Baseline Documentation Report (BDR)

Bowmanville Creek Valley

Bowmanville, ON

November 2015

Developed in combination with Valleys 2000 and Ecosystem Management Technology Students of Fleming College's School of Environmental & Natural Resource Sciences

This annotated Baseline Documentation Report (BDR) is based on the Ontario Land Trust Alliance (OLTA) BDR Template for Natural Heritage Lands Owned by a Land Trust (October 25, 2006)

Acknowledgements

We would like to sincerely thank Suzanne Barnes, Past President, Valleys 2000; Frank Lockhart, Past President, Valleys 2000; Heather Cooke, Volunteer Coordinator, Valleys 2000; and Sara Kelly, Credit for Product Course Instructor, Fleming College, for their collaboration and mentorship in the creation of this document. Additionally, we would like to thank Valleys 2000, the Municipality of Clarington, and Central Lake Ontario Conservation Authority for their collaboration and on this project.

Table of Contents

Executive Summary:

The purpose of this report was to collect baseline data for Valleys 2000 by establishing a baseline documentation report (BDR) for Bowmanville Creek. Using the Ecological Land Classification (ELC) for Southern Ontario (OMNR, 2001) protocol, the Credit for Product team from Fleming College confirmed ecosites and land classification for this property. Previous ELC conducted by Central Lake Ontario Conservation Authority (CLOCA) was completed to the community series level using the latest orthophotography. CLOCA acknowledges that through ground-truthing ELC polygons may be revised and refined better reflecting vegetation and soil characteristics. Arising from the students' field work, some of the ELC polygons have been refined using soil and vegetation samples. The updated ground-truthed polygons can be seen on the Ecological Land Classification (ELC) Boundary Map, within Appendix A. In general, soil types were found to be predominately silty or sandy loams, especially near the creek's edge, which may threaten shoreline integrity into the future. The average depth of organic material was 20 centimetres with moisture regimes of fresh to very fresh, indicating healthy vegetation.

Areas of Himalayan balsam, garlic mustard and dog-strangling vine were identified as the most predominant invasive species within the property of Bowmanville Creek. As the invasive stands have not yet taken over the native species yet, management practices should be put into place as soon as possible, before native stands are outcompeted. Hand removal by pulling of the invasive species should suffice for now as a management strategy, along with long-term restoration of native stands. This should be repeated biweekly to ensure minimal spread of the invasive, preferably beginning in April and repeated until the end of fall. See Appendix B: Literature Review 4 for best management practices of these invasive species. Additionally, areas of high human traffic and garbage dumping were observed throughout the property. The extent varies from small-scale (e.g. empty water bottles and trash) to large-scale (e.g. forts, huts, scorching due to campfires). These areas have been in the Human Disturbances Map within Appendix A, as areas that need to be monitored on a regular basis, i.e. monthly. Therefore, it is recommended that Valleys 2000 continue its partnership with Fleming College and use this resource to further collect information on a continuous spectrum which could allow monitoring of invasive species, human disturbances, and the overall health of the property. Furthermore, this BDR should be used as a starting point to establish a stewardship monitoring plan that volunteers or research teams can utilize and update as needed.

Property:
Bowmanville Creek Valley

Date of Site Visit(s)
October 5th 2015
October 19th 2015

BDR Prepared by:
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GENERAL PROPERTY INFORMATION

1. Property Information

Type of Agreement: N/A

Property Address: 95 Baseline Rd W, Bowmanville, ON L1C 5G3

Legal Description: N/A

Location (latitude, longitude): Latitude: 43° 53' 59.000" N Longitude: 78° 41' 02.000" W

UTM Reference: 17T Easting: 685992 Northing: 4863352

Surface Area (acres and hectares): 45 ha

Directions to the Property:
Take exit 432 Liberty Street from ON-401 W. Continue on Liberty Street until you reach Baseline Rd W. Turn left onto Baseline Rd W and follow it to the parking lot.

Access Details for the Property:
Follow on site trails.

Aerial Photo Numbers: N/A

Official Plan Land Use Designation(s): Environmental Protection Area

2. Site Description, Ecosystems and Habitats

Site Description: Bowmanville Valley (BV) between Baseline and King the area is approximately 45 ha, primarily flood plain /old field. The main trail through the Bowmanville Creek Valley is approximately 1.8 km.

Site Designations: The Bowmanville Creek Valley resides in an environmentally protected area .

Habitat Characterization: Please see Appendix C: Ecological Land Classification (ELC) data sheets and Appendix A: Ecological Land Classification (ELC) Boundary Map for specific eco-sites and vegetative communities within the property.

Other Ecological or Heritage Values: This site is considered to be a riparian buffer, and provides scenic value.

Land Uses

Historic use: The Bowmanville Valley was previously home to two rubber factories, the Durham rubber company in 1905 and the Goodyear rubber works factory in 1910.

Adjacent land use: Urban residential and gateway commercial

Current use

Recreational:

Activity	Occurring (Y/N)	Details
Hiking/walking	Y	Various walking trails throughout the property.
Berry Picking, Other Harvesting	Y	Raspberry bushes, currants, and other edible plants present on the property.
Bird Watching	Y	Various bird species present on site.
Picnicking	N	Not allowed under municipal bylaws.
Camping	N	Not allowed under municipal bylaws.
Agricultural	N	Not allowed under municipal bylaws.
Hunting	N	Not allowed under municipal bylaws.
Fishing	Y	High amount of anglers during fishing seasons for salmon and trout.
Four-Wheel Driving	N	Not allowed under municipal bylaws.
ATV Use	N	Not allowed under municipal bylaws.
Trail Riding (horse)	N	Not allowed under municipal bylaws.
Snowmobiling	N	Not allowed under municipal bylaws.
Cross-country skiing	N	Not allowed under municipal bylaws.
Swimming	N	Not allowed under municipal bylaws.
Cycling	Y	Cycling is permitted on various trails throughout the property.

Is public access allowed: Yes

3. Property Structures, Developments and Constructed Features

Buildings/Structures:

- Valleys 2000 information kiosk - Contains descriptions of information concerning various work that has been done in the valley by this volunteer organization
- Bowmanville fish bypass channel - Created to assist fish in getting upstream past the dam so that they may continue to travel to spawning locations

Trails & Roads: Refer to the Trail Map within Appendix A for locations of official and unofficial trails.

Wells & Septic: N/A

Fences: Fences generally bordered residential housing.

Power lines: Existing throughout property, along trails and by residences.

Pipelines/sewers: Exist throughout property.

Other: N/A

4. Disturbances & Potential Threats to Site

The following table lists disturbances already noted (O) as well as additional uses that can be anticipated to merit a particular management strategy (X) because of their nature or noted frequency of occurrence.

Vegetation/ Animals	O X	Removal of Resources	O X	Vandalism/ Liability	O X	Trails/Roads/ Cutlines	O X	Natural Processes	O X
Tree Cutting		Sand		Garbage/ litter	O X	ATV/ Snowmobile Trails		Landslide	
Bark Stripping	O X	Gravel		Signs of lack of		Roads			
Collecting Plants/ Animals		Peat		Structural damage or poor condition	O X	Hiking Trails	O X		

Hunting/ Trapping Animals		Water		Campfires	O X	Equestrian Trails			
Invasives	O X	Other disturbances (describe)		Swing ropes (diving, swimming etc)		Cutlines/ Seismic			
Use of pesticides/ herbicides				Steep Cliff Faces	O X	Fence lines			
Grazing				Mountain bike jumps & ramps	O X	Pipelines/ wellsite	O X		
Tree Plantation	O X			Other disturbances (describe):		Power lines	O X		
Beaver Cutting/ Flooding	O X			Tree Vandalism	O X	Trail erosion	O X		
Other disturbances (describe):						Drainage ditches			
						Other disturbance (describe):			
						Water and dredging rights of adjacent Goodyear plant	O X		

Additional detail:

Evidence of human disturbances such as campfires, tree scorching, garbage dumping, and tracks and trails were common within this site. Invasive species such as dog-strangling vine, garlic mustard, Himalayan balsam, and European Buckthorn were also present in many polygons. Tree planting must be selective under existing powerlines. Additionally, tree roots have potential to cause clogging in existing storm sewer pipelines that go from the residential subdivisions to the creek.The water and dredging rights help by the “Goodyear” plant could force major changes to the area around the fish bypass channel. Refer to page 12 (Conservation Goals and Concluding Remarks) for management suggestions, and to Appendix A: Invasive Species and Human Disturbances Map for more detail on the locations of above disturbances.

5. Water

Pond – This is a man-made pond of approximately 561m^2, and saturated year-round, located southeast of the parking lot. Shorelines were stable but showed signs of man-made erosion, and further mowing of the riparian edge is not encouraged.

Residential retention pond – Located south-east of Bowmanville Creek Valley, this constructed retention pond is approximately 3238m^2 in size, and is saturated year-round.

Bowmanville Creek –The creek, approximately 2.66 km long, is a natural feature located in the center of the property and runs north-south. The river is saturated year-round and drains towards the south. There is evidence of erosion along the shorelines and some of the stream banks were not stable. Vegetation was dense and healthy along the banks and shorelines. Stream bank planting was undergone in order to further stabilize the bank, including the planting of species such as red-osier dogwood and willow shrubs. Additionally these shrubs were secured with nets to help stabilize the shorelines. Engineered bank stabilization techniques such as the use of large boulders and rocks secured with wire mesh along the shorelines were used in order to maintain stream bank integrity.

Fish By-Pass Channel (Bowmanville Fish Ladder) –Constructed feature approximately 300m^2 in size, located directly southeast of the main trail, and flowing towards the south. Parts of the shoreline were eroded, but stabilizers were put in place in 2013 by Valleys 2000 to prevent avoid future erosion. Vegetation was generally healthy along the banks and shorelines.

6. Geology & Soils

See Appendix C: Ecological Land Classification (ELC) Data Sheets for specific identification of soils and moistures for designated polygons. Most soils are silty or sandy loams, which indicate that drainage occurs easily. The soil moisture regimes were found to be fresh to moist indicating healthy soil.

a) **Surficial and Bedrock Geology:** The surface soils tend to be mineral with an organic layer of approximately 20 cm. The bedrock for this area is most likely limestone, however we were unable to auger deep enough to confirm this.
b) **Soils:** We used the ELC for Southern Ontario manual (OMNR, 2001) to confirm soil substrate and moisture regimes. ELC revealed little to no clay found within the site, indicating good moisture drainage in the site. The substrate is non-saline. The most common substrate types found were silty and sandy loams. This was found to be

especially true closer to the creek. This could indicate a hotspot for erosion and an area that should be monitored into the future.

7. Wildlife and Wildlife Habitat

Evidence of Wildlife:

Wildlife/Trees/Snags/General		**Animal Tracks**		**Animal Scat**	
Squirrel or Mast Catches		Types of Tracks:		Types of Scat:	
Bird's Nests	X				
Feathers					
Burrows					
Browsed Vegetation					
Other: -Beaver damage -Salmon spawning	 X X				

Additional detail: Extensive beaver damage to trees, and the beginning stages of a dam located in MAS2-1 polygon near fish bypass channel (See Appendix D: Photo 1). Squirrel and birds' nests were abundant and observed throughout the property. The man-made fish bypass channel located in the cultural (CU) polygon provides access to suitable fish spawning habitat, specifically for Chinook salmon, Rainbow trout and brown trout.

General description of habitats and ecological systems: The Bowmanville Creek Valley property contains a combination of deciduous, coniferous, and mixed forests providing habitat for a variety of terrestrial mammals and birds. Additionally, marshes and the flowing creek provide habitat for fish and wetland-enduring plants and animals. Refer to Appendix C: Ecological Land Classification (ELC) Data Sheets for more detailed descriptions of all eco-sites determined within the property.

Wildlife observed on property:

Birds:

Common Name	**Scientific Name**	**Date Observed**
American gold finch	*Carduelis tristis*	Oct 5th 2015
Black-capped chickadee	*Poecile atricapillus*	Oct 19th 2015
Blue jay	*Cyanocitta cristata*	Oct 5th 2015
Cardinal	*Cardinalis cardinalis*	Oct 5th 2015
Downy woodpecker	*Picoides pubescens*	Oct 19th 2015
Mallard duck	*Anas platyrhynchos*	Oct 5th 2015

Robin	*Turdus migratorius*	Oct 19th 2015
Seagull	*Laridae species*	Oct 19th 2015
Sparrow	*Passeridae species*	Oct 19th 2015

Fish:

Common Name	**Scientific Name**	**Date(s) observed**
Chinook salmon	*Oncorhynchus tshawytscha*	Oct 5 2015,Oct 19 2015

Endangered, threatened, rare and significant species: None observed.

8. Vegetation

Description of habitats and ecological systems:

Trees:

Common Name	**Scientific Name**	**Notes**
Balsam poplar	*Populus balsamifera*	Native
Basswood	*Tilia americana*	Native
Black ash	*Fraxinus nigra*	Native
Black cherry	*Prunus serotina*	Native
Black locust	*Robinia pseudoacacia*	Non-native
Black walnut	*Juglans nigra*	Native
Blue spruce	*Picea pungens*	Native
Common (European) buckthorn	*Rhamnus cathartica*	Invasive
Common hawthorn	*Crataegus monogyna*	Native
Crab apple	*Malus species*	Native
European larch	*Larix decidua*	Native
Honey locust	*Gleditsia triacanthos*	Native
Ironwood	*Ostrya virginiana*	Native
Manitoba maple	*Acer negundo*	Non-native
Norway maple	*Acer platanoides*	Non-native
Red maple	*Acer rubrum*	Native
Red pine	*Pinus resinosa*	Native
Scott’s pine	*Pinus sylvestris*	Native
Sugar maple	*Acer saccharum*	Native
White elm	*Ulmus americana*	Native
White oak	*Quercus alba*	Native

White spruce	*Picea glauca*	Native
Willow	*Salix sp.*	Native

Common Name	Scientific Name	Notes
Blackberry	*Rubus aboriginum*	Native
Honeysuckle	*Lonicera sp.*	Native
Raspberry	*Rubus idaeus*	Native
Staghorn sumac	*Rhus typhina*	Native

Shrubs:

Forbs:
(Forbs are non-woody or non-grass plants)

Common Name	Scientific Name	Notes
Aster	*Aster sp.*	Native
Canada goldenrod	*Solidago canadensis*	Native
Hairy Solomon's seal	*Maianthemum racemosum*	Native
Canadian thistle	*Cirsium arvense*	Native
Cattail	*Typha species*	Native
Common burdock	*Arctium minus*	Non-native
Cow vetch	*Vicia cracca*	Native
Creeping nightshade	*Solanum dulcamara*	Native
Currant	*Vibernum sp.*	Native
Dog-strangling vine	*Cynanchum rossicum*	Invasive
Elderberry	*Sambucus nigra*	Native
Garlic mustard	*Alliaria petiolata*	Invasive
Himalayan balsam	*Impatiens glandulifera*	Invasive
Jerusalem artichoke	*Helianthus tuberosus*	Invasive
Common milkweed	*Aslepsias syriaca*	Native
Ostrich fern	*Matteucccia struthiopteris*	Native
Queen Anne's Lace	*Daucus carota*	Non-native
Red-osier dogwood	*Cornus stolonifera*	Native
Spotted jewelweed	*Impatiens capensis*	Native
Violet	*Viola sp.*	Native
Wild asparagus	*Asparagus officinalis*	Non-native
Wild cucumber	*Echinocystis lobata*	Native
Wild grape	*Vitis vinifera*	Native
Wild parsnip	*Pastinaca sativa*	Native

Wood fern	*Dryopteris sp.*	Native

Grasses:

Common Name	Scientific Name	Notes
American common reed	*Phragmites americus*	Native
Brome grass	*Bromus sp.*	Native
Common reed	*Phragmites australis*	Invasive
Horsetail	*Equisetum sp.*	Native
Orchard grass	*Dactylis glomerata*	Native
Reed canary grass	*Phalaris arundinacea*	Native
Timothy	*Phleum pratense*	Native

Fungi:

Common Name	Scientific Name	Notes
Dryad's saddle	*Polyporus squamosus*	Native

Endangered, threatened or rare species: None observed.

9. Conservation Goals:

The main conservation goals have been identified for Bowmanville Creek Valley based on the data collected in the BDR and on the mandate of Valleys 2000. The first goal is to establish the overall health of the creek. This can be achieved by performing Ontario Benthos Biomonitoring Network (OBBN) using the Ontario Stream Assessment Protocol (OSAP). With a major salmon run occurring every year through the Bowmanville Creek Valley, it is important to make sure this ecosystem is healthy and thriving. Along with in-stream monitoring, the riparian edge needs to be assessed. Due to the winding path of the creek, erosion is occurring around many of the bends, which if left too long, could become unsafe for anglers or hikers. This erosion issue is already being looked at within Soper Creek, and similar actions should be taken and applied within this site.

The second conservation goal is to prevent the invasive species on the property from spreading any further. There is not a major issue yet, but the small garlic mustard, dog strangling vine and Himalayan balsam stands can quickly become devastating to the native plant communities. Examples of how to control and monitor the invasive species on the property are found within the Literature Review 4 within Appendix B.

The third and final conservation goal for Bowmanville Creek Valley is to stop unplanned or unauthorized trimming or pruning of the trail edges. These are still important wildlife habitats and need to be treated as so. The Kawartha Lakes Forest Management Plan in Appendix E is a great example of how to plan trail and corridor maintenance.

10. Concluding Remarks and Recommendations:

It is recommended that a conservation team go out in April and begin removing the invasive species indicated on the Invasive Species and Human Disturbances Map in Appendix A. Pulling by hand should suffice as a management strategy as of right now, but the process should be repeated biweekly throughout the spring and summer months. This should effectively destroy the invasive plants before they get a chance to spread or take over native species' stands. More information on invasive species removal can be found in Appendix B: Literature Review 4. It is also recommended that a stewardship team walk the property on a regular basis, i.e. monthly, to assess areas having high human traffic, and those that have excessive amounts of garbage/dumping (as seen in the Invasive Species and Human Disturbance Map within Appendix A), and determine whether a cleanup day is necessary. Valleys 2000 should consider opening these clean-up days to the public to recruit more man power and show the community that they can have a role in the maintenance of the property they enjoy so much. The Bowmanville Creek Anglers club is a great place to start to establish a partnership with the community.

To further ensure the health and maintenance of Bowmanville Creek Valley it is recommended that Valleys 2000 continue its relationship with Fleming College in the future. This would allow for more continuous monitoring of the property by teams of students, through monitoring/controlling for invasive species stands, and keeping up to date records of the forest status and condition. The Bowmanville Creek Valley property is healthy and seems to be doing well with only a few areas targeted by invasive species. Based on the data gathered in the BDR it is recommended that Valleys 2000 establish a monthly monitoring program of the property. An example of how to construct this management plant can be found within the Ontario Land Trust Alliance- A volunteer's manual for land management (OLTA, 2005).

11.Important Contacts

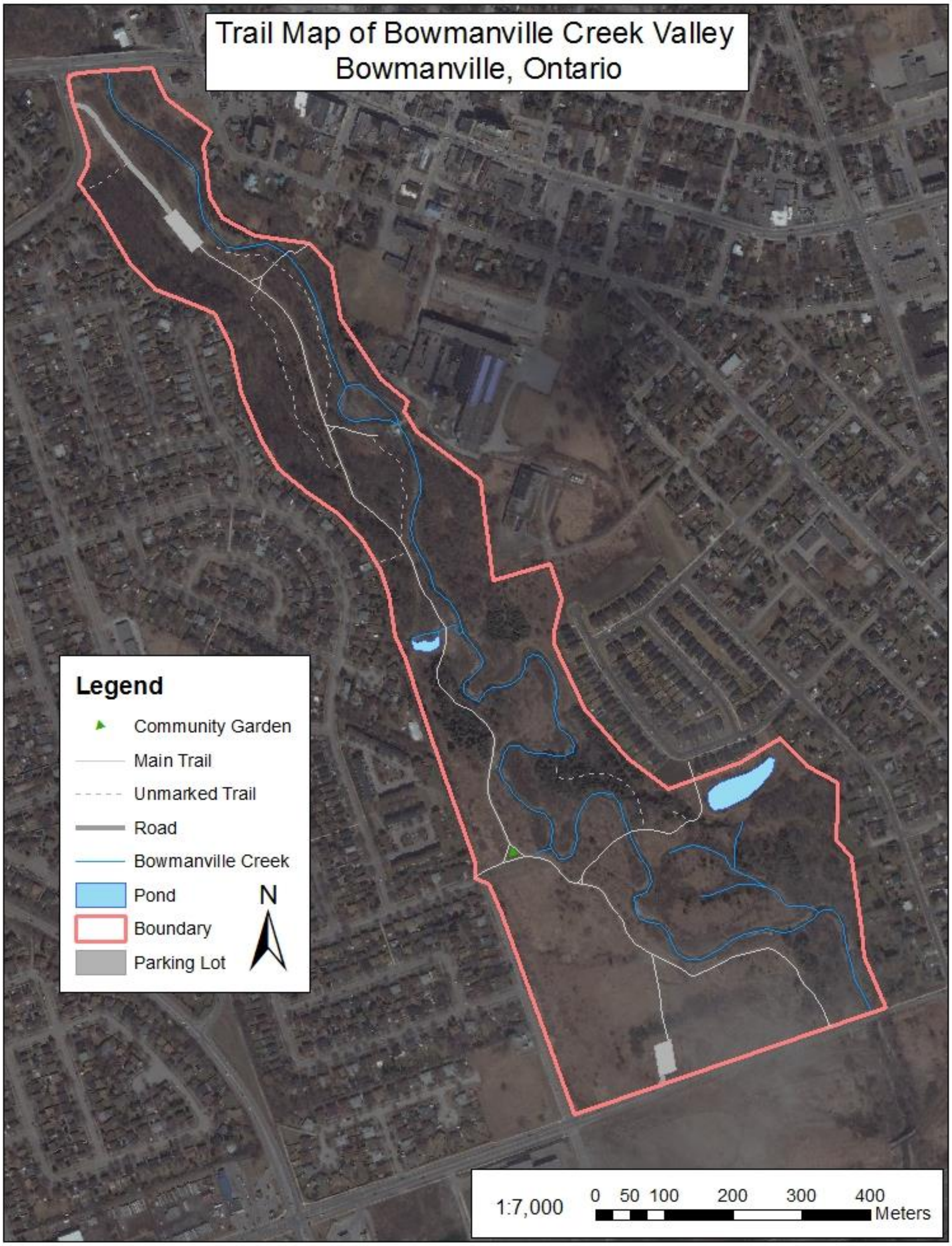
- Municipality of Clarington
  40 Temperance Street
  Bowmanville, ON L1C 3A6
  Phone: (905) 623 3379, Toll Free: 1-(800)-563-1195
- Central Lake Ontario Conservation Authority
  100 Whiting Avenue
  Oshawa, ON L1H 3T3
  Phone: (905) 579 0411
  Email: mail@cloca.com
- Heather Cooke, Volunteer Coordinator
  Valleys 2000
  Phone: (905) 623 4277
  Email: hcookie315@gmail.com
  Website: http://www.valleys2000.ca

12. List of Appendices

Appendix A:	Ecological Land Classification (ELC) Boundary Map, Trail Map, and Invasive Species and Human Disturbance Map
Appendix B:	Student Literature Reviews
Appendix C:	Ecological Land Classification (ELC) Data Sheets
Appendix D:	Photos
Appendix E:	References
Appendix F:	Project Plan for Valleys 2000 Lockhart Local Knowledge and Baseline Information Collection
Appendix G:	Progress Meeting Minutes and Revised Gantt Chart

Appendix A: Ecological Land Classification (ELC) Boundary Map

Appendix A: Trail Map



Appendix A: Invasive Species and Human Disturbances Map

Appendix B: Literature Reviews

Valleys 2000: Lockhart Local Knowledge
FLPL4 - Credit for Product
10/14/2015
Submitted to: Sara Kelly, Course instructor

Literature Review 1: The role of herbaceous perennial wildflowers, grasses and sedges in terrestrial meadow ecosystems

By: Evan Barton

Introduction

The meadow ecosystem can be very important to various wildlife species such as grassland nesting birds and insects such as pollinators. In the Bowmanville valley there is a large spread of meadow ecosystems which provide habitat to the insect community as well as pollinators. The meadows are home to herbaceous plants species such as perennial wildflowers, grasses and sedges; without these species pollinators and various other insect species would leave the area and pollination in the meadow ecosystem would dramatically decrease, with the degradation of the wildflowers, wildlife habitat would also begin to decline in the meadow limiting the available space for grassland nesting birds. This proves that herbaceous plants are an integral part of the meadow ecosystem. Herbaceous plants such as perennial wild flowers, grasses and sedges are an integral aspect of terrestrial meadow ecosystems, with respect to wildlife habitat and ecosystem function.

Grime, J. P. (1998), Benefits of plant diversity to ecosystems: immediate, filter and founder effects. *Journal of Ecology*, 86, 902–910

The relationship between plant diversity and ecosystem properties can be defined by grouping various species into three categories, dominants, subordinates and transients. Dominants make a substantial contribution to the plant biomass. Subordinates show high fidelity, and occupy space within a microhabitat which tends to be delineated by their respective dominants. Transients tend to simply be juveniles of the neighboring dominants and subordinates. Each of these categories have their own benefits to the ecosystem and all serve a purpose in which without would bring an unbalance to the ecosystem housing them.

Decourtye, A., Desneux, N., Gillespie, M., Mader, E., and Wratten, S.D. (2012). Pollinator habitat enhancement: Benefits to other ecosystem services. *Agriculture, Ecosystems & Environment* 159, 112-122.

Proper habitat for pollinators within an ecosystem is of great importance, for they allow for the continuation of wildflower pollination. Proper habitat for pollinators is based around the establishment of pollen and nectar resources. The success of the pollinator habitat depends on many variables such as, location, adjacent cropping systems, field borders, hedgerows and grass buffer strips. While the main focuses of these components are to increase and improve pollinator habitat, there are also other secondary benefits to the surrounding land. Some of these secondary benefits include soil and water quality, protection against erosion, and enhance the rural aesthetics of the area. If all primary and secondary objectives are met the overall health of the ecosystem will improve or remain at a healthy state.

Bersier, L.F., Haaland, C. and Naisbit, R.E. (2011), Sown wildflower strips for insect conservation: a review. *Insect Conservation and Diversity*, 4: 60–80.

Wildflower strips and being established at an increasing rate within areas of environmental importance to enhance the biodiversity of the area. In majority of studies these wildflower strips have proven to support higher insect abundance as well as diversity. While containing high pollen content flowers and flowers that are rich in nectar these wildflower strips have yielded higher population numbers and diversity tends to be higher than any other type of planted strip, such as grasses. Providing a proper habitat for the insect community is just one aspect of creating a stable and functional meadow ecosystem.

Motten, A. (1986). Pollination Ecology of the Spring Wildflower Community of a Temperate Deciduous Forest. *Ecological Monographs*, 56(1), 21-42.

Wildflower communities are very dependent in the actions of pollinators; the actions of pollinators will influence things such as population, plant health, community diversity and competition between various plant species. In this study there were many factors that were put to the test to determine the effect pollination has on wildflower communities such as; the extent that fecundity is limited to pollination and adequate population of population in the community, the importance of competition for pollination and the effect it has on seed sets, and the characteristics of plants and their floral visitors that contribute to pollination within the community. Inadequate pollination is the most likely to be responsible for any low fecundity, however it was shown that hand-pollination dramatically improved the fecundity of up to twelve different species within the community. Reproduction among the plant species was not affected by the change in pollination technique, except for plants that were primarily dependent on pollination by queen bees. All of the factors being taken into account and being tested, shows us results that prove that fecundity among wildflower species is not affected by changes in pollination technique.

Winter, M., & Faaborg, J. (2001). Patterns of Area Sensitivity in Grassland-Nesting Birds. *Conservation Biology*, 13(6), 1424-1436.

In this study there was a focus on grassland nesting birds and the effect that habitat fragmenting has on the available habitat space for these species as well as the effect on their respective population. Two area sensitive species were selected to be the target for this study; area sensitivity was determined by the already present reaction to habitat fragmentation. The species selected both were yielding a negative reaction to habitat fragmentation. Forest nesting species were selected to be compared to the grassland species to determine if habitat fragmentation is a constant between habitat types, and from there they could examine the effects that fragmentation has on grassland nesting birds. After comparing the two habitat types it was concluded that there is not enough evidence of similarities between grassland and forest nesting birds to determine that habitat fragmentation has a constant effect. However In the final conclusion it was determined that more research is needed to finalize on the effects of habitat fragmentation on available habitat and bird population.

Ahern, J., Niedner, C., & Allen, B. (1993). Roadside Wildflower Meadows: Summary of Benefits and Guidelines to Successful Establishment and Management. *Maintenance of Pavements, Lane Markings, and Roadsides*, (1334), 46-53.

Herbaceous meadows along roadsides can provide many benefits to ecosystems; planting herbaceous species along roods provides an opportunity to find plant species that are strong and resilient. This study stated that three were three main types of benefits that herbaceous plant species provide to ecosystems; ecological benefits from diverse self-sustaining plants, economic benefits in not needing to mow in the space occupied by these plant species, and finally aesthetic benefits from planting diverse indigenous wildflowers and grasses. The planting of native herbaceous plants have shown to improve the ecosystem health, for example it was concluded that tilling provided better establishment of native wildflowers and grasses that were planted, as well as stopping the establishment of invasive plants in the area. The herbaceous plants that were planted by roadsides serve as a great indication of which plants are strongest and most resilient even when it comes to combating invasive species.

Dunaway, D., Swanson, S., Wendel, J., & Clary, W. (2003). The effect of herbaceous plant communities and soil textures on particle erosion of alluvial streambanks. *Geomorphology*, 9(1), 47-56.

Soil and plants are known to be the two most important aspects in the deterrence of erosion on streamside banks. The study focused on these two factors and their interaction between the two; as a result the two of them combat bank erosion. Herbaceous plant species were the ones that were selected to be the target of the study, to see if their interaction with various soil types such as, sandy loam, loam and clay loam soil types to see if they have a relation with the decrease in bank erosion. An increase in percent clay or percent silt in the soil types resulted in a decrease in root volume density. In conclusion knowledge of both the herbaceous plant community and the soil types that are supporting those herbaceous plants, is required to accurately predict of manage stream bank erosion.

Gómez, J., Bosch, J., Perfectti, F., Fernández, J., & Abdelaziz, M. (2007). Pollinator diversity affects plant reproduction and recruitment: The tradeoffs of generalization. *Oecologia*, 153(3), 597-605.

An important part of conservation is understanding pollinator diversity and the effects that it has on plant health and performance. In the study there was evidence gathered on the topic of pollinator abundance, richness, diversity and plant population on eight different individual plant populations. The species E. Mediospanicum was selected for focus throughout this study; it was generalized at the regional and local level. Its flowers were visited by more than 100 different types of insects each with different morphology. Population differed in the degree of generalization; generalization was correlated with pollinator abundance and plant population size, but not with habitat. The results yielded that plants from populations with intermediate generalization ended up producing more seeds than the plants from populations with low or even high generalization.

Thompson, K., & Grime, J. (1979). Seasonal Variation in the Seed Banks of Herbaceous Species in Ten Contrasting Habitats. *The Journal of Ecology*, 67(3), 893-921.

To ensure proper health of herbaceous plant species the habitat must has proper soil conditions for species present in the area. Without proper conditions seeds of herbaceous plants will not be able to properly germinate and take root in the area. This study was all about the conditions to allow proper plant germination conditions, such as soil characteristics and planting techniques. It was found that proper germinated seeds were often found in the surface soil samples which were taken at a depth of 0-3cm. seeds at deeper depths were recovered as not able to be germinated. The techniques for identifying suitable seed banks, also allowed in the recognition of in which have a transient accumulation of detached germinated seeds. Comparison of the results suggests that seasonal variation in seed number is a function of plant species and not a function of the environment itself.

Conclusion

In conclusion all of the above annotations have relevance to the thesis statement of herbaceous plants such as perennial wild flowers, grasses and sedges are an integral aspect of terrestrial meadow ecosystems, with respect to wildlife habitat and ecosystem function. All of the topics that were in focus in each of the studies all tie in, from soil conditions, insect community, pollinator diversity, germination conditions and pollination effects are all important in knowing how herbaceous plant species contribute to wild life habitat and the overall ecosystem health and function.

Literature Review 2: A Review of the Management of Green Spaces in Developed Urban Areas

By: Justin Brodeur

Introduction

Urban spaces are an important addition to cities and towns. While often overlooked, they provide many services and provide a bouquet of diversity in the form of flora and fauna. Unfortunately human activity such as agriculture, urban development and transportation threatens these important urban ecosystems. Today organizations, often non-profit, strive to protect and maintain these areas for the future. Ensuring that human forces have little impact on these integral components of society. In order to protect and preserve the natural diversity of urban green spaces and associated aquatic habitats, we must continue to implement sound management plans that account for the future amplification of human use within and surrounding the natural area.

Booth, D., Jackson, C. (1997). Urbanization of Aquatic Systems: Degradation Thresholds, Storm waters Detection, and the Limits of Mitigation. *Journal of the American Water Resources Association*. 33, (5). pg 1077-1090

Urbanization is a degrading factor of both the form and function of downstream aquatic systems. Development in urban areas not only increases the rates of water flow and volume, but also can damage the riparian corridor. Clearing streamside vegetation does not allow for wood and other natural debris to enter the channel. Woody blockages in streams are important because they provide stabilizing elements that help to dissipate flow and help protect bank erosion. Debris in streams also provides habitats for beneficial aquatic macro invertebrates, fish and other animals. Additionally, the loss of vegetation eliminates shade that controls temperature and the leaf litter that supplements the aquatic food chain. This must be a consideration in any recommendations or management plans to preserve the riparian buffering of aquatic features, especially in urban environments.

