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Status Report on Princess Point: Prescribed Burn Monitoring and Restoration Initiatives

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Document Description

This report summarizes the condition of the prairie and oak savannah plant community at Princess Point, and the restoration activities that have occurred between 2003 and 2016.

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Executive Summary

Princess Point is a unique location at Royal Botanical Gardens (RBG) due to its' cultural and natural heritage. Located in the south west corner of Cootes Paradise Marsh (the western tip of Lake Ontario), Princess Point is a 250 meters long by 90 meters wide sand peninsula rising 5 meters above the water adjacent to the delta of Chedoke Creek. Restoration of the remnant tallgrass prairie and oak savannah following 50 years of use as mowed recreation areas has been ongoing since 2003. Of the 8 hectares of area at Princess Point, 2.5 hectares is being restored to tallgrass prairie and 0.5 hectares is being restored to oak savannah. Restoration activities include a prescribed burn of the oak savannah (2006) and 4 burns of the two prairie areas (2006-2014). The prescribed burns were combined with plantings of 38 prairie and oak savannah species including 12,672 herbaceous plants, the spreading 30 kg of seed, and the planting of 1,667 trees and shrubs. The plantings have been moderately successful with an estimated 60-70% plant survivorship. Of the 1,667 trees and shrubs that were planted (total of 17 species), survival success was variable, mostly due to vandalism.

Plant community monitoring indicates that the prairie and savannah habitats continue to have a considerable amount of non-native grasses; however the number of native species as well as their overall coverage is increasing. A total of 118 plant species have been recorded through monitoring of 20 1mx1m quadrats, with 66 species in the prairie (30 non-native) and 84 species in the oak savannah (28 non-native). The once dominant non-native Narrow-leaf Plantain (50% cover - 2003) has all but disappeared (1% cover - 2016). In the prairie section, the top two dominant plants have remained similar over the years but have switched status. As of 2016 a combination of two native Goldenrod species, Canada and Tall Goldenrod, became dominant (30% cover) and the formally dominant mowed non-native turf grass, Kentucky Bluegrass, is declining (19% cover). The number of native plants has increased compared to the number of non-native plants since 2011, as well as an increase in percent cover of native species compared to non-native species. While still uncommon, Indian Grass has a notable presence throughout the area and to a lesser extent Big Bluestem; both are signature species of a tallgrass prairie habitat. In the savannah section where non-native shrub removals and a single burn have occurred, there was a temporary surge in Red Oak seedlings and Riverbank Grape. Currently much of the understory is bare ground and leaf litter (55%). The amount of cover from leaf litter has been increasing since 2008 and the cover of native species has been decreasing since 2013, while non-native species cover has fluctuated over the years. Pointed-leaved Tick-trefoil (13% cover - 2016) has been the most dominate plant over the last decade, increasing from 1% cover in 2003. Gray Dogwood (2.5% cover) and non-native Orchard Grass (2% cover) are the next most abundant. When comparing the number of native and non-native species in the savannah plots, there has been a larger number of native species present than non-native species since 2003 but no trend is evident.

Table of Contents

List of Tables

List of Figures

1.0 Introduction

Princess Point is a unique location at Royal Botanical Gardens (RBG) due to its' cultural and natural heritage. Located in the south west corner of Cootes Paradise Marsh (the western tip of Lake Ontario), Princess Point is a 250 meters long by 90 meters wide sand peninsula rising 5 meters above the water adjacent to Chedoke Creek. This low waterside peninsula has made Princess Point a natural gathering place for people dating as far back as 10,000 years ago (Haines et al., 2011). Due to archeological discoveries at the peninsula, this area has been termed the Princess Point Complex, which also refers to the aboriginal groups that historically utilized this area of southern Ontario. These discoveries indicate that between 500 and 1000 AD the Middle Woodland culture brought agriculture in the form of corn production to the region (Crawford and Smith, 1996). Princess Point is also quite likely the 1669 landing location of LaSalle's first exploration into the Great Lakes (Galinee, 1670).

> *"….after five days voyage, arrived at the end of Lake Ontario, where there is a fine sandy bay, the bottom of which is the outlet of another little lake discharging itself. This guide made us enter about have a league and then unload our canoes at the place nearest the village….."*

Figure 1. *Aerial photo of Princess Point taken in 2016*

The natural heritage of Princess Point is highlighted by the remnant tallgrass prairie and oak savannah habitats. The current tallgrass prairie habitat covers 2.5 hectares, while the oak savannah portion represents 0.5 hectares. Oak species growing at Princess Point include Red (*Quercus rubra*), White (*Q. alba*) and Black Oak (*Q. velutina*), with Red Oak as the most common. Along the peninsula shoreline, various non-native willow (*Salix sp.*) species occur. Refer to Figure 1 to view a recent photograph of Princess Point. In southern Ontario, tallgrass communities once covered approximately 1000 kilometers^2, but currently less than 3 percent remains. Most tallgrass communities have been lost over

the past 200 years due to land use changes for agriculture and urbanization. Tallgrass habitat is a globally imperiled ecosystem and one of the most endangered ecosystems in Canada (Goodban et al., 1999; Tallgrass Ontario, 2005). These prairies provide habitat for many rare plant and wildlife species, including those designated as rare at the global, national, and/or provincial level.

Due to its popularity, over sixty years of significant modifications have occurred at Princess Point. This includes the use of fill in the 1950s on the upper portion of the point and in the marsh south of the point (currently makes up the parking lot), bulldozer activity to level the fill (Appendix A – Figure 3), intentional and accidental introduction of non-native species, and frequent mowing to maintain fields for recreational activities. Beginning in 2003, the mowed fields were left to naturalize (Burtenshaw, 2011; Haines et al., 2011) and the current walking trail along the perimeter was formalized. Additional disturbances experienced in the marsh, such as carp, regulated water levels and inflowing sewage, have also contributed to the loss of emergent wetland vegetation and shoreline erosion (Haines et al., 2011). Remediating these disturbances have and continue to guide the restoration activities which aim to restore and maintain remnant tallgrass prairie and oak savannah habitats at Princess Point. Such restoration activities include prescribed burns, native prairie seeding and plug plantings, invasive non-native species removals, reducing plant community fragmentation, and more recently shoreline re-stabilization and planting riparian species. In Cootes Paradise Marsh, carp exclusion and reduction in the annual amounts of sewage entering the marsh has allowed emergent shoreline plantings to establish (Theysmeyer et al., 2016).

Since 2008 four prescribed burns have occurred in the Princess Point prairie section, along with multiple plantings of native prairie vegetation. Princess Point savannah, however, has only been burned once in 2006. Prescribed burn monitoring has been conducted to track the changes in vegetation communities as a result of restoration efforts, which began in 2009 at seven monitoring stations for the prairie section and in 2003 at three stations for the savannah section. Below is a map of Princess Point with the locations of the monitoring stations (Figure 2). Although three monitoring methods are conducted during prescribed burn monitoring – photo board, transect, and quadrat – only vegetation recorded in the quadrats will be summarized in this report as it was one of the first methods used when monitoring began. For detailed descriptions of sampling methods, refer to *Prescribed Burn Monitoring Report: 2003-2010* by L. Burtenshaw. It is important to note that not all species of plants that exist at Princess Point occur at the monitoring sites and therefore are not recorded in the monitoring data.

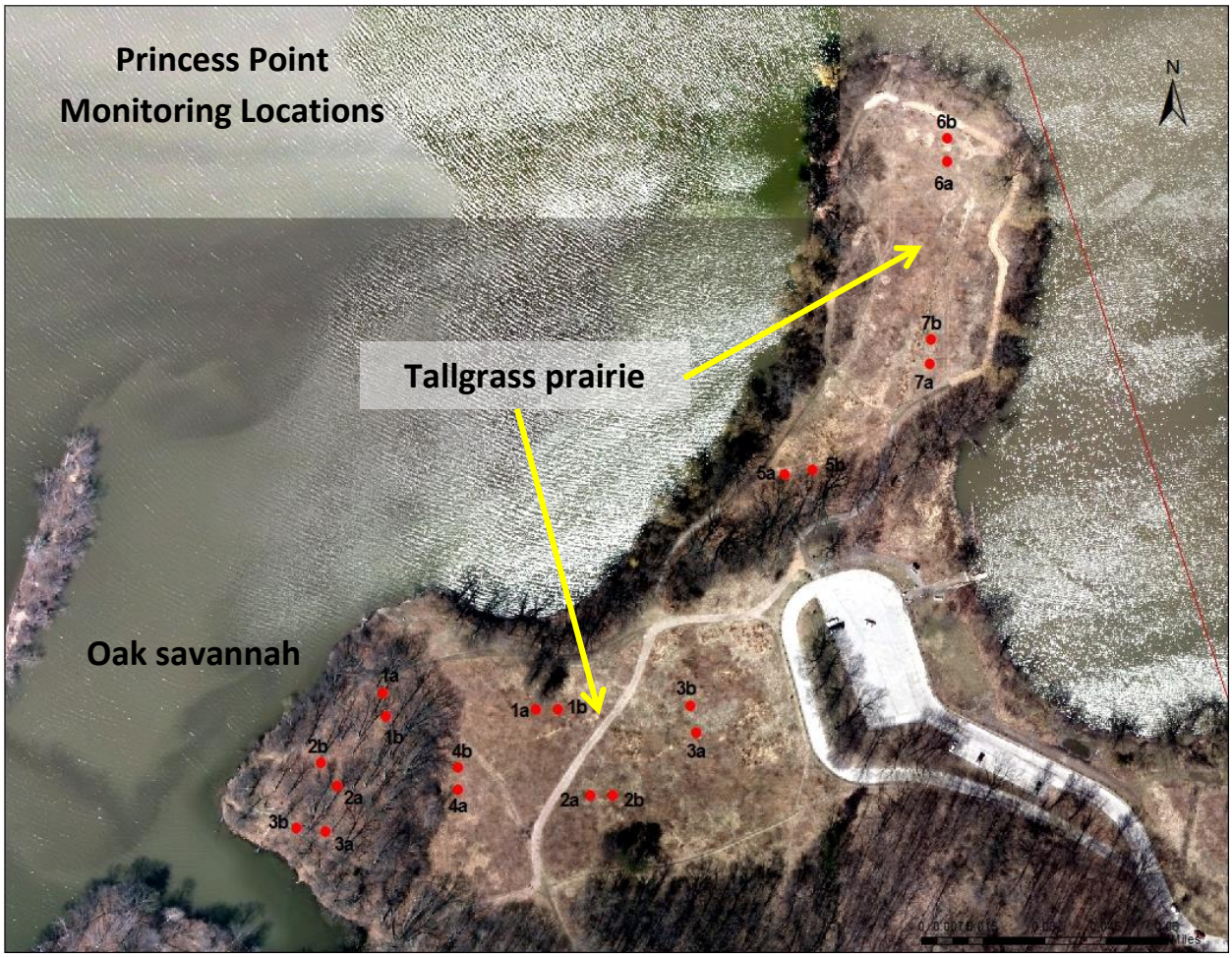

Figure 2. *Map of Princess Point, located in Cootes Paradise Marsh on the south shore, with prescribed burn monitoring locations*

2.0 Prescribed Burn History

Periodic disturbances such as fire, grazing and drought are an essential component to tallgrass prairie and oak savannah habitats. Prescribed burns have been identified as an ideal method for restoring and maintaining tallgrass prairie and oak savannah habitats (Tallgrass Ontario, 2005). Periodic fires not only return valuable nutrients to the soil for native plants to utilize, they also eliminate woody plant species from establishing and completely shading out prairie species (Burtenshaw, 2011). Repeated burns also reduce and/or eliminate introduced plant species and assists with restoring diverse and rare plants to the region. Tallgrass prairie and savannah plants are adapted to intermittent fires and can tolerate drought due to their extensive root systems (Ovington et al., 1963; Tallgrass Ontario, 2005).

There have been several prescribed burns that have taken place at Princess Point with the first one in 2006 in the savannah section. In 2008 the prairie section had been burned for the first time to aid in the recovery of prairie species. Table 1 below shows the years prescribed burns were conducted at Princess

Point. A burn is scheduled in early 2017 for both the prairie and savannah areas (see Section 5.0 Restoration Activities 2017). The photographs in Figure 3 following the table were taken by RBG staff during the most recent prescribed burn in the prairie section.

