THE JACKSON CREEK OLD-GROWTH FOREST

CORE AREA OF THE JACKSON CREEK SIGNIFICANT WOODLAND IN PETERBOROUGH, ONTARIO

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EXECUTIVE SUMMARY

The Jackson Creek Old-Growth Forest (OGF) is a 4.5 hectare (11.3 acre) urban old-growth forest with trees reaching 250 years old, predating the original settlement of the Town of Scott's Plains, now Peterborough, Ontario. This old-growth forest is part of the 92-hectare Jackson Creek Riparian Forest, which meets the recommended provincial criteria for both a Significant Woodland and a Significant Valleyland. The forests and wetlands surrounding Jackson Creek, which include a provincially significant wetland (Jackson Creek Wetland East), add substantially to Peterborough's urban biodiversity. This large natural area also provides an important natural corridor along Jackson Creek into the heart of Peterborough. It was identified as a natural linkage leading from the Cavan Swamp core area in the Big Picture 2002 and Kawarthas Naturally Connected studies.

The Jackson Creek OGF is dominated by large White Cedar (*Thuja occidentalis*), White Pine (*Pinus strobus*), and Eastern Hemlock (*Tsuga canadensis)*. Trees are commonly over 150 years, with a maximum age of 256 years. The largest trees reach 97 cm in diameter at breast height, and extend above the surrounding forest canopy to heights of almost 35 metres. Old-growth characteristics include pit and mound topography, coarse woody debris, large old trees, and super-canopy trees. Peterborough is one of only eight cities in Ontario with an identified remnant old-growth forest within its urban core, and the Jackson Creek OGF is the fourth oldest of Ontario's identified urban old-growth forests.

The Jackson Creek OGF is the best example of a mature White Cedar - White Pine - Eastern Hemlock stand on a glacial spillway slope known to the authors in Ecodistrict 6E-8. The characteristics of the Jackson Creek OGF compare favourably with other noteworthy examples of old-growth forests found in or near urban areas in Ontario. A recommendation is made that this outstanding natural feature be recognized and protected from any further disturbance.

INTRODUCTION

The Jackson Creek valley was formed by the torrent of glacial meltwater flowing from the ancient Lakes Algonquin and Jackson through the overlying till to create a glacial spillway approximately 12,000 years ago (Adams and Taylor 2009). At the location of the Jackson Creek OGF, near the head of Monaghan road, the spillway has a steep slope rising approximately 25 metres above the Creek. The north-east facing slopes and valley bottom provide ecological conditions that favour White Cedar and Eastern Hemlock. These slopes also have also discouraged land clearing and development, allowing an old-growth forest to persist here on the hilltop, slopes, and valley bottom.

The existence of a mature conifer forest in Jackson Park with high ecological, recreational, and educational value has been noted in numerous previous reports over many decades (Greig et al.1993, Golder Associates 2014, AECOM 2014), but until now no thorough field studies have been conducted to characterize the stand composition or tree ages. In this study we characterize the nature of the stand using plot-based sampling and compare it to other old-growth forests.

The focus of our field work was the Jackson Creek OGF. However, it became increasingly apparent as the field work progressed that the larger Jackson Creek Riparian Forest-Wetland Complex, taken as a whole,

is an important element of biodiversity and connectivity of the landscape of Peterborough and surrounding regions; the equivalent of an "*ecological gem*".

This project was undertaken in a manner which supports the City of Peterborough (2011) Urban Forest Strategic Plan, particularly several of its recommendations:

- Recommendation 1.2: Conduct plot samples, using a recognized classification system to complete periodic inventories of the urban forest within prescribed timelines and integrate the data with the City`s GIS system.
- Recommendation 1.4: Establish targets for native species composition in various land use classes.
- Recommendation 2.1: Establish a baseline for canopy cover and periodically update canopy cover performance (e.g. with each upgrade of the City orthographic photographs).
- Recommendation 6.1: Implement a heritage tree identification, designation and protection program following recognized standards (e.g. as recommended by the Ontario Heritage Tree Alliance).

METHODS

Aerial photography was used to estimate stand boundaries, then field observations and GPS were used to refine them. For field determination, the following criteria were considered:

- tree size and age,
- tree species composition, and
- other characteristics of high age or low disturbance, such as coarse woody debris, evidence of wildlife use, and microtopography.

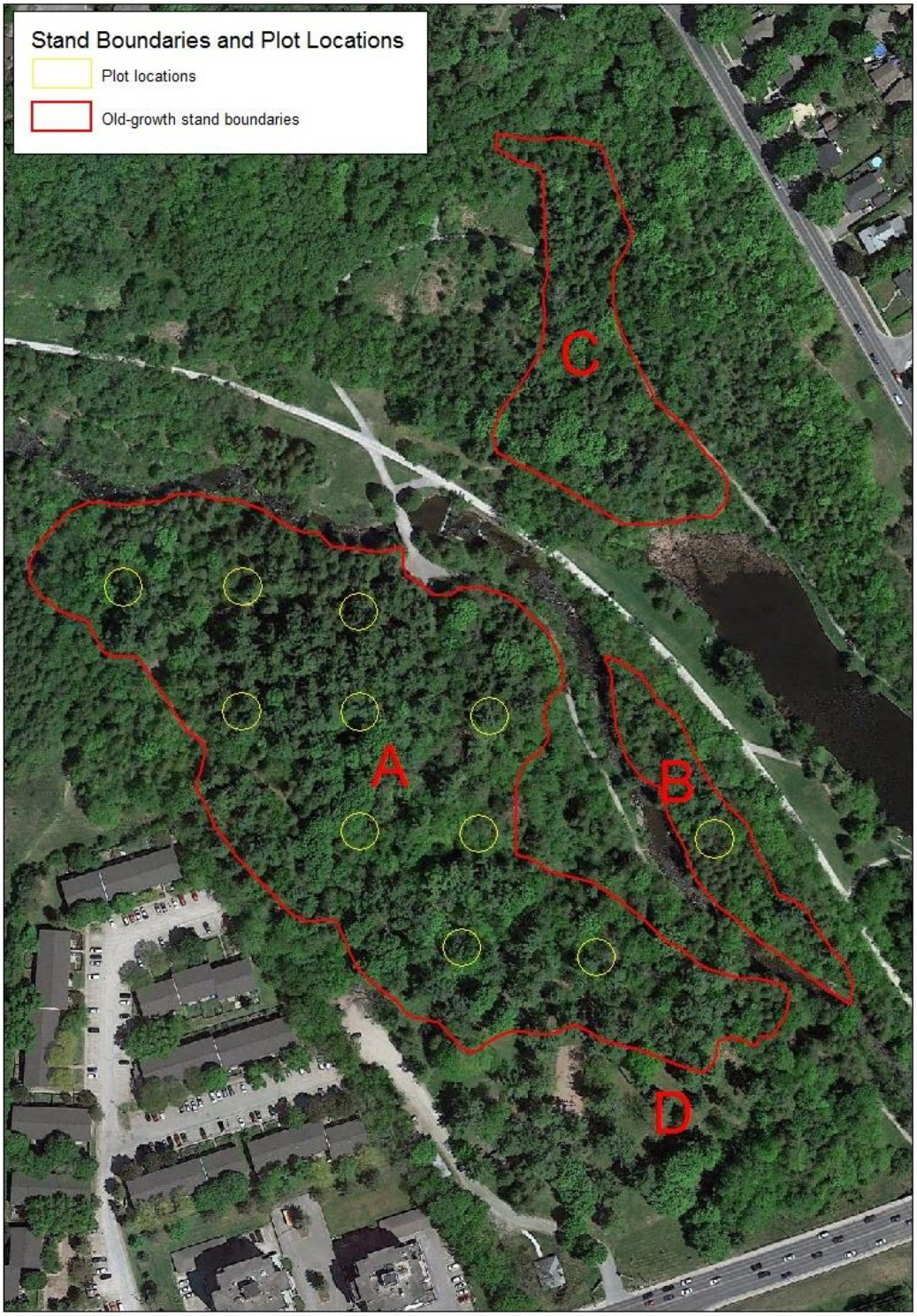
Three blocks of old-growth forest were identified (blocks A, B and C in Figure 1), which taken together represent a single fragmented old-growth forest stand. Blocks A and B are contiguous except for a disturbance along the southwest bank of Jackson Creek. Block C is more disturbed and was not initially included in this study, however it was added later because it contains late successional species with visual characteristics of old age. Another area (D in Figure 1) is not considered to be part of the old-growth forest because it has been landscaped as a city park, and lacks a forest understory or a normal distribution of trees, however the large pine trees here are likely 150+ years old.

