. Human activity in the underpass will significantly reduce the likelihood of wildlife use.
- Informal trails leading to the underpass are a high priority for closure and revegetation.
- Monitoring of wildlife use is required to determine the effectiveness of the underpass. Information gathered could be used to address wildlife movement issues in other areas throughout the City. Specific details that require additional research include the effective underpass dimensions (length, width and height), and the lighting requirements (artificial or natural).
- Habitat to the south of the underpass requires improvement.
- Signage at the intersection of the wildlife underpass and Bearspaw Dam Road is required.
- Records of deer and car conflicts on Bearspaw Dam Road and Nose Hill Drive extension would provide valuable information.

## **Escarpment**

The escarpment to the south of the coulee contains the largest patch of contiguous native grassland in the park. It forms a critical wildlife corridor for animals travelling to other natural areas and towards the Bow River (Please refer to map 11) Tuscany Hill Drive may impede wildlife movement if road traffic is not monitored and managed. Although a small box culvert (0.9 m high and 1.8 m wide) was constructed under the road to allow for the passage of small mammals and amphibians, it may be insufficient and it does not address the movement of larger mammals like coyotes and deer. Development to the west of the escarpment may also negatively impact wildlife movement and survival if the wildlife corridor is not considered and integrated into future development plans.

**Recommendations:**

- The escarpment is narrow. Access will be limited to the regional pathway on the top, a local pathway adjacent to Nose Hill Drive west of Stoney Trail and designated trails at key access locations.
- Wildlife crossing signage is required on Tuscany Hill Road
- Speed limits must be enforced on Tuscany Hill Road to minimize the potential for collisions with deer.
- The use of the box culvert by wildlife should be monitored.
- Weed infestations adjacent to Nose Hill Drive extension, Tuscany Hill Road and the periphery of the Tuscany Development require management.
- Records of car collisions with wildlife should be kept.
- Wildlife fencing on the North and South sides of Nose Hill Drive Extension are required.

**Dog Control**

Dogs will be required to be on a short leash and under close control, except in designated off-leash zones. High traffic areas within the off-leash zones may require minor restoration methods such as temporary fencing and additional plantings to ensure the area is adequately vegetated to minimize erosion as well as to ensure the site conditions are pleasant for users.

**Recommendations:**

- Impacts and compliance rates will be monitored.
- Maintenance costs for off-leash areas will be monitored and reviewed to better determine the actual costs involved in maintaining an off-leash area. These costs include more frequent garbage pickups, sweeping, and repair of turf damage.

**Organized Events**

Organized events encourage people to participate in many healthy recreational/social activities and can have positive community-building effects. However, some organized events can create additional park demands. In some cases use of the park (or certain facilities within the park) by a single group may conflict with casual park use and in other instances parking may be an issue. While the number of organized events is not overwhelming now, environmental impacts and potential increasing demands, particularly with respect to organized runs, walks, *etc.*, are issues to be addressed.

**Recommendations:**

- Organized events will conform to the mandate of the park and the Natural Area Management Plan. Events will be subject to approval by the Natural Area

Management Coordinator. Principles influencing approval will include environmental impacts, number of participants, safety, conflicts and timing.

- Participants will be expected to comply with policy and bylaw requirements pertaining to the use of facilities, designated trails and the regional pathway in the park.
- All permitted activities will have records kept and any relevant issues recorded such as complaints *etc.*

## **Vandalism**

Vandalism is a major issue in the park. Incidents of vandalism include: forts, bike jumps; broken glass; native plant removal, graffiti on the sandstone outcrops, graffiti on the pedestrian underpass, fire pits, and trees cut down for firewood.

### **Recommendations:**

- Parks staff will clean up vandalism as promptly as possible, in order to limit opportunities for further damage to the vandalized area.
- Volunteer involvement through the Natural Areas Adopt-A-Park program will be initiated.
- As part of the specialized maintenance procedures, regular assessments of frequently vandalized areas will be undertaken.
- Representatives from The City of Calgary Bylaw Services and Police Service will be informed and updated.
- Partnerships with organizations like Block Watch will be formed in an attempt to reduce vandalism through community involvement and monitoring.
- Additional vandalism reduction methods will be considered for implementation at highly vandalized locations (e.g. camera).
- Residents will be informed about the magnitude of the vandalism problem in Twelve Mile Coulee through articles in community newsletters.