Table 1. *Locations and Years Burns took place at Princess Point, Royal Botanical Gardens*

Location	Area (ha)	Year Burned	Next Scheduled Burn
Princess Point Prairie	2.5	2008, 2009, 2010, 2013	2017
Princess Point Savannah	0.5	2006	2017

Figure 3. *Photographs of 2013 prescribed burn at Princess Point taken by RBG staff*

3.0 Results of Prescribed Burn Monitoring at Princess Point

There are seven monitoring stations within the prairie section of Princess Point and three within the savannah section. At each station, two 1 meter by 1 meter quadrats are surveyed for all vegetation within each quadrat plot. There are a total of 14 quadrat plots within the prairie and 6 within the savannah section. These stations have been monitored annually between 2009 and 2016. Within the savannah section, monitoring also occurred in 2003, 2005, 2007, and 2008 by RBG staff. For each species growing in or leaning into the quadrat, percent cover is recorded. Additionally, number of stems (or clumps for graminoid species) are recorded for species growing inside the quadrat. However, the number of stems/clumps was not recorded for all species during all monitoring years. This could be due to time constraints and/or clumps are not always defined; instead carpets of vegetation are present. Thus, percent cover presents an effective measure of species presence/absence and dominance at the monitoring stations.

3.1 Princess Point Prairie

Table 2 reveals the most abundant plant species within the prairie quadrats based on relative percent cover and can be viewed below. During the first two years of monitoring, non-native *Plantago lanceolata* (Narrow-leaf Plantain) and *Poa pratensis* (Kentucky Bluegrass) had the most percent cover, follow by *Solidago sp.* which is composed of two native goldenrod species, *S. canadensis* (Canada Goldenrod) and *S. altissima* (Tall Goldenrod). Canada Goldenrod is more dominant than Tall Goldenrod, but these species are almost identical in the prairie during August when monitoring usually is conducted. From 2011 to 2015, *Solidago sp.* was the most dominate species, followed by *Poa pratensis* (which likely composed *Poa* sp. in 2014). Similarly, *Solidago* sp. in 2016 was either *Solidago canadensis* or *Solidago altissima*, which were difficult to distinguish apart due to stunted growth and flowering as a result of a prolonged drought that had occurred. The harsh growing conditions last year appeared to stunt the growth and seed production of many plant species present at Princess Point and other areas.

Table 2. *Most abundant species per year at Princess Point prairie based on relative cover (2009-2016)*

Year	Most Abundant	Second Most Abundant	Value Calculated
2009^	*Plantago lanceolata** (50.9%)	*Solidago sp.* (16.9%)	Relative Cover (percent cover)
2010^	*Poa pratensis** (28.5%)	*Solidago sp.* (27.1%)	Relative Cover (percent cover)
2011	*Solidago sp.* (32.4%)	*Poa pratensis** (30.6%)	Relative Cover (percent cover)
2012	*Solidago sp.* (31.6%)	*Poa pratensis** (28.6%)	Relative Cover (percent cover)
2013^	*Solidago sp.* (40%)	*Poa pratensis** (13.4%)	Relative Cover (percent cover)
2014	*Solidago sp.* (34.4%)	*Poa* sp. (18.8%)	Relative Cover (percent cover)
2015	*Solidago sp.* (33.1%)	*Poa pratensis** (18.8%)	Relative Cover (percent cover)
2016	*Solidago* sp. (29.3%)	*Poa pratensis** (18.8%)	Relative Cover (percent cover)

*indicates non-native, ^ indicates year burned

A total of 66 plant species have been recorded during monitoring in the prairie quadrat plots from 2009 to 2016. Of the plants identified to species, 35 were native and 31 were introduced/non-native. Additionally, a total of 16 plant records that had not been identified to species were documented. Species richness for 2016 surveys was 30 species with 19 native and 11 introduced. A total of 4 plants were not identified to species during the surveys. The species list from 2009 to 2016 can be found in Appendix B - Table I. Note that this species list does not include all species that can be found at Princess Point; only those recorded in the quadrats. The number of native and non-native plants documented

during quadrat surveys each year is presented below in Figure 4. Plants not identified to species are not included in Figure 4 as their provenance is unknown. From 2009 to 2010, the number of non-native plants present in the plots was greater than the number of native species present, with 2011 having a tie of 15 species each. Starting in 2012 there was more native species present within the plots compared to non-native species. In 2016, 19 species were native whereas 11 were non-native, with the highest number of native and non-native plants found in 2014 at 20 native and 18 non-native species. It is likely that the burns, which took place in 2009, 2010, and 2013, aided in influencing the increase of native species versus non-native species that have been recorded in the prairie plots.

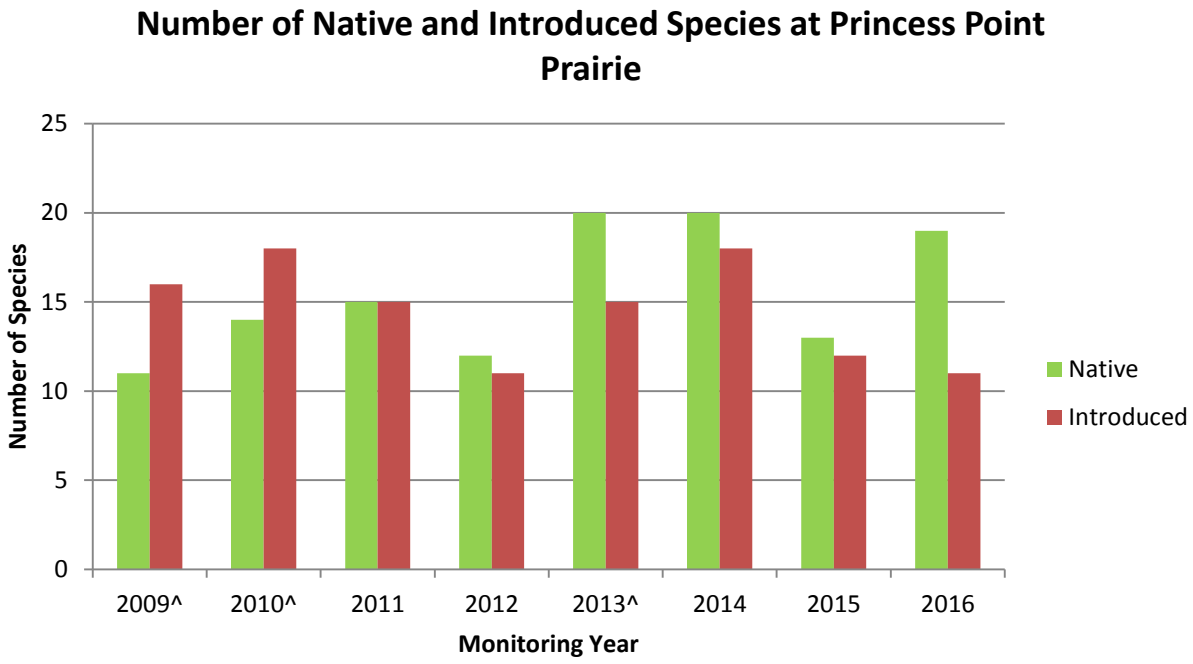

Figure 4. *Number of native and introduced/non-native species recorded in prairie quadrats per year; ^ indicates burn year*

In Figure 5 the total percent cover per year, including the cover of woody debris, bare ground and leaf litter that was present within the quadrats is represented. When viewing the total percent cover per year, it can be seen that there was more native plant biomass than biomass from introduced species within plots following 2010. Note that in 2016 *Solidago* sp. was either *Solidago canadensis* or S. *altissima*, both of which are native goldenrod species. Due to stunted plant growth and flower development due to the drought, it was difficult to distinguish between the two species that year. As the percent cover for native species continues to be greater than introduced species, it is interesting to note the increase in leaf litter cover. Some leaf litter includes leaves from trees but it also includes dead leaf matter from previous growing seasons produced by native prairie species, primarily grasses.

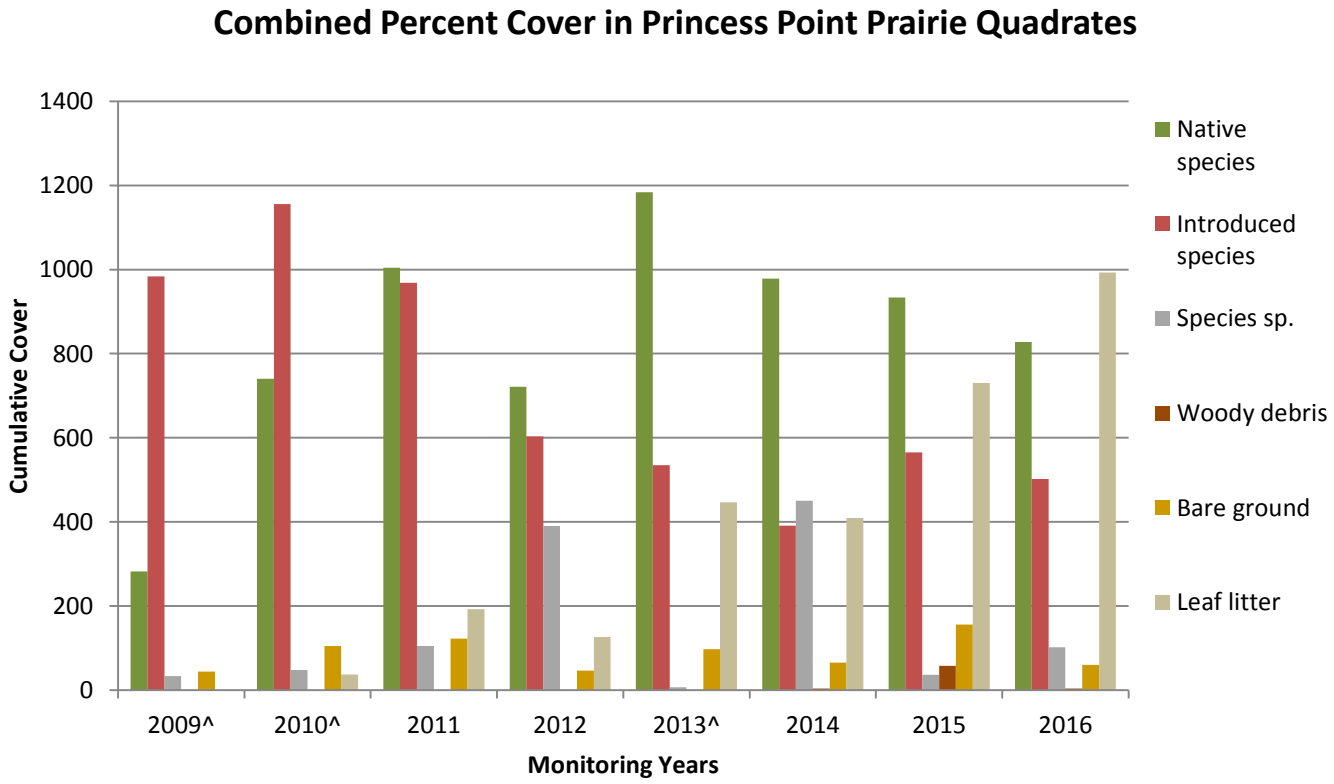

Figure 5. *Cumulative percent cover of the 14 quadrats categorized by native and introduced species, plants not identified to species (Species sp.), woody debris, leaf litter, and bare ground in Princess Point prairie; ^ indicates burn year.*

3.2 Princess Point Savannah

Surveys conducted in 2003 and 2005 recorded the average cover/abundance coefficient (one to five) for each species present. From 2007 to 2016 percent cover and number of stems (or clumps for graminoid species) were recorded. However, the number of stems or clumps for some plant species like *Poa pratensis* (Kentucky Bluegrass), were not documented in 2009, 2011 and 2015. Rather than have "not available" or n/a in Table 3 below for those years, the plant species which had data on number of stems or clumps were analyzed and put in. Blue coloured font was used for these species to highlight that they are likely not the most abundant if all species stems/clumps had been recorded. A full species list of plants present within the quadrats can be viewed in Appendix B.

In 2003 two native species, *Poa compressa* (Canada Bluegrass) and *Quercus rubra* (Red Oak seedlings) were the most abundant based on cover/abundance coefficient. In 2005, the most abundant plants were *Poaceae* sp. (Grass sp.) and *Dactylis glomerata* (Orchard Grass). Based on relative percent cover from 2007 to 2016, the most abundant plant most years has been *Hylodesmum glutinosum* (Pointed-leaved Tick-trefoil), followed by *Quercus rubra*, *Cornus racemosa* (Gray Dogwood), *Desmodium canadense* (Showy Trick-trefoil), *Vitis riparia* (Riverbank Grape), and *Poaceae* sp.

