BIOPHYSICAL IMPACT ASSESSMENT

Nose Hill Park - Cross-Park Pathway Routes

Prepared for

The City of Calgary Parks #75
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EXECUTIVE SUMMARY

A primary goal of the Nose Hill Trail and Pathway Plan (O2 Planning and Design Inc. 2005) was to develop a designated trail and pathway infrastructure that would meet the needs of users of the park and at the same time protect vulnerable and significant ecological resources. One of the 15 recommendations resulting from the plan was to establish two paved cross-park pathways. URSUS Ecosystem Management Ltd. (URSUS) was contracted in September 2005 to complete a Biophysical Impact Assessment (BIA) for the two cross-park routes: "East -West Pathway" - Edgemont Blvd. parking lot to Berkeley Gate parking lot (3.2 km); and, "North – South Pathway" - Edgemont Blvd. parking lot to Brisebois Drive parking lot (4.5 km).

The location of each route was overlaid onto existing ecological land mapping to determine potential impacts on significant biophysical resources. Site-specific inventory of each route was conducted and described using GPS waypoint locations. Five Valued Ecosystem Components (VECs) were selected based on previous studies conducted of Nose Hill Park. Five different kinds of potential impacts were described and the significance of these impacts was assessed for the five VECs using standard criteria. Impact ratings and significance were based on residual impacts taking into account mitigation measures.

The majority (3/4 or more) of each route traverses lands that are in a non-native condition. The entire length of each pathway follows existing trails and pathways of either dirt tread (43% to 60%), gravel (1% to 26%) or paved (14% to 57%) substrates. The majority of the N-S route (74%) and E-W route (53%) cross near level morainal plain. The most important native habitats crossed by the paths are native Rough Fescue grassland (plains, slopes and ravines) and aspen forest in ravines. Isolated patches of these native habitat types are crossed by the planned pathway routes.

Valued Ecosystem Components used to assess project effects were: Rough Fescue grasslands; Rough Fescue Grassland bird communities; Aspen/Tall Willow bird communities; Grassland native integrity; and, Rare plants and habitat. Types of potential impacts on VECs that were assessed included: direct habitat loss; habitat fragmentation from movement obstruction; habitat alienation; trampling by humans leading to exotic plant invasions; and increased wildlife mortality. The nature and potential magnitude of these effects were based on scientific literature review.

Key mitigation measures recommended include: Rerouting the N-S pathway between waypoints 6 and 8 a few meters to the north edge of the native grass community; avoiding trail construction/re-surfacing during the nesting/fledging period (May 1 to 31 July) along pathway segments that occur immediately adjacent native grassland habitat; and, reclamation of pathway edges with native sod and seed.

Impacts on VECs related to direct habitat loss were generally rated to be of negligible magnitude and significance primarily because of the limited land area affected and the positive gains associated with planned trail closures stemming from the Nose Hill Trail and Pathway Plan (NHTPP). The locating of planned cross-park paved trails on existing trails and pathways also limited direct habitat loss impacts. Effects on native vegetation relating to trampling and invasive plants are generally positive because of the reductions of bare ground substrate and the closure and rehabilitation of informal trails associated with the NHTPP. The future land use (cumulative) effects of habitat alienation from human use of pathways were rated as positive for Rough Fescue bird communities and Aspen/tall willow bird communities because of the reduced habitat fragmentation associated with the implementation of designated routes in the NHTPP. There is however uncertainty as to the actual magnitude of existing and future habitat alienation effects. Re-inventory and monitoring are recommended to lessen uncertainty and as a baseline for mitigating rare plant impacts. Movement obstruction leading to habitat fragmentation is not considered to be a significant impact on VECs assessed for Nose Hill Park. The significance of direct mortality effects on grassland and forest/shrub birds was rated as minor.

The designated route plan of the NHTPP includes recommendations for closure and rehabilitation of informal trails. This plan has potential to significantly reduce habitat alienation effects. The Nose Hill Trail and Pathway Plan (NHTPP) if successfully implemented will mitigate most (if not all) of the impacts on VECs associated with the paving of cross-park trails, and in fact will have a positive effect compared to existing conditions.

Increasing levels of recreational use of Nose Hill Park has resulted in losses of at least two provincially listed wildlife species at risk – Badger and Sharp-tailed Grouse. Additive and cumulative recreational effects will likely continue to eliminate sensitive species if designated trail and pathway routing is not successfully implemented. It is recommended that bird and rare plant inventory be conducted for Nose Hill Park as a baseline against which impact predictions can be tested. Adaptive environmental management including systematic monitoring of VECs should be an integral part of the NHTPP. The need for adaptive management and monitoring recognizes the scientific uncertainty surrounding impact predictions for some VECs and impact.

TABLE OF CONTENTS

TABLE OF CONTENTS
(continued)

TABLES

FIGURES

APPENDICES

1.0 INTRODUCTION

1.1 Background

A primary goal of the Nose Hill Trail and Pathway Plan (NHTPP) (O2 Planning and Design Inc. 2005) was to develop a designated trail and pathway infrastructure that would meet the needs of users of the park and at the same time protect vulnerable and significant ecological resources. One of the 15 recommendations resulting from the plan was to establish two paved cross-park pathways to provide connections to existing pathways in adjacent communities. Preliminary routing concepts for these cross-park pathways were developed using route planning and design evaluation criteria (i.e. ecological vulnerability, attractiveness, logistics). Extensive public input was sought and incorporated into the development of the NHTPP.

URSUS Ecosystem Management Ltd. (URSUS) was contracted in September 2005 to complete a Biophysical Impact Assessment (BIA) and mitigation plan for the two cross-park pathways described below.

- "East -West Pathway" – Berkley Gate parking lot to Edgemont Blvd. parking lot (3.2 km)

- "North – South Pathway" - Edgemont Blvd. parking lot to Brisebois Drive parking lot (4.5 km)

The locations of the two routes are illustrated in Figure 1. The N – S paved pathway route is mapped in blue in Figure 1 and will hereafter be termed the "N-S Route". The E – W route is mapped in yellow and will hereafter be termed the "E-W Route". Previously (October 2005) URSUS completed an ecological impact assessment and mitigation plan for a short pathway that connected the recently constructed John Laurie pedestrian bridge to the N – S pathway (Kansas 2005). This path is identified as Segment 1 and mapped in red in Figure 1. For this report we will refer to this short segment as the "Segment 1 pathway". Construction of the Segment 1 pathway was completed in November 2005.

1.2 Objectives

The objectives of this study and report are as follows:

- Identify and describe significant and sensitive biophysical features on and adjacent to the proposed pathway routes;

- Select Valued Ecosystem Components for biophysical impact assessment purposes;

- Identify potential impacts of pathway construction, use and maintenance on aspects of the ecology of Nose Hill Park with a focus on environmentally sensitive and significant features and areas.

- Outline methods that could be used to mitigate project impacts; and,

- Rate and describe the magnitude and significance of potential project impacts, relative to existing conditions in Nose Hill Park.

2.0 METHODS

2.1 Significant Features Identification/Description

2.1.1 Regional [Park-wide] Context

A detailed biophysical inventory and analysis of Nose Hill Park was completed in the early 1990s (Kansas et al. 1993). This project mapped ecological land units (ecosites) at a detailed scale of 1:5,000. These integrated land units provide information concerning soils, geomorphology, topography, and vegetation community. Wildlife inventory including small mammals and songbirds was conducted using ecosites as a sampling framework. The sensitivity, attractivity, representivity and ecological importance of 25 candidate ecological features (e.g. key wildlife species, vegetation communities) were rated and a list of environmentally significant features was developed. The sensitivity and suitability of soil and vegetation types (linked to ecosites) to trampling and pathway construction were also rated.

The Nose Hill biophysical inventory and analysis product described above is still highly relevant in spite of its vintage. We used this project's inventory and evaluations with minor modifications as a "regional" context for determining the relative significance of lands transected by the two pathway routes. Principle modifications pertained to the classification of rare, threatened and endangered plant and animal species, which have undergone some changes since the early 1990s. In addition, some wildlife species present in the Park at the time of the inventory may no longer be present or occur in significantly lower numbers.

2.1.2 Local [Pathway Route] Context

The ecological mapping conducted by Kansas et al. (1993) was completed at a scale of 1:5,000. At this mapping scale one centimeter on the map is equivalent to 50 meters on the ground. The width of existing trails followed by the E-W and N-S routes range from approximately 2 to 7 meters. As such the park-wide mapping conducted by Kansas et al. (1993) could not distinguish and map trails and the plant communities growing immediately adjacent to them. Site-specific inventory was conducted along each pathway route in order to determine with greater accuracy the vegetation associations occurring along the proposed paved pathways.

GPS waypoints were collected at points along each of the routes at which notable changes in either vegetation association or pathway width/substrate occurred. For each of the two routes vegetation and pathway descriptions were written that are linked to mapped waypoint locations.

2.1.3 Valued Ecosystem Components

From an environmental impact assessment perspective valued ecosystem components (VECs) are defined as:

"Any part of the environment that is considered important by the proponent, public, scientists and government involved in the assessment process. Importance may be determined on the basis of cultural values or scientific concern." (Hegmann et al. 1999).

For this project VECs are aspects of the biophysical environment that are valued as per the above definition and are used to assess the significance of project and cumulative impacts. Based on the identification and description of locally and regionally relevant ecological features (Sections 2.1.1 and 2.1.2), we identified several VECs for the impact assessment.

2.2 Impact Identification and Description

2.2.1 Project Impacts

This aspect of the BIA identifies potential types and sources of impact that could be caused by the two cross-park asphalt pathway projects. Similar impacts from other scientific studies relevant to this region were identified by literature review and discussed. Impacts relevant to this task were those associated with the construction and ongoing use of the two proposed pathways.

2.2.2 Cumulative Impacts

This aspect of the project identifies and discusses other planned and reasonably foreseeable land actions/projects on Nose Hill that have potential to add to, mitigate, lessen or interact with the effects of the paving and maintenance of the two cross-park pathways. Primary information sources used to guide the identification of cumulative land uses were the Nose Hill Trail and Pathway Plan (O2 Planning and Design Inc. 2005) and the Nose Hill Park Natural Area Management Plan (EnviResource Consulting Ltd. 1994).

2.3 Mitigation of Impacts

The purpose of this task was to identify and discuss approaches that could be taken to mitigate potential project-specific (incremental) and cumulative impacts. Broad approaches include: avoidance; minimization through limiting degree of magnitude of action; rectifying the impact by repair, rehabilitation or restoration; and compensation for impact by replacing or providing substitute resources.

2.4 Assessing Impact Significance

Potential project and cumulative impacts on valued ecosystem components were rated using standard criteria including:

- Direction of impact;
- Extent of impact;
- Magnitude of impact;
- Duration of impact;
- Frequency of occurrence of impact;
- Permanence of impact; and,
- Level of assessment confidence

A final rating of impact significance (no, negligible, minor, moderate or major) was assigned based on above criteria. All impact ratings assumed successful mitigation.

3.0 BASELINE ENVIRONMENTAL CONDITIONS

3.1 Regional [Park-wide] Context

3.1.1 Regional Ecology of Nose Hill Park

Nose Hill Park is a grassland-dominated natural area embedded within a surrounding matrix of urban residential development. The Park is approximately 11.3-km^2 in size and occurs along the western edge of the Foothills Fescue Natural Subregion where it abuts the Foothills Parkland Ecoregion. The Foothills Fescue Natural Subregion is one of four Natural Subregions in the Grassland Natural Region, along with the Dry Mixedgrass, Mixedgrass and Northern Fescue. It occurs as a narrow north to south trending band from the United States border to the Crossfield-Didsbury area. The Foothills Fescue accounts for 1.95% of the area of Alberta and it encompasses 13.5% of the Grassland Natural Region (Adams et al. 2003). It is estimated that 2,501 km2 (16.8%) of the original grassland area of the Foothills Fescue is still intact. The vast majority of ecologically intact native grassland within the Foothills Fescue Subregion occurs south of Nanton.

