APPENDIX 2

EARDLEY ESCARPMENT
DESCRIPTION AND CONSERVATION ISSUES

DEFINITION OF AN ESCARPMENT

In geology, an escarpment is a transitional zone between different physio-gegraphic provinces that involves a steep elevation differential characterized by a cliff. More commonly, an escarpment is a transition from one series of sedimentary rocks to another series of a different age and composition. It is usually the result of loss of the newer rock (situated on top of the older rock) through erosion.

Some escarpments were formed by tectonic movement (deforming movements of the Earth's crust or volcanic activity), and in particular by the vertical movement of the Earth's crust along a fault, creating a fault scarp. A fault is a fracture in the ground in which the adjacent surfaces are displaced along the plane of the fracture.

An escarpment can be divided into several portions, each subject to different levels of natural and human-induced impacts.

The first portion is the summit or roof (the upper surface of the escarpment, or the land immediately above it), and the foot or base (the land located at the bottom, covered with piles of rocks that have fallen from the cliff during erosion). It is here, at the summit and base, that the most abundant vegetation is found, in a variety of layers.

Between the two, the vertical or sloping portion of the escarpment is known as the wall. This is the portion that is most exposed to natural elements such as wind and rain, and usually has a large number of cracks, crevasses and ledges. A ledge or platform is a natural protrusion above a steep slope, formed by a resistant layer, around a plateau, with a softer layer below. Often, a thin layer of soil builds up on the ledge, allowing for the development of plant life. Cracks are discontinuities, breaks or tabular openings in the rock, ranging from a few centimetres to several decimetres in length, and from a few millimetres to several centimetres in width. They are produced by physical constraints. Crevasses, for their part, are superficial openings in the rock, sometimes used by plant or animal species as shelter.

ESCARPMENT RARITY, FRAGILITY AND WEALTH

Eardley Escarpment is located in the Province of Québec, and runs along the line between the Canadian Shield and the St. Lawrence Lowlands. It is also the richest and most fragile environment in Gatineau Park.

Eardley Escarpment is a cliff lying along a south-south-west line. It is approximately 300 metres high, with an average height of more than 200 metres, and is the dominant topographical element in the Outaouais region. It begins in the City of Gatineau and runs north-eastwards along the Ottawa River for several dozen kilometres, forming a characteristic rock slope alignment.

This type of environment is extremely rare; there are only a handful of documented escarpments in Canada and the world.

According to Gagnon (1981), Eardley Escarpment's ecological value for conservation is very high due to the diversity of its plant communities. In addition, its red oak (*Quercus rubra*), white oak (*Quercus alba*) and red oak/red cedar (*Juniperus virginiana*) stands are some of the rarest vegetation communities in the Ottawa Valley and Québec.

The plant species at risk are mainly associated with the Escarpment's carbonate rock outcrops and open oak stands, where their principal concentrations are found (Lavoie, 1992). These species are often vulnerable; nearly 40% exhibit limited distribution, require specialized habitats and have small populations.

Because of the Escarpment's micro-climate, it has developed a form of plant life that is unusual in Western Québec. The conditions on the Escarpment slopes are closer to those found further south, for example in the American Mid-West. The warm micro-climate is conducive to the growth of certain specific species such as the blunt-lobe cliff fern (*Woodsia obtusa*), the walking fern (*Asplenium rhizophyllum*), the white oak, the red cedar and the common hackberry (*Celtis occidentalis*). In many places, the vegetation resembles a savannah, with tall grasses and sparse trees. The slow growth and underdeveloped aspect of the trees, some of which are more than 100 years old, are evidence of the difficult edaphic conditions on the Escarpment.

Other threatened and vulnerable species, as well as species likely to be designated as such, are found in the Eardley Escarpment ecosystem. Gagnon et al. (1993) studied the population dynamics of eight threatened or vulnerable plant species, including the woodland sunflower (*Helianthus divaricatus*), Douglas' knotweed (*Polygonum douglasii*) and the fragrant sumac (*Rhus aromatica*), which are vulnerable species in Québec. Gagnon and Hay (1986) studied the

eastern few-fruit sedge (*Carex oligocarpa*), this being only the seventh known location in Canada of this species at risk.

The Escarpment, which is the only place within Gatineau Park where the red cedar is found, contains the largest population of red cedar in Québec, estimated at 15,000 trees (NCC, 2002c) and accounting for 80% of the total population in Québec (Forest, 1994). According to Forest (1994), the Eastern red cedar is one of the rarest species of trees in Québec, found almost exclusively within the oak-red cedar stands on Eardley Escarpment. This is a very rare type of community within the province, found only in the Ottawa Valley. Because the red cedar populations are located mainly on the Escarpment walls, they are under direct pressure from rock climbing activities. The most popular rock climbing site is also home to the second largest concentration of red cedar in the Park.