CABE. (2010). Managing Green spaces: Seven ingredients for success. *Commission for Architecture and the Built Environment*. Retrieved from http://webarchive.nationalarchives.gov.uk/20110118095356/ http:/www.cabe.org.uk /files/ managing-green-spaces.pdf on October 13, 2015

This management plan outlines seven guidelines for success in managing urban green spaces. It acknowledges the challenges associated with councils receiving more independence in operating green spaces, while receiving significantly less resources. Valleys 2000 is a similar non-profit organization that often encounters these struggles. The key challenges are often in finding strong and motivational leadership that helps to allocate resources and organize partnerships and funding. Organized partnerships with environmental organizations, municipalities and schools can help with both maintenance and environmental decision-making. Often having a network can help to make sound decisions that affect the space's environmental integrity that can help to manage human use and natural diversity.

Loudon Wildlife. (2015). Human Impacts Upon Watersheds. *Loudon Wildife Conservancy.* Retrieved from http://www.loudounwildlife.org /PDF_Files/ SM_Human_Impacts.pdf on October 13, 2015

Looking at land use and impact on streams. Major land uses include forest, agricultural and pasture, residential, commercial and industrial. Some sources of pollution effect water quality continuously. Cattle that use a stream for drinking water can harm the stream by ruining riparian vegetation, causing stream bank erosion and nutrient loading with manure run-off. These by products of cattle grazing can have consequences downstream. Residential areas have separate implications such as urban run-off, which can include grey or brown water. Urban areas can produce run-off in the form of oil, grease, heavy metal, and pesticides. Without vegetated buffers along streams, pollutants will easily run into streams instead of leaching into the ground and being fixed by bacteria and fungi. Once in the stream channel these pollutants are harmful to aquatic organisms as well as other organisms in the food chain

Mauro, B. (2015). How government combats invasive species. *Ontario Ministry of Natural Resources and Forestry*. Retrieved from http://www.ontario.ca/ page/how-government-combats-invasive-species on October 13, 2015

This online article outlines the ways invasive species are introduced into urban and natural green spaces as well as the implications of introduction. Invasives are harmful non-native species that are introduced mainly by humans and whose spread is harmful to biodiversity, the economy and human health. Introduced species become invasive due to having no natural predators. Once established, they can quickly dominate an area often changing the environment to suit their ecological needs. As human use in green spaces increase, there is a threat of invasive species domination. Ontario has a strategic plan when dealing with invasive species that helps to prevent, detect and effectively manage those that are already established. These management plans are integral to helping ecosystems deal with the stress caused by invasives, and the human health concerns. Such management plans have helped to implement biological controls. The control of purple loosestrife is a success story in which the Galerucella beetle was introduced. The beetle only feeds on the invasive loosestrife, keeping the plants population at a steady flux. The planning that helped to safely introduce the Galerucella beetle will be important to remember when considering the implementation of other biological controls.

McMahon, J. (2014). Effects of Urbanization on Stream Ecosystems. National Water-Quality Assessment Program. *USGS.* Retrieved from http://water.usgs.gov/nawqa/ urban/html/findings/index.html on September 28, 1015

This article explores the correlation of urbanization and stream health. It examines how urban development can create multiple stressors of varying intensities that can degrade aquatic ecosystems by altering the hydrology, habitat and chemistry of streams. Ephemeroptera, Plecoptera, and Trichoptera (EPT) are benthic macro invertebrate orders that have been well studied. Species that belong to the EPT orders have been found to be excellent indicators of water quality. When water is significantly contaminated, these particular invertebrates will be scarce or absent in an aquatic census. An aquatic study conducted in Atlanta observed that there is a correlation between the percentage of land used for urban development and the decline of sensitive aquatic invertebrates. Although urbanization has been linked to the loss of habitat and the altered hydrology and chemistry in streams, applying management actions to reduce stressors increases the likelihood of attaining a healthy stream. From a pilot study based on an earlier aquatic study in Boston, a model was developed to predict how different combinations of urban-related stressors affect stream health. Regional based management studies that utilize stressor models can potentially decrease the risk of altering watershed components by 70%. This primarily involves stream hydrology, habitat and chemistry in relation to the EPT species.

National Post. (2006). Salmon making their way up the dirty Don. Retrieved from http://www.canada.com/nationalpost/news/toronto/story.html?id= 10c25c8a-4575-4397-8d86-4e0e62dd3373 on October 13, 2015

A newspaper article covering the salmon run in an urban environment, the Don River. The article speaks of the public opinion and health concerns of the quality of the surrounding environment. The ministry of the Environment stocks the Don biannually and the fish return every year. Pregnant women and children are advised to not eat salmon caught in Lake Ontario due to the pollution that the surrounding urban watershed releases. The community is starting to visibly notice the importance of urban waterways when they see such large animals making their way up the polluted river. John Routh, who heads the Bring Back the Don task force, says the river has become progressively more polluted, but that the government is taking steps to clean it up. Unfortunately, the environmental implications are just recently being realized. It is a wake up call for areas that still have intact rivers, to protect and preserve the natural quality of the streams for future generations of salmon.

NOAA. (2015). Streams and River Restoration. NOAA Habitat Conservation. National Marine Fisheries Service. Restoration Center. Retrieved from http://www.habitat.noaa.gov/restoration/techniques/srrestoration.html on October 13, 2015

Urban streams are some of the most degraded in the world. Stream restoration can be implemented in a management plan, much like Valley 2000 has done with their restoration efforts. River restoration can involve bank stabilization. This activity involves the use of pants, woody debris, natural textiles and stone aggregates. The goal is to create a stream bank that absorbs the energy of the stream, slowing its velocity. This allows for less erosion and increased bank stability. Often large woody debris can be added to streams to encourage habitat for fish and other stream organisms. The importance of restoration is prevalent in heavily impacted areas as human disturbances will contribute to the stability of stream banks. Restoration methods are an important management strategy to preserve the integrity of stream ecosystems.

Parks Victoria. (2015). Urban planning and the importance of green space in cities to human and environmental health. *Healthy Parks Healthy People Central.* Retrieved from http://www.hphpcentral.com/article/urban-planning-and-the-importance-of-green-space-in-cities-to-human-and-environmental-health on October 13, 2015

The world’s most “liveable” cities have green spaces and some are attractions on their own. Open spaces in the urban environment have many advantages: recreation, preservation of the natural environment and even storm water management. Green spaces are becoming more valuable as urban development sprawls out into the country. Green space must be a key consideration in urban planning if the health of a city and the humans in it are considered important.

Zupancic, T. et al. (2015). The impact of green space on heat and air pollution in urban communities: A meta-narrative systematic review. *The David Suzuki Foundation*. Retrieved from: http://www.davidsuzuki.org/publications/ImpactofGreenSpaceonHeatandAirPollutioninUrbanCommunities.pdf on September 23, 2015

This report highlights the importance of protecting and preserving green spaces in urban environments. In recent decades we have begun to understand that human health, both mental and physical, can be linked to the amount of time spent outdoors an a natural green environment. In more recent studies it is found that life in the city can drastically reduce ones life expectancy. Excess air pollution is a contributing factor to human health degradation in urban centers. Green spaces naturally provide the service of filtering pollution from the air as well as providing cooling effects in hot weather. Various plant species provide heat and pollution mitigating effects. It is found that the density and diversity of plant species, mainly trees, are related to how successfully a green space mitigates stressors that affect human health. Trees are exceptional at capturing ground level ozone, sulphur dioxide, and particulate matter. When green spaces are managed well using comprehensive management plans, they can result in the overall betterment of society and the urban environment. The urban forest has staggering economic value with human health effects valued at US$6.8 billion, as found in a 2010 study conducted in the United States. There are still some uncertainties with the benefits of fragmented green spaces that are few and far between. Green space connectivity is something that could be improved on in the planning of concrete dense urban centers. Still, the outstanding evidence on the benefits of green spaces out-weighs the idea that they are a replaceable feature on the city landscape. They are irreplaceable and essential to our growth as both individuals and a species.

Conclusion

As major urban centers in the world become increasingly larger, management plans for urban ecosystems need to be implemented to maintain the natural environment. For mankind's sake, natural spaces provide a factory of processes that help to clean air, water and the soil for future generations. Long-term management plans will help steer green spaces and the organizations that steward them into long term sustainability. Green spaces can house complex diversity if managed well, by holding on to nutrients and moisture that is so beneficial to all organisms. Surely these spaces must be invested in to sustain our growing needs and growing populations.

Literature Review 3: Control methods used to mitigate the harmful effects of stream bank erosion within East Valley Creek and Soper Creek in Bowmanville

By: Matthew Guolo

Introduction

Stream bank erosion due to storm water runoff reduces the health of the East Valley Creek/Soper Creek located in Bowmanville and has a negative effect on the water quality and integrity of the land. Streambank erosion creates soil particles that are deposited and directly transported into creeks and rivers. Loose particulate organic matter will flow downstream and decompose which will reduce dissolved oxygen levels and create adverse effects on biological communities within these creeks. Soils with dispersible sub-soils are subject to serious erosion by tunnelling and gully formation which was evident within East Valley Creek/Soper Creek in Bowmanville. Control methods that can be used to help reduce the harmful effects of stream bank erosion include strategically placing vegetation or trees along stream banks, the use of wave breakers and placing stabilization structures along shorelines. These control methods have proven to be most effective in reducing stream bank erosion. The goal of these control methods is to reduce sediment production and the downstream transportation of sediment within the East Valley Creek and Soper Creek in order to help reduce water degradation and maintain a healthy aquatic ecosystem. While stream bank erosion creates suspended sediment that has a negative effect on water quality, control methods such as strategically placing vegetation cover, the use of wave breakers and structural engineering along shorelines have proven to be most effective in controlling the harmful effects of stream bank erosion.

Iowa Department of Natural Resources. (2006). How to Control Streambank Erosion Manual. Retrieved from: www.ctre.iastate.edu/erosion/manuals/streambank_erosion.pd (accessed September 27, 2015)

This manual assists in selecting materials and methods to control stream bank erosion and provides information on a number of alternative methods for controlling stream bank erosion. The manual describes both structural and bioengineering methods of stream bank erosion control. Structural methods use steel, wood, rock or other aggregate, concrete, or a combination of these materials to protect the stream bank. Useful information is provided that can be used to help select the stream bank stabilization methods that are most appropriate for a given situation.

Peacher, R, (2011). Impacts of land use on stream bank erosion in the Northeast Missouri Claypan Region" Graduate Theses and Dissertations. Paper 10395. (accessed September 26, 2015)

Sediment from erosion severely impacts water quality and interferes with the amount of oxygen available to aquatic life. The author of this study undertook this study to gain a deeper understanding of the stream bank erosion process in order to recommend current conservation practices and propose new ideas. Research was conducted in the Salt River Basin in Northeast Missouri, The Crooked and Otter Creek watersheds were chosen for study because of their type and land use. Stream order and season were used as independent variables and four categories of land use were tested: crop, pasture, riparian and forest. The erosion rates in this study, like many stream bank erosion studies, yield wide ranges in results across treatment reaches. There is a need for the development of survey methodologies that can be done by non-scientist volunteers in short periods of time and that can accurately predict erosion potential.

Polvi, L. E., Wohl, E., & Merritt, D. M. (2014). Modeling the functional influence of vegetation type on streambank cohesion. *Earth Surface Processes & Landforms*, *39*(9), 1245-1258. doi:10.1002/esp.3577. Retrieved from: ScienceDirect, EBSCOhost (accessed October 8, 2015)

The goal of this study was to develop a functional classification of riparian vegetation for bank stabilization based on vegetation type. This was done through the analysis of root characteristics for 14 species occurring in the Colorado Front Range and common throughout the Rocky Mountains. Species from four vegetation groups were selected to represent trees, shrubs, graminoids, and forbs. Vegetation root samples and data were collected from three study sites in the Colorado Front Range in order to obtain a range of riparian species. Results from this study showed that woody plants such as trees and shrubs will have greater bank stabilizing characteristics than non-woody or herbaceous plants.

Rickson, R. (2014). Can control of soil erosion mitigate water pollution by sediments? *Science Of The Total Environment*, 468-4691187-1197. doi:10.1016/j.scitotenv.2013.05.057. Retrieved from: Academic Search Premier, EBSCOhost (accessed October 10, 2015).

The purpose of this paper was to review the scientific evidence of the effectiveness of erosion control measures used in the UK to reduce sediment loads of hill slope origin in watercourses. Hill slope erosion processes can be significant sources of waterborne sediment, with rates of erosion likely to increase given predicted future weather patterns. The results of this study were variable and showed that linking on-site erosion rates with off-site impacts was complicated because of the limited data on soil erosion rates in the UK. The results of this study also showed that baseline comparisons for the 18 measures where data do exist reveal erosion control effectiveness is highly variable over time and between study locations.

Seutloali, K. E., & Beckedahl, H. R. (2015). A Review Of Road-Related Soil Erosion: An Assessment Of Causes, Evaluation Techniques And Available Control Measures. *Earth Sciences Research Journal*, 19(1), 73-80. doi:10.15446/esrj.v19n1.43841. Retrieved from: Academic Search Premier, EBSCOhost (accessed October 10, 2015).

This article reviews the causes of road-related soil erosion and includes assessment methods and control methods for comprehensive land management decisions and monitoring strategies. This article focuses on the linkages between roads and soil erosion and focuses on measurement and prediction of road–related erosion and erosion control and rehabilitation techniques. Steep slopes are prone to severe erosion and there are a variety of erosion control measures for controlling road–related erosion. This study provides guidance in future research on road–related soil erosion across the developing world.

Sistani, K., & Mays, D. (2001). Nutrient Requirements Of Seven Plant Species With Potential Use In Shoreline Control. *Journal Of Plant Nutrition*, 24(3), 459. (accessed September 26, 2015)

Field experiments were conducted in an effort to develop low cost and innovative biotechnical methods of shoreline erosion control at the Walter F. George Reservoir. Wave action resulting from prevailing westerly winds causes severe bank undercutting and erosion when the lake is at full pool level. Wave breakers were used in order to control and reduce the wave action prior to establishing the vegetation. Exploratory experiments were conducted using coconut fiber logs one foot in diameter and 10 feet long, square straw bales wrapped in poultry netting, large round hay bales, and pine logs bundled together with steel cable and anchored to the shoreline with Duck Bill anchors. An assortment of terrestrial and wetland plants were then planted at various times behind the breakwaters throughout the following two years. The results showed a significant increase in the lands ability to resist erosion and that plant growth had occurred in the areas where vegetation was exposed to nitrogen.

Toronto and Region Conservation, (2006). *Erosion and Sediment Control Guideline for Urban Construction.* Retrieved from: http://www.rvca.ca/plan (accessed October 8, 2015)

These erosion and sediment control guidelines have been prepared for common usage in an effort to coordinate the response of various municipalities and agencies involved in land development, construction and water management. This guideline provides a consistent approach to erosion and sediment control. Field surveys of erosion and sediment control practices on construction sites have revealed a number of serious deficiencies in current planning and implementation. This document provides a review of erosion and the sedimentation process and identifies the elements of an effective erosion and sediment control plan and offers methods of current erosion and sediment control measures routinely employed to protect natural environments within an urban construction project.

Konsoer, K. M., Rhoads, B. L., Langendoen, E. J., Best, J. L., Ursic, M. E., Abad, J. D., & Garcia, M. H. (2015). Spatial variability in bank resistance to erosion on a large meandering, mixed bedrock-alluvial river. *Geomorphology*, doi:10.1016/j.geomorph.2015.08.00 Retrieved from: ScienceDirect, EBSCOhost (accessed October 10, 2015)

The purpose of this study was to investigate the lateral and vertical heterogeneity in bank material properties and riparian vegetation within two elongate meander loops on a large mixed bedrock-alluvial river. Methods used within this study include the bank stability and toe-erosion numerical model and repeat terrestrial surveys were used to evaluate the capacity of the bank material properties to modify the rates and mechanisms of stream bank erosion. Results showed that riparian trees growing along the stream banks increase erosion resistance by contributing to the shear strength of the bank materials and are capable of increasing bank stability along a large river. Locally outcropping bedrock also reduces bank erosion in both bends. The results of this study demonstrate that spatial variability in the erosion-resistance properties of the channel banks is an important factor contributing to spatial variability in the rates and mechanisms of bank erosion.

Zaimes, G. N., & Schultz, R. C. (2015). Riparian land-use impacts on bank erosion and deposition of an incised stream in north-central Iowa, USA. Catena, 12561-73. doi:10.1016/j.catena.2014.09. Retrieved from: ScienceDirect, EBSCOhost (accessed October 8, 2015)

Spatial and temporal patterns and dominant geomorphologic processes of stream bank erosion and deposition along a 10 km reach of Bear Creek in north-central Iowa, USA. Plots were placed in each sub-reach and each plot had two photo-electronic erosion pins placed at 1/3 of the bank height and the other at 2/3 of the bank height. Daily measurements were compared to daily precipitation and streamflow. Results showed that the continuously grazed pasture banks had the highest erosion rates. The grass area banks had approximately equal rates of erosion and deposition. The riparian forest buffer banks had high erosion rates during the second year. In the continuously grazed pasture, fluvial entrainment was the dominant erosion process, although minor mass failures also caused erosion. In the riparian forest buffer most erosion was recorded after moderate stream flows removed the bank soil loosened by freeze–thaw cycling.

Conclusion

Results from this research showed that three main control methods will be most effective in controlling stream bank erosion within the East Valley Creek (EVC) and Soper Creek (SC) in Bowmanville. Control methods from previous studies that have proven to be most effective in mitigating the harmful effects of stream bank erosion includes; strategically planting vegetation and trees along stream banks, the use of wave breakers and placing stabilization structures along shorelines. Through the planting of riparian trees such as the Willow species and planting various shrubs then securing them with erosion control nets, strong root systems will develop over time and increase the resistance of stream banks. The use of wave breakers along streams will reduce the amount of wave action taking place, which will reduce the amount of stress on stream banks and help to seize erosion. Lastly, strategically placing stabilization structures such as large boulders or piles of stones along stream banks and securing them with metal mesh nets will drastically increase the streams ability to remain stable during flooding. All of these methods used in combination will significantly reduce stream bank erosion.

Literature Review 4: A Review of Control Methods for Invasive Plants in Bowmanville Valley, Ontario

By: Christina Myrdal

Introduction

Through habitat restoration and wildlife management, Ontario landowners have had a large impact in recent years on increasing the health of woodlots, watersheds and other ecosystems (Anderson et al., 2013). The management of invasive plants is a significant and challenging practise for landowners and is crucial in the maintenance of biodiversity and restoration of native plant and animal communities. Invasive species are defined as non-natives that have the means to negatively impact biodiversity, the economy, and human health. According to Anderson et al. (2013), Ontario has the highest population of invasives in all of Canada due to its popularity as an import destination and high level of urbanization. Theree common invasive plants in the Bowmanville Valley are Common (European) Buckthorn, Dog-strangling vine (DSV), and Himalayan balsam, all of which prevent natural forest regeneration and contribute to biodiversity loss by reducing resources to native plants, and providing little if any food and shelter to wildlife. Because invasive plants are one of the highest threats to biodiversity, Ontario landowners should implement best management practices to control for these species in order to encourage the natural succession of native vegetation.

Anderson, H., Bales, G., Forsyth, F., Gagnon, R., Krick, R., Macdonald, F., & Weisz, E. (2013). A Landowner's Guide to Managing and Controlling Invasive Plants in Ontario. Ontario, Canada: Credit Valley Conservation.

This document presents a guide to landowners on identifying invasive plants, developing a management plan and implementing control methods for them in order to restore native vegetation. The authors suggest first protecting high priority areas where invasive species are absent or just starting out, areas of rare species, and areas of rare community types. Control methods discussed in this guide include mechanical, chemical, biological, and integrated plant management; the latter of which combines all methods and is considered to be the most effective control method. When tackling control of invasives, this guide recommends removing outlier plants fist and working from the outside edges of infestation towards the more heavily populated areas. The proper disposal methods of invasive plant material differs between species, but generally any seeds remaining should be removed from site and if municipal by-laws permit, may be heated to destroy the seeds, burned, or disposed of in a landfill. Before partaking in invasive control measures, this guide urges landowners to review relevant legislation including the Endangered Species Act, Pesticides Act, Conservation By-laws. Long-term monitoring and record-taking, preferably during the summer months, should be implemented once control measures have been taken, to assess the effectiveness of removal and determine future steps. To help determine the best restoration techniques, landowners are recommended to assess the level of disturbance to the area, invasive species biology (i.e. seed dormancy), re-invasion risk, and the extent and diversity of existing native vegetation. Overall, this guide for landowners in Ontario is very relevant to the management of invasive plants in the Bowmanville Valley, as it provides the reader with a step-by-step plan for controlling invasive species and rejuvenating their land. The authors provide many external links and appendices to assist the reader in terms of plant identification assistance, legislation, funding resources, and species-specific protocols.

Anderson, H. (2012). Invasive Dog-strangling Vine (Vincetoxicum rossicum) Best Management Practices in Ontario. Peterborough, ON: Ontario Invasive Plant Council.

This document outlines the Best Management Practices (BMPs) for controlling the invasive Dog-Strangling Vine (DSV, *Vincetoxicum rossicum).* DSV thrives in old fields and forests, and is mainly spread by wind, machinery, and water. This invasive member of the milkweed family is able to alter soil chemical composition in the areas where it grows, to prevent competitors from growing nearby. The authors recommend a long-term strategy involving removal of outlying populations, focusing on high priority areas, dedicating a certain time each year for control efforts, replanting natives following control efforts, and pursuing follow-up monitoring. Control measures outlined by this document include mechanical (digging, mowing, clipping, pulling, seed pod removal, and tarping), chemical (herbicide treatment), and biological (currently undergoing testing). This document recommends restoration efforts during control - including mulching and planting natives - and after control, by implementing a soil rehabilitation protocol and planting large natives to discourage future invasive growth. This guide provides Ontario landowners with the most effective and environmentally safe protocols to follow when controlling for DSV. It provides good descriptions, photos, and other visual aids to assist landowners in identifying DSV and correctly implementing BMPs for its removal.

Anderson, H. (2012). Invasive Common (European) Buckthorn (Rhamnus cathartica): Best Management Practices in Ontario. Peterborough, ON: Ontario Invasive Plant Council.

Invasive Common (European) Buckthorn (*Rhamnus cathartica)* contains long-lived seeds and effectively colonizes Ontario forests, where it harms biodiversity by altering soil nitrogen content and affecting native plant and animal communities nearby. Being shade-tolerant, Common Buckthorn thrives in disturbed areas and can easily out-compete native understory vegetation. The Best Management Practices (BMPs) for Common Buckthorn involve focusing on high-priority areas of land first; identifying and removing fruit-bearing trees in late autumn, as their leaves remain green long after neighbouring trees have gone dormant; dedicating a certain time each year for control efforts; replanting with native species in stages to avoid opening the canopy to other invasives; follow-up monitoring to remove future seedlings. Recommended control measures include mechanical (pulling, cutting/girdling, or mowing), chemical (using herbicides), and biological (currently undergoing testing). To dispose of branches, the authors recommend getting a municipal permit to burn them on site, or compost them with all fruit removed. The fruits must be disposed of in the garbage, or by heating the seeds at a municipal compost waste facility, if possible. As Common Buckthorn can easily be confused with the native Alderleaf Buckthorn, this guide offers descriptive photos and a comparative guide to distinguishing native vs invasive buckthorn species. This manual also does a good job of comparing each method from an unbiased perspective, leaving the landowner to decide which method is best for them and their property.

Derickx, L.M. & Antunes, P.M. (2013). A guide to the Identification and Control of Exotic Invasive Species in Ontario's Hardwood Forests: Himalayan balsam (122-130). Ontario, Canada: Invasive Species Research Institute.

Himalayan balsam (*Impatiens glandulifera*) can be easily confused with other native *Impatiens* species, for which this guide offers excellent comparative descriptions and photos. Himalayan balsam was first introduced into North America from Europe, as an ornamental garden plant, where it also thrives in riparian areas and hardwood forests that have undergone recent disturbance. Although Himalayan balsam is able to self-pollinate, it rarely needs to as its bright flowers are very attractive to pollinators, allowing its seeds to be easily spread by vectors that would normally be distributing seeds from native plants. Additionally, these plants can produce about 800 mature seeds which explode when touched, allowing them to disperse away from the parent plant, where they can survive in the soil for up to 18 months. Himalayan balsam is able to successfully invade novel areas through its high reproductive potential, ability to self-pollinate, synchronous seed germination – by which all plants germinate within a few days of each other in the Spring – and high vegetative growth rate that native plants cannot keep up with. This competition with native vegetation reduces biodiversity and can have implications on forest health and regeneration. To prevent the spread of Himalayan balsam, prevention and early detection are key. However, if control measures must be implemented, this guide suggests hand-pulling, as a shallow root system allows them to be easily pulled from the ground. Cutting or mowing is also recommended before seedpods have been produced, and applying herbicides once plants flower should result in smaller populations the following year. Overall, this guide provides specific control methods for the removal of Himalayan balsam.

Derickx, L.M. & Antunes, P.M. (2013). A guide to the Identification and Control of Exotic Invasive Species in Ontario's Hardwood Forests: Common Buckthorn (131-142). Ontario, Canada: Invasive Species Research Institute.

In North America, Common Buckthorn can occupy a variety of habitats, including disturbed areas, fields, and forests – where it is able to dominate understories due to its shade tolerance. A fast growth rate and longer growing season compared to native plants are two advantages that allow Common Buckthorn to readily invade an area and outcompete and smother native understory species. Additionally, the leaves of common buckthorn contain high levels of nitrogen which is incorporated into the soil as they decompose, leading to changes in the food web and nutrient cycling within an ecosystem. As Common Buckthorn excludes other native trees from growing, birds and mammals may be forced to nest in these invasive trees which provide less suitable habitat. This has been shown to lead to increased predation on certain birds, further contributing to decreased biodiversity within ecosystems. The recommended measure of control for small populations of buckthorn is through mechanical hand-pulling and excavation. For larger populations, this guide suggests integrated control, using a regime of hand-pulling and herbicide applications, followed by restoration planting with native species. This guide provides species-specific control measures, while discussing in-depth the effects Common Buckthorn can have on Ontario ecosystems.

Government of Ontario (2015). How government combats invasive species. Retrieved from http://www.ontario.ca/page/how-government-combats-invasive-species

This article offers insight into the threats caused by invasive species, and the resulting legislation created in Ontario to protect ecosystems from these threats. In Ontario, invasive species enter the province mainly via the transportation of people and goods, and cause economic and social issues, including the reduction of land value, high prevention and removal costs, and human health impacts. Provincially, Ontario has invasive species legislation in the form of the Invasive Species Act and through amendments to the Public Lands Act, focusing on the prevention and eradication of invasives. Nationally, Ontario participates in the Invasive Alien Species Strategy addressing the threat of aquatic and terrestrial invasive species, and also participates in a number of international groups aimed at targeting invasive species. An example of recent successful legislation includes ballast water regulations for ships travelling between Canada and the USA, since such there has been no new aquatic invasive species found in the Great Lakes. In terms of public outreach and education, Ontario's Invading Species Awareness Program and the Ontario Invasive Plant Council raise awareness on preventing the spread of invasives while promoting the growth of native or non-invasive species instead. The Ontario government is also involved in research, monitoring, early detection, and management of invasive species to prevent future inhabitation. Although this document does not provide species-specific information, it provides an overview of the problems associated with invasive species and the resulting legislature and strategies aimed at minimizing their effects on ecosystems and human health.

OFAH/OMNR Invading Species Awareness Program (2012). Himalayan Balsam. Retrieved from http://www.invadingspecies.com/invaders/plants-terrestrial/himalayan-balsam/

Himalayan balsam (*Impatiens glandulifera)* is native to the western Himalayas, and is invasive in Ontario. Uniquely, this *Impatiens* species is able to launch its mature seeds up to 5 meters when touched, allowing it to quickly and effectively spread to new areas. Himalayan balsam is usually found along riparian edges and in wetlands, where it crowds out native vegetation, contributing to a decline in biodiversity and increased soil erosion. This invasive plant also attracts pollinators away from their native targets, allowing it to further outcompete natives, decreasing biodiversity and ecological land value. In addition to describing the impacts Himalayan balsam has on surrounding native plants, this document offers tips to readers on avoiding the accidental spread of this invasive, such as ensuring garden plants are purchased from reputable sources, and disposing of any invasive plant in the garbage instead of the compost. Although the best management practices for control of Himalayan balsam are not provided in this document, it does identify the impacts caused by this invasive plant, and descriptions landowners can use to help them initiate control measures.

Ontario Ministry of Natural Resources (2012). Ontario Invasive Species Strategic Plan. Ontario, Canada: Queen's Printer for Ontario.

This strategic plan, developed by the Ontario Ministry of Natural Resources, Ministry of Agriculture, Food and Rural Affairs, Ministry of the Environment, and Ministry of Transportation, aims to prevent the arrival of new invasive species, minimize the spread of current invasives, and reduce the negative impacts of existing invasives. The authors consider invasive species to be those which are introduced by human activities, and pose a threat to

Ontario's environment, economy, or society. In combination with other provincial and national initiatives, one of the main goals of this plan is to combat biodiversity loss caused by invasive species. Ontario is at a higher risk to incoming invasives due to many factors, including its high urban and suburban population, proximity to shipping routes, degraded ecosystems, and high road density. Invasive species are very costly to prevent and remove, and have ecological costs as being the second highest threat to biodiversity worldwide, and affecting about 20% of Ontario's listed species. Through cooperative research and monitoring, successful control and eradication, public education, and effective regulation, the Ontario government has managed to successfully manage and eradicate some invasive species thus far. The goals of the Ontario Invasive Species Strategic Plan include prevention, detection, response, and management through leadership, legislation, risk analysis, monitoring and science, management measures, communication and public outreach. The plan also outlines the roles and responsibilities of provincial and federal agencies in contributing to the prevention and removal of invasive species. In whole, this strategic plan not only encompasses participation at the governmental level, but also by certain organizations, landowners, and average citizens alike.

Sherman, K. (2015). Creating an Invasive Plant Management Strategy: A Framework for Ontario Municipalities. Peterborough, ON: Ontario Invasive Plant Council.

This document provides information to municipalities on the control of invasive plants. Impacts of invasive plants include degradation of natural areas, interference with agriculture, reduced forest regeneration and productivity, danger to human health, negative impacts on recreation and aesthetics, and other socioeconomic issues. This plan puts prevention first, and suggests building an early detection and rapid response (EDRR) program while optimizing resources and measuring the success of the strategy. The two main principles include using an Ecosystems Approach and Integrated Pest Management for the most effective control, after taking an invasive plant inventory to prioritize the control of different populations while restoration planting to minimize effects on native communities. This plan offers both non-regulatory and regulatory strategies for preventing the introduction and spread of invasive plants. Non-regulatory strategies include developing a 'Watch List' of invasive plants to limit their introduction, incorporating invasive plant management into land use planning, controlling contaminated materials and equipment, maintaining roads and highways to prevent the spread of invasives, contributing to public education and awareness, and offering landowner incentives to help offset the costs of invasives removal. Regulatory strategies include the creation of municipal bylaws to prevent residents from accidentally or purposefully spreading these plants. Overall, this plan offers a step-by-step plan for municipalities in Ontario to undergo invasive species management

Conclusion

As outlined by the above literature, best management practices for the control of invasive species generally consist of prevention first, followed by mechanical, chemical, and/or biological control measures with restoration planting and follow-up monitoring. It is important to prioritize areas of rare species or community types, and areas in which invasive species are absent or rare in order to manage proactively and to protect species at risk. From the above review, it is clear that mechanical and chemical controls seem to be the most practical measures from a landowner's perspective since biological controls have not yet been government approved for usage. While some of these documents provide advantages and disadvantages for each method of control, their usage is dependent on what the landowner wants to achieve and how much funding they are willing to put into a management project. Species- and land-specific characteristics should be taken into consideration when designing a management plan to eradicate invasives, and when possible, integrated management using a combination of physical and chemical controls with follow-up monitoring seems to be the most effective method. It is clear from the above literature that invasive species are a serious threat to biodiversity, our economy, and our health, and we can all do our part to help in the prevention of spread of these harmful species.

Literature Review 5: Trail Systems, the negative effects they can have on ecosystem health and how to manage it.

By: Kirstin Pautler

Introduction

Soper and Bowmanville Creeks within Bowmanville, Ontario are two well maintained forested areas within an urban environment. They allow their residents a place to unwind, tune out from the busy world and reconnect with nature. There are a lot of positive benefits to trail systems like these two including a wide variety of recreational activities such as sports, hiking, mountain biking and access to fishing points. With these activities becoming higher priority in our lives it is important to understand the impact they have on the environment in order to ensure the longest, healthiest relationship possible.

Since Soper and Bowmanville Creek are both popular recreation areas with many informal trials developed to access fishing spots along the creek that runs through them, it is extremely important to understand how these seemingly harmless trails can alter an ecosystem. The two most common issues that occur from hiking trails are increased dispersal of invasive plants species seeds via socks or shoes and trampling, which can result in altered water drainage within the systems and reduction of understory plants. This can disturb the plant communities adjacent to the trail systems and make room for more invasive species to take over. For this literature review I will focus on negative impacts trail systems can have on an ecosystems health and how to manage these damages.

Armour, G. et al. (2013). Natural Environment Trail Strategy. *City of Toronto*, 1-200. Retrieved Oct 10, 2015.
Web:
http://www1.toronto.ca/city_of_toronto/parks_forestry__recreation/community_involvement/files/pdf/trail_strategy.pdf

The document looks at the history of trail systems, how to implement trails, how to manage trails and how to maintain them. The authors express how people can damage these natural areas within an urban community, but since they will continue to use them whether the city says yes or no, it is better to come up with a plan to make them accessible to the public in a way that causes the least amount of ecosystem disturbance. In order to do so, the first step is to develop a committee who is passionate about conserving natural areas within urban environments and then communicating the plan to the city or stakeholders involved.