Ecodistricts are subdivisions of Natural Subregions that are delineated according to distinctive Physiographic and/or geological patterns. There are six Ecodistricts that occur within the Foothills Fescue Subregion. Nose Hill Park falls within the northern-most Ecodistrict – the Delacour Plain. This Ecodistrict stretches from Stavely in the south to the Crossfield area in the north.

According to mapping by Strong and Thompson (1995), the entire study area occurs within the Delacour Ecodistrict. This Ecodistrict is characterized by:

- 70% grassland (includes cultivated and pasture) vegetation on undulating (0% to 0.5%) morainal plain with moderately well drained, loam-textured black chernozem soils;
- 20% grassland (includes cultivated and pasture) on undulating (0.5% to 2.5%) morainal plain with moderately well drained, silty loam-textured black chernozem soils; and
- 10% grassland (includes cultivated and pasture) vegetation on rolling (6.0% to 9.0%), morainal deposits with well drained, sandy loam-textured dark brown chernozem soils.

As of the mid-1990s approximately 90% of the Delacour Ecodistrict had been cleared for agriculture (Strong and Thompson 1995).

3.1.2 Topography

Nose Hill Park is an isolated topographic remnant of the upland plain that flanks the Bow River valley (Kansas et al. 1993). The topography of Nose Hill Park includes three distinctive components: 1) upland plain; 2) side slopes [‘escarpment’]; and, 3) ravines that cut into the upland plain. Maximum topographic relief between the upland plain and lowest portion of the Park (SW corner) is 80 meters. The upland plain supports gently undulating (2 to 5%) to moderately sloping (5 to 9%) land surfaces. Side-slopes are generally between 15 and 30%. Ravines offer the steepest terrain at from 30 to 45%. O2 Planning and Design Inc. (2005) calculated that slopes between 0 and 10% occupied 47.1% of Nose Hill Park, while slopes from 10 to 30% and >30% comprised 41.5% and 5.4% respectively.

3.1.3 Parent Materials/Landforms

The integrated ecological land units (ecosites) mapped by Kansas et al. (1993) include information on dominant parent materials as well as landforms. Based on a re-grouping of ecosites, the following combinations of parent material and landform occur on Nose Hill Park:

- Anthropogenic lands — 156.9 ha (12 ecosites)
- Ravine slopes and bottoms — 183.4-ha (29 ecosites)
- Morainal plain — 481.7-ha (23 ecosites)
- Morainal slopes — 302.1-ha (16 ecosites)
- Waterbodies — 0.7-ha (1 ecosite)

Morainal plain landforms are the most abundant on Nose Hill Park (42.8% of Park). These landforms occur primarily on the flatter plateau portions of the Park on slopes ranging from 2 to 9% with some areas (on slope crests) supporting slopes of from 9 to 15%. Morainal slopes occupy 26.9% of the Park and occur as a fringe around the Park below the morainal plain. These landforms support slopes ranging from 5 to 45% but mostly occur between 15 and 30%. Ravine landforms comprise 16.3% of the Park. They are generally the most complex habitats in the Park and tend to support a wide range of vegetation associations. This is evidenced by the occurrence of 29 different ravine ecosites (as opposed to just 23 different morainal plain ecosites with 2.6 times the land area). Human-altered landforms (anthropogenic) occupy 13.9% of the park and are dominated by the large gravel pit on the plain and various cuts and fills. Waterbodies are rare on Nose Hill comprising 0.1% of the Park. No native wetlands occur in Nose Hill Park.

3.1.4 Soils

Each ecosite mapped by Kansas et al. (1993) includes information concerning dominant soil type (Soil Great Group). Based on a re-grouping of ecosites, the following soil combinations occur on Nose Hill Park:

- Orthic Regosols 156.9-ha
- Orthic Black Chernozems 894.9-ha
- Orthic Black and Dark Brown Chernozems 26.6-ha
- Orthic Dark Brown Chernozems 4.4-ha
- Orthic and Gleyed Black Chernozems 19.6-ha
- Orthic Eutric Brunisols/Orthic Black Chernozems 9.6-ha
- Orthic Black Chernozems/Orthic Eutric Brunisols 0.4-ha
- Orthic Eutric Brunisols 10.6-ha
- Gleyed and Orthic Black Chernozems 1.1-ha
- Not Soil (Water) 0.7-ha

The dominant soil type on Nose Hill Park is Orthic Black Chernozem, which occupies 79.6% of the Park. This soil type occurs on a wide variety of landforms and topographic site positions. The next most common soil type (13.9%) is Orthic Regosol, which is found only on disturbed (anthropogenic) sites. Dark Brown Chernozem soils are rare comprising just 31-ha (2.8%) of the Park. These soils occur only on steep ravine slopes that tend to support Western Wheatgrass plant associations. Gleyed Black Chernozem soils are equally rare occupying 20.7-ha (1.8%) of the Park. They are found on steeper (15 to 45%) ravine and morainal slopes with imperfect moisture regimes resulting from groundwater discharge. Willow-Snowberry shrub stands are found in association with Gleyed Black Chernozem soils. Orthic Eutric Brunisols are also a rare soil type in the Park that occurs on moderately well drained and steep (30 to 45%) ravine and morainal slopes. Aspen and balsam poplar forests are found with this soil type.

3.1.5 Vegetation Cover and Associations

Grasslands

Vegetation cover on Nose Hill Park is dominated by grassland, which occupies 979.9-ha (87.1%) of the Park (Kansas et al. 1993). Grassland dominated by native plants comprise 452.8-ha (46.2%) of the Park's grasslands. Grassland dominated by introduced (non-native) grass species make up the majority of grassland area (527.1-ha). The most common native grassland plant communities are Rough Fescue-Parry Oatgrass (265.7-ha), Rough Fescue-Golden Bean (155.1-ha) and Western Wheatgrass (31.5-ha). A very small amount of Needle Grass-Parry Oatgrass association also occurs embedded within the Rough Fescue matrix. Common non-native grassland communities include Bluegrass (203.6-ha), Western Wheatgrass – Bluegrass phase (157.3-ha), Smooth Brome (114.8-ha), Smooth Brome-Quack Grass (43.1-ha), and Alfalfa-Wheatgrass (8.8-ha).

Shrublands

As of the early 1990s, woody shrubland comprised a total of 74.4-ha (6.6%) of Nose Hill Park. Ecosites characterized by low shrub cover (<1 meter tall) occupy 43.9-ha of shrublands in the Park. These include the Rose/Snowberry (23.8-ha) and Snowberry (20.1-ha) plant community types. Medium height (1 to 3 meters) shrublands encompass 9.0-ha (0.8%) of the Park and include the Choke Cherry/Snowberry (0.3%), Saskatoon/Snowberry (7.9-ha) and Wolfwillow/Bluegrass (0.8-ha) plant communities. Tall shrubland (>3 meters) including the Willow/Snowberry (21.4-ha) and Poplar/Dandelion (13.4-ha) occupy 34.8-ha (3.1%) of the Park. The latter community is a primary succession type that occurs on the large gravel pit.

Forests

Forested land covers 33.7-ha (3.0%) of Nose Hill Park. Four forest plant communities occur including: Aspen/Rose (19.0-ha); Balsam Poplar/Rose (1.0-ha); Aspen/Snowberry (<0.5%); and, Aspen/Smooth Brome (13.2-ha). The first three communities are dominantly native, while the Aspen/Smooth Brome community represents disturbance vegetation resulting from historical grazing by livestock.

3.1.6 Rare Plants and Plant Communities

According to information provided by the Alberta Natural History Information Center (Vujnovic and Gould 2002), COSEWIC (2005), Moss (1983), Kansas et al. (1993) and Calgary Field Naturalists Society (Hallworth 1981) the following 14 rare plant species have potential to occur in Nose Hill Park.

Scientific Name	**Common Name**	**Habitat**
Carex tincta	Tinged sedge	Aspen/poplar forest: ravine bottoms
Ellisia nyctelea	Waterpod	Moist woods/stream banks
Geranium carolinianum	Carolina wild geranium	Clearings/disturbed ground
Orobanche uniflora	One-flowered cancer-root	Moist woods
Oryzopsis micrantha	Little-seed rice grass	Dry grassland
Oryzopsis canadensis	Canadian Rice grass	Grassland/open forest
Phacelia linearis	Linear-leaved scorpionweed	Dry grasslands
Polanisia dodecandra	Clammyweed	Gravelly/sandy soils
Potentilla finitima	Sandhills cinquefoil	Native grasslands
Rorippa tenerrima	Slender cress	Moist ravine bottoms
Sisyrinchium septentrionale	Pale blue-eyed grass	Moist meadows; grassy stream banks
Stellaria crispa	Chickweed	Moist forest
Viola pedatifida	Crowfoot violet	Banks in prairie grassland
Weissia controversa	Green-cushioned weissia	

Habitat affiliations of the above species indicate that habitats occurring on Nose Hill Park that have the greatest potential to support rare plants are as follows:

- Steep, well drained south and west facing ravine and morainal slopes with native grassland; and,

- Ravine bottoms and lower slopes with imperfectly drained soils that support Balsam Poplar and tall willow plant communities

Based on a review of descriptions of rare plant communities in the Foothills Fescue Subregion (Allen 2005) and the detailed botanical descriptions by Kansas et al. (1993), it is unlikely that any provincially rare plant communities occur on Nose Hill Park.

3.1.7 Wildlife Species and Habitats

Kansas et al. (1993) noted that 151 species of vertebrate wildlife were reported to occur in Nose Hill Park. This list included 127 bird, 22 mammal and 2 amphibian species. Songbird point counts conducted at 23 locations in 1993 resulted in the identification of 49 different bird species. Habitats with the highest bird species richness were the man-made pond in the SW corner, ravines and coulees with mixed low shrub and native grassland, and aspen/balsam poplar forests. Highest abundance of breeding songbirds was observed in the tall willow/snowberry habitat on ravine slopes of the Porcupine Valley. Lowest bird species richness was observed in non-native grasslands especially the Western Wheatgrass –bluegrass phase plant community. An exception was the Alfalfa-Wheatgrass community type, which supported relatively high species diversity and abundance. Based on known breeding and foraging habitat requirements, the authors noted that deciduous forest (aspen and balsam poplar), native [Rough Fescue] grassland, and tall willow communities were primary foraging and breeding habitat for the largest number of bird species.

Small mammals were inventoried at 7 locations during the 1993 study (Kansas et al. 1993). A total of 5 species of small mammals (voles, mice and shrews) were captured. Small mammal diversity was greatest in ravines that supported a mosaic of low shrub and native grassland. Other habitats that had abundant and diverse small mammal assemblage were Rough Fescue-Golden Bean native grassland, seepage tall willow/snowberry shrub, and aspen/rose forest.

3.1.8 Wildlife Species at Risk

Significant changes have occurred in the classification of vertebrate species at risk since the 1993 biophysical inventory and analysis of Nose Hill Park was completed. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) has updated its listings, as has the Alberta government. Designation systems have changed and the federal Species at Risk Act (SARA) has come into force. An updated list of vertebrate species at risk based on recent regulatory status documents (AEP 2000, 2001, 2002; FWD

2004; ASRD 2004; COSEWIC 2005; SARA 2005) is presented in Table 1. Status and abundance definitions are presented below. At risk definitions are presented in Table 2.