To characterize the forest, 11 sampling sites were selected using a 50 metre grid placed over the stand, excluding block C, which was added after plot sampling was complete. GPS and compass bearings were used to locate plot centers, which were marked without further searching as soon as the GPS read within 2 metres of the predetermined location. Where plots overlapped with a trail, the plot center was shifted perpendicular to the trail until the plot edge no longer overlapped.

Tree frequency and diameter classes were determined using fixed plots of 8 metre radius (201 m^2). Combined area of the plots was 2,211 m^2, or 5% of the old-growth forest area. DBH was measured for all trees in the plot (trees were considered ‘in’ if the tree diameter was more than half inside the plot radius). Height was measured for at least two trees, selected based on DBH and/or obvious height

differences. At each plot center, a prism sweep was also conducted using a wedge prism (BAF 2), to obtain a better stand-level basal area estimate by species.

FIGURE 1. STAND BOUNDARIES OF JACKSON CREEK OLD-GROWTH FOREST



To estimate stand age, trees were selected based on size and visual characteristics for sampling with an increment borer. A minimum of one tree was cored at each plot location, either within or in sight of the plot. Other trees were cored between plots based on visual characteristics of age, particularly in the west portion of the stand where some of the oldest trees are located. In Block C, representative individuals were selected in several areas of the block. Cores were collected and counted later, using magnification where necessary. To account for time to reach breast height, 15 years was added to most species age estimates (Fraver et al. 2011), and 24 years was added to Eastern Hemlock (Vasiliauskas 1995).

Most species commonly yielded complete ring counts, so the question of how to extrapolate incomplete cores was important only for White Cedars, which are among the oldest trees in the stand but produced few complete cores. We preferred a conservative method for estimation and we lacked a sufficient sample of complete cores to develop an effective non-linear formula. One simple linear method is to use the innermost 20 rings to estimate a growth rate for extrapolation (Rozas 2003). For the incomplete cores we extracted from White Cedar, this method yielded growth rates of 1.7 - 2.8 mm/year.

We compared this to growth rates from the inner wood of the few complete cores of White Cedar. Averaged over the inner 18 cm of wood (the approximate missing portion of our oldest trees), the fastest growth rate was 2.2 mm/year, the slowest was 1.2 mm/year. If the oldest tree in the stand, conservatively estimated at 256 years, grew at 1.2 mm/year in the missing section of core then its actual age would be 313 years. Visual characteristics suggest that these trees are in the range of 250-300+ years. Table 1 shows the range of estimated ages for White Cedar in the stand using different growth rates.

TABLE 1. COMPARISON OF METHODS OF EXTRAPOLATION FOR INCOMPLETE CORES OF WHITE CEDAR

DBH (cm)	Length of core (cm)	Counted rings (yrs)	Estimated age Fastest growth rate (yrs)	Estimated age Slowest growth rate (yrs)	Estimate age using Inner 20 rings (yrs)
73	17	130	234	308	256
54.1	11.5	106	192	251	209
53.1	16	113	176	216	181
74.7	15.5	116	230	313	256
57.7	13.4	104	189	248	177

In order to evaluate the rarity of remnant old-growth forests in urban areas we used internet resources, reports, and queries to individuals and organizations to build a preliminary list of urban old-growth forests in Ontario.

RESULTS AND DISCUSSION

The Jackson Creek OGF is dominated by White Cedar, White Pine and Eastern Hemlock (Fig 2). White Pine is predominantly found in the larger diameter classes, whereas White Cedar and Eastern Hemlock are more evenly distributed throughout all size classes (Fig 3). White Ash, Sugar Maple and American Beech are found in the smaller diameter classes. Tree coring focused on older individuals rather than determining age classes, however, diameter distributions suggest that White Cedar and Eastern

Hemlock are likely self-replacing. Tree core data, which show White Pine ages ranging between 113 and 168 in relatively close proximity, demonstrate that White Pine currently growing in the stand did not initiate after a single disturbance event (Fig 4).

American Beech had greater importance in the stand and higher densities in larger diameter classes before Beech Bark Disease (BBD) infected the stand. One third of the logs measured in the plots were American Beech, with an average diameter of 42 cm. Possible resistance to BBD was observed on one surviving American Beech (UTM 711938, 4910068), thus a more thorough survey of this species should be undertaken.