When focusing on relative abundance based on the number of stems or clumps, it can be seen that there are more non-native/introduced species than when looking at relative cover alone. From 2007 to 2016, the most abundant plant once again was *Hylodesmum glutinosum*, even when discounting 2009, 2011 and 2015. The next most abundant plants include *Dactylis glomerata*, *Phleum pretense* (Timothy Grass), *Poa pratensis*, *Cornus racemosa*, *Quercus rubra*, and *Solidago caesia* (Blue-stemmed Goldenrod). In 2008 and 2010 non-native grasses - *Poa pratensis*, *Dactylis glomerata*, and *Phleum pretense* - were the most dominant. Native plants - *Hylodesmum glutinosum* and *Solidago caesia* – were the two dominant species in 2016. *Hylodesmum glutinosum*, *Cornus racemosa* and *Quercus rubra* were possibly the most dominate native plant species in 2009 and 2011.

Table 3. *Most abundant species per year at Princess Point savannah based on cover-abundance coefficient (2003,2005), relative cover and relative abundance (2007-2016)*

Year	Most Abundant	Second Most Abundant	Value Calculated
2003	*Poa compressa*	*Quercus rubra*	Cover-Abundance Coefficient
2005	*Poaceae* sp.	*Dactylis glomerata**	Cover-Abundance Coefficient
2007	*Cornus racemosa* (13.8%)	*Quercus rubra* (11.8%)	Relative Cover (percent cover)
2008	*Hylodesmum glutinosum*(14.4%)	*Vitis riparia* (8.9%)	Relative Cover (percent cover)
2009	*Hylodesmum glutinosum*(11.2%)	*Cornus racemosa* (8.5%)	Relative Cover (percent cover)
2010	*Quercus rubra* (7.7%)	*Cornus racemosa* (7.6%)	Relative Cover (percent cover)
2011	*Hylodesmum glutinosum* (8.7%)	*Quercus rubra* (7.8%)	Relative Cover (percent cover)
2013	*Hylodesmum glutinosum* (15%)	*Desmodium canadense* (4.8%)	Relative Cover (percent cover)
2014	*Hylodesmum glutinosum* (11.2%)	*Poaceae* sp. (3.5%)	Relative Cover (percent cover)
2015	*Hylodesmum glutinosum* (12.1%)	*Desmodium canadense* (4.2%)	Relative Cover (percent cover)
2016	*Hylodesmum glutinosum* (13%)	*Poa pratensis** (4%)	Relative Cover (percent cover)
2007	*Poa compressa* (10.4%)	*Phleum pratense** (9.5%)	Relative Abundance (# of Plants/Clumps)
2008	*Poa pratensis** (42.9%)	*Dactylis glomerata** (12.2%)	Relative Abundance (# of Plants/Clumps)
2009	*Hylodesmum glutinosum* (19.4%)	*Cornus racemosa* (14.7%)	Relative Abundance (# of Plants/Clumps)
2010	*Dactylis glomerata** (19.1%)	*Phleum pratense** (15.6%)	Relative Abundance (# of Plants/Clumps)
2011	*Hylodesmum glutinosum* (23.6%)	*Quercus rubra* (12.4%)	Relative Abundance (# of Plants/Clumps)
2013	*Hylodesmum glutinosum* (23.6%)	*Dactylis glomerata** (8.4%)	Relative Abundance (# of Plants/Clumps)
2014	*Hylodesmum glutinosum* (21.4%)	*Phleum pratense** (8.8%)	Relative Abundance (# of Plants/Clumps)
2015	*Hylodesmum glutinosum* (23.5%)	*Dactylis glomerata** (11%); *Phleum pratense** (11%)	Relative Abundance (# of Plants/Clumps)
2016	*Hylodesmum glutinosum* (19.7%)	*Solidago caesia* (9.8%)	Relative Abundance (# of Plants/Clumps)

*indicated non-native

Overall species richness during monitoring at Princess Point savannah from 2003 to 2016 was 84 species. Of the overall total, 54 plant species were native and 31 were introduced species. A total of 26 plant records were not identified to species. A complete list of plant species, including those not identified to species, that have been recorded during monitoring can be found in Appendix B - Table II. When considering the number of species that are native and introduced from 2003 to 2016, there has been a greater number of native species in the savannah quadrats than introduced species. This can be observed in Figure 6, which displays the number of native and introduced species recorded in the quadrats each year monitoring occurred. Plants that were not identified to species were not included in Figure 6 as their provenance is unknown; with the exception of *Lonicera* sp. (honeysuckle sp.) as it is one of the ornamental varieties. Based on the number of species present each year, the number of species recorded has increased since 2005, which was the year before the prescribed burn took place in 2006. The increase in species richness post burn indicates that the burn had a positive influenced in the savannah. The year with the most native species and lowest introduced species was 2014 with 27 native and 9 introduced plant species. Surveys conducted in 2008 had the highest species richness with 42 plants (26 native, 16 introduced). In contrast, the year with the lowest species richness was 2005 with 14 species (9 native, 5 introduced). That year also happened to have the smallest gap between the number of native and non-native species, with a difference of 4 more native species than introduced. In 2016 there was a total of 37 species including 25 native and 12 introduced (9 unidentified to species).

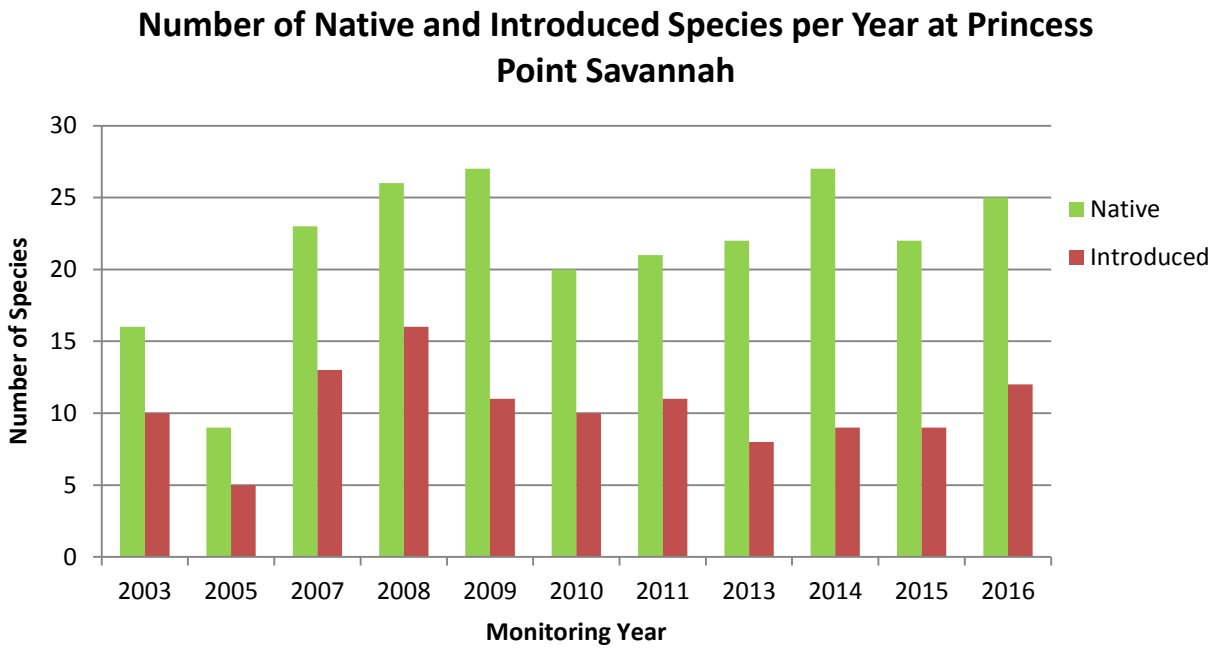

Figure 6. *Number of native and introduced/non-native species recorded in savannah quadrats per year; burn year was 2006*

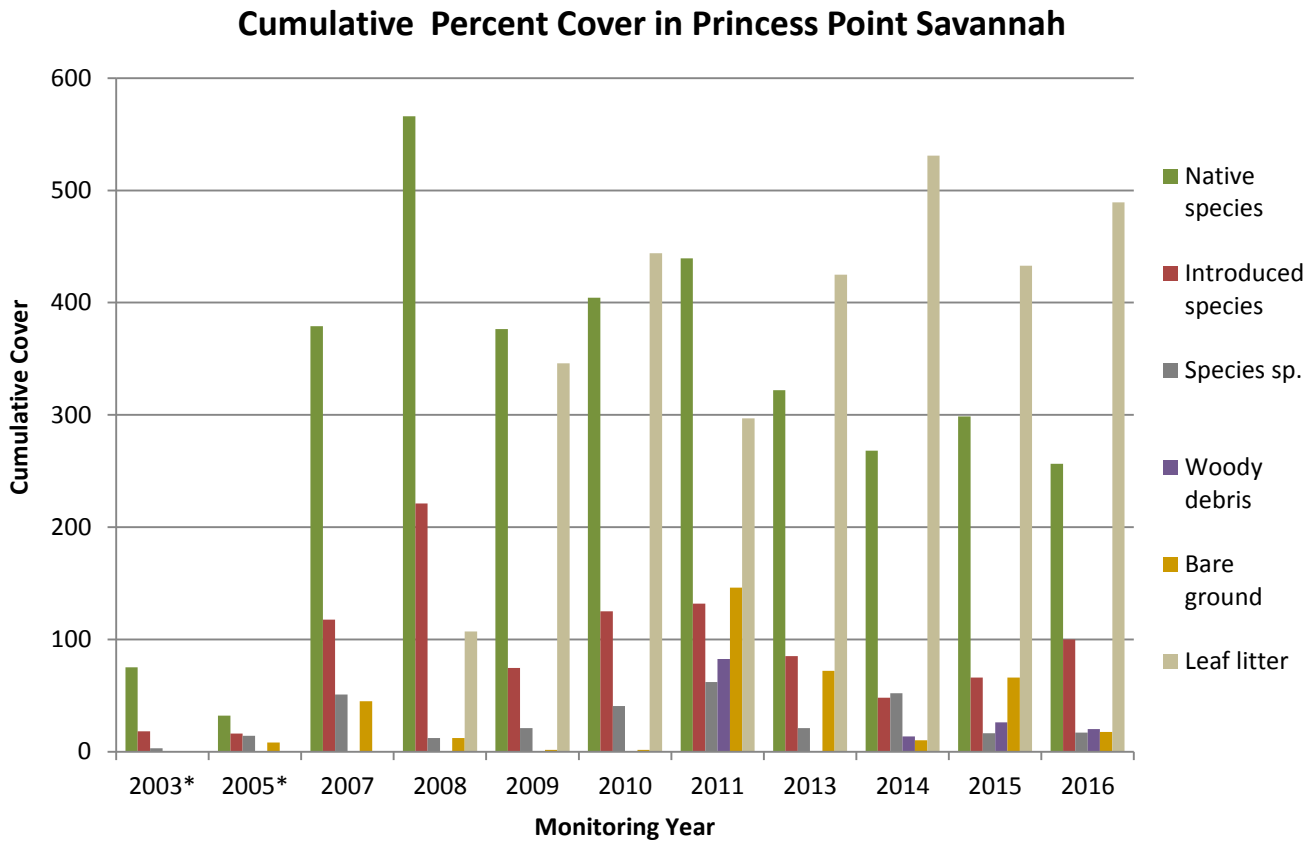

Figure 7. *Cumulative percent cover of the 6 quadrats categorized by native and introduced species, plants not identified to species (Species sp.), woody debris, leaf litter, and bare ground in Princess Point savannah; *average cover/abundance coefficient used; burn occurred in 2006*

In Figure 7 total percent cover of species, woody debris, bare ground, and leaf litter that was present within the quadrats each year monitoring occurred is represented. When viewing the total percent cover per year, it can be seen that there has been more native plant cover than introduced species cover. In 2008 native plants had the highest percent cover across all plots with a total of 566%. Additionally, 2008 also had the highest percent cover of introduced species at 221% cover. Since 2008 there has been a significant increase in the cover of leaf litter. During Ecological Land Classification (ELC) surveys the savannah section was classified as being a Dry Red Oak Woodland Type ecosite (WODM3-1). Refer to Appendix C for map of Princess Point with ELC ecosite polygons. As the dominant deciduous tree in the savannah is *Quercus rubra*, leaf litter is mainly composed of *Quercus* leaves and this could be why leaf litter cover has increased as it has been accumulating over time. It is also important to note that leaf litter cover may not have been recorded during the 2003, 2005 and 2007 surveys. Bare ground present fluctuated between years in percent cover, along with woody debris. From 2008 to 2016, it appears that native species percent cover has been decreasing. This could possibly be due to a number of factors, from visitors trampling off trail to species being shaded out by the *Quercus rubra* canopy. For 2016, a drought that lasted months occurred and may have also negatively impacted certain plant species, despite most of them being drought tolerant.