## **Encroachments**

A number of Tuscan residents back on to Twelve Mile Coulee Park. Encroachments occur when citizens extend their personal possessions or yard into the park space. Common encroachments include fire pits, mowed strips, unapproved plantings, yard waste dumping and compost bins. The planting of non-native plant material is of particular concern because many species are aggressive and will easily colonize within the park. Once established they often out compete native vegetation. Species of concern that have been found in Twelve Mile Coulee include cottoneaster and turf grass.

### **Recommendations**

- Educate residents that live adjacent to Twelve Mile Coulee about the impacts of encroachments.

## **HABITAT MANAGEMENT**

Habitat quality in urban natural areas is constantly challenged by overuse; invasion by introduced plant species, and fragmentation. Parks goal is to maximize the health or quality of these habitats, through either preservation or rehabilitation.

Vegetation communities in more natural systems constantly change depending on the environmental conditions they face. Grazing, fire and flooding are all natural processes that are important in the maintenance and regeneration of our native plant communities. In an urban setting, these processes are usually controlled, providing less opportunity for natural vegetation communities to thrive and propagate. Resulting affects of this may be, for example, an increase of rose/cinquefoil/wolf willow invasion into grasslands, or a lack of new poplar growth in balsam poplar forests due to a lack of flooding.

Many people believe that natural habitats do not require maintenance. These areas should be left alone to survive and thrive. This would be true in a setting that is free from human interference. However, in an urban environment, an unnatural setting, habitats must be managed carefully with specific strategies designed for specific circumstances.

### **General Recommendations**

- Natural vegetation communities will be managed at a variety of stages of maturity. In some cases active control may be required (e.g. replanting, soil scarification). Protection of a variety of habitat types will be actively pursued during development of park restoration plans.
- Research regarding habitat management is essential and will be updated regularly as techniques are improved. Inventories will be undertaken to determine ongoing conditions.
- Wood and brush downfall and tree stumps will be maintained where safety is not a concern. These are important microhabitat sites for perching, nest and den sites for birds and mammals. They are also critical habitat for a wide variety of insects, fungi and nonvascular plants. They play a vital role in nutrient cycling and can serve as a nurse site for tree seedlings.
- Snags (standing dead or dying trees) are very important in all forested areas for providing nesting and perch sites for a variety of wildlife species including waterfowl, raptors and insect eating birds. Removal of significant snags can have a deleterious effect on health of woodland. Snags will be removed only after careful consideration of:

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- Safety issues - especially near popular facilities such as the regional pathway. (e.g., ensuring that the base of snags are firmly anchored)
- Environmental value: (e.g., Snags most appropriate for nesting are generally over 6 years old, are more than 20 cm dbh (diameter at breast height), and have more than 40% bark cover. A variety of snags attract wildlife, especially those greater than 5 metres in height)
- A mixture of rotten and good quality snags will be maintained.
- Trees with nest holes will be protected.

### **Habitat-Specific Recommendations**

Each habitat type requires specific management actions.

#### **Balsam Poplar**

Regeneration campaigns will be undertaken for balsam poplar. A major concern in Calgary is that balsam poplar cannot propagate effectively, and is gradually (almost imperceptibly on our time scale) being replaced by other species such as manicured grassland, white spruce, and river birch shrubs. Currently, the Twelve Mile Coulee Park riverine woods area is in good condition, however the number of young trees establishing within the area needs to be monitored and the following steps taken:

- Research into regeneration methods will continue
- Areas suitable for balsam poplar regeneration will be identified and monitored. In some instances planting and root disturbance to promote suckering may be required
- Conifer planting is not recommended.
- Recreational use will be limited to designated trails

#### **Aspen Habitat**

- Replanting will be undertaken where new suckers are absent (i.e., regeneration is not naturally taking place).
- Conifer planting is not recommended.