The other benefits of the Escarpment's micro-climate include a number of bird species above the cliffs. The birds take advantage of rising air currents and warm winds directed upwards by the Escarpment's topography. Birds of prey migrate through the region in spring and early fall. During these periods, it is possible to observe the red-tailed hawk (*Buteo jamaicensis)* and the turkey vulture (*Cathartes aura*). Many species use the cliff for nesting, and groups of crows and rooks are regularly observed by climbers. Owls, rarely seen because of their nocturnal habits, are also common on the Escarpment. There are several potential nesting sites for the American peregrine falcon (*Falco peregrinus anatum*) on the Eardley Escarpment. These nesting sites are monitored every five years by the MDDEP.

Land-based wildlife is also abundant on the Escarpment. For example, the cervids winter on the western portion of the Escarpment. During March and early April, it is not unusual to see dozens of animals feeding in the fields at the base of the Escarpment, or travelling the network of paths they create by trampling the snow covered slopes. In winter, packs of wolves (*Canis lupus lycaon*) visit the Escarpment, hunting for white-tailed deer (*Odocoileus virginianus*). This part of the Park is also inhabited by black bear (*Ursus americanus*), which can be observed on occasion. The bears are attracted by the plentiful supplies of berries growing on top of the hills. Their dens are usually located alongside the Escarpment crest. Other common species include the racoon (*Procyon lotor*), muskrat (*Ondatra zibethicus*), squirrel (*Sciurus carolinensis*, *Tamiasciurus hudsonicus*) and chipmunk (*Tamias striatus*).

In 1990, a juniper hairstreak (*Callophrys gryneus*), a butterfly often found around the red cedar, was captured for the first time in Québec at the bottom of Eardley Escarpment. It is now classified as a threatened species in Québec by the Société d'entomologie du Québec (SEQ). Insect populations associated with the red cedar and other Escarpment plants have been studied on numerous occasions, highlighting the entomological richness of this habitat (Landry, 1990). In 1991, new lepidoptera species were seen along the Escarpment (Landry and Landry, 1991), while in 2001, researchers found six species of beetles that had never before been documented in Québec (Laplante, 2001). Goulet (1994) also found the first examples in Québec of three hymenoptera families, linked to the presence of the red cedar. The discovery of these species in Québec highlights the unique character of this region's wildlife.

Because of all these factors, Eardley Escarpment is without question Gatineau Park's richest natural environment. Because of its hot, dry climate and steep slopes, it is also the most fragile, and is particularly sensitive to erosion.

IMPACTS OF ROCK CLIMBING ON THE HOST ENVIRONMENT, AND CONSERVATION OPTIONS

A study by Dubé (1995) showed the significant impact of climbing on some Eardley Escarpment habitats. Many other studies have also been carried out, some on the question of protecting plant species and others on damage to the rock face and the potential decline in the number of wild animal species. In all, six major impacts have been identified. The table below summarizes the available information. In addition, Kuntz and Larson (2005) report that the impact of rock climbing varies according to the degree of difficulty of the wall. The study recommends the use of walls with a level of difficulty higher than 5.10, rather than easier walls, since their impact on the environment is less severe,.

The conservation options set out in the table have been applied in some locations, and it is therefore possible to comment on them:

- Closure of climbing sites: This management option has frequently been proposed in the literature. It allows plant and animal species to re-colonize the environment, increases species wealth, protects the plant cover and avoids loss of essential habitats. However, the literature also shows that it often does not produce satisfactory results because climbers continue to use the prohibited sites, and the closures are difficult to enforce. Even so, the results observed on Mont Saint-Hilaire are encouraging. (Camp and Knight, 1998; Rusterholz et al., 2004; Kelly and Larson, 1997; McMillan and Larson, 2002)

Closure of certain climbing paths and installation of permanent paths: This option, too, is mentioned frequently in the literature. It allows users to continue their activity, except during critical periods of the year, for example during flowering or nesting. The literature shows that climbers tend to comply with this type of rule. A management plan can also be introduced, allowing those in charge to set limits on climbing and introduce measures to ensure environmental sustainability (Camp and Knight, 1998; Rusterholz et al., 2004)

Introduction of monitoring programs: Also cited frequently in the literature, this option identifies damage to the ecosystem and allows for ongoing observation of the impacts of rock climbing and recreational activities on the cliffs and related communities. Based on these observations, managers are able to assess the intensity of the activities and decide on a management approach. A monitoring program may be combined with complete or partial closure of climbing sites. (Rusterholz et al., 2004; Richardson, 1999; McMillan and Larson, 2002)

Status quo: Many of the reports cited in this document show that the environment is affected significantly by rock climbing activities on the Escarpment cliff, and that measures are needed to correct this situation. In addition, it has been shown that the environment's level of resilience declines steadily as a result of species loss and community impoverishment, preventing the ecosystems from resuming their functions and developing normally after disturbance.