Planning of the trails and where they can go is the first step to managing a natural urban area. You need to make sure that they are not in areas of high erosion, as trails would only further develop this issue. The trails should be in areas where they cannot be made continuously bigger which will keep trail proliferation down and lastly the ecosystem type should be taken into account when planning the location of trails. Avoid meadows and open areas as they increase the chance of invasive species dispersal, avoid wetland as they are incredibly susceptible to ecosystem changes from runoff or erosion as well as introductions of invasive species.

Structures such as boardwalk and bridges need to be considered for areas with rivers or creeks or areas that tend to flood in the winter and spring. These then also have to be monitored and maintained in order to keep trail users safe as well as wildlife that will eventually use them as well.

Signage should lastly be placed on the trail informing its users of areas that may cause them danger, areas of high invasive species and what steps they can take themselves to help keep the trails and surrounding ecosystems healthy. A well planned and thought out trial system will result in years of use from hikers and bikers alike, without damaging the surrounding vegetation or altering the plant diversity too much.

Cole, D. (2004). Impacts of Hiking and camping on soils and vegetation: A review. *Environmental Impacts of Ecotourism,* (4) 41-60. Retrieved Sept 30, 2015. Web: https://books.google.ca/books

This book reviews on impacts of ecotourism and has a chapter (4) which looks specifically at the impacts of camping and hiking on soils and vegetation. The impacts are similar to other finding which indicate that soil compaction, run-off, loss of vegetation and increase in invasive species can occur from hiking trials. Depending on the site this can either be a minor problem or a serious issue to the health of the ecosystem. If there is a water body near by the run-off could affect the hydrology and chemistry of the water and thus alter fish spawning sites or invertebrate habitat. A great example of how trampling, the leading cause of trial degradation, can cause various forms of negative impacts on a site can be seen in Figure4.3. This figure shows the relationships between trampling and the affects it has on the environment beyond soil compaction and vegetation loss. It can be noted how the relationships can by cyclic, for example trampling causes reduction of little cover which can then change the soil biota and increase run-off and erosion, which can cause reduction in litter cover and so on. It is the lack of management of these issues that can cause serious damage to an ecosystem.

The change in soil microbial populations due to reduction of organic litter and ultimately understory vegetating from trampling reduces the amount of metabolizing nutrients found in the soil and directly impacts the soil food webs. This can cause less oxygen to be delivered to root systems, and reduce the nutrients invertebrates, like worms, are able in intake.

Since monitoring these trails and campsites can actually contribute to these negative impacts it is recommended that isolated or pristine sites monitor less frequently then busier ones, as they are already damaged and you are able to quantify effects more without making a huge difference to the data. When monitoring, the weather, slope of trail, temperature and location should be recorded as they can also affect the trails degradation.

Jones, Tamera. (2011). Hikers Spread Invasive Plant Seeds Accidentally. *Planet Earth Online*. Retrieved 26 Sept 2015. Web: <http://planetearth.nerc.ac.uk/news/story.aspx?id=1027&cookieConsent=A>.

This website explores various ways in which humans can act as a seed dispersal vector. Since plants cannot themselves move around a forested area and spread their seed they rely on other modes such as wind, animals and now humans. Seeds of invasive or none invasive species can pose a threat to a new environment if the conditions are right for them to root and begin growth. The main concern of unwanted seed dispersal is of course invasive species which outcompete existing ones for root growth, sunlight or water uptake and can degrade the overall health of the area. Jones describes the main mode of dispersal is hooked seeds present in burrs or touch-me nots which become attached to clothing of hikers or bikers along trails. These seeds can be carried a longer distance further increasing the seed dispersal area, sometimes over a 100 kilometers away. Jones describes this as an educational problem with most hikers either not knowing or not understanding the seriousness of their impact. The simple solution to this problem would be to include some sort of signage near the exits of the trails reminding outdoor enthusiasts to check their clothing, particularly sock for any seeds attached and discard in the garbage them before heading home.

Marion, J. (2006). Assessing and understanding trail degradation: results from Big Fork National River and recreational area. USGS Patuxent Wildlife Research Centre, 1-59. Retrieved Oct 11, 2015. Web: http://www.pwrc.usgs.gov/prodabs/pubpdfs/6612_marion.pdf

This literature discusses how soil compaction and erosion from trampling are the two biggest threats to trails and surrounding ecosystems. Soil compaction can reduce the organic little cover and thus increase water runoff to other areas of the ecosystem that may be more susceptible to slight chemical or physical changes. This directly affects the abundance and diversity of not only surrounding vegetation but near-by ecosystems.

Humans are not the only users of trails, the presence of wildlife must be taken into account during the planning process. Trails act as corridor for wildlife which can then lead deer or other herbivores to previously unknown feeding areas. This is another threat to vegetative ecosystems as wildlife may favor one type of plant which then cannot reproduce fast enough to keep up with the depletion of it. Trails can also draw in wildlife that are now seeking out human food, so waste disposal units should be installed along the trail to prevent this kind if negative interaction.

Over 47 trails were analyzed with a total of 79 miles of designated and undesignated trails examined for soil compaction and erosion. It was found that trails with lots of mud present were beginning to erode, as well, they had low penetration depths indicating soil compaction. The ATV and horse trails suffered the most damage.

One trail management strategy to prevent negative effects on ecosystem health is to use gravel on the trials, this reduces soil compaction as well as soil erosion. It is recommended for areas of high use or where motorized vehicles may be present. Since more soil damage can occur on wet soils visitor use regulation, stopping people from using the trail after a major rainfall or snowfall could also help maintain the health of the surrounding ecosystems by preventing excessive soil erosions during these times.

Patubo, Brenden. (2010). Environmental Impacts of Human Activity Associated with Geocatching. *Social Sciences Department*. 1-13. Retrieved September 27, 2015. Print.

This report looks at a new recreational activity that combines GPS with hiking along trials to ignite our thirst for adventure. With an increase in outdoor recreation sports taking place off known trails, their impact on vegetative health and diversity needs to be monitored. The main concern of recreational activities like this is is soil compaction. Its direct effect on pore space can lead to an increase in run off and soil erosion. This runoff can find its way into nearby streams or rivers and effect their waters turbidity and chemistry. This issue quickly begins to spread through an ecosystem disturbing not only flora but fauna as well.

When organizers are looking at areas to set up recreational scavenger hunts or treasure hunts off known trails they should consider performing some preliminary research on the area to determine what sites would cause the least disturbance. Sites with resilient vegetation such as grasses or ferns should be considered as they are not as effected by trampling or soil compaction due to their unique root systems. Soil type should also be looked at as low land, well drained soils with a well-developed organic horizon are more resistant to such recreational activities. In most situations these sports take you into areas with not a lot of human interactions, so we might not be aware of the different invasive or harmful weeds that may be present. A thorough plant inventory of desired areas would decrease this risk of unwanted seed dispersal by human vectors and help prevent long term issues even after the sport has moved to a new location. Since preventing seed dispersal in such activities is nearly impossible it is recommend that participants do a self-check and remove any seeds that are visible before leaving the area. These protocols should be implemented in the future in order to preserve the utilized environment and prevent further damage to the soil and vegetation to maintain a healthy forest ecosystem.

Pickering, C., Hill, W., Newsome, D., & Leung, Y. (2009). Comparing hiking, biking, horse riding impacts on vegetation and soils in Australia and United States. *Journal of Environmental Management, 91*, 551-562. Retrieved September 24, 2015. Print.

This journal article focuses on the various forms of recreation including hiking, mountain biking and horse riding and the impact they have on soil and vegetative diversity. For the purpose of this literature review I will be focusing on the effects of hiking and mountain biking only. The authors reviewed over 59 studies from Australia, USA and Canada to see how hiking led to soil compaction. The activities level of intensity, soil type, weather and season were also examined as parameters in these studies. Soil compaction from trampling over time on trails that are frequently used can cause loss of soil moisture, reduction of pores where roots can grow and spread which leads to a reduction of ground vegetative cover and in turn lower leaf litter production. These issues take place not only on the trail itself but on the edges as well. This can cause the soil to lose nutrients and make it more difficult for even the most resilient vegetation to survive.

The authors also examined six studies on the biophysical impacts of mountain biking on trails which are focused on soil erosion and trail degradation. It was found that these issues appeared quickly and at an accelerated rate at the beginning but over time seem to have less and less of an effect on the trail. Mountain biking did not seem to cause much more of an impact on trail and vegetative health then hiking did overall, however the intensity of the mountain biking (speed, skidding etc.) could increase the amount of damage to the surrounding flora life.

The authors agreed that most damaging factor to trail and vegetative health was the dispersal of weeds or invasive species via human vectors. The most common sources are socks of adult as well as children. The spread of not only invasive seed species but plant pathogens and water pathogens were indicated as areas that need to be further researched. An inventory of such species and pathogens can begin to help in the development of a monitoring plan to promote trail and vegetative health and sustainability.

Wells, F., Lauenroth, W., and Bradord, J (2012). Recreational trails as corridors for alien plants in the rocky mountains, USA. *Wester North American Naturalist,* 72(4), 507-533. Retrieved Oct 10, 2015.
Web: http://eds.a.ebscohost.com/eds/pdfviewer/pdfviewer?vid=1&sid=6c79ec98-32dc-4f19-996e-13b6c9c5de1f%40sessionmgr4003&hid=4211

This article focuses on how trails can be corridors for the dispersal of invasive species within an ecosystem. The authors believe that the first step to managing the spread of invasive is to first understand where they are coming from and how they interact with the native species. It was predicted that there would be more invasive species found along the trails, since this is where humans spend most of their time while hiking or mountain biking. The authors examined trail heads in aspen forests, open meadows and evergreen forests. A total of 8 trails were examined, 4 on the western slope in 2003 and 4 on the eastern slope in 2004. Not only did the authors examine the actual ground cover for both native and invasive species they also looked at seed bank samples (5 from each site) to determine whether future growth would primarily come from native or invasive species.

The authors found however little difference in diversity for the vegetation cover for both native and invasive species with roughly the same amount of diversity present at all the trails for each. It was found that for vegetation cover the native species were more abundant then the invasive, indicating that the native species were currently out competing the invasive species based on percent cover present. The surprising results came from the seed bank sample which found a higher number of invasive species present compared to native. This could indicate that in the near future the native species will have to work harder to out complete the newer, more abundant generation of invasive species.

Strategies to combat the spread of invasive species include, altering the native vegetation type, which could include planting more evergreen or coniferous plants which seem to withstand species invasion more than deciduous species. Another suggestion would be to direct trails away from open meadows or wetland which can be very susceptible to species invasions.

Winkle, J. (2014). Informal Trails and the spread of invasive species in urban natural areas: spatial analysis of informal trails and their effects on understory plant communities in Forest Park, Portland Oregon. *PDXScholar,* 1-91. Retrieved Oct 1, 2015. Web: http://pdxscholar.library.pdx.edu/cgi/viewcontent.cgi?article=2841&context=open_access_etds

The purpose of this paper was to examine whether or not there was a difference in how formal and informal trails influenced the surrounding vegetation diversity. Informal trails were counted as areas to walk off and use the washroom, party spots, waste dumping or camping areas, usually found near formal trail heads. The reason informal trails are more of a concern then formal trails is that they are normally not monitored as well or have little to no guideline on where they are created which can cause unknown areas to suffer from increased soil compaction and erosion. Like formal trails the main threats of informal ones are soil compaction, loss of vegetative diversity and in serious cases erosion. It is the lack of monitoring and spatial planning that makes these trails so dangerous to the ecosystems health. The issue of greatest concern is soil compaction as it can reduce soil air, macropore space and reduce the organic layer, which then results in a lower vegetative abundance or diversity.

For this report the author examined spatial distribution of informal trails within a 2000 hectare forest in Oregon as well as the abundance and diversity of understory plant communities that surrounded the trails. Transects were set up along the trail 10 m apart with quadrants at 0,1, and 2m from the trail to examine the plant communities.

It was found that plants with buds close to the ground like grasses or ground spreaders were found along the trails since they were able to survive through the trampling and were more resilient then other shrubs and flowers. Further off the trail the plant community changed and was found to be predominately wood species which can be sensitive to trampling.

The presence of informal and formal trails were found to effect the surrounding plant communities by increasing the species richness and presence of invasive species. This was only found to be true up until 1 m from the trail for informal and 2 m from the trail for formal, indicating that trails do act as corridors for the dispersal of not only invasive but native vegetation as well.

As a management strategy it is recommended to semi-annually take an inventory of the informal trail which are developing within the ecosystem and then asses the presence of invasive species surrounding the trail to predict whether further dispersal will occur.

Queiroz, R., et al. (2014). Plant diversity in hiking trails crossing Natura 2000 areas in the Azores: implications for tourism and nature. *Biodiversity Conservation,* (23) 1347-1365. Retrieved Oct 13, 2015. Web:http://eds.a.ebscohost.com.eztest.ocls.ca/eds/pdfviewer/pdfviewer?sid=2dfbb018-938b-45d1-9ca5-071324652e50%40sessionmgr4004&vid=2&hid=4110

Hiking is an incredibly popular activity that can cause widespread impacts on an ecosystem. Trails can cause a reduction in understory plant cover and changes in species compositions in areas adjacent to the trails. Vegetation can be directly harmed via bruising or breaking down of the cell walls, or via soil compaction which can alter the water drainage. It has also been found in previous studies that many flora species found along the trails sides are non-native species indicating that trails are corridors for seed dispersal, especially seeds of non-native species. The species that survive will be resilient to trampling and soil compaction and are thus able to outcompete the native species. This take over could allow for the non-native species to move further away from the trail and further disrupt the flora species compositions.

This study examined 72 official trails among the Azores territory, looking at the vegetative ground cover, top canopy cover, soil compaction, and lastly an inventory of flora adjacent to the trials and further away. In order to compare samples across trails and degradation level, flora was put into three categories the life form, indigenous or invasive. Species richness was also calculated using the Shannon and Weaver index.

Species diversity was found to differ at various distances from the trail as well as at various altitudes. As altitudes increased the occurrence of invasive species decreased. The overall plant diversity decreased as you move further from the trail system into the surrounding forest or woodland.

The results show a clear impact on vegetation from trail systems within 5 m of the trail but does not seem to significantly change the plant composition of the surrounding forest. The trail edge effect may not be in full swing at these trials yet but evidence would suggest that since most of the invasive species are introduced via human vectors it could be extrapolated that they would be more resilient to trampling and other human impacts.

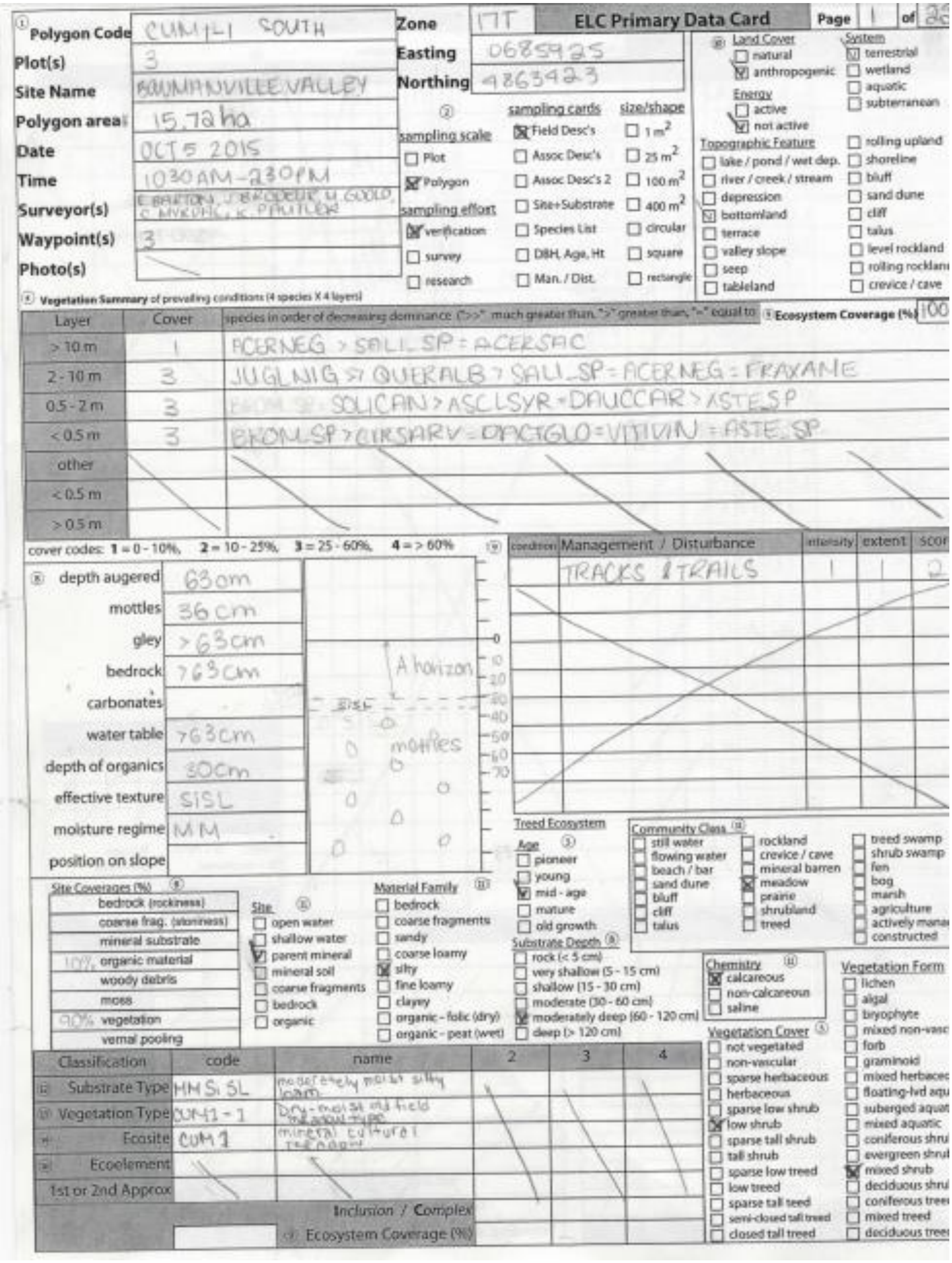
Conclusion

This literature examined the negative impacts trail systems can have on ecosystem health and various ways to manage these damages. The most destructive cause of hiking trails is trampling, which as Cole (2004) described can cause a chain effect on the ecosystem health and encourage the growth of more invasive species. The biggest concern for Bowmanville and Soper Creek would be to control the soil compaction, run-off and soil erosion as they have a healthy water system present in there ecosystem and the use of their trails present may alter the water physically and chemically as Pickering (2009) stated.

The most effective way to combat these negative impacts is the plan the trail location, length, and width thoroughly before implementing the construction of the trails themselves in order to make sure they are not in an area that is threatened, an open area near invasive species or on ground that may not be the most stable with spring flooding or water collection. The trail planning by the City of Toronto is a great resource for developing new trails in a safe and eco tourist friendly way.

Monitoring of the trails should be done on a consistent basis to ensure soil erosion is not occurring and to monitor the amount of invasive species which are present. A seed bank sample similar to the one Wells (2012) performed would be a great precautionary measure to see what the future flora generations along the trial may looks like. Lastly the best way to manage trail degradation and decrease these negative impacts on the ecosystems health is to create signage along the park and trails informing its users of the damage they could cause, reminding them to be mindful of the surrounding vegetation, to no create their own informal trails and to remove any seeds found on their sock or shoes as this is huge vector for seed, specifically invasive species, dispersal.

Appendix C: Ecological Land Classification (ELD) Data Sheets



ELC Primary Data Card Page 1 of 3

① **Polygon Code** CUM1-1 SOUTH
Plot(s) 3
Site Name BOWMANVILLE VALLEY
Polygon area 15.72 ha
Date OCT 5 2015
Time 1030 AM - 230 PM
Surveyor(s) E. BARTON, J. BRODEUR, M. GOOLD, C. MYKUPAC, K. PAUTLER
Waypoint(s) 3
Phot(s)

Zone 17T
Easting 0685925
Northing 4863423

② sampling scale
☐ Plot
☒ Polygon

sampling effort
☒ verification
☐ survey
☐ research

sampling cards
☒ Field Desc's
☐ Assoc Desc's
☐ Assoc Desc's 2
☐ Site+Substrate
☐ Species List
☐ DBH, Age, Ht
☐ Man. / Dist.

size/shape
☐ 1 m²
☐ 25 m²
☐ 100 m²
☐ 400 m²
☐ circular
☐ square
☐ rectangle

Land Cover
☐ natural
☒ anthropogenic

Energy
☐ active
☒ not active

System
☒ terrestrial
☐ wetland
☐ aquatic
☐ subterranean

Topographic Feature
☐ lake / pond / wet dep.
☐ river / creek / stream
☐ depression
☒ bottomland
☐ terrace
☐ valley slope
☐ seep
☐ tableland
☐ rolling upland
☐ shoreline
☐ bluff
☐ sand dune
☐ cliff
☐ talus
☐ level rockland
☐ rolling rocklan
☐ crevice / cave

④ **Vegetation Summary** of prevailing conditions (4 species X 4 layers)

Layer	Cover	species in order of decreasing dominance (">>" much greater than, ">" greater than, "=" equal to
> 10 m	1	ACERNEG > SALI_SP = ACERSAC
2 - 10 m	3	JUGLNIG >> QUERALB > SALI_SP = ACERNEG = FRAXANE
0.5 - 2 m	3	BROM_SP = SOLICAN > ASCLSYR = DAUCCAR > ASTE_SP
< 0.5 m	3	BROM_SP > CIRSARV = DACTGLO = VITIVIN = ASTE_SP
other		
< 0.5 m		
> 0.5 m		

cover codes: **1** = 0 - 10%, **2** = 10 - 25%, **3** = 25 - 60%, **4** = > 60%

⑤ Ecosystem Coverage (%) 100

⑧ depth augered 63 cm
mottles 36 cm
gley > 63 cm
bedrock > 63 cm
carbonates
water table > 63 cm
depth of organics 30 cm
effective texture SiSL
moisture regime MM
position on slope

A horizon
SiSL
mottles
0
10
20
30
40
50
60
70

⑨

condition	Management / Disturbance	intensity	extent	scor
	TRACKS & TRAILS	1	1	2

Site Coverages (%) ⑧

	bedrock (rockiness)
	coarse frag. (stoniness)
	mineral substrate
10%	organic material
	woody debris
	moss
90%	vegetation
	vernal pooling

Site ⑥
☐ open water
☐ shallow water
☒ parent mineral
☐ mineral soil
☐ coarse fragments
☐ bedrock
☐ organic

Material Family ⑪
☐ bedrock
☐ coarse fragments
☐ sandy
☐ coarse loamy
☒ silty
☐ fine loamy
☐ clayey
☐ organic - folic (dry)
☐ organic - peat (wet)

Treed Ecosystem
Age ③
☐ pioneer
☐ young
☒ mid - age
☐ mature
☐ old growth

Substrate Depth ⑧
☐ rock (< 5 cm)
☐ very shallow (5 - 15 cm)
☐ shallow (15 - 30 cm)
☐ moderate (30 - 60 cm)
☒ moderately deep (60 - 120 cm)
☐ deep (> 120 cm)

Community Class ⑭
☐ still water
☐ flowing water
☐ beach / bar
☐ sand dune
☐ bluff
☐ cliff
☐ talus
☐ rockland
☐ crevice / cave
☐ mineral barren
☒ meadow
☐ prairie
☐ shrubland
☐ treed
☐ treed swamp
☐ shrub swamp
☐ fen
☐ bog
☐ marsh
☐ agriculture
☐ actively mana
☐ constructed

Chemistry ⑪
☒ calcareous
☐ non-calcareous
☐ saline

Vegetation Cover ⑤
☐ not vegetated
☐ non-vascular
☐ sparse herbaceous
☐ herbaceous
☐ sparse low shrub
☒ low shrub
☐ sparse tall shrub
☐ tall shrub
☐ sparse low treed
☐ low treed
☐ sparse tall treed
☐ semi-closed tall treed
☐ closed tall treed

Vegetation Form
☐ lichen
☐ algal
☐ bryophyte
☐ mixed non-vasc
☐ forb
☐ graminoid
☐ mixed herbacec
☐ floating-lvd aqu
☐ suberged aquat
☐ mixed aquatic
☐ coniferous shru
☐ evergreen shrul
☒ mixed shrub
☐ deciduous shru
☐ coniferous tree
☐ mixed treed
☐ deciduous tree

Classification	code	name	2	3	4
Substrate Type	HM Si SL	moderately moist silty loam			
Vegetation Type	CUM1 - 1	Dry - moist old field meadow type			
Ecosite	CUM 1	mineral cultural meadow			
Ecoelement					
1st or 2nd Approx					
		Inclusion / Complex			
		Ecosystem Coverage (%)			

Polygon Code CUMF1 SOUTH

Field Descriptions

Page 2 **of** 2

plant species list for prevailing (1) ecosystem condition

① plant species code	>10	2-10	0.5-2	<0.5	other	<0.5	>0.5
SOLICAN	N	N	A	N			
PASTSAT	N	N	R	N			
ASCLSYR	N	N	O	N			
ARCTMIN	N	N	N	R			
ASTE_SP	N	R	O	R			
PINURES	N	R	N	N			
PICEGLA	N	N	R	N			
IMPAGLA	N	N	R	N			
LARIDEC	N	R	N	N			
SAMBNIG	N	N	R	N			
FRAXAME	N	O	N	N			
CORN_SP	N	N	R	N			
ACERSAC	R	R	N	N			
BROM_SP	N	N	N	A			
VICICRA	N	N	N	R			
PHALARU	N	N	N	R			
DACTGLO	N	N	N	R			
SOLADUL	N	N	N	R			
CIRSARV	N	N	N	O			
VITIVIN	N	N	N	R			
PHLEPRA	N	N	R	N			
THUOCC	N	O	N	N			
SALI_SP	R	O	N	N			
ECHILOB	N	N	R	N			
DAUCCAR	N	N	A	R			
CRATAMON	N	R	N	N			
ACERNEG	R	O	N	N			
IMPACAP	N	N	R	N			

plant species list for ______ ecosystem condition

② plant species code	>10	2-10	0.5-2	<0.5	other	<0.5	>0.5
JUGLNIG	N	A	R	N			
RHANCAT	N	R	N	N			
ASPAOFF	N	N	R	N			
CYNAROS	N	N	N	R			
QUERALB	N	A	N	N			
MALU_SP	N	R	N	N			
ACERRUB	N	R	N	N			
ROBIPSE	N	R	N	N			
EQUI_SP	N	N	N	R			

③

cond	type	Wildlife Species Code	#
OB	B	LARI_SP	5
OB	B	PASS_SP	2
OB	I	BOMB.SP	1

④

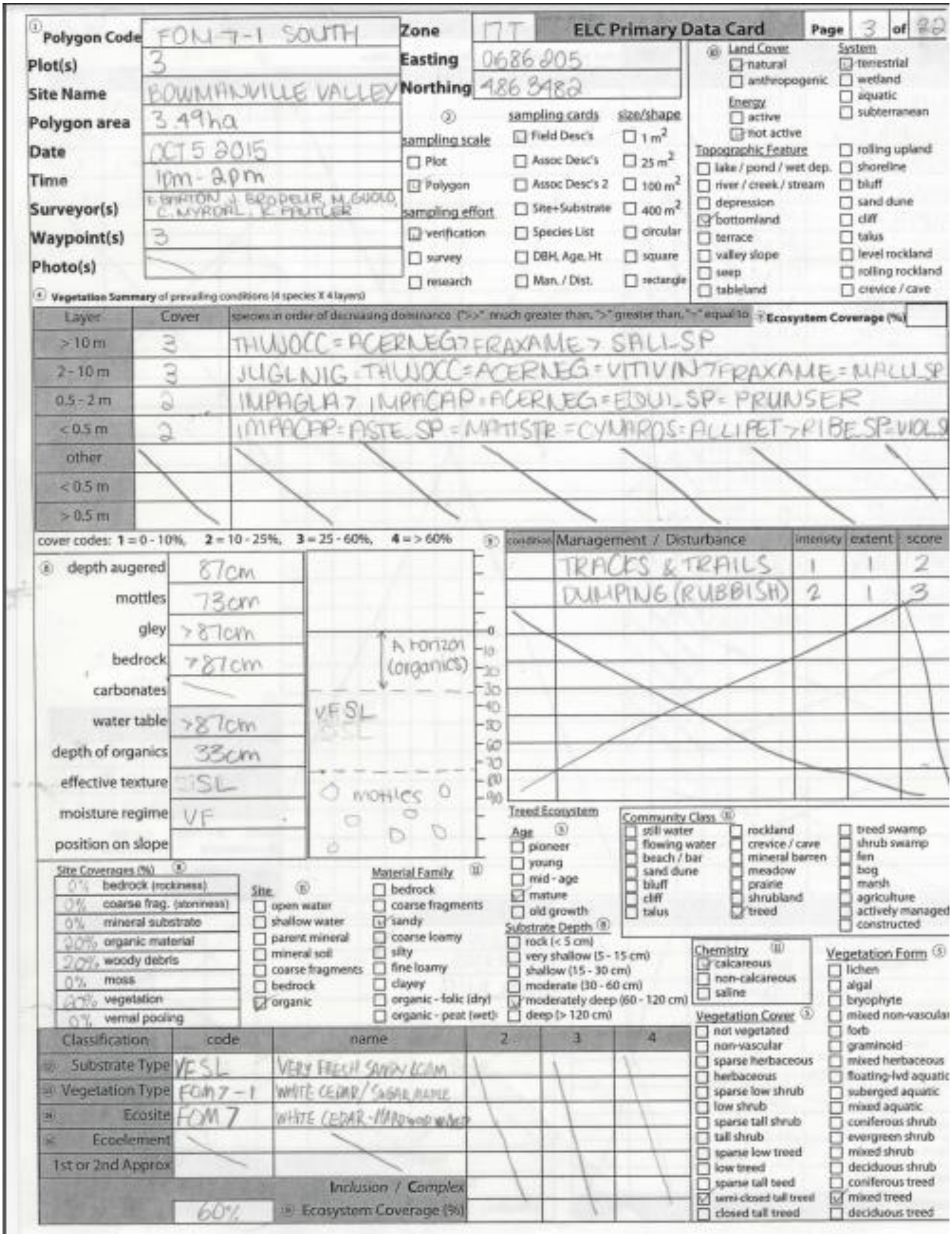
size class analysis (cm)	<10	10-25	25-30	>5
live				
standing dead				
deadfall				

codes: **N** = none **R** = rare
O = occasional **A** = abundant

⑦ condition/auger #	1 / 2	3 / 6	5 / 9	__ / __	__ / __
depth augered	60cm	60cm	70cm		
mottles	40cm	10cm	60cm		
gley	>60cm	>60cm	>70cm		
bedrock	>60cm	>60cm	>70cm		
carbonates					
water table	>60cm	>60cm	>70cm		
organics	30cm	50cm	20cm		
effective texture	Si S	SiCL	SL		
moisture regime	MM	VM	MM		
position on slope	O'	O'	O'		
Substrate Type	[illegible]	[illegible]	[illegible]		

Prism Sweeps ⑤ prism factor

tree species code	__ / __	__ / __	__ / __	__ / __	__ / __	totals	rel av
totals							100
basal area							
standing dead tally							



ELC Primary Data Card

Page 3 of 22

① Polygon Code	FOM7-1 SOUTH
Plot(s)	3
Site Name	BOWMANVILLE VALLEY
Polygon area	3.49ha
Date	OCT 5 2015
Time	1pm-2pm
Surveyor(s)	E BARTON, J. BRODEUR, M. GUOLO, C. MYRDAL, K PAUTLER
Waypoint(s)	3
Photo(s)	

Zone: 17T
Easting: 0686205
Northing: 4863482

②
sampling scale: ☐ Plot ☑ Polygon
sampling effort: ☑ verification ☐ survey ☐ research
sampling cards: ☑ Field Desc's ☐ Assoc Desc's ☐ Assoc Desc's 2 ☐ Site+Substrate ☐ Species List ☐ DBH, Age, Ht ☐ Man. / Dist.
size/shape: ☐ 1 m² ☐ 25 m² ☐ 100 m² ☐ 400 m² ☐ circular ☐ square ☐ rectangle

⑩ Land Cover: ☑ natural ☐ anthropogenic
Energy: ☐ active ☑ not active
System: ☑ terrestrial ☐ wetland ☐ aquatic ☐ subterranean
Topographic Feature: ☐ lake / pond / wet dep. ☐ river / creek / stream ☐ depression ☑ bottomland ☐ terrace ☐ valley slope ☐ seep ☐ tableland ☐ rolling upland ☐ shoreline ☐ bluff ☐ sand dune ☐ cliff ☐ talus ☐ level rockland ☐ rolling rockland ☐ crevice / cave

④ **Vegetation Summary** of prevailing conditions (4 species X 4 layers)

Ecosystem Coverage (%):

Layer	Cover	species in order of decreasing dominance (">>" much greater than, ">" greater than, "=" equal to)
>10 m	3	THUOCC=ACERNEG>FRAXAME>SALI_SP
2-10 m	3	JUGLNIG=THUOCC=ACERNEG=VITIVIN>FRAXAME=MALU_SP
0.5-2 m	2	IMPAGLA>IMPACAP=ACERNEG=EQUI_SP=PRUNSER
<0.5 m	2	IMPACAP=ASTE_SP=MATTSTR=CYNAROS=ALLIPET>RIBE_SP=VIOL_S
other		
<0.5 m		
>0.5 m		

cover codes: 1 = 0 - 10%, 2 = 10 - 25%, 3 = 25 - 60%, 4 = > 60%

⑥ depth augered	87cm
mottles	73cm
gley	>87cm
bedrock	>87cm
carbonates	
water table	>87cm
depth of organics	33cm
effective texture	SL
moisture regime	VF
position on slope	