#### **Native Grassland Habitat**

- Invasive agronomic grasses, such as smooth brome, Timothy (*Phleum pratense*), foxtail barley (*Hordeum jubatum*), and crested wheatgrass (*Agropyron cristatum*) are "weed" grasses that tend to out compete other productive grasses and forbs. These species will be controlled where possible and attempts will be made to re-introduce native vegetation.
- Tree planting is not recommended in grassland areas.
- Grasslands are one of the most resilient habitats to a variety of impacts. However, if soil is exposed or on slopes, significant erosion is likely. On the escarpments, activities will be restricted to designated trails and the regional pathway.
- Closure and rehabilitation of informal trails.

- With the change in natural controls (suppression of burning and grazing), low shrub and wolf-willow have encroached into a variety of grassland habitat types. Encroachments will be monitored and controlled over time.

### **White Spruce**

Regeneration to be considered carefully due to the slow and difficult process of regrowth and the high chance of erosion in these areas. Major restoration efforts should be directed towards the closure of informal trails and the re-establishment of the understory. Expense of rehabilitation is high.

### **Disturbed Areas**

Disturbed areas are dominated by bare ground, introduced plant species and weeds. They are not productive areas for wildlife. Restoration is undertaken to increase biodiversity and animal habitat suitability. Restoration projects are most successful when there is a specific objective identified, when natural vegetation (traditionally found on site) is used, and when the restored areas are consistently maintained over the long-term. The more damaged an area is, the more costly and difficult it is to rehabilitate. We need to determine the most crucial restoration pieces and decide what level of repair is appropriate. Restoration work can be very invasive. It is very costly and it takes a long time to see the final product, but it is an essential piece of the puzzle to improve the health and overall condition of the park for the long term.

- All planting in red, yellow and green zones will be strictly restorative or barrier in nature, with species used that represent the associated vegetation community. • No introduced species will be used.
- A site-specific assessment and implementation plan will be required for all major restorative projects. Each project will be staff supervised.
- Long term planning and maintenance will be taken into account.
- Monitoring and assessments of rehabilitated areas will be undertaken and kept on record.
- All restoration projects with the exception of minor trail repair will have detailed plans identifying objectives, specific restoration techniques, materials, timelines and plant lists. Monitoring of each restoration project will also be undertaken to evaluate effectiveness of the techniques and the progress towards the previously identified objectives.
- Signage will be used at restoration sites to inform and educate users.
- Bioengineering techniques such as erosion matting, landscape fabric, and specific planting techniques will be used where possible to control damage caused by erosion and other factors.

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- Seed for revegetation will be identified and/or acquired by Calgary Parks. Purchase by others except under the direction of Parks is not recommended.
- Seed collection by volunteers will be encouraged through the Natural Area Adopt-a-Park program.

### **Restoration Priorities**

- All disturbed areas identified in red on Map 6 are high priorities for restoration. Specific locations that require immediate management include:
  - Sandstone outcrops and surrounding area. The area is very sensitive, highly visible and has been vandalized.
  - Riparian area at the base of the coulee by the tipi ring requires extensive restoration including weed management, replanting, designated trail delineation, and trail closures.
  - Spruce forest located on a steep west facing escarpment that has been heavily impacted by informal trails.

## **PESTS AND PROBLEM WILDLIFE**

This section provides recommendations on the best methods of controlling pest species and problem wildlife specific to Twelve Mile Coulee Park. Some existing species in the park that may be considered “pests” include Canada thistle and smooth brome grass; yellow and white clover, caragana and cottoneaster. Weed control involves active monitoring and the removal of those species that are potentially harmful to natural areas and to residential communities. Provincial guidelines also provide direction and specific controls for weed management.

Introduced animals and birds include grey squirrel, house sparrow and European starling. Indigenous wildlife may also become a problem when high populations or particular behaviour interfere with neighbours, or actually do long term damage to the natural resource (e.g. beavers, coyotes, deer). In normal situations these species are considered important components of a natural environment. There are many incidents reported of conflicts between dogs and coyotes. Wildlife control is generally the responsibility of Provincial wildlife authorities.

### **Specific Species Recommendations:**

**Pest Bird Species:** The primarily control method suggested is to discourage the placement of birdhouses (erected by well-meaning public) in natural environment parks.

**Richardson Ground Squirrel:** Increase public understanding of the role of ground squirrels within the food chain.

**Insect Pests:** Increase public understanding of the role of insects, and that most infestations (except introduced varieties) are a result of stresses such as water loss, small size, and fragmentation.