4.0 Restoration Activities

The majority of restoration activities have taken place in Princess Point prairie and along the shoreline. Below are descriptions of restoration work that have taken place at Princess Point organized by year. Restoration activities included one prescribed burn of the Oak savannah and four prescribed burns of the two prairie areas. Refer to the map in Appendix D for a visual representation of burn locations and year's burns took place at Princess Point. In the prairie sections, the burns were combined with the planting of 38 prairie and oak savannah species including over 12,672 herbaceous plants and 1,667 trees and shrubs. Of the herbaceous vegetation planted, 17 were native wildflower species and 4 were native prairie grass species. Approximately 30 kilograms of native prairie seed mix has been broadcast as well. Refer to Table 4 below on planting/seeding dates. Species lists for each year seeding and/or planting took place can be found in Appendix D, along with a map of restoration locations that are described below. The plantings have been moderately successful overall with an estimated 60-70% survivorship. Of the 739 trees and shrubs that were planted (total of 17 species), survival was variable mainly due to vandalism. In addition over 900 non-native trees and shrubs have been removed.

Table 4. *Quantity of prairie and savannah vegetation planted between 2003 and 2016*

Plants	2003-2006	2008	2009	2010	2011	2012	2013	2014	2015	2016
Seed (kg)	10	5.2	13.9	-	-	-	1	-	-	-
Plugs	-	-	-	7000	2232	-	288	1584	1368	200
Trees/Shrubs*	917	-	-	-	442	-	-	12	278	18

** trees/shrubs planted in 2015 were mostly birch, sandbar willow, silver maple, and red-osier dogwood along the peninsula shoreline*

2003

- The mowed fields were left to naturalize.

Between 2003 and 2006

- Carl Rothfels, past Field Botanist at RBG, scattered the seed of two prairie species, *Andropogon gerardii* (Big Bluestem) and *Sorghastrum nutans* (Indian Grass).
- Rothfels planted 17 Black Oaks (*Quercus velutina*) in the savannah section on April 23rd, 2005.
- Several Earth Day riparian plantings had taken place - *data on number of plants and species planted for each planting event not currently known, except for 2005.*
- In 2006 a prescribed burn in the oak savannah portion took place.

2008

- In the prairie section, both the point/upper and lower field was burned to see if anything in the seed bank may be released.
- Big Bluestem, a prairie indicator species, was identified along the point. Several additional locations of Big Bluestem along with Indian Grass were noted along the point after the first burn. Nothing was noted in the lower field.
- Six 4x4 meter plots were seeded with a mix purchased from Ninth River Nursery.

2009

- Prescribed burn occurred in the prairie section on the upper and lower field.
- After the second burn in 2009, more Big Bluestem and Indian Grass were recorded at the point and several clumps were identified in the lower field. Areas where these species emerged are consistent with where Carl had scattered their seed. Upon realization that the original seed bank was limited due to the addition of fill, RBG's restoration efforts turned to focus on seeding and planting plugs.
- A larger area was scattered with seed – a mix of seed collected from RBG property and purchased from Ninth River. Two areas were tilled then seeded and another two areas were just seeded straight over the burned area.
- Three 4x4 meter plots that were seeded in 2008 had *Desmodium canadense* (Showy Tick-trefoil) and *Rudbeckia hirta* (Black-eyed Susan) germinated.

2010

- Prescribed burn occurred in the prairie section on the upper and lower field.
- 2010 marked the last year of three consecutive burns planned for Princess Point prairie. Burning is not recommended the year after plugs are planted, therefore RBG waited and planted plugs that were grown from seed that was mostly collected on RBG property with funds obtained from the Shell Environmental Fund. Plugs were purchased from Pterophyllya/St. Williams Nursery.
- Over 7,000 plugs were planted on approximately 0.5 hectares of land at Princess Point. The RBG Auxiliary, Burlington Green, Hamilton-Wentworth Stewardship Rangers and local community volunteers all played a key role in site preparation and planting.
- Site preparation techniques were varied and included solarization, water soaked newspapers and mulch, just mulch, tilling and mowing. The most effective techniques were solarization, tilling and newspapers followed by mulch.
- Plugs that were planted in June did extremely well (approximately 90% survival rate). The only plants that were planted at this stage that did not do well were the ones that had been planted either in just mulch or mowed areas. The successful plants occurred in the areas that were tilled, solarized or mulched over top of newspaper. Plugs that were planted late in the season (late July/August, 2010) did not show similar survivorship – less than 20% survival rate. This is likely due to the reduced growing season and the dry weather.
- There was successful germination of Indian Grass, Showy Tick-trefoil and Black-eyed Susan in a section of the upper field that had been tilled and seeded in 2009.
- Establishment of the current mowed visitor walking trail system was implemented.

2011

- 2011 was the first year in three that RBG did not perform a prescribed burn at Princess Point.
- RBG partnered with the provincial Envirothon who hosted their Legacy Project at Princess Point in May. Through the Legacy Project, one hundred high school students planted over 300 trees and shrubs along the edges of the fields. They also pulled invasive species from the edges and prepared the field for plug planting by laying newspapers and mulch in designated areas.
- In June and early July, over 2,000 plugs were planted with the help of volunteers from Burlington Green.
- The plug plantings that took place in 2011 did well throughout the summer and fall though there was more competition from *Cirsium arvense* (Canada Thistle) and *Solidago canadensis* (Canada Goldenrod) than expected.
- The plantings that were successful in 2010 continued to thrive.

2012

- Plug planting at Princess Point was not the main focus as a prescribed burn was planned for 2013, thus giving the planted plugs from 2010 and 2011 time to mature.

2013

- Prescribed burn took place in April at Princess Point in the upper and lower prairie sections.
- Following the burn, prairie seed mix was broadcast in sections of the prairie and about 288 plugs were planted.

2014

- In April approximately 500-750 non-native invasive trees/shrubs (*Rhamnus cathartica*, *Lonicera sp*., and *Salix fragilis*) were treated with herbicide using cut-stump/basal bark treatments along the edges of the prairie.
- A total of 1,584 plugs were planted in the upper and lower portions of the prairie, including in sections where the trail had been rerouted to follow the shoreline leading into the savannah. Additionally, 12 trees – *Quercus rubra* and *Quercus macrocarpa* - were also planted.
- A rain garden was installed in June and planted with native species by volunteers in partnership with the Bay Area Restoration Council (BARC).

2015

- Cut-stump herbicide treatments were conducted on approximately 200 non-native invasive trees/shrubs growing along the field edges on the upper portion of the prairie in April.
- Shoreline restoration took place in May, including adding sand to a portion where shoreline undercutting was taking place. A total of 822 emergent plants and riparian trees/shrubs were planted by RBG staff. A group of students from Waterdown High School assisted with the riparian plantings.
- Removals of *Arctium minus* (Common Burdock), *Melilotus albus* (White Sweet Clover) and *Lonicera maackii* (Amur Honeysuckle) took place in the prairie during the summer. A total of 1,368 plugs were planted in the prairie by staff and BARC (Bay Area Restoration Council) volunteers.

2016

- Addition of temporary barriers were installed to guide visitor use as a result of extensive habitat trampling in the rerouted portion of the trail that was done in 2014 between the lower prairie and savannah. A total of 18 shrubs were planted behind the barriers. Due to the prolonged drought conditions and vandalism, most of these plantings did not survive.
- *Arctium minus* was removed from the 2015 planting areas, the upper and lower prairie sections, and across from the parking lot.
- On June 4 public volunteers joined RBG staff and members from Cootes to Escarpment Ecopark to plant 200 prairie plugs through an initiative by Pollinator Paradise Project. Prior to planting, the planting location was solarized. On planting day volunteers helped prep the site with soaked newspapers and mulch. Planting occurred on the upper portion of the prairie in a spot where an unofficial path was developing.
- Due to the severe drought, all plants in the prairie (upper and lower) experienced stunted growth and delayed flowering/seeding including prairie grasses and *Solidago* species. Plugs and trees planted in the lower and upper portions of the prairie in 2015 and earlier this year were watered as some began to dry and shrivel.

5.0 Restoration Activities Planned for 2017

A variety of restoration activities are planned for the Princess Point area in 2017. The first major restoration activity that is scheduled for early spring is prescribed burns on the upper and lower prairie and in the oak savannah. Prior to the burn, bird houses located in the prairie will be taken down to prevent fire damage and to discourage any early bird arrivals from building their nests before the burn. This will also give RBG staff a chance to clear out old nesting material and provide more room for new nests with fresh nesting materials. After the burn the bird houses will be re-installed.

Following the burn there will be seeding and plug plantings composed of species similar to previous years. Some plugs and shrubs – possibly *Cornus racemosa*, *Zanthoxylum americanum*, and *Rosa carolina* – will be planted in the lower and upper prairie areas where unofficial trail use has been identified. These unofficial trails further increase prairie habitat fragmentation, prevent native prairie plants from establishing, and favour non-native grass species like *Poa pratensis*. The desired outcome of these plantings will be to discourage off trail use by keeping visitors on the official trails and increase continuous prairie habitat.

There will also be shoreline restoration activities following the burn, including revitalizing lookouts, planting riparian trees/shrubs, invasive species management, and creating turtle nesting habitat near the shoreline in the lower prairie. During the months of June and July there will be emergent vegetation plantings along sections of the Princess Point shoreline. Once these emergent plants are established they will reduce wave action from the open marsh and assist with directing visitors to the lookouts rather than trampling vegetation along the shoreline, both of which will reduce shoreline erosion. Figure 8 is a map of Princess Point detailing the above restoration activities described for 2017.

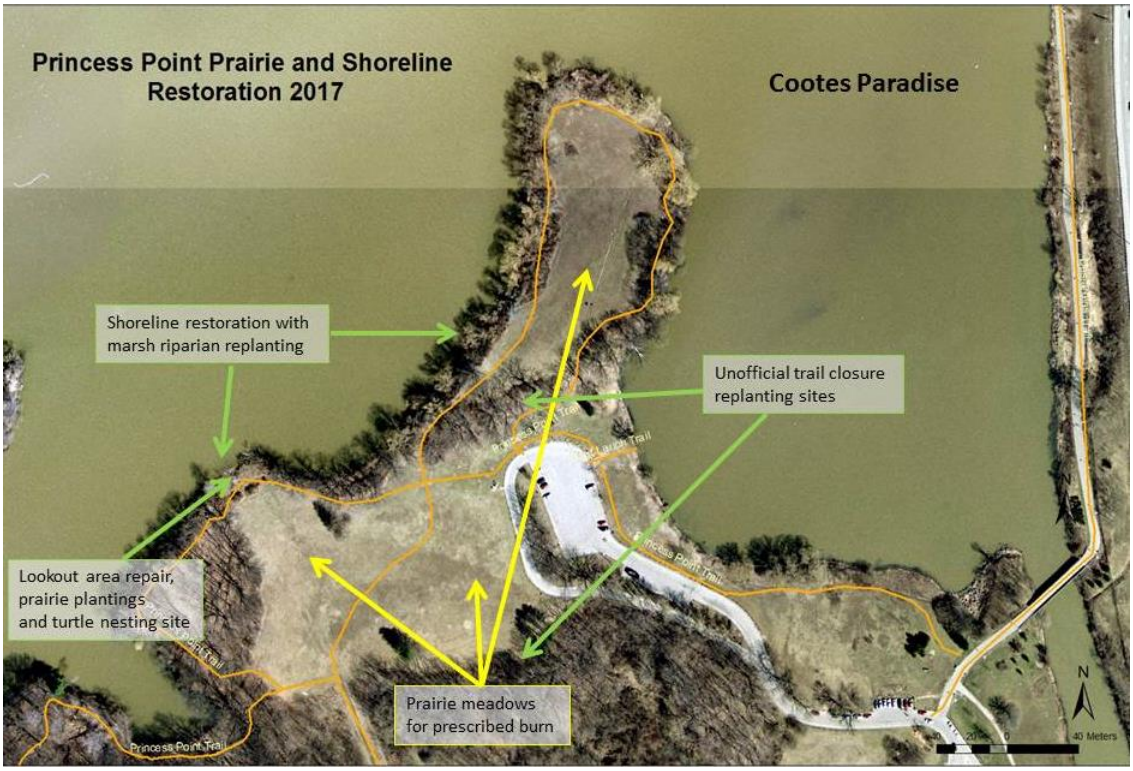

Figure 8. *Map of restoration activities scheduled for 2017 at Princess Point*

6.0 Conclusion

The data collected from the quadrat surveys indicates that overall the plant communities at Princess Point prairie and savannah are continuing to improve. In the prairie section, the top two dominant plants have remained similar over the years with *Solidago sp*. (*Solidago canadensis/Solidago altissima*) and *Poa pratensis*. However, the number of native plants has increased compared to the number of non-native plants since 2011, as well as an increase in percent cover of native species compared to non-native species starting in 2011. In the savannah section, *Hylodesmum glutinosum* has been the most dominate plant over the years, followed by *Cornus racemosa* when looking at relative percent cover and *Dactylis glomerata* when looking at relative abundance. When comparing the number of native and non-native species in the savannah plots, there has been a larger number of native species present than non-native species since 2003. Monitoring following the burn in 2006 documented an increase in species richness overall compared to the previous two years (2003 and 2005) of surveys, from an average of 21.5 plant species to an average of 42 species. In regards to overall percent cover, native plant species continue to have the most amount of cover compared to non-native species. Interesting trends to note, the amount of cover from leaf litter has been increasing since 2008 and the cover of native species has been decreasing since 2013, while non-native species cover has fluctuated over the years. The prescribed burn scheduled for 2017 in the savannah would likely be very beneficial for the native savannah plants and seed bank. Prescribed burn monitoring will carry on in 2017 and into the future to continue tracking changes in the vegetation community at Princess Point. Various restoration activities are planned for the 2017 field season – all of which will contribute to the overall goal of restoring the remnant tallgrass prairie and oak savannah habitats in the natural lands of Royal Botanical Gardens.