Status

- **S** summer resident, migrates out of study area for the winter
- **W** winter resident, present only during late fall, winter and early spring
- **R** permanent resident, present year-round although not necessarily active during winter
- **M** migrant, passes through area during spring and/or fall, not normally resident at any time of the year
- **T** transient, expected to occur only in passing, not normally resident at any time of the year

Abundance

- **C** common, detected whenever suitable habitat is investigated during an appropriate season
- **U** uncommon, detected often, but not always, whenever suitable habitat is investigated during an appropriate season
- **S** scarce, detected occasionally, but not usually, even when suitable habitat is investigated during an appropriate season
- **R** rare, unexpected but could occur in any given year, would not generally be considered a regular component of the study area fauna

Twelve Species at Risk occur or have potential to occur in Nose Hill Park including eight birds, two mammals and two reptiles (Table 1).

Table 1. Vertebrate Species at Risk Known, or with Potential, to be Resident in Nose Hill Park

Common Name	Scientific Name	Status*	Abundance*	Habitat Suitability	At Risk Designation*			
					Alberta		COSEWIC	SARA
					General	ESCC		
Sharp-tailed Grouse	*Tympanuchus phasianellus*	R	S	H	Sensitive			
Swainson's Hawk	*Buteo swainsoni*	S	C	H	Sensitive			
Prairie Falcon	*Falco mexicanus*	R	S	M	Sensitive			
Peregrine Falcon	*Falco peregrinus*	R	S	L	At Risk	Threatened	Threatened	Schedule 1
Short-eared Owl	*Asio flammeus*	S	S	H	May Be At Risk		Special Concern	Schedule 3
Common Nighthawk	*Chordeiles minor*	S	S	H	Sensitive			
Sprague's Pipit	*Anthus spragueii*	S	U	H	Sensitive	Special Concern	Threatened	Schedule 1
Baird's Sparrow	*Ammodramus bairdii*	S	U	H	Sensitive			
Long-tailed Weasel	*Mustela frenata*	R	U	H	May Be At Risk			
American Badger	*Taxidea taxus*	R	R	M	Sensitive			
Wandering Garter Snake	*Thamnophis elegans*	R	U	H	Sensitive			
Red-sided Garter Snake	*Thamnophis sirtalis*	R	U	H	Sensitive			

* refer to section 2.7

Table 2. At Risk Definitions

(AEP 2000; AEP 2001; FWD 2004; ASRD 2005; COSEWIC 2005; SARA 2005)

Alberta Environmental Protection (AEP)

General Status

At Risk – any species known to be "At Risk" after formal detailed status assessment and designation as "Endangered" or "Threatened" in Alberta

May Be At Risk – any species that "May Be At Risk" of extirpation or extinction, and is therefore a candidate for detailed risk assessment.

Sensitive – any species that is not at risk of extinction or extirpation but may require special attention or protection to prevent it from becoming at risk.

Endangered Species Conservation Committee

Endangered – a species facing imminent extirpation or extinction.

Threatened – a species likely to become endangered if limiting factors are not reversed.

Special Concern – a species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.

Data Deficient – a species for which there is insufficient scientific information to support status designation.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC)

Endangered - a species facing imminent extirpation or extinction.

Threatened - a species likely to become endangered if limiting factors are not reversed.

Special Concern - a species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.

Not at Risk - a species that has been evaluated and found to be not at risk.

Indeterminate - a species for which there is insufficient scientific information to support status designation.

3.1.9 Environmentally Significant/Sensitive Features

Kansas et al. (1993) synthesized biophysical inventory and analysis information on Nose Hill Park for the purpose of identifying significant environmental features. A total of 25 'candidate' environmentally significant features were identified based on this synthesis. Twelve of the 25 features were biological in nature (8 fauna and 4 flora); 5 geological; 5 cultural-archaeological; 2 hydrological; and, 1 landform-related. The significance of these features was scored and rated based on accepted criteria established by Alberta Recreation and Parks (1988). These criteria included abundance, representativeness, exclusive characteristics, scientific/educational importance, and quality. The biological resource features with the highest aggregate significance scores were all associated with Rough Fescue grassland. These included the two Rough Fescue plant communities, which were botanically diverse and supported abundant wildlife, and the Baird's Sparrow, which at the time was listed as a nationally threatened species. Rough Fescue grassland was also considered to be regionally significant because of its declining supply and rarity. Other relatively highly rated biological resource features included the moist deciduous and tall shrub communities associated with large ravines such as the Porcupine and Many Owls valleys. These habitats are of limited land area, are structurally and botanically diverse and offer important nesting substrate for birds and hiding cover for mammals. At the wildlife species level, Deer, American Badger, Richardson's Ground Squirrel and Sharp-tailed Grouse were all rated as significant features of Nose Hill Park.

Physical landscape features with highest aggregate significance scores were associated with glacial features, specifically glacial erratics, boulders with striations and sandstone boulders. Nose Hill Tertiary gravels were also highly rated. Man-made ponds and the weak seepage zones affiliated with ravine Willow/Snowberry plant communities were considered to be candidate hydrological features of environmental significance.

All of the above environmental features may still be considered to be significant on Nose Hill Park today. There is however uncertainty concerning the persistence of breeding Sharp-tailed grouse and American Badger on Nose Hill Park. No Sharp-tailed Grouse have been observed in the Park in recent years. Badger occurrence was not confirmed in 1993 by Kansas et al. (1993). Both of these species are sensitive to human and dog disturbance.

The increased concern for Sprague's Pipit as evidenced by up-listing to Threatened nationally make it another candidate feature of significance on Nose Hill Park. During 1993 surveys Sprague's Pipit was detected at 10 of 23 songbird point count locations. It was most abundant in Rough Fescue grasslands both on the morainal plateau and in ravine bottoms.

The current status of Sprague's Pipit and other sensitive bird species (e.g. Baird's Sparrow) is unknown without additional focused field surveys.

3.2 Local [Pathway Route] Context

The purpose of this section of the report is to document baseline environmental conditions in the immediate vicinity of the planned cross-park pathway routes. This information allows comparison with regional [park-wide] supply of similar biophysical conditions and places potential project impacts in a regional perspective.

3.2.1 Ecosites Transected by Pathways

Ecosites are integrated ecological land units that provide information on topography, parent materials, landforms, soils, vegetation cover and plant association. Understanding which, how many and how much of the various ecosites are transected by the planned pathways is fundamental to evaluating project impacts. Figure 2 shows the location of the two planned pathways relative to ecosites from Kansas et al. (1993). Below we summarize the amount of each ecosite (by length) transected by each planned pathway.

N-S Route

The N-S pathway route is 4,470 meters (4.47 km) in length. Table 3a shows the lengths of the planned route transecting each affected ecosite. It also describes the biophysical conditions characteristic of each affected ecosite. The majority (71.8%) of the route crosses ecosites that are classified [at a Park-wide level] as non-native vegetation. The remaining 28.2% (1,530 meters) crosses ecosites with a native vegetation classification. Of the 1,530 meters of route that crosses native vegetation, 1,159 meters are classified as Rough Fescue grasslands and the remainder (371 meters) as Aspen-Rose forest.

The majority (74.3%) of the N-S Route traverses morainal plain landforms with much of this length occurring along the upper escarpment. The route also crosses ravine slopes and bottoms (11.3%), morainal slopes (8.3%) and anthropogenic (human-altered) landforms (6.1%). The route is located primarily on near level to gently sloping landforms. Over 3/4 (76.0%) of the route is located on slopes of less than 10%. Only 13.8% of the route is located on slopes of greater than 15%. The vast majority (91.6%) of the N-S Route crosses ecosites that support solely or predominantly Orthic Black Chernozem soils. Other soils traversed by the route include Orthic Regosols (6.1%) and Orthic Eutric Brunisols (2.3%)

E-W Route

The E-W pathway route is 3,158 meters (3.16 km) in length. Table 3b shows the lengths of the planned route transecting each affected ecosite. It also describes the biophysical conditions characteristic of each affected ecosite. The majority (83.9%) of the route crosses ecosites that are classified [at a Park-wide level] as non-native vegetation. The remaining 16.1% (510 meters) crosses ecosites that support a predominantly native vegetation classification. Of the 510 meters of route that crosses native vegetation, 140 meters are classified as Rough Fescue grasslands and the remainder as mixed native grassland with low shrubs.

Table 3a. Ecosites transected by N-S Pathway Route					
Ecosite	***Length (m)***	***Dominant Vegetation***	***Landform***	***Percent Slope***	***Soil Great Group***
3A1.5/1	271	Non-native grassland	Anthropogenic	0-5%	Orthic Regosol
3F1.8/10	305	Non-native grassland	Ravine slopes	5-30%	Orthic Black Chernozem
3F1.8/2	44	Non-native grassland	Ravine slopes and bottoms	9 –30%	Orthic Black Chernozem
3F1.8/3	157	Non-native grassland	Ravine slopes and bottoms	30-45%	Orthic Black and Dark Brown Chernozem
3M1.13/1	68	Native [Fescue] grassland	Morainal plain [hummocky]	5-30%	Orthic Black Chernozem
3M1.24/1	1	Non-native grassland	Morainal plain [inclined]	2-9%	Orthic Black Chernozem
3M1.24/3	530	Non-native grassland	Morainal plain	5-9%	Orthic Black Chernozem
3M1.25/1	939	Native [Fescue] grassland	Morainal plain	2-5%	Orthic Black Chernozem
3M1.26/1	11	Native [Fescue] grassland	Morainal slope	15-30%	Orthic Black Chernozem
3M1.26/3	24	Native [Fescue] grassland	Morainal slope	5-9%	Orthic Black Chernozem
3M1.26/7	235	Native-Non-native mixed grassland	Morainal slope	15-30%	Orthic Black Chernozem
3M1.27/1	101	Aspen forest	Morainal slope	9-30%	Orthic Eutric Brunisol
3M1.6/1	203	Non-native grassland	Morainal plain [undulating]	2-5%	Orthic Black Chernozem
3M1.8/1	1021	Non-native grassland	Morainal plain	2-5%	Orthic Black Chernozem
3M1.8/11	243	Non-native grassland	Morainal plain	2-5%	Orthic Black Chernozem
3M1.8/3	150	Non-native grassland	Morainal plain	9-15%	Orthic Black Chernozem
Edgemont Parking Lot	167	Non-native grassland	Morainal plain	2-9%	Orthic Black Chernozem

Table 3b. Ecosites transected by E-W Pathway Route					
Ecosite	***Length (m)***	***Dominant Vegetation***	***Landform***	***Percent Slope***	***Soil Great Group***
3A1.1/3	15	Non-vegetated – Cuts and fills	Anthropogenic	30-45%	Orthic Regosol
3F1.1/4	45	Native grassland/shrubland	Ravine slopes	30-45%	Orthic Black Chernozem
3F1.8/5	113	Non-native grassland	Ravine slopes and bottoms	15–30%	Orthic Black Chernozem
3F1.8/10	392	Non-native grassland	Ravine slopes	5-30%	Orthic Black Chernozem
3M1.8/1	931	Non-native grassland	Morainal plain	2-5%	Orthic Black Chernozem
3M1.8/4	459	Non-native grassland	Morainal plain [undulating to rolling]	2-9%	Orthic Black Chernozem
3M1.24/1	48	Non-native grassland	Morainal plain [inclined]	2-9%	Orthic Black Chernozem
3M1.24/2	164	Non-native grassland	Morainal plain [draw]	5-9%	Orthic Black Chernozem
3M1.25/1	17	Native [Fescue] grassland	Morainal plain	2-5%	Orthic Black Chernozem
3M1.26/1	26	Native [Fescue] grassland	Morainal slope	15-30%	Orthic Black Chernozem
3M1.26/3	97	Native [Fescue] grassland	Morainal slope	5-9%	Orthic Black Chernozem
3M1.29/1	812	Non-native-Native mixed grassland	Morainal slope	15-30%	Orthic Black Chernozem
Edgemont Parking Lot	39	Non-native grassland	Morainal plain	2-9%	Orthic Black Chernozem

3.2.2 Site-Specific Pathway Descriptions

Ecosite mapping was conducted at a scale that may not represent actual conditions at a specific location on the land. The purpose of this task was to verify the substrate nature (width, surface) and immediately adjacent vegetation conditions along each of the two specific pathway routes. This data was essential in order to determine site-specific habitat impacts of the planned paving of pathways.