FIGURE 2. BASAL AREA OF TREES IN JACKSON CREEK OLD-GROWTH FOREST

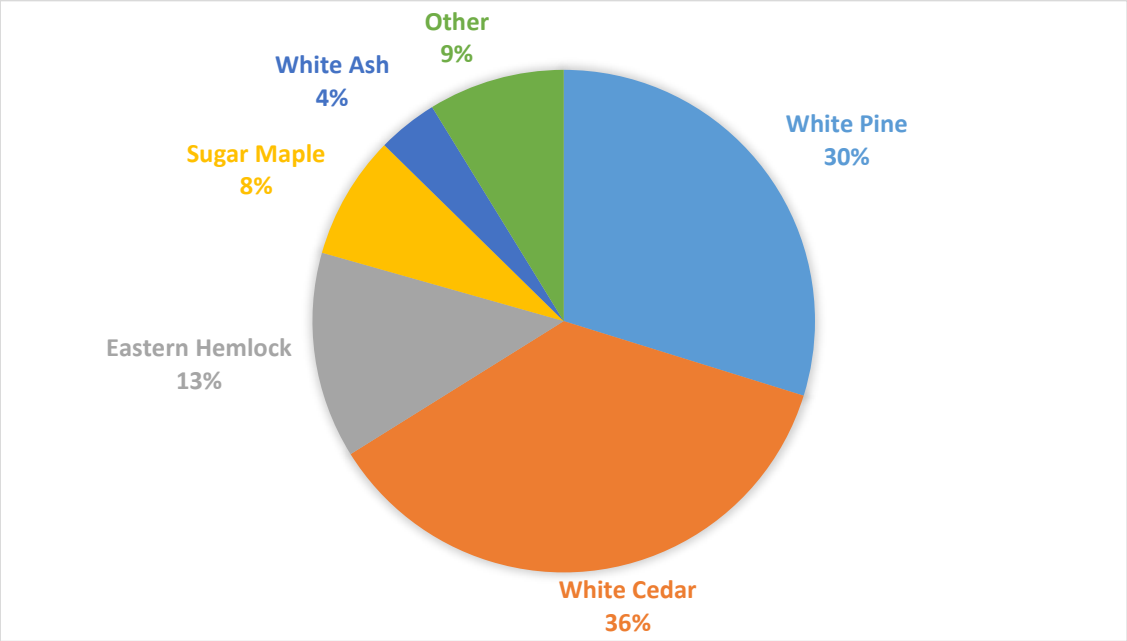


FIGURE 3. DIAMETER CLASSES OF TREES IN JACKSON CREEK OLD-GROWTH FOREST

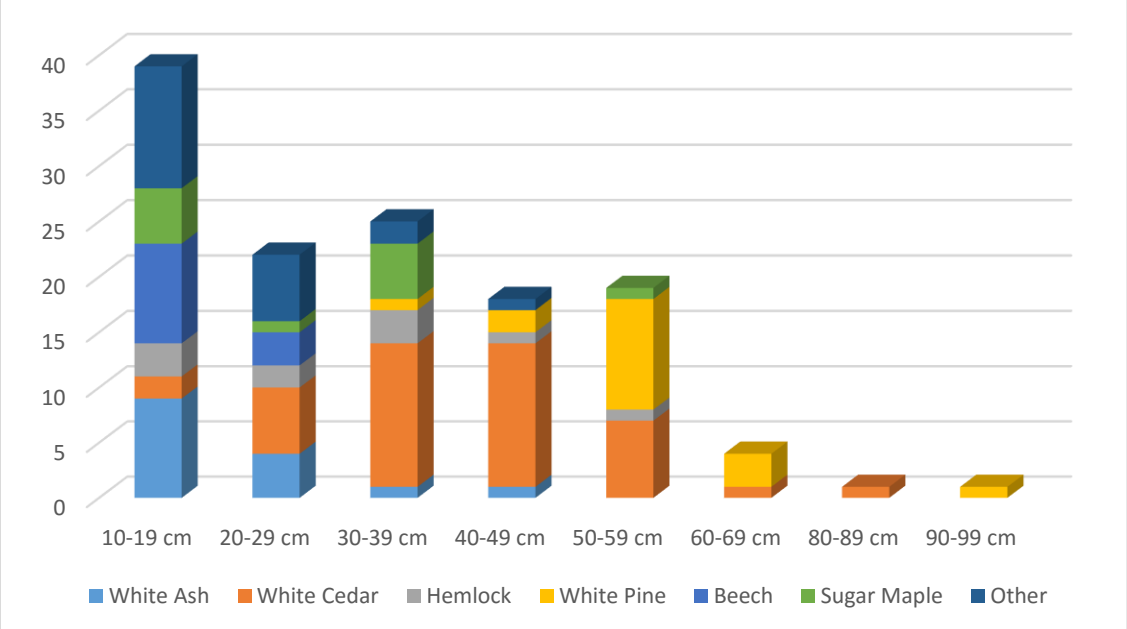
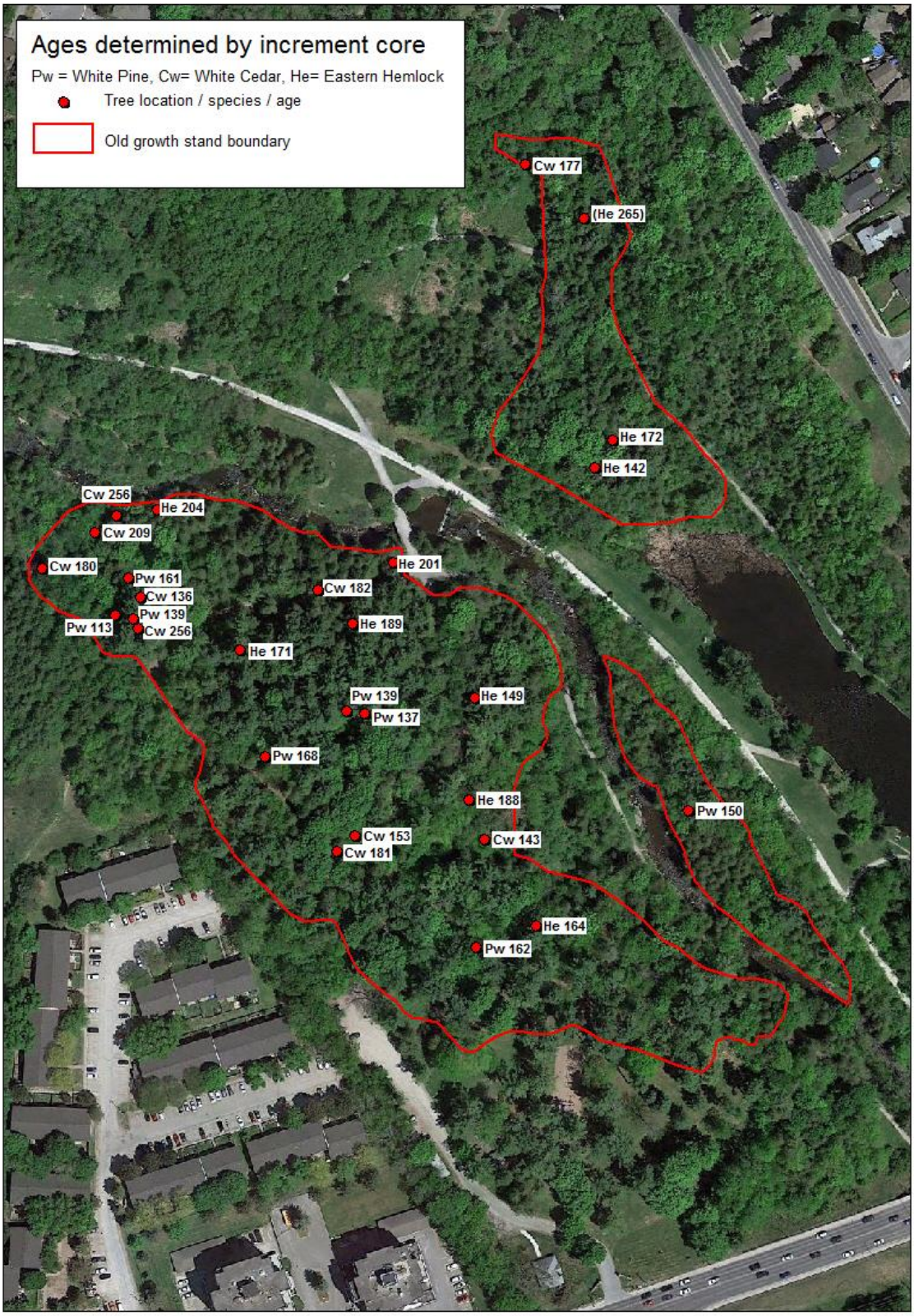


FIGURE 4. AGES (YRS) OF TREES IN JACKSON CREEK OLD-GROWTH FOREST



Block A (Fig 1) is a diverse forest: it is dominated by White Cedar on the lower slope and flat; by mixed Eastern Hemlock, White Cedar and White Pine on the steep spillway slope; and by White Pine mixed with White Cedar on the hilltop. The oldest trees (256 years) occur in the White Cedar swamp at the northwest corner of Block A and on the slope above it. Block B is a narrow (25 metre) strip of White Cedar with super-canopy of White Pines around 150 years old.

Block C is the most historically disturbed area, but includes a significant component of old White Cedar, Eastern Hemlock, and a few White Pines. At the heart of Block C is a small grove of Eastern Hemlock, White Cedar and White Pine with a groundwater seep and a picturesque first-order stream. As one climbs the hill it is more disturbed but remnant trees reaching at least 177 years persist. The Eastern Hemlocks on this slope tend to be hollow, however a relatively short section of core yielded 105 rings and an estimated age of 265 years (shown in brackets in Fig 4), potentially placing them among the oldest in the Jackson Creek OGF.

TABLE 2. SUMMARY OF TREE CORE DATA

Species (Number Of Cores)	**Minimum Age (yrs)**	**Maximum Age (yrs)**	**Average Age (yrs)**
White Pine (8)	113	168	146
White Cedar (10)	136	256	187
Eastern Hemlock (9)	149	204	176
Total (27)	113	256	171

OLD-GROWTH CHARACTERISTICS

Many old-growth forest definitions have been proposed. Although these definitions are often varied and specific to a forest type, they do share some common features (Leverett 1996). Many of these defining old-growth characteristics were observed and documented in the Jackson Creek OGF and are summarized in Table 3.