A horizon (organics)
VFSL
mottles
0 10 20 30 40 50 60 70 80 90

⑨

condition	Management / Disturbance	intensity	extent	score
	TRACKS & TRAILS	1	1	2
	DUMPING (RUBBISH)	2	1	3

Site Coverages (%) ⑥

0%	bedrock (rockiness)
0%	coarse frag. (stoniness)
0%	mineral substrate
20%	organic material
20%	woody debris
0%	moss
60%	vegetation
0%	vernal pooling

Site ⑮: ☐ open water ☐ shallow water ☐ parent mineral ☐ mineral soil ☐ coarse fragments ☐ bedrock ☑ organic

Material Family ⑪: ☐ bedrock ☐ coarse fragments ☑ sandy ☐ coarse loamy ☐ silty ☐ fine loamy ☐ clayey ☐ organic - folic (dry) ☐ organic - peat (wet)

Treed Ecosystem
Age ⑤: ☐ pioneer ☐ young ☐ mid - age ☑ mature ☐ old growth

Substrate Depth ⑧: ☐ rock (< 5 cm) ☐ very shallow (5 - 15 cm) ☐ shallow (15 - 30 cm) ☐ moderate (30 - 60 cm) ☑ moderately deep (60 - 120 cm) ☐ deep (> 120 cm)

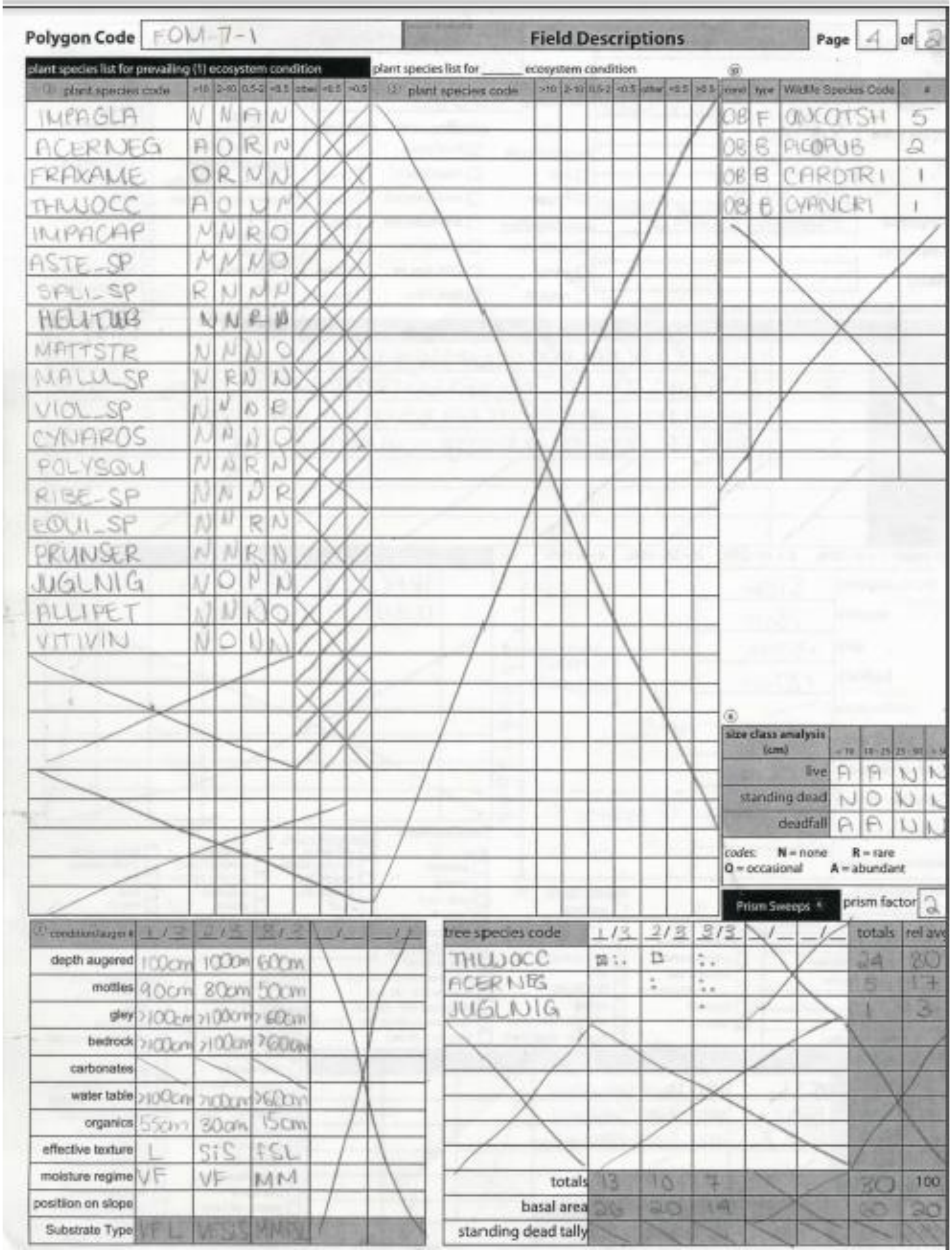
Community Class ⑪: ☐ still water ☐ flowing water ☐ beach / bar ☐ sand dune ☐ bluff ☐ cliff ☐ talus ☐ rockland ☐ crevice / cave ☐ mineral barren ☐ meadow ☐ prairie ☐ shrubland ☑ treed ☐ treed swamp ☐ shrub swamp ☐ fen ☐ bog ☐ marsh ☐ agriculture ☐ actively managed ☐ constructed

Chemistry ⑪: ☑ calcareous ☐ non-calcareous ☐ saline

Vegetation Cover ⑤: ☐ not vegetated ☐ non-vascular ☐ sparse herbaceous ☐ herbaceous ☐ sparse low shrub ☐ low shrub ☐ sparse tall shrub ☐ tall shrub ☐ sparse low treed ☐ low treed ☐ sparse tall teed ☑ semi-closed tall treed ☐ closed tall treed

Vegetation Form ⑤: ☐ lichen ☐ algal ☐ bryophyte ☐ mixed non-vascular ☐ forb ☐ graminoid ☐ mixed herbaceous ☐ floating-lvd aquatic ☐ suberged aquatic ☐ mixed aquatic ☐ coniferous shrub ☐ evergreen shrub ☐ mixed shrub ☐ deciduous shrub ☐ coniferous treed ☑ mixed treed ☐ deciduous treed

Classification	code	name	2	3	4
Substrate Type	VFSL	VERY FRESH SANDY LOAM			
Vegetation Type	FOM7-1	WHITE CEDAR/SUGAR MAPLE			
Ecosite	FOM7	WHITE CEDAR-HARDWOOD MIXED			
Ecoelement					
1st or 2nd Approx					
		Inclusion / Complex			
	60%	Ecosystem Coverage (%)			



Polygon Code FOM-T7-1

Field Descriptions

Page 4 **of** 2

plant species list for prevailing (1) ecosystem condition

(1) plant species code	>10	2-10	0.5-2	<0.5	other	<0.5	>0.5
IMPAGLA	N	N	A	N			
ACERNEG	A	O	R	N			
FRAXAME	O	R	N	N			
THUJOCC	A	O	N	N			
IMPACAP	N	N	R	O			
ASTE_SP	N	N	N	O			
SPLI_SP	R	N	N	N			
HELITUB	N	N	R	N			
MATTSTR	N	N	N	O			
MALU_SP	N	R	N	N			
VIOL_SP	N	N	N	R			
CYNAROS	N	N	N	O			
POLYSQU	N	N	R	N			
RIBE_SP	N	N	N	R			
EQUI_SP	N	N	R	N			
PRUNSER	N	N	R	N			
JUGLNIG	N	O	N	N			
ALLIPET	N	N	N	O			
VITIVIN	N	O	N	N			

plant species list for ______ ecosystem condition

(2) plant species code	>10	2-10	0.5-2	<0.5	other	<0.5	>0.5

cond	type	Wildlife Species Code	#
08	F	ANCOTSH	5
08	B	PICOPUB	2
08	B	CARDTRI	1
08	B	CYANCRI	1

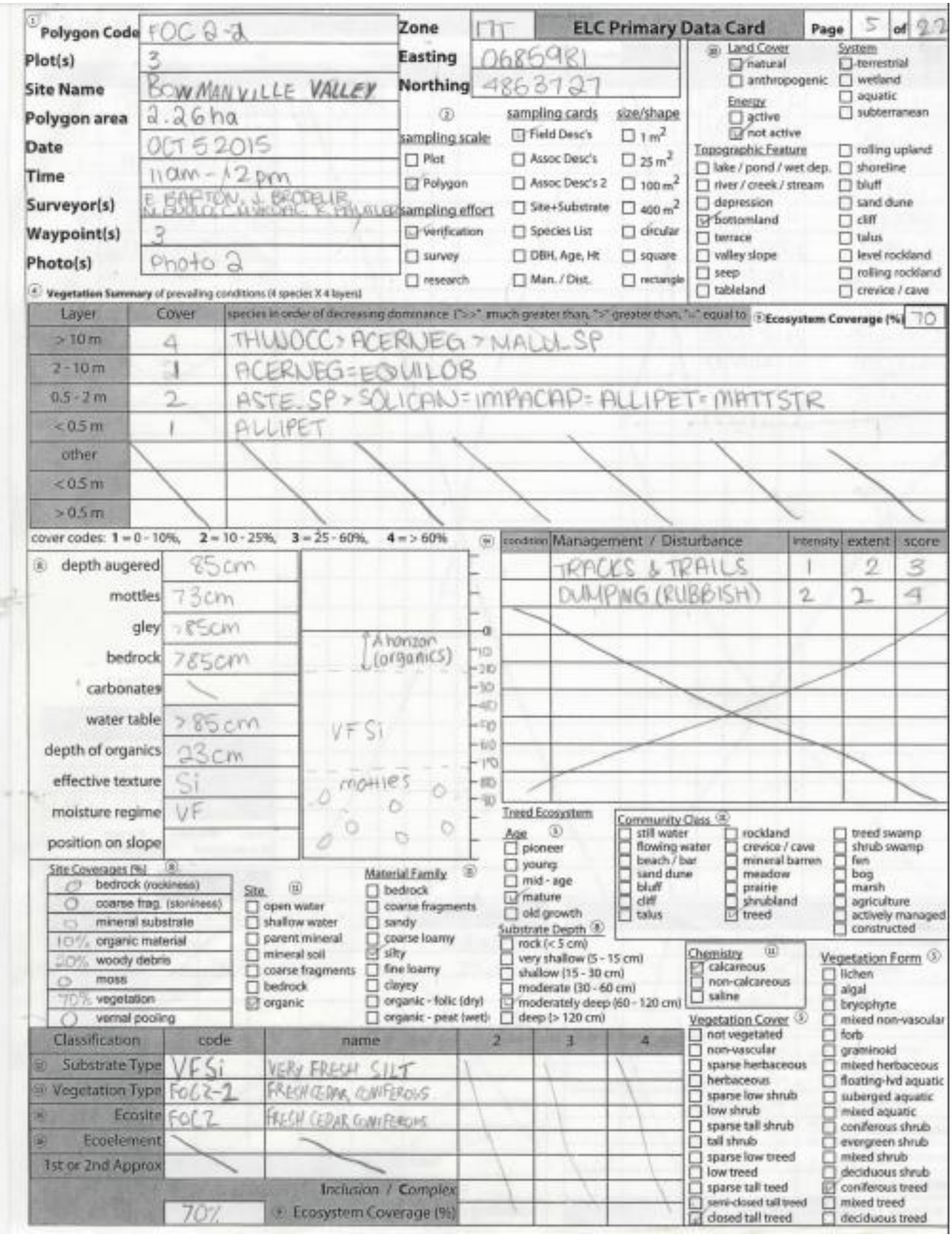
size class analysis (cm)	<10	10-25	25-50	>5
live	A	A	N	N
standing dead	N	O	N	N
deadfall	A	A	N	N

codes: **N** = none **R** = rare
O = occasional **A** = abundant

Prism Sweeps prism factor 2

(1) condition/auger #	1/3	2/3	3/3	_/_	_/_
depth augered	100cm	100cm	60cm		
mottles	90cm	80cm	50cm		
gley	>100cm	>100cm	>60cm		
bedrock	>100cm	>100cm	>60cm		
carbonates					
water table	>100cm	>100cm	>60cm		
organics	55cm	30cm	15cm		
effective texture	L	SiS	fSL		
moisture regime	VF	VF	MM		
position on slope					
Substrate Type	VFL	VFSS	MMSL		

tree species code	1/3	2/3	3/3	_/_	_/_	totals	rel avg
THUJOCC	▪:.	▫	⁚..			24	80
ACERNEG		:	⁚..			5	17
JUGLNIG			.			1	3
totals	13	10	7			30	100
basal area	26	20	14			60	20
standing dead tally							



ELC Primary Data Card Page 5 of 22

Polygon Code	FOC 2-2
Plot(s)	3
Site Name	BOWMANVILLE VALLEY
Polygon area	2.26ha
Date	OCT 5 2015
Time	11am - 12pm
Surveyor(s)	E. BARTON, J. BRODEUR [illegible]
Waypoint(s)	3
Photo(s)	Photo 2
Zone	17T
Easting	0685981
Northing	4863127

sampling scale
- ☐ Plot
- ☑ Polygon

sampling effort
- ☑ verification
- ☐ survey
- ☐ research

sampling cards
- ☑ Field Desc's
- ☐ Assoc Desc's
- ☐ Assoc Desc's 2
- ☐ Site+Substrate
- ☐ Species List
- ☐ DBH, Age, Ht
- ☐ Man. / Dist.

size/shape
- ☐ 1 m²
- ☐ 25 m²
- ☐ 100 m²
- ☐ 400 m²
- ☐ circular
- ☐ square
- ☐ rectangle

Land Cover
- ☑ natural
- ☐ anthropogenic

Energy
- ☐ active
- ☑ not active

System
- ☑ terrestrial
- ☐ wetland
- ☐ aquatic
- ☐ subterranean

Topographic Feature
- ☐ lake / pond / wet dep.
- ☐ river / creek / stream
- ☐ depression
- ☑ bottomland
- ☐ terrace
- ☐ valley slope
- ☐ seep
- ☐ tableland
- ☐ rolling upland
- ☐ shoreline
- ☐ bluff
- ☐ sand dune
- ☐ cliff
- ☐ talus
- ☐ level rockland
- ☐ rolling rockland
- ☐ crevice / cave

Vegetation Summary of prevailing conditions (4 species X 4 layers)

Ecosystem Coverage (%) 70

Layer	Cover	species in order of decreasing dominance (">>" much greater than, ">" greater than, "=" equal to
> 10 m	4	THUOCC > ACERNEG > MALU_SP
2 - 10 m	1	ACERNEG = EQUILOB
0.5 - 2 m	2	ASTE_SP > SOLICAN = IMPACAP = ALLIPET = MATTSTR
< 0.5 m	1	ALLIPET
other		
< 0.5 m		
> 0.5 m		

cover codes: **1** = 0 - 10%, **2** = 10 - 25%, **3** = 25 - 60%, **4** = > 60%

depth augered	85cm
mottles	73cm
gley	>85cm
bedrock	>85cm
carbonates	
water table	>85cm
depth of organics	23cm
effective texture	Si
moisture regime	VF
position on slope	

0 10 20 30 40 50 60 70 80 90

A horizon (organics)

VF Si

mottles

condition	Management / Disturbance	intensity	extent	score
	TRACKS & TRAILS	1	2	3
	DUMPING (RUBBISH)	2	2	4

Site Coverages (%)

	bedrock (rockiness)
	coarse frag. (stoniness)
	mineral substrate
10%	organic material
20%	woody debris
	moss
70%	vegetation
	vernal pooling

Site
- ☐ open water
- ☐ shallow water
- ☐ parent mineral
- ☐ mineral soil
- ☐ coarse fragments
- ☐ bedrock
- ☑ organic

Material Family
- ☐ bedrock
- ☐ coarse fragments
- ☐ sandy
- ☐ coarse loamy
- ☑ silty
- ☐ fine loamy
- ☐ clayey
- ☐ organic - folic (dry)
- ☐ organic - peat (wet)

Treed Ecosystem

Age
- ☐ pioneer
- ☐ young
- ☐ mid - age
- ☑ mature
- ☐ old growth

Substrate Depth
- ☐ rock (< 5 cm)
- ☐ very shallow (5 - 15 cm)
- ☐ shallow (15 - 30 cm)
- ☐ moderate (30 - 60 cm)
- ☑ moderately deep (60 - 120 cm)
- ☐ deep (> 120 cm)

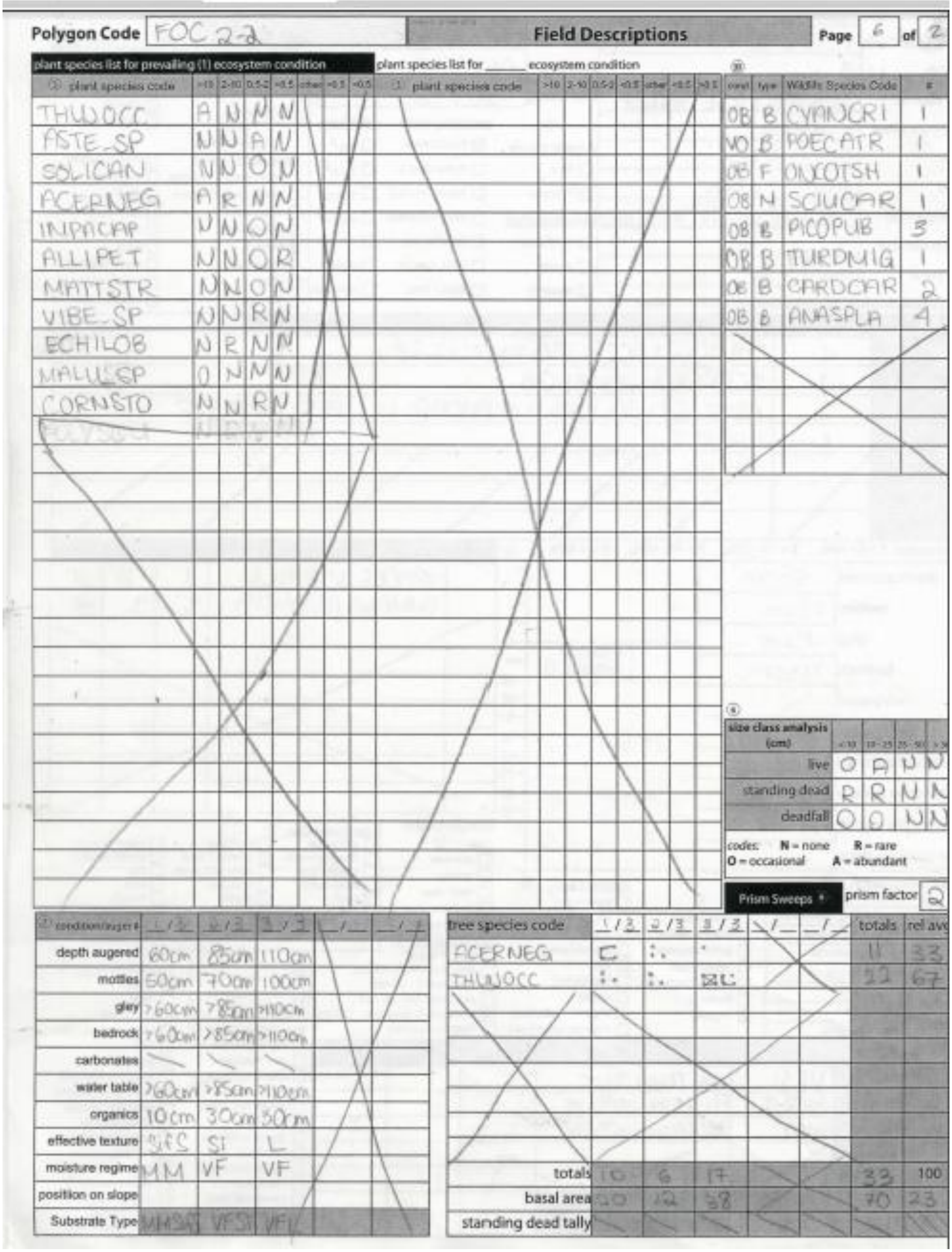
Community Class
- ☐ still water
- ☐ flowing water
- ☐ beach / bar
- ☐ sand dune
- ☐ bluff
- ☐ cliff
- ☐ talus
- ☐ rockland
- ☐ crevice / cave
- ☐ mineral barren
- ☐ meadow
- ☐ prairie
- ☐ shrubland
- ☑ treed
- ☐ treed swamp
- ☐ shrub swamp
- ☐ fen
- ☐ bog
- ☐ marsh
- ☐ agriculture
- ☐ actively managed
- ☐ constructed

Chemistry
- ☑ calcareous
- ☐ non-calcareous
- ☐ saline

Vegetation Cover
- ☐ not vegetated
- ☐ non-vascular
- ☐ sparse herbaceous
- ☐ herbaceous
- ☐ sparse low shrub
- ☐ low shrub
- ☐ sparse tall shrub
- ☐ tall shrub
- ☐ sparse low treed
- ☐ low treed
- ☐ sparse tall teed
- ☐ semi-closed tall treed
- ☑ closed tall treed

Vegetation Form
- ☐ lichen
- ☐ algal
- ☐ bryophyte
- ☐ mixed non-vascular
- ☐ forb
- ☐ graminoid
- ☐ mixed herbaceous
- ☐ floating-lvd aquatic
- ☐ suberged aquatic
- ☐ mixed aquatic
- ☐ coniferous shrub
- ☐ evergreen shrub
- ☐ mixed shrub
- ☐ deciduous shrub
- ☑ coniferous treed
- ☐ mixed treed
- ☐ deciduous treed

Classification	code	name	2	3	4
Substrate Type	VFSi	VERY FRESH SILT			
Vegetation Type	FOC2-2	FRESH CEDAR CONIFEROUS			
Ecosite	FOC2	FRESH CEDAR CONIFEROUS			
Ecoelement					
1st or 2nd Approx					
		Inclusion / Complex			
	70%	Ecosystem Coverage (%)			



Polygon Code FOC 2-2

Field Descriptions

Page 6 **of** 2

plant species list for prevailing (1) ecosystem condition

plant species code	>10	2-10	0.5-2	<0.5	other	<0.5	<0.5
THUJOCC	A	N	N	N			
ASTE_SP	N	N	A	N			
SOLICAN	N	N	O	N			
ACERNEG	A	R	N	N			
INPACAP	N	N	O	N			
ALLIPET	N	N	O	R			
MATTSTR	N	N	O	N			
VIBE_SP	N	N	R	N			
ECHILOB	N	R	N	N			
MALU_SP	O	N	N	N			
CORNSTO	N	N	R	N			

plant species list for ______ ecosystem condition

plant species code	>10	2-10	0.5-2	<0.5	other	<0.5	>0.5

cond	type	Wildlife Species Code	#
OB	B	CYANCRI	1
VO	B	POECATR	1
OB	F	ONCOTSH	1
OB	N	SCIUCAR	1
OB	B	PICOPUB	3
OB	B	TURDMIG	1
OB	B	CARDCAR	2
OB	B	ANASPLA	4

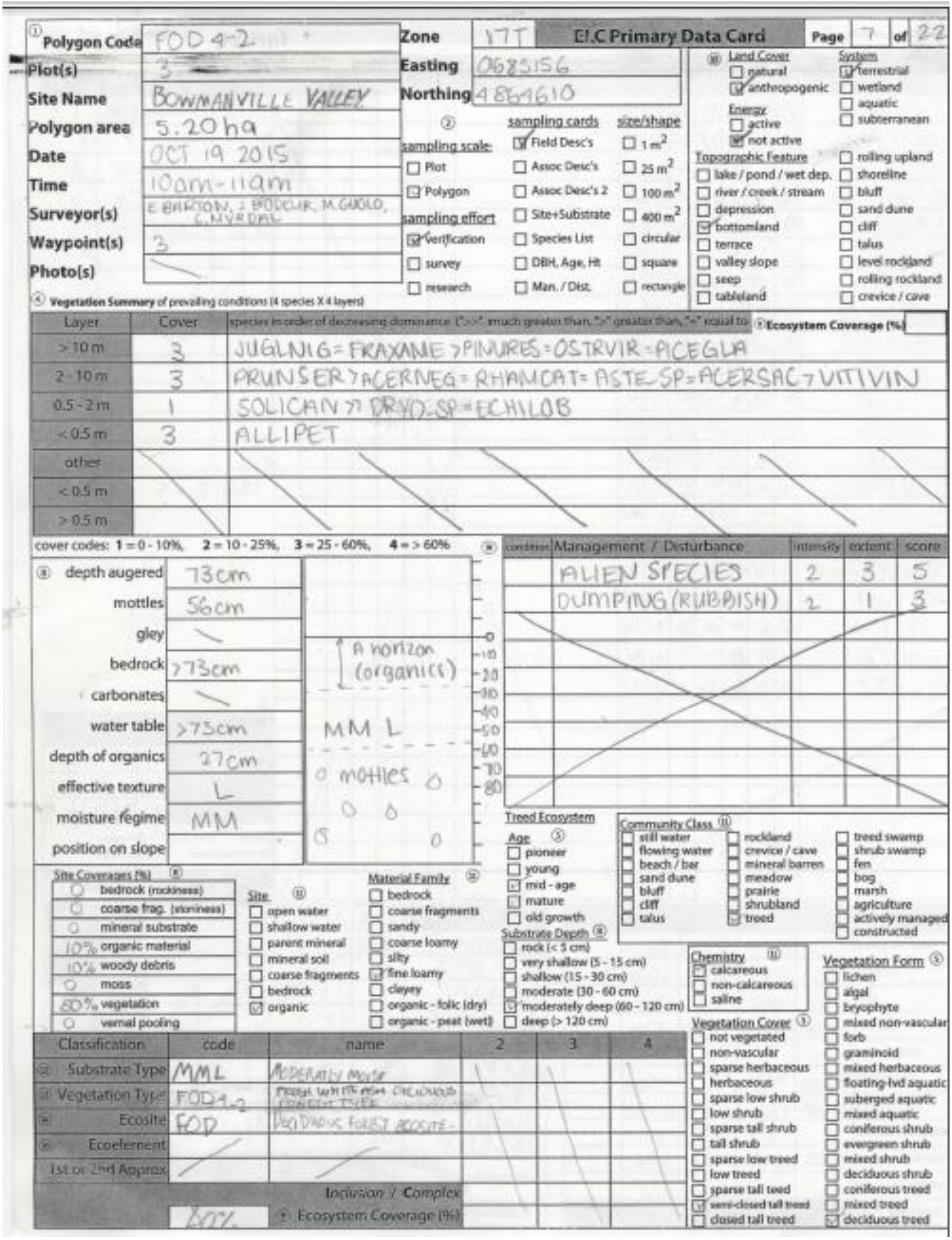
size class analysis (cm)	<10	10-25	25-50	>50
live	O	A	N	N
standing dead	R	R	N	N
deadfall	O	O	N	N

codes: **N** = none **R** = rare
O = occasional **A** = abundant

Prism Sweeps prism factor 2

condition/auger #	1 / 3	2 / 3	3 / 3	__ / __	__ / __
depth augered	60cm	85cm	110cm		
mottles	50cm	70cm	100cm		
gley	>60cm	>85cm	>110cm		
bedrock	>60cm	>85cm	>110cm		
carbonates	—	—	—		
water table	>60cm	>85cm	>110cm		
organics	10 cm	30cm	50cm		
effective texture	SfS	SI	L		
moisture regime	MM	VF	VF		
position on slope					
Substrate Type	MHSA	VFSI	VFL		

tree species code	1 / 3	2 / 3	3 / 3	__ / __	__ / __	totals	rel avg
ACERNEG	⊏	⁚.	·			11	33
THUJOCC	⁚.	⁚.	⊠⊏			22	67
totals	10	6	17			33	100
basal area	20	12	38			70	23
standing dead tally							



ELC Primary Data Card Page 7 of 22

① **Polygon Code**	FOD 4-2
Plot(s)	3
Site Name	BOWMANVILLE VALLEY
Polygon area	5.20 ha
Date	OCT 19 2015
Time	10am-11am
Surveyor(s)	E BARTON, J BODCUR, M GUOLO, C NVRDAL
Waypoint(s)	3
Photo(s)	

Zone	17T
Easting	0685156
Northing	4864610

②
sampling scale:
- ☐ Plot
- ☑ Polygon

sampling effort
- ☑ verification
- ☐ survey
- ☐ research

sampling cards
- ☑ Field Desc's
- ☐ Assoc Desc's
- ☐ Assoc Desc's 2
- ☐ Site+Substrate
- ☐ Species List
- ☐ DBH, Age, Ht
- ☐ Man. / Dist.

size/shape
- ☐ 1 m²
- ☐ 25 m²
- ☐ 100 m²
- ☐ 400 m²
- ☐ circular
- ☐ square
- ☐ rectangle

⑩ Land Cover
- ☐ natural
- ☑ anthropogenic

Energy
- ☐ active
- ☑ not active

System
- ☑ terrestrial
- ☐ wetland
- ☐ aquatic
- ☐ subterranean

Topographic Feature
- ☐ lake / pond / wet dep.
- ☐ river / creek / stream
- ☐ depression
- ☑ bottomland
- ☐ terrace
- ☐ valley slope
- ☐ seep
- ☐ tableland
- ☐ rolling upland
- ☐ shoreline
- ☐ bluff
- ☐ sand dune
- ☐ cliff
- ☐ talus
- ☐ level rockland
- ☐ rolling rockland
- ☐ crevice / cave

④ **Vegetation Summary** of prevailing conditions (4 species X 4 layers)

⑦ **Ecosystem Coverage (%)**

Layer	Cover	species in order of decreasing dominance (">>" much greater than, ">" greater than, "=" equal to
> 10 m	3	JUGLNIG = FRAXAME > PINURES = OSTRVIR = PICEGLA
2 - 10 m	3	PRUNSER > ACERNEG = RHAMCAT = ASTE SP = ACERSAC > VITIVIN
0.5 - 2 m	1	SOLICAN >> DRYO-SP = ECHILOB
< 0.5 m	3	ALLIPET
other		
< 0.5 m		
> 0.5 m		

cover codes: **1** = 0 - 10%, **2** = 10 - 25%, **3** = 25 - 60%, **4** = > 60%

⑧ depth augered	73cm
mottles	56cm
gley	
bedrock	>73cm
carbonates	
water table	>73cm
depth of organics	27cm
effective texture	L
moisture regime	MM
position on slope	

A horizon (organics)

MM L

mottles

0 10 20 30 40 50 60 70 80

⑧

condition	Management / Disturbance	intensity	extent	score
	ALIEN SPECIES	2	3	5
	DUMPING (RUBBISH)	2	1	3

Site Coverages (%) ⑧

0	bedrock (rockiness)
0	coarse frag. (stoniness)
0	mineral substrate
10%	organic material
10%	woody debris
0	moss
80%	vegetation
0	vernal pooling

Site ⑪
- ☐ open water
- ☐ shallow water
- ☐ parent mineral
- ☐ mineral soil
- ☐ coarse fragments
- ☐ bedrock
- ☑ organic

Material Family ⑧
- ☐ bedrock
- ☐ coarse fragments
- ☐ sandy
- ☐ coarse loamy
- ☐ silty
- ☑ fine loamy
- ☐ clayey
- ☐ organic - folic (dry)
- ☐ organic - peat (wet)

Treed Ecosystem

Age ⑤
- ☐ pioneer
- ☐ young
- ☑ mid - age
- ☐ mature
- ☐ old growth

Substrate Depth ⑧
- ☐ rock (< 5 cm)
- ☐ very shallow (5 - 15 cm)
- ☐ shallow (15 - 30 cm)
- ☐ moderate (30 - 60 cm)
- ☑ moderately deep (60 - 120 cm)
- ☐ deep (> 120 cm)