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Appendix A – Historical Photos of Princess Point

Figure I. Photo from 1935 taken from the Iroquois Bar (now Burlington Heights) facing southward towards Princess Point; notice that the Princess Point peninsula elevation appears to be level with the area that is now termed lower Prairie, thus this photo was taken before fill had been dumped and leveled on top of the peninsula

Figure II. Photo of Princess Point peninsula from 1952 taken from the east end; notice the level topography and turf on top of the peninsula (now the upper prairie portion)

Figure III. View of Princess Point from 1953 on top the peninsula facing towards the point and Iroquois Bar after recent leveling of added fill had taken place

Figure IV. Winter photo of Princess Point in 1955 looking north towards Cootes Paradise Marsh and the north shore; residents skating on the ice in Cootes Paradise Marsh

Appendix B – Quadrat Sampling Summaries

Table I. Quadrat sampling results (relative cover) from Princess Point Prairie, 2009-2016

Species	Plant Type	2009^	2010^	2011	2012	2013^	2014	2015	2016
Hawkweed sp. *Hieracium* sp.	forb	-	-	-	-	-	-	0.02%	-
Garlic Mustard* *Alliaria petiolata*	forb	-	-	-	-	0.02%	-	-	-
Staghorn Sumac *Rhus typhina*	shrub	-	-	-	-	-	0.02%	-	-
Horseweed *Conyza canadensis*	forb	-	-	-	-	0.02%	-	-	-
Maple-leaf Viburnum *Viburnum acerifolium*	shrub	-	-	-	-	-	-	0.02%	-
Cherry sp. *Prunus* sp.	tree	-	-	-	0.03%	-	-	-	-
Red Maple *Acer rubrum*	tree	-	-	-	-	-	-	-	0.02%
Early Goldenrod hybrid Solidago juncea x	forb	-	-	-	-	-	-	-	0.02%
St. John's Wart sp. *Hypericum* sp.	forb	-	-	-	-	-	0.02%	-	-
White Ash *Fraxinus americana*	tree	-	-	-	-	0.02%	0.02%	-	-
Meadow Ryegrass* *Lolium pratense*	graminoid	-	-	-	-	-	-	-	0.04%
Maple sp. *Acer* sp.	tree	-	0.02%	-	-	-	0.02%	-	-
Common Yarrow *Achillea millefolium*	forb	-	0.05%	-	-	-	-	-	-
Black Oak *Quercus velutina*	tree	-	-	-	-	-	-	-	0.04%
Avens sp. *Geum* sp.	forb	-	-	0.02%	-	-	-	-	0.02%
Redtop* *Agrostis gigantea*	graminoid	-	-	-	-	0.04%	-	-	-
Thistle sp. *Cirsium* sp.	forb	-	-	-	-	-	0.04%	-	-
Silver cinquefoil* *Potentilla argentea*	forb	-	-	-	-	-	0.04%	-	-
Cinquefoil sp. *Potentilla* sp.	forb	-	-	-	-	-	-	-	0.04%

Table I continued

Species	Plant Type	2009^	2010^	2011	2012	2013^	2014	2015	2016
Spiked sedge* *Carex spicata*	graminoid	-	-	-	-	-	-	-	0.04%
Browntop* *Agrostis capillaris*	graminoid	-	-	-	-	-	-	-	0.06%
Forb sp.	forb	-	-	-	-	-	0.07%	-	-
Blue-stemmed Goldenrod hybrid *Solidago caesia x canadensis*	forb	-	0.14%	-	-	-	-	-	0.06%
Sedge sp. *Carex* sp.	graminoid	-	-	-	-	-	0.04%	0.02%	-
Common Evening Primrose *Oenothera biennis*	forb	-	-	-	-	-	0.04%	-	0.04%
Daisy Fleabane *Erigeron annuus*	forb	0.11%	-	-	-	-	0.02%	-	-
Wood Sorrel sp. *Oxalis* sp.	forb	-	0.02%	0.04%	-	0.02%	-	0.02%	-
Eastern Redbud *Cercis canadensis*	shrub	-	-	-	-	-	0.02%	0.04%	0.04%
Common Dandelion* *Taraxacum officinale*	forb	-	0.05%	0.02%	-	0.02%	0.02%	-	-
Virginia Creeper *Parthenocissus quinquefolia*	vine	-	0.10%	-	-	0.02%	-	-	-
Rough-fruited Cinquefoil* *Potentilla recta*	forb	-	-	0.08%	0.03%	-	-	-	-
Moneywort* *Lysimachia nummularia*	forb	-	0.02%	0.10%	-	-	-	-	-
Blue-stemmed Goldenrod *Solidago caesia*	forb	-	-	-	-	-	-	-	-
Sky-blue Aster *Symphyotrichum oolentengiense*	forb	-	-	-	0.16%	-	-	-	-
Hoary Alyssum* *Berteroa incana*	forb	0.26%	-	-	-	-	-	-	-
Sticky Chickweed* *Cerastium glomeratum*	forb	-	0.05%	0.08%	-	0.02%	-	-	-

Table I continued

Species	Plant Type	2009^	2010^	2011	2012	2013^	2014	2015	2016
burdock-like basal leaves with teeth	forb	-	0.19%	-	-	-	-	-	-
Heath Aster *Symphyotrichum ericoides*	forb	-	-	-	-	0.09%	-	-	0.08%
Clover sp. *Trifolium* sp.	forb	-	-	0.06%	-	0.02%	0.02%	0.08%	-
European Buckthorn* *Rhamnus cathartica*	shrub	-	-	0.08%	0.03%	0.02%	0.07%	-	-
Spotted St. John's Wort *Hypericum punctatum*	forb	-	-	-	-	0.15%	-	-	0.04%
Red Clover* *Trifolium pratense*	forb	0.07%	0.14%	-	-	-	0.04%	-	-
Common Speedwell* *Veronica officinalis*	forb	-	0.02%	0.04%	0.16%	-	-	0.02%	-
Black Walnut *Junglans nigra*	tree	0.15%	0.02%	0.06%	-	-	0.04%	-	-
Common Cinquefoil *Potentilla simplex*	forb	-	-	-	-	0.11%	0.04%	0.08%	-
Frost Aster *Symphyotrichum pilosum*	forb	-	-	-	-	0.04%	0.24%	-	-
Yellow Wood Sorrel* *Oxalis stricta*	forb	0.11%	0.05%	-	-	0.13%	0.07%	-	-
Calico Aster *Symphyotrichum lateriflorum*	forb	-	-	0.17%	-	-	-	-	0.14%
Pointed-leaved Tick-trefoil *Hylodesmum glutinosum*	forb	-	0.02%	0.04%	-	0.02%	0.02%	0.04%	0.18%
Riverbank Grape *Vitis riparia*	vine	-	0.02%	0.06%	0.03%	0.09%	0.07%	0.04%	0.06%
Canada Thistle* *Cirsium arvense*	forb	-	-	-	-	-	0.13%	0.24%	0.06%
White Sweet Clover* *Melilotus albus*	forb	0.45%	0.10%	0.08%	-	-	0.09%	-	0.04%
Heal-all* *Prunella vulgaris*	forb	-	-	0.29%	0.26%	-	0.02%	0.04%	-
Rush sp. *Juncus* sp.	graminoid	1.04%	-	-	-	-	-	-	-
moss sp.	bryophyte	-	-	0.61%	-	-	0.04%	-	-

Table I continued

Species	Plant Type	2009^	2010^	2011	2012	2013^	2014	2015	2016
Orchard Grass* *Dactylis glomerata*	graminoid	0.04%	0.72%	0.02%	-	0.02%	-	-	-
White Clover* *Trifolium repens*	forb	0.04%	0.10%	-	-	-	0.57%	0.04%	-
Common Ragweed *Ambrosia artemisiifolia*	forb	0.30%	0.22%	0.21%	-	0.11%	0.04%	-	-
Early Goldenrod *Solidago juncea*	forb	-	-	0.02%	0.16%	0.09%	0.09%	0.12%	0.28%
Canada Bluegrass *Poa compressa*	graminoid	-	-	-	-	0.88%	-	-	-
Black-eyed Susan *Rudbeckia hirta*	forb	0.26%	0.55%	0.08%	0.16%	-	-	-	-
Common Burdock* *Arctium minus*	forb	0.04%	0.02%	-	0.11%	0.04%	0.76%	0.04%	-
Red Oak *Quercus rubra*	tree	0.19%	0.10%	0.38%	0.21%	0.15%	0.22%	0.06%	0.10%
Timothy* *Phleum pratense*	graminoid	0.04%	-	0.86%	0.21%	0.02%	0.07%	0.10%	0.12%
Wild Bergamot *Monarda fistulosa*	forb	-	-	0.04%	0.08%	0.29%	0.35%	0.56%	0.44%
Aster sp. *Symphyotrichum* sp.	forb	-	0.02%	1.07%	0.21%	0.09%	0.54%	-	-
Black Medic* *Medicago lupulina*	forb	1.86%	0.10%	0.10%	-	0.75%	0.09%	0.04%	0.02%
Alsike Clover* *Trifolium hybridum*	forb	0.41%	0.05%	-	-	0.97%	0.96%	-	-
Queen Anne's Lace* *Daucus carota*	forb	0.33%	0.31%	1.13%	0.05%	0.37%	0.52%	0.08%	0.06%
Common St. John's Wort* *Hypericum perforatum*	forb	0.11%	0.05%	-	0.11%	-	0.46%	2.06%	0.04%
Brome sp. *Bromus* sp.	graminoid	-	2.01%	1.55%	0.03%	0.18%	-	-	-
Flat-topped Goldenrod *Euthamia graminifolia*	forb	0.30%	1.20%	1.51%	0.42%	0.22%	0.17%	0.12%	0.28%
Woodland Speargrass* *Poa nemoralis*	graminoid	7.11%	-	-	-	-	-	-	-

Table I continued

Species	Plant Type	2009^	2010^	2011	2012	2013^	2014	2015	2016
Cow Vetch* *Vicia cracca*	forb	0.04%	0.07%	1.80%	0.74%	1.76%	0.26%	0.71%	-
Big Bluestem *Andropogon gerardii*	graminoid	0.82%	1.20%	2.09%	1.09%	1.41%	2.39%	0.54%	0.28%
Showy Tick-trefoil *Desmodium canadense*	forb	0.33%	1.29%	1.42%	1.32%	2.64%	1.96%	1.45%	0.06%
Path Rush *Juncus tenuis*	graminoid	0.48%	2.73%	2.93%	1.85%	3.41%	0.04%	-	0.02%
Indian Grass *Sorghastrum nutans*	graminoid	1.15%	0.77%	0.52%	1.11%	2.42%	3.26%	1.45%	1.73%
Goldenrod sp. *Solidago* sp.	forb	16.90%	27.13%	32.44%	31.63%	39.96%	33.50%	34.39%	29.34%
Tall goldenrod *Solidago altissima*	forb	-	-	-	-	-	-	-	-
Grass sp. *Poaceae* sp.	graminoid	1.45%	-	1.05%	20.40%	-	18.79%	0.04%	4.02%
Narrowleaf Plantain* *Plantago lanceolata*	forb	50.91%	25.07%	5.23%	1.67%	5.97%	1.76%	0.61%	0.92%
Kentucky Bluegrass* *Poa pratensis*	graminoid	11.43%	28.45%	30.56%	28.61%	13.39%	11.09%	18.84%	18.77%
Canada Goldenrod *Solidago canadensis*	forb	-	-	-	-	-	-	-	-
Woody debris		-	-	-	-	-	0.17%	2.34%	0.16%
Bare ground		3.28%	5.03%	5.12%	2.44%	4.30%	2.85%	6.29%	2.41%
Leaf litter		-	1.77%	8.03%	6.70%	19.67%	17.79%	29.45%	39.91%
Species Richness		***27***	***32***	***30***	***23***	***35***	***38***	***25***	***30***
Num. of Native Species		11	14	15	12	20	20	13	19
Num. of Introduced Species		16	18	15	11	15	18	12	11
Num. of Species sp.		2	5	7	4	4	9	6	4

*introduced species, ^ burn year

Note: *Solidago sp*. is composed of *S. canadensis* with *S. altissima*; due to difficulty identifying these two *Solidagos* to species at time of surveys (August) and even under ideal conditions, they have been lumped into one category (*Solidago sp*.). However, *S. canadensis* is more dominant than *S. altissima*.