Some old-growth forest definitions emphasize a lack of human disturbance as a key feature. However, this criterion is generally not applied to identification of old-growth forests in Ontario as this would exclude nearly all old-growth forests south of the Canadian Shield. For example, two nearby old-growth examples, Mark S. Burnham Provincial Park and Peter's Woods, have some evidence of previous logging.

It is probable that some White Pine was selectively logged from the Jackson Creek OGF in the mid-1800's. This would account for the lack of White Pine in the oldest tree age classes. Logging of the oldest White Pines 160 years ago may have been the disturbance that initiated establishment and growth of some of the White Pines that are found in this forest today. Other tree species in the Jackson Creek OGF, such as White Cedar and Eastern Hemlock, appear to have been left relatively undisturbed since they commonly occur at ages that predate settlement and logging in the Peterborough area.

TABLE 3. OLD-GROWTH CHARACTERISTICS IN JACKSON CREEK OLD-GROWTH FOREST

Characteristics	Occurrence in the Jackson Creek Old-Growth Forest
Climax species	Late successional species are dominant (57% of basal area) and are present in all diameter classes. White Cedar and Eastern Hemlock appear to be self-replacing.
Old trees	Trees >150 years old are common, with a maximum age of 256 years; 27 tree cores yielded an average ring count of 130, and an average estimated age of 171 years.
Large diameter trees	Almost one in five trees has a diameter of 50 cm or greater.
Coarse woody debris	Large diameter snags and logs are relatively abundant. Basal area of snags was 2.4 m^2/ha.
Pit and mound topography	Pit and mound topography was observed in all parts of the stand, but was least abundant on the north bank of Jackson Creek.
Super-canopy trees	White Pines up to 34.5 metres tall create a super-canopy over White Cedar and Eastern Hemlock.
Wildlife use	Pileated Woodpecker feeding cavities are common.

A standard reference for defining old-growth forest in Ontario is the *Old-Growth Forest Definitions for Ontario* (OMNR 2003). These definitions, developed for use on Crown Land in the Area of the Undertaking (the Canadian Shield portion of central and northern Ontario), are based on an old-growth initiation age by ecosite type, making determination of old-growth status very easy. Ages in the Jackson Creek OGF meet the old-growth age of onset criteria for all relevant ecosite types (Table 4). By any commonly accepted definition in Ontario, a 4.5 hectare (11.3 acre) portion of the Jackson Creek Riparian Forest is an old-growth forest.

TABLE 4. OLD GROWTH AGE OF ONSET VS AGES IN JACKSON CREEK OLD-GROWTH FOREST

Tree Species	Old Growth Age of Onset by Species (OMNR 2003; yrs)	Maximum Age in Jackson Creek Old-Growth Forest (yrs)	Average Age in Jackson Creek Old-Growth Forest (yrs)
White Pine	120-150	168	146
White Cedar	110-150	256	187
Eastern Hemlock	140-180	204	176

OMNR (2010) states that "due to the rarity and fragmented distribution of old growth forests in southern Ontario, as much of identified sites should be represented as many times as possible... Sites that could be lost or severely degraded and cannot be replaced by similar sites in the planning area, are highly significant." Old-growth forests are rare in Peterborough County due to a long history of logging and land clearing beginning in the first half of the 19th Century. White Pine forests were particular sought after, and by 1850 several mills were operating in the Peterborough area, primarily milling White Pine.

By 1964, only 0.7 percent of the woodland at that time had a diameter at breast height of 18 inches (46 cm), and only 2.7 per cent (1,986 acres; 794 hectares) of the forest cover in this area had a major component of White Pine (Conservation Authorities Branch 1964).

A comparison of our field results to the average of 35 heritage woodlands surveyed by Larson et al. (1999) shows that the Jackson Creek OGF compares favourably to these unique woodlands (Table 5). Mean tree diameter, percentage of large trees, and log frequency in the Jackson Creek OGF are similar to the average numbers from Larson et al. (1999), while basal area and mean log size are somewhat higher in the Jackson Creek OGF than the average from the 35 heritage woodlands.

TABLE 5. COMPARISON OF JACKSON CREEK OLD-GROWTH FOREST TO THE AVERAGE OF 35 HERITAGE WOODLANDS

Old Growth Characteristic	**Jackson Creek Old-Growth Forest**	**Heritage Woodland Average from Larson et al. (1999)**
Mean tree diameter (cm)	32.6	34
Percent of trees with diameter greater than 49 cm	19.4	19
Basal area (m^2/ha)	44.4	36
Mean # logs / point	1.1	1.2
Mean log diameter (cm)	35.3	31.7

URBAN BIODIVERSITY AND OLD-GROWTH FORESTS

Loeb (2011) recognized nine forms of urban old-growth forest. The form that occurs in Jackson Park is a remnant forest with limited tree harvesting, the rarest and most valuable in terms of urban biodiversity (Binelli 2000, Schmitt and Suffling 2006, Loeb 2011). Loeb (2011) emphasizes the role of urban old-growth forest in maintaining historical continuity, similar to the role of heritage building preservation. An equally important function of urban old-growth forests is biodiversity conservation (Binelli 2000). Urban areas were once thought to be biodiversity deserts, however newer research has shown that urban biodiversity is much greater than previously thought. As urbanization increases, the role of urban protected areas takes on greater importance in landscape-level conservation (Alvey 2006, Ahern 2013). Park size is the most important factor influencing biodiversity: large parks are better at maintaining biodiversity than small ones (Alvey 2006).

Remnant old-growth forests in urban areas are relatively uncommon, particularly those that are centrally located rather than on the urban periphery. We identified 13 remnant old-growth forests in urban areas of Ontario (see Appendix 1). Of these, Jackson Creek OGF is the fourth oldest, and also the smallest, although this may be deceptive as few studies accurately delineate boundaries of old-growth forest in the context of their connectivity with other forests and wetlands as described in this study.

The City of Peterborough is fortunate to have two high quality old-growth forests of pre-settlement origin within or next to the city limits; few municipalities in Ontario have comparable remnant forests. These two old-growth forests were preserved due to generous bequests by the Burnham family (Mark S. Burnham Provincial Park) and the Nicholls family (Jackson Park).

REPRESENTATIVE VALUE OF THE JACKSON CREEK OLD-GROWTH FOREST

Representative life science and earth science values are recognized in Ontario through the Areas of Natural and Scientific Interest (ANSI) program, managed by the Ministry of Natural Resources and Forestry. Many ANSIs occur on private lands and have not been incorporated into the provincial system of protected areas. The Provincial Policy Statement (MMAH 2014) under the Planning Act directs that

development shall not be permitted in significant ANSIs. As stated in ANSI policy: “ANSIs encourage the protection of additional areas not regulated as provincial parks and provide a focus for both the public and private sectors to contribute to the protection of Ontario’s natural heritage” (quoted in Hanna 1984).

A provincially-significant ANSI is the best example of a given ecological community/landform type in an ecodistrict and regionally-significant ANSIs are additional examples. The landscape units used in evaluating representation of natural heritage values were called site districts in early documents (e.g., Hills 1959, Hanna 1984), and are now referred to as ecodistricts (Crins 2000). These are areas with a characteristic pattern of physiographic features within which a predictable array of vegetation types develops (Hills 1959). Municipal boundaries are not considered in determining the level of significance.

The Jackson Creek OGF is the best example of a mature White Cedar - White Pine - Eastern Hemlock stand on a glacial spillway slope in Ecodistrict 6E-8 that the authors are aware of. This ecodistrict extends in a band from south of Lake Simcoe eastward to the Bay of Quinte, north of the Oak Ridges Moraine, and is characterized by rolling till plains with drumlins, eskers, and intervening wide river valleys (Hanna 1984).