**Grey Squirrel:** Increase public understanding about the harmful impacts of this introduced animal.

**Coyotes:** They are commonly seen in and around Calgary. They are considered a valued wildlife species that have a natural diet of rabbits, small rodents, fruits and berries. They are not naturally aggressive to humans. Their population is increasing in urban centres because they are very adaptable. Areas most often inhabited are communities along our rivers and in large natural environment parks. One of the primary roles of natural environment parks is to protect wildlife and wildlife habitat. Citizens strongly value these parks and feel fortunate to be able to share the areas with many species of wildlife including coyotes. Park users recognize that they have a privilege and a responsibility. They play a critical role in maintaining park health for the appreciation and enjoyment of others. While using off leash areas, they are encouraged to closely supervise dogs, refrain from disturbing wildlife, and remove garbage. In instances when aggressive coyotes are identified, citizens are asked to contact the province's coyote hotline because wildlife control is the responsibility of provincial wildlife authorities (The Alberta Environment Natural Resource Service Coyote Hotline: 297-7789). They may also be directed to the City of Calgary Animal Services.

### **General Recommendations**

- Existing approved guidelines in the *Natural Area Management Plan* and *Integrated Pest Management Policy* will be applied to manage pest species in Twelve Mile Coulee Park. Control will be at the discretion of the Natural Area Management Coordinator.
- A monitoring program for all problem species in this category will be implemented.
- If there is sufficient volunteer interest, a pilot project for manual weed control will be set up through the Natural Area Adopt-a-Park program. Parks will support the activity for an approved specified area with appropriate training for the volunteers.
- A variety of techniques will be used to decrease the risk of weed invasion in natural areas. Priorities for control will start with pests that threaten invasion into natural habitats and local residences, and will then include larger problem sites.
- The release of non-native wildlife within the park will not be permitted.
- Feeding of wildlife within the park will not be permitted
- Monitoring of weed problem through April to October. Areas of concern will be inventoried and documented.
- Aggressive removal will be required to protect natural vegetation.

- Priority where possible will be given to use less chemical options. Spot spraying is preferred in all natural areas. IPM strategies will be followed.
- Priority will be given closely monitor for noxious and restricted species such as Nodding Thistle

## **PARK MAINTENANCE**

Some aspects of maintenance in Natural Areas is similar to that of groomed parks. These activities include garbage pick-up and amenity repair. Both of these activities are undertaken by The North Area Division of Parks. Specialized maintenance includes activities that are related to natural area restoration, or activities that may need specialized equipment or expertise, such as erosion control or wildlife habitat enhancement. These activities are usually non-repetitive and change from year to year. This work is undertaken by Natural Areas Management Section of Parks.

### **Regular Maintenance Recommendations**

- An annual assessment of specific maintenance requirements.
- Regular maintenance practices record keeping.
- The use of heavy machinery will be minimized on site except in disturbed sites (with specific sensitivity to wildlife seasonal use).
- A servicing schedule will be established for parking lots , garbage cans and fences
- Enforcement and interpretive signage will be installed and maintained.
- Maintenance vehicle access to the park will be limited to the regional pathway.

### **Specialized Maintenance Recommendations:**

- An annual litter clean-up will be conducted.
- The use of heavy machinery will be kept to a minimum, except in disturbed sites that are to be restored (with specific sensitivity to wildlife seasonal use).
- Designated trails will be maintained as required.
- Strategies will be developed for control of weeds.

## **BIOPHYSICAL IMPACT ASSESSMENT**

A Biophysical Impact Assessment is an assessment that is undertaken to establish the issues and potential impacts of a specific project on the natural resource. It measures the scale and significance of the impacts and identifies any mitigation measures that could be used to minimize the anticipated negative impacts, or enhance a site/project. Specific details regarding Biophysical Impact Assessment requirements are provided in Appendix 3.

### **Recommendations:**

All construction projects within the Transportation Utility Corridor (TUC) segment of the park will require a Biophysical Impact Assessment and the identification of mitigation measures, prior to approval.

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## **INTERPRETATION, EDUCATION & STEWARDSHIP**

### **Interpretative Program**

The intent of an interpretive program is to create community and city-wide understanding of the importance of Twelve Mile Coulee Natural Environment Park and its role in the whole system of Calgary's parks. Interpretive features will be strategically located throughout the park to provide users with information on specific historical, cultural and environmentally significant points of interest.