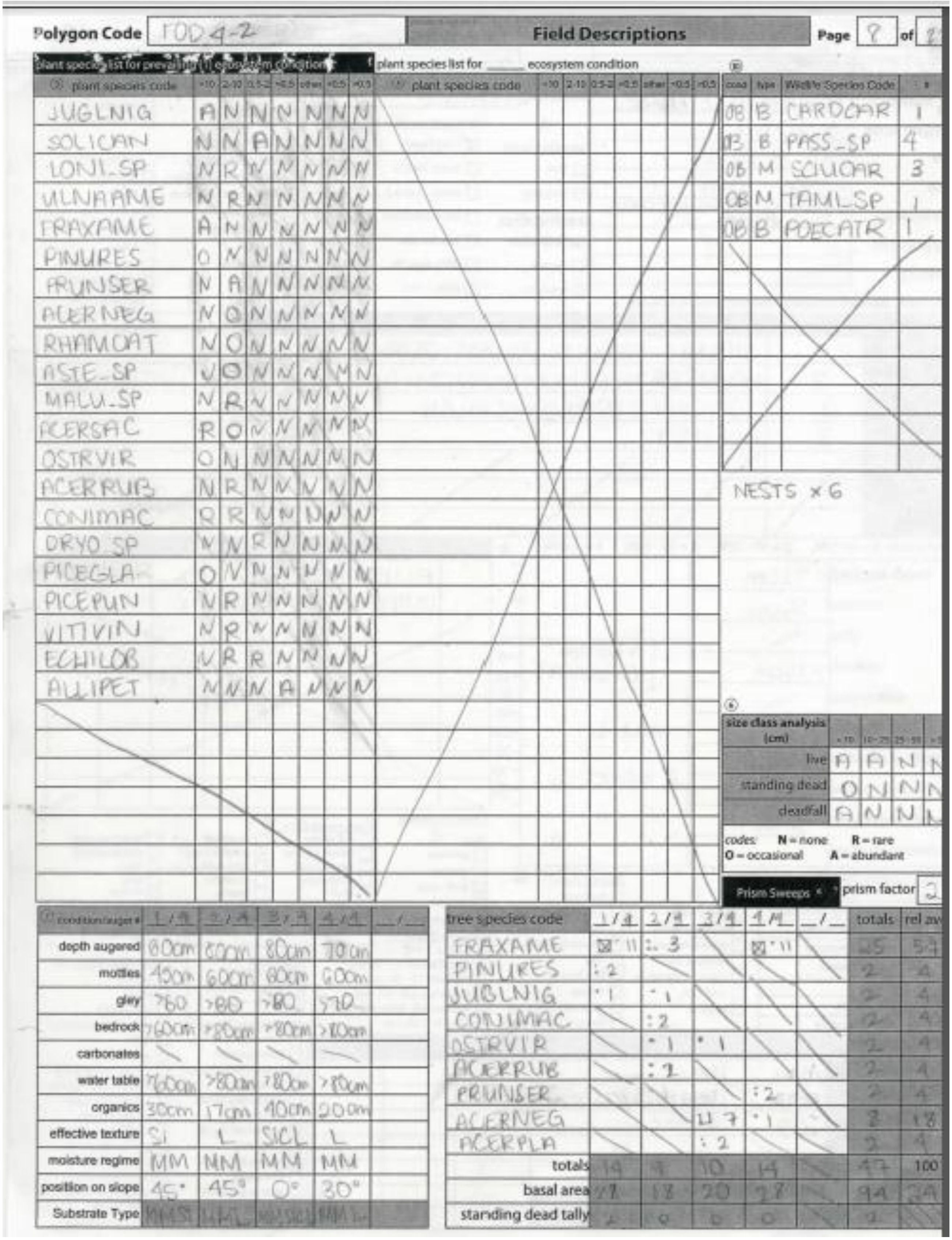
Community Class ⑪
- ☐ still water
- ☐ flowing water
- ☐ beach / bar
- ☐ sand dune
- ☐ bluff
- ☐ cliff
- ☐ talus
- ☐ rockland
- ☐ crevice / cave
- ☐ mineral barren
- ☐ meadow
- ☐ prairie
- ☐ shrubland
- ☑ treed
- ☐ treed swamp
- ☐ shrub swamp
- ☐ fen
- ☐ bog
- ☐ marsh
- ☐ agriculture
- ☐ actively managed
- ☐ constructed

Chemistry ⑪
- ☑ calcareous
- ☐ non-calcareous
- ☐ saline

Vegetation Cover ⑤
- ☐ not vegetated
- ☐ non-vascular
- ☐ sparse herbaceous
- ☐ herbaceous
- ☐ sparse low shrub
- ☐ low shrub
- ☐ sparse tall shrub
- ☐ tall shrub
- ☐ sparse low treed
- ☐ low treed
- ☐ sparse tall treed
- ☑ semi-closed tall treed
- ☐ closed tall treed

Vegetation Form ⑤
- ☐ lichen
- ☐ algal
- ☐ bryophyte
- ☐ mixed non-vascular
- ☐ forb
- ☐ graminoid
- ☐ mixed herbaceous
- ☐ floating-lvd aquatic
- ☐ suberged aquatic
- ☐ mixed aquatic
- ☐ coniferous shrub
- ☐ evergreen shrub
- ☐ mixed shrub
- ☐ deciduous shrub
- ☐ coniferous treed
- ☐ mixed treed
- ☑ deciduous treed

Classification	code	name	2	3	4
⑨ Substrate Type	MML	MODERATELY MOIST			
⑩ Vegetation Type	FOD4-2	FRESH WHITE ASH DECIDUOUS FOREST TYPE			
⑧ Ecosite	FOD	DECIDUOUS FOREST ECOSITE			
⑧ Ecoelement					
1st or 2nd Approx					
		Inclusion / Complex			
	80%	⑦ Ecosystem Coverage (%)			



Polygon Code TOD 4-2

Field Descriptions

Page ? **of** 2

plant species list for prevailing (1) ecosystem condition

plant species code	>10	2-10	0.5-2	<0.5	other	<0.5	<0.5
JUGLNIG	A	N	N	N	N	N	N
SOLICAN	N	N	A	N	N	N	N
LONI_SP	N	R	N	N	N	N	N
ULNAAME	N	R	N	N	N	N	N
FRAXAME	A	N	N	N	N	N	N
PINURES	O	N	N	N	N	N	N
PRUNSER	N	A	N	N	N	N	N
ACERNEG	N	O	N	N	N	N	N
RHAMCAT	N	O	N	N	N	N	N
ASTE_SP	N	O	N	N	N	N	N
MALU_SP	N	R	N	N	N	N	N
ACERSAC	R	O	N	N	N	N	N
OSTRVIR	O	N	N	N	N	N	N
ACERRUB	N	R	N	N	N	N	N
CONIMAC	R	R	N	N	N	N	N
DRYO_SP	N	N	R	N	N	N	N
PICEGLA	O	N	N	N	N	N	N
PICEPUN	N	R	N	N	N	N	N
VITIVIN	N	R	N	N	N	N	N
ECHILOB	N	R	R	N	N	N	N
ALLIPET	N	N	N	A	N	N	N

plant species list for ______ ecosystem condition

plant species code	>10	2-10	0.5-2	<0.5	other	<0.5	<0.5

code	type	Wildlife Species Code	#
0B	B	CARDCAR	1
0B	B	PASS_SP	4
0B	M	SCIUCAR	3
0B	M	TAMI_SP	1
0B	B	POECATR	1

NESTS × 6

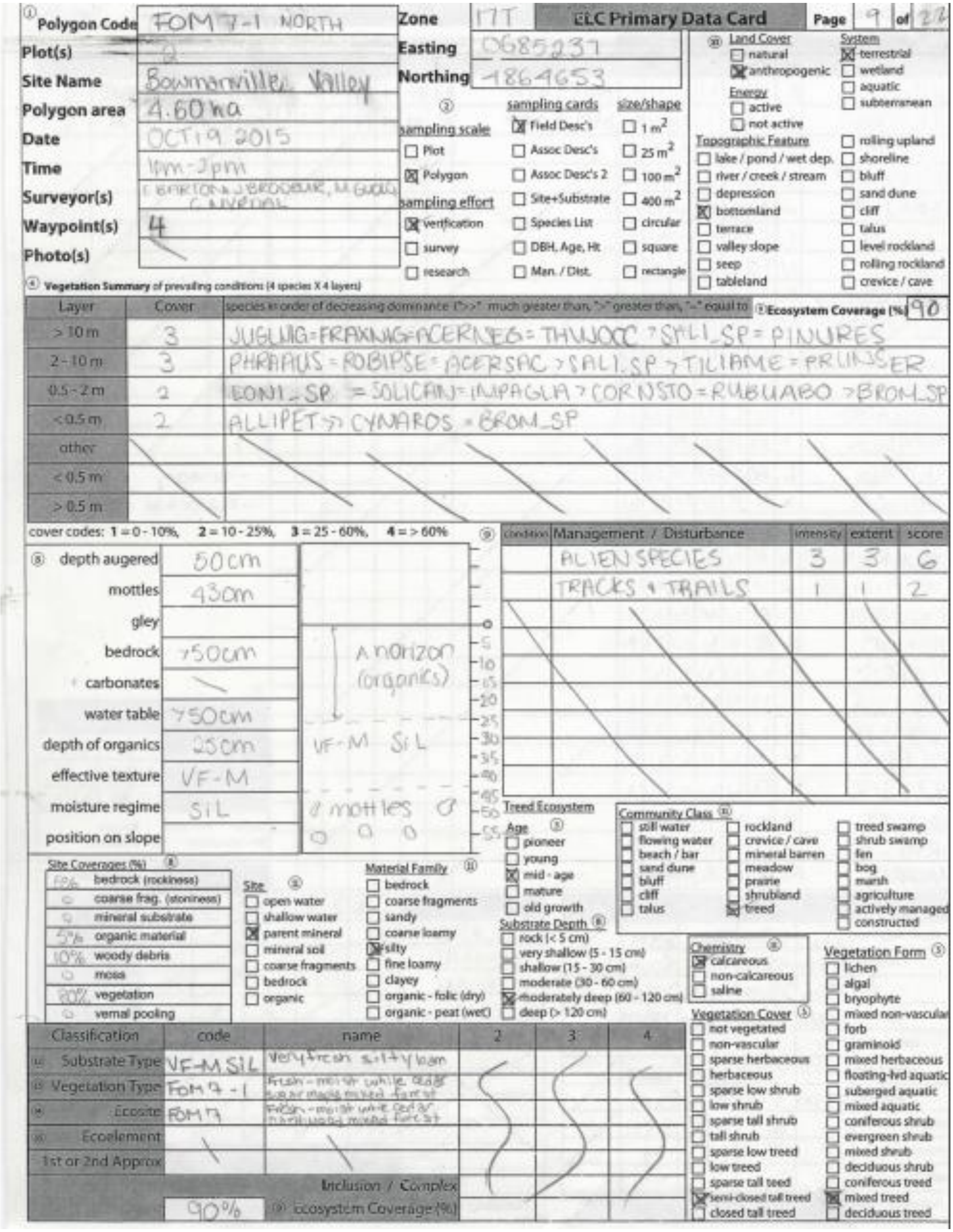
size class analysis (cm)	<10	10-25	25-50	>5
live	A	A	N	N
standing dead	O	N	N	N
deadfall	A	N	N	N

codes: **N** = none **R** = rare
O = occasional **A** = abundant

Prism Sweeps prism factor 2

condition/auger #	1/4	2/4	3/4	4/4	_/_
depth augered	80cm	80cm	80cm	70cm	
mottles	45cm	60cm	80cm	60cm	
gley	>60	>80	>80	>70	
bedrock	>60cm	>80cm	>80cm	>70cm	
carbonates					
water table	>60cm	>80cm	>80cm	>70cm	
organics	30cm	17cm	40cm	20cm	
effective texture	Si	L	SiCL	L	
moisture regime	MM	MM	MM	MM	
position on slope	45°	45°	0°	30°	
Substrate Type	MMSi	MML	MMSiCL	MM L	

tree species code	1/4	2/4	3/4	4/4	_/_	totals	rel ab
FRAXAME	☒˙ 11	:. 3		☒˙ 11		25	54
PINURES	: 2					2	4
JUGLNIG	˙ 1	˙ 1				2	4
CONIMAC		: 2				2	4
OSTRVIR		· 1	· 1			2	4
ACERRUB		: 2				2	4
PRUNSER				: 2		2	4
ACERNEG			⊔ 7	· 1		8	18
ACERPLA			: 2			2	4
totals	14	9	10	14		47	100
basal area	28	18	20	28		94	24
standing dead tally	2	0	0	0		2	



① Polygon Code: FOM 7-1 NORTH
Plot(s): 2
Site Name: Bowmanville Valley
Polygon area: 4.60 ha
Date: OCT 19 2015
Time: 1pm-2pm
Surveyor(s): F BARTON, J BRODEUR, M GUDIC, C NIVEDAL
Waypoint(s): 4
Photo(s): \

Zone: 17T
Easting: 0685237
Northing: 4864653

ELC Primary Data Card Page 9 of 22

②
sampling scale
☐ Plot
☒ Polygon
sampling effort
☒ verification
☐ survey
☐ research

sampling cards
☒ Field Desc's
☐ Assoc Desc's
☐ Assoc Desc's 2
☐ Site+Substrate
☐ Species List
☐ DBH, Age, Ht
☐ Man. / Dist.

size/shape
☐ 1 m²
☐ 25 m²
☐ 100 m²
☐ 400 m²
☐ circular
☐ square
☐ rectangle

⑩ Land Cover
☐ natural
☒ anthropogenic

Energy
☐ active
☐ not active

System
☒ terrestrial
☐ wetland
☐ aquatic
☐ subterranean

Topographic Feature
☐ lake / pond / wet dep.
☐ river / creek / stream
☐ depression
☒ bottomland
☐ terrace
☐ valley slope
☐ seep
☐ tableland
☐ rolling upland
☐ shoreline
☐ bluff
☐ sand dune
☐ cliff
☐ talus
☐ level rockland
☐ rolling rockland
☐ crevice / cave

④ Vegetation Summary of prevailing conditions (4 species X 4 layers)

⑦ Ecosystem Coverage (%) 90

Layer	Cover	species in order of decreasing dominance (">>" much greater than, ">" greater than, "=" equal to
> 10 m	3	JUGLNIG = FRAXNIG = ACERNEG = THUOCC > SALI_SP = PINURES
2 - 10 m	3	PHRAAUS = ROBIPSE = ACERSAC > SALI_SP > TILIAME = PRUNSER
0.5 - 2 m	2	LONI_SP = SOLICAN = IMPAGLA > CORNSTO = RUBUABO > BROM_SP
< 0.5 m	2	ALLIPET >> CYNAROS = BROM_SP
other	\	\
< 0.5 m	\	\
> 0.5 m	\	\

cover codes: 1 = 0 - 10%, 2 = 10 - 25%, 3 = 25 - 60%, 4 = > 60%

⑧	
depth augered	50 cm
mottles	43 cm
gley	
bedrock	>50 cm
carbonates	\
water table	>50 cm
depth of organics	25 cm
effective texture	VF-M
moisture regime	SIL
position on slope	

0 5 10 15 20 25 30 35 40 45 50 55

A horizon (organics)

VF-M SiL

mottles

⑨

condition	Management / Disturbance	intensity	extent	score
	ALIEN SPECIES	3	3	6
	TRACKS + TRAILS	1	1	2

Site Coverages (%) ⑧

0%	bedrock (rockiness)
0	coarse frag. (stoniness)
0	mineral substrate
5%	organic material
10%	woody debris
0	moss
80%	vegetation
0	vernal pooling

Site ⑧
☐ open water
☐ shallow water
☒ parent mineral
☐ mineral soil
☐ coarse fragments
☐ bedrock
☐ organic

Material Family ⑪
☐ bedrock
☐ coarse fragments
☐ sandy
☐ coarse loamy
☒ silty
☐ fine loamy
☐ clayey
☐ organic - folic (dry)
☐ organic - peat (wet)

Treed Ecosystem
Age ⑤
☐ pioneer
☐ young
☒ mid - age
☐ mature
☐ old growth

Substrate Depth ⑧
☐ rock (< 5 cm)
☐ very shallow (5 - 15 cm)
☐ shallow (15 - 30 cm)
☐ moderate (30 - 60 cm)
☒ moderately deep (60 - 120 cm)
☐ deep (> 120 cm)

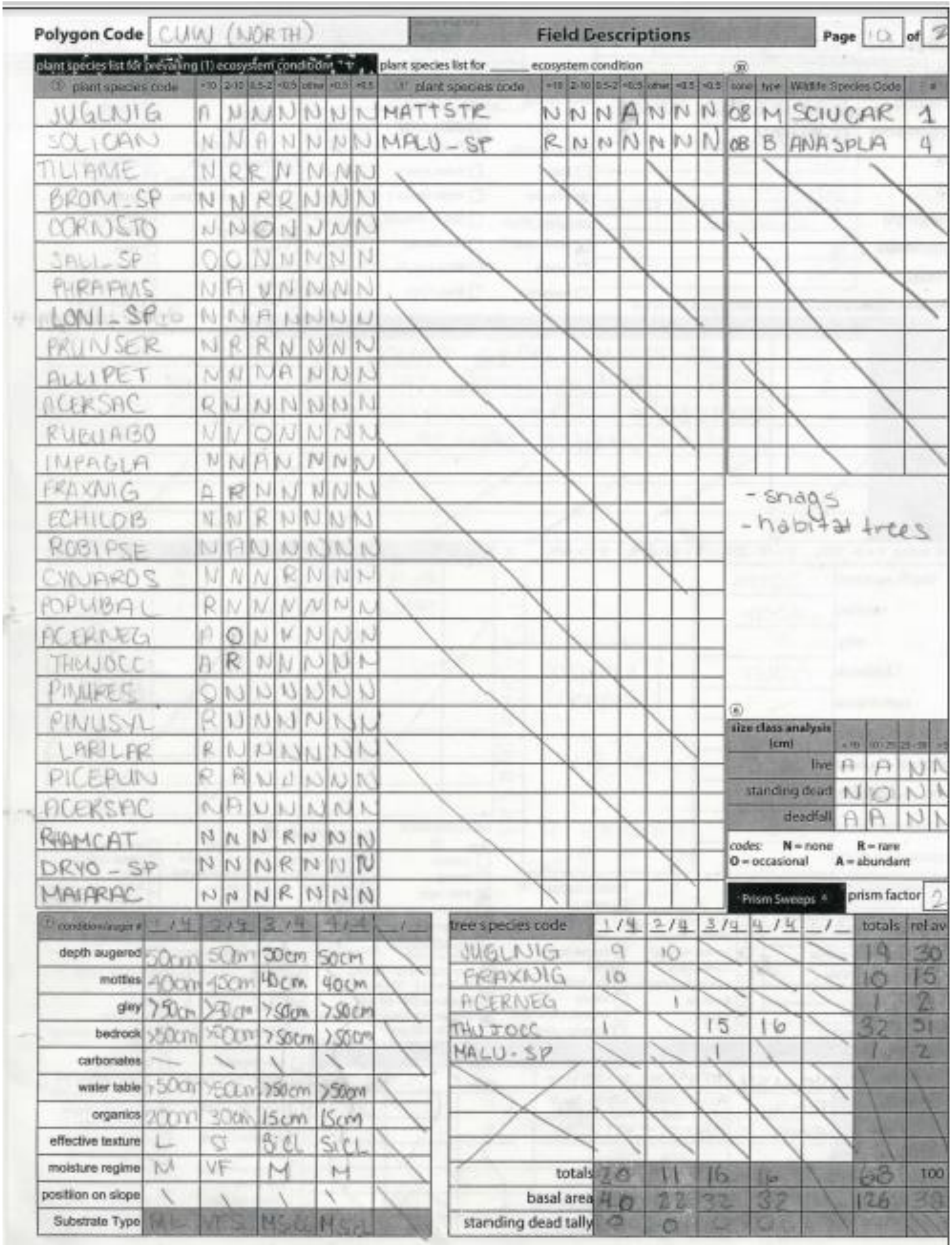
Community Class ⑪
☐ still water
☐ flowing water
☐ beach / bar
☐ sand dune
☐ bluff
☐ cliff
☐ talus
☐ rockland
☐ crevice / cave
☐ mineral barren
☐ meadow
☐ prairie
☐ shrubland
☒ treed
☐ treed swamp
☐ shrub swamp
☐ fen
☐ bog
☐ marsh
☐ agriculture
☐ actively managed
☐ constructed

Chemistry ⑧
☒ calcareous
☐ non-calcareous
☐ saline

Vegetation Cover ⑤
☐ not vegetated
☐ non-vascular
☐ sparse herbaceous
☐ herbaceous
☐ sparse low shrub
☐ low shrub
☐ sparse tall shrub
☐ tall shrub
☐ sparse low treed
☐ low treed
☐ sparse tall treed
☒ semi-closed tall treed
☐ closed tall treed

Vegetation Form ⑤
☐ lichen
☐ algal
☐ bryophyte
☐ mixed non-vascular
☐ forb
☐ graminoid
☐ mixed herbaceous
☐ floating-lvd aquatic
☐ subergerd aquatic
☐ mixed aquatic
☐ coniferous shrub
☐ evergreen shrub
☐ mixed shrub
☐ deciduous shrub
☐ coniferous treed
☒ mixed treed
☐ deciduous treed

Classification	code	name	2	3	4
Substrate Type	VF-M SiL	very fresh silty loam			
Vegetation Type	FOM 7-1	Fresh - moist white cedar sugar maple mixed forest			
Ecosite	FOM 7	Fresh - moist white cedar hardwood mixed forest			
Ecoelement	\	\			
1st or 2nd Approx					
		Inclusion / Complex			
	90%	⑦ Ecosystem Coverage (%)			



Polygon Code CUW (NORTH)

Field Descriptions

Page 10 **of** 2

plant species list for prevailing (1) ecosystem condition

① plant species code	>10	2-10	0.5-2	<0.5	other	<0.5	<0.5
JUGLNIG	A	N	N	N	N	N	N
SOLICAN	N	N	A	N	N	N	N
TILIAME	N	R	R	N	N	N	N
BROM_SP	N	N	R	R	N	N	N
CORNSTO	N	N	O	N	N	N	N
SALI_SP	O	O	N	N	N	N	N
PHRAAUS	N	A	N	N	N	N	N
LONI_SP	N	N	A	N	N	N	N
PRUNSER	N	R	R	N	N	N	N
ALLIPET	N	N	N	A	N	N	N
ACERSAC	R	N	N	N	N	N	N
RUBUIAGO	N	N	O	N	N	N	N
IMPAGLA	N	N	A	N	N	N	N
FRAXNIG	A	R	N	N	N	N	N
ECHILOB	N	N	R	N	N	N	N
ROBIPSE	N	A	N	N	N	N	N
CYNAROS	N	N	N	R	N	N	N
POPUBAL	R	N	N	N	N	N	N
ACERNEG	A	O	N	N	N	N	N
THUJOCC	A	R	N	N	N	N	N
PINURES	O	N	N	N	N	N	N
PINUSYL	R	N	N	N	N	N	N
LARILAR	R	N	N	N	N	N	N
PICEPUN	R	R	N	N	N	N	N
ACERSAC	N	A	N	N	N	N	N
RHAMCAT	N	N	N	R	N	N	N
DRYO_SP	N	N	N	R	N	N	N
MAIARAC	N	N	N	R	N	N	N

plant species list for ______ ecosystem condition

plant species code	<10	2-10	0.5-2	<0.5	other	<0.5	<0.5
MATTSTR	N	N	N	A	N	N	N
MALU_SP	R	N	N	N	N	N	N

zone	type	Wildlife Species Code	#
08	M	SCIUCAR	1
08	B	ANASPLA	4

- snags
- habitat trees

size class analysis (cm)	<10	10-25	25-50	>5
live	A	A	N	N
standing dead	N	O	N	N
deadfall	A	A	N	N

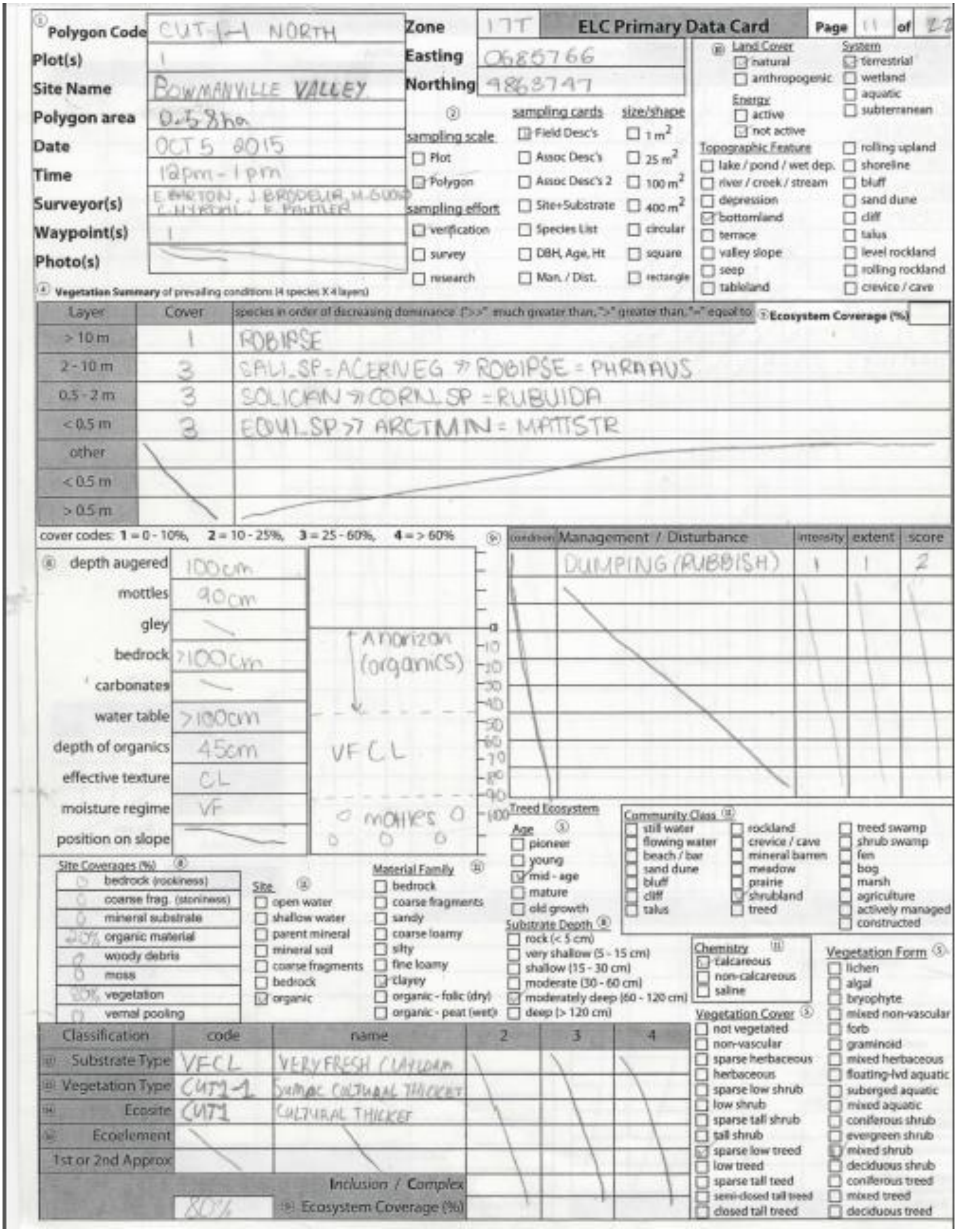
codes: **N** = none **R** = rare
O = occasional **A** = abundant

Prism Sweeps

prism factor 2

condition/auger #	1/4	2/4	3/4	4/4	_/_
depth augered	50cm	50cm	30cm	50cm	
mottles	40cm	45cm	40cm	40cm	
gley	>50cm	>50cm	>50cm	>50cm	
bedrock	>50cm	>50cm	>50cm	>50cm	
carbonates					
water table	>50cm	>50cm	>50cm	>50cm	
organics	20cm	30cm	15cm	15cm	
effective texture	L	S	SiCL	SiCL	
moisture regime	M	VF	M	M	
position on slope					
Substrate Type	ML	VTS	MSiL	MSiL	

tree species code	1/4	2/4	3/4	4/4	_/_	totals	rel av
JUGLNIG	9	10				19	30
FRAXNIG	10					10	15
ACERNEG		1				1	2
THUJOCC	1		15	16		32	51
MALU-SP			1			1	2
totals	20	11	16	16		63	100
basal area	40	22	32	32		126	30
standing dead tally	0	0					



ELC Primary Data Card

① **Polygon Code**	CUT-1-1 NORTH	**Zone**	17T	**Page** 11	**of** 22
Plot(s)	1	**Easting**	0685766		
Site Name	BOWMANVILLE VALLEY	**Northing**	9863747		
Polygon area	0.58ha				
Date	OCT 5 2015				
Time	12pm - 1pm				
Surveyor(s)	E. BARTON, J. BRODEUR, M. GOOD C. HYRONI, E. PALMER				
Waypoint(s)	1				
Photo(s)					

②
sampling scale
- ☐ Plot
- ☑ Polygon

sampling effort
- ☑ verification
- ☐ survey
- ☐ research

sampling cards
- ☑ Field Desc's
- ☐ Assoc Desc's
- ☐ Assoc Desc's 2
- ☐ Site+Substrate
- ☐ Species List
- ☐ DBH, Age, Ht
- ☐ Man. / Dist.

size/shape
- ☐ 1 m^2
- ☐ 25 m^2
- ☐ 100 m^2
- ☐ 400 m^2
- ☐ circular
- ☐ square
- ☐ rectangle

⑥ Land Cover
- ☑ natural
- ☐ anthropogenic

Energy
- ☐ active
- ☑ not active

System
- ☑ terrestrial
- ☐ wetland
- ☐ aquatic
- ☐ subterranean

Topographic Feature
- ☐ lake / pond / wet dep.
- ☐ river / creek / stream
- ☐ depression
- ☑ bottomland
- ☐ terrace
- ☐ valley slope
- ☐ seep
- ☐ tableland
- ☐ rolling upland
- ☐ shoreline
- ☐ bluff
- ☐ sand dune
- ☐ cliff
- ☐ talus
- ☐ level rockland
- ☐ rolling rockland
- ☐ crevice / cave

④ **Vegetation Summary** of prevailing conditions (4 species X 4 layers)

⑦ **Ecosystem Coverage (%)**

Layer	Cover	species in order of decreasing dominance (">>" much greater than, ">" greater than, "=" equal to)
> 10 m	1	ROBIPSE
2 - 10 m	3	SALI_SP = ACERNEG >> ROBIPSE = PHRAAUS
0.5 - 2 m	3	SOLICAN >> CORN_SP = RUBUIDA
< 0.5 m	3	EQUI_SP >> ARCTMIN = MATTSTR
other		
< 0.5 m		
> 0.5 m		

cover codes: **1** = 0 - 10%, **2** = 10 - 25%, **3** = 25 - 60%, **4** = > 60%

⑥	
depth augered	100cm
mottles	90cm
gley	
bedrock	>100cm
carbonates	
water table	>100cm
depth of organics	45cm
effective texture	CL
moisture regime	VF
position on slope	

0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100

A horizon (organics)

VF CL

mottles

⑨

condition	Management / Disturbance	intensity	extent	score
	DUMPING (RUBBISH)	1	1	2

Site Coverages (%) ⑧

0	bedrock (rockiness)
0	coarse frag. (stoniness)
0	mineral substrate
20%	organic material
0	woody debris
0	moss
80%	vegetation
0	vernal pooling

Site ④
- ☐ open water
- ☐ shallow water
- ☐ parent mineral
- ☐ mineral soil
- ☐ coarse fragments
- ☐ bedrock
- ☑ organic

Material Family ⑪
- ☐ bedrock
- ☐ coarse fragments
- ☐ sandy
- ☐ coarse loamy
- ☐ silty
- ☐ fine loamy
- ☑ clayey
- ☐ organic - folic (dry)
- ☐ organic - peat (wet)

Treed Ecosystem

Age ⑤
- ☐ pioneer
- ☐ young
- ☑ mid - age
- ☐ mature
- ☐ old growth

Substrate Depth ⑧
- ☐ rock (< 5 cm)
- ☐ very shallow (5 - 15 cm)
- ☐ shallow (15 - 30 cm)
- ☐ moderate (30 - 60 cm)
- ☑ moderately deep (60 - 120 cm)
- ☐ deep (> 120 cm)

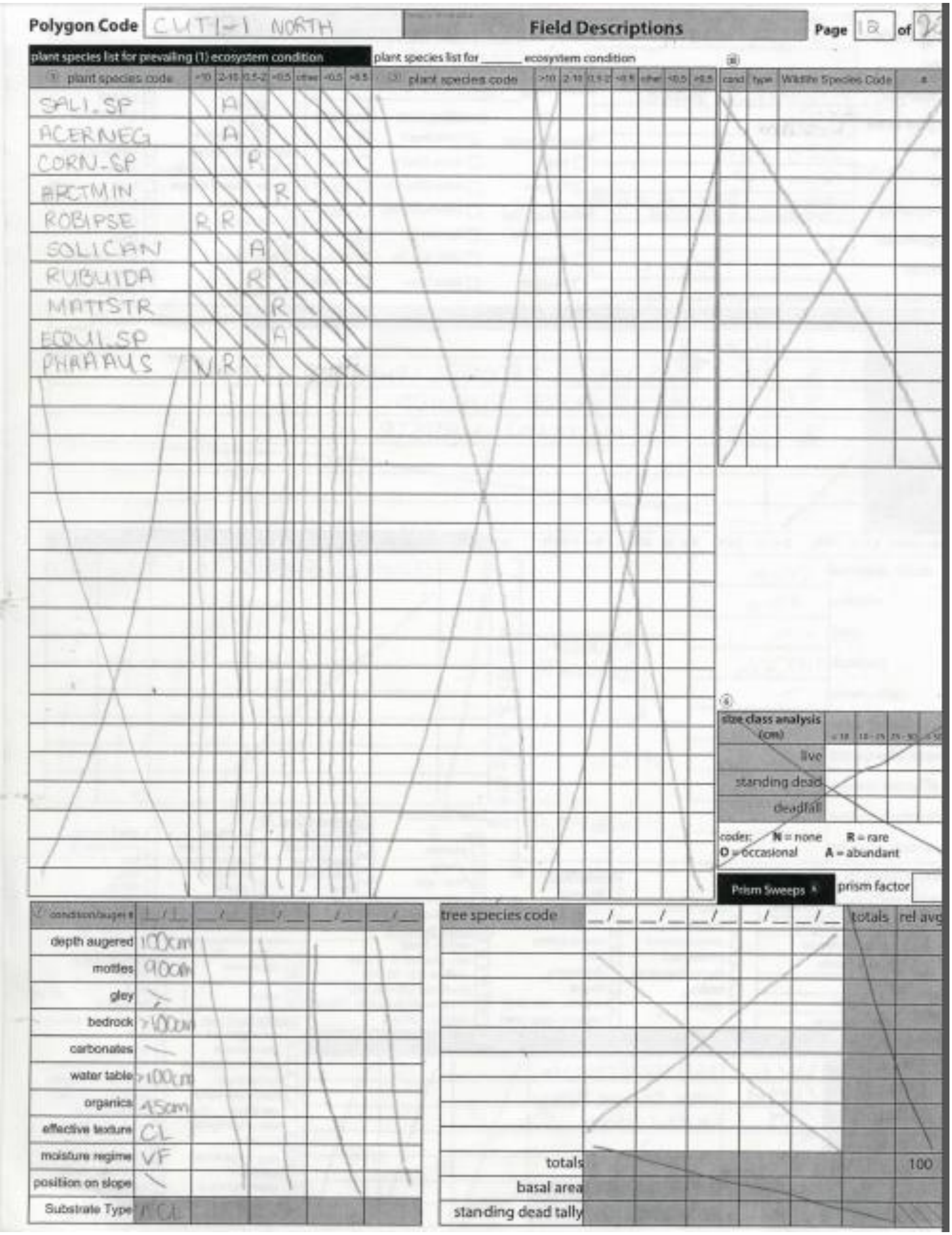
Community Class ⑬
- ☐ still water
- ☐ flowing water
- ☐ beach / bar
- ☐ sand dune
- ☐ bluff
- ☐ cliff
- ☐ talus
- ☐ rockland
- ☐ crevice / cave
- ☐ mineral barren
- ☐ meadow
- ☐ prairie
- ☑ shrubland
- ☐ treed
- ☐ treed swamp
- ☐ shrub swamp
- ☐ fen
- ☐ bog
- ☐ marsh
- ☐ agriculture
- ☐ actively managed
- ☐ constructed