N-S Route Field Description

Site visits were conducted on November 4 and 9, 2005. GPS waypoints used to describe pathway route segments are illustrated in Figure 3 and UTM coordinates in Table 4. Photographs of representative N-S route locations are provided in Appendix 1.

- The current pathway is 2 meters wide and paved through non-native grassland from the Edgemont parking lot to waypoint 1 (Appendix 1 - Photo 1).

- The current trail is approximately 7 meters wide and is packed dirt and vegetation between waypoints 1 and 2. This portion of the path passes through non-native grassland (Appendix 1 – Photo 2)

- The current pathway is 2 meters wide and paved between waypoints 2 and 3. It passes through disturbed native grassland (Appendix 1 – Photo 3).

- The current trail is 3-4 meters wide and is packed dirt and vegetation between waypoints 3 and 6. The trail passes through disturbed native grassland to waypoint 4 (Appendix 1 – Photo 4) and then crosses non-native grassland, a draw that is infested with smooth brome and non-native grassland and an old cultivated field.

- At waypoint 6 there is a sliver of native prairie and a draw infested with smooth brome (Appendix 1 – Photo 5). The trail turns easterly at this point.

- The current trail is 3 meters wide and is packed dirt and vegetation between waypoints 6 and 14. The trail roughly follows the crest of the escarpment between these waypoints. The vegetation to the north of the trail is all significantly disturbed native grassland, non-native grassland and an old cultivated field.

- The trail crosses the best example of native grassland along the entire route (approximately 50 meters) south of the path between waypoints 6 and 8 (Appendix 1 – Photo 6). It also passes an Aspen stand (waypoint 7) with an understory comprised of non-native Smooth Brome.

- Waypoint 8 is the top of a draw that is infested with smooth brome (Appendix 1 – Photo 7).

Table 4. Waypoints along the proposed pathway routes (NAD83 Zone 11U)				
Waypoint	**North – South Route**		**East – West Route**	
	Easting	**Northing**	**Easting**	**Northing**
1	700767	5667489	700642	5667795
2	701071	5666953	700640	5667823
3	701114	5666698	700671	5667793
4	701124	5666625	700683	5667779
5	701160	5666449	700789	5667710
6	701158	5666188	700856	5667664
7	701337	5666095	700919	5667665
8	701388	5666077	700997	5667658
9	701492	5666063	701086	5667658
10	701729	5666076	701069	5667503
11	701852	5665862	701145	5667416
12	701890	5665820	701588	5667218
13	701983	5665707	701691	5667204
14	702097	5665406	701717	5667183
15	702034	5665328	701917	5667224
16	701886	5665465	702166	5667229
17	701161	5665254	702605	5667257
18			702928	5667476
19			702981	5667516
20			703007	5667522
21			703236	5667578
22			703294	5667574

- There is a sliver of native grassland (about 20 m) east of the draw.

- Between waypoints 9 and 10, the vegetation immediately south of the path is a strip of non-native grasses and thistle invading into native grassland.

- The vegetation between waypoints 10 and 14 is predominantly non-native with patches of disturbed native grassland south of the path (Appendix 1 – Photo 8).

- At waypoint 11 is a short stretch of Rough Fescue that is invaded by Smooth Brome and Canada thistle.

- From waypoint 14 to its junction with the old service road the trail is a 3-meter wide gravel trail (Appendix 1 – Photo 9). It passes an aspen stand with a degraded understory.

- The rest of the current trail follows the old service road through the Many Owls Valley. It varies in width from 3-5 meters and is gravel. The vegetation along the road is predominantly Smooth Brome, Snowberry, Rose and other native and introduced shrubs. Large patches of toadflax occur at the upper end of this trail segment (above waypoint 16). There are several piles of concrete blocks lying along the road below waypoint 16 (Appendix 1 – Photo 10). Where the path turns west towards the Brisebois access, it passes through an aspen forest with an understory of predominantly non-native Smooth Brome.

E-W Route Field Description

The site visit for the E-W pathway route was conducted on November 18, 2005. GPS waypoints used to describe pathway route segments are illustrated in Figure 4 and UTM coordinates for waypoints in Table 4. Photographs of representative E-W route locations are provided in Appendix 2.

- This section starts at the Edgemont Boulevard N.W parking lot at waypoint 2. The entrance of the park is approximately 40 meters uphill at waypoint 3 along paved pathway

- From waypoint 3 to 4 the trail is 6m wide and is comprised of a gravel surface. The trail is flat, and both sides of it are dominated by non-native Crested Wheat Grass (Appendix 2 – Photo 1).

- The trail is 3m wide between waypoints 4 and 5 (Appendix 2 – Photo 2). This subsection is dirt/vegetation on a flat surface with non native plant species as dominant vegetation; mainly Smooth Brome with some Kentucky Bluegrass, Crested Wheatgrass and Rose.

- From waypoint 5 to 6, the trail is dirt/vegetation and 4 to 5 m wide going down hill (Appendix 2 – Photo 3). Non-native vegetation dominates this subsection, with some patches of heavily degraded grasslands (Smooth Brome infestation).
- At waypoint 6 there is a cross roads, surrounded by non-native vegetation (Smooth Brome). The trail heads east at this point.

- From waypoint 6 to 7 the trail is 3m wide on dirt/vegetation and goes down hill (Appendix 2 – Photo 4). The vegetation cover at this point is disturbed grassland with Smooth Brome as the dominant plant species.

- The trail is still dominated by non-native vegetation (Smooth Brome) on both sides between waypoints 7 and 8 but in this subsection very small patches (1m long by 0.2m wide, approx) of Needlegrass (*Stipa* sp.) were observed (Appendix 2 – Photo 5).

- The pathway is approximately 2m wide between waypoints 8 and 10, and it has Smooth Brome as the dominant species. It goes uphill between waypoints 8 and 9 (Appendix 2 – Photo 6) and changes direction to the South at waypoint 9 where there is a cross trail. The pathway goes parallel to an Aspen stand between waypoints 9 and 10.

- At waypoint 10 the dirt/vegetation trail intersects the approximately 2m wide paved pathway (Appendix 2 – Photo 7).

- At the intersection with the Edgemont Pathway, the pathway turns SE, following a dirt/vegetation trail 2m wide. The terrain is flat to slightly undulate. Disturbed grassland with Smooth Brome and Kentucky Bluegrass as dominant species.

- At waypoint 11 the trail splits, and the recommended pathway route follows the route going to the East. From waypoint 11 to 12 the path is approximately 2-3 m wide on a dirt/vegetation surface. The terrain is flat to slightly undulating and the grassland is disturbed by Smooth Brome and weeds (Appendix 2 – Photo 8)

- From waypoint 12 to the end of the recommended pathway route the route follows the crest of a valley, and runs 50m parallel to some patches of aspen and tall shrubs that are in the bottom and in the north-facing slope of the valley.

- The existing route from waypoint 12 to 14 is 3m wide on flat terrain with dirt/vegetation substrate. The vegetation is disturbed, being dominated by Smooth brome, Kentucky Bluegrass and some weeds (Appendix 2 – Photo 9). At waypoint 13 the recommended pathway route crosses a small trail – a few meters ahead, and at waypoint 14, the route joins the existing Porcupine Valley paved pathway.

- This section follows an existing 3m wide paved pathway (Porcupine Valley pathway) (Appendix 2 – Photo 10). From waypoint 14 to 17 the predominant vegetation community on both sides of the current pathway is either non-native, or heavily disturbed grasslands with smooth brome as dominant species.

- From waypoint 17 to 18 the current 3-m wide paved pathway continues through a disturbed native grassland that contains shrubby vegetation composed of Rose sp., Buckbrush (*Symporicarpus* sp.) and Sagewort (*Artemisia* spp.) (Appendix 2 – Photo 11)

- A patch of native grassland was found 2-3m South of the pathway border and between waypoints 18 and 19 (Appendix 2 – Photo 12).

- Between waypoints 19 and 20, in the South side of route, the grassland shows a low degree of disturbance (Appendix 2 –Photo 13).

- At waypoint 20 the current pathway intersects another paved pathway that leads toward the Berkeley Gate parking lot. From waypoint 20 to 21, at the South side of pathway, a less disturbed patch of native grassland was found which has some inclusions of Smooth Brome (Appendix 2 – Photo 14). .

- From waypoint 21 to 22 the paved pathway goes downhill to the parking lot.

3.2.3 Summary of Routes

N-S Route

- The entire N-S Route follows existing linear disturbance features including a gravel service road (26.5%), paved pathway (14.1%), and dirt/vegetation trail (59.4%).

- Existing trail widths range from 2 to 7 meters. Percent of total distance by trail width are: 2-m (14.1%); 3-m (35.5%); 3 to 4-m (11.6%); 4-m (24.7%); and, 7-m (14.1%).

- The N-S Route as currently planned traverses 255.6-m (5.7%) of lands that are in a predominantly native [grassland] condition; 675.5-m (15.1%) that is mixed native/non-native grassland; and, the remainder (79.2%) non-native habitat.

E-W Route

- The entire E-W Route follows existing linear disturbance features including: paved pathway (56.8%), gravel trail (0.6%), and dirt/packed-vegetation trail (42.6%).

- Existing trail widths range from 2 to 6 meters. Percent of total distance by trail width are: 2-m (11.7%); 3-m (85.1%); 5-m (2.6%); and 6-m (0.6%).

- The eastern-most 833-meters (26.3%) of the E-W Route traverses an area of mixed native/non-native grassland. The remaining portion of the route crosses disturbed lands.

4.0 ASSESSMENT OF BIOPHYSICAL IMPACTS

4.1 Project-Specific and Future Land Use Descriptions

4.1.1 Project-Specific

The NHTPP recommended N-S cross-park pathway is 4,470 meters in length. The route as proposed follows existing paved and dirt trails and a gravel service road at approximate elevations between 1100 m at the Brisebois access to 1300m at the high point on top of the escarpment. The route follows an old service road from the Brisebois access up the Many Owls Valley, east towards the gravel pit before swinging back to the north and west at the top of the escarpment. It follows a dirt/vegetation trail across the top of the escarpment north and west until it meets the paved pathway leading to the Edgemont access location.

The E-W cross-park pathway is 3,158 meters in length. The route connects Edgemont Boulevard N.W. parking lot with the parking lot at Berkeley Gate, crossing the upper section of the Nose Hill Park from West to East. Existing trails, many of which are braided, are followed for the entire length of this route.

Construction will result in a three-meter wide disturbance footprint including a two-meter wide finished pathway and approximately 0.5 meters on either side for workspace. The pathway surface will be comprised of a base of standard asphalt (as identified in Parks Development Guidelines and Standard Specifications Manual - 2004) covered with aggregate gravels

4.1.2 Future [Cumulative] Land Uses

The construction of the two cross-park pathways is one of the 15 recommendations arising from the Council Approved (July 2005) Nose Hill Trail and Pathway Plan (NHTPP) (O2 Planning and Design 2005). The recommendations of the NHTPP were grouped into: 1) Park use and routing recommendations; 2) Park amenity and parking lot upgrade recommendations; and, 3) implementation and management recommendations. Assessing cumulative land use impacts requires the identification of other [future land use] actions that may interact with effects caused by the action under review. Other land use actions can be classified as certain, reasonably foreseeable or hypothetical. Future land actions associated with the NHTPP are best classified as “reasonably foreseeable” according to criteria established by Hegmann et al. (1999).