### **Education Program**

An education program could be developed to provide memorable opportunities for students to experience the Twelve Mile Coulee's unique features, explore, discover and learn about the natural world while engaging in health-promoting, physical activity. The informal learning, non-formal programs and formal instruction associated with Twelve Mile Coulee Park could reinforce each other, enhancing academic achievement. Public support, stakeholder involvement and financial backing will be required for the development of a park specific education program.

### **Stewardship**

The Natural Areas Adopt-A-Park program gives interested individuals and groups opportunities to work collaboratively with The City of Calgary Parks Department to enhance Natural Environment Parks. The program strives to educate volunteers and park users about appropriate park use, create two way communication between Parks and the public as well as supply resources needed by volunteers for various roles and responsibilities.

Parks recognizes that citizen involvement and stewardship through the Natural Areas Adopt-A-Park program will be a critical component of successful park management. Depending on their area of interest and level of expertise, volunteers will provide assistance maintaining and improving park health, educating users about its value and the importance of following rules, as well as monitoring for vandalism.

### **Recommendations:**

- An interpretive program will be developed and phased in over time.
- A Natural Areas Adopt-A-Park program will be implemented in Twelve Mile Coulee as soon as feasible.
- Parks will work with interested organizations to develop and implement a Twelve Mile Coulee Education Program

## DESIGN DEVELOPMENT PLAN

Constructed elements such as paved pathways, designated trails, parking areas, entry points and signage can be important tools in managing the impacts of heavy use on a site. The purpose of the Twelve Mile Coulee Design Development Plan is to shape into hard design detail, the general recommendations for treatment of the park based on the Management Plan. Included in the Plan are cost estimates and phasing recommendations for implementation of the proposed work.

### Overview

In keeping with the Twelve Mile Coulee Natural Environment Park Management Plan, there are a number of objectives which will directly shape and guide the proposed development of Twelve Mile Coulee Park:

- maintain the natural environment in it's native state with an emphasis on maintaining or enhancing the biological diversity of the area
- protect areas of high quality environmental significance and to rehabilitate areas that have been previously disturbed and degraded
- ensure public access, safety and use at an appropriate environmentally sensitive level.
- minimize the human footprint on the park, both through the reduction of negative environmental impacts on the park and through the improved design and integration of site elements.

Any new developments proposed for the park will be guided by these principles.

### Plan Implementation

For all those involved in the management, protection and use of Twelve Mile Coulee Natural Environment Park, a working and effective plan is very important. It is also equally important that those involved with the management of the area be accountable for the results of the plan. Rarely have budget dollars been attached to a plan and the result is that we often have to take money from other priorities to implement the approved plan. The design and development plan will identify the phasing, priorities and rough costs associated with plan..

### Phasing

*Priorities for phasing are as follows:*

1. Public information and interpretive educational signage,(including park identity signs and information signs at major and secondary nodes and community entries; signage relating to off-leash usage of the park)
3. Safety risks

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4. Designated Trail development ( long term phasing for the establishment of the park-wide designated trail network)
5. Rehabilitation of informal undesignated trails (occurring in tandem with designated trail development)
6. Enhancement of riparian area through native tree and shrub planting as well as weed control.
7. Parking lot construction
8. Off-leash area fencing

## **Costing**

**Preliminary Design Development Plan Cost Estimate – Under Development**

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## **ADDITIONAL RESOURCES**

- Oetelaar, G.A. 2004. Landscape evolution and human occupation during the archaic period on the northern plains. *Canadian Journal of Earth Sciences*, **41**: 725-740.
- Oetelaar, G.A. 2002. River of change: A model for the development of terraces along the Bow River, Alberta. *Geographie physique et Quaternaire*, **56**: 155-69.
- Oetelaar, G.A. 2000. Beyond activity areas: Structures and symbolism in the organization and use of space inside tipis. 2000. *Plains Anthropologist*, **45**: 35-61.

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## GLOSSARY OF TERMS

**Abiotic** -Not living.

**Biophysical Impact Assessment** -An assessment of the biotic and abiotic features in an area as well as the impacts of a particular project has on those items. It should include any potential mitigation options.