Appendix B – Table II. Quadrat sampling results from Princess Point Savannah, 2003, 2005 (average cover-abundance coefficient), 2007-2016 (relative percent cover)

Species	Plant Type	2003	2005	2007	2008	2009	2010	2011	2013	2014	2015	2016
Agrimony sp.	forb	-	-	-	-	-	-	-	-	-	0.11%	-
Apple sp.* *Malus* sp.	tree	-	-	-	0.44%	0.98%	0.69%	1.42%	0.86%	0.54%	0.50%	-
Aster sp. *Symphyotrichum* sp.	forb	-	-	-	-	-	-	-	0.32%	0.16%	-	-
Avens sp. *Geum* sp.	forb	-	-	-	-	-	-	0.04%	0.05%	0.11%	-	0.11%
Avens sp. 1 *Geum* sp.	forb	-	-	-	-	0.06%	-	-	-	-	-	-
Avens sp. 2 *Geum* sp.	forb	-	-	-	-	0.06%	-	-	-	-	-	-
Birch sp. *Betulaceae* sp.	tree	-	-	0.51%	0.22%	0.24%	0.39%	-	-	-	0.06%	-
Black Cherry *Prunus serotina*	tree	0.17	-	0.34%	0.54%	0.24%	-	0.09%	0.22%	0.05%	-	0.22%
Black Raspberry *Rubus occidentalis*	shrub	-	-	-	-	-	-	-	-	0.54%	0.55%	0.39%
Blue-stemmed Goldenrod *Solidago caesia*	forb	1.33	1.33	3.54%	4.03%	2.44%	3.05%	2.50%	1.41%	1.36%	2.04%	1.89%
Bur-reed Sedge *Carex sp.arganioides*	graminoid	-	-	-	-	0.06%	-	-	0.11%	-	-	-
Butter and Eggs * *Linaria vulgaris*	forb	-	-	-	0.11%	-	-	-	-	-	-	-
Buttercup sp. *Ranunculus* sp.	forb	-	-	-	-	0.06%	-	-	-	-	-	-
Calico Aster *Symphyotrichum lateriflorum*	forb	-	0.17	-	-	0.18%	-	-	-	-	-	-
Canada Bluegrass *Poa compressa*	graminoid	3.17	-	2.03%	-	0.06%	-	-	0.05%	-	-	-
Canada Goldenrod *Solidago canadensis*	forb	1.00	-	-	0.98%	0.73%	0.59%	2.59%	1.41%	0.33%	1.88%	0.89%
cf. Clove Currant * *Ribes cf. aureum var. villosum*	shrub	0.17	-	-	-	-	-	-	-	-	-	-
Cherry sp. *Prunus* sp.	tree	-	0.17	-	-	-	-	-	-	0.11%	0.11%	0.11%
Chokecherry *Prunus virginiana*	shrub	-	-	-	0.11%	0.18%	-	-	-	0.11%	-	0.11%
Cinquefoil sp. *Potentilla* sp.	forb	-	-	-	-	-	-	-	-	-	-	0.06%

Table II continued

Species	Plant Type	2003	2005	2007	2008	2009	2010	2011	2013	2014	2015	2016
Common Chickweed * *Stellaria media*	forb	-	-	-	-	-	-	0.04%	-	-	-	-
Common Cinquefoil *Potentilla simplex*	forb	-	-	0.84%	0.54%	0.24%	0.39%	0.39%	0.05%	0.05%	0.06%	-
Common Dandelion * *Taraxacum officinale*	forb	0.17	-	0.17%	0.22%	0.12%	0.05%	-	-	-	-	-
Common Mouse-ear Chickweed * *Cerastium fontanum*	forb	-	-	-	-	-	-	-	-	-	-	0.11%
Common Ninebark *Physocarpus opulifolius*	shrub	-	-	0.51%	-	-	-	-	-	-	-	-
Common Speedwell * *Veronica officinalis*	forb	0.17	-	-	0.22%	0.12%	0.74%	0.56%	0.38%	0.22%	0.17%	0.61%
Common St. John's Wort * *Hypericum perforatum*	forb	0.17	-	-	0.33%	0.12%	0.20%	-	-	0.05%	0.11%	-
Dog Strangling Vine * *Cynanchum rossicum*	vine	-	-	-	0.22%	-	-	-	-	0.05%	0.06%	-
Downy Serviceberry *Amelanchier arborea*	shrub	-	-	-	0.22%	-	-	3.02%	-	-	-	0.06%
Early Goldenrod *Solidago juncea*	forb	0.17	0.50	1.35%	2.18%	1.28%	0.79%	0.26%	0.16%	0.22%	0.28%	0.44%
Eastern Woodland Sedge *Carex blanda*	graminoid	-	-	-	0.11%	-	-	-	-	-	-	-
Enchanters Nightshade *Circaea luteliana*	forb	0.17	-	-	-	0.12%	0.15%	-	-	0.05%	-	-
European Alder * *Alnus glutinosa*	tree	-	-	0.84%	0.65%	2.07%	4.92%	2.33%	0.54%	-	-	-
European Buckthorn * *Rhamnus cathartica*	shrub	0.17	0.33	0.34%	2.94%	-	0.79%	0.60%	0.38%	0.65%	-	1.00%
European Cranberrybush * *Viburnum opulus*	shrub	-	-	-	-	-	-	-	-	-	-	0.22%
Forb sp.	forb	-	-	-	-	-	-	-	-	0.22%	-	-
Goldenrod hybrid *Solidago caesia x canadensis*	forb	-	-	-	-	0.06%	-	0.30%	-	-	-	-
Goldenrod sp. *Solidago* sp.	forb	-	-	0.84%	-	1.04%	-	-	-	0.27%	-	-
Grape sp. *Vitis* sp.	vine	-	-	-	-	-	-	-	-	0.05%	-	-
Grass sp.* *Poaceae* sp.	graminoid	-	2.17	5.06%	-	-	2.76%	2.63%	-	3.52%	-	-
Grass spp. *Poaceae* spp.	graminoid	-	-	-	-	-	-	-	-	-	0.55%	-

Table II continued

Species	Plant Type	2003	2005	2007	2008	2009	2010	2011	2013	2014	2015	2016
Gray Dogwood *Cornus racemosa*	shrub	0.83	0.67	13.84%	5.66%	8.48%	7.58%	3.84%	3.89%	3.31%	4.03%	2.22%
Gray Goldenrod *Solidago nemoralis*	forb	-	-	-	-	-	-	-	-	0.11%	-	-
Greater Straw Sedge *Carex normalis*	graminoid	-	-	-	0.87%	-	-	-	0.32%	0.11%	-	0.33%
Green Ash Fraxinus pennsylvanica	tree	-	-	-	-	-	-	-	-	-	0.11%	0.06%
Hawthorn sp. *Cretaegus* sp.	shrub	-	-	-	-	-	-	-	0.05%	-	-	-
Heal-all * *Prunella vulgaris*	forb	0.17	0.17	2.53%	3.70%	0.55%	0.10%	0.86%	0.38%	0.60%	0.17%	-
Heart-leaved Aster *Symphyotrichum cordifolium*	forb	0.17	-	-	-	-	-	-	-	-	-	0.33%
Highbush cranberry *Viburnum trilobum*	shrub	-	-	-	-	-	-	-	-	-	0.11%	-
Hog-peanut *Amphicarpaea bracteata*	forb	0.17	-	3.38%	4.36%	6.04%	3.74%	-	0.97%	1.73%	2.59%	0.22%
Honeysuckle sp. * *Lonicera* sp.	shrub	-	-	-	0.33%	-	-	0.26%	-	-	-	-
Japanese Barberry * *Berberis thunbergii*	shrub	-	-	0.51%	-	-	-	0.04%	-	-	-	1.11%
Kentucky Bluegrass * *Poa pratensis*	graminoid	-	-	0.08%	5.12%	-	-	-	0.59%	-	3.86%	4.00%
Large-leaved Aster *Eurybia macrophylla*	forb	-	-	0.51%	0.44%	0.49%	0.49%	0.78%	0.76%	0.98%	0.66%	-
Maple-leaved Viburnum *Viburnum acerfolium*	shrub	-	-	0.51%	-	0.24%	0.39%	0.35%	0.22%	0.11%	-	-
Meadow Fescue * *Schedonorus pratensis*	graminoid	-	-	4.22%	-	-	-	-	-	-	-	-
Meadow Hawkweed * *Hieracium caespitosum*	forb	-	-	0.84%	0.33%	0.98%	0.59%	-	1.51%	0.65%	0.39%	0.67%
Meadow Ryegrass * *Lolium pratense*	graminoid	-	-	-	-	-	-	-	-	-	-	0.11%
Morrow's Honeysuckle * *Lonicera morrowii*	shrub	0.17	0.33	-	-	-	-	-	-	-	-	-
moss sp.	bryophyte	-	-	-	-	-	-	0.09%	0.05%	0.22%	-	0.44%
Multiflora Rose * *Rosa multiflora*	shrub	-	-	0.34%	0.87%	1.22%	0.39%	0.35%	-	-	0.06%	-
New-England Aster *Symphyotrichum novae-angliae*	forb	-	-	-	0.22%	0.49%	-	-	-	-	-	-

Table II continued

Species	Plant Type	2003	2005	2007	2008	2009	2010	2011	2013	2014	2015	2016
Orchard Grass * *Dactylis glomerata*	graminoid	0.50	1.67	4.22%	5.23%	2.14%	2.95%	1.55%	4.11%	1.57%	1.60%	1.83%
Oval-headed Sedge *Carex cephalophora*	graminoid	-	-	0.84%	1.63%	0.55%	0.10%	-	-	0.11%	0.11%	0.50%
Path Rush *Juncus tenuis*	graminoid	0.17	-	-	-	-	-	-	-	-	0.11%	0.06%
Pennsylvania Sedge *Carex pensylvanica*	graminoid	-	0.17	-	-	-	-	-	-	-	-	-
Pointed-leaved Tick-trefoil *Hylodesmum glutinosum*	forb	1.00	1.33	8.44%	14.38%	11.17%	7.49%	8.71%	15.03%	11.17%	12.09%	12.99%
Poison Ivy *Toxicodendron radicans*	shrub	-	-	-	-	-	0.15%	0.56%	-	-	0.06%	0.89%
Poplar sp. *Populus* sp.	tree	-	-	-	-	-	-	-	-	-	0.06%	-
Queen Anne's Lace * *Daucus carota*	forb	-	-	0.17%	-	-	-	-	-	-	-	-
Raspberry sp. *Rubus* sp.	shrub	-	-	0.17%	-	-	-	-	-	-	-	-
Red Maple *Acer rubrum*	tree	-	-	-	-	-	-	-	-	-	-	0.11%
Red Oak *Quercus rubra*	tree	2.17	0.83	11.81%	8.39%	6.47%	7.68%	7.77%	2.81%	2.55%	2.70%	1.67%
Riverbank Grape *Vitis riparia*	vine	0.83	-	3.88%	8.93%	1.71%	0.84%	0.95%	-	0.33%	0.11%	0.50%
Rosy Sedge *Carex rosea*	graminoid	-	-	0.51%	1.09%	0.06%	-	-	-	0.05%	-	-
Rush sp. *Juncus* sp.	graminoid	-	-	-	-	-	-	-	-	0.05%	-	-
Sedge sp. *Carex* sp.	graminoid	0.50	-	-	0.22%	0.12%	0.05%	1.16%	0.05%	0.54%	0.17%	0.78%
Sedge sp. 1 *Carex* sp.	graminoid	-	-	-	-	-	-	-	0.05%	-	-	-
Sedge sp. 2 *Carex* sp.	graminoid	-	-	1.18%	-	-	-	-	0.05%	-	0.22%	0.11%
Showy Tick-trefoil *Desmodium canadense*	forb	0.67	0.17	3.71%	1.63%	1.53%	3.64%	2.93%	4.81%	2.82%	4.19%	3.33%
Smooth Aster *Symphyotrichum laeve*	forb	-	-	0.51%	0.11%	-	-	-	0.05%	-	-	0.22%
Solomon's Seal sp. *Polygonatum* sp.	forb	-	-	-	-	-	-	-	-	-	-	0.11%
Spiked Sedge * *Carex spicata*	graminoid	-	-	0.17%	-	-	-	-	-	-	-	0.33%