The NHTPP recommendations that are most likely to result in future impacts to Park biophysical resources include:

- *Modify the configuration of the multi-use and escarpment zones*

    - This recommendation alters multi-use and escarpment zone boundaries to more accurately follow existing desire lines and areas of vegetation disturbance. This would re-direct multi-use activities away from native prairie vegetation particularly along the south side of the Porcupine Valley.

- *Establish an upper plateau route that clearly defines the modified multi-use and escarpment zone boundary*.

    - The intent of this recommendation is to establish well-demarcated trails and pathways (either granular or paved) around the edge between the native-dominated escarpment zone and the non-native dominated multi-use zone on the Park's plateau. The N-S paved route contributes to a major portion of the western boundary of this demarcation (Figure 1). From a biophysical impact perspective, implementation of this recommendation would serve to: 1) reduce human use of native areas (through clearer definition of boundaries); 2) reduce spread of non-native species from disturbed areas on plateau to native vegetation on escarpment; 3) convert 7.8 km of informal dirt/tread to granular surface-almost entirely in disturbed and non-native grassland areas; and, 4) reduce dirt surface areas, thereby reducing land available for noxious weed invasion.

- *Require all users to stay on designated pathways and trails outside of the multi-use zone.*

    - This recommendation could lead to significant reductions in the level of unrestricted human use throughout the Park including use of existing [informal] escarpment zone trails (mainly on native lands) and general dispersed use throughout the Park. It would lead to a concomitant increase in the use of the multi-use zone on the plateau, which occurs predominantly in non-native habitat. This recommendation would protect native plant communities and their fauna in the escarpment zone and would promote greater success of trail reclamation activities.

- *Adopt the proposed designated routing plan that provides for primary, secondary, upper plateau, cross-park and maintained track routes, as well as the pre-existing barrier free interpretive pathway.*

    - The NHTPP produced a routing plan that contains approximately 60.9 km of designated Park routes. This would result in the alteration of approximately 52 km of existing dirt tread trail to granular surface (24.1 km) and stabilized tread (27.9 km). It also includes the paving of 7.9 km of trail (i.e. as per this BIA). If implemented successfully in concert with the previous recommendation, the designated routing plan would reduce the use of existing informal Park trails by 80% and completely ban the public from wandering through native habitats. The majority of informal trail use reduction would occur on native lands within the escarpment zone. Upgrading of the existing trail surfaces would result in reduced trail proliferation and erosion of designated trails.

- *Close and rehabilitate all informal routes not included in the designated routing system.*

    - This recommendation would include developing a strategy for restoring >200 km of informal trails that would be closed to human use according to the NHTPP designated routing plan. This strategy would be supported by provision of well-marked trails and pathways that would clarify what is designated and what is not. Closure of informal trails has potential to reduce habitat loss and increase wildlife abundance by reducing sensory disturbance. Rehabilitation of informal trails has potential to decrease fragmentation and increase habitat quality supply for many wildlife species.

- *Close the Charleswood Drive entrance to the park upon completion of the Brisebois Drive pedestrian overpass.*

    - This recommendation would reduce informal entry into the Park across John Laurie Boulevard and up the existing informal escarpment trails. This action would reduce potential habitat loss and decrease sensory disturbance to wildlife on informal trails through native habitat along the escarpment adjacent to Charleswood Drive. Shifting human use to the Brisebois portion of the Park (pedestrian overpass) will minimally offset portions of the gains associated with avoiding the Charleswood area.

The implementation schedule for NHTPP recommendations calls for the surfacing and rehabilitation of trails to occur from 2006 to 2008.

4.2 Selection of Valued Ecosystem Components

Since no environmental assessment can study every aspect of the environment, a practical approach is to collect and analyze information only for relevant and valued environmental components (Spaling et al. 2001). Valued Ecosystem Components (VECs) are selected as indicators against which the significance of project-specific and cumulative land use impacts can be measured and monitored (Shoemaker 1994). Important criteria for selecting VECs include the following:

- Candidate VEC has documented susceptibility to the land action assessed;
- Candidate VEC is of recognized value, significance and/or sensitivity;
- Candidate VEC is suitable for monitoring (i.e. sufficient numbers, detectable);

Kansas et al. (1993) conducted a rigorous assessment of significance and sensitivity for Nose Hill Park environmental features. The list of 25 candidate features was reviewed with respect to the nature and magnitude of the project-specific and cumulative land actions proposed. Based on this review a total of 5 VECs were selected for this assessment. These VECs include: Rough Fescue Grassland supply; Rough Fescue grassland bird community diversity/abundance; Grassland native plant integrity; Ravine Aspen forest and tall willow bird community diversity/abundance; and Habitat with High Rare Plant Potential. Table 5 summarizes rationale for the selection of these five VECs.

Geologically significant features identified by Kansas et al. (1993) were not chosen as VECs because of the limited degree of threat to these features. Populations of Sharp-tailed Grouse and American badger were not selected because of their apparent current absence. Remnant deer populations were not chosen because of the inherent resilience of deer to human land use (Brush and Ehrenfeld 1991, Swihart et al. 1994).

Rare plants were not selected as environmentally significant features on Nose Hill by Kansas et al. (1993). Notwithstanding this fact, we selected rare plants [habitat potential] as a VEC for the following reasons:

- Native plants are considered wildlife under the National Wildlife Policy for Canada to which all provinces, territories and the federal government are signatories.
- The recent passage of Canada's Species at Risk Act heightens the need for consideration of rare plants, especially species at risk, in land use decisions.
- This is becomingly increasingly important as Alberta's native flora is increasingly at risk through the spread of human activities (Wallis et al. 1986).
- Rare plant lists and vascular plant range maps have been completed at regional, provincial and national levels (Vujnovic and Gould 2002; Allen 2005).

Large mammal species were purposefully not selected as VECs for the following reasons:

1. The remaining large mammals on Nose Hill Park are deer and coyote. The reason that they remain is that they are generalist foragers that are highly resilient to human activities.
2. VECs should be susceptible to the land action proposed. Neither deer nor coyote will be affected materially by the paving of cross-park pathways. In fact, by restoring trails especially in ravines, these two species will likely benefit from the planned Nose Hill Trail and Pathway Plan.
3. The only other large mammal that was considered was American Badger. Unfortunately, while this species did occur prior to the 1990s on Nose Hill, fragmentation effects and the level of human and dog use appears to have led to its disappearance.

Table 5. Valued Ecosystem Components (VECs) and rationale for selection

Valued Ecosystem Component	*Selection Rationale*
Rough Fescue Grassland supply	- Regionally important and rare ecosystem - Represents climax native grassland community - Representative native grassland on Nose Hill - Supports diverse wildlife assemblages - Most susceptible native grassland to trampling - NHTPP routing plan will affect Rough Fescue
Rough Fescue grassland bird community diversity/abundance	- high songbird species diversity/abundance - Occurrence of provincially and nationally listed species – Baird's Sparrow and Sprague's Pipit - grassland nesting species susceptible to impacts of recreational trail use elsewhere in North America
Grassland native plant integrity	- Over half of native grasslands currently altered in the Park - Native grasslands susceptible to invasive plants - Invasive plants a known problem along trails in Park
Ravine Aspen forest and tall willow bird community diversity/abundance	- ravine aspen and tall willow communities support highest songbird diversity in Park - important nesting habitat for songbirds and raptors - current informal use of ravines has potential to affect bird nesting success
Habitat with High Rare Plant Potential	- As many as 14 species of rare plants have potential to occur in Nose Hill Park (listed in Section 3.1.6) - Conservation profile of rare plants has heightened since 1993 inventory and analysis - No detailed rare plant inventory has been conducted in Nose Hill Park

4.3 Potential Project Impacts on VECs

This section of the report describes ways in which the proposed project-specific and future land uses may impact Valued Ecosystem Components.

4.3.1 Direct Habitat Loss

This includes the physical loss or gain of vegetation that is inherently valuable or useful to wildlife for feeding, denning, cover and reproduction. Land uses in Nose Hill Park most likely to result in direct habitat loss are erosion by trampling, route construction/re-surfacing; building of facilities; and, rehabilitation/restoration of plant associations.

Re-surfacing of routes with pavement, granular materials, and stabilized tread will lead to direct, long-term loss of vegetation and wildlife habitat along the linear strip of re-surfaced trail or pathway. When, however, re-surfacing occurs in areas that currently support pavement, gravel or severely compacted dirt/packed-vegetation surfaces then there is little or no functional loss of existing habitat. This is particularly true if continued or increasing levels of human use are predicted to occur on informal trails.

The physical footprint of proposed paving of the cross-park routes would affect a 3-meter wide strip of land (2-m of actual paved surface). The entire N-S and E-W routes follow existing trails and pathways of variable width and substrate status. Portions of the routes that are greater than or equal to 3-m in width and/or do not cross native lands will have little impact on VECs. Based on site-specific inventory summarized in Sections 3.2.2 and 3.2.3 it is estimated that the following amounts of native or semi-native vegetation would be impacted by the paved pathway routes.

N-S Route

- Between waypoints 6 and 8 a distance of 256 meters x 3-m = 768 m^2 (good condition native vegetation).

- Between waypoints 8 and 10 a distance of 342 meters x 3-m = 1,026 m^2 (disturbed native vegetation).

E-W Route

Where the E-W route traverses native or semi-native vegetation there is an existing pathway of 3-m width. Even if this pathway were re-surfaced, there would be no damage to existing native vegetation.

4.3.2 Habitat Fragmentation/Movement Obstruction

Fragmentation of habitat occurs when large contiguous patches of native land are broken up into smaller, isolated pieces (Noss and Csuti 1997). Fragmentation can take the form of blocks of land (agricultural fields, clearcuts) or linear strips (roads, pipelines, trails). On Nose Hill Park both of these effects have occurred (Gabert 1991, O2 Planning and Design Inc. 2005). Blocks of native habitat on the morainal plateau were converted to agricultural land in the late 1890'and early 1900's. A large gravel pit was subsequently constructed in the 1960's. Roads and trails began to proliferate in the 1950s and have steadily increased to the present time. Human use continues to increase on existing and new [informal] trails adding to the fragmentation effect through habitat alienation.

Fragmentation exerts its effect on wildlife populations in a number of ways (Noss and Csuti 1997). Initial exclusion occurs for species that occur only in the areas subject to development. These are usually animals with a very narrow distribution occurring in only a few patches of suitable habitat. Isolation of habitats through barriers to movement can then occur, effectively reducing habitat availability. Small, isolated habitats support smaller population sizes, which are in turn more susceptible to local extinction. Increased edge habitats often favor highly mobile and resilient plant and animal species, which then out-compete or prey on species that are less well adapted to edge.

Connectivity can be considered as the probability that an animal will move between habitat "patches" in the landscape (Taylor et al. 1993). The degree to which an animal will move effectively between patches depends on how close the patches are and how well they are connected (Taylor et al. 1993). If the structure, quality or availability (effectiveness) of lands between suitable habitat patches is degraded significantly by natural or human-caused disturbance then movement between patches lessens and patches become isolated. This fragmentation of habitat through movement obstruction can result in the conversion of continuous stable populations into increasingly unstable "metapopulations" (Harrison and Voller 1998).

The dominant land use feature of Nose Hill Park that exerts habitat fragmentation is in the form of a dense network of informal trails and uncontrolled accessibility to all habitats anywhere in the park. The effects of this kind of fragmentation on wildlife are not fully known, although there is evidence that species such as Sharp-tailed Grouse and American Badger have succumbed to the initial effects of fragmentation on Nose Hill (Kansas et al. 1993, O2 Planning and Design Inc. 2005). Additional fragmentation effects on remaining Valued Ecosystem Components are bound to occur with increasing use of these informal trails, but will be greatly diminished by the new bylaw requiring people to stay on designated trails. Sections 4.2.4 and 4.2.5 outline effects of habitat alienation and mortality that have been observed to occur on ground nesting birds and other species. Noss and Csuti (1997) note that nine kinds of species are particularly vulnerable to the effects of fragmentation: rare species; species with large home ranges; species with limited powers of dispersal; species with low reproductive potential; species with short life cycles; species dependant on resources that are unpredictable in time and space; ground-nesting birds; species of habitat interiors; and species exploited or persecuted by humans. The Rough Fescue bird assemblage on Nose Hill is characterized by several of these factors.