IMPACTS ON THE ENVIRONMENT	CONSERVATION OPTIONS
REDUCTION IN SPECIES WEALTH	
Decline in plant and animal species (Baker, 1999; Rusterholz et al., 2004; CPAWS, 2005). **D**ecline in lichen species on climbing sites, compared to non-climbing sites (Farris, 1998). **D**ecline in tree, bush and non-graminaceous grass species on climbing sites, compared to non-climbing sites (Camp and Knight, 1998). **D**ecline in snail population wealth (McMillan et al., 2003). **M**ore bird species (60 %) on non-climbing sites (Krajick, 1999). **L**oss of diversity in bryophyte, moss and liverwort species (McMillan and Larson, 2002; Kingsley, 2002). **H**ealth considered severe for three of the seven red cedar species (NCC, 2002a). **D**ecline in the number of three calcicole fern species: the walking fern (*Asplenium rhizophyllum*), purple cliffbreak (*Pellea atropurpurea*) and bluntlobe cliff fern (*Woodsia obtusa*) (Gagnon, 2002). **S**ignificant differences in the number of species and relative frequency of many species (Farris, 1995). **S**ubstantial damage to vegetation in areas used by rock climbers (Genetti and Zenone, 1987).	Close or control of access paths and inform users (Camp and Knight, 1998; Cornish, 2004; Farris, 1998; Francis, 2001; Kelly and Larson, 1997; McMillan and Larson, 2002; Nuzzo, 1995; Richardson, 1999; Rusterholz et al., 2004)
A DECLINE IN PLANT COVER	
Decline of more than 5% on climbing sites, compared to non-climbing sites (Rusterholz et al., 2004). **G**reater density of large white cedars on non-climbing sites (Farris, 1998). **D**ecline in lichen cover (Krajick, 1999). **D**ecline in plant cover at the base of climbing sites (McCarthy, 2003). **L**ess abundant plant life (Baker, 1999). **S**ignificant differences in total vegetation cover (Farris, 1995). **V**egetation shift and loss of plant growth sites (Genetti and Zenone, 1987).	Reduce access during critical (breeding) periods and install permanent path systems (Camp and Knight, 1998; Farris, 1998; Francis, 2001; Kelly and Larson, 1997; McMillan and Larson, 2002; Nuzzo, 1995; Rusterholz et al., 2004)
SOIL EROSION	
Soil compaction (McMillan et al., 2003). **S**oil displaced by climbers (Francis, 2001). **I**ncrease in soil degradation (Cornish, 2004). **C**reation of deep run-off runnels in the soil (Genetti and Zenone, 1987). **S**igns of soil erosion (CPAWS, 2005).	Limit access to climbing sites and prohibit the use of pitons and carabiners (Camp and Knight, 1998; Farris, 1998; Francis, 2001; Rusterholz et al., 2004; Cornish, 2004)
EROSION OF CLIFF WALLS	
Physical signs of damage on cliff walls (Francis, 2001; Cornish, 2004; Kelly and Larson, 2004). **E**vidence of rain-resistant chalk on the rock walls (McCarthy, 2003). **S**igns of cliff wall erosion (CPAWS, 2005).	Prohibit the use of pitons and carabiners, reduce treading and inform users (Camp and Knight, 1998; Farris, 1998; Kelly and Larson, 1997; Rusterholz et al., 2004; Cornish, 2004)

IMPACTS ON THE ENVIRONMENT	CONSERVATION OPTIONS
ALTERATION OF PLANT AND ANIMAL COMMUNITY COMPOSITION	
Change in the frequency of dwarf trees such as the creeping germander (*Teucrium chamaedrys*) and mountain germander (*Teucrium montanum*) (Rusterholz et al., 2004). **I**ncrease in monocotyledon populations on sites used by climbers (Farris, 1998). **F**ew trees in younger age classes (Kelly and Larson, 1997). **C**hange in snail population composition (McMillan et al., 2003). **I**nvasions of invasive species on sites used by climbers (Oosthoek, 2002). **D**ifferent bird communities, altering spatial distribution (Camp and Knight, 1998). **C**hanges in the number of invasive bird species (Camp and Knight, 1998).	Introduce monitoring programs (Camp and Knight, 1998; Farris, 1998; Francis, 2001; Kelly and Larson, 1997; McMillan and Larson, 2002; Nuzzo, 1995; Richardson, 1999; Rusterholz et al., 2004)
HABITAT LOSS	
Large percentage of bare rock (Rusterholz et al., 2004). **D**ecline in the number of growth sites suitable for plants (Camp and Knight, 1998). **D**egradation of the red cedar (*Juniperus virginiana*) habitat (NCC, 2002a).	Close or control access and inform users (Camp and Knight, 1998; Cornish, 2004; Farris, 1998; Francis, 2001; Kelly and Larson, 1997; Nuzzo, 1995; Richardson, 1999; Rusterholz et al., 2004)

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