The Jackson Spillway, where the Jackson Creek OGF is located, is one of several large valleys that was carved out approximately 12,000 years ago, when the outflow of glacial Lake Algonquin was channelled to the former glacial Lake Iroquois, a body of water larger than the current Lake Ontario but in the same general area (Ecclestone and Cogley 2009). The Jackson Creek valley is much wider than that needed to accommodate the current Jackson Creek, even in times of flood events.

Other examples of old-growth forests in Ecodistrict 6E-8 include those in Mark S. Burnham Provincial Park, Lady Eaton and South Drumlins on the Trent University campus, and the mixed forest at Fleming College (Table 6). All of these are on drumlins, not glacial meltwater channel slopes, so they are a different ecological community/landform type than the Jackson Creek OGF.

There is another excellent stand of mature White Pine at Young’s Point on Clear Lake, which has been recognized as a regionally-significant life science ANSI and has been used as a location for collecting White Pine seed (Lindsay 1986). However, Young’s Point is in Ecodistrict 6E-9, so it does not provide representation for communities in Ecodistrict 6E-8. The conifer forest at Warsaw Caves Conservation Area is located on the Indian River (glacial) Spillway (Ecclestone and Cogley 2009), but it is also located in Ecodistrict 6E-9 (Brunton 1990).

The studies that evaluated representation in Ontario's ecodistricts were done in the 1980s when there was less detailed knowledge about the natural heritage values in individual ecodistricts. This was also before GIS tools had been developed and applied to ecological studies. If these studies were repeated today, the Jackson Creek OGF may well be identified as a significant ANSI. This OGF has the added value of being contiguous to a forest that extends along the Jackson Creek valley and which connects with the provincially-significant Jackson Creek East Wetland (Ontario Ministry of Natural Resources and Forestry 2016). This wetland has the important function of absorbing water from severe rain storms and greatly reducing the damaging effects of flooding on downtown Peterborough.

TABLE 6. PETERBOROUGH AREA OLD-GROWTH FORESTS

SITE NAME, SOURCES	LOCATION/ECOSITE	MAIN SPECIES	CHARACTERISTICS
Jackson Creek Old-Growth Forest	Jackson Park, City of Peterborough, 6E-8	White Cedar, White Pine, Eastern Hemlock	White Pines 34+ m; trees 100+ years; White Pine 97 cm DBH; White Cedar 81 cm DBH; Eastern Hemlock 69 cm DBH; coarse woody debris; pit and mound topography
Mark S. Burnham Provincial Park	Mark S. Burnham Provincial Park, City of Peterborough, 6E-8	Eastern Hemlock, Sugar Maple, American Beech	Old Growth
Promise Rock Natural Area (Jones et al. 2002; p.264; Ben-Oliel et al. 1989, p.51)	Trent University, City of Peterborough, 6E-8	White Cedar, White Pine, Eastern Hemlock, White Spruce, Balsam Fir, American Larch	Super-canopy White Pines over 30 m; White Pines 60-71 cm DBH; White Spruce 54 cm DBH; White Cedar 63 cm DBH; Hemlock 47.7 cm DBH; trees 100+ years
Young`s Point ANSI	Young`s Point, Peterborough County, 6E-9	White Pine	Old Growth
Stewarts Woods	Otonabee River, Peterborough County, 6E-8		Old Growth
White Pine and Eastern Hemlock Forests (Ontario Parks 2005, p.27)	Tuckers Road , Anstruther Lake and Bottle Creek , Kawartha Highlands Provincial Park, Apsley, Peterborough County, 5E-11	White Pine, Eastern Hemlock	Old Growth
Sugar Maple and Red Oak Forests (Ontario Parks 2005, p.27)	Southwest limestone plain, Anstruther Lake Road, northeastern end, Kawartha Highlands Provincial Park, Apsley, Peterborough County,	Sugar Maple, Red Oak	High quality forests

	5E-11		
Highway 28 Woods (Jones et al. 2002, p.236; Ben-Oliel et al. 1989, p.43)	Trent University, City of Peterborough, 6E-8	White Ash, Sugar Maple, American Beech	Butternut 39.8 cm DBH; American Beech 35-83.5 cm DBH; White Ash 73 cm DBH; Sugar Maple 63.5 cm DBH; mature trees; fallen wood; pit-and-mound topography

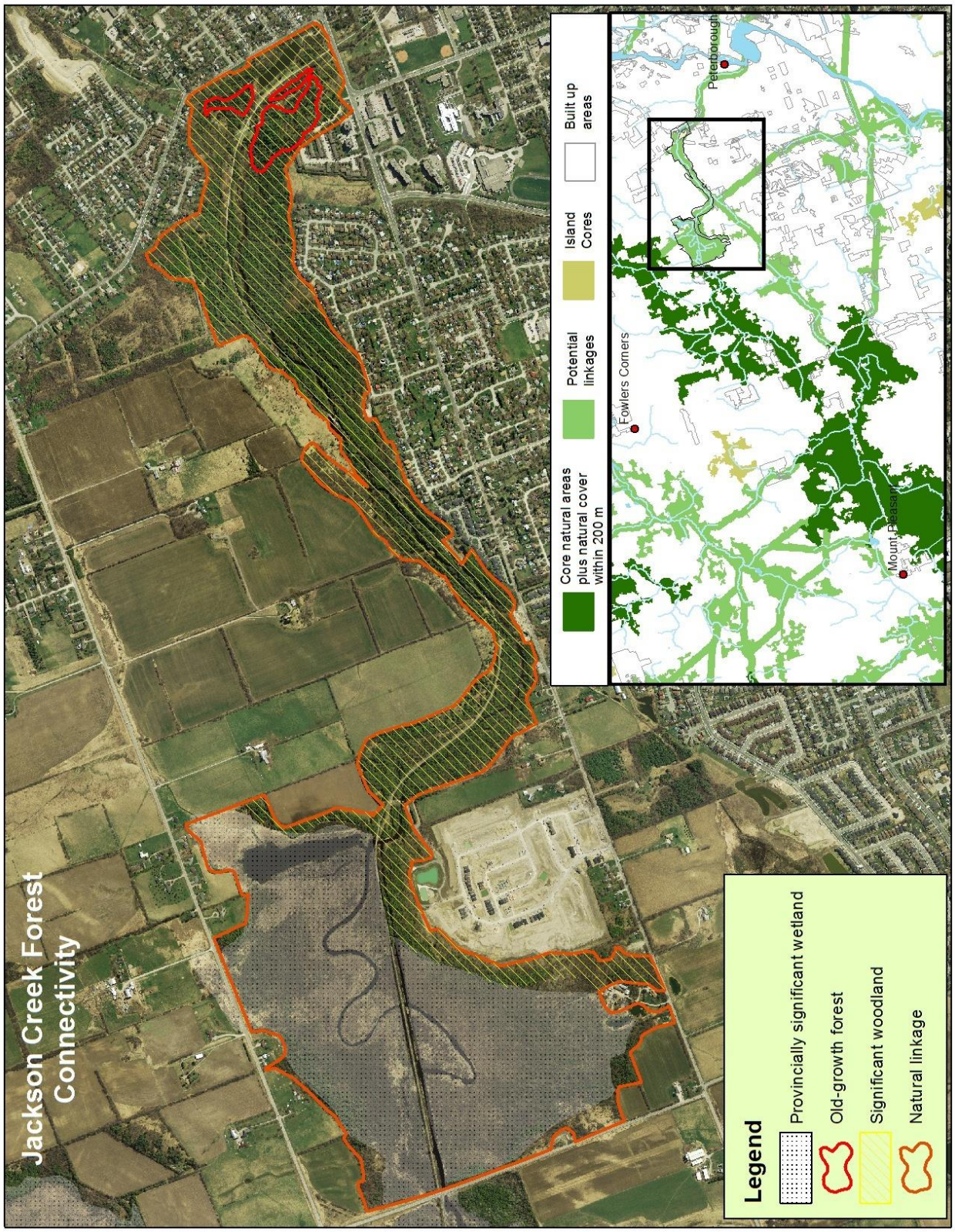
SIZE AND CONNECTIVITY

> *"Linkages that facilitate wildlife movement within a regional context would be those that offer large tracts of contiguous naturally vegetated cover and are most typically found along watercourse systems. Within the study area, the most apparent natural feature that offers these conditions is that of the natural communities located along Jackson Creek and are a part of Jackson Creek Park."* -- (AECOM 2014)