The designated routing network as proposed as part of the Nose Hill Trail and Pathway Plan (NHTPP) will serve to reduce fragmentation effects resulting from the current uncontrolled public travel/access throughout native habitats in the Park. The most important areas for reduction are the native grassland communities found along the escarpment and the larger tracts of forest and tall shrub found in the Park's major ravines.

4.3.3 Vegetation/Habitat Alteration from Trampling

Repeated passes by humans on foot and bicycles pulverizes organic soil matter and exposes the underlying mineral soil. When trampling compacts the mineral soil, particles are squeezed tightly together, which reduces the amount of pore space between particles. This in turn reduces aeration and water availability making it difficult for plant roots to penetrate the soil. Related reductions in germination success and plant vigor result in decline of soil dwelling organisms (Cole 1993). Compacted soils also contribute to excessive surface runoff after rains, causing erosion.

Vegetation composition is changed in trampled areas because more hardy, tolerant species survive and compete more effectively. Such plants tend to grow in tussocks, reproduce vegetatively, have leaves that grow flat against the ground, exhibit rapid refoliation and photosynthetic recovery, and have shallow roots (Liddle 1975; Cole 1981, Bazzaz 1986). Heavily trampled trails in grasslands have been shown to promote the establishment of introduced [exotic] plant species along the immediate trailside (Potito and Beatty 2005). It is thought that grasslands (and in some areas specifically Fescue grasslands) are particularly vulnerable to invasion by alien species in part because of high light intensity and frequent breaks in plant cover (Baker 1986, Tyser and Worley 1992, Kotanen et al. 1998). Using experimentally controlled trampling trials Cole (1987) showed that vegetation cover loss in Rough Fescue grasslands increased with the number of walking passes. He showed that 400 passes per year eliminated more than 50% cover in Fescue grassland. Plant species diversity was also reduced with increasing passes. The number of passes per year required to eliminate 50% of the species in Fescue grassland was 600 (Cole 1987). As little as two seasons of trampling were required to cause these effects on Fescue grasslands. Gomez-Limon and de Lucio (1995) reported that changes in plant species richness and diversity occurred with increasing soil compaction even before there was an obvious loss of vegetation cover.

Nose Hill Park is particularly vulnerable to vegetation alteration resulting from trampling because of the dominance of grassland vegetation and its occurrence in a densely populated and rapidly growing urban area. Research has shown that although persistent trail use causes increased soil compaction and vegetation damage, even initial and low levels of trail use produce significant and rapid losses of native plant species and cover (Cole 1987, Yorks et al. 1997). It is also known that higher trail use tends to hasten the establishment of exotic plant species along trailsides (Potito and Beatty 2005). Given the presence of >300 km of informal trails with varying degrees of soil compaction, it is essential that human use be focused on as few trails as possible in the Park.

On the positive side, plant species composition and cover effects associated with trampling tend to be limited to the area immediately (1 to 2 meters) on either side of the trail (Cole 1981). Dispersal of exotic vegetation from trailsides is unlikely to occur into core areas of native habitat that do not support compacted soils or other trails (Potito and Beatty 2005).

The recommendations of the NHTPP that pertain to the development and use of a designated trail and pathway system will be positive in terms of reducing the existing and future effects of trampling on Park vegetation integrity.

4.3.4 Alienation of Wildlife Habitat

Wildlife may avoid using habitat that is floristically and structurally intact because of the presence of human activity and associated sensory disturbance. This has been termed habitat alienation and can result in "effective habitat loss" (Weaver et al. 1986). The duration and magnitude of the human use and the behavioral response of the species in question determine whether the extent of the habitat loss will be complete, partial, temporary or permanent (Bromley 1985). The duration and extent of habitat avoidance resulting from sensory disturbance depends on a number of factors including: 1) type of human use; 2) the duration and intensity of human use; 3) the sensitivity of the species in question; and, 4) habitat characteristics (extent of hiding cover). The implications of effective habitat loss are greatest in the following situations:

- In areas of very high habitat quality or in "critical" reproductive habitat such as nest/den sites or courtship areas;
- In areas of traditional concentration of colonial or gregarious species (e.g. ungulate winter range);
- When the timing of visitation/use interrupts breeding, nesting or rearing of young;
- When the disturbance leads to effective loss of all or a high percentage of a particular high quality habitat type;
- When the population of a sensitive species is low or decreasing; and,
- When effective habitat loss occurs as linear disturbances create barriers to movement, which serve to fragment or isolate large areas of habitat.

As of 1997, an average of 5,426 persons per week visited Nose Hill Park during summer. This number includes cyclists and walkers. Dogs are additive to this total and are a significant "user" of the Park (O2 Planning and Design Inc. 2005). Although the exact numbers are unknown, it is likely that current use levels are significantly higher than in 1997, especially given Calgary's rapid population growth in the last decade.

Research concerning the effect of non-motorized recreational activity on wildlife is limited. No research of this type has occurred on Nose Hill Park and as such impact predictions must be based on the limited 'analog studies' available. Grassland songbirds, specifically those affiliated with Rough Fescue grasslands and aspen/tall willow habitats, are an important Valued Ecosystem Component for Nose Hill Park. The most recent and thorough study of the impact of recreational trails on breeding birds is by Miller et al. (1998). They investigated the influence of recreational trails on breeding bird communities in forest and mixed-grass prairie ecosystems in Colorado. Recreational activities in this area included hiking, wildlife viewing, exercising pets, jogging, mountain biking and horseback riding. Their results showed that recreational trail use affected the distribution, abundance and nesting success of bird species. They suggested that the influence of recreational trails on bird communities was due to some combination of the physical presence of the trail and associated human disturbance. Other research by Van der Zande et al. (1984) reported a negative relationship between the intensity of recreation occurring on trails and the density for eight of 13 bird species. Gutzwiller et al. (1994) reported that even a single pedestrian moving through a bird's territory was sufficient to reduce the occurrence and consistency of primary song.

The effect of current levels of recreational use on the array of informal trails in Nose Hill Park on grassland birds is uncertain. Given the evidence in the literature and the widespread and indiscriminate use of all habitats in the Park, it is not unreasonable to assume that the viability of nesting/breeding birds is currently seriously compromised. The magnitude of the impact of habitat alienation on Nose Hill is directly related to the people wandering indiscriminately through native habitats in the Park. As indiscriminate use levels increase so will cumulative sensory disturbance. The recommendations of the NHTPP that pertain to the development and use of a designated trail system will be very positive in terms of reducing the existing and future effects of habitat alienation on breeding birds in the Park.

4.3.5 Increased Wildlife Mortality

Potential sources of wildlife mortality in the study area are: killing by unleashed dogs; increased nest predation resulting from habitat fragmentation; and, trampling of nests by hikers, cyclists and dogs.

Domestic dogs are a major user of Nose Hill Park. Almost one-third (31%) of users of Nose Hill Park are dog walkers and almost all of these users leave their animals unleashed. Dogs can be effective predators of deer and other ungulates (Sime 1999). Dog predation on other species is not as well understood but it is reasonable to assume that other smaller mammal species such as microtines, Richardson's Ground Squirrel, and Long-tailed Weasel may be killed. The Long-tailed Weasel is a listed species in Alberta.

Fragmentation of habitat leads to increased habitat edge and can result in increased predation and brood parasitism. Miller et al. (1998) observed that nests were less likely to occur near non-motorized recreational trails than areas further away from trails. They also reported a positive relationship between nest survival and distance from trails. Edge-enhanced predation and brood parasitism were considered to be the primary agents of mortality in this study.

We could not find literature that documented trampling of nests as a major source of mortality of birds, but it is reasonable to assume that this does have potential to occur during the nesting period. Reduction of off-route and informal trail use will greatly reduce the magnitude of this potential effect.

4.4 Impact Mitigation

4.4.1 Project-specific Impacts

The following mitigation measures are proposed to reduce the effects of the paving the two cross-park pathways.

- Reroute the N-S pathway between waypoints 6 and 8 a few meters to the north edge of this native grassland community. This will protect the small patch of native grassland and will serve as a barrier to further encroachment by the non-native brome/thistle community to the north.

- There is no native transplant sod available to reclaim the pathway edges. If possible, when excavating the pathway route through a healthy native grassland community, store the vegetation and soil removed for the pathway bed and save to be mulched and spread along the edges of the pathway following construction.

- Restore disturbed pathway verges (from construction activities) by sowing native seeds from local (within southern Alberta) sources. Sow seeds along pathway verges following pathway construction to prevent invasion by non-native species.

- If sufficient seed crop is available, include in the seed mix seeds that were harvested from native vegetation communities in Nose Hill Park.

- Enhance native integrity of the disturbed native grassland south of waypoints 8 to 10 on the N-S Route. Remove Smooth Brome and Thistle especially.

- If feasible, avoid route construction/re-surfacing during the nesting/fledging period (May 1 to 31 July) along pathway segments that occur immediately adjacent to native grassland habitat. For the N-S route this includes waypoints 3 to 10 and for the E-W route waypoints 17 to 22.

- If above construction restriction is not feasible, then confirm the presence of sensitive ground nesting birds to determine if construction is appropriate by conducting breeding songbird and nesting surveys in native grassland habitat

- If feasible, avoid route construction/re-surfacing during nesting/fledging period (May 1 to 31 July) along pathway segments that occur immediately adjacent to aspen-tall willow habitats (vicinity of Waypoints #s 7, 14 and 15).

- If not feasible, confirm the presence of sensitive forest bird species to determine if construction is appropriate by conducting breeding songbird and nesting surveys in aspen-tall willow habitat

- Close and reclaim many of the informal trails associated with the E-W and N-S routes as already recommended in the NHTPP.

- Continue reclamation tasks aimed at eradicating perennial noxious weeds such as Canada thistle and toadflax.

- Conduct reconnaissance level rare plant surveys along pathway route prior to construction. Focus survey efforts in areas on or near native habitats.

4.4.2 Cumulative Land Use Impacts

The implementation of the Nose Hill Trail and Pathway Plan (NHTPP) and especially the designated routing plan is essential for managing the cumulative effects of human use on the Park's Valued Ecosystem Components (VEC). The following recommendations are forwarded in terms of priorities to protect VECs.

- Develop a restoration strategy as already recommended in the NHTPP that serves to prioritize restoration locations and approaches;

- Obstruct movement along informal trails through forest and tall shrub vegetation in ravines as soon as possible;

- Notify the public through education methods that both nationally and provincially listed Species at Risk require certain Park habitats for survival and reproduction

- Notify the public through appropriate education methods that some federal and provincial species at risk have been eliminated from the Park, in part from 'passive' recreational activities.

- Conduct Park-wide breeding bird surveys to establish a baseline for monitoring success of installing designated routes and overall mitigation success of the NHTPP.

- Conduct reconnaissance level rare plant surveys along park trails prior to the resurfacing of routes. Focus on trails that are located in areas on or near native habitats.

4.5 Significance of Residual Project-Specific Impacts

The purpose of this section of the report is to rate the significance of project impacts on Valued Ecosystem Components (VECs) with the assumption that mitigation measures as outlined (Section 4.3) are successfully implemented. Impact rating criteria from Table 6 and the review and analysis of project impacts in Section 4.3, were used to guide this assessment. Ratings are presented below by VEC.

4.5.1 Rough Fescue Grassland Supply

Project impacts on this VEC relate primarily to direct habitat loss and vegetation/habitat alteration from trampling.