Chemistry ⑪
- ☑ calcareous
- ☐ non-calcareous
- ☐ saline

Vegetation Cover ⑤
- ☐ not vegetated
- ☐ non-vascular
- ☐ sparse herbaceous
- ☐ herbaceous
- ☐ sparse low shrub
- ☐ low shrub
- ☐ sparse tall shrub
- ☐ tall shrub
- ☑ sparse low treed
- ☐ low treed
- ☐ sparse tall teed
- ☐ semi-closed tall treed
- ☐ closed tall treed

Vegetation Form ⑤
- ☐ lichen
- ☐ algal
- ☐ bryophyte
- ☐ mixed non-vascular
- ☐ forb
- ☐ graminoid
- ☐ mixed herbaceous
- ☐ floating-lvd aquatic
- ☐ suberged aquatic
- ☐ mixed aquatic
- ☐ coniferous shrub
- ☐ evergreen shrub
- ☑ mixed shrub
- ☐ deciduous shrub
- ☐ coniferous treed
- ☐ mixed treed
- ☐ deciduous treed

Classification	code	name	2	3	4
⑩ Substrate Type	VFCL	VERY FRESH CLAY LOAM			
⑬ Vegetation Type	CUT1-1	SUMAC CULTURAL THICKET			
⑭ Ecosite	CUT1	CULTURAL THICKET			
⑮ Ecoelement					
1st or 2nd Approx					
		Inclusion / Complex			
	80%	⑦ Ecosystem Coverage (%)			



Polygon Code CUT1-1 NORTH

Field Descriptions

Page 12 **of**

plant species list for prevailing (1) ecosystem condition

① plant species code	>10	2-10	0.5-2	<0.5	other	<0.5	>0.5
SALI.SP		A					
ACERNEG		A					
CORN.SP			R				
ARCTMIN				R			
ROBIPSE	R	R					
SOLICAN			A				
RUBUIDA			R				
MATTSTR				R			
EQUI.SP				A			
PHRAAUS	N	R					

plant species list for ______ ecosystem condition

③ plant species code	>10	2-10	0.5-2	<0.5	other	<0.5	>0.5

③

cand	type	Wildlife Species Code	#

⑥

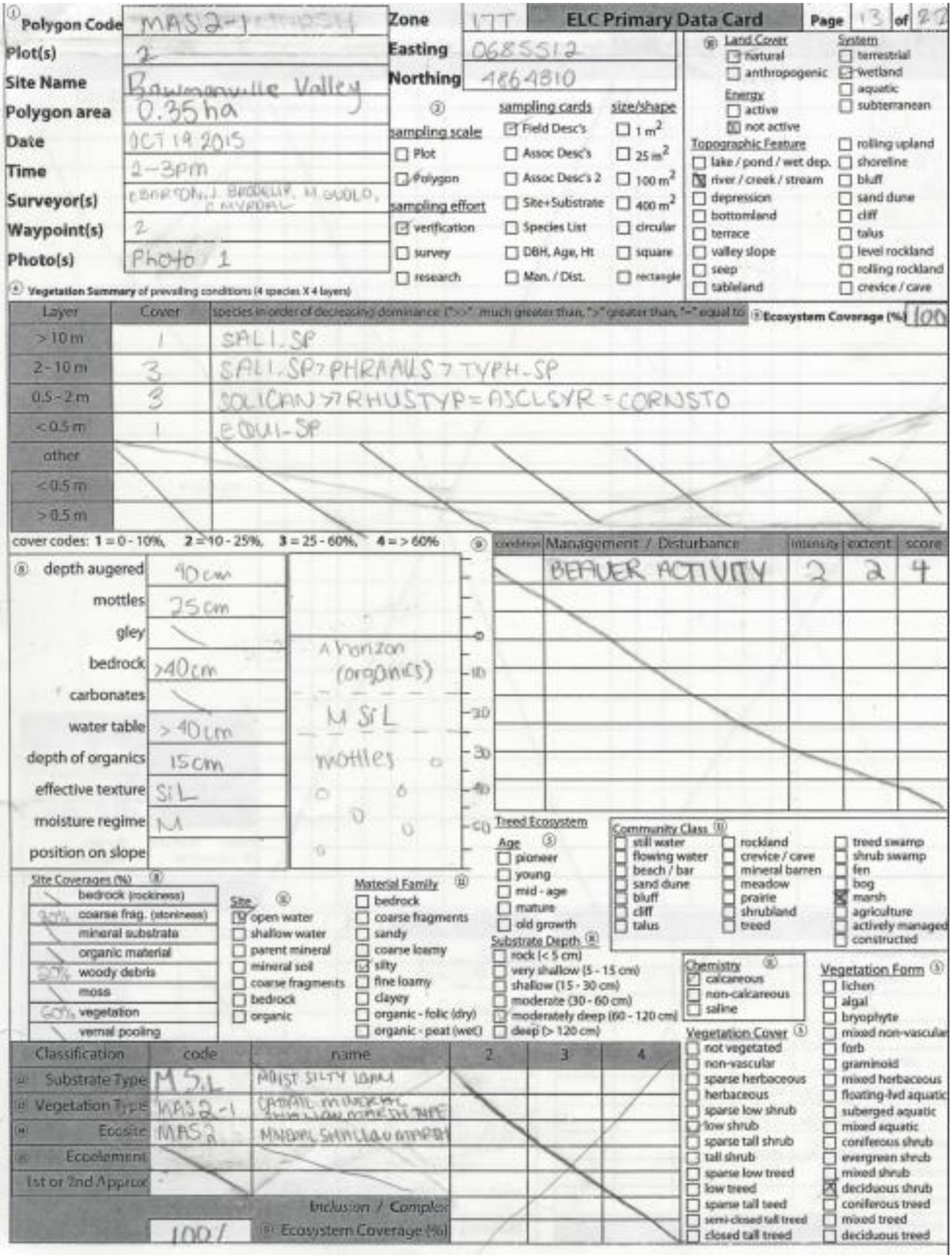
size class analysis (cm)	<18	18-25	25-30	
live				
standing dead				
deadfall				

coder: **N** = none **R** = rare
O = occasional **A** = abundant

⑦ condition/auger #	1 / 1	__/__	__/__	__/__	__/__
depth augered	100cm				
mottles	90cm				
gley	\				
bedrock	>100cm				
carbonates	\				
water table	>100cm				
organics	45cm				
effective texture	CL				
moisture regime	VF				
position on slope	\				
Substrate Type	MCL				

Prism Sweeps ⑧ prism factor

tree species code	__/__	__/__	__/__	__/__	__/__	totals	rel avg
totals							100
basal area							
standing dead tally							



ELC Primary Data Card Page 13 of 22

①
Polygon Code MAS2-1
Plot(s) 2
Site Name Bowmanville Valley
Polygon area 0.35 ha
Date OCT 19 2015
Time 1-3pm
Surveyor(s) E BARTON, J. BRODELLE, M. GUOLO, C MYRDAL
Waypoint(s) 2
Photo(s) Photo 1

Zone 17T
Easting 0685512
Northing 4864810

②
sampling scale
☐ Plot
☑ Polygon

sampling effort
☑ verification
☐ survey
☐ research

sampling cards
☑ Field Desc's
☐ Assoc Desc's
☐ Assoc Desc's 2
☐ Site+Substrate
☐ Species List
☐ DBH, Age, Ht
☐ Man. / Dist.

size/shape
☐ 1 m²
☐ 25 m²
☐ 100 m²
☐ 400 m²
☐ circular
☐ square
☐ rectangle

⑥ Land Cover
☑ natural
☐ anthropogenic

Energy
☐ active
☒ not active

System
☐ terrestrial
☑ wetland
☐ aquatic
☐ subterranean

Topographic Feature
☐ lake / pond / wet dep.
☒ river / creek / stream
☐ depression
☐ bottomland
☐ terrace
☐ valley slope
☐ seep
☐ tableland
☐ rolling upland
☐ shoreline
☐ bluff
☐ sand dune
☐ cliff
☐ talus
☐ level rockland
☐ rolling rockland
☐ crevice / cave

④ **Vegetation Summary** of prevailing conditions (4 species X 4 layers)

Layer	Cover	species in order of decreasing dominance (">>" much greater than, ">" greater than, "=" equal to
> 10 m	1	SALI.SP
2 - 10 m	3	SALI.SP > PHRAAUS > TYPH-SP
0.5 - 2 m	3	SOLICAN >> RHUSTYP = ASCLSYR = CORNSTO
< 0.5 m	1	EQUI-SP
other		
< 0.5 m		
> 0.5 m		

⑤ **Ecosystem Coverage (%)** 100

cover codes: **1** = 0 - 10%, **2** = 10 - 25%, **3** = 25 - 60%, **4** = > 60%

⑧ depth augered	40 cm
mottles	25 cm
gley	
bedrock	>40 cm
carbonates	
water table	> 40 cm
depth of organics	15 cm
effective texture	SiL
moisture regime	M
position on slope	

A horizon (organics)
M SiL
mottles
0
10
20
30
40
50

⑨

condition	Management / Disturbance	intensity	extent	score
	BEAVER ACTIVITY	2	2	4

Site Coverages (%) ⑧

	bedrock (rockiness)
30%	coarse frag. (stoniness)
	mineral substrate
	organic material
20%	woody debris
	moss
60%	vegetation
	vernal pooling

Site ⑧
☒ open water
☐ shallow water
☐ parent mineral
☐ mineral soil
☐ coarse fragments
☐ bedrock
☐ organic

Material Family ⑧
☐ bedrock
☐ coarse fragments
☐ sandy
☐ coarse loamy
☑ silty
☐ fine loamy
☐ clayey
☐ organic - folic (dry)
☐ organic - peat (wet)

Treed Ecosystem

Age ⑤
☐ pioneer
☐ young
☐ mid - age
☐ mature
☐ old growth

Substrate Depth ⑧
☐ rock (< 5 cm)
☐ very shallow (5 - 15 cm)
☐ shallow (15 - 30 cm)
☐ moderate (30 - 60 cm)
☑ moderately deep (60 - 120 cm)
☐ deep (> 120 cm)

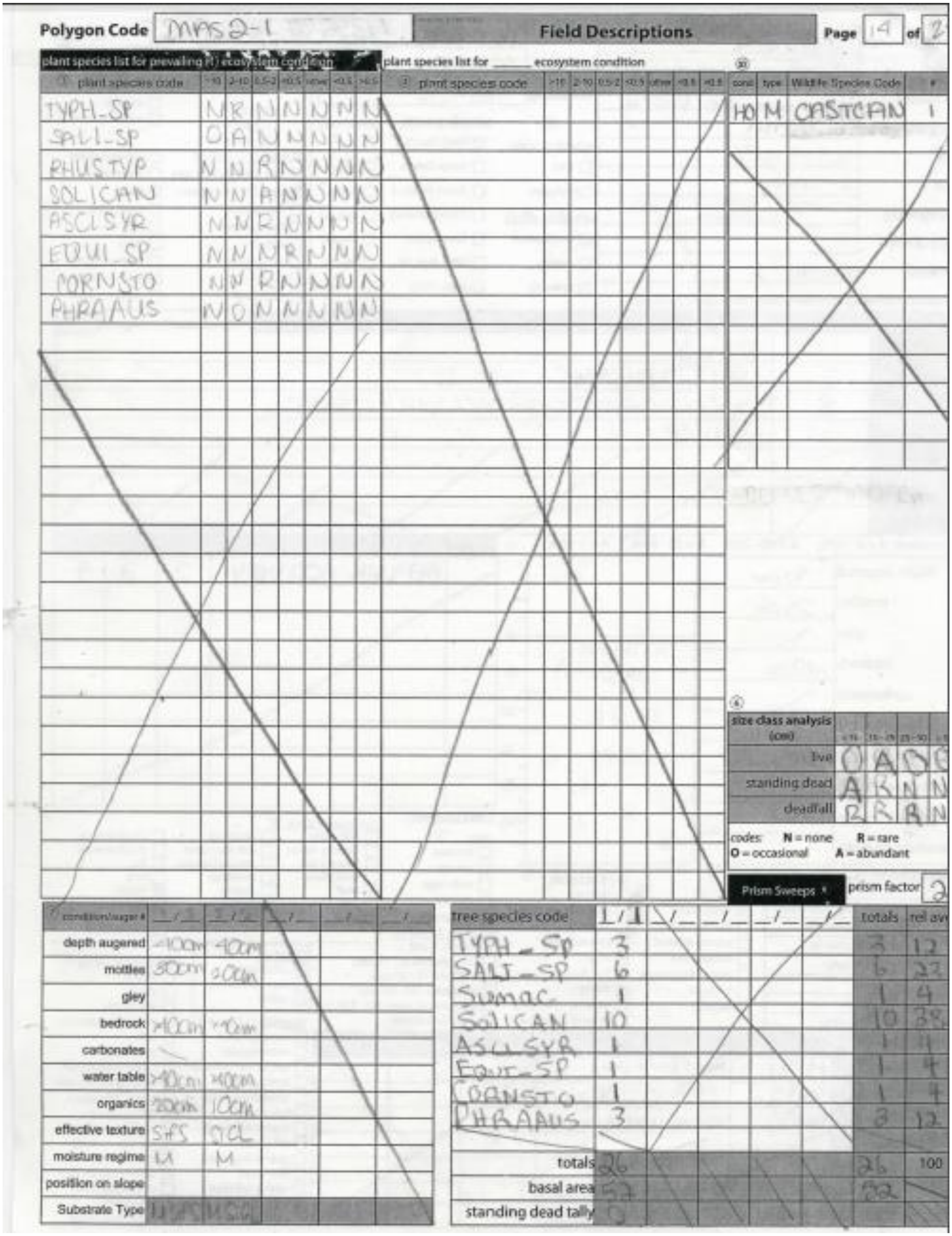
Community Class ⑪
☐ still water
☐ flowing water
☐ beach / bar
☐ sand dune
☐ bluff
☐ cliff
☐ talus
☐ rockland
☐ crevice / cave
☐ mineral barren
☐ meadow
☐ prairie
☐ shrubland
☐ treed
☐ treed swamp
☐ shrub swamp
☐ fen
☐ bog
☒ marsh
☐ agriculture
☐ actively managed
☐ constructed

Chemistry ⑧
☑ calcareous
☐ non-calcareous
☐ saline

Vegetation Cover ⑤
☐ not vegetated
☐ non-vascular
☐ sparse herbaceous
☐ herbaceous
☐ sparse low shrub
☑ low shrub
☐ sparse tall shrub
☐ tall shrub
☐ sparse low treed
☐ low treed
☐ sparse tall treed
☐ semi-closed tall treed
☐ closed tall treed

Vegetation Form ⑤
☐ lichen
☐ algal
☐ bryophyte
☐ mixed non-vascular
☐ forb
☐ graminoid
☐ mixed herbaceous
☐ floating-lvd aquatic
☐ suberged aquatic
☐ mixed aquatic
☐ coniferous shrub
☐ evergreen shrub
☐ mixed shrub
☒ deciduous shrub
☐ coniferous treed
☐ mixed treed
☐ deciduous treed

Classification	code	name	2	3	4
⑫ Substrate Type	MS.1	MOIST SILTY LOAM			
⑬ Vegetation Type	MAS2-1	CATTAIL MINERAL SHALLOW MARSH TYPE			
⑭ Ecosite	MAS2	MINERAL SHALLOW MARSH			
⑮ Ecoelement					
1st or 2nd Approx					
		Inclusion / Complex			
	100%	⑤ Ecosystem Coverage (%)			



Polygon Code MAS 2-1

Field Descriptions

Page 14 **of** 2

plant species list for prevailing (1) ecosystem condition

① plant species code	>10	2-10	0.5-2	<0.5	other	<0.5	>0.5
TYPH_SP	N	R	N	N	N	N	N
SALI_SP	O	A	N	N	N	N	N
RHUSTYP	N	N	R	N	N	N	N
SOLICAN	N	N	A	N	N	N	N
ASCLSYR	N	N	R	N	N	N	N
EQUI_SP	N	N	N	R	N	N	N
CORNSTO	N	N	R	N	N	N	N
PHRAAUS	N	O	N	N	N	N	N

plant species list for ______ ecosystem condition

③ plant species code	>10	2-10	0.5-2	<0.5	other	<0.5	>0.5

㉚

cond	type	Wildlife Species Code	#
HO	M	CASTCAN	1

⑥

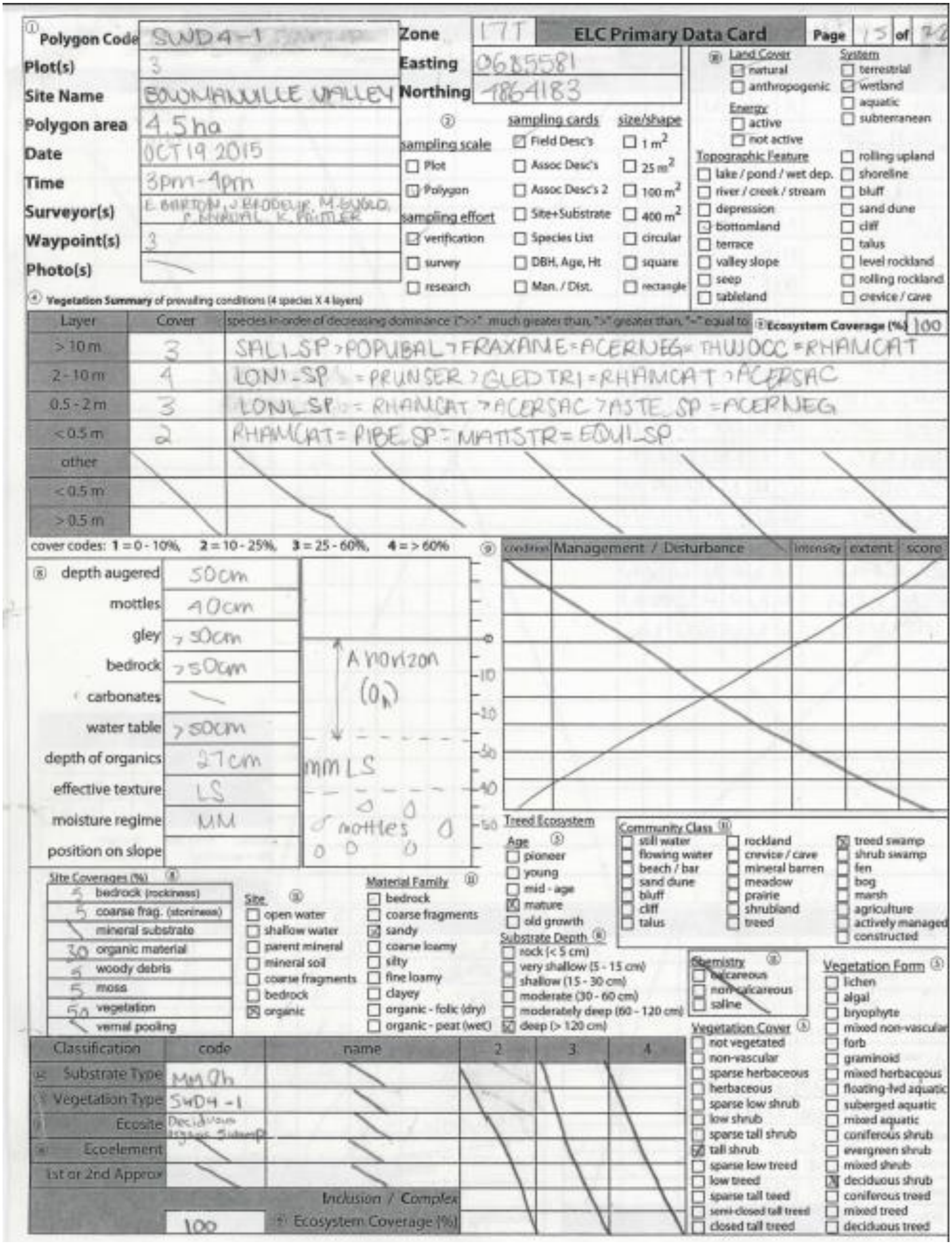
size class analysis (cm)	<15	15-25	25-50	
live	O	A	O	O
standing dead	A	R	N	N
deadfall	R	R	R	N

codes: **N** = none **R** = rare
O = occasional **A** = abundant

⑦ condition/auger #	1/1	1/2	_/_	_/_	_/_
depth augered	<100cm	40cm			
mottles	30cm	20cm			
gley					
bedrock	>100cm	>40cm			
carbonates	—				
water table	>40cm	>40cm			
organics	20cm	10cm			
effective texture	SiFS	SiCL			
moisture regime	M	M			
position on slope					
Substrate Type	[illegible]	MSC			

Prism Sweeps # prism factor 2

tree species code	1/1	_/_	_/_	_/_	_/_	totals	rel av
TYPH_SP	3					3	12
SALI_SP	6					6	23
Sumac	1					1	4
SOLICAN	10					10	38
ASCLSYR	1					1	4
EQUI_SP	1					1	4
CORNSTO	1					1	4
PHRAAUS	3					3	12
totals	26					26	100
basal area	52					52	
standing dead tally	0						



ELC Primary Data Card Page 15 of 72

① **Polygon Code** SWD4-1 [illegible]

Plot(s) 3

Site Name BOWMANVILLE VALLEY

Polygon area 4.5 ha

Date OCT 19 2015

Time 3pm-4pm

Surveyor(s) E. BARTON, J. BRODEUR, M. BUBLO, C. MANUAL, K. PRIMER

Waypoint(s) 3

Photo(s) —

Zone 17T

Easting 0685581

Northing 4864183

②

sampling scale
- ☐ Plot
- ☑ Polygon

sampling effort
- ☑ verification
- ☐ survey
- ☐ research

sampling cards
- ☑ Field Desc's
- ☐ Assoc Desc's
- ☐ Assoc Desc's 2
- ☐ Site+Substrate
- ☐ Species List
- ☐ DBH, Age, Ht
- ☐ Man. / Dist.

size/shape
- ☐ 1 m²
- ☐ 25 m²
- ☐ 100 m²
- ☐ 400 m²
- ☐ circular
- ☐ square
- ☐ rectangle

⑥ Land Cover
- ☑ natural
- ☐ anthropogenic

Energy
- ☐ active
- ☐ not active

System
- ☐ terrestrial
- ☑ wetland
- ☐ aquatic
- ☐ subterranean

Topographic Feature
- ☐ lake / pond / wet dep.
- ☐ river / creek / stream
- ☐ depression
- ☑ bottomland
- ☐ terrace
- ☐ valley slope
- ☐ seep
- ☐ tableland
- ☐ rolling upland
- ☐ shoreline
- ☐ bluff
- ☐ sand dune
- ☐ cliff
- ☐ talus
- ☐ level rockland
- ☐ rolling rockland
- ☐ crevice / cave

④ **Vegetation Summary** of prevailing conditions (4 species X 4 layers)

⑦ **Ecosystem Coverage (%)** 100

Layer	Cover	species in order of decreasing dominance (">>" much greater than, ">" greater than, "=" equal to)
> 10 m	3	SALI_SP > POPUBAL > FRAXANE = ACERNEG = THUJOCC = RHAMCAT
2 - 10 m	4	LONI_SP = PRUNSER > GLEDTRI = RHAMCAT > ACERSAC
0.5 - 2 m	3	LONI_SP = RHAMCAT > ACERSAC > ASTE_SP = ACERNEG
< 0.5 m	2	RHAMCAT = RIBE_SP = MATTSTR = EQUI_SP
other	—	—
< 0.5 m	—	—
> 0.5 m	—	—

cover codes: 1 = 0 - 10%, 2 = 10 - 25%, 3 = 25 - 60%, 4 = > 60%

⑧	
depth augered	50cm
mottles	40cm
gley	> 50cm
bedrock	> 50cm
carbonates	—
water table	> 50cm
depth of organics	27cm
effective texture	LS
moisture regime	MM
position on slope	

0
-10
-20
-30
-40
-50

A horizon (Oh)

mmLS

mottles

⑨

condition	Management / Disturbance	intensity	extent	score
—	—	—	—	—

Site Coverages (%) ⑥

5	bedrock (rockiness)
5	coarse frag. (stoniness)
—	mineral substrate
30	organic material
5	woody debris
5	moss
50	vegetation
—	vernal pooling

Site ⑪
- ☐ open water
- ☐ shallow water
- ☐ parent mineral
- ☐ mineral soil
- ☐ coarse fragments
- ☐ bedrock
- ☒ organic

Material Family ⑪
- ☐ bedrock
- ☐ coarse fragments
- ☑ sandy
- ☐ coarse loamy
- ☐ silty
- ☐ fine loamy
- ☐ clayey
- ☐ organic - folic (dry)
- ☐ organic - peat (wet)

Treed Ecosystem

Age ⑤
- ☐ pioneer
- ☐ young
- ☐ mid - age
- ☒ mature
- ☐ old growth

Substrate Depth ⑥
- ☐ rock (< 5 cm)
- ☐ very shallow (5 - 15 cm)
- ☐ shallow (15 - 30 cm)
- ☐ moderate (30 - 60 cm)
- ☐ moderately deep (60 - 120 cm)
- ☑ deep (> 120 cm)

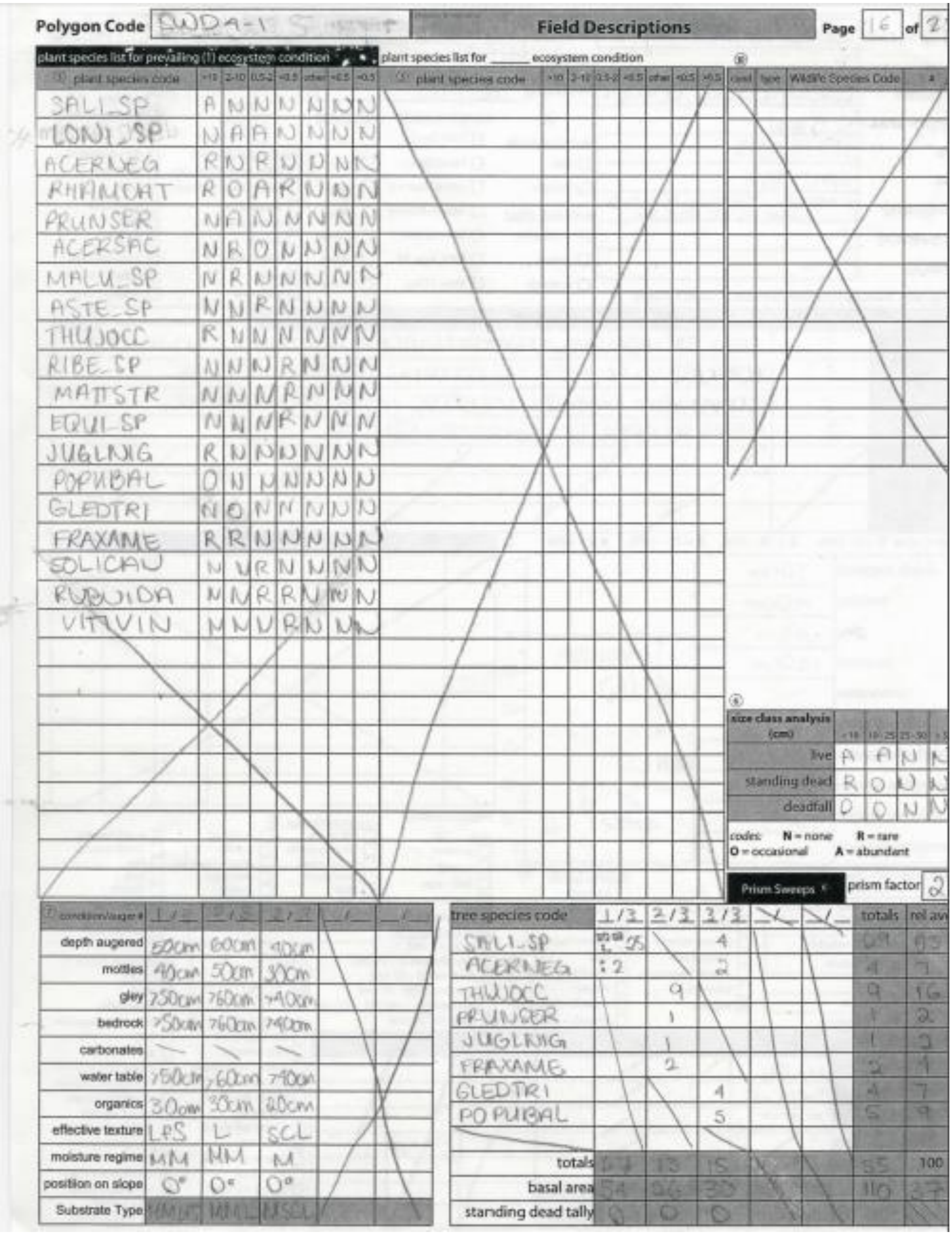
Community Class ⑪
- ☐ still water
- ☐ flowing water
- ☐ beach / bar
- ☐ sand dune
- ☐ bluff
- ☐ cliff
- ☐ talus
- ☐ rockland
- ☐ crevice / cave
- ☐ mineral barren
- ☐ meadow
- ☐ prairie
- ☐ shrubland
- ☐ treed
- ☒ treed swamp
- ☐ shrub swamp
- ☐ fen
- ☐ bog
- ☐ marsh
- ☐ agriculture
- ☐ actively managed
- ☐ constructed

Chemistry ⑪
- ☐ calcareous
- ☐ non-calcareous
- ☐ saline

Vegetation Cover ⑤
- ☐ not vegetated
- ☐ non-vascular
- ☐ sparse herbaceous
- ☐ herbaceous
- ☐ sparse low shrub
- ☐ low shrub
- ☐ sparse tall shrub
- ☑ tall shrub
- ☐ sparse low treed
- ☐ low treed
- ☐ sparse tall treed
- ☐ semi-closed tall treed
- ☐ closed tall treed

Vegetation Form ⑤
- ☐ lichen
- ☐ algal
- ☐ bryophyte
- ☐ mixed non-vascular
- ☐ forb
- ☐ graminoid
- ☐ mixed herbaceous
- ☐ floating-lvd aquatic
- ☐ suberged aquatic
- ☐ mixed aquatic
- ☐ coniferous shrub
- ☐ evergreen shrub
- ☐ mixed shrub
- ☒ deciduous shrub
- ☐ coniferous treed
- ☐ mixed treed
- ☐ deciduous treed

Classification	code	name	2	3	4
Substrate Type	MM Oh	—	—	—	—
Vegetation Type	SWD4-1	—	—	—	—
Ecosite	Deciduous Organic Swamp	—	—	—	—
Ecoelement	—	—	—	—	—
1st or 2nd Approx	—	—	—	—	—
		Inclusion / Complex	—	—	—
	100	⑦ Ecosystem Coverage (%)	—	—	—



Polygon Code SWD4-1 S[illegible]