The Jackson Creek OGF, approximately 4.5 Ha (11.3 acres) in size, is contained within the Jackson Creek Riparian Forest, a 92-ha valleyland forest with no road crossings. The Jackson Creek Forest is adjacent to wetlands and small forest patches, including the provincially significant Jackson Creek Wetland East (100 ha). The total contiguous natural area of roadless landscape that includes the Jackson Creek OGF is approximately 195 ha (Fig 5). The role of the Jackson Creek valley in linking to the larger core natural area of Cavan Swamp was recognized in two regional studies of natural heritage systems, the Big Picture 2002 (Riley et al. 2003) and Kawarthas Naturally Connected (van Hemessen 2013).

The Big Picture 2002, and 2012 Kawarthas Naturally Connected, are attempts to incorporate the concept of a protected area network into land use planning in southern Ontario to prevent the gradual erosion of connectivity that is otherwise likely to occur. Protected areas networks are generally considered to consist of nodes of high quality habitat (or core areas) connected with linkages (or corridors), and associated buffer areas; the goal is protection of biological diversity at genetic, species, and community scales (Noss and Harris 1986, Rudnick et al. 2012). In this context, the existence of a high quality node, such as the Jackson Creek OGF, with a high degree of connectivity to large identified core areas is valuable ecologically and should be prioritized in land use planning decisions.

FIGURE 5. CONNECTIVITY OF JACKSON CREEK FOREST IN RELATION TO BIG PICTURE 2002 ANALYSIS



A SIGNIFICANT WOODLAND

CORE OLD-GROWTH FOREST

There are a variety of definitions of significant in terms of woodlands. The *Provincial Policy Statement* (MMAH 2014) states:

> Significant: means ... b) in regard to *woodlands*, an area which is ecologically important in terms of features such as species composition, age of trees and stand history; functionally important due to its contribution to the broader landscape because of its location, size or due to the amount of forest cover in the planning area; or economically important due to site quality, species composition, or past management history. These are to be identified using criteria established by the Ontario Ministry of Natural Resources;

The *Natural Heritage Reference Manual* (OMNR 2010) recommends several criteria for significant woodland evaluation: woodland size, woodland interior, proximity to other woodlands or other habitats, linkages, water protection, woodland diversity, uncommon characteristics, and economic and social functional values. Below, these criteria for evaluating significant woodlands are discussed in relation to the Jackson Creek OGF.

1. A naturally occurring composition of native forest species that have declined significantly south and east of the Canadian Shield and meet minimum area thresholds (e.g., 1–20 ha, depending on circumstance)

Eastern Hemlock has declined significantly from pre-settlement levels, south and east of the Shield in Ontario, and throughout most of its range (Keddy 1994, Foster 1999, Suffling et al. 2003). Eastern Hemlock is the third most dominant tree at 13% of the basal area of the Jackson Creek OGF, is included as a component of the largest and oldest trees, and appears to be self-replacing in the stand.

2. Characteristics of older woodlands or woodlands with larger tree size structure in native species and meet minimum area thresholds (e.g., 1–10 ha, depending on circumstance):

- *older woodlands could be defined as having 10 or more trees/ha greater than 100 years old*
- *larger tree size structure could be defined as 10 or more trees/ha at least 50 cm in diameter, or a basal area of 8 or more m2/ha in trees that are at least 40 cm in diameter*

Our plot data indicates that the Jackson Creek OGF has over 100 trees/hectare at least 50 cm in diameter, or ten times the threshold. Based on tree core data, all of these are likely to be significantly older than 100 years.

3. A high value in special services, such as air-quality improvement or recreation at a sustainable level that is compatible with long-term retention and meet minimum area thresholds (e.g., 0.2–10 ha, depending on circumstance)

Greig et al. (1993) reported that Jackson Park was the most popular natural area in Peterborough particularly for its recreational and educational values. They also note that the Park is valuable for its habitat diversity, size, accessibility, facilities, safety features and connectivity for both wildlife and humans. The Task Force on Sustainable Development for the Peterborough Area (1990) noted that the Jackson Park natural area is held in “esteem” within the City.

4. Important identified appreciation, education, cultural or historical value and meet minimum area thresholds (e.g., 0.2–10 ha, depending on circumstance)

A recent assessment found that the Jackson Creek OGF is part of the Jackson Creek Cultural Heritage Landscape (Golder Associates 2014) based on urban park landscaping concepts that were popular in the late 1800s. The report interpreted the history of the Park using early photographs including many showing the historical forest. It found that, by the mid-20th Century, the large stand of White Pines and, to a lesser extent, the "red cedar" [sic] are considered key elements of the Park.

The Peterborough Natural Areas Steering committee (1996) found that the Jackson Creek System is "extensively used for nature-based recreation and ecological studies; highly valued by the community as a natural feature of the Peterborough landscape." In the Strategy, Jackson Park was identified as "perhaps Peterborough's best known and most popular natural area."

In 2009, as part of Peterborough Green-Up's Treasured Tree Hunt – a public contest to promote the appreciation of unique trees, and to search for candidate heritage trees in the city – the Jackson Creek OGF was nominated twice for its majestic qualities, the size and stature of the healthy trees, and for the habitat value it provides (Gooderham 2016).

LANDSCAPE-LEVEL RIPARIAN FOREST

The 92-hectare Jackson Creek Riparian Forest is a significant woodland based on the criteria of education and recreation in addition to the following two criteria of significant woodlands (OMNR 2010):

1. located within a defined natural heritage system or provides a connecting link between two other significant features, each of which is within a specified distance (e.g., 120 m) and meets minimum area thresholds (e.g., 1–20 ha, depending on circumstance)

The larger Jackson Creek Riparian Forest connects the smaller Jackson Creek OGF to a complex of wetlands and small forest patches, including the provincially-significant Jackson Creek Wetland East, and to other natural areas including a core area identified in at least two Natural Heritage System analyses (Riley et al. 2003, van Hemessen 2013).

2. a portion of the woodland is located within a specified distance (e.g., 30 m) of a significant natural feature or fish habitat likely receiving ecological benefit from the woodland and the entire woodland meets the minimum area threshold (e.g., 0.5–20 ha, depending on circumstance).

The 92 hectare Jackson Creek Riparian Forest is located adjacent to both Jackson Creek and the provincially significant Jackson Creek Wetland East. In Fact, the environmental impact study conducted for the Parkway Corridor Class Environmental Assessment found the Jackson Creek Riparian Forest to be both a Significant Woodland (WOD-3) and a Significant Valleyland after applying the criteria of the Natural Heritage Reference Manual (AECOM 2014).

CONCLUSIONS

The 1996 Peterborough Natural Areas Strategy laid out the following three vision statements:

- To protect what we've already got for the benefit of future generations,

- To build on our inheritance by completing Peterborough's system of natural areas and enhancing both natural and human use values within that system, and
- To plan for future natural areas as urban settlement expands.

The Jackson Creek Riparian Forest is among Peterborough's most valuable assets because of its biodiversity, recreational, educational, aesthetic and cultural heritage values, and has been identified as a significant natural area in numerous reports. In keeping with the first and most fundamental of the Natural Areas Strategy goals, the Jackson Creek Riparian Forest should be protected as a Significant Woodland, Significant Valleyland, and Cultural Heritage Landscape. Landscape connectivity along Jackson Creek should also be maintained and restored, as proposed in the Peterborough Natural Areas Strategy.