**Biophysical Inventory** -An assessment of the biotic and abiotic features in an area.

**Biotic** -Living.

**D.B.H** - Diameter breast height measurement of a tree. 4.5 ft. above ground.

**Design and Development Plan** - A plan that provides information on the layout, look, timing & phasing of park projects. It would also include the expected capital costs of a project.

**Diversity** -The variety of species, vegetation communities, habitats or landforms in a given area.

**Ecology** -The study of relationships between living things, with each other and with their environments.

**Ecoregion** -An area characterized by a distinctive regional climate as expressed by vegetation.

**Environmental Reserve** -An open space area, established in accordance with the Municipal Government Act, which is usually not physically suitable for development. These areas are normally left in their natural state and include unstable slopes, swamps, ravines, floodway areas, and shore setback.

**Escarpment** -A term used loosely to describe a steep slope formed by erosive action of water or wind and normally adjacent to a watercourse.

**Exotic** -A species which is not native and has been introduced to an area by people or their activities.

**Forbs** -Any herb other than grasses or grass-like plants.

**Fragmentation** -To separate or divide naturally occurring habitats or plant communities.

**Habitat** -A place where an organism lives.

**Interpretation** -Translation and communication of natural and historical information into meaningful and

contemporary messages.

**Introduced** -Species or habitat created or transported by people or their activities.

**Inventory** -A survey of natural resources not necessarily including an assessment.

**Maintenance** -The keeping of parks, buildings, equipment and supplies in accordance with standards for effective operation.

**Management** -To direct to a degree, the outcome of a particular project or land area.

**Native** -Species that have not been introduced by people or their direct activities.

**Natural** -Ecological processes that are relatively unchanged by humans.

**Naturalized** -A previously disturbed site that is left to natural processes.

**Natural Area** -Any land and/or water area that has existing characteristics of a:

- Natural/native plant or animal community.
- Portions of a natural ecological and or geomorphic system.

**Natural Environment Park** -A park class included in the Open Space Classification.

**Pest** -A species of animal that is undesirable. It may or may not be introduced.

**Protection** -A management technique used to keep an area from harm. It can include many methods.

**Reclamation** -The efforts to improve a disturbed site's condition.

**Restoration** -The efforts to restore a disturbed site to near its natural and native condition.

**Riparian** -The vegetation communities between the aquatic and upland ecosystem.

**Weed** -A species of plant that is undesirable.

**Wildlife** -Native plants and animals living in natural conditions.

## **APPENDICES**

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## Appendix 1 Urban Park Master Plan Vision and Principles

### **Vision statement:**

*The people of Calgary envision a continuous integrated river valley park system that reflects the city's unique prairie and foothills setting. The River Valley Park System will express citizen's commitment to its preservation, use and historic heritage. We envision a river valley park system in which we will take pride and in which every citizen will assume responsibility for its protection.*

### *Vision statement principles*

*The 1984 Calgary River Valleys Plan and the following principles will guide the development of Calgary's River Valley Park System:*

#### *In principle:*

- 1. The overall structure of the River Valley Park System will be based upon protection, rehabilitation and/or re-establishment of naturally sustainable landscapes, waterways and ecosystems.*
- 2. All significant sources of contamination or degradation of river and related waters will be eliminated, recognizing that watershed management co-ordination with upstream and downstream municipalities and governing agencies will be essential.*
- 3. The primary use of the River Valley Park System will be passive, low-intensity, informal, unstructured activities.*
- 4. Intensively used facilities will be designated to appropriate sites that are no environmentally sensitive and that are carefully designed as 'special use areas'.*
- 5. The River Valley Park System will include a continuous river valley pathway, not always adjacent to the river's edge.*
- 6. The River Valley Park System will be accessible, usable and safe for all persons where practical and environmentally appropriate, bearing in mind the needs of persons with disabilities.*
- 7. Year-round enjoyment of the River Valley Park System will be encouraged but balanced with environmental impact considerations.*
- 8. Appropriately designed park linkages will extend into adjacent communities, connecting school sites, community centres, recreational facilities and urban open spaces.*
- 9. Adjacent development will respect and reflect the character of the River Valley Park System, and provide for reasonable public access to the park system.*