Field Descriptions

Page 16 **of** 2

plant species list for prevailing (1) ecosystem condition

① plant species code	>10	2-10	0.5-2	<0.5	other	<0.5	>0.5
SALI_SP	A	N	N	N	N	N	N
LONI_SP	N	A	A	N	N	N	N
ACERNEG	R	N	R	N	N	N	N
RHAMCAT	R	O	A	R	N	N	N
PRUNSER	N	A	N	N	N	N	N
ACERSAC	N	R	O	N	N	N	N
MALU_SP	N	R	N	N	N	N	N
ASTE_SP	N	N	R	N	N	N	N
THUJOCC	R	N	N	N	N	N	N
RIBE_SP	N	N	N	R	N	N	N
MATTSTR	N	N	N	R	N	N	N
EQUI_SP	N	N	N	R	N	N	N
JUGLNIG	R	N	N	N	N	N	N
POPUBAL	O	N	N	N	N	N	N
GLEDTRI	N	O	N	N	N	N	N
FRAXAME	R	R	N	N	N	N	N
SOLICAN	N	N	R	N	N	N	N
RUBUIDA	N	N	R	R	N	N	N
VITRVIN	N	N	N	R	N	N	N

plant species list for ______ ecosystem condition

② plant species code	>10	2-10	0.5-2	<0.5	other	<0.5	>0.5

⑧

card	type	Wildlife Species Code	#

⑥

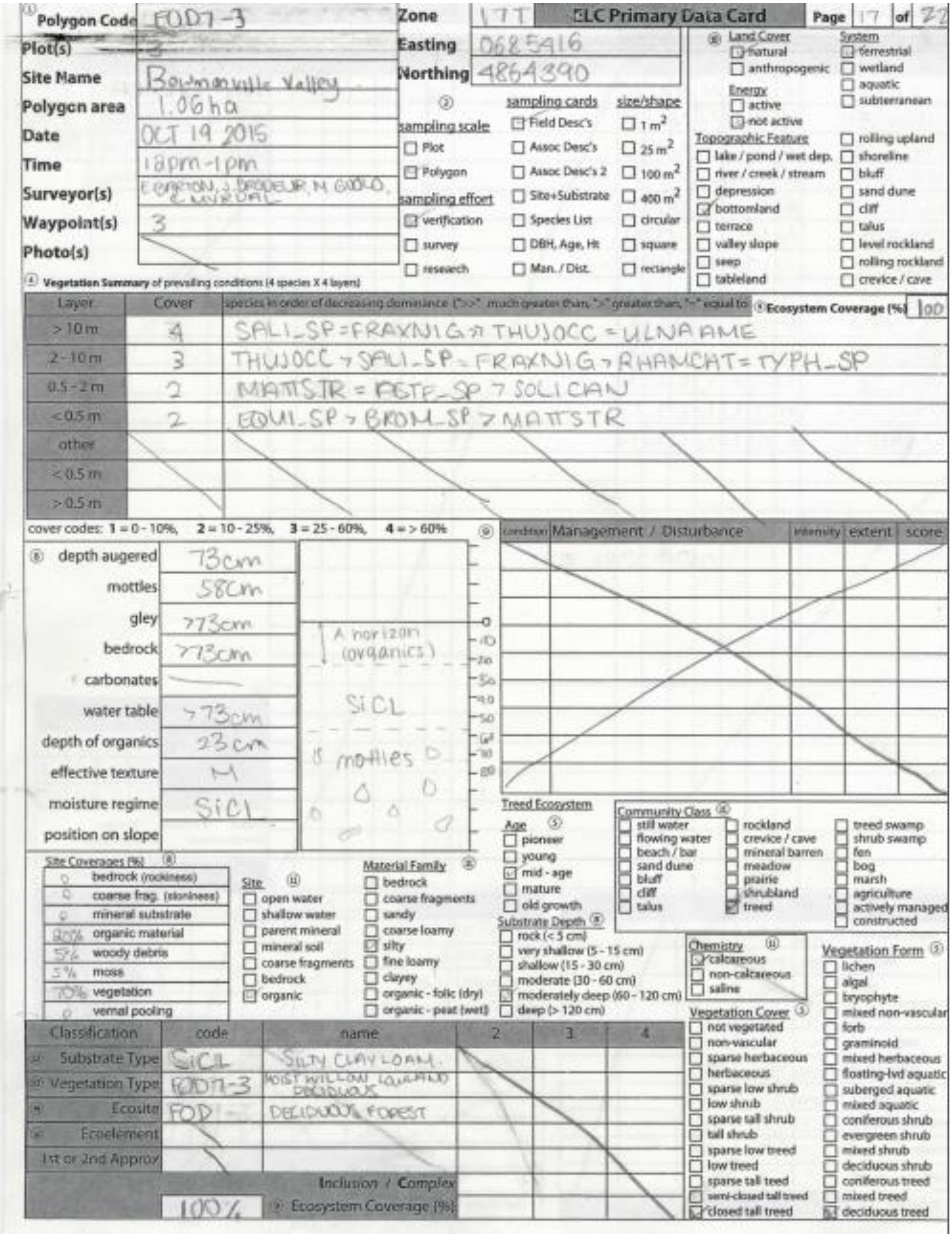
size class analysis (cm)	<10	10-25	25-50	>5
live	A	A	N	N
standing dead	R	O	N	N
deadfall	O	O	N	N

codes: **N** = none **R** = rare **O** = occasional **A** = abundant

⑦ condition/auger #	1/3	2/3	3/3	_/_	_/_
depth augered	50cm	60cm	40cm		
mottles	40cm	50cm	30cm		
gley	>50cm	>60cm	>40cm		
bedrock	>50cm	>60cm	>40cm		
carbonates	—	—	—		
water table	>50cm	>60cm	>40cm		
organics	30cm	30cm	20cm		
effective texture	LFS	L	SCL		
moisture regime	MM	MM	M		
position on slope	0°	0°	0°		
Substrate Type	MMLFS	MML	MSCL		

Prism Sweeps prism factor 2

tree species code	1/3	2/3	3/3	_/_	_/_	totals	rel av
SALI_SP	25		4			29	53
ACERNEG	2		2			4	7
THUJOCC		9				9	16
PRUNSER		1				1	2
JUGLNIG		1				1	2
FRAXAME		2				2	4
GLEDTRI			4			4	7
POPUBAL			5			5	9
totals	27	13	15			55	100
basal area	54	26	30			110	37
standing dead tally	0	0	0				



ELC Primary Data Card

Page 17 of 22

① Polygon Code: FOD7-3
Plot(s): 3
Site Name: Bowmanville Valley
Polygon area: 1.06ha
Date: OCT 19 2015
Time: 12pm-1pm
Surveyor(s): E EGERTON, J. BRODEUR, M. GOULD, C. MURDAL
Waypoint(s): 3
Photo(s):

Zone: 17T
Easting: 0685416
Northing: 4864390

② sampling scale
☐ Plot
☑ Polygon

sampling effort
☑ verification
☐ survey
☐ research

sampling cards
☑ Field Desc's
☐ Assoc Desc's
☐ Assoc Desc's 2
☐ Site+Substrate
☐ Species List
☐ DBH, Age, Ht
☐ Man. / Dist.

size/shape
☐ 1 m²
☐ 25 m²
☐ 100 m²
☐ 400 m²
☐ circular
☐ square
☐ rectangle

⑥ Land Cover
☑ natural
☐ anthropogenic

Energy
☐ active
☑ not active

System
☑ terrestrial
☐ wetland
☐ aquatic
☐ subterranean

Topographic Feature
☐ lake / pond / wet dep.
☐ river / creek / stream
☐ depression
☑ bottomland
☐ terrace
☐ valley slope
☐ seep
☐ tableland
☐ rolling upland
☐ shoreline
☐ bluff
☐ sand dune
☐ cliff
☐ talus
☐ level rockland
☐ rolling rockland
☐ crevice / cave

④ **Vegetation Summary** of prevailing conditions (4 species X 4 layers)

Layer	Cover	species in order of decreasing dominance (">>" much greater than, ">" greater than, "~" equal to)
> 10 m	4	SALI_SP=FRAXNIG >> THUJOCC = ULNAAME
2-10 m	3	THUJOCC > SALI_SP = FRAXNIG > RHAMCAT = TYPH_SP
0.5-2 m	2	MATTSTR = AGTE_SP > SOLICAN
< 0.5 m	2	EQUI_SP > BROM_SP > MATTSTR
other		
< 0.5 m		
> 0.5 m		

⑥ Ecosystem Coverage (%): 100

cover codes: 1 = 0 - 10%, 2 = 10 - 25%, 3 = 25 - 60%, 4 = > 60%

⑧	
depth augered	73cm
mottles	58Cm
gley	>73cm
bedrock	>73cm
carbonates	—
water table	>73cm
depth of organics	23cm
effective texture	M
moisture regime	SiCl
position on slope	

0
10
20
30
40
50
60
70
80

A horizon (organics)
SiCL
mottles

⑨ condition	Management / Disturbance	intensity	extent	score

Site Coverages (%) ⑧

0	bedrock (rockiness)
0	coarse frag. (stoniness)
0	mineral substrate
80%	organic material
5%	woody debris
5%	moss
70%	vegetation
0	vernal pooling

Site ⑪
☐ open water
☐ shallow water
☐ parent mineral
☐ mineral soil
☐ coarse fragments
☐ bedrock
☑ organic

Material Family ⑧
☐ bedrock
☐ coarse fragments
☐ sandy
☐ coarse loamy
☑ silty
☐ fine loamy
☐ clayey
☐ organic - folic (dry)
☐ organic - peat (wet)

Treed Ecosystem

Age ⑤
☐ pioneer
☐ young
☑ mid - age
☐ mature
☐ old growth

Substrate Depth ⑧
☐ rock (< 5 cm)
☐ very shallow (5 - 15 cm)
☐ shallow (15 - 30 cm)
☐ moderate (30 - 60 cm)
☑ moderately deep (60 - 120 cm)
☐ deep (> 120 cm)

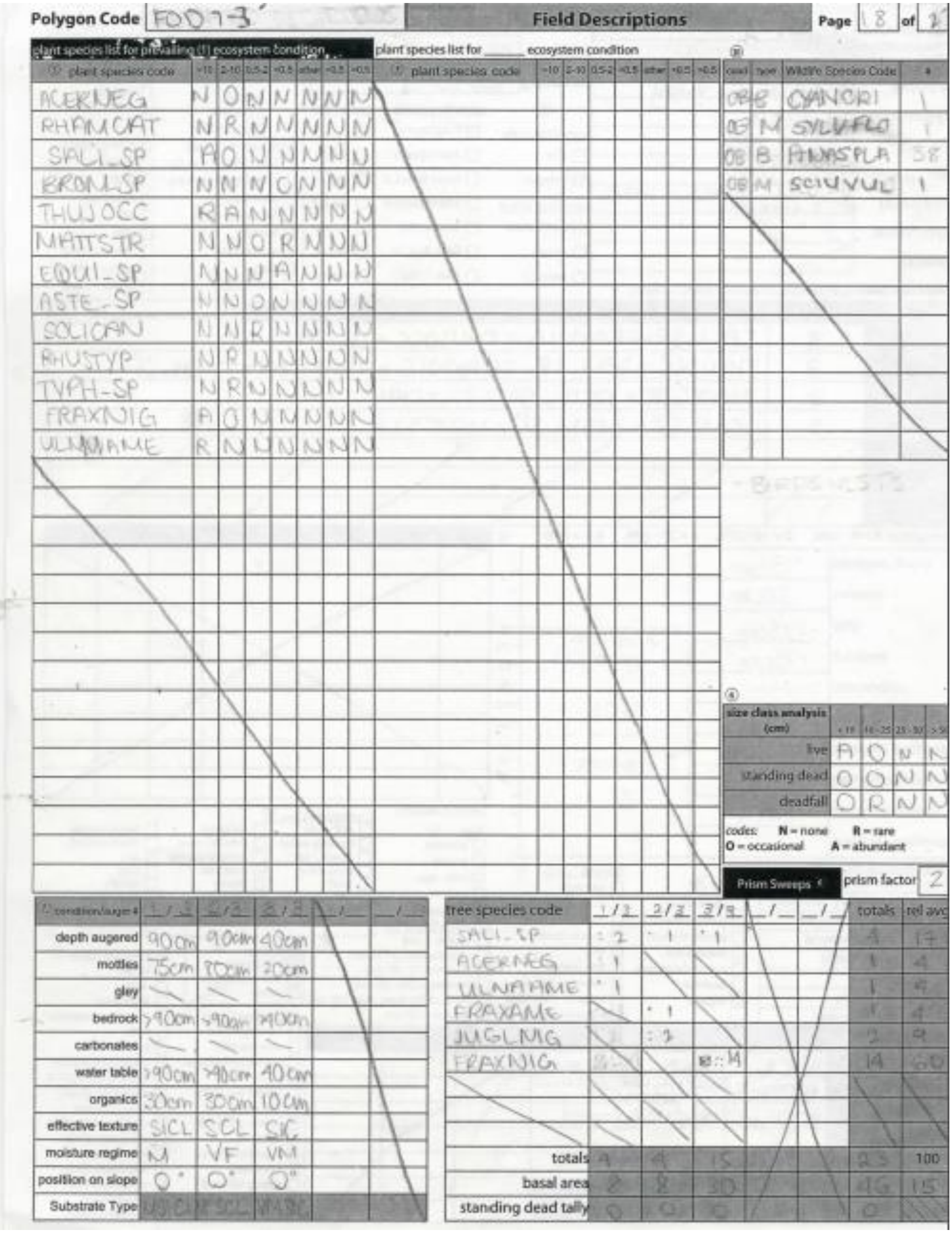
Community Class ④
☐ still water
☐ flowing water
☐ beach / bar
☐ sand dune
☐ bluff
☐ cliff
☐ talus
☐ rockland
☐ crevice / cave
☐ mineral barren
☐ meadow
☐ prairie
☐ shrubland
☑ treed
☐ treed swamp
☐ shrub swamp
☐ fen
☐ bog
☐ marsh
☐ agriculture
☐ actively managed
☐ constructed

Chemistry ⑪
☑ calcareous
☐ non-calcareous
☐ saline

Vegetation Cover ⑤
☐ not vegetated
☐ non-vascular
☐ sparse herbaceous
☐ herbaceous
☐ sparse low shrub
☐ low shrub
☐ sparse tall shrub
☐ tall shrub
☐ sparse low treed
☐ low treed
☐ sparse tall teed
☐ semi-closed tall treed
☑ closed tall treed

Vegetation Form ⑤
☐ lichen
☐ algal
☐ bryophyte
☐ mixed non-vascular
☐ forb
☐ graminoid
☐ mixed herbaceous
☐ floating-lvd aquatic
☐ suberged aquatic
☐ mixed aquatic
☐ coniferous shrub
☐ evergreen shrub
☐ mixed shrub
☐ deciduous shrub
☐ coniferous treed
☐ mixed treed
☑ deciduous treed

Classification	code	name	2	3	4
⑩ Substrate Type	SiCL	SILTY CLAY LOAM.			
⑩ Vegetation Type	FOD7-3	MOIST WILLOW LOWLAND DECIDUOUS			
⑩ Ecosite	FOD	DECIDUOUS FOREST			
⑩ Ecoelement					
1st or 2nd Approx					
		Inclusion / Complex			
	100%	⑨ Ecosystem Coverage (%)			



Polygon Code FO07-3 **Field Descriptions** **Page** 18 **of** 2

plant species list for prevailing (1) ecosystem condition

plant species code	>10	2-10	0.5-2	<0.5	other	<0.5	<0.5
ACERNEG	N	O	N	N	N	N	N
RHAMCAT	N	R	N	N	N	N	N
SALI_SP	A	O	N	N	N	N	N
BROM_SP	N	N	N	O	N	N	N
THUJOCC	R	A	N	N	N	N	N
MATTSTR	N	N	O	R	N	N	N
EQUI_SP	N	N	N	A	N	N	N
ASTE_SP	N	N	O	N	N	N	N
SOLICAN	N	N	R	N	N	N	N
RHUSTYP	N	R	N	N	N	N	N
TYPH_SP	N	R	N	N	N	N	N
FRAXNIG	A	O	N	N	N	N	N
ULMUAME	R	N	N	N	N	N	N

plant species list for ______ ecosystem condition

plant species code	>10	2-10	0.5-2	<0.5	other	<0.5	<0.5

quad	type	Wildlife Species Code	#
08	B	CYANCRI	1
08	M	SYLVFLO	1
08	B	ANASPLA	58
08	M	SCIUVUL	1

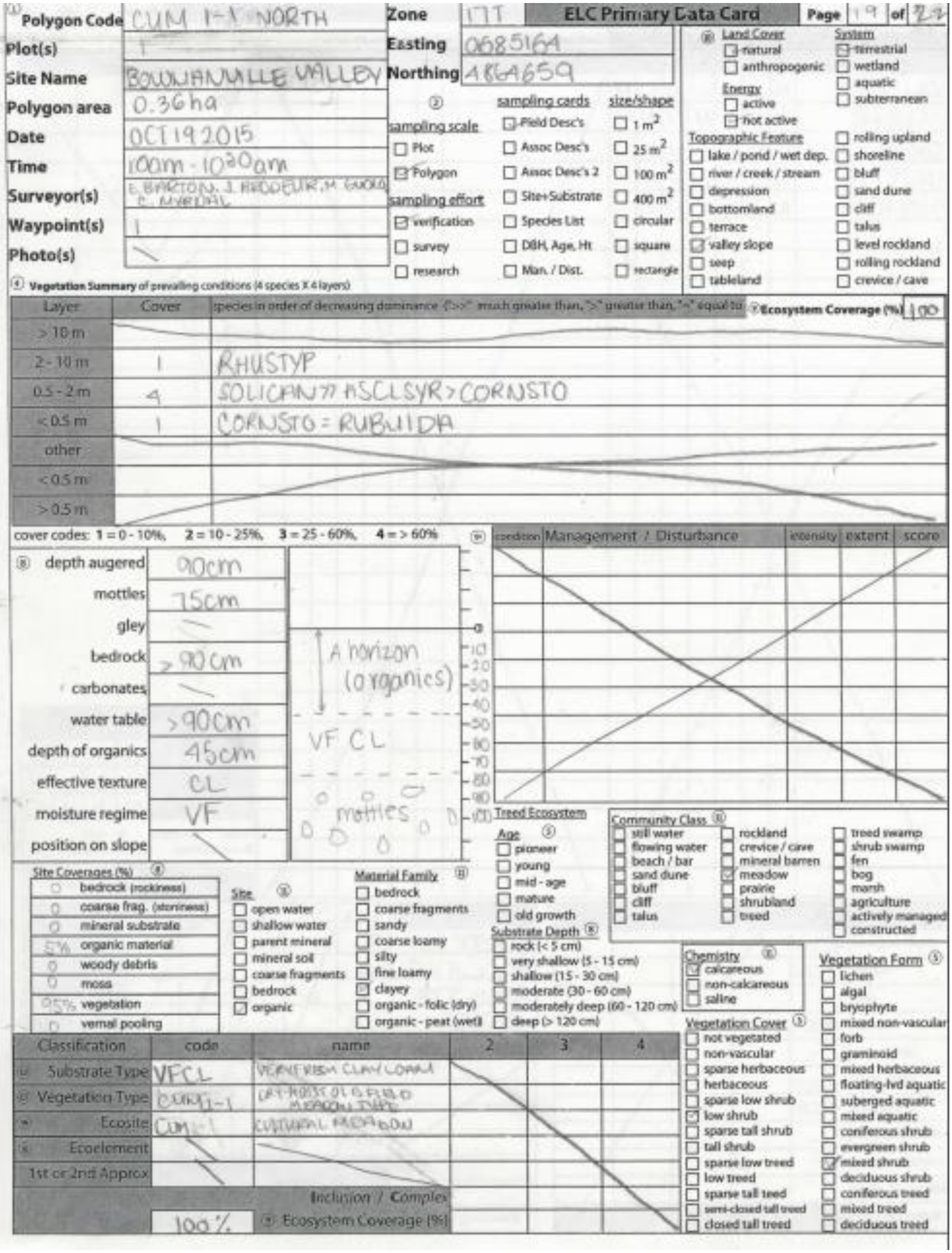
size class analysis (cm)	<10	10-25	25-50	>50
live	A	O	N	N
standing dead	O	O	N	N
deadfall	O	R	N	N

codes: **N** = none **R** = rare **O** = occasional **A** = abundant

Prism Sweeps prism factor 2

condition/auger #	1/3	2/3	3/3	_/_	_/_
depth augered	90cm	90cm	40cm		
mottles	75cm	80cm	20cm		
gley	—	—	—		
bedrock	>90cm	>90cm	>40cm		
carbonates	—	—	—		
water table	>90cm	>90cm	40cm		
organics	30cm	30cm	10cm		
effective texture	SiCL	SCL	SiC		
moisture regime	M	VF	VM		
position on slope	0°	0°	0°		
Substrate Type	MSiCL	VFSCL	VMSiC		

tree species code	1/3	2/3	3/3	_/_	_/_	totals	rel avg
SALI_SP	2	1	1			4	17
ACERNEG	1					1	4
ULNAAME	1					1	4
FRAXAME		1				1	4
JUGLNIG		2				2	9
FRAXNIG			14			14	60
totals	4	4	15			23	100
basal area	8	8	30			46	15
standing dead tally	0	0	0			0	



ELC Primary Data Card Page 19 of 22

① Polygon Code	CUM 1-1 NORTH
Plot(s)	1
Site Name	BOWMANVILLE VALLEY
Polygon area	0.36ha
Date	OCT 19 2015
Time	10am - 10^{30}am
Surveyor(s)	E. BARTON, J. BRODEUR, M. GUOLO, C. MYRDAL
Waypoint(s)	1
Photo(s)	\

Zone	17T
Easting	0685164
Northing	4864659

②

sampling scale
- ☐ Plot
- ☑ Polygon

sampling effort
- ☑ verification
- ☐ survey
- ☐ research

sampling cards
- ☑ Field Desc's
- ☐ Assoc Desc's
- ☐ Assoc Desc's 2
- ☐ Site+Substrate
- ☐ Species List
- ☐ DBH, Age, Ht
- ☐ Man. / Dist.

size/shape
- ☐ 1 m^2
- ☐ 25 m^2
- ☐ 100 m^2
- ☐ 400 m^2
- ☐ circular
- ☐ square
- ☐ rectangle

® Land Cover
- ☑ natural
- ☐ anthropogenic

Energy
- ☐ active
- ☑ not active

System
- ☑ terrestrial
- ☐ wetland
- ☐ aquatic
- ☐ subterranean

Topographic Feature
- ☐ lake / pond / wet dep.
- ☐ river / creek / stream
- ☐ depression
- ☐ bottomland
- ☐ terrace
- ☑ valley slope
- ☐ seep
- ☐ tableland
- ☐ rolling upland
- ☐ shoreline
- ☐ bluff
- ☐ sand dune
- ☐ cliff
- ☐ talus
- ☐ level rockland
- ☐ rolling rockland
- ☐ crevice / cave

④ **Vegetation Summary** of prevailing conditions (4 species X 4 layers)

Layer	Cover	species in order of decreasing dominance (">>" much greater than, ">" greater than, "=" equal to) ⑦ Ecosystem Coverage (%) 100
> 10 m		
2 - 10 m	1	RHUSTYP
0.5 - 2 m	4	SOLICAN >> ASCLSYR > CORNSTO
< 0.5 m	1	CORNSTO = RUBUIDA
other		
< 0.5 m		
> 0.5 m		

cover codes: 1 = 0 - 10%, 2 = 10 - 25%, 3 = 25 - 60%, 4 = > 60%

® depth augered	90cm
mottles	75cm
gley	—
bedrock	> 90 cm
carbonates	—
water table	> 90cm
depth of organics	45cm
effective texture	CL
moisture regime	VF
position on slope	\

0 10 20 30 40 50 60 70 80 90 100

A horizon (organics)

VF CL

mottles

condition	Management / Disturbance	intensity	extent	score

Site Coverages (%) ⑧

0	bedrock (rockiness)
0	coarse frag. (stoniness)
0	mineral substrate
5%	organic material
0	woody debris
0	moss
95%	vegetation
0	vernal pooling

Site ⑤
- ☐ open water
- ☐ shallow water
- ☐ parent mineral
- ☐ mineral soil
- ☐ coarse fragments
- ☐ bedrock
- ☑ organic

Material Family ®
- ☐ bedrock
- ☐ coarse fragments
- ☐ sandy
- ☐ coarse loamy
- ☐ silty
- ☐ fine loamy
- ☑ clayey
- ☐ organic - folic (dry)
- ☐ organic - peat (wet)

Treed Ecosystem

Age ⑤
- ☐ pioneer
- ☐ young
- ☐ mid - age
- ☐ mature
- ☐ old growth

Substrate Depth ®
- ☐ rock (< 5 cm)
- ☐ very shallow (5 - 15 cm)
- ☐ shallow (15 - 30 cm)
- ☐ moderate (30 - 60 cm)
- ☐ moderately deep (60 - 120 cm)
- ☐ deep (> 120 cm)

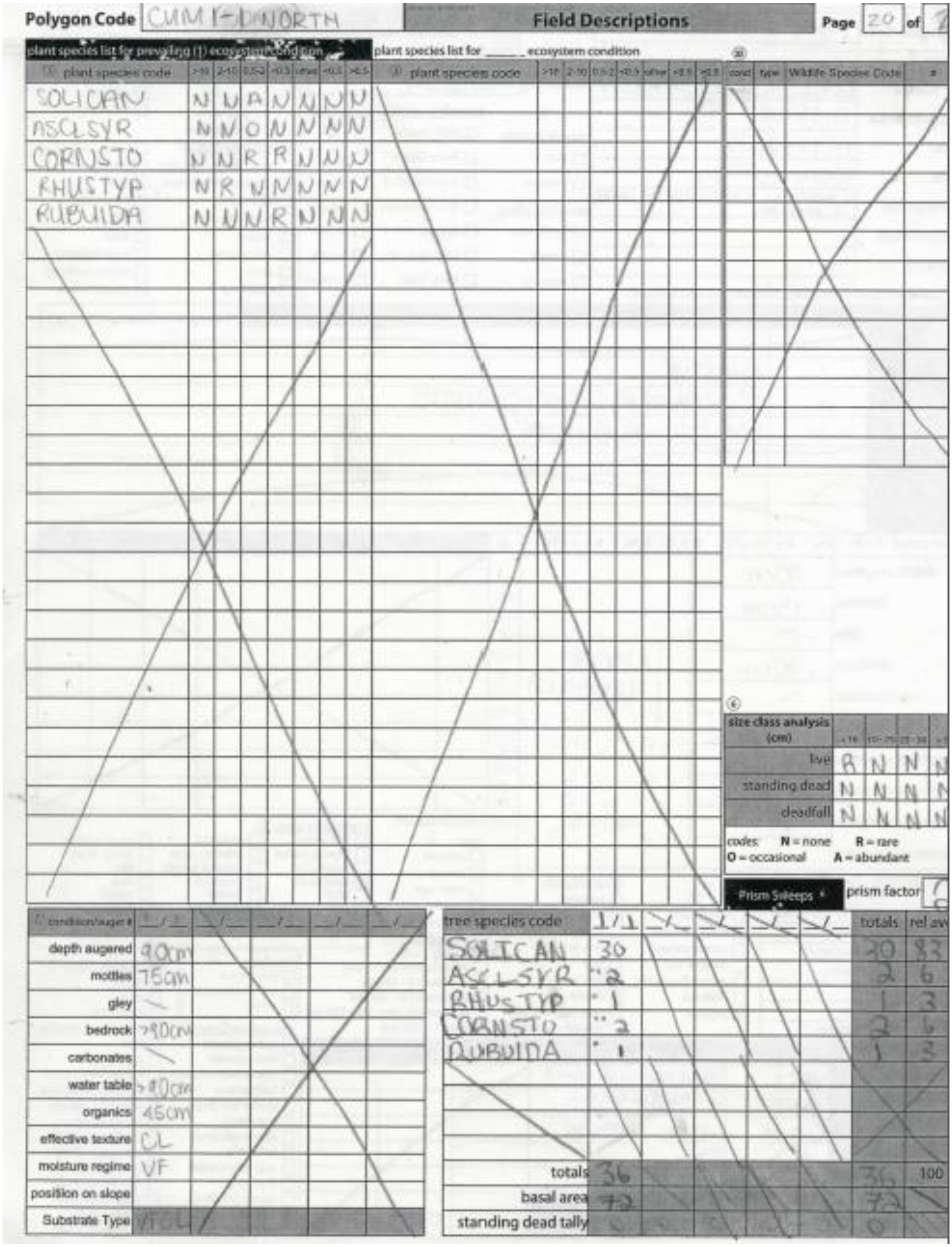
Community Class ®
- ☐ still water
- ☐ flowing water
- ☐ beach / bar
- ☐ sand dune
- ☐ bluff
- ☐ cliff
- ☐ talus
- ☐ rockland
- ☐ crevice / cave
- ☐ mineral barren
- ☑ meadow
- ☐ prairie
- ☐ shrubland
- ☐ treed
- ☐ treed swamp
- ☐ shrub swamp
- ☐ fen
- ☐ bog
- ☐ marsh
- ☐ agriculture
- ☐ actively managed
- ☐ constructed

Chemistry ®
- ☑ calcareous
- ☐ non-calcareous
- ☐ saline

Vegetation Cover ⑤
- ☐ not vegetated
- ☐ non-vascular
- ☐ sparse herbaceous
- ☐ herbaceous
- ☐ sparse low shrub
- ☑ low shrub
- ☐ sparse tall shrub
- ☐ tall shrub
- ☐ sparse low treed
- ☐ low treed
- ☐ sparse tall treed
- ☐ semi-closed tall treed
- ☐ closed tall treed

Vegetation Form ⑤
- ☐ lichen
- ☐ algal
- ☐ bryophyte
- ☐ mixed non-vascular
- ☐ forb
- ☐ graminoid
- ☐ mixed herbaceous
- ☐ floating-lvd aquatic
- ☐ suberged aquatic
- ☐ mixed aquatic
- ☐ coniferous shrub
- ☐ evergreen shrub
- ☑ mixed shrub
- ☐ deciduous shrub
- ☐ coniferous treed
- ☐ mixed treed
- ☐ deciduous treed

Classification	code	name	2	3	4
Substrate Type	VFCL	VERY FRESH CLAY LOAM			
Vegetation Type	CUM1-1	DRY-MOIST OLD FIELD MEADOW TYPE			
Ecosite	CUM1-1	CULTURAL MEADOW			
Ecoelement	\				
1st or 2nd Approx	\				
		Inclusion / Complex			
	100%	Ecosystem Coverage (%)			



Polygon Code CUM I-D NORTH

Field Descriptions

Page 20 **of**

plant species list for prevailing (1) ecosystem condition

plant species code	>10	2-10	0.5-2	<0.5	other	<0.5	>0.5
SOLICAN	N	N	A	N	N	N	N
ASCLSYR	N	N	O	N	N	N	N
CORNSTO	N	N	R	R	N	N	N
RHUSTYP	N	R	N	N	N	N	N
RUBUIDA	N	N	N	R	N	N	N

plant species list for ______ ecosystem condition

plant species code	>10	2-10	0.5-2	<0.5	other	<0.5	>0.5

cond	type	Wildlife Species Code	#

size class analysis (cm)

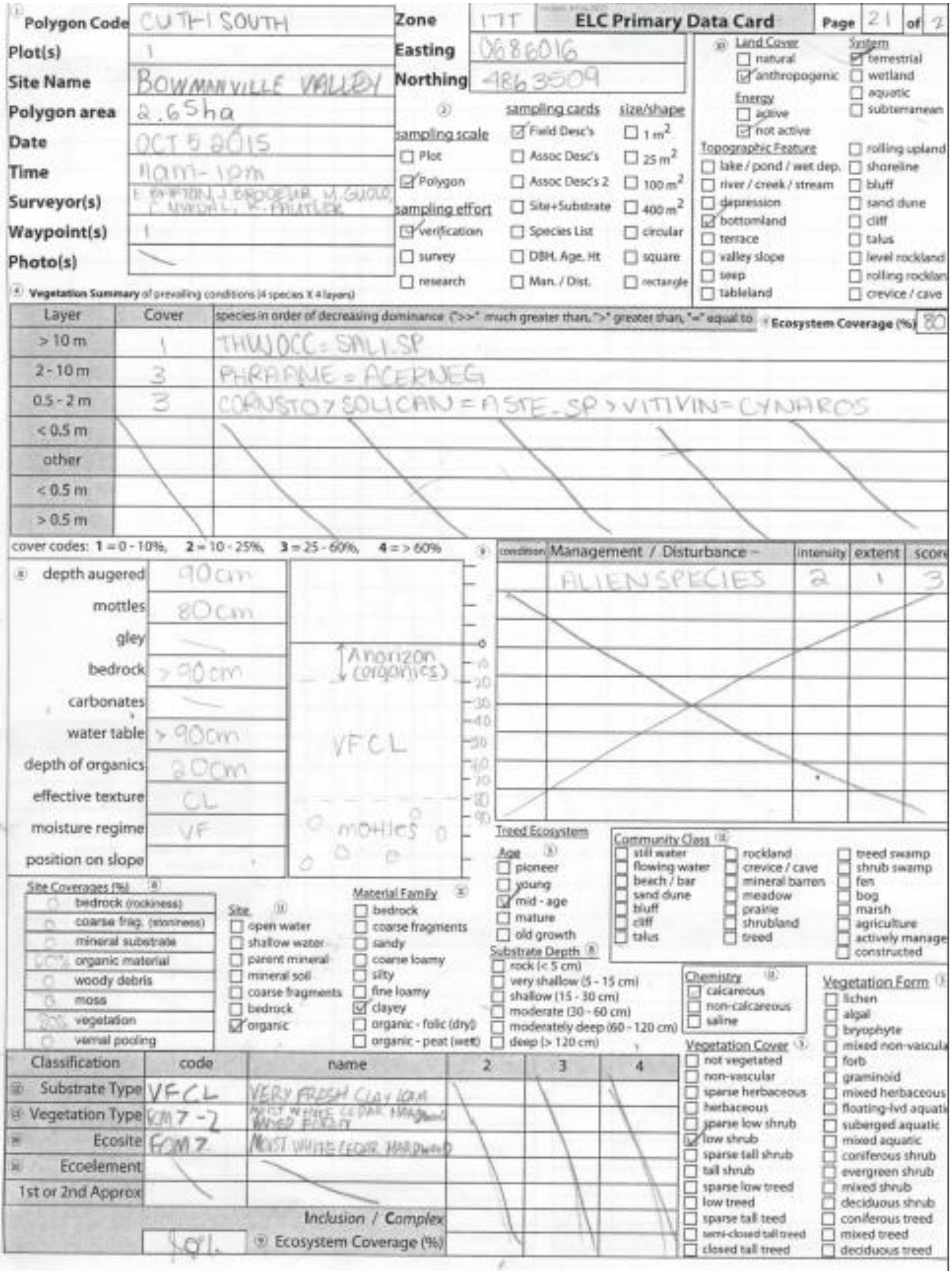
	<10	10-25	25-38	
live	R	N	N	N
standing dead	N	N	N	N
deadfall	N	N	N	N

codes: **N** = none **R** = rare **O** = occasional **A** = abundant

Prism Sweeps prism factor

condition/auger #	1 / 1	__ / __	__ / __	__ / __	__ / __
depth augered	90cm				
mottles	75cm				
gley	—				
bedrock	>90cm				
carbonates	—				
water table	>90cm				
organics	45cm				
effective texture	CL				
moisture regime	VF				
position on slope					
Substrate Type	VTOL				

tree species code	1/1	__/__	__/__	__/__	__/__	totals	rel ab
SOLICAN	30					30	83
ASCLSYR	2					2	6
RHUSTYP	1					1	3
CORNSTO	2					2	6
RUBUIDA	1					1	3
totals	36					36	100
basal area	72					72	
standing dead tally	0					0	