A management plan should be developed for the Jackson Creek Riparian Forest, with special emphasis on the old-growth forest remnants and the maintenance of natural landscape connectivity. The threat of introduced forest pests should be addressed in the management plan including a comprehensive survey of American Beech to determine resistance to BBD, and a strategy to monitor and treat for Hemlock Woolly Adelgid. Trampling and its effect on natural tree regeneration should also be addressed in the management plan.

The effects of the proposed parkway extension are not the focus of this report, however they are discussed briefly in Appendix 2. The impacts of greatest concern are the direct destruction of a number of the oldest known trees in the old-growth forest, and the severing of connectivity.

Peterborough finds itself gifted with an impressive natural legacy due to the foresight of its early citizens, including an impressive old-growth forest within the city, and a natural corridor extending along the banks of Jackson Creek nearly to the core of the downtown. The stewardship choices of today's citizens will determine the ecological integrity of this inheritance as it is handed down to future generations.

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APPENDIX 1. URBAN OLD-GROWTH FORESTS IN ONTARIO

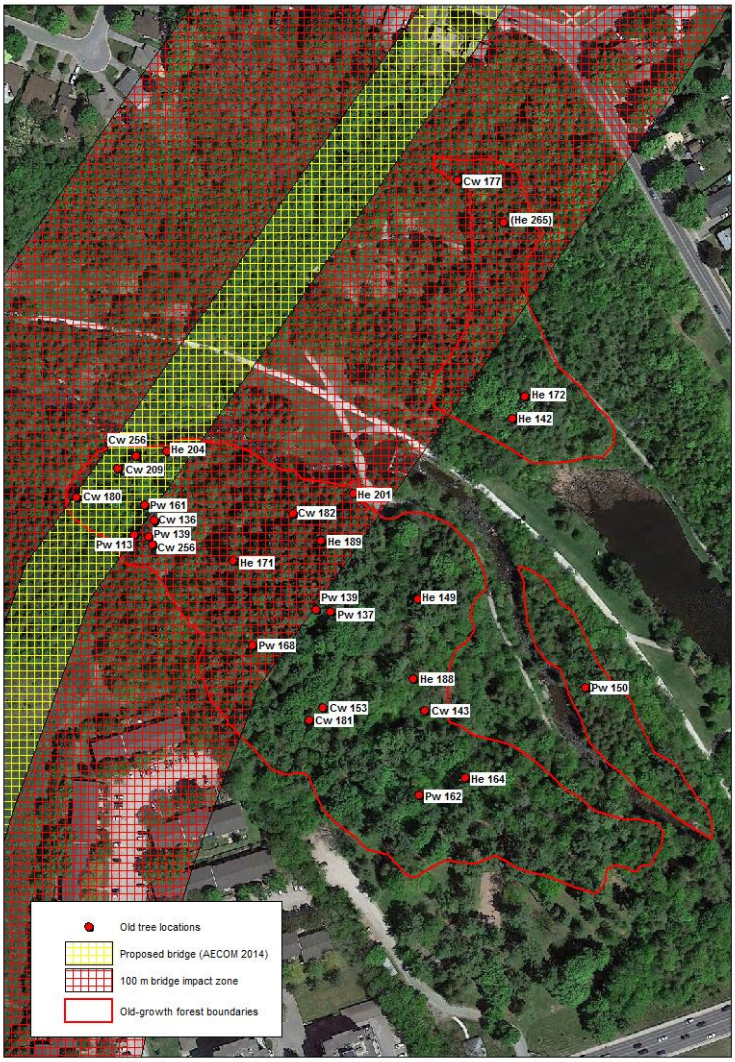
MUNICIPALITY	FOREST NAME	HA	AGE	URBAN?	COMPOSITION / NOTES
ARNPRIOR	Gillies Grove	22	250	Yes	Mixed forest
AURORA	Sheppard's Bush	26	?	Yes	Sugar Maple-Beech
HAMILTON	Cootes Paradise	800	180	Yes	Mixed forest, old-growth is a small portion of total
	Dundas Valley	401	203	Yes	Sugar Maple-Beech, includes areas of younger forest
NIAGARA FALLS	Clifton Hill Bluff	35	275	Yes	Carolinian
NIAGARA-ON-THE-LAKE	Paradise Grove	26	280	Yes	Oak Savannah
PETERBOROUGH	Jackson Creek	4.5	256	Yes	Cedar-White Pine-Hemlock
SAUBLE BEACH	Walker's Woods	14	350	Yes	Eastern Hemlock-White Cedar
TORONTO	Crothers Woods	52	100+	Yes	Sugar Maple-Beech-Oak
	High Park	151	190	Yes	Oak Savannah
	Morningside Tributary Ravine	10	110+	Yes	Cedar-hemlock, remnant white pine
	Rouge Park Cedars Trail	?	?	Yes	?
	Sherwood Park	6	150	Yes	Mixed hardwood
SOME OLD GROWTH FORESTS OCCURING NEAR (NOT IN) AN URBAN SETTING					
ALLISTON	Beattie Pinery	80	100+	Near	White Pine-Hemlock
FONTHILL	St. John's-Fonthill	150	120+	Near	Sugar Maple-Beech
NIAGARA FALLS	Niagara Gorge	100+	435	Near	Carolinian
PETERBOROUGH	Burnham Woods	44	460	Near	Sugar Maple-Beech-Hemlock

Note: This list of known urban old-growth forests in Ontario excludes ancient cliff-growing cedars.

APPENDIX 2. POSSIBLE EFFECTS OF A PROPOSED PARKWAY BRIDGE ON THE JACKSON CREEK OGF

Approximately 5% of the old-growth forest lies directly in the path of the proposed parkway extension, including the area with the oldest known trees. However, the impacts of roads and infrastructure extend well beyond the infrastructure itself and would place stress to the forest adjacent to the bridge. Depending on the type of impact that is considered, impact distances range from tens of meters to kilometers, and on average the width of the affected area is generally considered to extend beyond 100 meters (Seiler 2001), affecting at least 37% of the old-growth forest in this case. Impacts may include hydrological effects, erosion and sedimentation, salt damage to trees and aquatic systems, dust settling on foliage, invasive species introduction or propagule pressure, wildlife avoidance, air pollution, light pollution, noise pollution, and in general reduction of functional connectivity of the landscape (Seiler 2001, Bennet et al. 2011). The severing of the OGF from the larger Jackson Creek Forest is of great concern.

FIGURE 6. LOCATION OF PROPOSED BRIDGE RELATIVE TO JACKSON CREEK OGF



APPENDIX 3. EXPERT SURVEY RESPONSES

Following publication of our preliminary results bulletin in March 2016 we solicited expert opinion about the value of the Jackson Creek OGF. Only two responses were received but these were informative, and are collated below.

1. Please provide your name, organization, professional position, and any other relevant experience:

Dr. Erica Nol, Professor of Biology, Trent University

Martin Parker, Peterborough Field Naturalists, Past President, Currently Secretary, Life-long naturalist

2. Do you feel that the Jackson Creek Old Growth Forest:

- Is a Significant Woodland according to provincial definitions? Why? Any further rationale?

  Erica Nol: *Yes, it looks like it clearly falls under significant woodland according to provincial definitions.*

  Martin Parker: *Yes, the pines are well recognized in the City of Peterborough and it has been a protected area for in excess of 100 years through a family trust which was eventually transferred to the city. This is also a very threatened natural environment as the City of Peterborough wish to build a ¼ long, 4 lane wide bridge through part of the forest and across the valley.*

- Is part of a Significant Valleyland according to provincial definitions? Why?