- 10. The River Valley Park System will complement and reflect the unique character and the qualities of the individual park areas and adjacent communities.*
- 11. The River Valley Park System will be designed to be accommodated by creative alternatives outside of the river valley.*
- 12. Landscape features contributing to the visual continuity and aesthetic quality of the River Valley Park System will be protected, maintained and enhanced where appropriate.*
- 13. Through protection, sensitive planning and design, education and interpretation, the River Valley Park System will promote a sense of stewardship in all Calgarians.*
- 14. Calgarians will be urged to accept responsibility and liability for their use of the River Valley Park System.*
- 15. To assure long-term benefits for all Calgarians, the success of the plan will depend on fiscal responsibility in planning, management and maintenance.*
- 16. When human use versus wildlife use comes into serious conflict in those areas designated as major natural areas in the 1984 Calgary River Valleys Plan and the Urban Park Master Plan, wildlife and habitat will take priority.*
- 17. The River Valley Park System will be a park resource for all Calgarians and will be in addition to the neighbourhood parkland entitlement within adjacent communities.*
- 18. All bridges will accommodate pedestrian and bicycle use, and all new road and bridge construction required will comply with the Vision Statement.*

**Appendix 2 Vegetation Assessment Data – to be included**

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## Appendix 3 - Biophysical Impact Assessment Requirements

### 1. Description

<p><b>Purpose, Size and Scope</b></p>	<p>-detailed background reasons for the proposed impact activity (e.g. storm sewer outfall/upgrade; transportation/utility construction; etc.)</p> <ul style="list-style-type: none"> <li>- <b>purpose</b> cause or reason for disturbance.</li> <li>- <b>size</b> is given in areal measurements (m<sup>2</sup>, acres, ha)</li> <li>- <b>scope</b> indicates who is involved in the project (city and/or private contractors) and what level(s) of management and supervision are involved</li> </ul>
<p><b>Capital Cost and Financing</b></p>	<p><b>If applicable</b> - indicates funding for the project and what real/proposed funds have been designated for long-term site recovery and maintenance</p>
<p><b>Proposed Location</b></p>	<p>-Given as a <b>map, address and legal description</b> to identify exactly where the project is proposed (e.g. intersection of Country Hills Boulevard and Centre St. N. on the NE corner; NW<sup>1</sup>/<sub>4</sub> Sec. 36 Twp. 25 R2 W5.) The proximity to Natural Environment Parks be indicated in detail.</p>
<p><b>Consumptive use of Natural Resources during Construction</b></p>	<p>-what on-site materials will be expected to be exploited/removed during the course of the project (e.g. removal of gravel, sod, or soil, tree cutting, water drainage, etc.)</p>
<p><b>Timing</b></p>	<p>-How long the project will take, including preliminary planning, onsite activity, and follow-up maintenance and reclamation. Time of season must be specified (e.g. early spring, late summer, winter, fall so that appropriate evaluation of all natural impacts may be undertaken.)</p>
<p><b>Maintenance Requirements</b></p>	<p>- Foreseen management requirements for short- and long-term site maintenance. (eg. include mowing, weed and pest management, irrigation, planting, etc.)</p>

**2. Inventory**

<b>Topography</b>	-A physical description of existing land form, slope, aspect, and position within the landscape. In most cases this may require presentation of survey.
<b>Geology, Geomorphology</b>	-Description of surficial and sub-surficial geological (if possible) features at the affected site and immediate environment. Identified glacial landforms and stability issues should be included in the preliminary site report.
<b>Pedology</b>	- Description of the physical properties of the soils (e.g. horizon depths, texture, drainage, salinity, sodicity) and classified to soil type according to the <i>Canadian System of Soil Classification, 3rd edition</i>
<b>Biological Resources</b>	-On-site flora and fauna with additional emphasis on habitat value, wildlife corridor importance, and role of resident vegetation within the localized system. May include rare species summary.
<b>Cultural Resources (Prehistoric, Historic and Current)</b>	-Existing historical, interpretive, or recreational features. Includes the potential for developing recreational, interpretive or educational facilities at the site when completed.
<b>Hydrology, Water Bodies</b>	-Listing of all standing water features, water courses, or other natural hydrological source, surficial drainage patterns, depth to water table, and other features.
<b>Aesthetic</b>	-Subjective description of how this site fits into the landscape and/or city scape, and other noted significant features such as planned vision from Council approved policy and plans. Includes prominent views, human disturbance, aesthetic features, hydrologic/geological/biological resources, etc.
<b>Other Features</b>	-Descriptions or features which are of interest or importance to the site, and are not included in the previous categories. May include man-made features at site e.g. power lines, buildings, roads, etc. or items of special concern
<b>Existing Policy</b>	-Identify existing internal or external policy that may direct or influence proposal.