ELC Primary Data Card Page 21 of 2

Polygon Code	CUTH SOUTH
Plot(s)	1
Site Name	BOWMANVILLE VALLEY
Polygon area	2.65ha
Date	OCT 5 2015
Time	11am-1pm
Surveyor(s)	E. BARTON, J. BRODEUR, M. GUOLO, [illegible], K. PAUTLER
Waypoint(s)	1
Photo(s)	—

Zone	17T
Easting	0686016
Northing	4863509

sampling scale
- ☐ Plot
- ☑ Polygon

sampling effort
- ☑ verification
- ☐ survey
- ☐ research

sampling cards
- ☑ Field Desc's
- ☐ Assoc Desc's
- ☐ Assoc Desc's 2
- ☐ Site+Substrate
- ☐ Species List
- ☐ DBH, Age, Ht
- ☐ Man. / Dist.

size/shape
- ☐ 1 m²
- ☐ 25 m²
- ☐ 100 m²
- ☐ 400 m²
- ☐ circular
- ☐ square
- ☐ rectangle

Land Cover
- ☐ natural
- ☑ anthropogenic

Energy
- ☐ active
- ☑ not active

System
- ☑ terrestrial
- ☐ wetland
- ☐ aquatic
- ☐ subterranean

Topographic Feature
- ☐ lake / pond / wet dep.
- ☐ river / creek / stream
- ☐ depression
- ☑ bottomland
- ☐ terrace
- ☐ valley slope
- ☐ seep
- ☐ tableland
- ☐ rolling upland
- ☐ shoreline
- ☐ bluff
- ☐ sand dune
- ☐ cliff
- ☐ talus
- ☐ level rockland
- ☐ rolling rocklan
- ☐ crevice / cave

Vegetation Summary of prevailing conditions (4 species X 4 layers)

Ecosystem Coverage (%) 80

Layer	Cover	species in order of decreasing dominance (">>" much greater than, ">" greater than, "=" equal to
> 10 m	1	THUOCC = SALI.SP
2 - 10 m	3	PHRAAME = ACERNEG
0.5 - 2 m	3	CORNSTO > SOLICAN = ASTE_SP > VITIVIN = CYNAROS
< 0.5 m		
other		
< 0.5 m		
> 0.5 m		

cover codes: **1** = 0 - 10%, **2** = 10 - 25%, **3** = 25 - 60%, **4** = > 60%

depth augered	90cm
mottles	80cm
gley	—
bedrock	> 90cm
carbonates	—
water table	> 90cm
depth of organics	20cm
effective texture	CL
moisture regime	VF
position on slope	

A horizon (organics)

VFCL

mottles

0 10 20 30 40 50 60 70 80 90

condition	Management / Disturbance –	intensity	extent	score
	ALIEN SPECIES	2	1	3

Site Coverages (%)
- 0 bedrock (rockiness)
- 0 coarse frag. (stoniness)
- 0 mineral substrate
- 80% organic material
- 0 woody debris
- 0 moss
- 20% vegetation
- 0 vernal pooling

Site
- ☐ open water
- ☐ shallow water
- ☐ parent mineral
- ☐ mineral soil
- ☐ coarse fragments
- ☐ bedrock
- ☑ organic

Material Family
- ☐ bedrock
- ☐ coarse fragments
- ☐ sandy
- ☐ coarse loamy
- ☐ silty
- ☐ fine loamy
- ☑ clayey
- ☐ organic - folic (dry)
- ☐ organic - peat (wet)

Treed Ecosystem

Age
- ☐ pioneer
- ☐ young
- ☑ mid - age
- ☐ mature
- ☐ old growth

Substrate Depth
- ☐ rock (< 5 cm)
- ☐ very shallow (5 - 15 cm)
- ☐ shallow (15 - 30 cm)
- ☐ moderate (30 - 60 cm)
- ☐ moderately deep (60 - 120 cm)
- ☐ deep (> 120 cm)

Community Class
- ☐ still water
- ☐ flowing water
- ☐ beach / bar
- ☐ sand dune
- ☐ bluff
- ☐ cliff
- ☐ talus
- ☐ rockland
- ☐ crevice / cave
- ☐ mineral barren
- ☐ meadow
- ☐ prairie
- ☐ shrubland
- ☐ treed
- ☐ treed swamp
- ☐ shrub swamp
- ☐ fen
- ☐ bog
- ☐ marsh
- ☐ agriculture
- ☐ actively manage
- ☐ constructed

Chemistry
- ☐ calcareous
- ☐ non-calcareous
- ☐ saline

Vegetation Cover
- ☐ not vegetated
- ☐ non-vascular
- ☐ sparse herbaceous
- ☐ herbaceous
- ☐ sparse low shrub
- ☑ low shrub
- ☐ sparse tall shrub
- ☐ tall shrub
- ☐ sparse low treed
- ☐ low treed
- ☐ sparse tall teed
- ☐ semi-closed tall treed
- ☐ closed tall treed

Vegetation Form
- ☐ lichen
- ☐ algal
- ☐ bryophyte
- ☐ mixed non-vascula
- ☐ forb
- ☐ graminoid
- ☐ mixed herbaceous
- ☐ floating-lvd aquati
- ☐ suberged aquatic
- ☐ mixed aquatic
- ☐ coniferous shrub
- ☐ evergreen shrub
- ☐ mixed shrub
- ☐ deciduous shrub
- ☐ coniferous treed
- ☐ mixed treed
- ☐ deciduous treed

Classification	code	name	2	3	4
Substrate Type	VFCL	VERY FRESH CLAY LOAM			
Vegetation Type	FOM7-2	MOIST WHITE CEDAR HARDWOOD MIXED FOREST			
Ecosite	FOM7	MOIST WHITE CEDAR HARDWOOD			
Ecoelement					
1st or 2nd Approx					
Inclusion / Complex					
Ecosystem Coverage (%)	80%				

Polygon Code CUTI-1 SOUTH

Field Descriptions

Page 22 **of** 2

plant species list for prevailing (1) ecosystem condition

③ plant species code	>10	2-10	0.5-2	<0.5	other	<0.5	>0.5
ASTE_SP	N	N	O	N			
VITIVIN	N	N	R	N			
PHRAAME	N	A	N	N			
CORNSTO	N	N	A	N			
SOLICAN	N	N	O	N			
THUJOCC	R	N	N	N			
SALI_SP	R	N	N	N			
ACERNEG	N	A	N	N			
CYNAROS	N	N	R	N			

plant species list for ______ ecosystem condition

③ plant species code	>10	2-10	0.5-2	<0.5	other	<0.5	>0.5

⑩

const	type	Wildlife Species Code	#

⑥

size class analysis (cm)	<10	10-25	25-	>
live				
standing dead				
deadfall				

codes: **N** = none **R** = rare
O = occasional **A** = abundant

Prism Sweeps ▸ prism factor

⑦ condition/auger #	1 / 1	__/__	__/__	__/__	__/__
depth augered	90cm				
mottles	80cm				
gley	>90cm				
bedrock	>90cm				
carbonates	—				
water table	>90cm				
organics	00cm				
effective texture	CL				
moisture regime	VF				
position on slope					
Substrate Type	VFCL				

tree species code	__/__	__/__	__/__	__/__	__/__	totals	rel av
totals							100
basal area							
standing dead tally							

Appendix D: Photos

Photo 1: Extensive beaver-damaged trees within polygon MAS2-1.

Photo 2: Taken in polygon FOC 2-2, human disturbances are evident, with scorched trees and garbage dumped throughout the area. Kirstin is sad.

Appendix E: References

City of Kawartha Lakes Forestry (2015). Retrieved on Nov 14 2015 from: https://www.city.kawarthalakes.on.ca/residents/parks-recreation-culture/forestry

Ontario Land Trust Alliance (OLTA) (2006). The Baseline Documentation Report (BDR).

Ontario Land Trust Alliance (OLTA) (2005). A Volunteer's Manutal for Land Management. Retrieved from: http://olta.ca/wp-content/uploads/2015/05/20352_file.pdf

Ontario Ministry of Natural Resources (OMNR), et al. (2001). Ecological Land Classification for Southern Ontario: Training Manual. Canadian Cataloguing in Publication Data, Ontario, Canada.

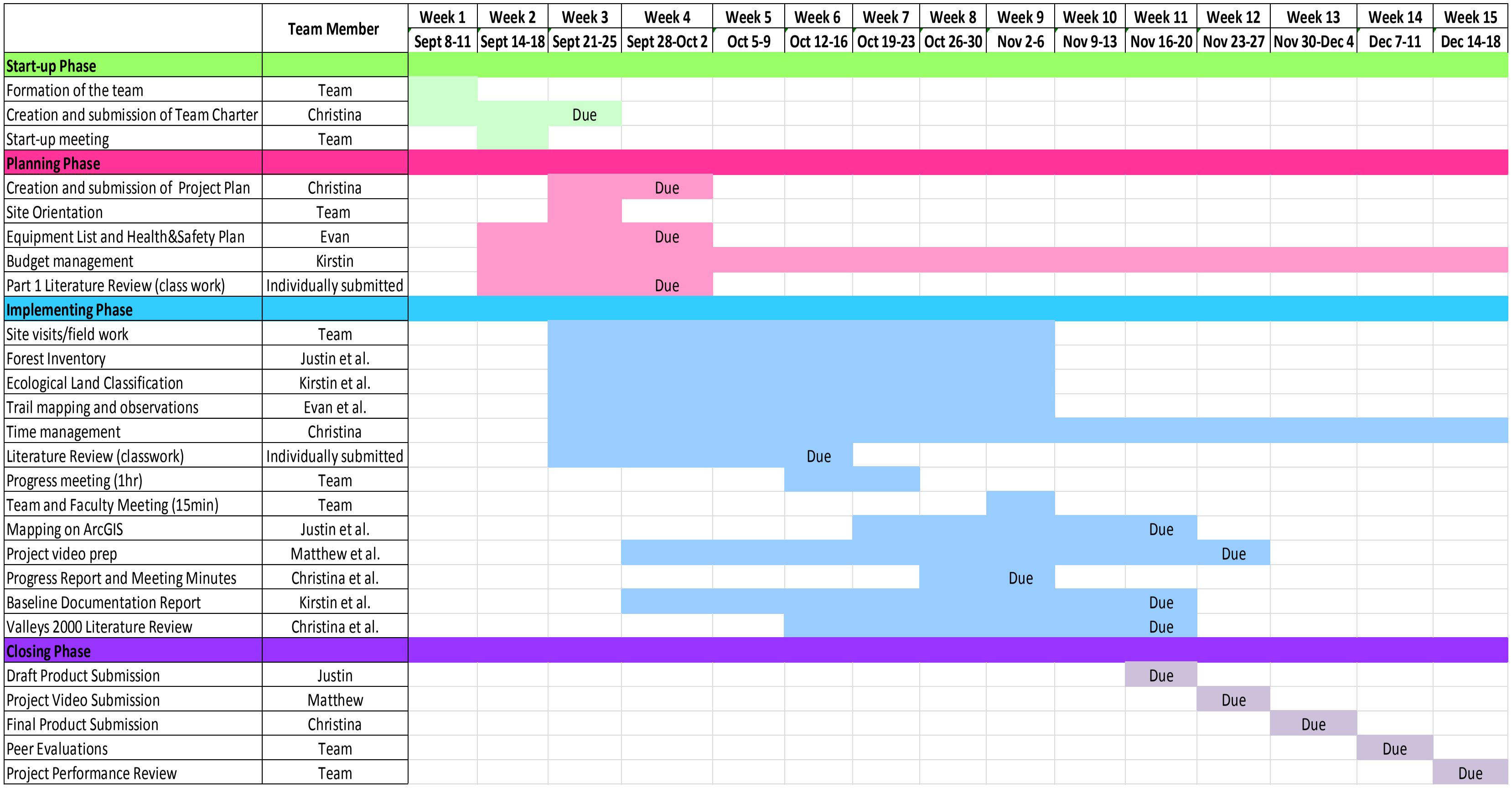
Appendix F: Project Plan for Valleys 2000 Lockhart Local Knowledge and Baseline Information Collection

Project Title	Valleys 2000 Lockhart Local Knowledge and Baseline Information Collection
Project Management Team	Evan Barton, *Student, Ecosystem Management Technology program, Fleming College* Justin Brodeur, *Student, Ecosystem Management Technology program, Fleming College* Matthew Guolo, *Student, Ecosystem Management Technology program, Fleming College* Christina Myrdal, *Student, Ecosystem Management Technology program, Fleming College* Kirstin Pautler*, Student, Ecosystem Management Technology program, Fleming College*
Faculty	Sara Kelly, Credit for Product Course Instructor, Fleming College
Project Sponsor(s)	Suzanne Barnes, President, Valleys 2000
Purpose	The purpose of our project is to use Frank Lockhart's knowledge, and our own identification and management skills to create a comprehensive Baseline Documentation Report and trail/property maps which will be used by Valleys 2000 and the community in future planning and management initiatives. As Valleys 2000 is a not-for-profit organization that relies on volunteers, having baseline data and management recommendations for these areas will help this organization in focusing their time and energy when undertaking future projects and funding proposals.
Issue	Until now, there has been very little ecological data collected and documented on the Bowmanville Valley Trail and Soper Creek Park. Having this data readily available to the Municipality, as well as organizations like Valleys 2000 and the Bowmanville community, is crucial for the protection and proper management of these areas.
Deliverables	1. Comprehensive Baseline Documentation Report (BDR) for Soper Creek and Bowmanville Valley including: • General property information • Site description, ecosystems and habitats including photographs and images • Property structures, developments and constructed features • Disturbances and potential threats to site • Geology and soils

	• Wildlife and wildlife habitat ➢ Final product will be saved in both PDF and MS Word file, sent as an email and/or delivered on a USB drive provided by mentor, and as a hardcopy by November 30th 2015 2. ArcGIS trail and property map highlighting: • Invasive species, • Land use • Species at risk ➢ Final product will be saved as an ArcGIS file, sent as an email and/or handed in on a USB drive provided by mentor and in hard copy to Valleys 2000 by November 30th 2015 3. Literature review: Landowners' guide to managing and controlling invasive species ➢ Final product will be saved as a PDF and MS Word file, sent as an email and/or handed in on a USB provided by mentor, and as a hard copy by November 30th 2015
Exclusions	• We are not responsible for implementing the management recommendations outlined in the BDR
Stakeholders	• Suzanne Barnes, President, Valleys 2000 ➢ Mentor and main contact for this project; any changes/additions to the project will be run by her ➢ Will be consulted at each step of production, and will be asked to provide feedback as necessary • Frank Lockhart, previous President, Valleys 2000 ➢ Will be consulted on his current knowledge of the sites (i.e. locations where he has planted trees and created trails) • The Bowmanville Community/Volunteers ➢ These trails and creeks are widely used by the community, and they should have a better understanding of the ecological systems that exist on each site ➢ Their cooperation is key in allowing us to do field work • Sara Kelly, Credit for Product Course Instructor, Fleming College ➢ Will be consulted consistently throughout the duration of the project on progress and questions/problems/issues that arise ➢ Will be asked for feedback regularly • Jason Kerr, Ecosystem Management Technologist, Fleming College ➢ Will be consulted for equipment needs throughout the duration of the project ❖ There are no political sensitivities within the scope of this project.

Scope	• Budget: $350 for gas mileage to/from site, $50 for printing (maps, resources, final product) • 7 Mondays dedicated specifically to our project until Draft is due, 9 Mondays until Final Product is due (8 hrs/day) ❖ A successful completion of our project will provide Valleys 2000 (and potentially the Municipality and CLOCA) with a base document that can be used in identifying future projects and funding proposals. A successful completion of this project will involve the submission of all deliverables to Valleys 2000, along with recommendations for future management of these properties so that they can continue to work with the community and the Municipality to maintain and improve the health and longevity of their Valley. Additionally, the completion of this project will initiate the beginning of a positive relationship between Fleming College and Valleys 2000, which can grow and flourish in the future.
Project Tasks and Timelines	See Gantt Chart.
Health and Safety Plan	See Health and Safety Plan.
Background	N/A

Gantt Chart



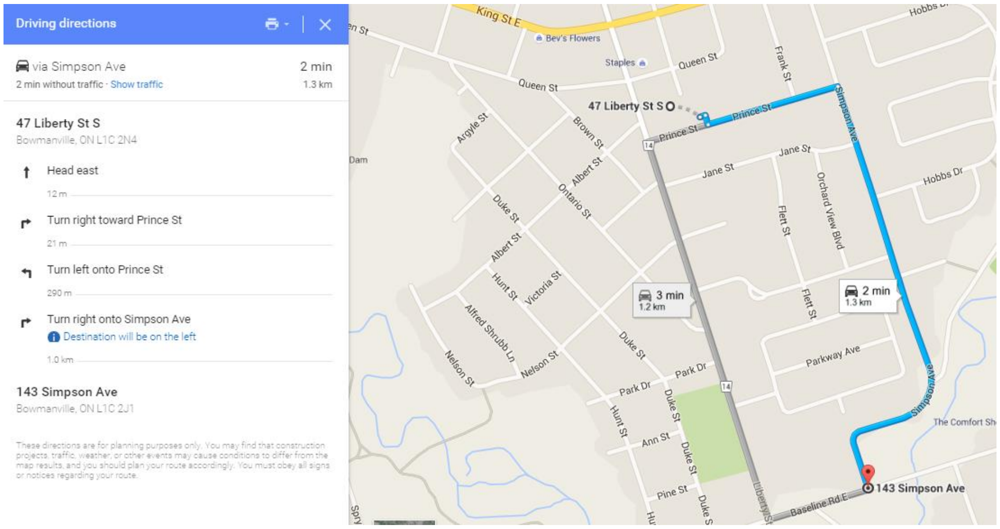
	Team Member	Week 1 Sept 8-11	Week 2 Sept 14-18	Week 3 Sept 21-25	Week 4 Sept 28-Oct 2	Week 5 Oct 5-9	Week 6 Oct 12-16	Week 7 Oct 19-23	Week 8 Oct 26-30	Week 9 Nov 2-6	Week 10 Nov 9-13	Week 11 Nov 16-20	Week 12 Nov 23-27	Week 13 Nov 30-Dec 4	Week 14 Dec 7-11	Week 15 Dec 14-18
Start-up Phase		▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
Formation of the team	Team	▨														
Creation and submission of Team Charter	Christina	▨	▨	Due												
Start-up meeting	Team		▨													
Planning Phase		▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
Creation and submission of Project Plan	Christina			▨	Due											
Site Orientation	Team			▨												
Equipment List and Health&Safety Plan	Evan		▨	▨	Due											
Budget management	Kirstin		▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
Part 1 Literature Review (class work)	Individually submitted		▨	▨	Due											
Implementing Phase		▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
Site visits/field work	Team			▨	▨	▨	▨	▨	▨	▨						
Forest Inventory	Justin et al.			▨	▨	▨	▨	▨	▨	▨						
Ecological Land Classification	Kirstin et al.			▨	▨	▨	▨	▨	▨	▨						
Trail mapping and observations	Evan et al.			▨	▨	▨	▨	▨	▨	▨						
Time management	Christina			▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
Literature Review (classwork)	Individually submitted			▨	▨	▨	Due									
Progress meeting (1hr)	Team						▨	▨								
Team and Faculty Meeting (15min)	Team									▨						
Mapping on ArcGIS	Justin et al.							▨	▨	▨	▨	Due				
Project video prep	Matthew et al.				▨	▨	▨	▨	▨	▨	▨	▨	Due			
Progress Report and Meeting Minutes	Christina et al.								▨	Due						
Baseline Documentation Report	Kirstin et al.				▨	▨	▨	▨	▨	▨	▨	Due				
Valleys 2000 Literature Review	Christina et al.						▨	▨	▨	▨	▨	Due				
Closing Phase		▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
Draft Product Submission	Justin											Due				
Project Video Submission	Matthew												Due			
Final Product Submission	Christina													Due		
Peer Evaluations	Team														Due	
Project Performance Review	Team															Due

Health and Safety Plan for Valleys 2000 Lockhart Local Knowledge and Baseline Information Collection

Project Name	Valleys 2000 Lockhart Local Knowledge and Baseline Information Collection
Project Management Team	Evan Barton, Justin Brodeur, Matthew Guolo, Christina Myrdal, Kirstin Pautler
Cell Number + Area Code	(905) 903 9272 – Evan Barton (705) 543 9409 – Justin Brodeur (647) 985 4864 – Matthew Guolo (416) 509 3332 – Christina Myrdal (905) 869 4237 – Kirstin Pautler
Date H&S Plan Completed	21/09/15
Project Location(s)	Soper Creek Park, 143 Simpson Ave, Lots 8 and 9, Concession 1, Darlington Township, Municipality of Clarington, Durham Region, Bowmanville ON, LIC Bowmanville Valley Trail, 35 Roenigk Dr. (North Parking Lot), Lots 12 and 13, Conession 1, Darlington Township, Municipality of Clarington, Durham Region, Bowmanville ON, LIC Both locations dial 911 for emergency.
Permission to be on Property/Project Location(s)	Granted by: Suzanne Barnes, President, Valleys 2000, 14/09/15

Description of all fieldwork involved in project	• Hiking and observation • Soil sampling • ELC work
Nearest Hospital to Project Location	Lakeridge Health, 47 Liberty St S, Bowmanville ON, L1C 2N4 (905) 623 3331
To report a life threatening emergency situation dial:	**911**
The course faculty member and host organization mentor must be informed by email within 24hrs of all incidents requiring first aid, and/or emergency care.	
Potential Hazard Identification	1. Tripping hazards/uneven ground 2. Hazardous plants (poison ivy, unknown) 3. Hunting season 4. Falling trees 5. Ticks
Hazard Mitigation Plan	1. Wear steel-toed boots 2. Be observant 3. Wear 'hunter orange' vests while in the field 4. Wear hard hats in the field 5. Long pants tucked in and end-of-day tick check
Personal Protective Equipment (PPE) Required	• Cell phones • Hunter orange vests • Hard hats • Close-toed shoes with tread and good ankle support • First aid kit • Long pants

Map from Bowmanville Valley site to Lakeridge Health**:**



Driving directions

via Simpson Ave — 2 min

2 min without traffic · Show traffic — 1.3 km

47 Liberty St S

Bowmanville, ON L1C 2N4

↑ Head east

12 m

↱ Turn right toward Prince St

21 m

↰ Turn left onto Prince St

290 m

↱ Turn right onto Simpson Ave

Destination will be on the left

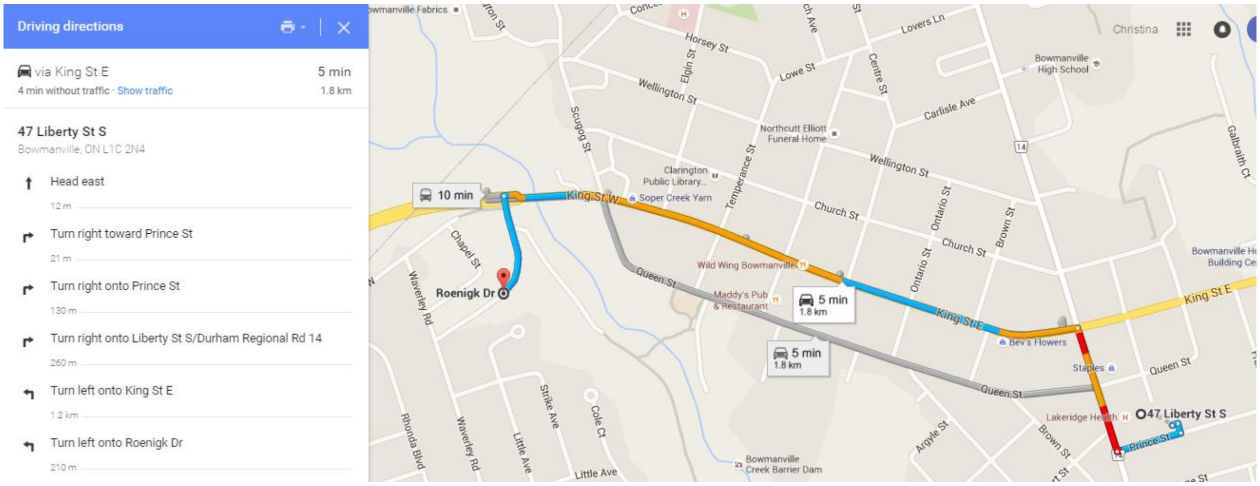
1.0 km

143 Simpson Ave

Bowmanville, ON L1C 2J1

These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may cause conditions to differ from the map results, and you should plan your route accordingly. You must obey all signs or notices regarding your route.

Map from Soper Creek site to Lakeridge Health**:**



Driving directions

via King St E — 5 min

4 min without traffic · Show traffic — 1.8 km

47 Liberty St S

Bowmanville, ON L1C 2N4

↑ Head east

12 m

↱ Turn right toward Prince St

21 m

↱ Turn right onto Prince St

130 m

↱ Turn right onto Liberty St S/Durham Regional Rd 14

260 m

↰ Turn left onto King St E

1.2 km

↰ Turn left onto Roenigk Dr

210 m

Appendix G: Progress Report - Meeting minutes and revised Gantt Chart

Valleys 2000: Baseline Documentation Report
For Soper and Bowmanville Creek.
Meeting Date: Monday, September 28th
Time: 9:00-9:20 am
Location: Sir Sandford Fleming College
Chair: Kirstin Pautler
Minutes taken by: Matthew Guolo
Present: Kirstin Pautler, Christina Myrdal, Justin Brodeur, Evan Barton, Matthew Guolo
Regrets: none.

	Key Points/ Actions	Follow-up/ Status
1.	**Call to order:** The Chair Kirstin P called the meeting to order at 9:00 am and welcomed everyone back after the weekend. Discusses how weather (heavy rain) will affect today. Evan is identified as the driver for this trip.	
2.	**Approval of agenda:** Team agreed on what was to be discussed at the meeting.	
3	**Business:**	
	3.1: What needs to be done today: -We do not have the shape file for Bowmanville or Soper Creek yet so we will head to Soper Creek to start a tree tally and record DBH. - We will walk around site and begin noting where informal trails are found.	- Justin will email Suzanne by tomorrow (Sept 29th) requesting shapefiles for both sites.
	3.2: Division of work: -Christina will record tree species, number identified and DBH of each. - Evan and Matt responsible for tree identification and measuring DBH. - Justin and Kirstin will look for and take coordinates of informal trails. - Christina will wear the GO-PRO to start collecting footage for our video.	- Justin will upload the GPS coordinates and send the file to the team by tonight.

	3.3: Housekeeping: - Evan will return out equipment today when we return from the field. - Kirstin will collect Evans beginning and end Km for this trip. **4.0:** Next meeting: Monday Oct 5, 9:00am Chair will be Justin. Minutes will be taken by Kirstin.	- Evan will send an email to Jason no later than Friday Oct 2 to request our equipment for the field on Oct 5. - Kirstin will update the expenses on the budget chart by tonight. - Christina will email Suzanne about what we accomplished today.

Valleys 2000: Baseline Documentation Report
For Soper and Bowmanville Creek.
Meeting Date: Monday, October 5th
Time: 9:00-9:20 am
Location: Sir Sandford Fleming College
Chair: Justin Brodeur
Minutes taken by: Kirstin Pautler
Present: Kirstin Pautler, Christina Myrdal, Justin Brodeur, Evan Barton, Matthew Guolo
Regrets: none.

	Key Points/ Actions	Follow-up/ Status
1	**Call to order:** The Chair Justin B called the meeting to order at 9:00 am and welcomed everyone back after the weekend. Evan is identified as the driver.	
2	**Approval of agenda:** Team agreed on what was to be discussed at the meeting.	
3	**Business:**	
	3.1: What needs to be done today: - Still can’t get Soper creek shape files to work so we decide to head to Bowmanville and begin ground truthing the CLOCA shapefile. - We will use ELC to do so. -Goal is to get at least half of the polygons finished today.	- Justin will contact Suzanne to try different shape files for Soper Creek.

	3.2: Division of work: -We will stick together to discuss boundaries of polygons. -Christina will take pictures and record data. - Justin is in charge of navigation and GPSing informal trails. -Evan and Kirstin will look for invasive species and human disturbances. -Matt will auger. -Everyone involved in vegetation identification.	- Christina will organize data sheets by tonight. - Justin will upload GPS coordinates when we return from the field.
	3.3: Housekeeping. - Evan will return equipment to Jason's office at the end of the day. -Kirstin will collect Evans beginning and end Km for this trip.	- Christina will email Suzanne and keep her updated on our progress by tonight. - Kirstin will update the expenses in the budget chart by tonight.
4	**Next meeting:** Wednesday Oct 7th at 5pm to prepare agenda for our Progress meeting scheduled for Wednesday, October 14th at 12 noon.	

Valleys 2000: Baseline Documentation Report
For Soper and Bowmanville Creek.
Meeting Date: Wednesday October 14th
Location: Fleming College Frost Campus, Rm 252
Time: 12:00 Noon
Minutes Taken By: Justin Brodeur, Christina Myrdal
Present: Evan Barton, Justin Broduer, Matthew Guolo, Sara Kelly, Christina Myrdal, Kirsten Pautler
Guests: Suzanne Barnes (By Phone)

	Key Points / Actions
1.	**Call to Order/Welcome/ Make Conference Call to Suzanne Barnes** -Conference call was made to Suzanne Barnes and meeting was called to order at 12:10PM
2.	**Description of Work Completed**

	-Field work at Soper Creek, inventory of urban trees -Bowmanville Creek ELC halfway done with plans to complete following week -Trail and Stream digitizing underwa
3.	**Updates/Comments From Suzanne Barnes** -Budget has been approved for two more days of mileage -Budget isn’t deal breaker, be thorough, regardless of going over budget (if necessary) -Use USB to hand over copy of BDR on December 14, 2015: Covered under expenses -Make corrections in polygon where we see fit -Track out invasive species and human disturbances to display on maps. Make sure they can be foun again by future teams to track spread, abundance
4.	**Comments from Sara Kelly** -Tuesday Nov 17 Draft product to be completed as close to final product as possible. Include Draft table of contents. Only final revisions needed to complete
5.	**Comments from Team Members** -Christina to email Suzanne to get a copy of the Valleys logo -Justin to email correct version of the map -Justin discussed the abundant presence of invasive species -Kirsten discussed the clean-up and monitoring of the garbage and disturbances throughout the site
6.	**Adjournment** -Meeting was called to a close at 12:52 PM

Revised Gantt Chart

	Team Member	Week 1 Sept 8-11	Week 2 Sept 14-18	Week 3 Sept 21-25	Week 4 Sept 28-Oct 2	Week 5 Oct 5-9	Week 6 Oct 12-16	Week 7 Oct 19-23	Week 8 Oct 26-30	Week 9 Nov 2-6	Week 10 Nov 9-13	Week 11 Nov 16-20	Week 12 Nov 23-27	Week 13 Nov 30-Dec 4	Week 14 Dec 7-11	Week 15 Dec 14-18
Start-up Phase																
Formation of the team	Team	▨	Complete													
Creation and submission of Team Charter	Christina	▨	▨	Due	Complete											
Start-up meeting	Team		▨	Complete												
Planning Phase																
Creation and submission of Project Plan	Christina			▨	Due	Complete										
Site Orientation	Team			▨	Complete											
Equipment List and Health&Safety Plan	Evan		▨	▨	Due	Complete										
Budget management	Kirstin		▨	▨	▨	▨	▨	▨	▨	Ongoing	▨	▨	▨	▨	▨	▨
Part 1 Literature Review (class work)	Individually submitted		▨	▨	Due	Complete										
Implementing Phase																
Site visits/field work	Team			▨	▨	▨	▨	▨	▨	Extended →	▨					
Forest Inventory	Justin et al.			▨	▨	▨	▨	▨	▨	Extended →	▨					
Ecological Land Classification	Kirstin et al.			▨	▨	▨	▨	▨	▨	Extended →	▨					
Trail mapping and observations	Evan et al.			▨	▨	▨	▨	▨	▨	Extended →	▨					
Time management	Christina			▨	▨	▨	▨	▨	▨	Ongoing	▨	▨	▨	▨	▨	▨
Literature Review (classwork)	Individually submitted			▨	▨	▨	Complete									
Progress meeting (1hr)	Team						▨	Complete								
Team and Faculty Meeting (15min)	Team									Ongoing						
Mapping on ArcGIS	Justin et al.							▨	▨	Ongoing	▨	Due				
Project video prep	Matthew et al.				▨	▨	▨	▨	▨	Ongoing	▨	▨	Due			
Progress Report and Meeting Minutes	Christina et al.								▨	Complete						
Baseline Documentation Report	Kirstin et al.				▨	▨	▨	▨	▨	Ongoing	▨	Due				
Valleys 2000 Literature Review	Christina et al.						▨	▨	▨	Ongoing	▨	Due				
Closing Phase																
Draft Product Submission	Justin									Ongoing		Due				
Project Video Submission	Matthew									Ongoing			Due			
Final Product Submission	Christina									Ongoing				Due		
Peer Evaluations	Team									Ongoing					Due	
Project Performance Review	Team									Ongoing						Due