Table II continued

Species	Plant Type	2003	2005	2007	2008	2009	2010	2011	2013	2014	2015	2016
Spotted St. John's Wort *Hypericum punctatum*	forb	-	-	-	-	-	-	-	0.05%	-	-	-
Star-flowered False Solomon's Seal *Maianthemum stellatum*	forb	-	-	2.53%	0.87%	0.18%	0.20%	0.35%	-	0.05%	0.06%	0.06%
Summer Grape *Vitis aestivalis*	vine	-	-	-	-	-	-	-	0.54%	-	-	-
Swamp Loostrife *Lysimachia terrestris*	forb	-	-	-	2.18%	-	-	-	-	-	-	-
Tall Buttercup * *Ranunculus acris*	forb	-	-	-	0.11%	0.49%	-	-	-	-	-	-
Tall Goldenrod *Solidago altissima*	forb	-	-	-	-	-	-	-	-	0.98%	-	-
Tall Rattlesnakeroot *Nabalus altissimus*	forb	-	-	-	-	-	-	-	-	-	-	0.17%
Tall White Lettuce *Prenanthes altissima*	forb	-	-	-	-	0.31%	-	-	-	-	-	-
Thimbleweed *Anemone virginiana*	forb	-	-	-	-	-	-	-	0.05%	0.22%	-	-
Timothy * *Phleum pratense*	graminoid	1.00	0.17	5.57%	3.59%	0.92%	1.67%	1.64%	1.30%	1.30%	0.88%	0.94%
Violet sp. *Viola* sp.	forb	-	-	-	-	-	0.10%	-	0.54%	0.05%	0.06%	0.06%
Viper's Bugloss * *Euchium vulgare*	forb	-	-	-	-	-	-	3.15%	-	-	-	-
Virginia Creeper *Parthenocissus quinquefolia*	vine	-	-	0.17%	-	-	-	-	-	-	-	0.22%
White Ash *Fraxinus americana*	tree	0.33	-	-	-	-	-	-	-	0.11%	-	-
White Birch *Betula papyrifera*	tree	-	-	-	-	-	-	0.17%	-	0.22%	-	-
White Clover * *Trifolium repense*	forb	-	-	-	0.11%	-	-	-	-	-	-	-
White Sweet Clover * *Melilotus alba*	forb	0.33	-	-	-	-	-	-	-	-	-	-
Whorled Loosestrife *Lysimachia quadrifolia*	forb	-	-	-	-	1.22%	0.20%	0.60%	0.05%	0.33%	0.55%	-
Wild Geranium *Geranium maculatum*	forb	-	-	-	-	-	-	0.43%	-	-	0.11%	-
Wild Licorice *Galium circaezans*	forb	-	-	2.53%	-	-	-	-	-	-	-	-
Wild Red Raspberry *Rubus idaeus*	shrub	-	-	0.17%	0.98%	0.61%	0.59%	0.47%	0.65%	-	-	-

Table II continued

Species	Plant Type	2003	2005	2007	2008	2009	2010	2011	2013	2014	2015	2016
Wild Strawberry *Fragaria virginiana*	forb	0.17	-	1.18%	0.87%	0.79%	1.58%	0.86%	1.19%	0.87%	-	0.61%
Witch-hazel sp. *Hamamelis* sp.	shrub	-	-	-	-	-	-	-	0.22%	-	-	-
Wood Anemone *Anemone quinquefolia*	forb	-	-	-	0.11%	-	-	-	-	-	-	-
Wood Sorrel sp. *Oxalis* sp.	forb	-	-	0.84%	0.44%	-	-	-	-	-	-	0.11%
Woodland Speargrass * *Poa nemoralis*	graminoid	-	-	0.68%	-	-	0.10%	-	-	0.11%	-	0.17%
Woodland Strawberry *Fragaria vesca*	forb	-	0.17	-	-	-	-	-	-	-	0.50%	-
Yellow Wood Sorrel * *Oxalis europea*	forb	-	-	-	-	0.37%	-	-	-	-	-	-
Zig-zag Goldenrod *Solidago flexicaulis*	forb	-	-	-	0.22%	-	-	-	-	-	0.06%	-
Woody debris		-	-	-	-	-	-	7.12%	-	1.46%	2.87%	2.22%
Bare ground		-	1.33	7.59%	1.31%	0.18%	0.15%	12.60%	7.78%	1.08%	7.28%	1.94%
Leaf litter		-	-	-	11.66%	42.22%	43.72%	25.63%	45.95%	57.56%	47.79%	54.36%
Species Richness		***26***	***14***	***36***	***42***	***38***	***30***	***32***	***30***	***36***	***31***	***37***
Num. of Native Species		16	9	23	26	27	20	21	22	27	22	25
Num. of Introduced Species		10	5	13	16	11	10	11	8	9	9	12
Num. of Species sp.		1	2	6	4	7	5	5	10	11	**9**	9

*introduced species; *likely an introduced species – regarding *Poaceae sp.* it is likely composed of *Poa pratensis*

Appendix C – Map of Ecological Land Classification Polygons at Princess Point

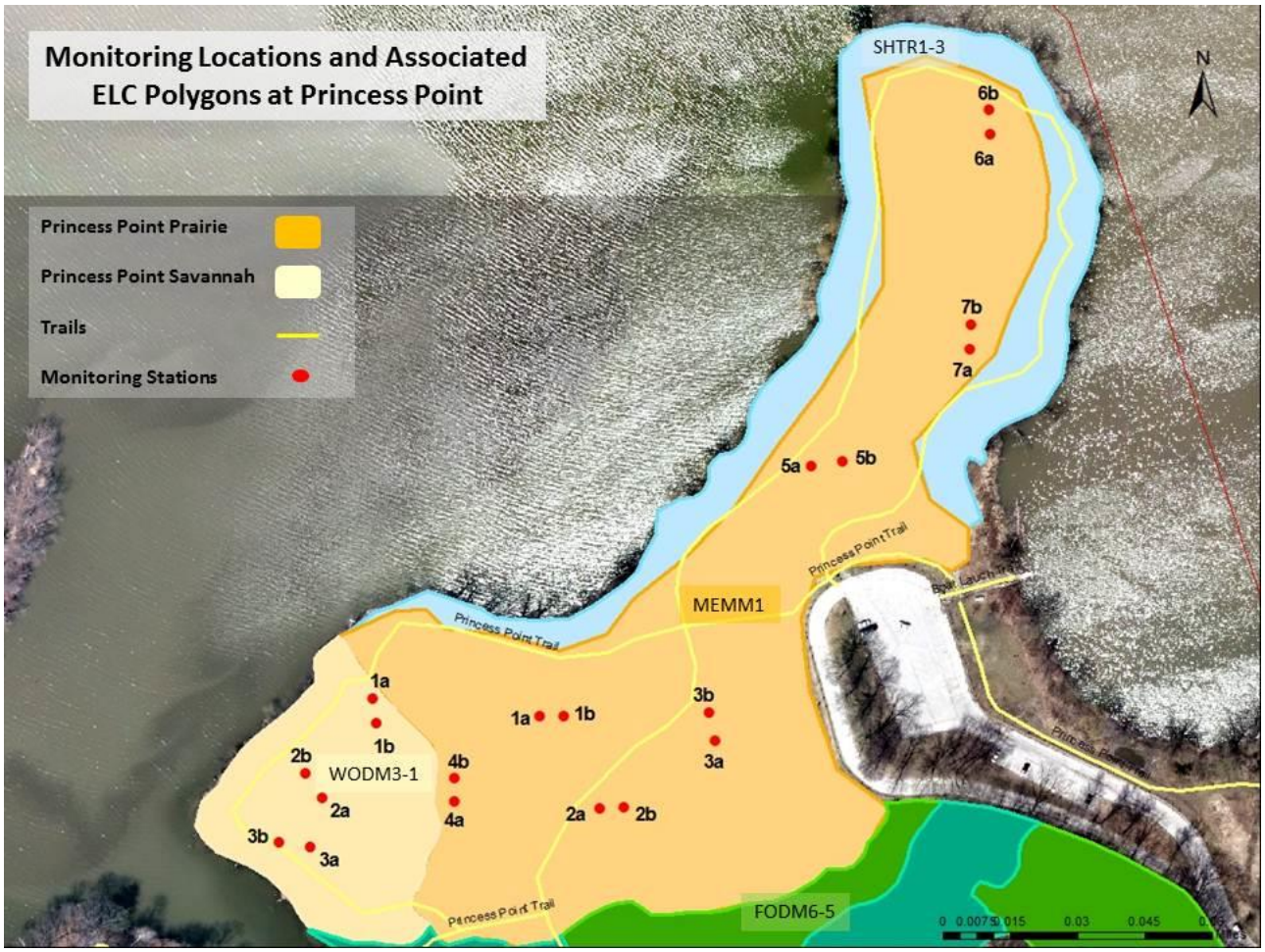

Figure I. Princess Point with Ecological Land Classification polygons – Prairie section ecosite is Dry Fresh Mixed Tallgrass prairie (MEMM1), Savannah section ecosite is Dry Red Oak Woodland Type (WODM3-1) and the shoreline ecosite is Willow Gravel Treed Shoreline (SHTR1-3)

Appendix D - Species Lists and Maps of Restoration Activities

Species List for Restoration Activities at Princess Point 2005 – 2016

Species list of trees and shrubs planted for Earth Day at Princess Point - 2005

Quantity	Botanical Name	Common Name	Nursery
100	*Cephalanthus occidentalis*	buttonbush	Acorus/Verbinnen's
350	*Alnus incana*	speckled alder	Acorus/Verbinnen's
200	*Sambucus canadensis*	common elderberry	Acorus/Verbinnen's
50	*Cornus stolonifera*	red-osier dogwood	Acorus/Verbinnen's
100	*Salix amygdaloides*	peach-leaved willow	Acorus/Verbinnen's
100	*Salix exigua*	sandbar willow	Acorus/Verbinnen's
17	*Quercus velutina*	black oaks	Acorus/Verbinnen's
Total = 917			

Species list of seed mix - 2008
purchased from Nith River Native Plants

kg	Botanical Name	Common Name	***seed source:***
0.5	*Desmodium canadense*	showy tick-trefoil	Brantford
0.25	*Rudbeckia hirta*	black-eyed Susan	Brantford
0.025	*Solidago juncea*	early goldenrod	Brantford
0.025	*Symphyotrichum oolentangiense*	sky blue aster	Brantford
2.2	*Andropogon gerardii*	big bluestem	Brantford
2.2	*Sorghastrum nutans*	Indian grass	Brantford
Total = 5.2 kg			

Species list of seed mix used - 2009
purchased from Nith River Native Plants

kg	Botanical Name	Common Name	***seed source:***
0.402	*Desmodium canadense*	showy tick-trefoil	Brantford
0.724	*Rudbeckia hirta*	black-eyed susan	Brantford
0.044	*Solidago juncea*	early goldenrod	Brantford
0.485	*Symphyotrichum oolentangiense*	sky blue aster	Brantford
0.051	*Penstemon digitalis*	hairy beardtongue	Brantford
0.066	*Symphyotrichum ericoides*	heath aster	Brantford
0.339	*Verbena stricta*	hoary vervain	Brantford
0.137	*Symphyotrichum novae-angliae*	new england aster	Brantford
0.038	*Symphyotrichum laeve*	smooth aster	Brantford
0.006	*Pycanthemum virginianum*	viginia mountain mint	Brantford
0.103	*Anemone virginiana*	thimbleweed	Brantford
0.232	*Monarda fistulosa*	wild bergamot	Brantford
1.447	*Scizachyrium scoparium*	little bluestem	Brantford
9.818	*Andropogon gerardii*	big bluestem	Brantford
	Sorghastrum nutans	indian grass	Brantford
Total = 13.892 kg			