Direct Habitat Loss

- Direction of Impact — Negative
- Extent of Impact — Local
- Magnitude of Impact — Negligible
- Duration of Impact — Long-term
- Frequency of Occurrence of Impact — Continuous
- Permanence of Impact — Permanent
- Level of Confidence — High

The significance of project effects on Rough Fescue habitat supply is rated as Negative and Negligible.

Table 6. Impact Assessment Significance Criteria

Rating Criteria	Rating	Impact Significance Criteria
Direction of Impact	Positive	Net benefit or gain to the resource or affected party.
	Neutral	No net benefit or gain; or benefits and losses are balanced.
	Negative	Net loss to the resource or detriment to the affected party.
Extent of Impact	Local	Impact confined to the area directly disturbed by project facilities.
	Subregional	Impact extends beyond area of direct disturbance but is limited to the local study area.
	Regional	Impact extends beyond the local study area but is limited to the regional study area.
	Extra-Regional	Impact extends beyond the regional study area.
Magnitude of Impact	Negligible	No discernable impact
	Low	Disturbance predicted to be somewhat above typical background concentrations and conditions and concentrations, but within established or accepted protective standards, or to cause no detectable changes in biological, social or economic parameters.
	Medium	Disturbance predicted to be above background conditions or concentrations but within established criteria or scientific effects thresholds, or to cause a detectable change in biological, social or economic parameters.
	High	Disturbance predicted to exceed established criteria of scientific effects thresholds associated with potential adverse effects, or to cause a detectable change in biological, social or economic parameters beyond the range of natural variability or social tolerance.
Duration of Impact	Immediate	Impact occurs for less than two days.
	Short-Term	Impact occurs for two days or longer but less than one year.
	Medium-Term	Impact occurs for one year or longer but less than ten years.
	Long-Term	Impact occurs for ten years or longer.
Frequency of Occurrence of Impact	Isolated	Impact occurs during a specified period.
	Occasional	Impact occurs intermittently and sporadically over assessment period.
	Regular	Impact occurs regularly over assessment period.
	Continuous	Impact occurs continually over assessment period.
Permanence of Impact	Reversible in Short-Term	Impact can be reversed in less than one year.
	Reversible in Medium-Term	Impact can be reversed in one year or more, but less than ten years.
	Reversible in Long-Term	Impact can be reversed in ten years or more.
	Irreversible	Impact is permanent.
Level of Confidence	Low	Assessment based on poor understanding of cause-effect relationships and data from elsewhere.
	Medium	Assessment based on good understanding of cause-effect relationships using data from elsewhere or poorly understood cause-effect relationships using data pertinent to project area.
	High	Assessment based on good understanding of cause-effect relationships and data pertinent to project area.
Impact Significance	Positive	Implementation of project development will lessen current impacts in the study area.
	No Impact	Impacts that did not occur.
	Negligible Impact	Impacts that are not discernable above background.
	Minor Impact	Impacts low in magnitude, short- or medium-term in duration and restricted to the (local or regional) study area.
	Moderate Impact	Impacts that are medium in magnitude, short-, medium, or long-term in duration and do not extend beyond the regional study area.
	Major Impact	Medium or high impacts that are long-term in duration and/or extend beyond the regional study area.

The vast majority of pathway construction would occur on existing pathways that do not support Rough Fescue grasslands. Even without the recommendation to modify the N-S route, the re-surfacing of the routes would result in the loss of only 0.18-ha of native Rough Fescue grassland. This equates to an impact of 0.1% of the 265.7-ha of supply of this plant community on Nose Hill Park. This is a negligible loss that will be more than off-set by the restoration of trails in the NHTPP.

Habitat Alteration from Trampling

• Direction of Impact	Positive
• Extent of Impact	Local
• Magnitude of Impact	Low
• Duration of Impact	Long-term
• Frequency of Occurrence of Impact	Continuous
• Permanence of Impact	Reversible in Short-term
• Level of Confidence	Medium

The significance of project effects on Rough Fescue habitat alteration from trampling is rated as Positive and <u>Minor.</u>

Paving of routes that are currently mixed dirt and compacted vegetation will decrease the amount of exotic plant establishment on these routes. When adjacent to Rough Fescue grassland (i.e. waypoints 6 to 10 of the N-S route) this will slow the colonization of exotic plants into native grasslands.

4.5.2 <u>Rough Fescue Grassland Bird Communities</u>

Project impacts on this VEC relate to direct habitat loss, habitat fragmentation/movement obstruction, alienation of wildlife habitat, and increased wildlife mortality.

Direct Habitat Loss

• Direction of Impact	Negative
• Extent of Impact	Local
• Magnitude of Impact	Negligible
• Duration of Impact	Long-term
• Frequency of Occurrence of Impact	Continuous
• Permanence of Impact	Permanent
• Level of Confidence	High

The significance of project effects relating to loss of Rough Fescue habitat supply for birds is rated as Negative and <u>Negligible.</u>

The ratings are the same as for the Rough Fescue grassland supply since these birds are directly linked to Rough Fescue grassland supply.

Habitat Fragmentation/Movement Obstruction

• Direction of Impact	Neutral
• Extent of Impact	Local
• Magnitude of Impact	Negligible
• Duration of Impact	Long-term
• Frequency of Occurrence of Impact	Continuous
• Permanence of Impact	Permanent
• Level of Confidence	High

The significance of project effects relating to fragmentation through movement obstruction on Rough Fescue grassland birds is rated as Neutral and <u>Negligible.</u>

Paving of trail surfaces will not obstruct bird movement. Since off-route use and trampling will be reduced through the addition of a paved route, native integrity of Rough Fescue grasslands adjacent to the paved trails should improve.

Alienation of Wildlife Habitat

• Direction of Impact	Negative
• Extent of Impact	Subregional
• Magnitude of Impact	Medium
• Duration of Impact	Long-term
• Frequency of Occurrence of Impact	Continuous
• Permanence of Impact	Reversible-Long term
• Level of Confidence	Low

The significance of project effects relating to alienation of habitat of Rough Fescue grassland birds is rated as Negative and <u>Moderate.</u>

The magnitude of potential habitat alienation effect arising from non-motorized recreational activity is unclear based on our review of the scientific literature. Given this, we assumed hypothetical variable disturbance buffers of 50-m and 100-m surrounding the cross-park paths. We overlaid these disturbance buffers onto ecosite mapping from Kansas et al. (1993). For Rough Fescue grassland the amount of habitat potentially disturbed within the 50-m wide buffer was 9.4-ha for the N-S route and 1.8-ha for the E-W route. If disturbance were 100% within this 50-m buffered area it would amount to an effective loss of 2.7% of the available supply of Rough Fescue grassland habitat in a Park-wide context. If the disturbance effect extended to 100-m then the amount of Rough Fescue grassland impacted would 19.0-ha for the N-S route and 6.0-ha for the E-W route. If disturbance were complete within this 100-m buffered area it would amount to 5.9% of the available supply of Rough Fescue grassland in all of Nose Hill Park.

Construction of pathways outside of the nesting/fledging season in areas adjacent to Rough Fescue grassland will lessen alienation effect during construction for species nesting within close proximity to pathway route. Paving will however focus human use of the routes and lead to more human and dog use in areas of native habitat during the breeding season in future years. There is uncertainty surrounding this project effect. This will require baseline inventory of birds in existing Rough Fescue grasslands and monitoring to determine project and cumulative effects over time.

If successfully implemented the designated routing plan of the NHTPP will serve to more than counter-balance the habitat alienation impacts of the cross-park paths described above. Over 200-km of trails are recommended for rehabilitation and closure as part of this plan, and uncontrolled access in the Park will no longer be permissible. This is much greater than the 7.7-km length of cross-park paths.

Increased Wildlife Mortality

- Direction of Impact — Negative
- Extent of Impact — Subregional
- Magnitude of Impact — Low
- Duration of Impact — Long-term
- Frequency of Occurrence of Impact — Continuous
- Permanence of Impact — Permanent
- Level of Confidence — Medium

The significance of project effects relating to increased mortality of Rough Fescue grassland birds is rated as Negative and <u>Minor.</u>

Construction of pathways outside of the nesting/fledging season in areas adjacent to Rough Fescue grassland will lessen the likelihood of trampling by workers and construction equipment during construction for species that are nesting within close proximity to pathways. Human and dog use has potential however to increase along the paved pathways adjacent to Rough Fescue grassland over time. There is some scientific uncertainty regarding the effect of dogs on ground nesting birds. If dog owners were forced to keep dogs on leash this additional mortality potential would not be realized.

4.5.3 Grassland Native Plant Integrity

Project impacts on this VEC relate primarily to vegetation/habitat alteration from trampling which is known to increase exotic plant species establishment.

Habitat Alteration from Trampling

• Direction of Impact	Positive
• Extent of Impact	Local
• Magnitude of Impact	Low
• Duration of Impact	Long-term
• Frequency of Occurrence of Impact	Continuous
• Permanence of Impact	Reversible in Short-term
• Level of Confidence	Medium

The significance of project effects on grassland native plant integrity from trampling is rated as Positive and Minor.

Paving of routes that are currently mixed dirt and compacted vegetation will decrease the amount of exotic plant establishment on these routes. This positive effect will be enhanced by sowing native seed and/or sod along the edges of the pathways following construction.

4.5.4 Aspen/Tall Willow Bird Communities in Large Ravines

Project impacts on this VEC relate to direct habitat loss, alienation of wildlife habitat, and increased wildlife mortality.

Direct Habitat Loss

• Direction of Impact	Neutral
• Extent of Impact	Local
• Magnitude of Impact	Negligible
• Duration of Impact	N/A
• Frequency of Occurrence of Impact	N/A
• Permanence of Impact	N/A
• Level of Confidence	High

The significance of project effects relating to loss of aspen forest or tall shrub habitat supply for birds is rated as Neutral and Negligible.

No aspen forest or tall shrub communities will be directly affected by habitat loss from paving of cross-park pathways.

Alienation of Wildlife Habitat

• Direction of Impact	Negative
• Extent of Impact	Subregional
• Magnitude of Impact	Moderate
• Duration of Impact	Long-term
• Frequency of Occurrence of Impact	Continuous
• Permanence of Impact	Permanent
• Level of Confidence	Low

The significance of project effects relating to potential alienation of habitat of birds associated with aspen/tall shrub ravine habitat is rated as Negative and <u>Moderate.</u> This is an ecologically conservative assessment. Scientific uncertainty is high and warrants research and monitoring.

The magnitude of potential habitat alienation effect arising from non-motorized recreational activity is unclear based on our review of the scientific literature. Given this, we assumed hypothetical variable disturbance buffers of 50-m and 100-m surrounding the cross-park paths. We overlaid these disturbance buffers onto ecosite mapping from Kansas et al. (1993). For Aspen and tall shrub (combined) the amount of habitat potentially disturbed within the 50-m wide buffer was 2.8-ha for the N-S route and 0.9-ha for the E-W route. If disturbance were 100% within this 50-m buffered area it would amount to an effective loss of 6.7% of the available supply of combined Aspen/tall shrub in a Park-wide context. If the disturbance effect extended to 100-m then the amount of Aspen and tall willow impacted would 7.1-ha for the N-S route and 7.6-ha for the E-W route. If disturbance were complete within this 100-m buffered area it would amount to 26.7% of the available supply of combined Aspen/tall shrub habitat in all of Nose Hill Park.

Construction of pathways outside of the nesting/fledging season in areas adjacent to Aspen-tall willow ravines will lessen alienation effect during construction. Paving of the trails will however focus human use of the trails and lead to more human and dog use during the breeding season in future years. There is uncertainty surrounding this project effect. Aspen forest and tall willow shrubland in ravines should be included in the baseline inventory of birds in order to monitor and assess project and cumulative effects over time.