  Erica Nol: *As above, the Jackson Creek Old-Growth forest does indeed appear to fit the definition of a Significant Valleyland.*

  Martin Parker: *The valley was created by the meltwaters from the last glaciation. The area to the west, known as the Cavan Swamp area was a large post-glacial meltwater lake. The lake was drained through an outlet carved through the drumlins of Peterborough. This outlet is the Jackson Creek Valley.*

- Fills representation needs at the City, County, and /or Site District level? Explain.

  Erica Nol: *Yes, while many of the other old growth forest fragments in the City or County are hardwood dominated, the Jackson Creek Old-Growth Forest is conifer dominated, so is definitely an important representative forest (even without its old growth status) as the trees are particularly large compared to much else found in the city.*

  Martin Parker: *I feel it fits Regional and Site District Designation. It has been identified in a joint City of Peterborough, County of Peterborough, City of Kawartha Lakes as a significant natural corridor.*

- Has important cultural, recreational and educational values? Which ones, and why?

  Erica Nol: *Jackson Creek and all of the associated riparian lands provide a respite from city life for 1000's of city residents every day. The park is well used as is the old-growth forest and is an important component of the well-being of the many city residents who live nearby and those who walk through the city to enjoy its peace and tranquility. It is a major area for dog-walkers as*

well as senior citizens, runners, and walkers who find the quiet and cool green during hot summers, very important to their mental health. I myself use it at least once a week either for a run or a bike ride, and I see regulars on its trails. Kids, and especially those who live in the apartments to the west of the old-growth section spend many happy hours playing in the woods and enjoying and being revived by nature. Thus, this section in particular, of Jackson Park is critically important culturally, recreationally and educationally.

Martin Parker: *The Valley and Jackson Park is an iconic area to the residents of Peterborough for recreational purposed, nature viewing, walking for in excess of 100 years, it is a link in the Trans Canada Trail from Peterborough to Lindsay – always people walking the trail.*

- Should be considered as an Area of Natural and Scientific Interest? Why?

  Erica Nol: *Yes, because of the very old trees. I am stunned at the ages that were determined through coring. Very impressive. The old white cedar started its life before the US became an independent country! Detailed study of the stand of trees will likely show many insect associates of old growth forests as well.*

  Martin Parker: *Yes – on natural features (forest), and especially geomorphological history.*

3. Do you know of other forests at the City, County, or Site District (6E-8) level that may have comparable features in terms of age, species composition, stand characteristics, and/or significance. Please specify and provide any further background on location, previous documentation, and contact people with knowledge of sites.

Erica Nol: *Trent University Canal nature area (off the John de Pencier trail) has some very large cedars, which may also be quite old.*

Martin Parker: *The site was identified in a 'Natural Areas Strategy' for the City of Peterborough completed in the 1990's by the Peterborough Field Naturalists. This report was accepted by Council and forwarded to the Planning Department so aspects could be incorporated in the Official Plan which was never completed by the Planning Department. The valley is lacking Official Plan recognition and protection.*

4. Do you have any further comments or information you would like to share regarding the Jackson Creek Old-Growth Forest?

Erica Nol: *I am impressed by these results. Many thanks for conducting this evaluation! As I am a bird watcher, I will do some bird surveys in the spring.*

Martin Parker: *Development is threatening this natural feature. The Engineers who completed the EA for the proposed Parkway extension stated at a Public Meeting that the road and bridge could be built and the old trees could be replaced or moved.*

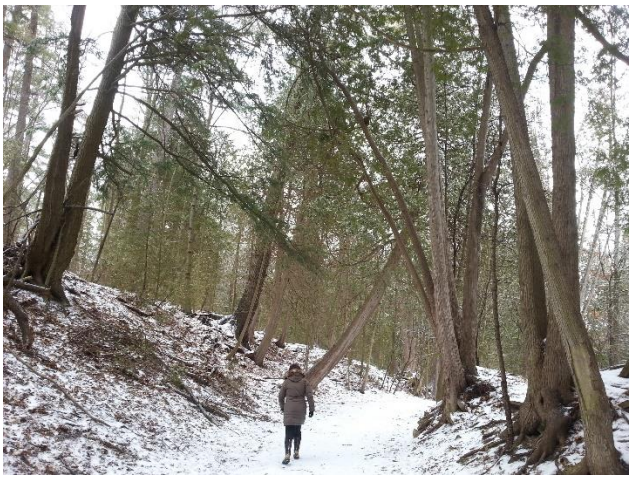
APPENDIX 4. PHOTOS OF JACKSON CREEK OLD-GROWTH FOREST

Signs of old age on a Sugar Maple (area A)

Pileated Woodpecker feeding cavities. Photo Evan Holt

Measuring tree heights (area A)

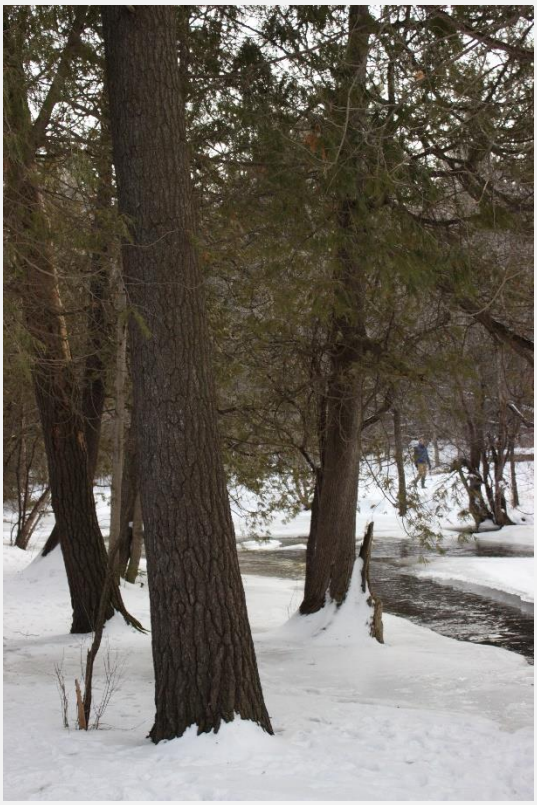
Mixed conifer forest on the spillway slope (area A)



Trail through old-growth forest (area A)

First order stream (Area C)

Coarse woody debris (area A)



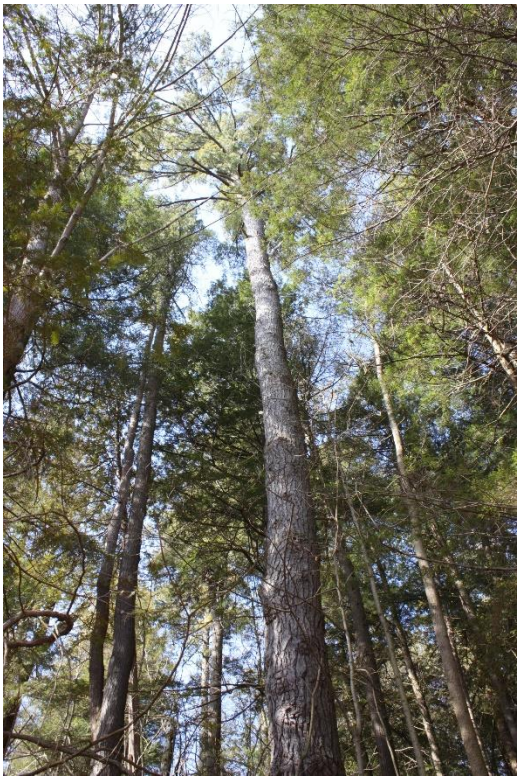
150 year-old White Pine / Cedar (area B)

Pileated Woodpecker cavities on an old Hemlock (area C)

A large White Pine (area A) Photo: Evan Holt

Old forest (area C)

Nesting cavity (area A)



Supercanopy White Pine (area A)