**3. Impact**

<b>Biological Resource Impact</b>	-Comprehensive account of actual and potential risks/benefits from development activity to: wildlife habitat; overall biodiversity; sensitive plant and animal populations; movement corridors; rare or threatened plants and animals; long-term flora and fauna community stability
<b>Geographical and Geological Impact</b>	-Physical impact of the development activity, including: elimination/alteration of unique landforms; alteration of drainage patterns; micro climatic effects; erosional processes; paleontological: surficial and sub-surficial alterations; slope stability
<b>Pedological impact</b>	Physical impact of the development activity to soils, including loss of intact/native soils, alteration or disturbance of soil profiles, salinity, erosion, compaction, windthrow hazard, <i>etc.</i>
<b>Visual Impact</b>	-Actual and potential impacts of project from the perspective of the expert and the non-expert. Includes enhancement/reduction of aesthetic features; alteration/obstruction of view lines; introduction of weeds and/or pests; landscape alteration; <i>etc.</i>
<b>Cultural Impact</b>	-Actual and potential impacts of project from a heritage perspective. Loss/gain of interpretive resources; impact on historical or archaeological sites; <i>etc.</i>
<b>Social/Economic Impacts</b>	-Actual and potential costs; loss/gain of recreational resource; localized community impacts; long-term cost in dollars, capital, and manpower; problem created/solved in perception of community.
<b>Cumulative Impact</b>	-Summary of combined (with other activities) actual and potential impacts, and how these will affect the rehabilitation, protection and operation of this site in the future
<b>Residual (Unmitigable) Impact</b>	-Summary of actual and potential impacts to the site which are inevitable, yet permanent. May include long-term species diversity, loss of habitat, loss of system connectivity, loss of public access, obstruction of wildlife movement, introduction of weeds or pests, long-term maintenance requirements, removal of natural features, aesthetic impacts

#### 4. Mitigation Recommendations

<b>Accepted Methods</b>	-Methods of available damage mitigation or recovery using standardized industry techniques including: (signage and fencing; grading and loaming; sod stockpiling; seeding with native mixtures; native plantings; limited-impact construction; etc.) Methods are well-known to industry contractors who are involved in tender bidding for projects.
<b>Experimental Methods</b>	-Methods of available damage mitigation or recovery which are specialized, require outside expertise, or have site-specific value. May include: (sod transplants; loam shredding and re-application; specialized native seed harvesting and application; usage of organic fertilizer and erosion control devices; other unconventional methods.)

#### 5. Significance of Impacts

<b>Regional</b>	Cumulative assessment of impacts to the regional area, incorporating all above criteria. Includes biological, geological and hydrological impacts along with aesthetic, landscape, and social factors. Identifies loss/gain of regional resource, and long-term effects on regional system. Attempts to extrapolate impacts to a south-central Alberta perspective e.g. downstream effects, extra-municipal impacts, etc.
<b>City Wide</b>	Cumulative assessment of impacts to Calgary's urban natural area system. Includes details of habitat loss/improvement; effects on system continuity and contiguous natural areas; effects on wildlife movement; large-scale aesthetic impact; social, cultural, and economic impact to Calgarians; etc.
<b>Park Wide</b>	Cumulative assessment of impacts to individual park. Similar to the above, but with a focus on identified environmentally significant areas, unique habitats, and representation within the park. How does the impact adversely affect unique or under-represented habitats, system connectivity, or system viability.
<b>Local</b>	Small-scale approach to impact assessment, including: impacts to adjacent vegetation communities; loss/gain of community recreational or natural resources; community economic/social impacts; long-term site maintenance requirements; aesthetic impacts to site; introduction of

	weeds/pests to community; isolation/connection of site to city-wide system; etc.
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