If successfully implemented the designated routing plan of the NHTPP will serve to more than counter-balance the habitat alienation impacts of the cross-park paths described above. The plan calls for closure and rehabilitation of the vast majority of informal trails that currently occur in ravines that support Aspen forest and tall willow shrubland.

Increased Wildlife Mortality

• Direction of Impact	Negative
• Extent of Impact	Local
• Magnitude of Impact	Low
• Duration of Impact	Long-term
• Frequency of Occurrence of Impact	Continuous
• Permanence of Impact	Permanent
• Level of Confidence	Medium

The significance of project effects relating to increased mortality of birds associated with aspen/tall shrub ravine habitat is rated as Negative and Minor. The cross-park pathways pass through only 101 meters of aspen forest. The magnitude of this effect is minor.

4.5.5 Rare Plants

Project effects on rare plants are most likely to arise from direct habitat loss.

Direct Habitat Loss

• Direction of Impact	Negative
• Extent of Impact	Local
• Magnitude of Impact	Negligible
• Duration of Impact	Short-term
• Frequency of Occurrence of Impact	Long-term
• Permanence of Impact	Permanent
• Level of Confidence	Medium

The significance of project effects relating to direct habitat loss relating to rare plants is rated as negative and Negligible.

The majority of rare plants that could occur will likely be found in ravines including steep side-slopes and moist bottomlands. Only 11.3% of the N-S route traverses ravines - all of this represented by disturbed (non-native) grasslands. 16.0% of the E-W route traverses ravines with all but 45-meters through non-native grassland. Almost the entire pathway route occurs on well-established informal trails that are already significantly disturbed by trampling. If rare plants are observed during pre-development reconnaissance surveys then they can be transplanted or avoided. Notwithstanding the greater likelihood of rare plant occurrence in ravines, the occurrence of these features is often highly site-specific (e.g. seeps, blowouts etc.). As such it is important that site-specific rare plant searches are made.

4.6 Future [Cumulative] Effects

Cumulative ecological effects arise when land uses become crowded in time and space to the point that their combined effects exceed the assimilative capacity of a Valued Ecosystem Component(s) (Beanlands et al. 1986). Some ecological attributes are more resilient than others to the build-up of land uses and it is always a challenge to identify, with scientific certainty, the point(s) at which thresholds may be breached.

The cumulative effects of intensive recreational land use on Nose Hill Park have not been rigorously assessed or researched. The biophysical inventory and analysis completed by Kansas et al. (1993) was the first quantitative "snapshot" of the status of biological features and diversity in the Park. That work is now 13 years old and needs updating in order to determine the current status and trajectory of sensitive park features. Periodic 're-inventorying' or monitoring is probably the only way to confidently determine the cumulative effects of land use on Valued Ecosystem Components of the Park. Inference from analogous studies is not possible because they don't exist. Cumulative impact models would suffer from lack of empirical information to build them.

The preceding section of the report assessed the impacts of the proposed cross-park path development as an incremental land use. This will of course not be the only land use occurring in the Park as time goes on. Implementation of the NHTPP will significantly alter the nature of the Park primarily through designating routes and closing and rehabilitating many other informal trails. It is not possible to predict with any accuracy the manner in which humans will alter their use of the Park in the face of such a plan. Nor is it possible to accurately predict the extent to which VECs will respond to changed human land use levels, patterns and distribution.

The NHTPP proposes a drastic reduction in informal trail use and the restoration of a large percentage (200+/- of 321 kilometers) of existing trails. It is beyond the scope of this project to quantitatively assess the impact of these actions on VECs. It is safe to say however that, if even remotely successful, the positive effects on Park habitats will be major and significantly outweigh the negative effects of the cross-park paving project under review here. Habitat gains associated with restoration have potential to be significant. If it were assumed that restored trails average 1.5 meters in width, the overall amount of habitat restored would be approximately 30 hectares. This exceeds the maximum potential negative effects of cross-park paving (0.18 hectare) by over two orders of magnitude.

Closure of the majority of trails on native escarpment lands will lessen habitat alienation and result in large contiguous patches of undisturbed and rehabilitated native grassland. It is unknown to what extent current trail levels have affected wildlife use of native grasslands on escarpment, however, the effects of the NHTPP can only be positive. An adaptive management plan including systematic monitoring of VECs should be considered as part of the NHTPP.

5.0 SUMMARY AND CONCLUSIONS

5.1 Methodology

- The construction of the two cross-park paved pathways is one of 15 recommendations arising from the Nose Hill Trail and Pathway Plan (NHTPP) (O2 Planning and Design 2005).

- Impacts of paved pathway construction and operation were assessed for 5 Valued Ecosystem Components including: Rough Fescue grasslands; Rough Fescue Grassland bird communities; Aspen/Tall Willow bird communities; Grassland native integrity; and, Rare plants and habitat.

- Types of potential impacts on VECs that were assessed included: direct habitat loss; habitat fragmentation/movement obstruction; habitat alienation; trampling by humans leading to exotic plant invasions; and increased wildlife mortality.

5.2 Results

- The N-S Route (4.5-km) as <u>currently planned</u> traverses (79.2%) non-native habitat, 675.5-m (15.1%) that is mixed native/non-native grassland; and, the remainder 255.6-m (5.7%) of lands that are in a predominantly native [grassland] condition. Re-routing of the trail between Waypoints 3 and 9 inward toward the disturbed grasslands of the upper plateau would reduce the effect on native grasslands to near zero. The extent to which the trail needs to be moved to reduce the native grassland effect to near zero is not currently known but is likely in the order of from 1 to 3 meters. Refinements to meet this objective need to be done in the field at a site-specific level of detail.

- 100% of the N-S route follows existing linear disturbance features including dirt/vegetation trail (59.4%) a gravel service road (26.5%), and paved trail (14.1%).

- 100% of the E/W route is disturbed. The entire E-W Route (3.2-km) follows existing linear disturbance features including: paved trail (56.8%), dirt/packed-vegetation trail (42.6%), and gravel trail (0.6%).

- The eastern-most 833-meters (26.3%) of the E-W Route traverses an area of mixed native/non-native grassland. The remaining portion of the route crosses disturbed lands.

- Construction will result in a three-meter wide [physical] disturbance footprint including a two-meter wide finished pathway and 0.5 meters on either side for workspace. On the escarpment, each side of the workspace will be restored. On the upper plateau, the workspace adjacent to the escarpment will be restored and the workspace within the multi-use area will be revegetated.

- Impacts on VECs related to direct habitat loss were generally of negligible magnitude and significance primarily because of the limited land area affected and the positive gains associated with planned trail closures stemming from the Nose Hill Trail and Pathway Plan (NHTPP).

- There are no negative effects on native vegetation relating to trampling and invasive plants because of the reductions of bare ground substrate and the closure and rehabilitation of informal trails associated with the NHTPP.

- The effects of habitat alienation from human use of trails were rated as moderate for Rough Fescue bird communities and potentially major for Aspen/tall willow bird communities. There is however uncertainty as to the actual magnitude of existing and future habitat alienation effects.

- If implemented, the NHTPP including closure and rehabilitation of informal trails will lead to net gains in realized habitat use (i.e. gains associated with trail closures will outweigh losses associated with increased use of paved trails).

- Movement obstruction leading to habitat fragmentation is not considered to be a significant impact on VECs assessed for Nose Hill Park.

- The significance of direct mortality effects on native grassland and aspen forest/tall willow birds was rated as minor.

- The Nose Hill Trail and Pathway Plan (NHTPP) if successfully implemented will mitigate most (if not all) of the impacts on VECs associated with the paving of cross-park trails.

- Increasing levels of recreational use of Nose Hill Park has resulted in losses of at least two provincially listed wildlife species at risk (Badger and Sharp-tailed grouse). Additive and cumulative recreational effects will likely continue to eliminate sensitive species if designated trail routing is not successfully implemented.

5.3 Mitigation and Monitoring Recommendations

Some key mitigation measures recommended to reduce impacts are listed in Table 7.

Table 7. Mitigation/Monitoring Recommendations for Valued Ecosystem Components		
Valued Ecosystem Component	*Mitigation Recommendations*	*Monitoring Recommendations*
Rough Fescue Grassland Supply	- Re-route the N-S pathway between Waypoints 6 and 8 a few meters to the north edge of this native grassland community - If feasible, stockpile vegetation and soil excavated in healthy native grassland and mulch and spread along pathway edges following construction. - Alternately, restore disturbed pathway verges (from construction activities) by sowing native seeds from local (within southern Alberta) and, possibly, Nose Hill sources. Sow seeds along pathway verges following pathway construction to prevent invasion by non-native species - Locating planned cross-park paved pathways on existing trails (as currently identified in NHTPP)	
Rough Fescue Grassland Bird Community	- If feasible, avoid route construction/re-surfacing during nesting/fledging period (May 1 to 31 July) along pathway segments that occur immediately adjacent to native habitat (Waypoints 3 to 10 for N-S route and 17-22 for E-W route) - If not feasible, confirm the presence of sensitive ground nesting birds to determine if construction is appropriate	Conduct breeding songbird and nesting surveys near native grassland habitat to confirm the presence of sensitive ground nesting habitats
Grassland Native Plant Integrity	- Harvest seed from native vegetation communities and sow along pathway immediately after construction - Enhance native integrity of disturbed native grassland S of Waypoints 3 to 10 on N-S route - Close and reclaim many of the informal trails associated with the E-W and N-S pathways as already recommended in the NHTPP - Continue reclamation tasks aimed at eradicating perennial noxious weeds such as Canada thistle and toadflax	
[Ravine] Aspen-tall willow bird community	- If feasible, avoid route construction/re-surfacing during nesting/fledging period (May 1 to 31 July) in vicinity of Waypoints #s 7, 14 and 15. - If not feasible, confirm the presence of sensitive forest bird species to determine if construction is appropriate	Conduct breeding songbird and nesting surveys near aspen-tall willow habitats to confirm the presence of sensitive songbirds.
Rare Plants and Habitat	- If rare plants are located within the disturbance footprint they should be transplanted ,if possible, to similar/suitable habitats in the Park	- Conduct reconnaissance level rare plant surveys along pathway route prior to construction. Focus survey efforts in areas on or near native habitats

5.4 Summary of Impact Significance

Five (5) Valued Ecosystem Components included: Rough Fescue grasslands; Rough Fescue Grassland bird communities; Aspen/Tall Willow bird communities; Grassland native integrity; and, Rare plants and habitat. Types of potential impacts on VECs that were assessed included: direct habitat loss; habitat fragmentation/movement obstruction; habitat alienation; trampling by humans leading to exotic plant invasions; and increased wildlife mortality. Table 8 summarizes impact significance ratings for each VEC and impact type. Ratings are shown before and after successful implementation of the NHTPP.

	Impact Type				
VEC	*Habitat Loss*	*Fragmentation Movement Obstruction*	*Habitat Alienation*	*Trampling leading to weed invasion*	*Increased Mortality*
Rough Fescue Grassland Supply	Negative Negligible	N/A	N/A	Positive Minor	N/A
Rough Fescue Bird Community	Negative Negligible	Neutral Negligible	Negative Moderate	N/A	Negative Minor
Aspen/Tall Willow Bird Community	Neutral Negligible	N/A	Negative Major	N/A	Negative Minor
Native Grassland integrity	N/A	N/A	N/A	Positive Minor	N/A
Rare plants and habitats	Negative Negligible	N/A	N/A	N/A	N/A

*P Project effect without successful implementation of NHTPP
** Cumulative effects = successful implementation of the NHTPP

The majority of project-specific effects are of negligible or minor impact, some negative and others positive. Habitat alienation has potential to be of major impact on breeding songbirds in ravine aspen communities but this effect (and all others) will be outweighed by positive effects of the NHTPP, if successfully implemented.

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