Species list of plugs planted at Princess Point - 2010

purchased from Pterophylla/St.Williams and Kayanase

# Plugs	Botanical Name	Common Name	*seed source:*
432	*Panicum virgatum*	switchgrass	RBG
1368	*Sorghastrum nutans*	indian grass	RBG
1080	*Andropogon gerardii*	big bluestem	RBG
1440	*Schizachyrium scoparium*	little bluestem	RBG
288	*Desmodium canadense*	showy tick-trefoil	RBG
360	*Asclepias tuberosa*	butterfly weed	RBG
792	*Monarda fistulosa*	wild bergamot	RBG
576	*Rudbeckia hirta*	black-eyed Susan	Norfolk
360	*Symphyotrichum oolentangiense*	sky-blue aster	Norfolk
216	*Lespedeza capitata*	round-headed bush clover	Norfolk/RBG
216	*Anemone virginiana*	thimbleweed	Norfolk/RBG
216	*Symphyotrichum ericoides*	heath aster	Hamilton
202	*Symphyotrichum laeve*	smooth aster	Hamilton
216	*Symohyotrichum urophyllum*	arrow leaved aster	Hamilton
243	*Penstemon digitalis*	foxglove beardtongue	Hamilton
243	*Penstemon hirsutus*	hairy beardtongue	Hamilton

Total = 8,248 - 7000 planted at Princess Point

** note that about **1000** plugs were planted in other areas like York Boulevard Prairie*

Species list of trees and shrubs planted at Princess Point - 2011 (Envirothon)

Quantity	Botanical Name	Common Name	Nursery
3	*Quercus rubra*	red oak	Connon's
6	*Pinus strobus*	white pine	Kayanase
194	*Prunus virginiana*	chokecherry	Kayanase /Verbinnen's
144	*Cornus alternifolia*	alternate-leaved dogwood	Verbinnen's
5	*Viburnum lentago*	nannyberry	Verbinnen's
9	*Amelanchier laevis*	smooth serviceberry	Verbinnen's
31	*Cornus racemosa*	gray dogwood	Verbinnen's
16	*Rubus idaeus*	wild red raspberry	Verbinnen's
34	*Zambucus pubens*	red-berried elder	Kayanase

Total = 442

Species list of plugs planted at Princess Point - 2011

purchased from St.Williams

# Plugs	Botanical Name	Common Name	*seed source:*
372	*Andorpogon gerardii*	big bluestem	RBG
360	*Schizachyrium scoparium*	little bluestem	RBG
348	*Sorghastrum nutans*	Indian grass	RBG
360	*Monarda fistulosa*	wild bergamot	RBG
360	*Rudbeckia hirta*	black-eyed Susan	RBG
360	*Symphyotrichum oolentangiense*	sky-blue aster	RBG
72	*Asclepias tuberosa*	butterflyweed	RBG

Total = 2,232

Species list of seed mix used at Princess Point - 2013
purchased from St. Williams

Botanical Name	Common Name	*seed source:*
Panicum virgatum	switchgrass	RBG
Sorghastrum nutans	Indian grass	RBG
Andropogon gerardii	big bluestem	RBG
Schizachyrium scoparium	little bluestem	RBG
Desmodium canadense	showy tick-trefoil	RBG
Helianthus strumosus	pale sunflower	RBG
Asclepias tuberosa	butterfly weed	RBG
Monarda fistulosa	wild bergamot	RBG
Rudbeckia hirta	black-eyed Susan	Norfolk
Symphyotrichum oolentangiense	sky-blue aster	Norfolk
Lespedeza capitata	round-headed bush clover	Norfolk/RBG
Anemone virginiana	thimbleweed	Norfolk/RBG
Total = 1 kg		

** note kg of seed per species not available; remainder from projects and previous years*

Species list of plugs planted at Princess Point - 2013

# Plugs	Botanical Name	Common Name	Nursery
72	*Rudbeckia hirta*	black-eyed susan	St. Williams
72	*Symphyotrichum oolentangiense*	sky-blue aster	St. Williams
72	*Lespedeza capitata*	round-headed bush clover	St. Williams
72	*Anemone virginiana*	thimbleweed	St. Williams
Total = 288			

Species list of trees and plugs planted at Princess Point - 2014

Quantity	Botanical Name	Common Name	Nursery
2	*Quercus macrocarpa*	bur oak	St. Williams
10	*Quercus rubra*	red oak	St. Williams
Total = 12			

Species list of plugs planted at Princess Point - 2014

purchased from St. Williams

# Plugs	Botanical Name	Common Name	*seed source:*
144	*Andropogon gerardii*	big bluestem	Norfolk
144	*Schizachyrium scoparium*	little bluestem	Norfolk
144	*Sorghastrum nutans*	Indian grass	Norfolk
72	*Anemone virginiana*	thimbleweed	Norfolk
144	*Asclepias tuberosa*	butterflyweed	Norfolk
72	*Helianthus strumosus*	woodland sunflower	Norfolk
144	*Helianthus giganteus*	tall sunflower	Norfolk
72	*Lespedeza capitata*	round-headed bush clover	Norfolk
72	*Monarda fistulosa*	wild bergamot	Norfolk
72	*Pycnanthemum virginianum*	viginia mountain mint	Norfolk
72	*Rudbeckia hirta*	black-eyed Susan	Norfolk
144	*Rudbeckia lanciniata*	green-headed coneflower	Norfolk
72	*Symphiotrichum oolentangiense*	sky-blue aster	Norfolk
72	*Symphiotrichum nova-angliae*	new england aster	Norfolk
144	*Verbena stricta*	hoary vervain	Norfolk
Total = 1,584			

Species list of trees and shrubs planted at Princess Point shoreline - 2015

Quantity	Botanical Name	Common Name	Nursery
28	*Acer saccharinum*	silver maple	Verbinnen's
7	*Amelanchier arborea*	downy serviceberry	Verbinnen's
18	*Quercus bicolor*	swamp white oak	St. Williams
5	*Cephalanthus occidentalis*	buttonbush	Verbinnen's
10	*Silax nigra*	black willow	Verbinnen's
10	*Salix discolor*	pussy willow	St. Williams
10	*Physocarpus opulifolius*	ninebark	St. Williams
15	*Viburnum lentago*	nannyberry	St. Williams
35	*Rosa palustris*	swamp rose	St. Williams
50	*Cornus obliqua*	silky dogwood	St. Williams
5	*Betula papyrifera*	white birch	Verbinnen's
80	*Salix exigua*	sandbar willow	St. Williams
5	*Spirea alba*	meadowsweet	St. Williams
Total = 278			

Species list of plugs planted - 2015

purchased from St. Williams

# Plugs	Botanical Name	Common Name	*seed source:*
144	*Rudbeckia hirta*	black-eyed Susan	Norfolk
216	*Asclepias tuberosa*	butterflyweed	Norfolk
144	*Monarda fistulosa*	wild bergamot	Norfolk
72	*Desmodium canadense*	showy tick-trefoil	Norfolk
72	*Penstemon digitalis*	foxglove beardtongue	Norfolk
72	*Symphyotrichum ericoides*	heath aster	Norfolk
72	*Solidago juncea*	early goldenrod	Norfolk
72	*Solidago nemoralis*	grey goldenrod	Norfolk
216	*Schizachyrium scoparium*	little bluestem	Norfolk
288	*Sorghastrum nutans*	Indian grass	Norfolk
Total = 1,368			

Species list of plugs planted at Princess Point - 2016

purchased from St. Williams by Jen Baker/Kestral through Pollinator Paradise Project

# Plugs	Botanical Name	Common Name	*seed source:*
20	*Rudbeckia hirta*	black-eyed Susan	Norfolk
20	*Asclepias tuberosa*	butterflyweed	Norfolk
20	*Monarda fistulosa*	wild bergamot	Norfolk
20	*Desmodium canadense*	showy tick-trefoil	Norfolk
20	*Penstemon digitalis*	foxglove beardtongue	Norfolk
20	*Symphyotrichum ericoides*	heath aster	Norfolk
20	*Solidago juncea*	early goldenrod	Norfolk
20	*Solidago nemoralis*	grey goldenrod	Norfolk
20	*Schizachyrium scoparium*	little bluestem	Norfolk
20	*Sorghastrum nutans*	Indian grass	Norfolk
Total = 200			

Species list of trees and shrubs planted at Princess Point - 2016

Quantity	Botanical Name	Common Name	Nursery
1	*Quercus rubra*	red oak	Verbinnen's
10	*Cornus racemosa*	gray dogwood	Verbinnen's
7	*Rosa carolina*	pasture rose	Verbinnen's
Total = 18			

Species planned to be seeded and planted at Princess Point 2017 will be similar to those above

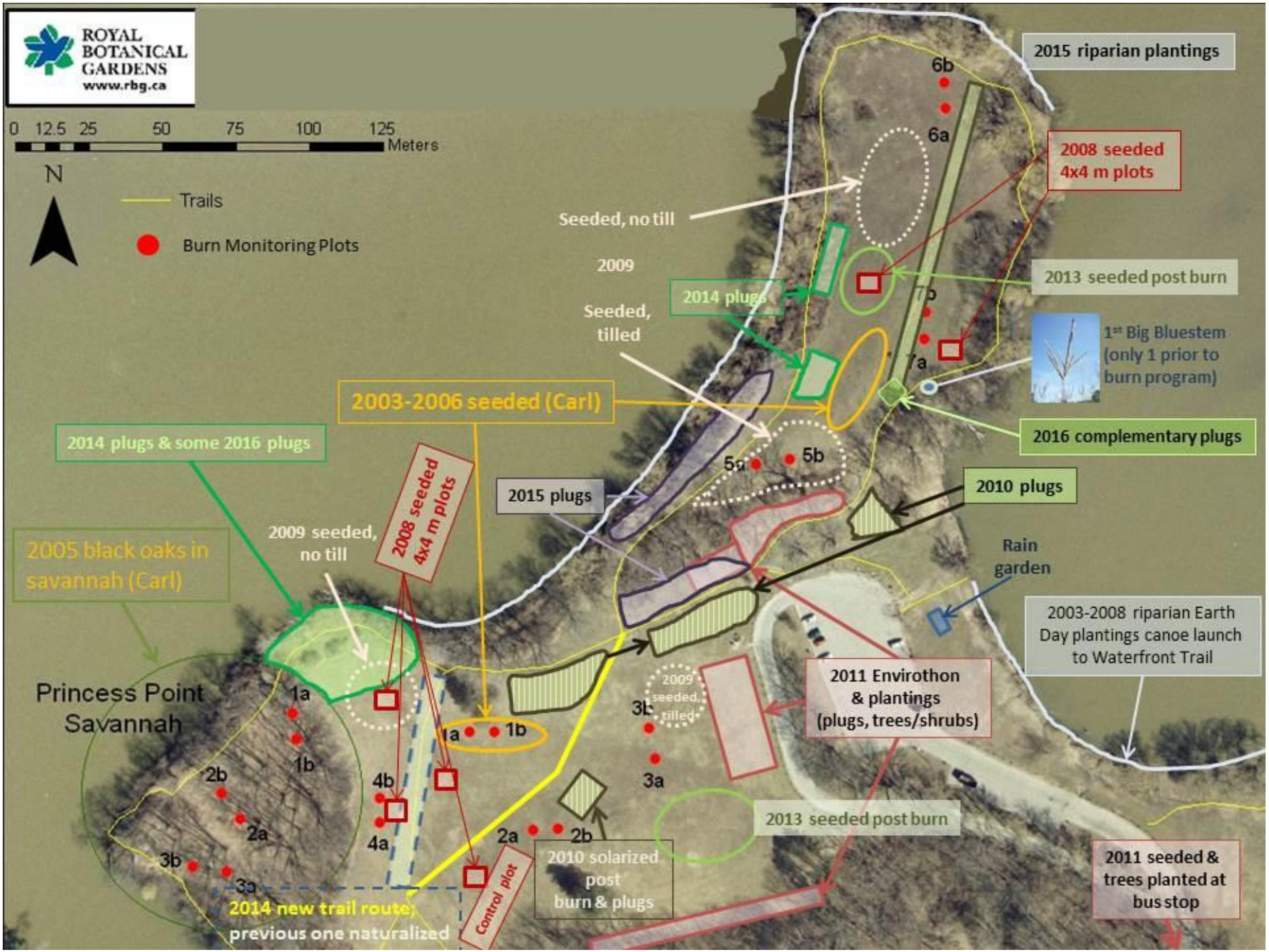

Figure i. Restoration locations at Princess Point from 2003-2016

Block A: 2008, 2009, 2010, 2013, 2017
Block B: 2008,2009, 2010, 2013, 2017
Block C: 2008, 2009, 2010, 2013, 2017
Block D: 2006, 2017
Block E: 2013, 2017
Block F: 2017

Figure ii. Map of burn locations and years burned at Princess Point

Figure iii. Black oak planting locations in the oak savannah by Carl Rothfels April 23rd, 2005